# ATTACHMENT 2. PROJECT JUSTIFICATION

The purpose of this attachment is to summarize the proposed projects included in the East Stanislaus Region grant application, describe how the projects included herein meet the needs of the East Stanislaus IRWM Region for effective water resource management, and address the physical benefits achieved by the projects.

## Project Summary Table

Table 2-1, below (which is Table 4 from the PSP), documents that both non-administrative projects included in this application meet at least four IRWM project elements as identified in the 2015 IRWM Implementation Grant Program PSP.

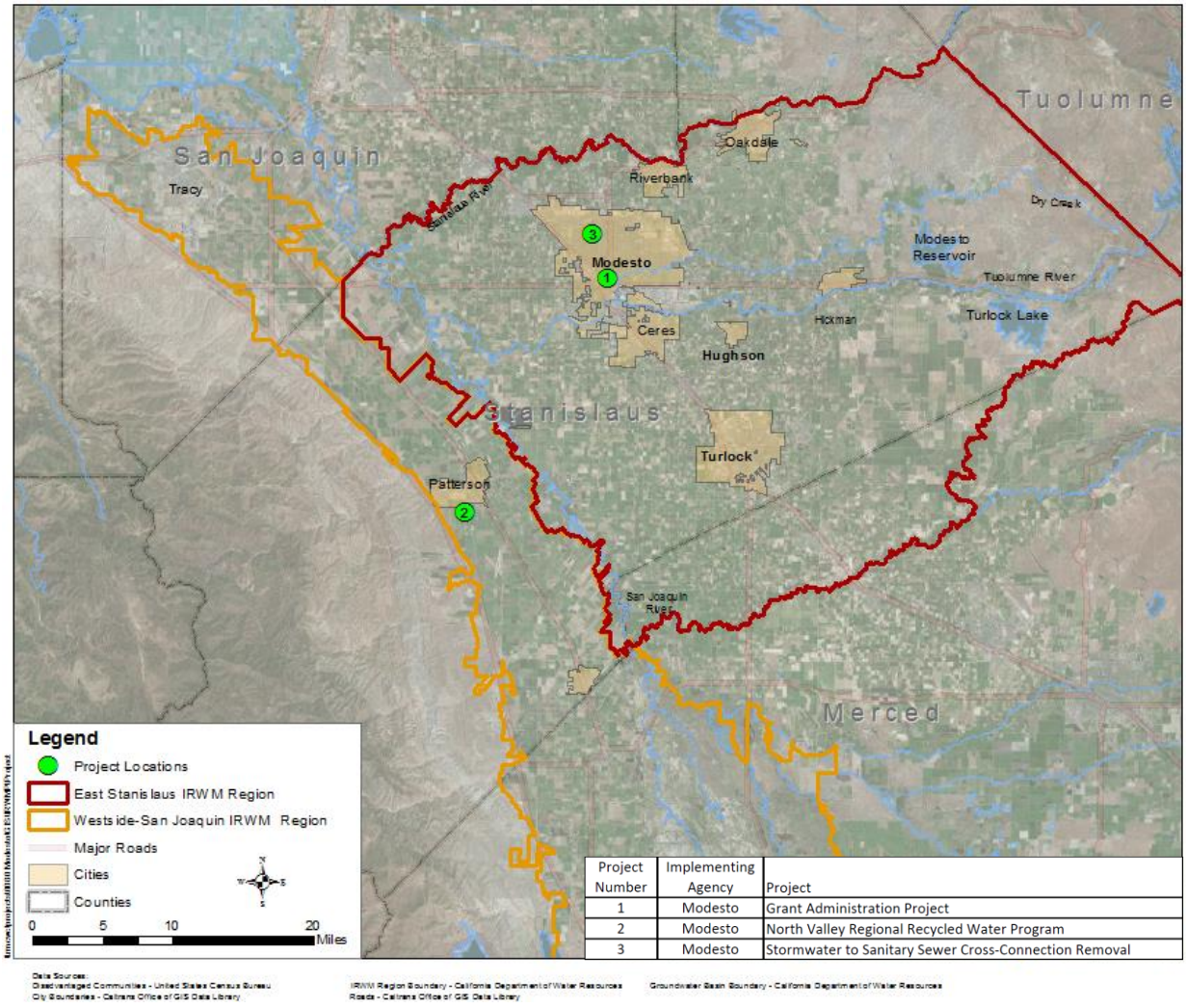
**Table 2-1: 2015 IRWM Grant Solicitation Project Summary Table (Table 4 from PSP)**

| Table 4 – 2015 IRWM Grant Solicitation Project Summary Table | | | |
|---|---|---|---|
| | | North Valley Regional Recycled Water Project | Area 2 Stormwater to Sanitary Sewer Cross-Connection Removal Project |
| | **IRWM Project Element** | | |
| **IR.1** | Water Supply reliability, water conservation, and water use efficiency | X | X |
| **IR.2** | Stormwater capture, storage, clean-up, treatment, and management | | X |
| **IR.3** | Removal of invasive non-native species, the creation and enhancement of wetlands, and the acquisition, protection, and restoration of open space and watershed lands | | |
| **IR.4** | Non-point source pollution reduction, management, monitoring | | X |
| **IR.5** | Groundwater recharge and management | | X |
| **IR.6** | Contaminant and salt removal through reclamation, desalting, and other treatment technologies and conveyance of reclaimed water for distribution to users | X | |
| **IR.7** | Water banking, exchange, reclamation, and improvement of water quality | X | |
| **IR.8** | Planning and implementation of multipurpose flood management programs | | X |
| **IR.9** | Watershed protection and management | | |
| **IR.10** | Drinking water treatment and distribution | | |
| **IR.11** | Ecosystem and fisheries restoration and protection | X | |

# Region Map

This grant application includes three projects; one administrative project (Grant Administration Project), one project in the East Stanislaus IRWM Region (the Area 2 Stormwater to Sanitary Sewer Cross-Connection Removal Project) and one inter-regional project (the North Valley Regional Recycled Water Program [NVRRWP]) located in both the East Stanislaus and Westside-San Joaquin IRWM Regions. The project locations are shown in Figure 2-1.

**Figure 2-1: East Stanislaus Grant Application Regional Map**




| Project Number | Implementing Agency | Project |
|---|---|---|
| 1 | Modesto | Grant Administration Project |
| 2 | Modesto | North Valley Regional Recycled Water Program |
| 3 | Modesto | Stormwater to Sanitary Sewer Cross-Connection Removal |

Data Sources:
Disadvantaged Communities - United States Census Bureau
City Boundaries - Caltrans Office of GIS Data Library
IRWM Region Boundary - California Department of Water Resources
Roads - Caltrans Office of GIS Data Library
Groundwater Basin Boundary - California Department of Water Resources

# Application Projects

## Project 1: Grant Administration Project (Implementing Agency: City of Modesto)

### Brief Project Description (25 words or less)

Through this Project, the City of Modesto will provide grant administration support and meet DWR requirements for the 2015 Proposition 84 IRWM Implementation Grant Program.

### Expanded Project Description

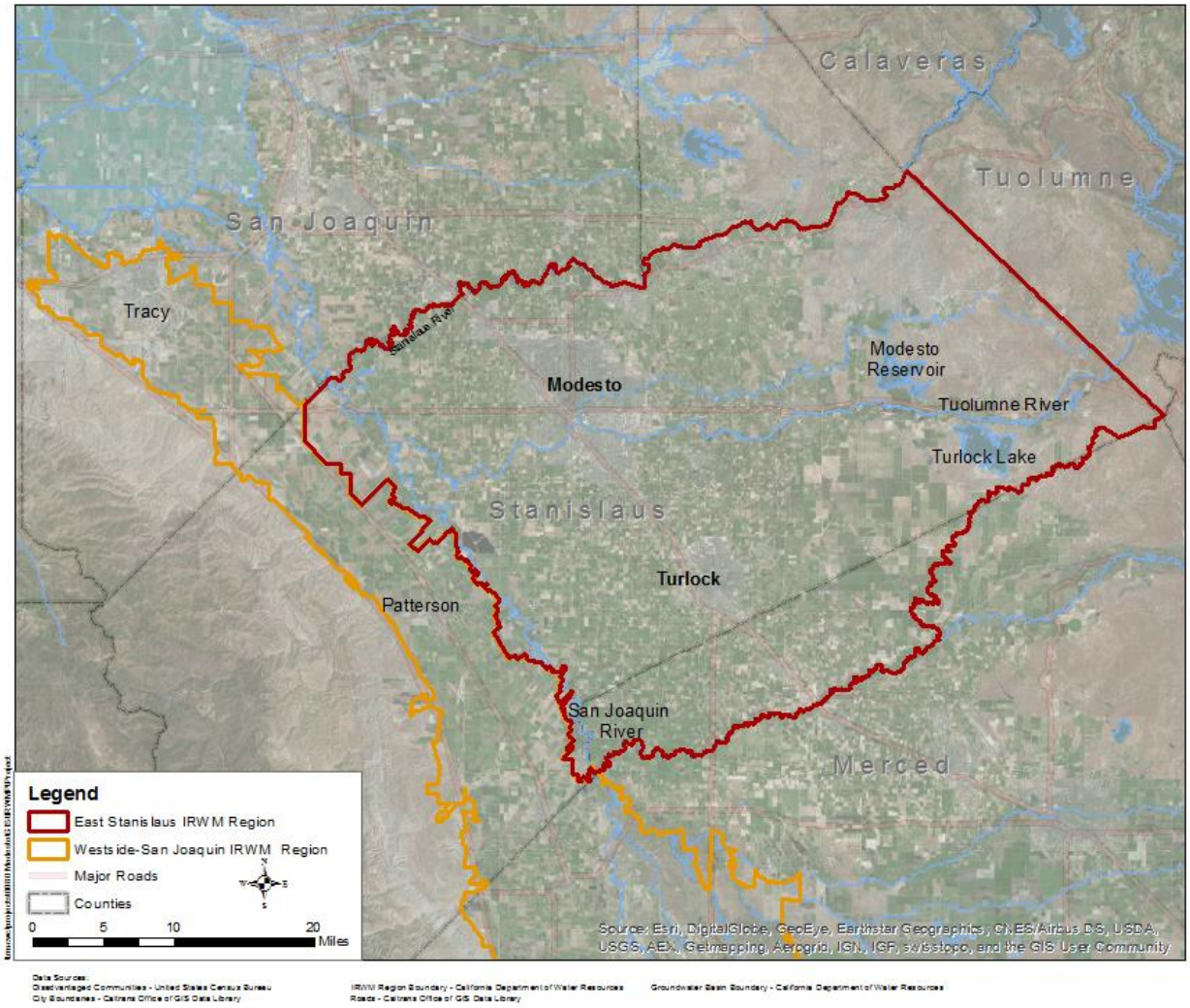
The City of Modesto's Grant Administration Project will provide administration support for the East Stanislaus IRWM Region's Proposition 84, Round 4 Implementation Grant funds, and serve as the contracting agency for California Department of Water Resources (DWR). As part of this 'project', the City will coordinate funding-related activities such reporting and invoicing, and implement program-level administration associated with any funding received under the 2015 IRWM Implementation Grant program. As part of this project, the City will:

- Coordinate execution of the funding agreement (including signing of the agreement);
- Ensure implementation and tracking of project performance monitoring;
- Ensure implementation and tracking labor compliance requirements;
- Compile and submit invoices and progress reports;
- Coordinate prepare project completion reports; and
- Coordinate all activities necessary for funding agreement close-out.

### Project Map

The City of Modesto's Grant Administration Project will provide administration support for the entire East Stanislaus IRWM Region. The Region's boundaries are shown below in Figure 2-2.

**Figure 2-2: East Stanislaus and Westside San Joaquin IRWM Regions**




## Project Physical Benefits

This project is administrative only in nature and therefore does not provide any physical benefits.

## Technical Analysis of Physical Benefits Claimed

This project is administrative only in nature and therefore does not provide any physical benefits.

## Project Performance Monitoring Plan

As this project is administrative only, there are no physical benefits to be monitored. However, overall project performance will be measured by the Region's success in meeting the funding agreement requirements, including meeting scheduled deliverables (i.e progress reports).

| Table 6 – Project Performance Monitoring Plan (from PSP) | | |
|---|---|---|
| **Project: Grant Administration Project** | | |
| **Proposed Physical Benefits** | **Targets** | **Measurement tools and methods** |
| Meet requirements of funding agreement | Executed Funding Agreement | DWR receipt of executed funding agreement |
| Meet requirements of funding agreement | Quarterly Progress Reports | DWR receipt of quarterly progress reports |
| Meet requirements of funding agreement | Project Completion Report | • DWR receipt of draft project completion report<br>• DWR receipt of final project completion report |

## Cost Effectiveness Analysis

Proposed grant administration as delineated under this task is approximately 3% of the requested grant amount and 0.2% of the overall application costs.

## Project 2: North Valley Regional Recycled Water Program (Implementing Agency: City of Modesto)

### Brief Project Description (25 words or less)

The North Valley Regional Recycled Water Program delivers recycled water produced by Modesto and Turlock to Del Puerto Water District for irrigation by District growers.

### Expanded Project Description

The North Valley Regional Recycled Water Program (NVRRWP) provides immediate regional drought relief and future drought preparedness and improved supply reliability through the application of recycled water and therefore is an eligible project type. The NVRRWP will create a regional solution to address south of the Sacramento-San Joaquin River Delta (Delta) water supply shortages and reliability concerns by utilizing recycled water produced by the Cities of Modesto and Turlock for beneficial use. The Project will augment CVP supplies and reduce groundwater pumping in the DPWD service area by delivering recycled water produced by the cities to DPWD, a Central Valley Project (CVP) agricultural water contractor. DPWD has seen significant shortages and decreased reliability in the quantity of water it receives annually under the terms of its federal water service contract and, both last year and this year, received 0% of its CVP contracted allocation. A portion of the supply will also be delivered to state and federal south of the Delta wildlife refuges that are not presently receiving water supplies necessary to meet the refuge's objectives for wildlife management.

With the development of conveyance capability (pipelines and a pumps station retrofit), Modesto and Turlock could provide 30,000 AFY upon start-up and up to 53,100 AFY at build-out of tertiary-treated recycled water to DPWD to supplement their CVP supplies, and to the U.S. Bureau of Reclamation to supplement water supplies to wildlife refuges.. At this time, it is anticipated that 80% of this supply would be delivered to DPWD and 20% to the refuges. The recycled water would be produced from wastewater collected from the Cities of Ceres, Turlock, and Modesto utilizing existing treatment facilities. This new water supply for local agriculture will reduce DPWD's dependence on highly unreliable CVP supplies and improve its supply resiliency with a resultant reduction in groundwater pumping and Delta diversions. Specifically, the NVRRWP will provide local and regional economic sustainability by improving non-potable water supply reliability to agricultural water users and disadvantaged communities (DACs) in the DPWD service area; provide an incremental water source to meet the environmental needs of south of the Delta wildlife refuges, and will optimize the use of recycled water, a valuable resource produced by the Cities of Turlock and Modesto. Furthermore, the Project will promote regional economic growth through sustained and/or increased annual agricultural production, contribute toward the State Water Resources Control Board's objective of increasing the beneficial use of recycled water, contribute to a local solution toward solving California's ever increasing water crisis, and utilize local water resources to their highest and best use, reducing dependence on imported water supplies that flow through the Delta.

Recycled water is considered a highly drought resistant and provides a high degree of supply reliability; as such, it can be considered a firm new water supply to DPWD growers. In order to improve water supply reliability and alleviate drought-related impacts currently being experienced by DPWD growers and DACs within the service area, and to restore the economy in the area that has been impacted by CVP and other water supply shortages, additional funding is needed so the NVRRWP can begin delivering recycled water to users in a cost-effective and timely manner. The DACs need a reliable water supply to continue to grow and manage the highly-productive agricultural crops, prevent crop damage and loss, and maintain jobs to help sustain the economy in the DPWD service area, the counties, and the region. Without funding, the project could be implemented if other grant and/or low-interest loan sources are identified and secured; if not, implementing the project would impact an area already burdened by drought-related economic impacts and an associated lack of reliable water.

## Project Map

The NVRRWP is an inter-regional project between the East Stanislaus and Westside-San Joaquin IRWM regions; the regions boundaries and the NVRRWP location is provided in Figure 2-3 and project details are shown in Figure 2-4. The maps show the location of the City of Modesto and Turlock wastewater treatment facilities that will produce the recycled water. The recycled water will be conveyed via the pipelines shown in the figures below, and the Delta-Mendota Canal (DMC) to DPWD users for irrigation and to the wildlife refuges shown for habitat management. Monitoring locations and DACs within the service area are also shown.

**Figure 2-3: North Valley Regional Recycled Water Program Inter-Regional Location Map**

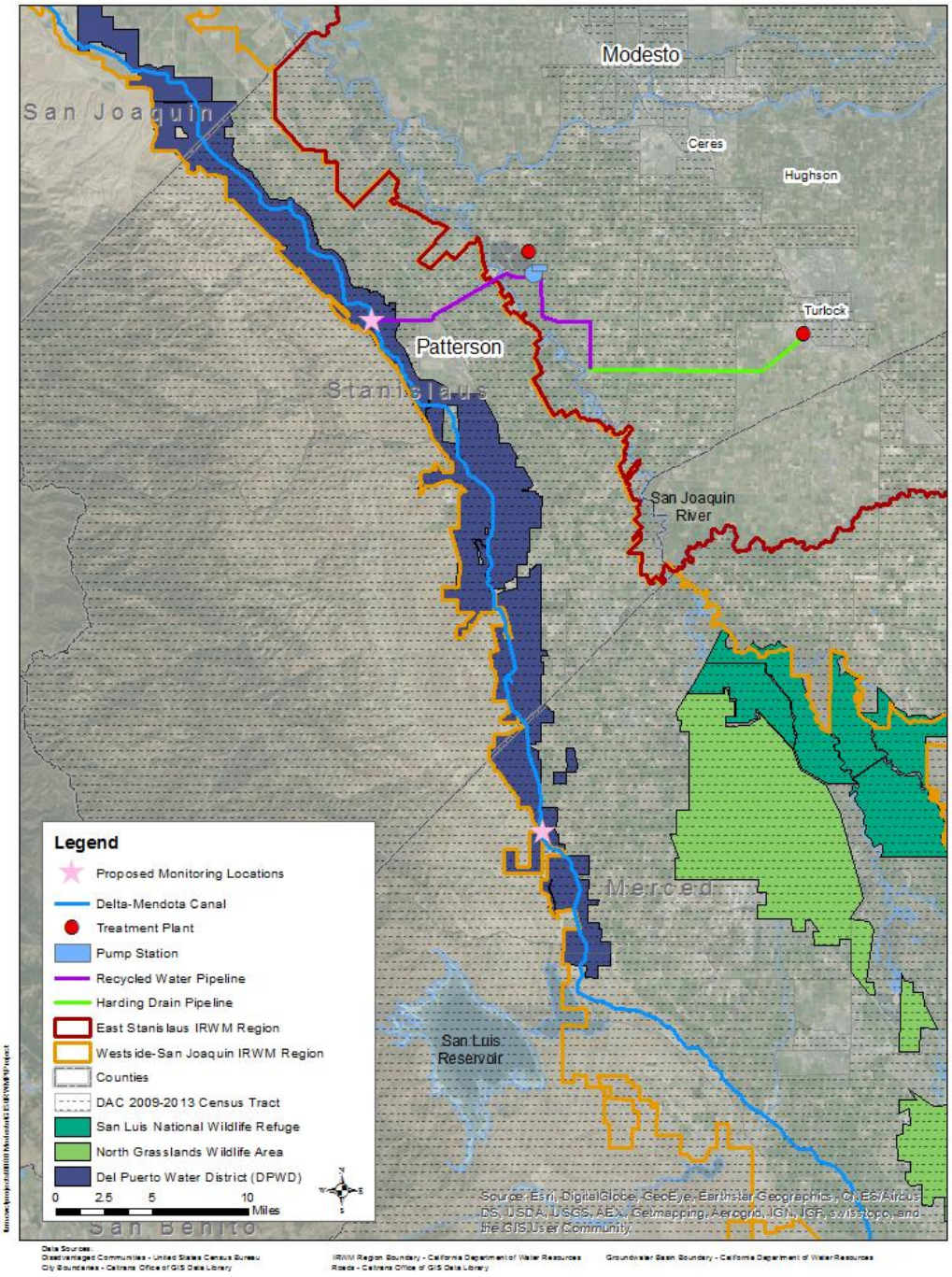
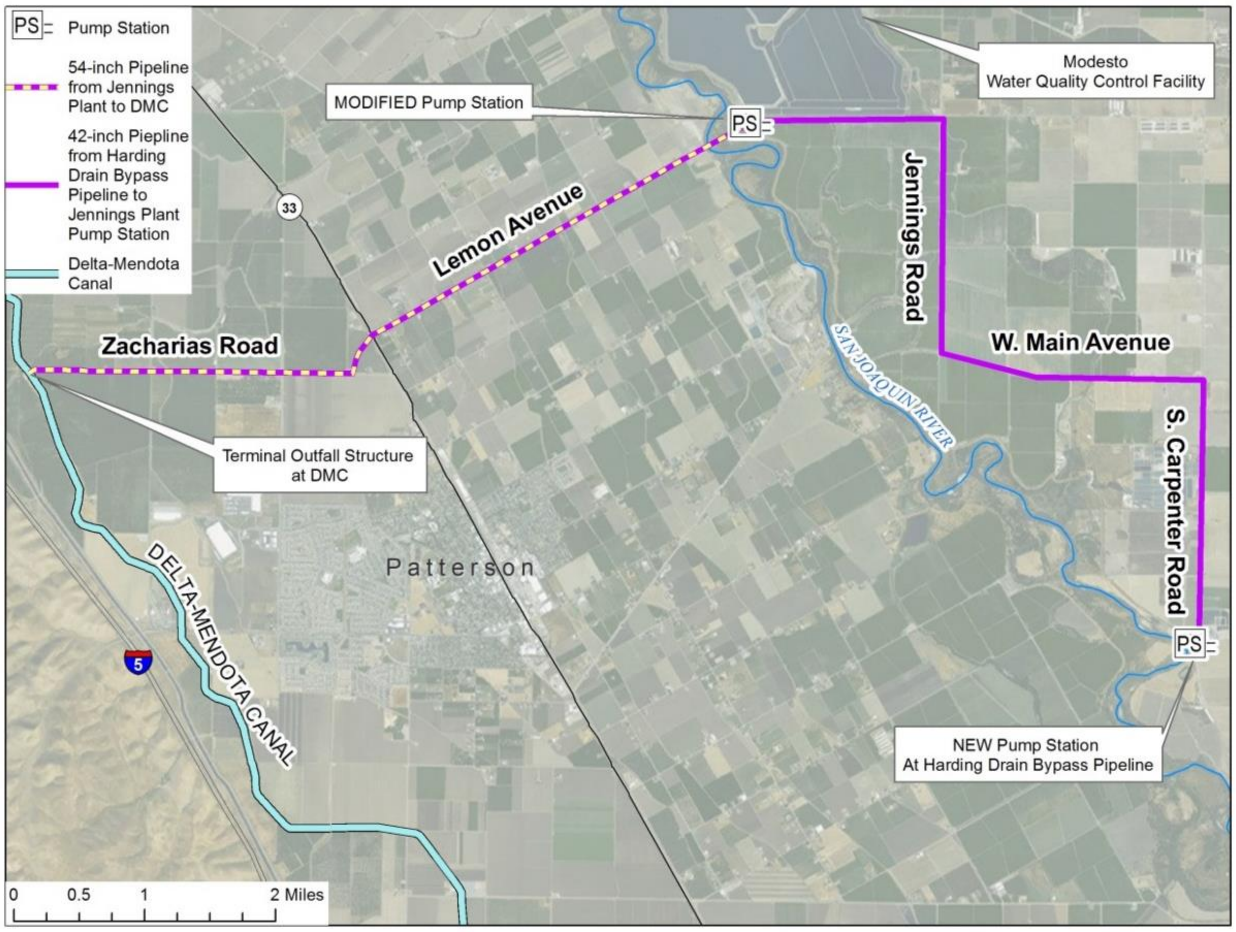


**Figure 2-4: North Valley Regional Recycled Water Program Map**




## Project Physical Benefits

The following presents the primary and secondary physically-quantifiable benefits that are expected from implementation of the NVRRWP.

The primary benefit of the NVRRWP is providing recycled water (as a new supply) to new users at agricultural sites in disadvantaged communities in the DPWD service area, thereby providing supplemental water supplies and increasing agricultural water supply reliability. The NVRRWP will expand recycled water use to the DPWD service area with recycled water produced by the Cities of Modesto and Turlock augmenting the District's CVP supplies by up to 42,480 AFY (or approximately 80% of the total 53,100 AFY produced).

A secondary benefit is recycled water from the NVRRWP will be delivered to south of the Delta wildlife refuges, helping Reclamation meet Incremental Level 4 water demands. On average, approximately 20 percent of the available recycled water will be delivered to the refuges (or approximately 10,620 AFY at build-out). Deliveries will vary by water year type, and will be made primarily during the winter-time "flood-up" months when the refuge water needs are the greatest.

**Table 2-2: North Valley Regional Recycled Water Project Physical Benefits**

| Project Physical Benefit | Quantification of Benefit | Technical Basis for Benefit |
|---|---|---|
| Primary Benefit: Water Supply - CVP Agricultural Supplies Augmented with Recycled Water | Up to 42,480 AFY of new agricultural water supply | • North Valley Regional Recycled Water Project Feasibility Study (RMC, 2013) – Pages 3-9 and 3-10 (see Appendix 2.1 of this attachment) - volume adjusted based on recent negotiations. |
| Secondary Benefit: - Habitat Improved, Restored or Protected - Recycled Water to the Central Valley Project Improvement Act (CVPIA)-designated State and Federal South of the Delta Wildlife Refuges | Up to 10,620 AFY of new supply for wildlife and habitat management | • North Valley Regional Recycled Water Project Feasibility Study (RMC, 2013) – Pages 2-6, 3-9 and 3-10 (see Appendix 2.1 of this attachment) - volume adjusted based on recent negotiations.<br>• Refuge Recycled Water Study (RMC, 2013) (see Appendix 2.1 of this attachment) |

The quantifiable physical benefits, including the CVP supplies augmented with recycled water and recycled water to wildlife refuges, are presented in the following tables.

**Table 2-3: North Valley Regional Recycled Water Program – CVP Supplies Augmented with Recycled Water Benefit – Primary Benefit**

| Table 5 – Annual Project Physical Benefits (from PSP) | | | |
|---|---|---|---|
| **Project Name:** North Valley Regional Recycled Water Program | | | |
| **Type of Benefit Claimed:** Primary: Water Supply - CVP Agricultural Supplies Augmented with Recycled Water | | | |
| **Units of the Benefit** Claimed: acre-feet per year (AFY) | | | |
| **Anticipated Useful Life of Project (years):** 50 | | | |
| **Additional Information About the Benefit**: CVP supplies augmented with Recycled Water delivered to agricultural customers in DPWD service area from Cities of Turlock and Modesto | | | |
| (a) | (b) | (c) | (d) |
| | Physical Benefits | | |
| Year | Without Project | With Project | Change Resulting from Project (c) – (b) |
| 2014 | 0 | 0 | 0 |
| 2015 | 0 | 0 | 0 |
| 2016 | 0 | 0 | 0 |
| 2017 | 0 | 0 | 0 |
| 2018 | 0 | 22,032 | 22,032 |
| 2019 | 0 | 22,608 | 22,608 |
| 2020 | 0 | 23,328 | 23,328 |
| 2021 | 0 | 24,048 | 24,048 |
| 2022 | 0 | 24,768 | 24,768 |
| 2023 | 0 | 25,560 | 25,560 |
| 2024 | 0 | 26,352 | 26,352 |
| 2025 | 0 | 27,216 | 27,216 |
| 2026 | 0 | 28,152 | 28,152 |
| 2027 | 0 | 29,160 | 29,160 |
| 2028 | 0 | 33,552 | 33,552 |
| 2029 | 0 | 34,632 | 34,632 |
| 2030 | 0 | 35,712 | 35,712 |
| 2031 | 0 | 35,712 | 35,712 |
| 2032 | 0 | 35,712 | 35,712 |
| 2033 | 0 | 35,712 | 35,712 |
| 2034 | 0 | 35,712 | 35,712 |
| 2035 | 0 | 39,096 | 39,096 |
| 2036 | 0 | 39,096 | 39,096 |
| 2037 | 0 | 39,096 | 39,096 |
| 2038 | 0 | 39,096 | 39,096 |
| 2039 | 0 | 39,096 | 39,096 |

| | | | |
|---|---|---|---|
| 2040 | 0 | 39,096 | 39,096 |
| 2041 | 0 | 39,096 | 39,096 |
| 2042 | 0 | 42,480 | 42,480 |
| 2043 | 0 | 42,480 | 42,480 |
| 2044 | 0 | 42,480 | 42,480 |
| 2045 | 0 | 42,480 | 42,480 |
| 2046 | 0 | 42,480 | 42,480 |
| 2047 | 0 | 42,480 | 42,480 |
| 2048 | 0 | 42,480 | 42,480 |
| 2049 | 0 | 42,480 | 42,480 |
| 2050 | 0 | 42,480 | 42,480 |
| 2051 | 0 | 42,480 | 42,480 |
| 2052 | 0 | 42,480 | 42,480 |
| 2053 | 0 | 42,480 | 42,480 |
| 2054 | 0 | 42,480 | 42,480 |
| 2055 | 0 | 42,480 | 42,480 |
| 2056 | 0 | 42,480 | 42,480 |
| 2057 | 0 | 42,480 | 42,480 |
| 2058 | 0 | 42,480 | 42,480 |
| 2059 | 0 | 42,480 | 42,480 |
| 2060 | 0 | 42,480 | 42,480 |
| 2061 | 0 | 42,480 | 42,480 |
| 2062 | 0 | 42,480 | 42,480 |
| 2063 | 0 | 42,480 | 42,480 |
| 2064 | 0 | 42,480 | 42,480 |
| 2065 | 0 | 42,480 | 42,480 |
| 2066 | 0 | 42,480 | 42,480 |
| 2067 | 0 | 42,480 | 42,480 |

Comments: Source of values - Calculation of Buildout Flows spreadsheet prepared for the North Valley Regional Recycled Water Program Feasibility Study, Volume 1: Final Report (Pages 3-9 and 3-10) (RMC, 2013). On average, 80% of available recycled water will be provided to DPWD; the remaining 20% of flows will be provided to Reclamation for the wildlife refuges as shown in the following table.

**Table 2-4: North Valley Regional Recycled Water Project – Recycled Water to CVPIA-designated State and Federal South of the Delta Wildlife Refuges Benefit – Secondary Benefit**

| Table 5 – Annual Project Physical Benefits (from PSP) | | | |
|---|---|---|---|
| **Project Name:** North Valley Regional Recycled Water Project | | | |
| **Type of Benefit Claimed:** Secondary: Habitat Improved, Restored or Protected - Recycled Water to CVPIA-designated State and Federal South of the Delta Wildlife Refuges | | | |
| **Units of the Benefit Claimed:** acre-feet per year (AFY) | | | |
| **Anticipated Useful Life of Project (years):** 50 | | | |
| **Additional Information About the Benefit:** Recycled water delivered to Reclamation to use for habitat and wildlife management at the refuges | | | |
| (a) | (b) | (c) | (d) |
| | Physical Benefits | | |
| Year | Without Project | With Project | Change Resulting from Project (b) – (c) |
| 2014 | 0 | 0 | 0 |
| 2015 | 0 | 0 | 0 |
| 2016 | 0 | 0 | 0 |
| 2017 | 0 | 0 | 0 |
| 2018 | 0 | 5,508 | 5,508 |
| 2019 | 0 | 5,652 | 5,652 |
| 2020 | 0 | 5,832 | 5,832 |
| 2021 | 0 | 6,012 | 6,012 |
| 2022 | 0 | 6,192 | 6,192 |
| 2023 | 0 | 6,390 | 6,390 |
| 2024 | 0 | 6,588 | 6,588 |
| 2025 | 0 | 6,804 | 6,804 |
| 2026 | 0 | 7,038 | 7,038 |
| 2027 | 0 | 7,290 | 7,290 |
| 2028 | 0 | 8,388 | 8,388 |
| 2029 | 0 | 8,658 | 8,658 |
| 2030 | 0 | 8,928 | 8,928 |
| 2031 | 0 | 8,928 | 8,928 |
| 2032 | 0 | 8,928 | 8,928 |
| 2033 | 0 | 8,928 | 8,928 |
| 2034 | 0 | 8,928 | 8,928 |
| 2035 | 0 | 9,774 | 9,774 |
| 2036 | 0 | 9,774 | 9,774 |
| 2037 | 0 | 9,774 | 9,774 |
| 2038 | 0 | 9,774 | 9,774 |
| 2039 | 0 | 9,774 | 9,774 |

| | | | |
|---|---|---|---|
| 2040 | 0 | 9,774 | 9,774 |
| 2041 | 0 | 9,774 | 9,774 |
| 2042 | 0 | 10,620 | 10,620 |
| 2043 | 0 | 10,620 | 10,620 |
| 2044 | 0 | 10,620 | 10,620 |
| 2045 | 0 | 10,620 | 10,620 |
| 2046 | 0 | 10,620 | 10,620 |
| 2047 | 0 | 10,620 | 10,620 |
| 2048 | 0 | 10,620 | 10,620 |
| 2049 | 0 | 10,620 | 10,620 |
| 2050 | 0 | 10,620 | 10,620 |
| 2051 | 0 | 10,620 | 10,620 |
| 2052 | 0 | 10,620 | 10,620 |
| 2053 | 0 | 10,620 | 10,620 |
| 2054 | 0 | 10,620 | 10,620 |
| 2055 | 0 | 10,620 | 10,620 |
| 2056 | 0 | 10,620 | 10,620 |
| 2057 | 0 | 10,620 | 10,620 |
| 2058 | 0 | 10,620 | 10,620 |
| 2059 | 0 | 10,620 | 10,620 |
| 2060 | 0 | 10,620 | 10,620 |
| 2061 | 0 | 10,620 | 10,620 |
| 2062 | 0 | 10,620 | 10,620 |
| 2063 | 0 | 10,620 | 10,620 |
| 2064 | 0 | 10,620 | 10,620 |
| 2065 | 0 | 10,620 | 10,620 |
| 2066 | 0 | 10,620 | 10,620 |
| 2067 | 0 | 10,620 | 10,620 |

Comments: Source of values - Calculation of Buildout Flows spreadsheet prepared for the North Valley Regional Recycled Water Program Feasibility Study, Volume 1: Final Report (Pages 3-9 and 3-10) (RMC, 2013). On average, 80% of available recycled water will be provided to DPWD as shown in the previous table; the remaining 20% of flows will be provided to Reclamation for the wildlife refuges.

## Technical Analysis of Physical Benefits Claimed

### *Documents Used to Support Technical Analysis*

The NVRRWP is supported by a series of studies documenting the potential project benefits, including:

- North Valley Regional Recycled Water Project Feasibility Study (RMC, 2013)
- Refuge Recycled Water Study (RMC, 2013)
- NVRRWP: San Joaquin River Flow Analysis (RMC, 2013);
- Pipeline Corridor Study (RMC, 2013);
- Impact on Regional Income, Employment, and Output (Jeffrey Michael & Thomas Pogue, 2010);
- Assessment of Potential Effects of the NVRRWP Reductions in Freshwater Discharges into the San Joaquin River on Fishery Habitat and Juvenile Salmon Survival (Hanson Environmental, 2013);
- North Valley Regional Recycled Water Program – Final Environmental Impact Report (June 2015)

Page numbers referencing the physical benefits are provided in Table 2-2.

### *Need for the Project*

DPWD provides agricultural irrigation water to approximately 45,000 acres of highly productive farmland in Stanislaus, San Joaquin, and Merced Counties with a production value of over $130 million gross farm dollars annually. DPWD serves its customers with water supplies from the CVP which it receives through a contract with the U.S. Bureau of Reclamation. DPWD receives up to 140,210 AFY of CVP water based on its contract entitlement, but in recent years, due to drought conditions and Delta pumping restrictions, DPWD has experienced significant shortages and decreased reliability. Both last year (2014) and this year (2015), DPWD's CVP supply is 0% of its full contract amount, and its future contract deliveries are uncertain.

Historically, the Cities of Modesto and Turlock have collected and treated wastewater from their service areas and from the City of Ceres. In 2009, Modesto treated over 23 mgd at its Jennings Road Secondary Treatment Facility. Effluent produced at the facility is presently applied to Modesto-owned ranch land (approximately 2,500 acres) or is discharged to the San Joaquin River between October 1st and May 31st, when the San Joaquin River flows provide a 20:1 dilution ratio. Storage ponds at the plant site are used when effluent cannot be discharged to the river or land-applied. Modesto received a permit from the Regional Water Quality Control Board (RWQCB) in 2008 allowing for year-round discharge to the San Joaquin River, but in order to meet discharge requirements, Modesto is also required to provide nutrient removal, tertiary filtration, and disinfection for discharge to the River. Modesto is upgrading its facilities through a phased approach. In 2010, the first phase of the upgrades was completed, providing the City with 2.3 mgd of tertiary treated effluent meeting Title 22 recycled water standards for unrestricted reuse. Phase 2 is scheduled to be online by February 2016, resulting in a total volume of 14.9 mgd of recycled water available. Ultimately, the Modesto will implement a total of 5 phases of upgrades, resulting in a total production capacity of 27.5 mgd of recycled water by the year 2040.

The City of Turlock's wastewater treatment facility has a design capacity of 20 mgd and currently treats an annual average flow of approximately 10 mgd. The facilities include secondary treatment, tertiary treatment, and chlorine disinfection. All recycled water produced at Turlock's facilities meet Title 22 standards. Currently, the majority of recycled water produced is discharged year-round to the San Joaquin River via the Harding Drain, an open channel drain owned by Turlock Irrigation District (TID). In early 2014, Turlock completed construction of a pipeline, the Harding Drain Bypass Pipeline, to convey recycled water directly to the San Joaquin River for discharge, which came online on October 31 2014.

Recognizing the Cities of Modesto and Turlock have a valuable resource that could be utilized rather than discharged to the San Joaquin River, and DPWD is in need of a reliable water supply, the three primary partners entered into a Memorandum of Understanding (MOU) and began developing the NVRRWP. The U.S. Bureau of Reclamation (Reclamation) has also been involved in program development. Reclamation has a contractual obligation under the CVPIA and in cooperation with the U.S. Fish and Wildlife Service (USFWS) and the California Department of Fish and Wildlife (CDFW) to provide water deliveries to the refuges on San Joaquin River to maintain and improve habitat areas on certain Federal and State wildlife refuges in the Central Valley (Level 2 deliveries). In addition to Level 2 deliveries, additional water supply is needed for optimal wildlife management (incremental Level 4 or IL4). Reclamation has entered into five long-term water supply contracts with Grassland Water District, USFWS, and CDFW for IL4 supplies. For the refuges south of the Delta, a total allocation of 105,514 AFY of IL4 supplies were identified. Reclamation is seeking additional supplies to meet the IL4 needs since this amount of delivery has not been achieved historically due to budget shortages, inconsistency in the timing of water deliveries, and other factors. The total 2012-2013 IL4 water delivery to the refuges was just 36,600 AFY, resulting in a shortfall of approximately 70,000 AFY. The shortfall of Level 4 deliveries affects the ability to provide optimum habitat management.

### *Estimates of Without-Project Conditions*

Without the project, new recycled water deliveries would not be established for agricultural users in the DPWD service area. The Cities of Modesto and Turlock would create the same amounts of recycled water at their wastewater treatment facilities and would discharge it to the San Joaquin River, in addition to certain existing land applications, as permit conditions allow. The City of Turlock delivers some recycled water to the Walnut Energy Center; this amount will remain the same under with and without project conditions. Should the cities continue to discharge wastewater effluent to the San Joaquin River, it is likely they would need to upgrade their facilities include partial to reverse osmosis (RO) to meet the more stringent discharge requirements anticipated in the future. This would have an economic impact on the cities and result in greater greenhouse gas (GHG) emissions as RO facilities require more energy than is currently needed to create recycled water (i.e. tertiary treatment). With increased energy use, CO2 emissions would be greater than they would be with project implementation.

Under this no-project scenario, DPWD would continue to rely on CVP supplies, and a gap between supply and demand would remain. Future CVP allocations to DPWD are uncertain, but are expected to be 35% of its full allocation (or 49,000 AFY) in normal hydrologic years. Should drought conditions continue or recur, even less of its contract CVP allocation would be expected. If DPWD does not receive its full CVP allocation, it will be forced to rely upon costly water transfers and/or groundwater which varies significantly in quantity and quality in the area. Further, reliance on groundwater supplies could result in depletion of the resource, degradation of groundwater quality, possible land subsidence, groundwater overdraft, and potential adverse impacts to crop yield from unsuitable groundwater quality. Water transfers are costly, and according to the 2009 California Water Plan Update, Delta exports and surface water supplies in the future are expected to become scarcer due to the impacts of climate change and the need to maintain the Delta ecosystem, which will likely result in water transfers becoming even costlier and less reliable. Without implementation of the NVRRWP, CVP supplies would not be augmented with recycled water.

If the NVRRWP recycled water is not delivered to the wildlife refuges south of the Delta, Reclamation would continue to seek a firm, reliable supply for IL4 and would likely not meet its mandated water deliveries. If Reclamation does not meet its contractual obligations to deliver IL4 water to the wildlife refuges, the ecosystems and habitats suffer. For example, the IL4 water is used to supply water to a 300-acre managed wetland in the Pixley National Wildlife Refuge (NWR) which provides habitat for migratory waterfowl and shorebirds. The Kern NWR provides wintering habitat for migratory birds, including endangered species.

Without the project, the DPWD service area will have poor water supply reliability, be susceptible to drought conditions, and continue to suffer from the lack of supplies it is receiving. The wildlife refuges will continue to suffer from the lack of supplies, resulting in impacts to the habitats and ecosystems.

### *Description of Methods Used to Estimate Physical Benefits*

**CVP Supplies Augmented with Recycled Water**

As discussed on pages 3-9 and 3-10 of the NVRRWP Feasibility Study, approximately 42.2 mgd (approximately 42,480 AFY – volume adjusted based on recent negotiations) of recycled water will be available for the NVRRWP, helping DPWD augment its existing CVP supplies. Beginning in 2018, 30,600 AFY of recycled water will be provided to DPWD. Then, as wastewater flows to the Cities of Modesto and Turlock increase with planned city growth, recycled water available to DPWD (and possibly other regional irrigators) will also increase. Projections for the City of Modesto's wastewater flows were based on the City's current land use and using flow coefficients from the City's Wastewater Master Plan with expected buildout to occur in 2042. The City of Turlock General Plan Update estimates the City will reach an influent flow of 27.5 mgd at buildout in the year 2030. A significant portion of projected job growth will occur in water intensive industries, including food processors, contributing to wastewater flow increases in Turlock. From 2018 through 2042, expected buildout recycled water deliveries will increase to 53,100 AFY and continue through the project's useful life. Over the Project's 50 year life, this equates to 2.6 million AF of CVP supplies augmented with recycled water. (Note: the CVP delivers to both DPWD and the Federal refuges.) Recycled water demands in DPWD's service area are greater than the projected recycled water available. Recycled water demands were estimated using the methodology described on page 3-2 of the NVRRWP Feasibility Study and in Appendix B of the Study. Water demands within the DPWD service area were estimated based on the specific water demand of each crop. Each year, DPWD conducts a survey of what crops were cultivated on each parcel and the associated acreages, which provided the basis for the demand estimate. Projected recycled water demand for 2040 for the District service area is approximately 120,000 AFY.

**Recycled Water to Wildlife Refuges**

The Refuge Recycled Water Study evaluated the feasibility of providing recycled water from the NVRRWP to the wildlife refuges. As described on page 2-6 of the NVRRWP Feasibility Study, on an annual basis, the optimum Incremental Level 4 (IL4) water delivered to wildlife refuges south of the Delta is 105,514 AFY. Recycled water would be delivered to the refuges with the DMC. Water quality sampling was conducted to ensure the quality would be appropriate for the refuges. The exact amount of recycled water that will be delivered to the refuges has not been determined, but is assumed to be 20% of available recycled water flows each year on average. This number will be negotiated between DPWD and the U.S. Bureau of Reclamation.

### *New Facilities, Policies, and Actions Required to Obtain Physical Benefits*

In order to achieve the benefits previously described, all NVRRWP facilities must be constructed, including:

- Turlock to Modesto Facilities:
  - 37,000 lineal feet (LF) of 42-inch diameter pipeline from the City of Turlock Harding Drain Bypass Pipeline to the City of Modesto wastewater treatment facility.
- Joint Facilities:
  - 4,000 LF of horizontal directionally drilled pipe from the City of Modesto wastewater treatment facility, crossing the San Joaquin River.
  - 34,000 LF of 54-inch pipeline from the San Joaquin River crossing to the DMC.
  - Two initial 500 hp pumps, with a build out of two 1,220hp pumps, and one standby pump.

An agreement with the U.S. Bureau of Reclamation will also be required for conveyance and storage of recycled water in the DMC.

The actions necessary to obtain the physical benefits above are completion of design and construction of the project.

### *Potential Adverse Physical Effects*

Construction of the NVRRWP will have temporary adverse impacts relating to project construction, but no long-term adverse effects are expected from the Project. Any significant adverse effects were identified and discussed in the project EIR/EIS, and have been reduced to less than significant through mitigation measures that will be implemented as part of project construction and operation. Based on the environmental analysis included in the EIR/EIS, potential adverse physical effects resulting from the NVRRWP construction and operation include:

- NOx construction emissions, which will be reduced to 10 tons per year,
- Effects on special-status plants, which include mitigation by avoiding and minimizing impact, performing focused surveys for special status plant species in suitable habitats, and monitoring or compensating for impacts.
- Effects on special-status fish from pile driving-related impacts, which will be mitigated by defined restrictions on the number of allowable strikes for 24 hour periods.
- Effects on the giant garter snake, which will be mitigated by avoiding and minimizing direct impacts.
- Facility damage and exposure of people to hazards from strong seismic groundshaking, liquefaction and lateral spreading, which will be mitigated by performing design-level geotechnical evaluations for seismic hazards and soil expansion.
- Accident conditions involving the release of hazardous materials into the environment, which will be mitigated with a Hazardous Materials and Spill Prevention Control Plan
- Violation of water quality standards, which will be mitigated by complying with the Construction General and NPDES permits, and implementing BMPs to control erosion and sediment during construction.
- Construction-related noise increases, which will be mitigated by noise reduction measures such as the mandated use of mufflers.
- Disruption of utilities or services, which will be mitigated by coordinating relocation and interruptions of utilities with Utility Providers.
- Transportation impacts, such as road closures and damage to driveways from open trench excavation, which will be mitigated by implementing a construction management plan and traffic control measures.

### *Long-Term Drought Preparedness*

The NVRRWP provides both immediate regional drought relief and long-term drought preparedness through the delivery and application of recycled water. The NVRRWP will provide a regional solution to address south-of-the-Delta water supply shortages and reliability concerns by utilizing recycled water produced by the Cities of Modesto and Turlock for beneficial use by augmenting surface water supplies and reducing groundwater pumping in the DPWD service area. Recycled water is considered a 'drought-proof' supply, and this project will provide the DPWD growers with a reliable water supply that can be counted on in all hydrologic water years.

## Direct Water-Related Benefit to a DAC

The NVRRWP lies in both the East Stanislaus and Westside-San Joaquin IRWM Regions. Based on the census tracts and census block groups (and as documented in Attachment 7 of this grant application), almost all of the DPWD service area is categorized as a DAC.

As noted above, the ongoing drought and reduced CVP allocations have created a water crisis in the area to be served by the NVRRWP. DPWD serves water to agricultural growers within its service area with CVP supplies through a contract with the U.S. Bureau of Reclamation; this contractual entitlement is the District's sole source of supply. Past water supply shortages, two years of 0% south-of-the-Delta CVP deliveries, and overall decreased supply reliability in the quantity of water it has received in recent years under the terms of its federal service contract has led to increasing impacts on the disadvantaged communities within the DPWD service area. Specifically, contractual limitations have had the following impacts to DPWD and its customers:

- Increased land fallowing and shifts in cropping patterns
- Increased groundwater pumping, which is unreliable in many areas and lacks the quality requirements for cropping
- Higher per unit delivery costs
- Economic hardship for users and local communities
- Crop loss and permanent crop damage

The NVRRWP will address the critical water supply need of the DACs in the DPWD service area by delivering recycled water from the Cities of Modesto and Turlock to the DPWD service area. The Project would improve water supply reliability and augment the shortfalls of the District's CVP supplies and offset further economic impacts to the local DACs.

## Project Performance Monitoring Plan

**Table 6 – Project Performance Monitoring Plan (from PSP)**

**Project: North Valley Regional Recycled Water Project**

| Proposed Physical Benefits | Targets | Measurement tools and methods |
|---|---|---|
| Primary: Water Supply - CVP Supplies Augmented with Recycled Water | 22,032 AFY of recycled water delivered at start-up<br>42,480 AFY of recycled water delivered at build-out | Metering of water deliveries via the NVRRWP pipeline at the Delta Mendota Canal outfall and comparing volumes delivered against projected deliveries. |
| Secondary: Habitat Improved, Restored or Protected - Recycled Water to State and Federal South of the Delta Wildlife Refuges | 5,508 AFY of recycled water delivered at start-up<br>10,620 AFY of recycled water delivered at build-out | Metering of water diversions from the Delta Mendota Canal via existing turnouts leading to the wildlife refuges and comparing volumes delivered against projected deliveries. Water quantities will be managed by the US Bureau of Reclamation in the CVP system with transfers and conveyance through existing infrastructure. |

## Cost Effectiveness Analysis

| Table 7 – Cost Effective Analysis | |
|---|---|
| **Project:** North Valley Regional Recycled Water Project | |
| Question 1 | Types of benefits provided as shown in Table 5<br>1. CVP Agricultural Supplies Augmented with Recycled Water<br>2. Recycled Water to CVPIA-designated State and Federal South of the Delta Wildlife Refuges |
| Question 2 | Have alternative methods been considered to achieve the same types and amounts of physical benefits as the proposed project been identified?<br>Yes |
| | If no, why? |
| | If yes, list the methods (including the proposed project) and estimated costs.<br>The NVRRWP Feasibility Study compared the recommended alternative of the NVRRWP (conveying recycled water via the DMC to DPWD) to other conveyance alternatives. These alternatives would deliver approximately the same amount of recycled water to DPWD and provide similar benefits to the NVRRWP as described in this application. The following summarizes the alternatives analyzed.<br><br><u>Preferred Alternative: Conveyance in the DMC</u><br>Summary: Convey recycled water via a pipeline to the DMC<br>Recycled Water Delivered in 2018 (AFY): 30,600<br>Unit Cost: $180 - $240/AF<br><br><u>Alternative 2B: Pipeline Conveyance to DPWD</u><br>Summary: Convey recycled water in a pipeline to the southern and central area of DPWD, with additional storage<br>Recycled Water Delivered in 2018 (AFY): 25,700<br>Unit Cost: $630/AF<br><br><u>Alternative 3: River Conveyance and Diversion</u><br>Summary: Discharge into and then divert recycled water from the San Joaquin River at a modified diversion facility<br>Recycled Water Delivered in 2018 (AFY): 30,600<br>Unit Cost: $100/AF<br><br><u>Alternative 4: Dilution and Conveyance via the Patterson Irrigation District to the DMC</u><br>Summary: Divert recycled water to PID's sedimentation basins or main canal for dilution with river water; convey diluted recycled water to the DMC<br>Recycled Water Delivered in 2018 (AFY): 30,600<br>Unit Cost: $150/AF<br><br><u>Alternative 5: DMC Operational Changes with Groundwater Aquifer Treatment</u><br>Summary: Divert recycled water into the DMC when the O'Neil Pumps are off; infiltrate diluted recycled water to groundwater and extract 6 months later for conveyance in DMC<br>Recycled Water Delivered in 2018 (AFY): 20,200<br>Unit Cost: $450-$490/AF |

| | |
|---|---|
| Question 3 | If the proposed project is not the least cost alternative, why is it the preferred alternative? Provide an explanation of any accomplishments of the proposed project that are different from the alternative project or methods.<br><br>The NVRRWP project discussed herein is not the initial lowest cost alternative for conveying the recycled water to DPWD but is the recommended option for conveying the recycled water from the Cities of Turlock and Modesto to the DMC for conveyance to DPWD (based on the alternatives analysis performed in the NVRRWP Feasibility Study). However, when future requirements for advanced treatment of effluent (potentially reverse osmosis) are included in the analysis for continued discharge to the San Joaquin River, the proposed project becomes the least cost alternative. (Cost analyses of the impacts of meeting more stringent treatment requirements indicate that O&M costs for treatment could be around $88/AF.) This alternative is technically feasible, avoids requirements for additional treatment upgrades, can convey all of the anticipated recycled water production at project buildout, uses the CVP facilities to provide seasonal storage, allows for delivery to all DPWD lands, is cost-effective compared to the other alternatives and has no identified fatal flaws from an institutional perspective. Additionally, it has fewer potential environmental impacts than Alternative 3, and is not as restrictive as Alternative 4 in terms of potential operational conflicts.<br><br>In addition to the alternatives analysis in which conveyance alternatives were analyzed for recycled water delivery, the Feasibility Study discusses alternative water supplies that could meet DPWD needs. Water transfers have been an effective and temporary way to meet DPWD's water demands, but are more costly than the NVRRWP and are not considered a long-term, reliable source of water due to uncertainties in the timing and quantities of Delta water that can be pumped in the future. Historically, water transfers have cost DPWD two to six times as much as its CVP contract supply, shown in the table below. Additionally, the cost of water transfers is expected to increase as demand for water increases. There are several factors that could impact future surface water supplies in California. Climate change is expected to affect the availability of Delta water exports because weather patterns are anticipated to become more severe (longer droughts and wetter non-drought years) and warmer temperatures are expected to reduce snowpack amounts and result in earlier springtime runoff. These weather changes are expected to impact the amount of surface water runoff, timing of runoff, and the ability to use runoff. For these reasons, relying on water transfers to meet DPWD current and future needs would not be reliable or cost effective. |

| Water Year | Bureau of Reclamation Contract ($/AF) | Additional Water Supply Rate [2] ($/AF) |
|---|---|---|
| 2006-2007 | $40 | $118 |
| 2007-2008 | $43 | $156 |
| 2008-2009 | $45 | $145 - $220 |
| 2009-2010 | $50 | $245 - $320 |
| 2010-2011 | $51 | $162 - $200 |
| 2011-2012 | $51 | $187 - $215 |
| 2012-2013 | $51 | $180 - $217 |
| 2013-2014 | $57 | $192 - $305 |
| 2014-2015 | $72 | $353 - $955 |

1. Information provided by DPWD.
2. Additional water supplies were obtained through a combination of temporary water transfers from Exchange Contractors, Cross Valley Canal Contractors, Patterson Irrigation District, Tracy, In-District Emergency Groundwater, and West Stanislaus Irrigation District.

| | |
|---|---|
| | While agricultural water users supplement CVP supplies with groundwater, it is not considered an effective long-term solution due to the potential for overdraft conditions and water quality parameters. Water quality and quantity vary throughout the DPWD service area. The DWR California Water Plan Update estimated in 1995 that the majority of overdraft conditions that were occurring in California were in the Tulare Lake, San Joaquin River, and Central Coast regions. DPWD is located within the San Joaquin River groundwater basin and overlies the Delta-Mendota groundwater subbasin. Groundwater has been used within the District to supplement CVP water deliveries, but there are potential long-term challenges associated with continued reliance on groundwater pumping such as declining water table elevation, land subsidence, degradation of groundwater quality, and adverse impacts to crop yield from unsuitable groundwater quality. Further or increased reliance on groundwater pumping to meet crop water demand is not considered a viable or sustainable option for DPWD given the potential adverse impacts that would likely occur. |
| Comments: | |

## Project 3: Area 2 Stormwater to Sanitary Sewer Cross-Connection Removal Project (Implementing Agency: City of Modesto)

### Brief Project Description (25 words or less)

The project captures, treats, and infiltrates stormwater using LID techniques including bioretention planters and underground retention to recharge groundwater in a fully developed neighborhood.

### Expanded Project Description

The City of Modesto's Area 2 Stormwater to Sanitary Sewer Cross-Connection Removal Project proposes to capture, treat, and infiltrate stormwater runoff to augment groundwater supplies, reduce flood-related damage, and improve the quality of stormwater runoff percolating to the underlying groundwater basin. The project is located in an area bound by Tully Avenue, West Orangeburg Avenue, the Virginia Corridor Trailway, and West Briggsmore Avenue, an area with persistent flooding. Stormwater is currently drained via five (5) sanitary sewer cross-connections which will be removed with this Project. The Project will, instead, utilize infiltration trenches under residential streets to direct stormwater runoff and recharge groundwater at the source. A larger infiltration basin will also be constructed under Roosevelt Park to capture and infiltrate the 100-year event. The project will augment groundwater by recharging an estimated 42 acre feet of runoff per year.

The Project will be implemented in four phases, each being a different project area; Phase 1 of the project has been completed and funding is sought herein for Phase 2. In 2014, the City completed construction of Phase I of the project in Garrison Park, constructing a subsurface infiltration basin under the park. The system was tested during a 100-year event that occurred on December 2, 2014 and worked flawlessly. Based on lessons learned from Phase I, this Phase 2 project was designed utilizing bioretention planters to filter stormwater at the source instead of a centralized pre-treatment device (as was used in the Phase 1 project), and the size of the retention basin was reduced by providing infiltration trenches under residential streets.

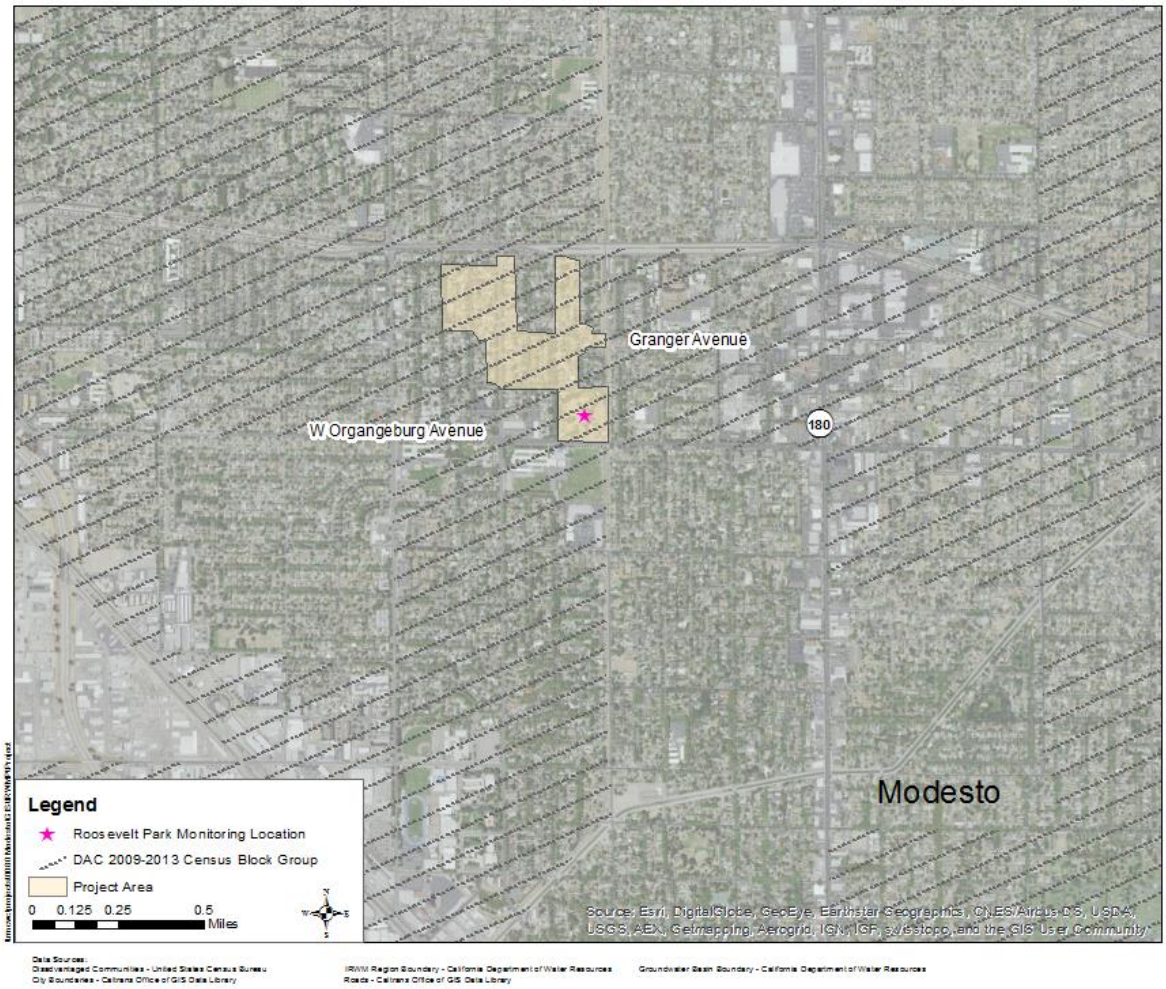
In 2010, a 35% Preliminary Design Report (PDR) was completed for the Project (encompassing all proposed phases). This report evaluated the feasibility and cost effectiveness of infiltrating stormwater close to its source and identified four areas centered on neighborhood parks for removing cross-connections and constructing subsurface infiltration systems. As previously noted, the proposed park (Roosevelt Park) is the second phase from the PDR. The PDR designed the retention system and stormwater conveyance system to a 35% level, including detailed topography, utility location, geotechnical investigations, cost estimates, and plan and profiles of proposed system. The City owns the street right-of-way for the project and Roosevelt Park, so no land purchases or easements are required for project construction. Necessary bid documents will be prepared using the Phase 1 documents as a foundation to expedite the final design and associated bidding. Overall, the project is ready to proceed to construction.

As previously noted, the Area 2 Stormwater to Sanitary Sewer Cross-Connection Removal Project, once implemented, will provide multiple benefits. Specifically, the project will augment groundwater supplies by recharging 42 acre feet of runoff per year. This will benefit the local neighborhood as one of the City's drinking water wells is located in Roosevelt Park and will benefit directly from additional groundwater recharge. The Project will also eliminate persistent street flooding in an approximately 5 acre area along Granger Avenue, a heavily traveled local collector and route to Roosevelt Junior High School and Freemont Elementary School, and bioretention planters in curb bulb-outs at intersections along Granger Avenue will treat stormwater to remove possible pollutants prior to recharge, improving groundwater quality that has historically been impact through the use of rock wells and sewers for stormwater discharge.

## Project Map

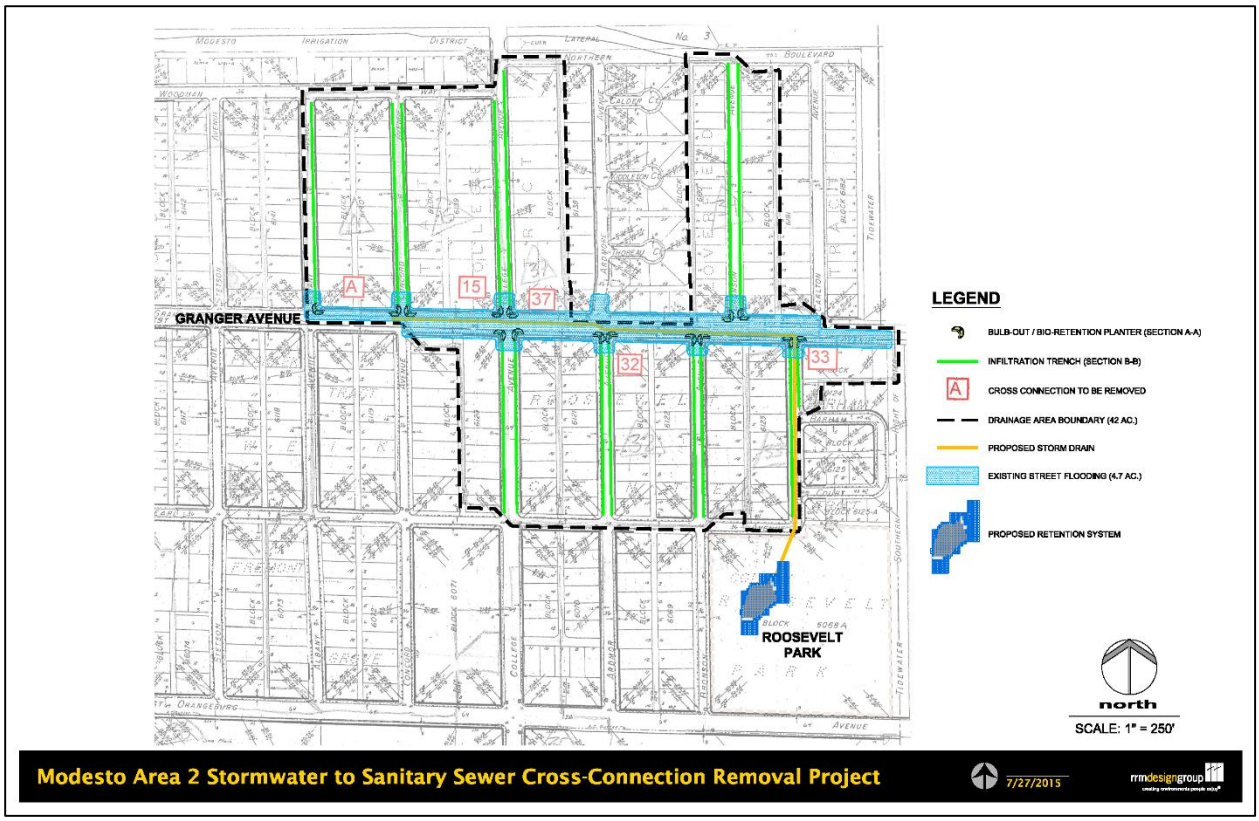
The City of Modesto's Area 2 Stormwater to Sanitary Sewer Cross-Connection Removal Project (location shown in Figure 2-1) coverage is displayed in Figure 2-5, with project details included in Figure 2-6.

**Figure 2-5: Area 2 Stormwater to Sanitary Sewer Cross-Connection Removal Project – Overall Project Location – Phase 2**




Data Sources:
Disadvantaged Communities - United States Census Bureau
City Boundaries - Caltrans Office of GIS Data Library
IRWM Region Boundary - California Department of Water Resources
Roads - Caltrans Office of GIS Data Library
Groundwater Basin Boundary - California Department of Water Resources

**Figure 2-6: Area 2 Stormwater to Sanitary Sewer Cross-Connection Removal Project – Project Details**




## Project Physical Benefits

**Table 2-5: Area 2 Stormwater to Sanitary Sewer Cross-Connection Removal Project Physical Benefits**

| Project Physical Benefit | Quantification of Benefit | Technical Basis for Benefit |
|---|---|---|
| Primary Benefit: Water Supply Produced/ Groundwater Recharge | Up to 42 AFY of groundwater recharge | Based on design criteria and sub-basin delineations shown in the Preliminary Design Report (Figure 2A). See Appendix 2.2 in this attachment. |
| Secondary Benefit: Flood Damage Reduction | Reduction/elimination of flooding approximately 4.7 acres | Figure 2A in Preliminary Design Report (see Appendix 2.2 in this attachment) and City Staff Field Observations. |

**Table 2-6: Area 2 Stormwater to Sanitary Sewer Cross-Connection Removal Project – Primary Benefit: Water Supply Reliability**

| Table 5 – Annual Project Physical Benefits (from PSP) | | | |
|---|---|---|---|
| **Project Name:** Area 2 Stormwater to Sanitary Sewer Cross-Connection Removal Project | | | |
| **Type of Benefit Claimed:** Water Supply Produced/Groundwater Recharge (Primary) | | | |
| **Units of the Benefit Claimed:** Acre-feet of groundwater recharge per year (AFY) | | | |
| **Anticipated Useful Life of Project (years):** 100 | | | |
| (a) | (b) | (c) | (d) |
| | Physical Benefits | | |
| Year | Without Project | With Project | Change Resulting from Project (c) – (b) |
| 2015-2017 | 0 | 0 | 0 |
| 2018-2118 | 0 | 42 | 42 |

**Table 2-7: Area 2 Stormwater to Sanitary Sewer Cross-Connection Removal Project – Secondary Benefit: Flood Damage Reduction**

| Table 5 – Annual Project Physical Benefits (from PSP) | | | |
|---|---|---|---|
| **Project Name:** Area 2 Stormwater to Sanitary Sewer Cross-Connection Removal Project | | | |
| **Type of Benefit Claimed:** Flood Damage Reduction (Secondary) | | | |
| **Units of the Benefit Claimed:** Inundated area reduced (acres) | | | |
| **Anticipated Useful Life of Project (years):** 100 | | | |
| (a) | (b) | (c) | (d) |
| | Physical Benefits | | |
| Year | Without Project | With Project | Change Resulting from Project (c) – (b) |
| 2015-2017 | 0 | 0 | 0 |
| 2018-2118 | 0 | 4.7 | 4.7 |

## Technical Analysis of Physical Benefits Claimed

### *Need for the Project*

At present, the City of Modesto manages urban stormwater runoff typically through a combination of routing stormwater runoff to sanitary sewers (cross-connection) and/or collecting and directing stormwater runoff to rock wells. Sanitary sewer cross-connections often cause sanitary sewer overflows (which, in turn, can cause health hazards) and/or decrease treatment efficiencies at the wastewater treatment plant. The use of rock wells by the City has resulted in groundwater quality impacts in the areas where rock wells are used as the system does little to eliminate pollutants entrained in the stormwater runoff.

The portion of the City evaluated by the Area 2 Stormwater to Sanitary Sewer Cross-Connection Removal Project has historically experienced chronic flooding (see Figure 2-7 for an example) and associated damage due to the sewer system cross-connections and poorly designed drainage system. This Project is working systematically to eliminate this flooding by redirecting stormwater runoff from the sanitary sewer system and into alternative, more beneficial, methods for runoff management.

**Figure 2-7: Flooding at Granger and College Avenue**

**<u>Primary Need</u>**

Groundwater is a primary water supply for the City of Modesto and other stakeholders overlying the Modesto Subbasin of the San Joaquin Valley Groundwater Basin. As such, the East Stanislaus IRWM identifies conjunctive management of groundwater and surface water as a primary means for managing groundwater basin sustainability and as being "ever more important" as climate change puts further demands on the Modesto Subbasin in responding to potentially more frequent droughts such as that the State is currently experiencing. Projected population growth in the region, combined with a greater reliance on groundwater as a supply, has and will continue to stress the groundwater system and is going to result in the increased overdrafting of the groundwater basin (as has historically occurred) and declining water quality unless measures are taken to counter such impacts.

**Secondary Need**

The project area has no positive storm drainage system. The area was developed with rock wells which have failed over time causing street flooding during minor rainfall events, particularly on Granger Avenue (collector street), a primary route for children to Freemont Elementary School and Roosevelt Junior High School. Flooding also occurs on Tully Road (arterial) in the project area causing traffic impacts and associated flood damage. At present, stormwater runoff is currently managed via five (5) sanitary sewer cross connections that have a history of causing sanitary sewer overflows during large rainfall events. These events can lead to both human health and environmental impacts, and have been shown to lead to discharges of fecal coliform and bacteria to Dry Creek and the Tuolumne River.

Historically, Granger Avenue has flooded during minor rainfall events. On December 11, 2014, the City Received 2.9 inches of rain in less than 24 hours. Granger Avenue was flooded from sidewalk to sidewalk requiring City Crews to pump stormwater with vacuum trucks.

Prior to 1995, the City of Modesto relied solely on groundwater supplies to meet potable demands, resulting the formation of a cone of depression under the City. In the mid-1990's, the City negotiated an agreement with Modesto Irrigation District (MID) under which MID would treat and deliver surface water supplies to the City to augment its potable supplies. Subsequent to this, the City significantly reduced its groundwater withdrawals, and the cone of depression was eliminated.

More recently, the Modesto Subbasin has experience declines in groundwater elevations on the order of 15 feet over the last 10 years, primarily as a result of increasing groundwater withdrawals to meet growing potable demands. It is anticipated that this trend will continue unless additional surface supplies are obtained and/or groundwater supplies are augmented in wet years.

### *Estimates of Without-Project Conditions*

There are no other similar projects planned for the project area. Without the project, flood-related damage and surface and groundwater quality impacts will continue. As such, there are no benefits associated with the Without-Project conditions.

### *Description of Methods Used to Estimate Physical Benefits*

Methods used to estimate the physical benefits follow basic engineering analyses, including the sizing of recharge facilities and evaluation of potential recharge benefits using mapped soil type and percolation information available from the Natural Resources Conservation Service (NRCS) with standard engineering design principals associated with urban stormwater management. Flood reduction benefits were evaluated based on the size of the area for which stormwater runoff will be managed and historically-reported information on the area of flooding and flood damage. Using standard engineering practices, the Project will eliminate street flooding for storm events less than or equal to the 100-year, 24-hour event (2.88 inches).

In addition to groundwater recharge and flood damage reduction benefits, the Project will reduce sanitary sewer overflows (SSOs) and associated discharges of coliform to Dry Creek. These SSO events (including coliform discharges to Dry Creek) have historically been monitored by the City and reported in the City's Annual Stormwater Report.

### *New Facilities, Policies and Actions Required to Obtain Physical Benefits*

New facilities include bioretention planters at intersection bulb-outs, underground retention systems in the street margins and under Roosevelt Park, catch basins, and new storm drain mains. No new policies will be required to obtain the anticipated physical benefits.

The actions necessary to obtain the physical benefits above are completion of design, environmental documentation, and construction of the project.

### *Potential Adverse Physical Effects*

Potential adverse physical impacts associated with the project are construction-related impacts. These impacts will be mitigated through the use of construction Best Management Practices and compliance with the State's General Permit for Stormwater Discharges Associated with Construction and Land Disturbance Activities. No long-term adverse effects are expected from Project implementation, although the system will require regular maintenance to ensure that clogging (and subsequently flooding) do not recur.

### *Long-Term Drought Preparedness*

The Project effectively addresses long-term drought preparedness by promoting the beneficial use of stormwater runoff by removing contaminants and using it to augment groundwater supplies. Groundwater is a primary source of water supply for the City of Modesto and surrounding communities, and the sustainability of that supply is a key component of long-term drought preparedness. As is well documented, the Central Valley (including the Modesto Area) substantially utilizes groundwater to offset reductions in surface water supplies in times of drought. Replacing those groundwater supplies in wet years will be key in ensuring that the groundwater basin maintains stable levels and is sustainable over the long term. This Project will be one piece of the larger management picture that will be required for the Modesto Subbasin to ensure its long-term sustainability as a groundwater supply under dry hydrologic conditions.

## Direct Water-Related Benefit to DAC

The City of Modesto's Area 2 Stormwater to Sanitary Sewer Cross-Connection Removal Project is located entirely within a Disadvantaged Community Block Group as identified per the DWR's Disadvantaged Communities Mapping Tool. The Project addresses the following water-related needs of the local DAC:

- Recharges groundwater with stormwater runoff (a new source of water) to raise groundwater elevations and improve basin sustainability. Elevated groundwater elevations, in turn, reduces pumping lift and energy usage (and energy cost) to local groundwater users, and reduces greenhouse gas emissions. As previously noted, one of the City's water supply wells is located in Roosevelt Park, and this well will benefit from the groundwater recharge and associated increases in groundwater levels.
- Reduces street flooding along Granger Avenue a minor collector and route to local schools (Freemont Elementary School, Roosevelt Junior HS)

## Project Performance Monitoring Plan

**Table 6 – Project Performance Monitoring Plan**

**Project:** Modesto Area 2 Stormwater to Sanitary Sewer Cross-Connection Removal Project

| Proposed Physical Benefits | Targets | Measurement tools and methods |
|---|---|---|
| Water Supply Produced/ Groundwater Recharge | Infiltrate into the groundwater basin 42 acre-feet per year of stormwater runoff currently entering sanitary sewer system. | Document removal of 5 cross connections; monitor infiltration system with real time volume metered data to verify capture and infiltration of storm flows; monitoring of a stilling basin with level sensor tied to the City's SCADA system to provide subsurface water level data (documenting the infiltration). |
| Flood Damage Reduction | Eliminate chronic flooding in an approximately 4.7 acres area along Granger Avenue. | Visually document (using field notes and photo documentation) no flooding relative to past observations during 3 to 5 storm events each year for 5 years post-construction and compare to historical data. |

## Cost Effectiveness Analysis

| Table 7 – Cost Effective Analysis | |
|---|---|
| **Project:** Modesto Area 2 Stormwater to Sanitary Sewer Cross-Connection Removal Project | |
| Question 1 | Types of benefits provided as shown in Table 5<br>1. Water Supply Produced/Groundwater Recharge<br>2. Flood Damage Reduction |
| Question 2 | Have alternative methods been considered to achieve the same types and amounts of physical benefits as the proposed project been identified?<br>Yes |
| | If no, why? |
| | If yes, list the methods (including the proposed project) and estimated costs.<br>The City prepared a 35% Design Report that looked at several methods for disposing of stormwater runoff, such as detention and pumped discharge, retention and infiltration, and constructing facilities proposed in the Storm Drain Cross Connection Report (Stantec, 2007). The Design Report determined that storing and infiltrating stormwater in four phases was the most cost effective ($22,434,378. RRM Design Group, 2010), with Phase 2 under Roosevelt Park costing between $5,604,183 and $7,121,611 depending on design (RRM Design Group, 2010). The cost for Phase 2 has since been lowered to $4,701,789, due to refinements in the design and the implementation of more low impact development (LID) practices. The alternative, the Storm Drain Cross Connection Report, proposed above-ground detention basins ($53,420,382, Stantec 2007); however, this disposal method was found to be more expensive. The Stantec report corroborates the findings in the 35% Design Report. |
| Question 3 | If the proposed project is not the least cost alternative, why is it the preferred alternative? Provide an explanation of any accomplishments of the proposed project that are different from the alternative project or methods.<br>The proposed project is the most cost effective alternative. The City Prepared a 35% Design Report that determined storing and infiltrating stormwater under neighborhood parks was the most cost effective method. The project proposes using biofiltration planters instead of a pretreatment device and infiltration trenches under existing roads to decrease the size of the retention basin in the park reducing demolition and reconstruction costs. |
| Comments: | |

# Appendix 2.1 – North Valley Regional Recycled Water Program Technical Documents

# North Valley Regional Recycled Water Program Feasibility Study
# Volume I:
# Final Report

**Prepared by:**

**May 2015**

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**Appendices**

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**Appendix B – Recycled Water Demand Estimate Methodology**
**Appendix C – NVRRWP Flow Rates and Buildout Projections**
**Appendix D – Advanced Treatment Costs of Recycled Water**
**Appendix E – Table 4a and Table 5 of the Pump-in Plan**
**Appendix F – City of Turlock Water Quality Data and Laboratory Information**
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**Appendix M – Detailed Alternative Cost Estimates**
**Appendix N – O'Neil Pumping Plant Historical Operations**

## List of Abbreviations

| | |
|---|---|
| AF | acre-feet |
| AFY | acre-feet per year |
| CCID | Central California Irrigation District |
| CDEC | California Data Exchange Network |
| CDFG | California Department of Fish and Game |
| CDFW | California Department of Fish and Wildlife |
| CEDEN | California Environmental Data Exchange Network |
| CEC | Constituent of Emerging Concern |
| CEQA | California Environmental Quality Act |
| cfs | cubic-feet per second |
| CIWQS | California Integrated Water Quality System |
| CNFR | California Northern Railway |
| CVP | Central Valley Project |
| CVPIA | Central Valley Project Improvement Act |
| DMC | Delta-Mendota Canal |
| DNQ | detected but not quantified |
| DPWD | Del Puerto Water District |
| DWR | California Department of Water Resources |
| FONSI | Finding of No Significant Impact |
| FT | Federally threatened |
| gpd | gallons per day |
| GPD/cap | gallons per day per capita |
| ID | Irrigation District |
| HP | Horsepower |
| kWh | kilowatt hour |
| LF | linear feet |
| MDL | minimum detection limit |
| MGD | million gallons per day |
| MPN | most probable number |
| NEPA | National Environmental Policy Act |
| NMFS | National Marine Fisheries Service |

| | |
|---|---|
| NPDES | National Pollutant Discharge Elimination System |
| NVRRWP | North Valley Regional Recycled Water Program |
| PID | Patterson Irrigation District |
| QA/QC | Quality Assurance / Quality Control |
| Reclamation | United State Bureau of Reclamation |
| RW | Recycled Water |
| RWQCB | Regional Water Quality Control Board |
| RWQCF | Regional Water Quality Control Facility |
| SWRCB | State Water Resources Control Board |
| TDS | Total Dissolved Solids |
| TM | Technical Memorandum |
| TID | Turlock Irrigation District |
| USBR | United States Bureau of Reclamation |
| USFWS | United States Fish and Wildlife Service |
| WQCF | Water Quality Control Facility |
| WWMP | Wastewater Master Plan |

This study was prepared to meet the requirements of the United States Bureau of Reclamation (Reclamation) Directives and Standards for the Title XVI Reclamation and Reuse Program (USBR Document WTR 11-01). The Directives and Standards provide a minimum report contents. The following table summarizes the minimum report contents by USBR Document WTR 11-01Chapter and Subchapter; the third column of the table indicates where in this study the information can be found. If using the electronic version of this report, the text in the third column contains a hyperlink to the referenced section.

| Reclamation Chapter | Reclamation Subchapter | Corresponding Section/Page No |
|---|---|---|
| **Introductory Information** | 1a. Identification of the non-Federal project sponsor | • 1.1 |
| | 1b. A description of the study area and an area/project map | • 1.2 |
| | 1c. A definition of the study area in terms of both the site-specific project area where the reclaimed water supply will be needed and developed, and any reclaimed water distribution systems. | • 1.2 |
| **Statement of Problems and Needs** | 2a. Description of the problem and needs for a water reclamation and reuse project | • 2.1 |
| | 2b. Description of current and projected water supplies, include water rights, and potential sources of additional water, other than the proposed Title XVI project, and plans for new facilities. | • 2.2,3.4 |
| | 2c. Description of current and projected water demands | • 2.3,3.3 |
| | 2d. Description of any water quality concerns for the current and projected water supply. | • Chapter 4 |
| | 2e. Description of current and projected wastewaters and disposal options other than the proposed Title XVI project, and plans for new wastewater facilities, including projected costs. | • 3.4 |
| **Water Reclamation and Reuse Opportunities** | 3a. Description of all uses for reclaimed water, or categories of potential uses (included but not limited to, environmental restoration, fish and wildlife, groundwater recharge, municipal, domestic, industrial, agricultural, power generation, and recreation). Identify any associated water quality, and associated treatment requirements. | • 3.2 |
| | 3b.Description of the water market available to utilize recycled water to be produced, including:<br>1. (i) Identification of:<br>1. Potential users, | • 3.2 |
| | 2. Expected use, peak use | • 3.4.1,3.4.2 |
| | 3. On-site conversion costs, | • 3.7 |
| | 4. Desire to use recycled water, including letters of intent if available. | • N/A |
| | 2. (ii) Description of any consultation with potential recycled water customers. | • N/A |
| | 3. (iii) Description of the market assessment procedures used. | • Appendix B |

| Reclamation Chapter | Reclamation Subchapter | Corresponding Section/Page No |
|---|---|---|
| | 3c. Discussion of considerations which may prevent implementing a water reuse project. Identify methods or community incentives to stimulate recycled water demand, and methods to eliminate obstacles which may inhibit the use of reclaimed water, including pricing. | • N/A |
| | 3d. Identification of all the water and wastewater agencies that have jurisdiction in the potential service area or over the sources of reclaimed water. | • 3.4 |
| | 3e. Description of potential sources of water to be reclaimed, including impaired surface and ground waters. | • 3.4 |
| | 3f. Description and location of the source water facilities, including: | |
| | 1. Capacities, plans for future facilities | • 3.4.1,3.4.2 |
| | 2. Treatment processes | • 3.4.1,3.4.2 |
| | 3. Plans for future source water facilities | • 3.4.1,3.4.2 |
| | 4. Existing flows, quantities of impaired water available to meet new reclaimed and reused water demands | • Chapter 5,Chapter 6 |
| | 3g. Description of the current water reuse taking place, including a list of reclaimed water uses, type and amount of reuse, and a map of existing pipelines and use sites. | • 3.4.1,3.4.2 |
| | 3h. Summary of water reclamation and reuse technology currently in use, and opportunities for development of improved technologies. | • 4.1 |
| **Description of Alternatives** | 4a. Description of non-Federal funding condition. The reasonably foreseeable future actions that the non-Federal project sponsor would take if Federal funding were not provided for the proposed water reclamation and reuse project, including estimated costs. | • Chapter 11 |
| | 4b. Statement of the objectives all alternatives are designed to meet. | • Chapter 7 |
| | 4c. Description of the other water supply alternatives considered to accomplish the objectives to be addressed by the proposed Title XVI project, including benefits to be gained by each alternative, total project cost, life cycle cost, and corresponding cost of the project water produced expressed in dollars per million gallons (MG), and/or dollars per acre-foot. An appraisal level cost estimates, or better, is acceptable for these alternatives. | • N/A |
| | 4d. Description of the proposed Title XVI project including detailed project cost estimate; annual operation, maintenance, and replacement cost estimate; and life cycle costs shall be provided with sufficient detail to permit a more in-depth evaluation of the project, including non-construction costs. | • Appendix M |

| Reclamation Chapter | Reclamation Subchapter | Corresponding Section/Page No |
|---|---|---|
| | 4e. Description of waste-stream discharge treatment and disposal water quality requirements for the proposed Title XVI project. | • Appendix E |
| | 4f. Description of at least two alternative measures, or technologies available for water reclamation, distribution, and reuse for the project under consideration. These alternatives must be approvable by the state(s) or tribal authorities in which the project will be located. | • N/A |
| **Economic Analysis** | 5a. The economic analysis included in the feasibility study report shall describe the conditions that exist in the area and provide projections of the future with, and without, the project. Emphasis in the analysis must be given to the contributions that the plan could make toward alleviation of economic problems and the meeting of future demand. | • Chapter 9 |
| | 5b. The Title XVI feasibility study must include a cost comparison of alternatives that would satisfy the same demand as the proposed Title XVI project. Alternatives used for comparison must be likely and realistic, and developed with the same standards with respect to interest rates and period of analysis. | • 7.8 |
| | 5c. When a Title XVI project provides water supplies for municipal and industrial use, the benefits of the Title XVI project can be measured in terms of the cost of the alternatives most likely to be implemented in the absence of the project. This is assuming that the two alternatives would provide comparable levels of service. | • N/A |
| | 5d. Some Title XVI project benefits may be difficult to quantify; for example, a drought tolerant water supply, reduced water importation, and other social or environmental benefits. These benefits shall be documented and described qualitatively as completely as possible. These qualitative benefits can be considered as part of the justification for a Title XVI project in conjunction with the comparison of project costs. | • 9.2.2 |
| **Selection of the Proposed Title XVI Project** | 6a. Provide an analysis of whether the proposed Title XVI project would address the following:<br>1. (i) Reduction, postponement, or elimination of development of new or expanded water supplies;<br>2. (ii) Reduction or elimination of the use of existing diversions from natural watercourses, or withdrawals from aquifers;<br>3. (iii) Reduction of demand on existing Federal water supply facilities; and<br>4. (iv) Reduction, postponement, or elimination of new or expanded wastewater facilities. | • 9.2.1 |

| Reclamation Chapter | Reclamation Subchapter | Corresponding Section/Page No |
|---|---|---|
| **Environmental Consideration and Potential Effects** | 7a. The Title XVI feasibility study report must include sufficient information on each alternative to allow Reclamation to assess the potential measures and costs that may be necessary to comply with NEPA, and any other applicable Federal law. Accordingly, the following information is required:<br>1. (i) Discussion whether, and to what extent, the proposed Title XVI project will have potentially significant impacts on endangered or threatened species, public health or safety, natural resources, regulated waters of the United States, or cultural resources.<br>2. (ii) Discuss whether, and to what extent, the project will have potentially significant environmental effects, or will involve unique or undefined environmental risks.<br>3. (iii) Description of the status of required Federal, state, tribal, and/or local environmental compliance measures for the proposed Title XVI project including copies of any documents that have been prepared, or results of any relevant studies.<br>4. (iv) Any other information available to the study lead that would assist with assessing the measures that may be necessary to comply with NEPA, and other applicable Federal, state or local environmental laws such as the Endangered Species Act or the Clean Water Act.<br>5. (v) Discussion of how the proposed Title XVI project will affect water supply and water quality from the perspective of a regional, watershed, aquifer or river basin condition.<br>6. (vi) Discussion of the extent to which the public was involved in the feasibility study, and a summary of comments received, if any.<br>7. (vii) Description of the potential effects the project may have on historic properties. Discussion must include potential mitigation measures, the potential for adaptive reuse of facilities, an analysis of historic preservation costs, and the potential for heritage education, if necessary. | • Chapter 6 |
| **Legal and Institutional Requirements** | 8a. Analysis of any water rights issues potentially resulting from implementation of the proposed water reclamation and reuse project. All proposed Title XVI projects must comply with state water law. | • 10.1 |
| | 8b. Discussion of legal and institutional requirements, state, and/or local requirements with the potential to affect implementation of the project. Title XVI projects using Reclamation project water must address contractual requirements. | • Chapter 10 |

| Reclamation Chapter | Reclamation Subchapter | Corresponding Section/Page No |
|---|---|---|
| | 8c. Discussion of the need for multi-jurisdictional or interagency agreements, any coordination undertaken, and any planned coordination activities. | • Chapter 10 |
| | 8d. Discussion of permitting procedures required for the implementation of water reclamation projects in the study area, and any measures that the non-Federal project sponsor can implement that could speed the permitting process. | • 10.3 |
| | 8e. Discussion of any unresolved issues associated with implementing the proposed water reclamation and reuse project, how and when such issues will be resolved, and how the project would be affected if such issues are not resolved. | • 10.4 |
| | 8f. Identification of current and projected wastewater discharge requirements resulting from the proposed Title XVI project. | • 10.3 |
| | 8g. Description of rights to wastewater discharges resulting from implementation of the proposed Title XVI project. | • 10.3 |
| **Financial Capability of Sponsor** | 9a. Proposed schedule for project implementation. | • 11.1 |
| | 9b. Discussion of the willingness of the non-Federal project sponsor to pay for its share of capital costs and the full operation, maintenance, and replacement costs. | • 11.2 |
| | 9c. A plan for funding the proposed water reclamation and reuse project's construction, operation, maintenance, and replacement costs, including an analysis of how the non-Federal project sponsor will pay construction and annual operation, maintenance, and replacement costs. | • 11.3 |
| | 9d. Description of all Federal and non-Federal sources of funding and any restrictions on such sources, for example, minimum or maximum cost-share limitations. Generally, for Title XVI authorized projects, the Federal cost share is limited to 25 percent, of $20,000,000, whichever is less. | • 11.4 |
| **Research Needs** | At a minimum the report must include a statement on whether the proposed water reclamation and reuse project includes basic research needs, and the extent that the proposed Title XVI project will use proven technologies and conventional system components. | • Chapter 10 |

# ES-1 Introduction

Del Puerto Water District (DPWD or District) is located along the west side of the San Joaquin Valley and extends from Vernalis to Santa Nella. The District provides agricultural irrigation water to approximately 45,000 acres of productive farmland in Stanislaus, San Joaquin, and Merced Counties. Currently, DPWD's only source of water is through a contract with the United States Bureau of Reclamation (Reclamation or USBR) for the delivery of up to 140,210 acre-feet (AF) of Central Valley Project (CVP) water annually.

Since the early 1990's, DPWD's CVP water allocations have been significantly reduced due to drought conditions and Delta pumping restrictions resulting from the passage of the Central Valley Project Improvement Act (CVPIA), and the National Marine Fisheries Service (NMFS) salmon and United States Fish and Wildlife Service (USFWS) Delta smelt biological opinions. In 2009, DPWD received only 10 percent (i.e. 14,000 AFY) of its contract allocation. DPWD's contract supply for 2013 is 20 percent of their contracted allocation (28,000 AFY). While future contract water deliveries to DPWD are uncertain, it is anticipated that restrictions to CVP operations will result in the District receiving an average of 35 percent of its contract allocation (i.e., 49,000 AFY) on an annual basis under normal hydrologic conditions (i.e. non-drought conditions).

These shortfalls in water deliveries from Reclamation have required DPWD to find alternative water sources to supplement its CVP deliveries, which has recently been accomplished by temporary water transfers from other agencies or the use of groundwater from privately owned wells. While groundwater and water transfers have been effective temporary methods to meet the District's water demands, they do not provide a reliable, sustainable, or affordable long-term solution.

DPWD is located in close proximity to the City of Modesto's (Modesto) and the City of Turlock's (Turlock) wastewater treatment facilities. Both Modesto and Turlock have recycled water available that could be delivered to the District and its customers, as shown in Table ES- 1. This supply of recycled water from Modesto and Turlock could provide a long-term, reliable water supply for the District and its customers that would serve to augment DPWD's CVP supply.

This feasibility study reviews and evaluates the following five recycled water delivery alternatives for this supply:

- **Alternative 1**: Pipeline Conveyance of Recycled Water Directly to the Delta-Mendota Canal (DMC)[1] ,
- **Alternative 2**: Pipeline Conveyance of Recycled Water Directly to DPWD Lands,
- **Alternative 3**: San Joaquin River Conveyance of Recycled Water to Existing Diversion Facilities for Conveyance to the DMC,
- **Alternative 4**: Pipeline Conveyance of Recycled Water to Patterson ID Existing Facilities for Dilution and Conveyance to the DMC,
- **Alternative 5**: Pipeline Conveyance of Recycled Water to the DMC Utilizing Groundwater Storage and Operational Modifications.

[1] The DMC is a USBR-owned concrete lined, open channel canal that conveys Sacramento-San Joaquin River Delta water south along the west side of the San Joaquin Valley, primarily for agricultural use, and ends at the Mendota Pool along the San Joaquin River.

**Table ES- 1: Summary of Recycled Water Available to DPWD**

| Recycled Water Source | 2018 Available Recycled Water (AFY) | 2045 Available Recycled Water (AFY) |
|---|---|---|
| Modesto | 16,500 | 30,600 |
| Turlock | 14,100 | 28,400 |
| **Total** | **30,600** | **59,000** |

# ES-2 Summary of Alternatives

As shown in Table ES- 1, both Modesto and Turlock anticipate expanding their recycled water production until reaching build-out conditions around 2045. The alternatives developed as part of this feasibility study were developed for the two recycled water production rates, i.e. 30,600 AFY available at the onset of the project (assumed to be 2018) and 59,000 AFY available at buildout in 2045. As shown in Table ES-2, some alternatives, which are further described below may require advanced levels of recycled water treatment (such as RO and advanced oxidation).

## Alternative 1: Pipeline Conveyance of Recycled Water Directly to the DMC

Alternative 1 consists of constructing a pipeline or combination of pipelines to deliver recycled water from Modesto and Turlock directly to the DMC. Five sub-alternatives were developed taking into consideration various corridor alignments within Stanislaus County.

- Alternative 1A: DMC-1A- Separate Alignments along Patterson Irrigation District (PID) Right-of-Way
- Alternative 1B: DMC-1B- Separate Alignments (Most Direct)
- Alternative 1C: DMC-2- Combined East at Las Palmas
- Alternative 1D: DMC-3- Combined West at Pomelo Avenue
- Alternative 1E: DMC-4- Combined East at Harding Drain

The DMC would be used to convey the recycled water to DPWD customers or to the San Luis Reservoir for storage during low water demand periods. This alternative would require a Warren Act Contract or a long-term Exchange Agreement for conveyance and storage of recycled water within the CVP system. Recycled water would be discharged to the DMC year-round, and all recycled water could be delivered to DPWD.

The range of unit costs for Alternatives 1A through 1E is included in Table ES-2. It was assumed that advanced treatment would not be needed for these alternatives

## Alternative 2: Pipeline Conveyance of Recycled Water Directly to DPWD Lands

Alternative 2 consists of constructing a pipeline from Modesto and Turlock to a selected service area within DPWD. Four sub-alternatives were developed taking into consideration delivery to different areas within DPWD and maximizing recycled water deliveries through the use of seasonal storage:

- Alternative 2A: Delivery to South and Central Areas, using seasonal storage at Modesto
- Alternative 2B: Delivery to South and Central Areas, with additional storage
- Alternative 2C: Delivery to the Central Area, using seasonal storage at Modesto
- Alternative 2D: Delivery to the North Area, using seasonal storage at Modesto

The range of unit costs for Alternatives 2A through 2D is included in Table ES-2. It was assumed that advanced treatment would not be needed for these alternatives

### Alternative 3: San Joaquin River Conveyance of Recycled Water to Existing Diversion Facilities for Conveyance to the DMC

Under Alternative 3, Modesto and Turlock would continue to discharge treated water to the San Joaquin River. The recycled water could then be diverted from the river at one of three existing river diversion facilities, and conveyed to the DMC for reuse by DPWD. The three alternative river diversion facilities have various capacities that DPWD could utilize, and therefore the volume of recycled water delivered to DPWD is slightly different for each sub-alternative.

- Alternative 3A: Banta Carbona Irrigation District (BCID) Diversion
- Alternative 3B: West Stanislaus Irrigation (WSID) District Diversion
- Alternative 3C: Patterson Irrigation District (PID) / WSID Diversion

The unit costs for Alternatives 3A through 3C are included in Table ES-2. Because this alternative results in continued discharge to the San Joaquin River, Modesto and Turlock would have to meet any new river discharge regulations that may take effect. Because salinity limits on San Joaquin River discharges may take effect within a 10 to 15 year timeframe, Table ES-2 includes the cost associated with treatment upgrades that may be required for salinity reduction of recycled water (i.e. reverse osmosis [RO] treatment). This alternative would also require a Warren Act Contract or Exchange Agreement for conveyance and storage of recycled water within the CVP system.

Alternative 3 is currently being evaluated under a separate program for the short-term interim period before ultimate permanent project is designed and constructed. DPWD and Turlock are investigating the water rights and transfer implications of delivering water through PID's diversion facilities. If approved, this water could be available as early as the 2014 irrigation season.

### Alternative 4: Pipeline Conveyance of Recycled Water to Existing Facilities for Dilution and Conveyance in the DMC

Alternative 4 consists of constructing a pipeline from Modesto and Turlock to PID conveyance facilities. The recycled water pipeline would cross the San Joaquin River, so that recycled water would either be discharged into PID's river sedimentation basins or into PID's Main Canal/pipeline. The recycled water would blend in their facilities with PID's appropriated San Joaquin River water (approximate dilution factor of 3:1 to 4:1 river water to treated water), and would then be conveyed to the DMC for delivery to DPWD and/or storage in San Luis Reservoir.

This alternative would maximize recycled water deliveries to DPWD because recycled water would be conveyed to PID as it is produced, and San Luis Reservoir would provide seasonal storage. This alternative would require a Warren Act Contract or Exchange Agreement for conveyance and storage of recycled water within the CVP system. Since recycled water would be mixed and diluted with diverted San Joaquin River water, PID's customers and Board of Directors may be required to approve use of recycled water in their service area. The unit costs for this alternative are included in Table ES-2. It was assumed that advanced treatment would not be needed for these alternatives. This alternative would also require a Warren Act Contract or Exchange Agreement for conveyance and storage of recycled water within the CVP system.

### Alternative 5: Pipeline Conveyance to the DMC Utilizing Groundwater Storage and Operational Modifications

Alternative 5 consists of constructing a pipeline from Modesto to the DMC to deliver recycled water directly into the DMC during three months of the year (April through June). It was assumed that operational strategies could be developed with Reclamation to allow recycled water discharge into the DMC at times when the O'Neil Pumps are not delivering DMC water into the O'Neil Forebay and ultimately into San Luis Reservoir. Seasonal storage at Modesto would be used to maximize the recycled water deliveries to the DMC during the three month period. During the remainder of the year, recycled water would be diluted with river water and percolated into the groundwater. It was assumed that at least a 6-month residence time could be provided prior to extracting the groundwater and dilution water. This alternative would require a Warren Act Contract or an Exchange Agreement for conveyance and storage of recycled water within the CVP system. A total of 20,200 AFY of water could be provided to DPWD under this alternative. As indicated in Table ES-2, it is assumed that advanced treatment would not be necessary.

**Table ES- 2: Summary of Alternatives**

| | Alternative 1: Pipeline to DMC | Alternative 2: Pipeline direct to DPWD | Alternative 3: San Joaquin River conveyance | Alternative 4: Pipeline to PID Facilities | Alternative 5: Groundwater Storage | Alternative 6: No Project / Action |
|---|---|---|---|---|---|---|
| **Advanced Treatment Required?** | No | No | Yes | No | No | Yes |
| **Capital Costs (range) [1]** | $96 M- $123 M | $168 - $175 M | $7.8M– $37.1 M | $41 M- $64 M | $128 M-$130 M | $259.5 M – $748 M |
| **Operating Cost (range)** | $1.5 M– $1.6 M | $2.1 –$2.6 M | $1.7 –$3.1 M | $1.7M – $3.4M | $2.7– $3.6 M | N/A |
| **AFY Delivered [2]** | 30,600 | 25,700 | 30,600 | 30,600 | 20,200 | 0 |
| **Comparative Unit Cost (range) [3]** | $180/AF - $240/AF | $470/AF - $660/AF | $1000/AF | $180/AF - $250/AF | $450/AF - $600 | N/A |

Notes:

1. Costs shown in 2013 dollars
2. Recycled Water Deliveries at Project Onset (year 2018)
3. Comparative unit costs assuming 25% capital cost grant, remaining capital financed at 5% over 30 years

## ES-3 Refuge Water Supply

Reclamation has a need for Incremental Level 4 (IL4) water supply for the Refuges located south of the Delta. Although no commitments have been made, delivery of a portion of the available recycled water to the Refuges via the DMC is a viable option that needs to be further evaluated relative to cost and delivery requirements and potentially incorporated into the program.

# ES-4 Conclusions and Recommendations

Each of the five alternatives was evaluated against the following criteria in order to determine the recommended alternative:

- Technical feasibility
- Potential treatment upgrades
- Recycled water delivery
- Ability to deliver water to the entire District
- Cost effectiveness
- Institutional issues and obstacles

Based on the evaluation of alternatives, Alternative 1, Pipeline Conveyance of Recycled Water Directly to the DMC, is the recommended option. Alternative 1 is technically feasible, avoids requirements for additional treatment upgrades, can convey all of the anticipated recycled water production at project buildout, uses the CVP facilities to provide seasonal storage, allows for delivery to all DPWD lands, is cost-effective compared to the other alternatives, and currently has no identified fatal flaws from an institutional perspective.

Within Alternative 1 it is recommended that two scenarios, DMC 1-B and DMC-4, be carried forward to the next phase of project development. DMC-1B, which conveys project water separately from each City to the DMC, is recommended because it allows each City to implement its recycled water system independently while being the the least costly of the separate pipeline scenarios. DMC-4, which conveys the combined flow from the two Cities to the DMC, is recommended because it is overall the lowest cost scenario in Alternative 1. The decision between these two scenarios will be based on more detailed evaluation of institutional agreements and project funding that will occur in the next project phase.

**Figure ES 1: Recommended Alternative DMC-1B**

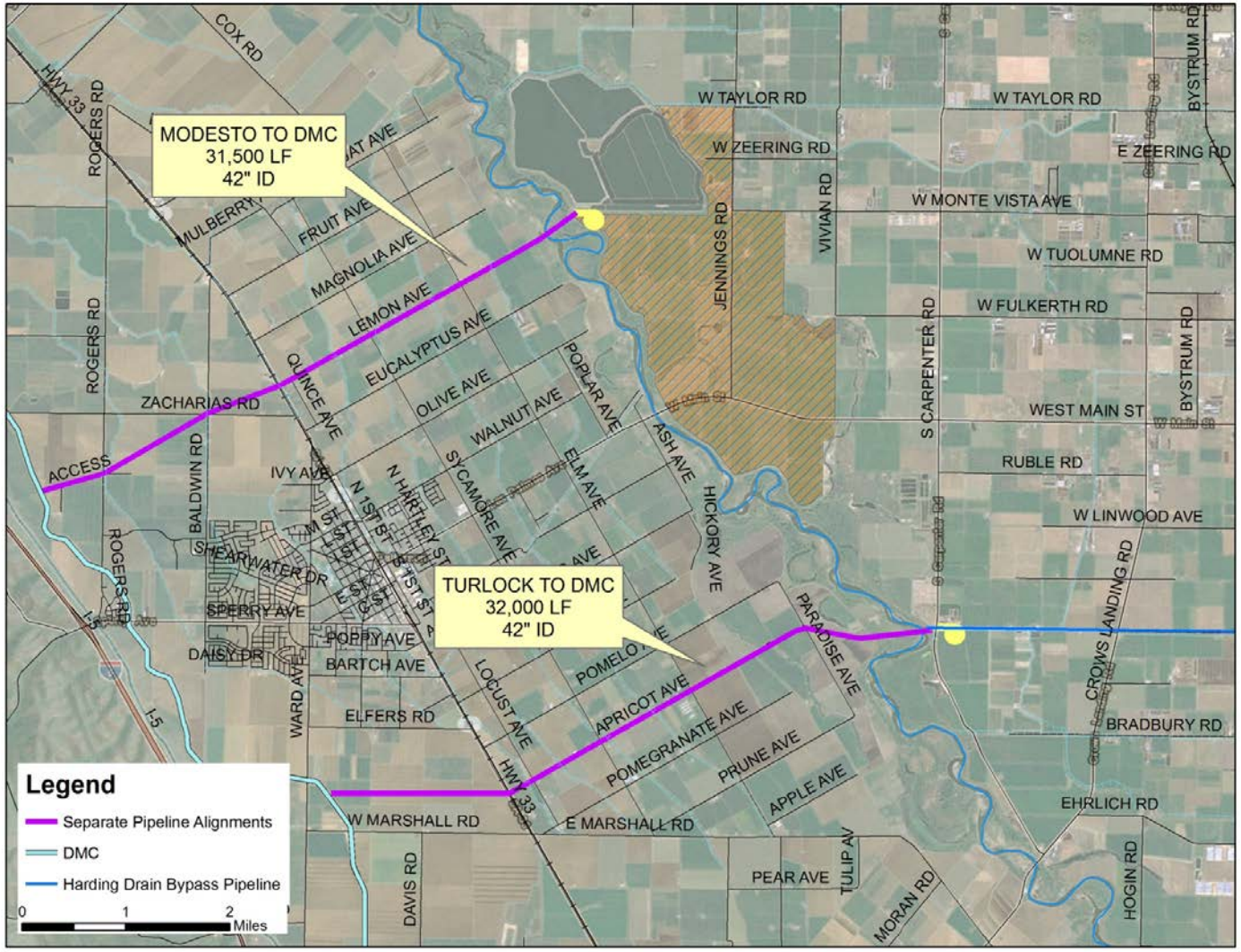
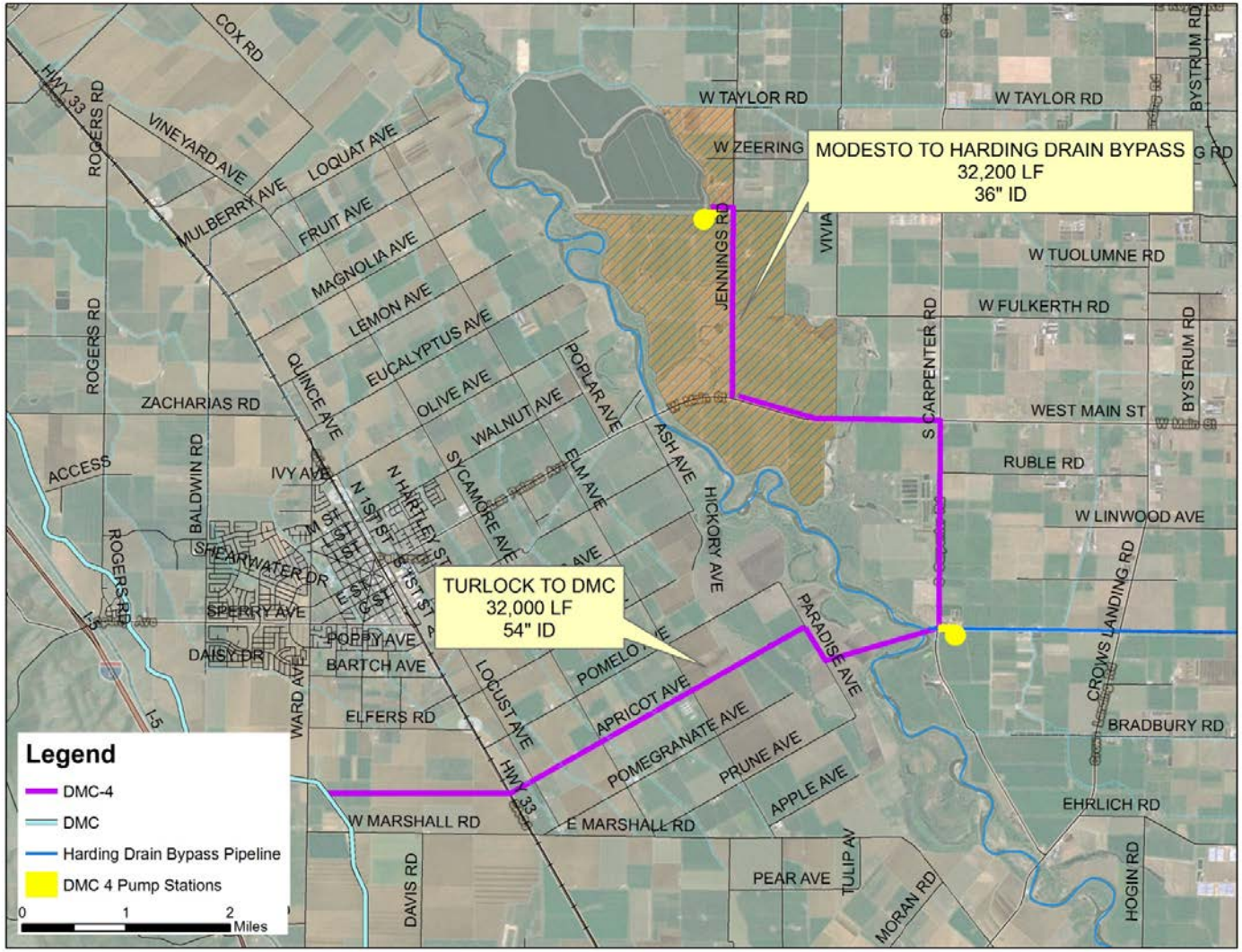


**Figure ES 2: Recommended Alternative DMC-4**



# Chapter 1 Introduction

## 1.1 General Background

Del Puerto Water District (DPWD or District) is a California Special District of the State of California, formed under the provisions of Division 13 of the State of California Water Code. DPWD is located along the west side of the San Joaquin Valley and extends from Vernalis to Santa Nella. The District includes approximately 45,000 acres of productive farmland which generates $130 million of gross revenue annually in Stanislaus, San Joaquin, and Merced Counties (Figure 1-1).

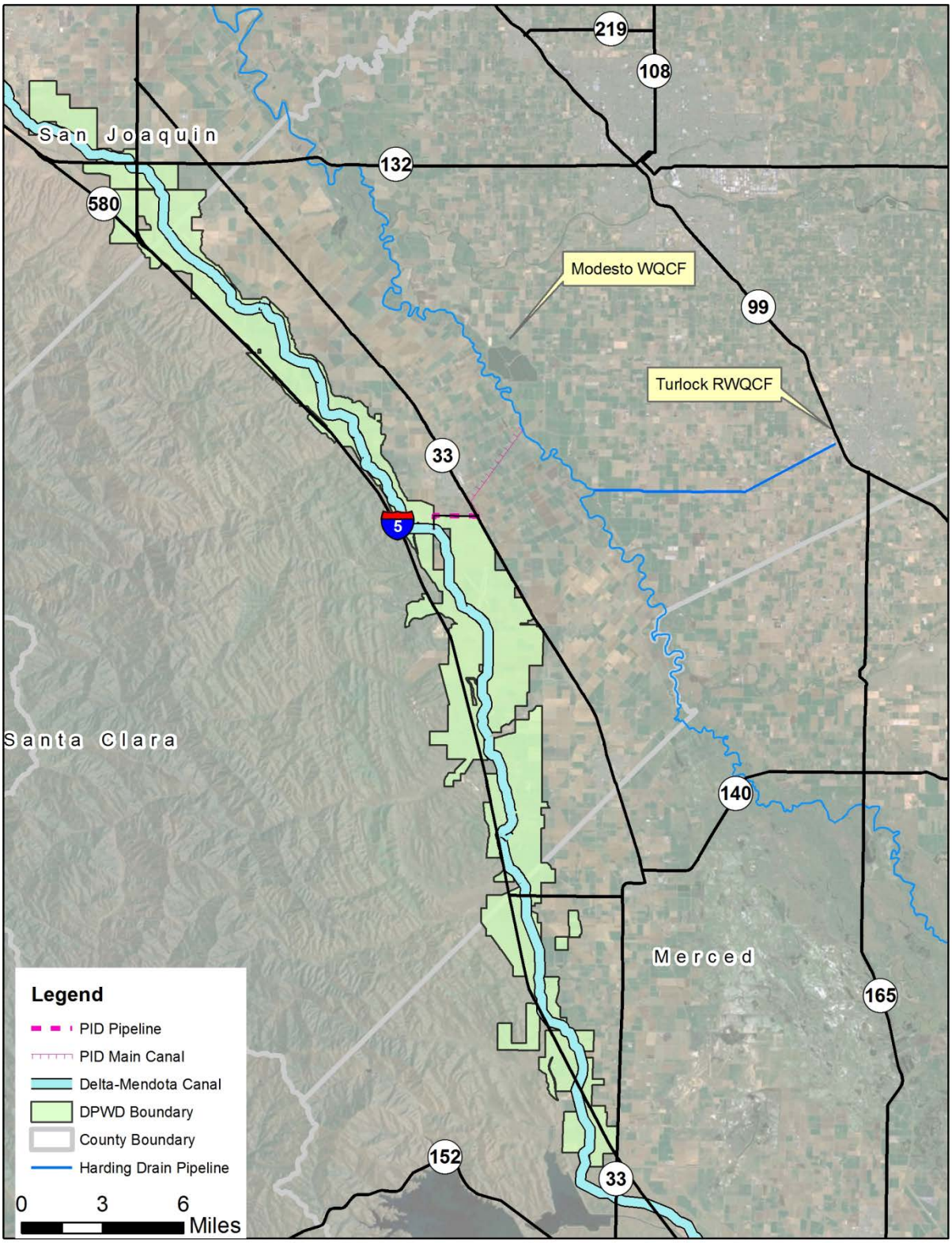
Currently, DPWD's only source of water is through its contract with the United States Bureau of Reclamation (Reclamation). The District's contract with Reclamation provides for an entitlement of up to 140,210 acre-feet (AF) of Central Valley Project (CVP) water annually, which correlates to an irrigation supply of approximately 3 AF per acre. Prior to the 1990's, DPWD received its full contractual water supply from Reclamation. Beginning in the early 1990's, DPWD's entitlements were significantly reduced due to drought conditions, impacts associated with implementation of the Central Valley Project Improvement Act (CVPIA), and regulatory restrictions imposed on Central Valley Project (CVP) operations. In 2009, due to hydrologic conditions as well as new Delta pumping restrictions resulting from the biological opinions of the NMFS and USFWS, DPWD only received 10 percent (≈14,000 AF) of its updated CVP allocation, which translated to an irrigation rate of approximately 4 inches per acre. In 2013, DPWD received only 20 percent of its CVP allocation. It is currently anticipated that future restrictions to the CVP operations will result in the District receiving an average of only 35 percent of its contract allocation (49,000 AFY) under normal hydrologic conditions (i.e., non-drought conditions).

## 1.2 Project Description

The water shortages and the lack of water supply reliability that DPWD has experienced have resulted in economic hardships on the District and its growers. In 2009, over 11,000 acres of lands were fallowed, representing approximately 25 percent of the District's productive farmland. To bridge the gap between Reclamation allocations and District demands, DPWD has relied on costly water transfers from other water agencies. However, Delta exports and surface water supplies in the future are expected to become scarcer due to the impacts of climate change and the need to maintain the Delta ecosystem (California Water Plan Update 2009, Bulletin 160-09, DWR), which will likely result in water transfers becoming more costly and less reliable. DPWD growers have also relied on groundwater from private wells to augment water supplies, but groundwater the DPWD service area ranges in quality and quantity across the District. The shortage of CVP water will continue to negatively impact the District, and may force the District's customers to rely more heavily on unreliable and sometimes poor quality groundwater supplies and/or to fallow more land.

One possible solution to DPWD's water supply shortage/reliability problem is to reuse or recycle treated wastewater from the Cities of Modesto (Modesto) and Turlock (Turlock) to supplement their CVP water supplies. Recycled water has been successfully used in California for a variety of agricultural uses, including the irrigation of raw fruit and vegetable crops. Modesto operates a water quality control facility (WQCF) located in Stanislaus County on the east side of the San Joaquin River (Figure 1-1.) A portion of Modesto's WQCF's effluent is treated to secondary standards and currently used for local pasture irrigation on City-owned property. The portion of the WQCF effluent that would be developed under the NVRRWP would receive tertiary treatment in full compliance with State of California Title 22 requirements for disinfected, tertiary recycled water.

**Figure 1-1: Project Site Map**



The City of Modesto had a population of 201,165 in 2011 and 202,290 in 2012. Domestic Flow into the City's Treatment Plants decreased between 2006 through 2012, from 27.2 MGD to 20.4 MGD. The decrease in flows may be attributed to water conservation (due to water metering), foreclosures, or reduction of year-round commercial industrial flows.

From that starting point, and using the same growth rates that were in the 2008 WWMP Supplement, it is assumed that there would be gradual growth of 0.6% in 2013-14, 1.6% from 2015-16, and 1.75% from then on, the City developed a reasonable projection of anticipated sewer connections in Modesto Municipal Sewer District #1, including Empire, North Ceres and County Islands. These assumptions include commercial and minor industrial growth, but exclude large scale industrial (canning) growth.

The 2007 WWMP used a per capita flow in 2005 of 117.3 GPD/cap, based on population and flow into the plant. Currently, flow per capita is estimated at 94.9 GPD/cap. A 5 year average (2008-2012) is 102.4 GPD/cap and 8 year average (2005-2012) is 109 GPD/cap. Based on these per capita flows, the estimated build-out date for the City of Modesto is between 2043 and 2046.

The City also estimated that expansion of the tertiary treatment facilities would occur in 5 phases, ultimately reaching a capacity of 27.5 mgd. Communication with the City indicates there will probably be some onsite uses of tertiary treated water, such as a demonstration irrigation project in the future. This memorandum estimates that 0.2 mgd will be used for in-facility recycled water use, leaving 27.3 mgd available at buildout for NVRRWP.

The Turlock RWQCF receives flow well in excess of what one would normally see for a City of 70,000 because they have a number of food processors, etc. The General Plan projects job growth commensurate with population growth, i.e. does not overestimate job growth. However, a significant portion of the job growth will occur in water intensive industries. The City has zoned a significant amount of land (1,700 acres) for new industrial development and has seen significant interest from food processors considering a move to Turlock. Therefore wastewater flows will increase significantly over time.

The City of Turlock has several long term commitments for recycled water use from the facility. The first commitment is for 2 mgd for 50 years for use at Turlock Irrigation District's (TID) Walnut Energy Center. Although the commitment is for up 2 mgd, the actual deliveries in 2012 have averaged 1.0 mgd. For the sake of assessing availability of recycled water, the contractual commitment of 2 mgd will be reserved for delivery to TID. The other current recycled water use in Turlock is for irrigation at Pedretti Park. The average irrigation use for the park is assumed to be 0.1 mgd, which was the average use in 2012. Therefore, in calculating the recycled water that would be available for NVRRWP, it is assumed that 2.1 mgd will be reserved for in-City use, leaving a flow rate of 25.4 mgd available at buildout for NVRRWP.

Based on the Cities' evaluation of buildout flows, it is estimated that approximately 52.7 mgd (59,000 AFY) of recycled water may be available by the year 2043 for the NVRRWP project.

The City of Ceres, located in between Modesto and Turlock, send a portion of their wastewater effluent to both Modesto and Turlock for further treatment. Currently, the rate of flow to either plant ranges from 0.5 to 2 mgd with a total planned export of 4.2 and 6.0 mgd to Modesto and Turlock, respectively. The timing of these increases is subject to when Ceres decides to discontinue their current practice of on-site disposal in the existing percolation ponds.

The geographic proximity of DPWD to Turlock's and Modesto's treatment facilities provides a unique opportunity for recycled water to be used to supplement DPWD's existing water supply and to improve water reliability for the District's customers. The respective wastewater outfalls of each City are located

approximately 4 river miles apart from each other. The recycled water delivery alternatives that were evaluated as part of this feasibility study include:

- **Alternative 1- Pipeline Conveyance of Recycled Water Directly to the Delta Mendota Canal (DMC)** for delivery to DPWD customers.
- **Alternative 2 - Pipeline Conveyance of Recycled Water Directly to DPWD Lands** from Modesto and Turlock Treatment Plants.
- **Alternative 3 – San Joaquin River Conveyance of Recycled Water to Existing Diversion Facilities for conveyance to the DMC.**
- **Alternative 4 – Pipeline Conveyance of Recycled Water to Patterson Irrigation District Existing Facilities for Conveyance to the DMC**. Recycled water would combine with river water diverted from Patterson Irrigation District's (PID) river diversion facility and the blended water would be used by PID customers and then pumped into the DMC for distribution to DPWD customers.
- **Alternative 5 - Pipeline Conveyance of Recycled to DMC Utilizing Groundwater Storage and Operational Modifications.** Recycled water would be pumped into the DMC when water is not being pumped from the DMC into O'Neil Forebay/San Luis Reservoir (assumed three-month period of April through June). Recycled water during the remainder of the year would be banked in the groundwater basin with dilution water, extracted six months later, and pumped into the DMC to DPWD customers.

