Section 7 Evaluation of Groundwater Management Alternatives

This section documents the reconnaissance-level evaluation of the groundwater management alternatives described in the previous section. The evaluation criteria include consistency with the goals described in Section 5, reliability of supply, cost, and implementation difficulty.

7.1 Consistency with SJBGMFP Goals

The management goals of the SJBGMFP were developed by the SJBA TAC, and impediments to achieving those goals and a list of actions that could be implemented to overcome the impediments were identified. The goals, impediments, and action items are listed in detail in Table 5-8. The goals include:

- Goal No. 1 – Enhance Basin Water Supplies. In addition to local groundwater, this goal applies to all sources of water available for the enhancement of the San Juan Basin (Basin). The intent is to maximize the use of all available water in the Basin. This goal will be accomplished by increasing the recharge of all available waters, including storm water discharge, dry-weather discharge, and recycled water.

- Goal No. 2 – Protect and Enhance Water Quality. The intent of this goal is to improve surface and groundwater quality to ensure the maximum use and reuse of available supplies and to minimize the cost of groundwater treatment. This goal will be accomplished by implementing activities that capture and treat contaminated groundwater for direct high-priority beneficial uses, implementing the recharge of storm water discharge, and encouraging better management of waste discharges that impact groundwater.

- Goal No. 3 – Maximize the Use of Unused Storage Space. The intent of this goal is to maximize the use of the Basin's storage capacity to improve water supply availability. This goal will be accomplished by determining the temporal and spatial availability of unused storage space in the Basin and subsequently determining how best to use that space to increase operational flexibility and water supply reliability.

- Goal No. 4 – Satisfy State Requirements for a Groundwater Management Program. The intent of this goal is to integrate the SJBGFMP into the South Orange County regional water management plan and to improve the opportunity of obtaining outside funding for SJBGFMP implementation. This goal will be accomplished by ensuring that the SJBGFMP contains the minimum elements required for a groundwater management plan and by inclusion of the SJBGFMP in the County's Integrated Regional Water Management Plan.

- Goal No. 5 – Establish Equitable Share of the Funding, Benefits, and Costs of the SJBGFMP. The intent of this goal is to align the benefits of the SJBGFMP with individual SJBA member agencies and SJBGFMP implementation costs. This goal will be accomplished by clearly articulating the benefits of the SJBGFMP to each

SJBA member agency and subsequently allocating the funding and costs in an equitable manner.

Table 7-1 shows the alignment of the alternatives to the management goals. The management alternatives were crafted to remove impediments to the goals and to exploit available resources. Thus, all but the baseline alternatives (Alternatives 1 and 7) have some or complete consistency with the goals. Alternative 1 is a refined version of the current status quo, and Alternative 7 is identical to Alternative 1 except it includes the SOCOD project. In these two alternatives, current producers do the best they can, given available resources and management, with the CSJC and SCWD managing their production pursuant to existing diversion permits and the interagency agreements. The other alternatives have varying amounts of new resources and management overlays that increase the yield overall and improve the reliability of the groundwater supply.

7.2 Yield and Costs of the Management Alternatives

Yield as used herein refers to the maximum production that can be developed from the basin in a year, given the location of wells, the hydrology, and management activities. Because the basin is small, the yield will be variable and highly responsive to stormwater recharge, activities that increase recharge, and pumping. Table 7-2 summarizes the yield of each alternative and the increments of new yield by management component. Tables 7-3a, b and c describe the cost opinions for a seawater injection barrier, a seawater extraction barrier, and a Ranney collector well, respectively. The cost to construct in-stream recharge facilities for storm and recycled water are $400,000 per year and $500,000 per year, respectively, based on information provided by OCWD.[35] The cost of recovering any water recharged in the basin was assumed to be $900 per acre-ft, based on the unit cost (all in capital and operations and maintenance costs, reduced by grant funding) projected for the Chino Basin desalter expansion.[36] An economic analysis of the recycled water recharge project was not completed in this SJBGMFP update as it was created late in the planning process and will require a substantial effort to complete. Table 7-4 summarizes the new yield and the volume weighted unit cost of new yield.

The average yield developed from the basin under Alternatives 1 and 7 (baseline alternatives) are about 9,200 acre-ft/yr and 7,500 acre-ft/yr, respectively; the decrease in Alternative 7 is attributable to the SOCOD project. The various management components added in the other alternatives increase yield during primarily dry periods, and some increase yield irrespective of the hydrology.

Alternatives 2 and 3 were designed to prevent seawater intrusion (Goals 2 and 4 and a requirement of the SJBA and SCWD diversion permits) and enhance yield (Goal 1). Alternative 2 does this through strategically located injection wells using supplemental water, and Alternative 3 accomplishes this through a seawater extraction barrier. Alternative 3 will produce a new supply that can benefit all members of the SJBA, in particular those SJBA members that are considering participation in the SOCOD project. The new yield from Alternative 3 will range from 2,000 to 4,000 acre-ft/yr—3,000 acre-ft/yr was assumed in

[35] Personal communication with Adam Hutchinson of OCWD, January 2013.

