BAWSCA
Bay Area Water Supply & Conservation Agency

Long-Term Reliable Water Supply Strategy

Phase II A Final Report
Volume II Attachments

CDM Smith

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Long-Term Reliable Water Supply Strategy Phase II A Final Report

Volume II Attachments

Attachment 1

TM 1: Updated Water Demand and Supply Need Projections for the Long-Term Reliable Water Supply Strategy

CDM Smith

STRATEGY PHASE II A TECHNICAL MEMORANDUM NO. 1

Updated Water Demand and Supply Need Projections for the Long-Term Reliable Water Supply Strategy

BAWSCA

January 26, 2012
DRAFT FINAL

Revised June 21, 2012

CDM Smith

Technical Memorandum No. 1 Updated Water Demand and Supply Need Projections for the Long-Term Reliable Water Supply Strategy

(Draft Final – January 26, 2012, minimal revisions June 21, 2012)

Errata

This Draft Final Technical Memorandum (TM) No. 1 was completed and reviewed by the BAWSCA member agencies. Changes and updates incorporated from those comments were only included in the Phase II A Final Report, with the following exceptions which are included in this TM:

- Mid-Peninsula Water District and Total "2018 Projected SFPUC Purchases" reduced by 0.05 mgd to 3.55 mgd and 272.3 mgd respectively.
- Clarifying footnote added to Tables A-2 to A-7 for "Brisbane and GVMID" that reads "Brisbane and Guadalupe Valley MID have based their anticipated SFPUC Purchases on modeling results that relay on various assumptions that result in a future projection with an anticipated variance."
- Correction to column titles for Table A-4.
- Clarifying language added to January 25, 2012 Memo on p. 3 "Future BAWSCA agency residential per capita values are calculated by applying the 2009/10 percentage of residential use to total production for each BAWSCA agency against future total water production for a specific year divided by the projected population for that same future year. The future values resulting from this calculation provide a consistent approach useful for overall planning, but may not accurately reflect individual agency future values."

Technical Memorandum No. 1
Updated Water Demand and Supply Need Projections for the Long-Term Reliable Water Supply Strategy
(Draft Final – January 26, 2012, Revised June 21, 2012)

Section 1
Summary

In This TM:

- Summary
- Introduction
- Projected Water Demands
- Anticipated Use of Available Water Supplies to Meet Projected Demands
- Projected Water Supply Need
- Issues That Affect Projected Supply Reliability
- Conclusions and Next Steps
- Appendices

The Bay Area Water Supply and Conservation Agency (BAWSCA) is developing its Long-Term Reliable Water Supply Strategy (Strategy). Central to the development of the Strategy is determining the level of water supply need of the BAWSCA member agencies.

Determining the water supply need is predicated on: 1) projections of demand; and 2) the availability of existing supplies under different hydrological and regulatory conditions. The method and tools to calculate both these elements, as well as the member agencies' outlook on demand and anticipated use of supplies, have changed since the water supply need was first assessed in Phase I of the Strategy. This technical memorandum (TM), prepared under Phase II A of the Strategy, updates both demand and supply projections through 2035 to determine the water supply need for the BAWSCA member agencies.

The Strategy addresses two different supply need values – one related to non-drought (normal year) conditions, and the other to drought conditions when supplies are curtailed. The updated projected water supply need in 2035 is 4 to 13 million gallons per day (mgd) under normal/non-drought conditions and 58 to 62 mgd under drought conditions. Figures 1 and 2 compare the projected water supply need based on from the 2005 Urban Water Management Plan (UWMP) to the projected need determined in 2011 for normal and drought conditions, respectively. The 2011 information presented in this TM is based on the BAWSCA member agency 2010 UWMPs and follow-up discussions with the agencies. Similar to the demand estimates the member agencies provided their estimates of supply availability for their non-SFPUC supplies as part of the development of their 2010 UWMPs and individual follow-up discussions.

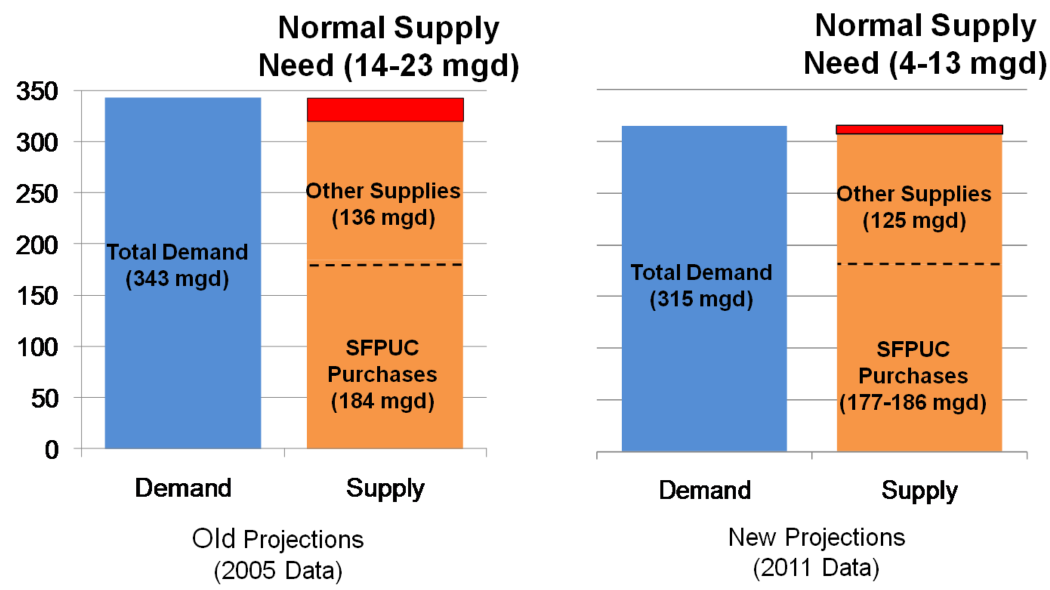

Figure 1
Comparison of 2005 and 2011 Assessments of Aggregate BAWSCA 2035 Demand, Supply, and Supply Need Under Normal Year Conditions

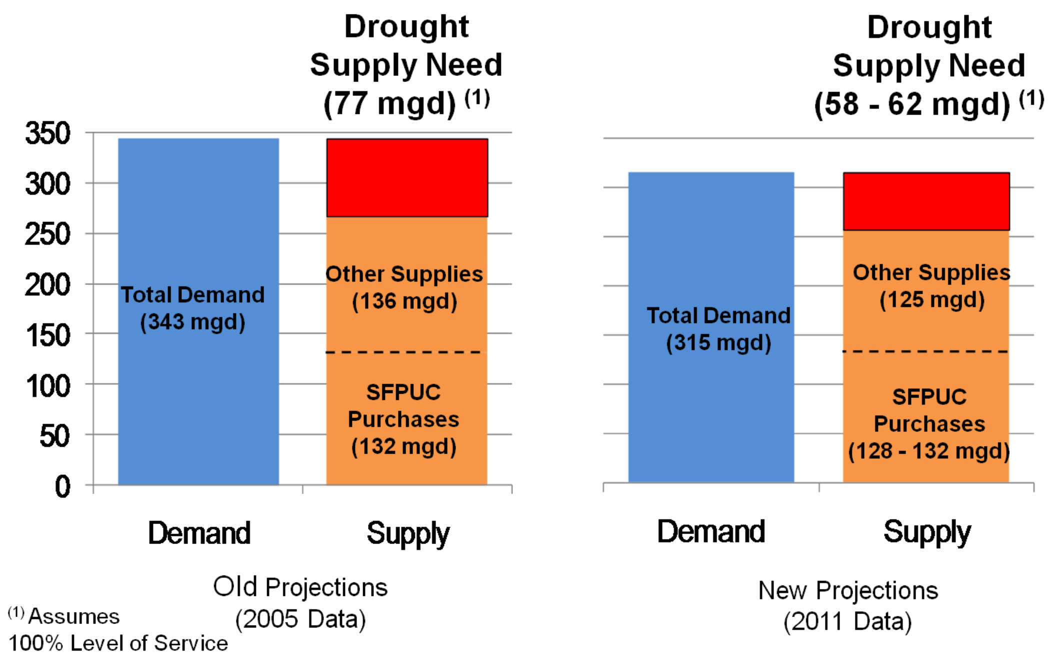

Figure 2
Comparison of 2005 and 2011 Assessments of Aggregate BAWSCA 2035 Demand, Supply, and Supply Need Under Drought Conditions (20% system-wide drought reduction on the San Francisco Regional Water System)

The reduction in projected BAWSCA agency demands result in a smaller water supply need. This may provide greater flexibility in the types of water supply management projects developed to address the supply need, as well as the timing of when these projects need to be developed. Reliability of non-San Francisco Public Utilities Commission (SFPUC) supplies available to the BAWSCA member agencies, though not addressed in this TM, may decrease or increase an agency's supply need during drought and must be considered by individual agencies in their long-term planning.

Because changes in demand forecasts may affect estimates of supply need, the comparison between a member agency's planned and actual demands over time should be tracked to understand the accuracy of projections and the need for future modification of the demand projection methodology. For effective planning at the regional level to support future local and regional investment decisions, a more robust and consistent demand projection process for BAWSCA as a whole is necessary. In order to address the differences in the projection methods used by the individual agencies, BAWSCA will be working with the agencies to develop a common and consistent methodology that is robust, transparent, and flexible that will be used for future demand projections, including the 2015 UWMPs.

Section 2
Introduction

This TM presents the updated projected water demand, anticipated available water supplies, and projected SFPUC water supply need identified within the BAWSCA service area based on new data collected in 2011 from the BAWSCA member agencies. The TM addresses the future planning years of 2015, 2018, 2020, 2025, 2030, and 2035.

The factors considered in the estimating the supply need (i.e., the difference between projected demands and available supply) for the Strategy include:

- Demand projections within the BAWSCA service area to 2035;
- Anticipated use of supplies within the BAWSCA service area to 2035;
- Conservation projections, active and passive, and their effect on the projected demands; and
- Hydrological, climate change, and regulatory-policy impacts to the BAWSCA agencies' SFPUC supply.

The Strategy does not address future drought year supply reliability from the non-SFPUC sources on which the BAWSCA member agencies rely, such as groundwater, local sources, or imported surface water. Rather, the Strategy is limited to evaluating the additional water needs of the BAWSCA member agencies above and beyond their current supply portfolios during normal years, and the additional supply need during drought years based on projected cutbacks to their SFPUC supplies.

The data presented in this TM has been aggregated for the entire BAWSCA service area. The 2011 updated demand, anticipated use of available supplies, and water supply need data for individual member agencies is provided in Appendix A. A comparison between the 2011 updated data and the 2005 data from the 2010 Strategy Phase I Scoping Report is provided in Appendix B. Appendix C contains details on the application of the Tier 2 Drought Implementation Plan for future planning and the calculations for BAWSCA member agencies' anticipated SFPUC purchases during drought.

2.1 Description of Supply Need Calculations

CDM Smith reviewed updated agency demands projections, which were sometimes characterized as demand before passive conservation, demand after passive conservation, or simply as annual demand. The agencies presented demand calculations using varying methods, such as conservation as a supply or as a reduction before net demand; therefore, a consistent representation of demand was needed for the supply need evaluation. After consideration of the 2010 UWMP data (prepared in 2011), the individual agency supply and demand worksheets, and BAWSCA staff discussions with some member agencies, demand after passive conservation was used as the starting point for determining supply need. Demand after passive conservation represents the demand that member agencies estimate will occur after projected passive conservation (e.g., water savings associated with implementation of state plumbing code requirements) is considered, but does not include the water savings anticipated from active conservation measures. As many member agencies consider active conservation to be a demand reduction method rather than a supply, demand after passive conservation may not be presented in the same way as the projected water demands included in the agencies' 2010 UWMPs.

CDM Smith reviewed agency supplies projected for 2015, 2018, 2020, 2025, 2030, and 2035. For normal year conditions, this included SFPUC supply and other individual agency supplies from sources such as groundwater, recycled water, local surface water, and imported surface water. SFPUC supply reductions during drought conditions were estimated by BAWSCA using the Tier 2 Drought Implementation Plan (DRIP) analysis as detailed in Appendix C. As mentioned above, drought impacts to non-SFPUC supplies were not considered in this analysis.

The individual agency water supply need in each planning year was calculated as the difference between the agency's demand after passive conservation and the total anticipated use of available supplies for both normal and drought conditions. The aggregate BAWSCA water supply need presented is the sum of the individual agency water supply need values. For purposes of the Strategy, no assumption was made regarding the availability of one agency's unused Individual Supply Guarantee from the SFPUC, or any other supply, for another BAWSCA agency.

Section 3
Projected Water Demands

This section presents the projected BAWSCA water demand over the planning period. As discussed in the previous sections, the water demands are presented as projections after passive conservation. To provide a consistent basis for calculating water demands, active conservation and planned savings to comply with Senate Bill X7-7 (SB-7) are accounted for in projected water supplies (see Section 4.0). The projected demand for each planning year is described below, along with a discussion of issues that affect the demand projections.

3.1 Summary

The change in aggregate BAWSCA water demand from the 2005 data to the 2011 data is presented in Table 1. In the time since the data presented in the 2010 Strategy Phase I Scoping Report was developed, the BAWSCA agencies have updated their demands based on population and employment projections in their 2010 UWMPs. Using this updated 2011 data, the projected 2035 demand in the BAWSCA service area decreased to about 315 mgd, a reduction of almost 28 mgd from the previous demand projections.

Table 1
2035 Aggregate BAWSCA Water Demands After Passive Conservation[1,2]

Data Set	2035 (mgd)
2005	342.9
2011	315.2
Difference	27.7

Source: 2005 Data: 2010 Strategy Phase I Scoping Report, Table A-4; 2011 Data: Agency Submitted Demand & Supply Worksheets, 2011

[1] Demand after passive conservation represents the demand that member agencies estimate will occur after projected passive conservation is considered, but does not include the water savings anticipated from active conservation measures. As many member agencies consider active conservation to be a demand reduction method rather than a supply, demand after passive conservation may not be consistent with the projected water demands included in agencies' 2010 UWMPs.

[2] Except as noted, demand after passive conservation includes demand for both potable and non-potable water.

3.2 Projected Aggregate BAWSCA Water Demands

Table 2 presents the aggregate BAWSCA water demand for years 2015, 2018, 2020, 2025, 2030, and 2035. Based on demand after passive conservation provided in the agency demand and supply worksheets in 2011[1], the aggregate demand in the BAWSCA service area is projected to increase from about 265 mgd in 2015 to about 315 mgd in 2035. This represents an increase of about 19% over the 20-year planning period.

[1] BAWSCA member agencies completed supply and demand worksheets in 2011 to serve as the basis for the current demand projections with the detailed information provided in Appendix A.

Table 2
Aggregate BAWSCA Water Demands After Passive Conservation[1,2] (mgd)

2015	2018	2020	2025	2030	2035
264.8	272.3	276.7	289.0	303.8	315.2

Source Data: Agency Submitted Demand & Supply Worksheets, 2011

[1] Demand after passive conservation represents the demand that member agencies estimate will occur after projected passive conservation is considered, but does not include the water savings anticipated from active conservation measures. As many member agencies consider active conservation to be a demand reduction method rather than a supply, demand after passive conservation may not be consistent with the projected water demands included in agencies' 2010 UWMPs.
[2] Except as noted, demand after passive conservation includes demand for both potable and non-potable water

3.3 Issues That Affect Demand Projections

3.3.1 Demand Projection Methodology

The demand projections presented in this analysis are based largely on the UWMPs prepared by the BAWSCA member agencies for the California Department of Water Resources (DWR) as part of their 2010 UWMPs. DWR recognizes that there are many acceptable methods for projecting water demands and does not specify that a particular methodology must be used. As a result, agencies used the method that best represented their systems, and several different projection methodologies were used across the BAWSCA agencies. BAWSCA worked closely with its member agencies in combining the individual agency demand projections for use at the regional level.

3.3.2 Conservation Savings

In CDM Smith's review of the 2010 UWMPs and 2011 supply and demand worksheets, differences were found in the way BAWSCA agencies addressed passive, active, and SB-7 related conservation savings. Some agencies provided projections for all three demand reductions explicitly and some choose only to identify one or two. Some agencies called out passive conservation in their projections while some agencies provided only demands after passive conservation. In order to correctly present a regional, aggregate picture of projected demand within the BAWSCA service area, a common means for including conservation is needed. Therefore, demand projections are presented as demand after passive conservation, with BAWSCA staff confirming this demand data in follow-up discussions with some agencies. As in the past, active conservation savings are presented as a water supply in the next section (as opposed to a demand reduction).

This issue is important when looking at demand aggregated at a regional level. Agencies have different methods for calculating and tracking their conservations savings. Individually, these different methods are correct and appropriate, however, these differences can be challenging when working at a regional level.

Section 4
Anticipated Use of Available Water Supplies to Meet Projected Demands

This section contains data regarding the anticipated use of available water supplies within the BAWSCA service area and issues that affect projected supply reliability. BAWSCA agency supplies include water purchased from the San Francisco Regional Water System (RWS), groundwater, local surface water, recycled water, desalinated water, imported surface water (includes water purchased from State Water Project and Santa Clara Valley Water District), and active conservation savings. The availability of SFPUC supplies available to BAWSCA agencies in drought were estimated for both a 10% and 20% system-wide drought reduction on the San Francisco RWS. This TM does not address future drought year supply shortfalls for the non-SFPUC sources on which the member agencies rely, such as groundwater, local sources, or imported surface water.

4.1 Summary

Table 3 presents the anticipated use of available water supplies in the BAWSCA service area in 2035 under normal conditions, and with 10% and 20% system-wide drought reduction on the San Francisco RWS.

Table 3
Aggregate BAWSCA Anticipated Use of Available Supplies for 2035 Under Normal and Drought Conditions (mgd)

Hydrologic Condition	Anticipated SFPUC Purchases[1]	Anticipated Use of Available Local & Other Supplies	Not Yet Determined	Total Anticipated Supply Use
Normal	177.1 - 186.1	124.8	4.3 - 13.3	315.2
10% SFPUC Drought Reduction	147.4 - 152.5	124.8	37.8 - 43.0	315.2
20% SFPUC Drought Reduction	127.9 - 132.4	124.8	58.0 - 62.5	315.2

Source Data: Agency Submitted Demand & Supply Worksheets, 2011

[1] Anticipated SFPUC Purchases represents the amount of water member agencies anticipate purchasing in 2035.

The change in anticipated use of SFPUC supplies in 2035 ranges from 177 – 186 mgd in normal conditions to 128 – 132 mgd in the 20% system-wide drought reduction condition. The lower end of the range of anticipated use of SFPUC supplies in normal conditions is associated with a potential future decision by San Francisco to not provide 9 mgd of permanent supply to Santa Clara and San Jose. As described above, drought shortfalls for non-SFPUC supplies were not evaluated, so the anticipated use of available local and other supplies is assumed not to change with hydrologic conditions for the purposes of this analysis.

Included in the table above is a “Not Yet Determined” category of supply that represents the difference between projected demand and the total anticipated use of water purchased from the San Francisco RWS and local supplies. This supply need, the amount of supply (from a source not yet determined) needed to meet projected demands, ranges from 4 to 13 mgd under normal conditions and from 58 to 62 mgd in a 20% system-wide drought reduction condition.

4.2 Aggregate BAWSCA Anticipated Use of Available Water Supplies Under Normal Conditions

The anticipated BAWSCA service area supply mix for 2035 is presented in Figure 3. Anticipated SFPUC purchases range from 177 mgd to 186 mgd. The lower end of the range is associated with a potential future decision by San Francisco to not provide 9 mgd of permanent supply to Santa Clara and San Jose. The remaining supplies are made up of groundwater, desalination, local surface water, recycled water, imported water (i.e., Santa Clara Valley Water District (SCVWD) and State Water Project (SWP) sources), as well as active conservation savings. These non-SFPUC supplies make up 40% of the total anticipated supply use. Included in Figure 3 is the "Not Yet Determined" category of supply that represents the amount of supply (from a source not yet determined) needed to meet projected demands. Again, the upper end of the need range is associated with a potential future decision by San Francisco to not provide 9 mgd of permanent supply to Santa Clara and San Jose.

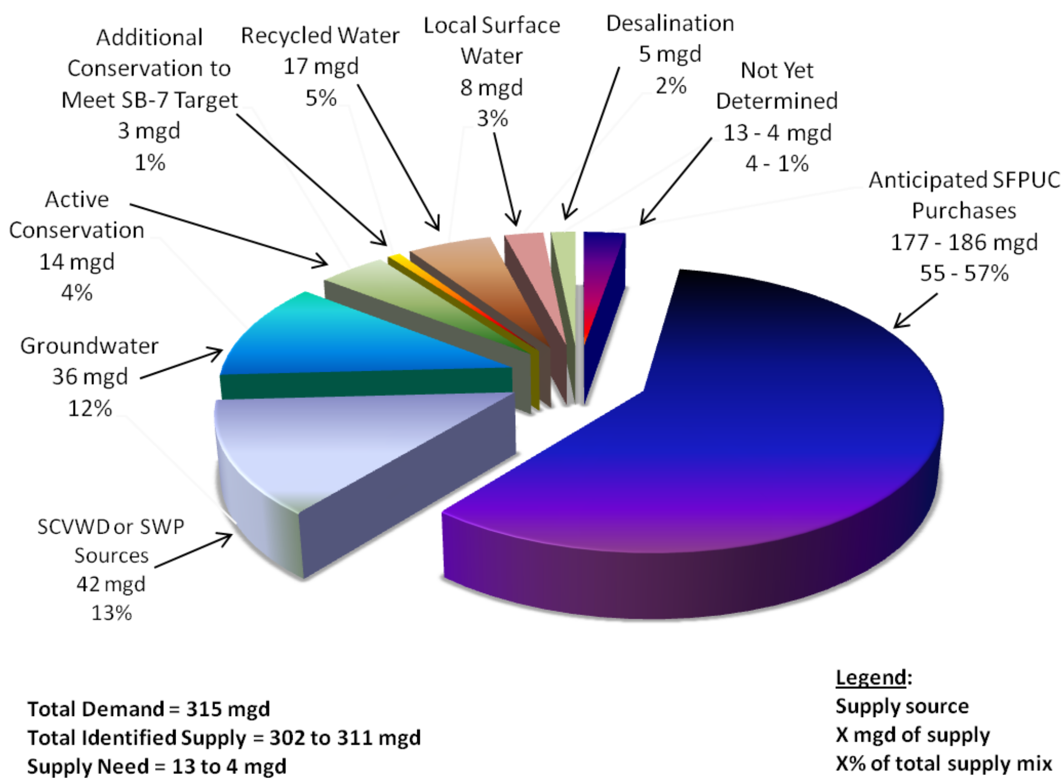

Figure 3
2035 Aggregate BAWSCA Anticipated Use of Available Supplies Under Normal Conditions

Table 4 presents the anticipated use of available supplies by the BAWSCA member agencies for 2015 through 2035, under normal year conditions. The use of some supplies is anticipated to remain constant or increase only slightly between 2015 and 2035. Use of local surface water supply is anticipated to increase by 0.3 mgd and use of supplies from desalination are expected to remain constant. Use of groundwater and SCVWD/SWP sources are projected to increase by as much as 12 mgd and 8 mgd, respectively, between 2015 and 2035. Savings from active conservation is expected to double between 2015 and 2035. The supply category "Not Yet Determined", the amount of supply (from a source not yet determined) needed to meet projected demands, increases from 2 mgd in 2015 to 4 to 13 mgd in 2035.

Table 4
Aggregate BAWSCA Anticipated Use of Available Supplies Under Normal Conditions (mgd)

Supply Type	2015	2018	2020	2025	2030	2035
Anticipated SFPUC Purchases[1]	170.9	171.8	161.8 - 170.8	166.6 - 175.6	172.7 - 181.7	177.1 - 186.1
Groundwater	24.4	26.0	26.9	29.9	33.7	36.4
Surface Water	7.6	7.6	7.7	7.7	7.8	7.9
Recycled Water	12.9	13.8	14.8	15.8	16.5	17.1
Desalination	5.0	5.0	5.0	5.0	5.0	5.0
SCVWD or SWP Sources	34.5	35.0	35.5	37.6	40.4	42.2
Active Conservation[2]	6.5	9.6	12.0	12.9	13.5	13.7
Additional Conservation to Meet SB-7 Target[3]	1.0	1.6	2.1	2.2	2.3	2.5
Not Yet Determined[4]	2.0	1.9	2.0 - 11.0	2.4 - 11.4	2.9 - 11.9	4.3 - 13.3
Total Anticipated Supply Use[5]	**264.8**	**272.3**	**276.7**	**289.0**	**303.8**	**315.2**

Source Data: Agency Submitted Demand & Supply Worksheets, 2011

[1] Anticipated SFPUC Purchases represents the amount of water a member agency anticipates purchasing in 2035.
[2] "Active Conservation" represents the savings associated with active conservation measures that a member agency plans on implementing in 2035. For summary purposes, active conservation is herein considered to be a supply source. Many agencies consider both passive and active conservation to be demand reduction methods in their 2010 UWMPs. It is assumed herein that demand after passive conservation does not include active conservation and therefore demand after passive conservation may not be consistent with 2010 UWMPs for these member agencies.
[3] "Additional Conservation to Meet SB-7 Targets" represents the conservation that agencies plan to implement to meet SB-7 targets, beyond that being implemented under existing active conservation measures.
[4] "Not Yet Determined" category of supply that represents the difference between projected demand and the total anticipated use of water purchased from the San Francisco RWS and other supplies.
[5] Total Anticipated Supply Use is the sum of all anticipated use of supplies.

4.3 Aggregate BAWSCA Anticipated Use of Available Water Supplies Under Drought Conditions (10% and 20%)

The pie charts below, Figures 4 and 5, present the projected 2035 supply mix based on the updated 2011 data for aggregate anticipated use of available water supplies with 10% and 20% system-wide drought reduction on the San Francisco RWS, respectively. As discussed earlier, this TM does not address future drought year supply shortfalls from the non-SFPUC sources on which the member agencies rely. Therefore, aggregate projected non-SFPUC supplies shown under both the 10% and 20% system-wide drought reduction conditions are the same as shown in Figure 3 and Table 4 for normal conditions. The difference between Figures 4 and 5 lies in the reduced quantity of anticipated purchases from SFPUC. This difference in anticipated purchases from SFPUC between the 10% and 20% system-wide drought reduction on the San Francisco RWS is approximately 20 mgd.

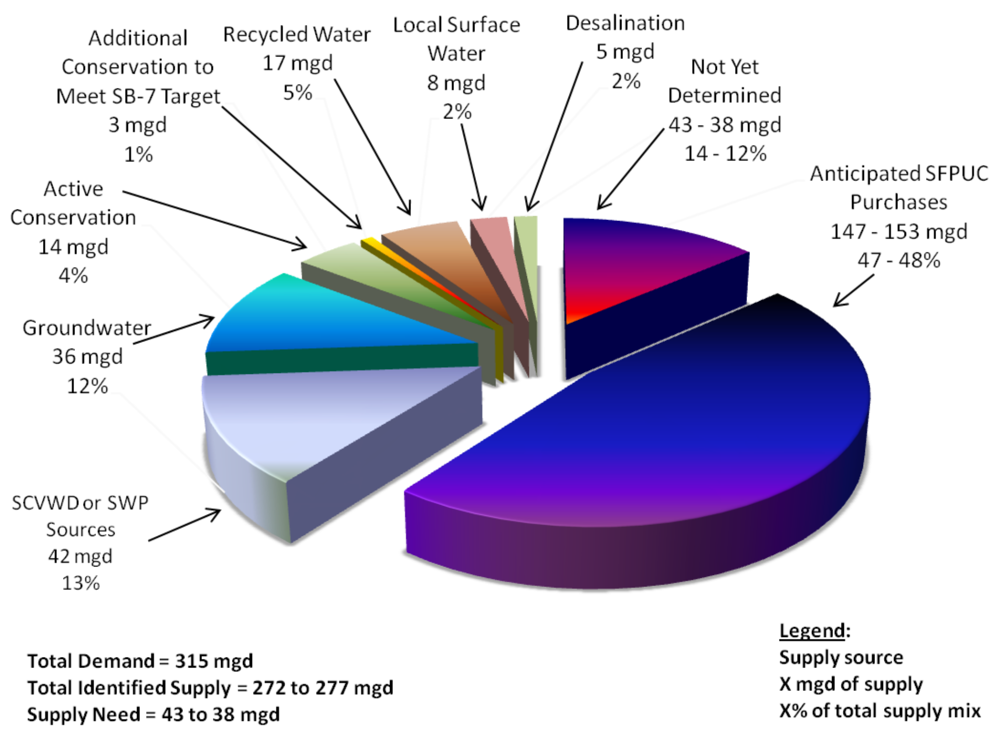

Figure 4
2035 Aggregate BAWSCA Anticipated Use of Available Supplies Under SFPUC 10% Regional Drought Conditions

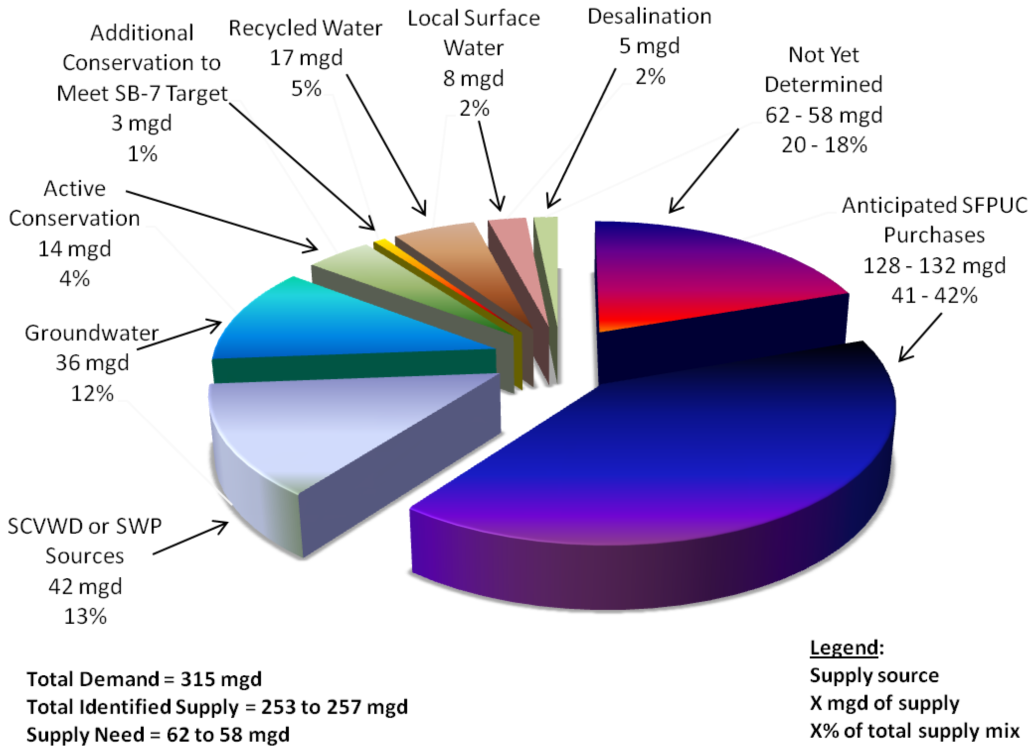

Figure 5
2035 Aggregate BAWSCA Anticipated Use of Available Supplies Under SFPUC 20% Regional Drought Conditions

In normal conditions, the lower end of the range in anticipated purchases from SFPUC is associated with a potential future decision by San Francisco to not provide 9 mgd of permanent supply to Santa Clara and San Jose. During drought, the range in anticipated purchases from SFPUC presented is less than 9 mgd because of the formulas and rules associated with the Tier 1 Water Shortage Allocation Plan.

The current analysis of supply need during drought conditions assumes the total supply including not yet determined sources will meet a 100% level of service. This assumption of 100% level of service willbe further discussed with BAWSCA member agencies.

Table 5 presents the data for aggregated use of available supplies for 2015 through 2035 for a 10% system-wide drought reduction from the San Francisco RWS.

Table 5
Aggregate BAWSCA Anticipated Use of Available Supplies Under 10% System-Wide Reduction in San Francisco RWS Supply Conditions (mgd)

Supply Type	2015	2018	2020	2025	2030	2035
Anticipated SFPUC Purchases[1]	143.7	143.7	137.4 - 142.6	139.9 - 145.0	143.9 - 149.1	147.4 - 152.5
Groundwater	24.4	26.0	26.9	29.9	33.7	36.4
Surface Water	7.6	7.6	7.7	7.7	7.8	7.9
Recycled Water	12.9	13.8	14.8	15.8	16.5	17.1
Desalination	5.0	5.0	5.0	5.0	5.0	5.0
SCVWD or SWP Sources	34.5	35.0	35.5	37.6	40.4	42.2
Active Conservation[2]	6.5	9.6	12.0	12.9	13.5	13.7
Additional Conservation to Meet SB-7 Target[3]	1.0	1.6	2.1	2.2	2.3	2.5
Not Yet Determined[4]	29.2	29.9	30.3 - 35.4	32.9 - 38.1	35.5 - 40.7	37.8 - 43.0
Total Anticipated Supply Use[5]	**264.8**	**272.3**	**276.7**	**289.0**	**303.8**	**315.2**

Source Data: Agency Submitted Demand & Supply Worksheets, 2011

1 Anticipated SFPUC Purchases represents the amount of water a member agency anticipates purchasing in 2035.
2 "Active Conservation" represents the savings associated with active conservation measures that a member agency plans on implementing in 2035. For summary purposes, active conservation is herein considered to be a supply source. Many agencies consider both passive and active conservation to be demand reduction methods in their 2010 UWMPs. It is assumed herein that demand after passive conservation does not include active conservation and therefore demand after passive conservation may not be consistent with 2010 UWMPs for these member agencies.
3 "Additional Conservation to Meet SB-7 Targets" represents the conservation that agencies plan to implement to meet SB-7 targets, beyond that being implemented under existing active conservation measures.
4 "Not Yet Determined" category of supply that represents the difference between projected demand and the total anticipated use of water purchased from the San Francisco RWS and other supplies.
5 Total Anticipated Supply Use is the sum of all anticipated use of supplies.

Table 6 presents the 2011 data for aggregated use of available supplies for 2015 through 2035 for the 20% system-wide drought reduction from the San Francisco RWS. Appendix C contains details on the application of the Tier 2 Drought Implementation Plan for future planning and the calculations for BAWSCA member agencies' anticipated SFPUC purchases during the 20% system-wide drought reduction.

Table 6
Aggregate BAWSCA Anticipated Use of Available Supplies Under 20% System-Wide Reduction in San Francisco RWS Supply Conditions (mgd)

Supply Type	2015	2018	2020	2025	2030	2035
Anticipated SFPUC Purchases[1]	124.8	124.7	119.2 - 123.7	121.4 - 125.9	124.9 - 129.4	127.9 - 132.4
Groundwater	24.4	26.0	26.9	29.9	33.7	36.4
Surface Water	7.6	7.6	7.7	7.7	7.8	7.9
Recycled Water	12.9	13.8	14.8	15.8	16.5	17.1
Desalination	5.0	5.0	5.0	5.0	5.0	5.0
SCVWD or SWP Sources	34.5	35.0	35.5	37.6	40.4	42.2
Active Conservation[2]	6.5	9.6	12.0	12.9	13.5	13.7
Additional Conservation to Meet SB-7 Target[3]	1.0	1.6	2.1	2.2	2.3	2.5
Not Yet Determined[4]	48.2	48.9	49.1 - 53.6	52.1 - 56.6	55.2 - 59.7	58.0 - 62.5
Total Anticipated Supply Use[5]	**264.8**	**272.3**	**276.7**	**289.0**	**303.8**	**315.2**

Source Data: Agency Submitted Demand & Supply Worksheets, 2011

1 Anticipated SFPUC Purchases represents the amount of water a member agency anticipates purchasing in 2035.
2 "Active Conservation" represents the savings associated with active conservation measures that a member agency plans on implementing in 2035. For summary purposes, active conservation is herein considered to be a supply source. Many agencies consider both passive and active conservation to be demand reduction methods in their 2010 UWMPs. It is assumed herein that demand after passive conservation does not include active conservation and therefore demand after passive conservation may not be consistent with 2010 UWMPs for these member agencies.
3 "Additional Conservation to Meet SB-7 Targets" represents the conservation that agencies plan to implement to meet SB-7 targets, beyond that being implemented under existing active conservation measures.
4 "Not Yet Determined" category of supply that represents the difference between projected demand and the total anticipated use of water purchased from the San Francisco RWS and other supplies.
5 Total Anticipated Supply Use is the sum of all anticipated use of supplies.

Section 5
Projected Water Supply Need

This section compares the projected future supplies to demands and identifies the timing, magnitude, and consequences of future water supply shortfalls. It should be noted that although the focus of the Strategy is on augmenting the SFPUC supply to meet the projected increase in water demands and to increase normal and dry year reliability, it is anticipated that the effects of climate change, regulatory changes, and drought on the local and Delta supplies for some of the BAWSCA members could increase the total regional supply need during future normal and drought years. At this time, it is assumed that any reductions in other non-SFPUC supplies will be addressed by the individual BAWSCA member agencies, or the other regional supply agencies (e.g., SCVWD).

5.1 Summary

Table 7 summarizes the projected need for water in 2035 under each hydrologic condition based on the anticipated SFPUC purchases and use of non-SFPUC supplies, total anticipated supply use, projected demand, and anticipated need for water.

Table 7
Aggregate BAWSCA Supply Need for 2035 Under Normal and Drought Conditions (mgd)

Hydrologic Condition	Anticipated SFPUC Purchases[1]	Anticipated Use of Available Local & Other Supplies	Total Anticipated SFPUC, Local, and Other Supply Use	Projected Demand After Passive Conservation[2]	Anticipated Need for Water[3]
Normal	177.1 - 186.1	124.8	301.9 - 310.9	315.2	4.3 - 13.3
10% SFPUC Drought Reduction	147.4 - 152.5	124.8	272.1 - 277.3	315.2	37.8 - 43.0
20% SFPUC Drought Reduction	127.9 - 132.4	124.8	252.7 - 257.2	315.2	58.0 - 62.5

Source Data: Agency Submitted Demand & Supply Worksheets, 2011

[1] Anticipated SFPUC Purchases represents the amount of water member agencies anticipate purchasing in 2035.

[2] Demand after passive conservation represents the demand that member agencies estimate will occur after projected passive conservation is considered, but does not include the water savings anticipated from active conservation measures. As many member agencies consider active conservation to be a demand reduction method rather than a supply, demand after passive conservation may not be consistent with the projected water demands included in agencies' 2010 UWMPs.

[3] Anticipated Need for Water is the difference between Total Anticipated Supply Use and Projected Demand After Passive Conservation, when Projected Demand After Passive Conservation exceeds Total Anticipated Supply Use. In drought conditions, the current analysis assumes an anticipated need for water to provide 100% level of service.

5.2 Aggregate BAWSCA Water Supply Need Under Normal Conditions

Table 8 presents the aggregate BAWSCA water supply need under normal conditions for 2015 through 2035. There is a water supply need under normal conditions in every year. Starting in 2020, the supply need is bracketed as a range of 9 mgd due to the temporary interruptible status of the current contracts between San Francisco and Santa Clara and San Jose. The projected aggregate supply need is greatest in 2035, at approximately 4 to 13 mgd.

Table 8
Aggregate BAWSCA Supply Need Under Normal Conditions (mgd)

	2015	2018	2020	2025	2030	2035
Total Anticipated SFPUC, Local, and Other Supply Use	**262.8**	**270.5**	**265.7 - 274.7**	**277.7 - 286.7**	**2912.0 - 301.0**	**301.9 - 310.9**
Anticipated SFPUC Purchases[1]	170.9	171.8	161.8 - 170.8	166.6 - 175.6	172.7 - 181.7	177.1 - 186.1
Anticipated Use of Available Local & Other Supplies	91.9	98.7	103.9	111.0	119.3	124.8
Projected Demand After Passive Conservation[2]	**264.8**	**272.3**	**276.7**	**289.0**	**303.8**	**315.2**
Anticipated Need for Water[3]	**2.0**	**1.9**	**2.0 - 11.0**	**2.4 - 11.4**	**2.9 - 11.9**	**4.3 - 13.3**

Source Data: Agency Submitted Demand & Supply Worksheets, 2011

[1] Anticipated SFPUC Purchases represents the amount of water member agencies anticipate purchasing in 2035.
[2] Demand after passive conservation represents the demand that member agencies estimate will occur after projected passive conservation is considered, but does not include the water savings anticipated from active conservation measures. As many member agencies consider active conservation to be a demand reduction method rather than a supply, demand after passive conservation may not be consistent with the projected water demands included in agencies' 2010 UWMPs.
[3] Anticipated Need for Water is the difference between Total Anticipated Supply Use and Projected Demand After Passive Conservation, when Projected Demand After Passive Conservation exceeds Total Anticipated Supply Use. In drought conditions, the current analysis assumes a need for water to achieve 100% level of service.

5.3 Aggregate BAWSCA Supply Need Under Drought Conditions (10% and 20%)

Table 9 presents the aggregate BAWSCA water supply need under the 10% system-wide reduction in San Francisco RWS supply condition for 2015 through 2035. The identified water supply need during the 10% system-wide reduction condition ranges from 29 mgd in 2015 to 38 to 43 mgd in 2035.

Table 10 presents the aggregate BAWSCA water supply need under the 20% system-wide reduction in San Francisco RWS supply condition for 2015 through 2035. The identified water supply need during the 20% system-wide reduction condition ranges from 48 mgd in 2015 to 58 to 62 mgd in 2035.

The current analysis of supply need during drought conditions assumes a need for water to provide 100% level of service. This assumption will need to be further discussed with BAWSCA and its member agencies in the future.

Table 9
Aggregate BAWSCA Supply Need Under 10% System-Wide Reduction in San Francisco RWS Supply Conditions (mgd)

	2015	2018	2020	2025	2030	2035
Total Anticipated SFPUC, Local, and Other Supply Use	**235.6**	**242.4**	**241.3 - 246.5**	**250.9 - 256.1**	**263.1 - 268.3**	**272.1 - 277.3**
Anticipated SFPUC Purchases[1]	143.7	143.7	137.4 - 142.6	139.9 - 145.0	143.9 - 149.1	147.4 - 152.5
Anticipated Use of Available Local & Other Supplies	91.9	98.7	103.9	111.0	119.3	124.8
Projected Demand After Passive Conservation[2]	**264.8**	**272.3**	**276.7**	**289.0**	**303.8**	**315.2**
Anticipated Need for Water[3]	**29.2**	**29.9**	**30.3 - 35.4**	**32.9 - 38.1**	**35.5 - 40.7**	**37.8 - 43.0**

Source Data: Agency Submitted Demand & Supply Worksheets, 2011

[1] Anticipated SFPUC Purchases represents the amount of water member agencies anticipate purchasing in 2035.
[2] Demand after passive conservation represents the demand that member agencies estimate will occur after projected passive conservation is considered, but does not include the water savings anticipated from active conservation measures. As many member agencies consider active conservation to be a demand reduction method rather than a supply, demand after passive conservation may not be consistent with the projected water demands included in agencies' 2010 UWMPs.
[3] Anticipated Need for Water is the difference between Total Anticipated Supply Use and Projected Demand After Passive Conservation, when Projected Demand After Passive Conservation exceeds Total Anticipated Supply Use. In drought conditions, the current analysis assumes a need for water to achieve 100% level of service.

Table 10
Aggregate BAWSCA Supply Need Under 20% System-Wide Reduction in San Francisco RWS Supply Conditions (mgd)

Year	2015	2018	2020	2025	2030	2035
Total Anticipated SFPUC, Local, and Other Supply Use	**216.6**	**223.4**	**223.2 - 227.7**	**232.4 - 236.9**	**244.2 - 248.7**	**252.7 - 257.2**
Anticipated SFPUC Purchases[1]	124.8	124.7	119.2 - 123.7	121.4 - 125.9	124.9 - 129.4	127.9 - 132.4
Anticipated Use of Available Local & Other Supplies	91.9	98.7	103.9	111.0	119.3	124.8
Projected Demand After Passive Conservation[2]	**264.8**	**272.3**	**276.7**	**289.0**	**303.8**	**315.2**
Anticipated Need for Water[3]	**48.2**	**48.9**	**49.1 - 53.6**	**52.1 - 56.6**	**55.2 - 59.7**	**58.0 - 62.5**

Source Data: Agency Submitted Demand & Supply Worksheets, 2011

[1] Anticipated SFPUC Purchases represents the amount of water member agencies anticipate purchasing in 2035.
[2] Demand after passive conservation represents the demand that member agencies estimate will occur after projected passive conservation is considered, but does not include the water savings anticipated from active conservation measures. As many member agencies consider active conservation to be a demand reduction method rather than a supply, demand after passive conservation may not be consistent with the projected water demands included in agencies' 2010 UWMPs.
[3] Anticipated Need for Water is the difference between Total Anticipated Supply Use and Projected Demand After Passive Conservation, when Projected Demand After Passive Conservation exceeds Total Anticipated Supply Use. In drought conditions, the current analysis assumes a need for water to achieve 100% level of service.

Section 6
Issues That Affect Projected Supply Reliability

The water supplies currently available to the BAWSCA member agencies are limited, and their reliability is affected by several factors including SFPUC policy decisions, hydrologic conditions, regulatory actions, climate change, and other causes. A description of each supply uncertainty and its potential impact on normal year and drought year supply reliability is presented below.

Although the some of the issues described below will affect a range of current supply sources, the Strategy does not address the impacts of any of these issues on non-SFPUC supplies.

6.1 Summary

Potential issues like climate change, regulatory changes, and drought on the local and Delta supplies could affect the reliability of supplies that BAWSCA member agencies will rely on in the future in addition to their supply from SFPUC. It is anticipated that the reduced reliability of these supplies for some of the BAWSCA members could affect the increase the total regional supply need during future normal and drought years.

Potential impacts of these issues on supply reliability are difficult to assess because, in most cases, studies are ongoing and there is still much uncertainty. For example, scientists researching climate change are nearing a general consensus on long-term forecasts of regional temperature rise and rainfall changes, but more research is needed to estimate the ultimate impact on local water supplies due to potential adaptations in water system operations and management of the supply systems like the RWS. However, it is essential to continue to track the assessments of these issues to include the necessary uncertainty considerations in long-term water supply planning.

6.2 Supply Assumptions

State law requires that water suppliers include data on drought supplies for a single year drought and multi-year droughts in their UWMPs. The information presented in this TM incorporates SFPUC's supply in terms of 10% and 20% system-wide drought reduction on the San Francisco RWS. BAWSCA is working with SFPUC to assess the frequency and magnitude of future droughts based on the updated anticipated SFPUC purchases presented in this TM. This information will be used in subsequent analyses in the Strategy. Although this TM does not consider drought impacts to non-SFPUC supplies, the BAWSCA member agencies have compiled information on these potential changes and what other supplies may be available to them in shortage conditions. Agencies should consider both these factors in their individual long-term planning.

6.3 SFPUC Policy Decisions

As part of the SFPUC Water Supply Improvement Program (WSIP) Program Environmental Impact Report (PEIR), SFPUC evaluated and unilaterally selected the Phased WSIP Variant as the preferred alternative. The Phased WSIP Variant includes full implementation of the proposed WSIP facility improvement projects to ensure that public health, seismic safety, and delivery reliability goals are achieved and that 265 mgd of water supply can be delivered through the San Francisco RWS in normal water years. However, the Phased WSIP Variant defers decisions as to whether any supplies above 265 mgd will be delivered through the RWS to meet the projected 2030 water needs within the RWS service area until 2018.

Specifically, as part of the Phased WSIP Variant, SFPUC made the unilateral decision to limit the water supply available from the RWS to the BAWSCA member agencies to 184 mgd until at least 2018.

Furthermore, SFPUC has determined that, in addition to limiting BAWSCA's aggregate deliveries to 184 mgd, it will impose an Interim Supply Limitation on each BAWSCA member agency. The sum of the individual BAWSCA member agency Interim Supply Limitations is 184 mgd. In the event that purchases from the RWS exceed the 265 mgd limit established by SFPUC, agencies that exceed their Individual Supply Limitations, including San Francisco retail, will be subject to environmental surcharge fees. Individual BAWSCA agency Interim Supply Limitations and environmental surcharge fees are set by SFPUC.

The Phased WSIP Variant established a mid-term planning milestone in 2018 when SFPUC will reevaluate water demands in the service area through 2030 and assess whether or not to increase deliveries from the RWS. At this time, and for purposes of the Strategy, BAWSCA has assumed that deliveries from the RWS to the BAWSCA member agencies will not be in excess of 184 mgd in the future. This assumption is consistent with what the SFPUC has stated in its Water Supply Assessment for the proposed Treasure Island – Yerba Buena project (PBS&J 2009) and the SFPUC's 2010 UWMP.

6.4 Hydrologic Conditions

California has historically experienced intermittent periods of low rainfall. At times, this has resulted in severe impacts on water supplies within the BAWSCA service area (e.g., the 1976-1977 and 1987-1992 droughts). Droughts are anticipated to occur in the future and to impact:

- ***SFPUC Supplies*** – The July 2009 "Water Supply Agreement between The City and County of San Francisco and Wholesale Customers in Alameda County, San Mateo County, and Santa Clara County (WSA)," presents the wholesale customer share of SFPUC supply under different drought conditions, including up to a 20% system-wide reductions. Based on the WSA, the distribution of water between SFPUC and the wholesale customers (BAWSCA member agencies) for various levels of system-wide drought reductions are presented in Table 11 below. Table 12 below presents the results of applying the Tier 1 calculations to the projected purchases from SFPUC and BAWSCA member agencies during a 20% system-wide drought reduction on the San Francisco RWS.

Table 11
Distribution of Available Water Under Drought Conditions As Defined in the Water Supply Agreement Between SFPUC and Wholesale Customers

Level of System Wide Reduction in Water Use Required	Share of Available Water	
	SFPUC Share	Wholesale Customers Share
5% or less	35.5%	64.5%
6% through 10%	36.0%	64.0%
11% through 15%	37.0%	63.0%
16% through 20%	37.5%	62.5%

Source: City and County of San Francisco and Wholesale Customers 2009.

Table 12
Reduction in SFPUC Purchases by BAWSCA Agencies in 20% System-Wide Reduction on RWS (mgd)

Year	Projected SFPUC Retail Demand[1]	Anticipated SFPUC Purchases by BAWSCA Agencies in Normal Year[2]	Total Anticipated Purchases From RWS in Normal Year	Total Supply Available From RWS in 20% System-Wide Reduction	BAWSCA Agencies Share of Total Supply from RWS in 20% System-Wide Reduction	Average Reduction in SFPUC Purchases by BAWSCA Agencies in 20% System-Wide Reduction	
	1	*2*	*3 = [1 + 2]*	*4 = [3 x 0.8]*	*5 = [4 x .625[3]*	*6 = [2 - 5]*	*7 = [(2-5)/2]*
2015	78.6	170.9	249.5	199.6	124.8	46.2	27%
2018	77.7	171.8	249.5	199.6	124.7	47.1	27%
2020	76.7	161.8 - 170.8	238.5 - 247.5	190.8 - 198.0	119.2 - 123.7	42.5 - 47.0	26% - 28%
2025	76.2	166.6 - 175.6	242.8 - 251.8	194.3 - 201.5	121.4 - 125.9	45.2 - 49.7	27% - 28%
2030	77.1	172.7 - 181.7	249.8 - 258.8	199.8 - 207.0	124.9 - 129.4	47.8 - 52.3	28% - 29%
2035	78.7	177.1 - 186.1	255.8 - 264.8	204.7 - 211.9	127.9 - 132.4	49.2 - 53.7	28% - 29%

[1] Projected SFPUC Retail demand based on SFPUC's 2010 Urban Water Management Plan.
[2] Anticipated SFPUC Purchases represents the amount of water member agencies anticipate purchasing in 2015 to 2035.
[3] Wholesale customers' share of total supply from RWS based on the Tier 1 split presented in Table 11.

As part of its WSIP, the SFPUC adopted a level of service goal which allows for rationing up to 20% system-wide. As such, this level of drought reduction in the SFPUC supplies is included in the drought assessment of projected BAWSCA supplies in this section.

Applying the contractual agreement between SFPUC and its wholesale customers on how to share drought shortages, under the 20% system-wide drought reduction, the wholesale customers would be allocated 62.5% of the available water supply from the RWS. For example, with a 20% system-wide drought reduction in 2035, the resultant cutback to the wholesale customers would be a 27 to 29% (or 46 to 53 mgd) reduction in SFPUC supply depending on the actual normal year amount of SFPUC purchases by the wholesale customers.

In Fall 2010, the BAWSCA agencies adopted the Tier 2 Drought Implementation Plan (DRIP) which presents how the SFPUC supply available to the BAWSCA agencies during drought would be allocated.

- ***Delta Supplies*** – The impact of drought and regulatory action on Delta supplies is significant, as illustrated by the reductions in water supplies exported from the Delta region in recent dry years. Quantification of impacts to Delta supplies is evolving and will be affected by long-term infrastructure improvements currently under consideration.

- ***Local Supplies*** – Impact of droughts on member agencies' local supplies will vary based on supply source. For purposes of the Strategy, BAWSCA is only addressing supply reliability for SFPUC supplies. BAWSCA assumes that any reductions in other non-SFPUC supplies will be addressed by the individual BAWSCA member agencies, or the other regional supply agencies.

Supply cutbacks based on hydrologic conditions, when they occur, will have significant economic and lifestyle impacts to residents and businesses. In a 2007 study of the economic impact of a drought on SFPUC supplies to BAWSCA member agencies, resource economist William Wade, Ph.D., estimated that a subset of industrial sectors that are particularly sensitive to curtailments in water supply (e.g., computer/electronic manufacturers, food and beverage manufacturers, and biotechnology) would be significantly affected by drought. The impact of a 20% water supply deficiency on shipments from these industries located in the BAWSCA service area was estimated at nearly $7.7 billion in each year the drought persists (Wade 2007). The economic impact of reductions to non-SFPUC supplies during a drought will also be significant.

6.5 Regulatory Actions

With concerns over maintaining ecosystem health taking greater prominence, a number of regulatory actions have affected, and may affect, the amount of supply available to the BAWSCA member agencies in the future. These regulatory actions include:

- ***Federal Energy Relicensing Commission (FERC)*** – With the recent investigation by FERC concerning potential additional instream flow requirements for fishery restoration purposes and the upcoming relicensing of Don Pedro Reservoir, there is the potential for further reductions of SFPUC deliveries to the BAWSCA member agencies. For example, in 2009, FERC was considering a proposal to increase instream flow requirements that would in turn require a reduction in drought year deliveries by as much as 53% (FERC 2009).

- ***Delta Fishery Issues*** – In 2007, U.S. District Court Judge Wanger rendered a decision that resulted in significant reductions in deliveries of Delta water to agricultural and municipal users (United States District Court 2007). Since 2007, other biological opinions on Delta supplies have been presented that may further reduce Delta supply reliability (National Marine Fisheries Service 2009, U.S. Fish and Wildlife Service 2008). While uncertainty in supplies from the Delta does not impact SFPUC supply, the BAWSCA member agencies that do utilize Delta supplies will be affected.

- ***Local Fishery Issues*** – Experiences of SCVWD, SFPUC, and Alameda County Water District have highlighted the potential for local stream flow requirements to limit water supply yields of local sources. Although the magnitude is not yet known, the evaluation of local surface water and groundwater supplies will have to consider this impact and potential changes in requirements for environmental flows beyond those already identified in the SFPUC WSIP.

- ***New Delta Legislation*** **–** In November 2009, Governor Schwarzenegger signed a package of eight separate pieces of legislation into law. The "Delta Legislation" package addresses new water storage and conveyance facilities, urban water conservation mandates, more efficient agricultural water use, monitoring and reporting of groundwater conditions, and enforcement of water use reporting. The water conservation requirements related to SB-7 directly affects BAWSCA agencies.

6.6 Climate Change

The California hydrologic system is sensitive to climate change. Based on the currently available data, it is generally known that warmer temperatures combined with increasingly variable precipitation patterns will affect Bay Area water supplies as a result of reduced snowpack in the Sierra Nevada Mountains and earlier seasonal runoff. In addition, rising sea levels combined with increasingly severe storms can damage levees and cause saltwater intrusion which can affect surface and groundwater supplies.

The SFPUC has performed an initial assessment of the potential effects of climate change on the RWS as part of their 2010 UWMP effort. The findings indicated that 7% of the runoff currently draining into Hetch Hetchy Reservoir will shift from the spring/summer seasons to the fall/winter seasons based on a temperature rise of 1.5-degrees Celsius and the associated change in snowpack in the Hetch Hetchy watershed (SFPUC 2011). According to the SFPUC, this change in runoff falls within the current year-to-year variation in runoff and is within the range accounted for during normal runoff forecasting and existing reservoir management practices. SFPUC is currently planning additional assessment analyses and is involved in ongoing monitoring and research regarding climate change trends and will continue to monitor the changes and predictions, particularly as these changes relate to water system operations and management of the RWS. Given that this is an area of ongoing study, the impact of climate change on the SFPUC supplies and the RWS remains a source of uncertainty.

The impacts of climate change on non-SFPUC supplies have not been fully evaluated and are still underway. Certainly, prolonged periods of low rainfall and changes in seasonal rainfall patterns may impact a wide range of supply sources for BAWSCA member agencies. Researchers are increasing their understanding of climate change impacts on sea level, snow pack-driven water supplies, and groundwater, among others. Climate change impacts on non-SFPUC supplies identified during Phase II may be incorporated during the refinement of supply projections.

6.7 Other Factors

Other factors affecting the accuracy of the projected supplies include the following:

- The ability of the agencies to fully implement the conservation measures indentified in the 2008 WSIP PEIR and the 2009 Water Conservation Implementation Plan is not certain and will have an impact on supplies.
- The ability of the agencies to fully implement the SB-7 related conservation measures is not certain and will also have an impact on supplies. Pursuant to SB-7, each agency now has the requirement of meeting a conservation goal of up to 20% by 2020. As required by the 2010 UWMPs, each agency had to identify measures to achieve the goals in 2015 and 2020. Agencies will be allowed to reevaluate their target conservation level in 2015, so the current conservation savings projected for meeting the SB-7 goals may change in the future.[2]

[2] Pursuant to SB-7, the state will have to reduce urban per capita water use by 20% no later than December 31, 2020, and by at least 10% no later than December 31, 2015. These water use reductions will be compared against a 10- to 15-year baseline period that ends between 2004 and 2010. SB-7 does not require individual urban water suppliers to reduce per capita water usage by more than 20%. However, each supplier will have to reduce daily per capita water use by at least 5%, unless their baseline water use is less than 100 gallons per capita per day. Urban water suppliers will have to meet their own, specified water use targets, which they can establish on an individual or regional basis.

Section 7
Conclusions and Next Steps

The review of agency projected demands and supplies from the 2011 data has resulted in a reduced aggregate supply need compared to estimates in the 2010 Strategy Phase I Scoping Report. However, there is still a 4 to 13 mgd supply need during normal years, and as much as a 58 to 62 mgd supply need in drought years due to reductions in SFPUC supplies. These drought year estimates are based on providing 100% level of service for the SFPUC supply (i.e., replacing all SFPUC shortfalls with new supply). This assumption will be further explored with the member agencies with the development of information on the potential economic impacts of supply shortfalls, and the costs of new water supply management projects.

This TM does not estimate future drought year supply shortfalls from the non-SFPUC sources on which the member agencies rely. It is assumed that agencies will have access to their other, non-SFPUC supplies during normal and drought conditions. A member agency's individual supply need could be greater or smaller depending upon the reliability of their non-SFPUC supplies. The BAWSCA agencies may want to consider analyzing their individual drought supply need while accounting for the true reliability of their non-SFPUC supplies.

The current analysis of supply need during drought conditions assumes a need for water to achieve 100% level of service. Individual agency level of service goals will need to be further discussed with BAWSCA and its member agencies, and more information (e.g., estimates from SFPUC on the expected timing and magnitude of future drought shortages) is needed to inform this discussion.

Member agencies have used different methods for projecting their demands, based on their system- and district-specific characteristics. For effective planning at the regional level, a more robust and consistent demand projection process for BAWSCA as a whole is necessary to support future local and regional investment decisions. In order to address the differences in the methods used by the individual agencies, BAWSCA will be working with the agencies to develop a common and consistent methodology that is robust, transparent, and flexible that will be used for future demand projections, including the 2015 UWMPs.

The refined supply need information presented in this TM will inform decisions on potential supply need and the types and capacities of water supply management projects assessed as part of the Strategy.

Appendix A
Demand, Supply, and Supply Need for Normal Conditions

- A-1: BAWSCA Demand Projections After Passive Conservation Savings
- A-2: Demand, Supply, and Supply Need for 2015 for Normal Conditions by Agency
- A-3: Demand, Supply, and Supply Need for 2018 for Normal Conditions by Agency
- A-4: Demand, Supply, and Supply Need for 2020 for Normal Conditions by Agency
- A-5: Demand, Supply, and Supply Need for 2025 for Normal Conditions by Agency
- A-6: Demand, Supply, and Supply Need for 2030 for Normal Conditions by Agency
- A-7: Demand, Supply, and Supply Need for 2035 for Normal Conditions by Agency

Table A-1: BAWSCA Demand Projections After Passive Conservation Savings [(1)]

Service Area	2015	2018	2020	2025	2030	2035
Alameda County Water District	45.47	46.57	47.30	48.93	50.89	51.80
Brisbane and Guadalupe Valley MID	1.00	1.04	1.05	1.07	1.09	1.12
Burlingame, City of	5.28	5.32	5.36	5.48	5.59	5.64
Cal Water (Combined)	38.95	39.48	39.65	40.42	41.39	42.49
Coastside County Water District	2.76	2.75	2.74	2.73	2.74	2.74
Daly City, City of	9.37	9.69	9.90	9.97	10.08	10.36
East Palo Alto, City of	2.37	2.44	2.48	2.64	2.82	3.04
Estero MID/Foster City	5.97	6.05	6.11	6.20	6.26	6.26
Hayward, City of	25.90	27.20	28.10	30.40	32.90	35.80
Hillsborough, Town of	3.14	3.27	2.92	2.93	2.94	2.94
Menlo Park, City of	3.20	3.07	2.85	2.91	2.97	2.96
Mid-Peninsula Water Distinct	3.78	3.78	3.87	3.87	3.97	4.07
Millbrae, City of	2.80	2.87	2.92	3.05	3.17	3.29
Milpitas, City of	11.36	12.22	12.79	14.78	16.77	18.77
Mountain View, City of	12.18	12.52	12.75	13.19	13.67	14.16
North Coast County Water District	3.10	3.16	3.16	3.18	3.29	3.36
Palo Alto, City of	14.41	14.67	14.83	15.15	16.09	16.33
Purissima Hills Water District	1.74	1.74	1.74	1.80	1.84	1.84
Redwood City, City of	11.24	11.55	11.75	12.31	12.88	12.88
San Bruno, City of	4.40	4.48	4.57	4.73	4.88	5.13
San Jose, City of (portion of north San Jose)	7.50	8.20	8.60	9.50	10.60	11.80
Santa Clara, City of	24.30	25.10	25.70	26.90	28.20	29.30
Stanford University	3.97	4.31	4.52	4.80	5.09	5.39
Sunnyvale, City of	19.70	19.94	20.20	21.22	22.85	22.85
Westborough Water District	0.89	0.88	0.88	0.87	0.85	0.84
TOTAL	**264.79**	**272.31**	**276.74**	**289.02**	**303.84**	**315.16**

Source: Agency Submitted Demand & Supply Worksheets, 2011, unless footnoted otherwise

Footnote:

(1) Demand after passive conservation represents the demand that member agencies estimate will occur after projected passive conservation is considered, but does not include the water savings anticipated from active conservation measures. As many member agencies consider active conservation to be a demand reduction method rather than a supply, demand after passive conservation may not be consistent with the projected water demands included ir agencies' 2010 UWMPs. Except as noted, demand after passive conservation includes demand for both potable and non-potable water.

Table A-2: Anticipated Use of Available Supplies to Meet Projected Demand in 2015

Member Agency	SFPUC Individual Supply Guarantee	2015 Anticipated SFPUC Purchases[2]	2015 Anticipated Use of Available Local & Other Supplies								2015 Total Anticipated Supply Use[5]	2015 Projected Demand After Passive Conservation[6]	2015 Anticipated Need for Water[7]
			Groundwater	Surface Water	Recycled Water	Desalination	SCVWD or SWP Sources	Active Conservation[3]	Additional Conservation to Meet SB-7 Target[4]	Sub-Total Local and Other Supply			
Alameda County Water District	13.76	13.76	4.04	4.58	0.00	5.00	17.39	0.70	0.00	31.71	45.47	45.47	0.00
Brisbane and Guadalupe Valley MID[8]	0.98	0.95	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.05	1.00	1.00	0.00
Burlingame, City of	5.23	4.90	0.00	0.00	0.30	0.00	0.00	0.08	0.00	0.38	5.28	5.28	0.00
Cal Water (Combined)	35.68	35.04	1.37	1.13	0.00	0.00	0.00	1.41	0.00	3.91	38.95	38.95	0.01
Coastside County Water District	2.18	1.76	0.11	0.68	0.00	0.00	0.00	0.15	0.07	1.00	2.76	2.76	0.00
Daly City, City of	4.29	4.29	2.99	0.00	0.01	0.00	0.00	0.61	0.00	3.61	7.90	9.37	1.47
East Palo Alto, City of[9]	1.96	1.96	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.96	2.37	0.41
Estero MID/Foster City	5.90	5.67	0.00	0.00	0.00	0.00	0.00	0.30	0.00	0.30	5.97	5.97	0.00
Hayward, City of[10, 11]		21.90	0.00	0.00	3.10	0.00	0.00	0.90	0.00	4.00	25.90	25.90	0.00
Hillsborough, Town of[12]	4.09	3.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.14	3.14	0.00
Menlo Park, City of	4.46	3.00	0.00	0.00	0.00	0.00	0.00	0.07	0.13	0.20	3.20	3.20	0.00
Mid-Peninsula Water District	3.89	3.55	0.00	0.00	0.00	0.00	0.00	0.07	0.16	0.23	3.78	3.78	0.00
Millbrae, City of	3.15	2.62	0.00	0.00	0.01	0.00	0.00	0.10	0.07	0.18	2.80	2.80	0.00
Milpitas, City of	9.23	7.07	0.00	0.00	0.99	0.00	3.30	0.00	0.00	4.29	11.36	11.36	0.00
Mountain View, City of[13]	13.46	9.85	0.22	0.00	0.92	0.00	1.18	0.00	0.00	2.32	12.18	12.18	0.00
North Coast County Water District	3.84	3.06	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.04	3.10	3.10	0.00
Palo Alto, City of	17.07	12.73	0.00	0.00	0.72	0.00	0.00	0.97	0.00	1.69	14.41	14.41	0.00
Purissima Hills Water District	1.62	1.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.62	1.74	0.12
Redwood City, City of	10.93	10.22	0.00	0.00	0.88	0.00	0.00	0.14	0.00	1.02	11.24	11.24	0.00
San Bruno, City of[14]	3.25	2.30	2.10	0.00	0.00	0.00	0.00	0.00	0.00	2.10	4.40	4.40	0.00
San Jose, City of (portion of north San Jose)[15, 16]		4.50	1.34	0.00	1.10	0.00	0.00	0.00	0.56	3.00	7.50	7.50	0.00
Santa Clara, City of[15]		4.50	11.23	0.00	3.57	0.00	4.08	0.92	0.00	19.80	24.30	24.30	0.00
Stanford University[17]	3.03	2.70	0.00	1.20	0.01	0.00	0.00	0.06	0.00	1.27	3.97	3.97	0.00
Sunnyvale, City of	12.58	8.93	0.98	0.00	1.25	0.00	8.54	0.00	0.00	10.77	19.70	19.70	0.00
Westborough Water District	1.32	0.89	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.89	0.89	0.00
Totals		**170.91**	**24.38**	**7.58**	**12.90**	**5.00**	**34.49**	**6.53**	**0.99**	**91.87**	**262.79**	**264.79**	**2.01**

Abbreviations:

"SB-7" = Senate Bill 7
"SCVWD" = Santa Clara Valley Water District
"SFPUC" = San Francisco Public Utilities Commission
"SWP" = State Water Project
"UWMP" = Urban Water Management Plan

Notes

(1) Except where noted, information herein was compiled based on information provided to BAWSCA May - September 2011 by each BAWSCA member agency and information included in BAWSCA member agencies' draft or final 2010 Urban Water Management Plans, referenced below. All data provided in million gallons per day.
(2) "Anticipated SFPUC Purchases" represents the amount of water a member agency anticipates purchasing in 2015.
(3) "Active Conservation" represents the savings associated with active conservation measures that a member agency plans on implementing in 2015. For summary purposes, active conservation is herein considered to be a supply source. Many agencies consider both passive and active conservation to be demand reduction methods in their 2010 UWMPs. It is assumed herein that demand after passive conservation does not include active conservation and therefore demand after passive conservation may not be consistent with 2010 UWMPs for these member agencies.
(4) "Additional Conservation to Meet SB-7 Targets" represents the conservation that agencies plan to implement to meet SB-7 targets, beyond that being implemented under existing active conservation measures.
(5) "Total Anticipated Supply Use" is the sum of all anticipated use of supplies.
(6) Demand after passive conservation represents the demand that member agencies estimate will occur after projected passive conservation is considered, but does not include the water savings anticipated from active conservation measures. As many member agencies consider active conservation to be a demand reduction method rather than a supply, demand after passive conservation may not be consistent with the projected water demands included in agencies' 2010 UWMPs. Except as noted, demand after passive conservation includes demand for both potable and non-potable water.
(7) "Anticipated Need for Water" is the difference between Total Anticipated Supply Use and Projected Demand After Passive Conservation, when Projected Demand After Passive Conservation exceeds Total Anticipated Supply Use.
(8) Brisbane and Guadalupe Valley MID have based their anticipated SFPUC Purchases on modeling results that relay on various assumptions that result in a future projection with an anticipated variance.
(9) East Palo Alto has identified the potential for possible future development of groundwater and recycled water in the service area to meet future water supply needs. To the extent that these new supplies are developed, they would offset any supply need identified as part of the Strategy.
(10) Hayward does not have an Individual Supply Guarantee.
(11) Hayward's estimates for Active Conservation include any additional conservation needed to meet the SB-7 target.
(12) The Town of Hillsborough has not done analysis on water use savings through passive conservation. The Town has conducted an analysis of potential active water conservation savings using DWR Provisional Method 4 calculator, which suggests that Hillsborough can meet its 2020 water demand projections through active conservation alone. The Town believes that this understates the role that passive conservation will play in meeting its 2020 demand projections.
(13) Continued conservation efforts are estimated to save Mountain View up to 0.75 mgd through the year 2035. Actual conservation will depend on several factors, and is not quantified above for conservative planning purposes.

(14) For San Bruno, the shown anticipated use of available supplies is based on a policy assumption for projected use of available supplies in the future and is subject to potential changes due to changed operational assumptions in the future for local groundwater, local conjunctive use, regional conjunctive use,and purchases from the SFPUC and the actual cost of alternative supplies.

(15) San Jose and Santa Clara have temporary and interruptible contracts with SFPUC to purchase water with a limit of 9 mgd between the two agencies.

(16) The City of San Jose has a temporary and interruptible contract with San Francisco. Per the 2009 Water Supply Agreement between San Francisco and its Wholesale Customers, San Francisco will supply a combined annual average of 9 mgd to the cities of San Jose and Santa Clara through 2018 subject to reductions as described in that agreement and would require a CEQA analysis. The City of San Jose's priority is to secure after 2018 a minimum of 4.5 mgd of supply for the North San Jose area. As part of the Strategy, San Jose has asked BAWSCA to include planning for a Supply Need up to 4.5 mgd.

(17) Stanford's non-potable supply identified as surface water is supplied from Stanford University Lake water, which in most years is a blend of surface water and groundwater, depending on availability of surface water.

References:

ACWD, 2011. Alameda County Water District, Urban Water Management Plan 2010-2015.
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NCCWD, 2011. Urban Water Management Plan 2010-2015, North Coast County Water District, prepared by Donaldson Associates, June 2011.
Town of Hillsborough, 2011. 2010 Draft Urban Water Management Plan, prepared by CSG Consultants, Sept. 2011.

Table A-3: Anticipated Use of Available Supplies to Meet Projected Demand in 2018

Member Agency	SFPUC Individual Supply Guarantee	2018 Anticipated SFPUC Purchases[2]	2018 Anticipated Use of Available Local & Other Supplies								2018 Total Anticipated Supply Use[5]	2018 Projected Demand After Passive Conservation[6]	2018 Anticipated Need for Water[7]
			Groundwater	Surface Water	Recycled Water	Desalination	SCVWD or SWP Sources	Active Conservation[3]	Additional Conservation to Meet SB-7 Target[4]	Sub-Total Local and Other Supply			
Alameda County Water District	13.76	13.76	4.78	4.58	0.00	5.00	17.39	1.06	0.00	32.81	46.57	46.57	0.00
Brisbane and Guadalupe Valley MID[8]	0.98	0.98	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.06	1.04	1.04	0.00
Burlingame, City of	5.23	4.93	0.00	0.00	0.30	0.00	0.00	0.09	0.00	0.39	5.32	5.32	0.00
Cal Water (Combined)	35.68	34.13	1.37	1.13	0.00	0.00	0.00	2.86	0.00	5.36	39.48	39.48	0.00
Coastside County Water District	2.18	1.70	0.11	0.68	0.00	0.00	0.00	0.16	0.10	1.04	2.75	2.75	0.00
Daly City, City of	4.29	4.29	3.40	0.00	0.01	0.00	0.00	0.73	0.00	4.14	8.43	9.69	1.26
East Palo Alto, City of[9]	1.96	1.96	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.96	2.44	0.48
Estero MID/Foster City	5.90	5.75	0.00	0.00	0.00	0.00	0.00	0.30	0.00	0.30	6.05	6.05	0.00
Hayward, City of[10, 11]		22.90	0.00	0.00	3.10	0.00	0.00	1.20	0.00	4.30	27.20	27.20	0.00
Hillsborough, Town of[12]	4.09	3.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.27	3.27	0.00
Menlo Park, City of	4.46	2.83	0.00	0.00	0.00	0.00	0.00	0.08	0.16	0.24	3.07	3.07	0.00
Mid-Peninsula Water District	3.89	3.55	0.00	0.00	0.00	0.00	0.00	0.07	0.16	0.23	3.78	3.78	0.00
Millbrae, City of	3.15	2.65	0.00	0.00	0.01	0.00	0.00	0.10	0.11	0.22	2.87	2.87	0.00
Milpitas, City of	9.23	7.44	0.00	0.00	1.11	0.00	3.67	0.00	0.00	4.78	12.22	12.22	0.00
Mountain View, City of[13]	13.46	9.94	0.23	0.00	1.18	0.00	1.18	0.00	0.00	2.59	12.52	12.52	0.00
North Coast County Water District	3.84	3.12	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.04	3.16	3.16	0.00
Palo Alto, City of	17.07	12.61	0.00	0.00	0.72	0.00	0.00	1.34	0.00	2.06	14.67	14.67	0.00
Purissima Hills Water District	1.62	1.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.62	1.74	0.12
Redwood City, City of	10.93	10.33	0.00	0.00	1.04	0.00	0.00	0.18	0.00	1.22	11.55	11.55	0.00
San Bruno, City of[14]	3.25	2.38	2.10	0.00	0.00	0.00	0.00	0.00	0.00	2.10	4.48	4.48	0.00
San Jose, City of (portion of north San Jose)[15, 16]		4.50	1.37	0.00	1.25	0.00	0.00	0.00	1.08	3.70	8.20	8.20	0.00
Santa Clara, City of[15]		4.50	11.66	0.00	3.73	0.00	4.08	1.13	0.00	20.60	25.10	25.10	0.00
Stanford University[17]	3.03	2.82	0.00	1.20	0.01	0.00	0.00	0.28	0.00	1.49	4.31	4.31	0.00
Sunnyvale, City of	12.58	8.93	0.98	0.00	1.32	0.00	8.71	0.00	0.00	11.01	19.94	19.94	0.00
Westborough Water District	1.32	0.88	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.88	0.88	0.00
Totals		**171.79**	**26.00**	**7.58**	**13.82**	**5.00**	**35.03**	**9.63**	**1.61**	**98.67**	**270.46**	**272.31**	**1.86**

Abbreviations:

"SB-7" = Senate Bill 7
"SCVWD" = Santa Clara Valley Water District
"SFPUC" = San Francisco Public Utilities Commission
"SWP" = State Water Project
"UWMP" = Urban Water Management Plan

Notes

(1) Except where noted, information herein was compiled based on information provided to BAWSCA May - September 2011 by each BAWSCA member agency and information included in BAWSCA member agencies' draft or final 2010 Urban Water Management Plans, referenced below. All data provided in million gallons per day.
(2) "Anticipated SFPUC Purchases" represents the amount of water a member agency anticipates purchasing in 2018.
(3) "Active Conservation" represents the savings associated with active conservation measures that a member agency plans on implementing in 2018. For summary purposes, active conservation is herein considered to be a supply source. Many agencies consider both passive and active conservation to be demand reduction methods in their 2010 UWMPs. It is assumed herein that demand after passive conservation does not include active conservation and therefore demand after passive conservation may not be consistent with 2010 UWMPs for these member agencies.
(4) "Additional Conservation to Meet SB-7 Targets" represents the conservation that agencies plan to implement to meet SB-7 targets, beyond that being implemented under existing active conservation measures.
(5) "Total Anticipated Supply Use" is the sum of all anticipated use of supplies.
(6) Demand after passive conservation represents the demand that member agencies estimate will occur after projected passive conservation is considered, but does not include the water savings anticipated from active conservation measures. As many member agencies consider active conservation to be a demand reduction method rather than a supply, demand after passive conservation may not be consistent with the projected water demands included in agencies' 2010 UWMPs. Except as noted, demand after passive conservation includes demand for both potable and non-potable water.
(7) "Anticipated Need for Water" is the difference between Total Anticipated Supply Use and Projected Demand After Passive Conservation, when Projected Demand After Passive Conservation exceeds Total Anticipated Supply Use.
(8) Brisbane and Guadalupe Valley MID have based their anticipated SFPUC Purchases on modeling results that relay on various assumptions that result in a future projection with an anticipated variance.
(9) East Palo Alto has identified the potential for possible future development of groundwater and recycled water in the service area to meet future water supply needs. To the extent that these new supplies are developed, they would offset any supply need identified as part of the Strategy.
(10) Hayward does not have an Individual Supply Guarantee.
(11) Hayward's estimates for Active Conservation include any additional conservation needed to meet the SB-7 target.
(12) The Town of Hillsborough has not done analysis on water use savings through passive conservation. The Town has conducted an analysis of potential active water conservation savings using DWR Provisional Method 4 calculator, which suggests that Hillsborough can meet its 2020 water demand projections through active conservation alone. The Town believes that this understates the role that passive conservation will play in meeting its 2020 demand projections.
(13) Continued conservation efforts are estimated to save Mountain View up to 0.75 mgd through the year 2035. Actual conservation will depend on several factors, and is not quantified above for conservative planning purposes.

(14) For San Bruno, the shown anticipated use of available supplies is based on a policy assumption for projected use of available supplies in the future and is subject to potential changes due to changed operational assumptions in the future for local groundwater, local conjunctive use, regional conjunctive use,and purchases from the SFPUC and the actual cost of alternative supplies.

(15) San Jose and Santa Clara have temporary and interruptible contracts with SFPUC to purchase water with a limit of 9 mgd between the two agencies.

(16) The City of San Jose has a temporary and interruptible contract with San Francisco. Per the 2009 Water Supply Agreement between San Francisco and its Wholesale Customers, San Francisco will supply a combined annual average of 9 mgd to the cities of San Jose and Santa Clara through 2018 subject to reductions as described in that agreement and would require a CEQA analysis. The City of San Jose's priority is to secure after 2018 a minimum of 4.5 mgd of supply for the North San Jose area. As part of the Strategy, San Jose has asked BAWSCA to include planning for a Supply Need up to 4.5 mgd.

(17) Stanford's non-potable supply identified as surface water is supplied from Stanford University Lake water, which in most years is a blend of surface water and groundwater, depending on availability of surface water.

References:

ACWD, 2011. Alameda County Water District, Urban Water Management Plan 2010-2015.
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NCCWD, 2011. Urban Water Management Plan 2010-2015, North Coast County Water District, prepared by Donaldson Associates, June 2011.
Town of Hillsborough, 2011. 2010 Draft Urban Water Management Plan, prepared by CSG Consultants, Sept. 2011.

Table A-4: Anticipated Use of Available Supplies to Meet Projected Demand in 2020

Member Agency	SFPUC Individual Supply Guarantee	2020 Anticipated SFPUC Purchases[2]	2020 Anticipated Use of Available Local & Other Supplies								2020 Total Anticipated Supply Use[5]	2020 Projected Demand After Passive Conservation[6]	2020 Anticipated Need for Water[7]
			Groundwater	Surface Water	Recycled Water	Desalination	SCVWD or SWP Sources	Active Conservation[3]	Additional Conservation to Meet SB-7 Target[4]	Sub-Total Local and Other Supply			
Alameda County Water District	13.76	13.76	5.28	4.58	0.00	5.00	17.39	1.29	0.00	33.54	47.30	47.30	0.00
Brisbane and Guadalupe Valley MID[8]	0.98	0.98	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.06	1.05	1.05	0.00
Burlingame, City of	5.23	4.97	0.00	0.00	0.30	0.00	0.00	0.09	0.00	0.39	5.36	5.36	0.00
Cal Water (Combined)	35.68	33.13	1.37	1.13	0.00	0.00	0.00	4.03	0.00	6.53	39.65	39.65	0.00
Coastside County Water District	2.18	1.70	0.11	0.68	0.00	0.00	0.00	0.16	0.09	1.03	2.74	2.74	0.00
Daly City, City of	4.29	4.29	3.43	0.00	0.01	0.00	0.00	0.77	0.00	4.21	8.50	9.90	1.40
East Palo Alto, City of[9]	1.96	1.96	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.96	2.48	0.52
Estero MID/Foster City	5.90	5.27	0.00	0.00	0.00	0.00	0.00	0.84	0.00	0.84	6.11	6.11	0.00
Hayward, City of[10, 11]		23.40	0.00	0.00	3.40	0.00	0.00	1.30	0.00	4.70	28.10	28.10	0.00
Hillsborough, Town of[12]	4.09	2.92	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.92	2.92	0.00
Menlo Park, City of	4.46	2.58	0.00	0.00	0.00	0.00	0.00	0.09	0.18	0.27	2.85	2.85	0.00
Mid-Peninsula Water District	3.89	3.60	0.00	0.00	0.00	0.00	0.00	0.07	0.20	0.27	3.87	3.87	0.00
Millbrae, City of	3.15	2.67	0.00	0.00	0.01	0.00	0.00	0.10	0.14	0.25	2.92	2.92	0.00
Milpitas, City of	9.23	7.69	0.00	0.00	1.19	0.00	3.91	0.00	0.00	5.10	12.79	12.79	0.00
Mountain View, City of[13]	13.46	9.91	0.23	0.00	1.44	0.00	1.18	0.00	0.00	2.85	12.75	12.75	0.00
North Coast County Water District	3.84	3.12	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.04	3.16	3.16	0.00
Palo Alto, City of	17.07	12.64	0.00	0.00	0.72	0.00	0.00	1.47	0.00	2.19	14.83	14.83	0.00
Purissima Hills Water District	1.62	1.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.62	1.74	0.12
Redwood City, City of	10.93	10.40	0.00	0.00	1.14	0.00	0.00	0.21	0.00	1.35	11.75	11.75	0.00
San Bruno, City of[14]	3.25	2.47	2.10	0.00	0.00	0.00	0.00	0.00	0.00	2.10	4.57	4.57	0.00
San Jose, City of (portion of north San Jose)[15, 16]		4.5 - 0	1.30	0.00	1.36	0.00	0.00	0.00	1.44	4.10	4.10 - 8.60	8.60	0.00 - 4.50
Santa Clara, City of[15]		4.5 - 0	12.06	0.00	3.84	0.00	4.08	1.22	0.00	21.20	21.20 - 25.70	25.70	0.00 - 4.50
Stanford University[17]	3.03	2.90	0.00	1.30	0.01	0.00	0.00	0.31	0.00	1.62	4.52	4.52	0.00
Sunnyvale, City of	12.58	8.93	0.98	0.00	1.36	0.00	8.93	0.00	0.00	11.27	20.20	20.20	0.00
Westborough Water District	1.32	0.88	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.88	0.88	0.00
Totals		**161.79 - 170.79**	**26.86**	**7.68**	**14.82**	**5.00**	**35.49**	**12.02**	**2.05**	**103.92**	**265.71 - 274.71**	**276.74**	**2.04 - 11.04**

Abbreviations:

"SB-7" = Senate Bill 7
"SCVWD" = Santa Clara Valley Water District
"SFPUC" = San Francisco Public Utilities Commission
"SWP" = State Water Project
"UWMP" = Urban Water Management Plan

Notes

(1) Except where noted, information herein was compiled based on information provided to BAWSCA May - September 2011 by each BAWSCA member agency and information included in BAWSCA member agencies' draft or final 2010 Urban Water Management Plans, referenced below. All data provided in million gallons per day.
(2) "Anticipated SFPUC Purchases" represents the amount of water a member agency anticipates purchasing in 2020. The upper range of total anticipated purchases range is associated with a continued delivery by San Francisco of 9 mgd to San Jose and Santa Clara.
(3) "Active Conservation" represents the savings associated with active conservation measures that a member agency plans on implementing in 2020. For summary purposes, active conservation is herein considered to be a supply source. Many agencies consider both passive and active conservation to be demand reduction methods in their 2010 UWMPs. It is assumed herein that demand after passive conservation does not include active conservation and therefore demand after passive conservation may not be consistent with 2010 UWMPs for these member agencies.
(4) "Additional Conservation to Meet SB-7 Targets" represents the conservation that agencies plan to implement to meet SB-7 targets, beyond that being implemented under existing active conservation measures.
(5) "Total Anticipated Supply Use" is the sum of all anticipated use of supplies.
(6) Demand after passive conservation represents the demand that member agencies estimate will occur after projected passive conservation is considered, but does not include the water savings anticipated from active conservation measures. As many member agencies consider active conservation to be a demand reduction method rather than a supply, demand after passive conservation may not be consistent with the projected water demands included in agencies' 2010 UWMPs. Except as noted, demand after passive conservation includes demand for both potable and non-potable water.
(7) "Anticipated Need for Water" is the difference between Total Anticipated Supply Use and Projected Demand After Passive Conservation, when Projected Demand After Passive Conservation exceeds Total Anticipated Supply Use. The upper end of the anticipated need for water range is needed if San Francisco decides not to provide 9 mgd of permanent supply to Santa Clara and San Jose.
(8) Brisbane and Guadalupe Valley MID have based their anticipated SFPUC Purchases on modeling results that relay on various assumptions that result in a future projection with an anticipated variance.
(9) East Palo Alto has identified the potential for possible future development of groundwater and recycled water in the service area to meet future water supply needs. To the extent that these new supplies are developed, they would offset any supply need identified as part of the Strategy.
(10) Hayward does not have an Individual Supply Guarantee.
(11) Hayward's estimates for Active Conservation include any additional conservation needed to meet the SB-7 target.
(12) The Town of Hillsborough has not done analysis on water use savings through passive conservation. The Town has conducted an analysis of potential active water conservation savings using DWR Provisional Method 4 calculator, which suggests that Hillsborough can meet its 2020 water demand projections through active conservation alone. The Town believes that this understates the role that passive conservation will play in meeting its 2020 demand projections.

(13) Continued conservation efforts are estimated to save Mountain View up to 0.75 mgd through the year 2035. Actual conservation will depend on several factors, and is not quantified above for conservative planning purposes.
(14) For San Bruno, the shown anticipated use of available supplies is based on a policy assumption for projected use of available supplies in the future and is subject to potential changes due to changed operational assumptions in the future for local groundwater, local conjunctive use, regional conjunctive use,and purchases from the SFPUC and the actual cost of alternative supplies.
(15) San Jose and Santa Clara have temporary and interruptible contracts with SFPUC to purchase water with a limit of 9 mgd between the two agencies.
(16) The City of San Jose has a temporary and interruptible contract with San Francisco. Per the 2009 Water Supply Agreement between San Francisco and its Wholesale Customers, San Francisco will supply a combined annual average of 9 mgd to the cities of San Jose and Santa Clara through 2018 subject to reductions as described in that agreement and would require a CEQA analysis. The City of San Jose's priority is to secure after 2018 a minimum of 4.5 mgd of supply for the North San Jose area. As part of the Strategy, San Jose has asked BAWSCA to include planning for a Supply Need up to 4.5 mgd.
(17) Stanford's non-potable supply identified as surface water is supplied from Stanford University Lake water, which in most years is a blend of surface water and groundwater, depending on availability of surface water.

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Town of Hillsborough, 2011. 2010 Draft Urban Water Management Plan, prepared by CSG Consultants, Sept. 2011.

Table A-5: Anticipated Use of Available Supplies to Meet Projected Demand in 2025

Member Agency	SFPUC Individual Supply Guarantee	2025 Anticipated SFPUC Purchases(2)	2025 Anticipated Use of Available Local & Other Supplies								2025 Total Anticipated Supply Use(5)	2025 Projected Demand After Passive Conservation(6)	2025 Anticipated Need for Water(7)
			Groundwater	Surface Water	Recycled Water	Desalination	SCVWD or SWP Sources	Active Conservation(3)	Additional Conservation to Meet SB-7 Target(4)	Sub-Total Local and Other Supply			
	13.76	13.76	6.91	4.58	0.00	5.00	17.39	1.29	0.00	35.17	48.93	48.93	0.00
Brisbane and Guadalupe Valley MID(8)	0.98	1.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.07	1.07	1.07	0.00
Burlingame, City of	5.23	5.07	0.00	0.00	0.30	0.00	0.00	0.10	0.00	0.40	5.48	5.48	0.00
Cal Water (Combined)	35.68	34.15	1.37	1.13	0.00	0.00	0.00	3.78	0.00	6.28	40.42	40.42	0.00
Coastside County Water District	2.18	1.73	0.11	0.68	0.00	0.00	0.00	0.15	0.06	0.99	2.73	2.73	0.00
Daly City, City of	4.29	4.29	3.43	0.00	0.01	0.00	0.00	0.79	0.00	4.23	8.52	9.97	1.45
East Palo Alto, City of(9)	1.96	1.96	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.96	2.64	0.68
Estero MID/Foster City	5.90	5.35	0.00	0.00	0.00	0.00	0.00	0.85	0.00	0.85	6.20	6.20	0.00
Hayward, City of(10, 11)		25.40	0.00	0.00	3.40	0.00	0.00	1.60	0.00	5.00	30.40	30.40	0.00
Hillsborough, Town of(12)	4.09	2.93	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.93	2.93	0.00
Menlo Park, City of	4.46	2.60	0.00	0.00	0.00	0.00	0.00	0.10	0.21	0.31	2.91	2.91	0.00
Mid-Peninsula Water District	3.89	3.60	0.00	0.00	0.00	0.00	0.00	0.07	0.20	0.27	3.87	3.87	0.00
Millbrae, City of	3.15	2.79	0.00	0.00	0.01	0.00	0.00	0.10	0.15	0.26	3.05	3.05	0.00
Milpitas, City of	9.23	8.25	0.00	0.00	1.38	0.00	5.15	0.00	0.00	6.53	14.78	14.78	0.00
Mountain View, City of(13)	13.46	10.34	0.23	0.00	1.44	0.00	1.18	0.00	0.00	2.85	13.19	13.19	0.00
North Coast County Water District	3.84	3.14	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.04	3.18	3.18	0.00
Palo Alto, City of	17.07	12.81	0.00	0.00	0.72	0.00	0.00	1.61	0.00	2.33	15.15	15.15	0.00
Purissima Hills Water District	1.62	1.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.62	1.80	0.18
Redwood City, City of	10.93	10.36	0.00	0.00	1.30	0.00	0.00	0.65	0.00	1.95	12.31	12.31	0.00
San Bruno, City of(14)	3.25	2.63	2.10	0.00	0.00	0.00	0.00	0.00	0.00	2.10	4.73	4.73	0.00
San Jose, City of (portion of north San Jose)(15, 16)		4.5 - 0	1.77	0.00	1.66	0.00	0.00	0.00	1.57	5.00	5.00 - 9.50	9.50	0.00 - 4.50
Santa Clara, City of(15)		4.5 - 0	13.00	0.00	4.02	0.00	4.08	1.30	0.00	22.40	22.40 - 26.90	26.90	0.00 - 4.50
Stanford University(17)	3.03	3.03	0.00	1.30	0.01	0.00	0.00	0.39	0.00	1.70	4.73	4.80	0.07
Sunnyvale, City of	12.58	8.93	0.98	0.00	1.47	0.00	9.84	0.00	0.00	12.29	21.22	21.22	0.00
Westborough Water District	1.32	0.87	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.87	0.87	0.00
Totals		**166.62 - 175.62**	**29.90**	**7.68**	**15.76**	**5.00**	**37.64**	**12.85**	**2.19**	**111.03**	**277.65 - 286.65**	**289.02**	**2.38 - 11.38**

Abbreviations:
"SB-7" = Senate Bill 7
"SCVWD" = Santa Clara Valley Water District
"SFPUC" = San Francisco Public Utilities Commission
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(4) "Additional Conservation to Meet SB-7 Targets" represents the conservation that agencies plan to implement to meet SB-7 targets, beyond that being implemented under existing active conservation measures.

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(7) "Anticipated Need for Water" is the difference between Total Anticipated Supply Use and Projected Demand After Passive Conservation, when Projected Demand After Passive Conservation exceeds Total Anticipated Supply Use. The upper end of the anticipated need for water range is needed if San Francisco decides not to provide 9 mgd of permanent supply to Santa Clara and San Jose.

(8) Brisbane and Guadalupe Valley MID have based their anticipated SFPUC Purchases on modeling results that relay on various assumptions that result in a future projection with an anticipated variance.

(9) East Palo Alto has identified the potential for possible future development of groundwater and recycled water in the service area to meet future water supply needs. To the extent that these new supplies are developed, they would offset any supply need identified as part of the Strategy.

(10) Hayward does not have an Individual Supply Guarantee.

(11) Hayward's estimates for Active Conservation include any additional conservation needed to meet the SB-7 target.

(12) The Town of Hillsborough has not done analysis on water use savings through passive conservation. The Town has conducted an analysis of potential active water conservation savings using DWR Provisional Method 4 calculator, which suggests that Hillsborough can meet its 2020 water demand projections through active conservation alone. The Town believes that this understates the role that passive conservation will play in meeting its 2020 demand projections.

(13) Continued conservation efforts are estimated to save Mountain View up to 0.75 mgd through the year 2035. Actual conservation will depend on several factors, and is not quantified above for conservative planning purposes.
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(16) The City of San Jose has a temporary and interruptible contract with San Francisco. Per the 2009 Water Supply Agreement between San Francisco and its Wholesale Customers, San Francisco will supply a combined annual average of 9 mgd to the cities of San Jose and Santa Clara through 2018 subject to reductions as described in that agreement and would require a CEQA analysis. The City of San Jose's priority is to secure after 2018 a minimum of 4.5 mgd of supply for the North San Jose area. As part of the Strategy, San Jose has asked BAWSCA to include planning for a Supply Need up to 4.5 mgd.
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Table A-6: Anticipated Use of Available Supplies to Meet Projected Demand in 2030

Member Agency	SFPUC Individual Supply Guarantee	2030 Anticipated SFPUC Purchases(2)	2030 Anticipated Use of Available Local & Other Supplies								2030 Total Anticipated Supply Use(5)	2030 Projected Demand After Passive Conservation(6)	2030 Anticipated Need for Water(7)
			Groundwater	Surface Water	Recycled Water	Desalination	SCVWD or SWP Sources	Active Conservation(3)	Additional Conservation to Meet SB-7 Target(4)	Sub-Total Local and Other Supply			
Alameda County Water District	13.76	13.76	8.87	4.58	0.00	5.00	17.39	1.29	0.00	37.13	50.89	50.89	0.00
Brisbane and Guadalupe Valley MID(8)	0.98	1.01	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.08	1.09	1.09	0.00
Burlingame, City of	5.23	5.18	0.00	0.00	0.30	0.00	0.00	0.11	0.00	0.41	5.59	5.59	0.00
Cal Water (Combined)	35.68	35.23	1.37	1.13	0.00	0.00	0.00	3.66	0.00	6.16	41.39	41.39	0.00
Coastside County Water District	2.18	1.77	0.11	0.68	0.00	0.00	0.00	0.15	0.04	0.97	2.74	2.74	0.00
Daly City, City of	4.29	4.29	3.43	0.00	0.01	0.00	0.00	0.82	0.00	4.25	8.55	10.08	1.53
East Palo Alto, City of(9)	1.96	1.96	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.96	2.82	0.86
Estero MID/Foster City	5.90	5.40	0.00	0.00	0.00	0.00	0.00	0.86	0.00	0.86	6.26	6.26	0.00
Hayward, City of(10, 11)		27.70	0.00	0.00	3.40	0.00	0.00	1.80	0.00	5.20	32.90	32.90	0.00
Hillsborough, Town of(12)	4.09	2.94	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.94	2.94	0.00
Menlo Park, City of	4.46	2.63	0.00	0.00	0.00	0.00	0.00	0.11	0.23	0.34	2.97	2.97	0.00
Mid-Peninsula Water District	3.89	3.70	0.00	0.00	0.00	0.00	0.00	0.07	0.20	0.27	3.97	3.97	0.00
Millbrae, City of	3.15	2.90	0.00	0.00	0.01	0.00	0.00	0.10	0.16	0.27	3.17	3.17	0.00
Milpitas, City of	9.23	8.80	0.00	0.00	1.57	0.00	6.40	0.00	0.00	7.97	16.77	16.77	0.00
Mountain View, City of(13)	13.46	10.81	0.24	0.00	1.44	0.00	1.18	0.00	0.00	2.86	13.67	13.67	0.00
North Coast County Water District	3.84	3.25	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.04	3.29	3.29	0.00
Palo Alto, City of	17.07	13.37	0.00	0.00	0.72	0.00	0.00	2.00	0.00	2.72	16.09	16.09	0.00
Purissima Hills Water District	1.62	1.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.62	1.84	0.22
Redwood City, City of	10.93	10.79	0.00	0.00	1.44	0.00	0.00	0.65	0.00	2.09	12.88	12.88	0.00
San Bruno, City of(14)	3.25	2.78	2.10	0.00	0.00	0.00	0.00	0.00	0.00	2.10	4.88	4.88	0.00
San Jose, City of (portion of north San Jose)(15, 16)		4.5 - 0	2.38	0.00	2.01	0.00	0.00	0.00	1.71	6.10	6.10 - 10.60	10.60	0.00 - 4.50
Santa Clara, City of(15)		4.5 - 0	14.22	0.00	4.02	0.00	4.08	1.38	0.00	23.70	23.70 - 28.20	28.20	0.00 - 4.50
Stanford University(17)	3.03	3.03	0.00	1.40	0.01	0.00	0.00	0.38	0.00	1.79	4.82	5.09	0.27
Sunnyvale, City of	12.58	8.93	0.98	0.00	1.58	0.00	11.36	0.00	0.00	13.92	22.85	22.85	0.00
Westborough Water District	1.32	0.85	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.85	0.85	0.00
Totals		**172.70 - 181.70**	**33.71**	**7.78**	**16.55**	**5.00**	**40.41**	**13.47**	**2.34**	**119.26**	**291.96 - 300.96**	**303.84**	**2.88 - 11.88**

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(17) Stanford's non-potable supply identified as surface water is supplied from Stanford University Lake water, which in most years is a blend of surface water and groundwater, depending on availability of surface water.

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Town of Hillsborough, 2011. 2010 Draft Urban Water Management Plan, prepared by CSG Consultants, Sept. 2011.

Table A-7: Anticipated Use of Available Supplies to Meet Projected Demand in 2035

Member Agency	SFPUC Individual Supply Guarantee	2035 Anticipated SFPUC Purchases[2]	2035 Anticipated Use of Available Local & Other Supplies								2035 Total Anticipated Supply Use[5]	2035 Projected Demand After Passive Conservation[6]	2035 Anticipated Need for Water[7]
			Groundwater	Surface Water	Recycled Water	Desalination	SCVWD or SWP Sources	Active Conservation[3]	Additional Conservation to Meet SB-7 Target[4]	Sub-Total Local and Other Supply			
Alameda County Water District	13.76	13.76	9.78	4.58	0.00	5.00	17.39	1.29	0.00	38.04	51.80	51.80	0.00
Brisbane and Guadalupe Valley MID[8]	0.98	1.04	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.08	1.12	1.12	0.00
Burlingame, City of	5.23	5.22	0.00	0.00	0.30	0.00	0.00	0.12	0.00	0.42	5.64	5.64	0.00
Cal Water (Combined)	35.68	35.68	1.37	1.13	0.00	0.00	0.00	3.63	0.00	6.13	41.81	42.49	0.69
Coastside County Water District	2.18	1.80	0.11	0.68	0.00	0.00	0.00	0.16	0.00	0.94	2.74	2.74	0.00
Daly City, City of	4.29	4.29	3.43	0.00	0.01	0.00	0.00	0.82	0.00	4.25	8.55	10.36	1.81
East Palo Alto, City of[9]	1.96	1.96	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.96	3.04	1.07
Estero MID/Foster City	5.90	5.40	0.00	0.00	0.00	0.00	0.00	0.86	0.00	0.86	6.26	6.26	0.00
Hayward, City of[10, 11]		30.50	0.00	0.00	3.40	0.00	0.00	1.90	0.00	5.30	35.80	35.80	0.00
Hillsborough, Town of[12]	4.09	2.94	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.94	2.94	0.00
Menlo Park, City of	4.46	2.60	0.00	0.00	0.00	0.00	0.00	0.12	0.24	0.36	2.96	2.96	0.00
Mid-Peninsula Water District	3.89	3.80	0.00	0.00	0.00	0.00	0.00	0.07	0.20	0.27	4.07	4.07	0.00
Millbrae, City of	3.15	3.02	0.00	0.00	0.01	0.00	0.00	0.10	0.16	0.27	3.29	3.29	0.00
Milpitas, City of	9.23	8.80	0.00	0.00	1.77	0.00	8.20	0.00	0.00	9.97	18.77	18.77	0.00
Mountain View, City of[13]	13.46	11.29	0.25	0.00	1.44	0.00	1.18	0.00	0.00	2.87	14.16	14.16	0.00
North Coast County Water District	3.84	3.32	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.04	3.36	3.36	0.00
Palo Alto, City of	17.07	13.47	0.00	0.00	0.72	0.00	0.00	2.14	0.00	2.86	16.33	16.33	0.00
Purissima Hills Water District	1.62	1.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.62	1.84	0.22
Redwood City, City of	10.93	10.79	0.00	0.00	1.44	0.00	0.00	0.65	0.00	2.09	12.88	12.88	0.00
San Bruno, City of[14]	3.25	3.03	2.10	0.00	0.00	0.00	0.00	0.00	0.00	2.10	5.13	5.13	0.00
San Jose, City of (portion of north San Jose)[15, 16]		4.5 - 0	3.04	0.00	2.33	0.00	0.00	0.00	1.93	7.30	7.30 - 11.80	11.80	0.00 - 4.50
Santa Clara, City of[15]		4.5 - 0	15.31	0.00	4.02	0.00	4.08	1.39	0.00	24.80	24.80 - 29.30	29.30	0.00 - 4.50
Stanford University[17]	3.03	3.03	0.00	1.50	0.01	0.00	0.00	0.38	0.00	1.89	4.92	5.39	0.47
Sunnyvale, City of	12.58	8.93	0.98	0.00	1.58	0.00	11.36	0.00	0.00	13.92	22.85	22.85	0.00
Westborough Water District	1.32	0.84	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.84	0.84	0.00
Totals		**177.14 - 186.14**	**36.37**	**7.88**	**17.07**	**5.00**	**42.21**	**13.71**	**2.53**	**124.77**	**301.91 - 310.91**	**315.16**	**4.26 - 13.26**

Abbreviations:

"SB-7" = Senate Bill 7
"SCVWD" = Santa Clara Valley Water District
"SFPUC" = San Francisco Public Utilities Commission
"SWP" = State Water Project
"UWMP" = Urban Water Management Plan

Notes

(1) Except where noted, information herein was compiled based on information provided to BAWSCA May - September 2011 by each BAWSCA member agency and information included in BAWSCA member agencies' draft or final 2010 Urban Water Management Plans, referenced below. All data provided in million gallons per day.
(2) "Anticipated SFPUC Purchases" represents the amount of water a member agency anticipates purchasing in 2035. The upper range of total anticipated purchases range is associated with a continued delivery by San Francisco of 9 mgd to San Jose and Santa Clara.
(3) "Active Conservation" represents the savings associated with active conservation measures that a member agency plans on implementing in 2035. For summary purposes, active conservation is herein considered to be a supply source. Many agencies consider both passive and active conservation to be demand reduction methods in their 2010 UWMPs. It is assumed herein that demand after passive conservation does not include active conservation and therefore demand after passive conservation may not be consistent with 2010 UWMPs for these member agencies.
(4) "Additional Conservation to Meet SB-7 Targets" represents the conservation that agencies plan to implement to meet SB-7 targets, beyond that being implemented under existing active conservation measures.
(5) "Total Anticipated Supply Use" is the sum of all anticipated use of supplies.
(6) Demand after passive conservation represents the demand that member agencies estimate will occur after projected passive conservation is considered, but does not include the water savings anticipated from active conservation measures. As many member agencies consider active conservation to be a demand reduction method rather than a supply, demand after passive conservation may not be consistent with the projected water demands included in agencies' 2010 UWMPs. Except as noted, demand after passive conservation includes demand for both potable and non-potable water.
(7) "Anticipated Need for Water" is the difference between Total Anticipated Supply Use and Projected Demand After Passive Conservation, when Projected Demand After Passive Conservation exceeds Total Anticipated Supply Use. The upper end of the anticipated need for water range is needed if San Francisco decides not to provide 9 mgd of permanent supply to Santa Clara and San Jose.
(8) Brisbane and Guadalupe Valley MID have based their anticipated SFPUC Purchases on modeling results that relay on various assumptions that result in a future projection with an anticipated variance.
(9) East Palo Alto has identified the potential for possible future development of groundwater and recycled water in the service area to meet future water supply needs. To the extent that these new supplies are developed, they would offset any supply need identified as part of the Strategy.
(10) Hayward does not have an Individual Supply Guarantee.
(11) Hayward's estimates for Active Conservation include any additional conservation needed to meet the SB-7 target.
(12) The Town of Hillsborough has not done analysis on water use savings through passive conservation. The Town has conducted an analysis of potential active water conservation savings using DWR Provisional Method 4 calculator, which suggests that Hillsborough can meet its 2020 water demand projections through active conservation alone. The Town believes that this understates the role that passive conservation will play in meeting its 2020 demand projections.

(13) Continued conservation efforts are estimated to save Mountain View up to 0.75 mgd through the year 2035. Actual conservation will depend on several factors, and is not quantified above for conservative planning purposes.
(14) For San Bruno, the shown anticipated use of available supplies is based on a policy assumption for projected use of available supplies in the future and is subject to potential changes due to changed operational assumptions in the future for local groundwater, local conjunctive use, regional conjunctive use,and purchases from the SFPUC and the actual cost of alternative supplies.
(15) San Jose and Santa Clara have temporary and interruptible contracts with SFPUC to purchase water with a limit of 9 mgd between the two agencies.
(16) The City of San Jose has a temporary and interruptible contract with San Francisco. Per the 2009 Water Supply Agreement between San Francisco and its Wholesale Customers, San Francisco will supply a combined annual average of 9 mgd to the cities of San Jose and Santa Clara through 2018 subject to reductions as described in that agreement and would require a CEQA analysis. The City of San Jose's priority is to secure after 2018 a minimum of 4.5 mgd of supply for the North San Jose area. As part of the Strategy, San Jose has asked BAWSCA to include planning for a Supply Need up to 4.5 mgd.
(17) Stanford's non-potable supply identified as surface water is supplied from Stanford University Lake water, which in most years is a blend of surface water and groundwater, depending on availability of surface water.

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Appendix B
Detailed Comparison Between 2005 and 2011 Demands, Supply and Supply Need Data

Appendix B
Detailed Comparison Between 2005 and 2011 Demands, Supply and Supply Need Data

This appendix summarizes the comparison of BAWSCA member agency demand and supply projections from the 2010 Strategy Phase I Scoping Report (based on data from member agencies' 2005 Urban Water Management Plan [UWMP] data) to the projected demand, supply, and supply need compiled in 2011 and summarized in this technical memo (based on data from member agencies' 2010 UWMPs and follow-up discussions with the agencies). As in the technical memo, this appendix includes two different supply need values – one related to normal or non-drought conditions, and the other to drought conditions estimated for both a 10% and 20% system-wide drought reduction on the San Francsico Regional Water System (RWS).

Table B-1 presents the aggregate BAWSCA water demand from both the 2005 and 2011 data sets. The Strategy Phase I Scoping Report, the "2005 Data," covered only 2018 and 2035. The 2011 data covers 2015, 2018, 2020, 2025, 2030, and 2035. Table B-1 also identifies the reduction in demand in 2018 and 2035.

The updates to aggregate BAWSCA water demand made in 2011 have reduced the demand by almost 27 mgd in 2018 and almost 28 mgd in 2035 from the 2005 data, a difference of 9 percent and 8 percent, respectively.

Table B-1
Aggregate BAWSCA Water Demands After Passive Conservation[(1)] (mgd)

Data Set	2015	2018	2020	2025	2030	2035
2005 Data	--	299.3	--	--	--	342.9
2011 Data	264.8	272.3	276.7	289.0	303.8	315.2
Difference between 2005 and 2010 Data	--	26.9	--	--	--	27.8

Source: 2005 Data: Strategy Phase I Scoping Report Tables A-3 and A-4; 2011 Data: Agency Submitted Demand & Supply Worksheets, 2011

(1) Demand after passive conservation represents the demand that member agencies estimate will occur after projected passive conservation is considered, but does not include the water savings anticipated from active conservation measures. As many member agencies consider active conservation to be a demand reduction method rather than a supply, demand after passive conservation may not be consistent with the projected water demands included in agencies' 2010 UWMPs.

Table B-2 presents the anticipated use of available water supplies in the BAWSCA service area in 2035 under normal conditions, and with 10% and 20% system-wide drought reductions on the San Francsico RWS. The table includes the anticipated use of supplies from the 2005 data (presented in the 2010 Strategy Phase I Scoping Report) and the updated anticipated use of supplies based on the 2011 data.

The change in estimated use of SFPUC supplies from 2005 data to 2011 data by 2035 ranges from an estimated increase of about 2 mgd to a decrease of almost 7 mgd in normal hydrologic conditions. Based on the 2011 data, the use of SFPUC supplies in 2035 under a 20% system-wide drought reduction of the San Francisco RWS condition is expected to range from an increase of about 0.1 mgd to a decrease of almost 5 mgd as compared to the 2005 data.

The update to 2035 local and other supply data from the 2005 data to 2011 data identified a decrease in total anticipated supply use of about 11 mgd. As described above, drought shortfalls for these non-SFPUC supplies were not evaluated, so the projected decrease in these supplies remains the same between all hydrologic conditions.

Overall, the change in aggregate BAWSCA total anticipated use of available supplies in 2035 between the 2005 and 2011 data has been projected to decrease by about 17 to 26 mgd under normal conditions, and 18 to 27 mgd in a 20% system-wide drought reduction of the San Francisco RWS condition.

Included in the Table B-2 is a "Not Yet Determined" category of supply that represents the difference between projected demand and the total anticipated use of water purchased from the San Francisco RWS and other supplies. The supply from the "Not Yet Determined" category, also referred to as the "supply need", in 2035 is 10 mgd lower in the 2011 data compared to the 2005 data for normal conditions. In a 20% system-wide drought reduction of the San Francisco RWS condition, the supply need is 10 – 15 mgd lower in the 2011 data compared to the 2005 data.

Table B-2
Aggregate BAWSCA Anticipated Use of Available Supplies for 2035 Under Normal and Drought Conditions (mgd)

Hydrologic Condition	Anticipated SFPUC Purchases[1]	Anticipated Use of Available Local & Other Supplies	Not Yet Determined	Total Anticipated Supply Use
2005 Data				
Normal	184	136.0	14.3 - 23.3	334.3 - 343.3
10% SFPUC Drought Reduction	N/A[2]	136.0	N/A	N/A
20% SFPUC Drought Reduction	132.5	136.0	67.0 - 76.0	335.5 - 344.5
2011 Data				
Normal	177.1 - 186.1	124.8	4.3 - 13.3	315.2
10% SFPUC Drought Reduction	147.4 - 152.5	124.8	37.8 - 43.0	315.2
20% SFPUC Drought Reduction	127.9 - 132.4	124.8	58.0 - 62.5	315.2
Difference Between 2005 and 2011 Data				
Normal	(-2.1) - 6.9	11.2	10.0	17.1 - 26.1
10% SFPUC Drought Reduction	N/A	11.2	N/A	N/A
20% SFPUC Drought Reduction	(-0.1) - 4.6	11.2	9 - 13.5	20.3 - 29.3

Source: 2005 Data: Strategy Phase I Scoping Report Table A-4; 2011 Data: Agency Submitted Demand & Supply Worksheets, 2011

[1] Anticipated SFPUC Purchases represents the amount of water member agencies anticipate purchasing in 2035.
[2] Data marked "N/A" were not included in the analysis of 2005 data. Anticipated SFPUC Purchases and "Not Yet Determined" supplies were not estimated for the 10% system-wide drought condition as part of the 2010 Strategy Phase I Scoping Report.

Table B-3 presents the aggregate BAWSCA water supply need under normal conditions for 2015 through 2035. The 2005 data estimated no supply need in 2018 and a supply need of 16 –to 25 mgd in 2035. Based on the 2011 data, there is a water supply need under normal conditions in every year. Starting in 2020, the supply need is bracketed as a range of 9 mgd due to the non-guaranteed contracts of San Jose and Santa Clara. According to the 2011 data, the projected aggregate supply need is greatest in 2035, at approximately 4 – 13 mgd.

Table B-3
Aggregate BAWSCA Supply Need Under Normal Conditions (mgd)

Year	2015	2018	2020	2025	2030	2035
2005 Data						
Anticipated SFPUC Purchases(1)	--	182.8	--	--	--	184.0
Anticipated Use of Available Local & Other Supplies	--	116.4	--	--	--	136.0
Total of SFPUC and Local Anticipated Supply Use	--	299.3	--	--	--	320.0
Projected Demand After Passive Conservation(2)	--	299.3	--	--	--	342.9
Anticipated Need for Water(3)	--	0.0	--	--	--	14 - 23
2011 Data						
Anticipated SFPUC Purchases(1)	170.9	171.8	161.8 - 170.8	166.6 - 175.6	172.7 - 181.7	177.1 - 186.1
Anticipated Use of Available Local & Other Supplies	91.9	98.7	103.9	111.0	119.3	124.8
Total of SFPUC and Local Anticipated Supply Use	262.8	270.5	265.7 - 274.7	277.7 - 286.7	2912.0 - 301.0	301.9 - 310.9
Projected Demand After Passive Conservation(2)	264.8	272.3	276.7	289.0	303.8	315.2
Anticipated Need for Water(3)	2.0	1.9	2.0 - 11.0	2.4 - 11.4	2.9 - 11.9	4.3 - 13.3
Difference Between What?						
Anticipated SFPUC Purchases(1)	--	11.0	--	--	--	(-2.1) - 6.9
Anticipated Use of Available Local & Other Supplies	--	17.7	--	--	--	11.2
Total of SFPUC and Local Anticipated Supply Use	--	28.7	--	--	--	7.1 - 16.1
Projected Demand After Passive Conservation(2)	--	26.9	--	--	--	27.8
Anticipated Need for Water(3)	--	-1.9	--	--	--	9.7

Source: 2005 Data: Strategy Phase I Scoping Report Section 2 and Table A-4; 2011 Data: Agency Submitted Demand & Supply Worksheets, 2011

(1) Anticipated SFPUC Purchases represents the amount of water member agencies anticipate purchasing in 2035.
(2) Demand after passive conservation represents the demand that member agencies estimate will occur after projected passive conservation is considered, but does not include the water savings anticipated from active conservation measures. As many member agencies consider active conservation to be a demand reduction method rather than a supply, demand after passive conservation may not be consistent with the projected water demands included in agencies' 2010 UWMPs. Except as noted, demand after passive conservation includes demand for both potable and non-potable water.
(3) Anticipated Need for Water is the difference between Total Anticipated Supply Use and Projected Demand After Passive Conservation, when Projected Demand After Passive Conservation exceeds Total Anticipated Supply Use.

Appendix C
Application of Tier 2 Drought Implementation Plan Under Two Future Scenarios – With and Without San Jose and Santa Clara

Bay Area Bay Area Bay Area Bay Area Bay Area

155 Bovet Road, Suite 650
San Mateo, California 94402
(650) 349-3000 tel. (650) 349-8395 fax

TO: BAWSCA Designated Water Management Representatives

FROM: Nicole M. Sandkulla, Water Resources Planning Manager

DATE: January 25, 2012

Re: Application of Tier 2 Drought Implementation Plan Under Two Future Scenarios – With and Without San Jose and Santa Clara

Summary

For near-term and long-term planning purposes, including the Long-Term Reliable Water Supply Strategy (Strategy), it is necessary to calculate potential future drought supply allocations from the San Francisco Regional Water System (RWS) to the BAWSCA member agencies. The allocation of available water during system-wide shortages on the RWS is defined by two plans: the Tier 1 Plan which allocates water between San Francisco and its 26 Wholesale Customers, collectively, and the Tier 2 Plan which allocates the collectively available water among the 26 Wholesale Customers (BAWSCA member agencies). The Tier 2 Plan expires in 2018. Both plans present methodologies for calculating the available supply using real-time data. For planning purposes, current planning estimates of demand and utilizing of available water supplies have been used for these calculations along with specific necessary assumptions. For direct use as part of BAWSCA's Strategy, two future scenarios are presented in this memo:

- Scenario 1 assumes continued SFPUC purchases of 4.5 mgd by San Jose and Santa Clara from the RWS.
- Scenario 2 assumes that San Francisco decides in 2018 to discontinue all deliveries to San Jose and Santa Clara through the RWS.

The summary results of these calculations are shown in Tables 3 through 6 below. Full results are attached to this memo as Tables A-1 through A-5 for Scenario 1 and B-1 through B-5 for Scenario 2.

Introduction

BAWSCA and its member agencies are actively engaged in developing the Strategy to quantify when, where, and how much additional supply reliability and new water supplies are needed throughout the BAWSCA service area through 2035. With completion of individual agency Urban Water Management Plans (UWMPs) and follow-up discussions with member agencies, updated demand projections through 2035 for each of the

BAWSCA member agencies are now available. For planning purposes, it is necessary to have an up to date understanding of what the potential allocation of available water supply from the RWS would be to each of the BAWSCA member agencies. With the new demand projections, updated potential Tier 2 drought allocations for each of the BAWSCA member agencies can now be calculated.

Background

In July 2009, in connection with adoption of the WSA, the Wholesale Customers and San Francisco adopted a Water Shortage Allocation Plan to allocate water from the RWS to retail and Wholesale Customers during system-wide shortages of 20% or less (the Tier 1 Plan). The Tier 1 Plan replaced the prior Tier 1 Interim Water Shortage Allocation Plan, adopted in 2000 and expired in June 2009, which allocated water for shortages up to 20%. The provisions of the Tier 1 Plan allow wholesale customers to "bank" drought allocations and to voluntarily transfer them to each other and San Francisco. The Tier 1 plan also presents an updated schedule for actions preceding and during a drought.

Section 3.11.C of the WSA authorizes the Wholesale Customers to adopt a methodology for allocating the water which is collectively available to the 26 Wholesale Customers among each individual Wholesale Customer (the Tier 2 Plan). The Tier 2 Plan adopted in 2000 expired in June 2009. As of March 29, 2011, all 26 Wholesale Customers had adopted the Tier 2 Plan.

The Tier 2 Plan term is through December 31, 2018. The Tier 2 Plan allocates the collective Wholesale Customer share among each of the 26 wholesale customers through 2018 to coincide with San Francisco's deferral of decisions about additional supply until at least 2018. The Tier 1 and Tier 2 Drought Allocation Plans apply only during times of water shortages caused by drought. San Francisco's Interim Supply Limitation applies in all years through at least 2018, regardless of water supply availability.

Necessary Assumptions Made and Qualifications on Use of Results

It is important to note that the calculations prescribed in both the Tier 1 and Tier 2 Plans require real-time data available just prior to the onset of a drought shortage emergency. As such, any calculation done in advance for planning purposes is only an estimate and actual results may vary. In order to perform the calculations at this time, the following necessary assumptions were made:

- Projected SFPUC purchases by the BAWSCA agencies from the Regional Water System are as shown in Table 1 below and as provided to BAWSCA in October 2011;
- Projected San Francisco Retail purchases from the Regional Water System are as shown in the SFPUC 2010 UWMP;
- The allocation of system-wide cutbacks to San Francisco Retail vs. Wholesale Customers is consistent with the Tier 1 Plan and results are shown in Table 2 below;
- The current Tier 2 Plan, which expires in 2018, is used to calculate Tier 2 results through 2035;

- For Scenario 1, continued SFPUC purchases of 4.5 mgd by San Jose and Santa Clara from the Regional Water System;
- For Scenario 2, no purchases by San Jose and Santa Clara from the Regional Water System after 2018;
- Future BAWSCA agency residential per capita values are calculated by applying the 2009/10 percentage of residential use to total production for each BAWSCA agency against future total water production for a specific year divided by the projected population for that same future year. The future values resulting from this calculation provide a consistent approach useful for overall planning, but may not accurately reflect individual agency future values; and
- Individual BAWSCA agency distribution of monthly water consumption by supply (potable and non-potable) is assumed same as FY 2009/10.

In addition, the current Tier 2 Plan includes a surrogate fixed value for the City of Hayward in place of an Individual Supply Guarantee. For years beyond 2018, the expiration of the current plan, the calculations for Hayward are significantly impacted by the inclusion of this value. It is recommended that additional examination by Hayward be performed prior to its use of results from this analysis for its own purposes.

Scenario 1: Tier 2 Calculation Results

Tables 3 and 4 below present a summary of the drought allocations and cutbacks for each BAWSCA agency for the years 2020, 20205, 2030, and 2035 for Scenario 1 in which San Jose and Santa Clara continue to purchase 4.5 MGD from the RWS.

Scenario 2: Tier 2 Calculation Results

Tables 5 and 6 below present a summary of the drought allocations and cutbacks for each BAWSCA agency for the years 2020, 20205, 2030, and 2035 for Scenario 2 in which there are no purchases from the SFPUC RWS by San Jose and Santa Clara after 2018.

Table 1 - Projected SFPUC Purchases					
	2015	2020	2025	2030	2035
ACWD	13.76	13.76	13.76	13.76	13.76
Brisbane/GVMID	0.95	0.98	1.00	1.01	1.04
Burlingame	4.90	4.97	5.07	5.18	5.22
Coastside	1.76	1.70	1.73	1.77	1.80
CWS Total	35.04	33.13	34.15	35.23	35.68
Daly City	4.29	4.29	4.29	4.29	4.29
East Palo Alto	1.96	1.96	1.96	1.96	1.96
Estero	5.67	5.27	5.35	5.40	5.40
Hayward	21.90	23.40	25.40	27.70	30.50
Hillsborough	3.14	2.92	2.93	2.94	2.94
Menlo Park	3.00	2.58	2.60	2.63	2.60
Mid Pen WD	3.55	3.60	3.60	3.70	3.80
Millbrae	2.62	2.67	2.79	2.90	3.02
Milpitas	7.07	7.69	8.25	8.80	8.80
Mountain View	9.85	9.91	10.34	10.81	11.29
North Coast	3.06	3.12	3.14	3.25	3.32
Palo Alto	12.73	12.64	12.81	13.37	13.47
Purissima Hills	1.62	1.62	1.62	1.62	1.62
Redwood City	10.22	10.40	10.36	10.79	10.79
San Bruno	2.30	2.47	2.63	2.78	3.03
Stanford	2.70	2.90	3.03	3.03	3.03
Sunnyvale	8.93	8.93	8.93	8.93	8.93
Westborough	0.89	0.88	0.87	0.85	0.84
Subtotal	161.91	161.79	166.62	172.70	177.13
San José	4.50	4.50	4.50	4.50	4.50
Santa Clara	4.50	4.50	4.50	4.50	4.50
Total	170.91	170.79	175.62	181.70	186.13

Table 2 -Average BAWSCA Agency Cutback During 20% System-Wide Shortage					
	2015	2020	2025	2030	2035
Overall Avg. BAWSCA Reduction	27.0%	27.5%	28.3%	28.8%	28.9%

Table 3 - Scenario 1 Drought Allocations (SJ/SC at 4.5 mgd each)					
	2015 Drought Allocation	2020 Drought Allocation	2025 Drought Allocation	2030 Drought Allocation	2035 Drought Allocation
ACWD	9.50	9.43	9.47	9.63	9.81
Brisbane/GVMID	0.66	0.67	0.67	0.68	0.69
Burlingame	3.61	3.61	3.67	3.77	3.85
Coastside	1.48	1.45	1.47	1.50	1.53
CWS Total	23.95	22.96	23.40	24.21	24.92
Daly City	3.31	3.30	3.32	3.36	3.39
East Palo Alto	1.70	1.69	1.69	1.68	1.68
Estero	3.96	3.77	3.81	3.89	3.96
Hayward	16.54	17.07	17.87	18.13	18.42
Hillsborough	2.13	2.03	2.03	2.07	2.13
Menlo Park	2.39	2.21	2.22	2.26	2.29
Mid Pen WD	2.58	2.58	2.59	2.67	2.76
Millbrae	2.03	2.04	2.10	2.18	2.27
Milpitas	5.69	5.93	6.21	6.55	6.66
Mountain View	7.74	7.69	7.89	8.21	8.56
North Coast	2.48	2.49	2.51	2.60	2.66
Palo Alto	9.71	9.58	9.66	10.03	10.27
Purissima Hills	0.97	0.96	0.95	0.97	1.00
Redwood City	7.28	7.29	7.29	7.58	7.72
San Bruno	1.93	1.98	2.05	2.15	2.28
Stanford	1.84	1.90	1.94	1.98	2.02
Sunnyvale	7.19	7.13	7.14	7.23	7.35
Westborough	0.77	0.76	0.76	0.76	0.76
Subtotal	119.44	118.51	120.70	124.08	126.98
San José	2.67	2.62	2.61	2.66	2.72
Santa Clara	2.66	2.62	2.60	2.66	2.72
Total	124.76	123.75	125.91	129.40	132.42

Table 4 - Scenario 1 Drought Cutbacks (SJ/SC at 4.5 mgd each)					
	2015 Drought Cutback	2020 Drought Cutback	2025 Drought Cutback	2030 Drought Cutback	2035 Drought Cutback
ACWD	-31.0%	-31.5%	-31.2%	-30.0%	-28.7%
Brisbane/GVMID	-30.3%	-32.0%	-33.1%	-32.7%	-33.4%
Burlingame	-26.4%	-27.3%	-27.6%	-27.2%	-26.2%
Coastside	-15.9%	-14.8%	-15.0%	-14.8%	-14.8%
CWS Total	-31.6%	-30.7%	-31.5%	-31.3%	-30.2%
Daly City	-22.9%	-23.2%	-22.7%	-21.8%	-20.9%
East Palo Alto	-13.5%	-13.8%	-14.2%	-14.4%	-14.4%
Estero	-30.1%	-28.5%	-28.8%	-28.0%	-26.7%
Hayward	-24.5%	-27.1%	-29.6%	-34.5%	-39.6%
Hillsborough	-32.0%	-30.3%	-30.7%	-29.5%	-27.7%
Menlo Park	-20.4%	-14.5%	-14.8%	-14.0%	-11.8%
Mid Pen WD	-27.4%	-28.4%	-28.2%	-27.9%	-27.5%
Millbrae	-22.5%	-23.7%	-24.8%	-24.9%	-25.0%
Milpitas	-19.5%	-22.9%	-24.7%	-25.6%	-24.3%
Mountain View	-21.5%	-22.3%	-23.7%	-24.1%	-24.2%
North Coast	-19.1%	-20.2%	-20.0%	-20.1%	-19.7%
Palo Alto	-23.7%	-24.2%	-24.6%	-24.9%	-23.8%
Purissima Hills	-40.0%	-41.0%	-41.3%	-40.1%	-38.4%
Redwood City	-28.8%	-29.9%	-29.6%	-29.7%	-28.4%
San Bruno	-16.3%	-19.7%	-21.8%	-22.8%	-24.7%
Stanford	-31.7%	-34.6%	-35.9%	-34.8%	-33.3%
Sunnyvale	-19.4%	-20.1%	-20.1%	-19.1%	-17.7%
Westborough	-13.6%	-13.7%	-12.8%	-10.6%	-10.0%
Subtotal	-26.2%	-26.7%	-27.6%	-28.2%	-28.3%
San José	-40.7%	-41.7%	-42.0%	-40.8%	-39.5%
Santa Clara	-40.9%	-41.9%	-42.2%	-40.9%	-39.6%
Total	-27.0%	-27.5%	-28.3%	-28.8%	-28.9%

Table 5 - Scenario 2 Drought Allocations (SJ/SC at 0 mgd after 2018)	2015 Drought Allocation	2020 Drought Allocation	2025 Drought Allocation	2030 Drought Allocation	2035 Drought Allocation
ACWD	9.50	9.49	9.52	9.69	9.88
Brisbane/GVMID	0.66	0.67	0.67	0.68	0.70
Burlingame	3.61	3.62	3.68	3.78	3.86
Coastside	1.48	1.44	1.47	1.50	1.53
CWS Total	23.95	23.15	23.58	24.42	25.15
Daly City	3.31	3.29	3.31	3.35	3.39
East Palo Alto	1.70	1.70	1.70	1.69	1.69
Estero	3.96	3.79	3.83	3.91	3.99
Hayward	16.54	17.13	17.93	18.20	18.51
Hillsborough	2.13	2.07	2.07	2.11	2.17
Menlo Park	2.39	2.23	2.24	2.29	2.32
Mid Pen WD	2.58	2.59	2.60	2.68	2.78
Millbrae	2.03	2.04	2.10	2.18	2.27
Milpitas	5.69	5.94	6.22	6.57	6.69
Mountain View	7.74	7.75	7.94	8.27	8.63
North Coast	2.48	2.49	2.51	2.60	2.67
Palo Alto	9.71	9.67	9.75	10.13	10.38
Purissima Hills	0.97	0.98	0.97	0.99	1.02
Redwood City	7.28	7.34	7.34	7.64	7.78
San Bruno	1.93	1.99	2.06	2.15	2.30
Stanford	1.84	1.92	1.97	2.00	2.05
Sunnyvale	7.19	7.18	7.18	7.28	7.41
Westborough	0.77	0.76	0.76	0.76	0.76
Subtotal	119.44	119.25	121.41	124.90	127.92
San José	2.67	0.00	0.00	0.00	0.00
Santa Clara	2.66	0.00	0.00	0.00	0.00
Total	124.76	119.25	121.41	124.90	127.92

Table 6 - Scenario 2 Drought Cutbacks (SJ/SC at 0 mgd after 2018)	2015 Drought Cutback	2020 Drought Cutback	2025 Drought Cutback	2030 Drought Cutback	2035 Drought Cutback
ACWD	-31.00%	-31.00%	-30.79%	-29.56%	-28.19%
Brisbane/GVMID	-30.28%	-31.52%	-32.67%	-32.25%	-32.84%
Burlingame	-26.37%	-27.05%	-27.40%	-26.91%	-25.91%
Coastside	-15.91%	-15.11%	-15.28%	-15.01%	-14.88%
CWS Total	-31.64%	-30.11%	-30.94%	-30.69%	-29.51%
Daly City	-22.91%	-23.46%	-22.96%	-21.96%	-21.05%
East Palo Alto	-13.50%	-13.15%	-13.57%	-13.84%	-13.89%
Estero	-30.08%	-28.03%	-28.38%	-27.50%	-26.12%
Hayward	-24.48%	-26.80%	-29.41%	-34.28%	-39.31%
Hillsborough	-31.99%	-28.91%	-29.36%	-28.14%	-26.20%
Menlo Park	-20.44%	-13.71%	-13.97%	-13.11%	-10.85%
Mid Pen WD	-27.35%	-27.98%	-27.80%	-27.49%	-26.97%
Millbrae	-22.52%	-23.46%	-24.58%	-24.66%	-24.67%
Milpitas	-19.50%	-22.70%	-24.56%	-25.33%	-24.01%
Mountain View	-21.45%	-21.76%	-23.16%	-23.48%	-23.52%
North Coast	-19.09%	-20.18%	-19.99%	-20.02%	-19.59%
Palo Alto	-23.71%	-23.48%	-23.92%	-24.21%	-22.95%
Purissima Hills	-40.04%	-39.68%	-40.04%	-38.79%	-36.99%
Redwood City	-28.75%	-29.43%	-29.18%	-29.23%	-27.90%
San Bruno	-16.32%	-19.48%	-21.59%	-22.54%	-24.30%
Stanford	-31.70%	-33.77%	-35.11%	-33.93%	-32.38%
Sunnyvale	-19.43%	-19.65%	-19.57%	-18.50%	-17.03%
Westborough	-13.62%	-13.49%	-12.61%	-10.36%	-10.00%
Subtotal	-26.23%	-26.29%	-27.13%	-27.68%	-27.78%
San José	-40.75%	0.00%	0.00%	0.00%	0.00%
Santa Clara	-40.89%	0.00%	0.00%	0.00%	0.00%
Total	-27.00%	-26.29%	-27.13%	-27.68%	-27.78%

Attachments

- Scenario 1 Results: Tables A-1 through A-5
- Scenario 2 Results: Tables B-1 through B-5

TABLE A-1: 2015 CALCULATION OF FINAL PURCHASE CUTBACK AND ALLOCATION FACTOR FOR TIER 2 DROUGHT IMPLEMENTATION PLAN (DRIP)

Overall Average Wholesale Customer Reduction: 27.00%

Base = 10.00%
Seasonal = 66.65%

Weighted average for Column 10:
0.33 =ISG component (Col. 2)
0.67 =Base/Seasonal component (Col. 9)

Variable component - Base/Seasonal Allocation (with ISG cap)
Minimum (Column 16) = 10.00%
Ceiling (Col. 18) = avg. cutback + 20.00%

Minimum residential per capita use threshold (Column 25) = 55.00 gpcpd

Initial Allocations Based on Weighted Fixed (ISG) and Variable (Base/Seasonal) Components Adjusting for SJ/SC

Wholesale Customers	(1) Agency Information: 2015 SFPUC Purchases	(2) Agency Information: Fixed Comp.	(3) Base/Seasonal Allocations: Lesser of Purchase or ISG	(4) Base/Seasonal Allocations: Base/Seasonal Allocation Cutback	(5) Base/Seasonal Allocations: Base/Seasonal Allocation	(6) Base/Seasonal Allocations: Base/Seasonal Purchase Cutback	(7) 1st SJ/SC Adjustment: Subtotal Allocation Factors	(8) 1st SJ/SC Adjustment: Adjusted Base/Seasonal Allocation	(9) Weighted Allocation: Weighted ISG-Base/Seasonal Avg	(10) Weighted Allocation: Allocation Factors	(11) Weighted Allocation: Weighted Shortage Allocation	(12) Weighted Allocation: Weighted Purchase Cutback	(13) 2nd SJ/SC Adjustment: Subtotal Allocation Factors	(14) 2nd SJ/SC Adjustment: Adjusted Weighted Shortage Allocation	(15) 2nd SJ/SC Adjustment: Adjusted Weighted Purchase Cutback
ACWD	13.76	13.76	13.76	-27.64%	9.96	-27.64%	8.44%	10.10	11.31	7.63%	9.52	-30.84%	7.97%	9.52	-30.84%
Brisbane/GVMID	0.95	0.98	0.95	-27.94%	0.68	-27.94%	0.58%	0.69	0.79	0.53%	0.66	-30.12%	0.56%	0.66	-30.12%
Burlingame	4.90	5.23	4.90	-22.84%	3.78	-22.84%	3.21%	3.84	4.30	2.90%	3.62	-26.20%	3.03%	3.62	-26.20%
Coastside	1.76	2.18	1.76	-12.90%	1.53	-12.90%	1.30%	1.55	1.76	1.19%	1.48	-15.72%	1.24%	1.48	-15.72%
CWS Total	35.04	35.68	35.04	-29.66%	24.65	-29.66%	20.89%	25.01	28.53	19.24%	24.01	-31.48%	20.10%	24.01	-31.48%
Daly City	4.29	4.29	4.29	-13.79%	3.70	-13.79%	3.14%	3.76	3.93	2.65%	3.31	-22.91%	2.77%	3.31	-22.91%
East Palo Alto	1.96	1.96	1.96	-21.42%	1.54	-21.54%	1.31%	1.56	1.69	1.14%	1.43	-27.38%	1.19%	1.43	-27.38%
Estero	5.67	5.90	5.67	-28.02%	4.08	-28.02%	3.46%	4.14	4.72	3.18%	3.97	-29.92%	3.33%	3.97	-29.92%
Hayward	21.90	25.11	21.90	-23.35%	16.79	-23.35%	14.23%	17.04	19.70	13.29%	16.58	-24.31%	13.88%	16.58	-24.31%
Hillsborough	3.14	4.09	3.14	-44.15%	1.75	-44.15%	1.48%	1.78	2.54	1.71%	2.14	-31.84%	1.79%	2.14	-31.84%
Menlo Park	3.00	4.46	3.00	-32.78%	2.02	-32.78%	1.71%	2.05	2.84	1.92%	2.39	-20.26%	2.00%	2.39	-20.26%
Mid Pen WD	3.55	3.89	3.55	-25.93%	2.63	-25.93%	2.23%	2.67	3.07	2.07%	2.59	-27.18%	2.16%	2.59	-27.18%
Millbrae	2.62	3.15	2.62	-22.66%	2.03	-22.66%	1.72%	2.06	2.42	1.63%	2.03	-22.35%	1.70%	2.03	-22.35%
Milpitas	7.07	9.23	7.07	-22.34%	5.49	-22.34%	4.65%	5.57	6.78	4.57%	5.70	-19.32%	4.78%	5.70	-19.32%
Mountain View	9.85	13.46	9.85	-28.70%	7.03	-28.70%	5.96%	7.13	9.22	6.22%	7.76	-21.27%	6.50%	7.76	-21.27%
North Coast	3.06	3.84	3.06	-19.14%	2.47	-19.14%	2.10%	2.51	2.95	1.99%	2.48	-18.91%	2.08%	2.48	-18.91%
Palo Alto	12.73	17.07	12.73	-31.47%	8.72	-31.47%	7.39%	8.85	11.57	7.80%	9.73	-23.53%	8.15%	9.73	-23.53%
Purissima Hills	1.62	1.62	1.62	-43.63%	0.91	-43.63%	0.77%	0.93	1.16	0.78%	0.97	-39.90%	0.82%	0.97	-39.90%
Redwood City	10.22	10.93	10.22	-27.08%	7.45	-27.08%	6.32%	7.56	8.67	5.85%	7.30	-28.59%	6.11%	7.30	-28.59%
San Bruno	2.30	3.25	2.30	-21.87%	1.80	-21.87%	1.52%	1.82	2.29	1.55%	1.93	-16.13%	1.62%	1.93	-16.13%
Stanford	2.70	3.03	2.70	-34.86%	1.76	-34.86%	1.49%	1.78	2.20	1.48%	1.85	-31.54%	1.55%	1.85	-31.54%
Sunnyvale	8.93	12.58	8.93	-27.21%	6.50	-27.21%	5.51%	6.60	8.57	5.78%	7.21	-19.24%	6.04%	7.21	-19.24%
Westborough	0.89	1.32	0.89	-20.98%	0.70	-20.98%	0.60%	0.71	0.91	0.62%	0.77	-13.62%	0.64%	0.77	-13.62%
Subtotal	161.91		161.91	-26.87%	117.97	-27.14%	100.00%	119.73	141.94		119.43	-26.24%	100.00%	119.43	-26.24%
San José	4.50	4.50	4.50	-27.03%	3.28	-27.03%		2.51	3.17	2.14%	2.67	-40.75%		2.67	-40.75%
Santa Clara	4.50	4.50	4.50	-22.13%	3.50	-22.13%		2.51	3.17	2.14%	2.67	-40.75%		2.67	-40.75%
Total	170.91		170.91	-26.49%	124.76	-27.00%		124.76	148.27	100.00%	124.76	-27.00%		124.76	-27.00%

Adjustment for Minimum and Maximum Cutbacks; **Adjustment for East Palo Alto**

Wholesale Customers	(16) Minimum Cutback Adj.: Adjusted for 10.00% Minimum Cutback	(17) Minimum Cutback Adj.: Add'l Cutback for Hardship Bank	(18) Maximum Cutback Adjustment: Adjusted for 47.00% Maximum Cutback	(19) Maximum Cutback Adjustment: Cutback Over Cap	(20) Maximum Cutback Adjustment: Allocations Adjusted For Cap	(21) Maximum Cutback Adjustment: Agencies To Which Cutback Over Cap Is Redistributed	(22) Maximum Cutback Adjustment: Min/Max Adjusted Allocation	(23) Maximum Cutback Adjustment: Adj. Min/Max Purchase Cutbacks	(24) Adjustment for East Palo Alto: 2015 Residential Per Capita	(25) Adjustment for East Palo Alto: Agencies To Which EPA Adjustment Applies	(26) Adjustment for East Palo Alto: Share of EPA Adjustment	(27) Adjustment for East Palo Alto: Allocations With EPA Adjustments	(28) Final Purchase Cutback	(29) Final Purchase Cutback	(30) Final Allocation Factor
ACWD	-30.84%		-30.84%		9.52	9.52	9.52	-30.84%	84.36	9.52	-0.02	9.50	-4.26	-31.00%	7.61%
Brisbane/GVMID	-30.12%		-30.12%		0.66	0.66	0.66	-30.12%	83.76	0.66	0.00	0.66	-0.29	-30.28%	0.53%
Burlingame	-26.20%		-26.20%		3.62	3.62	3.62	-26.20%	98.49	3.62	-0.01	3.61	-1.29	-26.37%	2.89%
Coastside	-15.72%		-15.72%		1.48	1.48	1.48	-15.72%	74.49	1.48	0.00	1.48	-0.28	-15.91%	1.18%
CWS Total	-31.48%		-31.48%		24.01	24.01	24.01	-31.48%	109.22	24.01	-0.06	23.95	-11.09	-31.64%	19.20%
Daly City	-22.91%		-22.91%		3.31	3.31	3.31	-22.91%	49.76			3.31	-0.98	-22.91%	2.65%
East Palo Alto	-27.38%		-27.38%		1.43	1.43	1.426	-27.38%	61.95	1.43	0.27	1.70	-0.27	-13.50%	1.36%
Estero	-29.92%		-29.92%		3.97	3.97	3.97	-29.92%	95.20	3.97	-0.01	3.96	-1.71	-30.08%	3.18%
Hayward	-24.31%		-24.31%		16.58	16.58	16.58	-24.31%	71.61	16.58	-0.04	16.54	-5.36	-24.48%	13.26%
Hillsborough	-31.84%		-31.84%		2.14	2.14	2.14	-31.84%	271.59	2.14	0.00	2.13	-1.00	-31.99%	1.71%
Menlo Park	-20.26%		-20.26%		2.39	2.39	2.39	-20.26%	86.46	2.39	-0.01	2.39	-0.61	-20.44%	1.91%
Mid Pen WD	-27.18%		-27.18%		2.59	2.59	2.59	-27.18%	99.75	2.59	-0.01	2.58	-0.97	-27.35%	2.07%
Millbrae	-22.35%		-22.35%		2.03	2.03	2.03	-22.35%	76.94	2.03	0.00	2.03	-0.59	-22.52%	1.63%
Milpitas	-19.32%		-19.32%		5.70	5.70	5.70	-19.32%	60.45	5.70	-0.01	5.69	-1.38	-19.50%	4.56%
Mountain View	-21.27%		-21.27%		7.76	7.76	7.76	-21.27%	77.11	7.76	-0.02	7.74	-2.11	-21.45%	6.20%
North Coast	-18.91%		-18.91%		2.48	2.48	2.48	-18.91%	56.19	2.48	-0.01	2.48	-0.58	-19.09%	1.98%
Palo Alto	-23.53%		-23.53%		9.73	9.73	9.73	-23.53%	103.40	9.73	-0.02	9.71	-3.02	-23.71%	7.78%
Purissima Hills	-39.90%		-39.90%		0.97	0.97	0.97	-39.90%	251.68	0.97	0.00	0.97	-0.65	-40.04%	0.78%
Redwood City	-28.59%		-28.59%		7.30	7.30	7.30	-28.59%	72.38	7.30	-0.02	7.28	-2.94	-28.75%	5.84%
San Bruno	-16.13%		-16.13%		1.93	1.93	1.93	-16.13%	67.04	1.93	0.00	1.93	-0.38	-16.32%	1.54%
Stanford	-31.54%		-31.54%		1.85	1.85	1.85	-31.54%	N/A	1.85	0.00	1.84	-0.86	-31.70%	1.48%
Sunnyvale	-19.24%		-19.24%		7.21	7.21	7.21	-19.24%	77.91	7.21	-0.02	7.19	-1.74	-19.43%	5.77%
Westborough	-13.62%		-13.62%		0.77	0.77	0.77	-13.62%	45.38			0.77	-0.12	-13.62%	0.62%
Subtotal	-26.24%		-26.24%		119.43	119.43	119.43	-26.24%		115.35		119.44	-42.47	-26.23%	
San José	-40.75%		-40.75%		2.67	2.67	2.67	-40.75%	49.45			2.67	-1.83	-40.75%	2.14%
Santa Clara	-40.75%		-40.75%		2.67	2.67	2.67	-40.75%	70.20	2.67	-0.01	2.66	-1.84	-40.89%	2.13%
Total	-27.00%		-27.00%		124.76	124.76	124.76	-27.00%		118.02	0.00	124.76	-46.15	-27.00%	100.00%

First SJ/SC Adjustment

1. Largest permanent customer cutback:	-44.15%	
2a. Adjusted SC allocation:	2.51	(Applying largest permanent customer cutback)
2b. Santa Clara adjustment:	-0.99	(Difference between initial and adjusted alloc.)
3a. Adjusted SJ allocation:	2.51	(Applying largest permanent customer cutback)
3b. San José adjustment:	-0.77	(Difference between initial and adjusted alloc.)
4. Total Adjustment:	-1.76	(2b + 3b)

Second SJ/SC Adjustment

1. Largest permanent customer cutba	-39.90%
2a. Adjusted SC allocation:	2.70
2b. Santa Clara adjustment:	
3a. Adjusted SJ allocation:	2.70
3b. San José adjustment:	
4. Total Adjustment:	

****All values in MGD unless noted otherwise***

Column Notes

Agency Information
(1) SFPUC Purchases: From Tab 1.
(2) Fixed Component: Individual Supply Guarantees for most agencies from Tab 1; 4.5 mgd for SJ & SC; projected 2018 demand before conservation used as surrogate for Hayward

Base/Seasonal Allocations
(3) Lesser of Purchase or ISG: The lesser of column (1) or column (2).
(4) Base/Seasonal Allocation Cutback: From Tab 3, column (17).
(5) Base/Seasonal Allocation: column (3) reduced by the Base/Seasonal cutback in column (4).
(6) Base/Seasonal Purchase Cutback: The change between column (5) and column (1) shown as a percentage.

First San Jose/Santa Clara Adjustment: This adjustment is made so that Santa Clara's and San José's cutbacks are at least as great as the highest cutback by the permanent customers.
(7) Subtotal Allocation Factors: The ratio of each permanent agency's column (5) allocation to the column (5) subtotal.
(8) Adjusted Base/Seasonal Allocation: Redistributes "First SJ/SC Adjustment" line 4 value among the permanent customers based on the proportionate shares in column (8).

Allocations Based on Weighted ISG/Base Seasonal Average
(9) Weighted ISG/Base-Seasonal Avg: 33% of column (2) plus 67% of column (8).
(10) Allocation Factors: Each agency's proportionate share of column (9).
(11) Weighted Shortage Allocation: Column (9) times the available water supply (column (5) total).
(12) Weighted Purchase Cutback: The change between column (11) and column (1) shown as a percentage.

Second San Jose/Santa Clara Adjustment: This adjustment is made so that Santa Clara's and San José's cutbacks are at least as great as the highest cutback by the permanent customers.
(13) Subtotal Allocation Factors: The ratio of each permanent agency's column (11) allocation to the column (11) subtotal.
(14) Adjusted Weighted Shortage Allocation: Redistributes "Second SJ/SC Adjustment" line 4 value among the permanent customers based on the proportionate shares in column (13).
(15) Adjusted Weighted Purchase Cutback: The change between column (14) and column (1).

Column Notes

Adjustment for Minimum Cutback: This adjustment forces a 10% minimum cutback with the reallocated water being placed in a hardship bank for later application to East Palo Alto.
(16) Adjusted for 10% Minimum Cutback: Decreases any percentage cutback in column (15) that is less than the minimum 10% floor to equal the 10% floor.
(17) Additional Cutback for Hardship Bank: The difference between column (15) and column (16) times column (1).

Adjustment for Maximum Cutback: This adjustment is made so that the maximum cutback applied to any agency is equal to the Overall Average BAWSCA Reduction + 20%.
(18) Adjusted for Maximum Cutback: Caps the cutbacks in column (18) to no more than 20% more than the average cutback.
(19) Cutback Over Cap: The difference between column (18) and column (15) times column (1).
(20) Allocations Adjusted for Cap: Purchases in column (1) reduced by the cutbacks in column (18).
(21) Agencies to Which Cutback Over Cap is Redistributed: Agencies that are not subject to the minimum or maximum adjustments in columns (17) and (19).
(22) Minimum/Maximum Adjusted Allocation: Redistributes the excess cutback in column (19) by the proportions in column (21) to agencies shown in column (21).
(23) Adjusted Minm/Max Purchase Cutbacks: The change between column (22) and column (1) shown as a percentage.

Adjustment for East Palo Alto (Low Residential Gallons per Capita per Day Adjustment)
(24) Residential Per Capita Usage: From Tab 1.
(25) Agencies To Which EPA Adjustment Applies: Column (22) agency allocations, except those whose GPCD is less than 55 GPCD & those who are impacted by the min./max. cutback .
(26) Share of EPA Adjustment: EPA value equal to difference 50% of the Overall Average Wholesale Customer Reduction and the sum of column (17) total (Hardship Bank value) and EPA allocation in column (22). Indivdiual agency proportionate shares of EPA's adjustment based on column (25).
(27) Allocation with EPA Adjustment: Column (22) plus column (26).

Final Allocations
(28) Final Purchase Cutback: Column (27) minus column (1) expressed as MGD
(29) Final Purchase Cutback: The change between column (31) and column (1) shown as a percentage.
(30) Final Allocation Factor: Each agency's allocation from Column (27) divided by the total water allocated to the wholesale agencies (total in Column (27)), shown as a percentage

TABLE A-2: 2020 CALCULATION OF FINAL PURCHASE CUTBACK AND ALLOCATION FACTOR FOR TIER 2 DROUGHT IMPLEMENTATION PLAN (DRIP)

Overall Average Wholesale Customer Reduction: 27.54%

Base = 10.00%
Seasonal = 68.89%

Weighted average for Column 10:
0.33 =ISG component (Col. 2)
0.67 =Base/Seasonal component (Col. 9)

Variable component - Base/Seasonal Allocation (with ISG cap)
Minimum (Column 16) = 10.00%
Ceiling (Col. 18) = avg. cutback + 20.00%

Minimum residential per capita use threshold (Column 25) = 55.00 gpcpd

Wholesale Customers	(1) 2020 SFPUC Purchases	(2) Fixed Comp.	(3) Lesser of Purchase or ISG	(4) Base/ Seasonal Allocation Cutback	(5) Base/ Seasonal Allocation	(6) Base/ Seasonal Purchase Cutback	(7) Subtotal Allocation Factors	(8) Adjusted Base/Seasonal Allocation	(9) Weighted ISG-Base/ Seasonal Avg	(10) Allocation Factors	(11) Weighted Shortage Allocation	(12) Weighted Purchase Cutback	(13) Subtotal Allocation Factors	(14) Adjusted Weighted Shortage Allocation	(15) Adjusted Weighted Purchase Cutback
	Agency Information		Initial Allocations Based on Weighted Fixed (ISG) and Variable (Base/Seasonal) Components Adjusting for SJ/SC: Base/Seasonal Allocations				1st SJ/SC Adjustment		Weighted Allocation				2nd SJ/SC Adjustment		
ACWD	13.76	13.76	13.76	-28.05%	9.90	-28.06%	8.46%	10.05	11.28	7.64%	9.45	-31.29%	7.98%	9.45	-31.29%
Brisbane/GVMID	0.98	0.98	0.98	-28.65%	0.70	-28.87%	0.60%	0.71	0.80	0.54%	0.67	-31.84%	0.57%	0.67	-31.84%
Burlingame	4.97	5.23	4.97	-23.34%	3.81	-23.34%	3.25%	3.87	4.32	2.93%	3.62	-27.10%	3.05%	3.62	-27.10%
Coastside	1.70	2.18	1.70	-12.46%	1.49	-12.46%	1.27%	1.51	1.73	1.17%	1.45	-14.60%	1.23%	1.45	-14.60%
CWS Total	33.13	35.68	33.13	-30.47%	23.04	-30.47%	19.69%	23.39	27.45	18.60%	23.01	-30.53%	19.42%	23.01	-30.53%
Daly City	4.29	4.29	4.29	-13.88%	3.70	-13.88%	3.16%	3.75	3.93	2.66%	3.30	-23.20%	2.78%	3.30	-23.20%
East Palo Alto	1.96	1.96	1.96	-21.87%	1.53	-21.99%	1.31%	1.56	1.69	1.14%	1.42	-27.87%	1.19%	1.42	-27.87%
Estero	5.27	5.90	5.27	-28.73%	3.76	-28.73%	3.21%	3.81	4.50	3.05%	3.78	-28.36%	3.19%	3.78	-28.36%
Hayward	23.40	25.11	23.40	-23.87%	17.81	-23.87%	15.22%	18.09	20.41	13.83%	17.11	-26.88%	14.44%	17.11	-26.88%
Hillsborough	2.92	4.09	2.92	-45.50%	1.59	-45.50%	1.36%	1.62	2.43	1.65%	2.04	-30.13%	1.72%	2.04	-30.13%
Menlo Park	2.58	4.46	2.58	-33.68%	1.71	-33.68%	1.46%	1.74	2.64	1.79%	2.21	-14.33%	1.87%	2.21	-14.33%
Mid Pen WD	3.60	3.89	3.60	-26.56%	2.64	-26.56%	2.26%	2.68	3.08	2.09%	2.59	-28.19%	2.18%	2.59	-28.19%
Millbrae	2.67	3.15	2.67	-23.16%	2.05	-23.16%	1.75%	2.08	2.44	1.65%	2.04	-23.50%	1.72%	2.04	-23.50%
Milpitas	7.69	9.23	7.69	-22.75%	5.94	-22.75%	5.08%	6.03	7.09	4.80%	5.94	-22.72%	5.01%	5.94	-22.72%
Mountain View	9.91	13.46	9.91	-29.42%	6.99	-29.42%	5.98%	7.10	9.20	6.23%	7.71	-22.14%	6.51%	7.71	-22.14%
North Coast	3.12	3.84	3.12	-19.50%	2.51	-19.50%	2.15%	2.55	2.98	2.02%	2.49	-20.04%	2.11%	2.49	-20.04%
Palo Alto	12.64	17.07	12.64	-32.31%	8.56	-32.31%	7.31%	8.69	11.46	7.76%	9.61	-24.01%	8.11%	9.61	-24.01%
Purissima Hills	1.62	1.62	1.62	-44.95%	0.89	-44.95%	0.76%	0.91	1.14	0.77%	0.96	-40.85%	0.81%	0.96	-40.85%
Redwood City	10.40	10.93	10.40	-27.76%	7.51	-27.76%	6.42%	7.63	8.72	5.91%	7.31	-29.71%	6.17%	7.31	-29.71%
San Bruno	2.47	3.25	2.47	-22.74%	1.91	-22.74%	1.63%	1.94	2.37	1.60%	1.99	-19.51%	1.68%	1.99	-19.51%
Stanford	2.90	3.03	2.90	-35.84%	1.86	-35.84%	1.59%	1.89	2.27	1.54%	1.90	-34.46%	1.60%	1.90	-34.46%
Sunnyvale	8.93	12.58	8.93	-28.01%	6.43	-28.01%	5.49%	6.53	8.53	5.78%	7.15	-19.95%	6.03%	7.15	-19.95%
Westborough	0.88	1.32	0.88	-21.42%	0.69	-21.42%	0.59%	0.70	0.91	0.61%	0.76	-13.67%	0.64%	0.76	-13.67%
Subtotal	161.79		161.79	-27.37%	117.02	-27.67%	100.00%	118.84	141.34		118.50	-26.75%	100.00%	118.50	-26.75%
San José	4.50	4.50	4.50	-27.70%	3.25	-27.70%		2.45	3.13	2.12%	2.62	-41.72%		2.62	-41.72%
Santa Clara	4.50	4.50	4.50	-22.79%	3.47	-22.79%		2.45	3.13	2.12%	2.62	-41.72%		2.62	-41.72%
Total	170.79		170.79	-27.00%	123.74	-27.54%		123.74	147.60	100.00%	123.75	-27.54%		123.75	-27.54%

Wholesale Customers	(16) Adjusted for 10.00% Minimum Cutback	(17) Add'l Cutback for Hardship Bank	(18) Adjusted for 47.54% Maximum Cutback	(19) Cutback Over Cap	(20) Allocations Adjusted For Cap	(21) Agencies To Which Cutback Over Cap Is Redistributed	(22) Min/Max Adjusted Allocation	(23) Adj. Min/Max Purchase Cutbacks	(24) 2020 Residential Per Capita	(25) Agencies To Which EPA Adjustment Applies	(26) Share of EPA Adjustment	(27) Allocations With EPA Adjustments	(28) Final Purchase Cutback	(29) Final Purchase Cutback	(30) Final Allocation Factor
	Adjustment for Minimum and Maximum Cutbacks: Minimum Cutback Adj.		Maximum Cutback Adjustment						Adjustment for East Palo Alto						
ACWD	-31.29%		-31.29%		9.45	9.45	9.45	-31.29%	86.08	9.45	-0.02	9.43	-4.33	-31.45%	7.62%
Brisbane/GVMID	-31.84%		-31.84%		0.67	0.67	0.67	-31.84%	80.93	0.67	0.00	0.67	-0.31	-32.00%	0.54%
Burlingame	-27.10%		-27.10%		3.62	3.62	3.62	-27.10%	96.66	3.62	-0.01	3.61	-1.35	-27.28%	2.92%
Coastside	-14.60%		-14.60%		1.45	1.45	1.45	-14.60%	72.25	1.45	0.00	1.45	-0.25	-14.80%	1.17%
CWS Total	-30.53%		-30.53%		23.01	23.01	23.01	-30.53%	100.81	23.01	-0.05	22.96	-10.17	-30.70%	18.55%
Daly City	-23.20%		-23.20%		3.30	3.30	3.30	-23.20%	49.11			3.30	-1.00	-23.20%	2.66%
East Palo Alto	-27.87%		-27.87%		1.42	1.42	1.416	-27.87%	61.95	1.42	0.28	1.69	-0.27	-13.77%	1.37%
Estero	-28.36%		-28.36%		3.78	3.78	3.78	-28.36%	86.53	3.78	-0.01	3.77	-1.50	-28.53%	3.04%
Hayward	-26.88%		-26.88%		17.11	17.11	17.11	-26.88%	73.40	17.11	-0.04	17.07	-6.33	-27.05%	13.79%
Hillsborough	-30.13%		-30.13%		2.04	2.04	2.04	-30.13%	251.67	2.04	0.00	2.03	-0.88	-30.29%	1.64%
Menlo Park	-14.33%		-14.33%		2.21	2.21	2.21	-14.33%	72.66	2.21	-0.01	2.21	-0.37	-14.53%	1.78%
Mid Pen WD	-28.19%		-28.19%		2.59	2.59	2.59	-28.19%	99.30	2.59	-0.01	2.58	-1.02	-28.36%	2.08%
Millbrae	-23.50%		-23.50%		2.04	2.04	2.04	-23.50%	75.08	2.04	0.00	2.04	-0.63	-23.68%	1.65%
Milpitas	-22.72%		-22.72%		5.94	5.94	5.94	-22.72%	61.38	5.94	-0.01	5.93	-1.76	-22.90%	4.79%
Mountain View	-22.14%		-22.14%		7.71	7.71	7.71	-22.14%	74.27	7.71	-0.02	7.69	-2.21	-22.33%	6.22%
North Coast	-20.04%		-20.04%		2.49	2.49	2.49	-20.04%	56.16	2.49	-0.01	2.49	-0.63	-20.23%	2.01%
Palo Alto	-24.01%		-24.01%		9.61	9.61	9.61	-24.01%	96.58	9.61	-0.02	9.58	-3.06	-24.19%	7.74%
Purissima Hills	-40.85%		-40.85%		0.96	0.96	0.96	-40.85%	251.27	0.96	0.00	0.96	-0.66	-40.99%	0.77%
Redwood City	-29.71%		-29.71%		7.31	7.31	7.31	-29.71%	71.96	7.31	-0.02	7.29	-3.11	-29.87%	5.89%
San Bruno	-19.51%		-19.51%		1.99	1.99	1.99	-19.51%	65.26	1.99	0.00	1.98	-0.49	-19.70%	1.60%
Stanford	-34.46%		-34.46%		1.90	1.90	1.90	-34.46%	N/A	1.90	0.00	1.90	-1.00	-34.62%	1.53%
Sunnyvale	-19.95%		-19.95%		7.15	7.15	7.15	-19.95%	76.53	7.15	-0.02	7.13	-1.80	-20.14%	5.76%
Westborough	-13.67%		-13.67%		0.76	0.76	0.76	-13.67%	44.84			0.76	-0.12	-13.67%	0.61%
Subtotal	-26.75%		-26.75%		118.50	118.50	118.50	-26.75%		114.45		118.51	-43.27	-26.75%	
San José	-41.72%		-41.72%		2.62	2.62	2.62	-41.72%	33.39			2.62	-1.88	-41.72%	2.12%
Santa Clara	-41.72%		-41.72%		2.62	2.62	2.62	-41.72%	69.63	2.62	-0.01	2.62	-1.88	-41.85%	2.11%
Total	-27.54%		-27.54%		123.75	123.75	123.75	-27.54%		117.07	0.00	123.75	-47.03	-27.54%	100.00%

First SJ/SC Adjustment

1. Largest permanent customer cutback:	-45.50%	
2a. Adjusted SC allocation:	2.45	(Applying largest permanent customer cutback)
2b. Santa Clara adjustment:	-1.02	(Difference between initial and adjusted alloc.)
3a. Adjusted SJ allocation:	2.45	(Applying largest permanent customer cutback)
3b. San José adjustment:	-0.80	(Difference between initial and adjusted alloc.)
4. Total Adjustment:	-1.82	(2b + 3b)

Second SJ/SC Adjustment

1. Largest permanent customer cutba	-40.85%
2a. Adjusted SC allocation:	2.66
2b. Santa Clara adjustment:	
3a. Adjusted SJ allocation:	2.66
3b. San José adjustment:	
4. Total Adjustment:	

****All values in MGD unless noted otherwise***

Column Notes

Agency Information

(1) SFPUC Purchases: From Tab 1.

(2) Fixed Component: Individual Supply Guarantees for most agencies from Tab 1; 4.5 mgd for SJ & SC; projected 2018 demand before conservation used as surrogate for Hayward

Base/Seasonal Allocations

(3) Lesser of Purchase or ISG: The lesser of column (1) or column (2).

(4) Base/Seasonal Allocation Cutback: From Tab 3, column (17).

(5) Base/Seasonal Allocation: column (3) reduced by the Base/Seasonal cutback in column (4).

(6) Base/Seasonal Purchase Cutback: The change between column (5) and column (1) shown as a percentage.

First San Jose/Santa Clara Adjustment: This adjustment is made so that Santa Clara's and San José's cutbacks are at least as great as the highest cutback by the permanent customers.

(7) Subtotal Allocation Factors: The ratio of each permanent agency's column (5) allocation to the column (5) subtotal.

(8) Adjusted Base/Seasonal Allocation: Redistributes "First SJ/SC Adjustment" line 4 value among the permanent customers based on the proportionate shares in column (8).

Allocations Based on Weighted ISG/Base Seasonal Average

(9) Weighted ISG/Base-Seasonal Avg: 33% of column (2) plus 67% of column (8).

(10) Allocation Factors: Each agency's proportionate share of column (9).

(11) Weighted Shortage Allocation: Column (9) times the available water supply (column (5) total).

(12) Weighted Purchase Cutback: The change between column (11) and column (1) shown as a percentage.

Second San Jose/Santa Clara Adjustment: This adjustment is made so that Santa Clara's and San José's cutbacks are at least as great as the highest cutback by the permanent customers.

(13) Subtotal Allocation Factors: The ratio of each permanent agency's column (11) allocation to the column (11) subtotal.

(14) Adjusted Weighted Shortage Allocation: Redistributes "Second SJ/SC Adjustment" line 4 value among the permanent customers based on the proportionate shares in column (13).

(15) Adjusted Weighted Purchase Cutback: The change between column (14) and column (1).

Column Notes

Adjustment for Minimum Cutback: This adjustment forces a 10% minimum cutback with the reallocated water being placed in a hardship bank for later application to East Palo Alto.

(16) Adjusted for 10% Minimum Cutback: Decreases any percentage cutback in column (15) that is less than the minimum 10% floor to equal the 10% floor.

(17) Additional Cutback for Hardship Bank: The difference between column (15) and column (16) times column (1).

Adjustment for Maximum Cutback: This adjustment is made so that the maximum cutback applied to any agency is equal to the Overall Average BAWSCA Reduction + 20%.

(18) Adjusted for Maximun Cutback: Caps the cutbacks in column (18) to no more than 20% more than the average cutback.

(19) Cutback Over Cap: The difference between column (18) and column (15) times column (1).

(20) Allocations Adjusted for Cap: Purchases in column (1) reduced by the cutbacks in column (18).

(21) Agencies to Which Cutback Over Cap is Redistributed: Agencies that are not subject to the minimum or maximum adjustments in columns (17) and (19).

(22) Minimum/Maximum Adjusted Allocation: Redistributes the excess cutback in column (19) by the proportions in column (21) to agencies shown in column (21).

(23) Adjusted Minm/Max Purchase Cutbacks: The change between column (22) and column (1) shown as a percentage.

Adjustment for East Palo Alto (Low Residential Gallons per Capita per Day Adjustment)

(24) Residential Per Capita Usage: From Tab 1.

(25) Agencies To Which EPA Adjustment Applies: Column (22) agency allocations, except those whose GPCD is less than 55 GPCD & those who are impacted by the min./max. cutback .

(26) Share of EPA Adjustment: EPA value equal to difference 50% of the Overall Average Wholesale Customer Reduction and the sum of column (17) total (Hardship Bank value) and EPA allocation in column (22). Indivdiual agency proportionate shares of EPA's adjustment based on column (25).

(27) Allocation with EPA Adjustment: Column (22) plus column (26).

Final Allocations

(28) Final Purchase Cutback: Column (27) minus column (1) expressed as MGD

(29) Final Purchase Cutback: The change between column (31) and column (1) shown as a percentage.

(30) Final Allocation Factor: Each agency's allocation from Column (27) divided by the total water allocated to the wholesale agencies (total in Column (27)), shown as a percentage

TABLE A-3: 2025 CALCULATION OF FINAL PURCHASE CUTBACK AND ALLOCATION FACTOR FOR TIER 2 DROUGHT IMPLEMENTATION PLAN (DRIP)

Overall Average Wholesale Customer Reduction: 28.30%

Base = 10.00%
Seasonal = 71.10%

Weighted average for Column 10:
0.33 =ISG component (Col. 2)
0.67 =Base/Seasonal component (Col. 9)

Variable component - Base/Seasonal Allocation (with ISG cap)
Minimum (Column 16) = 10.00%
Ceiling (Col. 18) = avg. cutback + 20.00%

Minimum residential per capita use threshold (Column 25) = 55.00 gpcpd

	Agency Information		Initial Allocations Based on Weighted Fixed (ISG) and Variable (Base/Seasonal) Components Adjusting for SJ/SC												
			Base/Seasonal Allocations				1st SJ/SC Adjustment		Weighted Allocation				2nd SJ/SC Adjustment		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Wholesale Customers	2025 SFPUC Purchases	Fixed Comp.	Lesser of Purchase or ISG	Base/ Seasonal Allocation Cutback	Base/ Seasonal Allocation	Base/ Seasonal Purchase Cutback	Subtotal Allocation Factors	Adjusted Base/Seasonal Allocation	Weighted ISG-Base/ Seasonal Avg	Allocation Factors	Weighted Shortage Allocation	Weighted Purchase Cutback	Subtotal Allocation Factors	Adjusted Weighted Shortage Allocation	Adjusted Weighted Purchase Cutback
ACWD	13.76	13.76	13.76	-28.55%	9.83	-28.56%	8.24%	9.99	11.23	7.53%	9.49	-31.05%	7.86%	9.49	-31.05%
Brisbane/GVMID	1.00	0.98	0.98	-29.35%	0.69	-30.85%	0.58%	0.70	0.79	0.53%	0.67	-32.97%	0.56%	0.67	-32.97%
Burlingame	5.07	5.23	5.07	-23.85%	3.86	-23.85%	3.24%	3.92	4.36	2.92%	3.68	-27.45%	3.05%	3.68	-27.45%
Coastside	1.73	2.18	1.73	-12.83%	1.51	-12.83%	1.27%	1.53	1.75	1.17%	1.48	-14.81%	1.22%	1.48	-14.81%
CWS Total	34.15	35.68	34.15	-31.22%	23.49	-31.22%	19.69%	23.86	27.76	18.62%	23.45	-31.34%	19.43%	23.45	-31.34%
Daly City	4.29	4.29	4.29	-14.03%	3.69	-14.03%	3.09%	3.75	3.93	2.64%	3.32	-22.70%	2.75%	3.32	-22.70%
East Palo Alto	1.96	1.96	1.96	-22.31%	1.52	-22.43%	1.28%	1.55	1.68	1.13%	1.42	-27.57%	1.18%	1.42	-27.57%
Estero	5.35	5.90	5.35	-29.43%	3.78	-29.43%	3.17%	3.83	4.52	3.03%	3.82	-28.69%	3.16%	3.82	-28.69%
Hayward	25.40	25.11	25.11	-24.39%	18.98	-25.26%	15.92%	19.28	21.21	14.23%	17.91	-29.47%	14.84%	17.91	-29.47%
Hillsborough	2.93	4.09	2.93	-46.83%	1.56	-46.83%	1.31%	1.58	2.41	1.62%	2.04	-30.53%	1.69%	2.04	-30.53%
Menlo Park	2.60	4.46	2.60	-34.57%	1.70	-34.57%	1.43%	1.73	2.63	1.76%	2.22	-14.57%	1.84%	2.22	-14.57%
Mid Pen WD	3.60	3.89	3.60	-27.18%	2.62	-27.18%	2.20%	2.66	3.07	2.06%	2.59	-28.01%	2.15%	2.59	-28.01%
Millbrae	2.79	3.15	2.79	-23.65%	2.13	-23.65%	1.79%	2.16	2.49	1.67%	2.10	-24.62%	1.74%	2.10	-24.62%
Milpitas	8.25	9.23	8.25	-23.03%	6.35	-23.03%	5.32%	6.45	7.37	4.94%	6.22	-24.57%	5.16%	6.22	-24.57%
Mountain View	10.34	13.46	10.34	-30.08%	7.23	-30.08%	6.06%	7.34	9.36	6.28%	7.91	-23.52%	6.55%	7.91	-23.52%
North Coast	3.14	3.84	3.14	-19.86%	2.52	-19.86%	2.11%	2.56	2.98	2.00%	2.52	-19.85%	2.09%	2.52	-19.85%
Palo Alto	12.81	17.07	12.81	-33.15%	8.57	-33.15%	7.18%	8.70	11.46	7.69%	9.68	-24.43%	8.02%	9.68	-24.43%
Purissima Hills	1.62	1.62	1.62	-46.27%	0.87	-46.27%	0.73%	0.88	1.13	0.76%	0.95	-41.15%	0.79%	0.95	-41.15%
Redwood City	10.36	10.93	10.36	-28.42%	7.42	-28.42%	6.22%	7.53	8.65	5.81%	7.31	-29.45%	6.06%	7.31	-29.45%
San Bruno	2.63	3.25	2.63	-23.60%	2.01	-23.60%	1.68%	2.04	2.44	1.63%	2.06	-21.63%	1.71%	2.06	-21.63%
Stanford	3.03	3.03	3.03	-36.82%	1.91	-36.82%	1.61%	1.94	2.30	1.55%	1.95	-35.77%	1.61%	1.95	-35.77%
Sunnyvale	8.93	12.58	8.93	-28.94%	6.35	-28.94%	5.32%	6.45	8.47	5.68%	7.15	-19.88%	5.93%	7.15	-19.88%
Westborough	0.87	1.32	0.87	-21.85%	0.68	-21.85%	0.57%	0.69	0.90	0.60%	0.76	-12.79%	0.63%	0.76	-12.79%
Subtotal	166.62		166.62	-27.96%	119.26	-28.42%	100.00%	121.14	142.88		120.69	-27.56%	100.00%	120.69	-27.56%
San José	4.50	4.50	4.50	-28.37%	3.22	-28.37%		2.39	3.09	2.07%	2.61	-42.04%		2.61	-42.04%
Santa Clara	4.50	4.50	4.50	-23.47%	3.44	-23.47%		2.39	3.09	2.07%	2.61	-42.04%		2.61	-42.04%
Total	175.62		175.62	-27.59%	125.93	-28.30%		125.93	149.06	100.00%	125.91	-28.30%		125.91	-28.30%

	Adjustment for Minimum and Maximum Cutbacks								Adjustment for East Palo Alto						
	Minimum Cutback Adj.		Maximum Cutback Adjustment												
	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)
Wholesale Customers	Adjusted for 10.00% Minimum Cutback	Add'l Cutback for Hardship Bank	Adjusted for 48.30% Maximum Cutback	Cutback Over Cap	Allocations Adjusted For Cap	Agencies To Which Cutback Over Cap Is Redistributed	Min/Max Adjusted Allocation	Adj. Min/Max Purchase Cutbacks	2025 Residential Per Capita	Agencies To Which EPA Adjustment Applies	Share of EPA Adjustment	Allocations With EPA Adjustments	Final Purchase Cutback		Final Allocation Factor
ACWD	-31.05%		-31.05%		9.49	9.49	9.49	-31.05%	86.58	9.49	-0.02	9.47	-4.29	-31.21%	7.52%
Brisbane/GVMID	-32.97%		-32.97%		0.67	0.67	0.67	-32.97%	75.79	0.67	0.00	0.67	-0.33	-33.12%	0.53%
Burlingame	-27.45%		-27.45%		3.68	3.68	3.68	-27.45%	95.76	3.68	-0.01	3.67	-1.40	-27.61%	2.92%
Coastside	-14.81%		-14.81%		1.48	1.48	1.48	-14.81%	72.23	1.48	0.00	1.47	-0.26	-14.99%	1.17%
CWS Total	-31.34%		-31.34%		23.45	23.45	23.45	-31.34%	100.79	23.45	-0.05	23.40	-10.75	-31.49%	18.58%
Daly City	-22.70%		-22.70%		3.32	3.32	3.32	-22.70%	48.20			3.32	-0.97	-22.70%	2.63%
East Palo Alto	-27.57%		-27.57%		1.42	1.42	1.422	-27.57%	61.94	1.42	0.26	1.69	-0.28	-14.15%	1.34%
Estero	-28.69%		-28.69%		3.82	3.82	3.82	-28.69%	86.55	3.82	-0.01	3.81	-1.54	-28.85%	3.02%
Hayward	-29.47%		-29.47%		17.91	17.91	17.91	-29.47%	76.56	17.91	-0.04	17.87	-7.53	-29.63%	14.20%
Hillsborough	-30.53%		-30.53%		2.04	2.04	2.04	-30.53%	251.76	2.04	0.00	2.03	-0.90	-30.69%	1.61%
Menlo Park	-14.57%		-14.57%		2.22	2.22	2.22	-14.57%	71.71	2.22	0.00	2.22	-0.38	-14.75%	1.76%
Mid Pen WD	-28.01%		-28.01%		2.59	2.59	2.59	-28.01%	96.12	2.59	-0.01	2.59	-1.01	-28.16%	2.05%
Millbrae	-24.62%		-24.62%		2.10	2.10	2.10	-24.62%	74.96	2.10	0.00	2.10	-0.69	-24.79%	1.67%
Milpitas	-24.57%		-24.57%		6.22	6.22	6.22	-24.57%	64.55	6.22	-0.01	6.21	-2.04	-24.73%	4.93%
Mountain View	-23.52%		-23.52%		7.91	7.91	7.91	-23.52%	74.09	7.91	-0.02	7.89	-2.45	-23.68%	6.27%
North Coast	-19.85%		-19.85%		2.52	2.52	2.52	-19.85%	55.43	2.52	-0.01	2.51	-0.63	-20.03%	1.99%
Palo Alto	-24.43%		-24.43%		9.68	9.68	9.68	-24.43%	93.91	9.68	-0.02	9.66	-3.15	-24.59%	7.67%
Purissima Hills	-41.15%		-41.15%		0.95	0.95	0.95	-41.15%	259.51	0.95	0.00	0.95	-0.67	-41.28%	0.76%
Redwood City	-29.45%		-29.45%		7.31	7.31	7.31	-29.45%	70.08	7.31	-0.02	7.29	-3.07	-29.60%	5.79%
San Bruno	-21.63%		-21.63%		2.06	2.06	2.06	-21.63%	64.12	2.06	0.00	2.05	-0.57	-21.80%	1.63%
Stanford	-35.77%		-35.77%		1.95	1.95	1.95	-35.77%	N/A	1.95	0.00	1.94	-1.09	-35.92%	1.54%
Sunnyvale	-19.88%		-19.88%		7.15	7.15	7.15	-19.88%	77.75	7.15	-0.02	7.14	-1.79	-20.06%	5.67%
Westborough	-12.79%		-12.79%		0.76	0.76	0.76	-12.79%	44.39			0.76	-0.11	-12.79%	0.60%
Subtotal	-27.56%		-27.56%		120.69	120.69	120.69	-27.56%		116.62		120.70	-45.92	-27.56%	
San José	-42.04%		-42.04%		2.61	2.61	2.61	-42.04%	27.34			2.61	-1.89	-42.04%	2.07%
Santa Clara	-42.04%		-42.04%		2.61	2.61	2.61	-42.04%	70.17	2.61	-0.01	2.60	-1.90	-42.16%	2.07%
Total	-28.30%		-28.30%		125.91	125.91	125.91	-28.30%		119.23	0.00	125.91	-49.71	-28.30%	100.00%

First SJ/SC Adjustment

1.	Largest permanent customer cutback:	-46.83%	
2a.	Adjusted SC allocation:	2.39	(Applying largest permanent customer cutback)
2b.	Santa Clara adjustment:	-1.05	(Difference between initial and adjusted alloc.)
3a.	Adjusted SJ allocation:	2.39	(Applying largest permanent customer cutback)
3b.	San José adjustment:	-0.83	(Difference between initial and adjusted alloc.)
4.	Total Adjustment:	-1.88	(2b + 3b)

Second SJ/SC Adjustment

1.	Largest permanent customer cutba	-41.15%
2a.	Adjusted SC allocation:	2.65
2b.	Santa Clara adjustment:	
3a.	Adjusted SJ allocation:	2.65
3b.	San José adjustment:	
4.	Total Adjustment:	

***All values in MGD unless noted otherwise*

Column Notes

Agency Information

(1) SFPUC Purchases: From Tab 1.
(2) Fixed Component: Individual Supply Guarantees for most agencies from Tab 1; 4.5 mgd for SJ & SC; projected 2018 demand before conservation used as surrogate for Hayward

Base/Seasonal Allocations

(3) Lesser of Purchase or ISG: The lesser of column (1) or column (2).
(4) Base/Seasonal Allocation Cutback: From Tab 3, column (17).
(5) Base/Seasonal Allocation: column (3) reduced by the Base/Seasonal cutback in column (4).
(6) Base/Seasonal Purchase Cutback: The change between column (5) and column (1) shown as a percentage.

First San Jose/Santa Clara Adjustment: This adjustment is made so that Santa Clara's and San José's cutbacks are at least as great as the highest cutback by the permanent customers.

(7) Subtotal Allocation Factors: The ratio of each permanent agency's column (5) allocation to the column (5) subtotal.
(8) Adjusted Base/Seasonal Allocation: Redistributes "First SJ/SC Adjustment" line 4 value among the permanent customers based on the proportionate shares in column (8).

Allocations Based on Weighted ISG/Base Seasonal Average

(9) Weighted ISG/Base-Seasonal Avg: 33% of column (2) plus 67% of column (8).
(10) Allocation Factors: Each agency's proportionate share of column (9).
(11) Weighted Shortage Allocation: Column (9) times the available water supply (column (5) total).
(12) Weighted Purchase Cutback: The change between column (11) and column (1) shown as a percentage.

Second San Jose/Santa Clara Adjustment: This adjustment is made so that Santa Clara's and San José's cutbacks are at least as great as the highest cutback by the permanent customers.

(13) Subtotal Allocation Factors: The ratio of each permanent agency's column (11) allocation to the column (11) subtotal.
(14) Adjusted Weighted Shortage Allocation: Redistributes "Second SJ/SC Adjustment" line 4 value among the permanent customers based on the proportionate shares in column (13).
(15) Adjusted Weighted Purchase Cutback: The change between column (14) and column (1).

Column Notes

Adjustment for Minimum Cutback: This adjustment forces a 10% minimum cutback with the reallocated water being placed in a hardship bank for later application to East Palo Alto.

(16) Adjusted for 10% Minimum Cutback: Decreases any percentage cutback in column (15) that is less than the minimum 10% floor to equal the 10% floor.
(17) Additional Cutback for Hardship Bank: The difference between column (15) and column (16) times column (1).

Adjustment for Maximum Cutback: This adjustment is made so that the maximum cutback applied to any agency is equal to the Overall Average BAWSCA Reduction + 20%.

(18) Adjusted for Maximun Cutback: Caps the cutbacks in column (18) to no more than 20% more than the average cutback.
(19) Cutback Over Cap: The difference between column (18) and column (15) times column (1).
(20) Allocations Adjusted for Cap: Purchases in column (1) reduced by the cutbacks in column (18).
(21) Agencies to Which Cutback Over Cap is Redistributed: Agencies that are not subject to the minimum or maximum adjustments in columns (17) and (19).
(22) Minimum/Maximum Adjusted Allocation: Redistributes the excess cutback in column (19) by the proportions in column (21) to agencies shown in column (21).
(23) Adjusted Minn/Max Purchase Cutbacks: The change between column (22) and column (1) shown as a percentage.

Adjustment for East Palo Alto (Low Residential Gallons per Capita per Day Adjustment)

(24) Residential Per Capita Usage: From Tab 1.
(25) Agencies To Which EPA Adjustment Applies: Column (22) agency allocations, except those whose GPCD is less than 55 GPCD & those who are impacted by the min./max. cutback .
(26) Share of EPA Adjustment: EPA value equal to difference 50% of the Overall Average Wholesale Customer Reduction and the sum of column (17) total (Hardship Bank value) and EPA allocation in column (22). Indivdiual agency proportionate shares of EPA's adjustment based on column (25).
(27) Allocation with EPA Adjustment: Column (22) plus column (26).

Final Allocations

(28) Final Purchase Cutback: Column (27) minus column (1) expressed as MGD
(29) Final Purchase Cutback: The change between column (31) and column (1) shown as a percentage.
(30) Final Allocation Factor: Each agency's allocation from Column (27) divided by the total water allocated to the wholesale agencies (total in Column (27)), shown as a percentage

TABLE A-4: 2030 CALCULATION OF FINAL PURCHASE CUTBACK AND ALLOCATION FACTOR FOR TIER 2 DROUGHT IMPLEMENTATION PLAN (DRIP)

Overall Average Wholesale Customer Reduction: 28.78%

Base = 10.00%
Seasonal = 69.60%

Weighted average for Column 10:
0.33 =ISG component (Col. 2)
0.67 =Base/Seasonal component (Col. 9)

Variable component - Base/Seasonal Allocation (with ISG cap)
Minimum (Column 16) = 10.00%
Ceiling (Col. 18) = avg. cutback + 20.00%

Minimum residential per capita use threshold (Column 25) =
55.00 gpcpd

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)
	Agency Information		Initial Allocations Based on Weighted Fixed (ISG) and Variable (Base/Seasonal) Components Adjusting for SJ/SC													Adjustment for Minimum and Maximum Cutbacks														
			Base/Seasonal Allocations				1st SJ/SC Adjustment		Weighted Allocation				2nd SJ/SC Adjustment			Minimum Cutback Adj.		Maximum Cutback Adjustment						Adjustment for East Palo Alto						
Wholesale Customers	**2030 SFPUC Purchases**	**Fixed Comp.**	**Lesser of Purchase or ISG**	**Base/ Seasonal Allocation Cutback**	**Base/ Seasonal Allocation**	**Base/ Seasonal Purchase Cutback**	**Subtotal Allocation Factors**	**Adjusted Base/Seasonal Allocation**	**Weighted ISG-Base/ Seasonal Avg**	**Allocation Factors**	**Weighted Shortage Allocation**	**Weighted Purchase Cutback**	**Subtotal Allocation Factors**	**Adjusted Weighted Shortage Allocation**	**Adjusted Weighted Purchase Cutback**	**Adjusted for 10.00% Minimum Cutback**	**Add'l Cutback for Hardship Bank**	**Adjusted for 48.78% Maximum Cutback**	**Cutback Over Cap**	**Allocations Adjusted For Cap**	**Agencies To Which Cutback Over Cap Is Redistributed**	**Min/Max Adjusted Allocation**	**Adj. Min/Max Purchase Cutbacks**	**2030 Residential Per Capita**	**Agencies To Which EPA Adjustment Applies**	**Share of EPA Adjustment**	**Allocations With EPA Adjustments**	**Final Purchase Cutback**		**Final Allocation Factor**
ACWD	13.76	13.76	13.76	-27.90%	9.92	-27.90%	8.08%	10.07	11.29	7.45%	9.65	-29.89%	7.77%	9.65	-29.89%	-29.89%		-29.89%		9.65	9.65	9.65	-29.89%	87.65	9.65	-0.019	9.628	-4.132	-30.03%	7.44%
Brisbane/GVMID	1.01	0.98	0.98	-28.87%	0.70	-31.08%	0.57%	0.71	0.80	0.53%	0.68	-32.61%	0.55%	0.68	-32.61%	-32.61%		-32.61%		0.68	0.68	0.68	-32.61%	71.28	0.68	-0.001	0.680	-0.331	-32.74%	0.53%
Burlingame	5.18	5.23	5.18	-23.51%	3.96	-23.51%	3.23%	4.02	4.42	2.92%	3.78	-27.03%	3.05%	3.78	-27.03%	-27.03%		-27.03%		3.78	3.78	3.78	-27.03%	95.21	3.78	-0.007	3.771	-1.407	-27.17%	2.91%
Coastside	1.77	2.18	1.77	-13.07%	1.53	-13.07%	1.25%	1.56	1.76	1.16%	1.51	-14.64%	1.21%	1.51	-14.64%	-14.64%		-14.64%		1.51	1.51	1.51	-14.64%	72.15	1.51	-0.003	1.504	-0.261	-14.81%	1.16%
CWS Total	35.23	35.68	35.23	-30.69%	24.42	-30.69%	19.90%	24.78	28.38	18.75%	24.26	-31.15%	19.55%	24.26	-31.15%	-31.15%		-31.15%		24.26	24.26	24.26	-31.15%	100.79	24.26	-0.047	24.209	-11.022	-31.29%	18.71%
Daly City	4.29	4.29	4.29	-13.93%	3.69	-13.94%	3.01%	3.75	3.93	2.59%	3.36	-21.78%	2.71%	3.36	-21.78%	-21.78%		-21.78%		3.36	3.36	3.36	-21.78%	47.63			3.358	-0.935	-21.78%	2.59%
East Palo Alto	1.96	1.96	1.96	-22.01%	1.53	-22.13%	1.25%	1.55	1.69	1.11%	1.44	-26.58%	1.16%	1.44	-26.58%	-26.58%		-26.58%		1.44	1.44	1.441	-26.58%	61.95	1.44	0.239	1.680	-0.283	-14.39%	1.30%
Estero	5.40	5.90	5.40	-28.96%	3.84	-28.96%	3.13%	3.89	4.56	3.01%	3.89	-27.89%	3.14%	3.89	-27.89%	-27.89%		-27.89%		3.89	3.89	3.89	-27.89%	86.51	3.89	-0.008	3.886	-1.514	-28.03%	3.00%
Hayward	27.70	25.11	25.11	-24.04%	19.07	-31.14%	15.54%	19.36	21.26	14.04%	18.17	-34.41%	14.64%	18.17	-34.41%	-34.41%		-34.41%		18.17	18.17	18.17	-34.41%	79.85	18.17	-0.035	18.132	-9.568	-34.54%	14.01%
Hillsborough	2.94	4.09	2.94	-45.93%	1.59	-45.93%	1.30%	1.61	2.43	1.61%	2.08	-29.36%	1.68%	2.08	-29.36%	-29.36%		-29.36%		2.08	2.08	2.08	-29.36%	251.75	2.08	-0.004	2.074	-0.868	-29.50%	1.60%
Menlo Park	2.63	4.46	2.63	-33.96%	1.74	-33.96%	1.42%	1.76	2.65	1.75%	2.27	-13.79%	1.83%	2.27	-13.79%	-13.79%		-13.79%		2.27	2.27	2.27	-13.79%	71.03	2.27	-0.004	2.263	-0.367	-13.96%	1.75%
Mid Pen WD	3.70	3.89	3.70	-26.76%	2.71	-26.76%	2.21%	2.75	3.13	2.07%	2.67	-27.77%	2.15%	2.67	-27.77%	-27.77%		-27.77%		2.67	2.67	2.67	-27.77%	97.07	2.67	-0.005	2.667	-1.033	-27.91%	2.06%
Millbrae	2.90	3.15	2.90	-23.32%	2.22	-23.32%	1.81%	2.26	2.55	1.69%	2.18	-24.78%	1.76%	2.18	-24.78%	-24.78%		-24.78%		2.18	2.18	2.18	-24.78%	74.89	2.18	-0.004	2.177	-0.723	-24.92%	1.68%
Milpitas	8.80	9.23	8.80	-22.56%	6.81	-22.56%	5.55%	6.92	7.68	5.07%	6.56	-25.41%	5.29%	6.56	-25.41%	-25.41%		-25.41%		6.56	6.56	6.56	-25.41%	67.47	6.56	-0.013	6.551	-2.249	-25.56%	5.06%
Mountain View	10.81	13.46	10.81	-29.52%	7.62	-29.52%	6.21%	7.73	9.62	6.35%	8.22	-23.91%	6.63%	8.22	-23.91%	-23.91%		-23.91%		8.22	8.22	8.22	-23.91%	74.14	8.22	-0.016	8.207	-2.599	-24.05%	6.34%
North Coast	3.25	3.84	3.25	-19.62%	2.61	-19.62%	2.13%	2.65	3.04	2.01%	2.60	-19.97%	2.10%	2.60	-19.97%	-19.97%		-19.97%		2.60	2.60	2.60	-19.97%	56.55	2.60	-0.005	2.596	-0.654	-20.13%	2.01%
Palo Alto	13.37	17.07	13.37	-32.58%	9.01	-32.58%	7.34%	9.15	11.76	7.77%	10.05	-24.79%	8.10%	10.05	-24.79%	-24.79%		-24.79%		10.05	10.05	10.05	-24.79%	89.43	10.05	-0.020	10.034	-3.333	-24.93%	7.75%
Purissima Hills	1.62	1.62	1.62	-45.38%	0.88	-45.38%	0.72%	0.90	1.14	0.75%	0.97	-39.96%	0.78%	0.97	-39.96%	-39.96%		-39.96%		0.97	0.97	0.97	-39.96%	264.21	0.97	-0.002	0.971	-0.649	-40.08%	0.75%
Redwood City	10.79	10.93	10.79	-27.97%	7.77	-27.97%	6.33%	7.89	8.89	5.87%	7.60	-29.57%	6.13%	7.60	-29.57%	-29.57%		-29.57%		7.60	7.60	7.60	-29.57%	71.39	7.60	-0.015	7.585	-3.205	-29.71%	5.86%
San Bruno	2.78	3.25	2.78	-23.60%	2.12	-23.60%	1.73%	2.16	2.52	1.66%	2.15	-22.67%	1.73%	2.15	-22.67%	-22.67%		-22.67%		2.15	2.15	2.15	-22.67%	63.49	2.15	-0.004	2.146	-0.635	-22.82%	1.66%
Stanford	3.03	3.03	3.03	-36.16%	1.93	-36.16%	1.58%	1.96	2.32	1.53%	1.98	-34.66%	1.60%	1.98	-34.66%	-34.66%		-34.66%		1.98	1.98	1.98	-34.66%	N/A	1.98	-0.004	1.976	-1.054	-34.79%	1.53%
Sunnyvale	8.93	12.58	8.93	-28.84%	6.35	-28.84%	5.18%	6.45	8.47	5.60%	7.24	-18.91%	5.84%	7.24	-18.91%	-18.91%		-18.91%		7.24	7.24	7.24	-18.91%	80.60	7.24	-0.014	7.227	-1.703	-19.07%	5.58%
Westborough	0.85	1.32	0.85	-21.56%	0.67	-21.56%	0.54%	0.68	0.89	0.59%	0.76	-10.61%	0.61%	0.76	-10.61%	-10.61%		-10.61%		0.76	0.76	0.76	-10.61%	43.44			0.760	-0.090	-10.61%	0.59%
Subtotal	172.70		172.70	-27.47%	122.72	-28.94%	100.00%	124.54	145.16		124.07	-28.16%	100.00%	124.07	-28.16%	-28.16%		-28.16%		124.07	124.07	124.07	-28.16%		119.96		124.083	-48.615	-28.15%	
San José	4.50	4.50	4.50	-27.92%	3.24	-27.92%		2.43	3.12	2.06%	2.66	-40.83%		2.66	-40.83%	-40.83%		-40.83%		2.66	2.66	2.66	-40.83%	24.15			2.663	-1.837	-40.83%	2.06%
Santa Clara	4.50	4.50	4.50	-23.36%	3.45	-23.36%		2.43	3.12	2.06%	2.66	-40.83%		2.66	-40.83%	-40.83%		-40.83%		2.66	2.66	2.66	-40.83%	71.56	2.66	-0.005	2.657	-1.843	-40.94%	2.05%
Total	181.70		181.70	-27.13%	129.41	-28.78%		129.41	151.39	100.00%	129.40	-28.78%		129.40	-28.78%	-28.78%		-28.78%		129.40	129.40	129.40	-28.78%		122.62	0.003	129.403	-52.295	-28.78%	100.00%

First SJ/SC Adjustment

1.	Largest permanent customer cutback:	-45.93%	
2a.	Adjusted SC allocation:	2.43	(Applying largest permanent customer cutback)
2b.	Santa Clara adjustment:	-1.02	(Difference between initial and adjusted alloc.)
3a.	Adjusted SJ allocation:	2.43	(Applying largest permanent customer cutback)
3b.	San José adjustment:	-0.81	(Difference between initial and adjusted alloc.)
4.	Total Adjustment:	-1.83	(2b + 3b)

Second SJ/SC Adjustment

1.	Largest permanent customer cutba	-39.96%
2a.	Adjusted SC allocation:	2.70
2b.	Santa Clara adjustment:	
3a.	Adjusted SJ allocation:	2.70
3b.	San José adjustment:	
4.	Total Adjustment:	

****All values in MGD unless noted otherwise***

Column Notes

Agency Information

(1) SFPUC Purchases: From Tab 1.
(2) Fixed Component: Individual Supply Guarantees for most agencies from Tab 1; 4.5 mgd for SJ & SC; projected 2018 demand before conservation used as surrogate for Hayward

Base/Seasonal Allocations

(3) Lesser of Purchase or ISG: The lesser of column (1) or column (2).
(4) Base/Seasonal Allocation Cutback: From Tab 3, column (17).
(5) Base/Seasonal Allocation: column (3) reduced by the Base/Seasonal cutback in column (4).
(6) Base/Seasonal Purchase Cutback: The change between column (5) and column (1) shown as a percentage.

First San Jose/Santa Clara Adjustment: This adjustment is made so that Santa Clara's and San José's cutbacks are at least as great as the highest cutback by the permanent customers.

(7) Subtotal Allocation Factors: The ratio of each permanent agency's column (5) allocation to the column (5) subtotal.
(8) Adjusted Base/Seasonal Allocation: Redistributes "First SJ/SC Adjustment" line 4 value among the permanent customers based on the proportionate shares in column (8).

Allocations Based on Weighted ISG/Base Seasonal Average

(9) Weighted ISG/Base-Seasonal Avg: 33% of column (2) plus 67% of column (8).
(10) Allocation Factors: Each agency's proportionate share of column (9).
(11) Weighted Shortage Allocation: Column (9) times the available water supply (column (5) total).
(12) Weighted Purchase Cutback: The change between column (11) and column (1) shown as a percentage.

Second San Jose/Santa Clara Adjustment: This adjustment is made so that Santa Clara's and San José's cutbacks are at least as great as the highest cutback by the permanent customers.

(13) Subtotal Allocation Factors: The ratio of each permanent agency's column (11) allocation to the column (11) subtotal.
(14) Adjusted Weighted Shortage Allocation: Redistributes "Second SJ/SC Adjustment" line 4 value among the permanent customers based on the proportionate shares in column (13).
(15) Adjusted Weighted Purchase Cutback: The change between column (14) and column (1).

Column Notes

Adjustment for Minimum Cutback: This adjustment forces a 10% minimum cutback with the reallocated water being placed in a hardship bank for later application to East Palo Alto.

(16) Adjusted for 10% Minimum Cutback: Decreases any percentage cutback in column (15) that is less than the minimum 10% floor to equal the 10% floor.
(17) Additional Cutback for Hardship Bank: The difference between column (15) and column (16) times column (1).

Adjustment for Maximum Cutback: This adjustment is made so that the maximum cutback applied to any agency is equal to the Overall Average BAWSCA Reduction + 20%.

(18) Adjusted for Maximun Cutback: Caps the cutbacks in column (18) to no more than 20% more than the average cutback.
(19) Cutback Over Cap: The difference between column (18) and column (15) times column (1).
(20) Allocations Adjusted for Cap: Purchases in column (1) reduced by the cutbacks in column (18).
(21) Agencies to Which Cutback Over Cap is Redistributed: Agencies that are not subject to the minimum or maximum adjustments in columns (17) and (19).
(22) Minimum/Maximum Adjusted Allocation: Redistributes the excess cutback in column (19) by the proportions in column (21) to agencies shown in column (21).
(23) Adjusted Minn/Max Purchase Cutbacks: The change between column (22) and column (1) shown as a percentage.

Adjustment for East Palo Alto (Low Residential Gallons per Capita per Day Adjustment)

(24) Residential Per Capita Usage: From Tab 1.
(25) Agencies To Which EPA Adjustment Applies: Column (22) agency allocations, except those whose GPCD is less than 55 GPCD & those who are impacted by the min./max. cutback .
(26) Share of EPA Adjustment: EPA value equal to difference 50% of the Overall Average Wholesale Customer Reduction and the sum of column (17) total (Hardship Bank value) and EPA allocation in column (22). Indivdiual agency proportionate shares of EPA's adjustment based on column (25).
(27) Allocation with EPA Adjustment: Column (22) plus column (26).