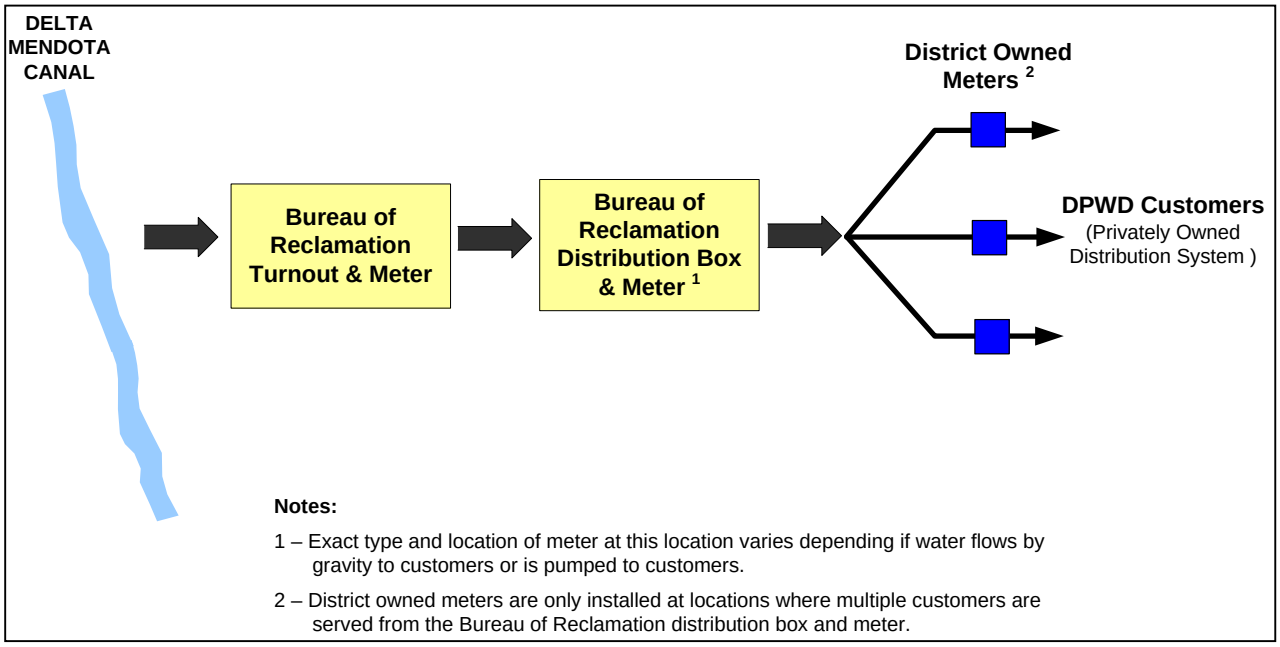
## 1.3 Existing Infrastructure

The Turlock RWQCF produces Title 22 tertiary treated recycled water and discharges it to the San Joaquin River via the Harding Drain Pipeline (currently under construction). The City of Turlock has several long-term commitments for recycled water use from the facility. The first commitment is for 2 mgd for 42 years for use at Turlock Irrigation District's (TID) Walnut Energy Center. Although the commitment is for up 2 mgd, the actual deliveries in 2012 averaged 1.0 mgd. For the sake of assessing availability of recycled water, the contractual commitment of 2 mgd will be reserved for delivery to TID. The other current recycled water use in Turlock is for irrigation at Pedretti Park. The average irrigation use for the park is assumed to be 0.1 mgd, which was the average use in 2012. Therefore, in calculating the recycled water that would be available for NVRRWP, it is assumed that 2.1 mgd will be reserved for in-City use, leaving a flow rate of 25.4 mgd (28,400 AFY) available at buildout for NVRRWP.

The Modesto WQCF is in the process of expanding their tertiary treatment facilities as flow has increased to the treatment plant. The City's total wastewater flow at build-out (in approximately 2040) is projected to be around 40.6 mgd. The expansion of the tertiary treatment facilities will occur in 5 phases, ultimately reaching a capacity of 27.5 mgd. Phase 1A is currently constructed and online, and the Phase 2 construction is currently in progress with an expected completion in 2016. There will likely be some onsite uses of tertiary treated water, such as a demonstration irrigation project in the future. It is estimated that 0.2 mgd will be used for in-facility recycled water use, leaving 27.3 mgd (30,600 AFY) available at buildout for NVRRWP. The remainder of the flow would be treated to secondary levels and would be used for local pasture irrigation at Modesto.

There are no recycled water treatment facilities within DPWD's service area, but there are three facilities in close proximity. DPWD does not currently own any water distribution facilities. CVP water is delivered to the District directly from the DMC through metered turnouts owned by the Bureau of Reclamation and licensed for DPWD's use. The water is then delivered to District customers either directly or through Bureau-owned distribution boxes via privately owned pumps, pipelines, and/or canals (see Figure 1-2). The San Luis and Delta Mendota Water Authority (SLDMWA) was established in 1992 to assume the operation and maintenance responsibilities of certain Reclamation CVP facilities, including those that deliver water to DPWD.

**Figure 1-2: DPWD Distribution System**



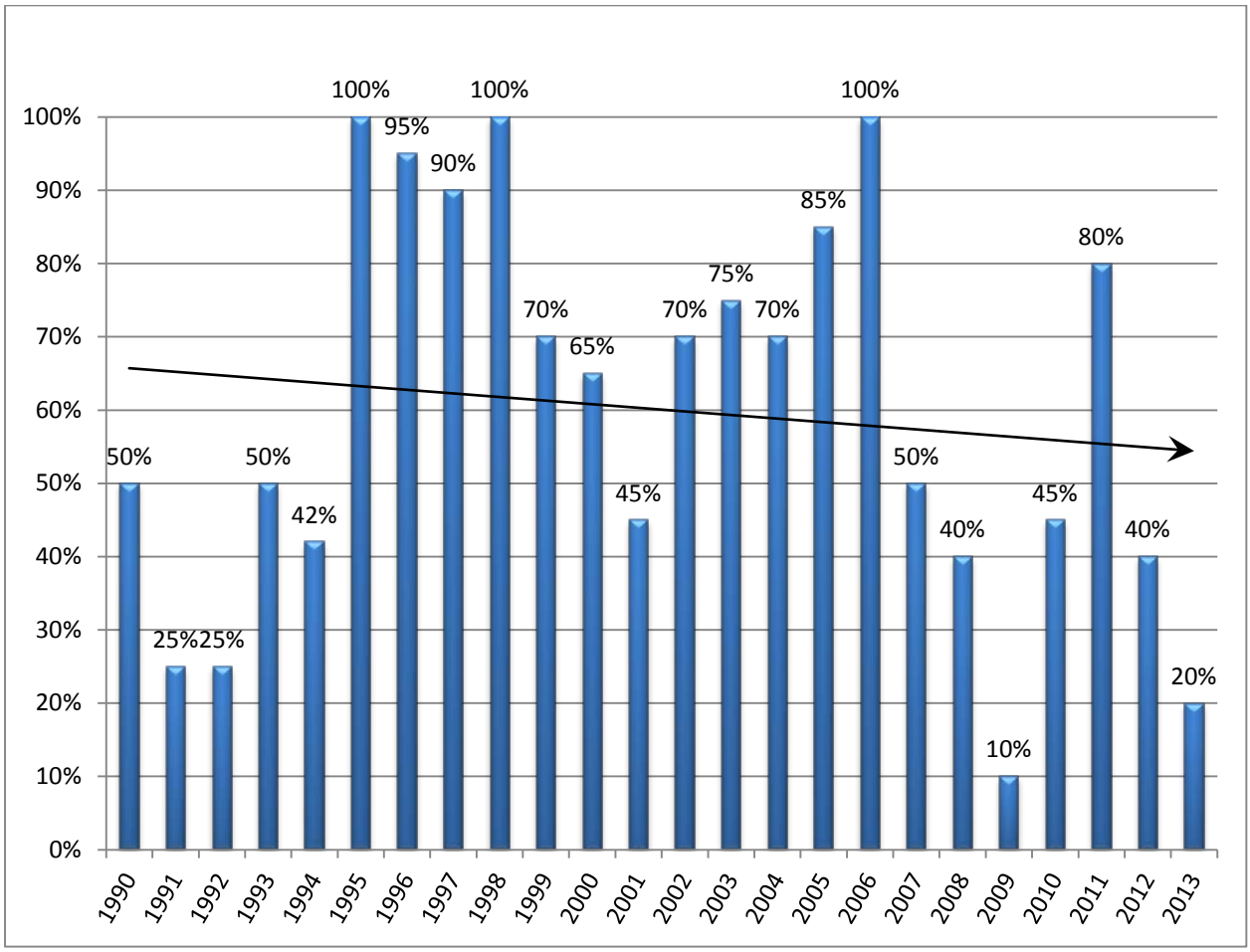

The three facilities that produce recycled water in proximity to DPWD are owned and operated by the Cities of Modesto, Turlock, and Patterson. The City of Patterson's (Patterson) Water Quality Control Facility (WQCF) is located approximately three miles northeast from central Patterson and has a design capacity of 2.75 mgd. The average daily flow treated at this facility is approximately 1.5 mgd (City of Patterson's WQCF monthly report, January 2010). Patterson's WQCF produces secondary effluent that is disposed of via percolation ponds located near the treatment facility. Patterson's 2010 General Plan indicates that they intend to recycle water within the city limits in the future to offset potable water demands and to recharge the groundwater basin. Because Patterson intends to use all treated water within its city limits, the Patterson's WQCF was not considered a potential source of recycled water for DPWD.

# Chapter 2 Statement of Problems and Needs

## 2.1 Project Need

DPWD relies on a single source of water supply, a CVP water contract with the USBR for up to 140,210 AFY. DPWD's full entitlement provides for approximately 3 AFY to District lands. In the early 1990's, water deliveries to DPWD were significantly reduced by up to 75 percent due to drought conditions (Figure 2-1). The drought was followed by the passage of the Central Valley Project Improvement Act (CVPIA), which resulted in Delta pumping restrictions and continued water delivery shortages (A Summary of Activities and Accomplishments in the Implementation of the CVPIA, Bureau of Reclamation, February 2005).

**Figure 2-1: Historic DPWD CVP Allocations[2]**



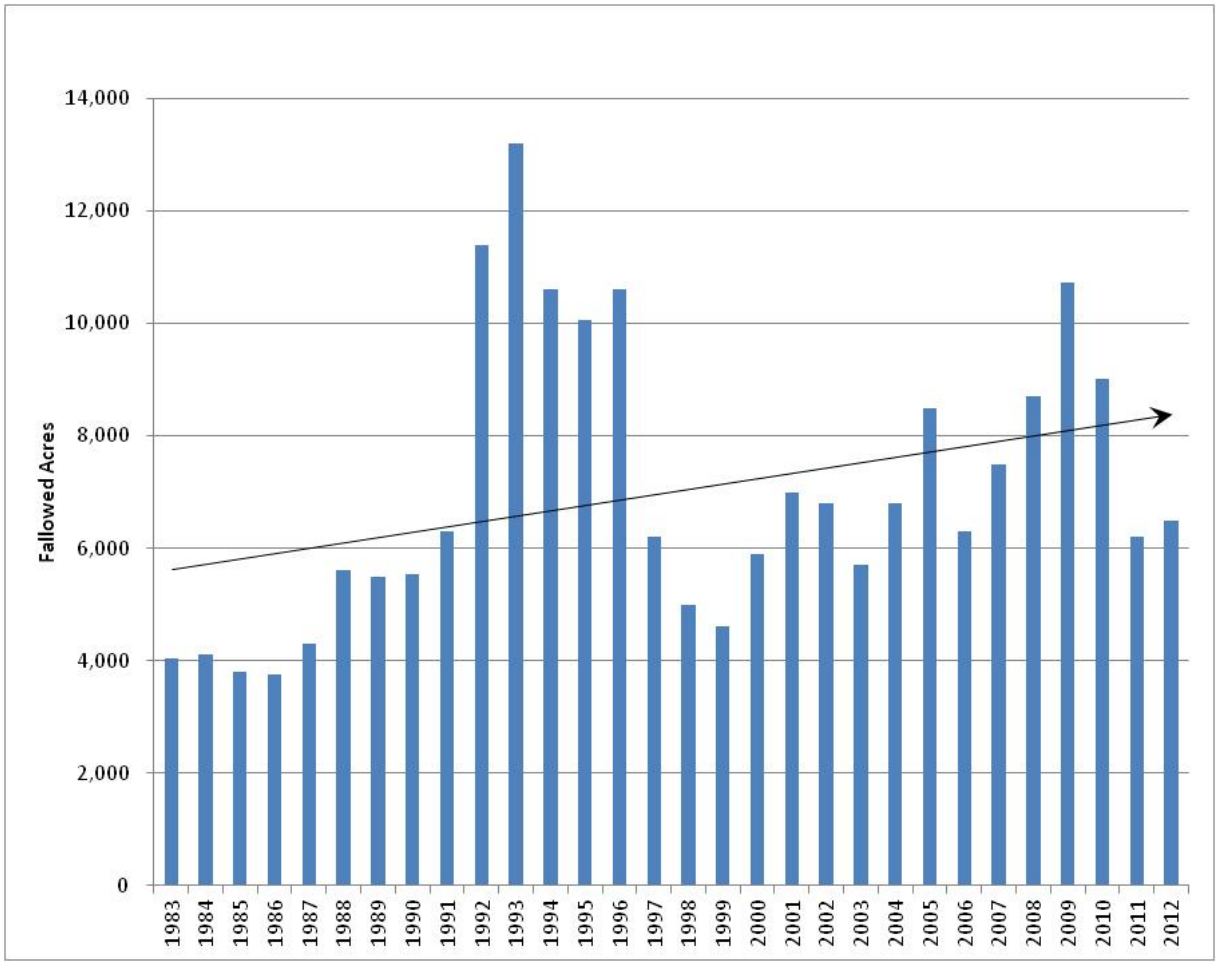

In 2009, when drought conditions and Delta pumping restrictions due to the National Marine Fisheries Service (NMFS) salmon and the USFWS Delta smelt biological opinions were imposed on CVP operations, DPWD received only 14,000 AFY of water from the CVP, which translates to an irrigation rate of approximately 4 inches per acre. In the past nineteen years, DPWD has been subject to water delivery reductions in all but three years. Under currently regulatory conditions, it is estimated that in the future DPWD may receive up to 35 percent of their contract entitlement (49,000 AFY) in an average hydrologic

[2] Data from DPWD based on historic CVP allocations for a water year

year, which would provide only 1 AF/acre. The future deliveries to DPWD were developed by applying historic South of Delta water allocation reductions from Delta pumping restrictions due to the CVPIA and biological opinions for Delta smelt and salmon, to the DPWD contract entitlement (see Appendix A).

Because DPWD does not have a secure alternate water supply, shortages in CVP deliveries result in economic hardships on the District as well as its growers, and results in fallowing practices within the District (Figure 2-2). In order to maintain the existing cropping patterns and economic conditions within the District, DPWD needs to secure an alternate water supply to supplement CVP deliveries.

**Figure 2-2: Historic Fallowing Practices**




## 2.2 Water Supplies

As discussed in Section 2.1, DPWD's primary source of water is its contract with Reclamation. When DPWD does not receive its full contract entitlement, it has historically relied on securing temporary water transfers each year from other water agencies to supplement its contract water deliveries. In addition, land owners increase their reliance on pumped groundwater in years when CVP water supplies are reduced. Table 2-1 provides a summary of recent water transfers and the cost incurred by DPWD for the water. The source and cost of the transferred water varies each year, but as indicated in Table 2-1, the water transfers can cost DPWD anywhere from two to six times as much as its CVP contract supply.

Water transfers have been an effective and temporary way to meet the District's water demands, but are not a reliable or sustainable long-term solution because of uncertainty in the availability of future surface water supplies, the projected difficulties in the ability to wheel water through the Delta in future years, and the

financial impact to customers associated with the constant increase in annual water costs. As the availability of source water decreases, the cost of water transfers will increase while the ability to secure water transfers will decrease. There are several factors that could impact future surface water supplies in California. Climate change is expected to affect the availability of Delta water exports because weather patterns are anticipated to become more severe (longer droughts and wetter non-drought years) and warmer temperatures are expected to reduce snowpack amounts. These two weather changes are expected to impact the amount of surface water runoff, the timing of runoff, and the ability to use runoff. In addition, changes in climate are expected to result in sea levels rising which will, in turn, increase the salinity of the Delta, requiring more fresh water to be kept in the Delta to maintain water quality conditions to support the Delta ecosystem and to maintain adequate flow and water quality in Old and Middle Rivers. Furthermore, a significant capital investment is needed in the future to maintain the infrastructure system that enables Delta conveyance. Without these improvements, Delta conveyance may be limited, which ultimately impacts the ability of South of the Delta water users to wheel water transfers through the Delta (California Water Plan Update 2009, Bulletin 160-09, DWR).

**Table 2-1: Historic Temporary Water Transfer Data**

| Water Year | Bureau of Reclamation Contract Rate ($/AF) | Additional Water Supply Rate[2] ($/AF) |
|---|---|---|
| 2006-2007 | $40 | $118 |
| 2007-2008 | $43 | $156 |
| 2008-2009 | $45 | $145-$220 |
| 2009-2010 | $50 | $245 - $320 |
| 2010-2011 | $51 | $162-$200 |

Notes:
1. Information provided by DPWD.
2. Additional water supplies were obtained through a combination of temporary water transfers from Exchange Contractors, Cross Valley Canal Contractors, PID, Tracy, In-District Emergency Groundwater, and WSID.

Groundwater is a major water supply source in the state of California for agricultural and municipal users. Shortages of surface water supplies have historically forced agricultural and municipal users to rely more heavily on limited groundwater supplies, which has led to overdraft and land subsidence conditions in some areas. The DWR California Water Plan Update estimated in 1995 that the majority of overdraft conditions that were occurring in California were in the Tulare Lake, San Joaquin River, and Central Coast regions. Furthermore, the area between Los Banos and Kettleman City has been identified as one of the most pronounced areas of historic and potential future subsidence problems (Poland and Lofgren, California Case History No. 9.13. San Joaquin Valley, California 1975). The risk at these locations is not merely the lowering of land elevation, but the destruction of recharge and storage capability within the aquifer (Galloway, Jones, and Ingebritsen, Land Subsidence in the United States, Part I, The San Joaquin Valley, Largest Human Alteration of the Earth's Surface, Circular 1182, 1999).

DPWD is located within the San Joaquin River groundwater basin and overlies the Delta Mendota groundwater subbasin. The Delta Mendota groundwater subbasin is not considered to be in a state of overdraft (DWR, California Groundwater Bulletin 118, January 2006). Groundwater has been used within the District to supplement CVP water deliveries but there are potential long-term challenges associated with continued reliance on groundwater pumping such as declining water table elevation, land subsidence, degradation of groundwater quality, and adverse impacts to crop yield from unsuitable groundwater quality. Further or increased reliance on groundwater pumping to meet crop water demand is not considered a viable or sustainable option for DPWD given the potential adverse impacts that would likely occur. For example, the City of Modesto relied solely on groundwater to meet the demands in its service area until 1995. In

1995, Modesto entered into a contract to purchase surface water from MID, thereby reducing their dependence on groundwater. As Modesto has decreased their reliance on groundwater, they have seen an increase in groundwater levels and a reduction in overdraft conditions, which demonstrates the potential impacts decreasing the reliance of groundwater as a major component of water supply (City of Modesto Urban Water Management Plan, 2005). Similarly, the Turlock subbasin is experiencing overdraft conditions as the result of groundwater reliance; like the City of Modesto area, these conditions will be addressed by the use of surface water in lieu of groundwater supplies.

Existing groundwater wells within the District are privately owned and maintained, and DPWD does not track and/or monitor groundwater use within the District. The majority of groundwater wells are located in the northern part of the District because the groundwater quality is generally better in this area. In the southern area of the District, including lands in southern Stanislaus and northern Merced Counties, groundwater is both harder to locate and generally of poorer quality. This presents a particular challenge for the District in that almond trees are the major crop in this area. Almonds, which typically stay in production for 25 years or more, are a capital intensive crop that are sensitive to salts (chloride and sodium in particular) and require an adequate and reliable source of water supply to maintain economic production throughout their lifespan. Because groundwater availability and quality in the southern area is often inadequate for use as a supplemental water supply, DPWD customers in the area are forced to find and purchase an alternate supply of surface water to supplement CVP deliveries. The District's northern area, which includes lands in southern San Joaquin and northern Stanislaus Counties, has groundwater that is both more available and of higher quality and can be used to supplement curtailed CVP deliveries.

The State of California recognizes that the conditions described above will result in a shortage of water in future years (California Water Plan Update 2009, Bulletin 160-09, DWR). Recognizing that recycled water use within the State is a key water resource and component to meeting future water demands, the State Water Resources Control Board adopted the following Recycled Water Policy on January 22, 2013:

> *"We declare our independence from relying on the vagaries of annual precipitation and move towards sustainable management of surface waters and groundwater, together with enhanced water conservation, water reuse and the use of storm water. To this end, we adopt the following goals for California:*
>
> - *Increase the use of recycled water over 2002 levels by at least one million acre-feet per year (afy) by 2020 and by at least two million afy by 2030.*
> - *Increase the use of storm water over use in 2007 by at least 500,000 afy by 2020 and by at least one million afy by 2030.*
> - *Increase the amount of water conserved in urban and industrial uses by comparison to 2007 by at least 20 percent by 2020.*
> - *Included in these goals is the substitution of as much recycled water for potable water as possible by 2030."*

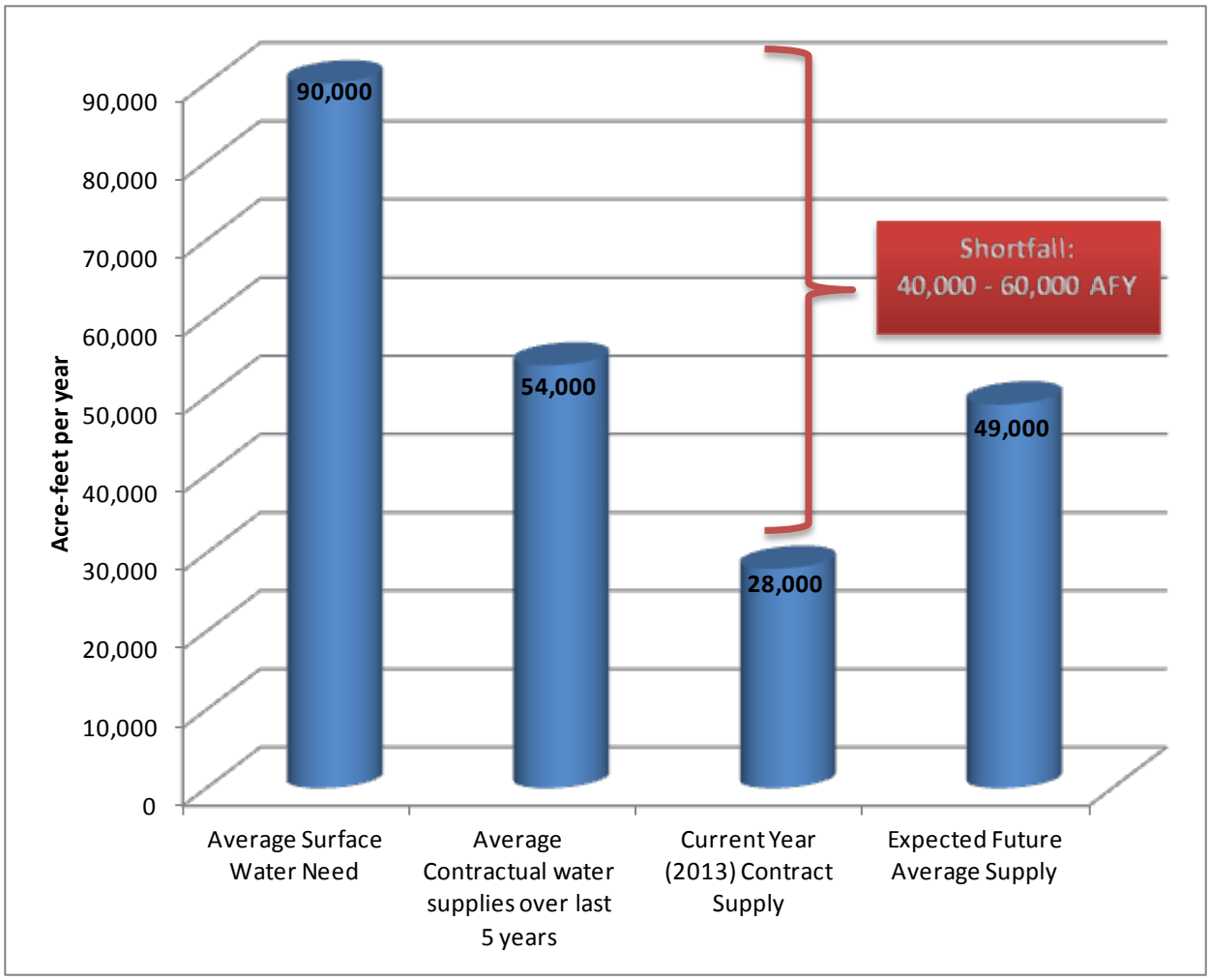
Modesto and Turlock treat their wastewater to specific water standards in order to meet the San Joaquin River discharge requirements in their NPDES permits. Use of this recycled water resource for agricultural irrigation aligns with the State Water Resources Control Board's overall objectives and goals and puts the recycled water to its highest and best use. It offers the additional benefit of helping to meet DPWD's water demand, while also offsetting future treatment upgrade costs for Modesto and Turlock that may be required for continued discharge to the San Joaquin River.

## 2.3 Water Gaps

It is predicted that future deliveries from the CVP to DPWD will average approximately 49,000 AFY of water, an allocation of only 1 AF/acre, which is inadequate to meet the District's water demand.

The 2013 water demand was estimated at approximately 90,000 AFY (Figure 2-3) and was assumed to represent the District's existing average annual water demand. The demand was estimated using the methodology described in Appendix B and the 2009 cropping pattern (Table 3-1). The existing water demand represents the demand in a dry hydrologic year, when fallowing patterns may be higher than average. It was recognized that if the District had an alternate, reliable source of water, cropping and fallowing patterns would resume historic patterns. Under this scenario, the projected water demand was estimated to be 110,000 AFY.

**Figure 2-3: DPWD Water Supplies and Shortfalls**




If DPWD is unable to deliver recycled water to its customers, the District will be forced to rely on reduced CVP deliveries supplemented with groundwater and/or water transfers, which are collectively unreliable and unsustainable sources of water for the future. This will result in economic hardships to the District, the Counties, and the agricultural community within DPWD. It is expected that future cropping patterns would be similar to 2009 (10,737 acres of land fallowed) if the District is unable to secure an alternate, reliable water source. Water transfers are not considered to be a long-term, reliable source of water due to uncertainties in the timing and quantities of Delta water that can be pumped in the future. The cost of water

transfers would likely increase as demand for water increases, which would result in economic hardship for the agricultural community in DPWD. Groundwater is also not considered to be an effective long-term solution due to the potential for overdraft conditions and water quality parameters.

## 2.4 Recycled Water Supply for South of Delta Refuges

A separate study prepared by Reclamation (Refuge Recycled Water Study, June, 2013) evaluated the feasibility of providing recycled water from the NVRRWP to the Sacramento-San Joaquin Delta (South of the Delta) refuges. The NVRRWP represents a potentially significant new water source which could help meet both agricultural irrigation demands in the Del Puerto Water District (DPWD) and Incremental Level 4 (IL4) water demands in the wildlife refuges south of the Delta. On an annual basis, the optimum IL4 water demand is 105,514 AFY. The total 2012-2013 IL4 water delivery to the San Joaquin Valley refuges was 36,600 AF, leaving an IL4 shortfall of approximately 70,000 AF. This shortfall is typical of the IL4 delivery to south of Delta refuges.

# Chapter 3 Water Reclamation and Reuse Opportunities

This section discusses reclamation and reuse opportunities for the disinfected tertiary-treated recycled water produced at the Turlock and Modesto treatment facilities.

## 3.1 Potential Water Uses

In 2005, Modesto prepared the Northern San Joaquin Valley Water Reclamation Project, Feasibility Study Report (RMC, 2005) which identified potential uses for recycled water in Modesto as well as the surrounding area, including Stanislaus County and the City of Patterson Urban recycled water use from the Jennings Road WQCF was determined to be cost prohibitive, and satellite treatment located at Modesto's Primary Treatment Plant was determined to be more cost effective because the facility is located close to the center of Modesto, near urban demands. The study further determined that recycled water use for agricultural irrigation within Modesto's service area would be challenging because MID currently provides a low-cost, highly reliable agricultural water supply. The 2005 study also recommended investigation of conveyance and distribution of recycled water to surrounding irrigation districts west of the San Joaquin River, via the DMC. Recycled water distribution to irrigation districts west of the San Joaquin River was identified as the most cost effective project because the magnitude of deliveries was greater than their urban demands, which translated into lower recycled water unit costs (unit recycled water cost of $700/AF for agricultural irrigation versus $1,500 to $5,000/AF for urban use).

Turlock currently distributes up to 2 mgd of recycled water to the Walnut Energy Center. Purple pipe (recycled water pipe) is installed to serve future irrigation demands that are near the Turlock WQCF (City of Turlock Urban Water Management Plan, 2005). Land immediately adjacent to the Turlock WQCF is primarily agricultural land, and farmers in the area have had little incentive to use recycled water due to the availability of low cost surface water. Turlock's 2005 Urban Water Management Plan indicated that the most cost effective recycled water projects within the city limits would be to supply recycled water to future developments due to the cost of constructing a distribution system in a developed area. Section 3.4.2 provides an analysis of recycled water from Turlock that could be available to DPWD, and includes a reservation of recycled water for future city uses. The remainder of the recycled water produced at Turlock would likely be discharged to the San Joaquin River, if it were not distributed to DPWD.

Distribution of Turlock's and Modesto's recycled water to DPWD is consistent with the findings and recommendations of earlier studies. The predominant crop in the District is almonds, with trees located mainly in the southern portion of the District (see Table 3-1). Almonds are a high-value crop that requires a significant capital investment and a constant water source. In general, use of recycled water for agricultural irrigation is much more cost-effective than for urban irrigation, due primarily to the scale of the required deliveries (Northern San Joaquin Valley Water Reclamation Project, RMC 2005). As such, delivering the recycled water to DPWD would be more cost-effective than delivery to urban centers for similar uses.

Beyond DPWD, other entities, including the City of Patterson and Stanislaus County, have expressed interest with using urban recycled water. These discussions are in preliminary stages and the development of feasibility with these entities will continue in subsequent phases of the project.

## 3.2 Market Assessment

A market assessment was conducted as a part of this feasibility study to assess the level of interest in tertiary recycled water use, as well as to obtain water user input on potential water quality issues, acceptance issues, and other related issues (e.g., acceptability with product processors) that could be associated with tertiary treated recycled water irrigation uses. The market assessment process also provided an opportunity to

discuss existing irrigation practices, water demands, current groundwater use (e.g. availability and quality), and water supply cost sensitivity. This information was carefully considered during the development of the feasibility study. A total of twelve customers were interviewed in individual meetings between June 8 and June 16, 2010. Individual meetings were conducted to provide a setting where open feedback could be obtained. The major findings from the market assessment can be summarized as follows:

- The potential use of tertiary treated recycled water for irrigation was well received and interviewees did not raise issues of negative perception related to tertiary recycled water use, potential water quality impacts to soil or crop production, or awareness of acceptability issues with product processors.
- The potential recycled water cost was an issue with all the interviewees. There was a concern that DPWD would have a difficult time delivering the tertiary recycled water at a cost that would be affordable.
- Most interviewees pump groundwater to supplement DPWD surface water deliveries; however groundwater pumping does not provide adequate flow or volume necessary to meet water demand, especially during peak water demand months in the summertime.
- DPWD groundwater contains elevated concentrations of soluble salts and chlorides in some locales, which may affect the production of agricultural crops sensitive to those constituents, unless groundwater is blended with other source water.

## 3.3 Recycled Water Demand Analysis

Water demands were estimated for the entire District and used to develop the alternatives described in Chapter 4. Based on the feedback from the initial market assessment, it is assumed that all customers within the District would be amenable to recycled water use if the cost of the water is reasonable and there are no issues with product processors. Therefore delivery of recycled water to the entire District for agricultural irrigation was considered a feasible option.

Water demands within the District were estimated based on the specific water demand (e.g., evapotranspiration requirement) of each crop grown in the District. Appendix B provides a detailed description of the methodology used to estimate the water demands throughout the District. Each year DPWD conducts a survey of what crops were cultivated on each parcel number; this annual data is tracked in a database that is maintained by DPWD. DPWD's database was used to determine the acreages associated with each crop type. The cropping patterns in 2009 were used to estimate the existing water demand for the District. It was recognized that 2009 represented a dry hydrologic year, and that projected cropping and fallowing patterns could resume historic patterns with an alternate, reliable source of water. The projected water demand was developed by performing a comparative parcel analysis using cropping pattern data from 2004, 2007 and 2009; land fallowed in 2009 was spread to the crop type in 2004 and/or 2007, if fallowing was due solely to a lack of water. Table 3 1 provides a summary of the 2009 cropping patterns for the District and the projected cropping pattern for the District.

**Table 3-1: Existing and Projected District Wide Cropping Patterns**

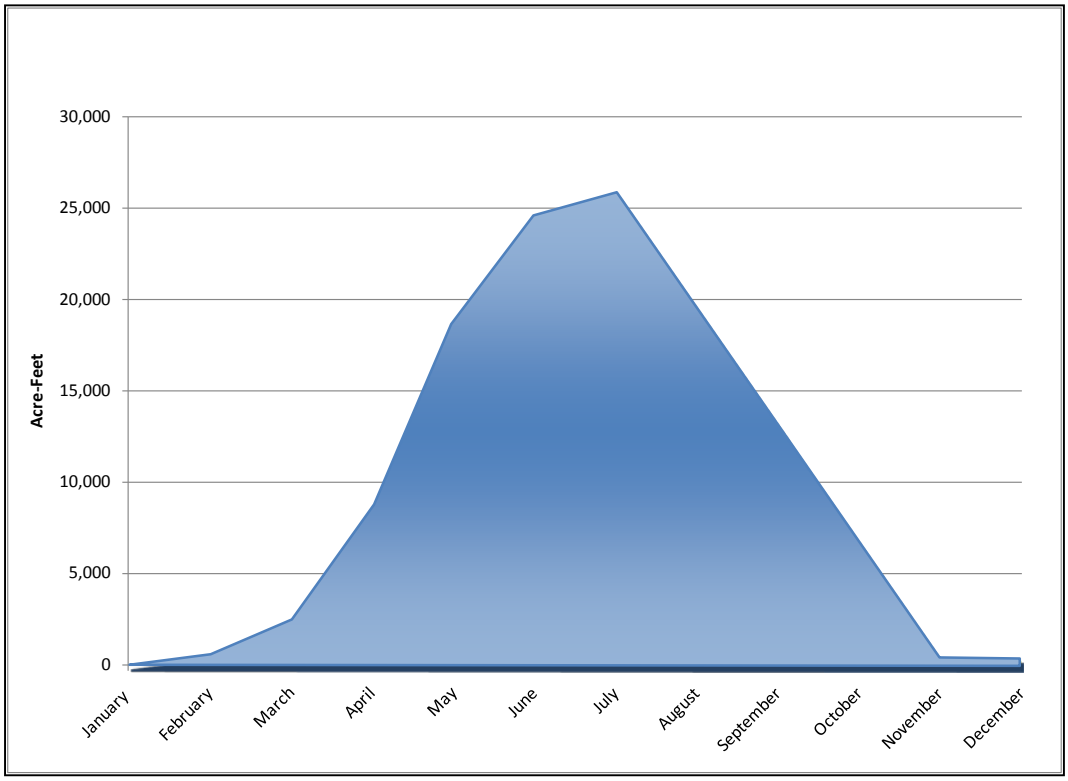
| Crop Type | 2009 acreage (acres) | Projected [1] (acres) |
|---|---|---|
| Alfalfa | 1,660 | 1,920 |
| Almonds | 14,184 | 15,184 |
| Apricots | 2,519 | 2,519 |
| Beans | 2,221 | 2,756 |
| Cantaloupes | 398 | 398 |
| Cherries | 518 | 518 |
| Citrus | 340 | 340 |
| Dry Farm (Barley/Oats) | 2,472 | 2,472 |
| Nursery | 66 | 66 |
| Other Deciduous Fruits & Nuts | 1,185 | 1,185 |
| Tomatoes | 3,892 | 5,011 |
| Vegetables | 915 | 1,197 |
| Vineyards | 370 | 370 |
| Walnuts | 1,782 | 1,782 |
| Subtotal Farmed Acres | 32,522 | 35,718 |
| Acres Fallowed | 10,737 | 7,541 |
| Total Acres | 43,259 | 43,259 |

Notes:

1. Projected cropping pattern was estimated by comparing cropping patterns, by parcel number, in 2004, 2007 and 2009. Land fallowed in 2009 was spread to the crop type in 2004 and/or 2007, if fallowing was due solely to a lack of water.

Table 3-1 presents the calculated crop acreages for the entire District, using the methodology described in Appendix B and the 2009 cropping patterns. The estimated demands for projected conditions are provided as Figure 3-1.

**Figure 3-1: Projected Future District Water Demands**




## 3.4 Recycled Water Sources and Availability

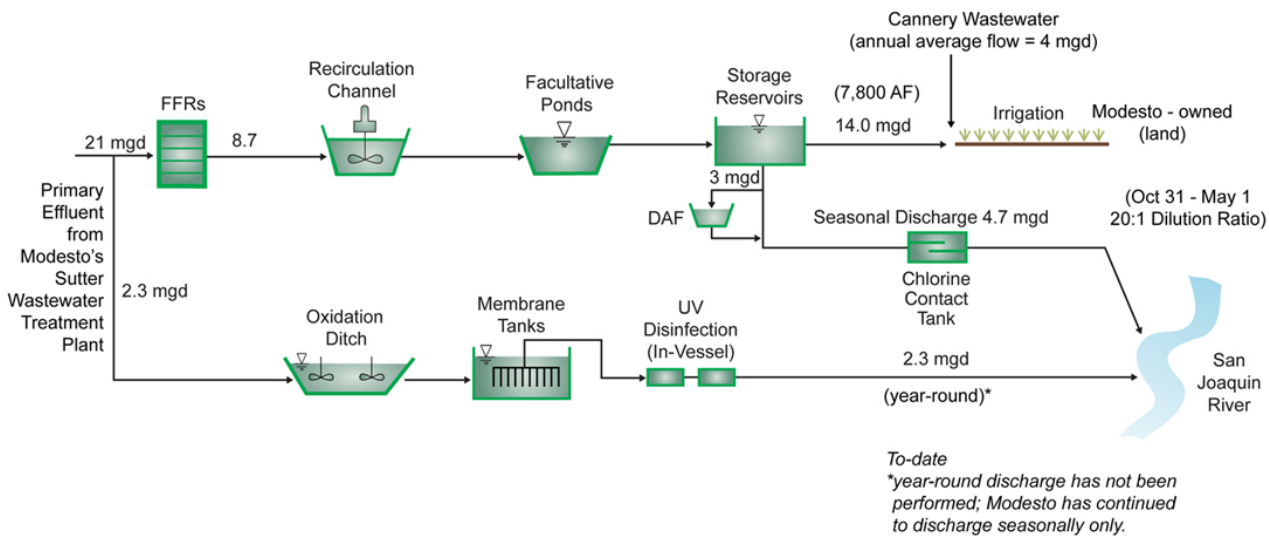
Modesto and Turlock will produce up to 59,000 AFY of recycled water that meets the Title 22 requirements for unrestricted reuse. Both treatment facilities are located in close proximity to DPWD and therefore are both considered as sources of recycled water. Sections 5.4.1 and 5.4.2 provide additional details on Turlock and Modesto's treatment facilities as well as the amount of recycled water that is available for reuse in 2018 and 2045.

### 3.4.1 City of Modesto

#### Treatment Facilities

In 2009, Modesto treated over 23 mgd (annual average daily flow) at the Jennings Road Secondary Treatment Facility (Jennings Plant). The secondary treatment facilities at the Jennings Plant consist of facultative ponds that produce secondary effluent that is applied on Modesto-owned ranch land (approximately 2,500 acres), or is discharged to the San Joaquin River between October 1 through May 31, when San Joaquin River flows provide a 20:1 dilution ratio (Figure 3-2). There are two storage ponds at the Jennings Plant that provide approximately 7,800 AF of seasonal secondary effluent storage when effluent cannot be discharged to the river or land-applied.

**Figure 3-2: Existing Modesto Wastewater Treatment Facilities**

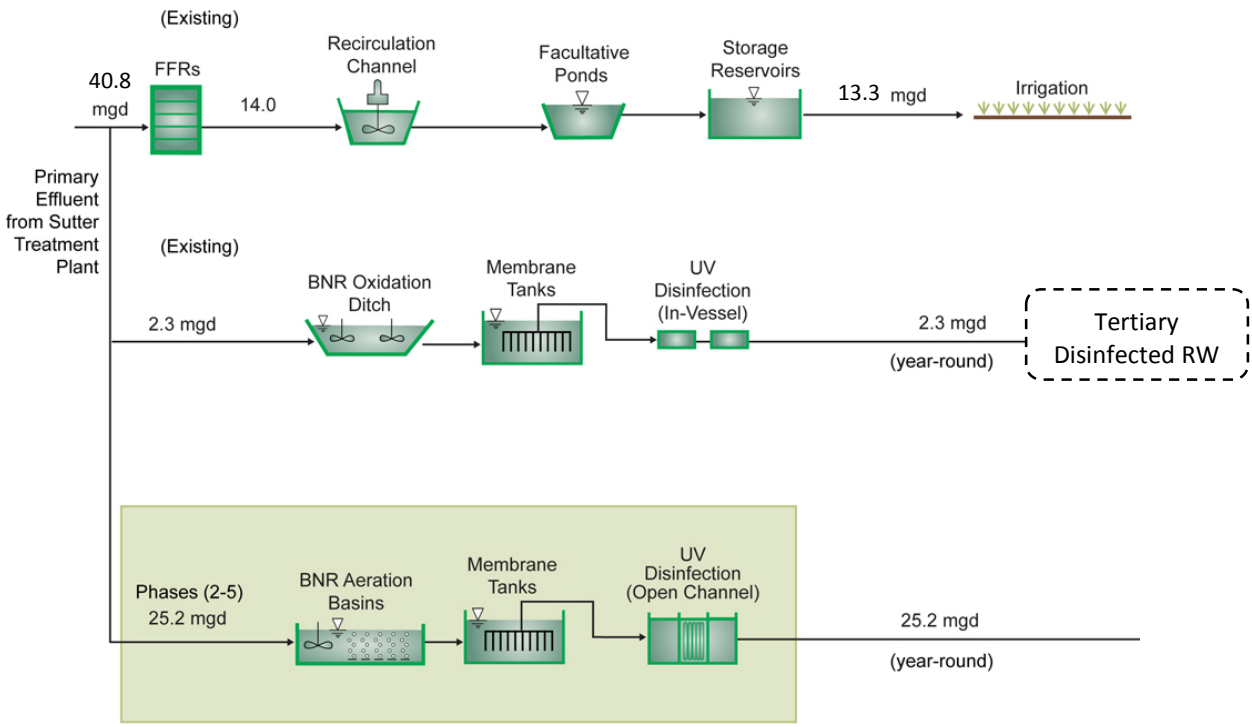



**Note:** Adapted from 2007 Modesto Wastewater Treatment Master Plan (Carollo, 2007)

In 2007, Modesto prepared a Wastewater Treatment Master Plan (Carollo, 2007) that addressed treatment upgrades that were needed to meet new discharge requirements and to increase Modesto's disposal capacity. The recommended approach to increase the City's disposal capacity was to obtain a permit from the Regional Water Quality Control Board (RWQCB) for year-round discharge to the San Joaquin River. The RWQCB granted a year-round discharge permit to Modesto in 2008. The new permit also increased the level of treatment required for discharge to the river. Based on the new permit requirements, Modesto is required to provide nutrient removal, tertiary filtration, and disinfection for discharge to the San Joaquin River. The recommended treatment processes from the Wastewater Treatment Master Plan include biological nitrogen removal, membrane filtration, and ultraviolet (UV) disinfection.

The master plan identified a phased approach to upgrading Modesto's treatment facilities (Figure 3-3). The phased approach enables Modesto to produce recycled water for reuse or river discharge, and to continue to treat a side-stream of wastewater in the facultative ponds (i.e., secondary effluent) for ranch-land irrigation. In 2010, the first phase of the treatment upgrades was completed (Phase 1A), which provides Modesto with 2.3 mgd of membrane-filtered tertiary effluent. The Phase 2 treatment facilities are scheduled to be online by February 2016, resulting in a total membrane-filtered tertiary effluent volume of 14.9 mgd. In total, the City plans to construct tertiary treatment in five phases reaching a total recycled water production capacity of 27.5 mgd by the year 2040.

**Figure 3-3: Future Modesto Wastewater Treatment Facilities**[3]




**Note:** Adapted from 2007 Modesto Wastewater Treatment Master Plan (Carollo, 2007)

## Recycled Water Availability

The City of Modesto has estimated its build-out flow to be around 40.8 mgd. The City originally estimated that it would reach buildout flow in 2030; however, based on outside factors, such as the economic downturn, water metering, etc., the City has seen reductions in population and sewer flow, which would impact the project build-out year.

The City of Modesto had a population of 201,165 in 2011 and 202,290 in 2012. Domestic Flow into the City's Treatment Plants decreased between 2006 through 2012 from 27.2 mgd to 20.4 mgd. The decrease in flows may be attributed to water conservation (due to water metering), foreclosures, or reduction of year-round commercial industrial flows.

From that starting point, and using the same growth rates that were presented in the 2008 WWMP Supplement, it is assumed that there would be gradual growth of 0.6% in 2013-14, 1.6% from 2015-16, and 1.75% from then on. Using these assumptions, the City developed a reasonable projection of anticipated sewer connections in Modesto Municipal Sewer District #1, including Empire, North Ceres and County Islands. These assumptions include commercial and minor industrial growth, but exclude large scale industrial (canning) growth.

[3] Phase 1 = 2.3 mgd
Phase 2 = 14.9 mgd
Phase 3 = 19.1 mgd
Phase 4 = 23.3 mgd
Phase 5 = 27.5 mgd

The 2007 WWMP used a per capita flow in 2005 of 117.3 GPD/capita, based on population and flow into the plant. Currently, flow per capita is estimated at 94.9 GPD/capita. A 5 year average (between 2008 and 2012) is 102.4 GPD/capita and 8 year average (between 2005 and 2012) is 109 GPD/capita. Based on these per capita flows, the estimated build-out date for the City of Modesto is between 2043 and 2046.

As previously mentioned, the City estimates expansion of the tertiary treatment facilities to occur in 5 phases, ultimately reaching a capacity of 27.5 mgd. Communication with the City indicates there will probably be some limited onsite uses of tertiary treated water, such as a 0.2 mgd demonstration irrigation project in the future. Reserving capacity for the demonstration irrigation project leaves 27.5 mgd available at buildout for the NVRRWP.

Modesto has two storage ponds that have a total volume of 7,300 AF. In the future, when Phases 1A and 2 are online, Modesto would either reuse the recycled water or discharge it year-round to the San Joaquin River. The side-stream of secondary effluent would still be produced and would be applied to the City's ranch lands during summer months. Because Modesto will continue to produce secondary effluent that can only be land applied seasonally, storage of secondary effluent would still be needed. It was assumed that secondary effluent would be stored during winter months (assumed 105 days per year) when the ranch lands cannot be irrigated. Table 3-2 provides the assumed volume of storage that would be reserved for secondary effluent storage and the volume of storage available for recycled water storage.

**Table 3-2: Modesto Recycled Water Storage**

| Parameter | |
|---|---|
| Total Storage Volume (AF)[1] | 7,300 |
| Volume Reserved for Secondary Effluent Storage (AF) | 4,700 |
| Volume Reserved for Recycled Water Storage (AF) | 2,600 |

Notes:
1. Two storage ponds are available at Modesto.
2. Assumes that secondary effluent treated until Phase 3 facilities are online (assumed in 2024) is stored for 105 days per year.
3. Assumes that secondary effluent treated until Phase 4 facilities are online is stored for 105 days per year.

### 3.4.2 City of Turlock

#### Treatment Facilities

The City of Turlock's wastewater treatment facility has a design capacity of 20 mgd; currently the plant treats an annual average flow of approximately 10 mgd. Turlock's treatment facilities include secondary treatment, tertiary treatment (cloth media filtration), and chlorine disinfection (Figure 3-4). All recycled water produced at Turlock meets the Title 22 recycled water standards for unrestricted reuse. Currently, the majority of recycled water produced at Turlock is discharged year-round to the San Joaquin River via the Harding Drain. The Harding Drain is an open channel drain owned by Turlock Irrigation District (TID). Because Turlock is permitted to discharge year-round to the San Joaquin River, recycled water storage is not needed. Turlock is currently constructing a pipeline (Harding Drain Bypass Pipeline) that will convey recycled water directly to the San Joaquin River for discharge. The Harding Drain Bypass Pipeline was designed to convey recycled water to the San Joaquin River and also to enable recycled water deliveries to irrigation customers along the pipeline alignment. The Harding Drain Bypass Pipeline represents Turlock's first step towards implementing a recycled water delivery program that would minimize and eventually eliminate recycled water discharges to the San Joaquin River.

## Recycled Water Availability

The City of Turlock General Plan Update (West Yost, 2012) estimated the City would reach an influent flow of 27.5 mgd at buildout in the year 2030. City staff has reviewed the projected buildout flows for the Turlock RWQCF and has researched the data provided to City planning staff and their consultants for the General Plan Update. Based on that review, the buildout flows and timing listed in the General Plan are the best reasonable estimate at this time and are reflective of projected job growth, not just population growth.

The Turlock RWQCF receives flow well in excess of what one would normally see for a City of 70,000 because they have a number of food processors. The General Plan projects job growth commensurate with population growth to prevent overestimating job growth. However, a significant portion of the job growth will occur in water intensive industries. The City has zoned a significant amount of land (1,700 acres) for new industrial development and has seen significant interest from food processors considering a move to Turlock. Therefore wastewater flows will increase significantly over time.

The City of Turlock has several long-term commitments for recycled water use from the facility. The first commitment is for 2 mgd for 42 years for use at TID's Walnut Energy Center. Although the commitment is for up 2 mgd, the actual deliveries in 2012 have averaged 1.0 mgd. For the sake of assessing availability of recycled water, the contractual commitment of 2 mgd will be reserved for delivery to TID. The other current recycled water use in Turlock is for irrigation at Pedretti Park. The average irrigation use for the park is assumed to be 0.1 mgd, which was the average use in 2012. Therefore, in calculating the recycled water that would be available for NVRRWP, it is assumed that 2.1 mgd will be reserved for in-City use, leaving a flow rate of 25.4 mgd available at buildout for NVRRWP.

**Figure 3-4: Turlock Wastewater Treatment Facilities**

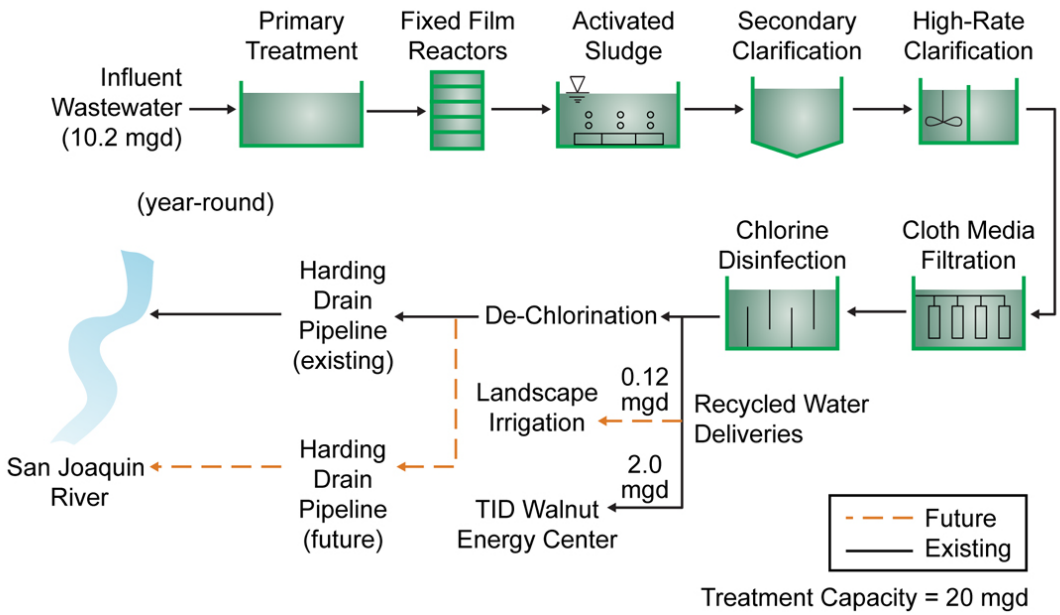


**Table 3-3: Turlock Recycled Water Production**

| Parameter | 2018 | 2045 |
|---|---|---|
| Influent Wastewater Flow | | |
| MGD | 14.7 | 27.5 |
| AFY | 16,500 | 30,800 |
| Total Recycled Water Produced | | |
| MGD | 14.7 | 27.5 |
| AFY | 16,500 | 30,800 |
| Recycled Water Reserved For Turlock Reuse[1] | | |
| MGD | 2.1 | 2.1 |
| AFY | 2,400 | 2,400 |
| Recycled Water Available to DPWD | | |
| MGD | 12.6 | 25.4 |
| AFY | 14,100 | 28,400 |

Notes:

1. Assumed volume of recycled water reserved for use within Turlock's service area. Includes Turlock's contracted supply of 2 mgd of recycled water to the Walnut Energy Center

### 3.4.3 Recycled Water Availability and Demands (Modesto and Turlock)

Based on the Cities' evaluation of the buildout flows, it is estimated that approximately 52.7 mgd (59,000 AFY) of recycled water may be available by the year 2045 for the NVRRWP.

Figure 3-5 and Figure 3-6 summarize the estimated recycled water flows annually from now until buildout. A detailed spreadsheet of the flow estimates is included in Appendix C.

**Figure 3-5: NVRRWP Flow Rates at Buildout, mgd**

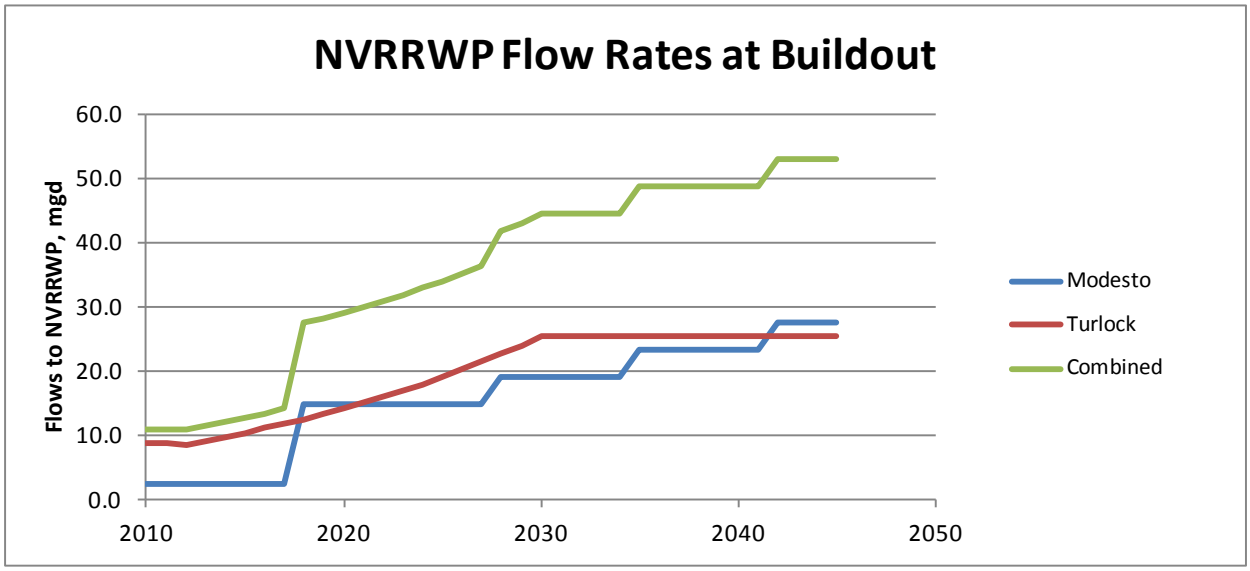
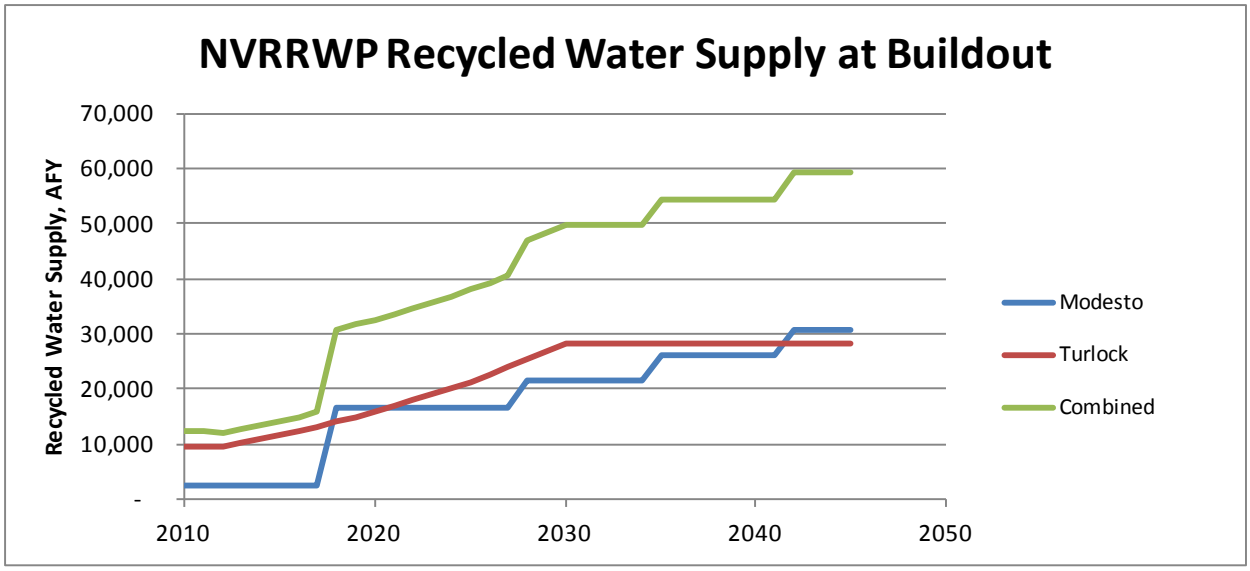


**Figure 3-6: NVRRWP Flow Rates at Buildout, AFY**




## 3.5 Water and Wastewater Agencies

DPWD supplies irrigation water to its customers. The Cities of Modesto and Turlock are the local water and wastewater service purveyors in their areas and are the producers of the recycled water that DPWD is proposing to use for supplemental agricultural irrigation supply. As DPWD would not be supplying recycled water for urban or commercial use, it will not directly affect potable water sales or use and therefore, there are no water and/or wastewater agencies that would have jurisdiction over DPWD's service area and/or the delivery of recycled water associated with this project. This feasibility study has been prepared on behalf of DPWD in cooperation with Modesto and Turlock; therefore the recycled water production rates and supply availability have been developed with input from Modesto and Turlock and do not conflict with their future or existing recycled water delivery commitments.

## 3.6 Renewable Energy and Energy Efficiency

Recycled water delivery to DPWD would not in itself generate electricity. However, the project consists of several components, described below, that would serve to: 1) minimize new energy demands, and 2) offset the energy demands of the project.

- **Minimize Energy Demands:**
  - The recycled water delivery projects described in Chapter 7 would include new pump stations and/or retrofits of existing pump station. In all project alternatives, it was assumed that new, energy efficient pumps would be utilized to minimize the energy demands of the project.
  - If the Cities continue to discharge to the San Joaquin River (i.e. if the NVRRWP is not constructed), they may be required to add energy-intensive reverse osmosis facilities in the future to meet river discharge requirements. For most of the NVRRWP alternatives, reverse osmosis treatment would not be required so the energy needed for future reverse osmosis treatment would be eliminated.
- **Offset Energy Demands:** Modesto's 2008 Wastewater Treatment Master Plan Supplement (Carollo, 2008) considered the construction of solar and wind power generation facilities for the purpose of offsetting the energy demands of the treatment plant upgrades, which consume more

energy than the older treatment facilities. Based on discussions with Modesto, Turlock and DPWD, solar power generation facilities (photovoltaic cells) could be installed to offset the energy requirements of the recycled water delivery project. If implemented, the photovoltaic cells would likely be installed at Modesto's WQCF.

## 3.7 Drought Protection and Climate Change

### 3.7.1 Drought Protection

California has a history of droughts that impact the delivery of water to DPWD. As a south of Delta CVP water contractor, the impacts of drought can be exacerbated by the impacts of Delta operations, resulting in potentially significant reductions in water supply reliability for DPWD. DPWD's CVP deliveries were reduced to 40% and 20% of its contract allocation in 2012 and 2013, respectively. Alternatively, recycled water has proven to be a highly drought resistant water supply.

For Modesto, the City's water supply is a combination of groundwater and surface water supply. The surface water supply is provided by the Modesto Irrigation District from its Tuolumne River supply. This combination of supplies provides a true conjunctive use water supply system that provides a high degree of drought tolerance to the City of Modesto.

For the City of Turlock, its present water supply is groundwater. However, the City of Turlock is in the process of evaluating a surface water supply that would augment its existing groundwater supplies. The City of Turlock's water supply provides a high level of drought tolerance, which will only increase if the City is able to implement a surface water supply and move to a conjunctive use water supply.

Recycled water is highly resistant to drought conditions. As urban supplies are reduced, the reduction in domestic water use is primarily focused on external uses, such as lawn and garden irrigation, with minimal reduction in internal uses, particularly as the Cities have invested in domestic water conservation programs. It is the internal water use that provides the wastewater flows that are treated and become the recycled water supply. As such, recycled water is highly drought resistant and provides a high degree of protection against drought conditions, and can be considered as firm water supply.

### 3.7.2 Response to Climate Change

Climate change is impacting the reliability of water supplies throughout California. Climate change does and will continue to impact the ability of water agencies to provide reliable water supplies through varying climatic conditions. Recycled water provides a reliable water supply that helps to reduce climate change impacts on water supplies.

For DPWD, introduction of recycled water as a source of supply will significantly improve its ability to meet the water supply needs of its landowners. When combined with DPWD's existing CVP supply and individual landowners' groundwater supplies, the mix of supply provides a high degree of reliance and protection against the impacts of climate change on DPWD's water supply portfolio.

## 3.8 Other Considerations

One of the considerations associated with the recycled water delivery options is the required level of treatment. As previously noted, the two Cities provide or are implementing facilities capable of providing tertiary treatment prior to discharge to the San Joaquin River. The existing and projected level of treatment for the two cities will result in a filtered, disinfected effluent that meets the requirements of Title 22 for unrestricted use.

Based on ongoing discussions with the RWQCB, it appears that conveyance of recycled water in the DMC will not require any levels of advanced treatment beyond the levels presently provided by the two cities,

i.e. reverse osmosis for all or a portion of the flow. Table 3-4 provides a summary of the estimated capital and operating costs for advanced treatment of all recycled water produced at the Modesto and Turlock treatment plants. As shown, reverse osmosis treatment would result in unit water costs that cannot be supported by DPWD customers. Any alternatives requiring advanced treatment would likely be financially infeasible.

**Table 3-4: Advanced Treatment Costs for Alternative**

| Item | Cost |
|---|---|
| **Modesto** | |
| Recycled Water Treatment Size (AFY) | 21,200 |
| Capital Cost[2] ($M) (No Grants) | $165.6 – $516.5 |
| Operating Cost ($M) | $8.9 -$9.0 |
| Annualized Capital and Operating Cost – No Grants[3] ($M) | $19.8 - $42.4 |
| Unit Cost – No Grants($/AF) | $934.4 – $2,005.2 |
| Unit Cost – With Grants($/AF) | $808.4 - $1,606.3 |
| **Turlock** | |
| Recycled Water Treatment Size (AFY) | 9,000 |
| Capital Cost[4] ($M) (No Grants) | $93.9 – $231.5 |
| Operating Cost ($M) | $5.2 - $5.4 |
| Annualized Capital and Operating Cost[3] ($M) | $11.4 - $20.4 |
| Unit Cost – No Grants ($/AF) | $1,270.3 - $2,267.7 |
| Unit Cost – With Grants ($/AF) | $1,112.8 - $1,858.2 |

Notes:

1. Appendix D provides a detailed cost estimate for advanced treatment costs of recycled water produced the Modesto and Turlock tertiary treatment plants.
2. Capital cost includes RO membranes for 24 mgd, and advanced oxidation for 19 mgd. An RO recovery rate of 80 percent was assumed. The range in capital costs is based on two methods for brine disposal (evaporation ponds or deep well injection). The capital costs are escalated to 2014 using a 4% escalation rate.
3. Capital costs were annualized based on a 5% over 30 years. No grants were assumed.
4. Capital cost includes MF for 10 mgd, RO membranes for 10 mgd, and advanced oxidation for 8 mgd. An RO recovery rate of 80 percent was assumed. The range in capital costs is based on two methods for brine disposal (evaporation ponds or deep well injection). The capital costs are escalated to 2014 using an escalation rate of 4%.
5. Unit costs for RO treatment are based on the capital costs provided in Modesto's Wastewater Treatment Facility Master Plan Supplement (Carollo, 2008), escalated to 2013 dollars

# Chapter 4 Water Quality

Tertiary treated recycled water from the NVRRWP must meet the stringent requirements established in Title 22 of the California Code of Regulations, and is suitable for a wide variety of non-potable uses. The recycled water quality is typically better than San Joaquin River water quality. For example, NVRRWP water contains lower concentration of constituents such as boron, selenium, electrical conductivity, mercury, and pesticides than the river.

Recycled water from the NVRRWP, when blended with water from the DMC, will comply with Reclamation's Groundwater Pump-in Program water quality standards for the Upper DMC. No other water quality standards are presently in place for water introduced into the DMC. With one exception, the recycled water quality also complies with the USBR's current water quality standards for acceptance of water into the Upper DMC. Both sets of standards are in place to regulate the practice of pumping well water into the DMC under Warren Act Contracts, and are not necessarily applicable to recycled water. Of the 48 constituents covered by these standards, only the recycled water of the NVRRWP sodium content is expected to exceed Reclamation's standards for acceptance into the DMC.

Salts are the primary water quality constituent of concern for agricultural irrigation water. In agriculture, salinity is typically monitored as a measure of conductivity with a preferred conductance level of 1,000 µS/cm or less for zero impact to almond crop yields (UNFAO#29, Water Quality for Agriculture). DMC water on average has a conductivity of approximately 500 µS/cm according to the DWR Online Water Data Library. Based on information provided by DPWD customers during the market assessment, groundwater underlying DPWD can have conductivity as high as 2,000 to 2,400 µS/cm. As this quality water is unsuitable for almonds (the main District crop), groundwater is typically blended with CVP water to improve quality prior to irrigation. Therefore, the quality and quantity of groundwater available is adequate only as a supplemental source, and cannot be relied upon as a primary source of water.

## 4.1 NVRRWP Recycled Water

DPWD is an agricultural water purveyor only; it does not provide potable water or wastewater treatment to residential or commercial/industrial customers in its service area. These services are provided by the cities and community services districts that are adjacent to DPWD's jurisdictional boundaries.

The Cities of Modesto and Turlock conduct water quality sampling of their effluent both for process control and to meet the Monitoring and Reporting Program requirements of their respective NPDES permits. The data resulting from this sampling are submitted to the Regional Water Quality Control Board (RWQCB) and are available through the California Integrated Water Quality System (CIWQS), a computer system used by the State and RWQCBs to track information about places of environmental interest, manage permits and other orders, track inspections, and manage violations and enforcement activities.

For Turlock, effluent data from the period April 2010 – February 2013 reported to CIWQS were used as the basis for this study, with the exception of a few constituents with no monitoring requirement under Turlock's current NPDES permit. For barium, nitrite, molybdenum, and sulfate, Turlock provided effluent data from samples collected over the period July 2007 – December 2009. The Turlock water quality data set used for this study is included in Appendix F.

The Modesto tertiary treatment facilities currently treat only a small portion of their effluent, and tertiary effluent has not yet been discharged to the San Joaquin River; this means that the data collected to meet NPDES Permit requirements is representative of Modesto's secondary treated effluent rather than their tertiary effluent. Therefore, for this study, the water quality data set for Modesto relies on samples collected for process control and other internal use. Effluent water quality data included in this study represent samples collected over the period July 2011 - December 2012. The Modesto water quality data set used for this study is included in Appendix G.

Based on preliminary discussions with the Region 5 California RWQCB, river discharge requirements are expected to become more stringent in the future. In particular, dischargers to the San Joaquin River could be faced with salinity limits (based on the Vernalis water quality standards) in the next 10 to 15 years. Limits for endocrine disruptors/constituents of emerging concern are also expected in the future, although the exact timing is uncertain. If salinity limits are imposed on Modesto and Turlock, advanced treatment (such as RO) would likely be required and would result in treatment upgrades at both facilities. In order to meet the Vernalis water quality standards (conductivity of 700 µS/cm), approximately 50 percent of the recycled water would need to be treated with RO for river discharge; the RO permeate could be blended with the remaining 50 percent of recycled water prior to discharge. Removal of these contaminants would require advanced oxidation for the entire recycled water flow.

## 4.2 Recycled Water Standards

Title 22, Chapter 3 of the California Code of Regulations forms the backbone of recycled water regulations through water quality standards and treatment reliability criteria for water recycling. Title 22 sets bacteriological water quality standards based on types of contact expected between the public and the recycled water, outlining applications for which disinfected tertiary treatment is required and also application for which three levels of secondary treatment would also suffice.

Recycled water treatment criteria vary depending on the application of the recycled water and its contact potential with the public. NVRRWP tertiary recycled water is suitable for all currently allowed uses of recycled water including irrigation of public parks and all food crops, toilet flushing, and some industrial processes.

## 4.3 Water Quality Standards for Acceptance of Groundwater into Upper Delta-Mendota Canal

The Warren Act of 1911 authorizes Reclamation to execute temporary contracts to impound, store, and carry water in federal irrigation canals when excess capacity is available. Such contracts are negotiated by Reclamation to allow the introduction of “non-project water” into the DMC. This non-project water can include groundwater from wells near the DMC.

To maintain appropriate water quality in the DMC, Reclamation has developed a set of standards for the acceptance of non-project water in the DMC based on the requirements of downstream water users. These standards are summarized in the following tables of the *2012 Delta-Mendota Canal Pump-in Program Water Quality Monitoring Plan* (herein referred to as Pump-in Plan):

- Table 4a, Maximum Allowable Concentration of Seven Constituents in the Upper DMC (between Jones Pumping Plant and Check 13)
- Table 4b, Maximum Allowable Concentration of Three Constituents in the Lower DMC
- Table 5, Water Quality Standards for Acceptance of Groundwater into the Upper Delta-Mendota Canal Jones Pumping Plant to Check 13 (O'Neill Forebay).
- Table 6, Water Quality Standards for Acceptance of Groundwater into the lower Delta-Mendota Canal Check 13 (O'Neill Forebay) To Check 21 (Mendota Pool).

Reclamation has not established similar water quality standards for any other source of water being introduced into the DMC. Because the NVRRWP recycled water would be put into the DMC north (upstream) of the O’Neill Forebay, Table 4a and Table 5 of the Pump-in Plan contain the only potentially relevant water quality criteria for comparison to the water quality of the NVRRWP. Both Table 4a and Table 5 of the Pump-in Plan are reproduced in Appendix E. As noted in the table footnotes, many of the water quality criteria listed in Table 5 are drinking water criteria. This is because several CVP water

contractors, such as Santa Clara Valley Water District and San Benito County Water District, use water from the San Luis Reservoir or the O'Neill Forebay for potable water supplies.

Reclamation will allow groundwater to be pumped into the DMC only if such water does not cause the concentration of important constituents in the canal to exceed the thresholds listed in Table 4a, and if the groundwater concentrations do not exceed the thresholds listed in Table 5. With the exception of specific conductance and total dissolved solids, the values in Table 4a are identical to those in Table 5.

## 4.4 Water Quality Data

The sources for water quality data used in this study are discussed below.

### 4.4.1 Modesto and Turlock Recycled Water Quality Data and Reporting

The Cities of Modesto and Turlock conduct water quality sampling of their effluent both for process control and to meet the Monitoring and Reporting Program requirements of their respective NPDES permits. The data resulting from this sampling are submitted to the RWQCB and are available through the California Integrated Water Quality System (CIWQS), a computer system used by the State and RWQCBs to track information about places of environmental interest, manage permits and other orders, track inspections, and manage violations and enforcement activities.

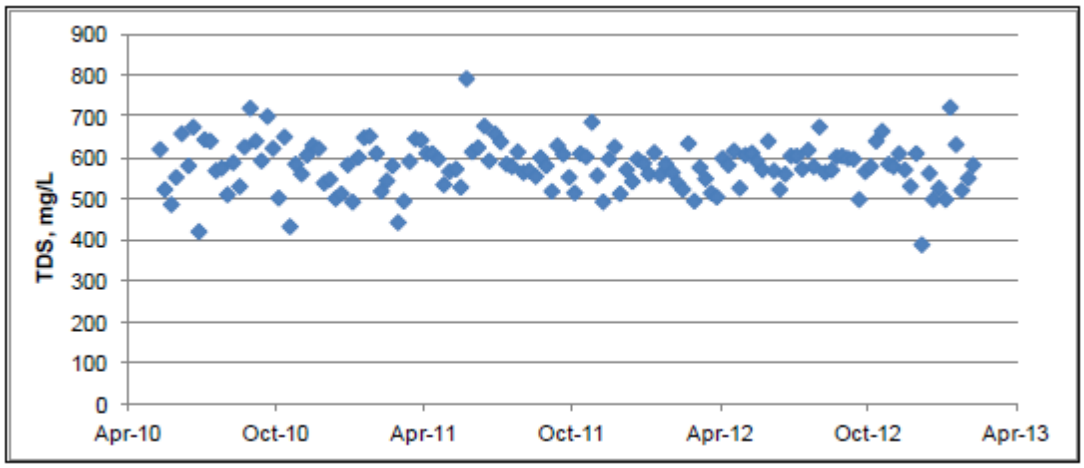
For Turlock, effluent data from the period April 2010 – February 2013 reported to CIWQS were used as the basis for this study, with the exception of a few constituents with no monitoring requirement under Turlock's current NPDES permit. For barium, nitrite, molybdenum, and sulfate, Turlock provided effluent data from samples collected over the period July 2007 – December 2009.

The Modesto tertiary treatment facilities currently treat only a small portion of their effluent, and tertiary effluent has not yet been discharged to the San Joaquin River; this means that the data collected to meet NPDES Permit requirements is representative of Modesto's secondary treated effluent rather than their tertiary effluent. Therefore, for this study, the water quality data set for Modesto relies on samples collected for process control and other internal use. Effluent water quality data included in this study represent samples collected over the period July 2011 - December 2012. The Turlock and Modesto water quality data sets used for this study is included in Appendix G.

For several organic constituents with no NPDES monitoring requirements (e.g., atrazine, bentazon, and others), no sample results are available from either Modesto or Turlock.

For some inorganic constituents, few sample results are available from Modesto or Turlock. However, wastewater effluent, particularly tertiary treated wastewater effluent, is generally very stable in its water quality profile and tends not to have significant seasonal variations or spikes in constituent concentrations. This trend is illustrated by the concentration of total dissolved solids in Turlock effluent shown below in Figure 4-1; unlike the DMC and San Joaquin River, there is no strong seasonal variability.

**Figure 4-1: Total Dissolved Solids Concentration in Turlock Effluent, 2010-2013**




Modesto and Turlock are both certified by the Environmental Laboratory Accreditation Program (ELAP) of the California Department of Public Health and maintain a high standard for laboratory procedures. The City of Modesto's Jennings Laboratory uses a Quality Assurance Manual which contains a Quality Assurance/Quality Control (QA/QC) plan, sample collection procedures and Standard Operating Procedures (SOPs) for all analytical methods. Likewise, the City of Turlock follows a Water Quality Control Laboratory Quality Assurance Manual, last updated in September 2012. Both labs use Standard Methods for the Examination of Water and Wastewater for test protocols.

The City of Modesto's Jennings Laboratory holds ELAP certificate #2674 with expiration in September 2013, and are in the process of renewing. The City of Turlock's ELAP certificate #2150 expires in September 2014. Both laboratories are certified to perform laboratory tests on microbiology and inorganic chemistry of wastewater; analyses for all other constituents, such as metals, volatile organics, semi-volatile organics, pesticides and chronic toxicity, are sent out to other certified facilities.

### 4.4.2 DMC Water Quality Data Collection and Reporting

DMC water quality data were obtained from the California Data Exchange Center (CDEC[28]) and the USBR Mid-Pacific Region's Environmental Monitoring Database. Water quality data for the DMC are from CDEC at the Tracy Pumping Plant (Station ID: TRP) and DMC Headworks (Station ID: DMC), covering the period 2003-2013. Data from the USBR Environmental Monitoring Database are from samples collected between 1991 and 2013 at three stations representing the Upper DMC: Milepost 9.87, the DMC at McCabe near Milepost 68, and the O'Neill Forebay Inlet Bridge.

Under the authority of California Water Code Sections 228 and 236, CDEC installs, maintains, and operates an extensive hydrologic data collection network, including automatic snow reporting gages for the California Cooperative Snow Surveys Program and precipitation and river stage sensors for the flood forecasting program. In addition, CDEC provides a centralized location to store and process real-time hydrologic information gathered by various cooperators throughout the State; and then disseminates this information to support forecasting and flood operations activities and to meet the data reporting needs of various cooperators, public and private agencies, the news media, and the public.

The USBR Mid-Pacific Region's Environmental Monitoring Database includes water quality monitoring data reported by the USBR Environmental Monitoring Branch, which was established in 1985 to design and implement environmental monitoring programs.

### 4.4.3 San Joaquin River Water Quality Data and Reporting

For most constituents, water quality data for the San Joaquin River was compiled from the California Environmental Data Exchange Network (CEDEN) stations "SJR @ Patterson" for the period covering

1995-2011, and from station "San Joaquin River @ PID Pumps" for the period covering 2008-2012. This data set is representative of the water quality in the PID canals as PID draws its water from the San Joaquin River near these locations. PID does not regularly monitor the water quality in their Main Canal.

CEDEN is a central location to find and share information about California's water bodies, including streams, lakes, rivers, and the coastal ocean. Many groups in California monitor water quality, aquatic habitat, and wildlife health to ensure good stewardship of our ecological resources. CEDEN aggregates this data and makes it accessible to environmental managers and the public.

For five constituents (antimony, beryllium, mercury, thallium, and silver) with no data available from CEDEN, water quality data are from CIWQS as reported by the City of Turlock at Receiving Water Station 003, which is located along the San Joaquin River 1,000 feet upstream of Harding Drain. These data cover the period April 2012 – March 2013, and consist entirely of non-detects.

Water quality and flow data for the San Joaquin River are also available from CDEC. The closest CDEC monitoring station to the area of interest is located near Vernalis, south of Tracy and nearly due west of Modesto. This data was not used in the analysis presented in this chapter because the CEDEN monitoring stations are closer to the intake of the PID canals.

### 4.4.4 Additional Sampling

As part of a separate USBR contract through RMC titled *Refuge Recycled Water Supply Study* (Task Order R13PD20071), a water quality sampling program was implemented in conjunction with the NVRRWP to assess the feasibility of providing program recycled water to Wildlife Areas and National Wildlife Refuges. These Wildlife Areas also receive DMC water and are a potential NVRRWP partner. On May 2, 2012 and May 9, 2013, samples were collected at four locations relevant to this Study: the Delta Mendota Canal (DMC) at the proposed point of addition of North Valley Regional Recycled Water Program (NVRRWP) water, the Patterson Irrigation District (PID) Main Canal, and Turlock tertiary effluent, and the Newman Canal at the water delivery point to the China Island Unit of the North Grasslands Wildlife Area. On May 9, 2013 a sample was also collected of Modesto secondary effluent (the Modesto tertiary facilities were offline during the duration of this sampling program). These samples were analyzed for "conventional constituents" (total dissolved solids, electrical conductivity, sodium, selenium, nitrate, nitrite, boron, mercury, and chloride) and Contaminants of Emerging Concern (CECs) Compete analysis of this complimentary water quality analysis is provided in Appendix I.

## 4.5 Comparison of Existing Water Quality Data to Relevant Water Quality Standards

The existing water quality data was compared to the water quality standards found in Tables 4a and 5 of the Pump-in Plan. Individual water quality parameters and chemical constituents are discussed and provided in Appendix I.

### 4.5.1 Summary of Findings

Recycled water from the NVRRWP, when blended with water from the DMC, will comply with the Reclamation's water quality standards for the Upper DMC. Those standards have been established by Reclamation for the Groundwater Pump-in Program. No other water quality standards are presently in place for water introduced into the DMC. With one exception, the recycled water quality also complies with the USBR's current water quality standards for acceptance of water into the Upper DMC as defined in Reclamation's Groundwater Pump-In Program. Both sets of standards are in place to regulate the practice of pumping well water into the DMC under Warren Act Contracts, and are not necessarily applicable to recycled water. Of the 48 constituents covered by these standards, only the recycled water sodium content is expected to exceed Reclamation's standards for acceptance into the DMC.

Selenium, a constituent of concern for recycled water use at wildlife refuges, is present in NVRRWP recycled water at a concentration comparable to the existing DMC water quality (0.8 µg/L). The same is true for boron and arsenic. Recycled water would be delivered to the refuges after mixing with the existing water in the DMC. Based on the results presented in this chapter, the recycled water generated from the NVRRWP is not expected to produce a significant change in water quality to downstream DMC users.

**Table 4-1: NVRRWP Water Quality Comparison to Table 4a**

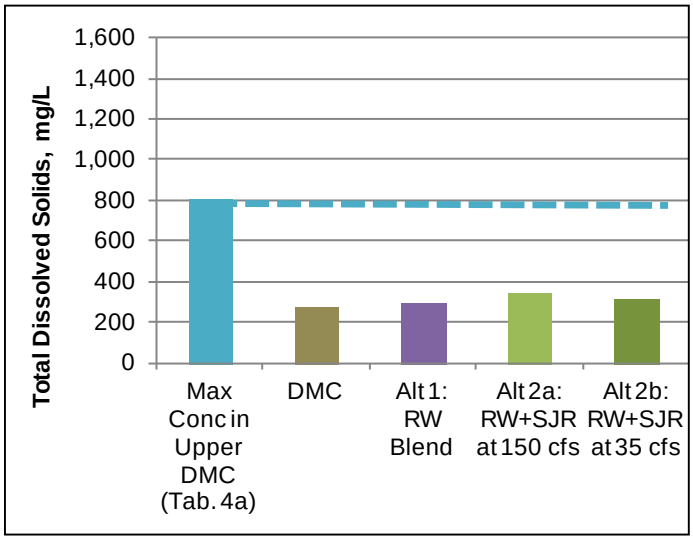
| Constituent | Maximum Concentration in DMC | Modesto Concentration | Turlock Concentration | Combined Concentration[4] |
|---|---|---|---|---|
| Arsenic | 0.01 mg/L | 0.001 | 0.006 | 0.0006 |
| Boron | 0.7 mg/L | 0.197 | 0.197 | 0.20 |
| Nitrates as N | 45 mg/L | 6 | 16.8 | 8.4 |
| Selenium | 0.002 mg/L | 0.0011 | 0.00026 | 0.001 |
| Specific Conductance (EC) | 1,200 µS/cm | 973 | 915 | 946 |
| Sulfates | 250 mg/L | 63 | 58 | 61 |
| Total Dissolved Solids | 800 mg/L | 522 | 582 | 550 |

For the constituents listed in Tables 4a and 5 of the Pump-in Plan and for which data were available, sodium is expected to be present in any mixture of recycled water, San Joaquin River water, and DMC water at levels that are expected to exceed water quality standards. Nitrate and/or nitrate + nitrite would exceed standards for alternatives that mix NVRRWP water with San Joaquin River water and blend with the PID Main Canal water for DMC conveyance.

Of particular interest is Total Dissolved Solids (TDS) in the DMC. Presented in Figure 4-2 is the TDS values for a range of the alternatives evaluated in this feasibility study.

[4] Projected flows for Modesto and Turlock total 27.3 MGD in 2018 (14.9 MGD Modesto, 12.6 MGD Turlock)

**Figure 4-2: Comparison Chart for Total Dissolved Solids**




For the CEC analyses conducted in May 2013, 34 analytes were detected in the Turlock tertiary effluent and/or Modesto secondary effluent samples with most analytes being detected in the samples from both locations. In the samples from the China Island delivery point, the DMC, and the PID canal, nine analytes were detected using the analysis for CECs and included both herbicides/pesticides and constituents that are likely originate from wastewater effluent (such as caffeine and the artificial sweetener sucralose). The detection of these analytes is to be expected as wastewater treatment plants discharge to the source waters for the DMC and the PID Main Canal.

# Chapter 5 Surface Water Modeling

## 5.1 Summary of Findings

Analysis of observed and modeled flows at two locations in the San Joaquin River indicate there are no significant impacts to San Joaquin River flows from removing wastewater discharges from the Cities of Modesto and Turlock. From a high-level analysis of electrical conductivity in the San Joaquin River, there is a small but positive impact on river water quality from removing wastewater discharges.

The complete technical memorandum, *NVRRWP San Joaquin River Flow Analysis*, is located in Appendix K.

## 5.2 Introduction and Background

The goal of this analysis was to determine if the impacts of ceasing City of Modesto and City of Turlock discharges to the San Joaquin River (SJR) are significant from an environmental point of view. The primary objective was to determine the impacts of flow changes. A secondary objective was to determine, if possible, the impacts to salinity in the San Joaquin River. The results of this analysis were also used as input for the aquatic species impact assessment for the San Joaquin River.

The San Joaquin River has a variety of inflows, outflows, and measuring points along its path to the California Delta. Figure 5-1 shows a schematic of the major components from Friant Dam to the Vernalis gauging station at river mile 0.

The Vernalis gauging station is an important monitoring point for the SJR. The Long-Term Central Valley Project Operational Criteria and Plan (OCAP) was developed in 2004 by the US Bureau of Reclamation (USBR) and summarized flow objectives at the Vernalis gage to both maintain minimum flows in the SJR and to maintain a specific salinity balance in the Delta. The flow objectives, shown in Table 5-1, include a higher and lower flow objective; the higher objective is used for more strict Delta salinity requirements.

**Table 5-1: OCAP Requirements at Vernalis Gage (cfs)**

| Year Type | All Years | Wet Year | | Above Normal Year | | Below Normal Year | | Dry Year | | Critical Year | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Flow Standards for Feb – Apr 14 and May 16- Jun | N/A | Low 2,130 | High 3,420 | Low 2,130 | High 3,420 | Low 1,420 | High 2,280 | Low 1,420 | High 2,280 | Low 710 | High 1,140 |

An analysis of the flow values at Vernalis was conducted based on the 2009 Delivery Reliability Report prepared by DWR. Figure 5-2 presents the exceedance values for flows at Vernalis based on an analysis of existing conditions (2009) and future conditions (2020) as presented in the 2009 Delivery Reliability Report. The analysis evaluated the impacts of removing the wastewater discharges from the San Joaquin River.

**Figure 5-1: Schematic of San Joaquin River Inflows and Monitoring Points**

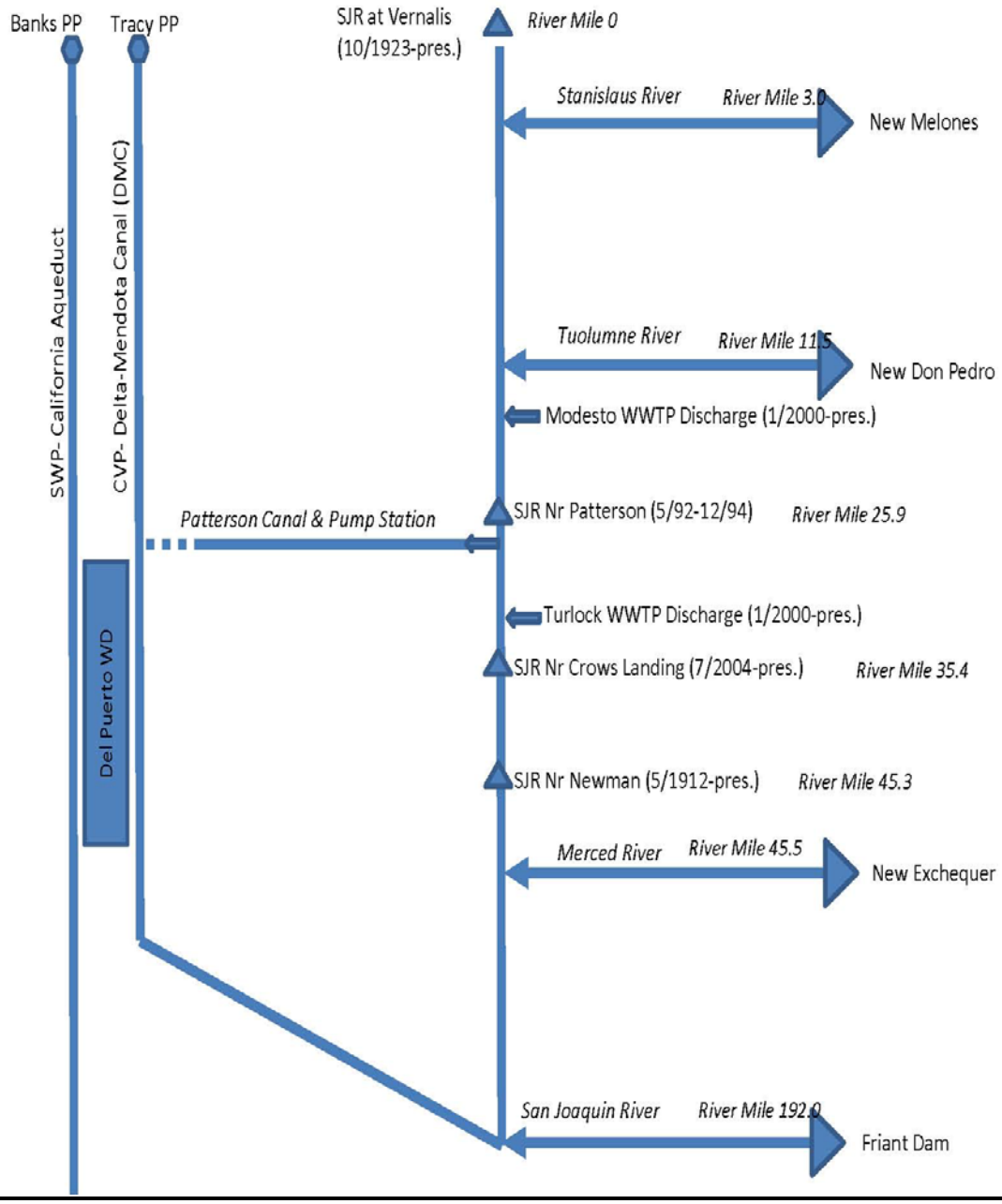
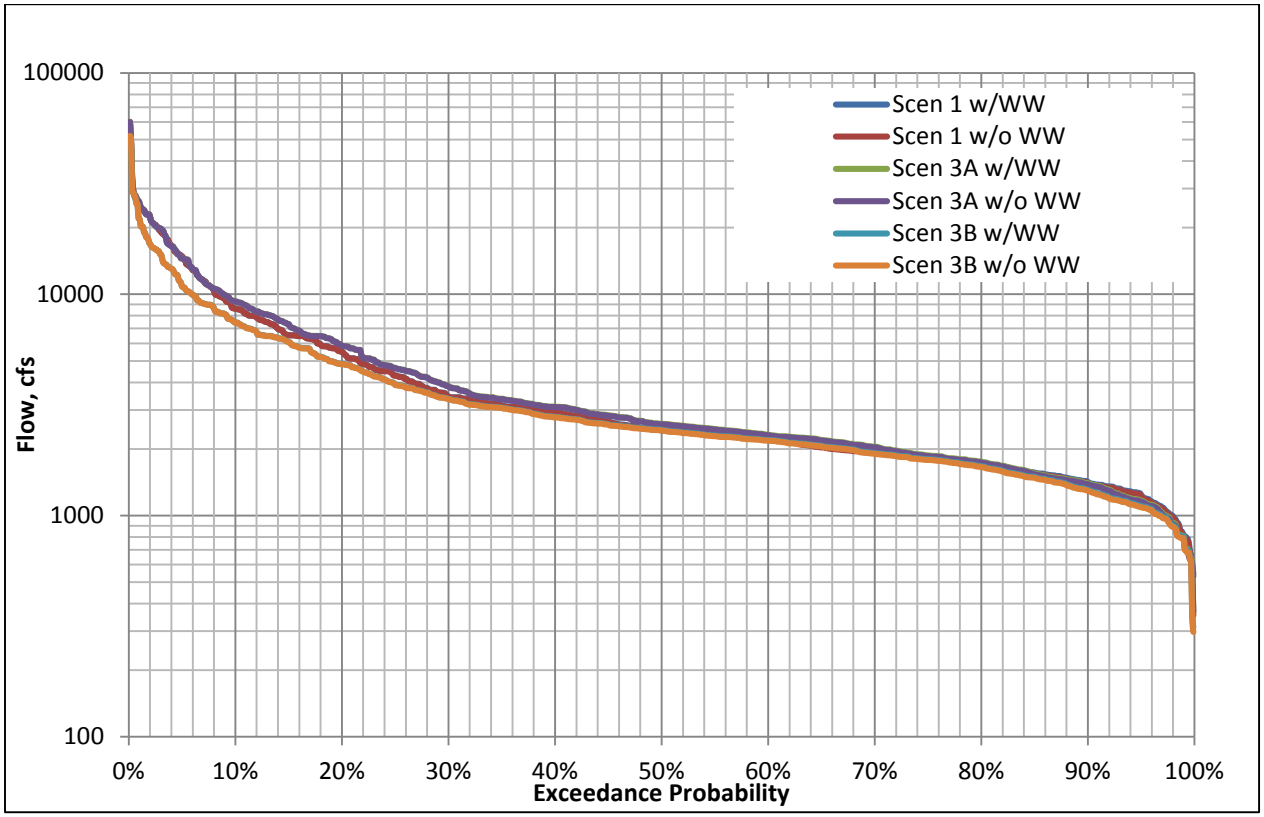


**Figure 5-2: Impacts of Cessation of Wastewater Discharge to San Joaquin River at Vernalis**




## 5.3 Conclusions

1- Observed data analysis:

- The Patterson Irrigation District ISMND study found that the 90% exceedance flow (160 cfs, 32.57 ft, mean sea level stage) is an acceptable flow criterion; the updated flow records find the 90% exceedance flow is approx. 180 cfs (33.19 ft, mean sea level stage); discharge flows are approximately less than 8% of the 90% flow.
- Cessation of discharge flows does not have a significant impact on the SJR flows, based on the Newman and Vernalis gage records.

2- Modeled data analysis:

- The WWTP discharge flows are less than 1% of the 90% exceedance flows at Vernalis and thus not significant for any impacts.

3- Water quality analysis:

- Removing wastewater flows has a positive impact on water quality in the SJR since less dilution water would be needed to meet salinity goals at the Vernalis gage.

# Chapter 6 Environmental Considerations

CEQA and NEPA studies have not yet been performed for this project, and will be performed as part of the next phase of project development. As described in Chapter 1, the purpose of this feasibility study is to identify and evaluate feasible conveyance alternatives that could be further developed for CEQA and NEPA evaluations.

The current phase of work did, however, conduct a study on the impacts of removing the Cities' effluent from the San Joaquin River. The following sections provide detail on the aquatic biota assessment.

## 6.1 Aquatic Biota Assessment

Hanson Environmental consulted with staff of the California Department of Fish and Wildlife (CDFW) and prepared an Aquatic Biology Assessment titled *Assessment of Potential Effects of the North Valley Regional Recycled Water Program (NVRRWP) Reductions in Freshwater Discharges into the San Joaquin River on Fishery Habitat and Juvenile Salmon Survival*, August 2013. This section provides a summary of results. The full memo is located in Appendix L.

### 6.1.1 Background

The San Joaquin River provides habitat for a diverse assemblage of fish and aquatic macroinvertebrates. The river also serves as a migration corridor and juvenile rearing habitat for Chinook salmon. Results of previous studies have shown positive relationships between the flow in the San Joaquin River during the spring (e.g., March-May) and the survival of juvenile salmon as well as adult salmon escapement 2.5 years later. Currently the Modesto and Turlock waste water treatment plants (WWTPs) discharge treated waste water into the San Joaquin River where it augments existing flows and therefore provides potential biological benefits to improved habitat conditions for salmon and other fishery resources. As shown in Table 6-1 the Modesto and Turlock WWTPs release an average of 25 cfs into the San Joaquin River with a range of average monthly flows of 12.9 – 51.4 cfs. The NVRRWP is proposing that rather than discharging the treated and processed wastewater into the San Joaquin River as is currently being done, the Modesto and Turlock treatment plants would recycle the wastewater for other inland uses such as irrigation of farmland. The curtailment in WWTP discharges from these two plants into the river would result in an incremental reduction in river flows as shown in Table 6-1. For comparison, the average flow in the San Joaquin River during the spring months (March –May) of dry water years typically ranges from approximately 1,500 to 2,000 cfs while average flows in a normal water year typically range from approximately 3,000 to 4,000 cfs. Spring flows in a wet year typically range from approximately 8,000 to 14,000 cfs. The actual flow in the San Joaquin River varies substantially within and among years.

**Table 6-1: Ave. Monthly WQCF Discharges to San Joaquin River from 2000 to 2012 (mgd)**

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Modesto** | 31.4 | 38.2 | 35.2 | 10.1 | 7.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 5.1 | 17.7 |
| **Turlock** | 13.1 | 13.2 | 12.9 | 13.0 | 12.7 | 12.9 | 12.9 | 13.4 | 13.3 | 13.8 | 13.3 | 13.4 |
| **Total** | **44.5** | **51.4** | **48.1** | **23.1** | **19.7** | **12.9** | **12.9** | **13.4** | **13.3** | **13.9** | **18.4** | **31.1** |

Although the amount of spring discharges is relatively small compared to total river flows (e.g., for example the April average WWTP discharge is 23.2 cfs and the San Joaquin River mean April flow at Vernalis is 3,095 cfs), the removal of these discharges into the San Joaquin River would contribute to an incremental reduction in the water levels and flows in the river downstream of the discharge location. This reduction in river flow could potentially adversely affect habitat conditions in the river for fish and the survival of juvenile salmon during their spring migration from the river to coastal marine waters. The objective of this analysis is to evaluate the potential for adverse effects of a reduction in freshwater discharges to the San

Joaquin River as a result of the proposed NVRRWP water recycling project on instream flows, fishery habitat and juvenile Chinook salmon survival and abundance.

### 6.1.2 Discussion

To assess the potential effects of changes in river flow four independent analyses were considered including (1) the predicted change in juvenile salmon survival as a function of river flow, (2) the predicted change in adult salmon escapement as a function of river flow during the spring outmigration period 2.5 years earlier, (3) changes in river habitat based on stage-discharge relationships developed for the river by the U.S. Geological Survey (USGS) and the location of the estuarine low salinity zone during biologically sensitive spring months, and (4) predicted changes in salmon abundance based on use of the California Department of Fish and Wildlife (CDFW) San Joaquin River fall-run salmon lifecycle simulation model (SalSim). By comparing historic flows to those flows without the addition of WWTP discharges the study simulates the potential effect that the removal of WWTP discharges would have on salmon from a variety of metrics. Results are summarized below:

Predicted changes to San Joaquin River flow when the WWTP discharge is removed (Adjusted flow) are on average less than 1% (ranges from 0.16 – 2.46%) of the total San Joaquin River flow (base flow) between March and May.

Using the SalSim model, the decreases in predicted juvenile Chinook salmon survival with and without the WWTP discharges ranged from 0.000 to 0.005 for conditions with the Head of Old River Barrier (HORB) in place and were all 0.000 without the HORB.

Total predicted reduction in adult Chinook salmon escapement in the March-May juvenile migration period is 145 fish out of predicted escapement estimates ranging from approximately 14,000 to 31,000 adults (less than 1%). The predicted small change in escapement appears well within the observed variability in the escapement/flow relationship and would not be detectable in the river.

The reduction in river stage height (a reflection of water depth in the river) associated with curtailment of the WWTP discharges was estimated to range from 0.02 to 0.08 feet. The predicted change in X2 location, a reflection of the low salinity zone habitat for estuarine fish and other organisms, moved upstream on average 0.06 km in March, an average of 0.03 km in April, and an average of 0.02 km in May. The magnitude of these changes would not be detectable in the field given the natural variation in X2 location based on variation in tidal conditions.

The SalSim model simulating hypothetical flow conditions and response of the Chinook salmon population showed a small reduction in metrics of salmon abundance. However, dry year results of the SalSim model appear to be the result of model simulation errors. These apparent errors were discussed with CDFW staff, and it was determined that the SalSim model was not developed to address changes in San Joaquin River flows as small as those that would occur under the proposed project operations, and therefore, the model could not be used to reliably predict changes in San Joaquin River fall-run Chinook salmon abundance or population dynamics as an assessment tool for the proposed project evaluation. Based on these initial model results and consultation with CDFW the SalSim model was not used in these analyses.

### 6.1.3 Conclusions

The report evaluated effects of reductions in flows associated with discontinuing wastewater discharges from the Modesto and Turlock Wastewater Treatment Plants (WWTP). The analysis considered average monthly discharges from each WWTP to the San Joaquin River, and compared base flow (with discharge) to adjusted flow (without discharge). Chinook salmon were used as the indicator species.

The two primary conclusions from this assessment are:

- Curtailment of treated waste water discharges from the Modesto and Turlock WWTPs into the San Joaquin River will result in a small incremental reduction in river flow from the point of the

existing discharge downstream. The reduction in San Joaquin River flow would contribute, based on the best scientific information available, to an incremental reduction in juvenile Chinook salmon survival during spring outmigration, a reduction in adult salmon escapement (0.00 to 0.05) to the San Joaquin River tributaries, and an incremental reduction in habitat quality and availability in the lower river and estuary.

- The magnitude of predicted changes in juvenile salmon survival, adult escapement, and habitat conditions in the lower river and estuary is small (typically less than 1% when compared to current baseline conditions) and is well within the natural observed variation in the regression relationships used in these analyses. The magnitude of predicted changes in juvenile salmon survival and adult escapement, habitat quality in the lower San Joaquin River, and the location of the estuarine low salinity zone (X2 location) would not be detectable in field studies and is considered to be less than significant.

# Chapter 7 Description of Alternatives

## 7.1 Overview

Five project alternatives were developed for the conveyance of recycled water from the Modesto and Turlock tertiary treatment facilities to DPWD customers. The primary objectives of the alternatives were to maximize delivery of recycled water to DPWD customers while minimizing project costs, and to identify a project that is technically feasible and implementable.

The five alternatives evaluated include:

- **Alternative 1**: Pipeline Conveyance of Recycled Water Directly to the DMC,
- **Alternative 2**: Pipeline Conveyance of Recycled Water Directly to DPWD Lands,
- **Alternative 3**: San Joaquin River Conveyance of Recycled Water to Existing Diversion Facilities for Conveyance to the DMC,
- **Alternative 4**: Pipeline Conveyance of Recycled Water to Patterson ID Existing Facilities for Dilution and Conveyance to the DMC,
- **Alternative 5**: Pipeline Conveyance of Recycled Water to the DMC Utilizing Groundwater Storage and Operational Modifications.
- **Alternative 6**: No Project Alternative. Assumes no long-term, sustainable recycled water supply would be available to meet demand within the District or south of Delta CVPIA-designated Refuges.

This feasibility study focuses on recycled water delivery mechanisms, and does not include the costs of expanding the tertiary facilities at Modesto or Turlock as influent flows increase since those treatment plant expansions would be required with or without the NVRRWP project.

## 7.2 Alternative 1: Pipeline Conveyance of Recycled Water Directly to DMC

Alternative 1 consists of several sub alternatives for conveying recycled water in a pipeline from Modesto and Turlock tertiary treatment facilities directly to the DMC (Figure 7-1). A detailed description of these alternatives is included in the Pipeline Corridor Study in Appendix M.

- **DMC-1A**: Separate Pipeline Alignments Using PID Right-of-Way Country Roads; Directly Discharge into DMC
- **DMC-1B**: Separate Pipeline Alignments with Most Direct Routes; Directly Discharge into DMC
- **DMC-2**: Pipeline Alignments Combined East at Las Palmas; Directly Discharge into DMC
- **DMC-3**: Pipeline Alignments Combined West at Pomelo Avenue; Directly Discharge into DMC
- **DMC-4**: Pipeline Alignments Combined East at Harding Drain; Directly Discharge into DMC

**Figure 7-1: Alternative 1 Pipeline Conveyance Alternatives**

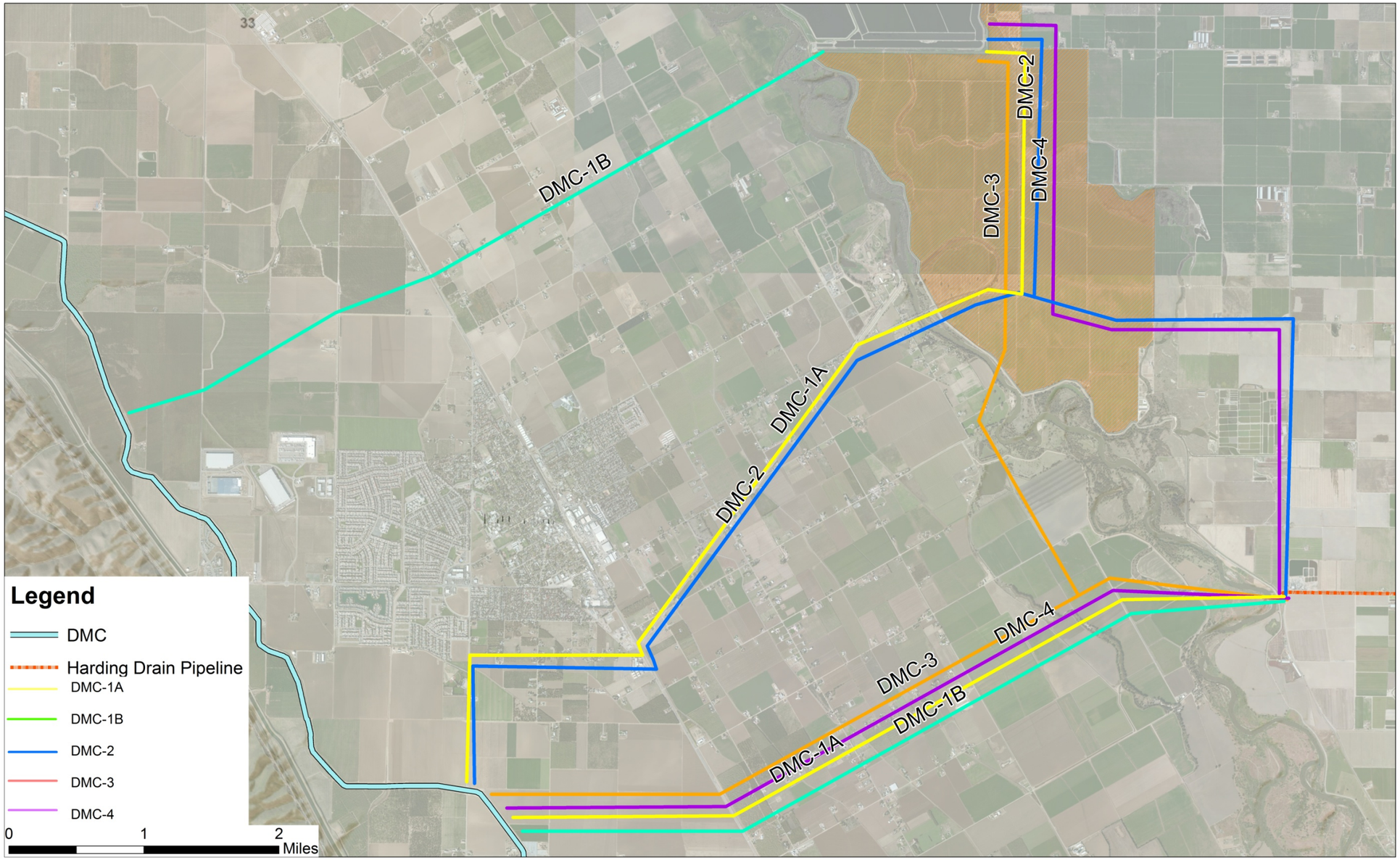


**Table 7-1: Summary of Sub Alternatives in Alternative 1**

| Alt No. | Description | Estimate of Most Probable Capital Cost | Advantages/Disadvantages |
|---|---|---|---|
| DMC-1A | Separate pipelines from Modesto and Turlock to DMC via, respectively, PID canal right-of-way and Apricot Avenue. HDD river crossings at Las Palmas bridge for Modesto and Harding Drain for Turlock. Pump stations at Jennings plant, Harding Drain and Las Palmas Avenue. | $123 million | • Highest cost DMC option<br>• Most difficult constructability due to multiple river, canal, highway crossings and two pipeline corridors<br>• Separate pipelines allows Cities to proceed independently of each other<br>• PID right-of-way alignment might conflict with PID capital improvements |
| DMC-1B | Separate pipelines from Modesto and Turlock to DMC via, respectively, Lemon Avenue and Apricot Avenue. HDD river crossings at Jennings Road WQCF San Joaquin River discharge for Modesto and Harding Drain Pipeline for Turlock. Pump stations at Jennings Road plant and at Harding Drain. | $102 million | • Separate pipelines allows Cities to proceed independently of each other<br>• Least-cost separate alignment option<br>• Modesto alignment does not follow PID right-of-way alignment |
| DMC-2 | Pipes from Jennings plant and Harding Drain combine at Las Palmas then follow PID canal right-of-way to DMC. HDD River crossing at Las Palmas bridge. Combined pump station at Las Palmas. | $104 million | • PID right-of-way alignment might conflict with PID capital improvements |
| DMC-3 | Separate HDD river crossings; combine east of Pomelo Ave and along Apricot Avenue. HDD river crossings south of Las Palmas for Modesto and at Harding Drain for Turlock. Pump stations at Jennings plant and at combined pump station. | $99 million | • Multiple river crossings increase permitting and constructability complexity.<br>• Separate river crossings allow Cities to proceed somewhat independently of each other |
| DMC-4 | Modesto pipeline to head south to Harding Drain Pipeline via Jennings Road, West Main Avenue, and South Carpenter Road. Combined pipe river crossing at Harding Drain Pipeline and follow Apricot Avenue. Combined pump station at Harding Drain. | $96 million | • Lowest cost DMC option. |

### 7.2.1 Alternative1A: DMC-1A

DMC-1A uses separate alignments from each City to the DMC with the Modesto pipeline following the PID right-of-way.

#### Modesto Alignment:

The proposed separate alignment from Modesto begins at the Modesto Recycled Water Facility off of Jennings Road. Following Jennings Road south, the alignment will turn west on West Main Avenue, crossing the river adjacent to the Las Palmas Bridge. The alignment continues west until reaching the intersection of the PID Main Canal and Las Palmas Avenue and then follows the PID Main Canal right-of-way utilizing the access roads that flank the north and south sides of the canal. The PID canal turns south along the east side of HWY 33, and at this point, the proposed alignment would cross underneath HWY 33, the CFNR, and the PID Main Canal. After heading south along HWY 33 for approximately 1,000 feet, the alignment then turns west along Bartch Avenue. When Bartch Avenue intersects Ward Avenue, the alignment will then head south along Ward Avenue until the intersection of Ward Avenue and Elfers Avenue, which constitutes the terminus of the Modesto section of pipeline.

#### Turlock Alignment:

The proposed separate alignment from Turlock would tie into the Harding Drain Bypass Pipeline (estimate construction completion in 2014) and immediately cross under the San Joaquin River heading west towards Paradise Avenue. Once reaching Paradise Avenue, the alignment heads southwest along Apricot Avenue towards Highway 33. This alignment avoids the high-pressure natural gas transmission lines along Marshall Road where Pomegranate Avenue or Apricot Avenue would intersect, as well as constituting the most direct and shortest alignment. Once reaching HWY 33, the alignment would then cross underneath HWY 33 and the CFNR, and head directly west toward the DMC, approximately 1,000 feet north of Marshall Avenue as a cross country route before reaching the DMC.

### 7.2.2 Alternative 1B: DMC-1B

DMC-1B is similar to DMC-1A in that this alternative includes separate pipelines from each Cities respective tertiary effluent location; however the Modesto alignment heads directly west towards the DMC north of Patterson as opposed to following the PID Main Canal right-of-way.

#### Modesto Alignment:

The proposed separate alignment from Modesto begins at the Modesto Recycled Water Quality Control Facility off of Jennings Road. The alignment immediately crosses under the San Joaquin River. Once on the west side of the San Joaquin River, the pipeline alignment heads west along Lemon Avenue until reaching the intersection of Lemon Avenue and Highway 33. After crossing under the CNFR and HWY 33, the alignment continues west following a County road alignment toward Access Road.

#### Turlock Alignment:

The Turlock alignment for DMC-1B is identical to DMC-1A.

### 7.2.3 Alternative 1C: DMC-2

DMC- 2 combines the Turlock and Modesto flows at a point east of the San Joaquin River and crosses under the San Joaquin River adjacent to the Las Palmas Bridge. The combined alignment then parallels the PID Main Canal right-of-way.

#### Modesto Alignment:

The proposed alignment from Modesto begins at the Modesto Recycled Water Quality Control Facility off of Jennings Road. Following Jennings Road south, the alignment intersects with West Main Avenue where it will tie into the Turlock alignment.

### Turlock Alignment:

The proposed alignment from Turlock begins at the Harding Drain Bypass Pipeline at the west end of Harding Road. After tying into the Harding Drain Bypass Pipeline (estimated construction completion in 2014), the alignment heads north on South Carpenter Road until reaching West Main Ave. At West Main Ave., the alignment turns west along West Main Ave until the intersection of Jennings Rd. and West Main Ave.

### Combined Alignments:

At the intersection of Jennings Road and West Main Ave, the pipelines from Turlock and Modesto combine into one pipeline alignment that heads west along West Main Ave. The alignment continues west on West Main Avenue, crossing under the river near the Las Palmas Bridge. The road changes names from West Main Avenue to Las Palmas Avenue at the San Joaquin River. From the Las Palmas Bridge, the alignment continues west until reaching the intersection of the PID Main Canal and Las Palmas Avenue. The alignment then follows the PID Main Canal Right-of-Way utilizing the access roads that flank the north and south sides of the canal. The PID canal intersects with HWY 33, and at this point, the proposed alignment would cross underneath HWY 33 and the CFNR, head south along HWY 33 until Bartch Avenue, and then continue west along Bartch Avenue. When Bartch Avenue intersects Ward Avenue, the alignment will then head south along Ward Avenue until the intersection of Ward Avenue and the DMC, which constitutes the terminus of the combined section of pipeline.

## 7.2.4 Alternative 1D: DMC-3

DMC- 3 combines the Turlock and Modesto flows at a point west of the San Joaquin River, and south of the PID Main Canal right-of-way. The alignment then follows Apricot Avenue before reaching the DMC.

### Modesto Alignment:

The proposed alignment from Modesto begins at the Modesto Recycled Water Quality Control Facility off of Jennings Road. Following Jennings Road south, the alignment intersects with West Main Avenue. The alignment would then cross underneath West Main Ave and continue heading south-southwest until reaching the San Joaquin River where it would cross under the river. The alignment would then connect with the Turlock pipeline near the intersection of Paradise Avenue and Apricot Avenue and combine before heading towards the DMC.

Note that this alignment is adjacent to Lake Ramona, a privately owned recreational lake, which was discussed earlier in this project as a potential location for recycled water storage. However, subsequent discussions with PID have determined that the Lake Ramona storage option is infeasible. Lake Ramona is private, recreational land owned by a local church and there is no connection from Lake Ramona to the PID main canal.

### Turlock Alignment:

The proposed separate alignment from Turlock begins at the Harding Drain Bypass Pipeline at the west end of Haring Road. After tying into the Harding Drain Bypass Pipeline (estimated construction completion in 2014), the alignment immediately crosses under the San Joaquin River heading west towards the combined pump station at Paradise Avenue.

### Combined Alignment:

The combined alignment heads southwest along Apricot Avenue towards Highway 33. This alignment avoids the high-pressure natural gas transmission lines along Marshall Road where Pomegranate Avenue or Apricot Avenue would intersect, as well as constituting the most direct and shortest alignment. Once reaching HWY 33, the alignment would then cross underneath HWY 33 and the CFNR, and head directly west toward the DMC, approximately 1,000 feet north of Marshall Avenue as a cross country route before reaching the DMC.

### 7.2.5 Alternative 1E: DMC-4

DMC- 4 combines the Turlock and Modesto flows at the Harding Drain Bypass Pipeline at the west end of Harding Road. The alignment then crosses the San Joaquin River and follows Apricot Avenue before reaching the DMC.

**Modesto Alignment:**

The proposed alignment from Modesto begins at the Modesto Recycled Water Facility off of Jennings Road. Following Jennings Road south, the alignment intersects with West Main Avenue. The alignment would then cross underneath West Main Ave and turn east along West Main Avenue before heading south on South Carpenter Road. Once reaching the Harding Drain Bypass Pipeline, the Modesto Alignment would tie into the Combined Alignment.

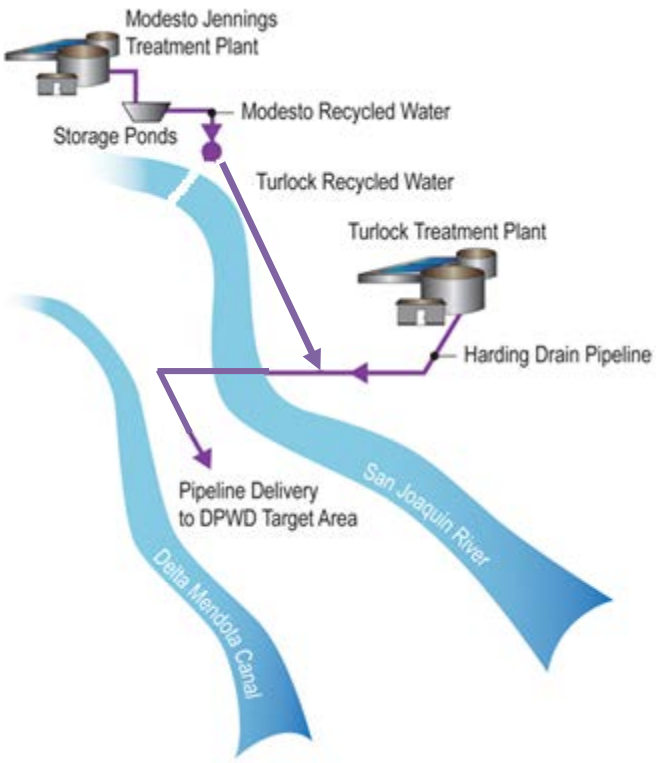
**Combined Alignment:**

The proposed separate alignment from Turlock begins with a combined pump station at the Harding Drain Bypass Pipeline terminus at the west end of Harding Road. After tying into the Harding Drain Bypass Pipeline (estimated construction completion in 2014), the alignment immediately crosses under the San Joaquin River heading west towards Paradise Avenue. The combined alignment then heads southwest along Apricot Avenue towards HWY 33. This alignment avoids the high-pressure natural gas transmission lines along Marshall Road where Pomegranate Avenue or Apricot Avenue would intersect, as well as constituting the most direct and shortest alignment. Once reaching HWY 33, the alignment would then cross underneath HWY 33 and the CFNR, and head directly west toward the DMC, approximately 1,000 feet north of Marshall Avenue as a cross country route before reaching the DMC

## 7.3 Alternative 2: Pipeline Conveyance of Recycled Water Directly to DPWD Lands

Alternative 2 consists of constructing a pipeline to deliver recycled water to target areas within DPWD (Figure 7-2). In this alternative it was assumed that a pipeline would approximately follow the alignment of the DMC and recycled water would be delivered either directly or by way of Reclamation-owned distribution boxes into privately owned irrigation systems. This delivery scenario enables customers to blend recycled water with canal water, when possible and if desired.

**Figure 7-2: Alternative 2 Pipeline Schematic**




Three delivery target areas shown in Figure 7-3 were developed for recycled water distribution: North, Central, and South Areas. The North Area is bounded by the San Joaquin/Stanislaus County border on the north, and the City of Patterson on the south, the Central Area is bounded by the City of Patterson on the north and Orestimba Creek on the south, and the South Area is bounded by Orestimba Creek on the north and the Merced/Stanislaus County border on the south. To avoid the capital costs associated with crossing the DMC multiple times, it was assumed that recycled water would be conveyed and distributed only to land on the east side of the DMC. Pipeline deliveries to the North, Central, and South Areas were reviewed; however the South Area was identified by DPWD to be the target delivery area due to the high percentage of permanent crops (almonds) and the relative lack of groundwater supplies in the South Area.