[36] Personal communication with Jack Safely of Western Municipal Water District, May 2013.

Tables 7-2 and 7-4. Alternative 2 will require supplemental water that could otherwise be put to use without treatment and will produce a relatively small increment to the groundwater yield compared to Alternative 3. 800 acre-ft/yr[37] was assumed in Tables 7-2 and 7-4. The final groundwater management plan must contain either an injection or extraction barrier to ensure that the SJBA member agencies can fully develop their diversion permits. The cost to construct four injection wells capable of injecting up to 1,000 acre-ft yr and connect them to the imported water system is about $3.0 million with an annual cost of about $1.2 million.[38] The unit cost to inject and recover water in Alternative 2 would be about $2,439 per acre-ft. The cost to construct the extraction barrier, treatment plant, and conveyance facilities capable of producing 3,000 acre-ft/yr long-term would be about $42 million with an annual cost of about $4.0 million. The unit cost to produce water would be about $1,326 per acre-ft.

Alternative 4 incorporates one or two Ranney-style collector wells that will enable the SJBA members to produce groundwater when levels are low due to drought and will increase the yield by creating space for new stormwater recharge (consistent with Goals 1, 2, and 3). Also included in Alternative 4 are adaptive production management and a seawater intrusion barrier. Recall from Section 3 that groundwater yield is predicted to be less than hoped for due to the small basin storage and relatively large production. Operating the basin at lower groundwater levels will increase storm water recharge. However, operating at lower levels may make it difficult or impossible for overlying producers to produce groundwater pursuant to their water rights. The SJBA and SCWD diversion permits currently limit the producers from lowering storage and impacting the overlying producers. Therefore, the SJBA would have to provide an alternative water supply for overlying producers if Ranney-style collector wells were used. The increase in groundwater production due to the construction of a Ranney-style collector well and the replacement of the overlying producers' groundwater supply are about 1,000 acre-ft/yr and 500 acre-ft/yr, respectively. It is anticipated that this new yield will be recovered within the existing capacity of the CSJC and SCWD treatment plants with a net yield of 1,200 acre-ft/yr.[39] The total yield for Alternatives 4a and 4b, with all components in, will be about 11,100 or 13,400 acre-ft/yr, respectively. The cost to construct a Ranney collector well is estimated to be about $5.5 million with an annual cost of about $651,000. The new yield is estimated to be about 2,000 acre-ft/yr at $1,841 per acre-ft for Alternative 4a and about 4,200 acre-ft at $1,445 per acre-ft for Alternative 4b.

Alternative 5 incorporates in-stream storm and dry-weather flow recharge facilities identical to what the OCWD does in the Santa Ana River (consistent with Goals 1, 2, and 3). Also included in Alternative 5 are adaptive production management, a seawater intrusion barrier, and Ranney-style collector wells. The increase in recharge for this alternative is estimated to range from 500 to 2,000 acre-ft/yr and was assumed to be 1,000 acre-ft/yr. It is anticipated that this new yield will be recovered within the existing capacity of the CSJC and SCWD treatment plants with a net yield of 800 acre-ft/yr. The total yield for Alternatives 5a and 5b with all components in will be 12,000 or 14,200 acre-ft/yr, respectively. There is no capital

[37] 1,000 acre-ft/yr would be injected. About 800 acre-ft/yr of the water would be recovered at the SCWD desalter, and the remaining 200 acre-ft/yr would discharged as brine to the SOCWA ocean outfall.

[38] Annualized capital cost (5 percent and 30 years) plus other operations and maintenance costs. These assumptions apply for all annualized costs.

[39] 20 percent of the new yield was assumed to be discharged as brine to the SOCWA ocean outfall.

cost assumed herein with the in-stream recharge facilities. The new yield is estimated to be about 2,800 acre-ft/yr at $1,715 per acre-ft for Alternative 5a and about 5,000 acre-ft at $1,438 per acre-ft for Alternative 5b.

Alternative 6 incorporates large-scale recycled water recharge and subsequent indirect potable reuse to develop a new source of potable water for the SJBA area. Also included in Alternative 6 are adaptive production management, a seawater intrusion barrier, and in-stream stormwater recharge facilities. In this alternative, natural and recycled water recharge would comingle in the groundwater basin, be recovered at wells, and be treated prior to use. This type of reuse project has been recently developed and successfully implemented in the Chino Basin by the Inland Empire Utilities Agency. Up to 10,000 acre-ft/yr of recycled water could be recharged in this alternative, starting at 1,000 acre-ft/yr and gradually increasing to full capacity. The additional stormwater recharge from in-stream recharge facilities will dilute and partially offset the salt load from the recycled water. The existing groundwater treatment facilities will have to be expanded or new facilities built to treat the additional 10,000 acre-ft/yr of new recharge created in this alternative. The type of treatment anticipated in this alternative is a combination of iron and manganese removal and reverse osmosis with an overall recovery of 80 percent. Therefore, the yield will be about 8,000 acre-ft/yr. The total yield for Alternative 6 with all components in will be about 21,400 acre-ft/yr, an increase of 12,200 acre-ft/yr over baseline conditions. There is no capital cost assumed herein with the in-stream recharge facilities. There will be a construction cost associated with the recycled water conveyance system required to distribute recycled water to in-stream recharge facilities and an annual cost for the treatment of recycled water—these costs have been excluded herein. The new yield is estimated to be about 12,200 acre-ft/yr at $1,042 per acre-ft.

