7.0 Cost Analysis

This cost analysis is performed using budgetary cost values. Any costs developed and provided in this estimate are order-of-magnitude budgetary-level costs. The Association for the Advancement of Cost Engineering (AACE) International defines order-of-magnitude costs as Class 5 cost estimates that are approximate without detailed engineering data. Examples would include: (1) an estimate from cost capacity curves, (2) an estimate using scale-up or scale-down factors, and (3) an approximate ratio estimate. The cost estimates shown, and any resulting conclusions on project financial or economic feasibility or funding requirements, have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final costs of the project and resulting feasibility will depend on actual costs of labor and material, competitive market conditions, actual site conditions, final project scope, implementation schedule, continuity of personnel and engineering, and other variable factors. As a result, the final project costs will vary from the estimates presented here.

7.1 Unit Cost Definition

7.1.1 Pipeline Costs

Pipeline costs can vary significantly depending on various factors such as availability of raw material, contractor backlog, site conditions, and various other factors. Given the remote setting of the Valley and current volatility in the raw materials market, conservative unit costs were used for estimating pipe costs. The unit costs are based on data developed by EPA in *Standardized Costs for Water Supply Distribution Systems* (1992) and updated to 2005 levels with the *Engineering News Record* (ENR) Construction Cost Index (CCI). Table 7-1 shows the unit costs used for this evaluation. These costs include material, trenching, embedment, line valving, backfill, sheeting and shoring, and pavement replacement. Other miscellaneous costs may be added to the project and are included in the contingency. The pipe material assumed in this evaluation is plastic, either PVC or HDPE. Maintenance costs for pipelines are low and currently are included in the contingency.

In addition to costs per linear foot, a unit cost for crossing major highways was developed. This unit cost included an assumption that microtunneling or the bore-and-jack technique would be used in areas where open-cut installation cannot be performed. The cost for approximately 300 feet of this technology installation is about $500,000. Site conditions and pipe diameters can influence this cost. For the purpose of this budgetary-level analysis, this cost is sufficient.

If other diameter costs need to be calculated, a cost of $12 per inch in diameter will be used. This amount is the average of per diameter-inch costs from Table 7-1, which range from $8 for the large-diameter pipes to $19 for the smaller-diameter pipes. This cost compares to the most recent pipeline construction activity in 2000. At that time, the installation of the pipeline was $11.20 per diameter-inch adjusted to 2005 levels.

TABLE 7-1
SUMMARY OF PIPELINE UNIT COSTS

Diameter (inches)	Cost per Linear Foot
4	$ 76
6	$ 114
8	$ 123
10	$ 132
12	$ 143
14	$ 153
16	$ 164
18	$ 165
20	$ 178
24	$ 203
27	$ 222
30	$ 242

Note: Unit costs are material only and do not include: construction, insulation, construction management, and traffic control during construction.

Annual O&M costs for pipelines are minimal because pipelines have a long life expectancy and can operate without significant input. Depending on pipe material, life expectancy of a pipe can exceed 50 years, as verified by the many 100-year-old pipes still in service. Therefore, minimal O&M costs were assigned to pipes. For the purpose of this study, the costs were assumed to be about half of 1 percent of capital costs.

7.1.2 Pumping Costs

Pumping costs have two significant components: the costs of the physical assets and the cost of O&M. Energy costs are the highest O&M costs for pumping systems. For the purposes of this analysis, the following unit costs were used:

- Pumps in the 10- to 30-hp range - $2,000 per hp
- Pumps above 30 hp - $1,500 per hp
- Energy costs - $0.13 per kilowatt-hour (kW-h)

The cost per horsepower for the smaller pump stations is larger because the size of a building for two 10-hp pumps is not significantly smaller than for two 60-hp pumps. Pumping costs assume that the pumps are located in an enclosed building and that there is one stand-by pump.

O&M assumptions for pumps include that most pumps will be run during peak irrigation hours. Some pump capacity will be needed year-round to deliver water to year-round users, such as the stickleback habitat. Annual O&M, in addition to energy costs, has been estimated to be about 0.5 percent of the capital costs, giving the facility a 20-year replacement schedule, which generally is acceptable for facilities that contain many mechanical parts.

7.1.3 Storage Costs

Storage costs were evaluated for surface storage and groundwater replenishment. Surface storage costs assumed a rate of $1.50 per gallon of storage, based on cost data provided by EPA. Groundwater replenishment costs were evaluated in detail and are provided in the following sections.