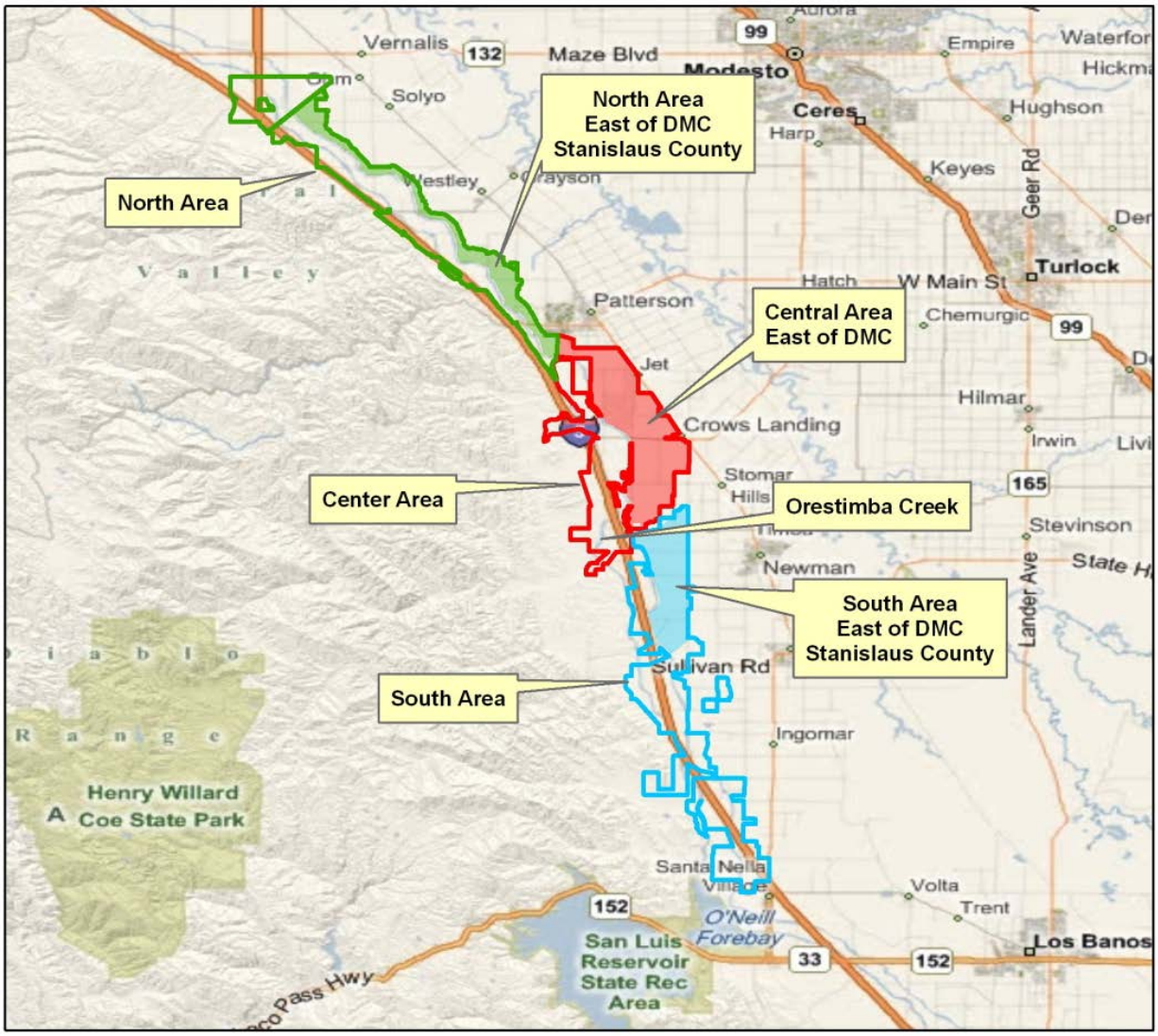
Since Alternative 2 does not have access to the seasonal storage facilities of the DMC and Central Valley Project, the Alternative 2 scenarios include seasonal storage at Modesto or elsewhere to increase the volume of recycled water that could be used by DPWD. Without seasonal storage, the recycled water production in the wet weather months would need to be discharged rather than used for irrigation.

The following pipeline conveyance scenarios were evaluated and are described in the following sections:

- Scenario 2A: Conveyance of recycled water to the Central and South Areas, using seasonal storage at Modesto only
- Scenario 2B: Conveyance of recycled water to the Central and South Areas with additional seasonal storage
- Scenario 2C: Conveyance of recycled water to the Central Area, using seasonal storage at Modesto only
- Scenario 2D: Conveyance of recycled water to the North Area, using seasonal storage at Modesto only

Costs were estimated for all four scenarios for both 2018 and 2045 recycled water production rates. Costs for use of Modesto's storage facilities are not included in the estimates.

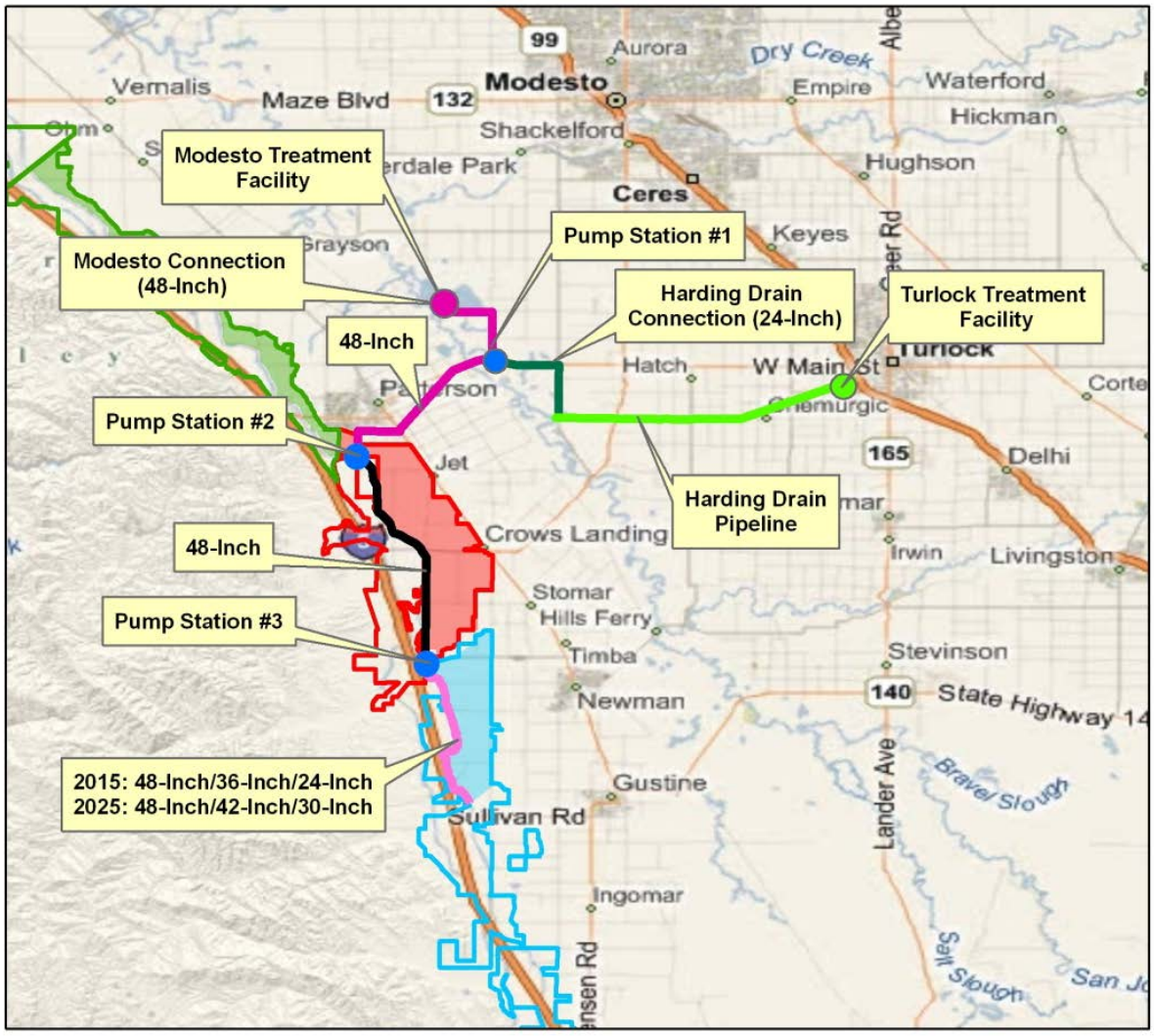
**Figure 7-3: DPWD Delivery Areas**




### 7.3.1 Scenario 2A: Pipeline to South and Central Areas, Seasonal Storage at Modesto Only

Under Scenario 2A, recycled water would be conveyed via a pipeline from the Modesto and Turlock tertiary treatment facilities to the Central and South Areas as shown in Figure 7-4. It is assumed that seasonal storage at Modesto would be used and additional storage would not be constructed, as the storage available at Modesto is adequate to serve the entire South Area and part of the Central Area water demands. Table 7-2 provides a summary of key design criteria assumed for this scenario.

**Figure 7-4: Scenario 2A Distribution System**




A 24-inch pipeline (Harding Drain Connection) would convey recycled water from Turlock's Harding Drain Pipeline at South Carpenter Road, north and west to the intersection of West Main Street and Jennings Road. At this location Turlock and Modesto recycled water would be combined and pumped into a 48-inch pipeline to the southern area. It was assumed that the pipeline would cross the San Joaquin River under the bridge at West Main Street, in lieu of tunneling under the San Joaquin River. After crossing the San Joaquin River, the 48-inch pipeline would follow PID's Main Canal, to Highway 33. It was assumed that the 48-inch pipeline would cross under Highway 33, and would be routed west and south along Bartch Avenue and Ward Avenue. The 48-inch pipeline would then follow the DMC through the Central and South areas. To provide operational flexibility for the distribution system, three pump stations were assumed at the locations shown in Figure 7-4. The costs for Scenario 2A are provided as Table 7-13.

**Table 7-2: Pipeline Scenario 2A Design Criteria**

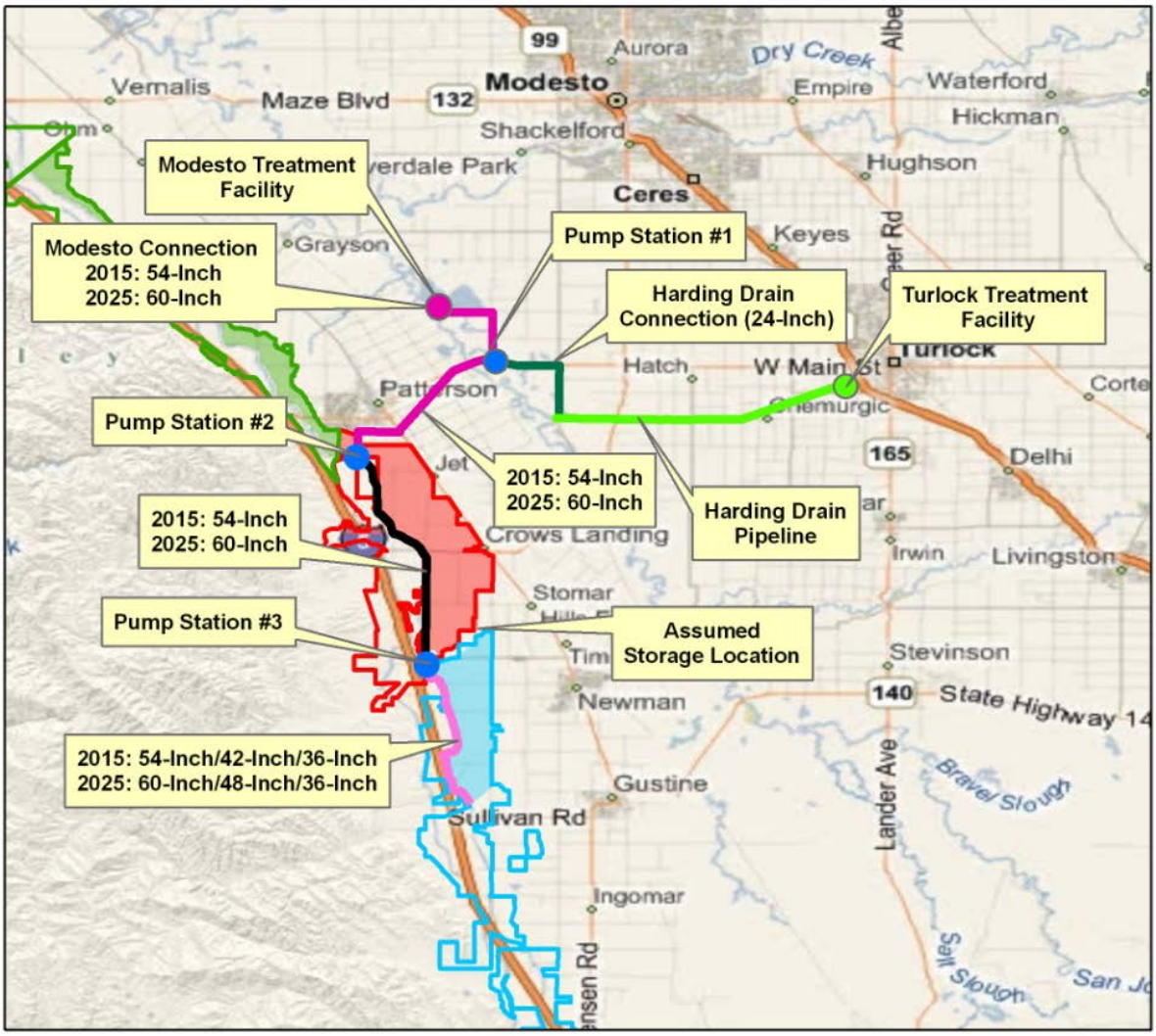
| Criteria | 2015 Recycled Water Delivery | 2025 Recycled Water Delivery |
|---|---|---|
| DPWD Area Served[1] | South and Central | South and Central |
| Peak Monthly Demand Cap (AFM)[2] | 2,400 | 3,500 |
| Volume of Seasonal Storage (AF) | 3,900 | 4,300 |
| Peak Recycled Water Delivery Rate (gpm/acre) | 5.4 | 5.5 |
| Total Acres Irrigated with Recycled Water (acres) | 4,900 | 4,900 |
| Recycled Water Delivered to DPWD (AFY) | 25,700 | 23,700 |
| Recycled Water Not Delivered to DPWD (AFY) | | 9,200 |
| Harding Drain Connection Pipeline | | |
| Diameter | 24-inch | 24-inch |
| Distance | 21,000 feet | 21,000 feet |
| Modesto Connection Pipeline | | |
| Diameter | 48-inch | 48-inch |
| Distance | 17,400 feet | 17,400 feet |
| Pipeline through Central Area | | |
| Diameter | 48-inch | 48-inch |
| Distance | 46,000 feet | 46,000 feet |
| Pipeline through Southern Area | | |
| Diameter[3] | 48,36,24-inch | 48,42,30-inch |
| Distance | 33,300 | 33,300 |
| Distribution Pump Stations[4] | | |
| Pump Station 1 (HP) | 2,250 | 3,000 |
| Pump Station 2 (HP) | 700 | 1,600 |
| Pump Station 3 (HP) | 1,200 | 1,800 |

Notes:
1. It is assumed that the southern area peak monthly demand is met, and remaining water is distributed to the central area.
2. Applies to Central Area because it is assumed the peak monthly demand of the southern area is met.
3. Pipeline diameter is reduced through the southern area as water demands are met along the alignment.
4. An allowance for a booster pump station is included in the cost estimate.

### 7.3.2 Scenario 2B: Pipeline to South and Central Areas, with Additional Seasonal Storage

Under Scenario 2B, recycled water would be conveyed via pipeline from the Modesto and Turlock tertiary treatment facilities to the Central and South Areas, as shown in Figure 7-5, and exactly as described in Scenario 2A. Additional storage would be constructed in addition to Modesto's storage ponds so that all recycled water produced by Modesto and Turlock is delivered to DPWD. Similar to Scenario 2A, it is assumed that after serving the South Area, recycled water would be distributed to the Central Area. Table 7-3 provides a summary of key design criteria assumed for this scenario. A summary of the costs of this scenario are provided in Table 7-14.

**Figure 7-5: Scenario 2B Distribution Facilities**




## Seasonal Storage

For this scenario, it was assumed that additional recycled water storage was constructed to augment the storage volume available at Modesto. The cost estimate provided in Table 7-14 assumes that lined storage ponds were constructed. The exact location of the storage ponds would need to be further investigated in subsequent studies due to the significant area of land required (approximately 1,300 acres).

Groundwater banking was also reviewed as an alternative to constructing recycled water storage ponds. Groundwater banking would consist of using spreading basins for recycled water to percolate into the groundwater aquifer and the construction of extraction wells down gradient of the basins to recapture the stored water. Groundwater injection wells also can be used as an alternative to spreading basins, however direct injection of recycled water into a groundwater aquifer would likely require advanced treatment (RO) prior to injection. There are a number of unknowns associated with groundwater banking at this time, including the true storage capacity of the aquifer, the soil and hydrogeologic conditions of the area, the percolation rate, and the regulatory requirements (e.g., need for dilution water, advanced treatment) for storage of recycled water in the groundwater aquifer. Due to these unknowns, it is recommended that additional information be obtained to better understand the soil, groundwater and hydrogeologic conditions in the area should groundwater banking be pursued as an option.

**Table 7-3: Pipeline Scenario 2B Design Criteria**

| Criteria | 2015 Recycled Water Delivery | 2025 Recycled Water Delivery |
|---|---|---|
| DPWD Area Served[1] | South and Central | South and Central |
| Peak Monthly Demand Cap (AFM)[2] | 4,000 | 5,800 |
| Total Volume of Seasonal Storage[4] (AF) | 9,700 | 13,400 |
| Seasonal Storage Constructed | | |
| Type of Storage | Lined storage pond | Lined storage pond |
| Volume (AF) | 5,800 | 9,100 |
| Peak Recycled Water Delivery Rate (gpm/acre) | 5.0 | 5.2 |
| Total Acres Irrigated with Recycled Water (acres) | 6,000 | 8,500 |
| Recycled Water Delivered to DPWD (AFY) | 25,700 | 32,900 |
| Recycled Water Not Delivered to DPWD (AFY) | — | — |
| Harding Drain Connection Pipeline | | |
| Diameter | 24-inch | 24-inch |
| Distance | 21,000 feet | 21,000 feet |
| Modesto Connection Pipeline | | |
| Diameter | 54-inch | 60-inch |
| Distance | 17,400 feet | 17,400 feet |
| Pipeline through Central Area | | |
| Diameter | 54-inch | 60-inch |
| Distance | 46,000 feet | 46,000 feet |
| Pipeline through Southern Area | | |
| Diameter[3] | 54,42,36-inch | 60,48,36-inch |
| Distance | 33,300 | 33,300 |
| Distribution Pump Stations[5] | | |
| Pump Station 1 (HP) | 3,000 | 3,300 |
| Pump Station 2 (HP) | 1,200 | 1,350 |
| Pump Station 3 (HP) | 1,200 | 2,000 |

Notes:
1. It is assumed that the southern area peak monthly demand is met, and remaining water is distributed to the central area.
2. Applies to Central Area because it is assumed the peak monthly demand of the southern area is met.
3. Pipeline diameter is reduced through the southern area as water demands are met along the alignment.
4. Assumes that storage available at Modesto is used (3,900 in 2015 and 4,300 in 2025), and additional storage is constructed.
5. An allowance for a booster pump station is included in the cost estimate.

### 7.3.3 Scenario 2C: Pipeline to Central Area, with Seasonal Storage at Modesto Only

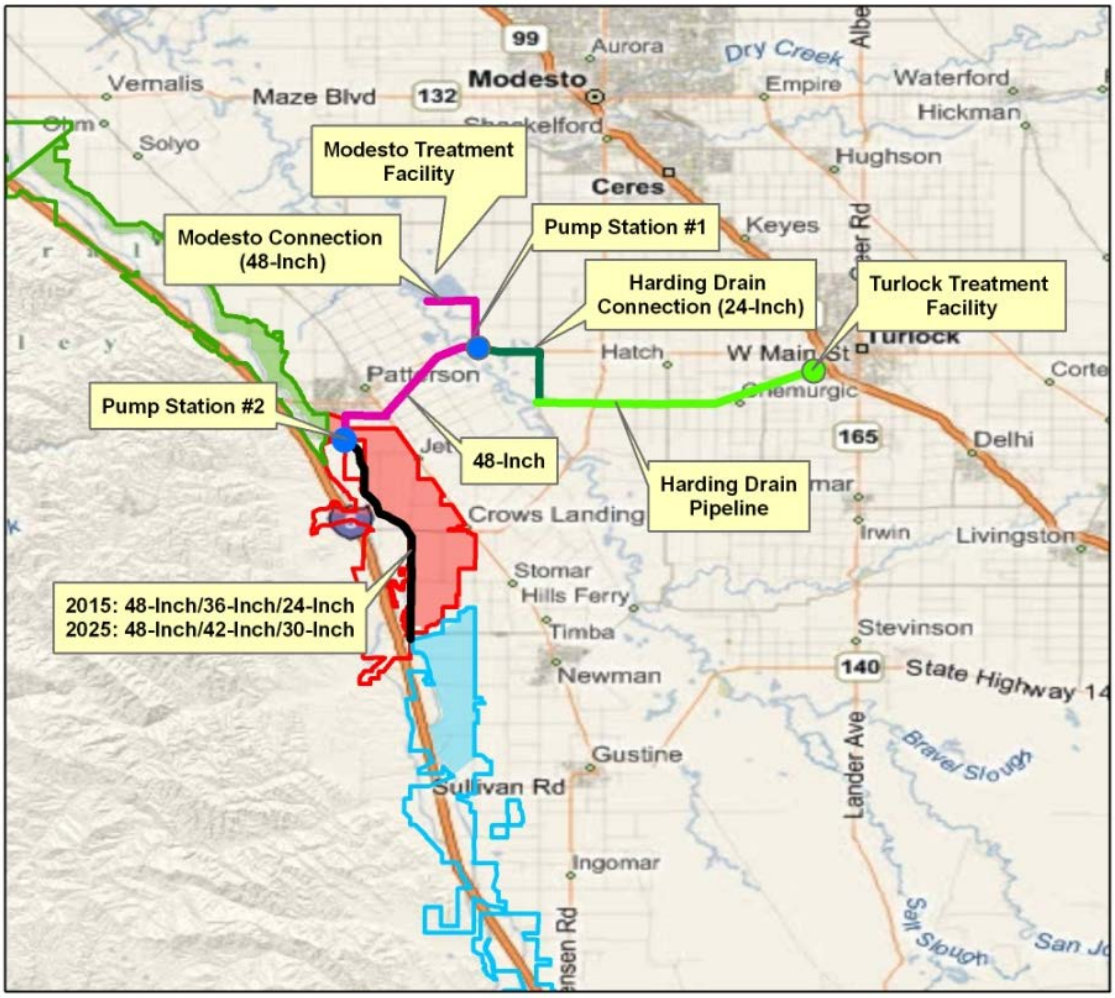
Scenario 2C consists of conveying recycled water in a pipeline from the Modesto and Turlock recycled water facilities to the entire Central Area, using only two pump stations, as shown in Figure 7-6, rather than 3 pump stations as described in Scenarios 2A and 2B. It was assumed that seasonal storage available at Modesto would be used. Table 7-4 provides a summary of key design criteria assumed for this scenario. A summary of the costs of this scenario are provided in Table 7-15.

**Table 7-4: Pipeline Scenario 2C Design Criteria**

| Criteria | 2015 Recycled Water Delivery | 2025 Recycled Water Delivery |
|---|---|---|
| DPWD Area Served | Central | Central |
| Peak Monthly Demand Cap (AFM) | 3,100 | 4,100 |
| Volume of Seasonal Storage (AF) | 3,900 | 4,300 |
| Peak Recycled Water Delivery Rate (gpm/acre) | 2.4 | 3.2 |
| Total Acres Irrigated with Recycled Water (acres) | 9,792 | 9,792 |
| Recycled Water Delivered to DPWD (AFY) | 28,100 | 20,400 |
| Recycled Water Not Delivered to DPWD (AFY) | | 12,500 |
| Harding Drain Connection Pipeline | | |
| Diameter | 24-inch | 24-inch |
| Distance | 21,000 feet | 21,000 feet |
| Modesto Connection Pipeline | | |
| Diameter | 48-inch | 48-inch |
| Distance | 17,400 feet | 17,400 feet |
| Pipeline through Central Area | | |
| Diameter[1] | 48,36,24-inch | 48,42,30-inch |
| Distance | 33,300 | 33,300 |
| Distribution Pump Stations | | |
| Pump Station 1 (HP) | 2,000 | 3,000 |
| Pump Station 2 (HP) | 1,400 | 1,500 |

Notes:
1. Pipeline diameter is reduced through the central area as water demands are met along the alignment.
2. An allowance for a booster pump station is included in the cost estimate.

**Figure 7-6: Scenario 2C Distribution Facilities**




## 7.3.4 Scenario 2D: Pipeline to North Area, Seasonal Storage at Modesto Only

Under Scenario 2D, recycled water is conveyed via a pipeline from Modesto to the North Area, as shown in Figure 7-7. A 48-inch pipeline from Modesto's tertiary treatment facility would be routed to the DMC using the same alignment. At Ward Avenue, the pipeline would follow the DMC through the North Area. The pipeline diameter would decrease as water is diverted from the distribution line. To provide operational flexibility for the distribution system, two pump stations were assumed at the locations shown in Figure 7-7. The existing storage ponds at Modesto would be used for seasonal storage. Table 7-5 provides a summary of key design criteria assumed for this scenario. There are several key differences with Scenario 2D. The demand in the North Area is such that recycled water from Modesto alone can meet the area's demands; therefore, this scenario does not include the costs of connecting Turlock recycled water with Modesto's. A summary of the costs of this scenario are provided as Table 7-16.

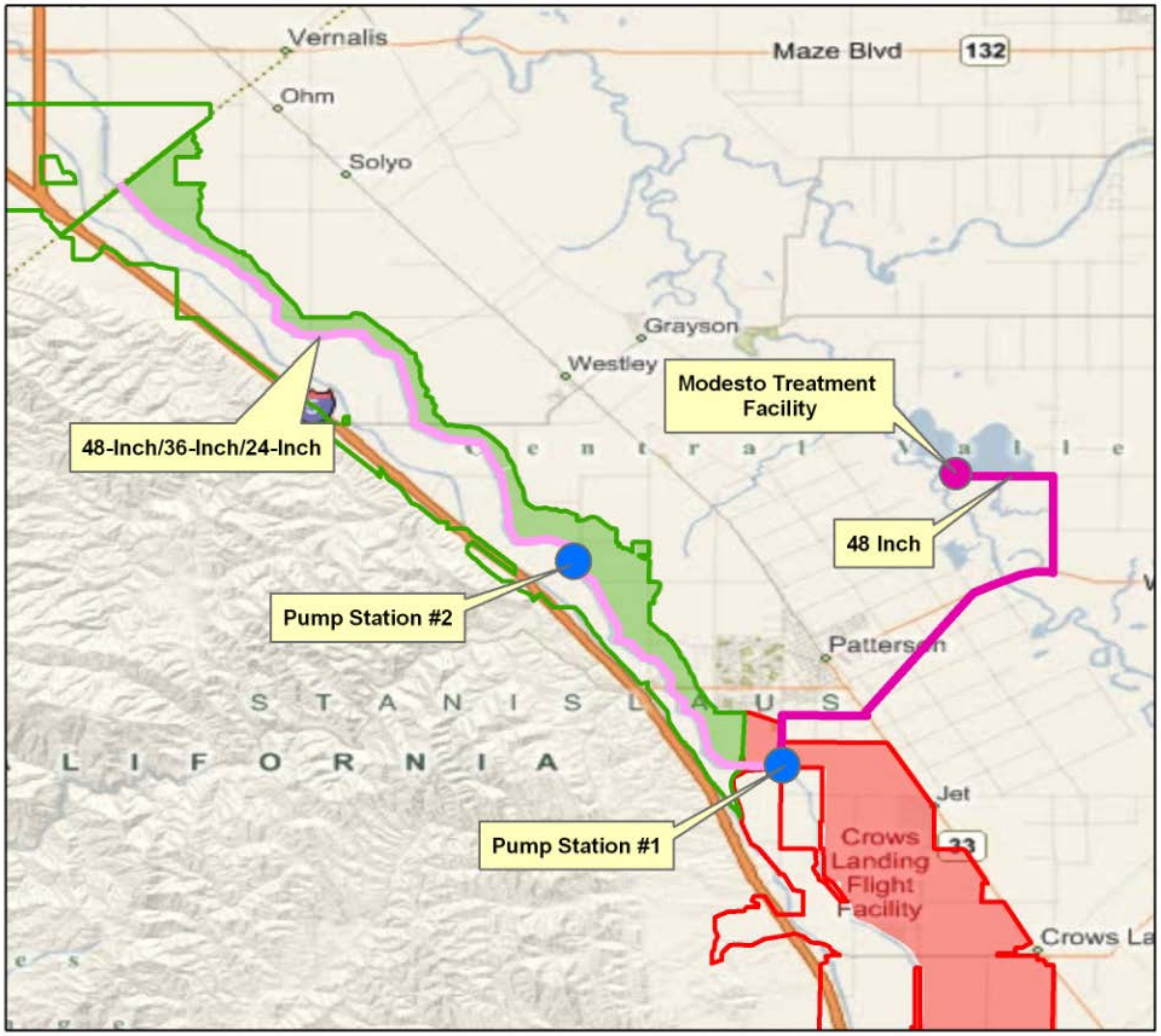
**Table 7-5: Pipeline Scenario 2D Design Criteria**

| Criteria | 2015 Recycled Water Delivery |
|---|---|
| DPWD Area Served | North |
| Peak Monthly Demand Cap[1] (AFM) | 3,000 |
| Volume of Seasonal Storage (AF) | 3,900 |
| Peak Recycled Water Delivery Rate (gpm/acre) | 5.8 |
| Total Acres Irrigated with Recycled Water (acres) | 3,386 |
| Recycled Water Delivered to DPWD (AFY)<br>Recycled Water Not Delivered to DPWD (AFY) | 28,100 |
| Modesto Pipeline<br>Diameter<br>Distance | <br>48-inch<br>17,400 feet |
| Pipeline through North Area<br>Diameter[2]<br>Distance | <br>48,36,24-inch<br>89,200 |
| Distribution Pump Stations<br>Pump Station 1 (HP)<br>Pump Station 2 (HP) | <br>1,800<br>900 |

Notes:
1. The peak monthly demand cap represents the peak month demand. Recycled water is adequate to meet the peak month demand.
2. Pipeline diameter is reduced through the north area as water demands are met along the alignment

Based on information from DPWD, recycled water delivery to the North Area could be institutionally more difficult to implement because the North Area customers have historically relied on groundwater to meet their water supplemental water demands. Finding incentives for North Area customers to use recycled water in lieu of groundwater may be difficult. For these reasons, delivery of recycled water to the North Area is not a preferred pipeline scenario under Alternative 2.

**Figure 7-7: Scenario 2D Distribution Facilities**

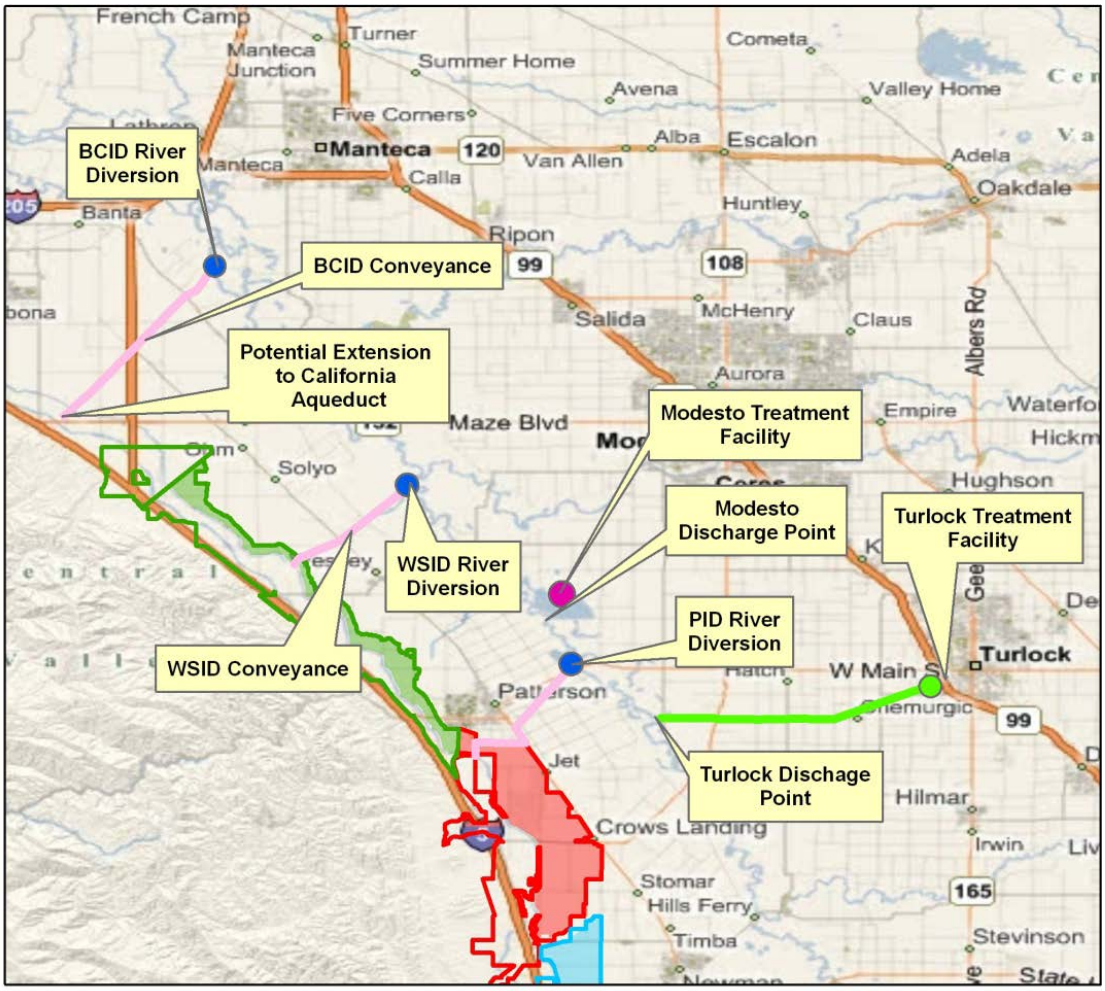



## 7.4 Alternative 3: San Joaquin River Conveyance of Recycled Water to Existing Diversion Facilities

Alternative 3 consists of conveying recycled water in the San Joaquin River, and diverting it at a downstream river diversion facility owned and operated by Banta Carbona Irrigation District (BCID), West Stanislaus Irrigation District (WSID), and/or at Patterson Irrigation District (PID). Figure 7-8 identifies the locations of three potential river diversion facilities relative to the location of Modesto and Turlock's permitted discharge locations. As can be seen in the figure, though downstream from Turlock's current discharge point, PID's river diversion facility is upstream of Modesto's permitted discharge location. Therefore, using PID's facility to convey Modesto's recycled water would require relocating the discharge point. The following sections further describe how this alternative would operate at each of the potential diversion facilities.

It was assumed for all alternatives that recycled water would be conveyed in the San Joaquin River and diverted at the rate of production (i.e., seasonal storage would not be required) into existing diversion facilities. The dilution ratio provided by the discharge of recycled water to the San Joaquin River ranges from 0.5 to 3 percent (recycled water to river water flows).

**Figure 7-8: River Diversion Facilities**




## 7.4.1 Banta Carbona Irrigation District (BCID) Diversion Facility

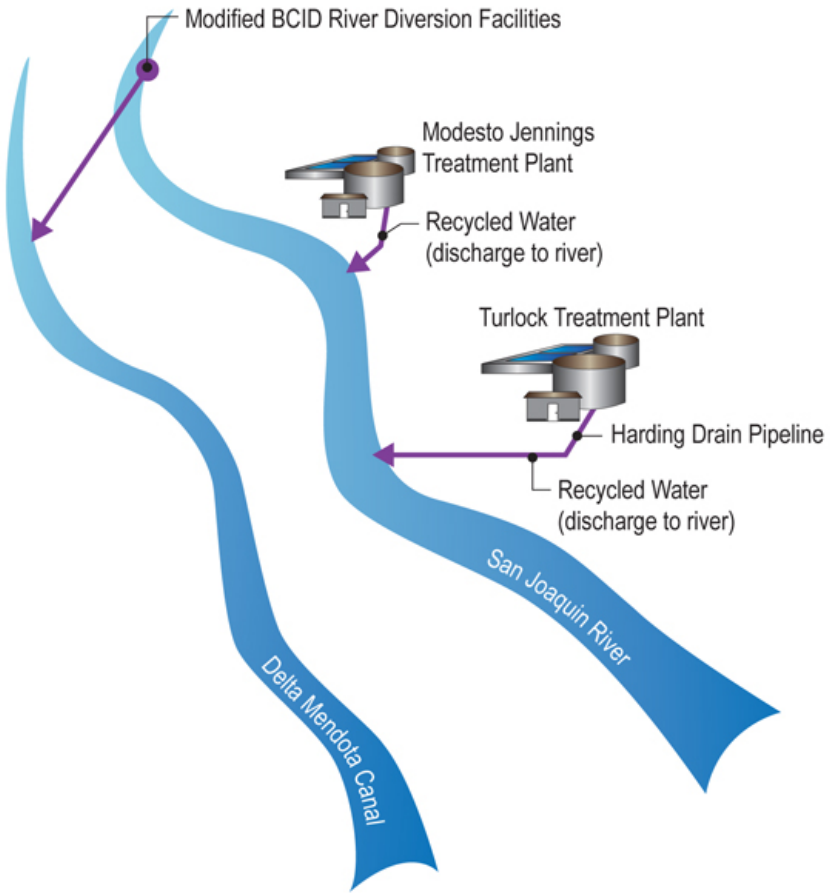
BCID's river diversion facility is located in Vernalis at Mile 63 of the San Joaquin River. The facility has the capacity to divert up to 250 cfs from the San Joaquin River. BCID is currently reviewing possible expansion of their river diversion facility to 400 cfs. River water that is currently diverted from the San Joaquin River is conveyed through a canal and a series of lift stations to BCID customers. The existing facilities are capable of delivering up to 60 cfs of river water to the DMC. The new facilities at BCID would include an additional 150 cfs of river diversion facilities, approximately 7.5 miles of new pipeline, and increased pumping capacity to deliver up to 150 cfs to the DMC or the California Aqueduct. BCID has estimated the capital cost of the new facilities is estimated to be $140 to $150 million.

BCID is currently looking for investors to buy capacity in the proposed new facilities. A preliminary method developed by BCID would involve investors purchasing ownership shares of the new facilities. One share would provide 1 AFY of diversion capacity, and would cost $1,000/share. Based on discussions with BCID, annual operating and maintenance costs would also be paid by the shareholders (estimated at $19/AF). All costs at this time are preliminary in nature and the institutional mechanism for BCID's concept is still under development, but a Joint Powers Authority established among shareholders is envisioned.

Based on the preliminary information provided by BCID, DPWD could purchase 33,000 shares in BCID's facility which would enable diversion of Turlock and Modesto 2025 recycled water flows from the San Joaquin River. The costs for this alternative are summarized in Table 7-17.

This alternative would require Modesto and Turlock to continue to discharge recycled water to the San Joaquin River and meet existing and future river discharge regulations. Advanced treatment prior to discharge could be required in the future. The cost for advanced treatment for river discharge (assuming evaporation ponds for RO concentrate disposal) was estimated to be $900/AF. Because the estimated recovery rate through the RO system is only 80 percent, this would reduce the amount of recycled water available to DPWD. The unit cost of the recycled water if advanced treatment is required is provided in Table 7-17.

**Figure 7-9: BCID River Diversion Scenario**

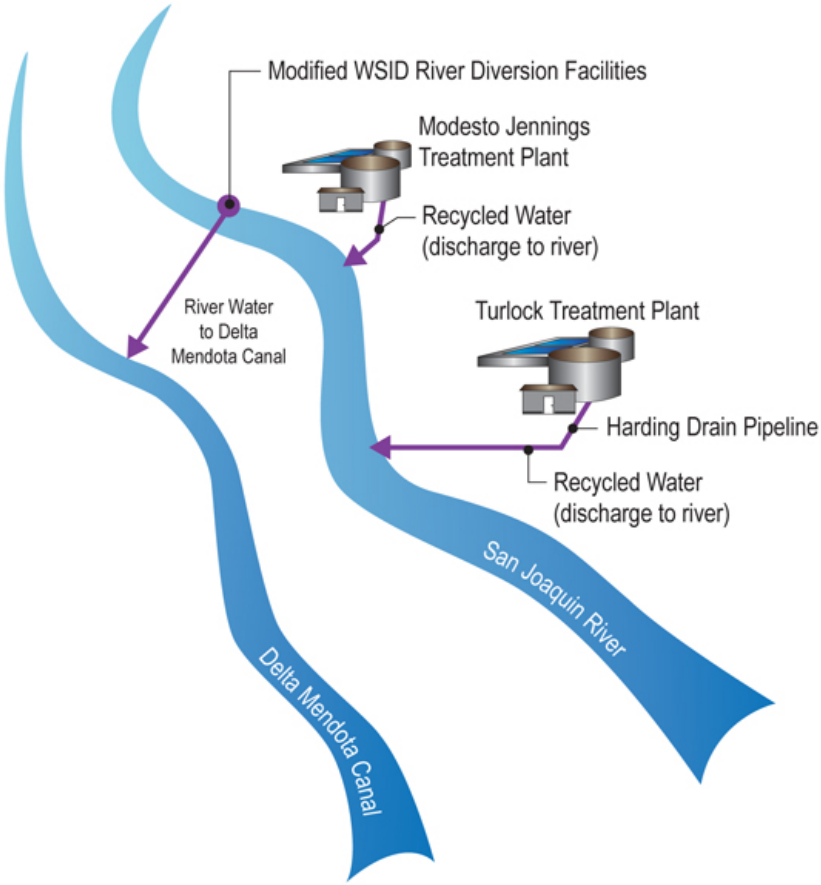



### 7.4.2 West Stanislaus Irrigation District (WSID) Diversion Facility

WSID diverts 262 cfs per their water right for irrigation from the San Joaquin River in accordance with their License Number 3957 (Permit 2758, Application 1987). The District is also obligated by a 1939 agreement to divert up to 45 cfs of riparian water for irrigation of the White Lake Water Company lands located north of the unincorporated community of Grayson at its diversion point on the San Joaquin River. WSID also provides river water to the USFWS to irrigate habitat maintained on the San Joaquin River National Wildlife Refuge. Including the USFWS diversions, WSID's existing river diversion capacity is approximately 350 cfs.

WSID's diversion from the San Joaquin River is by way of a two mile intake channel located just upstream of the confluence of the Tuolumne and San Joaquin Rivers and a pump station that lifts the water into WSID's Main Canal. The Main Canal consists of roughly 3 miles of concrete lined channel with six pump stations. In 2009, WSID installed a temporary pump station and 0.25 mile pipeline to convey up to 60 cfs of river water from the top of their Main Canal to the DMC. WSID is currently planning to design and construct a permanent pump station and pipeline capable of conveying up to 250 cfs of river water from the top of their Main Canal to the DMC. The estimated capital cost of the permanent conveyance facility is $5 million. WSID also intends to perform improvements to their river diversion facilities, which are estimated to have a capital cost of $7 million. At this time, WSID does not anticipate construction of fish screens in the near-term at their river intake facility; therefore, the capital costs associated with future fish screens are not considered in the alternative. WSID has indicated that the energy costs to pump river water to the DMC are approximately $44/AF. Maintenance and administrative costs are estimated to be an additional $23/AF.

**Figure 7-10: WSID River Diversion Scenario**




Initial discussions with WSID indicate that they could provide DPWD with 50 cfs of river diversion capacity for at least 10 months of the year. WSID may have the capacity to provide DPWD with river diversion capacity during the remaining two months of the year, however there is a level of uncertainty associated with this assumption due to limits in current installed capacity, water quality constraints, and institutional water rights agreements. Therefore, this alternative was developed assuming that DPWD could divert 50 cfs of recycled water at WSID's intake for 10 months of the year, which translates to approximately 30,500 AFY (or 42 cfs). An Exchange Agreement or Warren Act Contract would be needed with Reclamation to convey the water in the DMC and store the water in San Luis Reservoir.

Table 7-6 provides a summary of assumptions for this alternative and Table 7-18 provides the estimated capital and operating costs for this option. The cost estimate for this option was based on the assumption that DPWD would pay the capital costs of the diversion facility, pipeline and pump station improvements that are equivalent to the fraction of the facility capacity used by DPWD (e.g., 42 cfs of 350 cfs, or approximately 12 percent of the total capital costs). The current operating costs provided by WSID were used to develop the annual costs for this alternative. An additional $30/AF was included for the cost of a Warren Act Contract or Exchange Agreement with Reclamation. DPWD would be responsible to pay the O&M costs associated with diverting up to 50 cfs of water from the river and pumping it to the DMC.

As with the BCID alternative, continued discharge of Modesto and Turlock's recycled water to the San Joaquin River may require advanced treatment in the future. The cost for advanced treatment ($900/AF) was added to the capital and operating cost of recycled water for this project, and the total cost was divided by the expected amount of recycled water to be produced.

**Table 7-6: WSID River Diversion Design Criteria**

| Item | Design Criteria |
|---|---|
| Total WSID Diversion Facility Capacity (cfs) | 350 |
| Assumed River Diversion by DPWD (cfs)1 | 42 |
| WSID Conveyance Upgrades to DMC | |
| Pipeline length (ft) | 5,100 |
| Assumed diameter | 96-inch |
| WSID O&M Costs | |
| Operating cost to pump river water to the DMC | $44/AF |
| Maintenance and Administrative Costs | $23/AF |

Notes:

1. DPWD would have the ability to divert 50 cfs over 10 months of the year, which equates to an annual average of 42 cfs.

### 7.4.3 Patterson Irrigation District (PID) / WSID Dual River Diversion

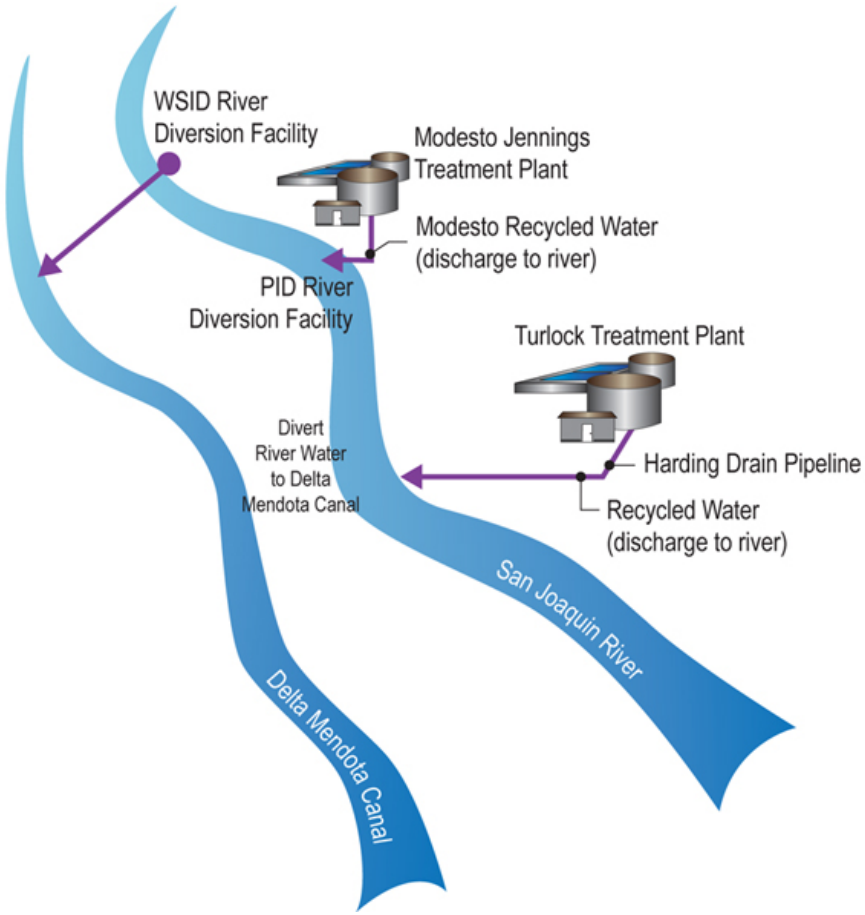
PID's river diversion facility is located on the San Joaquin River approximately 3.5 miles east of the City of Patterson at River Mile 98.5. PID's existing river diversion facility has a capacity of approximately 195 cfs. Diverted river water is conveyed in PID's main canal and through a series of lift stations to laterals that serve its customers. PID recently constructed a pump station and 2-mile pipeline to convey up to 35 cfs of river water to the DMC. PID is currently installing fish screens (195 cfs capacity) at their diversion facility for which funding has been received, and no further expansion of the diversion facility is planned. Within the next year, PID plans to design improvements to their canal system which may include construction of a pipeline to replace their main lift canal at an estimated capital cost of $23-$53 million. PID is also considering construction of sedimentation basins near their river diversion facility to settle out river sediment in the diverted water prior to its delivery. Based on conversations with PID, PID intends to make improvements to their diversion facilities that will enable delivery of up to 195 cfs of river water to the DMC, with a potential to expand to 300 cfs if the district is able to locate parties that are interested in utilizing a portion of the Main Canal capacity.

As shown in Figure 7-11, the PID river diversion facility is upstream of Modesto's permitted discharge point. Therefore, use of PID's diversion facility to move Modesto's recycled water would require Modesto to amend their NPDES permit and relocate their discharge point. Because relocation of Modesto's

discharge point would be time intensive and result in additional capital expenses, it was determined that this alternative would use multiple river diversion facilities as follows:

- Turlock would discharge recycled water to the San Joaquin River via the Harding Drain Pipeline, and recycled water would be diverted at PID's river diversion facility.
- Modesto would discharge recycled water to the San Joaquin River at their permitted location, and recycled water would be diverted at WSID's diversion facility.

**Figure 7-11: PID and WSID Dual River Diversion Scenario**




It is currently understood that recycled water could be diverted at WSID's river diversion facility 10 months of the year. Using the available seasonal storage at Modesto, recycled water could be stored for the 2 months of the year when diversion at WSID is not available. The stored recycled water could be discharged during the remaining 10 months of the year to enable DPWD to use all of Modesto's recycled water. Under this scenario, DPWD would utilize approximately 35 cfs of river diversion capacity at WSID for 10 months of year which translates into 21,200 AFY (or 29 cfs).

Turlock's recycled water would be diverted at PID's river diversion facility, which would require 16 cfs of capacity. PID has indicated that during peak irrigation demand months, there is uncertainty as to how much river diversion capacity could be made available to DPWD. Therefore, this alternative assumes that PID could provide 16 cfs of river diversion capacity to DPWD over 10 months of the year, which translates to approximately 9,700 AFY (or 13 cfs). The total recycled water that would be delivered to DPWD under this alternative would be approximately 31,000 AFY.

Table 7-7 provides a summary of design criteria for this alternative and Table 7-19 provides the estimated capital cost for DPWD to divert water at PID and WSID river diversion facilities.

**Table 7-7: PID and WSID Dual River Diversion Design Criteria**

| Item | Design Criteria |
|---|---|
| Total WSID River Diversion Capacity (cfs) | 350 |
| Total PID River Diversion Capacity (cfs) | 195 |
| Assumed River Diversions by DPWD | |
| WSID River Diversion [1] (cfs) | 29 |
| PID River Diversion [2](cfs) | 13 |
| WSID Conveyance Upgrades to DMC | |
| Pipeline length (ft) | 3,200 |
| Assumed diameter | 96-inch |
| PID Conveyance Upgrades to DMC | |
| Pipeline length (ft) | 29,000 |
| Assumed pipeline diameter | 84-inch |

Notes:
1. WSID would have the ability to divert 35 cfs over 10 months of the year for DPWD, which translates to an annual average value of 29 cfs and enables diversion of 21,200 AFY of recycled water from Modesto.
2. PID would have the ability to divert 16 cfs over 10 months of the year for DPWD, which translates to an annual average value of 13 cfs and enables diversion of 9,800 AFY per year of recycled water from Turlock.

For the purposes of developing preliminary budget numbers, the cost estimate for this option was based on the assumption that DPWD would pay the capital costs of diversion and conveyance facility upgrades at WSID and PID that are equivalent to the fraction of the facility capacity used. The operating costs provided by WSID ($44/AF for operating costs and $23/AF for labor and maintenance) and PID ($30/AF for operating and maintenance costs and an estimated $5/AF for labor costs) were used to estimate the annual costs for this alternative. O&M costs for this alternative would include the pumping, maintenance, and administrative costs for diverting recycled water from the San Joaquin River and conveying the water to the DMC at both facilities. An additional $30/AF was included for the costs associated with a Warren Act Contract or Exchange Agreement with Reclamation.

## 7.5 Alternative 4: Pipeline Conveyance of Recycled Water to Existing Facilities for Dilution and Conveyance in the DMC

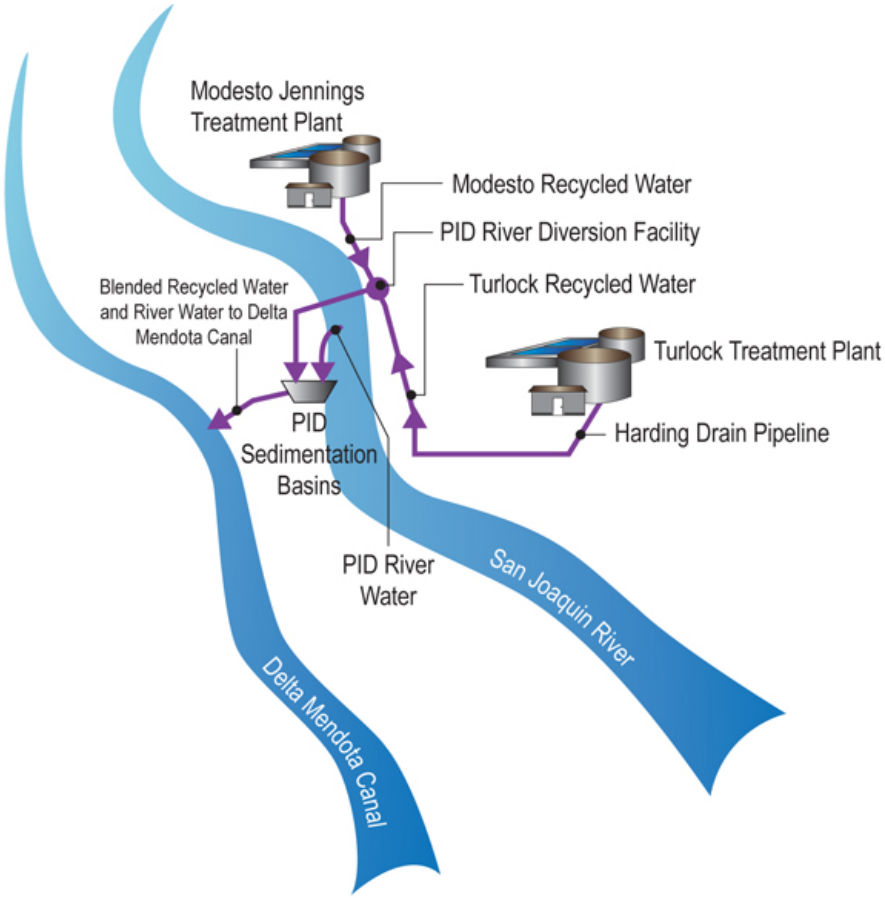
On August 30, 2013, PID issued a Proposal Solicitation to identify parties interested in participating in PID's East West Conveyance Project, which is designed to renovate, replace, modernize, and increase the capacity of PID facilities to more reliably meet the District's water demands, as well as increase the ability to wheel water supplies from the San Joaquin River or tributaries to the DMC.

The PID project is potentially considering several capacities beyond their current capacity of 195 cfs: 250, 350, and 500 cfs. These larger projects would require construction of a new fish screen and pumping facilities at the San Joaquin River.

Alternative 4 consists of directly conveying recycled water from the Modesto and Turlock tertiary treatment facilities via pipeline to the PID main lift canal or pipeline and participating in PID's East West Conveyance Project. Under this Alternative, the recycled water would be diluted with San Joaquin River water at either of these locations prior to being distributed to PID customers and/or to the DMC. The dilution ratio (river

water: recycled water) would range from 2:1 to 4:1, based on a PID river diversion rate 195 cfs, and a recycled water rate of 81 cfs. The recycled water would then be further diluted in the DMC. Figure 7-12 depicts dilution of the recycled water. Based on an average flow in the DMC of 4,000 cfs, the recycled water would represent less than 0.3% of flow in the DMC. Further dilution would occur in San Luis Reservoir, which has an approximate volume of 2 million AF.

**Figure 7-12: Diluted Recycled Water Scenario**




### 7.5.1 Alternative 4A: PID-1

PID-1 combines the Cities' project water east of the San Joaquin River along West Main Avenue. The alignment then crosses the San Joaquin River at Las Palmas Bridge and intersects with the PID Main Canal as shown in Figure 7-13. Table 7-8 shows the pump station information for the PID-1 alternative.

**Table 7-8: PID-1 Pump Stations**

| Pump Stations | Brake Horsepower | Motor Size, hp | No. Duty Pumps | No. Standby Pumps |
|---|---|---|---|---|
| Modesto | 56 | 100 | 1 | 1 |
| Turlock | 30 | 100 | 1 | 1 |
| Combined | 104 | 225 | 2 | 1 |

### Modesto Alignment:

The proposed alignment from Modesto begins at the Modesto Recycled Water Facility off of Jennings Road. Following Jennings Road south, the alignment intersects with West Main Avenue.

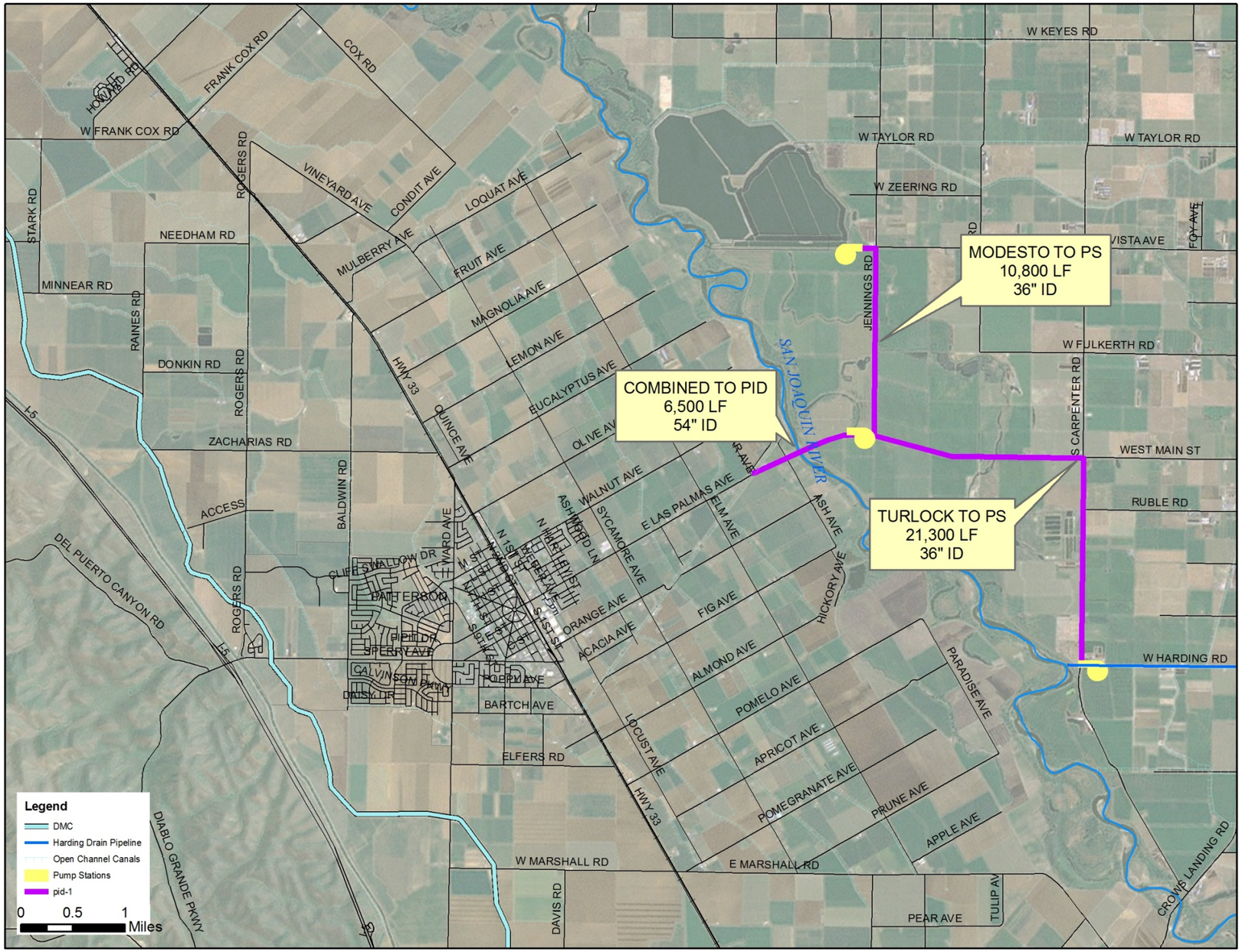
### Turlock Alignment:

The proposed alignment from Turlock begins at the Harding Drain Pipeline terminus along the San Joaquin River. The alignment will head north along S. Carpenter Road until reaching West Main Ave. At West Main Ave, the alignment then heads west along West Main Ave to the intersection of Jennings Rd. and West Main Ave.

### Combined Alignments:

At the intersection of Jennings Road and West Main Ave, the pipelines from Turlock and Modesto will be combined into one pipeline alignment and head west along West Main Ave. The alignment will continue west on West Main Avenue, crossing under the San Joaquin River near the Las Palmas Bridge. The road changes names from West Main Avenue to Las Palmas Avenue at the San Joaquin River. From the Las Palmas Bridge, the alignment continues west until reaching the intersection of the PID Main Canal and Las Palmas Avenue where it discharges into the PID Main Canal. This constitutes the terminus of the combined section of pipeline.

**Figure 7-13: PID-1 Pipeline Conveyance Alternative**



### 7.5.2 Alternative 4B: PID-2

PID-2 combines the Cities' recycled water west of the San Joaquin River at the PID Main Canal after both cities have crossed the San Joaquin River separately, as shown in Figure 7-14. Table 7-9 shows the pump station information for the PID-2 alternative.

**Table 7-9: PID-2 Pump Stations**

| Pump Stations | Brake Horsepower | Motor Size, hp | No. Duty Pumps | No. Standby Pumps |
|---|---|---|---|---|
| Modesto | 46 | 150 | 1 | 1 |
| Turlock | 95 | 225 | 2 | 1 |
| Combined | - | - | - | - |

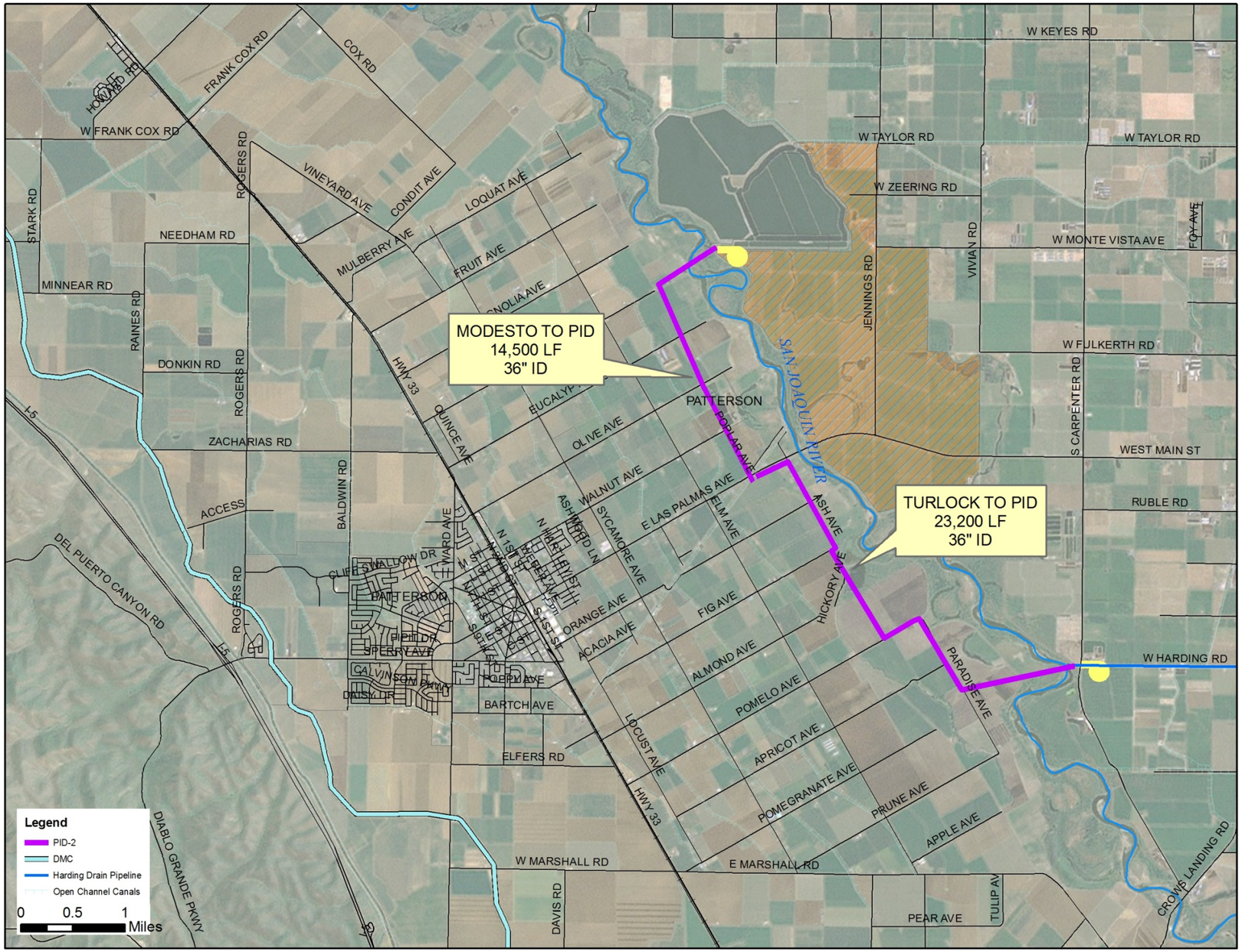
**Modesto Alignment:**

The proposed separate alignment from Modesto begins at the Modesto Recycled Water Facility at the discharge point along the San Joaquin River. The alignment immediately crosses under the San Joaquin River, heading west, until reaching Lemon Ave. From the end of Lemon Ave, the alignment would head southeast directly to the PID Main Canal, which constitutes the terminus of the Modesto Alignment.

**Turlock Alignment:**

The proposed separate alignment from Turlock begins at the Harding Drain outfall along the San Joaquin River. After tying into the Harding Drain (est. completion in 2014), the alignment immediately crosses under the San Joaquin River heading west towards Paradise Avenue. The alignment then heads northwest along Paradise Avenue until Paradise Avenue ends at Pomelo Avenue. The alignment would then head southwest along Pomelo Ave for approximately 1,500 ft. At this point, the alignment would head northwest directly to the PID Main Canal, which constitutes the terminus of the Turlock Alignment.

**Figure 7-14: PID-2 Pipeline Conveyance Alternative**



## 7.6 Alternative 5: Pipeline Conveyance of Recycled Water to the DMC Using Groundwater Storage and Operational Modifications

Alternative 5 consists of two components for delivering recycled water to DPWD, which are depicted in Figure 7-15. The first component requires determination of a schedule with Reclamation for delivery of recycled water to the DMC only when the O'Neil Pumping Plant is not operating to eliminate the potential delivery of recycled water into San Luis Reservoir. Currently, water from the DMC is pumped into O'Neil Forebay at times when downstream demands are lower than the amount of Delta water pumped at Jones Pumping Plant (see Figure 7-16). Conveyance of recycled water in the DMC when the O'Neil pumping plant is not operating would keep this water out of the Forebay and San Luis Reservoir which provides water to downstream potable water users. The second component requires storage of NVRRWP water in groundwater basins to provide seasonal storage during the periods when the O'Neil Pumping Plant is operational.

**Figure 7-15: Groundwater Storage and Operational Modifications Scenario**

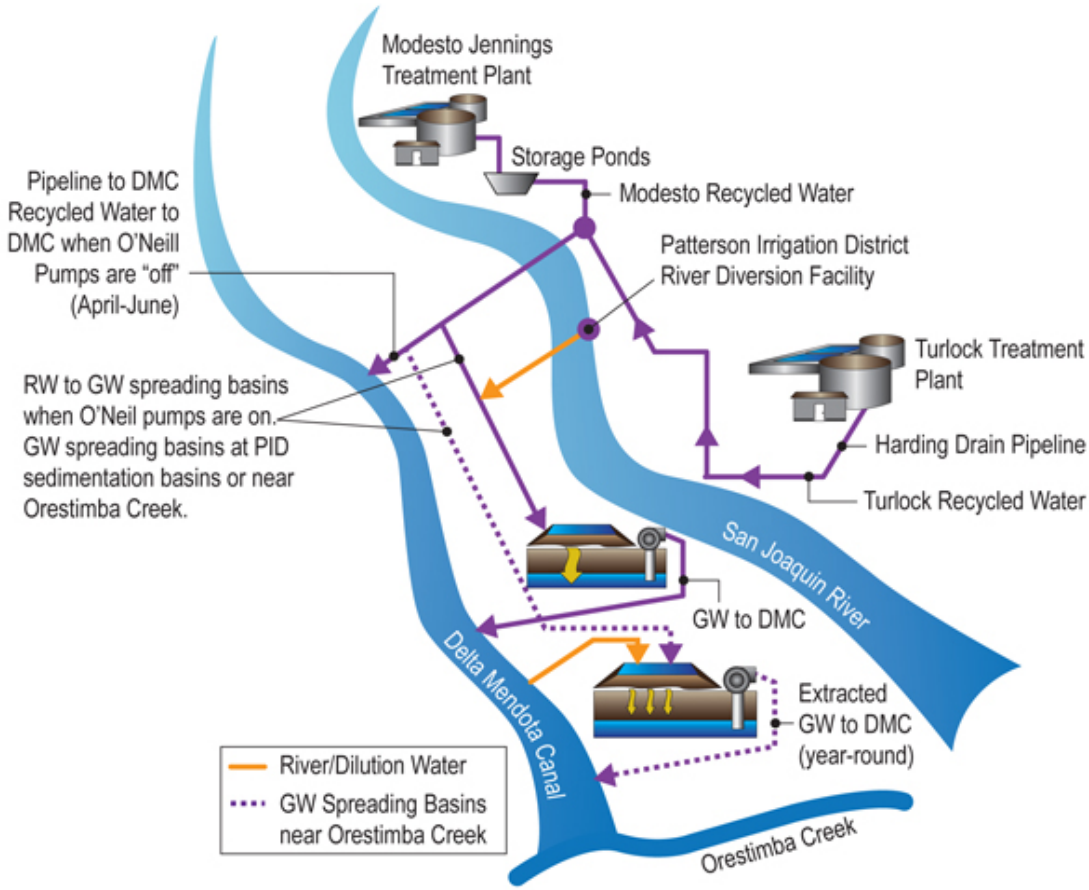
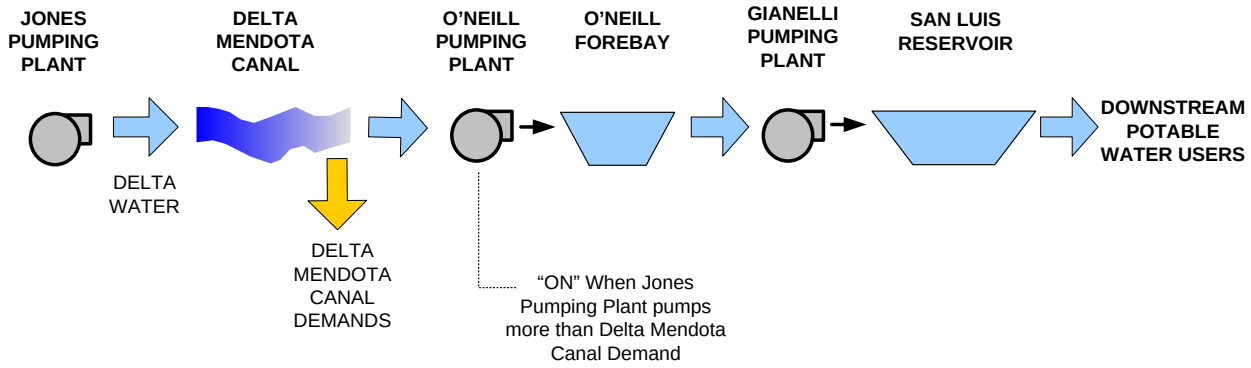


**Figure 7-16: Existing Delta-Mendota Canal Operation**




Based on the past 5 years of operating data from Reclamation, the O'Neil Pumps are typically off between April and June (approximately for 3 months) (Appendix N). It should be noted that the operation of the O'Neil Pumps varies from year to year and historically there has not been a set timeframe when the pumps are off; therefore, the key to this alternative is coordination with Reclamation and the SLDMWA to develop a standard schedule, taking into account operational changes that will occur when the intertie between the California Aqueduct and the DMC is operational. This alternative assumes that for three months per year, recycled water produced and stored in the Modesto ponds would be conveyed in the DMC for use by DPWD.

During the remainder of the year, recycled water would be diverted to spreading basins for soil aquifer treatment. Title 22 guidelines permit recycled water that is blended with an additional source of water (50-75% blend) to be percolated into a groundwater basin. After a six-month residence time the water can be extracted from the ground and reused for potable and/or other purposes. Advanced treatment is not required for this scenario. Based on the preliminary review of groundwater conditions underlying DPWD, it was assumed that up to 15,000 AFY of diluted recycled water could be percolated into the groundwater basin using spreading basins. If a 50% dilution ratio is assumed, 7,500 AFY of recycled water could be stored in groundwater basin, extracted six-months later and conveyed in the DMC to DPWD customers.

For evaluation of this alternative, two potential spreading basin locations were identified. The gravel pit area near Orestimba Creek is believed to have good conditions for percolation and spreading basins. Dilution water for this alternative would come from the DMC through an exchange agreement with PID or WSID for 7,500 AFY of river water (during the off-peak demand season when diversion capacity exists). The water would be conveyed in the DMC, and put into the spreading basins. When the water is extracted from the ground, it would then be transferred back to WSID or PID. The second potential location for spreading basins is near PID's sedimentation basins/river diversion facility. This location would enable river water to be used for dilution water in the spreading basins. The range of capital costs for this alternative are based on spreading basins located in the Orestimba Creek area and those that could be located at PID's sedimentation/river diversion facility.

Figure 7-17 provides a water balance schematic of this alternative. Because recycled water must be blended with dilution water in the spreading basins, the amount of recycled water that can be diverted to the spreading basins is limited. Under this alternative, approximately 20,200 AFY of recycled water would be delivered to DPWD, which is less than the volume of recycled water that Modesto will produce in 2025. Therefore, this alternative assumes that only recycled water from Modesto would be used. There is potential that future regulations could reduce the blending requirements for the groundwater spreading basins, which would increase the amount of recycled water that could be delivered to DPWD. Therefore, if the regulations change, Turlock could be connected to the project.

A summary of design criteria and facilities required for the alternative is provided as

Table 7-10. The range of costs for this alternative is provided in Table 7-21.

As previously stated in reference to Alternative 2, there are a number of unknowns associated with groundwater banking at this time, including the true storage capacity of the aquifer, the soil and hydrogeologic conditions of the area, the percolation rate, and the regulatory requirements (e.g., need for dilution water, advanced treatment) for storage of recycled water in the groundwater aquifer. Due to these unknowns, it is recommended that additional information be obtained to better understand the soil, groundwater and hydrogeologic conditions in the area should groundwater banking be pursued as an option.

**Figure 7-17: Alternative 5 Water Balance Schematic**

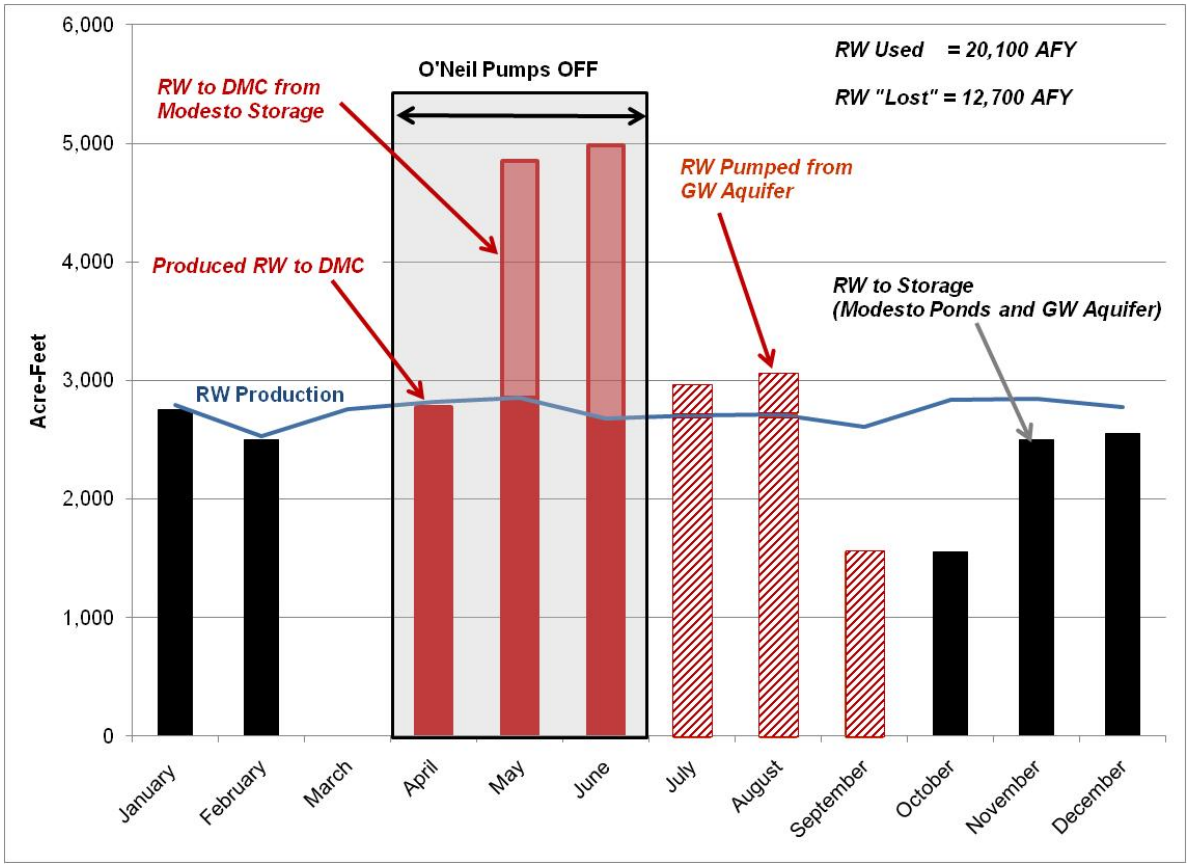


**Table 7-10: Alternative 5 Design Criteria**

| Criteria | GW Spreading Basins At PID | GW Spreading Basins at Orestimba Creek |
|---|---|---|
| Modesto Pipeline | | |
| Diameter | 48-inch | 48-inch |
| Distance | 51,200 feet | 51,200 feet |
| Pipeline to Orestimba Creek area | | |
| Diameter (inch) | | 48 |
| Distance (ft) | N/A | 16,700 |
| Distribution Pump Stations | | |
| Pump Station 1 (HP) | 3,500 | 3,500 |
| Pump Station 2 (HP) | NA | 500 |
| Capacity of Upper Aquifer (AFY) | 15,000 | 15,000 |
| Spreading Basins | | |
| Assumed Percolation Rate (ft/day) | 1 | 1 |
| Area Required for Spreading Basins | 103 | 103 |
| Dilution Percentage | 50% | 50% |
| Source of Dilution Water | River Water | DMC Water[1] |
| Timeline for RW Diversion to Basins | Oct - Feb | Oct - Feb |
| No. of Groundwater Extraction Wells | 10 | 10 |
| Pipeline from Groundwater Wells to DMC | | |
| Diameter (inch) | 42 | -- |
| Distance (ft) | 20,000 | --[2] |
| RW to the DMC | | |
| Assumed Timeline (months) | Apr – June | Apr – June |
| RW Delivered to DMC (AF) | 12,600 | 12,600 |
| Seasonal Storage Volume (AF) | 4,300 | 4,300 |

Notes:

1. Assumes an exchange agreement with WSID or PID could be reached for river water to be conveyed to Orestimba Creek area via the DMC.
2. This option assumes that the groundwater spreading area and associated groundwater extraction wells would be located in close proximity to the DMC to minimize pipeline costs. The cost associated with the construction of a pipeline from the extraction wells to the DMC is not considered to be significant and is not included at this time.

## 7.7 No Project / No Action Alternative

A No Project Alternative was evaluated in the Draft Environmental Impact Report / Environmental Impact Statement (EIR/EIS) to comply with CEQA and NEPA requirements. The No Project Alternative consists of no long-term, sustainable recycled water supply for DPWD or the south of the Delta Central Valley Project Improvement Act (CVPIA)-designated wildlife refuges. The U.S. Bureau of Reclamation (Reclamation) has a contractual obligation under the CVPIA and in cooperation with the U.S. Fish and Wildlife Service (USFWS) and the California Department of Fish and Wildlife (CDFW) to provide water deliveries to the refuges on the San Joaquin River to maintain and improve habitat areas on certain Federal and State wildlife refuges in the Central Valley (Level 2 deliveries). In addition to Level 2 deliveries, additional water supply is needed for optimal wildlife management (incremental Level 4 or IL4). IL4 deliveries are also a CVPIA mandate. Reclamation has entered into five long-term water supply contracts with Grassland Water District, USFWS, and CDFW for IL4 supplies. For the refuges south of the Delta, a total allocation of 105,514 AFY of IL4 supplies were identified. Reclamation is seeking additional supplies to meet the IL4 needs since this amount of delivery has not been achieved historically due to budget shortages, inconsistency in the timing of water deliveries, and other factors. A total allocation of approximately 271,000 AFY of Level 2 water and 105,000 AFY of Level 4 water supplies were identified for south of Delta refuges. From March 2012 to February 2013, Reclamation delivered a total of 312,990 AF of water, which exceeded Level 2 water requirements for all refuges except Pixley refuge. The resulting shortfall of IL4 deliveries affects the ability to provide optimum habitat management.

Under the No Project Alternative, DPWD would continue to rely on its CVP allocations and a gap in supply and demand would remain. DPWD would execute short-term water transfers/exchanges and/or pump groundwater from private wells when CVP supplies cannot meet demands. In 2014, the DPWD CVP allocation was 0% of its full entitlement, which required the fallowing of 11,500 acres of land, resulting in economic losses and loss of permanent crops, and placing greater pressure on the groundwater basin to meet water needs. Water transfers are costly, and according to the 2009 California Water Plan Update, Delta exports and surface water supplies in the future are expected to become scarcer due to the impacts of climate change and the need to maintain the Delta ecosystem, which will likely result in water transfers becoming more costly and less reliable. If DPWD continues to rely on groundwater pumping to meet water supply shortfalls, it could lead to groundwater overdraft of the basin and associated impacts, including subsidence and water quality degradation.

For the wildlife refuges, an alternative water supply source would need to be identified in order to provide optimal wildlife management and to allow Reclamation to meet its mandated water deliveries. If Reclamation does not meet its contractual obligations to deliver water to the wildlife refuges, the ecosystems and habitats suffer. For example, the IL4 water is used to supply water to a 300-acre managed wetland in the Pixley National Wildlife Refuge (NWR) which provides habitat for migratory waterfowl and shorebirds. The Kern NWR provides wintering habitat for migratory birds, including endangered species.

If recycled water is not provided to DPWD, the Cities of Modesto and Turlock would continue to discharge treated wastewater (recycled water) to the San Joaquin River. Consistent with the Central Valley Basin Plan (Basin Plan), current designated beneficial uses of the San Joaquin River downstream of the Turlock and Modesto discharges (from the mouth of the Merced River to Vernalis) include:

- Municipal and Domestic Supply (potential beneficial use; not existing in current Basin Plan)
- Agricultural – Irrigation and Stock Watering
- Industrial Process Supply
- Recreation – Water Contact, Canoeing/Rafting, and Other Non-Contact Water Recreation
- Freshwater Habitat- Warm Water Ecosystems
- Migration of Aquatic Organisms – Warm and Cold

- Spawning, Reproduction, and/or Early Development of Fish – Warm
- Wildlife Habitat

Since the mid-1990s, Reclamation has been operating the CVP to meet the Vernalis salinity objectives. The water quality objective is 1000 µmhos/cm 30-day running average of mean daily electrical conductivity (EC) from September 1 through April 29 and a 700 µmhos/cm 30-day running average of mean daily EC from April 30 through August 31. The Department of Water Resources and the United States Geological Survey, in partnership with Reclamation, have been participating in the San Joaquin River Real-Time Water Quality Program to perform ongoing work to facilitate the control and timing of wetland and agricultural drainage to coincide with periods when dilution flow is sufficient to meet the Vernalis salinity objectives. The water saved through this optimization can be used later to increase San Joaquin River basin streamflow during critical periods for anadromous fish restoration efforts.

If discharge to the river is continued, it is anticipated that both the Modesto and Turlock treatment plants would have to be upgraded in the future to meet increasingly stringent discharge regulations. Even though the City of Modesto is upgrading to BNR/tertiary treatment, future discharge regulations could increase treatment requirements. In particular, salinity in the effluent continues to be a long term concern. The Regional Water Quality Control Board Central Valley Region (CVRWQCB) has indicated that salinity limitations will be imposed in the future, which could require construction of reverse osmosis or other expensive desalination processes.

The City of Turlock would also likely need to upgrade treatment processes, possibly including new ultraviolet (UV) disinfection and nitrogen removal processes. Their existing facility provides ammonia removal to meet discharge permit requirements; however unlike the Modesto facility, the Turlock facility does not remove nitrates/nitrites from the effluent. Nitrate/nitrite removal could potentially be required in the future for Turlock, as it is for Modesto, which would require construction of new treatment processes similar to Modesto's. In addition, Turlock faces the same potential future restrictions on salinity for river discharge, which could require costly treatment processes such as reverse osmosis.

## 7.8 Evaluation of Alternatives

Alternatives 1 through 6 were evaluated to identify potential fatal flaws, identify key elements and features to be incorporated into the final alternative system design, and develop a preliminary construction cost estimate.

The following list summarizes the evaluation criteria:

- Technical feasibility
- Potential treatment upgrades
- Recycled water delivery
- Cost effectiveness
- Institutional issues and obstacles

For the alternatives evaluation, alternatives 2, 3 and 5 were evaluated during the first phase of this Feasibility Study, using 2015 and 2025 flow criteria and 2010 – 2012 dollars. As the Program transitioned to Phase 2, Alternatives 1 and 4 became the more viable alternatives and were thus looked into with greater scrutiny and evaluated using 2013 dollars.

### 7.8.1 Alternative 1 Evaluation

For the alternatives evaluation, alternatives 2, 3 and 5 were evaluated during the first phase of this Feasibility Study, using 2015 and 2025 flow criteria and 2010 – 2012 dollars. As the Program transitioned to Phase 2, Alternatives 1 and 4 became the more viable alternatives and were thus looked into with greater scrutiny and evaluated using 2013 dollars.

#### Cost

Table 7-11 provides the unit costs that are used in the evaluation of calculating Alternative 1 capital and operating costs.

**Table 7-11: Alternative 1 Unit Costs**

| Item | Unit | Cost | Description / Example |
|---|---|---|---|
| Pipeline – Open Cut Field | $ / in dia/ LF | $12 | Cross country and agricultural land alignments |
| Pipeline – Cut Road (non-residential) | $ / in dia/ LF | $14 | Rural roads and parallel to roads with adequately sized shoulders |
| Pipeline – Cut Road (residential) | $ / in dia/ LF | $18 | Heavy traffic roads, little to no shoulder<br>PID Main Canal access road (narrow corridor) |
| Bore and Jack | $ / LF | $1,800 | Crossing under lateral canals, major roads |
| River Crossing (HDD)[5] | $ / LF | $2,300 | San Joaquin River, Las Palmas Bridge |
| Pump Station – Capital | $ / HP | HP x (15,570 x HP^-.442)[6] | Complete pump station |
| Pump Station – Energy | $ / kW-hr | $0.07 | TID rate based on power usage between 500-2,999 kw demands |
| Easement Acquisition | $ / SF | $0.11 | Assumes 25% of land value |
| Direct Pipeline Tie-ins to DPWD services | $ / EA | $10,000 | Includes 40 LF of 10" piping, 10" tee, and 10" gate valve |

In general, the total length of pipe is proportional to cost and complexity of the project, and should be minimized within other constraints. The acquisition of easements is also a potentially significant cost for the project. Where possible, pipelines should be aligned within public rights of ways or on lands owned by participating agencies. Operational costs include the cost of energy to operate new pumping stations, an allowance for equipment repair and replacement, and the costs to wheel the recycled water through the Bureau's DMC facilities, which are assumed to be $30/AF for this report.

The cost of water for the alternatives varies significantly depending on the type of financing that will be available for construction. Four financing scenarios have been evaluated:

- 100% of capital financed with a new Reclamation Low Interest Loan program. Terms assumed to be 1% interest rate over 30 years.
- 25% of capital financed with a Reclamation Grant. Remainder financed with Bond financing. Terms assumed to be 5% interest rate over 30 years.
- 100% of capital financed with an SRF Loan. Terms assumed to be 2.5% interest rate over 20 years.
- 25% of capital financed with a Reclamation Grant. Remainder financed with an SRF Loan. Terms assumed to be 2.5% interest rate over 20 years.

In all cases shown, a 100% low interest Reclamation loan results in the lowest cost of water.

Table 7-12 provides the associated capital and O&M costs associated with Alternative 1.

[5] HDD: Horizontal Directional Drill
[6] James M. Montgomery Consulting Engineers, INC. Cost Estimating Manual

**Table 7-12: Alternative 1 Capital and O&M Costs**

| | DMC-1A (2018) Separate Pipelines to DMC (PID) | DMC-1B (2018) Separate Pipelines to DMC (Most Direct) | DMC-2 (2018) Combined Pipelines East | DMC-3 (2018) Combined Pipelines West | DMC-4 (2018) Combined @ Harding |
|---|---|---|---|---|---|
| **Summary of Costs** | | | | | |
| Capital Cost | $ 122,700,000 | $102,400,000 | $ 104,000,000 | $ 99,000,000 | $ 96,000,000 |
| Annual O&M Costs | $ 1,500,000 | $ 1,500,000 | $ 1,600,000 | $ 1,500,000 | $ 1,500,000 |
| Year | 2018 | 2018 | 2018 | 2018 | 2018 |
| Total Production, AFY | 30,600 | 30,600 | 30,600 | 30,600 | 30,600 |
| | | | | | |
| **Cost of Water[7] under Various Financing Scenarios ($/AF)** | | | | | |
| 100% Reclamation Low Interest Loan, 1% over 30 years | $ 200 | $ 180 | $ 180 | $ 180 | $ 180 |
| 25% Reclamation Grant 75% Bond financing, 5% over 30 years | $ 240 | $ 210 | $ 210 | $ 210 | $ 200 |
| SRF Loan, 2.5% over 20 year loan period | $ 310 | $ 260 | $ 270 | $ 260 | $ 230 |
| 25% Reclamation Grant 75% SRF Loan, 2.5% over 20 years | $ 240 | $ 210 | $ 210 | $ 210 | $ 200 |

[7] Unit cost of water calculated from NVRRWP facilities and O&M only and does not include costs associated with the treatment of water.

## Constructability

Constructability of the pipeline must take into consideration the proposed construction methods and existing site conditions to assess the relative risk and cost of the project. A January 28, 2013 field visit of the proposed alignment forms the basis for this assessment of constructability. The following constructability issues have been identified for the NVRRWP Recycled Water Pipeline:

- San Joaquin River crossing (Las Palmas Bridge / Directional Drill)

  All alignment alternatives require one or two crossings of the San Joaquin River, depending on whether Modesto and Turlock cross separately or as a combined pipeline. All river crossings are assumed to be accomplished by horizontal directional drilling (HDD). This construction method avoids direct impact to the waterway, but requires launching and receiving pits on either side of the waterway and outside of the river levees. There is a possibility that those alternatives that cross the river at the Las Palmas Bridge could be constructed in coordination with the planned bridge replacement at this location. The bridge would be designed to support the weight of the pipeline. However, this memo assumes that all river crossings would be done by HDD.

- Existing utility interferences (natural gas transmission lines, petroleum gas lines, fiber optic, etc.).

  Preliminary utility information was collected via an alignment field visit conducted on January 28, 2013. The proposed pipeline alignments run parallel and across a variety of underground and overhead utilities, including natural gas, fiber optic communication, cable, electricity, and water. Due to the rural location setting of the proposed project, most parcels are on septic systems, thus limiting the impacts of sewer mains on potential pipeline alignments, and no alignment conflicts with existing storm drain infrastructure.

  PG&E high-pressure natural gas transmission pipes are installed along Prune Avenue and Marshall Road. These pipes run parallel and occasionally cross underneath those roads. Due to the associated constructability issues associated with these high-pressure pipes, this corridor evaluation avoids alignments along Prune or Marshall.

  Recycled water pipelines must meet the State of California separation requirements. Preliminary and final design activities will confirm that separation meets the requirements. Title 22 separation standards for water, sewer, and recycled water pipelines call for 10 feet of horizontal clearance of recycled water lines to any parallel water or sewer pipeline. Vertical clearance requirements are one foot below any water line and one foot above any sewer line. Special construction details apply inside 10 feet and 4 feet from a parallel water line, and between one foot and 4 inches vertically for crossings. Special permission from the state and local health agencies may be required. Signs of underground utilities, as well as other constructability issues, were noted along the length of the proposed alignments.

  Most utilities in the project area can be avoided by selecting pipe corridors that slot between these utilities, or constructing the pipeline in the shoulder of the roadway; precise pipeline locations will be determined during final design. The alignments shown avoid known major utility conflicts.

- Irrigation canal crossings

  There are numerous irrigation canals throughout the project area; it will be necessary to cross these canals on most alignments. Crossing methods may vary. If a canal is in use when the crossing takes place, it may be necessary to tunnel beneath the crossing or to bypass pump canal water over the crossing area to allow open cut construction. If the canal is not in use, open cut construction followed by canal reconstruction may be possible without bypass. Cost estimates for this evaluation assume open-cut construction/restoration.

- State Highway 33 crossing

All alignment alternatives with the DMC as the final destination require one or two crossings of Highway 33, depending on whether Modesto and Turlock cross separately or combined at this location. Similar to the San Joaquin River crossing, the highway crossing is anticipated to be accomplished by HDD.

- California Northern Railroad Company (CFNR) crossing

  Primarily a transporter of food and agricultural commodities, the CFNR parallels the east side of Highway 33 through much of the San Joaquin Valley, and spans the extent of the NVRRWP project bounds. Similar to the State Highway 33 crossing, the CNFR crossing is anticipated to be accomplished by HDD. The center line of Highway 33 is approximately 75 ft apart from the center line of the CFNR. Due to the proximity of the highway to the CNFR, it is assumed that a single HDD will be sized to span both crossings.

- Narrow construction corridor along Patterson Irrigation District Canal and various roads.

  While much of the PID canal is served by a wide, gravel access road suitable for open cut construction, the available area varies along the length of the canal. It is assumed that an open cut corridor can be located within the available space; however this must be confirmed during final design. Embankments on either side of the canal will require shoring and settlement monitoring to protect the integrity of the canal where the alignment cannot be sited a sufficient distance from the canal. Geotechnical investigations conducted prior to final design will aid in selecting appropriate clearances and shoring requirements.

  PID is also in progress to either upgrade their facilities which may include increased capacity. This could potentially further the complexity of including the NVRRWP pipeline through the PID right-of-way.

- Environmental and Permitting impacts/requirements

  No environmental review has been completed as part of this evaluation. However, it is generally expected that the most significant environmental concerns will center on impacts to the San Joaquin River and other waterways or wetlands. Crossing of the river is addressed through trenchless technologies. Proposed alignments avoid other waterways (creeks, etc.) and lie within county roads or cultivated farmland. A full environmental review will be required to identify wetlands or sensitive habitats/species.

  Additional permitting will be required for the crossing of Highway 33 and the CFNR, work encroaching into local roadways (City of Patterson/Stanislaus County), and work impacting facilities of operated by any local jurisdiction, including the PID irrigation canals.

- Traffic Impacts

  Most of the roads in the project area are rural in nature, which will permit lane closures or road closures with minimal impact (though these must still be coordinated with local businesses and agricultural operations). However, West Main Avenue / Las Palmas Avenue is a high traffic area, and construction on this two-lane road will require significant traffic control, including potential detours and/or temporary signals depending on the final pipeline location along the road. If possible, aligning the pipeline in the shoulder right of way area would be recommended, though this may not be possible when the roadway is raised on an embankment.

## Schedule

A preliminary project schedule shows completion of construction in early 2018, if construction begins by 2015. This completion date coincides with completion of the expansion of the Modesto tertiary facilities. However, there may be opportunities to accelerate this schedule to convey the flows from Turlock since

the tertiary treatment facilities there are already in operation and the City is currently discharging tertiary treated flows to the San Joaquin River.

### Alternatives

A site visit to the project area was performed on January 28, 2013 to evaluate a number of potential corridors within Stanislaus County and make note of constraints and utilities that may constrain pipeline alignments.

Using the information gained from the field visit, a total of eight alternative alignments/corridor options were developed. The proposed project will convey tertiary treated, recycled water from both the City of Turlock and City of Modesto recycled water production facilities to the DMC.

## 7.8.2 Alternative 2 Evaluation

Alternative 2 consists of four alternatives that convey NVRRWP water to DPWD directly via a pipeline. Table 7-13, Table 7-14, Table 7-15, and Table 7-16 provide the capital and operating costs associated with Alternative 2.

**Table 7-13: Pipeline Scenario 2A Cost Estimate[1]**

| Item | 2015 Recycled Water Delivery | 2025 Recycled Water Delivery |
|---|---|---|
| Capital Cost [3] | $168,400,000 | $175,400,000 |
| Annual O&M[2,3] | $2,100,000 | $2,600,000 |
| | | |
| Grants (25%) | $38,900,000 | $40,600,000 |
| | | |
| Annualized Capital and O&M (without grants)[4] | $13,100,000 | $14,000,000 |
| Annualized Capital and O&M (with grants) [4] | $10,300,000 | $11,200,000 |
| Recycled Water Produced | 19,800 | 23,700 |
| | | |
| Unit Cost (without grants)[5] | $660/AF | $590/AF |
| Unit Cost (with grants) [5] | $520/AF | $470/AF |
| | | |
| Cost of Advanced Treatment with grants[6] | N/A | N/A |
| Total Unit Cost with advanced treatment (with grants) | N/A | N/A |

Notes:
1. Detailed cost estimates are provided in Appendix M.
2. O&M costs include power costs ($0.12/kWh), labor, maintenance, and equipment replacement.
3. Costs were escalated to June 2012 (24 months) at an escalation rate of 4%.
4. Capital costs were annualized over 30 years at an interest rate of 5%.
5. Cost of recycled water includes annualized capital costs, and annualized O&M costs, divided by the recycled water produced per year.
6. Advanced treatment would not be necessary with this alternative.

**Table 7-14: Pipeline Scenario 2B Cost Estimate**

| Item | 2015 Recycled Water Delivery | 2025 Recycled Water Delivery |
|---|---|---|
| Capital Cost [3] | $274,100,000 | $349,100,000 |
| Annual O&M[2,3] | $1,800,000 | $3,600,000 |
| | | |
| Grants (25%) | $63,400,000 | $80,700,000 |
| | | |
| Annualized Capital and O&M (without grants)[4] | $20,600,000 | $26,300,000 |
| Annualized Capital and O&M (with grants) [4] | $16,200,000 | $20,600,000 |
| Recycled Water Produced | 25,700 | 32,900 |
| | | |
| Unit Cost (without grants)[5] | $800/AF | $800/AF |
| Unit Cost (with grants) [5] | $630/AF | $630/AF |
| | | |
| Cost of Advanced Treatment (with grants)[6] | N/A | N/A |
| Total Unit Cost with Advanced Treatment (with grants) | N/A | N/A |

Notes:

1. Detailed cost estimates are provided in Appendix M.
2. O&M costs include power costs ($0.12/kWh), labor, maintenance, and equipment replacement.
3. Costs were escalated to June 2012 (24 months) at an escalation rate of 4%.
4. Capital costs were annualized over 30 years at an interest rate of 5%.
5. Cost of recycled water includes annualized capital costs, and annualized O&M costs, divided by the recycled water produced per year.
6. Advanced treatment would not be necessary with this alternative.

**Table 7-15: Pipeline Scenario 2C Cost Estimate**

| Item | 2015 Recycled Water Delivery | 2025 Recycled Water Delivery |
|---|---|---|
| Capital Cost [3] | $125,000,000 | $131,000,000 |
| Annual O&M[2,3] | $1,700,000 | $2,100,000 |
| | | |
| Grants (25%) | 28,900,000 | $30,300,000 |
| | | |
| Annualized Capital and O&M (without grants)[4] | $9,800,000 | $10,600,000 |
| Annualized Capital and O&M (with grants) [4] | $7,800,000 | $8,500,000 |
| Recycled Water Produced | 17,400 | 20,400 |
| | | |
| Unit Cost (without grants)[5] | $560/AF | $520/AF |
| Unit Cost (with grants) [5] | $450/AF | $420/AF |
| | | |
| Cost of Advanced Treatment (with grants)[6] | N/A | N/A |
| Total Unit Cost with Advanced Treatment (with grants) | N/A | N/A |

Notes:
1. Detailed cost estimates are provided in Appendix M.
2. O&M costs include power costs ($0.12/kWh), labor, maintenance, and equipment replacement.
3. Costs were escalated to June 2012 (24 months) at an escalation rate of 4%.
4. Capital costs were annualized over 30 years at an interest rate of 5%.
5. Cost of recycled water includes annualized capital costs, and annualized O&M costs, divided by the recycled water produced per year.
6. Advanced treatment would not be necessary with this alternative.

**Table 7-16: Pipeline Scenario 2D Cost Estimate**

| Item | 2015 Recycled Water Delivery |
|---|---|
| Capital Cost [3] | $143,400,000 |
| Annual O&M[2,3] | $1,400,000 |
| | |
| Grants (25%) | 33,200,000 |
| | |
| Annualized Capital and O&M (without grants)[4] | $10,700,000 |
| Annualized Capital and O&M (with grants) [4] | $8,400,000 |
| Recycled Water Produced | 12,200 |
| | |
| Unit Cost (without grants)[5] | $880/AF |
| Unit Cost (with grants) [5] | $690/AF |
| | |
| Unit Cost of Advanced Treatment (with grants)[6] | N/A |
| Total Unit Costs with Advanced Treatment (with grants) | N/A |

Notes:
1. Detailed cost estimates are provided in Appendix M.
2. O&M costs include power costs ($0.12/kWh), labor, maintenance, and equipment replacement.

3. Costs were escalated to June 2012 (24 months) at an escalation rate of 4%.
4. Capital costs were annualized over 30 years at an interest rate of 5%.
5. Cost of recycled water includes annualized capital costs, and annualized O&M costs, divided by the recycled water produced per year.
6. Advanced treatment would not be necessary with this alternative

In general, the total length of pipe is proportional to cost and complexity of the project, and should be minimized within other constraints. The acquisition of easements is also a potentially significant cost for the project. Due to solely consisting of pipeline, Alternative 2 was deemed too complex and cost prohibitive in order to move forward.

### 7.8.3 Alternative 3 Evaluation

Alternative 3 consists of three alternatives that utilize existing operations and facilities in order to convey NVRRWP water to the DMC. Table 7-17, Table 7-18, and Table 7-19 break down the costs associated with Alternative 3.

**Table 7-17: Alternative 3A - BCID River Diversion Cost Estimate**

| Item | Cost |
|---|---|
| Capital Cost [3]<br>(Purchase 33,000 shares of Expanded BCID Facility) | $ 37,100,000 |
| Total Annual O&M[2,3] | $ 1,700,000 |
| | |
| Grants (25%) | $ 8,575,000 |
| | |
| Annualized Capital Costs (without grants)[5] | $ 4,100,000 |
| Annualized Capital Costs (with grants)[5] | $ 3,500,000 |
| Recycled Water Produced (AFY) | 32,900 |
| | |
| Unit Cost (without grants)[6] | $120/AF |
| Unit Cost (with grants)[6] | $110/AF |
| | |
| Unit Cost of Advanced Treatment with Grants | $900/AF |
| Recycled Water Produced with Advanced Treatment (AFY)[6] | 31,600 |
| Unit Cost with Advanced Treatment (with grants) | $1010/AF |

Notes:
1. Detailed cost estimates are provided in Appendix M.
2. O&M costs include $19/AF for operating costs (provided by BCID), a $10/AF allowance for labor and maintenance, and a $20/AF allowance for agreements with the Bureau of Reclamation.
3. Costs were escalated to June 2012 (24 months) at an escalation rate of 4%.
4. Capital costs were annualized over 30 years at an interest rate of 5%.
5. Cost of recycled water includes annualized capital costs, and annualized O&M costs, divided by the recycled water produced per year.
6. Advanced treatment for river discharge assumes 50% of recycled water is treated with RO. Reduction in recycled water production is due to assumed 80% recovery rate of water through RO. It was assumed that Modesto would increase recycled water treatment facilities to deliver 21,200 AFY, and Turlock would deliver 10,400 AFY of recycled water to DPWD.

**Table 7-18: Alternative 3B – WSID River Diversion Cost Estimate**

| Item | Cost |
|---|---|
| Capital Cost [3] | $ 1,800,000 |
| Annual O&M Costs[2,3] | $ 3,100,000 |
| | |
| Grants (25%) | $ 425,000 |
| | |
| Annualized Capital and O&M (without grants)[4] | $3,220,000 |
| Annualized Capital and O&M (with grants)[4] | $ 3,200,000 |
| Recycled Water Produced (AFY)[5] | 30,500 |
| | |
| Unit Cost (without grants)[6] | **$110/AF** |
| Unit Cost (with grants)[6] | **$100/AF** |
| | |
| Cost of Advanced Treatment with Grants | $900/AF |
| Recycled Water Produced with Advanced Treatment (AFY)[7] | 29,600 |
| Total Unit Cost with Advanced Treatment (with grants) | **$1,000/AF** |

Notes:

1. Detailed cost estimates are provided in Appendix M.
2. O&M costs include $44/AF for operating costs (provided by WSID), a $23/AF allowance for labor and maintenance (provided by WSID), and a $20/AF allowance for agreements with the Bureau of Reclamation.
3. Costs were escalated to June 2012 (24 months) at an escalation rate of 4%.
4. Capital costs were annualized over 30 years at an interest rate of 5%.
5. It was assumed that Modesto would use seasonal storage to discharge 21,200 AFY over 10 months. Turlock would deliver 9,300 AFY over 10 months.
6. Cost of recycled water includes annualized capital costs, and annualized O&M costs, divided by the recycled water produced per year.
7. Advanced treatment for river discharge assumes 50% of recycled water is treated with RO. The cost of advanced treatment was added to the capital and operating costs of the alternative and divided by the reduced estimate of recycled water production. Recycled water produced with advanced treatment was assumed to be 29,500 AFY due to loss of recycled water through RO (80% recovery assumed). It is assumed that Modesto would increase recycled water treatment facilities to produce 21,200 AFY per year of advanced treated recycled water and Turlock would deliver approximately 8,400 AF of advanced treated recycled water.

**Table 7-19: Alternative 3C - PID and WSID Dual River Diversion Cost Estimate**

| Item | Cost |
|---|---|
| Capital Costs[3] | $ 7,800,000 |
| Annual O&M Costs [2,3] | $2,400,000 |
| | |
| Grants (25%) | $ 1,950,000 |
| | |
| Annualized Capital and O&M (without grants)[4] | $3,150,000 |
| Annualized Capital and O&M (with grants)[4] | $ 3,000,000 |
| Recycled Water Produced (AFY) | 31,000 |
| | |
| Unit Cost (without grants)[5] | $100/AF |
| Unit Cost (with grants)[5] | $100/AF |
| | |
| Unit Cost of Advanced Treatment (with grants) | $900/AF |
| Recycled Water Produced with Advanced Treatment (AFY)[6,7] | 29,500 |
| Total Unit Cost with Advanced Treatment (with grants)[7] | $1,000/AF |

Notes:

1. Detailed cost estimates are provided in Appendix M.
2. O&M costs for diversion of water at WSID were assumed to be $44/AF for operating costs and $23/AF for labor and maintenance costs (provided by WSID). O&M costs for diversion at PID's facilities were assumed to be $30/AF for operating and maintenance costs (provided by PID), and an assumed $5/AF for labor costs. An additional $20/AF was included for agreements with the Bureau of Reclamation.
3. Costs were escalated to June 2012 (24 months) at an escalation rate of 4%.
4. Capital costs were annualized over 30 years at an interest rate of 5%.
5. Cost of recycled water includes annualized capital costs, and annualized O&M costs, divided by the recycled water produced per year.
6. Advanced treatment for river discharge assumes 50% of recycled water is treated with RO. The cost of advanced treatment was added to the capital and operating costs of the alternative and divided by the reduced estimate of recycled water production.

Reduction in recycled water production is due to assumed 80% recovery rate of water through RO. It was assumed that Modesto would increase recycled water treatment facilities to produce 21,200 AFY per year of advanced treated recycled water. Turlock would be unable to do this and would produce approximately 8,000 AFY of recycled water.

Due to the likely requirement of increasing water treatment for both Cities and associated capital improvements necessary, Alternative 3 is considered infeasible.

### 7.8.4 Alternative 4 Evaluation

Alternative 4 consists of two alternatives that convey NVRRWP water to the existing PID Main Canal in order to utilize their facilities for DMC conveyance. Table 7-20 provides the capital and operating costs associated with Alternative 4.

**Table 7-20: Alternative 4 Cost Estimate**

| | PID-1 (2018) PID East | PID-2 (2018) PID West |
|---|---|---|
| **Summary of Costs** | | |
| Capital Cost | $ 41,600,000 | $ 64,000,000 |
| Annual O&M Costs | $ 3,400,000 | $ 3,300,000 |
| Year | 2018 | 2018 |
| Total Production, AFY | 30,600 | 30,600 |
| | | |
| **Cost of Water under Various Financing Scenarios** | | |
| 100% Reclamation Low Interest Loan, 1% over 30 years | $ 180 | $ 170 |
| 25% Reclamation Grant<br>75% Bond financing, 5% over 30 years | $ 200 | $ 200 |
| SRF Loan, 2.5% over 20 year loan period | $ 230 | $ 250 |
| 25% Reclamation Grant<br>75% SRF Loan, 2.5% over 20 years | $ 200 | $ 200 |

[1]The costs associated with Alternative 4 do not include shared capital costs with PID improvements.

Alternative 4 would reduce the amount of required pipeline length required, thus reducing total capital costs for the Program. However, a number of potential fatal flaws have been identified.

- PID routinely ceases pumping and operation of their Main Canal for approximately 4-6 weeks each year for routine sedimentation basin clearing and maintenance. With the limited storage at Modesto comprising as the only storage within the NVRRWP, the operational constraints of PID would hinder the ability for the Cities to discharge their effluent.
- Recent discussions with the RWQCB have indicated that mixing rations of PID Main Canal Water with NVRRWP water would require PID to comply with Title 22 Recycled Water regulations. Subsequent discussions with PID have indicated that the land owners and growers of the district may not be in favor of such indications and regulations.

Due to the potential fatal flaws, Alternative 4 is considered infeasible.

### 7.8.5 Alternative 5 Evaluation

Alternative 5 consists of groundwater banking and storage of NVRRWP program water. Table 7-21 provides the capital and operating costs associated with Alternative 5.

**Table 7-21: Alternative 5 Cost Estimate**

| Item | Cost with Spreading Basins at PID | Cost with Spreading Basins at Orestimba Creek |
|---|---|---|
| Capital Cost[3] | $ 128,400,000 | $ 129,900,000 |
| Annual O&M[2] | $ 2,700,000 | $ 3,600,000 |
| | | |
| Grants (25%) | $29,700,000 | $ 30,000,000 |
| | | |
| Annualized Capital + O&M (without grants)[4] | $11,100,000 | $12,100,000 |
| Annualized Capital + O&M Costs (with grants)[4] | $9,000,000 | 9,900,000 |
| Recycled Water Production, AFY | 20,200 | 20,200 |
| | | |
| Unit Cost (without grants) [5] | $550/AF | $600/AF |
| Unit Cost (with grants) [5] | $450/AF | $490/AF |
| | | |
| Cost of Advanced Treatment (with grants) | N/A | N/A |
| Total Unit Cost (with grants) | N/A | N/A |

Notes:
1. Detailed cost estimates are provided as Appendix M.
2. O&M costs include power costs ($0.12/kWh), labor, maintenance, equipment replacement, and agreements with the Bureau of Reclamation ($20/AF).
3. Costs were escalated to June 2012 (24 months) at an escalation rate of 4%.
4. Capital costs were annualized over 30 years at an interest rate of 5%.
5. Cost of recycled water includes annualized capital costs, and annualized O&M costs, divided by the recycled water produced per year.

Alternative 5 utilizes the local groundwater resources as well as positively impacts the groundwater levels in the surrounding area. However, potential fatal flaws have been identified with Alternative 5.

- Groundwater location: DPWD supplements their CVP allocations with groundwater from the northern area of the district. The feasibility of conveying program water to the spreading basins in the north as well as constructing the spreading basins would be cost prohibitive.
- Groundwater quality has been decreasing in recent years, and once mixed with NVRRWP project water, it is likely that the program will not meet the DMC Pump-in Program requirements.

Due to the potential fatal flaws of Alternative 5, this alternative is considered infeasible.

### 7.8.6 Alternative 6 Evaluation

Alternative 6 consists of a no project / no action alternative The District would continue to rely on CVP allocations and water transfers / exchanges and to pump groundwater from private wells. Under this alternative, the Cities would continue their discharge practices as they stand today, and the recycled water produced would not be used for beneficial use. Table 7-22 provides the capital and operating costs associated with the No Project / Action Alternative.

**Table 7-22: No Project / Action Alternative Cost Estimate**

| Item | Cost |
|---|---|
| **Modesto** | |
| Recycled Water Treatment Size (AFY) | 21,200 |
| Capital Cost[2] ($M) (No Grants) | $165.6 – $516.5 |
| Operating Cost ($M) | $8.9 -$9.0 |
| Annualized Capital and Operating Cost – No Grants[3] ($M) | $19.8 - $42.4 |
| Unit Cost – No Grants($/AF) | $934.4 – $2,005.2 |
| Unit Cost – With Grants($/AF) | $808.4 - $1,606.3 |
| **Turlock** | |
| Recycled Water Treatment Size (AFY) | 9,000 |
| Capital Cost[4] ($M) (No Grants) | $93.9 – $231.5 |
| Operating Cost ($M) | $5.2 - $5.4 |
| Annualized Capital and Operating Cost[3] ($M) | $11.4 - $20.4 |
| Unit Cost – No Grants ($/AF) | $1,270.3 - $2,267.7 |
| Unit Cost – With Grants ($/AF) | $1,112.8 - $1,858.2 |

Notes:

1. Appendix D provides a detailed cost estimate for advanced treatment costs of recycled water produced the Modesto and Turlock tertiary treatment plants.
2. Capital cost includes RO membranes for 24 mgd, and advanced oxidation for 19 mgd. An RO recovery rate of 80 percent was assumed. The range in capital costs is based on two methods for brine disposal (evaporation ponds or deep well injection). The capital costs are escalated to 2014 using a 4% escalation rate.
3. Capital costs were annualized based on a 5% over 30 years. No grants were assumed.
4. Capital cost includes MF for 10 mgd, RO membranes for 10 mgd, and advanced oxidation for 8 mgd. An RO recovery rate of 80 percent was assumed. The range in capital costs is based on two methods for brine disposal (evaporation ponds or deep well injection). The capital costs are escalated to 2014 using an escalation rate of 4%.
5. Unit costs for RO treatment are based on the capital costs provided in Modesto's Wastewater Treatment Facility Master Plan Supplement (Carollo, 2008), escalated to 2013 dollars

Alternative 6 does not meet any of the NVRRWP project goals and is not considered a recommended alternative.

**Table 7-23: Alternatives Analysis**

| Criteria | Alternative 1: Conveyance in the DMC | Alternative 2B: Pipeline Conveyance to DPWD[1] | Alternative 3: River Conveyance and Diversion | Alternative 4: Dilution and Conveyance via the PID to the DMC | Alternative 5: DMC Operational Changes with Groundwater Aquifer Treatment | Alternative 6: No Project / No Action |
|---|---|---|---|---|---|---|
| **Alternative Summary** | Convey 2018, 2045 recycled water flows in a pipeline to the DMC | Convey 2018 recycled water flows in a pipeline to the southern and central area of DPWD, with additional storage | Divert recycled water from the San Joaquin River at a modified diversion facility at WSID, PID or BCID | Divert recycled water to PID's sedimentation basins or main canal for dilution with river water; convey diluted recycled water to the DMC | Divert recycled water into the DMC when the O'Neil Pumps are Off; infiltrate diluted recycled water to groundwater and extract 6 months later for conveyance in the DMC. | District to continue relying on CVP allocations and spot-market transfers |
| **Recycled Water Delivered in 2018 (AFY)** | 30,600 | 25,700 | 30,600 | 30,600 | 20,200 | 0 |
| **Unit Cost without Advanced Treatment ($/AF)[2]** | $180 - $240/AF | $630/AF | $100/AF<br>Additional cost of Advanced Treatment could be required to meet future discharge regulations | $150/AF<br>Not including cost of PID Upgrades | $450 – 490/AF | N/A |
| **Unit Cost with Advanced Treatment ($/AF)** | $1,800/AF | $630/AF | $1,000/AF | $1,750/AF | $450 – 490/AF | N/A |
| **Technical Feasibility** | + | + | + | + | -<br>It may be difficult to coordinate and implement recycled water discharge to the DMC only when the O'Neil Pumping Plant is off. | N/A |
| **Potential to Avoid Additional Treatment Costs** | + | + | -<br>Advanced treatment could be required to meet future discharge regulations | + | + | Advanced treatment for Cities could be required to meet future discharge regulations |
| **Maximizes Recycled Water Delivery** | + | - | + | + | -<br>Modification of DMC operations and/or reduction in the % dilution required for groundwater infiltration would increase the amount of recycled water that could be delivered | - |
| **Ability to Deliver Water District-Wide** | + | - | + | + | + | - |
| **Cost Effectiveness** | + | - | + | + | - | N/A |

| Criteria | Alternative 1: Conveyance in the DMC | Alternative 2B: Pipeline Conveyance to DPWD[1] | Alternative 3: River Conveyance and Diversion | Alternative 4: Dilution and Conveyance via the PID to the DMC | Alternative 5: DMC Operational Changes with Groundwater Aquifer Treatment | Alternative 6: No Project / No Action |
|---|---|---|---|---|---|---|
| **Institutional Issues/Obstacles** | • -<br>•<br>• Requires coordination/permitting with Reclamation for use of DMC<br>• Easements required for pipeline construction<br>• Requires SWRCB permit for discharge into DMC<br>• Some uncertainty whether additional treatment may be required for introduction of recycled water into San Luis Reservoir | • +<br>• Easements required for pipeline construction<br>• Requires modification of customer turnouts to accept irrigation water from pipeline rather than DMC.<br>• Limits the availability of the Modesto storage facilities to serve as secondary effluent storage. If Modesto storage not available, requires construction of large seasonal storage reservoir.<br>• | • +<br>• Requires institutional agreements with BCID, WSID and/or PID<br>• Requires SWRCB permit for DMC conveyance<br>• Likely to require advanced treatment for continued river discharge.<br>• | • -<br>• This alternative increases the number of project stakeholders.<br>• May trigger the need for PID to comply with Title 22 recycled water distribution requirements.<br>• Requires coordination/permitting with Reclamation for use of DMC<br>• Easements required for pipeline construction<br>• Requires SWRCB permit for discharge into DMC<br>• Some uncertainty whether additional treatment may be required for introduction of recycled water into San Luis Reservoir | • -<br>• Requires coordination/permitting with Reclamation for use of DMC<br>• Easements required for pipeline construction<br>• Some uncertainty whether additional treatment may be required for introduction of recycled water into groundwater<br>• Requires operational coordination with the San Luis Reservoir to deliver water only when the San Luis Reservoir pump station is not operational. | • N/A |

Notes:
+ Indicates the alternative meets the criteria /objective
- Indicates the alternative does not meet the criteria/objective
0 Neutral or indicates that sufficient information does not exist to determine
N/A Indicates that sufficient information does not exist to determine

1. Alternative 2B is the pipeline alternative included in this summary table.

## 7.9 Recommended Alternative

Based on the evaluation of alternatives, Alternative 1 is the recommended option for the NVRRWP. Alternative 1 is technically feasible, avoids requirements for additional treatment upgrades, can convey all of the anticipated recycled water production at project buildout, uses the CVP facilities to provide seasonal storage, allows for delivery to all DPWD lands, is cost-effective compared to the other alternatives and currently has no identified fatal flaws from an institutional perspective.

Within Alternative 1 it is recommended that two scenarios, DMC 1-B and DMC-4, be carried forward to the next phase of project DMC-1B is recommended because it allows each City to implement its recycled water system independently and it is the lower cost of the separate pipeline scenarios. DMC-4 is recommended because it is overall the lowest cost scenario in Alternative 1. The decision between these two scenarios will be based on more detailed evaluation of institutional agreements and project funding that will occur in the next project phase.