Alternatives 8, 9, and 10 are identical to Alternatives 4, 5, and 6, respectively, except they do not include a seawater barrier component—the seawater barrier component is provided by the operation of SOCOD. The differences in yield are caused by SOCOD (-1,700 acre-ft/yr) and the seawater barrier projects. The new yield and unit cost estimates are listed in Table 7-4.

7.3 Implementation Difficulty

Implementation difficulty is best characterized by the features of the individual management components and then by Alternative. Table 7-5 summarizes the implementation difficulty by management component and management alternative.

7.3.1 Adaptive Production

Adaptive production is featured in all management alternatives. The implementation difficulty is not significant.

Adaptive production is required to comply with the diversion permits held by the SJBA and SCWD and with the interagency agreements. The SJBA would set annual groundwater production limits in the spring of each year based on groundwater levels measured that spring and an estimate of the groundwater storage that spring. These production limits would hold until the following spring. Since the permits and agreements are in place, the only obstacle to implementing adaptive production is the SJBA's decision to implement it.

7.3.2 Seawater Injection Barrier

The construction and operation of a seawater injection barrier is featured in Alternatives 2, 4a, and 5a. The implementation difficulty is not significant.

Environmental impacts will be insignificant if wells and conveyance facilities are sited properly. Imported water lines are close and future access to recycled water is also close. The injection wells will protect water quality in the San Juan Basin.

7.3.3 Seawater Extraction Barrier

The construction and operation of a seawater extraction barrier is featured in Alternatives 3, 4b, and 5b. The implementation difficulty is potentially significant.

There may be significant environmental impacts from the construction of wells, conveyance facilities, and treatment facilities. Some wells will be located close to the coast and have a greater level of regulatory scrutiny. There may be concerns regarding hydraulic impacts on the near shore lagoon from the operation of the barrier wells. These concerns can be technically addressed through careful siting of the facilities.

7.3.4 Ranney Collector Wells

The construction and operation of one or two Ranney collector wells is featured in Alternatives 4, 5, 8, and 9. The implementation difficulty is potentially significant.

Environmental impacts will be insignificant if wells and conveyance facilities are sited properly. There may be potentially significant environmental impacts from the cumulative drawdown caused by these and other wells that could limit the ability of overlying producers, such as the San Juan Hills golf course. This concern can be technically addressed by providing the overlying producers with alternative water supplies.

7.3.5 Enhanced Stormwater Recharge and Recycled Water Recharge

The construction of in-stream recharge facilities for stormwater recharge is featured in Alternatives 5, 6, 9, and 10, and for the recharge of recycled water in Alternatives 6 and 10.

The construction and reconstruction of berms in San Juan Creek may be problematic. Berms used for stormwater recharge would be constructed in October each year and reconstructed during the October through April period as necessary to maximize recharge. The upper reaches of San Juan Creek and the Arroyo Trabuco are Steelhead Trout habitat, and the berm construction and reconstruction process would have to include consideration of fish passage. There may be other sensitive habitat in San Juan Creek that would need to considered and mitigated. It is not clear at this time that these concerns can be addressed.

The process to obtain a permit to recharge recycled water is complex and time-consuming. The locations of recharge and recovery need to be thoroughly studied, and some wells may have to be relocated. These concerns can be technically addressed.

7.4 Recommended Alternative

The alternatives were reviewed and evaluated by the SJBA TAC members using the evaluation criteria described above and considerations of their individual agencies. The features of the alternatives were described at two SJBA Board meetings in late 2012. Based on the management goals of the SJBGMFP articulated in Section 5 and the ability of these alternatives to attain these goals, the SJBA TAC has recommended the phased implementation of Alternative 6. If MWDOC proceeds with the SOCOD project then the SJBA TAC recommends the phased implementation of Alternative 10. The implementation plan for Alternatives 6 and 10 are discussed in Section 8.

7.5 SJBGFMP Consistency with SB 1938

SB 1938, signed into law in 2002, requires any public agency seeking State funds administered through DWR for the construction of groundwater projects or groundwater quality projects to prepare and implement a groundwater management plan with certain specified components. Requirements include establishing basin management objectives, preparing a plan to involve other local agencies in a cooperative planning effort, and adopting monitoring protocols that promote efficient and effective groundwater management. The requirements applies to both agencies that have already adopted groundwater management plans as well as agencies that do not overlie groundwater basins identified in Bulletin 118 and its updates. The California Budget Act of 1999 directed DWR to complete several tasks including the development of criteria for evaluating groundwater management plans. In response to this mandate, DWR developed a set of recommended components for groundwater management plans with the intent of providing a framework by which local agencies can proactively plan for and implement effective management programs.