Annual O&M costs for aboveground storage tanks are expected to be minimal; therefore, an assumed value of about 0.5 percent of the total capital cost was used in the analysis. Repair and maintenance costs for the replenishment site are assumed to be 1 percent of the capital cost. Annual operation and maintenance costs are assumed to be 3 percent of the capital cost.

7.1.4 Treatment Costs

Treatment facility costs were estimated based on two proposed stages:

- Stage I: Production capacity of 1,000 acre-feet recycled water
- Stage II (Ultimate Stage): Production capacity of 1,600 acre-feet recycled water

The capital and O&M costs were estimated for an initial recycled water treatment facility generating 1,000 afy of flow for Stage I. Cost estimates for the site work, concrete, masonry, electrical system, and main equipment for the Stage I facility then were used to estimate costs of the subsequent capacity addition to bring up the final capacity to 1,600 afy. It was assumed that during Stage I construction, sufficient preparation for the ultimate stage equipment installation would be made. For example, concrete pump and tank pads, and pipe stubs with blind flanges would be installed, lowering the cost of the subsequent stage. All yard piping that would be needed for the ultimate capacity was assumed to be completed during Stage I construction.

For the brine handling facilities, it was assumed that a brine flow of 0.08 mgd (will be generated if 500 afy is treated via RO) will be sent to a 12-acre evaporation pond that will be located onsite. Because the treatment of the remaining brine flows (0.08 mgd) in Stage I require larger evaporation ponds potentially with evaporation enhancement equipment (i.e., misters), it was decided at this time in the planning process that other technologies with smaller footprints most likely would be used for the brine/concentrate treatment. For this reason, Vibratory Shear Enhanced Processing (VSEP) brine/concentrate treatment technology, as discussed in detail in the 2003 brine disposal evaluation, was selected to be included in the cost estimates (BBARWA, 2003).

The O&M costs include energy, labor, replacement of the equipment (i.e., membranes, UV lamps), chemicals and, waste disposal, repair and maintenance of the individual units and facilities and 10 percent of the capital cost as contingency.

7.1.5 Contingencies and Add-on Costs

Contingencies and add-on costs were estimated in an attempt to calculate total project costs. These include the following:

- Construction markups – 10 percent to account for contractor profit and other nonproject-related expenses such as mobilization, and office support
- Planning and Design – 10 percent of total construction cost
- Construction Management – 8 percent of total construction cost
- Other costs – 5 percent to account for internal BBARWA costs
- Traffic control – traffic control is significantly variable depending on area of construction. For planning purposes, a cost of $5,000 per 1,000 feet of pipeline was used.
- Contingency – 25 percent of total project cost to account for unforeseen issues in design and constructibility. Other contingencies may be added as necessary to various project components, depending on project complexity. The more complex the project, the higher the contingency should be.

7.2 Distribution System

A breakdown of costs based on diameter for the preferred pipeline alignments for phase 1 through 4 are shown in Table 7-2. Table 7-3 shows a breakdown by phase for pump station costs based on horsepower requirements. The costs of the distribution system are presented in Table 7-4 for the preferred pipe alignments for the first two phases, including both the pipeline and pump costs. These costs are based on the capability to deliver up to 1,000 afy in Phase 1 to the groundwater recharge site.

Based on the assumptions in Section 7.1, annual O&M costs for Phase 1 pipelines and pumps are about $61,000. This includes maintenance, power, and contingency costs. O&M estimates for the subsequent phases were not performed because of uncertainties in future costs.

TABLE 7-2
DISTRIBUTION SYSTEM COSTS – PIPELINE

Diameter (inches)	Length (feet)	Total Cost ($)
4	3,800	289,000
8	700	86,000
10	9,700	1,280,000
12	8,500	1,216,000
16	7,600	1,247,000
Total	30,300	4,119,000

Note: Includes all feasible potential phases (i.e. Phases 1 through 4).

TABLE 7-3
PUMP SYSTEM COSTS

Phase	HP - Pump Station			Total Cost ($)
	WWTP	Maple/ Baldwin	Total HP	
1 and 3	80	0	80	187,000
2 and 4	182	30	210	240,000
2B and 4B	182	30	210	240,000

Note: Costs were developed based on potential delivery of 1,000 afy in Phase 1 and 3 and 1,600 afy for Phase 2, 2b, 4, and 4b.