**Figure 7-18: Recommended Alternative: Alternative 1 – Subalternative DMC-1B**

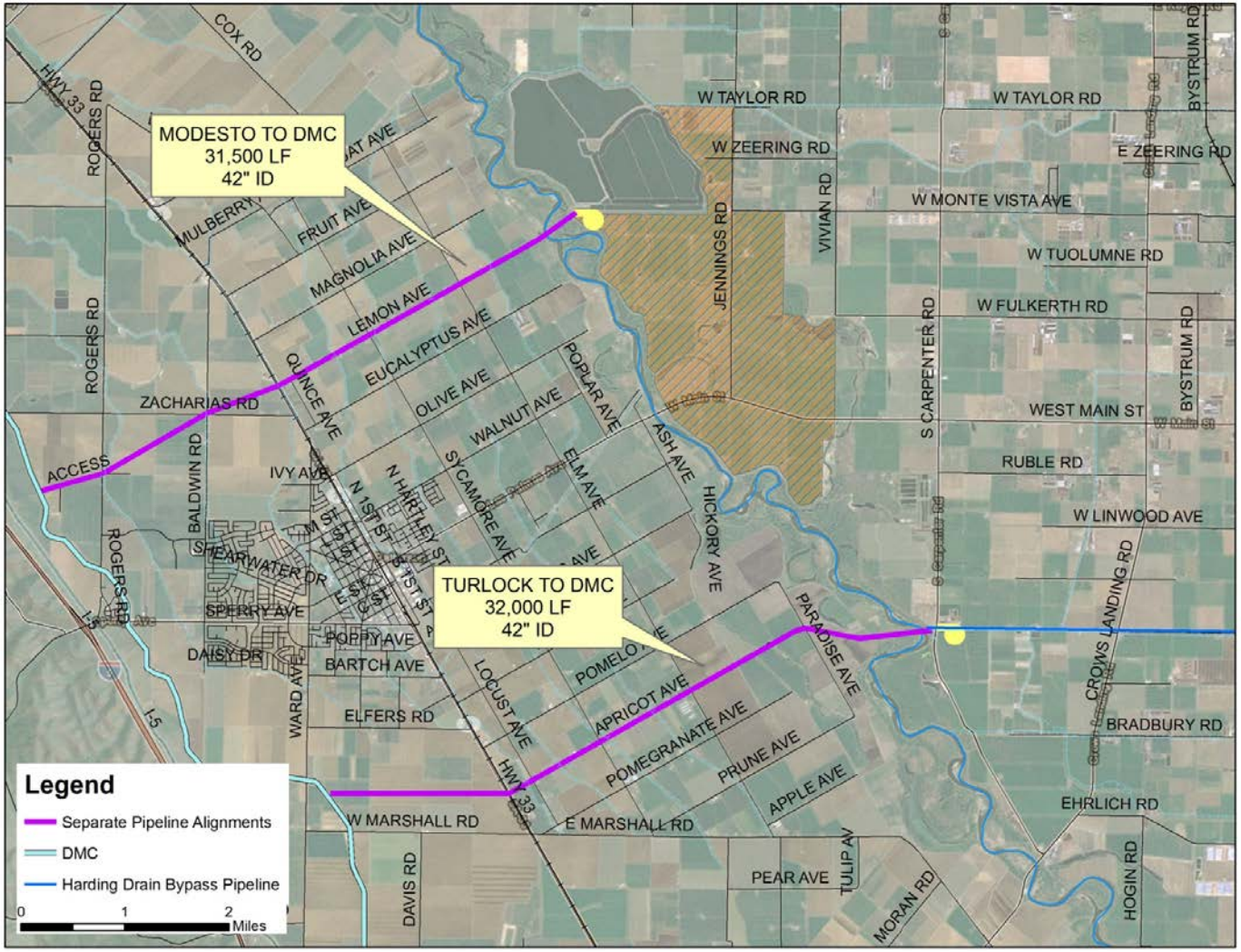
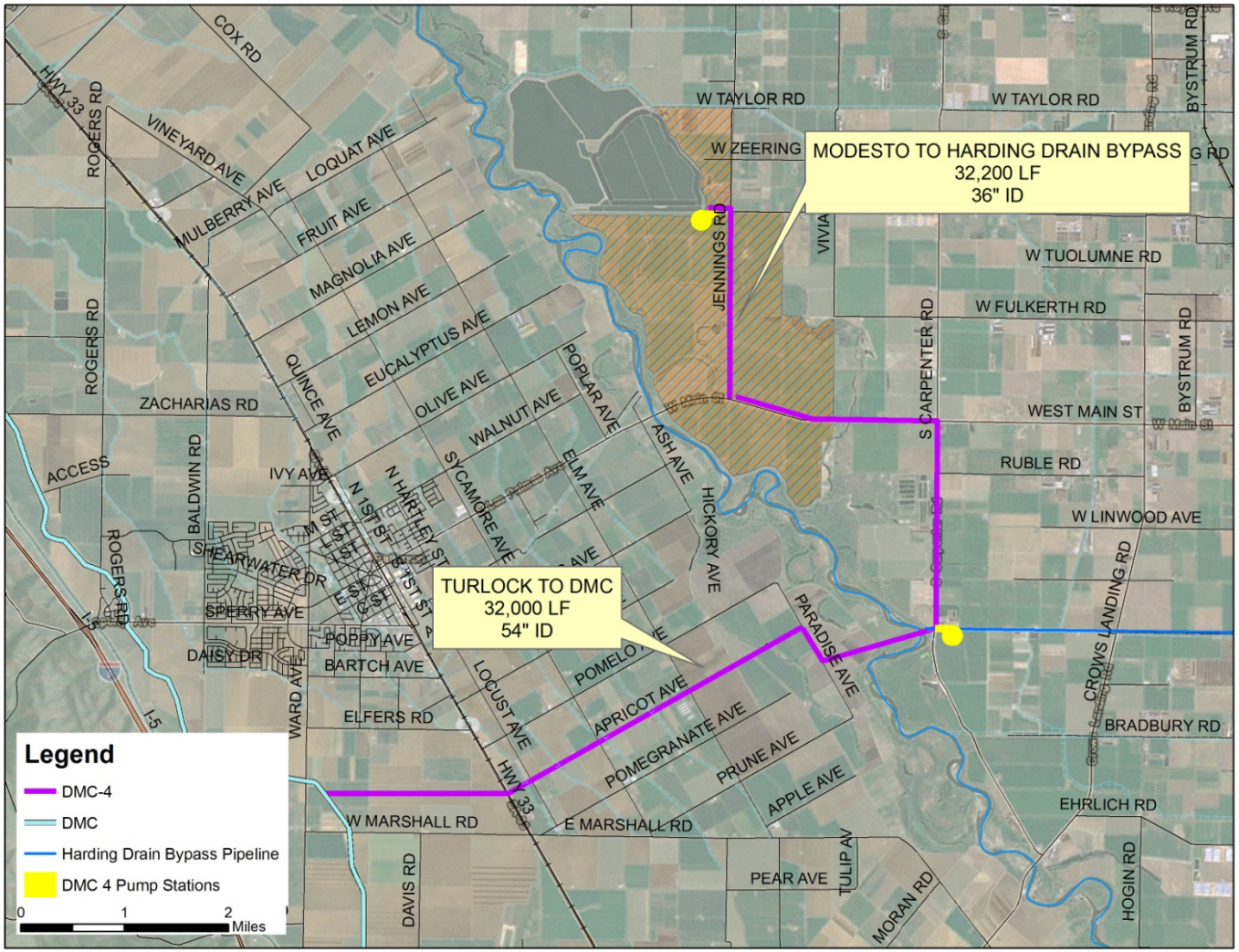


**Figure 7-19: Recommended Alternative: Alternative 1 – Subalternative DMC-4**



# Chapter 8 Stakeholder Outreach

## 8.1 Outreach Conducted to Date

The program partners have initiated numerous outreach efforts, with the intent of providing program updates and informing local, regional, and state level stakeholders. Table 8-1 provides a summary of agencies and entities contacted and the status of those contacts.

**Table 8-1: Entities and Agencies Contacted**

| Agency | Contact Notes |
|---|---|
| DPWD Land Owners / Growers | Joint Grower and Landowner meetings<br>Board Meetings and Workshops |
| San Luis and Delta-Mendota Water Authority | Continuing communication |
| USBR | Continuing communication |
| Turlock and Modesto City Councils | Continuing Communication |
| RWQCB | Continuing Communication |
| SWRCB | Continuing Communication |
| CDPH | Contact initiated, confirming RWQCB permitting approach before next outreach |
| Nature Conservancy | Continuing Communication |
| Various local and regional elected representatives | Continuing communication |

The project partners have met with and informed the State and federal elected officials whose jurisdictions coincide with the project area. To date, these meetings have resulted in expressions of support for the project.

## 8.2 Future Outreach Needed

Upon completion of this feasibility study, significant and continuing outreach will be required to keep stakeholders and interested entities fully informed regarding the project and its progress. It is anticipated that these meetings will include the entities shown in Table 8-2.

**Table 8-2: Future and Continuing Outreach Needed**

| Agency | Contact Notes |
|---|---|
| DPWD Land Owners / Growers | Joint Grower and Landowner meetings<br>Board Meetings and Workshops |
| San Luis Delta-Mendota Water Authority and member agencies | Continuing communication<br>DMC Operations |
| USBR | Continuing communication<br>Title XVI program<br>Refuge Water Supply Program |
| Turlock and Modesto City Councils | Continuing Communication |
| RWQCB | Continuing Communication |
| SWRCB | Water Rights applications<br>Continuing Communication |
| CDPH | Coordination thru RWQCB |
| Farm Bureau | Continuing Communication |
| Various local and regional elected representatives | Continuing communication |

# Chapter 9 Economic Analysis

## 9.1 Existing and Projected Conditions in Service Area

As described in Chapters 1 and 2, DPWD is under contract with Reclamation for the delivery of up to 140,210 AF of water annually to approximately 45,000 acres of highly productive farmland with a production value of over $130 million gross farm dollars annually. DPWD's contractual entitlement is its primary source of supply, though privately developed groundwater is used by growers in the District service area on a limited basis. Since the early 1990's, DPWD's CVP allocations have been subject to shortages due to the effects of drought conditions as well as new legislative and regulatory restrictions imposed on the CVP beginning in 1992. In 2009, a combination of these prior regulations, three years of below normal precipitation and more recent operating constraints imposed on the CVP under the Endangered Species Act resulted in a contractual allocation to DPWD of only 10 percent. Prior to the Federal biological opinions on Delta smelt and salmon, it was estimated that the District's future average allocation would be 65% (91,137 AFY). As a consequence of these most recent biological opinions, it is estimated that in normal years, DPWD will receive only about 35% (49,000 AFY) of its contract supply. These on-going shortages and lack of water supply reliability have created a severe hardship on the District and its growers. Over 10,000 acres were fallowed in 2009, resulting in a significant loss in both farm income and agricultural-related jobs. The effect of these shortages on the agriculturally-based economy of communities on the west side of the San Joaquin Valley has had severe economic repercussions and will exhibit continuing negative economic impacts as these losses ripple through the local and regional economies. It is assumed that if a No Project / Action alternative is chosen, these conditions and impacts will continue into the foreseeable future for the District as no supplemental water will be made available.

The shortage of surface water has, and will continue, to negatively impact local groundwater resources by forcing agricultural and municipal users to rely more heavily on limited groundwater supplies. Not only can this result in the depletion of this resource, it generates increasing concerns over possible land subsidence resulting from groundwater overdraft. With the introduction of Federal and State imported water supplies, groundwater increasingly was used as an "insurance hedge" during times of drought or imported water shortages. However, land subsidence has been a concern (Poland, U.S. Geological Survey, and Lofgren, California Case History No. 9.13. San Joaquin Valley, California, 1975). The risk is not merely the lowering of land elevation but the destruction of recharge and storage capability within the aquifer (Galloway, Jones, and Ingebritsen, Land Subsidence in the United States, Part I, The San Joaquin Valley, Largest Human Alteration of the Earth's Surface, Circular 1182, 1999). If this occurs, as the aquifer is allowed to recharge after a period of extensive groundwater pumping, less water is available for future needs when drought or imported water shortages occur. This diminishes the insurance value of the aquifer and makes cropping decisions more uncertain.

For this evaluation, the 2009 water supply conditions, characterized by a contract allocation of only 10% are projected as the "worst-case" scenario. The cropping patterns under the "worst-case" would look similar to those observed during 2009. According to the 2009 Crop Report, the District fallowed 10,737 acres of its 42,783 irrigable acres. In a recent examination of economic impacts in the San Joaquin Valley, Jeffery Michael and Richard Howitt, et al (Michael, Howitt, Medellín-Azuara, and MacEwan, "A Retrospective Estimate of the Economic Impacts of Reduced Water Supplies to the San Joaquin Valley in 2009" September 28, 2010), determined a San Joaquin Valley-wide fallowing estimate that distinguishes between "normal" annual fallowing practices and fallowing associated with the lack of imported water supplies due to Delta pumping restrictions. The estimate provides a basis for establishing acreage fallowed as a result of pumping restrictions (water shortages) at 36% of the total fallowed acreage. By this calculation, the DPWD cropping acreage impact attributable to shortages in 2009 was 3,865 acres. Thus, with reliable water supplies, we would expect to see 6,872 of "normally" fallowed acres (10,737-3,865 = 6,872). While this calculation provides a relatively robust "rule of thumb" for estimating fallowing from pumping restrictions, a specific estimate for DPWD was desired.

The portion of the DPWD service area specified as the targeted area for delivery of more reliable water from the project has experienced an increase in acreage planted to higher valued permanent crops. In the face of uncertain water deliveries, while growers may defer land conversion investments for a period of years and leave those lands fallow, this is not an option for already converted lands. For this reason and the lack of accessible groundwater for emergency uses in the target area, an area specific fallowing analysis was performed. Michael and Howitt, et al, determined that drought conditions and pumping restrictions had major economic impacts on San Joaquin Valley counties. Those impacts were mitigated somewhat by water transfers, cropping changes to less water intensive crops, and increased groundwater pumping. Additionally Michael and Howitt, et al, note that growers focused more on saving permanent crops like fruit and nut trees than on growing annual crops. The impacts were more pronounced on the west side of the San Joaquin Valley with Kern, Kings, and Fresno counties suffering the greatest losses. For the purposes of this analysis, the 2009 crop year was used for the baseline definition of the water-short future. While there is no specific method to distinguish "normal" fallowing from extraordinary fallowing due to drought or water shortage (other than the work of Michael, Howitt, et al.), an examination of historical fallowing practices can illuminate both trends and magnitudes of observations. For DPWD, historical cropping and fallowing practices were observed from 1982 to 1993. This period exhibited both full CVP deliveries and some dry years due to drought conditions in the early 1990s. This period also preceded the impacts associated with CVPIA, which was signed into law October 30, 1992.

Figure 9-1 illustrates both the initial and final CVP water allocations. Examining the periods of normal water delivery between 1982 and 1986, a period of low water rates and mild climate, out of total district acreage of 45,229 acres, average fallowing was 3,349 acres annually. From 1987 to 1989, when fisheries restoration discussions began as a prelude to the CVPIA, fallowing increased to an annual average of 5,272. Allocations to DPWD growers were cut to 50% of contractual commitment during the 1990-91 water year due primarily to drought.

**Figure 9-1: Historic Annual Initial / Final CVP Allocations[1]**

Notes:

1. Data provided by DPWD. Initial supply indicates the initial water supply allocation from the Bureau of Reclamation at the beginning of the water year (February). The final supply indicates the final allocation from the Bureau of Reclamation at the end of the water year.

Beginning with the implementation of CVPIA in 1993 and other legal and regulatory delivery constraints, there was a growing concern that the new "normal" allocation would not be a full allocation. As shown in Figure 9-1, only three water years since the 1990-91 water year provided full entitlement deliveries of CVP water: 1995-96, 1998-99, and 2006-07. As uncertainty entered growers' cropping decisions, they made risk calculations as best as possible given the growing number of unknowns surrounding water supply allocations. Thus, fallowing increased markedly from water year 1987 to 1992 when CVP water deliveries were anticipated to be and/or actually reduced but appeared somewhat more "measurable" and thus more amenable to risk assessment and better business decisions. Risk represents "measurable" assessments of potential future events. Uncertainty represents "immeasurable" assessments. Thus uncertain events cannot adequately be evaluated for business decision making. Uncertain situations produce more severe impacts on business decisions and result in extremely uninformed investment decisions.

For the purposes of this analysis, the "normal" agronomic fallowing decision is based on pre-CVPIA cropping decisions (3,349 acres annually on average, 1982-86) and compared to cropping and fallowing decisions during periods that include uncertainty (5,272 acres annually on average, 1987-1989) and increased risk leading up to promulgation of the CVPIA (7,913 acres on average, 1987-92). Thus, this analysis selects a period of normalcy, uncertainty, and risk for growers and their cropping and fallowing plans. By this statistic, 58 percent of the land that is fallowed in any year since CVPIA can be attributed to the uncertainty and risk of water shortage and not to agronomic decisions alone. The base year for analysis

is 2009 wherein growers in DPWD service area fallowed 10,737 acres. Of that acreage, by our calculation of fallowing causality, 58% of that acreage, or 6,227 acres, were fallowed due to uncertainty and risk associated with water shortages, legal and regulatory policies, and judicial decisions, and not strictly on agronomic decisions of growers. This recycled water delivery project provides a reliable water supply and as such removes uncertainty and risk associated with CVP deliveries and Delta diversions. The calculated cropping under a reliable water supply scenario would have increased crop acreage during the 2009 water year by 3,196 acres. Thus, the project resolves 51 percent (3,196/6,227) of the acreage in the District fallowed due to uncertainty and risk.

Figure 9-1 depicts the CVP deliveries to DPWD growers and graphically illustrates the basis for grower investment uncertainty and negative economic impacts. DPWD can expect avoidance of cropland investment from growers in the central and southern "target" region of the DPWD service area. Whether growers hold off investment in permanent plantings, grow lesser valued crops, or fallow more land, the economic costs, whether in terms of increased groundwater pumping and the attendant impacts or the continued loss of jobs and incomes in the surrounding communities, will be significant. The value of resolving such a high proportion of uncertainty and risk for growers in the DPWD and the surrounding community is explored in Section 5.3.1.

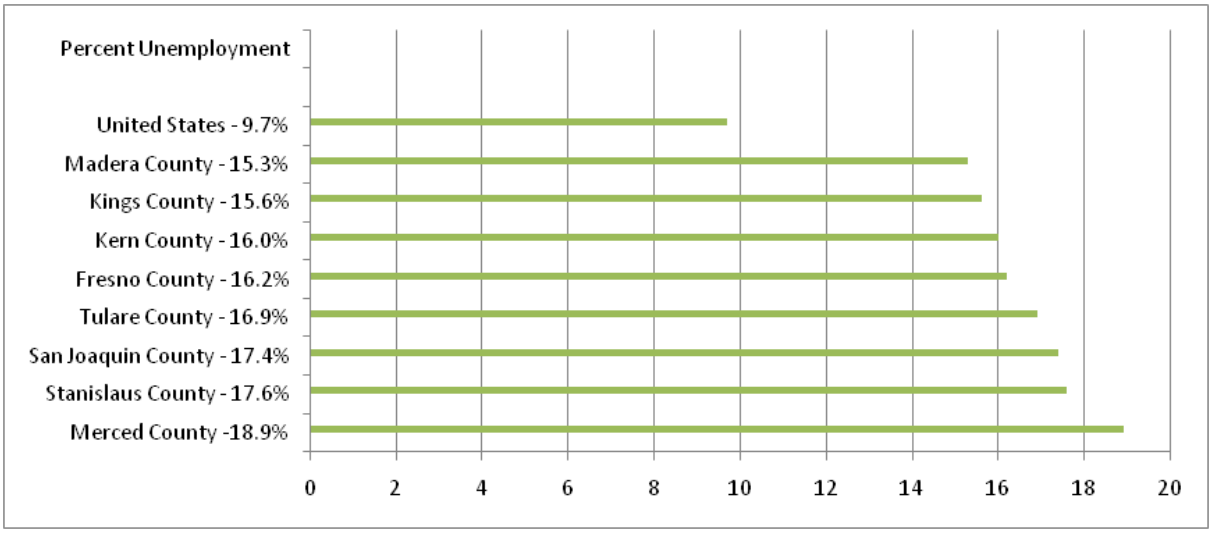
July unemployment rates in the eight counties in the San Joaquin Valley have been rising since July 2008. Two years ago, jobless rates ranged from 9.2 percent in Madera County to 12.1 percent in Merced County. By 2010, the lowest unemployment rate, 15.3 percent in Madera County, exceeded the highest rate recorded two years earlier. Merced County has had the area's highest jobless rate for the past three years.

**Table 9-1: United States and San Joaquin Valley Unemployment Rates, July 2010**

| Location | Unemployment Rate | | | Net Change From | |
|---|---|---|---|---|---|
| | July 2008 | July 2009 | July 2010 | July 2008 to July 2010 | July 2009 to July 2010 |
| United States | 6.0 | 9.7 | 9.7 | 3.7 | 0.0 |
| Fresno County | 9.9 | 14.8 | 16.2 | 6.3 | 1.4 |
| Kern County | 9.6 | 14.4 | 16.0 | 6.4 | 1.6 |
| Kings County | 9.9 | 13.8 | 15.6 | 5.7 | 1.8 |
| Madera County | 9.2 | 13.9 | 15.3 | 6.1 | 1.4 |
| San Joaquin County | 10.4 | 15.7 | 17.4 | 7.0 | 1.7 |
| Stanislaus County | 10.9 | 16.0 | 17.6 | 6.7 | 1.6 |
| Tulare County | 10.4 | 15.1 | 16.9 | 6.5 | 1.8 |

Notes:
1. Unemployment rates were not seasonally adjusted.

**Figure 9-2: United States and San Joaquin Valley Unemployment Rates, July 2010**




Notes:
1. Unemployment rates were not seasonally adjusted.

Jobs will be created directly from the project. In December 2010, Jeffery Michael and Thomas Pogue analyzed and reported the site-specific income and employment benefits that a recycled water delivery project would bring to the DPWD region (North Valley Regional Recycled Water Project: Impact on Regional Income, Employment and Output, December 2010). The analysis was performed using an input-output (I/O) model that was calibrated to the existing local economic data, and focused on quantifying the income and employment benefits associated with the additional water supply only and did not taken into account the short-term and long-term employment benefits associated with the construction, operation, and maintenance of the recycled water conveyance facilities. The Michael-Pogue approach allowed detailed analysis of the agricultural cropping impacts from new recycled water supplies measured as direct, indirect, and induced income and employment. The Michael-Pogue site-specific employment benefit numbers associated with the 2015 and 2025 projects were quantified to be 314 and 572 jobs, respectively. In order to fully capture the site-specific employment benefits of the project, these results would need to be supplemented with site-specific employment benefits associated with the construction, operation and maintenance of capital facilities as well.

The results from the Michael-Pogue analysis can be compared to the non-site specific employment benefit numbers developed using the guidance developed by the Executive Office of The President Council of Economic Advisers (Executive Office of The President Council of Economic Advisers, May 2009). The non-site-specific employment benefits of the "preferred" and "most likely" projects, further described in Section 5.2 can be quantified as follows:

- 2015 A Projects – Average capital cost of $15,800,000 results in the creation of 172 permanent jobs.
- 2015 B Projects – Capital cost of $70,200,000 results in the creation of 763 permanent jobs.
- 2025 Projects – Capital cost of $85,300,000 results in the creation of 927 permanent jobs.

The employment benefits quantified by Michael-Pogue have the same order of magnitude as the non-site-specific employment benefit numbers, and therefore support the use of the non-site-specific numbers, which comprehensively quantify the employment benefits associated with increased water supply and construction, operation, and maintenance of new conveyance facilities. Updating the Michael-Pogue analysis to include the direct, indirect, and induced incomes and employment from the construction and

operation and maintenance of the project would not significantly alter the findings or the employment benefits portrayed by the non-site specific analysis used herein, and therefore additional site-specific analyses were not performed at this time.

The Michael-Pogue analysis did not evaluate the impacts of a No Project / Action alternative; however, it may be inferred that any and all income, employment, and economic benefits from a No Project / Action alternative may be dismissed as null due to the analysis' direct correlation of increased water supply to these benefits.

## 9.2 Net Benefit Analysis

### 9.2.1 Net Project Benefits

1. The 2015 A scenario has a net benefit of $86/AFY. This is a positive net benefit and assumes that advanced treatment technologies will not be required. The benefit can also be explained as a ratio of benefit to cost. In this case, for every dollar of cost that the project incurs, it produces and additional $0.83 in benefits.
2. The 2015 B scenario has a net benefit of $530/AFY. When examined as a benefit/cost ratio, the project generates $1.96 for every $1.00 in project cost.
3. These alternatives both exhibit positive net benefit.
4. The most substantive benefit of Scenario 2015 B is that it evolves directly into the 2025 solution and minimizes additional capital investment necessary to deliver the recycled water yields expected in the future (2025 and beyond).
5. The 2025 solution has a net benefit of $560/AFY. The net benefit of this alternative improves as the longer term planning horizon is evaluated. Examined as a ratio, the 2025 solution, for each $1.00 of project cost incurred, produces $2.33 of benefits.
6. The No Project / Action alternative does not produce a net benefit, as no recycled water would become available for beneficial reuse.

### 9.2.2 Less Easily Quantified Benefits

Some Title XVI project benefits such as a drought tolerant water supply, reduced reliance on transfers and water importation, and increased water supply reliability, all of which influence grower long-term decision making on cropping and capital investments, are difficult to quantify. While these data can be reported, the extent of influence on benefits is less easily quantified and evaluated. Thus, the farm labor and management employment and income impacts from grower long-term decision making and investment is also identified but not rigorously estimated. The Title XVI Directives and Standards allow for these benefits to be documented and described qualitatively as completely as possible. Accordingly, these qualitative benefits can be considered as part of the justification for a Title XVI project in conjunction with the comparison of project costs described above. Less easily quantified benefits for replacing unreliable CVP water for DPWD fall in three key areas:

1. Increased investment certainty for growers,
2. Increased property values, and
3. Increased and more stable employment and income in the district, local community, and region.

#### Increased Investment Certainty for Growers

The lands in the southern portion of the District's service area are those that will receive the greatest benefits from the more reliable recycled water supply. Those lands have the least access to groundwater and are

where more permanent crops have been planted. For these growers, more reliable water supplies provide a stable basis for investment decisions that they cannot achieve relying solely on the availability of CVP water. Grower investment certainty allows more stable agricultural economies to sustain themselves. More consistent economic benefits can be expected from this increased certainty. Those economic benefits are realized as increased incomes, jobs, municipal tax base, and quality of life benefits such as public safety, efficient roadways and transit, clean and safe parks and playgrounds, increased educational opportunities, enhanced property values, and pride of community, among many others.

### Increased Property Values

When investment becomes stable, plant and operations (and agricultural lands) become more valuable. In the absence of reliable water supplies, investments fall off, land productivity declines, and land values also decline. Economic impacts are felt in declining tax receipts, which causes municipal and county budgets decline and municipal services to suffer.

### Increased and More Stable Employment and Income in the District, Local Community, and Region

Reliable water supplies lead to stable agricultural investments and more stable and plentiful agricultural employment. Incomes earned on the farm are spread throughout the local community and the region as farm labor wages are expended for goods and services within the community. When linked to increased property tax receipts, community health and safety increase along with quality of life. While less easily measured for evaluations such as this one, these types of economic benefits can be reflected in many municipal data.

# Chapter 10 Legal, Institutional, and Permitting Requirements

## 10.1 Legal Requirements

The primary legal issue facing the recommended project DMC-4 will be the need to establish the right to deliver recycled water to DPWD rather than discharge to the San Joaquin River and/or land disposal.

### 10.1.1 Water Rights

Modesto and Turlock have engaged legal counsel to review applicable water rights issues associated with securing the right to each City's recycled water. Securing the right to the recycled water is required prior to proceeding with implementation of recycled water delivery to DPWD. As the recycled water delivery options are narrowed and further refined as a result of this feasibility study, further analyses will be undertaken on behalf of both cities to confirm the water rights necessary to support the proposed delivery of recycled water to DPWD and to develop a specific path forward for obtaining regulatory approvals necessary for project implementation. A preliminary description of the legal considerations and possible regulatory approvals that were considered and that may be required for implementing any of the project alternatives is described below.

As a general matter, California Water Code Section 1210 provides in part: "The owner of a waste water treatment plant shall hold the exclusive right to the treated waste water as against anyone who has supplied the water discharged." That section and other provisions provide, however, that such rights do not affect a treatment plant's obligations to other legal users of treated waste water and provide for an approval processes through the State Water Resources Control Board (SWRCB) which may be applicable for certain alternatives herein described. Modesto currently has no discharge to the San Joaquin River, except during the winter when there are more significant flows, and therefore redirecting its recycled water would not appear to create any insurmountable legal issue. Modesto has an agreement with the surface water supplier of a portion of its supply, Modesto Irrigation District (MID), which recognizes that Modesto may increase its reclamation of wastewater and reuse that water. Turlock currently discharges most of its effluent to the San Joaquin River, but preliminary analysis shows that any potential impacts to downstream interests associated with the proposed recycled water projects would be minimal and temporary.

It is anticipated that a water rights approval for each City will required from the SWRCB. With respect to Alternative 3 (River Conveyance of Recycled Water), Water Code Section 1485 allows dischargers on the San Joaquin River to "wheel" recycled water. That is, they may appropriate, in an amount that is roughly equivalent to their discharge, downstream of the discharge point, water which can then be sold or used for any beneficial purpose.

Modesto and Turlock rely in whole or part on groundwater pumped from a groundwater basin that is not in overdraft. Except for a portion of the Modesto wastewater effluent, the recycled supply is not presently directly recharging the groundwater basin (i.e., it is being diverted to the San Joaquin River or lost through evaporation).

An analysis of the groundwater pumping by Turlock does not intercept flows that would otherwise reach the San Joaquin River. It is anticipated that a similar analysis for the City of Modesto groundwater pumping will result in a similar conclusion. The primary institutional issue facing the recommended project DMC-4 will be the contractual arrangements between Modesto, Turlock, DPWD and Reclamation.

## 10.2 Institutional Requirements

There are a number of agreements that would need to be in place for the project alternatives to be implemented. The key agreements or memoranda of understanding (MOU) that would need to be developed and entered into are as follows:

- Water Supply Agreement(s) to address the contractual delivery of up to 30,600 AFY of recycled water from Modesto and up to 28,400 AFY of recycled water from Turlock to DPWD, and the terms of any cost sharing for the conveyance and/or production of the recycled water.
- Exchange Agreement or Long-term Warren Act Contract with Reclamation for conveyance and storage of water in the DMC would be needed. The Exchange Agreement or Warren Act Contract would give DPWD the ability to convey water via the DMC throughout the year, and to store the water in San Luis Reservoir.
- Wheeling Agreement with Patterson Irrigation District if the PID Main Canal is utilized for conveyance. PID has entered into similar agreement with DPWD and other water entities, and is in the process of implementing improvements to its canal system and has solicited proposals from other water agencies for participation and utilization of the PID Main Canal for conveyance of water to the DMC.

## 10.3 Permitting Requirements

A variety of permits and regulatory actions are required to implement the recommended alternatives DMC-1B and DMC-4. Table 10-1 summarizes the permits and regulatory requirements, including the permitting agency names and the project implementation stage when each permit should be obtained.

## 10.4 Unresolved Issues

There are no known unresolved issues beyond the legal, institutional, and permitting issues described in this report.

## 10.5 Research Needs

There are no research needs resulting from the NVRRWP Feasibility Study. Treatment and distribution system technologies proposed for the NVRRWP will use conventional system components and proven technologies.

**Table 10-1: Summary of Permits and Regulatory Actions for the Recommended Project**

| Agency | Regulatory Requirement | Project Stage | Brief Description |
|---|---|---|---|
| CA Department of Conservation | Williamson Act Cancellation | Planning / Design | If any ag land that has a Williamson Act Contract with the state government is converted to non-ag land (e.g. pump station is put on a corner of an existing ag parcel), that portion of land will need to have the Williamson Act Contract cancelled on it. |
| CA Natural Resources Agency | CEQA Compliance (TBD as lead agency) | Planning | California Environmental Quality Act (CEQA) is a statute that requires state and local agencies to identify the significant environmental impacts of their actions and to avoid or mitigate those impacts, if feasible. |
| CA Office of Historic Preservation | Section 106 Consultation | Planning | Section 106 of the National Historic Preservation Act (NHPA) requires federal agencies to coordinate with the State Historic Preservation Officer (SHPO) and the Advisory Council on Historic Preservation (ACHP) regarding the effects a project may have on properties listed, or eligible for listing, in the National Register of Historic Places (NRHP) (16 USC 470 et seq.). |
| CA State Lands Commission | State Lands Lease Agreement | Planning | Depending on the lands near the San Joaquin River, a lease agreement with the State Lands Commission may be required. |
| Federal Government | NEPA Compliance (USBR as lead agency) | Planning | National Environmental Policy Act (NEPA) is the Federal equivalent of CEQA; NEPA can be done in conjunction with CEQA, pending USBR preference. |
| Natural Resource Conservation Service | Farmland Conversion Assessment | Planning | As part of compliance with the Farmland Preservation and Farmland Protection Act (FPPA), federal agencies assisting in projects that may convert important farmland to non-farm use must contact a local office of the Natural Resources Conservation Service (NRCS). NRCS uses a land evaluation and site assessment system to establish a farmland conversion impact rating score on each alternative project site. This score is used as an indicator for the project sponsor to consider alternative sites if the potential adverse impacts on the farmland exceed the recommended allowable level. |
| RWQCB | 401 Water Quality Certification | Planning | Section 401 of the CWA requires that the discharge of dredged or fill material into waters of the United States does not violate effluent limitations or water quality standards established by the state. |
| RWQCB | Regulatory pathway for Discharge to the DMC | Planning | Based on preliminary discussions with the RWQCB, this will be likely be an NPDES permit |
| SWRCB | Wastewater Change Petition (Petition for Change) | Planning | Because the program will result in the removal of wastewater discharges to the SJR, a petition for change is needed from the SWRCB. Downstream water users are notified as part of the petition process. |
| US Army Corps of Engineers | 404 Permit for any fill of wetlands or waters of the US | Planning / Design | Activities that result in discharge of dredged or fill material into waters of the United States are regulated by the U.S. Environmental Protection Agency (EPA) and U.S. Army Corps of Engineers (USACE) under Section 404 of the Clean Water Act (CWA). Discharges of dredged or fill material, including placement of structures, into waters of the United States, including wetlands, generally require a permit from USACE. |
| USBR | Warren Act Contract or Exchange Agreement | Planning | Under provisions of the Warren Act, Reclamation facilities can be utilized to convey and/or store water that is not a part of the CVP water supply (i.e., non-project water). DPWD presently has a Warren Act Agreement with Reclamation. Each Warren Act Agreement is specific to the source of water being conveyed and/or stored, and a new Warren Act Agreement will be required. Alternatively, an Exchange Agreement may be an appropriate vehicle for use of the DMC facilities for delivery of recycled water. |
| US Fish and Wildlife & National Marine Fisheries Service | Section 7 Consultation/Biological Opinions | Planning | Section 7 of the Endangered Species Act (ESA) requires all federal agencies, in consultation with USFWS and NMFS, to ensure that their actions do not jeopardize the continued existence of species listed as endangered or threatened or result in the destruction or adverse modification of the critical habitat of these species. Section 7 prohibits federal agencies from implementing an action that would result in the take of a species listed as threatened or endangered unless a biological opinion issued by USFWS or NMFS authorizes the take. Take includes harassing, harming, pursuing, hunting, wounding, killing or capturing, or attempting such activity. |

| Agency | Regulatory Requirement | Project Stage | Brief Description |
|---|---|---|---|
| San Joaquin Valley Air Pollution Control District | Authority to Construct / Permit to Operate | Construction | Only needed if a generator greater than 50 hp is included at the pump station. |
| County of Stanislaus (and Merced, pending Project Alternatives) | Encroachment Permit | Construction | Standard permit needed for work in County right-of-way. |
| Caltrans | Encroachment Permit | Construction | Standard permit needed for work in Caltrans right of way. |
| RWQCB | NOI for Coverage under Statewide Construction Storm water Permit (Section 402 CWA) | Construction | |
| RWQCB | NOI under Low-Threat Discharge Order for Coverage of Pipeline discharges for testing and startup | Construction | |
| CA Dept. of Fish and Game | Streambed Alteration Agreement for pipeline crossings of creeks | Construction | |
| CA Dept. of Fish and Game | Incidental Take Permit | Construction | |
| CalOSHA | Construction Permit / Tunnel Classification | Construction | |
| County of Stanislaus (and Merced pending project alternatives) | Grading Permit | Construction | Standard permit needed for grading work. |
| County of Stanislaus (and Merced pending project alternatives) | Building Permit | Construction | Standard permit needed for building work. |
| County of Stanislaus (and Merced pending project alternatives) | Tree Removal Permit | Construction | |
| UPRR | Encroachment Permit | Construction | Need permit for crossing CNFR / Union Pacific Railroad Road (UPRR). |
| Central Valley Flood Protection Board (CVFPB) | | Construction | Levee tunneling. |

# Chapter 11 Financial Capability Sponsor

## 11.1 Project Schedule

The proposed project schedule has recycled water deliveries beginning in the 2018 timeframe, as seen in Table 11-1. This means that the design and construction of the facilities would be completed in 2018. This project schedule is aggressive, but is an indication of the need for water in the DPWD service area.

**Table 11-1: Program Schedule**

| Activity | Schedule |
|---|---|
| Confirm Feasibility of DMC Conveyance | Complete by November 2013 |
| Begin Implementation Steps<br>• Environmental Documentation<br>• Secure Funding<br>• Interagency Agreements<br>• Predesign<br>• Stakeholder Outreach<br>• Permitting | Complete by December 2014 |
| Final Design | Complete by March 2016 |
| Construction | Complete by April 2018 |

## 11.2 Willingness to Pay for the Project

All project entities are currently in discussion in regards to which facilities will be owned by which entity as well as long term project commitments for purchasing water. Contractually, these arrangements have not been established or determined at this time.

DPWD is a California Special District, formed under the provisions of the Division 13 Water Code of the State of California. DPWD is governed by a 7 person Board of Directors elected from among landowners within DPWD's jurisdictional boundaries. Under California Water Code, DPWD has the authority to incur debt, borrow money and issue bonds. DPWD also has the authority to assess parcels within the District for the purpose of equitably sharing District costs.

DPWD is a public agency responsible to its agricultural customers and is, by its legal basis and enabling acts, charged with the development and management of reliable and affordable water supplies in the interest of its customers. DPWD is therefore willing to pay its share for a recycled water delivery project, and has demonstrated their willingness by providing funding for the next phase of work, together with the City of Modesto and Turlock.

## 11.3 Funding Plan for Construction, Operation, Maintenance, and Replacement of Facilities

There are a variety of financing methods available to special districts to finance capital improvements, replacements, and expansion of water systems. These include pay-as-you-go (cash reserves and operating revenues), state revolving fund loans, grants, and tax exempt borrowings, such as general obligation bonds, special tax bonds, assessment bonds, revenue bonds, bond pools, and certificates of participation.

## 11.4 Description of all Federal and Non-Federal Funding Sources and their Limitations

### 11.4.1 Potential Funding Sources

There are several funding sources that the Agencies may pursue:

- Grants of up to 25% of project costs or $20 million, whichever is less, are potentially available from Reclamation under its Title XVI program. There is also potential for the Title XVI program to be superseded by a new USBR low-interest loan program. This source assumes a potential 1% low interest rate for a 30-year amortization period.
- Grants are potentially available through the California DWR Integrated Regional Water Management Planning Implementation Program funded through Proposition 84 (Prop 84 grants). There is a total of $35 million available to the San Joaquin planning area; this project would be eligible for a portion of that available amount.
- State Revolving Fund (SRF) loans, a low interest loan program administered by the State Water Resources Control Board. SRF loans typically have a lower interest rate than bonds, but are paid back over a 20-year period. A 30-year period may be allowed, provided the project serves a disadvantaged community.
- Traditional bond financing for the project, which typically has a higher interest rate but may be paid back over a 30-year period so that annual payments might be lower than traditional SRF 20-year loan payments.

### 11.4.2 Modeling of Unit Cost of Water for Potential Funding Sources

An RMC developed tool, titled Integrated Finance Model (IFM), evaluates and compares the cost of a project based a variety of funding options. The IFM allows the user to apply multiple funding sources (including grants and SRF loans), variable interest rates, and payback periods to determine the financing cost of a project. The IFM provides a more complete project cost estimate because it factors in the cost of acquiring funds, the impacts associated with having multiple funding sources, and interest paid during construction.

The IFM was used to evaluate 7 different financing scenarios to determine their impact on the overall cost of water. Each of the seven scenarios used the following base assumption for project cost, schedule, and water available to the project.

- Total Project Cost: $96 million
- Environment/Permitting/Design Schedule: 2 years
- Construction Schedule: 2 years
- Assumed Inflation Rate: 1%

## IFM Runs and Assumptions

The seven IFM runs use a combination of the funding sources described in Table 11-2. For the IFM runs that use SRF and USBR funding (runs #5, 6, & 7), it was assumed an interim funding of approximately $10 million at 5% interest would be needed to fund the project through the design phase (e.g. a bridge loan). Once the SRF or USBR funding has been acquired, the IFM assumes the higher interest rate interim funding would be retired using the lower interest rate funds.

**Table 11-2: IFM Funding Assumptions**

| IFM Run # | Funding Source | Interest Rate | Loan Duration (yrs.) |
|---|---|---|---|
| 1 | Bond | 5% | 30 |
| 2 | SRF | 2.5% | 20 |
| 3 | SRF | 2.5% | 30 |
| 4 | USBR | 1% | 30 |
| 5 | SRF with $10 million Prop 84 grant | 2.5% | 20 |
| 6 | SRF with $10 million Prop 84 grant | 2.5% | 30 |
| 7 | USBR with $10 million Prop 84 grant | 1% | 30 |

Based on the assumptions listed above, Table 11-3 below summarizes the cost of water from the IFM runs and also shows the estimated financed cost of water ($/acre-foot) over a 30 year period. As the amount of available program water increases over time, the unit cost of water decreases. The largest drop in water cost occurs in the year 2038 for the SRF- 20 yrs. funding alternatives and 2048 for the others due to the completion of payments on the source of capital leaving only the O&M cost. This is an illustrative assumption used to demonstrate impacts that this type of funding would have on the overall program costs of water.

**Table 11-3: Unit Cost of Water**

| IFM Run # | Funding Source | 2018 | 2028 | 2038 | 2048 |
|---|---|---|---|---|---|
| 1 | Bond | $321 | $234 | $215 | $249 |
| 2 | SRF- 20 yrs. | $267 | $199 | $71 | $79 |
| 3 | SRF- 30 yrs. | $213 | $164 | $156 | $79 |
| 4 | USBR | $180 | $143 | $139 | $79 |
| 5 | SRF- 20 yrs. w/ $10M Prop 84 grant | $245 | $185 | $71 | $79 |
| 6 | SRF-30 yrs. w/ $10M Prop 84 grant | $196 | $154 | $147 | $79 |
| 7 | USBR w/$10M Prop 84 grant | $167 | $135 | $132 | $79 |

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RECLAMATION

*Managing Water in the West*

**Volume I - Project Report**

# Refuge Recycled Water Supply Study

**Task Order R13PD20071**

**U.S. Department of the Interior**
**Bureau of Reclamation**
**Sacramento, California**

**June 2013**

# Mission Statements

The mission of the Department of the Interior is to protect and provide access to our Nation's natural and cultural heritage and honor our trust responsibilities to Indian Tribes and our commitments to island communities.

---

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

# Refuge Recycled Water Supply Study

*Prepared by*

**RMC Water and Environment**

*In association with*
**United States Department of the Interior**
**Bureau of Reclamation**
**Mid Pacific Region**
**Sacramento Office**

**U.S. Department of the Interior**
**Bureau of Reclamation**
**Sacramento, California**

June 2013

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# Executive Summary

This study evaluates the feasibility of providing recycled water from the North Valley Regional Recycled Water Program (NVRRWP) to the Sacramento-San Joaquin Delta (South of the Delta) refuges. The NVRRWP represents a significant new water source which could help meet both agricultural irrigation demands in the Del Puerto Water District (DPWD) and incremental Level 4 (IL4) water demands in the wildlife refuges south of the Delta. On an annual basis, the total 2012-2013 IL4 water delivery to the San Joaquin Valley refuges was 36,600 AFY while the optimum IL4 water demand is 105,514 AFY, leaving an IL4 shortfall of approximately 70,000 AFY. At the program's final build-out flows in 2045, and depending on the amount of recycled water delivered to DPWD, the NVRRWP could potentially supply approximately 29,000 AFY to the refuges, which would be approximately 40 percent of the 2012-2013 IL4 shortage.

The recommended conveyance alternative is to pipe tertiary treated recycled water from the Cities of Modesto and Turlock to the Delta Mendota Canal (DMC) and then use the DMC to convey the recycled water south to the refuges. A diversion near Newman would be used to divert water to the Newman Canal for delivery of the project water to the refuges. The estimated capital cost of the project is $89 million.

Tertiary treated recycled water from the NVRRWP meets the stringent requirements established in Title 22 of the California Code of Regulations, and is suitable for a wide variety of non-potables uses. The recycled water quality is typically better than San Joaquin River water quality; for example, NVRRWP water contains lower concentrations of constituents such as boron, selenium, electrical conductivity, mercury, and pesticides than the river.

Recycled water from the NVRRWP, when blended with water from the Delta Mendota Canal (DMC), will comply with the United States Bureau of Reclamation's water quality standards for the Upper DMC.

As part of this study, a sampling program was conducted to confirm the usefulness of the existing data and to provide information about analytes, particularly Constituents of Emerging Concern (CECs) that are not included in the existing data sets. Analytical results for conventional constituents were comparable to the existing water quality data. For the CEC analyses, 34 analytes were detected in the Turlock tertiary effluent and/or Modesto secondary effluent samples with most analytes being detected in the samples from both locations. In the samples from the China Island delivery point, the DMC, the PID canal, nine analytes were detected using the analysis for CECs and included both herbicides/pesticides and constituents that likely originate from wastewater effluent (such as caffeine and the artificial sweetener sucralose). The detection of these analytes is to be expected as wastewater treatment plants discharge to the source waters for the DMC and the PID Main Canal.

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## Abbreviations and Acronyms

| | |
|---|---|
| AFM | Acre-feet per month |
| AFY | Acre-feet per year |
| CCID | Central California Irrigation District |
| CDEC | California Data Exchange Center |
| CDFG | California Department of Fish and Game |
| CDFW | California Department of Fish and Wildlife |
| CEDEN | California Environmental Data Exchange Network |
| cfs | cubic-feet per second |
| CIWQS | California Integrated Water Quality System |
| CVP | Central Valley Project |
| CVPIA | Central Valley Project Improvement Act |
| DMC | Delta-Mendota Canal |
| DNQ | Detected but not quantified |
| DPWD | Del Puerto Water District |
| GPD | Gallons per day |
| GPD/cap | Gallons per day per capita |
| GRCD | Grasslands Resource Conservation District |
| IL4 | Incremental Level 4 |
| L2 | Lever 2 |
| MDL | Minimum detection limit |
| MGD | Million gallons per day |
| MPN | Most probable number |
| NPDES | National Pollutant Discharge Elimination System |
| NVRRWP | North Valley Regional Recycled Water Program |
| NWR | National Wildlife Refuge |
| PID | Patterson Irrigation District |
| QA/QC | Quality Assurance / Quality Control |
| Reclamation | United States Department of the Interior, Bureau of Reclamation |
| RWQCB | Regional Water Quality Control Board |
| RWQCF | Regional Water Quality Control Facility |
| SWA | State Wildlife Area |
| TDS | Total Dissolved Solids |
| TM | Technical Memorandum |
| USBR | United States Bureau of Reclamation |
| USFWS | United States Fish and Wildlife Service |
| WA | Wildlife Area |
| WQCF | Water Quality Control Facility |
| WWMP | Wastewater Management Plan |

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# Chapter 1 Summary

## Introduction

The purpose of this study is to evaluate the feasibility of providing recycled water from the North Valley Regional Recycled Water Program (NVRRWP) to the Sacramento-San Joaquin Delta (South of the Delta) refuges. This study contains five chapters that collectively evaluate refuge water demand and availability of NVRRWP recycled water flows, water conveyance alternatives, and water quality of the recycled water for use in the refuges.

The Refuge Water Demand Analysis chapter presents the water supply needs for the refuges to fulfill contractual obligation under CVPIA, the shortfall in incremental Level 4 water (IL4) based on actual water delivered in 2012-2013, and the availability of recycled water from the NVRRWP to meet refuge needs. Based on the analysis, NVRRWP flows have the potential to meet up to 17 percent and 42 percent of the 2012-2013 IL4 shortage in 2018 and 2045, respectively.

The Refuge Conveyance Facilities chapter provides an evaluation of alternatives for new infrastructure (pipelines and pump stations) required to convey recycled water via either the existing Delta Mendota Canal (DMC) to South of Delta refuges or a dedicated pipeline directly to one refuge. The alternatives were evaluated to identify potential fatal flaws, identify key elements and features, and develop a preliminary construction cost estimate. Based on the analysis, the recommended alternative for conveyance of NVRRWP flows to refuges is the DMC alternative, as it is the least cost alternative and therefore more cost-effective, provides seasonal storage through the Central Valley Project (CVP) facilities, makes the recycled water available for all of the refuges south of the Delta, and has less impact on existing Del Puerto Water District (DPWD) users.

The Water Quality Analysis chapter presents the water quality of the recycled water and compares it to relevant water quality criteria for the DMC. The chapter found that tertiary treated recycled water from both Turlock and Modesto (source of NVRRWP flows) meets the stringent requirements established in Title 22 of the California Code of Regulations, and is suitable for a wide variety of non-potables uses. Recycled water from the NVRRWP, when blended with water from the DMC, will comply with Reclamation water quality standards for the Upper DMC. Those standards have been established by Reclamation for the Groundwater Pump-in Program. No other water quality standards are presently in place for water introduced into the DMC. With one exception, the recycled water quality also complies with the USBR's current Groundwater Pump-In water quality standards for acceptance into the Upper DMC.

As part of this study, a sampling program was conducted to confirm the usefulness of the existing data and to provide information about analytes, particularly Constituents of Emerging Concern (CECs) that are not included in the existing data sets. Analytical results for conventional constituents were comparable to the existing water quality data. For the CEC analyses, 34 analytes were detected in the Turlock tertiary effluent and/or Modesto secondary effluent samples with most analytes being detected in the samples from both locations. In the samples from the China Island delivery point, the DMC, the PID canal, nine analytes were detected using the analysis for CECs and included both herbicides/pesticides and constituents that are likely originate from wastewater effluent (such as caffeine and the artificial sweetener sucralose). The detection of these analytes is to be expected as wastewater treatment plants discharge to the source waters for the DMC and the PID Main Canal.

Based on the analyses conducted for this project, recycled water is a viable water supply option for the refuges to meet contractual obligations under CVPIA, and the existing DMC, along with new pump stations and pipelines necessary to convey recycled water to the DMC, would be the preferred delivery mechanism for water to the refuges. Thus, it is recommended that USBR further considers this option. The next steps to move forward with this project include:

- Establish relationships with NVRRWP partners to discuss participation in the NVRRWP and confirm availability/quantity of recycled water flows
- Confirm permitting viability of discharging Title 22 recycle water to the DMC with the Regional Water Quality Control Board (RWQCB) and California Department of Public Health (CDPH)
- Obtain USFWS concurrence on use of recycled water in refuges
- Participate in implementation planning being proposed by the NVRRWP partners, including:
  - Engineering/alignment studies for the proposed, new conveyance infrastructure
  - Environmental documentation (in compliance with the National Environmental Policy Act [NEPA] and California Environmental Quality Act [CEQA])
  - Funding availability determination
- Confirm viability of facilities associated with delivery to the DMC
- Confirm cities can secure water right for diversion of recycled water out of San Joaquin River

There are more than 40 National Wildlife Refuges (NWR) and Wildlife Areas (WA) in California. A subset of these units within the Central Valley is

considered Central Valley Project Improvement Act (CVPIA)[1] units or "refuges[2]" (see Figure 1-1). Within the Central Valley, there are 12 Federal NWR/units, six state wildlife areas/units, and one privately-managed complex within the Grassland Resource Conservation District. The units south of the Delta are summarized in Table 1-1 below.

[1] The CVPIA is a multipurpose water legislation which was signed into law on October 30, 1992. It contains 40 separate titles providing for water resource project throughout the West. Title 34, the Central Valley Project Improvement Act, mandates changes in management of the Central Valley Project, particularly for the protection, restoration, and enhancement of fish and wildlife. Provisions of the CVPIA authorized water supplies for those wetland areas covered by the *USBR Report on Refuge Water Supply Investigations – Central Valley Hydrologic Basin, California* (USBR, 1989) and the San Joaquin Basin Action Plan, and required the investigation of water and conveyance needs for private wetlands. Specifically, the CVPIA required Reclamation to supply more than 133,000 AF of Level 2 water annually to 19 Central Valley wildlife refuges and wildlife areas and fix plumbing problems that affect water delivers to refuges by 2020.

[2] The term "refuges" is used generally to refer to the 19 CVPIA identified wetland habitat areas, including NWRs, State Wildlife Areas (WA), and the private wetland area within the Grasslands Resources Conservation District.

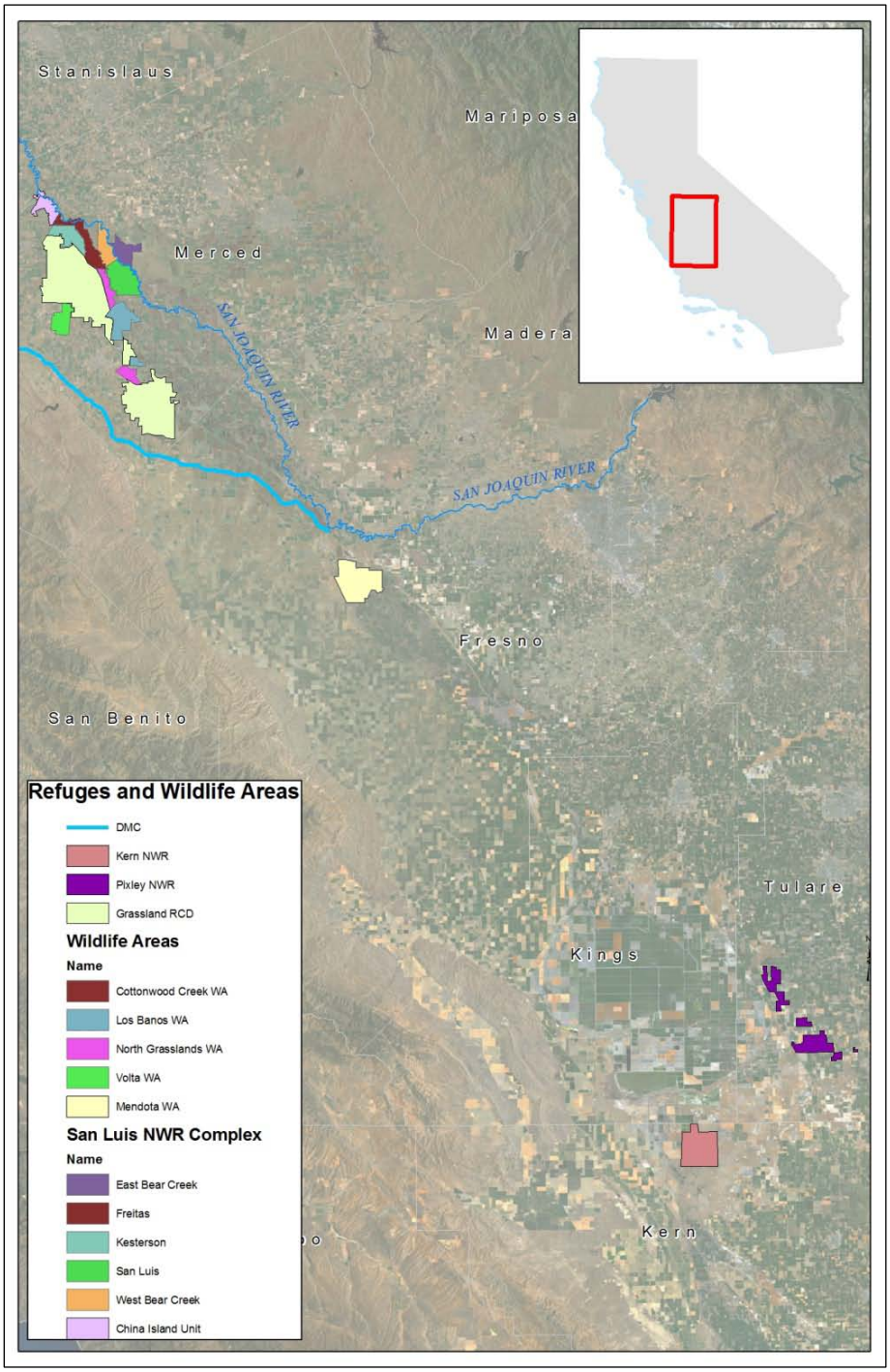


**Figure 1-1 Existing CVPIA Units / Refuges within the Central Valley**

**Table 1-1 South of the Delta CVPIA Units / Refuges**

| National Wildlife Complex and Refuges | Wildlife Areas | Other |
|---|---|---|
| San Luis National Wildlife Complex<br>• San Luis NWR<br>o East Bear Creek Unit<br>o Freitas Unit<br>o Kesterson Unit<br>o San Luis Unit<br>o West Bear Creek Unit<br>• Merced NWR<br>Pixley NWR<br>Kern NWR | Volta WA<br>Mendota WA<br>Los Banos WA<br>North Grasslands WA<br>• Salt Slough Unit<br>• China Island Unit | Grassland Resources Conservation District |

*Source: Reclamation and USFWS 2012. (The Refuge Water Supply Program – 2013 Annual Work Plan CVPIA 3406 (b)(3) & (d)(1)(2)(5) presentation); USFWS and CDFW.*
*Notes: NWR = National Wildlife Refuge; WA = Wilderness Area*

The United States Bureau of Reclamation (Reclamation or USBR) has a contractual obligation under the CVPIA, and in cooperation with the U.S. Fish and Wildlife Service (USFWS) and the California Department of Fish and Wildlife (CDFW, formerly California Department of Fish and Game - CDFG), to provide firm, average annual historical water deliveries (Level 2, or L2) of suitable quality to maintain and improve habitat areas on certain Federal and State wildlife refuges in the Central Valley. In addition to L2 deliveries, an additional increment of water supply is needed for optimal wildlife management (incremental Level 4, or IL4). There are various sources of IL4 water supply. Reclamation has entered into five long-term water supply contracts with Grassland Water District (GWD), USFWS and CDFW which established Reclamation's commitment to the CVPIA delivery mandates[3]. Currently, nine long-term conveyance agreements (15-50 years) are utilized to convey CVPIA surface water supplies to the refuges. Reclamation administers eight of these agreements, and USFWS administers one of these agreements. The Program utilizes cooperative agreements to reimburse delivering entities for costs of conveying L2 and IL4 water supplies through Federal, State, and private water distribution systems to the refuges.

Figure 2 shows the breakdown of Level 2 and Level 4 water demands for the CVPIA units according to Reclamation's Report on Refuge Water Supply Investigations (1989). Based on information provided by Reclamation for the period of March 2012 thru February 2013, the CVPIA units in San Joaquin Valley would need a combined Level 2 supply of 271,001 acre-feet (AF) and an incremental Level 4 supply of 105,514 AF[4]. The actual deliveries of IL4 water during the 2012-2013 water year were only 42,700 AF, falling short of the optimum deliveries.

[3] USBR. 2012. Draft CVPIA Fiscal Year 2013 Annual Work Plan. August 22.
[4] USBR. 2013. Monthly Water Use & Scheduled Water (100% Level 2) – As delivered through March 31, 2013. 2012-2013.

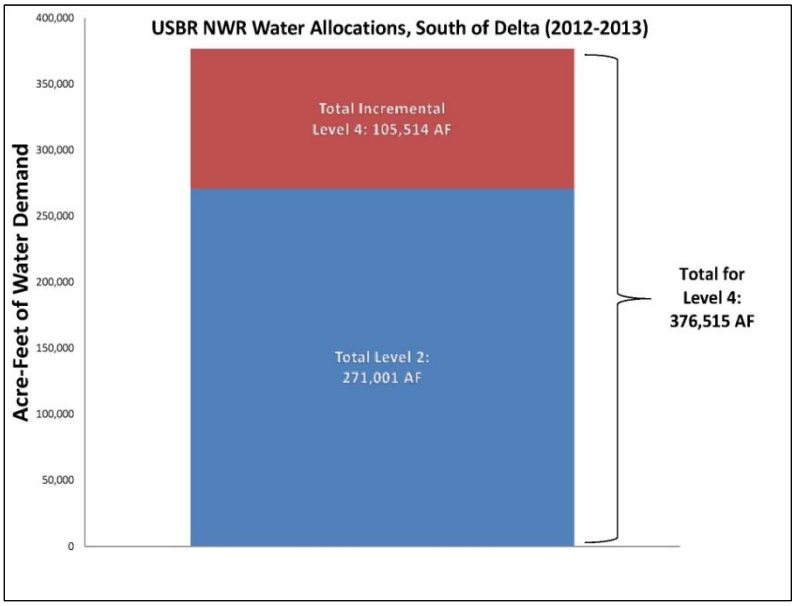


**Figure 1-2 Refuges Water Demand**

The NVRRWP could be an opportunity for the units south of the Delta to receive additional water toward meeting their full water allocations. Delivery of recycled water to Grassland Resource Conservation District (GRCD) wetlands, and therefore to a number of the South of Delta refuges, could be provided through, connection to the NVRRWP recycled water project via a new pipeline, or by using the Delta-Mendota Canal (DMC) for conveyance.

## CVPIA Units / Refuges

### San Luis NWR Complex[5]

The San Luis NWR Complex, managed by USFWS, includes the San Luis NWR, Merced NWR, San Joaquin River NWR, and Grasslands Wildlife Management Area. San Luis NWR and Merced NWR are described further below. San Luis Refuge is approximately 10 miles north of Los Banos, California. It encompasses over 26,800 acres of wetlands, riparian forests, native grasslands, and vernal pools[6]. The NWR supports populations of endemic tule elk and is host to assemblages of birds, mammals, reptiles, amphibians, fish, insects, and plants; some of which are endangered species. The NWR is a major wintering ground and migratory stopover point for large concentrations of waterfowl, shorebirds, and other water birds. The San Luis NWR includes the East Bear Creek Unit, Freitas Unit, Kesterson Unit, San Luis

[5] A National Wildlife Refuge Complex is an administrative grouping of two or more refuges, wildlife management areas or other refuge conservation areas that are primarily managed from a central location because they occur in a similar ecological region, such as a watershed or specific habitat type, and have a related purpose and management needs.

[6] USFWS. 2012. San Luis National Wildlife Refuge. Last updated December 18. Available at: http://www.fws.gov/Refuge/San_Luis/about.html

Unit, and West Bear Creek Unit. San Luis Refuge is intensively managed to produce optimum wetland conditions for a diversity of migratory birds.

Merced Refuge is approximately eight miles south of Merced on State Highway 59 and eight miles west on Sandy Mush Road. The Merced National Wildlife Refuge encompasses 10,258 acres of wetlands, native grasslands, vernal pools, and riparian areas[7]. The Refuge hosts to the largest wintering populations of lesser Sandhill cranes and Ross' geese along the Pacific Flyway. The Refuge also provides important breeding habitat for other birds.

## Pixley NWR

Pixley National Wildlife Refuge, managed by USFWS, is located 35 miles south of Tulare, and 45 miles north of Bakersfield in the San Joaquin Valley, California[8]. The 6,389-acre refuge represents one of the few remaining examples of the grasslands, vernal pools, and playas that once bordered historic Tulare Lake. Over 100 bird and six reptile species use the refuge. Approximately 300 acres of managed wetlands provide habitat for migratory waterfowl and shorebirds. The primary management focus of the refuge is to maintain and restore native habitats including wetlands and upland habitat.

## Kern NWR

Kern National Wildlife Refuge, managed by USFWS, is located approximately 20 miles west of the City of Delano[9]. The Refuge consists of 11,249-acres of natural desert uplands, a relict riparian corridor, and developed marsh[10]; it is situated on what was once the largest freshwater wetland complex in the western United States, Kern Refuge provides optimum wintering habitat for migratory birds with an emphasis on waterfowl and water birds. Through restoration and maintenance of native habitat diversity, the refuge also provides suitable habitat for several endangered species as well as preserving a remnant example of the historic valley uplands in the San Joaquin Desert.

## Wildlife Areas

### *Volta*

Volta WA, managed by CDFW, is located approximately 0.75 mile north of Volta[11]. Volta WA consists of 2,891 acres of managed marsh and valley alkali shrub, which support 150 species of birds including large numbers of waterfowl and shorebirds.

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[7] USFWS. No Date. Merced National Wildlife Refuge. Available at: http://www.fws.gov/refuges/profiles/index.cfm?id=81652
[8] USFWS. No date. Pixley National Wildlife Refuge. Available at: http://www.fws.gov/refuges/profiles/index.cfm?id=81612
[9] USFWS. No Date. Kern National Wildlife Refuge. Available at: http://www.fws.gov/refuges/profiles/index.cfm?id=81610
[10] USFWS. 2011. Kern National Wildlife Refuge. Last updated January 3. Available at: http://www.fws.gov/kern/refuges/kern/
[11] CDFW. No Date. Volta Wildlife Area – Merced County. Available at: http://www.dfg.ca.gov/lands/wa/region4/volta.html

### *Mendota WA*

Mendota WA, managed by CDFW, is located approximately three miles south of Mendota near Whites Bridge. It consists of 11,802 acres with flatlands and floodplain.

### *Los Banos WA*

Los Banos WA, managed by CDFW, is located approximately four miles northeast of Los Banos[12]. Los Banos WA was the first of a series of waterfowl refuges established throughout the state to manage habitat for wintering waterfowl and consists of more than 6,217 acres of wetland habitat which includes lakes, sloughs and managed marsh. The Refuge supports over 200 species of birds.

### *North Grasslands Wildlife Area*

The North Grasslands WA, managed by CDFW, is located approximately six miles north of Los Banos[13]. It consists of 7,069 acres of wetlands, riparian habitat and uplands, which support Swainson's hawk and sandhill crane. The North Grasslands WA includes China Island Unit and Salt Slough Unit.

## Other Units

### *GRCD*

The GRCD comprises approximately 60,000 acres of habitat land[14] and is composed of privately-owned hunting clubs and other privately-owned wetland areas, as well as all or portions of several state wildlife areas (such as Volta Wildlife Area [WA], Los Baños WA, Mud Slough Unit, Gadwall Unit, and Salt Slough Unit) and federal wildlife refuges (such as San Luis NWR)[15]. The area is the largest contiguous block of wetlands remaining in California's Central Valley and is a major wintering ground for migratory waterfowl and shorebirds of the Pacific Flyway. Up to 30 percent of the Central Valley's wintering population of ducks use this area. USFWS ranks the habitat provided by the GRCD as the most important complex of wetlands in the San Joaquin Valley.

Lands within the GRCD are primarily managed for waterfowl habitat. The GWD has a Water Management Plan, but no overall habitat management plan exists for the GRCD because of the large number of individual property owners. The management objectives of the GRCD include an active program to encourage natural food plant and habitat protection. Land uses include seasonally flooded wetlands, moist soil impoundments, permanent wetland, irrigated pasture, and croplands.

[12] CDFW. Not Date. Los Banos Wildlife Area – Merced County. Available at: http://www.dfg.ca.gov/lands/wa/region4/losbanos.html
[13] CDFW. No Date. North Grasslands Wildlife Area – Merced and Stanislaus County. Available at: http://www.dfg.ca.gov/lands/wa/region4/northgrasslands.html
[14] Habitat types within the complex include seasonal wetlands, permanent wetland, semi-permanent wetland, reverse cycle wetlands, riparian, irrigated pasture, and upland.
[15] Grassland Water District. 2013. About Grassland. Available at: http://gwdwater.org/about/grcd.php5

The GRCD contains most of the 51,530 acre Grasslands Water District. The GWD is a legal entity that was established under section 34000 of the California Water Code to receive and distribute CVP water. The GWD delivers CVP water to the wetland areas within its boundaries. The GWD contains approximately 165 separate ownerships, most of which are duck clubs. Perpetual easements have been purchased by the USFWS to help preserve wetland-dependant migratory bird habitat on approximately 31,000 acres serviced by the GWD. These easements authorize the USFWS to restrict land uses that would diminish wetland habitat values.

## Need for Additional Water Supply

Reclamation is striving to secure firm, reliable water supplies for the refuges to meet the CVPIA mandated water levels, which have not been achieved "due in large part to state and federal budget shortages, inconsistency in the timing of water deliveries, and increases in the costs of blocks of water made available annual from willing sellers on the open market[16]." For the refuges south of the Delta, a total allocation of 271,001 AF of Level 2 and 105,514 AFY of Level 4 water supplies were identified[17]. For the March 2012 to February 2013 period, the region received a total of 312,990 AF of water, which exceeded Level 2 water requirements for all of refuges except Pixley NWR (no Level 2 water was delivered to Pixley NWR during this period[18]). However, the lack of full acquisition of Level 4 water supplies by Reclamation affects the refuges' ability to provide optimum habitat management.

## Potential Sources of Water Supply

A potential source of supply for the refuges south of the Delta is recycled water obtained through the NVRRWP. The NVRRWP is being developed as a regional solution to address south of the Delta water supply shortages and reliability concerns by utilizing recycled water for beneficial uses. The proposed NVRRWP would deliver recycled water produced by the Cities of Modesto and Turlock to the DPWD, a CVP agricultural water service contractor.

Located in western San Joaquin, Stanislaus, and Merced Counties, DPWD delivers water directly from the DMC to 45,000 acres of farmland between Vernalis on the north and Santa Nella to the south. As a CVP water contractor

[16] Central Valley Joint Venture. 2006. 2006 Implementation Plan. Available at: http://www.centralvalleyjointventure.org/assets/pdf/CVJV_fnl.pdf

[17] USBR. 2013. Monthly Water Use & Scheduled Water (100% Level 2) – As delivered through March 31, 2013. (Provided by USBR)

[18] Since passage of the CVPIA, Pixley NWR has been completely dependent upon a single groundwater well on the refuge, providing its only reliable water supplies, averaging 12 percent of Pixley NWR's CVPIA allocation since 2002. Production from new groundwater starting in 2013 will provide the full L2 supplies on an annual basis for this refuge although there is concern that using groundwater for the full L4 allocation may result in potential overdraft of the regional aquifer (USBR. 2012. Draft CVPIA Fiscal Year 2013 Annual Work Plan. August 22).

located south of the Delta, DPWD has experienced significant shortages and decreased reliability in the quantity of water it receives annually under the terms of its federal water service contract.

Because DPWD does not have an alternate water supply, shortages in CVP deliveries have resulted in serious economic hardship not only on DPWD growers but on the region in general, including several Disadvantaged Communities. To address this situation, the NVRRWP is considering using recycled water to augment and provide a more reliable supply of irrigation water to DPWD.

Recycled water may also be available for the refuges south of the Delta. On an annual basis, the total 2012-2013 IL4 water delivery to the San Joaquin Valley refuges was 36,600 AFY while the optimum IL4 water demand is 105,514 AFY, leaving an IL4 shortfall of approximately 70,000 AFY. Assuming the NVRRWP comes on line in 2018 there would be an estimated 12,100 AFY of potentially available NVRRWP flow during the non-irrigation season. If this water is available to Reclamation and was delivered to the refuges, it would meet 17 percent of the 2012-2013 IL4 shortage. As the project flows increase to build-out in 2045, the potentially available NVRRWP flows would increase to approximately 29,400 AFY, which is 42 percent of the 2012-2013 IL4 shortage (as shown in the chart below). The NVRRWP recycled water is produced year round. However, because the agricultural irrigators have their greatest need during the dry season (March to November), the potentially available NVRRWP flows would be available during the wet season (November to February) only. One of the advantages of using the DMC for conveyance is that the DMC facilities could be used as storage for the NVRRWP flows, making them available year-round for use. See Chapter 2 for details.

Participants in the NVRRWP currently include the Cities of Modesto, Turlock, Ceres, Stanislaus County, and Del Puerto Water District (DPWD) on the west side of the San Joaquin Valley within Stanislaus County; Figure 3 shows the location of the cities relative to the GRCD complex. The cities of Modesto and Turlock provide wastewater treatment for their own metropolitan areas as well as smaller communities in Stanislaus County. Title 22 treated recycled water from Turlock and Modesto is currently discharged to the San Joaquin River or via land application to agricultural crops.

### City of Modesto

The City of Modesto provides sewerage service for the City of Modesto, the community of Empire, and a portion of the City of Ceres, serving a population of approximately 225,000[19]. The City owns and operates its secondary and tertiary treatment plants at the Jennings Road facility.

At present, the Modesto WQCF can produce 2,600 acre-feet/year (2.3 MGD) tertiary-treated effluent that meets Title 22 standards for unrestricted non-

[19] RWQCB. 2012. City of Modesto Water Quality Control Facility. ORDER R5-2012-0031, NPDES NO. CA0079103. Available at: http://www.swrcb.ca.gov/rwqcb5/board_decisions/adopted_orders/stanislaus/r5-2012-0031.pdf

potable reuse. By 2018 and 2045 (build-out), the City will have available 16,500 AFY and 30,600 AFY of NVRRWP flows.

### City of Turlock

The City of Turlock provides wastewater treatment for the City of Turlock and the community service districts of Keyes and Denair and a portion of the City of Ceres, with a total population of approximately 78,000 people[20]. By 2018, the City of Turlock will have available 14,100 AFY of NVRRWP flows. By build-out, the City will have 28,400 AFY of NVRRWP flows. This increase in flows includes a projected transfer of 4,500 AFY of flow to the Turlock treatment plant when the City of Ceres ceases operation of its existing pond treatment and disposal system. The December 2012 Ceres Sewer Master Plan envisions a purchase of a further 4 MGD of flow from Turlock. This would increase Ceres' wastewater flow to Turlock to 6 MGD, the maximum capacity of the pipeline in place. The Ceres' plan notes that this is a longer-term project, occurring after the year 2022.

[20] RWQCB. 2010. City of Turlock Water Quality Control Facility. ORDER R5-2012-0079, NPDES NO. CA0078948. Available at: http://www.swrcb.ca.gov/rwqcb5/board_decisions/adopted_orders/stanislaus/r5-2012-0031.pdf

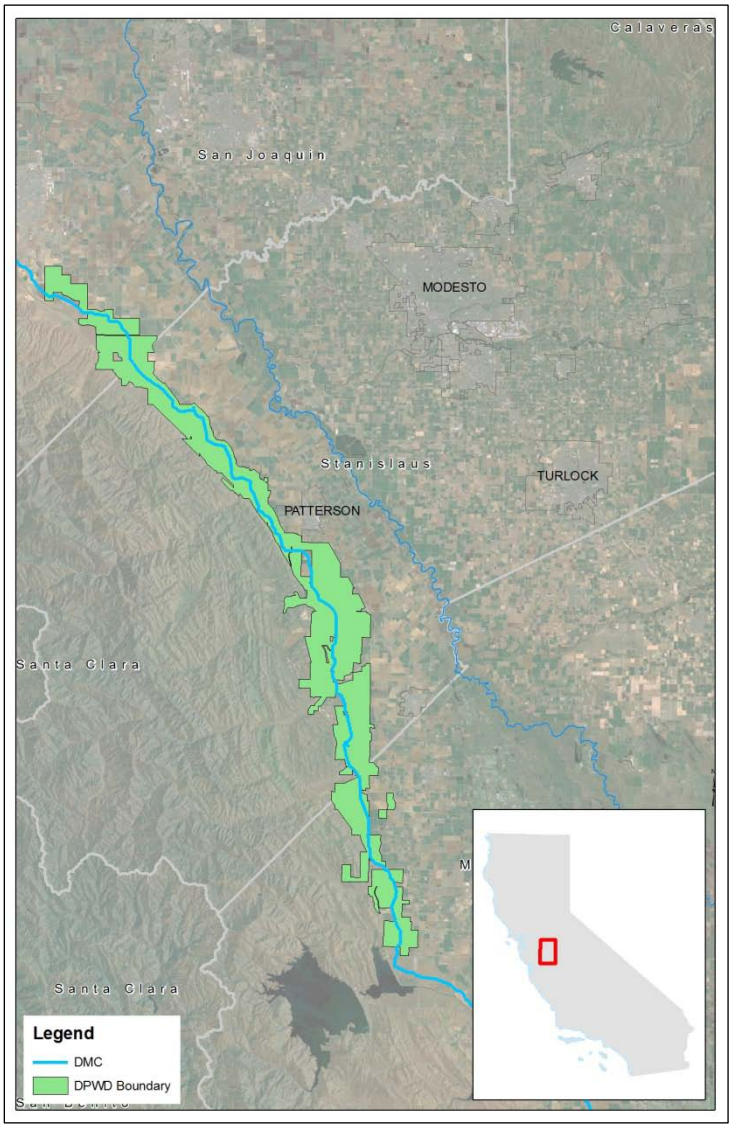


**Figure 1-3 NVRRWP Recycled Water Providers and Participants**

## Water Conveyance

The following sections provide a description of existing facilities that may be used in part to convey/store NVRRWP water to Reclamation and the refuges and results of the conveyance alternatives analysis. A map of the existing facilities and their proximity to the refuges and DPWD is presented in Figure 4.

Two main alternatives have been evaluated for conveyance of NVRRWP water to the refuges; a direct pipeline that would serve both DPWD and the refuges, or conveyance of the NVRRWP through the DMC. These alternatives are

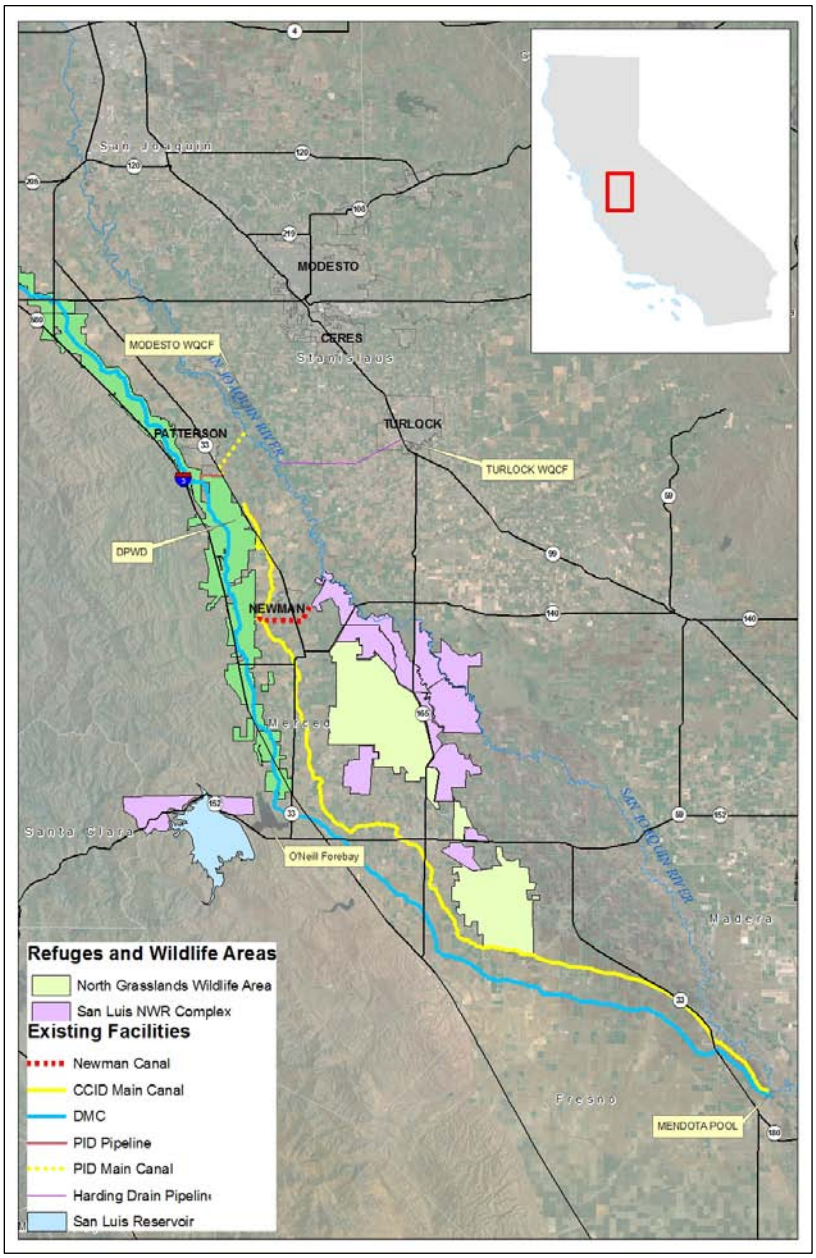


**Figure 1-4 Map of Existing Facilities**

described in detail in Chapter 3, Refuge Conveyance Facilities. Of those alternatives, using the DMC for conveyance is by far the more cost-effective option. The alternative would utilize the following existing facilities.

- Delta-Mendota Canal (DMC) and Mendota Pool
- San Luis Reservoir
- CCID and the Newman Canal

## Delta-Mendota Canal and Mendota Pool

The DMC is being considered as the most cost-effective facility for conveyance of water for the NVRRWP to DPWD and refuges. Currently, the DMC is the primary source of water for both DPWD and the refuges.

The DMC, a CVP facility operated and maintained by the San Luis and Delta-Mendota Water Authority under contract with Reclamation, is a 117 mile-aqueduct in central California that has a maximum capacity of 4,600 cubic feet per second (cfs) and gradually decreases to 3,211 cfs at its terminus[21] (see Figure 2).

The canal begins at the C.W. Bill Jones Pumping Plant (formerly the Tracy Pumping Plant), which pumps water from the Sacramento-San Joaquin Delta. The canal runs south along the western edge of the San Joaquin Valley, parallel to the California Aqueduct for much of its length, but diverges to the east after passing San Luis Reservoir, which receives some a portion of its water from the DMC (the remaining portion of water flowing into San Luis Reservoir comes from the California Aqueduct). The water is pumped from the canal into O'Neill Forebay, and then is pumped into San Luis Reservoir by the Gianelli Pumping-Generating Plant. Occasionally, water from O'Neill Forebay is released into the canal. The Delta–Mendota Canal ends at the Mendota Pool, a small reservoir created by Mendota Dam on the San Joaquin River near the town of Mendota, approximately 30 miles west of Fresno.

The DMC is also hydraulically connected with the SWP California Aqueduct via an intertie with a pumping station and two 108-inch diameter pipes west of the City of Tracy.

## San Luis Reservoir

The DMC is connected to the San Luis Reservoir midway along the length of the canal. The 2 million acre feet San Luis Reservoir is an artificial lake on San Luis Creek in the eastern slopes of the Diablo Range of Merced County that is jointly owned and operated by Reclamation and DWR and is one of California's largest reservoirs[22]. During the summer or dry season, water in the San Luis Reservoir is used by CVP contractors (as well as State Water Project contractors). Occasionally, water from O'Neill Forebay is released into the canal. South of the O'Neill Forebay, the DMC diverges from the path of the California Aqueduct and heads east towards its end point at the Mendota Pool.

## CCID and the Newman Canal

The Central California Irrigation District (CCID)-owned Main Canal begins at the Mendota Pool. This unlined canal conveys water north for roughly 80 miles, providing irrigation water along its route.

[21] Wikipedia. 2013. Delta-Mendota Canal. Last updated April 20. Available at: http://en.wikipedia.org/wiki/Delta%E2%80%93Mendota_Canal

[22] Santa Clara Valley Water District. 2013, Available at: http://www.valleywater.org/Services/SanLuisReservoirLowPointImprovement.aspx

The Newman Canal is a concrete lined, open channel canal that receives its source water from the DMC through a wheeling agreement with Central California Irrigation District (CCID) and the use of their Main Canal[23]. The wheeling point along CCID's Main Canal is located approximately 2.5 miles southwest of Newman, CA. This canal travels east from the Main Canal, adjacent to the Newman Wasteway, with the eventual delivery point in the China Island Unit of the North Grasslands Wildlife Area.

The Newman Canal, shown in Figure 1-5, was reconstructed in 2001 to address issues with soil compaction. The resulting canal has a design capacity of 40 cfs. However, with the accumulation of silt and other sediment, the actual maximum operational flow is estimated to be approximately 35 cfs.

**Figure 1-5 Newman Canal at China Island Unit**

## Patterson Irrigation District

The Patterson Irrigation District (PID) is located near the City of Patterson, CA and is bounded by the San Joaquin River to the east and the DMC on the west. PID owns and operates their Main Canal and laterals to serve agricultural users.

PID pumps water from the San Joaquin River into their Main Canal through a series of pump and lift stations. The Main Canal currently has a peak capacity of 200 cfs. The canal begins at the San Joaquin River, just north of the Las Palmas Bridge. The canal alignment heads southwest towards the City of Patterson for approximately 3.3 miles, before heading south along Highway 33. There are

[23] Miyamoto, Steve. 2013. Wildlife Habitat Supervisor of the USFWS China Island Unit. Conversation with Ryan Doyle (RMC Water and Environment)

five lift stations along the main canal. The Main Canal supplies 13 lateral canals that distribute water north and south from the main canal. At the west end of the PID Main Canal up to 35 cfs can be conveyed to the DMC via a 30" pipeline allowing for inter-agency transfers through a Warren Act Agreement. Figure 1-6 shows the PID pipeline diverting water into the DMC.

The PID Main Canal was originally constructed in the 1920s. PID has a pre-1914 water right to draw surface water from the San Joaquin River. PID recently completed construction of a new fish screen and main pump station, located on the San Joaquin River and discharging to the PID Main Canal. PID is projected to begin an overhaul of the rest of its system to increase conveyance capacity as well as increase conveyance reliability within the coming years. Efforts are underway to coordinate with PID to obtain a more precise schedule for this upgrade to evaluate whether the NVRRWP water may be conveyed in the PID Main Canal for delivery to the DMC.

**Figure 1-6 PID Main Canal Diversion into DMC**

## Conveyance Options

The Refuge Conveyance Facilities chapter evaluated two options for conveying NVRRWP flows to the refuges. The alternatives and a brief description are provided below:

- **DMC to the Mendota Pool:** recycled water from the Turlock and Modesto WQCF would be conveyed through 26,800 ft of 36-inch pipelines to a combined pump station located near West Main Avenue east of the San Joaquin River. The combined flows would be pumped through a 34,300 ft long, 48-inch pipeline which crosses the San Joaquin River at Las Palmas Bridge. The pipeline would then parallel the PID Main Canal, cross Highway 33, and end at the DMC where the recycled water would discharge into the DMC.
- **Direct pipeline to the refuges via the CCID Newman Canal:** this alternative would follow the DMC alignment described previously up to the DMC right-of-way. Once the alignment reaches the DMC right of

way, the 48" pipeline would turn south and follow the east bank of the DMC for an additional 10,500 feet to the southern Stanislaus County border to serve the majority of south DPWD demands. To reach the refuge (China Island Unit) facilities, there would be a 48 inch tee near the City of Newman, CA that would extend east for approximately 6,400 ft. This tee would eventually end at the CCID Main Canal where the Newman Canal would be used to convey the project water to the refuges.

The alternatives were evaluated to identify potential fatal flaws, identify key elements and features, and develop a preliminary construction cost estimate. Potential pipeline routes were evaluated relative to the following criteria:

- Cost
- Constructability
- Schedule

The analysis determined the DMC conveyance is the preferable option because it provides the following advantages:

- Since NVRRWP water availability in the winter months exceeds the refuges' IL4 demands, the CVP/DMC facilities provide seasonal storage so that the NVRRWP water can be used by the refuges and DPWD when needed to help meet their peak demand periods;
- It allows all refuges south of the Delta to receive NVRRWP water; and
- The DMC alternative is more cost-effective than the Direct Pipeline to the Refuges alternative. The DMC alternative would have a capital cost of $89M compared to $207M for the Direct Pipeline alternative.

## Water Quality

Tertiary treated recycled water from the NVRRWP must meet the requirements established in Title 22 of the California Code of Regulations. The recycled water quality is typically better than San Joaquin River water quality. Reclamation has established water quality standards for the Groundwater Pump-In Program, but does not have any existing standards for other sources of water that are or may be introduced into the DMC. In the absence of any other water quality standards, the water quality standards established in the Groundwater Pump-In Program have been utilized as a basis for evaluating introduction of recycled water into the DMC Recycled water from the NVRRWP, when blended with water from the DMC, will comply with Reclamation's Groundwater Pump-In water quality standards for the Upper DMC. With one exception, the recycled water quality also complies with the USBR's current water quality standards for acceptance into the Upper DMC. Both sets of standards are in place to regulate the practice of pumping well water into the DMC under Warren Act Contracts, and are not necessarily applicable to

recycled water. Of the 48 constituents covered by these standards, only the sodium content is expected to exceed Reclamation's standards for acceptance into the DMC. Selenium, a constituent of concern for recycled water use at wildlife refuges, is present in NVRRWP recycled water at a concentration comparable to the existing DMC water quality (0.8 µg/L). The same is true for boron and arsenic. Recycled water would be delivered to the refuges after mixing with the existing water in the DMC. The recycled water generated from the NVRRWP is not expected to produce a significant change in water quality to downstream DMC users. See the chapter on Water Quality Analysis for details.

## Recommendation

Based on the analyses conducted for this project, recycled water is a viable water supply option for the refuges. Specifically, recycled water developed as part of the NVRRWP could provide a reliable refuge water supply. Direct delivery via the DMC would require additional infrastructure, but would be more cost-effective than other conveyance alternatives. Thus, it is recommended that USBR further considers this option and the next steps to move forward with this project:

- Establish relationships with NVRRWP partners to discuss participation in the NVRRWP and confirm availability/quantity of recycled water flows
- Confirm permitting viability of discharging Title 22 recycle water to the DMC with the Regional Water Quality Control Board (RWQCB) and California Department of Public Health (CDPH)
- Obtain USFWS concurrence on use of recycled water in refuges
- Participate in implementation planning being proposed by the NVRRWP partners, including:
  - Engineering/alignment studies for the proposed, new conveyance infrastructure
  - Environmental documentation (in compliance with the National Environmental Policy Act [NEPA] and California Environmental Quality Act [CEQA])
  - Funding availability determination
- Confirm viability of facilities associated with delivery to the DMC
- Confirm cities can secure water right for diversion of recycled water out of San Joaquin River

# Chapter 2
# Water Demand Analysis

## Summary of Findings

The North Valley Regional Recycled Water Program (NVRRWP) represents a significant new water source which could help meet both agricultural irrigation demands in the Del Puerto Water District (DPWD) and incremental Level 4 (IL4) water demands in the wildlife refuges south of the Delta. Using the Central Valley Project (CVP) Delta-Mendota Canal (DMC) as the conveyance method for recycled water allows the NVRRWP water that may be in excess of monthly DPWD demands to be stored within the CVP system where it can be used on a schedule that best fits DPWD or other users needs.

On an annual basis, the total 2012-2013 IL4 water delivery to the San Joaquin Valley refuges was 36,600 AFY while the optimum IL4 water demand is 105,514 AFY, leaving an IL4 shortfall of approximately 70,000 AFY. Assuming the NVRRWP comes on line in 2018, and depending on the amount of recycled water delivered to DPWD, there could be an estimated 12,100 AFY of potentially available NVRRWP flow available for the refuges, which would meet 17 percent of the 2012-2013 IL4 shortage. As the program flows increase to build-out in 2045, the potentially available NVRRWP flows would increase to approximately 29,400 AFY, which is 42 percent of the 2012-2013 IL4 shortage.

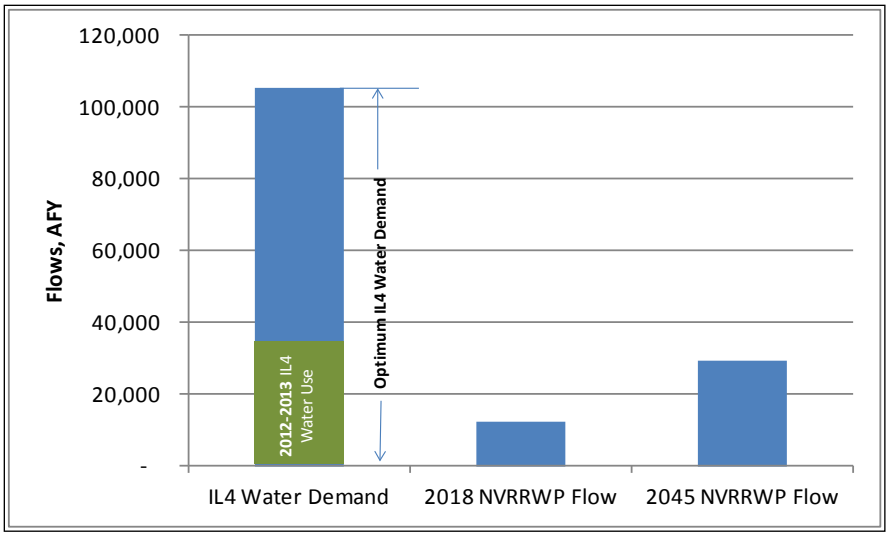


**Figure 2-1 NVRRWP Flows and IL4 Water Demands**

## Introduction

This chapter summarizes and compares the current National Wildlife Refuge (NWR) water demands to the DPWD demands and to the recycled water supply available from the NVRRWP.

## Refuge Water Use

Information on the timing and quantity of current refuge supplies has been provided by Reclamation and is shown on Table 2-1 for water year 2012-2013. Since the preferred conveyance option for NVRRWP water is via the DMC, the recycled water could be used for all of the refuges south of the Sacramento-San Joaquin Delta (south of the Delta). Therefore the total water use for the refuges[24] potentially served by this program is assumed to be the sum of the San Joaquin Valley as presented in Table 1.

Table 2-1 shows both the Level 2 (L2) and IL4 water deliveries for water year 2012-2013 as well as the full L2 and IL4 demands as established in the Report on Refuge Water Supply Investigations (USBR, 1989) L2 is defined as the amount of water required for minimum wetlands and wildlife habitat management based on historic average annual deliveries before 1989 while full Level 4 is the total annual amount of water identified for optimum wetland and wildlife habitat development and management[25]. IL4 water is the difference between L2 and Full Level 4 water uses. The IL4 water is acquired through voluntary measures such as conservation, conjunctive use, purchase, lease, donation, or similar activities. This study assumes that the NVRRWP recycled water would be one of the sources for the IL4 water use in the refuges. Therefore, subsequent comparisons of water supplies in this chapter focus on the IL4 water demands.

For water year 2012-2013 the total IL4 water delivery was 36,600 acre feet per year (AFY) which was distributed over the monthly basis shown on Figure 2-1 and Table 2-2. However, the optimum IL4 demand that was established in the Report on Refuge Water Supply Investigations (USBR, 1989) is 105,514 AFY, nearly 70,000 AFY more than the IL4 deliveries in water year 2012-2013.

[24] "refuges" is used generally to refer to the 19CVPIA identified wetland habitat areas, including NWRs, State Wildlife Areas (SWA), and the private wetland area within the Grasslands Resources Conservation District.
[25] USBR and USFWS. 2012. Draft CVPIA Fiscal Year 2013 Annual Work Plan. August 22.

## Table 2-1 Monthly Refuge Water Deliveries (AFM) In Water Year 2012-2013

| | Monthly Water Use for Water Year 2012 - 2013 | | | | | | | | | | | | | | | | | | | | | | | | Total IL4 Demand per 1989 Report, AFY |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mar-12 | | Apr-12 | | May-12 | | Jun-12 | | Jul-12 | | Aug-12 | | Sep-12 | | Oct-12 | | Nov-12 | | Dec-12 | | Jan-13 | | Feb-13 | | |
| Refuge | L2 | IL4 | L2 | IL4 | L2 | IL4 | L2 | IL4 | L2 | IL4 | L2 | IL4 | L2 | IL4 | L2 | IL4 | L2 | IL4 | L2 | IL4 | L2 | IL4 | L2 | IL4 | |
| **San Luis NWR Complex** | | | | | | | | | | | | | | | | | | | | | | | | | |
| - San Luis Unit | 1,854 | | 800 | | 1,300 | | 1,000 | | 800 | | 300 | | 1,800 | | 3,500 | | 2,500 | | 1,946 | | 1,800 | | 1,400 | | 0 |
| - West Bear Creek Unit | 300 | | 600 | | 550 | | 800 | | 500 | | 500 | | 300 | | 1,000 | | 1,100 | | 800 | | 400 | | 357 | | 3,603 |
| - East Bear Creek Unit | 0 | | 500 | | 800 | | 600 | | 200 | | 400 | | 900 | | 1,100 | | 1,100 | | 1,450 | | 1,000 | | 813 | | 4,432 |
| - Kesterson Unit | 1,014 | | 600 | | 1,043 | | 700 | | 500 | | 500 | | 1,450 | | 2,000 | | 1,300 | | 1,050 | | 511 | | 408 | | 0 |
| - Freitas Unit | 400 | | 200 | | 400 | | 500 | | 200 | | 200 | | 200 | | 450 | | 550 | | 800 | | 840 | | 550 | | 0 |
| Merced NWR | 1,752 | | 0 | 1,000 | 100 | 1,500 | 1,600 | 0 | 1,400 | | 1,600 | | 1,900 | | 2,400 | | 900 | | 900 | | 500 | | 448 | | 2,500 |
| Kern NWR | 0 | | 0 | | 0 | 183 | 0 | 100 | 0 | 100 | 3,000 | 143 | 1,000 | 1,600 | 1,155 | 1,600 | 1,395 | 1,549 | 1,000 | | 1,800 | | 600 | | 15,050 |
| Pixley NWR | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 4,720 |
| Volta WA | 112 | | 200 | | 0 | | 250 | | 1,127 | | 1,700 | | 2,700 | | 3,000 | | 1,600 | | 800 | | 800 | | 800 | | 3,000 |
| Los Banos WA | 664 | 45 | 500 | 200 | 300 | 555 | 600 | 0 | 800 | 0 | 1,800 | 500 | 3,000 | 400 | 4,200 | 130 | 2,100 | 0 | 1,500 | 0 | 1,500 | 0 | 370 | 255 | 8,330 |
| **Subtotal San Luis NWR** | 6,096 | 45 | 3,400 | 1,200 | 4,493 | 2,238 | 6,050 | 100 | 5,527 | 100 | 10,000 | 643 | 13,250 | 2,000 | 18,805 | 1,730 | 12,545 | 1,549 | 10,246 | 0 | 9,151 | 0 | 5,746 | 255 | 41,635 |
| | | | | | | | | | | | | | | | | | | | | | | | | | |
| **N. Grasslands WA** | | | | | | | | | | | | | | | | | | | | | | | | | |
| - China Island Unit | 243 | 441 | 0 | 479 | 0 | 300 | 0 | 355 | 182 | 300 | 1,500 | 0 | 1,000 | 0 | 830 | 0 | 855 | 0 | 950 | 0 | 1,100 | 0 | 550 | 0 | 3,483 |
| -Salt Slough Unit | 216 | 550 | 650 | 200 | 500 | 350 | 0 | 0 | 0 | 0 | 914 | 400 | 750 | 350 | 1,100 | 0 | 800 | 0 | 700 | 0 | 650 | 0 | 400 | 300 | 3,340 |
| Mendota Wildlife Area | 622 | 0 | 704 | 0 | 1,500 | 0 | 2,200 | 0 | 2,500 | 0 | 2,950 | 0 | 5,100 | 0 | 5,680 | 0 | 2,960 | 0 | 1,050 | 0 | 1,200 | 0 | 1,154 | 0 | 2,056 |
| Grassland RCD | 399 | 0 | 0 | 1,225 | 13,000 | 4,141 | 1,200 | 2,160 | 800 | 775 | 4,500 | 2,512 | 53,000 | 3,130 | 41,000 | 3,549 | 9,000 | 1,506 | 4,000 | 1,351 | 2,644 | 1,234 | 0 | 1,160 | 55,000 |
| **Subtotal N. Grasslands WA** | 1,480 | 991 | 1,354 | 1,904 | 15,000 | 4,791 | 3,400 | 2,515 | 3,482 | 1,075 | 9,864 | 2,912 | 59,850 | 3,480 | 48,610 | 3,549 | 13,615 | 1,506 | 6,700 | 1,351 | 5,594 | 1,234 | 2,104 | 1,460 | 63,879 |
| **TOTAL** | **7,576** | **1,036** | **4,754** | **3,104** | **19,493** | **7,029** | **9,450** | **2,615** | **9,009** | **1,175** | **19,864** | **3,555** | **73,100** | **5,480** | **67,415** | **5,279** | **26,160** | **3,055** | **16,946** | **1,351** | **14,745** | **1,234** | **7,850** | **1,715** | **105,514** |
| **TOTAL ANNUAL L2 WATER DELIVERY, AFY** | **276,362** | | | | | | | | | | | | | | | | | | | | | | | | |
| **TOTAL ANNUAL IL4 WATER DELIVERY, AFY** | **36,628** | | | | | | | | | | | | | | | | | | | | | | | | |

*Notes:*
As Delivered through March 31, 2013. At the Refuge boundary without conveyance losses - Water Year 2013-2014
*Source:* USBR. 2013. Monthly Water Use & Scheduled Water (100% Level 2) – As delivered through March 31, 2013.

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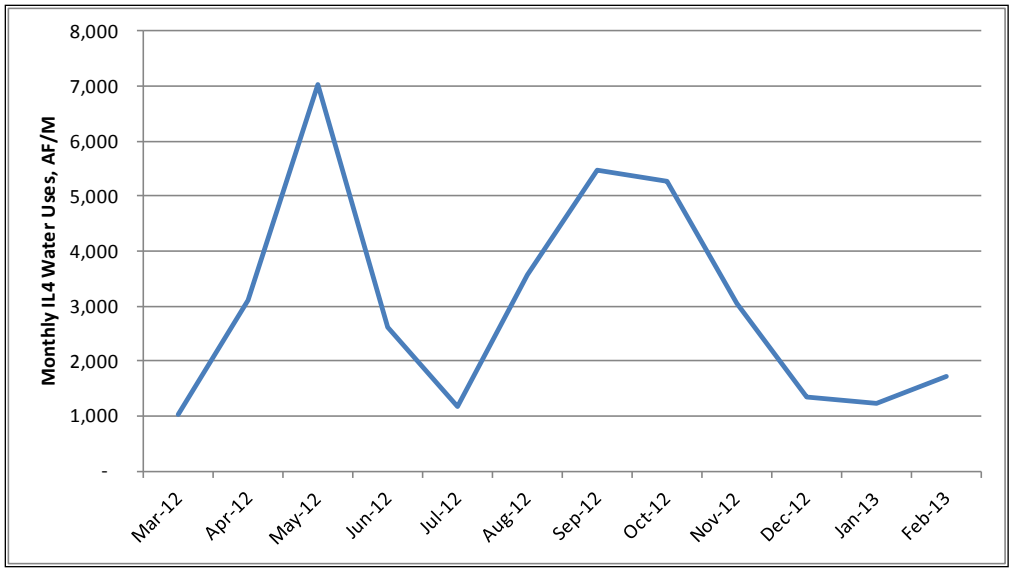


**Figure 2-2 Monthly IL4 Water Deliveries to San Joaquin Valley Refuges in Water Year 2012-2013**

**Table 2-2 Monthly IL4 Water Deliveries to San Joaquin Valley Refuges in Water Year 2012-2013**

| | Mar | Apr | May | Jun | Jul | Aug | Sept | Oct | Nov | Dec | Jan | Feb |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| IL4 Water Delivery, AF/M | 1,036 | 3,104 | 7,029 | 2,615 | 1,175 | 3,555 | 5,480 | 5,279 | 3,055 | 1,351 | 1,234 | 1,715 |

## DPWD Demands

DPWD, located in western San Joaquin, Stanislaus, and Merced Counties, delivers water directly from the DMC to 45,000 acres of productive farmland between Vernalis on the north and Santa Nella to the south. As a CVP water contractor located south of the Sacramento-San Joaquin Delta, DPWD has experienced significant shortages and decreased reliability in the quantity of water it receives annually under the terms of its federal water service contract. Over the past five years DPWD has received an average of just over 40 percent of its full contract supply; in 2013 will receive only 20 percent of its full contract supply.

Shortages in CVP deliveries have resulted in serious economic hardship not only for DPWD growers but for the region in general. The NVRRWP was conceived as a method to utilize available recycled water to augment and provide a more reliable supply of agricultural irrigation water to the region.

DPWD consists of three areas, the North, Central, and South areas. The NVRRWP will serve only the Central and South areas since those areas are

downstream of the proposed point of recycled water delivery to the DMC. The total combined annual water demand of the Central and South areas is 41,500 AFY, distributed across the year as shown in Table 2-3 and graphically in Figure 2.

**Table 2-3 Monthly DPWD Water Demands**

| | Mar | Apr | May | Jun | Jul | Aug | Sept | Oct | Nov | Dec | Jan | Feb |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DPWD Demand, AF/M | 765 | 2,773 | 6,199 | 9,459 | 9,845 | 6,237 | 3,871 | 2,019 | 146 | 111 | 0 | 117 |

*Source: DPWD 2013*

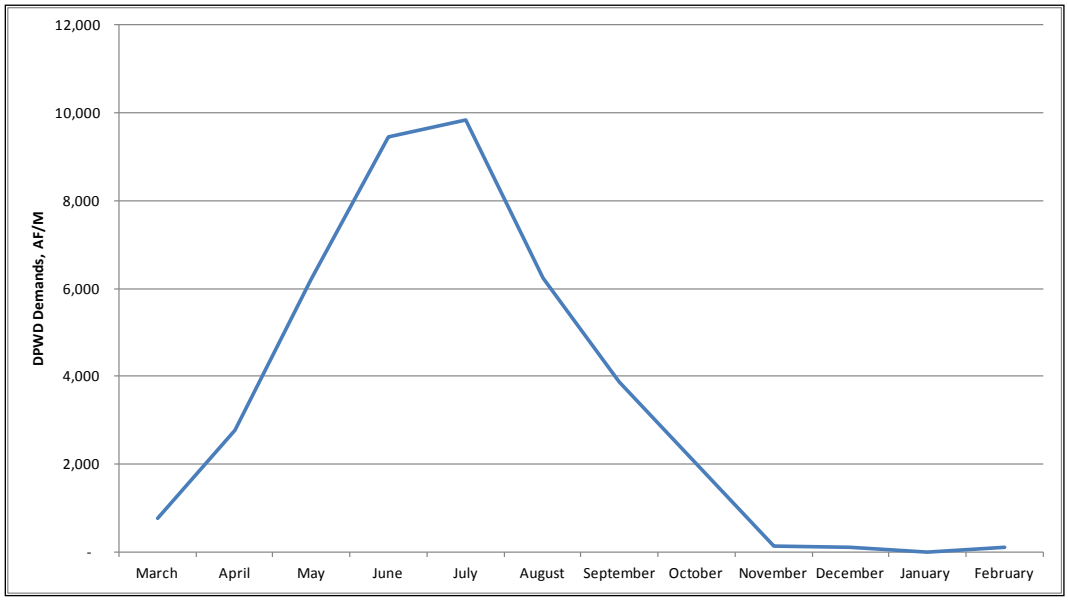


**Figure 2-3 DPWD Demand in Central and South Area, AFM**

## NVRRWP Supply

The Cities of Modesto and Turlock provide wastewater treatment for their own metropolitan areas as well as for smaller communities in Stanislaus County. The recycled water produced for the NVRRWP would be tertiary filtered, disinfected water in compliance with the State of California Title 22 standards for unrestricted bodily contact. Treated recycled water from Turlock and Modesto is currently discharged to the San Joaquin River or disposed of via land application. With the NVRRWP, this recycled water could instead be utilized for agricultural irrigation and refuge water supply.

Tables 2-4 and 2-5 below show the expected amounts of recycled water that will be available from the NVRRWP. The first value shown represents flows available when the program initially comes on line (estimated in 2018). Both Cities are anticipating increased growth within their service areas and have estimated their tertiary flows at build-out conditions (2030 for Turlock and 2045

for Modesto). The second value shown represents the flows available at full build-out conditions in 2045.

A detailed explanation of the build-out flow calculations is included as Appendix 2A. Table 2-4 below summarizes the anticipated NVRRWP flows when the program comes on-line in 2018 and when both cities reach build-out in 2045.

**Table 2-4 Projected NVRRWP Flows**

| Recycled Water Source | 2018 Available Recycled Water (acre-feet/year) | 2045 Available Recycled Water (acre-feet/year) |
|---|---|---|
| Modesto | 16,500 | 30,600 |
| Turlock | 14,100 | 28,400 |
| **Total** | **30,600** | **59,900** |

*Source: City of Modesto 2013; City of Turlock 2013.*

The monthly distribution of recycled water flows is based on the historic monthly distribution of effluent flows for each City and is shown in Table 5 and Figure 3.

**Table 2-5 Monthly Distribution of NVRRWP Supplies, AF/M**

| Year | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Jan | Feb |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2018 | 2,500 | 2,500 | 2,600 | 2,500 | 2,700 | 2,600 | 2,400 | 2,600 | 2,600 | 2,600 | 2,600 | 2,400 |
| 2045 | 4,800 | 4,900 | 5,000 | 4,800 | 4,900 | 5,000 | 4,800 | 5,200 | 4,900 | 5,000 | 5,200 | 4,500 |

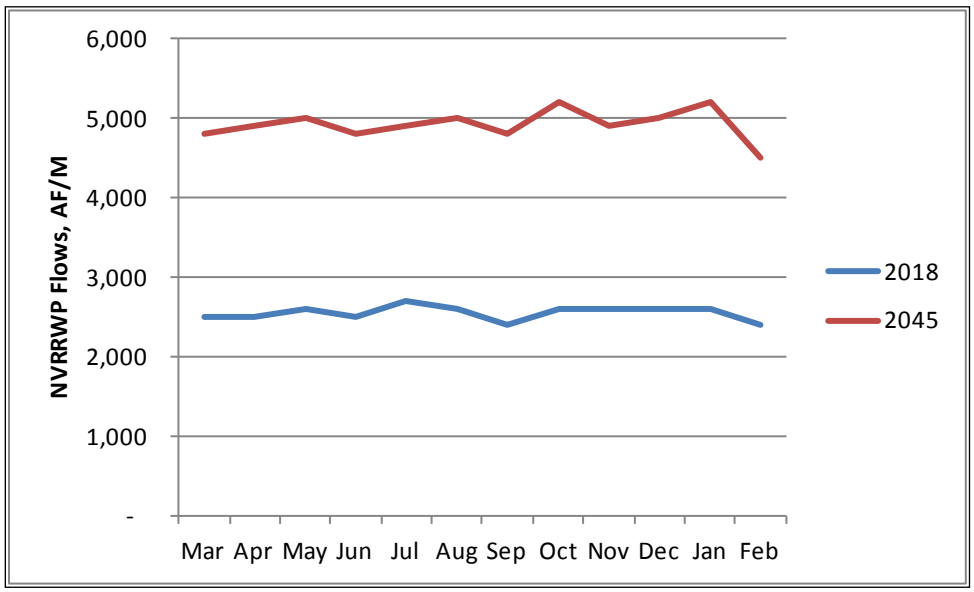


**Figure 2-4 Monthly Distribution of NVRRWP Supplies, AF/M**

# Comparison of Flows

## Comparison of DPWD Demands and NVRRWP Flows

NVRRWP flows in excess of DPWD demands could be available to help meet the IL4 water demands in the refuge. For the sake of this memo, NVRRWP flows in excess of the monthly DPWD demands are termed "Potentially Available NVRRWP Flows". Looking at the difference in DPWD demands versus NVRRWP excess flows on a monthly basis, there are NVRRWP flows potentially available in the months of October to March (September to April for build-out flows) Table 2-6 and Figure 2-5 show the calculation of NVRRWP flows potentially available on a monthly basis.

**Table 2-6 Comparison of DPWD Demands and NVRRWP Flows**

| | Mar | Apr | May | Jun | Jul | Aug | Sept | Oct | Nov | Dec | Jan | Feb |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DPWD Demand, AF/M | 765 | 2,773 | 6,199 | 9,459 | 9,845 | 6,237 | 3,871 | 2,019 | 146 | 111 | 0 | 117 |
| **At Program Inception (2018)** | | | | | | | | | | | | |
| NVRRWP Flows Available, AF/M | 2,500 | 2,500 | 2,600 | 2,500 | 2,700 | 2,600 | 2,400 | 2,600 | 2,600 | 2,600 | 2,600 | 2,400 |
| Excess NVRRWP Flows, AF/M | 1,735 | - | - | - | - | - | - | 581 | 2,454 | 2,489 | 2,600 | 2,283 |
| **At Program Build-out (2045)** | | | | | | | | | | | | |
| NVRRWP Flows Available, AF/M | 4,800 | 4,900 | 5,000 | 4,800 | 4,900 | 5,000 | 4,800 | 5,200 | 4,900 | 5,000 | 5,200 | 4,500 |
| Potentially Available NVRRWP Flows, AF/M | 4,038 | 2,127 | - | - | - | - | 929 | 3,181 | 4,754 | 4,889 | 5,200 | 4,383 |

Note that the DPWD monthly demands during the irrigation season are greater than shown in Table 2-6. The monthly demands in Table 2-6 are limited to the amount of NVRRWP water availability for each month.

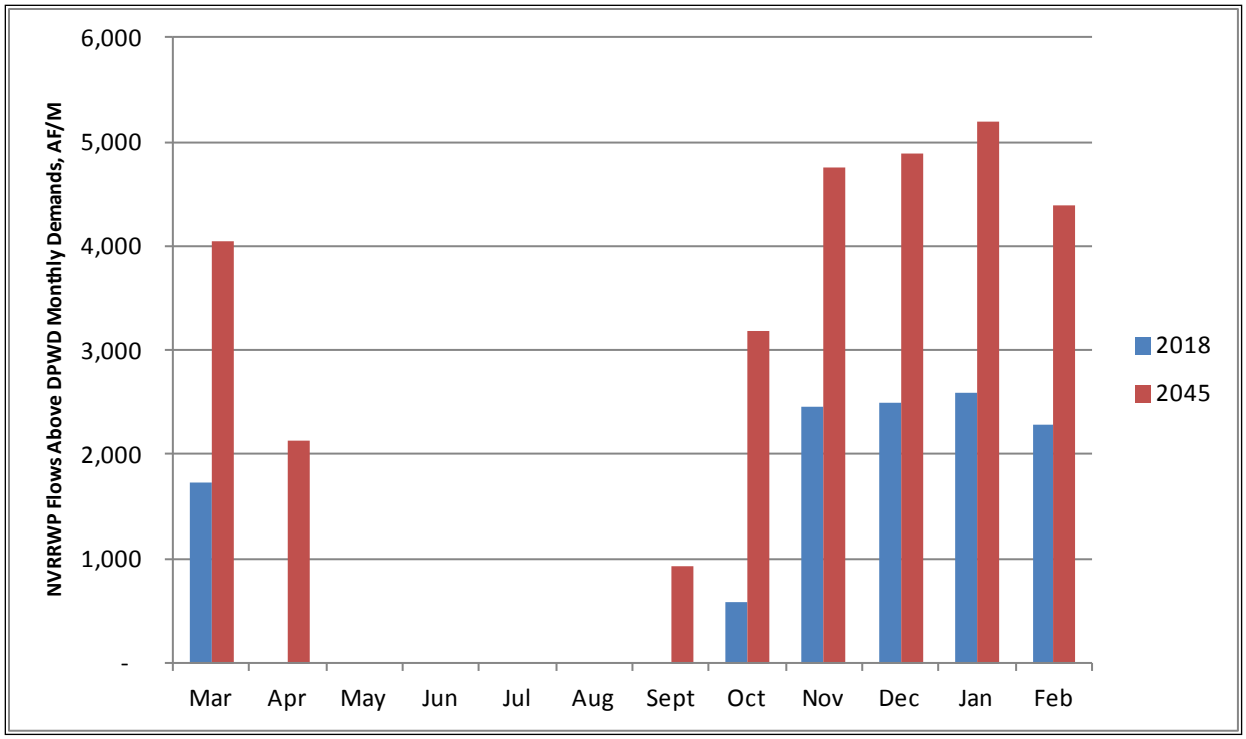


**Figure 2-5 NVRRWP Flows above DPWD Monthly Demands, AF/M**

## Comparison of IL4 Water Demands to NVRRWP Potentially Available Flows

The water demand for the refuges is highest in the summer and lowest in the winter. As shown in Figure 4, the availability of NVRRWP flows is opposite, i.e. highest in the winter and lowest in the summer. If the NVRRWP water was delivered to the refuges via a direct pipeline, construction of seasonal storage would be required to make full use of the NVRRWP flows. However, since the DMC is the preferred option for NVRRWP conveyance, NVRRWP flows could be stored within the CVP system and used when it best fits the user's needs.

Considering the water comparison on an annual basis, the total 2012-2013 IL4 water delivery was 36,600 AFY while the optimum IL4 water demand is 105,514 AFY, leaving an IL4 shortfall of approximately 70,000 AFY. Assuming the NVRRWP comes on line in 2018 there would be an estimated 12,100 AFY of potentially available NVRRWP flow, which would meet 17 percent of the 2012-2013 IL4 shortage. As the program flows increase to build-out in 2045, the potentially available NVRRWP flows would increase to approximately 29,400 AFY, which is 42 percent of the 2012-2013 IL4 shortage.

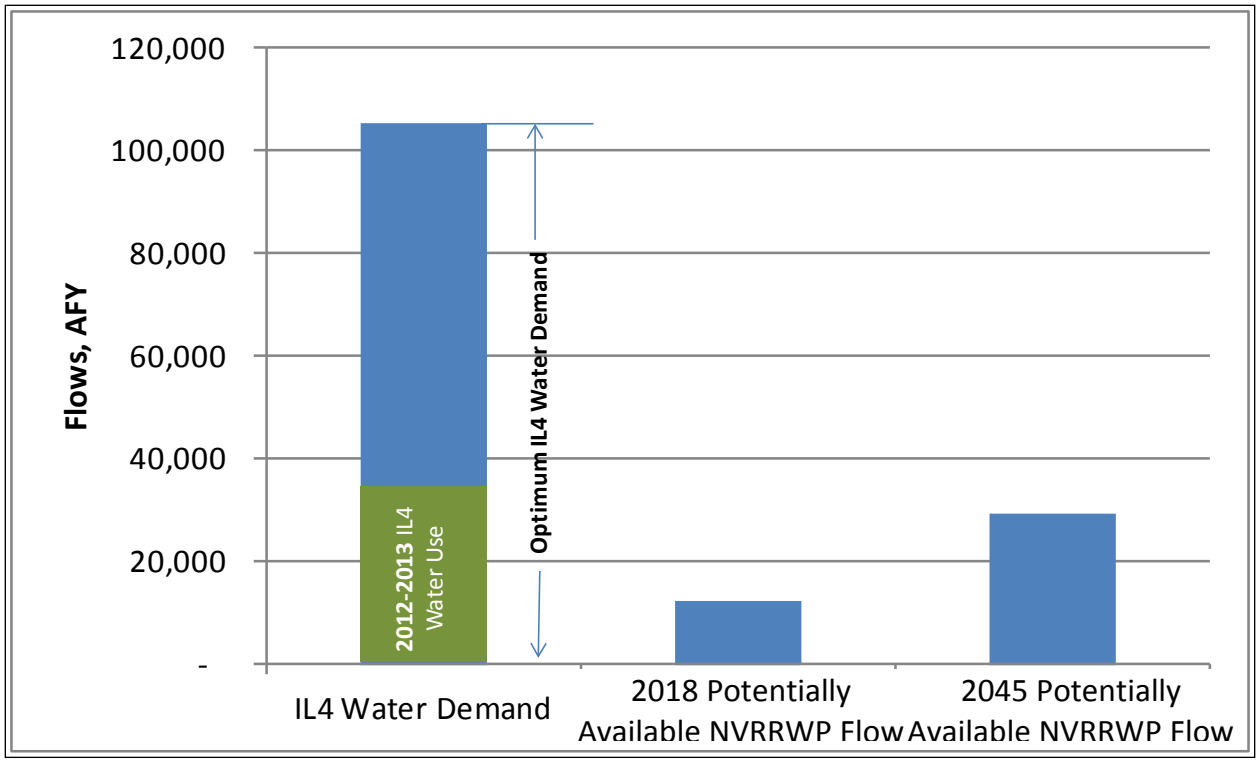


**Figure 2-6 Comparison of IL4 Water Use to Potentially Available NVRRWP Flow**

## Conclusion

The NVRRWP could provide a significant new water source which could help meet both agricultural irrigation demands in the DPWD and meet IL4 water use in the wildlife refuges south of the Delta. Looking at the monthly distribution of DPWD demands versus NVRRWP availability, there are NVRRWP flows potentially available during the cooler, wetter months when irrigation uses decline. Using the DMC as the conveyance vehicle for the recycled water allows the NVRRWP flows to be stored within the DMC system to be used on a schedule that best serves the user's needs. With that storage system in place, the potentially available NVRRWP flows could meet 33 percent of the 2012-2013 IL4 water use (or 11 percent of the optimum IL4 demand) when the NVRRWP comes on line in 2018. As the NVRRWP flows increase to build-out conditions, the program could provide 80 percent of the 2012-2013 IL4 water use (or 28 percent of the optimum IL4 demand) by 2045.

# Chapter 3
# Refuge Water Conveyance

## Summary of Findings

Two options were evaluated for conveying North Valley Regional Recycled Water Project (NVRRWP) flows to the refuges:

Delta-Mendota Canal (DMC) to the Mendota Pool

Direct Pipeline to the refuges via the Central California Irrigation District (CCID) Newman Canal

New facilities required to reach the DMC and Newman Canal include pipelines and pump stations, and are evaluated in further detail within this chapter.

The recommended alternative is DMC conveyance. Using the DMC as part of the conveyance system offers several advantages:

- The CVP/DMC facilities provide seasonal storage so that the NVRRWP water can be used by the refuges and Del Puerto Water District when needed to help meet their peak demand periods.
- It allows all refuges south of the Sacramento-San Joaquin Delta to receive NVRRWP project water, as opposed to the Direct Pipeline to Refuges, which would only serve the Grasslands Wildlife Area.

The DMC alternative is much more cost-effective than the Direct Pipeline to the Refuges alternative as shown below.

**Table 3-1 Comparison of Capital Costs**

| | Estimated Capital Cost[26] |
|---|---|
| DMC Alternative | $ 89,000,000 |
| Direct to Refuges Alternative | $207,000,000 |

[26] Most Probable Costs will be shared amongst project partners proportional to the amount NVRRWP project water allocated.

## Introduction

This chapter evaluates options for conveying recycled water from the NVRRWP to the south of Delta refuges and wildlife areas. Existing and proposed water conveyance facilities are evaluated with respect to their ability to provide conveyance of NVRRWP water to DPWD's agricultural fields as well as wildlife refuges south of the Delta.

## Existing Water Conveyance Facilities

California relies on an elaborate network of water storage and delivery systems to supply cities, farms, businesses, and the environment with adequate water year-round. Given the State's highly seasonable precipitation and the fact that annual runoff can vary widely from year to year, water supply infrastructure has given California improved ability to store and move water to where it's needed, when it's needed.

The proposed conveyance alternatives for the Refuge Recycled Water project potentially make use of a number of existing facilities, including the Patterson Irrigation District (PID) canal system, the CVP facilities, and the CCID Newman Canal. Figure 3-1 shows those facilities in relation to the refuges and wildlife areas.

## Proposed Facilities

Conveyance of recycled water to serve refuge and wildlife areas will require a combination of existing and new infrastructure. The alternatives were evaluated to identify potential fatal flaws, identify key elements and features, and develop a preliminary construction cost estimate.

Potential pipeline routes were evaluated relative to the following criteria:

- Cost
- Constructability
- Schedule

Appendix 3A describes the methodology used for evaluation of project costs.