These components are listed in Appendix C of Bulletin 118 and are listed below along with the demonstration of compliance with these components in the 2013 SJBGFMP Update and subsequent SJBA actions.

1. Include documentation that a written statement was provided to the public *"describing the manner in which interested parties may participate in developing the groundwater management plan,"* which may include appointing a technical advisory committee (Water Code § 10753.4 (b)).

2013 SJBGFMP Update and Subsequent SJBA Actions – The SJBA conducted two formal workshops where the public was invited to attend through posted public notices and provide comments. Various deliverables of the development process were presented orally at regularly scheduled SJBA Board meetings and the public was informed of these meetings through public notices. A draft report was published on the SJBA website and the public comment was solicited and obtained. Each comment was responded to directly and the comment and responses are included in Appendix A to the SJBGFMP.

2. Include a plan by the managing entity to *"involve other agencies that enables the local agency to work cooperatively with other public entities whose service area or boundary overlies the groundwater basin."* (Water Code § 10753.7 (a)(2)). A local agency includes *"any local public agency that provides water service to all or a portion of its service area"* (Water Code § 10752 (g)).

2013 SJBGFMP Update and Subsequent SJBA Actions – All agencies serving water in the SJBGFMP active management area were involved with the development of the SJBGFMP and include the CSJC, MNWD, SCWD and SMWD.

3. Provide a map showing the area of the groundwater basin, as defined by DWR Bulletin 118, with the area of the local agency subject to the plan as well as the boundaries of other local agencies that overlie the basin in which the agency is developing a groundwater management plan (Water Code § 10753.7 (a)(3)).

2013 SJBGFMP Update and Subsequent SJBA Actions – The 2012 SJBGFMP Update report (this report) contains several maps that define the groundwater management area as wells as the service area boundaries of the interested water management agencies including the CSJC, MNWD, SMWD and the SCWD.

4. Establish an advisory committee of stakeholders (interested parties) within the plan area that will help guide the development and implementation of the plan and provide a forum for resolution of controversial issues.

2013 SJBGFMP Update and Subsequent SJBA Actions – A technical advisory committee was established that consisted of representatives of the CSJC, MNWD, SMWD and the SCWD. The TAC met periodically during the preparation of the SJBGFMP Update.

5. Describe the area to be managed under the plan, including:
   a. The physical structure and characteristics of the aquifer system underlying the plan area in the context of the overall basin.
   b. A summary of the availability of historical data including, but not limited to, the components in Section 7 below.
   c. Issues of concern including, but not limited to, issues related to the components in Section 7 below.
   d. A general discussion of historical and projected water demands and supplies.

2013 SJBGFMP Update and Subsequent SJBA Actions – The 2012 SJBGFMP Update report (this report) contains all the information described above. Specifically: the contents of items "a", "b" and "c" above can be found in Section 3; and the contents of item "d" above can be found in in Section 4.

6. Establish management objectives for the groundwater basin that is subject to the plan. (Water Code § 10753.7 (a)(1)).

2013 SJBGFMP Update and Subsequent SJBA Actions – The 2012 SJBGFMP Update report (this report) contains the management objectives in Section 5.

7. Include components relating to the monitoring and management of groundwater levels, groundwater quality, inelastic land surface subsidence, and changes in surface flow and surface water quality that directly affect groundwater levels or quality or are caused by groundwater pumping. (Water Code § 10753.7 (a)(1)). Consider additional components listed in Water Code § 10753.8 (a) through (l). These water code citations are listed below.

   "10753.7. (a) For the purposes of qualifying as a groundwater management plan under this part, a

plan shall contain the components that are set forth in this section. In addition to the requirements of a specific funding program, any local agency seeking state funds administered by the department for the construction of groundwater projects or groundwater quality projects, excluding programs that are funded under Part 2.78 (commencing with Section 10795), shall do all of the following:

(1) Prepare and implement a groundwater management plan that includes basin management objectives for the groundwater basin that is subject to the plan. The plan shall include components relating to the monitoring and management of groundwater levels within the groundwater basin, groundwater quality degradation, inelastic land surface subsidence, and changes in surface flow and surface water quality that directly affect groundwater levels or quality or are caused by groundwater pumping in the basin."