Final Allocations

(28) Final Purchase Cutback: Column (27) minus column (1) expressed as MGD
(29) Final Purchase Cutback: The change between column (31) and column (1) shown as a percentage.
(30) Final Allocation Factor: Each agency's allocation from Column (27) divided by the total water allocated to the wholesale agencies (total in Column (27)), shown as a percentage

TABLE A-5: 2035 CALCULATION OF FINAL PURCHASE CUTBACK AND ALLOCATION FACTOR FOR TIER 2 DROUGHT IMPLEMENTATION PLAN (DRIP)

Overall Average Wholesale Customer Reduction: 28.86%

Base = 10.00%
Seasonal = 66.35%

Weighted average for Column 10:
0.33 =ISG component (Col. 2)
0.67 =Base/Seasonal component (Col. 9)

Variable component - Base/Seasonal Allocation (with ISG cap)
Minimum (Column 16) = 10.00%
Ceiling (Col. 18) = avg. cutback + 20.00%

Minimum residential per capita use threshold (Column 25) = 55.00 gpcpd

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
	Agency Information		Initial Allocations Based on Weighted Fixed (ISG) and Variable (Base/Seasonal) Components Adjusting for SJ/SC												
			Base/Seasonal Allocations				1st SJ/SC Adjustment		Weighted Allocation				2nd SJ/SC Adjustment		
Wholesale Customers	2035 SFPUC Purchases	Fixed Comp.	Lesser of Purchase or ISG	Base/ Seasonal Allocation Cutback	Base/ Seasonal Allocation	Base/ Seasonal Purchase Cutback	Subtotal Allocation Factors	Adjusted Base/Seasonal Allocation	Weighted ISG-Base/ Seasonal Avg	Allocation Factors	Weighted Shortage Allocation	Weighted Purchase Cutback	Subtotal Allocation Factors	Adjusted Weighted Shortage Allocation	Adjusted Weighted Purchase Cutback
ACWD	13.76	13.76	13.76	-26.84%	10.07	-26.85%	8.01%	10.20	11.38	7.42%	9.82	-28.63%	7.74%	9.82	-28.61%
Brisbane/GVMID	1.04	0.98	0.98	-27.84%	0.71	-32.00%	0.56%	0.72	0.80	0.52%	0.69	-33.30%	0.55%	0.69	-33.28%
Burlingame	5.22	5.23	5.22	-22.77%	4.03	-22.77%	3.21%	4.08	4.46	2.91%	3.85	-26.14%	3.03%	3.85	-26.12%
Coastside	1.80	2.18	1.80	-13.23%	1.56	-13.23%	1.24%	1.58	1.78	1.16%	1.54	-14.63%	1.21%	1.54	-14.61%
CWS Total	35.68	35.68	35.68	-29.31%	25.22	-29.31%	20.07%	25.57	28.90	18.84%	24.95	-30.07%	19.65%	24.96	-30.05%
Daly City	4.29	4.29	4.29	-13.74%	3.70	-13.74%	2.95%	3.75	3.93	2.56%	3.39	-20.95%	2.67%	3.39	-20.93%
East Palo Alto	1.96	1.96	1.96	-21.35%	1.54	-21.48%	1.23%	1.56	1.69	1.10%	1.46	-25.52%	1.15%	1.46	-25.50%
Estero	5.40	5.90	5.40	-27.92%	3.89	-27.92%	3.10%	3.95	4.59	2.99%	3.96	-26.62%	3.12%	3.96	-26.60%
Hayward	30.50	25.11	25.11	-23.28%	19.27	-36.83%	15.33%	19.53	21.37	13.93%	18.45	-39.52%	14.53%	18.45	-39.50%
Hillsborough	2.94	4.09	2.94	-43.97%	1.65	-43.97%	1.31%	1.67	2.47	1.61%	2.13	-27.56%	1.68%	2.13	-27.53%
Menlo Park	2.60	4.46	2.60	-32.66%	1.75	-32.66%	1.39%	1.77	2.66	1.73%	2.30	-11.66%	1.81%	2.30	-11.63%
Mid Pen WD	3.80	3.89	3.80	-25.85%	2.82	-25.85%	2.24%	2.86	3.20	2.08%	2.76	-27.36%	2.17%	2.76	-27.34%
Millbrae	3.02	3.15	3.02	-22.59%	2.34	-22.59%	1.86%	2.37	2.63	1.71%	2.27	-24.89%	1.79%	2.27	-24.87%
Milpitas	8.80	9.23	8.80	-21.64%	6.90	-21.64%	5.49%	6.99	7.73	5.04%	6.67	-24.19%	5.26%	6.67	-24.16%
Mountain View	11.29	13.46	11.29	-28.39%	8.08	-28.39%	6.43%	8.19	9.93	6.47%	8.57	-24.06%	6.75%	8.58	-24.04%
North Coast	3.32	3.84	3.32	-19.10%	2.69	-19.10%	2.14%	2.72	3.09	2.01%	2.67	-19.64%	2.10%	2.67	-19.62%
Palo Alto	13.47	17.07	13.47	-31.35%	9.25	-31.35%	7.36%	9.37	11.91	7.77%	10.28	-23.65%	8.10%	10.29	-23.62%
Purissima Hills	1.62	1.62	1.62	-43.45%	0.92	-43.45%	0.73%	0.93	1.16	0.76%	1.00	-38.28%	0.79%	1.00	-38.26%
Redwood City	10.79	10.93	10.79	-26.99%	7.88	-26.99%	6.27%	7.99	8.96	5.84%	7.73	-28.35%	6.09%	7.73	-28.33%
San Bruno	3.03	3.25	3.03	-23.33%	2.32	-23.33%	1.85%	2.36	2.65	1.73%	2.29	-24.56%	1.80%	2.29	-24.54%
Stanford	3.03	3.03	3.03	-34.73%	1.98	-34.73%	1.57%	2.00	2.34	1.53%	2.02	-33.22%	1.59%	2.02	-33.21%
Sunnyvale	8.93	12.58	8.93	-27.82%	6.45	-27.82%	5.13%	6.53	8.53	5.56%	7.36	-17.56%	5.80%	7.36	-17.54%
Westborough	0.84	1.32	0.84	-20.93%	0.66	-20.93%	0.53%	0.67	0.89	0.58%	0.77	-8.89%	0.60%	0.77	-8.86%
Subtotal	177.13		177.13	-26.38%	125.66	-29.06%	100.00%	127.38	147.06		126.94	-28.34%	100.00%	126.98	-28.32%
San José	4.50	4.50	4.50	-26.94%	3.29	-26.94%		2.52	3.17	2.07%	2.74	-39.11%		2.72	-39.52%
Santa Clara	4.50	4.50	4.50	-22.80%	3.47	-22.80%		2.52	3.17	2.07%	2.74	-39.11%		2.72	-39.52%
Total	186.13		186.13	-26.09%	132.42	-28.86%		132.42	153.41	100.00%	132.42	-28.86%		132.42	-28.86%

	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)
	Adjustment for Minimum and Maximum Cutbacks								Adjustment for East Palo Alto						
	Minimum Cutback Adj.		Maximum Cutback Adjustment												
Wholesale Customers	Adjusted for 10.00% Minimum Cutback	Add'l Cutback for Hardship Bank	Adjusted for 48.86% Maximum Cutback	Cutback Over Cap	Allocations Adjusted For Cap	Agencies To Which Cutback Over Cap Is Redistributed	Min/Max Adjusted Allocation	Adj. Min/Max Purchase Cutbacks	2035 Residential Per Capita	Agencies To Which EPA Adjustment Applies	Share of EPA Adjustment	Allocations With EPA Adjustments	Final Purchase Cutback		Final Allocation Factor
ACWD	-28.61%		-28.61%		9.82	9.82	9.82	-28.61%	86.47	9.82	-0.02	9.81	-3.95	-28.73%	7.41%
Brisbane/GVMID	-33.28%		-33.28%		0.69	0.69	0.69	-33.28%	67.26	0.69	0.00	0.69	-0.35	-33.39%	0.52%
Burlingame	-26.12%		-26.12%		3.85	3.85	3.85	-26.12%	93.19	3.85	-0.01	3.85	-1.37	-26.24%	2.91%
Coastside	-14.61%		-14.61%		1.54	1.54	1.54	-14.61%	66.26	1.54	0.00	1.53	-0.27	-14.75%	1.16%
CWS Total	-30.05%		-30.05%		24.96	24.96	24.96	-30.05%	100.77	24.96	-0.04	24.92	-10.76	-30.17%	18.82%
Daly City	-20.93%		-20.93%		3.39	3.39	3.39	-20.93%	48.15			3.39	-0.90	-20.93%	2.56%
East Palo Alto	-25.50%		-25.50%		1.46	1.46	1.462	-25.50%	61.98	1.46	0.21	1.68	-0.28	-14.43%	1.27%
Estero	-26.60%		-26.60%		3.96	3.96	3.96	-26.60%	85.73	3.96	-0.01	3.96	-1.44	-26.72%	2.99%
Hayward	-39.50%		-39.50%		18.45	18.45	18.45	-39.50%	84.07	18.45	-0.03	18.42	-12.08	-39.60%	13.91%
Hillsborough	-27.53%		-27.53%		2.13	2.13	2.13	-27.53%	251.75	2.13	0.00	2.13	-0.81	-27.65%	1.61%
Menlo Park	-11.63%		-11.63%		2.30	2.30	2.30	-11.63%	69.02	2.30	0.00	2.29	-0.31	-11.78%	1.73%
Mid Pen WD	-27.34%		-27.34%		2.76	2.76	2.76	-27.34%	97.98	2.76	0.00	2.76	-1.04	-27.46%	2.08%
Millbrae	-24.87%		-24.87%		2.27	2.27	2.27	-24.87%	75.07	2.27	0.00	2.27	-0.75	-25.00%	1.71%
Milpitas	-24.16%		-24.16%		6.67	6.67	6.67	-24.16%	69.84	6.67	-0.01	6.66	-2.14	-24.29%	5.03%
Mountain View	-24.04%		-24.04%		8.58	8.58	8.58	-24.04%	74.28	8.58	-0.01	8.56	-2.73	-24.16%	6.47%
North Coast	-19.62%		-19.62%		2.67	2.67	2.67	-19.62%	57.23	2.67	0.00	2.66	-0.66	-19.75%	2.01%
Palo Alto	-23.62%		-23.62%		10.29	10.29	10.29	-23.62%	86.25	10.29	-0.02	10.27	-3.20	-23.75%	7.76%
Purissima Hills	-38.26%		-38.26%		1.00	1.00	1.00	-38.26%	263.14	1.00	0.00	1.00	-0.62	-38.36%	0.75%
Redwood City	-28.33%		-28.33%		7.73	7.73	7.73	-28.33%	71.39	7.73	-0.01	7.72	-3.07	-28.45%	5.83%
San Bruno	-24.54%		-24.54%		2.29	2.29	2.29	-24.54%	63.89	2.29	0.00	2.28	-0.75	-24.66%	1.73%
Stanford	-33.21%		-33.21%		2.02	2.02	2.02	-33.21%	N/A	2.02	0.00	2.02	-1.01	-33.32%	1.53%
Sunnyvale	-17.54%		-17.54%		7.36	7.36	7.36	-17.54%	77.94	7.36	-0.01	7.35	-1.58	-17.67%	5.55%
Westborough	-10.00%	-0.010	-10.00%		0.76		0.76	-10.00%	42.93			0.76	-0.08	-10.00%	0.57%
Subtotal	-28.32%		-28.32%		126.97	126.21	126.97	-28.32%		122.82		126.98	-50.15	-28.31%	
San José	-39.52%		-39.52%		2.72	2.72	2.72	-39.52%	22.14			2.72	-1.78	-39.52%	2.06%
Santa Clara	-39.52%		-39.52%		2.72	2.72	2.72	-39.52%	72.26	2.72	0.00	2.72	-1.78	-39.62%	2.05%
Total	-28.86%	-0.010	-28.86%		132.41	131.65	132.41	-28.86%		125.54	0.00	132.42	-53.71	-28.86%	100.00%

First SJ/SC Adjustment

1. Largest permanent customer cutback:	-43.97%	
2a. Adjusted SC allocation:	2.52	(Applying largest permanent customer cutback)
2b. Santa Clara adjustment:	-0.95	(Difference between initial and adjusted alloc.)
3a. Adjusted SJ allocation:	2.52	(Applying largest permanent customer cutback)
3b. San José adjustment:	-0.77	(Difference between initial and adjusted alloc.)
4. Total Adjustment:	-1.72	(2b + 3b)

Second SJ/SC Adjustment

1. Largest permanent customer cutba	-39.52%
2a. Adjusted SC allocation:	2.72
2b. Santa Clara adjustment:	-0.02
3a. Adjusted SJ allocation:	2.72
3b. San José adjustment:	-0.02
4. Total Adjustment:	-0.04

****All values in MGD unless noted otherwise***

Column Notes

Agency Information

(1) SFPUC Purchases: From Tab 1.
(2) Fixed Component: Individual Supply Guarantees for most agencies from Tab 1; 4.5 mgd for SJ & SC; projected 2018 demand before conservation used as surrogate for Hayward

Base/Seasonal Allocations

(3) Lesser of Purchase or ISG: The lesser of column (1) or column (2).
(4) Base/Seasonal Allocation Cutback: From Tab 3, column (17).
(5) Base/Seasonal Allocation: column (3) reduced by the Base/Seasonal cutback in column (4).
(6) Base/Seasonal Purchase Cutback: The change between column (5) and column (1) shown as a percentage.

First San Jose/Santa Clara Adjustment: This adjustment is made so that Santa Clara's and San José's cutbacks are at least as great as the highest cutback by the permanent customers.

(7) Subtotal Allocation Factors: The ratio of each permanent agency's column (5) allocation to the column (5) subtotal.
(8) Adjusted Base/Seasonal Allocation: Redistributes "First SJ/SC Adjustment" line 4 value among the permanent customers based on the proportionate shares in column (8).

Allocations Based on Weighted ISG/Base Seasonal Average

(9) Weighted ISG/Base-Seasonal Avg: 33% of column (2) plus 67% of column (8).
(10) Allocation Factors: Each agency's proportionate share of column (9).
(11) Weighted Shortage Allocation: Column (9) times the available water supply (column (5) total).
(12) Weighted Purchase Cutback: The change between column (11) and column (1) shown as a percentage.

Second San Jose/Santa Clara Adjustment: This adjustment is made so that Santa Clara's and San José's cutbacks are at least as great as the highest cutback by the permanent customers.

(13) Subtotal Allocation Factors: The ratio of each permanent agency's column (11) allocation to the column (11) subtotal.
(14) Adjusted Weighted Shortage Allocation: Redistributes "Second SJ/SC Adjustment" line 4 value among the permanent customers based on the proportionate shares in column (13).
(15) Adjusted Weighted Purchase Cutback: The change between column (14) and column (1).

Column Notes

Adjustment for Minimum Cutback: This adjustment forces a 10% minimum cutback with the reallocated water being placed in a hardship bank for later application to East Palo Alto.

(16) Adjusted for 10% Minimum Cutback: Decreases any percentage cutback in column (15) that is less than the minimum 10% floor to equal the 10% floor.
(17) Additional Cutback for Hardship Bank: The difference between column (15) and column (16) times column (1).

Adjustment for Maximum Cutback: This adjustment is made so that the maximum cutback applied to any agency is equal to the Overall Average BAWSCA Reduction + 20%.

(18) Adjusted for Maximun Cutback: Caps the cutbacks in column (18) to no more than 20% more than the average cutback.
(19) Cutback Over Cap: The difference between column (18) and column (15) times column (1).
(20) Allocations Adjusted for Cap: Purchases in column (1) reduced by the cutbacks in column (18).
(21) Agencies to Which Cutback Over Cap is Redistributed: Agencies that are not subject to the minimum or maximum adjustments in columns (17) and (19).
(22) Minimum/Maximum Adjusted Allocation: Redistributes the excess cutback in column (19) by the proportions in column (21) to agencies shown in column (21).
(23) Adjusted Minm/Max Purchase Cutbacks: The change between column (22) and column (1) shown as a percentage.

Adjustment for East Palo Alto (Low Residential Gallons per Capita per Day Adjustment)

(24) Residential Per Capita Usage: From Tab 1.
(25) Agencies To Which EPA Adjustment Applies: Column (22) agency allocations, except those whose GPCD is less than 55 GPCD & those who are impacted by the min./max. cutback .
(26) Share of EPA Adjustment: EPA value equal to difference 50% of the Overall Average Wholesale Customer Reduction and the sum of column (17) total (Hardship Bank value) and EPA allocation in column (22). Indivdiual agency proportionate shares of EPA's adjustment based on column (25).
(27) Allocation with EPA Adjustment: Column (22) plus column (26).

Final Allocations

(28) Final Purchase Cutback: Column (27) minus column (1) expressed as MGD
(29) Final Purchase Cutback: The change between column (31) and column (1) shown as a percentage.
(30) Final Allocation Factor: Each agency's allocation from Column (27) divided by the total water allocated to the wholesale agencies (total in Column (27)), shown as a percentage

TABLE B-1: 2015 CALCULATION OF FINAL PURCHASE CUTBACK AND ALLOCATION FACTOR FOR TIER 2 DROUGHT IMPLEMENTATION PLAN (DRIP)

Overall Average Wholesale Customer Reduction: 27.00%

Base = 10.00%
Seasonal = 66.65%

Weighted average for Column 10:
0.33 =ISG component (Col. 2)
0.67 =Base/Seasonal component (Col. 9)

Variable component - Base/Seasonal Allocation (with ISG cap)
Minimum (Column 16) = 10.00%
Ceiling (Col. 18) = avg. cutback + 20.00%

Minimum residential per capita use threshold (Column 25) = 55.00 gpcpd

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
	Agency Information		Initial Allocations Based on Weighted Fixed (ISG) and Variable (Base/Seasonal) Components Adjusting for SJ/SC												
			Base/Seasonal Allocations				1st SJ/SC Adjustment		Weighted Allocation				2nd SJ/SC Adjustment		
Wholesale Customers	2015 SFPUC Purchases	Fixed Comp.	Lesser of Purchase or ISG	Base/ Seasonal Allocation Cutback	Base/ Seasonal Allocation	Base/ Seasonal Purchase Cutback	Subtotal Allocation Factors	Adjusted Base/Seasonal Allocation	Weighted ISG-Base/ Seasonal Avg	Allocation Factors	Weighted Shortage Allocation	Weighted Purchase Cutback	Subtotal Allocation Factors	Adjusted Weighted Shortage Allocation	Adjusted Weighted Purchase Cutback
ACWD	13.76	13.76	13.76	-27.64%	9.96	-27.64%	8.44%	10.10	11.31	7.63%	9.52	-30.84%	7.97%	9.52	-30.84%
Brisbane/GVMID	0.95	0.98	0.95	-27.94%	0.68	-27.94%	0.58%	0.69	0.79	0.53%	0.66	-30.12%	0.56%	0.66	-30.12%
Burlingame	4.90	5.23	4.90	-22.84%	3.78	-22.84%	3.21%	3.84	4.30	2.90%	3.62	-26.20%	3.03%	3.62	-26.20%
Coastside	1.76	2.18	1.76	-12.90%	1.53	-12.90%	1.30%	1.55	1.76	1.19%	1.48	-15.72%	1.24%	1.48	-15.72%
CWS Total	35.04	35.68	35.04	-29.66%	24.65	-29.66%	20.89%	25.01	28.53	19.24%	24.01	-31.48%	20.10%	24.01	-31.48%
Daly City	4.29	4.29	4.29	-13.79%	3.70	-13.79%	3.14%	3.76	3.93	2.65%	3.31	-22.91%	2.77%	3.31	-22.91%
East Palo Alto	1.96	1.96	1.96	-21.42%	1.54	-21.54%	1.31%	1.56	1.69	1.14%	1.43	-27.38%	1.19%	1.43	-27.38%
Estero	5.67	5.90	5.67	-28.02%	4.08	-28.02%	3.46%	4.14	4.72	3.18%	3.97	-29.92%	3.33%	3.97	-29.92%
Hayward	21.90	25.11	21.90	-23.35%	16.79	-23.35%	14.23%	17.04	19.70	13.29%	16.58	-24.31%	13.88%	16.58	-24.31%
Hillsborough	3.14	4.09	3.14	-44.15%	1.75	-44.15%	1.48%	1.78	2.54	1.71%	2.14	-31.84%	1.79%	2.14	-31.84%
Menlo Park	3.00	4.46	3.00	-32.78%	2.02	-32.78%	1.71%	2.05	2.84	1.92%	2.39	-20.26%	2.00%	2.39	-20.26%
Mid Pen WD	3.55	3.89	3.55	-25.93%	2.63	-25.93%	2.23%	2.67	3.07	2.07%	2.59	-27.18%	2.16%	2.59	-27.18%
Millbrae	2.62	3.15	2.62	-22.66%	2.03	-22.66%	1.72%	2.06	2.42	1.63%	2.03	-22.35%	1.70%	2.03	-22.35%
Milpitas	7.07	9.23	7.07	-22.34%	5.49	-22.34%	4.65%	5.57	6.78	4.57%	5.70	-19.32%	4.78%	5.70	-19.32%
Mountain View	9.85	13.46	9.85	-28.70%	7.03	-28.70%	5.96%	7.13	9.22	6.22%	7.76	-21.27%	6.50%	7.76	-21.27%
North Coast	3.06	3.84	3.06	-19.14%	2.47	-19.14%	2.10%	2.51	2.95	1.99%	2.48	-18.91%	2.08%	2.48	-18.91%
Palo Alto	12.73	17.07	12.73	-31.47%	8.72	-31.47%	7.39%	8.85	11.57	7.80%	9.73	-23.53%	8.15%	9.73	-23.53%
Purissima Hills	1.62	1.62	1.62	-43.63%	0.91	-43.63%	0.77%	0.93	1.16	0.78%	0.97	-39.90%	0.82%	0.97	-39.90%
Redwood City	10.22	10.93	10.22	-27.08%	7.45	-27.08%	6.32%	7.56	8.67	5.85%	7.30	-28.59%	6.11%	7.30	-28.59%
San Bruno	2.30	3.25	2.30	-21.87%	1.80	-21.87%	1.52%	1.82	2.29	1.55%	1.93	-16.13%	1.62%	1.93	-16.13%
Stanford	2.70	3.03	2.70	-34.86%	1.76	-34.86%	1.49%	1.78	2.20	1.48%	1.85	-31.54%	1.55%	1.85	-31.54%
Sunnyvale	8.93	12.58	8.93	-27.21%	6.50	-27.21%	5.51%	6.60	8.57	5.78%	7.21	-19.24%	6.04%	7.21	-19.24%
Westborough	0.89	1.32	0.89	-20.98%	0.70	-20.98%	0.60%	0.71	0.91	0.62%	0.77	-13.62%	0.64%	0.77	-13.62%
Subtotal	161.91		161.91	-26.87%	117.97	-27.14%	100.00%	119.73	141.94		119.43	-26.24%	100.00%	119.43	-26.24%
San José	4.50	4.50	4.50	-27.03%	3.28	-27.03%		2.51	3.17	2.14%	2.67	-40.75%		2.67	-40.75%
Santa Clara	4.50	4.50	4.50	-22.13%	3.50	-22.13%		2.51	3.17	2.14%	2.67	-40.75%		2.67	-40.75%
Total	170.91		170.91	-26.49%	124.76	-27.00%		124.76	148.27	100.00%	124.76	-27.00%		124.76	-27.00%

	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)
	Adjustment for Minimum and Maximum Cutbacks														
	Minimum Cutback Adj.		Maximum Cutback Adjustment						Adjustment for East Palo Alto						
Wholesale Customers	Adjusted for 10.00% Minimum Cutback	Add'l Cutback for Hardship Bank	Adjusted for 47.00% Maximum Cutback	Cutback Over Cap	Allocations Adjusted For Cap	Agencies To Which Cutback Over Cap Is Redistributed	Min/Max Adjusted Allocation	Adj. Min/Max Purchase Cutbacks	2015 Residential Per Capita	Agencies To Which EPA Adjustment Applies	Share of EPA Adjustment	Allocations With EPA Adjustments	Final Purchase Cutback		Final Allocation Factor
ACWD	-30.84%		-30.84%		9.52	9.52	9.52	-30.84%	84.36	9.52	-0.02	9.50	-4.26	-31.00%	7.61%
Brisbane/GVMID	-30.12%		-30.12%		0.66	0.66	0.66	-30.12%	83.76	0.66	0.00	0.66	-0.29	-30.28%	0.53%
Burlingame	-26.20%		-26.20%		3.62	3.62	3.62	-26.20%	98.49	3.62	-0.01	3.61	-1.29	-26.37%	2.89%
Coastside	-15.72%		-15.72%		1.48	1.48	1.48	-15.72%	74.49	1.48	0.00	1.48	-0.28	-15.91%	1.18%
CWS Total	-31.48%		-31.48%		24.01	24.01	24.01	-31.48%	109.22	24.01	-0.06	23.95	-11.09	-31.64%	19.20%
Daly City	-22.91%		-22.91%		3.31	3.31	3.31	-22.91%	49.76			3.31	-0.98	-22.91%	2.65%
East Palo Alto	-27.38%		-27.38%		1.43	1.43	1.426	-27.38%	61.95	1.43	0.27	1.70	-0.27	-13.50%	1.36%
Estero	-29.92%		-29.92%		3.97	3.97	3.97	-29.92%	95.20	3.97	-0.01	3.96	-1.71	-30.08%	3.18%
Hayward	-24.31%		-24.31%		16.58	16.58	16.58	-24.31%	71.61	16.58	-0.04	16.54	-5.36	-24.48%	13.26%
Hillsborough	-31.84%		-31.84%		2.14	2.14	2.14	-31.84%	271.59	2.14	0.00	2.13	-1.00	-31.99%	1.71%
Menlo Park	-20.26%		-20.26%		2.39	2.39	2.39	-20.26%	86.46	2.39	-0.01	2.39	-0.61	-20.44%	1.91%
Mid Pen WD	-27.18%		-27.18%		2.59	2.59	2.59	-27.18%	99.75	2.59	-0.01	2.58	-0.97	-27.35%	2.07%
Millbrae	-22.35%		-22.35%		2.03	2.03	2.03	-22.35%	76.94	2.03	0.00	2.03	-0.59	-22.52%	1.63%
Milpitas	-19.32%		-19.32%		5.70	5.70	5.70	-19.32%	60.45	5.70	-0.01	5.69	-1.38	-19.50%	4.56%
Mountain View	-21.27%		-21.27%		7.76	7.76	7.76	-21.27%	77.11	7.76	-0.02	7.74	-2.11	-21.45%	6.20%
North Coast	-18.91%		-18.91%		2.48	2.48	2.48	-18.91%	56.19	2.48	-0.01	2.48	-0.58	-19.09%	1.98%
Palo Alto	-23.53%		-23.53%		9.73	9.73	9.73	-23.53%	103.40	9.73	-0.02	9.71	-3.02	-23.71%	7.78%
Purissima Hills	-39.90%		-39.90%		0.97	0.97	0.97	-39.90%	251.68	0.97	0.00	0.97	-0.65	-40.04%	0.78%
Redwood City	-28.59%		-28.59%		7.30	7.30	7.30	-28.59%	72.38	7.30	-0.02	7.28	-2.94	-28.75%	5.84%
San Bruno	-16.13%		-16.13%		1.93	1.93	1.93	-16.13%	67.04	1.93	0.00	1.93	-0.38	-16.32%	1.54%
Stanford	-31.54%		-31.54%		1.85	1.85	1.85	-31.54%	N/A	1.85	0.00	1.84	-0.86	-31.70%	1.48%
Sunnyvale	-19.24%		-19.24%		7.21	7.21	7.21	-19.24%	77.91	7.21	-0.02	7.19	-1.74	-19.43%	5.77%
Westborough	-13.62%		-13.62%		0.77	0.77	0.77	-13.62%	45.38			0.77	-0.12	-13.62%	0.62%
Subtotal	-26.24%		-26.24%		119.43	119.43	119.43	-26.24%		115.35		119.44	-42.47	-26.23%	
San José	-40.75%		-40.75%		2.67	2.67	2.67	-40.75%	49.45			2.67	-1.83	-40.75%	2.14%
Santa Clara	-40.75%		-40.75%		2.67	2.67	2.67	-40.75%	70.20	2.67	-0.01	2.66	-1.84	-40.89%	2.13%
Total	-27.00%		-27.00%		124.76	124.76	124.76	-27.00%		118.02	0.00	124.76	-46.15	-27.00%	100.00%

First SJ/SC Adjustment

1. Largest permanent customer cutback:	-44.15%	
2a. Adjusted SC allocation:	2.51	(Applying largest permanent customer cutback)
2b. Santa Clara adjustment:	-0.99	(Difference between initial and adjusted alloc.)
3a. Adjusted SJ allocation:	2.51	(Applying largest permanent customer cutback)
3b. San José adjustment:	-0.77	(Difference between initial and adjusted alloc.)
4. Total Adjustment:	-1.76	(2b + 3b)

Second SJ/SC Adjustment

1. Largest permanent customer cutba	-39.90%
2a. Adjusted SC allocation:	2.70
2b. Santa Clara adjustment:	
3a. Adjusted SJ allocation:	2.70
3b. San José adjustment:	
4. Total Adjustment:	

0.003

*****All values in MGD unless noted otherwise***

Column Notes

Agency Information

(1) SFPUC Purchases: From Tab 1.

(2) Fixed Component: Individual Supply Guarantees for most agencies from Tab 1; 4.5 mgd for SJ & SC; projected 2018 demand before conservation used as surrogate for Hayward

Base/Seasonal Allocations

(3) Lesser of Purchase or ISG: The lesser of column (1) or column (2).

(4) Base/Seasonal Allocation Cutback: From Tab 3, column (17).

(5) Base/Seasonal Allocation: column (3) reduced by the Base/Seasonal cutback in column (4).

(6) Base/Seasonal Purchase Cutback: The change between column (5) and column (1) shown as a percentage.

First San Jose/Santa Clara Adjustment: This adjustment is made so that Santa Clara's and San José's cutbacks are at least as great as the highest cutback by the permanent customers.

(7) Subtotal Allocation Factors: The ratio of each permanent agency's column (5) allocation to the column (5) subtotal.

(8) Adjusted Base/Seasonal Allocation: Redistributes "First SJ/SC Adjustment" line 4 value among the permanent customers based on the proportionate shares in column (8).

Allocations Based on Weighted ISG/Base Seasonal Average

(9) Weighted ISG/Base-Seasonal Avg: 33% of column (2) plus 67% of column (8).

Allocation Factors: Each agency's proportionate share of column (9).

Weighted Shortage Allocation: Column (9) times the available water supply (column (5) total).

Weighted Purchase Cutback: The change between column (11) and column (1) shown as a percentage.

Second San Jose/Santa Clara Adjustment: This adjustment is made so that Santa Clara's and San José's cutbacks are at least as great as the highest cutback by the permanent customers.

Subtotal Allocation Factors: The ratio of each permanent agency's column (11) allocation to the column (11) subtotal.

Adjusted Weighted Shortage Allocation: Redistributes "Second SJ/SC Adjustment" line 4 value among the permanent customers based on the proportionate shares in column (13).

Column Notes

Adjustment for Minimum Cutback: This adjustment forces a 10% minimum cutback with the reallocated water being placed in a hardship bank for later application to East Palo Alto.

(16) Adjusted for 10% Minimum Cutback: Decreases any percentage cutback in column (15) that is less than the minimum 10% floor to equal the 10% floor.

(17) Additional Cutback for Hardship Bank: The difference between column (15) and column (16) times column (1).

Adjustment for Maximum Cutback: This adjustment is made so that the maximum cutback applied to any agency is equal to the Overall Average BAWSCA Reduction + 20%.

(18) Adjusted for Maximum Cutback: Caps the cutbacks in column (18) to no more than 20% more than the average cutback.

(19) Cutback Over Cap: The difference between column (18) and column (15) times column (1).

(20) Allocations Adjusted for Cap: Purchases in column (1) reduced by the cutbacks in column (18).

(21) Agencies to Which Cutback Over Cap is Redistributed: Agencies that are not subject to the minimum or maximum adjustments in columns (17) and (19).

(22) Minimum/Maximum Adjusted Allocation: Redistributes the excess cutback in column (19) by the proportions in column (21) to agencies shown in column (21).

(23) Adjusted Minm/Max Purchase Cutbacks: The change between column (22) and column (1) shown as a percentage.

Adjustment for East Palo Alto (Low Residential Gallons per Capita per Day Adjustment)

(24) Residential Per Capita Usage: From Tab 1.

(25) Agencies To Which EPA Adjustment Applies: Column (22) agency allocations, except those whose GPCD is less than 55 GPCD & those who are impacted by the min./max. cutback .

(26) Share of EPA Adjustment: EPA value equal to difference 50% of the Overall Average Wholesale Customer Reduction and the sum of column (17) total (Hardship Bank value) and EPA allocation in column (22). Indivdiual agency proportionate shares of EPA's adjustment based on column (25).

(27) Allocation with EPA Adjustment: Column (22) plus column (26).

Final Allocations

(28) Final Purchase Cutback: Column (27) minus column (1) expressed as MGD

(29) Final Purchase Cutback: The change between column (31) and column (1) shown as a percentage.

(30) Final Allocation Factor: Each agency's allocation from Column (27) divided by the total water allocated to the wholesale agencies (total in Column (27)), shown as a percentage

TABLE B-2: 2020 CALCULATION OF FINAL PURCHASE CUTBACK AND ALLOCATION FACTOR FOR TIER 2 DROUGHT IMPLEMENTATION PLAN (DRIP)

Overall Average Wholesale Customer Reduction: 26.29%

Base = 10.00%
Seasonal = 64.27%

Weighted average for Column 10:
0.33 =ISG component (Col. 2)
0.67 =Base/Seasonal component (Col. 9)

Variable component - Base/Seasonal Allocation (with ISG cap)
Minimum (Column 16) = 10.00%
Ceiling (Col. 18) = avg. cutback + 20.00%

Minimum residential per capita use threshold (Column 25) = 55.00 gpcpd

Wholesale Customers	(1) Agency Information: 2020 SFPUC Purchases	(2) Fixed Comp.	(3) Base/Seasonal Allocations: Lesser of Purchase or ISG	(4) Base/Seasonal Allocation Cutback	(5) Base/Seasonal Allocation	(6) Base/Seasonal Purchase Cutback	(7) 1st SJ/SC Adjustment: Subtotal Allocation Factors	(8) Adjusted Base/Seasonal Allocation	(9) Weighted Allocation: Weighted ISG-Base/Seasonal Avg	(10) Allocation Factors	(11) Weighted Shortage Allocation	(12) Weighted Purchase Cutback	(13) 2nd SJ/SC Adjustment: Subtotal Allocation Factors	(14) Adjusted Weighted Shortage Allocation	(15) Adjusted Weighted Purchase Cutback	(16) Minimum Cutback Adj.: Adjusted for 10.00% Minimum Cutback	(17) Add'l Cutback for Hardship Bank	(18) Maximum Cutback Adjustment: Adjusted for 46.29% Maximum Cutback	(19) Cutback Over Cap	(20) Allocations Adjusted For Cap	(21) Agencies To Which Cutback Over Cap Is Redistributed	(22) Min/Max Adjusted Allocation	(23) Adj. Min/Max Purchase Cutbacks	(24) Adjustment for East Palo Alto: 2020 Residential Per Capita	(25) Agencies To Which EPA Adjustment Applies	(26) Share of EPA Adjustment	(27) Allocations With EPA Adjustments	(28) Final Purchase Cutback	(29) Final Purchase Cutback	(30) Final Allocation Factor
ACWD	13.76	13.76	13.76	-26.64%	10.09	-26.64%	8.46%	10.09	11.30	7.98%	9.52	-30.83%	7.98%	9.52	-30.83%	-30.83%		-30.83%		9.52	9.52	9.52	-30.83%	86.08	9.52	-0.02	9.49	-4.27	-31.00%	7.96%
Brisbane/GVMID	0.98	0.98	0.98	-27.19%	0.71	-27.41%	0.60%	0.71	0.80	0.57%	0.67	-31.34%	0.57%	0.67	-31.34%	-31.34%		-31.34%		0.67	0.67	0.67	-31.34%	80.93	0.67	0.00	0.67	-0.31	-31.52%	0.56%
Burlingame	4.97	5.23	4.97	-22.30%	3.86	-22.30%	3.24%	3.86	4.31	3.04%	3.63	-26.87%	3.04%	3.63	-26.87%	-26.87%		-26.87%		3.63	3.63	3.63	-26.87%	96.66	3.63	-0.01	3.62	-1.34	-27.05%	3.04%
Coastside	1.70	2.18	1.70	-12.27%	1.49	-12.27%	1.25%	1.49	1.72	1.21%	1.45	-14.89%	1.21%	1.45	-14.89%	-14.89%		-14.89%		1.45	1.45	1.45	-14.89%	72.25	1.45	0.00	1.44	-0.26	-15.11%	1.21%
CWS Total	33.13	35.68	33.13	-28.86%	23.57	-28.86%	19.76%	23.57	27.56	19.46%	23.21	-29.94%	19.46%	23.21	-29.94%	-29.94%		-29.94%		23.21	23.21	23.21	-29.94%	100.81	23.21	-0.06	23.15	-9.98	-30.11%	19.42%
Daly City	4.29	4.29	4.29	-13.57%	3.71	-13.58%	3.11%	3.71	3.90	2.76%	3.29	-23.46%	2.76%	3.29	-23.46%	-23.46%		-23.46%		3.29	3.29	3.29	-23.46%	49.11			3.29	-1.01	-23.46%	2.76%
East Palo Alto	1.96	1.96	1.96	-20.94%	1.55	-21.06%	1.30%	1.55	1.69	1.19%	1.42	-27.72%	1.19%	1.42	-27.72%	-27.72%		-27.72%		1.42	1.42	1.419	-27.72%	61.95	1.42	0.29	1.70	-0.26	-13.15%	1.43%
Estero	5.27	5.90	5.27	-27.26%	3.83	-27.26%	3.21%	3.83	4.52	3.19%	3.80	-27.85%	3.19%	3.80	-27.85%	-27.85%		-27.85%		3.80	3.80	3.80	-27.85%	86.53	3.80	-0.01	3.79	-1.48	-28.03%	3.18%
Hayward	23.40	25.11	23.40	-22.79%	18.07	-22.79%	15.15%	18.07	20.39	14.40%	17.17	-26.62%	14.40%	17.17	-26.62%	-26.62%		-26.62%		17.17	17.17	17.17	-26.62%	73.40	17.17	-0.04	17.13	-6.27	-26.80%	14.36%
Hillsborough	2.92	4.09	2.92	-42.72%	1.67	-42.72%	1.40%	1.67	2.47	1.74%	2.08	-28.74%	1.74%	2.08	-28.74%	-28.74%		-28.74%		2.08	2.08	2.08	-28.74%	251.67	2.08	-0.01	2.07	-0.84	-28.91%	1.74%
Menlo Park	2.58	4.46	2.58	-31.82%	1.76	-31.82%	1.48%	1.76	2.65	1.87%	2.23	-13.50%	1.87%	2.23	-13.50%	-13.50%		-13.50%		2.23	2.23	2.23	-13.50%	72.66	2.23	-0.01	2.23	-0.35	-13.71%	1.87%
Mid Pen WD	3.60	3.89	3.60	-25.26%	2.69	-25.26%	2.26%	2.69	3.09	2.18%	2.60	-27.80%	2.18%	2.60	-27.80%	-27.80%		-27.80%		2.60	2.60	2.60	-27.80%	99.30	2.60	-0.01	2.59	-1.01	-27.98%	2.17%
Millbrae	2.67	3.15	2.67	-22.13%	2.08	-22.13%	1.74%	2.08	2.43	1.72%	2.05	-23.26%	1.72%	2.05	-23.26%	-23.26%		-23.26%		2.05	2.05	2.05	-23.26%	75.08	2.05	-0.01	2.04	-0.63	-23.46%	1.71%
Milpitas	7.69	9.23	7.69	-21.75%	6.02	-21.75%	5.05%	6.02	7.08	5.00%	5.96	-22.50%	5.00%	5.96	-22.50%	-22.50%		-22.50%		5.96	5.96	5.96	-22.50%	61.38	5.96	-0.01	5.94	-1.75	-22.70%	4.98%
Mountain View	9.91	13.46	9.91	-27.90%	7.14	-27.90%	5.99%	7.14	9.23	6.52%	7.77	-21.57%	6.52%	7.77	-21.57%	-21.57%		-21.57%		7.77	7.77	7.77	-21.57%	74.27	7.77	-0.02	7.75	-2.16	-21.76%	6.50%
North Coast	3.12	3.84	3.12	-18.76%	2.53	-18.76%	2.13%	2.53	2.96	2.09%	2.50	-19.98%	2.09%	2.50	-19.98%	-19.98%		-19.98%		2.50	2.50	2.50	-19.98%	56.16	2.50	-0.01	2.49	-0.63	-20.18%	2.09%
Palo Alto	12.64	17.07	12.64	-30.56%	8.78	-30.56%	7.36%	8.78	11.52	8.13%	9.70	-23.29%	8.13%	9.70	-23.29%	-23.29%		-23.29%		9.70	9.70	9.70	-23.29%	96.58	9.70	-0.02	9.67	-2.97	-23.48%	8.11%
Purissima Hills	1.62	1.62	1.62	-42.21%	0.94	-42.21%	0.78%	0.94	1.16	0.82%	0.98	-39.53%	0.82%	0.98	-39.53%	-39.53%		-39.53%		0.98	0.98	0.98	-39.53%	251.27	0.98	0.00	0.98	-0.64	-39.68%	0.82%
Redwood City	10.40	10.93	10.40	-26.36%	7.66	-26.36%	6.42%	7.66	8.74	6.17%	7.36	-29.26%	6.17%	7.36	-29.26%	-29.26%		-29.26%		7.36	7.36	7.36	-29.26%	71.96	7.36	-0.02	7.34	-3.06	-29.43%	6.15%
San Bruno	2.47	3.25	2.47	-21.74%	1.93	-21.74%	1.62%	1.93	2.36	1.67%	1.99	-19.28%	1.67%	1.99	-19.28%	-19.28%		-19.28%		1.99	1.99	1.99	-19.28%	65.26	1.99	0.00	1.99	-0.48	-19.48%	1.67%
Stanford	2.90	3.03	2.90	-33.82%	1.92	-33.82%	1.61%	1.92	2.29	1.61%	1.93	-33.60%	1.61%	1.93	-33.60%	-33.60%		-33.60%		1.93	1.93	1.93	-33.60%	N/A	1.93	0.00	1.92	-0.98	-33.77%	1.61%
Sunnyvale	8.93	12.58	8.93	-26.60%	6.56	-26.60%	5.50%	6.56	8.54	6.03%	7.19	-19.45%	6.03%	7.19	-19.45%	-19.45%		-19.45%		7.19	7.19	7.19	-19.45%	76.53	7.19	-0.02	7.18	-1.75	-19.65%	6.02%
Westborough	0.88	1.32	0.88	-20.52%	0.70	-20.52%	0.59%	0.70	0.90	0.64%	0.76	-13.49%	0.64%	0.76	-13.49%	-13.49%		-13.49%		0.76	0.76	0.76	-13.49%	44.84			0.76	-0.12	-13.49%	0.64%
Subtotal	161.79		161.79	-26.01%	119.26	-26.29%	100.00%	119.26	141.62		119.25	-26.29%	100.00%	119.25	-26.29%	-26.29%		-26.29%		119.25	119.25	119.25	-26.29%		115.20		119.25	-42.53	-26.29%	
San José																														
Santa Clara																														
Total	161.79		161.79	-25.67%	119.26	-26.29%		119.26	141.62	100.00%	119.25	-26.29%		119.25	-26.29%	-26.29%		-26.29%		119.25	119.25	119.25	-26.29%		115.20	0.00	119.25	-42.53	-26.29%	100.00%

First SJ/SC Adjustment
1. Largest permanent customer cutback: -42.72%
2a. Adjusted SC allocation: (Applying largest permanent customer cutback)
2b. Santa Clara adjustment: (Difference between initial and adjusted alloc.)
3a. Adjusted SJ allocation: (Applying largest permanent customer cutback)
3b. San José adjustment: (Difference between initial and adjusted alloc.)
4. Total Adjustment: (2b + 3b)

Second SJ/SC Adjustment
1. Largest permanent customer cutba -39.53%
2a. Adjusted SC allocation:
2b. Santa Clara adjustment:
3a. Adjusted SJ allocation:
3b. San José adjustment:
4. Total Adjustment:

0.004

****All values in MGD unless noted otherwise***

Column Notes

Agency Information
(1) SFPUC Purchases: From Tab 1.
(2) Fixed Component: Individual Supply Guarantees for most agencies from Tab 1; 4.5 mgd for SJ & SC; projected 2018 demand before conservation used as surrogate for Hayward

Base/Seasonal Allocations
(3) Lesser of Purchase or ISG: The lesser of column (1) or column (2).
(4) Base/Seasonal Allocation Cutback: From Tab 3, column (17).
(5) Base/Seasonal Allocation: column (3) reduced by the Base/Seasonal cutback in column (4).
(6) Base/Seasonal Purchase Cutback: The change between column (5) and column (1) shown as a percentage.

First San Jose/Santa Clara Adjustment: This adjustment is made so that Santa Clara's and San José's cutbacks are at least as great as the highest cutback by the permanent customers.
(7) Subtotal Allocation Factors: The ratio of each permanent agency's column (5) allocation to the column (5) subtotal.
(8) Adjusted Base/Seasonal Allocation: Redistributes "First SJ/SC Adjustment" line 4 value among the permanent customers based on the proportionate shares in column (8).

Allocations Based on Weighted ISG/Base Seasonal Average
(9) Weighted ISG/Base-Seasonal Avg: 33% of column (2) plus 67% of column (8).
Allocation Factors: Each agency's proportionate share of column (9).
Weighted Shortage Allocation: Column (9) times the available water supply (column (5) total).
Weighted Purchase Cutback: The change between column (11) and column (1) shown as a percentage.

Second San Jose/Santa Clara Adjustment: This adjustment is made so that Santa Clara's and San José's cutbacks are at least as great as the highest cutback by the permanent customers.
Subtotal Allocation Factors: The ratio of each permanent agency's column (11) allocation to the column (11) subtotal.
Adjusted Weighted Shortage Allocation: Redistributes "Second SJ/SC Adjustment" line 4 value among the permanent customers based on the proportionate shares in column (13).

Column Notes

Adjustment for Minimum Cutback: This adjustment forces a 10% minimum cutback with the reallocated water being placed in a hardship bank for later application to East Palo Alto.
(16) Adjusted for 10% Minimum Cutback: Decreases any percentage cutback in column (15) that is less than the minimum 10% floor to equal the 10% floor.
(17) Additional Cutback for Hardship Bank: The difference between column (15) and column (16) times column (1).

Adjustment for Maximum Cutback: This adjustment is made so that the maximum cutback applied to any agency is equal to the Overall Average BAWSCA Reduction + 20%.
(18) Adjusted for Maximun Cutback: Caps the cutbacks in column (18) to no more than 20% more than the average cutback.
(19) Cutback Over Cap: The difference between column (18) and column (15) times column (1).
(20) Allocations Adjusted for Cap: Purchases in column (1) reduced by the cutbacks in column (18).
(21) Agencies to Which Cutback Over Cap is Redistributed: Agencies that are not subject to the minimum or maximum adjustments in columns (17) and (19).
(22) Minimum/Maximum Adjusted Allocation: Redistributes the excess cutback in column (19) by the proportions in column (21) to agencies shown in column (21).
(23) Adjusted Minm/Max Purchase Cutbacks: The change between column (22) and column (1) shown as a percentage.

Adjustment for East Palo Alto (Low Residential Gallons per Capita per Day Adjustment)
(24) Residential Per Capita Usage: From Tab 1.
(25) Agencies To Which EPA Adjustment Applies: Column (22) agency allocations, except those whose GPCD is less than 55 GPCD & those who are impacted by the min./max. cutback .
(26) Share of EPA Adjustment: EPA value equal to difference 50% of the Overall Average Wholesale Customer Reduction and the sum of column (17) total (Hardship Bank value) and EPA allocation in column (22). Indivdiual agency proportionate shares of EPA's adjustment based on column (25).
(27) Allocation with EPA Adjustment: Column (22) plus column (26).

Final Allocations
(28) Final Purchase Cutback: Column (27) minus column (1) expressed as MGD
(29) Final Purchase Cutback: The change between column (31) and column (1) shown as a percentage.
(30) Final Allocation Factor: Each agency's allocation from Column (27) divided by the total water allocated to the wholesale agencies (total in Column (27)), shown as a percentage

TABLE B-3: 2025 CALCULATION OF FINAL PURCHASE CUTBACK AND ALLOCATION FACTOR FOR TIER 2 DROUGHT IMPLEMENTATION PLAN (DRIP)

Overall Average Wholesale Customer Reduction: 27.13%

Base = 10.00%
Seasonal = 66.75%

Weighted average for Column 10:
0.33 =ISG component (Col. 2)
0.67 =Base/Seasonal component (Col. 9)

Variable component - Base/Seasonal Allocation (with ISG cap)
Minimum (Column 16) = 10.00%
Ceiling (Col. 18) = avg. cutback + 20.00%

Minimum residential per capita use threshold (Column 25) = 55.00 gpcpd

	Agency Information		Initial Allocations Based on Weighted Fixed (ISG) and Variable (Base/Seasonal) Components Adjusting for SJ/SC													Adjustment for Minimum and Maximum Cutbacks														
			Base/Seasonal Allocations				1st SJ/SC Adjustment		Weighted Allocation				2nd SJ/SC Adjustment			Minimum Cutback Adj.		Maximum Cutback Adjustment						Adjustment for East Palo Alto						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)
Wholesale Customers	2025 SFPUC Purchases	Fixed Comp.	Lesser of Purchase or ISG	Base/ Seasonal Allocation Cutback	Base/ Seasonal Allocation	Base/ Seasonal Purchase Cutback	Subtotal Allocation Factors	Adjusted Base/Seasonal Allocation	Weighted ISG-Base/ Seasonal Avg	Allocation Factors	Weighted Shortage Allocation	Weighted Purchase Cutback	Subtotal Allocation Factors	Adjusted Weighted Shortage Allocation	Adjusted Weighted Purchase Cutback	Adjusted for 10.00% Minimum Cutback	Add'l Cutback for Hardship Bank	Adjusted for 47.13% Maximum Cutback	Cutback Over Cap	Allocations Adjusted For Cap	Agencies To Which Cutback Over Cap Is Redistributed	Min/Max Adjusted Allocation	Adj. Min/Max Purchase Cutbacks	2025 Residential Per Capita	Agencies To Which EPA Adjustment Applies	Share of EPA Adjustment	Allocations With EPA Adjustments	Final Purchase Cutback		Final Allocation Factor
ACWD	13.76	13.76	13.76	-27.23%	10.01	-27.24%	8.25%	10.01	11.25	7.86%	9.55	-30.63%	7.86%	9.55	-30.63%	-30.63%		-30.63%		9.55	9.55	9.55	-30.63%	86.58	9.55	-0.02	9.52	-4.24	-30.79%	7.84%
Brisbane/GVMID	1.00	0.98	0.98	-27.97%	0.71	-29.51%	0.58%	0.71	0.80	0.56%	0.68	-32.51%	0.56%	0.68	-32.51%	-32.51%		-32.51%		0.68	0.68	0.68	-32.51%	75.79	0.68	0.00	0.67	-0.33	-32.67%	0.56%
Burlingame	5.07	5.23	5.07	-22.86%	3.91	-22.86%	3.22%	3.91	4.35	3.04%	3.69	-27.24%	3.04%	3.69	-27.24%	-27.24%		-27.24%		3.69	3.69	3.69	-27.24%	95.76	3.69	-0.01	3.68	-1.39	-27.40%	3.03%
Coastside	1.73	2.18	1.73	-12.63%	1.51	-12.63%	1.25%	1.51	1.73	1.21%	1.47	-15.08%	1.21%	1.47	-15.08%	-15.08%		-15.08%		1.47	1.47	1.47	-15.08%	72.23	1.47	0.00	1.47	-0.26	-15.28%	1.21%
CWS Total	34.15	35.68	34.15	-29.71%	24.00	-29.71%	19.77%	24.00	27.86	19.47%	23.64	-30.78%	19.47%	23.64	-30.78%	-30.78%		-30.78%		23.64	23.64	23.64	-30.78%	100.79	23.64	-0.05	23.58	-10.56	-30.94%	19.42%
Daly City	4.29	4.29	4.29	-13.74%	3.70	-13.74%	3.05%	3.70	3.90	2.72%	3.31	-22.96%	2.72%	3.31	-22.96%	-22.96%		-22.96%		3.31	3.31	3.31	-22.96%	48.20			3.31	-0.99	-22.96%	2.72%
East Palo Alto	1.96	1.96	1.96	-21.44%	1.54	-21.56%	1.27%	1.54	1.68	1.17%	1.42	-27.44%	1.17%	1.42	-27.44%	-27.44%		-27.44%		1.42	1.42	1.424	-27.44%	61.94	1.42	0.27	1.70	-0.27	-13.57%	1.40%
Estero	5.35	5.90	5.35	-28.05%	3.85	-28.05%	3.17%	3.85	4.53	3.16%	3.84	-28.21%	3.16%	3.84	-28.21%	-28.21%		-28.21%		3.84	3.84	3.84	-28.21%	86.55	3.84	-0.01	3.83	-1.52	-28.38%	3.16%
Hayward	25.40	25.11	25.11	-23.37%	19.24	-24.24%	15.85%	19.24	21.18	14.80%	17.97	-29.24%	14.80%	17.97	-29.24%	-29.24%		-29.24%		17.97	17.97	17.97	-29.24%	76.56	17.97	-0.04	17.93	-7.47	-29.41%	14.77%
Hillsborough	2.93	4.09	2.93	-44.21%	1.64	-44.21%	1.35%	1.64	2.45	1.71%	2.08	-29.20%	1.71%	2.08	-29.20%	-29.20%		-29.20%		2.08	2.08	2.08	-29.20%	251.76	2.08	0.00	2.07	-0.86	-29.36%	1.71%
Menlo Park	2.60	4.46	2.60	-32.82%	1.75	-32.82%	1.44%	1.75	2.64	1.85%	2.24	-13.77%	1.85%	2.24	-13.77%	-13.77%		-13.77%		2.24	2.24	2.24	-13.77%	71.71	2.24	-0.01	2.24	-0.36	-13.97%	1.84%
Mid Pen WD	3.60	3.89	3.60	-25.96%	2.67	-25.96%	2.20%	2.67	3.07	2.15%	2.61	-27.63%	2.15%	2.61	-27.63%	-27.63%		-27.63%		2.61	2.61	2.61	-27.63%	96.12	2.61	-0.01	2.60	-1.00	-27.80%	2.14%
Millbrae	2.79	3.15	2.79	-22.68%	2.16	-22.68%	1.78%	2.16	2.49	1.74%	2.11	-24.40%	1.74%	2.11	-24.40%	-24.40%		-24.40%		2.11	2.11	2.11	-24.40%	74.96	2.11	0.00	2.10	-0.69	-24.58%	1.73%
Milpitas	8.25	9.23	8.25	-22.11%	6.43	-22.11%	5.29%	6.43	7.35	5.14%	6.24	-24.38%	5.14%	6.24	-24.38%	-24.38%		-24.38%		6.24	6.24	6.24	-24.38%	64.55	6.24	-0.01	6.22	-2.03	-24.56%	5.13%
Mountain View	10.34	13.46	10.34	-28.65%	7.38	-28.65%	6.08%	7.38	9.38	6.56%	7.96	-22.98%	6.56%	7.96	-22.98%	-22.98%		-22.98%		7.96	7.96	7.96	-22.98%	74.09	7.96	-0.02	7.94	-2.39	-23.16%	6.54%
North Coast	3.14	3.84	3.14	-19.16%	2.54	-19.16%	2.09%	2.54	2.97	2.07%	2.52	-19.81%	2.07%	2.52	-19.81%	-19.81%		-19.81%		2.52	2.52	2.52	-19.81%	55.43	2.52	-0.01	2.51	-0.63	-19.99%	2.07%
Palo Alto	12.81	17.07	12.81	-31.50%	8.78	-31.50%	7.23%	8.78	11.52	8.05%	9.77	-23.74%	8.05%	9.77	-23.74%	-23.74%		-23.74%		9.77	9.77	9.77	-23.74%	93.91	9.77	-0.02	9.75	-3.07	-23.92%	8.03%
Purissima Hills	1.62	1.62	1.62	-43.69%	0.91	-43.69%	0.75%	0.91	1.15	0.80%	0.97	-39.90%	0.80%	0.97	-39.90%	-39.90%		-39.90%		0.97	0.97	0.97	-39.90%	259.51	0.97	0.00	0.97	-0.65	-40.04%	0.80%
Redwood City	10.36	10.93	10.36	-27.11%	7.55	-27.11%	6.22%	7.55	8.67	6.06%	7.35	-29.02%	6.06%	7.35	-29.02%	-29.02%		-29.02%		7.35	7.35	7.35	-29.02%	70.08	7.35	-0.02	7.34	-3.02	-29.18%	6.04%
San Bruno	2.63	3.25	2.63	-22.63%	2.03	-22.63%	1.67%	2.03	2.43	1.70%	2.06	-21.40%	1.70%	2.06	-21.40%	-21.40%		-21.40%		2.06	2.06	2.06	-21.40%	64.12	2.06	0.00	2.06	-0.57	-21.59%	1.70%
Stanford	3.03	3.03	3.03	-34.91%	1.97	-34.91%	1.62%	1.97	2.32	1.62%	1.97	-34.96%	1.62%	1.97	-34.96%	-34.96%		-34.96%		1.97	1.97	1.97	-34.96%	N/A	1.97	0.00	1.97	-1.06	-35.11%	1.62%
Sunnyvale	8.93	12.58	8.93	-27.59%	6.47	-27.59%	5.33%	6.47	8.48	5.93%	7.20	-19.39%	5.93%	7.20	-19.39%	-19.39%		-19.39%		7.20	7.20	7.20	-19.39%	77.75	7.20	-0.02	7.18	-1.75	-19.57%	5.92%
Westborough	0.87	1.32	0.87	-21.00%	0.69	-21.00%	0.57%	0.69	0.90	0.63%	0.76	-12.61%	0.63%	0.76	-12.61%	-12.61%		-12.61%		0.76	0.76	0.76	-12.61%	44.39			0.76	-0.11	-12.61%	0.63%
Subtotal	166.62		166.62	-26.68%	121.42	-27.13%	100.00%	121.42	143.07		121.41	-27.13%	100.00%	121.41	-27.13%	-27.13%		-27.13%		121.41	121.41	121.41	-27.13%		117.34		121.41	-45.21	-27.13%	
San José																														
Santa Clara																														
Total	166.62		166.62	-26.34%	121.42	-27.13%		121.42	143.07	100.00%	121.41	-27.13%		121.41	-27.13%	-27.13%		-27.13%		121.41	121.41	121.41	-27.13%		117.34	0.00	121.41	-45.21	-27.13%	100.00%

First SJ/SC Adjustment
1. Largest permanent customer cutback: -44.21%
2a. Adjusted SC allocation: (Applying largest permanent customer cutback)
2b. Santa Clara adjustment: (Difference between initial and adjusted alloc.)
3a. Adjusted SJ allocation: (Applying largest permanent customer cutback)
3b. San José adjustment: (Difference between initial and adjusted alloc.)
4. Total Adjustment: (2b + 3b)

Second SJ/SC Adjustment
1. Largest permanent customer cutba -39.90%
2a. Adjusted SC allocation:
2b. Santa Clara adjustment:
3a. Adjusted SJ allocation:
3b. San José adjustment:
4. Total Adjustment:

0.003

*****All values in MGD unless noted otherwise***

Column Notes

Agency Information
(1) SFPUC Purchases: From Tab 1.
(2) Fixed Component: Individual Supply Guarantees for most agencies from Tab 1; 4.5 mgd for SJ & SC; projected 2018 demand before conservation used as surrogate for Hayward

Base/Seasonal Allocations
(3) Lesser of Purchase or ISG: The lesser of column (1) or column (2).
(4) Base/Seasonal Allocation Cutback: From Tab 3, column (17).
(5) Base/Seasonal Allocation: column (3) reduced by the Base/Seasonal cutback in column (4).
(6) Base/Seasonal Purchase Cutback: The change between column (5) and column (1) shown as a percentage.

First San Jose/Santa Clara Adjustment: This adjustment is made so that Santa Clara's and San José's cutbacks are at least as great as the highest cutback by the permanent customers.
(7) Subtotal Allocation Factors: The ratio of each permanent agency's column (5) allocation to the column (5) subtotal.
(8) Adjusted Base/Seasonal Allocation: Redistributes "First SJ/SC Adjustment" line 4 value among the permanent customers based on the proportionate shares in column (8).

Allocations Based on Weighted ISG/Base Seasonal Average
(9) Weighted ISG/Base-Seasonal Avg: 33% of column (2) plus 67% of column (8).
Allocation Factors: Each agency's proportionate share of column (9).
Weighted Shortage Allocation: Column (9) times the available water supply (column (5) total).
Weighted Purchase Cutback: The change between column (11) and column (1) shown as a percentage.

Second San Jose/Santa Clara Adjustment: This adjustment is made so that Santa Clara's and San José's cutbacks are at least as great as the highest cutback by the permanent customers.
Subtotal Allocation Factors: The ratio of each permanent agency's column (11) allocation to the column (11) subtotal.
Adjusted Weighted Shortage Allocation: Redistributes "Second SJ/SC Adjustment" line 4 value among the permanent customers based on the proportionate shares in column (13).

Column Notes

Adjustment for Minimum Cutback: This adjustment forces a 10% minimum cutback with the reallocated water being placed in a hardship bank for later application to East Palo Alto.
(16) Adjusted for 10% Minimum Cutback: Decreases any percentage cutback in column (15) that is less than the minimum 10% floor to equal the 10% floor.
(17) Additional Cutback for Hardship Bank: The difference between column (15) and column (16) times column (1).

Adjustment for Maximum Cutback: This adjustment is made so that the maximum cutback applied to any agency is equal to the Overall Average BAWSCA Reduction + 20%.
(18) Adjusted for Maximun Cutback: Caps the cutbacks in column (18) to no more than 20% more than the average cutback.
(19) Cutback Over Cap: The difference between column (18) and column (15) times column (1).
(20) Allocations Adjusted for Cap: Purchases in column (1) reduced by the cutbacks in column (18).
(21) Agencies to Which Cutback Over Cap is Redistributed: Agencies that are not subject to the minimum or maximum adjustments in columns (17) and (19).
(22) Minimum/Maximum Adjusted Allocation: Redistributes the excess cutback in column (19) by the proportions in column (21) to agencies shown in column (21).
(23) Adjusted Minm/Max Purchase Cutbacks: The change between column (22) and column (1) shown as a percentage.

Adjustment for East Palo Alto (Low Residential Gallons per Capita per Day Adjustment)
(24) Residential Per Capita Usage: From Tab 1.
(25) Agencies To Which EPA Adjustment Applies: Column (22) agency allocations, except those whose GPCD is less than 55 GPCD & those who are impacted by the min./max. cutback .
(26) Share of EPA Adjustment: EPA value equal to difference 50% of the Overall Average Wholesale Customer Reduction and the sum of column (17) total (Hardship Bank value) and EPA allocation in column (22). Indivdiual agency proportionate shares of EPA's adjustment based on column (25).
(27) Allocation with EPA Adjustment: Column (22) plus column (26).

Final Allocations
(28) Final Purchase Cutback: Column (27) minus column (1) expressed as MGD
(29) Final Purchase Cutback: The change between column (31) and column (1) shown as a percentage.
(30) Final Allocation Factor: Each agency's allocation from Column (27) divided by the total water allocated to the wholesale agencies (total in Column (27)), shown as a percentage

TABLE B-4: 2030 CALCULATION OF FINAL PURCHASE CUTBACK AND ALLOCATION FACTOR FOR TIER 2 DROUGHT IMPLEMENTATION PLAN (DRIP)

Overall Average Wholesale Customer Reduction: 27.68%

Base = 10.00%
Seasonal = 65.32%

Weighted average for Column 10:
0.33 =ISG component (Col. 2)
0.67 =Base/Seasonal component (Col. 9)

Variable component - Base/Seasonal Allocation (with ISG cap)
Minimum (Column 16) = 10.00%
Ceiling (Col. 18) = avg. cutback + 20.00%

Minimum residential per capita use threshold (Column 25) = 55.00 gpcpd

	Agency Information		Initial Allocations Based on Weighted Fixed (ISG) and Variable (Base/Seasonal) Components Adjusting for SJ/SC												
			Base/Seasonal Allocations				1st SJ/SC Adjustment		Weighted Allocation				2nd SJ/SC Adjustment		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Wholesale Customers	2030 SFPUC Purchases	Fixed Comp.	Lesser of Purchase or ISG	Base/ Seasonal Allocation Cutback	Base/ Seasonal Allocation	Base/ Seasonal Purchase Cutback	Subtotal Allocation Factors	Adjusted Base/Seasonal Allocation	Weighted ISG-Base/ Seasonal Avg	Allocation Factors	Weighted Shortage Allocation	Weighted Purchase Cutback	Subtotal Allocation Factors	Adjusted Weighted Shortage Allocation	Adjusted Weighted Purchase Cutback
ACWD	13.76	13.76	13.76	-26.61%	10.10	-26.62%	8.08%	10.10	11.31	7.78%	9.71	-29.42%	7.78%	9.71	-29.42%
Brisbane/GVMID	1.01	0.98	0.98	-27.52%	0.71	-29.76%	0.57%	0.71	0.80	0.55%	0.69	-32.11%	0.55%	0.69	-32.11%
Burlingame	5.18	5.23	5.18	-22.54%	4.01	-22.54%	3.21%	4.01	4.41	3.04%	3.79	-26.76%	3.04%	3.79	-26.76%
Coastside	1.77	2.18	1.77	-12.85%	1.54	-12.85%	1.23%	1.54	1.75	1.20%	1.50	-14.83%	1.20%	1.50	-14.83%
CWS Total	35.23	35.68	35.23	-29.20%	24.94	-29.20%	19.97%	24.94	28.49	19.59%	24.47	-30.54%	19.59%	24.47	-30.54%
Daly City	4.29	4.29	4.29	-13.65%	3.71	-13.66%	2.97%	3.71	3.90	2.68%	3.35	-21.96%	2.68%	3.35	-21.96%
East Palo Alto	1.96	1.96	1.96	-21.15%	1.55	-21.27%	1.24%	1.55	1.68	1.16%	1.45	-26.38%	1.16%	1.45	-26.38%
Estero	5.40	5.90	5.40	-27.59%	3.91	-27.59%	3.13%	3.91	4.57	3.14%	3.92	-27.36%	3.14%	3.92	-27.36%
Hayward	27.70	25.11	25.11	-23.03%	19.33	-30.23%	15.47%	19.33	21.23	14.60%	18.24	-34.15%	14.60%	18.24	-34.15%
Hillsborough	2.94	4.09	2.94	-43.35%	1.67	-43.35%	1.33%	1.67	2.47	1.70%	2.12	-27.99%	1.70%	2.12	-27.99%
Menlo Park	2.63	4.46	2.63	-32.24%	1.78	-32.24%	1.43%	1.78	2.67	1.83%	2.29	-12.93%	1.83%	2.29	-12.93%
Mid Pen WD	3.70	3.89	3.70	-25.56%	2.75	-25.56%	2.21%	2.75	3.13	2.15%	2.69	-27.34%	2.15%	2.69	-27.34%
Millbrae	2.90	3.15	2.90	-22.36%	2.25	-22.36%	1.80%	2.25	2.55	1.75%	2.19	-24.51%	1.75%	2.19	-24.51%
Milpitas	8.80	9.23	8.80	-21.66%	6.89	-21.66%	5.52%	6.89	7.66	5.27%	6.58	-25.18%	5.27%	6.58	-25.18%
Mountain View	10.81	13.46	10.81	-28.12%	7.77	-28.12%	6.22%	7.77	9.65	6.63%	8.29	-23.32%	6.63%	8.29	-23.32%
North Coast	3.25	3.84	3.25	-18.93%	2.63	-18.93%	2.11%	2.63	3.03	2.09%	2.60	-19.86%	2.09%	2.60	-19.86%
Palo Alto	13.37	17.07	13.37	-30.96%	9.23	-30.96%	7.39%	9.23	11.82	8.13%	10.15	-24.05%	8.13%	10.15	-24.05%
Purissima Hills	1.62	1.62	1.62	-42.84%	0.93	-42.84%	0.74%	0.93	1.16	0.80%	0.99	-38.67%	0.80%	0.99	-38.67%
Redwood City	10.79	10.93	10.79	-26.68%	7.91	-26.68%	6.33%	7.91	8.91	6.13%	7.65	-29.09%	6.13%	7.65	-29.09%
San Bruno	2.78	3.25	2.78	-22.62%	2.15	-22.62%	1.72%	2.15	2.51	1.73%	2.16	-22.38%	1.73%	2.16	-22.38%
Stanford	3.03	3.03	3.03	-34.28%	1.99	-34.28%	1.59%	1.99	2.34	1.61%	2.01	-33.80%	1.61%	2.01	-33.80%
Sunnyvale	8.93	12.58	8.93	-27.49%	6.48	-27.49%	5.18%	6.48	8.49	5.84%	7.29	-18.34%	5.84%	7.29	-18.34%
Westborough	0.85	1.32	0.85	-20.73%	0.67	-20.73%	0.54%	0.67	0.89	0.61%	0.76	-10.36%	0.61%	0.76	-10.36%
Subtotal	172.70		172.70	-26.21%	124.90	-27.68%	100.00%	124.90	145.40		124.90	-27.68%	100.00%	124.90	-27.68%
San José															
Santa Clara															
Total	172.70		172.70	-25.90%	124.90	-27.68%		124.90	145.40	100.00%	124.90	-27.68%		124.90	-27.68%

	Adjustment for Minimum and Maximum Cutbacks								Adjustment for East Palo Alto						
	Minimum Cutback Adj.		Maximum Cutback Adjustment												
	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)
Wholesale Customers	Adjusted for 10.00% Minimum Cutback	Add'l Cutback for Hardship Bank	Adjusted for 47.68% Maximum Cutback	Cutback Over Cap	Allocations Adjusted For Cap	Agencies To Which Cutback Over Cap Is Redistributed	Min/Max Adjusted Allocation	Adj. Min/Max Purchase Cutbacks	2030 Residential Per Capita	Agencies To Which EPA Adjustment Applies	Share of EPA Adjustment	Allocations With EPA Adjustments	Final Purchase Cutback		Final Allocation Factor
ACWD	-29.42%		-29.42%		9.71	9.71	9.71	-29.42%	87.65	9.71	-0.02	9.69	-4.07	-29.56%	7.76%
Brisbane/GVMID	-32.11%		-32.11%		0.69	0.69	0.69	-32.11%	71.28	0.69	0.00	0.68	-0.33	-32.25%	0.55%
Burlingame	-26.76%		-26.76%		3.79	3.79	3.79	-26.76%	95.21	3.79	-0.01	3.78	-1.39	-26.91%	3.03%
Coastside	-14.83%		-14.83%		1.50	1.50	1.50	-14.83%	72.15	1.50	0.00	1.50	-0.26	-15.01%	1.20%
CWS Total	-30.54%		-30.54%		24.47	24.47	24.47	-30.54%	100.79	24.47	-0.05	24.42	-10.81	-30.69%	19.55%
Daly City	-21.96%		-21.96%		3.35	3.35	3.35	-21.96%	47.63			3.35	-0.94	-21.96%	2.68%
East Palo Alto	-26.38%		-26.38%		1.45	1.45	1.445	-26.38%	61.95	1.45	0.25	1.69	-0.27	-13.84%	1.35%
Estero	-27.36%		-27.36%		3.92	3.92	3.92	-27.36%	86.51	3.92	-0.01	3.91	-1.49	-27.50%	3.13%
Hayward	-34.15%		-34.15%		18.24	18.24	18.24	-34.15%	79.85	18.24	-0.04	18.20	-9.50	-34.28%	14.57%
Hillsborough	-27.99%		-27.99%		2.12	2.12	2.12	-27.99%	251.75	2.12	0.00	2.11	-0.83	-28.14%	1.69%
Menlo Park	-12.93%		-12.93%		2.29	2.29	2.29	-12.93%	71.03	2.29	0.00	2.29	-0.34	-13.11%	1.83%
Mid Pen WD	-27.34%		-27.34%		2.69	2.69	2.69	-27.34%	97.07	2.69	-0.01	2.68	-1.02	-27.49%	2.15%
Millbrae	-24.51%		-24.51%		2.19	2.19	2.19	-24.51%	74.89	2.19	0.00	2.18	-0.72	-24.66%	1.75%
Milpitas	-25.18%		-25.18%		6.58	6.58	6.58	-25.18%	67.47	6.58	-0.01	6.57	-2.23	-25.33%	5.26%
Mountain View	-23.32%		-23.32%		8.29	8.29	8.29	-23.32%	74.14	8.29	-0.02	8.27	-2.54	-23.48%	6.62%
North Coast	-19.86%		-19.86%		2.60	2.60	2.60	-19.86%	56.55	2.60	-0.01	2.60	-0.65	-20.02%	2.08%
Palo Alto	-24.05%		-24.05%		10.15	10.15	10.15	-24.05%	89.43	10.15	-0.02	10.13	-3.24	-24.21%	8.11%
Purissima Hills	-38.67%		-38.67%		0.99	0.99	0.99	-38.67%	264.21	0.99	0.00	0.99	-0.63	-38.79%	0.79%
Redwood City	-29.09%		-29.09%		7.65	7.65	7.65	-29.09%	71.39	7.65	-0.02	7.64	-3.15	-29.23%	6.11%
San Bruno	-22.38%		-22.38%		2.16	2.16	2.16	-22.38%	63.49	2.16	0.00	2.15	-0.63	-22.54%	1.72%
Stanford	-33.80%		-33.80%		2.01	2.01	2.01	-33.80%	N/A	2.01	0.00	2.00	-1.03	-33.93%	1.60%
Sunnyvale	-18.34%		-18.34%		7.29	7.29	7.29	-18.34%	80.60	7.29	-0.01	7.28	-1.65	-18.50%	5.83%
Westborough	-10.36%		-10.36%		0.76	0.76	0.76	-10.36%	43.44			0.76	-0.09	-10.36%	0.61%
Subtotal	-27.68%		-27.68%		124.90	124.90	124.90	-27.68%		120.79		124.90	-47.80	-27.68%	
San José															
Santa Clara															
Total	-27.68%		-27.68%		124.90	124.90	124.90	-27.68%		120.79	0.00	124.90	-47.80	-27.68%	100.00%

First SJ/SC Adjustment
1. Largest permanent customer cutback: -43.35%
2a. Adjusted SC allocation: (Applying largest permanent customer cutback)
2b. Santa Clara adjustment: (Difference between initial and adjusted alloc.)
3a. Adjusted SJ allocation: (Applying largest permanent customer cutback)
3b. San José adjustment: (Difference between initial and adjusted alloc.)
4. Total Adjustment: (2b + 3b)

Second SJ/SC Adjustment
1. Largest permanent customer cutba -38.67%
2a. Adjusted SC allocation:
2b. Santa Clara adjustment:
3a. Adjusted SJ allocation:
3b. San José adjustment:
4. Total Adjustment:

0.003

*****All values in MGD unless noted otherwise***

Column Notes

Agency Information
(1) SFPUC Purchases: From Tab 1.
(2) Fixed Component: Individual Supply Guarantees for most agencies from Tab 1; 4.5 mgd for SJ & SC; projected 2018 demand before conservation used as surrogate for Hayward

Base/Seasonal Allocations
(3) Lesser of Purchase or ISG: The lesser of column (1) or column (2).
(4) Base/Seasonal Allocation Cutback: From Tab 3, column (17).
(5) Base/Seasonal Allocation: column (3) reduced by the Base/Seasonal cutback in column (4).
(6) Base/Seasonal Purchase Cutback: The change between column (5) and column (1) shown as a percentage.

First San Jose/Santa Clara Adjustment: This adjustment is made so that Santa Clara's and San José's cutbacks are at least as great as the highest cutback by the permanent customers.
(7) Subtotal Allocation Factors: The ratio of each permanent agency's column (5) allocation to the column (5) subtotal.
(8) Adjusted Base/Seasonal Allocation: Redistributes "First SJ/SC Adjustment" line 4 value among the permanent customers based on the proportionate shares in column (8).

Allocations Based on Weighted ISG/Base Seasonal Average
(9) Weighted ISG/Base-Seasonal Avg: 33% of column (2) plus 67% of column (8).
Allocation Factors: Each agency's proportionate share of column (9).
Weighted Shortage Allocation: Column (9) times the available water supply (column (5) total).
Weighted Purchase Cutback: The change between column (11) and column (1) shown as a percentage.

Second San Jose/Santa Clara Adjustment: This adjustment is made so that Santa Clara's and San José's cutbacks are at least as great as the highest cutback by the permanent customers.
Subtotal Allocation Factors: The ratio of each permanent agency's column (11) allocation to the column (11) subtotal.
Adjusted Weighted Shortage Allocation: Redistributes "Second SJ/SC Adjustment" line 4 value among the permanent customers based on the proportionate shares in column (13).

Column Notes

Adjustment for Minimum Cutback: This adjustment forces a 10% minimum cutback with the reallocated water being placed in a hardship bank for later application to East Palo Alto.
(16) Adjusted for 10% Minimum Cutback: Decreases any percentage cutback in column (15) that is less than the minimum 10% floor to equal the 10% floor.
(17) Additional Cutback for Hardship Bank: The difference between column (15) and column (16) times column (1).

Adjustment for Maximum Cutback: This adjustment is made so that the maximum cutback applied to any agency is equal to the Overall Average BAWSCA Reduction + 20%.
(18) Adjusted for Maximun Cutback: Caps the cutbacks in column (18) to no more than 20% more than the average cutback.
(19) Cutback Over Cap: The difference between column (18) and column (15) times column (1).
(20) Allocations Adjusted for Cap: Purchases in column (1) reduced by the cutbacks in column (18).
(21) Agencies to Which Cutback Over Cap is Redistributed: Agencies that are not subject to the minimum or maximum adjustments in columns (17) and (19).
(22) Minimum/Maximum Adjusted Allocation: Redistributes the excess cutback in column (19) by the proportions in column (21) to agencies shown in column (21).
(23) Adjusted Minm/Max Purchase Cutbacks: The change between column (22) and column (1) shown as a percentage.

Adjustment for East Palo Alto (Low Residential Gallons per Capita per Day Adjustment)
(24) Residential Per Capita Usage: From Tab 1.
(25) Agencies To Which EPA Adjustment Applies: Column (22) agency allocations, except those whose GPCD is less than 55 GPCD & those who are impacted by the min./max. cutback .
(26) Share of EPA Adjustment: EPA value equal to difference 50% of the Overall Average Wholesale Customer Reduction and the sum of column (17) total (Hardship Bank value) and EPA allocation in column (22). Indivdiual agency proportionate shares of EPA's adjustment based on column (25).
(27) Allocation with EPA Adjustment: Column (22) plus column (26).

Final Allocations
(28) Final Purchase Cutback: Column (27) minus column (1) expressed as MGD
(29) Final Purchase Cutback: The change between column (31) and column (1) shown as a percentage.
(30) Final Allocation Factor: Each agency's allocation from Column (27) divided by the total water allocated to the wholesale agencies (total in Column (27)), shown as a percentage

TABLE B-5: 2035 CALCULATION OF FINAL PURCHASE CUTBACK AND ALLOCATION FACTOR FOR TIER 2 DROUGHT IMPLEMENTATION PLAN (DRIP)

Overall Average Wholesale Customer Reduction: 27.78%

Base = 10.00%
Seasonal = 61.92%

Weighted average for Column 10:
0.33 =ISG component (Col. 2)
0.67 =Base/Seasonal component (Col. 9)

Variable component - Base/Seasonal Allocation (with ISG cap)
Minimum (Column 16) = 10.00%
Ceiling (Col. 18) = avg. cutback + 20.00%

Minimum residential per capita use threshold (Column 25) = 55.00 gpcpd

	Agency Information		Initial Allocations Based on Weighted Fixed (ISG) and Variable (Base/Seasonal) Components Adjusting for SJ/SC												
			Base/Seasonal Allocations				1st SJ/SC Adjustment		Weighted Allocation				2nd SJ/SC Adjustment		
Wholesale Customers	(1) 2035 SFPUC Purchases	(2) Fixed Comp.	(3) Lesser of Purchase or ISG	(4) Base/ Seasonal Allocation Cutback	(5) Base/ Seasonal Allocation	(6) Base/ Seasonal Purchase Cutback	(7) Subtotal Allocation Factors	(8) Adjusted Base/Seasonal Allocation	(9) Weighted ISG-Base/ Seasonal Avg	(10) Allocation Factors	(11) Weighted Shortage Allocation	(12) Weighted Purchase Cutback	(13) Subtotal Allocation Factors	(14) Adjusted Weighted Shortage Allocation	(15) Adjusted Weighted Purchase Cutback
ACWD	13.76	13.76	13.76	-25.52%	10.25	-25.52%	8.01%	10.25	11.41	7.74%	9.90	-28.07%	7.74%	9.90	-28.07%
Brisbane/GVMID	1.04	0.98	0.98	-26.44%	0.72	-30.68%	0.56%	0.72	0.81	0.55%	0.70	-32.72%	0.55%	0.70	-32.72%
Burlingame	5.22	5.23	5.22	-21.77%	4.08	-21.77%	3.19%	4.08	4.46	3.03%	3.87	-25.79%	3.03%	3.87	-25.79%
Coastside	1.80	2.18	1.80	-12.98%	1.57	-12.98%	1.22%	1.57	1.77	1.20%	1.53	-14.73%	1.20%	1.53	-14.73%
CWS Total	35.68	35.68	35.68	-27.79%	25.76	-27.79%	20.14%	25.76	29.04	19.70%	25.19	-29.39%	19.70%	25.19	-29.39%
Daly City	4.29	4.29	4.29	-13.44%	3.72	-13.45%	2.90%	3.72	3.91	2.65%	3.39	-21.05%	2.65%	3.39	-21.05%
East Palo Alto	1.96	1.96	1.96	-20.46%	1.56	-20.58%	1.22%	1.56	1.69	1.15%	1.47	-25.24%	1.15%	1.47	-25.24%
Estero	5.40	5.90	5.40	-26.51%	3.97	-26.51%	3.10%	3.97	4.61	3.12%	4.00	-26.00%	3.12%	4.00	-26.00%
Hayward	30.50	25.11	25.11	-22.23%	19.53	-35.98%	15.26%	19.53	21.37	14.49%	18.54	-39.21%	14.49%	18.54	-39.21%
Hillsborough	2.94	4.09	2.94	-41.30%	1.73	-41.30%	1.35%	1.73	2.51	1.70%	2.18	-26.07%	1.70%	2.18	-26.07%
Menlo Park	2.60	4.46	2.60	-30.88%	1.80	-30.88%	1.40%	1.80	2.68	1.82%	2.32	-10.70%	1.82%	2.32	-10.70%
Mid Pen WD	3.80	3.89	3.80	-24.60%	2.87	-24.60%	2.24%	2.87	3.20	2.17%	2.78	-26.84%	2.17%	2.78	-26.84%
Millbrae	3.02	3.15	3.02	-21.60%	2.37	-21.60%	1.85%	2.37	2.63	1.78%	2.28	-24.54%	1.78%	2.28	-24.54%
Milpitas	8.80	9.23	8.80	-20.73%	6.98	-20.73%	5.45%	6.98	7.72	5.24%	6.70	-23.88%	5.24%	6.70	-23.88%
Mountain View	11.29	13.46	11.29	-26.95%	8.25	-26.95%	6.45%	8.25	9.97	6.76%	8.65	-23.39%	6.76%	8.65	-23.39%
North Coast	3.32	3.84	3.32	-18.38%	2.71	-18.38%	2.12%	2.71	3.08	2.09%	2.67	-19.45%	2.09%	2.67	-19.45%
Palo Alto	13.47	17.07	13.47	-29.67%	9.47	-29.67%	7.40%	9.47	11.98	8.13%	10.40	-22.82%	8.13%	10.40	-22.82%
Purissima Hills	1.62	1.62	1.62	-40.82%	0.96	-40.82%	0.75%	0.96	1.18	0.80%	1.02	-36.88%	0.80%	1.02	-36.88%
Redwood City	10.79	10.93	10.79	-25.66%	8.02	-25.66%	6.27%	8.02	8.98	6.09%	7.79	-27.78%	6.09%	7.79	-27.78%
San Bruno	3.03	3.25	3.03	-22.28%	2.36	-22.28%	1.84%	2.36	2.65	1.80%	2.30	-24.17%	1.80%	2.30	-24.17%
Stanford	3.03	3.03	3.03	-32.79%	2.04	-32.79%	1.59%	2.04	2.37	1.60%	2.05	-32.27%	1.60%	2.05	-32.27%
Sunnyvale	8.93	12.58	8.93	-26.42%	6.57	-26.42%	5.14%	6.57	8.55	5.80%	7.42	-16.89%	5.80%	7.42	-16.89%
Westborough	0.84	1.32	0.84	-20.07%	0.67	-20.07%	0.52%	0.67	0.89	0.60%	0.77	-8.55%	0.60%	0.77	-8.55%
Subtotal	177.13		177.13	-25.09%	127.93	-27.78%	100.00%	127.93	147.43		127.92	-27.78%	100.00%	127.92	-27.78%
San José															
Santa Clara															
Total	177.13		177.13	-24.83%	127.93	-27.78%		127.93	147.43	100.00%	127.92	-27.78%		127.92	-27.78%

	Adjustment for Minimum and Maximum Cutbacks								Adjustment for East Palo Alto						
	Minimum Cutback Adj.		Maximum Cutback Adjustment												
Wholesale Customers	(16) Adjusted for 10.00% Minimum Cutback	(17) Add'l Cutback for Hardship Bank	(18) Adjusted for 47.78% Maximum Cutback	(19) Cutback Over Cap	(20) Allocations Adjusted For Cap	(21) Agencies To Which Cutback Over Cap Is Redistributed	(22) Min/Max Adjusted Allocation	(23) Adj. Min/Max Purchase Cutbacks	(24) 2035 Residential Per Capita	(25) Agencies To Which EPA Adjustment Applies	(26) Share of EPA Adjustment	(27) Allocations With EPA Adjustments	(28) Final Purchase Cutback	(29)	(30) Final Allocation Factor
ACWD	-28.07%		-28.07%		9.90	9.90	9.90	-28.07%	86.47	9.90	-0.02	9.88	-3.88	-28.19%	7.72%
Brisbane/GVMID	-32.72%		-32.72%		0.70	0.70	0.70	-32.72%	67.26	0.70	0.00	0.70	-0.34	-32.84%	0.55%
Burlingame	-25.79%		-25.79%		3.87	3.87	3.87	-25.79%	93.19	3.87	-0.01	3.86	-1.35	-25.91%	3.02%
Coastside	-14.73%		-14.73%		1.53	1.53	1.53	-14.73%	66.26	1.53	0.00	1.53	-0.27	-14.88%	1.20%
CWS Total	-29.39%		-29.39%		25.19	25.19	25.19	-29.39%	100.77	25.19	-0.04	25.15	-10.53	-29.51%	19.66%
Daly City	-21.05%		-21.05%		3.39	3.39	3.39	-21.05%	48.15			3.39	-0.90	-21.05%	2.65%
East Palo Alto	-25.24%		-25.24%		1.47	1.47	1.467	-25.24%	61.98	1.47	0.21	1.69	-0.27	-13.89%	1.32%
Estero	-26.00%		-26.00%		4.00	4.00	4.00	-26.00%	85.73	4.00	-0.01	3.99	-1.41	-26.12%	3.12%
Hayward	-39.21%		-39.21%		18.54	18.54	18.54	-39.21%	84.07	18.54	-0.03	18.51	-11.99	-39.31%	14.47%
Hillsborough	-26.07%		-26.07%		2.18	2.18	2.18	-26.07%	251.75	2.18	0.00	2.17	-0.77	-26.20%	1.70%
Menlo Park	-10.70%		-10.70%		2.32	2.32	2.32	-10.70%	69.02	2.32	0.00	2.32	-0.28	-10.85%	1.81%
Mid Pen WD	-26.84%		-26.84%		2.78	2.78	2.78	-26.84%	97.98	2.78	0.00	2.78	-1.02	-26.97%	2.17%
Millbrae	-24.54%		-24.54%		2.28	2.28	2.28	-24.54%	75.07	2.28	0.00	2.27	-0.75	-24.67%	1.78%
Milpitas	-23.88%		-23.88%		6.70	6.70	6.70	-23.88%	69.84	6.70	-0.01	6.69	-2.11	-24.01%	5.23%
Mountain View	-23.39%		-23.39%		8.65	8.65	8.65	-23.39%	74.28	8.65	-0.01	8.63	-2.66	-23.52%	6.75%
North Coast	-19.45%		-19.45%		2.67	2.67	2.67	-19.45%	57.23	2.67	0.00	2.67	-0.65	-19.59%	2.09%
Palo Alto	-22.82%		-22.82%		10.40	10.40	10.40	-22.82%	86.25	10.40	-0.02	10.38	-3.09	-22.95%	8.11%
Purissima Hills	-36.88%		-36.88%		1.02	1.02	1.02	-36.88%	263.14	1.02	0.00	1.02	-0.60	-36.99%	0.80%
Redwood City	-27.78%		-27.78%		7.79	7.79	7.79	-27.78%	71.39	7.79	-0.01	7.78	-3.01	-27.90%	6.08%
San Bruno	-24.17%		-24.17%		2.30	2.30	2.30	-24.17%	63.89	2.30	0.00	2.30	-0.74	-24.30%	1.79%
Stanford	-32.27%		-32.27%		2.05	2.05	2.05	-32.27%	N/A	2.05	0.00	2.05	-0.98	-32.38%	1.60%
Sunnyvale	-16.89%		-16.89%		7.42	7.42	7.42	-16.89%	77.94	7.42	-0.01	7.41	-1.52	-17.03%	5.79%
Westborough	-10.00%	-0.012	-10.00%		0.76		0.76	-10.00%	42.93			0.76	-0.08	-10.00%	0.59%
Subtotal	-27.78%		-27.78%		127.91	127.15	127.91	-27.79%		123.76		127.92	-49.21	-27.78%	
San José															
Santa Clara															
Total	-27.78%	-0.012	-27.78%		127.91	127.15	127.91	-27.79%		123.76	0.00	127.92	-49.21	-27.78%	100.00%

First SJ/SC Adjustment
1. Largest permanent customer cutback: -41.30%
2a. Adjusted SC allocation: (Applying largest permanent customer cutback)
2b. Santa Clara adjustment: (Difference between initial and adjusted alloc.)
3a. Adjusted SJ allocation: (Applying largest permanent customer cutback)
3b. San José adjustment: (Difference between initial and adjusted alloc.)
4. Total Adjustment: (2b + 3b)

Second SJ/SC Adjustment
1. Largest permanent customer cutba -39.21%
2a. Adjusted SC allocation:
2b. Santa Clara adjustment:
3a. Adjusted SJ allocation:
3b. San José adjustment:
4. Total Adjustment:

0.002

****All values in MGD unless noted otherwise***

Column Notes

Agency Information
(1) SFPUC Purchases: From Tab 1.
(2) Fixed Component: Individual Supply Guarantees for most agencies from Tab 1; 4.5 mgd for SJ & SC; projected 2018 demand before conservation used as surrogate for Hayward

Base/Seasonal Allocations
(3) Lesser of Purchase or ISG: The lesser of column (1) or column (2).
(4) Base/Seasonal Allocation Cutback: From Tab 3, column (17).
(5) Base/Seasonal Allocation: column (3) reduced by the Base/Seasonal cutback in column (4).
(6) Base/Seasonal Purchase Cutback: The change between column (5) and column (1) shown as a percentage.

First San Jose/Santa Clara Adjustment: This adjustment is made so that Santa Clara's and San José's cutbacks are at least as great as the highest cutback by the permanent customers.
(7) Subtotal Allocation Factors: The ratio of each permanent agency's column (5) allocation to the column (5) subtotal.
(8) Adjusted Base/Seasonal Allocation: Redistributes "First SJ/SC Adjustment" line 4 value among the permanent customers based on the proportionate shares in column (8).

Allocations Based on Weighted ISG/Base Seasonal Average
(9) Weighted ISG/Base-Seasonal Avg: 33% of column (2) plus 67% of column (8).
Allocation Factors: Each agency's proportionate share of column (9).
Weighted Shortage Allocation: Column (9) times the available water supply (column (5) total).
Weighted Purchase Cutback: The change between column (11) and column (1) shown as a percentage.

Second San Jose/Santa Clara Adjustment: This adjustment is made so that Santa Clara's and San José's cutbacks are at least as great as the highest cutback by the permanent customers.
Subtotal Allocation Factors: The ratio of each permanent agency's column (11) allocation to the column (11) subtotal.
Adjusted Weighted Shortage Allocation: Redistributes "Second SJ/SC Adjustment" line 4 value among the permanent customers based on the proportionate shares in column (13).

Column Notes

Adjustment for Minimum Cutback: This adjustment forces a 10% minimum cutback with the reallocated water being placed in a hardship bank for later application to East Palo Alto.
(16) Adjusted for 10% Minimum Cutback: Decreases any percentage cutback in column (15) that is less than the minimum 10% floor to equal the 10% floor.
(17) Additional Cutback for Hardship Bank: The difference between column (15) and column (16) times column (1).

Adjustment for Maximum Cutback: This adjustment is made so that the maximum cutback applied to any agency is equal to the Overall Average BAWSCA Reduction + 20%.
(18) Adjusted for Maximun Cutback: Caps the cutbacks in column (18) to no more than 20% more than the average cutback.
(19) Cutback Over Cap: The difference between column (18) and column (15) times column (1).
(20) Allocations Adjusted for Cap: Purchases in column (1) reduced by the cutbacks in column (18).
(21) Agencies to Which Cutback Over Cap is Redistributed: Agencies that are not subject to the minimum or maximum adjustments in columns (17) and (19).
(22) Minimum/Maximum Adjusted Allocation: Redistributes the excess cutback in column (19) by the proportions in column (21) to agencies shown in column (21).
(23) Adjusted Minm/Max Purchase Cutbacks: The change between column (22) and column (1) shown as a percentage.

Adjustment for East Palo Alto (Low Residential Gallons per Capita per Day Adjustment)
(24) Residential Per Capita Usage: From Tab 1.
(25) Agencies To Which EPA Adjustment Applies: Column (22) agency allocations, except those whose GPCD is less than 55 GPCD & those who are impacted by the min./max. cutback .
(26) Share of EPA Adjustment: EPA value equal to difference 50% of the Overall Average Wholesale Customer Reduction and the sum of column (17) total (Hardship Bank value) and EPA allocation in column (22). Indivdiual agency proportionate shares of EPA's adjustment based on column (25).
(27) Allocation with EPA Adjustment: Column (22) plus column (26).

Final Allocations
(28) Final Purchase Cutback: Column (27) minus column (1) expressed as MGD
(29) Final Purchase Cutback: The change between column (31) and column (1) shown as a percentage.
(30) Final Allocation Factor: Each agency's allocation from Column (27) divided by the total water allocated to the wholesale agencies (total in Column (27)), shown as a percentage

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Attachment 2

TM 2: Updated Agency-Identified Water Supply Management Project Information for the Long-Term Reliable Water Supply Strategy

CDM Smith

STRATEGY PHASE II A TECHNICAL MEMORANDUM NO. 2

Updated Agency-Identified Water Supply Management Project Information for the Long-Term Reliable Water Supply Strategy

BAWSCA

April 5, 2012

DRAFT FINAL

CDM Smith

Technical Memorandum No. 2
Updated Agency-Identified Water Supply Management Project Information for the Long-Term Reliable Water Supply Strategy

(Draft Final– April 5, 2012)

Errata

This Draft Final Technical Memorandum (TM) No. 2 was completed and reviewed by the BAWSCA member agencies. Changes and updates incorporated from those comments were only included in the Phase II A Final Report.

Technical Memorandum No. 2
Updated Agency-Identified Water Supply Management Project Information for the Long-Term Reliable Water Supply Strategy
Draft Final – April 5, 2012

Section 1
Summary

In This TM:

As part of the Long-Term Reliable Water Supply Strategy (Strategy), the Bay Area Water Supply and Conservation Agency (BAWSCA) is evaluating alternative water supply management projects (projects) to augment existing supplies to meet the future normal and/or drought year demands of its member agencies though 2035. The May 2010 *Phase I Scoping Report* identified sixty-five (65) agency-identified water projects for further evaluation in Phase II A of the Strategy.

As part of Phase II A, the BAWSCA member agencies and the Strategy Team (i.e., BAWSCA staff and the consultant team) participated in the project refinement process summarized in Figure 1. As a result of that process, four agency-identified projects were retained for development and evaluation in Phase II A and six agency-identified projects were identified for potential evaluation in later phases of the Strategy. The four agency-identified projects retained for development and evaluation in Phase II A are:

- Daly City - Recycled Water Expansion (DC-4);
- Representative Coastal Desalination Project (*formerly the North Coast County Water District (NCCWD) – Desalination Plant (NC-4)*);

- Palo Alto – Palo Alto Recycled Water Plant Expansion (PA-2); and
- Redwood City – Redwood City Recycled Water Treatment Plant Expansion (RC-4).

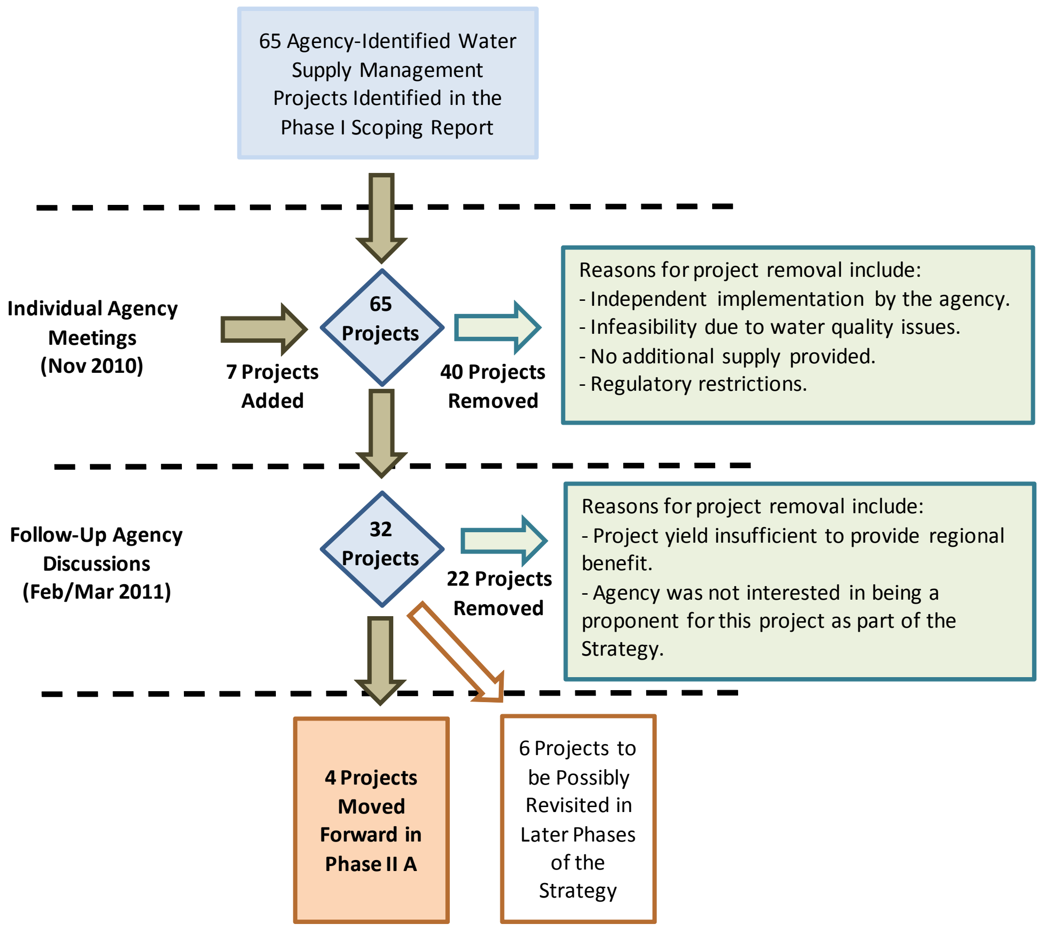

Figure 1
Phase II A Refinement Process for Agency-Identified Projects

The six agency-identified projects that have been retained for potential evaluation in later phases of the Strategy include:

- California Water Service Company (Cal Water) - Water Desalination Project (CW-6);
- City of Mountain View - Recycled Water Intertie with Sunnyvale (MV-2);
- City of Mountain View - Increase Recycled Water Supply From Palo Alto Regional Water Quality Control Plant (PARWQCP) (MV-3);

- City of San Jose - Intertie Connection with Santa Clara Valley Water District (SCVWD) (SJ-4);
- City of Sunnyvale - Increase Recycled Water Output from Wastewater Treatment Plant (WWTP) (SV-2); and
- City of Sunnyvale - Expand Use of New or Converted Wells to Normal Year Supply (SV-4).

During interviews with the BAWSCA member agencies, the Strategy Team also assessed each agencies interest in pursuing rainwater harvesting, stormwater capture, or greywater reuse. Some of the agencies are interested in supporting these types of local water capture and reuse projects and others are already supporting their implementation locally. As such, rainwater harvesting, stormwater capture, or greywater reuse projects are included in this TM for comparative purposes.

In order to allow evaluation and comparison of the projects within the Strategy, key types of project information are needed. This TM summarizes the information for costs, facilities; supply reliability and schedule developed to date for the above agency-identified projects.

1.1 Project Descriptions

The following sections summarize key information regarding the description of the agency-identified and local water capture projects, and their estimated yields, costs and implementation timeframes (i.e., schedule). Figure 2 indicates the BAWSCA member agency service areas, and the specific service areas for Daly City, Redwood City, Palo Alto, and Pacifica.

1.1.1 Daly City Recycled Water Expansion Project

The Daly City recycled water expansion project is summarized in the text below. Additional information is presented in Section 3 and in Exhibit 2.

Description
The Daly City recycled water expansion project expands the existing Daly City recycled water expansion project to serve irrigation customers within the Town of Colma (Colma). Daly City and the San Francisco Public Utilities Commission (SFPUC) jointly funded a study of the expansion of the existing Daly City Recycled Water Plant to serve both Colma and areas within the City and County of San Francisco. The proposed project described in this TM is an expansion of 3 million gallons per day (mgd) and only includes service within Colma

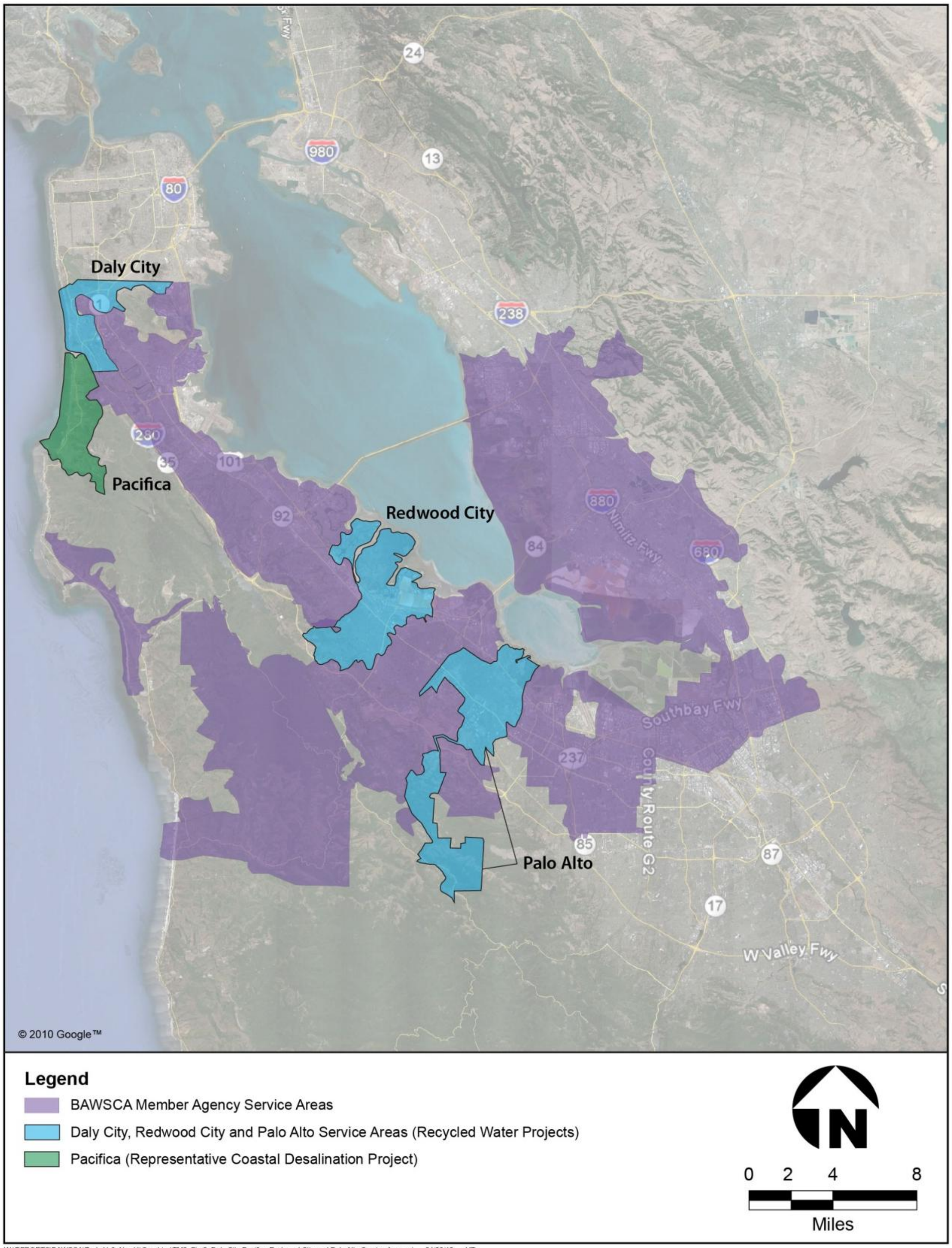

Figure 2
Daly City, Redwood City and Palo Alto Service Areas and Pacifica

The expansion of the existing recycled water treatment, transmission, and distribution system will serve irrigation customers within Colma, including cemeteries, city parks, schools and a golf course. These irrigation customers currently use private groundwater wells that extract groundwater from the Westside Groundwater Basin, or potable water served by the South San Francisco District of Cal Water to irrigate turf and other landscaping. Converting these irrigation customers to recycled water would free up these supplies for other uses.

Yield
The project expansion of 3 mgd is designed to meet the estimated combined annual demand of the Colma irrigation customers of 1,060 acre-feet (AF) per year. The project yield is lower than the maximum potential yield available from the 3 mgd expansion due to the timing and duration of the irrigation demand.

Costs
The present worth cost for this project is about $2,100/AF, not including operations and maintenance (O&M). O&M costs have not been developed at this time for the recycled distribution system. Inclusion of those O&M costs will increase the present worth costs.

Project Implementation Schedule
A specific implementation schedule was not developed for this project. However, based on similar types of projects, it is anticipated that implementation, including planning and environmental review, preliminary design, final design, and construction, will take about 6 years after a decision has been made to move forward with the project.

1.1.2 Representative Coastal Desalination Project

The representative coastal desalination project is a project that was originally identified by the NCCWD during the Phase I Scoping Report (*North Coast County Water District–Desalination Plant (NC-4))*. In subsequent discussions, NCCWD indicated that they would not be pursuing the development of this project independently (see *Exhibit 2*). However, because of the potential benefits to the region, a similar project concept has been carried forward for evaluation by BAWSCA. This representative coastal desalination project is summarized below. Additional information is presented in Section 4 and in Exhibit 2.

Description
The representative coastal desalination project would treat sea water from a subsurface intake structure developed on the coast near Pacifica. The water would be treated through a reverse osmosis (RO) desalination process and delivered to a connection with the San Francisco (SF) Regional Water System (RWS) on the upper San Mateo Peninsula. This project has an estimated maximum treated water capacity of 7.5 mgd based on facility capacity limitations. This treated water capacity is specifically limited due to space constraints at the proposed desalination treatment plant site (assumed to be the former Sharp Park Wastewater Treatment Plant (WWTP) site, and the potential capacity of the subsurface intake (i.e., assumed to be Ranney Collector Wells located in the Pacifica State Beach area). The potential subsurface intake capacity is based on the identified

beach area and conservative estimates of spacing for multiple Ranney Collector Wells. However, specific information is not known about thickness of the beach sands or the off-shore geologic formations that could affect this capacity.

Yields
Annual production estimates depend on whether the project is developed for normal and/or drought year supply. For the purposes of this analysis, the annual production is assumed to be at 80% of the 7.5 mgd treated water design capacity, or 6,700 AF per year.

Costs
The present worth cost for this project is about $2,200/AF excluding costs for land acquisition for the Ranney Collector Wells, the treatment plant site, the reservoir storage site and conveyance through the SF RWS.

Project Implementation Schedule
The overall implementation schedule is estimated to take 6 to 8 years to complete after a decision is made to move forward with the project. This schedule includes: Phase I field investigations; assessments; financing, and other studies; and Phase 2 preliminary design and draft Environmental Impact Report (EIR), permit applications, final design, bid and construction, and project startup.

1.1.3 Redwood City Recycled Water Treatment Plant Expansion Project

The Redwood City recycled water treatment plant expansion project is currently being evaluated by Redwood City and only limited information is available at this time. It is anticipated that the yield, cost, implementation, schedule and other information for this project will be available from Redwood City by mid-2012. The project information that is available to date is included in Section 5 and Exhibit 3.

Description
This Redwood City recycled water treatment plant expansion is an expansion of the existing Redwood City/South Bayside System Authority (SBSA) recycled water treatment facility from 2.8 to 8.0 mgd. The existing Redwood City recycled water system includes tertiary-treatment facilities, two 2.2 million gallon storage tanks, a distribution system pump station (all located at the SBSA WWTP), and recycled water distribution facilities throughout Redwood City.

Yields
The customers and delivered water quantity, yield, is currently being developed by Redwood City.

Costs
The costs for this project are currently being developed by Redwood City.

Project Implementation Schedule
The implementation schedule is currently being developed by Redwood City.

1.1.4 Palo Alto Recycled Water Plant Expansion Project

The Palo Alto recycled water treatment plant expansion project is currently being evaluated by the City of Palo Alto and only limited information is available at this time. It is anticipated that the yield, cost, implementation schedule and other information will be available from Palo Alto by mid-2013 as part of the project EIR. The project information that is available to date is included in Section 6 and Exhibit 3.

Description
The Palo Alto recycled water treatment plant expansion project is an expansion of the recycled water treatment facilities at the Regional Water Quality Control Plant (RWQCP) to produce recycled water to potentially serve the Stanford Research Park. The average annual and peak demands for this project are estimated to be 0.8 mgd and 2.0 mgd, respectively. The City of Palo Alto owns and operates the RWQCP which treats wastewater for six communities and districts including Los Altos, Los Altos Hills, Mountain View, Palo Alto, Stanford University, and the East Palo Alto Sanitary District.

The current filtration/chlorination system capacity is 4.5 mgd. Ultraviolet (UV) disinfection can increase this capacity by 6.0 mgd to a total of 10.5 mgd. Addition, of another 2.0 mgd of UV capacity with an extra UV bank could increase the total capacity to 12.5 mgd. The City of Palo Alto is currently evaluating the expansion alternative based on the long-term recycled demands of the potential customers.

Yields
The potential recycled water customers, their demands, projections of delivered water quantity and annual yield, are currently being developed by Palo Alto.

Costs
The costs for this project are currently being developed by Palo Alto.

Project Implementation Schedule
A conceptual project schedule was provided by Palo Alto with design completed in 2012 and construction completed in 2014. However, this project schedule is currently being updated as part of the EIR preparation.

1.1.5 Rainwater Harvesting Projects

The rainwater harvesting projects are summarized in the text below. Additional detailed information is presented in Section 7 and in Exhibit 4.

Description
Rainwater harvesting includes the collection of rainwater runoff from roof surfaces by gutters and downspouts and storage of that water for use during a subsequent dry day. Using the stored water for landscape watering and non-potable indoor uses reduces potable water demands. In the most straightforward single-family residential applications, rainwater is collected from a roof in a rain barrel and used to irrigate a yard or garden. This simple application requires only the purchase of a rain barrel and the appropriate hoses and fittings to convey water to the irrigated area.

For larger scale roof rainwater collection and storage, such as for commercial developments and multi-family housing, greater quantities may be captured provided that large cisterns are constructed in basements, or if underground or surface level storage tanks are present at the site. The stored rainwater is then pumped from storage and used for non-potable purposes such as irrigation, car washing, clothes washing machines, toilet flushing, swimming pools, and process water for commercial and industrial uses. Many of these applications, including toilet flushing, and use in swimming pools and process water, require treatment and separate piping systems.

Yields
A preliminary estimate of the potential yield for rainwater harvesting in 2035 in the BAWSCA service areas ranges from 190 AF/year to 610 AF/year. This calculation is based on the projected number of single family residential units within the BAWSCA service area in 2035, average monthly rainfall, average roof size, the percentage of roof area captured by the system, and assumed percentage of total homes that install a rainwater harvesting system. The range in yield was determined by varying the percent of roof runoff that is captured by the rainwater harvesting system (25 and 50%) and the participation rate (10 and 20%).

Costs
The estimated cost of this supply ranges from about $13.3 to $26.6 million based on the following assumptions:

- Each household system costs $300 (estimate for 1 rain barrel, and associated fittings, per unit);
- Estimated equipment life of 15 years; and
- Number of households participating - 44,400 (10% participation rate) and 88,800 (20% participation rate).

Estimates of present worth costs have not been developed for rainwater harvesting projects at this time.

Project Implementation Schedule
Rainwater harvesting projects, depending on ownership and size, will vary in the time required to implement them on an individual basis, and within an agency service area. Part of the implementation on the agency level will be the types of rebates or other incentives that an agency may provide to encourage the installation and use of rainwater harvesting equipment.

1.1.6 Stormwater Capture Projects

The stormwater capture projects are summarized below. Additional information is presented in Section 8 and in Exhibit 4.

Description
These projects evaluated herein include the capture stormwater that can then be used for a variety of purposes, including to increase the groundwater supply through recharge and to reduce potable water use for outdoor irrigation. These stormwater capture projects focus on the potential potable water demand reductions within the BAWSCA service area, and area-wide implementation of low-impact development (LID) projects[1].

Yields
The stormwater capture projects are estimated to potentially save from 4,100 to 7,500 AF/year through the reduction of the outdoor irrigation demands and potential benefits of groundwater recharge. The wide range of potential water demand reductions reflects a range of variables and input values that include average monthly rainfall throughout the region, land use information including impervious surface metrics, and method of retention (i.e., capture and storage for reuse or infiltration into the groundwater aquifer in areas where large-scale groundwater pumping occurs).

Costs
Reliable cost information is not currently available for implementation of stormwater capture and reuse or LID projects on a regional or local scale. As such, neither capital nor present worth costs are included at this time.

Project Implementation Schedule
Stormwater capture projects, depending on ownership and size, and will vary in the time required to implement.

1.1.7 Greywater Reuse Projects

The greywater reuse projects are summarized below. Additional information is presented in Section 9 and in Exhibit 4.

Description
Greywater (also spelled graywater, grey water, and gray water) is the untreated household waste water from bathtubs, showers, bathroom sinks, and washing machines. Waste water from toilets, referred to as "black water", is not included. In California, waste water from kitchen sinks or dishwashers is also not an acceptable source of greywater.

Unlike rainwater harvesting and stormwater capture, greywater production capacity does not vary seasonally. However, the potential yield from greywater reuse projects is dependent on the timing and magnitude of the demand, especially to the extent that the water is used for irrigation. During the winter months, when irrigation demands are

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[1] A study by the Natural Resources Defense Council (NRDC) found that LID has a substantial potential to save both water and energy in the San Francisco Bay area California. The group estimated that LID projects implemented throughout a 3,850 square mile study area including San Francisco, Marin, Contra Costa, Alameda, Santa Clara, and San Mateo counties could provide 34,500 – 63,000 AF of water per year by 2030 (or 9.0 – 16.4 AF/year of savings per square mile) (NRDC 2009). Using this example, the 460 square mile BAWSCA service area would potentially save 4,100 - 7,500 AF per year through service area-wide implementation of LID projects.

lower, there could be a surplus of greywater supply which would have to be discharged to the sewer or septic system. Greywater can also be used to flush toilets, which provide year-round demands, but this would require the construction of a more complex and permitted system that would provide treatment to Title 22 standards.

Yields
A preliminary estimate of potential greywater yield in 2035 for the BAWSCA member agencies' service areas ranges from about 1,100 AF/year to 2,700 AF/year for simple systems used for irrigation. This estimate is based on a calculation using the number of single family residential units within the BAWSCA service area, assumed participation rate, and an average volume of greywater generated per household. The range in yield was estimated by varying the average volume of greywater generated per household (41 to 108 gallons per day). The yield range is based on assumed greywater production per household (41 and 108 gpd) and participation rate (10 and 20%).

Costs
The estimated cost of this supply ranges from about $13.3 to $26.6 million based on the following assumptions:

- Each household system costs $300 (estimate for one rain barrel, and associated fittings, per unit);
- Estimated equipment life of 15 years; and
- Number of households participating - 44,400 (10% participation rate) and 88,800 (20% participation rate).

Estimates of present worth costs have not been developed for rainwater harvesting projects at this time.

Project Implementation Schedule
Greywater reuse projects, depending on ownership and size, will vary in the time required to implement on an individual basis, and within the service areas. Part of the implementation will be the types of rebates that may be available to provide incentives to install and use the equipment, and maintenance and eventual replacement. In addition, regulations which currently limit the use of greywater also will affect the implementation of these projects.

1.2 Project Evaluation

One of the goals of the Strategy, as described in the *Phase I Scoping Report,* is to develop a quantitative and defensible project evaluation process. To that end, evaluation criteria and metrics have been developed (see *Exhibit 5*).

These six criteria include:

- Increase Supply Reliability;
- Provide High Level of Water Quality;
- Minimize Cost of New Water Supplies;
- Reduce Potable Water Demand;
- Minimize Environmental Impacts; and
- Increase Implementation Potential.

This TM focuses on the supply reliability (yield for normal and dry years), facilities and cost, and implementation schedule for the agency-identified projects. Table1 compares these key metrics, to the extent that the information is available, for the Daly City recycled water expansion project, the representative coastal desalination project, the Redwood City recycled water treatment plant expansion project, the Palo Alto recycled water plant expansion project, rainwater harvesting projects, stormwater capture projects and greywater reuse projects.

Table 1
Summary of Project Yields, Costs and Implementation Schedules

Item	Daly City Recycled Water Expansion Project [1]	Representative Coastal Desalination Project	Redwood City Recycled Water Treatment Plant Expansion Project	Palo Alto Recycled Water Plant Expansion Project	Rainwater Harvesting Projects	Stormwater Capture Projects	Greywater Reuse Projects
Assumed Treatment Production Capacity (mgd)	2.89	7.5	NA[6]	NA[7]	NA	NA	NA
Estimated Annual Production (AF/Year)	1,060	6,700 [2]	NA[6]	NA[7]	190 – 610	4,100 – 7,500	1,120 – 2,700
Capital Cost							
Capital Cost ($M)[3]	$50.1	$214.7 [9]	NA[6]	NA[7]	$13.3 – $26.6	NA	$13.3 – $26.6
Present Worth Costs [4]							
Total Production – 30 years (AF)	31,800	201,600	NA[6]	NA[7]	NA	NA	NA
Total Present Worth Cost ($M)	$65.0[5,8]	$448[9,10]	NA[6]	NA[7]	NA	NA	NA
Present Worth Unit Cost ($/AF)[6]	$2,100[5,8]	$2,200[9,10]	NA[6]	NA[7]	NA	NA	NA
Implementation Schedule							
Implementation Schedule (Years)	6	6 to 8	NA[6]	NA[7]	NA	NA	NA

[1] Based on data provided by Daly City.
[2] Assumes annual operation at 80% of capacity.
[3] Costs adjusted to August 2011.
[4] Annualized cost based on 30 year return with 3% discount rate.
[5] Data developed by Strategy Team.
[6] Data being developed by Redwood City.
[7] Data being developed by Palo Alto.
[8] Does not include O&M for distribution system costs.
[9] Does not include land and conveyance costs.
[10] Does not include potential costs for conveyance through SF RWS.

1.3 Key Outstanding Project Issues and Next Steps

There are key issues which apply to all of the BAWSCA Regional Projects that may affect the yield, cost, implementation, water quality and other aspects of project viability. The following identifies those groups of issues, and provides examples of how they apply in general. Table 2 provides a more detailed description of the issues critical to the viability of each of the regional projects.

- ***Yield***: In most cases, the yield of the various projects, including what yields may be available to BAWSCA, are unknown at this time and will need to be confirmed.
- ***Cost***: In many cases, the costs are incomplete (e.g., they do not include some facilities, conveyance or other critical information) and additional information will be needed to determine total project cost and to compare project costs.
- ***Implementation***: All of the projects listed herein are complex and would require the agreement of multiple parties, as well as the construction of facilities, environmental review and other elements (e.g., land purchase, wheeling agreements, permitting, rights-of-way).
- ***Water Quality***: Water quality can have a significant impact on treatment costs, conveyance ability, and beneficial use of the water. The water quality for the projects is not fully known and will need to be confirmed if it significantly affects cost or implementation.

If it is determined that all or some of the agency-identified projects should proceed, several additional technical steps will be required to confirm their feasibility including:

- ***Daly City Recycled Water Expansion Project.*** A decision needs to be made by Daly City and SFPUC as to who will and own and operate this project. In addition, commitments need to be obtained from the proposed recycled water customers to ensure that the project is viable. Daly City will need to develop O&M costs.
- ***Representative Coastal Desalination Project.*** The availability of the suggested facility sites (wells, treatment plant and storage) needs to be confirmed and costs identified. In addition, the pumping capacity and yield at the proposed Ranney Collector Wells needs to be determined.
- ***Redwood City Water Treatment Plant Expansion Project.*** Project information will need to be updated based on the not yet released Redwood City 2012 Feasibility Study update. Whether this project is intended to be implemented by Redwood City or some other agency needs to be determined.
- ***Palo Alto Recycled Water Plant Expansion Project.*** Project information will need to be updated based on final EIR to be completed in 2013. Palo Alto's interest in implementing this project will need to be determined.

- ***Rainwater Harvesting Projects***. The degree of on-going interest for these types of programs by BAWSCA member agencies and their customers.

- ***Stormwater Capture Projects.*** Track the development and implementation of stormwater capture projects like East Palo Alto's Martin Luther King Park system and the Half Moon Bay Blue Sky Farm's stormwater capture and reuse system to address information gaps that still exist in terms of the feasibility, potential yield and cost of stormwater capture projects.

- ***Greywater Reuse Projects.*** Track the on-going interest for greywater reuse programs by BAWSCA member agencies and their customers, and the current efforts of agencies like Greywater Guerrillas/Greywater Action in Berkeley who support greywater reuse through workshops including an "Install your own greywater system" workshop in San Francisco that is part of a pilot program from SFPUC.

In parallel, BAWSCA will continue to work with the BAWSCA agencies to assess the magnitude and timing of their water supply needs and to confirm their interest in pursuing any of the above projects.

1.4 Conclusions

The water supply management projects presented herein could potentially be used by BAWSCA and the BAWSCA member agencies to meet the normal and/or drought supply needs through 2035. In addition, *TM 3 - Updated Regional Water Supply Management Project Information* presents other potential regional projects that have been identified for evaluation as part of the Strategy.

The projects presented herein and in TM 3 were initially identified in the *Phase I Strategy Scoping Report*. The project information development to date has focused on preliminary estimates of the yield, cost, reliability and implementation schedule. The objective has been to develop the information to a common level so that the projects can be compared to each other and preliminarily ranked to determine which individual or combination of projects could best meet the identified supply need. For each of the projects presented in TMs 2 and 3, key issues and outstanding technical information has been identified, along with potential next steps.

In July 2012, the *Long-Term Reliable Water Supply Strategy Phase II A Report* (*Phase II A Report*) will be completed. This *Phase II A Report* will present the technical information developed to date as part of the Strategy (from TMs 1, 2, and 3), as well as updated information on the frequency and magnitude of expected supply shortfalls from the SF RWS. The *Phase II A Report* will also present a recommended implementation plan to achieve the Strategy's goal of ensuring that a reliable, high quality supply of water is available where and when people within the BAWSCA service area need it.

Table 2
Summary of Project Key Issues

Issue Type	Daly City Recycled Water Expansion Project	Representative Coastal Desalination Project	Redwood City Recycled Water Treatment Plant Expansion Project	Palo Alto Recycled Water Plant Expansion Project	Rainwater Harvesting Projects	Stormwater Capture Projects	Greywater Reuse Projects
Yield	• Yield is dependent on customers' long-term commitment to use.	• Hydrogeologic information is not available for the proposed intake area; and • Mitigation of the potential impacts on water quality or yield for other groundwater pumpers in the area may impact pumping capacity and long-term yield.	• Ongoing work by Redwood City will confirm the demands for this project.	• Ongoing work by Palo Alto will confirm the demands for this project.	• Frequency and amount of rainwater does not coincide with when demands occur; • Storage capacity limits rainwater harvesting during wet periods; • Local plumbing codes do not require a permit if they have a maximum storage capacity of 360 gallons; and • Long-term yield is dependent on number of units installed, whether they are maintained and on-going customer participation.	• Frequency and amount of stormwater does not coincide with when demands occur; • Yield is dependent on available uses of water captured; • Yield is dependent on rainfall and especially the collection of high rainfall events; • Limited year-round availability (depending on rainfall patterns) with no availability during drought conditions; and • Long-term yield is dependent on number of units installed, whether they are maintained and on-going customer participation.	• Long-term yield is dependent on number of units installed, whether they are maintained and on-going customer participation.
Cost	• Distribution system and operation and maintenance (O&M) costs estimates have not been developed for the project.	• The availability and the potential use of land for the Ranney Collector Wells (Pacifica Beach Area), desalination treatment plant (old Sharp Park WWTP), and tank site (Milagra Ridge Park) need to be confirmed. If these sites are not available the cost of the project will be greater than currently estimated; and • If the proposed alignment for the raw water, treated water, and brine pipelines is not available, the pipeline costs could be greater than currently estimated.	• Funding sources; • Capital, O&M and present worth (life-cycle) costs need to be developed to determine project viability; and • Purchase price for water, whether subsidized or not needs to be developed.	• Funding sources; • Capital, O&M and present worth (life-cycle) costs need to be developed to determine project viability; and • Purchase price for water, whether subsidized or not needs to be developed.	• Capital costs are high compared to yield.	• Most systems will require pressure pumps and controls compared to using municipal system water pressure, increasing maintenance costs.	• Can be expensive to retrofit because of the dual plumbing (wastewater and greywater) required.

Table 2
Summary of Project Key Issues

Issue Type	Daly City Recycled Water Expansion Project	Representative Coastal Desalination Project	Redwood City Recycled Water Treatment Plant Expansion Project	Palo Alto Recycled Water Plant Expansion Project	Rainwater Harvesting Projects	Stormwater Capture Projects	Greywater Reuse Projects
Implementation	• Both Daly City and the City of San Francisco are jointly evaluating this project. The role of the City of San Francisco would need to be resolved prior to this project proceeding. • The potential recycled water customers identified by Daly City (i.e., the cemeteries in Colma) would need to commit to long-term use and purchase of the recycled water.; and • Potential funding partners for the project and the retail unit price for the recycled water have not been determined.	• Potential partners for project development and water supply customers need to be determined; • Ownership and operation of the treatment, pumping and brine disposal facilities needs to be determined; • Public support and/or opposition; • Availability and the potential use of land for the Ranney Collector Wells (Pacifica Beach Area), desalination treatment plant (old Sharp Park WWTP), and tank site (Milagra Ridge Park) need to be confirmed. If these sites are not available the feasibility of the project will be impacted; and • Availability of proposed alignment for raw water, treated water, and brine pipelines need to be confirmed and potential mitigation and permitting issues determined.	• Potential partners for project development need to be identified; • Potential recycled water customers need to be determined; and • Interagency agreements will require long-term purchase commitments along with a recycled water supply sales agreement.	• Potential partners for project development need to be identified; • Potential recycled water customers need to be determined; and • Interagency agreements will require long-term purchase commitments along with recycled water supply sales agreement.	• Storage may not be aesthetically pleasing to neighbors; and • Deed restrictions in some developments may limit a homeowner's ability to add an outdoor storage tank (rain barrel); and • Requires individual customer implementation.	• Stormwater discharge is primarily regulated by the United States Environmental Protection Agency's Clean Water Act, Title 40 requirements for permitting and discharge of stormwater, and water quality and wetland permits from the US Army Corps of Engineers. Water below the ordinary high water level or in wetland areas is not available for collection; and • National Pollutant Discharge Elimination System (NPDES) permits for point source discharges must implement region-specific water quality standards defined by the Regional Water Quality Control Board. (California Resources Agency 2002); and • Requires individual customer implementation.	• Can be difficult and costly to obtain a permit for greywater reuse systems; and • Reduced sewer flows from greywater systems have led to increases in sewer blockages and increases in odor complaints in some areas; and • Requires individual customer implementation.
Water Quality	• Public and the potential customers may not find the use of recycled water for application at the cemeteries to be acceptable.	• Source water quality (e.g., salinity, iron, manganese, etc.) is currently unknown and may affect the treatment process, treatment cost, and the brine discharge requirements and cost; and • Use of the SF RWS for conveyance to member agencies, if required.	• Total dissolved solids (TDS) was identified as a potential issue for sensitive plants; and • Public acceptance of the use of recycled water.	• The project is subject to a potential limitation on recycled water use due to salt impacts.	• Developments that utilize larger roof areas for collection of rainwater can increase the contamination risks from bird or animal droppings.	• Permits for urban stormwater runoff stored and reused for irrigation may be reviewed by the Department of Public Health to ensure the necessary water quality is maintained.	• Greywater can contain soaps and other chemicals that can kill plants and antimicrobial products that can reduce beneficial soil microbes; and • Greywater supply cannot be used to irrigate most food plants.

Section 2
Potential Agency-Identified Projects

2.1 Summary of Phase I and Phase II Compilation of Projects

The May 2010 *Phase I Scoping Report* presented 65 agency-identified water supply management projects (projects) that would be further evaluated during Phase II A of the BAWSCA Strategy.

Phase II of the Strategy was originally intended to include three phases:

- Phase II A – Develop Near-Term Recommendations;
- Phase II B – Develop Mid-Term Projects and Conduct Field Investigations; and
- Phase II C – Develop Long-Term Recommendations.

The Strategy is currently in Phase II A. The need for Phases II B and II C will be evaluated later in 2012. Whether this effort will be required will depend on the overall supply need and types of projects that the BAWSCA members may want to continue to evaluate.

As part of Phase II A, the BAWSCA member agencies and the Strategy Team participated in a project refinement and screening process. Based on the results of this effort, ten (10) agency-identified projects were retained for further evaluation in the Strategy: four for evaluation in Phase II A, and six for potential evaluation in later phases of the Strategy. The rest of the agency-identified projects are not being evaluated further as part of the Strategy based on the screening criteria agreed upon by BAWSCA and the member agencies.

The level of information currently available for the agency-identified projects moving forward in the Strategy varies significantly. Additional information will be required to fill remaining data gaps and to provide a common basis for project comparison (e.g., individual project cost, etc.). To facilitate initial comparison between the agency-identified projects, the Strategy Team has summarized the critical project data needs for the 10 agency-identified projects. For the projects to be evaluated as part of the Strategy (either in Phase II or a later phase) this data will be developed either by the sponsoring agency (mid 2012 for Redwood City and mid 2013 for Palo Alto), or by BAWSCA.

2.2 Compilation of Agency-Identified Projects

The May 2010 *Phase I Scoping Report* identified 65 agency projects as existing, planned, or potential opportunities that could be included in the Strategy. These projects, summarized in *Exhibit 1*, would develop groundwater, recycled water, or desalination sources within the BAWSCA service area, and water transfers from outside the Bay Area or between member agencies.

In September 2010, the Strategy Team developed a Project Information Sheet for each of the 65 projects to consolidate the information available from the *Phase I Scoping Report*. The Project Information Sheets identified: (1) the information needed to support the comparison of projects, and (2) the project information that was available from existing studies and documents. The information requested included the following:

- General project information;
- Infrastructure – facilities, costs, and ownership;
- Supply reliability;
- Water quality;
- Schedule;
- Funding;
- Environmental impacts; and
- Implementation potential.

In October 2010, each agency received a Project Information Sheet for each project they had identified within their service area. Each member agency was asked to review the Project Information Sheets and complete them with available information. In November and December 2010, the Strategy Team held individual meetings with each agency to discuss details of their projects, along with their expectations for the Strategy.

Through the course of the meetings, seven member agencies added projects to the Strategy, as shown in *Exhibit 1, Table 2*. These were projects that had been: (1) identified subsequent to the completion of the Phase I Scoping Report; (2) identified as distinct elements of a project identified in Phase I; or (3) were future expansions of projects identified in Phase I.

In addition, based on discussions with the member agencies regarding their current plans and activities, 40 projects were removed from further consideration in the Strategy. The reasons that agencies opted to remove a project included:

- Independent implementation by the agency;
- Infeasibility due to water quality issues;

- Implementation as part of the SFPUC Water Supply Improvement Program to provide dry year supply reliability;
- No additional supply provided or additional yield was unlikely;
- Lack of interest by the agency in pursuing the project;
- Regulatory restrictions;
- Existing wells would remain as emergency supply; or
- The project was a study only, not a supply project.

Exhibit 1 Table 3 identifies the 40 projects that were removed from consideration in the Strategy in November and December 2010. These projects are identified in *Exhibit 1, Table 3* as being removed during the "Individual agency meetings" step of the project screening process. *Exhibit 1 Table 3* also lists the 21 additional projects that were removed in later stages of the project screening process.

2.3 Information Needed to Complete Project Evaluation

Complete and accurate information is critical to comparing and evaluating the agency-identified projects that were retained for evaluation as part of the Strategy. Although additional project information was obtained from the individual agency meetings and the returned Project Information Sheets, information gaps remain.

To help identify the existing level of completion for certain critical pieces of project information and quickly assess the remaining information gaps, the Strategy Team summarized the current status of available project information for costs, facilities, supply reliability, schedule, water quality, implementation, environmental impacts, funding, and ownership.

Of the 32 projects retained as of January 2011:

- No projects had complete information in every category;
- Only two projects had 25 to 75 percent of the cost information;
- Only seven projects had 25 percent or more of the project facility information; and
- Ten projects had less than 25 percent of the requested information for all categories.

2.4 Summary of Commitment Letters and Follow-up Agency Discussions

In January 2011, for the 32 retained projects, BAWSCA sent each agency a commitment letter wherein each agency was asked to confirm which of their projects they would like retained in the Strategy, and to commit to which of the remaining information gaps the agency would fill for each project and by when. As an example, *Exhibit 1* contains the tables and commitment form sent to Daly City in January 2011.

Through the project commitment letter process, an additional 22 projects (for a total of 61) were removed from consideration in Phase II A of the Strategy. These projects are identified in *Exhibit 1* as being removed during the "Follow-up agency meeting" step of the project screening process. Reasons for removing these projects included:

- No commitment to pursuing this project as part of the Strategy;
- No commitment to pursuing this project as part of the Strategy; however, similar projects are being evaluated in the Strategy as part of the analysis of regional water transfer options;
- Insufficient yield to provide regional benefit; or
- Independent implementation by the agency.

Following the return of the commitment letters, the Strategy Team met with Daly City, NCCWD, Redwood City, and Sunnyvale in April 2011 for follow-up discussions regarding their projects. These were agencies who had agreed, through their completed and signed commitment forms, to develop additional information for their projects. The meetings were conducted to identify any outstanding questions, or issues regarding the projects, and to confirm member agency interest in the potential projects and the schedule for project information development. The representative coastal desalination project was originally identified by the NCCWD as a Desalination Plant with a designation of NC-4. After discussions between BAWSCA staff and NCCWD representatives, it was determined that NCCWD was not a proponent of a specific coastal desalination project at this time. As this is the only potential coastal desalination site currently included in the Strategy, the generic representative coastal desalination project replaces NCCWD NC-4 and has been included as a new project.

2.5 Priority Projects for Phase II A

As a result of the follow-up agency meetings in April 2011, four projects were identified for evaluation in Phase II A of the Strategy. In order to track each agency-indentified project, a unique identifier was developed with the first two letters representing the agency with the following number indicating the project number.

- Daly City – Recycled Water Project Expansion (DC-4);
- Representative Coastal Desalination Project (*formerly the North Coast County Water District (NCCWD) – Desalination Plant (NC-4)*);
- Palo Alto – Palo Alto Recycled Water Plant Expansion (PA-2); and

- Redwood City – Redwood City Recycled Water Treatment Plant Expansion (RC-4).

Further technical detail on these four projects is presented in Sections 3, 4, 5, and 6 of this TM 2, respectively.

During interviews with the BAWSCA member agencies, the Strategy Team also assessed each agencies interest in pursuing rainwater harvesting, stormwater capture, or greywater reuse. Some of the agencies are interested in supporting these types of local water capture and reuse projects and others are already supporting their implementation locally. As such, rainwater harvesting, stormwater capture, or greywater reuse projects are included in this TM for comparative purposes.

Local rainwater harvesting, stormwater, and greywater projects are summarized in Sections 7, 8, and 9 of this TM, respectively.

In parallel with the development of the needed information for these agency-identified projects, information was developed in early 2012 for the identified potential regional projects (i.e., regional desalination and water transfer projects), which are addressed in TM 3.

2.6 Projects Retained for Potential Evaluation in Later Phases of the Strategy

At the time of the follow-up agency meetings in April 2011, a number of agencies were in the process of developing information for their projects and committed to providing this information to BAWSCA for use in the Strategy when it became available. However, the schedule for developing this information was extended beyond the deadline for the Phase II A evaluation. These projects may be revisited in later phases of the Strategy depending on when information is provided to BAWSCA. The six agency-identified projects that have been retained for potential evaluation in later phases of the Strategy include:

- California Water Service Company (Cal Water) - Water Desalination Project (CW-6);
- City of Mountain View - Recycled Water Intertie with Sunnyvale (MV-2);
- City of Mountain View - Increase Recycled Water Supply From Palo Alto Regional Water Quality Control Plant (PARWQCP) (MV-3);
- City of San Jose - Intertie Connection with Santa Clara Valley Water District (SCVWD) (SJ-4);
- City of Sunnyvale - Increase Recycled Water Output from Wastewater Treatment Plant (WWTP) (SV-2); and
- City of Sunnyvale - Expand Use of New or Converted Wells to Normal Year Supply (SV-4).

Table 3 presents this information for the above 10 proposed projects, including agency, project name, identification code, water source, and yield. The level of information provided is distinguished by the empty, partial, or filled-in circle under each data category. A "○" denotes that less than 25 percent of the data identified in the Project Information Sheet for that data category is currently available; a "◗" means 25 to 75 percent of the information is available; and a "●" denotes 75 percent or more of the data is available.

Table 3
Summary of Information Gaps for Retained Agency-Identified Projects, as of January 2011

General Project Information							Information Provided								
Agency	**Project Index**	**Title**	**Type**	**Status**	**Yield [1]**		**Costs**	**Facilities**	**Supply Reliability**	**Schedule**	**Water Quality**	**Implementation Potential**	**Environmental Impacts**	**Funding**	**Ownership**
					(mgd)	**(AF/year)**									
Cal Water	CW-6	Cal Water Desalination Project	Desalination	Potential	NA		○	○	○	○	○	○	○	○	○
Daly City	DC-4	Daly City Recycled Water Service to Cemeteries	Recycled Water	Potential	--	3,100	○	◗	●	○	○	●	◗	○	○
Mountain View	MV-2	Recycled Water Intertie with Sunnyvale	Recycled Water	Potential	NA		○	○	○	○	●	●	○	○	○
	MV-3	Increase Recycled Water Supply From PARWQCP	Recycled Water	Existing	NA		○	○	○	○	●	●	○	◗	◗
NCCWD	NC-4	NCCWD Desalination Plant	Desalination	Potential	10-15	--	○	○	○	○	○	○	○	○	○
Palo Alto	PA-2	Expand Recycled Water Plant to Serve Stanford Research Park	Recycled Water	Existing	0.8	--	◗	●	●	●	◗	●	●	●	◗
Redwood City	RC-4	Redwood City Recycled Water Treatment Plant Expansion	Recycled Water	Potential	--	9,000	○	○	◗	○	●	◗	◗	○	○
San Jose	SJ-4	Intertie Connection with SCVWD	Treated Water	Potential	NA		○	○	○	○	○	○	○	○	○
Sunnyvale	SV-2	Increase Recycled Water Output from WWTP	Recycled Water	Existing	4-8	4,500-9,000	○	○	◗	○	●	◗	○	●	○
	SV-4	Expand Use of New or Converted Wells to Normal Year Supply	Groundwater	Potential	3	3,300	○	◗	●	◗	●	●	●	●	○

Key

○ Less than 25% of information available

◗ 25-75% of information available

● More than 75% of information available

Note:
[1] mgd = million gallons per day, AF/year = acre feet per year; NA = data not available; - - = data available only in one set of units.

Section 3
Daly City Recycled Water Expansion Project

Daly City and the SFPUC jointly developed a feasibility study[2] of the expansion of the Daly Recycled Water System in October 2009 (Feasibility Study). The Feasibility Study addressed expansion of recycled water treatment facilities at the Daly City WWTP, and new transmission and distribution system facilities to supply recycled water to irrigation customers in the Town of Colma (Colma) and to three properties in San Francisco. However, this project within the Strategy only includes the service within Colma.

3.1 Project Description

The current project proposed by Daly City only includes service within Colma which has an estimated demand of 1,060 AF per year. This requires 3.0 mgd of the 3.4 mgd total expansion examined in the Feasibility Study. For the purposes of this TM, the capacities and costs have been adjusted to reflect only the Daly City to Colma portion of the project. The Daly City recycled water expansion project involves expansion of the existing recycled water treatment, transmission and distribution system to serve irrigation customers in Colma. This expansion project will supply recycled water to irrigation customers including cemeteries, city parks, schools and a golf course in Colma. These irrigation customers currently use private groundwater wells drawing from the Westside Groundwater Basin, or potable water from the South San Francisco District of Cal Water, to irrigate turf and other landscaping. Converting these irrigation customers to recycled water would make supplies available for other uses. Figure 3 indicates the location of the Daly City WWTP and the recommended transmission pipeline alignment to the Colma Storage Tank and pump stations that would provide service within Colma.

3.2 Project Yield

The full project would increase the existing tertiary treatment plant capacity from 2.8 mgd to a total capacity of 6.2 mgd (i.e., an increase of 3.4 mgd). This is the maximum expansion possible within the existing treatment plant site constraints and provides 0.4 mgd more than Colma is currently proposing to use. The annual estimated total yield is about 1,060 AF per year for Colma customers.

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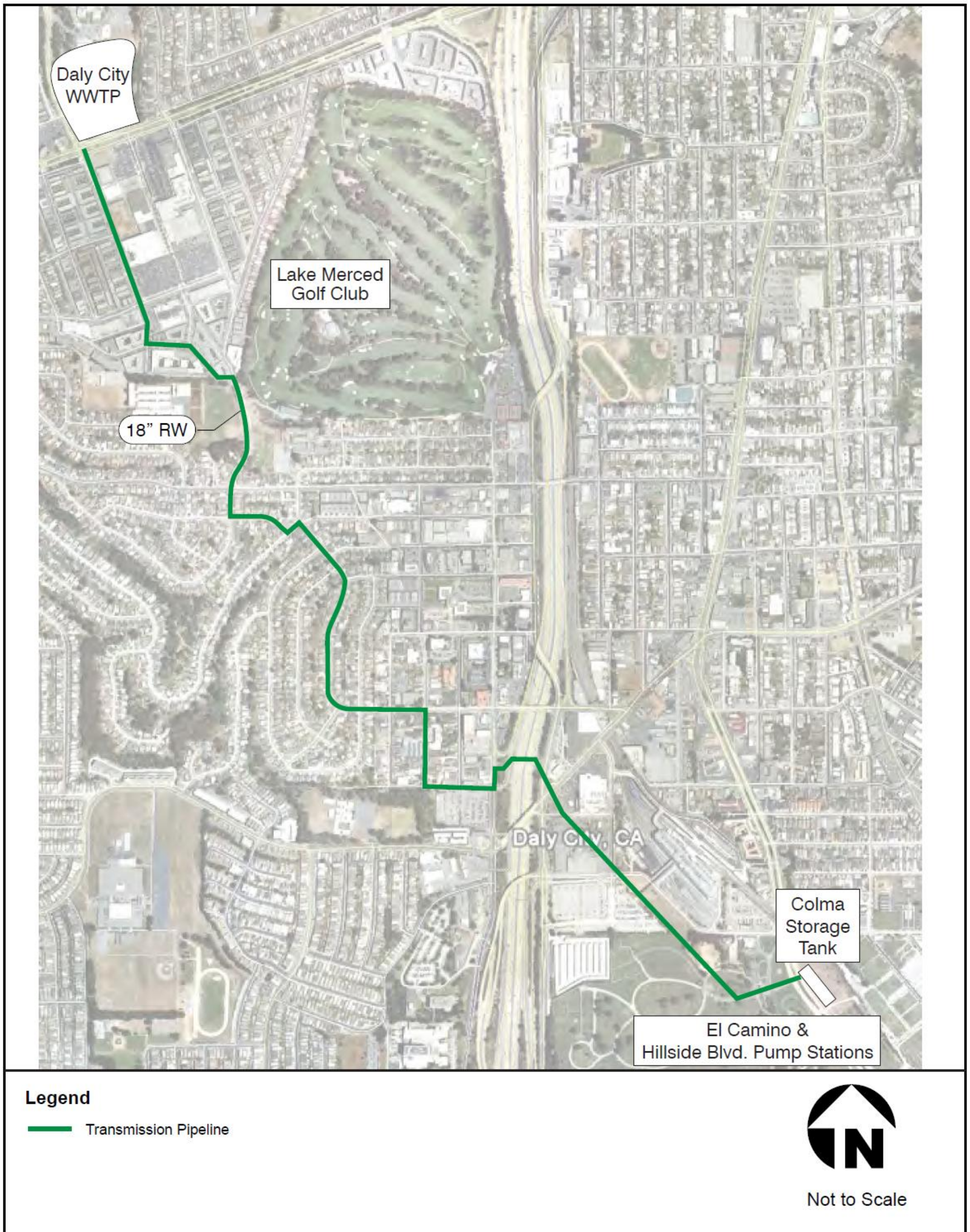
[2] *Combined Results of the Recycled Water Treatment and Delivery System Expansion Feasibility Study, Final (October 2009), Carollo Engineers.*



Source: Recycled Water Treatment and Delivery System Expansion Feasibility Study, Final October 2009. Carollo Engineers.

W:\REPORTS\BAWSCA\Task 11.3_Nov11\Graphics\BAWSCA 2-B Memo Figure 2 122111 Daly City to Colma Recomd Transmission Pipe Align.ai 12/14/11 JJT

Figure 3
Daly City to Colma Recommended Transmission Pipeline Alignment

3.3 Project Costs

Construction costs and capital costs for the treatment, transmission and distribution system were presented in the Feasibility Study. The Feasibility Study sized treatment facilities for a joint project to provide recycled water to both the Colma and irrigation customers in San Francisco. The Strategy team adjusted these treatment costs to provide treatment facilities sized for a Colma only project. The Strategy team briefly reviewed the transmission pipeline costs in the Feasibility Study, and the costs appear consistent with other costs used in the Strategy. Table 4 presents the cost estimate for the recycled water project expansion adjusted to August 2011. These costs include the capital cost for the new distribution system, but the O&M costs were not included as part of the Feasibility Study, or developed as part of the Strategy.

The total estimated construction cost for the treatment, transmission and distribution system facilities is $40.5 million. The estimated capital cost for the project, which includes engineering, legal, administrative, and a change order allowance, is $50.6 million. Costs assume a midpoint of construction in August 2014.

The Feasibility Study also estimated O&M costs for the treatment facility including process chemicals, energy, labor, and membrane module replacement. The O&M costs were estimated at $481,000 in years 1 to 10 and $457,000 in years 11 to 20. The Feasibility Study was not explicit as to why O&M costs were lower in years 11 to 20. For this analysis, an ongoing annual O&M cost for treatment of $481,000 or $450/AF was assumed. The present worth cost for this project is $2,100/AF.

The Feasibility Study did not include O&M cost estimates for the transmission and distribution system. These costs normally would include power, labor and incidental costs and will increase the total cost of delivered water. At this time the O&M costs for the transmission and distribution system are not included as there is not sufficient information in the Feasibility Study to include that information. A summary of project capacity, estimated annual production and estimated costs are shown in Table 4.

Table 4
Daly City Recycle Water Service Expansion Cost Estimate

Cost Item	Adjusted Cost[1]
Total Estimated Project Cost (Capital Cost)	$50,606,000
Annualized Capital Cost[2] ($M/Year)	$2.6
Annual Recycled Water Production (AF)	1060
Annualized Capital Cost - $/AF	$**2,400** [3]
Annual O&M Cost - Tertiary Treatment Plant	$481,000
Annual O&M Cost - $/AF[4]	$450
Total Annualized Cost	**$2,900** [3]

[1] Based on Feasibility Report Table ES.6
[2] Annualized cost based on 30 year return at 3% interest rate.
[3] Rounded to nearest $100/AF.
[4] Does not include O&M costs for distribution system (i.e., energy, labor, and maintenance).

3.4 Project Implementation Schedule

Neither the Feasibility Report nor the subsequent information provided by Daly City included an implementation schedule. For comparison purposes a preliminary schedule based on similar types of projects have been developed. The implementation schedule includes a planning and environmental review phase, preliminary design, final design, and a construction phase with an estimated completion within 6 years. Work during the planning and environmental review phase will include finalizing the customer base, development of customer agreements to receive recycled water, interagency agreements (anticipated to include recycled water supply and sales agreements and possibly others), securing funding sources, environmental review and related engineering support.

3.5 Key Project Issues

Key project issues associated with the Daly City recycled water expansion project include:

Yield

- Project yield is dependent on customers' long-term commitment to use.

Cost

- Distribution system and O&M costs estimates have not been developed for the project.

Implementation

- Both Daly City and the City of San Francisco are jointly evaluating this project. The role of the City of San Francisco would need to be resolved prior to this project proceeding;
- The potential recycled water customers identified by Daly City (i.e., the cemeteries in Colma) would need to commit to long-term use and purchase of the recycled water. There is a potential difficulty in converting customers, particularly groundwater customers, to recycled water as they are currently paying much lower costs for groundwater; and
- Potential funding partners for the project and the retail unit price for the recycled water have not been determined.

Water Quality

- Public and the potential customers may not find the use of recycled water for application at the cemeteries to be acceptable.

3.6 Project Next Steps

If it is determined that the Daly City recycled water expansion project should proceed, several steps will be required to confirm the project feasibility, including:

- Determine project sponsors, owners and funders;
- Develop distribution system O&M cost estimates; and
- Confirm willingness of potential buyers to switch to recycled water and commit to long term agreements.

Section 4
Representative Coastal Desalination Project

The representative coastal desalination project was originally identified by the NCCWD as a desalination plant with a designation of NC-4. After discussions between BAWSCA staff and NCCWD representatives, it was determined that NCCWD was not a proponent of a specific coastal desalination project at this time. As this is the only potential coastal desalination site currently included in the Strategy, the generic representative coastal desalination project replaces NCCWD NC-4 and has been included as a new project.

Exhibit 2 describes the representative coastal desalination project in more detail as well as providing general details on intake, desalination treatment, brine disposal and other infrastructure requirements.

4.1 Project Description

4.1.1 Project Alternatives

A 1996 study[3] had proposed an open seawater intake capacity of 3.3 mgd, and treated water capacity of 1.5 mgd. No further analysis was apparently done for this alternative.

An alternative proposal had also been suggested for a subsurface intake desalination project with capacity ranging from 10 to 15 mgd. No planning beyond the initial identification and sizing of facilities had been performed for this project. The yield of this project would be dependent on the capacity of the intake supply and site limitations at the potential desalination plant site. However, after review of local hydrologic information and some of the proposed facility sites it was determined that the project identified was not viable as described at that time.

Based on review of potential siting for an alternative location for the intake, and size limitations at the intake location and suggested desalination treatment plant site a representative project was identified with a maximum treated water capacity of 7.5 mgd. Figure 4 indicates the general location of this project and the infrastructure components. The following sections present these issues and describe the representative coastal desalination project carried forward as part of this analysis. *Exhibit 2* provides additional information on the earlier studies, and the identified representative project.

[3] Boyle Engineering Corporation, Final Desalination Feasibility Study for the North Coast County Water District, February 6, 1996.

4.1.2 Local Hydrogeology

Most of the coastline in the Pacifica area is rocky, and does not fall within the boundary of aquifers identified and studied by the California Department of Water Resources (DWR). However, a preliminary study was conducted in 1993[4] to investigate the potential yield specifically for Ranney Collector Wells in the area of Sharp Park. This study concluded that "Suitable geologic conditions do not exist for the development of the required seawater supply" with yields of less than 100 gallons per minute (gpm) for a subsurface intake (less than 0.15 mgd). This study only evaluated the Sharp Park beach area, but did suggest potential higher yields could be developed at other beaches farther south along the coast including Pacifica State Beach. The representative coastal desalination project is based on Ranney Collector Wells located at Pacifica State Beach.

[4] Ranney Method Western Corporation, Report on Hydrogeological Survey Sharp Park Test Site for the North Coast County Water District, April 30, 1993.

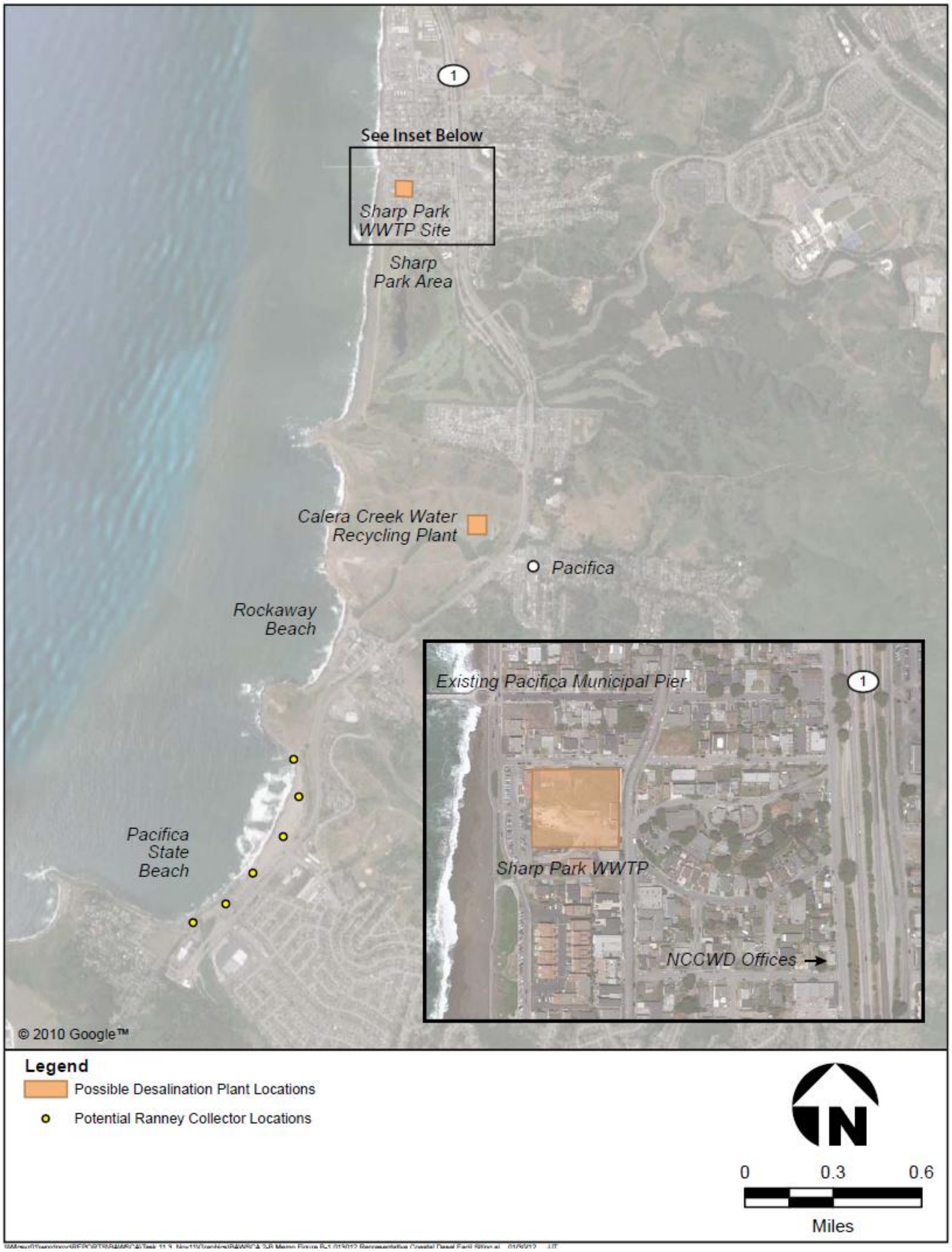


Figure 4
Representative Coastal Desalination Project - Potential Facility Locations

4.1.3 Representative Coastal Desalination Project

The representative coastal desalination project is focused on the Pacifica area for subsurface intake through Ranney Collector Wells. This intake would be pumping from a beach area and aquifer which is not currently utilized.

The representative project facilities include:

- Ranney Collector Well intake located at Pacifica State Beach;
- Desalination treatment plant located at the former Sharp Park WWTP site;
- Brine disposal through a new ocean outfall: and
- Raw water pipelines from Pacifica State Beach to the desalination treatment site, brine pipelines to the new ocean outfall, and treated water pipelines to connect to the SF RWS on the upper San Mateo Peninsula.

The project treated water capacity is limited by the size of the former Sharp Park WWTP to 7.5 mgd assuming a subsurface intake through the Ranney Well Collectors. If an open ocean intake were required the potential capacity would be reduced below 7.5 due to the need to include pre-treatment at the site.

Based on the identified beach area at Pacifica State Beach, and conservative estimates of spacing for multiple Ranney Collector Wells, there would be adequate raw water capacity for the 7.5 mgd treated water desalination plant. However, specific information is not known about thickness of the beach sands or the off-shore geologic formations at Pacifica State Beach, and that could potentially reduce the intake and treated water capacity for the representative project.

4.2 Project Yield

As described in Section 4.1.3 the capacity for the representative coastal desalination project is limited to 7.5 mgd. With that assumed plant capacity, and an annual operation at 80% of the design capacity the annual production would 6,720 AF. As described above that is the maximum yield available for those identified facilities, with potential reductions in treated water capacity if the full wastewater treatment plant site is not available, or the yield from the Ranney Collector Wells is limited either by available space, or hydrogeology.

4.3 Project Costs

Table 5 presents the present worth and annualized cost estimates for this project based on planning level construction and capital cost estimates for the major project items, including facility sizing, and the O&M costs included in *Exhibit 2*. The unit costs for each of the different items were developed based on similar types of projects in California and the United States. All construction costs were adjusted to August 2011 which is being used as the common base for all of the water supply management projects.

Some key costs are not included:

- Land purchase cost for Ranney Collector Well site, desalination plant site and reservoir site;
- Purchase of easements or rights-of-way;
- Wheeling or "transfer" costs for conveyance of water through other agencies facilities; and
- Purchase price of water (if required).

Table 5
Representative Coastal Desalination Project Present Worth and Annualized Cost Estimates

Present Worth Costs	
Annual O&M Cost ($ M)	$ 7.8
Present Worth of Capital Cost ($M)	$ 214.8
Present Worth of Annual O&M Cost ($M)	$ 232.5
Total Present Worth ($M)	**$ 447.3**
Total Production (AF)	201,534
Unit Cost of Total Present Worth ($/AF)	**$ 2,200**
Annualized Project Costs	
Capital Costs Annualized ($M)	$ 11.0
Annual O&M Cost ($M)	$ 7.8
Total Annual Cost	**$ 18.7**
Annual Production (AF)	6,720
Unit Annualized Costs ($/AF)	**$ 2,800**

[1] 2011 costs are current as of August 2011.
[2] 2015 project start date (O&M costs starting 2016).
[3] Assumed project life of 30 years.
[4] Present Worth estimates include a 3% escalation and a 3% discount rate. The same escalation rate is used for electricity, materials, labor and capital costs.
[5] Annual and total production assumes a base load of 80%.
[6] Annualized Costs are calculated over project life in 2011 dollars.

4.4 Project Implementation Schedule

The schedule presented below is based on experience with similar projects (e.g., Santa Cruz and Marin Municipal Water District) and professional judgment. Considerably longer schedules have resulted for projects in Carlsbad and Huntington Beach.

The preliminary project schedule for the representative coastal desalination project is 6 to 8 years, including:

- Phase I field investigations, assessments, financing, and other studies
- Phase 2
  - *Preliminary design and draft EIR;*
  - *Finalization of EIR and permit applications;*
  - *Final design;*
  - *Bid and construction; and*
  - *Project startup.*

The cited 6 to 8 year schedule for completion of the Phase 1 and 2 efforts for the representative coastal desalination project is aggressive. Depending on the results of the field investigations, environmental documentation and permitting the schedule could extend well beyond 8 years.

4.5 Key Project Issues

Key issues associated with the representative coastal desalination project include:

Yield

- Hydrogeologic information is not available for the proposed intake area to confirm the hydraulic capacity and long-term yield of the Ranney Collector Wells; and
- Mitigation of the potential impacts on water quality or yield for other groundwater pumpers in the area may impact pumping capacity and long-term yield.

Cost

- The availability and the potential use of land for the Ranney Collector Wells (Pacifica Beach Area), desalination treatment plant (old Sharp Park WWTP), and tank site (Milagra Ridge Park) need to be confirmed. If these sites are not available the cost of the project will be greater than currently estimated; and
- If the proposed alignment for the raw water, treated water, and brine pipelines is not available, the pipeline costs could be greater than currently estimated.

Implementation

- Potential partners for project development and water supply customers need to be determined;

- Ownership and operation of the treatment, pumping and brine disposal facilities needs to be determined;
- Public support and/or opposition to this project needs to be determined;
- Availability and the potential use of land for the Ranney Collector Wells (Pacifica Beach Area), desalination treatment plant (old Sharp Park WWTP), and tank site (Milagra Ridge Park) need to be confirmed. If these sites are not available the feasibility of the project will be impacted; and
- Availability of proposed alignment for raw water, treated water, and brine pipelines need to be confirmed and potential mitigation and permitting issues determined.

Water Quality

- Source water quality (e.g., salinity, iron, manganese, etc.) is currently unknown and may affect the current estimates for treatment process and treatment cost and the brine discharge requirements and cost; and
- Ensuring water quality compatibility with the SF RWS.

4.6 Project Next Steps

If it is determined that the representative coastal desalination project should proceed, several steps will be required to confirm the project feasibility, including:

- Confirm the expected yield and water quality from the potential seawater subsurface locations. The unknowns could be addressed by performing borings to indentify the boundaries of the most promising geological formations, performing pump tests, developing groundwater models to estimate sustainable yield, and performing a more thorough review of existing or gathering new water quality data.
- Confirm the availability of potential sites for intakes and treatment plant facilities. In addition, more detailed hydraulic analysis will be needed to identify improvements that may be required to convey the treated water supply from the new plant location to the existing distribution system and then to distribute it to customers within the existing system.

Section 5
Redwood City Recycled Water Treatment Plant Expansion Project

The Redwood City recycled water treatment plant expansion project (RC-4) is an expansion of the Redwood City/SBSA recycled water treatment facility from 2.8 to 8.0 mgd. Most of the information presented herein is based on information provided by Redwood City in the Project Information Survey and from an interview with City staff in November 2010 and in 2011. Other sources of information used in preparation of this TM include:

1. Initial Study for the Redwood City Recycled Water Project, June 2002, CH2MHill (Initial Study).

2. Water Recycling Feasibility Study for Redwood City Final Report, August 7, 2002. Kennedy/Jenks Consultants (2002 Feasibility Study).

3. TM Redwood City Recycled Water Program, Internal Memo Design Basis: Recycled Water Production, Storage and Pumping Facilities, 7 January 2004 (Internal Memo Design Basis).

4. City of Redwood City Recycled Water Program, SBSA Facilities Project Disinfection Storage and Pumping Facility Design Criteria Summary, Draft Final, 9 January 2009, Kennedy/Jenks Consultants (Design Criteria).

Exhibit 3 provides some additional information on the Redwood City recycled water treatment plant expansion project.

5.1 Project Description

The existing Redwood City recycled water system includes tertiary-treatment facilities, two 2.2 MG storage tanks, and a distribution system pump station all located at the SBSA WWTP, and recycled water distribution facilities throughout Redwood City. SBSA's WWTP is owned by four entities, the West Bay Sanitary District, and the cities of Belmont, Redwood City, and San Carlos. The distribution system operates as a pumped storage system, with all storage located at the SBSA WWTP.

The current recycled water treatment capacity is 2.8 mgd, and Redwood City indicated that approximately 1.8 mgd of this existing capacity is available for future demand either within Redwood City or to other agencies. Redwood City would like to expand their recycled water system and potentially partner with other agencies for the expansion. Expanding and partnering with other agencies has potential benefits to Redwood City including reduction of costs to existing customers and providing a revenue source to

Redwood City. Redwood City has recycled water distribution pipelines extending to the north and south boundaries of their service area along the east side of Highway 101 which will facilitate connections to other neighboring agencies including Cal Water, Foster City and Menlo Park.

5.2 Project Yield

The project assumptions for the treatment facility expansion are not defined at this time. Redwood City is in the process of preparing its Water Recycling Feasibility Study Update (2012 Feasibility Study Update) which will better define facility requirements for the expansion. The final report is anticipated to be available in mid 2012 and will provide the basis for updating and revising the project data. The current assumptions for the project based on the earlier reports include:

- Up to 1.8 mgd of existing capacity (average annual capacity) is available for use per year by another agency in the existing 2.8 mgd system; and

- Expansion of the recycled water treatment plant from its current capacity of 2.8 mgd to 8.0 mgd (average annual capacity). Annual yield for 8.0 mgd project is 8,962 acre feet as indicated in the Project Information Survey.

Details of treatment facility improvements required for the expansion are anticipated to be included in the 2012 Feasibility Study Update. Improvements to the recycled water treatment facility may include upgrades to the distribution system pump station and possibly additional storage. The recycled water treatment facility may have sufficient filtration and disinfection capacity for the expansion, but this should be confirmed when the 2012 Feasibility Study Update becomes available.

5.3 Project Costs

Redwood City is in the process of updating its project information which is anticipated to include estimated costs for an expansion.

5.4 Project Implementation Schedule

Redwood City has not provided an initial project schedule, and has indicated that one may not be included in the 2012 Feasibility Study update.

5.5 Key Project Issues

Key issues associated with the Redwood City recycled water treatment plant expansion project include:

Yield

- Ongoing work by Redwood City will confirm the demands for this project.

Cost

- Funding sources need to be identified and evaluated;
- Capital, O&M and present worth (life-cycle) costs need to be developed to determine project viability; and
- Purchase price for water, whether subsidized or not, needs to be developed.

Implementation

- Potential partners for project development need to be identified;
- Potential recycled water customers need to be determined; and
- Interagency agreements will require long-term purchase commitments along with a recycled water supply sales agreement.

Water Quality

- Total Dissolved Solids (TDS) was identified as a potential issue for sensitive plants. The Project Information Survey indicates that some plant materials can be affected by a TDS of 650 – 750 mg/L;
- A determination is needed to identify any potential prohibitions or limitations on market potential due to water quality; and
- Public acceptance of the use of recycled water where there may be public contact needs to be included in the project evaluation.

5.6 Project Next Steps

If it is determined that the Redwood City recycled water treatment plant expansion project should proceed, several steps will be required to confirm the project feasibility, including:

- Update project information based on the not yet released Redwood City 2012 Feasibility Study Update; and
- Determine whether this project is intended to be implemented by Redwood City, others, or through the Strategy.

Section 6
Palo Alto Recycled Water Treatment Plant Expansion Project

The Palo Alto recycled water treatment plant expansion project (PA-2) is an expansion of the existing recycled water treatment facilities at the RWQCP to produce recycled water to serve the Stanford Research Park. Most of the information below is based on information provided by Palo Alto in the Project Information Survey and from an interview with Palo Alto staff in December 2010 and January 2012. Other sources of information used in preparation of this TM include the following:

1. City of Palo Alto Recycled Water Facility Plan, December 2008, RMC.

2. City of Palo Alto Recycled Water Project Initial Study/Mitigated Negative Declaration, March 2009, RMC.

3. Notice of Preparation of a Draft EIR for the City of Palo Alto Utilities Recycled Water Project, June 2011.

Exhibit 3 provides some additional information on the Palo Alto recycled water treatment plant expansion project.

6.1 Project Description

The City of Palo Alto owns and operates the RWQCP treating wastewater for six communities/ districts including Los Altos, Los Altos Hills, Mountain View, Palo Alto, Stanford University and the East Palo Alto Sanitary District. The RWQCP has a current average dry weather flow of approximately 23 mgd. Treatment processes at the RWQCP include primary treatment (bar screening and primary sedimentation), secondary treatment (trickling filters, followed by activated sludge and secondary clarifiers), tertiary filtration, and disinfection. The RWQCP recently converted its disinfection facilities from sodium hypochlorite to ultraviolet (UV) disinfection.

The RWQCP also includes a recycled water treatment train that produces recycled water meeting California Title 22 requirements for unrestricted reuse. The RWQCP currently provides recycled water to several customers in Palo Alto and to the City of Mountain View through a recently completed pipeline.

Recycled water treatment facilities at the RWQCP include: 1) a filtration and chlorination production train, and 2) a backup UV disinfection system production train. The current filtration/chlorination system capacity is 4.5 mgd. Ultraviolet (UV) disinfection can increase this capacity by 6.0 mgd to a total of 10.5 mgd. Addition, of another 2.0 mgd of

UV capacity with an extra UV bank could increase the total capacity to 12.5 mgd. The City of Palo Alto is currently evaluating the expansion alternative based on the long-term recycled demands of the potential customers.

6.2 Project Yield

The City of Palo Alto Utilities Department is evaluating an expansion of the existing recycled water system through an additional connection to the Stanford Research Park. This project will serve primarily irrigation demand and a smaller proportion of cooling tower usage. The average annual demand for the project is estimated at 0.8 mgd as provided in the Project Information Survey.

The Project Information Survey also indicated there is potential for expansion beyond the above identified project in the range of 2,000 to 3,000 AF/year. Other agencies that could potentially be served through the expansion project include Stanford University, Los Altos, and Purissima Hills Water District. There may also be potential to serve Menlo Park.

Following is a list of key assumptions for the PA-2 Project based on conversations with Palo Alto staff in January 2012:

- Sufficient Title 22 recycled water tertiary treatment capacity exists at the RWQCP, including filtration and required upstream treatment processes (coagulation and flocculation);
- The estimated project cost is assumed to include engineering, construction, and administrative costs. However, this should be confirmed and updated with Palo Alto staff if the project moves forward in the BAWSCA Strategy.

6.3 Project Costs

The estimated project capital and O&M costs to expand the UV disinfection facility are currently being prepared by Palo Alto as part of preparation of an EIR.

New recycled water distribution system facilities will also be required to serve the Stanford Research Park, however, these costs were not included herein, as project PA-2 is solely to expand the recycled water treatment facility. BAWSCA may want to consider including the cost for distribution in their analysis to determine the true cost of delivered water to compare to other alternatives. Some distribution system costs appear to be included in the Project Information Survey, however, additional review and/or coordination with Palo Alto staff is likely be required to include these costs in the analysis. These costs may change during the environmental review process due to changes to pipeline alignments.

6.4 Project Implementation Schedule

A conceptual project schedule was provided in the Project Information Survey with design completed in 2012 and construction completed in 2014. However, this project schedule is currently being updated by Palo Alto as part of the preparation of an EIR.

6.5 Key Project Issues

Key issues associated with the Palo Alto recycled water treatment plant expansion project include:

Yield

- Ongoing work should confirm the demands for this project, both for the existing system and expansion, including average annual and maximum day demands as it relates to the treatment facility expansion so that the project yield can be accurately quantified.

Cost

- Funding sources need to be identified and evaluated;
- Capital, O&M and present worth (life-cycle) costs need to be developed to determine project viability; and
- Purchase price for water, whether subsidized or not, needs to be developed.

Implementation

- Potential partners for project development need to be identified;
- Potential recycled water customers need to be determined; and
- Interagency agreements will require long-term purchase commitments along with a recycled water supply agreement.

Water Quality

- The project is subject to a potential limitation on recycled water use due to salt impacts. A limitation may include restrictions on recycled water use on redwood trees due to the recycled water TDS. The RWQCP, along with its partners in the treatment plant, have created an inflow and infiltration program that may reduce the TDS in the wastewater.

6.6 Project Next Steps

If it is determined that the Palo Alto recycled water treatment plant expansion project should proceed, several steps will be required to confirm the project feasibility, including:

- Update project information based on the EIR to be released by Palo Alto; and
- Determine whether this project is intended to be implemented by Palo Alto, others, or through the Strategy.

Section 7
Rainwater Harvesting Projects

Rainwater harvesting involves the collection of rainwater runoff from roof surfaces by gutters and downspouts and storage in containers called "rain barrels" for use during a subsequent dry day. Using stored rainwater for landscape watering and non-potable indoor uses reduces potable water demands. In a typical single-family residential rainwater harvesting application, rainwater collected via roof rainfall storage is used to irrigate a yard or garden. This simple application requires only the purchase of a rain barrel and the appropriate hoses and fittings to convey water to the irrigated area. The rainwater harvesting system would be owned and maintained by the homeowner.

For larger scale roof rainwater collection and storage, such as for commercial developments and multi-family housing, greater quantities may be captured if large cisterns are constructed in basements, underground or surface level storage tanks. The stored rainwater could then be pumped from storage and used for non-potable purposes such as irrigation, car washing, clothes washing machines, toilet flushing, swimming pools, and process water for commercial and industrial uses. Many of these applications, including toilet flushing, use in swimming pools and process water, require treatment and separate piping systems.

7.1 Project Description

7.1.1 Project Implementation

Implementation of rainwater harvesting projects throughout the BAWSCA member service area would require the support of BAWSCA member agencies and participation from member agency customers. Support for rainwater harvesting projects may include educational or marketing programs or rebates for system components like storage barrels. The yield and cost calculations in this section assume a 10 – 20% participation rate amongst single family residents in the BAWSCA service area. The primary assumed use for the stored rainwater supply is outdoor irrigation.

7.1.2 Projects Implemented in the BAWSCA Service Area

During member agency interviews conducted as a part of the Strategy, several agencies stated that their customers have expressed interest in rainwater harvesting. The following BAWSCA agencies offer rainwater harvesting support:

- The City of Millbrae is planning to offer rain barrel rebates starting in late 2012;
- The City of Palo Alto offers rebates of $50 per rain barrel. Cistern rebates are $0.15 per gallon with a maximum residential rebate of $1,000 and a maximum commercial

rebate of $10,000. Palo Alto also hosts rainwater harvesting education events to educate its customers on the benefits and opportunities for rainwater harvesting;

- The City of Brisbane has a Rain Barrel Guidance manual;
- Stanford's Graduate School of Business is considering a 75,000 gallon rainwater harvesting system; and
- Westborough Water District is considering rainwater harvesting to serve the fountain at its office.

7.2 Project Yield

The potential yield from rainwater harvesting in the BAWSCA member agencies' service areas in the year 2010 was estimated to range from 150 AF/year to 480 AF/year based on a calculation using the number of single family residential units within the BAWSCA service area, average monthly rainfall, average roof size, an assumed participation amongst single family residential units[5], and an estimate of the magnitude and timing of landscape irrigation demands that could be served by the stored rainwater. Detailed calculations are presented in *Exhibit 4*. Potential yield in 2035 is estimated at between and 190 AF/year to 610 AF/year, using similar calculations. The range was determined by varying the percent of roof that is being captured by the rainwater harvesting system and the percent of single family residences in the BAWSCA service area that participate in the program. The following assumptions were made in determining single-family residential potential:

- For the higher yield estimate, it was assumed that 50 percent of the roof area could be captured in a barrel or cistern and that 20 percent of the single family residences in the BAWSCA service area participate.
- For the lower yield estimate, it was assumed that 25 percent of the roof area could be captured in a barrel or cistern and that 10 percent of the single family residences in the BAWSCA service area participate.

7.3 Project Costs

For the purposes of this memorandum, costs for the rainwater harvesting system were assumed to include only the basic tank and fittings (i.e., 55 gallon barrel costing approximately $300 per system). The cost range based on this assumption would be $13.3 to $26.6 million for the minimum and maximum yield estimates, respectively. This

[5] Actual acceptance rates are difficult to estimate because of the many influences an agency needs to accommodate in its program design. The only available documented acceptance rate statistic found is for the State of Queensland where 20 percent of the population has installed rain catchment tanks since 2006. Although rainwater harvesting systems were not required in Queensland, rebates were offered and a strong outreach program implemented during the decades-old drought.

assumes 10% participation (44,400 households) to 20% participation (88,800 households). Based on these cost estimates, the cost per AF for the rainwater harvesting supply would be $2,900 to $4,800, assuming a life expectancy of 15 years for the rainwater harvesting system.[6]

7.4 Project Implementation Schedule

Project schedules have not been developed for these projects. The timing for implementation, cost and yield will all be a function of when individual home owners and higher density residential building owners decide to implement these programs.

7.5 Key Project Issues

Key issues associated with rainwater harvesting projects include:

Yield

- Frequency and amount of rainwater does not coincide with when demands occur, seasonally, or during droughts;
- Storage capacity limits harvesting during wet periods;
- Local plumbing codes do not require a permit for exterior rainwater catchment systems used for outdoor drip and subsurface irrigation if storage capacity is less than 360 gallons; and
- Long-term yield is dependent on number of units installed, whether they are maintained and on-going customer participation.

Cost

- Capital costs are high compared to yield.

Implementation

- Storage may not be aesthetically pleasing to neighbors;
- Deed restrictions in some developments may limit a homeowner's ability to add an outdoor storage tank (rain barrel); and
- Requires individual customer implementation.

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[6] Rainwater harvesting estimate includes range of yields and costs: $26.6 million / 610 AF/year / 15 years life expectancy = $2,914/AF. $13.3 million / 190 AF/year / 15 years life expectancy = $4,786/AF.

Water Quality

- Developments that utilize larger roof areas for collection of rainwater can increase the contamination risks from bird or animal droppings.

7.6 Project Next Steps

If it is determined that rainwater harvesting projects should proceed, several steps will be required to confirm the project feasibility, including:

- Identify the degree of on-going interest for these types of programs by BAWSCA member agencies and their customers; and
- Further examine the feasibility of a BAWSCA service area-wide implementation of rainwater harvesting projects and compare with other potential water supply management projects being investigated as part of the Strategy.

Section 8
Stormwater Capture Projects

Stormwater capture involves the collection of rainfall that typically runs off of land surfaces and storage of that water in large ponds, tanks, and reservoirs for the purposes of reuse as irrigation or groundwater recharge. The quantity of stormwater varies throughout the year with typical wet months (November through May) not coinciding with higher water demand summer months. For the period of time following significant stormwater events, landscape or agricultural users do not typically require stored stormwater to supplement irrigation demands. As such, storage volumes need to be quite large to support demands for extended periods between storm events. Stormwater reuse project design is therefore typically based on infiltration/storage and subsequent beneficial reuse of the water instead of the traditional stormwater approach to convey the stormwater away from the area a quickly as possible.

8.1 Project Description

8.1.1 Project Implementation

Implementation of stormwater capture projects throughout the BAWSCA member service area would require support of BAWSCA member agencies and participation from member agency customers. Support for stormwater capture projects may differ slightly from that of rainwater harvesting or greywater reuse projects due to the larger size of stormwater capture projects. BAWSCA member agencies could use marketing programs to support incorporating stormwater capture and LID elements in commercial and industrial developments. The primary assumed use for the stored stormwater supply is outdoor irrigation.

8.1.2 Projects Implemented in the BAWSCA Service Area and Other Areas

Water agencies in Northern and Southern California have implemented large projects to collect and reuse stormwater runoff, primarily to recharge groundwater basins. Most of these are much larger projects than those considered in this TM. For example, the Alameda County Water District (ACWD) captures local runoff from the Alameda Creek watershed behind inflatable rubber dams which span the width of the Alameda Creek Flood Control Channel. These dams divert water to several hundred acres of ponds (former gravel quarries) where water percolates to recharge the underlying Niles Cone Groundwater Basin. This recharge accounts for approximately 40% of ACWD's total supply.

An example of a project with a capacity more feasible to implementation within the BAWSCA service area is the project that the Santa Margarita Water District (SMWD) in Orange County, California. This district, in cooperation with Trabuco Canyon Water District (TCWD), has developed a project to capture urban stormwater runoff to augment their recycled water supply. By rerouting stormwater to the SMWD Portola Reservoir and the TCWD Dove Lake, the project diverts 200 AF/year (SMWD 2011). Implementation of a project of this size in the BAWSCA service area would require a large amount of storage and the ability to recharge the underlying production groundwater aquifer efficiently. The water supply benefit of this type of project is not clear given the uncertainty associated with the complete recovery of the recharged water.

The City of East Palo Alto included stormwater capture in its October 2010 Water System Master Plan, noting "Stormwater capture and reuse has the potential to become a valuable method of supplementing an area's water supply." The Master Plan identified multiple sites within the City where a stormwater reuse/recycling project could be utilized with two ideal locations identified as Martin Luther King Park and Jack Farell Park. The Master Plan identified a budget of $450,000 for the proposed Martin Luther King Park stormwater capture project to include stormwater collection, 90,000 gallons storage tank, irrigation pump, and tertiary treatment system to serve the 5.4 acre park.

Ken Coverdell, a Board member of Coastside County Water District won the Silicon Valley Water Conservation Award in 2010 for a rainwater harvesting/stormwater capture project at his Half Moon Bay Blue Sky Farms plant nursery. A 30,000 gallon cistern was installed to store and reuse rainwater and stormwater runoff from the 2.5 acre nursery and home. Use of the 110 foot long cistern buried under the parking lot has reduced the nursery's potable water use by 750,000 gallons per year by also using a sophisticated satellite weather service to activate the nursery's drip-irrigation system.

LID projects can also reduce potable water demand and increase the groundwater supply through recharge. LID is a term used to describe a land planning and engineering design approach to managing stormwater runoff. LID was developed to ameliorate, and where possible, eliminate the pollution and erosion problems generated by runoff from urban and suburban development at the source, where rain falls on paved surfaces, by maximizing the natural onsite infiltration and treatment abilities of soils and vegetation or by capturing water for later use.

8.2 Project Yield

Because of the limited documentation of stormwater projects in the BAWSCA service area, it is difficult to estimate yields and costs for these types of projects. A 2009 study by the NRDC "A Clear Blue Future: How Greening California Cities Can Address Water Resources and Climate Challenges in the 21st Century" found that LID has a substantial estimated potential to save both water and energy in the San Francisco Bay Area. The group estimated that LID projects implemented throughout a 3,850 square mile study area including San Francisco, Marin, Contra Costa, Alameda, Santa Clara, and San Mateo counties could provide 34,500 – 63,000 AF of water per year by 2030 (or 9.0 – 16.4 AF/year of savings per square mile). The analysis involved estimating the amount of runoff and potential infiltration from "urban density" land uses – areas with greater than 20 percent impervious surface cover or more than 2 single family residential structures per acre. For detailed information on the analysis, refer to the NRDC report discussed above.

The wide ranges of potential water supply reductions reflect a set of variables and input values that include average rainfall throughout the region, land use information including surface impervious metrics, and method of retention (either capture and storage for reuse, or infiltration into the groundwater aquifer in areas where large-scale groundwater pumping occurs). The portion of water savings from groundwater recharge is not identified, nor is the cost to implement the regional LID development program. Using this example, the 460 square mile BAWSCA service area could be estimated to potentially save 4,100 - 7,500 AF/ year through service area-wide implementation of LID projects.

8.3 Project Costs

Due to limited data, it is very difficult to develop costs for these types of projects. The NRDC report discussed above did not include costs to implement the projects necessary to achieve the potential savings nor did it identify or differentiate how such estimates of savings would benefit overall water supply. Reliable yield and cost information is not currently available for implementation of LID projects on a regional scale.

8.4 Project Implementation Schedule

Project schedules have not been developed for these projects. The timing for implementation, cost and yield will all be a function of when individual home owners and higher density residential, and commercial building owners decide to implement these programs.

8.5 Key Project Issues

Key issues associated with stormwater capture projects include:

Yield

- Frequency and amount of stormwater does not coincide with when demands occur;
- Yield of stormwater capture projects is dependent on available uses of water captured;
- Yield is dependent on rainfall and especially the collection of high rainfall events. Consequently, systems are commonly more expensive to implement due to large storage and treatment needs;
- Limited year-round availability (depending on rainfall patterns) with no availability during drought conditions; and
- Long-term yield is dependent on number of units installed, whether they are maintained and on-going customer participation.

Cost

- Most systems will require pressure pumps and controls compared to using municipal system water pressure, increasing maintenance costs.

Implementation

- Stormwater discharge is primarily regulated by the United States Environmental Protection Agency's Clean Water Act, Title 40 requirements for permitting and discharge of stormwater, and water quality and wetland permits from the US Army Corps of Engineers. Water below the ordinary high water level or in wetland areas is not available for collection. Stormwater above the ordinary high water level can be collected in drainage channels or from diffused overland flow. This would limit stormwater capture projects at low elevations near the Bay;

- NPDES permits for point source discharges must implement region-specific water quality standards defined by the Regional Water Quality Control Board. Dischargers must file a report of waste discharge with the appropriate regional board (California Resources Agency 2002). Several of the BAWSCA member agencies have issued guidance documents to support compliance with the requirements in the municipal regional stormwater NPDES permit issued by the San Francisco Regional Water Quality Control Board; and

- Requires individual customer implementation.

Water Quality

- Permits for urban stormwater runoff stored and reused for irrigation may be reviewed by the Department of Public Health to ensure the necessary water quality is maintained.

8.6 Project Next Steps

If it is determined that stormwater capture projects should proceed, several steps will aid in assessing project feasibility, including:

- Track the development and implementation of stormwater capture projects like East Palo Alto's Martin Luther King Park system and the Half Moon Bay Blue Sky Farm's stormwater capture and reuse system to address information gaps that still exist in terms of the feasibility, potential yield and cost of stormwater capture projects; and

- Once more information is available, evaluate the feasibility of a regional implementation of stormwater capture projects through a comparison with other potential water supply management projects evaluated as part of the Strategy.

Section 9
Greywater Reuse Projects

Greywater (also spelled graywater, grey water, and gray water) is the untreated household waste water from bathtubs, showers, bathroom sinks, and washing machines. Waste water from toilets, referred to as “black water,” is not included. In California, waste water from kitchen sinks or dishwashers is also not an acceptable source of greywater. Unlike rainwater harvesting and stormwater capture, the potential yield estimate of greywater reuse is not dependent on precipitation as the amount of greywater generated in a typical single-family home does not vary seasonally. The potential yield estimate of greywater reuse is dependent on the demand that is served. Winter months in the Bay Area, when irrigation demands are lower, could produce a surplus of greywater supply which must be discharged to the sewer or septic system. Treated greywater could be used to provide toilet flush water supply when outdoor irrigation demands are low, realizing a higher potential year round yield. However, treated systems are not simple to install and maintain, can be costly, and require permitting. Indoor reuse of greywater for toilet flushing requires treatment of the greywater to Title 22 standards.

9.1 Project Description

9.1.1 Project Implementation

As with rainwater harvesting, an implementation of greywater reuse projects throughout the BAWSCA member service area would require the support of BAWSCA member agencies and participation from member agency customers. Support for greywater reuse projects may include educational or marketing programs or rebates for system components like storage barrels. The yield and cost calculations in this section assume a 10 – 20% participation rate amongst single family residents in the BAWSCA service area. The primary assumed use for the greywater supply is outdoor irrigation.

9.1.2 Projects Implemented in the BAWSCA Service Area

Based on the results of agency interviews as a part of the Strategy, many BAWSCA agencies are interested in promoting greywater, as public interest exists, but have some concerns regarding sewer system backflow and potential conflicts with recycled water programs. There is also concern that reduction in wastewater flows due to the implementation of greywater reuse projects may affect solids movement in wastewater lines. There are currently no documented greywater projects being implemented by BAWSCA member agencies.

9.2 Project Yield

Typically, greywater supply is about 50 percent of residential wastewater generated from the home. Over the past two decades water conserving fixtures have become mandatory, thus reducing the volume of greywater available. To estimate a potential greywater flow, the State Plumbing Code assumes 25 gallons per day (gpd) per person for showers, tub, and bathroom sink; and 15 gpd per person for laundry wash water, thus an upper yield of 40 gpd per person. Given a range of 15 to 40 gpd of greywater production per person, and an assumed average of 2.7 persons per household, the resulting estimated greywater production is 41 to 108 gpd per household.

The yield calculations (see 4*5*) rely on the estimate of the potential water savings based on irrigation needs and storage capacity for each month and is similar to the rainwater harvesting analysis. The assumptions include: (1) from November through February, no water savings was assumed due to the availability of rain during this period and subsequently low irrigation demand, (2) for the summer months between May and August, it is assumed that the maximum amount of water savings would be realized, including the use of up to one 55 gallon barrel a day to meet outdoor irrigation demand (55 gallons x 30 days a month = 1,650 gallons total), and (3) during the spring and fall months of March, April, September and October, one-half of the maximum water savings would be realized, equal to the use of one 55 gallon barrel every two days (55 gallons x 15 days a month = 825 gallons total).

As shown in *Exhibit 4*, and under the demographic characteristic assumptions presented above, the range of potential greywater reuse yield under 2010 demographic characteristics is 287 MG (880 AF/year) to 691 MG (2,120 AF/year) for simple systems used for irrigation. The yield range is based on assumed greywater production per household (41 and 108 gpd) and assumed participation rate (10 and 20%). For 2035 demographic characteristics, the potential yield ranges from 365 MG (1,120 AF/year) to 879 MG (2,700 AF/year), again for simple systems used for irrigation only. At the high end of the yield range, the estimate of yield is constrained by the potential water savings based on irrigation needs and storage capacity. If larger storage is provided or more demand identified, especially during the winter months, the resulting yield could be greater.

9.3 Project Costs

The cost of installing a simple greywater system collecting water from a clothes washer to serve outdoor irrigation is similar to that of rainwater harvesting systems. A storage barrel may cost between $150 and $300 including fittings. The cost of a more complex system collecting multiple water sources within a house can be relatively high. Permitting costs can also make up a significant portion of the project's total cost.

For example, three greywater systems were recently installed under a City of Santa Monica grant program. Two were engineered and one was "off the shelf". One of the systems was highly advanced and included a retrofit. It used potable water, greywater, and rainwater for garden irrigation and took three years for final approval. Total cost was $20,750 for an anticipated savings of 71,000 gallons per year. The off the shelf system required many modifications to make it legal resulting in a higher cost. All systems are working now, but the City of Santa Monica noted there were many lessons learned during the approval process for these first systems (O'Cain, 2010).

SFPUC recently developed a Graywater Design Manual for Outdoor Irrigation to aid homeowners and professionals in installing greywater systems. A Laundry to Landscape pilot program was also started to help the SFPUC, City Department of Building Inspection, and Department of Public Health evaluate how laundry to landscape systems work in San Francisco. The laundry to landscape pilot program identifies specific requirements for participation such as having a yard that is level or down sloping from the clothes washer. The subsidy provided is $95 towards the purchase of a $100 starter kit that includes a 3-way valve, piping, tubing, fittings, and other materials for installation. Up to 150 properties will be eligible to participate.

For the purposes of this TM, costs for the greywater system were assumed to include only the basic tank and fittings (i.e., 55 gallon barrel costing approximately $300 per system). The cost range based on this assumption would be $13.3 to $26.6 million for the minimum and maximum yield estimates, respectively. This assumes 10% participation (44,400 households) to 20% participation (88,800 households). Based on these cost estimates, the estimated cost per AF for the greywater reuse supply would be $660 to $790, assuming a life expectancy of 15 years for the greywater reuse system.[7]

9.4 Project Implementation Schedule

Project schedules have not been developed for these projects. The timing for implementation, cost and yield will all be a function of when individual home owners and higher density residential, and commercial building owners decide to implement these programs.

9.5 Key Project Issues

Key issues associated with greywater reuse projects include:

Yield

- Long-term yield is dependent on number of units installed, whether they are maintained and on-going customer participation.

Cost

- Can be expensive to retrofit because of the dual plumbing (wastewater and greywater) required.

[7] Greywater reuse estimate includes range of yields and costs: $26.6 million/ 2,700 AF/year / 15 years life expectancy = $658/AF. $13.3 million / 1,120 AF/year / 15 years life expectancy = $792/AF.

Implementation

- Can be difficult and costly to obtain a permit for greywater reuse systems;
- Reduced sewer flows from greywater systems have led to increases in sewer blockages and increases in odor complaints in some areas; and
- Requires individual customer implementation.

Water Quality

- Greywater can contain soaps and other chemicals that can kill plants and antimicrobial products (triclosan) that can reduce beneficial soil microbes. Additionally, water with high sodium levels can cause discoloration and burning of leaves, contribute to alkaline soil conditions, can be toxic to plants, and can prevent calcium from reaching plants; and
- Greywater supply cannot be used to irrigate most food plants;

9.6 Project Next Steps

If it is determined that greywater reuse projects should proceed, several steps will be required to confirm the project feasibility, including:

- Track the on-going interest for greywater reuse programs by BAWSCA member agencies and their customers;
- Track current efforts of agencies like Greywater Guerrillas/Greywater Action in Berkeley who support greywater reuse through workshops including an "Install your own greywater system" workshop in San Francisco that is part of a pilot program from the SFPUC; and
- Further examine the feasibility of a BAWSCA service area-wide implementation of a greywater reuse projects and compare with other potential water supply management projects being investigated as part of the Strategy.

Section 10 Conclusions

The water supply management projects presented herein could potentially be used by BAWSCA and the BAWSCA member agencies to meet the normal and/or drought supply needs through 2035. In addition, *TM 3 - Updated Regional Water Supply Management Project Information* presents other potential projects that have been identified by the BAWSCA member agencies for evaluation as part of the Strategy.

The projects presented herein and in TM 3 were initially identified in the *Phase I Strategy Scoping Report*. The project information development to date has focused on preliminary estimates of the yield, cost, reliability and implementation schedule. The objective has been to develop the information to a common level so that the projects can be compared to each other and preliminarily ranked to determine which individual or combination of projects could best meet the identified supply need. For each of the projects presented in TMs 2 and 3, key issues and outstanding technical information has been identified, along with potential next steps.

In July 2012, the *Long-Term Reliable Water Supply Strategy Phase II A Report* (*Phase II A Report*) will be completed. This *Phase II A Report* will present the technical information developed to date as part of the Strategy (from *TMs 1, 2, and 3*), as well as updated information on the frequency and magnitude of expected supply shortfalls from the SF RWS. The *Phase II A Report* will also present a recommended implementation plan to achieve the Strategy's goal of ensuring that a reliable, high quality supply of water is available where and when people within the BAWSCA service area need it.

cdmsmith.com

Technical Memorandum No. 2

Updated Agency-Identified Water Supply Management Project Information for the Long-Term Reliable Water Supply Strategy

Draft Final – April 5, 2012

EXHIBITS

Exhibit 1	**Revised Draft Task 2-A Memo** **Agency-Identified Project Information and Information Gaps**
Exhibit 2	**Revised Draft Task 2-B Memo** **Project Information Developed for Agency Projects - Daly City Recycled Water Project – Service Area Expansion and Representative Coastal Desalination Project**
Exhibit 3	**Revised Draft Task 2-C Memo** **Consolidate Agency-Identified Project Information Redwood City & Palo Alto Recycled Water Projects**
Exhibit 4	**Revised Draft Task 2-D Memo** **Rainwater Harvesting, Stormwater Capture and Greywater Reuse**
Exhibit 5	**Revised Draft Task 6-A Memo** **Refined Evaluation Criteria and Metrics**

CDM Smith

Exhibit 1
Revised Draft Task 2-A Memo
Agency-Identified Project Information and Information Gaps

Memorandum

To: *Nicole Sandkulla*

From: *Bill Fernandez*
Andria Loutsch

Cc: *Craig Von Bargen*

Date: *February 21, 2012*

Subject: *Revised Draft Task 2-A Memo Agency-Identified Project Information and Information Gaps*

1.0 Introduction

In this Memo:

1. Introduction
2. Compilation of Agency-Identified Projects
3. Information Needed to Complete Project Evaluation
4. Summary of Commitment Letters and Follow-up Agency Discussions
5. Priority Projects for Phase II A
6. Projects for Further Consideration in Phase II B or II C
7. Next Steps

Appendices:

- A – Project Summary for DC-4: Daly City Recycled Water Service to Cemeteries Information Survey (DC-4)
- B – Project Summary for NC-4: NCCWD Desalination Plant
- C – Commitment Letter Forms for DC-4: Daly City Recycled Water Service to Cemeteries

The May 2010 Phase I Scoping Report presented 65 agency-identified water supply management projects (projects) that would be further evaluated during Phase II A of the Bay Area Water Supply and Conservation Agency (BAWSCA) Long Term Reliable Water Strategy (Strategy). As part of Phase II A, the BAWSCA member agencies, BAWSCA, and CDM participated in a project refinement and selection process. Based on the results of this effort, 11 agency-identified projects were retained for further evaluation in the Strategy: Four for evaluation in Phase II A, and seven for potential evaluation in Phase II B or II C. The rest of the agency-identified projects are not being evaluated further as part of the Strategy based on the screening criteria agreed upon by BAWSCA and the member agencies. Figure 1 summarizes the process by which the 11 agency-identified projects were selected for further evaluation.

In order to track each agency-indentified project, a unique identifier was developed with the first two letters representing the agency with the following number indicating the project number. The four agency-identified projects retained for development and evaluation in Phase II A are:

- Daly City – Recycled Water Service to Cemeteries (DC-4);
- North Coast County Water District (NCCWD) – Desalination Plant (NC-4);
- Palo Alto – Expand Recycled Water Plant to Serve Stanford Research Park (PA-2); and
- Redwood City – Redwood City Recycled Water Treatment Plant Expansion (RC-4).

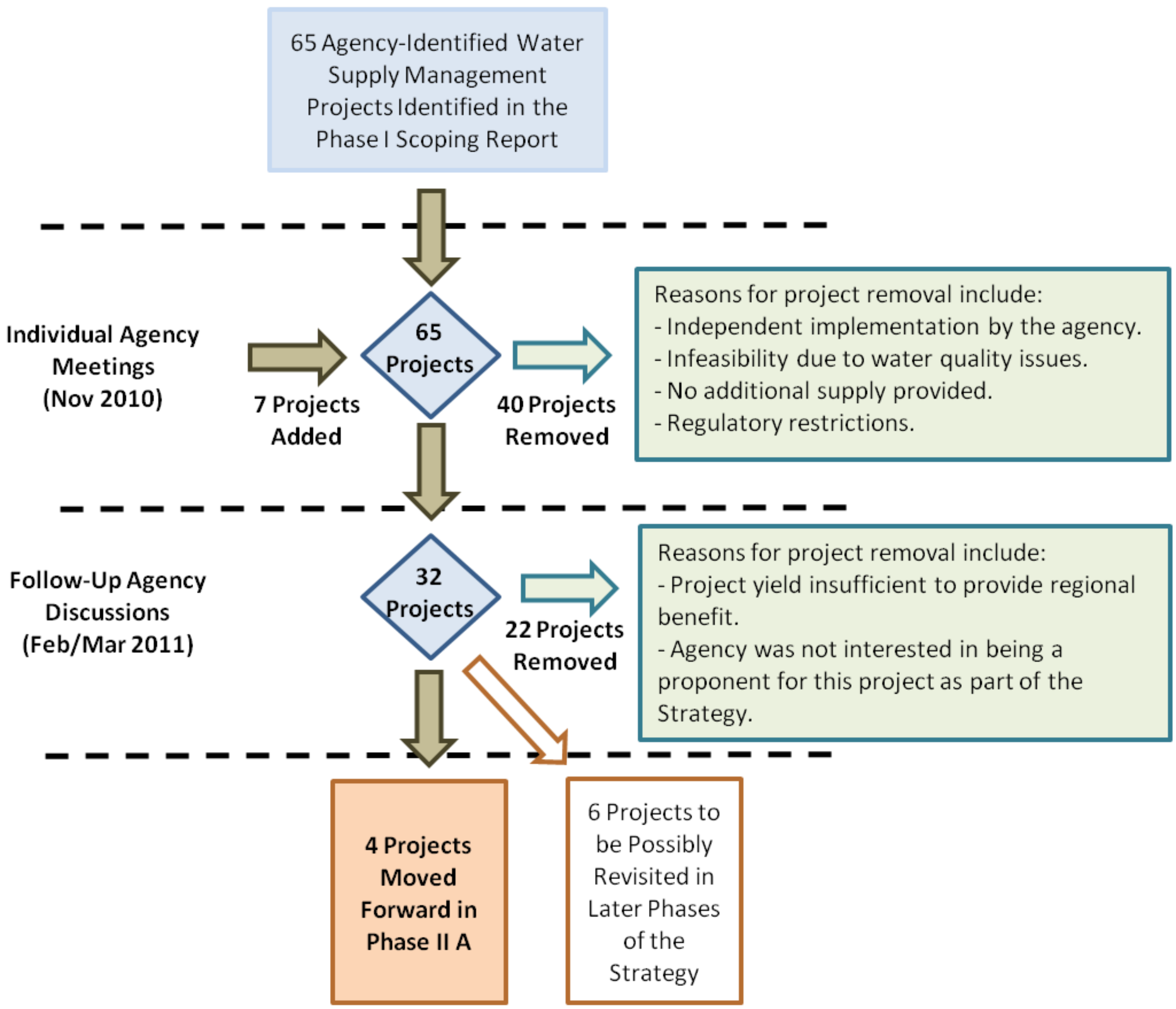


Figure 1
Phase II A Refinement Process for Agency-Identified Projects

Based on the preliminary capacity information for these projects, the total yield for the four Phase II A projects ranges from 4 million gallons per day (mgd) to 17 mgd. The total yield for the seven Phase II B/II C projects ranges from 12 to 30 mgd.

The agency-identified projects retained for potential evaluation in Phase II B or II C are:

- California Water Service Company – Desalination Project (CW-6);
- Mountain View – Recycled Water Intertie with Sunnyvale (MV-2);
- Mountain View – Increase Recycled Water Supply From Palo Alto Regional Water Quality Control Plant (PARWQCP) (MV-3);
- San Jose – Intertie Connection with Santa Clara Valley Water District (SCVWD) (SJ-4);
- San Jose – Increase Recycled Water Output from Wastewater Treatment Plant (WWTP) (SV-2); and
- San Jose – Expand Use of New or Converted Wells to Normal Year Supply (SV-4).

The level of information currently available for the agency-identified projects moving forward in the Strategy varies significantly and additional information will be required to fill remaining data gaps and to provide a common basis for project comparison (e.g., individual project cost, etc.). To facilitate comparison between the agency-identified projects, CDM has summarized the critical project data needs for the 11 agency-identified projects. For the projects to be evaluated in Phase II A, this data will be developed either by the sponsoring agency (early 2012 Redwood City and early 2013 for Palo Alto) or by BAWSCA by early 2012. Data for the Phase II B and II C projects will not be developed for some time.

This Task 2-A Memo presents details on the currently available information and key information gaps for the retained agency-identified project. The memo consists of the following sections:

- Compilation of Agency-Identified Projects
- Information Needed to Complete Project Evaluation
- Summary of Commitment Letters and Follow-up Agency Discussions
- Priority Projects for Phase II A;
- Projects for Further Consideration in Phase II B or II C;
- Next Steps;
- Tables; and
- Appendices

2.0 Compilation of Agency-Identified Projects

The Phase I Scoping Report for the Long-Term Water Supply Strategy (May 2010) identified 65 agency projects as existing, planned, or potential opportunities that could be included in the Strategy. These projects, summarized in Table 1, would develop groundwater, recycled water, or desalination sources within the BAWSCA service area, and potential water transfers from outside the Bay Area to the member agencies, or between member agencies.