In general, the capital cost of the project is proportional to the total length of pipe. The acquisition of easements is also a potentially significant cost for the project. Where possible, pipelines should be aligned within public rights of ways or on lands owned by participating agencies. Operational costs include the costs of energy to operate the new pumping stations, allowances for equipment repair and replacement, and, for the DMC alternatives, the cost to wheel the recycled water through existing facilities (assumed to be $75/AF for options

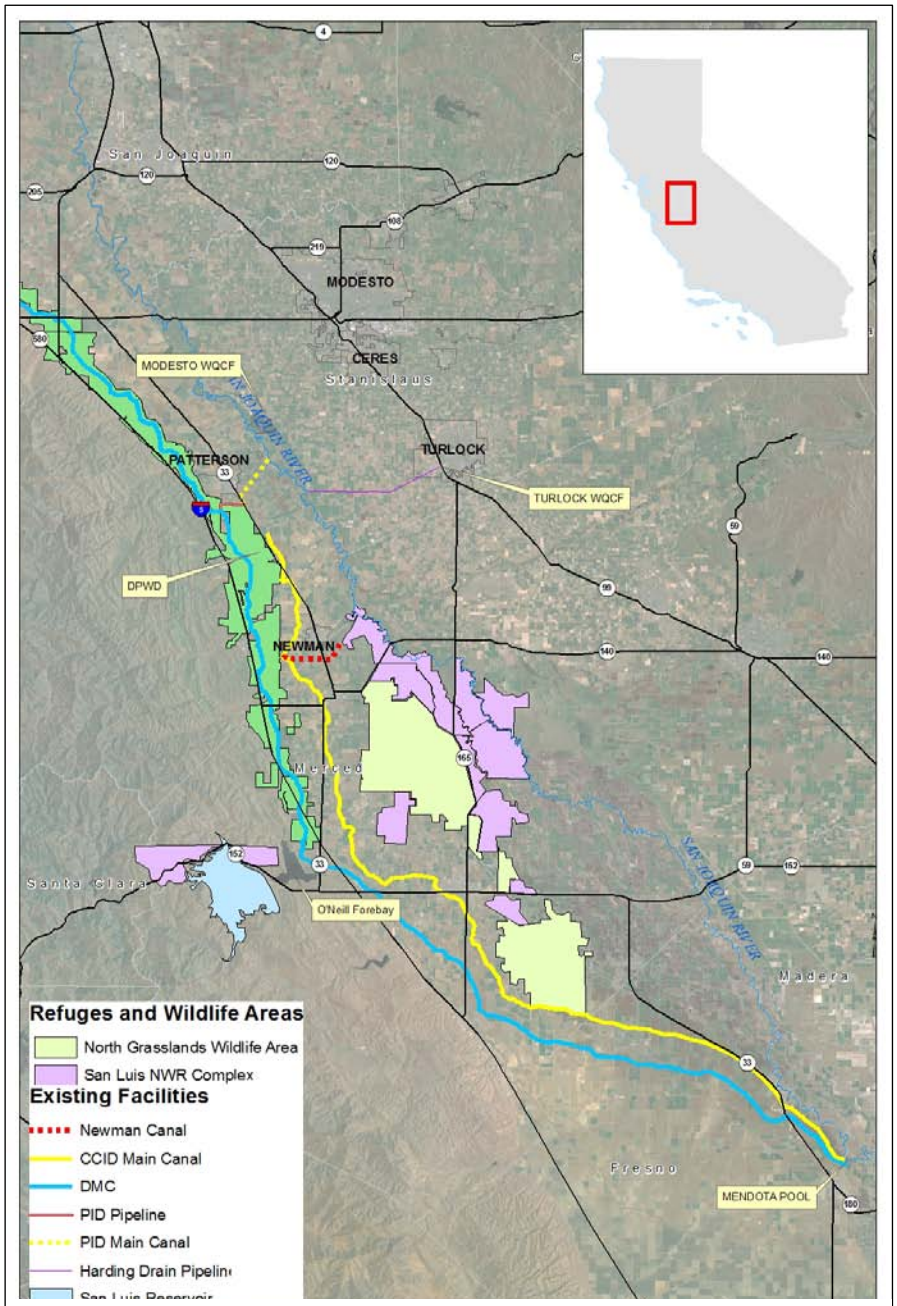


**Figure 3-1: Map of Existing Facilities**

including the PID system and $30/AF for DMC conveyance and storage for any water delivered to users other than Reclamation).

## DMC Alternative

Alternatives for delivering recycled water to the DMC either via the PID Main Canal or via a pipeline directly to the DMC were evaluated in a Draft Corridor Study memorandum prepared by RMC Water and Environment for the NVRRWP in March 2013. The Modesto and Turlock water quality control facilities (WQCFs) are located on the east side of the San Joaquin River. All other facilities and locations of project water deliveries and use are located on the west side of the San Joaquin River.

The purpose of the Corridor Study was to evaluate conceptual pipeline alignments and develop capital and operating cost estimates. Two scenarios were evaluated:

- Direct Pipeline to DMC – convey recycled water via a pipeline or combination of pipelines directly to the DMC.
- PID Main Canal – convey recycled water to the PID Main Canal and then use the PID canal facilities to convey the rest of the way to the DMC.

Six alternatives were developed to consider alternate pipe corridors, river crossings, pumping systems, and whether the recycled water from each City would be conveyed separately or together.

Table 3-1 summarizes the alternatives considered in that study. The alternatives were evaluated based on cost and on other factors such as land acquisition, utility conflicts, traffic and community disruption, potential environmental impacts, construction schedule and permitting. For the purpose of the analysis of conveyance alternatives for this study, it was determined that the preferred alternative for conveying water to the DMC was DMC-2, and that alternative is used in this report as the DMC alternative. The actual preferred alternative for conveyance of recycled water for the NVRRWP is subject to further consideration.

### Summary of Facilities for Recommended DMC Alternative

As shown on Figure 2, tertiary treated recycled water from the Turlock and Modesto WQCF would be conveyed through 26,800 ft of 36-inch pipelines to a combined pump station located near West Main Avenue east of the San Joaquin River. The combined flows would be pumped through a 34,300 ft long, 48-inch pipeline which crosses the San Joaquin River at Las Palmas Bridge. The pipeline would then parallel the PID Main Canal, cross Highway 33, and end at the DMC where the recycled water would discharge into the DMC.

Pump Stations

The horsepower required for each City to reach the combined point on West Main Avenue and for the combined pipeline to reach the DMC is as follows:

- Modesto's required Duty Horsepower: 90 hp
- Turlock's required Duty Horsepower: 20 hp
- Combined required Duty Horsepower: 1,200 hp

Cost

- Capital Cost: $ 89,000,000
- Annual Operating Cost $ 2,200,000

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.

**Table 3-2: Summary of DMC Alternatives**

| Alt No. | Description | Estimate of Most Probable Capital Cost | Advantages/Disadvantages |
|---|---|---|---|
| DMC-1 | Separate pipelines from Modesto and Turlock to DMC via, respectively, PID canal right-of-way and Pomelo Ave. River crossings at Las Palmas bridge for Modesto and Harding Drain for Turlock. Pump stations at Jennings plant and at Harding Drain. | $118 million | • Highest cost DMC option<br>• Most difficult constructability due to multiple river, canal, highway crossings and two pipeline corridors<br>• Separate pipelines allows Cities to proceed independently of each other |
| DMC-2 | Pipes from Jennings plant and Harding Drain combine at Las Palmas then follow PID canal right-of-way to DMC. River crossing at Las Palmas bridge. Joint pump station at Las Palmas. | $89 million | • Lowest cost DMC option<br>• River crossing contingent on Las Palmas bridge construction so less ability to accelerate schedule |
| DMC-3 | Separate pipes across river, then combine east of Pomelo Ave and follow Pomelo Ave to DMC. River crossings south of Las Palmas for Modesto and at Harding Drain for Turlock. New pump stations at Jennings plant and at joint pump station. | $102 million | • Multiple river crossings increase permitting and constructability complexity.<br>• Separate river crossings allow Cities to proceed somewhat independently of each other |
| DMC-4 | Pipe Modesto south to Harding Drain then combined pipe across river and follow Pomelo Ave to DMC. River crossing at Harding Drain. Combined pump station at Harding Drain. | $105 million | • Potential ability to accelerate project and convey Turlock flows while waiting for Modesto tertiary facilities to be constructed. |
| PID-1 | Pipes from Jennings plant and Harding Drain combine at Las Palmas then follow Las Palmas to PID canal. River crossing and combined pump station at Las Palmas. | $42 million (does not include cost of PID connection) | • Total capital cost is contingent on the cost of the PID connection<br>• River crossing contingent on Las Palmas bridge construction so less ability to accelerate schedule<br>• PID wheeling cost is high |
| PID-2 | Separate pipelines from Modesto and Turlock to PID canal via, respectively Poplar and Ashe. River crossings at Modesto outfall and Harding Drain. New pump stations at Jennings Plant and Harding Drain.<br>A connection to Lake Ramona could be added to this alternative. | $64 million (does not include cost of PID connection) | • Total capital cost is contingent on the cost of the PID connection<br>• Separate pipelines from each plant could allow Cities to proceed independently; potential schedule acceleration<br>• PID wheeling cost is high |

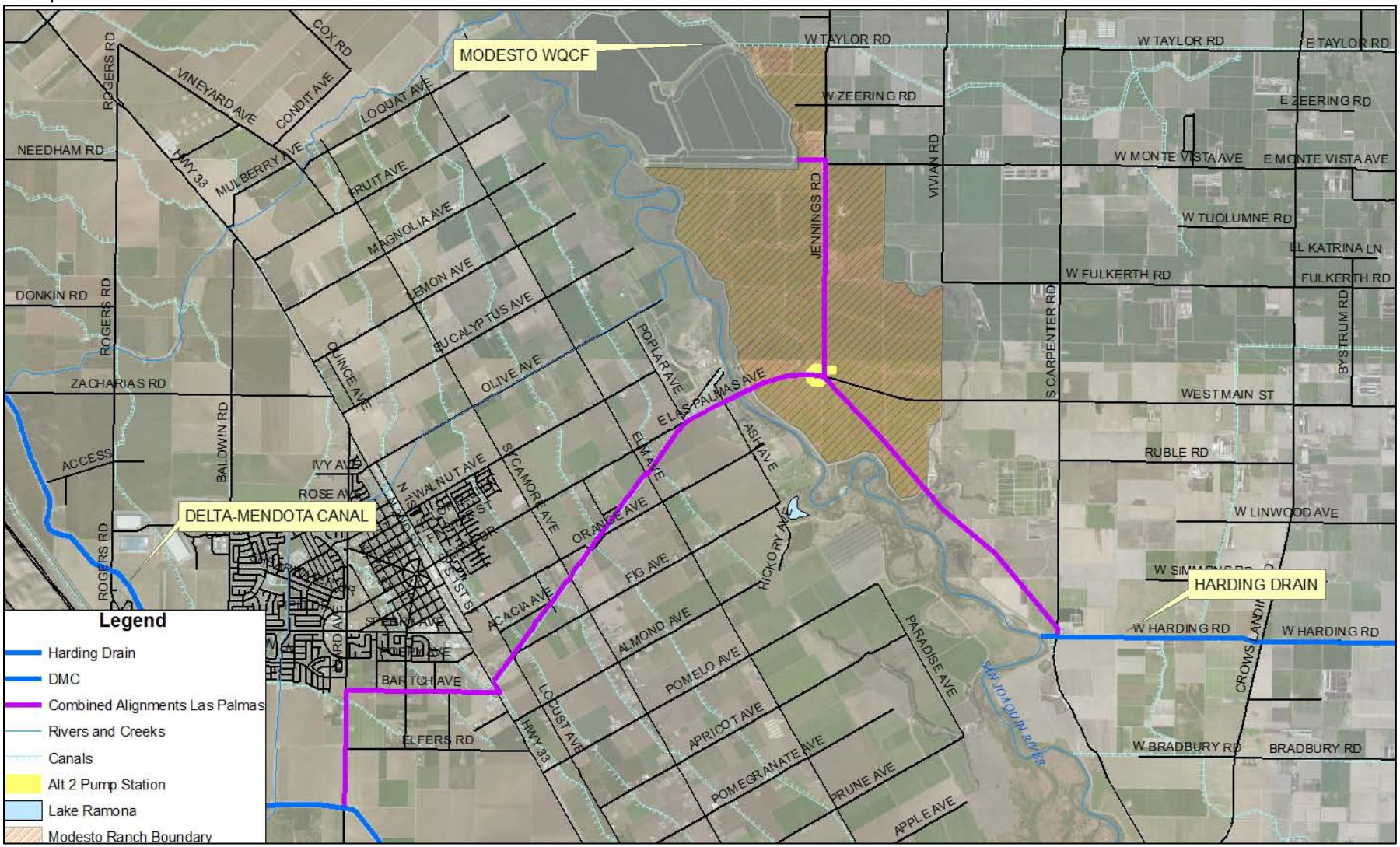


**Figure 3-2 DMC Conveyance Alternative**

## Direct Pipeline to Refuge Conveyance Facilities

The Direct Pipeline to Refuge alternative would convey recycled water directly to DPWD irrigated lands and then to the China Island Unit. One disadvantage of this alternative is that other refuges and wildlife areas would not have direct access to the NVRRWP water.

As shown on Figure 3, the direct pipeline alternative would follow the DMC alignment described previously up to the DMC right-of-way. Once the alignment reaches the DMC right of way, the 48" pipeline would turn south and follow the east bank of the DMC for an additional 10.500 feet to the southern Stanislaus County border to serve the majority of south DPWD demands. DPWD demands in Merced County are lower than those in Stanislaus County; extension of the pipe into Merced County would require crossing the DMC which would be prohibitively expensive given the volume of demands.

To reach the refuge facilities, there would be a 48 inch tee near Newman, CA, and the pipeline would extend east for approximately 6,400 ft. This pipeline would eventually end at the CCID Main Canal where the Newman Canal would be used to convey the project water to the refuges.

Pump Stations

The horsepower required for each City to reach the combined point on West Main Avenue and for the combined pipeline to reach the refuges is as follows:

- Modesto's required Duty Horsepower: 105 hp
- Turlock's required Duty Horsepower: 20 hp
- Combined required Duty Horsepower: 1,700 hp

Cost

- Capital Cost: $ 207,000,000
- Annual O&M Cost $ 1,400,000

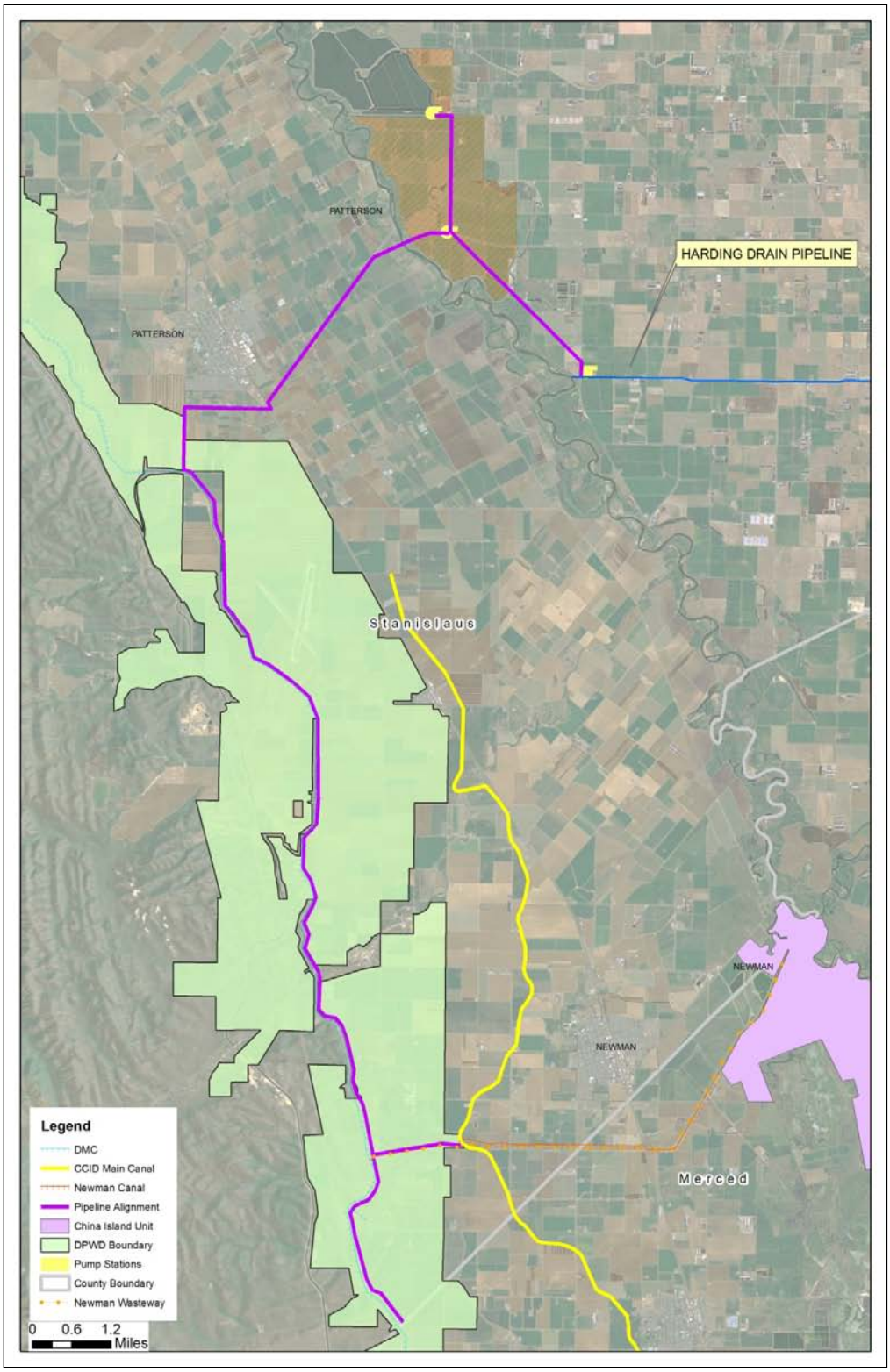


**Figure 3-3 Direct Pipeline to Refuges**

## Comparison of Alternatives

Table 3-3 summarizes the costs for the DMC and Direct Pipeline to Refuges alternatives. The cost of water in terms of $/AF will be dependent on the financing available for the project; for example, unit costs for the direct pipeline alternative differ by up to $160/AF among various financing scenarios. For both alternatives, the lowest cost of water would be from a scenario in which the existing Title XVI grant program was converted to a low interest loan program. In all cases the DMC alternative is the lower cost alternative.

**Table 3-3 Cost Comparison of Alternatives**

| | DMC | Direct Pipeline to Refuges |
|---|---|---|
| Annual Yield, AFY | 33,810 | 33,810 |
| Estimated Capital Costs | $ 89,000,000 | $207,000,000 |
| Annual Costs | $ 1,200,000 | $ 1,400,000 |
| Cost of Water under Various Financing Scenarios, $/AF [1] | | |
| 100% Reclamation Low Interest Loan at 1% over 30 years [2] | $140 | $280 |
| 25% Title XVI Grant, 75% Bond financing, 5% over 30 years | $160 | $340 |
| State Revolving Fund Loan at 2.5% over 20 year loan period | $200 | $440 |
| 25% Title XVI Grant, 75% SRF Loan at 2.5% over 20 years | $160 | $340 |

(1) Cost of water for DPWD in DMC alternative would be approximately $30/AF higher than values shown to account for Warren Act wheeling charges through DMC.

(2) Low interest loan terms are speculative at this time since loan program does not currently exist.

Table 3-4 shows the breakdown of capital costs by project component

**Table 3-4 Capital Costs by Project Component**

| Project Component | Estimated Capital Cost DMC | Estimated Capital Cost Direct Pipeline |
|---|---|---|
| Combined Facilities | $ 89,000,000 | $177,000,000 |
| Reclamation extension to Newman Canal | N/A | $ 21,000,000 |
| DPWD Extension to County line | N/A | $ 9,000,000 |
| | | |
| Total Project Capital Cost | $ 89,000,000 | $207,000,000 |

## Conclusion

Table 3-5 compares the facilities, estimated costs, and advantages/ disadvantages of the two alternatives.

The recommended alternative for conveyance of NVRRWP flows is the DMC alternative. It is more cost-effective, provides seasonal storage through the CVP facilities, makes the recycled water available for all of the refuges south of the Delta, and has less impact on existing DPWD users since existing turnouts form the DMC could be used to access the water.

**Table 3-5: Comparison of Alternatives**

| Alt | Description | Capital Cost | Annual Operating Costs | Unit Cost, $/AF | Constructability Issues | Advantages/Disadvantages |
|---|---|---|---|---|---|---|
| DMC | Pipes from Jennings plant and Harding Drain combine at Las Palmas, cross the San Joaquin River, and then follow PID canal right-of-way to DMC. Includes 61,100 feet of pipe, 3 pump stations | $89 million | $1.2 million | $140 - $160 [(1)] | • One San Joaquin River crossing<br>• Significant utility interference<br>• Nine irrigation canal crossings<br>• One HWY 33 crossing<br>• One railroad crossing<br>• Potential interferences along the PID canal right-of-way<br>• Moderate environmental permitting requirements<br>• Potential traffic impacts due to alignment crossing at West Main, Avenue, HWY 33 and railroad crossings | • Lowest cost alternative<br>• Seasonal storage could be provided by the CVP facilities which would provide more flexibility as to when the recycled water could be used.<br>• Permitting for introduction of recycled water into the DMC potentially more difficult than the direct pipeline alternative.<br>• No modifications needed to existing turnouts |
| Direct Pipeline to Refuges | Same as DMC alternative except at the DMC pipe turns south and follows the east bank of the DMC for an additional 10,500 feet to the southern border of Stanislaus County. Refuges would be served by a tee near the City of Newman that would extend east to the CCID Newman Canal. Includes 119,000 feet of pipe, 3 pump stations | $207 million | $1.4 million | $280 - $440 | • Same as DMC alternative, plus the following:<br>• Potential interferences along the DMC canal right-of-way<br>• Modifications needed to all DPWD turnouts between Patterson and the Newman Wasteway. | • Highest cost alternative<br>• Alternative does not include seasonal storage so timing of recycled water availability (winter) versus refuge demands may not coincide<br>• Recycled water only available to N. Grasslands and China Island Unit |

[(3)] Cost of water for DPWD in DMC alternative would be approximately $30/AF higher than values shown to account for Warren Act wheeling charges through DMC.

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# Chapter 4
# Summary of Existing Water Quality Information

## Summary of Findings

Tertiary treated recycled water from the North Valley Regional Recycled Water Program (NVRRWP) must meet the stringent requirements established in Title 22 of the California Code of Regulations, and is suitable for a wide variety of non-potables uses. The recycled water quality is typically better than San Joaquin River water quality; for example, NVRRWP water contains lower concentrations of constituents such as boron, selenium, electrical conductivity, mercury, and pesticides than the river.

Recycled water from the NVRRWP, when blended with water from the Delta Mendota Canal (DMC), will comply with the Reclamation's water quality standards for the Upper DMC. Those standards have been established by Reclamation for the Groundwater Pump-in Program. No other water quality standards are presently in place for water introduced into the DMC. With one exception, the recycled water quality also complies with the USBR's current water quality standards for acceptance of water into the Upper DMC as defined in Reclamation's Groundwater Pump-In Program. Both sets of standards are in place to regulate the practice of pumping well water into the DMC under Warren Act Contracts, and are not necessarily applicable to recycled water. Of the 48 constituents covered by these standards, only the recycled water sodium content is expected to exceed Reclamation's standards for acceptance into the DMC.

Selenium, a constituent of concern for recycled water use at wildlife refuges, is present in NVRRWP recycled water at a concentration comparable to the existing DMC water quality (0.8 µg/L). The same is true for boron and arsenic. Recycled water would be delivered to the refuges after mixing with the existing water in the DMC. Based on the results presented in this chapter, the recycled water generated from the NVRRWP is not expected to produce a significant change in water quality to downstream DMC users.

## Introduction

As part of an effort to evaluate the feasibility of providing recycled water from the NVRRWP to wildlife refuges in the San Joaquin Valley, this chapter

characterizes the water quality of the recycled water and compares it to relevant water quality criteria for the DMC. The DMC is the preferred conveyance alternative for delivering the recycled water to the refuges, which are located south of the Sacramento-San Joaquin Delta (south of the Delta), and is also one of the existing sources of water for the refuges. Additionally, Appendix 4E discusses other projects where recycled water is being used for wetlands or wildlife refuges.

The analysis in the chapter is based on available water quality data from the two recycled water suppliers to the NVRRWP (the City of Modesto and City and Turlock), the San Joaquin River, and the DMC.

## Water Quality Standards

Relevant water quality criteria that are useful for interpreting the available water quality data are described below.

### Title 22 Recycled Water Standards

Title 22, Chapter 3 of the California Code of Regulations forms the backbone of recycled water regulations through water quality standards and treatment reliability criteria for water recycling. Title 22 sets bacteriological water quality standards based on types of contact expected between the public and the recycled water, outlining applications for which disinfected tertiary treatment is required and also applications for which three levels of secondary treatment would also suffice.

In addition to establishing recycled water quality standards, Title 22 specifies the reliability and redundancy for each recycled water treatment and use operation. Title 22 (Articles 9 and 10) specify that the facilities must be designed to provide operational flexibility. Multiple treatment units capable of producing the required quality must be provided in the event that one unit is not in operation. In lieu of multiple units, alternative treatment processes, storage or disposal provisions may be provided for redundancy.

Recycled water treatment criteria vary depending on the application of the recycled water and its contact potential with the public. Disinfected tertiary recycled water, such as that to be produced at the NVRRWP, is suitable for almost all currently allowed uses for recycled water including irrigation of public parks and all food crops, toilet flushing, and some industrial processes.

California Title 22 regulations for tertiary recycled water require that the 7-day median concentration of total coliform bacteria measured in the disinfected effluent does not exceed 2.2 most probable number (MPN) per 100 mL, 23 MPN/100 mL more than once in any 30-day period, and 240 MPN/100 mL in any single sample.

## Water Quality Standards for Acceptance of Groundwater into the Upper Delta-Mendota Canal

The Warren Act of 1911 authorizes Reclamation to execute temporary contracts to impound, store, and carry water in federal irrigation canals when excess capacity is available. Such contracts are negotiated by Reclamation to allow the introduction of "non-project water" into the DMC. This non-project water can include groundwater from wells nearby the DMC.

To maintain appropriate water quality in the DMC, Reclamation has developed a set of standards for the acceptance of non-project water in the DMC based on the requirements of downstream water users. These standards are summarized in the following tables of the *2012 Delta-Mendota Canal Pump-in Program Water Quality Monitoring Plan* (herein referred to as Pump-in Plan):

- Table 4a, Maximum Allowable Concentration of Seven Constituents in the Upper DMC (between Jones Pumping Plant and Check 13)
- Table 4b, Maximum Allowable Concentration of Three Constituents in the Lower DMC
- Table 5, Water Quality Standards for Acceptance of Groundwater into the Upper Delta-Mendota Canal Jones Pumping Plant to Check 13 (O'Neill Forebay).
- Table 6, Water Quality Standards for Acceptance of Groundwater into the lower Delta-Mendota Canal Check 13 (O'Neill Forebay) To Check 21 (Mendota Pool).

Reclamation has not established similar water quality standards for any other source of water being introduced into the DMC. Because the NVRRWP recycled water would be put into the DMC north (upstream) of the O'Neill Forebay, Table 4a and Table 5 contain the only potentially relevant water quality criteria for comparison to the water quality of the NVRRWP. Both Table 4a and Table 5 of the Pump-in Plan are reproduced in Appendix 4A. As noted in the table footnotes, many of the water quality criteria list in Table 5 are drinking water criteria. This is because several CVP water contractors, such as Santa Clara Valley Water District and San Benito County Water District, use water from the San Luis Reservoir or the O'Neill Forebay for potable water supplies.

Reclamation will allow groundwater to be pumped into the DMC only if such water does not cause the concentration of important constituents in the canal to exceed the thresholds listed in Table 4a, and if the groundwater concentrations do not exceed the thresholds listed in Table 5. With the exception of specific conductance and total dissolved solids, the values in Table 4a are identical to those in Table 5.

Other than those for the groundwater pump-in program, no other formal water quality standards exist for the DMC. The DMC is *not* subject to the water

quality criteria typically applied to point-source discharges to surface waters, which are regulated through the federal National Pollutant Discharge Elimination System (NPDES) program.

## Available Water Quality Data

The existing sources of water quality data used in this study are discussed below.

### Modesto and Turlock Recycled Water Quality Data and Reporting

The Cities of Modesto and Turlock conduct water quality sampling of their effluent both for process control and to meet the Monitoring and Reporting Program requirements of their respective NPDES permits. The data resulting from this sampling are submitted to the Regional Water Quality Control Board (RWQCB) and are available through the California Integrated Water Quality System (CIWQS[27]), a computer system used by the State and RWQCBs to track information about places of environmental interest, manage permits and other orders, track inspections, and manage violations and enforcement activities.

For Turlock, effluent data from the period April 2010 – February 2013 reported to CIWQS were used as the basis for this study, with the exception of a few constituents with no monitoring requirement under Turlock's current NPDES permit. For barium, nitrite, molybdenum, and sulfate, Turlock provided effluent data from samples collected over the period July 2007 – December 2009. The Turlock water quality data set used for this study is included in Appendix 4B.

The Modesto tertiary treatment facilities currently treat only a small portion of their effluent, and tertiary effluent has not yet been discharged to the San Joaquin River; this means that the data collected to meet NPDES Permit requirements is representative of Modesto's secondary treated effluent rather than their tertiary effluent. Therefore, for this study, the water quality data set for Modesto relies on samples collected for process control and other internal use. Effluent water quality data included in this study represent samples collected over the period July 2011 - December 2012. The Modesto water quality data set used for this study is included in Appendix 4C.

For several organic constituents with no NPDES monitoring requirements (e.g., atrazine, bentazon, and others), no sample results are available from either Modesto or Turlock.

For some inorganic constituents, few sample results are available from Modesto or Turlock. However, wastewater effluent, particularly tertiary treated wastewater effluent, is generally very stable in its water quality profile and tends not to have significant seasonal variations or spikes in constituents concentrations. This trend is illustrated by the concentration of total dissolved

[27] http://ciwqs.waterboards.ca.gov/ciwqs/readOnly/PublicReportEsmrAtGlanceServlet?inCommand=reset

solids in City of Turlock effluent shown below in Figure 4-1; unlike the DMC and San Joaquin River, there is no strong seasonal variability.

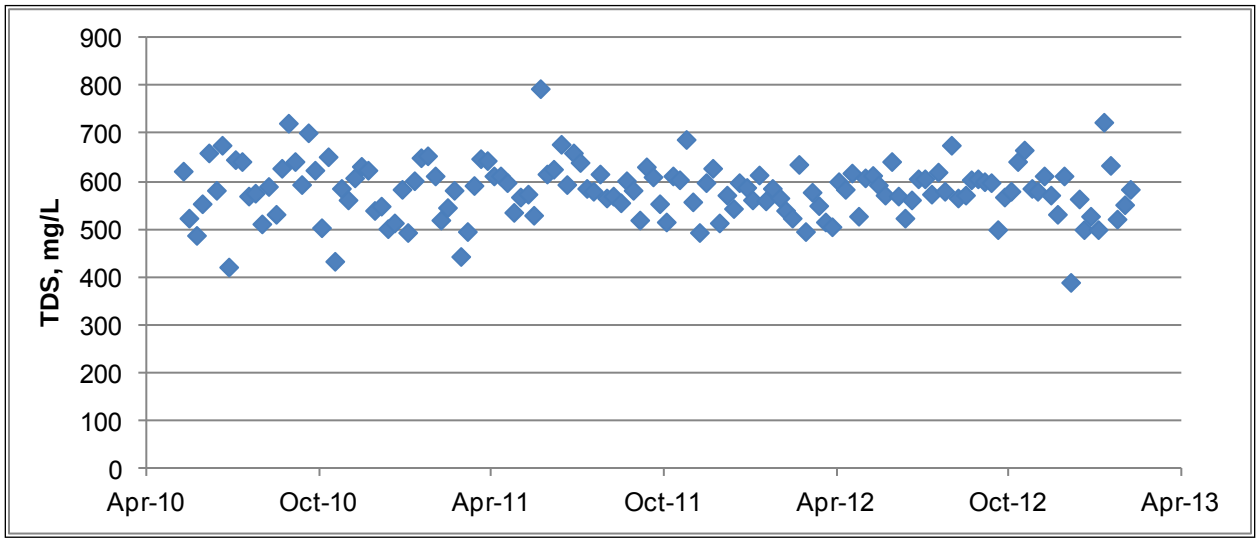


**Figure 4-1: Total Dissolved Solids Concentration in Turlock Effluent, 2010-2013**

Modesto and Turlock are both certified by the Environmental Laboratory Accreditation Program (ELAP) of the California Department of Public Health and maintain a high standard for laboratory procedures. The City of Modesto's Jennings Laboratory uses a Quality Assurance Manual which contains a Quality Assurance/Quality Control (QA/QC) plan, sample collection procedures and Standard Operating Procedures (SOPs) for all analytical methods. Likewise, the City of Turlock follows a Water Quality Control Laboratory Quality Assurance Manual, last updated in September 2012. Both labs use *Standard Methods for the Examination of Water and Wastewater* for test protocols.

The City of Modesto's Jennings Laboratory holds ELAP certificate #2674 with expiration in September 2013. The City of Turlock's ELAP certificate #2150 expires in September 2014. Both laboratories are certified to perform laboratory tests on microbiology and inorganic chemistry of wastewater; analyses for all other constituents, such as metals, volatile organics, semi-volatile organics, pesticides and chronic toxicity, are sent out to other certified facilities.

Appendix 4B contains example laboratory reports from the City of Turlock's two contract laboratory services providers, GeoAnalytical Laboratories and Caltest Analytical Laboratory, while Appendix 4C contains example laboratory reports from the City of Modesto's two contract laboratory services providers, BSK Associates and Alpha Analytical Laboratories.

## DMC Water Quality Data Collection and Reporting

For this study, DMC water quality data were obtained from the California Data Exchange Center (CDEC[28]) and the USBR Mid-Pacific Region's Environmental Monitoring Database[29].

Water quality data from the DMC are from CDEC at the Tracy Pumping Plant (Station ID: TRP) and DMC Headworks (Station ID: DMC), covering the period 2003-13. Data from the USBR Environmental Monitoring Database are from samples collected between 1991 and 2013 at three stations representing the Upper DMC: Milepost 9.87, the DMC at McCabe near Milepost 68, and the O'Neill Forebay Inlet Bridge.

Under the authority of California Water Code Sections 228 and 236, CDEC installs, maintains, and operates an extensive hydrologic data collection network, including automatic snow reporting gages for the California Cooperative Snow Surveys Program and precipitation and river stage sensors for the flood forecasting program. In addition, CDEC provides a centralized location to store and process real-time hydrologic information gathered by various cooperators throughout the State; and then disseminates this information to support forecasting and flood operations activities and to meet the data reporting needs of various cooperators, public and private agencies, the news media, and the public.

The USBR Mid-Pacific Region's Environmental Monitoring Database includes water quality monitoring data reported by the USBR Environmental Monitoring Branch, which was established in 1985 to design and implement environmental monitoring programs.

## San Joaquin River Water Quality Data and Reporting

For most constituents, water quality data for the San Joaquin River was compiled from the California Environmental Data Exchange Network (CEDEN[30]) stations "SJR @ Patterson" for the period covering 1995-2011, and from station "San Joaquin River @ PID Pumps" for the period covering 2008-2012. This data set is representative of the water quality in the PID canals as PID draws its water from the San Joaquin River near these locations. PID does not regularly monitor the water quality in their Main Canal.

CEDEN is a central location to find and share information about California's water bodies, including streams, lakes, rivers, and the coastal ocean. Many groups in California monitor water quality, aquatic habitat, and wildlife health to ensure good stewardship of our ecological resources. CEDEN aggregates this data and makes it accessible to environmental managers and the public.

For five constituents (antimony, beryllium, mercury, thallium, and silver) with no data available from CEDEN, water quality data are from CIWQS as reported by the City of Turlock at Receiving Water Station 003, which is located along

[28] http://cdec.water.ca.gov
[29] http://www.usbr.gov/mp/mp150/mp157/env_home.cfm
[30] http://ceden.org

the San Joaquin River 1,000 feet upstream of Harding Drain. These data cover the period April 2012 – March 2013, and consist entirely of non-detects.

Water quality and flow data for the San Joaquin River are also available from CDEC. The closest CDEC monitoring station to the area of interest is located near Vernalis, south of Tracy and nearly due west of Modesto. This data was not used in the analysis presented in this chapter because the CEDEN monitoring stations are closer to the intake of the PID canals.

## Comparison of Existing Water Quality Data to Relevant Water Quality Standards

In this section, the existing water quality data is compared to the water quality standards found in Tables 4a and 5 of the Pump-in Plan. Individual water quality parameters and chemical constituents are discussed below. Additionally, a summary table is provided in Appendix 4D.

### Analysis Methodology and Assumptions

The proposal to add NVRRWP recycled water to the DMC involves first combining the treated tertiary effluent from Modesto and Turlock and then adding the recycled water to either the PID Main Canal or directly to the DMC. Flow-weighted average concentrations of constituents of interest were calculated from the available water quality data from Modesto and Turlock discussed in Section 0. When the data set indicated that laboratory analysis for a particular constituent resulted in a non-detect, the concentration of that constituent was conservatively assumed to be equal to the reported method detection limit. The base assumptions regarding recycled water flows and three alternatives warranting water quality analyses are presented below. Alternatives 2a and 2b are similar with respect to institutional arrangements but different in the ratio of fresh versus recycled water, to account for the different geographic input of NVRRWP recycled water in the system.

- Recycled Water Quality: The average water quality of the NVRRWP flows was calculated using the available water quality information and the estimated future total flows in 2045 (build-out) (52.7 MGD total – 27.3 MGD from Modesto, 25.4 MGD from Turlock). The flow rate of 52.7 MGD in 2045 corresponds to 59,000 acre-feet/year (AFY) or 82 cubic feet per second (cfs).
- Alternative 1: Discharge recycled water directly to the DMC: Under this alternative, the NVRRWP recycled water would be piped directly to the DMC and thus comparison of recycled water quality is to the Table 5 standards and the blend of the recycled water and the DMC water to Table 4a standards. For the purposes of this comparison, it was assumed that the recycled water flow is 52.7 MGD and that flow in the DMC is 582 MGD (900 cfs). This

DMC flow roughly corresponds to the 10th percentile flow rate for the Tracy Pumping Plant, as reported to CDEC, and as such represent a conservatively large amount of recycled water (9%) as a percentage of the total DMC flow.

- Alternative 2a: Blend recycled water with San Joaquin River water in PID Main Canal and discharge blended water to the DMC: This blend represents the scenario in which the NVRRWP recycled water is conveyed through the PID Main canal to the DMC. It was assumed that flow in the DMC is 582 MGD (900 cfs - see discussion above), flow in the PID Main Canal from the San Joaquin River is 96.0 MGD (150 cfs), and total recycled water flow is 52.7 MGD (82 cfs). This flow weighting contains a conservatively large amount of San Joaquin River water in the blend with recycled water compared to Alternative 2b, described below, and represents NVRRWP flow entering the PID Main Canal at the upstream end near the San Joaquin River. It also represents a conservatively large amount of San Joaquin River water entering the DMC (150 cfs River water + 82 cfs NVRRWP recycled water).
- Alternative 2b: Blend recycled water with San Joaquin River water in PID Main Canal and discharge blended water to the DMC: This blend is the same as Alternative 2a, described above, except that the flow in the PID Main Canal from the San Joaquin River is much lower at 22.6 MGD (35 cfs). This flow weighting contains a conservatively large amount of recycled water, representing NVRRWP flow entering the PID canal downstream of most irrigation withdrawals.

In all cases, complete blending/mixing was assumed. The nomenclature of "Alternative 1" and "Alternative 2" is used for ease of discussion and is not intended to convey that these are the only alternatives worthy of consideration at this junction. Currently, there is a third alternative of using a pipeline to convey recycled water to the Del Puerto Water District and the refuges. In that case, the water quality delivered to the refuges would be the same as the water quality delivered under Alternative 1, and thus no further analysis is provided here.

## Discussion of Individual Constituents

For the constituents listed in Tables 4a and 5 of the Pump-in Plan and for which data were available, sodium is expected to be present in any mixture of recycled water, San Joaquin River water, and DMC water at levels that are expected to exceed the applicable water quality standards. Thus, under all alternatives, sodium levels exceed water quality standards. Nitrate and/or nitrate + nitrate would exceed standards for Alternatives 2a and 2b.

This section provides detailed information regarding water quality constituents that are listed in Table 4a of the Pump-in Plan (arsenic, boron, nitrates,

selenium, conductance, sulfates, and TDS), as well as additional parameters of interest (sodium, bacteria, and chronic toxicity). This section also provides water quality analyses of the constituents for the individual alternatives.

## Total Dissolved Solids (TDS)/Electrical Conductivity

Total Dissolved Solids (TDS) is a measure of the combined content of all inorganic and organic substances contained in a liquid in: molecular, ionized or micro-granular (<2 micrometers) suspended form. In surface water and groundwater, the most common constituents of TDS are calcium, phosphates, nitrates, sodium, potassium and chloride. TDS can be taken as a field measurement by using an electrical conductivity meter and applying an appropriate conversion factor. Where necessary, the conversion factor listed on page 12 of the Pump-in Plan was used for the conductivity data from DMC:

$$\text{TDS (mg/L)} = \text{Electrical Conductivity } (\mu\text{S/cm}) \times 0.618 + 16.$$

**Figures 4-2** and **4-3** show the results of the water quality analysis for TDS/Electrical for each of the three alternatives.

Alternative 1: Discharge recycled water directly to the DMC: As shown in **Figure 4-2** below, adding the recycled water to the DMC (average TDS of 275 mg/L) has the potential to raise the TDS in the DMC slightly, but to a level (298 mg/L) that is significantly below the 800 mg/L threshold established in Table 4a of the Pump-in Plan. The average TDS in the recycled water (551 mg/L) is significantly lower than the TDS standard in Table 5 of the Pump-in Plan (1,500 mg/L).

Alternative 2: Blend recycled water with San Joaquin River water in PID Canal and discharge blended water to the DMC: Adding a blend of recycled water and river water to the DMC has the potential to slightly raise TDS in the DMC, but to a level (634-589 mg/L) significantly below the Table 4a threshold of800 mg/L. At an average of 679 mg/L, TDS in the San Joaquin River near Patterson is similar to but slightly higher than the TDS of the recycled water and still lower than the Table 5 threshold of 1,500 mg/L.

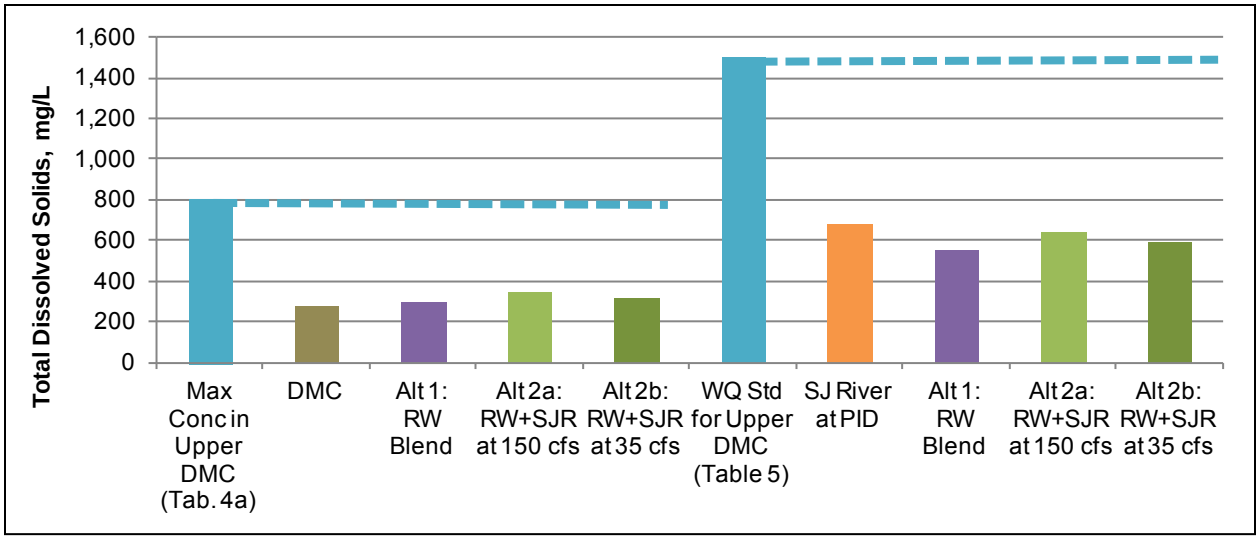


**Figure 4-2 Comparison Chart for Total Dissolved Solids**

The trends for electrical conductivity (expressed as specific conductance) closely mirror those for TDS.

<u>Alternative 1: Discharge recycled water directly to the DMC</u>: As shown in the graph below, adding the recycled water to the DMC (average specific conductance of 419 µS/cm) has the potential to raise the specific conductance in the DMC slightly, but to a level (463 µS/cm) that is significantly below the 1,200 µS/cm threshold established in Table 4a of the Pump-in Plan. Average specific conductance in the recycled water (945 µS/cm) is significantly lower than the standard in Table 5 of the Pump-in Plan (2,200 µS/cm).

<u>Alternative 2: Blend recycled water with San Joaquin River water in PID Canal and discharge blended water to the DMC</u>: Adding a blend of recycled water and river water to the DMC has the potential to slightly raise the specific conductance in the DMC, but to a level (972-1,003 µS/cm) significantly below the Table 4a threshold of 1,200 µS/cm. At an average of 1,035 µS/cm, TDS in the San Joaquin River near Patterson is similar but slightly higher than the TDS of the recycled water and still lower than the threshold of 2,200 µS/cm in Table 5 of the Pump-in Plan.

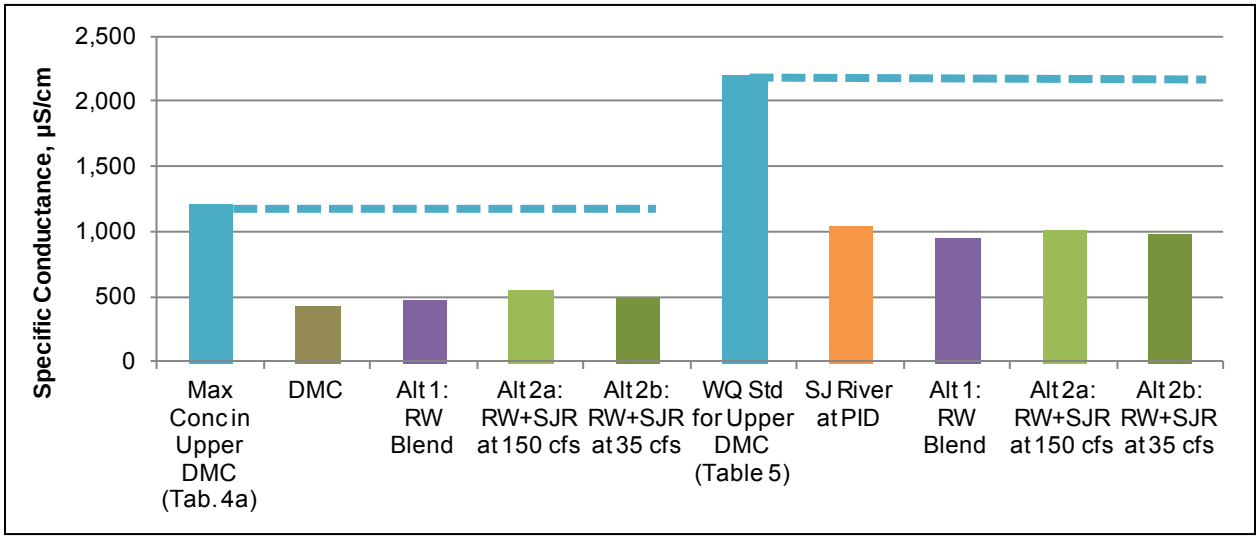


**Figure 4-3 Comparison Chart for Specific Conductance**

There is significant seasonality to the TDS and specific conductance of the San Joaquin River and DMC, while the recycled water is relatively consistent throughout the year. However, even the maximum observed conductivity in the San Joaquin River at Patterson (1,920 µS/cm) and the maximum observed conductivity in the DMC (1,046 µS/cm) would, when combined with recycled water, produce a blend that is below the thresholds established in Table 4a and Table 5.

## Sodium

Sodium is of particular interest to both agricultural users of DMC water and to the refuges because managing and minimizing salt loads and salt accumulation in soils is important to the health of plants and other biota. The acceptance criteria of 69 mg/L listed in Table 5 of the Pump-in Plan is based on a water quality standard for agricultural irrigation. **Figure 4-4** shows the results of the water quality analysis for sodium for each of the three alternatives.

Alternative 1: Discharge recycled water directly to the DMC: As shown in Figure 4-4 below and in Appendix 4D, the calculated average sodium concentration (116 mg/L) in the recycled water is higher than the standard for sodium (69 mg/L) in Table 5 of the Pump-in Plan.

Alternative 2: Blend recycled water with San Joaquin River water in PID Canal and discharge blended water to the DMC: The calculated average sodium concentration in the San Joaquin River near Patterson (taken to represent water quality in the PID canals) is, at 138 mg/L, even higher than the calculated average sodium concentration (116 mg/L) in the recycled water.

Table 4a of the Pump-in Plan does not include a water quality standard for maximum sodium levels in the DMC, but the average sodium concentration in the DMC is 51 mg/L. After blending the recycled water or the recycled water plus the San Joaquin/PID canal water into the DMC, the sodium level is

expected to be slightly lower than the standard of 69 mg/L in Table 5 of the Pump-in Plan.

Reducing sodium concentrations in the recycled water would involve significant and costly changes to the treatment facilities at the Modesto WQCF and Turlock WQCF.

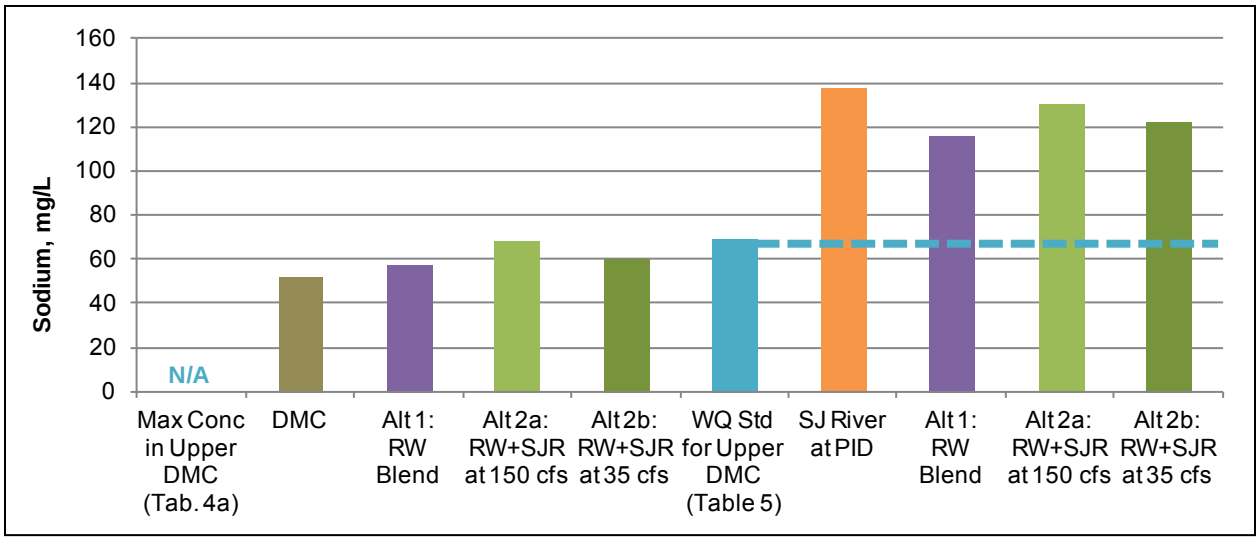


**Figure 4-4 Comparison Chart for Sodium**

**Nitrate and Nitrite**

Relative to surface waters, the influent to wastewater treatment plants contains high levels of ammonia. Wastewater treatment plants nitrify (convert ammonia to nitrite and then to nitrate) and denitrify (reduce nitrate to nitrogen gas) to varying degrees based on treatment processes employed. Modesto's tertiary treatment train includes full nitrification and denitrification, while Turlock's does not. Turlock's process includes nearly complete nitrification, resulting in low levels of ammonia and nitrite.

**Figure 4-5** shows the results of the water quality analysis for nitrate for each of the three alternatives.

Alternative 1: Discharge recycled water directly to the DMC: Based on the available water quality data and the expected 2045 ratio of Modesto to Turlock tertiary effluent, the recycled water has an expected average nitrate concentration of 8.4 mg/L nitrate as N. Blending the recycled water with the DMC water results in a nitrate concentration of 2.0 mg/L. As the Table 4a standard and the Table 5 standard in the Pump-in Plan for nitrate are both 10 mg/L, "Alternative 1" (directly piping recycled water to the DMC), is consistent with the water quality standards in the Pump-in Plan.

With an average concentration of just 0.l mg/L nitrite, the recycled water is also below the Table 4a and Table 5 (of the Pump-in Plan) criteria for nitrite + nitrate (sum as N). See Appendix 4A for the water quality standards and Appendix 4D for calculated nitrite + nitrate concentrations.

Alternative 2: Blend recycled water with SJR water in PID Canal and discharge blended water to the DMC: The average nitrate concentration in the San Joaquin River at Patterson is 13.3 mg/L. However, blending with DMC water reduces the nitrate concentration to levels (2.3-3.5 mg/L) well below the Table 4a and Table 5 standard of 10 mg/L. When the recycled water and the San Joaquin River water are blended using the flow assumptions described above for Alternative 2a (150 cfs in the PID canal), the resulting concentration of 11.6 mg/L is above the standards of 10 mg/L due to the large contribution of San Joaquin River water. For Alternative 2b (35 cfs in the PID Main Canal), the resulting concentration of 9.9 mg/L is close to the standards in Table 4a and Table 5 of the Pump-in Plan.

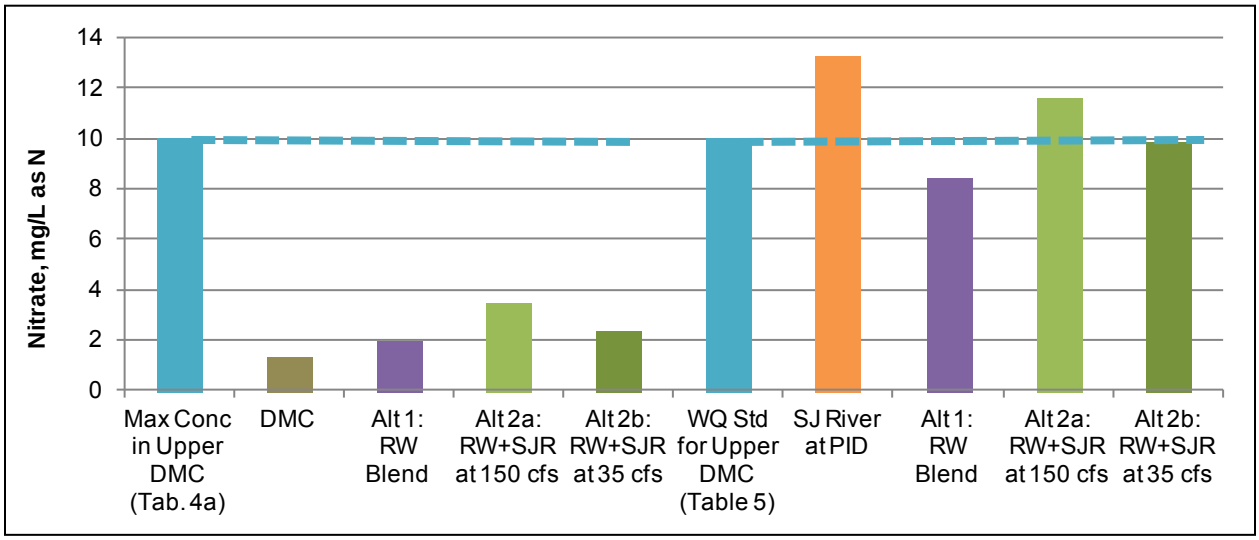


**Figure 4-5 Comparison Chart for Nitrate**

## Selenium

The acceptance criteria in Tables 4a and 5 of the Pump-in Plan list a threshold of 2 µg/L selenium based on the standard for Grasslands water supply channels. Selenium is often present at concentrations close to the method detection limit and/or reporting limit, making the average values in Turlock and Modesto effluent, the San Joaquin River, and the DMC potentially dependent on the method used. Therefore, this section contains additional information about the detection limits and reporting limits about each data set, where this information is known.

Turlock's NPDES permit contains an average monthly effluent limitation for selenium of 3.7 µg/L and requires monthly monitoring. Samples are analyzed using EPA method 200.8 (ICP-MS). The selenium concentrations in Turlock's effluent data set (N=33), which has an MDL of 0.06 µg/L, were all lower than the reporting limit (i.e., detected but not quantified, or DNQ). The reporting limit ranged from 0.5 - 1 µg/L, and the average concentration was 0.26 µg/L.

By contrast, Modesto has no NPDES permit limit and has not discharged tertiary effluent to the receiving water, so the data set is more limited. For

Modesto, just three samples of tertiary effluent were available; selenium was detected in all the samples, at an average concentration of 1.2 µg/L. No reporting limit or MDL was available.

For the San Joaquin River, the selenium data set is drawn from CEDEN station 'SJR @ Patterson' as reported by the Grasslands Bypass Project, with an MDL of 0.1 µg/L and a reporting limit of 0.4 µg/L. The average value was 1.9 µg/L, with only 11 of 916 samples below the reporting limit.

The DMC data set from the USBR Environmental Monitoring Database contains sample results with a reporting limit of 0.4 µg/L, 1.0 µg/L, and 2.0 µg/L. The database does not include information about a separate MDL, but most results (188 of 268) were below the respective reporting limit. In these cases, the average value is based on the reporting limit (not ½ the reporting limit); therefore, the calculated average value of 0.8 µg/L used for calculating blended concentrations is conservatively high.

**Figure 4-6** shows the results of the water quality analysis for selenium for each of the three alternatives.

<u>Alternative 1: Discharge recycled water directly to the DMC</u>: As shown in **Figure 4-6** below, average selenium in the recycled water (0.0007 mg/L) is significantly lower than the selenium standard in Table 4a (0.002 mg/L). The DMC has a comparable concentration of selenium (0.0008 mg/L) to the recycled water, so adding recycled water results in no significant change; the DMC will remain well below the 0.002 mg/L threshold established in Table 4a and Table 5 of the Pump-in Plan.

<u>Alternative 2: Blend recycled water with San Joaquin River water in PID Canal and discharge blended water to the DMC</u>: At an average of 0.0019 mg/L, selenium in the San Joaquin River near Patterson is higher than either the recycled water or the DMC. However, blending with DMC water reduces the selenium concentration to well below the standard of 0.002 mg/L in Table 4a of the Pump-in Plan. When the recycled water and the San Joaquin River water are blended using the flow assumptions described above, the resulting selenium concentrations of 0.0015 mg/L for Alternative 2a and 0.0010 mg/L for Alternative 2b are below the criteria in Table 5 of the Pump-in Plan.

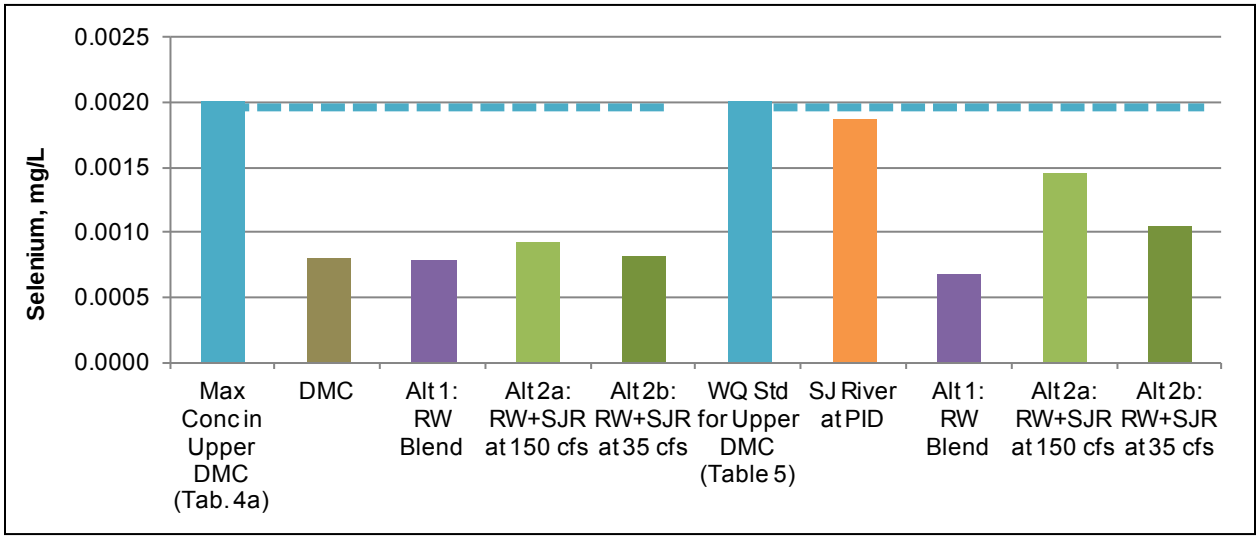


**Figure 4-6 Comparison Chart for Selenium**

## Boron

The acceptance criteria of 0.7 mg/L listed in Tables 4a and 5 of the Pump-in Plan is based on a water quality standard for agricultural irrigation. **Figure 4-7** shows the results of the water quality analysis for boron for each of the three alternatives.

Alternative 1: Discharge recycled water directly to the DMC: As shown in the graph below, average boron in the recycled water (0.20 mg/L) is significantly lower than the boron standard in Table 4a of the Pump-in Plan (0.7 mg/L). The DMC has a comparable concentration of boron (0.19 mg/L) to the recycled water, so adding recycled water results in no significant change; the DMC will remain well below the 0.7 mg/L threshold established in Table 4a and Table 5 of the Pump-in Plan.

Alternative 2: Blend recycled water with San Joaquin River water in PID Canal and discharge blended water to the DMC: At an average of 0.59 mg/L, boron in the San Joaquin River near Patterson is higher than either the recycled water or the DMC, and close to the Table 5 limit of 0.7 mg/L. However, blending with DMC water reduces the boron concentration to well below the standard of 0.002 mg/L in Table 4a of the Pump-in Plan. When the recycled water and the San Joaquin River water are blended using the flow assumptions described above, the resulting boron concentrations of 0.45 mg/L for Alternative 2a and 0.32 mg/L for Alternative 2b are below the criteria of Table 4a and Table 5 of the Pump-in Plan.

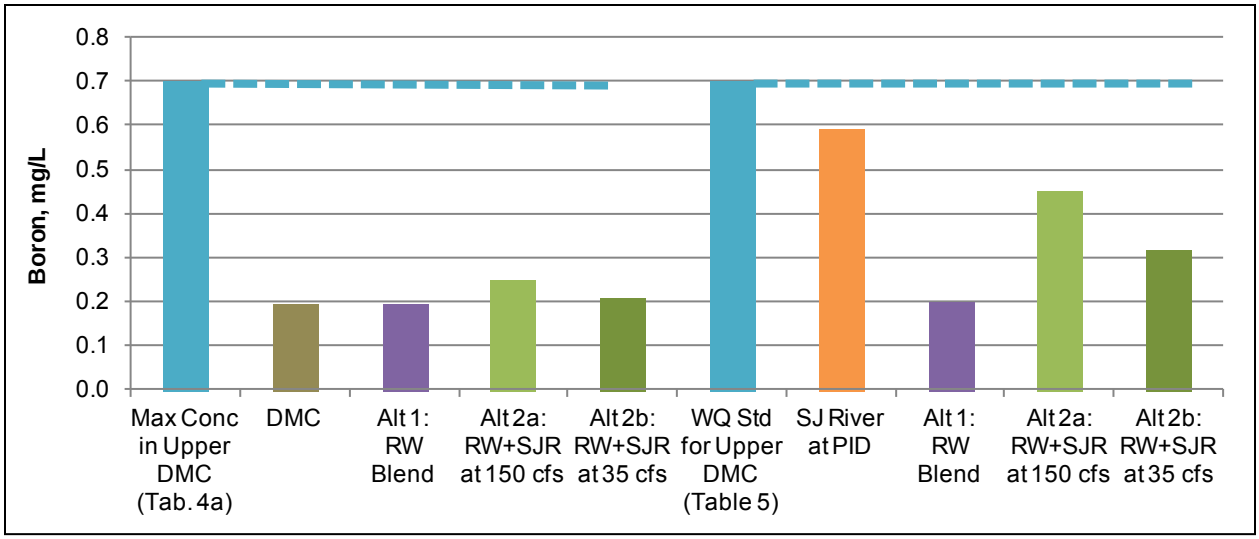


**Figure 4-7 Comparison Chart for Boron**

## Metals, Arsenic and Mercury

The acceptance criteria for arsenic and mercury listed in the Pump-in Plan are based on drinking water regulations. **Figures 4-8** and **4-9** show the results of the water quality analyses for arsenic and mercury for each of the three alternatives.

Alternative 1: Discharge recycled water directly to the DMC: As shown in the graph below, average arsenic in the recycled water (0.003 mg/L) is significantly lower than the arsenic standard in Table 4a (0.01 mg/L). The DMC has a higher concentration of arsenic (0.005 mg/L) than the recycled water, so adding recycled water does not result in any degradation, and the DMC will remain well below the 0.01 mg/L threshold established in Table 4a of the Pump-in Plan.

Alternative 2: Blend recycled water with San Joaquin River water in PID Canal and discharge blended water to the DMC: At an average of 0.004 mg/L, arsenic in the San Joaquin River near Patterson is higher than the recycled water concentration but lower than the DMC concentrations, but below the Table 4a limit of 0.01 mg/L. When the recycled water and the San Joaquin River water are blended using the flow assumptions described above, the resulting arsenic concentration of 0.004 mg/L is also below the Table 4a and Table 5 criteria. Blending with DMC water increases the arsenic concentration to 0.005 mg/L, but the mixture remains well below the standard of 0.01 mg/L in Table 4a and Table 5 of the Pump-in Plan.

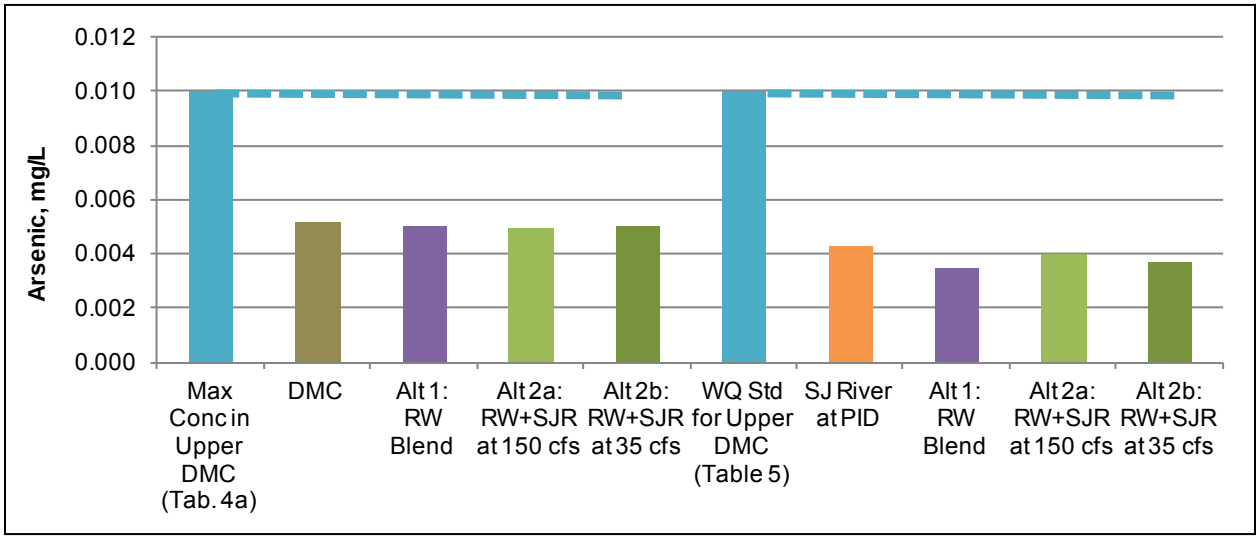


**Figure 4-8 Comparison Chart for Arsenic**

Unlike the constituents discussed above, mercury appears only in Table 5, and not Table 4a, of the Pump-in Plan. Therefore, the existing concentration in the DMC is not addressed in this study; only the mixture of recycled water and San Joaquin River water is relevant for comparison with Table 5 of the Pump-in Plan.

Alternative 1: Discharge recycled water directly to the DMC: As shown in the graph below, average mercury in the recycled water ($2 \times 10^{-6}$ mg/L) is extremely low compared to the mercury standard in Table 5 of the Pump-in Plan (0.002 mg/L).

Alternative 2: Blend recycled water with San Joaquin River water in PID Canal and discharge blended water to the DMC: At an average of 0.0003 mg/L, mercury in the San Joaquin River near Patterson is higher than the recycled water concentration, but still well below the Table 5 limit of 0.002 mg/L. When the recycled water and the San Joaquin River water are blended using the flow assumptions described above, the resulting mercury concentrations of 0.0002 mg/L for Alternative 2a and 0.00009 mg/L for Alternative 2b are also well below the criteria in Table 5 of the Pump-in Plan .

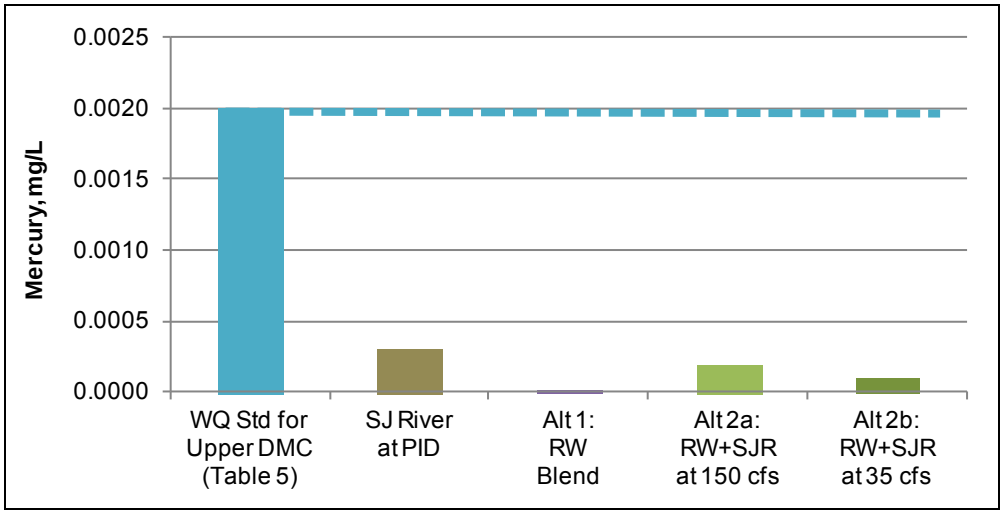


**Figure 4-9 Comparison Chart for Mercury**

## Chloride

Like mercury, chloride appears only in Table 5, and not Table 4a, of the Pump-in Plan. Therefore, the existing concentration in the DMC is not addressed in this study; only the mixture of recycled water and San Joaquin River water is relevant for comparison with Table 5 of the Pump-in Plan. **Figure 4-10** shows the results of the water quality analysis for chlorides for each of the three alternatives.

Alternative 1: Discharge recycled water directly to the DMC: As shown in the graph below, average chloride in the recycled water (152 $^{mg}$/L) is well below the chloride standard in Table 5 (250 mg/L).

Alternative 2: Blend recycled water with San Joaquin River water in PID Canal and discharge blended water to the DMC: At an average of 126 mg/L, chloride in the San Joaquin River near Patterson is comparable to the concentration in recycled water. When the recycled water and the San Joaquin River water are blended using the flow assumptions described above, the resulting chloride concentrations of 135 mg/L for Alternative 2a and 144 mg/L for Alternative 2b are still well below the Table 5 criteria of 250 mg/L.

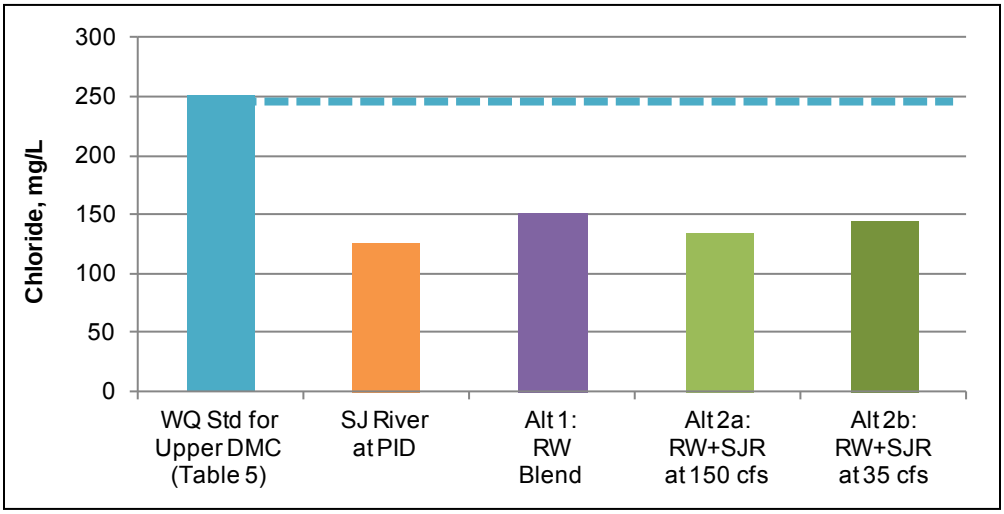


**Figure 4-10 Comparison Chart for Chloride**

## Organic Chemicals including Pesticides

The acceptance criteria listed in Table 5 of the Pump-in Plan are based on a drinking water quality standards, with the exception of chlorpyrifos and diazinon. The for these two constituents, TMDLs and Basin Plan amendments have been developed for the San Joaquin River, which form the basis for the water quality standards in Table 5 of the Pump-in Plan. Both Modesto and Turlock have specific effluent monitoring requirements for chlorpyrifos and diazinon in their NPDES permits.

Of the 20 organic chemicals listed in Table 5, effluent data were only available for eight; all of these sample results were "non-detects." For six of these eight organic chemicals (all except chlorpyrifos and diazinon), effluent data were available from Turlock only, and were assumed to be representative of NVRRWP recycled water. For the constituents with data available from Turlock's effluent, all of the method detection limits were equal to or less than the detection limit for reporting required by Table 5 of the Pump-in Plan. Modesto's data for chlorpyrifos and diazinon did not list an MDL.

A few of the organic chemicals listed in Table 5 of the Pump-in Plan were detected in the San Joaquin River near Patterson. Of the 20 organic chemicals listed in Table 5, San Joaquin River water quality data were available for twelve. Most of these sample results were "non-detects," with the exception of chlorpyrifos, diazinon, methoxychlor, and simazine. All were reported at levels below the relevant standards in Table 5. For the constituents with data available, the method detection limits were equal to or less than the detection limit for reporting required by Table 5, where listed.

## Bacteria

The Pump-in Plan does not address bacteria or include a bacteria limit. However, as stated above, California Title 22 regulations for tertiary recycled water require that the 7-day median concentration of total coliform bacteria

measured in the disinfected effluent does not exceed 2.2 most probable number (MPN) per 100 mL, 23 MPN/100 mL more than once in any 30-day period, and 240 MPN/100 mL in any single sample. These same requirements are also specifically listed in the NPDES permits for both Modesto and Turlock, and are applicable for discharges of tertiary effluent. The limited data available for the San Joaquin River and DMC indicate that they do not comply with the Title 22 standards listed above. Therefore, the addition of recycled water is not expected to result in any bacterial degradation of water quality.

**Chronic Toxicity**

Both Modesto and Turlock conduct whole effluent chronic toxicity monitoring as a requirement of their NPDES permits. Compliance with the narrative prohibition against chronic toxicity in the effluent discharge is achieved by conducting the required monitoring; if chronic toxicity is observed, the discharger must conduct accelerated monitoring and identify corrective actions to reduce or eliminate effluent toxicity. Both NPDES Permits identify a trigger of 1 chronic toxicity unit (1 $TU_c$) as the threshold for triggering accelerated monitoring. Modesto and Turlock will continue to comply with the narrative toxicity objective, as required.

## Conclusions

Tertiary treated recycled water from both Turlock and Modesto meets the stringent requirements established in Title 22 of the California Code of Regulations, and is suitable for a wide variety of non-potables uses including all types of irrigation, toilet flushing, and industrial processes.

The recycled water quality is typically better than San Joaquin River water quality, since the river carries a high salt load at certain times of year and is listed as an impaired water body for boron, selenium, electrical conductivity, mercury, and several pesticides. On average, the recycled water contains lower concentrations of these chemicals than those currently found in the river. Compared to the river, the recycled water also contains lower concentrations of metals such as cadmium, chromium, and nickel, and lower concentrations of nitrates. In fact, if NVRRWP water is blended with San Joaquin River water in the PID Main Canal prior to entering the DMC, described as Alternative 2a or 2b in this chapter, the blended water is expected to exceed the DMC water quality standard for acceptance of 10 mg/L. This is because the San Joaquin River already exceeds the standard.

Recycled water, when blended with water from the DMC, is expected to comply with the water quality standards for the Upper DMC. With a few exceptions, the recycled water quality also complies with the Reclamation's current water quality standards for acceptance into the DMC. Both sets of standards are in place to regulate the practice of pumping well water into the DMC under Warren Act Contracts. Of the 48 constituents covered by these standards, only the recycled water sodium content is expected to exceed the standards for

acceptance into the DMC. The San Joaquin River also exceeds the 69 mg/L standard for sodium, so any blend of NVRRWP and San Joaquin River water would also exceed the standard.

Selenium, a constituent of concern for recycled water use at wildlife refuges, is present in NVRRWP recycled water at a concentration comparable to the existing DMC water quality (0.8 µg/L). The same is true for boron and arsenic. Recycled water would be delivered to the refuges after mixing with the existing water in the DMC. Based on the results presented in this chapter, the project is not expected to produce a significant change in water quality to downstream DMC users.

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# Chapter 5 Water Quality Sampling and Analysis

## Summary of Findings

On May 2, 2012 and May 9, 2013, samples were collected at four locations relevant to this Study: Newman Canal at the water delivery point to the China Island Unit of the North Grasslands Wildlife Area, the Delta Mendota Canal (DMC) at the proposed point of addition of North Valley Regional Recycled Water Program (NVRRWP) water, the Patterson Irrigation District (PID) Main Canal, and Turlock tertiary effluent. On May 9, 2013 a sample was also collected of Modesto secondary effluent (the Modesto tertiary facilities were offline during the duration of this sampling program).

These samples were analyzed for "conventional constituents" (total dissolved solids, electrical conductivity, sodium, selenium, nitrate, nitrite, boron, mercury, and chloride) and Contaminant of Emerging Concern (CECs). Analytical results for conventional constituents were comparable to the existing water quality data. For the CEC analyses, 34 analytes were detected in the Turlock tertiary effluent and/or Modesto secondary effluent samples with most analytes being detected in the samples from both locations. In the samples from the China Island delivery point, the DMC, the PID canal, nine analytes were detected using the analysis for CECs and included both herbicides/pesticides and constituents that are likely originate from wastewater effluent (such as caffeine and the artificial sweetener sucralose). The detection of these analytes is to be expected as wastewater treatment plants discharge to the source waters for the DMC and the PID Main Canal.

## Introduction

This chapter summarizes the sampling program conducted under Task 4 of the Refuge Recycled Water Supply Study and compares the laboratory analytical results to existing water quality data as presented in Chapter 4.

The purpose of the sampling program was to confirm the usefulness of the existing data and to provide information about analytes, particularly Constituents of Emerging Concern (CECs) that are not included in the existing data sets.

# Sampling Program

The sampling program, including the sample locations, requested analyses, and quality control/quality assurance (QA/QC) samples, is described below.

## Sample Locations and Sampling Events

The proposal to add North Valley Regional Recycled Water Program (NVRRWP) recycled water to the Delta Mendota Canal (DMC) involves first combining the treated tertiary effluent from Modesto and Turlock and then adding the recycled water to either the Patterson Irrigation District (PID) Main Canal or directly to the DMC. As such, existing conditions water quality data from each of these four points – Modesto effluent, Turlock effluent, the DMC, and the PID Main Canal – is crucial to understanding the potential impacts of adding NVRRWP recycled water to the DMC (and potentially the PID Main Canal). Additionally, understanding the water quality profile of the water currently provided to the refuges is necessary to understand how this proposal would affect the refuges and whether the NVRRWP recycled water after mixing in the DMC is appropriate for use in the refuge areas. Under this sampling program, water samples were collected from these five locations as shown below in Table 5-1.

**Table 5-1. Sample Locations and Sample Names**

| Sampling Location | Sample Name |
|---|---|
| China Island | RRW-1 |
| DMC | RRW-2 |
| PID Main Canal | RRW-3 |
| Modesto Effluent | RRW-4 |
| Turlock Effluent | RRW-5 |

The samples were given generic sample names to prevent any bias in the laboratory analysis. The sample locations are shown on Figure 5-1 and are further described below.

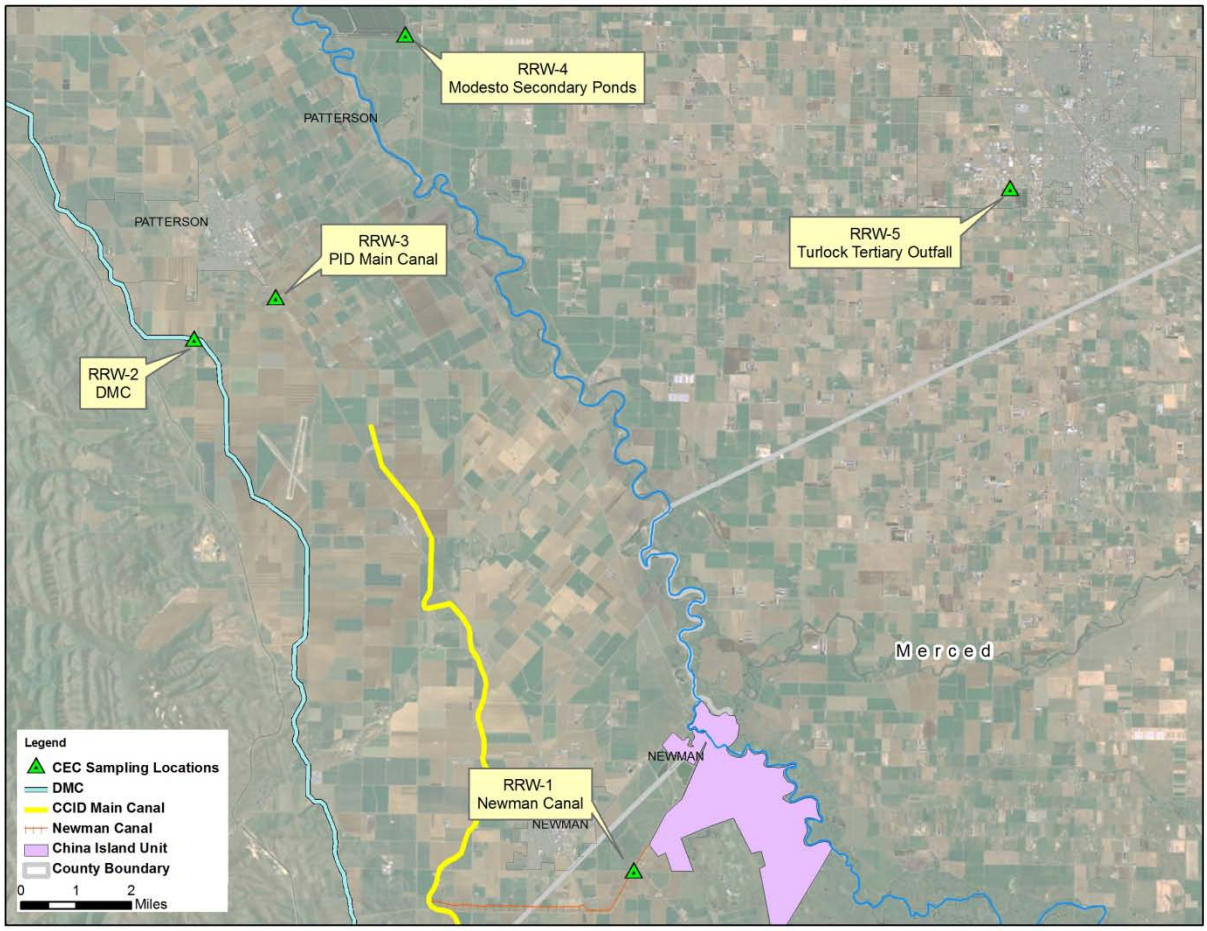


**Figure 5-1: Sample Locations**

### *China Island (RRW-1)*

The China Island (RRW-1) samples were collected from Newman Canal at the water delivery point to the China Island Unit of the North Grasslands Wildlife Area.

The Newman Canal is a 4.75 mile long, concrete lined, open channel canal that receives its source water from the U.S. Bureau of Reclamation via the Delta-Mendota Canal (DMC) through a wheeling contract with Central California Irrigation District's (CCID) Main Canal. The Newman Canal begins approximately 2.5 miles southwest of Newman, CA and travels east towards the China Island Unit.

The samples for RRW-1 were collected at the intersection of the Newman Canal and Braza Road, in an unincorporated section of Stanislaus County. Using a disposable Teflon bailer, water was collected from the northeast and downstream side of the siphon that runs under Braza Road, seen in igure

.

**Figure 5-2: RRW-1 Sampling Location, as seen on May 2nd, 2013**

Follow up discussions with the U.S. Fish and Wildlife Service determined that the Newman Canal flow rates during the two sampling dates of May 2nd and May 9th were approximately 8 cubic-feet per second (cfs) and 2 cfs, respectively[31].

### *Delta Mendota Canal (RRW-2)*

The DMC (RRW-2) samples were collected using a disposable Teflon bailer from the northern (upstream) side of the Ward Avenue bridge where it crosses over the DMC, as seen in igure . RRW-2 is located just south of the City of Patterson, CA city limits along Ward Avenue. The California Data Exchange Center's (CDEC) Tracy Pumping Plant monitoring station recorded flow rates for May 2nd and May 9th of 3,155 cfs and 978 cfs, respectively.

[31] Miyamoto, Steve. 2013. Wildlife Habitat Supervisor of the USFWS China Island Unit. Conversation with Ryan
Doyle (RMC Water and Environment)

**Figure 5-3: RRW-2 Sampling Location, as seen on May 9th, 2013**

***PID Main Canal (RRW-3)***

The PID Main Canal (RRW-3) samples were collected from the PID owned and operated Main Canal. At the intersection of the Main Canal and Almond Avenue, a disposable Teflon bailer was used to collect the water samples at the edge of the canal at the location shown in igure .

**Figure 5-4: RRW-3 Sampling Location, as seen on May 9th, 2013**

### *Modesto Effluent (RRW-4)*

A Modesto effluent sample was not collected on May 2, 2013 because the tertiary treatment facilities at the Modesto WQCF were not operational at that time and the original intention of this sampling program was to collect and analyze samples of the Modesto WQCF tertiary effluent. There are no current uses of Modesto WQCF effluent that require tertiary treatment so the tertiary facilities can be shut down for extended periods if needed. On May 9th, 2013 the tertiary facilities remained offline and a Modesto effluent (RRW-4) sample was collected from secondary effluent ponds located within the Jennings Facility, as seen in igure .

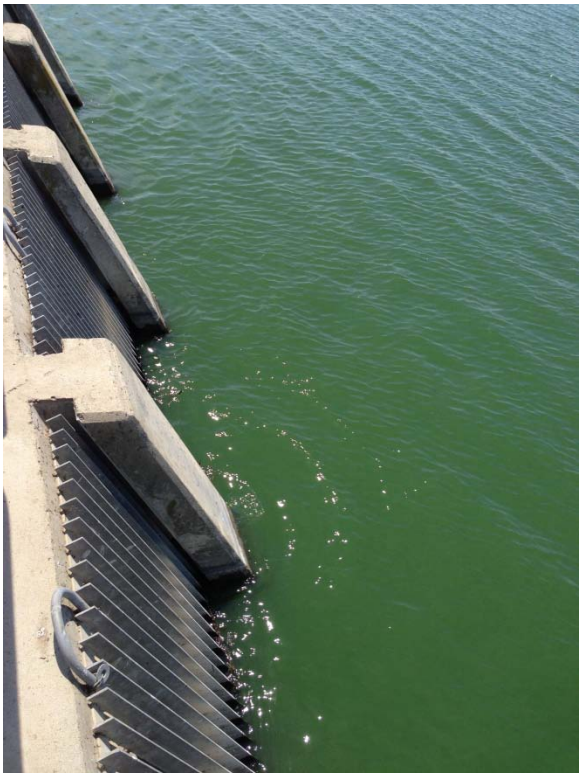

**Figure 5-5: RRW-4 Sampling Location, as seen on May 9th, 2013**

Although samples of the tertiary effluent would be more representative of the water that is proposed to be conveyed through the DMC, the secondary effluent should not differ substantially from the secondary effluent with respect to the chemical constituents and water quality parameters analyzed as part of this sampling program. The Modesto WQCF tertiary treatment process is a two-step membrane bioreactor (MBR) process that includes nitrification/denitrification and microfiltration. The filtration process removes particulates, i.e. suspended particles but does not remove dissolved constituents. The tertiary effluent water quality will be better than that of the secondary effluent sampled in this study so the results sampled are conservative with respect to the actual water quality of the Modesto flows sent to NVRRWP.

#### *Turlock Effluent (RRW-5)*

On May 2, 2013 and May 9, 2013 the Turlock effluent samples (RRW-5) were collected from the sampling tap for the tertiary effluent of the Turlock WQCF. The Turlock tertiary facilities were operating normally at the time.

### Analytical Laboratories and Requested Analyses

The analytical laboratories, all of which are on the USBR list of approved laboratories, were as follows:

- California Laboratory Services (CLS) – USBR approved for inorganic, organic, and microbiological parameters. CLS analyzed the samples for

boron, mercury, sodium, chloride, nitrate, specific conductance (electrical conductivity – EC), and TDS.

- South Dakota Agricultural Laboratories – USBR approved for selenium. South Dakota Analytical Laboratories analyzed the samples for selenium.
- Eurofins Eaton Analytical (Eurofins) – USBR approved for all inorganic, organic, and radiochemistry parameters in water. Eurofins analyzed the samples for CECs.

Within this memorandum, the chemical constituents analyzed by CLS and South Dakota Agricultural Laboratories are referred to as "conventional constituents" and the Eurofins analytes are referred to as CECs.

## Sampling Procedures and Protocols

On both May 2, 2013 and May 9, 2013, the sampling team consisted of Ryan Doyle of RMC Water and Environment and Corey Kilpatrick of Blaine Tech Services. The weather on both May 2, 2013 and May 9, 2013 was sunny and dry. Field notes including field measurements of water quality parameters (pH, conductivity, turbidity, dissolved oxygen, oxidation reduction potential, and total dissolved solids) are provided in Appendix 5-A.

Sample bottles for conventional constituents (including selenium) were provided by CLS and sample bottles for CECs were provided by Eurofins. All sample bottles came with the appropriate preservatives for the analyses being requested.

In addition to standard sampling procedures (changing gloves for every sample, keeping samples on ice, etc.), the sampling team followed the sampling protocols provided by Eurofins for collection of samples to be analyzed for CECs. A copy of these sampling protocols is provided in Appendix 5-B. The disposable Teflon bailers used for sample collection are consistent with these protocols.

## QA/QC Samples

The following field QA/QC samples were collected and analyzed:

- Field duplicate (RRW-6). The field duplicate of the Turlock effluent samples (RRW-5) was collected on both May 2, 2013 and May 9, 2013 and analyzed for all analytes. The RRW-6 samples were collected in an identical manner as the RRW-5 samples (from the Turlock tertiary effluent sampling tap).
- Equipment blank (RRW-7): An equipment blank was collected on both May 2, 2013 and May 9, 2013, and analyzed for all analytes. The equipment blank was collected by pouring deionized water provided by the laboratories into a new disposable Teflon bailer and then pouring the water in the bailer into the sample bottles.

# Conventional Constituents Analytical Results

As discussed above, the conventional constituents analyzed for were TDS, EC, sodium, selenium, nitrate, nitrite, boron, mercury, and chloride. The analytical results are compiled in Appendix 5-C. Copies of the laboratory reports are provided in Appendix 5-D (CLS) and Appendix 5-E (South Dakota Agricultural Laboratories).

## Comparison to Existing Water Quality Data for Conventional Constituents

As shown in Appendix 5-C, the analytical results for the samples collected on May 2, 2013 and May 9, 2013 were compared to the existing water quality data presented in Chapter 4. For all analytes, the concentrations found in the May 2, 2013 and May 9, 2013 samples were within the range of concentrations seen in the existing data set.

## Conventional Constituent QA/QC Results

This section discusses the results of field collected QA/QC samples as well as internal laboratory QA/QC procedures. In summary, neither the field collected QA/QC samples nor the internal laboratory QA/QC revealed any data quality issues for conventional constituents.

### *Field Duplicates (RRW-6)*

On May 2, 2013 and May 9, 2013 a field duplicate (RRW-6) was collected at the Turlock tertiary effluent sampling location (the field sample of Turlock tertiary effluent is designated RRW-5). These field duplicates were analyzed for all conventional constituents to assess variability introduced by field sampling procedures

The precision of field duplicates was evaluated by calculating the relative percent difference (RPD) between the involved samples. Generally, an RPD of less than 25% is considered acceptable.

$$\text{RPD} = \left| \frac{\left(\text{field sample concentration} - \text{field duplicate concentration}\right)}{\text{mean}} \right| \times 100$$

Where:

$$\text{mean} = \frac{(\text{field sample concentration} + \text{field duplicate concentration})}{2}$$

As shown in Appendix 5-C, the field duplicate RPD was below 10% for all conventional constituents with the exception of selenium in the May 9, 2013 samples. In the May 9, 2013 samples, selenium was not detected in the field sample (RRW-5) above the laboratory reporting limit of 0.4 µg/L while selenium was detected at a concentration of 0.521 µg/L in the field duplicate

(RRW-6) and as such the RPD in this instance is greater than 26%. Because of the relatively low selenium detection limit of 0.4 µg/L and the low RPDs for other conventional constituents, this higher field duplicate RPD is unlikely to represent any wider data quality issues.

On May 9, 2013, RRW-6 was mislabeled as RRW-7 and RRW-7 was mislabeled as RRW-6. The error has been corrected in the data tables in Appendix 5-C. A note has also been inserted in the laboratory reports (Appendix 5-D and Appendix 5-E) to avoid confusion.

#### *Equipment Blanks (RRW-7)*

On May 2, 2013 and May 9, 2012, equipment blank samples (RRW-7) were collected by pouring deionized water provided by CLS into a new Teflon bailer and then pouring the water in the bailer into the sample bottles.

As shown in Appendix 5-C, concentrations of conventional constituent in the RRW-7 samples were either not detected, below method reporting limits, or very low compared to the results for the field samples. As such, it is unlikely that the equipment or the sampling procedures affected analytical results for conventional constituents in any significant way.

#### *Internal Laboratory QA/QC for Conventional Constituents*

Per notes on the laboratory reports (see Appendix 5-D and Appendix 5-E), no unresolvable data quality issues were encountered by either CLS or the South Dakota Agricultural Laboratory.

## Chemicals of Emerging Concern (CEC)

This section presents the results of CEC analysis. CECs include new classes of chemicals, such as pharmaceuticals, current use pesticides, and industrial chemicals.

### Regulatory Framework for CEC Monitoring

Many CECs are potentially present in recycled water, surface waters, and groundwater, but the ability to detect many of these chemicals at low concentrations is so recent that a robust framework for interpreting their potential human or ecosystem health effects is unavailable.

In California, the most well-established regulations and policies related to CECs in recycled water are associated with the State Water Resources Control Board (SWRCB) Recycled Water Policy. The SWRCB adopted the Recycled Water Policy in May 2009 and in April 2013 adopted an amendment to the Recycled Water Policy that provided CEC monitoring requirements for groundwater recharge projects using recycled water.

Table 5-2 shows the human health-relevant and performance indicator CECs to be monitored at least in the initial assessment phase of projects that include surface application of recycled water for groundwater recharge of a groundwater basin designated for municipal use.

**Table 5-2. CECs to be Monitored per the Recycled Water Policy**

| Constituent | Constituent Group | Relevance/Indicator Type[1] | Monitoring Trigger Level (µg/L) |
|---|---|---|---|
| 17β-estradiol | Steroid hormones | Health | 0.009 |
| Caffeine | Stimulant | Health & Performance | 0.35 |
| N-Nitrosodimethylamine (NDMA) | Disinfection byproduct | Health | 0.01 |
| Triclosan | Antimicrobial | Health | 0.35 |
| Gemfibrozil | Pharmaceutical | Performance | -- |
| Iopromide | Pharmaceutical | Performance | -- |
| N,N-Diethyl-meta-toluamide (DEET) | Personal care product | Performance | -- |
| Sucralose | Food additive | Performance | -- |

Within the Recycled Water Policy, CECs of toxicological relevance to human health are referred to as "health-based CECs." CECs determined not to have human health relevance, but useful for monitoring treatment process effectiveness, are referred to as "performance indicator CECs." A performance indicator CEC is an individual CEC used for evaluating a family of CECs with similar physicochemical or biodegradable characteristics. The removal of a performance indicator CEC through a treatment process provides an indication of removal of CECs with similar properties. A health-based CEC may also serve as a performance indicator CEC.

For the health-based CECs, monitoring trigger levels have been established. If initial monitoring shows the concentration of a CEC as equal to or greater than the monitoring trigger level, then the CEC should be considered for inclusion in a longer-term monitoring program.

The monitoring requirements and criteria for evaluating monitoring results in the Policy are based on recommendations the Science Advisory Panel that was convened in accordance with provisions of the Policy. The panel's recommendations were presented in the report; *Monitoring Strategies for Chemicals of Emerging Concern (CECs) in Recycled Water – Recommendations of a Science Advisory Panel*, dated June 25, 2010.

## Requested CEC Analytes and Laboratory Test Methods

Because the Recycled Water Policy is the most well-established regulatory framework in California that addresses CECs in recycled water and because no regulatory framework exists for assessing CEC impacts in wetland areas such as the refuges, the constituents listed above in Table 2 were the requested analytes for the samples collected on May 2, 2013 and May 9, 2013.

In order in analyze for the eight constituents shown in Table 5-2, Eurofins runs four different laboratory test methods as shown in Table 5-3.

**Table 5-3. Laboratory Test Methods for CECs**

| Constituent | Test Method Names | Comments |
|---|---|---|
| 17β-estradiol | EPA 539 | EPA approved method |
| N-Nitrosodimethylamine (NDMA) | EPA 521 – Nitrosamines by GCMS | EPA approved method |
| Caffeine | LC-MS-MS - Endocrine Disruptors Positive Mode - SPE | This is a research test method developed by Eurofins |
| N,N-Diethyl-meta-toluamide (DEET) | | |
| Triclosan | LC-MS-MS - Endocrine Disruptors Negative Mode - SPE | This is a research test method developed by Eurofins |
| Gemfibrozil | | |
| Iopromide | | |
| Sucralose | | |

GCMS = Gas chromatography–mass spectrometry
LC-MS-MS = Liquid chromatography-tandem mass spectrometry

These test methods detect a variety of constituents beyond those listed in Table 5-2. The full list of analytes is shown in the laboratory reports (Appendix 5-F).

## Analytical Results of CEC Sampling

The analytical results of CEC sampling are summarized in the table provided in Appendix 5-G. 34 different analytes were detected amongst the seven samples (RRW-1 through RRW-7). In Appendix 5-G and the tables below, concentrations are reported using the same units as in the Eurofins laboratory reports – ng/L (nanograms per liter) except for the analyte 4-androstene-3,17-dione which is reported in µg/L (micrograms per liter).

**Table 5-4. Units of Concentration Conversions**

| mg/L | µg/L | ng/L |
|---|---|---|
| milligrams per liter | micrograms per liter | nanograms per liter |
| parts per million (ppm) | parts per billion (ppb) | parts per trillion (ppt) |
| 1 mg/L = | 1,000 µg/L = | 1,000,000 ng/L |
| equivalent to one drop of water diluted into 50 liters (13 gallons) | equivalent to one drop of water diluted into 50 cubic meters (~13,000 gallons) | Equivalent to a drop of water diluted into 20 Olympic-size swimming pools. |
| Coffee has a concentration caffeine of approximately 500 mg/L | Coffee has a concentrations caffeine of approximately 500,000 µg/L | Coffee has a concentration caffeine of approximately 500,000,000 ng/L |

### *RRW-1, RRW-2 and RRW-3 Analytical Results (Canal Samples)*

As shown below in Table 5-5, the detected analytes were similar amongst the three canal samples: RRW-1 (China Island), RRW-2 (DMC) and RRW-3 (PID Main Canal). When an analyte was detected in two or more of these samples, the analytical results between the samples were similar (at least within an order of magnitude).

**Table 5-5. Canal Sample Analytical Results from CEC Sampling**

| Analyte | Analyte Description | Units | Method Reporting Limit* | RRW-1 | | RRW-2 | | RRW-3 | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | China Island | | DMC | | PID Main Canal | |
| | | | | May 2 | May 9 | May 2 | May 9 | May 2 | May 9 |
| 2,4-D | herbicide | ng/L | 5 | 27 | 22 | 16 | 89 | 18 | 56 |
| Acesulfame-K | artificial sweetener | ng/L | 20 | 340 | 260 | 290 | 200 | 960 | 730 |
| Caffeine | stimulant (as in coffee, tea, etc.) | ng/L | 5 | 7.8 | 5.2 | 8.9 | 6.7 | 22 | 21 |
| Diuron | herbicide | ng/L | 5 | 700 | 360 | 160 | 170 | 600 | 230 |
| Fluoxetine | pharmacetical (Prozac) | ng/L | 10 | ** | ** | ** | 13 | ** | ** |
| Iohexal | contrast agent used in clinical radiology | ng/L | 10 | 48 | ** | 54 | ** | 39 | ** |
| Metolachlor | herbicide | ng/L | 5 | 17 | 18 | 21 | 20 | 38 | 140 |
| Simazine | herbicide | ng/L | 5 | 6.2 | ** | ** | ** | ** | ** |
| Sucralose | artificial sweetener | ng/L | 100 | 690 | 440 | 410 | 300 | 650 | 580 |

* When the concentration of a chemical is high relative to the method reporting limit, dilution of the sample per standard laboratory protocols may be needed and will result in higher reporting limits. See laboratory reports (Appendix 5-F) for reporting limits for individual analysis.
** Analyte was not detected above the method reporting limit.

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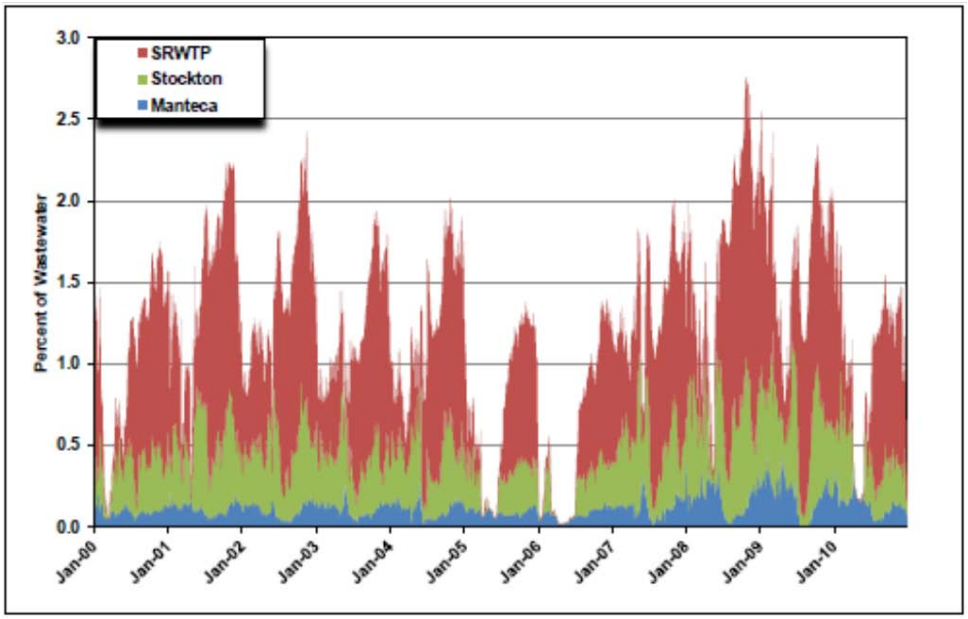
The presence of the non-herbicide analytes in the RRW-1 through RRW-3 samples likely indicates that these waters have at some point mixed with wastewater treatment plant effluent. This is to be expected as the water in the DMC is drawn from the Delta and multiple wastewater treatment plants discharge treated effluent to the Delta or to waterways that flow to the Delta. *The California State Water Project Watershed Sanitary Survey 2011 Update*[32] estimated that the discharge from three of the largest wastewater dischargers to Delta tributaries can comprise up to approximately 3% of the flow at the DMC intake at C.W. "Bill" Jones Pumping Plant (Delta intake for DMC).




*Source: California State Water Project Watershed Sanitary Survey, 2011 Update.*

**Figure 5-6 Estimated Percent of Wastewater at C.W. "Bill" Jones Pumping Plant (Delta intake for DMC)**

Similarly, the water pumped into the PID Main Canal is sourced from the San Joaquin River which contains a number of upstream wastewater treatment plant dischargers that pump effluent into the San Joaquin River, including the City of Turlock.

### *RRW-4 and RRW-5 Analytical Results (Treatment Plant Samples)*

As shown below in Table 5-6, the detected analytes were similar amongst the three treatment plant samples: the one RRW-4 sample (Modesto secondary effluent), and the two RRW-5 samples (Turlock tertiary effluent) When an analyte was detected in two or more of these samples, the analytical results between the samples were similar (at least within an order of magnitude). Table 5-7 gives a short description of each of the chemicals detected in the RRW-4 and RRW-5 samples.

[32] *The California State Water Project Watershed Sanitary Survey 2011 Update*, Archibald Consulting, Palencia Consulting Engineers, Starr Consulting. June 2012.

**Table 5-6. Treatment Plant Sample Analytical Results from CEC Sampling**

| Analyte | Units | Method Reporting Limit* | RRW-4 | RRW-5 | |
|---|---|---|---|---|---|
| | | | Modesto | Turlock | |
| | | | May 9 | May 2 | May 9 |
| 2,4-D | ng/L | 5 | 18 | 64 | 92 |
| 4-androstene-3,17-dione | µg/L | 0.0003 | | 0.0029 | 0.00098 |
| Acesulfame-K | ng/L | 20 | 36,000 | 28,000 | 21,000 |
| Atrazine | ng/L | 5 | | 12 | 12 |
| BPA (Bisphenol A) | ng/L | 10 | | 100 | ** |
| Caffeine | ng/L | 5 | 73 | 920 | 700 |
| Carbamazepine | ng/L | 5 | 120 | 84 | 140 |
| Carisoprodol | ng/L | 5 | 270 | 82 | 100 |
| Cotinine | ng/L | 10 | 12 | 99 | 87 |
| DACT | ng/L | 5 | 49 | 26 | 51 |
| DEA | ng/L | 5 | 15 | 9.8 | 10 |
| DEET | ng/L | 10 | 44 | 340 | 180 |
| Dehydronifedipine | ng/L | 5 | | 99 | 110 |
| DIA | ng/L | 5 | | 9.6 | 7.9 |
| Dilantin | ng/L | 20 | 150 | 110 | 110 |
| Diuron | ng/L | 5 | 35 | 32 | 35 |
| Estrone | ng/L | 0.002 | 27 | ** | ** |
| Fluoxetine | ng/L | 10 | | 93 | ** |
| Gemfibrozil | ng/L | 5 | 170 | 19 | 19 |
| Ibuprofen | ng/L | 10 | | 42 | 61 |
| Iohexal | ng/L | 10 | 7,000 | 3,400 | 2,200 |
| Lidocaine | ng/L | 5 | 33 | ** | ** |
| Lincomycin | ng/L | 10 | 25 | ** | ** |
| Meprobamate | ng/L | 5 | 230 | 380 | 310 |
| Metolachlor | ng/L | 5 | | ** | ** |
| NDMA | ng/L | 2 | | 2.4 | 2.5 |
| Pentoxifylline | ng/L | 5 | | 14 | 13 |
| Primidone | ng/L | 5 | 63 | 50 | 53 |
| Simazine | ng/L | 5 | | ** | 6 |
| Sucralose | ng/L | 100 | 24,000 | 38,000 | 11,000 |
| Sulfamethoxazole | ng/L | 5 | 1,700 | ** | ** |
| TCPP | ng/L | 100 | 360 | 200 | 200 |
| TDCPP | ng/L | 100 | 140 | 250 | 270 |

* When the concentration of a chemical is high relative to the method reporting limit, dilution of the sample per standard laboratory protocols may be needed and will result in higher reporting limits. See laboratory reports (Appendix 5-F) for reporting limits for individual analysis.
**Analyte was not detected above the method reporting limit.

**Table 5-7. Descriptions of Analytes Detected in Treatment Plant Samples**

| Analyte | Description |
|---|---|
| 2,4-D | Common pesticide/herbicide |
| 4-androstene-3,17-dione | Steroid hormone produced in the adrenal glands and the gonads |
| Acesulfame-K | Artificial sweetener (marketed under the trade names Sunett and Sweet One). |
| Atrazine | Common herbicide |
| BPA (Bisphenol A) | Man-made compound used in plastics and epoxy resins |
| Caffeine | Natural compound that acts as a stimulant drug. Caffeine is found in varying quantities in the seeds, leaves, and fruit of some plants . |
| Carbamazepine | Prescription drug used to treat seizures, nerve pain and bipolar disorder. |
| Carisoprodol | Prescription drug used to treat pain and muscle spasms.. |
| Cotinine | Alkaloid found in tobacco and is also a metabolite of nicotine |
| DACT | Herbicide |
| DEA | Chemical used as a wetting agent in shampoos, lotions, creams and other cosmetics. |
| DEET | Most common active ingredient in insect repellents. |
| Dehydronifedipine | Main metabolite of the pharmaceutical Nifedipine, a pharmaceutical taken to treat high blood pressure and angina (chest pain) |
| DIA (Desisopropyl atrazine) | Herbicide |
| Dilantin | Prescription drug used to treat seizures.. |
| Diuron | Herbicide. |
| Estrone | Estrogenic hormone secreted by the ovary as well as adipose tissue |
| Fluoxetine | Prescription drug (Prozac) used to treat depression, obsessive compulsive disorder, eating disorders, and panic disorders. |
| Gemfibrozil | Prescription drug used to lower triglyceride and cholesterol levels. |
| Ibuprofen | Over-the-counter drug used to treat fever and pain. |
| Iohexal | Contrast agent used during coronary angiography. |
| Lidocaine | Prescription drug (local anesthetic) |
| Lincomycin | Prescription antibiotic |
| Meprobamate | Prescription drug used to treats tension, anxiety, and nervousness. |
| Metolachlor | Widely used herbicide. |
| NDMA | By-product of water disinfection by chlorination or chloramination. |
| Pentoxifylline | Prescription drug used to treat poor blood circulation. |
| Primidone | Prescription drug used to treat seizure disorders. |
| Simazine | Herbicide. |
| Sucralose | Artificial sweetener (marketed under the trade name Splenda). |
| Sulfamethoxazole | Prescription antibiotic. |
| TCPP | Flame retardant chemical. |
| TDCPP | Flame retardant chemical. |

### *Comparison of CEC Analytical Results for RRW-4 and RRW-5 to Recycled Water Policy Monitoring Trigger Levels*

Table 5-8 shows concentrations of CECs detected in the Modesto (RRW-4) and Turlock (RRW-5) as compared to the monitoring trigger levels established in the Recycled Water Policy. Only caffeine in the Turlock effluent samples exceeds these monitoring trigger levels. As discussed earlier in this chapter, these motoring trigger levels are based on human health risks associated with the use of recycled water in the surface application groundwater recharge projects.

**Table 5-8. Comparison of CEC Analytical Results to Recycled Water Policy Monitoring Trigger Levels**

| Constituent | Monitoring Trigger Level (µg/L) | RRW-4 | RRW-5 | |
|---|---|---|---|---|
| | | Modesto | Turlock | |
| | | May 9 | May 2 | May 9 |
| 17β-estradiol | 0.009 | <0.004 | <0.004 | <0.004 |
| Caffeine | 0.35 | 0.073 | 0.920 | 0.700 |
| N-Nitrosodimethylamine (NDMA) | 0.01 | <0.002 | 0.0024 | 0.0025 |
| Triclosan | 0.35 | <0.01 | <0.01 | <0.01 |

## Estimation of Concentrations of Detected CECs After Addition of NVRRWP Recycled Water in the DMC

The CEC data collected as part of this sampling program was used to estimate the concentrations of CEC in the DMC if the NVRRWP recycled water were added to the DMC via a direct pipeline (Alternative 1 as described in Chapter 4). Assumptions about flow of recycled water from Modesto and Turlock and flow in the DMC and PID Main Canal were identical to those used in the analysis of conventional constituent concentrations presented in Chapter 4. When a particular was not detected above the method reporting limit, the concentration of that constituent was estimated as half the method reporting limit. The results of this analysis are presented in Appendix 5-H. With exception of the herbicides 2,4-D, diruron, and metachlor that were detected as higher concentrations in the DMC samples (RRW-2) than in either the Modesto (RRW-4) or Turlock (RRW-6) samples, the calculated concentration in the DMC as a percentage of the calculated concentrations in the 2045 blend of NVRRWP recycled water range between 8% and 62% representing dilutions of between 92% and 48%.

## CEC QA/QC Results

This section discusses the results of field collected QA/QC samples analyzed for CEC as well as Eurofins internal laboratory QA/QC procedures..

### *Field Duplicates (RRW-6)*

On May 2, 2013 and May 9, 2013 a field duplicate (RRW-6) was collected at the Turlock tertiary effluent sampling location (the primary field sample of Turlock tertiary effluent is designated RRW-5). These field duplicates were analyzed for all CEC analytes to assess variability introduced by field sampling procedures

On May 9, 2013, RRW-6 was mislabeled as RRW-7 and RRW-7 was mislabeled as RRW-6. The error has been corrected in the data tables below. A note has also been inserted in the laboratory reports (Appendix 5-F) to avoid confusion.

The precision of field duplicates was evaluated by calculating the relative percent difference (RPD) between the analytical results for the primary (RRW-5) and duplicate (RRW-6) samples. As shown in Table 5-9 and Table 5-10, the field duplicate RPDs for several analytes were greater than 25%. All of these analytes are tested for using one of the two research methods (LC-MS-MS - Endocrine Disruptors Negative Mode or LC-MS-MS - Endocrine Disruptors Negative Mode) rather than the EPA approved methods (EPA 539 and EPA 521). Generally, an RPD of less than 25% is considered acceptable, however, with the very low detection limits (ng/L level) associated with these analyses RPDs of greater than 25% are not unusual.

**Table 5-9. Comparison of Field Duplicate and Primary Samples for CEC Analytes – May 2, 2013**

| Analyte | Units | Method Reporting Limit* | RRW-5 Turlock May 2 | RRW-6 Turlock May 2 | RDP |
|---|---|---|---|---|---|
| 2,4-D | ng/L | 5 | 64 | 64 | 0% |
| 4-androstene-3,17-dione | µg/L | 0.0003 | 0.0029 | 0.0033 | 13% |
| Acesulfame-K | ng/L | 20 | 28,000 | 28,000 | 0% |
| Atrazine | ng/L | 5 | 12 | 11 | 9% |
| BPA | ng/L | 10 | 100 | 71 | 34% |
| Caffeine | ng/L | 5 | 920 | 820 | 11% |
| Carbamazepine | ng/L | 5 | 84 | 80 | 5% |
| Carisoprodol | ng/L | 5 | 82 | 86 | 5% |
| Cotinine | ng/L | 10 | 99 | 89 | 11% |
| DACT | ng/L | 5 | 26 | 21 | 21% |
| DEA | ng/L | 5 | 9.8 | 9 | 9% |
| DEET | ng/L | 10 | 340 | 330 | 3% |
| Dehydronifedipine | ng/L | 5 | 99 | 91 | 8% |
| DIA | ng/L | 5 | 9.6 | 5.9 | 48% |
| Dilantin | ng/L | 20 | 110 | 90 | 20% |
| Diuron | ng/L | 5 | 32 | 31 | 3% |
| Estrone | ng/L | 0.002 | ** | ** | -- |
| Fluoxetine | ng/L | 10 | 93 | 61 | 42% |
| Gemfibrozil | ng/L | 5 | 19 | 27 | 35% |
| Ibuprofen | ng/L | 10 | 42 | 41 | 2% |
| Iohexal | ng/L | 10 | 3,400 | 7,000 | 69% |
| Lidocaine | ng/L | 5 | ** | ** | -- |
| Lincomycin | ng/L | 10 | ** | ** | -- |
| Meprobamate | ng/L | 5 | 380 | 310 | 20% |
| Metolachlor | ng/L | 5 | ** | ** | -- |
| NDMA | ng/L | 2 | 2.4 | 2.9 | 19% |
| Pentoxifylline | ng/L | 5 | 14 | 14 | 0% |
| Primidone | ng/L | 5 | 50 | 48 | 4% |
| Simazine | ng/L | 5 | ** | ** | -- |
| Sucralose | ng/L | 100 | 27,000 | 20,000 | 30% |
| Sulfamethoxazole | ng/L | 5 | ** | ** | -- |
| TCPP | ng/L | 100 | 200 | 180 | 11% |
| TDCPP | ng/L | 100 | 250 | 260 | 4% |

* When the concentration of a chemical is high relative to the method reporting limit, dilution of the sample per standard laboratory protocols may be needed and will result in higher reporting limits. See laboratory reports (Appendix 5-F) for reporting limits for individual analysis.
**Analyte was not detected above the method reporting limit.

**Table 5-10. Comparison of Field Duplicate and Primary Samples for CEC Analytes – May 9, 2013**

| Analyte | Units | Method Reporting Limit* | RRW-5 Turlock May 9 | RRW-6 Turlock May 9 | RDP |
|---|---|---|---|---|---|
| 2,4-D | ng/L | 5 | 92 | 95 | 3% |
| 4-androstene-3,17-dione | µg/L | 0.0003 | 0.00098 | 0.0016 | **48%** |
| Acesulfame-K | ng/L | 20 | 21,000 | 22,000 | 5% |
| Atrazine | ng/L | 5 | 12 | 11 | 9% |
| BPA | ng/L | 10 | ** | ** | -- |
| Caffeine | ng/L | 5 | 700 | 660 | 6% |
| Carbamazepine | ng/L | 5 | 140 | 120 | 15% |
| Carisoprodol | ng/L | 5 | 100 | 110 | 10% |
| Cotinine | ng/L | 10 | 87 | 85 | 2% |
| DACT | ng/L | 5 | 51 | 28 | **58%** |
| DEA | ng/L | 5 | 10 | 11 | 10% |
| DEET | ng/L | 10 | 180 | 160 | 12% |
| Dehydronifedipine | ng/L | 5 | 110 | 110 | 0% |
| DIA | ng/L | 5 | 7.9 | 8.6 | 8% |
| Dilantin | ng/L | 20 | 110 | 110 | 0% |
| Diuron | ng/L | 5 | 35 | 40 | 13% |
| Estrone | ng/L | 0.002 | ** | ** | -- |
| Fluoxetine | ng/L | 10 | ** | 10 | (b) |
| Gemfibrozil | ng/L | 5 | 19 | 18 | 5% |
| Ibuprofen | ng/L | 10 | 61 | 110 | **57%** |
| Iohexal | ng/L | 10 | 2,200 | 2,800 | 24% |
| Lidocaine | ng/L | 5 | ** | ** | -- |
| Lincomycin | ng/L | 10 | ** | ** | -- |
| Meprobamate | ng/L | 5 | 310 | 330 | 6% |
| Metolachlor | ng/L | 5 | ** | ** | -- |
| NDMA | ng/L | 2 | 2.5 | 2.3 | 8% |
| Pentoxifylline | ng/L | 5 | 13 | 12 | 8% |
| Primidone | ng/L | 5 | 53 | 56 | 6% |
| Simazine | ng/L | 5 | 6 | 6.8 | 13% |
| Sucralose | ng/L | 100 | 11,000 | 19,000 | **53%** |
| Sulfamethoxazole | ng/L | 5 | ** | ** | -- |
| TCPP | ng/L | 100 | 200 | 230 | 14% |
| TDCPP | ng/L | 100 | 270 | 280 | 4% |

* When the concentration of a chemical is high relative to the method reporting limit, dilution of the sample per standard laboratory protocols may be needed and will result in higher reporting limits. See laboratory reports (Appendix 5-F) for reporting limits for individual analysis.
**Analyte was not detected above the method reporting limit.

### *Equipment Blanks (RRW-7)*

On May 2, 2013 and May 9, 2013, equipment blank samples (RRW-7) were collected by pouring deionized water provided by Eurofins into a new Teflon bailer and then pouring the water in the bailer into the sample bottles.

Concentrations of CECs in the May 9, RRW-7 samples were not detected above the method reporting limits. As shown in the table below, three analytes were detected in the May 2, RRW-7 sample

**Table 5-11. CEC Analytes Detected in Field Blanks (RRW-7)**

| Analyte | Units | Method Reporting Limit* | RRW-7 | |
|---|---|---|---|---|
| | | | Field Blank | |
| | | | May 2 | May 9 |
| Caffeine | ng/L | 5 | 8.4 | ** |
| Erythromycin | ng/L | 10 | 73 | ** |
| Fluoxetine | ng/L | 10 | 48 | ** |

* When the concentration of a chemical is high relative to the method reporting limit, dilution of the sample per standard laboratory protocols may be needed and will result in higher reporting limits. See laboratory reports (Appendix 5-F) for reporting limits for individual analysis.
**Analyte was not detected above the method reporting limit.

At 8.4 ng/L, the detected concentration of caffeine in the May 2, 2013 RRW-7 is similar to the detected concentrations of caffeine in the China Island (RRW-1) and DMC (RRW-2) samples. At 48 ng/L, the detected concentration of fluoxetine in the May 2, 2013 RRW-7 sample is similar to the detected concentrations of fluoxetine in the Modesto (RRW-4) and Turlock samples (RRW-4). Erythromycin, an antibiotic, was not detected in any other sample. Because only three analytes were detected in the May 2, 2013 sample and because these detections do not seem to follow any particular pattern, they are unlikely to represent any wider data quality issues.

### *Internal Laboratory QA/QC for CECs*

Eurofins internal QA/QC results are noted in their laboratory reports (Appendix 5-F).