"10753.8. A groundwater management plan may include components relating to all of the following:

a. The control of saline water intrusion.
b. Identification and management of wellhead protection areas and recharge areas.
c. Regulation of the migration of contaminated groundwater.
d. The administration of a well abandonment and well destruction program.
e. Mitigation of conditions of overdraft.
f. Replenishment of groundwater extracted by water producers.
g. Monitoring of groundwater levels and storage.
h. Facilitating conjunctive use operations.
i. Identification of well construction policies.
j. The construction and operation by the local agency of groundwater contamination cleanup, recharge, storage, conservation, water recycling, and extraction projects.
k. The development of relationships with state and federal regulatory agencies.
l. The review of land use plans and coordination with land use planning agencies to assess activities which create a reasonable risk of groundwater contamination."

2013 SJBGFMP Update and Subsequent SJBA Actions – As to Water Code § 10753.7 (a)(1)), the SJBA already has an extensive groundwater monitoring plan in place that characterizes groundwater levels and quality and which is being used to manage groundwater production. The adaptive groundwater production element of the recommended alternative has already been implemented and is based on the data produced by the SJBA monitoring plan. The implementation plan of the 2013 SJBGFMP Update includes a description of this monitoring plan in Section 8. As to Water Code § 10753.8 (a) through (l), the 2013 SJBGFMP Update contains management components "a", "c," "e", "f", "g", and "j".

8. For each management objective, describe how meeting the management objective will contribute to a more reliable supply for long-term beneficial uses of groundwater in the plan area, and describe existing or planned management actions to achieve management objectives.

2013 SJBGFMP Update and Subsequent SJBA Actions – Consistency with management objectives is described in Sections 7 and 8 of the 2013 SJBGFMP Update report.

9. Adopt monitoring protocols for the components in Section 7 (Water Code § 10753.7

(a)(4)). Monitoring protocols are not defined in the Water Code, but the section is interpreted to mean developing a monitoring program capable of tracking changes in conditions for the purpose of meeting management objectives.

2013 SJBGFMP Update and Subsequent SJBA Actions – The nexus between the information developed through the SJBA groundwater monitoring program and the tracking of the performance of the management program in meeting the objectives stated in Section 5 is discussed in Section 8 of the 2013 SJBGFMP Update report.

10. Describe the monitoring program, including:
    a. A map indicating the general locations of any applicable monitoring sites for groundwater levels, groundwater quality, subsidence stations, or stream gages.
    b. A summary of monitoring sites indicating the type (groundwater level, groundwater quality, subsidence, stream gage) and frequency of monitoring. For groundwater level and groundwater quality wells, indicate the depth interval(s) or aquifer zone monitored and the type of well (public, irrigation, domestic, industrial, monitoring).

2013 SJBGFMP Update and Subsequent SJBA Actions – A monitoring and reporting program was developed for the SJBGFMP to specifically produce information to manage production and recharge pursuant to the management objectives contained in Section 5 of the 2013 SJBGFMP Update report, to make this information available in near real time to each of the SJBA members and to the public through the SJBA member agencies and to produce a semiannual report on the state of the basin and management activities. The monitoring program is described in detail in Appendix B.

11. Describe any current or planned actions by the local managing entity to coordinate with other land use, zoning, or water management planning agencies or activities (Water Code § 10753.8 (k), (l)).

2013 SJBGFMP Update and Subsequent SJBA Actions – The SJBA continuously coordinates its SJBGFMP with its member agencies, MWDOC (as the wholesale entity for imported water and the SOCOD project), Metropolitan (as the importation agency and provider of incentive funding), the County of Orange (land use, flood control and IRWMP) and the SOCWA (JPA responsible for treatment and disposal of wastewater and provider of recycled water) .

12. Provide for periodic report(s) summarizing groundwater basin conditions and groundwater management activities. The report(s), prepared annually or at other frequencies as determined by the local management agency, should include:
    a. Summary of monitoring results, including a discussion of historical trends.
    b. Summary of management actions during the period covered by the report.
    c. A discussion, supported by monitoring results, of whether management actions are achieving progress in meeting management objectives.
    d. Summary of proposed management actions for the future.
    e. Summary of any plan component changes, including addition or modification of management objectives, during the period covered by the report.
    f. Summary of actions taken to coordinate with other water management and land use agencies, and other government agencies.

2013 SJBGFMP Update and Subsequent SJBA Actions – Same response to item 10 above.

13. Provide for the periodic re-evaluation of the entire plan by the managing entity.

2013 SJBGFMP Update and Subsequent SJBA Actions – The SJBA has committed to review and update the SJBGFMP every five years.