In September 2010, CDM developed a Project Information Sheet for each of the 65 projects to consolidate the information available from the Phase I Scoping Report. The Project Information Sheets identified: (1) the information needed to support the comparison of projects, and (2) the project information that was available from existing studies and documents. The information needs included the following:

- General project information;
- Infrastructure – facilities;
- Infrastructure – costs;
- Infrastructure – ownership;
- Supply reliability;
- Water quality;
- Schedule;
- Funding;
- Environmental impacts; and
- Implementation potential.

In October 2010, each agency received a Project Information Sheet for each project they had identified within their service area. Each member agency was asked to review the Project Information Sheets and complete them if information was available. In November and December 2010, BAWSCA and CDM held individual meetings with each agency to discuss details of their projects, along with their expectations for the Strategy.

Through the course of the meetings, seven member agencies added projects to the Strategy, as shown in Table 2. These were projects that had been: (1) identified subsequent to the completion of the Phase I Scoping Report; (2) identified as distinct elements of a project identified in Phase I; or (3) were future expansions of projects identified in Phase I.

In addition, based on discussions with the member agencies regarding their current plans and activities, 40 projects were removed from further consideration in the Strategy. The reasons that agencies opted to remove a project included:

- Independent implementation by the agency;
- Infeasibility due to water quality issues;
- Implementation as part of the SFPUC Water Supply Improvement Program to provide dry year supply reliability;
- No additional supply provided or additional yield was unlikely;
- Lack of interest by the agency in pursuing the project;
- Regulatory restrictions;

- Existing wells would remain as emergency supply; or
- The project was a study only, not a supply project.

Table 3 identifies the 40 projects that were removed from consideration in the Strategy in November and December 2010. These projects are identified in Table 3 as being removed during the "Individual agency meetings" step of the project screening process. The additional 21 projects that were removed in later stages of the project screening process are also shown in Table 3 and are discussed in Section 3.0 and 4.0.

3.0 Information Needed to Complete Project Evaluation

Complete and accurate information is critical to comparing and evaluating the agency-identified projects. Although additional project information was gained from the individual agency meetings and the returned Project Information Sheets, information gaps remain.

To help identify the existing level of completion for certain critical pieces of project information and quickly assess the remaining information gaps, CDM summarized the current status of available project information for costs, facilities, supply reliability, schedule, water quality, implementation, environmental impacts, funding, and ownership. Table 4 presents this information for all proposed projects to be retained as of January 2011, including agency, project name, identification code, water source, and yield. The level of information provided is distinguished by the empty, partial, or filled-in circle under each data category. A "○" denotes that less than 25 percent of the data identified in the Project Information Sheet for that data category is currently available; a "◗" means 25 to 75 percent of the information is available; and a "●" denotes 75 percent or more of the data is available.

Of the 32 proposed retained projects as of January 2011:

- No projects had complete information in every category;
- Only two projects had 25 to 75 percent of the cost information;
- Only seven projects had 25 percent or more of the project facility information; and
- Ten projects had less than 25 percent of the requested information for all categories.

To better illustrate how the differing amounts of project data correspond to the empty/partial/full table of information gaps, Appendices A and B contain the summarized Project Information Sheets for two of the projects retained as of early January 2011. They were chosen as examples of the wide range of data completion. As mentioned above, CDM identified the most critical project data in each category based on information required for the evaluation criteria. The summarized Project Information Sheet displayed only those questions, along with the answers provided by the agency at that point in time and with the remaining data gaps highlighted.

Appendix A contains the summarized Project Information Sheet for DC-4, "*Daly City Recycled Water Service to Cemeteries.*" Daly City provided information on project yield, customers, permitting, and facilities. Information is still needed on funding, schedule, and environmental impacts.

Appendix B presents the summarized Project Information Sheet for NC-4, "*NCCWD Desalination Plant*." NCCWD provided only partial information as the project is still in the conceptual phase.

4.0 Summary of Commitment Letters and Follow-up Agency Discussions

In January 2011, for the 32 proposed retained projects, BAWSCA sent each agency a commitment letter wherein each agency was asked to confirm which of their projects they would like retained in the Strategy, and to commit to which of the remaining information gaps the agency would fill for each project and by when. As an example, Appendix C contains the tables and commitment form sent to Daly City in January 2011.

Following the return of the commitment letters, BAWSCA and CDM met with Daly City, NCCWD, Redwood City, and Sunnyvale in April 2011 for follow-up discussions regarding their projects. These agencies had agreed to develop additional information for their projects. The purpose of the meetings was to identify any outstanding questions or issues regarding the projects, confirm member agency interest in the potential projects, and confirm the schedule of project information development identified in the commitment letters. Based on the information collected from the commitment letters and the follow-up meetings, 22 additional projects (for a total of 61) were removed from consideration in Phase II A of the Strategy. These projects are identified in Table 3 as being removed during the "Follow-up agency meeting" step of the project screening process. Reasons for removing these projects included:

- No commitment to pursuing this project as part of the Strategy;
- No commitment to pursuing this project as part of the Strategy; however, similar projects are being evaluated in the Strategy as part of the analysis of regional water transfer options;
- Insufficient yield to provide regional benefit; or
- Independent implementation by the agency.

5.0 Priority Projects for Phase II A

As a result of the follow-up agency meetings, four projects were identified for evaluation in Phase II A of the Strategy. These projects, summarized in Table 5, are:

- DC-4: Daly City Recycled Water Service to Cemeteries;
- NC-4: NCCWD Desalination Plant;
- PA-2: Expand Recycled Water Plant to Serve Stanford Research Park; and
- RC-4: Redwood City Recycled Water Treatment Plant Expansion.

6.0 Projects for Further Consideration in Phase II B or II C

At the time of the follow-up agency meetings in April 2011, a number of agencies were in the process of developing information for their projects and committed to providing this information to BAWSCA for use in the Strategy when it became available. However, the information was not going to be available for inclusion in the Phase II A evaluation. These projects may be revisited in Phase II B or II C depending on when the information is provided to BAWSCA. The information gaps for these seven projects are summarized in Table 6. The six agency-identified projects identified for potential evaluation in Phase II B or II C are:

- CW-6: Cal Water Desalination Project;
- MV-2: Recycled Water Intertie with Sunnyvale;
- MV-3: Increase Recycled Water Supply From PARWQCP;
- SJ-4: Intertie Connection with SCVWD;
- SV-2: Increase Recycled Water Output from WWTP; and
- SV-4: Expand Use of New or Converted Wells to Normal Year Supply.

7.0 Next Steps

Of the four projects retained for evaluation in Phase II A of the Strategy, BAWSCA determined that although two agencies were not going to be able to develop the needed information in time for the Phase II A evaluation in early 2012, these two projects provided sufficient potential regional benefit and should continue to be evaluated. BAWSCA directed CDM Smith to develop the information necessary to address the remaining data gaps for projects DC-4 and NC-4. Based on discussions with NCCWD representatives it was determined that NCCWD was not interested in being a proponent for a project at this time. Project NC-4, the NCCWD Desalination Plant, is in early conceptual planning and therefore will require the development by the Strategy team of a wide range of data including:

- Costs;
- Facilities;
- Supply Reliability;
- Schedule;
- Water Quality;
- Implementation Potential;
- Environmental Impacts;
- Funding; and,
- Ownership.

Project DC-4, Daly City Recycled Water Service to Cemeteries, has been studied in-depth in a recent feasibility study ("Recycled Water Treatment and Delivery System Expansion Feasibility Study," Carollo, October 2009) which provided information on customers the project could serve, project supply reliability, and implementation potential. The remaining data gaps to be addressed prior to evaluation in Phase II A include:

- Costs;
- Facilities;
- Schedule;
- Water Quality;
- Environmental Impacts;
- Funding; and,
- Ownership.

Palo Alto and Redwood City are currently developing information to address the data gaps for their respective projects PA-2 and RC-4. This information is planned to be provided by Redwood City for RC-4 in August 2011 and by Palo Alto for PA-2 in September 2011.

In parallel with the development of the needed information for these four agency-identified projects, information is being developed for the identified potential regional projects:

- Local area rainwater harvesting, stormwater, and greywater projects (see the Task 2-D memo); and
- Regional desalination and water transfer projects.

All the project information for agency-identified, local and regional projects will be available by November 2011. These projects will form the basis of project alternatives that will be evaluated against the near- and long-term supply need for the member agencies for both normal and dry year conditions. The development of comparable levels of information on project capacities, costs, schedules, and institutional issues is critical to making reasoned decisions regarding the best choices and opportunities for new sources of supply.

Tables

Table 1 Agency-Identified Projects in the Phase I Scoping Report				
Agency	**Project ID**	**Water Type**	**Project Status**	**Project Name**
Alameda County Water District (ACWD)	AC-1	Recycled Water	Planned	Alternative 1 - Connect to South Bay Water Recycling
	AC-2	Recycled Water	Planned	Project A - Irvington Pump Station Recycled Water Project
	AC-3	Recycled Water	Potential	Project B - Alvarado Wastewater Treatment Plant Recycled Water Project
California Water Service Company (Cal Water)	CW-1	Groundwater	Existing	Regional Groundwater Storage and Recovery Project - Cal Water
	CW-2	Groundwater	Planned	Mid-Peninsula Groundwater Investigation
	CW-3/SB-3	Recycled Water	Planned	Joint Cal Water, South San Francisco, San Bruno and SFPUC Recycled Water Project - Cal Water
	CW-4	Groundwater	Potential	Expansion of Mid-Peninsula Groundwater
	CW-5	Recycled Water	Potential	Expansion of Joint Cal Water, South San Francisco, San Bruno and SFPUC Recycled Water Project
Coastside County Water District	CS-1	Recycled Water	Planned	Recycled Water Project Development
	CS-2	Recycled Water	Planned	Increase Yield of Recycled Water Project to 2,240 AFY
	CS-3	Recycled Water	Potential	Increase Yield of Recycled Water Project Beyond 2,240 AFY
Daly City	DC-1	Groundwater	Existing	Regional Groundwater Storage and Recovery Project - Daly City
	DC-2	Groundwater	Planned	Replacement Well Project
	DC-3	Groundwater	Potential	Emergency Supply Retrofit of A Street Well
	DC-4	Recycled Water	Potential	Daly City Recycled Water Service to Cemeteries
East Palo Alto	EPA-1	Groundwater	Existing	Rehabilitate Existing Gloria Bay Well
	EPA-2	Recycled Water	Planned	Scalping Plant Development
	EPA-3	Groundwater	Potential	Install New Well
	EPA-4	Recycled Water	Potential	Expand Scalping Plant Supply Beyond EPA-2 Capacity
Hayward	HAY-1A	Recycled Water	Planned	Construct New Recycled Water Plant to Deliver Up to 3,920 AFY
	HAY-1B	Recycled Water	Planned	Utilize Excess Recycled Water from Planned Plant Not Used by Calpine, 680 AFY
	HAY-2	Groundwater	Potential	Upgrade Current Emergency Wells to Normal Year Supply
	HAY-3	Recycled Water	Potential	Construct Larger Plant to Supply Recycled Water Above 4,600 AFY
Menlo Park	MEN-1	Groundwater	Planned	Construct Additional Wells for Emergency Use
	MEN-2	Groundwater	Potential	Construct Wells for Normal Year Supply
	MEN-3	Groundwater	Potential	Construct Wells for Irrigation Supply
	MEN-4	Groundwater	Potential	Upgrade Emergency Wells to Supplement Normal Year Supply (from MEN-1)
Millbrae	MILL-1	Recycled Water	Planned	Recycled Water Treatment Plant Construction
	MILL-2	Recycled Water	Potential	Expand New Treatment Plant to Serve Recycled Water Beyond Planned 1 mgd Capacity
Milpitas	MILP-1	Groundwater	Existing	Pinewood Well Conversion to Normal Supply
	MILP-2	Groundwater	Potential	Curtis Well Conversion to Normal Supply

Table 1 Agency-Identified Projects in the Phase I Scoping Report				
Agency	**Project ID**	**Water Type**	**Project Status**	**Project Name**
Mountain View	MV-1	Recycled Water	Existing	Increase Recycled Water Purchases to Demand of 1,200 AFY
	MV-2	Recycled Water	Existing	Feasibility Study for Recycled Water Intertie with Sunnyvale
	MV-3	Recycled Water	Existing	Conduct a Joint Recycled Water Feasibility Study with PARWQCP
	MV-4	Groundwater	Planned	Complete Two Well Rehabilitation Projects by 2015
	MV-5	Groundwater	Potential	Integrate 4 Emergency Wells into Normal Year Supply
	MV-6	Recycled Water	Potential	Increase Use of Palo Alto Recycled Water Above Projected Demand of 1,800 AFY (see MV-3 entry)
North Coast County Water District (NCCWD)	NC-1	Recycled Water	Existing	Calera Creek Water Recycling Plant - Phase 1
	NC-2	Recycled Water	Planned	Calera Creek Water Recycling Plant - Phase 2
	NC-3	Recycled Water	Potential	Calera Creek Water Recycling Plant - Phase 3
	NC-4	Desalination	Potential	NCCWD Desalination Plant
Palo Alto [(1)]	PA-1	Groundwater	Existing	Rehabilitate 5 Existing Wells and Construct 3 New Wells
	PA-2/PA-4	Recycled Water	Existing	Expand Recycled Water Plant to Serve Stanford Research Park and Additional Areas
	PA-3	Groundwater	Potential	Convert Existing or Planned Emergency Wells to Normal Year Supply
Redwood City	RC-1	Recycled Water	Existing	Redwood City Recycled Water Utilization Project
	RC-2	Groundwater	Potential	Redwood City Normal Year Supply Well Construction
	RC-3	Groundwater	Potential	Expansion of Redwood City Normal Year Supply Well Construction
	RC-4	Recycled Water	Potential	Redwood City Recycled Water Treatment Plant Expansion
San Bruno	SB-1	Groundwater	Existing	Regional Groundwater Storage and Recovery Project - San Bruno
	SB-2	Groundwater	Potential	Maximize Safe Yield of Wells Based on Groundwater Management Plan
	CW-3/SB-3	Recycled Water	Potential	Joint Cal Water, South San Francisco, San Bruno and SFPUC Recycled Water Project - San Bruno
San Jose	SJ-1	Recycled Water	Existing	SBWR Expansion - San Jose
	SJ-2	Groundwater	Planned	San Jose Well Construction
	SJ-3	Groundwater	Potential	Expansion of San Jose Well Construction
Santa Clara	SC-1	Recycled Water	Existing	SBWR Expansion - Santa Clara
	SC-2	Groundwater	Planned	Santa Clara Groundwater Wells 32 and 34
	SC-3	Groundwater	Potential	Expand Santa Clara Groundwater Wells 32 and 34
Stanford University	SU-1	Groundwater	Potential	Increase Existing Well Use for Non-Potable Supply
	SU-2	Recycled Water	Potential	Increase Use of Recycled Water from Cooling Tower Blowdown
	SU-3	Recycled Water	Potential	Develop a Scalping Plant for Landscape and Playfield Irrigation

Table 1 Agency-Identified Projects in the Phase I Scoping Report				
Agency	**Project ID**	**Water Type**	**Project Status**	**Project Name**
Sunnyvale	SV-1	Groundwater	Existing	Convert One Standby Well to Normal Supply
	SV-2	Recycled Water	Existing	Increase Recycled Water Output from WWTP
	SV-3	Groundwater	Planned	Construct New Wells for Normal Supply
	SV-4	Groundwater	Potential	Expand Use of New or Converted Wells to Normal Year Supply
	SV-5	Recycled Water	Potential	Maximize Recycled Water Output from WWTP

(1) In the Phase 1 Scoping Report, PA-2 and PA-4 were one project. PA-4 has been split out as a separate, new project.
AFY=acre-feet per year; SBWR=South Bay Water Recycling; SFPUC=San Francisco Public Utilities Commission.

Table 2 Agency-Identified Projects Added During Agency Meetings				
Agency	**Project ID**	**Water Type**	**Project Status**	**Project Name**
ACWD	AC-4	Desalination	Potential	East Bay Saline Groundwater Desalination Facility
Cal Water	CW-6	Desalination	Potential	Cal Water Desalination Project
Coastside County Water District	CS-4	Groundwater	Existing	Restore Denniston Well Field to Historical Yield of 614-920 AFY
Hillsborough	HB-1	Stormwater Capture	Potential	Pipe Stormwater to Reservoir Road Reservoir for Irrigation Use in the El Cerrito Area
Palo Alto [(1)]	PA-4	Recycled Water	Potential	Expand Recycled Water Plant to Serve Additional Areas
San Jose	SJ-4	Treated	Potential	Intertie Connection with SCVWD
Stanford University	SU-4	Raw Water	Existing	Local Activities to Reduce Demand

[(1)] In the Phase 1 Scoping Report, PA-2 and PA-4 were one project. PA-4 has been split out as a separate, new project based on discussions during the agency meetings.

Table 3 Agency-Identified Projects Removed During Agency Meetings and Follow-up Discussions						
Agency	**Project ID**	**Water Type**	**Project Status**	**Project Name**	**Reason for Removal**	**Removed During Which Task 2-A Step**
ACWD	AC-1	Recycled Water	Planned	Alternative 1 - Connect to South Bay Water Recycling	Being implemented independently	Individual agency meetings
	AC-2	Recycled Water	Planned	Project A - Irvington Pump Station Recycled Water Project	Being implemented independently	Individual agency meetings
	AC-3	Recycled Water	Planned	Project B - Alvarado Wastewater Treatment Plant Recycled Water Project	Being implemented independently	Individual agency meetings
	AC-4	Desalination	Potential	East Bay Saline Groundwater Desalination Facility	Not interested due to potential impact to existing freshwater and brackish groundwater supplies	Follow-up agency meetings
Cal Water	CW-1	Groundwater	Existing	Regional Groundwater Storage and Recovery Project - Cal Water	Being implemented as part of SFPUC WSIP to provide dry year reliability	Individual agency meetings
	CW-2	Groundwater	Planned	Mid-Peninsula Groundwater Investigation	Study only; planned to be implemented by Cal Water	Individual agency meetings
	CW-3/SB-3	Recycled Water	Planned	Joint Cal Water, South San Francisco, San Bruno and SFPUC Recycled Water Project - Cal Water	Project does not provide additional yield	Follow-up agency meetings
	CW-4	Groundwater	Potential	Expansion of Mid-Peninsula Groundwater	Being implemented independently	Individual agency meetings
	CW-5	Recycled Water	Potential	Expansion of Joint Cal Water, South San Francisco, San Bruno and SFPUC Recycled Water Project	Project does not provide additional yield	Follow-up agency meetings
Coastside County Water District	CS-1	Recycled Water	Planned	Recycled Water Project Development	Agency has not committed to pursuing this project as part of the Strategy	Follow-up agency meetings
	CS-2	Recycled Water	Planned	Increase Yield of Recycled Water Project to 2,240 AFY	Expansion of recycled water project not feasible at this time	Individual agency meetings
	CS-3	Recycled Water	Potential	Increase Yield of Recycled Water Project Beyond 2,240 AFY	Expansion of recycled water project not feasible at this time	Individual agency meetings
	CS-4	Groundwater	Existing	Restore Denniston Well Field to Historical Yield of 614-920 AFY	Being implemented independently	Individual agency meetings
Daly City	DC-1	Groundwater	Existing	Regional Groundwater Storage & Recovery Project - Daly City	Being implemented as part of SFPUC WSIP to provide dry year reliability	Individual agency meetings
	DC-2	Groundwater	Planned	Replacement Well Project	Being implemented independently	Individual agency meetings
	DC-3	Groundwater	Potential	Emergency Supply Retrofit of A Street Well	Being implemented independently	Individual agency meetings
East Palo Alto	EPA-1	Groundwater	Existing	Rehabilitate Existing Gloria Bay Well (estimated 350 gpm)	The potential yield of the project is insufficient to provide regional benefit	Follow-up agency meetings
	EPA-2	Recycled Water	Planned	Scalping Plant Development	The potential yield of the project is insufficient to provide regional benefit	Follow-up agency meetings
	EPA-3	Groundwater	Potential	Install New Well	The potential yield of the project is insufficient to provide regional benefit	Follow-up agency meetings
	EPA-4	Recycled Water	Potential	Expand Scalping Plant Supply Beyond EPA-2 Capacity	Expansion not feasible at this time	Individual agency meetings
Hayward	HAY-1A	Recycled Water	Planned	Construct New Recycled Water Plant to Deliver Up to 3,920 AFY	Agency is unable to provide project information on a schedule that is consistent with the timing of the Phase II A evaluation; project may be revisited in Phases II B or II C of the Strategy	Follow-up agency meetings
	HAY-1B	Recycled Water	Planned	Utilize Excess Recycled Water from Planned Plant Not Used by Calpine, 680 AFY	Agency is unable to provide project information on a schedule that is consistent with the timing of the Strategy Phase II A evaluation. Project may be revisited in Phases II B or II C of the Strategy	Follow-up agency meetings
	HAY-2	Groundwater	Potential	Upgrade Current Emergency Wells to Normal Year Supply	Agency has not committed to pursuing this project as part of the Strategy	Follow-up agency meetings
	HAY-3	Recycled Water	Potential	Construct Larger Plant to Supply Recycled Water Above 4,600 AFY	Agency has not committed to pursuing this project as part of the Strategy	Follow-up agency meetings

Table 3 Agency-Identified Projects Removed During Agency Meetings and Follow-up Discussions						
Agency	**Project ID**	**Water Type**	**Project Status**	**Project Name**	**Reason for Removal**	**Removed During Which Task 2-A Step**
Hillsborough	HB-1	Stormwater	Potential	Pipe Stormwater to Reservoir Road Reservoir for Irrigation Use in the El Cerrito Area	Agency has not committed to pursuing this project as part of the Strategy	Follow-up agency meetings
Menlo Park	MEN-1	Groundwater	Planned	Construct Additional Wells for Emergency Use	Being implemented independently	Individual agency meetings
	MEN-2	Groundwater	Potential	Construct Wells for Normal Year Supply	Not interested due to additional regulations for normal supply wells	Individual agency meetings
	MEN-3	Groundwater	Potential	Construct Wells for Irrigation Supply	Being implemented independently	Individual agency meetings
	MEN-4	Groundwater	Potential	Upgrade Emergency Wells to Supplement Normal Year Supply (from MEN-1)	Not interested due to additional regulations for normal supply wells	Individual agency meetings
Millbrae	MILL-1	Recycled Water	Planned	Recycled Water Treatment Plant Construction	Agency has not committed to pursuing this project as part of the Strategy	Follow-up agency meetings
	MILL-2	Recycled Water	Potential	Expand New Treatment Plant to Serve Recycled Water Beyond Planned 1 mgd Capacity	Millbrae not pursuing at this time	Individual agency meetings
Milpitas	MILP-1	Groundwater	Existing	Pinewood Well Conversion to Normal Supply	Well will remain emergency supply	Individual agency meetings
	MILP-2	Groundwater	Potential	Curtis Well Conversion to Normal Supply	Well will remain emergency supply	Individual agency meetings
Mountain View	MV-1	Recycled Water	Existing	Increase Recycled Water Purchases to Demand of 1,200 AFY	Being implemented independently	Individual agency meetings
	MV-4	Groundwater	Planned	Complete Two Well Rehabilitation Projects by 2015	Being implemented independently	Individual agency meetings
	MV-5	Groundwater	Potential	Integrate 4 Emergency Wells into Normal Year Supply	Being implemented independently	Individual agency meetings
	MV-6	Recycled Water	Potential	Increase Use of Palo Alto Recycled Water Above Projected Demand of 1,800 AFY (see MV-3 entry)	Agency not interested in pursuing at this time	Individual agency meetings
NCCWD	NC-1	Recycled Water	Existing	Calera Creek Water Recycling Plant - Phase 1	Being implemented independently	Individual agency meetings
	NC-2	Recycled Water	Planned	Calera Creek Water Recycling Plant - Phase 2	Agency has not committed to pursuing this project as part of the Strategy	Follow-up agency meetings
	NC-3	Recycled Water	Potential	Calera Creek Water Recycling Plant - Phase 3	Agency has not committed to pursuing this project as part of the Strategy	Follow-up agency meetings
Palo Alto	PA-1	Groundwater	Existing	Rehabilitate 5 Existing Wells and Construct 3 New Wells	Being implemented independently	Individual agency meetings
	PA-3	Groundwater	Potential	Convert Existing or Planned Emergency Wells to Normal Year Supply	Precluded by existing permit, well will remain emergency supply	Individual agency meetings
	PA-4	Recycled Water	Potential	Expand Recycled Water Plant to Serve Additional Areas	Agency is unable to provide project information on a schedule that is consistent with the timing of the Phase II A evaluation; project may be revisited in Phases II B or II C of the Strategy	Follow-up agency meetings
Redwood City	RC-1	Recycled Water	Existing	Redwood City Recycled Water Utilization Project	Project is being completed by agency independent of the Strategy	Follow-up agency meetings
	RC-2	Groundwater	Potential	Redwood City Normal Year Supply Well Construction	The potential yield of the project is insufficient to provide regional benefit	Follow-up agency meetings
	RC-3	Recycled Water	Existing	Expansion of Redwood City Normal Year Supply Well Construction	Additional yield beyond RC-2 is unlikely	Individual agency meetings
San Bruno	SB-1	Groundwater	Existing	Regional Groundwater Storage and Recovery Project – San Bruno	Being implemented as part of SFPUC WSIP to provide dry year reliability	Individual agency meetings
	SB-2	Groundwater	Potential	Maximize Safe Yield of Wells Based on Groundwater Management Plan	Being implemented independently	Individual agency meetings
	CW-3/SB-3	Recycled Water	Potential	Joint Cal Water, South San Francisco, San Bruno and SFPUC Recycled Water Project - San Bruno	Project does not provide additional yield.	Follow-up agency meetings

Table 3

Agency-Identified Projects Removed During Agency Meetings and Follow-up Discussions

Agency	Project ID	Water Type	Project Status	Project Name	Reason for Removal	Removed During Which Task 2-A Step
San Jose	SJ-1	Recycled Water	Existing	SBWR Expansion - San Jose	Being implemented independently	Individual agency meetings
	SJ-2	Groundwater	Planned	San Jose Well Construction	Being implemented independently	Individual agency meetings
	SJ-3	Groundwater	Potential	Expansion of San Jose Well Construction	Infeasible due to water quality issues	Individual agency meetings
Santa Clara	SC-1	Recycled Water	Existing	SBWR Expansion – Santa Clara	Being implemented independently	Individual agency meetings
	SC-2	Groundwater	Planned	Santa Clara Groundwater Wells 32 and 34	Being implemented independently	Individual agency meetings
	SC-3	Groundwater	Potential	Expand Santa Clara Groundwater Wells 32 and 34	Infeasible due to water quality issues	Individual agency meetings
Stanford University	SU-1	Groundwater	Potential	Increase Existing Well Use for Non-Potable Supply	Agency has not committed to pursuing this project as part of the Strategy	Follow-up agency meetings
	SU-2	Recycled Water	Potential	Increase Use of Recycled Water from Cooling Tower Blowdown	Being implemented independently	Individual agency meetings
	SU-3	Recycled Water	Potential	Develop a Scalping Plant for Landscape and Playfield Irrigation	Agency has not committed to pursuing this project as part of the Strategy	Follow-up agency meetings
	SU-4	Raw Water	Existing	Local Activities to Reduce Demand	Being implemented independently	Individual agency meetings
Sunnyvale	SV-1	Groundwater	Existing	Convert One Standby Well to Normal Supply	Being implemented independently	Individual agency meetings
	SV-3	Groundwater	Planned	Construct New Wells for Normal Supply	Being implemented independently	Individual agency meetings
	SV-5	Recycled Water	Potential	Maximize Recycled Water Output from WWTP	Agency has not committed to pursuing this project as part of the Strategy	Follow-up agency meetings

Table 4
Summary of Information Gaps for Retained Agency-Identified Projects, as of January 2011

General Project Information							Information Provided									
Agency	**Project Index**	**Title**	**Type**	**Status**	**Yield (1)**		**Costs**	**Facilities**	**Supply Reliability**	**Schedule**	**Water Quality**	**Implementation Potential**	**Environmental Impacts**	**Funding**	**Ownership**	**Ongoing Project Data Development by Agencies**
					(mgd)	**(AFY)**										
ACWD	AC-4	East Bay Saline Groundwater Desalination Facility	Desalination	Potential	5-15	--	○	◗	○	○	○	○	○	○	○	
Cal Water	CW-3/SB-3 (2)	Joint Cal Water, South San Francisco, San Bruno and SFPUC Recycled Water Project - Cal Water	Recycled Water	Planned	--	500	○	○	●	○	●	●	◗	○	○	
	CW-5	Expansion of Joint Cal Water, South San Francisco, San Bruno and SFPUC Recycled Water Project	Recycled Water	Potential	NA		○	○	●	○	●	●	◗	○	○	
	CW-6	Cal Water Desalination Project	Desalination	Potential	NA		○	○	○	○	○	○	○	○	○	Completing Peninsula Integration Plan by February 2011.
Coastside County Water District	CS-1	Recycled Water Project Development	Recycled Water	Planned	NA		○	○	○	○	○	●	○	○	○	
Daly City	DC-4	Daly City Recycled Water Service to Cemeteries	Recycled Water	Potential	--	3,100	○	◗	●	○	○	●	◗	○	○	Studying recycled water acceptability for cemeteries.
East Palo Alto	EPA-1	Rehabilitate Existing Gloria Bay Well (estimated 350 gpm)	Groundwater	Existing	--	1,000	◗	◗	●	○	◗	◗	○	○	◗	
	EPA-2	Scalping Plant Development	Recycled Water	Planned	--	300	○	◗	◗	○	○	●	○	○	◗	
	EPA-3	Install New Well	Groundwater	Potential	1.4	--	○	○	○	○	○	○	○	○	○	
Hayward	HAY-1A	Construct New Recycled Water Plant to Deliver Up to 3,920 AFY	Recycled Water	Planned	3.5	3,920	○	○	◗	○	●	●	○	◗	○	
	HAY-1B	Utilize Excess Recycled Water from Planned Plant Not Used by Calpine, 680 AFY	Recycled Water	Planned	0.5	680	○	○	◗	○	●	◗	○	○	○	
	HAY-2	Upgrade Current Emergency Wells to Normal Year Supply	Groundwater	Potential	NA		○	○	○	○	○	◗	○	○	○	Planning preliminary investigation to determine benefit of developing a Groundwater Management Plan.
	HAY-3	Construct Larger Plant to Supply Recycled Water Above 4,600 AFY	Recycled Water	Potential	NA		○	○	○	○	○	◗	○	○	○	
Hillsborough	HB-1	Pipe Stormwater to Reservoir Road Reservoir for Irrigation Use in the El Cerrito Area	Stormwater	Potential	NA		○	○	○	○	○	○	○	○	○	
Millbrae	MILL-1	Recycled Water Treatment Plant Construction	Recycled Water	Planned	1.0	--	○	○	○	○	●	◗	○	○	○	May include conceptual development for project in upcoming Water Master Plan.
Mountain View	MV-2	Recycled Water Intertie with Sunnyvale	Recycled Water	Potential	NA		○	○	○	○	●	●	○	○	○	Feasibility study likely to occur early 2011. Updating City General Plan.
	MV-3	Increase Recycled Water Supply From PARWQCP	Recycled Water	Existing	NA		○	○	○	○	●	●	○	◗	◗	Developing contract with PARWQCP. Updating City General Plan.
NCCWD	NC-2	Calera Creek Water Recycling Plant - Phase 2	Recycled Water	Planned	--	100	○	○	◗	○	○	○	○	○	○	
	NC-3	Calera Creek Water Recycling Plant - Phase 3	Recycled Water	Potential	NA		○	○	○	○	○	○	○	○	○	
	NC-4	NCCWD Desalination Plant	Desalination	Potential	10-15	--	○	○	○	○	○	○	○	○	○	Will be completing a white paper on project expectations and objectives, capacity, footprint, neighborhood acceptance, and fatal flaws.

Table 4
Summary of Information Gaps for Retained Agency-Identified Projects, as of January 2011

General Project Information							Information Provided										Ongoing Project Data Development by Agencies
Agency	Project Index	Title	Type	Status	Yield (1) (mgd)	Yield (1) (AFY)	Costs	Facilities	Supply Reliability	Schedule	Water Quality	Implementation Potential	Environmental Impacts	Funding	Ownership		
Palo Alto	PA-2	Expand Recycled Water Plant to Serve Stanford Research Park	Recycled Water	Existing	0.8	--	◗	●	●	●	◗	●	●	●	◗		Preparing Draft Environmental Impact Report, due in 2011.
	PA-4	Expand Recycled Water Plant to Serve Additional Areas	Recycled Water	Potential	NA		○	○	○	○	○	○	○	○	○		
Redwood City	RC-1	Redwood City Recycled Water Utilization Project	Recycled Water	Potential	1.8	2,000	○	○	●	○	●	◗	◗	○	○		Investigating plant capacity; was planned for completion in mid-December 2010.
	RC-2	Redwood City Normal Year Supply Well Construction	Groundwater	Potential	--	500-1,000	○	◗	●	○	○	◗	◗	○	◗		
	RC-4	Redwood City Recycled Water Treatment Plant Expansion	Recycled Water	Potential	--	9,000	○	○	◗	○	●	◗	◗	○	○		
San Bruno	CW-3/SB-3 [(2)]	Joint Cal Water, South San Francisco, San Bruno and SFPUC Recycled Water Project - San Bruno	Recycled Water	Potential	NA		○	○	○	○	○	○	○	○	○		
San Jose	SJ-4	Intertie Connection with SCVWD	Treated Water	Potential	NA		○	○	○	○	○	○	○	○	○		
Stanford University	SU-1	Increase Existing Well Use for Non-Potable Supply	Groundwater	Potential	NA		○	○	○	○	○	○	○	○	○		Studying non-potable water supply; may be complete mid/end of 2011.
	SU-3	Develop a Scalping Plant for Landscape and Playfield Irrigation	Recycled Water	Potential	NA		○	○	○	○	○	○	○	○	○		
Sunnyvale	SV-2	Increase Recycled Water Output from WWTP	Recycled Water	Existing	4-8	4,500-9,000	○	○	◗	○	●	◗	○	●	○		Completing specific project plan in next year or two.
	SV-4	Expand Use of New or Converted Wells to Normal Year Supply	Groundwater	Potential	3	3,300	○	◗	●	◗	●	●	●	●	○		
	SV-5	Maximize Recycled Water Output from WWTP	Recycled Water	Potential	4-8	4,500-9,000	○	○	◗	○	●	◗	○	○	○		Completing specific project plan in next year or two.

Key
○ Less than 25% of information available
◗ 25-75% of information available
● More than 75% of information available

Note:
[(1)] gpm = gallons per minute; NA = data not available; - - = data available only in one set of units.
[(2)] CW-3/SB-3 is a joint project that will serve multiple agencies from the same wastewater treatment plant. Project information on costs, facilities, yield, and schedule for Cal Water and San Bruno will vary.

Table 5
Summary Information for Agency-Identified Projects Moving Forward in Phase II A

General Project Information							Information Provided									
Agency	**Project Index**	**Title**	**Type**	**Status**	**Yield (1)**		**Costs**	**Facilities**	**Supply Reliability**	**Schedule**	**Water Quality**	**Implementation Potential**	**Environmental Impacts**	**Funding**	**Ownership**	**Ongoing Project Data Development by Agencies**
					(mgd)	**(AFY)**										
Daly City	DC-4	Daly City Recycled Water Service to Cemeteries	Recycled Water	Potential	--	3,100	○	◗	●	○	○	●	◗	○	○	Studying recycled water acceptability for cemeteries.
NCCWD	NC-4	NCCWD Desalination Plant	Desalination	Potential	2-15	--	○	○	○	○	○	○	○	○	○	Will be completing a white paper on project expectations and objectives, capacity, footprint, neighborhood acceptance, and fatal flaws.
Palo Alto	PA-2	Expand Recycled Water Plant to Serve Stanford Research Park	Recycled Water	Existing	0.8	--	◗	●	●	●	◗	●	●	●	◗	Preparing Draft Environmental Impact Report, due in Fall/Winter 2011.
Redwood City	RC-4	Redwood City Recycled Water Treatment Plant Expansion	Recycled Water	Potential	--	1,600 AFY (RWC target for 2030)	○	○	◗	○	●	◗	◗	○	○	

Key

○ Less than 25% of information available

◗ 25-75% of information available

● More than 75% of information available

Table 6
Summary Information for Agency-Identified Projects that May Be Revisited in Phase II B or II C

General Project Information							Information Provided										Ongoing Project Data Development by Agencies
Agency	Project Index	Title	Type	Status	Yield (1)		Costs	Facilities	Supply Reliability	Schedule	Water Quality	Implementation Potential	Environmental Impacts	Funding	Ownership		
					(mgd)	(AFY)											
ACWD	AC-4	East Bay Saline Groundwater Desalination Facility	Desalination	Potential	5-15	--	○	◗	○	○	○	○	○	○	○		
Cal Water	CW-6	Cal Water Desalination Project	Desalination	Potential	NA		○	○	○	○	○	○	○	○	○		Completing Peninsula Integration Plan by February 2011.
Mountain View	MV-2	Recycled Water Intertie with Sunnyvale	Recycled Water	Potential	NA		○	○	○	○	●	●	○	○	○		Feasibility study likely to occur early 2011. Updating City General Plan.
	MV-3	Increase Recycled Water Supply From PARWQCP	Recycled Water	Existing	NA		○	○	○	○	●	●	○	◗	◗		Developing contract with PARWQCP. Updating City General Plan.
San Jose	SJ-4	Intertie connection with SCVWD	Transfer	Potential	NA		○	○	○	○	○	○	○	○	○		
Sunnyvale	SV-2	Increase Recycled Water Output from WWTP	Recycled Water	Existing	4-8	4,500-9,000	○	○	◗	○	●	◗	○	●	○		Completing specific project plan in next year or two.
	SV-4	Expand Use of New or Converted Wells to Normal Year Supply	Groundwater	Potential	3	3,300	○	◗	●	◗	●	●	●	●	○		

Key

○ Less than 25% of information available

◗ 25-75% of information available

● More than 75% of information available

Appendix A

Project Summary for DC-4: Daly City Recycled Water Service to Cemeteries

Project: DC-4: Daly City Recycled Water Service to Cemeteries

Instructions: Please complete contact information in the **ORANGE** *shaded cells. This person may be contacted if there are questions regarding any submitted information. Cells will change color after information is entered.*

General Agency Contact Information

Date:	29-Oct-10
Agency:	City of Daly City
Project Contact Name:	Patrick Sweetland
Project Contact Position:	Director of Water and Wastewater Resources
Email:	psweetland@dalycity.org
Phone:	(650) 991-8201

Project: DC-4: Daly City Recycled Water Service to Cemeteries

Instructions: Please complete project information in the **ORANGE** *shaded cells. For all responses, use as many lines as needed or attach additional sheets. Cells will change color after information is entered.*

General Project Information

1) Project Description and Information Sources:

Brief project description: (*e.g., Design and construction of 4 new wells to provide a total capacity of 6 mgd for emergency and drought supply*).

Construction of a new tertiary recycled water facility, associated transmission main and storage tank to provide irrigation water to Colma cemeteries.

2) Is supply from this project included in supply projections as presented in the updated 2010 UWMP documents?

____ Yes x No

3) Indicate the type of project by selecting one of the categories below.

x Recycled Water for Non-Potable Reuse
____ Recycled Water for Indirect Potable Reuse
____ Groundwater Wells
____ Desalination
____ Water Transfers
x Groundwater Banking
  x Between Member Agencies
  Specify opportunity: Project provides for preservation of Westside Basin Aquifer as a drinking water supply by moving existing irrigators off to a recycled water supply. Provides potential for increased production yield within the groundwater basin.
____ Local Stormwater/Urban Runoff/Other Water Capture
____ Graywater
____ Other

4) a) What types of demands will be served by the project?

Check all that apply.
x Potable
x Non-potable
____ Other
Specify type: Free up pumping capacity now used for irrigation by making it available for potable production purposes.

b) Which agency customers will the project serve?

Check all that apply.
x All Agency Customers
____ Residential
____ Commercial
____ Industrial
____ Municipal
____ Dedicated Irrigation
____ Golf/Park
x Other
____ Not yet investigated/Do not know

c) Could other agencies be served by this project?

x Yes ____ No ____ Not yet investigated/Do not know

If yes, specify agency(ies): SFPUC, California Water Service, City of San Bruno

5) When will the supply be used?

Check all that apply.

x Daily/Normal Use

____ Drought-Only Use

Expected Frequency *(e.g., X years out of every Y years)* :

____ Emergency Use

____ Seasonal Use (*e.g., irrigation*)

6) Will this project be developed by an individual agency or a regional partnership?

Check all that could apply, indicating your preference with a “1”.

____ Individual Agency

Specify agency:

x Regional Partnership

Specify other agencies: BAWSCA, SFPUC, California Water Service, City of San

Indicate agreement type (*e.g. JPA, MOU, etc.*): MOU

Project:	DC-4: Daly City Recycled Water Service to Cemeteries

Instructions: Please identify all project infomation in the ***ORANGE*** *shaded cells, to the extent that information is currently available. For each type of facility, use as many lines as needed. All project elements may not apply to every type of project. If detailed information on all the facilities is not available, please complete "General System Information" at the bottom of this sheet. Cells will change color after information is entered.*

Infrastructure - Facilities

Return to Instruction Sheet

Project Element	Description					Cost Information								Ownership								Facility Reliability	
Treatment	**Process/Type**		**Capacity (mgd)**	**Location**	**Notes/Comments**	**Capital Cost ($)**	**Annual Production (AF)**	**Annual O&M Cost ($)**	**Annual Water Transfer Cost ($)**	**Total Annual Cost ($)**	**Cost per AF ($/AF)**	**Base Year for Cost Est.**	**Notes/Comments**	**Existing Facility? (Y/N)**	**Rehabilitation of Existing Facility? (Y/N)**	**Age of Facility (Years)**	**Expansion of Existing Facility? (Y/N)**	**New Facility? (Y/N)**	**SFPUC owned Facility? (Y/N)**	**Other owner/Don't Know**	**Notes/Comments**	**Are Facilities located near existing faults? (Y/N)**	**Location**
1)	Tertiary Treatment		3.4	153 Lake Merced Blvd.	Expansion of tertiary production by constructing new recycled water facility.	$8,879,000	3,100	TBD		TBD	TBD	2,010											
Conveyance - Pipelines	**Length (feet)**	**Diameter (inches)**	**Capacity (mgd)**	**Location**	**Notes/Comments**	**Capital Cost ($)**	**Annual Production (AF)**	**Annual O&M Cost ($)**	**Annual Water Transfer Cost ($)**	**Total Annual Cost ($)**	**Cost per AF ($/AF)**	**Base Year for Cost Est.**	**Notes/Comments**	**Existing Facility? (Y/N)**	**Rehabilitation of Existing Facility? (Y/N)**	**Age of Facility (Years)**	**Expansion of Existing Facility? (Y/N)**	**New Facility? (Y/N)**	**SFPUC owned Facility? (Y/N)**	**Other owner/Don't Know**	**Notes/Comments**	**Are Facilities located near existing faults? (Y/N)**	**Location**
1)	13728	18	3	"Southern Alignment	2.6 mile transmission pipeline to 3 mgd storage tank	$3,055,000								N									
2)	11616	3 to 16	TBD	Hillside Distribution Network		$5,604,000							Colma Delivery System estimate includes pipelines and pump stations	N									
3)	16008	3 to 24	TBD	El Camino Distribution Network									See above	N									
4)	2610	18	TBD	San Francisco Distribution Network	Lake Merced Hill, Parkmerced, San Francisco State University	$623,000								N									
Conveyance - Pump Stations	**Type**	**Size (HP)**	**Capacity (mgd)**	**Location**	**Notes/Comments**	**Capital Cost ($)**	**Annual Production (AF)**	**Annual O&M Cost ($)**	**Annual Water Transfer Cost ($)**	**Total Annual Cost ($)**	**Cost per AF ($/AF)**	**Base Year for Cost Est.**	**Notes/Comments**	**Existing Facility? (Y/N)**	**Rehabilitation of Existing Facility? (Y/N)**	**Age of Facility (Years)**	**Expansion of Existing Facility? (Y/N)**	**New Facility? (Y/N)**	**SFPUC owned Facility? (Y/N)**	**Other owner/Don't Know**	**Notes/Comments**	**Are Facilities located near existing faults? (Y/N)**	**Location**
1)	Pump Station	TBD	TBD	TBD	Hillside Distribution Pump Station, 1,620 gpm	$1,229,000							Estimate to account for total project cost scope	N									
2)	Pump Station	TBD	TBD	TBD	El Camion Distribution Pump Station, 4,610 gpm									N									
3)	Pump Station	TBD	TBD	TBD	1,120 Irrigation Pump Stations for Lake Merced Hill, Parkmerced and San Francisco State University									N									
Storage	**Type**	**Number of Tanks (#)**	**Capacity each Tank (MG)**	**Location**	**Notes/Comments**	**Capital Cost ($)**	**Annual Production (AF)**	**Annual O&M Cost ($)**	**Annual Water Transfer Cost ($)**	**Total Annual Cost ($)**	**Cost per AF ($/AF)**	**Base Year for Cost Est.**	**Notes/Comments**	**Existing Facility? (Y/N)**	**Rehabilitation of Existing Facility? (Y/N)**	**Age of Facility (Years)**	**Expansion of Existing Facility? (Y/N)**	**New Facility? (Y/N)**	**SFPUC owned Facility? (Y/N)**	**Other owner/Don't Know**	**Notes/Comments**	**Are Facilities located near existing faults? (Y/N)**	**Location**
1)	Tertiary Recycled Water	1	3	El Camino Real at F Street, Colma		$3,441,000								N									
2)	Tertiary Recycled Water	1	0.021	Lake Merced Hill		$2,054,000							Includes Lake Merced Hill, Parkmerced and SFSU estimates	N									
3)	Tertiary Recycled Water	1	0.467	Parkmerced										N									
4)	Tertiary Recycled Water	1	0.234	San Francisco State University										N									
Other	**Type**		**Capacity (mgd)**	**Location**	**Notes/Comments**	**Capital Cost ($)**	**Annual Production (AF)**	**Annual O&M Cost ($)**	**Annual Water Transfer Cost ($)**	**Total Annual Cost ($)**	**Cost per AF ($/AF)**	**Base Year for Cost Est.**	**Notes/Comments**	**Existing Facility? (Y/N)**	**Rehabilitation of Existing Facility? (Y/N)**	**Age of Facility (Years)**	**Expansion of Existing Facility? (Y/N)**	**New Facility? (Y/N)**	**SFPUC owned Facility? (Y/N)**	**Other owner/Don't Know**	**Notes/Comments**	**Are Facilities located near existing faults? (Y/N)**	**Location**
1)						$23,243,000							Estimating Contingency, OH & P, Midpoint Escalation, Sales Tax and General Conditions										
2)						$12,032,000							Engineering, Legal, Administrative, Contract Change Order Reserve										
General System Information	**Source**	**Treatment**	**Capacity (mgd)**	**Connection**	**Notes/Comments**	**Capital Cost ($)**	**Annual Production (AF)**	**Annual O&M Cost ($)**	**Annual Water Transfer Cost ($)**	**Total Annual Cost ($)**	**Cost per AF ($/AF)**	**Base Year for Cost Est.**	**Notes/Comments**	**Existing Facility? (Y/N)**	**Rehabilitation of Existing Facility? (Y/N)**	**Age of Facility (Years)**	**Expansion of Existing Facility? (Y/N)**	**New Facility? (Y/N)**	**SFPUC owned Facility? (Y/N)**	**Other owner/Don't Know**	**Notes/Comments**		
1)					Total Costs	$60,160,000																	

Project: DC-4: Daly City Recycled Water Service to Cemeteries

Instructions: Please complete project information in the **ORANGE** *shaded cells. For all responses, use as many lines as needed or attach additional sheets. Cells will change color after information is entered.*

Supply Reliability Information

1) Normal year yield in acre-feet per year: 3100

2) Define how the yield above is calculated (i.e., pumping capacity, aquifer sustainable yield, etc.) and list sources of information.

Calculated amount from Feasibility Study

3) Is the project yield dependent on hydrology/weather?

____ Yes x No ____ Not yet investigated/Do not know

4) Peak capacity in million gallons per day: ____

5) Could the project water supply be subject to regulatory restrictions that affect project feasibility, cost, or schedule?

____ Yes x No ____ Not yet investigated/Do not know

Water Quality Information

1) What is the expected total dissolved solids (TDS) concentration of product water in milligrams per liter (mg/L)?

____ mg/L TDS

2) For projects designed to meet non-potable water demands, to what level will the finished water be treated?

Check all that apply.

____ Disinfection only
____ Secondary treatment
____ Secondary treatment with disinfection
x Tertiary treatment
____ Membrane bioreactor
____ Membrane bioreactor/reverse osmosis
____ Denitrification
____ Other Please specify type:

3) Are there any limitations on application or use of this water due to water quality concerns (*e.g., TDS for irrigation,*

____ Yes ____ No x Not yet investigated/Do not know

Project: DC-4: Daly City Recycled Water Service to Cemeteries

Instructions: Please complete project information in the **ORANGE** *shaded cells. For all responses, use as many lines as needed or attach additional sheets. Cells will change color after information is entered.*

Project Implementation Schedule Information

1) Current Project Status:

Indicate the current status of the project based on the definitions provided below.

____ Existing project under development

____ Planned project identified by a BAWSCA member agency

x Potential future new project not specifically identified or specifically studied by a BAWSCA member agency to date

2) If available, what is the projected schedule for project implementation?

Project Step	Estimated Duration	Estimated Completion Year
Planning		
Demonstration project/pilot study		
Design		
Environmental documentation/permitting		
Construction		
Startup		

3) Does the potential for expansion exist beyond the above identified phases?

____ Yes ____ No x Not yet investigated/Do not know

Is a separate survey being filled out for this expansion?

____ Yes x No If yes, what is the Project Title for the Expansion?

Project: DC-4: Daly City Recycled Water Service to Cemeteries

Instructions: Please complete project information in the **ORANGE** *shaded cells. For all responses, use as many lines as needed or attach additional sheets. Cells will change color after information is entered.*

Project Funding Information

1) What is the source(s)/potential source(s) of funding for the project?
(*e.g., your agency, developers, user fees, member agency bonds, state grants/loans, federal grants/loans, etc.*)

	Potential Funding Source	When will these funding sources be available?
1)		
2)		
3)		
4)		
5)		

Project Implementation Potential

1) Does the project involve coordination with other agencies or entities (not related to permitting)?

x Yes ___ No ___ Not yet investigated/Do not know

If yes, list agencies and any previously identified coordination-related issue(s) (*e.g., funding, conveyance, identifying*

Without assigning coordination among agenciesthere are a number of issues dealing with customer acceptance, alignment of facilities and location, identification of benefits and beneficiary(ies) of project, identification of funding. Essentially, we have a ways to go.

2) What are the permitting/regulatory requirements for the project? Check all that apply.

___ NEPA – sponsoring federal agency
x CEQA – lead agency (water provider)
x Clean Water Act (Wetland Permit), Rivers and Harbor Act – US Army Corps of Engineers
x Drinking Water Standards and Regulations – California Department of Public Health
___ Water Rights Permits, Clean Water Act (Water Quality Certification), NPDES Permits – State Water Resources Control Board
x Recycled Water Regulations – California Department of Public Health, Regional Water Quality Control Board, State Water Resources Control Board
___ Lake or Streambed Alteration – California Department of Fish and Game
___ Endangered Species – US Fish and Wildlife Service, National Marine Fisheries Service
___ Cultural Resources – State Historic Preservation Office
___ Development Permits – cities, counties

Project: DC-4: Daly City Recycled Water Service to Cemeteries

Instructions: Please complete project information in the **ORANGE** *shaded cells. For all responses, use as many lines as needed or attach additional sheets. Cells will change color after information is entered.*

Potential Environmental Impacts

1) What are the expected treatment and pumping energy requirements in kilowatts per year?
(*This will be used as surrogate for greenhouse gas emissions.*)
TBD kilowatts per year

2) Will there be artificial replenishment for water recovered from the groundwater basin(s)?
____ Yes   X No   ____ Not yet investigated/Do not know

3) Will this project provide environmental benefits?
____ Yes   ____ No   x Not yet investigated/Do not know

If yes, explain:

4) Will this project cause adverse impacts to habitat areas?
____ Yes   ____ No   x Not yet investigated/Do not know

If yes, explain:

If answered yes to questions **#3 or #4**, are there any studies/reports that provide an environmental evaluation?
____ Yes   x No

If answered yes to questions **#3 or #4**, provide data source(s) for the environmental evaluation.
1)
2)
3)

5) Have other significant environmental impacts been identified?
(*e.g., increased flood potential, decrease water quality, increased discharges to surface water bodies, etc.*)

Appendix B

Project Summary for NC-4: NCCWD Desalination Plant

Project: North Coast County Water District Desalination Plant

Instructions: Please complete contact information in the **ORANGE** *shaded cells. This person may be contacted if there are questions regarding any submitted information. Cells will change color after information is entered.*

General Agency Contact Information

Date:	
Agency:	
Project Contact Name:	
Project Contact Position:	
Email:	
Phone:	

Project: North Coast County Water District Desalination Plant

Instructions: Please complete project information in the **ORANGE** *shaded cells. For all responses, use as many lines as needed or attach additional sheets. Cells will change color after information is entered.*

General Project Information

1) **Project Description and Information Sources:**

Brief project description: (*e.g., Design and construction of 4 new wells to provide a total capacity of 6 mgd for emergency and drought supply*).

Brackish groundwater for desalination, 10 to 15 mgd, with three water supply sources to be evaluated: brackish groundwater, seawater subsurface intake,and seawater open intake.

2) **Is supply from this project included in supply projections as presented in the updated 2010 UWMP documents?**

____ Yes ____ No

3) **Indicate the type of project by selecting one of the categories below.**

____ Recycled Water for Non-Potable Reuse
____ Recycled Water for Indirect Potable Reuse
____ Groundwater Wells
x Desalination
    ____ Brackish groundwater
    ____ Seawater subsurface intake
    ____ Seawater open intake
____ Water Transfers
____ Groundwater Banking
____ Local Stormwater/Urban Runoff/Other Water Capture
____ Graywater
____ Other
Specify type:

4) a) **What types of demands will be served by the project?**

Check all that apply.
____ Potable
____ Non-potable
____ Other

Specify type:

b) **Which agency customers will the project serve?**

Check all that apply.
____ All Agency Customers
____ Residential
____ Commercial
____ Industrial
____ Municipal
____ Dedicated Irrigation
____ Golf/Park
____ Other
____ Not yet investigated/Do not know

c) **Could other agencies be served by this project?**

____ Yes ____ No ____ Not yet investigated/Do not know

If yes, specify agency(ies):

5) **When will the supply be used?**

Check all that apply.
____ Daily/Normal Use
____ Drought-Only Use

Expected Frequency *(e.g., X years out of every Y years)* :

____ Emergency Use
____ Seasonal Use (*e.g., irrigation*)

6) Will this project be developed by an individual agency or a regional partnership?

Check all that could apply, indicating your preference with a “1”.

____ Individual Agency

Specify agency:

____ Regional Partnership

Specify other agencies:

Indicate agreement type (*e.g. JPA, MOU, etc.*):

Project: North Coast County Water District Desalination Plant

Instructions: Please identify all project infomation in the **ORANGE** *shaded cells, to the extent that information is currently available. For each type of facility, use as many lines as needed. All project elements may not apply to every type of project. If detailed information on all the facilities is not available, please complete "General System Information" at the bottom of this sheet. Cells will change color after information is entered.*

Infrastructure - Facilities

Return to Instruction Sheet

Project Element	Description					Cost Information								Ownership								Facility Reliability	
Treatment	Process/Type		Capacity (mgd)	Location	Notes/Comments	Capital Cost ($)	Annual Production (AF)	Annual O&M Cost ($)	Annual Water Transfer Cost ($)	Total Annual Cost ($)	Cost per AF ($/AF)	Base Year for Cost Est.	Notes/Comments		ion of g (Y/N)	Age of Facility (Years)	Expansion of Existing Facility? (Y/N)	New Facility? (Y/N)	SFPUC owned Facility? (Y/N)	Other owner/Don't Know	Notes/Comments	Are Facilities located near existing faults? (Y/N)	Location
1)																							
2)																							
3)																							
4)																							
5)																							
Conveyance - Pipelines	Length (feet)	Diameter (inches)	Capacity (mgd)	Location	Notes/Comments	Capital Cost ($)	Annual Production (AF)	Annual O&M Cost ($)	Annual Water Transfer Cost ($)	Total Annual Cost ($)	Cost per AF ($/AF)	Base Year for Cost Est.	Notes/Comments	Existing Facility? (Y/N)	Rehabilitation of Existing Facility? (Y/N)	Age of Facility (Years)	Expansion of Existing Facility? (Y/N)	New Facility? (Y/N)	SFPUC owned Facility? (Y/N)	Other owner/Don't Know	Notes/Comments	Are Facilities located near existing faults? (Y/N)	Location
1)																							
2)																							
3)																							
4)																							
5)																							
Conveyance - Pump Stations	Type	Size (HP)	Capacity (mgd)	Location	Notes/Comments	Capital Cost ($)	Annual Production (AF)	Annual O&M Cost ($)	Annual Water Transfer Cost ($)	Total Annual Cost ($)	Cost per AF ($/AF)	Base Year for Cost Est.	Notes/Comments	Existing Facility? (Y/N)	Rehabilitation of Existing Facility? (Y/N)	Age of Facility (Years)	Expansion of Existing Facility? (Y/N)	New Facility? (Y/N)	SFPUC owned Facility? (Y/N)	Other owner/Don't Know	Notes/Comments	Are Facilities located near existing faults? (Y/N)	Location
1)																							
2)																							
3)																							
4)																							
5)																							
Storage	Type	Number of Tanks (#)	Capacity each Tank (MG)	Location	Notes/Comments	Capital Cost ($)	Annual Production (AF)	Annual O&M Cost ($)	Annual Water Transfer Cost ($)	Total Annual Cost ($)	Cost per AF ($/AF)	Base Year for Cost Est.	Notes/Comments	Existing Facility? (Y/N)	Rehabilitation of Existing Facility? (Y/N)	Age of Facility (Years)	Expansion of Existing Facility? (Y/N)	New Facility? (Y/N)	SFPUC owned Facility? (Y/N)	Other owner/Don't Know	Notes/Comments	Are Facilities located near existing faults? (Y/N)	Location
1)																							
2)																							
3)																							
4)																							
5)																							
Groundwater Wells	Type	Number of Wells (#)	Capacity per Well (mgd)	Location	Notes/Comments	Capital Cost ($)	Annual Production (AF)	Annual O&M Cost ($)	Annual Water Transfer Cost ($)	Total Annual Cost ($)	Cost per AF ($/AF)	Base Year for Cost Est.	Notes/Comments	Existing Facility? (Y/N)	Rehabilitation of Existing Facility? (Y/N)	Age of Facility (Years)	Expansion of Existing Facility? (Y/N)	New Facility? (Y/N)	SFPUC owned Facility? (Y/N)	Other owner/Don't Know	Notes/Comments	Are Facilities located near existing faults? (Y/N)	Location
1)																							
2)																							
3)																							
4)																							
5)																							
Disposal	Type		Capacity (mgd)	Location	Notes/Comments	Capital Cost ($)	Annual Production (AF)	Annual O&M Cost ($)	Annual Water Transfer Cost ($)	Total Annual Cost ($)	Cost per AF ($/AF)	Base Year for Cost Est.	Notes/Comments	Existing Facility? (Y/N)	Rehabilitation of Existing Facility? (Y/N)	Age of Facility (Years)	Expansion of Existing Facility? (Y/N)	New Facility? (Y/N)	SFPUC owned Facility? (Y/N)	Other owner/Don't Know	Notes/Comments	Are Facilities located near existing faults? (Y/N)	Location
1)																							
2)																							
3)																							
4)																							
5)																							
Other	Type		Capacity (mgd)	Location	Notes/Comments	Capital Cost ($)	Annual Production (AF)	Annual O&M Cost ($)	Annual Water Transfer Cost ($)	Total Annual Cost ($)	Cost per AF ($/AF)	Base Year for Cost Est.	Notes/Comments	Existing Facility? (Y/N)	Rehabilitation of Existing Facility? (Y/N)	Age of Facility (Years)	Expansion of Existing Facility? (Y/N)	New Facility? (Y/N)	SFPUC owned Facility? (Y/N)	Other owner/Don't Know	Notes/Comments	Are Facilities located near existing faults? (Y/N)	Location
1)																							
2)																							
3)																							
4)																							
5)																							

General System Information	Source	Treatment	Capacity (mgd)	Connection	Notes/Comments	Capital Cost ($)	Annual Production (AF)	Annual O&M Cost ($)	Annual Water Transfer Cost ($)	Total Annual Cost ($)	Cost per AF ($/AF)	Base Year for Cost Est.	Notes/Comments	Existing Facility? (Y/N)	Rehabilitation of Existing Facility? (Y/N)	Age of Facility (Years)	Expansion of Existing Facility? (Y/N)	New Facility? (Y/N)	SFPUC owned Facility? (Y/N)	Other owner/Don't Know	Notes/Comments
1)																					
2)																					

Project: North Coast County Water District Desalination Plant

Instructions: Please complete project information in the **ORANGE** *shaded cells. For all responses, use as many lines as needed or attach additional sheets. Cells will change color after information is entered.*

Supply Reliability Information

1) **Normal year yield in acre-feet per year:** ______

2) **Define how the yield above is calculated (i.e., pumping capacity, aquifer sustainable yield, etc.) and list sources of information.**

3) **Is the project yield dependent on hydrology/weather?**
___ Yes ___ No ___ Not yet investigated/Do not know

If yes, what is the drought or dry year yield in acre-feet per year?
(e.g., dry year yield = 2,000 AFY) ______
(e.g., critical dry year yield = 1,000 AFY) ______
(e.g., design drought yield = 0 AFY) ______

4) **Peak capacity in million gallons per day:** ______

5) **Could the project water supply be subject to regulatory restrictions that affect project feasibility, cost, or schedule?**
___ Yes ___ No ___ Not yet investigated/Do not know

If yes, list restrictions:
1) ______
2) ______
3) ______

Water Quality Information

1) **For projects designed to meet potable water demands, what is the expected total dissolved solids (TDS)**
___ mg/L TDS

2) **For projects designed to meet non-potable water demands, to what level will the finished water be treated?**
Check all that apply.
___ Disinfection only
___ Secondary treatment
___ Secondary treatment with disinfection
___ Tertiary treatment
___ Membrane bioreactor
___ Membrane bioreactor/reverse osmosis
___ Denitrification
___ Other Please specify type: ______

3) **Are there any limitations on application or use of this water due to water quality concerns (*e.g., TDS for irrigation,***
___ Yes ___ No ___ Not yet investigated/Do not know

If yes, explain:

Project: North Coast County Water District Desalination Plant

Instructions: Please complete project information in the **ORANGE** *shaded cells. For all responses, use as many lines as needed or attach additional sheets. Cells will change color after information is entered.*

Project Implementation Schedule Information

1) Current Project Status:

Indicate the current status of the project based on the definitions provided below.

- [ ] Existing project under development
- [ ] Planned project identified by a BAWSCA member agency
- [ ] Potential future new project not specifically identified or specifically studied by a BAWSCA member agency to date

2) If available, what is the projected schedule for project implementation?

Project Step	Estimated Duration	Estimated Completion Year
Planning		
Demonstration project/pilot study		
Design		
Environmental documentation/permitting		
Construction		
Startup		

3) Does the potential for expansion exist beyond the above identified phases?

- [ ] Yes
- [ ] No
- [ ] Not yet investigated/Do not know

If yes, identify the ultimate yield in acre-feet per year: ______

and capacity in mgd: ______

Is a separate survey being filled out for this expansion?

- [ ] Yes
- [ ] No

If yes, what is the Project Title for the Expansion? ______

Project: North Coast County Water District Desalination Plant

Instructions: Please complete project information in the **ORANGE** *shaded cells. For all responses, use as many lines as needed or attach additional sheets. Cells will change color after information is entered.*

Project Funding Information

1) What is the source(s)/potential source(s) of funding for the project?
(*e.g., your agency, developers, user fees, member agency bonds, state grants/loans, federal grants/loans, etc.*)

	Potential Funding Source	When will these funding sources be available?
1)		
2)		
3)		
4)		
5)		

Project Implementation Potential

1) Does the project involve coordination with other agencies or entities (not related to permitting)?

☐ Yes ☐ No ☐ Not yet investigated/Do not know

If yes, list agencies and any previously identified coordination-related issue(s) (*e.g., funding, conveyance, identifying*

2) What are the permitting/regulatory requirements for the project? Check all that apply.

- ☐ NEPA – sponsoring federal agency
- ☐ CEQA – lead agency (water provider)
- ☐ Clean Water Act (Wetland Permit), Rivers and Harbor Act – US Army Corps of Engineers
- ☐ Drinking Water Standards and Regulations – California Department of Public Health
- ☐ Water Rights Permits, Clean Water Act (Water Quality Certification), NPDES Permits – State Water Resources Control Board
- ☐ Recycled Water Regulations – California Department of Public Health, Regional Water Quality Control Board, State Water Resources Control Board
- ☐ Lake or Streambed Alteration – California Department of Fish and Game
- ☐ Endangered Species – US Fish and Wildlife Service, National Marine Fisheries Service
- ☐ Cultural Resources – State Historic Preservation Office
- ☐ Development Permits – cities, counties

Project: North Coast County Water District Desalination Plant

Instructions: Please complete project information in the **ORANGE** *shaded cells. For all responses, use as many lines as needed or attach additional sheets. Cells will change color after information is entered.*

Potential Environmental Impacts

1) What are the expected treatment and pumping energy requirements in kilowatts per year?
(*This will be used as surrogate for greenhouse gas emissions.*)
______ kilowatts per year

2) Will there be artificial replenishment for water recovered from the groundwater basin(s)?
___ Yes ___ No ___ Not yet investigated/Do not know

3) Will this project provide environmental benefits?
___ Yes ___ No ___ Not yet investigated/Do not know

If yes, explain:

4) Will this project cause adverse impacts to habitat areas?
___ Yes ___ No ___ Not yet investigated/Do not know

If yes, explain:

If answered yes to questions **#3 or #4**, are there any studies/reports that provide an environmental evaluation?
___ Yes ___ No

If answered yes to questions **#3 or #4**, provide data source(s) for the environmental evaluation.
1) ______
2) ______
3) ______

5) Have other significant environmental impacts been identified?
(*e.g., increased flood potential, decrease water quality, increased discharges to surface water bodies, etc.*)

Appendix C

Commitment Letter Forms for DC-4: Daly City Recycled Water Service to Cemeteries

BAWSCA
Bay Area Water Supply & Conservation Agency

January 24, 2011

Patrick Sweetland
Director of Water and Wastewater
City of Daly City
153 Lake Merced Blvd.
Daly City, CA 94015

Subject: Strategy Phase II A – Agency Project Commitment Letter Requested by February 11, 2011

Dear Mr. Sweetland:

In November 2010, you participated in a meeting with us regarding the Bay Area Water Supply and Conservation Agency (BAWSCA) Long Term Reliable Water Supply Strategy (Strategy). At that meeting we reviewed your agency's expectations of the Strategy and the Project Information Sheets developed for the projects identified by your agency in the Strategy Phase I Scoping Report. Following our meeting, you received a letter from BAWSCA confirming both your agency's expectations of the Strategy and the project(s) your agency retained for evaluation in Phase II A of the Strategy.

In order to move forward with project evaluation and screening, we ask that your agency provide additional information to bring the retained project(s) up to a common level of information. Filling the outstanding data gaps for retained projects is critical to the successful evaluation and comparison of projects and the development of recommendations to meet the objectives of the Strategy.

The attached tables summarize your projects that are currently retained for evaluation in the Strategy and those that are planned to be removed, per our discussion at the November meeting:

- Table 1 – A list of projects currently retained for evaluation and a summary of the level of information provided to date; and
- Table 2 – A list of projects removed from evaluation in the Strategy.

Please review the information included in Tables 1 and 2 and confirm that your agency wishes to retain the project(s) listed in Table 1 for evaluation in the Strategy. For each of the retained project(s), please fill out the attached Agency Project Commitment Form which identifies the timing with which you expect to be able to provide the necessary information.

Please return the completed Agency Project Commitment Form(s) to BAWSCA no later than February 11, 2011.

Thank you for your active participation in and support for the Strategy. If you have any questions, please feel free to contact Anona or myself at the BAWSCA offices (650) 349-3000.

Very truly yours,

Nicole M. Sandkulla, P.E.
Water Resources Planning Manager

Attachment 1: Tables 1 and 2
Attachment 2: Agency Project Commitment Form(s)

Table 1 – Proposed Retained Projects and Level of Information Provided to Date

General Project Information				Information Provided											Ongoing Project Data Developed by Agency
Agency	Project Index	Title	Type	Yield[(1)] (mgd)	Yield[(1)] (AFY)	Costs	Facilities	Supply Reliability	Schedule	Water Quality	Implementation Potential	Environmental Impacts	Funding	Ownership	
Daly City	DC-4	Daly City Recycled Water Service to Cemeteries	Recycled Water	--	3,100	○	◗	●	○	○	●	◗	○	○	Studying recycled water acceptability for cemeteries.

Note:
(1) mgd = million gallons per day; AFY = acre-feet per year; NA = data not available; -- = data available only in one set of units.

○ Less than 25% of information available
◗ 25-75% of information available
● More than 75% of information available

Table 2 - Projects Removed From Strategy

Agency	Project ID	Water Type	Project Name	Reason for Removal
Daly City	DC-1	Groundwater	Regional Groundwater Storage & Recovery Project - Daly City	Project does not provide additional supply.
	DC-2	Groundwater	Replacement Well Project	Being implemented independent of the Strategy.
	DC-3	Groundwater	Emergency Supply Retrofit of A Street Well	Being implemented independent of the Strategy.

AGENCY PROJECT COMMITMENT FORM Attachment 2

Instructions: For each information category listed on the left:
1) Review the amount of information provided on this project by your agency to date, using the table's key located below the table.
2) If your agency will provide remaining information to BAWSCA by April 1, 2011, make a check in Column 3 of the table.
3) If your agency will provide additional information for the project in the future, provide that date in Column 4 of the table.
4) If your agency will not be providing any additional information for the project, make a check mark in Column 5 of the table.
5) Provide an appropriate signature and date at the bottom of the form, and return form as described below.

General Project Information				
Agency	Daly City			
Title	Daly City Recycled Water Service to Cemeteries			
Project ID	DC-4			
Information Needs	Information Provided in Project Information Survey (See Key Below)	Agency Will Provide Remaining Information by April 1, 2011 (Check for yes)	Agency Will Provide Remaining Information by Future Date (Enter Date)	Agency Will **Not** Provide Remaining Information (Check for no)
Costs Life-Cycle Costs Capital Costs O & M Costs	○			
Facilities Treatment Storage Conveyance	◗			
Supply Reliability Normal Year Yield Drought Yield Regulatory Restrictions?	●			
Schedule Duration Completion Date	○			
Water Quality Expected TDS of Supply	○			
Implementation Potential Coordination Needed Permitting Required	●			
Environmental Impacts Energy Usage Groundwater Impact	◗			
Funding Funding Source Partnerships	○			
Ownership Treatment Storage Conveyance	○			

Key
○ Less than 25% of information available
◗ 25-75% of information available
● More than 75% of information available

I commit my agency to meeting the information deadlines provided above and/or the decision to not provide further information to BAWSCA on this project.

Name: ____ Date: _________________

Title: ____

Signature: ____
Name, title, and signature of person with authority to concur with information provided by agency above.

Please complete the form in full and return via mail, email, or fax by February 11, 2011 to:
Nicole M. Sandkulla, P. E.
BAWSCA
155 Bovet Road, Suite 302
San Mateo, CA 94402

Exhibit 2
Revised Draft Task 2-B Memo
Project Information Developed for Agency Projects - Daly City Recycled Water Project – Service Area Expansion and Representative Coastal Desalination Project

Memorandum

To: *Nicole Sandkulla*

From: *Craig Von Bargen*
Jeff Sellberg
Paula Kulis

cc: *Bill Fernandez*
Phillippe Daniel

Date: *April 5, 2012*

Subject: *Revised Draft Task 2-B Memo: Project Information Developed for Agency Projects - Daly City Recycled Water Project –Service Area Expansion and Representative Coastal Desalination Project*

1.0 Introduction

In this Memo:

1. Introduction
2. Daly City Recycled Water Project – Service Area Expansion
3. Representative Coastal Desalination Project

Appendices:

- A- Daly City Recycled Water Project – Service Area Expansion: Project Information Survey (DC-4)
- B –Representative Coastal Desalination Project
- C – References

Sixty-five (65) agency-identified water supply management projects (projects) were presented in the May 2010 Phase 1 Scoping Report for further evaluation in Phase II A of the Bay Area Water Supply and Conservation Agency (BAWSCA) Long Term Reliable Water Strategy (Strategy). As part of Phase II A the BAWSCA member agencies, BAWSCA, and CDM Smith participated in a project refinement and selection process. In that process, four agency identified projects were retained for development and evaluation in Phase II A (see Revised Draft Task 2-A Memo: Agency-Identified Projects Information and Information Gaps). Of the four projects retained for evaluation, two projects provided sufficient potential regional benefit, yet the agencies lacked resources to further develop the projects in time for the Phase II A evaluations in early 2012. BAWSCA decided that these two projects should continue to be evaluated at this time. CDM Smith, as part of the Strategy Team, was directed to develop the information necessary to address remaining data gaps for these two projects:

- Daly City Recycled Water Project - Service Area Expansion (DC-4); and

- Representative Coastal Desalination Water Project (originally North Coast County Water District (NCCWD) – Desalination Plant (NC-4)).

In order to allow evaluation and comparison of the projects within the Strategy, key types of project information are needed. This information includes:

- Costs;
- Facilities;
- Supply Reliability;
- Schedule;
- Water Quality;
- Implementation Potential;
- Environmental Impacts;
- Funding; and
- Ownership.

This Task 2-B Memo summarizes the information that has been provided by the two agencies and augmented and/or developed by the Strategy Team for these two projects.

1.1 Projects Evaluated

Daly City Recycled Water Project Expansion – This project involves an expansion of the existing Daly City Recycled Water Project to serve areas within the City of Colma. Daly City and the San Francisco Public Utilities Commission (SFPUC) jointly funded a study of the expansion of the Daly Recycled Water to serve both Colma and areas within the City and County of San Francisco. The current project proposed by Daly City and described in this memo only includes service within the Town of Colma. The estimated demand is 1,060 acre-foot (AF) per year. This requires 2.98 million gallons per day (mgd) of the potential 3.4 mgd total expansion, leaving 0.4 mgd for potential service to San Francisco customers. For the purposes of this memo the capacities and costs have been adjusted to reflect only the Daly City to Colma portion of the project (i.e., 3 mgd of expansion).

Seawater or Brackish Groundwater Project – The second project would be a seawater or brackish groundwater project located on the coast near Pacifica. The water would be treated through a reverse osmosis (RO) desalination process with the treated water delivered to a connection with the SFPUC Regional Water System (RWS) on the upper San Mateo Peninsula. This project has an estimated treated water capacity of approximately 7.5 mgd. This treated water capacity is limited due to space constraints at the proposed desalination treatment plant site (assumed use of the old Sharp Park Wastewater Treatment Plant site), and the potential capacity of the potential Ranney Collector Wells located in the Pacifica State Beach area about 2 miles south of Sharp Park. Annual production would depend on whether the project is developed to provide normal year supply, or supply developed only during drought events. For the purposes of this analysis the annual production is assumed to be at 80% of the 7.5 mgd design capacity, or 6,700 AF per year of normal year supply.

Figure 1 indicates the overall BAWSCA service area and the specific service areas for Daly City and North Coast County Water District.

1.2 Summary Project Information

Neither of these projects had fully developed project information, though the Daly City project evaluation had progressed significantly further than the representative coastal desalination project. Table 1 indicates the type of information that was made available by the agencies in responding to the project surveys and interviews in November and December 2010, subsequent discussions with the agencies in early 2011, and information developed by the Strategy project team.

Table 1
Agency and Strategy Developed Information for Selected Projects Moving Forward

Information	Daly City Recycled Water Project – Expanded Service Area			Representative Coastal Desalination Project		
	Provided in Survey	Agency Provided Later	Strategy Developed	Provided in Survey	Agency Provided Later[1]	Strategy Developed[2]
Costs	○	X	Updated	○	-	X
Facilities	◗	X	-	○	X	X[2]
Supply Reliability	●	X	-	○	X	X[2]
Schedule	○	TBD	X	○	-	X
Water Quality	○	TBD	-	○	-	X
Implementation Potential	●	-	-	○	-	X
Environmental Impacts	◗	TBD	-	○	-	X
Funding	○	June 2012	-	○	-	TBD
Ownership	○	TBD	-	○	-	TBD

[1] Originally NCCWD Project NC-4

[2] CDM Smith Modified several of the originally identified facilities due to siting constraints and supply availability.

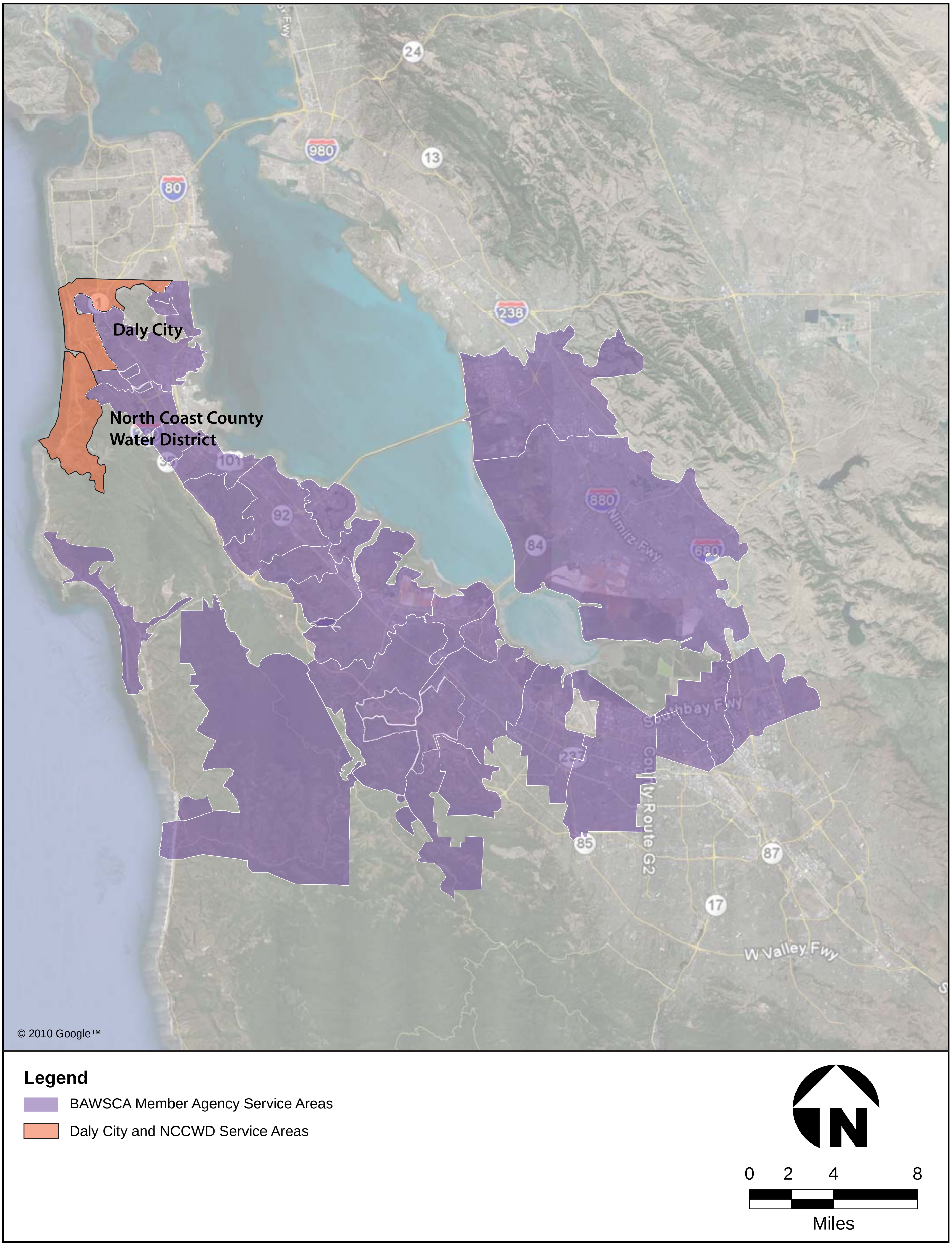
Symbol Key:

X Information added.
- No additional information included.
○ Less than 25% of information available.
◗ 25-75% of information available.
● More than 75% of information available.

Appendix A includes the project information that was provided by Daly City in late 2010 in the Project Information Survey and Sheets. As NCCWD did not provide survey information for their project, no Project Information Survey and Sheets are included with this memo.

1.2.1 Summary of Project Yield and Cost

Table 2 summarizes the approximate yield and costs for these two projects as updated for this memo. Additional information on the assumptions for yield and cost for the Daly City Recycled Project are included in Section 2. The information developed for the yield and cost estimates for



W:\REPORTS\BAWSCA\Task 11.3_Nov11\Graphics\BAWSCA 2-B Memo Figure 1 021512 Daly City and NCCWD Service Areas.ai 04/05/12 JJT

CDM Smith

Figure 1
Daly City and NCCWD Service Areas

the Representative Coastal Desalination Project are presented in Section 3, with additional detail presented in Appendix B.

Table 2
Summary of Project Yields and Cost for Daly City Recycled Water Project and Representative Coastal Desalination Project

Item	Daly City Recycled Water Project[1]	Representative Coastal Desalination Project
Assumed Production Capacity (mgd)	2.89	7.5
Assumed Annual Production (AF/Year)	1,060	6,700[2]
Present Worth Costs		
Total Production – 30 years (AF)	31,800	201,600
Total Present Worth Cost ($M)	$65.0[5]	$448
Present Worth Unit Cost ($/AF)[6]	$2,100[5]	$2,200
Annualized Costs		
Capital Cost ($M)[3]	$50.1	$214.7
O&M Cost ($M year)[3]	$0.48	$7.8
Total Annualized Cost ($M/Year)[3]	$3.1	$18.7
Total Annualized Cost ($/AF)	$2,900[4]	$2,800[4]

1 Based on data provided by Daly City.
2 Assumes annual operation at 80% of capacity.
3 Costs adjusted to August 2011.
4 Annualized cost based on 30 year return with 3% discount rate.
5 Data developed by Strategy team.

The yields and costs presented for the Daly City project are only for service to the Town of Colma.

In addition to the capital costs (construction costs plus adjustments) and operation and maintenance costs (O&M) two different approaches are included for comparing projects. These include the development of present worth analysis (or life-cycle costs) and annualized costs. The present worth analysis includes the conversion of all cash flows to a common point in time, August 2011. As such, it requires the consideration of the time value of money and all future cash flows discounted back to the present. The present worth analysis converts all annual O&M costs (i.e., chemicals, power, labor, RO membrane replacement, etc.) to a present worth value and adds this to the present worth of the capital cost. To compute a unit cost of water this sum of the present worth of capital and O&M costs is divided by the total amount of water produced over the expected life of the project. For the purposes of this analysis a period of 30 years is used for the comparison of all projects.

The annual cost comparison estimates the yearly cost of owning and operating an asset, and is also expressed in present dollars. The annual cost analysis computes the annual debt service on the capital (i.e., one year of payments of interest and principal required on the bond or loan used for financing the project) and adds it to one year's worth of O&M costs. To compute the unit cost of water this sum can be divided by the total amount of water produced by the project in one year.

Both of these methods will provide the same ranking of alternatives, but they result in different unit costs for water. Neither method calculates the actual unit cost of water as this requires a more detailed analysis that is tailored to the specific conditions of how the project is financed and how this financing is paid back through water rates. The simplified approach for both methods (and often the more conservative) is to assume that the annual escalation rate is the same as the discount rate (i.e., bond or loan rate).

1.2.2 Other Project Information and Evaluation Criteria

In addition to project yield and cost there is other project information that will be used in the comparison of water supply management projects. Table 1 indicates the information provided by the agencies, through the Project Information Survey, and the information developed by the Strategy team. Table 3 summarizes this project information for both the Daly City Recycled Water Project – Expanded Service Area, and the Representative Coastal Desalination Project. Sections 2 and 3 provide the background for this information for these two projects respectively.

Some of the information for Table 3 will be developed and updated at a later time when a common comparison and development of values will be prepared for all projects.

1.2.3 Implementation Schedules

Implementation schedules were not developed by the agencies for either project. However, the Strategy team has developed preliminary implementation schedules for both the Daly City Recycled Project and the Representative Coastal Desalination Project.

The preliminary project schedule for the Daly City Recycled Water Project - Service Area Expansion is anticipated to be about 6 years, including:

- Planning and environmental review;
- Preliminary design;
- Final design;
- Bid and construction; and
- Project startup.

Additional information regarding this preliminary project schedule is presented in Section 2.

Table 3 Project Summary for Daly City Recycled Water Project and Representative Coastal Desalination Project Evaluation Criteria and Metric Values				
Objective	**Criteria**	**Metrics**	**Project Values**	
			Daly City Recycled Project	**Coastal Desalination Project**
1 - Increase Supply Reliability	**Criterion 1A** – Ability to Meet Normal Year Supply Need	Quantitative (AF /year): Average annual yield in normal years in 2018 and 2035.	1,060	6,700
	Criterion 1B – Ability to Meet Drought Supply Need	Quantitative (AF/year): Average annual yield with drought hydrology of 1987 – 1992.	1,060	6,700
	Criterion 1C – Risk of Facility Outage	Qualitative (1-5): Estimated probability and duration of major conveyance failure	(1)	(1)
	Criterion 1D – Potential for Regulatory Vulnerability	Qualitative (1-5): Potential for regulatory decisions to impact supply reliability	(1)	(1)
2 - Provide High Level of Water Quality	**Criterion 2A** – Meets or Surpasses Drinking Water Quality Standards	Quantitative (mg/L): Total dissolved solids (TDS) level as an indicator of water quality.	N/A	<150
	Criterion 2B – Meets or Surpasses Non-Potable Water Quality Standards	Qualitative: Meets minimum water quality requirement (e.g., Title 22) for the targeted use. (Yes or no)	Yes	N/A
3 - Minimize Cost of New Water Supplies	**Criterion 3** – Capital and Present Worth Costs	Quantitative ($/AF): Present Worth costs including capital and operating costs	$2,100	$2,200
4 - Reduce Potable Water Demand	**Criterion 4** – Augment Non-Potable Water Supplies	Quantitative (AF/year): Reduction of potable water demand by use of non-potable supply.	250-1,060	N/A
5 - Minimize Environmental Impacts	**Criterion 5A** –Greenhouse Gas Emissions	Quantitative (metric tons/ AF of Supply): Estimates of unit greenhouse gas emissions	1	1
	Criterion 5B –Impact to Groundwater Quantity and Quality	Qualitative (1-5): Potential impacts to groundwater levels, groundwater quality, or potential for subsidence	1	1
	Criterion 5C –Impact to Habitat	Qualitative (1-5): Potential impacts to habitat, such as wetlands, riparian zones, fisheries, and inundation areas.	1	1
6 - Increase Implementation Potential	**Criterion 6A** – Institutional Complexity	Qualitative (1-5): Number and type of agencies and agreements involved	1	1
	Criterion 6B –Level of Local Control	Qualitative (1-5): BAWSCA and Member Agency ownership of supply projects	1	1
	Criterion 6C –Permitting Requirements	Qualitative (1-5): Permitting or regulatory issues for supply projects	1	1

[1] These values will be developed as part of the overall analysis and comparison of projects.

The preliminary project schedule for the Representative Coastal Desalination Project is 6 to 8 years, including:

- Phase I field investigations, assessments, financing, and other studies
- Phase 2
  - *Preliminary design and draft EIR*

- *Finalization of EIR and permit applications*
- *Final design*
- *Bid and construction, and*
- *Project startup.*

Completion of the Phase 1 and 2 efforts for the Representative Desalination Project is aggressive. Depending on the results of the field investigations, environmental documentation and permitting the schedule could extend to eight years. Additional information regarding this schedule is presented in Section 3 and Appendix B Section B.10.

1.2.4 Key Issues

Daly City Recycled Water Project – Expanded Service Area

There are several key institutional and political issues that can affect the implementation of the Daly City Recycled Project – Service Area Expansion. These include:

- Resolving role of the City of San Francisco in this project. To date Daly City and San Francisco have jointly evaluated this project;
- Confirming/guaranteeing that the identified customers of the recycled water supply will commit to long-term use and purchase of the supply; and
- Determining the funding partners and cost of the supply to the new customers in the Town of Colma.

Representative Coastal Desalination Project

As with the Daly City project there are several key issues which will affect the cost and feasibility of the desalination project. These include:

- Source water quality (e.g., salinity, iron, manganese, contaminants) variability;
- Source water yield;
- Land availability, cost and permitting for Ranney Collector Wells;
- Availability, cost and permitting for the use of the old Sharp Park Wastewater Treatment Plant (WWTP) site as a desalination plant site;
- Alignment issues and costs for construction of new raw water and treated water pipelines;
- Property availability, cost and permitting for identified tank site;

- Public support and opposition;
- Permitting for a new outfall for brine discharge off the coast; and
- Funding and ownership of a coastal desalination plant and ancillary facilities.

1.3 Next Steps

The projects developed and presented in this memo are two of several that might be part of the long-term supply opportunities for the BAWSCA member agencies. Prior to more detailed development of the project information these supply projects will be compared based on series of criteria to determine which projects warrant additional investigation and/or evaluation.

If either of these projects is selected to move forward the following are some of the possible key next steps:

1.3.1 Daly City Recycle Project – Service Area Expansion

- Determine project sponsors, owners and funders;
- Develop distribution system O&M cost estimates; and
- Confirm willingness of potential buyers to switch to recycled water and commit to long term agreements.

1.3.2 Representative Coastal Desalination Project

- Confirm availability and cost for desalination treatment plant site and Ranney Collector Wells;
- Determine capacity and yield for proposed Ranney Collector Well locations;
- Confirm availability and cost for proposed reservoir site;
- Determining project sponsors, owners and funders; and
- Confirm interest by potential buyers of this supply.

2.0 Daly City Recycled Water Project – Service Area Expansion

Daly City and the San Francisco Public Utilities Commission (SFPUC) jointly funded developed a feasibility study[1] of the expansion of the Daly Recycled Water System in October 2009 (Feasibility Study). The Feasibility Study addressed expansion of recycled water treatment facilities at the Daly City Wastewater Treatment Plant (WWTP), and new transmission and distribution system facilities to supply recycled water to irrigation customers in the Town of Colma and to three properties in San Francisco. The full project would increase the existing tertiary treatment plant

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[1] *Combined Results of the Recycled Water Treatment and Delivery System Expansion Feasibility Study, Final October 2009, Carollo Engineers.*

capacity from 2.77 mgd by 3.4 mgd for a total capacity of 6.2 mgd. This is the maximum expansion possible within the existing treatment plant site constraints and will require two story construction of the treatment facilities to expand to this capacity. The annual estimated total supply is about 1,060 AF per year for the Colma customers and 258 AF/year for the San Francisco customers.

However, the current project proposed by Daly City only includes service within the Town of Colma which has an estimated demand of 1,060 AF per year. This requires 2.98 mgd of the 3.4 mgd total expansion, leaving 0.4 mgd for service to San Francisco customers. In the Feasibility Study, San Francisco identified a need for up to 0.72 mgd of peak day demand. In order to meet this additional 0.32 mgd of demand the Feasibility Study discussed supplementing the supply with potable water for the approximate 30 days per year when the demand is anticipated to exceed the 3.4 mgd of additional capacity. For the purposes of this memo, the capacities and costs have been adjusted to reflect only the Daly City to Colma portion of the project.

The Daly City Recycled Water Project Expansion involves expansion of the existing recycled water treatment, transmission and distribution system to serve irrigation customers in the Town of Colma. This expansion project will supply recycled water to irrigation customers including cemeteries, city parks, schools and a golf course in the Town of Colma. These irrigation customers currently use private groundwater wells drawing from the Westside Groundwater Basin, or potable water from Cal Water, to irrigate turf and other landscaping. Converting these irrigation customers to recycled water would free up these supplies for other uses.

2.1 Existing Recycled Water Treatment System

The existing Daly City WWTP consists of primary, secondary and tertiary treatment facilities. The tertiary treatment process includes coagulation, flocculation, filtration, and disinfection to produce recycled water meeting California Title 22 requirements for unrestricted irrigation.

The recycled water project expansion requires additional tertiary treatment capacity at the WWTP. The WWTP is located on a constrained site with limited space available for expansion. Requirements for the recycled water treatment facility expansion are discussed briefly below along with the new transmission and distribution system required to serve the project.

2.2 Project Assumptions

The wastewater plant average inflow is 6.2 mgd. The current Daly City Recycled Water Project has a tertiary treatment capacity of 2.77 mgd. With the addition of 3.4 mgd capacity within the existing site constraints the total capacity will match the average inflow of 6.2 mgd.

The Daly City Recycled Water Project Expansion requires additional recycled water treatment capacity at the Daly City WWTP, a transmission pipeline to Colma, and a storage and distribution system to serve irrigation customers. Treatment, transmission and distribution alternatives for the project were evaluated by Carollo Engineers in the Feasibility Study. The recommended treatment, transmission and delivery system from this study is presented below and is used for this analysis. The average annual demand for the Colma portion of the Project was estimated at

1,060 AF/year, with a peak day (24-hour average) demand of 2.98 mgd. Table 4 summarizes the estimated customer demands for the project as well as the current source of supply for each customer.

Table 4
Town of Colma Customer Recycled Water Demands

Name	Current Water Supply	Total Irrigated Acreage	Average Annual Demand (AF/year)	Maximum Month Demand (mgd)[1]	Peak Day Demand (mgd)[2]
Alta Loma Park	Cal Water	5.4	9	0.02	0.03
El Camino High School	Cal Water	8.2	36	0.08	0.10
Alta Loma Middle School	Cal Water	5.0	14	0.03	0.04
Sunshine Gardens Elementary	Cal Water	3.4	6	0.01	0.02
Holy Cross Cemetery	Private Well	150	255	0.55	0.72
Cypress Lawn Memorial Park	Private Well	146	248	0.54	0.70
Cypress Hills Golf Course	Cal Water	30	62	0.13	0.17
Woodlawn Cemetery	Private Well	49.5	84	0.18	0.24
Olivet Memorial Park	Private Well	56.7	96	0.21	0.27
Salem Cemetery	Private Well	11.7	20	0.04	0.06
Hills of Eternity and Home of Peace	Private Well	31.5	54	0.12	0.15
Greenlawn Memorial Park	Cal Water	27	46	0.10	0.13
Golden Hill Memorial Park	Cal Water	2	16	0.04	0.05
Eternal Home	Cal Water	12.6	21	0.05	0.06
Winston Manor Park	Cal Water	1.44	2	0.01	0.01
Hoy Sun Cemetery	Cal Water	7.2	16	0.03	0.04
Serbian Cemetery	Cal Water	13.5	23	0.05	0.06
Italian Cemetery	Private Well/Cal Water	28	48	0.10	0.13
Total		**589.1**	**1,060[3]**	**2.29**	**2.98**

1 Demand is based on the max month demand averaged over 30 days.
2 Peak day demand includes a peaking factor of 1.3 over average day demand.
3 Total rounded to nearest 10 AF/year.

Source: *Combined Results of the Recycled Water Treatment and Delivery System Expansion Feasibility Study, October 2009,* Carollo Engineers.

2.2.1 Recycled Water Treatment System

The Feasibility Study evaluated several filtration and disinfection alternatives for the expansion. Filtration alternatives included depth filtration, cloth media filtration, and microfiltration/ultra filtration membranes. Disinfection alternatives included ozone, UV and pasteurization. Primary disinfection by chlorine was not considered due to space constraints at the site for a chlorine contact basin.

The Feasibility Study recommended a tertiary treatment process for the expansion which includes new secondary effluent pumps, a microfiltration system with upstream coagulant addition, a HiPOx™ ozone disinfection system, chlorine addition for distribution system residual, and a recycled water pump station. Due to space constraints at the site, the tertiary treatment facilities are housed in a two story building.

2.2.2 Recycled Water Transmission and Distribution System

After treatment at the Daly City WWTP, the recycled water would be pumped via an 18-inch diameter transmission pipeline to a recycled water storage tank located in northern Colma. Figure 2 illustrates the recommended transmission pipeline alignment and storage tank location. Several alternative alignments were evaluated for the transmission pipeline. The storage tank in northern Colma stores recycled water throughout the day for use during the nighttime irrigation period. An 8-hour nighttime irrigation period was assumed in the Feasibility Study for sizing the storage and distribution system facilities.

The recycled water distribution system consists of two pump stations pumping from the Colma Storage Tank to two distribution system pressure zones with different service elevations. Figure 3 provides a schematic of the Colma Distribution System. Figure 4 presents the distribution system facilities and the potential customers served by the system.

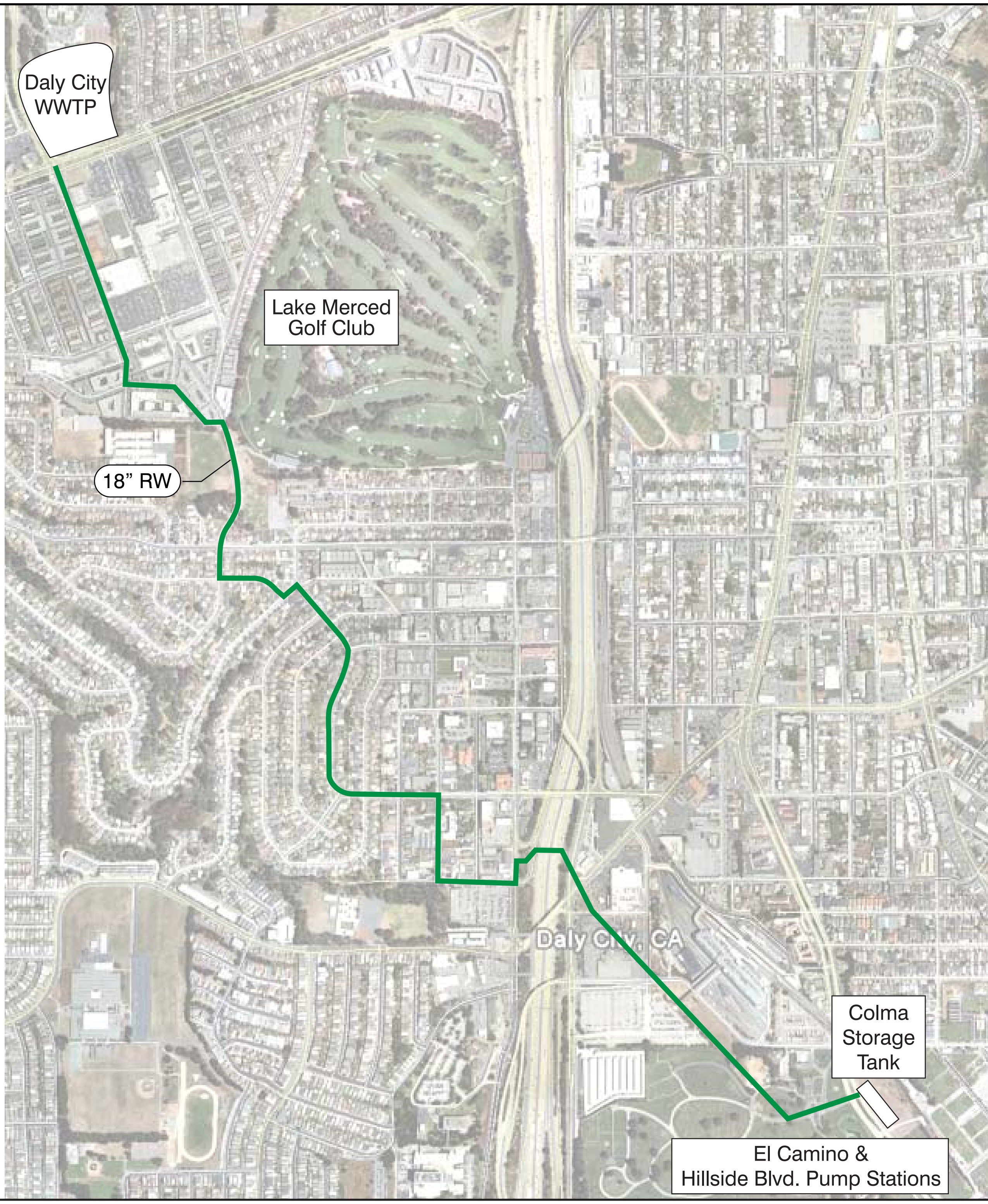
2.3 Planning Level Costs

Construction costs and capital costs for the treatment, transmission and distribution system were presented in the Feasibility Study. For treatment, the Feasibility Study sized treatment facilities for a joint project to provide recycled water to both Colma and irrigation customers in San Francisco. CDM has adjusted these treatment costs to provide treatment facilities sized for the Colma project only. CDM briefly reviewed the transmission pipeline costs in the Feasibility Study, and the costs appear consistent with other costs used in the Strategy. Table 5 presents the cost estimate for the recycled water project expansion adjusted to August 2011.

The total estimated construction cost for the treatment, transmission and distribution system facilities is $40.5 million. The estimated capital cost for the project, which includes engineering, legal, administrative, and a change order allowance, is $50.6 million. Costs assume a midpoint of construction in August 2014. Assuming a 30 year payback period and discount rate of 3%, the annualized capital cost is $2.6 million ($M) or $2,400/AF assuming 1,060 AF of water delivered annually.

The Feasibility Study also estimated O&M costs for the treatment facility including process chemicals, energy, labor, and membrane module replacement. The O&M costs were estimated at $481,000 in years 1 to 10 and $457,000 in years 11 to 20. It is unclear from the Feasibility Study why O&M costs were lower in years 11 to 20. For this analysis, we have assumed an ongoing annual O&M cost for treatment of $481,000 or $450/AF. The total annual cost per acre-foot including capital and O&M costs is $2,900/AF.

The Feasibility Study did not include O&M cost estimates for the transmission and distribution system. These costs could include power, labor and incidental costs and will increase the total cost of delivered water. At this time the O&M costs for the transmission and distribution system are not included as there is not sufficient information in the Feasibility Study to include that information. A summary of project capacity, estimated annual production and estimated costs are shown in Table 5.



Legend

Transmission Pipeline

Not to Scale

Source: *Recycled Water Treatment and Delivery System Expansion Feasibility Study, Final October 2009. Carollo Engineers.*

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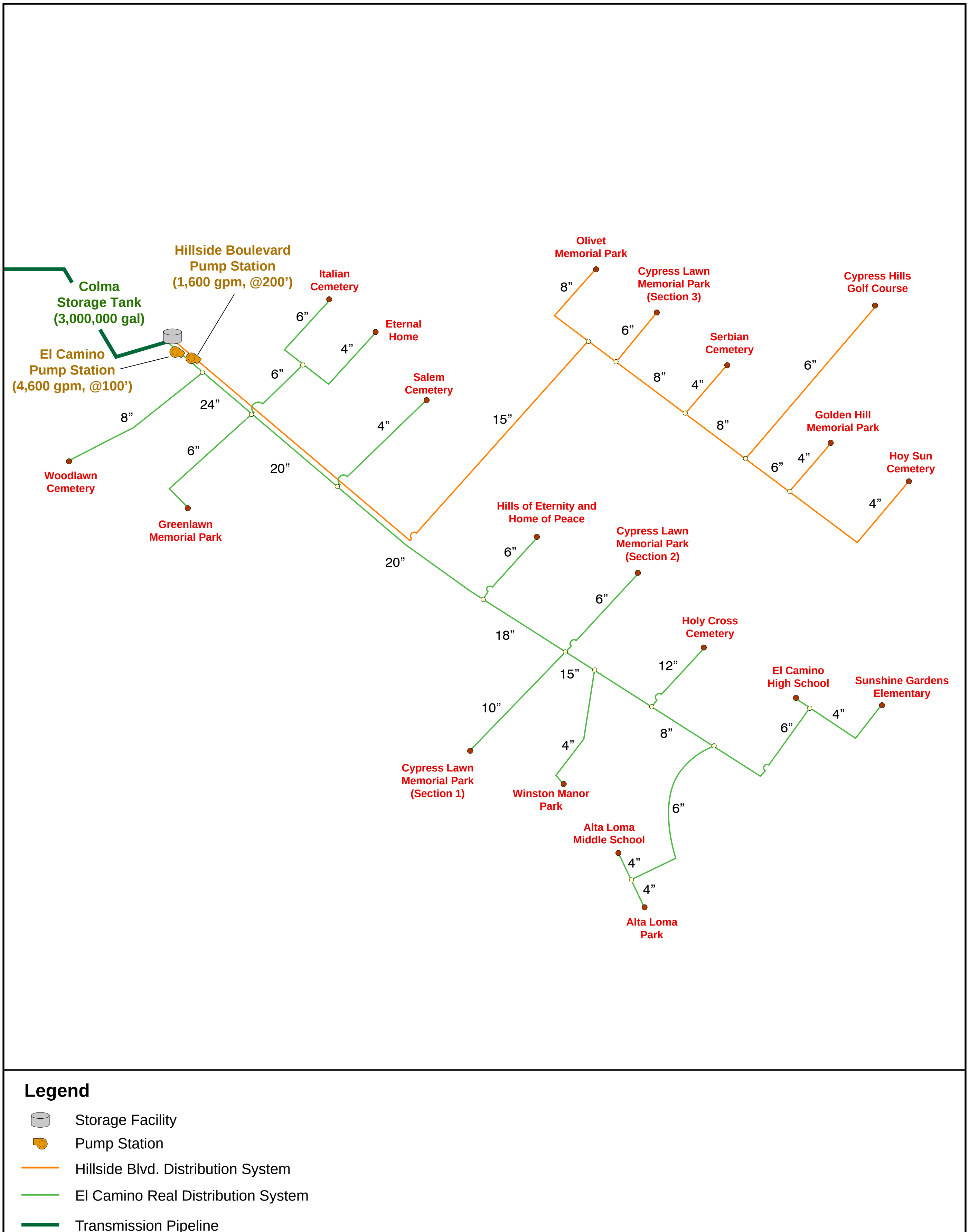
Figure 2
Daly City to Colma Recommended Transmission Pipeline Alignment



Source: *Recycled Water Treatment and Delivery System Expansion Feasibility Study, Final October 2009. Carollo Engineers.*

W:\REPORTS\BAWSCA\Task 11.3_Nov11\Graphics\BBAWSCA 2-B Memo Figure 3 122111 Daly City to Colma Distribution System Schematic.ai 12/14/11 JJT

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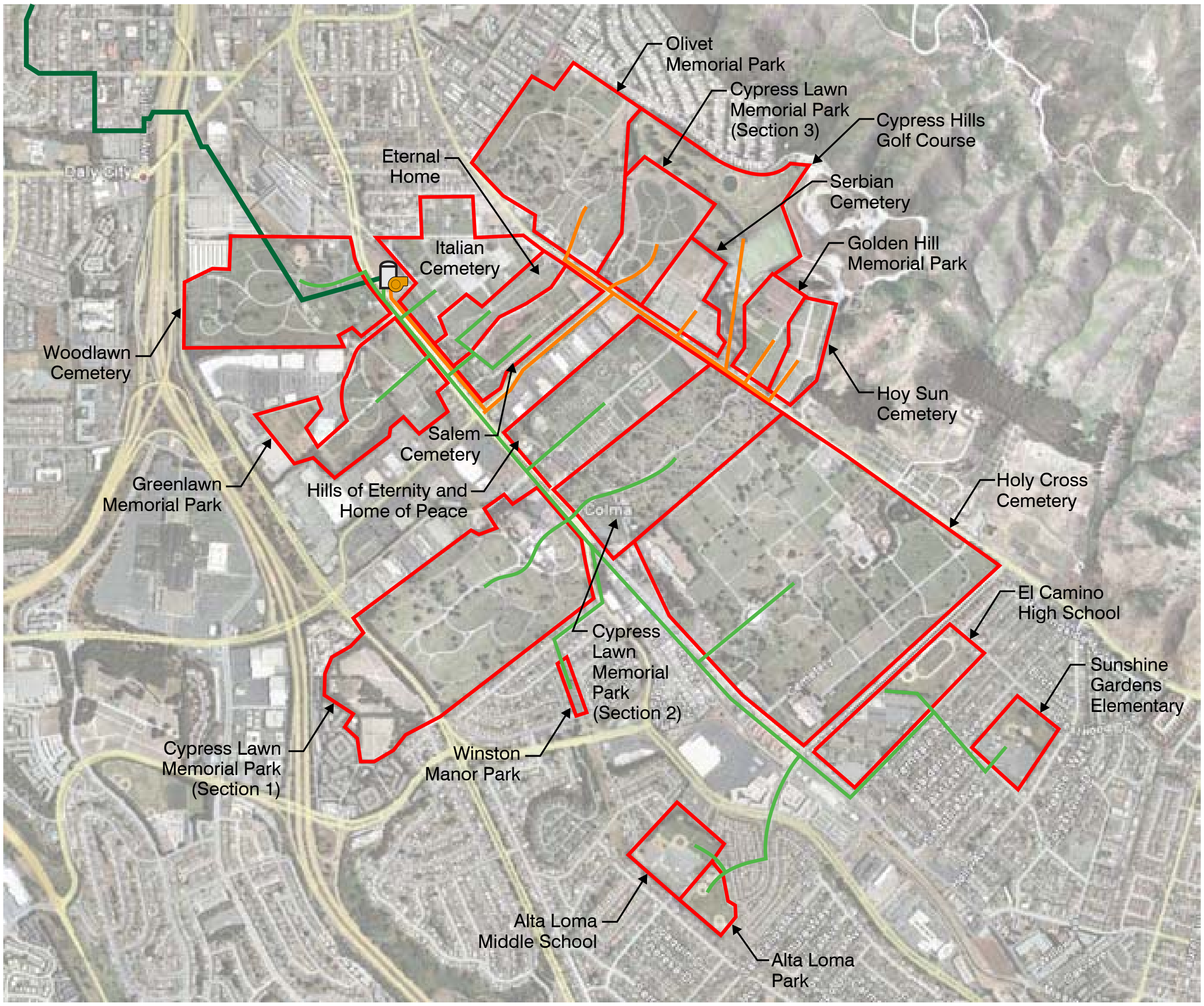
Figure 3
Daly City to Colma Distribution System Schematic



Legend

New Storage Tank

Pump Station(s)

Hillside Blvd. Distribution System

El Camino Real Distribution System

Transmission Pipeline

Not to Scale

Source: *Recycled Water Treatment and Delivery System Expansion Feasibility Study, Final October 2009. Carollo Engineers.*

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Figure 4

Daly City to Colma Distribution System and Recycled Customers

Table 5
Daly City Recycle Water Service Expansion
Cost Estimate

Cost Item	Adjust-ment	Original Cost Estimate[1]	Escalated Cost[2]	Capacity Adjustment[3]	Adjusted Cost[4]
Tertiary Treatment Plant Expansion					
Secondary Effluent Pump Station		$340,000	$357,000	88%	$314,000
Microfiltration Membranes		$3,064,000	$3,217,000	88%	$2,831,000
HiPOX Disinfection		$1,115,000	$1,171,000	88%	$1,030,000
Tertiary Building		$869,000	$912,000	88%	$803,000
Recycled Effluent Pump Station		$295,000	$310,000	88%	$273,000
Site Work & Yard Piping		$818,000	$859,000	88%	$756,000
E&IC		$2,178,000	$2,287,000	88%	$2,012,000
Outfall Modifications Allowance		$200,000	$ 210,000	100%	$210,000
Subtotal Tertiary Treatment Plant Expansion		$8,879,000	$9,323,000		$8,229,000
Colma Delivery System					
Transmission Main		$3,055,000	$3,208,000		$3,208,000
Storage Tank		$3,441,000	$3,613,000		$3,613,000
Distribution Systems (Pump Stations and Pipelines)		$5,604,000	$5,884,000		$5,884,000
Subtotal Colma Delivery System		$12,100,000	$12,705,000		$12,705,000
Total Direct Cost		$20,979,000	$22,028,000		$20,934,000
Estimating Contingency	30%	$6,294,000	$6,608,000		$6,280,000
Contractor Overhead and Profit	12%	$3,273,000	$3,436,000		$3,266,000
Escalation to Midpoint of Construction[4]	5%	$4,814,000	$5,055,000		$4,804,000
Sales Tax[5]	8.25%	$865,000	$909,000		$864,000
General Conditions	12%	$4,347,000	$4,564,000		$4,338,000
Total Estimated Construction Cost		$40,572,000	$42,600,000		$40,485,000
Engineering, Legal, Administrative Fees	20%	$8,114,000	$8,520,000		$8,097,000
Owners Change Order Reserve	5%	$2,029,000	$2,130,000		$2,024,000
Total Estimated Project Cost (Capital Cost)		$50,715,000	$53,250,000		$50,606,000
Annualized Capital Cost[6] ($M/Year)		-	-		$2.6
Annual Recycled Water Production (AF)		-	-		1060
Annualized Capital Cost - $/AF		-	-		$**2,400**[7]
Annual O&M Cost - Tertiary Treatment Plant		-	-		$481,000
Annual O&M Cost - $/AF[8]		-	-		$450
Total Annualized Cost		-	-		**$2,900**[7]

1 Based on Feasibility Report Table ES.6
2 Costs adjusted to August 2011 using San Francisco Bay Area CCI.
3 Capacity Adjustment.
4 Escalation to mid-point of construction per year. Assumes 3 years to midpoint.
5 Sales tax applied to 50% of total direct cost to estimate tax on materials.
6 Annualized cost based on 30 year return at 3% interest rate.
7 Rounded to nearest $100/AF.
8 Does not include operational costs for distribution system (i.e., energy costs and labor)

Funding partners for this project may include the San Francisco Public Utilities Commission (SFPUC) or other local water suppliers such as Cal Water.

2.4 Preliminary Project Schedule

Neither the Feasibility Report nor the information provided by Daly City included a schedule. For comparison purposes we have developed a preliminary schedule based on similar types of projects. This preliminary schedule is shown in Figure 5. The implementation schedule includes a planning and environmental review phase, preliminary design, final design, and a construction phase with an estimated completion within 6 years. Work during the planning and environmental review phase will include finalizing the customer base, development of customer agreements to receive recycled water, interagency agreements (anticipated to include recycled water supply and sales agreements and possibly others), securing funding sources, environmental review and related engineering support.

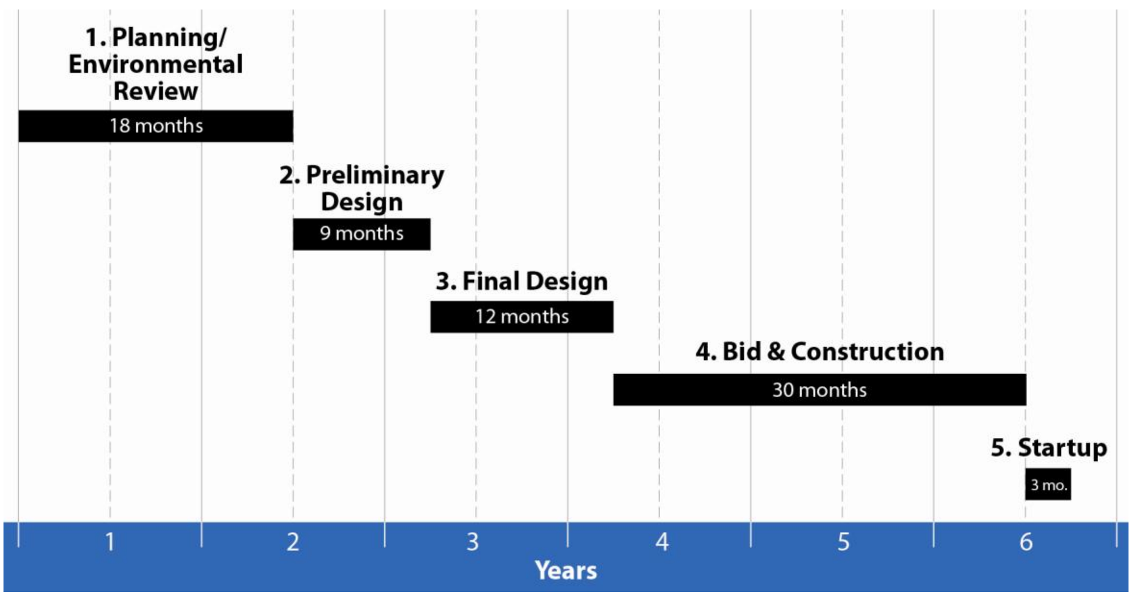

Figure 5 Daly City Recycled Project – Service Area Expansion Preliminary Schedule

2.5 Other Project Information and Evaluation Criteria

In addition to project yield, cost and schedule there is other project information that will be used in the comparison of water supply management projects. These information needs were identified in the Project Information Survey and Sheets, and were shown in Table 1 in this memo. This section presents this preliminary quantitative and qualitative information and how it is applied to the evaluation criteria that will be used in the future comparison of water supply management projects. The Strategy Revised Draft Task Memo: Refined Evaluation Criteria and

Metrics, January 25, 2011 provides more information on the development of the criteria, subcriterion and metrics. Following are brief descriptions of the evaluation criteria and their preliminary quantitative and qualitative values for the Daly City Recycled Water Project – Service Area Expansion. Table 6 summarizes this information.

Table 6
Daly City Recycled Water Project
Evaluation Criteria and Metrics

Objective	Criteria	Metrics	Project Values
1 - Increase Supply Reliability	**Criterion 1A** – Ability to Meet Normal Year Supply Need	Quantitative (AF/year): Average annual yield in normal years in 2018 and 2035	1,060
	Criterion 1B – Ability to Meet Drought Supply Need	Quantitative (AF/year): Average annual yield with drought hydrology of 1987 – 1992	1,060
	Criterion 1C – Risk of Facility Outage	Qualitative (1-5): Estimated probability and duration of major conveyance failure	[1]
	Criterion 1D – Potential for Regulatory Vulnerability	Qualitative (1-5): Potential for regulatory decisions to impact supply reliability	[1]
2 - Provide High Level of Water Quality	**Criterion 2A** – Meets or Surpasses Drinking Water Quality Standards	Quantitative (mg/L): Total dissolved solids (TDS) level as an indicator of water quality.	N/A
	Criterion 2B – Meets or Surpasses Non-Potable Water Quality Standards	Qualitative: Meets minimum water quality requirement (e.g., Title 22) for the targeted use.	Yes
3 - Minimize Cost of New Water Supplies	**Criterion 3** – Capital and Present Worth Costs	Quantitative ($/AF): Present Worth costs including capital and operating costs	$2,100
4 - Reduce Potable Water Demand	**Criterion 4** – Augment Non-Potable Water Supplies	Quantitative (AF/year): Reduction of potable water demand by use of non-potable supply.	250 – 1,060
5 - Minimize Environmental Impacts	**Criterion 5A** –Greenhouse Gas Emissions	Quantitative (metric tons/ AF of Supply): Estimates of unit greenhouse gas emissions	[1]
	Criterion 5B –Impact to Groundwater Quantity and Quality	Qualitative (1-5): Potential impacts to groundwater levels, groundwater quality, or potential for subsidence	[1]
	Criterion 5C –Impact to Habitat	Qualitative (1-5): Potential impacts to habitat, such as wetlands, riparian zones, fisheries, and inundation areas.	[1]
6 - Increase Implementation Potential	**Criterion 6A** – Institutional Complexity	Qualitative (1-5): Number and type of agencies and agreements involved	[1]
	Criterion 6B –Level of Local Control	Qualitative (1-5): BAWSCA and Member Agency ownership of supply projects	[1]
	Criterion 6C –Permitting Requirements	Qualitative (1-5): Permitting or regulatory issues for supply projects	[1]

[1] These values will be developed as part of the overall analysis and comparison of projects.

2.5.1 Supply Reliability

The *Increase Supply Reliability* criteria has four subcriterion:

- *Criterion 1A – Ability to Meet Normal Year Supply Need* - An estimate of the ability of a water supply management project to meet the normal hydrologic year supply needs of BAWSCA member agencies is measured by the annual yield of the project during normal hydrologic conditions by the 2018 and 2035 planning horizons.

- *The yield is indicated in Table 6.*

- *Criterion 1B – Ability to Meet Drought Supply Need* - An estimate of the ability of a water supply management project to meet the supply need during a drought is measured by the annual yield of the project during the 1987 – 1992 drought. The criterion of drought reliability captures whether a supply project is resistant to drought impacts.
    - *The yield is indicated in Table 6.*

- *Criterion 1C – Risk of Facility Outage* - Supply vulnerability is measured by the probability and duration of potential outages to a particular water supply management project due to a major conveyance failure. This criterion captures the vulnerability of projects to emergency outages. This metric is a qualitative measure ranging from 1 through 5, with a score of "1" identifying the projects that are least susceptible to emergency outages and a score of "5" indicating high susceptibility to conveyance failures.
    - *These values will be developed as part of the overall analysis and comparison of projects.*

- *Criterion 1D – Potential for Regulatory Vulnerability* - The susceptibility of a water supply management project to interruption as a result of regulatory issues includes legal, political, or environmental constraints. This metric is a qualitative measure ranging from 1 through 5, with a score of "1" identifying the projects that are least susceptible to regulatory risk and a score of "5" indicating high susceptibility to regulatory risk.
    - *These values will be developed as part of the overall analysis and comparison of projects.*

2.5.2 Water Quality

The *Provide High Level of Water Quality* criteria has two subcriterion:

- *Criterion 2A – Meets or Surpasses Drinking Water Quality Standards* – A measure representing potable supply is addressed by the quantitative metric of the aggregate water quality, measured by TDS levels, of the potable supply projects and portfolios. TDS is a surrogate for other water quality parameters representing water quality.
    - *This criterion is not applicable to recycled supply.*

- *Criterion 2B – Meets or Surpasses Non-Potable Water Quality Standards* - For non-potable supply projects, where water quality constraints vary according to use, the value will be a qualitative assessment of whether or not the water supply management projects and portfolios meet the minimum water quality requirement for the targeted use. In most cases, this metric will be used to designate whether a non-potable supply source meets Title 22 requirements, as this is a common target water quality level for a non-potable demand.
    - *The proposed project meets the Title 22 requirements.*

2.5.3 Cost

The *Minimize Cost of New Water Supplies* criteria has one quantitative subcriterion:

- *Criterion 3 – Capital and Present Worth Costs* - The present worth costs, including capital, operations, and maintenance costs, for each water supply management project are estimated. The performance metric is the normalized unit cost presented in $/AF for each project.
  - *The costs are indicated in Table 6.*

2.5.4 Reduce Potable Water Demand

The *Reduce Potable Water Demand* criteria has one criterion:

- *Criterion 4A –Augment non-potable water supplies* is quantitative metric for the annual yield of additional non-potable supply produced and utilized to offset potable demand.
  - *The project yield is indicated in Table 6. However, there is a range associated with the non-potable offset for this project. As indicated in Table 4 a portion of this new recycled water would offset current potable surface supply from Cal Water customers (251 AF), and a portion would offset existing groundwater use (805 AF). If the offset groundwater becomes available in the future the upper range of potable offset could be about 1,060 AF.*

2.5.5 Environmental Impacts

The *Minimize Environmental Impacts* criteria includes three qualitative subcriterion:

- *Criterion 5A* -The metric for *5A* is represented by the increase in greenhouse gas emissions due to a potential water supply management project. This quantitative metric will be measured in terms of metric tons of carbon dioxide produced, or reduced, per unit of supply based on energy use.
  - *These values will be developed as part of the overall analysis and comparison of projects.*
- *Criterion 5B –Impact to Groundwater Quantity and Quality* - Water supply management projects that do not negatively affect groundwater supplies will be measured favorably in this criterion. A combined qualitative estimate of potential groundwater impacts will be evaluated in terms of potential reductions in groundwater levels, impacts to groundwater quality, and the risk of increase in land subsidence. This metric will be a qualitative measure ranging from 1 through 5, with a score of "1" identifying the projects with the least potential for adversely affecting groundwater quantity and quality and a score of "5" indicating high probability of adverse impacts.
  - *These values will be developed as part of the overall analysis and comparison of projects.*
- *Criterion 5C –Impact to Habitat* - This criterion addresses long-term impacts to the ecosystems, not short-term effects related to temporary construction activities. Water supply management projects that do not adversely affect sensitive habitat areas such as wetlands,

riparian zones, potential special-status species habitat, or have significant inundation areas will be measured favorably in this criterion. A combined qualitative estimate of potential habitat impacts is evaluated in terms of potential site acreage, proximity to sensitive habitat zones, and flood potential. This metric is a qualitative measure ranging from 1 through 5, with a score of "1" identifying the projects with the least potential for adverse impacts to habitat and a score of "5" indicating high probability of adverse effects to terrestrial, aquatic, and riparian species.

- *These values will be developed as part of the overall analysis and comparison of projects.*

2.5.6 Implementation Potential

The *Increase Implementation Potential* criteria has three qualitative subcriterion:

- *Criterion 6A –Institutional Complexity* - This criterion addresses the level of institutional coordination required for implementation of a water supply management project. A qualitative metric will be used to estimate the coordination required if multiple local or regional agencies or agreements are necessary. The projects that are assumed to require less coordination, and to receive less opposition, will score better than those that are more complex or potentially controversial.

    - *At this time, Daly City owns and operates the WWTP. Any change in ownership or operations at this time with any potential partners, including SFPUC, has not been determined.*

- *Criterion 6B –Level of Local Control of Water Supply* - Local management of a water supply management project will minimize dependency on imported water supplies and the drought impacts associated with those supplies. A common rating scale will be developed to evaluate the amount of BAWSCA-owned or BAWSCA member-owned supply for each project. Projects that are fully owned by BAWSCA or the member agencies will score higher than supply projects owned fully or partially by other entities that might be affected by regulatory risk, multiple party agreements, and supplies that may have a higher risk of not being available further into the future, or under drought conditions.

    - *These values will be developed as part of the overall analysis and comparison of projects.*

- *Criterion 6C –Permitting Requirements* - This criterion addresses the objective of minimizing the regulatory and environmental permitting obstacles associated with water supply management projects. Projects with other similar metrics (including cost) may have differing permitting requirements, which can affect their overall implementation. The performance metric is a qualitative measure of the permitting requirements of each project or portfolio.

    - *These values will be developed as part of the overall analysis and comparison of projects.*

2.6 Key Project Issues

Below is a list of identified outstanding issues and data gaps for the Daly City project. The Agency-Identified issues were presented in the Feasibility Study. Other potential issues which will need to be evaluated, but were not included in the initial list of issues in the Feasibility Study have also been included. These Other Potential Issues are based on experience with other similar recycled projects.

Agency identified issues:

- Public acceptance of irrigation of cemeteries and headstones with recycled water (potential concern with kissing headstone irrigated with recycled water).
- Funding sources.

Other identified issues:

- Potential difficulty converting customers, particularly groundwater customers to recycled water use, as they are currently paying much lower costs for pumped groundwater;
- Uncertainty of customer base, especially with several low cost groundwater pumpers, as a smaller customer base will increase the recycled water unit cost;
- Development of customer rate structure;
- Several key agreements needed - interagency agreements, recycled water supply and sales agreement, groundwater and potable water transfer agreements; and
- Distribution system O&M cost estimates which are not currently included.

2.7 Next Steps

The project developed and presented in this memo is one of several that might be part of the long-term supply opportunities for the BAWSCA member agencies. Prior to more detailed development of project information, these supply projects will be compared based on series of criteria to determine which projects warrant additional investigation and/or evaluation.

If the Representative Daly City Recycled Water Project – Service Area Expansion is selected to proceed the possible key next steps include:

- Determine project sponsors, owners and funders;
- Develop distribution system O&M cost estimates; and
- Confirm willingness of potential buyers to switch to recycled water and commit to long term agreements.

3.0 Representative Coastal Desalination Project

The representative coastal desalination project was originally identified by the North Coast County Water District (NCCWD) as a Desalination Plant with a designation of NC-4. After discussions by BAWSCA staff with NCCWD representatives, it was determined that NCCWD was not a proponent of a coastal desalination project at this time. As this is the only potential coastal desalination site currently included in the Strategy, the generic Representative Coastal Desalination Project replaces NCCWD NC-4 and has been included as a new project.

Appendix B describes the NCCWD NC-4 earlier project in more detail as well as providing general details on intake, desalination treatment, brine disposal and other infrastructure requirements. The specific facilities proposed for the Representative Coastal Desalination Project and facility costs are presented in this appendix.

3.1 Project Assumptions

3.1.1 Project Alternatives

Prior to the identification of NCCWD NC-4, an earlier study assessing the potential for a desalination project had been prepared for NCCWD. The Desalination Feasibility Study[2] was presented to the North Coast County Water District on February 6, 1996 with a proposed open seawater capacity of 3.3 mgd, and treated water capacity of 1.5 mgd. It is our understanding that no further analysis was done for this alternative.

In meetings with NCCWD staff in November 2010 and April 2011, a conceptual alternative (NC-4) was discussed which included development of intake wells in the area of Sharp Park, use of the NCCWD office site for the treatment facilities, offshore brine disposal and with a treated water capacity ranging from 10 to 15 mgd. No planning beyond the initial identification and sizing of facilities had been performed for this project. NCCWD indicated that the yield would be dependent on the capacity of the intake supply and site limitations at the potential desalination plant site.

However, after review of local hydrologic information and some of the proposed facility sites it was determined that the project identified by NCCWD was not viable as described at that time. The following sections present these issues and describe the project carried forward as part of this analysis.

3.1.2 Local Hydrogeology

Most of the coastline within NCCWD is rocky, and does not fall within the boundary of aquifers identified and studied by the California Department of Water Resources (DWR). However, a preliminary study was conducted in 1993[3] to investigate the potential yield for subsurface ocean

[2] Boyle Engineering Corporation, Final Desalination Feasibility Study for the North Coast County Water District, February 6, 1996.

[3] Ranney Method Western Corporation, Report on Hydrogeological Survey Sharp Park Test Site for the North Coast County Water District, April 30, 1993.

water wells in the area of Sharp Park. This study concluded that "suitable geologic conditions do not exist for the development of the required seawater supply" with yields of less than 100 gallons per minute (gpm) for a subsurface intake (less than 0.15 mgd).

The 1993 study also suggested that along the Pacifica State Beach, subsurface yields may be higher, though no known hydrogeologic investigations have been performed. The Beach overlies part of the San Pedro Valley Groundwater Basin (DWR Basin 2-36). The basin is small, totaling only 700 acres. It is bounded on the west by the Pacific Ocean, and north, east and south by Castle Hill, Whiting Ridge and San Pedro Mountain, respectively. While there is very limited data, the basin contains alluvial deposits containing sands, silts, and clays with some gravel (DWR, 2004). Potential groundwater yields and water balance information is not available. The potential for alluvial deposits of the San Pedro Valley Basin to supply sufficient yield for a desalination plant is unknown, and would require further investigation if this project were to proceed. Figure 6 indicates the location of Pacifica State Beach.

3.1.3 Desalination Project Components

There are a number of facilities associated with a desalination project. These key components include:

- Intake options;
- Desalination treatment options; and
- Brine discharge options.

Appendix B Sections B.3, B.4, and B.5 provide detailed descriptions of these options respectively, and some of the issues associated with the types of facilities selected for different projects.

3.2 Potential Facility Sizing and Capacity

As with the different desalination project components there are number of factors associated with these facilities that affect overall sizing and capacity of a project. These include:

- Intake capacity;
- Treatment requirements and source water considerations;
- Available siting areas for a desalination plant;
- Brine disposal capacity; and
- Potential treated water customers and transmission facilities.

The affect on the sizing of the proposed project are discussed in the following sections.

3.2.1 Intake Capacity

As discussed in Section 3.1.2 and Appendix B Section B.2 the proposed location for the intake is along Pacifica State Beach. The facilities included for this analysis were Ranney Collector Wells which would maximize the potential intake capacity, while maintaining subsurface intake. Along the beach area, installation of 6 collectors was assumed with an approximate intake capacity of 3 mgd per collector, or a total raw water capacity of 18 mgd. The potential capacity is determined based on the length and width of the beach area, and the necessary spacing between the Ranney Collector Wells.

This suggested capacity is strictly based on information from other beach Ranney Collector Wells. There is no hydrologic data available at this time to confirm the 18 mgd capacity.

Figure 6 indicates the location of these facilities, and Appendix B, Section B.7.1 provides a more detailed discussion of this analysis.

3.2.2 Treatment Requirements and Source Water Considerations

Due to the close proximity of the Ranney Collector Wells to the ocean it has been assumed that the source water will be seawater (saline) rather than a blend of seawater and brackish or fresh groundwater.

Open water intakes would require significantly more pre-treatment (primarily coagulation, flocculation, clarification and filtration) to protect the membranes, especially during storm and algal bloom events than subsurface intakes. The subsurface intakes use the overlying sand and gravel layers as filters to remove most of the material requiring pre-treatment for an open intake.

Treating seawater versus brackish water also requires larger facilities as the efficiency of the membranes decreases as the salinity increases. A full seawater treatment facility may only recover 40 percent of the raw water coming into the plant, while a brackish plant may recover up to 80 percent. For example a 10 mgd seawater supply would produce 4 mgd or treated water, while a plant treating 10 mgd of brackish water would produce about 7.5 mgd of treated water supply.

An open water ocean intake, including pre-treatment, membrane desalination, and post-treatment requires about 1 acre of land for every mgd of treated water produced from seawater. Treatment of subsurface source water decreases the land requirement and can provide treated water capacity of 2 to 4 mgd on the same acre of land.

Figure 6 indicates the location of these facilities and Appendix B, Section B.7.2 provides a more detailed discussion of this analysis.

3.2.3 Available Siting Areas for Desalination Plant

The initial discussions with NCCWD staff indicated three possible locations for a desalination treatment plant, including:

- Existing NCCWD offices (2400 Francisco Blvd., Pacifica, CA);

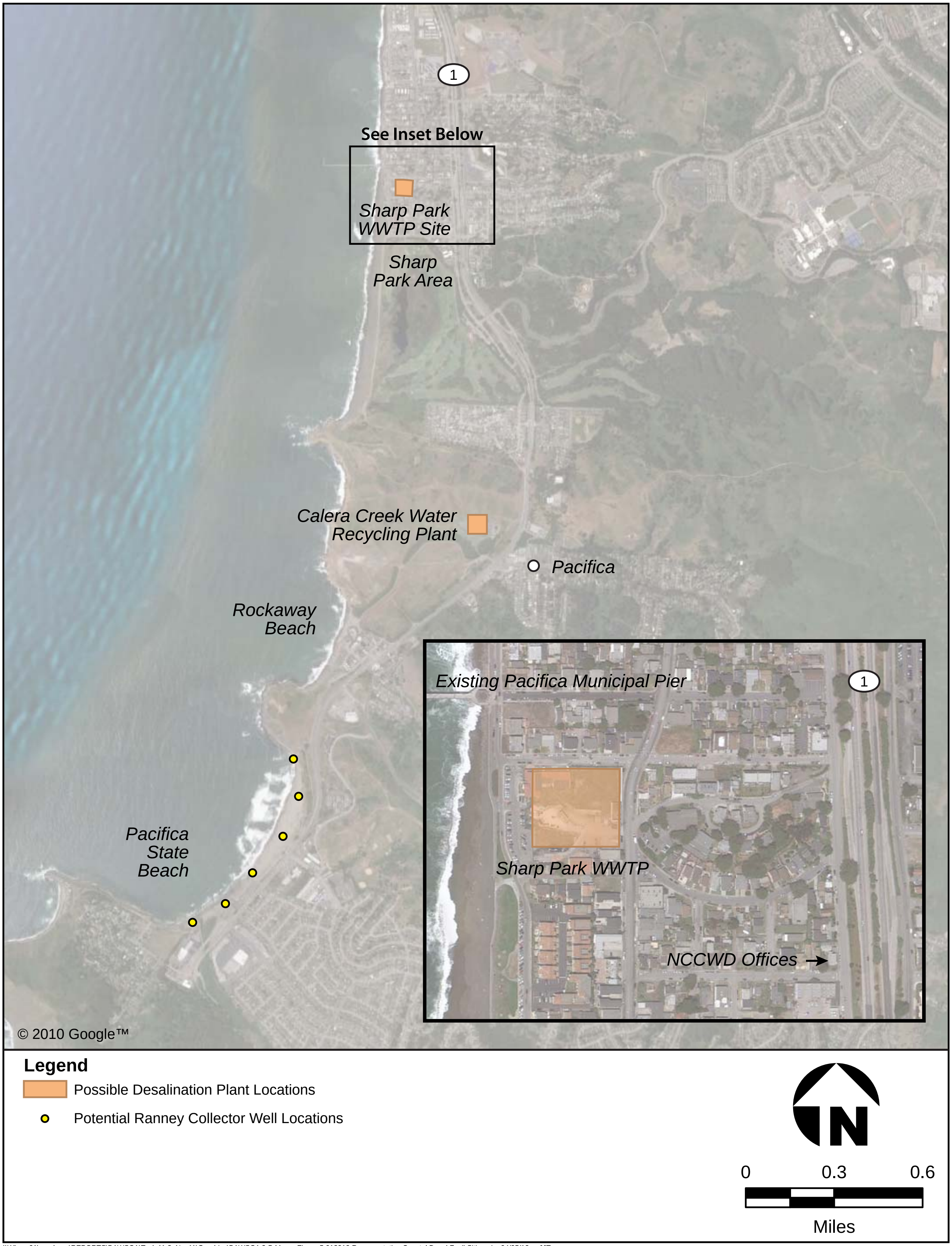

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Figure 6

Representative Coastal Desalination Project - Potential Facility Locations

- Calera Creek Water Recycling Plant; and
- Sharp Park Wastewater Treatment Plant (WWTP).

Figure 6 indicates the locations for these facilities.

After further discussions with NCCWD it was determined that the current office location would not be available as a treatment plant site. NCCWD is currently reviewing the possibility of selling this site, and it is also relatively small. This site was eliminated as a possible desalination plant site.

Also, the Calera Creek Water Recycling Plant site was eliminated as a potential site. This was done for several reasons, including: limitations in constructing additional treatment facilities; introduction of raw water, brine and treated water pipelines through existing wetland restoration areas; and limitations in use of the Rockaway Beach area as it is also in the restoration area.

The Sharp Park WWTP located near the Pacifica Municipal Pier has been abandoned for several years. The City of Pacifica may sell and/or develop the site. This site has an area of approximately 2.5 acres. Treating seawater with an open intake at this site is limited to about 2.5 mgd of treated water. Treating water from a subsurface intake at this site could provide up to 7.5 mgd (assuming 3 mgd per acre) of treated water. Assuming a subsurface intake and 40 percent recovery, the size of this site provides room for treatment facilities to treat about 18 mgd of the raw water source.

Combining a subsurface supply provide by Ranney Collector Wells at the Pacifica Beach, and a potential raw water treatment capacity of 18 mgd at the Sharp Park WWTP site, it is estimated that this project could produce around 7.5 mgd of treated water supply. Those two locations are assumed to provide the supply and treatment sites for the Representative Coastal Desalination Project.

Figures 6 and 7 indicate the location of these facilities and Appendix B, Section B.7.3 provides a more detailed discussion of this analysis.

3.2.4 Brine Disposal Capacity

Brine disposal onshore or through deep wells is most likely not feasible in this area. The brine disposal is assumed to be through a new offshore pipeline from the old Sharp Park WWTP to approximately one mile offshore. This is typical to other proposed offshore brine disposal projects. The existing wastewater outfall is assumed to be in too poor of condition to be cost effectively rehabilitated.

Figure 7 indicates the location of these facilities.

3.2.5 Treated Water Customers and Transmission Facilities

The average annual water demand for NCCWD is about 3 mgd and is projected by NCCWD to only increase slightly by 2035. BAWSCA member agencies that are adjacent to NCCWD include:

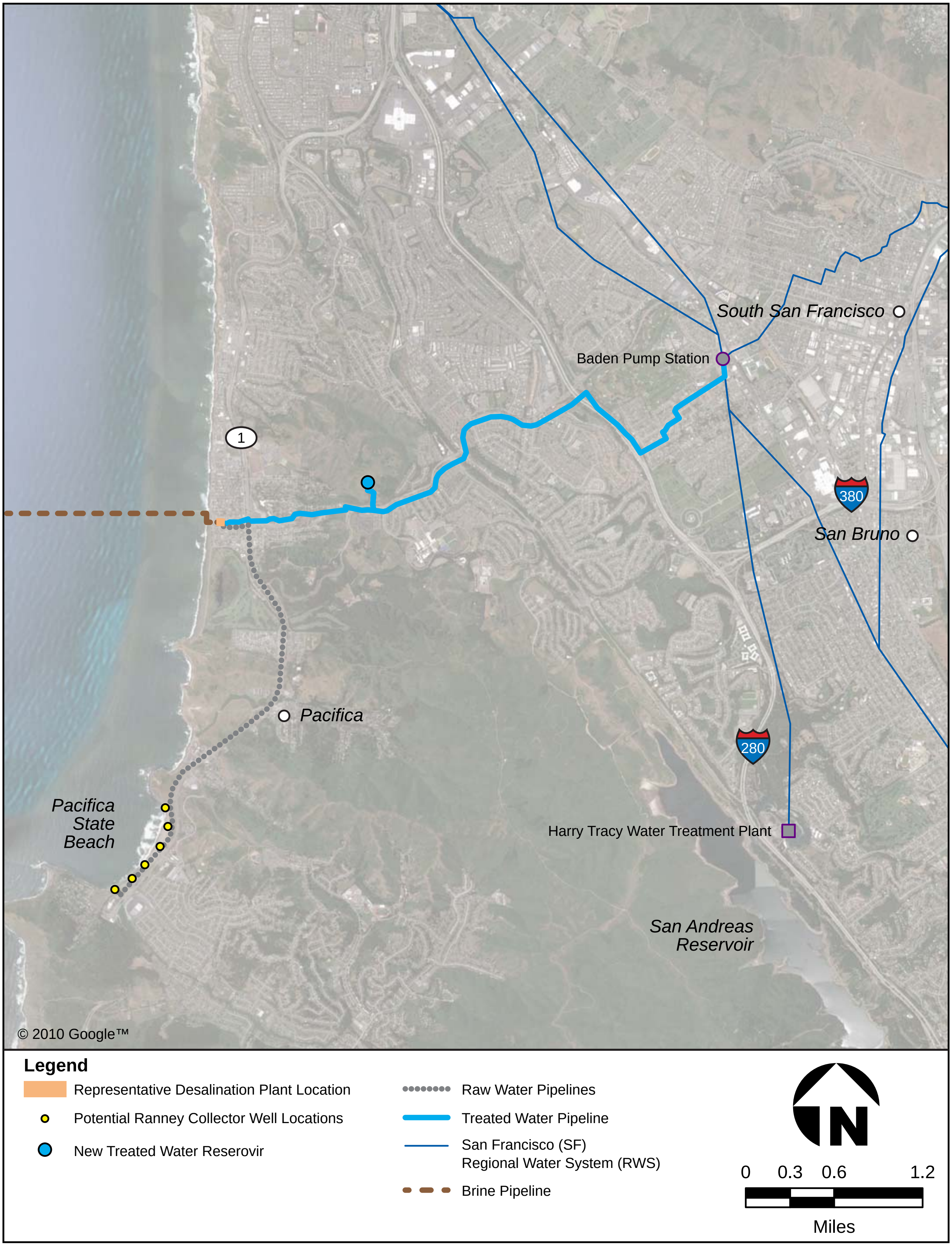

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Figure 7
Representative Coastal Desalination - Project Facilities

- City of Daly City;
- Westborough Water District; and
- City of San Bruno.

The 2015 projected demand for these three agencies plus NCCWD is about 17 mgd, increasing to 20 mgd by 2035. Potential customers for the 7.5 mgd could include a combination of some of these agencies, or the supply could be conveyed to the SFPUC RWS for conveyance through that system or as an Individual Supply Guarantee (ISG) transfer.

In order to deliver the treated water supply to any of the above agencies, outside of NCCWD, transmission facilities would need to be constructed to convey this water over the hills to east. The most direct route would be along Sharp Park Road to Milagra Ridge, and continuing along Westborough Boulevard.

A 10 million gallon reservoir is included for operational storage off of Sharp Park Road at Milagra Ridge. A pumping plant would be required at the desalination plant to boost the treated water to Milagra Ridge, and then with gravity flow to the east.

Figure 7 indicates the proposed locations for the intake, desalination plant, raw water, treated water, and brine pipelines as well as the proposed tank on Milagra Ridge. Figure 7 also includes the continuation of the treated water pipeline along Westborough Road to a possible connection to the SFPUC RWS near the Baden Pump Station.

3.3 Planning Level Costs

In order to allow future comparison of water supply alternatives several cost elements have been developed. These include:

- Construction Costs ($M);
- Capital Costs ($M);
- Annual O&M Costs ($M);
- Present Worth Costs ($M);
- Estimated Annual Production ($M);
- Unit Cost of Total Present Worth ($M/AF); and
- Unit Annualized Costs ($/AF).

Appendix B, Section 8 provides detailed information on the basis of cost assumptions for the above financial characteristics of projects.

Table 7 presents the planning level construction and capital cost estimates for the major project items for the Representative Coastal Desalination Project, including facility sizing. The adjustments used to convert construction costs to capital costs are also shown in the table. The unit costs for each of the different items were developed based on similar types of projects in California and the United States. All construction costs were adjusted to August 2011 which is being used as the common base for all of the water supply management projects.

Table 7
Representative Coastal Desalination Project Capital Cost Estimate

Item	Capacity (mgd)	Pumping Power (HP)	Diameter (in.)	Length (ft.)	Capital Cost ($ M)
Source Water: *Ocean*					
Recovery: *40%*					
Treated Water Capacity: *7.5 mgd*					
Construction Cost Items					
Intake Structure	18.8	-	-	-	$ 10.6
Desalination Plant	7.5	-	-	-	$ 66.6
Pipelines[1]					
Raw Water Pipeline/Tunnel	18.8	-	30	13,000	$ 5.9
Treated Water Pipeline/Tunnel	7.5	-	21	22,300	$ 7.3
Brine Pipeline/Tunnel	11.3	-	24	5,000	$ 3.5
Pump Stations[2]					
Raw Water Pump Station (HP)	18.8	270	-	-	$ 0.6
Treated Water Pump Station (HP)	7.5	1,225	-	-	$ 2.9
Brine Pump Station (HP)	11.3	-	-	-	-
Treated Water Storage (MG)	2	-	-	-	$ 1.6
Total Construction Costs					**$ 99.0**
Contractor Profit (15%)					$ 14.8
Engineering, Engineering During Construction, & Construction Management (25%)					$ 24.7
Soft Cost Adjustment (15%)					$ 14.8
Contingency (40%)					$ 61.4
Total Adjustments					$ 115.8
Capital Cost Estimate					**$ 214.7**

1 Pipeline costs include tunneling and boring under obstructions such as highways.
2 Capital costing curves used to estimate intake and treatment plant construction costs include 50 HP pump stations for raw, treated and concentrated brine water. The costs itemized above for pump stations include costs for pumping capacity greater than 50 HP.

Capital costs were developed for the proposed facilities based on the construction costs presented in Section B.8.1 adjusted for:

- Contractor markup; including overhead, profit and prorates -15 percent;

- Engineering feasibility studies, preliminary and final design, services during construction and construction management – 25 percent;
- "Soft costs" including legal fees, permitting, and other miscellaneous costs – 15 percent; and
- Contingency – 40 percent.

Some key costs that have not been included in the current analysis include:

- Land purchase cost;
- Purchase of easements or rights-of-way; and
- Wheeling or "Transfer" costs for conveyance of water through other agencies facilities.

These costs that are not currently included will be developed later as part of the more detailed evaluation for the projects moving forward into detailed evaluation, ranking and comparison.

Table 8 presents the present worth and annualized cost estimates for this project based on the capital costs presented in Table 7 and the O&M costs.

Table 8
Representative Coastal Desalination Project Present Worth and Annualized Cost Estimates[1,2,3]

Present Worth Costs	
Annual O&M Cost ($M)	$ 7.75
Present Worth of Capital Cost ($M)	$ 214.75
Present Worth of Annual O&M Cost ($M)	$ 232.50
Total Present Worth ($M)[4]	**$ 447.25**
Total Production (AF)[5]	201,534
Unit Cost of Total Present Worth ($/AF)[4,7]	**$ 2,200**
Annualized Project Costs	
Capital Costs Annualized ($M)[6]	$ 10.96
Annual O&M Cost ($M)[6]	$ 7.75
Total Annual Cost	**$ 18.71**
Annual Production (AF)[5]	6,720
Unit Annualized Costs ($/AF)[7]	**$ 2,800**

1 2011 costs are current as of August 2011.
2 2015 project start date (O&M costs starting 2016).
3 Assumed project life of 30 years.
4 Present Worth estimates include a 3% escalation and a 3% discount rate. The same escalation rate is used for electricity, materials, labor and capital costs.
5 Annual and total production assumes a base load of 80%.
6 Annualized Costs are calculated over project life in 2011 dollars.
7 Costs rounded to nearest $100/AF

3.4 Preliminary Schedule

The schedule presented below is based on experience with similar projects (e.g., Santa Cruz and MMWD) and professional judgment. Considerably longer schedules have been experienced by projects in Carlsbad and Huntington Beach.

Two considerations which can have a significant impact on schedule include:

- *Piloting:* Every major project has had a pilot plant study (e.g., Newark, Marin, Santa Cruz, BADRP, Long Beach, Dana Pt, Carlsbad, West Basin) with the exception of Huntington Beach (relied on Carlsbad results) and Sand City (since beach wells were used, the project relied on water quality data from a beach test well, reverse osmosis software projections, and direct measurement of Silt Density Index (SDI) as basis of 0.5 mgd design).

- *Source water assessments:* For setting treatment requirements, CDPH requires 12 month testing for well-extracted water and 24 months for an open water intake source. This can be obviated by simply installing greater levels of pre-treatment. For example Sand City elected this option by installing post-treatment UV disinfection to achieve the maximum required virus, *Cryptosporidium* and *Giardia* log removal credits for an impaired source water. This saved up to 12 months of groundwater under the influence monitoring and the potential for an additional 12 month watershed sanitary survey and 24 months of Long Term 2 Surface Water Treatment Rule monitoring for turbidity and *Cryptosporidium*.

The preliminary project schedule shown in Figure 8 has been developed to incorporate lessons learned from other projects in California and provide a potential duration for each phase of the project. This schedule assumes that piloting is performed and source water assessments are developed. The anticipated schedule will likely change depending on the permitting climate and public perception of the selected project at the time of project inception.

3.5 Other Project Information and Evaluation Criteria

In addition to project yield, cost and schedule there is other project information that will be used in the comparison of water supply management projects. These information needs were identified in the Project Information Survey and Sheets, and were shown in Table 1 in this memo. This section presents this preliminary quantitative and qualitative information and how it is applied to the evaluation criteria that will be used in the future comparison of water supply management projects. The Strategy Revised Draft Task Memo: Refined Evaluation Criteria and Metrics, January 25, 2011 provides more information on the development of the criteria, subcriterion and metrics. Following are brief descriptions of the evaluation criteria and their preliminary quantitative and qualitative values for the Representative Coastal Desalination Project. Table 9 summarizes this information.

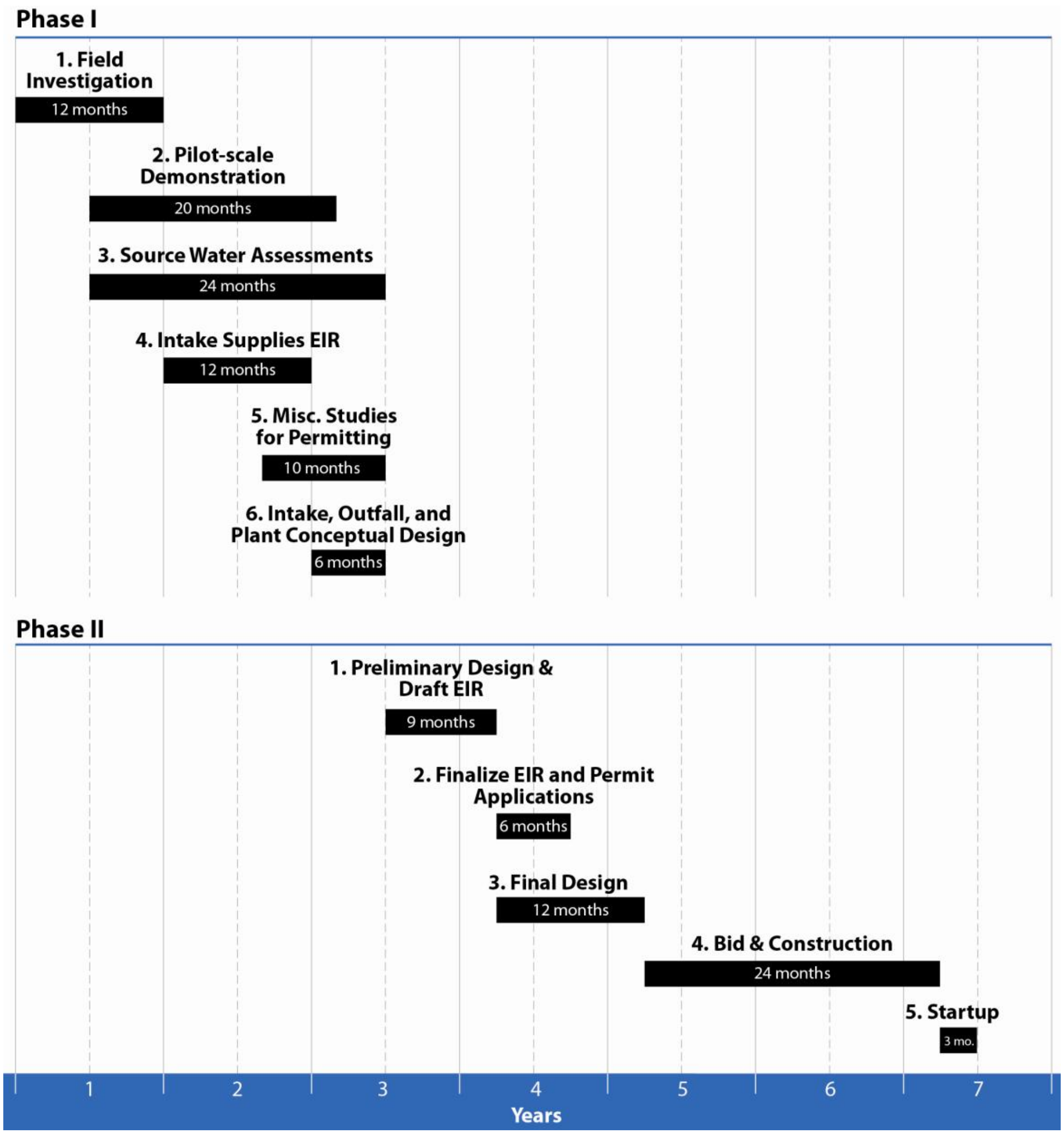

Figure 8 Preliminary Schedule for Representative Coastal Desalination Project

Table 9 Representative Coastal Desalination Project Evaluation Criteria and Metrics			
Objective	**Criteria**	**Metrics**	**Project Values**
1 - Increase Supply Reliability	**Criterion 1A** – Ability to Meet Normal Year Supply Need	Quantitative (AF/year): Average annual yield in normal years in 2018 and 2035.	6,700
	Criterion 1B – Ability to Meet Drought Supply Need	Quantitative (AF/year): Average annual yield with drought hydrology of 1987 – 1992.	6,700
	Criterion 1C – Risk of Facility Outage	Qualitative (1-5): Estimated probability and duration of major conveyance failure.	[1]
	Criterion 1D – Potential for Regulatory Vulnerability	Qualitative (1-5): Potential for regulatory decisions to impact supply reliability.	[1]
2 - Provide High Level of Water Quality	**Criterion 2A** – Meets or Surpasses Drinking Water Quality Standards	Quantitative (mg/L): Total dissolved solids (TDS) level as an indicator of water quality.	<120
	Criterion 2B – Meets or Surpasses Non-Potable Water Quality Standards	Qualitative: Meets minimum water quality requirement (e.g., Title 22) for the targeted use.	N/A
3 - Minimize Cost of New Water Supplies	**Criterion 3** – Capital and Present Worth Costs	Quantitative ($/AF): Present Worth costs including capital and operating costs.	$2,200
4 - Reduce Potable Water Demand	**Criterion 4** – Augment Non-Potable Water Supplies	Quantitative (AF/year): Reduction of potable water demand by use of non-potable supply.	N/A
5 - Minimize Environmental Impacts	**Criterion 5A** –Greenhouse Gas Emissions	Quantitative (metric tons/ AF of Supply): Estimates of unit greenhouse gas emissions.	[1]
	Criterion 5B –Impact to Groundwater Quantity and Quality	Qualitative (1-5): Potential impacts to groundwater levels, groundwater quality, or potential for subsidence	[1]
	Criterion 5C –Impact to Habitat	Qualitative (1-5): Potential impacts to habitat, such as wetlands, riparian zones, fisheries, and inundation areas.	[1]
6 - Increase Implementation Potential	**Criterion 6A** – Institutional Complexity	Qualitative (1-5): Number and type of agencies and agreements involved.	[1]
	Criterion 6B –Level of Local Control	Qualitative (1-5): BAWSCA and Member Agency ownership of supply projects.	[1]
	Criterion 6C –Permitting Requirements	Qualitative (1-5): Permitting or regulatory issues for supply projects.	[1]

[1] These values will be developed as part of the overall analysis and comparison of projects.

3.5.1 Supply Reliability

The *Increase Supply Reliability* criteria has four subcriterion:

- *Criterion 1A – Ability to Meet Normal Year Supply Need* - An estimate of the ability of a water supply management project to meet the normal hydrologic year supply needs of BAWSCA member agencies is measured by the annual yield of the project during normal hydrologic conditions by the 2018 and 2035 planning horizons.
    - *The yield is indicated in Table 9.*

- *Criterion 1B – Ability to Meet Drought Supply Need* - An estimate of the ability of a water supply management project to meet the supply need during a drought is measured by the annual yield of the project during the 1987 – 1992 drought. The criterion of drought reliability captures whether a supply project is resistant to drought impacts.
  - *The yield is indicated in Table 9.*

- *Criterion 1C – Risk of Facility Outage* - Supply vulnerability is measured by the probability and duration of potential outages to a particular water supply management project due to a major conveyance failure. This criterion captures the vulnerability of projects to emergency outages. This metric is a qualitative measure ranging from 1 through 5, with a score of "1" identifying the projects that are least susceptible to emergency outages and a score of "5" indicating high susceptibility to conveyance failures.
  - *These values will be developed as part of the overall analysis and comparison of projects.*

- *Criterion 1D – Potential for Regulatory Vulnerability* - The susceptibility of a water supply management project to interruption as a result of regulatory issues includes legal, political, or environmental constraints. This metric is a qualitative measure ranging from 1 through 5, with a score of "1" identifying the projects that are least susceptible to regulatory risk and a score of "5" indicating high susceptibility to regulatory risk.
  - *These values will be developed as part of the overall analysis and comparison of projects.*

3.5.2 Water Quality

The *Provide High Level of Water Quality* criteria has two subcriterion:

- *Criterion 2A – Meets or Surpasses Drinking Water Quality Standards* – A measure representing potable supply is addressed by the quantitative metric of the aggregate water quality, measured by TDS levels, of the potable supply projects and portfolios. TDS is a surrogate for other water quality parameters representing water quality.
  - *The TDS level will be designed to be similar to the SFPUC RWS Hetch Hetchy and/or local reservoir supply, which is less than 120 mg/L.*

- *Criterion 2B – Meets or Surpasses Non-Potable Water Quality Standards* - For non-potable supply projects, where water quality constraints vary according to use, the value will be a qualitative assessment of whether or not the water supply management projects and portfolios meet the minimum water quality requirement for the targeted use. In most cases, this metric will be used to designate whether a non-potable supply source meets Title 22 requirements, as this is a common target water quality level for a non-potable demand.
  - *This is a potable water project. This criterion does not apply.*

3.5.3 Cost

The *Minimize Cost of New Water Supplies* criteria has one quantitative subcriterion:

- *Criterion 3 – Capital and Present Worth Costs* - The present worth costs, including capital, operations, and maintenance costs, for each water supply management project are estimated. The performance metric is the normalized unit cost presented in $/AF for each project.
  - *The costs are indicated in Table 9.*

3.5.4 Reduce Potable Water Demand

The *Reduce Potable Water Demand* criteria has one criterion:

- *Criterion 4A –Augment non-potable water supplies* is quantitative metric for the annual yield of additional non-potable supply produced and utilized to offset potable demand.
  - *This is a potable water project. This criterion does not apply.*

3.5.5 Environmental Impacts

The *Minimize Environmental Impacts* criteria includes three qualitative subcriterion:

- *Criterion 5A* -The metric for *5A* is represented by the increase in greenhouse gas emissions due to a potential water supply management project. This quantitative metric will be measured in terms of metric tons of carbon dioxide produced, or reduced, per unit of supply based on energy use.
  - *These values will be developed as part of the overall analysis and comparison of projects.*
- *Criterion 5B –Impact to Groundwater Quantity and Quality* - Water supply management projects that do not negatively affect groundwater supplies will be measured favorably in this criterion. A combined qualitative estimate of potential groundwater impacts will be evaluated in terms of potential reductions in groundwater levels, impacts to groundwater quality, and the risk of increase in land subsidence. This metric will be a qualitative measure ranging from 1 through 5, with a score of "1" identifying the projects with the least potential for adversely affecting groundwater quantity and quality and a score of "5" indicating high probability of adverse impacts.
  - *These values will be developed as part of the overall analysis and comparison of projects.*
- *Criterion 5C –Impact to Habitat* - This criterion addresses long-term impacts to the ecosystems, not short-term effects related to temporary construction activities. Water supply management projects that do not adversely affect sensitive habitat areas such as wetlands, riparian zones, potential special-status species habitat, or have significant inundation areas will be measured favorably in this criterion. A combined qualitative estimate of potential habitat impacts is evaluated in terms of potential site acreage, proximity to sensitive habitat zones, and flood potential. This metric is a qualitative measure ranging from 1 through 5, with

a score of "1" identifying the projects with the least potential for adverse impacts to habitat and a score of "5" indicating high probability of adverse effects to terrestrial, aquatic, and riparian species.

- *These values will be developed as part of the overall analysis and comparison of projects.*

3.5.6 Implementation Potential

The *Increase Implementation Potential* criteria has three qualitative subcriterion:

- *Criterion 6A –Institutional Complexity* - This criterion addresses the level of institutional coordination required for implementation of a water supply management project. A qualitative metric will be used to estimate the coordination required if multiple local or regional agencies or agreements are necessary. The projects that are assumed to require less coordination, and to receive less opposition, will score better than those that are more complex or potentially controversial.

  - *Currently the ownership for the facilities has not been determined, as NCCWD has not agreed to sponsor this project. Depending on who owns and operates the facility there will be issues about use of the old Sharp Park WWTP for a desalination plant site and the Pacifica State Beach for the Ranney Collector Wells.*

- *Criterion 6B –Level of Local Control of Water Supply* - Local management of a water supply management project will minimize dependency on imported water supplies and the drought impacts associated with those supplies. A common rating scale will be developed to evaluate the amount of BAWSCA-owned or BAWSCA member-owned supply for each project. Projects that are fully owned by BAWSCA or the member agencies will score higher than supply projects owned fully or partially by other entities that might be affected by regulatory risk, multiple party agreements, and supplies that may have a higher risk of not being available further into the future, or under drought conditions.

  - *These values will be developed as part of the overall analysis and comparison of projects.*

- *Criterion 6C –Permitting Requirements* - This criterion addresses the objective of minimizing the regulatory and environmental permitting obstacles associated with water supply management projects. Projects with other similar metrics (including cost) may have differing permitting requirements, which can affect their overall implementation. The performance metric is a qualitative measure of the permitting requirements of each project or portfolio.

These values will be developed as part of the overall analysis and comparison of projects.

3.6 Key Project Issues

Key issues and risks associated with implementing a desalination facility are discussed in this section. During this planning stage, several of the key issues are not fully known and will require additional analysis. Potential next steps to address some of these uncertainties are summarized in the next section.

Key issues associated with representative coastal desalination project include:

- Source water quality (e.g., salinity, iron, manganese, contaminants) variability;
- Source water yield;
- Land availability, cost and permitting for Ranney Collector Wells located in the Pacifica Beach Area;
- Availability, cost and permitting for the use of the old Sharp Park WWTP site as a desalination plant site;
- Alignment issues and costs for construction of new raw water pipelines along Highway 1, and treated water pipelines along Westborough Boulevard;
- Property availability, cost and permitting for a tank site in Milagra Ridge Park;
- Public support and opposition;
- Permitting for a new outfall for brine discharge off the coast; and
- Funding and ownership of a coastal desalination plant.

The key risks noted during development of this analysis are:

- *Seawater and subsurface options:* Projecting expected yield and assessing impacts on other wells in the aquifer including well yield and water quality (e.g., potential for increased salt water intrusion and subsidence).
- *Subsurface options:* Long-term yield and reliability of Ranney Collector Wells or other subsurface intakes including slant or horizontal wells depending on the site-specific hydrogeology under the ocean and future sediment deposition which may reduce water transport rates from the ocean into the aquifer.
- All options:
    - *Costs and delays to overcome potential permitting hurdles, public opposition, and litigation are risks even though subsurface intakes and co-located brine discharges are expected to reduce this risk. California experience indicates that such delays have been the norm. It is*

unclear whether implementation time for future plants will be reduced (i.e., if State-wide regulatory streamlining for desalination plants occurs).

- *Risks associated with introducing a new treated water source into an existing distribution system, such as water stabilization and corrosion control to minimize impacts to existing scales, maintaining disinfectant stability in the presence of bromide in the desalinated water, aesthetic differences, irrigation use with higher concentrations of boron and chloride, and potential SFPUC requirements to match existing salinity and hardness parameters.*

- *Risk that the cost of power may escalate more quickly than anticipated and increase the operational costs.*

- *Risk that wastewater utilities may not allow a co-located brine discharge with or without additional costs or negotiations.*

3.7 Next Steps

The project developed and presented in this memo is one of several that might be part of the long-term supply opportunities for the BAWSCA member agencies. Prior to more detailed development of project information, these supply projects will be compared based on series of criteria to determine which projects warrant additional investigation and/or evaluation.

If the Representative Coastal Desalination Project is selected to proceed, the possible key next steps include:

- Confirm the expected yield and water quality from the potential seawater subsurface locations. The unknowns could be addressed by performing borings to indentify the boundaries of the most promising geological formations, performing pump tests, updating groundwater models to estimate sustainable yield, and performing a more thorough review of existing or gathering new water quality data.

- Confirm the availability of potential sites at suitable locations for intakes and treatment plant facilities. In addition, more detailed hydraulic analysis will be needed to identify improvements that may be required to convey the treated water supply from the new plant location to the existing distribution system and then to distribute it to customers within the existing system.

Appendix A
Daly City Recycled Water Project – Service Area Expansion: Information Survey and Sheets

Instructions for Completing the Project Information Survey and Sheets

1. Review and complete this Project Information Sheet for the project listed below. The Project Information Sheet includes questions designed to collect additional information on supply projects to facilitate evaluation of these projects within the Strategy framework. The project information below was presented in the Phase I A Scoping Report.

Agency	***Potential Water Supply Management Project Description***	***Potential Project Benefit***			***Comments / Potential Issues***
		Augment Local Supply	***Develop Asset for Regional Benefit***	***Accelerate Schedule***	
Daly City	Increase recycled water use to meet treatment plant capacity of 3,100 AFY	X	X	NA	• Feasibility of potential project has not been evaluated. • Customers, demand, schedule, and cost need to be developed.

2. Please update the project title below:

Project Title: Increase Recycled Water Use

3. The Project Information Sheet includes the following worksheets. Please complete each worksheet to the extent possible. Click on the links below to fill out a worksheet.

Worksheet Name	**Description**
Contact	General Agency Contact Information
General Information	General Project Information
Facilities	Infrastructure - Facilities
Costs	Infrastructure - Costs
Ownership	Infrastructure - Ownership
Supply	Supply Reliability Information
Water Quality	Water Quality Information
Schedule	Project Implementation Schedule Information
Funding	Project Funding Information
Environmental	Potential Environmental Impacts
Implementation	Project Implementation Potential

4. Please contact Anona Dutton at 650-349-3000 if you have any questions regarding the completion of the Project Information Sheets.

Project: Increase Recycled Water Use

General Agency Contact Information

Instructions: Please complete contact information in the shaded cells. This person may be contacted if there are questions regarding any submitted information. Cells will change color after information is entered.

Date:	29-Oct-10
Agency:	City of Daly City
Project Contact Name:	Patrick Sweetland
Project Contact Position:	Director of Water and Wastewater Resources
Email:	psweetland@dalycity.org
Phone:	(650) 991-8201

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Project: Increase Recycled Water Use

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General Project Information

Instructions: Please complete the general project information in the shaded cells. For all responses, use as many lines as needed. Additional sheets/reports can accompany the submittal if necessary. Cells will change color after information is entered.

1) **Project Description and Information Sources:**

Brief project description: (*e.g., Design and construction of 4 new wells to provide a total capacity of 6 mgd for emergency and drought supply*).

Construction of a new tertiary recycled water facility, associated transmission main and storage tank to provide irrigation water t

2) **Is this project an expansion of another project for which you are filling out another Project Information Sheet?**

[ ] Yes [x] No Reference Project Title:

NOTE: If this project is an expansion of another project, fill out the survey with any additional information related to the expansion.

3) **Available information sources for this project:**

[ ] Urban Water Management Plan [ ] Year (The project team has the reviewed the 2005 UWMPs)
[ ] Capital Improvement Program [ ] Year

Other reports, maps, studies, environmental documents, etc.:
1) Project Feasibility Study conducted by Carollo Engineers dated October 2009
2)
3)
Provide copies (electronic or hard copy) of any reports/documents that are not available online. If available online please provide link in the space above.

4) **Is supply from this project included in supply projections as presented in the updated 2010 UWMP documents?**

[ ] Yes [x] No

5) **Indicate the type of project by selecting one of the categories below.**

- [x] Recycled Water for Non-Potable Reuse
- [ ] Recycled Water for Indirect Potable Reuse
- [ ] Groundwater Wells
- [ ] Desalination
  - [ ] Brackish groundwater
  - [ ] Seawater subsurface intake
  - [ ] Seawater open intake
- [ ] Water Transfers
  - [ ] Between Member Agencies
  - [ ] Supply from outside BAWSCA Service Area
- [x] Groundwater Banking
  - [x] Between Member Agencies

    Specify opportunity: moving existing irrigators off to a recycled water supply. Provides potential for increased production yield within the groundwater basin.
- [ ] Local Stormwater/Urban Runoff/Other Water Capture
  - [ ] Rainwater harvesting with storage
  - [ ] Fog capture
  - [ ] Stormwater diversion to non-potable reuse
  - [ ] Stormwater diversion to groundwater recharge
  - [ ] Surface water capture and storage
  - [ ] Other

    Specify type:
- [ ] Graywater
- [ ] Other

  Specify type:

6) a) **What types of demands will be served by the project?**

Check all that apply.
- [x] Potable
- [x] Non-potable
- [ ] Other

Specify type: Free up pumping capacity now used for irrigation by making it available for potable production purposes.

b) Which agency customers will the project serve?

Check all that apply.

- [x] All Agency Customers
- [ ] Residential
- [ ] Commercial
- [ ] Industrial
- [ ] Municipal
- [ ] Dedicated Irrigation
- [ ] Golf/Park
- [x] Other
- [ ] Not yet investigated/Do not know

c) Could other agencies be served by this project?

[x] Yes [ ] No [ ] Not yet investigated/Do not know

If yes, specify agency(ies): SFOUC, California Water Service, City of San Bruno

7) When will the supply be used?

Check all that apply.

- [x] Daily/Normal Use
- [ ] Drought-Only Use

Expected Frequency *(e.g., X years out of every Y years)*:

- [ ] Emergency Use
- [ ] Seasonal Use (*e.g., irrigation*)

8) Will this project be developed by an individual agency or a regional partnership?

Check all that could apply, indicating your preference with a “1”.

- [ ] Individual Agency

Specify agency:

- [x] Regional Partnership

Specify other agencies: BAWSCA, SFPUC, California Water Service, City of San

Indicate agreement type (*e.g. JPA, MOU, etc.*): MOU

Project:	Increase Recycled Water Use

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Infrastructure - Facilities

Instructions: Please identify all project facilities in the shaded cells, to the extent that information is currently available. For each type of facility, use as many lines as needed. Example information is provided. All project elements may not apply to every type of project. If detailed information on all the facilities is not available, please complete "General System Information" at the bottom of this sheet. Cells will change color after information is entered.

Project Element	Description				
Treatment	**Process/Type**		**Capacity (mgd)**	**Location**	**Notes/Comments**
example:	*Disinfection*		*7.2*	*Wells*	
1)	Tertiary Treatment		3.4	153 Lake Merced Blvd.	Expansion of tertiary production by constructing new recycled water facility.
2)					
3)					
4)					
5)					
Conveyance - Pipelines	**Length (feet)**	**Diameter (inches)**	**Capacity (mgd)**	**Location**	**Notes/Comments**
example:	*5000*	*12*	*10*	*Wells to SFPUC Connection at Turnout #1*	
1)	13728	18	3	"Southern Alignment	2.6 mile transmission pipeline to 3 mgd storage tank
2)	11616	3 to 16	TBD	Hillside Distribution Network	
3)	16008	3 to 24	TBD	El Camino Distribution Network	
4)	2610	18	TBD	San Francisco Distribution Network	Lake Merced Hill, Parkmerced, San Francisco State University
5)					
Conveyance - Pump Stations	**Type**	**Size (HP)**	**Capacity (mgd)**	**Location**	**Notes/Comments**
example:	*Booster at wells*	*100*	*7.2*	*Wells*	
1)	Pump Station	TBD	TBD	TBD	Hillside Distribution Pump Station, 1,620 gpm
2)	Pump Station	TBD	TBD	TBD	El Camion Distribution Pump Station, 4,610 gpm
3)	Pump Station	TBD	TBD	TBD	1,120 Irrigation Pump Stations for Lake Merced Hill, Parkmerced and San Francisco State University
4)					
5)					
Storage	**Type**	**Number of Tanks (#)**	**Capacity each Tank (MG)**	**Location**	**Notes/Comments**
example:	*Pumped groundwater*	*4*	*4*	*Wells*	
1)	Tertiary Recycled Water	1	3	El Camino Real at F Street, Colma	
2)	Tertiary Recycled Water	1	0.021	Lake Merced Hill	
3)	Tertiary Recycled Water	1	0.467	Parkmerced	
4)	Tertiary Recycled Water	1	0.234	San Francisco State University	
5)					
Groundwater Wells	**Type**	**Number of Wells (#)**	**Capacity per Well (mgd)**	**Location**	**Notes/Comments**
example:	*Potable*	*16*	*0.45*	*Near corner of Harris and Longley St.*	
1)					
2)					
3)					
4)					
5)					
Disposal	**Type**		**Capacity (mgd)**	**Location**	**Notes/Comments**
example:	*Brine Discharge*		*5*	*Shared outfall*	
1)					
2)					
3)					
4)					
5)					

Other	Type		Capacity (mgd)	Location	Notes/Comments
1)					
2)					
3)					
4)					
5)					

General System Information	Source	Treatment	Capacity (mgd)	Connection	Notes/Comments
example:	*Groundwater*	*Disinfection*	*7.2*	*Main at Harris and Longley St.*	
1)					
2)					

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Project: Increase Recycled Water Use

Infrastructure - Costs

Instructions: Please identify cost information (capital costs, operations & maintenance, etc.) for all projects facilities in the shaded cells, to the extent that information is currently available. Project facilities shown on the left side of the table come from information completed in the "Facilities" worksheet. Example information is provided. Scrolling to the right and downward may be necessary to see all categories in the table. All cost elements may not apply to every type of project. If detailed information on the costs is not available, please complete "General System Information" at the bottom of this sheet. Cells will change color after information is entered.

If costs are currently under development, when are they expected to be available?

Project Element	Description (information entered into "Facilities" sheet)				Cost Information							
Treatment	**Process/Type**		**Capacity (mgd)**	**Location**	**Capital Cost ($)**	**Annual Production (AF)**	**Annual O&M Cost ($)**	**Annual Water Transfer Cost ($)**	**Total Annual Cost ($)**	**Cost per AF ($/AF)**	**Base Year for Cost Est.**	**Notes/Comments**
example:	*Disinfection*		*7.2*	*Wells*	*$1,000,000*	*4,000*	*$800,000*	*$0*	*$800,000*	*$200*	*2009*	
1)	Tertiary Treatment	--	3.4	153 Lake Merced Blvd.	$8,879,000	3,100	TBD		TBD	TBD	2,010	
2)	--	--	--	--								
3)	--	--	--	--								
4)	--	--	--	--								
5)	--	--	--	--								

Project Element												
Conveyance - Pipelines	**Length (feet)**	**Diameter (inches)**	**Capacity (mgd)**	**Location**	**Capital Cost ($)**	**Annual Production (AF)**	**Annual O&M Cost ($)**	**Annual Water Transfer Cost ($)**	**Total Annual Cost ($)**	**Cost per AF ($/AF)**	**Base Year for Cost Est.**	**Notes/Comments**
example:	*5000*	*12*	*10*	*Wells to SFPUC Connection at Turnout #1*	*$7,500,000*	*2,000*	*$0*	*$0*	*$0*	*$0*	*2009*	
1)	13728	18	3	"Southern Alignment	$3,055,000							
2)	11616	3 to 16	TBD	Hillside Distribution Network	$5,604,000							Colma Delivery System estimate includes pipelines and pump stations
3)	16008	3 to 24	TBD	El Camino Distribution Network								See above
4)	2610	18	TBD	San Francisco Distribution Network	$623,000							
5)	--	--	--	--								

Project Element												
Conveyance - Pump Stations	**Type**	**Size (HP)**	**Capacity (mgd)**	**Location**	**Capital Cost ($)**	**Annual Production (AF)**	**Annual O&M Cost ($)**	**Annual Water Transfer Cost ($)**	**Total Annual Cost ($)**	**Cost per AF ($/AF)**	**Base Year for Cost Est.**	**Notes/Comments**
example:	*Booster at wells*	*100*	*7.2*	*Wells*	*$10,000,000*	*4,000*	*$1,000,000*	*$0*	*$1,000,000*	*$250*	*2009*	
1)	Pump Station	TBD	TBD	TBD	$1,229,000							Estimate to account for total project cost scope
2)	Pump Station	TBD	TBD	TBD								
3)	Pump Station	TBD	TBD	TBD								
4)	--	--	--	--								
5)	--	--	--	--								

Project Element												
Storage	**Type**	**Number of Tanks (#)**	**Capacity (MG)**	**Location**	**Capital Cost ($)**	**Annual Production (AF)**	**Annual O&M Cost ($)**	**Annual Water Transfer Cost ($)**	**Total Annual Cost ($)**	**Cost per AF ($/AF)**	**Base Year for Cost Est.**	**Notes/Comments**
example:	*Pumped groundwater*	*4*	*4*	*Wells*	*$8,000,000*	*4,000*	*$50,000*	*$0*		*$13*	*2009*	
1)	Tertiary Recycled Water	1	3	El Camino Real at F Street, Colma	$3,441,000							
2)	Tertiary Recycled Water	1	0.021	Lake Merced Hill	$2,054,000							Includes Lake Merced Hill, Parkmerced and SFSU estimates
3)	Tertiary Recycled Water	1	0.467	Parkmerced								
4)	Tertiary Recycled Water	1	0.234	San Francisco State University								
5)	--	--	--	--								

Groundwater Wells	Type	Number of Wells (#)	Capacity per Well (mgd)	Location	Capital Cost ($)	Annual Production (AF)	Annual O&M Cost ($)	Annual Water Transfer Cost ($)	Total Annual Cost ($)	Cost per AF ($/AF)	Base Year for Cost Est.	Notes/Comments
example:	*Potable*	*16*	*0.45*	*Near corner of Harris and Longley St.*	*$10,000,000*	*4,000*	*$500,000*			*$125*	*2009*	
1)	--	--	--	--								
2)	--	--	--	--								
3)	--	--	--	--								
4)	--	--	--	--								
5)	--	--	--	--								

Disposal	Type		Capacity (mgd)	Location	Capital Cost ($)	Annual Production (AF)	Annual O&M Cost ($)	Annual Water Transfer Cost ($)	Total Annual Cost ($)	Cost per AF ($/AF)	Base Year for Cost Est.	Notes/Comments
example:	*Brine Discharge*	*0*	*5*	*Shared outfall*								
1)	--	--	--	--								
2)	--	--	--	--								
3)	--	--	--	--								
4)	--	--	--	--								
5)	--	--	--	--								

Other	Type		Capacity (mgd)	Location	Capital Cost ($)	Annual Production (AF)	Annual O&M Cost ($)	Annual Water Transfer Cost ($)	Total Annual Cost ($)	Cost per AF ($/AF)	Base Year for Cost Est.	Notes/Comments
1)	--	--	--	--	$23,243,000							Estimating Contingency, OH & P, Midpoint Escalation, Sales Tax and General Conditions
2)	--	--	--	--	$12,032,000							Engineering, Legal, Administrative, Contract Change Order Reserve
3)	--	--	--	--								
4)	--	--	--	--								
5)	--	--	--	--								

General System Information	Source	Treatment	Capacity (mgd)	Connection	Capital Cost ($)	Annual Production (AF)	Annual O&M Cost ($)	Annual Water Transfer Cost ($)	Total Annual Cost ($)	Cost per AF ($/AF)	Base Year for Cost Est.	Notes/Comments
example:	*Groundwater*	*Disinfection*	*7.2*	*Main at Harris and Longley St.*	*$2,800,000*	*4,000*	*$2,350,000*			*$588*	*2009*	
1)	0	0	0	0	$60,160,000							
2)	0	0	0	0								

Project: **Increase Recycled Water Use**

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Infrastructure - Ownership

Instructions: Please identify facility ownership information for all projects facilities in the shaded cells, to the extent that information is currently available. Project facilities shown on the left side of the table come from information completed in the "Facilities" worksheet. Example information is provided. Scrolling to the right and downward may be necessary to see all categories in the table. All ownership questions may not apply to every type of project. If detailed information on the facility ownership is not available, please complete "General System Information" at the bottom of this sheet. Cells will change color after information is entered.

Project Element	Description (information entered into "Facilities" sheet)				Ownership								Facility Reliability	
Treatment	**Process/Type**		**Capacity (mgd)**	**Location**	**Existing Facility? (Y/N)**	**Rehabilitation of Existing Facility? (Y/N)**	**Age of Facility (Years)**	**Expansion of Existing Facility? (Y/N)**	**New Facility? (Y/N)**	**SFPUC owned Facility? (Y/N)**	**Other owner/Don't Know**	**Notes/Comments**	**Are Facilities located near existing faults? (Y/N)**	**Location**
example:	*Disinfection*	*0*	*7.2*	*Wells*	*N*				*Y*				*Y*	*San Andreas Fault at SFPUC Turnout #1*
1)	Tertiary Treatment	--	3.4	153 Lake Merced Blvd.	N									
2)	--	--	--	--										
3)	--	--	--	--										
4)	--	--	--	--										
5)	--	--	--	--										
Conveyance - Pipelines	**Length (feet)**	**Diameter (inches)**	**Capacity (mgd)**	**Location**	**Existing Facility? (Y/N)**	**Rehabilitation of Existing Facility? (Y/N)**	**Age of Facility (Years)**	**Expansion of Existing Facility? (Y/N)**	**New Facility? (Y/N)**	**SFPUC owned Facility? (Y/N)**	**Other owner/Don't Know**	**Notes/Comments**	**Are Facilities located near existing faults? (Y/N)**	**Location**
example:	*5000*	*12*	*10*	*Wells to SFPUC Connection at Turnout #1*	*N*				*Y*				*Y*	*San Andreas Fault at SFPUC Turnout #1*
1)	13728	18	3	"Southern Alignment	N									
2)	11616	3 to 16	TBD	Hillside Distribution Network	N									
3)	16008	3 to 24	TBD	El Camino Distribution Network	N									
4)	2610	18	TBD	San Francisco Distribution Network	N									
5)	--	--	--	--										
Conveyance - Pump Stations	**Type**	**Size (HP)**	**Capacity (mgd)**	**Location**	**Existing Facility? (Y/N)**	**Rehabilitation of Existing Facility? (Y/N)**	**Age of Facility (Years)**	**Expansion of Existing Facility? (Y/N)**	**New Facility? (Y/N)**	**SFPUC owned Facility? (Y/N)**	**Other owner/Don't Know**	**Notes/Comments**	**Are Facilities located near existing faults? (Y/N)**	**Location**
example:	*Booster at wells*	*100*	*7.2*	*Wells*	*N*				*Y*				*Y*	*San Andreas Fault at SFPUC Turnout #1*
1)	Pump Station	TBD	TBD	TBD	N									
2)	Pump Station	TBD	TBD	TBD	N									
3)	Pump Station	TBD	TBD	TBD	N									
4)	--	--	--	--										
5)	--	--	--	--										
Storage	**Type**	**Number of Tanks (#)**	**Capacity (MG)**	**Location**	**Existing Facility? (Y/N)**	**Rehabilitation of Existing Facility? (Y/N)**	**Age of Facility (Years)**	**Expansion of Existing Facility? (Y/N)**	**New Facility? (Y/N)**	**SFPUC owned Facility? (Y/N)**	**Other owner/Don't Know**	**Notes/Comments**	**Are Facilities located near existing faults? (Y/N)**	**Location**
example:	*Pumped groundwater*	*4*	*4*	*Wells*	*N*				*Y*				*Y*	*San Andreas Fault at SFPUC Turnout #1*
1)	Tertiary Recycled Water	1	3	El Camino Real at F Street, Colma	N									
2)	Tertiary Recycled Water	1	0.021	Lake Merced Hill	N									
3)	Tertiary Recycled Water	1	0.467	Parkmerced	N									
4)	Tertiary Recycled Water	1	0.234	San Francisco State University	N									
5)	--	--	--	--										
Groundwater Wells	**Type**	**Number of Wells (#)**	**Capacity per Well (mgd)**	**Location**	**Existing Facility? (Y/N)**	**Rehabilitation of Existing Facility? (Y/N)**	**Age of Facility (Years)**	**Expansion of Existing Facility? (Y/N)**	**New Facility? (Y/N)**	**SFPUC owned Facility? (Y/N)**	**Other owner/Don't Know**	**Notes/Comments**	**Are Facilities located near existing faults? (Y/N)**	**Location**
example:	*Potable*	*16*	*0.45*	*Near corner of Harris and Longley St.*	*Y*		*2*						*Y*	*San Andreas Fault at SFPUC Turnout #1*
1)	--	--	--	--										
2)	--	--	--	--										
3)	--	--	--	--										
4)	--	--	--	--										
5)	--	--	--	--										

Disposal	Type		Capacity (mgd)	Location	Existing Facility? (Y/N)	Rehabilitation of Existing Facility? (Y/N)	Age of Facility (Years)	Expansion of Existing Facility? (Y/N)	New Facility? (Y/N)	SFPUC owned Facility? (Y/N)	Other owner/Don't Know	Notes/Comments	Are Facilities located near existing faults? (Y/N)	Location
example:	*Brine Discharge*	*0*	*5*	*Shared outfall*									*Y*	*San Andreas Fault at SFPUC Turnout #1*
1)	--	--	--	--										
2)	--	--	--	--										
3)	--	--	--	--										
4)	--	--	--	--										
5)	--	--	--	--										

Other	Type		Capacity (mgd)	Location	Existing Facility? (Y/N)	Rehabilitation of Existing Facility? (Y/N)	Age of Facility (Years)	Expansion of Existing Facility? (Y/N)	New Facility? (Y/N)	SFPUC owned Facility? (Y/N)	Other owner/Don't Know	Notes/Comments	Are Facilities located near existing faults? (Y/N)	Location
1)	--	--	--	--										
2)	--	--	--	--										
3)	--	--	--	--										
4)	--	--	--	--										
5)	--	--	--	--										

General System Information	Source	Treatment	Capacity (mgd)	Connection	Existing Facility? (Y/N)	Rehabilitation of Existing Facility? (Y/N)	Age of Facility (Years)	Expansion of Existing Facility? (Y/N)	New Facility? (Y/N)	SFPUC owned Facility? (Y/N)	Other owner/Don't Know	Notes/Comments
example:	*Groundwater*	*Disinfection*	*7.2*	*Main at Harris and Longley St.*								
1)	0	0	0	0								
2)	0	0	0	0								

Project: Increase Recycled Water Use

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Supply Reliability Information

Instructions: Please complete supply reliability information in the shaded cells. For all responses, use as many lines as needed or attach additional sheets. Cells will change color after information is entered.

1) Normal year yield in acre-feet per year: 3100

2) Define how the yield above is calculated (i.e., pumping capacity, aquifer sustainable yield, etc.) and list sources of information.

Calculated amount from Feasibility Study

3) Is the project yield dependent on hydrology/weather?

[ ] Yes [x] No [ ] Not yet investigated/Do not know

If yes, what is the drought or dry year yield in acre-feet per year?

(e.g., dry year yield = 2,000 AFY)

(e.g., critical dry year yield = 1,000 AFY)

(e.g., design drought yield = 0 AFY)

4) Peak capacity in million gallons per day:

5) Provide data source(s) for the yield/capacity estimates provided in question #3 and #4.

1) Carollo Engineers Feasibility Report, October 2009
2)
3)

6) Could the project water supply be subject to regulatory restrictions that affect project feasibility, cost, or schedule?

[ ] Yes [x] No [ ] Not yet investigated/Do not know

If yes, list restrictions:

1)
2)
3)

Project: Increase Recycled Water Use

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Water Quality Information

Instructions: Please complete water quality information in the shaded cells. For all responses, use as many lines as needed or attach additional sheets. Cells will change color after information is entered.

1) For projects designed to meet potable water demands, what is the expected total dissolved solids (TDS) concentration of product water in milligrams per liter (mg/L)?

___ mg/L TDS

2) For projects designed to meet non-potable water demands, to what level will the finished water be treated?

Check all that apply.

- [ ] Disinfection only
- [ ] Secondary treatment
- [ ] Secondary treatment with disinfection
- [x] Tertiary treatment
- [ ] Membrane bioreactor
- [ ] Membrane bioreactor/reverse osmosis
- [ ] Denitrification
- [ ] Other Please specify type:

3) Are there any limitations on application or use of this water due to water quality concerns (*e.g., TDS for irrigation, etc.*)?

- [ ] Yes
- [ ] No
- [x] Not yet investigated/Do not know

If yes, explain:

Project: Increase Recycled Water Use

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Project Implementation Schedule Information

Instructions: Please complete implementation schedule information in the shaded cells. For all responses, use as many lines as needed or attach additional sheets. Cells will change color after information is entered.

1) Current Project Status:

Indicate the current status of the project based on the definitions provided below.

- [ ] Existing project under development
- [ ] Planned project identified by a BAWSCA member agency
- [x] Potential future new project not specifically identified or specifically studied by a BAWSCA member agency to date

2) If available, what is the projected schedule for project implementation?

Project Step	Estimated Duration	Estimated Completion Year
Planning		
Demonstration project/pilot study		
Design		
Environmental documentation/permitting		
Construction		
Startup		

3) Is the project expected to be completed/expanded in phases?

[x] Yes [ ] No

4) If there are project phases, what is the yield for each phase and expected implementation year?

[x] Not yet investigated/Do not know

Phase I
Yield in Acre-feet per year: ____ Capacity in mgd: ____ Implementation Year: ____

Phase II
Yield in Acre-feet per year: ____ Capacity in mgd: ____ Implementation Year: ____

Phase III
Yield in Acre-feet per year: ____ Capacity in mgd: ____ Implementation Year: ____

If applicable, list additional phases:

5) Does the potential for expansion exist beyond the above identified phases?

[ ] Yes [ ] No [x] Not yet investigated/Do not know

If yes, identify the ultimate yield in acre-feet per year: ____
and capacity in mgd: ____

Is a separate survey being filled out for this expansion?

[ ] Yes [x] No If yes, what is the Project Title for the Expansion? ____

6) Provide data source(s) for yield estimates provided in #4 and #5.

1)
2)
3)

Project: Increase Recycled Water Use

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Project Funding Information

Instructions: Please complete project funding information in the shaded cells. For all responses, use as many lines as needed or attach additional sheets. Cells will change color after information is entered.

1) What is the source(s)/potential source(s) of funding for the project?
(*e.g., your agency, developers, user fees, member agency bonds, state grants/loans, federal grants/loans, etc.*)

	Potential Funding Source	When will these funding sources be available?
example:	*IRWMP Grant*	*Fall 2011*
1)		
2)		
3)		
4)		
5)		

2) If funding has not been identified, what would be needed for that to occur?
(*e.g., more/outside funding, additional users, lifted environmental restrictions, etc.*)

Determination of interest by existing groundwater users to convert their current beneficial use irrigation supply to tertiary recycled water.

3) Is there potential for cost-sharing with other agencies?

x Yes ___ No ___ Not yet investigated/Do not know

If yes, what agencies could potentially contribute to project costs?

If determined there is a regional benefit, BAWSCA, is solely individual benefit, Daly City, San Bruno and California Water Service Company, if drought supply reliability or regional benefit, SFPUC

4) Is the project potentially eligible for State grants?

___ Yes ___ No x Not yet investigated/Do not know

If yes, have you applied and for what grants?

5) Is the project potentially eligible for Federal grants?

___ Yes ___ No x Not yet investigated/Do not know

If yes, have you applied and for what grants?

Project: Increase Recycled Water Use

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Potential Environmental Impacts

Instructions: Please complete potential environmental impacts information in the shaded cells. For all responses, use as many lines as needed or attach additional sheets. Cells will change color after information is entered.

1) What are the expected treatment and pumping energy requirements in kilowatts per year?
(*This will be used as surrogate for greenhouse gas emissions.*)
TBD kilowatts per year

2) For new groundwater well projects, what groundwater basin(s) will be pumped from or otherwise affected?

3) Will there be artificial replenishment for water recovered from the groundwater basin(s)?
[ ] Yes [X] No [ ] Not yet investigated/Do not know

4) Have there been any reports/studies regarding the safe yield of the groundwater basin(s)?
[X] Yes [ ] No [ ] Not yet investigated/Do not know

Provide data source(s) for the safe yield estimate.
1) Fio and Yates Groundwater Model 2009, currently under revision.
2)
3)

5) Will this project provide environmental benefits?
[ ] Yes [ ] No [x] Not yet investigated/Do not know

If yes, explain:

6) Will this project cause adverse impacts to habitat areas?
[ ] Yes [ ] No [x] Not yet investigated/Do not know

If yes, explain:

If answered yes to questions **#5 or #6**, are there any studies/reports that provide an environmental evaluation?
[ ] Yes [x] No

If answered yes to questions **#5 or #6**, provide data source(s) for the environmental evaluation.
1)
2)
3)

7) Are you aware of any other new projects proposing to extract water from the basin(s)?
[x] Yes [ ] No [ ] Not yet investigated/Do not know

If yes, provide the project name and agency proposing the project:
Daly City Well Replacement, Emergency Well Rehabilitation, SFPUC Groundwater Storage and Recovery Project

8) Will projects listed in #7 provide environmental benefits?
[ ] Yes [ ] No [x] Not yet investigated/Do not know

If yes, explain:

9) Will projects listed in #7 cause adverse impacts to habitat areas?
[ ] Yes [ ] No [x] Not yet investigated/Do not know

If yes, explain:

If answered yes to questions **#8 or #9**, are there any studies/reports that provide an environmental evaluation?

[ ] Yes [x] No

If answered yes to questions **#8 or #9**, provide data source(s) for the environmental evaluation.

1) ______

2) ______

3) ______

10) Have other significant environmental impacts been identified?

(*e.g., increased flood potential, decrease water quality, increased discharges to surface water bodies, etc.*)

Project: Increase Recycled Water Use

Return to Instruction Sheet

Project Implementation Potential

Instructions: Please complete project implementation potential in the shaded cells. For all responses, use as many lines as needed or attach additional sheets. Cells will change color after information is entered.

1) Does the project involve coordination with other agencies or entities (not related to permitting)?

[x] Yes [ ] No [ ] Not yet investigated/Do not know

If yes, list agencies and any previously identified coordination-related issue(s) (*e.g., funding, conveyance, identifying customers, etc.*)

Without assigning coordination among agenciesthere are a number

2) What are the permitting/regulatory requirements for the project? Check all that apply.

- [ ] NEPA – sponsoring federal agency
- [x] CEQA – lead agency (water provider)
- [x] Clean Water Act (Wetland Permit), Rivers and Harbor Act – US Army Corps of Engineers
- [x] Drinking Water Standards and Regulations – California Department of Public Health
- [ ] Water Rights Permits, Clean Water Act (Water Quality Certification), NPDES Permits – State Water Resources Control Board
- [x] Recycled Water Regulations – California Department of Public Health, Regional Water Quality Control Board, State Water Resources Control Board
- [ ] Lake or Streambed Alteration – California Department of Fish and Game
- [ ] Endangered Species – US Fish and Wildlife Service, National Marine Fisheries Service
- [ ] Cultural Resources – State Historic Preservation Office
- [ ] Development Permits – cities, counties

3) List any groundwater permits required:

N/A for this project

Appendix B
Representative Coastal Desalination Project

This appendix presents the potential facility options for a representative coastal desalination project, the general basis of cost assumptions for this type of project, and the capital and present worth cost for this specific project.

In this Appendix:

B.1 Initially Identified Projects

The Representative Coastal Desalination Project was originally identified for the Strategy by the North Coast County Water District (NCCWD) as a Desalination Plant with a designation of NC-4. After discussions by BAWSCA staff with NCCWD representatives it was determined that NCCWD was not interested in being a proponent for a coastal desalination project at this time. As this is the only potential coastal desalination site currently included in the Strategy, the generic Representative Coastal Desalination Project replaces NCCWD NC-4 and has been included as a new project.

Prior to the identification of NCCWD NC-4 an earlier study assessing the potential for a desalination project had been prepared for NCCWD. The Feasibility Study[1] was presented to the North Coast County Water District on February 6, 1996. This project included evaluation of:

- Open seawater intake – capacity of 3.3 million gallons per day (mgd);
- Two alternative sites for desalination plant – treated water production of 1.5 mgd;
  - Sharp Park Wastewater Treatment Plant (WWTP), or
  - North Quarry WWTP (Currently known as Calera Creek Recycling Plant).
- Brine disposal – 1.8 mgd;
  - Outfall at Pacifica Municipal Pier, or
  - Blending with North Quarry WWTP recycled water to discharge to wetlands.

[1] Boyle Engineering Corporation, Final Desalination Feasibility Study for the North Coast County Water District, February 6, 1996.

- Delivery of treated water to the NCCWD distribution system.

Based on available information, no further action was taken on that project.

In meetings with NCCWD staff in November 2010 and April 2011, an alternative conceptual alternative (NC-4) was discussed which included:

- Sand bed intake wells for brackish water east of the seawall at Sharp Park;
- Desalination plant located at the NCCWD offices (2400 Francisco Blvd., Pacifica, CA);
- Brine disposal through a rehabilitated deep water outfall extending out from Pacifica Municipal Pier;
- Treated water pumped to a new 20 million gallon (MG) reservoir at Milagra Ridge Park; and
- Treated water conveyed to SFPUC wholesale customers through connection to the SFPUC Regional Water System (RWS).

No planning beyond the initial identification and sizing of facilities had been performed. NCCWD suggested this project might have a treated water capacity from 10 to 15 mgd, though that would be dependent on the capacity of the intake supply and site limitations at the potential desalination plant site.

B.2 Local Hydrogeology

Most of the coastline within NCCWD is rocky, and does not fall within the boundary of aquifers identified and studied by the California Department of Water Resources (DWR). However, a preliminary study was conducted in 1993[2] to investigate the potential yield for subsurface ocean water wells in the area of Sharp Park. This study concluded that "suitable geologic conditions do not exist for the development of the required seawater supply" with yields of less than 100 gallons per minute (gpm) for a subsurface intake (less than 0.15 mgd).

The 1993 study also suggested that along the Pacifica State Beach, subsurface yields may be higher; though no known hydrogeologic investigations have been performed. The Beach overlies part of the San Pedro Valley Groundwater Basin (DWR Basin 2-36). The basin is small, totaling only 700 acres. It is bounded on the west by the Pacific Ocean, and north, east and south by Castle Hill, Whiting Ridge and San Pedro Mountain, respectively. While there is very limited data, the basin contains alluvial deposits containing sands, silts, and clays with some gravel (DWR, 2004). Potential groundwater yields and water balance information is not available. The potential for alluvial deposits of the San Pedro Valley Basin to supply sufficient yield to support a desalination plant is unknown, and

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[2] Ranney Method Western Corporation, Report on Hydrogeological Survey Sharp Park Test Site for the North Coast County Water District, April 30, 1993.

would require further investigation if this project were to move forward. Figure B-1 indicates the location of Pacifica State Beach.

B.3 Intake Options

Intake options for ocean water sources are typically divided into two options: 1) subsurface; and 2) open water intakes.

B.3.1 Subsurface Intakes

Subsurface intake options may include wells drilled near or under the ocean floor, infiltration galleries, or similar types of subsoil collection strategies such as vertical wells radial. However, based on the limited hydrogeologic information available it is unlikely that the hydrogeology will support vertical wells. The subsurface options being evaluated for this project focus on vertical wells radial. Depending on the proximity to the coast the water supply for the subsurface intake options could range from seawater to brackish water depening on the mix of seawater and fresh water mixing at the intake. For the vertical radial the primary source will be seawater, and no blending with freshwater is assumed for this project.

- *Vertical wells Radial ("Ranney") collector wells* (see Figure B-2) – Consists of well laterals and well-screens installed horizontally under the ocean floor from a vertical caisson near the coast. The laterals are typically limited to less than 300 feet in length using conventional drilling methods. These wells can provide more water than vertical wells, but have not been selected for large facilities yet in California due to site-specific geology limitations.

  The key considerations for subsurface well intakes are identifying locations with the following attributes:

  - A permeable brackish water aquifer or permeable alluvial material hydraulically connected to the ocean;
  - Sufficient horizontal area to permit multiple wells for larger facilities; and
  - Depth of sand to protect intake screens from erosion and damage.