## Conclusions

Analytical results for conventional constituents were comparable to the existing water quality data. For the CEC analyses, 34 analytes were detected in the Turlock tertiary effluent and/or Modesto secondary effluent samples with most analytes being detected in the samples from both locations. In the samples from the China Island delivery point, the DMC, the PID canal, nine analytes were detected using the analysis for CECs and included both herbicides/pesticides and constituents that likely originate from wastewater effluent (such as caffeine and the artificial sweetener sucralose). The detection of these analytes is to be expected as wastewater treatment plants discharge to the source waters for the DMC and the PID Main Canal.

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# Appendix 2.2 – Flood Mitigation and Storm Water Storage Project Technical Documents

# City of Modesto
# Area 2 Storm Drain to Sanitary Sewer Cross Connections Removal
# Final Preliminary Design Report

April 30, 2010

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April 30, 2010

David Felix, Assistant Civil Engineer
City of Modesto Public Works Department
Capital Improvement Services, 4th Floor
P.O. Box 642
Modesto, California 95353

**Re: Area 2 Storm Drain to Sanitary Sewer Cross Connection Removal Preliminary Design Report**

Dear David:

RRM Design Group is pleased to present to the City of Modesto this Final Preliminary Design Report for the Area 2 Storm Drain to Sanitary Sewer Cross Connection Removal Project. Transmitted herein is the report.

We look forward to working with the City on implementation of the project. Please call me at (209) 847-1794 with any questions.

Sincerely,
**RRM DESIGN GROUP**

William F. Strand, M.S., P.E.
Manager of Engineering Services

REGISTERED PROFESSIONAL ENGINEER
WILLIAM FREDERICK STRAND
No. C 65712
Exp. 09/30/11
CIVIL
STATE OF CALIFORNIA
4/30/10

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## LIST OF ACRONYMS

| | |
|---|---|
| AC | Acre |
| AC-FT | Acre foot (43,560 cubic feet) |
| CF | Cubic feet |
| CFS | Cubic feet per second |
| City | City of Modesto. |
| FT | Feet |
| GIS | Geographic information system |
| HDPE | High density polyethylene |
| MH | Manhole |
| MID | Modesto Irrigation District |
| NPDES | National Pollution Discharge Elimination System |
| O&M | Operations and Maintenance |
| PDR | Preliminary Design Report |
| RCP | Reinforced concrete pipe |
| RWQCB | Regional Water Quality Control Board |
| SD | Storm Drain |
| WQ | Water Quality |
| WQF | Water Quality Flow Rate (CFS) |
| WQV | Water Quality Volume (CF) |

# 1. INTRODUCTION

This preliminary design report (PDR) summarizes the results of the preliminary analysis and design for the Modesto Area 2 Storm to Sanitary Sewer Drain Cross Connection Project. The goals of the PDR are to determine the most effective means of collecting and discharging stormwater from the twenty-one existing Cross Connections to four existing City of Modesto Neighborhood Parks (Roosevelt, Pike, Catherine Everett, and Garrison). The PDR evaluated three alternatives for each park on the basis of cost, functionality, and constructability. The three alternatives were: detention and pumped discharge, retention and infiltration, and constructing the facilities proposed in the Storm Drain Cross Connection Report (Stantec, 2007).

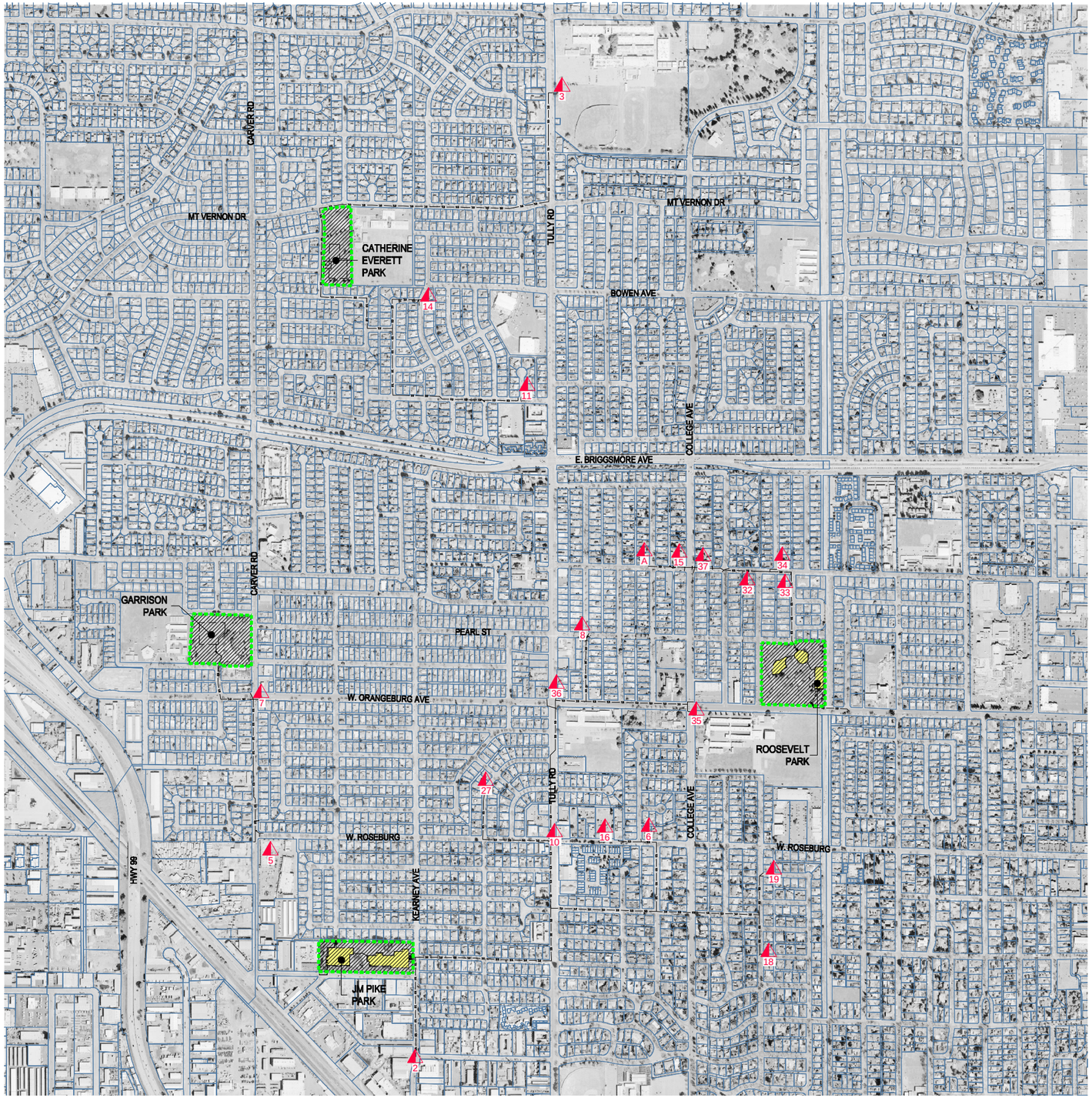
## 1.1 Background

The 2007 City of Modesto Waste Water Master Plan (WWMP) divides the city into ten areas. Area 2 is located in the northwest portion of the City and contains twenty-one existing cross connections. The Cross Connection Removal Project was identified in the WWMP as a highest priority project.

A cross connection is the connection of a non sanitary sewer flow to the sanitary sewer system. In areas of Modesto which do not have a storm drainage conveyance system, cross connections have been utilized to drain areas of persistent flooding. In many cases existing rockwells with a history of not draining street intersections in a timely manner have had a cross connection pipe installed connecting them to an adjacent sanitary sewer manhole. When the capacity of the rockwell is exceeded, storm water is drained by the sanitary sewer. In other areas a “lamp hole” was installed in the roadway adjacent to an area with persistent flooding. A lamp hole is a terminal sanitary sewer cleanout. During periods of flooding City maintenance crews remove the cleanout lid allowing storm water to flow into the sanitary sewer.

Cross connections present several problems to the sanitary sewer and storm drainage systems. Cross connections typically do not drain stormwater efficiently. Because sewer flows are typically smaller than storm drainage flows, the sewer system is not adequately sized to convey storm flows. Large storms can lead to sanitary sewer overflows into streets and buildings. Finally there is a cost to treat the stormwater at the sewer treatment plant.

For this project, the City of Modesto determined that four existing neighborhood parks would be utilized to store and infiltrate stormwater. The stormwater is to be stored underground to minimize the impact to the parks. Figure 1 shows an overview of the project location and proposed improvements.




north

SCALE: 1" = 400'

## Legend

- Park Boundary
- 18 Cross Connection Number
- SD Proposed Storm Drain Line

Figure 1

City of Modesto | Modesto Area II Storm Drain to Sewer Cross Connection Removal Project

January 26, 2010

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## 1.2 Project Goals

The main goal of the project is to remove the twenty-one storm drain to sanitary sewer cross connections. Additional project goals include:

- Reduce street flooding in the vicinity of the cross connections
- Provide conveyance of the 10-year storm
- Provide detention/retention of the 100-year storm
- Remove aging rockwells
- Provide improved water quality treatment
- Rehabilitate existing parks

## 1.3 Scope of Work and Approach

The project scope of work was negotiated with the City of Modesto and executed on April 7th, 2009. The major items in the scope are:

Data collection – Existing utility information was obtained from the City and private utility companies in the form of utility plats and as-built drawings. The City of Modesto's Geographical Information System files were obtained and utilized as a basemap. City of Modesto grade maps were obtained to help define areas draining to the cross connections. Field surveys were conducted of the four parks and portions of the roadways along the proposed conveyance system alignments. Preliminary geotechnical explorations were conducted including deep borings, soil profiles, and infiltration testing.

Preliminary Hydrology – Utilizing the grade maps provided by the City of Modesto, areas draining to the cross connections were delineated. Utilizing these areas, stormwater runoff rates and volumes were calculated.

Disposal Options Analysis – A thorough investigation of underground stormwater storage and disposal products was conducted. The products were ranked based on their scores for six criteria.

Water Quality Treatment Option Analysis – A thorough investigation was conducted of water quality treatment devices and methods. The products were ranked based on their scores for four criteria.

Public Outreach Meeting – A public outreach meeting was held August 27, 2009 at Fremont Elementary School to advise the public of the project and solicit comments.

Preliminary CEQA Review – A preliminary review of the proposed improvements was conducted to determine potential issues with regard to the California Environmental Quality Act (CEQA).

Preliminary Design – Based on the preliminary hydrology, preliminary designs of the storm drainage system to convey flows from the cross connections to the disposal systems in the parks were prepared.

Preliminary designs of the underground storage and disposal systems and pre-treatment devices were prepared. Preliminary park surface improvements were described.

Preliminary Design Report – This PDR summarizes the findings of this project and recommends proposed improvements.

### 1.4 Authorization

The work associated with this PDR is being completed by RRM Design Group under an Agreement authorized by the City of Modesto on April 7th, 2009.

## 2. DESIGN CRITERIA

This section defines the criteria by which the PDR was conducted. The City of Modesto Standard Specifications (2006) and the City of Modesto Guidance Manual for On-Site Stormwater Quality Control Measures were utilized for design criteria. The City of Modesto's NPDES permit was reviewed for conformance.

### 2.1 Runoff Rates and Volumes

The City of Modesto Standard Specifications, 2006 and the City of Modesto Guidance Manual for On-Site Stormwater Quality Control Measures were utilized to calculate runoff rates and volumes, size storm drainage pipes, and size underground storage and disposal facilities. Per section 4.02A of the Standard Specifications, the Rational Method should be used when the design area is less than 400 acres. Because the project area is less than 400 acres the Rational Method was used.

2.1.1 Storm Drain Pipe Design Return Period – 10-year (Section 4.01 B.2 Standard Specifications)

- For starting HGL, assume storm basin is full.
- Rational Method - Q = CIA

  Q = Design runoff, in cubic feet per second
  C = Coefficient of runoff based on ultimate development of the drainage area
  I = Rainfall intensity in inches per hour from Detail 400 (City of Modesto Standards and Specifications), Time to gutter = 10 minutes
  A = Area tributary to cross connection in acres

2.1.2 Storm Basin Design Return Period – 100-year (Section 4.01 B.1 Standard Specifications)

- 100-year volume to be contained within top of curb (provided pad grades are a minimum of 1' above top of curb)

  Rational Method V = CAR/12

  - V = Volume in acre-feet
  - C = Runoff Coefficient

        - A = Area in acres
        - R = Design runoff in inches

    - Retention (Infiltration) Basins
        - Volume 100-year, 6 day duration storm
        - R = 5.6 inches
        - Minimum of 2 infiltration tests required for design
        - Infiltration rate must drain the 100-year, 24 hour volume in 48 hours.

    - Detention Basins (With Pumped Discharge)
        - 100-year, 24 hour storm
        - V = CAR/12
          V = Volume in acre-feet
          C = Runoff Coefficient
          A = Area in acres
          R = 100-year, 24 hour runoff (2.88 inches per Figure 4-2 of the Standard Specifications)
        - Pumps sized to drain the 1-year, 3 day storm in 48 hours, following 48 hours of retention.

2.1.3 Storm Water Quality - Design event is 2-year, six hour storm (City of Modesto Guidance Manual for On-Site Stormwater Quality Control Measures)

WQF-CIA

- WQF – Water quality flow in cubic feet per second
- C = Runoff Coefficient
- I = Rainfall intensity, (0.15 inches per hour)
- A= Tributary area in acres

## 2.2 Storm Drain Lines

The City of Modesto Standards and Specifications, 2006 were utilized for the design of the storm drainage pipe system and separation from other utilities.

2.2.1 Line Size – Minimum 12 inch diameter and sized to flow with a minimum velocity of 2 feet per second when flowing full.

2.2.2 Vertical Alignment – Minimum of 2 feet of cover from finished grade to top of pipe or 1 foot below subgrade whichever is greater.

2.2.3 Manholes – Shall be placed at changes in grade, conduit size, or junction points. Spacing shall not exceed 400 feet. Manholes shall be placed at beginning and end of curves.

2.2.4 Horizontal separation from utilities – Per Title 22, Section 64572 of the California Code of Regulations, horizontal separation from water mains shall be 4 feet.

2.2.5 Vertical separation from utilities

- Basic separation from water – For perpendicular crossings of water mains the water main shall be at least 1 foot above the storm drain line.
- Alternate criteria for construction – Where the basic separation cannot be obtained and the waterline is to cross under the storm drain line the water main shall be constructed of one of the following and have no joints for 10 feet either side of the crossing:
    - Ductile iron pipe with hot dip bituminous coating.
    - Dipped and wrapped ¼" thick welded steel pipe.
    - Class 200 pressure rated plastic water pipe (DR 14 per AWWA C900) or equivalent.
    - Reinforced concrete pressure pipe, steel cylinder type, per AWWA (C300-74 or C301-79 or C303-70 C303-70).

2.2.6 Sewer Drops – Where existing sewer lines are to be lowered to accommodate proposed storm drains, drops are to occur in standard manholes – Per City of Modesto direction.

# 3. PROPOSED PROJECT FACILITIES

As mentioned in the Introduction, the project proposes to remove twenty-one (21) storm drain to sanitary sewer cross connections. Storm water will be conveyed to existing parks in proposed storm drains. The stormwater will be detained/retained underground at the parks and disposed.

## 3.1 Conveyance Systems

Storm drains will be provided to convey runoff to the four parks. Alignments of the storm drains were selected to provide the most efficient routes to the parks while avoiding major streets and utilizing streets with minimal utilities. In much of the project area, utilities are located in the existing alleys. In these areas residential streets where utilized to minimize costs and utility interruptions during construction.

Proposed alignments were analyzed to ensure minimal crossings. The depth of the proposed storm drains was minimized whenever possible. In several locations, existing sewer and water lines were lowered to minimize the depth of the proposed storm drains. Plan and profiles of the proposed storm drains are provided in Appendix A.

## 3.2 Disposal Systems

Underground disposal systems will be provided in each of the four parks. The systems will provide either retention or detention depending on the soil properties at the park and costs of each option. The disposal systems are analyzed in more detail in Section 5.

## 3.3 Park Improvements

Construction of the proposed underground detention/retention facilities will require excavation and restoration of large areas of each park site. Existing park features within the limits of excavation will need to be removed and replaced. Construction staging areas, soil stockpiles, and other construction

support activities may also require removal and replacement of existing site features. Wherever possible, the open turf areas were targeted for limits of excavation and other construction activities as these areas would be the least expensive to reconstruct; however, this was not always possible and some significant park features will require removal and replacement. In some cases, it makes sense to replace these park features exactly as they were prior to construction and in other cases there are opportunities to reconfigure these park features to enhance the function of the park. In some situations, reconfiguring these site features is required due to constraints imposed by the new underground detention/retention facilities. In addition, the replacement of existing features that are removed during construction in conjunction with development of maintenance access drives and large paved areas required for maneuvering maintenance vehicles in the areas around the pump stations and pretreatment devices may provide opportunities to add recreation features at little additional cost to the project. Specific improvements at each park site are discussed in further detail later in this report.

# 4. PRELIMINARY HYDROLOGY

Preliminary hydrologic and hydraulic analyses were conducted to determine the areas tributary to the cross connections, runoff volumes, and flow rates. Infiltration rates from the preliminary geotechnical explorations were evaluated.

## 4.1 Sub-Basin Delineation

Utilizing the grade maps provided by the City of Modesto sub-basins were defined which are tributary to the twenty-one cross connections. Sub-basin boundaries were defined by high and low points along roadways as depicted on the grade maps. In addition, it was assumed that residential lots drained from their back property line to the street in front. In alley locations, the center of the alley was assumed to be the divide. On corner lots, the center of the house was assumed to be the divide with water flowing to the side street and the fronting street.

Sub-basin boundaries were field verified. Commercial and institutional facilities were field verified with respect to drainage facilities observable at the surface. It was assumed that onsite drainage facilities were adequately sized and flows would not enter the street system except where grading visibly drained to adjacent streets. The sub-basin delineations are presented in Figures 2A & 2B.

## 4.2 Runoff Volumes and Rates

Based on the design criteria and sub-basin delineations, runoff volumes were calculated for detention and retention. The results are presented in table format in Figure 2A. The results are grouped by park site. Volumes were assigned to each park based on location relative to the parks and the available space in the parks.

Runoff rates for the 10-year event were calculated using the computer program Hydroflow. Hydroflow was utilized to size the storm drainage lines and calculate hydraulic grade lines (HGL's). Hydroflow

utilizes the Rational Method to calculate peak runoff rates and dynamically route hydrographs. HGL's were checked to ensure compliance with city storm water design standards. These hydraulic analyses are located in Appendix C.

## Hydrology Summary

| Park Name | Cross Connection Number | Area ac | V (100 yr) (Detention ac-ft) | V (100 yr) (Retention ac-ft) |
|---|---|---|---|---|
| Garrison Park | 5 | 7.63 | 1.2 | 2.2 |
| | 7 | 9.74 | 1.4 | 2.8 |
| | | 17.37 | 2.6 | 5.0 |

| Park Name | Cross Connection Number | Area ac | V (100 yr) (Detention ac-ft) | V (100 yr) (Retention ac-ft) |
|---|---|---|---|---|
| Catherine Everett Park | 3 | 2.27 | 0.3 | 0.6 |
| | 11 | 6.64 | 1.0 | 1.9 |
| | 14 | 10.64 | 1.5 | 3.0 |
| | | 19.55 | 2.8 | 5.5 |

| Park Name | Cross Connection Number | Area ac | V (100 yr) (Detention ac-ft) | V (100 yr) (Retention ac-ft) |
|---|---|---|---|---|
| JM Pike Park | 2 | 15.57 | 2.9 | 5.6 |
| | 6 | 6.95 | 1.0 | 1.9 |
| | 8 | 14.31 | 2.1 | 4.0 |
| | 10 | 3.37 | 0.6 | 1.1 |
| | 16 | 6.35 | 1.1 | 2.1 |
| | 18 | 7.21 | 1.0 | 2.0 |
| | 19 | 5.73 | 0.8 | 1.6 |
| | 27 | 4.26 | 0.6 | 1.2 |
| | 35 | 6.05 | 1.0 | 2.0 |
| | 36 | 9.00 | 1.4 | 2.6 |
| | | 78.80 | 12.4 | 24.2 |

| Park Name | Cross Connection Number | Area ac | V (100 yr) (Detention ac-ft) | V (100 yr) (Retention ac-ft) |
|---|---|---|---|---|
| Roosevelt Park | 15 | 6.55 | 0.9 | 1.8 |
| | 32 | 9.87 | 1.4 | 2.8 |
| | 33 | 3.59 | 0.5 | 1.0 |
| | 34 | 6.52 | 0.9 | 1.8 |
| | 37 | 9.76 | 1.4 | 2.7 |
| | A | 5.67 | 0.8 | 1.6 |
| | | 41.96 | 6.0 | 11.7 |

### Legend

- Park Boundary
- Tributary Area (To Park)
- 14 Cross Connection
- Flow Arrow

north

SCALE: 1" = 200'

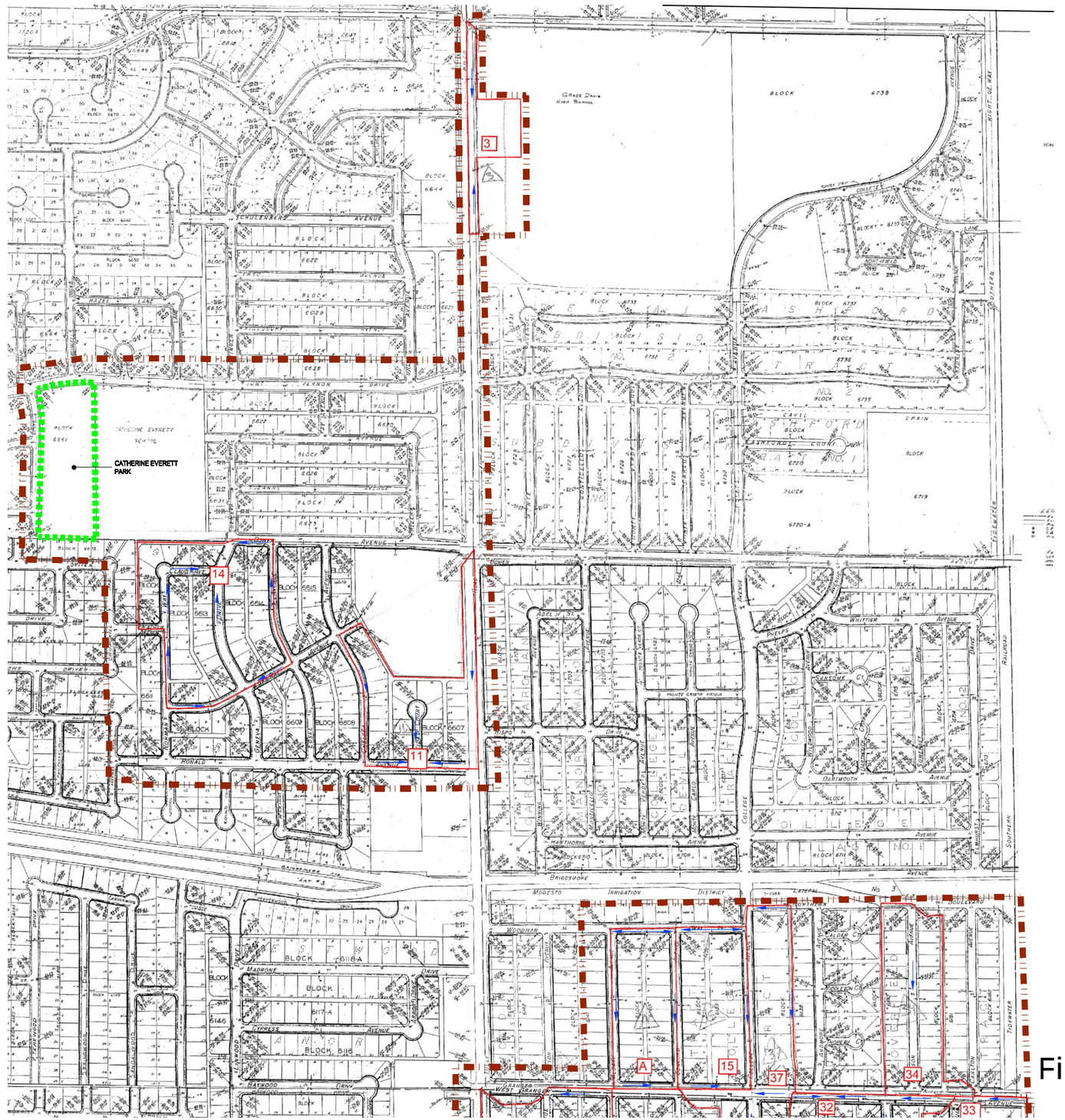


Figure 2A

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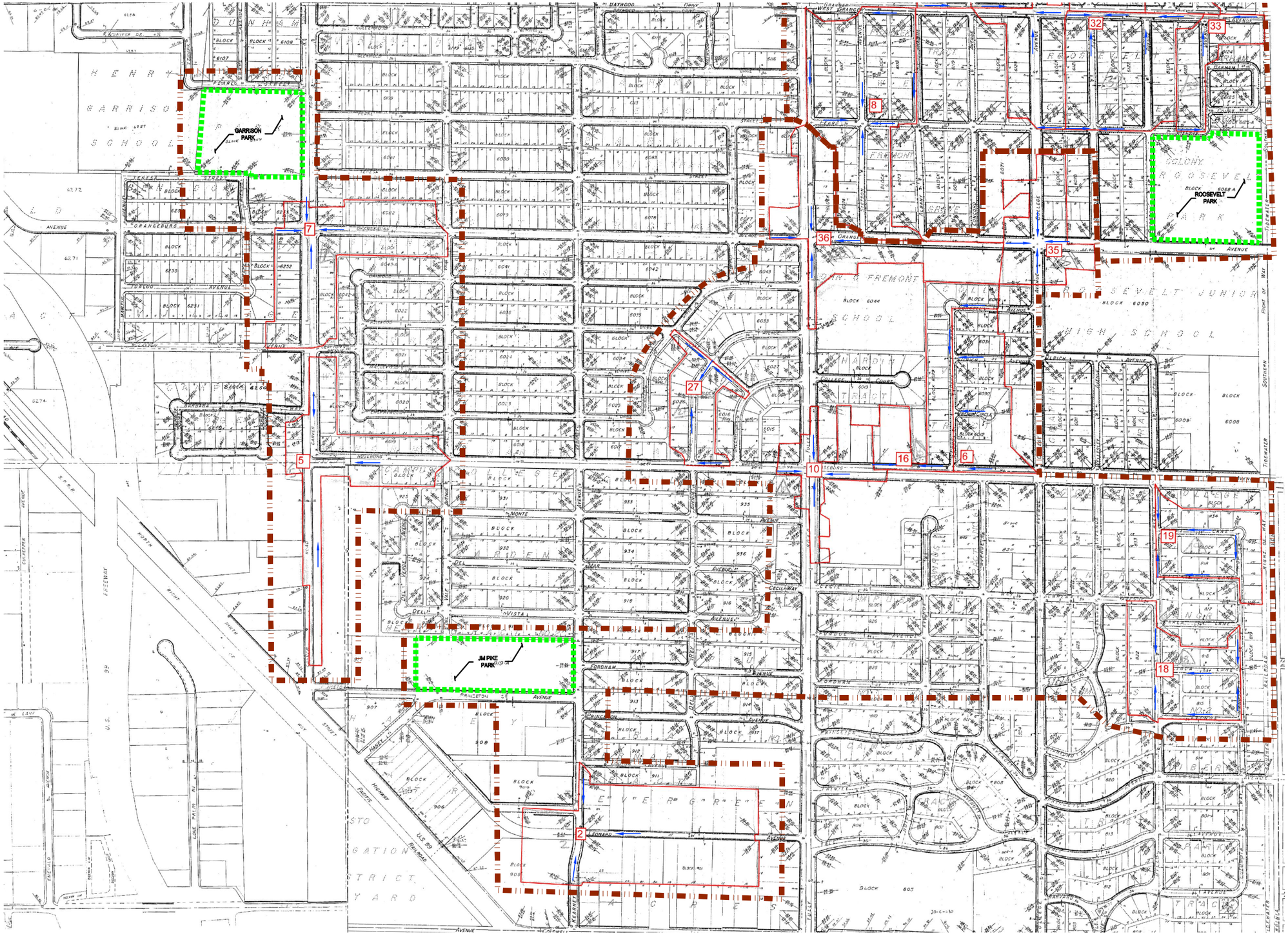
# Modesto Area II Storm Drain to Sanitary Sewer Cross Connection Removal - Hydrology Map (North)

2108543

January 26, 2010




north

SCALE: 1" = 200'

Figure 2B

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# Modesto Area II Storm Drain to Sanitary Sewer Cross Connection Removal - Hydrology Map (South)

2108543

January 26, 2010

**Modesto Area 2**
**Water Quality Calculations verified with Modesto Grade Maps**
**February 15, 2010**

**Garrison Park**

| Storm / Sewer Cross Connection* | Area (ac) | C * | WQF (cfs) | WQV (ft^3) | WQV (gallons) | WQV (ac-ft) | |
|---|---|---|---|---|---|---|---|
| 7 | 9.74 | 0.61 | 0.89 | 17,678 | 132,232 | 0.41 | |
| 5 | 7.63 | 0.63 | 0.72 | 13,848 | 103,586 | 0.32 | |
| | **17.37** | | **1.61** | **31,527** | **235,819** | **0.72** | **Total** |

**Catherine Everett Park**

| Storm / Sewer Cross Connection* | Area (ac) | C * | WQF (cfs) | WQV (ft^3) | WQV (gallons) | WQV (ac-ft) | |
|---|---|---|---|---|---|---|---|
| 3 | 2.27 | 0.6 | 0.20 | 4,120 | 30,818 | 0.09 | |
| 11 | 6.64 | 0.6 | 0.60 | 12,052 | 90,146 | 0.28 | |
| 14 | 10.64 | 0.6 | 0.96 | 19,312 | 144,451 | 0.44 | |
| | **19.55** | | **1.76** | **35,483** | **265,415** | **0.81** | **Total** |

**JM Pike Park**

| Storm / Sewer Cross Connection* | Area (ac) | C * | WQF (cfs) | WQV (ft^3) | WQV (gallons) | WQV (ac-ft) | |
|---|---|---|---|---|---|---|---|
| 2 | 15.57 | 0.77 | 1.80 | 28,260 | 211,382 | 0.65 | |
| 6 | 6.95 | 0.6 | 0.63 | 12,614 | 94,355 | 0.29 | |
| 8 | 14.31 | 0.6 | 1.29 | 25,973 | 194,276 | 0.60 | |
| 10 | 3.37 | 0.71 | 0.36 | 6,117 | 45,752 | 0.14 | |
| 16 | 6.35 | 0.71 | 0.68 | 11,525 | 86,209 | 0.26 | |
| 18 | 7.21 | 0.6 | 0.65 | 13,086 | 97,884 | 0.30 | |
| 19 | 5.73 | 0.6 | 0.52 | 10,400 | 77,792 | 0.24 | |
| 27 | 4.26 | 0.6 | 0.38 | 7,732 | 57,835 | 0.18 | |
| 35 | 6.05 | 0.7 | 0.64 | 10,981 | 82,136 | 0.25 | |
| 36 | 9 | 0.63 | 0.85 | 16,335 | 122,186 | 0.38 | |
| | **78.8** | | **7.78** | **143,022** | **1,069,805** | **3.28** | **Total** |

**Roosevelt Park**

| Storm / Sewer Cross Connection* | Area (ac) | C * | WQF (cfs) | WQV (ft^3) | WQV (gallons) | WQV (ac-ft) | |
|---|---|---|---|---|---|---|---|
| 15 | 6.55 | 0.6 | 0.59 | 11,888 | 88,924 | 0.27 | |
| 32 | 9.87 | 0.6 | 0.89 | 17,914 | 133,997 | 0.41 | |
| 33 | 3.59 | 0.6 | 0.32 | 6,516 | 48,739 | 0.15 | |
| 34 | 6.52 | 0.6 | 0.59 | 11,834 | 88,517 | 0.27 | |
| 37 | 9.76 | 0.6 | 0.88 | 17,714 | 132,504 | 0.41 | |
| A | 5.67 | 0.6 | 0.51 | 10,291 | 76,977 | 0.24 | |
| | **41.96** | | **3.78** | **76,157** | **569,658** | **1.75** | **Total** |

* Indicates Data obtained directly from "City of Modesto Storm Drain Cross Connection Report" Prepared by Stantec Consulting Inc
WQF = Water Quality Flow Rate
WQV = Water Quality Volume

## 4.3 Preliminary Geotechnical Findings

Blackburn Consulting conducted preliminary borings and infiltration tests at the four parks. The Preliminary Geotechnical Report is attached in the Appendix E.

The report found that infiltration rates were favorable at Catherine Everett, Garrison, and Pike parks. Roosevelt Park is underlain by a layer of hardpan and infiltration rates are not favorable for retention and infiltration.

Average infiltration rates for the parks are as follows:

- Catherine Everett 7.6 inches per hour
- JM Pike 16.9 inches per hour
- Garrison 4.5 inches per hour
- Roosevelt infiltration not recommended

Groundwater was encountered between 28 and 38 feet below the surface of the parks. These groundwater depths allow for adequate separation from the bottom of the proposed retention/detention systems.

# 5. DISPOSAL OPTION ANALYSIS

The underground disposal is a large component of the total project cost. The parks in which the disposal systems will be constructed have been in existence for many years and will continue to be a vital part of the community for many more. Because of the cost and longevity concerns, it is vital to select disposal systems which are cost effective, have demonstrated their longevity, and meet the storm drainage needs of the project. To accomplish this, a thorough evaluation was conducted of potential products.

## 5.1 Potential Disposal Products

RRM Design group worked with the City of Modesto to develop a list of potential disposal products. Internet searches for underground detention and retention systems as well as products advertised in stormwater publications were utilized to develop the list. This list was forwarded to the City of Modesto for any addition of products which may have been missed in the searches, but had submitted information directly to the City. No additional products were discovered.

## 5.2 Analysis of Potential Disposal Products

RRM and the City of Modesto evaluated the potential disposal products based on design information provided by the manufacturers, product specifications, and verification with owners or agencies of installed products. Six criteria were evaluated and given a 1 – 5 score (5 being the most favorable):

- Cost

- Ability to be implemented
- Similar Installations
- Corrosion Resistance – Included because Modesto has Moderate to High Corrosion Potential for Steel
- Warranty
- Maintainability

The rankings are included in Table 2.

## 5.3 Recommended Disposal Products

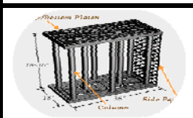
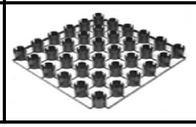
Two products obtained a 27 out 30 ranking and are recommended for use in this project: Storm Chamber by HydroLogic Solutions and Stormwater Chambers by Triton Environmental Solutions. Both products are high density polyethylene open bottom arches which are installed with ¾ inch angular rock backfill. Both products can be used for either retention or detention systems. The Storm Chamber (Hydrologic Solutions) is capable of being installed in stacked configurations 1 to 3 layers deep. The Stormwater Chambers (Triton) are capable of being stacked 1 to 2 layers deep.

# Modesto Area 2
## Draft Disposal Option Ranking
## February 15, 2010

| Manufacturer | Products | Product Description | Cost Ranking [1] | Capital Cost ($/CF) | Ability to be Implemented [2] | Similar Installations [3] | Installation Description | Corrosion Resistance [4] | Warranty Ranking [5] | Warranty Period Years | Maintainability [6] | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Triton Environmental Solutions | Stormwater Chambers | | 4 | $4.24 | 4 | 4 | Underground detention system designed for 100,000 cf. Keyser shopping complex Keyser, West Virginia. | 5 | 5 | Limited Lifetime (100 yrs) | 5 | 27 |
| Hydrologic Solution | Storm Chamber | | 4 | $4.29 | 4 | 4 | Commercial site in Jordan UT. (116,840 cf) Under parking lot. | 5 | 5 | Limited Lifetime | 5 | 27 |
| Contech | Corrugated Metal Pipe | | 5 | $3.90 | 5 | 5 | Wal-Mart, Greeley Colorado underground detention system (255,353 cf) | 3 | 1 | 1 | 5 | 24 |
| Rotondo Environmental Solutions | Precast Conc. Vaults | | 2 | $10.00 | 5 | 4 | Underground detention/infiltration/ treatment system (200,000 cu-ft). WQV (30,400 cu-ft) Under commercial parking lot in Stafford VA | 5 | 1 | Varies | 5 | 22 |
| Contech | Con/Span | | 1 | $14.00 | 5 | 4 | Seattle Tacoma International Airport, precast detention system designed for (215,187cf) | 5 | 1 | 1 | 5 | 21 |
| Contech | Plate System | | 1 | $10.00 | 5 | 5 | Wal-Mart and Sam's Club, Laurel Maryland. (363,000 cf of storage) under parking lot. | 3 | 1 | 1 | 5 | 20 |
| Stormtech / Landsavor | SC-740 | | 3 | $5.32 | 1 | 5 | Underground detention system using 5,600 units (420,000 cf) Parking Lot Application | 5 | 1 | 1 | 5 | 20 |
| Stormtech | MC3500 | | 4 | $4.05 | 3 | 1 | New Product. | 5 | 1 | 1 | 5 | 19 |
| Kristar | CUDO | | 3 | $6.00 | 5 | 3 | Underground retention system (13,226 cf) Under Parking Lot Application | 5 | 1 | 1 | 1 | 18 |

Table 2

# Modesto Area 2
## Draft Disposal Option Ranking
## February 15, 2010

| Manufacturer | Products | Product Description | Cost Ranking [1] | Capital Cost ($/CF) | Ability to be Implemented [2] | Similar Installations [3] | Installation Description | Corrosion Resistance [4] | Warranty Ranking [5] | Warranty Period Years | Maintainability [6] | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Brentwood | Storm Tank |  | 3 | $5.45 | 4 | 4 | Underground detention system (123,093 cf) athletic field | 5 | 1 | 1 | 1 | 18 |
| ADS | HDPE Pipe | | 1 | $14.40 | 3 | 3 | Underground retention system (22,500 cf) under Walgreens parking lot in Naperville, IL | 5 | 1 | 1 | 5 | 18 |
| Layfield Group | Atlantis D | | 2 | $6.62 | 5 | 3 | Underground detention system (26,839 cf) Parking Lot Application for Villa Riva Apartment Complex in Miami Florida | 5 | 1 | 0 | 1 | 17 |
| Contech | Chamber Max | | 2 | $6.30 | 1 | 3 | Medical Plaza Way, Clarksville, Indiana underground retention system (62,000 cf) | 5 | 1 | 1 | 5 | 17 |
| Invisible Structure | Rainstore 3 |  | 2 | $7.09 | 5 | 2 | Underground retention system (3,610 cf) under grass play area surrounded by tricycle track. | 5 | 2 | 2 | 1 | 17 |

* Note - List developed from internet search for stormwater treatment systems and product advertisements in stormwater publications. Scoring system is based on a 1 thru 5 rating, with 5 being the most favorable.

[1] Cost Ranking (S/ CFS): 5(≤ $4.00), 4 ($4.01 - $5.00), 3 ($5.01 - $6.00), 2 ($6.01 - $9.99), 1 (≥ $10.00) Cost are based on systems designed to hold at least 100,000 cf of storm runoff.

[2] Each product analyzed to verify if it can be implemented based on useable park area. Ranking based on number of applications (retention and detention). Maximum 8 points: 5 (≥ 6) , 4 (5), 3 (4), 2 (3), 1 (≤ 2)

[3] Similar Installations: 5 (systems designed for over 250,000 cf), 4 (systems design for 100,000 to 250,000 cf of storage), 3 (systems designed < 100,000 cf but under a parking lot), 2 (systems designed < 100,000 cf but under turf) and 1 ( no installations)

[4] Corrosion Resistance: 5 (non corrosive), 3 (corrosive but can be protected), 1 (corrosive)

[5] Warranty Ranking: 5 (≥50), 4 (25 - 49.9), 3 (10 - 24.9), 2 (1.1 - 9.9), 1 (≤ 1)

[6] Maintainability: 5 (can be accessed and hydraulically flushed) and 1 (not maintainable)

# 6. WATER QUALITY TREATMENT PRODUCTS

The City of Modesto has a NPDES permit issued by the Regional Water Quality Control Board in 2008, Order Number R5-2008-0092. This project complies with the permit.

Treatment of stormwater will be provided in two ways as a part of this project. Flows entering the disposal system will be pre-treated before entering the system. The systems will also be designed with siltation chambers to allow water quality flows to settle prior to entering the main system. The siltation chambers will be fitted with sumps and access hatches to allow City crews to annually remove accumulated sediment.

## 6.1 Potential Pre-Treatment Products

RRM Design Group worked with the City of Modesto to develop a list of potential pre-treatment products. Internet searches for stormwater treatment systems as well as products advertised in stormwater publications were utilized to develop the list. The list was forwarded to the City of Modesto for addition of products which may have been missed in the searches, but had submitted information directly to the City. No additional products were discovered.

## 6.2 Analysis of Potential Pre-Treatment Products

The list of potential pre-treatment products was refined to only include products which remove 80% of Total Suspended Solids (TSS). 80% TSS removal is a common standard used by many agencies such as the Washington Department of Ecology. The Washington Department of Ecology requires 80% TSS removal for Basic Treatment devices. Grassy Swales and Sand Filters typically remove 80% TSS.

Of the products which remove 80% TSS, a questionnaire was emailed to the manufacturer or manufacturer representative requesting: capital cost data, maintenance cost, treatment capacity, TSS removal, and 3 references for installed products.

Based on the information provided by the manufacturers, product specifications, and responses from the references, the products were evaluated based on 4 criteria and given a 1-5 score (5 being the most favorable):

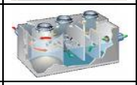
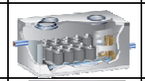
- Capital Cost
- Maintenance Cost
- Maximum treatment flow
- Ability to be implemented

The rankings are included in Table 3. Additional products were evaluated but not ranked because they did not remove 80% TSS. The complete list of products considered is included in Appendix F. Reference checks were made for the top three ranked products and are included in Appendix F.

## 6.3 Recommended Pre-Treatment Product

Upon completion of the analysis and ranking of the pre-treatment devices RRM and City staff met to review the results. The BaySeparator ranked the highest with an 18 out of 20 ranking and is recommend for use in the project. The BaySeparator is a patented flow diversion device which connects two sump manholes. The BaySeperator has a maximum treatment rate of 21.8 CFS, 80% TSS removal, and removal of trash, oil and grease.

# Modesto Area 2
## Draft Pre-Treatment Ranking
## February 15, 2010

| Manufacturer | Products | Image | Provided Requested Information | Capital Cost Ranking [1] | Capital Cost ($)/Treatment CFS | Maintenance Cost Ranking [2] | Maintenance Cost $/YR | Max Treatment Ranking [3] | Max Treatment Q (cfs) | Percent TSS Removal | Ability to be Implemented / Maintained [4] | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Baysaver Technologies inc | Bay Separator | | Yes | 4 | $2,100 | 4 | $1,150 | 5 | 21.8 | 80 | 5 | 18 |
| Contech | VortSentry HS | | Yes | 3 | $8,318 | 4 | $1,343 | 5 | 8.1 | 80 | 5 | 17 |
| Contech | CDS | | Yes | 2 | $12,750 | 4 | $1,414 | 5 | 7.5 | 100 | 5 | 16 |
| Bio Clean | Nutrient Separating Baffle Box | | Yes | 3 | $9,681 | 4 | $1,675 | 5 | 42.4 | 87 | 3 | 15 |
| Contech | Vortechs |  | Yes | 2 | $14,089 | 4 | $2,357 | 5 | 14.0 | 80 | 4 | 15 |
| KriStar | FloGard Dual Vortex | | Yes | 1 | $22,838 | 3 | $3,063 | 5 | 9.5 | 80 | 5 | 14 |
| KriStar | FloGard | | Yes | 3 | $5,450 | 5 | $100 | 3 | 3.9 | 80 | 3 | 14 |
| Bio Clean | Grate Inlet Skimmer Box | | Yes | 5 | $800 | 5 | $267 | 1 | 1.0 | 84 | 3 | 14 |
| Bio Clean | Curb Inlet Basket | | Yes | 5 | $1,059 | 5 | $267 | 1 | 0.9 | 93 | 2 | 13 |
| Bio Clean | Nutrient Separating Baffle Box with Up Flow Media Filter | | Yes | 1 | $37,795 | 3 | $3,851 | 5 | 42.4 | 85 | 3 | 12 |
| Contech | MFS |  | Yes | 1 | $72,953 | 2 | $7,848 | 5 | 7.0 | 83.6 | 3 | 11 |
| Fabco | Storm Basin | | Yes | 3 | $9,939 | 4 | $1,100 | 1 | 0.5 | 80 | 3 | 11 |
| KriStar | Up-Flow Filter | | Yes | 1 | $98,949 | 1 | $11,863 | 5 | 7.0 | 80 | 3 | 10 |
| KriStar | Perk Filter | | Yes | 1 | $76,367 | 1 | $15,525 | 5 | 7.5 | 80 | 2 | 9 |
| Modular Wetlands | MWS Linear Underground Vault | | Yes | 1 | $103,704 | 5 | $860 | 1 | 0.3 | 98 | 2 | 9 |

* Note - List developed from internet search for stormwater treatment systems and product advertisements in stormwater publications. Scoring system is based on a 1 thru 5 rating, with 5 being the most favorable.
All devices must have capability of removing trash and capturing a minimum of 80% T.S.S. and have submitted all the requested information and a minimum of three project references.
[1] Capital Cost Ranking based on cost per Water Quality Treatment (CFS): 5 (< $1,500), 4 ($1,500 - $5,000), 3 ($5,001 - $10,000), 2 ($10,001 - $20,000), 1 ($20,001)
[2] Maintenance Cost Ranking based on estimated yearly cost: 5 ( ≤ $ 1,000), 4 ($1,001 - $3,000), 3 ($3,001 - $5,000), 2 ($5,001 - $10,000), 1 ( > $10,000)
[3] Max Treatment (CFS): 5 ( ≥ 7), 4 (5 - 6.9), 3 (3 - 4.9), 2 (1 - 2.9) 1 ( < 1)
[4] Ability to be Implemented: 5 (Small centralized), 4 (Medium centralized), 3 (Decentralized or large centralized), 2 (Decentralized w/ modification), 1 (Not applicable)

Table 3

# 7. INTERAGENCY COORDINATION

Because the project affects many departments within the City of Modesto, an effort has been made to include representatives from Planning, Parks Planning, Parks Maintenance, Stormwater, Public Works Operations and Maintenance. Representatives were included in the kick-off meeting, parks tour, and key meetings throughout the project.

## 7.1 Coordination with Planning

The City of Modesto's planning department was involved in the project to review CEQA compliance. Representatives attended meetings, consulted by phone, and reviewed the Initial Study Checklist.

## 7.2 Coordination with Parks and Recreation

Since a large amount of the construction activity will occur in the four parks, the City's parks and recreation department has been involved throughout the project. Several meetings with Parks Planning and Parks Maintenance have been held on-site in the parks to discuss the project and potential issues. Specific issues have been raised and resolved with the parks department including:

- Maintaining the character of the parks
- Minimizing removal of large trees
- Removing older restrooms and pools
- Removing and replacing play structures
- Rehabilitation of existing athletic fields
- Rehabilitation of existing irrigation systems
- Minimizing down time during construction
- Operation and maintenance of the systems

## 7.3 Coordination with Operations and Maintenance

The City's Public Works Operations and Maintenance Department attended several meetings regarding operations, maintenance, water quality and disposal. The department provided review of the proposed pre-treatment and disposal products. Input was also received regarding the proposed designs, access, and maintenance.

## 7.4 Regional Water Quality Control Board

The project is a part of the implementation of the City's Sanitary Sewer Master Plan (SSMP). The project also complies with the City's NPDES Permit.

# 8. CONSTRUCTION CONSIDERATIONS

Because the projects are entirely in developed areas of the city and will impact existing roads and parks, there are several construction considerations. The storm drain lines will run down several major streets

and many residential streets. The streets have many existing utilities constructed in the public right-of-way. The parks have large shade trees of significant value and athletic fields that are utilized frequently.

## 8.1 Existing Utilities

The proposed improvements will take place in the public right-of-way or in City parks which contain a number of existing utilities. These utilities were preliminarily identified based on utility plats, asbuilts, and limited field surveys. Where possible, the proposed storm drainage lines have been routed down streets with minimal utilities or on the side of the street with the least utilities. Additional survey and potholing work to identify utilities will be completed during final design.

## 8.2 Construction Excavation

Excavations greater than 5 feet deep must be sloped or shored to prevent failure. The soils in the project area are Class C and must be sloped no steeper than 1.5:1 (H:V). Excavations in the right-of-way are to be shored using conventional methods. Excavations in the parks have been designed to allow for sloping of excavations at 1.5:1 (H:V) in most cases with some shoring around structures.

## 8.3 Construction Within Existing Parks

Several construction considerations will be required for the existing parks due to their mature tree canopies, intensive development, and high usage. Scheduling of construction within the parks will need to be coordinated with the City's parks and recreation department to minimize impact on use of the athletic fields.

The preliminary design has attempted to avoid construction within the drip line (root zone) of existing trees with trunks over 6 inches in diameter. During construction the contractor will be required to keep all excavation and equipment outside of the tree drip lines. The contractor will also be required to avoid damaging tree limbs with construction equipment.

Stockpiling of excavations and storage of construction equipment and materials will likely necessitate phased construction within the parks. A portion of the site will have to be utilized for stockpiling and storage while the remainder of the park is being constructed and visa versa.

Security fencing will be required around active areas of construction. Areas of the parks not being improved should be left open for use by the public.

The scheduling of the project's construction will be coordinated with the City's parks and recreation department so construction occurs during the times of the year with the least use of the athletic fields. The final construction documents will specify the exact move-in and move-out dates for construction within the parks along with penalties for non compliance. Reconstruction of the parks will include sod turf and rehabilitation of irrigation systems to allow for immediate use of the athletic fields.

## 8.4 Public Outreach

Public outreach is a key part of this project. To date, one public outreach meeting has been conducted. During final design an additional public outreach meeting will be conducted.

Six community members attended the public outreach meeting that was held August 27, 2009 at Fremont Elementary School. Community members were supportive of the project and well aware of the flooding problems in the project area. Their main concerns were of disruption of the parks and construction impacts in their streets.

Prior to construction, mailers will be sent to affected residents advising them of the project, general construction timeframes, and what types of impacts they will have. During construction flyers should be distributed to affected blocks one week prior to construction indicating lane closures, restricted parking, and other impacts.

On major roadways at least one week notice shall be provided to alert motorists of upcoming construction that will be occurring and what type of traffic limitations will occur.

## 8.5 Traffic Control

Where possible, the proposed storm drainage lines have been routed down residential streets to minimize traffic disruption. The proposed storm drains have been run adjacent to the curb in the parking lane where possible to limit disturbances to one side of the roadway. This will permit two way traffic in most cases, with limited use of one way traffic with flaggers. Standard construction signing and delineation for lane closures and detours shall be utilized.

# 9. PERMITTING AND CEQA CONSIDERATIONS

Permitting issues related to CEQA, City of Modesto Public Works, City of Modesto Parks and Recreation Department, and City of Modesto Stormwater were investigated.

## 9.1 CEQA Compliance

The City of Modesto's Wastewater Master Plan Master Environmental Impact Report, published in December 2006, analyzed the program of facility improvements in the WWMP including the cross connection removal project. This project must comply with the MEIR's mitigation monitoring program.

## 9.2 Permitting

The project will be required to obtain City Plan Check Approval, City Encroachment Permits, State Stormwater Construction Permits, and San Joaquin Valley Air Pollution Control District Permits.

# 10. PROJECT ALTERNATIVES ANALYSIS

Three project alternatives were evaluated as a part of this PDR. The first alternative evaluated was retention and infiltration of stormwater in existing parks. The second alternative evaluated was detention of stormwater in existing parks and pumping to existing storm drains. The third alternative evaluated was that proposed in the City of Modesto Storm Drain Cross Connection Report prepared by Stantec.

## 10.1 Retention Alternative

This alternative utilized retention and infiltration as the means for disposing of stormwater. Stormwater was conveyed to the parks, pretreated, and then infiltrated. Advantages of the retention alternative are: pumps not required, lower operation costs, lower maintenance costs, no mechanical systems to fail, and recharge of groundwater. Disadvantages of this system include: larger underground systems due to retention standards, and dependence on infiltration rates of the soils.

## 10.2 Detention Alternative

This alternative conveyed stormwater to the parks, provided pre-treatment, detained the stormwater and then pumped to existing storm drains. Advantages of the detention alternative are: smaller underground systems, not dependant on the infiltration rates of the soils. Disadvantages are: higher operational costs, higher maintenance costs, and mechanical systems which could fail.

## 10.3 Stantec Cross Connection Report Alternative

The City of Modesto Storm Drain Cross Connection Report (Stantec 2007) proposed building portions of the storm drainage system proposed in the Draft City of Modesto 2008 Storm Drainage Master Plan (Stantec). The storm drain lines were proposed to be oversized to provide storage. The system was to utilize existing rockwells and proposed Turlock Rockwells to drain the system.

It is difficult to compare the Stantec Cross Connection Report Alternative because the design was for the 100-year, 24 hour event, while retention systems, should be designed for the 100-year, 6 day event.

To compare the Stantec Cross Connection Report Alternative to the Retention and Detention Alternatives, only the cross connections being removed by this project were evaluated. The Cross Connection Report includes other areas in addition to Area 2. The retention volumes required to meet the City Standards were calculated. Because the Cross Connection report utilized different volumes, a unit cost per cubic foot was calculated based on the total project cost in the Cross Connection Report. The unit cost was applied to the required retention volumes to develop a revised project cost to meet the City Standards.

Advantages of the Stantec Cross Connection Report Alternative are: it builds a portion of the Master Plan infrastructure, and does not disturb the parks. Disadvantages include high cost, extreme difficulty of constructing oversized pipes in existing roads with many existing utilities, length of time until downstream facilities are constructed, and no water quality treatment.

## 10.4 Construction Cost

A preliminary opinion of the probable cost of construction was prepared for each of the detention and retention alternatives based on current cost data obtained from bid results, suppliers, and construction estimation guides. Cost comparisons for all three alternatives are listed in Appendix B.

# 11. RECOMMENDED PROJECTS

The recommended project is a combination of the detention and retention options. Retention is preferred where economically feasible because it has lower operation and maintenance costs. Detention tends to have lower capital costs because the required storage volume is half that of retention, but the operation and maintenance costs are higher.

All retention/detention systems will have pretreatment devices, isolation valves, isolation rows (for sediment deposition), observation wells and SCADA systems. Detention systems will have duplex pump stations and force mains.

At a minimum, surface improvements at each park will generally include replacing irrigation system components—sprinkler heads, pipe, control wire, valves, etc.—and turf within the limits of excavation and within other areas disturbed by construction activities. It is recommended that the new turf be planted with sod to reduce the grow-in period. Additionally, new sprinkler heads will be installed on individual irrigation zones that span across disturbed and undisturbed areas as may be required to balance the precipitation rate for the affected zone. In addition to this minimum amount of restoration, each park will require other surface improvements, which are summarized in the following paragraphs.

The recommended improvements at each park are shown in Figures 3 thru 10.

## 11.1 Garrison Park

For Garrison Park, retention is recommended. Percolation tests indicate percolation should be good. The park also has adequate open space to accommodate the volume required for retention. The capital costs for retention are only slightly higher than detention.

In addition to the basic restoration of turf and irrigation in disturbed areas, surface improvements at this park will include replacement of the baseball infield and replacement of concrete walks that extend into the park from Teresa Street. This segment of concrete walk will be designed to accommodate truck access to the pre-treatment as required for maintenance. Given the size of the area required for maneuvering a vacuum truck, an opportunity is presented to configure this new paving as a useable space. The concept plan presented in Figure #3 demonstrates how this space can be designed as a double half-court basketball court with an adjacent seating area while accommodating maintenance access. The final design of this area will need to be closely coordinated with the requirements of the

maintenance vehicles. The excavation plan is designed to avoid the existing baseball backstop so it should not require replacement.

## 11.2 Catherine Everett Park

Retention is recommended for Catherine Everett Park. The park has enough open space to accommodate the retention volume. Percolation tests indicate percolation should be good. The costs of detention and retention are nearly identical for this park.

It is anticipated that construction activities at this site will be limited to open turf areas and the baseball infield. As a result, reconstruction of the baseball infield is the only surface improvement required in addition to the basic turf and irrigation replacement described above. The excavation plan is designed to avoid the existing backstop so it should not require replacement.

## 11.3 JM Pike Park

JM Pike Park has the largest proposed storage system. Detention has significantly lower capital costs than retention because of the large storage volume required. Detention requires a pump station with a force main to the existing storm drain line in 9$^{th}$ Street at Tully, south of the park. Removal of one large tree is necessary to achieve the required storage volume. Removal of this tree was discussed with City Parks Department staff during the design process.

Due to the extent of the excavation required at this park, significantly more surface improvements are required in addition to the basic irrigation and turf restoration described above. Generally, these improvements include reconstruction of the large play area, replacement of the baseball backstop, and reconstruction of the baseball infield. These reconstructed facilities require ADA-compliant access from Princeton Avenue as well as from the neighborhood to the north. ADA-compliant access between the new facilities is also required. Additional proposed surface improvements include a new concrete walkway system in the core area of the park interconnecting all new features and the existing restroom building. See Figure #7 for a design concept of how this can be accomplished as well as other details about the proposed surface improvements.

The existing play equipment will be re-used to the extent possible based on review of compliance with governing safety and access regulations in effect at the time of implementation. The excavation plan has been designed to avoid the existing restroom building so replacement of this building should not be required.

## 11.4 Roosevelt Park

Roosevelt Park is the most heavily developed and used of the four parks. Detention is recommended because percolation rates were very low. An existing City storm drain line which is part of the McHenry Storm Drain system is located just east of the park in Orangeburg Avenue allowing the system to be pumped.

Due to site constraints at this park, significantly more surface improvements are required than at the other parks. Surface improvements at this site will include the basic irrigation system and turf restoration common to all sites as well as additional modifications to the irrigation system and replacement of some significant site features.

The existing irrigation system for this park appears to be directly connected to the City's water main. It should be isolated from the City water system as part of this project. To accomplish this, it is recommended that a new City water main be installed as part of this project. This new City water main would extend from the existing well site to Bronson Avenue and branch north and south to connect into the City's water system. The existing 12-inch line that appears to be serving both as a City water main and irrigation mainline should then be isolated from the City water system except for a single point of connection to the new City water main with a new backflow prevention device. It can then continue to serve as the irrigation mainline; however, the City may want to consider replacing the full length of the existing 12-inch line with a new PVC line that is more appropriately sized (smaller) for the irrigation system demand. This would facilitate easier maintenance on that line should the need occur. The opinion of probable cost in this report assumes leaving the existing 12-inch pipe in place.

Due to the abundance of mature trees, limited open turf areas, and the directive from the City to minimize removal of trees, it was necessary to locate a portion of the underground detention facilities where the tennis courts, restrooms, and play areas are currently located. As a result, reconstruction of these features is included in this project. The tennis court is proposed to be replaced in its original location and configuration; whereas, the restroom and play areas require reconfiguration because the restroom cannot be constructed over the top of the detention facilities. Figure #9 illustrates a conceptual plan for this reconfiguration that perpetuates the circular forms of the original park design. In reconstructing the play area, it is anticipated that the existing play equipment will be re-used to the extent possible based on review of compliance with governing safety and access regulations in effect at the time of implementation.

This park also requires a new paved drive to provide maintenance vehicles access to the pretreatment device. This access is proposed to come off of the corner of Pearl Street and Carlton Avenue. The paved area over the pretreatment device is expanded to accommodate maneuvering of a vacuum truck and other vehicles. This expanded paved area presents an opportunity to develop this area as a "plaza" area that can be used for children's games that require a hard surface. Similarly, the existing maintenance access drive from West Orangeburg to the existing well site requires some modification to accommodate access to the new pump station. The concept plan illustrates how the expanded paved area at this location can be enhanced as a small sitting area.

Note that the conceptual design includes reference to a pergola as a future project. That feature is shown for reference only and is not proposed to be constructed as part of this project.

## 11.5 Alternatives

There may be a possibility to work with the Modesto City School District to utilize Roosevelt Junior High School in place of Roosevelt Park. The school district has indicated they are open to the idea and there have been a couple meetings with the district to date. Because the talks are very preliminary, and this option is beyond the scope of this report, it is only briefly discussed.

Should the City and the School District reach agreement on utilizing the school site, both Roosevelt Park and JM Pike Park would need to be reevaluated for hydrology and hydraulics. The school site has much more space available for detention and volume should be shifted to it from JM Pike Park. This may allow JM Pike to be developed as a retention basin. To confirm this, both parks and their associated detention/retention systems and conveyance systems would need to be preliminarily designed. This preliminary design could occur as an addendum to this report or as part of the final design for either Roosevelt Park or JM Pike Park.

## 11.6 Operations

Operation is a key component of each park. Both conveyance and disposal systems will require maintenance. All systems will have pretreatment devices, isolation valves, observation wells, and SCADA systems to report pump operations, water levels, and alarms.

Conveyance systems will require routine maintenance to flush sediment and debris. The pretreatment devices will need to be flushed approximately twice a year with one cleaning occurring prior to the rainy season. Retention/detention systems will need to be monitored for sediment build up. If accumulation occurs in the isolation rows, it will need to be removed with a vacuum truck.

Pump systems on detention systems should be maintained yearly and tested prior to the rainy season. Valves in both the pumping system and the retention/detention systems should be maintained yearly. Above ground park improvements will require ongoing maintenance.

## 11.7 Project Schedule and Phasing

Since the total recommended project cost is $22.6 million, it is recommended that the project be phased. Garrison Park has been identified as Phase One because it has the lowest cost, will relieve flooding at two major intersections on Carver Road, will have minimal effect on adjacent residences, and will serve as a good demonstration project. JM Pike Park is recommended as Phase 2 because it will alleviate flooding at two major intersections on Tully Road and one major intersection on College Avenue. Roosevelt Park is recommended for Phase 3 because it will alleviate flooding along Granger Avenue. Catherine Everett Park has been recommended as Phase 4 because it only alleviates one source of flooding on a major roadway, Tully Road.

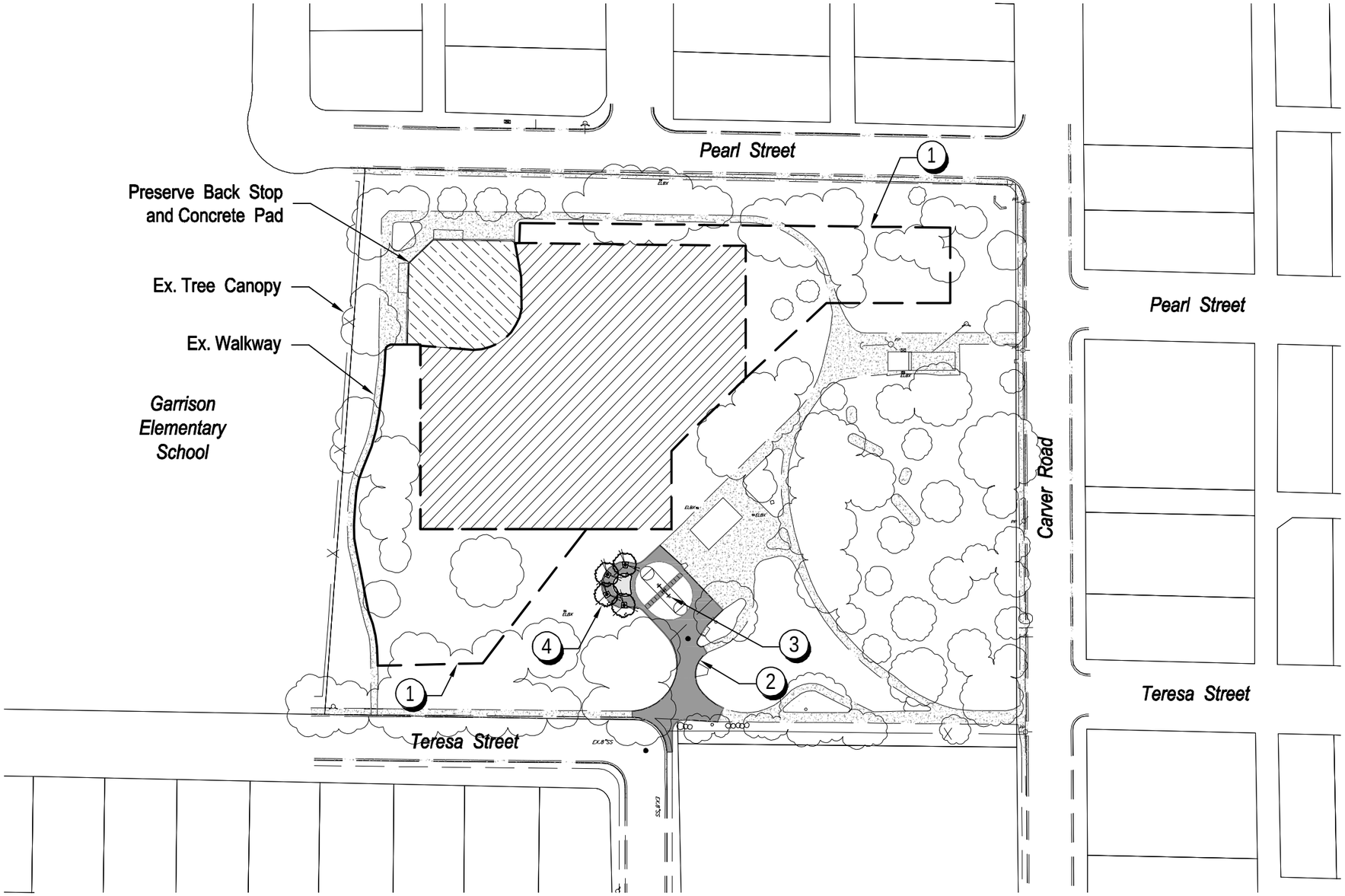
Only the schedule for Garrison Park (Phase 1) is included in this report (Figure 11) because the funding for future phases in unknown. The entire project will likely occur over many years.

## 11.8 Implementation

Each phase will build upon the Preliminary Design Report. Construction Documents, including final plans, specifications, and estimates will be prepared for each phase. Included in this task will be additional topographic surveys, design refinement, cost estimating, coordination with utility companies, coordination with parks and recreation, permitting, public outreach, and bid assistance.

# 12. LIMITATIONS

This report was prepared solely for the City of Modesto in accordance with professional standards at the time the services were performed and in accordance with the contract between the City of Modesto and RRM Design Group dated April 7, 2009. This document is governed by the above listed contract and its scope of work. This document is not intended for any use other than that described in the contract. Information provided by the City of Modesto and other parties utilized in this report unless expressly indicated has not been verified as a part of this project.




# LEGEND

| SYMBOL | DESCRIPTION |
|---|---|
| | Replace Irrigation System Components and Turf within Limits of Excavation |
| | New Infield with Bases |
| 1 | Area of Sprinkler Head Replacement to Match New Irrigation Equipment |
| 2 | New Paved Area to Support Vacuum Truck |
| 3 | New Basketball Court. Coordinate Pavement Design and Basket Location with Vacuum Truck Reqmts. |
| 4 | Develop Paved Seating Area with Trees and Landscaping Around Pre-Treatment Device |

NOTES:

1. This exhibit does not illustrate extent of restoration improvements related to areas distrubed by construction staging and other construction support activities. The opinion of cost includes an allowance for these addtional improvements.

north

SCALE

50' 0' 50' 100' 200'

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CITY of MODESTO

# AREA 2 STORM DRAIN CROSS CONNECTION REMOVAL GARRISON PARK SURFACE IMPROVEMENTS - FIGURE 3

Sheet No. G - L1
By RSH
Checked WRM
Date JANUARY 26, 2010
Job No. 2108543
Scale AS SHOWN

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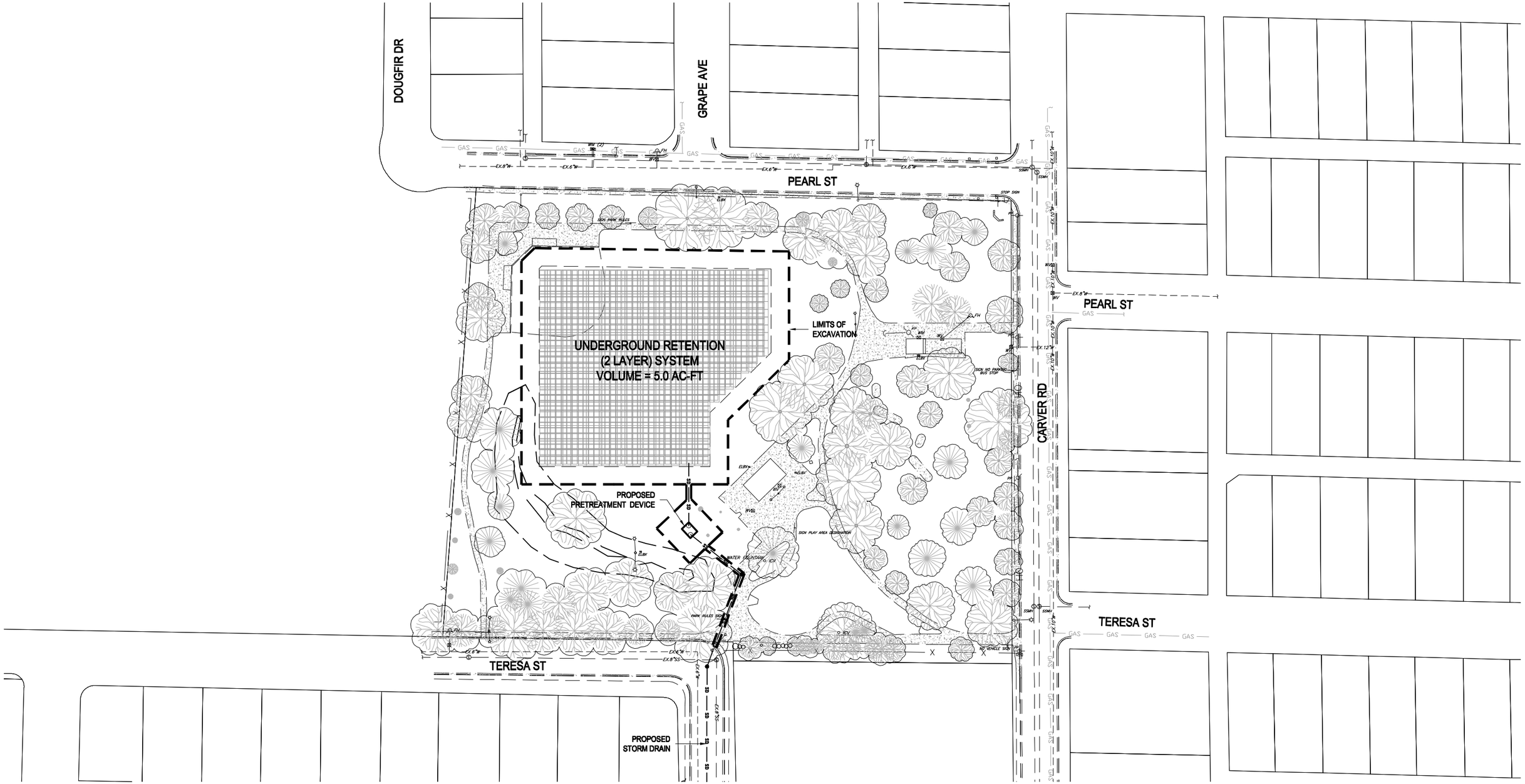


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NORTH

# AREA 2 STORM DRAIN
# CROSS CONNECTION REMOVAL
# GARRISON PARK
# UNDERGROUND IMPROVEMENTS - FIGURE 4

Sheet No. 1 OF 4

By RAC

Checked WFS

Date JANUARY 26, 2010

Job No. 2108543

Scale 1" = 100'

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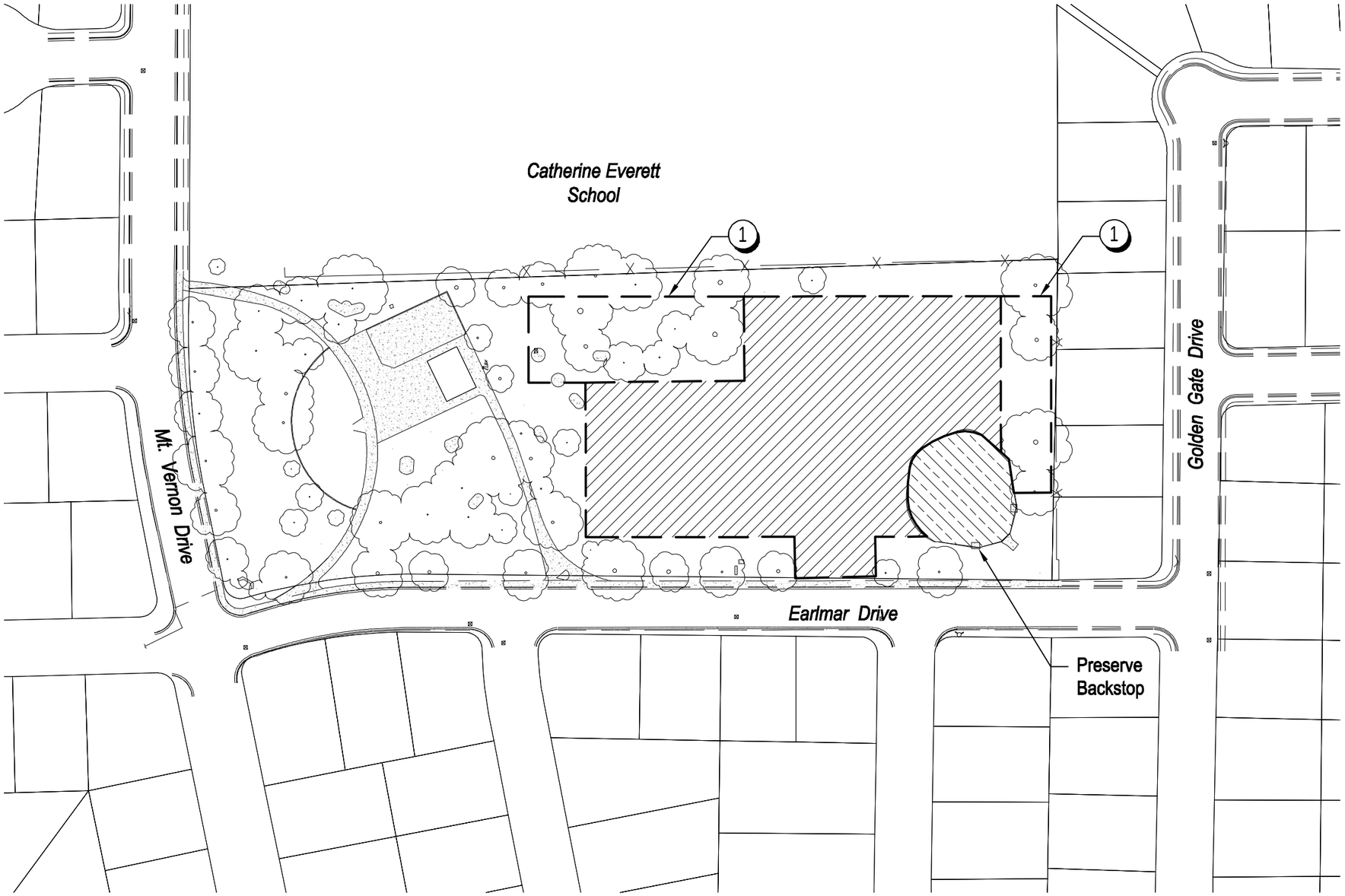


## LEGEND

| SYMBOL | DESCRIPTION |
|---|---|
| | Replace Irrigation System Components and Turf within Limits of Excavation |
| | Replace Infield and Bases |
| 1 | Area of Sprinkler Head Replacement to Match New Irrigation Equipment |

NOTES:

1. This exhibit does not illustrate extent of restoration improvements related to areas distrubed by construction staging and other construction support activities. The opinion of cost includes an allowance for these addtional improvements.

north

SCALE

50' 0' 50' 100' 200'

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# AREA 2 STORM DRAIN
# CROSS CONNECTION REMOVAL
# CATHERINE EVERETT PARK
# SURFACE IMPROVEMENTS - FIGURE 5

Sheet No. CE - L1
By RSH
Checked WRM
Date JANUARY 26, 2010
Job No. 2108543
Scale AS SHOWN

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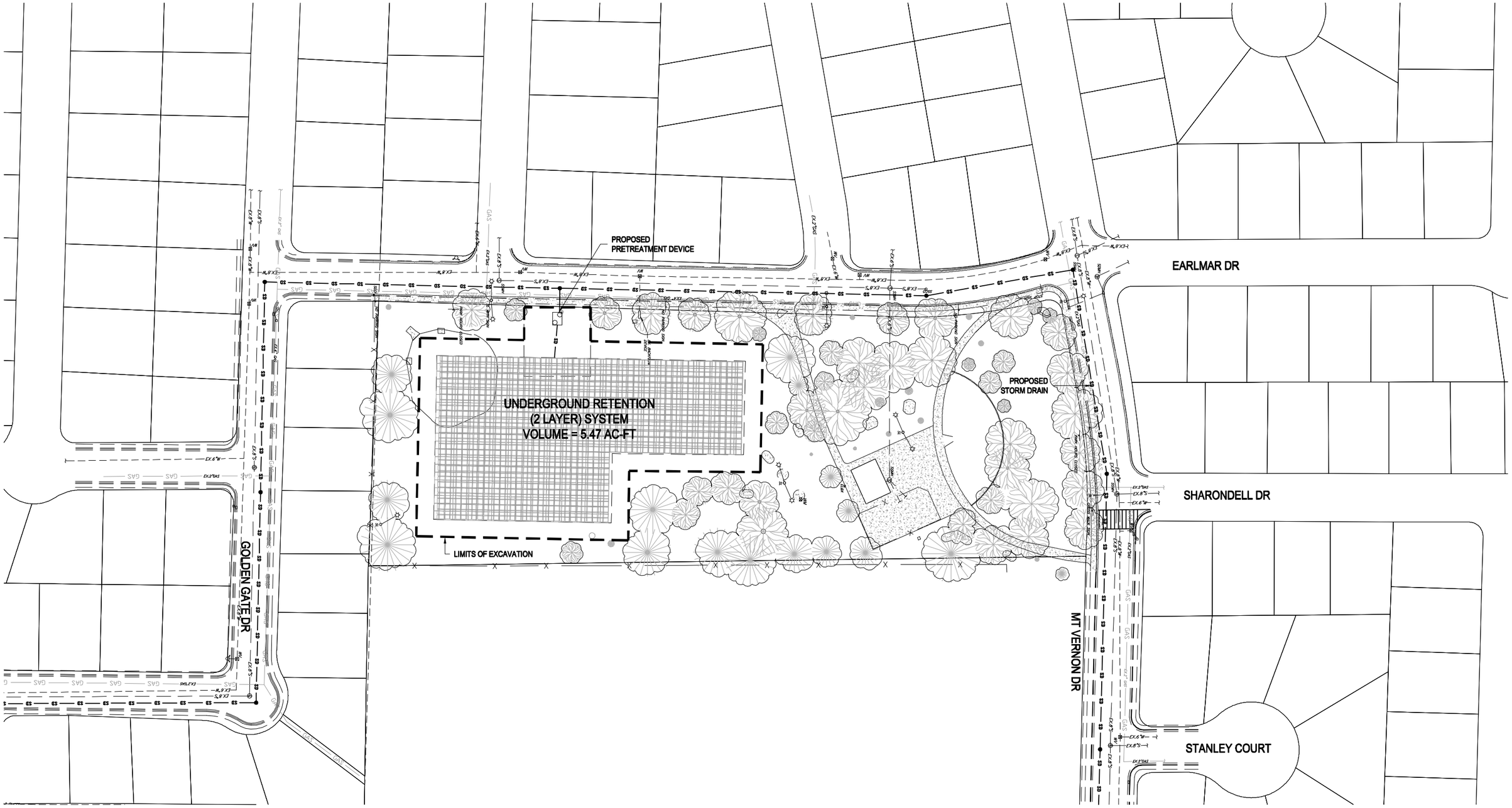


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# AREA 2 STORM DRAIN
# CROSS CONNECTION REMOVAL
# CATHERINE EVERETT PARK
# UNDERGROUND IMPROVEMENTS - FIGURE 6

Sheet No. 2 OF 4
By RAC
Checked WFS
Date JANUARY 26, 2010
Job No. 2108543
Scale 1" = 100'

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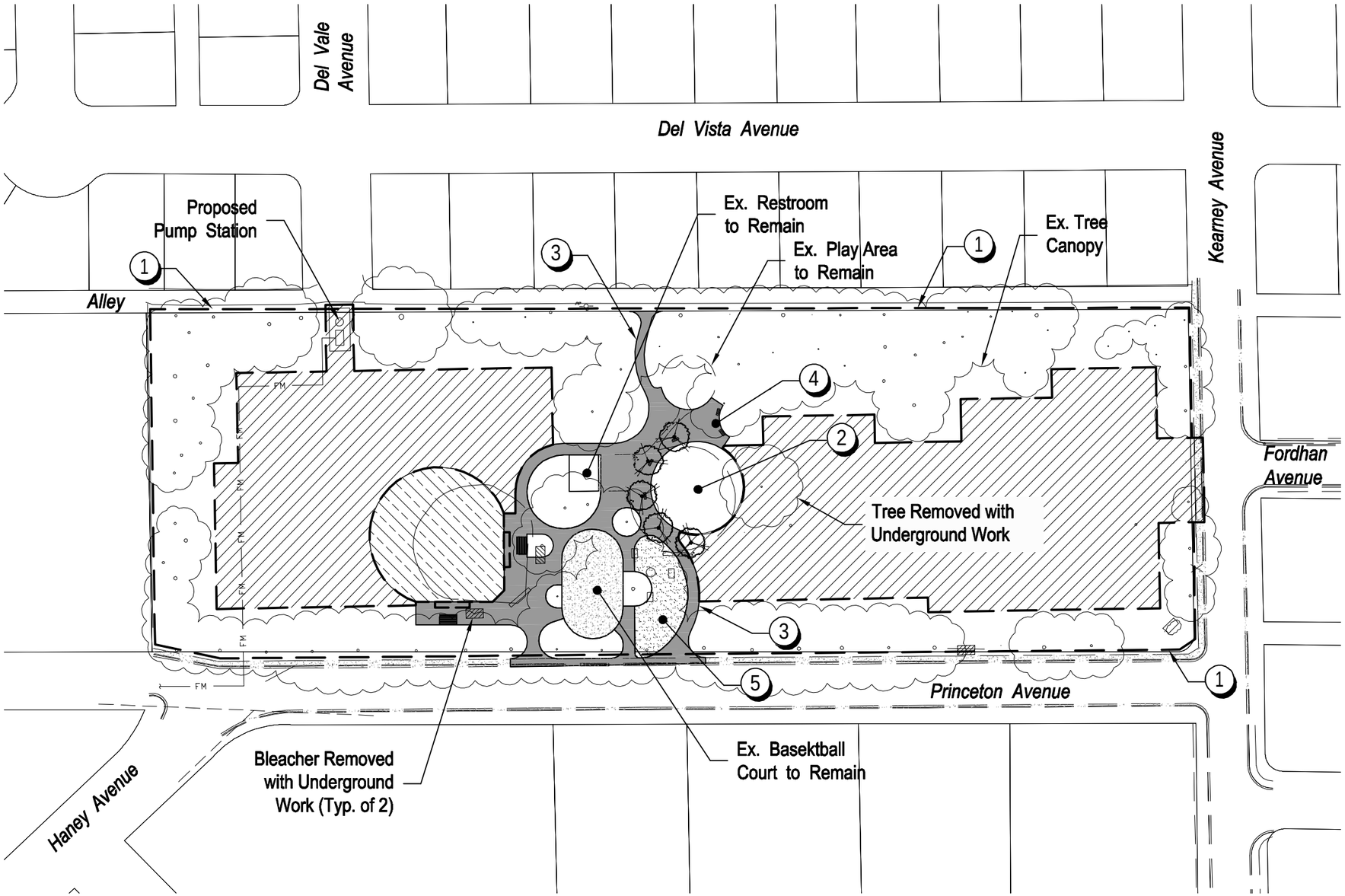


# LEGEND

| SYMBOL | DESCRIPTION |
|---|---|
| | Replace Irrigation System Components and Turf within Limits of Excavation |
| | New Baseball Backstop, Infield, Bases, Dugouts and Bleachers |
| 1 | Area of Sprinkler Head Replacement to Match New Irrigation Equipment |
| 2 | Re-Build Play Area. Re-Use Existing Play Structures. Provide New Trees and Benches Along Perimeter. |
| 3 | New Paving. |
| 4 | New Seating Area |
| 5 | Bar-B-Que Area with Picnic Tables. New Furnishings. Decomposed Granite or other All-Weather Surface. |

NOTES:

1. This exhibit does not illustrate extent of restoration improvements related to areas distrubed by construction staging and other construction support activities. The opinion of cost includes an allowance for these addtional improvements.

north

SCALE

50' 0' 50' 100' 200'

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# AREA 2 STORM DRAIN CROSS CONNECTION REMOVAL J.M. PIKE PARK SURFACE IMPROVEMENTS - FIGURE 7

Sheet No. JM - L1
By RSH
Checked WRM
Date JANUARY 26, 2010
Job No. 2108543
Scale AS SHOWN

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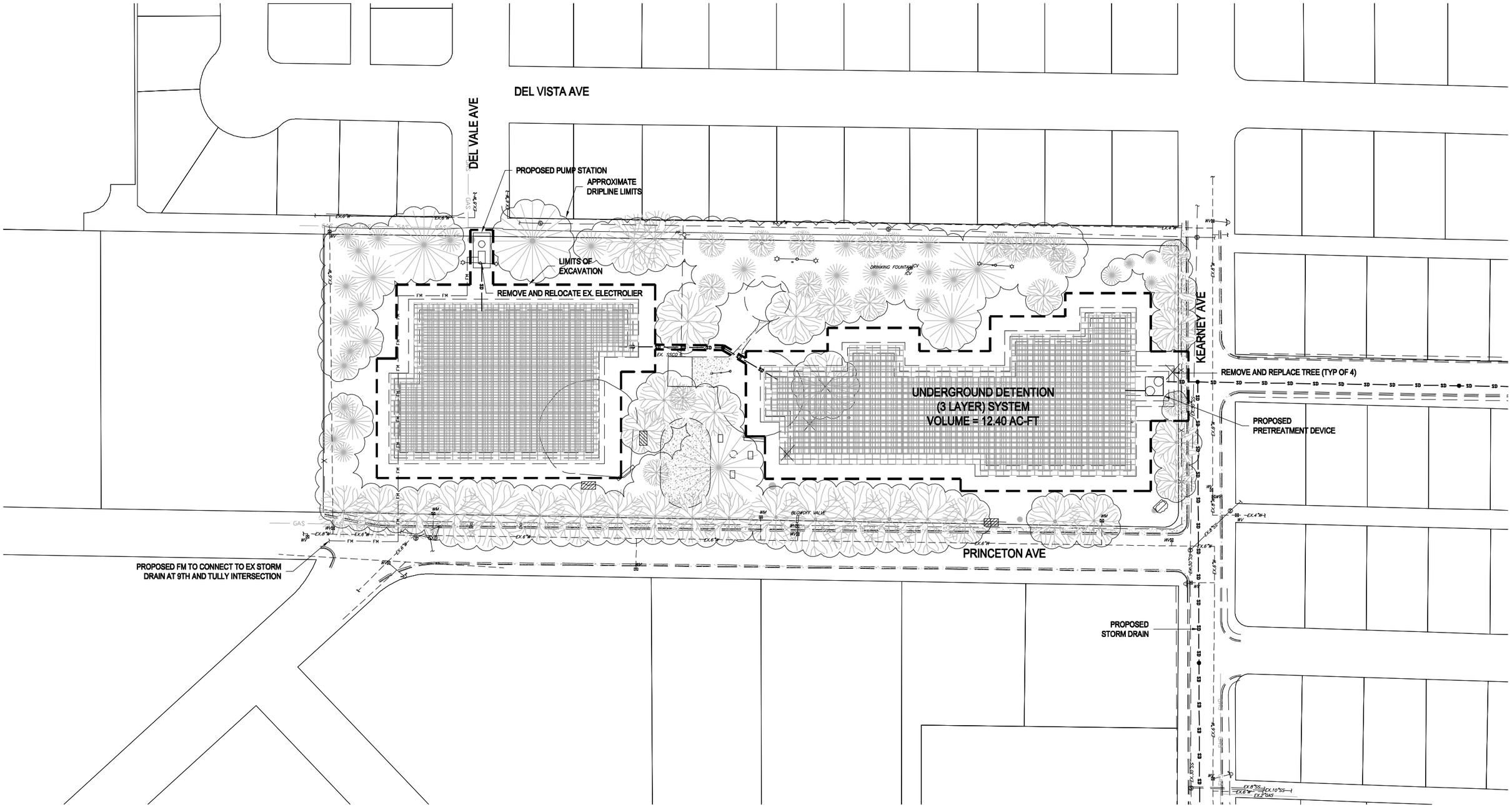


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# AREA 2 STORM DRAIN CROSS CONNECTION REMOVAL JM PIKE PARK UNDERGROUND IMPROVEMENTS - FIGURE 8

| | |
|---|---|
| Sheet No. | 3 OF 4 |
| By | RAC |
| Checked | WFS |
| Date | JANUARY 26, 2010 |
| Job No. | 2108543 |
| Scale | 1" = 100' |

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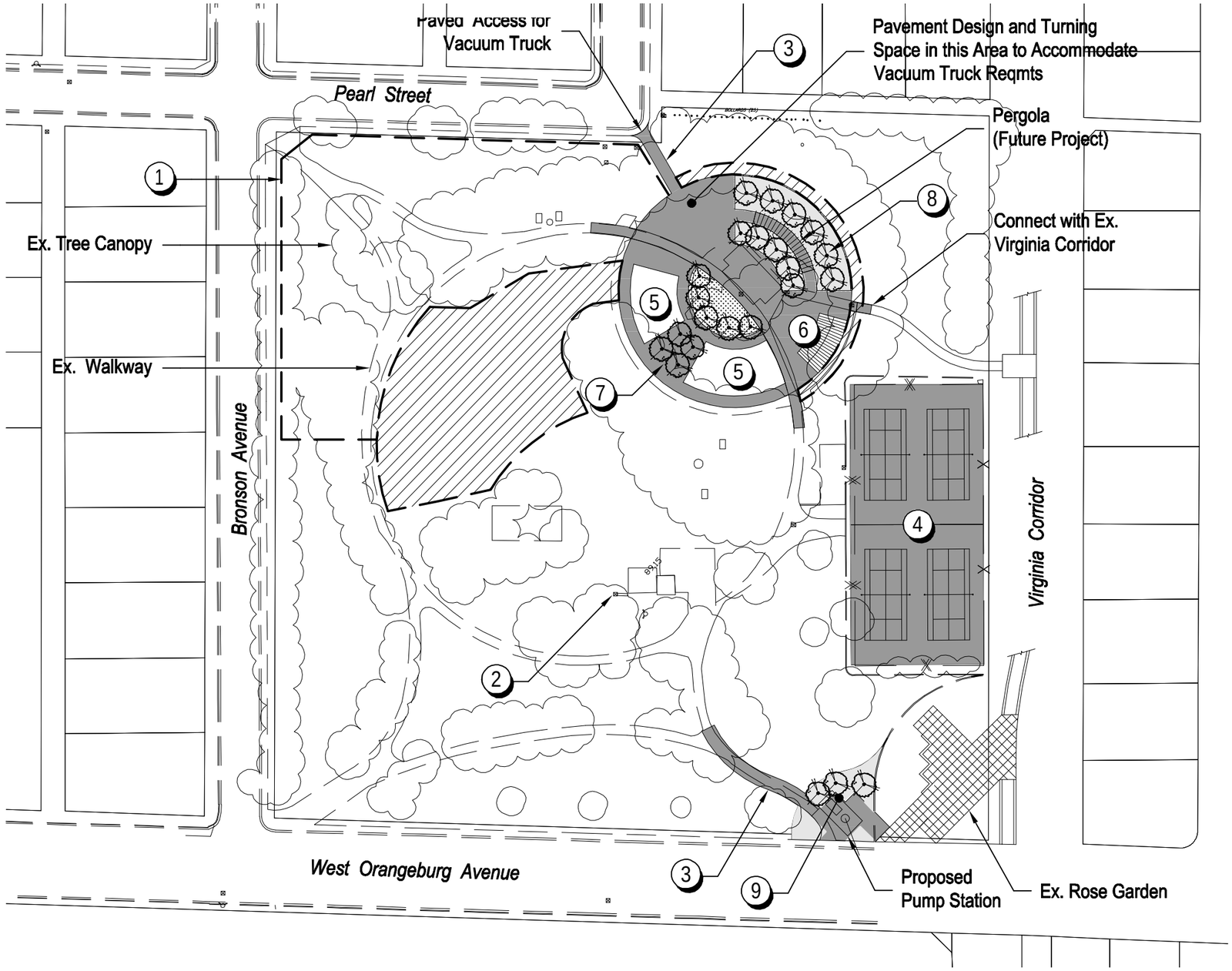


# LEGEND

| SYMBOL | DESCRIPTION |
|---|---|
| | Replace Irrigation System Components and Turf within Limits of Excavation |
| 1 | Area of Sprinkler Head Replacement to Match New Irrigation Equipment |
| 2 | New Irrigation POC and Backflow Preventer |
| 3 | New Paving (Shaded Area) |
| 4 | New Tennis Courts, Fencing, and Lights |
| 5 | Rebuild Play Area, Re-Use Existing Play Structure |
| 6 | New Restroom |
| 7 | Shade Trees and Benches |
| 8 | Planted Area with Shade Trees and Benches |
| 9 | Expand Paving, Seat Wall and Planter from Rose Garden Plaza |

NOTES:

1. This exhibit does not illustrate extent of restoration improvements related to areas distrubed by construction staging and other construction support activities. The opinion of cost includes an allowance for these addtional improvements.

north

SCALE

50' 0' 50' 100' 200'

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# AREA 2 STORM DRAIN CROSS CONNECTION REMOVAL ROOSEVELT PARK SURFACE IMPROVEMENTS - FIGURE 9

Sheet No. R - L1
By RSH
Checked WRM
Date JANUARY 26, 2010
Job No. 2108543
Scale AS SHOWN

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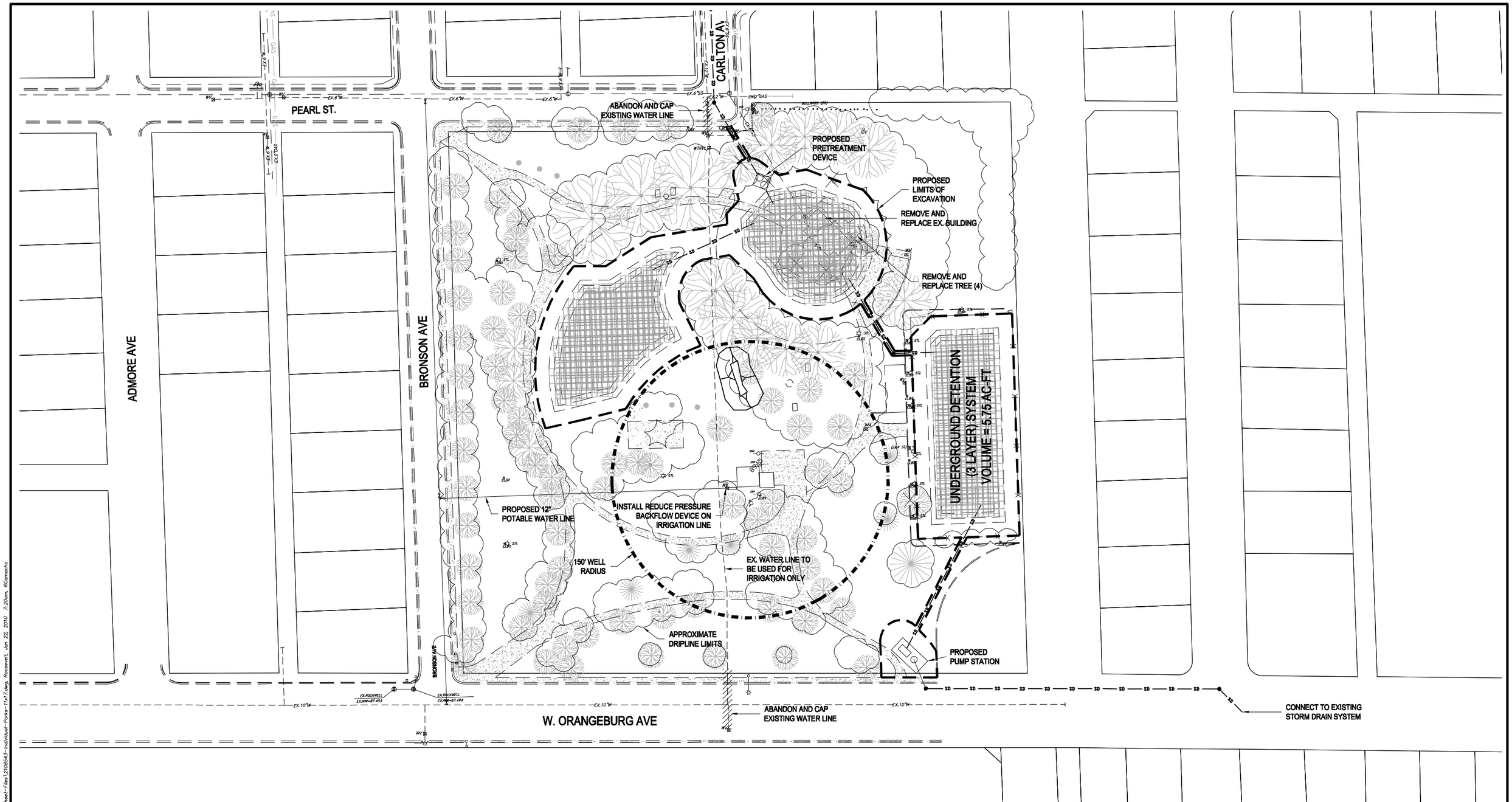


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# AREA 2 STORM DRAIN CROSS CONNECTION REMOVAL ROOSEVELT PARK UNDERGROUND IMPROVEMENTS - FIGURE 10

Sheet No. 4 OF 4
By RAC
Checked WFS
Date JANUARY 26, 2010
Job No. 2108543
Scale 1" = 100'

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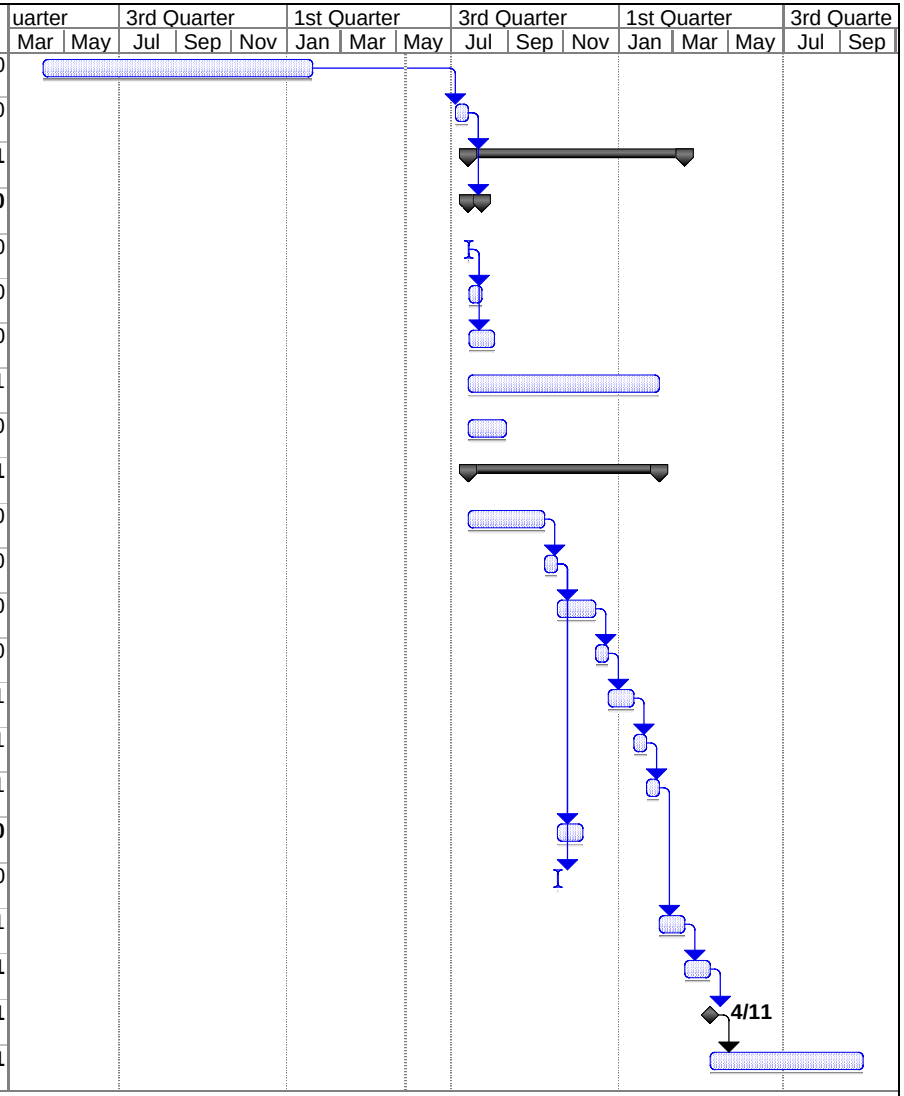
| ID | Task Name | Duration | Start | Finish |
|---|---|---|---|---|
| 1 | Preliminary Design | 212 days? | Thu 4/9/09 | Fri 1/29/10 |
| 2 | Scope/Contract | 2 wks | Tue 7/6/10 | Mon 7/19/10 |
| 3 | **Final Design** | **170 days** | **Tue 7/20/10** | **Mon 3/14/11** |
| 4 | **Task A - Project Set Up** | **11 days** | **Tue 7/20/10** | **Tue 8/3/10** |
| 5 | A.1 - Kick-Off Meeting | 1 day | Tue 7/20/10 | Tue 7/20/10 |
| 6 | A.2 Supplimental Survey | 2 wks | Wed 7/21/10 | Tue 8/3/10 |
| 7 | Task B - Addendum to PDR | 4 wks | Wed 7/21/10 | Tue 8/17/10 |
| 8 | Task C - Agency Coordination | 150 days | Tue 7/20/10 | Mon 2/14/11 |
| 9 | Task D - Park Design Development | 6 wks | Tue 7/20/10 | Mon 8/30/10 |
| 10 | **Task E - Plan, Specificaton, and Estir** | **150 days** | **Tue 7/20/10** | **Mon 2/14/11** |
| 11 | 50% Construction Documents | 3 mons | Tue 7/20/10 | Mon 10/11/10 |
| 12 | 50% Review | 2 wks | Tue 10/12/10 | Mon 10/25/10 |
| 13 | 90% Construction Documents | 6 wks | Tue 10/26/10 | Mon 12/6/10 |
| 14 | 90% Review | 2 wks | Tue 12/7/10 | Mon 12/20/10 |
| 15 | 100% Construction Documents | 1 mon | Tue 12/21/10 | Mon 1/17/11 |
| 16 | 100% Review | 2 wks | Tue 1/18/11 | Mon 1/31/11 |
| 17 | Bid Set of Plans | 2 wks | Tue 2/1/11 | Mon 2/14/11 |
| 18 | **Task F - CEQA** | **1 mon** | **Tue 10/26/10** | **Mon 11/22/10** |
| 19 | **Task G - Public Outreach** | 1 day | Tue 10/26/10 | Tue 10/26/10 |
| 20 | Design Acceptance By City | 1 mon | Tue 2/15/11 | Mon 3/14/11 |
| 21 | **Bidding** | **1 mon** | **Tue 3/15/11** | **Mon 4/11/11** |
| 22 | **Award Construction Contract** | **0 days** | **Mon 4/11/11** | **Mon 4/11/11** |
| 23 | **Construction** | **6 mons** | **Tue 4/12/11** | **Mon 9/26/11** |




Project: Modesto Area 2
Date: Tue 5/11/10

| | | | | | |
|---|---|---|---|---|---|
| Task | | Milestone | | External Tasks | |
| Split | | Summary | | External Milestone | |
| Progress | | Project Summary | | Deadline | |



Figure 11

# GLOSSARY

**Asbuilts:** Drawings which have been prepared by an engineer which represent the constructed state of improvements.

**Cross Connection:** The connection of a non-sanitary sewer pipe to the sanitary sewer system

**Conveyance System:** The drainage facilities, both natural and human-made, which collect, contain, and provide for the flow of surface water and urban runoff from the highest points on the land down to a receiving water. The natural elements of the conveyance system include swales and small drainage courses, streams, rivers, lakes, and wetlands. The human-made elements of the conveyance system include gutters, ditches, pipes, channels, and most retention/detention facilities.

**Design Return Period:** A rainfall event of specified size and return frequency (e.g., a 10-year storm, a storm that has a 10% chance of occurring in any year) that is used to calculate the runoff volume and peak discharge rate.

**Detention:** The delay of storm runoff prior to discharge into receiving waters.

**Disposal System:** A system for the disposing of wastes, either by surface or underground methods; includes sewer systems, treatment works, disposal wells, and other systems.

**Geographical Information System (GIS):** computer system that can store manipulate and display geographically referenced information .

**Hydraulics:** study of the mechanical uses of fluids (especially water) in motion
California Environmental Quality Ac t (CEQA) - Enacted in 1970 and amended through 1983, established state policy to maintain a high-quality environment in California and set up regulations to inhibit degradation of the environment.

**Hydrology :** a science dealing with the properties, distribution, and circulation of water on and below the earth's surface and in the atmosphere.

**Manhole:** opening with a removable cover through which a person can access a sewer (or stormdrain)
AWWA: American Water Works Association.

**National Pollutant Discharge Elimination System (NPDES):** the surface water quality program authorized by Congress as part of the 1987 Clean Water Act. This is EPA's program to control the discharge of pollutants to waters of the United States (see 40 CFR 122.2).

**Plats:** A plot; a plan; a design; a diagram; a map; a chart.

**Pre-Treatment:** Processes used to reduce or eliminate stormwater pollutants from before they are discharged.

**Regional Water Quality Control Board (RWQCB):** There are nine Regional Water Quality Control Boards. The mission of the Regional Boards is to develop and enforce water quality objectives and implementation plans that will best protect the beneficial uses of the State's waters, recognizing local differences in climate, topography, geology and hydrology.

**Retention:** The prevention of direct discharge of storm runoff into receiving waters; included as examples are systems which discharge through percolation, exfiltration, and evaporation processes and which generally have residence times less than 3 days.

**Right-of-Way:** a strip of land granted for the public to travel over it, such as a street, road, sidewalk, or footpath.

**Rockwell:** A vertical drain that infiltrates stormwater into the ground.

**Runoff:** the portion of precipitation on land that ultimately reaches streams.

**Sanitary Sewer:** A system of underground pipes that carries sanitary waste or process wastewater to a treatment plant.

**Storm Sewer (Storm Drain):** Above and below ground structures for transporting stormwater to streams or outfalls for flood control purposes.

**Sub-Basin:** A portion of a subregion or basin drained by a single stream or group of minor streams Infiltration - the gradual downward flow of water from the surface of the earth into the soil.

**Total Suspended Solids (TSS):** A measure of water quality defined as those solids which are retained by a glass fiber filter and dried to constant weight at 103-105EC.

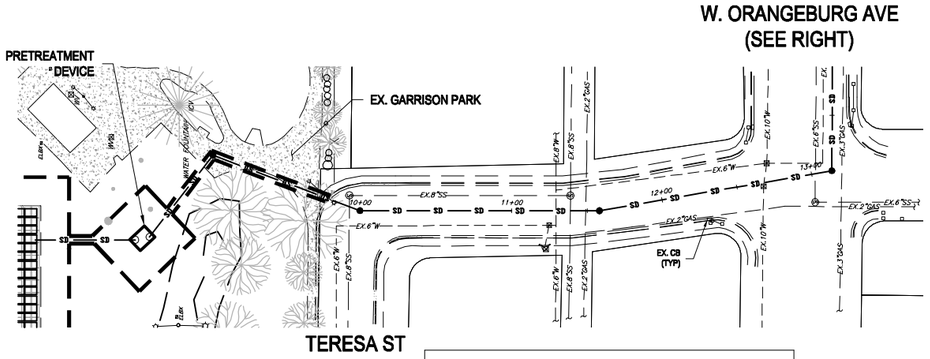
**Water Quality:** The chemical, physical and biological characteristics of water in respect to its suitability for a particular purpose.

**Water Quality Flow Rate:** “First flush” defined as the runoff associated with the two-year/siz-hour storm (average intensity = 0.15 inches per hour).

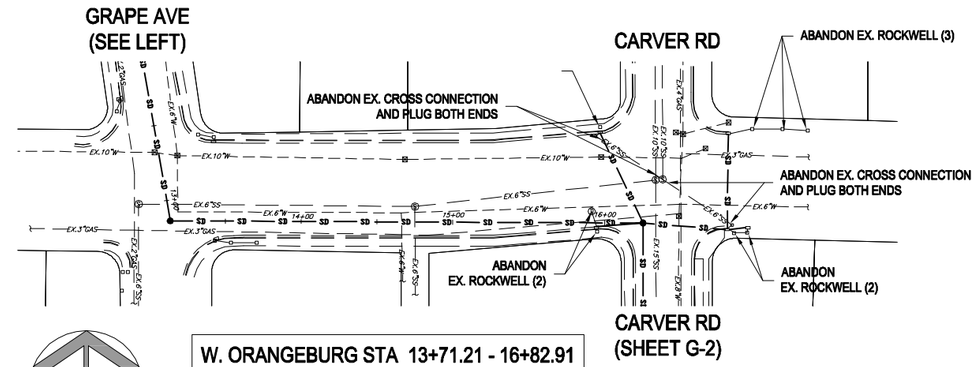
**Water Quality Volume:** “First Flush” also defined as the first 0.5 inch of runoff.

# APPENDIX A

## PRELIMINARY DESIGN DRAWINGS




GRAPE AVENUE STA 10+57.62 - 13+71.21




W. ORANGEBURG STA 13+71.21 - 16+82.91

north

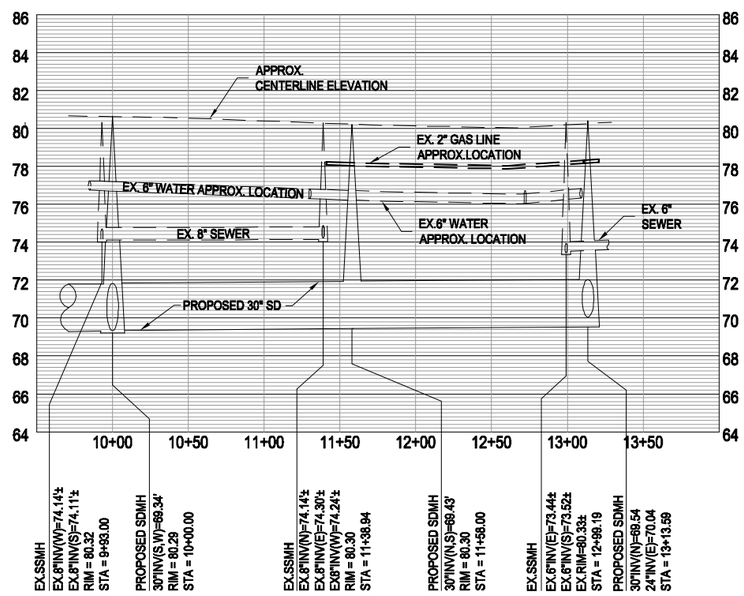
SCALE: 1" = 100'

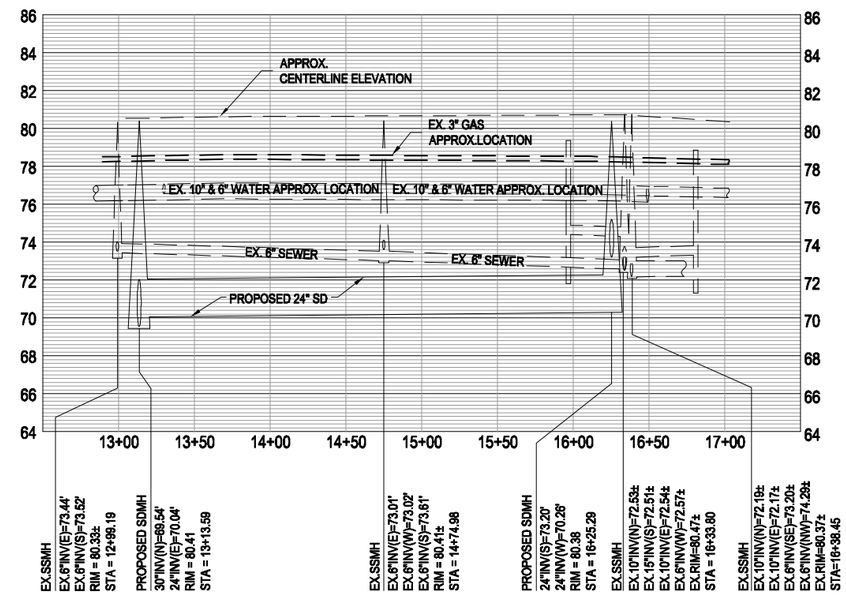
NOTE: PROPERTY AND ROW LINES BASED ON CITY GIS LINEWORK, NOT SURVEYED.

north

SCALE: 1" = 100'

**NOT FOR CONSTRUCTION**

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CITY of MODESTO

# AREA 2 STORM DRAIN
# CROSS CONNECTION REMOVAL
# GARRISON - CONVEYANCE SYSTEM

Sheet No. G-1
By RC
Checked WFS
Date JANUARY 26, 2010
Job No. 2108543
Scale 1" = 100'

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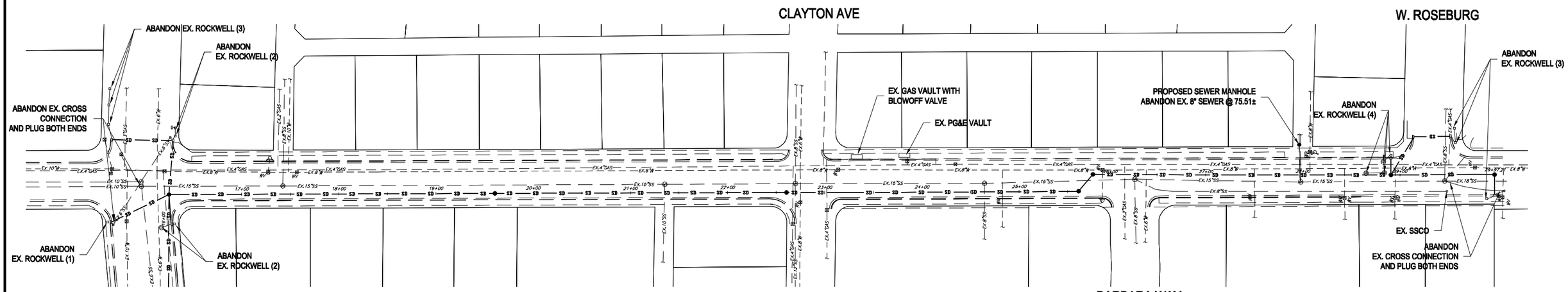
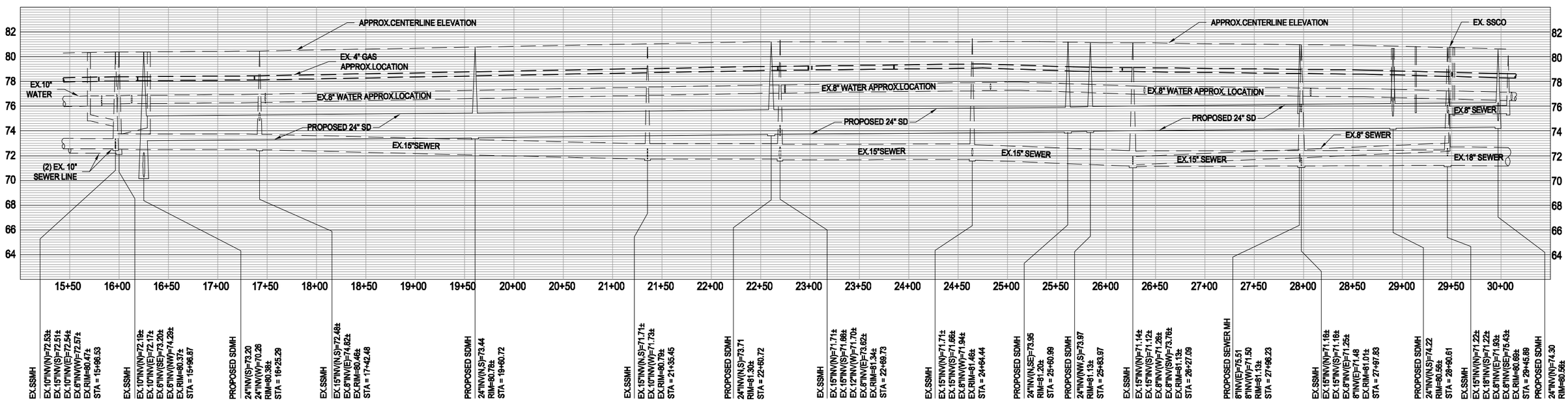



CARVER ROAD STA 16+82.91 - 30+54.83

NOTE: PROPERTY AND ROW LINES BASED ON CITY GIS LINEWORK, NOT SURVEYED.

**NOT FOR CONSTRUCTION**





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north

SCALE: 1" = 100'

# AREA 2 STORM DRAIN CROSS CONNECTION REMOVAL GARRISON - CONVEYANCE SYSTEM

| | |
|---|---|
| Sheet No. | G-2 |
| By | RC |
| Checked | WFS |
| Date | JANUARY 26, 2010 |
| Job No. | 2108543 |
| Scale | 1" = 100' |

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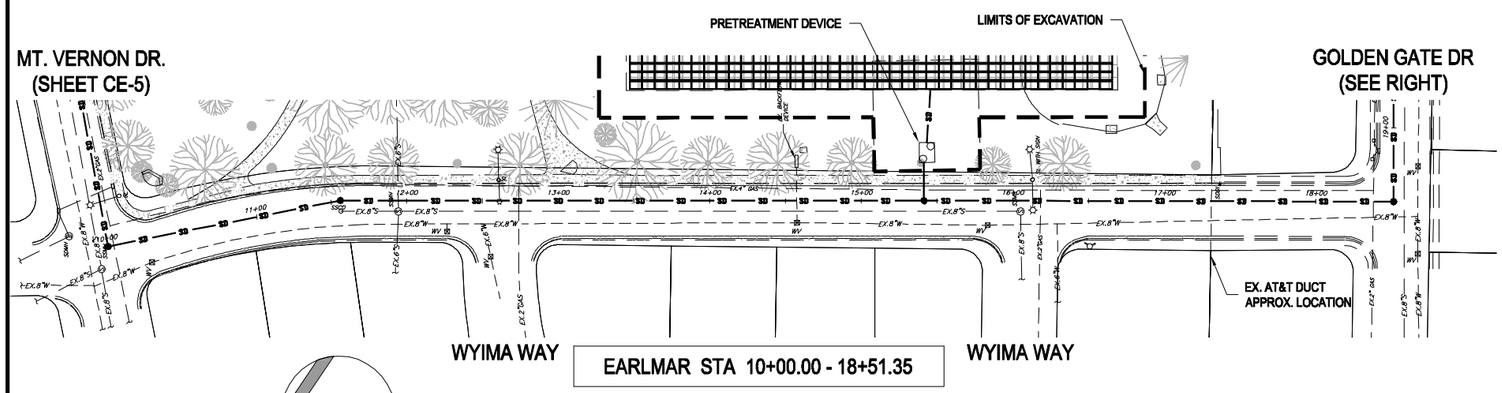
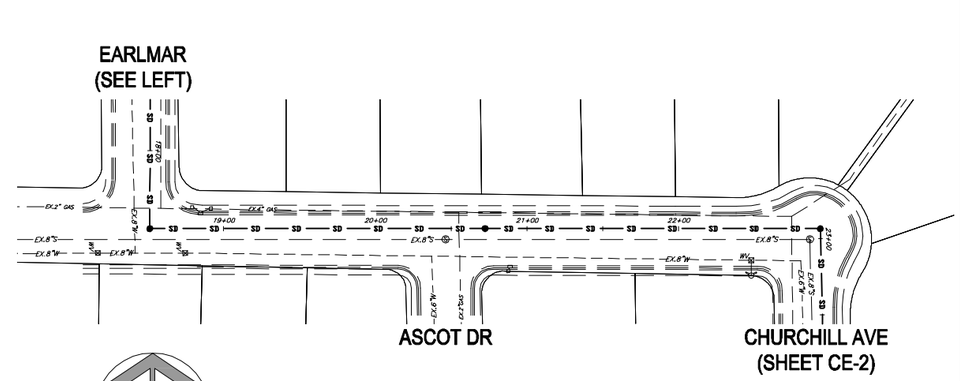



EARLMAR STA 10+00.00 - 18+51.35

north

SCALE: 1" = 100'

NOTE: PROPERTY AND ROW LINES BASED ON CITY GIS LINEWORK, NOT SURVEYED.