TABLE 7-4
DISTRIBUTION SYSTEM COSTS – PHASE SUMMARY

Phase	Capital Cost ($)	O & M Costs ($)
1	5,166,000	61,000
2	3,876,000	156,000

Note: Phase 2b included with phase 2.

7.3 Treatment System

The estimated costs for the treatment system are presented in Table 7-5 for each stage of the project implementation. The table includes the estimated total capital cost for the ultimate capacity, which is approximately $26.7 million. It must be emphasized that the capital costs are for construction of additional facilities to bring up the capacity to ultimate capacity, while the O&M costs are calculated for the installed units operating at indicated capacity levels.

TABLE 7-5
TREATMENT SYSTEM ESTIMATED COSTS

	Stage I	Stage II (Ultimate Phase)	TOTAL
Recycle Water Product Capacity	1,000 afy (0.9 mgd)	1,600 afy (1.45 mgd)	1,600 afy (1.45 mgd)
Capital Costs	$23,670,000	$3,070,000	$26,740,000
Facility O&M Costs	$964,000	$1,232,000	

7.4 Storage Costs

The size of the storage tank will depend on the number of users implemented, irrigation scheduling, and the implementation of the groundwater replenishment sites. For the Phase 1 project, a storage tank of 0.3 MG will be necessary. This analysis found that if irrigation scheduling is implemented along with the use of the groundwater replenishment

site, a storage tank of 0.3 MG will be sufficient. However, if the users are not fully optimized, a 1.0-MG tank may be necessary for storage. For the purpose of this analysis, the 0.3-MG tank will be used. This size tank, with contingency and all other add-on costs, would have a total cost of $540,000.

The cost for the Green Spot groundwater replenishment site was calculated using the preliminary layout shown in Figure 7-1. Figure 7-1 shows a proposed layout of the Green Spot site. These costs include mobilization/demobilization, excavation, fill, site piping, flow control structures, return ditches, overflow structures, landscaping, gravel access road, and a general contingency. The construction cost for the Green Spot site is projected to be about $2.4 million. After the contingency and add-on costs are accounted for and added, the total increases to almost $3.6 million for the Green Spot site. Table 7-6 shows the breakdown of costs for the potential storage site.

TABLE 7-6
STORAGE COSTS

Storage Facility	Type	Capacity	Capital Cost ($)	O&M Cost ($/Year)
Tank at WWTP	Storage Tank	0.3 MG	540,000	3,000
Green Spot	Recharge Site	1,000 afy	3,600,000	534,000
Total			4,140,000	537,000

7.5 Cost Summary

The recycled water program will require the implementation of advanced water treatment facilities, brine handling and treatment, conveyance, and storage facilities. If the entire program is implemented (Phases 1 through 4B), the capital costs for these facilities are estimated to be approximately $47.6 million. Land acquisition costs are based on estimated land value at this time; therefore, due to the real estate market volatility, these costs could be affected significantly by market conditions at the time of implementation. In Phases 2 and 4, no retrofit costs were estimated at this time because costs are user specific and depend significantly on the type and sophistication of the water system to be replaced for recharge purposes.

The recycled water program will be implemented in phases. The first phase is projected to include an AWTF with a production capacity of 1,000 afy, brine handling and treatment facilities, a 0.3-MG storage facility, and the Green Spot Recharge Site, pumping to the recharge site from the AWTF, and transmission and distribution mains. Based on these facilities, Table 7-7 summarizes the capital and O&M costs for Phase 1 improvements.