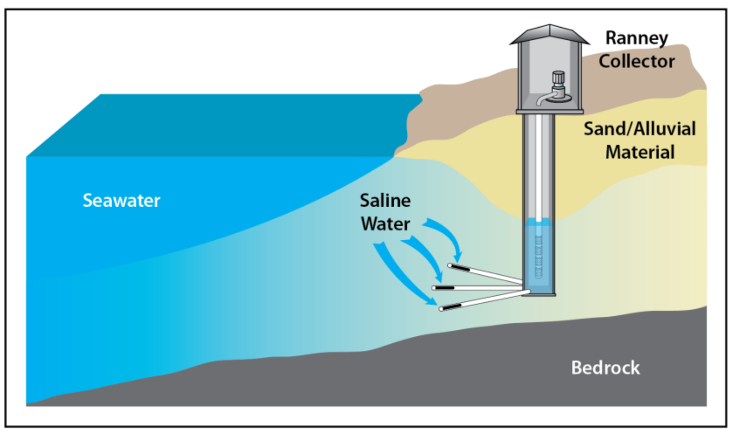
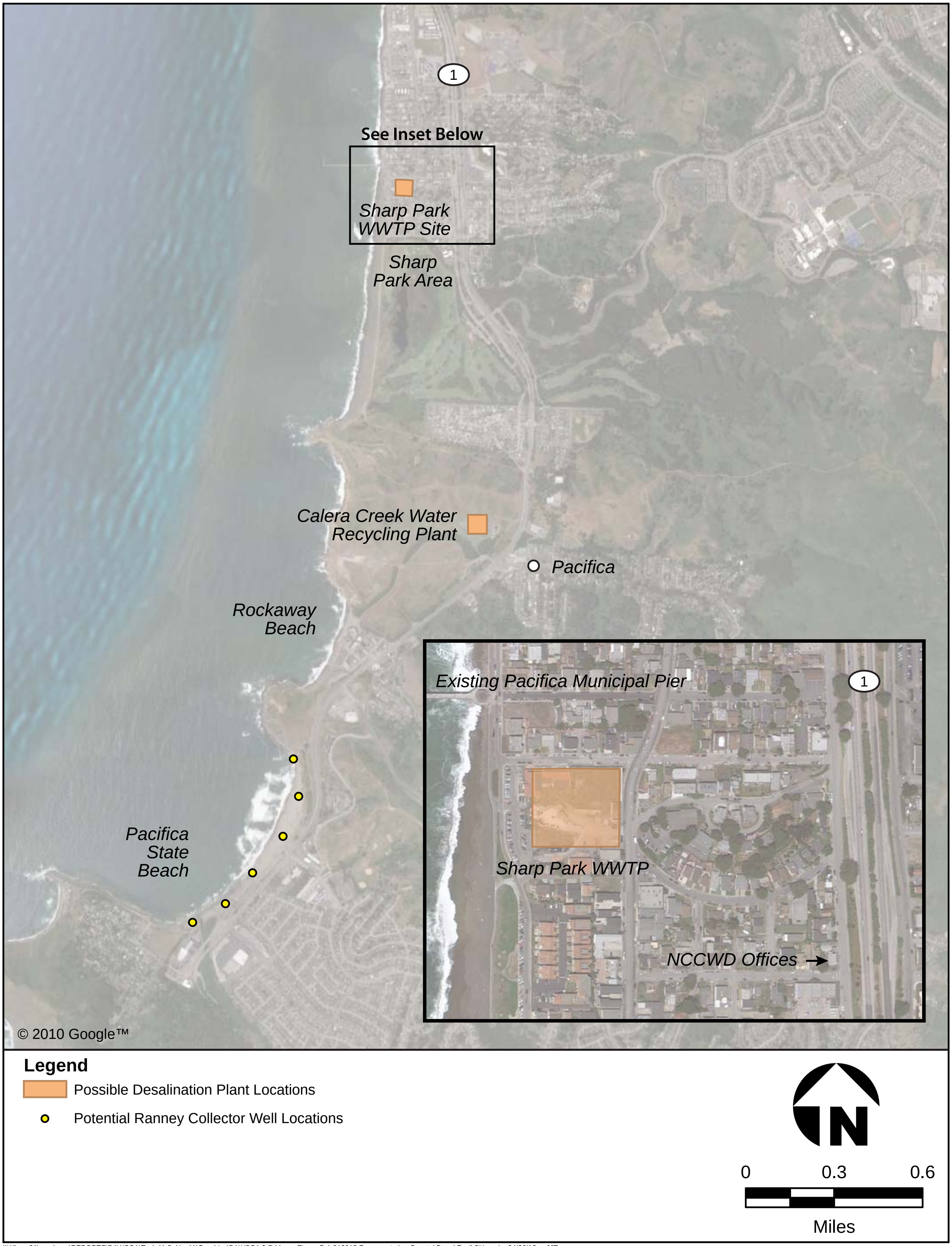


Figure B-2 "Ranney Collector Well" Type Installation



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CDM

Figure B-1

Representative Coastal Desalination Project - Potential Facility Locations

B.3.2 Open Water Intake Options

Open water intakes are typically used for desalination facilities greater than 5 mgd and in locations where subsurface options are not feasible due to cost and/or local geology. Conventional screens such as bar screens, traveling screens, and drum screens with large slot widths and high input velocities are not expected to be permitted here because low velocity and fine screen open water intakes are preferred by permitting agencies to limit impingement of marine life to the surface of the screen and entrainment of marine life through the screen and into the intake pipeline and pumps.

The low velocity intake options currently being considered for proposed seawater reverse osmosis (SWRO) desalination facilities in California are as follows:

- *Velocity cap structures* (see Figure B-3) – Structures designed to reduce the velocity of the incoming water to less than 0.5 foot per second (fps). Most structures provide coarse screening to reduce entrainment of debris which may damage the intake pumps. These are considered more viable in "low biologically productive" areas (equivalent to undersea deserts). Recently, multiple large capacity (>50 mgd) velocity cap intakes have been constructed for seawater desalination facilities in Australia and Europe.

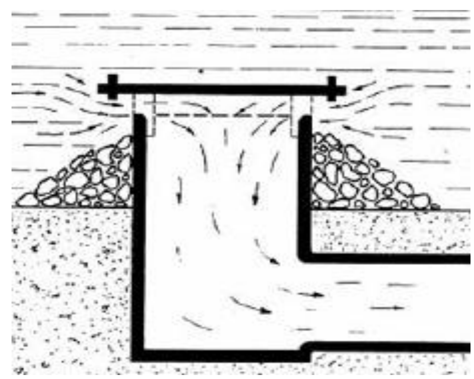

Figure B-3 Velocity Cap Illustration

- *Passive screen intake structures* (see Figure B-4) – These structures are considered the preferred open water intake technology in California. This is because passive screens are expected to have the least impact on marine life. Passive screens use a combination of fine screening and low water velocities (<0.5 fps) to minimize impingement and entrainment. The Coastal Commission has recommended 1 and 2 millimeter screens which are currently being piloted for the proposed facilities in Santa Cruz and El Segundo, California. The Department of Fish and Game has recommended 3/32-inch screens for the proposed Bay water facility in Marin County. The reliability of passive screens is a concern in locations which require frequent cleaning. Passive screens are designed to use both local currents and air sparging to clean the screens; however, divers are occasionally required to perform more thorough cleanings. Copper-nickel alloys or super-duplex stainless steels with special coatings are typically used to minimize corrosion and biological growth on the screen surface.

Figure B-4 Passive Screen Illustration and a Picture of a Large-Diameter Passive Wedgewire Screen (Courtesy of Johnson Screens)

Before an open water intake will be permitted, hydrogeologic investigations are typically required to determine the feasibility of a subsurface intake. If a subsurface option is not feasible, it is likely that a passive screen intake structure will be preferred by permitting agencies unless a location can be found suitable for a velocity cap type intake.

A 316(b) type impingement and entrainment study will also be required to assess the impact on marine life by different open water intake options. The Environmental Protection Agency (EPA) 316(b) regulation assumes that any organism entrained into the intake pipeline will not survive. Smaller screen slot sizes reduce entrainment, but also increase cleaning frequency and reliability concerns.

It is also anticipated that development of coastal wetlands or other types of habitat restoration will likely be required to offset the estimated entrainment of an open water intake.

B.4 Desalination Treatment

The components for a potential desalination facility can be divided into the following eight categories: (1) the intake and raw water supply system; (2) the pre-treatment system; (3) the reverse osmosis (RO) desalination and energy recovery system; (4) the post-treatment and stabilization system; (5) treated water disinfection, storage, and high service pump station; (6) solids handling system; (7) brine disposal system; and (8) ancillary facilities. Figure B-5 presents a schematic of the treatment process for a seawater desalination facility assuming an open water intake and a robust pre-treatment system.

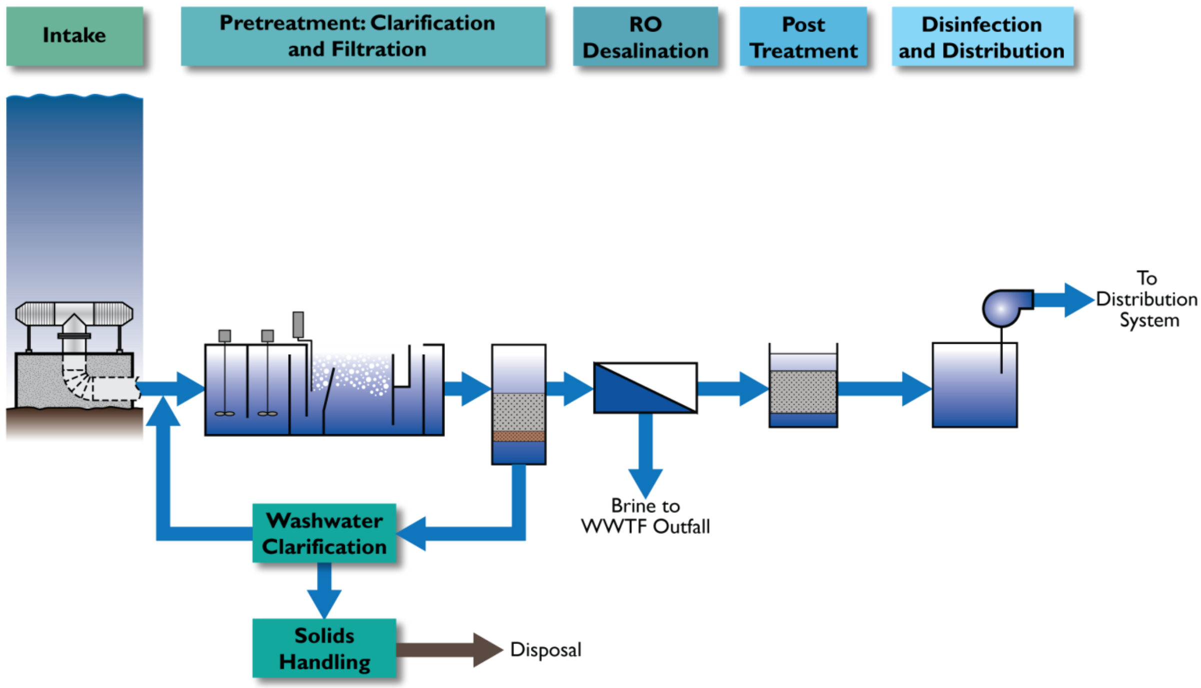

Figure B-5 Open Water Intake RO Desalination Plant Process Schematic

The selection and complexity of the process components vary for different sources of supply and site-specific considerations such as source water quality and intake type.

B.4.1 Pre-treatment

Pre-treatment is required to protect the RO membranes used for desalination and to limit downtime due to maintenance and cleaning of the desalination system. The level of pre-treatment required is determined by source water quality and California Department of Public Health (DPH) requirements are based on source water monitoring results. Below is a discussion of pre-treatment for well sources (which apply to the subsurface intakes) and for open water intake sources.

Pre-treatment for Well Sources

Well water sources typically require only the addition of chemicals (e.g., antiscalant) and cartridge filtration to maximize the useful life of the RO membranes in the desalination system. However, additional pre-treatment may be required if iron or manganese is present or if the test wells are determined to be "under the influence of surface water" according to DPH guidelines during pump tests.

If iron or manganese is present, additional pre-treatment such as chlorination, filtration, and dechlorination may be required to protect against particulate iron or manganese which can clog and physically damage the RO membrane surface. If the wells are determined to be "under the influence of surface water", a Watershed Sanitary Survey (WSS), Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR) monitoring, and potentially pilot-scale testing may be required to determine the amount of filtration and disinfection to comply with DPH pathogen removal requirements. Alternatively, monitoring and pilot-scale testing can be bypassed if the maximum pathogen removal/inactivation requirements are achieved within the treatment process. This approach is typically more cost-effective for small facilities, and was used to “fast-track” the permitting process for the beach well source desalination facility (less than one mgd) in Sand City, California, which began operation in 2009.

Pre-treatment for Open Water Intake Sources
Most seawater desalination facilities with open water intakes require a robust and reliable pre-treatment system (e.g., coagulation, flocculation, clarification, filtration, 5-micron cartridge filters and multiple chemicals) especially during storm and algal bloom events (e.g., red tides). One year of pilot-scale testing, a one-year WSS, and two years of LT2ESWTR monitoring are typically required by DPH to determine the pre-treatment and pathogen removal requirements for facilities with new open water intakes.

B.4.2 RO System Options

RO membranes and process configurations for brackish water and ocean water facilities are discussed below.

RO Membranes
Brackish water desalination facilities typically utilize brackish water reverse osmosis (BWRO) membranes which are designed to achieve desired water quality with minimal energy use at pressures less than 300 psi.

Ocean water facilities would utilize SWRO membranes to achieve desired water quality with minimal energy use at pressures that exceed 300 psi. If the salinity of the source water varies significantly, a combination of BWRO and SWRO elements may be used to achieve the lowest energy use over a range of source water quality conditions.

RO Process Configurations
BWRO systems operate at higher production efficiencies than ocean water RO systems due to the lower salinity of the source water and the RO membrane fouling potential of the source water. The efficiency of an RO system is commonly known as RO system recovery rate.

Brackish water desalination facilities typically utilize a single-pass, two-stage configuration to maximize water production from a facility (e.g., 70 to 85 percent of source water is converted to drinking water; the remaining flow is discharged as high-saline brine). A third stage is required to exceed 85 percent recovery; however, fouling concerns typically limit recovery to 80 percent or less for brackish water sources.

Ocean water facilities typically utilize a single-pass, single-stage configuration and achieve recoveries of 40 to 60 percent depending on source water salinity. A second pass RO system may be required for the desalinated water to match chloride bromide, and boron concentrations in existing sources. Bromide is of particular concern because it impacts the stability of chloramine formation at the facility and the stability of the residual in the distribution system. Boron and chloride are of concern because these salts may impact plant health/growth at concentrations exceeding those in typical surface water sources. A second pass RO system uses additional RO membranes to re-treat a portion of the water produced by the first RO pass to further reduce salts (e.g., bromide) in the final product water. In some cases, a second stage or RO membranes may also be desired to increase total recovery during periods of lower source water salinity.

This analysis assumes: 1) that a second pass will not be required for brackish subsurface intake sources; and 2) that a 33 percent partial second pass may be required for ocean water sources to match SFPUC water quality in terms of sodium, chloride, bromide, and boron. Even if the SFPUC does not require that these goals be met, a partial second pass may be required to reduce bromide to limit the impacts on chloramine residual concentration in the distribution system. Partial second pass systems are typically a minor cost item compared to overall facility cost.

The Representative Ocean Desalination Project though using subsurface intake is still treating seawater and is assumed to have a 40% recovery rate and that a second pass is required.

B.5 Brine Discharge Options

Disposal of brine from the desalination process usually incorporates one of the following options:

- Subsurface discharge;
- New open water discharge; and
- Co-location with existing open water discharges (Existing Outfall).

B.5.1 Subsurface Discharge

A subsurface discharge entails discharging the brine via wells or an infiltration gallery similar to the subsurface intake options. This approach is often used at small facilities located near beaches or other locations with suitable geology to discharge the brine at a location (e.g., surf zone) with sufficient dilution and mixing to quickly disperse the high salinity brine. Beach wells are used at the existing facility in Sand City, California. A surf zone infiltration gallery is currently being pilot tested for the proposed facility in Long Beach, California.

However, based on the uncertainties of the hydrologic conditions in the Sharp Park area this alternative for brine disposal has not been included as an alternative.

B.5.2 New Open Water Discharge

A new open water discharge includes the construction of a new outfall pipeline or structure with diffusers to efficiently disperse the brine into the receiving water. This approach typically requires the following:

1) The salinity of the discharge stream is less than the salinity of the receiving water. For example, the proposed facility in Carlsbad, California has been permitted to discharge the brine if the salinity of the combined discharge stream is less than the salinity of the receiving water. This permit condition required additional source water to dilute the brine stream to the salinity of the receiving water, which in turn significantly increased the mitigation efforts required to offset the estimated impacts on marine life associated with the source water (i.e., impingement and entrainment of the intake to draw in the source water).

2) The outfall discharge nozzles and ambient currents or wave energy will provide sufficient dilution and mixing to quickly disperse the brine. Water quality modeling and calculations were required to demonstrate that the discharge would achieve the RWQCB dilution and toxicity requirements for a new NPDES permit.

Other examples include the new brine outfall pipelines in Europe and Australia, which required dilution and current studies to design the discharge nozzles to avoid the creation of anoxic zones. Anoxic zones form when the dense brine sinks to the ocean floor without sufficient dilution and mixing. This approach is being considered for the proposed facilities in San Diego County, California.

B.5.3 Discharge Co-located with Existing Open Water Discharges

This approach typically entails discharging the brine via an existing power plant or WWTP outfall and is being considered for the proposed facilities in Santa Cruz and Orange County. For the proposed discharge in Santa Cruz, the RWQCB determined that the combined discharge will be beneficial and that a new permit would not be necessary. Thus, this approach may simplify the discharge permitting requirements depending on site specific conditions.

It is important to note that wastewater facilities may not want to allow another entity to discharge via their existing outfall. However, as conservation and recycling become more common, it is anticipated that the brine may become a beneficial “dilution water” to assist the wastewater utilities in achieving current and future discharge regulations including endocrine disrupting compounds and other emerging contaminants.

When the Sharp Park WWTP was operational the outfall from this plant extended out along the Pacifica Municipal Pier and then to a discharge point farther off shore. The pipeline connections have been disconnected at the pier and it is assumed that a new outfall would be required for brine disposal.

Additional information on permitting requirements and locations are included in the Permitting Overview and Potential Location sections that follow.

B.6 Permitting Overview

The permitting agencies that guide the planning process for new desalination facilities include the Bay Conservation and Development Commission (BCDC), California Coastal Commission (CCC), California Department of Fish and Game (DFG), Department of Public Health (DPH), and Regional Water Quality Control Board (RWQCB). Key concerns of these agencies are discussed below.

The shoreline along the City of Pacifica is not within the Monterey Bay National Marine Sanctuary (Sanctuary). However, the Sanctuary is located about 1 to 2 miles offshore, and the additional environmental requirments associated with being within the Sanctuary will need to be evaluated relative to the location of an offshore brine outfall.

B.6.1 BCDC, DFG and CCC

BCDC is primarily concerned with the following items (DFG concerns include the first four items):

- Impingement and entrainment associated with a new open water intake;
- Water quality characteristics and potential impacts of the brine discharge (particularly in regards to salinity, dissolved oxygen, particulates, and potential contaminants);
- Co-location with existing facilities (e.g., outfalls or wastewater outfalls) that may prolong the use of facilities that is harmful to public health and/or marine life in the vicinity;
- Increased energy use and greenhouse emissions; and
- Environmental justice issues regarding storage of chemicals and other public health issues if the facility is located in an area other than the area benefited by the facility.

BCDC and DFG recommend that intakes be located in relatively deep, “low biologically productive” areas to limit potential impacts to plankton, fish eggs, larvae, shellfish beds, and other organisms that may be impacted by construction and operation of the intake.

DFG is aware of the precedent set by the CCC for new desalination plants along the California coast. CCC has publicly communicated the overall planning approach which will simplify coastal development permitting process.

The approach preferred by the CCC is summarized in Table B-1 and is contrasted with the alternative approaches which are not preferred.

Table B-1
Key Considerations for California Coastal Commission Permitting

"Easier" Review	"More Difficult" Review
Away from shoreline	On or next to shoreline
Subsurface intake	Open water intake
Publicly owned facility	Privately owned facility
Defined service area with known level of build out	Unknown or extensive service area
Part of local/regional plan where significant part of water portfolio is conservation, recycling, etc.	Not part of a local/regional plan; in an area without effective conservation

B.6.2 DPH

DPH requires that up to one year of monitoring be performed to determine if well sources are "under the influence of surface water" and up to two years of LT2ESWTR monitoring for surface water sources.

If an aquifer is determined to be under the influence of surface water or if an open water intake is proposed, then a WSS, pilot-scale testing, and two years of LT2ESWTR monitoring may be required to determine treatment and disinfection requirements.

B.6.3 RWQCB

RWQCB requires that new discharges to the ocean meet the requirements of National Pollution Discharge Elimination System (NPDES) permits including typical pH, toxicity, and dissolved oxygen requirements. The primary concern with brine discharges include salinity and dissolved oxygen. If the discharge salinity is higher than that of the receiving water, then the high salinity plume may be considered toxic to some organisms before it is sufficiently diluted. Furthermore, the density of water increases with salinity, so that if the outfall nozzles and local currents do not provide sufficient dilution and mixing energy, the brine will begin to sink and create a plume of high salinity and low dissolved oxygen on the ocean floor.

Therefore, the RWQCB typically requires that a dilution study be performed to characterize the typical and worst-case discharge scenarios and document that existing or new outfall structures will provide sufficient dilution and mixing within a specified distance from the discharge nozzles.

Limits for dissolved oxygen and salinity typically guide this analysis, as follows:

- Receiving water salinity and a specific dilution ratio requirement must be achieved within a specified distance from the outfall nozzles (this distance is known as the zone of initial dilution and is site specific);
- Dissolved oxygen shall not be less than 5 mg/L from the influence of the discharge;
- The median dissolved oxygen concentration for any three consecutive months shall not be less than 80 percent of the dissolved oxygen content at saturation; and

- When natural factors cause concentrations of less than 5 mg/L, the discharge shall not cause further reduction in ambient dissolved oxygen concentrations.

B.6.4 Additional Permitting Requirements

Permitting requirements for desalination facilities include the typical permits required for new drinking water facilities (e.g., construction, domestic water supply, easement/encroachment, etc.). In addition, there are additional requirements associated with facilities that require coastal access and/or that may impact coastal resources.

Table B-2 lists the typical permitting agencies which require permits for new coastal desalination facilities in California. However, more may be required depending on the exact location. For example, the recently permitted facility in Carlsbad, California required permits from 24 separate agencies due to additional requirements associated with the co-location of their intake and outfall with an existing power plant.

Table B-2
Typical Permits Required for New Desalination Facilities in California

Federal	**Agencies/Parties**
Section 10 and 404	Army Corps of Engineers & Environmental Protection Agency (EPA)
Section 7	Fish and Wildlife Service & EPA
Easement/Encroachment permits	Multiple agencies depending on the site
Consultation to determine applicable requirements	National Oceanic and Atmospheric Administration and the Coast Guard
State Historic Preservation Office, Memorandum of Understanding if federally funded	EPA & other agencies depending on historic or archaeological significance
National Environmental Policy Act Compliance	EPA & other agencies depending on the site
State	**Agencies/Parties**
Coastal Development Permit	BCDC
California Endangered Species Act Section 2081 Permit & Streambed Alteration Agreement Equivalent	DFG
Easement/Encroachment permits	Numerous agencies, including State Lands Commission, State Parks, Department of Transportation, port authorities, and others depending on the site
Domestic Water Supply Permit	DPH
Water Rights Permit	State Water Resources Control Board
Application for Certification Amendment	California Energy Commission
NPDES Permit, 401 Certification, & Brine Discharge Requirements	RWQCB
Permit to Construct/Operate	Air Quality Management District
Certification of Public Convenience and Necessity (if private retailer)	State of California Public Utilities Commissin (PUC)
Local	**Agencies/Parties**
Coastal development, construction, hazardous chemical storage, and conditional use permits	County/City
Use/right of way/Lease approvals	Public and Private parties
Water contracts	Partner agencies/other

B.7 Potential Facility Siting and Capacity

The project initially identified by NCCWD in November 2010 and April 2011 was suggested to provide from 10 to 15 mgd of treated water supply. This supply was to be conveyed to adjacent BAWSCA member agencies (i.e., San Bruno, Cal Water or Daly City) or to the SFPUC RWS.

The treated water capacity that may be developed from a desalination project is a function of several factors, including:

- Intake capacity;
- Treatment requirements and source water considerations;
- Available siting areas for a desalination plant;
- Brine disposal capacity; and
- Treated water customers and transmission facilities.

This section presents the assumptions used for the locating key facilities and potential treated water capacity.

B.7.1 Intake Capacity

Based on the 1993 Study the hydrology for the originally proposed locations for Ranney Collector Wells near Sharp Park will not produce more than about 100 gpm, or less than 0.15 mgd.

An alternative site located along Pacifica State Beach was suggested in the 1993 study (Figure B-1). Ranney Collector Wells typically have lengths of 100 to 200 feet with a maximum length up to 300 feet and capacities ranging from 0.5 to 2 mgd. Larger fresh water intake capacities of up to 20 mgd have been installed along rivers. However, this type of capacity would be expected only under ideal hydrogeologic conditions.

Based on the potentially available beach area along Pacifica State Beach it is assumed that Ranney Collector Wells would be need to spaced 300 feet apart. For each of the collectors 3 laterals of approximately 300 foot length would be installed. Each collector would have an assumed capacity of 3 mgd. Based on the length of the beach area up to 6 Collectors are assumed to be installed. With the six collectors a maximum raw water capacity of 18 mgd has been assumed for this intake location. Figure B-1 indicates these locations.

B.7.2 Treatment Requirements and Source Water Considerations

Due to the close proximity of the Ranney Collector Wells to the ocean it has been assumed that the source water will be seawater (saline) rather than a blend of seawater and brackish or fresh groundwater. The type source water and collection system significantly affect the treatment requirements, as described in Section B.4.

Open water intakes require significantly more pre-treatment (primarily coagulation, flocculation, clarification and filtration) to protect the membranes, especially during storm and algal bloom events than subsurface intakes. The subsurface intakes use the overlying sand and gravel layers as filters to remove most of the material requiring pre-treatment for an open intake. The proposed Ranney Collector Wells are subsurface intakes.

Treating seawater versus brackish water also requires larger facilities as the efficiency of the membranes decreases as the salinity increases. A full seawater treatment facility may only recover 40 percent of the raw water coming into the plant, while a brackish plant may recover up to 75 percent. For example a 10 mgd seawater supply would produce 4 mgd or treated water, while a plant treating 10 mgd of brackish water would produce about 7.5 mgd of treated water supply.

An ocean intake, including pre-treatment, membrane desalination, and post-treatment requires about 1 acre of land for every mgd of treated water produced from seawater. Treatment of subsurface source water decreases the land requirement and can provide treated water capacity of 2 to 4 mgd on the same acre of land.

B.7.3 Available Siting Areas for Desalination Plant

The initial discussions with NCCWD staff indicated three possible locations for a desalination treatment plant, including:

- Existing NCCWD offices (2400 Francisco Blvd., Pacifica, CA);
- Calera Creek Water Recycling Plant; and
- Sharp Park Wastewater Treatment Plant (WWTP).

Figure B-1 indicates the locations for the WWTP and the Calera Creek Water Recycling Plant.

After further discussions with NCCWD it was determined that the current office location would not be available as a treatment plant site. NCCWD is currently reviewing the possibility of selling this site, and it is also relatively small. This site was eliminated as a possible desalination plant site.

The 4 mgd Calera Creek Water Recycling Plant was completed in 2000 replacing the old Sharp Park WWTP. This facility treats wastewater to a high level using batch reactors (aeration and clarification), filtration, and ultraviolet disinfection prior to discharge to Calera Creek. This new supply provides ongoing restoration to the habitat and species originally native to the area around the creek. The treatment plant site may be large enough to include a desalination facility. However, seawater would have to be pumped to the site, and the brine transported back to the ocean. As the wetlands area and the alignment from the water recycling plant to Rockaway Beach is protected, it is anticipated that it would be very difficult to obtain permission to build additional facilities on the site, and construct two new pipelines through the area. No further exploration of the feasibility of this site was performed.

The Sharp Park WWTP located near Pacifica Municipal Pier has been abandoned for several years. The City of Pacifica may be looking to sell and/or develop the site. This site has an area of approximately 2.5 acres. Treating seawater with an open intake at this site is limited to about 2.5 mgd of treated water, while a subsurface intake could provide up to 7.5 mgd (assuming 3 mgd per acre) of treated water. Assuming a subsurface intake and 40 percent recovery the raw water source capacity would need to be about 18 mgd.

With Ranney Collector Wells at the Pacifica Beach and potential raw water capacity of 18 mgd, the combination of this source with full use of the old Sharp Park WWTP site could produce around 7.5 mgd of treated water supply. Those two are assumed to provide the supply and treatment locations for the Representative Coastal Desalination Project.

B.7.4 Brine Disposal Capacity

Brine disposal onshore or through deep wells is most likely not feasible in this area. The brine disposal is assumed to be through a new offshore pipeline from the old Sharp Park WWTP to approximately one mile offshore. This is typical to other proposed offshore brine disposal projects. The existing wastewater outfall is assumed to be in too poor of condition to be cost effectively rehabilitated.

B.7.5 Treated Water Customers and Transmission Facilities

The average annual water demand for NCCWD is about 3 mgd and is projected by NCCWD to only increase slightly by 2035. BAWSCA member agencies that are adjacent to NCCWD include:

- City of Daly City;
- Westborough Water District; and
- City of San Bruno.

The 2015 projected demand for these three agencies plus NCCWD is about 17 mgd, increasing to 20 mgd by 2035. Potential customers for the 7.5 mgd could include a combination of some of these agencies, or the supply could be conveyed to the SFPUC RWS for conveyance through that system or as an ISG transfer.

In order to deliver the treated water supply to any of the above agencies, outside of NCCWD, transmission facilities would need to be constructed to convey this water over the hills to east. The most direct route would be along Sharp Park Road to Milagra Ridge, and continuing along Westborough Boulevard.

A 10 million gallon reservoir is included for operational storage off of Sharp Park Road at Milagra Ridge. A pumping plant would be required at the desalination plant to boost the treated water to Milagra Ridge, and then with gravity flow to the east.

Figure B-6 indicates the locations for the intake, and desalination plant, raw water, treated water, and brine pipelines as well as the proposed tank on Milagra Ridge. Figure B-6 also includes the continuation of the treated water pipeline along Westborough Road to a possible connection to the SFPUC RWS near the Baden Pump Station.

B.8 Planning Level Costs

This section presents the following planning level cost information for the potential desalination facilities described in Section B.7.

In addition to the capital costs (construction costs plus adjustments) and operation and maintenance costs (O&M) two different approaches are included for comparing alternative projects. These include the development of present worth analysis (or life-cycle costs) and annual costs. The present worth analysis includes the conversion of all cash flows to a common point in time, August 2011. As such, it requires the consideration of the time value of money and all future cash flows discounted back to the present. The present worth analysis converts all annual O&M costs (i.e., chemicals, power, labor, RO membrane replacement, etc.) to a present worth value and adds this to the present worth of the capital cost. To compute a unit cost of water this sum of the present worth of capital and O&M costs is divided by the total amount of water produced over the expected life of the project. For the purposes of this analysis a period of 30 years is used for the comparison of all projects.

An annual cost comparison estimates the yearly cost of owning and operating an asset, and is also expressed in present dollars. The annual cost analysis computes the annual debt service on the capital (i.e., one year of payments of interest and principal required on the bond or loan used for financing the project) and adds it to one year's worth of O&M costs. To compute the unit cost of water this sum can be divided by the total amount of water produced by the project in one year.

Both of these methods provide the same ranking of alternatives, but they result in different unit costs for water. Neither method calculates the actual unit cost of water as this requires a more detailed analysis that is tailored to the specific conditions of how the project is financed and how this financing is paid back through water rates. The simplified approach for both methods (and often the more conservative) is to assume that the annual escalation rate for expendables is the same as the discount rate (i.e., bond or loan rate).

For the purposes of our future analysis and comparison of water supply alternatives we have included both the present worth and annual cost analysis for the projects.

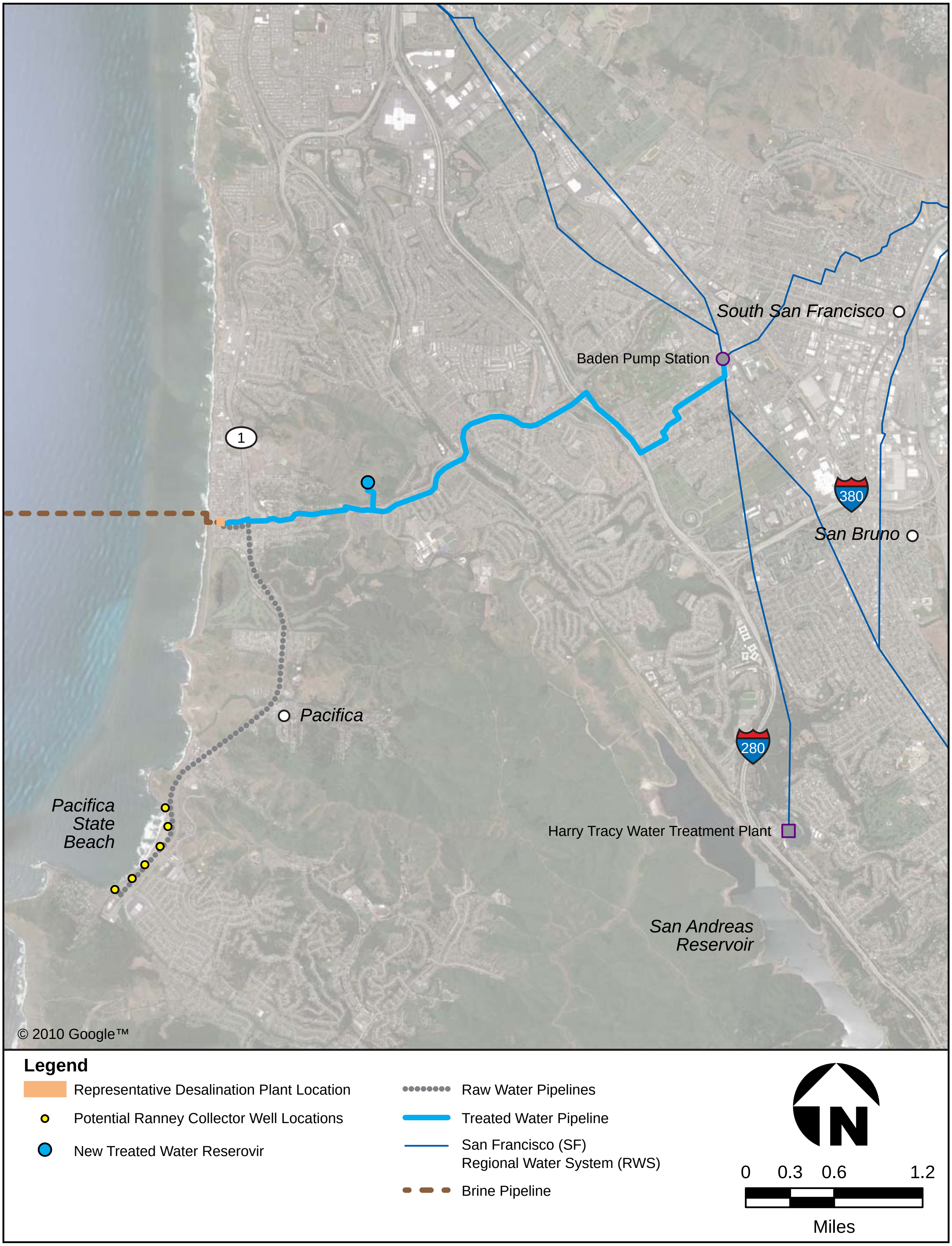

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Figure B-6

Representative Coastal Desalination Project - Facilities

The cost information developed includes:

- Construction Costs ($M);
- Capital Costs ($M);
- Annual O&M Costs ($M);
- Present Worth Costs ($M);
- Estimated Annual Production ($M);
- Unit Cost of Total Present Worth ($M/AF); and
- Unit Annualized Costs ($/AF).

B.8.1 Unit Construction Cost Curves

Desalination Treatment Construction Costs

Unit construction cost curves were developed for brackish water, Bay water, and seawater RO desalination facilities based on recent other desalination projects. These cost information was developed based on existing and proposed facilities in the US and Australia, which have similar permitting requirements to the US. Projects from the Bahamas and Oman were added to provide additional costs for beach well facilities. US costs were escalated using the San Francisco ENR factor to August 2011 dollars; international projects were escalated at 5 percent annually from project bid cost numbers published in the Global Water Intelligence World Desalination Report. Table B-3 summarizes the information that was used in developing the cost curves, and Figure B-7 presents these construction cost data points and cost curves for the projects indicated in Table B-3.

Table B-3
Desalination Plant Construction Cost Data Table

	Capacity (mgd)	Plant Construction Cost As Bid	Bid Date	ENR Factor (if available)	ENR Reference City	Escalation Factor	Costs Escalated to August 2011	
							Plant Construction Cost ($M)	Unit Construction Cost ($M/mgd)
Brackish Well BWRO								
Alameda County Water District (ACWD) NDF1, Freemont, CA	5.0	$13,000,000	2002	7722	San Francisco	1.32	$17	$3.4
ACWD NDF2, Freemont, CA	10.0	$20,000,000	2009	9725	San Francisco	1.05	$21	$2.1
EL Paso, TX	28.0	$30,000,000	2005	7298	General	1.40	$42	$1.5
Deerfield Beach, FL	13.0	$13,900,000	2006	6538	General	1.56	$22	$1.7
Clewiston	3.0	$13,295,000	2005	7647	General	1.33	$18	$5.9
Lake Region WTP	10.0	$19,727,000	2005	7479	General	1.36	$27	$2.7

Table B-3
Desalination Plant Construction Cost Data Table

	Capacity (mgd)	Plant Construction Cost As Bid	Bid Date	ENR Factor (if available)	ENR Reference City	Escalation Factor	Costs Escalated to August 2011	
							Plant Construction Cost ($M)	Unit Construction Cost ($M/mgd)
Slant Well SWRO								
Municipal Water District of Orange County, CA	15.0	$136,000,000	2007	8873	Los Angeles	1.15	$156	$10.4
Monterey County, CA	7.5	$58,000,000	2003	7789	San Francisco	1.31	$76	$10.1
Monterey County, CA	10.0	$72,000,000	2003	7789	San Francisco	1.31	$94	$9.4
Bay/Brackish River Open Intake BWRO/SWRO								
Taunton, Massachusetts (open River intake under influence of seawater)	5.0	$65,000,000	2008	9071	General	1.12	$73	$14.6
BARDP at East Contra Costa Site, CA	25.0	$113,000,000	2007	9063	San Francisco	1.12	$127	$5.1
BARDP at East Contra Costa Site, CA	65.0	$234,000,000	2007	9063	San Francisco	1.12	$263	$4.0
Beach Well SWRO								
Sand City	0.6	$5,700,000	2008	9134	San Francisco	1.12	$6	$10.6
Blue Hills, Bahamas	7.2	$29,500,000	2006		3% Escalation	1.16	$34	$4.8
Sur, Oman	21.2	$65,000,000	2007		3% Escalation	1.13	$73	$3.5
Open Water SWRO								
Gold Coast, Australia	35.1	$285,000,000	2007		3% Escalation	1.13	$321	$9.1
Carlsbad, California (estimate)	50.0	$335,000,000	2007	8871	Los Angeles	1.15	$385	$7.7
Huntington Beach, CA (estimate)	50.0	$520,000,000	2008	8871	Los Angeles	1.15	$597	$11.9
Marin County, CA, (estimate)	10.0	$94,627,003	2007	9101	San Francisco	1.12	$106	$10.6
Marin County, CA, (estimate)	5.0	$62,715,451	2007	9101	San Francisco	1.12	$70	$14.0
Perth, Australia	38.0	$326,000,000	2006		3% Escalation	1.16	$378	$9.9
Coquina Coast, FL (estimate)	25.0	$188,052,000	2010	9088	General	1.12	$211	$8.4
Tianjin, China	39.6	$108,000,000	2007		3% Escalation	1.13	$122	$3.1
Palmachim, Israel (update)	22.0	$127,300,000	2008		3% Escalation	1.09	$139	$6.3
Hadera, Israel (update)	87.2	$238,000,000	2008		3% Escalation	1.09	$260	$3.0
Point Lisas, Trinidad	31.4	$130,000,000	2002		3% Escalation	1.30	$170	$5.4

Table B-3
Desalination Plant Construction Cost Data Table

	Capacity (mgd)	Plant Construction Cost As Bid	Bid Date	ENR Factor (if available)	ENR Reference City	Escalation Factor	Costs Escalated to August 2011	
							Plant Construction Cost ($M)	Unit Construction Cost ($M/mgd)
Carboneras, Spain	31.7	$95,000,000	2002		3% Escalation	1.30	$124	$3.9
Tampa Bay, Florida (rehab)	25.1	$158,000,000	2006		3% Escalation	1.16	$183	$7.3
Port Everglades (estimate)	35.0	$181,700,000	2006		3% Escalation	1.16	$211	$6.0
Tuas, Singapore	36.0	$120,000,000	2003		3% Escalation	1.27	$152	$4.2
Ashkelon, Israel	86.2	$212,000,000	2001		3% Escalation	1.34	$285	$3.3

The cost information used for Figure B-7 includes reported construction bid amounts and engineer's estimates from feasibility or preliminary design reports, and in general do not include costs for offsite pipeline installation, soft costs (permitting, legal fees, other studies), environmental mitigation, land purchase, obtaining right of ways/easements, or utility staff time.

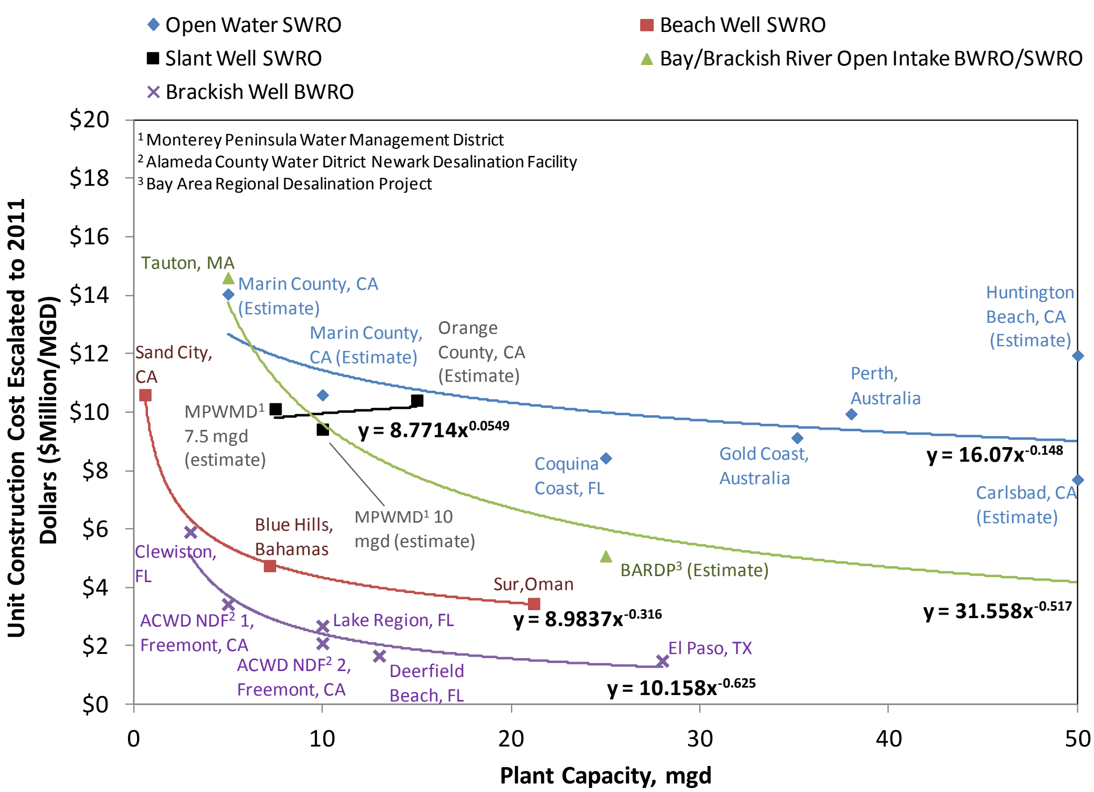

Figure B-7 Desalination Plant Unit Construction Costs and Curves – Historical Data

The estimates included in the curves assume base-load operations, a significant amount of redundancy, and other assumptions that may add capital costs to a facility that is only required as a supplemental source of supply. There are a number of planning and design phase decisions that will affect capital costs. Some of these decisions include the procurement approach (e.g., design-build), treated water quality goals (e.g., chloride, boron, and bromide), and conditions suitable to allow a shutdown of the facility (e.g., equipment redundancy). Figure B-8 indicates the treatment construction costs for the different source waters by capacity, and reflects the data presented in Figure B-7. All costs are adjusted to August 2011.

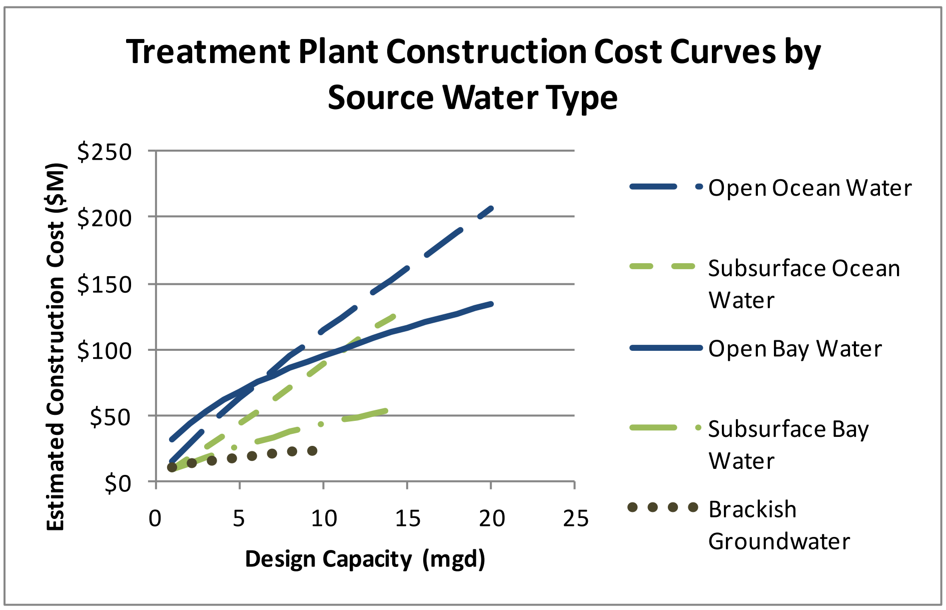

Figure B-8 Desalination Treatment Construction Cost Curves

Intake Construction Costs

Table B-4 indicates the information and assumtions used in developing construction cost estimates for the different types of intakes for the desalination projects. Figure B-9 presents the construction costs used for costing the intake facilities. All costs are adjusted to August 2011.

Table B-4 Basis of Construction Costs for Intake Structures		
Intake Type	**Source**	**Formula**
Brackish Groundwater	Assumes values from September meeting with Ranney/Layne	Brackish vertical well field (assumes up to 1500 gpm wells at $1.0M per well)
Ranney Collector Ocean Subsurface	Assumes values from September meeting with Ranney/Layne	Ranney Collector well subsurface intake (assumes 300 ft laterals and 2500 gpm wells at $1.5M per well)
Slant well subsurface	Assumes values from August meeting with Geoscience	Slant well subsurface intake (assumes up to 2000 gpm at 700 ft)
Horizontally Directionally Drilled Well (HDDW) - Subsurface Baywater	Assumes values from August meeting with Geoscience	HDDW - subsurface intake (assumes up to 2000 gpm wells up to 3000 feet in length)
Open Ocean or Open Bay Intake	Assumes equation using cost curve for Santa Cruz, Marin, and SF Bay Regional projects	Regression Curve

Figure B-9 presents the construction costs curves used for costing the intake facilities. All costs are adjusted to August 2011.

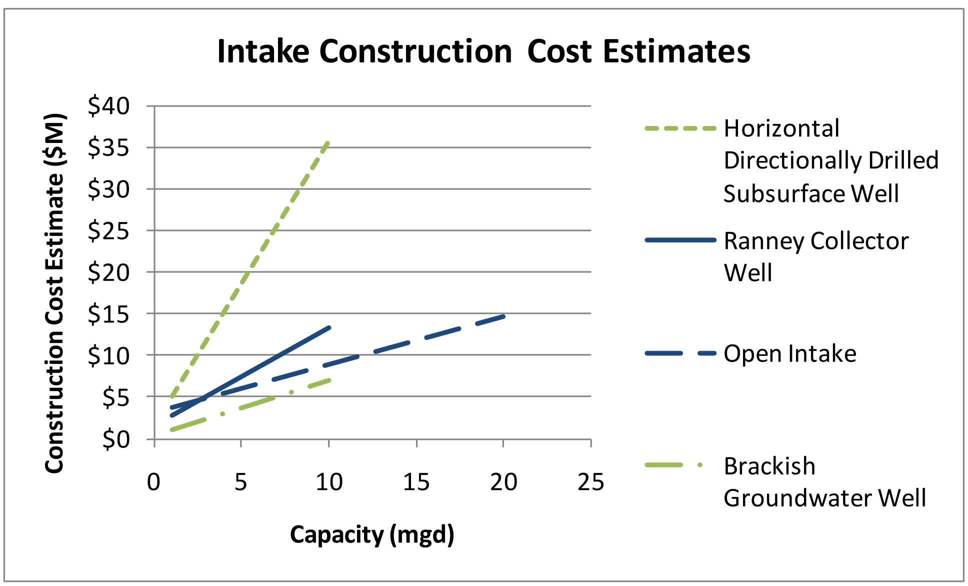

Figure B-9 Intake Construction Cost Curves

Pipeline and Treated Water Storage Construction Cost Assumptions

Pipeline construction costs were estimated by assuming a length of pipe and a diameter based on a maximum design velocity of less than 6 feet per second (fps). The length and diameter estimates were then multiplied by the unit cost assumptions included in Table B-5 to develop a cost for the pipeline. Storage costs were estimated by assuming a total volume of storage and multiplying this by the unit cost assumption included in Table B-5 and the pump station costs are based on the calculated horsepower for each of the pump stations, including raw water, brine, and treated water facilities. The unit cost assumptions for the pipelines, pump stations and reservoir storage are based on review of projects constructed within the Bay Area over the last ten years. All unit costs were adjusted to August 2011.

Table B-5
Pipeline and Storage Construction Cost Assumptions

Description	Unit Cost Assumption
Pipelines installed in an urban area	$15/in-ft
Pipelines requiring Jack & Bore	$29/in-ft
Offshore Pipelines	$20/in-ft
Pump Stations[1]	$2,400/HP
Steel above ground treated water storage tank	$800,000 per MG

[1] It is assumed that the intake and treatment plant construction cost curves include construction costs for a pump station worth a nominal power of 50 HP. Costs are included for any HP requirements above 50 HP.

B.8.2 Capital Costs

Capital costs were developed for the proposed facilities based on the construction costs presented in Section B.8.1 adjusted for:

- Contractor markup: including overhead, profit and prorates -15 percent;
- Engineering feasibility studies, preliminary and final design, services during construction and construction management – 25 percent;
- "Soft costs" including legal fees, permitting, and other miscellaneous costs – 15 percent; and
- Contingency – 40 percent.

The 15 percent allowance for "soft costs" is a higher percentage than typically included in planning level cost estimates; however, a higher than typical estimate is appropriate given the costs incurred for permitting other desalination facilities in California. For example, the costs incurred for permitting the facility in Carlsbad have been greater than 6 percent (over $20 million) of the estimated construction cost (approximately $300 million) information provided by Poseidon Resources.

Some key costs are not included in these capital costs, including:

- Land purchase cost for Ranney Collector Well site, desalination plant site and reservoir site;

- Purchase of easements or rights-of-way;
- Wheeling or "Transfer" costs for conveyance of water through other agencies facilities; and
- Purchase price of water if required.

Table B-6 presents the construction and capital cost estimates for the facilities for the Representative Coastal Desalination Project with a treated water capacity of 7.5 mgd.

Table B-6
Representative Coastal Desalination Project Capital Cost Estimate

Item	Capacity (mgd)	Pumping Power (HP)	Diameter (in.)	Length (ft.)	Capital Cost ($ M)
Source Water: *Ocean*					
Recovery: *40%*					
Treated Water Capacity: *7.5 mgd*					
Construction Cost Items					
Intake Structure	18.8	-	-	-	$ 10.6
Desalination Plant	7.5	-	-	-	$ 66.6
Pipelines [1]					
Raw Water Pipeline/Tunnel	18.8	-	30	13,000	$ 5.9
Treated Water Pipeline/Tunnel	7.5	-	21	22,300	$ 7.3
Brine Pipeline/Tunnel	11.3	-	24	5,000	$ 3.5
Pump Stations [2]					
Raw Water Pump Station (HP)	18.8	270	-	-	$ 0.6
Treated Water Pump Station (HP)	7.5	1,225	-	-	$ 2.9
Brine Pump Station (HP)	11.3	-	-	-	-
Treated Water Storage (MG)	2	-	-	-	$ 1.6
Total Construction Costs [3]					**$ 99.0**
Contractor Profit (15%)					$ 14.8
Engineering, Engineering During Construction, & Construction Management (25%)					$ 24.7
Soft Cost Adjustment (15%)					$ 14.8
Contingency (40%)					$ 61.4
Total Adjustments					$ 115.8
Capital Cost Estimate					**$ 214.7**

[1] Pipeline costs include tunneling and boring under obstructions such as highways.
[2] Capital costing curves used to estimate intake and treatment plant construction costs include 50 HP pump stations for raw, treated and concentrated brine water. The costs itemized above for pump stations include costs for pumping capacity greater than 50 HP.
[3] Capital costs do not include property costs for well sites, desalination plant site, or storage site.

B.8.3 Operations and Maintenance Costs

Operations and maintenance costs (O&M) are a key part of the overall costs for desalination facilities. These costs include:

- Cost of power (electrical);
- Chemicals;
- Labor;
- Solids disposal to landfills;
- MF/UF Membrane replacement costs;
- Cartridge filter replacement; and
- RO membrane replacement.

The O&M costs are adjusted for General Maintenance (non-labor costs) at 10 percent of the total for the components listed above, and also include 10 percent contingency for those same items. Table B-7 presents the annual O&M cost for 2011.

Table B-7
Annual O&M Costs
Representative Coastal Desalination Project

Component	Cost
Chemicals	$ 586,248
Electrical power	$ 5,134,610
Labor	$ 338,650
Solids Disposal to landfill	$ -
MF/UF Membrane Replacement Cost	$ -
Cartridge filter replacement	$ 46,468
RO Membrane Replacement Cost	$ 351,563
Subtotal Annual O&M	$ 6,458,000
General Maintenance (non-labor costs - 10% of subtotal)	$ 645,800
Contingency (10% of subtotal)	$ 645,800
Total Annual O&M	$ 7,750,000

Table B-8 presents the present worth (PW) calculations for the assumed 30 year life of these projects. This includes the onetime cost for all capital facilities assumed to occur in the future as well as the stream of operational costs escalated each year over 30 years and then brought back to a PW value in August 2011.

Table B-8
Present Worth Costs

Assumptions		**Present Worth and Annualized Cost Summary**	
Project Life (years)	30	Total Production (AF)	201,534
Treated Water Capacity (mgd)	7.5	PW Capital ($M)	$214.75
Base load	80%	PW O&M ($M)	$232.50
Annual Production (AF/year)	6,720	PW Total ($M)	$447.25
Startup date	1/1/2015	**PW Unit Cost ($/AF)**	$2,219
Implementation Time (years)	7	Capital Costs Annualized ($M)	$10.96
2011 Capital Cost ($M)	$210	Annual O&M Cost ($M)	$7.75
Discount Rate/bond rate	3%	Total Annual Cost ($M)	$18.71
Capital Escalation Factor	3%	Annual Production (AF)	6,720
Energy Cost ($/kWh)	0.14	**Unit Annualized Costs ($/AF)**	$2,785

Present Worth Calculations

Year	Capital Cost	O&M	Total PW
PW	$214,746,000	$232,500,000	**$447,246,000**
2011	$214,746,000	$7,750,000	**$222,496,000**
2012	$0	$0	$0
2013	$0	$0	$0
2014	$0	$0	$0
2015	$241,698,000	$0	$241,698,000
2016	$0	$8,984,000	$8,984,000
2017	$0	$9,254,000	$9,254,000
2018	$0	$9,532,000	$9,532,000
2019	$0	$9,817,000	$9,817,000
2020	$0	$10,112,000	$10,112,000
2021	$0	$10,415,000	$10,415,000
2022	$0	$10,728,000	$10,728,000
2023	$0	$11,050,000	$11,050,000
2024	$0	$11,381,000	$11,381,000
2025	$0	$11,723,000	$11,723,000
2026	$0	$12,074,000	$12,074,000
2027	$0	$12,436,000	$12,436,000
2028	$0	$12,810,000	$12,810,000
2029	$0	$13,194,000	$13,194,000
2030	$0	$13,590,000	$13,590,000
2031	$0	$13,997,000	$13,997,000
2032	$0	$14,417,000	$14,417,000
2033	$0	$14,850,000	$14,850,000
2034	$0	$15,295,000	$15,295,000
2035	$0	$15,754,000	$15,754,000
2036	$0	$16,227,000	$16,227,000
2037	$0	$16,714,000	$16,714,000
2038	$0	$17,215,000	$17,215,000
2039	$0	$17,731,000	$17,731,000
2040	$0	$18,263,000	$18,263,000
2041	$0	$18,811,000	$18,811,000
2042	$0	$19,376,000	$19,376,000
2043	$0	$19,957,000	$19,957,000
2044	$0	$20,556,000	$20,556,000
2045	$0	$21,172,000	$21,172,000

Table B-9 summarizes these PW calculations and also presents the annualized costs (including both capital and O&M components).

Table B-9
Representative Coastal Desalination Project Present Worth and Annualized Cost Estimates[1,2,3]

Present Worth Costs	
Annual O&M Cost ($M)	$ 7.75
Present Worth of Capital Cost ($M)	$ 214.75
Present Worth of Annual O&M Cost ($M)	$ 232.50
Total Present Worth ($M)[4]	**$ 447.25**
Total Production (AF)[5]	201,534
Unit Cost of Total Present Worth ($/AF)[4,7]	**$ 2,200**
Annualized Project Costs	
Capital Costs Annualized ($M)[6]	$ 10.96
Annual O&M Cost ($M)[6]	$ 7.75
Total Annual Cost	**$ 18.71**
Annual Production (AF)[5]	6,720
Unit Annualized Costs ($/AF)[7]	**$ 2,800**

[1] 2011 costs are current as of August 2011.
[2] 2015 project start date (O&M costs starting 2016).
[3] Assumed project life of 30 years.
[4] Present Worth estimates include a 3% escalation and a 3% discount rate. The same escalation rate is used for electricity, materials, labor and capital costs.
[5] Annual and total production assumes a base load of 80%.
[6] Annualized Costs are calculated over project life in 2011 dollars.
[7] Costs rounded to nearest $100/AF

B.9 Key Issues and Risks

Key issues and risks associated with implementing a desalination facility are discussed in this section. During this planning stage, several of the key issues are not fully known and will require additional analysis. Potential next steps to address some of these uncertainties are summarized in the next section.

Key issues associated with the representative coastal desalination project include:

- Source water quality (e.g., salinity, iron, manganese, contaminants) variability;
- Source water yield;
- Land availability, cost and permitting for Ranney Collector Wells located in the Pacifica Beach Area;
- Availability, cost and permitting for the use of the old Sharp Park WWTP site as a desalination plant site;

- Alignment issues and costs for construction of new raw water pipelines along Highway 1, and treated water pipelines along Westborough Boulevard;
- Property availability, cost and permitting for a tank site in Milagra Ridge Park;
- Public support and opposition;
- Permitting for a new outfall for brine discharge off the coast; and
- Funding and ownership of a coastal desalination plant.

The key risks noted during development of this analysis are:

- *Brackish and subsurface options:* Projecting expected yield and assessing impacts on other wells in the aquifer including well yield and water quality (e.g., potential for increased salt water intrusion and subsidence).
- *Subsurface options:* Long-term yield and reliability of slant or horizontal wells depending on the site-specific hydrogeology under the ocean floor and future sediment deposition which may reduce water transport rates from the ocean into the aquifer.
- *Open water intake option:* Cleaning frequency and long-term reliability of intake screens.
- *All options:*

  a) Costs and delays to overcome potential permitting hurdles, public opposition, and litigation are risks even though subsurface intakes and co-located brine discharges are expected to reduce this risk. California experience indicates that such delays have been the norm. It is unclear whether implementation time for future plants will be reduced (i.e., if State-wide regulatory streamlining for desalination plants occurs).

  b) Risks associated with introducing a new treated water source into an existing distribution system, such as water stabilization and corrosion control to minimize impacts to existing scales, maintaining disinfectant stability in the presence of bromide in the desalinated water, aesthetic differences, irrigation use with higher concentrations of boron and chloride, and potential SFPUC requirements to match existing salinity and hardness parameters.

  c) Risk that the cost of power may escalate more quickly than anticipated and increase the operational costs.

  d) Risk that wastewater utilities may not allow a co-located brine discharge with or without additional costs or negotiations.

B.10 Next Steps

The project developed and presented in this Memo is one of several that might be part of the short and long-term supply opportunities for the BAWSCA member agencies. Prior to more detailed development of the project information these supply projects will be compared based on series of criteria to determine which projects warrant additional investigation and/or evaluation.

If the Representative Coastal Desalination Project is selected to move forward following are some the possible key next steps:

- Confirm the expected yield and water quality from the potential seawater subsurface locations. The unknowns could be addressed by performing borings to indentify the boundaries of the most promising geological formations, performing pump tests, updating groundwater models to estimate sustainable yield, and performing a more thorough review of existing or gathering new water quality data; and

- Confirm the availability of potential sites at suitable locations for intakes and treatment plant facilities. In addition, more detailed hydraulic analysis will be needed to identify improvements that may be required to convey the treated water supply from the new plant location to the existing distribution system and then to distribute it to customers within the existing system.

For planning purposes, Table B-10 lists the studies expected to be future steps required to acquire permits for a new desalination project.

Table B-10 **Summary of Studies Required for Permitting of New Local Desalination Facility**
Geotechnical investigation and hydrogeologic modeling to confirm the proposed intake options are feasible and refine estimated costs. Pump tests to confirm potential yields.
Additional environmental impact studies may be required for subsurface intakes if they are expected to impact benthic organisms in the soil
Requires 6 to 12 months of monitoring from test wells to determine if the groundwater is "under the influence of surface water;" which will require additional "surface water" monitoring associated with an open water intake
Pilot-scale testing may be recommended depending on source water quality and may be required by DPH if the source is determined to be under the influence of surface water
Dilution study to determine feasibility of proposed brine discharge location

B.11 Preliminary Schedule

The schedule presented below is based on experience with similar projects (e.g., Santa Cruz and MMWD) and professional judgment. Considerably longer schedules have been experienced by projects in Carlsbad and Huntington Beach.

Two considerations which can have a significant impact on schedule include:

- *Is piloting necessary?* Every major project has had a pilot plant study (e.g., Newark, Marin, Santa Cruz, BADRP, Long Beach, Dana Pt, Carlsbad, West Basin) with the exception of Huntington Beach (relied on Carlsbad results) and Sand City (since used beach wells were used, the project relied on water quality data from a beach test well, reverse osmosis software projections, and direct measurement of Silt Density Index (SDI) as basis of 0.5 mgd design).

- *Source water assessments:* for setting treatment requirements, CDPH requires 12 month testing for well-extracted water and 24 months for an open water intake source. This can be obviated by simply installing greater levels of pre-treatment (Sand City elected this option by installing post-treatment UV disinfection to achieve the maximum required virus, Cryptosporidium and Giardia log removal credits for an impaired source water. This saved up to 12 months of groundwater under the influence monitoring and the potential for an additional 12 month watershed sanitary survey and 24 months of Long Term 2 Surface Water Treatment Rule monitoring for turbidity and Cryptosporidium.

The schedule on the next page (Figure B-10) has been developed to incorporate lessons learned from other projects in California and provide a potential duration for each phase of the project. The anticipated schedule will likely change depending on the permitting climate and public perception of the selected project at the time of project inception.

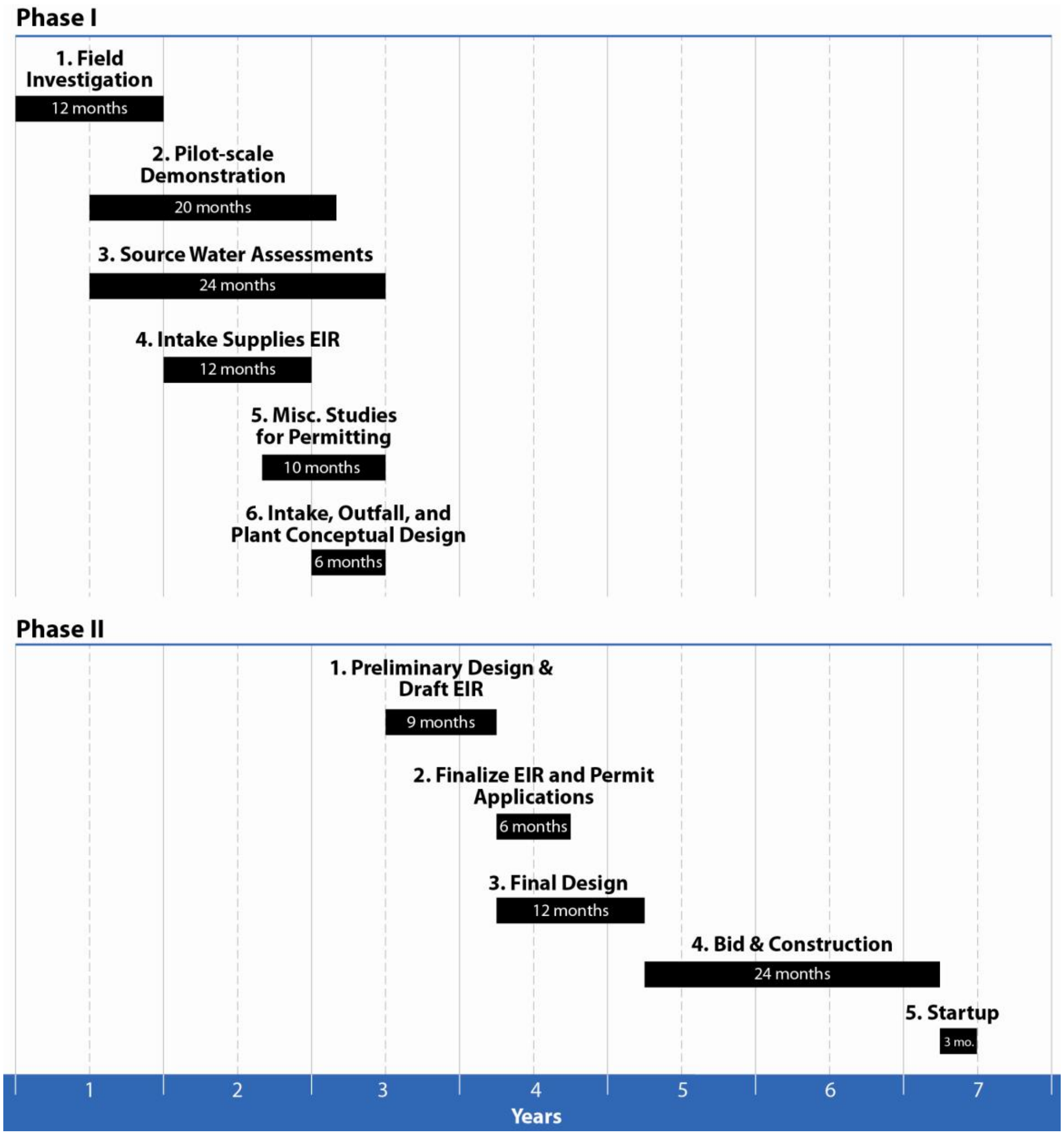

Figure B-10 Preliminary Schedule for Representative Coastal Desalination Project

Appendix C
References

General:

Revised Draft Task 6-A Memo: Refined Evaluation Criteria and Metrics, January 25, 2011, by CDM.

Daly City:

Combined Results of the Recycled Water Treatment and Delivery System Expansion Feasibility Study, Final October 2009, Carollo Engineers.

Technical Memorandum; Westside Basin Groundwater- Flow Model: Updated Model and 2008 No Project Simulation Results, May 6, 2011 to Mr. Patrick Sweetland, from Hydrofocus, Inc.

Representative Coastal Desalination Project:

DWR. 2004. bulletin 118 San Pedro Valley Groundwater Basin. http://www.water.ca.gov/pubs/groundwater/bulletin_118/basindescriptions/2-36.pdf

Final Desalination Feasibility Study, Prepared for North Coast County Water District, February 6, 1996 by Boyle Engineering Corporation.

Report on Hydrogeological Survey Sharp Park Test Site for North Coast County Water District, Pacifica California, April 30, 1993 by Ranney Method Western Corporation.

Exhibit 3
Revised Draft Task 2-C Memo
Consolidate Agency-Identified Project Information Redwood City & Palo Alto Recycled Water Projects

CDM Smith

Memorandum

To: *Nicole Sandkulla*

From: *Jeff Sellberg*
Craig Von Bargen

cc: *Bill Fernandez*
Phillipe Daniel

Date: *February 7, 2012*

Subject: *Revised Draft Task 2-C Memo Consolidate Agency-Identified Project Information Redwood City & Palo Alto Recycled Water Projects*

1.0 Introduction

Sixty-five (65) agency-identified water supply management projects (projects) were presented in the May 2010 Phase 1 Scoping Report for further evaluation in Phase II A of the Bay Area Water Supply and Conservation Agency (BAWSCA) Long Term Reliable Water Strategy (Strategy). As part of Phase II A the BAWSCA member agencies, BAWSCA, and CDM Smith participated in a project refinement and selection process. In that process, four agency identified projects were retained for development and evaluation in Phase II A (see Revised Draft Task 2-A Memo: Agency-Identified Projects Information and Information Gaps). Of the four projects retained for evaluation two projects are still being further developed by the agencies. These include:

- City of Redwood City (Redwood City) Recycled Water Treatment Plant Expansion (RC-4); and
- City of Palo Alto (Palo Alto) Expanded Recycled Water Plant to Serve Stanford Research Park (PA-2).

In this Memo:

In order to allow evaluation and comparison of the projects within the Strategy, key types of project information are needed. This information was identified in the Project Informatin Survey and includes:

- Costs;
- Facilities;
- Supply Reliability;
- Schedule;
- Water Quality;
- Implementation Potential;
- Environmental Impacts;
- Funding; and
- Ownership.

This Task 2-C Memo summarizes the information that has been provided by the two agencies for their two projects. When the updated and additional information is available this project, information will be updated by the Strategy Team.

1.1 Projects Evaluated

Redwood City Recycled Water Treatment Plant Expansion- This project is an expansion of the existing Redwood City/South Bayside System Authority (SBSA) recycled water treatment facility from 2.8 to 8 mgd. The existing Redwood City recycled water system includes tertiary-treatment facilities, two 2.2 million gallon storage tanks, and a distribution system pump station all located at the South Bayside System Authority (SBSA) Wastewater Treatment Plant (WWTP), and recycled water distribution facilities throughout Redwood City.

Palo Alto Expanded Recycled Water Plant to Serve Stanford Research Park – This second project is an expansion of the recycled water treatment facilities at the Regional Water Quality Control Plant (RWQCP) to produce recycled water to serve the Stanford Research Park. The average annual and peak demand for this project is estimated in the project information survey at 0.8 mgd and 1.99 mgd, respectively. The City of Palo Alto owns and operates the RWQCP treating wastewater for six communities/districts including Los Altos, Los Altos Hills, Mountain View, Palo Alto, Stanford University and the East Palo Alto Sanitary District. The RWQCP has a current average dry weather flow of approximately 23 mgd.

Figure 1 indicates the overall BAWSCA service area and the specific service areas for Redwood City and Palo Alto.

1.2 Summary of Project Information

Neither of these projects had fully developed project information, but the two agencies are continuing development of the information necessary for eventual evaluation and comparison with the other water supply management projects to be evaluated as part of the Strategy. In addition, they have indicated that some of the information may be changing as the project evaluations progress. Table 1 indicates the type of information that was made available by the agencies in responding to the project surveys, in interviews in November and December 2010, and subsequent discussions with the agencies in early 2011 and fall 2011.

Table 1
Agency and Strategy Developed Information for Selected Projects Moving Forward in the Strategy

Information	Redwood City Recycled Water Treatment Plant Expansion (RC-4)			Palo Alto Expanded Recycled Water Plant to Serve Stanford Research Park (PA-2)		
	Provided in Survey	Agency to Provide By[1]	Agency to Provide – Revised Date[2]	Provided in Survey	Agency to Provide By[1]	Agency to Provide – Revised Date[3]
Costs	○	1/1/2012	3/2012	◗	9/1/2011	2/2013
Facilities	○	1/1/2012	3/2012	●	9/1/2011	2/2013
Supply Reliability	◗	1/1/2012	3/2012	●	9/1/2011	2/2013
Schedule	○	X	X	●	9/1/2011	2/2013
Water Quality	●	TBD	TBD	◗	9/1/2011	2/2013
Implementation Potential	◗	1/1/2012	3/2012	●	9/1/2011	2/2013
Environmental Impacts	◗	X	X	●	9/1/2011	2/2013
Funding	○	X	X	●	9/1/2011	2/2013
Ownership	○	1/1/2012	3/2012	◗	9/1/2011	2/2013

[1] Based on commitment responses on 2/11/2011.
[2] Based on follow up conversations with Redwood City in fall 2011.
[3] Based on follow up conversation with Palo Alto January 2012

Symbol Key:
X Agency not providing data.
- No additional information included.
○ Less than 25% of information available.
◗ 25-75% of information available.
● More than 75% of information available.

Appendix A includes the Project Information Survey provided by Redwood City for RC-4, and Appendix B includes the Project Information Survey for Palo Alto's project PA-2 in late 2010. Subsequent to the meetings with Redwood City and Palo Alto, both agencies indicated that they were still developing information for their respective projects, and that several of the project attributes were being updated. In addition, the timing, sizing, cost and funding, and ownership are still being evaluated.

1.2.1 Summary of Project Yield and Cost

Initial estimates of the project yields have been developed by the cities. However, these yields and the costs and schedules for these projects are currently being updated and may change the current information. When that information becomes available it will be incorporated into the project evaluation and comparison analysis later in the Strategy.

1.2.2 Other Project Information and Evaluation Criteria

In addition to project yield and cost there is other project information that will be used in the comparison of water supply management projects. These information needs were identified in the Project Information Survey, and were shown in Table 1 in this memo. Table 2 indicates the types of quantitative and qualitative information and how it will be applied to the evaluation criteria that will be used in the future comparison of water supply management projects. The Strategy Revised Draft Task Memo: Refined Evaluation Criteria and Metrics, January 25, 2011 provides more information on the development of the objectives, criteria, and metrics. The information and values for Table 2 will be incorporated into the project evaluation and comparison analysis later in the Strategy when provided by Redwood City and Palo Alto.

Table 2 Project Summary – Redwood City and Palo Alto Recycled Projects Evaluation Criteria and Metric Values				
			Project Values	
Objective	**Criteria**	**Metrics**	**Redwood City Recycled Water Treatment Plant Expansion**	**Palo Alto Expanded Recycled Water Plant to Serve Stanford Research Park**
1 - Increase Supply Reliability	**Criterion 1A** – Ability to Meet Normal Year Supply Need	Quantitative (AF /year): Average annual yield in normal years in 2018 and 2035.	TBD	TBD
	Criterion 1B – Ability to Meet Drought Supply Need	Quantitative (AF/year): Average annual yield with drought hydrology of 1987 – 1992.	TBD	TBD
	Criterion 1C – Risk of Facility Outage	Qualitative (1-5): Estimated probability and duration of major conveyance failure	TBD	TBD
	Criterion 1D – Potential for Regulatory Vulnerability	Qualitative (1-5): Potential for regulatory decisions to impact supply reliability	TBD	TBD
2 - Provide High Level of Water Quality	**Criterion 2A** – Meets or Surpasses Drinking Water Quality Standards	Quantitative (mg/L): Total dissolved solids (TDS) level as an indicator of water quality.	TBD	TBD
	Criterion 2B – Meets or Surpasses Non-Potable Water Quality Standards	Qualitative: Meets minimum water quality requirement (e.g., Title 22) for the targeted use. (Yes or no)	TBD	TBD
3 - Minimize Cost of New Water Supplies	**Criterion 3** – Capital and Present Worth Costs	Quantitative ($/AF): Present Worth costs including capital and operating costs	TBD	TBD
4 - Reduce Potable Water Demand	**Criterion 4** – Augment Non-Potable Water Supplies	Quantitative (AF/year): Reduction of potable water demand by use of non-potable supply.	TBD	TBD
5 - Minimize Environmental Impacts	**Criterion 5A** –Greenhouse Gas Emissions	Quantitative (metric tons/ AF of Supply): Estimates of unit greenhouse gas emissions	TBD	TBD
	Criterion 5B –Impact to Groundwater Quantity and Quality	Qualitative (1-5): Potential impacts to groundwater levels, groundwater quality, or potential for subsidence	TBD	TBD)
	Criterion 5C –Impact to Habitat	Qualitative (1-5): Potential impacts to habitat, such as wetlands, riparian zones, fisheries, and inundation areas.	TBD	TBD
6 - Increase Implementation Potential	**Criterion 6A** – Institutional Complexity	Qualitative (1-5): Number and type of agencies and agreements involved	TBD	TBD
	Criterion 6B –Level of Local Control	Qualitative (1-5): BAWSCA and Member Agency ownership of supply projects	TBD	TBD
	Criterion 6C –Permitting Requirements	Qualitative (1-5): Permitting or regulatory issues for supply projects	TBD	TBD

2.0 Redwood City Recycled Water Treatment Plant Expansion

The Redwood City Recycled Water Treatment Plant Expansion Project (RC-4) is an expansion of the Redwood City/South Bayside System Authority (SBSA) recycled water treatment facility from 2.8 to 8 mgd. Most of the information presented herein is based on information provided by the City in the Project Information Survey and from an interview with City staff in November 2010. Other sources of information used in preparation of this memo include:

1. Initial Study for the Redwood City Recycled Water Project, June 2002, CH2MHill. (Initial Study).

2. Water Recycling Feasibility Study for Redwood City Final Report, August 7, 2002. Kennedy/Jenks Consultants. (2002 Feasibility Study).

3. Technical Memorandum Redwood City Recycled Water Program, Internal Memo Design Basis: Recycled Water Production, Storage and Pumping Facilities, 7 January 2004. (Internal Memo Design Basis).

4. City of Redwood City Recycled Water Program, SBSA Facilities Project Disinfection Storage and Pumping Facility Design Criteria Summary, Draft Final, 9 January 2009, Kennedy/Jenks Consultants, (Design Criteria).

2.1 Existing Redwood City Recycled Water System

The existing Redwood City recycled water system includes tertiary-treatment facilities, two 2.2 million gallon storage tanks, and a distribution system pump station all located at the South Bayside System Authority (SBSA) Wastewater Treatment Plant (WWTP), and recycled water distribution facilities throughout Redwood City. SBSA's WWTP is owned by four entities, the West Bay Sanitary District, and the cities of Belmont, Redwood City, and San Carlos. The distribution system operates as a pumped storage system, with all storage located at the SBSA WWTP.

The first phase of the Redwood City Recycled Water Project, Phase 1, began operation in 2007 with construction complete by the summer of 2010. Major planning studies completed prior to implementation of the Phase 1 project included the Initial Study, 2002 Feasibility Study, and Design Criteria documents listed above. The studies estimated the recycled water market potential and outlined facilities required for the recycled water system.

Demand for the Phase 1 system was initially estimated at 2,000 acre feet per year, however, the actual connected demand has been less than this. System demand in 2009 was 360 acre feet and Redwood City estimates their demand will be approximately 1,120 acre feet (1 mgd) for the system. It is our understanding that not all of the customers identified as part of the Phase 1 planning were connected to the system. As discussed in the next section, the City is in the process of updating their Water Recycling Feasibility Study which is anticipated to better define the existing customer base, extent of existing facilities, and requirements for expansion of the system.

The current recycled water treatment capacity is 2.8 mgd, and the City indicated that approximately 1.8 mgd of this existing capacity is available for future demand either within Redwood City or to other agencies. Redwood City would like to expand their recycled water system and potentially partner with other agencies for the expansion. Expanding and partnering with other agencies has potential benefits to Redwood City including reduction of costs to existing customers and providing a revenue source to the City. The City has recycled water distribution pipelines extending to the north and south boundaries of their service area along the east side of Highway 101 which will facilitate connections to other neighboring agencies including Cal Water, Foster City and Menlo Park.

2.2 Project Assumptions

The project assumptions for the treatment facility expansion are not defined at this time. The City is in the process of preparing its Water Recycling Feasibility Study Update (2012 Feasibility Study Update) which will better define facility requirements for the expansion. The final report is anticipated to be available in early 2012 and will provide the basis for updating and revising the project data. The current assumptions for the project based on the earlier reports include:

- Expansion of the recycled water treatment plant from its current capacity of 2.8 mgd to 8 mgd (average annual capacity). Annual yield for 8 mgd project is 8,962 acre feet as indicated in the Project Information Survey; and

- Up to 1.8 mgd of existing capacity (average annual capacity) is available for use in the existing 2.8 mgd system.

Details of treatment facility improvements required for the expansion are not known at this time, but are anticipated to be included in the 2012 Feasibility Study Update. Improvements to the recycled water treatment facility may include upgrades to the distribution system pump station and possibly additional storage. The recycled water treatment facility may have sufficient filtration and disinfection capacity for the expansion, but this should be confirmed when the 2012 Feasibility Study Update becomes available.

2.3 Planning Level Costs

Project costs are still being developed by Redwood City. As noted above, the City is in the process of updating its project information which is anticipated to include estimated costs for an expansion.

2.4 Preliminary Project Schedule

Redwood City has not provided an initial project schedule, and has indicated that one may not be included in the 2012 Feasibility Study update.

2.5 Data Gaps and Outstanding Issues

Following is a preliminary list of outstanding issues and data gaps for the project:

- Participating agency partners and commitments for the expansion, including updated demands and capacity;
- Funding sources;
- Environmental review requirements;
- Interagency agreements. Agreements are anticipated to include a recycled water supply and sales agreement;
- Water Quality. TDS was identified as a potential issue for sensitive plants. The Project Information Survey indicates that some plant materials can be affected by a TDS of 650 - 750 mg/L. The 2012 Feasibility Study Update should be reviewed to determine if any potential prohibitions or limitations on market potential exist due to water quality; and
- Capital, operations and maintenance (O&M) and present worth (life-cycle) costs. Potential water purchase rates for new customers.

2.6 Next Steps

The key next step will be to complete the project information when this becomes available from the City of Redwood City. If some of the information needs identified in this memo are not addressed by the additional information, the Strategy project team will consider developing estimates for the missing values, or request additional information from the City of Redwood City.

This project is one of several that might be part of the long-term supply opportunities for the BAWSCA member agencies. Prior to more detailed development of the project information, these supply projects will be compared based on a series of criteria to determine which projects warrant additional investigation and/or evaluation.

3.0 Palo Alto – Expanded Recycled Water Plant to Serve Stanford Research Park

The Palo Alto Project (PA-2) is an expansion of the existing recycled water treatment facilities at the Regional Water Quality Control Plant (RWQCP) to produce recycled water to serve the Stanford Research Park. Most of the information below is based on information provided by the City in the Project Information Survey and from an interview with City staff in December 2010. Other sources of information used in preparation of this memorandum include the following:

1. Notice of Preparation of a Draft Environmental Impact Report (EIR) for the City of Palo Alto Utilities Recycled Water Project, June 2011.

2. City of Palo Alto Recycled Water Facility Plan, December 2008, RMC.

3. City of Palo Alto Recycled Water Project Initial Study/Mitigated Negative Declaration, March 2009, RMC.

3.1 Existing Palo Alto Recycled Water System

The City of Palo Alto owns and operates the RWQCP treating wastewater for six communities/ districts including Los Altos, Los Altos Hills, Mountain View, Palo Alto, Stanford University and the East Palo Alto Sanitary District. The RWQCP has a current average dry weather flow of approximately 23 mgd. Treatment processes at the RWQCP include primary treatment (bar screening and primary sedimentation), secondary treatment (trickling filters, followed by activated sludge and secondary clarifiers), tertiary filtration, and disinfection. The RWQCP recently converted its disinfection facilities from sodium hypochlorite to ultraviolet (UV) disinfection.

The RWQCP also includes a recycled water treatment train that produces recycled water meeting California Title 22 requirements for unrestricted reuse. The RWQCP currently provides recycled water to several customers in Palo Alto, and to the City of Mountain View through a recently completed pipeline.

Recycled water treatment facilities at the RWQCP include: 1) a filtration and chlorination production train, and 2) a backup UV disinfection system production train. Production capacity of these treatment systems as reported by the City is as follows:

- The filtration and chlorination production train is 4.5 mgd;
- The backup UV disinfection system production train is 6 mgd. Future expansion of this system by adding an additional UV bank would allow production of 8 mgd; and
- The City has future plans to consolidate these systems into a 10.5 mgd facility. Consolidation will require some modifications to plant piping and storage tanks to remove bottlenecks from the system.

The above information is based on discussions with Palo Alto staff in January 2012.

3.2 Project Assumptions

The City of Palo Alto Utilities Department is evaluating an expansion of the recycled water system through an additional connection to the Stanford Research Park. This project will serve primarily irrigation demand and a smaller proportion of cooling tower usage. The average annual demand for the project is estimated at 0.8 mgd as provided in the Project Information Survey.

The Project Information Survey also indicated there is potential for expansion beyond the above identified project in the range of 2,000 to 3,000 acre-feet per year. Other agencies that could potentially be served through the expansion project include Stanford University, Los Altos, and Purissima Hills Water District. There may also be potential to serve Menlo Park.

Following is a list of key assumptions for the PA-2 Project based on conversations with Palo Alto staff in January 2012:

- Sufficient Title 22 recycled water tertiary treatment capacity exists at the RWQCP, including filtration and required upstream treatment processes (coagulation and flocculation).
- As indicated in the project information survey, expansion of the UV disinfection facilities from its current capacity may allow recycled water production of up to 8.6 mgd.
- The estimated project cost noted below is assumed to include engineering, construction, and administrative costs. However, this should be confirmed with City staff if the project moves forward in the BAWSCA analysis.

3.3 Planning Level Costs

The estimated project capital and O&M costs to expand the UV disinfection facility are currently being updated by the city as part of preparation of an EIR.

New recycled water distribution system facilities will also be required to serve the Stanford Research Park, however, these costs were not included herein, as project PA-2 is solely to expand the recycled water treatment facility. BAWSCA may want to consider including the cost for distribution in their analysis to determine the true cost of delivered water to compare to other alternatives. Some distribution system costs appear to be included in the Project Information Survey, however, additional review and/or coordination with City staff is likely be required to include these costs in the analysis. There are indications that these costs may change during the environmental review process due to changes to pipeline alignments.

3.4 Preliminary Project Schedule

A conceptual project schedule was provided in the Project Information Survey with design completed in 2012 and construction completed in 2014. However this project schedule is currently being updated by the City as part of the preparation of an EIR.

3.5 Data Gaps and Outstanding Issues

Following is an initial list data gaps and outstanding issues for this project:

- The project is subject to potential risks including potential regulatory restrictions that affect project feasibility, cost and schedule. There may also be public acceptance issues and limitations on application or use of the recycled water due to water quality;

- The project is subject to a potential limitation on recycled water use due to salt impacts. A limitation may include restrictions on recycled water use on redwood trees due to the recycled water TDS. The Regional Water Quality Control Plant (RWQCP), along with its partners in the treatment plant, have created an inflow and infiltration program that may reduce the TDS in the wastewater;

- Public acceptance of the recycled water project may be an issue. The City prepared an Initial Study/Mitigated Negative Declaration (IS/MND) for the project in 2009. Significant comments were received on the IS/MND. Due to public concerns regarding the irrigation of redwood trees with recycled water, the City did not take action on the IS/MND. Since then, the city has been in the process of preparing an EIR that focuses on the key issues of the project, including the effects of project on redwood trees. It is anticipated that the Draft EIR will be completed in early 2012.

- Ongoing work should confirm the demands for the project with the City, both for the existing system and expansion, including average annual and maximum day demands as it relates to the treatment facility expansion.

  - The Project Information Survey indicated that the Stanford Research Project could add an additional 0.8 mgd (average annual yield) and that the peak capacity is 1.99 mgd. The normal year yield (average annual) for the current system is indicated to be 2 to 4 mgd in the Project Information Survey.

3.6 Next Steps

The key next step will be to complete the project information when this becomes available from the City of Palo Alto. If some of the information needs identified in this memo are not addressed by the additional information, the Strategy project team will consider developing estimates for the missing values, or request additional information from the City of Palo Alto.

This project is one of several that might be part of the long-term supply opportunities for the BAWSCA member agencies. Prior to more detailed development of the project information these supply projects will be compared based on series of criteria to determine which projects warrant additional investigation and/or evaluation.

Appendix A
Redwood City Recycled Water Project – Service Area Expansion: Information Survey

Instructions for Completing the Project Information Survey and Sheets

Review and complete this Project Information Sheet for the project listed below. The Project Information Sheet includes questions designed to collect additional information on supply projects to facilitate evaluation of these projects within the Strategy framework. The project information already entered into other worksheets in this file reflect information provided in November 2010.

Project Title: RC-4: Redwood City Recycled Water Treatment Plant Expansion

The Project Information Sheet includes the worksheets below. All worksheets are included for your project, but sections that your agency has not committed to providing additional information for are grayed out. If any of this information is developed as part of your effort we would appreciate your including it.

Please include any information shaded in **orange** on each worksheet to the extent possible. Information shaded in gray has been provided by your agency in previous information requests and meetings. Click on the links below to fill out a worksheet.

Worksheet Name	Description
Contact	General Agency Contact Information
General Information	General Project Information
Facilities, Costs and Ownership	Infrastructure - Facilities, Costs, Ownership
Supply and Water Quality	Supply Reliability Information and Water Quality Information
Schedule	Project Implementation Schedule Information
Funding and Implementation	Project Funding Information and Implementation
Environmental	Potential Environmental Impacts

Please contact Anona Dutton at 650-349-3000 if you have any questions regarding the completion of the Project Information Sheets.

Project: RC-4: Redwood City Recycled Water Treatment Plant Expansion

Return to Instruction Sheet

Instructions: Please complete contact information in the **ORANGE** *shaded cells. This person may be contacted if there are questions regarding any submitted information. Cells will change color after information is entered.*

General Agency Contact Information

Date:	3-Nov-10
Agency:	Redwood City
Project Contact Name:	Justin Ezell
Project Contact Position:	Superitntendent
Email:	jezell@redwoodcity.org
Phone:	650.780.7474

Project: RC-4: Redwood City Recycled Water Treatment Plant Expansion

Return to Instruction Sheet

Instructions: Please complete project information in the ***ORANGE*** *shaded cells. For all responses, use as many lines as needed or attach additional sheets. Cells will change color after information is entered.*

General Project Information

1) Project Description and Information Sources:

Brief project description: (*e.g., Design and construction of 4 new wells to provide a total capacity of 6 mgd for emergency and drought supply*).

Expand City/SBSA recycled water treatment plant capacity from 2.8 mgd to 8 mgd (current plant expansion capability).

2) Is this project an expansion of another project for which you are filling out another Project Information Sheet?

X Yes ___ No Reference Project Title: Make the City's current excess treatment plant capacity (1.8 mgd) from the City/South Bayside System Authority (SBSA)

3) Available information sources for this project:

Other reports, maps, studies, environmental documents, etc.:

1) http://www.redwoodcity.org/publicworks/pdf/K_J_FEAS_RPT_RWC_8_02.pdf
2) SBSA Facilities Project Disinfection Storage and Pumping Facility Design Criteria Summary
3) ___

Provide copies (electronic or hard copy) of any reports/documents that are not available online. If available online please provide link in the space above.

4) Is supply from this project included in supply projections as presented in the updated 2010 UWMP documents?

___ Yes X No

5) Indicate the type of project by selecting one of the categories below.

X Recycled Water for Non-Potable Reuse
___ Recycled Water for Indirect Potable Reuse
___ Groundwater Wells
___ Desalination
___ Water Transfers
___ Groundwater Banking
___ Local Stormwater/Urban Runoff/Other Water Capture
___ Graywater
___ Other

6) a) What types of demands will be served by the project?

Check all that apply.

___ Potable
X Non-potable
___ Other

b) Which agency customers will the project serve?

Check all that apply.

X All Agency Customers
___ Residential
___ Commercial
___ Industrial
___ Municipal
___ Dedicated Irrigation
___ Golf/Park
___ Other
___ Not yet investigated/Do not know

c) Could other agencies be served by this project?

X Yes ___ No ___ Not yet investigated/Do not know

If yes, specify agency(ies): TBD

7) When will the supply be used?

Check all that apply.

X Daily/Normal Use
___ Drought-Only Use
___ Emergency Use
X Seasonal Use (*e.g., irrigation*)

8) Will this project be developed by an individual agency or a regional partnership?

Check all that could apply, indicating your preference with a "1".

___ Individual Agency
X Regional Partnership

Specify other agencies: TBD

Indicate agreement type (*e.g. JPA, MOU, etc.*): TBD

Project: RC-4: Redwood City Recycled Water Treatment Plant Expansion

Instructions: Please identify all project finformation in the ***ORANGE*** *shaded cells, to the extent that information is currently available. For each type of facility, use as many lines as needed. All project elements may not apply to every type of project. If detailed information on all the facilities is not available, please complete "General System Information" at the bottom of this sheet. Cells will change color after information is entered.*

Return to Instruction Sheet

Infrastructure - Facilities

Project Element	Description					Cost Information								Ownership								Facility Reliability	
Treatment	**Process/Type**		**Capacity (mgd)**	**Location**	**Notes/Comments**	**Capital Cost ($)**	**Annual Production (AF)**	**Annual O&M Cost ($)**	**Annual Water Transfer Cost ($)**	**Total Annual Cost ($)**	**Cost per AF ($/AF)**	**Base Year for Cost Est.**	**Notes/Comments**	**Existing Facility? (Y/N)**	**Rehabilitation of Existing Facility? (Y/N)**	**Age of Facility (Years)**	**Expansion of Existing Facility? (Y/N)**	**New Facility? (Y/N)**	**SFPUC owned Facility? (Y/N)**	**Other owner/Don't Know**	**Notes/Comments**	**Are Facilities located near existing faults? (Y/N)**	**Location**
1)																							
2)																							
3)																							
4)																							
5)																							
Conveyance - Pipelines	**Length (feet)**	**Diameter (inches)**	**Capacity (mgd)**	**Location**	**Notes/Comments**	**Capital Cost ($)**	**Annual Production (AF)**	**Annual O&M Cost ($)**	**Annual Water Transfer Cost ($)**	**Total Annual Cost ($)**	**Cost per AF ($/AF)**	**Base Year for Cost Est.**	**Notes/Comments**	**Existing Facility? (Y/N)**	**Rehabilitation of Existing Facility? (Y/N)**	**Age of Facility (Years)**	**Expansion of Existing Facility? (Y/N)**	**New Facility? (Y/N)**	**SFPUC owned Facility? (Y/N)**	**Other owner/Don't Know**	**Notes/Comments**	**Are Facilities located near existing faults? (Y/N)**	**Location**
1)																							
2)																							
3)																							
4)																							
5)																							
Conveyance - Pump Stations	**Type**	**Size (HP)**	**Capacity (mgd)**	**Location**	**Notes/Comments**	**Capital Cost ($)**	**Annual Production (AF)**	**Annual O&M Cost ($)**	**Annual Water Transfer Cost ($)**	**Total Annual Cost ($)**	**Cost per AF ($/AF)**	**Base Year for Cost Est.**	**Notes/Comments**	**Existing Facility? (Y/N)**	**Rehabilitation of Existing Facility? (Y/N)**	**Age of Facility (Years)**	**Expansion of Existing Facility? (Y/N)**	**New Facility? (Y/N)**	**SFPUC owned Facility? (Y/N)**	**Other owner/Don't Know**	**Notes/Comments**	**Are Facilities located near existing faults? (Y/N)**	**Location**
1)																							
2)																							
3)																							
4)																							
5)																							
Storage	**Type**	**Number of Tanks (#)**	**Capacity each Tank (MG)**	**Location**	**Notes/Comments**	**Capital Cost ($)**	**Annual Production (AF)**	**Annual O&M Cost ($)**	**Annual Water Transfer Cost ($)**	**Total Annual Cost ($)**	**Cost per AF ($/AF)**	**Base Year for Cost Est.**	**Notes/Comments**	**Existing Facility? (Y/N)**	**Rehabilitation of Existing Facility? (Y/N)**	**Age of Facility (Years)**	**Expansion of Existing Facility? (Y/N)**	**New Facility? (Y/N)**	**SFPUC owned Facility? (Y/N)**	**Other owner/Don't Know**	**Notes/Comments**	**Are Facilities located near existing faults? (Y/N)**	**Location**
1)																							
2)																							
3)																							
4)																							
5)																							
Disposal	**Type**		**Capacity (mgd)**	**Location**	**Notes/Comments**	**Capital Cost ($)**	**Annual Production (AF)**	**Annual O&M Cost ($)**	**Annual Water Transfer Cost ($)**	**Total Annual Cost ($)**	**Cost per AF ($/AF)**	**Base Year for Cost Est.**	**Notes/Comments**	**Existing Facility? (Y/N)**	**Rehabilitation of Existing Facility? (Y/N)**	**Age of Facility (Years)**	**Expansion of Existing Facility? (Y/N)**	**New Facility? (Y/N)**	**SFPUC owned Facility? (Y/N)**	**Other owner/Don't Know**	**Notes/Comments**	**Are Facilities located near existing faults? (Y/N)**	**Location**
1)																							
2)																							
3)																							
4)																							
5)																							
Other	**Type**		**Capacity (mgd)**	**Location**	**Notes/Comments**	**Capital Cost ($)**	**Annual Production (AF)**	**Annual O&M Cost ($)**	**Annual Water Transfer Cost ($)**	**Total Annual Cost ($)**	**Cost per AF ($/AF)**	**Base Year for Cost Est.**	**Notes/Comments**	**Existing Facility? (Y/N)**	**Rehabilitation of Existing Facility? (Y/N)**	**Age of Facility (Years)**	**Expansion of Existing Facility? (Y/N)**	**New Facility? (Y/N)**	**SFPUC owned Facility? (Y/N)**	**Other owner/Don't Know**	**Notes/Comments**	**Are Facilities located near existing faults? (Y/N)**	**Location**
1)																							
2)																							
3)																							
4)																							
5)																							

General System Information	Source	Treatment	Capacity (mgd)	Connection	Notes/Comments	Capital Cost ($)	Annual Production (AF)	Annual O&M Cost ($)	Annual Water Transfer Cost ($)	Total Annual Cost ($)	Cost per AF ($/AF)	Base Year for Cost Est.	Notes/Comments	Existing Facility? (Y/N)	Rehabilitation of Existing Facility? (Y/N)	Age of Facility (Years)	Expansion of Existing Facility? (Y/N)	New Facility? (Y/N)	SFPUC owned Facility? (Y/N)	Other owner/Don't Know	Notes/Comments
1)	Recycled Water	Tertiary	8	SBSA			8,962							Yes	No	4	Yes	No	No		

Project: RC-4: Redwood City Recycled Water Treatment Plant Expansion

Return to Instruction Sheet

Instructions: Please complete project information in the ***ORANGE*** *shaded cells. For all responses, use as many lines as needed or attach additional sheets. Cells will change color after information is entered.*

Supply Reliability Information

1) Normal year yield in acre-feet per year: 8,962

2) Define how the yield above is calculated (i.e., pumping capacity, aquifer sustainable yield, etc.) and list sources of information.

Theoretical treatment and pumping capacity of facilities

3) Is the project yield dependent on hydrology/weather?

___ Yes X No ___ Not yet investigated/Do not know

4) Peak capacity in million gallons per day: Unknown

5) Provide data source(s) for the yield/capacity estimates provided in #4.

1) http://www.redwoodcity.org/publicworks/pdf/K_J_FEAS_RPT_RWC_8_02.pdf
2) SBSA Facilities Project Disinfection Storage and Pumping Facility Design Criteria Summary
3)

6) Could the project water supply be subject to regulatory restrictions that affect project feasibility, cost, or schedule?

___ Yes ___ No X Not yet investigated/Do not know

If yes, list restrictions:
1)
2)
3)

Water Quality Information

1) What is the expected total dissolved solids (TDS) concentration of product water in milligrams per liter (mg/L)?

___ mg/L TDS

2) For projects designed to meet non-potable water demands, to what level will the finished water be treated?

Check all that apply.

___ Disinfection only
___ Secondary treatment
___ Secondary treatment with disinfection
X Tertiary treatment
___ Membrane bioreactor
___ Membrane bioreactor/reverse osmosis
___ Denitrification
___ Other Please specify type:

3) Are there any limitations on application or use of this water due to water quality concerns (*e.g., TDS for irrigation,*

X Yes ___ No ___ Not yet investigated/Do not know

If yes, explain:

Some plant materials affected by the 650-750 mg/l TDS levels

Project: RC-4: Redwood City Recycled Water Treatment Plant Expansion

Return to Instruction Sheet

Instructions: Please complete project information in the ***ORANGE*** *shaded cells. For all responses, use as many lines as needed or attach additional sheets. Cells will change color after information is entered.*

Project Implementation Schedule Information

1) **Current Project Status:**

Indicate the current status of the project based on the definitions provided below.

- ____ Existing project under development
- ____ Planned project identified by a BAWSCA member agency
- X Potential future new project not specifically identified or specifically studied by a BAWSCA member agency to date

2) **If available, what is the projected schedule for project implementation?**

Project Step	Estimated Duration	Estimated Completion Year
Planning		
Demonstration project/pilot study		
Design		
Environmental documentation/permitting		
Construction		
Startup		

3) **Is the project expected to be completed/expanded in phases?**

____ Yes X No

4) **Does the potential for expansion exist beyond the above identified phases?**

____ Yes ____ No X Not yet investigated/Do not know

If yes, identify the ultimate yield in acre-feet per year:

and capacity in mgd:

Project: RC-4: Redwood City Recycled Water Treatment Plant Expansion

Return to Instruction Sheet

Instructions: Please complete project information in the ***ORANGE*** *shaded cells. For all responses, use as many lines as needed or attach additional sheets. Cells will change color after information is entered.*

Project Funding Information

1) **What is the source(s)/potential source(s) of funding for the project?**
(*e.g., your agency, developers, user fees, member agency bonds, state grants/loans, federal grants/loans, etc.*)

	Potential Funding Source	When will these funding sources be available?
1)		
2)		
3)		
4)		
5)		

2) **If funding has not been identified, what would be needed for that to occur?**
(*e.g., more/outside funding, additional users, lifted environmental restrictions, etc.*)

Commitments and funding from end-users

3) **Is there potential for cost-sharing with other agencies?**
X Yes ____ No ____ Not yet investigated/Do not know

4) **Is the project potentially eligible for State grants?**
X Yes ____ No ____ Not yet investigated/Do not know

If yes, have you applied and for what grants?
No

5) **Is the project potentially eligible for Federal grants?**
X Yes ____ No ____ Not yet investigated/Do not know

If yes, have you applied and for what grants?
No

Project Implementation Potential

1) **Does the project involve coordination with other agencies or entities (not related to permitting)?**
X Yes ____ No ____ Not yet investigated/Do not know

If yes, list agencies and any previously identified coordination-related issue(s) (*e.g., funding, conveyance, identifying*

Agency commitments and funding needed

2) **What are the permitting/regulatory requirements for the project? Check all that apply.**
- ____ NEPA – sponsoring federal agency
- ____ CEQA – lead agency (water provider)
- ____ Clean Water Act (Wetland Permit), Rivers and Harbor Act – US Army Corps of Engineers
- ____ Drinking Water Standards and Regulations – California Department of Public Health
- ____ Water Rights Permits, Clean Water Act (Water Quality Certification), NPDES Permits – State Water Resources Control Board
- ____ Recycled Water Regulations – California Department of Public Health, Regional Water Quality Control Board, State Water Resources Control Board
- ____ Lake or Streambed Alteration – California Department of Fish and Game
- ____ Endangered Species – US Fish and Wildlife Service, National Marine Fisheries Service
- ____ Cultural Resources – State Historic Preservation Office
- ____ Development Permits – cities, counties

Project: RC-4: Redwood City Recycled Water Treatment Plant Expansion

Instructions: Please complete project information in the ***ORANGE*** *shaded cells. For all responses, use as many lines as needed or attach additional sheets. Cells will change color after information is entered.*

Potential Environmental Impacts

Return to Instruction Sheet

1) What are the expected treatment and pumping energy requirements in kilowatts per year?
(*This will be used as surrogate for greenhouse gas emissions.*)
________ kilowatts per year

2) Will this project provide environmental benefits?
[ ] Yes [ ] No [X] Not yet investigated/Do not know

If yes, explain:

3) Will this project cause adverse impacts to habitat areas?
[ ] Yes [ ] No [ ] Not yet investigated/Do not know

If yes, explain:

If answered yes to questions **#2 or #3**, are there any studies/reports that provide an environmental evaluation?
[ ] Yes [ ] No

If answered yes to questions **#2 or #3**, provide data source(s) for the environmental evaluation.
1)
2)
3)

4) Have other significant environmental impacts been identified?
(*e.g., increased flood potential, decrease water quality, increased discharges to surface water bodies, etc.*)

Appendix B
Palo Alto Recycled Water Project – Service Area Expansion: Information Survey

Instructions for Completing the Project Information Survey and Sheets

Review and complete this Project Information Sheet for the project listed below. The Project Information Sheet includes questions designed to collect additional information on supply projects to facilitate evaluation of these projects within the Strategy framework. The project information already entered into other worksheets in this file reflect information provided in November 2010.

Project Title: PA-2: Expand Recycled Water Plant to Serve Stanford Research Park

The Project Information Sheet includes the worksheets below. All worksheets are included for your project, but sections that your agency has not committed to providing additional information for are grayed out. If any of this information is developed as part of your effort we would appreciate your including it.

Please include any information shaded in **orange** on each worksheet to the extent possible. Information shaded in gray has been provided by your agency in previous information requests and meetings. Click on the links below to fill out a worksheet.

Worksheet Name	Description
Contact	General Agency Contact Information
General Information	General Project Information
Facilities, Costs and Ownership	Infrastructure - Facilities, Costs, Ownership
Supply and Water Quality	Supply Reliability Information and Water Quality Information
Schedule	Project Implementation Schedule Information
Funding and Implementation	Project Funding Information and Implementation
Environmental	Potential Environmental Impacts

Please contact Anona Dutton at 650-349-3000 if you have any questions regarding the completion of the Project Information Sheets.

Project: PA-2: Expand Recycled Water Plant to Serve Stanford Research Park

Instructions: Please complete contact information in the **ORANGE** *shaded cells. For all responses, use as many lines as needed or attach additional sheets. Cells will change color after information is entered.*

General Agency Contact Information

Date:	10/21/2010
Agency:	City of Palo Alto
Project Contact Name:	Nicolas Procos
Project Contact Position:	Senior Resource Planner
Email:	nicolas.procos@cityofpaloalto.org
Phone:	6503292214

Return to Instruction Sheet

Project: PA-2: Expand Recycled Water Plant to Serve Stanford Research Park

Return to Instruction Sheet

Instructions: Please complete project information in the **ORANGE** *shaded cells. For all responses, use as many lines as needed or attach additional sheets. Cells will change color after information is entered.*

General Project Information

1) Project Description and Information Sources:

Brief project description: (*e.g., Design and construction of 4 new wells to provide a total capacity of 6 mgd for emergency and drought supply*).

The Regional Water Quality Control Plant currently provides recycled water to several customers within the City of Palo Alto and to the City of Mountainview's recently completed recycled water pipeline. The City of Palo Alto Utilities' Dept is evaluating an additional connection to the Stanford Research Park. The proposed project for purposes of the BAWSCA report is to: (1) Evaluate the regional benefit costs of a connection to the Stanford Research park; and (2) Evaluate additional expansion to areas adjacent to the Stanford Research park and also to other areas within the RWQCP service area.

2) Is supply from this project included in supply projections as presented in the updated 2010 UWMP documents?

X Yes ____ No

3) Indicate the type of project by selecting one of the categories below.

X Recycled Water for Non-Potable Reuse
X Recycled Water for Indirect Potable Reuse
____ Groundwater Wells
____ Desalination
____ Water Transfers
____ Groundwater Banking
____ Local Stormwater/Urban Runoff/Other Water Capture
____ Graywater
____ Other

4) a) What types of demands will be served by the project?

Check all that apply.
X Potable
X Non-potable
____ Other

Specify type: the Stanford research Park project will serve primarily irrigation demand and a smaller proportion of cooling tower usage. Future expansions and adjacent projects could include indirect re-use

b) Which agency customers will the project serve?

Check all that apply.
____ All Agency Customers
____ Residential
X Commercial
X Industrial
X Municipal
X Dedicated Irrigation
X Golf/Park
____ Other
____ Not yet investigated/Do not know

c) Could other agencies be served by this project?

X Yes ____ No ____ Not yet investigated/Do not know

If yes, specify agency(ies): Stanford, Los Altos, Purissima Hills, Menlo Park(?)

5) When will the supply be used?

Check all that apply.
____ Daily/Normal Use
____ Drought-Only Use

Expected Frequency *(e.g., X years out of every Y years)* :

____ Emergency Use
X Seasonal Use (*e.g., irrigation*)

6) Will this project be developed by an individual agency or a regional partnership?

Check all that could apply, indicating your preference with a "1".
X Individual Agency

Specify agency: City of Palo Alto Utilities Dept.; City of Palo Alto Public Works Dept. (Treatment Plant)

____ Regional Partnership
Specify other agencies: ____________________
____
____

Indicate agreement type (*e.g. JPA, MOU, etc.*):

Project: PA-2: Expand Recycled Water Plant to Serve Stanford Research Park

Return to Instruction Sheet

*Instructions: Please identify all project information in the **ORANGE** shaded cells, to the extent that information is currently available. For each type of facility, use as many lines as needed. All project elements may not apply to every type of project. If detailed information on all the facilities is not available, please complete "General System Information" at the bottom of this sheet. Cells will change color after information is entered.*

Infrastructure - Facilities

Project Element	Description					Cost Information								Ownership								Facility Reliability	
Treatment	**Process/Type**		**Capacity (mgd)**	**Location**	**Notes/Comments**	**Capital Cost ($)**	**Annual Production (AF)**	**Annual O&M Cost ($)**	**Annual Water Transfer Cost ($)**	**Total Annual Cost ($)**	**Cost per AF ($/AF)**	**Base Year for Cost Est.**	**Notes/Comments**	**Existing Facility? (Y/N)**	**Rehabilitation of Existing Facility? (Y/N)**	**Age of Facility (Years)**	**Expansion of Existing Facility? (Y/N)**	**New Facility? (Y/N)**	**SFPUC owned Facility? (Y/N)**	**Other owner/Don't Know**	**Notes/Comments**	**Are Facilities located near existing faults? (Y/N)**	**Location**
1)	Disinfection		8.6	RWQCP	Expansion of new UV system may allow production of up to 8.6 MGD	$100,000	9,632	?	$0			2,009	UV expansion project costs embedded in Treatment plant CIP. Expansion from 6 mGD production capacity to 8.6 will require addition of new UV Bank	Y/N		3 years			N	RWQCP	RWQCP owns and operates system	N	
Conveyance - Pipelines	**Length (feet)**	**Diameter (inches)**	**Capacity (mgd)**	**Location**	**Notes/Comments**	**Capital Cost ($)**	**Annual Production (AF)**	**Annual O&M Cost ($)**	**Annual Water Transfer Cost ($)**	**Total Annual Cost ($)**	**Cost per AF ($/AF)**	**Base Year for Cost Est.**	**Notes/Comments**	**Existing Facility? (Y/N)**	**Rehabilitation of Existing Facility? (Y/N)**	**Age of Facility (Years)**	**Expansion of Existing Facility? (Y/N)**	**New Facility? (Y/N)**	**SFPUC owned Facility? (Y/N)**	**Other owner/Don't Know**	**Notes/Comments**	**Are Facilities located near existing faults? (Y/N)**	**Location**
1)	8300	18	4.64	Segment 1	Peak Hour. Different pipeline sizes for different segments. Future expansions to adjacent areas not addressed	$5,398,000	N/A					2,008	Annual O&M costs estimated to be $400,000 to $600,000.	N	N	0	N	Y	N			n	
2)	10300	16	3.9	Segment 3	See above	$2,653,000	N/A							N	N	0	N	Y	N			n	
3)	2100	12	1.9	Segment 6	See above	$502,000	N/A							N	N	0	N	Y	N			n	
4)	1800	6	0.26	Segment 7	See above	$1,489,000	N/A							N	N	0	N	Y	N			n	
5)	6500	10	0.95	Segment 8	See above	$1,437,000	N/A							N	N	0	N	Y	N			n	
Conveyance - Pump Stations	**Type**	**Size (HP)**	**Capacity (mgd)**	**Location**	**Notes/Comments**	**Capital Cost ($)**	**Annual Production (AF)**	**Annual O&M Cost ($)**	**Annual Water Transfer Cost ($)**	**Total Annual Cost ($)**	**Cost per AF ($/AF)**	**Base Year for Cost Est.**	**Notes/Comments**	**Existing Facility? (Y/N)**	**Rehabilitation of Existing Facility? (Y/N)**	**Age of Facility (Years)**	**Expansion of Existing Facility? (Y/N)**	**New Facility? (Y/N)**	**SFPUC owned Facility? (Y/N)**	**Other owner/Don't Know**	**Notes/Comments**	**Are Facilities located near existing faults? (Y/N)**	**Location**
1)	RWQCP Booster	350	4.8	RWQCP		$800,000						2,008	See above for annual O&M costs	n	N	0	N	Y	N				
2)	In line Booster	400	4.1	Mayfield Park		$900,000								n	N	0	N	Y	N				
Storage	**Type**	**Number of Tanks (#)**	**Capacity each Tank (MG)**	**Location**	**Notes/Comments**	**Capital Cost ($)**	**Annual Production (AF)**	**Annual O&M Cost ($)**	**Annual Water Transfer Cost ($)**	**Total Annual Cost ($)**	**Cost per AF ($/AF)**	**Base Year for Cost Est.**	**Notes/Comments**	**Existing Facility? (Y/N)**	**Rehabilitation of Existing Facility? (Y/N)**	**Age of Facility (Years)**	**Expansion of Existing Facility? (Y/N)**	**New Facility? (Y/N)**	**SFPUC owned Facility? (Y/N)**	**Other owner/Don't Know**	**Notes/Comments**	**Are Facilities located near existing faults? (Y/N)**	**Location**
1)	Title 22 RW	1	0.6	RWQCP	Existing storage	Existing								Y	N	Unknown			N			N	
2)	Title 22 RW	1	1.8	RWQCP	Converted Cl Tank once UV project complete.	TBD							Existing Chlorine tank to be converted to RW stroage tank.	N	Y	Unknown			N			N	
General System Information	**Source**	**Treatment**	**Capacity (mgd)**	**Connection**	**Notes/Comments**	**Capital Cost ($)**	**Annual Production (AF)**	**Annual O&M Cost ($)**	**Annual Water Transfer Cost ($)**	**Total Annual Cost ($)**	**Cost per AF ($/AF)**	**Base Year for Cost Est.**	**Notes/Comments**	**Existing Facility? (Y/N)**	**Rehabilitation of Existing Facility? (Y/N)**	**Age of Facility (Years)**	**Expansion of Existing Facility? (Y/N)**	**New Facility? (Y/N)**	**SFPUC owned Facility? (Y/N)**	**Other owner/Don't Know**	**Notes/Comments**		
1)																							

Project: PA-2: Expand Recycled Water Plant to Serve Stanford Research Park

Instructions: Please complete project information in the **ORANGE** *shaded cells. For all responses, use as many lines as needed or attach additional sheets. Cells will change color after information is entered.*

Return to Instruction Sheet

Supply Reliability Information

1) **Normal year yield in acre-feet per year:** Current Yield 2-4 MGD. Project to serve Stanford Research Park additional .8 MGD

3) **Is the project yield dependent on hydrology/weather?**
___ Yes X No ___ Not yet investigated/Do not know

4) **Peak capacity in million gallons per day:** 1.99

6) **Could the project water supply be subject to regulatory restrictions that affect project feasibility, cost, or schedule?**

X Yes ___ No ___ Not yet investigated/Do not know

If yes, list restrictions:
1) Project is subject to Title 22 water quality standards and other future legal or regulatory risks, including future limitations on Recycled Water due to Salt and Nutrient Management Plans.
2)
3)

Water Quality Information

1) **What is the expected total dissolved solids (TDS) concentration of product water in milligrams per liter (mg/L)?**
___ mg/L TDS

2) **For projects designed to meet non-potable water demands, to what level will the finished water be treated?**
Check all that apply.
___ Disinfection only
___ Secondary treatment
___ Secondary treatment with disinfection
X Tertiary treatment
___ Membrane bioreactor
___ Membrane bioreactor/reverse osmosis
___ Denitrification
___ Other Please specify type:

3) **Are there any limitations on application or use of this water due to water quality concerns (*e.g., TDS for irrigation, etc.*)?**
X Yes ___ No ___ Not yet investigated/Do not know

If yes, explain:
It is likely irrigation with Redwoods will prove to be a future limitation. However, the RWQCP and the Plant partners have created an inflow and infiltration program and it is possible the TDs could fall to the 600-700 PPM in the very near future.

Project: PA-2: Expand Recycled Water Plant to Serve Stanford Research Park

Return to Instruction Sheet

Instructions: Please complete project information in the ***ORANGE*** *shaded cells. For all responses, use as many lines as needed or attach additional sheets. Cells will change color after information is entered.*

Project Implementation Schedule Information

1) Current Project Status:

Indicate the current status of the project based on the definitions provided below.

____ Existing project under development

X Planned project identified by a BAWSCA member agency

____ Potential future new project not specifically identified or specifically studied by a BAWSCA member agency to date

2) If available, what is the projected schedule for project implementation?

Project Step	Estimated Duration	Estimated Completion Year
Planning	Complete	
Demonstration project/pilot study		
Design	1	2012
Environmental documentation/permitting	1	2011
Construction	2	2014
Startup		

3) Does the potential for expansion exist beyond the above identified phases?

X Yes ____ No ____ Not yet investigated/Do not know

If yes, identify the ultimate yield in acre-feet per year: 2MGD to 3

and capacity in mgd: 2000 AFY to 3000AFY

Project: PA-2: Expand Recycled Water Plant to Serve Stanford Research Park

Return to Instruction Sheet

Instructions: Please complete project information in the **ORANGE** *shaded cells. For all responses, use as many lines as needed or attach additional sheets. Cells will change color after information is entered.*

Project Funding Information

1) What is the source(s)/potential source(s) of funding for the project?
(*e.g., your agency, developers, user fees, member agency bonds, state grants/loans, federal grants/loans, etc.*)

	Potential Funding Source	When will these funding sources be available?
example:	*IRWMP Grant*	*Fall 2011*
1)	Prop 84	Unknown
2)	Title 16	Pending Authorization
3)	SWRCB SRF	After project approval
4)		
5)		

Project Implementation Potential

1) Does the project involve coordination with other agencies or entities (not related to permitting)?
X Yes ____ No ____ Not yet investigated/Do not know

If yes, list agencies and any previously identified coordination-related issue(s) (*e.g., funding, conveyance, identifying customers, etc.*)

RWQCP
RWQCP Plant partners

2) What are the permitting/regulatory requirements for the project? Check all that apply.

X NEPA – sponsoring federal agency
X CEQA – lead agency (water provider)
____ Clean Water Act (Wetland Permit), Rivers and Harbor Act – US Army Corps of Engineers
____ Drinking Water Standards and Regulations – California Department of Public Health
____ Water Rights Permits, Clean Water Act (Water Quality Certification), NPDES Permits – State Water Resources Control Board
____ Recycled Water Regulations – California Department of Public Health, Regional Water Quality Control Board, State Water Resources Control Board
____ Lake or Streambed Alteration – California Department of Fish and Game
____ Endangered Species – US Fish and Wildlife Service, National Marine Fisheries Service
____ Cultural Resources – State Historic Preservation Office
____ Development Permits – cities, counties

Project: PA-2: Expand Recycled Water Plant to Serve Stanford Research Park

Return to Instruction Sheet

Instructions: Please complete project information in the ***ORANGE*** *shaded cells. For all responses, use as many lines as needed or attach additional sheets. Cells will change color after information is entered.*

Potential Environmental Impacts

1) **What are the expected treatment and pumping energy requirements in kilowatts per year?**
(*This will be used as surrogate for greenhouse gas emissions.*)
4834820 kilowatts per year

2) **Will this project provide environmental benefits?**
____ Yes ____ No ____ Not yet investigated/Do not know

If yes, explain:

3) **Will this project cause adverse impacts to habitat areas?**
____ Yes X No ____ Not yet investigated/Do not know

4) **Have other significant environmental impacts been identified?**
(*e.g., increased flood potential, decrease water quality, increased discharges to surface water bodies, etc.*)
Staff is currently preparing a single issue EIR to address issue associated with RW use on sensitive plant species (primarily redwood).

Appendix C
References

City of Redwood City:

Initial Study for the Redwood City Recycled Water Project, June 2002, CH2MHill.

Water Recycling Feasibility Study for Redwood City Final Report, August 7, 2002. Kennedy/Jenks Consultants.

Technical Memorandum Redwood City Recycled Water Program, Internal Memo Design Basis: Recycled Water Production, Storage and Pumping Facilities, 7 January 2004.

City of Redwood City Recycled Water Program, SBSA Facilities Project Disinfection Storage and Pumping Facility Design Criteria Summary, Draft Final, 9 January 2009, Kennedy/Jenks Consultants.

City of Palo Alto:

Notice of Preparation of a Draft Environmental Impact Report (EIR) for the City of Palo Alto Utilities Recycled Water Project, June 2011.

City of Palo Alto Recycled Water Facility Plan, December 2008, RMC.

City of Palo Alto Recycled Water Project Initial Study/Mitigated Negative Declaration, March 2009, RMC.

Exhibit 4
Revised Draft Task 2-D Memo
Rainwater Harvesting, Stormwater Capture and Greywater Reuse

CDM Smith

CDM Smith

Memorandum

To: *Nicole Sandkulla*

From: *Bill Fernandez*
Mark McCluskey
Don VanderTulip

cc: *Craig Von Bargen*
Phillippe Daniel

Date: *February 22, 2012*

Subject: *Revised Draft Task 2-D Memo Rainwater Harvesting, Stormwater Capture and Greywater Reuse*

1.0 Introduction

In this Memo:

1. Introduction
2. Rainwater Harvesting
3. Stormwater Capture
4. Greywater Reuse

Appendices:

- A - Technical Memorandum: Draft Rainwater Harvesting and Graywater Use Potential

The May 2010 Phase I Scoping Report for the Bay Area Water Supply and Conservation Agency (BAWSCA) Long-Term Reliable Water Supply Strategy (Strategy) identified a variety of water supply management projects (projects) that could potentially address the future water supply needs of the BAWSCA member agencies through 2035. The potential projects included groundwater, water transfers, recycled water, desalination, expanded conservation, and local water capture and reuse. The local water capture and reuse alternatives discussed herein include rainwater harvesting, stormwater capture, and greywater reuse.

This memorandum presents an overview of estimated potential yields, costs and other information for rainwater harvesting, stormwater capture, and greywater reuse projects for inclusion in the Strategy to help BAWSCA member agencies address their future supply needs. It is important to note that given the nature of these types of projects and the available information to date, the information on yields is an estimate and should be viewed as such.

1.1 Projects Evaluated

For the sake of clarity, local water capture and reuse projects, as presented herein, are defined below:

- ***Rainwater Harvesting:*** Rainwater conveyed from a building roof and stored in a barrel or cistern for reuse. The stored rainwater can be used for landscape irrigation without being disinfected. If the stored rainwater is used for toilet flushing or other non-potable uses, filtration and disinfection is required.

- ***Stormwater Capture:*** Collection of rainwater (that normally runs off land surfaces into municipal storm drains) in large ponds, tanks, and reservoirs for uses such as irrigation and groundwater recharge. Stormwater capture projects include low-impact development (LID) projects that capture and store urban runoff for reuse as a non-potable supply or to recharge groundwater.

- ***Greywater (also spelled graywater, grey water, and gray water):*** Untreated waste water that has not come in contact with toilet waste. Greywater includes water from bathtubs, showers, bathroom sinks, and washing machines. In California, waste water from kitchen sinks or dishwashers is not an acceptable source of greywater.

1.2 Summary of Project Information

1.2.1 Summary of Project Yield and Cost

Rainwater Harvesting – A preliminary estimate of the potential yield for rainwater harvesting in 2035 in the BAWSCA service areas ranges from 190 acre-feet per year (AF/year) to 610 AF/year. This calculation is based on the projected number of single family residential units within the BAWSCA service area in 2035, average monthly rainfall, average roof size, the percentage of roof area captured by the system, and assumed percentage of total homes that install a rainwater harvesting system, termed the "participation rate". The range in yield was determined by varying the percent of roof runoff that is captured by the rainwater harvesting system (25 and 50%) and participation rate (10 and 20%). The cost of this supply ranges from $13.3 to $26.6 million assuming each household system costs $300 (estimate for 1 rain barrel, and associated fittings, per unit and an estimated life of 15 years) and 44,400 (10% participation rate) and 88,800 (20% participation rate) households participating.

Stormwater Capture – Projects that capture stormwater, reduce potable water demand, and increase the groundwater supply through recharge could potentially save an estimated 4,100 to 7,500 AF/year through reduction of potable water outdoor irrigation demands, recharge of groundwater supplies, and possible storage and reuse of captured stormwater with BAWSCA service area-wide implementation of LID projects[1]. The wide ranges of potential water supply reductions reflect a set of variables and input values that include average monthly rainfall throughout the region, land use information including surface impervious metrics, and method of retention (either capture and storage for reuse or infiltration into the groundwater aquifer in areas where large-scale groundwater pumping occurs). Reliable cost information is not currently available for implementation of LID projects on a regional or local scale.

Greywater Reuse – An estimate of potential greywater yield in 2035 for the BAWSCA member agencies' service areas ranges from 1,120 AF/year to 2,700 AF/year for simple systems used for irrigation based on a calculation using the number of single family residential units within the BAWSCA service area, assumed participation rate, and an average volume of greywater generated per household. The range in yield was estimated by varying the average volume of greywater generated per household (41 – 108 gallons per day). The yield range is based on greywater use per household. The cost of this supply is estimated to range from $13.3 to $26.6 million assuming costs of $300 per participating household (estimate for 1 storage barrel, and associated fittings, per unit and an estimated life of 15 years) and 44,400 to 88,800 households participating.

Yield and cost information for the rainwater harvesting, stormwater capture, and greywater reuse projects presented in this memorandum are summarized in Table 1. Estimates of cost per acre-foot assume a project life expectancy of 15 years.[2]

Table 1
Summary of Estimated Potential Project Yields and Cost for Regional Implementation of Rainwater Harvesting, Stormwater Capture, and Greywater Reuse Projects

Item	Rainwater Harvesting Project	Stormwater Capture Project	Greywater Reuse Project
Assumed Annual Production (AF/Year)	190 – 610	4,100 – 7,500	1,120 – 2,700
Capital Cost ($M)	$13.3 – $26.6	N/A	$13.3 – $26.6
Cost per Acre-foot ($/AF)[1]	N/A	N/A	N/A

[1] Cost per acre foot based on estimated capital cost in 2011 divided by estimated production over 15 years.

[1] A study by the Natural Resources Defense Council (NRDC) found that LID has a substantial potential to save both water and energy in the San Francisco Bay area California. The group estimated that LID projects implemented throughout a 3,850 square mile study area including San Francisco, Marin, Contra Costa, Alameda, Santa Clara, and San Mateo counties could provide 34,500 – 63,000 acre-feet (AF) of water per year by 2030 (or 9 – 16.4 AF/year of savings per square mile) (NRDC 2009). Using this example, the 460 square mile BAWSCA service area would potentially save 4,100 - 7,500 AF per year through service area-wide implementation of LID projects.

[2] A 2009 Colorado State study entitled "Economic And Environmental Analysis Of Residential Greywater Systems For Toilet Use" indentified the typical lifespan of greywater systems as 15 years, at which point important system components such as pumps or valves may need replacing. This assumption was used for the rainwater harvesting and stormwater capture projects presented in this memorandum as well. http://www.urbanwater.colostate.edu/Final_GW_Toilet_Use_CRC.pdf

1.2.2 Other Project Information and Evaluation Criteria

Additional project information to be used in comparing rainwater harvesting, stormwater capture, and greywater reuse projects are summarized in Table 2.

Table 2
Project Summary
Evaluation Criteria and Metric Values

Objective	Criteria	Metrics	Project Values		
			Rainwater Harvesting	**Stormwater Capture**	**Greywater Reuse**
1 - Increase Supply Reliability	**Criterion 1A** – Ability to Meet Normal Year Supply Need	Quantitative (AF /year): Average annual yield in normal years in 2018 and 2035.	190 – 610	4,100 – 7,500	1,120 – 2,700
	Criterion 1B – Ability to Meet Drought Supply Need	Quantitative (AF/year): Average annual yield with drought hydrology of 1987 – 1992.	0	0	1,120 – 2,700
	Criterion 1C – Risk of Facility Outage	Qualitative (1-5): Estimated probability and duration of major conveyance failure	[1]	[1]	[1]
	Criterion 1D – Potential for Regulatory Vulnerability	Qualitative (1-5): Potential for regulatory decisions to impact supply reliability	[1]	[1]	[1]
2 - Provide High Level of Water Quality	**Criterion 2A** – Meets or Surpasses Drinking Water Quality Standards	Quantitative (mg/L): Total dissolved solids (TDS) level as an indicator of water quality.	N/A	N/A	N/A
	Criterion 2B – Meets or Surpasses Non-Potable Water Quality Standards	Qualitative: Meets minimum water quality requirement (e.g., Title 22) for the targeted use. (Yes or no)	No[2]	No[2]	No[2]
3 - Minimize Cost of New Water Supplies	**Criterion 3** – Capital and Present Worth Costs	Quantitative ($/AF): Present Worth costs including capital and operating costs[3]	N/A	N/A	N/A
4 - Reduce Potable Water Demand	**Criterion 4** – Augment Non-Potable Water Supplies	Quantitative (AF/year): Reduction of potable water demand by use of non-potable supply.	190 – 610	4,100 – 7,500	1,120 – 2,700
5 - Minimize Environmental Impacts	**Criterion 5A** –Greenhouse Gas Emissions	Quantitative (metric tons/ AF of Supply): Estimates of unit greenhouse gas emissions	[1]	[1]	[1]
	Criterion 5B –Impact to Groundwater Quantity and Quality	Qualitative (1-5): Potential impacts to groundwater levels, groundwater quality, or potential for subsidence	[1]	[1]	[1]
	Criterion 5C –Impact to Habitat	Qualitative (1-5): Potential impacts to habitat, such as wetlands, riparian zones, fisheries, and inundation areas.	[1]	[1]	[1]
6 - Increase Implementation Potential	**Criterion 6A** – Institutional Complexity	Qualitative (1-5): Number and type of agencies and agreements involved	[1]	[1]	[1]
	Criterion 6B –Level of Local Control	Qualitative (1-5): BAWSCA and Member Agency ownership of supply projects	[1]	[1]	[1]
	Criterion 6C –Permitting Requirements	Qualitative (1-5): Permitting or regulatory issues for supply projects	[1]	[1]	[1]

[1] These values will be developed as part of the overall analysis and comparison of projects.
[2] To meet Title 22 water quality standards, filtration and/or treatment would be necessary.
[3] Estimates of capital costs in $/AF assume a 15 year life expectancy for projects and are based on estimates of cost in 2011. The capital cost represents only the estimated cost for purchase and installation.

1.2.3 Implementation

Individual rainwater harvesting, stormwater capture, and greywater reuse projects, depending on ownership and size, will vary in the time required to implement. More importantly the overall realization of water use reduction is dependent on when these individual projects are developed, and how they are operated, maintained and replaced. This realized potable demand reduction will be a function of community and individual interest, cost for installation and maintenance, operation and maintenance of system, potential financial incentives, and local regulations encouraging or limiting implementation.

1.2.4 Key Issues

A partial list of potential key issues associated with rainwater harvesting, stormwater capture and greywater reuse projects is provided below:

- For supplies that are rainfall dependent, like rainwater harvesting and stormwater capture, the frequency and amount of rainwater does not coincide with water demands. Most of the rainfall in the Bay Area falls between November and March, when outdoor irrigation demands are low. Moreover, these supplies are not available during drought periods;

- Greywater systems can be expensive to retrofit because of the dual plumbing (wastewater and greywater) required;

- Greywater can contain soaps and other chemicals that can kill plants and antimicrobial products (triclosan) that can reduce beneficial soil microbes. Additionally, water with high sodium levels can cause discoloration and burning of leaves, contribute to alkaline soil conditions, can be toxic to plants, and can prevent calcium from reaching plants;

- Storage capacity can be a limiting factor on the yield of a project;

- Some systems will require pressure pumps and controls which increases complexity, cost, and potential of system breaking down without proper maintenance;

- It can often be difficult and costly to obtain a permit for stormwater capture and greywater reuse systems; and

- Implementing small rainwater harvesting, stormwater capture, and greywater reuse projects might be developed in service areas of an agency that does not have a water supply need. To achieve an overall benefit in the region, transfers may be required.

1.3 Next Steps

Based on the preliminary information presented in this memorandum these types of potential supply projects will be compared with the Agency-Identified and Regional water supply management projects. It is important to note that given the nature of these types of projects and the available information to date, the information on yields is an estimate and any assumptions and calculations made should be refined. These projects developed and presented in this memo are part of several that might be part of the long-term supply opportunities for the BAWSCA member agencies. Prior to more detailed development of project information, these supply projects will be compared based on a series of criteria to determine which projects warrant additional investigation and/or evaluation.

In terms of drought supply, only greywater reuse is expected to provide yield during a drought, since rainwater harvesting and stormwater capture are rainfall dependent. Because greywater reuse creates a more reliable year-round supply of water, less storage is typically needed compared to rainfall-dependent sources to provide a similar level of supply.

Information gaps still exist in terms of the feasibility and potential yield and cost of stormwater capture projects which will have to be addressed before this supply option is further considered in the Strategy. As more stormwater capture projects, like East Palo Alto's Martin Luther King Park system discussed in Section 3, are developed and implemented, more data will be available to assess the costs and benefits of these types of projects.

2.0 Rainwater Harvesting

Rainwater runoff collected from roof surfaces by gutters and downspouts is usually stored in containers called "rain barrels" for use during a subsequent dry day. Using stored water for landscape watering and non-potable indoor uses reduces potable water demands. In most straightforward single-family residential application rainwater collected via roof rainfall storage could be used to irrigate a yard or garden. This simple application requires only the purchase of a rain barrel and the appropriate hoses and fittings to convey water to the irrigated area. In some instances, subsidies are available from cities or water suppliers to reduce the cost of rain barrels.

For larger scale roof rainwater collection and storage, such as for commercial developments and multi-family housing, greater quantities may be captured if large cisterns are constructed in basements, underground or surface level storage tanks. The stored rainwater is then pumped from storage and used for non-potable purposes such as irrigation, car washing, clothes washing machines, toilet flushing, swimming pools, and process water for commercial and industrial uses. Many of these applications, including toilet flushing, use in swimming pools and process water, require treatment and separate piping systems.

2.1 Potential Yield and Costs for Rainwater Harvesting Projects

A preliminary estimate of the potential yield from rainwater harvesting in the BAWSCA member agencies' service areas in the year 2010 was estimated to range from 150 AF/year to 480 AF/year based on a calculation using the number of single family residential units within the BAWSCA service area, average monthly rainfall and average roof size. The range was determined by varying the percent of roof that is being captured by the rainwater harvesting system. The cost of this supply would be approximately $10.5 and $21 million assuming each families system cost $300 (rain barrel and fittings) and 34,900 and 69,800 households participating. Potential yield in 2035 is estimated at between and 190 AF/year to 610 AF/year, using similar calculations. The cost of this supply would be approximately $13.3 to $26.6 million. It should be noted that these calculations assume 20% participation amongst single family residential units[3].

A range of the rainwater harvesting supply yield has been developed after comparing precipitation conditions of various cities. The high variation in spatial and temporal rainfall in the United States allows for the potential to overestimate the yield of rainwater harvesting in California. Table 3 compares monthly precipitation data for a range of BAWSCA member agencies, with communities known for their active rainfall harvesting programs.

Table 3
Comparison of Mean Monthly Precipitation for Select BAWSCA Member Agencies (inches)

Month	Redwood City	Coastside County Water District	City of Santa Clara
January	4.29	5.50	3.00
February	3.60	4.80	2.50
March	2.81	3.90	2.40
April	1.24	1.60	1.10
May	0.43	0.60	0.40
June	0.11	0.20	0.10
July	0.02	0.00	0.00
August	0.06	0.10	0.00
September	0.17	0.30	0.30
October	0.99	1.30	0.70
November	2.32	3.40	1.50
December	3.80	3.70	2.70
Total	**19.84**	**25.40**	**14.70**

Source: 2005 UWMPs for Redwood City, CCWD, and Santa Clara.

Rainwater harvesting yield is based on potable demands being offset when rainwater is available. This quantity is determined based on precipitation conditions, storage capacity, demand of uses (irrigation or indoor toilet flushing, etc.), and participation rates. A range of potential yield was calculated based on specific assumptions. For 1,000 square feet of roof area, every inch of rainfall can produce approximately 623 gallons of rainwater. For example, for 17 inches of rainfall a year, up to 10,600 gallons could theoretically be captured annually from a 1,000 square foot roof, adjusted for the amount lost as a first flush, the capture rate, storage capacity, use during capture times, etc.

In the Bay Area, the months of November through February typically require little to no irrigation supplies, while irrigation demands are highest in May through August. The shoulder months of March, April, September, and October have the greatest potential to fully utilize stored rainwater

[3] Actual acceptance rates are difficult to estimate because of the many influences an agency needs to accommodate in its program design. The only available documented acceptance rate statistic found is for the State of Queensland where 20 percent of the population has installed rain catchment tanks since 2006. Although rainwater harvesting systems were not required in Queensland, rebates were offered and a strong outreach program implemented during the decades-old drought.

as there is sporadic rainfall to capture while there is demand for the water. With rainfall heaviest between November and February, during times where irrigation demands are lowest, available storage becomes the criteria for yield potential. Residential barrels available for individual downspouts typically have a capacity of 50 to 75 gallons each while more expensive cisterns of several hundred to several thousand gallons can be sited under decks and other structures at a home.

Commercial applications are similarly limited to storage capacity; underground cisterns are more financially feasible when constructed in new development. Irrigation demands are typically more limited for commercial applications than for residential lands but toilet demands could be greater.

A range of potential yield to offset potable water demands for single family homes in the BAWSCA service area was calculated. A similar calculation could be made for multi-family and commercial uses with storage being the most important criteria. The following assumptions were made in determining single-family residential potential.

- Average annual rainfall (using Redwood City to represent average precipitation conditions for the BAWSCA member agency service areas) is approximately 20 inches;
- BAWSCA's annual survey indicates a 2009 population of 1.7 million and 2 million at 2030. The 2030 estimate was used here for 2035;
- BAWSCA's annual survey indicates 350,000 (rounded from 348,662) single family residential accounts (BAWSCA, 2010). This estimate was confirmed by calculating homes from population (1.7 million population at 2.7 people per household = 630,000 dwelling units x .60 percent for single-family units, attached and detached equals approximately 377,000 single family dwelling units [sfdu]);
- For year 2035 based on the above formula for a 2 million population, 444,000 sfdu are estimated;
- Average roof size is 1,500 square feet (sf);
- As presented in Table 4, an estimate of the potential water savings based on irrigation needs and storage capacity was made for each month. The assumptions include: (1) from November through February, no water savings was assumed due to the availability of rain during this period and subsequently low irrigation demand, (2) for the summer months between May and August, it is assumed that the maximum amount of potential water savings would be realized, including the use of up to one 55 gallon barrel a day to meet outdoor irrigation demand (55 gallons x 30 days a month = 1650 gallons total), and (3) during the spring and fall months of March, April, September and October, one-half of the maximum potential water savings would be realized, equal to the use of one 55 gallon barrel every two days (55 gallons x 15 days a month = 825 gallons total); and

- The estimated maximum water savings is the minimum of the rainfall captured and the potential water savings based on irrigation needs and storage capacity for each month.

For the higher yield estimate, it was assumed that 50 percent of the roof area could be captured in a barrel or cistern and there is a 20 percent participation rate. Fifty (50) percent of roof area was assumed because rain barrels only capture a portion of the roof and to compensate for a diverted first flush. As presented in Table 4, under these assumptions the maximum amount of supply to potentially offset potable demands from rainfall harvesting with 2010 conditions is approximately 156 MG (479 AF) from single family homes and 199 MG (610 AF) at 2035.

Table 4
Rainwater Harvesting High Yield Worksheet

Month	Rainfall (Redwood City) (inches)	Roof Area (sf/du)	Rainfall Volume (gallons/du)	Potential Rainfall Captured Assuming 50% of Roof Area Connected to System[1] (gallons/du)	Potential Water Savings Based on Irrigation Needs and Storage Capacity[2] (gallons/du)	High Yield Estimated Water Savings[3] (gallons/du)	Service Area High Yield Estimate with 20 Percent Participation Rate[4] (MG)	
							2010	2035
January	4.29	1500	4,009	2,004	0	0	0.0	0.0
February	3.60	1500	3,364	1,682	0	0	0.0	0.0
March	2.81	1500	2,626	1,312	825	825	57.6	73.3
April	1.24	1500	1,159	580	825	580	40.5	51.5
May	0.43	1500	402	200	1650	200	14.0	17.8
June	0.11	1500	103	52	1650	52	3.6	4.6
July	0.02	1500	19	10	1650	10	0.7	0.9
August	0.06	1500	56	28	1650	28	2.0	2.5
September	0.17	1500	159	80	825	80	5.6	7.1
October	0.99	1500	925	462	825	462	32.2	41.0
November	2.32	1500	2,168	1,084	0	0	0.0	0.0
December	3.80	1500	3,551	1,776	0	0	0.0	0.0
Total	**19.84**	**1500**	**18,540**	**9,270**	**9,900**	**2,237**	**156**	**199**

1 A runoff coefficient of 85 percent is typically applied to account for evaporation, retention, first flush loss, etc.; this was accounted for within the 50 percent roof area assumption.
2 Zero potential water savings were assumed for November through February. The maximum amount of potential water savings assumed for the summer months between May and August is use of up to one 55 gallon barrel a day to meet outdoor irrigation demand (55 gallons x 30 days a month = 1650 gallons total). During the spring and fall months of March, April, September and October, the potential water savings is assumed to be one-half of the maximum, equal to the use of one 55 gallon barrel every two days (55 gallons x 15 days a month = 825 gallons total).
3 Maximum estimated water savings is the minimum of the rainfall captured and the potential water savings based on irrigation needs and storage capacity for each month.
4 349,000 total dwelling units assumed for 2010; 444,000 assumed for 2035.

However, because of cost considerations for storage and plumbing retrofit to accommodate toilets (with backflow preventers etc), space limitations for storage, and lack of water demands during months of greatest supply availability, a lower yield was estimated to offset potable demands. Total annual estimated potential yield was 48 MG (150 AF) for 2010 conditions and

61 MG (190 AF) for 2035. If harvested rainwater were used for toilets, a significant increase in yield would be possible, using a greater supply during winter months.

For the purposes of this memorandum, costs for the rainwater harvesting system were assumed to include only the basic tank and fittings (~$300 per system). The cost range based on this assumption would be $13.3 to $26.6 million for the minimum and maximum yield estimates, respectively. This assumes 10% participation (44,400 households) to 20% participation (88,800 households). Based on these cost estimates, the cost per AF for the rainwater harvesting supply would be $2,900 to $4,800, assuming a life expectancy of 15 years for the rainwater harvesting system.[4]

Table 5
Rainwater Harvesting Low Yield Worksheet

Month	Rainfall (Redwood City) (inches)	Roof Area (sf/du)	Rainfall Volume (gallons/du)	Potential Rainfall Captured Assuming 25% of Roof Area Connected to System[1] (gallons/du)	Potential Water Savings Based on Irrigation Needs and Storage Capacity[2] (gallons/du)	Low Yield Estimated Water Savings[3] (gallons/du)	Service Area Low Yield Estimate with 10 Percent Participation Rate[4] (MG)	
							2010	2035
January	4.29	1500	4,009	1,002	0	0	0.0	0.0
February	3.6	1500	3,364	841	0	0	0.0	0.0
March	2.81	1500	2,626	656	825	656	22.9	29.1
April	1.24	1500	1,159	290	825	290	10.1	12.9
May	0.43	1500	402	100	1650	100	3.5	4.4
June	0.11	1500	103	26	1650	26	0.9	1.2
July	0.02	1500	19	5	1650	5	0.2	0.2
August	0.06	1500	56	14	1650	14	0.5	0.6
September	0.17	1500	159	40	825	40	1.4	1.8
October	0.99	1500	925	231	825	231	8.1	10.3
November	2.32	1500	2,168	542	0	0	0.0	0.0
December	3.8	1500	3,551	888	0	0	0.0	0.0
Total	**19.84**	**1500**	**18,540**	**4,635**	**9,900**	**1,362**	**48**	**61**

1 A runoff coefficient of 85 percent is typically applied to account for evaporation, retention, first flush loss, etc.; this was accounted for within the 25 percent roof area assumption.
2 Zero potential water savings were assumed for November through February. The maximum amount of potential water savings assumed for the summer months between May and August is use of up to one 55 gallon barrel a day to meet outdoor irrigation demand (55 gallons x 30 days a month = 1650 gallons total). During the spring and fall months of March, April, September and October, the potential water savings is assumed to be one-half of the maximum, equal to the use of one 55 gallon barrel every two days (55 gallons x 15 days a month = 825 gallons total).
3 Maximum estimated water savings is the minimum of the rainfall captured and the potential water savings based on irrigation needs and storage capacity for each month.
4 349,000 total dwelling units assumed for 2010; 444,000 assumed for 2035.

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4 Rainwater harvesting estimate includes range of yields and costs: $26.6 million / 610 AF/year / 15 years life expectancy = $2,914/AF. $13.3 million / 190 AF/year / 15 years life expectancy = $4,786/AF.

2.2 Other Project Information and Evaluation Criteria

In addition to project yield, cost and schedule there is other project information that will be used in the comparison of water supply management projects. This section presents this preliminary quantitative and qualitative information and how it is applied to the evaluation criteria that will be used in the future comparison of water supply management projects. The Strategy Revised Draft Task Memo: Refined Evaluation Criteria and Metrics, January 25, 2011 provides more information on the development of the criteria, subcriterion and metrics. Following are brief descriptions of the evaluation criteria and their preliminary quantitative and qualitative values based on a regional implementation of rainwater harvesting projects as described in the yield section above. Table 6 summarizes this information.

Table 6
Rainwater Harvesting Project
Evaluation Criteria and Metrics

Objective	Criteria	Metrics	Project Values
1 - Increase Supply Reliability	**Criterion 1A** – Ability to Meet Normal Year Supply Need	Quantitative (AF/year): Average annual yield in normal years in 2018 and 2035	190 – 610
	Criterion 1B – Ability to Meet Drought Supply Need	Quantitative (AF/year): Average annual yield with drought hydrology of 1987 – 1992	0
	Criterion 1C – Risk of Facility Outage	Qualitative (1-5): Estimated probability and duration of major conveyance failure	[1]
	Criterion 1D – Potential for Regulatory Vulnerability	Qualitative (1-5): Potential for regulatory decisions to impact supply reliability	[1]
2 - Provide High Level of Water Quality	**Criterion 2A** – Meets or Surpasses Drinking Water Quality Standards	Quantitative (mg/L): Total dissolved solids (TDS) level as an indicator of water quality	N/A
	Criterion 2B – Meets or Surpasses Non-Potable Water Quality Standards	Qualitative: Meets minimum water quality requirement (e.g., Title 22) for the targeted use	No
3 - Minimize Cost of New Water Supplies	**Criterion 3** – Capital and Present Worth Costs	Quantitative ($/AF): Present Worth costs including capital and operating costs	N/A
4 - Reduce Potable Water Demand	**Criterion 4** – Augment Non-Potable Water Supplies	Quantitative (AF/year): Reduction of potable water demand by use of non-potable supply	190 – 610
5 - Minimize Environmental Impacts	**Criterion 5A** –Greenhouse Gas Emissions	Quantitative (metric tons/ AF of Supply): Estimates of unit greenhouse gas emissions	[1]
	Criterion 5B –Impact to Groundwater Quantity and Quality	Qualitative (1-5): Potential impacts to groundwater levels, groundwater quality, or potential for subsidence	[1]
	Criterion 5C –Impact to Habitat	Qualitative (1-5): Potential impacts to habitat, such as wetlands, riparian zones, fisheries, and inundation areas	[1]
6 - Increase Implementation Potential	**Criterion 6A** – Institutional Complexity	Qualitative (1-5): Number and type of agencies and agreements involved	[1]
	Criterion 6B –Level of Local Control	Qualitative (1-5): BAWSCA and Member Agency ownership of supply projects	[1]
	Criterion 6C –Permitting Requirements	Qualitative (1-5): Permitting or regulatory issues for supply projects	[1]

[1] These values will be developed as part of the overall analysis and comparison of projects.

2.2.1 Supply Reliability

The *Increase Supply Reliability* objective has four criteria:

- *Criterion 1A – Ability to Meet Normal Year Supply Need* - An estimate of the ability of a water supply management project to meet the normal hydrologic year supply needs of BAWSCA member agencies is measured by the annual yield of the project during normal hydrologic conditions by the 2018 and 2035 planning horizons.
  - *The estimated potential yield is indicated in Table 6.*
- *Criterion 1B – Ability to Meet Drought Supply Need* - An estimate of the ability of a water supply management project to meet the supply need during a drought is measured by the annual yield of the project during the 1987 – 1992 drought. The criterion of drought reliability captures whether a supply project is resistant to drought impacts.
  - *The estimated potential yield is indicated in Table 6. Because rainwater harvesting is dependent on rainfall, the estimated potential drought yield is considered to be zero.*
- *Criterion 1C – Risk of Facility Outage* - Supply vulnerability is measured by the probability and duration of potential outages to a particular water supply management project due to a major conveyance failure. This criterion captures the vulnerability of projects to emergency outages. This metric is a qualitative measure ranging from 1 through 5, with a score of "1" identifying the projects that are least susceptible to emergency outages and a score of "5" indicating high susceptibility to conveyance failures.
  - *These values will be developed as part of the overall analysis and comparison of projects.*
- *Criterion 1D – Potential for Regulatory Vulnerability* - The susceptibility of a water supply management project to interruption as a result of regulatory issues includes legal, political, or environmental constraints. This metric is a qualitative measure ranging from 1 through 5, with a score of "1" identifying the projects that are least susceptible to regulatory risk and a score of "5" indicating high susceptibility to regulatory risk.
  - *These values will be developed as part of the overall analysis and comparison of projects.*

2.2.2 Water Quality

The *Provide High Level of Water Quality* objective has two criteria:

- *Criterion 2A – Meets or Surpasses Drinking Water Quality Standards* – A measure representing potable supply is addressed by the quantitative metric of the aggregate water quality, measured by TDS levels, of the potable supply projects and portfolios. TDS is a surrogate for other water quality parameters representing water quality.
  - *This criterion is not applicable to rainwater harvesting.*
- *Criterion 2B – Meets or Surpasses Non-Potable Water Quality Standards* - For non-potable supply projects, where water quality constraints vary according to use, the value will be a

qualitative assessment of whether or not the water supply management projects and portfolios meet the minimum water quality requirement for the targeted use. In most cases, this metric will be used to designate whether a non-potable supply source meets Title 22 requirements, as this is a common target water quality level for a non-potable demand.

- *Filtration and/or treatment may be necessary to meet Title 22 water quality standards.*

2.2.3 Cost

The *Minimize Cost of New Water Supplies* objective has one quantitative criterion:

- *Criterion 3 – Capital and Present Worth Costs* - The present worth costs, including capital, operations, and maintenance costs, for each water supply management project are estimated. The performance metric is the normalized unit cost presented in $/AF for each project.
  - *The costs are indicated in Table 6.*

2.2.4 Reduce Potable Water Demand

The *Reduce Potable Water Demand* objective has one criterion:

- *Criterion 4A –Augment non-potable water supplies* is quantitative metric for the annual yield of additional non-potable supply produced and utilized to offset potable demand.
  - *The estimated potential yield is indicated in Table 6.*

2.2.5 Environmental Impacts

The *Minimize Environmental Impacts* objective includes three qualitative criteria:

- *Criterion 5A* -The metric for *5A* is represented by the increase in greenhouse gas emissions due to a potential water supply management project. This quantitative metric will be measured in terms of metric tons of carbon dioxide produced, or reduced, per unit of supply based on energy use.
  - *These values will be developed as part of the overall analysis and comparison of projects.In general, use of local water sources like rainwater harvesting reduces the energy and treatment requirements of delivering equivalent amounts of potable water from regional sources.*

- *Criterion 5B –Impact to Groundwater Quantity and Quality* - Water supply management projects that do not negatively affect groundwater supplies will be measured favorably in this criterion. A combined qualitative estimate of potential groundwater impacts will be evaluated in terms of potential reductions in groundwater levels, impacts to groundwater quality, and the risk of increase in land subsidence. This metric will be a qualitative measure ranging from 1 through 5, with a score of “1” identifying the projects with the least potential for adversely affecting groundwater quantity and quality and a score of “5” indicating high probability of adverse impacts.

- *These values will be developed as part of the overall analysis and comparison of projects.*

- *Criterion 5C –Impact to Habitat* - This criterion addresses long-term impacts to the ecosystems, not short-term effects related to temporary construction activities. Water supply management projects that do not adversely affect sensitive habitat areas such as wetlands, riparian zones, potential special-status species habitat, or have significant inundation areas will be measured favorably in this criterion. A combined qualitative estimate of potential habitat impacts is evaluated in terms of potential site acreage, proximity to sensitive habitat zones, and flood potential. This metric is a qualitative measure ranging from 1 through 5, with a score of "1" identifying the projects with the least potential for adverse impacts to habitat and a score of "5" indicating high probability of adverse effects to terrestrial, aquatic, and riparian species.

  - *These values will be developed as part of the overall analysis and comparison of projects.*

2.2.6 Implementation Potential

The *Increase Implementation Potential* objective has three qualitative criteria:

- *Criterion 6A –Institutional Complexity* - This criterion addresses the level of institutional coordination required for implementation of a water supply management project. A qualitative metric will be used to estimate the coordination required if multiple local or regional agencies or agreements are necessary. The projects that are assumed to require less coordination, and to receive less opposition, will score better than those that are more complex or potentially controversial.

  - *Rainwater harvesting systems will be owned and maintained by homeowners. This would indicate a high score for this criterion though the values will be developed as part of the overall analysis and comparison of projects.*

- *Criterion 6B –Level of Local Control of Water Supply* - Local management of a water supply management project will minimize dependency on imported water supplies and the drought impacts associated with those supplies. A common rating scale will be developed to evaluate the amount of BAWSCA-owned or BAWSCA member-owned supply for each project. Projects that are fully owned by BAWSCA or the member agencies will score higher than supply projects owned fully or partially by other entities that might be affected by regulatory risk, multiple party agreements, and supplies that may have a higher risk of not being available further into the future, or under drought conditions.

  - *Rainwater harvesting systems will be owned and maintained by homeowners, not the local BAWSCA member agency. This would indicate a low score for this criterion though the values will be developed as part of the overall analysis and comparison of projects.*

- *Criterion 6C –Permitting Requirements* - This criterion addresses the objective of minimizing the regulatory and environmental permitting obstacles associated with water supply management projects. Projects with other similar metrics (including cost) may have differing permitting requirements, which can affect their overall implementation. The performance metric is a qualitative measure of the permitting requirements of each project or portfolio.

- *These values will be developed as part of the overall analysis and comparison of projects.*

2.3 Key Project Issues

2.3.1 Regulatory Issues

There are limited State of California regulations regarding rainwater harvesting. Three proposed bills that apply to general water conservation features in homes (AB 300 and AB 1408) and rainwater harvesting, the Rainwater Capture Act of 2011 (AB 275), were recently introduced in the California state legislature. AB 300 and AB 1408 did not make it out of committee in 2010 and AB 275 was vetoed by the Governor in October of 2011. These bills promoted the installation and use of water conservation devices in the home and, in the case of the Rainwater Capture Act of 2011, promoted the use of rainwater harvesting systems specifically by providing guidance and education to interested homeowners and developers.

Local plumbing codes do not require a permit for exterior rainwater catchment systems used for outdoor drip and subsurface irrigation if they have a maximum storage capacity of 360 gallons.

2.3.2 Other Issues

A partial list of potential issues associated with rainwater harvesting is provided below:

- Frequency and amount of rainwater does not coincide with demands; not an available supply during dry periods of each year;
- Storage capacity limits harvesting during wet periods;
- Capital costs can be high; return on investment is very low;
- Storage requires space and may not be aesthetically pleasing to neighbors;
- Deed restrictions in some developments may limit a homeowner's ability to add an outdoor storage tank (rainbarrel); and
- For developments that utilize larger roof areas for collection of rainwater, the increase in roof size can increase the contamination risks from bird or animal droppings.

2.4 BAWSCA Agency Current Activities

During member agency interviews conducted as a part of the Strategy, several agencies stated that their customers have expressed to them interest in rainwater harvesting, however the high anticipated costs have lowered rainwater harvesting as a priority for most of the agencies. The following BAWSCA agencies offer rainwater harvesting support:

- The City of Millbrae offers rain barrel rebates;

- The City of Palo Alto offers rebates of $50 per rain barrel. Cistern rebates are $0.15 per gallon with a maximum residential rebate of $1,000 and a maximum commercial rebate of $10,000. Palo Alto also hosts rainwater harvesting education events to educate its customers on the benefits and opportunities for rainwater harvesting;
- The City of Brisbane has a Rain Barrel Guidance manual;
- Stanford's Graduate School of Business is considering a 75,000 gallon rainwater harvesting system; and
- Westborough Water District is considering rainwater harvesting to serve the fountain at its office.

2.5 Possible Next Steps

The following possible follow-up steps are based on the review of the potential yield of rainwater harvesting projects in the BAWSCA service area and the actions of other communities with successful rainwater harvesting programs.

- Identify the on-going interest for these types of programs in the Bay Area and for the BAWSCA member agencies; and
- Examine the feasibility of a regional implementation of rainwater harvesting project through a comparison with other potential water supply management projects being investigated as part of the Strategy.

3.0 Stormwater Capture

Stormwater capture involves the collection of rainfall that typically runs off of land surfaces and storage of that water in large ponds, tanks, and reservoirs for the purposes of reuse as irrigation or groundwater recharge. The quantity of stormwater varies throughout the year with typical wet months (November through May) not coinciding with higher water demand summer months. For the period of time following significant stormwater events, landscape or agricultural users do not typically require stored stormwater to supplement irrigation demands. Storage volumes then need to be quite large to support demands for extended periods between storm events. Stormwater reuse project design is therefore typically based on infiltration/storage and subsequent beneficial reuse of the water instead of the traditional stormwater approach to convey the stormwater away from the area a quickly as possible.

Water agencies in Northern and Southern California have implemented large projects to collect and reuse stormwater runoff, primarily to recharge groundwater basins. Most of these are much larger projects than those considered in this memorandum. For example, Alameda County Water District (ACWD) captures local runoff from the Alameda Creek watershed behind inflatable rubber dams which span the width of the Alameda Creek Flood Control Channel. These dams divert water to several hundred acres of ponds (former gravel quarries) where water percolates to recharge the underlying Niles Cone Groundwater Basin. This recharge accounts for approximately 40% of ACWD's total supply.

Santa Clara Valley Water District captures stormwater in its upstream reservoirs for eventual release to downstream groundwater recharge systems, which consist of both in-stream and off-stream facilities. For example, the 3,228 AF Guadalupe Reservoir captures runoff from winter storms to recharge in the Alamitos percolation pond system during the summer. The groundwater aquifers that are recharged through this system, and others like it, are used for water supply by BAWSCA member agencies including Sunnyvale, San Jose, Santa Clara and Mountain View.

The Orange County Water District of Southern California (OCWD) has a recharge system along 6 miles of the Santa Anna River that provides an annual recharge averaging 250,000 AF/year to the Lower Santa Anna River Groundwater Basin, 50,000 AF/year of which is stormwater (Boon, 2009). Dedicated stormwater runoff recharge facilities also exist in the Raymond Basin (SGCWD 2011) in Pasadena. The Los Angeles Department of Water and Power (LADWP) also uses a mixture of imported water and collected urban stormwater runoff for groundwater recharge.

An example of a project with a capacity more feasible to implementation within the BAWSCA service area is the project that the Santa Margarita Water District (SMWD) in Orange County, California. This district, in cooperation with Trabuco Canyon Water District (TCWD), has developed a project to capture urban stormwater runoff to augment their recycled water supply. By rerouting stormwater to the SMWD Portola Reservoir and the TCWD Dove Lake, both recycled water reservoirs, instead of into the Audubon Starr Ranch Sanctuary, the project helps reduce ecological stressors. The project diverts 200 AF/year (SMWD 2011). Implementation of a project of this size in the BAWSCA service area would require a large amount of storage and the ability to recharge the underlying production groundwater aquifer efficiently.

Low-impact development (LID) projects can also reduce potable water demand and increase the groundwater supply through recharge. LID is a term used to describe a land planning and engineering design approach to managing stormwater runoff. LID was developed to ameliorate, and where possible, eliminate the pollution and erosion problems generated by runoff from urban and suburban development at the source, where rain falls on paved surfaces, by maximizing the natural onsite infiltration and treatment abilities of soils and vegetation or by capturing water for later use.

3.1 Potential Yield and Costs for Stormwater Projects

Because of the limited documentation of stormwater projects in the BAWSCA service area, it is difficult to estimate yields and costs for these types of projects. A 2009 study by the Natural Resources Defense Council (NRDC) "A Clear Blue Future: How Greening California Cities Can Address Water Resources and Climate Challenges in the 21st Century" found that LID has a substantial estimated potential to save both water and energy in the San Francisco Bay area California. The group estimated that LID projects implemented throughout a 3,850 square mile study area including San Francisco, Marin, Contra Costa, Alameda, Santa Clara, and San Mateo counties could provide 34,500 – 63,000 AF of water per year by 2030 (or 9 – 16.4 AF/year of savings per square mile). The analysis involved estimating the amount of runoff and potential infiltration from "urban density" land uses – areas with greater than 20 percent impervious surface cover or more than 2 single family residential structures per acre. For detailed information on the analysis, refer to the NRDC report discussed above.

The wide ranges of potential water supply reductions reflect a set of variables and input values that include average rainfall throughout the region, land use information including surface impervious metrics, and method of retention (either capture and storage for reuse, or infiltration into the groundwater aquifer in areas where large-scale groundwater pumping occurs). The portion of water savings from groundwater recharge is not identified, nor is the cost to implement the regional LID development program. Using this example, the 460 square mile BAWSCA service area could be estimated to potentially save 4,100 - 7,500 AF per year through service area-wide implementation of LID projects. The NRDC report did not include costs to implement the projects necessary to achieve the potential savings. Reliable cost information is not currently available for implementation of LID projects on a regional scale.

3.2 Other Project Information and Evaluation Criteria

In addition to project yield additional project information will be used in comparing water supply management projects. This section presents this preliminary quantitative and qualitative information and how it is applied to the evaluation criteria that will be used in the future comparison of water supply management projects. The Strategy Revised Draft Task Memo: Refined Evaluation Criteria and Metrics, January 25, 2011 provides more information on the development of the criteria, subcriterion and metrics. Following are brief descriptions of the evaluation criteria and their preliminary quantitative and qualitative values based on a regional implementation of stormwater capture projects as described in the yield section above. Table 7 summarizes this information.

3.2.1 Supply Reliability

The *Increase Supply Reliability* objective has four criteria:

- *Criterion 1A – Ability to Meet Normal Year Supply Need* - An estimate of the ability of a water supply management project to meet the normal hydrologic year supply needs of BAWSCA member agencies is measured by the annual yield of the project during normal hydrologic conditions by the 2018 and 2035 planning horizons.
  - *The estimated potential yield is indicated in Table 7.*
- *Criterion 1B – Ability to Meet Drought Supply Need* - An estimate of the ability of a water supply management project to meet the supply need during a drought is measured by the annual yield of the project during the 1987 – 1992 drought. The criterion of drought reliability captures whether a supply project is resistant to drought impacts.
  - *The estimated potential yield is indicated in Table 7. Because stormwater capture is dependent on rainfall, the estimated potential drought yield is considered to be zero.*

Table 7
Stormwater Capture Project
Evaluation Criteria and Metrics

Objective	Criteria	Metrics	Project Values
1 - Increase Supply Reliability	**Criterion 1A** – Ability to Meet Normal Year Supply Need	Quantitative (AF/year): Average annual yield in normal years in 2018 and 2035	4,100 – 7,500
	Criterion 1B – Ability to Meet Drought Supply Need	Quantitative (AF/year): Average annual yield with drought hydrology of 1987 – 1992	0
	Criterion 1C – Risk of Facility Outage	Qualitative (1-5): Estimated probability and duration of major conveyance failure	(1)
	Criterion 1D – Potential for Regulatory Vulnerability	Qualitative (1-5): Potential for regulatory decisions to impact supply reliability	(1)
2 - Provide High Level of Water Quality	**Criterion 2A** – Meets or Surpasses Drinking Water Quality Standards	Quantitative (mg/L): Total dissolved solids (TDS) level as an indicator of water quality	N/A
	Criterion 2B – Meets or Surpasses Non-Potable Water Quality Standards	Qualitative: Meets minimum water quality requirement (e.g., Title 22) for the targeted use	No
3 - Minimize Cost of New Water Supplies	**Criterion 3** – Capital and Present Worth Costs	Quantitative ($/AF): Present Worth costs including capital and operating costs	N/A
4 - Reduce Potable Water Demand	**Criterion 4** – Augment Non-Potable Water Supplies	Quantitative (AF/year): Reduction of potable water demand by use of non-potable supply	N/A
5 - Minimize Environmental Impacts	**Criterion 5A** –Greenhouse Gas Emissions	Quantitative (metric tons/ AF of Supply): Estimates of unit greenhouse gas emissions	1
	Criterion 5B –Impact to Groundwater Quantity and Quality	Qualitative (1-5): Potential impacts to groundwater levels, groundwater quality, or potential for subsidence	1
	Criterion 5C –Impact to Habitat	Qualitative (1-5): Potential impacts to habitat, such as wetlands, riparian zones, fisheries, and inundation areas	1
6 - Increase Implementation Potential	**Criterion 6A** – Institutional Complexity	Qualitative (1-5): Number and type of agencies and agreements involved	1
	Criterion 6B –Level of Local Control	Qualitative (1-5): BAWSCA and Member Agency ownership of supply projects	1
	Criterion 6C –Permitting Requirements	Qualitative (1-5): Permitting or regulatory issues for supply projects	1

[1] These values will be developed as part of the overall analysis and comparison of projects.

- *Criterion 1C – Risk of Facility Outage* - Supply vulnerability is measured by the probability and duration of potential outages to a particular water supply management project due to a major conveyance failure. This criterion captures the vulnerability of projects to emergency outages. This metric is a qualitative measure ranging from 1 through 5, with a score of "1" identifying the projects that are least susceptible to emergency outages and a score of "5" indicating high susceptibility to conveyance failures.
  - *These values will be developed as part of the overall analysis and comparison of projects.*

- *Criterion 1D – Potential for Regulatory Vulnerability* - The susceptibility of a water supply management project to interruption as a result of regulatory issues includes legal, political, or environmental constraints. This metric is a qualitative measure ranging from 1 through 5, with a score of "1" identifying the projects that are least susceptible to regulatory risk and a score of "5" indicating high susceptibility to regulatory risk.
  - *These values will be developed as part of the overall analysis and comparison of projects.*

3.2.2 Water Quality

The *Provide High Level of Water Quality* objective has two criteria:

- *Criterion 2A – Meets or Surpasses Drinking Water Quality Standards* – A measure representing potable supply is addressed by the quantitative metric of the aggregate water quality, measured by TDS levels, of the potable supply projects and portfolios. TDS is a surrogate for other water quality parameters representing water quality.
  - *This criterion is not applicable to stormwater capture.*

- *Criterion 2B – Meets or Surpasses Non-Potable Water Quality Standards* - For non-potable supply projects, where water quality constraints vary according to use, the value will be a qualitative assessment of whether or not the water supply management projects and portfolios meet the minimum water quality requirement for the targeted use. In most cases, this metric will be used to designate whether a non-potable supply source meets Title 22 requirements, as this is a common target water quality level for a non-potable demand.
  - *Filtration and/or treatment may be necessary to meet Title 22 water quality standards.*

3.2.3 Cost

The *Minimize Cost of New Water Supplies* objective has one quantitative criterion:

- *Criterion 3 – Capital and Present Worth Costs* - The present worth costs, including capital, operations, and maintenance costs, for each water supply management project are estimated. The performance metric is the normalized unit cost presented in $/AF for each project.
  - *The costs are indicated in Table 7.*

3.2.4 Reduce Potable Water Demand

The *Reduce Potable Water Demand* objective has one criterion:

- *Criterion 4A –Augment non-potable water supplies* is quantitative metric for the annual yield of additional non-potable supply produced and utilized to offset potable demand.
    - *The estimated potential yield is indicated in Table 7.*

3.2.5 Environmental Impacts

The *Minimize Environmental Impacts* objective includes three qualitative criteria:

- *Criterion 5A* -The metric for *5A* is represented by the increase in greenhouse gas emissions due to a potential water supply management project. This quantitative metric will be measured in terms of metric tons of carbon dioxide produced, or reduced, per unit of supply based on energy use.
    - *These values will be developed as part of the overall analysis and comparison of projects.In general, use of local water sources like stormwater capture reduces the energy and treatment requirements of delivering equivalent amounts of potable water from regional sources.*
- *Criterion 5B –Impact to Groundwater Quantity and Quality* - Water supply management projects that do not negatively affect groundwater supplies will be measured favorably in this criterion. A combined qualitative estimate of potential groundwater impacts will be evaluated in terms of potential reductions in groundwater levels, impacts to groundwater quality, and the risk of increase in land subsidence. This metric will be a qualitative measure ranging from 1 through 5, with a score of "1" identifying the projects with the least potential for adversely affecting groundwater quantity and quality and a score of "5" indicating high probability of adverse impacts.
    - *These values will be developed as part of the overall analysis and comparison of projects.*
- *Criterion 5C –Impact to Habitat* - This criterion addresses long-term impacts to the ecosystems, not short-term effects related to temporary construction activities. Water supply management projects that do not adversely affect sensitive habitat areas such as wetlands, riparian zones, potential special-status species habitat, or have significant inundation areas will be measured favorably in this criterion. A combined qualitative estimate of potential habitat impacts is evaluated in terms of potential site acreage, proximity to sensitive habitat zones, and flood potential. This metric is a qualitative measure ranging from 1 through 5, with a score of "1" identifying the projects with the least potential for adverse impacts to habitat and a score of "5" indicating high probability of adverse effects to terrestrial, aquatic, and riparian species.
    - *These values will be developed as part of the overall analysis and comparison of projects.*

3.2.6 Implementation Potential

The *Increase Implementation Potential* objective has three qualitative criteria:

- *Criterion 6A –Institutional Complexity* - This criterion addresses the level of institutional coordination required for implementation of a water supply management project. A qualitative metric will be used to estimate the coordination required if multiple local or regional agencies or agreements are necessary. The projects that are assumed to require less coordination, and to receive less opposition, will score better than those that are more complex or potentially controversial.

    - *Stormwater capture systems will most liekly be owned and maintained by the developments in which they are implemented, not the local BAWSCA member agency. This would indicate a low score for this criterion though the values will be developed as part of the overall analysis and comparison of projects.*

- *Criterion 6B –Level of Local Control of Water Supply* - Local management of a water supply management project will minimize dependency on imported water supplies and the drought impacts associated with those supplies. A common rating scale will be developed to evaluate the amount of BAWSCA-owned or BAWSCA member-owned supply for each project. Projects that are fully owned by BAWSCA or the member agencies will score higher than supply projects owned fully or partially by other entities that might be affected by regulatory risk, multiple party agreements, and supplies that may have a higher risk of not being available further into the future, or under drought conditions.

    - *Stormwater capture systems will most likely be owned and maintained by the developments in which they are implemented. This would indicate a high score for this criterion though the values will be developed as part of the overall analysis and comparison of projects.*

- *Criterion 6C –Permitting Requirements* - This criterion addresses the objective of minimizing the regulatory and environmental permitting obstacles associated with water supply management projects. Projects with other similar metrics (including cost) may have differing permitting requirements, which can affect their overall implementation. The performance metric is a qualitative measure of the permitting requirements of each project or portfolio.

    - *These values will be developed as part of the overall analysis and comparison of projects.*

3.3 Key Project Issues

3.3.1 Regulatory Issues

Regulations that could influence the development of a small scale stormwater capture project include stormwater storage and discharge requirements, dam safety requirements (if the storage impoundment is large enough), and California Environmental Quality Act/ National Environmental Policy Act requirements.

Stormwater discharge is primarily regulated by the United States Environmental Protection Agency's Clean Water Act, Title 40 requirements for permitting and discharge of stormwater, and water quality and wetland permits from the US Army Corps of Engineers. Water below the ordinary high water level or in wetland areas is not available for collection. Stormwater above the ordinary high water level can be collected in drainage channels or from diffused overland flow. This would limit stormwater capture projects at low elevations near the Bay.

National Pollutant Discharge Elimination System (NPDES) permits for point source discharges must implement region-specific water quality standards defined by the Regional Water Quality Control Board. Dischargers must file a report of waste discharge with the appropriate regional board (California Resources Agency 2002). Several of the BAWSCA member agencies have issued guidance documents to support compliance with the requirements in the municipal regional stormwater NPDES permit issued by the San Francisco Regional Water Quality Control Board.

Permits for urban stormwater runoff stored and reused for irrigation may be reviewed by the Department of Public Health to ensure the necessary water quality is maintained.

3.3.2 Other Issues

A partial list of potential other issues associated with stormwater capture is provided below:

- Yield of stormwater capture projects is dependent on rainfall and especially the collection of high rainfall events. Because of this systems are commonly more expensive to implement due to large storage and treatment needs;
- Yield of stormwater capture projects is dependent on available uses of water captured;
- Most systems will require pressure pumps and controls compared to using municipal system water pressure; and
- Limited year-round availability (depending on rainfall patterns) with no availability during drought conditions.

3.4 BAWSCA Agency Current Stormwater Capture Activities

The following activities identified or implemented by BAWSCA member agencies, other regional agencies, and individuals demonstrate interest in stormwater capture:

- The City of East Palo Alto, CA included stormwater capture in its October 2010 Water System Master Plan, noting "Stormwater capture and reuse has the potential to become a valuable method of supplementing an area's water supply". The Master Plan identified multiple sites within the City where a stormwater reuse/recycling project could be utilized with two ideal locations identified as Martin Luther King Park and Jack Farell Park. The Master Plan identified a budget of $450,000 for the proposed Martin Luther King Park stormwater capture project to include stormwater collection, 90,000 gallons storage tank, irrigation pump, and tertiary treatment system to serve the 5.4 acre park;
- The Alameda Countywide Clean Water Program (ACCWP) issued a new document "C.3 Stormwater Technical Guidance, Version 2.1", identified as a handbook for developers,

builders and project applicants, updated and issued October 19, 2010. ACCWP also issued a site design guidebook in August 2005 entitled "Protecting Water Quality in Development Projects, A Guidebook of Post-Construction BMP Examples" that includes examples of 41 area agency projects including examples of single and multi-family residential; mixed-use/ commercial; commercial; and public area projects; and

- Ken Coverdell, a Board member of Coastside County Water District won the Silicon Valley Water Conservation Award in 2010 for a rainwater harvesting/stormwater capture project at his Half Moon Bay Blue Sky Farms plant nursery. The Coverdell's installed a 30,000 gallon cistern to store and reuse rainwater and stormwater runoff from their 2.5 acre nursery and home. Use of the 110 foot long cistern buried under the parking lot has reduced the nursery's potable water use by 750,000 gallons per year by also using a sophisticated satellite weather service to activate the nursery's drip-irrigation system.

3.5 Possible Next Steps for BAWSCA

The following potential follow-up steps are based on the review of the potential yield of stormwater capture projects in the BAWSCA service area:

- Track the development and implementation of stormwater capture projects like East Palo Alto's Martin Luther King Park system and Ken Coverdell's stormwater capture and reuse system to address information gaps that still exist in terms of the feasibility, potential yield and cost of stormwater capture projects; and

- Once more information is available, evaluate the feasibility of a regional implementation of stormwater capture projects through a comparison with other potential water supply management projects evaluated as part of the Strategy.

4.0 Greywater Reuse

As with rainwater harvesting, the quantity of greywater generated in a typical single-family home (from laundry, shower, bath, and bathroom sink water) does not balance with landscaping requirements year-round. Winter months in the Bay Area see a surplus of greywater supply which must be discharged to the sewer or septic system and summer months see a shortage of supply at typical homes with extensive high water use landscaping. Winter months could be better balanced if a treated greywater system is installed to provide toilet flush water supply. However, treated systems are not simple to install and maintain, can be costly, and require permitting. Indoor reuse of greywater for toilet flushing now requires treatment of the greywater to Title 22 standards.

4.1 Potential Yield and Costs for Greywater Reuse Projects

Typically, greywater supply is about 50 percent of residential wastewater generated from the home. Over the past two decades water conserving fixtures have become mandatory, thus reducing the volume of greywater available. To estimate a potential greywater flow, the State Plumbing Code assumes 25 gallons per day (gpd) per person for showers, tub, and bathroom sink; and 15 gpd per person for laundry wash water, thus an upper yield of 40 gpd per person.

(Dishwashing and kitchen sink flows are not considered a greywater supply.) A range of 15 to 40 gpd per person was used in the yield analysis presented in Tables 8 and 9 along with an assumed average of 2.7 persons per household. The resulting estimated greywater production is 41 to 108 gpd per household.

The yield calculations in Tables 8 and 9 rely on the estimate of the potential water savings based on irrigation needs and storage capacity for each month and is similar to the rainwater harvesting analysis. The assumptions include: (1) from November through February, no water savings was assumed due to the availability of rain during this period and subsequently low irrigation demand, (2) for the summer months between May and August, it is assumed that the maximum amount of water savings would be realized, including the use of up to one 55 gallon barrel a day to meet outdoor irrigation demand (55 gallons x 30 days a month = 1650 gallons total), and (3) during the spring and fall months of March, April, September and October, one-half of the maximum water savings would be realized, equal to the use of one 55 gallon barrel every two days (55 gallons x 15 days a month = 825 gallons total).

Table 8
Greywater Reuse High Yield Worksheet

Month	Rainfall (Redwood City) (inches)	Greywater Reuse per Household[1] (gallons/du)	Potential Water Savings Based on Irrigation Needs and Storage Capacity[2] (gallons/du)	High Yield Estimated Water Savings[3] (gallons/du)	Service Area High Yield Estimate with 20 Percent Participation Rate[4] (MG)	
					2010	2035
January	4.29	3,240	0	0	0.0	0.0
February	3.60	3,240	0	0	0.0	0.0
March	2.81	3,240	825	825	57.6	73.3
April	1.24	3,240	825	825	57.6	73.3
May	0.43	3,240	1650	1650	115.2	146.5
June	0.11	3,240	1650	1650	115.2	146.5
July	0.02	3,240	1650	1650	115.2	146.5
August	0.06	3,240	1650	1650	115.2	146.5
September	0.17	3,240	825	825	57.6	73.3
October	0.99	3,240	825	825	57.6	73.3
November	2.32	3,240	0	0	0.0	0.0
December	3.80	3,240	0	0	0.0	0.0
Total	**19.84**	**38,880**	**9,900**	**9,900**	**691**	**879**

[1] A greywater reuse of 108 gpd (40 gpd from laundry wash water, showers, tub, and bathroom sink x 2.7 people per household) was used in the high yield estimate. Greywater reuse per household is 108 gpd x 30 days = 3,240 gallons per month per household.

[2] Zero potential water savings were assumed for November through February. The maximum amount of potential water savings assumed for the summer months between May and August is use of up to one 55 gallon barrel a day to meet outdoor irrigation demand (55 gallons x 30 days a month = 1650 gallons total). During the spring and fall months of March, April, September and October, the potential water savings is assumed to be one-half of the maximum, equal to the use of one 55 gallon barrel every two days (55 gallons x 15 days a month = 825 gallons total).

[3] Maximum estimated water savings is the minimum of the greywater reuse per household and the potential water savings based on irrigation needs and storage capacity for each month.

(4) 349,000 total dwelling units assumed for 2010; 444,000 assumed for 2035.

Table 9
Greywater Reuse Low Yield Worksheet

Month	Rainfall (Redwood City) (inches)	Greywater Reuse per Household[1] (gallons/du)	Potential Water Savings Based on Irrigation Needs and Storage Capacity[2] (gallons/du)	Low Yield Estimated Water Savings[3] (gallons/du)	Service Area Low Yield Estimate with 10 Percent Participation Rate[4] (MG)	
					2010	2035
January	4.29	1,230	0	0	0.0	0.0
February	3.60	1,230	0	0	0.0	0.0
March	2.81	1,230	825	825	28.8	36.6
April	1.24	1,230	825	825	28.8	36.6
May	0.43	1,230	1650	1230	42.9	54.6
June	0.11	1,230	1650	1230	42.9	54.6
July	0.02	1,230	1650	1230	42.9	54.6
August	0.06	1,230	1650	1230	42.9	54.6
September	0.17	1,230	825	825	28.8	36.6
October	0.99	1,230	825	825	28.8	36.6
November	2.32	1,230	0	0	0.0	0.0
December	3.80	1,230	0	0	0.0	0.0
Total	**19.84**	**14,760**	**9,900**	**8,220**	**287**	**365**

1 A greywater reuse of 41 gpd (15 gpd from laundry wash water x 2.7 people per household) was used in the low yield estimate. Greywater reuse per household is 41 gpd x 30 days = 1,230 gallons per month per household.

2 Zero potential water savings were assumed for November through February. The maximum amount of potential water savings assumed for the summer months between May and August is use of up to one 55 gallon barrel a day to meet outdoor irrigation demand (55 gallons x 30 days a month = 1650 gallons total). During the spring and fall months of March, April, September and October, the potential water savings is assumed to be one-half of the maximum, equal to the use of one 55 gallon barrel every two days (55 gallons x 15 days a month = 825 gallons total).

3 Maximum estimated water savings is the minimum of the greywater reuse per household and the potential water savings based on irrigation needs and storage capacity for each month.

4 349,000 total dwelling units assumed for 2010; 444,000 assumed for 2035.

As shown in Tables 8 and 9, under the demographic characteristic assumptions presented for above, the range of potential greywater reuse yield under 2010 demographic characteristics is 287 MG (880 AF/year) to 691 MG (2,120 AF/year) for simple systems used for irrigation. For 2035 demographic characteristics, the potential yield ranges from 365 MG (1,120 AF/year) to 879 MG (2,700 AF/year), again for simple systems used for irrigation only. At the high end of the yield range, the estimate of yield is constrained by the potential water savings based on irrigation needs and storage capacity. If larger storage is provided or more demand identified, especially during the winter months, the resulting yield could be greater.

The cost of installing a simple greywater system collecting water from a clothes washer to serve outdoor irrigation is similar to that of rainwater harvesting systems. A storage barrel may cost between $150 and $300 including fittings. The cost of a more complex system collecting multiple water sources within a house can be relatively high. Permit costs can also make up a significant portion of the projects total cost.

For example, three greywater systems were recently installed under a City of Santa Monica grant program. Two were engineered and one was "off the shelf". One of the systems was highly advanced and included a retrofit. It used potable water, greywater, and rainwater for garden irrigation and took three years for final approval. Total cost was $20,750 for an anticipated savings of 71,000 gallons per year. The off the shelf system required many modifications to make it legal resulting in a very high cost. All systems are working now, but the City noted there were many lessons learned during the approval process for these first systems (O'Cain, 2010).

The SFPUC recently developed a Graywater Design Manual for Outdoor Irrigation to aid homeowners and professionals in installing greywater systems. A Laundry to Landscape pilot program was also started to help the SFPUC, City Department of Building Inspection, and Department of Public Health evaluate how laundry to landscape systems work in the City. The laundry to landscape pilot program identifies specific requirements for participation such as having a yard that is level or down sloping from the clothes washer. The subsidy provided is $95 towards the purchase of a $100 starter kit that includes a 3-way valve, piping, tubing, fittings, and other materials for installation. Up to 150 properties will be eligible to participate.

For the purposes of this memorandum, costs for the greywater system were assumed to include only the basic tank and fittings (~$300 per system). The cost range based on this assumption would be $13.3 to $26.6 million for the minimum and maximum yield estimates, respectively. This assumes 10% participation (44,400 households) to 20% participation (88,800 households). Based on these cost estimates, the estimated cost per AF for the greywater reuse supply would be $660 to $790, assuming a life expectancy of 15 years for the greywater reuse system.[5]

4.2 Other Project Information and Evaluation Criteria

In addition to project yield and cost there is other project information that will be used in the comparison of water supply management projects. This section presents this preliminary quantitative and qualitative information and how it is applied to the evaluation criteria that will be used in the future comparison of water supply management projects. The Strategy Revised Draft Task Memo: Refined Evaluation Criteria and Metrics, January 25, 2011 provides more information on the development of the objectives, criteria and metrics. Following are brief descriptions of the evaluation criteria and their preliminary quantitative and qualitative values based on a regional implementation of greywater reuse projects as described in the yield section above. Table 10 summarizes this information.

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[5] Greywater reuse estimate includes range of yields and costs: $26.6 million/ 2,700 AF/year / 15 years life expectancy = $658/AF. $13.3 million / 1,120 AF/year / 15 years life expectancy = $793/AF.

Table 10
Greywater Reuse Project
Evaluation Criteria and Metrics

Objective	Criteria	Metrics	Project Values
1 - Increase Supply Reliability	**Criterion 1A** – Ability to Meet Normal Year Supply Need	Quantitative (AF/year): Average annual yield in normal years in 2018 and 2035	1,120 – 2,700
	Criterion 1B – Ability to Meet Drought Supply Need	Quantitative (AF/year): Average annual yield with drought hydrology of 1987 – 1992	1,120 – 2,700
	Criterion 1C – Risk of Facility Outage	Qualitative (1-5): Estimated probability and duration of major conveyance failure	[1]
	Criterion 1D – Potential for Regulatory Vulnerability	Qualitative (1-5): Potential for regulatory decisions to impact supply reliability	[1]
2 - Provide High Level of Water Quality	**Criterion 2A** – Meets or Surpasses Drinking Water Quality Standards	Quantitative (mg/L): Total dissolved solids (TDS) level as an indicator of water quality	N/A
	Criterion 2B – Meets or Surpasses Non-Potable Water Quality Standards	Qualitative: Meets minimum water quality requirement (e.g., Title 22) for the targeted use	No
3 - Minimize Cost of New Water Supplies	**Criterion 3** – Capital and Present Worth Costs	Quantitative ($/AF): Present Worth costs including capital and operating costs	N/A
4 - Reduce Potable Water Demand	**Criterion 4** – Augment Non-Potable Water Supplies	Quantitative (AF/year): Reduction of potable water demand by use of non-potable supply	1,120 – 2,700
5 - Minimize Environmental Impacts	**Criterion 5A** –Greenhouse Gas Emissions	Quantitative (metric tons/ AF of Supply): Estimates of unit greenhouse gas emissions	[1]
	Criterion 5B –Impact to Groundwater Quantity and Quality	Qualitative (1-5): Potential impacts to groundwater levels, groundwater quality, or potential for subsidence	[1]
	Criterion 5C –Impact to Habitat	Qualitative (1-5): Potential impacts to habitat, such as wetlands, riparian zones, fisheries, and inundation areas	[1]
6 - Increase Implementation Potential	**Criterion 6A** – Institutional Complexity	Qualitative (1-5): Number and type of agencies and agreements involved	[1]
	Criterion 6B –Level of Local Control	Qualitative (1-5): BAWSCA and Member Agency ownership of supply projects	[1]
	Criterion 6C –Permitting Requirements	Qualitative (1-5): Permitting or regulatory issues for supply projects	[1]

[1] These values will be developed as part of the overall analysis and comparison of projects.

4.2.1 Supply Reliability

The *Increase Supply Reliability* objectives has four criteria:

- *Criterion 1A – Ability to Meet Normal Year Supply Need* - An estimate of the ability of a water supply management project to meet the normal hydrologic year supply needs of BAWSCA member agencies is measured by the annual yield of the project during normal hydrologic conditions by the 2018 and 2035 planning horizons.
    - *The estimated potential yield is indicated in Table 10.*

- *Criterion 1B – Ability to Meet Drought Supply Need* - An estimate of the ability of a water supply management project to meet the supply need during a drought is measured by the annual yield of the project during the 1987 – 1992 drought. The criterion of drought reliability captures whether a supply project is resistant to drought impacts.
  - *The estimated potential yield is indicated in Table 10. The drought supply from greywater reuse projects are assumed to be equal to the estimated potential yield during normal conditions.*

- *Criterion 1C – Risk of Facility Outage* - Supply vulnerability is measured by the probability and duration of potential outages to a particular water supply management project due to a major conveyance failure. This criterion captures the vulnerability of projects to emergency outages. This metric is a qualitative measure ranging from 1 through 5, with a score of “1” identifying the projects that are least susceptible to emergency outages and a score of “5” indicating high susceptibility to conveyance failures.
  - *These values will be developed as part of the overall analysis and comparison of projects.*

- *Criterion 1D – Potential for Regulatory Vulnerability* - The susceptibility of a water supply management project to interruption as a result of regulatory issues includes legal, political, or environmental constraints. This metric is a qualitative measure ranging from 1 through 5, with a score of “1” identifying the projects that are least susceptible to regulatory risk and a score of “5” indicating high susceptibility to regulatory risk.
  - *These values will be developed as part of the overall analysis and comparison of projects.*

4.2.2 Water Quality
The *Provide High Level of Water Quality* objective has two criteria:

- *Criterion 2A – Meets or Surpasses Drinking Water Quality Standards* – A measure representing potable supply is addressed by the quantitative metric of the aggregate water quality, measured by TDS levels, of the potable supply projects and portfolios. TDS is a surrogate for other water quality parameters representing water quality.
  - *This criterion is not applicable to greywater reuse.*

- *Criterion 2B – Meets or Surpasses Non-Potable Water Quality Standards* - For non-potable supply projects, where water quality constraints vary according to use, the value will be a qualitative assessment of whether or not the water supply management projects and portfolios meet the minimum water quality requirement for the targeted use. In most cases, this metric will be used to designate whether a non-potable supply source meets Title 22 requirements, as this is a common target water quality level for a non-potable demand.
  - *Water quality of the proposed project is dependent on the source of the household water captured by the project. To meet Title 22 water quality standards, filtration and/or treatment would be necessary.*

4.2.3 Cost

The *Minimize Cost of New Water Supplies* objective has one criterion:

- *Criterion 3 – Capital and Present Worth Costs* - The present worth costs, including capital, operations, and maintenance costs, for each water supply management project are estimated. The performance metric is the normalized unit cost presented in $/AF for each project.
  - *The costs are indicated in Table 10.*

4.2.4 Reduce Potable Water Demand

The *Reduce Potable Water Demand* objective has one criterion:

- *Criterion 4A –Augment non-potable water supplies* is quantitative metric for the annual yield of additional non-potable supply produced and utilized to offset potable demand.
  - *The estimated potential yield is indicated in Table 10.*

4.2.5 Environmental Impacts

The *Minimize Environmental Impacts* objective includes three qualitative criteria:

- *Criterion 5A* -The metric for *5A* is represented by the increase in greenhouse gas emissions due to a potential water supply management project. This quantitative metric will be measured in terms of metric tons of carbon dioxide produced, or reduced, per unit of supply based on energy use.
  - *These values will be developed as part of the overall analysis and comparison of projects.In general, use of local water sources like greywater reuse reduces the energy and treatment requirements of delivering equivalent amounts of potable water from regional sources.*
- *Criterion 5B –Impact to Groundwater Quantity and Quality* - Water supply management projects that do not negatively affect groundwater supplies will be measured favorably in this criterion. A combined qualitative estimate of potential groundwater impacts will be evaluated in terms of potential reductions in groundwater levels, impacts to groundwater quality, and the risk of increase in land subsidence. This metric will be a qualitative measure ranging from 1 through 5, with a score of “1” identifying the projects with the least potential for adversely affecting groundwater quantity and quality and a score of “5” indicating high probability of adverse impacts.
  - *These values will be developed as part of the overall analysis and comparison of projects.*
- *Criterion 5C –Impact to Habitat* - This criterion addresses long-term impacts to the ecosystems, not short-term effects related to temporary construction activities. Water supply management projects that do not adversely affect sensitive habitat areas such as wetlands, riparian zones, potential special-status species habitat, or have significant inundation areas will be measured favorably in this criterion. A combined qualitative estimate of potential habitat impacts is

evaluated in terms of potential site acreage, proximity to sensitive habitat zones, and flood potential. This metric is a qualitative measure ranging from 1 through 5, with a score of "1" identifying the projects with the least potential for adverse impacts to habitat and a score of "5" indicating high probability of adverse effects to terrestrial, aquatic, and riparian species.

- *These values will be developed as part of the overall analysis and comparison of projects.*

4.2.6 Implementation Potential

The *Increase Implementation Potential* objective has three qualitative criteria:

- *Criterion 6A –Institutional Complexity* - This criterion addresses the level of institutional coordination required for implementation of a water supply management project. A qualitative metric will be used to estimate the coordination required if multiple local or regional agencies or agreements are necessary. The projects that are assumed to require less coordination, and to receive less opposition, will score better than those that are more complex or potentially controversial.

    - *Gryewater reuse systems will be owned and maintained by homeowners, not the local BAWSCA member agency. This would indicate a low score for this criterion though the values will be developed as part of the overall analysis and comparison of projects.*

- *Criterion 6B –Level of Local Control of Water Supply* - Local management of a water supply management project will minimize dependency on imported water supplies and the drought impacts associated with those supplies. A common rating scale will be developed to evaluate the amount of BAWSCA-owned or BAWSCA member-owned supply for each project. Projects that are fully owned by BAWSCA or the member agencies will score higher than supply projects owned fully or partially by other entities that might be affected by regulatory risk, multiple party agreements, and supplies that may have a higher risk of not being available further into the future, or under drought conditions.

    - *Greywater reuse systems will be owned and maintained by homeowners. This would indicate a high score for this criterion though the values will be developed as part of the overall analysis and comparison of projects.*

- *Criterion 6C –Permitting Requirements* - This criterion addresses the objective of minimizing the regulatory and environmental permitting obstacles associated with water supply management projects. Projects with other similar metrics (including cost) may have differing permitting requirements, which can affect their overall implementation. The performance metric is a qualitative measure of the permitting requirements of each project or portfolio.

    - *These values will be developed as part of the overall analysis and comparison of projects.*

4.3 Key Project Issues

4.3.1 Regulatory Issues

California was the first state to study and permit the reuse of greywater, but the permitting process was expensive and was not easy to comply with (Lee, 2009). As a result, most of the approximately 1.7 million greywater systems existing in California were illegal until recently. Many of these systems have since been grandfathered in with the recent changes to State regulations. The California Plumbing Code, California Health and Safety Code and the California Water Code all have sections that address the development of greywater systems.

According to the Strategy survey of BAWSCA member agencies, it appears that none of the agencies have more stringent greywater regulations than the recently adopted California State greywater regulations. As with rainwater, both International Association of Plumbing and Mechanical Officials (IAPMO) and the International Code Council have code requirements for greywater systems. The UPC Green Supplement does not require treatment of greywater for outdoor subsurface use of greywater. Application rates, site location of surge tank, tank size and piping materials, caution notices and site plan are required by the UPC code, subject to approval of the Jurisdiction Having Authority.

Key California Greywater Regulations:

- California Plumbing Code: Greywater system plumbing requirements
- California **Health and Safety Code:** Buildings Standards Code giving local agencies authority to adopt stricter greywater codes
- California Water Code: Water reuse guidelines

Because of the interest in greywater systems, IAPMO has developed a testing and certification program for small [less than 100 gpd] treatment systems. National Sanitation Foundation (NSF) is nearly complete with development of NSF Treatment Standard 350 that originally was to apply to systems larger than 100 gpd. Based on continued discussion with manufactures, NSF may also certify small systems if of the same manufacturer design as a large system certified by NSF.

4.3.2 Other Issues

Major potential issues associated with greywater reuse include the cost of infrastructure, concerns of sewer line backflows and blockages, and potential contamination of greywater. A partial list of potential issues associated with greywater reuse is provided below:

- Can be expensive to retrofit because of the dual plumbing (wastewater and greywater) required;
- Greywater supply cannot be used to irrigate most food plants;
- Greywater can contain soaps and other chemicals that can kill plants and antimicrobial products (triclosan) that can reduce beneficial soil microbes. Additionally, water with high

sodium levels can cause discoloration and burning of leaves, contribute to alkaline soil conditions, can be toxic to plants, and can prevent calcium from reaching plants;

- Can be difficult and costly to obtain a permit for greywater reuse systems; and
- Reduced sewer flows from greywater systems have led to increases in sewer blockages and increases in odor complaints.

4.4 BAWSCA Agency Current Greywater Reuse Activities

Based on the results of agency interviews as a part of the Strategy, many BAWSCA agencies are interested in promoting greywater, as public interest exists, but some concerns regarding sewer system backflow and conflicts with recycled water programs exist. There is also concern that reduction in wastewater flows due to the implementation of greywater reuse projects may affect solids movement in wastewater lines. There are currently no documented greywater projects being implemented by BAWSCA member agencies.

4.5 Possible Next Steps

The following potential follow-up steps are based on the review of the potential yield of greywater reuse projects in the BAWSCA service area:

- Track the on-going interest for greywater reuse programs in the Bay Area and for the BAWSCA member agencies;
- Track current efforts of agencies like Greywater Guerrillas/ Greywater Action in Berkeley who support greywater reuse through workshops including an "Install your own greywater system" workshop in San Francisco that is part of a pilot program from the SF Public Utilities Commission; and
- Examine the feasibility of implementation of greywater reuse projects through a comparison with other potential water supply management projects as part of the Strategy.

BAWSCA Long Term Water Supply Plan

Draft Rainwater Harvesting and Graywater Use Potential Technical Memorandum

Prepared for CDM, Inc.

Prepared by Karen E. Johnson,
Water Resources Planning

4/28/2011

BAWSCA Long Term Water Supply Plan

Rainwater Harvesting and Graywater Use Potential Technical Memorandum

Section 1 – Introduction

This technical memorandum (TM) provides an overview of current regulations, activities, and potential use of rainwater harvesting and graywater use. The study area includes the BAWSCA member agencies' service area, and a sampling of communities in California and elsewhere.

Authorization

This TM was prepared by Karen E. Johnson, Water Resources Planning in accordance with an agreement for the BAWSCA Long Term Water Supply Plan (LTWSP) with Camp Dresser and McKee, Inc (CDM) authorized November 2010.

Phase 2 of the BAWSCA LTWSP is investigating water supply options which, in Phase 1 of the analysis, showed promise as a local supply. Water Resources Planning focused its investigations, under Task T2.4, on rainwater harvesting and graywater use.

Memorandum Organization and Objectives

The TM is organized into the following sections. A summary of the scope of work for each section is included here to clarify the extent of investigation for each subject.

Section 1 Introduction. This section describes the organization of the TM and scope objectives along with the definition of key terms and a brief description of rainwater harvesting and graywater use and a summary of key points.

Section 2 Rainwater Harvesting. Survey responses from BAWSCA member agencies were used to identify existing and pending rainwater harvesting programs and interest in future programs. Existing and pending regulations in California and in a sampling of communities elsewhere are summarized in this section. A description of several key rainwater harvesting activities are summarized in this section.

A qualitative assessment of the market potential and market penetration for rainwater harvesting was conducted based on key market influences (e.g., financial incentives, rate increases, costs and return on investment, environmental sensitivity, retention rates, assistance, etc.) as well as discussions with manufacturers, trade associations, and active agencies. The potential increase in municipal demands during times when rainwater has limited harvest was also described.

Section 3 Graywater Use. Documents requested and survey responses from BAWSCA member agencies were used to identify existing and pending graywater programs and interest in future programs. Existing and pending regulations in California and in a sampling of communities elsewhere are summarized in this section. Existing BAWSCA member agency graywater activities, provided by information obtained in a CDM survey and project information sheets for this project, were summarized along with several key projects in other areas.

A qualitative assessment of the market potential and market penetration for graywater use was conducted based on key market influences (e.g., financial incentives, rate increases, costs and return on investment, environmental sensitivity, retention rates, assistance, etc.) as well as discussions with manufacturers, trade associations, and active agencies. The potential increase in municipal demands during times when the graywater supply is not available was also determined and is described here.

Section 4 References. Organizations promoting rainwater harvesting and graywater use are provided in this section along with sources of information used to develop this TM.

Attachment 1 – Current Rainwater Harvesting and Graywater Use Activities. Rainwater harvesting and graywater activities of various jurisdictions other than BAWSCA member agencies were summarized and located in this attachment. Activities include rebates and other financial incentives, studies, and case studies of implementation projects.