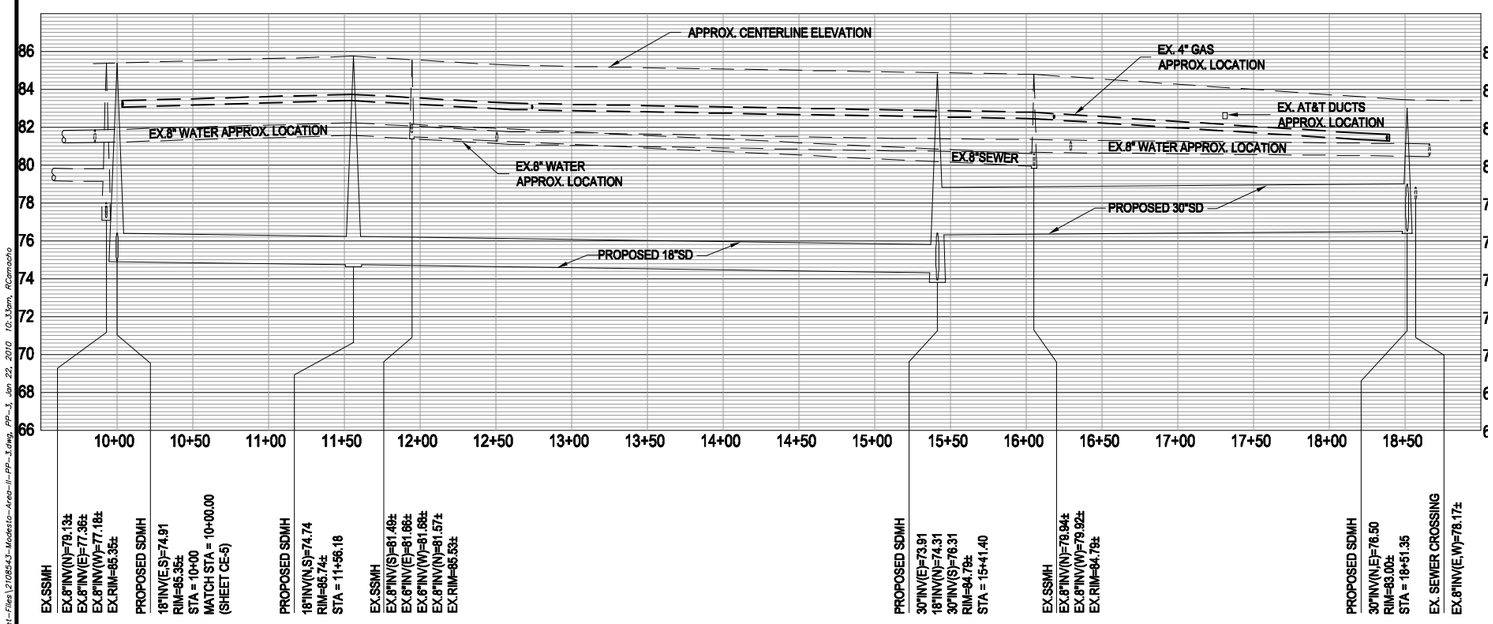


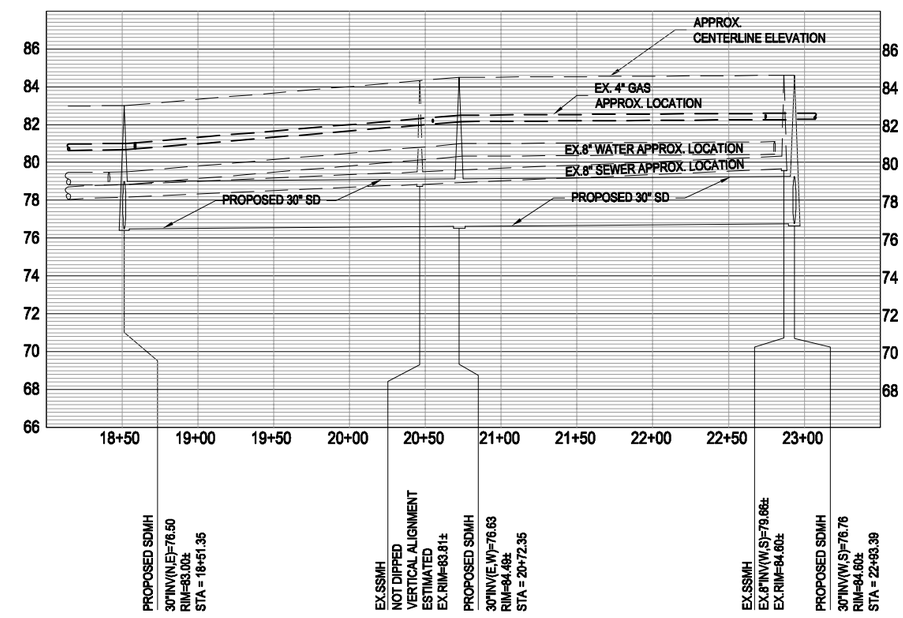

GOLDEN GATE DR STA 18+51.35 - 22+93.39

north

SCALE: 1" = 100'

**NOT FOR CONSTRUCTION**

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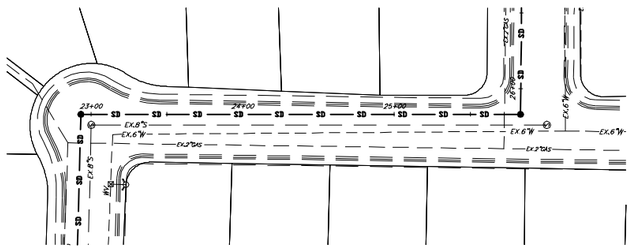
CITY of MODESTO

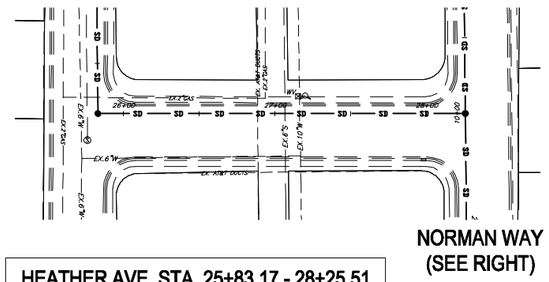
# AREA 2 STORM DRAIN
# CROSS CONNECTION REMOVAL
# CATHERINE EVERETT - CONVEYANCE SYSTEM

| | |
|---|---|
| Sheet No. | CE-1 |
| By | RC |
| Checked | WFS |
| Date | JANUARY 26, 2010 |
| Job No. | 2108543 |
| Scale | 1" = 100' |

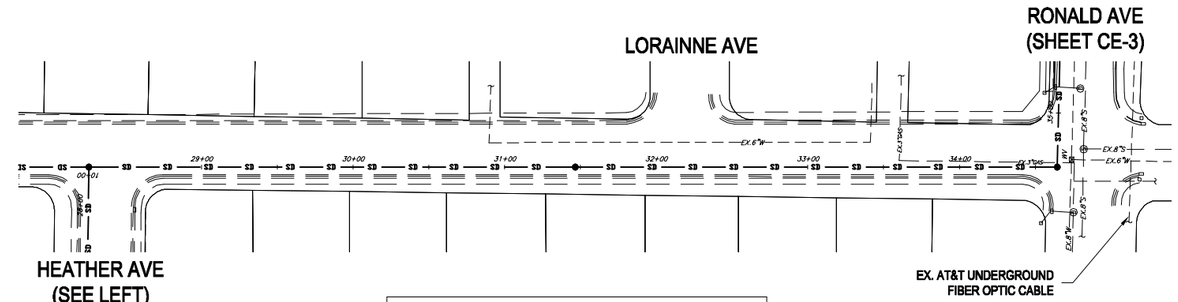
N:\2008\2108543-Modesto25tom\Engineering\DesDev\Sheet-Files\2108543-Modesto-Area-II-PP-3.dwg, PP-3, Jan 22, 2010 10:33am, RCamacho




CHURCHILL AVE STA 22+93.39 - 25+83.17




HEATHER AVE STA 25+83.17 - 28+25.51




NORMAN WAY STA 28+25.51 - 38+64.53

north

SCALE: 1" = 100'

north

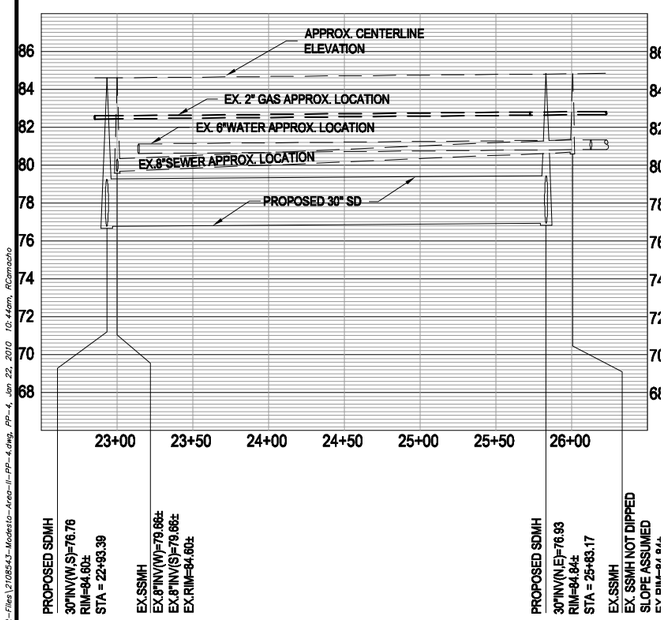
SCALE: 1" = 100'

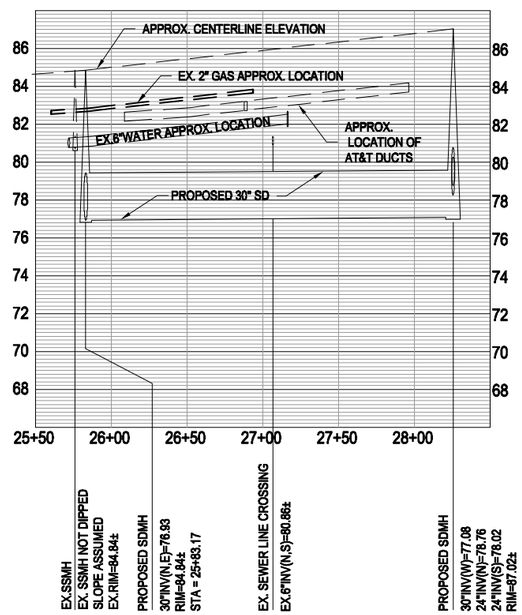
NOTE: PROPERTY AND ROW LINES BASED ON CITY GIS LINEWORK, NOT SURVEYED.

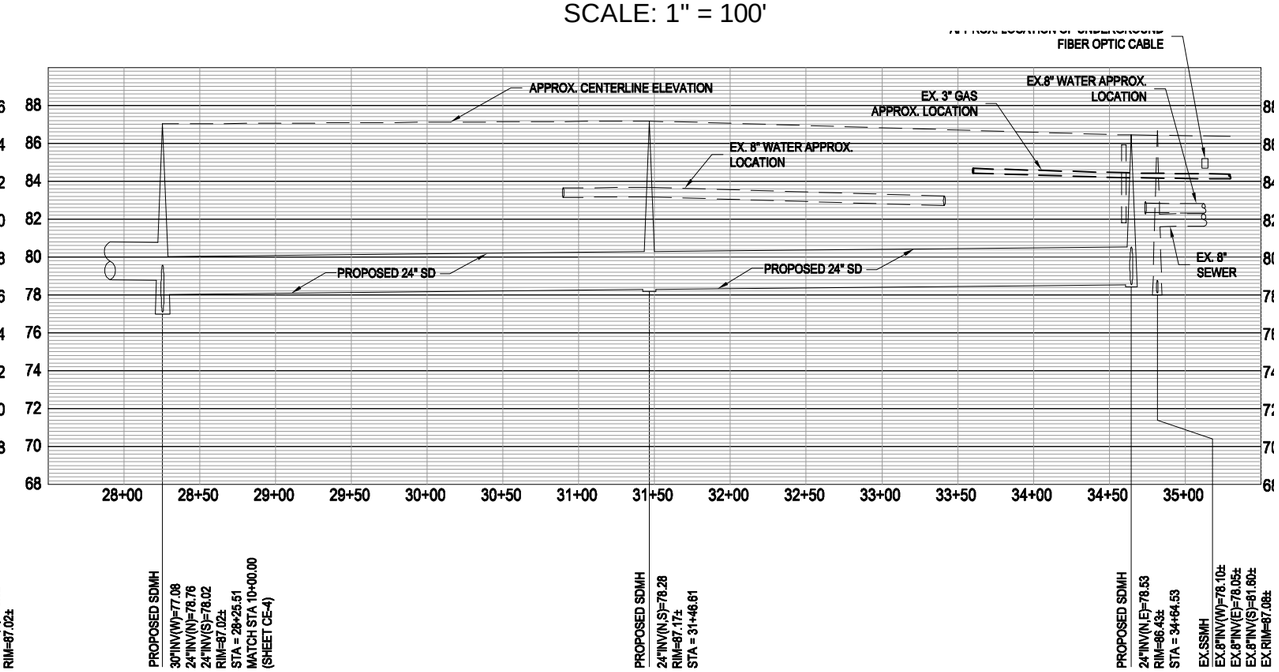
north

SCALE: 1" = 100'

**NOT FOR CONSTRUCTION**





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CITY of MODESTO

# AREA 2 STORM DRAIN
# CROSS CONNECTION REMOVAL
# CATHERINE EVERETT - CONVEYANCE SYSTEM

| | |
|---|---|
| Sheet No. | CE-2 |
| By | RC |
| Checked | WFS |
| Date | JANUARY 26, 2010 |
| Job No. | 2108543 |
| Scale | 1" = 100' |


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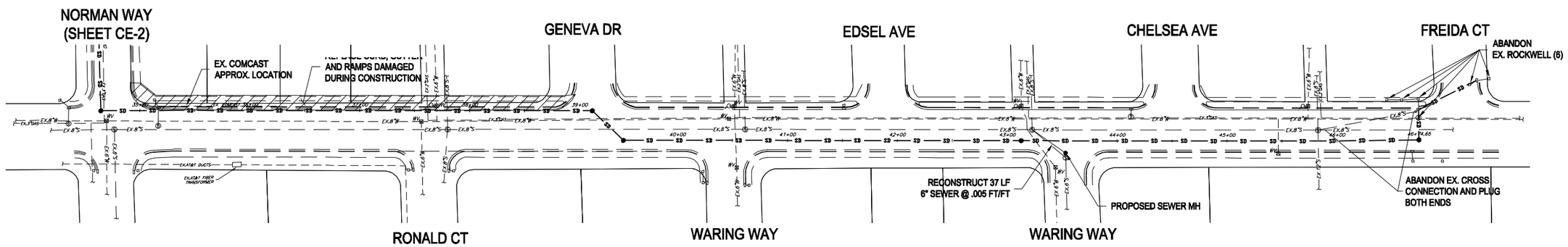
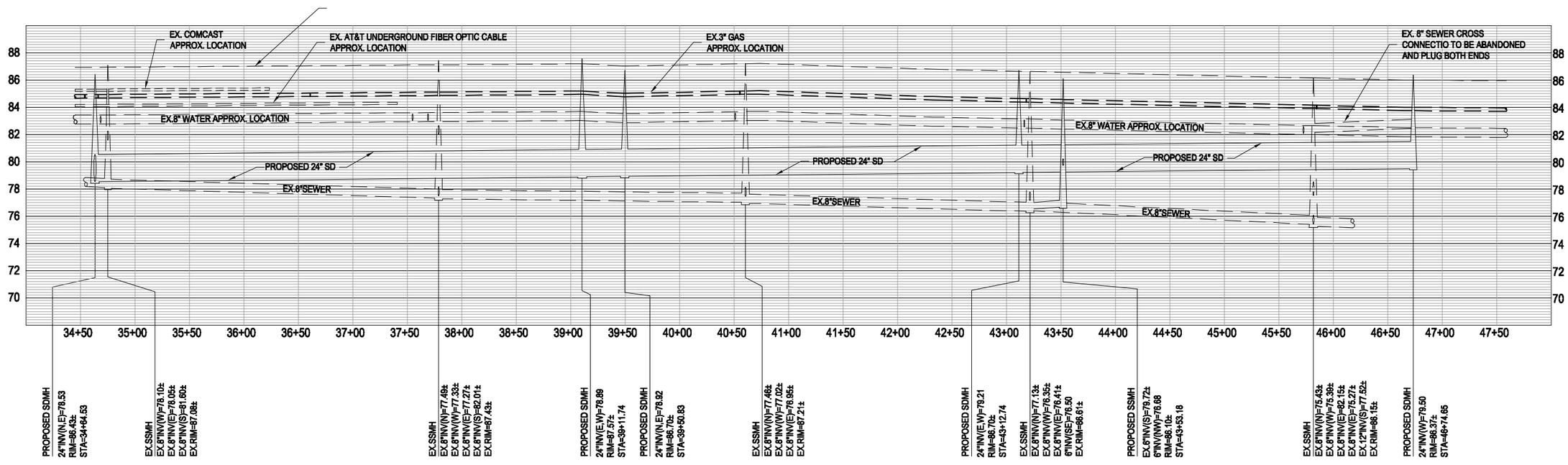


SCALE: 1" = 100'

RONALD AVE STA 34+64.53 - 46+74.65

NOTE: PROPERTY AND ROW LINES BASED ON CITY GIS LINEWORK, NOT SURVEYED.

**NOT FOR CONSTRUCTION**

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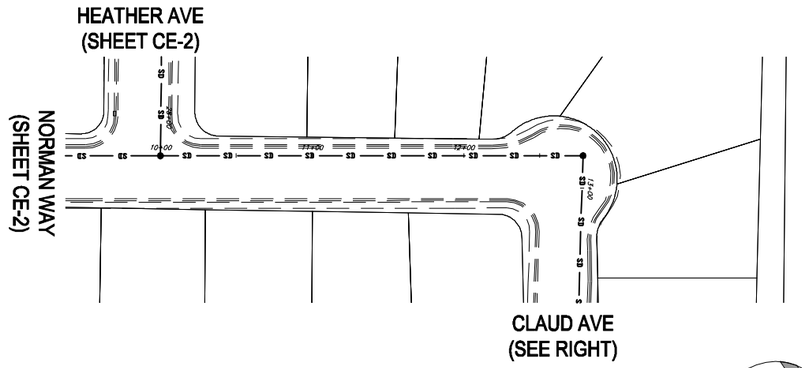
# AREA 2 STORM DRAIN
# CROSS CONNECTION REMOVAL
# CATHERINE EVERETT - CONVEYANCE SYSTEM

| | |
|---|---|
| Sheet No. | CE-3 |
| By | RC |
| Checked | WFS |
| Date | JANUARY 26, 2010 |
| Job No. | 2108543 |
| Scale | 1" = 100' |

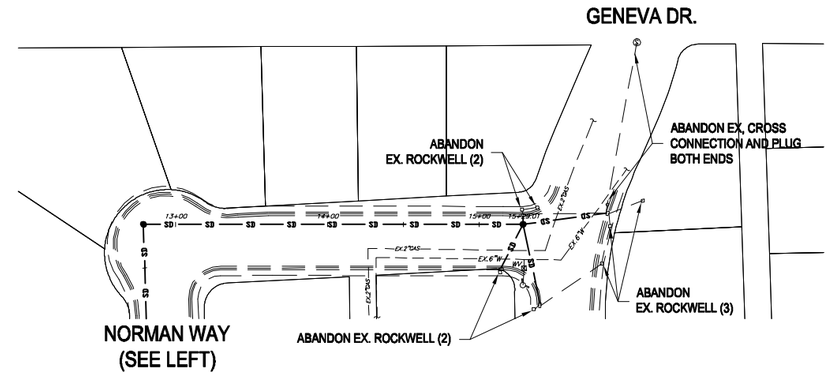
N:\2008\2108543-Modesto2Storm\Engineering\DwgDev\Sheet-Files\2108543-Modesto-Area-1-PP-5.dwg, PP-5, Feb 03, 2010 11:18am, rcamacho




NORMAN WAY STA 10+00.00 - 12+78.72

north

SCALE: 1" = 100'



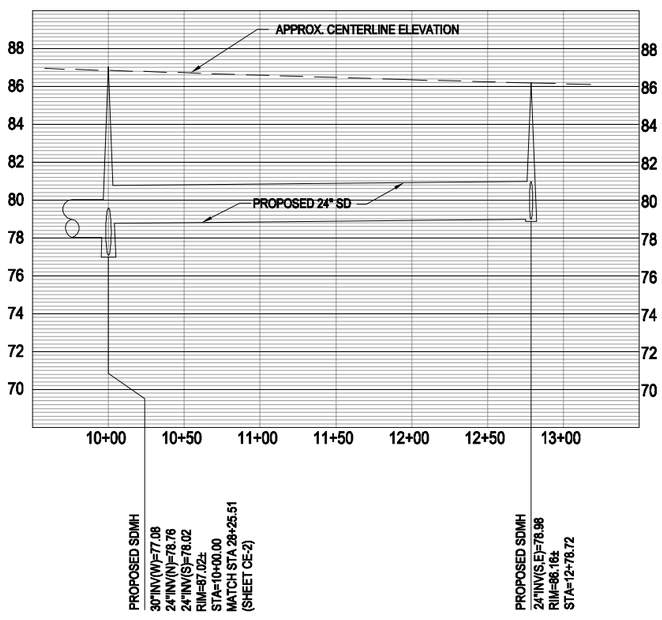

CLAUD STA 12+78.72 - 15+29.01

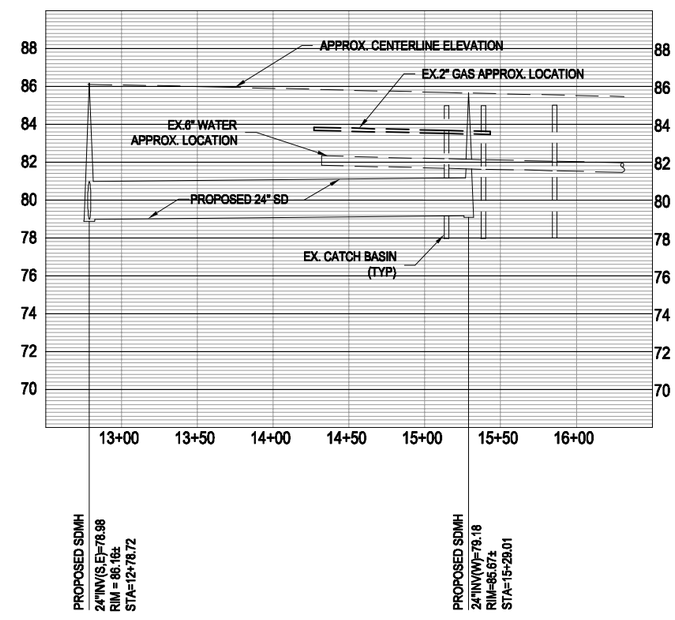
north

SCALE: 1" = 100'

NOTE: PROPERTY AND ROW LINES BASED ON CITY GIS LINEWORK, NOT SURVEYED.

**NOT FOR CONSTRUCTION**

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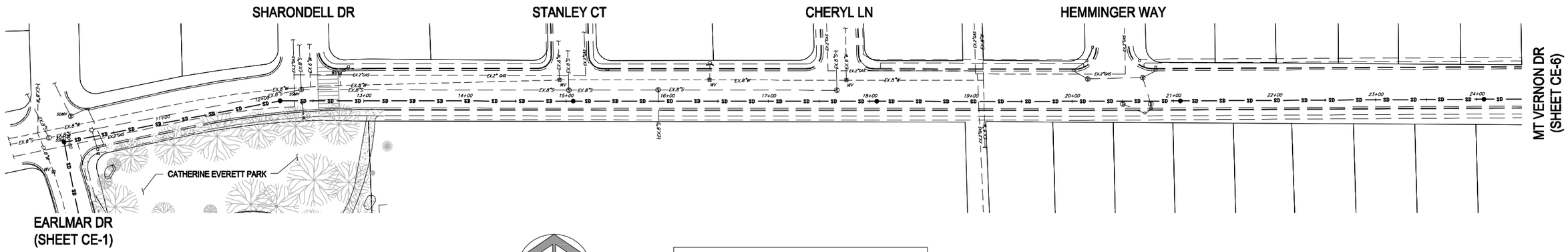
CITY of MODESTO

# AREA 2 STORM DRAIN
# CROSS CONNECTION REMOVAL
# CATHERINE EVERETT - CONVEYANCE SYSTEM

Sheet No. CE-4
By RC
Checked WFS
Date JANUARY 26, 2010
Job No. 2108543
Scale 1" = 100'

N:\2008\2108543-Modesto2Storm\Engineering\DesDev\Sheet-Files\2108543-Modesto-Area-II-PP-6.dwg, PP-5, Feb 05, 2010 8:02am, RCamacho



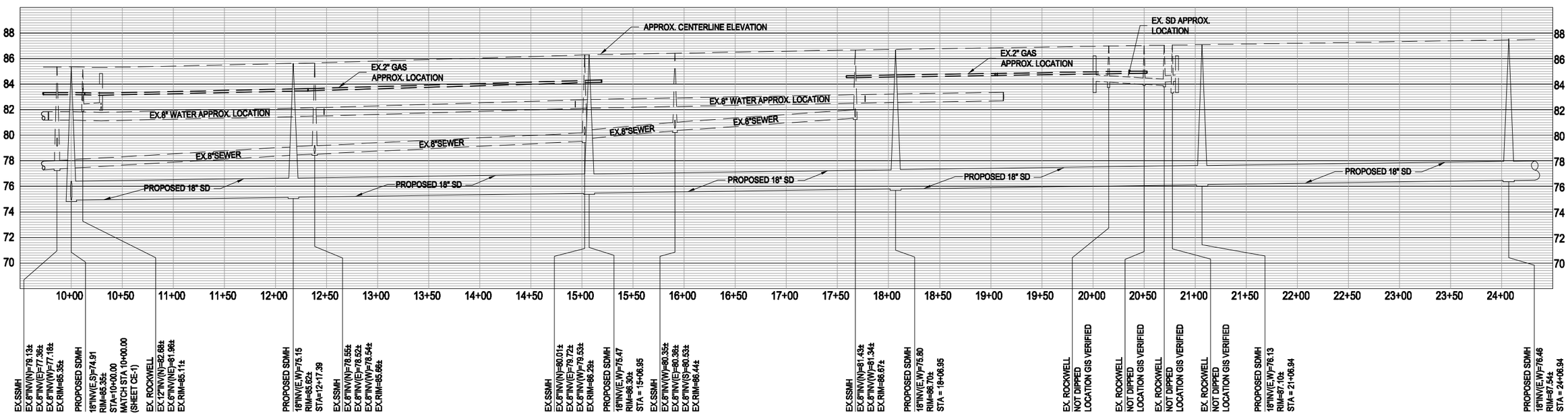

north

SCALE: 1" = 100'

MT VERNON DR STA 10+00.00 - 24+32.83

NOTE: PROPERTY AND ROW LINES BASED ON CITY GIS LINEWORK, NOT SURVEYED.

**NOT FOR CONSTRUCTION**

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CITY of MODESTO

# AREA 2 STORM DRAIN
# CROSS CONNECTION REMOVAL
# CATHERINE EVERETT - CONVEYANCE SYSTEM

| | |
|---|---|
| Sheet No. | CE-5 |
| By | RC |
| Checked | WFS |
| Date | JANUARY 26, 2010 |
| Job No. | 2108543 |
| Scale | 1" = 100' |

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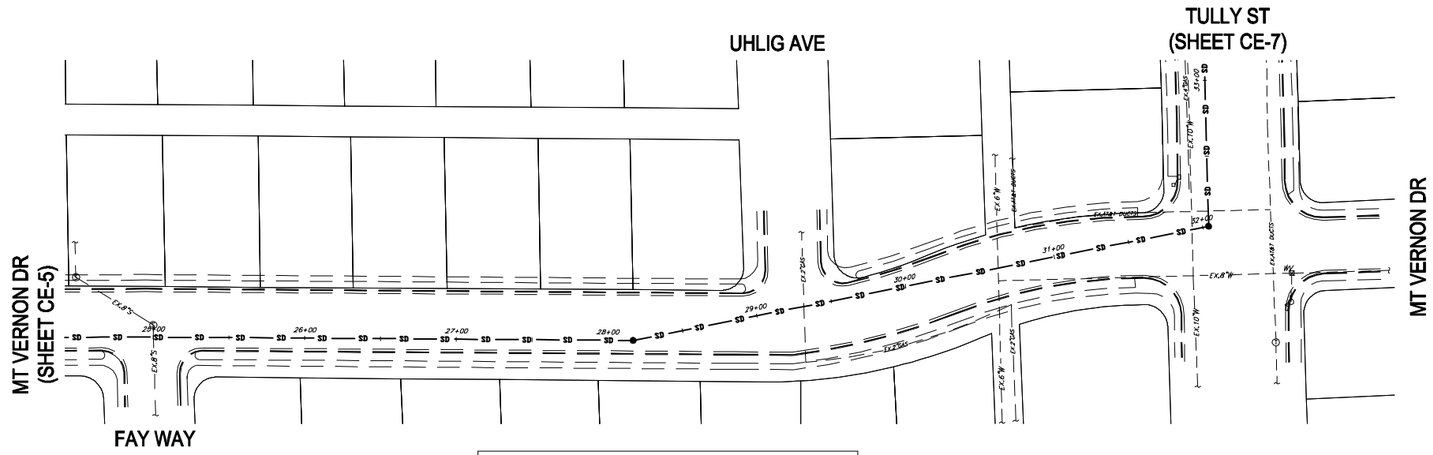


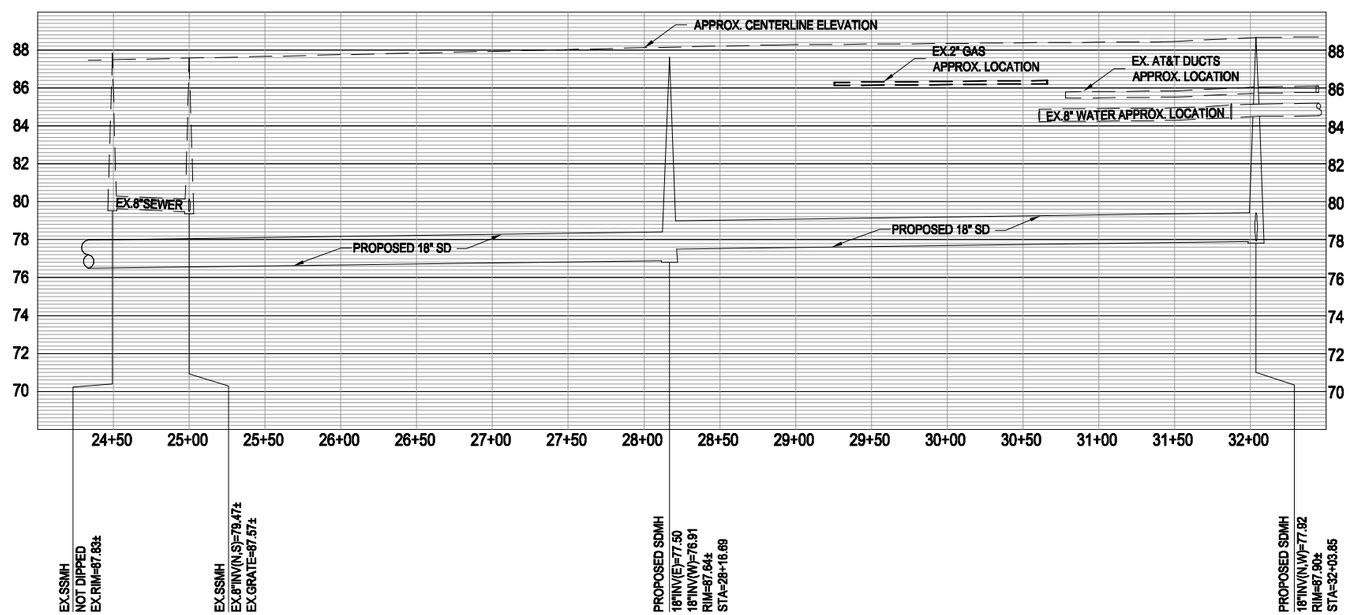

MT VERNON DR STA 24+32.83 - 32+03.85

north

SCALE: 1" = 100'

**NOT FOR CONSTRUCTION**

NOTE: PROPERTY AND ROW LINES BASED ON CITY GIS LINEWORK, NOT SURVEYED.

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CITY of MODESTO

# AREA 2 STORM DRAIN
# CROSS CONNECTION REMOVAL
# CATHERINE EVERETT - CONVEYANCE SYSTEM

Sheet No. CE-6
By RC
Checked WFS
Date JANUARY 26, 2010
Job No. 2108543
Scale 1" = 100'

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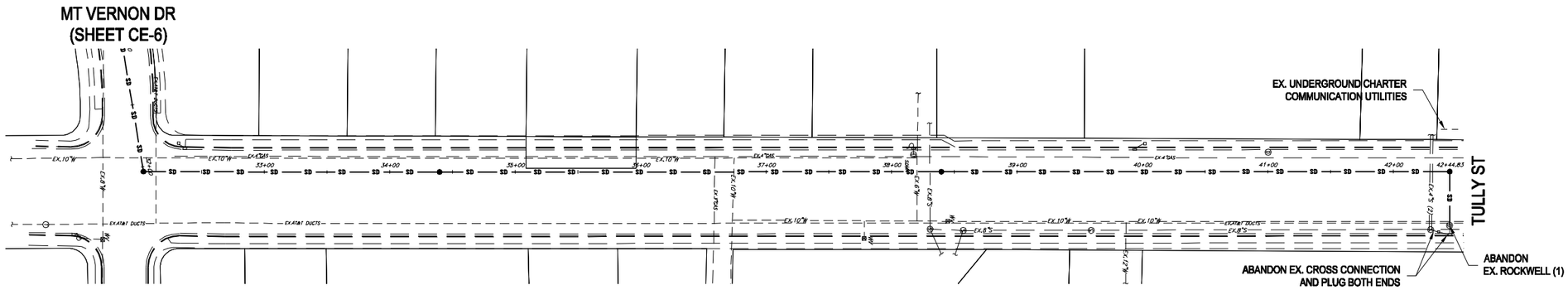


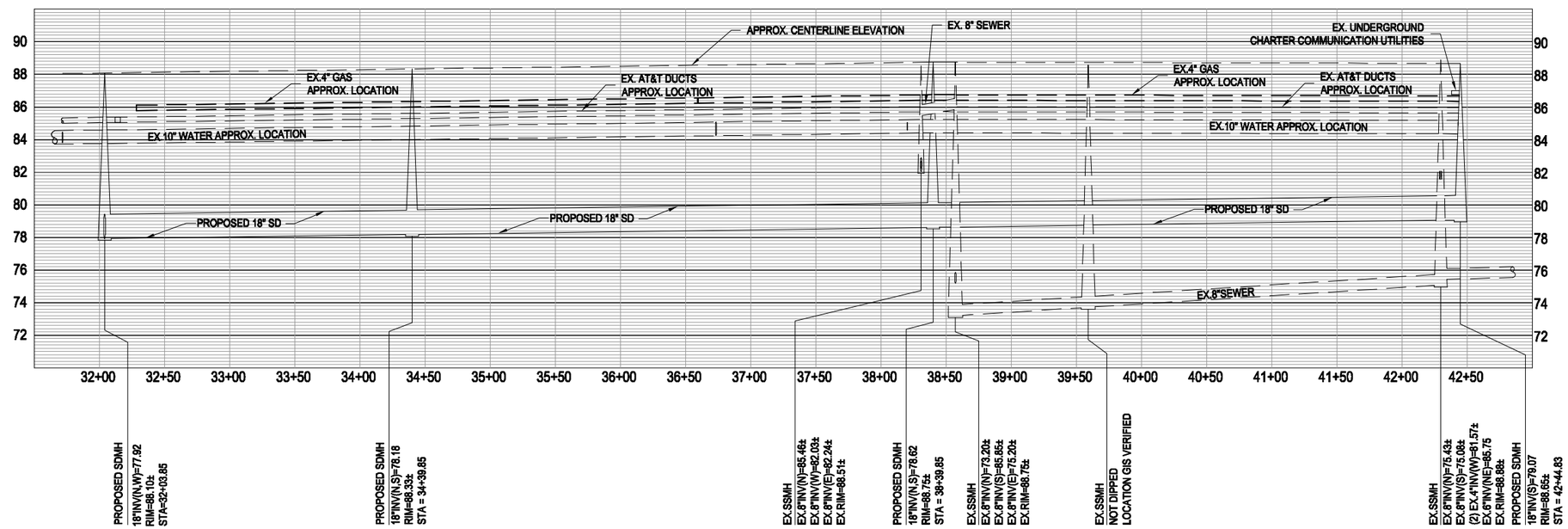

TULLY ST STA 32+03.85 - 42+44.83

NOTE: PROPERTY AND ROW LINES BASED ON CITY GIS LINEWORK, NOT SURVEYED.

north

SCALE: 1" = 100'

**NOT FOR CONSTRUCTION**





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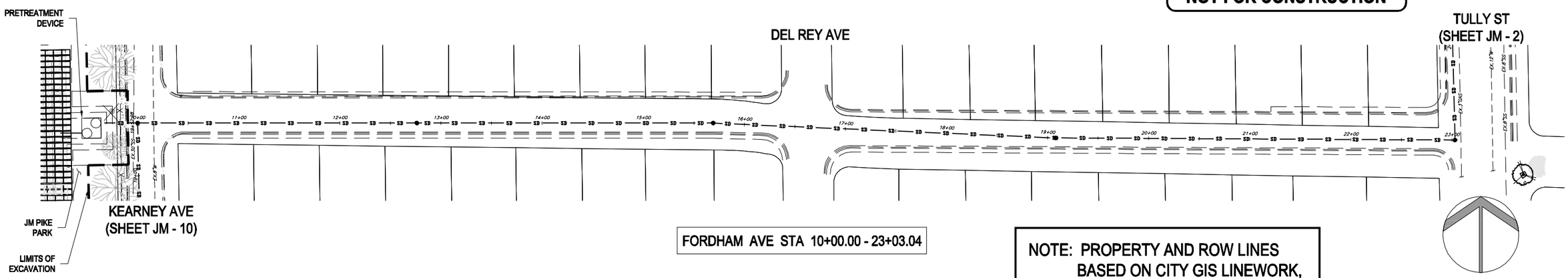
CITY of MODESTO

# AREA 2 STORM DRAIN
# CROSS CONNECTION REMOVAL
# CATHERINE EVERETT - CONVEYANCE SYSTEM

| | |
|---|---|
| Sheet No. | CE-7 |
| By | RC |
| Checked | WFS |
| Date | JANUARY 26, 2010 |
| Job No. | 2108543 |
| Scale | 1" = 100' |

N:\2008\2108543-Modesto25tom\Engineering\DesDev\Sheet-Files\2108543-Modesto-Area-II-PP-9.dwg, PP-9, Jan 25, 2010 11:24am, RCamacho

**NOT FOR CONSTRUCTION**

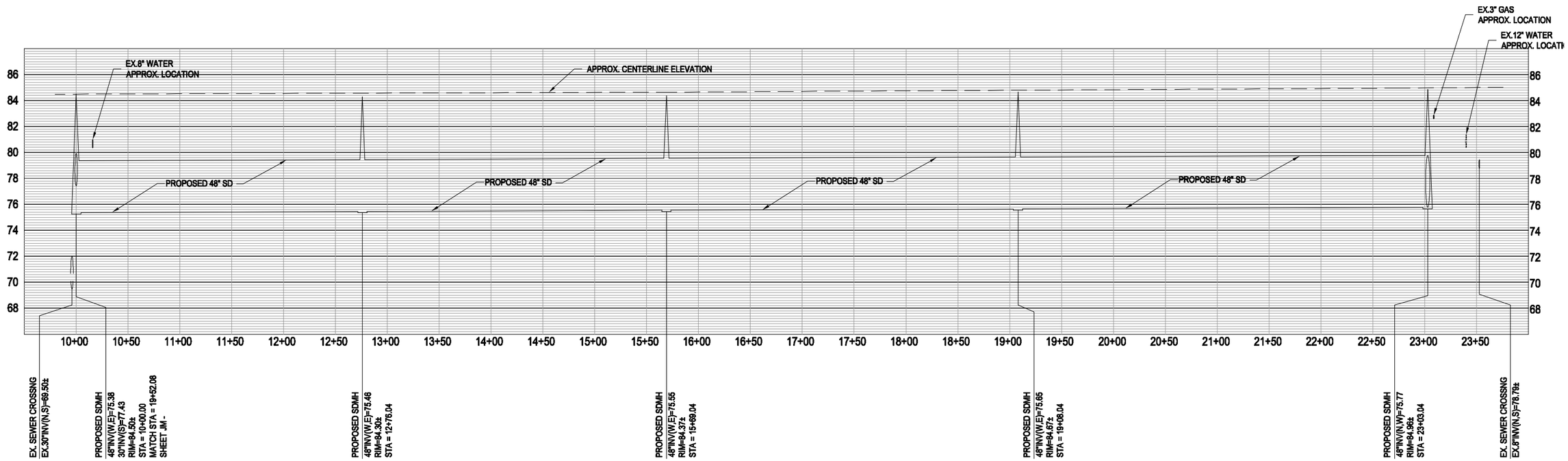



FORDHAM AVE STA 10+00.00 - 23+03.04

NOTE: PROPERTY AND ROW LINES BASED ON CITY GIS LINEWORK, NOT SURVEYED.

north

SCALE: 1" = 100'





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CITY of MODESTO

# AREA 2 STORM DRAIN
# CROSS CONNECTION REMOVAL
# JM PIKE - CONVEYANCE SYSTEM

| | |
|---|---|
| Sheet No. | JM-1 |
| By | RC |
| Checked | WFS |
| Date | JANUARY 26, 2010 |
| Job No. | 2108543 |
| Scale | 1" = 100' |


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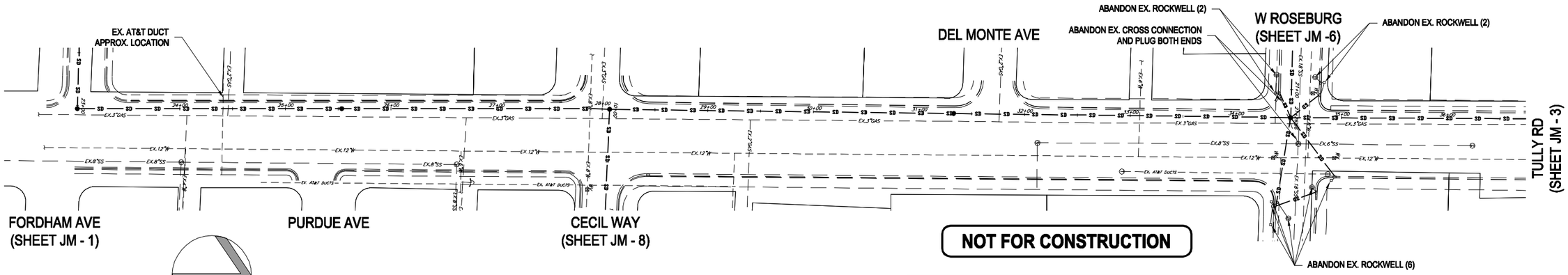


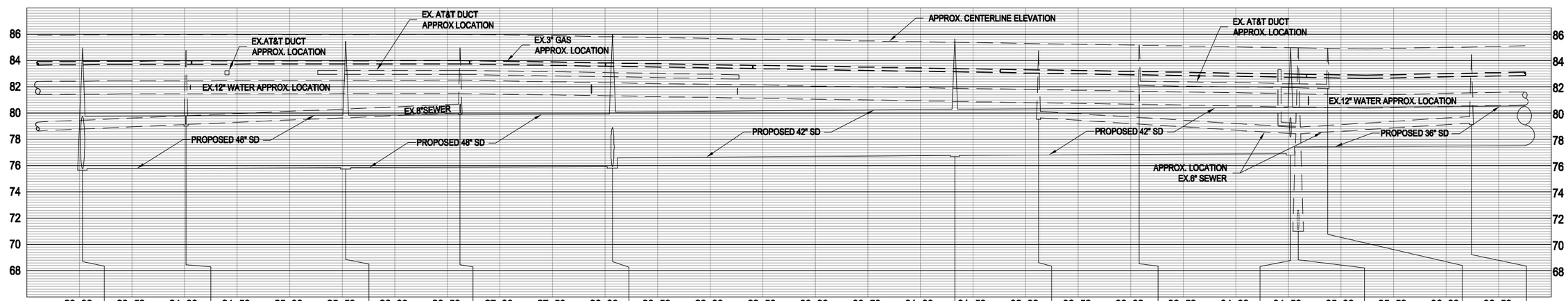

**NOT FOR CONSTRUCTION**

north

SCALE: 1" = 100'

TULLY RD STA 23+03.04 - 36+75.00

NOTE: PROPERTY AND ROW LINES BASED ON CITY GIS LINEWORK, NOT SURVEYED.

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CITY of MODESTO

# AREA 2 STORM DRAIN
# CROSS CONNECTION REMOVAL
# JM PIKE - CONVEYANCE SYSTEM

| | |
|---|---|
| Sheet No. | JM-2 |
| By | RC |
| Checked | WFS |
| Date | JANUARY 26, 2010 |
| Job No. | 2108543 |
| Scale | 1" = 100' |

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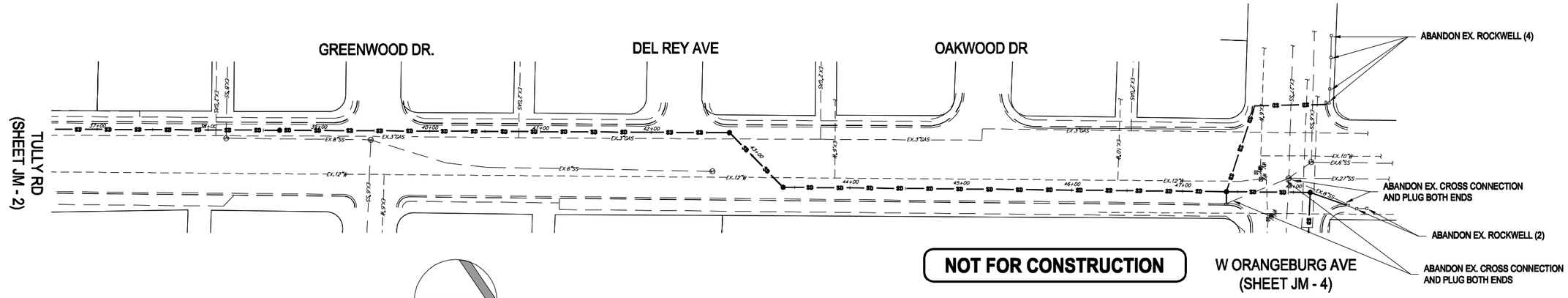


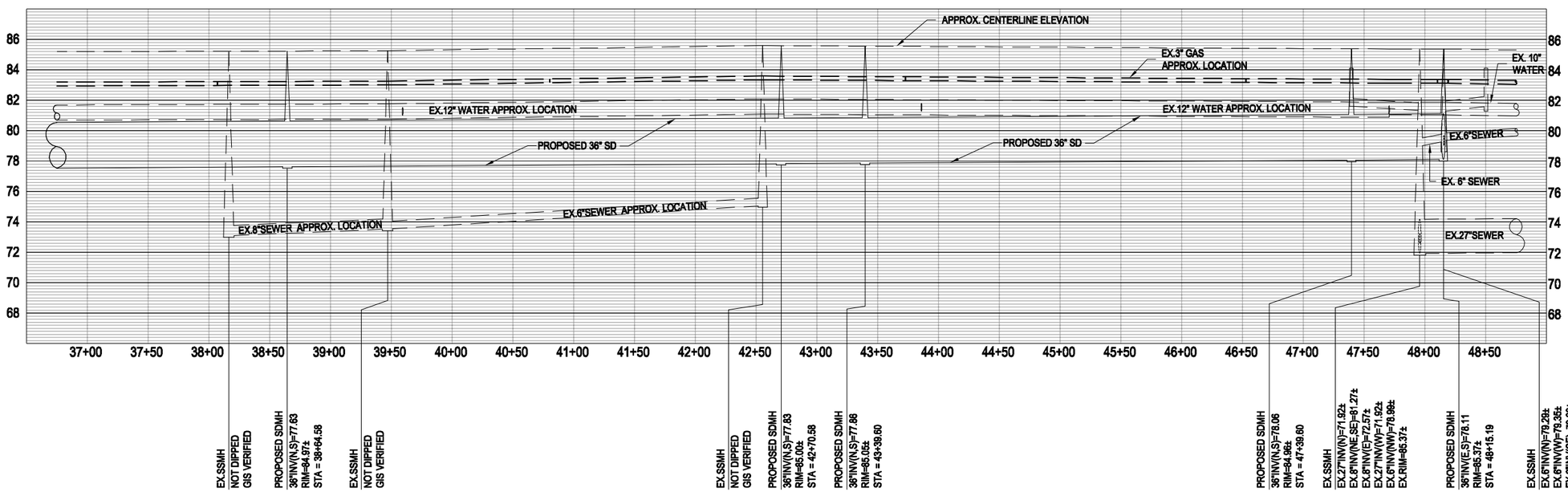

**NOT FOR CONSTRUCTION**

north

SCALE: 1" = 100'

TULLY RD STA 36+75.00 - 48+15.19

NOTE: PROPERTY AND ROW LINES BASED ON CITY GIS LINEWORK, NOT SURVEYED.

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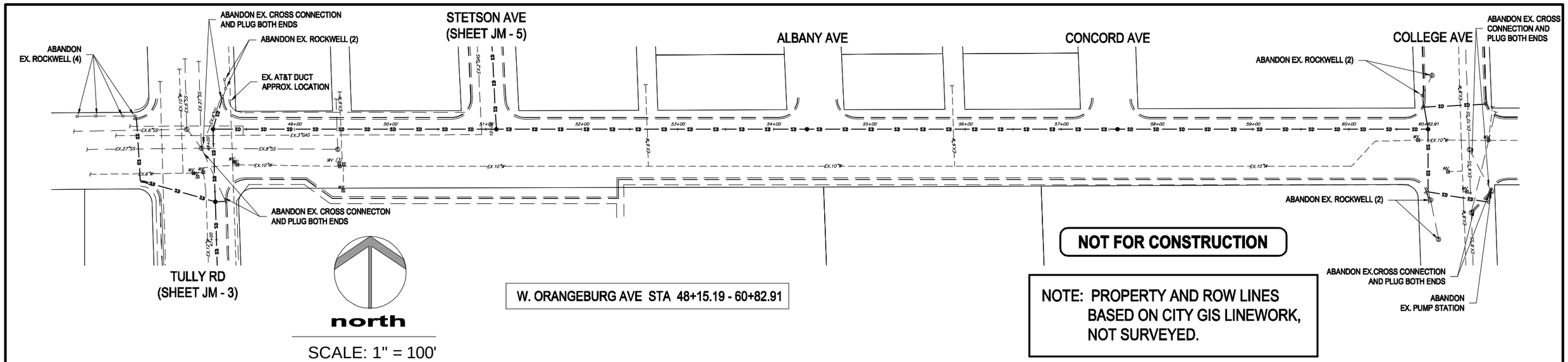
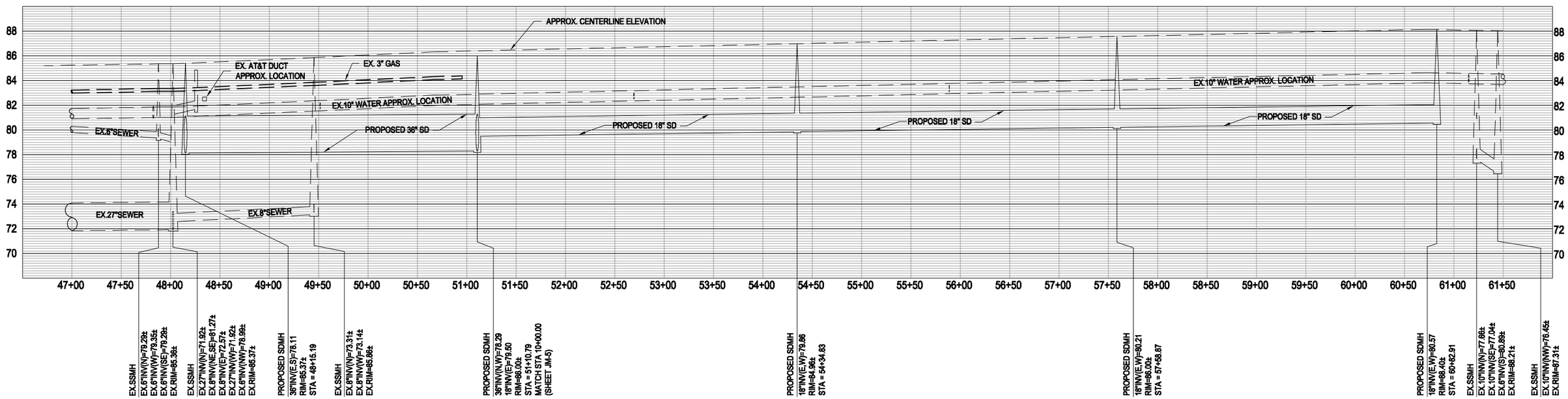
CITY of MODESTO

# AREA 2 STORM DRAIN
# CROSS CONNECTION REMOVAL
# JM PIKE - CONVEYANCE SYSTEM

Sheet No. JM-3
By RC
Checked WFS
Date JANUARY 26, 2010
Job No. 2108543
Scale 1" = 100'

N:\2008\2108543-Modesto25Storm\Engineering\DesDev\Sheet-Files\2108543-Modesto-Area-II-PP-14.dwg, PP-14, Jan 25, 2010 12:12pm, RCamacho

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# AREA 2 STORM DRAIN CROSS CONNECTION REMOVAL JM PIKE - CONVEYANCE SYSTEM

Sheet No. JM-4
By RC
Checked WFS
Date JANUARY 26, 2010
Job No. 2108543
Scale 1" = 100'

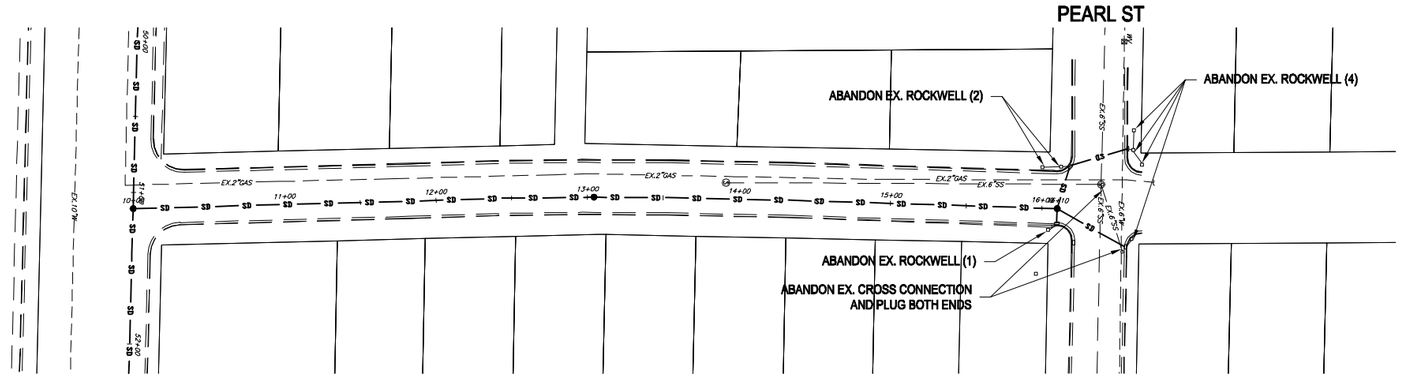
N:\2008\2108543-Modesto2Storm\Engineering\DesDev\Sheet-Files\2108543-Modesto-Area-II-PP-15.dwg, PP-15, Jan 26, 2010 12:37pm, RCamacho

north

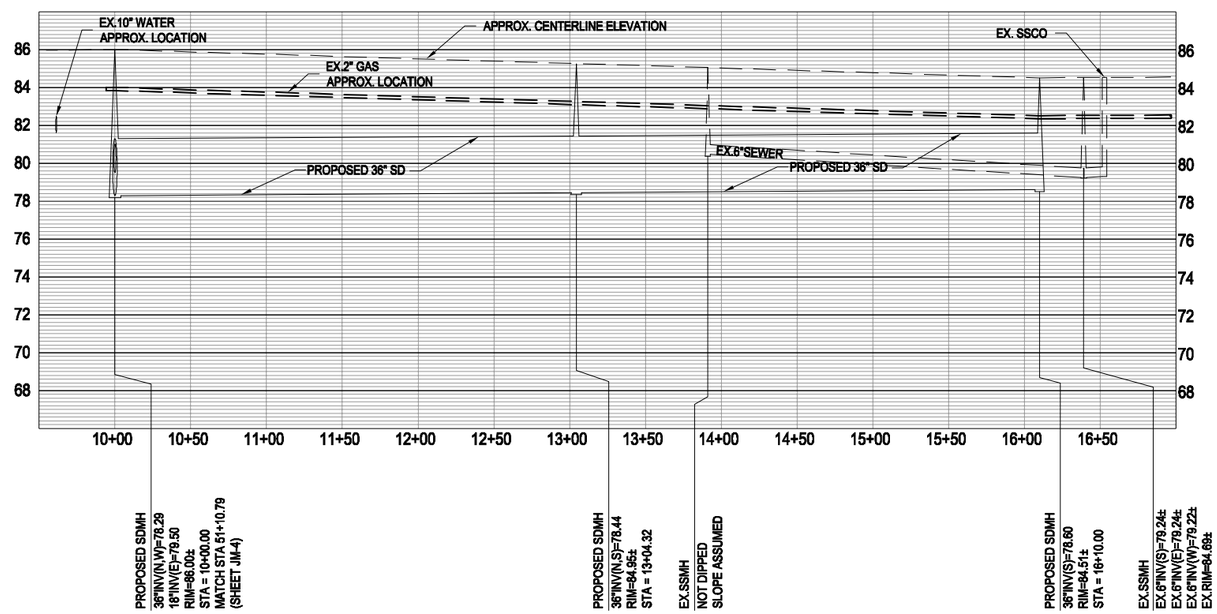
SCALE: 1" = 100'

**NOT FOR CONSTRUCTION**

NOTE: PROPERTY AND ROW LINES BASED ON CITY GIS LINEWORK, NOT SURVEYED.




STETSON AVE STA 10+00.00 - 16+10.00





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# AREA 2 STORM DRAIN
# CROSS CONNECTION REMOVAL
# JM PIKE - CONVEYANCE SYSTEM

Sheet No. JM-5

By RC

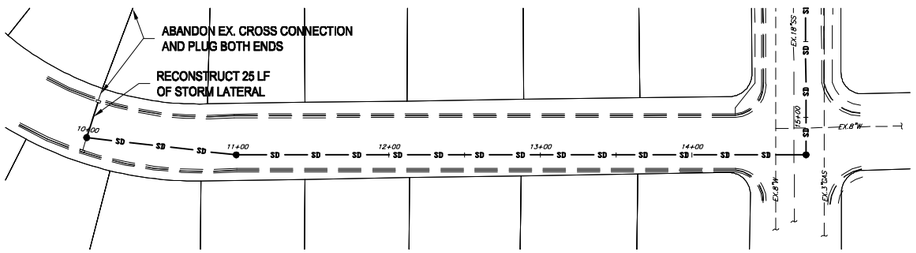
Checked WFS

Date JANUARY 26, 2010

Job No. 2108543

Scale 1" = 100'


N:\2008\2108543-Modesto\2Storm\Engineering\DesDev\Sheet-Files\2108543-Modesto-Area-II-PP-16.dwg, PP-16, Jan 25, 2010 12:41pm, RCamacho

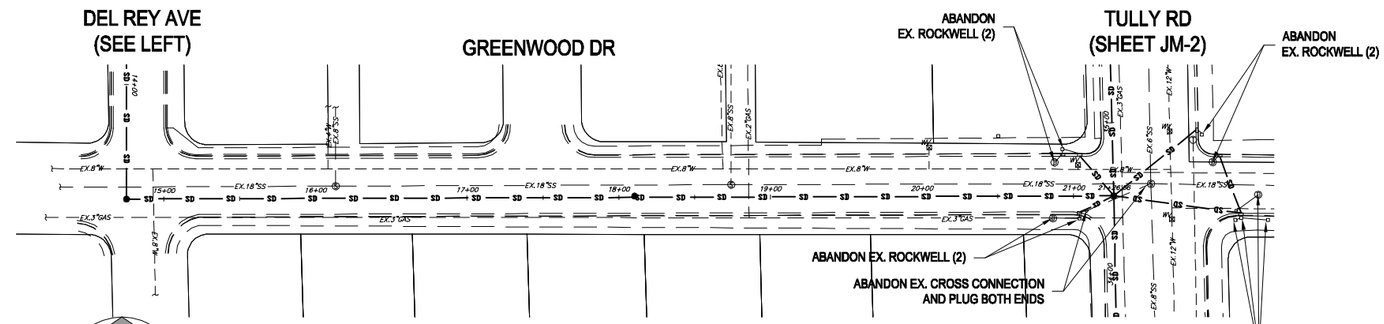



DEL REY AVE 10+00.00 - 14+75.32

north

SCALE: 1" = 100'

NOTE: PROPERTY AND ROW LINES BASED ON CITY GIS LINEWORK, NOT SURVEYED.

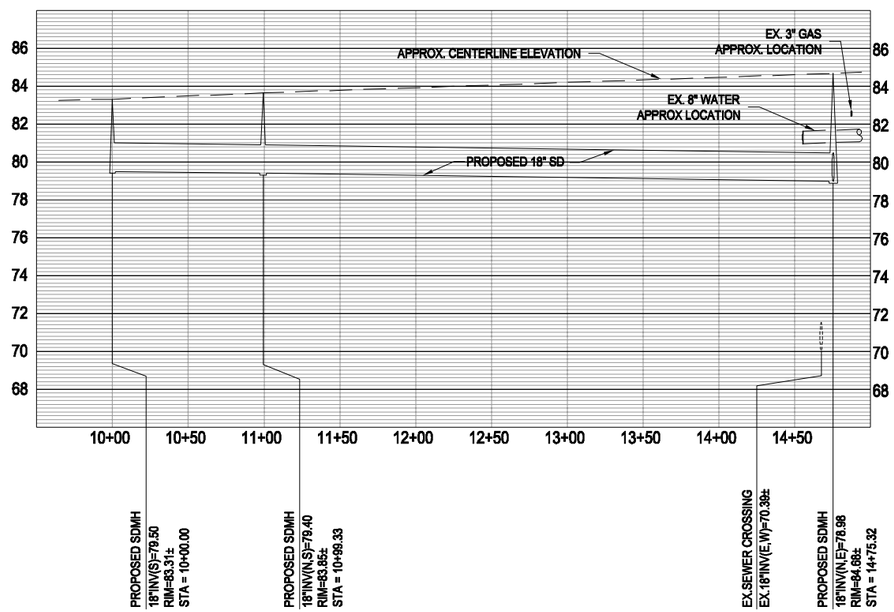


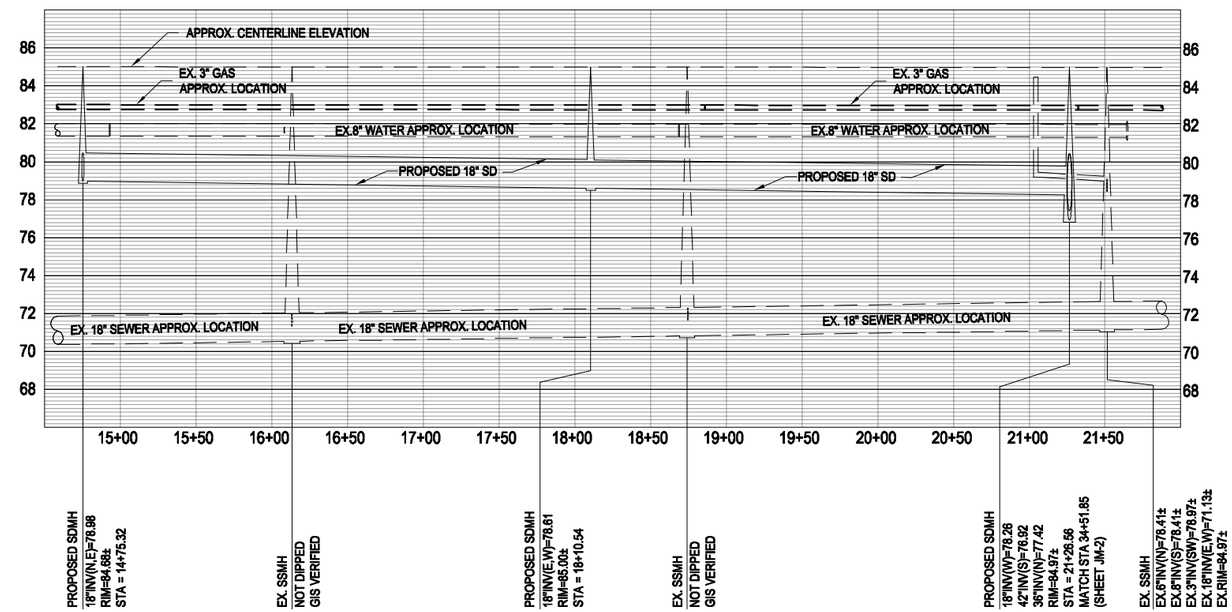

W ROSEBURG 14+75.32 - 21+26.56

north

SCALE: 1" = 100'

**NOT FOR CONSTRUCTION**

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CITY of MODESTO

# AREA 2 STORM DRAIN CROSS CONNECTION REMOVAL JM PIKE - CONVEYANCE SYSTEM

| | |
|---|---|
| Sheet No. | JM-6 |
| By | RC |
| Checked | WFS |
| Date | JANUARY 26, 2010 |
| Job No. | 2108543 |
| Scale | 1" = 100' |

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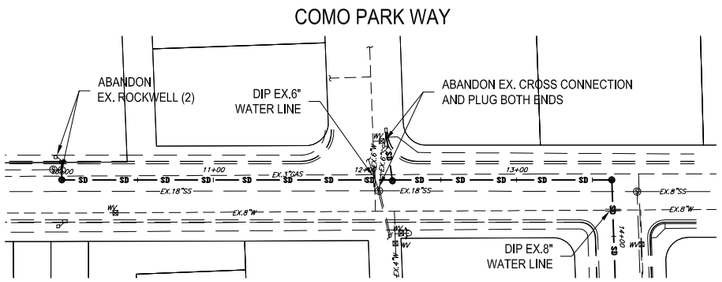
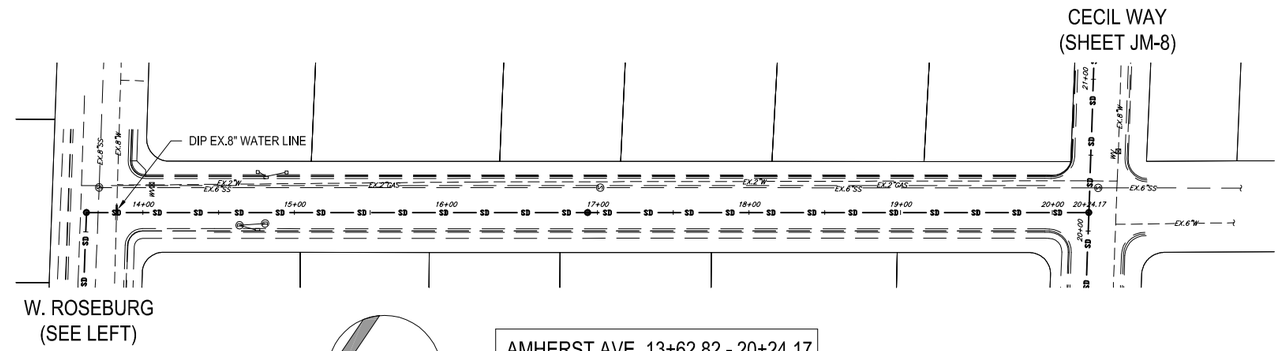



W. ROSEBURG 10+00.00 - 13+62.82

north

SCALE: 1" = 100'

NOTE: PROPERTY AND ROW LINES BASED ON CITY GIS LINEWORK, NOT SURVEYED.

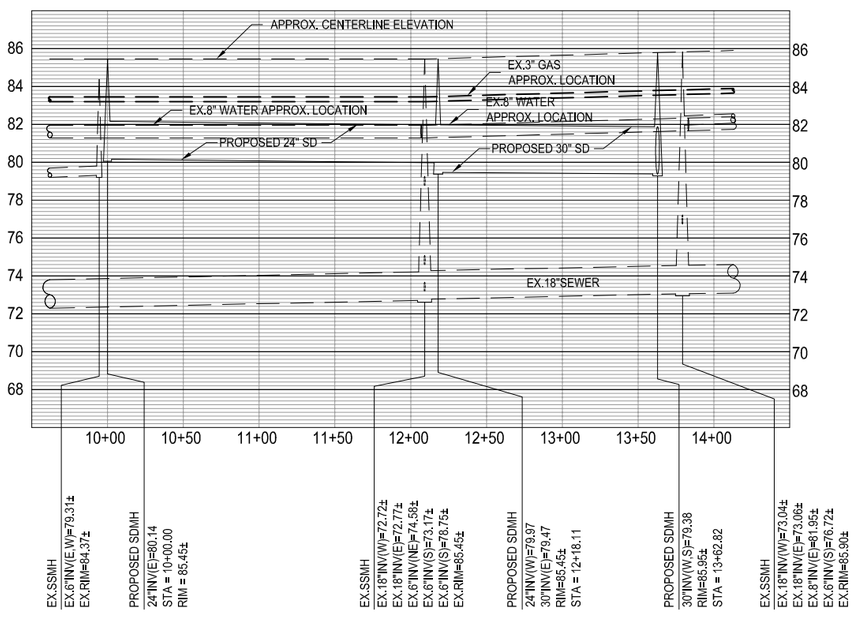


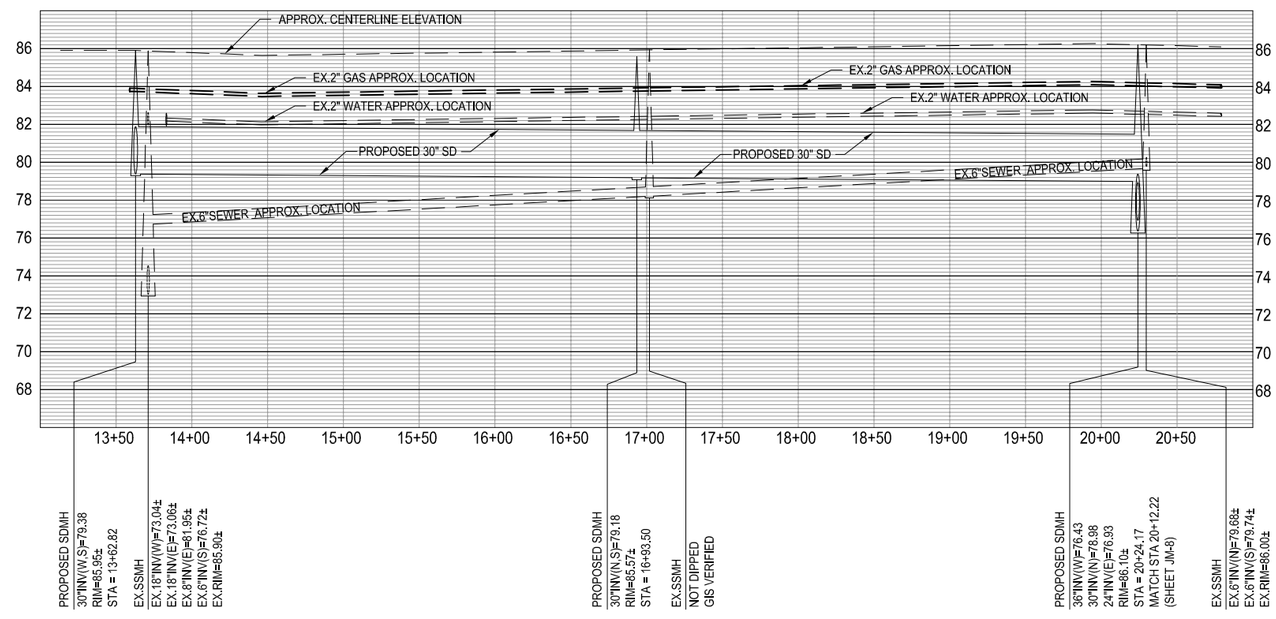

AMHERST AVE 13+62.82 - 20+24.17

north

SCALE: 1" = 100'

**NOT FOR CONSTRUCTION**

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# AREA 2 STORM DRAIN
# CROSS CONNECTION REMOVAL
# JM PIKE - CONVEYANCE SYSTEM

Sheet No. JM-7
By RC
Checked WFS
Date JANUARY 26, 2010
Job No. 2108543
Scale 1" = 100'

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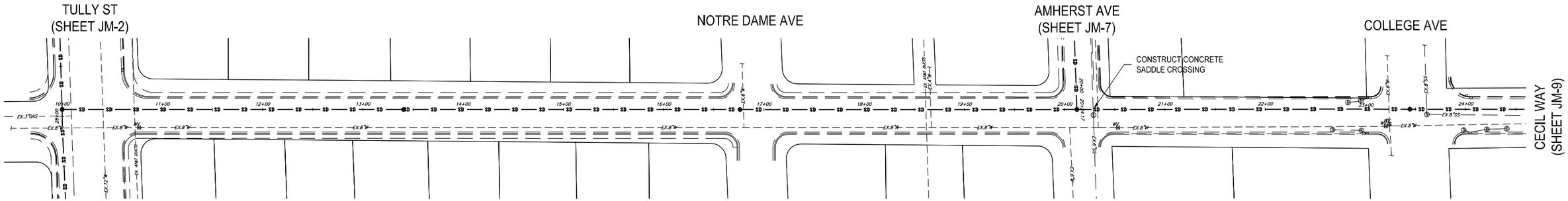


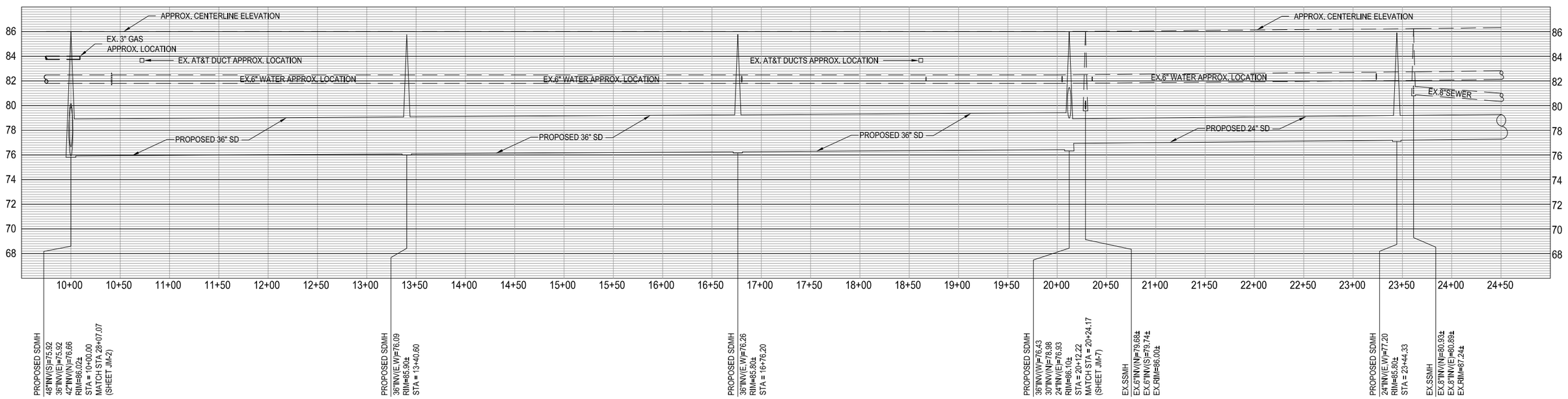

CECIL WAY 10+00.00 - 24+50.00

north

SCALE: 1" = 100'

NOTE: PROPERTY AND ROW LINES BASED ON CITY GIS LINEWORK, NOT SURVEYED.

**NOT FOR CONSTRUCTION**

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# AREA 2 STORM DRAIN
# CROSS CONNECTION REMOVAL
# JM PIKE - CONVEYANCE SYSTEM

| | |
|---|---|
| Sheet No. | JM-8 |
| By | RC |
| Checked | WFS |
| Date | JANUARY 26, 2010 |
| Job No. | 2108543 |
| Scale | 1" = 100' |

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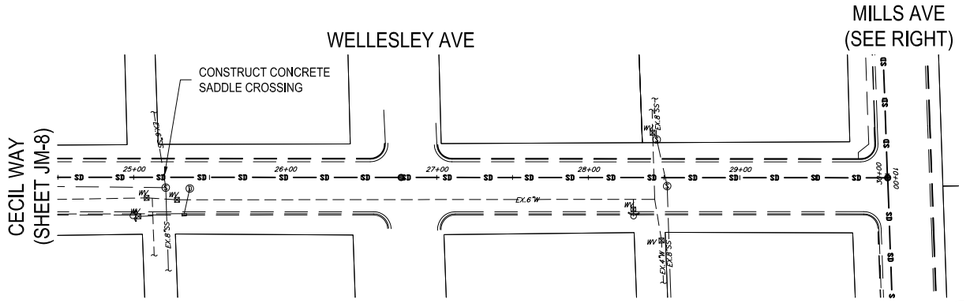
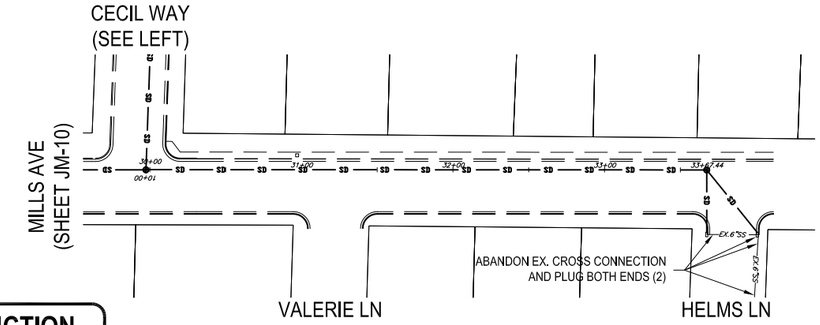



CECIL WAY 24+50.00 - 29+97.39




MILLS AVE 29+97.39 - 33+67.44

**NOT FOR CONSTRUCTION**

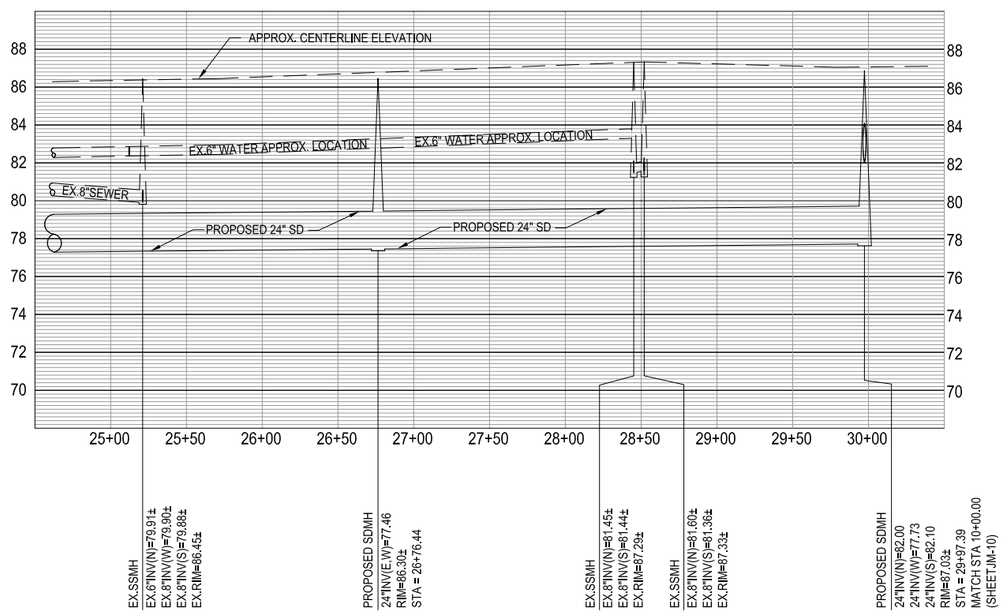
NOTE: PROPERTY AND ROW LINES BASED ON CITY GIS LINEWORK, NOT SURVEYED.

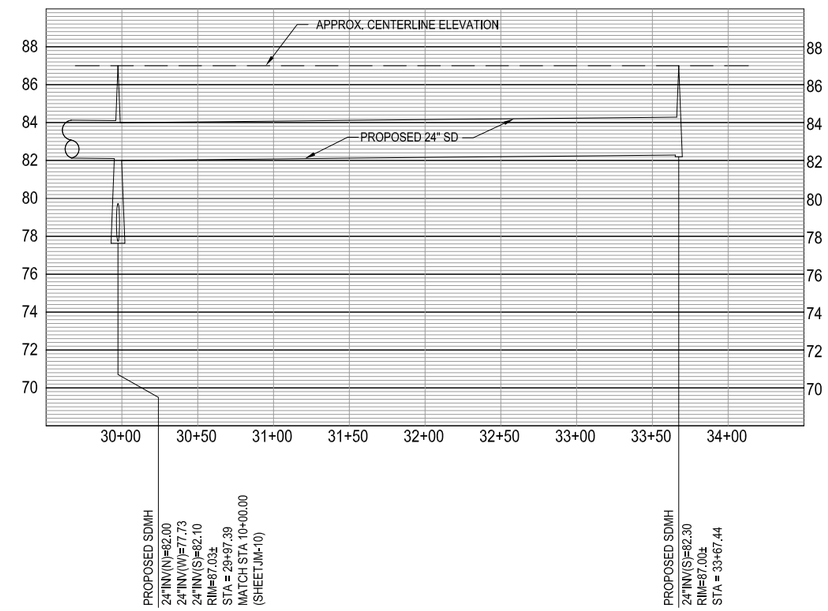
north

SCALE: 1" = 100'

north

SCALE: 1" = 100'

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# AREA 2 STORM DRAIN CROSS CONNECTION REMOVAL JM PIKE - CONVEYANCE SYSTEM

Sheet No. JM-9
By RC
Checked WFS
Date JANUARY 26, 2010
Job No. 2108543
Scale 1" = 100'

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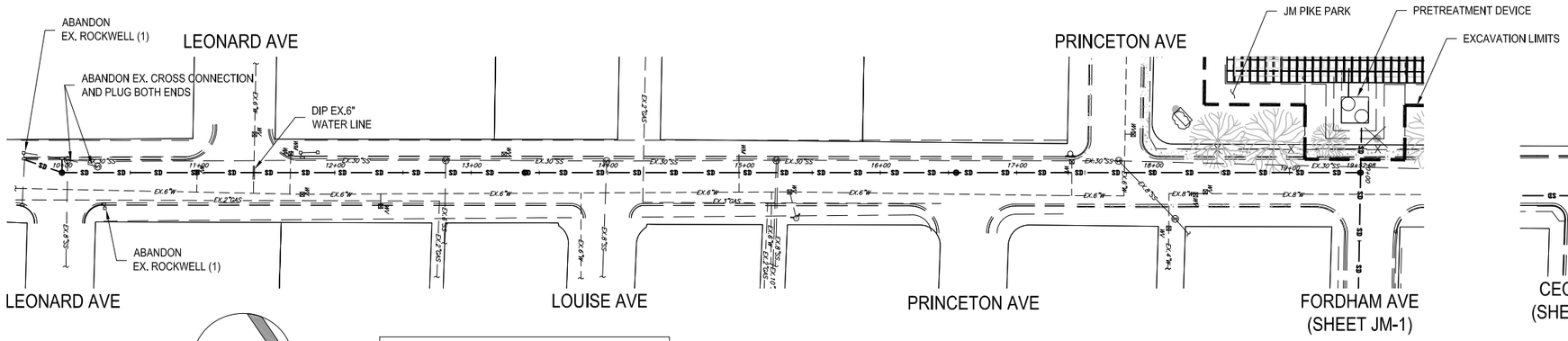
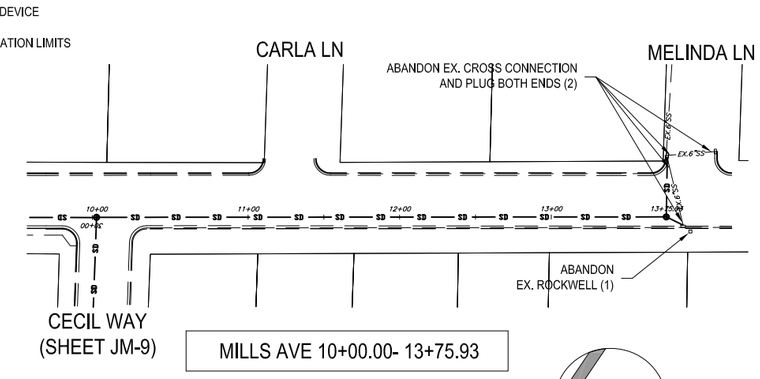



KEARNEY AVE 10+00.00 - 19+52.08

north

SCALE: 1" = 100'

NOTE: PROPERTY AND ROW LINES BASED ON CITY GIS LINEWORK, NOT SURVEYED.

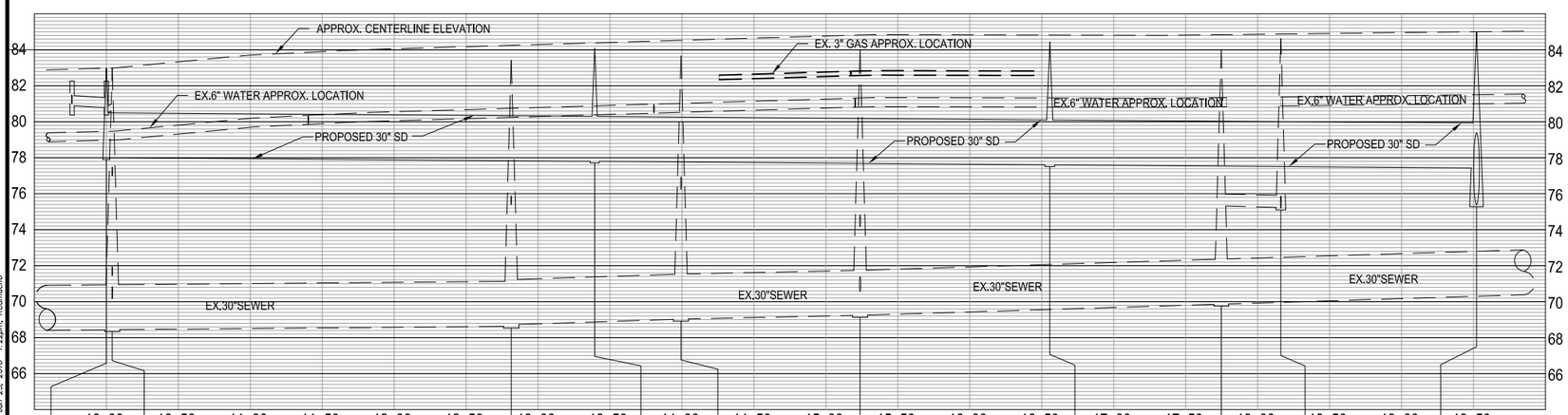


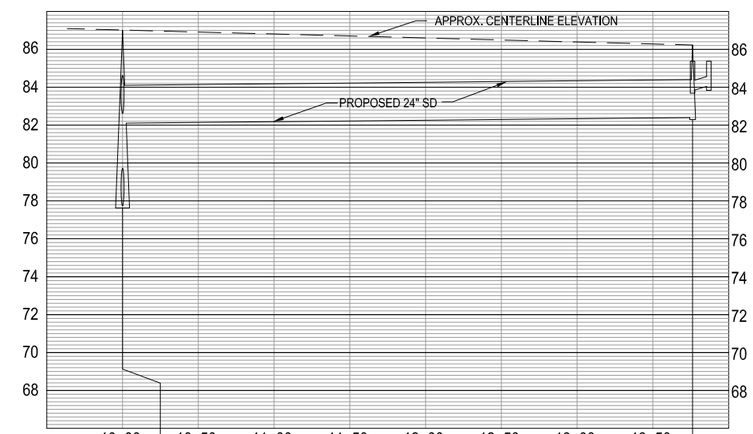

MILLS AVE 10+00.00- 13+75.93

north

SCALE: 1" = 100'

**NOT FOR CONSTRUCTION**

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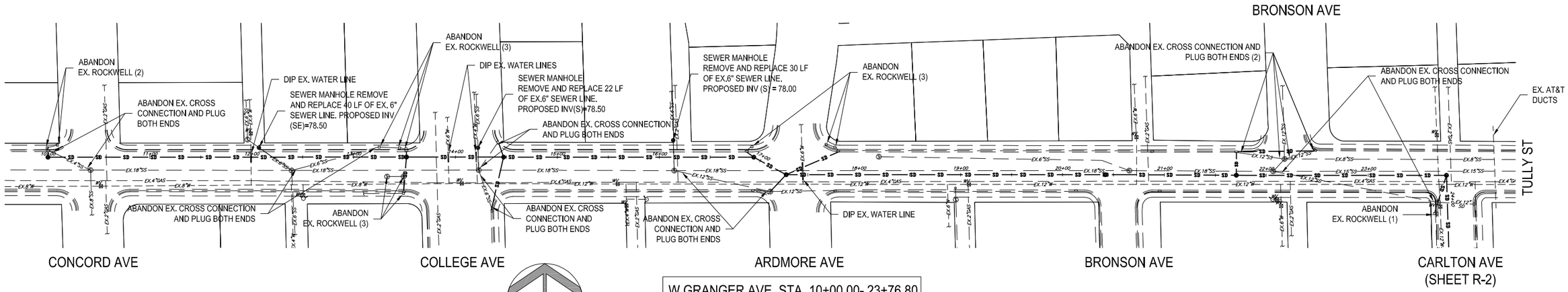
CITY of MODESTO

# AREA 2 STORM DRAIN
# CROSS CONNECTION REMOVAL
# JM PIKE - CONVEYANCE SYSTEM

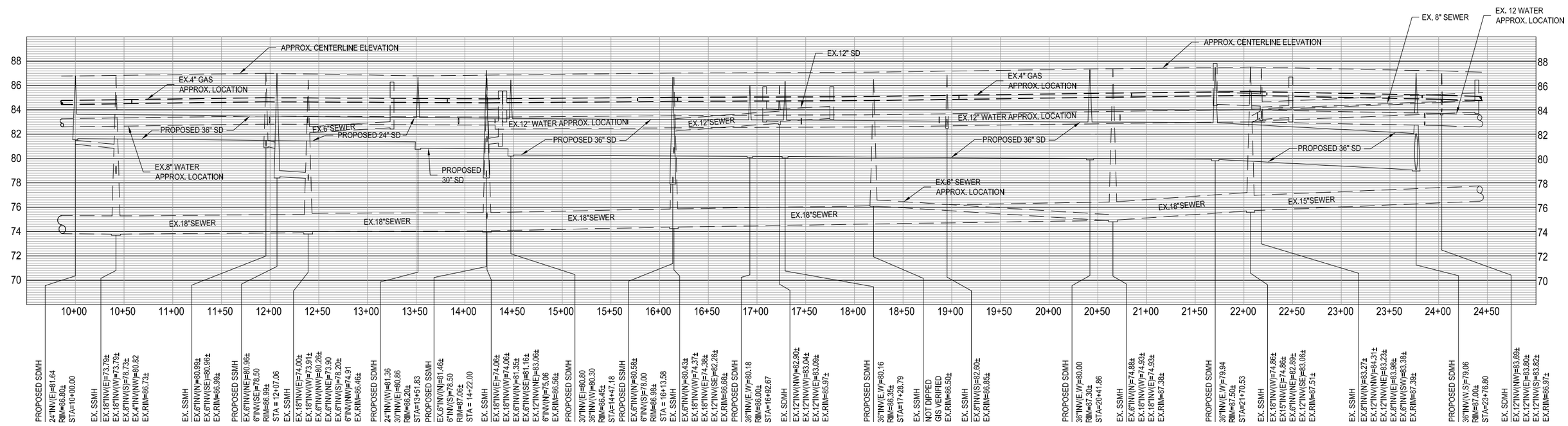
| | |
|---|---|
| Sheet No. | JM-10 |
| By | RC |
| Checked | WFS |
| Date | JANUARY 26, 2010 |
| Job No. | 2108543 |
| Scale | 1" = 100' |




SCALE: 1" = 100'

NOTE: PROPERTY AND ROW LINES BASED ON CITY GIS LINEWORK, NOT SURVEYED.

**NOT FOR CONSTRUCTION**

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# AREA 2 STORM DRAIN CROSS CONNECTION REMOVAL ROOSEVELT - CONVEYANCE SYSTEM

| | |
|---|---|
| Sheet No. | R-1 |
| By | RC |
| Checked | WFS |
| Date | JANUARY 26, 2010 |
| Job No. | 2108543 |
| Scale | 1" = 100' |

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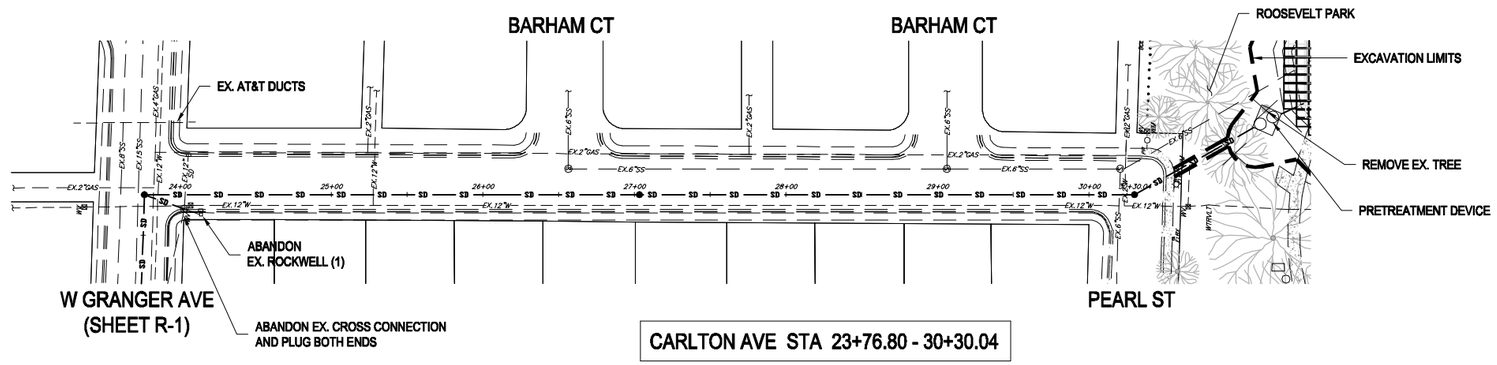
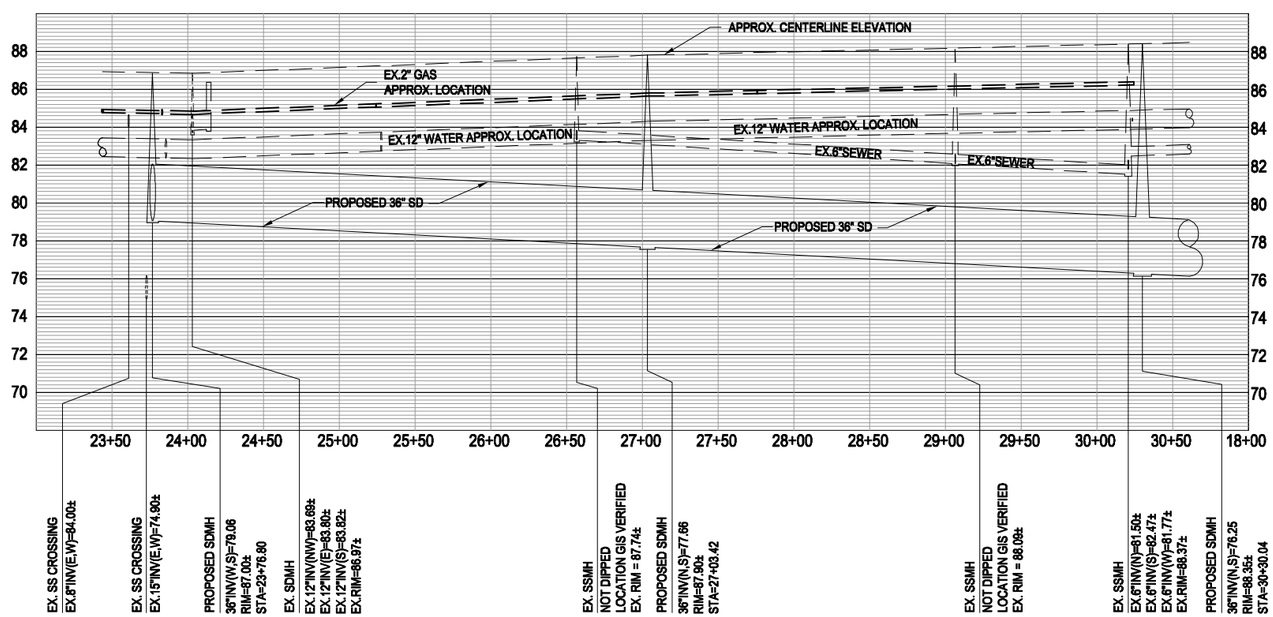



north

SCALE: 1" = 100'

**NOT FOR CONSTRUCTION**

NOTE: PROPERTY AND ROW LINES BASED ON CITY GIS LINEWORK, NOT SURVEYED.

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CITY of MODESTO

# AREA 2 STORM DRAIN
# CROSS CONNECTION REMOVAL
# ROOSEVELT - CONVEYANCE SYSTEM

| | |
|---|---|
| Sheet No. | R-2 |
| By | RC |
| Checked | WFS |
| Date | JANUARY 26, 2010 |
| Job No. | 2108543 |
| Scale | 1" = 100' |

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# APPENDIX B

## PRELIMINARY OPINIONS OF COST

## OPINION OF PROBABLE COST

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**Project:** **Modesto Area 2**

**SUMMARY**

**Project No:** **2108543**

In providing this opinion of probable cost, it is recognized that neither the Client nor RRM Design Group has control over the costs of labor, equipment, or materials, or over the Contractor's methods of determining prices for bidding. This opinion of probable costs is based on RRM Design Group's reasonable professional judgment and experience and does not constitute a warranty, expressed or implied, that the Contractor's bids or negotiated price of Work will not vary from the Client's budget or from any opinion prepared by RRM Design Group.

| DESCRIPTION | CONSTRUCTION SUB TOTAL | TOTAL INCL CONTINGENCIES AND SOFT COSTS |
|---|---|---|
| **Garrison - Retention** | $ 1,874,634 | **$ 2,929,116** |
| **Garrison - Detention** | $ 1,792,403 | **$ 2,800,630** |
| **Catherine Everett - Retention** | $ 2,491,478 | **$ 3,892,934** |
| **Catherine Everett - Detention** | $ 2,428,463 | **$ 3,794,474** |
| **JM Pike - Retention** | $ 8,651,517 | **$ 13,517,996** |
| **JM Pike - Detention** | $ 6,550,458 | **$ 10,235,090** |
| **Roosevelt - Retention** | $ 4,557,831 | **$ 7,121,611** |
| **Roosevelt - Detention** | $ 3,586,677 | **$ 5,604,183** |
| **Total Detention Alternative** | $ 14,358,002 | **$ 22,434,378** |
| **Total Retention Alternative** | $ 17,575,460 | **$ 27,461,657** |
| **Total Stantec Cross Connection Report Alternative** | | **$ 53,420,382** |
| **Recommended Project** | | |
| **$ -** | $ 1,874,634 | **$ -** |
| **$ -** | $ 2,491,478 | **$ -** |
| | $ 6,550,458 | **$ -** |
| | $ 3,586,677 | **$ -** |
| | | **$ 22,661,323** |

## OPINION OF PROBABLE COST

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**Project:** **Modesto Area 2**
**Project No:** **2108543**
**Park:** **Garrison - Retention**

In providing this opinion of probable cost, it is recognized that neither the Client nor RRM Design Group has control over the costs of labor, equipment, or materials, or over the Contractor's methods of determining prices for bidding. This opinion of probable costs is based on RRM Design Group's reasonable professional judgment and experience and does not constitute a warranty, express or implied, that the Contractor's bids or negotiated price of Work will not vary from the Client's budget or from any opinion prepared by RRM Design Group.

**TOTAL: $ 2,929,116**

| | | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | EXTENSION | SECTION TOTAL |
|---|---|---|---|---|---|---|---|
| **0.00** | | **SITE PREPARATION** | | | | | $ 8,542 |
| | 0.01 | PARK DEMOLITION AND REMOVAL | 63,217 | SF | $ 0.13 | $ 8,218 | |
| | 0.02 | REMOVE EX. RESTROOM | | LS | $ 16,000.00 | $ - | |
| | 0.03 | REMOVE EXISTING POOL | | LS | $ 9,500.00 | $ - | |
| | 0.04 | TREE REMOVAL 1" DIA OR LARGER | | EA | $ 822.64 | $ - | |
| | 0.05 | TREE REMOVAL 1" DIA OR SMALLER | | EA | $ 328.98 | $ - | |
| | 0.06 | REMOVE EXISTING TENNIS COURT AND ELECTROLIERS | | EA | $ 31,223.00 | $ - | |
| | 0.07 | REMOVE SIDEWALK | 251 | SF | $ 1.29 | $ 324 | |
| **1.00** | | **CONVEYANCE SYSTEM** | | | | | $ 336,509 |
| | 1.01 | SAWCUT | 4,526 | LF | $ 2.23 | $ 10,092 | |
| | 1.02 | ABANDON EX. ROCKWELL | 15 | EA | $ 300.00 | $ 4,500 | |
| | 1.03 | ABANDON EX. CROSS CONNECTION AND PLUG BOTH ENDS | 3 | EA | $ 400.00 | $ 1,200 | |
| | 1.04 | REMOVE EX. 6" SANITARY SEWER PIPE | | LF | $ 9.56 | $ - | |
| | 1.05 | REPLACE EX. 6" SANITARY SEWER PIPE | | LF | $ 30.74 | $ - | |
| | 1.06 | REMOVE EX. 8" SANITARY SEWER PIPE | 38 | LF | $ 9.56 | $ 367 | |
| | 1.07 | REPLACE EX. 8" SANITARY SEWER PIPE | | LF | $ 35.95 | $ - | |
| | 1.08 | REMOVE AND REPLACE EXISTING SEWER LATERAL | | EA | $ 500.00 | $ - | |
| | 1.09 | REMOVE EXISTING PUMP STATION | | EA | $ 1,000.00 | $ - | |
| | 1.10 | REPLACE SIDEWALK | 251 | SF | $ 3.14 | $ 788 | |
| | 1.11 | REMOVE CURB AND GUTTER | 31 | LF | $ 2.63 | $ 82 | |
| | 1.12 | REPLACE CURB AND GUTTER | 31 | LF | $ 14.01 | $ 436 | |
| | 1.13 | CONNECT TO EXISTING CATCH BASIN | 8 | EA | $ 500.00 | $ 4,000 | |
| | 1.14 | CONNECT TO EXISTING MANHOLE | | EA | $ 500.00 | $ - | |
| | 1.15 | COLLAR CONNECTION TO EXISTING | | EA | $ 250.00 | $ - | |
| | 1.16 | SEWER DIVERSION (DURING CONSTRUCTION) | | EA | $ 2,500.00 | $ - | |
| | 1.17 | PAVEMENT REMOVAL | 8,650 | SF | $ 0.83 | $ 7,180 | |
| | 1.18 | HOT PATCH | 8,650 | SF | $ 2.43 | $ 21,020 | |
| | 1.19 | DIP EXISTING WATER LINE | | EA | $ 2,000.00 | $ - | |
| | 1.20 | CONSTRUCT CONCRETE SADDLE | | EA | $ 500.00 | $ - | |
| | 1.19 | 12" STORM DRAIN | 212 | LF | $ 43.90 | $ 9,320 | |
| | 1.21 | 15" STORM DRAIN | | LF | $ 57.78 | $ - | |
| | 1.22 | 18" STORM DRAIN | 30 | LF | $ 73.20 | $ 2,221 | |
| | 1.23 | 24" STORM DRAIN | 1,684 | LF | $ 99.53 | $ 167,571 | |

## OPINION OF PROBABLE COST

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**Project:** **Modesto Area 2**
**Project No:** **2108543**
**Park:** **Garrison - Retention**

In providing this opinion of probable cost, it is recognized that neither the Client nor RRM Design Group has control over the costs of labor, equipment, or materials, or over the Contractor's methods of determining prices for bidding. This opinion of probable costs is based on RRM Design Group's reasonable professional judgment and experience and does not constitute a warranty, express or implied, that the Contractor's bids or negotiated price of Work will not vary from the Client's budget or from any opinion prepared by RRM Design Group.

**TOTAL: $ 2,929,116**

| | | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | EXTENSION | SECTION TOTAL |
|---|---|---|---|---|---|---|---|
| | 1.24 | 30" STORM DRAIN | 551 | LF | $ 134.71 | $ 74,264 | |
| | 1.25 | 36" STORM DRAIN | | LF | $ 168.26 | $ - | |
| | 1.26 | 42" STORM DRAIN | | LF | $ 186.52 | $ - | |
| | 1.27 | 48" STORM DRAIN | | LF | $ 204.78 | $ - | |
| | 1.28 | 48" MANHOLE | 12 | EA | $ 2,789.00 | $ 33,468 | |
| | 1.29 | 60" MANHOLE | | EA | $ 5,000.00 | $ - | |
| **2.00** | | **DISPOSAL SYSTEM** | | | | | $ 1,138,564 |
| | 2.01 | RETENTION SYSTEM<br>(Including excavation, filter fabric, bedding, and installation) | 213,444 | CF | $ 4.50 | $ 960,498 | |
| | 2.02 | EARTHWORK<br>(Including excavation, stockpile, off-haul and replace) | 213,444 | CF | $ 0.60 | $ 128,066 | |
| | 2.03 | PUMP STATION<br>(Includes power connection, control, SCADA) | | EA | $ 300,000.00 | $ - | |
| | 2.04 | SCADA SYSTEM<br>(No pump station) | 1 | LS | $ 50,000.00 | $ 50,000 | |
| | 2.05 | 6" FORCEMAIN | | LF | $ 45.32 | $ - | |
| | 2.06 | 48" MANHOLE | | EA | $ 2,789.00 | $ - | |
| | 2.07 | 36" STORM DRAIN | | LF | $ 168.26 | $ - | |
| | 2.08 | SAWCUT | | LF | $ 2.23 | $ - | |
| | 2.09 | REMOVE CURB AND GUTTER | | LF | $ 2.63 | $ - | |
| | 2.10 | REPLACE CURB AND GUTTER | | LF | $ 14.01 | $ - | |
| | 2.11 | REMOVE SIDEWALK | | SF | $ 1.29 | $ - | |
| | 2.12 | REPLACE SIDEWALK | | SF | $ 3.14 | $ - | |
| | 2.13 | PAVEMENT REMOVAL | | SF | $ 0.83 | $ - | |
| | 2.14 | HOT PATCH | | SF | $ 2.43 | $ - | |
| | 2.15 | OUTLET STRUCTURE | | EA | $ 10,000.00 | $ - | |

## OPINION OF PROBABLE COST

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**Project:** **Modesto Area 2**
**Project No:** **2108543**
**Park:** **Garrison - Retention**

In providing this opinion of probable cost, it is recognized that neither the Client nor RRM Design Group has control over the costs of labor, equipment, or materials, or over the Contractor's methods of determining prices for bidding. This opinion of probable costs is based on RRM Design Group's reasonable professional judgment and experience and does not constitute a warranty, express or implied, that the Contractor's bids or negotiated price of Work will not vary from the Client's budget or from any opinion prepared by RRM Design Group.

**TOTAL: $ 2,929,116**

| | | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | EXTENSION | SECTION TOTAL |
|---|---|---|---|---|---|---|---|
| **3.00** | | **TREATMENT SYSTEM** | | | | | $ 60,000 |
| | 3.01 | PRETREATMENT DEVICE | 1 | EA | $ 30,000.00 | $ 30,000 | |
| | 3.02 | ISOLATION VALVE | 1 | EA | $ 30,000.00 | $ 30,000 | |
| **4.00** | | **PARK IMPROVEMENTS** | | | | | $ 216,750 |
| | 4.01 | SITE DRAINAGE | 1 | LS | $ 2,000.00 | $ 2,000 | |
| | 4.02 | PAVING AND SURFACING | 1 | LS | $ 69,000.00 | $ 69,000 | |
| | 4.03 | SITE WALLS | | LS | | $ - | |
| | 4.04 | SITE FURNISHING AND EQUIPMENT | 1 | LS | $ 10,750.00 | $ 10,750 | |
| | 4.05 | TENNIS COURTS, COMPLETE INCLUDING PAVEMENT, STRIPING, LIGHTING, FENCING AND EQUIPMENT | | LS | | $ - | |
| | 4.06 | RE-SET EXISTING PLAY STRUCTURE | | EA | $ 15,000.00 | $ - | |
| | 4.07 | BASEBALL INFIELD AND BASES | 1 | LS | $ 32,250.00 | $ 35,250 | |
| | 4.08 | IRRIGATION | 1 | LS | $ 16,250.00 | $ 16,250 | |
| | 4.09 | PLANTING AND TURF | 1 | LS | $ 83,500.00 | $ 83,500 | |
| | 4.10 | RESTROOM | | LS | | $ - | |
| **5.00** | | **MISC.** | | | | | $ 25,000 |
| | 5.01 | DISCONNECT AND ABANDON EXISTING 12 WATER LINE | | EA | $ 500.00 | $ - | |
| | 5.02 | 12" WATER LINE<br>(Including trenching, sawcutting and hatch patch) | | LF | $ 85.20 | $ - | |
| | 5.03 | 12" WATER VALVE | | EA | $ 2,154.63 | $ - | |
| | 5.04 | CONNECT TO EXISTING WATER LINE | | EA | $ 5,401.59 | $ - | |
| | 5.05 | PRESSURE BACKFLOW DEVICE | | EA | $ 28,570.00 | $ - | |
| | 5.06 | TRAFFIC CONTROL | 1 | LS | $ 25,000.00 | $ 25,000 | |
| | 5.07 | SHORING | | EA | $ 10,000.00 | $ - | |
| | | SUBTOTAL | | | | | $ 1,785,366 |
| **6.00** | | **Mobilization and Bonding** | | | | | $ 89,268 |
| | 6.01 | Mobilization<br>(Includes the cost of purchase, installation and maintenance of all proposed erosion control methods shown on the civil plans.) | | % | 4% | $ 71,415 | |
| | 6.02 | Bonding | | % | 1% | $ 17,854 | |
| | | CONSTRUCTION SUBTOTAL | | | | | $ 1,874,634 |
| | | Design Contingency | | | 25.0% | $ 468,659 | $ 468,659 |
| | | SUBTOTAL | | | | | $ 2,343,293 |
| | | Legal, Engineering and Administration | | | 25.0% | $ 585,823 | $ 585,823 |
| | | TOTAL | | | | | $ 2,929,116 |

## OPINION OF PROBABLE COST

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**Project:** **Modesto Area 2**
**Project No:** **2108543**
**Park:** **Garrison - Detention**

In providing this opinion of probable cost, it is recognized that neither the Client nor RRM Design Group has control over the costs of labor, equipment, or materials, or over the Contractor's methods of determining prices for bidding. This opinion of probable costs is based on RRM Design Group's reasonable professional judgment and experience and does not constitute a warranty, express or implied, that the Contractor's bids or negotiated price of Work will not vary from the Client's budget or from any opinion prepared by RRM Design Group.