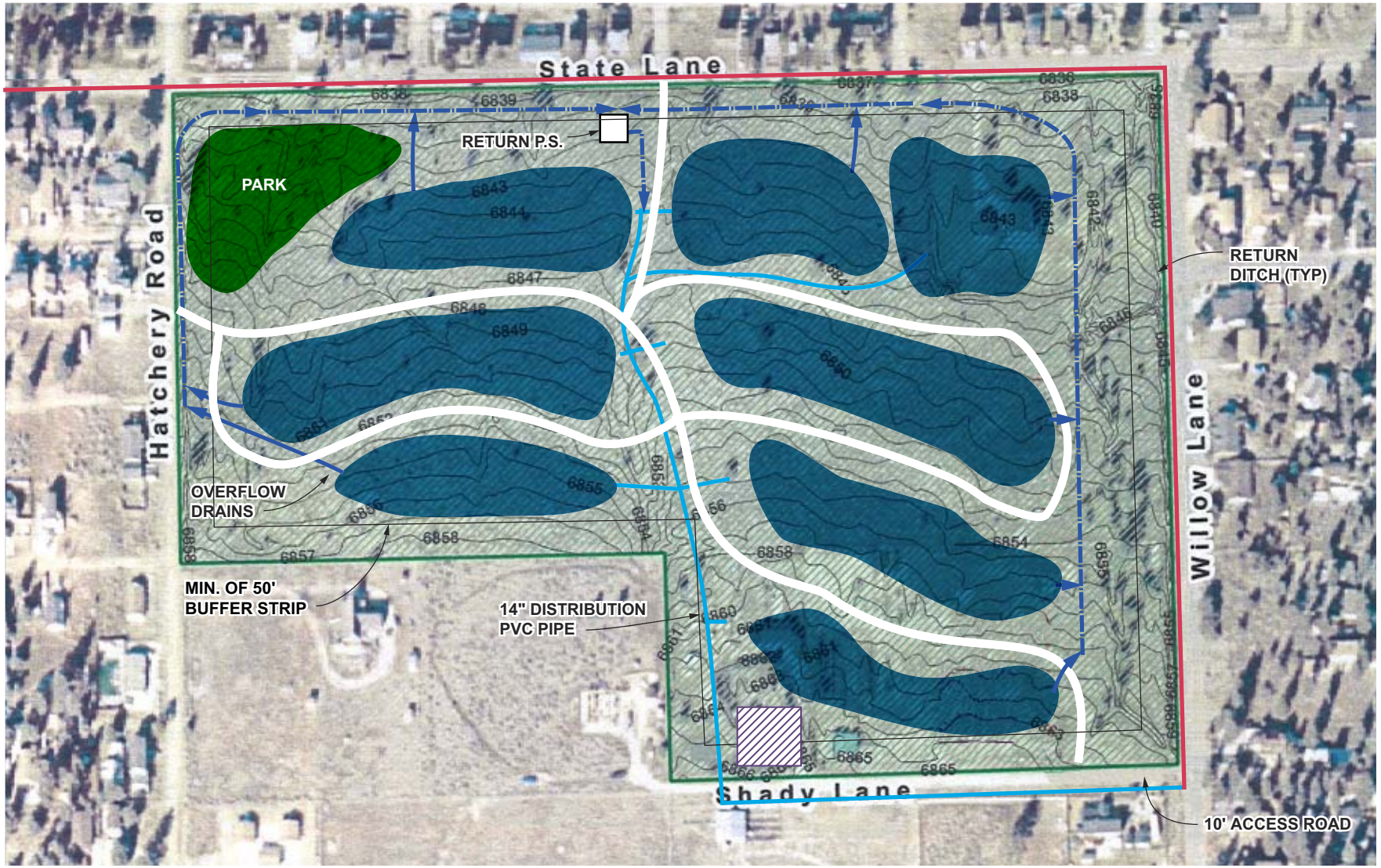
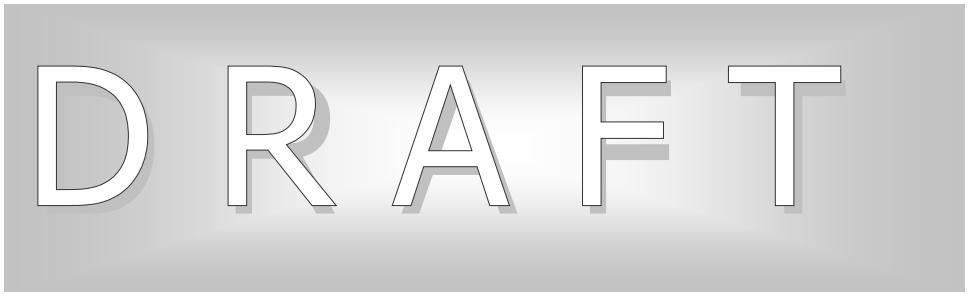


FIGURE 7-1
CONCEPTUAL GREEN SPOT GROUNDWATER RECHARGE BASIN SITE
BBARWA RECYCLED WATER MASTER PLAN

W082005006RDD_02 (9/8/05)