Definition of Key Terms

Since rainwater harvesting as a water supply is a relatively new concept in California, there is confusion about what harvested rainwater really is. Some municipalities in the United States erroneously consider it reclaimed water and others refer to it as graywater. Definitions are provided below to clarify the use of water supply terminology in this TM. This TM is focused only on harvested rainwater and graywater.

Black Water is toilet waste. Not discussed in this TM.

Graywater (also spelled greywater, grey water, and gray water) is untreated waste water that has not come in contact with toilet waste. Graywater includes used water from bathtubs, showers, bathroom sinks, and washing machines. In California it does not include waste water from kitchen sinks or dishwashers.

Harvested Rainwater (RWH) is rain water conveyed from a building roof, stored in a barrel or cistern and, if used for toilet flushing, is disinfected and filtered. It can also be used for landscape irrigation without being disinfected.

Reclaimed or Recycled Water is composed of graywater and black water which, as a result of tertiary treatment by a public agency, can be used for controlled indoor uses such as toilets and urinals. Recycled water systems are usually called a “purple pipe” system because it is conveyed in pipe that is required to be purple.

Stormwater, as used in this TM, is rainwater that typically runs off of property into municipal storm drains. Stormwater can be managed to be retained on-site through low impact development practices to reduce peak attenuations, minimize pollutant loadings, and possibly contribute to groundwater recharge.

Rainwater Harvesting Description

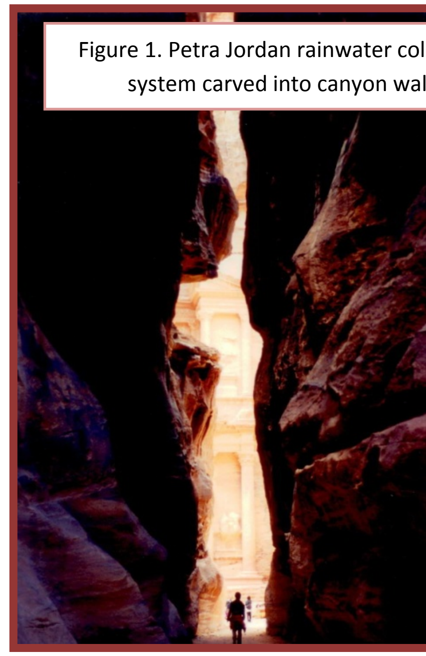

Figure 1. Petra Jordan rainwater collection system carved into canyon walls

Before the advent of large-scale public water systems, capturing rain in cisterns was common practice in many parts of the world. Figure 1 shows the entrance to Petra Jordan with a rainwater collection system carved into the canyon walls. This ancient city in the desert obtained year round water supplies by conveying rainwater to cisterns for storage. In the United States, the ancient practice is becoming more acceptable and popular as people become more interested in sustainable supplies and water rates increase.

Harvesting rainfall is to collect and store rain. There are several methods available to harvest rainwater including land-based and roof runoff storage. Land-based rainwater harvesting occurs when diffused stormwater runoff from land surfaces is conveyed by constructing small berms and drainages to direct flow into ponds, tanks, and reservoirs. Land based rainwater harvesting is often required or encouraged by stormwater management agencies to reduce peak runoff and loadings of contaminated runoff entering stormwater systems.

On a larger scale stormwater management can be used to increase groundwater production yield. According to a report by NRDC, for areas other than the Santa Clara Valley, where extensive groundwater production does occur, rooftop runoff is the preferred means of increasing local supply. Although opportunities for infiltration exist throughout the Bay Area, groundwater accounts for a small percent of the regions average annual water supply (NRDC, 2009).

Roof runoff storage refers to rainwater runoff conveyed from roof surfaces into gutters and downspouts to storage containers. Roof-based rainwater harvesting results in a clean source of stored water to reduce potable water demands. The systems provide water that can be used both for landscape watering and for indoor non-potable purposes. Rooftops provide the source of water, on-site barrels or cisterns provide the storage, and the distribution is provided by hoses for irrigation or a modification of internal plumbing to toilets. Roof-based rainwater harvesting is the focus of this report.

Allowing rainwater to be captured on-site and stored in a rain barrel (often called a cistern if capacity is over 100 gallons) also benefits stormwater management if enough storage is provided to reducing peak runoff. In California, the dry season is long; rainwater harvesting can be beneficial during dry periods within the rainy season and in extending the avoidance of potable water use for a limited time into the irrigation season. To allow for better utilization of harvested rainwater during winter months when irrigation demands are lowest, the supply can be used for toilet flushing or washing machines.

For larger scale storage, which the City of Los Angeles calls centralized direct use, such as for new commercial developments and multi-family housing, greater quantities of roof runoff can be captured if large cisterns are constructed in basements or underground tanks with pumps and controls. Water is then pumped and used for non-potable purposes such as irrigation, car washing, clothes washing machines, toilet flushing, swimming pools, and process water at commercial and industrial uses. The primary limitation to rainwater harvesting is the timing of availability versus demands which is usually a storage/cost constraint.

Summary of Rainwater Harvesting Conclusions

Stormwater management agencies in California have taken the lead in developing rainwater harvesting programs because they can demonstrate benefits in reducing peak stormwater runoff and contaminant loadings. Developing rainwater harvesting programs to support water supply portfolios is not prevalent because of the limited potential yield compared to other supply sources, and costs to support an outreach program with financial incentives versus potential yield. The individual decision by potable water customers on whether to install a rainwater harvesting system is primarily based in a conservation ethic - the desire to save water - followed by financial incentives if offered and the desire to reduce ones water bill, and institutional influences, which are usually a deterrent.

The potential market penetration in the BAWSCA member agencies' service areas was estimated here to be within a range of 43 acre-feet per year (afy) to 1,998 afy under 2010 demographic characteristics and 55 afy to 2,526 afy under 2035 characteristics, using conservative assumptions. The real value of rainwater harvesting to the water purveyor is indirect: raising consumer awareness of water supply, irrigation demands, and overall water consumption patterns, and thus strive to reduce consumption.

Advantages of Rainwater Harvesting

- Education tool: Raise customer awareness of water supplies and landscaping requirements to be more water efficient
- Decrease volume of potable water used for irrigation
- Provide non-potable supply for toilets
- Recharge groundwater
- Gravity fed systems conserve energy otherwise required to deliver municipal supplies
- Good quality water for landscaping that is low in hardness and sodium and nearly neutral pH
- Reduce non-point source water quality impacts to stormwater
- Reduce peak flows allowing for water to infiltrate into the soil at a reduced intensity
- Home systems simple to install

Disadvantages of Rainwater Harvesting

- Frequency and amount of rainwater does not coincide with demands; not an available supply during dry periods of each year
- Storage capacity limits harvesting during certain times of the year
- Capital costs can be high; return on investment is very low
- Systems require maintenance
- Storage requires space and may not be aesthetically pleasing to neighbors
- Water quality may be compromised by use of copper or zinc materials, lead based paints, or preservative treated wood; fecal coliform levels originating from birds and other wildlife

There are rainfall harvesting concerns specific to land uses which are not single-family residential.

- Liability associated with the supply of water by an entity other than a municipal water purveyor or by a homeowner for its own use
- Greater risk of cross-connections (e.g., roof drainage pipes being inadvertently connected to the potable water system) due to more a complicated system
- More complex institutional arrangements, with different people involved in planning, design and maintenance
- Increased potential for access to roof collection and cisterns by people unfamiliar with the system (e.g., maintenance personnel, vandals)
- Larger roof areas increase contamination risks from bird or animal droppings

Graywater Use Description

Graywater is generated from fixtures such as a washing machine, shower, bath tub, and bathroom sinks and reused on-site for landscape irrigation or toilets. The State of California does not include black water or wastewater from kitchen sinks or dishwashers in its graywater usage regulations. Graywater systems can vary greatly in complexity from simple, homeowner installed, gravity fed systems with a hose that is moved manually around the yard, to professionally installed, automated systems with storage, treatment, and both subsurface distribution and distribution to indoor toilets with backflow preventers and cross connection controls.

For the more complex systems, graywater is collected and conveyed to a holding or storage tank where it is filtered and disinfected. The treated water is then pumped to irrigation piping or pumped to supply toilets with flush water. Connections to toilets with dual potable water connections must have appropriate backflow protection. All systems must allow for excess wastewater to drain to the sewer through an overflow pipe.

Connections to existing plumbing convey graywater from inside to outside of the house when used for irrigation. Pipes then convey the water to locations throughout the landscaping. The water should be applied to the aerobic topsoil layer but under the surface, so soil bacteria can decompose organic matter and deactivate the microorganisms in graywater, thus making nutrients available to plants.

The costs vary, depending on the new construction or retrofit, and size and complexity of the system Systems can range from $200 dollars for a single source used for landscaping, up to $20,000 for high end treated supplies with extensive irrigation systems and or toilet use. New construction systems costs documented in a San Diego study range from $650 for a basic system to $4,200 for an advanced system (MWD, 2009). A hybrid system uses rainwater along with graywater as the supply source. Graywater systems vary in complexity but generally consist of the following components.

- Dual plumbing to collect wastewater from sinks, showers, tubs, etc.
- Three-way valve to divert contaminated or excess water to the sewer or septic system
- Treatment assembly such as a sand filter
- Holding tank to store the water until needed but not more than 24 hours

- Bilge pump to pump water from the holding tank to the irrigation system (unless gravity fed)
- Irrigation or leaching system to use the water (or plumbing to refill toilet tanks)
- May need regular charge of a chemical agent such as chlorine or bromine
- Holding tank needs to be flushed a few times per year; clean filters every 2 to 3 weeks

Figure 2. Point-of-use system in Japan (CSBE, 2003)

Point-of-use systems utilizing graywater have been used in other countries, particularly Japan, and are generating more interest locally; these systems avoid restrictions on storing graywater. An example of a point-of-use system is shown in Figure 2: a bathroom sink that augments flush water for a single toilet. Predesigned kits are available for these single toilet systems, but permits are usually still required. Water volumes generated from bathroom sinks are generally not very high and likely requires augmentation from potable or recycled water system. Using sink/toilet combination fixtures or sink water storage units can be implemented relatively easily but may be considered cost prohibitive to retrofit a home. Maintenance required is primarily cleaning the screening filter and maintaining the pump, if the storage tank is under the sink instead of built into the toilet. Manufacturer Sloan Valve Company's AQUS Greywater System diverts bathroom sink water through a sanitizing device that cleans and filters the water. The water goes to a storage reservoir under the sink. When the connected toilet flushes, water is pumped from the reservoir to the flush tank. This product is appropriate for residential as well as commercial, industrial, and institutional uses that have regular tank toilets (Sloan Valve Company).

The least contaminated supply available is usually shower and bath water followed by laundry rinse water. Wastewater can contain pathogens, viruses, and parasites as well as oils, fats, salts, and residue from cleaning, personal care, and pharmaceutical products as shown on Table 1.

Table 1. Possible Contents of Graywater

Source of Graywater Supply	Possible Contents
Clothes Washer	Suspended solids (dirt, lint), organic material, oil and grease, sodium, nitrates, and phosphates (from detergent), increased salinity and pH, bleach, heat
Bathtub and Shower	Bacteria, hair, organic material and suspended solids (skin, particles, lint), oil and grease, soap and detergent residue, heat, personal care and pharmaceutical products, cleaning products
Dishwasher	Organic material and suspended solids (from food), bacteria, increased pH and salinity, fat, oil and grease, detergent material, heat
Sinks, including Kitchen	Bacteria, organic matter and suspended solids (food particles), fat, oil and grease, soap and detergent residue, heat, personal care and pharmaceutical products, cleaning products
Swimming Pool	Chlorine, organic material, suspended solids

Source: Adapted from CSBE, 2003.

A key concern by public health officials is the introduction of pathogens into the supply. This can occur with washing soiled clothes (and diapers which are always outlawed), or clothes with blood or vomit. A greater risk occurs when someone in the household has an infectious illness such as intestinal parasites, diarrhea, etc. and body waste gets onto clothes or is washed off during bathing. Proper construction and operation of graywater systems allow for discharge flows to be diverted to the sewer system at the homeowner's discretion.

As rainwater harvesting provides great benefits to stormwater management, graywater use can impact sewage collection and treatment, but not always beneficial. With increased usage of graywater systems there is less flow to push solids in long drain lines, availability of recycled water is reduced, and chemical composition changes may impact wastewater treatment plant operations. These negative impacts are the same as that already being experienced by some wastewater agencies with the increasing use of low flow indoor plumbing fixtures.

Summary of Graywater Use Conclusions

As with rainwater harvesting, the quantity of graywater generated in a typical single-family home (from laundry, shower, bath, and bathroom sink water) does not balance with landscaping requirements year-round. Winter months in the Bay Area see a surplus of graywater supply which must be discharged to the sewer or septic system and summer months see a shortage of supply at typical homes with extensive high water use landscaping. Winter months could be better balanced if a treated graywater system is installed to provide toilet flush water supply. However, treated systems are not simple to install and maintain, can be costly, and require permitting.

There is consumer demand for simple, inexpensive residential graywater systems using one (or more) sources to offset potable irrigation demands. With recent changes to the State of California laws allowing residential graywater usage unless local authorities proactively restrict its use, barriers are reduced for consumers. As with rainwater harvesting, the individual decision by potable water customers to install graywater systems is primarily based in a conservation ethic - the desire to save water - followed by financial considerations and institutional influences.

Based on these market influences, a conservative potential graywater yield for the BAWSCA member agencies' service areas under 2010 demographic characteristics ranges from 468 afy to 2,465 afy for simple systems used for irrigation. For 2035 demographic characteristics, the potential yield ranges from 1,277 afy to 4,355 afy for simple systems used for irrigation.

Advantages of Graywater Use

- Education tool: Raise customer awareness of water supplies and outdoor landscaping water demands
- Replaces potable water by reusing wastewater for landscaping or toilets
- Reduced use of potable water
- Provides non-potable supply for toilets
- Available year-round
- Home systems simple to install

- Less flow to wastewater treatment plants
- Often contains nutrients such as nitrogen and phosphorus
- Reduced energy and chemical use due to reduced potable demands and wastewater flows

Disadvantages of Graywater Use

- Expensive to retrofit because of the dual plumbing required
- Can be intrusive to retrofit for dual plumbing
- Large indoor water users (e.g., older, less expensive homes that have not replaced fixtures and appliances with low water users) will benefit most
- As plumbing becomes more efficient, available supply is reduced
- Cannot be used on most food plants
- Soaps and other chemical can kill plants
- Water with high sodium levels or a buildup of sodium in the soils can cause discoloration and burning of leaves, contribute to alkaline soil conditions, can be toxic to plants, and can prevent calcium from reaching plants
- Can be difficult and costly to obtain a permit
- As graywater use increases, insufficient sewer flows to carry solids may result during dry seasons

Section 2 – Rainwater Harvesting

Regulations – Rainwater Harvesting

There are no State of California regulations regarding rainwater harvesting (roof runoff storage). Rainwater harvesting systems are popular for buildings seeking LEED certification because local regulations generally permit the use of untreated rainwater for irrigation and, if treated, for toilet flushing (Elmer, date unknown). Permits are usually required if the water is used for toilet flushing to prevent cross connections.

Within the BAWSCA service area, Brisbane, Millbrae, and Palo Alto have guidelines and encourage the development of rainwater harvesting systems. Guidelines for designing and installing rainwater harvesting systems in other states where rainwater harvesting is more common, or even required, usually distinguish between systems with large water storage capacity (e.g., more than 100 gallons), or by its intended use (e.g., toilet flushing where water is required to be disinfected and installed to prevent backflows).

This section presents information on rainwater harvesting regulations and guidelines including:

- summary of jurisdictions that require rainwater harvesting; and
- a sample of jurisdictions that have regulations or guidelines for development of rainwater harvesting systems.

Jurisdictions Requiring Rainwater Harvesting

U.S. Virgin Islands. In the U.S. Virgin Islands, all new buildings are required by law to capture and store roof runoff. The law requires that roofs be guttered and that cisterns are constructed having a volume that depends on the size of the roof, the intended use of the structure, and the number of floors. Cistern construction is regulated by the Virgin Islands Building Code to insure the structural integrity of the cisterns which usually form an integral part of the building foundation. (OAS, 1997)

Barbados. All new residences in Barbados are required to construct water storage facilities if the roof area or living area equals or exceeds 3,000 square feet. They are also required for new commercial buildings with a roof area of 1,000 square feet.

Australia. In Victoria Australia, new single family and multi-family residences must be built to meet water management requirements of its 5 Star standard which requires “water efficient taps and fillings; plus either a rainwater tank for toilet flushing or a solar hot water system. In South Australia, new homes are required to have a rainwater tank plumbed into new homes. In Sydney and New South Wales, building regulations call for a 40 percent reduction in potable (mains) water usage. A typical home will meet the target if it includes certain plumbing fixtures and “a rainwater tank or alternative water supply for outdoor water use and toilet flushing and/or laundry” (CSE, 2010).

New Mexico. The County of Santa Fe, New Mexico requires the installation of rainwater harvesting systems on all new residential structures greater than 2,500 square feet.

Arizona. A Water Harvesting Guidance Manual was developed by the City of Tucson in 2005 for use by developers in implementing water harvesting for new developments, including city projects. In October 2008, Tucson passed the nation's first law to require rainwater collection on commercial properties to defray potable water use on landscaping. The City of Tucson rainwater harvesting ordinance No. 10597 (2008) requires that at least 50 percent of the landscape water budget be supplied by harvested rainwater.

Residences in the City of Albuquerque and Bernalillo County with homes 2,500 square feet or greater must install a rainwater catchment and storage system. All commercial developments in Albuquerque and Bernalillo County are required to collect roof drainage into cisterns to be used for landscape irrigation.

Sampling of Jurisdictions with Regulations

According to the organization Harvest H20, code language can be found in the states of Ohio, Oregon, Texas, and Washington; and in the cities of Portland, Eugene, and Seattle. Arizona, Florida, Hawaii, New Mexico, Texas, Washington, and West Virginia have guidelines (Harvest H20, 2010). Research uncovered the following examples of States or local jurisdictions' regulations; this is not meant to be an exhausted list. Many regulations are changing or being added as more states clarify plumbing requirements associated with rainwater harvesting versus other types of water use.

California Regulations

The 2008 California Green Building Standards Code (CGBSC Title 24 part 1) went into effect in August 2009. Voluntary standards include rainwater or stormwater collection. The 2010 California Green Building Standards Code (CGBSC Title 24 part 1) going into effect January 2011 has mandatory standards including:

- 20 percent reduction of indoor water use for residential and non residential uses, and
- Wastewater reduction in non-residential new construction which encourages use of rainwater, graywater, and recycled water use as an option for compliance.

The State Department of Public Health has cross connection control regulations that require water suppliers to adopt cross connection program operating rules or ordinances and backflow prevention protections. Cross connection and backflow prevention regulations appear to be pertinent to rainwater harvesting only if a cistern is connected to a potable water supply system.

Local municipal codes for building, electric, plumbing, etc. in California typically do not address rainwater harvesting, but there are also no known local laws restricting rainwater harvesting used for irrigation. A sample of communities in California with regulations pertaining to the development of rainwater harvesting systems is provided below.

The Rainwater Capture Act of 2010 (AB 1834) was vetoed by the Governor in September 2010. This act would have authorized a landowner to install, maintain, and operate, on the landowner's property, a rainwater capture system meeting specified requirements.

City of Los Angeles On-site Containment. As of January 2010, the City of Los Angeles Board of Public Works requires "rainwater harvesting" on all new homes, large developments, and some redevelopment projects. Rainwater harvesting under this ordinance includes both land-based runoff capture and roof runoff storage and is intended to prevent rainfall leaving the site. The ordinance allows for various methods to capture, reuse, or infiltrate rainwater runoff generated in a ¾-inch storm. The plans give specific guidelines for installing swales, vegetation, permeable pavement, and other systems to prevent stormwater from flowing into storm drains. Any builders who are unable to contain 100 percent of a project's runoff on-site are required to pay a penalty of $13 per gallon for water that is not redirected. This fee will help to fund sustainable off-site water management projects.

As a part of its stormwater management program, the city recently conducted a rain barrel pilot program, giving away almost 600 55-gallon barrels, to be able to study its acceptance and utilization. The results are summarized under Activities in this TM. The results of the pilot program will lead to developing standards for city-wide rain barrel implementation.

City of Berkeley Guidelines. The City of Berkeley has guidelines, standards, and procedures outlined for rainwater harvesting and use of rainwater. Systems are divided into two types: No permit required and permit required. Rain barrel systems using storage containers of 100 gallons and less, meeting requirements for rain barrels, do not require permits. Rain barrel systems not meeting the requirements of the "no permit systems, and rain catchment systems using vessels greater than 100 gallons, require permits.

City and County of San Francisco. The City and County of San Francisco allows rainwater harvesting for toilet flushing as well as irrigation. The City does require building permits, but the plumbing code specifically allows water collected on structures to be directed to an "alternate location" other than drains or sewers, such as toilet flushing and clothes washing, subject to approval.

County of San Diego Requirements. The County of San Diego is required by the San Diego Regional Water Quality Control Board (Regional Board) to reduce the discharge of pollutants in urban runoff to the maximum extent practicable. It can achieve this by requiring development to use stormwater best management practices (BMPs) and Low Impact Development (LID) techniques in new and redesigned developments.

As part of the revised Municipal Stormwater Permit from the Regional Board, San Diego jurisdictions initially encouraged developments to incorporate minimal LID techniques into Priority Development Projects by January 2008. During this initial phase, a LID Handbook developed for this purpose by the County served as the guidance structure for these LID techniques which helped developers replicate the site's natural hydrological function through a range of LID Integrated Management Practices (IMPs). IMPs may include directing runoff to natural and landscaped areas, man-made filtration devices such as small vegetated swales, rain gardens, and permeable pavements and pavers. Other basic principals include preventing large continuously paved areas, eliminating runoff pathways and not allowing downspouts to be connected to storm drains, and, where feasible, harvesting of rain water in rain barrels or cisterns and using the runoff as an irrigation source.

The County of San Diego then established feasibility and applicability criteria and developed specific LID requirements. Once these specific criteria and requirements are established and accepted by the Board, the jurisdictions will have one year to incorporate the new LID requirements into their local codes and ordinances. Therefore, by the year 2010, the County and other local jurisdictions should each have an updated stormwater program with a comprehensive list of BMPs, including the new LID standards and criteria which include rainwater capture and storage.

City of Santa Monica Requirements. If a cistern is being connected to a pressurized irrigation system, a set of plans are required to be submitted to the city's Building and Safety Department. In addition, a plumbing permit must be obtained prior to installation. The city does not allow rainwater to be used for indoor uses. It is currently working with Los Angeles County on guidelines for indoor use of rainwater.

Colorado Restrictions

One cannot divert rainwater in the State of Colorado and put it to a beneficial use without a plan to replace the stream depletions associated with that diversion. State water law states that rainwater falling on property must be allowed to flow unimpeded into creeks. Senate Bill 09-080 (SB-80), which became law in 2009, allows limited collection and use of rainwater for Colorado landowners. The changes apply only to residential properties that are supplied by a well, or could qualify for a well permit. Landowners apply to the Division of Water Resources to provide notice of their intent to collect rainwater and a description of how they intend to do it. SB-80 allows limited collection and use of rainwater for landowners, only if ALL of the criteria below are met.

- The property on which the collection takes place is residential property
- The landowner uses a well, or is legally entitled to a well, for the water supply
- The well is permitted for domestic uses according to specific statutes
- There is no water supply available in the area from a municipality or water district
- The rainwater is collected only from the roof
- The water is used only for those uses that are allowed by, and identified on, the well permit (Colorado, 2010)

New Mexico Indoor Requirements

Rainwater harvesting is mandatory for new homes in Santa Fe County. There are no state government requirements for outdoor use of rainwater. However, rainwater used indoors must meet the standards for reclaimed water and require a variance if used for a residence.

Oregon Regulations

The City of Portland requires that if a rainwater harvesting system is developed, a cistern have a minimum capacity of 1,500 gallons and be capable of being filled with harvested rainwater or municipal water, have a reduced pressure backflow device, and an air gap protecting the municipal supply from cross-connection. Multifamily housing and commercial uses using rainwater for toilets are required to treat the water by filtering and disinfecting. If used for toilet flushing, a permit is required to ensure that cross contamination is prevented. If rainwater is to replace potable water, a permit appeal must be applied for to ensure that homeowner understands the commitment that once pipes have been used for rainwater, they cannot be converted back to potable city water.

Permits not required for residential collection if the supply is used outside of the house. The following permits are generally necessary for the installation of a rainwater harvesting system in the city.

1. A plumbing permit
2. An electrical permit for the pump or other electrical controls
3. Building permits for cistern footings, foundations, enclosures and roof structures
4. Grading permits or erosion control may be necessary for underground tanks

The Bureau of Development Services has produced a rainwater harvesting code guide that explains the local code requirements and details how to design and build a residential rainwater harvesting system for permit approval. Details shown in the guide ensure that rainwater remains separate from indoor potable water use. For commercial projects, the City reviews each system through the appeal process. (Portland, 2010).

Washington Regulations

The City of Seattle partnered with Seattle & King County Public Health to develop rainwater harvesting policy and procedures. These policies and procedures titled, *Rainwater Harvesting and Connection to Plumbing Fixtures*, augment the Uniform Plumbing Code. The regulations address rainwater harvesting systems connected to indoor plumbing fixtures; it does not apply to non-pressurized outdoor storage for irrigation use. Regulations provide design guidelines and address specific regulatory requirements and procedures for commercial and residential rainwater harvesting systems. (Seattle & Kings County, 2007)

The City of Seattle Public Utilities recently received a water right permit from the Washington State Department of Ecology to capture and use rainwater that falls on rooftops and structures in areas of the City with combined and partially combined drainage and sewage systems. The water right permits clears the way for property owners by removing legal uncertainty (City of Seattle, 2010).

Australia Guidelines

As part of its *Australian Guidelines for Water Recycling*, which addresses health and environmental risks associated with water recycling, guidelines were developed: *Australian Guidelines for Water Recycling: Stormwater Harvesting and Reuse*. According to the Australian Water Commission, there has been an upsurge in rainwater tank installations due to water restrictions, state or local government policies, including rebate schemes, and homeowners' personal choice (NWC, 2010).

Current Activities – Rainwater Harvesting

Many cities around the country are supporting developments that incorporate rainwater harvesting, primarily to meet stormwater water quality objectives, but also to supplement or replace potable supplies. This supply is primarily used on outdoor landscaping, with some interest gaining for use in toilets, where allowed. Other uses of rainwater in communities with high precipitation include cooling towers and car washes. A brief description of fog capture is provided here along with key rainwater harvesting activities.

Fog Capture

Fog is captured using double-sided nets that then allow for the water to drip into a trough and be conveyed through pipes to holding tanks. Capturing fog as a water supply may be best suited along the western side of the Peninsula in the vicinity of BAWSCA member agencies of City of Pacifica, Coastside County Water District, and western Daly City. Fog capture yield would be based on-site specific conditions. Fog capture nets used in a Cape Verde project produced more than 1,000 gallons of water with each net costing $800.

An installer interviewed for this analysis, indicated that a product called Atmospheric Water Generator, manufactured by AridTec (a Singapore based company that is a subsidiary of Australia's Refresh Group Limited), looks promising. This product captures condensation in the air and treats the generated supply to drinking water levels (AirQua, 2010).

BAWSCA Agency Activities

Based on the results of agency interviews as a part of this LTWSP, the following conclusions can be made regarding BAWSCA agency interest in rainwater harvesting.

- Public interest is high for rainwater harvesting
- Perception is that rainwater harvesting is not cost effective and offers little benefit; more interest if it were cost effective
- A few private homeowners are harvesting rainwater
- A few agencies are encouraging rainwater harvesting but not funding specific projects other than educational assistance
- Millbrae offers barrel rebates
- Stanford's Graduate School of Business is considering rainwater harvesting; may yield 75,000 gallons
- Westborough Water District considering rainwater harvesting for fountain use at its office
- The City of Palo Alto offers rebates of $50 per rain barrel. Cistern rebates are $0.15 per gallon with a maximum residential rebate of $1,000 and a maximum commercial rebate of $10,000. Palo Alto hosts rainwater harvesting education events.
- The City of Brisbane has a Rain Barrel Guidance manual.

Activities in Other Jurisdictions

States leading in rainwater harvesting activities include Arizona, California, Oregon, Texas, and Washington. There are numerous examples of rainwater harvesting activities in other jurisdictions. Highlights of activities in Los Angeles, San Diego, and Australia are provided here. A summary of current activities in other jurisdictions is provided in Attachment 1.

City of Los Angeles

The City of Los Angeles' rainwater harvesting program (formerly named Downspout Disconnect Program) was designed primarily to reduce the amount of rainfall from roofs flowing into the storm drain system, as well as to aid homeowners in learning how to capture rainwater for on-site use. The program calls for disconnecting downspouts that discharge to the storm drain system and redirecting flow to areas where rainwater can either percolate in a rain garden or collect in rain barrels.

As a part of the program, the City recently conducted a $1 million Rainwater Harvesting Pilot Program, giving away 55 gallon barrels to almost 600 homes with free installation, to be able to study its acceptance and utilization. Over 3,000 requests were made for these free barrels, reflecting the interest by residents and the effective outreach program. A follow up survey of participants indicated that the majority like the appearance of their barrel, would recommend it to others, and would consider adding another barrel (Los Angeles, 2010).

A guidance manual and how-to video was prepared to support homeowners by providing information on how to disconnect downspouts, extend downspouts to infiltration areas, install rain barrels, and construct a rain garden (Los Angeles, 2009). The City anticipates an eventual yield of 2,430 acre-feet of rainwater captured at 800,000 homes annually that could be used for outdoor irrigation.

Case Study. At TreePeople's Center for Community Forestry, its underground 216,000 gallon cistern (70 feet diameter and 8 feet deep), filled completely for the season after one major storm; it provided much of the irrigation supply needed for its four acres of landscaping for a year. Collected from the Center's rooftops and parking grove, the water is filtered and stored for use in dry months. The supply can also be used by the local fire department.

City of San Diego

In 2009, the City of San Diego Storm Water Department began a pilot program to determine effectiveness of rainwater harvesting to reduce polluted runoff and provide a water supply during dry periods. The "Rain Barrel Downspout Disconnect (RBDD) BMPs Effectiveness Monitoring and Operations Program" had the following objectives.

- Determine the average volume of runoff captured and treated during the wet weather season by the different RBDD systems located at each of eight sites.
- Determine the average pollutant load removal by the RBDD systems located at each site.
- Determine the approximate operational and maintenance costs and requirements associated with each RBDD system.

The intent of the project was to evaluate various RBDD system configurations and determine their cost-effectiveness as a non-structural BMP for City application. Systems were designed in several basic configurations and implemented at locations with varying roof drainage areas and building materials, and monitored during two storms. Based on-site constraints and project assessment objectives, some systems were designed to capture, attenuate, and treat more than the design 0.6-inch, 24-hour storm, while others would need additional barrels to increase capacity to meet the design storm criteria.

Although the primary purpose of the pilot program was to reduce attenuation of stormwater runoff and reduce pollutant loads, several interesting findings applicable to rainwater harvesting using roof runoff could be derived. Copper or galvanized metal building materials associated with roofs, gutters, etc. are potentially significant point sources of metals (copper, aluminum, iron for copper roof and zinc for galvanized metal) which are best used for flow reduction/attenuation from large buildings in combination with bioswales and other LID BMPs. The piloted gravity flow systems (versus the planter-barrel and automated irrigation systems) had the lowest cost and the best overall performance for flow and load reduction.

Additional recommendations include increasing flow capacity and load reduction of systems by using larger barrels (e.g., 75 gallon barrels, cisterns, and tanks) and connecting multiple barrels in series. Size and install the systems for the appropriate roof area and recommended design storm (e.g., 0.6 inch over 24 hours preferred, and 0.2 inch over 24 hours for first flush). It is recommended that building codes or specifications be modified to prohibit use of copper or galvanized roofs, rain gutters, and downspouts unless alternative disconnect or treatment is provided. This would reduce future contaminant contributions. (San Diego, 2010)

Australia

During Australia's severe drought, the federal government, as a part of the National Water Initiative, worked with states, territories, and local water agencies to provide education, incentives, and tools to manage water better including reducing urban water demands. The national government developed a AUS $12.9 billion *Water for the Future* plan, which has a *National Rainwater and Greywater Initiative* to encourage water efficiencies (Australia, 2010).

All Australians meeting requirements have had the opportunity since January 30, 2009 and through March 31, 2014 to receive a federal grant of up to AUS $500 (approximately US $425) towards the purchase and installation of a rainwater tank of 2,000 liter (approximately 540 US gallon) capacity or greater for existing buildings. This program does not cover new construction since, in many Australian jurisdictions integrated rainwater harvesting systems are now mandated by building codes as part of design requirements (Lee, 2010). States and territories also offer financial incentives for rainwater harvesting. For example, Victoria offers a rebate of AUS $150 for a tank of 600 liters or greater plus $150 for a tank to toilet connection; $500 for a tank connected to toilet or laundry (cistern size of 2,000 to 4,999 liters); and $900 for the tank to toilet/laundry connection if tank size is 5,000 liters or greater. All systems must be installed by a licensed plumber (Victoria, 2010).

City of Melbourne. City West Water is one of the three major water utilities providing water to the City of Melbourne, in the State of Victoria, Australia. It serves around 800,000 of the city's more than three million residents. City West Water offers rebates on rainwater tanks (up to US $850) and graywater systems (up to US $425) to promote water use efficiency.

State of Victoria. The government of Victoria established Water Smart Gardens and Homes program that includes rainwater harvesting rebates. Some 38,000 rebates have been issued for the installation of rainwater harvesting systems. As of June 2010, a rebate of approximately US $125 was being offered to homeowners for installation of a tank of approximately 160 to 540 US gallons. For larger tanks connected to a toilet and/or laundry, rebates are higher, ranging from US $425 for approximately 540 to 1,080 US gallon tanks to approximately US $850 for an approximately 1,080 gallon or greater tank (Victoria, 2010).

State of Queensland. In Queensland, Australia's fastest-growing state, about 20 percent of the population has installed "rain catchment tanks" since 2006. In addition to outreach, Queensland had a $261 million rebate program that provided its residents with 508,000 water saving devices including rainwater tanks and plumbing fixtures. The result was that the goal – to reduce consumption to 35 to 40 gallons of water per person per day – was exceeded to an average of 30 gallons per day (LA Times, Jan 15, 2010).

Assessment of Market Potential – Rainwater Harvesting

Market influences and potential market penetration and acceptance of rainwater harvesting are described here.

Market Influences – Rainwater Harvesting

Market penetration of rainwater harvesting in the Bay Area is influenced by the following.

- Behavioral changes
- Financial considerations
- Institutional influences

Behavioral Changes

Many customers are motivated to reduce their potable water footprint, although they may call it being environmentally sensitive, having a conservation ethic, or just interested in saving water. Outreach programs that accompany droughts are known to heighten customers' sensitivity toward water usage, which leads to greater acceptance of conservation practices. This concept is applicable to rainwater harvesting by tapping into a person's conservation ethic, by increasing consumer knowledge, and changing behavior towards water use and supplies. The City of San Diego found that many residents purchased rain barrels as a fun and easy way to save water. But once they were in operation, the residents began thinking about their outdoor water usage and became more aware of the linkage to supplies (Brown, 2010). With rainwater harvesting systems in place, customers often reduce the areal extent of landscaping, change to lower water using plant materials, and increase the coverage of permeable hardscapes. Because the return on investment is so low, tapping into the customer's conservation ethic could have the greatest influence on the viability of a rainwater harvesting program.

Many customers lack knowledge of what a rain barrel is and its value in saving potable water. Education and assistance provides value in helping integrate a simple rainwater barrel design into the property. This in turn, can lead to greater customer satisfaction (i.e., retention of systems) and the informal marketing to neighbors and friends. The City of Santa Monica found, when mapping residents' inquiries or projects, there were clusters. As people implemented systems, interest spread in the neighborhood. These behavioral motivations (versus financial) are rooted in doing something that makes people feel proactive and that feels good. However, it was noted by manufacturers/installers that because of the cooler and wetter 2010, interest dropped off.

There are several behavioral motivations in addition to the conservation ethic; those identified by manufacturers and installers are listed below (Samis, 2010; Lasell, 2010; Ortiz, 2010).

- Frustration with rising water bills and concern over future water bills (leading to the installation of a rainwater harvesting system that has minimal return on investment)
- Increasing supply reliability during a drought, fire, earthquake or other disaster
- Desire to be "off the grid"
- Interest in a sustainable garden

Case Study. Jerry Block of Monte Sereno who installed a 20,000 gallon system was quoted: "Collecting rainwater locally and growing food locally will reduce our dependence on foreign powers…What if there is an earthquake and what if the drought continues? At least I will have water for my family and neighbors." "Jerry isn't installing the system to save money, because his water bill will only reduce by about $65 a year for saving 20,000 gallons of rainwater," says Robert Lenney, co-owner of Rain Harvesting Systems, the northern California company that installed Block's project. "He's doing it to help the earth by reducing the carbon footprint from the electrical company and the water agency because they won't have to pump that 20,000 gallons of water to his home anymore." Rain Harvesting Systems are again quoted: "Our customers don't just collect rain for the financial benefit, they also do it because it makes them feel better about reducing the demand on local water agencies."

Financial Considerations

In the Bay Area, particularly with individual homeowners, the cost of rainwater storage is greater than the cost of water, even when amortized over several years. This is due to the long, dry summers with minimal if any precipitation simultaneous with the greatest irrigation demands. Costs for rain barrels and diverter hardware start around $100 for a 55 gallon system which puts it out of reach for many residents unless subsidized. Cistern (large) systems can cost $1,600 to $7,000 (for 5,000 gallon tanks installed) depending on the size and site conditions. Costs to connect to indoor plumbing for toilets add additional costs. Several manufacturer/installers suggest 5,000 gallon tanks for single family residential homes, if site conditions allow. Multifamily properties typically require in excess of 10,000 gallons of storage. Multi-family costs of a toilet supply are even greater due to the separate piping needed from the tank to each toilet on the property, requiring a significant investment to replumb the building.

An analysis was conducted of cost effectiveness of a residential rainwater harvesting project in Oakland versus Melbourne Australia, by Dr. Michael D. Lee, professor in the Department of Geography and Environmental Studies at California State University East Bay in 2010. He notes that rainwater harvesting in the Bay Area is not cost effective due to the long summer dry season, relatively low water rates, high labor costs for installation, and the imbalance between rooftop supply and irrigation demand. The additional cost associated with connecting the system to indoor uses such as toilets can be offset by the value of using the supply in the winter months. (Lee, 2010)

All jurisdictions and manufacturers interviewed agreed that there is great public interest in rainwater harvesting. When the economy was better, people were willing to pay more for green activities. In the current economic situation people are not willing to pay very much and manufacturers and installers have recently gone out of business. The conservation ethic may be strong and a customer who is generally not price sensitive may begin the process by thinking that cost is not a factor, until the price starts to increase, according to Bill Lasell of Rain Harvesting Systems (Lasell, 2010). Interestingly, he found while responding to inquiries that most households interested in rainwater systems had not yet implemented irrigation BMPs that have a high rate of return on investment (e.g., turf removal, sprinkler replacement, low water use landscaping, etc.), but customers were still interested in rainwater harvesting systems.

A few years ago there was more interest from home builders because of public interest in rainwater harvesting, however, builders now are looking for ways to make homes more affordable. Financial influences such as grants, subsidies, tax exemptions, revolving funds, and income-producing activities can be important to the success of a rainwater harvesting program. Financial incentives include price incentives - covering all or part of the cost of materials (usually the barrel); the ability to recover installation costs; and the price of water. Kim O'Cain of the City of Santa Monica noted that homeowners often will pay full price to purchase a barrel out of personal interest, then use the City's rebate program to purchase additional barrels or larger capacity tanks (O'Cain, 2010).

Conservation BMP rebate programs typically provide financial incentives for apartment owners to retrofit properties with water conserving techniques such as reducing lawn area and using low water use plants, retrofitting with efficient irrigation equipment and methods, and restricting outdoor uses such as car washing. With these actions, outdoor water demands can be reduced significantly, making the investment in rainwater harvesting equipment and maintenance less attractive.

The price of water provides an incentive to use rainwater harvesting. It takes the form of interest in reducing one's water bill and concern over water rates which have risen sharply in recent years and will continue to rise in the future. Without financial incentives, to implement a project that is not economically viable, customers must be committed to a conservation ethic or wish to become more self-sufficient.

Institutional Influences

Currently there are no regulations preventing the capture and storage of rainwater in California, but the cost to permit and the hassle of obtaining permits can be a disincentive. However, building code requirements are usually only applicable to cisterns (being large facilities requiring structural support), if pumping is required, or if the system is connected to a potable water system thus requiring backflow prevention. Rain barrels are usually exempt from these requirements (except for requirements to double strap).

During the recent drought when there was extensive residential construction, several jurisdictions required developers to provide their own water supplies. Some rainwater harvesting systems qualified for these offsets to potable supplies. There is little interest at the present time due to the changed economic conditions. Several jurisdictions, those researched were in the Santa Cruz mountains, required fire supplies to be retained on-site, thus providing an incentive for cisterns.

The City of Los Angeles and San Diego County both require or will soon require runoff retention on-site for new developments. Since the City of San Diego's runoff water quality pilot program discussed previously indicated great value of rain barrels (and planter systems) to retain runoff and treat it, this runoff requirement is anticipated to result in a greater utilization of rainwater harvesting systems, even if the objectives are for stormwater management not water supply.

Case Study. During Australia's recent decade-long drought, extreme conservation measures were implemented resulting in a heightened sensitivity to water consumption. In many communities, potable water was not allowed to be used for landscaping, resulting in a shift in the way that people had always gardened in a culture with a preference for lush English gardens. Plant materials were changed or the areal extent of irrigated landscaping was reduced to match precipitation or rain barrel saved water supplies. Rain barrel rebates were provided by some water purveyors which increased the market penetration. Adoption of rainwater harvesting and graywater use increased over time after considerable investment by the governments to meet increasing targets. "Less than 10 years ago it was illegal in many cases to install a rainwater tank on a domestic house. Now it is increasingly illegal not to" (NWC, 2010).

Potential Market Penetration and Acceptance – Rainwater Harvesting

Penetration/Acceptance

Behavioral changes, financial considerations, and institutional influences will determine the market penetration rate of a rainwater harvesting program. Actual penetration rates are difficult to estimate because of the many influences an agency needs to accommodate in its program design. The only available documented market penetration statistic found is for the State of Queensland where 20 percent of the population has installed rain catchment tanks since 2006. Although rainwater harvesting systems were not required in Queensland, rebates were offered and a strong outreach program implemented during the decades-old drought.

The Bay Area probably has the highest concentration of environmentally sensitive and ecologically active residents in the world. With an aggressive outreach program tapping into this conservation ethic, coupled with financial incentives from stormwater management jurisdictions and the presence of dry water years, the market penetration rate of single-family residential homes could eventually be greater than 20 percent, even with our long dry irrigation season.

Retention

There are no documented studies on the retention rate of rainwater systems. As an installer noted, "you have to be passionate about it [installing rainwater harvesting systems]" otherwise, there is little interest in maintaining systems. Also, new homeowners generally will not maintain a system that came with the house if something goes wrong (Samis, 2010). Conversations with several people that took advantage of Oakland's rain barrel rebate program indicated that there is difficulty operating the barrels because of roof debris clogging the screens (both homes were in the hills with tall trees). They were not informed of this being a “first flush” problem and that there are first flush diverters available to prevent this problem. Instead, they allowed the screens to remain clogged and rainwater to spill over.

Precipitation Comparison

A range of the market potential for rainwater harvesting supply yield is provided after comparing precipitation conditions of various cities. The high variation in spatial and temporal rainfall in the United States allows for the potential to overestimate the yield of rainwater harvesting in California. Table 2 compares monthly precipitation data for a range of BAWSCA member agencies, with communities known for their active rainfall harvesting programs. Catchment systems have been implemented successfully in Oregon, Texas, Washington, and the City of Melbourne, all places with year round rainfall. But in Southern and Central Arizona where rainwater harvesting is most commonly used, there are two rainy periods: summer and winter, with dry periods between them. Tucson has its highest monthly rainfall in July and August and Austin in May and June, while the months of June through September in the Bay Area have virtually no rainfall.

Precipitation is a key factor regarding yield, but evapotranspiration rates are also important. The City of Los Angeles’ annual precipitation is similar to Santa Clara, but since the weather is warmer during southern California winter months, stored water can be used for irrigation between rainfall events more frequently, thus offsetting the year-round irrigation demands for potable water use.

Rainwater Harvesting Market Penetration

Rainwater harvesting yield is based on potable demands being offset when rainwater is available. This quantity is determined based on precipitation conditions, storage capacity, demand of uses (irrigation or indoor toilet flushing, etc.), and penetration rates. A range of potential yield was calculated based on assumptions. For 1,000 square feet of roof area, every inch of rainfall can produce approximately 623 gallons of rainwater. For example, for 17 inches of rainfall a year, up to 10,600 gallons could theoretically be captured annually from a 1,000 square foot roof, adjusted for the amount lost as a first flush, the capture rate, storage capacity, use during capture times, etc.

In the Bay Area, the months of December through February typically require little to no irrigation supplies, while irrigation demands are highest in June through September. The shoulder months of April, May, October, and November have the greatest potential to fully utilize stored rainwater as there is sporadic rainfall to capture yet there is demand for the water. With rainfall heaviest between November and March, during times where irrigation demands are lowest, storage becomes the criteria for yield potential. Residential barrels available for individual downspouts typically have a capacity of 50 to 75 gallons each while more expensive cisterns of several hundred to several thousand gallons can be sited under decks and other structures at a home.

Commercial applications are similarly limited to storage capacity; underground cisterns are more financially feasible when constructed in new development. Irrigation demands are typically more limited for commercial applications than for residential lands but toilet demands could be greater.

Table 2. Comparison of Mean Monthly Precipitation (inches)

Month	BAWSCA Member Agencies			Los Angeles	Tucson Arizona	Austin Texas	Portland Oregon	Melbourne Australia
	Redwood City	Coastside County WD	City of Santa Clara					
January	4.29	5.50	3.00	3.31	0.99	1.80	6.24	1.90
February	3.60	4.80	2.50	4.05	0.88	2.30	5.07	1.90
March	2.81	3.90	2.40	2.68	0.81	1.90	4.51	1.80
April	1.24	1.60	1.10	0.84	0.28	2.70	3.10	2.20
May	0.43	0.60	0.40	0.26	0.24	5.00	2.49	2.80
June	0.11	0.20	0.10	0.09	0.24	3.90	1.60	1.70
July	0.02	0.00	0.00	0.01	2.07	2.10	0.76	2.00
August	0.06	0.10	0.00	0.04	2.30	2.10	0.99	2.40
September	0.17	0.30	0.30	0.23	1.45	3.40	1.87	2.20
October	0.99	1.30	0.70	0.63	1.21	3.60	3.39	2.70
November	2.32	3.40	1.50	1.00	0.67	2.50	6.39	2.30
December	3.80	3.70	2.70	1.97	1.03	2.00	6.75	2.40
Total	**19.84**	**25.40**	**14.70**	**15.10**	**12.17**	**33.30**	**43.16**	**26.30**

Source: 2005 UWMPs for Redwood City, CCWD, and Santa Clara. Draft 2010 MWD UWMP for downtown Los Angeles. Tucson data from rssWeather.com. Austin and Melbourne data from climate-charts.com.

A range of potential yield to offset potable water demands for single family homes in the BAWSCA service area was calculated. A similar calculation could be made for multi-family and commercial uses with storage being the most important criteria. The following assumptions were made in determining single-family residential potential.

- Average annual rainfall (using Redwood City to represent average precipitation conditions for the BAWSCA member agency service areas) is approximately 20 inches.
- BAWSCA's annual survey indicates a 2009 population of 1.7 million and 2 million at 2030. The 2030 estimate was used here for 2035.
- BAWSCA's annual survey indicates 350,000 (rounded from 348,662) single family residential accounts (BAWSCA, 2010). This estimate was confirmed by calculating homes from population (1.7 million population at 2.7 people per household = 630,000 dwelling units x .60 percent for single-family units, attached and detached equals approximately 377,000 single family dwelling units [sfdu]).
- 2035 sfdu were calculated using the above formula for a 2 million population, resulting in 444,000 sfdu.
- Average roof size is 1,500 square feet (sf)

Higher Yield. For the higher yield, it was assumed that 50 percent of the roof area could be captured in a barrel or cistern and there is a 20 percent acceptance and retention rate. 50 percent of roof area was used because rain barrels only capture a portion of the roof and to compensate for a diverted first flush. As presented in Table 3, under these assumptions the maximum amount of supply to potentially offset potable demands from rainfall harvesting with 2010 conditions is approximately 2,000 afy from single family homes and 2,500 acre-feet at 2035. This higher yield assumed winter demands (e.g., toilets) and no restriction on storage capacity.

Table 3. Rainwater Harvesting Higher Yield Worksheet

Year	Rainfall (Redwood City) (inches)	Convert Rainfall [1] (gal/sf)	Total Roof Area[2] (ksf)	Gross Annual Rainfall Capture Potential (mgal)	Net Capture 50 Percent of Roof Area [3] (mgal)	Service Area Yield with 20 Percent Acceptance Rate	
						(mgal)	(afy)
2010[4]	19.84	12.36	523,500	6,471	3,235	**647**	**1,986**
2035	19.84	12.36	666,000	8,232	4,116	**823**	**2,526**

(1) Multiply rainfall by 0.623 gallons

(2) 349,000 SFR dwelling units for 2010 x 1,500 sf; 444,000 du for 2035

(3) A runoff coefficient of 85 percent is typically applied to account for evaporation, retention, first flush loss, etc.; this was accounted for within the 50 percent roof area assumption.

(4) 19.84 inches per year x total roof area of 523.5 million square feet (1,500 sf x 349,000 single family housing units) x .623 gallons per inch of precipitation per sf roof area (19.84 in x .623gal x 523 msf) assuming 50% roof capture and 20% acceptance rate, equals 647 million gallons (mgal) annually or 1,986 afy.

Lower Yield. However, because of cost considerations for storage and plumbing retrofit to accommodate toilets (with backflow preventers etc); space limitations for storage; lack of water demands during months of greatest supply availability; and limited market penetration and acceptance; a lower yield was estimated to offset potable demands. As presented in Table 4, an estimate of lower service area yield assumed one 55 gallon barrel per single family residential unit, capturing 25 percent of the roof area, barrels fill and discharge completely over one to two precipitation events per month from April through October (except July and only the rainfall that is available), water is used for outdoor landscaping only, with a 10 percent acceptance/retention rate. Total yield was 43 acre-feet (13.96 million gallons [mgal]) for 2010 conditions and 55 acre-feet (17.76 mgal) for 2035. If harvested rainwater were used for toilets, a significant increase in yield would be possible, using a greater supply during winter months.

A more sophisticated analysis of the potential harvested yield used for irrigation can be determined by looking at daily precipitation data during the winter and shoulder months, comparing it with evapotranspiration data and vegetation coefficients to determine daily irrigation demands, and adjusting for days when soils are still saturated from precipitation events. Savings yield depends on the ability to utilize the stored supply between rainfall events and storage capacity to extend the supply into the summer. Harvested yield for indoor demands can be better calculated based on the demands of toilets and/or laundry units that can realistically be retrofitted to accommodate the supplemental supply (supplemental since the municipal supply must be used during months or dry periods when there is no rainfall) and storage capacity. For individuals, SFPUC has a performance calculator available to size rainwater tanks for irrigation and non-potable use within the city, but it relies on monthly rainfall and demand totals, not more specific daily data.

Table 4. Rainwater Harvesting Lower Yield Worksheet

Month	Rainfall (Redwood City) (inches)	Convert Rainfall [(1)] (gal/sf)	Roof Area (sf/du)	Rainfall per Month (gallons/du)	Net Capture 25 Percent of Roof Area [(2)]	Capture 55 Gallons and Use 1 to 2 Times/Mo. [(3)] (gal)	Service Area Yield with 10 Percent Acceptance Rate [(4)] (mgal)	
							2010	2035
January	4.29	2.673	1500	4,009	1,002	NA		
February	3.60	2.243	1500	3,364	841	NA		
March	2.81	1.751	1500	2,626	656	NA		
April	1.24	0.773	1500	1,159	290	110	3.84	4.88
May	0.43	0.268	1500	402	100	100	3.49	4.44
June	0.11	0.069	1500	103	26	26	0.91	1.15
July	0.02	0.012	1500	19	5	NA		
August	0.06	0.037	1500	56	14	14	0.49	0.62
September	0.17	0.106	1500	159	40	40	1.40	1.78
October	0.99	0.617	1500	925	231	110	3.84	4.88
November	2.32	1.445	1500	2,168	542	NA		
December	3.80	2.367	1500	3,551	888	NA		
Total	19.84	12.360	1500	18,540	4,635	400	**13.96**	**17.76**

(1) Multiply rainfall by 0.623 gallons
(2) A runoff coefficient of 85 percent is typically applied to account for evaporation, retention, first flush loss, etc.; this was accounted for within the 25 percent roof area assumption.
(3) NA: Minimal outdoor demands assumed for November through March; supply not available during July.
(4) 3350,000 total dwelling units assumed for 2010; 444,000 assumed for 2035.

Determining potential rainfall harvesting yield for multifamily housing relies on less accurate assumptions and more information needed on storage capacity. The range of styles of multifamily housing is great, from high rise towers with minimal landscaping to garden apartments. Thus, irrigation demands, areal extent of roofs, and the return on investment for storage capacity are key factors with greater variation between properties.

Increased Demands When Rainwater is Not Available

In California, rainwater harvesting systems are typically not developed as the sole source of supply due to the inverse precipitation and demand patterns. Unless the storage capacity is extensive (manufacturers recommend an average system of 5,000 gallons plus per house), it is likely that some amount of reliable water supply will be needed during summer months when the barrels and cisterns have drained. The potential range of supply yield presented above is approximately 43 to 2,000 afy for single family homes in the BAWSCA member agency service areas. If rainwater were not available during prolonged droughts or more frequent dry periods, potable demands on municipal water systems could increase by the amount of rainfall that was not captured but assumed to be available in the design of the system. For example, demands may increase by 43 to 2,000 afy throughout the entire service areas.

Recommendations by Others

Policy and standards recommendations, which could increase rainwater harvesting acceptance and retention, are provided by other agencies and summarized here. This is followed by a summary of key recommendations for the BAWSCA member service areas.

ARCSA Standards Guide. The American Rainwater Catchment Systems Association (ARCSA) in conjunction with the International Association of Plumbing and Mechanical Officials (IAPMO) developed a standards guide (ARCSA website), a "green supplement" to the Uniform Plumbing Code. The code supplement handles the issue of cross-contamination (e.g., for toilet supply) but exempts systems that do not connect to potable water. For those that do connect into a potable water system, backflow prevention devices are required.

US EPA Recommendations. The U.S. Environmental Protection Agency recommends that cities and states implement the following.

- Specify rainwater as a supply source. Otherwise, it is often treated as graywater, which has tight restrictions on its use.
- Specify permitted uses for rainwater, such as irrigation, toilet flushing, and vehicle washing. Also provide a permitting and testing process if rainwater is to be filtered and used as potable water.
- Detail requirements for water systems, such as storage standards, filtration, preventing backflow into treated water supply, and signage.
- Establish a permit application process for harvesting systems but exempt rain barrels (EPA, 2008).

Recommendations for BAWSCA. The following recommendations are based on the review of other communities with successful rainwater harvesting programs and the analysis of potential yield in the BAWSCA member agency service areas.

- Draft a rainwater harvesting guidebook for water purveyors or a model rainwater harvesting ordinance that clarifies the distinction between rainwater and recycled water and encourages the development of systems by confining permitting and regulations to storage facilities larger than 100 gallons, those that require electrical connections for pumping, and for system that supply toilet water. The model language could include EPA and State of Texas recommendations described above. Example engineering and building plans, practices, and ordinances could be provided for jurisdictions to adopt following the ARCSA example in its Standards Guide. Encourage reasonable permitting fees and requirements to prevent residents from being discouraged from implementing systems.
- Prepared a guidance manual for homeowners to clarify implementation and retention techniques for individuals implementing their own systems.

- Encourage the incorporation of rainwater harvesting principles into the newly adopted Landscape Ordinances for each jurisdiction (for those communities that do not rely on the State ordinance).
- Develop outreach messages that provide consistency regarding applications of residential rainwater systems and direct and indirect benefits to homeowners and the community. Increased public knowledge will likely lead to requests for other related information on conservation techniques, such as the use of low water use landscaping, and information on stormwater management related subjects such as rain gardens and LID retrofits.
- Target outreach materials to reach audiences with greatest likelihood to be interested in developing rainwater harvesting systems. For example, Oakland's rain barrel outreach program includes barrel sales at farmers' markets.
- Coordinate with stormwater management agencies to encourage or require rainwater harvesting as a part of any on-site stormwater retention program for greater outreach potential, fiscal synergies in preventing overlapping activities, and outside funding opportunities. Consider retrofitting public buildings with rainwater harvesting systems and use as models for public education.
- Market penetration studies prepared for suppliers outside of the Bay Area have indicated tremendous growth potential for rainwater harvesting tanks, filters, etc. But the results of these studies are not applicable to California's unique characteristics of lengthy dry seasons, relatively inexpensive water, and high labor costs. A full market penetration study for the Bay Area would take these factors into account along with demographic data, daily rainfall and evapotranspiration patterns, security/vandalism considerations for commercial uses, rates, and impacts to irrigation demands from conservation efforts which would reduce the rate of return on rainwater harvesting systems.

Section 3 – Graywater Use

Regulations – Graywater Use

Approximately 1.7 million graywater systems exist in California; most were illegal because homeowners want to avoid the permitting process and fees which were not easy to comply with and can double the costs (Lee, 2009). Many of these systems have since been grandfathered in with the recent changes to State regulations.

Graywater reuse occurs throughout the world, usually informally, and particularly in lower income communities without a water connection in the home. There are no federal regulations or national policies in the United States regarding graywater use; it is left to states and local jurisdictions. California was the first state to study and permit the reuse of graywater, but its requirements indirectly encouraged illegal uses. The City of Santa Barbara was the first local agency in the United States in 1989 to introduce graywater regulations (CSBE, 2003).

Key California Graywater Regulations

--California Plumbing Code: Title 24, Part 5, Chapter 16A, Part I Graywater Systems

--California Health and Safety Code: Division 13, Part 2.5, Chapter 4: Buildings Standards Code - local agencies authority to adopt stricter graywater codes

--California Water Code: Division 1, Chapter 6: Water Reuse

--California Water Code: Division 7 (Water Quality), Chapter 2: Definitions; Chapter 4.5: On-site Sewage Treatment Systems; Chapter 7: Water Reclamation; Chapter 7.5 Water Recycling Act of 1991; Chapter 22: Graywater Systems

The Center for Disease Control in the United States has embarked on a project with EPA to develop national guidelines for the safe use of graywater. The State of Arizona's code has resulted in innovative building designs and retrofits. It allows local agencies to develop their own regulations; Arizona's code has been copied by other states, most recently by California. See Appendix E - *Summary of States' Graywater Regulations* in Sheikh, 2010, for a summary listing of all State governing agencies and the titles and chapters of their graywater regulations.

According to the LTWSP survey of BAWSCA member agencies, it appears that none of the agencies have more stringent graywater regulations than the recently adopted State graywater regulations. Following the discussion of current California regulations, the State of Arizona is highlighted here because of Arizona's progressive graywater regulatory activity in streamlining the permit process.

Sampling of Jurisdictions with Regulations

California

California Senate Bill 1258, passed in 2008 (and emergency regulations made permanent by the California Building Standards Commission on July 30, 2009), authorizes a city, county, or other local agency to adopt building standards that prohibit the use of graywater, or that are more restrictive than State requirements, thus allowing residential graywater systems except where an agency specifically does not allow it. This bill moved the responsibility for regulating residential graywater from DWR to the Department of Housing and Community Development (HCD). HCD was tasked with revising existing code to encourage the installation of legal graywater systems in residences.

The new residential graywater standard**,** divides graywater installations into three types of systems, two of which usually require treatment.

- Clothes washer system (commonly referred to as laundry-to-landscape systems) or single fixture system. Usually does not need to be treated.
- Simple system, which reuse up to 250 gallons per day
- Complex system, using over 250 gallons per day.

A clothes washer system can be installed without a building permit, as long as homeowners follow 12 guidelines. If it requires treatment, then it becomes a permitted system. The remaining systems require construction permits and plans unless exempted by the enforcing agency (HCD, 2009).

This revised State code specifies that untreated graywater may only be used outdoors (for irrigation). It may be applied to all kinds of plants, including food plants, except the edible portions. It may be distributed fairly near the soil surface, but must be covered by at least two inches of mulch. Required setbacks from buildings and property lines are two and 1.5 feet respectively, to prevent foundations from getting wet and from water draining onto adjacent property. Graywater that will be reused indoors (for toilet flushing) must be treated to at least tertiary recycled water standards and it is subject to other regulations governing recycled water.

Graywater systems for land uses not regulated by HCD, such as commercial, institutional, and industrial, are subject to requirements in various areas of State and local laws and regulations, differing by the type of facility and intended use of the graywater system.

Arizona

The State of Arizona has become the model for statewide graywater regulations. It uses the three tiered approach to permitting graywater systems.

1. Systems less than 400 gallons per day (gpd). Must meet reasonable performance goals under a Type 1 general permit without having to apply for a permit from the Arizona Department of Environmental Quality (ADEQ). For irrigation use only.
2. Systems over 400 gpd but less than 3,000 gpd. A Type 3 general permit is required to be obtained for each individual system.
3. Systems over 3,000 gpd. Each permit is considered on an individual basis. (ADEQ, 2010; Oasis Design, 2010)

The ADEQ regulates domestic graywater systems. The regulations are considered the most progressive because the tiered approach allows for easy development for individual homeowners and encourages innovation in the design. The prohibitions are standard to minimize public health risks and plant health.

Arizona's regulations permit single and multi-family residences to use graywater for surface irrigation if it is not used for irrigation of food plants except citrus and nut trees. Surface application is restricted to flood or drip irrigation; sprinkling is not allowed. Hazardous chemicals and diaper water is not permitted in the graywater reused. Systems should be constructed so that if blockage occurs, graywater is directed into the sewage collection system. Groundwater cannot be within five feet of the point of application.

Conditions for systems greater than 400 gallons include ADEQ approval of the design and construction of the system. The system must include a settling or holding tank to settle out the grit and heavier material from the graywater. A filtration device is also required. If the graywater is to be applied to the surface a means of disinfecting the graywater also is necessary. ADEQ has delegated authority to the health departments of Pima, Maricopa, and Yavapai counties to perform technical review of graywater use systems. Graywater used for surface irrigation must meet allowable water quality and monitoring specifications. Allowable limits are set for fecal coliform and chlorine residuals. A sampling schedule also is established. Surface is defined as extending two feet below the surface.

The State of New Mexico passed regulations in 2003 using the Arizona model where homeowners do not have to obtain a permit if performance measures are met. The State of Texas has a similar program as Arizona. Permits are not required for domestic graywater systems that use less than 400 gpd that meet performance standards.

Colorado

The use of graywater systems is not viable for most homeowners in the State of Colorado. Currently graywater is regulated under the State of Colorado Guidelines on Individual Sewage Disposal Systems (ISDS) and applicable county ISDS regulations. The Colorado Department of Public Health and Environment (CDPHE) does not currently separate graywater from black water in its regulations. Consequently, both surface and subsurface applications require permitting and may trigger monitoring requirements.

If graywater is discharged in the soil below the root zone in the manner of a leach field, a permit from the local health department is required. The local county health or planning department will have specifications for adequate soil cover for leach fields of a minimum of 18 to 24 inches of soil cover. However, this deep application of the graywater will not meet the practical needs of most homeowners, unless they want to install a windbreak of trees or large shrubs. If graywater is used to irrigate below the soil surface, but within the root zone (above frost line), a local permit plus monitoring is required.

If the graywater is applied to the surface, a means of disinfecting the graywater is necessary. Bacteria and other fecal borne pathogens in graywater are a concern and may require installation of advanced treatment systems. Graywater may also contain sodium and chloride, which can be harmful to sensitive plant species. Research on the public health hazards of graywater use is limited, with no data indicating problems, or non-problems for that matter.

Oregon

The State of Oregon 2008 Plumbing Specialty Code allow for use of graywater for flushing toilets as an alternate method to the State plumbing code. Oregon's alternate method for water conservation systems focuses on manufactured, off the shelf, and predesigned systems (Oregon, 2010). A plumbing permit is needed. An American National Standards Institute (ANSI) accredited product listing agency must list any water conservation system installed in Oregon (Oregon Smart Guide).

Australia

As the use of recycled water gained interest during Australia's 12 year drought, interest in graywater use also increased. For example, regulations in Queensland before the drought required that all domestic wastewater be disposed of into the sewer system if there is one; graywater reuse was permitted in non-sewered areas only. However, because of the drought, the federal government and several states such as Queensland and Victoria have implemented regulations that encouraged the use of graywater. In New South Wales, for example, untreated graywater can be used for subsurface irrigation, while in Tasmania, all graywater must be treated before reuse (Pacific Institute, 2010). At the national level, guidelines ("Australian Guidelines for Water Recycling: Managing Health and Environmental Risks") were developed in phases and a decision support tool made available to assist users of the guidelines (Australian Government, 2008).

Current Activities – Graywater Use

BAWSCA Agency Activities

Based on the results of agency interviews as a part of this LTWSP, the following conclusions can be made regarding BAWSCA agency interest in graywater use.

- Public interest in graywater systems is high
- The yield is perceived as negligible
- Several agencies may consider promoting graywater in the future but it is not currently a priority
- Backflows are a great concern to some jurisdictions
- There is more interest for new developments; most agree there is a need for more studies
- Several agencies have known small graywater projects within its jurisdiction
- One agency is opposed because of current limitations on solids movement in wastewater flows due to conservation activities
- One agency will not implement programs because of its existing extensive recycled water program

Activities in Other Jurisdictions

There are numerous examples of household graywater use activities throughout California, the United States, and other countries, but limited examples of multifamily residential and institutional usage. Highlights from the City of Santa Monica and Japan and a survey conducted in Arizona are provided here. A summary of current graywater use activities in other jurisdictions can be found in Attachment 1.

City and County of San Francisco

The SFPUC recently developed a Graywater Design Manual for Outdoor Irrigation to aid homeowners and professionals in installing graywater systems. A Laundry to Landscape pilot program was also started to help the SFPUC, City Department of Building Inspection, and Department of Public Health evaluate how laundry to landscape systems work in the City.

The draft design manual provides a detailed process (including extensive photographs) for designing and installing the laundry to landscape systems, including steps for estimating graywater flows and irrigation demands, setback requirements, and design, installation, operation, and maintenance of branched drain and pumped systems. Permitting requirements are identified along with recommendations on products, system placement, signage, what plants to irrigate with graywater, and additional resources, are provided in the manual.

The laundry to landscape pilot program identifies specific requirements for participation such as having a yard that is level or down sloping from the clothes washer. The subsidy provided is $95 towards the purchase of a $100 starter kit that includes a 3-way valve, piping, tubing, fittings, and other materials for installation. Up to 150 properties will be eligible to participate.

City of Santa Monica

Three graywater systems were installed under a City of Santa Monica grant program. Two were engineered and one was "off the shelf". One of the systems was highly advanced and a retrofit; it used potable water, graywater, and rainwater for garden irrigation. It took three years for final approval. Total cost was $20,750 for an anticipated savings of 71,000 gallons per year, or $95,200 per acre-foot over a 15 year period. The off the shelf system required so many modifications to make it legal that its costs were also very high. All systems are working now, but the City noted there were lots of lessons learned during the approval process for these first systems (O'Cain, 2010).

Japan

According to Sheikh (2010), graywater sources at high rise apartment or office buildings in Japan are sometimes collected separately and treated in an on-site wastewater treatment plant. Black water is collected in a separate sewer and sent to the municipal treatment plant. Effluent from the on-site treatment system is then utilized as nonpotable recycled water in a manner similar to that for recycled water. Graywater sources within a high rise building typically provide enough water to meet nonpotable demands in the building and vicinity.

1998 Arizona Graywater Use Survey

Water Conservation Alliance of Southern Arizona, supported by the ADWR, ADEQ, and Pima county DEQ, conducted a survey of graywater users in the Tucson area (Water CASA, 1999).

8.4 percent of respondents use graywater at their homes. To better estimate the Tucson area use, a weighted average was calculated at 13 percent of owner occupied single family and manufactured residences. Of the 8.4 percent that do reuse graywater, the clothes washer accounted for 66 percent of all sources, followed by showers and bathtubs at 15 percent, and kitchen sinks at 10 percent. Most tapped a single source of supply. The most common method of application was surface application at 34 percent, garden hose at 20 percent, and by bucket at 15 percent. Two-thirds of the landscape uses were irrigation of shade or ornamental trees, shrubs, and grass. 9 percent irrigate fruit/nut trees and 4 percent irrigate vegetable/herb gardens.

When asked why the over 90 percent respondents did not reuse graywater, the majority (30 percent) answered that they don't know how and they need information and assistance. Other responses included: water is not near use, no use for water, not sure if safe/sanitary, water is salty/chemicals, and legal and permitting issues.

Such systems are common in Japan, especially in cities where developers of new buildings containing over 3,000 square meters or over 5,000 square meters (depending on local regulations) of usable space are required to provide on-site treatment and reuse, mainly for toilet flushing. These graywater systems utilize highly sophisticated treatment systems, including membrane biological reactors, and are closely monitored (Sheikh, 2010). In Tokyo, graywater reuse is mandatory for buildings with an area over 30,000 square meters or with the potential reuse of 100 cubic meters per day (CSBE, 2003).

Assessment of Market Potential – Graywater Use

Permitted graywater systems in California are few, with a lack of consistent data on actual usage and existence. Most systems in California are not permitted, mainly because of the rigorous State requirements prior to 2009. Many of these preexisting systems may not be in compliance with the new regulations or if they are single source systems for irrigation use, they no longer require a permit, unless the local jurisdiction has more stringent regulations than the State's.

Because most systems currently exist solely out of personal interest, with the right influences the market potential for small, simple systems could be great. Market influences, potential market penetration, and acceptance are described here.

Market Influences

According to the NPD Group survey described previously, people start using graywater with the primary intention of conserving water, for watering landscaping, and because of hot dry weather conditions. The cost of water bills and reducing flow to septic systems also plays a role; regulations did not appear to be a strong influence (The PDG Group, 1999).

Certain site specific conditions can influence graywater use (identified by HUD, 2002 and modified here).

- Water is extremely scarce and expensive, as it is in many parts of the southwest
- Severe limitations on wastewater discharges
- Volume of water used for irrigation is over 20 percent of total water use
- Retrofitting is relatively easy due to interior plumbing setup
- Local utilities offer rebates for the installation of graywater systems

Water is neither extremely scarce nor expensive in the Bay Area and there typically are no limitations on wastewater discharges, except individual septic systems experiencing problems. Outdoor water use is typically over 20 percent of total water use in the Bay Area, most of it being irrigated turf. Retrofitting complexities are most often associated with a home having a slab foundation or a second story. Financial incentives, such as rebates, are not commonly used to encourage graywater use, in part because of liability concerns.

Conditions that influence the market penetration of graywater systems in the Bay Area overlap greatly but were summarized into the following topic areas.

- Behavioral changes and market forces, tapping into a conservation ethic or environmental sensitivity
- Institutional influences
- Financial considerations including costs and difficulty in implementing and operating the system

Behavioral Changes

Conservation Ethic. The demand by the public to retrofit their homes for graywater systems and for easing restrictions on graywater use is a key factor affecting the market penetration of graywater use. This is evident by the estimated number of illegal systems thought to exist in California. Similar to rainwater harvesting, interest in graywater use at a single-family home often originates from a strong conservation ethic - the desire to be sensitive to the environment and reduce one's water footprint.

Public interest impediments to graywater penetration and acceptance can often be managed with outreach efforts. In particular, the public have concerns regarding health risks, complexity of installation and maintenance, and costs versus savings on water bills. These are discussed in later sections.

Another form of behavior change influencing market penetration of graywater use can be found with awareness of droughts and other supply shortages augmented by local agency outreach to encourage graywater usage. For example, during Australia's 12 year drought, in some areas graywater usage was encouraged formally through incentives and public education and informally by restricting outdoor irrigation to nonpotable supplies only.

Market Forces. As more systems are implemented throughout the Bay Area, manufacturing and installation advertising and news sources will increase awareness of graywater projects. In addition, residents observing their neighbor's systems may be more likely to implement their own system.

New Construction. Leadership in Energy and Environmental Design (LEED) points can provide an attractive incentive for designers and developers trying to meet sustainability objectives for new commercial and residential developments.

Institutional Influences

Permitting. Permitting requirements and/or costs can be a disincentive for market penetration. An installer described the varying building permit costs for a typical simple graywater system relying on two sources of supply (e.g., laundry and shower) and used for irrigation: in a Marin County jurisdiction the permit cost $2,500 for this simple system, and $80 for the same type of system permitted in a Sonoma County jurisdiction. Generally, graywater building codes have discouraged it use by being overly complicated. With the new state regulations, single source to irrigation use systems do not have to be permitted, which should reduce some barriers. However, it was noted that systems with two sources (e.g., laundry and shower water) do not necessarily increase risks, yet they require a permit under the new regulations.

Supply Offsets for New Construction. In areas where recycled water may not be available, developers who install graywater systems in new residential construction may qualify for water demand management offset credits for projects subject to SB 610 Water Supply Assessments and SB 221 Written Verifications of Water Supply (MWD, 2009), in addition to LEED points previously discussed. Graywater offers a very reliable water supply when compared with supplies subject to weather and other conditions.

Conservation BMPs. Graywater (as well as rainwater) is recognized by CUWCC as a water saving technique within its Flex Track menus for 2008 Commercial, Industrial, and Institutional (CII) (item 10c; item 10e for rainwater), and 2008 Landscape (item 3g includes rainwater) menus (CUWCC, 2010). This provides another tool for BMP signatories to use in achieving the required 20 percent municipal water savings by 2020.

Public Health Risk. The familiarity of and comfort with graywater systems by a water utility and local building officials influence market penetration rates. Public health risk challenges were part of the reason for past regulations that were so onerous that residents illegally installed their own systems. From a cautious local agencies' perspective, the use of graywater by the public increases the risk of exposure to untreated or undertreated wastewater potentially containing high levels of bacteria and possibly pharmaceuticals. Many local regulatory agencies required permits for graywater systems out of concern that an unqualified person would be doing the retrofits and that the system may be inadvertently connected to the potable water system. But with the simple, single source systems which now do not require a permit, the likelihood of connecting a laundry discharge hose into a potable water line, is slim.

A Water Environment Research Foundation (WERF) analysis conducted by Colorado State University identified a study that indicated shower water is higher in total and fecal coliform bacteria than laundry water. According to WateReuse Association et al., the high number of indicator bacteria in graywater was cause for most public health officials to oppose reuse of untreated graywater without permits, restrictions, and other regulatory controls (Sheikh, 2010). Not all of the public health risks are known and not all of the known risks have been resolved, leading to continued resistance by some local agencies.

There are issues regarding the color of piping since purple piping implies a highly treated municipal recycled water supply and graywater is not highly treated at on-site systems if treated at all (Vandertulip and Weaver, 2010). The new State regulations have provisions to minimize health risks by preventing cross connections, avoiding direct application to lawns, fruit, and vegetables unless trees are under mulch, and not using sprinklers.

Financial Considerations

Installation Costs. The cost of installing graywater systems is relatively high when compared with the cost of other retrofit conservation BMPs. The primary cost of installation is labor which will depend on the complexity of the system and use of the water. With low priced potable water in the Bay Area, there is little incentive due to the return on investment. The cost of installing graywater systems, which must be designed and installed specifically to the site, can be high. It was noted by one jurisdiction that graywater retrofits do not yield enough flow in their community because housing prices are very expensive, residents remodel and replace fixtures and appliances during the remodel, and are therefore very efficient with indoor water use (O'Cain, 2010). As indoor efficiencies increase, the return on investment in graywater system will continue to decrease without significant rate increases.

Because greater compliance with regulations is anticipated since State regulations became more flexible, it is likely that costs for materials and labor may be reduced over time. The graywater retail market may evolve with approved in-home system devices as well as homeowner kits for laundry to landscape conversions, and professional installation services will be more readily available and competitive to properly install systems. Eliminating treatment requirements and inspections (which increase costs and complexity) for single source systems will certainly remove a barrier to increased usage.

New Construction. Since the new California code was adopted, manufacturers have received a "tremendous number of inquiries". ReWater Systems manufactures graywater materials (e.g., holding tanks, treatment systems, irrigation systems) for systems other than single source systems. Most of their clients are building new homes and have contacted them because the return on investment is good for new construction with large landscaping (ReWater Systems Inc., 2010). The development industry is more favorable to implementing innovative water recycling and LID alternatives for new construction, because it can pass the costs on to the consumer through the use of exactions and development fees (Elmer). However, during these difficult economic times, developers are more focused on reducing the cost of housing.

Lower Water/Sewer Bills and Anticipated Rate Increases. As water rates continue to increase, municipal water customers are starting to "see the future" and look for ways to reduce water bills. The financial benefits to a homeowner of saving money on their potable water bills and in some cases, lower sewer costs, can be significant enough to influence the decision to install a system. Some organizations (e.g., Graywater Action) have a calculator on their website to determine cost savings implications of graywater systems.

Difficulty of Implementation and Operation. Another key influence is the difficulty of implementation and operation. Installation and maintenance complexity can be daunting to the general public. Systems with more complexity that a single source to landscaping system may require pumping, filters, and disinfection; filter maintenance can be high due to high solids content in the water. Without treatment, it is usually recommended that the supply be used within 24 hours because bacteria multiply to septic levels quickly. Educational outreach for installation can increase market penetration, but follow up support by local agencies to maintain the systems increases retention.

Utilizing graywater for irrigation requires use of appropriate indoor cleaning products, and the flows must be diverted to the sewer when washing diapers or if water was in contact with someone with an infectious disease. Graywater systems in apartment complexes have the added concern that the residents are not educated on product use and disposal of contaminants or they do not share in the environmental/ conservation ethic and do not support the system.

Other implementation influences are site specific: soil may be too permeable or not permeable enough. It cannot be applied on lawns or on fruits and vegetables that are eaten raw – no direct human contact should occur. Large areas are needed for an effective system, e.g., enough topsoil is needed to process the graywater; and density and type of landscaping to use it (e.g., lawns are a challenge). And there are seasonal challenges when used as an irrigation supply. Graywater can have high levels of sodium and high alkalinity, and higher concentrations of dissolved salts, all of which impact soils and plant growth. Graywater users must be better educated than most residents on what products are appropriate to use.

Existing Residents. It can be difficult to retrofit homes for graywater systems because many plumbing systems are built into a concrete slab. Multiple showers that are not proximate to each other prevent a consolidation of supply sources to one storage and treatment facility. Second story bathrooms or laundry rooms with plumbing in the wall can be difficult to access.

New Construction. New homes, if not built with graywater systems integrated into the design, can be built with stubouts, like those required by Tucson. The primary target market for graywater systems should be new homes and major remodels.

Potential Market Penetration and Acceptance

Market Penetration

There are no market studies for graywater penetration in the Bay Area. The Metropolitan Water District recently acknowledged that more research and development is needed before market potential and cost-effectiveness of graywater use can be established (MWD, 2009). According to the WateReuse Foundation et al., there are no peer-reviewed survey research results available regarding actual volumes of graywater currently diverted and used.

With the recent changes in California's graywater regulations, it is anticipated that better data will be available in the future to determine the existing use of graywater systems and the market potential. In the absence of good data to estimate market potential for single-family residential graywater use as a range of potential supply yield, assumptions were made regarding supplies and demands. These assumptions can be updated once better data are available in the future.

Supply Estimate. Typically, graywater supply is about 50 percent of residential wastewater generated from the home. Over the past two decades water conserving fixtures have become mandatory, thus reducing the volume of graywater available. To calculate potential graywater flow, the State Plumbing Code assumes 25 gpd per person for showers, tub, and bathroom sink; and 15 gpd per person for laundry wash water, thus an upper yield of 40 gpd per person. (Dishwashing and kitchen sink flows are not considered a graywater supply.) These unit factors were used in the yield analysis presented in Table 5 assuming 2.7 persons per dwelling unit (pph), which is relatively low for single family homes only. The code calculates graywater discharge based on number of bedrooms (HCD Ch 16A, 2009). The potential yield range presented below was based on people per household versus number of bedrooms.

According to ReWater System, a manufacturer, only the regularly used showers, tubs, and clothes washer should be connected to the surge tank they manufacture; about 95 percent of the reusable water comes from these sources. Supplies that should not be included in the flow calculation are from bathroom sinks which produce another three percent, and guest bathrooms with showers, tubs, and sinks which contribute the remaining small portion (ReWater System, 2010).

Demands. Irrigation water demands are lower during winter months, thus requiring graywater to be discharged into the unit's sewer, and higher during summer months, often requiring augmentation with potable supplies. It was assumed for this analysis that irrigation demands are for seven months only: April through October (214 days). Realistically, there may be outdoor irrigation demands during most months, depending on the location in the service area, but it is not likely to fully utilize the entire amount of graywater available during winter months. Additional analyses on service area irrigation demands could aid in determining excess winter flows and summer augmentation requirements with potable supplies.

Potential Supply Yield. As shown in Table 5, under the demographic characteristic assumptions presented for rainwater harvesting and graywater supply estimates above, the range of potential graywater yield under 2010 demographic characteristics is 468 to 2,465 afy for simple systems used for irrigation. For 2035 demographic characteristics, the potential yield ranges from 1,277 to 4,355 afy, again for simple systems used for irrigation only.

Table 5. Graywater Supply Yield Worksheet

Year	SFR Dwelling Units (1)	BAWSCA Households Acceptance Rate		Graywater Reuse per Household (2,3) (gpd)	Service Area Yield (5)	
		Percent (4)	Dwelling Units		(mgal)	(afy)
2010 - Low	349,000	5%	17,450	41	152	**468**
High	349,000	10%	34,900	108	803	**2,465**
2035 - Low	444,000	20%	88,800	22	416	**1,277**
High	444,000	20%	88,800	75	1419	**4,355**

(1) Number of single family residential homes (sf du) based on estimates provided by BAWSCA for 2010; for 2035, 60% (sf du versus multi-family) of 2.0 million population divided by 2.7 pph equals 444,000 sf du. See rainwater harvesting yield discussion on assumptions.

(2) HCD unit factors equate to 41 gpd laundry water only for household of 2.7 people; 108 reflect laundry and bathing water for 2.7 pph.

(3) Sheikh, 2010. 2030 estimates of reduced supply from Sheikh assumed for 2035.

(4) 1999 and 2030 estimates of 13.9 and 20 percent from The NDP Group, respectively, for California revised downward to provide more conservative ranges.

(5) Supply yields reflect use per household times number of households at specified acceptance rates for seven months.

Acceptance

The Pacific Institute recently released a study which described public perception and acceptance of graywater in various countries (Pacific Institute, 2010). It indicated high public acceptance for watering a garden in Australia for example and lower acceptance for using graywater for washing a car or clothes with it. Strategies identified by others and summarized in the report to encourage acceptance included education and awareness building campaigns; community engagement, particularly with women “as the primary water managers on the household level”; and working with the media.

Retention

A survey conducted in 1998 on graywater usage indicated that 85 percent of graywater users intend to continue using graywater in the future. It is not likely that new homeowners, inheriting a graywater system, will maintain it (The PDR Group, 1999, Samis, 2010). According to the California Urban Water Conservation Council, most new graywater systems are abandoned or achieve less than 10 percent reuse efficiency within five years (H2ouse, 2010).

Increased Demands When Graywater is Not Available

Since flushing toilets uses about 30 percent of a household's wastewater stream, indoor graywater systems only need to recover about 30 percent of the wastewater. If additional water is needed for toilet flushing or if the graywater system is not in operation, the potable water system is used to make up the difference. For landscaping, when the graywater system is not in operation or if a drought increases outdoor demands, again, the potable system must be utilized to meet demands. Increased demands when graywater is not available would be roughly equivalent to the amount of graywater supply utilized. Only in cases where landscaping is modified to include higher water use materials because of the availability of the graywater supply, would the demands be higher than without the graywater system.

Studies have recommended that capacity requirements for new potable water systems and sewage collection systems not be reduced to accommodate increasing graywater usage. This is because retention rates could drop, systems can fail, and droughts may push irrigation demands higher than adjusted peaking factors can accommodate.

Recommendations by Others

Although graywater has been reused in some communities for many years, there are still many uncertainties regarding its use. The MWD Graywater Task Force, as a part of its Integrated Resource Plan (IRP), identified the following graywater topics in need of further research.

- Water quality, including pathogen removal for indoor units
- Market potential
- Drain line hydraulics
- Indoor versus outdoor use
- Cost effectiveness for assessing future incentives.

The task force also identified the following recommendations regarding graywater being included as a supply source in its IRP supply portfolio.

1. Do not take an active role in providing financial incentives for installing graywater systems at this time. When new graywater regulations are adopted, reevaluate the cost-effectiveness of incentives.
2. Focus efforts toward reviewing and suggesting standards and pursuing changes to legislation and regulations in order to reduce barriers for consumer acceptance, facilitate permitting

processes, and ensure distinction between graywater and recycled water so that graywater does not become an impediment to development of local water resources or public health.

3. Work with local entities to create model guidelines for a graywater permitting process.
4. Assist with public information efforts to build public support for graywater.
5. Use the public’s interest in graywater as an opportunity to promote other water efficient landscaping measures. (MWD, 2009)

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Attachment 1 – Select Rainwater Harvesting and Graywater Use Activities

Rainwater Harvesting Activities in Other Jurisdictions

States leading in rainwater harvesting activities include Arizona, California, Oregon, Texas, Virginia, and Washington. A few examples of activities such as financial incentives, implemented projects, studies, etc. are provided here. Regulations were previously described in this TM.

California

Numerous jurisdictions in California currently offer rebates to cover or partially cover the costs of rainwater systems. Below are summaries of several of these rebate programs along with a description of other related activities.

MPWMD and CalAm. Monterey Peninsula Water Management District and California American Water Company currently offer rainwater harvesting rebates. Cistern water tanks rebates are $25 per 100 gallons of water storage capacity, up to a maximum storage capacity of 25,000 gallons per qualifying property. Sites must have sufficient roof area to fill the cistern.

City of Oakland. The City's Watershed and Stormwater Management Rain Barrel Program is a three year initiative to provide rain barrels at reduced cost to reduce urban stormwater impacts. A 65 gallon barrel is $45 with a limit of six per household and the 200 gallon capacity is $116 with a limit of two per household. Mills College has a 2,000 gallon cistern for the Natural Sciences Building using the captured stormwater for toilets in the building and harvests as much as 60,000 gallons annually. The new Graduate School of Business has a 4,000 gallon cistern using stored water for toilets.

San Francisco Public Utilities Commission. San Francisco residents, businesses and schools can purchase 60 gallon rain barrels and larger volume cisterns at discounted prices. Participants can purchase up to 11 discounted rain barrels or 660 gallons of cistern storage space through this program. The first barrel can be purchased for $85 and each additional barrel for $45. Cistern discounts range from $160 to $640 depending upon capacity.

City of Santa Monica. Through June 2011, or until funds are depleted, rainwater harvesting rebates listed in Table A.1 are being offered by the City of Santa Monica for its rainwater harvesting program.

Table A.1. Current City of Santa Monica Rainwater Harvesting Rebates

Storage Container	Single Unit Capacity (per container)	Rebate for Design, Labor, and Materials
Barrel(1)	Up to 199 gallons	$100
Cistern(2)	200 to 499 gallons	$250
Cistern(3)	500 gallons or larger	$500

Source: City of Santa Monica, November 2010.
[1] Limited to 2 per downspout per property with a maximum of 8 total.
[2] Limited to 4 cisterns per property.
[3] Limited to 2 cisterns per property.

City of Santa Rosa. The City of Santa Rosa's water conservation program offers rainwater harvesting rebates at $0.25 per gallon of storage for systems with a minimum of 100 gallons of storage capacity and a maximum based on the estimated peak month water use for individual sites. Water can only be used for landscape irrigation and permits and backflow devices are required. Labor costs cannot be reimbursed.

City of Seaside Case Study. Chartwell School in the City of Seaside developed an 8,700 gallon cistern in 2007. The rainwater is being used to meet approximately 50 percent of toilet flushing water demands with an overflow bypass line feeding the irrigation system.

Soquel Creek Water District. Soquel Creek Water District's rebate program offers a flat $25 rebate per 100 gallons of storage capacity. There is a minimum capacity of 200 gallons and a maximum rebate of $750 for 3,000 gallons.

The photos in Figure A.1 show a 2,500 gallon cistern installed in the SCWD service area when it was first installed and after landscaping was established. The system is gravity fed from the roof and supplies drip irrigation and a few sprinklers in the yard. Rain collected in winter months is enough to irrigate drought tolerant landscaping year-round, thus balancing storage capacity with demands (SCWD website, 2010).

Figure A.1 A 2,500 gallon cistern supplies irrigation water year round in Soquel Creek Water District service

Arizona

The State of Arizona has numerous examples of graywater system implementation. Financial incentives are described here. The State has tax incentives for rainwater harvesting. Credit is given for plumbing stubouts and water conservation in place through tax year 2011. The maximum residential credit is $1,200. Credits for businesses are available in the tax statue. The tax credit was formerly only given for graywater systems, but it now also applies to rainwater harvesting systems. (Harvesth2o, 2010).

New Mexico

Rainwater harvesting rebates in Albuquerque are based upon capacity: $25 for 50 to 149 gallons; $50 for 150 to 299 gallons; $75 for 300 to 499 gallons; $100 for 500 to 999 gallons; $125 for 1,000 to 1499 gallons; $150 for 1,500 gallons or more.

Santa Fe had a program for free rain barrels that switched to rain barrel rebates. Rain barrel and cistern rebates vary depending on capacity: $12 for a 50 to 99 gallon barrel; $25 for a 100 to 199 gallon cistern; $50 for a 200 to 299 gallon cistern; $0.25 per gallon for the installation of a water harvesting system.

North Carolina

Under North Carolina's program the landowner may be reimbursed up to 75 percent of the pre-established average cost of the conservation BMP, including rainwater harvesting systems. NC 1385, currently under consideration, provides a tax credit for installation of a cistern, and prohibits cities from prohibiting rainwater recovery systems.

Oregon

The City of Portland Planning and Sustainability, Environmental Services, and Development Services bureaus all encourage on-site stormwater innovations. Stormwater management fees are reduced if runoff is retained on-site. In some locations, Portland will pay an incentive to disconnect eligible downspouts from sewers through its Downspout Disconnect Program.

The City of Portland conducted a feasibility study for a new 12-story affordable housing tower in downtown Portland. The study found that rainwater harvesting was technically feasible, but would significantly increase capital and operational costs compared to conventional plumbing and potable water use.

Washington

The City of Seattle is promoting rainwater harvesting through the development of a Client Assistance Memo (CAM) 520 titled *Rainwater Harvesting for Beneficial Use*. The CAM offers suggestions on system components, requirements and design considerations, and features a commercial and residential case study that includes the rainwater system design components.

The Seattle Green Factor requires new development in neighborhood business districts to meet a landscaping target that improves landscaping while meeting open space requirements. When used for landscape irrigation, rainwater harvesting can provide bonus credits for the Green Factor requirements.

Case Studies. There are numerous examples of rainwater harvesting systems in Seattle including: Cedar River Watershed Education Center, Carkeek Environmental Learning Center, Seattle City Hall, Seattle Central Library, Northgate Civic Center, Fire Station 10, King Street Center, and Cascade Eco-Center (City of Seattle, 2010). The King County Government Center located at the King Street Center in downtown Seattle collects enough roof runoff to supply over 60 percent of the toilet flushing and irrigation water requirements, saving approximately 4.3 acre-feet of potable water per year. The Carkeek Environmental Learning Center, a smaller building, drains roof runoff into a 3,500 gallon cistern to supply toilets (County of San Diego, 2010).

Texas

The State of Texas offers multiple incentives at the local and state levels. Starting in 1993, Texas passed several laws encouraging rainwater harvesting. State law provides property tax relief to facilities that use rainwater harvesting. State law allows local taxing entities the authority to exempt all or part of the assessed value of the property on which water conservation modifications, such as rainwater harvesting, are made. The taxing entity designates by ordinance or law the eligible water conservation initiatives. In addition, the State tax code exempts rainwater harvesting and recycled water equipment and supplies from state sales tax.

Texas supports rainwater harvesting activities at state and higher education facilities through a task force and code. Finally, it promotes rainwater harvesting with code allowing performance contracting, which allows recuperation of initial investments through savings earned on utility bills. In other words, the water- and energy-conserving measures pay for themselves within the contracted period.

City of Austin. Beginning July 1, 2010 the existing Austin Water Utility rainwater harvesting and rain barrel rebate programs were combined into one capacity-based incentive program. Rebate amounts will be calculated at $0.50 per gallon for non-pressurized systems and $1.00 per gallon for pressurized systems. The maximum rebate amount will be increased to $5,000, not to exceed 50 percent of the project cost. Systems of more than 500 gallons will require approval prior to system installation. Participation will be limited to once every 12 months. Additionally, the minimum capacity of 75 gallons that is currently required for participation will be lifted, making all sizes of rain barrels eligible.

City of San Antonio. In San Antonio, a 50 percent rebate is available for new water-saving equipment at the commercial scale.

Washington DC

Case Study. George Washington University was interested in converting Square 80, considered underutilized lands, into an urban, multi-functional, sustainable plaza. Completed in 2010, Square 80 design collects 100 percent of on-site rainwater (roof and land based) and uses it directly or stores it for irrigation, maintenance, and fountains. Elements of the project include underground cisterns, rain barrels, biofiltration planters, bioswales, pervious paving, native plants, and rain gardens; primary rainwater harvesting activities are located at Guthridge Hall, 2109 F Street, and the plaza.

At Square 80, overflow from the rain barrel is piped to the underground cistern (see Figure A.2). An underground vortex fine filter separator removes debris and diverts 90 percent of clean rainwater to the cistern. Rainwater from the Guthridge Hall and 2109 F Street roof downspouts, the drain inlets and trench drains, the pervious paving, and the overflows from the biofiltration tree planters, rain garden and bioswale are all collected and stored in the underground cisterns. The downspout at 2109 F

Figure A.2 Square 80 Cistern #3

Street is connected to a 300 gallon rain barrel and is used for routine maintenance. The overflow from this source and the downspout at Guthridge Hall are connected to vortex separators. Additional vortex separators are utilized at each inlet to the cisterns. Each underground cistern has one outfall multiple inlet sources.

In the plaza, all stormwater collection systems convey water to three underground cisterns with 8,000, 10,000, and 15,000-gallon capacities, respectively. Prior to the water reaching the cisterns, it is flushed by the vortex fine filter separators, which remove small debris. The stored water is redistributed to either the irrigation system or the rainwater fountain feature at the center of the plaza. (Green Building Pro, 2010)

United Kingdom

"Water butts" are found in domestic gardens to collect rainwater for irrigation. The government's *Code for Sustainable Homes* encourages large underground tanks on newly built homes and using stored water for toilets, washing machines, landscape irrigation, and car washing.

Graywater Use Activities in Other Jurisdictions

In addition to activities discussed for Santa Monica and Japan, and the description of the Arizona survey results, a few examples of graywater activities such as financial incentives, implemented projects, studies, cost estimates, etc. are provided here.

California

City of Los Angeles Case Study. Susan Carpenter, a columnist for the LA Times decided to implement some of the eco-friendly projects she had been reporting on over the years. Her most successful project was a graywater system (followed by solar power and rain barrels). The plumbing on her washing machine was retrofitted to be used for landscape irrigation. It was so successful she had a plumber expand it, connecting the bathtub, shower, and bathroom sink into the same gravity fed pipeline as the laundry wash water. Estimated savings were roughly 37 gpd. Costs were $312 for the laundry-to-landscaping plumbing and $1,676 for bathroom connection. "In drought-prone Southern California, gray water feels like the right thing to do. It's been the easiest, most sensible, hassle-free, sustainable system I've put in place at my house." (Carpenter, October 2010)

Padre Dam Municipal Water District. PDMWD in San Diego County conducted a study in 2000 and found that graywater use has potential benefits in reducing potable irrigation demands and wastewater flows, but actual performance was influenced by the following factors.

- User's familiarity with the system
- Size of landscaping area that can utilize the graywater system
- Local health department and jurisdictional agencies' acceptance
- Operation and maintenance of the system
- Amount of water contributed to the graywater system (MWD, 2009)

City of San Diego. The City of San Diego analyzed possible discount fees in 1999 to promote graywater systems for new construction. Cost estimates for different levels of system complexity, for new construction, were developed with capital costs ranging from $650 to $4,200. The total costs over 15 years with a discount rate of six percent ranged from $2,500 to $1,700 per acre foot.

UCLA Study. A study of graywater potential by Professor Cohen of UCLA estimated the capacity for graywater recycling and reuse for single and multi-family homes in the South Coast Hydrologic Region at approximately 650 million gallons per day (mgd) and 285 mgd, respectively, or about 25 percent of the total municipal and industrial water used in that region. It is estimated that the residential graywater reuse capacity in the Los Angeles Department of Water and Power service area could range from a low of 50 mgd to a high of 165 mgd (or about 8 to 27 percent of the total municipal and industrial demands for the service area) (Cohen, 2009).

Arizona

As discussed under regulations, the State of Arizona has lead the way in providing regulations that are somewhat flexible yet protect public health, resulting in numerous examples of graywater systems throughout the state. The State offers financial incentives for graywater systems. A State income tax credit of $200 is offered. A State Department of Revenue Tax Incentive provides for 25 percent of the costs up to $1,000 for residential systems, and $200 per home for stubouts for graywater to be included in new construction. The cities of Chino Valley, Cottonwood, and Tucson require graywater stubouts for all new construction after June 1, 2010.

Texas

In the State of Texas, rainwater harvesting and reclaimed water systems, including graywater, are all sales tax exempt. The State tax code provides an exemption for equipment, supplies, and services used solely to reduce or eliminate water use (Onecle, 2010).

Jordan

In the City of Amman, Jordan, 60 percent of households and 30 percent in rural Jordan reuse water on-site. Systems can be simple, diverting sink water outside and manually watering vegetation, for example. In the case of the King Abdullah mosque, water used in the ablution of worshippers is collected, pumped to a rooftop cistern, filtered, and used for irrigation of mosque landscaping. New construction with dual plumbing, dedicated underground cistern and treatment system was installed. The graywater, collected throughout the house, was filtered and pumped through a sprinkling irrigation system. However, the system was abandoned within the first two months of operation due to adverse odors from the irrigation water. Analysis of the system indicated the sprinkler system caused the problems (CSBE, 2003).

Australia

Government-provided information and certification regarding commercial graywater systems is clear and posted on government web sites. In addition, detailed information is provided to the public sector on available and acceptable graywater recycling technologies and approaches. Moreover, the Australian government has established a National Rainwater and Graywater Initiative with funding and rebates to promote efficient and safe graywater recycling and rainwater storage (Cohen, 2009). Rebates are available for up to AUS $500 for households to install new rainwater tanks or a graywater system. Grants were also provided for up to AUS $10,000 for "surf life saving club" for water saving devices on club premises. The national government has a dedicated water information telephone line and educational materials on graywater systems for assistance on choosing the right systems.

In many states and territories rebates are available for graywater systems using the water for irrigation, for rainwater tanks, and related garden products such as mulch. Educational assistance is provided to encourage its use. In some jurisdictions, permits are not needed if using shower and laundry water within 24 hours for irrigation and are installed by a licensed plumber.

Exhibit 5
Revised Draft Task 6-A Memo
Refined Evaluation Criteria and Metrics

CDM Smith

Memorandum

To: *Anona Dutton, BAWSCA*
Nicole Sandkulla

From: *Bill Fernandez*
Craig Von Bargen

Date: *March 18, 2012*

Subject: *Revised Draft Task 6-A Memo: Refined Evaluation Criteria and Metrics*

1.0 Introduction

In this Memo:

1. Introduction
2. Proposed Evaluation Criteria Updates
3. Representative Coastal Desalination Project

Appendices:

- A- Project and Portfolio Evaluation Process
- B – Detailed Descriptions of Phase II A Evaluation Criteria

This memorandum presents the proposed criteria to be used to evaluate and rank the water supply management projects and portfolios as part of Phase II A of the Long-term Reliable Water Supply Strategy (Strategy). It incorporates changes based on responses to comments and questions received from BAWSCA on the *Draft Task 6-A Memo* and earlier *Revised Draft Task 6-A Memo*.

One of the goals of the Strategy decision process, as described in the May 2010 *Phase I Scoping Report*, is to create quantitative and defensible project and portfolio rankings. The Strategy decision process uses both quantitative and qualitative evaluation criteria and specific metrics used to distinguish water supply management projects and portfolios and facilitate comparisons.

The evaluation criteria will be used to compare projects and portfolios in the project ranking and portfolio evaluation step of the Phase II A decision process. Details of each process step are described in *Appendix A*. During the project evaluation step, the metrics for each of the criteria described in this memorandum will be calculated for each project based on the quantitative or qualitative formulas defined for each. This will allow projects within supply categories (i.e. recycled water, groundwater, and transfers) to be compared. In the portfolio evaluation step, metrics for portfolios of projects will be a function of each project's metric weighted by the yield it contributes to the total portfolio yield. In portfolios that combine projects with normal and drought-only supplies, the yield of each project will be weighted by the factor that corresponds to the type of supply the project provides.

The proposed evaluation criteria updates are presented below. In addition to Appendix A, Appendix B presents a detailed description of the evaluation criteria.

2.0 Proposed Evaluation Criteria Updates

Evaluation criteria and metrics have been revised since the *Phase I Scoping Report*. Updates included refinements in objective and criteria titles, changes to metrics and removal of a criterion that was found to be redundant. In addition, comments and requested changes from the BAWSCA Board have been incorporated. The complete set of Phase II A evaluation criteria and metrics, including the updates, are presented in Appendix B. The major proposed changes to the criteria are summarized below, and include updates for Criteria 1, 2, and 4.

- *Criteria 1A and 1B* – The original metrics for Criteria 1A and 1B were "Portion of demand met in normal years in 2018 and 2035" and "Portion of demand met during drought of 1987 – 1992," respectively. During the development of Phase II A of the Strategy, projections of supply, demands, and supply have continued to evolve as agencies update this information for incorporation into their UWMPs and other planning documents. As such, instead of making the metrics for Criteria 1A and 1B a function of a specific demand or supply need, we propose changing the metric to measure estimated annual yield under these conditions in acre-foot (AF) per year. The relative comparisons of this metric will be the same, but there will be one less calculation step. The updates to Criteria 1A and 1B are summarized in Table 1.

Table 1
Updates to Criteria 1A and 1B

Strategy Phase	Criteria Objective	Criteria	Metrics (For Project/For Portfolio)
Phase I	Increase Supply Reliability	Criterion 1A – Normal Year Supply	Quantitative (mgd/%): Portion of demand met in normal years in 2018 and 2035
		Criterion 1B – Drought Supply	Quantitative (mgd/%): Portion of demand met during drought of 1987 – 1992
Phase II A	Increase Supply Reliability	Criterion 1A – Ability to Meet Normal Year Supply Need	Quantitative (acre-foot /year [AF/year]): Average annual yield in normal years in 2018 and 2035
		Criterion 1B – Ability to Meet Drought Supply Need	Quantitative (AF/year): Average annual yield during drought (e.g., hydrology similar to 1987 – 1992 drought)

- *Criterion 2B* – The original metric for Criterion 2B was "Potential impact of water quality on groundwater," a qualitative metric measuring the impact of non-potable supply projects (e.g., recycled water projects that could include use of supply as landscaping or irrigation) on groundwater resources. The affect on groundwater quality from these types of projects is difficult to measure and is secondary to the need for a project to meet the water quality requirements of the type of demand to be served. To address this issue, the metric is updated to include a qualitative assessment (e.g. "yes" or "no") of the ability of potential non-potable projects to meet the water quality requirements of the target use. In most cases, this metric will be used to designate whether a non-potable supply source meets Title 22 requirements, as this is a common target water quality level for a non-potable demand. The updates to Criterion 2B are summarized in Table 2.

Table 2
Updates to Criterion 2B

Strategy Phase	Criteria Objective	Criteria	Metrics (For Project/For Portfolio)
Phase I	Provide High Level of Water Quality	Criterion 2B – Provide High Level of Non-Potable Water Quality	Qualitative: Potential impact of water quality on groundwater
Phase II A	Provide High Level of Water Quality	Criterion 2B – Meets or Surpasses Non-Potable Water Quality Standards	Qualitative: Meets minimum water quality requirement (e.g., Title 22) for the targeted use.

- *Criteria 4A and 4B* – Criterion 4A was originally "Reduce Potable Water Demand" measured by "Potable demand reduction due to conservation." Criterion 4B was "Augment Non-Potable Water Supplies" measured by "Demand met with non-potable water supply." Because conservation is now tracked separately as a part of an agency's projected supply, the criterion specific to conservation projects, Criterion 4A, will be removed. Criterion 4 will be a single criterion used to measure the potable water use reduction by use of non-potable supply. The criterion objective has also been changed to "Reduce Potable Water Demand" to reflect the change in this metric. The updates to Criterion 4 are summarized in Table 3.

Table 3
Updates to Criterion 4

Strategy Phase	Criteria Objective	Criteria	Metrics (For Project/For Portfolio)
Phase I	Increase Potable Water Use Efficiency	Criterion 4A – Reduce Potable Water Demand	Quantitative (mgd/%): Potable demand reduction due to conservation
		Criterion 4B – Augment Non-Potable Water Supplies	Quantitative (mgd/%): Demand met with non-potable water supply
Phase II A	Reduce Potable Water Demand	Criterion 4 – Augment Non-Potable Water Supplies	Quantitative (AF/year): Reduction of potable water demand by use of non-potable supply.

Appendix A
Project and Portfolio Evaluation Process

This appendix summarizes the development of project information over the last 18 months and the decision process designed to rank projects and evaluate project portfolios.

The water supply management projects (projects) presented in this *TM 2 – Updated Agency-Identified Water Supply Management Project Information* could potentially be used by BAWSCA and the BAWSCA member agencies to meet the normal and/or drought supply needs as identified in *TM 1– Updated Water Demand and Supply Need Projections for the Long-Term Reliable Water Supply Strategy for BAWSCA*. In addition, *TM 3 - Updated Regional Water Management Project Information* presents other potential projects including groundwater, desalination, and water transfers.

Collection of Project Information

The projects presented in TMs 2 and 3 were initially identified during the Phase I Strategy Scoping process. Information for these projects has now been further developed to a common level so that the projects can be compared to each other and preliminarily ranked to determine which individual or combination of projects could best meet the identified supply need. This initial project information development has focused on preliminary estimates of the yield, cost, reliability and implementation schedule. For each of the projects presented in TMs 2 and 3, key issues and outstanding technical information are identified along with potential next steps.

In July 2012, the *Long-Term Reliable Water Supply Strategy Phase II A Report* (*Phase II A Report*) will be completed. This *Phase II A Report* will present the technical information developed to date as part of the Strategy (from TMs 1, 2, and 3), as well as updated information on the frequency and magnitude of expected supply shortfalls from the San Francisco Regional Water System. The *Interim Report* will also present a recommended implementation plan to achieve the Strategy's goal of ensuring that a reliable, high quality supply of water is available where and when people within the BAWSCA service area need it. Depending on the BAWSCA decisions coming after the *Interim Report* additional analysis of specific water supply management projects may occur, including:

- Project Ranking;
- Portfolio Development; and
- Portfolio Evaluation.

These efforts would be part of the development of the Strategy Recommendations.

Project Ranking

Individual water supply management projects may be compared with each other within each supply category (e.g., desalination, recycled water, surface water, etc.) for each of the evaluation criteria. The metrics for each of the criteria described in this memo would be calculated for each project based on the quantitative or qualitative formulas defined for each, allowing comparisons of projects within supply categories. The six criteria metrics described in this memo would be estimated for each project, allowing comparisons of projects within supply categories. The relative weighting, or importance, of the criteria could be adjusted during this process. This evaluation would compare similar projects and aid development of portfolios.

Portfolio Development

Since no single water supply management project is likely to be able to meet the entire future supply need for BAWSCA member agencies (either under normal or dry conditions), multiple projects could be combined into water supply management portfolios. The resulting portfolios would consist of multiple projects and increase the water supply diversity within the BAWSCA service area.

Portfolio Evaluation

After developing the water supply management portfolios, the next step would be to evaluate and compare the portfolios. Criteria metrics for portfolios of projects would be a function of each project's metric weighted by the yield it contributes to the total portfolio yield. The portfolios, and the specific projects, that perform the best against the evaluation criteria would be recommended for implementation as part of the Strategy.

Strategy Recommendations

Once a range of portfolios are evaluated, the projects from the top-ranked portfolios could be combined into a recommendation for one or more portfolios moving forward into possible later phases of the Strategy. Multiple portfolios may be necessary to effectively meet different agencies' objectives regarding future supply need. Projects that are consistently in the top-ranked portfolios, yet have uncertainty associated with project yield, may be addressed with additional refinement of project information as part of later Strategy phases. Once the project information is refined, its ranking and value in potential supply portfolios they would be reassessed to confirm that it remains a recommended project.

Appendix B
Detailed Descriptions of Phase II A Evaluation Criteria

The proposed objectives, evaluation criteria, and metrics for Phase II A are summarized in Table 2-1 and the detailed descriptions below. Major updates to the Phase I evaluation criteria and metrics in Table 2-1 are shown in bold lettering.

Table 2-1
Proposed Phase II A Evaluation Criteria and Metrics

Objective	Criteria	Metrics (For Project/For Portfolio)
1 - Increase Supply Reliability	Criterion 1A – Ability to Meet Normal Year Supply Need	**Quantitative (acre-foot /year [AF/year]): Average annual yield in normal years in 2018 and 2035**
	Criterion 1B – Ability to Meet Drought Supply Need	**Quantitative (AF/year): Average annual yield with drought hydrology of 1987 – 1992**
	Criterion 1C – Risk of Facility Outage	Qualitative (1-5): Estimated probability and duration of major conveyance failure
	Criterion 1D – Potential for Regulatory Vulnerability	Qualitative (1-5): Potential for regulatory decisions to impact supply reliability
2 - Provide High Level of Water Quality	Criterion 2A – Meets or Surpasses Drinking Water Quality Standards	Quantitative (mg/L): Total dissolved solids (TDS) level as an indicator of water quality.
	Criterion 2B – Meets or Surpasses Non-Potable Water Quality Standards	**Qualitative: Meets minimum water quality requirement (e.g., Title 22) for the targeted use.**
3 - Minimize Cost of New Water Supplies	Criterion 3 – Capital and Present Worth Costs	Quantitative ($/acre-foot [AF]): Present Worth costs including capital and operating costs
4 - Reduce Potable Water Demand	Criterion 4 – Augment Non-Potable Water Supplies	**Quantitative (AF/year): Reduction of potable water demand by use of non-potable supply.**
5 - Minimize Environmental Impacts	Criterion 5A –Greenhouse Gas Emissions	Quantitative (metric tons/ AF of Supply): Estimates of unit greenhouse gas emissions
	Criterion 5B –Impact to Groundwater Quantity and Quality	Qualitative (1-5): Potential impacts to groundwater levels, groundwater quality, or potential for subsidence
	Criterion 5C –Impact to Habitat	Qualitative (1-5): Potential impacts to habitat, such as wetlands, riparian zones, fisheries, and inundation areas.
6 - Increase Implementation Potential	Criterion 6A – Institutional Complexity	Qualitative (1-5): Number and type of agencies and agreements involved
	Criterion 6B –Level of Local Control	Qualitative (1-5): BAWSCA and Member Agency ownership of supply projects
	Criterion 6C –Permitting Requirements	Qualitative (1-5): Permitting or regulatory issues for supply projects

Objective 1 - Increase Supply Reliability

Criteria 1A and 1B evaluate the reliability of potential water supply management projects and portfolios during a normal year and drought year, respectively. The criteria and the associated metrics that further define this objective are shown below.

- *Criterion 1A – Ability to Meet Normal Year Supply Need* - An estimate of the ability of a water supply management project or portfolio to meet the normal hydrologic year supply needs of BAWSCA member agencies will be measured by the annual yield of the project during normal hydrologic conditions by the 2018 and 2035 planning horizons. This will be a quantitative value, measured in acre-foot (AF) per year.

- *Criterion 1B – Ability to Meet Drought Supply Need* - An estimate of the ability of a water supply management project or portfolio to meet the supply need during a drought is measured by the annual yield of the project during drought (e.g. hydrology similar to the 1987 – 1992 drought). The criterion of drought reliability captures whether a supply project is resistant to drought impacts. This will be a quantitative value, measured in AF per year.

- *Criterion 1C – Risk of Facility Outage* - The supply vulnerability is measured by the probability and duration of potential outages to a particular water supply management project or portfolio due to a major conveyance failure. This criterion captures the vulnerability of projects or portfolios to emergency outages. This metric will be a qualitative measure ranging from 1 through 5, with a score of "1" identifying the projects that are least susceptible to emergency outages and a score of "5" indicating high susceptibility to emergency outages.

- *Criterion 1D – Potential for Regulatory Vulnerability* - This criterion estimates the susceptibility of a water supply management project or portfolio to interruption as a result of regulatory issues including legal, political, or environmental constraints. This metric will be a qualitative measure ranging from 1 through 5, with a score of "1" identifying the projects that are least susceptible to regulatory risk and a score of "5" indicating high susceptibility to regulatory risk.

Objective 2 – Provide a High Level of Water Quality

These criteria address the ability of member agencies to meet the water quality needs of their customers, both for potable and non-potable water. Thus, the criteria further refine whether a given alternative meets potable water quality objectives or other water quality objectives.

- *Criterion 2A – Meets or Surpasses Drinking Water Quality Standards* - The criterion representing potable supply will be addressed by the quantitative metric of the aggregate water quality, measured by Total Dissolved Solids (TDS) levels, of the potable supply projects and portfolios. TDS is a surrogate for other water quality parameters representing water quality.

- *Criterion 2B – Meets or Surpasses Non-Potable Water Quality Standards* - For non-potable supply projects, where water quality constraints vary according to use, the metric will be a qualitative assessment of whether or not the water supply management projects and portfolios meet the minimum water quality requirement for the targeted use. In most cases, this metric will be used to designate whether a non-potable supply source meets Title 22 requirements, as this is a common target water quality level for a non-potable demand. This will be a qualitative measure.

Objective 3 – Minimize the Cost of New Water Supplies

This criterion will evaluate the present worth costs for each water supply management project.

- *Criterion 3 – Capital and Present Worth Costs* - The present worth costs, including capital, operations, and maintenance costs, for each water supply management project and portfolio are estimated. The performance metric is the normalized cost presented in $/AF for each project and portfolio.

Objective 4 – Reduce Potable Water Demand

This criterion will evaluate the impact that each water supply management project and portfolio will have on reducing the demand for potable water supplies. This criterion addresses the augmentation of non-potable supplies.

- *Criterion 4 – Augment Non-Potable Water Supplies* - The use of non-potable water sources will help reduce the overall potable water supply need. Projects and portfolios that include non-potable water supplies, commensurate with a demand for the additional non-potable water, will score well within this criterion. The quantitative metric for this criterion will be the annual yield of additional non-potable supply produced and utilized to offset potable demand. This will be a quantitative value, measured in AF per year.

Objective 5 – Minimize Environmental Impacts of New Water Supplies

With these criteria, water supply management projects and portfolios that provide environmental benefits, or have no or limited negative environmental impacts, will score better than projects that provide no benefits or result in greater environmental impacts. Environmental benefits and impacts are evaluated both within and outside of the BAWSCA service area. Potential environmental impacts are measured with three criteria, designed to be proxies for a wide range of environmental issues.

- *Criterion 5A –Greenhouse Gas Emissions* - The increase in greenhouse gas emissions due to a potential water supply management portfolio will be calculated as a planning level estimate of the unit greenhouse gas emissions of the associated projects. This quantitative metric will be measured in terms of metric tons of carbon dioxide produced, or reduced, per AF of supply.

- *Criterion 5B –Impact to Groundwater Quantity and Quality* - Water supply management projects that do not negatively affect groundwater supplies will be measured favorably in this criterion. A combined qualitative estimate of potential groundwater impacts will be evaluated in terms of potential reductions in groundwater levels, impacts to groundwater quality, and the risk of increase in land subsidence. This metric will be a qualitative measure ranging from 1 through 5, with a score of "1" identifying the projects with the least potential for adversely affecting groundwater quantity and quality and a score of "5" indicating high probability of adverse impacts.

- *Criterion 5C –Impact to Habitat* - This criterion addresses long-term impacts to the ecosystems, not short-term effects related to temporary construction activities. Water supply management projects that do not adversely affect sensitive habitat areas such as wetlands, riparian zones, potential special-status species habitat, or have significant inundation areas will be measured favorably in this criterion. A combined qualitative estimate of potential habitat impacts will be evaluated in terms of potential site acreage, proximity to sensitive habitat zones, and flood potential. This metric will be a qualitative measure ranging from 1 through 5, with a score of "1" identifying the projects with the least potential for adverse impacts to habitat and a score of "5" indicating high probability of adverse effects to terrestrial, aquatic, and riparian species.

Objective 6 – Increase Implementation Potential of New Water Supplies

Developing water supply solutions that can be implemented within the 2018 and 2035 planning horizons is a primary objective of the Strategy. These criteria assess the implementation potential of water supply management projects and portfolios. All of these criteria will be assessed qualitatively. Metrics for these criteria will be a qualitative assessment ranging from 1 through 5, with a score of "1" being the most favorable and a score of "5" indicating the least favorable.

- *Criterion 6A –Institutional Complexity* - This criterion addresses the level of institutional coordination required for implementation of a water supply management project or portfolio. A qualitative metric will be used to estimate the coordination required if multiple local or regional agencies or agreements are necessary. The projects that are assumed to require less coordination, and to receive less opposition, will score better than those that are more complex or potentially controversial.

- *Criterion 6B –Level of Local Control of Water Supply* - Local management of a water supply management project or portfolio will minimize dependency on imported water supplies and the drought impacts associated with those supplies. A rating scale will be developed to evaluate the amount of BAWSCA-owned or BAWSCA member-owned supply for each project. Projects that are fully owned by BAWSCA or the member agencies will score higher than supply projects owned fully or partially by other entities that might be affected by regulatory risk, multiple party agreements, and supplies that may have a higher risk of not being available further into the future, or under drought conditions.

- *Criterion 6C –Permitting Requirements* - This criterion addresses the objective of minimizing the regulatory and environmental permitting obstacles associated with water supply management projects or portfolios. Projects with other similar metrics (including cost) may have differing permitting requirements, which can affect their overall implementation. The performance metric is a qualitative measure of the permitting requirements of each project or portfolio. Projects or portfolios that have less regulatory and environmental permitting obstacles will receive a better score than those projects with more complex permitting requirements.

Attachment 3

TM 3: Updated Regional Water Supply Management Project Information for the Long-Term Reliable Water Supply Strategy

CDM Smith

STRATEGY PHASE II A TECHNICAL MEMORANDUM NO. 3

Updated Regional Water Supply Management Project Information for the Long-Term Reliable Water Supply Strategy

BAWSCA

April 5, 2012

DRAFT FINAL

Limited Revisions June 25, 2012

CDM Smith

Technical Memorandum No. 3
Updated Regional Water Supply Management Project Information for the Long-Term Reliable Water Supply Strategy

(Draft Final– April 5, 2012, minor revisions June 25, 2012)

Errata

This Draft Final Technical Memorandum (TM) No. 3 was completed and reviewed by the BAWSCA member agencies. Changes and updates incorporated from those comments were only included in the Phase II A Final Report, with the following exceptions which are included in this TM:

- The location figures and cost tables for the following two representative desalination project areas:
  - Dumbarton Bridge Area; and
  - San Mateo Bridge Area.

Technical Memorandum No. 3 Updated Regional Water Supply Management Project Information for the Long-Term Reliable Water Supply Strategy Draft Final– April 5, 2012

Section 1 Summary

As part of the Long-Term Reliable Water Supply Strategy (Strategy), the Bay Area Water Supply and Conservation Agency (BAWSCA) is evaluating alternative water supply management projects (projects) to augment existing supplies to meet the future normal and/or drought year demands of its member agencies though 2035. The May 2010 *Phase I Scoping Report* identified several regional projects for evaluation in Phase II A of the Strategy including:

- Groundwater Projects;
- BAWSCA Representative Regional Desalination Projects;
- Bay Area Regional Desalination Project; and
- Water Transfers.

In this TM:

1. Summary
2. Groundwater Projects
3. BAWSCA Representative Regional Desalination Projects
4. Bay Area Regional Desalination Project
5. Water Transfers
6. Conclusions

Exhibits:

- 1 - Task 3-A/B Memo: Updated Regional Groundwater and Desalination Water Supply Management Project Information
- 2 – Task 3-C Memo: Water Transfers

This Technical Memorandum (TM) summarizes the information that has been developed to date for these regional projects, including yields, costs, facilities, supply reliability and potential implementation schedule. This information is needed to allow evaluation and comparison of the projects within the Strategy process.

1.1 BAWSCA Regional Projects Description

The following sections summarize key information regarding the description of the regional projects, and their estimated yields, costs and implementation timeframes (i.e., schedule).

1.1.1 Groundwater Projects

Several relatively large and high-yield groundwater aquifers are located within the BAWSCA service area (e.g., the Westside Groundwater Basin, Santa Clara Groundwater Basin, and the Niles Cone Groundwater Basin). However, these aquifers are already heavily utilized by BAWSCA member agencies and others for conjunctive use operations and water supply. Based on work completed in other portions of the BAWSCA service area, there appears to be limited potential to develop a high-quality (freshwater) groundwater supply to support a regional project. Some smaller scale groundwater projects are being pursued by individual BAWSCA agencies to locally increase their supplies. As such, no such freshwater groundwater projects have been included as part of the Strategy. Section 2 of this TM and *Exhibit 1 - Task 3-A/B Memo: Updated Regional Groundwater and Desalination Water Supply Management Project Information* presents additional information on the groundwater projects originally identified in Phase I of the Strategy.

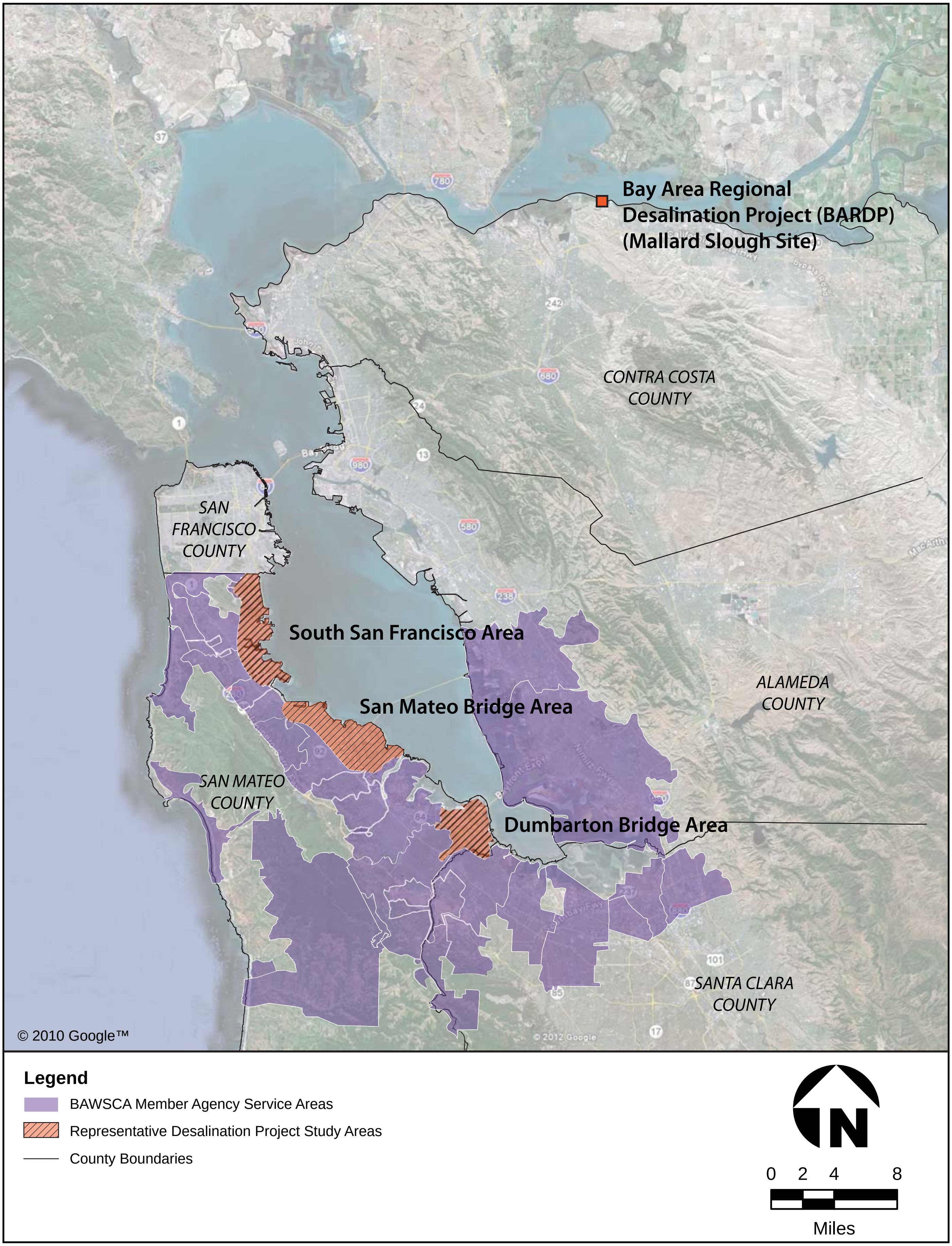
Work completed to date throughout the BAWSCA service area indicates that brackish groundwater aquifers do exist along the western portion of the Bay that are not currently utilized by any of the BAWSCA member agencies or other agencies. What has been included as part of the Strategy is the possible development of these brackish groundwater sources to support a regional desalination project. Further discussion of development of brackish groundwater projects as related to the BAWSCA representative regional desalination projects is summarized in Section 1.1.2 below, and described in more detail in Sections 2 and 3 of this TM and *Exhibit 1*.

1.1.2 BAWSCA Representative Regional Desalination Projects

The BAWSCA representative regional desalination projects are summarized below and in Table 1. Additional information is presented in Section 3 and in *Exhibit 1*.

Description

Fourteen representative regional desalination projects have been developed based on the different types of intakes and source water quality for three potential areas along the Bay side of the San Francisco Peninsula (Peninsula). These general areas include: Dumbarton Bridge Area; San Mateo Bridge Area; and South San Francisco Area, which are shown in Figure 1. These areas were selected because they are sites with possibly favorable groundwater characteristics, currently undeveloped sites for intakes and treatment facilities, potential co-location for brine disposal with existing wastewater treatment plants (WWTPs)and outfalls, and connection points to either local agency's water systems or to the San Francisco (SF) Regional Water System (RWS) for conveyance to other member agencies.



W:\REPORTS\BAWSCA\Task 11.3_Nov11\Graphics\TM3_Fig 1_BAWSCA Regional Desal Project Study Areas and BARDP.ai 06/28/12 JJT

Figure 1
BAWSCA Representative Desalination Project Study Areas and BARDP

CDM Smith

Table 1
Representative Regional Desalination Project Elements

Select Project Elements	Dumbarton Bridge Area	San Mateo Bridge Area	South San Francisco Area
Brackish Groundwater Well Capacity (mgd)[1]	1 – 5	1 – 5	1 – 2
HDDW[2] Capacity (mgd)	–	5 – 10	5 – 10
Open Water Intake Capacity (mgd)	--	10	20
Assumed Water Quality (mg/L[3], TDS[4])	1,000 – 10,000	1,000 – 25,000	1,000 – 25,000
Potential Brine Disposal Option	Palo Alto RWQCP[5]	San Mateo WWTP[6]	South San Francisco/San Bruno WQCP[7]
Range in Cost ($/AF[8])	$1,000 – $2,000	$900 – $2,200	$1,400 – $1,900
Implementation Duration (years)	6 to 8	6 to 15	10 to 15

1 mgd – million gallons per day
2 HDDW – Horizontally Directionally Drilled Wells
3 mg/L – milligrams per liter
4 TDS – Total Dissolved Solids
5 RWQCP – Regional Water Quality Control Plant
6 WWTP – Wastewater Treatment Plant
7 WQCP – Water Quality Control Plant
8 AF – acre-feet

The three types of intakes considered for the BAWSCA representative regional desalination projects are vertical groundwater wells, horizontally directionally drilled wells (HDDW), and open water intakes. Depending on the intake type, the quality of the source water varies. For example, the brackish groundwater accessed by vertical wells is assumed to have a salinity ranging from about 1,000 to 10,000 milligrams per liter (mg/L) of Total Dissolved Solids (TDS). In contrast, the Bay water, which would be accessed via HDDW or open water intakes, is assumed to have a TDS of about 25,000 mg/L.

Yields

The potential yield of brackish groundwater supply developed through vertical wells is limited by the local hydrogeology and available recharge. Based on the available information, treated water capacities of 1, 2 and 5 million gallons per day (mgd) were assumed for the brackish vertical wells, with the larger capacities including multiple well locations. Capacities of 5 and 10 mgd were assumed for the HDDW projects and capacities of up to 20 mgd were assumed for the open water intake projects. Annual yields for these projects assume operation at 80% of the capacity with resulting annual yields of 900 to 4,500 acre-feet (AF) for the vertical wells, 4,500 to 9,000 AF for HDDW, and 17,900 AF for open water intakes. In all cases, additional work would need to be done to confirm the yields.

Costs

The present worth costs for the BAWSCA representative desalination projects, excluding site acquisition and brine discharge, range from $2,200/AF for the 1 mgd brackish groundwater projects to $1,000/AF for the 5 mgd brackish groundwater projects. The costs for the HDDW projects range from $1,700/AF to $1,400/AF for the 5 mgd and 10 mgd projects respectively. The 10 and 20 mgd open water intake projects have an estimated present worth cost of $1,900/AF and $1,500/AF, respectively. Inclusion of the site acquisition and brine disposal costs are expected to significantly increase the present worth costs of these representative projects.

Project Implementation Schedule

In general, the desalination projects that utilize brackish groundwater pumped from vertical wells will have the shortest implementation time (e.g., 6 to 8 years). The implementation time for the HDDW projects is expected be longer (e.g., 10 to 12 years), and the open water intake projects are expected to require the longest time (e.g., 10 to 15 years). These implementation schedules are based on estimated time durations after a decision has been made to proceed with a specific project or projects and reflect the different complexities associated with the permitting, environmental and other issues associated with desalination projects.

1.1.3 Bay Area Regional Desalination Project

The Bay Area Desalination Project (BARDP) is summarized below and in Table 2. Additional information is presented in Section 4 and in *Exhibit 1*.

Table 2
BARDP Project Elements

Select Project Elements	Scenario 1	Scenario 2	Scenario 3
Source	Sacramento River Mallard Slough	Sacramento River Mallard Slough	Sacramento River
Capacity (mgd)	20	20	20
Source Water Quality (TDS)	Freshwater to brackish	Freshwater to brackish	Freshwater to brackish
Annual Yield (AF/year)	22,400[1]	7,600[2]	22,400[1]
Potential Brine Disposal Option	TBD[3]	TBD	TBD
Range in Cost ($/AF)	$550	$1,069	$566
Implementation Duration (years)	6-7	6-7	6-7

[1] Operation at 100% capacity every year.
[2] Operation at 100% capacity, but only in dry years.
[3] To be determined

Description

The BARDP is being evaluated by five Bay Area regional water agencies (East Bay Municipal Utilities District [EBMUD]; Santa Clara Valley Water District [SCVWD]; San Francisco Public Utilities Commission [SFPUC]; Contra Costa Water District [CCWD]; and the Alameda County Flood Control and Water Conservation District, Zone 7 [Zone 7]) for potential normal and dry year supply. To date, BAWSCA's interests in the BARDP have been represented by SFPUC (i.e., BAWSCA has paid for two-thirds of SFPUC's share of the

BARDP costs). The BARDP has been included for evaluation in the Strategy for two reasons: (1) to serve as a benchmark for Sacramento River desalination project costs; and (2) to assess if BAWSCA wants to pursue participation in the BARDP independent of SFPUC.

Figure 1 also shows the location of the current proposed BARDP site, which is assumed to be at CCWD's Mallard Slough Pump Station Site on the Sacramento River. Three different 20 mgd BARDP pumping and treatment scenarios have been evaluated to date by the five agencies. Scenarios 1 and 2 assume intake and treatment at the Mallard Slough location, but at different operational levels (i.e., Scenario 1 assumes operation in both normal and dry years, while Scenario 2 assumes only dry-year operation). Scenario 3 assumes intake, treatment, and brine disposal at some as-of-yet un-defined locations. Operation for Scenario 3 occurs in both normal and dry years.

Evaluations of conveyance of the treated water to the participating agencies, or into the BAWSCA service area, have not been completed to date. CCWD has initiated an evaluation of the potential use of Los Vaqueros Reservoir for storage of the BARDP water and other supplies. EBMUD is currently evaluating the potential hydraulic capacity and treatment and conveyance requirements to convey water from either the BARDP plant site or the CCWD system to other potential users in the Bay Area (i.e., SCVWD, SFPUC, Zone 7, and BAWSCA). These studies are anticipated to be completed in Spring/Summer of 2013.

Yield
The BARDP is sized to produce 20 mgd when the facilities are operated at full capacity in both normal and dry years. However, the amount of BARDP water that might be available to BAWSCA and its agencies is currently unknown and will depend on, among other things, the needs of the other participating agencies and the available conveyance capacity. The annual yield for the BARDP projects range from 7,600 to 22,400 AF with the lower yield based on operation only during dry years. The higher yields are based on assumed operation at 100% of capacity during all years.

Costs
The present worth costs for the BARDP range from $550/AF to $566/AF for Scenarios 1 and 3 respectively, and up to $1,069/AF for Scenario 2. The Scenario 2 present worth costs are higher because the project is assumed to only operate during dry years. None of these scenarios include site property costs, brine disposal, or conveyance from the BARDP site to the SF RWS, or through the SF RWS to the BAWSCA member agencies.

Project Implementation Schedule
After completion of the EBMUD and CCWD conveyance and storage studies, the participating agencies are expected to make a decision as to which agencies will continue to fund BARDP and on what schedule it will be implemented. Based on the earlier BARDP studies, it was estimated that it will take approximately 6 to 7 years to complete the

environmental documentation, design, construction, and startup once the agencies agree to implement the BARDP.

1.1.4 Water Transfers

The BAWSCA water transfer projects are summarized below and in Table 3. Additional information is presented in Section 4 and in *Exhibit 2*.

Table 3
Water Transfer Project Elements

Source of Supply	Yield (AF/year)	Purchase Cost $/AF[1]	Conveyance Option				
			SF RWS	SWP/ SBA	CVP/San Felipe Project	EBMUD/ SFPUC Intertie	SCVWD/ SFPUC Intertie
Intra-BAWSCA[2]	NA	NA	X[3]	-	-	-	-
Sacramento Valley Area	1,000 - >5,000	$200-$900	-	X	X	X	X
Delta and San Joaquin Valley Areas	1,000 – 5,000	$200-$900	-	X	X	X	X
State Water Project	NA	-	-	X	-	-	X
Central Valley Project	NA	-	-	-	X	-	X
Tuolumne/Stanislaus Rivers	TBD	TBD	X	-	-	-	-

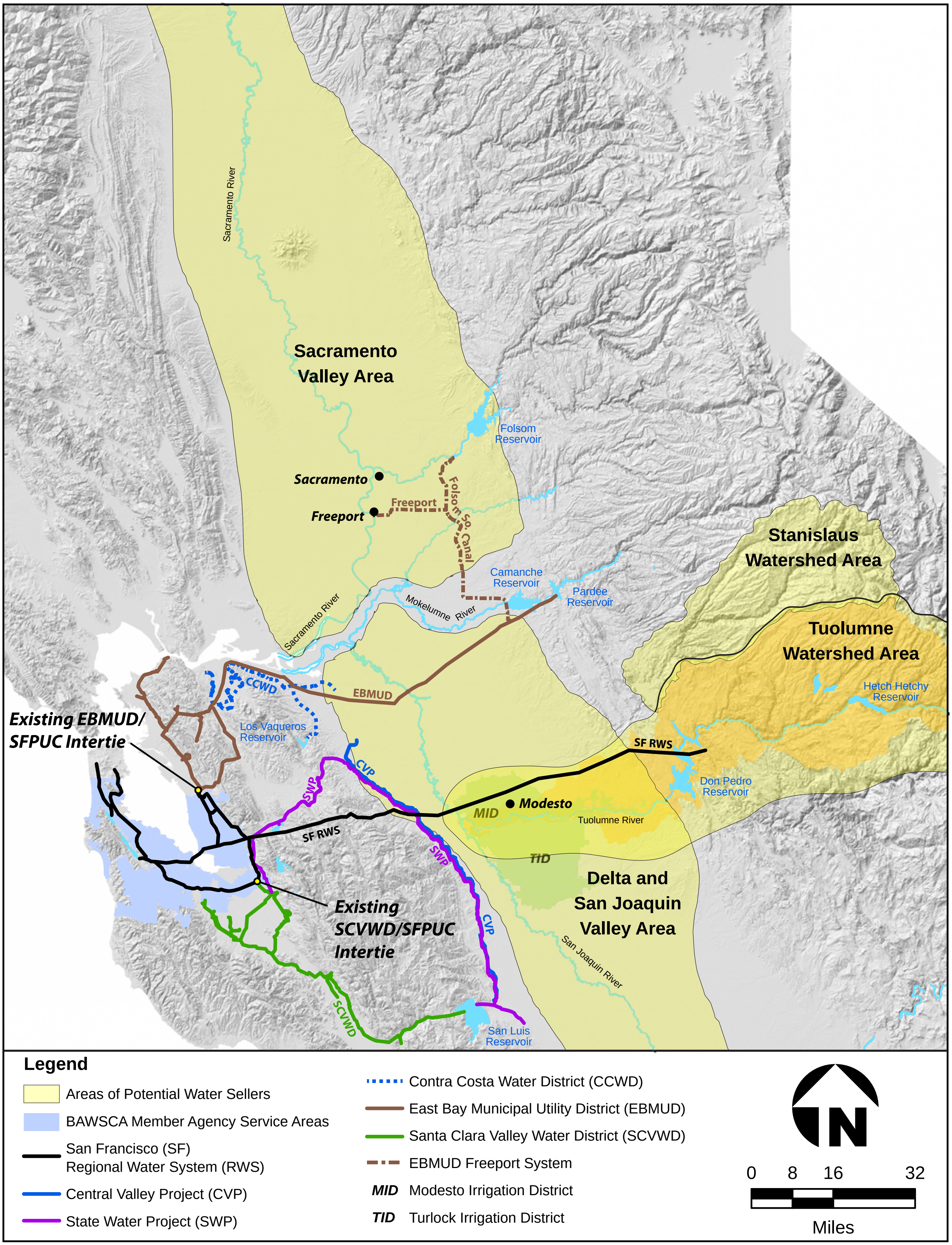
1 Does not include cost for conveyance.
2 Not evaluated as part of the Strategy.
3 X – included as part of conveyance.

Description

A water transfer must include a willing seller and buyer, and a means to convey that water from the buyer to the seller. As part of the Strategy, BAWSCA has evaluated several combinations of options for the source of supply and conveyance to the BAWSCA agencies. BAWSCA is primarily evaluating options for dry-year transfers.

As can be seen on Figure 2, there are a number of options for the source of the supply for the BAWSCA water transfer projects, including the following: (1) transfers from the State Water Project (SWP) and Central Valley Project (CVP) systems; (2) transfers from Sacramento Valley, Sacramento-San Joaquin Delta (Delta), San Joaquin Valley, and private owners; and (3) transfers from the Tuolumne River Watershed or Stanislaus Watershed.

A critical component of any transfer is the ability to physically move the water from the seller to the buyer. For supplies originating outside of the Bay Area, there are a limited number of existing conveyance facilities that could be used to wheel water to the BAWSCA member agencies. The potential options evaluated herein are shown on Figure 2 and include: SWP and CVP facilities; SCVWD/SFPUC emergency intertie and SCVWD facilities; EBMUD/SFPUC emergency intertie and EBMUD facilities; and SF RWS.



W:\REPORTS\BAWSCA\Task 11.3_Nov11\Graphics\TM3_Fig 2_Conveyance Options to the BAWSCA Member Agencies for Potential Water Transfer Seller Areas.ai 04/05/12 JJT

CDM Smith

Figure 2
Conveyance Options to the BAWSCA Member Agencies for Potential Water Transfer Seller Areas

Based on the work performed to date, the most promising option for BAWSCA is purchase of a supply that can be accessed north of the Delta (e.g., at the EBMUD's Freeport Project or south) and wheeled through existing infrastructure (e.g., the EBMUD and/or CCWD systems) to the SF RWS for delivery to the BAWSCA agencies. BAWSCA is also closely monitoring the progress of the potential SFPUC water transfer with the Modesto Irrigation District (MID) from the Tuolumne River Watershed. The results of that effort (i.e., costs, timing, supply benefits to the BAWSCA agencies, etc) will be incorporated into the Strategy assessment as the information becomes available.

Yields
Yields for water transfer projects may range from 1,000 AF to over 5,000 AF/year depending on the supply source and owner. The majority of sellers identified to date by BAWSCA have available supply in the range of 1,000 to 5,000 AF per year. However, the amount of transfer water that might be available to BAWSCA and its agencies is currently unknown and will depend on, among other things, the available conveyance capacity. However, based on initial discussions the maximum transfer is anticipated to be about 20 mgd (about 22,000 AF/year), and this capacity will most likely not be available year round.

Costs
The location and reliability of the supply will significantly affect the total cost, as will the treatment and conveyance options. Based on recent water transfers enacted within the State of California, the cost of the water may range from $200 to $900/AF. Conveyance costs to move the water from the seller to the buyer are a major factor, as is the availability of seasonal or annual storage associated with the supply. For example, EBMUD has indicated that preliminary estimates of cost to wheel water through their system could be about $1,200 to $1,600/AF. It is expected that the work being done by EBMUD and CCWD to support the BARDP will help inform better estimates of local conveyance and storage costs associated with transfers into the Bay Area and then to the BAWSCA agencies.

Project Implementation Schedule
The implementation schedule for water transfers is dependent on many factors including: water source location and type; need for construction of additional infrastructure for conveyance and/or storage; negotiations and agreements with sellers and potential conveying agencies; and completion of environmental documentation and permitting. Because of the complexity associated with each of the above issues, it is estimated that a water transfer project would take 2 to 5 years to implement, depending on the yield, complexity, and number of partners.

1.2 Project Evaluation

One of the goals of the Strategy, as described in the *Phase I Scoping Report,* is to develop a quantitative and defensible project evaluation process. To that end, evaluation criteria and metrics have been developed (see *Task 2 TM Updated Agency-Identified Water Supply Management Project Information for the Long-Term Reliable Water Supply Strategy*).

These six criteria include:

- Increase supply reliability;
- Provide high level of water quality;
- Minimize cost of new water supplies;
- Reduce potable water demand;
- Minimize environmental impacts; and
- Increase Implementation potential.

This TM focuses on the supply reliability (yield for normal and dry years), facilities and cost, and implementation schedule for the BAWSCA regional projects. Table 4 compares these key metrics, to the extent that the information is available, for the BAWSCA representative desalination projects, BARDP, and water transfers.

To the extent that additional information is currently available to evaluate a project against the other criteria (e.g., water quality, environmental impacts, etc), that information has been presented in *Exhibits 1* and *2*. As part of the final Strategy evaluation process, the project rankings against all of the various criteria will be used to inform final recommendations for how to move forward.

1.3 Key Outstanding Project Issues and Next Steps

There are key issues which apply to all of the BAWSCA regional projects that may affect the yield, cost, implementation, water quality and other aspects of project viability. The following identifies those groups of issues and provides examples of how they apply in general. Table 5 provides a more detailed description of the issues critical to the viability of each of the regional projects.

- ***Yield***: In most cases, the yield of the various projects, including what yields may be available to BAWSCA, are unknown at this time and will need to be confirmed.

- ***Cost***: In many cases, the costs are incomplete (e.g., they do not include some facilities, conveyance, or other critical information) and additional information will be needed to better assess total project cost and to compare projects.

Table 4
Summary of Project Sizing, Cost, and Implementation Schedule

Item	BAWSCA Representative Regional Desalination Projects														Bay Area Regional Desalination Project[1]			Water Transfers
	Dumbarton Bridge Area			San Mateo Bridge Area						South San Francisco Area								
	1 mgd Brackish GW[1] Wells	2 mgd Brackish GW Wells	5 mgd Brackish GW Wells	1 mgd Brackish GW Wells	2 mgd Brackish GW Wells	5 mgd Brackish GW Wells	5 mgd Bay Water HDDW[3] Wells	10 mgd Bay Water HDDW[3] Wells	10 mgd Bay Water Open Intake	1 mgd Brackish GW Wells	2 mgd Brackish GW Wells	5 mgd Bay Water HDDW[3] Wells	10 mgd Bay Water HDDW[3] Wells	20 mgd Bay Water Open Intake	Scenario 1	Scenario 2	Scenario 3	
Assumed Treated Water Production Capacity[4] (mgd)	1	2	5	1	2	5	5	10	10	1	2	5	10	20	20	20	20	-
Assumed Annual Production (AF/year)[4,5]	900	1,800	4,500	900	1,800	4,500	4,500	9,000	9,000	900	1,800	4,500	9,000	17,900	22,400	7,600	22,400	1,000 - > 5,000
Facility Sizing																		
RO Recovery %	75%	75%	75%	75%	75%	75%	55%	55%	55%	75%	75%	75%	55%	55%	80%	80%	80%	-
Source Water Capacity (mgd)[1]	1.3	2.7	6.7	1.3	2.7	6.7	9.1	18.2	18.2	1.3	2.7	6.7	18.2	36.4	25	25	25	-
RO Treated Water Capacity (mgd)	1	2	5	1	2	5	5	10	10	1	2	5	10	20	20	20	20	-
Brine Disposal Capacity (mgd)	0.3	0.7	1.7	0.3	0.7	1.7	4.1	8.2	18.2	0.3	0.7	1.7	8.2	16.4	5	5	5	-
Capital Cost																		
Capital Cost ($M)[6,7]	$30.6	$43.0	$64.4	$35.8	$47.3	$72.1	$126.5	$201.8	$274.7	$31.1	$42.7	$120.5	$194.3	$364.6	$159.4	$159.4	$171.7	-
Present Worth Costs																		
Total Production – 30 years (AF)[4,5]	27,000	54,000	135,000	7,000	54,000	135,000	135,000	270,000	270,000	27,000	54,000	135,000	270,000	537,000	680,000	227,000	680,000	> 150,000
Total Present Worth Cost ($M)[6,7,8]	$52.9	$76.2	$129.4	$58.5	$82.9	$137.4	$229.1	$395.3	$516.6	$53.0	$74.2	$223.5	$388.4	$829.7	$374.2	$242.2	$386.3	-
Present Worth Unit Cost ($/AF)[6,7,8,9]	$2,000	$1,400	$1,000	$2,200	$1,500	$1,000	$1,700	$1,500	$1,900	$1,900	$1,400	$1,700	$1,400	$1,500	$550	$1,069	$566	$200 - $900
Implementation Schedules																		
Implementation (years)	6-8	6-8	6-8	6-8	6-8	6-8	10-12	10-12	10-15	6-8	6-8	10-12	10-12	10-15	6-7	6-7	6-7	-

[1] GW – groundwater, mgd – million gallons per day.
[2] BARDP project description and data are presented in *Exhibit 1*. Unit Present worth costs presented in this table have been adjusted to August 2011 dollars.
[3] Horizontally Directionally Drilled Wells.
[4] Capacity is treated water production from desalination plant.
[5] Assumes annual operation at 80% of capacity for representative regional desalination projects (100% for BARDP scenarios 1 and 3, 33% on average for BARDP scenario 2).
[6] Costs adjusted to August 2011. Annual O&M costs for BARDP Scenario 2 are based on dry-year operation (which is assumed to occur once every three years).
[7] Costs do not include property acquisition, cost for use of wastewater treatment plant outfall capacity, conveyance costs by others, or purchase price of water, or conveyance to BAWSCA member agencies or storage.
[8] Present Worth estimates include a 3% escalation and a 3% discount rate. The same escalation rate is used for electricity, materials, labor and capital costs.
[9] Costs are rounded to the nearest $100/AF (except for BARDP).

Table 5
Summary of Project Key Issues

Issue Type	BAWSCA Representative Desalination Projects			Bay Area Regional Desalination Project	Water Transfers
	Dumbarton Bridge Area	San Mateo Bridge Area	South San Francisco Area		
Yield	▪ Limited hydrogeologic information is available for the brackish aquifers. As such the location and potential yield of these aquifers is relatively unknown; ▪ The recharge, long term yield, and potential impact on other groundwater users needs to be evaluated to confirm the assumed capacities and yields; ▪ Whether the brackish groundwater wells are assumed to operate in all years, or only during dry years, will impact the cost; and ▪ Open intake yields may be limited by regulatory limitations.	▪ Limited hydrogeologic information is available for the brackish aquifers. As such the location and potential yield of these aquifers is relatively unknown; ▪ The recharge, long term yield, and potential impact on other groundwater users needs to be evaluated to confirm the assumed capacities and yields; ▪ Whether the brackish groundwater wells are assumed to operate in all years, or only during dry years, will impact the cost; and ▪ Open intake yields may be limited by regulatory limitations.	▪ Limited hydrogeologic information is available for the brackish aquifers. As such the location and potential yield of these aquifers is relatively unknown; ▪ The recharge, long term yield, and potential impact on other groundwater users needs to be evaluated to confirm the assumed capacities and yields; ▪ Whether the brackish groundwater wells are assumed to operate in all years, or only during dry years, will impact the cost; and ▪ Open intake yields may be limited by regulatory limitations.	▪ Ability to transfer CCWD water rights to new diversion point; ▪ SCVWD/SFPUC and EBMUD/SFPUC interties – Use of these existing interties will require expansion of their current use, which would require compliance with CEQA and addressing Bay Area Air Quality Management District permits ▪ Total conveyance capacity through EBMUD system and potential competition for capacity with other agencies.	▪ Transfer supply availability ▪ SCVWD/SFPUC and EBMUD/SFPUC interties – Use of these existing interties will require expansion of their current use, which would require compliance with CEQA and addressing Bay Area Air Quality Management District permits ▪ Total conveyance capacity through EBMUD system and potential competition for capacity with other agencies.
Cost	▪ Land availability, cost and permitting for subsurface intakes, and for new desalination plant sites; ▪ Alignment issues and rights-of-way for construction of new raw water, brine and treated water pipelines; ▪ Funding and ownership of a regional desalination facilities; and ▪ Conveyance cost through SF RWS.	▪ Land availability, cost and permitting for subsurface intakes, and for new desalination plant sites; ▪ Alignment issues and rights-of-way for construction of new raw water, brine and treated water pipelines; ▪ Funding and ownership of a regional desalination facilities; and ▪ Conveyance cost through SF RWS.	▪ Land availability, cost and permitting for subsurface intakes, and for new desalination plant sites; ▪ Alignment issues and rights-of-way for construction of new raw water, brine and treated water pipelines; ▪ Funding and ownership of a regional desalination facilities; and ▪ Conveyance cost through SF RWS.	▪ Cost of electrical power is based on U. S. Bureau of Reclamation rates which are lower than could be obtained by non-Reclamation agencies; ▪ The estimates are based on 100% production throughout the year, with the exception of Scenario 2 (which assumes 100% production every third year, with moth balling involving minimal maintenance in between); ▪ Additional costs from agency-specific blending, storage and/or conveyance fees are not included in the estimate; and ▪ Conveyance cost through SF RWS.	▪ Cost of transfer supply and difference between normal and dry year supply; ▪ Additional costs from agency-specific blending, storage and/or conveyance fees are not included in the estimate; and ▪ Conveyance cost through SF RWS.
Implementation	▪ Willingness to allow use of existing wastewater plant outfall capacity for brine disposal; ▪ Public support and/or opposition; ▪ Use of the SF RWS system for conveyance to member agencies if required; ▪ Permitting for a new intakes in the Bay; and ▪ SCVWD/SFPUC and EBMUD/SFPUC interties – Use of these existing interties will require expansion of their current use, which would require compliance with CEQA and addressing Bay Area Air Quality Management District permits.	▪ Willingness to allow use of existing wastewater plant outfall capacity for brine disposal; ▪ Public support and/or opposition; ▪ Use of the SF RWS system for conveyance to member agencies if required; ▪ Permitting for a new intakes in the Bay; and ▪ SCVWD/SFPUC and EBMUD/SFPUC interties – Use of these existing interties will require expansion of their current use, which would require compliance with CEQA and addressing Bay Area Air Quality Management District permits.	▪ Willingness to allow use of existing wastewater plant outfall capacity for brine disposal; ▪ Public support and/or opposition; ▪ Use of the SF RWS system for conveyance to member agencies if required; ▪ Permitting for a new intakes in the Bay; and ▪ SCVWD/SFPUC and EBMUD/SFPUC interties – Use of these existing interties will require expansion of their current use, which would require compliance with CEQA and addressing Bay Area Air Quality Management District permits.	▪ Facility ownership; ▪ Who will operate the facilities; and, ▪ Potential users (purchasers of the supply); and ▪ SCVWD/SFPUC and EBMUD/SFPUC interties – Use of these existing interties will require expansion of their current use, which would require compliance with CEQA and addressing Bay Area Air Quality Management District permits.	▪ Agreements or negotiation with outside agencies or partners; and ▪ SCVWD/SFPUC and EBMUD/SFPUC interties – Use of these existing interties will require expansion of their current use, which would require compliance with CEQA and addressing Bay Area Air Quality Management District permits.
Water Quality	▪ Source water quality will affect treatment process and cost; and ▪ Brine concentrate may affect ability to discharge through existing wastewater outfall facilities.	▪ Source water quality will affect treatment process and cost; and ▪ Brine concentrate may affect ability to discharge through existing wastewater outfall facilities.	▪ Source water quality will affect treatment process and cost; and ▪ Brine concentrate may affect ability to discharge through existing wastewater outfall facilities.	▪ Source water quality will affect treatment process and cost; and ▪ Brine concentrate may affect ability to discharge through existing wastewater outfall facilities.	▪ Source water quality may require treatment and/or treatment prior to conveyance.

- ***Implementation***: All of the projects listed herein are complex and would require the agreement of multiple parties, as well as the construction of facilities, environmental review, and other elements (e.g., land purchase, wheeling agreements, permitting, rights-of-way).

- ***Water Quality***: Water quality may have a significant impact on treatment costs, conveyance ability, and beneficial use of the water. The water quality for the projects is not fully known and will need to be confirmed if it significantly affects cost or implementation.

If it is determined that all or some of the regional projects should proceed, several additional technical steps will be required to confirm their feasibility including:

- ***BAWSCA Representative Regional Desalination Projects***. Develop regional groundwater model to provide an initial assessment of the yields; construct pilot pumping and monitoring wells to confirm estimated yields; and confirm that the regional wastewater agencies will provide brine disposal capacity through a long-term agreement.

- ***Bay Area Regional Desalination Project***. Engage the BARDP agencies to determine what water quantities may be available to the BAWSCA member agencies.

- ***Water Transfers***. Monitor the CCWD and EBMUD studies to evaluate the capacity and potential cost to convey BARDP (or other transfer) water to the BAWSCA agencies; engage the BARDP agencies to determine what conveyance capacity may be available to the BAWSCA member agencies; closely monitor the results of the SFPUC/Modesto Irrigation District (MID) water transfer; and develop a pilot project with EBMUD, and possibly CCWD, to transfer water through the EBMUD and CCWD systems to the EBMUD/SFPUC Intertie in Hayward.

In parallel, BAWSCA will continue to work with the BAWSCA agencies to assess the magnitude and timing of their water supply needs and to confirm their interest in pursuing any of the above projects.

1.4 Conclusions

The projects presented herein could potentially be used by BAWSCA and the BAWSCA member agencies to meet the normal and/or drought supply needs through 2035. In addition, *TM 2 - Updated Agency-Identified Water Supply Management Project Information* presents other potential projects that have been identified by the BAWSCA member agencies for evaluation as part of the Strategy.

The projects presented herein and in TM 2 were initially identified in the *Phase I Scoping Report*. The project information development to date has focused on preliminary estimates of the yield, cost, reliability, and implementation schedule. The objective has been to develop the information to a common level so that the projects can be compared to each other and preliminarily ranked to determine which individual or combination of projects could best meet the identified supply need. For each of the projects presented in *TMs 2 and 3*, key issues and outstanding technical information has been identified, along with potential next steps.

In July 2012, the *Long-Term Reliable Water Supply Strategy Phase II A Report* (*Phase II A Report*) will be completed. This *Phase II A Report* will present the technical information developed to date as part of the Strategy (from TMs 1, 2, and 3), as well as updated information on the frequency and magnitude of expected supply shortfalls from the SF RWS. The *Phase II A Report* will also present a recommended implementation plan to achieve the Strategy's goal of ensuring that a reliable, high quality supply of water is available where and when people within the BAWSCA service area need it.

Section 2
Groundwater Projects

2.1 Project Description

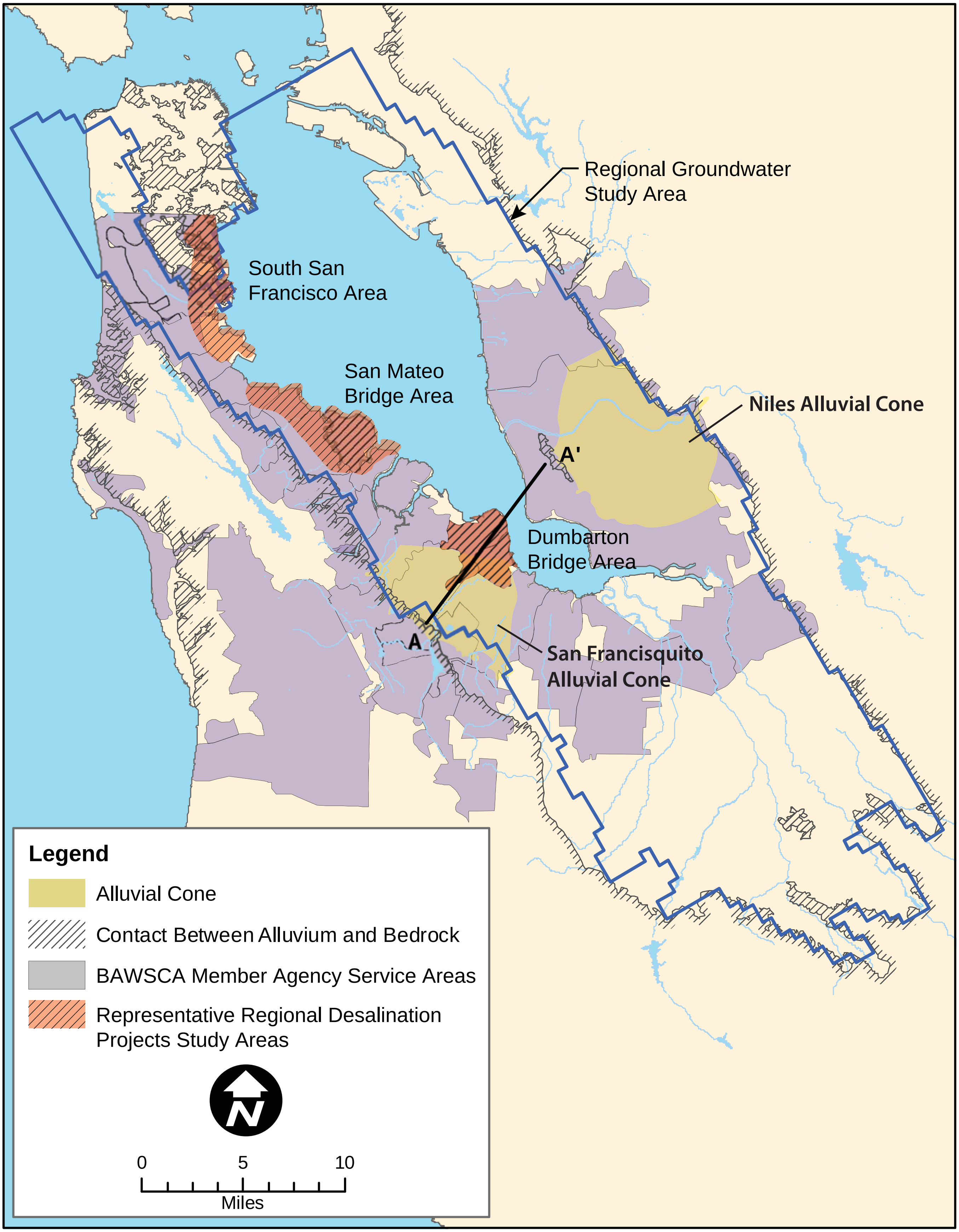
Several relatively large and high-yield groundwater aquifers are located within the BAWSCA service area (e.g., the Westside Groundwater Basin, Santa Clara Groundwater Basin, and the Niles Cone Groundwater Basin). However, these aquifers are already heavily utilized by BAWSCA member agencies and others for conjunctive use operations and water supply. Based on work completed to date in other portions of the BAWSCA service area, there appears to be limited potential to develop a high-quality (freshwater) groundwater supply to support a regional project. As such, no such freshwater groundwater projects have been evaluated as part of the Strategy. Some smaller scale groundwater projects are being pursued by individual BAWSCA agencies to locally increase their supplies, see *Exhibit 1*.

Review of existing data from well logs, historic geologic investigations, and groundwater models indicates that brackish groundwater aquifers exist along the western portion of the Bay that are not currently utilized by any of the BAWSCA agencies. As shown in Figure 3, the three general areas that were evaluated for brackish groundwater production are: area near the western end of the Dumbarton Bridge (Dumbarton Bridge Area); area near the western end of the San Mateo Bridge (San Mateo Bridge Area); and the area of South San Francisco near Oyster Point (South San Francisco Area).

The most complete set of data regarding potential brackish groundwater aquifers is in the vicinity of the Dumbarton Bridge where several geologic borings were completed and pump tests performed as part of the design for the new SF RWS Bay Tunnel. More limited geologic and hydrogeologic data is available farther north along the Peninsula. Based on borings drilled as part of the modifications to the San Mateo Bridge, there are thick formations under the Bay that not only include Bay mud but also sands and gravels that could potentially provide productive water bearing zones. Unfortunately, these formations were not characterized as completely as for the more recent work near the Dumbarton Bridge. However, extension of this geology to the north is consistent with the formations similar to those in the Niles Cone area (which extend over to the Peninsula) continuing north. It would be anticipated that similar formations could extend to the South San Francisco area, but less information is available both on- and offshore in that area. *Exhibit 1* provides additional detail.

Figure 3 indicates the regional groundwater study area, the alluvial zones near the Dumbarton Bridge, and the geologic cross section across the San Francisco. Figure 4 presents the hydrogeologic cross section.

Brackish groundwater is attractive as a source of supply for a desalination project as the use of a subsurface intake can reduce the pre-treatment requirements, simplify permitting, and reduce capital and operating costs relative to open water intake projects. As such, development of brackish groundwater sources has been included in the Strategy



Source: BAWSCA Strategy, HydroFocus Inc., May 2011

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Figure 3

Alluvial Cones and Geologic Cross-Section at the Dumbarton Bridge

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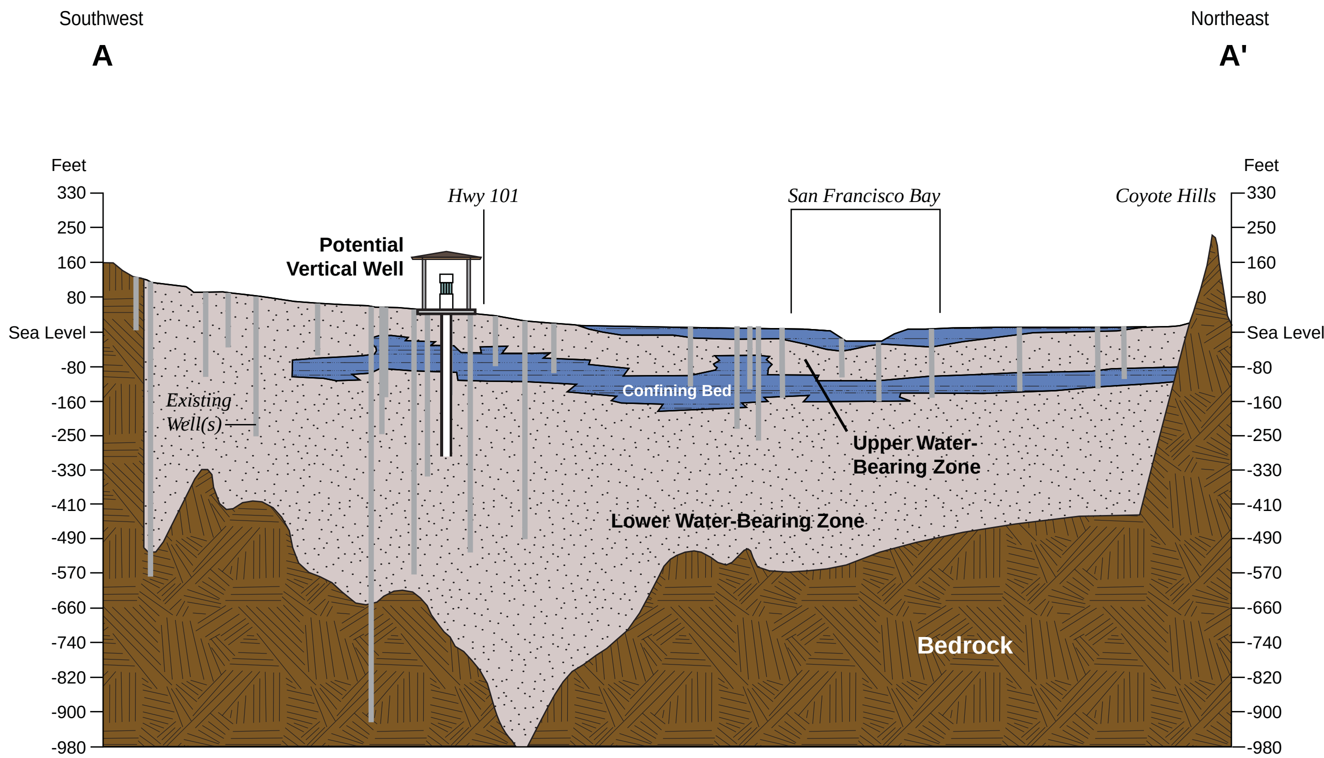

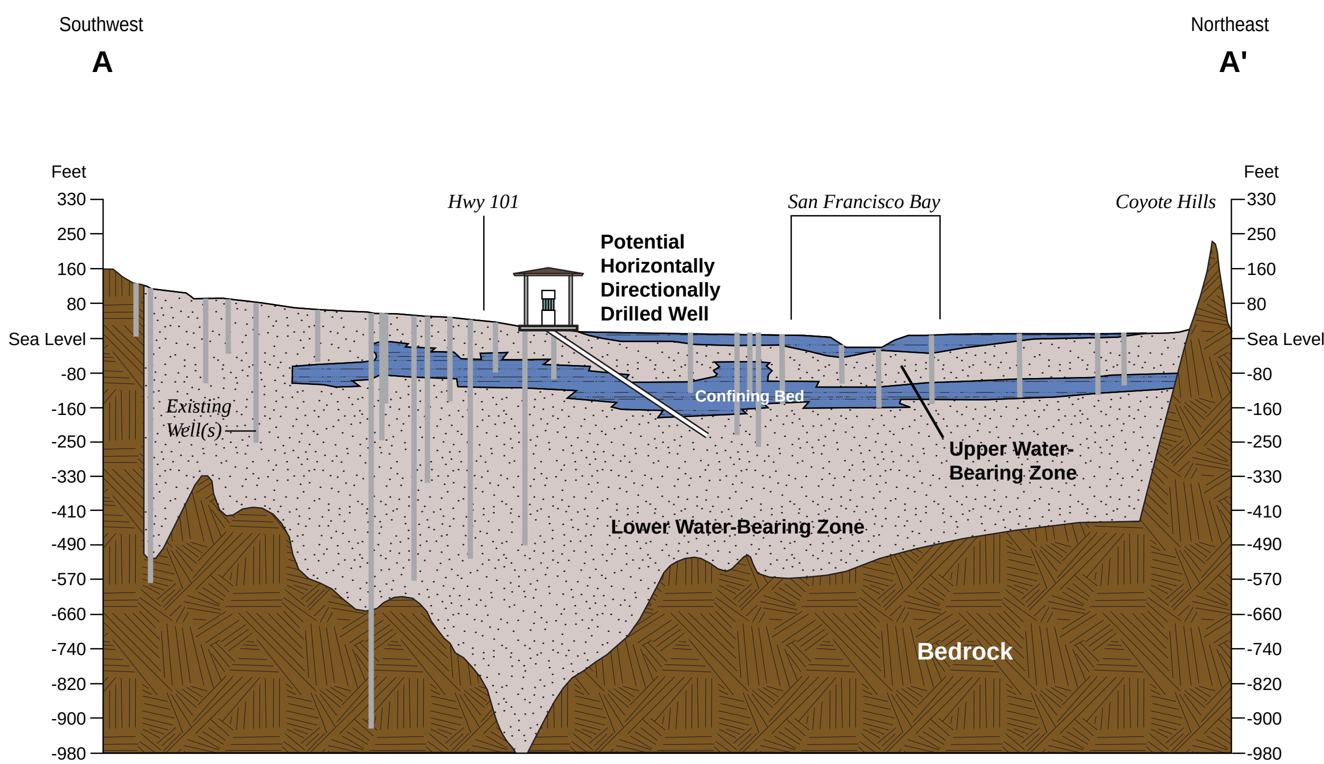

Source: Groundwater-Flow System Description and Simulated Constituent Transport, Raychem/Tyco Electonics Site, HydroFocus Inc., November 21, 2003.

0 1 2 Miles

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Figure 4

Planning Level Illustration of Vertical and Horizontally Directionally Drilled Wells in Dumbarton Bridge Area to support the BAWSCA representative regional desalination projects. *Exhibit 1* provides additional information regarding these brackish groundwater sources.

2.2 Project Yield

The initial assessment the historic data and limited calculations of potential yield based on the hydrogeologic characteristics indicate that the Dumbarton Bridge area has the highest potential brackish groundwater yield (i.e., 1 to 5 mgd). For the purposes of developing representative regional desalination projects and costs, similar brackish groundwater yields were assumed for the San Mateo Bridge and South San Francisco Areas. These representative capacities are more fully presented Section 3 and *Exhibit 1*.

2.3 Project Costs

Planning level costs for the development of brackish groundwater supplies are included in the costs for the representative regional desalination projects and are presented in Section 3 and *Exhibit 1*.

2.4 Project Implementation Schedules

Preliminary project implementation schedules have not been developed for the brackish groundwater supplies individually. Schedules, including the development of brackish groundwater supplies, have been developed as part of the BAWSCA representative regional desalination projects and are presented in Section 3 and *Exhibit 1*.

2.5 Key Project Issues

The key project issues associated with the brackish groundwater projects include:

- Limited hydrogeologic information is available for the brackish aquifers. As such, the location and potential yield of these aquifers is relatively unknown. The best information available to confirm potential yields is in the Dumbarton Bridge Area, with less hydrogeologic information available for the brackish groundwater aquifers and off-shore areas of the San Mateo Bridge and South San Francisco Areas. However, the recharge, long term yield, and potential impact on other groundwater users needs to be evaluated to confirm the assumed capacities and yields for all three areas.

- Whether the brackish groundwater wells are assumed to operate in all years, or only during dry years, will impact the cost. For the purposes of developing preliminary cost estimates for the representative regional desalination projects an annual operation at 80% of total capacity was assumed. This would be representative of normal year use. If this supply is only used for dry year supply the present worth and annualized cost, will increase significantly.

2.6 Project Next Steps

If it is determined that all or some of the representative regional desalination projects should proceed using brackish groundwater, several steps will be required to confirm their feasibility, including:

- Development of a regional groundwater model extending from Peninsula to the recharge areas on the east side of the San Francisco Bay and south to Santa Clara County to provide an initial assessment of the brackish groundwater yields, including recharge and potential impacts of pumping on other groundwater users; and

- Construction of pilot pumping and monitoring wells to confirm whether the model is representative of the actual conditions in specific locations on the Peninsula and whether the estimated yield is appropriate.

Section 3
BAWSCA Representative Regional Desalination Projects

The BAWSCA representative regional desalination projects have the potential to provide normal and dry year supply. They are defined as "representative" because the source locations and required infrastructure are not necessarily specific to projects that would be built, but represent the range in yield and cost if similar types of projects were to be developed. In order to develop this cost information, specific water sources, yields, and facility locations were assumed.

One of the key issues for these projects is the source yield. As these brackish groundwater aquifers onshore and offshore have not been explored as fully as the freshwater aquifers, there is greater uncertainty as to the available yield. However, the representative projects provide a basis for comparison with other projects to determine whether further investigation of these projects is warranted.

3.1 Project Description

The BAWSCA representative regional desalination projects are focused on the Bay side of the Peninsula and include sources from brackish and Bay groundwater (accessed via vertical wells and HDDW, respectively), and open intakes in the Bay. The vertical wells are assumed to pump from the brackish aquifers which are not currently developed or utilized. The HDDW intakes extend under the Bay to provide an opportunity to increase yield by increasing the potential recharge available from the Bay. The open water intakes pump Bay water directly.

There are a number of common facilities associated with all the desalination projects. These key facilities include:

- Intake (i.e., vertical groundwater wells, HDDW, or open water intakes);
- Desalination treatment (i.e., potential alternative pre-treatment requirements depending on source water quality); and
- Brine discharge (i.e., subsurface discharge, new open water discharge, or co-location with existing wastewater plant outfalls).

Table 6 indicates the range of types of options included for the BAWSCA representative desalination projects.

Table 6
Key Project Components

	Source Option	Pre-treatment Option	Brine Discharge Option
Subsurface Bay Intake			
Vertical Brackish Groundwater Wells	Brackish water	Not required	WWTP Outfall
Horizontal Directionally Drilled Wells	Bay Water	Not required	WWTP Outfall
Open Water Intake			
Bay Water	Bay Water	Yes	WWTP Outfall

Based on the facility requirements for a desalination project, potential sites within the BAWSCA service area were prioritized for the location of the representative projects based on:

- Proximity to water supply source (i.e., near the Bay and areas with favorable groundwater conditions);
- Proximity to existing WWTP sites for potential brine disposal;
- Qualitative assessment of surrounding land use (i.e., parcels in residential areas were not considered likely sites for this analysis);
- Topography (i.e., parcels with steeply sloping areas were not included due to construction and land use issues); and
- Proximity to SF RWS existing turnouts.

3.1.1 Representative Project Locations

Three potential areas along the Bay side of the Peninsula were selected to site the representative regional desalination projects, including the:

- Dumbarton Bridge Area;
- San Mateo Bridge Area; and
- South San Francisco Area.

Figure 3 indicates the general location of these three areas. These areas were selected because they are sites with possibly favorable groundwater characteristics, possible space for siting intake and treatment facilities, potential co-location for brine disposal with existing wastewater treatment plants and outfalls, and connection to either local agencies water systems or to the SF RWS for conveyance.

Table 7 summarizes the range of capacity, pre-treatment, RO treatment recovery (% of intake flow available as treated water), and whether this type of intake was included in the current evaluation.

Table 7
Capacity, Pre-treatment, Recovery and Inclusion Summary for Intakes

	Total capacity per unit (well or intake unit) (mgd)	Pretreatment Required? (Y/N)	RO Treatment Recovery Percentage	Intake Included?
Subsurface Bay Intake				
Vertical Brackish Groundwater Wells	1-2	N	Brackish 75%	Y
Horizontal Directionally Drilled Wells	3	N	55% for Bay water	Y
Open Water Intake				
Bay Water	10 - 40	Y	55% for Bay water	Y

3.1.2 Local Hydrogeology and Intake Capacity

While the initial information suggests that a brackish groundwater project may be promising in the Dumbarton Bridge Area, additional analysis will be required to determine the hydrogeologic capacity and yields at this location and the potential impacts on other wells. Due to concerns with potential impacts to the ACWD groundwater production wells, only vertical wells with assumed yields of 1 to 5 mgd were evaluated for this area.

The availability of hydrogeologic information for potential brackish groundwater projects is limited for the San Mateo Bridge and South San Francisco Areas. However, for the purposes of developing preliminary cost estimates, groundwater projects ranging from 1 to 5 mgd for vertical wells and 5 and 10 mgd for HDDW were included for the San Mateo Bridge and South San Francisco Areas.

Figure 3 indicates overall groundwater study area which includes the three project areas and provides an overview of the locations of alluvial formation near the Dumbarton Bridge Area. Figure 4 provides a planning level illustration of two types of potential wells (i.e., vertical and HDDW) and their locations.

Because of poorer Bay water quality and circulation in the southern end of the San Francisco Bay, open water intakes were not included for the Dumbarton Bridge Area. Open water intakes with up to 20 mgd capacity were assumed for the San Mateo Bridge and South San Francisco Areas.

3.1.3 Source Water Quality and Desalination Treatment Requirements

All of the representative desalination projects assume treatment with reverse osmosis (RO) membranes. However, water from subsurface intakes (i.e., vertical wells or HDDW) does not require the same level of pre-treatment as the water from open water intakes due to the lower salinity level (brackish) water and natural filtration. *Exhibits 1 and 2* present the treatment requirements for these different source water and quality supplies.

Table 8 summarizes for each of the planning areas the possible SF RWS connection point, possible brine discharge location, and the type of intakes assumed for the representative regional desalination projects.

Table 8
Summary of Desalination Plant Options Evaluated

Area	Potential SF RWS Connection	Potential WW Discharge Collocation	Vertical Brackish Groundwater Well	Subsurface Bay HDDW	Open Intake
Dumbarton Bridge Area	Turnout 10	Palo Alto Water Quality Control Plant	X	-	-
San Mateo Bridge Area	Turnout 107	San Mateo Wastewater Treatment Plant	X	X	X
South San Francisco Area	Turnout 116	South San Francisco/San Bruno Water Quality Control Plant	X	X	X

3.1.4 Brine Disposal Capacity

Brine disposal from the desalination process usually incorporates one of the following options:

- Subsurface discharge;
- New open water discharge; or
- Co-location with existing wastewater plant outfalls.

Exhibit 1 describes these options in more detail. For the purposes of this assessment, brine disposal is assumed to be by co-location with the existing WWTP outfalls. The local wastewater agencies were contacted and initial calculations developed as to the potential capacity available for joint discharge.

Figure 5 indicates the three planning areas and the existing WWTP and outfall locations. There are two possible capacity constraints associated with the co-location for the brine disposal: (1) sufficient available capacity in the pipeline to combine the WWTP flows with the brine flows (all seasons with exception of high winter flows) and remain below the current hydraulic capacity; and (2) the combined salinity of the discharge flow should stay below 120% of the Bay receiving water. The combined salinity requirement is due to

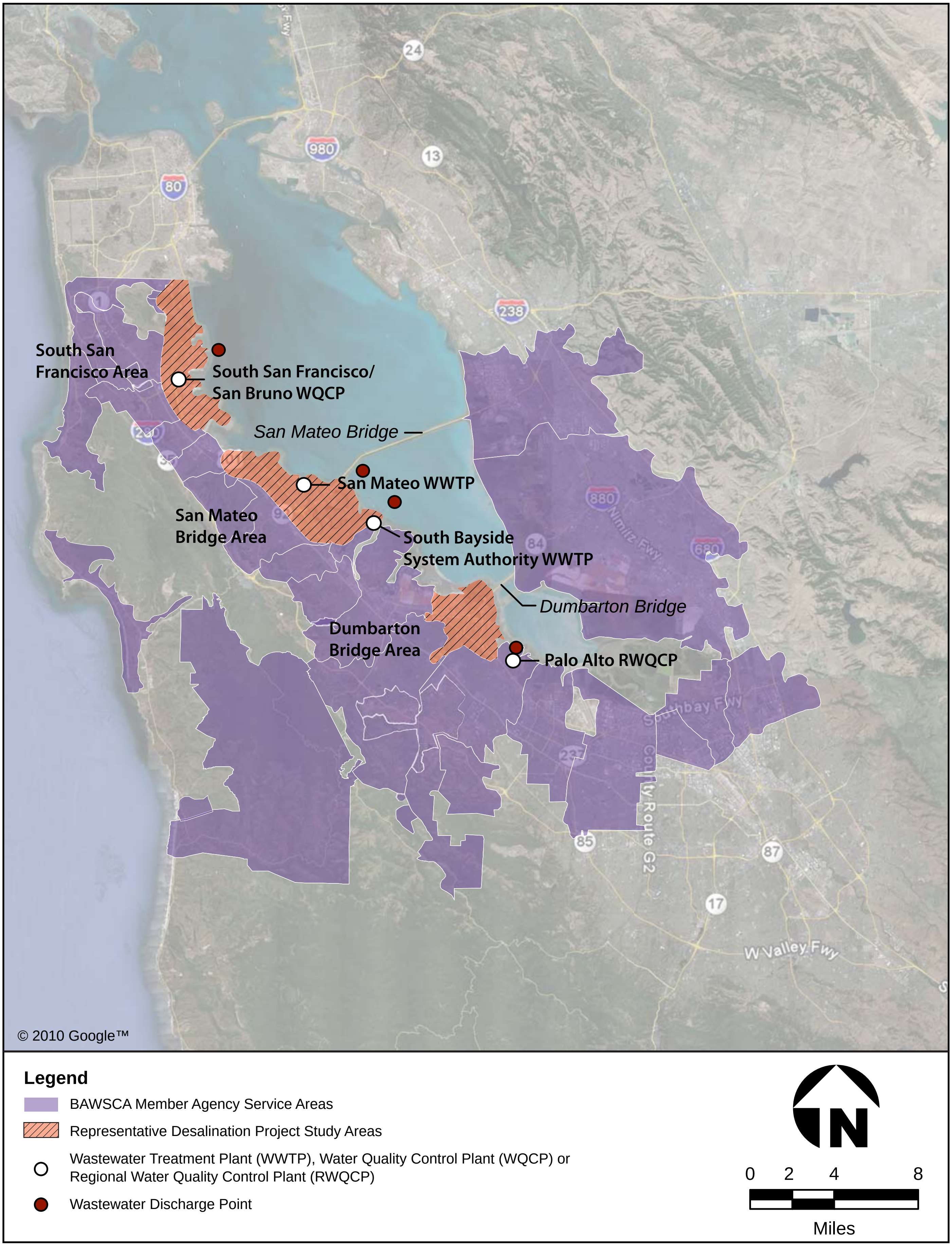

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Figure 5
BAWSCA Representative Desalination Project Study Areas
and Regional Wastewater Plants and Outfalls

CDM Smith

water quality discharge regulations. Blended flows above 100% of ambient salinity levels may require additional studies, but salinity concentrations above 120% may not be allowed, even with studies.

With assumed maximum treated water capacity of up to 20 mgd, there appears to be both hydraulic capacity and blending capacity (maintaining combined discharge) at all of the existing WWTPs. For the purposes of this analysis, the salinity of the source water has been assumed to be conservatively high (at the upper end or above of the brackish and estimated Bay water salinities). This may allow outfall use at these flow levels without additional studies to determine the impact of higher salinity blending.

3.1.5 Representative Regional Desalination Projects

Based on the information presented above and in *Exhibit 1*, a total of fourteen BAWSCA representative regional desalination projects have been identified. Table 8 summarizes key information for each of the three representative regional desalination project areas, including the possible SF RWS connection point, possible brine discharge location, and the type of intakes assumed.

Selected (representative) potential intake and treatment plant site properties identified for the Dumbarton Bridge, San Mateo, and South San Francisco areas are shown in Figures 6, 7, and 8 respectively. The conceptual pipelines connecting the properties to the WWTPs for co-location with the outfall pipelines, treated water turnouts on the SF RWS, and source water intakes are highlighted in the figures. Conceptual pipeline alignments were identified on non-highway roads for permitting and cost purposes. Alignments were also identified that would minimize tunneling associated with pipeline construction (i.e., where pipelines pass under existing highways).

3.2 Project Yield

As discussed in Section 2, the yields of the groundwater projects are not well defined as only limited data is available to determine the maximum yields. The best data available for these brackish zones are near Dumbarton Bridge where relatively extensive geologic and hydrogeologic data is available. In addition, it is known that the alluvial zones used by ACWD for their brackish groundwater development extend across the Bay. Further north along the Peninsula less information is available. However, based on the geology along the Peninsula, it is anticipated the brackish water bearing zones exist.

For the purposes of the development of the representative projects, supply capacities for each of the study areas have been assumed as shown in Table 9.

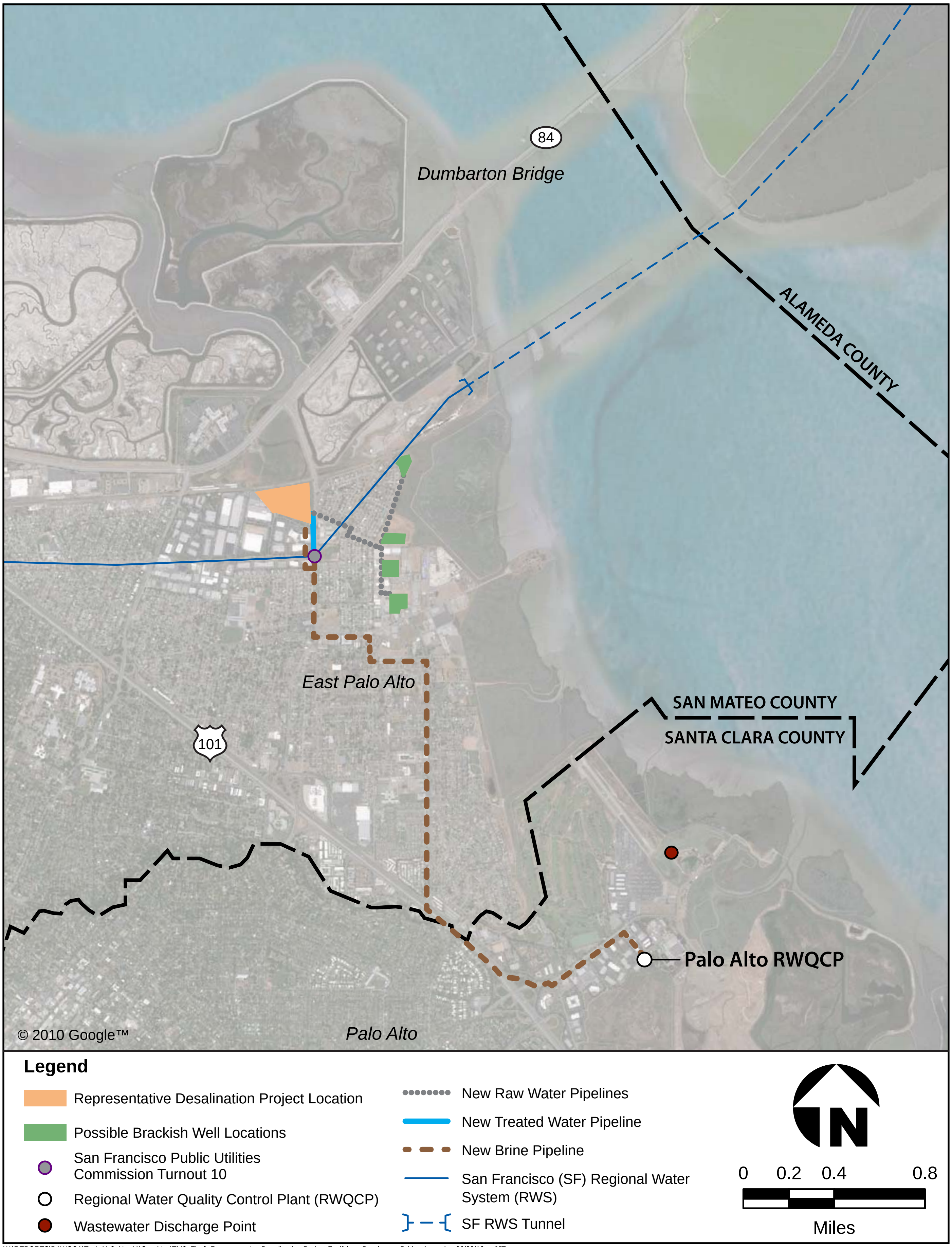

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Figure 6

Representative Desalination Project Facilities - Dumbarton Bridge Area

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Figure 7
Representative Desalination Project Facilities - San Mateo Bridge Area

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Figure 8

Representative Desalination Project Facilities - South San Francisco Area

CDM Smith

Table 9
Project Location, Capacity, Type of Intake and Percentage Recovery

Location	Treated Water Capacity (mgd)	Vertical Brackish Groundwater Well	Subsurface Bay HDDW	Open Bay Intake	Yield (AF/year)[1]
Recovery Percentage		75%	55%	55%	
Dumbarton Bridge Area	1	X	-	-	900
	2	X	-	-	1,800
	5	X	-	-	4,500
San Mateo Bridge Area	1	X	-	-	900
	2	X	-	-	1,800
	5	X	-	-	4,500
	5	-	X	-	4,500
	10	-	X	-	9,000
South San Francisco Area	1	X	-	-	900
	2	X	-	-	1,800
	5	-	X	-	4,500
	10	-	X	-	9,000
	20	-	-	X	17,900

[1] Annual yield is based on 80% production of the design capacity.

There are number of other factors associated with the development of a desalination project that affect the overall sizing, capacity, and yield. These include:

- Intake capacity;
- Recharge to groundwater to maintain long-term yields;
- Potential impacts on other groundwater pumpers that may limit pumping capacity;
- Treatment requirements and source water considerations;
- Available siting areas for a desalination plant;
- Brine disposal capacity; and
- Potential treated water customers and transmission facilities.

Based on the information available and assumptions made to date, the range in yield for the representative regional desalination projects is 900 to 17,900 AF/ year, as indicated in Table 9.

3.3 Project Costs

Several cost elements have been developed for the representative regional desalination projects. These include:

- Construction Costs ($M);
- Capital Costs ($M);
- Annual O&M Costs ($M);
- Present Worth Costs ($M);
- Estimated Annual Production ($M);
- Unit Cost of Total Present Worth ($M/AF); and
- Unit Annualized Costs ($/AF).

Exhibit 1 provides detailed information on the basis of cost assumptions for the above financial characteristics of projects.

Table 10 presents the planning level construction and capital cost estimates for the major project items for the representative regional desalination projects, including facility sizing. The adjustments used to convert construction costs to capital costs are also shown in Table 10. The unit costs for each of the different items were developed based on similar types of projects in California and the United States. All construction costs were adjusted to August 2011 dollars, which is being used as the common base for all of the projects being evaluated as part of the Strategy.

Some key costs that have not been included in the current analysis include:

- Land purchase cost;
- Purchase of easements or rights-of-way;
- Wheeling or “transfer” costs for conveyance of water through other agencies facilities; and
- Purchase price of water, if applicable.

Table 10
Representative Desalination Project Sizing and Capital Cost

Item	Dumbarton Bridge Area			San Mateo Bridge Area						South San Francisco Area				
	1 mgd Brackish Groundwater Wells	2 mgd Brackish Groundwater Wells	5 mgd Brackish Groundwater Wells	1 mgd Brackish Groundwater Wells	2 mgd Brackish Groundwater Wells	5 mgd Brackish Groundwater Wells	5 mgd Bay Water HDDW[1] Wells	10 mgd Bay Water HDDW[1] Wells	10 mgd Bay Water Open Intake	1 mgd Brackish Groundwater Wells	2 mgd Brackish Groundwater Wells	5 mgd Bay Water HDDW[1] Wells	10 mgd Bay Water HDDW[1] Wells	20 mgd Bay Water Open Intake
Assumed Treated Water Production Capacity (mgd)[2]	1	2	5	1	2	5	5	10	10	1	2	5	10	20
Assumed Annual Production (AF/Year)[2,3]	900	1,800	4,500	900	1,800	4,500	4,500	9,000	9,000	900	1,800	4,500	9,000	17,900
Facility Sizing														
RO Recovery %	75%	75%	75%	75%	75%	75%	55%	55%	55%	75%	75%	75%	55%	55%
Source Water Capacity (mgd)	1.3	2.7	6.7	1.3	2.7	6.7	9.1	18.2	18.2	1.3	2.7	6.7	18.2	36.4
RO Treated Water Capacity (mgd)	1	2	5	1	2	5	5	10	10	1	2	5	10	20
Brine Disposal Capacity (mgd)	0.3	0.7	1.7	0.3	0.7	1.7	4.1	8.2	8.2	0.3	0.7	1.7	8.2	16.4
Capital Cost														
Capital Cost ($M)[4,5]	$30.6	$43.0	$64.4	$35.8	$47.3	$72.1	$126.5	$201.8	$274.7	$31.1	$42.7	$120.5	$194.3	$364.6

[1] Horizontally Directionally Drilled Wells.
[2] Capacity is treated water production from the desalination plant in million gallons per day (mgd).
[3] Assumes annual operation at 80% of capacity.
[4] Costs adjusted to August 2011.
[5] Costs do not include property acquisition, or conveyance costs by others.

In addition to the capital costs and O&M costs, two different approaches are included for comparing between projects. These include the development of present worth analysis (or life-cycle costs) and annual costs. The present worth analysis includes the conversion of all cash flows to a common point in time, August 2011. As such, it requires the consideration of the time value of money and all future cash flows discounted back to the present. The present worth analysis converts all annual O&M costs (i.e., chemicals, power, labor, RO membrane replacement, etc.) to a present worth value and adds this to the present worth of the capital cost. To compute a unit cost of water, this sum of the present worth of capital and O&M costs is divided by the total amount of water produced over the expected life of the project. For the purposes of this analysis, a period of 30 years is used for the comparison of all projects.

Table 11 presents the present worth and annualized cost estimates for the representative regional desalination projects based on the capital costs presented in Table 10 and the methodology described above.

3.5 Project Implementation Schedule

Preliminary implementation schedules have been developed for the representative regional desalination projects. The schedules presented below are based on experience with similar desalination projects (e.g., Santa Cruz and Monterey Peninsula Water Management District) and professional judgment. Considerably slower schedules have been experienced by desalination projects in Carlsbad and Huntington Beach.

Two considerations which can have a significant impact on schedule include:

- *Piloting*: Almost every major project used for comparative purposes has had a pilot plant study (e.g., Newark, Marin, Santa Cruz, BARDP, Long Beach, Dana Point, Carlsbad, West Basin). However, if project conditions were such that permitting and design could proceed without pilot testing, the schedule may be able to be accelerated by approximately 6 months; and

- *Source water assessments*: For setting treatment requirements, the California Department of Public Health (CDPH) requires 12 months of testing for well-extracted source water and 24 months for an open water intake source. This and other schedule impacts may be avoided by installing greater levels of pre-treatment.

Table 11
Summary of Project Yields and Cost

Item	Dumbarton Bridge Area			San Mateo Bridge Area						South San Francisco Area				
	1 mgd Brackish Groundwater Wells	2 mgd Brackish Groundwater Wells	5 mgd Brackish Groundwater Wells	1 mgd Brackish Groundwater Wells	2 mgd Brackish Groundwater Wells	5 mgd Brackish Groundwater Wells	5 mgd Bay Water HDDW[1] Wells	10 mgd Bay Water HDDW[1] Wells	10 mgd Bay Water Open Intake	1 mgd Brackish Groundwater Wells	2 mgd Brackish Groundwater Wells	5 mgd Bay Water HDDW[1] Wells	10 mgd Bay Water HDDW[1] Wells	20 mgd Bay Water Open Intake
Assumed Production Capacity (mgd) [2,3]	1	2	5	1	2	5	5	10	10	1	2	5	10	20
Assumed Annual Production (AF/year) [3,4]	900	1,800	4,500	900	1,800	4,500	4,500	9,000	9,000	900	1,800	4,500	9,000	17,900
Annualized Costs														
Annualized Capital Cost ($M/year) [4,6]	$1.56	$2.19	$3.28	$1.83	$2.41	$3.68	$6.45	$10.29	$14.01	$1.59	$2.18	$6.15	$9.91	$18.60
O&M Cost ($M/year) [4]	$0.74	$1.11	$2.17	$0.76	$1.68	$2.18	$3.42	$6.45	$8.07	$0.70	$1.05	$3.43	$6.47	$15.50
Total Annualized Cost ($M/year) [5,6]	$2.30	$3.30	$5.45	$2.58	$3.60	$5.86	$9.87	$16.75	$22.08	$2.28	$3.23	$9.58	$16.38	$34.10
Total Annualized Cost ($/AF) [5,6,8]	$2,600	$1,800	$1,200	$2,900	$2,000	$1,300	$2,200	$1,900	$2,500	$2,500	$1,800	$2,100	$1,800	$1,900
Present Worth Costs														
Total Production – 30 years (AF)	27,000	54,000	135,000	27,000	54,000	135,000	135,000	270,000	270,000	27,000	54,000	135,000	270,000	537,000
Total Present Worth Cost ($M) [6,7]	$52.90	$76.23	$129.38	$58.5	$82.9	$137.4	$229.1	$395.3	$516.6	$52.98	$74.22	$223.49	$388.37	$829.65
Present Worth Unit Cost ($/AF) [6,8]	$2,000	$1,400	$1,000	$2,200	$1,500	$1,000	$1,700	$1,500	$1,900	$1,900	$1,400	$1,700	$1,400	$1,500

1 Horizontally Directionally Drilled Wells.
2 mgd – million gallons per day.
3 Capacity is treated water production from desalination plant.
4 Assumes annual operation at 80% of capacity.
5 Annualized cost based on 30 year return at 3% interest rate.
6 Costs do not include property acquisition, cost for use of wastewater treatment plant outfall capacity, or conveyance costs by others.
7 Present Worth estimates include a 3% escalation and a 3% discount rate. The same escalation rate is used for electricity, materials, labor and capital costs.
8 Costs are rounded to the nearest $100/AF.

The preliminary project implementation schedules for the representative regional desalination projects include the following activities:

- Field investigation;
- Pilot-scale demonstration projects;
- Source water assessments;
- Intake supply studies;
- Miscellaneous studies for permitting;
- Intake, Outfall and Plant Conceptual Design;
- Preliminary design and EIR;
- Finalize EIR and permit applications;
- Final design;
- Bid and construction; and
- Startup.

The schedules will likely change depending on the permitting climate, the public perception of the selected project, and the specific siting and permitting requirements. In general, the projects using brackish groundwater wells will have the shortest implementation time (i.e., 6 to 8 years). The implementation time for projects using HDDW are expected to be longer (i.e., 10 to 12 years), and projects using open water intakes are expected to take from 10 to 15 years. *Exhibit 1* provides additional detail on the project schedules.

3.6 Key Issues

Key issues associated with representative regional desalination projects include:

- Source water quality (e.g., salinity, iron, manganese, contaminants) variability;
- Source water yield;
- Land availability, cost and permitting for subsurface intakes and for new desalination plant sites;
- Alignment issues and rights-of-way for construction of new raw water, brine, and treated water pipelines;

- Willingness and cost to allow use of existing WWTP outfall capacity for brine disposal;
- Public support and/or opposition to these projects needs to be determined;
- Use of the SF RWS system for conveyance to member agencies if required;
- Permitting for a new intakes in the Bay; and
- Funding and ownership of a regional desalination facilities.

The key risks noted during development of this analysis include:

- Protracted permitting approval process. This has been the experience with the Marin, Carlsbad, and Santa Cruz projects;
- Costs and delays to overcome potential permitting hurdles, public opposition, and litigation. California experience indicates that such delays have been the norm. It is unclear whether implementation time for future plants will be reduced (i.e., if State-wide regulatory streamlining for desalination plants occurs).
- Risks associated with introducing a new treated water source into an existing distribution system, such as water stabilization and corrosion control to minimize impacts to existing scales, maintaining disinfectant stability in the presence of bromide in the desalinated water, aesthetic differences, irrigation use with higher concentrations of boron and chloride, and potential SFPUC requirements to match existing salinity and hardness parameters; and
- Risk that the cost of power may escalate more quickly than anticipated and increase the operational costs.
- Risk that wastewater utilities may not allow a co-located brine discharge with or without additional costs or negotiations.
- *Brackish groundwater and HDDW options:* Projecting expected yield and assessing impacts on other wells in the aquifer including well yield and water quality (e.g., potential for increased salt water intrusion and subsidence);
- *HDDW options:* Long-term yield and reliability of slant or horizontal wells depending on the site-specific hydrogeology under the Bay floor and future sediment deposition which may reduce water transport rates from the ocean into the aquifer; and
- *Open water intake options:* Cleaning frequency and long-term reliability of intake screens.

3.7 Project Next Steps

If it is determined that all or some of the representative desalination projects should proceed, several steps will be required to confirm their feasibility including:

- Develop regional groundwater model to provide an initial assessment of the water supply yields;
- Construct pilot pumping and monitoring wells to confirm estimated yields; and
- Confirm with the regional wastewater agencies that they are interested and willing to provide brine disposal capacity through a long-term agreement.

Section 4
Bay Area Regional Desalination Project

SFPUC, EBMUD, CCWD, SCVWD, and Zone 7 are jointly investigating a Bay Area Regional Desalination Project[1]. To date, BAWSCA's interests in the BARDP have been represented by SFPUC (i.e., BAWSCA has paid for two-thirds of SFPUC's share of the BARDP costs). The BARDP has been included for evaluation in the Strategy for two reasons: (1) to serve as a benchmark for Sacramento River desalination project costs; and (2) to assess if BAWSCA wants to pursue participation in the BARDP independent of SFPUC.

4.1 Project Description

In 2007, the agencies released the BARDP Feasibility Study[2] (Feasibility Study) which investigated several potential infrastructure options and evaluated several site locations in the Bay Area against a set of criteria. These criteria included: 1) raw water quality; 2) costs; 3) permitting/water rights requirements; 4) public acceptance/ socioeconomic effects (including environmental justice, growth inducement, and land use impacts); 5) potential to receive grant funding; 6) capability to supply product water to multiple agencies during droughts; and 7) environmental effects. Twenty-two potential facility locations were evaluated based on these criteria, and three locations were selected as the most feasible: East Contra Costa County, Oceanside, and near the easterly side of the Bay Bridge in Alameda County.