14. For local agencies not overlying groundwater basins, plans should be prepared including the above listed components and using geologic and hydrologic principles appropriate to those areas (Water Code § 10753.7 (a)(5)). Water Code § 10753.7 (a)(5) reads:

> *"Local agencies that are located in areas outside the groundwater basins delineated on the latest edition of the department's groundwater basin and subbasin map shall prepare groundwater management plans incorporating the components in this subdivision, and shall use geologic and hydrologic principles appropriate to those areas."*

2013 SJBGFMP Update and Subsequent SJBA Actions – Not applicable.

Table 7-1
Consistency of Groundwater Management Plan Alternatives to Goals

Alternative	Goals				
	Goal 1 -- Enhance Basin Water Supplies	Goal 2 -- Protect and Enhance Water Quality	Goal 3 -- Maximize the use of Unused Storage Space	Goal 4 -- Satisfy the State Requirements for a Groundwater Management Program	Goal 5 -- Establish Equitable Share of the Funding, Benefits and Costs of the SJBGMP[1]
Alternative 1 – Adaptive Production Management within Existing Recharge and Production Facilities					
Alternative 2 – Adaptive Production Management within Existing Recharge and Production Facilities with a Seawater Injection Barrier	✔	✔		✔	tbd
Alternative 3 – Adaptive Production Management within Existing Recharge and Production Facilities with a Seawater Extraction Barrier	✔	✔		✔	tbd
Alternative 4a – Adaptive Production Management with Seawater Injection Barrier and Construction of Ranney-Style Collector Well(s)	✔	✔	✔	✔	tbd
Alternative 4b – Adaptive Production Management with Seawater Extraction Barrier and Construction of Ranney-Style Collector Well(s)	✔	✔	✔	✔	tbd
Alternative 5a – Adaptive Production Management, with Seawater Injection Barrier, Construction of Ranney-Style Collector Wells, and In-stream Recharge	✔	✔	✔	✔	tbd
Alternative 5b – Adaptive Production Management, with Seawater Extraction Barrier, Construction of Ranney-Style Collector Wells, and In-stream Recharge	✔	✔	✔	✔	tbd
Alternative 6 – Adaptive Production Management, Creation of a Seawater Extraction Barrier, Construction of Ranney-Style Collector Wells, In-stream Recharge and Recycled Water Recharge	✔	✔	✔	✔	tbd
Alternative 7– Adaptive Production Management within Existing Recharge and Production Facilities (Alternative 1 with SOCOD).					
Alternative 8– Adaptive Production Management, Existing Recharge and Production Facilities (Alternative 1 with SOCOD), Construction of Ranney-Style Collector Wells	✔	✔	✔	✔	tbd
Alternative 9– Adaptive Production Management, Existing Recharge and Production Facilities, Construction of Ranney-Style Collector Wells, and In-stream Recharge	✔	✔	✔	✔	tbd
Alternative 10– Adaptive Production Management, Existing Recharge and Production Facilities, Construction of Ranney-Style Collector Wells, In-stream Recharge and Recycled Water Recharge	✔	✔	✔	✔	tbd

[1] tbd -- to be determined in the final implementation plan.

Table 7-2
Estimated Yield of the SJBGMFP Alternatives

Alternative	Yield from Key Features (acre-ft/yr)							
	Adaptive Production	Seawater Injection Barrier	Seawater Extraction Barrier	Ranney Collector Wells	Enhanced Stormwater Recharge	Recycled Water Recharge	Alternative Water Supply for Overlying Water Right Holders	Total
Alternative 1 – Adaptive Production Management within Existing Recharge and Production Facilities	9,200							9,200
Alternative 2 – Adaptive Production Management within Existing Recharge and Production Facilities with a Seawater Injection Barrier	9,200	800						10,000
Alternative 3 – Adaptive Production Management within Existing Recharge and Production Facilities with a Seawater Extraction Barrier	9,200		3,000					12,200
Alternative 4a – Adaptive Production Management with Seawater Injection Barrier and Construction of Ranney-Style Collector Well(s)	9,200	800		800			400	11,200
Alternative 4b – Adaptive Production Management with Seawater Extraction Barrier and Construction of Ranney-Style Collector Well(s)	9,200		3,000	800			400	13,400
Alternative 5a – Adaptive Production Management, with Seawater Injection Barrier, Construction of Ranney-Style Collector Wells, and In-stream Recharge	9,200	800		800	800		400	12,000
Alternative 5b – Adaptive Production Management, with Seawater Extraction Barrier, Construction of Ranney-Style Collector Wells, and In-stream Recharge	9,200		3,000	800	800		400	14,200
Alternative 6 – Adaptive Production Management, Creation of a Seawater Extraction Barrier, Construction of Ranney-Style Collector Wells, In-stream Recharge and Recycled Water Recharge	9,200		3,000		800	8,000	400	21,400
Alternative 7– Adaptive Production Management within Existing Recharge and Production Facilities (Alternative 1 with SOCOD).	7,500							7,500
Alternative 8– Adaptive Production Management, Existing Recharge and Production Facilities (Alternative 1 with SOCOD), Construction of Ranney-Style Collector Wells	7,500			800			400	8,700
Alternative 9– Adaptive Production Management, Existing Recharge and Production Facilities, Construction of Ranney-Style Collector Wells, and In-stream Recharge	7,500			800	800		400	9,500
Alternative 10– Adaptive Production Management, Existing Recharge and Production Facilities, Construction of Ranney-Style Collector Wells, In-stream Recharge and Recycled Water Recharge	7,500				800	8,000	400	16,700