CH2MHILL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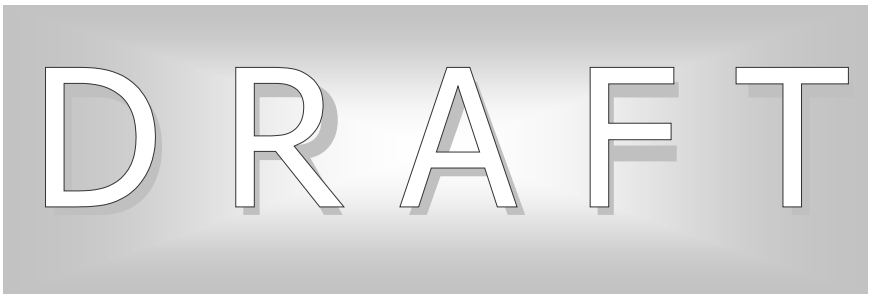
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TABLE 7-7
ESTIMATED COSTS SUMMARY FOR PHASE 1 IMPROVEMENTS

Facility	Size	Capital Cost ($)	Annual O&M Cost ($/Year)
Treatment and Brine Handling [a]	1,000 afy	23,670,000	964,000
Green Spot Recharge Site [b]	1,000 afy	3,600,000	534,000
Transmission and Distribution [c]	12-inch and 16-inch	5,166,000	61,000
Property Acquisition	-	2,099,000	-
Legal Services	-	1,000,000	-
Environmental Documentation (includes permitting, etc.)	-	1,500,000	-
Total		37,034,000	1,560,000

Notes:
[a] Only Phase 1 implementation is shown. Total facility costs are shown in Section 7 tables.
[b] Full site development. Phase 1 implementation includes up to 1,000 afy of recharge.
[c] Transmission and distribution costs include pumping and pump stations.

7.6 User Impacts

7.6.1 Potable Water Rates

Two agencies supply potable water in the Valley, DWP and BBCCSD. Each agency charges a bimonthly minimum fee of $37.63 and $57.48 for BBCCSD and DWP, respectively, for water service. In addition to the bimonthly fee, charges based on water usage are calculated. Both agencies have tiered rates in 5 blocks. Table 7-8 summarizes the current potable water rates as provided by DWP and BBCCSD.

For users to find recycled water attractive, the recycled water rates must be equivalent or lower than potable water levels. In cases where significant retrofits are needed by the users, return period on rate savings usually is expected by the user. To compare the existing potable rates to the costs of producing the recycled water, a cost analysis was performed. The cost analysis assumed a 20-year study period with an inflation rate of 3 percent.

TABLE 7-8
SUMMARY OF EXISTING POTABLE WATER RATES IN THE BIG BEAR VALLEY

		Potable Water Rates			
		DWP		BBCCSD	
Block Unit	Unit Range [b]	per Unit	per Acre-Foot	per Unit	per Acre-Foot
1	0 - 24	$ 2.06	$ 897.34	$ 1.39	$ 605.48
2	25 - 40	$ 2.86	$ 1,245.82	$ 1.74	$ 757.94
3 [a]	41 - 60	$ 4.27	$ 1,860.01	$ 2.08	$ 906.05
4	61 - 100	$ 7.04	$ 3,066.62	$ 2.63	$ 1,145.63
5	101 +	$ 9.77	$ 4,255.81	$ 4.20	$ 1,829.52

Notes:
(a). The range of units varies in this and the 4th block by 10 between the two agencies. Range shown is for DWP; the BBCCSD rate is 41 to 70, etc.
(b). Units are in cubic feet x 100.

The cost analysis was performed for the first phase of improvements with an estimated capital cost of about $37 million. When the annualized present value is added to the annual O&M, the total annual present value approaches $1.6 million. Given that the facility will produce about 1,000 afy in Phase 1, the cost per acre-foot is about $4,970. The greatest contributor to the cost is the treatment process and the transmission facilities. The treatment cost accounts for almost 62 percent of the annual O&M and more than 64 percent of the capital cost, while the transmission facilities account for less than 4 percent of the O&M and almost 14 percent of the capital cost.

The estimated costs to produce and deliver the recycled water appear to be significantly higher than most of the potable water costs. To lower the impact of the capital costs, various capital funding and subsidies should be sought.