Based on the results of the Feasibility Study, the BARDP agencies conducted a pilot test at CCWD's Mallard Slough Pump Station (PS) site located in the eastern part of Contra Costa County. The results of the pilot study were documented in the 2010 Pilot Testing at Mallard Slough Engineering Report (Pilot Engineering Report)[3]. Figure 9 indicates the location for the BARDP pilot plant and the most likely area for a full sized desalination project if BARDP moves forward.

4.2 Project Yield

Three membrane configurations were evaluated as part of the BARDP pilot study, providing a recovery range between 50 and 82%, depending on raw water TDS levels and membrane type. The pilot study helped the BARDP agencies identify membrane combinations for a larger size treatment plant, and also confirmed that a larger size plant is feasible at the Mallard Slough PS

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[1] In 2011 the Alameda County Flood Control and Water Conservation District Zone 7 joined the BARDP group, and Alameda County Water District decided to no longer participate in the investigations.

[2] Bay Area Regional Desalination Project Feasibility Study, 2007, prepared by URS for Contra Costa Water District, East Bay Municipal Utility District, San Francisco Public Utilities Commission, and Santa Clara Valley Water District. http://www.regionaldesal.com/documents.html

[3] Bay Area Regional Desalination Project Pilot Testing at Mallard Slough Engineering Report, 2010, prepared by MWH for Contra Costa Water District, East Bay Municipal Utility District, San Francisco Public Utilities Commission, and Santa Clara Valley Water District. http://www.regionaldesal.com/documents.html

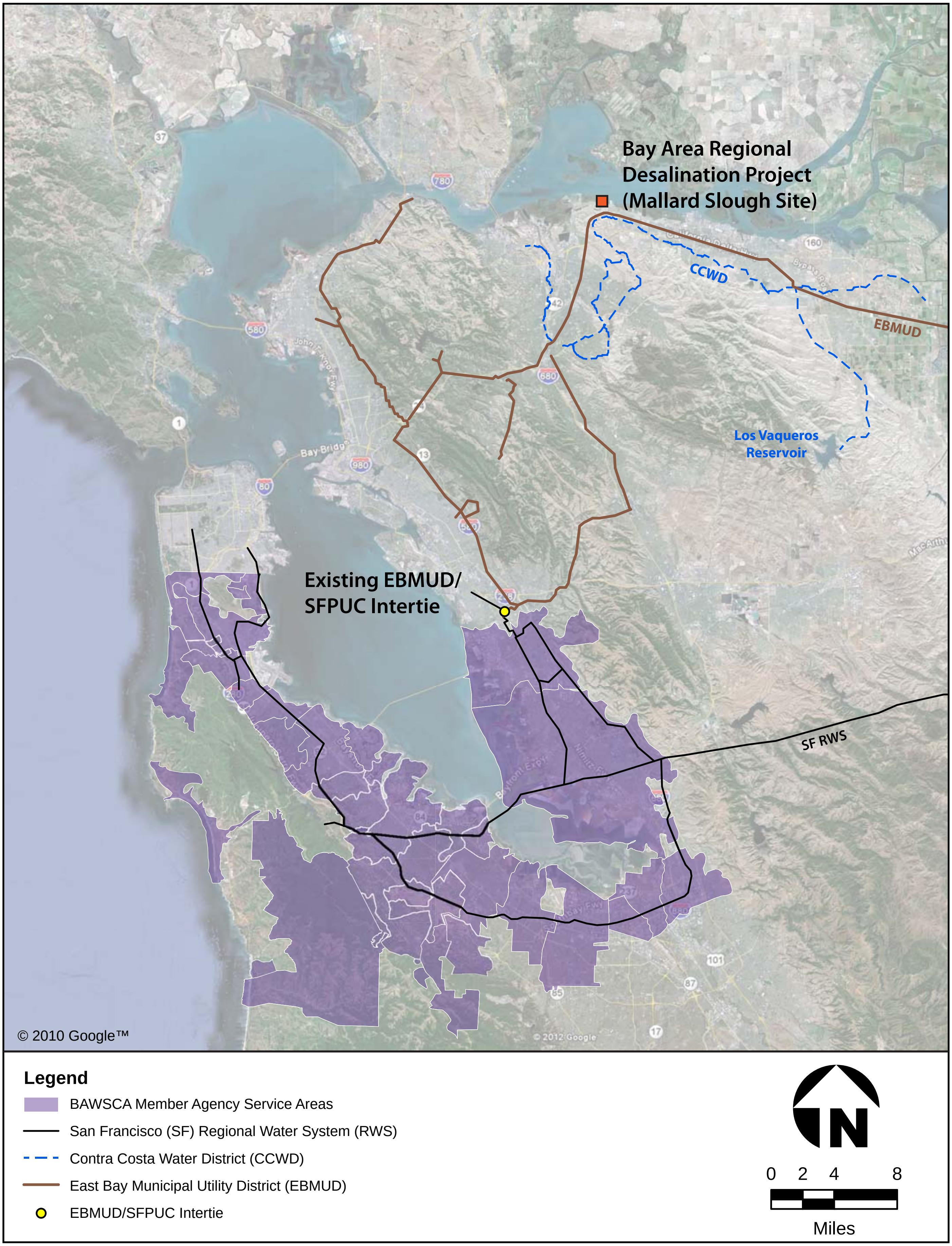

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Figure 9
Bay Area Regional Desalination Project Location

site. Results from the pilot study were used to develop a cost estimate for four desalination plant scenarios, using the different membrane configurations, different operation schedules, and plant locations. Three of these scenarios were recommended for further consideration with a two-stage combination of brackish and seawater membranes.

The characteristics of the three BARDP scenarios that have been retained for further evaluation are summarized in Table 12 below. All three scenarios are based on 20 mgd treated water facilities. Scenarios 1 and 3 assume operation at 100% of design capacity year round, or an annual production of 22,400 AF. Scenario two is assumed to operate every third year and has an average annual production of about 7,600 AF.

Table 12
BARDP Desalination Plant Scenarios[1]

	Scenario 1	Scenario 2	Scenario 3
Capacity [2]	20 mgd	20 mgd	20 mgd
Average Recovery Rate[2]	80%	80%	80%
Operation	Continual	Every 3rd year (mothball)	Continual
Annual Yield	22,400 AF	7,600 AF	22,400 AF
Location	Mallard Slough	Mallard Slough	To be determined (site other than Mallard Slough)
Intake Structure	Mallard Slough PS	Mallard Slough PS	To be constructed
Treated Water Transmission	Existing lines	Existing lines	To be constructed
Construction Considerations	Pile foundation required	Pile foundation required	None

1 Source: Table 1-5 in the Pilot Study Engineering Report.
2 Capacity and recovery rates decrease during times of maximum raw water TDS.

4.3 Project Cost

Facility costs for the BARDP are based on more detailed information than is currently developed for other projects considered within the Strategy. This is due to the more detailed analysis and investigations for the more mature BARDP project. The identification of a single plant type (brackish, open intake), capacity (20 mgd), and plant location (Mallard Slough or nearby) made this detailed estimate possible.

4.3.1 Capital Cost Estimates

Capital cost estimates from the Pilot Engineering Report are summarized in Table 13. The capital cost estimates have been adjusted in the last row to match the BAWSCA Strategy cost base year of August 2011.

The capital costs do not include allowance for additional infrastructure or pumping capacity to convey the treated water beyond the desalination facility. The potential use of the EBMUD system for conveyance to the SF RWS existing emergency intertie at Hayward is currently being evaluated by EBMUD. Those costs will increase the capital cost if additional infrastructure is required, and will significantly increase the O&M costs.

Table 13
Present Worth and Annualized Cost Estimates
BARDP Scenarios[1]

	Scenario 1	Scenario 2[2]	Scenario 3
Present Worth Project Costs			
Annual O&M Costs[3] ($M)	$ 10.5	$ 10.5	$ 10.5
Total Capital Cost ($M)	$ 152.1	$ 152.1	$ 163.8
Present Worth of Annual O&M Cost ($M)	$ 204.9	$ 79.0	$ 204.9
Total Present Worth ($M)	$ 357.0	$ 231.1	$ 368.6
Total Production[4] (AF)	680,000	227,000	680,000
Unit Cost of Total Present Worth[5] ($/AF)	$ 525	$ 1,020	$ 540
Unit Cost of Total Present Worth Adjusted for Strategy Base Year[5, 6, 7] ($/AF)	$ 550	$ 1,069	$ 566

1 Source: Table 1-5 in the Pilot Study Engineering Report.
2 Annual cost during dry year operation. A dry year is assumed to occur once every three years.
3 Does not include conveyance costs through CCWD or EBMUD systems.
4 Assumed project life is 30 years.
5 Unit Cost Estimates from the BARDP Report were developed based on September 2009 costs. The Strategy base year is August 2011 and adjustments to the unit costs are based on the ENR data for San Francisco ENR.
6 Costs do not include conveyance costs through CCWD or EBMUD systems.
7 The BARDP Pilot Study Engineering Report references a 5% interest rate and 2% inflation rate, but also references using a 3% discount rate for the life cycle cost analysis. It is not clear which of these assumptions were used in the later tables.

4.3.2 Annual O&M Costs

Annual Operation and Maintenance O&M costs from the Pilot Engineering Report are summarized in Table 13 Though Scenario 2 involves only operating the facility during drought periods (assumed to occur ever third year), costs are provided for a dry year when the plant is fully operational. Power requirements for Scenario 3 are higher than Scenarios 1 and 2 due to the pumping requirements associated with an offsite location. The O&M cost estimates have been adjusted in the last row from September 2009 to the BAWSCA Strategy planning base of August 2011. No other adjustments have been made to reflect different planning level assumptions.

As with the capital costs, the O&M cost estimates do not include conveyance beyond the desalination facility. If this water is conveyed through the EBMUD system to the emergency intertie in Hayward between EBMUD and the SF RWS there will be significant costs for conveyance. In addition to pumping the water may also have to be retreated in the EBMUD system if it is necessary to be conveyed through the EBMUD raw water system.

4.3.3 Present Worth Cost

The Pilot Engineering Report also included a life-cycle analysis (present worth), with an estimated project life of 30 years, net discount rate of 3% based on a discount rate of 5% and escalation rate of 2%. The present worth costs range from $550 to $1,069 for the three scenarios summarized in Table 13.

4.4 Project Implementation Schedule

Several additional steps need to be taken prior to making final decisions on BARDP, including: a) inter-agency agreements that clearly define agency roles and responsibilities, and agreement between agencies as to the size and location of the project; b) final site selection, which will involve discussions with land owners and regulatory agencies; c) completion of an EIR and possibly and Environmental Impact Statement (EIS); d) preliminary designs and geotechnical investigations; and e) determination of monthly water extraction to ensure compliance with CCWD's existing water rights at the Mallard Slough PS.[4]

In addition, CCWD is beginning evaluation of the potential for use of the Los Vaqueros Reservoir for storage of the BARDP and other supplies. EBMUD is evaluating the potential hydraulic capacity and treatment and conveyance requirements to convey water from either the desalination water treatment plant site or the CCWD system to other potential users in the Bay Area (i.e., SCVWD, SFPUC, Zone 7, and BAWSCA). These studies are anticipated to be completed in Spring/Summer of 2013.

After completion of these additional studies, a determination will be made whether the BARDP will be sponsored, by which agencies, and what the time frame will be to implement the project. Based on the earlier BARDP studies, it is anticipated that it will take approximately 6 to 7 years to complete the environmental documentation, design, construction, and startup.

4.5 Key Issues

Key issues presented in the Pilot Engineering Report that affects the overall costs include:

- Cost of electrical power is based on Reclamation rates which are lower than could be obtained by non-Reclamation agencies. If CCWD (or possibly SCVWD) is not the owning and operating partner, these costs could be significantly higher,
- Cost estimates are based on 100% production throughout the year, with the exception of Scenario 2 (which assumes 100% production every third year, with moth balling involving minimal maintenance in between);
- The BARDP estimates assume $1 million for brine concentrate discharge permitting fees and discharge facility construction each though the brine disposal location has not been finalized; and
- Additional costs from agency-specific blending, storage and/or conveyance fees are not included in the estimate.

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[4] Between CCWD's existing water extraction permit and license, a total of 26,780 AF/year can be diverted per year. While the Mallard Slough PS may be subject to pumping restrictions for one month out of the year, sufficient water rights should exist to accommodate the 25 mgd of raw water needed for a 20 mgd treated water desalination plant. This is based on realizing an overall 75% efficiency with the treatment process.

Key Institutional issues include:

- Facility ownership;
- Who will operate the facilities; and,
- Potential users (purchasers of the supply).

These institutional issues will likely be addressed in a formal agreement as the planning and preliminary design process moves forward. Other key issues that will affect permitting and cost include:

- Cost estimates do not include the cost of conveyance (including potential additional treatment) through CCWD and EBMUD transmission systems;
- Identifying the final brine disposal option. There are several potential options, including co-location with either wastewater streams or cooling plants; and
- Source water intake. If the desalination plant is not located at Mallard Slough (where CCWD already operates a surface water intake), alternate intake options would need to be evaluated.

4.6 Next Steps

If BAWSCA determines that independent participation in BARDP may be beneficial, there are several steps that the BARDP agencies and BAWSCA will need to take, including:

- Monitor the CCWD and EBMUD studies to evaluate the capacity and potential cost to convey BARDP supply or other transfer water to the BAWSCA member agencies; and
- Engage the BARDP agencies to determine what quantities may be available to BAWSCA.

Section 5
Water Transfers

Water transfers can be a cost-effective alternative for future water supply. However, as with other water supply alternatives, there are a number of specific issues that need to be assessed regarding the viability of water transfer options, including supply reliability, conveyance, storage, costs, and institutional, legal, environmental, and regulatory issues. A detailed discussion of the BAWSCA water transfer options being evaluated as part of the Strategy is included in *Exhibit 2*.

5.1 Project Description

A successful water transfer needs to combine a water supply and conveyance to meet the timing and need of the water supply for an agency. These water transfers have the potential to make additional water supply available to the BAWSCA member agencies for normal and drought needs. The general areas that have been identified with willing sellers include:

- Sacramento Valley Area (North of the Delta)
- Delta and San Joaquin Valley Area (South of Delta); and
- Tuolumne and Stanislaus Watershed areas.

A critical component of any transfer is the ability to physically move the water from the seller to the buyer. For supplies originating outside of the Bay Area there are a limited number of existing conveyance facilities that could be used to wheel water to the BAWSCA member agencies. Figure 10 indicates the general areas of the willing sellers and the regional water conveyance facilities discussed below. The current potential options include:

- North or south of Delta through EBMUD facilities to the EBMUD/SFPUC emergency intertie;
- South of Delta SWP and CVP conveyance facilities to the SCVWD/SFPUC emergency intertie;
- Tuolumne and Stanislaus supply through the SF RWS; and
- In all instances transferred water would need to utilize the SF RWS to move water to the BAWSCA member agency service areas.

Figure 10 indicates the general location for potential water sellers and the regional water systems that might be used to convey water to the BAWSCA member agencies. Additional information on the various transfer and conveyance options potentially available to BAWSCA to import transfer water is included in *Exhibit 2.*

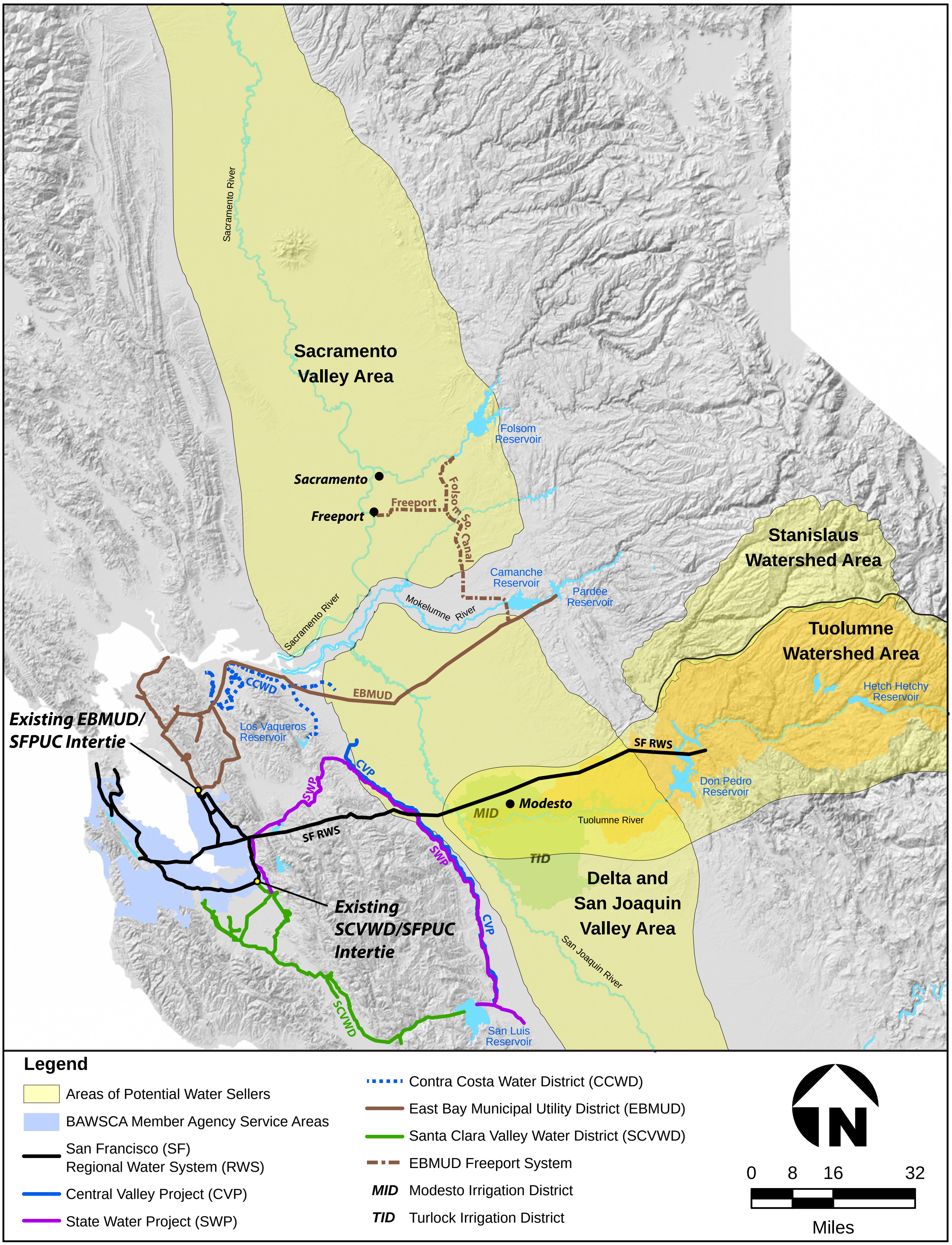

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Figure 10
Conveyance Options to the BAWSCA Member Agencies for Potential Water Transfer Seller Areas

Table 14 provides a brief summary of the viability and issues associated with the water transfer options identified to date.

Table 14
Summary of Water Transfer Options

Water Transfer Supply Options	Likelihood	Yield	Dry Year	Conveyance	Issues
Intra-BAWSCA[1]	-	-	-	-	-
Sacramento-Central Valley	Medium	Low to High	Yes	Medium	EBMUD conveyance capacity and potential environmental concerns
State Water Project	Low	Low	No	Difficult	Limited South Bay Aqueduct Capacity and priority for BAWSCA, and potential environmental concerns
Central Valley Project	Low	Low	No	Medium/Difficult	Use of CVP and SCVWD systems and their available capacities and potential environmental concerns
Tuolumne River	Medium	Medium/High	Yes	Easy/Medium	SFPUC role, Federal Energy Regulatory Commission issues, and potential environmental concerns

[1] Not included in the Strategy.

There are potentially a number of possible sellers and transfer/wheeling options to provide more water to the Bay Area. Tables 15 and 16 summarize the types of potential sellers and transfer options identified in the Sacramento Valley and in the Delta and San Joaquin Valley, respectively.

Table 15
Summary of Sacramento Valley Types of Potential Sellers and Conveyance Options

Potential Seller	Potential Conveyance Options						
	Amount		SF RWS	SWP SBA	CVP/San Felipe Project	EBMUD/SFPUC Intertie	SCVWD/SFPUC Intertie
	(AF/year)	(mgd)					
Irrigation Districts	2,000 - >5,000	2 - >5	-	X	X	X	X
Reclamation Districts	5,000	5	-	X	X	X	X
Private Owners	1,000 to 5,000	1 - 5	-	X	X	X	X
Water Districts	>5,000	>5	-	X	X	X	X
Water Agencies	>5,000	>5	-	X	-	X	-

Table 16
Summary of Delta and San Joaquin Valley Types of Potential Sellers and Conveyance Options

Potential Seller	Potential Conveyance Options						
	Amount		SF RWS	SWP SBA	CVP/San Felipe Project	EBMUD/ SFPUC Intertie	SCVWD/SFPUC Intertie
	(AF/year)	(mgd)					
Irrigation Districts	1,000 - >5,000	1 - >5	X	X	X	X	X
Private Owners	1,000 to 3,000	1 to 3	-	X	X	X	X

Based on the work done to date, the most promising option for BAWSCA appears to be to purchase a supply that can be accessed north of the Delta (e.g., at the EBMUD's Freeport Project) and wheeled through existing infrastructure (e.g., the EBMUD and/or CCWD systems) to the SF RWS for delivery to the BAWSCA agencies. BAWSCA is also closely monitoring the progress of the SFPUC water transfer with the MID from the Tuolumne River Watershed. The results of that effort (i.e., costs, timing, supply benefits to the BAWSCA agencies, etc) will be incorporated into the Strategy assessment as the information becomes available.

5.2 Project Yield

Pursuant to discussions with representatives from different types of potential sellers, Table 17 indicates example projects from different types of potential water sellers in the Sacramento Valley, and Table 18 includes examples of potential water sellers in the Delta and San Joaquin Valley. These tables further provide preliminary estimates of the quantities of water that may be available from these example transfer projects, how the supply would be made available for transfer, the reliability of the supply, availability of storage, and other information. Figure 10 indicates the approximate general areas of these water sellers and the regional water systems that might be used to convey water to the BAWSCA member agencies. *Exhibit 2* includes additional information on these projects.

Table 17
Potential Types of Water Sellers in the Sacramento Valley

Potential Seller	Amount (AF/year)	Available Water Supply	Reliability	Storage
Irrigation Districts	2,000 to >5,000	Fallowing and/or groundwater substitution.	High in most years, possible decrease in extremely dry years (subject to negotiations).	Potential access to existing reservoirs with constraints.
Reclamation Districts	Up to 5,000	Fallowing and/or groundwater substitution.	High in most years, possible decrease in extremely dry years (subject to negotiations).	Potential access to existing reservoirs with constraints.
Private Owners	1,000 – 5,000	Fallowing and/or groundwater substitution.	High in most years, possible decrease in extremely dry years (subject to negotiations).	Potential access to existing reservoirs with constraints.
Water Districts	>5,000	Groundwater substitution, transfer of surface water.	Unknown	Possible surface water or groundwater
Water Agencies	>5,000	Reservoir storage release, groundwater substitution.	High in normal years and low in dry years.	Surface water

Table 18
Potential Types of Water Sellers in the Delta and San Joaquin Valley

Potential Seller	Amount (AF/year)	How Supply Made Available?	Reliability	Storage	Comments
Irrigation Districts	1,000 – 5,000 (possibly greater)	Groundwater substitution, transfer of pre-1914 water rights. Some may be complex based on existing agreements, and water rights needed.	High in normal and dry years, but will depend on negotiations and conveyance options.	State and local reservoirs	Uncertain whether certain agencies have the ability to sell water. Potential FERC relicensing issues
Private Owners	1,000 – 3,000	Mostly likely fallowing, but some problems were raised by DWR.	High in all years depending on how senior the water rights.	No	Will likely require crop water use monitoring program in first year. Long-term transfer opportunities unknown, but interested in short-term transfers.

5.3 Project Costs

Costs for the purchase of water for transfer or conveyance from the seller to the BAWSCA member agencies have not been developed at this time. However, based on recent water transfers within the state the selling cost may range from $200 to $900/AF depending on the location, supply source, and type of supply (i.e., normal year, dry year, or both).

A key part of the cost of transfers is conveyance from the seller to the buyer (i.e., BAWSCA and its member agencies). EBMUD has indicated that preliminary estimates of costs to wheel water through their system could be $1,200 to $1,600/AF.

5.4 Project Implementation Schedule

The development of project transfers is dependent on the ability to convey the purchased supply to the BAWSCA member agencies. The currently most promising option for BAWSCA would be conveyance through the EMBUD system, and possibly CCWD system, to the EBMUD/SFPUC Intertie in Hayward, and then conveyance through the SF RWS to member agencies purchasing transfer water. The studies that EBMUD and CCWD are currently performing to determine the capacity to convey water through their systems, and potentially store it in CCWD's Los Vaqueros Reservoir are scheduled to be completed in Spring/Summer of 2013. After that information is available BAWSCA can evaluate the overall cost and potential benefit of developing agreements for purchase of water and transfer through the EBMUD system, and possible storage in CCWD's Los Vaqueros Reservoir. Because of the complexity associated with each of the above issues, it is estimated that a water transfer project would take 2 to 5 years to implement, depending on the yield, complexity and number of partners.

5.5 Key Project Issues

Potential issues affecting the implementation of water transfer projects are described below.

- *Transfer supply availability* – Transfers will have varying levels of reliability, for both normal and drought conditions, depending on their location and the characteristics of the supply source being considered. Key components of the reliability of any given supply is whether regional storage capacity is available that can be used to store seasonal supply, and whether there is transmission capacity available to transfer the supply when needed.

- *Available conveyance capacity* – Transfers from outside the Bay Area will require some type of conveyance mechanism to move the water to the member agencies. Alternatives include: the SWP SBA and CVP water through SCVWD system; Tuolumne River water conveyed through the SF RWS; and Delta and North of Delta supply conveyed through the EBMUD system. Each of these conveyance systems has their own hydraulic, operational, and institutional constraints. However, without some type of reliable conveyance to the Bay Area transfers of water from outside the Bay Area are not feasible.

- *Cost effectiveness* – The total costs associated with water transfers must be determined, including purchase, possible storage, transfer, or wheeling costs to the BAWSCA member agencies. These costs will vary depending on the type and location of the supply source, and the agreements and infrastructure required to wheel the transfer supplies to the BAWSCA service area.

- *Timing for implementation* - A potential key advantage of water transfers is that in many cases they do not require construction of infrastructure facilities to obtain, treat, and convey these supplies, and so may be able to be implemented more rapidly than those requiring large infrastructure improvements.

- *Project funding* – Alternatives for funding the purchase of transfer supply will be important and will require evaluation of the benefits of developing long-term contracts to minimize cost impacts to the participating agencies.

- *Agreements or negotiation with outside agencies or partners* – Any water transfer will require several agreements for the purchase, storage, and wheeling of a given supply. Negotiation of such agreements can be difficult and complex and will depend on having many willing partners. A key part of the successful negotiations will be clearly defining the objectives for the use of the transfer projects, and the potential impacts on reliability, cost, and operations based on limitations proposed by sellers or the wheeling agencies.

- *SCVWD/SFPUC and EBMUD/SFPUC emergency interties* – Use of these existing interties will require expansion of their current use (emergency operation only), which would require compliance with CEQA and addressing Bay Area Air Quality Management District permits.

5.6 Project Next Steps

There are several potential water sellers who are interested in continuing discussions with BAWSCA. Based on the previous discussions, the most promising means to convey water from the Delta would be through the EBMUD system. Transfer projects with any of these agencies may not be feasible until the available capacity constraints for transfer of supply through the EBMUD system are better understood. The key next steps are to determine the technical and institutional needs and feasibility of the water transfer projects, including:

- Closely monitoring the evaluations being performed by CCWD and EBMUD to evaluate the capacity and potential cost to convey this water to the BAWSCA agencies;

- Engaging the BARDP agencies to determine what quantities may be available to the BAWSCA member agencies, if they are interested; and

- Developing a pilot project with EBMUD, and possibly CCWD, for a pilot test of a water transfer through the EBMUD and CCWD systems to the EBMUD/SFPUC Intertie in Hayward.

Section 6 Conclusions

The water supply management projects presented herein could potentially be used by BAWSCA and the BAWSCA member agencies to meet the normal and/or drought supply needs through 2035. In addition, *TM 2 - Updated Agency-Identified Water Supply Management Project Information* presents other potential projects that have been identified by the BAWSCA member agencies for evaluation as part of the Strategy.

The projects presented herein and in TM 2 were initially identified in the *Phase I Strategy Scoping Report*. The project information development to date has focused on preliminary estimates of the yield, cost, reliability and implementation schedule. The objective has been to develop the information to a common level so that the projects can be compared to each other and preliminarily ranked to determine which individual or combination of projects could best meet the identified supply need. For each of the projects presented in TMs 2 and 3, key issues and outstanding technical information has been identified, along with potential next steps.

In July 2012, the *Long-Term Reliable Water Supply Strategy Phase II A Report* (*Phase II A Report*) will be completed. This *Phase II A Report* will present the technical information developed to date as part of the Strategy (from TMs 1, 2, and 3), as well as updated information on the frequency and magnitude of expected supply shortfalls from the SF RWS. The *Phase II A Report* will also present a recommended implementation plan to achieve the Strategy's goal of ensuring that a reliable, high quality supply of water is available where and when people within the BAWSCA service area need it.

Exhibit 1
Draft Task 3-A/B Memo
Updated Regional Groundwater and Desalination Water Supply Management Project Information

CDM Smith

Memorandum

To: *Nicole Sandkulla*

From: *Craig Von Bargen*
Paula Kulis
Erik Desormeaux

cc: *Bill Fernandez*
Phillippe Daniel

Date: *April 2, 2012*

Subject: *Draft Task 3-A/B Memo Updated Regional Groundwater and Desalination Water Supply Management Project Information*

1.0 Introduction

The May 2010 Phase I Scoping Report identified water supply management projects (projects) for evaluation in Phase II A of the Bay Area Water Supply and Conservation Agency (BAWSCA) Long-Term Reliable Water Strategy (Strategy). In addition to the agency-identified projects presented in the *Task 2 TM* three groups of potentially larger regional desalination projects were also in the *Phase I Scoping Report*. These regional projects included:

- Groundwater Projects;
- BAWSCA Representative Regional Desalination Projects;
- Bay Area Regional Desalination Project; and
- Water Transfers.

In this Memo:

This memo provides information on the groundwater, BAWSCA representative regional desalination projects, and the Bay Area Regional Desalination Project (BARDP). The water transfers projects are discussed in the separate *Task 3-C Memo* in the *Task 3 Technical Memorandum*.

In order to allow evaluation and comparison of the projects within the Strategy, key types of project information are needed. This *Task 3-A/B Memo* summarizes the information that has been developed for the three categories of BAWSCA regional-projects.

1.1 Projects Evaluated

Agency-Identified Groundwater and Desalination Projects
As part of the development of the Phase I analysis both agency-identified groundwater and desalination projects were identified. As discussed in *Appendix A - Agency-Identified Groundwater and Desalination Projects* the *Phase I Scoping Report (Phase I Report) for the Long-Term Water Supply Strategy* (May 2010) identified 65 agency projects, of which 30 were freshwater groundwater projects and one desalination project. As part of the Phase II A screening the majority of all of the projects, including groundwater and desalination projects, were removed from further evaluation within the Strategy for a variety of reasons. The reasons for their removal are presented in *Appendix A*.

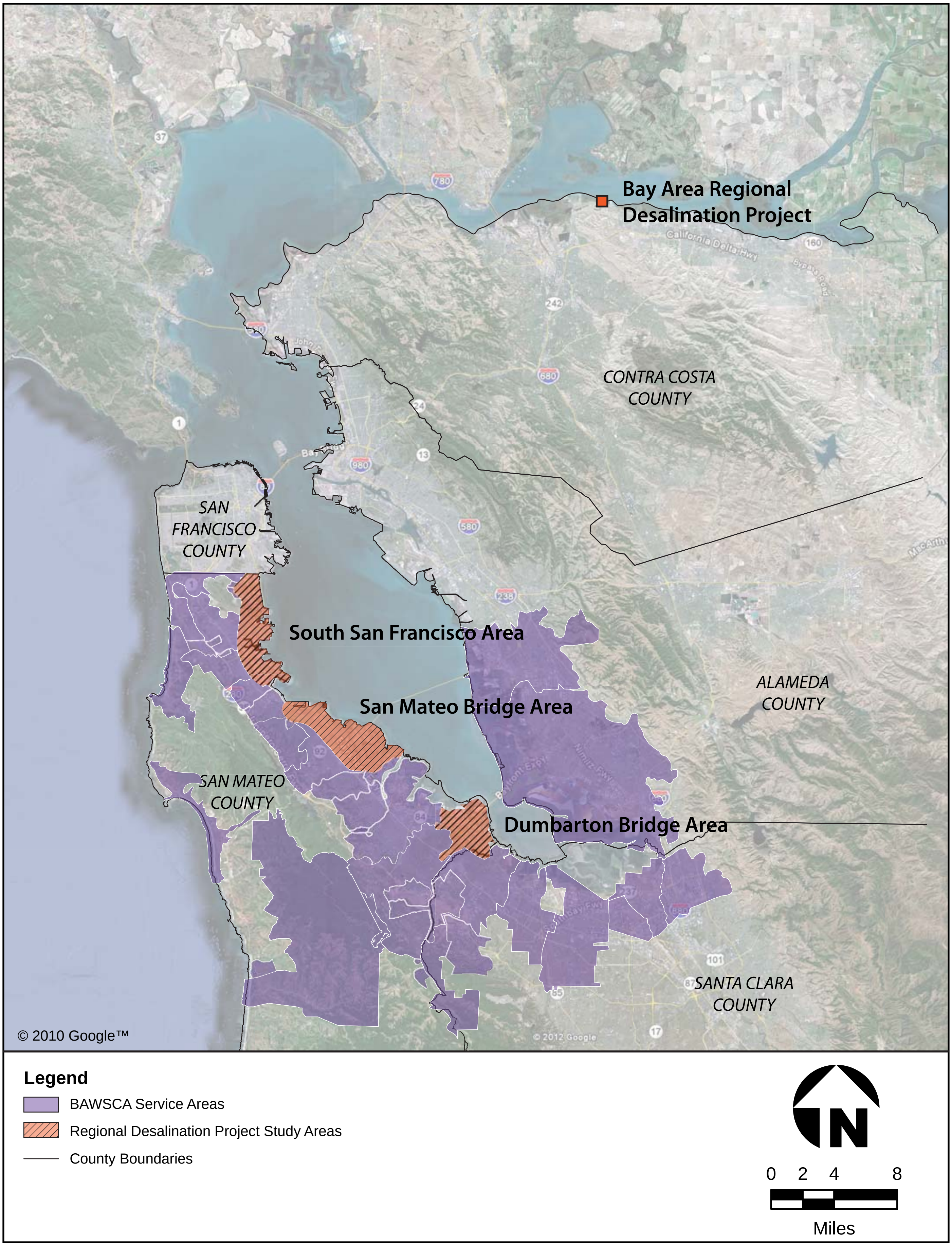
None of the continuing projects include fresh or brackish groundwater, and there are no continuing agency-identified desalination projects. A representative coastal desalination project replaced the North Coast County Water District (NCCWD) desalination project as NCCWD was not interested in being a proponent for the project. The representative coastal desalination project is presented in the *Task 2 TM*. The one brackish groundwater project identified by the California Water Services Company (Cal Water) has been delayed, but may be developed as their project or as a regional project in later phases of the Strategy. The originally identified projects and the reasons for removal are presented in *Appendix A*.

In summary:

- No regional freshwater projects are being developed in the Strategy, and any freshwater groundwater projects proceeding are being developed by the member agencies themselves; and

- Brackish groundwater is included as part of the representative regional desalination projects.

BAWSCA Representative Regional Desalination Projects
The regional desalination projects include sources of brackish groundwater, and Bay water through either subsurface intakes or open Bay intakes. Representative BAWSCA regional desalination projects have been developed based on the different types of intakes and source water quality for three potential areas along the Bay side of the San Francisco Peninsula (Peninsula) including: Dumbarton Bridge Area; San Mateo Bridge Area; and South San Francisco Area. Figure 1 indicates the general location for these three areas. These areas were chosen based on hydrogeology, proximity to wastewater treatment plant outfall, potential sites of sufficient size to locate desalination treatment facilities, and access to existing San Francisco (SF) Regional



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CDM Smith

Figure 1
BAWSCA Regional Desalination Project Study Areas

Water System (RWS) turnouts for connection and possible conveyance through that treated water system.

All of the brackish and Bay water intake projects require reverse osmosis (RO) treatment to remove the salts in the water. The subsurface intakes, brackish vertical wells and Bay water horizontally directionally drilled wells (HDDW), do not require the more extensive and expensive pre-treatment required by the open Bay water intake.

Representative projects were identified and cost information developed for the specific projects indicated in Table 1. The recovery % represents the amount of total water recovered through the RO treatment process, the treated water capacity is the design treated water capacity in million gallons per day (mgd).

Table 1
Project Location, Capacity, Type of Intake and Percentage Recover

Location	Treated Water Capacity (mgd)	Vertical Brackish Groundwater Well	Subsurface Bay HDDW	Open Bay Intake
Recovery Percentage		75%	55%	55%
Dumbarton Bridge Area	1	X	-	-
	2	X	-	-
	5	X	-	-
San Mateo Bridge Area	1	X	-	-
	2	X	-	-
	5	X	-	-
	5	-	X	-
	10	-	X	X
South San Francisco Area	1	X	-	-
	2	X	-	-
	5	-	X	-
	10	-	X	-
	20	-	-	X

In summary:

- The treatment technology is sufficiently mature for implementing desalination;
- Subsurface intake vertical wells may be able to provide from 1 to 5 mgd, and HDDW 5 to 10 mgd of treated water supply;
- A 20 mgd open Bay water plant capacity is feasible based on discharge of the brine through existing wastewater treatment outfalls;
- Intake choice is open but requires more investigations. An open intake is the most challenging from a permitting perspective. Brackish groundwater and sub-surface option have the greatest uncertainties with respect to yield;

- Implementation risk is higher for the desalination projects due to increased permitting (especially for open Bay water intakes), potential impacts to other groundwater pumpers, and use of wastewater treatment plant outfalls; and

Costs are higher than SFPUC wholesale rates, though as the costs for SFPUC continue to increase that difference will become narrower.

Bay Area Regional Desalination Project
The Bay Area Regional Desalination Project (BARDP) is being evaluated by five Bay Area regional water agencies as potential normal and dry year supply. Three alternative 20 mgd alternatives are still being evaluated, including transfer of treated water from the currently identified intake location on the Sacramento River near Pittsburgh and through the East Bay Municipal Utility District (EBMUD) with potential connection to the SF RWS in Hayward. Figure 2 indicates the location of the BARDP site.

In summary:

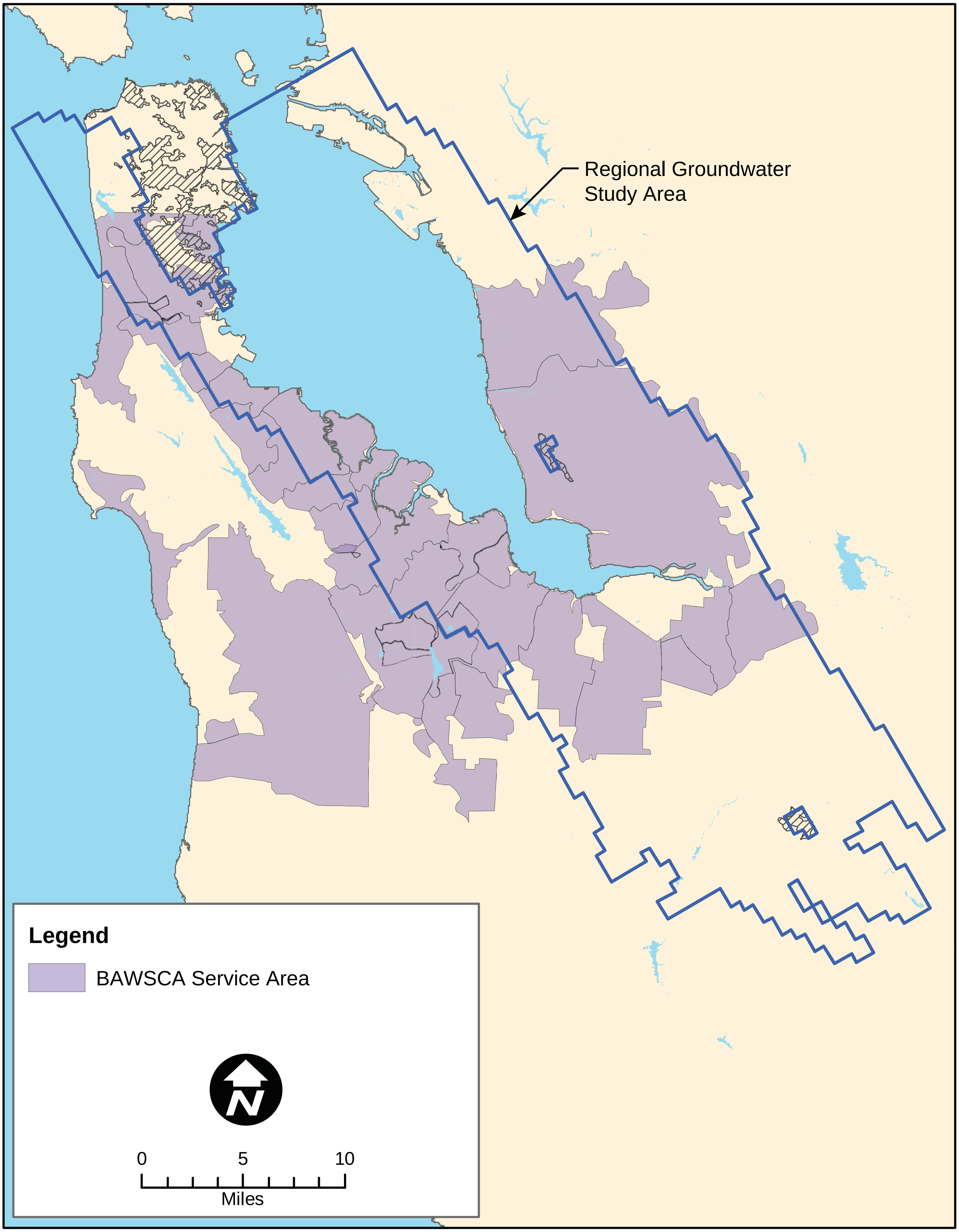
- There is continued interest by the participating water agencies in possibly developing the BARDP along the Sacramento River;
- The projects are currently sized at 20 mgd of treated water capacity; and
- Additional analysis is currently being performed by some of the participating water agencies to evaluate the hydraulic capacity for conveyance to a connection with the SF RWS in Hayward.

1.2 Summary of Project Yield and Cost

Table 2 summarizes the approximate yield and costs for the BAWSCA representative regional desalination projects and BARDP projects as updated for this memo. No freshwater projects are moving forward in the Strategy, and the brackish groundwater supply are included as part of the BAWSCA representative regional desalination projects. Additional information on the assumptions for yield and cost for the BAWSCA representative regional desalination projects are included in Section 3, and for BARDP in Section 4.

More detailed background information for the BAWSCA representative regional desalination projects is included in Appendix *C – BAWSCA Regional Desalination Projects – Facility Options*, and *Appendix D – Representative Regional Desalination Projects*. Additional information on BARDP is included in *Appendix E – Bay Area Regional Desalination Project*.

As presented in Table 2 the capital costs range from $31 million for a 1 mgd ($31M/mgd) brackish groundwater project up to $365 million for a 20 mgd open water intake ($18M/mgd) for the BAWSCA representative regional desalination projects. The capital costs for the BARDP projects range from $159 million to $172 million ($8M/mgd to $9M/mgd) for 20 mgd projects. However, these costs do not include the infrastructure and conveyance costs to convey the water



Source: BAWSCA Strategy, HydroFocus Inc., May 2011

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Figure 2
BAWSCA Service Area and Groundwater Study Area

CDM Smith

from the Sacramento River to the BAWSCA member agencies. BARDP also assumes 100 percent operation (20 mgd for 365 days per year) versus the current assumption for BAWSCA representative desolation projects at 80 percent of capacity operation.

For the BAWSCA representative regional desalination projects all of the information has been developed by the Strategy project team. The costs for the BARDP were presented in earlier reports prepared by others, and have been adjusted to August 2011 base used for the Strategy. BARDP Scenario 2 assumes operation only in dry years. This does not affect the capital cost, but does affect the present worth cost per acre-foot (AF).

The costs for the similar capacity sources (i.e., 1 mgd brackish groundwater projects) are very similar across the three different study areas with the San Mateo Bridge Area project at $39.6M being slightly higher than the Dumbarton Bridge Area, $30.6M, or the South San Francisco Area at $31.1M. This is primarily due to the difference in lengths for the raw water, treated water and brine pipelines. This same difference occurs for the HDDW and open Bay water projects as the same pipeline alignments are assumed for each of the different sources for each area. This difference can be seen between the Dumbarton Bridge Area projects and South San Francisco projects. The total length of the treated water and brine pipelines for the Dumbarton Bridge Area is 19,300 feet versus 24,500 feet for the South San Francisco Area, or a difference in capital cost of about $1.7M ($0.8M construction cost difference),

Table 3 summarizes the annualized and present worth costs for these same projects based on the calculations presented in *Appendix D*. The relative differences between the present worth cost for the different source types and project areas are similar in nature to those for the capital costs. The present worth costs range from a low of about $1,000/AF for the 5 mgd brackish groundwater projects to about $2,000/AF for the 1 mgd brackish groundwater projects. The HDDW well costs range from about $1,400/AF to $1,700/AF for 10 mgd and 5 mgd projects respectively at both the San Mateo and South San Francisco Areas. The 20 mgd Bay water open intake in the South San Francisco Bay Area has an estimated present worth cost of about $1,500/AF.

The present worth costs for BARDP range from $550/AF for Scenario 1 to $1,069/AF for Scenario 2. Scenario 2 present worth costs are higher due to supply only being produced during dry years, with total production over the 30 years is significantly less than for the projects producing supply every year.

Table 2
Summary Project Sizing and Capital Cost

Item	BAWSCA Representative Regional Desalination Projects														Bay Area Regional Desalination Project[1]		
	Dumbarton Bridge Area			San Mateo Bridge Area						South San Francisco Area							
	1 mgd Brackish Groundwater Wells	2 mgd Brackish Groundwater Wells	5 mgd Brackish Groundwater Wells	1 mgd Brackish Groundwater Wells	2 mgd Brackish Groundwater Wells	5 mgd Brackish Groundwater Wells	5 mgd Bay Water HDDW[2] Wells	10 mgd Bay Water HDDW[2] Wells	10 mgd Bay Water Open Intake	1 mgd Brackish Groundwater Wells	2 mgd Brackish Groundwater Wells	5 mgd Bay Water HDDW[2] Wells	10 mgd Bay Water HDDW[2] Wells	20 mgd Bay Water Open Intake	Scenario 1	Scenario 2	Scenario 3
Assumed Treated Water Production Capacity (mgd)[(2)]	1	2	5	1	2	5	5	10	20	1	2	5	10	20	20	20	20
Assumed Annual Production (AF/Year)[(2,3)]	900	1,800	4,500	900	1,800	4,500	4,500	9,000	9,000	900	1,800	4,500	9,000	17,900	22,400	7,600	22,400
Facility Sizing																	
RO Recovery %	75%	75%	75%	75%	75%	75%	55%	55%	55%	75%	75%	75%	55%	55%	80%	80%	80%
Source Water Capacity (mgd)	1.3	2.7	6.7	1.3	2.7	6.7	9.1	9.2	9.2	1.3	2.7	6.7	18.2	36.4	25	25	25
RO Treated Water Capacity (mgd)	1	2	5	1	2	5	5	10	10	1	2	5	10	20	20	20	20
Brine Disposal Capacity (mgd)	0.3	0.7	1.7	0.3	0.7	1.7	4.1	8.2	8.2	0.3	0.7	1.7	8.2	16.4	5	5	5
Capital Cost																	
Capital Cost ($M)[(4,5)]	$30.6	$43.0	$64.4	$35.8	$47.3	$72.1	$126.5	$201.8	$274.7	$31.1	$42.7	$120.5	$194.3	$364.6	$159.4	$159.4	$171.7

[1] BARDP project description and data are presented in *Appendix E to Task 3-AB Memo*. Unit Present worth costs presented in this table have been adjusted to August 2011 dollars.
[2] Horizontally Directionally Drilled Wells.
[3] Capacity is treated water production from desalination plant.
[4] Assumes annual operation at 80% of capacity.
[5] Costs adjusted to August 2011.
[6] Costs do not include property acquisition, cost for use of wastewater treatment plant outfall capacity, conveyance costs by others, or purchase price of water.

Table 3
Summary of Project Yields, Annualized and Present Worth Costs

Item	BAWSCA Representative Regional Desalination Projects														Bay Area Regional Desalination Project[1]		
	Dumbarton Bridge Area			San Mateo Bridge Area						South San Francisco Area							
	1 mgd Brackish Groundwater Wells	2 mgd Brackish Groundwater Wells	5 mgd Brackish Groundwater Wells	1 mgd Brackish Groundwater Wells	2 mgd Brackish Groundwater Wells	5 mgd Brackish Groundwater Wells	5 mgd Bay Water HDDW[2] Wells	10 mgd Bay Water HDDW[2] Wells	10 mgd Bay Water Open Intake	1 mgd Brackish Groundwater Wells	2 mgd Brackish Groundwater Wells	5 mgd Bay Water HDDW[2] Wells	10 mgd Bay Water HDDW[2] Wells	20 mgd Bay Water Open Intake	Scenario 1	Scenario 2	Scenario 3
Assumed Production Capacity (mgd)[(2)]	1	2	5	1	2	5	5	10	10	1	2	5	10	20	20	20	20
Assumed Annual Production (AF/year)[3,4]	900	1,800	4,500	900	1,800	4,500	4,500	9,000	9,000	900	1,800	4,500	9,000	17,900	22,400	7,600	22,400
Annualized Costs																	
Annualized Capital Cost ($M/year)[5]	$1.56	$2.19	$3.28	$1.83	$2.41	$3.68	$6.45	$10.29	$14.01	$1.59	$2.18	$6.15	$9.91	$18.60	$8.12	$1.41	$5.92
O&M Cost ($M/year)[5]	$0.74	$1.11	$2.17	$0.76	$1.68	$2.18	$3.42	$6.45	$8.07	$0.70	$1.05	$3.43	$6.47	$15.50	$10.95	$10.95	$13.78
Total Annualized Cost ($M/year)[5]	$2.30	$3.30	$5.45	$2.58	$3.60	$5.86	$9.87	$16.75	$22.08	$2.28	$3.23	$9.58	$16.38	$34.10	$18.2	$11.8	$18.8
Total Annualized Cost ($/AF)[6,7]	$2,600	$1,800	$1,200	$2,900	$2,000	$1,300	$2,200	$1,900	$2,500	$2,500	$1,800	$2,100	$1,900	$1,900	$800	$1600	$900
Present Worth Costs																	
Total Production – 30 years (AF)	27,000	54,000	135,000	27,000	54,000	135,000	135,000	270,000	270,000	27,000	54,000	135,000	270,000	537,000	680,000	227,000	680,000
Total Present Worth Cost ($M)[8]	$52.90	$76.2	$129.4	$58.5	$82.9	$137.4	$229.1	$395.3	$516.6	$52.98	$74.22	$223.49	$388.37	$829.65	$374.17	$242.21	$386.33
Present Worth Unit Cost ($/AF)[7]	$2,000	$1,400	$1,000	$2,200	$1,500	$1,000	$1,700	$1,500	$1,900	$1,900	$1,400	$1,700	$1,400	$1,500	$550	$1,069	$565

[1] BARDP project description and data are presented in *Appendix E to Task 3-AB Memo*. Unit Present worth costs presented in this table have been adjusted to August 2011 dollars.
[2] Horizontally Directionally Drilled Wells.
[3] Capacity is treated water production from desalination plant.
[4] Assumes annual operation at 80% of capacity (100% for BARDP scenarios 1 and 3, 33% on average for BARDP scenario 2).
[5] Costs adjusted to August 2011. Annual O&M costs for BARDP Scenario 2 are based on dry-year operation (which is assumed to occur once every three years).
[6] Annualized cost based on 30 year return at 3% interest rate.
[7] Costs do not include property acquisition, cost for use of wastewater treatment plant outfall capacity, conveyance costs by others, or purchase price of water.
[8] Present Worth estimates include a 3% escalation and a 3% discount rate. The same escalation rate is used for electricity, materials, labor and capital cost.
[9] Costs are rounded to the nearest $100/AF.

1.3 Other Project Information and Evaluation Criteria

One of the goals of the Strategy, as described in the *Phase I Scoping Report,* is to develop a quantitative and defensible project evaluation. To that end evaluation criteria and metrics have been developed to facilitate that process. *Appendix A – Revised Draft Task 6-A Memo: Refined Evaluation Criteria and Metrics* in the *Task 1 TM* presents that process and criteria. These six criteria include:

- Increase Supply Reliability;
- Provide High Level of Water Quality;
- Minimize Cost of New Water Supplies;
- Reduce Potable Water Demand;
- Minimize Environmental Impacts; and
- Increase Implementation Potential.

The current Memo focuses on the supply reliability (yield for normal and dry years), facilities and cost, and schedule. Other information that is currently available is included in Table 3.

Table 4
Summary Project Evaluation Criteria and Metric Values

Objective	Criteria	Metrics	Project Values																
			BAWSCA Representative Regional Desalination Projects														Bay Area Regional Desalination Project[2]		
			Dumbarton Bridge Area			San Mateo Bridge Area						South San Francisco Area							
			1 mgd Brackish Groundwater Wells	2 mgd Brackish Groundwater Wells	5 mgd Brackish Groundwater Wells	1 mgd Brackish Groundwater Wells	2 mgd Brackish Groundwater Wells	5 mgd Brackish Groundwater Wells	5 mgd Bay Water HDDW[2] Wells	10 mgd Bay Water HDDW[2] Wells	10 mgd Bay Water Open Intake	1 mgd Brackish Groundwater Wells	2 mgd Brackish Groundwater Wells	5 mgd Bay Water HDDW[2] Wells	10 mgd Bay Water HDDW[2] Wells	20 mgd Bay Water Open Intake	Scenario 1	Scenario 2	Scenario 3
1 - Increase Supply Reliability	**Criterion 1A –** Ability to Meet Normal Year Supply Need	Quantitative (AF /year): Average annual yield in normal years in 2018 and 2035.[2,3]	900	1,800	4,500	900	1,800	4,500	4,500	9,000	9,000	900	1,800	4,500	16,300	32,600	22,400	0	22,400
	Criterion 1B – Ability to Meet Drought Supply Need	Quantitative (AF/year): Average annual yield with drought hydrology of 1987 – 1992.[3,4]	900	1,800	4,500	900	1,800	4,500	4,500	9,000	9,000	900	1,800	4,500	16,300	32,600	22,400	7,600	22,400
	Criterion 1C – Risk of Facility Outage	Qualitative (1-5): Estimated probability and duration of major conveyance failure	N/A[5]	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Criterion 1D – Potential for Regulatory Vulnerability	Qualitative (1-5): Potential for regulatory decisions to impact supply reliability	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2 - Provide High Level of Water Quality	**Criterion 2A –** Meets or Surpasses Drinking Water Quality Standards	Quantitative (mg/L): Total dissolved solids (TDS) level as an indicator of water quality.	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120
	Criterion 2B – Meets or Surpasses Non-Potable Water Quality Standards	Qualitative: Meets minimum water quality requirement (e.g., Title 22) for the targeted use. (Yes or no)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3 - Minimize Cost of New Water Supplies	**Criterion 3 –** Capital and Present Worth Costs	Quantitative ($/AF): Present Worth unit costs including capital and operating costs	$2,000	$1,400	$1,000	$2,200	$1,500	$1,000	$1,700	$1,500	$1,900	$1,900	$1,400	$1,700	$1,400	$1,500	$ 550	$ 1,069	$ 565

Table 4
Summary Project Evaluation Criteria and Metric Values

Objective	Criteria	Metrics	Project Values																
			BAWSCA Representative Regional Desalination Projects														Bay Area Regional Desalination Project[2]		
			Dumbarton Bridge Area			San Mateo Bridge Area						South San Francisco Area							
			1 mgd Brackish Groundwater Wells	2 mgd Brackish Groundwater Wells	5 mgd Brackish Groundwater Wells	1 mgd Brackish Groundwater Wells	2 mgd Brackish Groundwater Wells	5 mgd Brackish Groundwater Wells	5 mgd Bay Water HDDW[2] Wells	10 mgd Bay Water HDDW[2] Wells	10 mgd Bay Water Open Intake	1 mgd Brackish Groundwater Wells	2 mgd Brackish Groundwater Wells	5 mgd Bay Water HDDW[2] Wells	10 mgd Bay Water HDDW[2] Wells	20 mgd Bay Water Open Intake	Scenario 1	Scenario 2	Scenario 3
4 - Reduce Potable Water Demand	**Criterion 4 –** Augment Non-Potable Water Supplies	Quantitative (AF/year): Reduction of potable water demand by use of non-potable supply.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5 - Minimize Environmental Impacts	**Criterion 5A –** Greenhouse Gas Emissions	Quantitative (metric tons/ AF of Supply): Estimates of unit greenhouse gas emissions	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Criterion 5B – Impact to Groundwater Quantity and Quality	Qualitative (1-5): Potential impacts to groundwater levels, groundwater quality, or potential for subsidence	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Criterion 5C – Impact to Habitat	Qualitative (1-5): Potential impacts to habitat, such as wetlands, riparian zones, fisheries, and inundation areas.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6 - Increase Implementation Potential	**Criterion 6A –** Institutional Complexity	Qualitative (1-5): Number and type of agencies and agreements involved	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Criterion 6B – Level of Local Control	Qualitative (1-5): BAWSCA and Member Agency ownership of supply projects	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Criterion 6C – Permitting Requirements	Qualitative (1-5): Permitting or regulatory issues for supply projects	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

[1] BARDP project description and data are presented in *Appendix E to Task 3-AB Memo*. Unit Present worth costs presented in this table have been adjusted to August 2011 dollars.
[2] Horizontally Directionally Drilled Wells.
[3] Capacity is treated water production from desalination plant.
[4] Assumes annual operation at 80% of capacity.
[5] Information will be developed at a later time when a common a common comparison and development of metrics will be prepared for all projects.

1.4 Implementation Schedules

1.4.1 BAWSCA Representative Regional Desalination Projects

Preliminary implementation schedules have been developed for the brackish groundwater well, Bay water subsurface intake and Bay water intake projects, and are presented in Section 3 and *Appendix D*. In general of the desalination projects the brackish groundwater wells will have the shortest implementation time ranging from 6 to 8 years. The implementation time for HDDW will be longer ranging from 10 to 12 years, and the open intakes taking from 10 to 15 years. These implementation schedules are based on estimated time durations after the decision has been made to move forward with a specific project or projects.

1.4.2 Bay Area Desalination Project

Several studies have already taken place for BARDP, including the BARDP Feasibility Study[1] (Feasibility Study) which investigated several potential infrastructure options and evaluated several site locations in the Bay Area against a set of criteria, and the 2010 Pilot Testing at Mallard Slough Engineering Report (Pilot Engineering Report)[2].

Several additional steps need to be taken prior to making final decisions on this project, including: a) inter-agency agreements that clearly define agency roles and responsibilities, and agreement between agencies as to the size and location of the project; b) final site selection, which will involve discussions with land owners and regulatory agencies; c) completion of an Environmental Impact Report (EIR) and possibly and Environmental Impact Statement (EIS); d) preliminary designs and geotechnical investigations; and e) determination of monthly water extraction to ensure compliance with existing water rights that CCWD has at the Mallard Slough PS.[3]

In addition, CCWD is beginning evaluation of the potential for use of the Los Vaqueros Reservoir for storage of the BARDP and other supplies. EBMUD is evaluating the potential hydraulic capacity and treatment and conveyance requirements to convey water from either the desalination water treatment plant site or the CCWD system to other potential users in the Bay Area (i.e., SCVWD, SFPUC, Zone 7, and BAWSCA). These studies are anticipated to be completed in Spring/Summer of 2013.

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1 Bay Area Regional Desalination Project Feasibility Study, 2007, prepared by URS for Contra Costa Water District, East Bay Municipal Utility District, San Francisco Public Utilities Commission, and Santa Clara Valley Water District. http://www.regionaldesal.com/documents.html

2 Bay Area Regional Desalination Project Pilot Testing at Mallard Slough Engineering Report, 2010, prepared by MWH for Contra Costa Water District, East Bay Municipal Utility District, San Francisco Public Utilities Commission, and Santa Clara Valley Water District. http://www.regionaldesal.com/documents.html

3 Between CCWD's existing water extraction permit and license, a total of 26,780 AF can be diverted per year. While the Mallard Slough PS may be subject to pumping restrictions for one month out of the year, sufficient water rights should exist to accommodate the 25 mgd of raw water needed for a 20 mgd treated water desalination plant. This is based on realizing an overall 75% efficiency with the treatment process.

After completion of these additional studies a determination will be made whether this project will be sponsored, by which agencies and the time frame to implement the project. Based on the earlier BARDP studies it is anticipated that it will take approximately 5 to 7 years to complete the environmental documentation, design, construction and startup.

1.5 Key Issues

Key issues associated with implementing a desalination facility, whether BAWSCA regional projects or BARDP, are discussed in this section. At this preliminary planning stage several of the key issues are not fully defined and will require additional analysis.

Key issues associated with BAWSCA regional desalination projects include:

- Source water quality (e.g., salinity, iron, manganese, contaminants) variability;
- Source water yield;
- Land availability, cost and permitting for subsurface intakes, and for new desalination plant sites;
- Alignment issues and rights-of-way for construction of new raw water, brine and treated water pipelines;
- Willingness and cost to allow use of existing wastewater plant outfall capacity for brine disposal;
- Public support and/or opposition;
- Use of the SF RWS system for conveyance to member agencies if required;
- Permitting for a new intakes in the Bay; and
- Funding and ownership of a regional desalination facilities.

1.6 Next Steps

BAWSCA Representative Regional Desalination Projects

In order to determine whether the subsurface brackish and Bay water supplies are feasible two several activities will need to occur, though they could be done sequentially:

- Development of a regional groundwater model extending from Peninsula to the recharge areas on the east side of the San Francisco Bay and down to Santa Clara County to provide an initial assessment of the yields, including recharge, and potential impacts of pumping in the brackish zones under the Peninsula, or Bay water from pumping under the Bay; and

- Construction of pilot pumping and monitoring wells to confirm whether the model is representative of the actual conditions in specific locations on the Peninsula and whether the estimated yield is appropriate.

BARDP

Several steps need to be taken in moving forward with BARDP: a) inter-agency agreements that clearly define agency roles and responsibilities, and agreement between agencies as to the size and location of the project; b) final site selection, which will involve discussions with land owners and regulatory agencies; c) completion of an Environmental Impact Report (EIR) and possibly and Environmental Impact Statement (EIS); d) preliminary designs and geotechnical investigations; and e) determination of monthly water extraction to ensure compliance with existing water rights that CCWD has at the Mallard Slough PS.[4]

In addition, CCWD is beginning evaluation of the potential for use of the Los Vaqueros Reservoir for storage of the BARDP and other supplies. EBMUD is evaluating the potential hydraulic capacity and treatment and conveyance requirements to convey water from either the desalination water treatment plant site or the CCWD system to other potential users in the Bay Area (i.e., SCVWD, SFPUC, Zone 7, and BAWSCA). These studies are anticipated to be completed in Spring/Summer of 2013.

From the perspective of BAWSCA A key part of feasibility of this project is the ability to convey the water from the water desalination treatment plant site or CCWD system to potentially interested BAWSCA agencies as well as the BARDP partners. BAWSCA will be closely watching the evaluations being performed by CCWD and EBMUD to evaluate the capacity and potential cost to convey this water to the BAWSCA agencies. In addition, BAWSCA will continue to engage the BARDP agencies to determine who is interested in this supply, and what quantities may be available to the BAWSCA member agencies if they are interested

2.0 Groundwater Projects

2.1 Project Descriptions

2.2.1 Agency-Identified Groundwater and Desalination Projects

As part of the development of the Phase I analysis both agency-identified groundwater and desalination projects were identified. As discussed in *Appendix A - Agency-Identified Groundwater and Desalination Projects Phase I Scoping Report (Phase I Report) for the Long-Term Water Supply Strategy* (May 2010) identified 65 agency projects, of which 30 were freshwater groundwater projects and one desalination project. As part of the Phase

[4] Between CCWD's existing water extraction permit and license, a total of 26,780 AF can be diverted per year. While the Mallard Slough PS may be subject to pumping restrictions for one month out of the year, sufficient water rights should exist to accommodate the 25 mgd of raw water needed for a 20 mgd treated water desalination plant. This is based on realizing an overall 75% efficiency with the treatment process.

II A screening the majority of all of the project, including groundwater and desalination projects, were removed from further evaluation within the Strategy for the following reasons:

- Independent implementation by the agency;
- Infeasibility due to water quality issues;
- Implementation as part of the San Francisco Public Utilities Commission (SFPUC) Water Supply Improvement Program (WSIP) to provide dry year supply reliability;
- No additional supply provided or additional yield was unlikely;
- Lack of interest by the agency in pursuing the project;
- Regulatory restrictions;
- Existing wells would remain as emergency supply;
- The project was a study only, not a supply project;
- No commitment to pursuing this project as part of the Strategy;
- No commitment to pursuing this project as part of the Strategy; however, similar projects are being evaluated in the Strategy as part of the analysis of regional water transfer options; or
- Insufficient yield to provide regional benefit.

Four projects are continuing in the Strategy, including:

- DC-4: Daly City Recycled Water Service to Cemeteries;
- NC-4: North Coast County Water District (NCCWD) Desalination Plant;
- PA-2: Palo Alto Expand Recycled Water Plant to Serve Stanford Research Park; and
- RC-4: Redwood City Recycled Water Treatment Plant Expansion.

None of these continuing projects include fresh or brackish groundwater, and there are no continuing agency-identified desalination projects, with the exception of a representative coastal desalination project which replaced the NCCWD desalination project where NCCWD was not interested in being a proponent for the project. The *Task 2 Technical Memorandum* provides information on the four projects indicated above. The one brackish groundwater project identified by the California Water Services Company

(Cal Water) has been delayed, but may be developed this as their own project or as a regional project in later phases of the Strategy.

2.2.2 BAWSCA Regional Groundwater Projects

In order to develop planning level estimates of the potential yield and availability of brackish or Bay water supplies for BAWSCA member agencies, existing well information, local and regional groundwater studies and models, geology and hydrogeology were reviewed. While a limited number of groundwater projects have been identified for the Strategy (see *Appendix A* to this *Task 3-A/B Memo* no agency-identified freshwater or brackish groundwater projects are under consideration).

Previous agency and regional studies had dismissed brackish groundwater or subsurface water from beneath the Bay based on capacity limitations due to low permeability groundwater basins on the Bay side of the Peninsula. However, the use of small desalination facilities with subsurface intakes is included here as an approach that could simplify permitting and reduce capital and operating costs over treatment of open intake Bay water. The subsurface intakes reduce the pre-treatment requirements associated with open intakes, and do not have to address the potential aquatic and biological impacts of those open intakes. The exception to the low groundwater yields are the aquifers underlying the Alameda County Water District (ACWD) service area, and those member agencies located in Santa Clara County that use groundwater wells. The Santa Clara Valley Water District (SCVWD) monitors and provides recharge to the basins within Santa Clara County. As ACWD is fully developing the use of both the fresh and brackish groundwater supplies the evaluation of potential brackish supplies for potential use as BAWSCA regional water supplies focuses on the Bay side of the Peninsula, and not in Alameda County or Santa Clara County.

Based on review of existing data from wells logs, historic geologic investigations and groundwater models, an initial assessment of the potential development of brackish groundwater, or Bay water from subsurface wells was conducted. Three general areas were reviewed for their potential yields: area near the western end of the Dumbarton Bridge (Dumbarton Bridge Area); area near the western end of the San Mateo Bridge (San Mateo Bridge Area); and the area of South San Francisco near Oyster Point (South San Francisco Area). The most complete set of data regarding potential brackish production zones is in the vicinity of the Dumbarton Bridge where several geologic borings were completed and pump tests performed as part of the design for the new SF RWS Bay Tunnel. More limited geologic and hydrogeologic data is available farther north along the Peninsula.

The initial assessment the historic data, and limited calculations of potential yield based on the hydrogeologic characteristics indicated that the Dumbarton Bridge area has the highest potential for developing a range of desalination projects either from brackish wells (i.e., 1 to 5 mgd) or from subsurface bay intakes (i.e., 5 to15 mgd). Several items will need to be addressed to better assess the viability of such projects including verification that:

- The hydraulic capacity exists within the brackish water areas to support from 1 to 5 mgd; and/or subsurface Bay water formations to support Bay water yields ranging from 5 to 15 mgd in the Dumbarton Bridge Area;

- Potential hydraulic capacity exists for brackish water areas and subsurface Bay water formations to provide a minimum of 1 to 5 mgd for the San Mateo Bridge area and South San Francisco Area;

- There is adequate long-term recharge to support the yields; and

- Pumping within these zones does not significantly impact other freshwater and/or brackish water wells.

2.3 Planning Level Costs

No freshwater groundwater projects are moving forward as discussed above and in *Appendix A,* and no costs for these types of projects have been developed for this memo. Planning level costs, including for these brackish groundwater supplies, have been developed as part of the BAWSCA representative regional desalination projects and are presented in Section 3 and *Appendices C and D*.

2.4 Preliminary Project Schedules

Preliminary project schedules have not been developed for the brackish groundwater supplies individually. Schedules, including these brackish groundwater supplies, have been developed as part of the BAWSCA representative regional desalination projects and are presented in Section 3 and *Appendix D*.

2.5 Other Project Information and Evaluation Criteria

In addition to project yield, cost and schedule there is other project information that will be used in the comparison of water supply management projects. These brackish groundwater supplies, have been developed as part of the BAWSCA representative regional desalination projects and are presented in Section 3 and *Appendices C and D*.

2.6 Key Project Issues

The key project issues associated with the brackish groundwater project include:

- Limited hydrogeologic information is available for the brackish and under Bay saline aquifers. This is primarily due to the fact that the brackish zones have not been evaluated in detail in the past on the San Francisco Peninsula (Peninsula) as the SF SFPUC provided supply to the member agencies with some freshwater supply to meet the potable water needs on the Peninsula.

- The area with the most detailed hydrogeologic data in the brackish zones is in the area near the available west end of the Dumbarton Bridge Area, and currently provides the best potential for brackish groundwater development. However, the recharge, long term yield and potential impact on other groundwater users needs to be evaluated to confirm the representative capacities and yields assumed for these projects.

- The proposed use for a desalination supply will significantly affect the cost. For the purposes of developing preliminary cost estimates for the representative desalination projects an annual operation at 80% of total capacity was assumed. This would be representative of normal year use. If this supply is only used for dry year supply the present worth, and annualized cost, will increase significantly as the 30 year production is reduced.

3.0 BAWSCA Representative Regional Desalination Projects

Regional desalination projects can provide normal and/or dry year supply for member agencies. Treated brackish groundwater and treated Bay water may provide a supply with normal and dry year yields ranging from 1 to 20 million gallons per day (mgd). These projects are being identified as regional projects as they may be large enough to provide supply to more than one agency, and specific sponsors (e.g., member agency or BAWSCA) have not yet been identified.

3.1 Project Assumptions

3.1.1 Project Alternative Areas

As presented in Section 3 three general areas with possibly favorable groundwater characteristics, possible siting for intakes and treatment facilities, potential co-location for brine disposal with wastewater treatment plants and outfalls, and connection to either local agencies water systems, or connection to the SF RWS were identified for representative desalination projects. These three areas shown on Figure 1 include:

- Dumbarton Bridge Area;

- San Mateo Bridge Area; and

- South San Francisco Area.

While the initial information suggests that brackish groundwater projects may be promising in the Dumbarton Bridge Area additional analysis will be required for all the areas to determine the hydrogeologic capacity and yields of new desalination facilities at these locations and the potential impacts on other wells. The availability of hydrogeologic information for potential brackish groundwater projects is limited for the San Mateo Bridge and South San Francisco Areas.

3.1.2 Local Hydrogeology and Intake Capacity

As discussed in Section 2 the hydrogeology appears potentially favorable for development of brackish groundwater or Bay water extraction through subsurface intakes and pumps in the Dumbarton Bridge Area. However, due to concerns with potential impacts to the ACWD freshwater and brackish groundwater wells only vertical wells were included for this area. Also, due to poorer Bay water quality and circulation in the southern end of the San Francisco Bay open Bay intakes were not included for the Dumbarton Bridge Area. Figure 2 indicates overall groundwater study area which includes the three project areas.

Less hydrogeologic information is available for the other two areas. However, for the purposes of developing preliminary cost estimates in all three areas groundwater projects ranging from 1 to 5 mgd for vertical wells were included for the Dumbarton Bridge Area, and 5 and 10 mgd HDDW wells were included for the San Mateo Bridge and South San Francisco Areas. 20 mgd open Bay water intakes were also included for both of those areas. Figure 3 provides an overview of the locations of alluvial formation near the Dumbarton Bridge Area, and Figure 4 provides a planning level illustration of two types of potential wells and their locations.

3.1.3 Desalination Project Components

There are a number of facilities associated with a desalination project. These key components include:

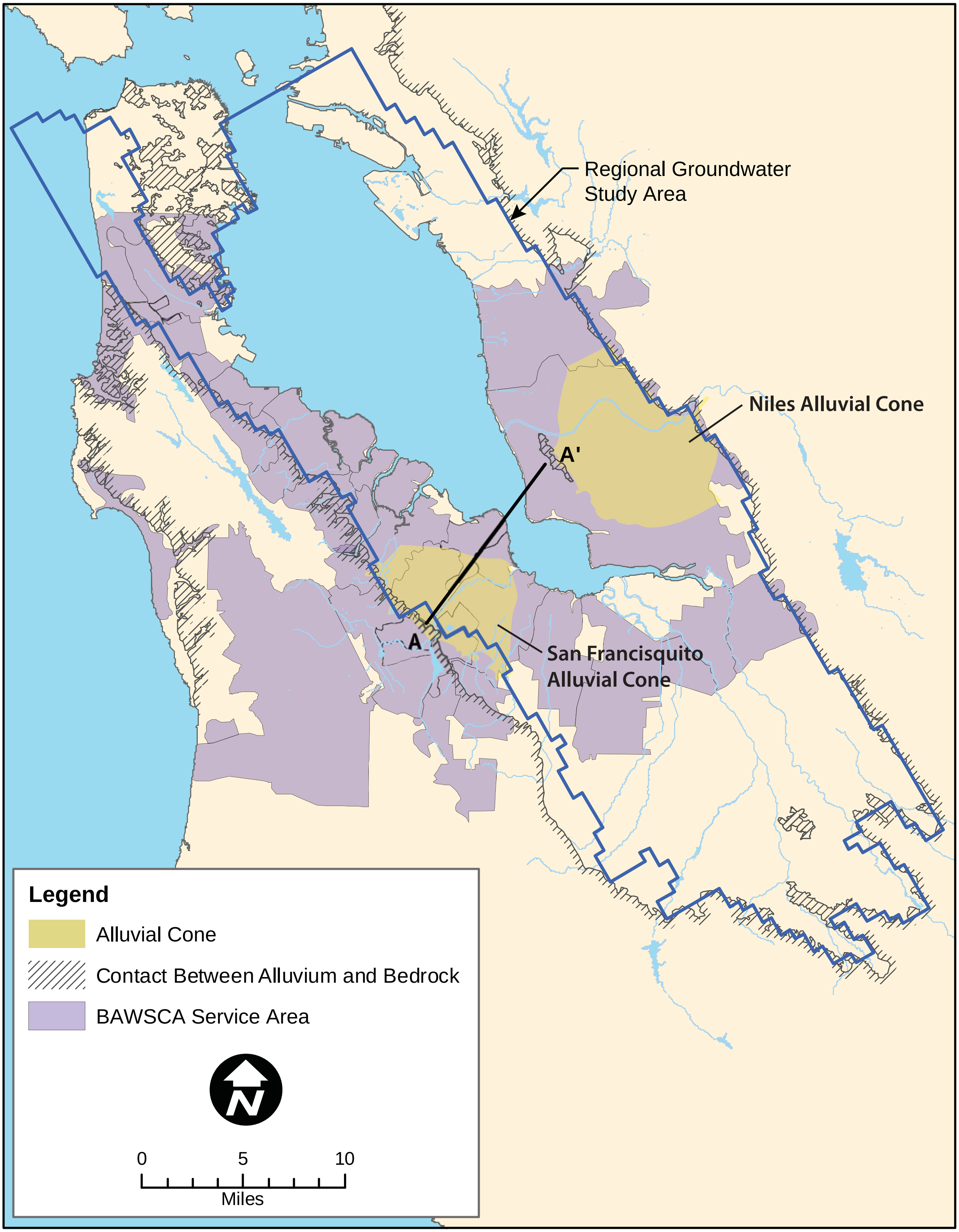
- Intake options;
- Desalination treatment options; and
- Brine discharge options.

Appendices C and D provide detailed descriptions of these options respectively, and some of the issues associated with the types of facilities selected for different projects.

3.2 Potential Facility Sizing and Capacity

As with the different desalination project components there are number of factors associated with these facilities that affect overall sizing and capacity of a project. These include:

- Intake capacity;
- Treatment requirements and source water considerations;
- Available siting areas for a desalination plant;
- Brine disposal capacity; and



Source: BAWSCA Strategy, HydroFocus Inc., May 2011

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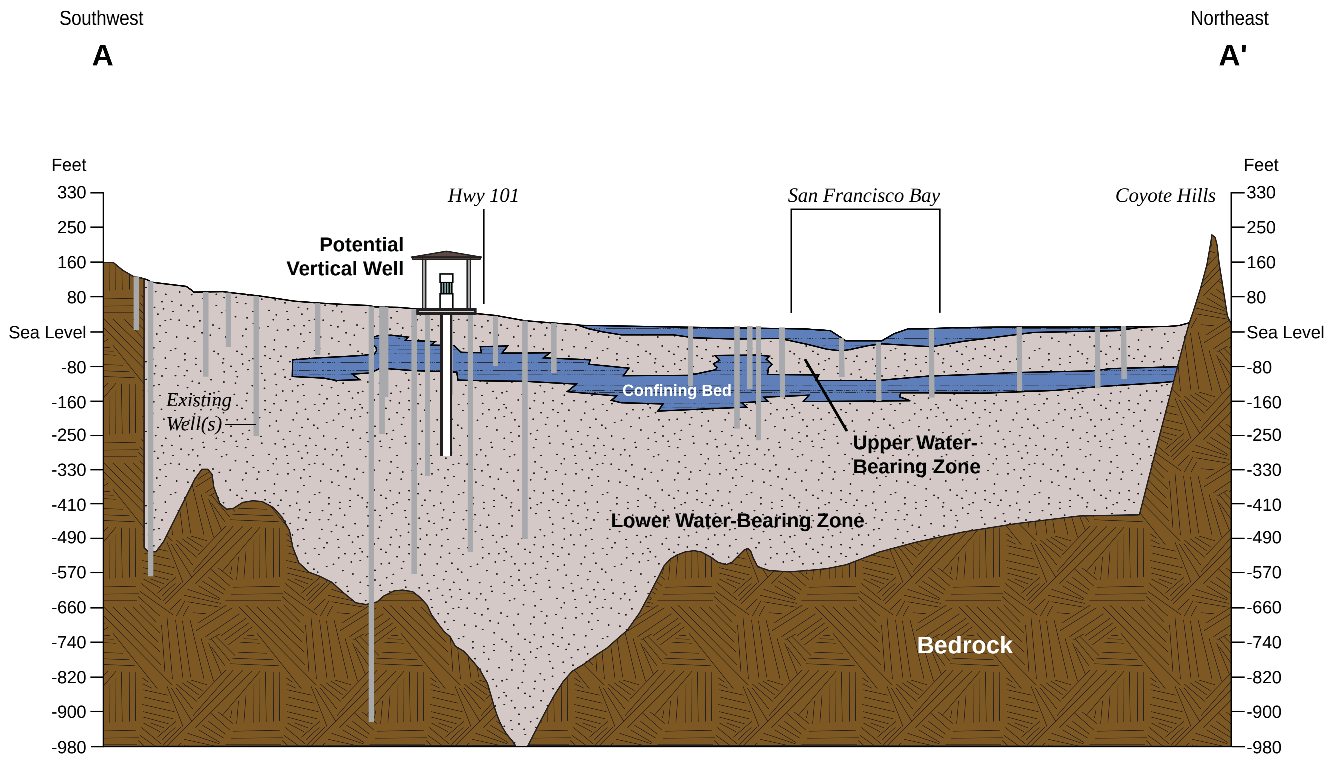
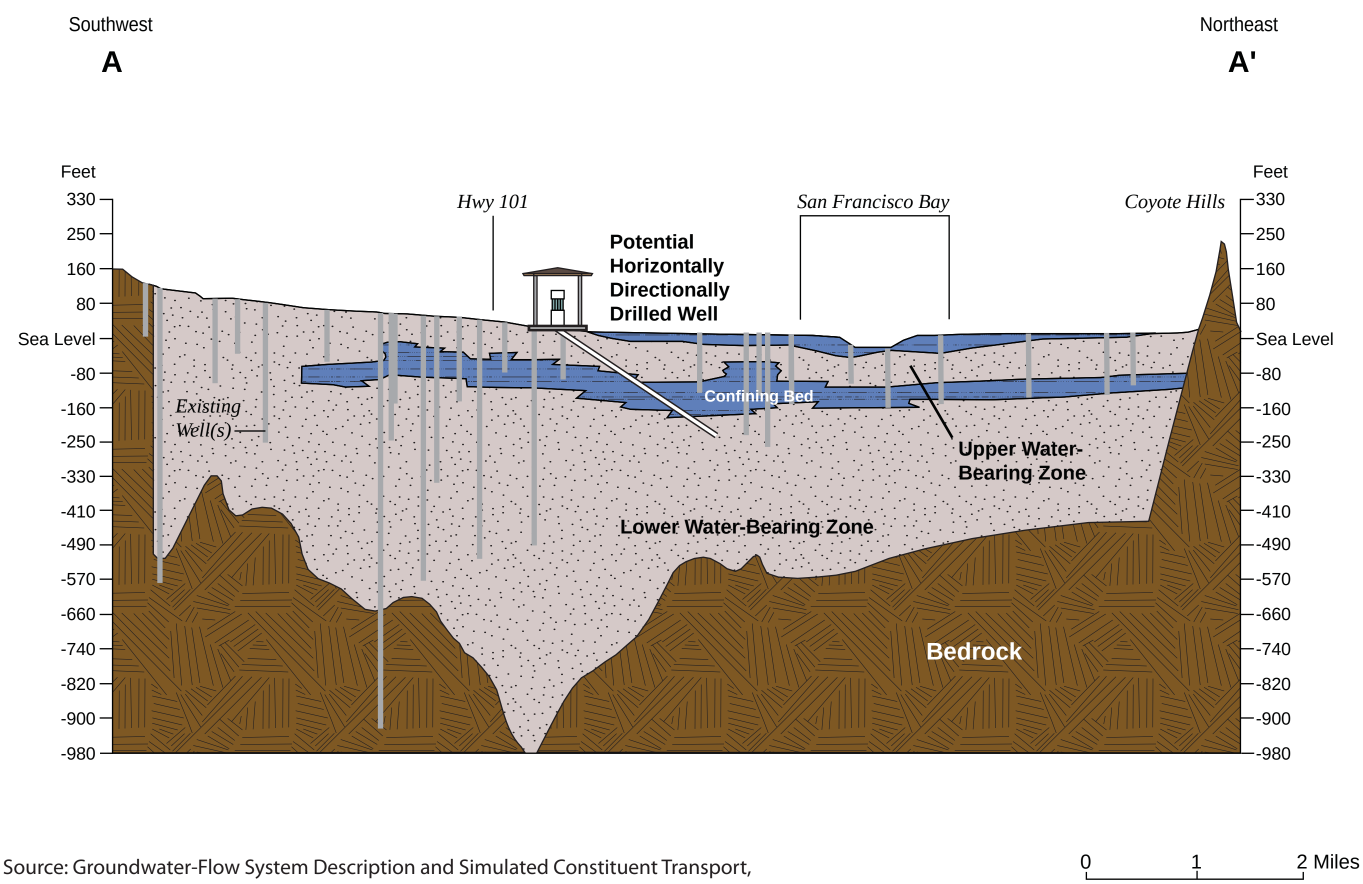
Figure 3

Alluvial Cones and Geologic Cross-Section at the Dumbarton Bridge





Source: Groundwater-Flow System Description and Simulated Constituent Transport, Raychem/Tyco Electonics Site, HydroFocus Inc., November 21, 2003.

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Figure 4
Planning Level Illustration of Vertical and Horizontally Directionally Drilled Wells in Dumbarton Bridge Area

- Potential treated water customers and transmission facilities.

The affect on the sizing of the proposed project are discussed in the following sections.

3.2.1 Source Water Quality and Desalination Treatment Requirements

All of the representative desalination projects assume treatment with reverse osmosis (RO) membranes. As indicated above the brackish wells and subsurface intakes (HDDW) do not require the same level of pre-treatment as the open Bay intake due to the lower salinity level (brackish) water and natural filtration. *Appendices C and D* present the treatment requirements for these different source water and quality supplies.

Table 5 summarizes the range of capacity, pre-treatment, RO treatment recovery (% of intake flow available as treated water), and whether this type of intake was included in the current evaluation.

Table 5
Capacity, Pre-treatment, Recovery and Inclusion Summary for Intakes

	Total capacity per unit (well or intake unit) (mgd)	Pretreatment Required? (Y/N)	RO Treatment Recovery Percentage	Intake Included?
Subsurface Bay Intake				
Vertical Brackish Groundwater Wells	1-2	N	Brackish 75%	Y
Ranney Collector Wells [1]	4	N	55% for Bay water	N
Slant Wells [2]	3	N	55% for Bay water	N
Horizontal Directionally Drilled Wells	3	N	55% for Bay water	Y
Infiltration Gallery [3]	2.5	N	55% for Bay water	N
Open Water Intake				
Bay Water	10 - 40	Y	55% for Bay water	Y

[1] Lack of permeable upper formations not conducive to Ranney Collector Well development.
[2] For the purposes of this evaluation slant wells and HDDW wells are similar, and HDDW wells have been included as they can be constructed with longer reaches.
[3] Lack of permeable upper formations not conducive to Infiltration Gallery development.

3.2.2 Brine Disposal Capacity

Brine disposal from the desalination process usually incorporates one of the following options:

- Subsurface discharge;
- New open water discharge; or
- Co-location with existing wastewater plant outfalls.

Appendix C Section C.5, describes these options in more detail. Based on the discussion in that section brine disposal is assumed to be by co-location with the wastewater treatment plant outfalls. The local wastewater agencies were contacted and initial calculations developed as to the potential capacity available for joint discharge. Figure 5 indicates those locations. With an assumed maximum treated water capacity of up to 20 mgd there is both hydraulic capacity and blending capacity (maintaining combined discharge) no greater than 20% above the ambient Bay water TDS concentration.

3.2.3 Representative Regional Desalination Projects

At this time it is uncertain whether regional desalination projects will be part of the BAWSCA Strategy moving forward. However, in order to develop sufficient information to be able to compare with the other water supply management projects representative sites and sizes for facilities were identified and planning level costs in order to allow a relative between comparison of the regional desalination projects as well as comparison with the other Phase II A Strategy projects.

Potential sites were prioritized as part of the representative projects based on:

- Proximity to water supply source (near the Bay);
- Proximity to WWTP sites for potential brine disposal;
- Qualitative assessment of surrounding land use. For example, parcels in residential areas were not considered likely sites for this analysis;
- Topography- Parcels with steeply sloping areas are not included due to construction and land use issues; and
- Proximity to SF RWS existing turnouts.

The open Bay water intake options considered were developed to identify locations that would minimize some of the primary concerns raised during the permitting of other facilities in California. This included identifying locations that have:

- Access to construct the open water intake in deep, “low biologically productive” areas to minimize the impacts on marine life and construction on the Bay floor; and
- Existing wastewater outfalls with additional hydraulic capacity during dry weather conditions to provide a beneficial way to discharge the brine back to the Bay even though this approach may limit the capacity of the desalination facility.

Selected (representative) potential intake and treatment plant site properties identified for the Dumbarton Bridge, San Mateo, and South San Francisco areas are shown in Figures 6, 7, and 8 respectively. The pipelines connecting the properties to the WWTPs for co-location with the outfall pipelines, treated water turnouts on the SF RWS, and source water intakes are highlighted in the figures. Conceptual pipeline alignments were identified on non-highway roads for permitting and cost purposes. Alignments were also

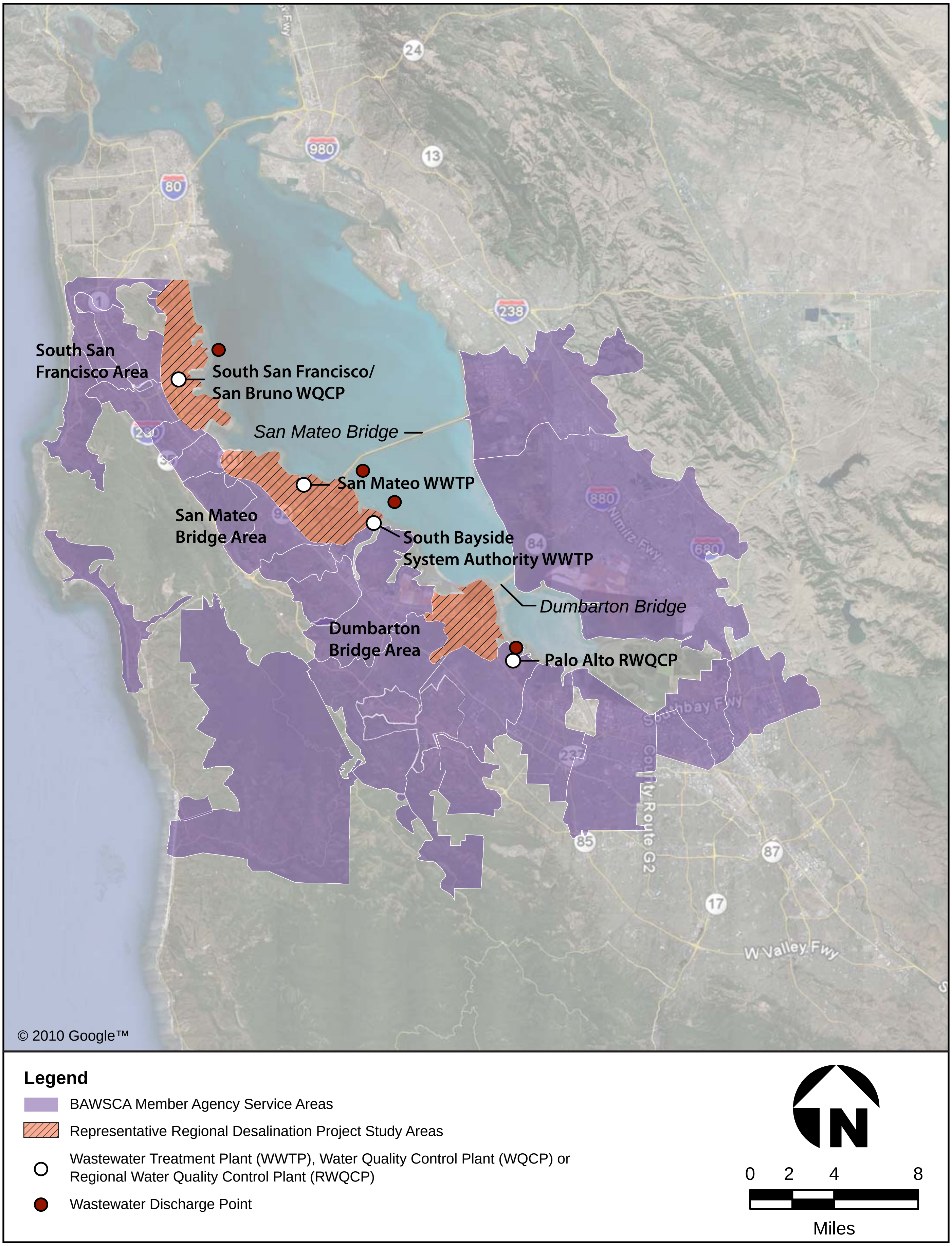

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Figure 5
BAWSCA Representative Regional Desalination Project Study Areas and Regional Wastewater Plants and Outfalls

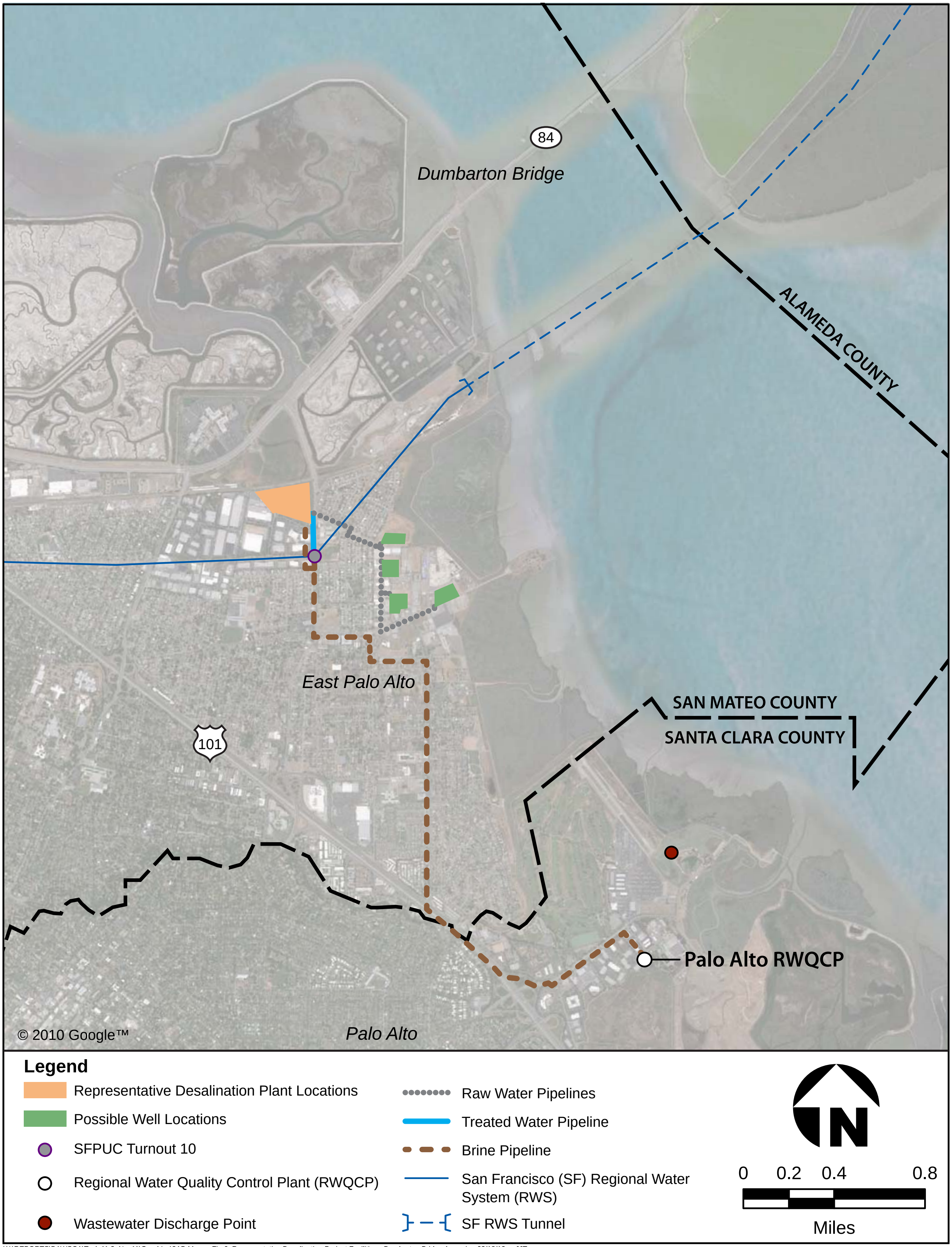

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Figure 6
Representative Desalination Project Facilities - Dumbarton Bridge Area

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Figure 7

Representative Desalination Project Facilities - San Mateo Bridge Area

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Figure 8

Representative Desalination Project Facilities - South San Francisco Area identified minimizing tunneling that would be associated with pipeline construction (i.e., where pipelines pass under existing highways).

Table 6 summarizes for each of the planning areas the possible SF RWS connection point, possible brine discharge location, and the type of intakes assumed for the representative regional desalination projects. Due to poor water circulation and poor water quality in the South Bay south of the Dumbarton Bridge HDDW and open Bay intakes were not included as projects in that area. Also, in the South San Francisco area HDDW were not included due the rapid off-shore drop off and difficulty in constructing those types of wells under those conditions.

Table 6
Summary of Desalination Plant Options Evaluated

Area	Potential SF RWS Connection	Potential WW Discharge Collocation	Vertical Brackish Groundwater Well	Subsurface Bay HDDW	Open Intake
Dumbarton Bridge Area	Turnout 10	Palo Alto Water Quality Control Plant	X	-	-
San Mateo Bridge Area	Turnout 99	San Mateo Wastewater Treatment Plant	X	X	X
South San Francisco Area	Turnout 116	South San Francisco/San Bruno Water Quality Control Plant	X	X	X

Table 7 presents the treated water capacities for each of the areas and type of intake for the representative desalination projects.

Table 7
Project Location, Capacity, Type of Intake and Percentage Recover

Location	Treated Water Capacity (mgd)	Vertical Brackish Groundwater Well	Subsurface Bay HDDW	Open Bay Intake
Recovery Percentage		75%	55%	55%
Dumbarton Bridge Area	1	X	-	-
	2	X	-	-
	5	X	-	-
San Mateo Bridge Area	1	X	-	-
	2	X	-	-
	5	X	-	-
	5	-	X	-
	10	-	X	-
	20	-	-	X
South San Francisco Area	1	X	-	-
	2	X	-	-
	5	-	X	-
	10	-	X	-
	20	-	-	X

3.3 Planning Level Costs

In order to allow future comparison of water supply alternatives several cost elements have been developed. These include:

- Construction Costs ($M);
- Capital Costs ($M);
- Annual O&M Costs ($M);
- Present Worth Costs ($M);
- Estimated Annual Production ($M);
- Unit Cost of Total Present Worth ($M/AF); and
- Unit Annualized Costs ($/AF).

Appendix D, Section 8 provides detailed information on the basis of cost assumptions for the above financial characteristics of projects.

Table 8 presents the planning level construction and capital cost estimates for the major project items for the Representative Coastal Desalination Project, including facility sizing. The adjustments used to convert construction costs to capital costs are also shown in the table. The unit costs for each of the different items were developed based on similar types of projects in California and the United States. All construction costs were adjusted to August 2011 which is being used as the common base for all of the water supply management projects.

Capital costs were developed for the proposed facilities based on the construction costs presented in *Appendix D* adjusted for:

- Contractor profit –15 percent;
- Engineering feasibility studies, preliminary and final design, services during construction and construction management – 25 percent;
- "Soft costs" including legal fees, permitting, and other miscellaneous costs – 15 percent; and
- Contingency – 40 percent.

Some key costs that have not been included in the current analysis include:

- Land purchase cost;
- Purchase of easements or rights-of-way;

- Wheeling or "Transfer" costs for conveyance of water through other agencies facilities; and
- Purchase price of water if applicable.

These costs will be developed later as part of the more detailed evaluation for the projects moving forward into detailed evaluation, ranking and comparison.

In addition to the capital costs (construction costs plus adjustments) and operation and maintenance costs (O&M) two different approaches are included for comparing alternative projects. These include the development of present worth analysis (or life-cycle costs) and annual costs. The present worth analysis includes the conversion of all cash flows to a common point in time, August 2011. As such, it requires the consideration of the time value of money and all future cash flows discounted back to the present. The present worth analysis converts all annual O&M costs (i.e., chemicals, power, labor, RO membrane replacement, etc.) to a present worth value and adds this to the present worth of the capital cost. To compute a unit cost of water this sum of the present worth of capital and O&M costs is divided by the total amount of water produced over the expected life of the project. For the purposes of this analysis a period of 30 years is used for the comparison of all projects.

Table 9 presents the present worth and annualized cost estimates for this project based on the capital costs presented in Table 4.

Table 8
Representative Desalination Project Sizing and Capital Cost

Item	Dumbarton Bridge Area			San Mateo Bridge Area						South San Francisco Area				
	1 mgd Brackish Groundwater Wells	2 mgd Brackish Groundwater Wells	5 mgd Brackish Groundwater Wells	1 mgd Brackish Groundwater Wells	2 mgd Brackish Groundwater Wells	5 mgd Brackish Groundwater Wells	5 mgd Bay Water HDDW[1] Wells	10 mgd Bay Water HDDW[1] Wells	10 mgd Bay Water Open Intake	1 mgd Brackish Groundwater Wells	2 mgd Brackish Groundwater Wells	5 mgd Bay Water HDDW[1] Wells	10 mgd Bay Water HDDW[1] Wells	20 mgd Bay Water Open Intake
Assumed Treated Water Production Capacity (mgd)[2]	1	2	5	1	2	5	5	10	20	1	2	5	10	20
Assumed Annual Production (AF/Year)[2,3]	900	1,800	4,500	900	1,800	4,500	4,500	9,000	17,900	900	1,800	4,500	9,000	17,900
Facility Sizing														
RO Recovery %	75%	75%	75%	75%	75%	75%	55%	55%	55%	75%	75%	75%	55%	55%
Source Water Capacity (mgd)	1.3	2.7	6.7	1.3	2.7	6.7	9.1	18.2	18.2	1.3	2.7	6.7	18.2	36.4
RO Treated Water Capacity (mgd)	1	2	5	1	2	5	5	10	10	1	2	5	10	20
Brine Disposal Capacity (mgd)	0.3	0.7	1.7	0.3	0.7	1.7	4.1	8.2	8.2	0.3	0.7	1.7	8.2	16.4
Capital Cost														
Capital Cost ($M)[4,5]	$30.6	$43.0	$64.4	$35.8	$47.3	$72.1	$126.5	$201.8	$274.7	$31.1	$42.7	$120.5	$194.3	$364.6

[1] Horizontally Directionally Drilled Wells.
[2] Capacity is treated water production from desalination plant.
[3] Assumes annual operation at 80% of capacity.
[4] Costs adjusted to August 2011.
[5] Costs do not include property acquisition, conveyance costs by others, or purchase price of water.

Table 9
Summary of Project Yields and Cost

Item	Dumbarton Bridge Area			San Mateo Bridge Area						South San Francisco Area				
	1 mgd Brackish Groundwater Wells	2 mgd Brackish Groundwater Wells	5 mgd Brackish Groundwater Wells	1 mgd Brackish Groundwater Wells	2 mgd Brackish Groundwater Wells	5 mgd Brackish Groundwater Wells	5 mgd Bay Water HDDW(1) Wells	10 mgd Bay Water HDDW(1) Wells	10 mgd Bay Water Open Intake	1 mgd Brackish Groundwater Wells	2 mgd Brackish Groundwater Wells	5 mgd Bay Water HDDW[1] Wells	10 mgd Bay Water HDDW[1] Wells	20 mgd Bay Water Open Intake
Assumed Production Capacity (mgd)[2]	1	2	5	1	2	5	5	10	10	1	2	5	10	20
Assumed Annual Production (AF/year) [2,3]	900	1,800	4,500	900	1,800	4,500	4,500	9,000	9,000	900	1,800	4,500	9,000	17,900
Annualized Costs														
Annualized Capital Cost ($M/year) [4]	$1.56	$2.19	$3.28	$1.83	$2.41	$3.68	$6.45	$10.29	$14.01	$1.59	$2.18	$6.15	$9.91	$18.60
O&M Cost ($M/year) [4]	$0.74	$1.11	$2.17	$0.76	$1.68	$2.18	$3.42	$6.45	$8.07	$0.70	$1.05	$3.43	$6.47	$15.50
Total Annualized Cost ($M/year) [4]	$2.30	$3.30	$5.45	$2.58	$3.60	$5.86	$9.87	$16.75	$22.08	$2.28	$3.23	$9.58	$16.38	$34.10
Total Annualized Cost ($/AF) [5,6,8]	$2,600	$1,800	$1,200	$2,900	$2,000	$1,300	$2,200	$1,900	$2,500	$2,500	$1,800	$2,100	$1,800	$1,900
Present Worth Costs														
Total Production – 30 years (AF)	27,000	54,000	135,000	7,000	54,000	135,000	135,000	270,000	270,000	27,000	54,000	135,000	270,000	537,000
Total Present Worth Cost ($M) [7]	$52.90	$76.2	$129.4	$58.5	$82.9	$137.4	$229.1	$395.3	$516.6	$52.98	$74.22	$223.49	$388.37	$829.65
Present Worth Unit Cost ($/AF) [6,8]	$2,000	$1,400	$1,000	$2,200	$1,500	$1,00	$1,700	$1,500	$1,900	$1,900	$1,400	$1,700	$1,400	$1,500

1 Horizontally Directionally Drilled Wells.
2 Capacity is treated water production from desalination plant.
3 Assumes annual operation at 80% of capacity.
4 Costs adjusted to August 2011.
5 Annualized cost based on 30 year return at 3% interest rate.
6 Costs do not include property acquisition, cost for use of wastewater treatment plant outfall capacity, conveyance costs by others, or purchase price of water.
7 Present Worth estimates include a 3% escalation and a 3% discount rate. The same escalation rate is used for electricity, materials, labor and capital costs.
8 Costs are rounded to the nearest $100/AF.

3.5 Other Project Information and Evaluation Criteria

One of the goals of the Strategy, as described in the *Phase I Scoping Report,* is to develop a quantitative and defensible project evaluation. To that end evaluation criteria and metrics have been developed to facilitate that process. *Appendix A – Revised Draft Task 6-A Memo: Refined Evaluation Criteria and Metrics* in the *Task 1 TM* presents that process and criteria. These six criteria include:

- Increase Supply Reliability;
- Provide High Level of Water Quality;
- Minimize Cost of New Water Supplies;
- Reduce Potable Water Demand;
- Minimize Environmental Impacts; and
- Increase Implementation Potential.

The current memo focuses on the supply reliability (yield for normal and dry years), facilities and cost, and schedule. Other information that is currently available is included in the appendices to this TM. Some of the information for Table 10 will be developed and updated at a later time when a common comparison and development of values will be prepared for all projects.

Table 10
Project Summary for Desalination Project Evaluation Criteria and Metrics
Project Values

Objective	Criteria	Metrics	Dumbarton Bridge Area			San Mateo Bridge Area						South San Francisco Area				
			1 mgd Brackish Groundwater Wells	2 mgd Brackish Groundwater Wells	5 mgd Brackish Groundwater Wells	1 mgd Brackish Groundwater Wells	2 mgd Brackish Groundwater Wells	5 mgd Brackish Groundwater Wells	5 mgd Bay Water HDDW Wells	10 mgd Bay Water HDDW Wells	10 mgd Bay Water Open Intake	1 mgd Brackish Groundwater Wells	2 mgd Brackish Groundwater Wells	5 mgd Bay Water HDDW Wells	10 mgd Bay Water Open Intake	20 mgd Bay Water Open Intake
1 - Increase Supply Reliability	**Criterion 1A** – Ability to Meet Normal Year Supply Need	Quantitative (AF /year): Average annual yield in normal years in 2018 and 2035.[2,3]	900	1,800	4,500	900	1,800	4,500	4,500	9,000	9,000	900	1,800	4,500	9,000	17,900
	Criterion 1B – Ability to Meet Drought Supply Need	Quantitative (AF/year): Average annual yield with drought hydrology of 1987 – 1992.[2,3]	900	1,800	4,500	900	1,800	4,500	4,500	9,000	9,000	900	1,800	4,500	9,000	17,900
	Criterion 1C – Risk of Facility Outage	Qualitative (1-5): Estimated probability and duration of major conveyance failure	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Criterion 1D – Potential for Regulatory Vulnerability	Qualitative (1-5): Potential for regulatory decisions to impact supply reliability	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2 - Provide High Level of Water Quality	**Criterion 2A** – Meets or Surpasses Drinking Water Quality Standards	Quantitative (mg/L): Total dissolved solids (TDS) level as an indicator of water quality.	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120
	Criterion 2B – Meets or Surpasses Non-Potable Water Quality Standards	Qualitative: Meets minimum water quality requirement (e.g., Title 22) for the targeted use. (Yes or no)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3 - Minimize Cost of New Water Supplies	**Criterion 3** – Capital and Present Worth Costs	Quantitative ($/AF): Present Worth unit costs including capital and operating costs	$2,000	$1,400	$1,000	$2,200	$1,500	$1,000	$1,700	$1,500	$1,900	$1,900	$1,400	$1,700	$1,400	$1,500
4 - Reduce Potable Water Demand	**Criterion 4** – Augment Non-Potable Water Supplies	Quantitative (AF/year): Reduction of potable water demand by use of non-potable supply.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Table 10
Project Summary for Desalination Project Evaluation Criteria and Metrics

Objective	Criteria	Metrics	Project Values													
			Dumbarton Bridge Area			San Mateo Bridge Area						South San Francisco Area				
			1 mgd Brackish Groundwater Wells	2 mgd Brackish Groundwater Wells	5 mgd Brackish Groundwater Wells	1 mgd Brackish Groundwater Wells	2 mgd Brackish Groundwater Wells	5 mgd Brackish Groundwater Wells	5 mgd Bay Water HDDW Wells	10 mgd Bay Water HDDW Wells	10 mgd Bay Water Open Intake	1 mgd Brackish Groundwater Wells	2 mgd Brackish Groundwater Wells	5 mgd Bay Water HDDW Wells	10 mgd Bay Water Open Intake	20 mgd Bay Water Open Intake
5 - Minimize Environmental Impacts	**Criterion 5A** –Greenhouse Gas Emissions	Quantitative (metric tons/ AF of Supply): Estimates of unit greenhouse gas emissions	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Criterion 5B –Impact to Groundwater Quantity and Quality	Qualitative (1-5): Potential impacts to groundwater levels, groundwater quality, or potential for subsidence	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Criterion 5C –Impact to Habitat	Qualitative (1-5): Potential impacts to habitat, such as wetlands, riparian zones, fisheries, and inundation areas.	1	1	1	1	1	1	1	1	1	1	1	1	1	1
6 - Increase Implementation Potential	**Criterion 6A** – Institutional Complexity	Qualitative (1-5): Number and type of agencies and agreements involved	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Criterion 6B –Level of Local Control	Qualitative (1-5): BAWSCA and Member Agency ownership of supply projects	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Criterion 6C –Permitting Requirements	Qualitative (1-5): Permitting or regulatory issues for supply projects	1	1	1	1	1	1	1	1	1	1	1	1	1	1

[1] BARDP project description and data presented in Appendix E to Task 3-AB Memo. Unit Present Worth Costs presented in this table have been adjusted to August 2011 dollars.
[2] Capacity is treated water production from desalination plant.
[3] Assumes annual operation at 80% of capacity.

3.5.1 Supply Reliability

The *Increase Supply Reliability* criteria has four subcriterion:

- *Criterion 1A – Ability to Meet Normal Year Supply Need* - An estimate of the ability of a water supply management project to meet the normal hydrologic year supply needs of BAWSCA member agencies is measured by the annual yield of the project during normal hydrologic conditions by the 2018 and 2035 planning horizons.
    - *The yield is indicated in Table 10.*
- *Criterion 1B – Ability to Meet Drought Supply Need* - An estimate of the ability of a water supply management project to meet the supply need during a drought is measured by the annual yield of the project during the 1987 – 1992 drought. The criterion of drought reliability captures whether a supply project is resistant to drought impacts.
    - *The yield is indicated in Table 10.*
- *Criterion 1C – Risk of Facility Outage* - Supply vulnerability is measured by the probability and duration of potential outages to a particular water supply management project due to a major conveyance failure. This criterion captures the vulnerability of projects to emergency outages. This metric is a qualitative measure ranging from 1 through 5, with a score of "1" identifying the projects that are least susceptible to emergency outages and a score of "5" indicating high susceptibility to conveyance failures.
    - *These values will be developed as part of the overall analysis and comparison of projects. However, it is anticipated that these projects could have a lower risk of facility outage than water transfer projects where there are multiple agencies and conveyance systems required to convey the water into the BAWSCA service area.*
- *Criterion 1D – Potential for Regulatory Vulnerability* - The susceptibility of a water supply management project to interruption as a result of regulatory issues includes legal, political, or environmental constraints. This metric is a qualitative measure ranging from 1 through 5, with a score of "1" identifying the projects that are least susceptible to regulatory risk and a score of "5" indicating high susceptibility to regulatory risk.
    - *These values will be developed as part of the overall analysis and comparison of projects. However, it is anticipated between the desalination projects the Bay water open intake will score lower than the HDDW and brackish groundwater projects as open intake will require a new intake and subsequent requirements for additional studies and permitting.*

3.5.2 Water Quality

The *Provide High Level of Water Quality* criteria has two subcriterion:

- *Criterion 2A – Meets or Surpasses Drinking Water Quality Standards* – A measure representing potable supply is addressed by the quantitative metric of the aggregate water quality, measured by TDS levels, of the potable supply projects and portfolios. TDS is a surrogate for other water quality parameters representing water quality.

- *The TDS level will be designed to be similar to the SF RWS Hetch Hetchy and/or local reservoir supply. Treatment process and costs are based keeping the TDS less than 120 mg/L.*

- *Criterion 2B – Meets or Surpasses Non-Potable Water Quality Standards* - For non-potable supply projects, where water quality constraints vary according to use, the value will be a qualitative assessment of whether or not the water supply management projects and portfolios meet the minimum water quality requirement for the targeted use. In most cases, this metric will be used to designate whether a non-potable supply source meets Title 22 requirements, as this is a common target water quality level for a non-potable demand.
  - *This is a potable water project. This criterion does not apply.*

3.5.3 Cost

The *Minimize Cost of New Water Supplies* criteria has one quantitative subcriterion:

- *Criterion 3 – Capital and Present Worth Costs* - The present worth costs, including capital, operations, and maintenance costs, for each water supply management project are estimated. The performance metric is the normalized unit cost presented in $/AF for each project.
  - *The costs are indicated in Table 10.*

3.5.4 Reduce Potable Water Demand

The *Reduce Potable Water Demand* criteria has one criterion:

- *Criterion 4A –Augment non-potable water supplies* is quantitative metric for the annual yield of additional non-potable supply produced and utilized to offset potable demand.
  - *This is a potable water project. This criterion does not apply.*

3.5.5 Environmental Impacts

The *Minimize Environmental Impacts* criteria includes three qualitative subcriterion:

- *Criterion 5A* -The metric for *5A* is represented by the increase in greenhouse gas emissions due to a potential water supply management project. This quantitative metric will be measured in terms of metric tons of carbon dioxide produced, or reduced, per unit of supply based on energy use.
  - *These values will be developed as part of the overall analysis and comparison of projects.*

- *Criterion 5B –Impact to Groundwater Quantity and Quality* - Water supply management projects that do not negatively affect groundwater supplies will be measured favorably in this criterion. A combined qualitative estimate of potential groundwater impacts will be evaluated in terms of potential reductions in groundwater levels, impacts to groundwater quality, and the risk of increase in land subsidence. This metric will be a qualitative measure ranging from 1 through 5, with a score of "1" identifying the projects with the least potential for adversely affecting groundwater quantity and quality and a score of "5" indicating high probability of adverse impacts.

- *These values will be developed as part of the overall analysis and comparison of projects. This criterion is important as it may affect yield, cost and project feasibility if there is a significant impact to other wells. In comparing the desalination projects the subsurface (i.e., brackish groundwater vertical wells and HDDW projects have the potential for greater impacts on other groundwater supplies than the open Bay water intakes.*

- *Criterion 5C –Impact to Habitat* - This criterion addresses long-term impacts to the ecosystems, not short-term effects related to temporary construction activities. Water supply management projects that do not adversely affect sensitive habitat areas such as wetlands, riparian zones, potential special-status species habitat, or have significant inundation areas will be measured favorably in this criterion. A combined qualitative estimate of potential habitat impacts is evaluated in terms of potential site acreage, proximity to sensitive habitat zones, and flood potential. This metric is a qualitative measure ranging from 1 through 5, with a score of "1" identifying the projects with the least potential for adverse impacts to habitat and a score of "5" indicating high probability of adverse effects to terrestrial, aquatic, and riparian species.
  - *These values will be developed as part of the overall analysis and comparison of projects. In comparing the desalination projects the open Bay water intake projects have a higher potential for environmental impacts to the Bay than the subsurface intakes. The potential specific habitat impacts from construction of the required infrastructure are dependent on the specific locations and construction techniques.*

3.5.6 Implementation Potential

The *Increase Implementation Potential* criteria has three qualitative subcriterion:

- *Criterion 6A –Institutional Complexity* - This criterion addresses the level of institutional coordination required for implementation of a water supply management project. A qualitative metric will be used to estimate the coordination required if multiple local or regional agencies or agreements are necessary. The projects that are assumed to require less coordination, and to receive less opposition, will score better than those that are more complex or potentially controversial.
  - *Currently the ownership for the facilities has not been determined. Depending on who owns and operates the facility there will be issues about property ownership, use of the existing wastewater treatment plant outfall capacity for brine disposal, and use of the SF RWS for conveyance.*

- *Criterion 6B –Level of Local Control of Water Supply* - Local management of a water supply management project will minimize dependency on imported water supplies and the drought impacts associated with those supplies. A common rating scale will be developed to evaluate the amount of BAWSCA-owned or BAWSCA member-owned supply for each project. Projects that are fully owned by BAWSCA or the member agencies will score higher than supply projects owned fully or partially by other entities that might be affected by regulatory risk, multiple party agreements, and supplies that may have a higher risk of not being available further into the future, or under drought conditions.

- *These values will be developed as part of the overall analysis and comparison of projects. In general the desalination projects have a high level of local control of water supply as these are locally controlled supplies, either groundwater or Bay water.*

- *Criterion 6C –Permitting Requirements* - This criterion addresses the objective of minimizing the regulatory and environmental permitting obstacles associated with water supply management projects. Projects with other similar metrics (including cost) may have differing permitting requirements, which can affect their overall implementation. The performance metric is a qualitative measure of the permitting requirements of each project or portfolio.
  - *These values will be developed as part of the overall analysis and comparison of projects. Within the desalination projects the open Bay water intakes will have a higher level of permitting requirements than the subsurface intakes due to the additional agencies involved.*

3.6 Project Schedules

Preliminary implementation schedules have been developed for the brackish groundwater well, Bay water subsurface intake and Bay water intake projects. The schedules presented below are based on experience with similar projects (e.g., Santa Cruz and Monterey Peninsula Water Management District (MPWMD) and professional judgment. Considerably slower schedules have been experienced by projects in Carlsbad and Huntington Beach.

Two considerations which can have a significant impact on schedule include:

- *Piloting*: Every major project has had a pilot plant study (e.g., Newark, Marin, Santa Cruz, BARDP, Long Beach, Dana Point, Carlsbad, West Basin) with the exception of Huntington Beach (relied on Carlsbad results) and Sand City (since used beach wells were used, the project relied on water quality data from a beach test well, reverse osmosis software projections, and direct measurement of Silt Density Index (SDI) as basis of 0.5 mgd design). For brackish, if there are no special water quality circumstances (e.g., iron, manganese, silica), pilot testing is not typically necessary and a few days of operating a single-element RO tester at the test well can be used to generate brine samples if needed for RWQCB permitting. Eliminating pilot testing would save approximately 6 months on the schedule; and

- *Source water assessments*: For setting treatment requirements, CDPH requires 12 month testing for well-extracted water and 24 months for an open water intake source. This can be obviated by simply installing greater levels of pre-treatment (Sand City elected this option by installing post-treatment UV disinfection to achieve the maximum required virus, Cryptosporidium and Giardia log removal credits for an impaired source water. This saved up to 12 months of groundwater under the influence monitoring and the potential for an additional 12 month watershed sanitary survey and 24 months of Long Term 2 Surface Water Treatment Rule monitoring for turbidity and Cryptosporidium.

The preliminary project schedules for all of the desalination projects include the following 11 activities:

- Field Investigation;
- Pilot-Scale Demonstration Projects;
- Source Water Assessments;
- Intake Supply Studies;
- Miscellaneous Studies for Permitting;
- Intake, Outfall and Plant Conceptual Design;
- Preliminary Design and EIR;
- Finalize EIR and Permit Applications;
- Final Design;
- Bid & Construction; and
- Startup.

The preliminary schedules below, Figures 9, 10 and 11 for brackish groundwater wells, HDDW and open Bay intakes respectively have been developed incorporating lessons learned from other projects in California, and provide a potential duration for each phase of the project. The schedules will likely change depending on the permitting climate, and the public perception of the selected project, and the specific siting and permitting requirements.

In general the brackish groundwater wells will have the shortest implementation time ranging from 6 to 8 years. The implementation time for HDDW will be longer ranging from 10 to 12 years, and the open intakes taking from 10 to 15 years.

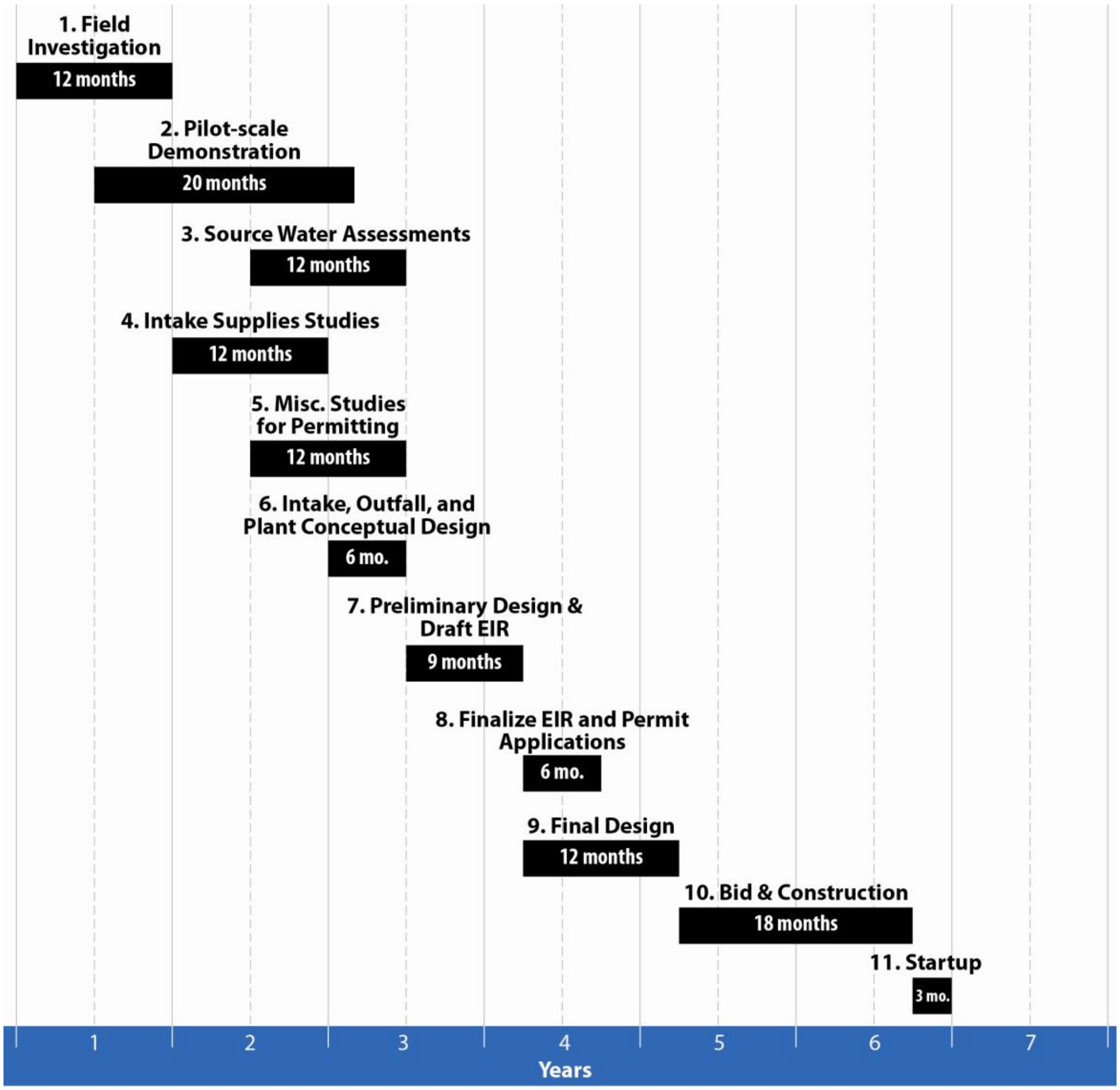


Figure 9
Preliminary Schedule for Representative Brackish Groundwater Desalination Project

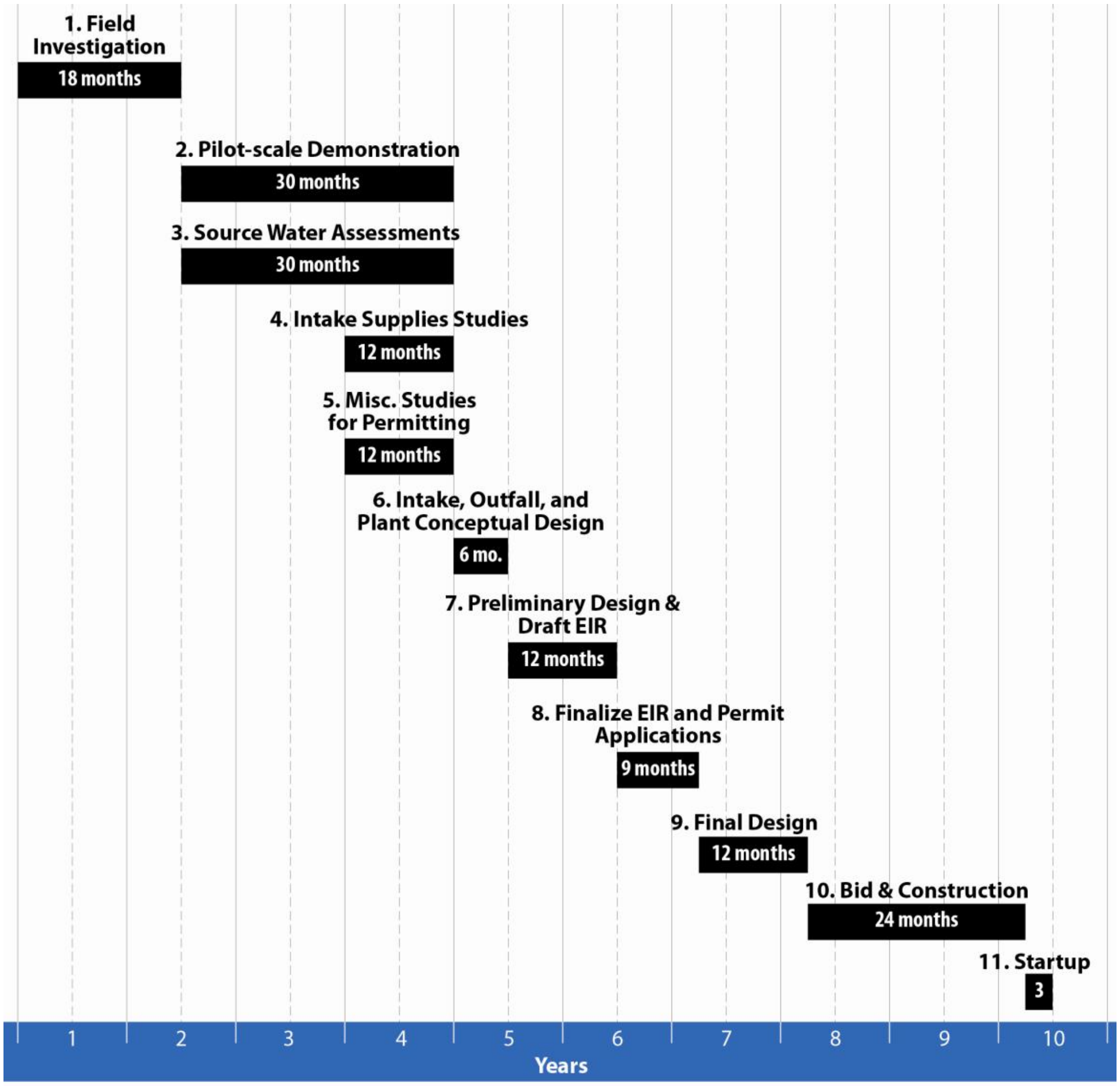


Figure10
Preliminary Schedule for Representative Subsurface Bay Water Desalination Project

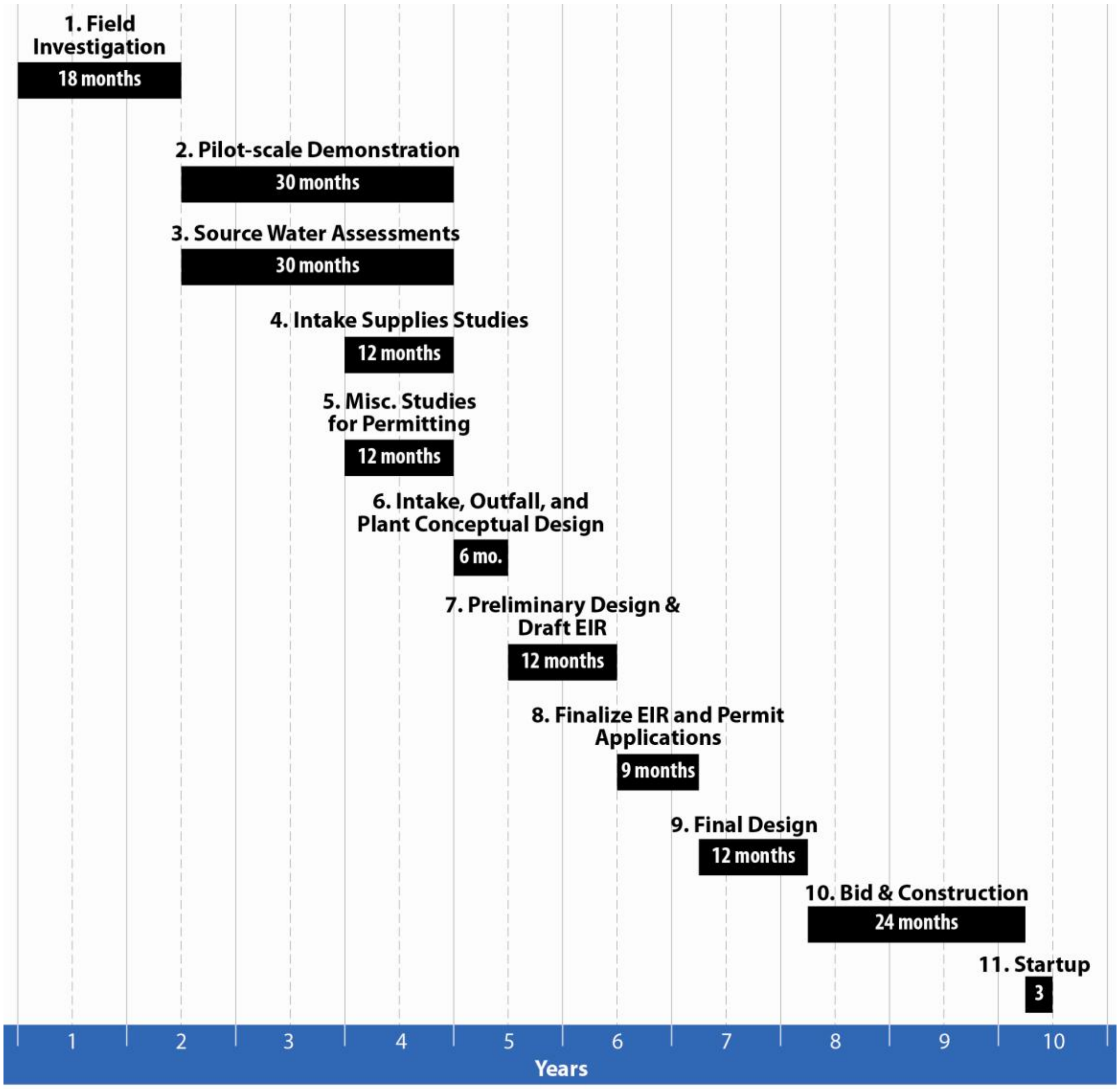


Figure 11
Preliminary Schedule for Representative Open Intake Bay Water Desalination Project

3.7 Key Project Issues

Key issues associated with regional desalination projects include:

- Source water quality (e.g., salinity, iron, manganese, contaminants) variability;
- Source water yield;
- Land availability, cost and permitting for subsurface intakes, and for new desalination plant sites;
- Alignment issues and rights-of-way for construction of new raw water, brine and treated water pipelines;
- Willingness and cost to allow use of existing wastewater plant outfall capacity for brine disposal;
- Public support and/or opposition;
- Use of the SF RWS system for conveyance to member agencies if required;
- Permitting for a new intakes in the Bay; and
- Funding and ownership of a regional desalination facilities.

The key risks noted during development of this analysis include:

- *All options:*
  - *Protracted permitting approval process. This has been the experience with the Marin, Carlsbad and Santa Cruz projects; and*
  - *Costs and delays to overcome potential permitting hurdles, public opposition, and litigation even though subsurface intakes and co-located brine discharges are expected to reduce this risk. California experience indicates that such delays have been the norm. It is unclear whether implementation time for future plants will be reduced (i.e., if State-wide regulatory streamlining for desalination plants occurs).*
- *Brackish and subsurface options:* Projecting expected yield and assessing impacts on other wells in the aquifer including well yield and water quality (e.g., potential for increased salt water intrusion and subsidence);
- *Subsurface options:* Long-term yield and reliability of slant or horizontal wells depending on the site-specific hydrogeology under the Bay floor and future sediment deposition which may reduce water transport rates from the ocean into the aquifer; and

- *Open water intake option:* Cleaning frequency and long-term reliability of intake screens.
    - *Risks associated with introducing a new treated water source into an existing distribution system, such as water stabilization and corrosion control to minimize impacts to existing scales, maintaining disinfectant stability in the presence of bromide in the desalinated water, aesthetic differences, irrigation use with higher concentrations of boron and chloride, and potential SFPUC requirements to match existing salinity and hardness parameters; and*
    - *Risk that the cost of power may escalate more quickly than anticipated and increase the operational costs.*
- Risk that wastewater utilities may not allow a co-located brine discharge with or without additional costs or negotiations.

4.0 Bay Area Regional Desalination Project

4.1 Project Assumptions

The East Bay Municipal Utility District (EBMUD), San Francisco Public Utilities Commission (SFPUC), Santa Clara Valley Water District (SCVWD), and Contra Costa Water District (CCWD) are jointly investigating a Bay Area Regional Desalination Project (BARDP). In 2011 the Alameda County Flood Control and Water Conservation District Zone 7 joined the BARDP group, and Alameda County Water District decided to no longer participate in the investigations. In 2007 the agencies released the BARDP Feasibility Study[5] (Feasibility Study) which investigated several potential infrastructure options and evaluated several site locations in the Bay Area against a set of criteria. These criteria included: 1) raw water quality; 2) costs; 3) permitting/water rights requirements; 4) public acceptance/ socioeconomic effects (including environmental justice, growth inducement, and land use impacts); 5) potential to receive grant funding; 6) capability to supply product water to multiple agencies during droughts; and 7) environmental effects. Twenty two potential facility locations were evaluated based on these criteria, and three locations were selected as the most feasible: East Contra Costa County, Oceanside, and near the easterly side of the Bay Bridge in Alameda County.

Based on the results of the Feasibility Study, the BARDP agencies conducted a pilot test at CCWD's Mallard Slough Pump Station (PS) site located in the eastern part of Contra Costa County. The results of the pilot study were documented in the 2010 Pilot Testing at Mallard Slough

[5] Bay Area Regional Desalination Project Feasibility Study, 2007, prepared by URS for Contra Costa Water District, East Bay Municipal Utility District, San Francisco Public Utilities Commission, and Santa Clara Valley Water District. http://www.regionaldesal.com/documents.html

Engineering Report (Pilot Engineering Report)[6]. Figure 12 indicates the location for the BARDP pilot plant and the most likely area for a full sized desalination project if BARDP moves forward.

The pilot study helped the BARDP agencies identify membrane combinations for a larger size treatment plant, and also confirmed that a larger size plant is feasible at the Contra Costa site selected. Results from the pilot study were used to develop a cost estimate for four (4) desalination plant scenarios, using the different membrane configurations, different operation schedules, and plant locations. Three of these scenarios were recommended for further consideration with a 2-stage combination of brackish and seawater membranes. The characteristics of these scenarios are summarized in Table 11 below.

Table 11
BARDP Desalination Plant Scenarios [1]

	Scenario 1	Scenario 2	Scenario 3
Capacity [2]	20 mgd	20 mgd	20 mgd
Average Recovery Rate [2]	80%	80%	80%
Operation	Continual	Every 3rd year (mothball)	Continual
Location	Mallard Slough	Mallard Slough	TBD (site other than Mallard Slough)
Intake Structure	Mallard Slough PS	Mallard Slough PS	To be constructed
Treated Water Transmission	Existing lines	Existing lines	To be constructed
Construction Considerations	Pile foundation required	Pile foundation required	None

1 Information in this table is from the Pilot Study Engineering Report.
2 Capacity and Recovery rates decrease during times of maximum raw water TDS.

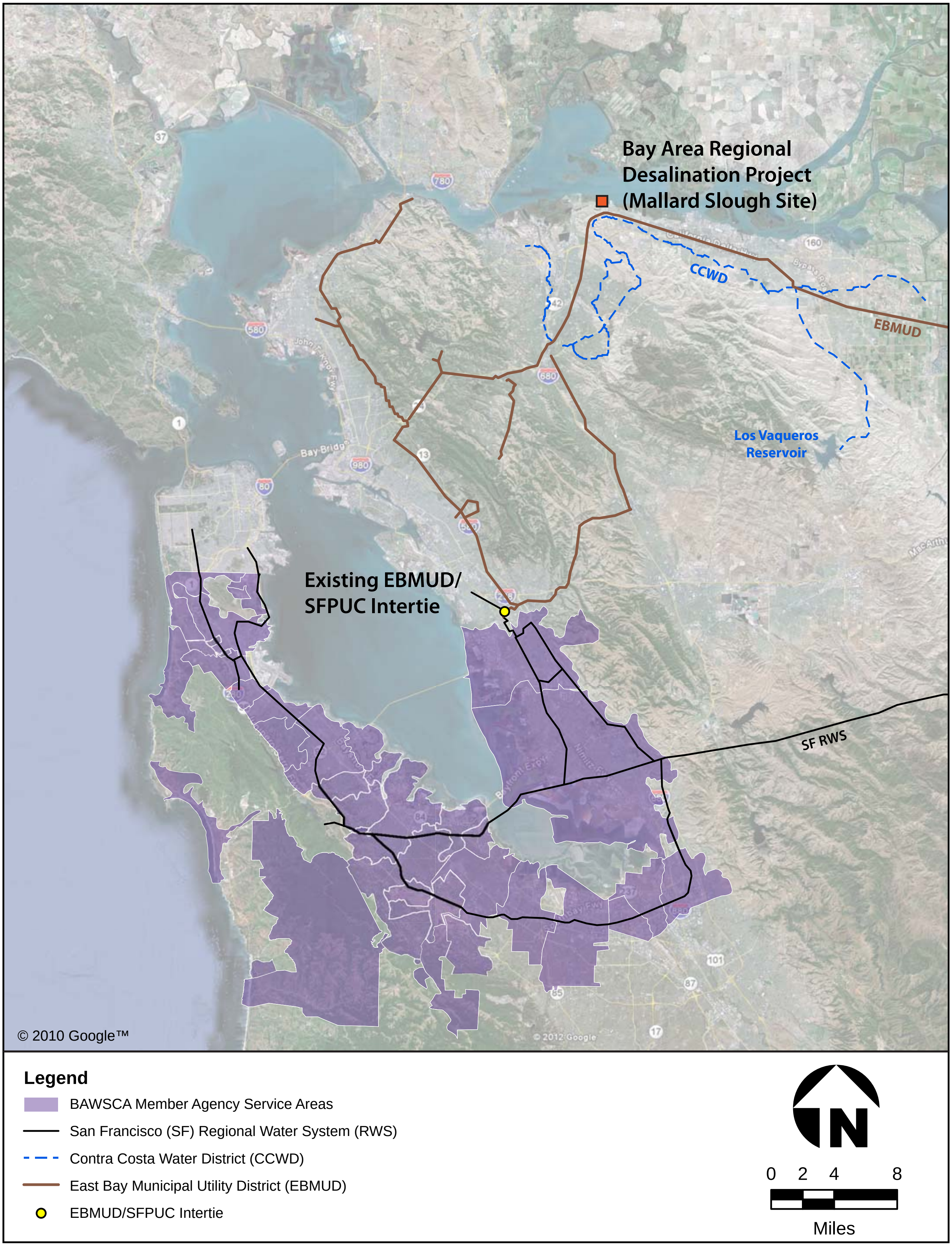
4.2 Potential Facility Sizing and Costing

Three membrane configurations were evaluated, providing a recovery range between 50 and 82%, depending on raw water TDS levels and membrane type. Water quality also varied with these parameters. The pilot study helped the BARDP agencies identify membrane combinations for a larger size treatment plant, and also confirmed that a larger size plant is feasible at the Contra Costa site selected. Results from the pilot study were used to develop a cost estimate for four (4) desalination plant scenarios, using the different membrane configurations, different operation schedules, and plant locations. Three of these scenarios were recommended for further consideration with a 2-stage combination of brackish and seawater membranes. The characteristics of these scenarios are summarized in Table 7 below.

4.3 Planning Level Costing

Facility costs for the BARDP project are based on more detailed information than is currently developed for the Strategy. This is due to the more detailed analysis and investigations for the more mature BARDP project. The identification of a single plant type (brackish, open intake),

6 Bay Area Regional Desalination Project Pilot Testing at Mallard Slough Engineering Report, 2010, prepared by MWH for Contra Costa Water District, East Bay Municipal Utility District, San Francisco Public Utilities Commission, and Santa Clara Valley Water District. http://www.regionaldesal.com/documents.html



W:\REPORTS\BAWSCA\Task 11.3_Nov11\Graphics\3AB Memo_Fig 12_Bay Area Regional Desalination Project Location.ai 04/05/12 JJT

CDM Smith

Figure 12
Bay Area Regional Desalination Project Location

capacity (20mgd), and plant location (Mallard Slough or nearby) made this detailed estimate possible.

4.3.1 Capital Cost Estimates

Capital cost estimates from the Pilot Engineering Report are summarized in Table 12. The Capital cost estimates have been adjusted in the last row to match the BAWSCA Strategy planning year of August 2011.

Table 12
BARDP Capital Cost Estimates[1]

	Scenario 1	Scenario 2	Scenario 3
Sitework	$4,200,000	$4,200,000	$4,200,000
Intake and Raw Water Pump Station			$3,100,000
Brine Disposal	$1,100,000	$1,100,000	$1,100,000
MF/UF Facilities	$18,300,000	$18,300,000	$18,300,000
Filtrate Tanks	$1,100,000	$1,100,000	$1,100,000
RO Facilities	$44,100,000	$44,100,000	$44,100,000
Permeate Tank	$500,000	$500,000	$500,000
Clearwells	$1,900,000	$1,900,000	$1,900,000
High Service Pumping Station	$4,400,000	$4,400,000	$4,400,000
Neutralization Tanks	$400,000	$400,000	$400,000
Chemical Building A	$1,900,000	$1,900,000	$1,900,000
Chemical Building B	$2,300,000	$2,300,000	$2,300,000
Solids Handling Facilities	$9,900,000	$9,900,000	$9,900,000
Pile Foundations	$3,100,000	$3,100,000	
Transmission Main			$7,800,000
Site Electrical Systems	$5,200,000	$5,200,000	$5,200,000
Subtotal Construction Costs	**$98,400,000**	**$98,400,000**	**$106,200,000**
Contingencies (20%)	$19,700,000	$19,700,000	$21,200,000
Planning, Permitting, Engineering & Administrative Costs (25%)	$29,500,000	$29,500,000	$31,900,000
Land Acquisition	$3,500,000	$3,500,000	$3,500,000
Concentrate Discharge Permit & Connection Fee	$1,000,000	$1,000,000	$1,000,000
Subtotal Adjustments	**$53,700,000**	**$53,700,000**	**$57,600,000**
Capital Cost	**$152,100,000**	**$152,100,000**	**$163,800,000**
Capital Cost Adjusted for Strategy Base Year[2]	**$159,400,000**	**$159,400,000**	**$171,700,000**

[1] Unless otherwise noted, source is Table 6-6 in the Pilot Study Engineering Report.
[2] Capital Cost Estimates from the BARDP Report were developed using September 2009 costs. The Strategy base year is August 2011 and adjustments based on the ENR data for San Francisco ENR to were made to the BARDP calculations for the same planning base date as the Strategy.

The capital costs do not include allowance for additional infrastructure or pumping capacity to convey the treated water beyond the desalination facility. The potential use of the EBMUD system for conveyance to the SF RWS existing emergency intertie at Hayward is currently being evaluated by EBMUD. Those infrastructure costs may increase the capital cost if additional infrastructure is required, but will significantly increase the O&M costs.

4.3.2 Annual O&M Costs

Annual Operation and Maintenance (O&M) costs from the Pilot Engineering Report are summarized in Table 13. Though Scenario 2 involves "moth-balling" the facility, costs are provided for a dry year when the plant is fully operational. Power requirements for Scenario 3 are higher than Scenarios 1 and 2 due to the pumping requirements associated with an offsite location. The O&M cost estimates have been adjusted in the last row from September 2009 to the BAWSCA Strategy planning base of August 2011. No other adjustments have been made to reflect different planning level assumptions.

As with the capital costs the O&M cost estimates do not include conveyance beyond the desalination facility. If this water is conveyed through the EBMUD system to the emergency intertie in Hayward between EBMUD and the SF RWS there will be significant costs for conveyance. In addition to pumping the water may also have to be retreated in the EBMUD system if it is necessary to be conveyed through the EBMUD raw water system.

Table 13
Annual O&M Costs[1]

	Scenario 1	Scenario 2	Scenario 3
1. Power Requirements	$5,400,000	$5,400,000	$7,900,000
2. Chemical Costs	$1,400,000	$1,400,000	$1,400,000
3. Equipment Replacement Cost	$1,400,000	$1,400,000	$1,700,000
4. Staffing Costs	$900,000	$900,000	$900,000
5. Outside Services (hauling, landfill use, concrete disposal)	$1,350,000	$1,350,000	$1,350,000
Annual O&M Costs	**$10,450,000**	**$10,450,000**	**$13,150,000**
Annual O&M Costs Adjusted for BAWSCA Strategy Base Year [2]	**$10,953,000**	**$10,953,000**	**$13,782,000**

[1] Source: Table 6-6 in the Pilot Study Engineering Report, base September 2009.
[2] Annual O&M Estimates from the BARDP Report were made using September 2009 costs. The Strategy base year is August 2011 and adjustments based on the ENR data for San Francisco ENR to adjust the O&M costs.

4.3.3 Life Cycle Analysis

The Pilot Engineering Report also included a life cycle analysis (present worth), with an estimated project life of 30 years, net discount rate of 3% based on a discount rate of 5% and escalation rate of 2%. The present worth and annualized cost estimates are summarized in Table 14.

Table 14 Present Worth and Annualized Cost Estimates BARDP Scenarios[1]			
	Scenario 1	**Scenario 2**	**Scenario 3**
Present Worth Project Costs			
Annual O&M Cost[2 3] ($M)	$ 10.5	$ 10.5	$ 10.5
Total Capital Cost ($M)	$ 152.1	$ 152.1	$ 163.8
Present Worth of Annual O&M Cost ($M)	$ 204.9	$ 79.0	$ 204.9
Total Present Worth ($M)	$ 357.0	$ 231.1	$ 368.6
Total Production[4] (AF)	680,000	227,000	680,000
Unit Cost of Total Present Worth ($/AF)	$ 525	$ 1,020	$ 540
Unit Cost of Total Present Worth Adjusted for Strategy Base Year[5 6 7] ($/AF)	$ 550	$ 1,069	$ 566
Annualized Project Costs			
Total Annual Cost (Capital + O&M) ($M)	$ 18.2	$ 11.8	$ 18.8
Annual Production (AF) (Based on 20 mgd plant capacity)	22,400	7,600	22,400
Unit Annualized Costs ($/AF)	$ 800	$ 1,560	$ 830
Unit Annualized Costs[5 6 7] ($/AF)	$ 838	$ 1,635	$ 870

1 Source: Table 1-5 in the Pilot Study Engineering Report.
2 Annual cost during dry year operation. A dry year is assumed to occur once every three years.
3 Does not include conveyance costs through CCWD or EBMUD systems.
4 Assumed project life is 30 years.
5 Unit Cost Estimates from the BARDP Report were made using September 2009 costs. The Strategy base year is August 2011 and adjustments based on the ENR data for San Francisco ENR to adjust the unit costs.
6 Costs do not include conveyance costs through CCWD or EBMUD systems.
7 The BARDP Pilot Study Engineering Report references a 5% interest rate and 2% inflation rate, but also references using a 3% discount rate for the life cycle cost analysis. It is not clear which of these assumptions were used in the later tables.

4.4 Preliminary Implementation Schedule

Several studies have already taken place for BARDP, including the BARDP Feasibility Study[7] (Feasibility Study) which investigated several potential infrastructure options and evaluated several site locations in the Bay Area against a set of criteria, and the 2010 Pilot Testing at Mallard Slough Engineering Report (Pilot Engineering Report)[8].

Several additional steps need to be taken prior to making final decisions on this project, including: a) inter-agency agreements that clearly define agency roles and responsibilities, and agreement between agencies as to the size and location of the project; b) final site selection, which will involve discussions with land owners and regulatory agencies; c) completion of an Environmental Impact Report (EIR) and possibly and Environmental Impact Statement (EIS); d) preliminary designs and geotechnical investigations; and e) determination of monthly water

7 Bay Area Regional Desalination Project Feasibility Study, 2007, prepared by URS for Contra Costa Water District, East Bay Municipal Utility District, San Francisco Public Utilities Commission, and Santa Clara Valley Water District. http://www.regionaldesal.com/documents.html
8 Bay Area Regional Desalination Project Pilot Testing at Mallard Slough Engineering Report, 2010, prepared by MWH for Contra Costa Water District, East Bay Municipal Utility District, San Francisco Public Utilities Commission, and Santa Clara Valley Water District. http://www.regionaldesal.com/documents.html

extraction to ensure compliance with existing water rights that CCWD has at the Mallard Slough PS.[9]

In addition, CCWD is beginning evaluation of the potential for use of the Los Vaqueros Reservoir for storage of the BARDP and other supplies. EBMUD is evaluating the potential hydraulic capacity and treatment and conveyance requirements to convey water from either the desalination water treatment plant site or the CCWD system to other potential users in the Bay Area (i.e., SCVWD, SFPUC, Zone 7, and BAWSCA). These studies are anticipated to be completed in Spring/Summer of 2013.

After completion of these additional studies a determination will be made whether this project will be sponsored, by which agencies and the time frame to implement the project. Based on the earlier BARDP studies it is estimated that it will take approximately 6 to 7 years to complete the environmental documentation, design, construction and startup.

The Pilot Engineering Report the implementation schedule included the following elements:

- Planning and design – 48 months;
- Construction and commissioning (startup) – additional 30 months; for
- Total time from finalizing the Pilot Engineering Report – 72 to 80 months.

4.5 Other Project Information and Evaluation Criteria

One of the goals of the Strategy, as described in the *Phase I Scoping Report,* is to develop a quantitative and defensible project evaluation. To that end evaluation criteria and metrics have been developed to facilitate that process. *Appendix A – Revised Draft Task 6-A Memo: Refined Evaluation Criteria and Metrics* in the *Task 1 TM* presents that process and criteria. These six criteria include:

- Increase Supply Reliability;
- Provide High Level of Water Quality;
- Minimize Cost of New Water Supplies;
- Reduce Potable Water Demand;
- Minimize Environmental Impacts; and

[9] Between CCWD's existing water extraction permit and license, a total of 26,780 AF can be diverted per year. While the Mallard Slough PS may be subject to pumping restrictions for one month out of the year, sufficient water rights should exist to accommodate the 25 mgd of raw water needed for a 20 mgd treated water desalination plant. This is based on realizing an overall 75% efficiency with the treatment process.

- Increase Implementation Potential.

The current memo focuses on the supply reliability (yield for normal and dry years), facilities and cost, and schedule. Other information that is currently available is included in the appendices to this TM. Some of the information for Table 15 will be developed and updated at a later time when a common comparison and development of values will be prepared for all projects.

4.6 Key Assumptions and Issues

Several key assumptions were presented in the Pilot Engineering Report that affects the overall costs, including:

- Power costs associated with pumping brine to a discharge facility are not included in annual O&M cost estimates;

- Cost of electrical power is based on Reclamation rates which are lower than could be obtained by non-Reclamation agencies. If CCWD is not the owning and operating partner these costs could be significantly higher;

- The estimates are based on 100% production throughout the year, with the exception of Scenario 2 (which assumes 100% production every third year, with moth balling involving minimal maintenance in between);

- All construction cost estimates made by BARDP assume that there will be no overtime labor;

- The BARDP estimates assume $1M for brine concentrate discharge permitting fees and discharge facility construction each;

- Additional costs from agency-specific blending, storage and/or conveyance fees are not included in the estimate;

- The BARDP Pilot Study Engineering Report references a 5% interest rate and 2% inflation rate, but also references using a 3% discount rate for the life cycle cost analysis. It is not clear which of these assumptions were used in the table provided; and

- The estimate assumes that the cost of land will be $3.5M for 10 acres.

Table 15
Summary Project Evaluation Criteria and Metric Values

Objective	Criteria	Metrics	Project Values – Bay Area Regional Desalination Project [1] Scenario 1	Scenario 2	Scenario 3
1 - Increase Supply Reliability	**Criterion 1A** – Ability to Meet Normal Year Supply Need	Quantitative (AF /year): Average annual yield in normal years in 2018 and 2035.[(2,3)]	22,400	0	22,400
	Criterion 1B – Ability to Meet Drought Supply Need	Quantitative (AF/year): Average annual yield with drought hydrology of 1987 – 1992. [(2,3)]	22,400	7,600	22,400
	Criterion 1C – Risk of Facility Outage	Qualitative (1-5): Estimated probability and duration of major conveyance failure	1	1	1
	Criterion 1D – Potential for Regulatory Vulnerability	Qualitative (1-5): Potential for regulatory decisions to impact supply reliability	1	1	1
2 - Provide High Level of Water Quality	**Criterion 2A** – Meets or Surpasses Drinking Water Quality Standards	Quantitative (mg/L): Total dissolved solids (TDS) level as an indicator of water quality.	<120	<120	<120
	Criterion 2B – Meets or Surpasses Non-Potable Water Quality Standards	Qualitative: Meets minimum water quality requirement (e.g., Title 22) for the targeted use. (Yes or no)	N/A	N/A	N/A
3 - Minimize Cost of New Water Supplies	**Criterion 3** – Capital and Present Worth Costs	Quantitative ($/AF): Present Worth unit costs including capital and operating costs	$ 550	$ 1,069	$ 565
4 - Reduce Potable Water Demand	**Criterion 4** – Augment Non-Potable Water Supplies	Quantitative (AF/year): Reduction of potable water demand by use of non-potable supply.	N/A	N/A	N/A
5 - Minimize Environmental Impacts	**Criterion 5A** –Greenhouse Gas Emissions	Quantitative (metric tons/ AF of Supply): Estimates of unit greenhouse gas emissions	1	1	1
	Criterion 5B –Impact to Groundwater Quantity and Quality	Qualitative (1-5): Potential impacts to groundwater levels, groundwater quality, or potential for subsidence	1	1	1
	Criterion 5C –Impact to Habitat	Qualitative (1-5): Potential impacts to habitat, such as wetlands, riparian zones, fisheries, and inundation areas.	1	1	1
6 - Increase Implementation Potential	**Criterion 6A** – Institutional Complexity	Qualitative (1-5): Number and type of agencies and agreements involved	1	1	1
	Criterion 6B –Level of Local Control	Qualitative (1-5): BAWSCA and Member Agency ownership of supply projects	1	1	1
	Criterion 6C –Permitting Requirements	Qualitative (1-5): Permitting or regulatory issues for supply projects	1	1	1

Institutional issues will include:

- Facility ownership;
- Who will operate the facilities; and,
- Potential users (purchasers of the supply).

These institutional issues will likely be addressed in a formal agreement as the planning and preliminary design process moves forward. Other key issues that will affect permitting and cost include:

- Cost estimates do not include the cost of conveyance (including potential additional treatment) through CCWD and EBMUD transmission systems;
- Identifying the final brine disposal option. There are several potential options, including co-location with either wastewater streams or cooling plants; and
- Source water intake. If the desalination plant is not located at Mallard Slough (where CCWD already operates a surface water intake), alternate intake options would need to be evaluated.

4.7 BARDP Future Plans

Several steps need to be taken for BARDP to move forward: a) inter-agency agreements that clearly define agency roles and responsibilities, and agreement between agencies as to the size and location of the project; b) final site selection, which will involve discussions with land owners and regulatory agencies; c) completion of an Environmental Impact Report (EIR) and possibly and Environmental Impact Statement (EIS); d) preliminary designs and geotechnical investigations; and e) determination of monthly water extraction to ensure compliance with existing water rights that CCWD has at the Mallard Slough PS.[10]

In addition, CCWD is beginning evaluation of the potential for use of the Los Vaqueros Reservoir for storage of the BARDP and other supplies. EBMUD is evaluating the potential hydraulic capacity and treatment and conveyance requirements to convey water from either the desalination water treatment plant site or the CCWD system to other potential users in the Bay Area (i.e., SCVWD, SFPUC, Zone 7, and BAWSCA). These studies are anticipated to be completed in Spring/Summer of 2013.

[10] Between CCWD's existing water extraction permit and license, a total of 26,780 AF can be diverted per year. While the Mallard Slough PS may be subject to pumping restrictions for one month out of the year, sufficient water rights should exist to accommodate the 25 mgd of raw water needed for a 20 mgd treated water desalination plant. This is based on realizing an overall 75% efficiency with the treatment process.

4.8 BAWSCA Potential Next Steps for BARDP

A key part of feasibility of this project is the ability to convey the water from the water desalination treatment plant site or CCWD system to potentially interested BAWSCA agencies as well as the BARDP partners. BAWSCA will be closely watching the evaluations being performed by CCWD and EBMUD to evaluate the capacity and potential cost to convey this water to the BAWSCA agencies. In addition, BAWSCA will continue to engage the BARDP agencies to determine who is interested in this supply, and what quantities may be available to the BAWSCA member agencies if they are interested.

Appendix A
Agency-Identified Groundwater and Desalination Projects

This appendix summarizes a) why the agency-identified projects identified as part of Phase I of the Long-Term Water Supply Strategy (Strategy) were removed during this Phase II A of the Strategy, b) focuses on the new groundwater and desalination projects developed in Phase II A, and c) how they relate to potential regional water supply management projects.

In this Appendix:

The groundwater projects discussed are assumed to be freshwater not brackish groundwater projects. The desalination projects could be treating brackish groundwater, saline ocean or Bay water.

A.1 Summary

The *Phase I Scoping Report (Phase I Report) for the Long-Term Water Supply Strategy* (May 2010) identified 65 agency projects, of which 30 were freshwater groundwater projects and one desalination project. As part of the Phase II A screening the majority of all of the project, including groundwater and desalination projects, were removed from further evaluation within the Strategy for the following reasons:

- Independent implementation by the agency;
- Infeasibility due to water quality issues;
- Implementation as part of the San Francisco Public Utilities Commission (SFPUC) Water Supply Improvement Program (WSIP) to provide dry year supply reliability;
- No additional supply provided or additional yield was unlikely;
- Lack of interest by the agency in pursuing the project;
- Regulatory restrictions;
- Existing wells would remain as only emergency supply;
- The project was a study only, not a supply project;
- No commitment to pursuing this project as part of the Strategy;
- No commitment to pursuing this project as part of the Strategy; however, similar projects are being evaluated in the Strategy as part of the analysis of regional water transfer options; or

Four projects are continuing in the Strategy, including:

- DC-4: Daly City Recycled Water Service to Cemeteries;
- NC-4: North Coast County Water District (NCCWD) Desalination Plant;
- PA-2: Palo Alto Expand Recycled Water Plant to Serve Stanford Research Park; and
- RC-4: Redwood City Recycled Water Treatment Plant Expansion.

None of these continuing projects include fresh or brackish groundwater, and there are no continuing agency-identified desalination projects, with the exception of a representative coastal desalination project which replaced the NCCWD desalination project since NCCWD was not interested in being a proponent for the project. The *Task 2 Technical Memorandum* provides information on the four projects indicated above. The one brackish groundwater project identified by the California Water Services Company (Cal Water) has been delayed, but may be developed as their own project or as a regional project in later phases of the Strategy.

A.2 Phase I Agency-Identified Projects

The *Phase I Scoping Report* for the identified 65 agency projects as existing, planned, or potential opportunities that could be included in the Strategy. These projects, summarized in Table A-1, include development of groundwater, recycled water, or desalination sources within the BAWSCA service area, and potential water transfers from outside the Bay Area to the member agencies, or between member agencies. Of these 65 projects 30 projects were freshwater groundwater projects and one desalination project.

Table A-1
Agency-Identified Projects in Phase I of the Strategy

Agency	Project ID	Water Type	Project Status	Project Name
Alameda County Water District (ACWD)	AC-1	Recycled Water	Planned	Alternative 1 - Connect to South Bay Water Recycling
	AC-2	Recycled Water	Planned	Project A - Irvington Pump Station Recycled Water Project
	AC-3	Recycled Water	Potential	Project B - Alvarado Wastewater Treatment Plant Recycled Water Project
Cal Water	CW-1	Groundwater	Existing	Regional Groundwater Storage and Recovery Project - Cal Water
	CW-2	Groundwater	Planned	Mid-Peninsula Groundwater Investigation
	CW-3/SB-3	Recycled Water	Planned	Joint Cal Water, South San Francisco, San Bruno and SFPUC Recycled Water Project - Cal Water
	CW-4	Groundwater	Potential	Expansion of Mid-Peninsula Groundwater
	CW-5	Recycled Water	Potential	Expansion of Joint Cal Water, South San Francisco, San Bruno and SFPUC Recycled Water Project
Coastside County Water District	CS-1	Recycled Water	Planned	Recycled Water Project Development
	CS-2	Recycled Water	Planned	Increase Yield of Recycled Water Project to 2,240 acre-feet per year (AF/year)
	CS-3	Recycled Water	Potential	Increase Yield of Recycled Water Project Beyond 2,240 AF/year

Table A-1
Agency-Identified Projects in Phase I of the Strategy

Agency	Project ID	Water Type	Project Status	Project Name
Daly City	DC-1	Groundwater	Existing	Regional Groundwater Storage and Recovery Project - Daly City
	DC-2	Groundwater	Planned	Replacement Well Project
	DC-3	Groundwater	Potential	Emergency Supply Retrofit of A Street Well
	DC-4	Recycled Water	Potential	Daly City Recycled Water Service to Cemeteries
East Palo Alto	EPA-1	Groundwater	Existing	Rehabilitate Existing Gloria Bay Well
	EPA-2	Recycled Water	Planned	Scalping Plant Development
	EPA-3	Groundwater	Potential	Install New Well
	EPA-4	Recycled Water	Potential	Expand Scalping Plant Supply Beyond EPA-2 Capacity
Hayward	HAY-1A	Recycled Water	Planned	Construct New Recycled Water Plant to Deliver Up to 3,920 AF/year
	HAY-1B	Recycled Water	Planned	Utilize Excess Recycled Water from Planned Plant Not Used by Calpine, 680 AF/year
	HAY-2	Groundwater	Potential	Upgrade Current Emergency Wells to Normal Year Supply
	HAY-3	Recycled Water	Potential	Construct Larger Plant to Supply Recycled Water Above 4,600 AF/year
Menlo Park	MEN-1	Groundwater	Planned	Construct Additional Wells for Emergency Use
	MEN-2	Groundwater	Potential	Construct Wells for Normal Year Supply
	MEN-3	Groundwater	Potential	Construct Wells for Irrigation Supply
	MEN-4	Groundwater	Potential	Upgrade Emergency Wells to Supplement Normal Year Supply (from MEN-1)
Millbrae	MILL-1	Recycled Water	Planned	Recycled Water Treatment Plant Construction
	MILL-2	Recycled Water	Potential	Expand New Treatment Plant to Serve Recycled Water Beyond Planned 1 mgd Capacity
Milpitas	MILP-1	Groundwater	Existing	Pinewood Well Conversion to Normal Supply
	MILP-2	Groundwater	Potential	Curtis Well Conversion to Normal Supply
Mountain View	MV-1	Recycled Water	Existing	Increase Recycled Water Purchases to Demand of 1,200 AF/year
	MV-2	Recycled Water	Existing	Feasibility Study for Recycled Water Intertie with Sunnyvale
	MV-3	Recycled Water	Existing	Conduct a Joint Recycled Water Feasibility Study with Palo Alto Regional Water Quality Control Park (PARWQCP)
	MV-4	Groundwater	Planned	Complete Two Well Rehabilitation Projects by 2015
	MV-5	Groundwater	Potential	Integrate 4 Emergency Wells into Normal Year Supply
	MV-6	Recycled Water	Potential	Increase Use of Palo Alto Recycled Water Above Projected Demand of 1,800 AF/year (see MV-3 entry)
North Coast County Water District (NCCWD)	NC-1	Recycled Water	Existing	Calera Creek Water Recycling Plant - Phase 1
	NC-2	Recycled Water	Planned	Calera Creek Water Recycling Plant - Phase 2
	NC-3	Recycled Water	Potential	Calera Creek Water Recycling Plant - Phase 3
	NC-4	*Desalination*	Potential	NCCWD Desalination Plant
Palo Alto[1]	PA-1	Groundwater	Existing	Rehabilitate 5 Existing Wells and Construct 3 New Wells
	PA-2/PA-4	Recycled Water	Existing	Expand Recycled Water Plant to Serve Stanford Research Park and Additional Areas
	PA-3	Groundwater	Potential	Convert Existing or Planned Emergency Wells to Normal Year Supply
Redwood City	RC-1	Recycled Water	Existing	Redwood City Recycled Water Utilization Project
	RC-2	Groundwater	Potential	Redwood City Normal Year Supply Well Construction
	RC-3	Groundwater	Potential	Expansion of Redwood City Normal Year Supply Well Construction
	RC-4	Recycled Water	Potential	Redwood City Recycled Water Treatment Plant Expansion

Table A-1
Agency-Identified Projects in Phase I of the Strategy

Agency	Project ID	Water Type	Project Status	Project Name
San Bruno	SB-1	Groundwater	Existing	Regional Groundwater Storage and Recovery Project - San Bruno
	SB-2	Groundwater	Potential	Maximize Safe Yield of Wells Based on Groundwater Management Plan
	CW-3/SB-3	Recycled Water	Potential	Joint Cal Water, South San Francisco, San Bruno and SFPUC Recycled Water Project - San Bruno
San Jose	SJ-1	Recycled Water	Existing	SBWR Expansion - San Jose
	SJ-2	Groundwater	Planned	San Jose Well Construction
	SJ-3	Groundwater	Potential	Expansion of San Jose Well Construction
Santa Clara	SC-1	Recycled Water	Existing	SBWR Expansion - Santa Clara
	SC-2	Groundwater	Planned	Santa Clara Groundwater Wells 32 and 34
	SC-3	Groundwater	Potential	Expand Santa Clara Groundwater Wells 32 and 34
Stanford University	SU-1	Groundwater	Potential	Increase Existing Well Use for Non-Potable Supply
	SU-2	Recycled Water	Potential	Increase Use of Recycled Water from Cooling Tower Blowdown
	SU-3	Recycled Water	Potential	Develop a Scalping Plant for Landscape and Playfield Irrigation
Sunnyvale	SV-1	Groundwater	Existing	Convert One Standby Well to Normal Supply
	SV-2	Recycled Water	Existing	Increase Recycled Water Output from WWTP
	SV-3	Groundwater	Planned	Construct New Wells for Normal Supply
	SV-4	Groundwater	Potential	Expand Use of New or Converted Wells to Normal Year Supply
	SV-5	Recycled Water	Potential	Maximize Recycled Water Output from WWTP

[1] In the Phase 1 Scoping Report, PA-2 and PA-4 were indicated as one project. PA-4 has been split out as a separate, new project.
AF=acre-feet; SBWR=South Bay Water Recycling; SFPUC=San Francisco Public Utilities Commission.

A.3 Phase II A Project Screening

A.3.1 Initial Screening

In September 2010, CDM Smith developed a Project Information Sheet for each of the 65 projects to consolidate the information available from the Phase I Scoping Report. The Project Information Sheets identified: (1) the information needed to support the comparison of projects; and (2) the project information that was available from existing studies and documents.

In October 2010, each agency received a Project Information Sheet for each project they had identified within their service area. Each member agency was asked to review the Project Information Sheets and complete them if information was available. In November and December 2010 BAWSCA and CDM Smith held individual meetings with each agency to discuss details of their projects, along with their expectations for the Strategy.

Through the course of the meetings, seven member agencies added projects to the Strategy, as shown in Table A-2. These were projects that had been: (1) identified subsequent to the completion of the Phase I Scoping Report; (2) identified as distinct elements of a project identified in Phase I; or (3) were future expansions of projects identified in Phase I. One of the projects added was a freshwater groundwater project and two were desalination projects.

Table A-2
Agency-Identified Projects Added During Agency Meetings

Agency	Project ID	Water Type	Project Status	Project Name
ACWD	AC-4	Desalination	Potential	East Bay Saline Groundwater Desalination Facility
California Water Services Company (Cal Water)	CW-6	Desalination	Potential	Cal Water Desalination Project
Coastside County Water District	CS-4	Groundwater	Existing	Restore Denniston Well Field to Historical Yield of 614-920 AFY
Hillsborough	HB-1	Stormwater Capture	Potential	Pipe Stormwater to Reservoir Road Reservoir for Irrigation Use in the El Cerrito Area
Palo Alto[1]	PA-4	Recycled Water	Potential	Expand Recycled Water Plant to Serve Additional Areas
San Jose	SJ-4	Treated	Potential	Intertie Connection with SCVWD
Stanford University	SU-4	Raw Water	Existing	Local Activities to Reduce Demand

[1] In the *Phase 1 Scoping Report*, PA-2 and PA-4 were one project. PA-4 has been split out as a separate, new project based on discussions during the agency meetings.

In addition, based on subsequent discussions with the member agencies regarding their current plans and activities, 40 projects were removed from further consideration in the Strategy. The reasons that agencies opted to remove a project, including the freshwater groundwater projects and desalination projects, were:

- Independent implementation by the agency;
- Infeasibility due to water quality issues;
- Implementation as part of the SFPUC WSIP to provide dry year supply reliability;
- No additional supply provided or additional yield was unlikely;
- Lack of interest by the agency in pursuing the project;
- Regulatory restrictions;
- Existing wells would remain as emergency supply; or
- The project was a study only, not a supply project.

Table A-3 identifies the 40 projects that were removed from consideration in the Strategy in November and December 2010. These projects are identified in Table A-3 as being removed during the "Individual agency meetings" step of the project screening process. The additional 21 projects that were removed in later stages of the project screening process are also shown in Table A-3. Through this process all of the freshwater groundwater projects were removed as well as the desalination project. However, some of the groundwater projects were going forward as agency only projects.

The *Task 2 Technical Memorandum* describes this screening process in more detail.

A.3.2 Follow-up Agency Discussions

In January 2011, for the 32 proposed retained projects, BAWSCA sent each agency a commitment letter wherein each agency was asked to confirm which of their projects they would like retained in the Strategy, and to commit to which of the remaining information gaps the agency would fill for each project and by when.

Following the return of the commitment letters, BAWSCA and CDM Smith met with several of the agencies in April 2011 for follow-up discussions regarding their projects. These were agencies who had agreed to develop additional information and the purposes of the meetings were to identify any outstanding questions, or issues regarding the projects. These meetings were held to confirm member agency interest in the potential projects and the schedule of project information development identified in the commitment letters. Based on the information collected from the commitment letters and the follow-up meetings, 21 additional projects (for a total of 61) were removed from consideration in Phase II A of the Strategy. These projects are identified in Table A-3 as being removed during the "Follow-up agency meeting" step of the project screening process. Reasons for removing these projects included:

- No commitment to pursuing this project as part of the Strategy;
- Similar projects are being evaluated in the Strategy as part of the analysis of regional water transfer options;
- Insufficient yield to provide regional benefit; or
- Independent implementation by the agency.

Table A-3
Agency-Identified Projects Removed During Phase II A Agency Meetings and Follow-up Discussions

Agency	Project ID	Water Type	Project Status	Project Name	Reason for Removal	Removed During Which Task Phase II-A Step
ACWD	AC-1	Recycled Water	Planned	Alternative 1 - Connect to South Bay Water Recycling	Being implemented independently	Individual agency meetings
	AC-2	Recycled Water	Planned	Project A - Irvington Pump Station Recycled Water Project	Being implemented independently	Individual agency meetings
	AC-3	Recycled Water	Planned	Project B - Alvarado Wastewater Treatment Plant Recycled Water Project	Being implemented independently	Individual agency meetings
	AC-4	Desalination	Potential	East Bay Saline Groundwater Desalination Facility	Not interested due to potential impact to existing freshwater and brackish groundwater supplies	Follow-up agency meetings
California Water Services Company (Cal Water)	CW-1	Groundwater	Existing	Regional Groundwater Storage and Recovery Project - Cal Water	Being implemented as part of SFPUC WSIP to provide dry year supply reliability	Individual agency meetings
	CW-2	Groundwater	Planned	Mid-Peninsula Groundwater Investigation	Study only; planned to be implemented by Cal Water	Individual agency meetings
	CW-3/SB-3	Recycled Water	Planned	Joint Cal Water, South San Francisco, San Bruno and SFPUC Recycled Water Project - Cal Water	Project does not provide additional yield	Follow-up agency meetings
	CW-4	Groundwater	Potential	Expansion of Mid-Peninsula Groundwater	Being implemented independently	Individual agency meetings
	CW-5	Recycled Water	Potential	Expansion of Joint Cal Water, South San Francisco, San Bruno and SFPUC Recycled Water Project	Project does not provide additional yield	Follow-up agency meetings
Coastside County Water District	CS-1	Recycled Water	Planned	Recycled Water Project Development	Agency has not committed to pursuing this project as part of the Strategy	Follow-up agency meetings
	CS-2	Recycled Water	Planned	Increase Yield of Recycled Water Project to 2,240 AFY	Expansion of recycled water project not feasible at this time	Individual agency meetings
	CS-3	Recycled Water	Potential	Increase Yield of Recycled Water Project Beyond 2,240 AFY	Expansion of recycled water project not feasible at this time	Individual agency meetings
	CS-4	Groundwater	Existing	Restore Denniston Well Field to Historical Yield of 614-920 AF/year	Being implemented independently	Individual agency meetings

Table A-3
Agency-Identified Projects Removed During Phase II A Agency Meetings and Follow-up Discussions

Agency	Project ID	Water Type	Project Status	Project Name	Reason for Removal	Removed During Which Task Phase II-A Step
Daly City	DC-1	Groundwater	Existing	Regional Groundwater Storage & Recovery Project - Daly City	Being implemented as part of SFPUC WSIP to provide dry year supply reliability	Individual agency meetings
	DC-2	Groundwater	Planned	Replacement Well Project	Being implemented independently	Individual agency meetings
	DC-3	Groundwater	Potential	Emergency Supply Retrofit of A Street Well	Being implemented independently	Individual agency meetings
East Palo Alto	EPA-1	Groundwater	Existing	Rehabilitate Existing Gloria Bay Well (estimated 350 gallons per minute (gpm)	The potential yield of the project is insufficient to provide regional benefit	Follow-up agency meetings
	EPA-2	Recycled Water	Planned	Scalping Plant Development	The potential yield of the project is insufficient to provide regional benefit	Follow-up agency meetings
	EPA-3	Groundwater	Potential	Install New Well	The potential yield of the project is insufficient to provide regional benefit	Follow-up agency meetings
	EPA-4	Recycled Water	Potential	Expand Scalping Plant Supply Beyond EPA-2 Capacity	Expansion not feasible at this time	Individual agency meetings
Hayward	HAY-1A	Recycled Water	Planned	Construct New Recycled Water Plant to Deliver Up to 3,920 AF/year	Agency is unable to provide project information on a schedule that is consistent with the timing of the Phase II A evaluation; project may be revisited in Phases II B or II C of the Strategy	Follow-up agency meetings
	HAY-1B	Recycled Water	Planned	Utilize Excess Recycled Water from Planned Plant Not Used by Calpine, 680 AF/year	Agency is unable to provide project information on a schedule that is consistent with the timing of the Strategy Phase II A evaluation. Project may be revisited in later phases of the Strategy	Follow-up agency meetings
	HAY-2	Groundwater	Potential	Upgrade Current Emergency Wells to Normal Year Supply	Agency has not committed to pursuing this project as part of the Strategy	Follow-up agency meetings
	HAY-3	Recycled Water	Potential	Construct Larger Plant to Supply Recycled Water Above 4,600 AF/year	Agency has not committed to pursuing this project as part of the Strategy	Follow-up agency meetings

Table A-3
Agency-Identified Projects Removed During Phase II A Agency Meetings and Follow-up Discussions

Agency	Project ID	Water Type	Project Status	Project Name	Reason for Removal	Removed During Which Task Phase II-A Step
Hillsborough	HB-1	Stormwater	Potential	Pipe Stormwater to Reservoir Road Reservoir for Irrigation Use in the El Cerrito Area	Agency has not committed to pursuing this project as part of the Strategy	Follow-up agency meetings
Menlo Park	MEN-1	Groundwater	Planned	Construct Additional Wells for Emergency Use	Being implemented independently	Individual agency meetings
	MEN-2	Groundwater	Potential	Construct Wells for Normal Year Supply	Not interested due to additional regulations for normal supply wells	Individual agency meetings
	MEN-3	Groundwater	Potential	Construct Wells for Irrigation Supply	Being implemented independently	Individual agency meetings
	MEN-4	Groundwater	Potential	Upgrade Emergency Wells to Supplement Normal Year Supply (from MEN-1)	Not interested due to additional regulations for normal supply wells	Individual agency meetings
Millbrae	MILL-1	Recycled Water	Planned	Recycled Water Treatment Plant Construction	Agency has not committed to pursuing this project as part of the Strategy	Follow-up agency meetings
	MILL-2	Recycled Water	Potential	Expand New Treatment Plant to Serve Recycled Water Beyond Planned 1 mgd Capacity	Millbrae not pursuing at this time	Individual agency meetings
Milpitas	MILP-1	Groundwater	Existing	Pinewood Well Conversion to Normal Supply	Well will remain emergency supply	Individual agency meetings
	MILP-2	Groundwater	Potential	Curtis Well Conversion to Normal Supply	Well will remain emergency supply	Individual agency meetings
Mountain View	MV-1	Recycled Water	Existing	Increase Recycled Water Purchases to Demand of 1,200 AF/year	Being implemented independently	Individual agency meetings
	MV-4	Groundwater	Planned	Complete Two Well Rehabilitation Projects by 2015	Being implemented independently	Individual agency meetings
	MV-5	Groundwater	Potential	Integrate 4 Emergency Wells into Normal Year Supply	Being implemented independently	Individual agency meetings
	MV-6	Recycled Water	Potential	Increase Use of Palo Alto Recycled Water Above Projected Demand of 1,800 AF/year (see MV-3 entry)	Agency not interested in pursuing at this time	Individual agency meetings

Table A-3
Agency-Identified Projects Removed During Phase II A Agency Meetings and Follow-up Discussions

Agency	Project ID	Water Type	Project Status	Project Name	Reason for Removal	Removed During Which Task Phase II-A Step
NCCWD	NC-1	Recycled Water	Existing	Calera Creek Water Recycling Plant - Phase 1	Being implemented independently	Individual agency meetings
	NC-2	Recycled Water	Planned	Calera Creek Water Recycling Plant - Phase 2	Agency has not committed to pursuing this project as part of the Strategy	Follow-up agency meetings
	NC-3	Recycled Water	Potential	Calera Creek Water Recycling Plant - Phase 3	Agency has not committed to pursuing this project as part of the Strategy	Follow-up agency meetings
Palo Alto	PA-1	Groundwater	Existing	Rehabilitate 5 Existing Wells and Construct 3 New Wells	Being implemented independently	Individual agency meetings
	PA-3	Groundwater	Potential	Convert Existing or Planned Emergency Wells to Normal Year Supply	Precluded by existing permit, well will remain emergency supply	Individual agency meetings
	PA-4	Recycled Water	Potential	Expand Recycled Water Plant to Serve Additional Areas	Agency is unable to provide project information on a schedule that is consistent with the timing of the Phase II A evaluation; project may be revisited in later phases of the Strategy	Follow-up agency meetings
Redwood City	RC-1	Recycled Water	Existing	Redwood City Recycled Water Utilization Project	Project is being completed by agency independent of the Strategy	Follow-up agency meetings
	RC-2	Groundwater	Potential	Redwood City Normal Year Supply Well Construction	The potential yield of the project is insufficient to provide regional benefit	Follow-up agency meetings
	RC-3	Recycled Water	Existing	Expansion of Redwood City Normal Year Supply Well Construction	Additional yield beyond RC-2 is unlikely	Individual agency meetings
San Bruno	SB-1	Groundwater	Existing	Regional Groundwater Storage and Recovery Project – San Bruno	Being implemented as part of SFPUC WSIP to provide dry year supply reliability	Individual agency meetings
	SB-2	Groundwater	Potential	Maximize Safe Yield of Wells Based on Groundwater Management Plan	Being implemented independently	Individual agency meetings
	CW-3/SB-3	Recycled Water	Potential	Joint Cal Water, South San Francisco, San Bruno and SFPUC Recycled Water Project - San Bruno	Project does not provide additional yield.	Follow-up agency meetings

Table A-3
Agency-Identified Projects Removed During Phase II A Agency Meetings and Follow-up Discussions

Agency	Project ID	Water Type	Project Status	Project Name	Reason for Removal	Removed During Which Task Phase II-A Step
San Jose	SJ-1	Recycled Water	Existing	SBWR Expansion - San Jose	Being implemented independently	Individual agency meetings
	SJ-2	Groundwater	Planned	San Jose Well Construction	Being implemented independently	Individual agency meetings
	SJ-3	Groundwater	Potential	Expansion of San Jose Well Construction	Infeasible due to water quality issues	Individual agency meetings
Santa Clara	SC-1	Recycled Water	Existing	SBWR Expansion – Santa Clara	Being implemented independently	Individual agency meetings
	SC-2	Groundwater	Planned	Santa Clara Groundwater Wells 32 and 34	Being implemented independently	Individual agency meetings
	SC-3	Groundwater	Potential	Expand Santa Clara Groundwater Wells 32 and 34	Infeasible due to water quality issues	Individual agency meetings
Stanford University	SU-1	Groundwater	Potential	Increase Existing Well Use for Non-Potable Supply	Agency has not committed to pursuing this project as part of the Strategy	Follow-up agency meetings
	SU-2	Recycled Water	Potential	Increase Use of Recycled Water from Cooling Tower Blowdown	Being implemented independently	Individual agency meetings
	SU-3	Recycled Water	Potential	Develop a Scalping Plant for Landscape and Playfield Irrigation	Agency has not committed to pursuing this project as part of the Strategy	Follow-up agency meetings
	SU-4	Raw Water	Existing	Local Activities to Reduce Demand	Being implemented independently	Individual agency meetings
Sunnyvale	SV-1	Groundwater	Existing	Convert One Standby Well to Normal Supply	Being implemented independently	Individual agency meetings
	SV-3	Groundwater	Planned	Construct New Wells for Normal Supply	Being implemented independently	Individual agency meetings
	SV-5	Recycled Water	Potential	Maximize Recycled Water Output from WWTP	Agency has not committed to pursuing this project as part of the Strategy	Follow-up agency meetings

A.3.3 Priority Projects for Phase II A

As a result of the follow-up agency meetings, four agency-identified projects were identified for evaluation in Phase II A of the Strategy.

In order to track each agency-indentified project, a unique identifier was developed with the first two letters representing the agency with the following number indicating the project number.

- DC-4: Daly City Recycled Water Service to Cemeteries;
- NC-4: North Coast County Water District (NCCWD) Desalination Plant;

- PA-2: Palo Alto Expand Recycled Water Plant to Serve Stanford Research Park; and
- RC-4: Redwood City Recycled Water Treatment Plant Expansion.

Of the four projects retained for evaluation, two projects provided sufficient potential regional benefit, yet the agencies lacked resources to further develop the projects in time for the Phase II A evaluations in early 2012. BAWSCA decided that these two projects should continue to be evaluated at this time. CDM Smith, as part of the Strategy Team, was directed to develop the information necessary to address remaining data gaps for these two projects:

- Daly City Recycled Water Project - Service Area Expansion (DC-4); and
- Representative Coastal Desalination Water Project (originally North Coast County Water District (NCCWD) – Desalination Plant (NC-4)).

The *Task 2 Technical Memorandum* presents more detailed information on the above two projects that were further developed by the Strategy team.

The remaining two projects retained for evaluation are still being further developed by the agencies:

- City of Redwood City (Redwood City) Recycled Water Treatment Plant Expansion (RC-4); and
- City of Palo Alto (Palo Alto) Expanded Recycled Water Plant to Serve Stanford Research Park (PA-2).

The *Task 2 Technical Memorandum* presents more detailed on the above two projects being further developed by the member agencies.

Some of the agencies are continuing forward with freshwater groundwater projects to address their own supply needs. In general these are smaller capacity (i.e., less than 1 mgd) projects as the freshwater yields are limited. None of the agencies have included new brackish groundwater projects.

Cal Water has delayed their potential desalination project, and may develop this as their own project or as a regional project in later phases of the Strategy.

Appendix B
Groundwater Hydrogeology

This appendix focuses on the current understanding of the hydrogeology on the San Francisco Bay (Bay) side of the San Francisco Peninsula (Peninsula), and how it relates to existing and potential brackish or subsurface Bay water regional water supply projects.

In this Appendix:

B.1 Summary

Several relatively large and high yield groundwater aquifers are located within the BAWSCA service area (e.g., the Westside Groundwater Basin, Santa Clara Groundwater Basin, and the Niles Cone Groundwater Basin). However, these aquifers are already heavily utilized by BAWSCA member agencies and others for conjunctive use operations and water supply. Based on work completed in other portions of the BAWSCA service area, there appears to be limited potential do develop a high-quality (freshwater) groundwater supply to support a regional project. Some smaller scale groundwater projects are being pursued by individual BAWSCA agencies to locally increase their supplies. As such, no such freshwater groundwater projects have been included as part of the Strategy. The discussion of the BAWSCA member agency freshwater projects is discussed in *Appendix A*.

Work completed to date throughout the BAWSCA service area indicates that brackish groundwater aquifers do exist along the western portion of the Bay that are not currently utilized by any of the BAWSCA or other agencies. What has been included as part of the Strategy is the possible development of these brackish groundwater sources to support a regional desalination project.

Brackish groundwater is attractive as a source of supply for a desalination project as the use of a subsurface intake can reduce the pre-treatment requirements, simplify permitting, and reduce capital and operating costs relative to open water intake projects. As such, development of brackish groundwater sources has been included in the Strategy to support the representative regional desalination projects.

The three types of intakes considered for the BAWSCA representative regional desalination projects are: vertical groundwater wells pumping brackish water; subsurface wells (assumed for this analysis to be horizontally directionally drilled wells [HDDW]) pumping Bay water; and open water intakes also pumping Bay water. Depending on the intake type, the quality of the source water varies. For example, the brackish groundwater accessed by vertical wells is assumed to have a salinity ranging from about 1,000 to 10,000 milligrams per liter (mg/L) of Total Dissolved Solids (TDS).

In contrast, the Bay water, which would be accessed via HDDW or open water intakes, is assumed to have a TDS of about 25,000 mg/L.

Several items will need to be addressed to better assess the viability of such projects including verification that:

- The hydraulic capacity exists within the brackish water areas to support from 1 to 5 mgd vertical wells in the Dumbarton Bridge Area;
- Potential hydraulic capacity exists for brackish water areas to support from 1 to 5 mgd vertical wells; and/or subsurface intakes to support Bay water yields ranging from 5 to 15 mgd HDDW for the San Mateo Bridge and South San Francisco Areas;
- There is adequate long-term recharge to support the yields; and
- Pumping within these zones does not significantly impact other freshwater and/or brackish groundwater pumpers.

The necessary studies to address these questions could include:

- Development of a regional groundwater model extending from Peninsula to the recharge areas on the east side of the San Francisco Bay and down to Santa Clara County to provide an initial assessment of the yields, including recharge, and potential impacts of pumping in the brackish zones under the Peninsula, or Bay water from pumping under the Bay; and
- Construction of pilot pumping and monitoring wells to confirm whether the model is representative of the actual conditions in specific locations on the Peninsula and whether the estimated yield is appropriate.

B.2 Hydrogeology

For the purposes of this analysis we distinguish between fresh, brackish groundwater and Bay water sources as potential future water supplies for the BAWSCA member agencies. Throughout these documents we define these sources as follows:

- ***Fresh water sources:*** Salinity range of 50 to 500 milligrams per liter (mg/L) of Total Dissolved Solids (TDS);
- ***Brackish groundwater sources***: Salinity range of 1,000 to 10,000 mg/L of TDS. Brackish groundwater sources are characterized by a blend of inland groundwater sources with moderate salinity and high hardness levels from local geology or mixing with Bay or sea water; and

- ***Bay water sources:*** Salinity range of 10,000 to 30,000 mg/L of TDS[1]: This categorization is used because the complexity and cost of system components begin to increase above a salinity threshold of approximately 10,000 mg/L. Bay water quality is assumed for open intakes, and subsurface intakes under the Bay.

A preliminary investigation has been conducted to identify potential areas suitable for brackish wells or other subsurface intakes along the Bay side of the Peninsula. The criteria included identifying areas that provide:

- Promising geology for brackish groundwater wells or subsurface Bay wells in terms of soil type and permeability for higher yields; and

- Groundwater basins that would minimize potential interference with existing water supplies including Santa Clara Valley production wells and areas with groundwater contamination south of Palo Alto.

BAWSCA agencies on the Peninsula overlie portions of the Santa Clara, Westside, and Visitacion Valley Groundwater Basins on the Bay side. Geological information and data were reviewed from Department of Water Resources (DWR), borings performed for the SF RWS Bay Tunnel Project, and from various other studies associated with groundwater supplies in the Peninsula. The data included existing and expected well yields from the freshwater and brackish aquifers in the vicinity of the BAWSCA service areas along the Peninsula. However, there was very little information on the brackish water aquifers and geology under the Bay itself, except in the area around the Dumbarton Bridge.

Figure B-1 shows the BAWSCA service area and the groundwater study area.

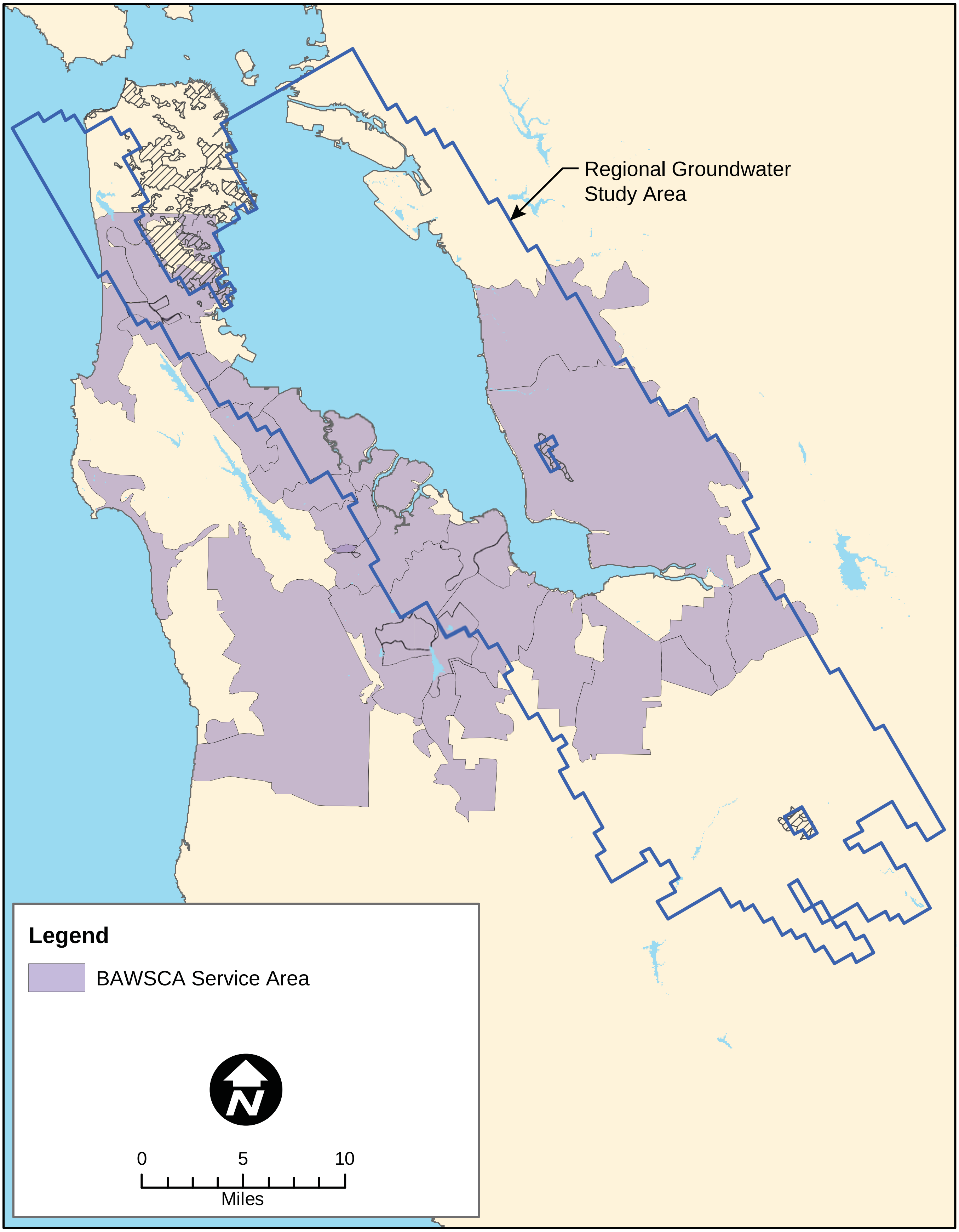
B.2.1 Overview of Bay Sediments along the Peninsula

The geology along the Peninsula includes layers of bedrock covered by interbedded layers of both alluvial materials and clays. The clay layers act as aquitards which limit groundwater flow from one layer to the next. The depth and consistency of these layers varies both north to south along the Peninsula, as well as from east to west between the Bay and the foothills.

Geographic features in the San Francisco Bay Area are often referred to with multiple names, and similar terms often describe different features. For the purposes of this assessment, the term "South San Francisco Bay" will refer to the San Francisco Bay from the Bay Bridge southwards to San Jose.

The geology with the most promising potential yield includes the Niles and San Francisquito alluvial cones in the southern portion of San Francisco Bay, near the Dumbarton Bridge, consisting primarily of deposits of intermittent sandy gravel and clay layers. Figure B-2 indicates these alluvial areas and the geologic cross section near the

[1] For reference, Pacific Ocean seawater typically has a salinity of 35,000 mg/L of TDS.



Source: BAWSCA Strategy, HydroFocus Inc., May 2011

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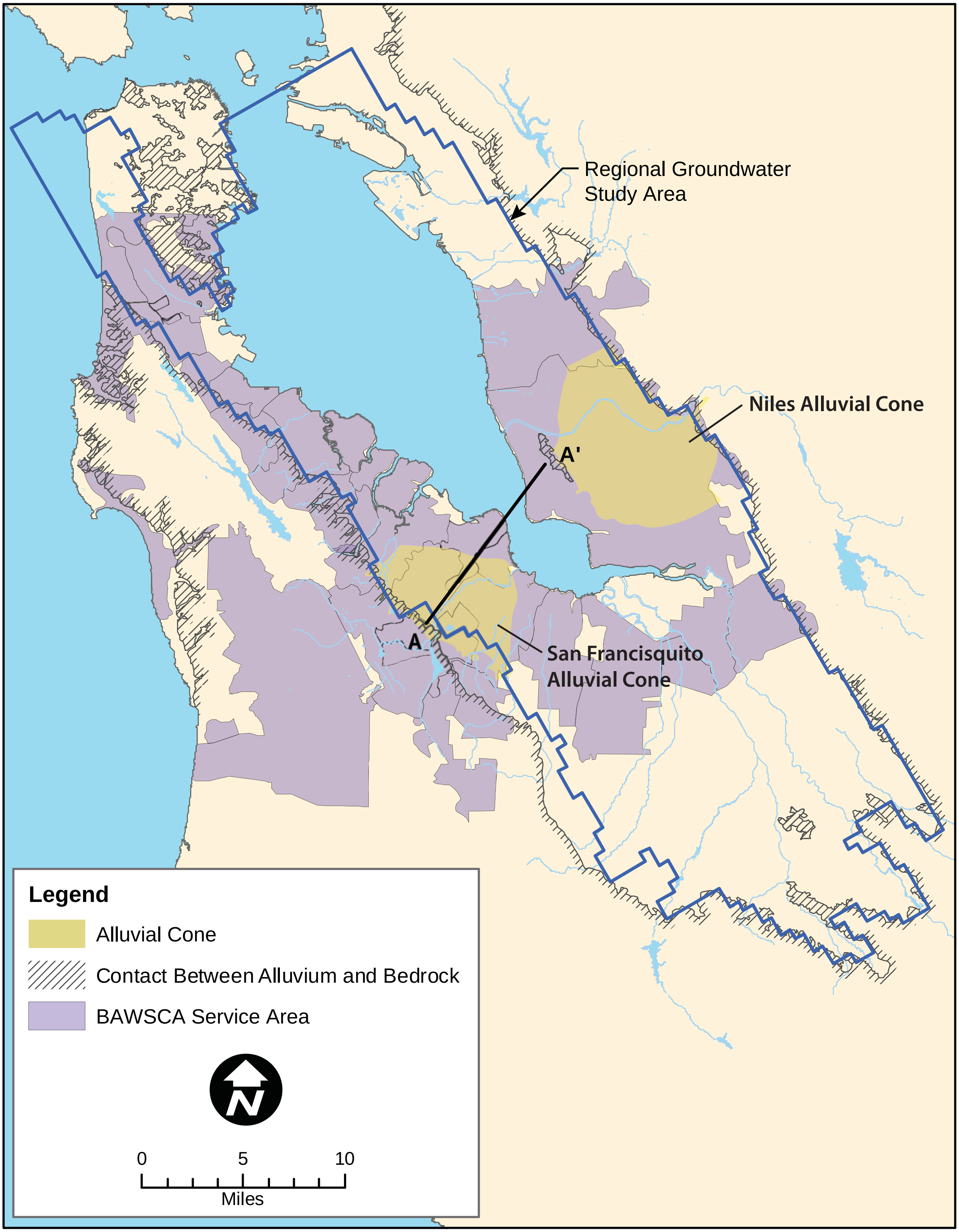
CDM Smith

Figure B-1
BAWSCA Service Area and Groundwater Study Area



Source: BAWSCA Strategy, HydroFocus Inc., May 2011

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Figure B-2
Alluvial Cones and Geologic Cross-Section at the Dumbarton Bridge

CDM Smith

Dumbarton Bridge area shown in Figure B-3.These layers are present both onshore and offshore and appear to be hydraulically connected within the borders created by bedrock outcroppings (the foothills of the Santa Cruz Mountains to the west and the foothills to the Diablo Range to the east).

There is very little data available regarding soils beneath the Bay except in the area surrounding the Dumbarton Bridge. This data confirms that the layers are continuous across the Bay in the vicinity of the Bridge and also provides an indication that the Niles and San Francisquito cones meet near the western shore of the Bay (Jacobs Associates 2007[2], SFPUC 2006[3], and SFPUC 2009[4]). Onshore geological information indicates that the alluvial layers appear to become thinner and less permeable heading north of the Redwood City area to the San Mateo Bridge, and marine deposits begin to replace the alluvial layers north of the San Mateo Bridge.

The Niles Cone sub-basin extends from the Diablo Range to the east, under the San Francisco Bay, and into portions of the Peninsula. As shown in Figure B-3, the surficial extent of Niles Alluvial Cone extends only to the plains east of the Bay (DWR 1967[5]). However, the underlying aquifers extend throughout the sub-basin including offshore under the entire width of the Bay.

The Niles Cone sub-basin consists of several layers between the Bay floor and bedrock. The uppermost layers consists of a partial aquitard of young bay mud near the surface, which is above an alluvial layer known as the Newark Aquifer. ACWD pumps from the Newark Aquifer for both the aquifer replenishment wells which provide a barrier to saltwater intrusion and to supply the Newark Desalination Facility for some of its water supply. Existing data suggests that saline Bay water enters the Newark Aquifer through portions of the ship channel where the aquitard layer separating the Bay from the Newark Aquifer is thin.

Less information is available for the San Francisquito Alluvial Cone as it has not been developed as extensively for water supply as the Niles Alluvial Cone. However, based on the data for the Bay Tunnel the Bay Shore side of the Peninsula appears to have similar geologic characteristics. The focus of this analysis is to identify potential brackish and subsurface Bay water areas along the edge of the Bay to: minimize potential impacts with other groundwater pumpers on the Peninsula; and maximize potential recharge from the Bay.