Table 7-3a
Construction Cost and Annual and Unit Cost Opinions for the
Proposed 1,000 Acre-ft/yr Seawater Injection Barrier

Item	Description	Unit Type	Units	Cost per Unit	Cost
	Capital Cost				
C1	Injection Well Construction and Development	LS	4	$184,500	$738,000
C2	Injection Wellhead Completion and Equipping	LS	4	$70,500	$282,000
C3	Piping to Connect Injection Wells to the Imported Water Pipeline	LS	1	$1,000,000	$1,000,000
C4	Misc Fittings[4]	LS	1		$100,000
	Subtotal Construction Cost				$2,120,000
C5	Contingency[1]				$424,000
	Total Construction Cost				$2,544,000
	Planning, Engineering and Legal[2]				$381,600
	Total Capital Cost				$2,925,600
	Annual and Unit Costs				
A1	Annualized Cost of Construction[3]				$190,314
A2	Injection Water	AF	1,000	$953	$953,000
A3	Fixed O&M	LS	1	$71,000	$88,000
	Total Annual Cost				$1,231,314
	Unit Cost				$1,539.14

[1]Contingency estimated to be 20% of subtotal construction cost

[2]Planning, Engineering and Legal estimated to be 15% of total construction cost

[3]Annual amortization cost based on 30-yr bond at 5.00%

[4]Misc Fitting estimated at 10% of pipeline construction cost

Table 7-3b
Construction Cost and Annual and Unit Cost Opinions for the
Proposed Extraction Well Barrier Well Field and Water Supply Project

Derivation of 2013 Construction Cost Opinion for the Proposed Extraction Barrier Well Field and Water Supply Project

16	mgd product water capacity of the proposed SOCOD project			
$125,577,000	MWDOC 2011 Level 4 Estimate of the construction cost of the SOCOD project			
$44,759,000	MWDOC estimate of slant wells construction cost			
$80,818,000	Subtotal 2011 SOCOD construction cost for treatment and product water conveyance system to end users			
5%	Escalator to 2013			
$84,858,900	Subtotal 2013 SOCOD construction cost for treatment and product water conveyance system to end users			
$5,303,681.25	Subtotal 2013 SOCOD construction cost for treatment and product water conveyance system to end users per mgd			
3.00	mgd product water capacity for proposed extraction barrier project			
$15,911,044	Subtotal 2013 construction cost for proposed extraction barrier treatment and product water conveyance system to end users			
6,000	Raw water pumping rate of extraction barrier wells in acre-ft/yr			
6.00	No. of wells required to pump 8,000 acre-ft/yr at	800 gpm and	90% utilization	
2.00	No. of back up wells			
5.95	mgd raw water production rate			
$10,400,000	Subtotal 2013 construction cost of new equipped extraction barrier wells at		$1,300,000 ea.	
$4,000,000	2013 construction cost estimate for raw water conveyance			
$30,311,044	Subtotal 2013 extraction barrier system construction cost			
$7,577,761	Contingency at	25%		
$4,546,657	Engineering at	15%		
$42,435,461	Total Construction Cost			

Derivation of 2013 Unit Cost Opinion for the Proposed Extraction Barrier Well Field and Water Supply Project

$2,760,488	Annualized capital cost at	30 years and	5%
362	2011 per acre-ft for O&M, all cost in per MWDOC		
5%	Escalator to 2013		
$380	2013 O&M cost for the extraction barrier		
$1,277,304	2013 total O&M costs		
$3,976,968	2013" All-in" Annual Cost		
$1,326	per acre-ft unit cost		

Source of 2011 proposed SOCOD project costs were obtained from the MWDOC presentation entitled "SOCOD Project Decision Making: Spring 2013" prepared in December 2012, and the handout from the SOCOD March 21, 2013 TAC meeting.

Table 7-3c

Construction Cost and Annual and Unit Cost Opinions for the

Proposed 4,300 Acre-ft/yr Ranney Collector Well

Line Item	Description	Unit Type	Units	Cost per Unit	Cost
	Capital Cost				
C1	16-ft OD, 13-ft ID RC Caisson	LF	100	$8,000	$800,000
C2	12-in Stainless Steel Wire-wrapped Screens	LF	1,200	$1,000	$1,200,000
C3	Motor, Pump, Motor Control Panels and SCADA	LS	1	$1,500,000	$1,500,000
C4	Piping to Connect to SJBA Desalter	LF	1	$500,000	$500,000
C5	Misc Fittings[4]	LS	1		$50,000
	Subtotal Construction Cost				$4,000,000
C6	Contingency[1]				$800,000
	Total Construction Cost				$4,800,000
	Planning, Engineering and Legal[2]				$720,000
	Total Capital Cost				$5,520,000
	Annual and Unit Costs				
A1	Annualized Construction Cost[3]				$359,084
A2	Energy at 4,300 acre-ft/yr	kwh	628,842	$0.20	$125,768
A3	Fixed O&M	LS	1	$166,000	$166,000
	Total Annual Cost				$650,852
	Additional Cost per Acre-ft of Desalter Production				$151