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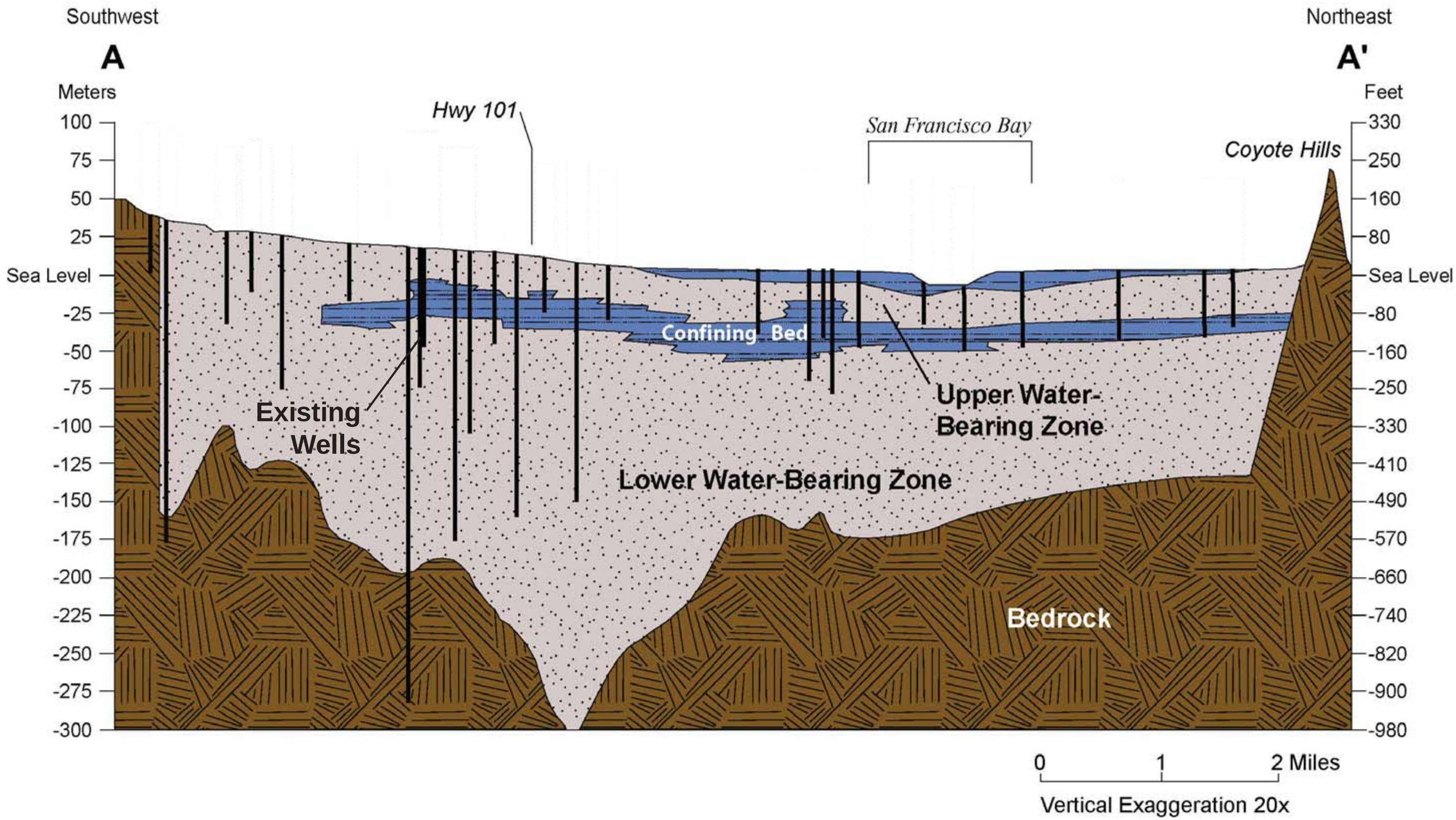
[2] Jacobs Associates. 2007. *Bay Division Pipelines Reliability Upgrade Bay Tunnel Project (CUW36801): Geotechnical Interpretive Memorandum*. Prepared for the San Francisco Public Utilities Commission.

[3] San Francisco Public Utilities Commission. 2006. *Bay Division Pipeline Reliability Upgrade, Phase 3: Conceptual Engineering Report.* Project No. CUW36801, Control No. 201441.

[4] San Francisco Public Utilities Commission. 2009 *Geotechnical Data Report: Bay Division Pipelines Reliability Upgrade, Bay Division Pipeline NO. 5 – Bay Tunnel*. Contract No. WD-2531, Project No. CUW368.01

[5] California Department of Water Resources. 1967. *Evaluation of Ground Water Resources: South Bay*. Bulletin No. 118-1. Appendix A: Geology.



Source: BAWSCA Strategy, HydroFocus Inc., May 2011

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CDM Smith

Figure B-3

East - West Hydrogeologic Cross-Section Near the Dumbarton Bridge

Beneath the Newark Aquifer lies a clay aquiclude that separates the Newark Aquifer from the Centerville Aquifer, which is relatively low in salinity (DWR 1967, DWR 2006a[6]) and supplies additional ACWD water supply wells. The Newark and Centerville aquifers are hydraulically contiguous from the western shore of the Bay up to the Diablo Range. Further investigation is needed to assess the permeability of the soils under the Bay and the impact of subsurface Bay water extraction on existing wells drawing from these layers.

Due to the anticipated salinity levels for brackish sources and subsurface Bay water projects water treatment utilizing reverse osmosis treatment to remove the salts (TDS) will be required. The groundwater study areas were selected based on the hydrogeology, proximity to Bay, and also on proximity to locations for brine disposal utilizing existing wastewater treatment plant outfalls. *Appendix C* describes the locations for the potential brine disposal and locations for possible intakes and treatment facilities.

For this analysis, the hydrogeology and general study locations include:

- Dumbarton Bridge Area;
- San Mateo Bridge Area; and
- South San Francisco Area near Oyster Point.

B.2.2 Dumbarton Bridge Area Hydrogeology

The San Mateo Sub-basin is part of the San Francisquito Alluvial Cone, as shown in Figure B-3. Within this cone, the unconsolidated sediments are relatively thick. The sediments are up to 600 feet thick within the eastern-most portions of the service area close to the Bay in Atherton, and reach thicknesses of over 1,000 feet farther east in Palo Alto.

In the San Mateo sub-basin, the unconsolidated alluvium is roughly categorized into a shallow, unconfined to semi-confined aquifer and a deeper, semi-confined to confined aquifer. These two aquifers are hydraulically connected to aquifers at similar depths in the Niles Cone Basin, the Newark and Centerville Aquifers, and are thus indirectly connected to the Bay (DWR 1967). Groundwater generally flows from the San Mateo sub-basin into the Niles Cone subbasin (towards the Bay) when groundwater levels are high; however, overpumping can result in saltwater intrusion into the San Mateo sub-basin (DWR 2004b). Water in the San Mateo Basin is classified as hard water, and TDS is generally over 1,000 mg/L.

Due to the potential higher yield in this area, it is recommended that further investigation be performed to determine the suitability of using the San Francisquito Cone as a

[6] California Department of Water Resources. 2006a. *California's Groundwater Bulletin 118, San Francisco Bay Hydrologic Region, Santa Clara Valley Groundwater Basin, Niles Cone Subbasin*. January 20, 2006. Available at http://www.water.ca.gov/pubs/groundwater/bulletin_118/basindescriptions/2-9.01.pdf.

potential brackish desalination water source. There are private and municipal wells that access the shallow and deeper freshwater aquifers in the San Mateo sub-basin in Atherton, Redwood City. The potential impact of brackish wells with existing private wells or the potential to induce salt water intrusion into the sub-basin will need to be analyzed.

The geologic information also suggests that HDDW extending under the Bay in the vicinity of the Dumbarton Bridge, or in the two other study areas, may provide higher yields. This would be due to permeable soils which are also more hydraulically connected to the Bay, providing greater recharge to the pumping zones.

Figure B-4 indicates the estimated potential well yield within the study area in the brackish zones.

B.2.3 San Mateo Bridge Area Hydrogeology

The Niles Cone sub-basin, on the eastern shore of the Bay, is known to extend under the San Francisco Bay and merge with the San Mateo sub-basin along the Bay's western shore. The unconsolidated, water-bearing sediments in the San Mateo sub-basin are bordered on the west by the Santa Cruz Mountains.

Geologic cross-sections are available of the San Mateo Basin in the San Mateo and San Carlos areas, running both parallel and perpendicular to the shore of the Bay (as shown in Figure B-3). These cross-sections, along with literature from various sources (DWR 2004b[7] , RWQCB 2003[8]), show that alluvial deposits are very thin in the San Carlos area, and grow thicker towards the north, approaching the San Mateo area. The thickest areas of unconsolidated sediments are over 400 feet thick, very close to the Bay's shore. Inland of El Camino Real, sediments are less than 100 feet thick in the San Carlos area, and less than 300 feet thick almost everywhere in the San Mateo area.

In this area, discontinuous layers of more permeable gravel and sand are separated by layers of less permeable silt and clay. The sediments in the San Carlos area are predominantly fine-grained, while those in the San Mateo area contain more sand and gravel. The deepest wells tested were approximately 300 feet deep and the capacity range of existing wells in this area is 16 to 235 gallons per minute (0.02 to 0.34 mgd). This area does not appear to be suitable for a brackish water desalination plant because a large number of wells would be required to supply a relatively small desalination plant and would significantly increase the costs of the project.

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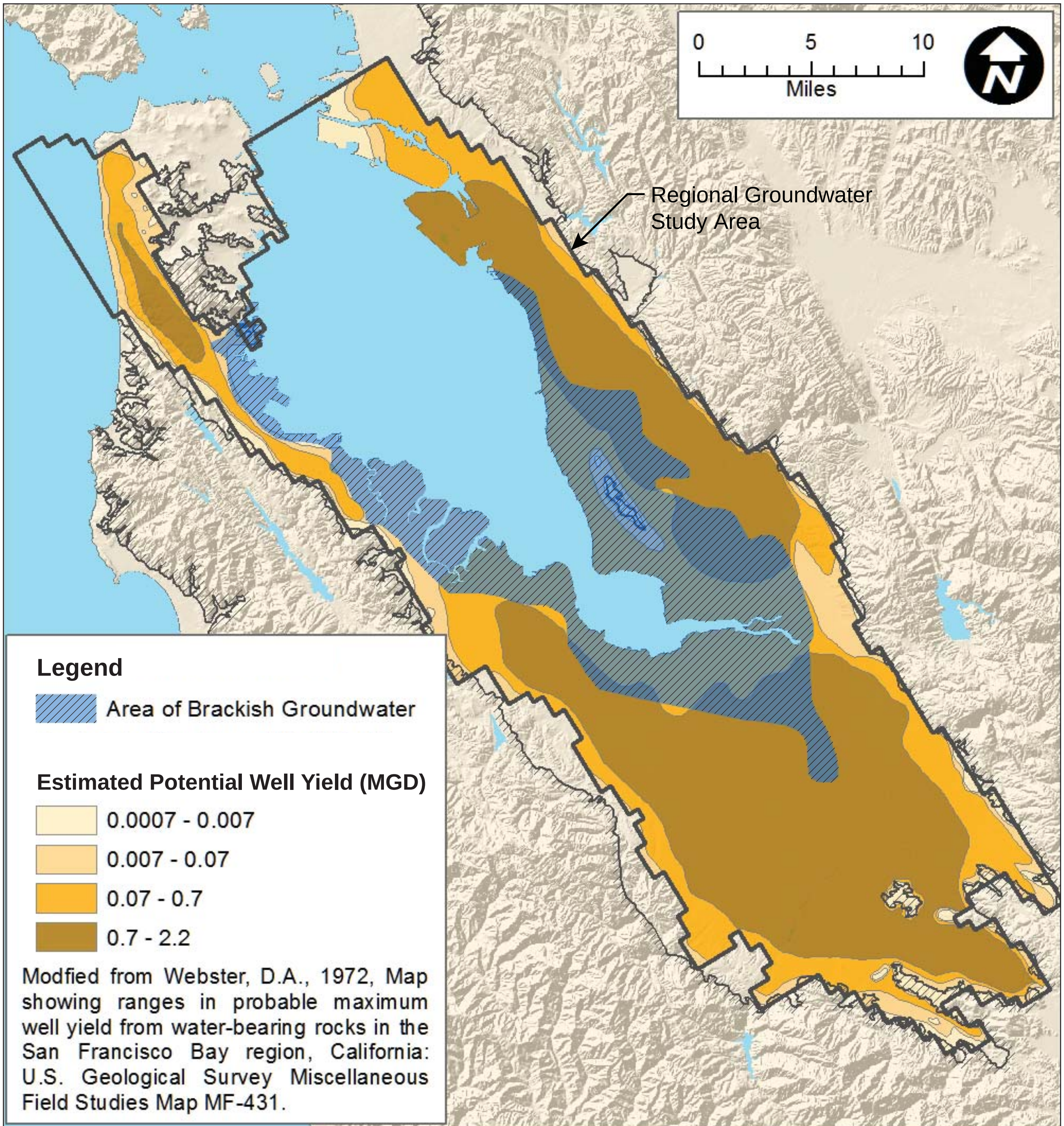
[7] California Department of Water Resources. 2004b. *California's Groundwater Bulletin 118, San Francisco Bay Hydrologic Region, Santa Clara Valley Groundwater Basin, San Mateo Subbasin*. February 27, 2004. Available at http://www.water.ca.gov/pubs/groundwater/bulletin_118/basindescriptions/2-9.03.pdf.

[8] Regional Water Quality Control Board. 2003. *A Comprehensive Groundwater Protection Evaluation for the South San Francisco Bay Basins*.



Source: BAWSCA Strategy, HydroFocus Inc., May 2011

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Figure B-4
Estimated Potential Well Yields in Brackish Groundwater Areas

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If this potential supply source is pursued, the offshore geology will need to be investigated to determine if a portion of the Niles Cone sub-basin near the San Mateo shoreline may be suitable for a subsurface well extending under the Bay.

B.2.4 South San Francisco Area Hydrogeology

There are two groundwater basins underlying the South San Francisco Area and BAWSCA Agencies along the Peninsula; Westside Basin and Visitacion Valley. The Westside Basin is effectively separated from the San Francisco Bay by the San Bruno Mountains along the Peninsula's eastern shore (DWR 2006b[9]). This bedrock outcropping separates the Westside Basin from the Visitacion Valley Basin to the east and north. As the Westside Basin is separated hydraulically from the Bay, freshwater wells in the South San Francisco Area currently exist in the basin. Compared with other groundwater towards the eastern portion of the Peninsula, the groundwater in these wells has relatively low TDS and hardness. Because of its hydraulic separation from the Bay and its current and planned increase in groundwater pumping, the Westside Groundwater Basin is not recommended for further investigation as a potential brackish well site. The potential for brackish groundwater wells on the Bay-side of the San Bruno Mountains (outside of the Westside Basin's boundaries) has not been investigated to-date.

The Visitacion Valley Groundwater Basin is bordered by a combination of outcropping bedrock (the San Bruno Mountains) and the South San Francisco Bay. Recharge to the basin is estimated to be less than 300 acre-feet (AF)/year, and unconsolidated material is 200 feet thick or less throughout the basin (DWR 2004a[10]). There is no reported pumping for drinking water or irrigation in the Visitacion Valley Basin. Because the unconsolidated material is so thin and natural recharge to the aquifer is so low, Visitacion Valley is not recommended for further investigation as a potential brackish groundwater site.

Neither Visitacion Valley nor Westside Basin is likely suitable as a potential site for brackish groundwater desalination. However, the South San Francisco Area (near Oyster Point) east of the San Bruno Mountains (and east of the Westside Basin) has not been evaluated for potential brackish groundwater supply. The San Bruno Mountains may prevent brackish wells in South San Francisco Area from influencing existing groundwater wells in the Westside Basin, making South San Francisco Area an advantageous location for brackish groundwater wells, if sufficient yield is available. However, additional field investigations would be required to confirm this assumption.

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9 California Department of Water Resources. 2006b. *California's Groundwater Bulletin 118, San Francisco Bay Hydrologic Region, Westside Groundwater Basin*. January 20, 2006. Available at http://www.water.ca.gov/pubs/groundwater/bulletin_118/basindescriptions/2-35.pdf

10 California Department of Water Resources. 2004a. *California's Groundwater Bulletin 118, San Francisco Bay Hydrologic Region, Visitacion Groundwater Basin*. February 27, 2004. Available at http://www.water.ca.gov/pubs/groundwater/bulletin_118/basindescriptions/2-32.pdf.

B.2.5 Summary of Key Findings for Potential Intake Locations

Based on the existing limited hydrogeologic data it is not certain whether the capacities and long-term yields for brackish groundwater in the three areas have sufficient capacity within their aquifers to support brackish groundwater wells above 1 mgd. As discussed above, the San Francisquito Alluvial Cone provides the most promising geology for use of brackish wells on the Peninsula as well as other types of subsurface intakes. This same uncertainty exists for the HDDW wells, though they may tend to have a larger recharge area. Figure B-5 shows a planning level illustration of potential vertical (brackish) and horizontally directionally drilled well (Bay water) installed in the alluvial layers in the Dumbarton Bridge area between the Niles Cone and the San Francisquito Cone. The aquitards are colored in blue and are labeled as the confining bed.

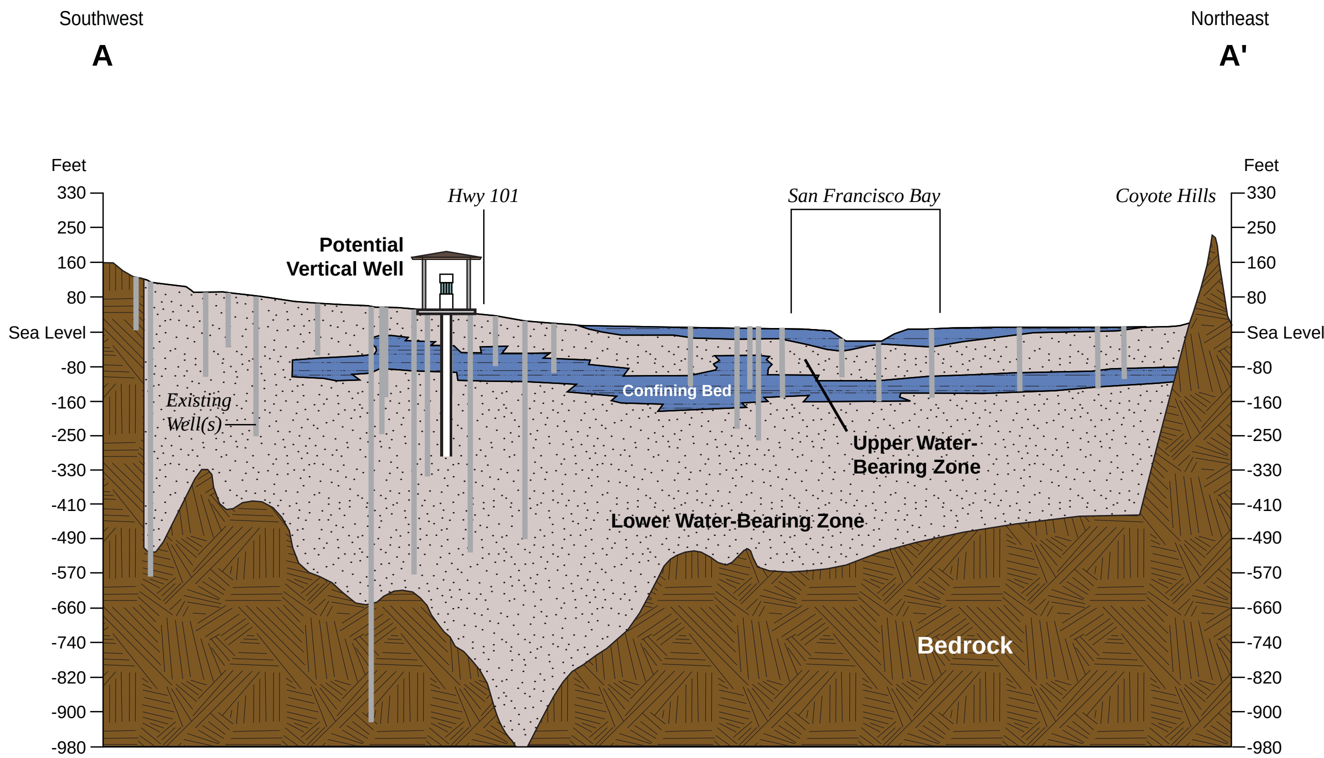
The locations and suitable type of intakes shown on Figure B-5 consider the key findings of the hydrogeologic evaluations for the individual service areas, as summarized below.

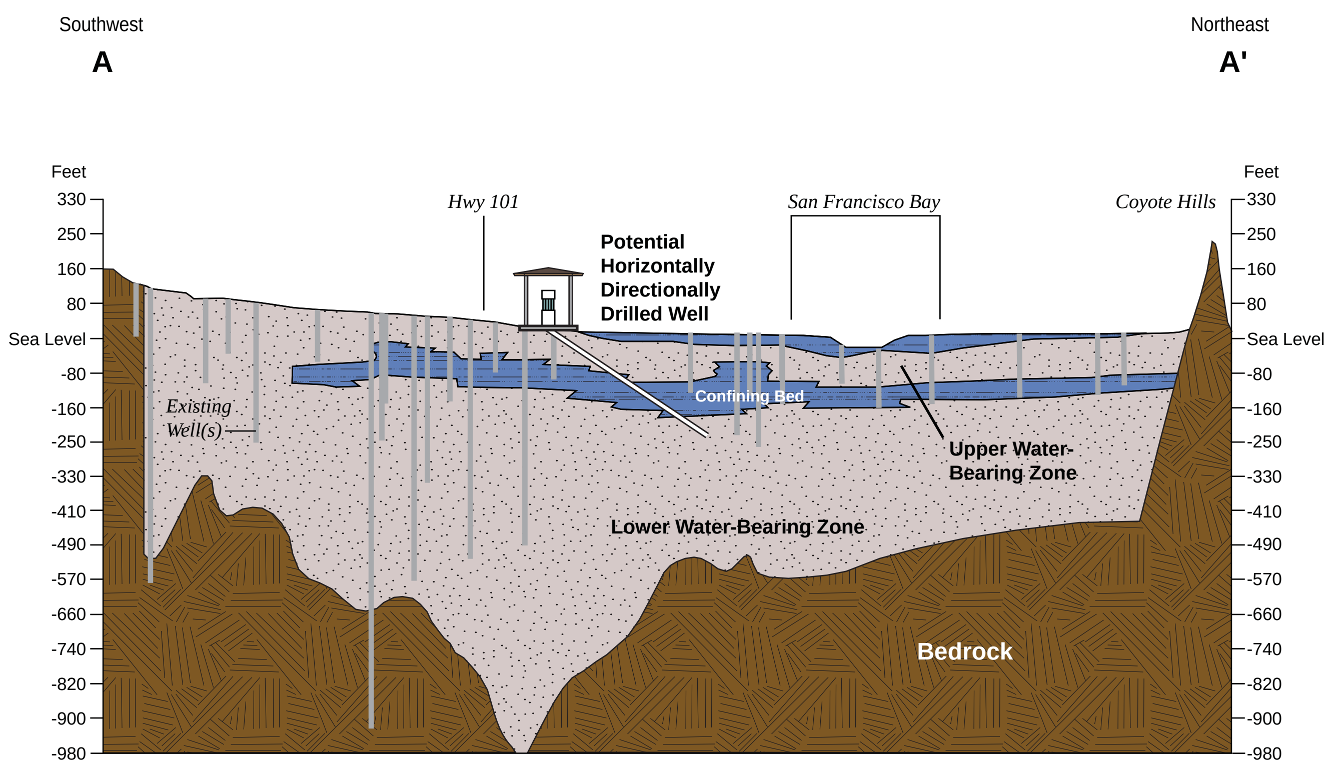
- *Dumbarton Bridge Area* –Promising geology for brackish ground water wells. Further investigation would be required to determine the suitability of using the San Francisquito Cone as a brackish groundwater source. New brackish water supply wells may potentially interfere with existing private wells in the area or induce saltwater intrusion. Horizontal directionally drilled well extending under the Bay in the vicinity of the Dumbarton Bridge may provide higher yields from more permeable soils which are also more hydraulically connected to the Bay;

- *San Mateo Bridge Area* – Does not appear very suitable for brackish groundwater wells due to low well yield and the large number of wells needed. If this potential supply source is pursued, the offshore geology will need to be investigated to determine if a portion of the Niles Cone sub-basin near the San Mateo shoreline may be suitable for a subsurface well extending under the Bay; and

- *South San Francisco Area* – It is possible that the aquifers in the South San Francisco Area are suitable for brackish groundwater wells. However, the bedrock that separates sub-bay groundwater from the Westside Basin may prevent pumping activity closer to the shore from influencing the groundwater supplies in the Westside Basin.

For all of these areas limited hydrogeologic information is available for the brackish aquifers. As such the location and potential yield of these aquifers is relatively unknown. The best information available to confirm potential yields is in the Dumbarton Bridge Area, with less hydrogeologic information available for the brackish groundwater aquifers and off-shore areas of the San Mateo Bridge and South San Francisco Areas. However, the recharge, long term yield and potential impact on other groundwater users needs to be evaluated to confirm the assumed capacities and yields for all three areas.





Source: Groundwater-Flow System Description and Simulated Constituent Transport,
Raychem/Tyco Electonics Site, HydroFocus Inc., November 21, 2003.

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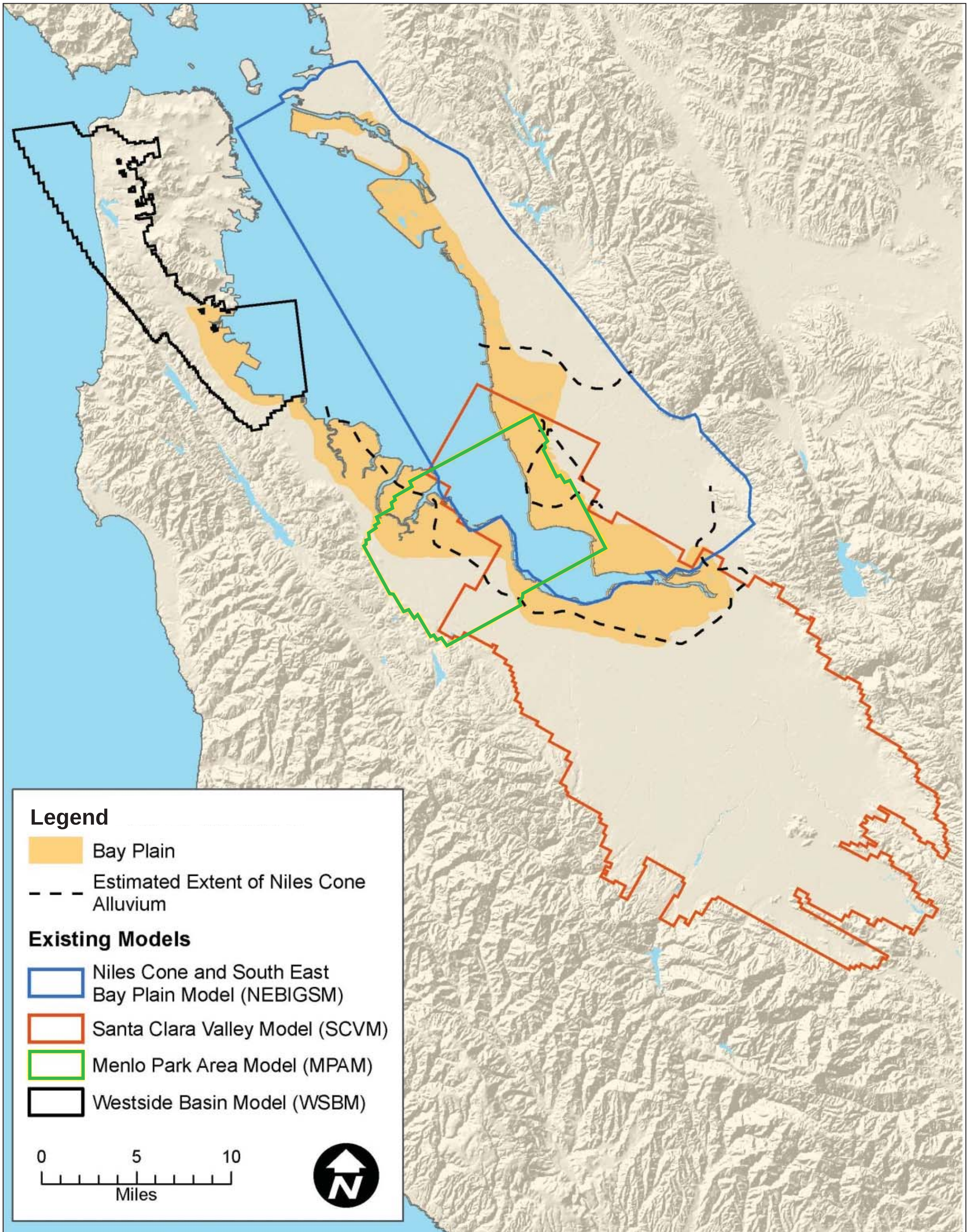
Figure B-5
Planning Level Illustration of Vertical and Horizontally
Directionally Drilled Wells in Dumbarton Bridge Area

B.3 Possible Groundwater Modeling

In order to address the key issues a groundwater flow model can help assess the potential hydraulic capacity, long-term yield and potential impacts of pumping brackish or subsurface Bay water. Several groundwater models exist, but none of them include all of the potential project development areas for brackish or Bay water.

Figure B-6 indicates the areas covered by the existing groundwater models. Figure B-7 indicates the existing models and the proposed unifying model grid if a groundwater model were developed by BAWSCA as part of the evaluation.

The determination of the potential need for a unified groundwater model to help address some of the underlying questions associated with the groundwater supply will depend on whether the brackish groundwater and /or Bay water projects are determined to merit further analysis. This determination is targeted for Summer 2012 when BAWSCA will be deciding whether to further explore these and other water supply management projects.



Source: BAWSCA Strategy, HydroFocus Inc., May 2011

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Figure B-6
Existing Groundwater Models

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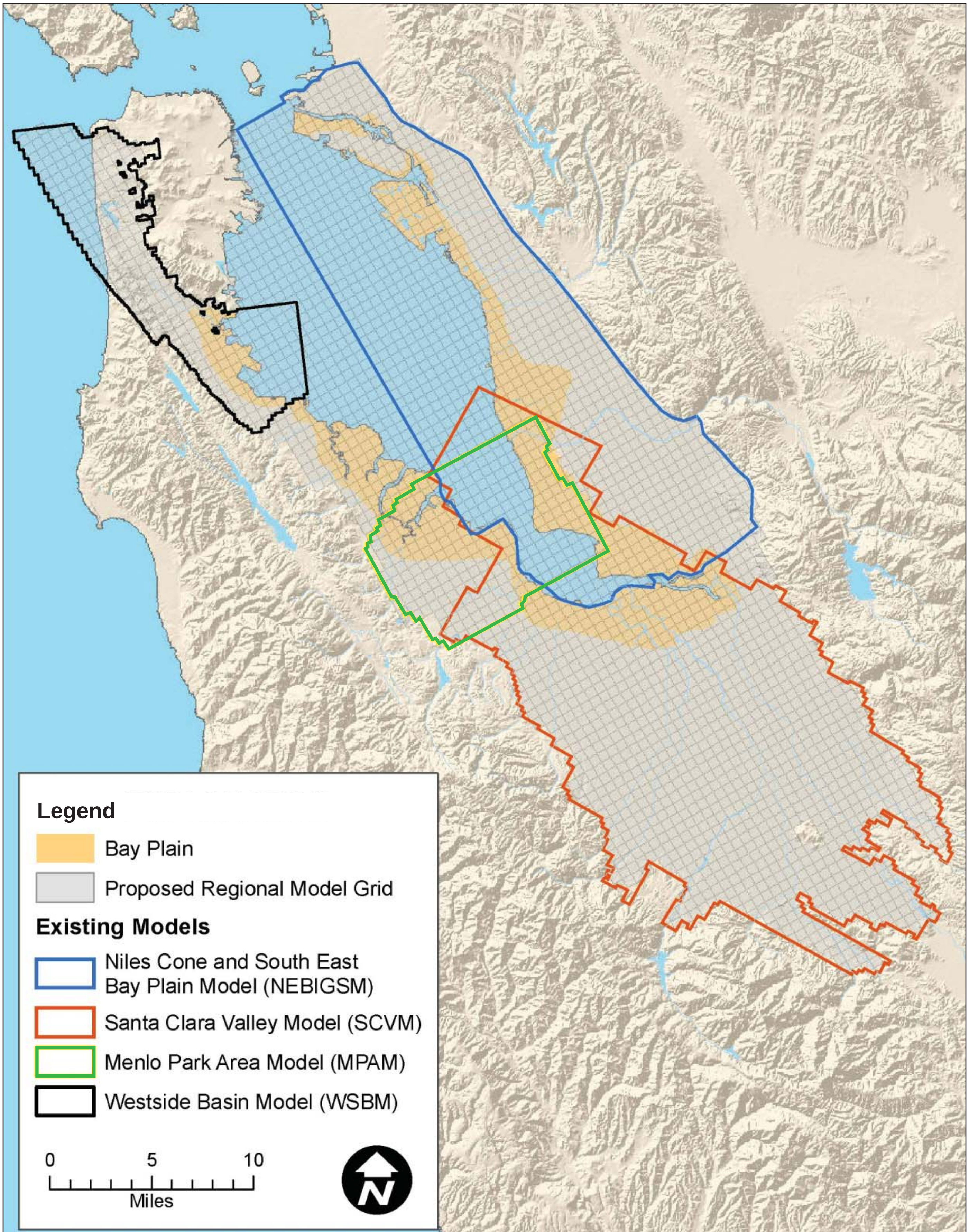

Source: BAWSCA Strategy, HydroFocus Inc., May 2011

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Figure B-7
Existing Groundwater Models and Proposed Unifying Model Grid

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Appendix C
Regional Desalination Projects – Facility Options

This appendix presents the potential facility options for the regional desalination projects.

C.1 Summary

In this Appendix:

Several different types of desalination projects have been identified and evaluated as part of the development of regional desalination projects. There is a wide range of options that affect the capacity, reliability and cost for desalination projects. These may include:

- Source water quality and salinity;
- Intake type;
- Desalination Treatment;
- Facility Site locations; and
- Brine discharge or disposal options.

This planning-level evaluation considers several different combinations of options in looking at the feasibility and cost for representative regional desalination projects, focusing on areas on the San Francisco Peninsula from near the Dumbarton Bridge up to South San Francisco.

In summary:

- The treatment technology is sufficiently mature for implementing desalination;
- A 20 mgd plant capacity is feasible based on discharge of the brine through existing wastewater treatment outfalls;
- Intake choice is open but requires more investigations. An open intake is the most challenging from a permitting perspective. Brackish groundwater and sub-surface option has the greatest uncertainties with respect to yield; and
- Costs are likely to be higher than current sources of supply, though as the costs for SFPUC continue to increase that difference will become narrower.

C.2 Source Water Quality

This evaluation includes a review of previous studies and other available information to identify locations suitable for both subsurface and open Bay water intakes. Previous studies dismissed subsurface intakes based on capacity limitations due to the low permeability of the groundwater basins on the Peninsula. However, the use of multiple, small desalination facilities with subsurface intakes are included here as an approach to simplify permitting and reduce capital and operating costs.

Source water salinity varies greatly depending on the source, including: brackish groundwater; Bay water; and ocean water. This appendix uses total dissolved solids (TDS) as a measure of water salinity. For the purposes of this analysis, sources for a desalination facility are categorized in the following three categories:

1) ***Brackish groundwater sources***: The salinity range of 1,000 to 10,000 milligram per liter (mg/L) of TDS. Brackish groundwater RO desalination facilities are characterized by inland well sources with moderate salinity and high hardness levels, relatively low RO system operating pressures (less than 300 psi), and limited pretreatment and post-treatment requirements.

2) ***Bay water sources with a salinity range of 10,000 to 30,000 mg/L of TDS[1]:*** This categorization is used because the complexity and cost of system components begin to increase above a salinity threshold of approximately 10,000 mg/L. Bay water Reverse Osmosis (RO) desalination facilities are characterized by saline source waters from either subsurface or open water intakes, relatively high RO system operating pressures (300 to 800 psi), and potentially more significant pre-treatment and post-treatment requirements.

3) ***Ocean water sources***: With a typical salinity of 35,000 mg/L of TDS. Ocean water RO desalination facilities are characterized by saline source waters from either subsurface or open water intakes, relatively high RO system operating pressures and potentially more significant pre-treatment and post-treatment requirements. The only ocean desalination project (Representative Coastal Desalination Project) is described in the Strategy Phase II A Task 2-B memo dated January 30, 2012 .

Although open Bay water intakes were evaluated as part of the Bay Area Regional Desalination Project (BARDP) and Marin Municipal Water District (MMWD) desalination projects, open water intakes are not ideal since they: 1) involve more extensive permitting; 2) require increased energy use; 3) increase capital and operating costs; and 4) are opposed by many environmental special interest groups, including groups which have filed lawsuits against the proposed MMWD and southern California desalination facilities that have gone through the Environmental Impact Report (EIR) review process. The BARDP project is described in more detail in Appendix E.

[1] For reference, Pacific Ocean seawater typically has a salinity of 35,000 mg/L of TDS.

C.3 Intake Options

Intake options for Bay water and ocean water sources are typically subdivided into three options: 1) groundwater; 2) subsurface; and 3) open water. Regulatory agencies with jurisdiction over new intakes, including the Bay Conservation and Development Commission (BCDC), prefer that subsurface intakes be used, if feasible, to limit impacts to marine life. This view tends to be shared by other permitting agencies and environmental groups as long as construction of a subsurface intake is not perceived to be more damaging than the long-term impacts of an open water intake.

C.3.1 Subsurface Intakes

Subsurface Intake Options

Subsurface intake options include wells drilled near or under the Bay floor, infiltration galleries, and similar types of subsoil collection strategies.

The key considerations for subsurface well intakes are identifying locations with the following attributes:

- A permeable brackish water aquifer or permeable alluvial material hydraulically connected to the ocean;
- Sufficient horizontal area to permit multiple wells for larger facilities; and
- Depth of over lying material to protect intake screens from erosion and damage.

The intake options currently being considered for proposed for Brackish Water Reverse Osmosis (BWRO) include:

- *Vertical Brackish Groundwater Wells* - Vertical groundwater wells (see Figure C-1) are typically used for brackish groundwater supplies. This type of water supply is practical when used for small facilities (less than 5 mgd), such as the existing facility in Sand City, California.

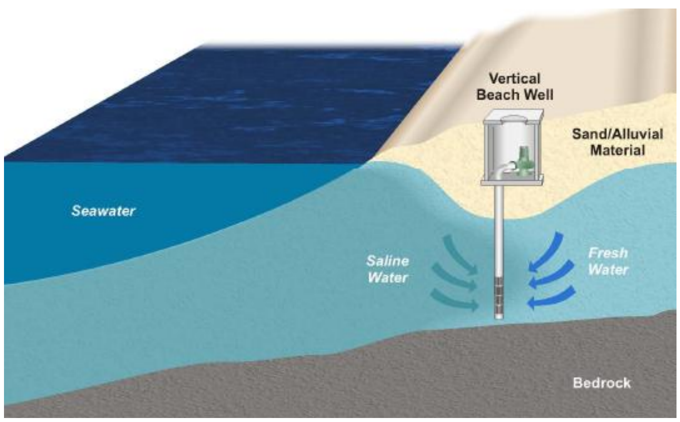


Figure C-1
Vertical Wells

Surface Water (Ocean or Bay water) Reverse Osmosis (SWRO) desalination facilities may include:

- *Radial Vertical ("Ranney") collector wells* (see Figure C-2) – Consists of well laterals and well-screens installed horizontally under the Bay floor from a vertical caisson near the coastline. The laterals are typically limited to less than 300 feet in length using conventional drilling methods. These wells can provide more water than vertical wells, but have not been selected for large facilities yet in California due to site-specific geology limitations. Radial vertical wells are not evaluated as a potential collection configuration in the present study.

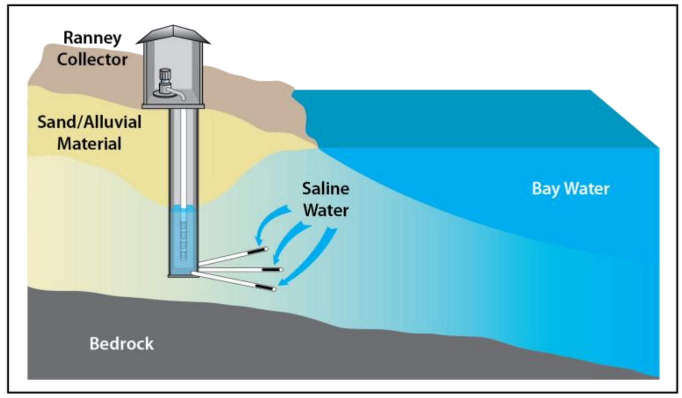


Figure C-2
"Ranney Collector Well" Type Installation

- *Slant wells and/or horizontally directionally drilled wells* (see Figure C-3) – Use relatively new pipe drilling methods to drill at an angle beneath the Bay floor. Well shafts, screens, and a gravel pack slurry are inserted into the pipe to create the well prior to the pipe being removed. The slant well approach is currently being piloted for a proposed facility in Orange County, California and the horizontal approach is being considered for proposed facilities in Monterey and San Diego Counties.

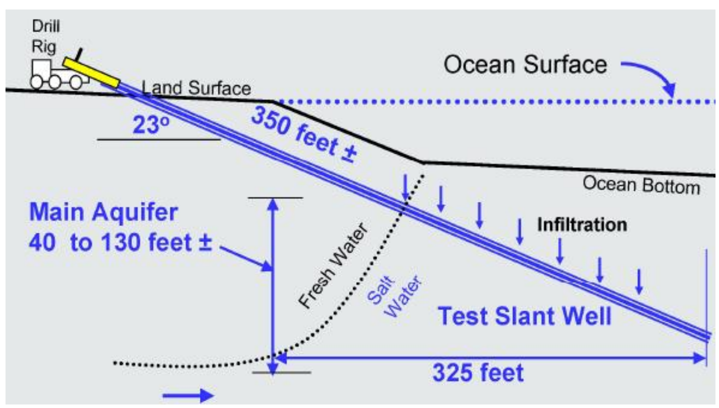


Figure C-3
Horizontally Directionally Drilled Well - Illustration

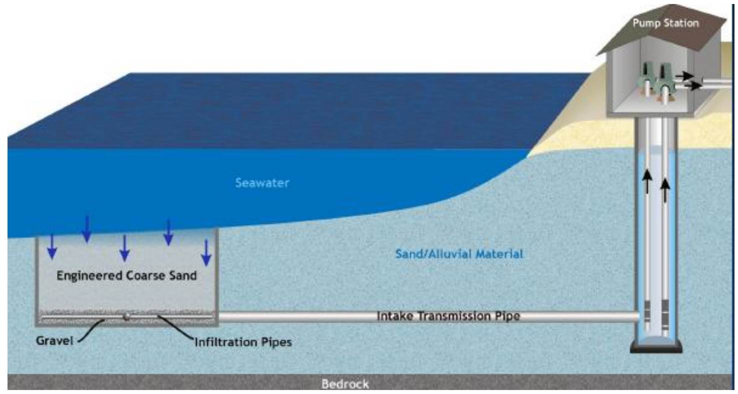


Figure C-4
Engineered Infiltration Gallery Illustration

- *Infiltration gallery* (see Figure C-4) – Utilizes a man-made filter of coarse, permeable sand to draw in water at a faster rate than native Bay floor materials. The gallery consists of a constructed bank of engineered sand and pipe laterals in the surf zone or offshore. This approach is currently being piloted in the surf zone for a proposed facility in Long Beach, California. Infiltration galleries are not considered to be a potential collection configuration in the present study.

The key considerations for subsurface well intakes are identifying locations with the following attributes:

- A permeable brackish water aquifer or permeable alluvial material hydraulically connected to the Bay; and

- Sufficient horizontal area to permit multiple wells for larger facilities.

Vertical wells or Ranney Collector Wells may be viable options for new facilities with relatively small production capacities (less than 3 mgd of drinking water). Slant wells and horizontal directionally drilled wells may be able to provide greater capacities especially if the well screens can be placed near the ship channel in the central part of the Bay where it is believed that there is a higher influx of Bay water into the shallow aquifers.

C.3.2 Open Water Intake Options

Open water (ocean or Bay) intakes are typically used for desalination facilities greater than 5 mgd and in locations where subsurface options are not feasible due to cost and/or local geology. Conventional screens such as bar screens, traveling screens, and drum screens with large slot widths and high input velocities are not expected to be permitted here because low velocity and fine screen open water intakes are preferred by permitting agencies to limit impingement of marine life to the surface of the screen and entrainment of marine life through the screen and into the intake pipeline and pumps.

The low velocity intake options currently being considered for proposed SWRO desalination facilities in California include:

- *Velocity cap structures* (see Figure C-5) – Structures designed to reduce the velocity of the incoming water to less than 0.5 foot per second (fps). Most structures provide coarse screening to reduce entrainment of debris which may damage the intake pumps. These are considered more viable in "low biologically productive" areas (equivalent to undersea deserts). Recently, multiple large capacity (>50 mgd) velocity cap intakes have been constructed for seawater desalination facilities in Australia and Europe.

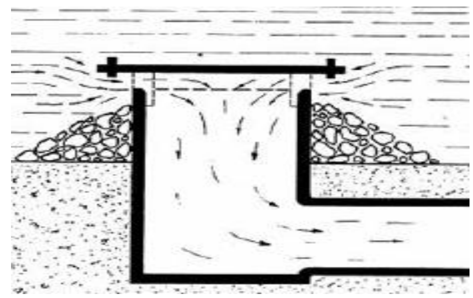


Figure C-5
Velocity Cap Illustration

- *Passive screen intake structures* (see Figure C-6) – These structures are considered the preferred open water intake technology in California. This is because passive screens are expected to have the least impact on marine life. Passive screens use a combination of fine screening and low water velocities (<0.5 fps) to minimize impingement and entrainment. The Coastal Commission has recommended 1 and 2 millimeter screens which are currently being piloted for the proposed facilities in Santa Cruz and El Segundo, California. The Department of Fish and Game has recommended 3/32-inch screens for the proposed Bay water facility in Marin County. The reliability of passive screens is a concern in locations which require frequent cleaning. Passive screens are designed to use both local currents and air sparging to clean the screens; however, divers are occasionally required to perform more thorough cleanings. Copper-nickel alloys or super-duplex stainless steels with special coatings are typically used to minimize corrosion and biological growth on the screen surface.

Figure C-6
Passive Screen Illustration and a Picture of a Large-Diameter Passive Wedgewire Screen (Courtesy of Johnson Screens)

Before an open water intake will be permitted, hydrogeologic investigations are typically required to determine the feasibility of a subsurface intake. If a subsurface option is not feasible, it is likely that a passive screen intake structure will be preferred by permitting agencies unless a location can be found suitable for a velocity cap type intake.

A 316(b) type impingement and entrainment study will also be required to assess the impact on marine life by different open water intake options. The Environmental Protection Agency (EPA) 316(b) regulation assumes that any organism entrained into the intake pipeline will not survive. Smaller screen slot sizes reduce entrainment, but also increase cleaning frequency and reliability concerns.

It is also anticipated that development of coastal wetlands or other types of habitat restoration may be required to offset the estimated entrainment of an open water intake.

C.4 Desalination Treatment

The components for a potential desalination facility can be divided into the following eight categories: (1) the intake and raw water supply system; (2) the pre-treatment system; (3) the reverse osmosis (RO) desalination and energy recovery system; (4) the post-treatment and stabilization system; (5) treated water disinfection, storage, and high service pump station; (6) solids handling system; (7) brine disposal system; and (8) ancillary facilities. Figure C-7 presents a schematic of the treatment process for a Bay water or seawater desalination facility assuming an open Bay intake and a robust pre-treatment system. The pre-treatment clarification and filtration processes would not be required for subsurface intakes.

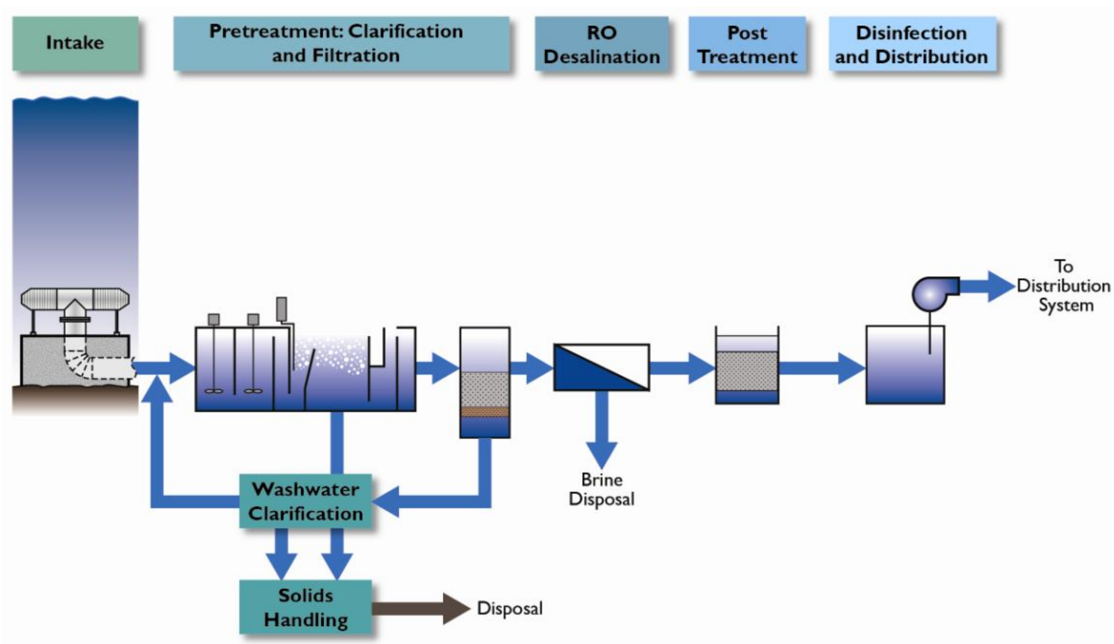


Figure C-7
Bay Water Intake RO Desalination Plant Process Schematic

The selection and complexity of the process components vary for different sources of supply and site-specific considerations such as source water quality and intake type.

C.4.1 Pre-treatment

Pre-treatment is required to protect the RO membranes used for desalination and to limit downtime due to maintenance and cleaning of the desalination system. The level of pre-treatment required is determined by source water quality and California Department of Public Health (DPH) requirements are based on source water monitoring results. Below is a discussion of pre-treatment for well sources (which apply to the subsurface intakes) and for open water intake sources.

Pre-treatment for Well Sources

Well water sources typically require only the addition of chemicals (e.g., antiscalant) and cartridge filtration to maximize the useful life of the RO membranes in the desalination system. However, additional pre-treatment may be required if iron or manganese is present or if the test wells are determined to be "under the influence of surface water" according to DPH guidelines during pump tests.

If iron or manganese is present, additional pre-treatment such as chlorination, filtration, and dechlorination may be required to protect against particulate iron or manganese which can clog and physically damage the RO membrane surface. If the wells are determined to be "under the influence of surface water", a Watershed Sanitary Survey (WSS), Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR) monitoring, and potentially pilot-scale testing may be required to determine the amount of filtration and disinfection to comply with DPH pathogen removal requirements. Alternatively, monitoring and pilot-scale testing can be bypassed if the maximum pathogen removal/inactivation requirements are achieved within the treatment process. This approach is typically more cost-effective for small facilities, and was used to "fast-track" the permitting process for the beach well source desalination facility (less than one mgd) in Sand City, California, which began operation in 2009.

Pre-treatment for Open Water Intake Sources

Most seawater desalination facilities with open water intakes require a robust and reliable pre-treatment system (e.g., coagulation, flocculation, clarification, filtration, 5-micron cartridge filters and multiple chemicals) especially during storm and algal bloom events (e.g., red tides). One year of pilot-scale testing, a one-year WSS, and two years of LT2ESWTR monitoring are typically required by DPH to determine the pre-treatment and pathogen removal requirements for facilities with new open water intakes.

C.4.2 RO System Options

RO membranes and process configurations for brackish water and Bay water facilities are discussed below.

RO Membranes

Brackish water desalination facilities typically utilize BWRO membranes which are designed to achieve desired water quality with minimal energy use at pressures less than 300 psi.

Bay water facilities would utilize SWRO membranes to achieve desired water quality with minimal energy use at pressures that exceed 300 psi. If the salinity of the source water varies significantly, a combination of BWRO and SWRO elements may be used to achieve the lowest energy use over a range of source water quality conditions.

RO Process Configurations

BWRO systems operate at higher production efficiencies than ocean or Bay water RO systems due to the lower salinity of the source water and the RO membrane fouling potential of the source water. The efficiency of an RO system is commonly known as RO system recovery rate.

Brackish water desalination facilities typically utilize a single-pass, two-stage configuration to maximize water production from a facility (e.g., 70 to 85 percent of source water is converted to drinking water; the remaining flow is discharged as high-saline brine). A third stage is required to exceed 85 percent recovery; however, fouling concerns typically limit recovery to 80 percent or less for brackish water sources.

Bay water facilities typically utilize a single-pass, single-stage configuration and achieve recoveries of 40 to 60 percent depending on source water salinity. A second pass RO system may be required for the desalinated water to match chloride bromide, and boron concentrations in existing sources. Bromide is of particular concern because it impacts the stability of chloramine formation at the facility and the stability of the residual in the distribution system. Boron and chloride are of concern because these salts may impact plant health/growth at concentrations exceeding those in typical surface water sources. A second pass RO system uses additional RO membranes to re-treat a portion of the water produced by the first RO pass to further reduce salts (e.g., bromide) in the final product water. In some cases, a second stage or RO membranes may also be desired to increase total recovery during periods of lower source water salinity.

This analysis assumes: 1) that a second pass will not be required for brackish subsurface intake sources; and 2) that a 33 percent partial second pass may be required for ocean or Bay water sources to match SFPUC water quality in terms of sodium, chloride, bromide, and boron. Even if the SFPUC does not require that these goals be met, a partial second pass may be required to reduce bromide to limit the impacts on chloramine residual concentration in the distribution system. Partial second pass systems are typically a minor cost item compared to overall facility cost. Because of these assumptions, a 55 percent recovery is assumed for all Bay water intake configurations for planning purposes. A 75 percent recovery is assumed for brackish water sources.

Vertical groundwater wells are assumed to be treating brackish water, while the other subsurface intakes including Ranney Collector Wells, slant wells, horizontally directionally drilled wells, and infiltration galleries are treating Bay water.

C.5 Brine Discharge Options

Disposal of brine from the desalination process usually incorporates one of the following options:

- Subsurface discharge;
- New open water discharge; and
- Co-location with existing open water discharges (existing wastewater plant outfalls).

C.5.1 Subsurface Discharge

A subsurface discharge entails discharging the brine via wells or an infiltration gallery similar to the subsurface intake options. This approach is often used at small facilities located near beaches or other locations with suitable geology to discharge the brine at a location (e.g., surf zone) with sufficient dilution and mixing to quickly disperse the high salinity brine. Beach wells are used at the existing facility in Sand City, California. A surf zone infiltration gallery is currently being pilot tested for the proposed facility in Long Beach, California.

However, based on the uncertainties of the hydrologic conditions along the Bay this type of alternative for brine disposal is not considered as a viable alternative.

C.5.2 New Open Bay Water Discharge

A new Bay water discharge includes the construction of a new outfall pipeline or structure with diffusers to efficiently disperse the brine into the receiving water. This approach typically requires the following:

1) The salinity of the discharge stream is less than the salinity of the receiving water. For example, the proposed facility in Carlsbad, California has been permitted to discharge the brine if the salinity of the combined discharge stream is less than the salinity of the receiving water. This permit condition required additional source water to dilute the brine stream to the salinity of the receiving water, which in turn significantly increased the mitigation efforts required to offset the estimated impacts on marine life associated with the source water (i.e., impingement and entrainment of the intake to draw in the source water).

2) The outfall discharge nozzles and ambient currents or wave energy will provide sufficient dilution and mixing to quickly disperse the brine. Water quality modeling and calculations were required to demonstrate that the discharge would achieve the RWQCB dilution and toxicity requirements for a new NPDES permit.

Other examples include the new brine outfall pipelines in Europe and Australia, which required dilution and current studies to design the discharge nozzles to avoid the creation of anoxic zones. Anoxic zones form when the dense brine sinks to the Bay floor without sufficient dilution and mixing. This approach is being considered for the proposed facilities in San Diego County, California. However, for the Bay area projects we have not included this alternative as it appears that there is a good potential that the brine could be discharged with the local wastewater treatment plant pipelines and outfalls. If that option is not viable in the future then new outfalls would be required. The costs for new outfalls could be significantly more expensive than co-location (use) with the wastewater treatment plants. Also, the permitting process for a new outfall will be much more difficult and time consuming.

C.5.3 Discharge Co-located with Existing Wastewater Outfalls

Co-location typically entails discharging desalination brine as part of an existing power plant or wastewater treatment plant (WWTP) outfall. This approach may simplify the discharge permitting requirements depending on site specific conditions, as discharged brine would be mixed with an existing waste stream (with an existing NPDES permit). It may not be in a wastewater facility's best interest to allow another entity to discharge via their existing outfall, as an added waste stream may lead to additional permitting. However, increasingly strict outfall dilution requirements may also give brine co-location the benefit of serving as"dilution water" to assist wastewater utilities in meeting current and future discharge requirements.

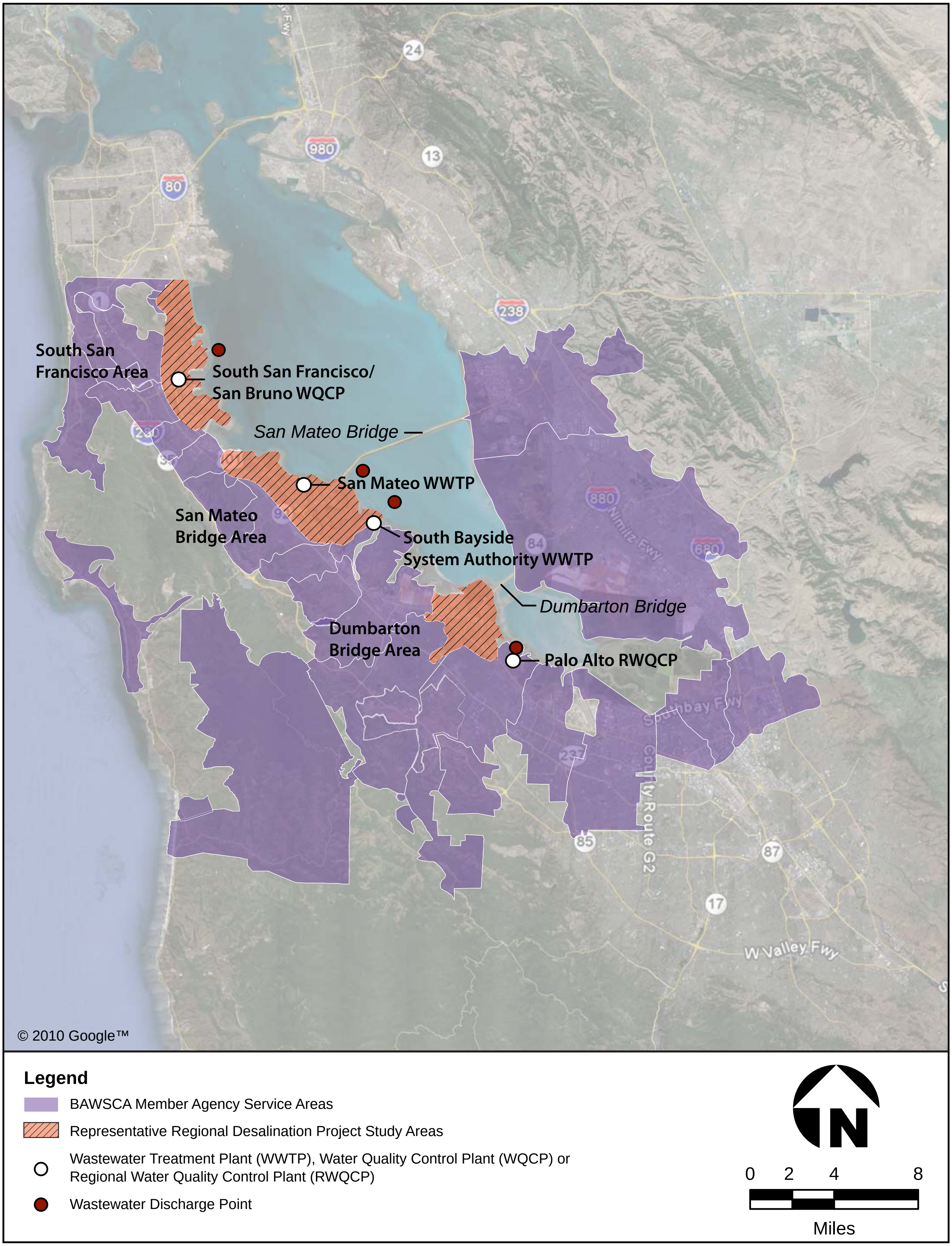
Hydraulically, the discharge pipeline must be large enough to accept average monthly WWTP flows and desalination brine flows. Water quality regulations will also impose restrictions on brine flows. The permitting process will be simplified if brine flows are mixed with a wastewater stream. The dilution possible from this mixing depends on the wastewater flows available for mixing. As a result, low wastewater flows may limit the desalination plant's treated water production.

Four wastewater treatment plants and outfalls are located along the easterly shore of the San Francisco Peninsula, including:

- San Mateo Wastewater Treatment Plant (SM WWTP);
- South San Francisco Water Quality Control Plant (SSF WQCP);
- South Bayside Authority Wastewater Treatment Plant (SBSA WWTP); and
- Palo Alto Regional Water Quality Control Plant (PA RWQCP).

The locations of these wastewater plants and their outfalls are shown in Figure C-8.

The SSF WQCP could potentially Accommodate brine discharges for a desalination plant located to determine whether these outfalls were potentially acceptable discharge locations for accepting desalination brine, recent flow data was collected from the treatment plants using the outfalls. Estimates were made of hydraulic capacities in the pipelines during dry seasons based on recent flow data, and estimates were also made of flow restrictions that may result from brine dilution requirements. In most cases,



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CDM Smith

Figure C-8
BAWSCA Regional Desalination Project Study Areas and Regional Wastewater Plants and Outfalls

potential dilution requirements on brine disposal may limit the outfalls' ability to accommodate brine, rather than physical hydraulic capacities in the outfall pipeline.

C.5.4 Outfall Hydraulic Capacities

Hydraulic capacities for these outfalls were obtained from NPDES permits. In addition the historic monthly characteristics of daily flow data from 2010 were reviewed for San Mateo WWTP and South San Francisco WWTP, and data from 2008 were analyzed for the South Bayside Authority WQCP. Peaking curves were inferred for the Palo Alto WQCP based on the average annual flow for 2010 at Palo Alto RWQCP and 2010 flow data that was available from the other treatment plants along the peninsula.

From this data, the remaining potential available capacity for blending with brine flows were calculated. For SBSA, daily effluent flows were provided from 2004 through 2009. For San Mateo, daily effluent flow data was provided for 2010. For each WWTP, monthly and seasonal maximum, minimum and average flows were calculated. The summer season was defined as extending from May through October and the winter season from November through April. Tables C-1 through C-4 contain the results of this analysis.

Table C-1
South San Francisco WQCP Potential Hydraulic Capacity Available for Brine Flow Blending

Total Outfall Capacity: 63 mgd	Wastewater Average Daily Flow Characteristics			Potential Outfall Capacity Available for Brine Flow Blending		
Month	Minimum Daily Flow (mgd)	Maximum Daily Flow (mgd)	Average Daily Flow (mgd)	Maximum Available Capacity (mgd)	Minimum Available Capacity (mgd)	Average Available Capacity (mgd)
Jan	14.7	45.2	21.7	48.3	17.8	41.3
Feb	15.7	26.8	19.7	47.3	36.2	43.3
Mar	16.1	38.9	20.1	46.9	24.1	42.9
Apr	16.5	32.9	19.5	46.5	30.1	43.5
May	15.3	19.4	16.5	47.7	43.6	46.5
Jun	14.7	17.7	16.1	48.3	45.3	46.9
Jul	13.8	16.1	15.3	49.2	46.9	47.7
Aug	14.4	16.5	15.2	48.6	46.5	47.9
Sep	13.9	15.9	15.2	49.1	47.1	47.8
Oct	14.7	21.9	15.6	48.3	41.1	47.4
Nov	14.6	22.2	16.5	48.4	40.8	46.5
Dec	15.0	42.5	21.6	48.0	20.5	41.4
Average	15.0	26.3	17.7	48.1	36.7	45.3
Season						
Summer (May - October)	13.8	21.9	15.6	48.5	45.1	47.4
Winter (November - April)	14.6	45.2	19.8	47.6	28.3	43.2

Table C-2
South Bayside Authority WWTP Potential Hydraulic Capacity Available for Brine Flow Blending

Total Outfall Capacity: 50 mgd	Wastewater Average Daily Flow Characteristics			Hydraulic Outfall Capacity Based on Wastewater Flow		
Month	**Minimum Daily Flow (mgd)**	**Maximum Daily Flow (mgd)**	**Average Daily Flow (mgd)**	**Maximum Available Capacity (mgd)**	**Minimum Available Capacity (mgd)**	**Average Available Capacity (mgd)**
Jan	13.5	39.7	21.5	36.5	10.3	28.5
Feb	15.4	27.8	19.6	34.6	22.2	30.4
Mar	14.3	17.9	16.2	35.7	32.1	33.8
Apr	13.5	16.2	15.5	36.5	33.8	34.5
May	12.5	15.8	14.9	37.5	34.2	35.1
Jun	12.2	15.6	14.5	37.8	34.5	35.5
Jul	12.2	15.2	14.1	37.9	34.8	35.9
Aug	12.4	15.7	14.1	37.6	34.4	35.9
Sep	13.4	15.3	14.6	36.6	34.7	35.4
Oct	13.3	15.3	14.4	36.7	34.7	35.6
Nov	13.6	19.7	15.1	36.4	30.3	34.9
Dec	13.9	19.2	15.0	36.1	30.8	35.0
Average	13.3	19.4	15.8	36.7	30.6	34.2
Season						
Summer (May - October)	12.2	15.8	14.5	37.9	34.2	35.5
Winter (November - April)	13.5	39.7	17.2	36.5	10.3	32.8

Table C-3
San Mateo WWTP Potential Hydraulic Capacity Available for Brine Flow Blending

Total Outfall Capacity: 40 mgd	Wastewater Average Daily Flow Characteristics			Hydraulic Outfall Capacity Based on Wastewater Flow		
Month	**Minimum Daily Flow (mgd)**	**Maximum Daily Flow (mgd)**	**Average Daily Flow (mgd)**	**Maximum Available Capacity (mgd)**	**Minimum Available Capacity (mgd)**	**Average Available Capacity (mgd)**
Jan	11.0	42.4	16.9	29.0	-2.4	23.1
Feb	11.6	22.4	14.0	28.5	17.6	26.0
Mar	11.7	23.7	14.3	28.3	16.3	25.7
Apr	12.1	26.7	14.3	28.0	13.3	25.7
May	11.8	15.2	12.5	28.2	24.8	27.6
Jun	11.5	12.4	11.9	28.5	27.6	28.1
Jul	10.9	12.2	11.6	29.1	27.8	28.5
Aug	11.0	12.0	11.5	29.0	28.0	28.5
Sep	10.7	12.4	11.5	29.3	27.6	28.6
Oct	10.8	14.7	11.2	29.2	25.3	28.8
Nov	10.2	17.5	11.6	29.8	22.5	28.4
Dec	10.4	35.2	16.0	29.6	4.8	24.0
Average	**11.1**	**20.6**	**13.1**	**28.9**	**19.4**	**26.9**
Season						
Summer (May - October)	10.7	15.2	11.7	28.9	26.9	28.3
Winter (November - April)	10.2	42.4	14.5	28.8	12.0	25.5

Table C-4
Palo Alto RWQCP Potential Hydraulic Capacity Available for Brine Flow Blending

Total Outfall Capacity: 80 mgd	Wastewater Average Daily Flow Characteristics			Hydraulic Outfall Capacity Based on Wastewater Flow		
Month	**Minimum Daily Flow (mgd)**	**Maximum Daily Flow (mgd)**	**Average Daily Flow (mgd)**	**Maximum Available Capacity (mgd)**	**Minimum Available Capacity (mgd)**	**Average Available Capacity (mgd)**
Jan	19.2	65.3	28.8	60.8	14.7	51.2
Feb	20.3	36.7	25.1	59.7	43.3	54.9
Mar	20.8	46.7	25.6	59.2	33.3	54.4
Apr	21.3	44.5	25.3	58.7	35.5	54.7
May	20.2	25.8	21.6	59.8	54.2	58.4
Jun	19.6	22.4	20.9	60.4	57.6	59.1
Jul	18.4	21.1	20.0	61.6	58.9	60.0
Aug	18.9	21.2	19.9	61.1	58.8	60.1
Sep	18.4	21.1	19.8	61.6	58.9	60.2
Oct	19.0	27.3	20.0	61.0	52.7	60.0
Nov	18.5	29.6	20.9	61.5	50.4	59.1
Dec	18.9	58.0	28.1	61.1	22.0	51.9
Average	19.5	35.0	23.0	60.5	45.0	57.0
Season						
Summer (May - October)	18.4	27.3	20.4	61.6	52.7	59.6
Winter (November - April)	18.5	65.3	25.6	61.5	14.7	54.4

Table C-5 summarizes the potential average hydraulic capacity available for brine flow blending for each of the peninsula wastewater treatment plants based on the previous four tables.

Table C-5
Summary of Potential Hydraulic Capacity Available for Brine Flow Blending

Total Outfall Capacity: 80 mgd	Hydraulic Outfall Capacity Based on Wastewater Flow					
Wastewater Facility	**Maximum Available Capacity (mgd)**		**Minimum Available Capacity (mgd)**		**Average Available Capacity (mgd)**	
	Summer	Winter	Summer	Winter	Summer	Winter
South San Francisco WQCP	48.5	47.6	45.1	28.3	47.4	43.2
South Bayside Authority WWTP	37.9	36.5	34.2	10.3	35.5	32.8
San Mateo WWTP	28.9	28.8	26.9	12.0	28.3	25.5
Palo Alto RWQCP	61.6	61.5	52.7	14.7	59.6	54.4

As would be expected with the winter flows normally being higher than summer flows due to wet weather inflow the available hydraulic capacity for blending is higher during the summer months rather than the winter months.

C.5.5 Potential Brine Dilution Requirements

In addition to hydraulic capacity the permitting agencies will often look at the salinity of the discharge flow at the outfall to the ambient salinity of the receiving water. If the combined salinity can be kept below, or within 10% of the ambient level, the required level of analysis for permitting is simpler. As the discharge salinity increases significantly over ambient plus 10% additional field investigations and discharge modeling may be required. In looking at the potential available capacity for adding brine flow to the existing outfalls the blended salinity levels may also reduce blending capacity.

The following assumptions were used for the evaluation of potential brine dilution impacts on brine flow blending based on review of representative water and wastewater quality in the Bay:

- Desalination plant intake salinity of 25 g/L (25,000 mg/L TDS);
- Bay water: recovery rate of 55% (resulting in a brine salinity of 55.56 g/L[55,500 mg/L TDS]);
- WWTP effluent salinity of 1 g/L TDS; and
- Target outfall discharge salinity *not to exceed* 25 g/L (equal to the assumed open Bay intake salinity of 25,000 mg/L TDS).

Table C-6 shows the treatment plant design capacity that would provide the maximum annual production for the assumptions listed above. Calculations made in Tables C-7 through C-10 are based on wastewater flows as they vary over the course of the year, using the flows presented in Tables C-1 through C-4 as a basis for calculations. Maximum desalination plant capacities are calculated based on maximum possible brine flows, which are limited in turn by monthly wastewater flows. Actual possible flows (and the resulting outfall salinities) vary from month to month, and Tables C-7 through C-10 present the summary of the potential capacity evaluation which has been performed on a monthly basis.

In most cases, dilution constraints are more limiting than hydraulic capacity limitations, and therefore drive potential desalination plant capacities. Hydraulic capacity is only more limiting under maximum WWTP flow conditions (typically in the winter). In cases where hydraulic capacities limit brine flows in any month over the course of the year, the mixed outfall in that month may have a *lower* salinity than the receiving water (reflected in the column titled “Minimum variation from receiving water salinity” in Table C-6).

Table C-6
Potential Desalination Plant Capacities As Limited by Brine Discharge Dilution Constraints

Location	Recovery Rate	Maximum Design Treated Water Capacity[1] (mgd)	Maximum Design Brine Discharge[1] (mgd)	Maximum Design Total Intake[1] (mgd)	Annual Treated Water Production[2] (mgd)	Percent production (out of total design capacity)	Minimum variation from receiving water salinity[3]	Maximum variation from receiving water salinity[3]
Palo Alto RWQCP	55%	28	22.9	50.9	22.1	79%	0%	0%
SBSA WWTP	55%	21	20.0	40.0	15.2	72%	0%	0%
San Mateo WWTP	55%	16	13.1	29.1	12.6	79%	-1%	0%
SSF/San Bruno WQCP	55%	21	17.2	38.2	17.0	81%	0%	0%

[1] Capacities listed are the maximum capacity possible to meet brine hydraulic outfall pipeline capacity limitations and discharge requirements of not exceeding the receiving water salinity in any month, using the average monthly wastewater flows in Tables C-2 through C-5.
[2] For the design capacity listed, annual production is the cumulative production possible over the course of a year, considering monthly variations in hydraulic capacities and dilution limitations resulting from monthly variations in wastewater flows.
[3] The minimum/maximum month's variation in outfall salinity from the receiving water over the course of a year resulting from brine flows constrained by the design capacities listed and monthly variations in flow limitations. Assumes that monthly desalination plant production is at the maximum possible within limitations posed by hydraulic capacities and dilution requirements.

Dilution limitations are also less restrictive if the objective wastestream salinity is allowed to exceed the receiving water salinity. Tables C -7 indicates Bay water (55% recovery) desalination plant capacity limitations where the objective ultimate discharge salinity should not exceed 110% of Bay salinity.

Where brackish groundwater sources are considered, a higher associated recovery rate of 75% increases potential plant capacity (based on brine discharge dilution requirements alone). Table C-8 shows the maximum possible treated water production at all 3 locations based on the hydraulic capacity and potential brine dilution constraints discussed above, where design outfall salinity is the same as the receiving water. For the calculations reflected in this table, a source water salinity of 15,000 TDS is assumed. The table shows that hydraulic capacity is more limiting for more brackish source water than for higher salinity source water; the maximum salinity of an potential outfall over the course of a year is below the receiving water's salinity at all treatment plants but one.

Table C-7
Potential Desalination Plant Capacities As Limited by Potential Brine Discharge Dilution Constraints – 10% Exceedance at 55% Recovery

Location	Recovery Rate	Maximum Design Treated Water Capacity[1] (mgd)	Maximum Design Brine Discharge[1] (mgd)	Maximum Design Total Intake[1] (mgd)	Annual Treated Water Production[2] (mgd)	Percent production (out of total design capacity)	Minimum variation from receiving water salinity[3]	Maximum variation from receiving water salinity[3]
Palo Alto RWQCP	55%	34	27.8	61.8	27.1	80%	10%	10%
SBSA WWTP	55%	25	20.0	40.0	18.6	74%	9%	10%
San Mateo WWTP	55%	20	16.4	36.4	15.1	76%	10%	10%
SSF/San Bruno WQCP	55%	26	21.3	47.3	20.9	80%	10%	10%

[1] Capacities listed are the maximum capacity possible to meet brine hydraulic outfall pipeline capacity limitations and discharge requirements of not exceeding 110% of the receiving water salinity in any month, using the average monthly wastewater flows in tables C-2 through C-5.
[2] For the design capacity listed, annual production is the cumulative production possible over the course of a year, considering monthly variations in hydraulic capacities and dilution limitations resulting from monthly variations in wastewater flows.
[3] The minimum/maximum month's variation in outfall salinity from the receiving water over the course of a year resulting from brine flows constrained by the design capacities listed and monthly variations in flow limitations. Assumes that monthly desalination plant production is at the maximum possible within limitations posed by hydraulic capacities and dilution requirements.

Table C-8
Potential Desalination Plant Capacities As Limited by Potential Brine Discharge Dilution Constraints – 10% Exceedance at 75% Recovery

Location	Recovery Rate	Maximum Design Treated Water Capacity[1] (mgd)	Maximum Design Brine Discharge[1] (mgd)	Maximum Design Total Intake[1] (mgd)	Annual Treated Water Production[2] (mgd)	Percent production (out of total design capacity)	Minimum variation from receiving water salinity[3]	Maximum variation from receiving water salinity[3]
Palo Alto RWQCP	75%	54	18.0	72.0	51.5	95%	-25%	-13%
SBSA WWTP	75%	44	14.7	58.7	32.5	74%	-25%	-13%
San Mateo WWTP	75%	35	11.7	46.7	35.2	100%	-12%	0%
SSF/San Bruno WQCP	75%	45	15.0	60.0	36.5	81%	-25%	-13%

[1] Capacities listed are the maximum capacity possible to meet brine hydraulic outfall pipeline capacity limitations and discharge requirements of not exceeding the receiving water salinity in any month, using the average monthly wastewater flows in tables C-2 through C-5.
[2] For the design capacity listed, annual production is the cumulative production possible over the course of a year, considering monthly variations in hydraulic capacities and dilution limitations resulting from monthly variations in wastewater flows.
[3] The minimum/maximum month's variation in outfall salinity from the receiving water over the course of a year resulting from brine flows constrained by the design capacities listed and monthly variations in flow limitations. Assumes that monthly desalination plant production is at the maximum possible within limitations posed by hydraulic capacities and dilution requirements.

The largest treated water capacity considered at this time for a single facility is 20 mgd. Evaluation of a 20 mgd plant for hydraulic capacity and dilution and hydraulic brine disposal restrictions shows that regardless of source water type (i.e., recovery rate), all three general siting areas are near a WWTP that could accommodate at least a 75% base load for a 20 mgd plant. This analysis is summarized in Table C-9 for a range for 55 and 75 percent recovery rates for the desalination treatment (Bay water and brackish water respectively).

Table C-9
Summary of Potential Desalination Plant Capacity As Limited by Potential Brine Discharge Dilution Constraints

Location	Recovery Rate	Design Treated Water Capacity (mgd)	Corresponding Discharge (mgd)	Corresponding Total Intake (mgd)	Annual Treated Water Production (mgd)	Percent Production	Minimum variation from receiving water salinity	Maximum variation from receiving water salinity
Palo Alto RWQCP	55%	20	16.4	36.4	19.7	99%	-16%	0%
	75%	20	6.7	26.7	20.0	100%	-52%	-37%
SBSA WWTP	55%	20	20.0	40.0	15.1	76%	-2%	0%
	75%	20	13.3	33.3	20.0	100%	-40%	-20%
San Mateo WWTP	55%	20	16.4	36.4	12.6	63%	0%	0%
	75%	20	6.7	26.7	20.0	100%	-29%	-8%
SSF/San Bruno WQCP	55%	20	16.4	36.4	16.9	85%	-2%	0%
	75%	20	6.7	26.7	20.0	100%	-40%	-24%

Tables C-6 through C-8 presented maximum possible design brine flows at each wastewater outfall considered in this analysis, based on monthly averages of daily wastewater flows and hydraulic pipeline capacities. The tables also provide design source water intake flows and treated water capacities that correspond to the design brine flows. The tables also include maximum actual treated water production that would result from these design flows, and the range of monthly outfall salinity (relative to a receiving water body) that would result from the design capacities. Table C-10 summarizes this information for both the hydraulic and brine dilution potential constraints indicating the treated water capacity that might be developed for both brackish (75% recovery) and Bay water (55% recovery).

The tables show that for brackish saline water with a recovery rate of 75%, brine discharges are only limited by hydraulic capacities and all four outfalls could accommodate flows from a 20 mgd (or larger) treated water desalination facility. In most cases, the salinity of the final waste stream at the outfall would be less than the receiving water. The tables also show that for higher source water salinities with a recovery rate of 55%, brine flows of 20 mgd (or larger) could be accommodated by all facilities except the San Mateo WWTP, which would only be able to accommodate a maximum capacity of brine flow that would correspond to a 16 mgd treated water plant. For these higher salinity cases, discharge salinities would be close to, if not equal to, the receiving water salinity, if design desalination treated water capacity of 20 mgd is used. Table C-10 summarizes the treated water capacities for each of the WWTP based on WWTP monthly flows and the hydraulic and brine dilutions constraints.

Table C-10
Treated Water Capacity Based on Hydraulic and Brine Dilution Constraints

Facility	Recovery (%)	Average Treated Water Capacity Based on Brine Disposal Hydraulic Constraints (mgd)[1]		Average Treated Water Capacity Based on Brine Dilution Constraints (mgd)					
		Summer[2]	Winter[2]	Summer[2]			Winter[2]		
				Blended Flow < Ambient Salinity	Blended Flow < Ambient + 10%	% Salinity Over Ambient 20 mgd[3]	Blended Flow < Ambient Salinity	Blended Flow < Ambient + 10%	% Salinity Over Ambient 20 mgd[3]
South San Francisco/ San Bruno WQCP	55%	> 20	> 20	15.0	18.1	**16%**	18.8	19.8	3%
	75%	> 20	> 20	> 20	> 20	< 0%	> 20	> 20	< 0%
San Mateo WWTP	55%	> 20	> 20	11.2	13.5	**31%**	13.9	16.8	**20%**
	75%	> 20	> 20	> 20	> 20	< 0%	> 20	> 20	< 0%
SBSA	55%	> 20	> 20	13.9	16.7	**20%**	16.4	18.6	11%
	75%	> 20	> 20	> 20	> 20	< 0%	> 20	> 20	< 0%
Palo Alto RWQCP	55%	> 20	> 20	19.4	> 20	1%	> 20	> 20	< 0%
	75%	> 20	> 20	> 20	> 20	< 0%	> 20	> 20	< 0%

1 Hydraulic capacity is based on pipeline hydraulic capacity and monthly average WWTP flows.
2 Summer flows are considered flows from May through October. Winter flows include flows from November through April.
3 Percentage exceedance is the percentage salinity of the outfall (brine blended with WWTP flows) that is in exceedance of the receiving water salinity. Percentages reported in the table are the average exceedance occurring in any month. Entries of "< 0%" indicate that average outfall salinities would be lower than the receiving water. Flow is 20 mgd of treated water flow.

C.5.6 Cargill Brine Line

Cargill currently operates a brine line that supplies brine to the Cargill salt ponds in Newark and Redwood City. The 20-mile long brine line is used for transfer of brine between the facilities in Newark and Redwood City. The potential to work with Cargill for potential desalination brine discharge into the Cargill salt ponds was investigated, and it was determined that this would not fit with their current and future operations due to hydraulic capacity limitations, and lack of control of the timing, quantity, and salinity levels from a desalination plant. Because of these factors, it is unlikely that there would be capacity available in the Cargill brine in the next 10-20 years. However, it may be useful to revisit the potential of working with Cargill in the future.

C.6 Basis for Planning Level Costs

This section presents the planning level cost information used as the basis of costs for the potential desalination facilities described in Appendix D:

- Construction Costs ($M);
- Capital Costs ($M);

- Annual O&M Costs ($M);
- Present Worth Costs ($M);
- Estimated Annual Production ($M);
- Unit Cost of Total Present Worth ($M/AF); and
- Unit Annualized Costs ($/AF).

In addition to the capital costs (construction costs plus adjustments) and operation and maintenance costs (O&M) two different approaches are included for comparing alternative projects. These include the development of present worth analysis (or life-cycle costs) and annualized costs. The present worth analysis includes the conversion of all cash flows to a common point in time, August 2011. As such, it requires the consideration of the time value of money and all future cash flows discounted back to the present. The present worth analysis converts all annual O&M costs (i.e., chemicals, power, labor, RO membrane replacement, etc.) to a present worth value and adds this to the present worth of the capital cost. To compute a unit cost of water this sum of the present worth of capital and O&M costs is divided by the total amount of water produced over the expected life of the project. For the purposes of this analysis a period of 30 years is used for the comparison of all projects.

An annualized cost estimates the yearly cost of owning and operating an asset, and is also expressed in present dollars. The annualized cost analysis computes the annual debt service on the capital (i.e., one year of payments of interest and principal required on the bond or loan used for financing the project) and adds it to one year's worth of O&M costs. To compute the unit cost of water this sum can be divided by the total amount of water produced by the project in one year.

Both of these methods provide the same ranking of alternatives, but they result in different unit costs for water. Neither method calculates the actual unit cost of water as this requires a more detailed analysis that is tailored to the specific conditions of how the project is financed and how this financing is paid back through water rates. The simplified approach for both methods (and often the more conservative) is to assume that the annual escalation rate for expendables is the same as the discount rate (i.e., bond or loan rate).

C.6.1 Unit Construction Cost Curves

Desalination Treatment Construction Costs

Unit construction cost curves were developed for brackish water, Bay water, and seawater RO desalination facilities based on recent other desalination projects. These cost information was developed based on existing and proposed facilities in the US and Australia, which have similar permitting requirements to the US Projects from the Bahamas and Oman were added to provide additional costs for beach well facilities. US costs were escalated using the San Francisco Engineering News Record (ENR) factor to

August 2011 dollars; international projects were escalated at 5 percent annually from project bid cost numbers published in the Global Water Intelligence World Desalination Report. Table C-11 summarizes the information that was used in developing the cost curves, and Figure C-9 presents these construction cost data points.

Table C-11
Desalination Plant Construction Cost Data Table

	Capacity (mgd)	Plant Construction Cost As Bid	Bid Date	ENR Factor (if available)	ENR Reference City	Escalation Factor	Costs Escalated to August 2011	
							Plant Construction Cost (M)	Unit Construction Cost (M/mgd)
Brackish Well BWRO								
(Alameda County Water District(ACWD) NDF1, Fremont, CA	5.0	$13,000,000	2002	7722	San Francisco	1.32	$17	$3.4
ACWD NDF2, Fremont, CA	10.0	$20,000,000	2009	9725	San Francisco	1.05	$21	$2.1
EL Paso, TX	28.0	$30,000,000	2005	7298	General	1.40	$42	$1.5
Deerfield Beach, FL	13.0	$13,900,000	2006	6538	General	1.56	$22	$1.7
Clewiston	3.0	$13,295,000	2005	7647	General	1.33	$18	$5.9
Lake Region WTP	10.0	$19,727,000	2005	7479	General	1.36	$27	$2.7
Slant Well SWRO								
Municipal Water District of Orange County, CA	15.0	$136,000,000	2007	8873	Los Angeles	1.15	$156	$10.4
Monterey County, CA	7.5	$58,000,000	2003	7789	San Francisco	1.31	$76	$10.1
Monterey County, CA	10.0	$72,000,000	2003	7789	San Francisco	1.31	$94	$9.4
Cambria, CA	1.1	$15,000,000	2011	10192	Los Angeles	1.00	$15	$14.0
Bay/Brackish Open Intake BWRO/SWRO								
Taunton, Massachusetts (open River intake under influence of seawater)	5.0	$65,000,000	2008	9071	General	1.12	$73	$14.6
Haverstraw, NY	2.5	$35,000,000	2011	9080	General	1.12	$39	$15.7
BARDP at East Contra Costa Site, CA	25.0	$113,000,000	2007	9063	San Francisco	1.12	$127	$5.1
BARDP at East Contra Costa Site, CA	65.0	$234,000,000	2007	9063	San Francisco	1.12	$263	$4.0

Table C-11
Desalination Plant Construction Cost Data Table

	Capacity (mgd)	Plant Construction Cost As Bid	Bid Date	ENR Factor (if available)	ENR Reference City	Escalation Factor	Costs Escalated to August 2011	
							Plant Construction Cost (M)	Unit Construction Cost (M/mgd)
Beach Well SWRO								
Sand City	0.6	$5,700,000	2008	9134	San Francisco	1.12	$6	$10.6
Blue Hills, Bahamas	7.2	$29,500,000	2006		3% Escalation	1.16	$34	$4.8
Sur, Oman	21.2	$65,000,000	2007		3% Escalation	1.13	$73	$3.5
Open Water SWRO								
Gold Coast, Australia	35.1	$285,000,000	2007		3% Escalation	1.13	$321	$9.1
Carlsbad, California (estimate)	50.0	$335,000,000	2007	8871	Los Angeles	1.15	$385	$7.7
Huntington Beach, CA (estimate)	50.0	$520,000,000	2008	8871	Los Angeles	1.15	$597	$11.9
Marin County, CA, (estimate)	10.0	$94,627,003	2007	9101	San Francisco	1.12	$106	$10.6
Marin County, CA, (estimate)	5.0	$62,715,451	2007	9101	San Francisco	1.12	$70	$14.0
Santa Cruz, CA (estimate)	2.5	$49,000,000	2011	10115	San Francisco	1.00	$49	$19.6
Cambria, CA (estimate)	1.1	$20,000,000	2011	10192	San Francisco	1.00	$20	$18.7
Perth, Australia	38.0	$326,000,000	2006		3% Escalation	1.16	$378	$9.9
Coquina Coast, FL (estimate)	25.0	$188,052,000	2010	9088	General	1.12	$211	$8.4
Tianjin, China	39.6	$108,000,000	2007		3% Escalation	1.13	$122	$3.1
Palmachim, Israel (update)	22.0	$127,300,000	2008		3% Escalation	1.09	$139	$6.3
Hadera, Israel (update)	87.2	$238,000,000	2008		3% Escalation	1.09	$260	$3.0
Point Lisas, Trinidad	31.4	$130,000,000	2002		3% Escalation	1.30	$170	$5.4
Carboneras, Spain	31.7	$95,000,000	2002		3% Escalation	1.30	$124	$3.9
Tampa Bay, Florida (rehab)	25.1	$158,000,000	2006		3% Escalation	1.16	$183	$7.3
Port Everglades (estimate)	35.0	$181,700,000	2006		3% Escalation	1.16	$211	$6.0
Tuas, Singapore	36.0	$120,000,000	2003		3% Escalation	1.27	$152	$4.2
Ashkelon, Israel	86.2	$212,000,000	2001		3% Escalation	1.34	$285	$3.3

The cost information used for Figure C-9 includes reported construction bid amounts and engineer's estimates from feasibility or preliminary design reports, and in general do not include costs for offsite pipeline installation, soft costs (permitting, legal fees, other studies), environmental mitigation, land purchase, obtaining right of ways/easements, or utility staff time.

The estimates included in the curves assume base-load operations, a significant amount of redundancy, and other assumptions that may add capital costs to a facility that is only required as a supplemental source of supply. There are a number of planning and design phase decisions that will affect capital costs. Some of these decisions include the procurement approach (e.g., design-build), treated water quality goals (e.g., chloride, boron, and bromide), and conditions suitable to allow a shutdown of the facility (e.g., equipment redundancy). Figure C-10 indicates the treatment construction costs for the different source waters by capacity, and reflects the data presented in Figure C-9. All costs are adjusted to August 2011.

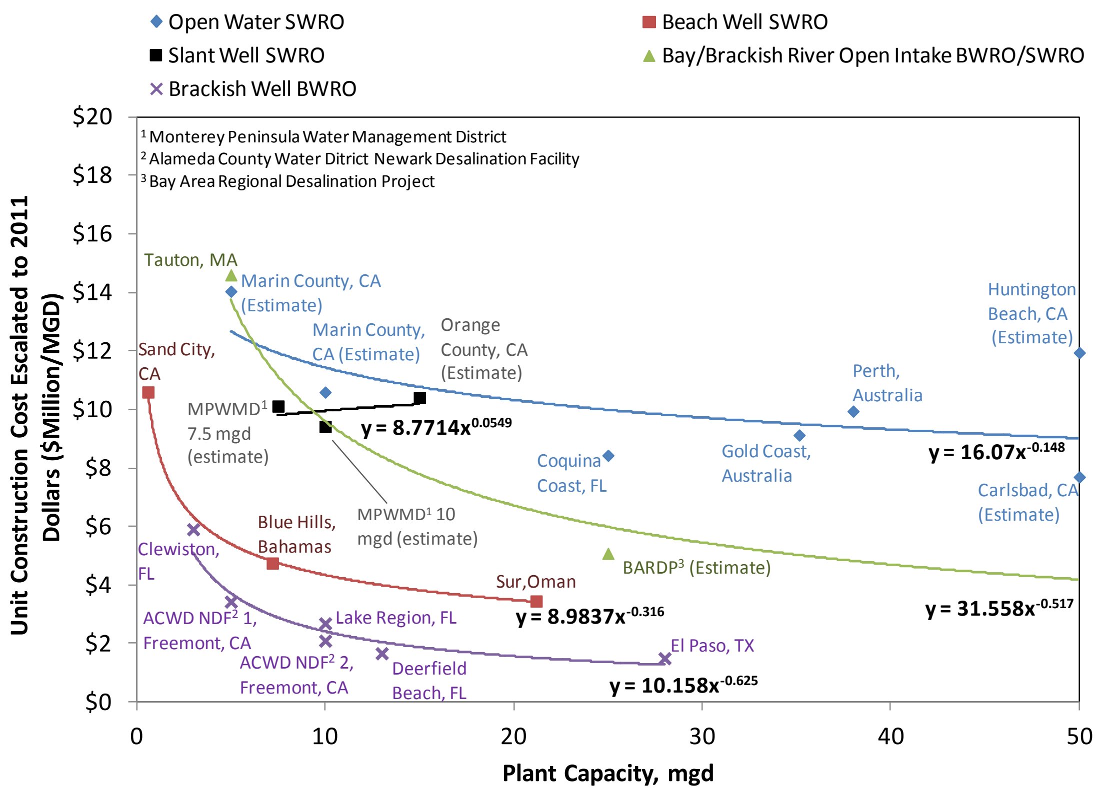

Figure C-9
Desalination Plant Unit Construction Costs and Curves – Historical Data

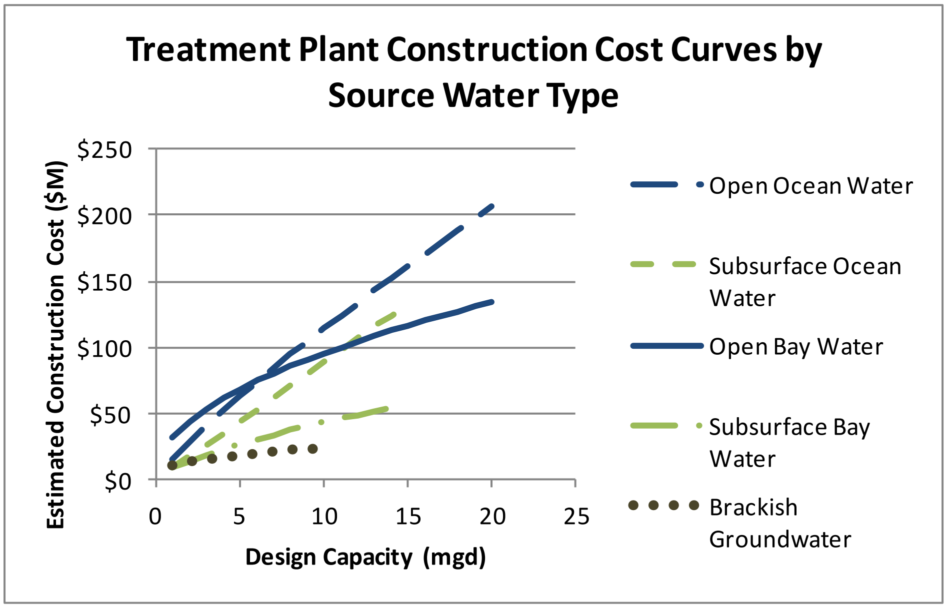

Figure C-10
Desalination Treatment Construction Cost Curves

Table C-12 indicates the information and assumptions used in developing construction cost estimates for the different types of intakes for the desalination projects. Figure C-11 presents the construction costs used for costing the intake facilities. All costs are adjusted to August 2011.

Table C-12
Basis of Construction Costs for Intake Structures

Intake Type	Source	Formula
Brackish Groundwater	Assumes values from September meeting with Ranney/Layne	Brackish vertical well field (assumes up to 1500 gpm wells at $1.0M per well)
Ranney Collector Bay Subsurface	Assumes values from September meeting with Ranney/Layne	Ranney Collector well subsurface intake (assumes 300 ft laterals and 2500 gpm wells at $1.5M per well)
Slant well subsurface	Assumes values from August meeting with Geoscience	Slant well subsurface intake (assumes up to 2000 gpm at 700 ft)
Horizontally Directionally Drilled Well (HDDW) - Subsurface Baywater	Assumes values from August meeting with Geoscience	HDDW - subsurface intake (assumes up to 2000 gpm wells up to 3000 feet in length)
Open Ocean or Open Bay Intake	Assumes equation using cost curve for Santa Cruz, Marin, and SF Bay Regional projects	Regression Curve

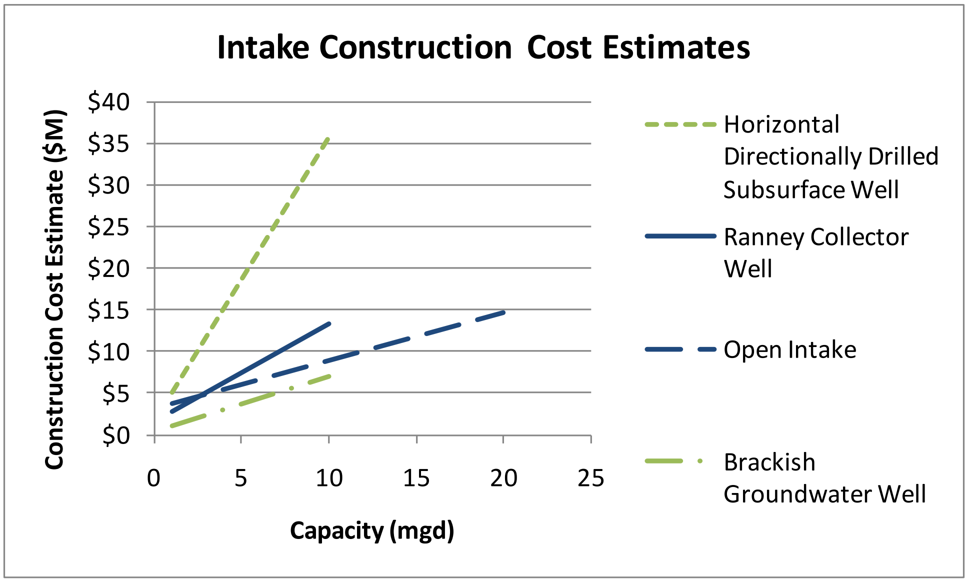

Figure C-11
Intake Construction Cost Curves

Pipeline and Treated Water Storage Construction Cost Assumptions

The unit cost assumptions for the pipelines, pump stations and reservoir storage are based on review of projects constructed within the Bay Area over the last ten years. All unit costs indicated in Table C-13 were adjusted to August 2011.

Table C-13
Pipeline and Storage Construction Cost Assumptions

Description	Unit Cost Assumption
Pipelines installed in an urban area	$15/in-ft
Pipelines requiring Jack & Bore	$29/in-ft
Offshore Pipelines	$20/in-ft
Pump Stations[1]	$2,400/HP
Steel above ground treated water storage tank	$800,000 per MG

[1] It is assumed that the intake and treatment plant construction cost curves include construction costs for a pump station worth a nominal power of 50 HP. Costs are included for any HP requirements above 50 HP.

C.6.2 Capital Costs

Capital costs are developed for the proposed facilities based on the construction costs presented in Section C.5.1 adjusted by the factors noted in Table C-14.

Table C-14
Cost Adjustment Factors

Cost Element	Portion of Construction Cost
Engineering feasibility studies, preliminary and final design, services during construction and construction management	25 percent
Contractor markup: including overhead, profit and prorates	15 percent
"Soft costs" including legal fees, permitting, and other miscellaneous costs	15 percent
Contingency	40 percent

The 15 percent allowance for "soft costs" is a higher percentage than typically included in planning level cost estimates; however, a higher than typical estimate is appropriate given the costs incurred for permitting other desalination facilities in California. For example, the costs incurred for permitting the facility in Carlsbad have been greater than 6 percent (over $20 million) of the estimated construction cost (approximately $300 million) information provided by Poseidon Resources.

Some key costs have not been included the current analysis, including:

- Land purchase cost;
- Purchase of easements or rights-of-way;
- Wheeling or "Transfer" costs for conveyance of water through other agencies facilities; and
- Purchase price of water if required.

C.6.3 Operations and Maintenance Costs

Operations and maintenance costs (O&M) are a key part of the overall costs for desalination facilities. These costs include:

- Cost of power (electrical);
- Chemicals;
- Labor;
- Solids disposal to landfills;
- MF/UF Membrane replacement costs;
- Cartridge filter replacement; and
- RO membrane replacement.

The O&M costs will be adjusted for General Maintenance (non-labor costs) at 10 percent of the total for the components listed above, and also include 10 percent contingency for those same items.

The present worth (PW) calculations for the assumed 30 year life of these projects includes the onetime cost for all capital facilities assumed to occur in the future as well as the stream of operational costs escalated each year over 30 years and then brought back to a PW value in August 2011. The present worth calculations use the following assumptions:

- 2011 costs are current as of August 2011;
- 2015 project start date (O&M costs starting 2016);
- Assumed project life of 30 years;
- Present Worth estimates include a 3% escalation and a 3% discount rate. The same escalation rate is used for electricity, materials, labor and capital costs;
- Annual and total production assumes a base load of 80%; and
- Annualized Costs are calculated over project life in 2011 dollars.

Appendix D
BAWSCA Representative Regional Desalination Projects

This appendix presents the planning level information for the representative BAWSCA regional desalination projects on the San Francisco Peninsula. Information includes; facility sizing, capacity and yield, planning level capital and present worth cost estimates, preliminary implementation schedules, permitting overview, key issues and risks, and next steps.

In this Appendix:

D.1 Summary

Regional desalination projects can provide normal and/or dry year supply for member agencies. The agency-identified groundwater and desalination projects are either being developed by the agencies themselves, or were removed from further consideration in Phase II A of the Strategy (see *Appendix A* of the *Task 3-A/B Memo*). However, treated brackish groundwater and treated Bay water may provide a supply with normal and dry year yields ranging from 1 to 20 million gallons per day (mgd). These projects are being identified as regional projects as they may be large enough to provide supply to more than one agency, and specific sponsors (e.g., member agency or BAWSCA) have not yet been identified.

Appendix B of the *Task 3-A/B Memo* presents the information on the potential availability of brackish groundwater, and *Appendix C* of the *Task 3-A/B Memo* presents the facility options for the regional desalination projects. The facility options which affect the size, yield and location of facilities include:

- Source water quality;
- Intake options;
- Desalination treatment;
- Facility site locations;
- Brine discharge options; and
- Connections to San Francisco (SF) Regional Water System (RWS).

This evaluation included a review of previous studies and other available information to identify locations suitable for both subsurface and open Bay water intakes. Previous studies by member agencies had dismissed larger (greater than 1 mgd) subsurface intakes based on capacity limitations due to the low permeability groundwater basins on Bay side of the San Francisco Peninsula (Peninsula). However, the use of multiple, small desalination facilities with subsurface intakes is included here as an approach that would simplify permitting, reduce pre-treatment needs, and reduce capital and operating costs. In addition, directionally drilled wells under the Bay have also been included for sizing and costing purposes.

Three general areas with possibly favorable groundwater characteristics, possible siting for intakes and treatment facilities, potential co-location for brine disposal with wastewater treatment plants and outfalls, and connection to either local agencies water systems, or connection to the SF RWS were identified for representative desalination projects. These three areas shown on Figure D-1 include:

- Dumbarton Bridge Area;
- San Mateo Bridge Area; and
- South San Francisco Area.

While the initial information suggests that brackish groundwater projects may be promising in the Dumbarton Bridge Area additional analysis will be required for all the areas to determine the hydrogeologic capacity and yields of new desalination facilities at these locations and the potential impacts on other wells. The availability of hydrogeologic information for potential brackish groundwater projects is limited for the San Mateo Bridge and South San Francisco Areas.

Although open Bay water intakes are being pursued by the BARDP and MMWD desalination projects, open water intakes are not ideal since they: 1) involve more extensive permitting; 2) require increased energy use; 3) increase capital and operating costs; and 4) are opposed by many environmental special interest groups, including groups which have filed lawsuits against the proposed MMWD and southern California desalination facilities that have gone through the EIR review process. More detail on the BARDP project is presented in *Appendix E* of the *Task 3-A/B Memo*.

Also, for the purpose developing costs for a range of project the open Bay water intake options were also developed, and locations were identified that would minimize some of the primary concerns raised during the permitting of other facilities in California.

Specific locations near existing wastewater outfalls selected for representative desalination projects include: 1) the area near the Dumbarton Bridge with a nearby existing outfall from the Palo Alto Regional Water Quality Control Plant (RWQCP); 2) near the San Mateo Bridge with nearby existing outfalls from San Mateo WWTP and the South Bayside Authority (SBSA) WWTP serving Redwood City and San Mateo; and 3) in South San Francisco just north of SFO near the existing outfall from the South San Francisco/San Bruno (SSFSB) RWQCP.

Figure D-1 indicates these general areas, and the locations of the wastewater treatment plants and their outfalls.

In Summary:

1. The Dumbarton Bridge Area is potentially promising for brackish groundwater development.

2. Two additional areas have been identified, San Mateo Bridge and South San Francisco, may be potentially promising for either brackish or subsurface bay water desalination and have been included for development of representative project information.

3. Initial information suggests that the desalination projects may cost-effective supply.

4. A number of issues need to be further developed to see how well these options would pan out.

5. Desalination projects are vulnerable to a number of risks which make the implementation schedule lengthier.

D.2 Potential Facility Sizing

D.2.1 Local Hydrogeology and Intakes

As discussed in *Appendix B* the potential yield of brackish groundwater supply developed through vertical wells is limited due to the geology and potential recharge. For the purposes of the representative projects treated water project capacities of 1, 2 and 5 mgd were identified, with the larger capacities including multiple well locations. The brackish groundwater is assumed to have a salinity ranging from about 500 to 10,000 milligrams per liter (mg/L) of Total Dissolved Solids (TDS).

Another option discussed in *Appendix B* and *Appendix C* of the *Task 3-A/B Memo* is the use of subsurface wells (horizontally directionally drilled [HDDW]) that extend under the Bay. Extending under the Bay increases the potential recharge, but also increases the salinity of the water. It is assumed for sizing and costing purposes that the salinity for this water will be equivalent to the Bay water (on average about 25,000 mg/L). This salinity is lower than ocean water at 35,000 mg/L TDS. The advantage of the subsurface intake is that the level of pre-treatment required is reduced due to the natural filtration through the sands and other materials as the Bay water flows to the intake. In reducing the pre-treatment requirements the required size for the treatment facilities are also significantly reduced.

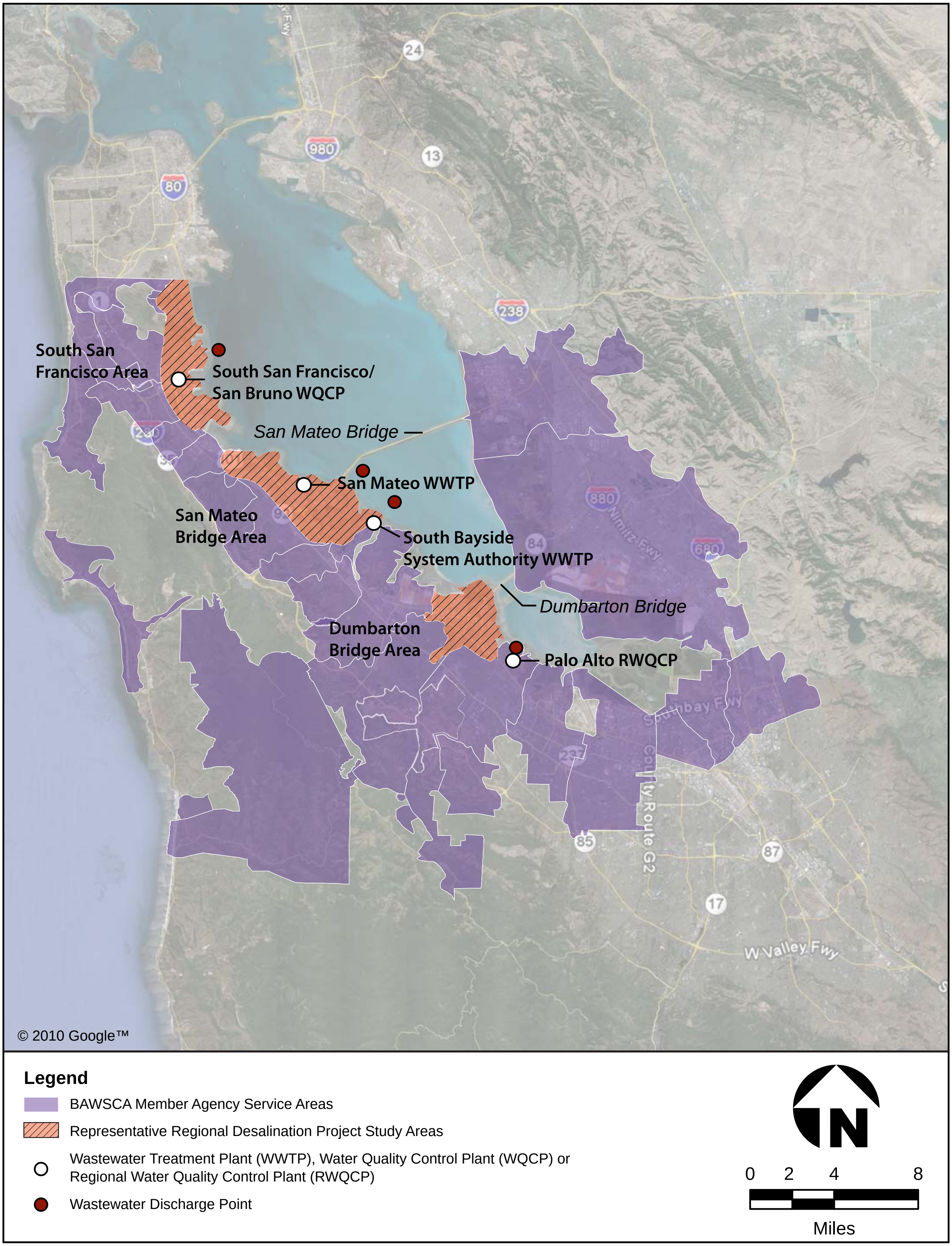

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Figure D-1
BAWSCA Regional Desalination Project Study Areas and Regional Wastewater Plants and Outfalls

Open water intakes are also included as possible alternatives and are a typically used for desalination projects 5 mgd or greater due to their higher treatment costs. These intakes have significantly greater permitting requirements than for the groundwater or subsurface intakes as they may impinge and entrain fish and other biological organisms. In addition, due to the higher salinity and need for pre-treatment they require larger space for the treatment facilities. However, the open Bay intakes may provide benefits, including larger project capacity that may provide benefits that the smaller subsurface projects cannot provide.

D.2.2 Source Water Quality and Desalination Treatment Requirements

All of the representative desalination projects assume treatment with reverse osmosis (RO) membranes. As indicated above the brackish wells and subsurface intakes (HDDW) do not require the same level of pre-treatment as the open Bay intake due to the lower salinity level (brackish) water and natural filtration. *Appendix B* presents the treatment requirements for these different source water and quality supplies.

Table D-1 summarizes the range of capacity, pre-treatment, RO treatment recovery (% of intake flow available as treated water), and whether this type of intake was included in the current evaluation.

Table D-1
Capacity, Pre-treatment, Recovery and Inclusion Summary for Intakes

	Total capacity per unit (well or intake unit) (mgd)	Pretreatment Required? (Y/N)	RO Treatment Recovery Percentage	Intake Included?
Subsurface Bay Intake				
Vertical Brackish Groundwater Wells	1-2	N	Brackish 75%	Y
Ranney Collector Wells [1]	4	N	55% for Bay water	N
Slant Wells [2]	3	N	55% for Bay water	N
Horizontal Directionally Drilled Wells	3	N	55% for Bay water	Y
Infiltration Gallery [3]	2.5	N	55% for Bay water	N
Open Water Intake				
Bay Water	10 - 40	Y	55% for Bay water	Y

[1] Lack of permeable upper formations not conducive to Ranney Collector Well development.
[2] For the purposes of this evaluation slant wells and HDDW wells are similar, and HDDW wells have been included as they can be constructed with longer reaches.
[3] Lack of permeable upper formations not conducive to Infiltration Gallery development.

Table D-2 indicates the approximate property size required in acres for the different water sources and intakes based on the intake type and water quality. These property sizes are conservative and based on information for similar types of plants in California and the United States.

Table D-2 Property Sizes Required for Desalination Plants of Varied Raw Water Sources and Treated Water Capacity		
Treated Water Capacity (mgd)	**Property Size Required for Subsurface or Brackish Well Water (acres)**	**Property Size Required for open Bay Intake (acres)**
1	1.0	2.0
2	1.0	2.0
5	2.5	5.0
10	5.0	10.0
20	10.0	20.0

D.2.3 Brine Discharge

Brine disposal from the desalination process usually incorporates one of the following options:

- Subsurface discharge;
- New open water discharge; or
- Co-location with existing wastewater plant outfalls.

Appendix C Section C.5, Task 3-A/B Memo, describes these options in more detail. Based on the discussion in that section brine disposal is assumed to be by co-location with the wastewater treatment plant outfalls. The local wastewater agencies were contacted and initial calculations developed as to the potential capacity available for joint discharge. Figure D-1 indicates those locations. With an assumed maximum treated water capacity of up to 20 mgd there is both hydraulic capacity and blending capacity (maintaining combined discharge) no greater than 20% above the ambient Bay water TDS concentration.

D.2.4 Representative BAWSCA Regional Desalination Projects

At this time it is uncertain whether regional desalination projects will be part of the BAWSCA Strategy moving forward. However, in order to develop sufficient information to be able to compare with the other water supply management projects representative sites and sizes for facilities were identified and planning level costs in order to allow a relative between comparison of the regional desalination projects as well as comparison with the other Phase II A Strategy projects.

Potential Available Intake and Treatment Plant Property Site Identification

Table D-2 presented the property requirements for the different treated water capacities and source waters. This information was used to identify vacant property that could potentially accommodate wells and/or desalination plants. The Google Earth satellite imagery in 2011 and 2012 were used to identify currently vacant or undeveloped land in the vicinity of the Dumbarton Bridge, San Mateo Bridge, and South San Francisco areas.

In some cases the undeveloped land may be part of existing properties, where these portions of the property have not currently been developed. It is possible that some of these parcels may be available for desalination well construction and/or treatment plant construction in the future. Multiple property locations were identified for each of the capacities identified in Table D-2 to allow for potential competing uses and development prior to property acquisition. At this time no additional investigation has been undertaken to determine the likelihood that any apparent undeveloped lots are in fact available. Figures D-2, D-3, and D-4 indicate these potential sites for the Dumbarton Bridge, San Mateo Bridge and South San Francisco areas respectively.

Identifying Representative Desalination Projects

The potential intake and treatment plant sites were used in conjunction with locations of the WWTP sites for potential co-location for brine disposal to identify representative projects for development of facility and cost information.

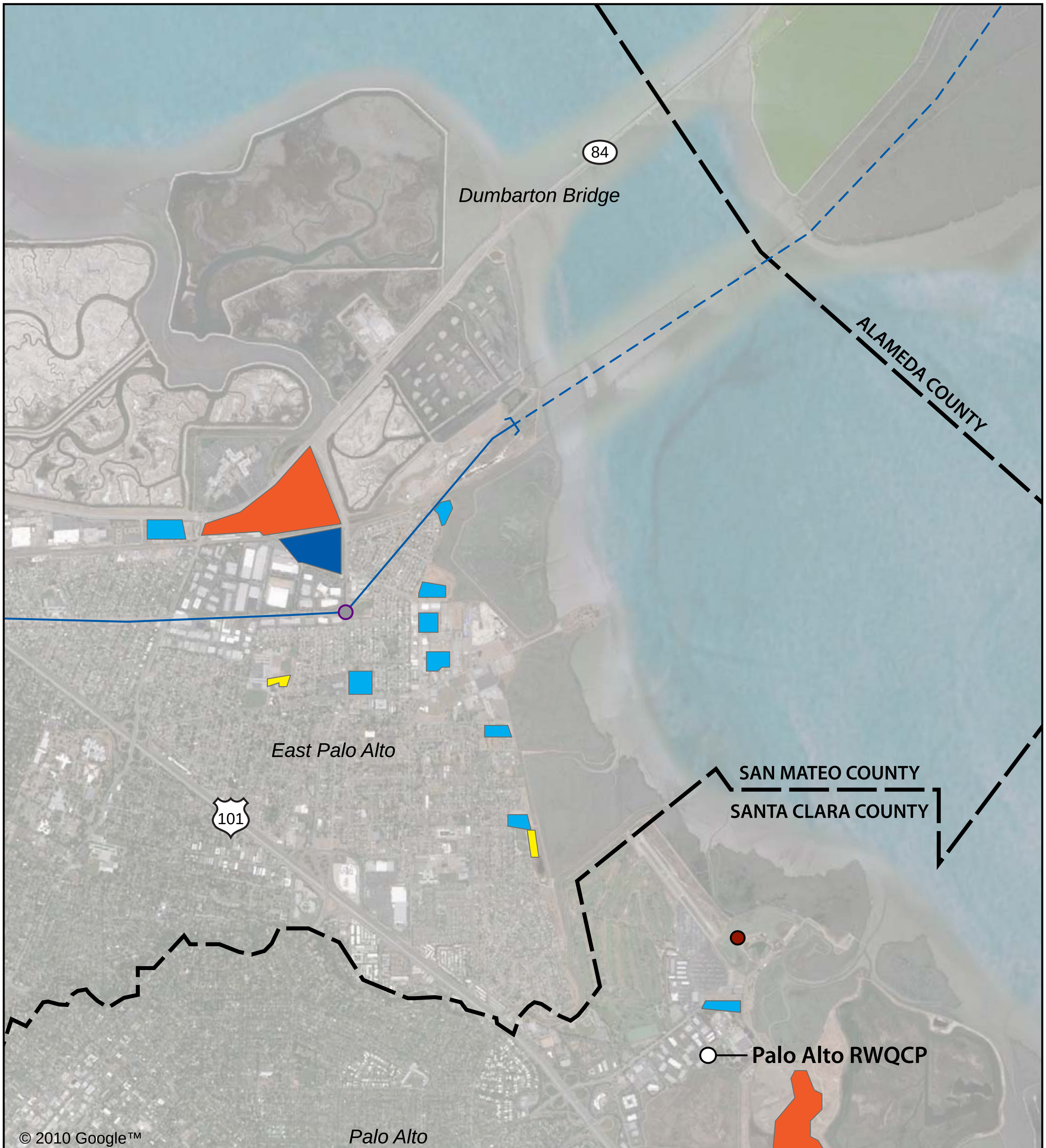
Potential sites were prioritized as part of the representative projects based on:

- Proximity to water supply source (near the Bay);
- Proximity to WWTP sites for potential brine disposal;
- Qualitative assessment of surrounding land use. For example, parcels in residential areas were not considered likely sites for this analysis;
- Topography- Parcels with steeply sloping areas are not included due to construction and land use issues; and
- Proximity to SF RWS existing turnouts.

The open Bay water intake options considered were developed to identify locations that would minimize some of the primary concerns raised during the permitting of other facilities in California. This included identifying locations that have:

- Access to construct the open water intake in deep, "low biologically productive" areas to minimize the impacts on marine life and construction on the Bay floor; and
- Existing wastewater outfalls with additional hydraulic capacity during dry weather conditions to provide a beneficial way to discharge the brine back to the Bay even though this approach may limit the capacity of the desalination facility.

Selected (representative) potential intake and treatment plant site properties identified for the Dumbarton Bridge, San Mateo, and South San Francisco areas are shown in Figures D- 5, D-6, and D-7 respectively. The pipelines connecting the properties to the WWTPs for co-location with the outfall pipelines, treated water turnouts on the SF RWS, and source water intakes are highlighted in the figures. Conceptual pipeline alignments were identified on non-highway roads for permitting and cost purposes. Alignments



Legend

- Up to 5 mgd Horizontally Directionally Drilled (HDD) Brackish Wells
- Any HDD/Brackish Wells
- Any HDD/Brackish Wells - Over 10 mgd Open Intake
- Any HDD/Brackish Wells - Over 20 mgd Open Intake
- SFPUC Turnout 10
- Wastewater Treatment Plant (WWTP) or Regional Water Quality Control Plant (RWQCP)
- Wastewater Discharge Point
- San Francisco (SF) Regional Water System (RWS)
- SF RWS Tunnel

N

0 0.2 0.4 0.8

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Figure D-2

Potential Desalination Plant Sites - Dumbarton Bridge Area

Legend

- Up to 5 mgd Horizontally Directionally Drilled (HDD) Brackish Wells
- Any HDD/Brackish Wells
- Any HDD/Brackish Wells - Over 10 mgd Open Intake
- Any HDD/Brackish Wells - Over 20 mgd Open Intake
- SFPUC Turnout 99
- Wastewater Treatment Plant (WWTP) or Regional Water Quality Control Plant (RWQCP)
- Wastewater Discharge Point
- San Francisco (SF) Regional Water System (RWS)

0 0.5 1 2

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Figure D-3

Potential Desalination Plant Sites - San Mateo Bridge Area

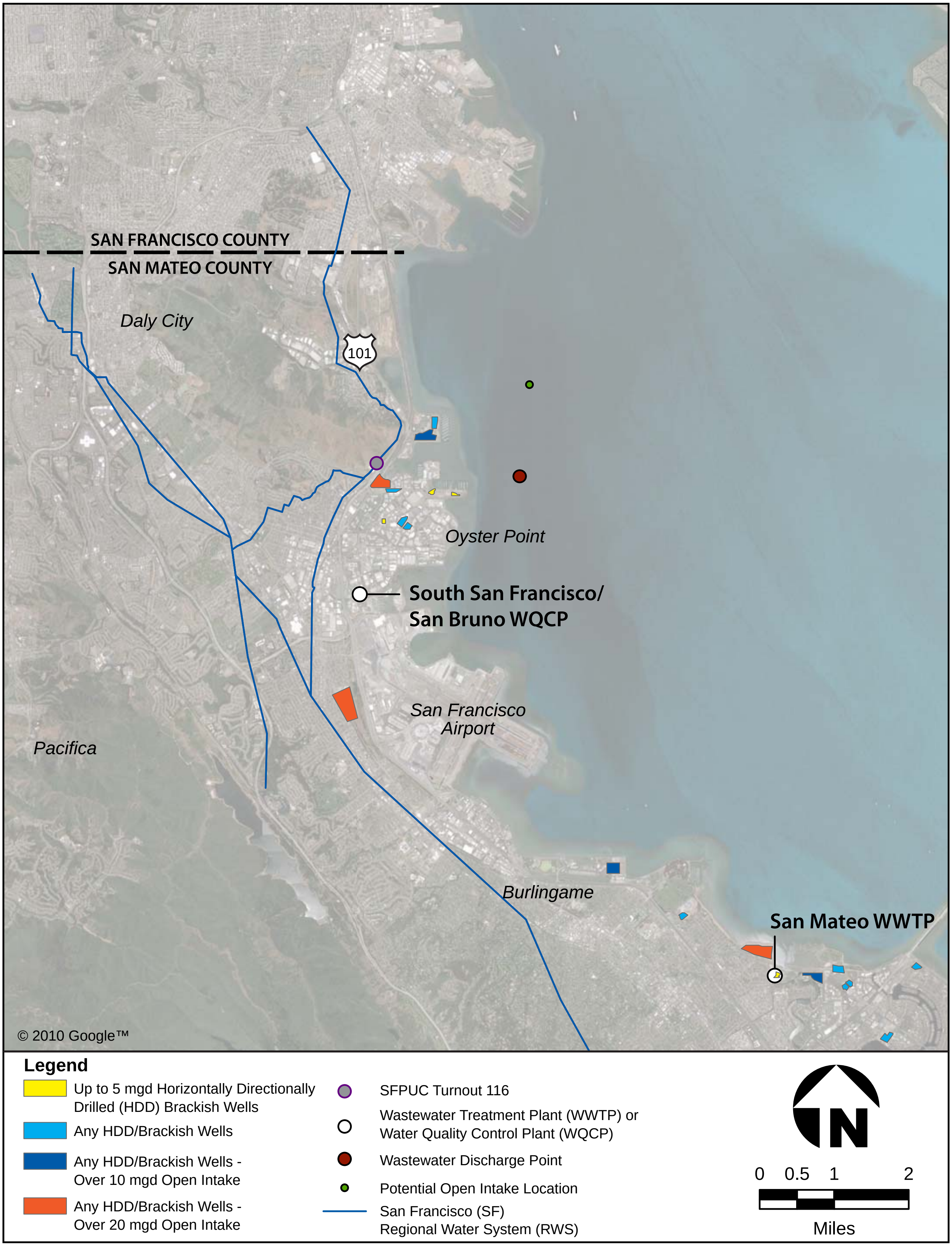

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Figure D-4
Potential Desalination Plant Sites - South San Francisco Area

were also identified minimizing tunneling that would be associated with pipeline construction (i.e., where pipelines pass under existing highways).

Table D-3 summarizes for each of the planning areas the possible SF RWS connection point, possible brine discharge location, and the type of intakes assumed for the representative regional desalination projects. Due to poor water circulation and poor water quality in the South Bay south of the Dumbarton Bridge HDDW and open Bay intakes were not included as projects in that area. Also, in the South San Francisco area HDDW were not included due the rapid off-shore drop off and difficulty in constructing those types of wells under those conditions.

Table D-3
Summary of Desalination Plant Options Evaluated

Area	Potential SF RWS Connection	Potential WW Discharge Collocation	Vertical Brackish Groundwater Well	Subsurface Bay HDDW	Open Intake
Dumbarton Bridge Area	Turnout 10	Palo Alto Water Quality Control Plant	X	-	-
San Mateo Bridge Area	Turnout 99	San Mateo Wastewater Treatment Plant	X	X	X
South San Francisco Area	Turnout 116	South San Francisco/San Bruno Water Quality Control Plant	X	X	X

Table D-4 presents the treated water capacities for each of the areas and type of intake for the representative desalination projects.

Table D-4
Project Location, Capacity, Type of Intake and Percentage Recover

Location	Treated Water Capacity (mgd)	Vertical Brackish Groundwater Well	Subsurface Bay HDDW	Open Bay Intake
Recovery Percentage		75%	55%	55%
Dumbarton Bridge Area	1	X	-	-
	2	X	-	-
	5	X	-	-
San Mateo Bridge Area	1	X	-	-
	2	X	-	-
	5	X	-	-
	5	-	X	-
	10	-	X	X
	20	-	-	-
South San Francisco Area	1	X	-	-
	2	X	-	-
	5	-	X	-
	10	-	X	-
	20	-	-	X

D.3 Planning Level Cost Estimates for Representative Desalination Projects

D.3.1 Basis of Cost Assumptions

Appendix C presents a more detailed discussion of the basis of cost assumptions for the brackish and Bay water desalination projects. This section presents the specific cost information for the representative regional desalination projects.

In addition to the capital costs (construction costs plus adjustments) and operation and maintenance costs (O&M) two different approaches are included for comparing alternative projects. These include the development of present worth analysis (or life-cycle costs) and annualized costs. The present worth analysis includes the conversion of all cash flows to a common point in time, August 2011. As such, it requires the consideration of the time value of money and all future cash flows discounted back to the present. The present worth analysis converts all annual O&M costs (i.e., chemicals, power, labor, RO membrane replacement, etc.) to a present worth value and adds this to the present worth of the capital cost. To compute a unit cost of water this sum of the present worth of capital and O&M costs is divided by the total amount of water produced over the expected life of the project. For the purposes of this analysis a period of 30 years is used for the comparison of all projects.

An annualized cost estimates the yearly cost of owning and operating an asset, and is also expressed in present dollars. The annualized cost analysis computes the annual debt service on the capital (i.e., one year of payments of interest and principal required on the bond or loan used for financing the project) and adds it to one year's worth of O&M costs. To compute the unit cost of water this sum can be divided by the total amount of water produced by the project in one year.

Both of these methods provide the same ranking of alternatives, but they result in different unit costs for water. Neither method calculates the actual unit cost of water as this requires a more detailed analysis that is tailored to the specific conditions of how the project is financed and how this financing is paid back through water rates. The simplified approach for both methods (and often the more conservative) is to assume that the annual escalation rate for expendables is the same as the discount rate (i.e., bond or loan rate).

For the purposes of comparison of water supply alternatives we have included both the present worth and annual cost analysis for the projects.

The cost information developed includes:

- Construction Costs ($M);
- Capital Costs ($M);
- Annual O&M Costs ($M);

- Present Worth Costs ($M);
- Estimated Annual Production ($M);
- Unit Cost of Total Present Worth ($M/AF); and
- Unit Annualized Costs ($/AF).

D.3.2 Capital Costs

Capital costs were developed for the proposed facilities based on the construction costs presented in Appendix C, Section C.6 adjusted for:

- Contractor markup: including overhead, profit and prorates –15 percent;
- Engineering feasibility studies, preliminary and final design, services during construction and construction management – 25 percent;
- "Soft costs" including legal fees, permitting, and other miscellaneous costs – 15 percent; and
- Contingency – 40 percent.

The 15 percent allowance for "soft costs" is a higher percentage than typically included in planning level cost estimates; however, a higher than typical estimate is appropriate given the costs incurred for permitting other desalination facilities in California. For example, the costs incurred for permitting the facility in Carlsbad have been greater than 6 percent (over $20 million) of the estimated construction cost (approximately $300 million) information provided by Poseidon Resources.

Some key costs have not been included for the current analysis due to limited or no information, including:

- Land purchase cost;
- Purchase of easements or rights-of-way;
- Cost for co-location with the wastewater treatment plants for brine disposal;
- Wheeling or "Transfer" costs for conveyance of water through other agencies facilities; and
- Purchase price of water if required.

The conveyance costs could potentially be as high as the present worth cost per acre-foot, depending on where the supply and treatment is located and how it is conveyed to the member agencies. These costs that are not currently included may be developed later as part of the more detailed evaluation of the projects moving forward within the Strategy.

D.3.3 Representative Desalination Project Sizing and Costs

For costing purposes preliminary estimates of capacities and sizing for the following facilities were developed:

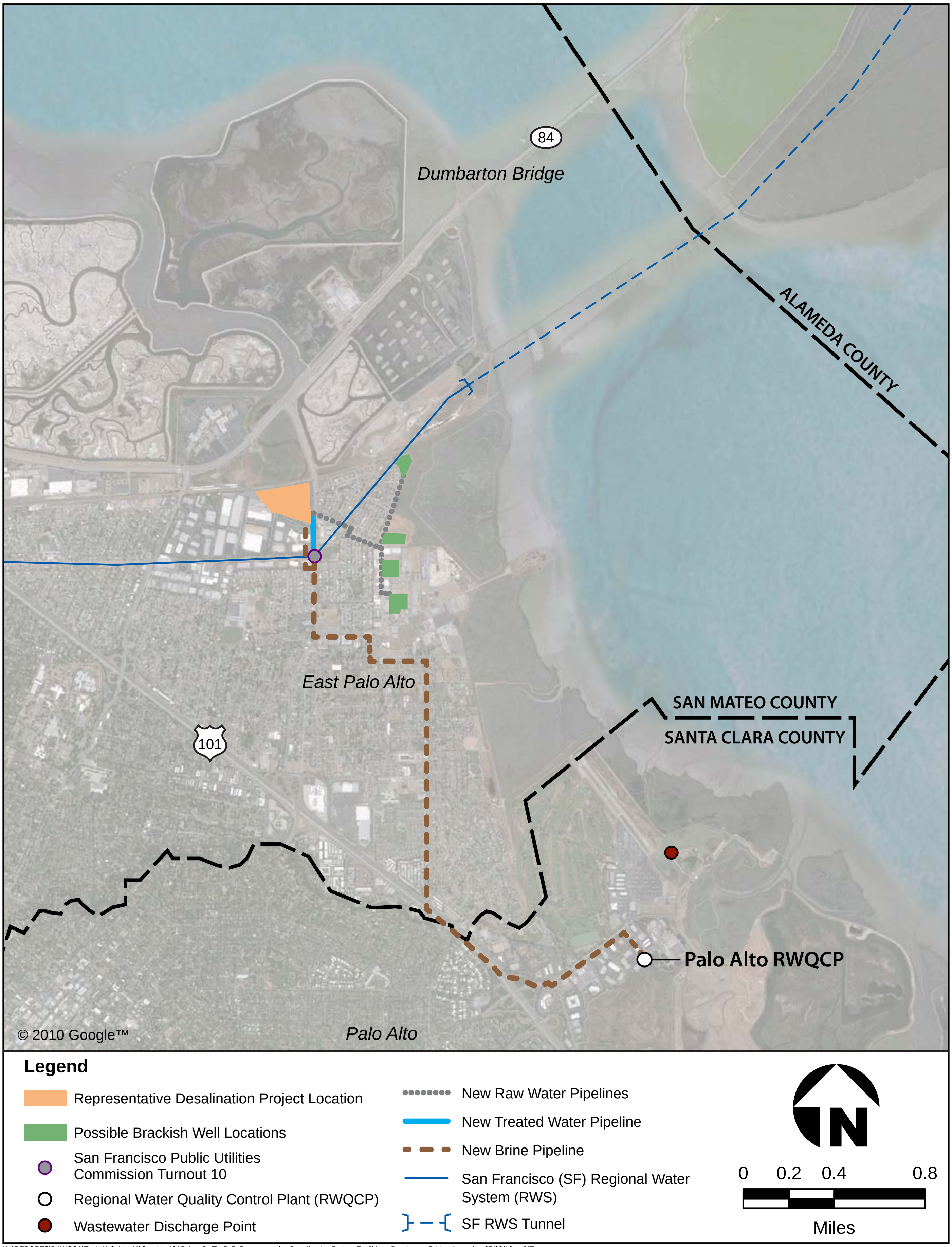
- Intakes;
- Raw water pipelines from intakes to the desalination treatment site;
- Desalination treatment plant;
- Treated water pipelines to connections to the SF RWS; and
- Brine pipelines from the desalination treatment plant site to the wastewater treatment plant site assumed for co-use of the outfall pipelines for brine disposal.

Table D-5 summarizes the capacity, and production for the source water, treatment facilities, and brine disposal. Also included in Table D-5 is the capital cost for each of the projects. For the purposes of costing the facilities are assumed to operate at an average 80% of total capacity on an annual basis.

Attachment A to this appendix provides more detailed information on the development of the capital, O&M, present worth and annualized costs for each of the alternatives.

As presented in Table D-5 the capital costs range from $31 million for a 1 mgd ($31M/mgd) brackish groundwater project up to $365 million for a 20 mgd open water intake ($18M/mgd).

The costs for the similar capacity sources (i.e., 1 mgd brackish groundwater projects) are very similar across the three different study areas with the San Mateo Bridge Area project at $39.6M being slightly higher than the Dumbarton Bridge Area, $30.6M, or the South San Francisco Area at $31.1M. This is primarily due to the difference in lengths for the raw water, treated water and brine pipelines. This same difference occurs for the HDDW and open Bay water projects as the same pipeline alignments are assumed for each of the different sources for each area. This difference can be seen between the Dumbarton Bridge Area projects and South San Francisco projects in Figures D-5 and D-7 respectively. The total length of the treated water and brine pipelines for the Dumbarton Bridge Area is 19,300 feet versus 24,500 feet for the South San Francisco Area, or a difference in capital cost of about $1.7M ($0.8M construction cost difference).



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CDM Smith

Figure D-5
Representative Desalination Project Facilities - Dumbarton Bridge Area

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Figure D-6

Representative Desalination Project Facilities - San Mateo Bridge Area

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CDM Smith

Figure D-7

Representative Desalination Project Facilities - South San Francisco Area

Table D-5
Representative Desalination Project Sizing and Capital Cost

Item	Dumbarton Bridge Area			San Mateo Bridge Area						South San Francisco Area				
	1 mgd Brackish Groundwater Wells	2 mgd Brackish Groundwater Wells	5 mgd Brackish Groundwater Wells	1 mgd Brackish Groundwater Wells	2 mgd Brackish Groundwater Wells	5 mgd Brackish Groundwater Wells	5 mgd Bay Water HDDW[1] Wells	10 mgd Bay Water HDDW[1] Wells	10 mgd Bay Water Open Intake	1 mgd Brackish Groundwater Wells	2 mgd Brackish Groundwater Wells	5 mgd Bay Water HDDW[1] Wells	10 mgd Bay Water HDDW[1] Wells	20 mgd Bay Water Open Intake
Assumed Treated Water Production Capacity (mgd)[2]	1	2	5	1	2	5	5	10	10	1	2	5	10	20
Assumed Annual Production (AF/Year)[2,3]	900	1,800	4,500	900	1,800	4,500	4,500	9,000	9,000	900	1,800	4,500	9,000	17,900
Facility Sizing														
RO Recovery %	75%	75%	75%	75%	75%	75%	55%	55%	55%	75%	75%	75%	55%	55%
Source Water Capacity (mgd)	1.3	2.7	6.7	1.3	2.7	6.7	9.1	18.2	18.2	1.3	2.7	6.7	18.2	36.4
RO Treated Water Capacity (mgd)	1	2	5	1	2	5	5	10	10	1	2	5	10	20
Brine Disposal Capacity (mgd)	0.3	0.7	1.7	0.3	0.7	1.7	4.1	8.2	8.2	0.3	0.7	1.7	8.2	16.4
Capital Cost														
Capital Cost ($M)[4,5]	$30.6	$43.0	$64.4	$35.8	$47.3	$72.1	$126.5	$201.8	$274.7	$31.1	$42.7	$120.5	$194.3	$364.6

[1] Horizontally Directionally Drilled Wells.
[2] Capacity is treated water production from desalination plant.
[3] Assumes annual operation at 80% of capacity.
[4] Costs adjusted to August 2011.
[5] Costs do not include property acquisition, conveyance costs by others, or purchase price of water.

Table D-6 summarizes the annualized and present worth costs for these same projects based on the calculations presented in *Attachment A*. The relative differences between the present worth cost for the different source types and project areas are similar in nature to those for the capital costs. The present worth costs range from a low of about $900/AF for the 5 mgd brackish groundwater projects to about $2,000/AF for the 1 mgd brackish groundwater projects. The HDDW well costs range from about $1,400/AF to $1,700/AF for 10 mgd and 5 mgd projects respectively at both the San Mateo and South San Francisco Areas. The 20 mgd Bay water open intake in the South San Francisco Bay Area has an estimated present worth cost of about $1,500/AF.

D.4 Other Project Information and Evaluation Criteria

In addition to project yield and cost there is other project information that will be used in the comparison of water supply management projects. Table D-7 summarizes this project information for each of the representative desalination projects.

Some of the information for Table D-7 will be developed and updated at a later time when a common comparison and development of values will be prepared for all projects.

D.4.1 Supply Reliability

The *Increase Supply Reliability* criteria has four subcriterion:

- *Criterion 1A – Ability to Meet Normal Year Supply Need* - An estimate of the ability of a water supply management project to meet the normal hydrologic year supply needs of BAWSCA member agencies is measured by the annual yield of the project during normal hydrologic conditions by the 2018 and 2035 planning horizons.
  - The yield is indicated in Table D-7.
- *Criterion 1B – Ability to Meet Drought Supply Need* - An estimate of the ability of a water supply management project to meet the supply need during a drought is measured by the annual yield of the project during the 1987 – 1992 drought. The criterion of drought reliability captures whether a supply project is resistant to drought impacts.
  - The yield is indicated in Table D-7.

Table D-6
Summary of Project Yields and Cost

Item	Dumbarton Bridge Area			San Mateo Bridge Area						South San Francisco Area				
	1 mgd Brackish Groundwater Wells	2 mgd Brackish Groundwater Wells	5 mgd Brackish Groundwater Wells	1 mgd Brackish Groundwater Wells	2 mgd Brackish Groundwater Wells	5 mgd Brackish Groundwater Wells	5 mgd Bay Water HDDW[1] Wells	10 mgd Bay Water HDDW[1] Wells	10 mgd Bay Water Open Intake	1 mgd Brackish Groundwater Wells	2 mgd Brackish Groundwater Wells	5 mgd Bay Water HDDW[1] Wells	10 mgd Bay Water HDDW[1] Wells	20 mgd Bay Water Open Intake
Assumed Production Capacity (mgd)[2]	1	2	5	1	2	5	5	10	10	1	2	5	10	20
Assumed Annual Production (AF/year)[2,3]	900	1,800	4,500	900	1,800	4,500	4,500	9,000	9,000	900	1,800	4,500	9,000	17,900
Annualized Costs														
Annualized Capital Cost ($M/year)[4]	$1.56	$2.19	$3.28	$2.02	$2.68	$4.13	$6.98	$11.02	$14.04	$1.59	$2.18	$6.15	$9.91	$18.60
O&M Cost ($M/year)[4]	$0.74	$1.11	$2.17	$0.77	$1.21	$2.20	$3.44	$6.49	$8.05	$0.70	$1.05	$3.43	$6.47	$15.50
Total Annualized Cost ($M/year)[4]	$2.30	$3.30	$5.45	$2.79	$3.89	$6.33	$10.42	$17.51	$22.09	$2.28	$3.23	$9.58	$16.38	$34.10
Total Annualized Cost ($/AF)[5,6,8]	$2,600	$1,800	$1,200	$3,100	$2,200	$1,400	$2,300	$2,000	$2,500	$2,500	$1,800	$2,100	$1,800	$1,900
Present Worth Costs														
Total Production – 30 years (AF)	27,000	54,000	135,000	27,000	54,000	135,000	135,000	270,000	270,000	27,000	54,000	135,000	270,000	537,000
Total Present Worth Cost ($M)[7]	$52.9	$76.2	$129.4	$58.5	$82.9	$137.4	$229.1	$395.3	$516.6	$52.98	$74.22	$223.49	$388.37	$829.65
Present Worth Unit Cost ($/AF)[6,8]	$2,000	$1,400	$1,000	$2,200	$1,500	$1,000	$1,700	$1,500	$1,900	$1,900	$1,400	$1,700	$1,400	$1,500

1 Horizontally Directionally Drilled Wells.
2 Capacity is treated water production from desalination plant.
3 Assumes annual operation at 80% of capacity.
4 Costs adjusted to August 2011.
5 Annualized cost based on 30 year return at 3% interest rate.
6 Costs do not include property acquisition, cost for use of wastewater treatment plant outfall capacity, conveyance costs by others, or purchase price of water.
7 Present Worth estimates include a 3% escalation and a 3% discount rate. The same escalation rate is used for electricity, materials, labor and capital costs.
8 Costs are rounded to the nearest $100/AF.

Table D-7
Project Summary for Desalination Project Evaluation Criteria and Metrics

			Project Values													
			Dumbarton Bridge Area			**San Mateo Bridge Area**						**South San Francisco Area**				
Objective	**Criteria**	**Metrics**	**1 mgd Brackish Groundwater Wells**	**2 mgd Brackish Groundwater Wells**	**5 mgd Brackish Groundwater Wells**	**1 mgd Brackish Groundwater Wells**	**2 mgd Brackish Groundwater Wells**	**5 mgd Brackish Groundwater Wells**	**5 mgd Bay Water HDDW Wells**	**10 mgd Bay Water HDDW Wells**	**10 mgd Bay Water Open Intake**	**1 mgd Brackish Groundwater Wells**	**2 mgd Brackish Groundwater Wells**	**5 mgd Bay Water HDDW Wells**	**10 mgd Bay Water Open Intake**	**20 mgd Bay Water Open Intake**
1 - Increase Supply Reliability	**Criterion 1A** – Ability to Meet Normal Year Supply Need	Quantitative (AF /year): Average annual yield in normal years in 2018 and 2035.[2,3]	900	1,800	4,500	900	1,800	4,500	4,500	9,000	9,000	900	1,800	4,500	9,000	17,900
	Criterion 1B – Ability to Meet Drought Supply Need	Quantitative (AF/year): Average annual yield with drought hydrology of 1987 – 1992.[2,3]	900	1,800	4,500	900	1,800	4,500	4,500	9,000	9,000	900	1,800	4,500	9,000	17,900
	Criterion 1C – Risk of Facility Outage	Qualitative (1-5): Estimated probability and duration of major conveyance failure	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Criterion 1D – Potential for Regulatory Vulnerability	Qualitative (1-5): Potential for regulatory decisions to impact supply reliability	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2 - Provide High Level of Water Quality	**Criterion 2A** – Meets or Surpasses Drinking Water Quality Standards	Quantitative (mg/L): Total dissolved solids (TDS) level as an indicator of water quality.	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120
	Criterion 2B – Meets or Surpasses Non-Potable Water Quality Standards	Qualitative: Meets minimum water quality requirement (e.g., Title 22) for the targeted use. (Yes or no)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3 - Minimize Cost of New Water Supplies	**Criterion 3** – Capital and Present Worth Costs	Quantitative ($/AF): Present Worth unit costs including capital and operating costs	$2,000	$1,400	$1,000	$2,300	$1,700	$1,100	$1,500	$1,800	$1,900	$1,900	$1,400	$1,700	$1,400	$1,500
4 - Reduce Potable Water Demand	**Criterion 4** – Augment Non-Potable Water Supplies	Quantitative (AF/year): Reduction of potable water demand by use of non-potable supply.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Table D-7
Project Summary for Desalination Project Evaluation Criteria and Metrics

			Project Values													
			Dumbarton Bridge Area			San Mateo Bridge Area						South San Francisco Area				
Objective	Criteria	Metrics	1 mgd Brackish Groundwater Wells	2 mgd Brackish Groundwater Wells	5 mgd Brackish Groundwater Wells	1 mgd Brackish Groundwater Wells	2 mgd Brackish Groundwater Wells	5 mgd Brackish Groundwater Wells	5 mgd Bay Water HDDW Wells	10 mgd Bay Water HDDW Wells	10 mgd Bay Water Open Intake	1 mgd Brackish Groundwater Wells	2 mgd Brackish Groundwater Wells	5 mgd Bay Water HDDW Wells	10 mgd Bay Water Open Intake	20 mgd Bay Water Open Intake
5 - Minimize Environmental Impacts	**Criterion 5A** –Greenhouse Gas Emissions	Quantitative (metric tons/ AF of Supply): Estimates of unit greenhouse gas emissions	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Criterion 5B –Impact to Groundwater Quantity and Quality	Qualitative (1-5): Potential impacts to groundwater levels, groundwater quality, or potential for subsidence	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Criterion 5C –Impact to Habitat	Qualitative (1-5): Potential impacts to habitat, such as wetlands, riparian zones, fisheries, and inundation areas.	1	1	1	1	1	1	1	1	1	1	1	1	1	1
6 - Increase Implementation Potential	**Criterion 6A** – Institutional Complexity	Qualitative (1-5): Number and type of agencies and agreements involved	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Criterion 6B –Level of Local Control	Qualitative (1-5): BAWSCA and Member Agency ownership of supply projects	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Criterion 6C –Permitting Requirements	Qualitative (1-5): Permitting or regulatory issues for supply projects	1	1	1	1	1	1	1	1	1	1	1	1	1	1

[1] BARDP project description and data presented in Appendix E to Task 3-AB Memo. Unit Present Worth Costs presented in this table have been adjusted to August 2011 dollars.
[2] Capacity is treated water production from desalination plant.
[3] Assumes annual operation at 80% of capacity.

- *Criterion 1C – Risk of Facility Outage* - Supply vulnerability is measured by the probability and duration of potential outages to a particular water supply management project due to a major conveyance failure. This criterion captures the vulnerability of projects to emergency outages. This metric is a qualitative measure ranging from 1 through 5, with a score of "1" identifying the projects that are least susceptible to emergency outages and a score of "5" indicating high susceptibility to conveyance failures.
  - These values will be developed as part of the overall analysis and comparison of projects. However, it is anticipated that these projects could have a lower risk of facility outage than water transfer projects where there are multiple agencies and conveyance systems required to convey the water into the BAWSCA service area.
- *Criterion 1D – Potential for Regulatory Vulnerability* - The susceptibility of a water supply management project to interruption as a result of regulatory issues includes legal, political, or environmental constraints. This metric is a qualitative measure ranging from 1 through 5, with a score of "1" identifying the projects that are least susceptible to regulatory risk and a score of "5" indicating high susceptibility to regulatory risk.
  - These values will be developed as part of the overall analysis and comparison of projects. However, it is anticipated between the desalination projects the Bay water open intake will score lower than the HDDW and brackish groundwater projects as open intake will require a new intake and subsequent requirements for additional studies and permitting.

D.4.2 Water Quality

The *Provide High Level of Water Quality* criteria has two subcriterion:

- *Criterion 2A – Meets or Surpasses Drinking Water Quality Standards* – A measure representing potable supply is addressed by the quantitative metric of the aggregate water quality, measured by TDS levels, of the potable supply projects and portfolios. TDS is a surrogate for other water quality parameters representing water quality.
  - The TDS level will be designed to be similar to the SF RWS Hetch Hetchy and/or local reservoir supply. Treatment process and costs are based keeping the TDS less than 120 mg/L.
- *Criterion 2B – Meets or Surpasses Non-Potable Water Quality Standards* - For non-potable supply projects, where water quality constraints vary according to use, the value will be a qualitative assessment of whether or not the water supply management projects and portfolios meet the minimum water quality requirement for the targeted use. In most cases, this metric will be used to designate whether a non-potable supply source meets Title 22 requirements, as this is a common target water quality level for a non-potable demand.
  - This is a potable water project. This criterion does not apply.

D.4.3 Cost

The *Minimize Cost of New Water Supplies* criteria has one quantitative subcriterion:

- *Criterion 3 – Capital and Present Worth Costs* - The present worth costs, including capital, operations, and maintenance costs, for each water supply management project are estimated. The performance metric is the normalized unit cost presented in $/AF for each project.
  - The costs are indicated in Table D-7.

D.4.4 Reduce Potable Water Demand

The *Reduce Potable Water Demand* criteria has one criterion:

- *Criterion 4A –Augment non-potable water supplies* is quantitative metric for the annual yield of additional non-potable supply produced and utilized to offset potable demand.
  - This is a potable water project. This criterion does not apply.

D.4.5 Environmental Impacts

The *Minimize Environmental Impacts* criteria includes three qualitative subcriterion:

- *Criterion 5A* -The metric for *5A* is represented by the increase in greenhouse gas emissions due to a potential water supply management project. This quantitative metric will be measured in terms of metric tons of carbon dioxide produced, or reduced, per unit of supply based on energy use.
  - These values will be developed as part of the overall analysis and comparison of projects.

- *Criterion 5B –Impact to Groundwater Quantity and Quality* - Water supply management projects that do not negatively affect groundwater supplies will be measured favorably in this criterion. A combined qualitative estimate of potential groundwater impacts will be evaluated in terms of potential reductions in groundwater levels, impacts to groundwater quality, and the risk of increase in land subsidence. This metric will be a qualitative measure ranging from 1 through 5, with a score of “1” identifying the projects with the least potential for adversely affecting groundwater quantity and quality and a score of “5” indicating high probability of adverse impacts.
  - These values will be developed as part of the overall analysis and comparison of projects. This criterion is important as it may affect yield, cost and project feasibility if there is a significant impact to other wells. In comparing the desalination projects the subsurface (i.e., brackish groundwater vertical wells and HDDW projects have the potential for greater impacts on other groundwater supplies than the open Bay water intakes.

- *Criterion 5C –Impact to Habitat* - This criterion addresses long-term impacts to the ecosystems, not short-term effects related to temporary construction activities. Water supply management projects that do not adversely affect sensitive habitat areas such as wetlands, riparian zones, potential special-status species habitat, or have significant inundation areas will be measured favorably in this criterion. A combined qualitative estimate of potential habitat impacts is evaluated in terms of potential site acreage, proximity to sensitive habitat zones, and flood potential. This metric is a qualitative measure ranging from 1 through 5, with a score of "1" identifying the projects with the least potential for adverse impacts to habitat and a score of "5" indicating high probability of adverse effects to terrestrial, aquatic, and riparian species.
  - These values will be developed as part of the overall analysis and comparison of projects. In comparing the desalination projects the open Bay water intake projects have a higher potential for environmental impacts to the Bay than the subsurface intakes. The potential specific habitat impacts from construction of the required infrastructure are dependent on the specific locations and construction techniques.

D.4.6 Implementation Potential

The *Increase Implementation Potential* criteria has three qualitative subcriterion:

- *Criterion 6A –Institutional Complexity* - This criterion addresses the level of institutional coordination required for implementation of a water supply management project. A qualitative metric will be used to estimate the coordination required if multiple local or regional agencies or agreements are necessary. The projects that are assumed to require less coordination, and to receive less opposition, will score better than those that are more complex or potentially controversial.
  - Currently the ownership for the facilities has not been determined. Depending on who owns and operates the facility there will be issues about property ownership, use of the existing wastewater treatment plant outfall capacity for brine disposal, and use of the SF RWS for conveyance.

- *Criterion 6B –Level of Local Control of Water Supply* - Local management of a water supply management project will minimize dependency on imported water supplies and the drought impacts associated with those supplies. A common rating scale will be developed to evaluate the amount of BAWSCA-owned or BAWSCA member-owned supply for each project. Projects that are fully owned by BAWSCA or the member agencies will score higher than supply projects owned fully or partially by other entities that might be affected by regulatory risk, multiple party agreements, and supplies that may have a higher risk of not being available further into the future, or under drought conditions.
  - These values will be developed as part of the overall analysis and comparison of projects. In general the desalination projects have a high level of local control of

water supply as these are locally controlled supplies, either groundwater or Bay water.

- *Criterion 6C –Permitting Requirements* - This criterion addresses the objective of minimizing the regulatory and environmental permitting obstacles associated with water supply management projects. Projects with other similar metrics (including cost) may have differing permitting requirements, which can affect their overall implementation. The performance metric is a qualitative measure of the permitting requirements of each project or portfolio.
  - These values will be developed as part of the overall analysis and comparison of projects. Within the desalination projects the open Bay water intakes will have a higher level of permitting requirements than the subsurface intakes due to the additional agencies involved.

D.5 Preliminary Implementation Schedules

Preliminary implementation schedules have been developed for the brackish groundwater well, Bay water subsurface intake and Bay water intake projects. The schedules presented below are based on experience with similar projects (e.g., Santa Cruz and Monterey Peninsula Water Management District (MPWMD) and professional judgment. Considerably slower schedules have been experienced by projects in Carlsbad and Huntington Beach. Table D-8 provides a summary of project start dates and the current status of selected desalination projects.

Two considerations which can have a significant impact on schedule include:

- *Piloting*: Every major project has had a pilot plant study (e.g., Newark, Marin, Santa Cruz, BARDP, Long Beach, Dana Point, Carlsbad, West Basin) with the exception of Huntington Beach (relied on Carlsbad results) and Sand City (since used beach wells were used, the project relied on water quality data from a beach test well, reverse osmosis software projections, and direct measurement of Silt Density Index (SDI) as basis of 0.5 mgd design). For brackish, if there are no special water quality circumstances (e.g., iron, manganese, silica), pilot testing is not typically necessary and a few days of operating a single-element RO tester at the test well can be used to generate brine samples if needed for RWQCB permitting. Eliminating pilot testing would save approximately 6 months on the schedule; and
- *Source water assessments*: For setting treatment requirements, CDPH requires 12 month testing for well-extracted water and 24 months for an open water intake source. This can be obviated by simply installing greater levels of pre-treatment (Sand City elected this option by installing post-treatment UV disinfection to achieve the maximum required virus, Cryptosporidium and Giardia log removal credits for an impaired source water. This saved up to 12 months of groundwater under the influence monitoring and the potential for an additional 12 month watershed sanitary survey and 24 months of Long Term 2 Surface Water Treatment Rule monitoring for turbidity and Cryptosporidium.

Table D-8
Summary of Project Start Date and Status of California Desalination Projects

Location	Capacity (mgd)	Start Year	Status
Carlsbad	50	1998	In construction after many delays associated with permitting and litigation. Target operational date of 2016.
Dana Point	15	2005	Slant wells tested and obtained environmental support. Currently operating a pilot-scale well and desalination system to determine pretreatment requirements. Target date is 2018 for completing construction.
Huntington Beach	50	2002	Obtained NPDES permit but still seeking permits from the California Coastal Commission and possibly from the State Lands Commission.
Long Beach	5-20	2002	Just completing pilot tests of an infiltration gallery type intake and a demonstration scale desalination system. Permitting demonstration project was challenging. Decision on capacity pending.
Los Angeles Department of Water & Power	5-50	2000	Completed pilot study but abandoned in favor of conservation and water reuse projects due to environmental pressures
Marin	5	1997	Plans for construction deferred due to litigation and policy choice to augment conservation efforts.
Sand City	0.6	2005	Use of beach wells eased permitting. Operational in 2009.
Santa Cruz	2.5	2003	In design phase after multiple years of planning and 3 years of studies. Significant public debate. Targeting 2016 start-up.
West Basin El Segundo	20	2003	Commissioning a 1 mgd demonstration scale plant to confirm large-scale feasibility and confirm effectiveness of intake and pretreatment design selected from a three year pilot study. Preparing to begin site location and feasibility study.
Monterey Peninsula Water Management District (MPWMD)	10	2002	Originally proposed an open intake, but have now decided to use a slant well subsurface intake to simplify permitting and reduce likelihood of litigation. Project currently on hold.

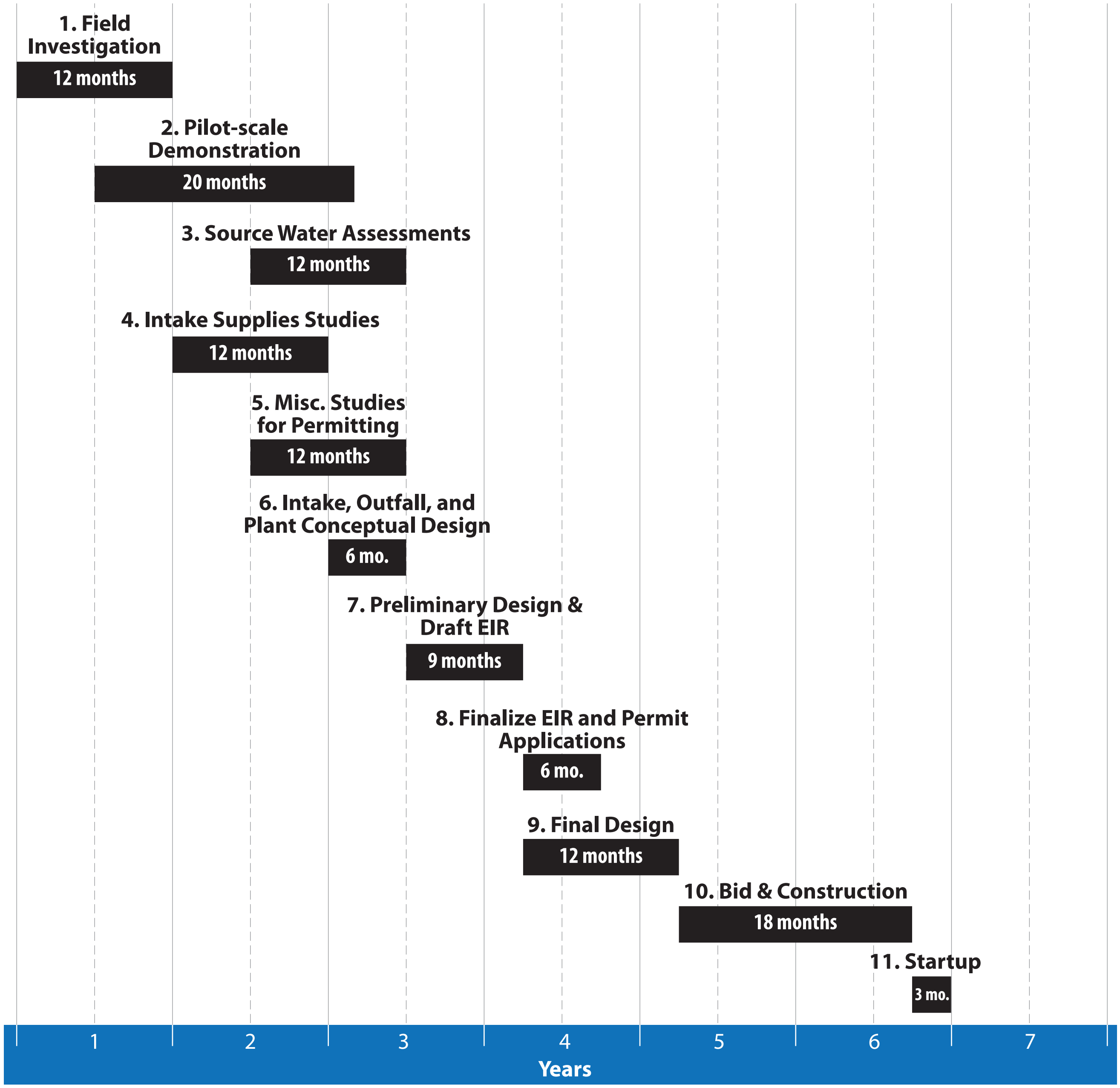
The preliminary project schedules for all of the desalination projects include the following 11 activities:

- Field Investigation;
- Pilot-Scale Demonstration Projects;
- Source Water Assessments;
- Intake Supply Studies;
- Miscellaneous Studies for Permitting;

- Intake, Outfall and Plant Conceptual Design;
- Preliminary Design and EIR;
- Finalize EIR and Permit Applications;
- Final Design;
- Bid & Construction; and
- Startup.

The preliminary schedules below, Figures D-8, D-9 and D-10 for brackish groundwater wells, HDDW and open Bay intakes respectively have been developed incorporating lessons learned from other projects in California, and provide a potential duration for each phase of the project. The schedules will likely change depending on the permitting climate, and the public perception of the selected project, and the specific siting and permitting requirements.

In general the brackish groundwater wells will have the shortest implementation time ranging from 6 to 8 years. The implementation time for HDDW will be longer ranging from 10 to 12 years, and the open intakes taking from 10 to 15 years.



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CDM Smith

Figure D-8
Preliminary Schedule for Representative Brackish Groundwater Desalination Projects (1 to 5 mgd)

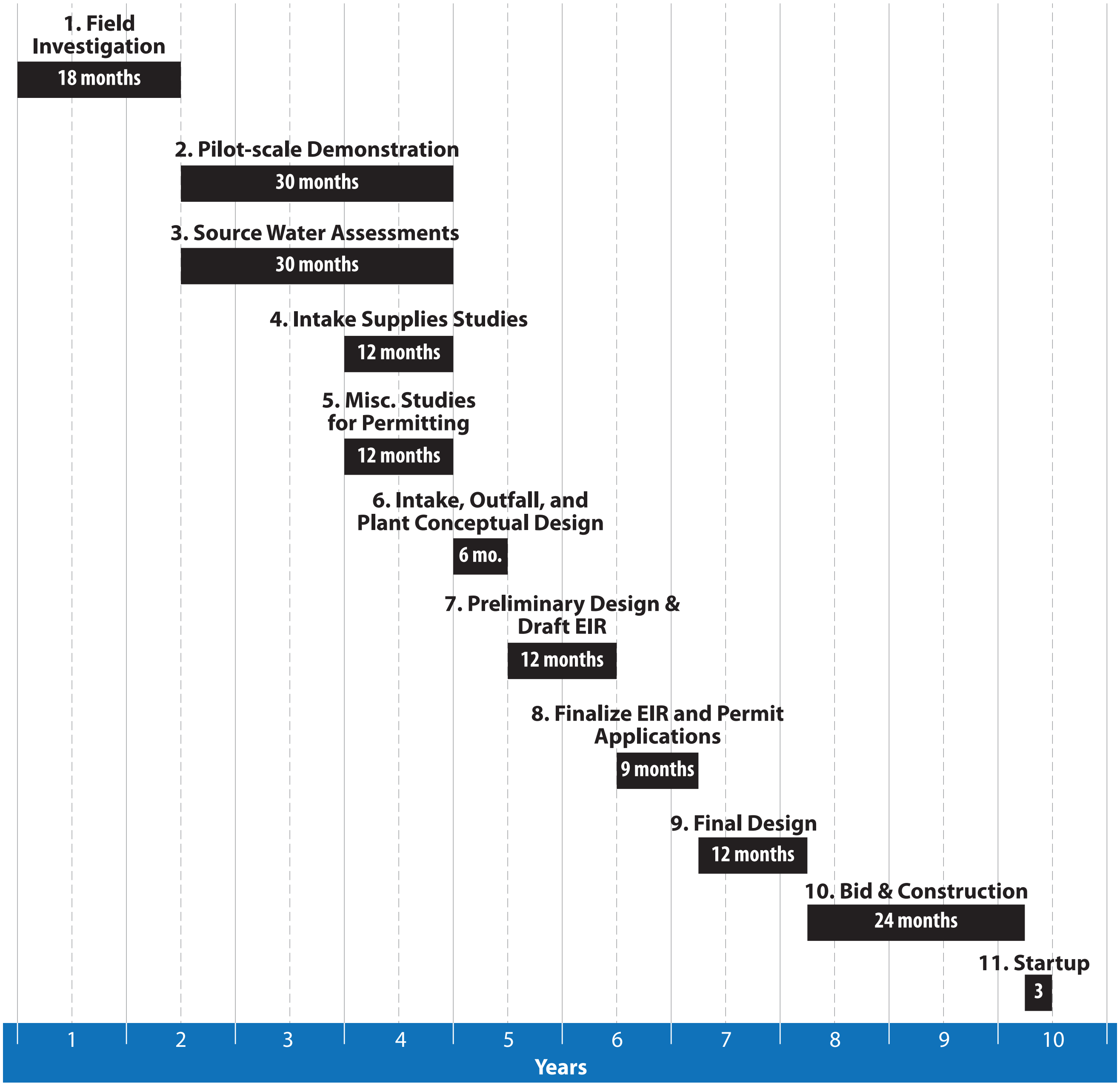

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Figure D-9

Preliminary Schedule for Representative Subsurface Bay Water Desalination Projects (5 to 10 mgd)

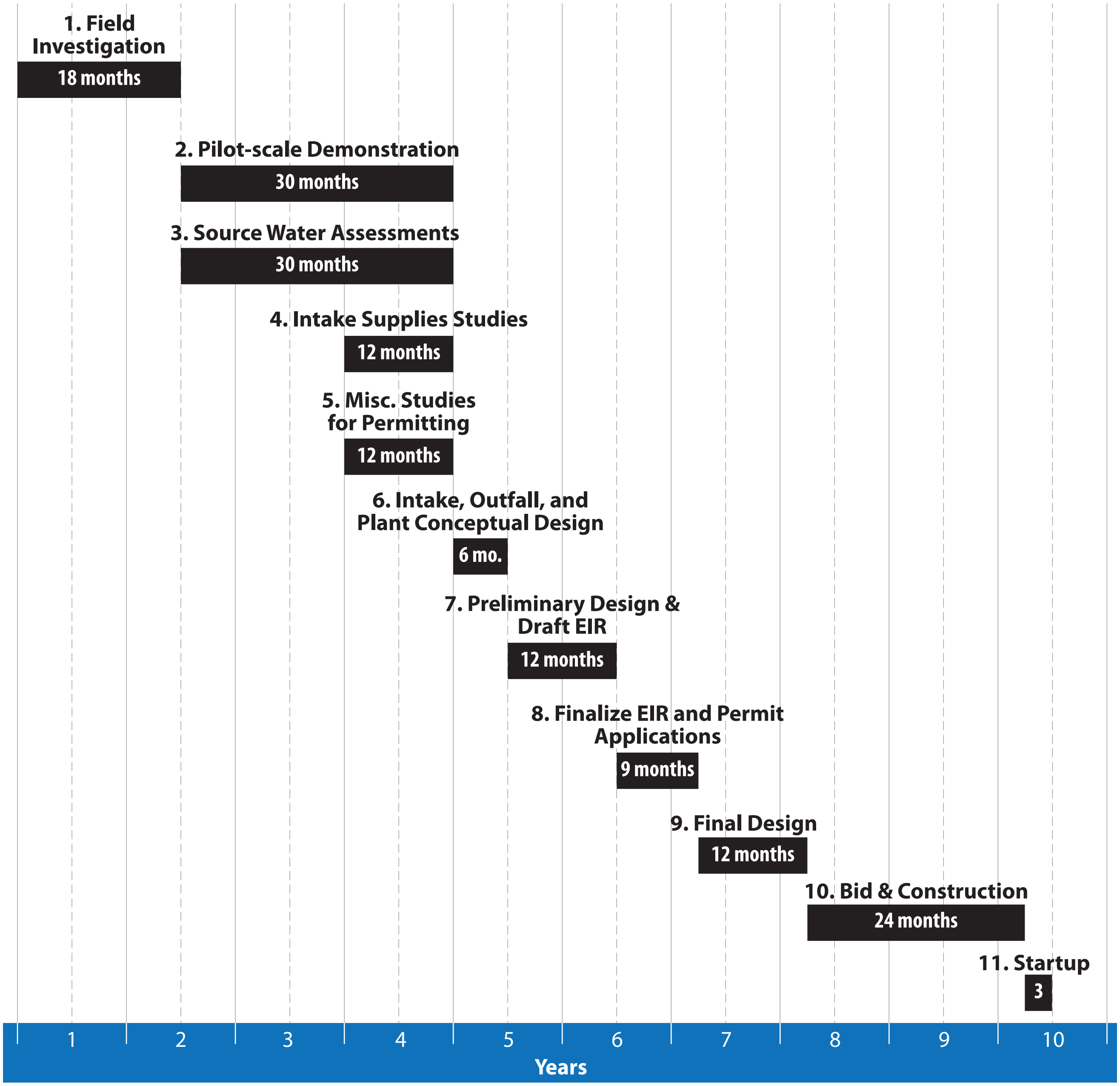

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Figure D-10
Preliminary Schedule for Representative Bay Water Open Intake Desalination Projects (10 to 20 mgd)

D.6 Permitting Overview

The permitting agencies that guide the planning process for new desalination facilities include the Bay Conservation and Development Commission (BCDC), California Coastal Commission (CCC), California Department of Fish and Game (DFG), Department of Public Health (DPH), and Regional Water Quality Control Board (RWQCB). Key concerns of these agencies are discussed below.

D.6.1 BCDC, DFG and CCC

BCDC is primarily concerned with the following items (DFG concerns include the first four items):

1. Impingement and entrainment associated with a new open water intake;

2. Water quality characteristics and potential impacts of the brine discharge (particularly in regards to salinity, dissolved oxygen, particulates, and potential contaminants);

3. Co-location with existing facilities (e.g., outfalls or wastewater outfalls) that may prolong the use of facilities that is harmful to public health and/or marine life in the vicinity;

4. Increased energy use and greenhouse emissions; and

5. Environmental justice issues regarding storage of chemicals and other public health issues if the facility is located in an area other than the area benefited by the facility.

BCDC and DFG recommend that intakes be located in relatively deep, "low biologically productive" areas to limit potential impacts to plankton, fish eggs, larvae, shellfish beds, and other organisms that may be impacted by construction and operation of the intake.

DFG is aware of the precedent set by the CCC for new desalination plants along the California coast. CCC has publicly communicated the overall planning approach which will simplify coastal development permitting process.

The project features preferred by the CCC is summarized in Table D-9 and is contrasted with alternatives which are more difficult to permit by CCC.

Table D-9
Key Considerations for California Coastal Commission Permitting

"Easier" Review	"More Difficult" Review
Away from shoreline	On or next to shoreline
Subsurface intake	Open water intake
Publicly owned facility	Privately owned facility
Defined service area with known level of build out	Unknown or extensive service area
Part of local/regional plan where significant part of water portfolio is conservation, recycling, etc.	Not part of a local/regional plan; in an area without effective conservation

D.6.2 DPH

DPH requires that up to one year of monitoring be performed to determine if well sources are "under the influence of surface water" and up to two years of LT2ESWTR monitoring for surface water sources.

If an aquifer is determined to be under the influence of surface water or if an open water intake is proposed, then a WSS, pilot-scale testing, and two years of LT2ESWTR monitoring may be required to determine treatment and disinfection requirements.

D.6.3 RWQCB

RWQCB requires that new discharges to the ocean or Bay meet the requirements of National Pollution Discharge Elimination System (NPDES) permits including typical pH, toxicity, and dissolved oxygen requirements. The primary concern with brine discharges include salinity and dissolved oxygen. If the discharge salinity is higher than that of the receiving water, then the high salinity plume may be considered toxic to some organisms before it is sufficiently diluted. Furthermore, the density of water increases with salinity, so that if the outfall nozzles and local currents do not provide sufficient dilution and mixing energy, the brine will begin to sink and create a plume of high salinity and low dissolved oxygen on the ocean or Bay floor.

Therefore, the RWQCB typically requires that a dilution study be performed to characterize the typical and worst-case discharge scenarios and document that existing or new outfall structures will provide sufficient dilution and mixing within a specified distance from the discharge nozzles.

Limits for dissolved oxygen and salinity typically guide this analysis, as follows:

- Receiving water salinity and a specific dilution ratio requirement must be achieved within a specified distance from the outfall nozzles (this distance is known as the zone of initial dilution and is site specific);
- Dissolved oxygen shall not be less than 5 mg/L from the influence of the discharge;
- The median dissolved oxygen concentration for any three consecutive months shall not be less than 80 percent of the dissolved oxygen content at saturation; and
- When natural factors cause concentrations of less than 5 mg/L, the discharge shall not cause further reduction in ambient dissolved oxygen concentrations.

D.6.4 Additional Permitting Requirements

Permitting requirements for desalination facilities include the typical permits required for new drinking water facilities (e.g., construction, domestic water supply, easement/encroachment, etc.). In addition, there are additional requirements associated with facilities that require coastal access and/or that may impact coastal resources.

Table D-10 lists the typical permitting agencies which require permits for new coastal desalination facilities in California. However, more may be required depending on the exact location. For example, the recently permitted facility in Carlsbad, California required permits from 24 separate agencies due to additional requirements associated with the co-location of their intake and outfall with an existing power plant.

Table D-10
Typical Permits Required for New Desalination Facilities in California

Federal	Agencies/Parties
Section 10 and 404	Army Corps of Engineers & Environmental Protection Agency (EPA)
Section 7	Fish and Wildlife Service & EPA
Easement/Encroachment permits	Multiple agencies depending on the site
Consultation to determine applicable requirements	National Oceanic and Atmospheric Administration and the Coast Guard
State Historic Preservation Office, Memorandum of Understanding if federally funded	EPA & other agencies depending on historic or archaeological significance
National Environmental Policy Act Compliance	EPA & other agencies depending on the site
State	**Agencies/Parties**
Coastal Development Permit	BCDC
California Endangered Species Act Section 2081 Permit & Streambed Alteration Agreement Equivalent	DFG
Easement/Encroachment permits	Numerous agencies, including State Lands Commission, State Parks, Department of Transportation, port authorities, and others depending on the site
Domestic Water Supply Permit	DPH
Water Rights Permit	State Water Resources Control Board
Application for Certification Amendment	California Energy Commission
NPDES Permit, 401 Certification, & Brine Discharge Requirements	RWQCB
Permit to Construct/Operate	Air Quality Management District
Certification of Public Convenience and Necessity (if private retailer)	State of California Public Utilities Commission (PUC)
Local	**Agencies/Parties**
Coastal development, construction, hazardous chemical storage, and conditional use permits	County/City
Use/right of way/Lease approvals	Public and Private parties
Water contracts	Partner agencies/other

D.7 Key Issues and Risks

Key issues and risks associated with implementing a desalination facility are discussed in this section. During this planning stage, several of the key issues are not fully defined and will require additional analysis.

Key issues associated with regional desalination projects include:

- Source water quality (e.g., salinity, iron, manganese, contaminants) variability;
- Source water yield;

- Land availability, cost and permitting for subsurface intakes, and for new desalination plant sites;
- Alignment issues and rights-of-way for construction of new raw water, brine and treated water pipelines;
- Willingness and cost to allow use of existing wastewater plant outfall capacity for brine disposal;
- Public support and/or opposition;
- Use of the SF RWS system for conveyance to member agencies if required;
- Permitting for a new intakes in the Bay; and
- Funding and ownership of a regional desalination facilities.

The key risks noted during development of this analysis include:

- *All options:*
  - Protracted permitting approval process. This has been the experience with the Marin, Carlsbad and Santa Cruz projects; and
  - Costs and delays to overcome potential permitting hurdles, public opposition, and litigation even though subsurface intakes and co-located brine discharges are expected to reduce this risk. California experience indicates that such delays have been the norm. It is unclear whether implementation time for future plants will be reduced (i.e., if State-wide regulatory streamlining for desalination plants occurs).
- *Brackish and subsurface options:* Projecting expected yield and assessing impacts on other wells in the aquifer including well yield and water quality (e.g., potential for increased salt water intrusion and subsidence);
- *Subsurface options:* Long-term yield and reliability of slant or horizontal wells depending on the site-specific hydrogeology under the Bay floor and future sediment deposition which may reduce water transport rates from the ocean into the aquifer; and
- *Open water intake option:* Cleaning frequency and long-term reliability of intake screens.
  - Risks associated with introducing a new treated water source into an existing distribution system, such as water stabilization and corrosion control to minimize impacts to existing scales, maintaining disinfectant stability in the presence of

bromide in the desalinated water, aesthetic differences, irrigation use with higher concentrations of boron and chloride, and potential SFPUC requirements to match existing salinity and hardness parameters; and

- Risk that the cost of power may escalate more quickly than anticipated and increase the operational costs.

- Risk that wastewater utilities may not allow a co-located brine discharge with or without additional costs or negotiations.

Appendix D – Representative Regional Desalination Projects
Attachment A: Project Cost Tables

Attachment A

Attachment A includes the following tables for each of the representative desalination projects listed below:

- A – Capital Cost Estimate
- B – Annual O&M Costs
- C – Present Worth and Annualized Cost Details
- D – Present Worth and Annualized Cost Summary

List of Attachments:

- A-1: Dumbarton Bridge Area – 1 mgd Brackish Groundwater Wells
- A-2: Dumbarton Bridge Area – 2 mgd Brackish Groundwater Wells
- A-3: Dumbarton Bridge Area – 5 mgd Brackish Groundwater Wells
- A-4: San Mateo Bridge Area – 1 mgd Brackish Groundwater Wells
- A-5: San Mateo Bridge Area – 2 mgd Brackish Groundwater Wells
- A-6: San Mateo Bridge Area – 5 mgd Brackish Groundwater Wells
- A-7: San Mateo Bridge Area – 5 mgd Bay Water Horizontally Directionally Drilled Wells
- A-8: San Mateo Bridge Area – 10 mgd Bay Water Horizontally Directionally Drilled Wells
- A-9: San Mateo Bridge Area – 20 mgd Bay Water Open Intake
- A-10: South San Francisco Area – 1 mgd Brackish Groundwater Wells
- A-11: South San Francisco Area – 2 mgd Brackish Groundwater Wells
- A-12: South San Francisco Area – 5 mgd Bay Water Horizontally Directionally Drilled Wells
- A-13: South San Francisco Area – 10 mgd Bay Water Horizontally Directionally Drilled Wells
- A-14: South San Francisco Area –20 mgd Bay Water Open Intake

A-1: Dumbarton Bridge Area– 1 mgd Brackish Groundwater Wells

Table A-1 A
Capital Cost Estimate
Representative 1 mgd Brackish Groundwater Desalination Project, Dumbarton Bridge Area

Item	Capacity (mgd)	Pumping Power (HP)	Diameter (in.)	Length (ft.)	Capital Cost ($M)
Source Water: *Groundwater*					
Recovery: *75%*					
Treated Water Capacity: *1 mgd*					
Construction Cost Items					
Intake Structure	1.3	-	-	-	$ 1.00
Desalination Plant (Treated Water)	1	-	-	-	$ 10.20
Pipelines[1]					
Raw Water Pipeline/Tunnel	1.3	-	8	0	-
Treated Water Pipeline/Tunnel	1	-	8	1,100	$ 0.13
Brine Pipeline/Tunnel	0.3	-	4	18,200	$ 1.09
Pump Stations[2]					
Raw Water Pump Station	1.3	0	-	-	-
Treated Water Pump Station	1.0	25	-	-	$ 0.06
Brine Pump Station	0.3	10	-	-	$ 0.02
Treated Water Storage (MG)	2	-	-	-	$ 1.60
Total Construction Costs					**$ 14.11**
Contractor Profit (15%)					$ 2.12
Engineering, Engineering During Construction, & Construction Management (25%)					$ 3.53
Soft Cost Adjustment (15%)					$ 2.12
Contingency (40%)					$ 8.75
Total Adjustments					$ 16.51
Capital Cost Estimate					**$ 30.61**

1 Pipeline costs include tunneling and boring under obstructions such as highways.
2 Capital costing curves used to estimate intake and treatment plant construction costs include 50 HP pump stations for raw, treated and concentrated brine water. The costs itemized above for pump stations include costs for pumping capacity greater than 50 HP.

Table A-1 B
Annual O&M Costs
Representative 1 mgd Brackish Groundwater Desalination Project, Dumbarton Bridge Area

Component	Cost
Chemicals	$ 25,800
Electrical Power	$ 224,500
Labor	$ 338,700
Solids Disposal to Landfill	$ -
MF/UF Membrane Replacement	$ -
Cartridge Filter Replacement	$ 3,300
RO Membrane Replacement	$ 26,800
Subtotal Annual O&M	$ 619,100
General Maintenance (non-labor costs - 10% of subtotal)	$ 61,900
Contingency (10% of subtotal)	$ 61,900
Total Annual O&M	$ 742,900

Table A-1 C Present Worth and Annualized Cost Details Representative 1 mgd Brackish Groundwater Desalination Project, Dumbarton Bridge Area			
Assumptions		**Present Worth and Annualized Cost Summary**	
Project Life (years)	30	Total Production (AF)	26,900
Capacity (mgd)	1	PW Capital ($M)	$30.61
Baseload	80%	PW O&M ($M)	$22.28
Annual Production (AF/Y)	900	PW Total ($M)	$52.90
Start up date	1/1/2015	**PW Unit Cost ($/AF)**	$1,969
Implementation Time (years)	5	Capital Costs Annualized ($M)	$1.56
2011 Capital Cost ($M)	$ 30.61	Annual O&M Cost ($M)	$0.74
Discount Rate/bond rate	3%	Total Annual Cost ($M)	$2.30
Capital Escalation Factor[1]	3%	Annual Production (AF)	900
Energy Cost ($/kWh)	0.14	**Unit Annualized Costs ($/AF)**	$2,573
Present Worth Calculations			
Year	**Capital Cost**	**O&M**	**Total PW**
PW	$30,614,000	$22,289,000	**$52,903,000**
2011	$30,614,000	$743,000	**$31,357,000**
2012	$0	$0	$0
2013	$0	$0	$0
2014	$0	$0	$0
2015	$34,456,000	$0	$34,456,000
2016	$0	$861,000	$861,000
2017	$0	$887,000	$887,000
2018	$0	$914,000	$914,000
2019	$0	$941,000	$941,000
2020	$0	$969,000	$969,000
2021	$0	$999,000	$999,000
2022	$0	$1,028,000	$1,028,000
2023	$0	$1,059,000	$1,059,000
2024	$0	$1,091,000	$1,091,000
2025	$0	$1,124,000	$1,124,000
2026	$0	$1,158,000	$1,158,000
2027	$0	$1,192,000	$1,192,000
2028	$0	$1,228,000	$1,228,000
2029	$0	$1,265,000	$1,265,000
2030	$0	$1,303,000	$1,303,000
2031	$0	$1,342,000	$1,342,000
2032	$0	$1,382,000	$1,382,000
2033	$0	$1,424,000	$1,424,000
2034	$0	$1,466,000	$1,466,000
2035	$0	$1,510,000	$1,510,000
2036	$0	$1,556,000	$1,556,000
2037	$0	$1,602,000	$1,602,000
2038	$0	$1,650,000	$1,650,000
2039	$0	$1,700,000	$1,700,000
2040	$0	$1,751,000	$1,751,000
2041	$0	$1,803,000	$1,803,000
2042	$0	$1,858,000	$1,858,000
2043	$0	$1,913,000	$1,913,000
2044	$0	$1,971,000	$1,971,000
2045	$0	$2,030,000	$2,030,000

[1] The same escalation rate is used for electricity, materials, labor and capital costs.

Table A-1 D
Present Worth and Annualized Cost Summary
Representative 1 mgd Brackish Groundwater Desalination Project, Dumbarton Bridge Area

Present Worth Costs	
Annual O&M Cost ($M)	$ 0.74
Present Worth of Capital Cost ($M)	$ 30.61
Present Worth of Annual O&M Cost ($M)	$ 22.28
Total Present Worth ($M)	**$ 52.90**
Total Production (AF)	26,900
Unit Cost of Total Present Worth ($/AF)	**$ 1,969**
Annualized Project Costs	
Capital Costs Annualized ($M)	$ 1.56
Annual O&M Cost ($M)	$ 0.74
Total Annual Cost	**$ 2.30**
Annual Production (AF)	900
Unit Annualized Costs ($/AF)	**$ 2,573**

[1] 2011 costs are current as of August 2011.
[2] 2015 project start date (O&M costs starting 2016).
[3] Assumed project life of 30 years.
[4] Present Worth estimates include a 3% escalation and a 3% discount rate. The same escalation rate is used for electricity, materials, labor and capital costs.
[5] Annual and total production assume a base load of 80%.
[6] Annualized Costs are calculated over project life in 2011 dollars.

A-2: Dumbarton Bridge Area– 2 mgd Brackish Groundwater Wells

Table A-2 A
Capital Cost Estimate
Representative 2 mgd Brackish Groundwater Desalination Project, Dumbarton Bridge Area

Item	Capacity (mgd)	Pumping Power (HP)	Diameter (in.)	Length (ft.)	Capital Cost ($M)
Source Water: *Groundwater*					
Recovery: *75%*					
Treated Water Capacity: *2 mgd*					
Construction Cost Items					
Intake Structure	2.7	-	-	-	$ 2.00
Desalination Plant (Treated Water)	2	-	-	-	$ 13.20
Pipelines[1]					
Raw Water Pipeline/Tunnel	2.7	-	12	5,300	$ 0.95
Treated Water Pipeline/Tunnel	2	-	10	1,100	$ 0.17
Brine Pipeline/Tunnel	0.7	-	6	18,200	$ 1.64
Pump Stations[2]					
Raw Water Pump Station	2.7	0	-	-	$ -
Treated Water Pump Station	2.0	95	-	-	$ 0.23
Brine Pump Station	0.7	10	-	-	$ 0.02
Treated Water Storage (MG)	2	-	-	-	$ 1.6
Total Construction Costs					**$ 19.81**
Contractor Profit (15%)					$ 2.97
Engineering, Engineering During Construction, & Construction Management (25%)					$ 4.95
Soft Cost Adjustment (15%)					$ 2.97
Contingency (40%)					$ 12.28
Total Adjustments					$ 23.18
Capital Cost Estimate					**$ 42.99**

[1] Pipeline costs include tunneling and boring under obstructions such as highways.
[2] Capital costing curves used to estimate intake and treatment plant construction costs include 50 HP pump stations for raw, treated and concentrated brine water. The costs itemized above for pump stations include costs for pumping capacity greater than 50 HP.

Table A-2 B
Annual O&M Costs
Representative 2 mgd Brackish Groundwater Desalination Project, Dumbarton Bridge Area

Component	Cost
Chemicals	$ 46,600
Electrical Power	$ 477,500
Labor	$ 338,700
Solids Disposal to Landfill	$ -
MF/UF Membrane Replacement	$ -
Cartridge Filter Replacement	$ 6,600
RO Membrane Replacement	$ 53,600
Subtotal Annual O&M	$ 923,000
General Maintenance (non-labor costs - 10% of subtotal)	$ 92,300
Contingency (10% of subtotal)	$ 92,300
Total Annual O&M	$ 1,107,600

Table A-2 C Present Worth and Annualized Cost Details Representative 2 mgd Brackish Groundwater Desalination Project, Dumbarton Bridge Area			
Assumptions		**Present Worth and Annualized Cost Summary**	
Project Life (years)	30	Total Production (AF)	53,700
Capacity (mgd)	2	PW Capital ($M)	$42.99
Baseload	80%	PW O&M ($M)	$33.24
Annual Production (AF/Y)	1,800	PW Total ($M)	$76.23
Start up date	1/1/2015	**PW Unit Cost ($/AF)**	$1,418
Implementation Time (years)	5	Capital Costs Annualized ($M)	$2.19
2011 Capital Cost ($M)	$42.99	Annual O&M Cost ($M)	$1.11
Discount Rate/bond rate	3%	Total Annual Cost ($M)	$3.30
Capital Escalation Factor[1]	3%	Annual Production (AF)	1,800
Energy Cost ($/kWh)	0.14	**Unit Annualized Costs ($/AF)**	$1,843
Present Worth Calculations			
Year	**Capital Cost**	**O&M**	**Total PW**
PW	$42,986,000	$33,240,000	**$76,226,000**
2011	$42,986,000	$1,108,000	**$44,094,000**
2012	$0	$0	$0
2013	$0	$0	$0
2014	$0	$0	$0
2015	$48,381,000	$0	$48,381,000
2016	$0	$1,284,000	$1,284,000
2017	$0	$1,323,000	$1,323,000
2018	$0	$1,363,000	$1,363,000
2019	$0	$1,404,000	$1,404,000
2020	$0	$1,446,000	$1,446,000
2021	$0	$1,489,000	$1,489,000
2022	$0	$1,534,000	$1,534,000
2023	$0	$1,580,000	$1,580,000
2024	$0	$1,627,000	$1,627,000
2025	$0	$1,676,000	$1,676,000
2026	$0	$1,726,000	$1,726,000
2027	$0	$1,778,000	$1,778,000
2028	$0	$1,831,000	$1,831,000
2029	$0	$1,886,000	$1,886,000
2030	$0	$1,943,000	$1,943,000
2031	$0	$2,001,000	$2,001,000
2032	$0	$2,061,000	$2,061,000
2033	$0	$2,123,000	$2,123,000
2034	$0	$2,187,000	$2,187,000
2035	$0	$2,252,000	$2,252,000
2036	$0	$2,320,000	$2,320,000
2037	$0	$2,390,000	$2,390,000
2038	$0	$2,461,000	$2,461,000
2039	$0	$2,535,000	$2,535,000
2040	$0	$2,611,000	$2,611,000
2041	$0	$2,689,000	$2,689,000
2042	$0	$2,770,000	$2,770,000
2043	$0	$2,853,000	$2,853,000
2044	$0	$2,939,000	$2,939,000
2045	$0	$3,027,000	$3,027,000

[1] The same escalation rate is used for electricity, materials, labor and capital costs.

Table A-2 D Present Worth and Annualized Cost Summary Representative 2 mgd Brackish Groundwater Desalination Project, Dumbarton Bridge Area	
Present Worth Costs	
Annual O&M Cost ($M)	$ 1.11
Present Worth of Capital Cost ($M)	$ 42.99
Present Worth of Annual O&M Cost ($M)	$ 33.24
Total Present Worth ($M)	**$ 76.23**
Total Production (AF)	53,700
Unit Cost of Total Present Worth ($/AF)	**$ 1,418**
Annualized Project Costs	
Capital Costs Annualized ($M)	$ 2.19
Annual O&M Cost ($M)	$ 1.11
Total Annual Cost	**$ 3.30**
Annual Production (AF)	1,800
Unit Annualized Costs ($/AF)	**$ 1,843**

[1] 2011 costs are current as of August 2011.
[2] 2015 project start date (O&M costs starting 2016).
[3] Assumed project life of 30 years.
[4] Present Worth estimates include a 3% escalation and a 3% discount rate. The same escalation rate is used for electricity, materials, labor and capital costs.
[5] Annual and total production assume a base load of 80%.
[6] Annualized Costs are calculated over project life in 2011 dollars.

A-3: Dumbarton Bridge Area – 5 mgd Brackish Groundwater Wells

Table A-3 A
Capital Cost Estimate
Representative 5 mgd Brackish Groundwater Desalination Project, Dumbarton Bridge Area

Item	Capacity (mgd)	Pumping Power (HP)	Diameter (in.)	Length (ft.)	Capital Cost ($M)
Source Water: *Groundwater*					
Recovery: *75%*					
Treated Water Capacity: *5 mgd*					
Construction Cost Items					
Intake Structure	6.7	-	-	-	$ 4.00
Desalination Plant (Treated Water)	5	-	-	-	$ 18.60
Pipelines[1]					
Raw Water Pipeline/Tunnel	6.7	-	18	5,600	$ 1.51
Treated Water Pipeline/Tunnel	5	-	18	1,100	$ 0.30
Brine Pipeline/Tunnel	1.7	-	10	18,200	$ 2.73
Pump Stations[2]					
Raw Water Pump Station	6.7	70	-	-	$ 0.17
Treated Water Pump Station	5.0	305	-	-	$ 0.73
Brine Pump Station	1.7	10	-	-	$ 0.02
Treated Water Storage (MG)	2	-	-	-	$ 1.6
Total Construction Costs					**$ 29.66**
Contractor Profit (15%)					$ 4.45
Engineering, Engineering During Construction, & Construction Management (25%)					$ 7.42
Soft Cost Adjustment (15%)					$ 4.45
Contingency (40%)					$ 18.39
Total Adjustments					$ 34.71
Capital Cost Estimate					**$ 64.37**

1 Pipeline costs include tunneling and boring under obstructions such as highways.

2 Capital costing curves used to estimate intake and treatment plant construction costs include 50 HP pump stations for raw, treated and concentrated brine water. The costs itemized above for pump stations include costs for pumping capacity greater than 50 HP.

Table A-3 B
Annual O&M Costs
Representative 5 mgd Brackish Groundwater Desalination Project, Dumbarton Bridge Area

Component	*Cost*
Chemicals	$ 109,000
Electrical Power	$ 1,207,800
Labor	$ 338,700
Solids Disposal to Landfill	$ -
MF/UF Membrane Replacement	$ -
Cartridge Filter Replacement	$ 16,500
RO Membrane Replacement	$ 133,900
Subtotal Annual O&M	$ 1,805,900
General Maintenance (non-labor costs - 10% of subtotal)	$ 180,600
Contingency (10% of subtotal)	$ 180,600
Total Annual O&M	$ 2,167,100

Table A-3 C Present Worth and Annualized Cost Details Representative 5 mgd Brackish Groundwater Desalination Project, Dumbarton Bridge Area			
Assumptions		**Present Worth and Annualized Cost Summary**	
Project Life (years)	30	Total Production (AF)	134,400
Capacity (mgd)	5	PW Capital ($M)	$64.37
Baseload	80%	PW O&M ($M)	$65.01
Annual Production (AF/Y)	4,500	PW Total ($M)	$129.38
Start up date	1/1/2015	**PW Unit Cost ($/AF)**	$963
Implementation Time (years)	5	Capital Costs Annualized ($M)	$3.28
2011 Capital Cost ($M)	$64.37	Annual O&M Cost ($M)	$2.17
Discount Rate/bond rate	3%	Total Annual Cost ($M)	$5.45
Capital Escalation Factor[1]	3%	Annual Production (AF)	4,500
Energy Cost ($/kWh)	0.14	**Unit Annualized Costs ($/AF)**	$1,217
Present Worth Calculations			
Year	**Capital Cost**	**O&M**	**Total PW**
PW	$64,369,000	$65,010,000	**$129,379,000**
2011	$64,369,000	$2,167,000	**$66,536,000**
2012	$0	$0	$0
2013	$0	$0	$0
2014	$0	$0	$0
2015	$72,448,000	$0	$72,448,000
2016	$0	$2,512,000	$2,512,000
2017	$0	$2,588,000	$2,588,000
2018	$0	$2,665,000	$2,665,000
2019	$0	$2,745,000	$2,745,000
2020	$0	$2,827,000	$2,827,000
2021	$0	$2,912,000	$2,912,000
2022	$0	$3,000,000	$3,000,000
2023	$0	$3,090,000	$3,090,000
2024	$0	$3,182,000	$3,182,000
2025	$0	$3,278,000	$3,278,000
2026	$0	$3,376,000	$3,376,000
2027	$0	$3,477,000	$3,477,000
2028	$0	$3,582,000	$3,582,000
2029	$0	$3,689,000	$3,689,000
2030	$0	$3,800,000	$3,800,000
2031	$0	$3,914,000	$3,914,000
2032	$0	$4,031,000	$4,031,000
2033	$0	$4,152,000	$4,152,000
2034	$0	$4,277,000	$4,277,000
2035	$0	$4,405,000	$4,405,000
2036	$0	$4,537,000	$4,537,000
2037	$0	$4,673,000	$4,673,000
2038	$0	$4,814,000	$4,814,000
2039	$0	$4,958,000	$4,958,000
2040	$0	$5,107,000	$5,107,000
2041	$0	$5,260,000	$5,260,000
2042	$0	$5,418,000	$5,418,000
2043	$0	$5,580,000	$5,580,000
2044	$0	$5,748,000	$5,748,000
2045	$0	$5,920,000	$5,920,000

[1] The same escalation rate is used for electricity, materials, labor and capital costs.

Table A-3 D
Present Worth and Annualized Cost Summary
Representative 5 mgd Brackish Groundwater Desalination Project, Dumbarton Bridge Area

Present Worth Costs	
Annual O&M Cost ($M)	$ 2.17
Present Worth of Capital Cost ($M)	$ 64.37
Present Worth of Annual O&M Cost ($M)	$ 65.01
Total Present Worth ($M)	**$129.38**
Total Production (AF)	134,400
Unit Cost of Total Present Worth ($/AF)	**$ 963**
Annualized Project Costs	
Capital Costs Annualized ($M)	$ 3.28
Annual O&M Cost ($M)	$ 2.17
Total Annual Cost	**$ 5.45**
Annual Production (AF)	4,500
Unit Annualized Costs ($/AF)	**$ 1,217**

[1] 2011 costs are current as of August 2011.
[2] 2015 project start date (O&M costs starting 2016).
[3] Assumed project life of 30 years.
[4] Present Worth estimates include a 3% escalation and a 3% discount rate. The same escalation rate is used for electricity, materials, labor and capital costs.
[5] Annual and total production assume a base load of 80%.
[6] Annualized Costs are calculated over project life in 2011 dollars.

A-4: San Mateo Bridge Area - 1 mgd Brackish Groundwater Wells

Table A-4 A
Capital Cost Estimate
Representative 1 mgd Brackish Groundwater Desalination Project, San Mateo Bridge Area

Item	Capacity (mgd)	Pumping Power (HP)	Diameter (in.)	Length (ft.)	Capital Cost ($M)
Source Water: *Groundwater*					
Recovery: *75%*					
Treated Water Capacity: *1 mgd*					
Construction Cost Items					
Intake Structure	1.3	-	-	-	$ 1.00
Desalination Plant (Treated Water)	1	-	-	-	$ 10.20
Pipelines[1]					
Raw Water Pipeline/Tunnel	1.3	-	8	0	-
Treated Water Pipeline/Tunnel	1	-	8	8,500	$ 1.06
Brine Pipeline/Tunnel	0.3	-	4	16,000	$ 0.96
Pump Stations[2]					
Raw Water Pump Station	1.3	0	-	-	-
Treated Water Pump Station	1.0	30	-	-	$ 0.07
Brine Pump Station	0.3	5	-	-	$ 0.01
Treated Water Storage (MG)	2	-	-	-	$ 1.6
Total Construction Costs					**$ 14.90**
Contractor Profit (15%)					$ 2.24
Engineering, Engineering During Construction, & Construction Management (25%)					$ 3.73
Soft Cost Adjustment (15%)					$ 2.24
Contingency (40%)					$ 9.24
Total Adjustments					$ 17.44
Capital Cost Estimate					**$ 32.34**

1 Pipeline costs include tunneling and boring under obstructions such as highways.
2 Capital costing curves used to estimate intake and treatment plant construction costs include 50 HP pump stations for raw, treated and concentrated brine water. The costs itemized above for pump stations include costs for pumping capacity greater than 50 HP.

Table A-4 B
Annual O&M Costs
Representative 1 mgd Brackish Groundwater Desalination Project, San Mateo Bridge Area

Component	Cost
Chemicals	$ 25,800
Electrical Power	$ 216,100
Labor	$ 338,700
Solids Disposal to Landfill	$ -
MF/UF Membrane Replacement	$ -
Cartridge Filter Replacement	$ 3,300
RO Membrane Replacement	$ 26,800
Subtotal Annual O&M	$ 610,700
General Maintenance (non-labor costs - 10% of subtotal)	$ 61,100
Contingency (10% of subtotal)	$ 61,100
Total Annual O&M	$ 732,900

Table A-4 C Present Worth and Annualized Cost Details Representative 1 mgd Brackish Groundwater Desalination Project, San Mateo Bridge Area			
Assumptions		**Present Worth and Annualized Cost Summary**	
Project Life (years)	30	Total Production (AF)	26,900
Capacity (mgd)	1	PW Capital ($M)	$32.34
Baseload	80%	PW O&M ($M)	$21.99
Annual Production (AF/Y)	900	PW Total ($M)	$54.33
Start up date	1/1/2015	**PW Unit Cost ($/AF)**	$2,022
Implementation Time (years)	5	Capital Costs Annualized ($M)	$1.65
2011 Capital Cost ($M)	$32.34	Annual O&M Cost ($M)	$0.73
Discount Rate/bond rate	3%	Total Annual Cost ($M)	$2.38
Capital Escalation Factor[1]	3%	Annual Production (AF)	900
Energy Cost ($/kWh)	0.14	**Unit Annualized Costs ($/AF)**	$2,660
Present Worth Calculations			
Year	**Capital Cost**	**O&M**	**Total PW**
PW	$32,338,000	$21,990,000	**$54,328,000**
2011	$32,338,000	$733,000	**$33,071,000**
2012	$0	$0	$0
2013	$0	$0	$0
2014	$0	$0	$0
2015	$36,397,000	$0	$36,397,000
2016	$0	$850,000	$850,000
2017	$0	$875,000	$875,000
2018	$0	$901,000	$901,000
2019	$0	$929,000	$929,000
2020	$0	$956,000	$956,000
2021	$0	$985,000	$985,000
2022	$0	$1,015,000	$1,015,000
2023	$0	$1,045,000	$1,045,000
2024	$0	$1,076,000	$1,076,000
2025	$0	$1,109,000	$1,109,000
2026	$0	$1,142,000	$1,142,000
2027	$0	$1,176,000	$1,176,000
2028	$0	$1,212,000	$1,212,000
2029	$0	$1,248,000	$1,248,000
2030	$0	$1,285,000	$1,285,000
2031	$0	$1,324,000	$1,324,000
2032	$0	$1,364,000	$1,364,000
2033	$0	$1,405,000	$1,405,000
2034	$0	$1,447,000	$1,447,000
2035	$0	$1,490,000	$1,490,000
2036	$0	$1,535,000	$1,535,000
2037	$0	$1,581,000	$1,581,000
2038	$0	$1,628,000	$1,628,000
2039	$0	$1,677,000	$1,677,000
2040	$0	$1,727,000	$1,727,000
2041	$0	$1,779,000	$1,779,000
2042	$0	$1,833,000	$1,833,000
2043	$0	$1,888,000	$1,888,000
2044	$0	$1,944,000	$1,944,000
2045	$0	$2,002,000	$2,002,000

[1] The same escalation rate is used for electricity, materials, labor and capital costs.