[1]Contingency estimated to be 20% of subtotal construction cost

[2]Planning, Engineering and Legal estimated to be 15% of total construction cost

[3]Annual amortization cost based on 30-yr bond at 5.00%

[4]Misc Fitting estimated at 10% of pipeline construction cost

Table 7-4
Unit Cost Comparisons of SJBGMFP Alternatives

Alternative	New Yield [acre-ft]	Annual Cost [dollars]	Unit Cost [dollars per acre-ft]
Alternative 1 – Adaptive Production Management within Existing Recharge and Production Facilities	0	$0	na
Alternative 2 – Adaptive Production Management within Existing Recharge and Production Facilities with a Seawater Injection Barrier	800	$1,951,314	$2,439
Alternative 3 – Adaptive Production Management within Existing Recharge and Production Facilities with a Seawater Extraction Barrier	3,000	$3,976,968	$1,326
Alternative 4a – Adaptive Production Management with Seawater Injection Barrier and Construction of Ranney-Style Collector Well(s)	2,000	$3,682,167	$1,841
Alternative 4b – Adaptive Production Management with Seawater Extraction Barrier and Construction of Ranney-Style Collector Well(s)	4,200	$6,067,820	$1,445
Alternative 5a – Adaptive Production Management, with Seawater Injection Barrier, Construction of Ranney-Style Collector Wells, and In-stream Recharge	2,800	$4,802,167	$1,715
Alternative 5b – Adaptive Production Management, with Seawater Extraction Barrier, Construction of Ranney-Style Collector Wells, and In-stream Recharge	5,000	$7,187,820	$1,438
Alternative 6 – Adaptive Production Management, Creation of a Seawater Extraction Barrier, In-stream Recharge and Recycled Water Recharge	12,200	--	$1,042
Alternative 7– Adaptive Production Management within Existing Recharge and Production Facilities (Alternative 1 with SOCOD).	0	$0	na
Alternative 8– Adaptive Production Management, Existing Recharge and Production Facilities (Alternative 1 with SOCOD), Construction of Ranney-Style Collector Well	1,200	$1,730,852	$1,442
Alternative 9– Adaptive Production Management, Existing Recharge and Production Facilities, Construction of Ranney-Style Collector Well, and In-stream Recharge	2,000	$2,130,852	$1,065
Alternative 10– Adaptive Production Management, Existing Recharge and Production Facilities, In-stream Recharge and Recycled Water Recharge	9,200	--	$949

Table 7-5
Implementation Difficulty

Alternative	Adaptive Production	Seawater Injection Barrier	Seawater Extraction Barrier	Ranney Collector Wells	Enhanced Stormwater Recharge	Recycled Water Recharge	Alternative Water Supply for Overlying Water Right Holders
Alternative 1 – Adaptive Production Management within Existing Recharge and Production Facilities	not significant						
Alternative 2 – Adaptive Production Management within Existing Recharge and Production Facilities with a Seawater Injection Barrier	not significant	not significant					
Alternative 3 – Adaptive Production Management within Existing Recharge and Production Facilities with a Seawater Extraction Barrier	not significant		potentially significant				
Alternative 4a – Adaptive Production Management with Seawater Injection Barrier and Construction of Ranney-Style Collector Well(s)	not significant	not significant		potentially significant			potentially significant
Alternative 4b – Adaptive Production Management with Seawater Extraction Barrier and Construction of Ranney-Style Collector Well(s)	not significant		potentially significant	potentially significant			potentially significant
Alternative 5a – Adaptive Production Management, with Seawater Injection Barrier, Construction of Ranney-Style Collector Wells, and In-stream Recharge	not significant	not significant		potentially significant	potentially significant		potentially significant
Alternative 5b – Adaptive Production Management, with Seawater Extraction Barrier, Construction of Ranney-Style Collector Wells, and In-stream Recharge	not significant		potentially significant	potentially significant	potentially significant		potentially significant
Alternative 6 – Adaptive Production Management, Creation of a Seawater Extraction Barrier, Construction of Ranney-Style Collector Wells, In-stream Recharge and Recycled Water Recharge	not significant		3,000		potentially significant	significant	potentially significant
Alternative 7– Adaptive Production Management within Existing Recharge and Production Facilities (Alternative 1 with SOCOD).	not significant						
Alternative 8– Adaptive Production Management, Existing Recharge and Production Facilities (Alternative 1 with SOCOD), Construction of Ranney-Style Collector Wells	not significant			potentially significant			potentially significant
Alternative 9– Adaptive Production Management, Existing Recharge and Production Facilities, Construction of Ranney-Style Collector Wells, and In-stream Recharge	not significant				potentially significant		potentially significant
Alternative 10– Adaptive Production Management, Existing Recharge and Production Facilities, Construction of Ranney-Style Collector Wells, In-stream Recharge and Recycled Water Recharge	not significant				potentially significant	significant	potentially significant