Table A-4 D Present Worth and Annualized Cost Summary Representative 1 mgd Brackish Groundwater Desalination Project, San Mateo Bridge Area	
Present Worth Costs	
Annual O&M Cost ($M)	$ 0.73
Present Worth of Capital Cost ($M)	$ 32.34
Present Worth of Annual O&M Cost ($M)	$ 21.99
Total Present Worth ($M)	**$ 54.33**
Total Production (AF)	26,900
Unit Cost of Total Present Worth ($/AF)	**$ 2,000**
Annualized Project Costs	
Capital Costs Annualized ($M)	$ 1.65
Annual O&M Cost ($M)	$ 0.73
Total Annual Cost	**$ 2.38**
Annual Production (AF)	900
Unit Annualized Costs ($/AF)	**$ 2,700**

[1] 2011 costs are current as of August 2011.
[2] 2015 project start date (O&M costs starting 2016).
[3] Assumed project life of 30 years.
[4] Present Worth estimates include a 3% escalation and a 3% discount rate. The same escalation rate is used for electricity, materials, labor and capital costs.
[5] Annual and total production assumes a base load of 80%.
[6] Annualized Costs are calculated over project life in 2011 dollars.

A-5: San Mateo Bridge Area - 2 mgd Brackish Groundwater Wells

Table A-5 A
Capital Cost Estimate
Representative 2 mgd Brackish Groundwater Desalination Project, San Mateo Bridge Area

Item	Capacity (mgd)	Pumping Power (HP)	Diameter (in.)	Length (ft.)	Capital Cost ($M)
Source Water: *Groundwater*					
Recovery: *75%*					
Treated Water Capacity: 2 *mgd*					
Construction Cost Items					
Intake Structure	2.7	-	-	-	$ 2.00
Desalination Plant (Treated Water)	2	-	-	-	$ 13.20
Pipelines[1]					
Raw Water Pipeline/Tunnel	2.7	-	12	0	$ -
Treated Water Pipeline/Tunnel	2	-	10	8,500	$ 1.32
Brine Pipeline/Tunnel	0.7	-	6	16,000	$ 1.44
Pump Stations[2]					
Raw Water Pump Station	2.7	0	-	-	$ -
Treated Water Pump Station	2.0	120	-	-	$ 0.29
Brine Pump Station	0.7	0	-	-	$ -
Treated Water Storage (MG)	2	-	-	-	$ 1.6
Total Construction Costs					**$ 19.85**
Contractor Profit (15%)					$ 2.98
Engineering, Engineering During Construction, & Construction Management (25%)					$ 4.96
Soft Cost Adjustment (15%)					$ 2.98
Contingency (40%)					$ 12.31
Total Adjustments					$ 23.23
Capital Cost Estimate					**$ 43.08**

[1] Pipeline costs include tunneling and boring under obstructions such as highways.
[2] Capital costing curves used to estimate intake and treatment plant construction costs include 50 HP pump stations for raw, treated and concentrated brine water. The costs itemized above for pump stations include costs for pumping capacity greater than 50 HP.

Table A-5 B
Annual O&M Costs
Representative 2 mgd Brackish Groundwater Desalination Project, San Mateo Bridge Area

Component	Cost
Chemicals	$ 46,600
Electrical Power	$ 460,400
Labor	$ 338,700
Solids Disposal to Landfill	$ -
MF/UF Membrane Replacement	$ -
Cartridge Filter Replacement	$ 6,600
RO Membrane Replacement	$ 53,600
Subtotal Annual O&M	$ 905,900
General Maintenance (non-labor costs - 10% of subtotal)	$ 90,600
Contingency (10% of subtotal)	$ 90,600
Total Annual O&M	$ 1,087,100

Table A-5 C Present Worth and Annualized Cost Details Representative 2 mgd Brackish Groundwater Desalination Project, San Mateo Bridge Area			
Assumptions		**Present Worth and Annualized Cost Summary**	
Project Life (years)	30	Total Production (AF)	53,700
Capacity (mgd)	2	PW Capital ($M)	$43.08
Baseload	80%	PW O&M ($M)	$32.61
Annual Production (AF/Y)	1,800	PW Total ($M)	$75.69
Start up date	1/1/2015	**PW Unit Cost ($/AF)**	$1,408
Implementation Time (years)	5	Capital Costs Annualized ($M)	$2.20
2011 Capital Cost ($M)	$43.08	Annual O&M Cost ($M)	$1.09
Discount Rate/bond rate	3%	Total Annual Cost ($M)	$3.28
Capital Escalation Factor[1]	3%	Annual Production (AF)	1,800
Energy Cost ($/kWh)	0.14	**Unit Annualized Costs ($/AF)**	$1,834
Present Worth Calculations			
Year	**Capital Cost**	**O&M**	**Total PW**
PW	$43,077,000	$32,611,000	**$75,688,000**
2011	$43,077,000	$1,087,000	**$44,164,000**
2012	$0	$0	$0
2013	$0	$0	$0
2014	$0	$0	$0
2015	$48,484,000	$0	$48,484,000
2016	$0	$1,260,000	$1,260,000
2017	$0	$1,298,000	$1,298,000
2018	$0	$1,337,000	$1,337,000
2019	$0	$1,377,000	$1,377,000
2020	$0	$1,418,000	$1,418,000
2021	$0	$1,461,000	$1,461,000
2022	$0	$1,505,000	$1,505,000
2023	$0	$1,550,000	$1,550,000
2024	$0	$1,596,000	$1,596,000
2025	$0	$1,644,000	$1,644,000
2026	$0	$1,694,000	$1,694,000
2027	$0	$1,744,000	$1,744,000
2028	$0	$1,797,000	$1,797,000
2029	$0	$1,851,000	$1,851,000
2030	$0	$1,906,000	$1,906,000
2031	$0	$1,963,000	$1,963,000
2032	$0	$2,022,000	$2,022,000
2033	$0	$2,083,000	$2,083,000
2034	$0	$2,145,000	$2,145,000
2035	$0	$2,210,000	$2,210,000
2036	$0	$2,276,000	$2,276,000
2037	$0	$2,344,000	$2,344,000
2038	$0	$2,415,000	$2,415,000
2039	$0	$2,487,000	$2,487,000
2040	$0	$2,562,000	$2,562,000
2041	$0	$2,638,000	$2,638,000
2042	$0	$2,718,000	$2,718,000
2043	$0	$2,799,000	$2,799,000
2044	$0	$2,883,000	$2,883,000
2045	$0	$2,970,000	$2,970,000

[1] The same escalation rate is used for electricity, materials, labor and capital costs.

Table A-5 D Present Worth and Annualized Cost Summary Representative 2 mgd Brackish Groundwater Desalination Project, San Mateo Bridge Area	
Present Worth Costs	
Annual O&M Cost ($M)	$ 1.09
Present Worth of Capital Cost ($M)	$ 43.08
Present Worth of Annual O&M Cost ($M)	$ 32.61
Total Present Worth ($M)	**$ 75.69**
Total Production (AF)	53,700
Unit Cost of Total Present Worth ($/AF)	**$ 1,408**
Annualized Project Costs	
Capital Costs Annualized ($M)	$ 2.20
Annual O&M Cost ($M)	$ 1.09
Total Annual Cost	**$ 3.28**
Annual Production (AF)	1,800
Unit Annualized Costs ($/AF)	**$ 1,834**

[1] 2011 costs are current as of August 2011.
[2] 2015 project start date (O&M costs starting 2016).
[3] Assumed project life of 30 years.
[4] Present Worth estimates include a 3% escalation and a 3% discount rate. The same escalation rate is used for electricity, materials, labor and capital costs.
[5] Annual and total production assumes a base load of 80%.
[6] Annualized Costs are calculated over project life in 2011 dollars.

A-6: San Mateo Bridge Area - 5 mgd Brackish Groundwater Wells

Table A-6 A
Capital Cost Estimate
Representative 5 mgd Brackish Groundwater Desalination Project, San Mateo Bridge Area

Item	Capacity (mgd)	Pumping Power (HP)	Diameter (in.)	Length (ft.)	Capital Cost ($M)
Source Water: *Groundwater*					
Recovery: *75%*					
Treated Water Capacity: *5 mgd*					
Construction Cost Items					
Intake Structure	6.7	-	-	-	$ 4.00
Desalination Plant (Treated Water)	5	-	-	-	$ 18.60
Pipelines[1]					
Raw Water Pipeline/Tunnel	6.7	-	18	0	$ -
Treated Water Pipeline/Tunnel	5	-	18	8,500	$ 2.38
Brine Pipeline/Tunnel	1.7	-	10	16,000	$ 2.40
Pump Stations[2]					
Raw Water Pump Station	6.7	45	-	-	$ 0.11
Treated Water Pump Station	5.0	280	-	-	$ 0.67
Brine Pump Station	1.7	0	-	-	$ -
Treated Water Storage (MG)	2	-	-	-	$ 1.6
Total Construction Costs					**$ 29.76**
Contractor Profit (15%)					$ 4.46
Engineering, Engineering During Construction, & Construction Management (25%)					$ 7.44
Soft Cost Adjustment (15%)					$ 4.46
Contingency (40%)					$ 18.45
Total Adjustments					$ 34.82
Capital Cost Estimate					**$ 64.58**

[1] Pipeline costs include tunneling and boring under obstructions such as highways.
[2] Capital costing curves used to estimate intake and treatment plant construction costs include 50 HP pump stations for raw, treated and concentrated brine water. The costs itemized above for pump stations include costs for pumping capacity greater than 50 HP.

Table A-6 B
Annual O&M Cost
Representative 5 mgd Brackish Groundwater Desalination Project, San Mateo Bridge Area

Component	Cost
Chemicals	$ 109,000
Electrical Power	$ 1,132,200
Labor	$ 338,700
Solids Disposal to Landfill	$ -
MF/UF Membrane Replacement	$ -
Cartridge Filter Replacement	$ 16,500
RO Membrane Replacement	$ 133,900
Subtotal Annual O&M	$ 1,730,300
General Maintenance (non-labor costs - 10% of subtotal)	$ 173,000
Contingency (10% of subtotal)	$ 173,000
Total Annual O&M	$ 2,076,300

Table A-6 C
Present Worth and Annualized Cost Details
Representative 5 mgd Brackish Groundwater Desalination Project, San Mateo Bridge Area

Assumptions		**Present Worth and Annualized Cost Summary**	
Project Life (years)	30	Total Production (AF)	134,400
Capacity (mgd)	5	PW Capital ($M)	$64.58
Baseload	80%	PW O&M ($M)	$62.28
Annual Production (AF/Y)	4,500	PW Total ($M)	$126.86
Start up date	1/1/2015	**PW Unit Cost ($/AF)**	$944
Implementation Time (years)	5	Capital Costs Annualized ($M)	$3.29
2011 Capital Cost ($M)	$ 64.58	Annual O&M Cost ($M)	$2.08
Discount Rate/bond rate	3%	Total Annual Cost ($M)	$5.37
Capital Escalation Factor[1]	3%	Annual Production (AF)	4,500
Energy Cost ($/kWh)	0.14	**Unit Annualized Costs ($/AF)**	$1,199

Present Worth Calculations

Year	**Capital Cost**	**O&M**	**Total PW**
PW	$64,582,000	$62,280,000	**$126,862,000**
2011	$64,582,000	$2,076,000	**$66,658,000**
2012	$0	$0	$0
2013	$0	$0	$0
2014	$0	$0	$0
2015	$72,688,000	$0	$72,688,000
2016	$0	$2,407,000	$2,407,000
2017	$0	$2,479,000	$2,479,000
2018	$0	$2,553,000	$2,553,000
2019	$0	$2,630,000	$2,630,000
2020	$0	$2,709,000	$2,709,000
2021	$0	$2,790,000	$2,790,000
2022	$0	$2,874,000	$2,874,000
2023	$0	$2,960,000	$2,960,000
2024	$0	$3,049,000	$3,049,000
2025	$0	$3,140,000	$3,140,000
2026	$0	$3,234,000	$3,234,000
2027	$0	$3,331,000	$3,331,000
2028	$0	$3,431,000	$3,431,000
2029	$0	$3,534,000	$3,534,000
2030	$0	$3,640,000	$3,640,000
2031	$0	$3,749,000	$3,749,000
2032	$0	$3,862,000	$3,862,000
2033	$0	$3,978,000	$3,978,000
2034	$0	$4,097,000	$4,097,000
2035	$0	$4,220,000	$4,220,000
2036	$0	$4,347,000	$4,347,000
2037	$0	$4,477,000	$4,477,000
2038	$0	$4,611,000	$4,611,000
2039	$0	$4,750,000	$4,750,000
2040	$0	$4,892,000	$4,892,000
2041	$0	$5,039,000	$5,039,000
2042	$0	$5,190,000	$5,190,000
2043	$0	$5,346,000	$5,346,000
2044	$0	$5,506,000	$5,506,000
2045	$0	$5,671,000	$5,671,000

[1] The same escalation rate is used for electricity, materials, labor and capital costs.

Table A-6 D
Present Worth and Annualized Cost Summary
Representative 5 mgd Brackish Groundwater Desalination Project, San Mateo Bridge Area

Present Worth Costs	
Annual O&M Cost ($M)	$ 2.08
Present Worth of Capital Cost ($M)	$ 64.58
Present Worth of Annual O&M Cost ($M)	$ 62.28
Total Present Worth ($M)	**$126.86**
Total Production (AF)	134,400
Unit Cost of Total Present Worth ($/AF)	**$ 944**
Annualized Project Costs	
Capital Costs Annualized ($M)	$ 3.29
Annual O&M Cost ($M)	$ 2.08
Total Annual Cost	**$ 5.37**
Annual Production (AF)	4,500
Unit Annualized Costs ($/AF)	**$ 1,199**

[1] 2011 costs are current as of August 2011.
[2] 2015 project start date (O&M costs starting 2016).
[3] Assumed project life of 30 years.
[4] Present Worth estimates include a 3% escalation and a 3% discount rate. The same escalation rate is used for electricity, materials, labor and capital costs.
[5] Annual and total production assume a base load of 80%.
[6] Annualized Costs are calculated over project life in 2011 dollars.

A-7: San Mateo Bridge Area - 5 mgd Bay Water Horizontally Directionally Drilled Wells

Table A-7 A
Capital Cost Estimate
Representative 5 mgd Bay Water HDDW[1] Desalination Project, San Mateo Bridge Area

Item	Capacity (mgd)	Pumping Power (HP)	Diameter (in.)	Length (ft.)	Capital Cost ($M)
Source Water: *Bay Water*					
Recovery: 5*5%*					
Treated Water Capacity: *5 mgd*					
Construction Cost Items					
Intake Structure	9.1	-	-	-	$ 20.75
Desalination Plant (Treated Water)	5	-	-	-	$ 27.10
Pipelines[2]					
Raw Water Pipeline/Tunnel	9.1	-	21	0	$ -
Treated Water Pipeline/Tunnel	5	-	18	8,500	$ 2.38
Brine Pipeline/Tunnel	4.1	-	15	16,000	$ 3.60
Pump Stations[3]					
Raw Water Pump Station	9.1	30	-	-	$ 0.07
Treated Water Pump Station	5.0	50	-	-	$ 0.12
Brine Pump Station	4.1	35	-	-	$ 0.08
Treated Water Storage (MG)	2	-	-	-	$ 1.6
Total Construction Costs					**$ 55.71**
Contractor Profit (15%)					$ 8.36
Engineering, Engineering During Construction, & Construction Management (25%)					$ 13.93
Soft Cost Adjustment (15%)					$ 8.36
Contingency (40%)					$ 34.54
Total Adjustments					$ 65.18
Capital Cost Estimate					**$ 120.89**

[1] Horizontally Directionally Drilled Wells.
[2] Pipeline costs include tunneling and boring under obstructions such as highways.
[3] Capital costing curves used to estimate intake and treatment plant construction costs include 50 HP pump stations for raw, treated and concentrated brine water. The costs itemized above for pump stations include costs for pumping capacity greater than 50 HP.

Table A-7 B
Annual O&M Costs
Representative 5 mgd Bay Water HDDW[1] Desalination Project, San Mateo Bridge Area

Component	Cost
Chemicals	$ 365,100
Electrical Power	$ 1,897,300
Labor	$ 338,700
Solids Disposal to Landfill	$ -
MF/UF Membrane Replacement	$ -
Cartridge Filter Replacement	$ 22,500
RO Membrane Replacement	$ 234,400
Subtotal Annual O&M	$ 2,858,000
General Maintenance (non-labor costs - 10% of subtotal)	$ 285,800
Contingency (10% of subtotal)	$ 285,800
Total Annual O&M	$ 3,429,600

[1] Horizontally Directionally Drilled Wells.

Table A-7 C Present Worth and Annualized Cost Details Representative 5 mgd Bay Water HDDW[1] Desalination Project, San Mateo Bridge Area			
Assumptions		**Present Worth and Annualized Cost Summary**	
Project Life (years)	30	Total Production (AF)	134,400
Capacity (mgd)	5	PW Capital ($M)	$120.89
Baseload	80%	PW O&M ($M)	$102.90
Annual Production (AF/Y)	4,500	PW Total ($M)	$223.78
Start up date	1/1/2015	**PW Unit Cost ($/AF)**	$1,666
Implementation Time (years)	5	Capital Costs Annualized ($M)	$6.17
2011 Capital Cost ($M)	$120.89	Annual O&M Cost ($M)	$3.43
Discount Rate/bond rate	3%	Total Annual Cost ($M)	$9.60
Capital Escalation Factor[2]	3%	Annual Production (AF)	4,500
Energy Cost ($/kWh)	0.14	**Unit Annualized Costs ($/AF)**	$2,143
Present Worth Calculations			
Year	**Capital Cost**	**O&M**	**Total PW**
PW	$120,885,000	$102,899,000	**$223,784,000**
2011	$120,885,000	$3,430,000	**$124,315,000**
2012	$0	$0	$0
2013	$0	$0	$0
2014	$0	$0	$0
2015	$136,057,000	$0	$136,057,000
2016	$0	$3,976,000	$3,976,000
2017	$0	$4,096,000	$4,096,000
2018	$0	$4,218,000	$4,218,000
2019	$0	$4,345,000	$4,345,000
2020	$0	$4,475,000	$4,475,000
2021	$0	$4,610,000	$4,610,000
2022	$0	$4,748,000	$4,748,000
2023	$0	$4,890,000	$4,890,000
2024	$0	$5,037,000	$5,037,000
2025	$0	$5,188,000	$5,188,000
2026	$0	$5,344,000	$5,344,000
2027	$0	$5,504,000	$5,504,000
2028	$0	$5,669,000	$5,669,000
2029	$0	$5,839,000	$5,839,000
2030	$0	$6,015,000	$6,015,000
2031	$0	$6,195,000	$6,195,000
2032	$0	$6,381,000	$6,381,000
2033	$0	$6,572,000	$6,572,000
2034	$0	$6,769,000	$6,769,000
2035	$0	$6,972,000	$6,972,000
2036	$0	$7,182,000	$7,182,000
2037	$0	$7,397,000	$7,397,000
2038	$0	$7,619,000	$7,619,000
2039	$0	$7,848,000	$7,848,000
2040	$0	$8,083,000	$8,083,000
2041	$0	$8,326,000	$8,326,000
2042	$0	$8,575,000	$8,575,000
2043	$0	$8,833,000	$8,833,000
2044	$0	$9,098,000	$9,098,000
2045	$0	$9,370,000	$9,370,000

[1] Horizontally Directionally Drilled Wells.
[2] The same escalation rate is used for electricity, materials, labor and capital costs.

Table A-7 D
Present Worth and Annualized Cost Summary
Representative 5 mgd Bay Water HDDW[1] Desalination Project, San Mateo Bridge Area

Present Worth Costs	
Annual O&M Cost ($M)	$ 3.43
Present Worth of Capital Cost ($M)	$120.89
Present Worth of Annual O&M Cost ($M)	$102.90
Total Present Worth ($M)	**$223.78**
Total Production (AF)	134,400
Unit Cost of Total Present Worth ($/AF)	**$ 1,666**
Annualized Project Costs	
Capital Costs Annualized ($M)	$ 6.17
Annual O&M Cost ($M)	$ 3.43
Total Annual Cost	**$ 9.60**
Annual Production (AF)	4,500
Unit Annualized Costs ($/AF)	**$ 2,143**

1 Horizontally Directionally Drilled Wells.
2 2011 costs are current as of August 2011.
3 2015 project start date (O&M costs starting 2016).
4 Assumed project life of 30 years.
5 Present Worth estimates include a 3% escalation and a 3% discount rate. The same escalation rate is used for electricity, materials, labor and capital costs.
6 Annual and total production assumes a base load of 80%.
7 Annualized Costs are calculated over project life in 2011 dollars.

A-8: San Mateo Bridge Area - 10 mgd Bay Water Horizontally Directionally Drilled Wells

Table A-8 A
Capital Cost Estimate
Representative 10 mgd Bay Water HDDW[1] Desalination Project, San Mateo Bridge Area

Item	Capacity (mgd)	Pumping Power (HP)	Diameter (in.)	Length (ft.)	Capital Cost ($M)
Source Water: *Bay Water*					
Recovery: *55%*					
Treated Water Capacity: *10 mgd*					
Construction Cost Items					
Intake Structure	18.2	-	-	-	$ 35.75
Desalination Plant (Treated Water)	10	-	-	-	$ 43.40
Pipelines[2]					
Raw Water Pipeline/Tunnel	18.2	-	30	0	$ -
Treated Water Pipeline/Tunnel	10	-	24	8,500	$ 3.18
Brine Pipeline/Tunnel	8.2	-	21	16,000	$ 5.04
Pump Stations[3]					
Raw Water Pump Station	18.2	105	-	-	$ 0.25
Treated Water Pump Station	10.0	140	-	-	$ 0.34
Brine Pump Station	8.2	50	-	-	$ 0.12
Treated Water Storage (MG)	2	-	-	-	$ 1.6
Total Construction Costs					**$ 89.67**
Contractor Profit (15%)					$ 13.45
Engineering, Engineering During Construction, & Construction Management (25%)					$ 22.42
Soft Cost Adjustment (15%)					$ 13.55
Contingency (40%)					$ 55.60
Total Adjustments					$ 104.92
Capital Cost Estimate					**$ 194.59**

[1] Horizontally Directionally Drilled Wells.
[2] Pipeline costs include tunneling and boring under obstructions such as highways.
[3] Capital costing curves used to estimate intake and treatment plant construction costs include 50 HP pump stations for raw, treated and concentrated brine water. The costs itemized above for pump stations include costs for pumping capacity greater than 50 HP.

Table A-8 B
Annual O&M Costs
Representative 10 mgd Bay Water HDDW[1] Desalination Project, San Mateo Bridge Area

Component	Cost
Chemicals	$ 720,200
Electrical Power	$ 3,809,200
Labor	$ 338,700
Solids Disposal to Landfill	$ -
MF/UF Membrane Replacement	$ -
Cartridge Filter Replacement	$ 45,100
RO Membrane Replacement	$ 468,800
Subtotal Annual O&M	$ 5,382,000
General Maintenance (non-labor costs - 10% of subtotal)	$ 538,200
Contingency (10% of subtotal)	$ 538,200
Total Annual O&M	$ 6,458,000

[1] Horizontally Directionally Drilled Wells.

Table A-8 C Present Worth and Annualized Cost Details Representative 10 mgd Bay Water HDDW[1] Desalination Project, San Mateo Bridge Area			
Assumptions		**Present Worth and Annualized Cost Summary**	
Project Life (years)	30	Total Production (AF)	268,700
Capacity (mgd)	10	PW Capital ($M)	$194.59
Baseload	80%	PW O&M ($M)	$193.74
Annual Production (AF/Y)	9,000	PW Total ($M)	$388.33
Start up date	1/1/2015	**PW Unit Cost ($/AF)**	$1,445
Implementation Time (years)	5	Capital Costs Annualized ($M)	$9.93
2011 Capital Cost ($M)	$ 194.59	Annual O&M Cost ($M)	$6.46
Discount Rate/bond rate	3%	Total Annual Cost ($M)	$16.39
Capital Escalation Factor[2]	3%	Annual Production (AF)	9,000
Energy Cost ($/kWh)	0.14	**Unit Annualized Costs ($/AF)**	$1,829
Present Worth Calculations			
Year	**Capital Cost**	**O&M**	**Total PW**
PW	$194,591,000	$193,740,000	**$388,331,000**
2011	$194,591,000	$6,458,000	**$201,049,000**
2012	$0	$0	$0
2013	$0	$0	$0
2014	$0	$0	$0
2015	$219,014,000	$0	$219,014,000
2016	$0	$7,487,000	$7,487,000
2017	$0	$7,711,000	$7,711,000
2018	$0	$7,943,000	$7,943,000
2019	$0	$8,181,000	$8,181,000
2020	$0	$8,426,000	$8,426,000
2021	$0	$8,679,000	$8,679,000
2022	$0	$8,939,000	$8,939,000
2023	$0	$9,208,000	$9,208,000
2024	$0	$9,484,000	$9,484,000
2025	$0	$9,768,000	$9,768,000
2026	$0	$10,061,000	$10,061,000
2027	$0	$10,363,000	$10,363,000
2028	$0	$10,674,000	$10,674,000
2029	$0	$10,994,000	$10,994,000
2030	$0	$11,324,000	$11,324,000
2031	$0	$11,664,000	$11,664,000
2032	$0	$12,014,000	$12,014,000
2033	$0	$12,374,000	$12,374,000
2034	$0	$12,745,000	$12,745,000
2035	$0	$13,128,000	$13,128,000
2036	$0	$13,522,000	$13,522,000
2037	$0	$13,927,000	$13,927,000
2038	$0	$14,345,000	$14,345,000
2039	$0	$14,775,000	$14,775,000
2040	$0	$15,219,000	$15,219,000
2041	$0	$15,675,000	$15,675,000
2042	$0	$16,146,000	$16,146,000
2043	$0	$16,630,000	$16,630,000
2044	$0	$17,129,000	$17,129,000
2045	$0	$17,643,000	$17,643,000

[1] Horizontally Directionally Drilled Wells.
[2] The same escalation rate is used for electricity, materials, labor and capital costs.

Table A-8 D
Present Worth and Annualized Cost Summary
Representative 10 mgd Bay Water HDDW(1) Desalination Project, San Mateo Bridge Area

Present Worth Costs	
Annual O&M Cost ($M)	$ 6.46
Present Worth of Capital Cost ($M)	$194.59
Present Worth of Annual O&M Cost ($M)	$193.74
Total Present Worth ($M)	**$388.33**
Total Production (AF)	268,700
Unit Cost of Total Present Worth ($/AF)	**$ 1,445**
Annualized Project Costs	
Capital Costs Annualized ($M)	$ 9.93
Annual O&M Cost ($M)	$ 6.46
Total Annual Cost	**$ 16.39**
Annual Production (AF)	9,000
Unit Annualized Costs ($/AF)	**$ 1,829**

[1] Horizontally Directionally Drilled Wells.
[2] 2011 costs are current as of August 2011.
[3] 2015 project start date (O&M costs starting 2016).
[4] Assumed project life of 30 years.
[5] Present Worth estimates include a 3% escalation and a 3% discount rate. The same escalation rate is used for electricity, materials, labor and capital costs.
[6] Annual and total production assumes a base load of 80%.
[7] Annualized Costs are calculated over project life in 2011 dollars.

A-9: San Mateo Bridge Area - 20 mgd Bay Water Open Intake

Table A-9 A
Capital Cost Estimate
Representative 20 mgd Bay Water Open Intake Desalination Project, San Mateo Bridge Area

Item	Capacity (mgd)	Pumping Power (HP)	Diameter (in.)	Length (ft.)	Capital Cost ($M)
Source Water: *Bay Water*					
Recovery: *55%*					
Treated Water Capacity: *20 mgd*					
Construction Cost Items					
Intake Structure	36.4	-	-	-	$ 14.67
Desalination Plant (Treated Water)	20	-	-	-	$ 134.20
Pipelines[1]					
Raw Water Pipeline/Tunnel	36.4	-	42	10,500	$ 8.82
Treated Water Pipeline/Tunnel	20	-	36	8,500	$ 4.76
Brine Pipeline/Tunnel	16.4	-	30	16,000	$ 7.20
Pump Stations[2]					
Raw Water Pump Station	36.4	305	-	-	$ 0.73
Treated Water Pump Station	20.0	255	-	-	$ 0.61
Brine Pump Station	16.4	35	-	-	$ 0.08
Treated Water Storage (MG)	2	-	-	-	$ 1.60
Total Construction Costs					**$ 172.69**
Contractor Profit (15%)					$ 25.90
Engineering, Engineering During Construction, & Construction Management (25%)					$ 43.17
Soft Cost Adjustment (15%)					$ 25.90
Contingency (40%)					$ 107.06
Total Adjustments					$ 202.04
Capital Cost Estimate					**$ 374.73**

1 Pipeline costs include tunneling and boring under obstructions such as highways.
2 Capital costing curves used to estimate intake and treatment plant construction costs include 50 HP pump stations for raw, treated and concentrated brine water. The costs itemized above for pump stations include costs for pumping capacity greater than 50 HP.

Table A-9 B
Annual O&M Costs
Representative 20 mgd Bay Water Open Intake Desalination Project, San Mateo Bridge Area

Component	Cost
Chemicals	$ 2,003,600
Electrical Power	$ 8,740,000
Labor	$ 410,200
Solids Disposal to Landfill	$ 233,900
MF/UF Membrane Replacement	$ 482,800
Cartridge Filter Replacement	$ 90,100
RO Membrane Replacement	$ 937,500
Subtotal Annual O&M	$ 12,898,100
General Maintenance (non-labor costs - 10% of subtotal)	$ 1,289,800
Contingency (10% of subtotal)	$ 1,289,800
Total Annual O&M	$ 15,477,700

Table A-9 C Present Worth and Annualized Cost Details Representative 20 mgd Bay Water Open Intake Desalination Project, San Mateo Bridge Area			
Assumptions		**Present Worth and Annualized Cost Summary**	
Project Life (years)	30	Total Production (AF)	537,400
Capacity (mgd)	20	PW Capital ($M)	$374.73
Baseload	80%	PW O&M ($M)	$464.34
Annual Production (AF/Y)	17,900	PW Total ($M)	$839.07
Start up date	1/1/2015	**PW Unit Cost ($/AF)**	$1,561
Implementation Time (years)	5	Capital Costs Annualized ($M)	$19.12
2011 Capital Cost ($M)	$ 374.73	Annual O&M Cost ($M)	$15.48
Discount Rate/bond rate	3%	Total Annual Cost ($M)	$34.60
Capital Escalation Factor[1]	3%	Annual Production (AF)	17,900
Energy Cost ($/kWh)	0.14	**Unit Annualized Costs ($/AF)**	$1,931
Present Worth Calculations			
Year	**Capital Cost**	**O&M**	**Total PW**
PW	$374,727,000	$464,340,000	**$839,067,000**
2011	$374,727,000	$15,478,000	**$390,205,000**
2012	$0	$0	$0
2013	$0	$0	$0
2014	$0	$0	$0
2015	$421,759,000	$0	$421,759,000
2016	$0	$17,943,000	$17,943,000
2017	$0	$18,482,000	$18,482,000
2018	$0	$19,036,000	$19,036,000
2019	$0	$19,607,000	$19,607,000
2020	$0	$20,195,000	$20,195,000
2021	$0	$20,801,000	$20,801,000
2022	$0	$21,425,000	$21,425,000
2023	$0	$22,068,000	$22,068,000
2024	$0	$22,730,000	$22,730,000
2025	$0	$23,412,000	$23,412,000
2026	$0	$24,114,000	$24,114,000
2027	$0	$24,838,000	$24,838,000
2028	$0	$25,583,000	$25,583,000
2029	$0	$26,350,000	$26,350,000
2030	$0	$27,141,000	$27,141,000
2031	$0	$27,955,000	$27,955,000
2032	$0	$28,794,000	$28,794,000
2033	$0	$29,657,000	$29,657,000
2034	$0	$30,547,000	$30,547,000
2035	$0	$31,464,000	$31,464,000
2036	$0	$32,407,000	$32,407,000
2037	$0	$33,380,000	$33,380,000
2038	$0	$34,381,000	$34,381,000
2039	$0	$35,413,000	$35,413,000
2040	$0	$36,475,000	$36,475,000
2041	$0	$37,569,000	$37,569,000
2042	$0	$38,696,000	$38,696,000
2043	$0	$39,857,000	$39,857,000
2044	$0	$41,053,000	$41,053,000
2045	$0	$42,284,000	$42,284,000

[1] The same escalation rate is used for electricity, materials, labor and capital costs.

Table A-9 D
Present Worth and Annualized Cost Summary
Representative 20 mgd Bay Water Open Intake Desalination Project, San Mateo Bridge Area

Present Worth Costs	
Annual O&M Cost ($M)	$ 15.48
Present Worth of Capital Cost ($M)	$ 374.73
Present Worth of Annual O&M Cost ($M)	$ 464.34
Total Present Worth ($M)	**$ 839.07**
Total Production (AF)	537,400
Unit Cost of Total Present Worth ($/AF)	**$ 1,561**
Annualized Project Costs	
Capital Costs Annualized ($M)	$ 19.12
Annual O&M Cost ($M)	$ 15.48
Total Annual Cost	**$ 34.60**
Annual Production (AF)	17,900
Unit Annualized Costs ($/AF)	**$ 1,931**

[1] 2011 costs are current as of August 2011.
[2] 2015 project start date (O&M costs starting 2016).
[3] Assumed project life of 30 years.
[4] Present Worth estimates include a 3% escalation and a 3% discount rate. The same escalation rate is used for electricity, materials, labor and capital costs.
[5] Annual and total production assumes a base load of 80%.
[6] Annualized Costs are calculated over project life in 2011 dollars.

A-10: South San Francisco Area – 1 mgd Brackish Groundwater Wells

Table A-10 A
Capital Cost Estimate
Representative 1 mgd Brackish Groundwater Desalination Project, South San Francisco Area

Item	Capacity (mgd)	Pumping Power (HP)	Diameter (in.)	Length (ft.)	Capital Cost ($M)
Source Water: *Groundwater*					
Recovery: *75%*					
Treated Water Capacity: *1 mgd*					
Construction Cost Items					
Intake Structure	1.3	-	-	-	$ 1.00
Desalination Plant (Treated Water)	1	-	-	-	$ 10.20
Pipelines[1]					
Raw Water Pipeline/Tunnel	1.3	-	8	0	$ -
Treated Water Pipeline/Tunnel	1	-	8	3,800	$ 0.57
Brine Pipeline/Tunnel	0.3	-	4	15,600	$ 0.94
Pump Stations[2]					
Raw Water Pump Station	1.3	0	-	-	$ -
Treated Water Pump Station	1.0	10	-	-	$ 0.02
Brine Pump Station	0.3	0	-	-	$ -
Treated Water Storage (MG)	2	-	-	-	$ 1.6
Total Construction Costs					**$ 14.33**
Contractor Profit (15%)					$ 2.15
Engineering, Engineering During Construction, & Construction Management (25%)					$ 3.58
Soft Cost Adjustment (15%)					$ 2.15
Contingency (40%)					$ 8.89
Total Adjustments					$ 16.77
Capital Cost Estimate					**$ 31.10**

[1] Pipeline costs include tunneling and boring under obstructions such as highways.
[2] Capital costing curves used to estimate intake and treatment plant construction costs include 50 HP pump stations for raw, treated and concentrated brine water. The costs itemized above for pump stations include costs for pumping capacity greater than 50 HP.

Table A-10 B
Annual O&M Costs
Representative 1 mgd Brackish Groundwater Desalination Project, South San Francisco Area

Component	Cost
Chemicals	$ 25,800
Electrical Power	$ 185,100
Labor	$ 338,700
Solids Disposal to Landfill	$ -
MF/UF Membrane Replacement	$ -
Cartridge Filter Replacement	$ 3,300
RO Membrane Replacement	$ 26,800
Subtotal Annual O&M	$ 579,700
General Maintenance (non-labor costs - 10% of subtotal)	$ 58,000
Contingency (10% of subtotal)	$ 58,000
Total Annual O&M	$ 695,700

Table A-10 C Present Worth and Annualized Cost Details Representative 1 mgd Brackish Groundwater Desalination Project, South San Francisco Area			
Assumptions		**Present Worth and Annualized Cost Summary**	
Project Life (years)	30	Total Production (AF)	26,900
Capacity (mgd)	1	PW Capital ($M)	$31.10
Baseload	80%	PW O&M ($M)	$20.88
Annual Production (AF/Y)	900	PW Total ($M)	$51.98
Start up date	1/1/2015	**PW Unit Cost ($/AF)**	$1,934
Implementation Time (years)	5	Capital Costs Annualized ($M)	$1.59
2011 Capital Cost ($M)	$ 31.10	Annual O&M Cost ($M)	$0.70
Discount Rate/bond rate	3%	Total Annual Cost ($M)	$2.28
Capital Escalation Factor[1]	3%	Annual Production (AF)	900
Energy Cost ($/kWh)	0.14	**Unit Annualized Costs ($/AF)**	$2,548
Present Worth Calculations			
Year	**Capital Cost**	**O&M**	**Total PW**
PW	$31,099,000	$20,879,000	**$51,978,000**
2011	$31,099,000	$696,000	**$31,795,000**
2012	$0	$0	$0
2013	$0	$0	$0
2014	$0	$0	$0
2015	$35,002,000	$0	$35,002,000
2016	$0	$807,000	$807,000
2017	$0	$831,000	$831,000
2018	$0	$856,000	$856,000
2019	$0	$882,000	$882,000
2020	$0	$908,000	$908,000
2021	$0	$935,000	$935,000
2022	$0	$963,000	$963,000
2023	$0	$992,000	$992,000
2024	$0	$1,022,000	$1,022,000
2025	$0	$1,053,000	$1,053,000
2026	$0	$1,084,000	$1,084,000
2027	$0	$1,117,000	$1,117,000
2028	$0	$1,150,000	$1,150,000
2029	$0	$1,185,000	$1,185,000
2030	$0	$1,220,000	$1,220,000
2031	$0	$1,257,000	$1,257,000
2032	$0	$1,295,000	$1,295,000
2033	$0	$1,334,000	$1,334,000
2034	$0	$1,374,000	$1,374,000
2035	$0	$1,415,000	$1,415,000
2036	$0	$1,457,000	$1,457,000
2037	$0	$1,501,000	$1,501,000
2038	$0	$1,546,000	$1,546,000
2039	$0	$1,592,000	$1,592,000
2040	$0	$1,640,000	$1,640,000
2041	$0	$1,689,000	$1,689,000
2042	$0	$1,740,000	$1,740,000
2043	$0	$1,792,000	$1,792,000
2044	$0	$1,846,000	$1,846,000
2045	$0	$1,901,000	$1,901,000

[1]The same escalation rate is used for electricity, materials, labor and capital costs.

Table A-10 D Present Worth and Annualized Cost Summary Representative 1 mgd Brackish Groundwater Desalination Project, South San Francisco Area	
Present Worth Costs	
Annual O&M Cost ($M)	$ 0.70
Present Worth of Capital Cost ($M)	$ 31.10
Present Worth of Annual O&M Cost ($M)	$ 20.88
Total Present Worth ($M)	**$ 51.98**
Total Production (AF)	26,900
Unit Cost of Total Present Worth ($/AF)	**$ 1,934**
Annualized Project Costs	
Capital Costs Annualized ($M)	**$ 1.6**
Annual O&M Cost ($M)	**$ 0.7**
Total Annual Cost	**$ 2.3**
Annual Production (AF)	**900**
Unit Annualized Costs ($/AF)	**$ 2,548**

[1] 2011 costs are current as of August 2011.
[2] 2015 project start date (O&M costs starting 2016).
[3] Assumed project life of 30 years.
[4] Present Worth estimates include a 3% escalation and a 3% discount rate. The same escalation rate is used for electricity, materials, labor and capital costs.
[5] Annual and total production assume a base load of 80%.
[6] Annualized Costs are calculated over project life in 2011 dollars.

A-11: South San Francisco Area – 2 mgd Brackish Groundwater Wells

Table A-11 A
Capital Cost Estimate
Representative 2 mgd Brackish Groundwater Desalination Project, South San Francisco Area

Item	Capacity (mgd)	Pumping Power (HP)	Diameter (in.)	Length (ft.)	Capital Cost ($M)
Source Water: *Groundwater*					
Recovery: *75%*					
Treated Water Capacity: *2 mgd*					
Construction Cost Items					
Intake Structure	2.7		-	-	$ 2.00
Desalination Plant (Treated Water)	2		-	-	$ 13.20
Pipelines[1]					
Raw Water Pipeline/Tunnel	2.7		12	3,200	$ 0.58
Treated Water Pipeline/Tunnel	2		10	3,800	$ 0.71
Brine Pipeline/Tunnel	0.7		6	15,600	$ 1.40
Pump Stations[2]					
Raw Water Pump Station	2.7	0	-	-	$ -
Treated Water Pump Station	2.0	75	-	-	$ 0.18
Brine Pump Station	0.7	0	-	-	$ -
Treated Water Storage (MG)	2		-	-	$ 1.60
Total Construction Costs					**$ 19.67**
Contractor Profit (15%)					$ 2.95
Engineering, Engineering During Construction, & Construction Management (25%)					$ 4.92
Soft Cost Adjustment (15%)					$ 2.95
Contingency (40%)					$ 12.20
Total Adjustments					$ 23.02
Capital Cost Estimate					**$ 42.69**

[1] Pipeline costs include tunneling and boring under obstructions such as highways.
[2] Capital costing curves used to estimate intake and treatment plant construction costs include 50 HP pump stations for raw, treated and concentrated brine water. The costs itemized above for pump stations include costs for pumping capacity greater than 50 HP.

Table A-11 B
Annual O&M Costs
Representative 2 mgd Brackish Groundwater Desalination Project, South San Francisco Area

Component	Cost
Chemicals	$ 46,600
Electrical Power	$ 430,700
Labor	$ 338,700
Solids Disposal to Landfill	$ -
MF/UF Membrane Replacement	$ -
Cartridge Filter Replacement	$ 6,600
RO Membrane Replacement	$ 53,600
Subtotal Annual O&M	$ 876,200
General Maintenance (non-labor costs - 10% of subtotal)	$ 87,600
Contingency (10% of subtotal)	$ 87,600
Total Annual O&M	$ 1,051,400

Table A-11 C
Present Worth and Annualized Cost Details
Representative 2 mgd Brackish Groundwater Desalination Project, South San Francisco Area

Assumptions		**Present Worth and Annualized Cost Summary**	
Project Life (years)	30	Total Production (AF)	53,700
Capacity (mgd)	2	PW Capital ($M)	$42.69
Baseload	80%	PW O&M ($M)	$31.53
Annual Production (AF/Y)	1,790	PW Total ($M)	$74.22
Start up date	1/1/2015	**PW Unit Cost ($/AF)**	$1,381
Implementation Time (years)	5	Capital Costs Annualized ($M)	$2.18
2011 Capital Cost ($M)	$ 42.69	Annual O&M Cost ($M)	$1.05
Discount Rate/bond rate	3%	Total Annual Cost ($M)	$3.23
Capital Escalation Factor[1]	3%	Annual Production (AF)	1,790
Energy Cost ($/kWh)	0.14	**Unit Annualized Costs ($/AF)**	$1,803
Present Worth Calculations			
Year	**Capital Cost**	**O&M**	**Total PW**
PW	$42,693,000	$31,529,000	**$74,222,000**
2011	$42,692,600	$1,051,000	**$43,743,600**
2012	$0	$0	$0
2013	$0	$0	$0
2014	$0	$0	$0
2015	$48,051,000	$0	$48,051,000
2016	$0	$1,218,000	$1,218,000
2017	$0	$1,255,000	$1,255,000
2018	$0	$1,293,000	$1,293,000
2019	$0	$1,331,000	$1,331,000
2020	$0	$1,371,000	$1,371,000
2021	$0	$1,412,000	$1,412,000
2022	$0	$1,455,000	$1,455,000
2023	$0	$1,498,000	$1,498,000
2024	$0	$1,543,000	$1,543,000
2025	$0	$1,590,000	$1,590,000
2026	$0	$1,637,000	$1,637,000
2027	$0	$1,687,000	$1,687,000
2028	$0	$1,737,000	$1,737,000
2029	$0	$1,789,000	$1,789,000
2030	$0	$1,843,000	$1,843,000
2031	$0	$1,898,000	$1,898,000
2032	$0	$1,955,000	$1,955,000
2033	$0	$2,014,000	$2,014,000
2034	$0	$2,074,000	$2,074,000
2035	$0	$2,136,000	$2,136,000
2036	$0	$2,201,000	$2,201,000
2037	$0	$2,267,000	$2,267,000
2038	$0	$2,335,000	$2,335,000
2039	$0	$2,405,000	$2,405,000
2040	$0	$2,477,000	$2,477,000
2041	$0	$2,551,000	$2,551,000
2042	$0	$2,628,000	$2,628,000
2043	$0	$2,706,000	$2,706,000
2044	$0	$2,788,000	$2,788,000
2045	$0	$2,871,000	$2,871,000

[1]The same escalation rate is used for electricity, materials, labor and capital costs.

Table A-11 D Present Worth and Annualized Cost Summary Representative 2 mgd Brackish Groundwater Desalination Project, South San Francisco Area	
Present Worth Costs	
Annual O&M Cost ($M)	$ 1.05
Present Worth of Capital Cost ($M)	$ 42.69
Present Worth of Annual O&M Cost ($M)	$ 31.53
Total Present Worth ($M)	**$ 74.22**
Total Production (AF)	53,700
Unit Cost of Total Present Worth ($/AF)	**$ 1,381**
Annualized Project Costs	
Capital Costs Annualized ($M)	$ 2.18
Annual O&M Cost ($M)	$ 1.05
Total Annual Cost	**$ 3.23**
Annual Production (AF)	1,800
Unit Annualized Costs ($/AF)	**$ 1,803**

[1] 2011 costs are current as of August 2011.
[2] 2015 project start date (O&M costs starting 2016).
[3] Assumed project life of 30 years.
[4] Present Worth estimates include a 3% escalation and a 3% discount rate. The same escalation rate is used for electricity, materials, labor and capital costs.
[5] Annual and total production assume a base load of 80%.
[6] Annualized Costs are calculated over project life in 2011 dollars.

A-12: South San Francisco Area – 5 mgd Bay Water Horizontally Directionally Drilled Wells

Table A-12 A
Capital Cost Estimate
Representative 5 mgd Bay Water HDDW[1] Desalination Project, South San Francisco Area

Item	Capacity (mgd)	Pumping Power (HP)	Diameter (in.)	Length (ft.)	Capital Cost ($M)
Source Water: *Bay Water*					
Recovery: *55%*					
Treated Water Capacity: *5 mgd*					
Construction Cost Items					
Intake Structure	9.1	-	-	-	$ 20.75
Desalination Plant (Treated Water)	5	-	-	-	$ 27.10
Pipelines[2]					
Raw Water Pipeline/Tunnel	9.1	-	21	3,200	$ 1.01
Treated Water Pipeline/Tunnel	5	-	18	3,800	$ 1.29
Brine Pipeline/Tunnel	4.1	-	15	15,600	$ 3.51
Pump Stations[3]					
Raw Water Pump Station	9.1	45	-	-	$ 0.11
Treated Water Pump Station	5.0	35	-	-	$ 0.08
Brine Pump Station	4.1	30	-	-	$ 0.07
Treated Water Storage (MG)	2	-	-	-	$ 1.60
Total Construction Costs					**$ 55.52**
Contractor Profit (15%)					$ 8.33
Engineering, Engineering During Construction, & Construction Management (25%)					$ 13.88
Soft Cost Adjustment (15%)					$ 8.33
Contingency (40%)					$ 34.42
Total Adjustments					$ 64.96
Capital Cost Estimate					**$ 120.47**

[1] Horizontally Directionally Drilled Wells.
[2] Pipeline costs include tunneling and boring under obstructions such as highways.
[3] Capital costing curves used to estimate intake and treatment plant construction costs include 50 HP pump stations for raw, treated and concentrated brine water. The costs itemized above for pump stations include costs for pumping capacity greater than 50 HP.

Table A-12 B
Annual O&M Costs
Representative 5 mgd Bay Water HDDW[1] Desalination Project, South San Francisco Area

Component	Cost
Chemicals	$ 365,100
Electrical Power	$ 1,901,700
Labor	$ 338,700
Solids Disposal to Landfill	$ -
MF/UF Membrane Replacement	$ -
Cartridge Filter Replacement	$ 22,500
RO Membrane Replacement	$ 234,400
Subtotal Annual O&M	$ 2,862,400
General Maintenance (non-labor costs - 10% of subtotal)	$ 286,200
Contingency (10% of subtotal)	$ 286,200
Total Annual O&M	$ 3,434,800

[1] Horizontally Directionally Drilled Wells.

Table A-12 C
Present Worth and Annualized Cost Details
Representative 5 mgd Bay Water HDDW[1] Desalination Project, South San Francisco Area

Assumptions		**Present Worth and Annualized Cost Summary**	
Project Life (yrs)	30	Total Production (AF)	134,400
Capacity (mgd)	5	PW Capital ($M)	$120.47
Baseload	80%	PW O&M ($M)	$103.02
Annual Production (AFY)	4,500	PW Total ($M)	$223.49
Start up date	1/1/2015	**PW Unit Cost ($/AF)**	$1,663
Implementation Time (yrs)	7	Capital Costs Annualized ($M)	$6.15
2011 Capital Cost ($M)	$ 120.47	Annual O&M Cost ($M)	$3.43
Discount Rate/bond rate	3%	Total Annual Cost ($M)	$9.58
Capital Escalation Factor[2]	3%	Annual Production (AF)	4,500
Energy Cost ($/kWh)	0.14	**Unit Annualized Costs ($/AF)**	$2,139

Present Worth Calculations

Year	Capital Cost	O&M	Total PW
PW	$120,472,000	$103,019,000	**$223,491,000**
2011	$120,472,000	$3,434,000	**$123,906,000**
2012	$0	$0	$0
2013	$0	$0	$0
2014	$0	$0	$0
2015	$135,592,000	$0	$135,592,000
2016	$0	$3,981,000	$3,981,000
2017	$0	$4,100,000	$4,100,000
2018	$0	$4,223,000	$4,223,000
2019	$0	$4,350,000	$4,350,000
2020	$0	$4,481,000	$4,481,000
2021	$0	$4,615,000	$4,615,000
2022	$0	$4,753,000	$4,753,000
2023	$0	$4,896,000	$4,896,000
2024	$0	$5,043,000	$5,043,000
2025	$0	$5,194,000	$5,194,000
2026	$0	$5,350,000	$5,350,000
2027	$0	$5,511,000	$5,511,000
2028	$0	$5,676,000	$5,676,000
2029	$0	$5,846,000	$5,846,000
2030	$0	$6,022,000	$6,022,000
2031	$0	$6,202,000	$6,202,000
2032	$0	$6,388,000	$6,388,000
2033	$0	$6,580,000	$6,580,000
2034	$0	$6,777,000	$6,777,000
2035	$0	$6,981,000	$6,981,000
2036	$0	$7,190,000	$7,190,000
2037	$0	$7,406,000	$7,406,000
2038	$0	$7,628,000	$7,628,000
2039	$0	$7,857,000	$7,857,000
2040	$0	$8,092,000	$8,092,000
2041	$0	$8,335,000	$8,335,000
2042	$0	$8,585,000	$8,585,000
2043	$0	$8,843,000	$8,843,000
2044	$0	$9,108,000	$9,108,000
2045	$0	$9,381,000	$9,381,000

[1] Horizontally Directionally Drilled Wells.
[2] The same escalation rate is used for electricity, materials, labor and capital costs.

Table A-12 D Present Worth and Annualized Cost Summary Representative 5 mgd Bay Water HDDW[1] Desalination Project, South San Francisco Area	
Present Worth Costs	
Annual O&M Cost ($M)	$ 3.43
Present Worth of Capital Cost ($M)	$120.47
Present Worth of Annual O&M Cost ($M)	$103.02
Total Present Worth ($M)	**$223.49**
Total Production (AF)	134,400
Unit Cost of Total Present Worth ($/AF)	**$ 1,663**
Annualized Project Costs	
Capital Costs Annualized ($M)	$ 6.15
Annual O&M Cost ($M)	$ 3.43
Total Annual Cost	**$ 9.58**
Annual Production (AF)	4,500
Unit Annualized Costs ($/AF)	**$ 2,139**

[1] Horizontally Directionally Drilled Wells.
[2] 2011 costs are current as of August 2011.
[3] 2015 project start date (O&M costs starting 2016).
[4] Assumed project life of 30 years.
[5] Present Worth estimates include a 3% escalation and a 3% discount rate. The same escalation rate is used for electricity, materials, labor and capital costs.
[6] Annual and total production assume a base load of 80%.
[7] Annualized Costs are calculated over project life in 2011 dollars.

A-13: South San Francisco Area – 10 mgd Bay Water Horizontally Directionally Drilled Wells

Table A-13 A
Capital Cost Estimate
Representative 10 mgd Bay Water HDDW[1] Desalination Project, South San Francisco Area

Item	Capacity (mgd)	Pumping Power (HP)	Diameter (in.)	Length (ft.)	Capital Cost ($M)
Source Water: *Bay Water*					
Recovery: *55%*					
Treated Water Capacity: *10 mgd*					
Construction Cost Items					
Intake Structure	18.2	-	-	-	$ 35.75
Desalination Plant (Treated Water)	10	-	-	-	$ 43.40
Pipelines[2]					
Raw Water Pipeline/Tunnel	18.2	-	30	3,200	$ 1.44
Treated Water Pipeline/Tunnel	10	-	24	3,800	$ 1.71
Brine Pipeline/Tunnel	8.2	-	21	15,600	$ 4.91
Pump Stations[3]					
Raw Water Pump Station	18.2	135	-	-	$ 0.32
Treated Water Pump Station	10.0	120	-	-	$ 0.29
Brine Pump Station	8.2	40	-	-	$ 0.10
Treated Water Storage (MG)	2	2	-	-	-
Total Construction Costs					**$ 89.53**
Contractor Profit (15%)					$ 13.43
Engineering, Engineering During Construction, & Construction Management (25%)					$ 22.38
Soft Cost Adjustment (15%)					$ 13.43
Contingency (40%)					$ 55.51
Total Adjustments					$ 104.74
Capital Cost Estimate					**$ 194.27**

1 Horizontally Directionally Drilled Wells.
2 Pipeline costs include tunneling and boring under obstructions such as highways.
3 Capital costing curves used to estimate intake and treatment plant construction costs include 50 HP pump stations for raw, treated and concentrated brine water. The costs itemized above for pump stations include costs for pumping capacity greater than 50 HP.

Table A-13 B
Annual O&M Costs
Representative 10 mgd Bay Water HDDW[1] Desalination Project, South San Francisco Area

Component	Cost
Chemicals	$ 720,200
Electrical Power	$ 3,819,800
Labor	$ 338,700
Solids Disposal to Landfill	$ -
MF/UF Membrane Replacement	$ -
Cartridge Filter Replacement	$ 45,100
RO Membrane Replacement	$ 468,800
Subtotal Annual O&M	$ 5,392,600
General Maintenance (non-labor costs - 10% of subtotal)	$ 539,300
Contingency (10% of subtotal)	$ 539,300
Total Annual O&M	$ 6,471,200

1 Horizontally Directionally Drilled Wells.

Table A-13 C
Present Worth and Annualized Cost Details
Representative 10 mgd Bay Water HDDW[1] Desalination Project, South San Francisco Area

Assumptions		**Present Worth and Annualized Cost Summary**	
Project Life (yrs)	30	Total Production (AF)	268,700
Capacity (mgd)	10	PW Capital ($M)	$194.27
Baseload	80%	PW O&M ($M)	$194.10
Annual Production (AFY)	9,000	PW Total ($M)	$388.37
Start up date	1/1/2015	**PW Unit Cost ($/AF)**	$1,445
Implementation Time (yrs)	7	Capital Costs Annualized ($M)	$9.91
2011 Capital Cost ($M)	$ 194.27	Annual O&M Cost ($M)	$6.47
Discount Rate/bond rate	3%	Total Annual Cost ($M)	$16.38
Capital Escalation Factor[2]	3%	Annual Production (AF)	9,000
Energy Cost ($/kWh)	0.14	**Unit Annualized Costs ($/AF)**	$1,829

Present Worth Calculations

Year	Capital Cost	O&M	Total PW
PW	$194,271,000	$194,100,000	**$388,371,000**
2011	$194,271,000	$6,470,000	**$200,741,000**
2012	$0	$0	$0
2013	$0	$0	$0
2014	$0	$0	$0
2015	$218,654,000	$0	$218,654,000
2016	$0	$7,501,000	$7,501,000
2017	$0	$7,726,000	$7,726,000
2018	$0	$7,957,000	$7,957,000
2019	$0	$8,196,000	$8,196,000
2020	$0	$8,442,000	$8,442,000
2021	$0	$8,695,000	$8,695,000
2022	$0	$8,956,000	$8,956,000
2023	$0	$9,225,000	$9,225,000
2024	$0	$9,501,000	$9,501,000
2025	$0	$9,786,000	$9,786,000
2026	$0	$10,080,000	$10,080,000
2027	$0	$10,382,000	$10,382,000
2028	$0	$10,694,000	$10,694,000
2029	$0	$11,015,000	$11,015,000
2030	$0	$11,345,000	$11,345,000
2031	$0	$11,686,000	$11,686,000
2032	$0	$12,036,000	$12,036,000
2033	$0	$12,397,000	$12,397,000
2034	$0	$12,769,000	$12,769,000
2035	$0	$13,152,000	$13,152,000
2036	$0	$13,547,000	$13,547,000
2037	$0	$13,953,000	$13,953,000
2038	$0	$14,372,000	$14,372,000
2039	$0	$14,803,000	$14,803,000
2040	$0	$15,247,000	$15,247,000
2041	$0	$15,704,000	$15,704,000
2042	$0	$16,176,000	$16,176,000
2043	$0	$16,661,000	$16,661,000
2044	$0	$17,161,000	$17,161,000
2045	$0	$17,675,000	$17,675,000

[1] Horizontally Directionally Drilled Wells.
[2] The same escalation rate is used for electricity, materials, labor and capital costs.

Table A-13 D Present Worth and Annualized Cost Summary Representative 10 mgd Bay Water HDDW[1] Desalination Project, South San Francisco Area	
Present Worth Costs	
Annual O&M Cost ($M)	$ 6.47
Present Worth of Capital Cost ($M)	$ 194.27
Present Worth of Annual O&M Cost ($M)	$ 194.10
Total Present Worth ($M)	**$ 388.37**
Total Production (AF)	268,700
Unit Cost of Total Present Worth ($/AF)	**$ 1,445**
Annualized Project Costs	
Capital Costs Annualized ($M)	$ 9.91
Annual O&M Cost ($M)	$ 6.47
Total Annual Cost	**$ 16.38**
Annual Production (AF)	9,000
Unit Annualized Costs ($/AF)	**$ 1,829**

[1] Horizontally Directionally Drilled Wells.
[2] 2011 costs are current as of August 2011.
[3] 2015 project start date (O&M costs starting 2016).
[4] Assumed project life of 30 years.
[5] Present Worth estimates include a 3% escalation and a 3% discount rate. The same escalation rate is used for electricity, materials, labor and capital costs.
[6] Annual and total production assume a base load of 80%.
[7] Annualized Costs are calculated over project life in 2011 dollars.

A-14: South San Francisco Area –20 mgd Bay Water Open Intake

Table A-14 A
Capital Cost Estimate
Representative 20 mgd Bay Water Open Intake Desalination Project, South San Francisco Area

Item	Capacity (mgd)	Pumping Power (HP)	Diameter (in.)	Length (ft.)	Capital Cost ($M)
Source Water: *Bay Water*					
Recovery: *55%*					
Treated Water Capacity: *20 mgd*					
Construction Cost Items					
Intake Structure	36.4	-	-	-	$ 14.67
Desalination Plant (Treated Water)	20	-	-	-	$ 134.2
Pipelines[1]					
Raw Water Pipeline/Tunnel	36.4	-	42	7,700	$ 6.47
Treated Water Pipeline/Tunnel	20	-	36	3,800	$ 2.57
Brine Pipeline/Tunnel	16.4	-	30	15,600	$ 7.02
Pump Stations[2]					
Raw Water Pump Station	36.4	335	-	-	$ 0.80
Treated Water Pump Station	20.0	255	-	-	$ 0.61
Brine Pump Station	16.4	20	-	-	$ 0.05
Treated Water Storage (MG)	2	-	-	-	$ 1.6
Total Construction Costs					**$ 168.00**
Contractor Profit (15%)					$ 25.20
Engineering, Engineering During Construction, & Construction Management (25%)					$ 42.00
Soft Cost Adjustment (15%)					$ 25.20
Contingency (40%)					$ 104.16
Total Adjustments					$ 196.56
Capital Cost Estimate					**$ 364.55**

[1] Pipeline costs include tunneling and boring under obstructions such as highways.
[2] Capital costing curves used to estimate intake and treatment plant construction costs include 50 HP pump stations for raw, treated and concentrated brine water. The costs itemized above for pump stations include costs for pumping capacity greater than 50 HP.

Table A-14 B
Annual O&M Costs
Representative 20 mgd Bay Water Open Intake Desalination Project, South San Francisco Area

Component	Cost
Chemicals	$ 2,003,600
Electrical Power	$ 8,761,100
Labor	$ 410,200
Solids Disposal to Landfill	$ 233,900
MF/UF Membrane Replacement	$ 482,800
Cartridge Filter Replacement	$ 90,100
RO Membrane Replacement	$ 937,500
Subtotal Annual O&M	$ 12,919,200
General Maintenance (non-labor costs - 10% of subtotal)	$ 1,291,900
Contingency (10% of subtotal)	$ 1,291,900
Total Annual O&M	$ 15,503,000

Table A-14 C Present Worth and Annualized Cost Details Representative 20 mgd Bay Water Open Intake Desalination Project, South San Francisco Area			
Assumptions		**Present Worth and Annualized Cost Summary**	
Project Life (years)	30	Total Production (AF)	537,400
Capacity (mgd)	20	PW Capital ($M)	$364.55
Baseload	80%	PW O&M ($M)	$465.09
Annual Production (AF/Y)	17,900	PW Total ($M)	$829.65
Start up date	1/1/2015	**PW Unit Cost ($/AF)**	$1,544
Implementation Time (years)	5	Capital Costs Annualized ($M)	$18.60
2011 Capital Cost ($M)	$ 364.55	Annual O&M Cost ($M)	$15.50
Discount Rate/bond rate	3%	Total Annual Cost ($M)	$34.10
Capital Escalation Factor[1]	3%	Annual Production (AF)	17,900
Energy Cost ($/kWh)	0.14	**Unit Annualized Costs ($/AF)**	$1,904
Present Worth Calculations			
Year	**Capital Cost**	**O&M**	**Total PW**
PW	$364,553,000	$465,092,000	**$829,645,000**
2011	$364,553,000	$15,503,000	**$380,056,000**
2012	$0	$0	$0
2013	$0	$0	$0
2014	$0	$0	$0
2015	$410,308,000	$0	$410,308,000
2016	$0	$17,972,000	$17,972,000
2017	$0	$18,511,000	$18,511,000
2018	$0	$19,067,000	$19,067,000
2019	$0	$19,639,000	$19,639,000
2020	$0	$20,228,000	$20,228,000
2021	$0	$20,835,000	$20,835,000
2022	$0	$21,460,000	$21,460,000
2023	$0	$22,104,000	$22,104,000
2024	$0	$22,767,000	$22,767,000
2025	$0	$23,450,000	$23,450,000
2026	$0	$24,153,000	$24,153,000
2027	$0	$24,878,000	$24,878,000
2028	$0	$25,624,000	$25,624,000
2029	$0	$26,393,000	$26,393,000
2030	$0	$27,185,000	$27,185,000
2031	$0	$28,000,000	$28,000,000
2032	$0	$28,840,000	$28,840,000
2033	$0	$29,705,000	$29,705,000
2034	$0	$30,597,000	$30,597,000
2035	$0	$31,514,000	$31,514,000
2036	$0	$32,460,000	$32,460,000
2037	$0	$33,434,000	$33,434,000
2038	$0	$34,437,000	$34,437,000
2039	$0	$35,470,000	$35,470,000
2040	$0	$36,534,000	$36,534,000
2041	$0	$37,630,000	$37,630,000
2042	$0	$38,759,000	$38,759,000
2043	$0	$39,922,000	$39,922,000
2044	$0	$41,119,000	$41,119,000
2045	$0	$42,353,000	$42,353,000

[1]The same escalation rate is used for electricity, materials, labor and capital costs.

Table A-14 D
Present Worth and Annualized Cost Summary
Representative 20 mgd Bay Water Open Intake Desalination Project, South San Francisco Area

Present Worth Costs		
Annual O&M Cost ($M)	$	15.50
Present Worth of Capital Cost ($M)	$	364.55
Present Worth of Annual O&M Cost ($M)	$	465.09
Total Present Worth ($M)	**$**	**829.65**
Total Production (AF)		537,400
Unit Cost of Total Present Worth ($/AF)	**$**	**1,544**
Annualized Project Costs		
Capital Costs Annualized ($M)	$	18.60
Annual O&M Cost ($M)	$	15.50
Total Annual Cost	**$**	**34.10**
Annual Production (AF)		17,900
Unit Annualized Costs ($/AF)	**$**	**1,904**

[1] 2011 costs are current as of August 2011.
[2] 2015 project start date (O&M costs starting 2016).
[3] Assumed project life of 30 years.
[4] Present Worth estimates include a 3% escalation and a 3% discount rate. The same escalation rate is used for electricity, materials, labor and capital costs.
[5] Annual and total production assume a base load of 80%.
[6] Annualized Costs are calculated over project life in 2011 dollars.

Appendix E
Bay Area Regional Desalination Project

This appendix presents the background, facility and cost information for the Bay Area Regional Desalination Project (BARDP).

In this Appendix:

E.1 Background

The East Bay Municipal Utility District (EBMUD), San Francisco Public Utilities Commission (SFPUC), Santa Clara Valley Water District (SCVWD), and Contra Costa Water District (CCWD) are jointly investigating a Bay Area Regional Desalination Project (BARDP). In 2011 the Alameda County Flood Control and Water Conservation District Zone 7 joined the BARDP group, and Alameda County Water District decided to no longer participate in the investigations. In 2007 the agencies released the BARDP Feasibility Study[1] (Feasibility Study) which investigated several potential infrastructure options and evaluated several site locations in the Bay Area against a set of criteria. These criteria included: 1) raw water quality; 2) costs; 3) permitting/water rights requirements; 4) public acceptance/ socioeconomic effects (including environmental justice, growth inducement, and land use impacts); 5) potential to receive grant funding; 6) capability to supply product water to multiple agencies during droughts; and 7) environmental effects. Twenty two potential facility locations were evaluated based on these criteria, and three locations were selected as the most feasible: East Contra Costa County, Oceanside, and near the easterly side of the Bay Bridge in Alameda County.

Based on the results of the Feasibility Study, the BARDP agencies conducted a pilot test at CCWD's Mallard Slough Pump Station (PS) site located in the eastern part of Contra Costa County. The results of the pilot study were documented in the 2010 Pilot Testing at Mallard Slough Engineering Report (Pilot Engineering Report)[2]. The site was selected for a pilot study based on the feasibility study criteria. This location also facilitated the pilot study as the existing Mallard Slough Pump Station (PS) could be used as an intake for the pilot plant. Few pilot studies exist in estuarine environments, and the BARDP pilot study helped to fill this void. Figure E-1 indicates the location for the BARDP pilot plant and the most likely area for a full sized desalination project if BARDP moves forward.

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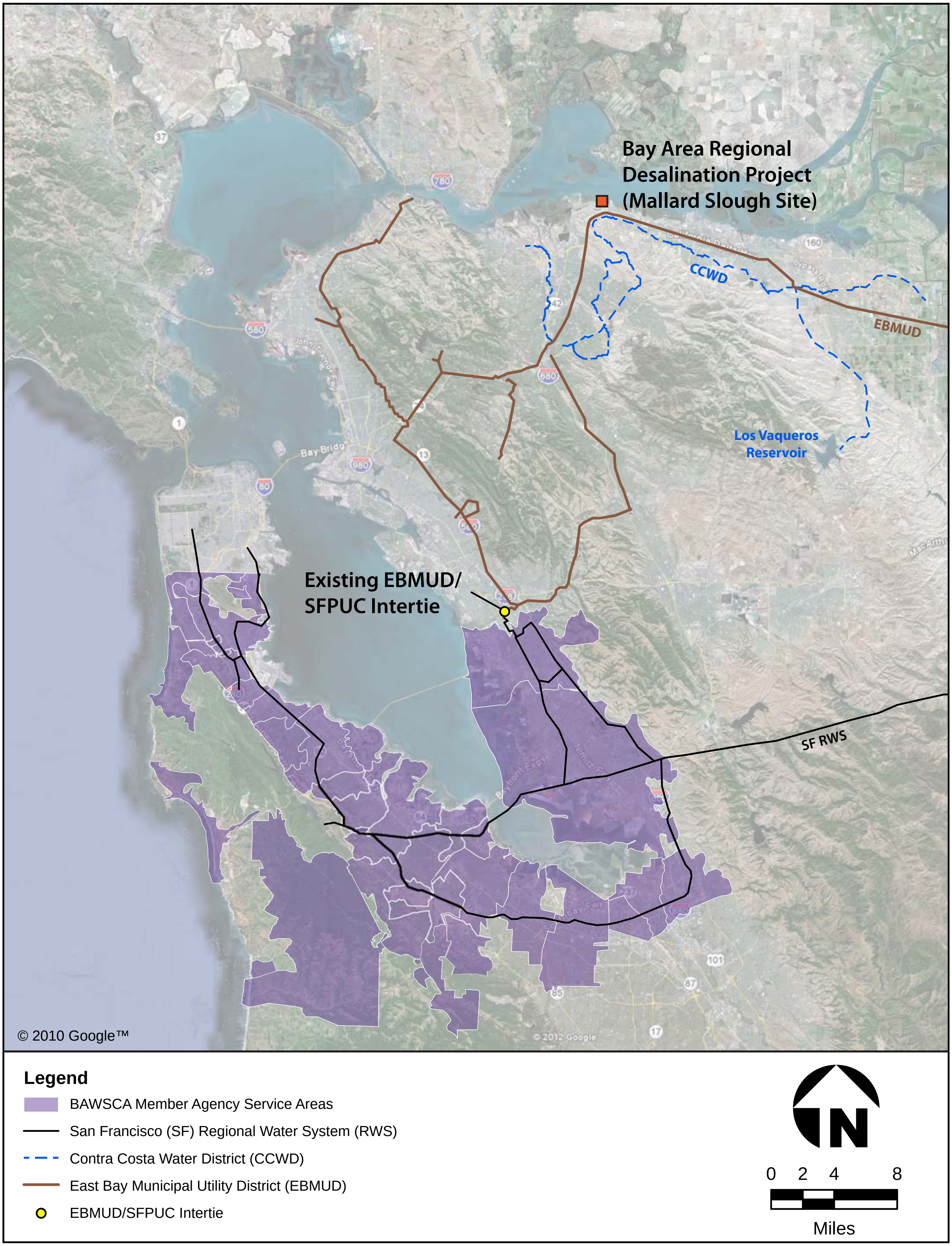
[1] Bay Area Regional Desalination Project Feasibility Study, 2007, prepared by URS for Contra Costa Water District, East Bay Municipal Utility District, San Francisco Public Utilities Commission, and Santa Clara Valley Water District. http://www.regionaldesal.com/documents.html

[2] Bay Area Regional Desalination Project Pilot Testing at Mallard Slough Engineering Report, 2010, prepared by MWH for Contra Costa Water District, East Bay Municipal Utility District, San Francisco Public Utilities Commission, and Santa Clara Valley Water District. http://www.regionaldesal.com/documents.html



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CDM Smith

Figure E-1
Bay Area Regional Desalination Project Location

The pilot study lasted from October 2008 through April 2009, and data was collected during both the wet and dry seasons. Raw water total dissolved solids (TDS) levels ranged from less than 1,000 milligrams per liter (mg/L) to as high as 12,000 mg/L. Three membrane configurations were evaluated, providing a recovery range between 50 and 82%, depending on raw water TDS levels and membrane type. Water quality also varied with these parameters. The pilot study helped the BARDP agencies identify membrane combinations for a larger size treatment plant, and also confirmed that a larger size plant is feasible at the Contra Costa site selected. Results from the pilot study were used to develop a cost estimate for four (4) desalination plant scenarios, using the different membrane configurations, different operation schedules, and plant locations. Three of these scenarios were recommended for further consideration with a 2-stage combination of brackish and seawater membranes. The characteristics of these scenarios are summarized in Table E-1 below.

Table E-1
BARDP Desalination Plant Scenarios[1]

	Scenario 1	Scenario 2	Scenario 3
Capacity [2]	20 mgd	20 mgd	20 mgd
Average Recovery Rate[2]	80%	80%	80%
Operation	Continual	Every 3rd year (mothball)	Continual
Location	Mallard Slough	Mallard Slough	TBD (site other than Mallard Slough)
Intake Structure	Mallard Slough PS	Mallard Slough PS	To be constructed
Treated Water Transmission	Existing lines	Existing lines	To be constructed
Construction Considerations	Pile foundation required	Pile foundation required	None

1 Information in this table is from the Pilot Study Engineering Report.
2 Capacity and Recovery rates decrease during times of maximum raw water TDS.

E.2 Cost Estimates

E.2.1 Scenario Assumptions

The Pilot Plant Engineering Report included cost estimates for the three scenarios described above. For these estimates, all costs are in September 2009 dollars. The report includes capital cost estimates; annual O&M cost estimates, and a life cycle analysis. Several differences exist between the assumptions made for the BARDP costing estimate and those developed for the Strategy. These differences are summarized in Table E-2 below.

Table E-2
BARDP and Strategy Characteristics and Assumptions

	BARDP Pilot [1]	BAWSCA Strategy
Source Water	Brackish water (1,000-12,000 mg/L TDS)	Brackish Water (15,000 mg/L TDS) Bay Water (25,000 mg/L TDS)
Intake Types	Open intake in Sacramento River	Open intake in Bay Subsurface HDDW wells Inland vertical wells
Treated Water Capacities	20 mgd	1 – 20 mgd
Base Load	100% (33% on average for Scenario 2)	80%
Project Life	30 years	30 years
Reference Year	September 2009 dollars	August 2011 dollars
Escalation and Interest Rates [3]	5% discount rate 2% inflation rate	3% interest rate 3% escalation factor
Estimated Recovery Rate	75-80%	75% for brackish source water 55% for Bay source water
Intake and Treatment Plant Construction Costs	Itemized list of facilities and estimated costs	Cost curves developed from several treatment plant cost estimates
Cost of Power	$0.1/kWh [2]	$0.14/kWh
Contingency calculation	20% of construction subtotal	40% of Construction Costs
Land Acquisition	$3.5 M	Included in soft costs (15% of construction costs)
Permitting	Included in Planning, Permitting, Engineering & Admin Costs (25% of contingency + construction costs) $1M for discharge permit/connection fee	Included in soft costs (15% of construction costs)
Contractor Profit	5% of construction costs + General Conditions + Bonds Insurance	15% of Construction Costs
Engineering	Included in Planning, Permitting, Engineering & Administrative Costs (25% of contingency + construction costs)	Included in Engineering, Engineering During Construction, & Construction Management (25% of construction costs)

1 Information in this column is from the Pilot Study Engineering Report.
2 Based on CCWD having access to lower cost United States Bureau of Reclamation power.
3 The BARDP Pilot Study Engineering Report references a 5% interest rate and 2% inflation rate, but also references using a 3% discount rate for the life cycle cost analysis. It is not clear which of these assumptions were used in the later tables.

E.2.2 Capital Costs

Facility costs for the BARDP project are based on more detailed information than is currently developed for the Strategy. This is due to the more detailed analysis and investigations for the more mature BARDP project. The identification of a single plant type (brackish, open intake), capacity (20mgd), and plant location (Mallard Slough or nearby) made this detailed estimate possible. Capital cost estimates from the Pilot Engineering Report are summarized in Table E-3. The Capital cost estimates have been adjusted in the last row to match the BAWSCA Strategy planning year of August 2011.

Table E-3
BARDP Capital Cost Estimates[1]

	Scenario 1	Scenario 2	Scenario 3
Sitework	$4,200,000	$4,200,000	$4,200,000
Intake and Raw Water Pump Station			$3,100,000
Brine Disposal	$1,100,000	$1,100,000	$1,100,000
MF/UF Facilities	$18,300,000	$18,300,000	$18,300,000
Filtrate Tanks	$1,100,000	$1,100,000	$1,100,000
RO Facilities	$44,100,000	$44,100,000	$44,100,000
Permeate Tank	$500,000	$500,000	$500,000
Clearwells	$1,900,000	$1,900,000	$1,900,000
High Service Pumping Station	$4,400,000	$4,400,000	$4,400,000
Neutralization Tanks	$400,000	$400,000	$400,000
Chemical Building A	$1,900,000	$1,900,000	$1,900,000
Chemical Building B	$2,300,000	$2,300,000	$2,300,000
Solids Handling Facilities	$9,900,000	$9,900,000	$9,900,000
Pile Foundations	$3,100,000	$3,100,000	
Transmission Main			$7,800,000
Site Electrical Systems	$5,200,000	$5,200,000	$5,200,000
Subtotal Construction Costs	**$98,400,000**	**$98,400,000**	**$106,200,000**
Contingencies (20%)	$19,700,000	$19,700,000	$21,200,000
Planning, Permitting, Engineering & Administrative Costs (25%)	$29,500,000	$29,500,000	$31,900,000
Land Acquisition	$3,500,000	$3,500,000	$3,500,000
Concentrate Discharge Permit & Connection Fee	$1,000,000	$1,000,000	$1,000,000
Subtotal Adjustments	**$53,700,000**	**$53,700,000**	**$57,600,000**
Capital Cost	**$152,100,000**	**$152,100,000**	**$163,800,000**
Capital Cost Adjusted for Strategy Base Year[2]	**$159,400,000**	**$159,400,000**	**$171,700,000**

[1] Unless otherwise noted, source is Table 6-6 in the Pilot Study Engineering Report.
[2] Capital Cost Estimates from the BARDP Report were developed using September 2009 costs. The Strategy base year is August 2011 and adjustments based on the ENR data for San Francisco ENR to were made to the BARDP calculations for the same planning base date as the Strategy.

E.2.3 Annual O&M Costs

Annual Operation and Maintenance (O&M) costs from the Pilot Engineering Report are summarized in Table E-4 below. Though Scenario 2 involves "moth-balling" the facility, costs are provided for a dry year when the plant is fully operational. Power requirements for Scenario 3 are higher than Scenarios 1 and 2 due to the pumping requirements associated with an offsite location. The O&M cost estimates have been adjusted in the last row from September 2009 to the BAWSCA Strategy planning base of August 2011. No other adjustments have been made to reflect different planning level assumptions.

Table E-4
Annual O&M Costs[1]

	Scenario 1	Scenario 2	Scenario 3
1. Power Requirements	$5,400,000	$5,400,000	$7,900,000
2. Chemical Costs	$1,400,000	$1,400,000	$1,400,000
3. Equipment Replacement Cost	$1,400,000	$1,400,000	$1,700,000
4. Staffing Costs	$900,000	$900,000	$900,000
5. Outside Services (hauling, landfill use, concrete disposal)	$1,350,000	$1,350,000	$1,350,000
Annual O&M Costs	**$10,450,000**	**$10,450,000**	**$13,150,000**
Annual O&M Costs Adjusted for BAWSCA Strategy Base Year [2]	**$10,953,000**	**$10,953,000**	**$13,782,000**

1 Source: Table 6-6 in the Pilot Study Engineering Report, base September 2009.
2 Annual O&M Estimates from the BARDP Report were made using September 2009 costs. The Strategy base year is August 2011 and adjustments based on the ENR data for San Francisco ENR to adjust the O&M costs.

E.2.4 Life Cycle Analysis

The Pilot Engineering Report also included a life cycle analysis (present worth), with an estimated project life of 30 years, net discount rate of 3% based on a discount rate of 5% and escalation rate of 2%. The present worth and annualized cost estimates are summarized in Table E-5 below.

Table E-5
Present Worth and Annualized Cost Estimates
BARDP Scenarios[1]

	Scenario 1	Scenario 2	Scenario 3
Present Worth Project Costs			
Annual O&M Cost[2 3] ($M)	$ 10.5	$ 10.5	$ 10.5
Total Capital Cost ($M)	$ 152.1	$ 152.1	$ 163.8
Present Worth of Annual O&M Cost ($M)	$ 204.9	$ 79.0	$ 204.9
Total Present Worth ($M)	$ 357.0	$ 231.1	$ 368.6
Total Production[4] (AF)	680,000	227,000	680,000
Unit Cost of Total Present Worth ($/AF)	$ 525	$ 1,020	$ 540
Unit Cost of Total Present Worth Adjusted for Strategy Base Year[5 6 7]($/AF)	$ 550	$ 1,069	$ 566
Annualized Project Costs			
Total Annual Cost (Capital + O&M) ($M)	$ 18.2	$ 11.8	$ 18.8
Annual Production (AF) (Based on 20 mgd plant capacity)	22,400	7,600	22,400
Unit Annualized Costs ($/AF)	$ 800	$ 1,560	$ 830
Unit Annualized Costs[5 6 7] ($/AF)	$ 838	$ 1,635	$ 870

1 Source: Table 1-5 in the Pilot Study Engineering Report.
2 Annual cost during dry year operation. A dry year is assumed to occur once every three years.
3 Does not include conveyance costs through CCWD or EBMUD systems.
4 Assumed project life is 30 years.
5 Unit Cost Estimates from the BARDP Report were made using September 2009 costs. The Strategy base year is August 2011 and adjustments based on the ENR data for San Francisco ENR to adjust the unit costs.
6 Costs do not include conveyance costs through CCWD or EBMUD systems.
7 The BARDP Pilot Study Engineering Report references a 5% interest rate and 2% inflation rate, but also references using a 3% discount rate for the life cycle cost analysis. It is not clear which of these assumptions were used in the later tables.

E.3 Key Assumptions and Issues

Several key assumptions were presented in the Pilot Engineering Report that affects the overall costs, including:

- Power costs associated with pumping brine to a discharge facility are not included in annual O&M cost estimates;
- Cost of electrical power is based on Reclamation rates which are lower than could be obtained by non-Reclamation agencies. If CCWD is not the owning and operating partner these costs could be significantly higher;
- The estimates are based on 100% production throughout the year, with the exception of Scenario 2 (which assumes 100% production every third year, with moth balling involving minimal maintenance in between);
- All construction cost estimates made by BARDP assume that there will be no overtime labor;
- The BARDP estimates assume $1M for brine concentrate discharge permitting fees and discharge facility construction each;
- Additional costs from agency-specific blending, storage and/or conveyance fees are not included in the estimate;
- The BARDP Pilot Study Engineering Report references a 5% interest rate and 2% inflation rate, but also references using a 3% discount rate for the life cycle cost analysis. It is not clear which of these assumptions were used in the table provided; and
- The estimate assumes that the cost of land will be $3.5M for 10 acres.

Institutional issues will include:

- Facility ownership;
- Who will operate the facilities; and,
- Potential users (purchasers of the supply).

These institutional issues will likely be addressed in a formal agreement as the planning and preliminary design process moves forward. Other key issues that will affect permitting and cost include:

- Cost estimates do not include the cost of conveyance (including potential additional treatment) through CCWD and EBMUD transmission systems;

- Identifying the final brine disposal option. There are several potential options, including co-location with either wastewater streams or cooling plants; and

- Source water intake. If the desalination plant is not located at Mallard Slough (where CCWD already operates a surface water intake), alternate intake options would need to be evaluated.

E.4 BARDP Future Plans

Several steps need to be taken: a) inter-agency agreements that clearly define agency roles and responsibilities, and agreement between agencies as to the size and location of the project; b) final site selection, which will involve discussions with land owners and regulatory agencies; c) completion of an Environmental Impact Report (EIR) and possibly and Environmental Impact Statement (EIS); d) preliminary designs and geotechnical investigations; and e) determination of monthly water extraction to ensure compliance with existing water rights that CCWD has at the Mallard Slough PS.[3]

In addition, CCWD is beginning evaluation of the potential for use of the Los Vaqueros Reservoir for storage of the BARDP and other supplies. EBMUD is evaluating the potential hydraulic capacity and treatment and conveyance requirements to convey water from either the desalination water treatment plant site or the CCWD system to other potential users in the Bay Area (i.e., SCVWD, SFPUC, Zone 7, and BAWSCA). These studies are anticipated to be completed in Spring/Summer of 2013.

E.5 BAWSCA Next Steps

A key part of feasibility of this project is the ability to convey the water from the water desalination treatment plant site or CCWD system to potentially interested BAWSCA agencies as well as the BARDP partners. BAWSCA will be closely watching the evaluations being performed by CCWD and EBMUD to evaluate the capacity and potential cost to convey this water to the BAWSCA agencies. In addition, BAWSCA will continue to engage the BARDP agencies to determine who is interested in this supply, and what quantities may be available to the BAWSCA member agencies if they are interested.

[3] Between CCWD's existing water extraction permit and license, a total of 26,780 AF can be diverted per year. While the Mallard Slough PS may be subject to pumping restrictions for one month out of the year, sufficient water rights should exist to accommodate the 25 mgd of raw water needed for a 20 mgd treated water desalination plant. This is based on realizing an overall 75% efficiency with the treatment process.

Exhibit 2
Revised Draft Task 3-C Memo
Water Transfers

CDM Smith

CDM Smith

Memorandum

To: *Nicole Sandkulla*

From: *Craig Von Bargen*
Paula Kulis

cc: *Bill Fernandez*

Date: *April 5, 2012*

Subject: *Revised Draft Task 3-C Memo Water Transfers for Task 3 Technical Memorandum*

1.0 Introduction

In this Memo:

As part of the Long-Term Reliable Water Supply Strategy (Strategy), the Bay Area Water Supply and Conservation Agency (BAWSCA) is evaluating alternative water supply management projects (projects) to augment existing supplies to meet the future normal and/or drought year demands of its member agencies though 2035. The projects under consideration include: groundwater; recycled water; desalination of brackish groundwater or seawater; expanded conservation; local water capture and reuse; and water transfers.

Water transfers can be a cost-effective alternative for future water supply. However, as with other water supply alternatives, there are a number of specific issues that need to be assessed regarding the viability of water transfer options, including:

- Reliability of the transfer supply during drought years;
- Ability to convey transfer supply to the BAWSCA member agencies;
- Ability to store this water when needed;

- Cost to purchase the transfer supply, and the additional costs associated with the construction of new conveyance facilities, and/or conveyance through existing facilities; and
- Institutional, legal, environmental, and regulatory issues that may affect a supply transfer at the source of the supply, through the conveyance facilities, or at the place of use by the BAWSCA member agencies.

This *Task 3-C Memo* focuses on the potential sources of supply for water transfers and the conveyance options to each of these sources water to the SF RWS, or directly to the BAWSCA member agencies.

2.0 Sources of Supply for Water Transfers

A successful water transfer needs to combine a water supply and conveyance to meet the timing and need of the water supply for an agency. These water transfers have the potential to make additional water supply available to the BAWSCA member agencies for normal and drought needs. The general areas that have been identified with willing sellers include:

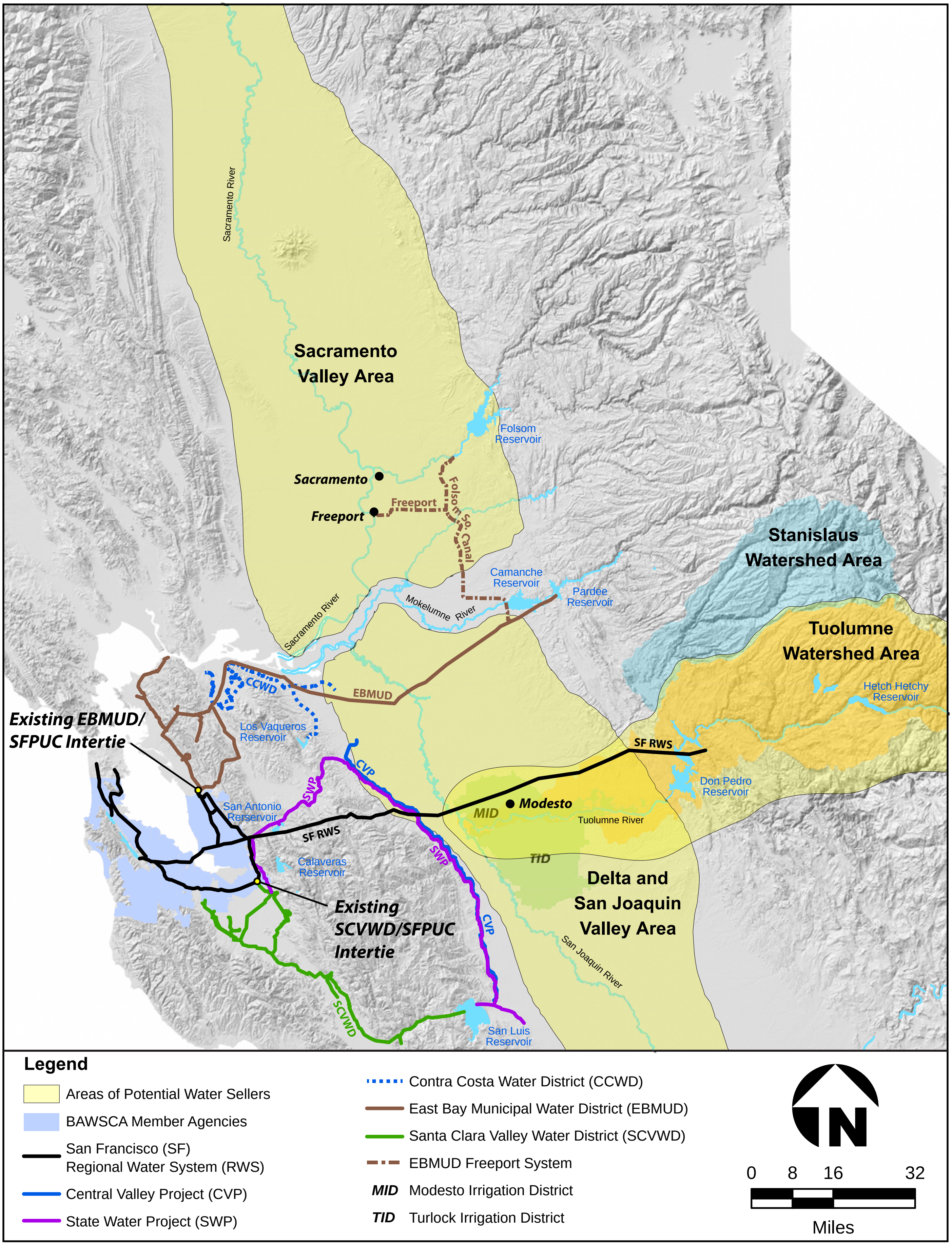
- Sacramento Valley Area (North of the Delta)
- Delta and San Joaquin Valley Area (South of Delta); and
- Tuolumne and Stanislaus Watershed areas.

A critical component of any transfer is the ability to physically move the water from the seller to the buyer. For supplies originating outside of the Bay Area there are a limited number of existing conveyance facilities that could be used to wheel water to the BAWSCA member agencies. Figure 1 indicates the general areas of the willing sellers and the regional water conveyance facilities discussed below. The current potential options include:

- North or south of Delta through EBMUD facilities to the EBMUD/SFPUC emergency intertie;
- South of Delta SWP and CVP conveyance facilities to the SCVWD/SFPUC emergency intertie;
- Tuolumne and Stanislaus supply through the SF RWS; and

In all instances transferred water would need to utilize the SF RWS to move water to the BAWSCA member agency service areas.

Table 1 provides a brief summary of the water transfer options identified to date.



W:\REPORTS\BAWSCA\Task 11.3_Nov11\Graphics\3C_Figure 2_Conveyance Options to the BAWSCA Member Agencies for Potential Water Transfer Seller Areas.ai 04/05/12 JJT

CDM Smith

Figure 1

Conveyance Options to the BAWSCA Member Agencies for Potential Water Transfer Seller Areas

Table 1
Summary of Water Transfer Options

Water Transfer Supply Options	Likelihood	Yield	Dry Year	Conveyance	Issues
Intra-BAWSCA[1]	-	-	-	-	-
Sacramento-Central Valley	Medium	Low to High	Yes	Medium	EBMUD conveyance capacity and potential environmental concerns
State Water Project	Low	Low	No	Difficult	Limited SBA Capacity and potential environmental concerns
Central Valley Project	Low	Low	No	Medium/Difficult	Use of CVP and SCVWD systems and their available capacities and potential environmental concerns
Tuolumne or Stanislaus Watershed	Medium	Medium/High	Yes	Easy/Medium	SFPUC role, Federal Energy Regulatory Commission issues, and potential environmental concerns

[1] Not included in the Strategy.

2.1 Transfers Between BAWSCA Member Agencies

Water transfers between BAWSCA member agencies from supply sources within the BAWSCA service area may include either: 1) temporary or permanent transfer of SFPUC supply within the restrictions of the 2009 Water Supply Agreement (WSA); or 2) transfer of a new supply developed within or outside the BAWSCA service area and independent of the SFPUC supply. These transfers could be either direct or exchange transfers and could be designed to meet normal or drought demand.

Pursuant to Article 3, Section 3.04 of the WSA, any BAWSCA agency that has an Individual Supply Guarantee (ISG) may transfer a portion of it to one or more BAWSCA member agencies. Such transfers are permanent and without additional penalties or additional charges from the SFPUC, and SFPUC will not unreasonably withhold or deny transfer approval. This transfer mechanism can be used if a BAWSCA agency has an ISG in excess of its planned SFPUC purchases, either because of that agency's contract capacity or because that agency has developed or acquired another supply and chooses to sell a portion of its ISG.

Transfer of SFPUC supply drought allocations between the BAWSCA agencies are governed by Section 3.11(C) of the WSA and the Tier 1 and Tier 2 Shortage Plan. In the event that SFPUC declares a drought emergency under California Water Code Sections 350 et seq., the Tier 1 Shortage Plan allows transfer of shortage allocations among BAWSCA member agencies.

Pursuant to the WSA, BAWSCA member agencies can also wheel water through the SF RWS from sources outside of the SF RWS. Section 3.12 of the WSA states that "the SFPUC will not deny use of

Regional Water System unused capacity for wheeling when such capacity is available for wheeling purposes during periods when the SFPUC has declared a water shortage emergency…." Specific conditions apply including:

- Reasonable wheeling charges can be incurred by the SFPUC as a result of the wheeling, including capital, operation, maintenance, administration and replacement costs;
- Wheeled water stored in SFPUC reservoirs spills first;
- Wheeled water will not unreasonably impact fish and wildlife resources in the RWS reservoirs, diminish the quality of water delivered for consumptive use, or increase the risk of exotic species impairing RWS operations; and
- Priority is given to wheeling by Wholesale Customers over arrangements for third party public entities.
- While wheeling through the SF RWS during non-water shortage emergency conditions is not discussed in the WSA such an arrangement would be made pursuant to State law.

2.2 State Water Project and Central Valley Project

The majority of the water moving through the California Delta (Delta) for agricultural and municipal and industrial use is conveyed through the DWR, SWP or the Reclamation CVP systems. Water transfers within California were formalized by state legislation in the early 1980s and expanded in the late 1980s to address water supply shortages, primarily during the 1987 through 1992 drought period. A previously available option, the DWR Drought Water Bank, is no longer in place. Transfers between SWP contractors are now arranged directly between the buyers and sellers with DWR keeping track of the agreements and transfers.

With increasing legal restrictions on the ability to pump water from the Delta and increased environmental flow releases, most of the major SWP and CVP contractors are competing for what limited water is available through the State and Federal programs. With the exception of Alameda County Water District (ACWD), neither BAWSCA nor the other member agencies are SWP or CVP contractors. Furthermore, much of the BAWSCA service area is not within the Place of Use for either the CVP or SWP. As such, it is considered unlikely that BAWSCA or any of the member agencies, excepting ACWD, would be able to secure a long-term contract for SWP or CVP supplies.

Reclamation is required to prepare CEQA/NEPA documentation for transfers and is currently preparing the Long-Term Water Transfer EIS/EIR to address potential impacts of the transfer of Reclamation contract water through Reclamation facilities. This Environmental Impact Statement (EIS)/Environmental Impact Report (EIR) only applies to CVP related supplies and facilities. Contra Costa Water District (CCWD), SCVWD and EBMUD are included in the EIS/EIR process, so any future conveyance of CVP water through those systems will be covered within the document.

However, this does not include transfers into Alameda County (outside of ACWD) or San Mateo County. Based on discussions with staff preparing the EIS/EIR and BAWSCA staff, it was determined that it is not critical to include either BAWSCA or the member agencies in the EIS/EIR as potential transfer buyers at this time as only CVP contractors are included in the EIS/EIR and only the three agencies indicated above (CCWD, SCVWD, and EBMUD) are CVP contractors.

Due to the limitations described above, it is assumed that neither CVP nor SWP supply will be available to the member agencies for either normal or dry year supply. The potential to use the SWP and CVP facilities for conveyance of other transfer water is discussed in Section 3.1 and in Appendix A, Section A2.3.

2.3 Transfers from Sacramento Valley, Sacramento-San Joaquin Delta, San Joaquin Valley, and Private Owners

Irrigation and reclamation districts and private property owners in the Sacramento Valley, Sacramento-San Joaquin Delta (Delta), and San Joaquin Valley who have a strong record of conducting water transfers and/or that have indicated an interest in possibly selling water to additional entities were identified as possible transfer suppliers. The sources of supply for the potential sellers include:

- Groundwater substitution;
- Transfer of pre-1914 water rights;
- Fallowing of farmland;
- Conservation, including water saved by reducing supply losses and increasing irrigation efficiency; and
- Reservoir storage and release.

These sources of supply are discussed in more detail in Appendix A, Section 2.

Pursuant to discussions with representatives from different types of potential sellers Table 2 indicates example projects from different types of potential water sellers in the Sacramento Valley, and Table 3 includes examples of potential water sellers in the Delta and San Joaquin Valley. These tables further provide preliminary estimates of the quantities of water that may be available from these example projects, how the supply would be made available for transfer, the reliability of the supply, availability of storage, and other information. Figure 1 indicates the approximate general areas of these water sellers.

Table 2 Potential Types of Water Sellers in the Sacramento Valley				
Potential Seller	**Amount (acre-feet per year [AF/year])**	**Available Water Supply**	**Reliability**	**Storage**
Irrigation Districts	2,000 to 5,000 and higher	Fallowing and/or groundwater substitution.	High in most years, possible decrease in extremely dry years (subject to negotiations).	Potential access to existing reservoirs with constraints.
Reclamation Districts	Up to 5,000	Fallowing and/or groundwater substitution.	High in most years, possible decrease in extremely dry years (subject to negotiations).	Potential access to existing reservoirs with constraints.
Private Owners	1,000 – 5,000	Fallowing and/or groundwater substitution.	High in most years, possible decrease in extremely dry years (subject to negotiations).	Potential access to existing reservoirs with constraints.
Water Districts	Up to 5,000 and greater	Groundwater substitution, transfer of surface water.	Unknown	Possible surface water or groundwater
Water Agencies	Up to 5,000 and higher	Reservoir storage release, groundwater substitution.	High in both normal and dry years.	Surface water

Table 3 Water Transfers Potential Types of Water Sellers in the Delta and San Joaquin Valley					
Potential Seller	**Amount (AF/year)**	**How Supply Made Available?**	**Reliability**	**Storage**	**Comments**
Irrigation Districts	1,000 – 5,000 (possibly greater)	Groundwater substitution, transfer of pre-1914 water rights. Some may be complex based on existing agreements, and water rights needed.	High in normal and dry years, but will depend on negotiations and conveyance options.	State and local reservoirs	Uncertain whether certain agencies have the ability to sell water. Potential FERC relicensing issues
Private Owners	1,000 – 3,000	Mostly likely fallowing, but some problems were raised by DWR.	High in all years since water rights are senior.	No	Will likely require crop water use monitoring program in first year. Long-term transfer opportunities unknown, but interested in short-term transfers.

2.4 Transfers from the Tuolumne and Stanislaus Watershed Areas

The primary source of water supply for SFPUC is the Tuolumne River watershed, with storage in the Hetch Hetchy, Lake Eleanor, and Lake Lloyd Reservoirs. Modesto Irrigation District (MID), and Turlock Irrigation District (TID) also obtain water from this watershed and have their own separate storage reservoirs, (e.g., the New Don Pedro Reservoir).

The type of transfer that is likely to be most successful within the Tuolumne River watershed is an agricultural water conservation transfer. An agricultural water conservation transfer could occur if an entity provided one of the irrigation districts or farmer(s) with economic incentives to encourage them to voluntarily implement water conservation measures at no cost to them. The saved water would then be available for transfer through the infrastructure associated with the existing water systems.

Transfers within the Tuolumne River watershed with either TID or MID would not require construction of additional facilities. Consistent with the WSIP, the SFPUC is currently pursuing a 2 mgd transfer with MID to the benefit of the SF RWS, and possibly more at a future date. Information from the SFPUC/MID transfer negotiations will be incorporated into this evaluation as it becomes available.

Another potential transfer option within the Tuolumne River watershed is associated with the nearby Oakdale Irrigation District (OID), which has a well-established track record of successful agricultural water conservation transfers. The OID obtains water from the Stanislaus River watershed, but is close enough to the Tuolumne River watershed and the MID service areas that a transfer or exchange deal could potentially be developed wherein MID would receive conserved water from OID and release additional water into the SF RWS. A transfer from OID would require the construction of facilities to move the water from the OID service area into the MID service area. At this time, no specific transfer opportunity is being pursued by BAWSCA or the above-mentioned parties. However, such an option may be considered as part of future efforts.

3.0 Water Conveyance to the San Francisco Bay Area

A critical component of any transfer is the ability to physically move the water from the seller to the buyer. For supplies originating outside of the Bay Area there are a limited number of existing conveyance facilities that could be used to wheel water to the BAWSCA member agencies. The current potential options discussed in this section include:

- SWP and CVP facilities;
- SCVWD/SFPUC emergency intertie and SCVWD facilities;
- EBMUD/SFPUC emergency intertie and EBMUD facilities; and
- SF RWS.

3.1 State Water Project and Central Valley Project

The SWP and CVP currently convey water into the San Francisco Bay area. ACWD receives SWP supply through the South Bay Aqueduct (SBA). The SCVWD can receive SWP water through the SBA and CVP water through the CVP San Felipe project, which is owned by Reclamation but operated by SCVWD. Figure 1 shows the locations of these facilities.

ACWD, as part of developing their own water transfer agreements and use of the SBA, has evaluated the potential available capacity for transfers of additional supply through the SBA and has indicated to BAWSCA that there would be both limited capacity and a very variable and narrow time window to transfer surplus, non-ACWD supplies, through the SBA during droughts and normal years. This limitation is primarily due to the operation by the other SBA contractors (SCVWD and the Alameda County Flood Control and Water Conservation District-Zone 7 (Zone 7)) and DWR, who would also be transferring water during drought periods. In addition, during drought periods, restrictions on pumping from the Delta will also limit any potential available supply even if the supply does not have to be transported through the SWP or CVP.

Based on the limited ability of the BAWSCA member agencies (with the exception of ACWD) to be able to purchase transfer supply from the SWP system, and the potential capacity limitations on transfer through the SBA, it is highly unlikely that the SBA could be used by BAWSCA to transfer purchased supply from the Sacramento Valley, Delta, or San Joaquin Valley to the other BAWSCA member agencies.

Water purchased from sellers north of the Delta generally must move through the Delta and then through the SWP's delta pump station (Harvey O. Banks Pumping Plant [Banks PP]) or the CVP's delta pump station (C.W. "Bill" Jones Pumping Plant [Jones PP]). Transferred water from north of the Delta is more frequently pumped through the Banks PP because the Jones PP generally operates at maximum capacity to meet CVP needs, even during drier years. The recent biological opinions on the long-term operations of the CVP and SWP include provisions for up to 600,000 AF of transfers that can only be pumped from July through September (U.S. Fish and Wildlife Service 2008, National Marine Fisheries Service 2009).

Non-SWP and non-CVP contractors can also wheel water through the SWP or CVP projects; however, they have the lowest priority for use of the pumping plants and conveyances to transfer the supply. There must be sufficient capacity to transfer the existing contractors supply, and such transfers are also subject to a wheeling charge.

Transfers from sources south of the Delta do not need to be moved through the Delta. However, regardless of the source, BAWSCA or the member agencies would have to develop agreements and/or water supply exchanges with SWP and CVP contractors in order move water into the Bay Area through the SBA to either ACWD or SCVWD, and/or through the CVP to San Luis Reservoir and then to the SCVWD system through the Reclamation San Felipe project. The ability to move transfer water through the SWP and/or CVP will require available system capacity. These types of transfers would have the lowest priority for excess system capacity. BAWSCA is discussing the potential for transfers through the SCVWD system, however, at this time SCVWD is looking primarily at its own water supply needs.

3.2 SCVWD/SFPUC Emergency Intertie

The SCVWD/SFPUC emergency intertie, located in Milpitas, was constructed in 2002 for two specific purposes: (a) for the SCVWD and the SFPUC to have the ability to supply each other with water during events described as "emergencies" and "critical work;" and (b) to return water furnished during an emergency or critical work to the agency that initially provided it. The Preliminary Negative Declaration (ND) from 1997 for the SCVWD/SFPUC intertie project was amended in November 1999, and the project was developed and designed in accordance with those documents.

The SCVWD/SFPUC intertie consists of piping that connects the two systems as well as a pump station to pump from the SF RWS into the SCVWD system. The capacity for the pump station is about 35 to 40 mgd as determined during pump testing in the fall of 2009. Figure 1 shows the location of the intertie and the SFPUC and SCVWD transmission facilities.

The SCVWD/SFPUC intertie has been used to provide water to SFPUC during planned shutdowns for construction and connection of the SFPUC WSIP facilities. Prior to the shutdowns, SFPUC transferred water to SCVWD to offset the water to be transferred back during the planned SFPUC shutdowns. Transfers to SCVWD from SFPUC have also occurred at the request of SCVWD.

In order to use the EBMUD/SFPUC intertie for non-emergency types of operation such as water transfers during normal and/or drought years, a new CEQA Initial Study would need to be performed to determine the potential environmental impacts of this revised operation. Based on the results, an MND or full EIR would be required.

The primary mechanism for using SCVWD/SFPUC intertie for BAWSCA initiated transfers would be to purchase water from sellers in the San Joaquin Valley, wheel this water through the CVP into the San Luis Reservoir facilities, and then wheel this supply through SCVWD/CVP joint facilities to the Penitencia Water Treatment Plant (WTP), and then deliver the water to the SF RWS through the intertie. If a transfer capacity greater than 20 mgd is needed, expansion of the Penitencia WTP Plant and construction of a pump station from SCVWD to SFPUC may be required, at a minimum. However, a primary constraint to moving water through SCVWD is getting the water to San Luis Reservoir, as this is limited by the SWP and CVP supplies and capacity which move water to San Luis Reservoir.

As with all of the potential water transfer projects, storage may be needed if the supply cannot be conveyed when it is available from the seller and during the periods when the buyers can utilize the supply and when there is adequate conveyance capacity to move the water to the Bay Area. At this time, it is not known whether surface or groundwater storage within the SCVWD system could be used for seasonal storage or for storage during normal years for use during drought periods. SCVWD is currently evaluating their long-term supply and storage requirements; however, it seems unlikely that excess storage capacity would be available for BAWSCA's use.

In order to use the SCVWD/SFPUC intertie for non-emergency types of operation, such as water transfers during normal and/or drought years, a new California Environmental Quality Act (CEQA) document (likely an "Initial Study") would be needed to evaluate the potential environmental impacts of this revised operation. Based on the results, a Mitigated Negative Declaration (MND) or full EIR would be required. In addition to the environmental documentation, the potential capacity, seasonal availability and costs for transferring water through the CVP, SCVWD, and SF RWS would have to be determined.

3.3 EBMUD/SFPUC Emergency Intertie

The EBMUD/ SFPUC emergency intertie was completed in 2007 to provide the ability to transfer water to and from the SF RWS and EBMUD. Table 4 includes the delivery scenarios and supply allocation.

As with the SCVWD/SFPUC intertie, this emergency intertie has been used to provide water to SFPUC during planned shutdowns for construction and connection of the SFPUC WSIP facilities. Prior to the shutdowns, SFPUC transferred water to EBMUD in to offset the water to be transferred back during the planned SFPUC shutdowns. This emergency intertie was approved under an MND.

Table 4
Delivery Scenarios and Water Allocation[1]

Delivery Scenario	Planned Maintenance (mgd)	Emergency (mgd)
SFPUC to EBMUD	30	30
EBMUD to SFPUC	30	30
EBMUD to City of Hayward	15	15

[1] Actual delivered supply would depend on the demand and water availability during the time of repairs.

In order to use the EBMUD/SFPUC intertie for non-emergency types of operation such as water transfers during normal and/or drought years, a new CEQA Initial Study would need to be performed to determine the potential environmental impacts of this revised operation. Based on the results, an MND or full EIR would be required.

The EBMUD/SFPUC intertie has a hydraulic capacity of about 40 mgd and includes a connection between EBMUD and the City of Hayward water system, the Skywest Pump Station, and about 1.5 miles of pipeline. The general locations of these facilities are shown on Figure 1. Hayward controls operation of the facility because the intertie connection to the SFPUC Bay Division Pipelines includes part of Hayward's distribution system.

EBMUD is performing a hydraulic capacity analysis to estimate the maximum available seasonal capacity for transfer in their raw water and treated water systems into the Bay Area. EBMUD has initially indicated that the maximum long-term capacity through their treated water system would be about 20 mgd; however, they are currently looking at the future system demands and developing estimates of the possible available capacity. This study should be completed in early 2013. In addition, a separate EBMUD study is evaluating partnering with some Sacramento County water agencies and cities to evaluate the potential for developing groundwater storage for water transferred through the FSC. This evaluation will continue at least through early 2013.

The Bay Area Regional Desalination Project (BARDP) is also examining the use of this wheeling capacity through the EBMUD system. A pilot plant study was prepared for a BARDP location along the Sacramento River near the City of Pittsburg. The current thinking is that the treated water capacity for this facility would be about 20 mgd. This may be very close to the available hydraulic capacity within the existing EBMUD treated water system, leaving limited or no capacity available for transfer of other sources of supply through the EBMUD system. The location of the potential BARDP connection is shown in Figure 1.

EBMUD has also expressed an interest in allowing water transfers through their system possibly as part of their Freeport project, with conveyance through the FSC and into their raw water system. Any transfers will have the same capacity constraints as discussed above. EBMUD is also currently investigating a possible joint storage option with CCWD in the Los Vaqueros (LV) Reservoir project. This reservoir location is also shown on Figure 1.

3.4 SFPUC Regional Water System

As discussed in Section 2.4, there may be the potential for BAWSCA to secure a water transfer from irrigation districts that are located near Hetch Hetchy and the San Joaquin Pipelines that convey water from Hetch Hetchy across the San Joaquin Valley and into the Sunol Valley and Bay Area.

Some of these districts have the physical ability to transfer water to the SF RWS within the Tuolumne watershed through storage agreements on New Don Pedro Reservoir. However, FERC is currently in the relicensing process for hydropower generation on the New Don Pedro Project, and the districts may be reticent to pursue additional transfers until the FERC relicensing, and the decisions regarding additional environmental flow releases, are completed.

In order to obtain water from the irrigation districts, BAWSCA and the member agencies could provide economic incentives to encourage irrigation districts and/or individual farmers to implement water conservation measures. That would save both money and water, with resulting benefits to all stakeholders. The "conserved" water would serve to both increase supplies to the BAWSCA member agencies and to increase flows downstream of Don Pedro Dam.

3.5 Local Storage of Transferred Supply

A key part of any transfer is the ability to either transfer the supply during the period when the supply is needed (i.e., summer peaking or during droughts), or to provide storage either at the source or in the Bay Area. Storage in the Bay Area is limited, with the other local water agencies maximizing their reservoir storage for their own use. The two large water districts in the area that store groundwater, ACWD and SCVWD, already maximize the use of this storage.

However, there is the potential under the current WSA to use storage in the SFPUC San Antonio Reservoir or Calaveras Reservoir during drought periods, if transfer water is available. Transfers could be made from the SBA existing intertie to SF RWS pipelines in the Sunol Valley, or through SBA releases into local creeks that flow into the San Antonio Reservoir. However, SFPUC currently operates this system to maintain high levels of storage in these reservoirs going into the summer months. Storage will likely only be available during extended drought periods.

If the Calaveras Reservoir is expanded beyond the proposed capacity of 100,000 AF, a very unlikely scenario, there might be storage available for BAWSCA for maintain water for use during droughts. There is no physical means to move water from the SF RWS into Calaveras Reservoir. However, the BAWSCA member agencies might be able store water purchased from SFPUC that is in excess of their demand, assuming that SFPUC can operate the reservoirs to limit drawdown and spills from Calaveras. In addition, during the drought periods, reoperation of storage between Calaveras and San Antonio Reservoirs may provide additional capacity.

One of the key issues with storage in San Antonio Reservoir is SFPUC's current position that the operation and storage of the local reservoirs is already maximized during normal operations, and that no surplus storage is available during normal years. If there were any spills from the reservoir(s), the loss of water would be applied to any stored transfer water first. BAWSCA has requested that the SFPUC analyze the SF RWS and potential storage availability in Calaveras and San Antonio Reservoir under varying demand and hydrologic conditions to verify the storage assumptions.

Even though SFPUC stored SWP SBA water in San Antonio Reservoir from1993 to 1994, during the last major drought, there is still a long-term concern by SFPUC about the water quality impacts to San Antonio Reservoir and the SF RWS system of transferring larger quantities of Delta water into the system. Additional studies would be required to demonstrate whether these types of transfers would have significant negative water quality impacts to the reservoir, and use.

Another potential storage option is the use of the expanded Los Vaqueros Reservoir project. This facility is operated owned and operated by CCWD, and the potential operation of this storage is discussed above in Section 3.3 as part of the EBMUD/SFPUC emergency intertie and possible conveyance of water through the EBMUD system and storage in Los Vaqueros Reservoir.

4.0 Summary of Supply and Transfer Options

There are potentially a number of possible sellers and transfer/wheeling options to provide more water to the Bay Area. Tables 5 and 6 summarize the types of potential sellers and transfer options identified in the Sacramento Valley and in the Delta and San Joaquin Valley, respectively.

Table 5
Summary of Sacramento Valley Types of Potential Sellers and Conveyance Options

Potential Seller	Potential Conveyance Options						
	Amount		SF RWS	SWP SBA	CVP/San Felipe Project	EBMUD/SFPUC Intertie(1)	SCVWD/SFPUC Intertie
	(AF/year)	(mgd)					
Irrigation Districts	2,000 - >5,000	2 - >5	-	X	X	X	X
Reclamation Districts	5,000	5	-	X	X	X	X
Private Owners	1,000 to 5,000	1 - 5	-	X	X	X	X
Water Districts	>5,000	>5	-	X	X	X	X
Water Agencies	>5,000	>5	-	X	-	X	-

Table 6
Summary of Delta and San Joaquin Valley Types of Potential Sellers and Conveyance Options

Potential Seller	Potential Conveyance Options						
	Amount		SF RWS	SWP SBA	CVP/San Felipe Project	EBMUD/ SFPUC Intertie	SCVWD/SFPUC Intertie
	(AF/year)	(mgd)					
Irrigation Districts	1,000 - >5,000	1 - >5	X	X	X	X	X
Private Owners	1,000 to 3,000	1 to 3	-	X	X	X	X

Though the potential sellers north of the Delta (Sacramento Valley) have a wide range of potential supply available (1,000 AF/year to greater than 5,000 AF/year, equivalent to 1 mgd to 5 mgd), the primary constraint in moving this water to the Bay Area will probably be the available capacity for transfers through the EBMUD system. Depending on transfers required for BARDP, the available capacity could be limited from zero to about 20 mgd if BARDP was not constructed.

Another option for the transferring water from the agencies that have CVP or SWP contracts would be to try and transfer the flows through the Sacramento River to the CVP and SWP pumping and transmission facilities, and then either through the SWP SBA or the CVP San Luis Reservoir system. However, based on the earlier assessment, it is very unlikely that there would be hydraulic capacity available for transfer of this water due to competition with the other CVP and SWP contractors who have first priority for use of the facilities.

5.0 Data Gaps/Outstanding Issues

5.1 Agreements Needed for Out-Of-Service Area Water Transfers

The transfer of water from outside of the BAWSCA service area into the BAWSCA service area would require cooperation and several different types of agreements with several entities potentially including:

- BAWSCA member agencies;
- SFPUC;
- Other local water agencies;
- Entities that might provide infrastructure and capacity for wheeling of water, including DWR, Reclamation, and ACWD or SCVWD once the supply is in the Bay Area; and
- Agencies selling supply and storing it either locally or regionally.

In addition, several of the issues that must be addressed as part of the identification and negotiation of these agreements are:

- Types and duration of the agreements or contracts, or operating conditions such as change in use permits;
- Ownership of the transfer agreements;
- Costs associated with the services provided under the agreements and potential penalty provisions;
- Complexity of involvement of multiple entities;
- Reliability and availability of the proposed transfer supply;
- Available transfer capacity in the system;
- Authority of the agencies to enter into agreements; and
- Strength of, and ability to enforce, the provisions of the agreements.

The specific agreements that would be required for each agency have not been identified at this time. That information will be further developed after determination of the feasibility of wheeling these supplies into the Bay Area and identification/confirmation of the best potential transfer opportunities based on current information on cost for purchase of water, reliability of supply, quantity of supply and seasonal availability or storage opportunities.

5.2 Potential Issues Associated with Developing Water Transfer Projects

Potential issues affecting the implementation of water transfer projects are described below.

- *Transfer Supply Availability* – Transfers will have varying levels of reliability, for both normal and drought conditions, depending on their location and the characteristics of the supply source being considered. Key components of the reliability of any given supply is whether regional storage capacity is available that can be used to store seasonal supply, and whether there is transmission capacity available to transfer the supply when needed.

- *Available Conveyance Capacity* – Transfers from outside the Bay area will require some type of conveyance mechanism to move the water to the member agencies. Alternatives include: the SWP SBA or CVP water through CVP and SCVWD system; Tuolumne River water conveyed through the SF RWS; and Delta and North of Delta supply conveyed through the EBMUD system. Each of these conveyance systems has their own hydraulic, operational, and institutional constraints. This was further discussed with the agencies to determine their interest in wheeling arrangements. Without some type of reliable conveyance to the Bay area transfers of water from outside the Bay area are not feasible.

- *Cost effectiveness* – The total costs associated with water transfers must be determined, including purchase, possible storage, transfer, or wheeling costs to the BAWSCA member agencies. These costs will vary depending on the type and location of the supply source, and the agreements and infrastructure required to wheel the transfer supplies to the BAWSCA service area. The costs may be higher if there are contract requirements requiring payment for supply even if the supply is not taken every year, or maintaining wheeling capacity through other agency water systems.

- *Timing for Implementation* - A potential key advantage of water transfers is that in many cases they do not require construction of infrastructure facilities to obtain, treat, and convey these supplies, and so may be able to be implemented more rapidly than those requiring large infrastructure improvements.

- *Project funding* – Alternatives for funding the purchase of transfer supply will be important and will require evaluation of the benefits of developing long-term contracts to minimize cost impacts to the participating agencies.

- *Agreements or negotiation with outside agencies or partners* – Any water transfer will require several agreements for the purchase, storage, and wheeling of a given supply. Negotiation of such agreements can be difficult and complex and will depend on having many willing partners. A key part of the successful negotiations will be clearly defining the objectives for the use of the transfer projects, and the potential impacts on reliability, cost, and operational limitations that by be proposed by sellers or the wheeling agencies.

- *SCVWD/SFPUC and EBMUD/SFPUC interties* – Use of these existing interties will require expansion of their current use, which would require compliance with CEQA ad addressing Bay Area Air Quality Management District permits.

These issues will be addressed in more detail after the available hydraulic capacity issues with EBMUD and interest in allowing transfers by SCVWD have been further explored with these agencies. The interest, capacity for wheeling and potential for storage are key issues which could be fatal flaws to transfers.

6.0 Next Steps

There are several potential water sellers who are interested in continuing discussions with BAWSCA. Based on the previous discussions the most promising means to convey water from the Delta would be through the EBMUD system. Transfer projects with any of these agencies may not be feasible until the available capacity constraints for transfer of supply through the EBMUD system are better understood. The key next steps for 2012 are to determine the technical and institutional needs and feasibility of the water transfer projects including:

- BAWSCA directing RWS modeling analysis by SFPUC, including evaluating the potential for storage of transferred water in Calaveras and San Antonio Reservoirs during droughts (March 2012);

- Additional meetings with SCVWD to discuss potential options and interest in wheeling water transfers through their system (Fall/Winter 2012); and

- Additional meetings with EBMUD to discuss its capacity constraints and potential options for wheeling water transfers through its raw and treated water systems (Winter 2011/2012).

Appendix A
Water Transfer Options Background

Source: Long-Term Reliable Water Supply Strategy Phase I Scoping Report, Appendix B, Section 3 May 27, 2010 (Edited July 2011)

Appendix A
Water Transfer Options Background

The water transfer options have potential that, if BAWSCA or one or more of the member agencies decided to pursue a water transfer project, additional potable water or non-potable supply could be made available (e.g., via sale, exchange, or transfer) to a participating BAWSCA agency needing supply. Table A-1 summarizes information regarding the general water transfer options, by source of supply.

In this Appendix:

The water transfer options included in this evaluation can be generally grouped as follows:

- *Transfer of supply between BAWSCA member agencies* under the conditions of the WSA, where this transfer could include SFPUC supply, or supply from development of existing, planned, or potential local supply projects (e.g., recycled water or groundwater), or water transferred into the BAWSCA service area; or

- *Transfer of supply from outside the BAWSCA service area* that may have the potential to move water into the BAWSCA service area to offset the demand of a BAWSCA agency(ies) through a direct or exchange transfer.

As briefly discussed above, there are source, storage, conveyance, and agreement elements to water transfer projects. Different combinations of those elements can constitute different projects.

A.1 Water Transfer Options Associated With the Transfer of Supply Between BAWSCA Member Agencies

As described below, pursuant to the WSA, BAWSCA member agencies can transfer SFPUC supply, or other supplies, amongst each other.

A.1.1 Supply Sources for Inter-Agency Transfers

Water transfers between BAWSCA member agencies from supply sources within the BAWSCA service area may include either 1) temporary or permanent transfer of SFPUC supply within the restrictions of the WSA, or 2) transfer of a new supply developed within or outside the BAWSCA service area and independent of the SFPUC supply. These transfers could be either direct or exchange transfers and could be designed to meet normal or drought demand.

The reliability of any inter-agency transfer project will depend on a) the reliability of the supply source, b) the ability to transfer the supply to the member agency(ies) when needed, and c) the ability to store the supply either locally or nearer the source of the supply.

It is anticipated that the majority of inter-agency transfer projects that would be pursued would be for potable water supply. However, agencies in close proximity to each other may be able to physically transfer recycled water or poorer quality groundwater for non-potable use.

A.1.2 Mechanism for Inter-Agency Transfers

There are three primary forms of transfer between BAWSCA member agencies that are addressed in the WSA, including:

- Permanent transfer of a portion of an Individual Supply Guarantee (ISG);
- Drought transfers; and
- Wheeling of a non-SFPUC supply though the SFPUC system.

Pursuant to Article 3, Section 3.04 of the WSA, any BAWSCA agency that has an ISG may transfer a portion of it to one or more BAWSCA member agencies. Such transfers are permanent and without additional penalties or additional charges from the SFPUC. The SFPUC will not unreasonably withhold or deny transfer approval. This transfer mechanism can be used if a BAWSCA agency has an ISG in excess of its SFPUC purchases, either because of that agency's contract capacity or because that agency has developed or acquired another supply and chooses to sell a portion of its ISG.

Transfer of SFPUC supply drought allocations between the BAWSCA agencies are governed by Section 3.11(C) and the Tier 1 Shortage Plan. In the event that SFPUC declares a drought emergency under California Water Code Sections 350 et seq., the Tier 1 Shortage Plan allows transfer of shortage allocations among BAWSCA member agencies.

Pursuant to the WSA, BAWSCA member agencies can also wheel water through the SFPUC system from sources outside of the SFPUC system. Section 3.12 of the WSA states that "the SFPUC will not deny use of Regional Water System unused capacity for wheeling when such capacity is available for wheeling purposes during periods when the SFPUC has declared a water shortage emergency…." Specific conditions apply including:

- Reasonable wheeling charges;
- Loss of wheeled water stored in SFPUC reservoirs that spill;

- Wheeled water will not unreasonably impact fish and wildlife resources in the RWS reservoirs, diminish the quality of delivered water, or increase the risk of exotic species impairing RWS operations; and
- Priority is given to wheeling by Wholesale Customers over arrangements for third party public entities.

A.2 Water Transfer Options Associated With Supplies Outside the BAWSCA Service Area

A water supply management project that includes a transfer of supply into the BAWSCA service area from outside the BAWSCA service area may incorporate some or all of the following key elements of a water supply transfer:

- Supply source;
- Storage;
- Conveyance (wheeling); and
- Agreements.
- Each of these is discussed in more detail below.

A.2.1 Supply Sources for Out-Of-Service Area Water Transfers

A water transfer generally involves an interested seller reducing water use to make water available to other entities. The seller must take action to reduce consumptive water use, or identify unused supply, in order to have water available for transfer.

The supply sources associated with an out-of-service area transfer may include surface water runoff/diversions, surface water storage, groundwater, or supplies freed up by reduction in water demand (i.e., reductions in agricultural demand through crop-shifting, and cropland idling or fallowing, or through agricultural water conservation). These sources are described in more detail below.

Surface Water Diversions

The majority of the water supply within the State of California originates as surface water diversions. In order to ensure the reasonable and beneficial use of this water, in 1914 the State of California established a review, licensing and permitting process for water rights associated with these diversions. There is a hierarchy associated with the pre- and post-1914 water rights, and also the right's priority at the time of receiving a permit from the State of California. In general the pre-1914 rights have a higher priority than post-1914 rights. Occasionally, surface water diversion rights, either pre- or post-1914, become available for purchase from the owners of those rights. These supplies, if imported into the BAWSCA service area, could potentially augment either or both normal and drought supplies.

Both the State of California and Reclamation have surface water diversion rights that serve as the source of supply for the state and federal water projects in California (i.e. the SWP and the CVP, respectively). The majority of the large water transfers currently being looked at within the state are the contracts associated with the SWP and CVP water rights. During dry years, and sometimes normal years, the state and federal contractors are seeing their contract deliveries reduced due to limited river flows and environmental and legislative restrictions on pumping from the Delta. A program has been developed to allow willing sellers (contractors) within the SWP and CVP systems to sell available supply to other contractors, or to non-SWP or non-CVP contractors. The SWP and CVP contractors have first rights for purchasing those transfer supplies, which limits the ability of non-SWP and non-CVP contractors to purchase this water. In addition, the operators of the state and federal systems, and their contractors have first rights for use of the capacity of those systems to deliver contract and transfer water.

Stored Reservoir Water

Water rights holders or owners may make water available from unused surface water stored in reservoirs owned by local agencies (i.e., those that are not part of the CVP or SWP systems). If an agency releases water that was stored in a reservoir to make it available for a transfer, the reservoir is drawn down. To refill the reservoir, the seller must prevent some flow from going downstream. Sellers must refill the storage at a time when downstream users would not have otherwise captured the water, either in downstream CVP or SWP reservoirs or with CVP or SWP pumps in the Delta. Typically, refill can only occur during Delta excess conditions (when there is more water than the CVP and SWP can pump).[1] The frequency and duration of when excess conditions exist, and the storage available will determine how reliable this supply will be under drought conditions.

Groundwater Substitution

Groundwater substitution transfers occur when a seller opts to forego their use of surface water supplies (these could be SWP or CVP contracts or other water rights) and pumps an equivalent amount of groundwater as an alternative supply. These transfers typically involve agricultural users; therefore, water from this acquisition method is typically only available during the irrigation season of April through October. Furthermore, while the water may be available at the start of the irrigation season, if the water then needs to be transferred through the Delta, the current biological opinions regarding the Delta dictate that transfers cannot move through the Delta until July (when the “transfer window” begins). This constraint on the timing of the water availability and the transport of that water means that this option would likely also require some sort of storage.

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[1] Delta excess water conditions, also referred to as unbalanced conditions, are defined in the Coordinated Operation Agreement as “periods when it is agreed that releases from upstream reservoirs plus unregulated flow exceed Sacramento Valley in-basin uses, plus exports.” (U.S. Department of the Interior, Bureau of Reclamation and California Department of Water Resources 1986)

Since groundwater substitution transfers require increased withdrawal of water from a groundwater basin, this option is only viable for sellers in basins that are not in a state of groundwater overdraft or in areas where the water supplier determines that the water transfer would not contribute to the groundwater overdraft.

Stored Groundwater Purchase

Entities may be willing to sell groundwater assets that they have stored in a groundwater bank such as the Semi-tropic or Kern County Water Agency (KCWA) banking projects. However, the opportunities to purchase this type of stored groundwater are very limited, and typically the water is only available in Kern County. The water is typically delivered to the buyer by exchanging SWP or CVP contract supplies at San Luis Reservoir.

Cropland Idling/Crop Shifting

Cropland idling and crop shifting transfers come from water that would otherwise have been used for agricultural production. These transfers involve:

- Cropland idling transfers involve paying farmers to idle land that they would otherwise have placed in production. The quantity of water available for sale (i.e., the water that would have otherwise been used to irrigate crops grown on that land) is based on the former crop's evapotranspiration of applied water (ETAW). Most cropland idling transfers have historically involved rice because it has a high ETAW, but other crops can also be idled; and

- Crop shifting transfers, can occur when farmers shift from growing a higher water use crop to a lower water use crop. The quantity of water available is the difference in ETAW between the higher water need crop to the lower water need crop. Accounting for the amount of water made available in this type of transfer is more difficult that in a crop idling transfer. Farmers generally rotate between several crops, and it is may not be clear what crop type the farmer would have planted in the year of the transfer. These uncertainties require a substantial amount of information from the seller, including historic cropping patterns and five years of historical water use data.

Similar to groundwater substitution transfers, cropland idling and crop shifting water is available at the beginning of the irrigation season (April) but, if it needs to be transferred through the Delta, it cannot be moved through the Delta until July. Storing water in upstream reservoirs is extremely unlikely on the Sacramento River, and difficult on other rivers. But unlike groundwater substitution, cropland idling or crop shifting cannot wait to start until Delta conveyance or other conveyance capacity is available. For transfers on the Sacramento River, and other transfers if storage agreements cannot be negotiated, the crop must be idled or shifted for the entire season even when the water cannot be stored. Without storage, the water received would be only a fraction of the water made available through this action.

Agricultural Water Conservation Transfers

Agricultural water conservation transfers could occur if an entity provides an irrigation district or farmer with economic incentives to encourage them to voluntarily implement water conservation measures at no cost to them.

A specific example of the this would be where BAWSCA member agencies could provide economic incentives to encourage Tuolumne Irrigation District and/or Modesto Irrigation District, the Cities of Modesto and Turlock, or individual growers, canners, and orchardists to implement water conservation measures at no cost to them, that would save both money and water, with resulting benefits to all stakeholders (BAWSCA 2007). The water that was freed up through this process would both serve to increase supplies to the BAWSCA member agencies and to increase flows downstream of Don Pedro dam.

These types of agricultural water conservation transfer arrangements are now in place in California on a much larger scale. For example, the Imperial Irrigation District (IID) has contracted to transfer over 300,000 AFY to San Diego and other coastal cities served by the Metropolitan Water District of Southern California. IID's "Efficiency Conservation Definite Plan" adopted in May 2007 contains very detailed analyses of the costs/benefits and water savings achievable by a range of irrigation efficiency measures.

A.2.2 Storage Requirements for Out-Of-Service Area Water Transfers

As discussed above, many of the supply sources for out-of-service area transfers are only available seasonally and may not be available during drought periods. In order to ensure that the supply is available when needed, many of the transfer options would need to include either groundwater or surface water storage.

Transfers of surface water diversions can include groundwater storage in the vicinity of the river diversion points, such as the KCWA and Semi-tropic water banks. When excess supply is available water is stored in the water bank. During dry periods or when pumping from the Delta is reduced or curtailed, the banked water can be pumped out of the basin. In the case of a transfer the seller rather than taking the delta diversion the contract supply is pumped from the groundwater bank, and the entity receiving the transfer supply receives water pumped from the Delta. For agencies in the Bay Area this supply would be conveyed either through the SWP or CVP facilities to a location where they can move the transfer supply into their water systems.

Existing groundwater storage in the Bay Area could also potentially be used to store water that may be imported by the BAWSCA agency(ies) to meet seasonal or drought needs. The SCVWD operation of its groundwater basins, through recharge of local runoff and SBA and CVP supplies, is an example of conjunctive management of groundwater and surface water supplies.

A.2.3 Conveyance Requirements for Out-Of-Service Area Water Transfers

The supplies sources discussed above generally originate in the following areas:

- North of the Delta (Sacramento Valley;
- South of the Delta (Delta Area and San Joaquin Valley);
- Tuolumne River watershed; and
- San Francisco Bay Area (outside of BAWSCA service area).

How these potential supplies could be directly transferred into the Bay area is a function of source location, possible storage requirements or options (groundwater or surface water), existing conveyance infrastructure, and the institutional and infrastructure constraints associated with conveying the water.

Potential Transfer to the BAWSCA Service Area through the SBA and/or CVP/SCVWD Systems

The supplies discussed in Section A.3.1 that originate either north or south of the Delta would need to be transported to the BAWSCA service area. This would most likely have to occur either through the SBA to ACWD or SCVWD or via the San Felipe portion of the CVP to the SCVWD system. At a minimum, wheeling agreements would be required with DWR for transfers through the SBA (to ACWD or SCVWD), and with Reclamation and SCVWD to wheel CVP water to SCVWD.

Water purchased from sellers north of the Delta generally must move through the Delta and then through the SWP's delta pump station (Harvey O. Banks Pumping Plant [Banks PP]) or the CVP's delta pump station (C.W. "Bill" Jones Pumping Plant [Jones PP]). Non-SWP and non-CVP contractors can also wheel water through the SWP or CVP projects; however, they have the lowest priority for transfer of the supply. There must be sufficient capacity to transfer the existing contractors supply, and such transfers are subject to a wheeling charge.

Transferred water from north of the Delta is more frequently pumped through the Banks PP because the Jones PP generally operates at maximum capacity to meet CVP needs, even during drier years. The recent biological opinions on the long-term operations of the CVP and SWP include provisions for up to 600,000 AF of transfers that can only be pumped from July through September (U.S. Fish and Wildlife Service 2008, National Marine Fisheries Service 2009).

Transfers from sources south of the Delta do not need to be moved through the Delta. However, regardless of the source, BAWSCA or the member agencies would have to develop agreements and/or water supply exchanges with SWP and CVP contractors in order move water into the Bay Area through the SBA to either ACWD or SCVWD, and/or through the CVP to San Luis Reservoir and then to the SCVWD system through the

Reclamation San Felipe project. The ability to move transfer water through the SWP and/or CVP will require available system capacity. These types of transfers would have the lowest priority for excess system capacity.

The following are specific examples of how water might hypothetically be transferred into the BAWSCA service area through existing systems:

- ACWD is currently the only BAWSCA member agency with the ability to perform a direct transfer of supply from the SWP. ACWD could theoretically purchase additional SWP supply from another SWP contractor and this additional supply could then be conveyed to ACWD through the SBA, assuming there was capacity in the SBA to import those additional supplies. Having backfilled its supplies, ACWD could then theoretically transfer part of its SFPUC supply to the BAWSCA member agencies, although there are water quality and other constraints on their ability or willingness to enact such an exchange.

- Transfers through SCVWD could be directly transferred to their treated water customers or through groundwater extraction by the common SCVWD/SFPUC customers. Specifically,

    1. SCVWD receives supply from both the SWP and CVP. The Cities of Milpitas, Mountain View, and Sunnyvale receive treated SWP or CVP water and could receive transferred supply directly from SCVWD.

    2. Several of the common SFPUC and SCVWD customers also pump groundwater, which is recharged with a combination of local surface water runoff and SWP and CVP supplies. These agencies may be able to receive transferred supply through this recharge and extraction of groundwater.

Potential Transfers through the RWS

Another potential method for transferring water into the Bay Area would be to directly import it using the RWS. The types of transfers during normal or drought conditions will most likely be limited to two options:

- Agricultural conservation; or

- Transfer of purchased water through the SBA into San Antonio Reservoir.

The first option, the agricultural conservation supply, if coming from the Tuolumne River watershed, could be transferred through the SFPUC system, and could be conveyed directly to the individual member agencies through existing turnouts.

The second option, purchased supply from willing sellers either north or south of the Delta, would be transported into the SFPUC San Antonio Reservoir from the SBA during dry-year or drought events. This could be a purchase of SWP contract supply from another SWP contractor, or transfer of the other types of source water described previously. Such a purchase and transfer into San Antonio Reservoir of a limited amount of water was completed in 1991 and 1995 to help improve water supply conditions during the extended drought from 1987 through 1994 (CDM Smith 2003).

Due to the difference in water quality between the Delta supply and Hetch Hetchy supply the second type of transfer may not be approved by SFPUC except during drought events, or regional water supply emergencies. A preliminary study was prepared in 2003 addressing the potential for these types of transfers (CDM Smith 2003). The approach appears feasible, and regulatory compliance appeared to be achievable. However, additional water quality, potential public health concerns, treatment options, and operational concerns would need to be addressed more fully to determine the feasibility, availability of supply, and cost for this type of transfer.

Regional Transfers from within the Bay Area to the BAWSCA Service Area

A number of potential water supply management projects have been identified that would require transfer of supply from agencies within the Bay Area, but outside of the BAWSCA service area. Conveyance may be possible through the water distribution systems and interties of other regional water agencies. An example would be transfer of desalination supply from the Sacramento River into the Contra Costa Water District (CCWD) system, transfer to EBMUD, and then to Hayward. The specific transfer mechanisms and types of agreements will depend on a number of factors, including:

- Location of the supply source;
- Water quality;
- Quantity;
- Time of year and duration when transfer water is available and needed;
- Storage and hydraulic capacity available through the wheeling agency’s system; and
- Other limitations that may affect quantity and timing of the transfers.

Most of the large regional water systems including EBMUD, CCWD, ACWD, and SCVWD have some type of emergency or other connection between their agencies. For example, CCWD and EBMUD have emergency connections, as do EBMUD and the City of Hayward. If capacity exists and the agencies are willing, this would potentially allow transfer of new supply from CCWD or EBMUD to the SFPUC system through the City of Hayward, or exchange of SFPUC supply between member agencies. Similarly, if additional supply were available in the Livermore Valley it could potentially be conveyed through the SBA (if capacity was available) to either ACWD and the SFPUC system, or SCVWD where supply could be conveyed to the SFPUC/SCVWD common customers.

These regional interconnections currently exist primarily to address emergency conditions and local loss of supply. Making this part of normal year, or even dry year, transfers will require extensive discussions with each of the potential agencies involved and evaluation of the potential physical and water quality limitations in implementing the transfers.

A.2.4 Agreements Needed for Out-Of-Service Area Water Transfers

The transfer of water from outside of the BAWSCA service area into the BAWSCA service area would require cooperation and several different types of agreements with several entities potentially including:

- BAWSCA member agencies;
- SFPUC;
- Other local water agencies;
- Entities that might provide infrastructure and capacity for wheeling of water including DWR for the SWP, Reclamation for the CVP, and ACWD or SCVWD once the supply is in the Bay Area; and
- Agencies selling supply and storing it either locally or regionally.

Several of the issues that must be addressed as part of the identification and negotiation of these agreements are:

- Types and duration of the agreements or contracts, or operating conditions such as change in use permits;
- Ownership of the transfer agreements (i.e., is it better to have SCVWD or ACWD own the transfer agreements than a non-CVP or non-SWP contractor);
- Costs associated with the services provided under the agreements and potential penalty provisions;
- Complexity of involvement of multiple entities;
- Reliability and availability of the proposed transfer supply;
- Available of transfer capacity in the system;
- Authority of the agencies to enter into agreements; and
- Strength of, and ability to enforce, the provisions of the agreements.

A.3 Potential Issues Associated with Developing Water Transfer Projects

Potential issues affecting the implementation of water transfer projects are described below.

- *Transfer Supply Availability* – Transfers will have varying levels of reliability, for both normal and drought conditions, depending on their location and the characteristics of the supply source being considered. Key components of the reliability of any given supply is whether regional storage capacity is available that can be used to store seasonal supply, and whether there is transmission capacity available to transfer the supply when needed;

- *Cost effectiveness* – The total costs associated with water transfers must be determined, including purchase, possible storage, transfer, or wheeling costs to the BAWSCA member agencies. These costs will vary depending on the type and location of the supply source, and the agreements and infrastructure required to wheel the transfer supplies to the BAWSCA service area. One issue that may affect the cost will be whether there are contract requirements requiring payment for supply even if the supply is not taken every year, or maintaining wheeling capacity through other agency water systems;

- *Timing for Implementation* - A potential key advantage of water transfers is that in many cases they do not require construction of infrastructure facilities to obtain, treat, and convey these supplies, and so may be able to be implemented more rapidly than those requiring large infrastructure improvements;

- *Project funding* – Alternatives for funding the purchase of transfer supply will be important and will require evaluation of the benefits of developing long-term contracts to minimize cost impacts to the participating agencies; and

- *Agreements or negotiation with outside agencies or partners* – Any water transfer will require several agreements for the purchase, storage, wheeling, etc., of a given supply. Negotiation of such agreements can be difficult and complex and will depend on having many willing partners. A key part of the successful negotiations will be clearly defining the objectives for the use of the transfer projects, and the potential impacts on reliability, cost, and operational limitations that by be proposed by sellers or the wheeling agencies.

Table A-1 Potential Water Transfer Projects Outside the BAWSCA Service Area to be Evaluated in Phase II					
Supply Type	**Potential Water Supply Management Project Description**	**Potential Project Benefit**			**Comments / Potential Issues**
		Augment Local Supply	**Develop Asset for Regional Benefit[1]**	**Accelerate Schedule[2]**	
Surface water diversions	Transfer of surface water rights from the Central Valley.	--	X	Regional	▪ Limited reliable drought or normal year supply available to non-SWP or CVP contractors. ▪ Pre-1914 rights have higher reliability and higher cost than CVP or SWP supplies. ▪ Requires transfer through either SBA or Reclamation/SCVWD transmission facilities to the Bay Area. Ability to move transfer water will require available capacity in the SWP/CVP system. These types of transfers would have the lowest priority for excess system capacity. ▪ Requires direct transfer from ACWD or SCVWD systems to member agencies, or ▪ Exchange transfer of SFPUC contract supply for ACWD or common SFPUC/SCVWD customers.
Stored Reservoir Water	Transfer of unused surface water stored in reservoirs that are not part of the SWP or CVP systems.	--	X	Regional	▪ Limited reliable drought or normal year supply available to non-SWP or CVP contractors. ▪ Requires transfer through either SBA or Reclamation/SCVWD transmission facilities to the Bay Area. Ability to move transfer water will require available capacity in the SWP/CVP system. These types of transfers would have the lowest priority for excess system capacity. ▪ Requires direct transfer from ACWD or SCVWD systems to member agencies, or ▪ Exchange transfer of SFPUC contract supply for ACWD or common SFPUC/SCVWD customers.
Groundwater Substitution & Stored Groundwater Purchase	Transfer or substitution of diversions from SWP, CVP, or other sources to stored groundwater by sellers, or transfer of groundwater assets from water previously stored in groundwater basin.	--	X	Regional	▪ Limited reliable drought or normal year supply available to non-SWP or CVP contractors. ▪ Requires transfer through either SBA or Reclamation/SCVWD transmission facilities to the Bay Area. Ability to move transfer water will require available capacity in the SWP/CVP system. These types of transfers would have the lowest priority for excess system capacity.

Table A-1
Potential Water Transfer Projects Outside the BAWSCA Service Area to be Evaluated in Phase II

Supply Type	Potential Water Supply Management Project Description	Potential Project Benefit			Comments / Potential Issues
		Augment Local Supply	Develop Asset for Regional Benefit[1]	Accelerate Schedule[2]	
					▪ Requires direct transfer from ACWD or SCVWD systems to member agencies, or ▪ Exchange transfer of SFPUC contract supply for ACWD or common SFPUC/SCVWD customers.
Crop idling/crop shifting	Transfer of surface water diversion or groundwater supply by reducing agricultural use through idling of crops, or shifting lower water use crops	--	X	Regional	▪ Requires transfer through either SBA or Reclamation/SCVWD transmission facilities to the Bay Area. Ability to move transfer water m require available capacity in the SWP/CVP system. These types of transfers would have the lowest priority for excess system capacity. ▪ Requires direct transfer from ACWD or SCVWD systems to member agencies, or ▪ Exchange transfer of SFPUC contract supply for ACWD or common SFPUC/SCVWD customers. ▪ Potential local environmental and land use impacts.
Agricultural conservation	Transfer of surface water diversion or groundwater supply through support of implementation of water conservation for agricultural and/or municipal and industrial use.	--	X	Regional	▪ Interest and participation required by district, cities, and/or growers, to accept economic incentives to implement additional conservation measures. ▪ Depending on where the supply is located, transfer through the direct or exchange transfer could go through SWP or Reclamation facilities to the Bay Area, or potentially through the RWS. ▪ Ability to move transfer water may require available capacity in the SWP/CVP system. These types of transfers would have the lowest priority for excess system capacity.

1 Projects that provide "regional benefit" could be local projects that could be expanded to provide a water supply benefit for more than one member agency or projects outside the BAWSCA service area that have the potential to serve one or more member agencies. In order for multiple agencies to be involved, agreements (cost, schedule, etc.), conveyance, and water quality issues may have to be addressed as part of Phase II of the Strategy.

2 Opportunity exists to accelerate the schedule for the "local" or "regional" benefit, or "both". "NA" = Not Available, project is too ill-defined to make a determination.

cdmsmith.com

Attachment 4

Task 6-B Memo: Summary of SFPUC Shortfall Evaluation

CDM Smith

Memorandum

To: *Nicole Sandkulla*

From: *Paula Kulis*
Bill Fernandez

cc: *Craig Von Bargen*
Phillippe Daniel

Date: *July 2, 2012*

Subject: *Draft Task 6-B Summary of SFPUC HH/LSM Modeling to Assess Magnitude and Timing of Drought on the SF RWS*

1.0 Introduction

As part of the Bay Area Water Supply and Conservation Agency's (BAWSCA) Long-term Reliable Water Supply Strategy (Strategy) effort to assess the reliability of the San Francisco Public Utility Commission (SFPUC) San Francisco (SF) Regional Water System (RWS), the magnitude and timing of drought shortages on the SF RWS was evaluated. This evaluation was performed utilizing the SFPUC's Hetch Hetchy/Local Simulation Model (HH/LSM) and under several potential water demand scenarios. The model simulations were completed by the SFPUC, and results were analyzed by BAWSCA to quantify the magnitude and timing of drought shortages on the SF RWS.

In this Memo:

This memorandum documents the BAWSCA demand scenarios modeled by the SFPUC on BAWSCA's behalf, and the subsequent water supply reliability model results.

2.0 Operational Assumptions in the SFPUC HH/LSM

Currently the SFPUC models the frequency and magnitude of supply shortfalls on the SF RWS using HH/LSM. The HH/LSM model simulates monthly SF RWS operations over an 82-year sequence that represents historical hydrological conditions between 1920 and 2002. The model also has a Design Drought planning sequence which replicates the hydrologic conditions associated with the 1987 through 1992 drought, followed by the hydrologic conditions associated with the 1976 though1977 drought. The basis for the design of this sequence is that by adding the worst hydrologic years of record to the end of the most severe drought of record, the SFPUC can attempt to mimic the situation a water system manager faces when deciding how much water can be provided to residents and businesses during a drought, when there is no certainty as to when that drought may actually end.

HH/LSM incorporates information about key aspects of the SF RWS such as reservoir and conveyance configuration, stream runoff, and water demands. By iteratively running the model for the Design Drought and other key periods of the historical record, operating rules have been developed that provide for a viable system operation for all tested hydrologic sequences. One of the procedures developed from this modeling is the protocol for triggering a reduction to SF RWS deliveries (i.e., the Action Levels) during a drought so as to not run out of water before the drought ends.

2.1 Supply Shortage Calculations During Drought

System-wide supply shortages are imposed within the SF RWS operations (and modeled in the HH/LSM) in a step wise manner. Each step (or "Action Level") is triggered by thresholds based on total system storage on July 1 of each year. Action Level 1 does not impose a reduction in water supply deliveries, but does impose a change in system operation, including the use of the Westside Basin Groundwater Program to supplement SFPUC water deliveries. Action Levels 2 and 3 result in 10% and 20% system-wide supply reductions, respectively. These reductions, per the Tier 1 Plan, correspond to up to 18% and 29% projected reductions in supply to the Wholesale Customers in 2035, respectively. These Action Levels and their corresponding supply shortfalls (assuming 2035 conditions) are summarized in Table 1.

Table 1
SFPUC Drought Action Levels and Projected 2035 Supply Reductions

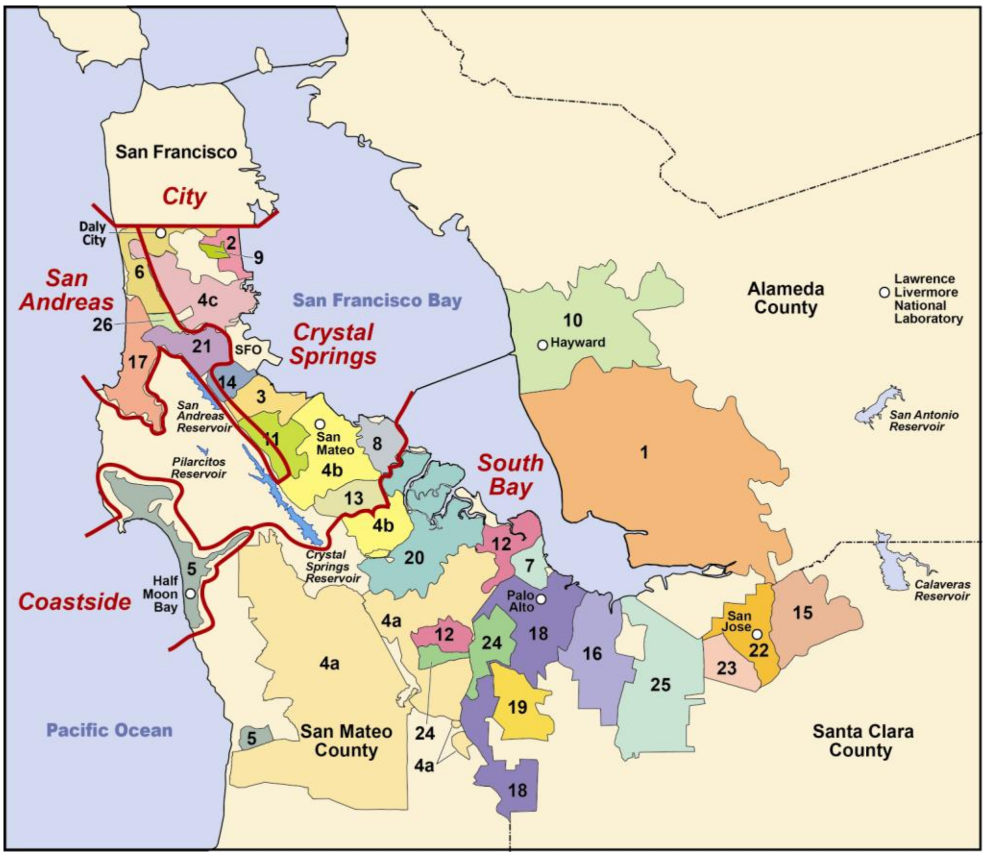
Action Level	Supplemental Water Supply Action	System-wide Supply Reduction	Wholesale Supply Reduction
1	Westside Basin Groundwater Program; Water transfer	None	None
2	Westside Basin Groundwater Program; Water transfer	10%	18%[1]
3	Westside Basin Groundwater Program; Water transfer	20%	29%[2]

[1] This percentage is associated with the higher end of the SFPUC purchase projection in 2035. At the lower end of the SFPUC purchase projection in 2035, this value is 17%.

[2] This percentage is associated with the higher end of the SFPUC purchase projection in 2035. At the lower end of the SFPUC purchase projection in 2035, this value is 28%.

2.2 Modeled Demand Centers

In HH/LSM, the monthly demands associated with SFPUC customers are centralized in four demand centers: South Bay, Crystal Springs, San Andreas, and the City of San Francisco. Demands associated with Coastside County Water District (CCWD) and non-BAWSCA suburban and retail customers are accounted for separately in the model. The allocation of BAWSCA member agencies' demands among the demand centers are described by a memo from Dan Steiner dated in 1999. Aside from CCWD, demands associated with all BAWSCA member agencies are distributed among the South Bay, Crystal Springs and San Andreas demand centers. The geographic distribution of demands among the demand centers is depicted in Figure 1.



Sources: BAWSCA, San Mateo County General Plan

Legend

1 Alameda County Water District
2 City of Brisbane
3 City of Burlingame
4a CWS – Bear Gulch
4b CWS – Mid-Peninsula
4c CWS – South San Francisco
5 Coastside County Water District
6 City of Daly City
7 City of East Palo Alto
8 Estero Municipal Improvement District
9 Guadalupe Valley MID
10 City of Hayward
11 Town of Hillsborough
12 City of Menlo Park
13 Mid-Peninsula Water District
14 City of Millbrae
15 City of Milpitas
16 City of Mountain View
17 North Coast County Water District
18 City of Palo Alto
19 Purissima Hills Water District
20 City of Redwood City
21 City of San Bruno
22 San Jose Municipal Water System
23 City of Santa Clara
24 Stanford University
25 City of Sunnyvale
26 Westborough Water District

Figure 1
BAWSCA Member Agency Service Area Map Showing HH/LSM Demand Zone Boundaries

3.0 Demand Scenarios Analyzed

At BAWSCA's request, the SFPUC analyzed the frequency and magnitude of the potential water supply shortfalls under various demand scenarios using HH/LSM. Three demand scenarios were considered wherein the average purchase projections for the BAWSCA member agencies varied from a minimum of 148.6 mgd, which was the total SFPUC purchases by the BAWSCA member agencies in FY 2009-10, to a maximum of 186.1 mgd, which is the projected BAWSCA member agency purchases in 2035, including San Jose and Santa Clara. The SFPUC retail purchases from the SF RWS are projected to range from 68.4 mgd to 81.0 mgd in these scenarios. The demand scenarios evaluated in this analysis are summarized in Table 2. The distribution of demand among the demand centers is shown graphically in Figures 2-4. The purpose in selecting these demand scenarios to look at the sensitivity of lowered demands on supply cutbacks from the SFPUC during dry year and drought events.

Table 2
HH/LSM Analysis Scenarios

Scenario Name	Total System Demand (mgd)	Purchases by the BAWSCA Agencies (mgd)	SFPUC Retail Demand (mgd)
Minimum Demand (FY 2009-10)	224.1	148.6	75.5
Intermediate Demand (Projected 2025)	251.8	175.6	76.2
Maximum Demand (Projected 2035)	264.8	186.1[1]	78.7

[1] Total anticipated SFPUC purchases for the BAWSCA member agencies is projected to be 186.1 mgd in 2035, including delivery of 9 mgd to the Cities of San Jose and Santa Clara.

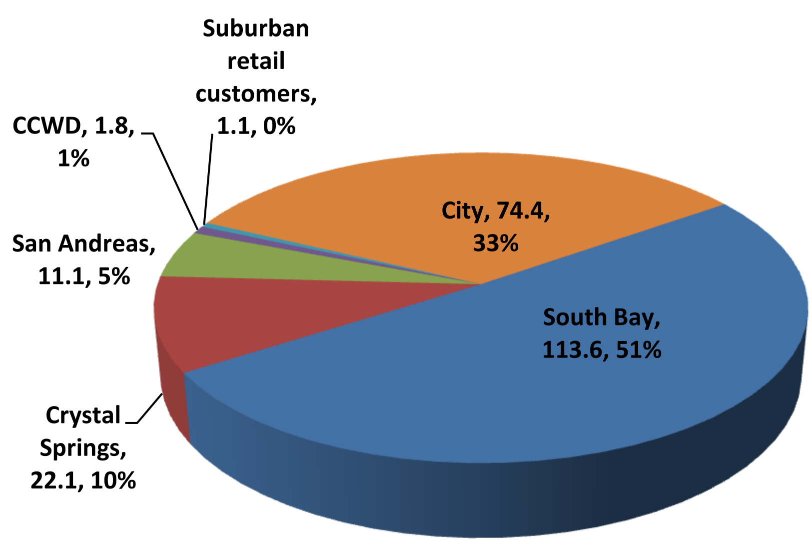


Figure 2
Average Demand Distribution Amongst the HH/LSM Demand Zones in the Minimum Demand Scenario (224 mgd)

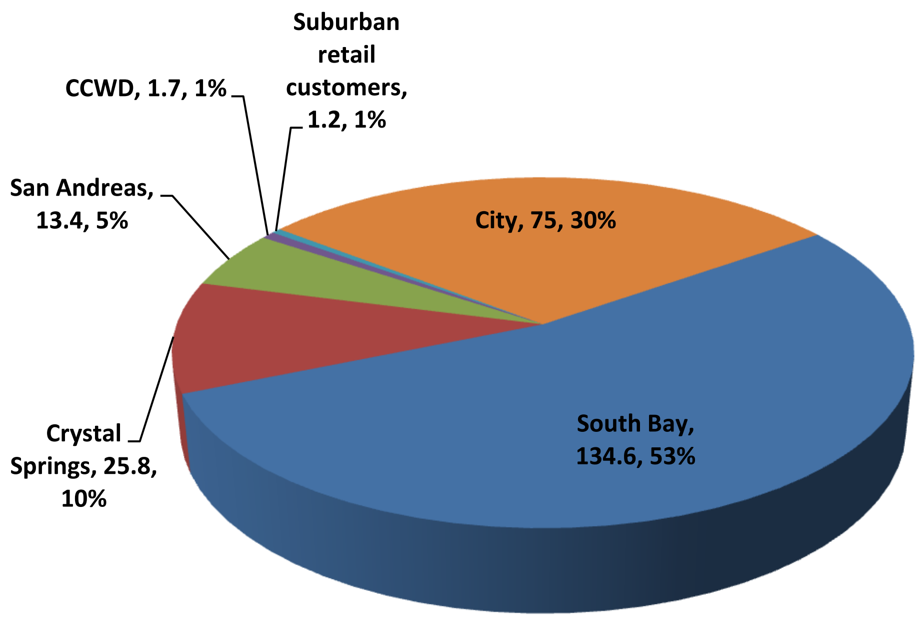


Figure 3
Average Demand Distribution Amongst the HH/LSM Demand Zones in the r Intermediate Demand Scenario (252 mgd)

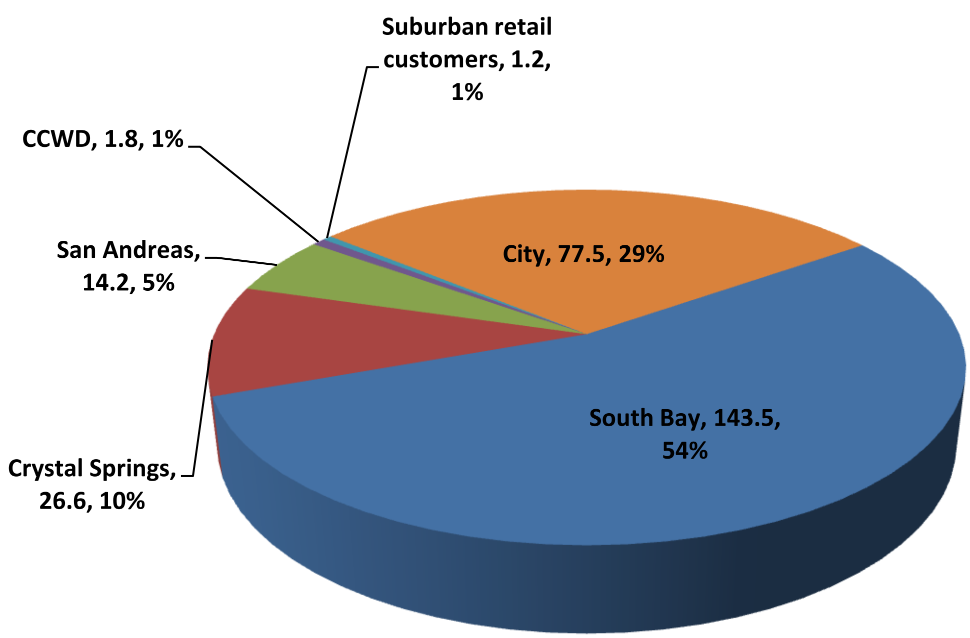


Figure 4
Average Demand Distribution Amongst the HH/LSM Demand Zones in the Maximum Demand Scenario (265 mgd)

3.1 Analysis Assumptions

Individual BAWSCA member agency purchase projections were used to estimate modeled system demands for the member agencies in the three scenarios. The distribution of demands within the HH/LSM was estimated using the agency delivery distribution described in the 1999 memo from Steiner. The 2010 SFPUC Urban Water Management Plan (UWMP) was used to estimate modeled system demands for the City of San Francisco and suburban retail along the Peninsula. Monthly peaking curves associated with average demands were developed based on flow meters in the SFPUC regional system.

Modeled Hydrologic Conditions

All demand scenarios were assessed under hydrologic conditions represented by the hydrologic years 1920 through 2002 (i.e., assuming that the historical hydrology is representative of hydrology expected in the future). Scenarios were also assessed under the SFPUC's Design Drought conditions. The Design Drought is used by SFPUC in their water supply planning analysis and is based on a drought that is more severe than the worst drought that has occurred historically, but that may occur in the future. The historical hydrologic evaluation therefore is limited to historical droughts, while the Design Drought analysis includes a longer-term, hypothetical drought. It should be noted that while updates to HH/LSM were made by SFPUC to simulate the impact on the system from the increased requirements for instream flows below Calaveras and Crystal Springs Dams, hydrologic conditions observed between 2002 and 2012 and the potential future impacts of climate change and other changed conditions have not been included in the HH/LSM modeling to date.

Water Supply System Configuration

Water System Improvement Program (WSIP) modifications to the SFPUC supply system are implicit in the model simulations and subsequent analysis[1]. Drought allocations adhere to the Interim Water Shortage Allocation Plan (ISWAP) Tier 1 split. Dam releases are simulated according to Biological Opinions for Calaveras Dam Replacement Project and Lower Crystal Springs Dam Improvement Project. The Alameda Creek filter gallery is simlated with a capacity of up to 6,300 AF/year.

For the various demand scenarios, some adjustments were made in the HH/LSM to maintain reliable system operation through the entire hydrologic sequence. Under the maximum demand scenario, a surrogate water transfer is imposed with the Tuolumne River of 6,930 AF/year. Shortage action levels are also triggered differently in the minimum and intermediate demand scenarios than they are triggered in the maximum demand scenario. Table 3 summarizes the HH/LSM configuration for all demand scenarios.

[1] Details about the projects associated with the WSIP can be found on SFPUC's website, www.sfwater.org.

Table 3 Demand Scenarios and HH/LSM Features				
HH/LSM Feature		**Minimum Demand**	**Intermediate Demand**	**Maximum Demand**
Drought Allocations		ISWAP Tier 1 Split	ISWAP Tier 1 Split	ISWAP Tier 1 Split
Dam Releases		Biological Oppinions for Calaveras Dam Replacement Project and Lower Crystal Springs Improvement Project	Biological Oppinions for Calaveras Dam Replacement Project and Lower Crystal Springs Improvement Project	Biological Oppinions for Calaveras Dam Replacement Project and Lower Crystal Springs Improvement Project
Alameda Creek Filter Gallery Capacity (AF/Year)		6,300	6,300	6,300
Surrogate Water Transfer with Tuolumne River (AF/Year)		0	0	6,930
Shortage Action Level Triggers	Action Level 1 Trigger	1,276.5 Thousand Acre Feet (TAF) total system storage	1,276.5 TAF total system storage	1,276.5 TAF total system storage
	Action Level 2 Trigger	0 TAF total system storage	1,100 TAF total system storage	1,100 TAF total system storage
	Action Level 3 Trigger	0 TAF total system storage	850 TAF total system storage	890 TAF total system storage

4.0 Projected Action Levels and Shortages for Historical Hydrology and Design Drought Conditions

Model results from the maximum, intermediate and minimum demand scenarios were analyzed to assess SFPUC water supply reliablilty under various potential future water demands, and under both historical and hypothetical (design drought) hydrologic conditions.

4.1 Projected Action Levels Assuming Historical Hydrologic Conditions

Under historical hydrologic conditions, Shortage Action Level 1 occurs in 13 years during the Minimum Demand simulation, and Action Levels 2 and 3 do not occur. In the Intermediate Demand simulation, Action Level 1 occurs during six years, Action Level 2 occurs during 7 years, and Action Level 3 occurs during 1 year (1992). In the Maximum Demand simulation, Action Level 1 occurs during 7 years, Action Level 2 occurs during 6 years, and Action Level 3 occurs during 2 years. A summary of the count of action levels applied in all 3 simulations is shown in Table 4. Figures 5-7 show the Shortage Action Levels applied for the Minimum, Intermediate and Maximum Demand scenarios, respectively.

Table 4 Projected SFPUC Shortage Action Levels with Historical Hydrology			
Shortage Action Level	Projected Supply Reduction to the BAWSCA Member Agencies		
	Minimum Demand Scenario (224 mgd)[1]	Intermediate Demand Scenario (252 mgd)[1]	Maximum Demand Scenario (265 mgd)[1]
1924	1	1	1
1931	1	2	2
1934	1	1	1
1948	1	1	1
1960	0	0	1
1961	1	2	2
1976	1	1	1
1977	1	2	2
1987	0	1	1
1988	1	2	2
1989	1	2	2
1990	1	2	3
1991	1	2	2
1992	1	3	3
1994	1	1	1

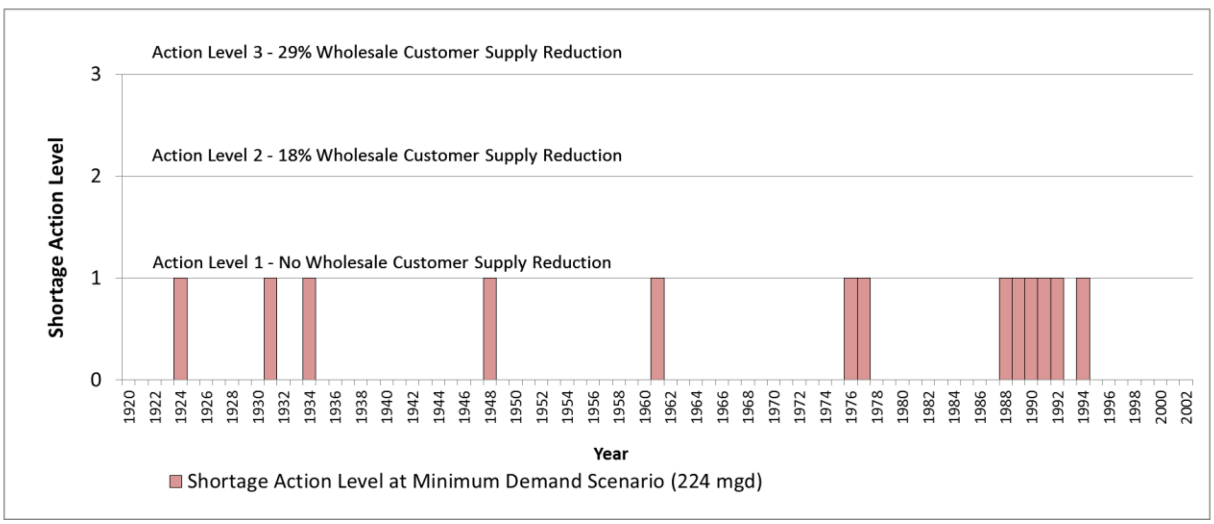


Figure 5
Projected Shortage Action Level for Minimum Demand Scenario (Assuming Historical Hydrology)

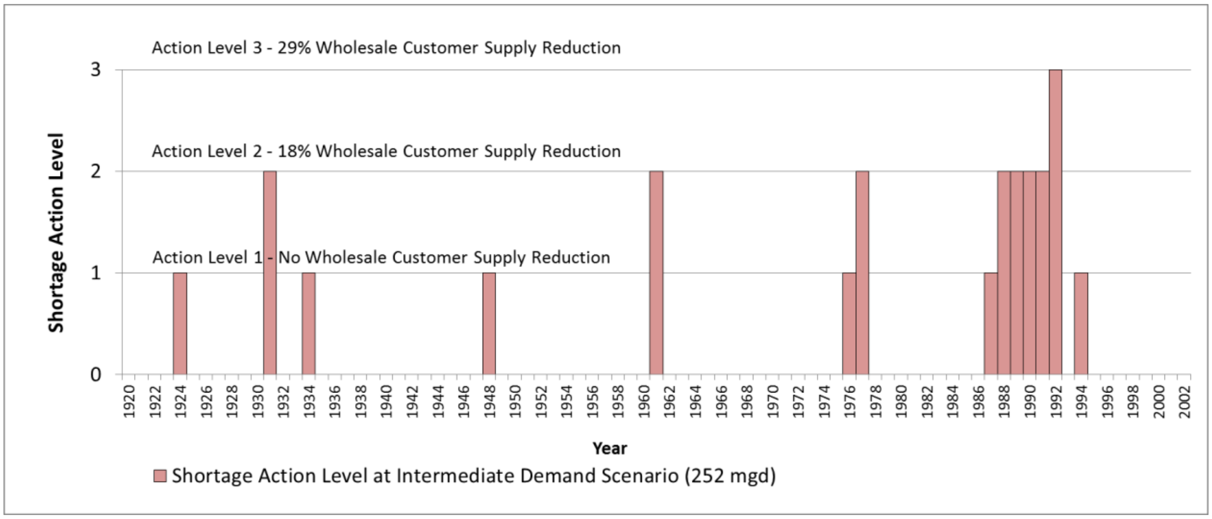


Figure 6
Projected Shortage Action Level for Intermediate Demand Scenario (Assuming Historical Hydrology)

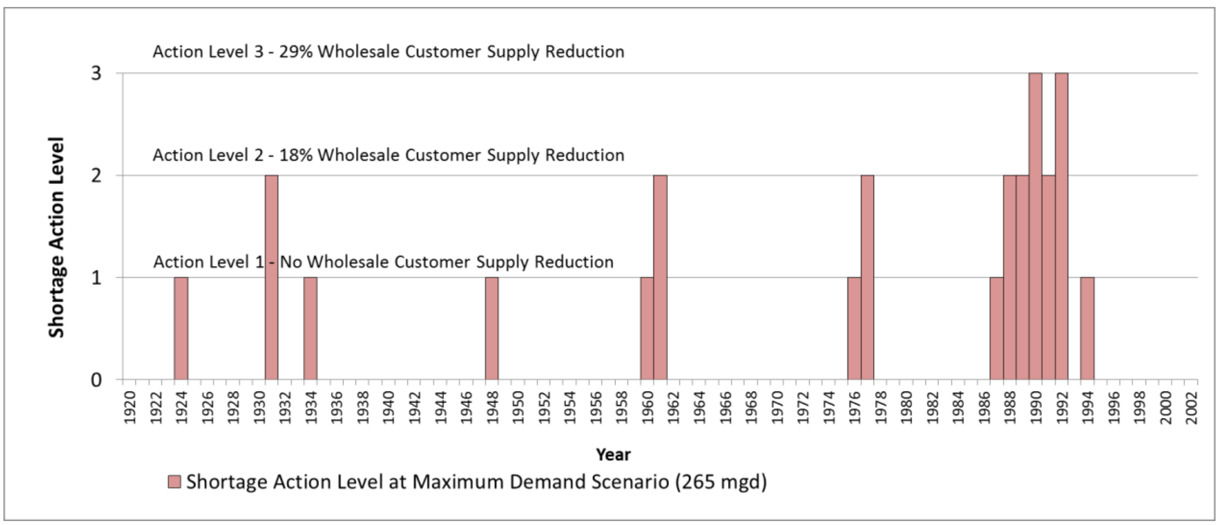


Figure 7
Projected Shortage Action Level for Maximum Demand Scenario (Assuming Historical Hydrology)

4.2 Shortfalls Assuming Historical Hydrologic Conditions

Shortage Action Level 1 does not result in a water supply shortage, but Levels 2 and 3 result in supply shortages in the HH/LSM. Under historical hydrologic conditions (as opposed to the Design Drought conditions), the Minimum Demand scenario results in no water supply shortfalls. The Intermediate and Maximum Demand scenarios result in drought shortages in eight years during the 82-year simulation: 1931; 1961; 1977; and 1988-92.Table 5summarizes the projected supply reduction to the BAWSCA member agencies and the years in which they occur. Figures 8 and 9 show the supply reductions for the Intermediate and Maximum Demand scenarios, respectively. Because there are no simulated supply reductions for the Minimum Demand scenario, supply reductions for the Minimum Demand scenario are not plotted.

Table 5
Projected SFPUC Supply Reduction to BAWSCA Member Agencies with Historical Hydrology Only

Year	Projected Supply Reduction to the BAWSCA Member Agencies		
	Minimum Demand Scenario (224 mgd)[1]	Intermediate Demand Scenario (252 mgd)[1]	Maximum Demand Scenario (265 mgd)[1]
1931	0%	18%	18%
1961	0%	18%	18%
1977	0%	18%	18%
1988	0%	18%	18%
1989	0%	18%	18%
1990	0%	18%	29%
1991	0%	18%	18%
1992	0%	29%	29%

[1] Total demand including San Francisco Retail and Wholesale Customers

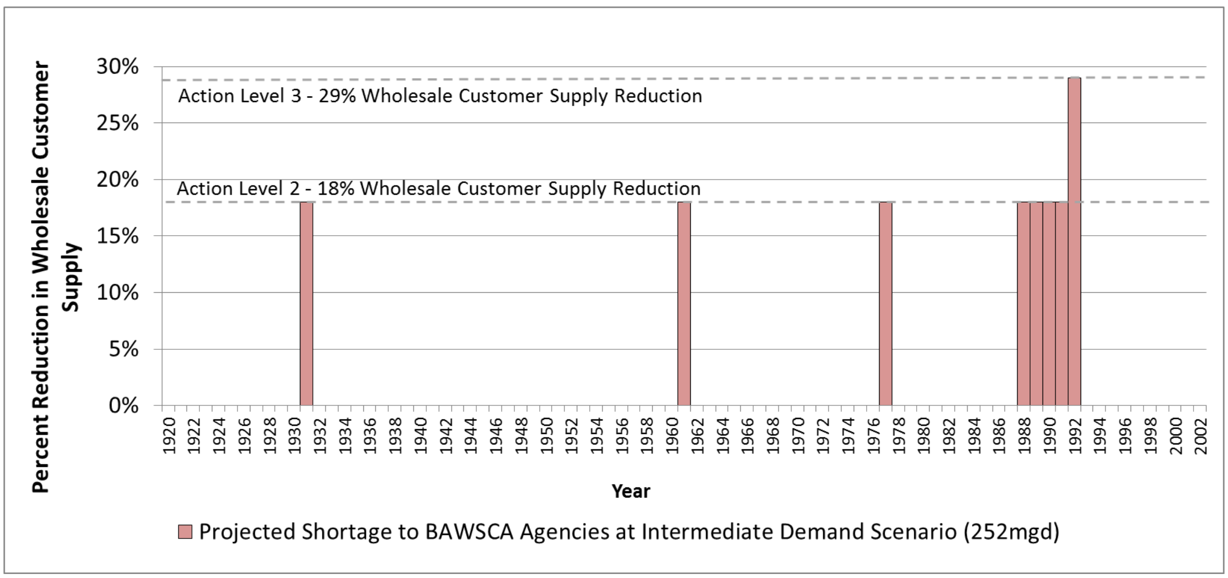


Figure 8
Projected SFPUC Supply Reduction to BAWSCA Member Agencies (Assuming Maximum Demand and Historical Hydrology)

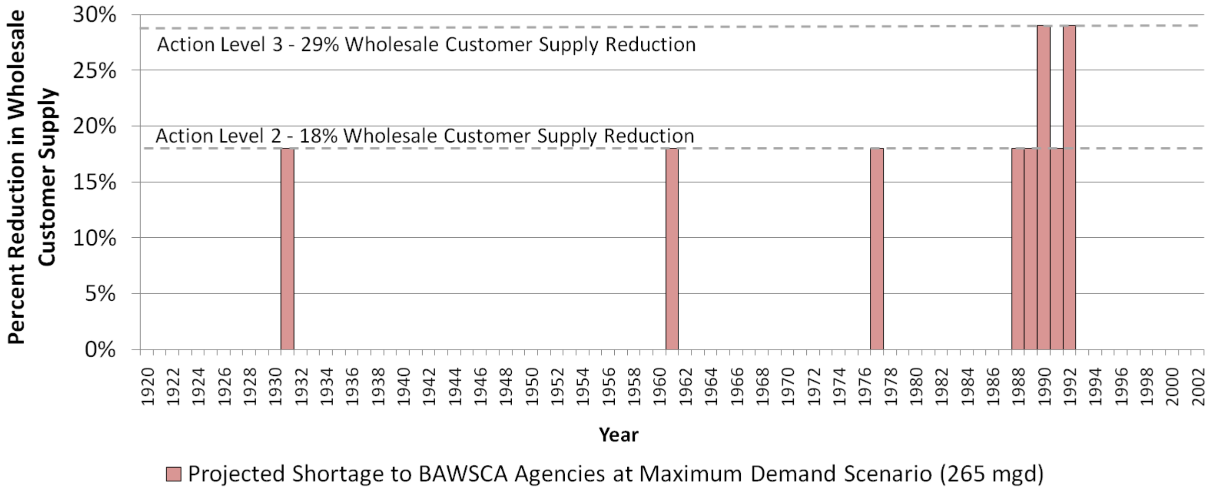


Figure 9
Projected SFPUC Supply Reduction to BAWSCA Member Agencies (Assuming Maximum Demand and Historical Hydrology)

4.3 Projected Action Levels Assuming Design Drought Conditions

Under the Design Drought evaluation, the hydrology for the years leading up to the Design Drought itself (1920-1987) is the same as those in the historical hydrology conditions analysis. However, the Design Drought extends the 1988-92 drought period through 1994. The two additional years of drought produce a shortage Action Level of 3 in the Intermediate and Maximum Demand scenarios.

Under Design Drought hydrologic conditions, Shortage Action Level 1 occurs in 14 years during the Minimum Demand simulation, and Action Levels 2 and 3 do not occur. In the Intermediate Demand simulation, Action Level 1 occurs during five years, Action Level 2 occurs during seven years, and Action Level 3 occurs during three years (1992-1994). In the Maximum Demand simulation, Action Level 1 occurs during six years, Action Level 2 occurs during six years, and Action Level 3 occurs during four years. A summary of the count of action levels applied in all 3 simulations is shown in Table 6. Figures 10-12 show the Shortage Action Levels applied for the Minimum, Intermediate and Maximum Demand scenarios, respectively, with the two additional years of drought identified by cross hatching.

Table 6 Projected SFPUC Shortage Action Levels with Historical Hydrology			
Shortage Action Level	Projected Supply Reduction to the BAWSCA Member Agencies		
	Minimum Demand Scenario (224 mgd)[1]	Intermediate Demand Scenario (252 mgd)[1]	Maximum Demand Scenario (265 mgd)[1]
1924	1	1	1
1931	1	2	2
1934	1	1	1
1948	1	1	1
1960	0	0	1
1961	1	2	2
1976	1	1	1
1977	1	2	2
1987	0	1	1
1988	1	2	2
1989	1	2	2
1990	1	2	3
1991	1	2	2
1992	1	3	3
1993	1	3	3
1994	1	3	3

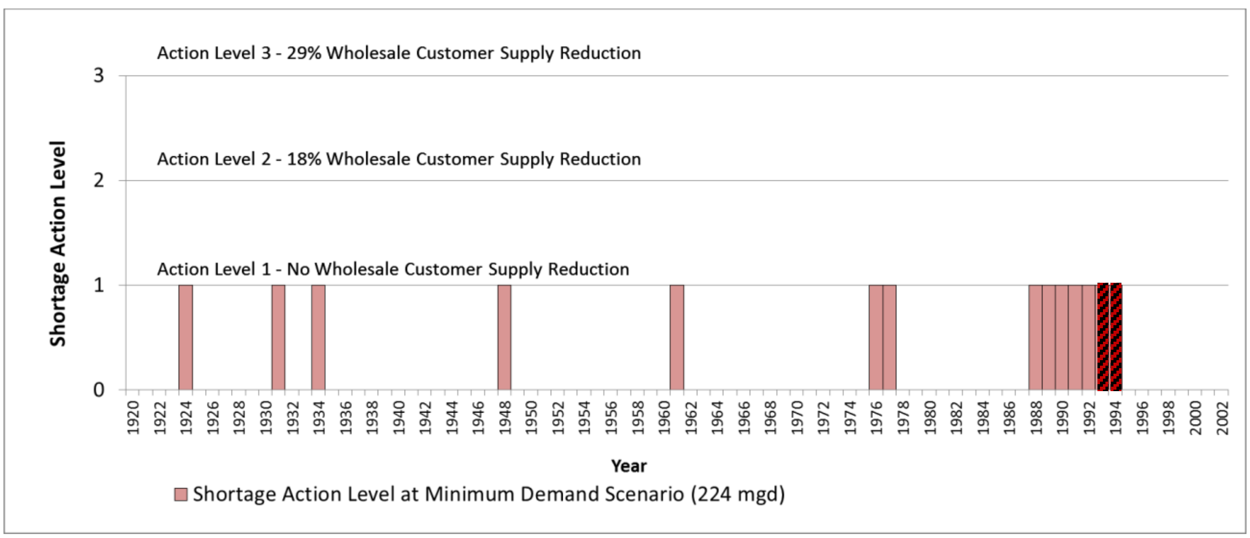


Figure 10
Projected Shortage Action Level for Minimum Demand Scenario (Assuming Historical Hydrology)

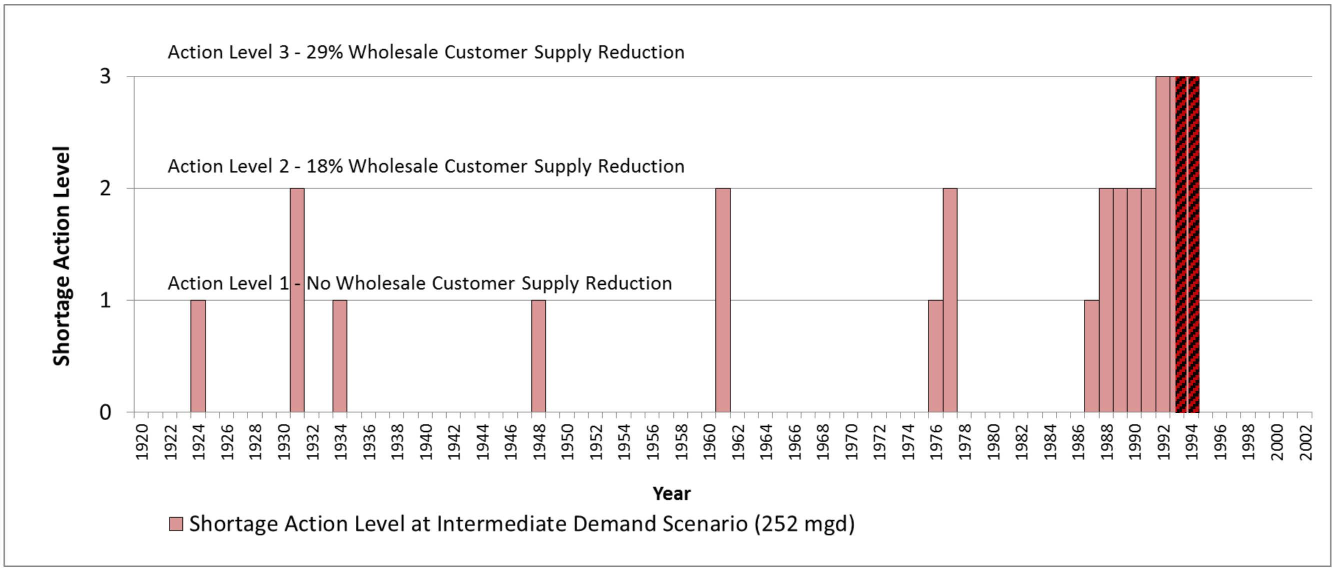


Figure 11
Projected Shortage Action Level for Intermediate Demand Scenario (Assuming Historical Hydrology)

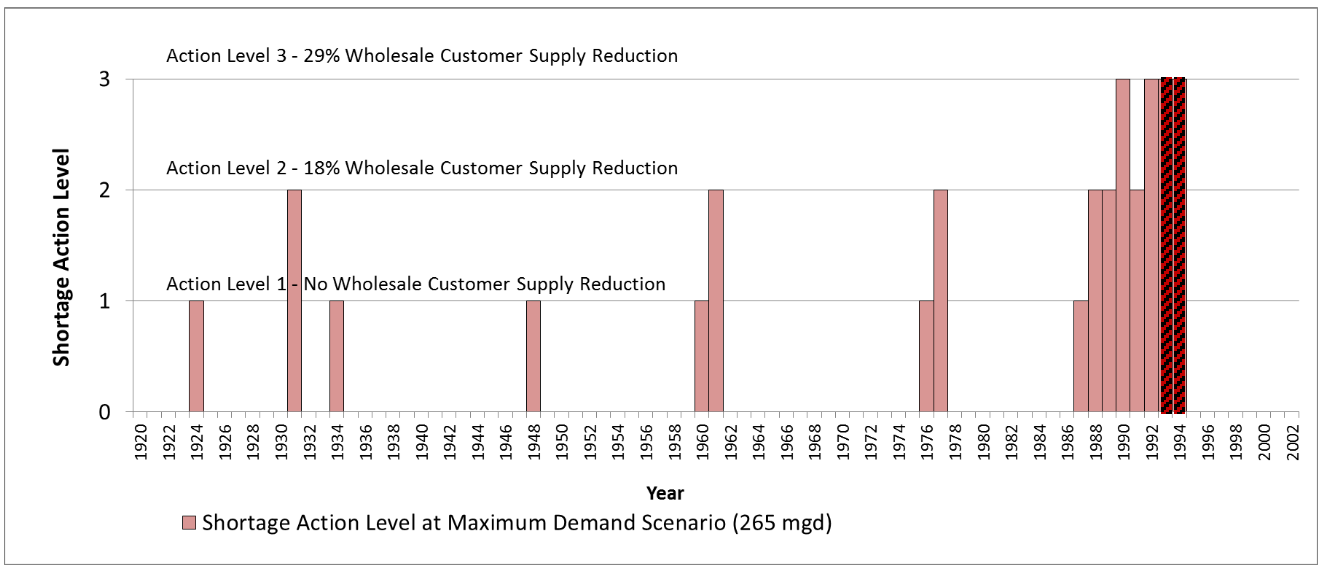


Figure 12
Projected Shortage Action Level for Maximum Demand Scenario (Assuming Historical Hydrology)

4.4 Estimated Future Shortfalls Assuming Design Drought Hydrologic Conditions

Under historical hydrologic conditions, the Minimum Demand scenario results in no water supply shortfalls, even during the Design Drought. The Intermediate and Maximum Demand scenarios result in drought shortages in 10 years during the 82-year simulation: 1931; 1961; 1977; and

1988-94. Table 7 summarizes the projected supply reduction to the BAWSCA member agencies and the years in which they occur, and also shows the years with a supply shortfall under all demand scenarios for the Design Drought evaluation. Figures 13 and 14 show shortages under the Design Drought evaluation for the Intermediate and Maximum Demand scenarios, with the two additional years of drought identified by cross hatching.

Table 7
Projected Supply Reduction to BAWSCA Member Agencies Under the Design Drought Evaluation

Year	Projected Supply Reduction to BAWSCA Member Agencies		
	Minimum Demand Scenario (224 mgd)[1]	Intermediate Demand Scenario (252 mgd)[1]	Maximum Demand Scenario (265 mgd)[1]
1931	0%	18%	18%
1961	0%	18%	18%
1977	0%	18%	18%
1988	0%	18%	18%
1989	0%	18%	18%
1990	0%	18%	29%
1991	0%	18%	18%
1992	0%	29%	29%
1993	0%	29%	29%
1994	0%	29%	29%

[1] Total demand including San Francisco Retail and Wholesale Customers

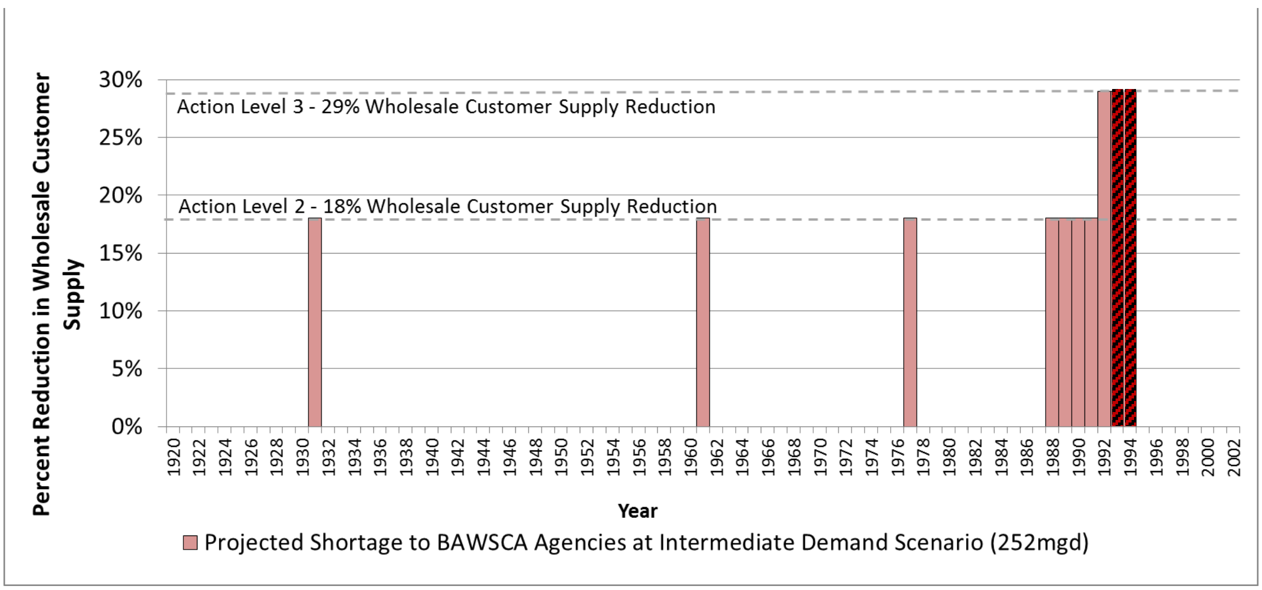


Figure 13
Projected SFPUC Supply Reduction to BAWSCA Member Agencies (Assuming Intermediate Demand and Design Drought)

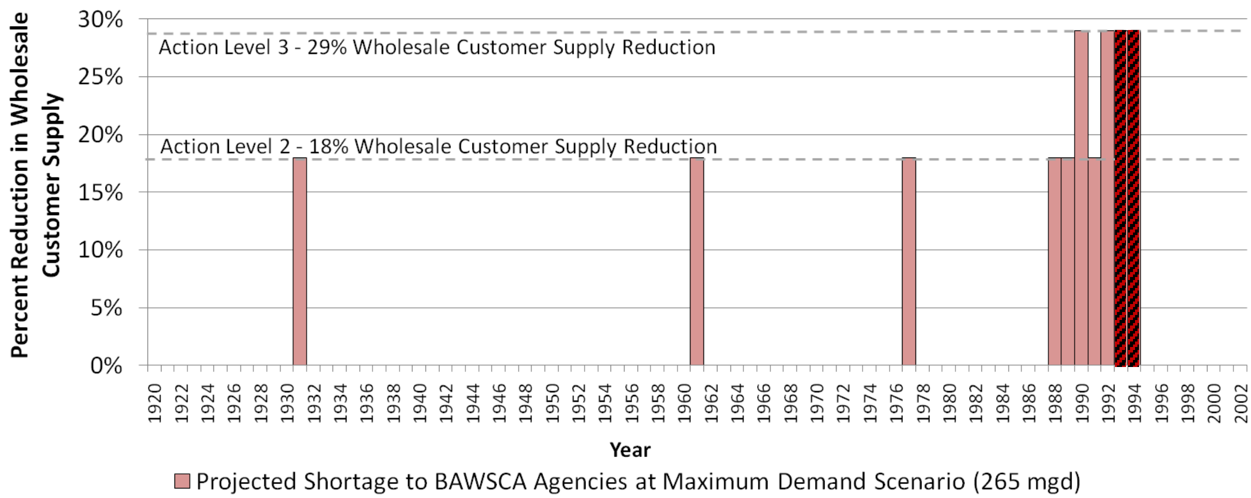


Figure 14
Projected SFPUC Supply Reduction to BAWSCA Member Agencies (Assuming Maximum Demand and Design Drought)

5.0 Considering Recent Dry Years May Increase Projected Number of Shortfalls

While the SFPUC's HH/LSM provides the best information to date on the frequency and magnitude of the anticipated supply shortfalls on the SF RWS for different projected future demand scenarios, these estimates may not provide the complete picture of the reliability of the SFPUC supply. For example, the SFPUC modeling is based on the historical hydrologic sequence from 1920 through 2002. While this 82-year record does include a number of significant dry periods, it does not capture the recent droughts experienced on the SF RWS between 2002 and 2012. Specifically, the calls for 10% voluntary rationing in 2007 and 2008 (i.e., Action Level 2 shortages) are not accounted for, nor is the very dry year of 2011 represented. If these shortages are factored in, the frequency of cutbacks appears to increase to eleven (11) Action Level 2 or 3 years over the 92-year analysis period. Two multiple dry year events, including the drought of record, have occurred over the last 25 years.

By comparison, the recent water system modeling done by East Bay Municipal Utility District (EBMUD) that extends through 2011 does include these more recent drought conditions. As illustrated in Figure 15, SFPUC's projected Action Levels appear to roughly correlate with the years that EBMUD has identified as "Dry" and "Critical Dry". As such, it would be expected that if the SFPUC modeling did extend through 2011, additional dry years would be identified on the SF RWS, and these results may change the current estimates of drought frequency. The SFPUC has indicated that it is extending the HH/LSM simulation period through 2011, and the updated model should be available by Fall 2012.

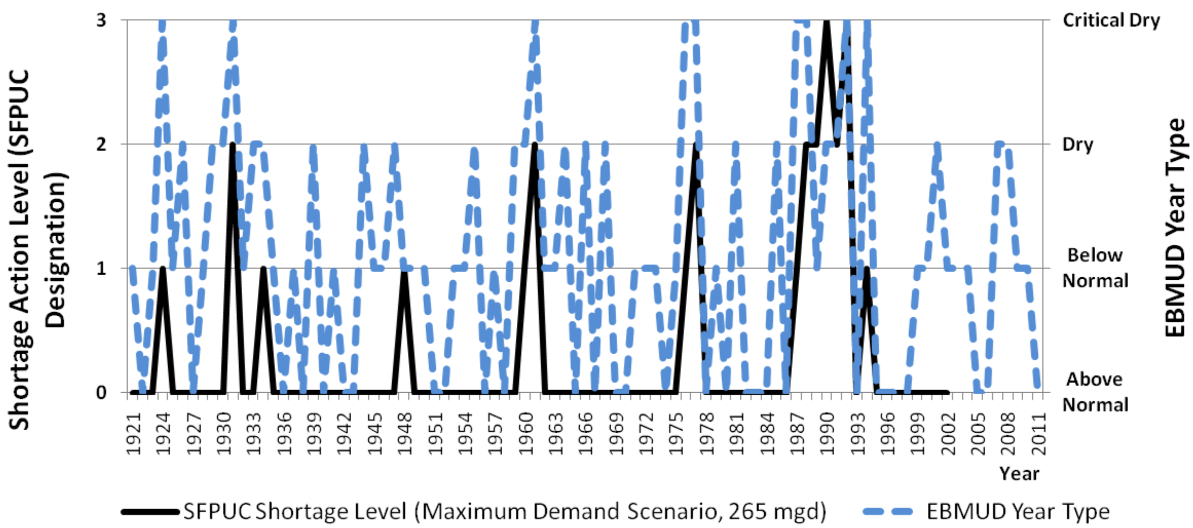


Figure 15
Comparison of SFPUC and EBMUD Water System Hydrology – Water Year Type Classification Indicates Potential Increased Frequency of SFPUC Supply Shortfall in Recent Years

6.0 Conclusions

With assistance from the SFPUC, the HH/LSM was used to assess SFPUC water supply reliability under various hydrologic conditions and demand scenarios. The three potential demand scenarios analyzed vary from annual water use consistent with total BAWSCA purchases for the fiscal year 2009-2010, 148.6 mgd, to the maximum supply that SFPUC has guaranteed to make available to BAWSCA in a normal hydrologic year, 186.1 mgd. The various demand scenarios were analyzed under both historical and hypothetical design drought hydrologic conditions.

Analysis of HH/LSM results indicates that under minimum demand conditions, no supply shortages would be imposed on BAWSCA supplies, even in design drought hydrologic conditions. However, model results from both the intermediate and maximum demand scenarios indicate that with BAWSCA demands above the minimum scenario, shortages of up to an average of a 29% supply reduction across BAWSCA member agencies would be likely in the event of a severe drought. The design drought HH/LSM simulations indicate three continuous years with a 29% supply reduction for both intermediate and maximum demands.

Attachment 5

Phase II A Task Status and Planned Reprogramming of Tasks

CDM Smith

Attachment 5

Phase II A Task Status and Planned Reprogramming of Tasks

This attachment presents the Phase II A task status as of April 1, 2012, the recommended additional work to be completed from April through September 2012, and recommended additional work from September through December 2014. Activities that are identified as "Reprogrammed" indicate changes from the original Phase II A Scope of Work.

Table 1 – Phase II A Task Status and Planned Reprogramming of Tasks

Phase II A Tasks	Current Status	Work Product - OR - Reason For Scope Modification	Recommended Additional Work (April - Sept. 2012)[1]	Recommended Additional Work (Sept. 2012 – Dec. 2014)[1]
Task 1 Update Water Demand	Complete	TM-1; Phase II A Report	-	-
Task 2 Update Agency-Identified Water Supply Management Project Information	Complete	TM-2; Phase II A Report	-	-
Task 3 Update Regional Water Supply Management Project Information	Complete	TM-3; Phase II A Report	-	-
Task 4 Perform Fatal Flaw Analysis and Screening of Agency-Identified Projects and Regional Projects	Complete or Reprogrammed	TM-2; TM-3; Draft Task 4-A Memo; Phase II A Report	-	Possible updates to criteria and screening.
Task 5 Develop Analysis Tools to Assess Regional Systems Operations	Complete or Reprogrammed	Draft Task 5-F Memo; Draft Task 5-C Memo; Development of supporting information was reprogrammed or made more sense to complete after the number of projects had been narrowed and the type of projects and their key information was known.	X	X
Task 6 Develop, Evaluate and Compare Projects and Portfolios	Complete or Reprogrammed	Draft Task 6-A Memo; Draft Task 6-B Memo; Phase II A Report; Development of supporting information was reprogrammed or made more sense to complete after the number of projects had been narrowed and the type of projects and their key information was known.	X	X
Task 7 Develop Recommendations to Inform Development of Phases II B, C and Phase III	Complete, Reprogrammed, or Eliminated	Phase II A Report; Development of supporting information was reprogrammed; No additional work required.	X	X

Table 1 – Phase II A Task Status and Planned Reprogramming of Tasks

Phase II A Tasks	Current Status	Work Product - OR - Reason For Scope Modification	Recommended Additional Work (April - Sept. 2012)[1]	Recommended Additional Work (Sept. 2012 – Dec. 2014)[1]
Task 8 Identify Scope & Budget for Phase II B	Complete, Reprogrammed, or Eliminated	Phase II A Report; Development of supporting information was reprogrammed; No additional work required.	X	-
Task 9 Identify Preliminary Scope and Budget for Phase II C	Eliminated	Being completed as part of Final Strategy within existing budget.	-	-
Task 10 Prepare Phase II A Report	Complete	Phase II A Report	-	-
Task 11 Project Management	Ongoing	-	X	X
Task 12 Pilot Water Transfer Analysis				
EBMUD Water Transfer	New	A key recommendation from Phase II A is for BAWSCA to pursue a pilot water transfer project to meet the dry year need.	-	Support BAWSCA to develop a pilot water transfer plan and implement a pilot water transfer with EBMUD.
SCVWD Water Transfer	New	A key recommendation from Phase II A is for BAWSCA to pursue a pilot water transfer project to meet the dry year need.	-	Support BAWCSA to evaluate potential opportunities to conduct a pilot water transfer with SCVWD.
Additional work reviewing SFPUC Emergency Intertie flows and water quality	New	A key recommendation from Phase II A is for BAWSCA to pursue a pilot water transfer project to meet the dry year need.	-	Evaluate potential impacts of non-emergency transfers on permitting, operations, water quality, and other matters related to use of the existing interties.
Task 13 Prepare Final Strategy Report	New	Final Strategy Report	-	X

[1] "X" - indicates that work will be completed during this period. "-" indicates no additional work planned.