**TOTAL: $ 2,800,630**

| | | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | EXTENSION | SECTION TOTAL |
|---|---|---|---|---|---|---|---|
| **0.00** | | **SITE PREPARATION** | | | | | $ 8,542 |
| | 0.01 | PARK DEMOLITION AND REMOVAL | 63,217 | SF | $ 0.13 | $ 8,218 | |
| | 0.02 | REMOVE EX. RESTROOM | | LS | $ 16,000.00 | $ - | |
| | 0.03 | REMOVE EXISTING POOL | | LS | $ 9,500.00 | $ - | |
| | 0.04 | TREE REMOVAL 1" DIA OR LARGER | | EA | $ 822.64 | $ - | |
| | 0.05 | TREE REMOVAL 1" DIA OR SMALLER | | EA | $ 328.98 | $ - | |
| | 0.06 | REMOVE EXISTING TENNIS COURT AND ELECTROLIERS | | EA | $ 31,223.00 | $ - | |
| | 0.07 | REMOVE SIDEWALK | 251 | SF | $ 1.29 | $ 324 | |
| **1.00** | | **CONVEYANCE SYSTEM** | | | | | $ 336,509 |
| | 1.01 | SAWCUT | 4,526 | LF | $ 2.23 | $ 10,092 | |
| | 1.02 | ABANDON EX. ROCKWELL | 15 | EA | $ 300.00 | $ 4,500 | |
| | 1.03 | ABANDON EX. CROSS CONNECTION AND PLUG BOTH ENDS | 3 | EA | $ 400.00 | $ 1,200 | |
| | 1.04 | REMOVE EX. 6" SANITARY SEWER PIPE | | LF | $ 9.56 | $ - | |
| | 1.05 | REPLACE EX. 6" SANITARY SEWER PIPE | | LF | $ 30.74 | $ - | |
| | 1.06 | REMOVE EX. 8" SANITARY SEWER PIPE | 38 | LF | $ 9.56 | $ 367 | |
| | 1.07 | REPLACE EX. 8" SANITARY SEWER PIPE | | LF | $ 35.95 | $ - | |
| | 1.08 | REMOVE AND REPLACE EXISTING SEWER LATERAL | | EA | $ 500.00 | $ - | |
| | 1.09 | REMOVE EXISTING PUMP STATION | | EA | $ 1,000.00 | $ - | |
| | 1.10 | REPLACE SIDEWALK | 251 | SF | $ 3.14 | $ 788 | |
| | 1.11 | REMOVE CURB AND GUTTER | 31 | LF | $ 2.63 | $ 82 | |
| | 1.12 | REPLACE CURB AND GUTTER | 31 | LF | $ 14.01 | $ 436 | |
| | 1.13 | CONNECT TO EXISTING CATCH BASIN | 8 | EA | $ 500.00 | $ 4,000 | |
| | 1.14 | CONNECT TO EXISTING MANHOLE | | EA | $ 500.00 | $ - | |
| | 1.15 | COLLAR CONNECTION TO EXISTING | | EA | $ 250.00 | $ - | |
| | 1.16 | SEWER DIVERSION (DURING CONSTRUCTION) | | EA | $ 2,500.00 | $ - | |
| | 1.17 | PAVEMENT REMOVAL | 8,650 | SF | $ 0.83 | $ 7,180 | |
| | 1.18 | HOT PATCH | 8,650 | SF | $ 2.43 | $ 21,020 | |
| | 1.19 | DIP EXISTING WATER LINE | | EA | $ 2,000.00 | $ - | |
| | 1.20 | CONSTRUCT CONCRETE SADDLE | | EA | $ 500.00 | $ - | |
| | 1.19 | 12" STORM DRAIN | 212 | LF | $ 43.90 | $ 9,320 | |
| | 1.21 | 15" STORM DRAIN | | LF | $ 57.78 | $ - | |
| | 1.22 | 18" STORM DRAIN | 30 | LF | $ 73.20 | $ 2,221 | |
| | 1.23 | 24" STORM DRAIN | 1,684 | LF | $ 99.53 | $ 167,571 | |

## OPINION OF PROBABLE COST

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**Project:** **Modesto Area 2**
**Project No:** **2108543**
**Park:** **Garrison - Detention**

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**TOTAL: $ 2,800,630**

| | | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | EXTENSION | SECTION TOTAL |
|---|---|---|---|---|---|---|---|
| | 1.24 | 30" STORM DRAIN | 551 | LF | $ 134.71 | $ 74,264 | |
| | 1.25 | 36" STORM DRAIN | | LF | $ 168.26 | $ - | |
| | 1.26 | 42" STORM DRAIN | | LF | $ 186.52 | $ - | |
| | 1.27 | 48" STORM DRAIN | | LF | $ 204.78 | $ - | |
| | 1.28 | 48" MANHOLE | 12 | EA | $ 2,789.00 | $ 33,468 | |
| | 1.29 | 60" MANHOLE | | EA | $ 5,000.00 | $ - | |
| **2.00** | | **DISPOSAL SYSTEM** | | | | | $ 1,050,250 |
| | 2.01 | DETENTION SYSTEM<br>(Including excavation, filter fabric, bedding, and installation) | 112,367 | CF | $ 4.50 | $ 505,652 | |
| | 2.02 | EARTHWORK<br>(Including excavation, stockpile, off-haul and replace) | 112,367 | CF | $ 0.60 | $ 67,420 | |
| | 2.03 | PUMP STATION<br>(Includes power connection, control, SCADA) | 1 | EA | $ 300,000.00 | $ 300,000 | |
| | 2.04 | SCADA SYSTEM<br>(No pump station) | 1 | LS | $ 50,000.00 | $ 50,000 | |
| | 2.05 | 6" FORCEMAIN | 1,897 | LF | $ 45.32 | $ 85,962 | |
| | 2.06 | 48" MANHOLE | | EA | $ 2,789.00 | $ - | |
| | 2.07 | 36" STORM DRAIN | | LF | $ 168.26 | $ - | |
| | 2.08 | SAWCUT | 3,794 | LF | $ 2.23 | $ 8,460 | |
| | 2.09 | REMOVE CURB AND GUTTER | 10 | LF | $ 2.63 | $ 26 | |
| | 2.10 | REPLACE CURB AND GUTTER | 10 | LF | $ 14.01 | $ 140 | |
| | 2.11 | REMOVE SIDEWALK | 50 | SF | $ 1.29 | $ 65 | |
| | 2.12 | REPLACE SIDEWALK | 50 | SF | $ 3.14 | $ 157 | |
| | 2.13 | PAVEMENT REMOVAL | 3,794 | SF | $ 0.83 | $ 3,149 | |
| | 2.14 | HOT PATCH | 3,794 | SF | $ 2.43 | $ 9,219 | |
| | 2.15 | OUTLET STRUCTURE | 2 | EA | $ 10,000.00 | $ 20,000 | |

## OPINION OF PROBABLE COST

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**Project:** **Modesto Area 2**
**Project No:** **2108543**
**Park:** **Garrison - Detention**

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**TOTAL: $ 2,800,630**

| | | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | EXTENSION | SECTION TOTAL |
|---|---|---|---|---|---|---|---|
| **3.00** | | **TREATMENT SYSTEM** | | | | | $ 60,000 |
| | 3.01 | PRETREATMENT DEVICE | 1 | EA | $ 30,000.00 | $ 30,000 | |
| | 3.02 | ISOLATION VALVE | 1 | EA | $ 30,000.00 | $ 30,000 | |
| **4.00** | | **PARK IMPROVEMENTS** | | | | | $ 216,750 |
| | 4.01 | SITE DRAINAGE | 1 | LS | $ 2,000.00 | $ 2,000 | |
| | 4.02 | PAVING AND SURFACING | 1 | LS | $ 69,000.00 | $ 69,000 | |
| | 4.03 | SITE WALLS | | LS | | $ - | |
| | 4.04 | SITE FURNISHING AND EQUIPMENT | 1 | LS | $ 10,750.00 | $ 10,750 | |
| | 4.05 | TENNIS COURTS, COMPLETE INCLUDING PAVEMENT, STRIPING, LIGHTING, FENCING AND EQUIPMENT | | LS | | $ - | |
| | 4.06 | RE-SET EXISTING PLAY STRUCTURE | | EA | $ 15,000.00 | $ - | |
| | 4.07 | BASEBALL INFIELD AND BASES | 1 | LS | $ 32,250.00 | $ 35,250 | |
| | 4.08 | IRRIGATION | 1 | LS | $ 16,250.00 | $ 16,250 | |
| | 4.09 | PLANTING AND TURF | 1 | LS | $ 83,500.00 | $ 83,500 | |
| | 4.10 | RESTROOM | | LS | | $ - | |
| **5.00** | | **MISC.** | | | | | $ 35,000 |
| | 5.01 | DISCONNECT AND ABANDON EXISTING 12 WATER LINE | | EA | $ 500.00 | $ - | |
| | 5.02 | 12" WATER LINE<br>(Including trenching, sawcutting and hatch patch) | | LF | $ 85.20 | $ - | |
| | 5.03 | 12" WATER VALVE | | EA | $ 2,154.63 | $ - | |
| | 5.04 | CONNECT TO EXISTING WATER LINE | | EA | $ 5,401.59 | $ - | |
| | 5.05 | PRESSURE BACKFLOW DEVICE | | EA | $ 28,570.00 | $ - | |
| | 5.06 | TRAFFIC CONTROL | 1 | LS | $ 25,000.00 | $ 25,000 | |
| | 5.07 | SHORING | 1 | EA | $ 10,000.00 | $ 10,000 | |
| | | SUBTOTAL | | | | | $ 1,707,051 |
| **6.00** | | **Mobilization and Bonding** | | | | | $ 85,353 |
| | 6.01 | Mobilization<br>(Includes the cost of purchase, installation and maintenance of all proposed erosion control methods shown on the civil plans.) | | % | 4% | $ 68,282 | |
| | 6.02 | Bonding | | % | 1% | $ 17,071 | |
| | | CONSTRUCTION SUBTOTAL | | | | | $ 1,792,403 |
| | | Design Contingency | | | 25.0% | $ 448,101 | $ 448,101 |
| | | SUBTOTAL | | | | | $ 2,240,504 |
| | | Legal, Engineering and Administration | | | 25.0% | $ 560,126 | $ 560,126 |
| | | TOTAL | | | | | $ 2,800,630 |

## OPINION OF PROBABLE COST

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**Project:** **Modesto Area 2**
**Project No:** **2108543**
**Park:** **Catherine Everett - Retention**

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**TOTAL: $ 3,892,934**

| | | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | EXTENSION | SECTION TOTAL |
|---|---|---|---|---|---|---|---|
| **0.00** | | **SITE PREPARATION** | | | | | $ 14,613 |
| | 0.01 | PARK DEMOLITION AND REMOVAL | 67,389 | SF | $ 0.13 | $ 8,761 | |
| | 0.02 | REMOVE EX. RESTROOM | | LS | $ 16,000.00 | $ - | |
| | 0.03 | REMOVE EXISTING POOL | | LS | $ 9,500.00 | $ - | |
| | 0.04 | TREE REMOVAL 1" DIA OR LARGER | | EA | $ 822.64 | $ - | |
| | 0.05 | TREE REMOVAL 1" DIA OR SMALLER | | EA | $ 328.98 | $ - | |
| | 0.06 | REMOVE EXISTING TENNIS COURT AND ELECTROLIERS | | EA | $ 31,223.00 | $ - | |
| | 0.07 | REMOVE SIDEWALK | 4,537 | SF | $ 1.29 | $ 5,853 | |
| **1.00** | | **CONVEYANCE SYSTEM** | | | | | $ 946,558 |
| | 1.01 | SAWCUT | 15,329 | LF | $ 2.23 | $ 34,184 | |
| | 1.02 | ABANDON EX. ROCKWELL | 14 | EA | $ 300.00 | $ 4,200 | |
| | 1.03 | ABANDON EX. CROSS CONNECTION AND PLUG BOTH ENDS | 3 | EA | $ 400.00 | $ 1,200 | |
| | 1.04 | REMOVE EX. 6" SANITARY SEWER PIPE | 39 | LF | $ 9.56 | $ 373 | |
| | 1.05 | REPLACE EX. 6" SANITARY SEWER PIPE | 39 | LF | $ 30.74 | $ 1,199 | |
| | 1.06 | REMOVE EX. 8" SANITARY SEWER PIPE | | LF | $ 9.56 | $ - | |
| | 1.07 | REPLACE EX. 8" SANITARY SEWER PIPE | | LF | $ 35.95 | $ - | |
| | 1.08 | REMOVE AND REPLACE EXISTING SEWER LATERAL | 11 | EA | $ 500.00 | $ 5,500 | |
| | 1.09 | REMOVE EXISTING PUMP STATION | | EA | $ 1,000.00 | $ - | |
| | 1.10 | REPLACE SIDEWALK | 4,537 | SF | $ 3.14 | $ 14,246 | |
| | 1.11 | REMOVE CURB AND GUTTER | 462 | LF | $ 2.63 | $ 1,215 | |
| | 1.12 | REPLACE CURB AND GUTTER | 462 | LF | $ 14.01 | $ 6,475 | |
| | 1.13 | CONNECT TO EXISTING CATCH BASIN | 8 | EA | $ 500.00 | $ 4,000 | |
| | 1.14 | CONNECT TO EXISTING MANHOLE | 1 | EA | $ 500.00 | $ 500 | |
| | 1.15 | COLLAR CONNECTION TO EXISTING | 1 | EA | $ 250.00 | $ 250 | |
| | 1.16 | SEWER DIVERSION (DURING CONSTRUCTION) | 1 | SF | $ 2,500.00 | $ 2,500 | |
| | 1.17 | PAVEMENT REMOVAL | 26,862 | SF | $ 0.83 | $ 22,296 | |
| | 1.18 | HOT PATCH | 26,862 | SF | $ 2.43 | $ 65,275 | |
| | 1.19 | DIP EXISTING WATER LINE | | EA | $ 2,000.00 | $ - | |
| | 1.20 | CONSTRUCT CONCRETE SADDLE | | EA | $ 500.00 | $ - | |
| | 1.19 | 12" STORM DRAIN | 146 | LF | $ 43.90 | $ 6,414 | |
| | 1.21 | 15" STORM DRAIN | | LF | $ 57.78 | $ - | |
| | 1.22 | 18" STORM DRAIN | 3,913 | LF | $ 73.20 | $ 286,459 | |
| | 1.23 | 24" STORM DRAIN | 2,378 | LF | $ 99.53 | $ 236,690 | |

## OPINION OF PROBABLE COST

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**Project:** **Modesto Area 2**
**Project No:** **2108543**
**Park:** **Catherine Everett - Retention**

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**TOTAL: $ 3,892,934**

| | | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | EXTENSION | SECTION TOTAL |
|---|---|---|---|---|---|---|---|
| | 1.24 | 30" STORM DRAIN | 1,344 | LF | $ 134.71 | $ 181,068 | |
| | 1.25 | 36" STORM DRAIN | | LF | $ 168.26 | $ - | |
| | 1.26 | 42" STORM DRAIN | | LF | $ 186.52 | $ - | |
| | 1.27 | 48" STORM DRAIN | | LF | $ 204.78 | $ - | |
| | 1.28 | 48" MANHOLE | 26 | EA | $ 2,789.00 | $ 72,514 | |
| | 1.29 | 60" MANHOLE | | EA | $ 5,000.00 | $ - | |
| **2.00** | | **DISPOSAL SYSTEM** | | | | | $ 1,169,664 |
| | 2.01 | RETENTION SYSTEM<br>(Including excavation, filter fabric, bedding, and installation) | 219,542 | CF | $ 4.50 | $ 987,939 | |
| | 2.02 | EARTHWORK<br>(Including excavation, stockpile, off-haul and replace) | 219,542 | CF | $ 0.60 | $ 131,725 | |
| | 2.03 | PUMP STATION<br>(Includes power connection, control, SCADA) | | EA | $ 300,000.00 | $ - | |
| | 2.04 | SCADA SYSTEM<br>(No pump station) | 1 | LS | $ 50,000.00 | $ 50,000 | |
| | 2.05 | 6" FORCEMAIN | | LF | $ 45.32 | | |
| | 2.06 | 48" MANHOLE | | EA | $ 2,789.00 | $ - | |
| | 2.07 | 36" STORM DRAIN | | LF | $ 168.26 | $ - | |
| | 2.08 | SAWCUT | | LF | $ 2.23 | $ - | |
| | 2.09 | REMOVE CURB AND GUTTER | | LF | $ 2.63 | $ - | |
| | 2.10 | REPLACE CURB AND GUTTER | | LF | $ 14.01 | $ - | |
| | 2.11 | REMOVE SIDEWALK | | SF | $ 1.29 | $ - | |
| | 2.12 | REPLACE SIDEWALK | | SF | $ 3.14 | $ - | |
| | 2.13 | PAVEMENT REMOVAL | | SF | $ 0.83 | $ - | |
| | 2.14 | HOT PATCH | | SF | $ 2.43 | $ - | |
| | 2.15 | OUTLET STRUCTURE | | EA | $ 10,000.00 | $ - | |

## OPINION OF PROBABLE COST

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**Project:** **Modesto Area 2**
**Project No:** **2108543**
**Park:** **Catherine Everett - Retention**

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**TOTAL: $ 3,892,934**

| | | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | EXTENSION | SECTION TOTAL |
|---|---|---|---|---|---|---|---|
| **3.00** | | **TREATMENT SYSTEM** | | | | | $ 60,000 |
| | 3.01 | PRETREATMENT DEVICE | 1 | EA | $ 30,000.00 | $ 30,000 | |
| | 3.02 | ISOLATION VALVE | 1 | EA | $ 30,000.00 | $ 30,000 | |
| **4.00** | | **PARK IMPROVEMENTS** | | | | | $ 122,000 |
| | 4.01 | SITE DRAINAGE | | LS | | $ - | |
| | 4.02 | PAVING AND SURFACING | | LS | | $ - | |
| | 4.03 | SITE WALLS | | LS | | $ - | |
| | 4.04 | SITE FURNISHING AND EQUIPMENT | | LS | | $ - | |
| | 4.05 | TENNIS COURTS, COMPLETE INCLUDING PAVEMENT, STRIPING, LIGHTING, FENCING AND EQUIPMENT | | LS | | $ - | |
| | 4.06 | RE-SET EXISTING PLAY STRUCTURE | | EA | $ 15,000.00 | $ - | |
| | 4.07 | BASEBALL INFIELD AND BASES | 1 | LS | $ 32,500.00 | $ 32,500 | |
| | 4.08 | IRRIGATION | 1 | LS | $ 7,500.00 | $ 7,500 | |
| | 4.09 | PLANTING AND TURF | 1 | LS | $ 82,000.00 | $ 82,000 | |
| | 4.10 | RESTROOM | | LS | | $ - | |
| **5.00** | | **MISC.** | | | | | $ 60,000 |
| | 5.01 | DISCONNECT AND ABANDON EXISTING 12 WATER LINE | | EA | $ 500.00 | $ - | |
| | 5.02 | 12" WATER LINE<br>(Including trenching, sawcutting and hatch patch) | | LF | $ 85.20 | $ - | |
| | 5.03 | 12" WATER VALVE | | EA | $ 2,154.63 | $ - | |
| | 5.04 | CONNECT TO EXISTING WATER LINE | | EA | $ 5,401.59 | $ - | |
| | 5.05 | PRESSURE BACKFLOW DEVICE | | EA | $ 28,570.00 | $ - | |
| | 5.06 | TRAFFIC CONTROL | 1 | LS | $ 50,000.00 | $ 50,000 | |
| | 5.07 | SHORING | | EA | $ 10,000.00 | $ 10,000 | |
| | | SUBTOTAL | | | | | $ 2,372,836 |
| **6.00** | | **Mobilization and Bonding** | | | | | $ 118,642 |
| | 6.01 | Mobilization<br>(Includes the cost of purchase, installation and maintenance of all proposed erosion control methods shown on the civil plans.) | | % | 4% | $ 94,913 | |
| | 6.02 | Bonding | | % | 1% | $ 23,728 | |
| | | CONSTRUCTION SUBTOTAL | | | | | $ 2,491,478 |
| | | Design Contingency | | | 25.0% | $ 622,869 | $ 622,869 |
| | | SUBTOTAL | | | | | $ 3,114,347 |
| | | Legal, Engineering and Administration | | | 25.0% | $ 778,587 | $ 778,587 |
| | | TOTAL | | | | | $ 3,892,934 |

## OPINION OF PROBABLE COST

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**Project:** **Modesto Area 2**
**Project No:** **2108543**
**Park:** **Catherine Everett - Detention**

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**TOTAL: $ 3,794,474**

| | | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | EXTENSION | SECTION TOTAL |
|---|---|---|---|---|---|---|---|
| **0.00** | | **SITE PREPARATION** | | | | | $ 14,613 |
| | 0.01 | PARK DEMOLITION AND REMOVAL | 67,389 | SF | $ 0.13 | $ 8,761 | |
| | 0.02 | REMOVE EX. RESTROOM | | LS | $ 16,000.00 | $ - | |
| | 0.03 | REMOVE EXISTING POOL | | LS | $ 9,500.00 | $ - | |
| | 0.04 | TREE REMOVAL 1" DIA OR LARGER | | EA | $ 822.64 | $ - | |
| | 0.05 | TREE REMOVAL 1" DIA OR SMALLER | | EA | $ 328.98 | $ - | |
| | 0.06 | REMOVE EXISTING TENNIS COURT AND ELECTROLIERS | | EA | $ 31,223.00 | $ - | |
| | 0.07 | REMOVE SIDEWALK | 4,537 | SF | $ 1.29 | $ 5,853 | |
| **1.00** | | **CONVEYANCE SYSTEM** | | | | | $ 946,558 |
| | 1.01 | SAWCUT | 15,329 | LF | $ 2.23 | $ 34,184 | |
| | 1.02 | ABANDON EX. ROCKWELL | 14 | EA | $ 300.00 | $ 4,200 | |
| | 1.03 | ABANDON EX. CROSS CONNECTION AND PLUG BOTH ENDS | 3 | EA | $ 400.00 | $ 1,200 | |
| | 1.04 | REMOVE EX. 6" SANITARY SEWER PIPE | 39 | LF | $ 9.56 | $ 373 | |
| | 1.05 | REPLACE EX. 6" SANITARY SEWER PIPE | 39 | LF | $ 30.74 | $ 1,199 | |
| | 1.06 | REMOVE EX. 8" SANITARY SEWER PIPE | | LF | $ 9.56 | $ - | |
| | 1.07 | REPLACE EX. 8" SANITARY SEWER PIPE | | LF | $ 35.95 | $ - | |
| | 1.08 | REMOVE AND REPLACE EXISTING SEWER LATERAL | 11 | EA | $ 500.00 | $ 5,500 | |
| | 1.09 | REMOVE EXISTING PUMP STATION | | EA | $ 1,000.00 | $ - | |
| | 1.10 | REPLACE SIDEWALK | 4,537 | SF | $ 3.14 | $ 14,246 | |
| | 1.11 | REMOVE CURB AND GUTTER | 462 | LF | $ 2.63 | $ 1,215 | |
| | 1.12 | REPLACE CURB AND GUTTER | 462 | LF | $ 14.01 | $ 6,475 | |
| | 1.13 | CONNECT TO EXISTING CATCH BASIN | 8 | EA | $ 500.00 | $ 4,000 | |
| | 1.14 | CONNECT TO EXISTING MANHOLE | 1 | EA | $ 500.00 | $ 500 | |
| | 1.15 | COLLAR CONNECTION TO EXISTING | 1 | EA | $ 250.00 | $ 250 | |
| | 1.16 | SEWER DIVERSION (DURING CONSTRUCTION) | 1 | SF | $ 2,500.00 | $ 2,500 | |
| | 1.17 | PAVEMENT REMOVAL | 26,862 | SF | $ 0.83 | $ 22,296 | |
| | 1.18 | HOT PATCH | 26,862 | SF | $ 2.43 | $ 65,275 | |
| | 1.19 | DIP EXISTING WATER LINE | | EA | $ 2,000.00 | $ - | |
| | 1.20 | CONSTRUCT CONCRETE SADDLE | | EA | $ 500.00 | $ - | |
| | 1.19 | 12" STORM DRAIN | 146 | LF | $ 43.90 | $ 6,414 | |
| | 1.21 | 15" STORM DRAIN | | LF | $ 57.78 | $ - | |
| | 1.22 | 18" STORM DRAIN | 3,913 | LF | $ 73.20 | $ 286,459 | |
| | 1.23 | 24" STORM DRAIN | 2,378 | LF | $ 99.53 | $ 236,690 | |

## OPINION OF PROBABLE COST

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**Project:** **Modesto Area 2**
**Project No:** **2108543**
**Park:** **Catherine Everett - Detention**

In providing this opinion of probable cost, it is recognized that neither the Client nor RRM Design Group has control over the costs of labor, equipment, or materials, or over the Contractor's methods of determining prices for bidding. This opinion of probable costs is based on RRM Design Group's reasonable professional judgment and experience and does not constitute a warranty, express or implied, that the Contractor's bids or negotiated price of Work will not vary from the Client's budget or from any opinion prepared by RRM Design Group.

**TOTAL: $ 3,794,474**

| | | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | EXTENSION | SECTION TOTAL |
|---|---|---|---|---|---|---|---|
| | 1.24 | 30" STORM DRAIN | 1,344 | LF | $ 134.71 | $ 181,068 | |
| | 1.25 | 36" STORM DRAIN | | LF | $ 168.26 | $ - | |
| | 1.26 | 42" STORM DRAIN | | LF | $ 186.52 | $ - | |
| | 1.27 | 48" STORM DRAIN | | LF | $ 204.78 | $ - | |
| | 1.28 | 48" MANHOLE | 26 | EA | $ 2,789.00 | $ 72,514 | |
| | 1.29 | 60" MANHOLE | | EA | $ 5,000.00 | $ - | |
| **2.00** | | **DISPOSAL SYSTEM** | | | | | $ 1,109,650 |
| | 2.01 | DETENTION SYSTEM<br>(Including excavation, filter fabric, bedding, and installation) | 122,630 | CF | $ 4.50 | $ 551,835 | |
| | 2.02 | EARTHWORK<br>(Including excavation, stockpile, off-haul and replace) | 122,630 | CF | $ 0.60 | $ 73,578 | |
| | 2.03 | PUMP STATION<br>(Includes power connection, control, SCADA) | 1 | EA | $ 300,000.00 | $ 300,000 | |
| | 2.04 | SCADA SYSTEM<br>(No pump station) | 1 | LS | $ 50,000.00 | $ 50,000 | |
| | 2.05 | 6" FORCEMAIN | 2,200 | LF | $ 45.32 | $ 99,694 | |
| | 2.06 | 48" MANHOLE | | EA | $ 2,789.00 | $ - | |
| | 2.07 | 36" STORM DRAIN | | LF | $ 168.26 | $ - | |
| | 2.08 | SAWCUT | 4,400 | LF | $ 2.23 | $ 9,811 | |
| | 2.09 | REMOVE CURB AND GUTTER | 10 | LF | $ 2.63 | $ 26 | |
| | 2.10 | REPLACE CURB AND GUTTER | 10 | LF | $ 14.01 | $ 140 | |
| | 2.11 | REMOVE SIDEWALK | 50 | SF | $ 1.29 | $ 65 | |
| | 2.12 | REPLACE SIDEWALK | 50 | SF | $ 3.14 | $ 157 | |
| | 2.13 | PAVEMENT REMOVAL | 4,400 | SF | $ 0.83 | $ 3,652 | |
| | 2.14 | HOT PATCH | 4,400 | SF | $ 2.43 | $ 10,692 | |
| | 2.15 | OUTLET STRUCTURE | 1 | EA | $ 10,000.00 | $ 10,000 | |

## OPINION OF PROBABLE COST

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**Project:** **Modesto Area 2**
**Project No:** **2108543**
**Park:** **Catherine Everett - Detention**

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**TOTAL: $ 3,794,474**

| | | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | EXTENSION | SECTION TOTAL |
|---|---|---|---|---|---|---|---|
| **3.00** | | **TREATMENT SYSTEM** | | | | | $ 60,000 |
| | 3.01 | PRETREATMENT DEVICE | 1 | EA | $ 30,000.00 | $ 30,000 | |
| | 3.02 | ISOLATION VALVE | 1 | EA | $ 30,000.00 | $ 30,000 | |
| **4.00** | | **PARK IMPROVEMENTS** | | | | | $ 122,000 |
| | 4.01 | SITE DRAINAGE | | LS | | $ - | |
| | 4.02 | PAVING AND SURFACING | | LS | | $ - | |
| | 4.03 | SITE WALLS | | LS | | $ - | |
| | 4.04 | SITE FURNISHING AND EQUIPMENT | | LS | | $ - | |
| | 4.05 | TENNIS COURTS, COMPLETE INCLUDING PAVEMENT, STRIPING, LIGHTING, FENCING AND EQUIPMENT | | LS | | $ - | |
| | 4.06 | RE-SET EXISTING PLAY STRUCTURE | | EA | $ 15,000.00 | $ - | |
| | 4.07 | BASEBALL INFIELD AND BASES | 1 | LS | $ 32,500.00 | $ 32,500 | |
| | 4.08 | IRRIGATION | 1 | LS | $ 7,500.00 | $ 7,500 | |
| | 4.09 | PLANTING AND TURF | 1 | LS | $ 82,000.00 | $ 82,000 | |
| | 4.10 | RESTROOM | | LS | | $ - | |
| **5.00** | | **MISC.** | | | | | $ 60,000 |
| | 5.01 | DISCONNECT AND ABANDON EXISTING 12 WATER LINE | | EA | $ 500.00 | $ - | |
| | 5.02 | 12" WATER LINE<br>(Including trenching, sawcutting and hatch patch) | | LF | $ 85.20 | $ - | |
| | 5.03 | 12" WATER VALVE | | EA | $ 2,154.63 | $ - | |
| | 5.04 | CONNECT TO EXISTING WATER LINE | | EA | $ 5,401.59 | $ - | |
| | 5.05 | PRESSURE BACKFLOW DEVICE | | EA | $ 28,570.00 | $ - | |
| | 5.06 | TRAFFIC CONTROL | 1 | LS | $ 50,000.00 | $ 50,000 | |
| | 5.07 | SHORING | 1 | EA | $ 10,000.00 | $ 10,000 | |
| | | SUBTOTAL | | | | | $ 2,312,822 |
| **6.00** | | **Mobilization and Bonding** | | | | | $ 115,641 |
| | 6.01 | Mobilization<br>(Includes the cost of purchase, installation and maintenance of all proposed erosion control methods shown on the civil plans.) | | % | 4% | $ 92,513 | |
| | 6.02 | Bonding | | % | 1% | $ 23,128 | |
| | | CONSTRUCTION SUBTOTAL | | | | | $ 2,428,463 |
| | | Design Contingency | | | 25.0% | $ 607,116 | $ 607,116 |
| | | SUBTOTAL | | | | | $ 3,035,579 |
| | | Legal, Engineering and Administration | | | 25.0% | $ 758,895 | $ 758,895 |
| | | TOTAL | | | | | $ 3,794,474 |

## OPINION OF PROBABLE COST

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**Project:** **Modesto Area 2**
**Project No:** **2108543**
**Park:** **JM Pike - Retention**

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**TOTAL: $ 13,517,996**

| | | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | EXTENSION | SECTION TOTAL |
|---|---|---|---|---|---|---|---|
| **0.00** | | **SITE PREPARATION** | | | | | $ 18,442 |
| | 0.01 | PARK DEMOLITION AND REMOVAL | 127,362 | SF | $ 0.13 | $ 16,557 | |
| | 0.02 | REMOVE EX. RESTROOM | | LS | $ 16,000.00 | $ - | |
| | 0.03 | REMOVE EXISTING POOL | | LS | $ 9,500.00 | $ - | |
| | 0.04 | TREE REMOVAL 1" DIA OR LARGER | 1 | EA | $ 822.64 | $ 823 | |
| | 0.05 | TREE REMOVAL 1" DIA OR SMALLER | 3 | EA | $ 328.98 | $ 987 | |
| | 0.06 | REMOVE EXISTING TENNIS COURT AND ELECTROLIERS | | EA | $ 31,223.00 | $ - | |
| | 0.07 | REMOVE SIDEWALK | 58 | SF | $ 1.29 | $ 75 | |
| **1.00** | | **CONVEYANCE SYSTEM** | | | | | $ 2,107,475 |
| | 1.01 | SAWCUT | 24,976 | LF | $ 2.23 | $ 55,696 | |
| | 1.02 | ABANDON EX. ROCKWELL | 32 | EA | $ 300.00 | $ 9,600 | |
| | 1.03 | ABANDON EX. CROSS CONNECTION AND PLUG BOTH ENDS | 12 | EA | $ 400.00 | $ 4,800 | |
| | 1.04 | REMOVE EX. 6" SANITARY SEWER PIPE | | LF | $ 9.56 | $ - | |
| | 1.05 | REPLACE EX. 6" SANITARY SEWER PIPE | | LF | $ 30.74 | $ - | |
| | 1.06 | REMOVE EX. 8" SANITARY SEWER PIPE | | LF | $ 9.56 | $ - | |
| | 1.07 | REPLACE EX. 8" SANITARY SEWER PIPE | | LF | $ 35.95 | $ - | |
| | 1.08 | REMOVE AND REPLACE EXISTING SEWER LATERAL | 1 | EA | $ 500.00 | $ 500 | |
| | 1.09 | REMOVE EXISTING PUMP STATION | 1 | EA | $ 1,000.00 | $ 1,000 | |
| | 1.10 | REPLACE SIDEWALK | 58 | SF | $ 3.14 | $ 182 | |
| | 1.11 | REMOVE CURB AND GUTTER | 10 | LF | $ 2.63 | $ 26 | |
| | 1.12 | REPLACE CURB AND GUTTER | 10 | LF | $ 14.01 | $ 140 | |
| | 1.13 | CONNECT TO EXISTING CATCH BASIN | 25 | EA | $ 500.00 | $ 12,500 | |
| | 1.14 | CONNECT TO EXISTING MANHOLE | | EA | $ 500.00 | $ - | |
| | 1.15 | COLLAR CONNECTION TO EXISTING | | EA | $ 250.00 | $ - | |
| | 1.16 | SEWER DIVERSION (DURING CONSTRUCTION) | | SF | $ 2,500.00 | $ - | |
| | 1.17 | PAVEMENT REMOVAL | 48,523 | SF | $ 0.83 | $ 40,274 | |
| | 1.18 | HOT PATCH | 48,523 | SF | $ 2.43 | $ 117,910 | |
| | 1.19 | DIP EXISTING WATER LINE | 3 | EA | $ 2,000.00 | $ 6,000 | |
| | 1.20 | CONSTRUCT CONCRETE SADDLE | 2 | EA | $ 500.00 | $ 1,000 | |
| | 1.19 | 12" STORM DRAIN | 867 | LF | $ 43.90 | $ 38,052 | |
| | 1.21 | 15" STORM DRAIN | | LF | $ 57.78 | $ - | |
| | 1.22 | 18" STORM DRAIN | 2,142 | LF | $ 73.20 | $ 156,769 | |
| | 1.23 | 24" STORM DRAIN | 1,949 | LF | $ 99.53 | $ 194,009 | |

## OPINION OF PROBABLE COST

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**Project:** **Modesto Area 2**
**Project No:** **2108543**
**Park:** **JM Pike - Retention**

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**TOTAL: $ 13,517,996**

| | | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | EXTENSION | SECTION TOTAL |
|---|---|---|---|---|---|---|---|
| | 1.24 | 30" STORM DRAIN | 1,758 | LF | $ 134.71 | $ 236,839 | |
| | 1.25 | 36" STORM DRAIN | 3,281 | LF | $ 168.26 | $ 552,083 | |
| | 1.26 | 42" STORM DRAIN | 645 | LF | $ 186.52 | $ 120,294 | |
| | 1.27 | 48" STORM DRAIN | 2,081 | LF | $ 204.78 | $ 426,131 | |
| | 1.28 | 48" MANHOLE | 30 | EA | $ 2,789.00 | $ 83,670 | |
| | 1.29 | 60" MANHOLE | 10 | EA | $ 5,000.00 | $ 50,000 | |
| **2.00** | | **DISPOSAL SYSTEM** | | | | | $ 5,427,624 |
| | 2.01 | RETENTION SYSTEM<br>(Including excavation, filter fabric, bedding, and installation) | 1,054,436 | CF | $ 4.50 | $ 4,744,962 | |
| | 2.02 | EARTHWORK<br>(Including excavation, stockpile, off-haul and replace) | 1,054,436 | CF | $ 0.60 | $ 632,662 | |
| | 2.03 | PUMP STATION<br>(Includes power connection, control, SCADA) | | EA | $ 300,000.00 | $ - | |
| | 2.04 | SCADA SYSTEM<br>(No pump station) | 1 | LS | $ 50,000.00 | $ 50,000 | |
| | 2.05 | 6" FORCEMAIN | | LF | $ 45.32 | | |
| | 2.06 | 48" MANHOLE | | EA | $ 2,789.00 | $ - | |
| | 2.07 | 36" STORM DRAIN | | LF | $ 168.26 | $ - | |
| | 2.08 | SAWCUT | | LF | $ 2.23 | $ - | |
| | 2.09 | REMOVE CURB AND GUTTER | | LF | $ 2.63 | $ - | |
| | 2.10 | REPLACE CURB AND GUTTER | | LF | $ 14.01 | $ - | |
| | 2.11 | REMOVE SIDEWALK | | SF | $ 1.29 | $ - | |
| | 2.12 | REPLACE SIDEWALK | | SF | $ 3.14 | $ - | |
| | 2.13 | PAVEMENT REMOVAL | | SF | $ 0.83 | $ - | |
| | 2.14 | HOT PATCH | | SF | $ 2.43 | $ - | |
| | 2.15 | OUTLET STRUCTURE | | EA | $ 10,000.00 | $ - | |

## OPINION OF PROBABLE COST

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**Project:** **Modesto Area 2**
**Project No:** **2108543**
**Park:** **JM Pike - Retention**

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**TOTAL: $ 13,517,996**

| | | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | EXTENSION | SECTION TOTAL |
|---|---|---|---|---|---|---|---|
| **3.00** | | **TREATMENT SYSTEM** | | | | | $ 60,000 |
| | 3.01 | PRETREATMENT DEVICE | 1 | EA | $ 30,000.00 | $ 30,000 | |
| | 3.02 | ISOLATION VALVE | 1 | EA | $ 30,000.00 | $ 30,000 | |
| **4.00** | | **PARK IMPROVEMENTS** | | | | | $ 551,000 |
| | 4.01 | SITE DRAINAGE | 1 | LS | $ 18,500.00 | $ 18,500 | |
| | 4.02 | PAVING AND SURFACING | 1 | LS | $ 208,500.00 | $ 208,500 | |
| | 4.03 | SITE WALLS | | LS | | $ - | |
| | 4.04 | SITE FURNISHING AND EQUIPMENT | 1 | LS | $ 34,500.00 | $ 34,500 | |
| | 4.05 | TENNIS COURTS, COMPLETE INCLUDING PAVEMENT, STRIPING, LIGHTING, FENCING AND EQUIPMENT | | LS | | $ - | |
| | 4.06 | RE-SET EXISTING PLAY STRUCTURE | 1 | EA | $ 15,000.00 | $ 15,000 | |
| | 4.07 | BASEBALL INFIELD, FENCING AND EQUIPMENT | 1 | LS | $ 84,500.00 | $ 84,500 | |
| | 4.08 | IRRIGATION | 1 | LS | $ 40,000.00 | $ 40,000 | |
| | 4.09 | PLANTING AND TURF | 1 | LS | $ 150,000.00 | $ 150,000 | |
| | 4.10 | RESTROOM | | LS | | $ - | |
| **5.00** | | **MISC.** | | | | | $ 75,000 |
| | 5.01 | DISCONNECT AND ABANDON EXISTING 12 WATER LINE | | EA | $ 500.00 | $ - | |
| | 5.02 | 12" WATER LINE<br>(Including trenching, sawcutting and hatch patch) | | LF | $ 85.20 | $ - | |
| | 5.03 | 12" WATER VALVE | | EA | $ 2,154.63 | $ - | |
| | 5.04 | CONNECT TO EXISTING WATER LINE | | EA | $ 5,401.59 | $ - | |
| | 5.05 | PRESSURE BACKFLOW DEVICE | | EA | $ 28,570.00 | $ - | |
| | 5.06 | TRAFFIC CONTROL | 1 | LS | $ 75,000.00 | $ 75,000 | |
| | 5.07 | SHORING | | EA | $ 10,000.00 | $ - | |
| | | SUBTOTAL | | | | | $ 8,239,540 |
| **6.00** | | **Mobilization and Bonding** | | | | | $ 411,977 |
| | 6.01 | Mobilization<br>(Includes the cost of purchase, installation and maintenance of all proposed erosion control methods shown on the civil plans.) | | % | 4% | $ 329,582 | |
| | 6.02 | Bonding | | % | 1% | $ 82,395 | |
| | | CONSTRUCTION SUBTOTAL | | | | | $ 8,651,517 |
| | | Design Contingency | | | 25.0% | $ 2,162,879 | $ 2,162,879 |
| | | SUBTOTAL | | | | | $ 10,814,397 |
| | | Legal, Engineering and Administration | | | 25.0% | $ 2,703,599 | $ 2,703,599 |
| | | TOTAL | | | | | $ 13,517,996 |

## OPINION OF PROBABLE COST

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**Project:** **Modesto Area 2**
**Project No:** **2108543**
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**TOTAL: $ 10,235,090**

| | | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | EXTENSION | SECTION TOTAL |
|---|---|---|---|---|---|---|---|
| **0.00** | | **SITE PREPARATION** | | | | | $ 18,441 |
| | 0.01 | PARK DEMOLITION AND REMOVAL | 127,362 | SF | $ 0.13 | $ 16,557 | |
| | 0.02 | REMOVE EX. RESTROOM | | LS | $ 16,000.00 | $ - | |
| | 0.03 | REMOVE EXISTING POOL | | LS | $ 9,500.00 | $ - | |
| | 0.04 | TREE REMOVAL 1" DIA OR LARGER | 1 | EA | $ 822.64 | $ 823 | |
| | 0.05 | TREE REMOVAL 1" DIA OR SMALLER | 3 | EA | $ 328.98 | $ 987 | |
| | 0.06 | REMOVE EXISTING TENNIS COURT AND ELECTROLIERS | | EA | $ 31,223.00 | $ - | |
| | 0.07 | REMOVE SIDEWALK | 58 | SF | $ 1.29 | $ 75 | |
| **1.00** | | **CONVEYANCE SYSTEM** | | | | | $ 2,107,641 |
| | 1.01 | SAWCUT | 24,976 | LF | $ 2.23 | $ 55,696 | |
| | 1.02 | ABANDON EX. ROCKWELL | 32 | EA | $ 300.00 | $ 9,600 | |
| | 1.03 | ABANDON EX. CROSS CONNECTION AND PLUG BOTH ENDS | 12 | EA | $ 400.00 | $ 4,800 | |
| | 1.04 | REMOVE EX. 6" SANITARY SEWER PIPE | | LF | $ 9.56 | $ - | |
| | 1.05 | REPLACE EX. 6" SANITARY SEWER PIPE | | LF | $ 30.74 | $ - | |
| | 1.06 | REMOVE EX. 8" SANITARY SEWER PIPE | | LF | $ 9.56 | $ - | |
| | 1.07 | REPLACE EX. 8" SANITARY SEWER PIPE | | LF | $ 35.95 | $ - | |
| | 1.08 | REMOVE AND REPLACE EXISTING SEWER LATERAL | 1 | EA | $ 500.00 | $ 500 | |
| | 1.09 | REMOVE EXISTING PUMP STATION | 1 | EA | $ 1,000.00 | $ 1,000 | |
| | 1.10 | REPLACE SIDEWALK | 58 | SF | $ 3.14 | $ 182 | |
| | 1.11 | REMOVE CURB AND GUTTER | 20 | LF | $ 2.63 | $ 53 | |
| | 1.12 | REPLACE CURB AND GUTTER | 20 | LF | $ 14.01 | $ 280 | |
| | 1.13 | CONNECT TO EXISTING CATCH BASIN | 25 | EA | $ 500.00 | $ 12,500 | |
| | 1.14 | CONNECT TO EXISTING MANHOLE | | EA | $ 500.00 | $ - | |
| | 1.15 | COLLAR CONNECTION TO EXISTING | | EA | $ 250.00 | $ - | |
| | 1.16 | SEWER DIVERSION (DURING CONSTRUCTION) | | SF | $ 2,500.00 | $ - | |
| | 1.17 | PAVEMENT REMOVAL | 48,523 | SF | $ 0.83 | $ 40,274 | |

## OPINION OF PROBABLE COST

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**Project:** **Modesto Area 2**
**Project No:** **2108543**
**Park:** **JM Pike - Detention**

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**TOTAL: $ 10,235,090**

| | | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | EXTENSION | SECTION TOTAL |
|---|---|---|---|---|---|---|---|
| | 1.18 | HOT PATCH | 48,523 | SF | $ 2.43 | $ 117,910 | |
| | 1.19 | DIP EXISTING WATER LINE | 3 | EA | $ 2,000.00 | $ 6,000 | |
| | 1.20 | CONSTRUCT CONCRETE SADDLE | 2 | EA | $ 500.00 | $ 1,000 | |
| | 1.19 | 12" STORM DRAIN | 867 | LF | $ 43.90 | $ 38,052 | |
| | 1.21 | 15" STORM DRAIN | | LF | $ 57.78 | $ - | |
| | 1.22 | 18" STORM DRAIN | 2,142 | LF | $ 73.20 | $ 156,769 | |
| | 1.23 | 24" STORM DRAIN | 1,949 | LF | $ 99.53 | $ 194,009 | |
| | 1.24 | 30" STORM DRAIN | 1,758 | LF | $ 134.71 | $ 236,839 | |
| | 1.25 | 36" STORM DRAIN | 3,281 | LF | $ 168.26 | $ 552,083 | |
| | 1.26 | 42" STORM DRAIN | 645 | LF | $ 186.52 | $ 120,294 | |
| | 1.27 | 48" STORM DRAIN | 2,081 | LF | $ 204.78 | $ 426,131 | |
| | 1.28 | 48" MANHOLE | 30 | EA | $ 2,789.00 | $ 83,670 | |
| | 1.29 | 60" MANHOLE | 10 | EA | $ 5,000.00 | $ 50,000 | |
| **2.00** | | **DISPOSAL SYSTEM** | | | | | $ 3,416,449 |
| | 2.01 | DETENTION SYSTEM<br>(Including excavation, filter fabric, bedding, and installation) | 551,034 | CF | $ 4.50 | $ 2,479,653 | |
| | 2.02 | EARTHWORK<br>(Including excavation, stockpile, off-haul and replace) | 551,034 | CF | $ 0.60 | $ 330,620 | |
| | 2.03 | PUMP STATION<br>(Includes power connection, control, SCADA) | 1 | EA | $ 300,000.00 | $ 300,000 | |
| | 2.04 | SCADA SYSTEM<br>(No pump station) | 1 | LS | $ 50,000.00 | $ 50,000 | |
| | 2.05 | 6" FORCEMAIN | 4,634 | LF | $ 45.32 | $ 210,013 | |
| | 2.06 | 48" MANHOLE | | EA | $ 2,789.00 | $ - | |
| | 2.07 | 36" STORM DRAIN | | LF | $ 168.26 | $ - | |
| | 2.08 | SAWCUT | 9,268 | LF | $ 2.23 | $ 20,668 | |
| | 2.09 | REMOVE CURB AND GUTTER | 10 | LF | $ 2.63 | $ 26 | |
| | 2.10 | REPLACE CURB AND GUTTER | 10 | LF | $ 14.01 | $ 140 | |
| | 2.11 | REMOVE SIDEWALK | 50 | SF | $ 1.29 | $ 65 | |
| | 2.12 | REPLACE SIDEWALK | 50 | SF | $ 3.14 | $ 157 | |
| | 2.13 | PAVEMENT REMOVAL | 4,634 | SF | $ 0.83 | $ 3,846 | |
| | 2.14 | HOT PATCH | 4,634 | SF | $ 2.43 | $ 11,261 | |
| | 2.15 | OUTLET STRUCTURE | 1 | EA | $ 10,000.00 | $ 10,000 | |

## OPINION OF PROBABLE COST

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**Project:** **Modesto Area 2**
**Project No:** **2108543**
**Park:** **JM Pike - Detention**

In providing this opinion of probable cost, it is recognized that neither the Client nor RRM Design Group has control over the costs of labor, equipment, or materials, or over the Contractor's methods of determining prices for bidding. This opinion of probable costs is based on RRM Design Group's reasonable professional judgment and experience and does not constitute a warranty, express or implied, that the Contractor's bids or negotiated price of Work will not vary from the Client's budget or from any opinion prepared by RRM Design Group.

**TOTAL: $ 10,235,090**

| | | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | EXTENSION | SECTION TOTAL |
|---|---|---|---|---|---|---|---|
| **3.00** | | **TREATMENT SYSTEM** | | | | | $ 60,000 |
| | 3.01 | PRETREATMENT DEVICE | 1 | EA | $ 30,000.00 | $ 30,000 | |
| | 3.02 | ISOLATION VALVE | 1 | EA | $ 30,000.00 | $ 30,000 | |
| **4.00** | | **PARK IMPROVEMENTS** | | | | | $ 551,000 |
| | 4.01 | SITE DRAINAGE | 1 | LS | $ 18,500.00 | $ 18,500 | |
| | 4.02 | PAVING AND SURFACING | 1 | LS | $ 208,500.00 | $ 208,500 | |
| | 4.03 | SITE WALLS | | LS | | $ - | |
| | 4.04 | SITE FURNISHING AND EQUIPMENT | 1 | LS | $ 34,500.00 | $ 34,500 | |
| | 4.05 | TENNIS COURTS, COMPLETE INCLUDING PAVEMENT, STRIPING, LIGHTING, FENCING AND EQUIPMENT | | LS | | $ - | |
| | 4.06 | RE-SET EXISTING PLAY STRUCTURE | 1 | EA | $ 15,000.00 | $ 15,000 | |
| | 4.07 | BASEBALL INFIELD, FENCING AND EQUIPMENT | 1 | LS | $ 84,500.00 | $ 84,500 | |
| | 4.08 | IRRIGATION | 1 | LS | $ 40,000.00 | $ 40,000 | |
| | 4.09 | PLANTING AND TURF | 1 | LS | $ 150,000.00 | $ 150,000 | |
| | 4.10 | RESTROOM | | LS | | $ - | |
| **5.00** | | **MISC.** | | | | | $ 85,000 |
| | 5.01 | DISCONNECT AND ABANDON EXISTING 12 WATER LINE | | EA | $ 500.00 | $ - | |
| | 5.02 | 12" WATER LINE<br>(Including trenching, sawcutting and hatch patch) | | LF | $ 85.20 | $ - | |
| | 5.03 | 12" WATER VALVE | | EA | $ 2,154.63 | $ - | |
| | 5.04 | CONNECT TO EXISTING WATER LINE | | EA | $ 5,401.59 | $ - | |
| | 5.05 | PRESSURE BACKFLOW DEVICE | | EA | $ 28,570.00 | $ - | |
| | 5.06 | TRAFFIC CONTROL | 1 | LS | $ 75,000.00 | $ 75,000 | |
| | 5.07 | SHORING | 1 | EA | $ 10,000.00 | $ 10,000 | |
| | | SUBTOTAL | | | | | $ 6,238,531 |
| **6.00** | | **Mobilization and Bonding** | | | | | $ 311,927 |
| | 6.01 | Mobilization<br>(Includes the cost of purchase, installation and maintenance of all proposed erosion control methods shown on the civil plans.) | | % | 4% | $ 249,541 | |
| | 6.02 | Bonding | | % | 1% | $ 62,385 | |
| | | CONSTRUCTION SUBTOTAL | | | | | $ 6,550,458 |
| | | Design Contingency | | | 25.0% | $ 1,637,614 | $ 1,637,614 |
| | | SUBTOTAL | | | | | $ 8,188,072 |
| | | Legal, Engineering and Administration | | | 25.0% | $ 2,047,018 | $ 2,047,018 |
| | | TOTAL | | | | | $ 10,235,090 |

## OPINION OF PROBABLE COST

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**Project:** **Modesto Area 2**
**Project No:** **2108543**
**Park:** **Roosevelt - Retention**

In providing this opinion of probable cost, it is recognized that neither the Client nor RRM Design Group has control over the costs of labor, equipment, or materials, or over the Contractor's methods of determining prices for bidding. This opinion of probable costs is based on RRM Design Group's reasonable professional judgment and experience and does not constitute a warranty, express or implied, that the Contractor's bids or negotiated price of Work will not vary from the Client's budget or from any opinion prepared by RRM Design Group.

**TOTAL: $ 7,121,611**

| | | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | EXTENSION | SECTION TOTAL |
|---|---|---|---|---|---|---|---|
| **0.00** | | **SITE PREPARATION** | | | | | $ 78,745 |
| | 0.01 | PARK DEMOLITION AND REMOVAL | 39,897 | SF | $ 0.13 | $ 5,187 | |
| | 0.02 | REMOVE EX. RESTROOM | 1 | LS | $ 16,000.00 | $ 16,000 | |
| | 0.03 | REMOVE EXISTING POOL | 1 | LS | $ 9,500.00 | $ 9,500 | |
| | 0.04 | TREE REMOVAL 1" DIA OR LARGER | 5 | EA | $ 822.64 | $ 4,113 | |
| | 0.05 | TREE REMOVAL 1" DIA OR SMALLER | 2 | EA | $ 328.98 | $ 658 | |
| | 0.06 | REMOVE EXISTING TENNIS COURT AND ELECTROLIERS | 1 | EA | $ 31,223.00 | $ 31,223 | |
| | 0.07 | REMOVE SIDEWALK | 9,352 | SF | $ 1.29 | $ 12,064 | |
| **1.00** | | **CONVEYANCE SYSTEM** | | | | | $ 500,822 |
| | 1.01 | SAWCUT | 5,450 | LF | $ 2.23 | $ 12,154 | |
| | 1.02 | ABANDON EX. ROCKWELL | 12 | EA | $ 300.00 | $ 3,600 | |
| | 1.03 | ABANDON EX. CROSS CONNECTION AND PLUG BOTH ENDS | 8 | EA | $ 400.00 | $ 3,200 | |
| | 1.04 | REMOVE EX. 6" SANITARY SEWER PIPE | 91 | LF | $ 9.56 | $ 869 | |
| | 1.05 | REPLACE EX. 6" SANITARY SEWER PIPE | 91 | LF | $ 30.74 | $ 2,794 | |
| | 1.06 | REMOVE EX. 8" SANITARY SEWER PIPE | | LF | $ 9.56 | $ - | |
| | 1.07 | REPLACE EX. 8" SANITARY SEWER PIPE | | LF | $ 35.95 | $ - | |
| | 1.08 | REMOVE AND REPLACE EXISTING SEWER LATERAL | 1 | EA | $ 500.00 | $ 500 | |
| | 1.09 | REMOVE EXISTING PUMP STATION | | EA | $ 1,000.00 | $ - | |
| | 1.10 | REPLACE SIDEWALK | 60 | SF | $ 3.14 | $ 190 | |
| | 1.11 | REMOVE CURB AND GUTTER | 12 | LF | $ 2.63 | $ 32 | |
| | 1.12 | REPLACE CURB AND GUTTER | 12 | LF | $ 14.01 | $ 168 | |
| | 1.13 | CONNECT TO EXISTING CATCH BASIN | 10 | EA | $ 500.00 | $ 5,000 | |
| | 1.14 | CONNECT TO EXISTING MANHOLE | 5 | EA | $ 500.00 | $ 2,500 | |
| | 1.15 | COLLAR CONNECTION TO EXISTING | 3 | EA | $ 250.00 | $ 750 | |
| | 1.16 | SEWER DIVERSION (DURING CONSTRUCTION) | 3 | EA | $ 2,500.00 | $ 7,500 | |
| | 1.17 | PAVEMENT REMOVAL | 8,646 | SF | $ 0.83 | $ 7,176 | |
| | 1.18 | HOT PATCH | 8,646 | SF | $ 2.43 | $ 21,009 | |
| | 1.19 | DIP EXISTING WATER LINE | 4 | EA | $ 2,000.00 | $ 8,000 | |
| | 1.20 | CONSTRUCT CONCRETE SADDLE | | EA | $ 500.00 | $ - | |
| | 1.19 | 12" STORM DRAIN | 288 | LF | $ 43.90 | $ 12,648 | |
| | 1.21 | 15" STORM DRAIN | | LF | $ 57.78 | $ - | |
| | 1.22 | 18" STORM DRAIN | 28 | LF | $ 73.20 | $ 2,038 | |
| | 1.23 | 24" STORM DRAIN | 352 | LF | $ 99.53 | $ 35,018 | |

## OPINION OF PROBABLE COST

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**Project:** **Modesto Area 2**
**Project No:** **2108543**
**Park:** **Roosevelt - Retention**

In providing this opinion of probable cost, it is recognized that neither the Client nor RRM Design Group has control over the costs of labor, equipment, or materials, or over the Contractor's methods of determining prices for bidding. This opinion of probable costs is based on RRM Design Group's reasonable professional judgment and experience and does not constitute a warranty, express or implied, that the Contractor's bids or negotiated price of Work will not vary from the Client's budget or from any opinion prepared by RRM Design Group.

**TOTAL: $ 7,121,611**

| | | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | EXTENSION | SECTION TOTAL |
|---|---|---|---|---|---|---|---|
| | 1.24 | 30" STORM DRAIN | 95 | LF | $ 134.71 | $ 12,843 | |
| | 1.25 | 36" STORM DRAIN | 1,957 | LF | $ 168.26 | $ 329,366 | |
| | 1.26 | 42" STORM DRAIN | | LF | $ 186.52 | $ - | |
| | 1.27 | 48" STORM DRAIN | | LF | $ 204.78 | $ - | |
| | 1.28 | 48" MANHOLE | 12 | EA | $ 2,789.00 | $ 33,468 | |
| | 1.29 | 60" MANHOLE | | EA | $ 5,000.00 | $ - | |
| **2.00** | | **DISPOSAL SYSTEM** | | | | | $ 2,660,068 |
| | 2.01 | RETENTION SYSTEM<br>(Including excavation, filter fabric, bedding, and installation) | 511,778 | CF | $ 4.50 | $ 2,303,001 | |
| | 2.02 | EARTHWORK<br>(Including excavation, stockpile, off-haul and replace) | 511,778 | CF | $ 0.60 | $ 307,067 | |
| | 2.03 | PUMP STATION<br>(Includes power connection, control, SCADA) | | EA | $ 300,000.00 | $ - | |
| | 2.04 | SCADA SYSTEM<br>(No pump station) | 1 | LS | $ 50,000.00 | $ 50,000 | |
| | 2.05 | 6" FORCEMAIN | | LF | $ 45.32 | | |
| | 2.06 | 48" MANHOLE | | EA | $ 2,789.00 | $ - | |
| | 2.07 | 36" STORM DRAIN | | LF | $ 168.26 | $ - | |
| | 2.08 | SAWCUT | | LF | $ 2.23 | $ - | |
| | 2.09 | REMOVE CURB AND GUTTER | | LF | $ 2.63 | $ - | |
| | 2.10 | REPLACE CURB AND GUTTER | | LF | $ 14.01 | $ - | |
| | 2.11 | REMOVE SIDEWALK | | SF | $ 1.29 | $ - | |
| | 2.12 | REPLACE SIDEWALK | | SF | $ 3.14 | $ - | |
| | 2.13 | PAVEMENT REMOVAL | | SF | $ 0.83 | $ - | |
| | 2.14 | HOT PATCH | | SF | $ 2.43 | $ - | |
| | 2.15 | OUTLET STRUCTURE | | EA | $ 10,000.00 | $ - | |

## OPINION OF PROBABLE COST

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**Project:** **Modesto Area 2**
**Project No:** **2108543**
**Park:** **Roosevelt - Retention**

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**TOTAL: $ 7,121,611**

| | | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | EXTENSION | SECTION TOTAL |
|---|---|---|---|---|---|---|---|
| **3.00** | | **TREATMENT SYSTEM** | | | | | $ 60,000 |
| | 3.01 | PRETREATMENT DEVICE | 1 | EA | $ 30,000.00 | $ 30,000 | |
| | 3.02 | ISOLATION VALVE | 1 | EA | $ 30,000.00 | $ 30,000 | |
| **4.00** | | **PARK IMPROVEMENTS** | | | | | $ 853,750 |
| | 4.01 | SITE DRAINAGE | 1 | LS | $ 16,500.00 | $ 16,500 | |
| | 4.02 | PAVING AND SURFACING | 1 | LS | $ 248,500.00 | $ 248,500 | |
| | 4.03 | SITE WALLS | 1 | LS | $ 10,500.00 | $ 10,500 | |
| | 4.04 | SITE FURNISHING AND EQUIPMENT | 1 | LS | $ 34,500.00 | $ 34,500 | |
| | 4.05 | TENNIS COURTS, COMPLETE INCLUDING PAVEMENT, STRIPING, LIGHTING, FENCING AND EQUIPMENT | 1 | LS | $ 175,000.00 | $ 175,000 | |
| | 4.06 | RE-SET EXISTING PLAY STRUCTURE | 2 | EA | $ 15,000.00 | $ 30,000 | |
| | 4.07 | BASEBALL INFIELD AND BASES | | LS | | $ - | |
| | 4.08 | IRRIGATION | 1 | LS | $ 58,250.00 | $ 58,250 | |
| | 4.09 | PLANTING AND TURF | 1 | LS | $ 55,500.00 | $ 55,500 | |
| | 4.10 | RESTROOM | 1 | LS | $ 225,000.00 | $ 225,000 | |
| **5.00** | | **MISC.** | | | | | $ 187,407 |
| | 5.01 | DISCONNECT AND ABANDON EXISTING 12 WATER LINE | 2 | EA | $ 500.00 | $ 1,000 | |
| | 5.02 | 12" WATER LINE<br>(Including trenching, sawcutting and hatch patch) | 971 | LF | $ 85.20 | $ 82,724 | |
| | 5.03 | 12" WATER VALVE | 2 | EA | $ 2,154.63 | $ 4,309 | |
| | 5.04 | CONNECT TO EXISTING WATER LINE | 2 | EA | $ 5,401.59 | $ 10,803 | |
| | 5.05 | PRESSURE BACKFLOW DEVICE | 1 | EA | $ 28,570.00 | $ 28,570 | |
| | 5.06 | TRAFFIC CONTROL | 1 | LS | $ 50,000.00 | $ 50,000 | |
| | 5.07 | SHORING | 1 | EA | $ 10,000.00 | $ 10,000 | |
| | | SUBTOTAL | | | | | $ 4,340,791 |
| **6.00** | | **Mobilization and Bonding** | | | | | $ 217,040 |
| | 6.01 | Mobilization<br>(Includes the cost of purchase, installation and maintenance of all proposed erosion control methods shown on the civil plans.) | | % | 4% | $ 173,632 | |
| | 6.02 | Bonding | | % | 1% | $ 43,408 | |
| | | CONSTRUCTION SUBTOTAL | | | | | $ 4,557,831 |
| | | Design Contingency | | | 25.0% | $ 1,139,458 | $ 1,139,458 |
| | | SUBTOTAL | | | | | $ 5,697,289 |
| | | Legal, Engineering and Administration | | | 25.0% | $ 1,424,322 | $ 1,424,322 |
| | | TOTAL | | | | | $ 7,121,611 |

## OPINION OF PROBABLE COST

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**Project:** **Modesto Area 2**
**Project No:** **2108543**
**Park:** **Roosevelt - Detention**

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**TOTAL: $ 5,604,183**

| | | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | EXTENSION | SECTION TOTAL |
|---|---|---|---|---|---|---|---|
| **0.00** | | **SITE PREPARATION** | | | | | $ 78,745 |
| | 0.01 | PARK DEMOLITION AND REMOVAL | 39,897 | SF | $ 0.13 | $ 5,187 | |
| | 0.02 | REMOVE EX. RESTROOM | 1 | LS | $ 16,000.00 | $ 16,000 | |
| | 0.03 | REMOVE EXISTING POOL | 1 | LS | $ 9,500.00 | $ 9,500 | |
| | 0.04 | TREE REMOVAL 1" DIA OR LARGER | 5 | EA | $ 822.64 | $ 4,113 | |
| | 0.05 | TREE REMOVAL 1" DIA OR SMALLER | 2 | EA | $ 328.98 | $ 658 | |
| | 0.06 | REMOVE EXISTING TENNIS COURT AND ELECTROLIERS | 1 | EA | $ 31,223.00 | $ 31,223 | |
| | 0.07 | REMOVE SIDEWALK | 9,352 | SF | $ 1.29 | $ 12,064 | |
| **1.00** | | **CONVEYANCE SYSTEM** | | | | | $ 501,528 |
| | 1.01 | SAWCUT | 5,450 | LF | $ 2.23 | $ 12,152 | |
| | 1.02 | ABANDON EX. ROCKWELL | 12 | EA | $ 300.00 | $ 3,600 | |
| | 1.03 | ABANDON EX. CROSS CONNECTION AND PLUG BOTH ENDS | 8 | EA | $ 400.00 | $ 3,200 | |
| | 1.04 | REMOVE EX. 6" SANITARY SEWER PIPE | 91 | LF | $ 9.56 | $ 869 | |
| | 1.05 | REPLACE EX. 6" SANITARY SEWER PIPE | 91 | LF | $ 30.74 | $ 2,794 | |
| | 1.06 | REMOVE EX. 8" SANITARY SEWER PIPE | | LF | $ 9.56 | $ - | |
| | 1.07 | REPLACE EX. 8" SANITARY SEWER PIPE | | LF | $ 35.95 | $ - | |
| | 1.08 | REMOVE AND REPLACE EXISTING SEWER LATERAL | 1 | EA | $ 500.00 | $ 500 | |
| | 1.09 | REMOVE EXISTING PUMP STATION | | EA | $ 1,000.00 | $ - | |
| | 1.10 | REPLACE SIDEWALK | 60 | SF | $ 3.14 | $ 188 | |
| | 1.11 | REMOVE CURB AND GUTTER | 12 | LF | $ 2.63 | $ 32 | |
| | 1.12 | REPLACE CURB AND GUTTER | 12 | LF | $ 14.01 | $ 168 | |
| | 1.13 | CONNECT TO EXISTING CATCH BASIN | 10 | EA | $ 500.00 | $ 5,000 | |
| | 1.14 | CONNECT TO EXISTING MANHOLE | 5 | EA | $ 500.00 | $ 2,500 | |
| | 1.15 | COLLAR CONNECTION TO EXISTING | 3 | EA | $ 250.00 | $ 750 | |
| | 1.16 | SEWER DIVERSION (DURING CONSTRUCTION) | 3 | EA | $ 2,500.00 | $ 7,500 | |
| | 1.17 | PAVEMENT REMOVAL | 8,646 | SF | $ 0.83 | $ 7,176 | |
| | 1.18 | HOT PATCH | 8,646 | SF | $ 2.43 | $ 21,009 | |
| | 1.19 | DIP EXISTING WATER LINE | 4 | EA | $ 2,000.00 | $ 8,000 | |
| | 1.20 | CONSTRUCT CONCRETE SADDLE | | EA | $ 500.00 | $ - | |
| | 1.19 | 12" STORM DRAIN | 288 | LF | $ 43.90 | $ 12,648 | |
| | 1.21 | 15" STORM DRAIN | | LF | $ 57.78 | $ - | |
| | 1.22 | 18" STORM DRAIN | 28 | LF | $ 73.20 | $ 2,038 | |
| | 1.23 | 24" STORM DRAIN | 352 | LF | $ 99.53 | $ 35,018 | |

## OPINION OF PROBABLE COST

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**Project:** **Modesto Area 2**
**Project No:** **2108543**
**Park:** **Roosevelt - Detention**

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**TOTAL: $ 5,604,183**

| | | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | EXTENSION | SECTION TOTAL |
|---|---|---|---|---|---|---|---|
| | 1.24 | 30" STORM DRAIN | 95 | LF | $ 134.71 | $ 12,843 | |
| | 1.25 | 36" STORM DRAIN | 1,962 | LF | $ 168.26 | $ 330,074 | |
| | 1.26 | 42" STORM DRAIN | | LF | $ 186.52 | $ - | |
| | 1.27 | 48" STORM DRAIN | | LF | $ 204.78 | $ - | |
| | 1.28 | 48" MANHOLE | 12 | EA | $ 2,789.00 | $ 33,468 | |
| | 1.29 | 60" MANHOLE | | EA | $ 5,000.00 | $ - | |
| **2.00** | | **DISPOSAL SYSTEM** | | | | | $ 1,724,453 |
| | 2.01 | DETENTION SYSTEM<br>(Including excavation, filter fabric, bedding, and installation) | 250,034 | CF | $ 4.50 | $ 1,125,155 | |
| | 2.02 | EARTHWORK<br>(Including excavation, stockpile, off-haul and replace) | 250,034 | CF | $ 0.60 | $ 150,021 | |
| | 2.03 | PUMP STATION<br>(Includes power connection, control, SCADA) | 1 | EA | $ 300,000.00 | $ 300,000 | |
| | 2.04 | SCADA SYSTEM<br>(No pump station) | 1 | LS | $ 50,000.00 | $ 50,000 | |
| | 2.05 | 6" FORCEMAIN | 34 | LF | $ 45.32 | $ 1,537 | |
| | 2.06 | 48" MANHOLE | 2 | EA | $ 2,789.00 | $ 5,578 | |
| | 2.07 | 36" STORM DRAIN | 529 | LF | $ 168.26 | $ 89,028 | |
| | 2.08 | SAWCUT | 708 | LF | $ 2.23 | $ 1,578 | |
| | 2.09 | REMOVE CURB AND GUTTER | 10 | LF | $ 2.63 | $ 26 | |
| | 2.10 | REPLACE CURB AND GUTTER | 10 | LF | $ 14.01 | $ 140 | |
| | 2.11 | REMOVE SIDEWALK | 53 | SF | $ 1.29 | $ 68 | |
| | 2.12 | REPLACE SIDEWALK | 53 | SF | $ 3.14 | $ 166 | |
| | 2.13 | PAVEMENT REMOVAL | 354 | SF | $ 0.83 | $ 294 | |
| | 2.14 | HOT PATCH | 355 | SF | $ 2.43 | $ 862 | |
| | 2.15 | OUTLET STRUCTURE | | EA | $ 10,000.00 | $ - | |

## OPINION OF PROBABLE COST

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**Project:** **Modesto Area 2**
**Project No:** **2108543**
**Park:** **Roosevelt - Detention**

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**TOTAL: $ 5,604,183**

| | | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | EXTENSION | SECTION TOTAL |
|---|---|---|---|---|---|---|---|
| **3.00** | | **TREATMENT SYSTEM** | | | | | $ 60,000 |
| | 3.01 | PRETREATMENT DEVICE | 1 | EA | $ 30,000.00 | $ 30,000 | |
| | 3.02 | ISOLATION VALVE | 1 | EA | $ 30,000.00 | $ 30,000 | |
| **4.00** | | **PARK IMPROVEMENTS** | | | | | $ 853,750 |
| | 4.01 | SITE DRAINAGE | 1 | LS | $ 16,500.00 | $ 16,500 | |
| | 4.02 | PAVING AND SURFACING | 1 | LS | $ 248,500.00 | $ 248,500 | |
| | 4.03 | SITE WALLS | 1 | LS | $ 10,500.00 | $ 10,500 | |
| | 4.04 | SITE FURNISHING AND EQUIPMENT | 1 | LS | $ 34,500.00 | $ 34,500 | |
| | 4.05 | TENNIS COURTS, COMPLETE INCLUDING PAVEMENT, STRIPING, LIGHTING, FENCING AND EQUIPMENT | 1 | LS | $ 175,000.00 | $ 175,000 | |
| | 4.06 | RE-SET EXISTING PLAY STRUCTURE | 2 | EA | $ 15,000.00 | $ 30,000 | |
| | 4.07 | BASEBALL INFIELD AND BASES | | LS | | $ - | |
| | 4.08 | IRRIGATION | 1 | LS | $ 58,250.00 | $ 58,250 | |
| | 4.09 | PLANTING AND TURF | 1 | LS | $ 55,500.00 | $ 55,500 | |
| | 4.10 | RESTROOM | 1 | LS | $ 225,000.00 | $ 225,000 | |
| **5.00** | | **MISC.** | | | | | $ 197,407 |
| | 5.01 | DISCONNECT AND ABANDON EXISTING 12 WATER LINE | 2 | EA | $ 500.00 | $ 1,000 | |
| | 5.02 | 12" WATER LINE<br>(Including trenching, sawcutting and hatch patch) | 971 | LF | $ 85.20 | $ 82,724 | |
| | 5.03 | 12" WATER VALVE | 2 | EA | $ 2,154.63 | $ 4,309 | |
| | 5.04 | CONNECT TO EXISTING WATER LINE | 2 | EA | $ 5,401.59 | $ 10,803 | |
| | 5.05 | PRESSURE BACKFLOW DEVICE | 1 | EA | $ 28,570.00 | $ 28,570 | |
| | 5.06 | TRAFFIC CONTROL | 1 | LS | $ 50,000.00 | $ 50,000 | |
| | 5.07 | SHORING | 2 | EA | $ 10,000.00 | $ 20,000 | |
| | | SUBTOTAL | | | | | $ 3,415,883 |
| **6.00** | | **Mobilization and Bonding** | | | | | $ 170,794 |
| | 6.01 | Mobilization<br>(Includes the cost of purchase, installation and maintenance of all proposed erosion control methods shown on the civil plans.) | | % | 4% | $ 136,635 | |
| | 6.02 | Bonding | | % | 1% | $ 34,159 | |
| | | CONSTRUCTION SUBTOTAL | | | | | $ 3,586,677 |
| | | Design Contingency | | | 25.0% | $ 896,669 | $ 896,669 |
| | | SUBTOTAL | | | | | $ 4,483,346 |
| | | Legal, Engineering and Administration | | | 25.0% | $ 1,120,837 | $ 1,120,837 |
| | | TOTAL | | | | | $ 5,604,183 |

Modesto Area 2
Cost Comparison for Stantec Cross Connection Report

| Cross Connection | Cross Connection Report Detention Volume | Field Verified Retention Volume | *Cross Connection Report Unit Cost | Cost To Meet City Design Standards |
|---|---|---|---|---|
| | | | | |
| | (CF) | (CF) | ($) | ($) |
| | | | | |
| Sub-Basin 22 | | | | |
| 2 | 61,107 | 243,710 | $ 27.61 | 6,728,833 |
| 5 | 29,384 | 27,687 | $ 27.61 | 764,438 |
| 6 | 10,476 | 84,768 | $ 27.61 | 2,340,444 |
| 7 | 71,373 | 120,777 | $ 27.61 | 3,334,653 |
| 8 | 13,263 | 174,536 | $ 27.61 | 4,818,939 |
| 10 | 53,217 | 48,639 | $ 27.61 | 1,342,923 |
| 15 | 45,100 | 79,889 | $ 27.61 | 2,205,735 |
| 16 | 16,483 | 91,649 | $ 27.61 | 2,530,429 |
| 18 | 28,143 | 87,939 | $ 27.61 | 2,427,996 |
| 19 | 28,143 | 69,888 | $ 27.61 | 1,929,608 |
| 27 | 29,533 | 51,958 | $ 27.61 | 1,434,560 |
| 32 | 27,895 | 120,382 | $ 27.61 | 3,323,747 |
| 33 | 29,541 | 43,787 | $ 27.61 | 1,208,959 |
| 34 | 29,541 | 79,523 | $ 27.61 | 2,195,630 |
| 35 | 59,302 | 86,089 | $ 27.61 | 2,376,917 |
| 36 | 15,862 | 115,260 | $ 27.61 | 3,182,329 |
| 37 | 58,224 | 119,041 | $ 27.61 | 3,286,722 |
| A | | 69,159 | $ 27.61 | 1,909,480 |
| | 606,587 | 1,714,681 | | **47,342,342** |

| | | | | |
|---|---|---|---|---|
| Sub-Basin 89 | | | | |
| 3 | 38541 | 27687 | $25.49 | $705,742 |
| 11 | 58033 | 80987 | $25.49 | $2,064,359 |
| 14 | 56984 | 129774 | $25.49 | $3,307,939 |
| | 153,558 | 238,448 | | **$6,078,040** |

**Total Area 2 Retention Cost $ 53,420,382**

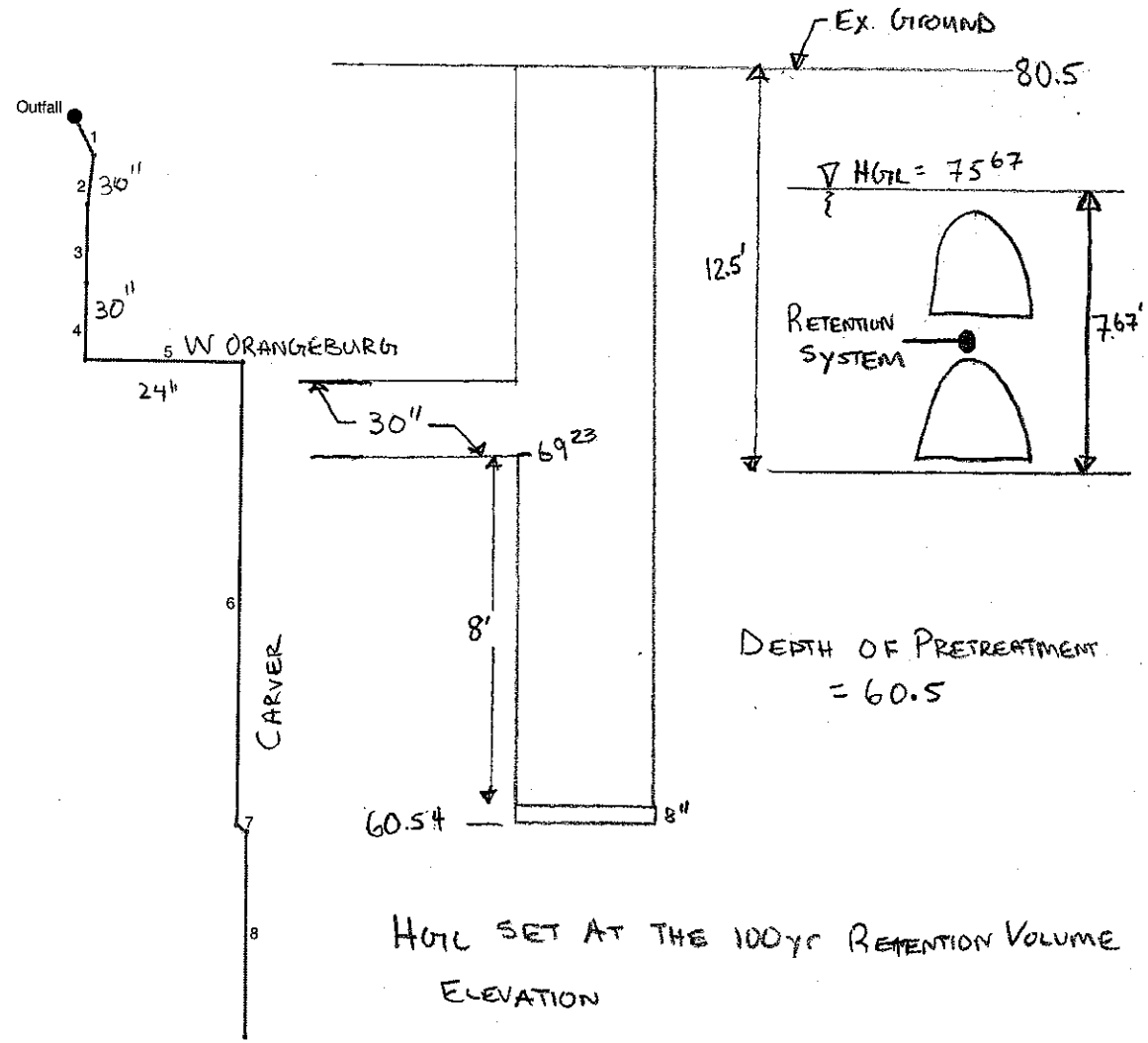
*Cross Connection Report Sub-basin 22 Recommendations Cost $15,408,000 for 558,061 CF or $ 27.61/CF

Cross Connection Report Sub-Basin 89 recommendations cost $10,839,653 for 425,277 CF or $25.49/CF

# APPENDIX C

## HYDRAULIC ANALYSES

# Hydraflow Storm Sewers Extension for AutoCAD® Civil 3D® 2009 Plan




REQUIRED 100 yr RETENTION VOLUME: 5.0 AC-FT
RETENTION SYSTEM = 4.9 AC-FT
PIPE STORAGE = .18 ACFT
TOTAL DESIGN = 5.08 AC-FT

| Project File: Garrison Park-11.stm | Number of lines: 8 | Date: 10-30-2009 |
|---|---|---|

# Storm Sewer Tabulation



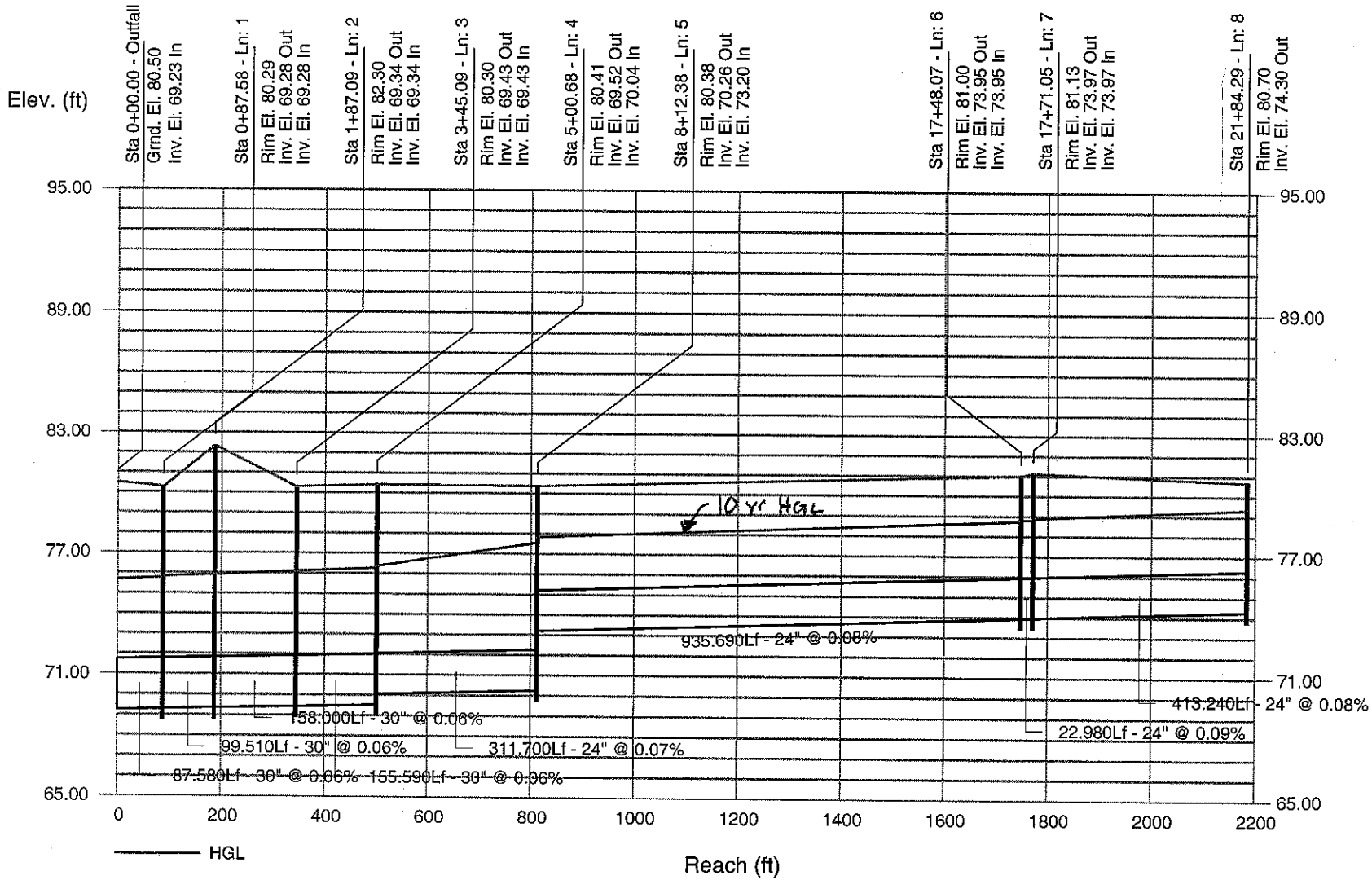
| Station | | Len | Drng Area | | Rnoff coeff | Area x C | | Tc | | Rain (I) | Total flow | Cap full | Vel | Pipe | | Invert Elev | | HGL Elev | | Grnd / Rim Elev | | Line ID |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Line | To Line | | Incr | Total | | Incr | Total | Inlet | Syst | | | | | Size | Slope | Dn | Up | Dn | Up | Dn | Up | |
| | | (ft) | (ac) | (ac) | (C) | | | (min) | (min) | (in/hr) | (cfs) | (cfs) | (ft/s) | (in) | (%) | (ft) | (ft) | (ft) | (ft) | (ft) | (ft) | |
| 1 | End | 87.580 | 0.00 | 17.37 | 0.00 | 0.00 | 10.75 | 0.0 | 21.6 | 1.2 | 12.63 | 9.80 | 2.57 | 30 | 0.06 | 69.23 | 69.28 | 75.67 | 75.75 | 80.50 | 80.29 | |
| 2 | 1 | 99.510 | 0.00 | 17.37 | 0.00 | 0.00 | 10.75 | 0.0 | 21.1 | 1.2 | 12.78 | 10.07 | 2.60 | 30 | 0.06 | 69.28 | 69.34 | 75.81 | 75.91 | 80.29 | 82.30 | |
| 3 | 2 | 158.000 | 0.00 | 17.37 | 0.00 | 0.00 | 10.75 | 0.0 | 20.2 | 1.2 | 13.02 | 9.79 | 2.65 | 30 | 0.06 | 69.34 | 69.43 | 75.93 | 76.09 | 82.30 | 80.30 | |
| 4 | 3 | 155.590 | 0.00 | 17.37 | 0.00 | 0.00 | 10.75 | 0.0 | 19.4 | 1.2 | 13.27 | 9.86 | 2.70 | 30 | 0.06 | 69.43 | 69.52 | 76.10 | 76.26 | 80.30 | 80.41 | |
| 5 | 4 | 311.700 | 9.74 | 17.37 | 0.61 | 5.94 | 10.75 | 10.0 | 17.6 | 1.3 | 13.79 | 6.01 | 4.39 | 24 | 0.07 | 70.04 | 70.26 | 76.38 | 77.54 | 80.41 | 80.38 | Area 7 |
| 6 | 5 | 935.690 | 0.00 | 7.63 | 0.00 | 0.00 | 4.81 | 0.0 | 12.4 | 1.5 | 7.00 | 6.40 | 2.23 | 24 | 0.08 | 73.20 | 73.95 | 77.84 | 78.73 | 80.38 | 81.00 | |
| 7 | 6 | 22.980 | 0.00 | 7.63 | 0.00 | 0.00 | 4.81 | 0.0 | 12.3 | 1.5 | 7.02 | 6.67 | 2.23 | 24 | 0.09 | 73.95 | 73.97 | 78.80 | 78.82 | 81.00 | 81.13 | |
| 8 | 7 | 413.240 | 7.63 | 7.63 | 0.63 | 4.81 | 4.81 | 10.0 | 10.0 | 1.6 | 7.46 | 6.39 | 2.38 | 24 | 0.08 | 73.97 | 74.30 | 78.89 | 79.34 | 81.13 | 80.70 | Area 5 |

Project File: Garrison Park-11.stm | Number of lines: 8 | Run Date: 10-30-2009

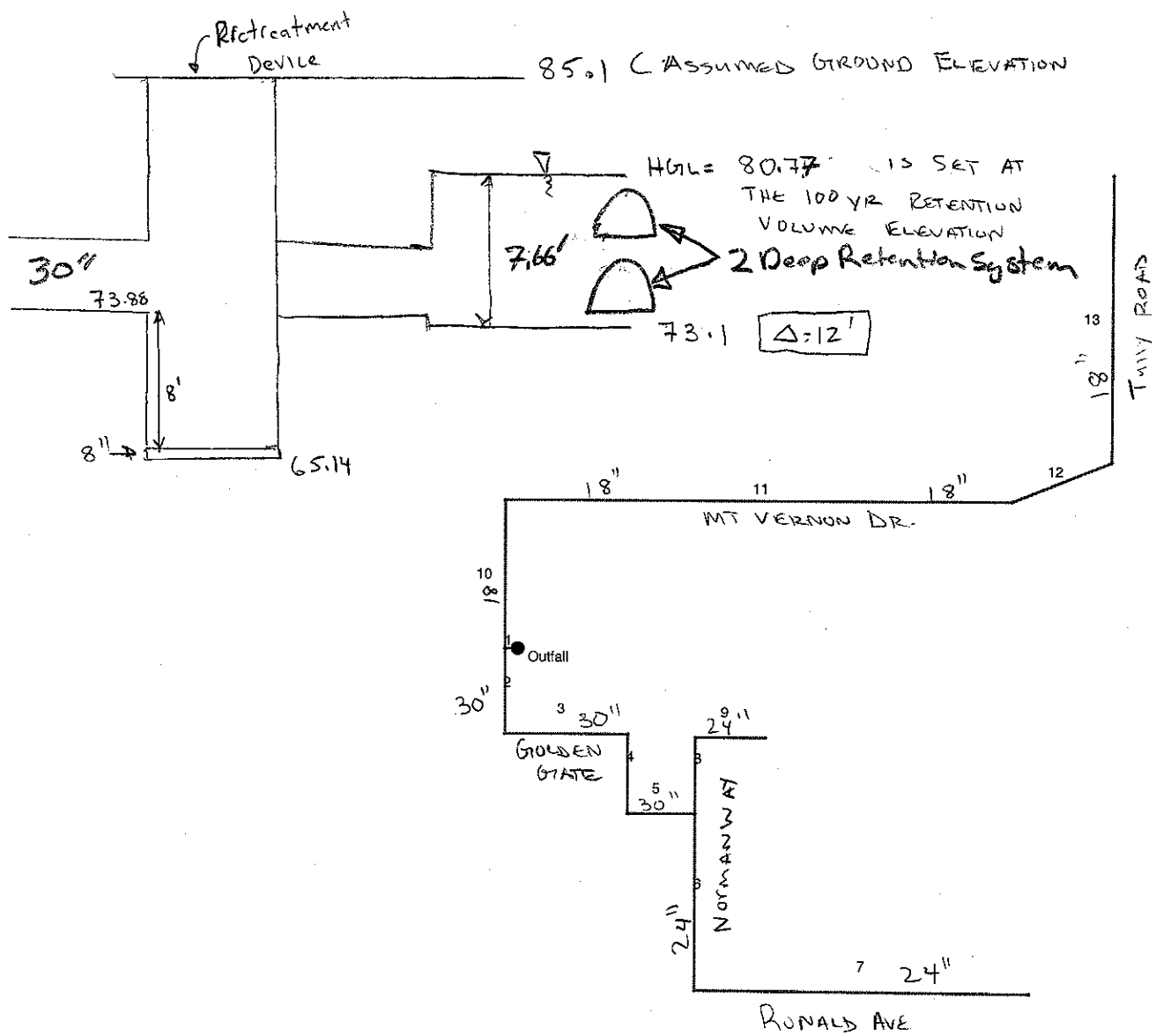
NOTES: Intensity = 61.96 / (Inlet time + 27.10) ^ 1.02; Return period = 10 Yrs. ; c = cir e = ellip b = box

# Storm Sewer Profile

Proj. file: Garris Park-11.stm



# Hydraflow Storm Sewers Extension for AutoCAD® Civil 3D® 2009 Plan




Volume Required = 5.47 Ac Ft
100-YR Retention

- Retention System = 5.04 Ac-Ft.
- Pipe Storage = .47 Ac-Ft

Total Design Storage = 5.51 Ac Ft

| | | |
|---|---|---|
| Project File: Catherine Everett-10.stm | Number of lines: 13 | Date: 09-18-2009 |

# Storm Sewer Tabulation



| Station | | Len | Drng Area | | Rnoff coeff | Area x C | | Tc | | Rain (I) | Total flow | Cap full | Vel | Pipe | | Invert Elev | | HGL Elev | | Grnd / Rim Elev | | Line ID |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Line | To Line | (ft) | Incr (ac) | Total (ac) | (C) | Incr | Total | Inlet (min) | Syst (min) | (in/hr) | (cfs) | (cfs) | (ft/s) | Size (in) | Slope (%) | Dn (ft) | Up (ft) | Dn (ft) | Up (ft) | Dn (ft) | Up (ft) | |
| 1 | End | 49.670 | 0.00 | 19.55 | 0.00 | 0.00 | 11.73 | 0.0 | 31.0 | 1.0 | 11.52 | 10.08 | 2.35 | 30 | 0.06 | 73.88 | 73.91 | 80.77 | 80.81 | 84.69 | 84.79 | |
| 2 | 1 | 309.940 | 0.00 | 17.28 | 0.00 | 0.00 | 10.37 | 0.0 | 25.7 | 1.1 | 11.23 | 10.15 | 2.29 | 30 | 0.06 | 76.31 | 76.50 | 80.89 | 81.13 | 84.79 | 83.00 | |
| 3 | 2 | 442.030 | 0.00 | 17.28 | 0.00 | 0.00 | 10.37 | 0.0 | 23.2 | 1.1 | 11.79 | 9.95 | 2.40 | 30 | 0.06 | 76.50 | 76.76 | 81.21 | 81.57 | 83.00 | 84.49 | |
| 4 | 3 | 289.800 | 0.00 | 17.28 | 0.00 | 0.00 | 10.37 | 0.0 | 21.6 | 1.2 | 12.19 | 9.93 | 2.48 | 30 | 0.06 | 76.76 | 76.93 | 81.66 | 81.92 | 84.49 | 84.84 | |
| 5 | 4 | 242.400 | 0.00 | 17.28 | 0.00 | 0.00 | 10.37 | 0.0 | 20.3 | 1.2 | 12.54 | 10.20 | 2.56 | 30 | 0.06 | 76.93 | 77.08 | 82.02 | 82.24 | 84.84 | 87.02 | |
| 6 | 5 | 638.950 | 0.00 | 6.64 | 0.00 | 0.00 | 3.98 | 0.0 | 16.7 | 1.3 | 5.22 | 6.39 | 1.66 | 24 | 0.08 | 78.02 | 78.53 | 82.34 | 82.68 | 87.02 | 86.43 | |
| 7 | 6 | 1210.100 | 6.64 | 6.64 | 0.60 | 3.98 | 3.98 | 10.0 | 10.0 | 1.6 | 6.19 | 6.40 | 1.97 | 24 | 0.08 | 78.53 | 79.50 | 82.73 | 83.63 | 86.43 | 86.37 | Area 7 |
| 8 | 5 | 278.720 | 0.00 | 10.64 | 0.00 | 0.00 | 6.38 | 0.0 | 11.4 | 1.5 | 9.55 | 6.35 | 3.04 | 24 | 0.08 | 78.76 | 78.98 | 82.34 | 82.84 | 87.02 | 86.50 | |
| 9 | 8 | 250.290 | 10.64 | 10.64 | 0.60 | 6.38 | 6.38 | 10.0 | 10.0 | 1.6 | 9.91 | 6.39 | 3.16 | 24 | 0.08 | 78.98 | 79.18 | 82.98 | 83.47 | 86.50 | 85.67 | Area 14 |
| 10 | 1 | 541.400 | 0.00 | 2.27 | 0.00 | 0.00 | 1.36 | 0.0 | 28.0 | 1.0 | 1.41 | 3.50 | 0.80 | 18 | 0.11 | 74.31 | 74.91 | 80.89 | 80.99 | 84.79 | 85.35 | |
| 11 | 10 | 1816.690 | 0.00 | 2.27 | 0.00 | 0.00 | 1.36 | 0.0 | 17.9 | 1.3 | 1.74 | 3.48 | 0.98 | 18 | 0.11 | 74.91 | 76.91 | 81.00 | 81.50 | 85.35 | 87.64 | |
| 12 | 11 | 387.160 | 0.00 | 2.27 | 0.00 | 0.00 | 1.36 | 0.0 | 15.8 | 1.3 | 1.82 | 3.46 | 1.03 | 18 | 0.11 | 77.50 | 77.92 | 81.51 | 81.62 | 87.64 | 87.90 | |
| 13 | 12 | 1040.980 | 2.27 | 2.27 | 0.60 | 1.36 | 1.36 | 10.0 | 10.0 | 1.6 | 2.11 | 3.49 | 1.20 | 18 | 0.11 | 77.92 | 79.07 | 81.64 | 82.06 | 87.90 | 88.65 | Area 3 |

Project File: Catherine Everett-10.stm

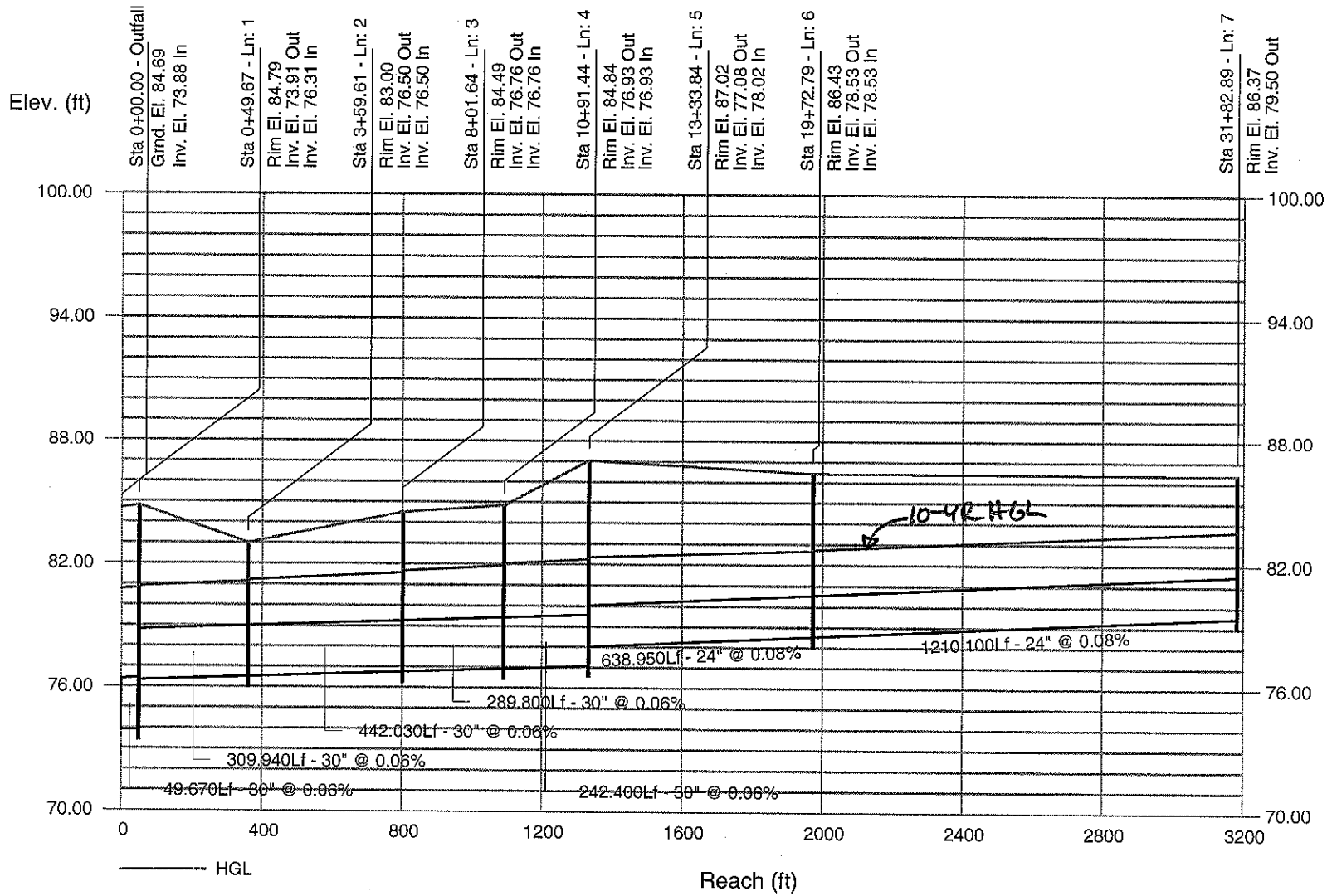
Number of lines: 13

Run Date: 09-25-2009

NOTES: Intensity = 61.96 / (Inlet time + 27.10) ^ 1.02; Return period = 10 Yrs. ; c = cir e = ellip b = box

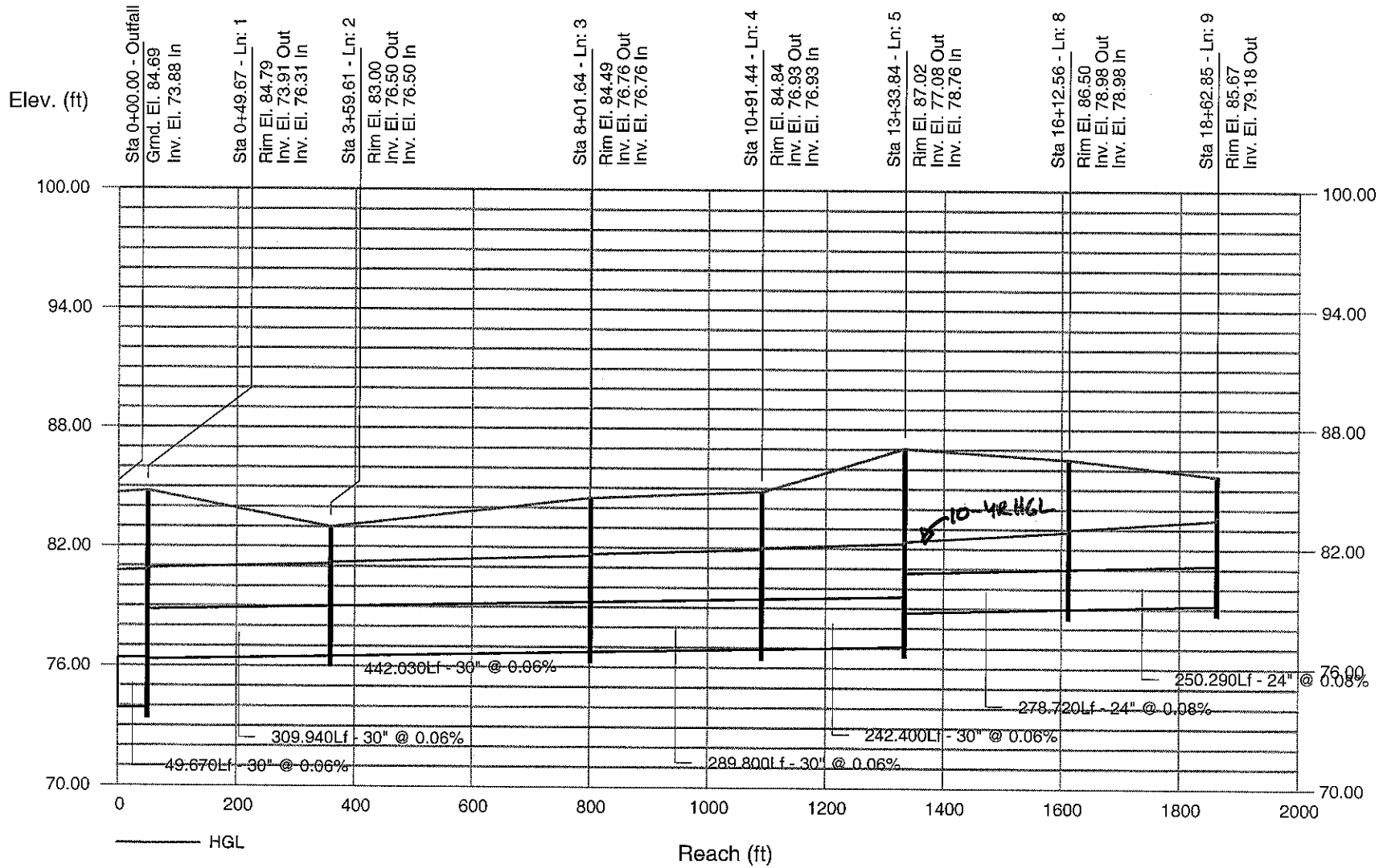
# Storm Sewer Profile

Proj. file: Catherine Everett-10.stm



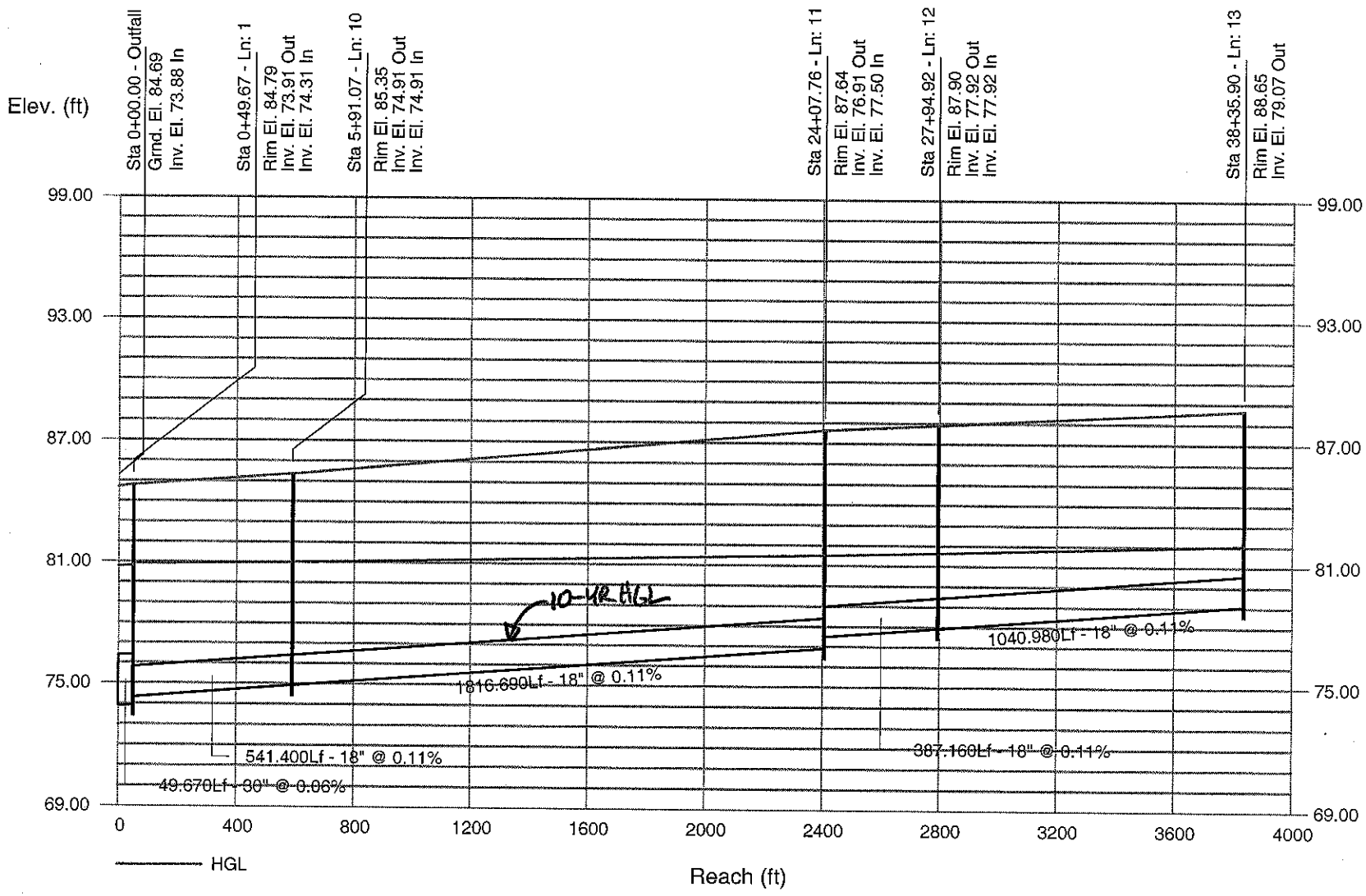
# Storm Sewer Profile

Proj. file: Catherine Merrett-10.stm

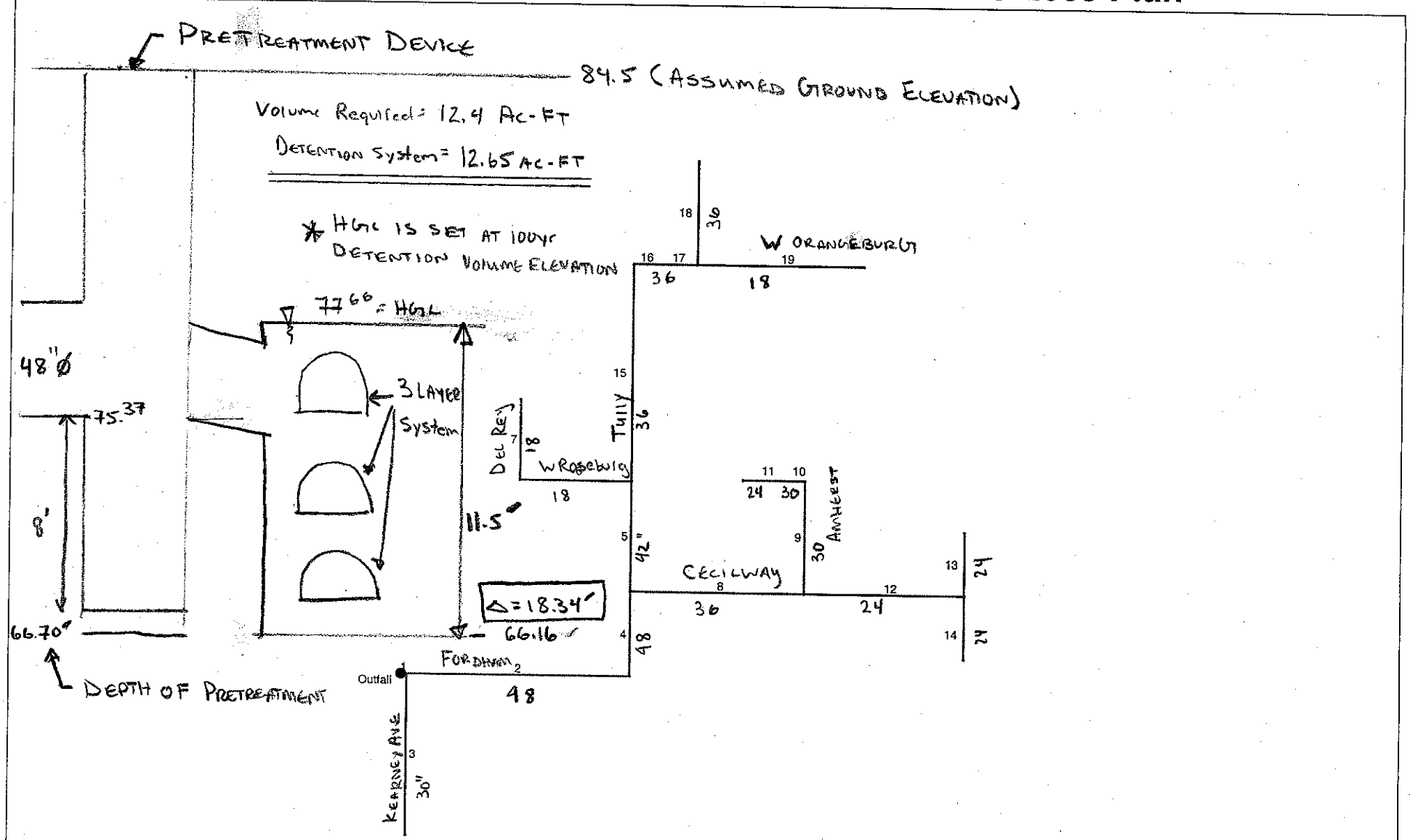


# Storm Sewer Profile

Proj. file: Catherine Everett-10.stm



# Hydraflow Storm Sewers Extension for AutoCAD® Civil 3D® 2009 Plan




| Project File: JM Pike-17.stm | Number of lines: 19 | Date: 10-07-2009 |
|---|---|---|

# Storm Sewer Tabulation



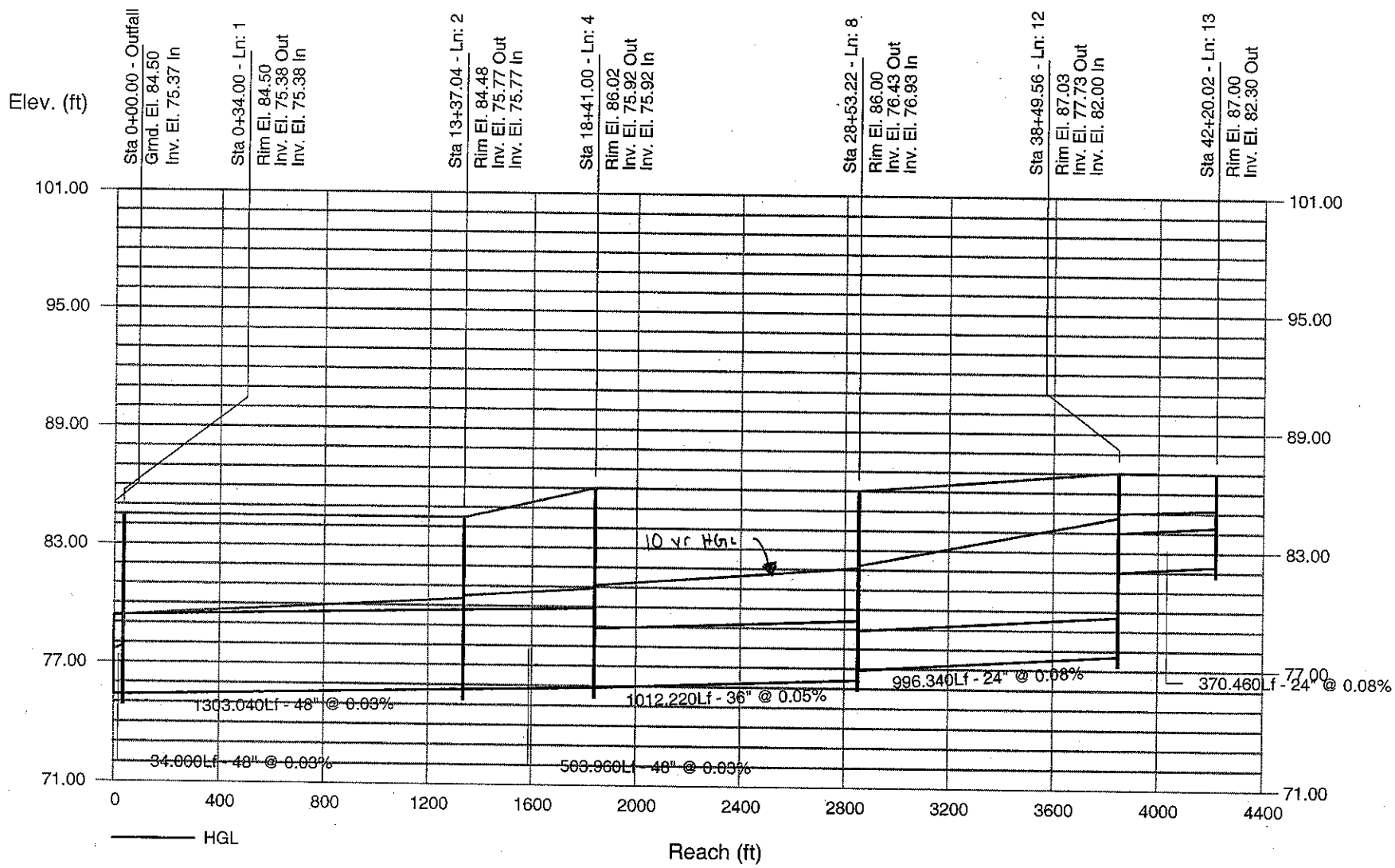
| Station | | Len | Drng Area | | Rnoff coeff | Area x C | | Tc | | Rain (I) | Total flow | Cap full | Vel | Pipe | | Invert Elev | | HGL Elev | | Grnd / Rim Elev | | Line ID |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Line | To Line | (ft) | Incr (ac) | Total (ac) | (C) | Incr | Total | Inlet (min) | Syst (min) | (in/hr) | (cfs) | (cfs) | (ft/s) | Size (in) | Slope (%) | Dn (ft) | Up (ft) | Dn (ft) | Up (ft) | Dn (ft) | Up (ft) | |
| 1 | End | 34.000 | 0.00 | 78.80 | 0.00 | 0.00 | 51.87 | 0.0 | 38.2 | 0.9 | 45.21 | 24.63 | 5.86 | 48 | 0.03 | 75.37 | 75.38 | 77.66 | 77.82 | 84.50 | 84.50 | |
| 2 | 1 | 303.040 | 0.00 | 63.23 | 0.00 | 0.00 | 39.88 | 0.0 | 31.0 | 1.0 | 39.19 | 24.85 | 3.12 | 48 | 0.03 | 75.38 | 75.77 | 79.38 | 80.35 | 84.50 | 84.48 | |
| 3 | 1 | 952.080 | 15.57 | 15.57 | 0.77 | 11.99 | 11.99 | 10.0 | 10.0 | 1.6 | 18.61 | 10.03 | 3.79 | 30 | 0.06 | 77.43 | 78.00 | 79.93 | 81.89 | 84.50 | 83.50 | Area 2 |
| 4 | 2 | 503.960 | 0.00 | 63.23 | 0.00 | 0.00 | 39.88 | 0.0 | 28.2 | 1.0 | 41.21 | 24.78 | 3.28 | 48 | 0.03 | 75.77 | 75.92 | 80.50 | 80.92 | 84.48 | 86.02 | |
| 5 | 4 | 644.940 | 3.37 | 36.99 | 0.71 | 2.39 | 23.44 | 10.0 | 24.6 | 1.1 | 25.93 | 20.20 | 2.70 | 42 | 0.04 | 76.66 | 76.92 | 81.08 | 81.51 | 86.02 | 84.97 | Area 10 |
| 6 | 5 | 651.230 | 0.00 | 4.26 | 0.00 | 0.00 | 2.56 | 0.0 | 12.6 | 1.4 | 3.70 | 3.49 | 2.09 | 18 | 0.11 | 78.26 | 78.98 | 81.62 | 82.43 | 84.97 | 85.00 | |
| 7 | 6 | 475.320 | 4.26 | 4.26 | 0.60 | 2.56 | 2.56 | 10.0 | 10.0 | 1.6 | 3.97 | 3.47 | 2.25 | 18 | 0.11 | 78.98 | 79.50 | 82.50 | 83.18 | 85.00 | 83.50 | Area 27 |
| 8 | 4 | 1012.220 | 0.00 | 26.24 | 0.00 | 0.00 | 16.44 | 0.0 | 17.6 | 1.3 | 21.10 | 14.97 | 2.98 | 36 | 0.05 | 75.92 | 76.43 | 81.08 | 82.10 | 86.02 | 86.00 | |
| 9 | 8 | 661.340 | 0.00 | 13.30 | 0.00 | 0.00 | 8.68 | 0.0 | 12.0 | 1.5 | 12.77 | 10.09 | 2.60 | 30 | 0.06 | 78.98 | 79.38 | 82.23 | 82.88 | 86.00 | 85.90 | |
| 10 | 9 | 144.710 | 6.95 | 13.30 | 0.60 | 4.17 | 8.68 | 10.0 | 11.2 | 1.5 | 13.04 | 10.23 | 2.66 | 30 | 0.06 | 79.38 | 79.47 | 82.98 | 83.13 | 85.90 | 85.45 | Area 6 |
| 11 | 10 | 218.110 | 6.35 | 6.35 | 0.71 | 4.51 | 4.51 | 10.0 | 10.0 | 1.6 | 7.00 | 6.31 | 2.23 | 24 | 0.08 | 79.97 | 80.14 | 83.14 | 83.35 | 85.45 | 84.40 | Area 16 |
| 12 | 8 | 996.340 | 0.00 | 12.94 | 0.00 | 0.00 | 7.76 | 0.0 | 12.1 | 1.5 | 11.40 | 6.40 | 3.63 | 24 | 0.08 | 76.93 | 77.73 | 82.23 | 84.77 | 86.00 | 87.03 | |
| 13 | 12 | 370.460 | 5.73 | 5.73 | 0.60 | 3.44 | 3.44 | 10.0 | 10.0 | 1.6 | 5.34 | 6.44 | 1.70 | 24 | 0.08 | 82.00 | 82.30 | 84.97 | 85.18 | 87.03 | 87.00 | Area 19 |
| 14 | 12 | 376.180 | 7.21 | 7.21 | 0.60 | 4.33 | 4.33 | 10.0 | 10.0 | 1.6 | 6.72 | 6.39 | 2.14 | 24 | 0.08 | 82.10 | 82.40 | 84.97 | 85.30 | 87.03 | 86.23 | Area 18 |
| 15 | 5 | 1286.820 | 0.00 | 29.36 | 0.00 | 0.00 | 18.49 | 0.0 | 17.5 | 1.3 | 23.81 | 14.87 | 3.37 | 36 | 0.05 | 77.42 | 78.06 | 81.62 | 83.27 | 84.97 | 85.36 | |
| 16 | 15 | 75.590 | 9.00 | 29.36 | 0.63 | 5.67 | 18.49 | 10.0 | 17.0 | 1.3 | 24.04 | 17.15 | 3.40 | 36 | 0.07 | 78.06 | 78.11 | 83.44 | 83.54 | 85.36 | 85.36 | Area 36 |
| 17 | 16 | 295.600 | 0.00 | 20.36 | 0.00 | 0.00 | 12.82 | 0.0 | 15.4 | 1.4 | 17.33 | 16.46 | 2.45 | 36 | 0.06 | 78.11 | 78.29 | 83.57 | 83.77 | 85.36 | 86.00 | |
| 18 | 17 | 610.000 | 14.31 | 14.31 | 0.60 | 8.59 | 8.59 | 10.0 | 10.0 | 1.6 | 13.33 | 15.03 | 1.89 | 36 | 0.05 | 78.29 | 78.60 | 83.86 | 84.10 | 86.00 | 84.60 | Area 8 |
| 19 | 17 | 972.120 | 6.05 | 6.05 | 0.70 | 4.24 | 4.24 | 10.0 | 10.0 | 1.6 | 6.58 | 3.48 | 3.72 | 18 | 0.11 | 79.50 | 80.57 | 83.86 | 87.67 | 86.00 | 88.40 | Area 35 |

Project File: JM Pike-17.stm | Number of lines: 19 | Run Date: 10-07-2009

NOTES: Intensity = 61.96 / (Inlet time + 27.10) ^ 1.02; Return period = 10 Yrs. ; c = cir e = ellip b = box

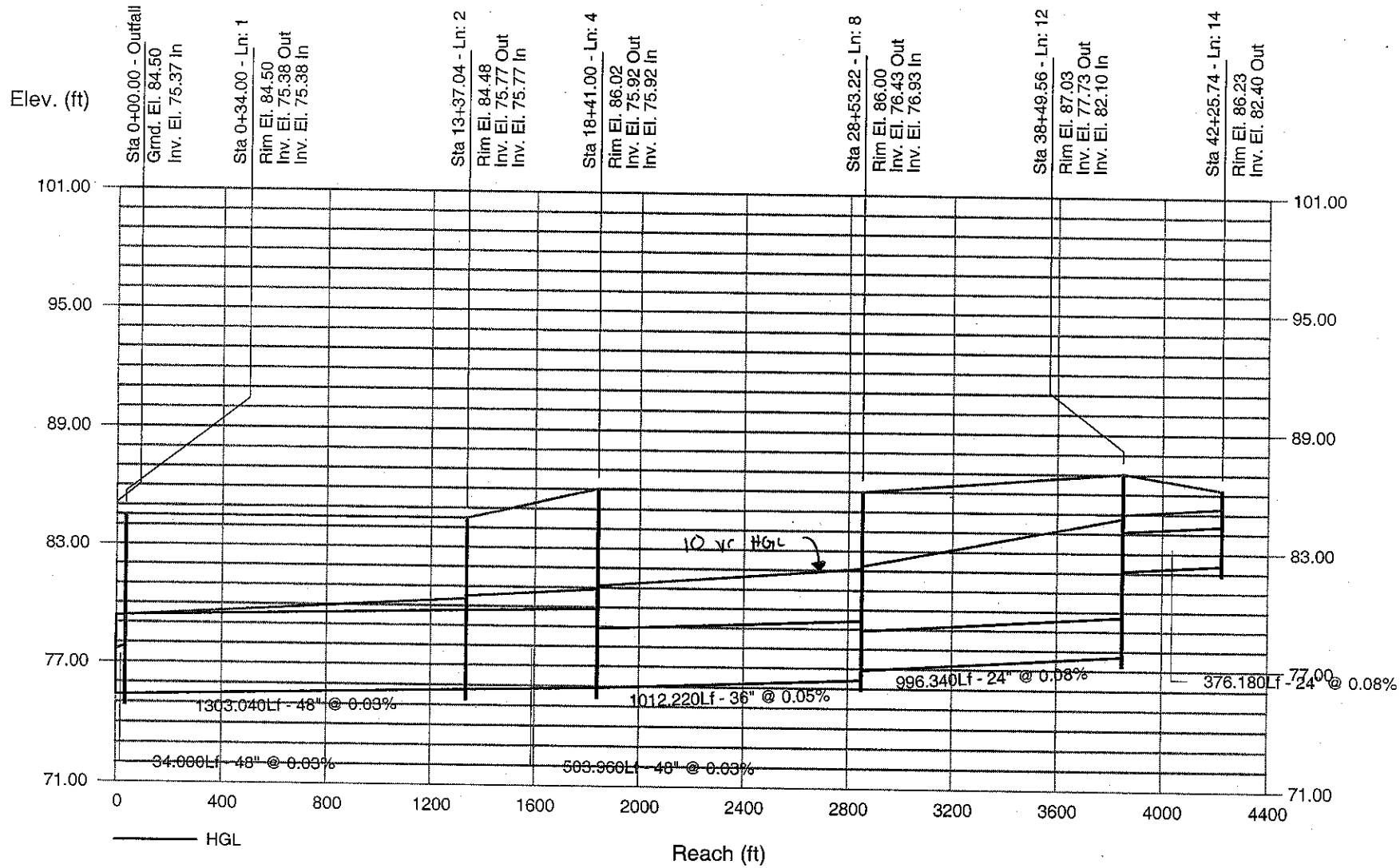
# Storm Sewer Profile

Proj. file: Pike-17.stm



# Storm Sewer Profile

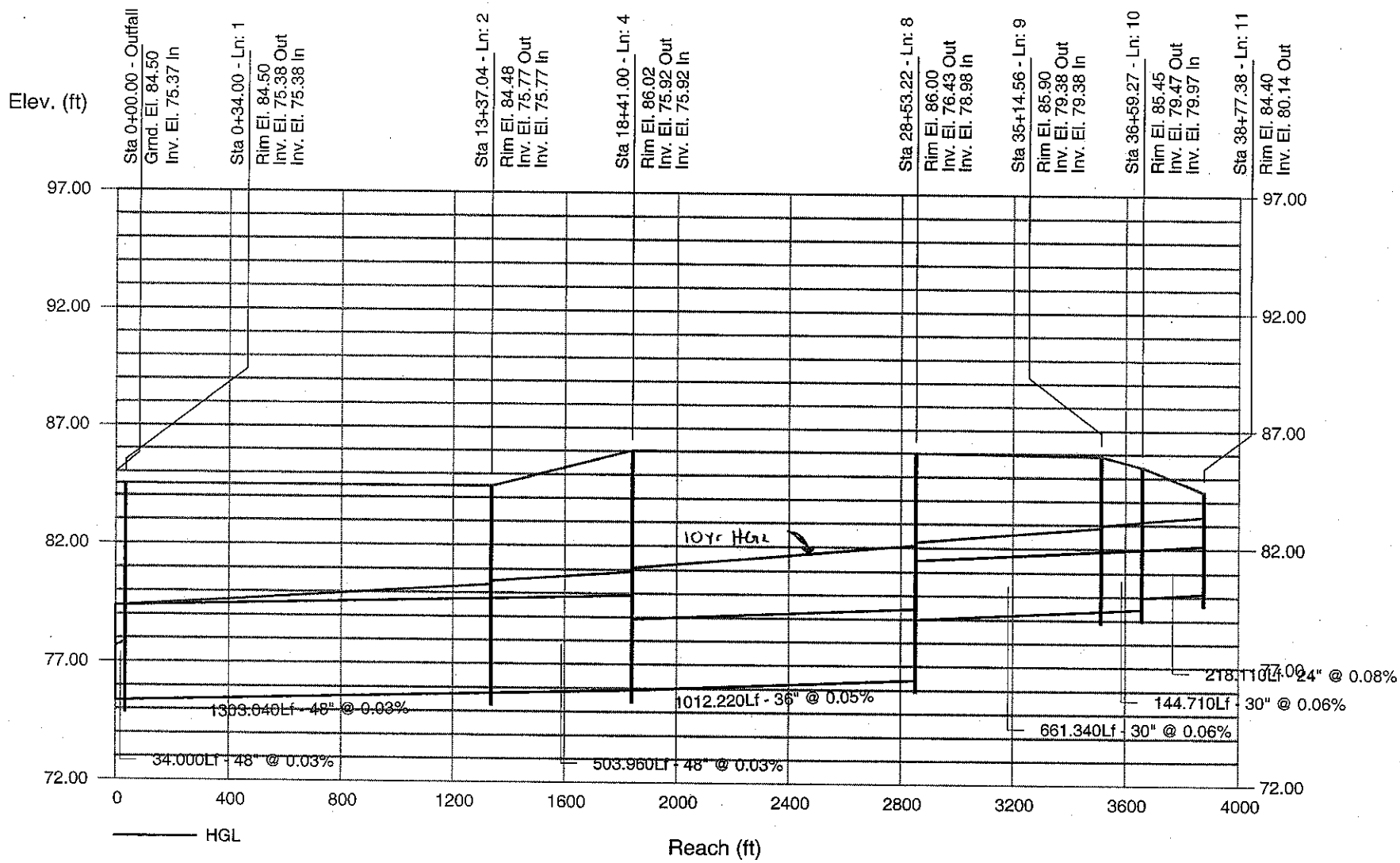
Proj. file: Pike-17.stm




Hydraflow Storm Sewers Extension

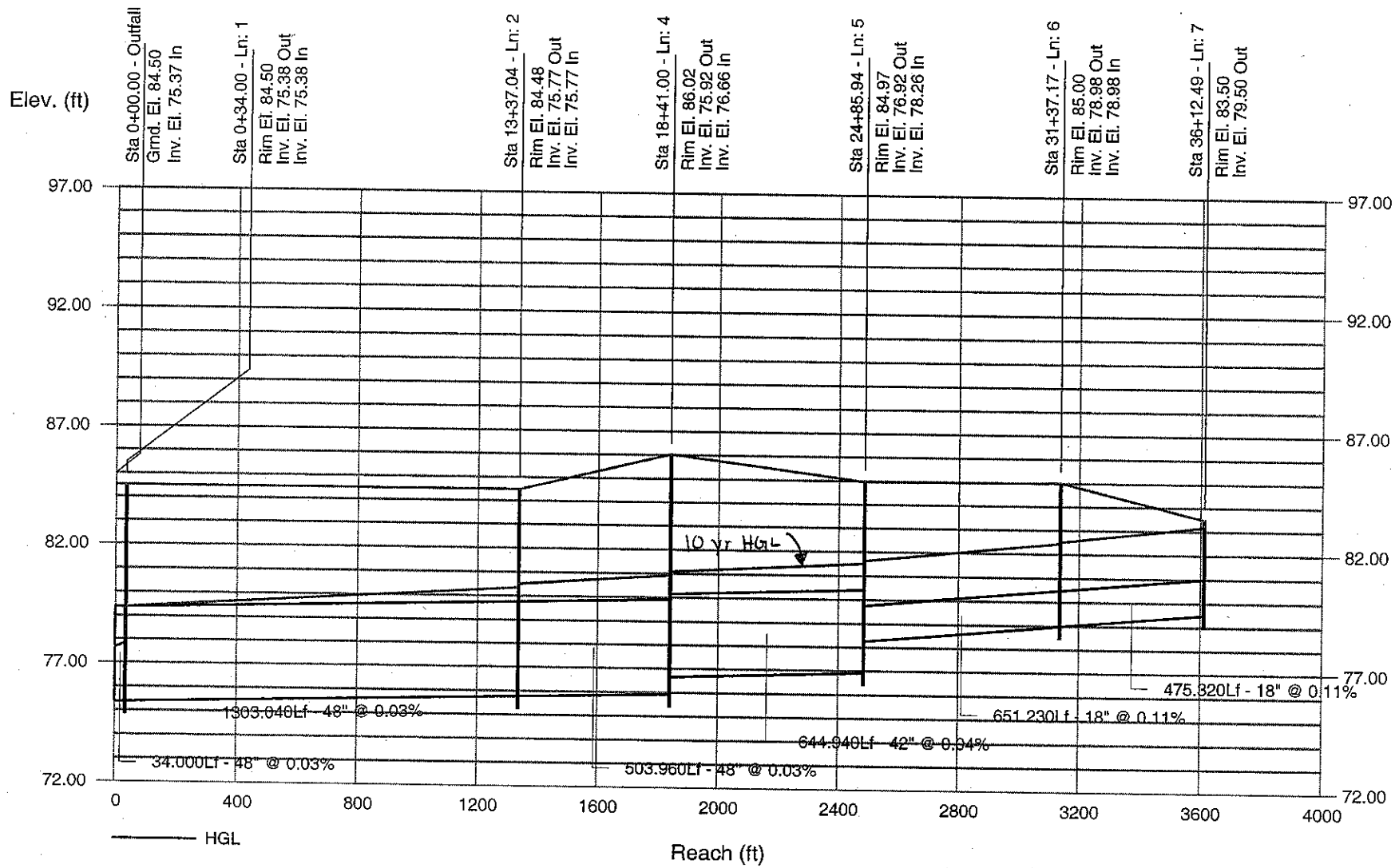
# Storm Sewer Profile

Proj. file: Pike-17.stm



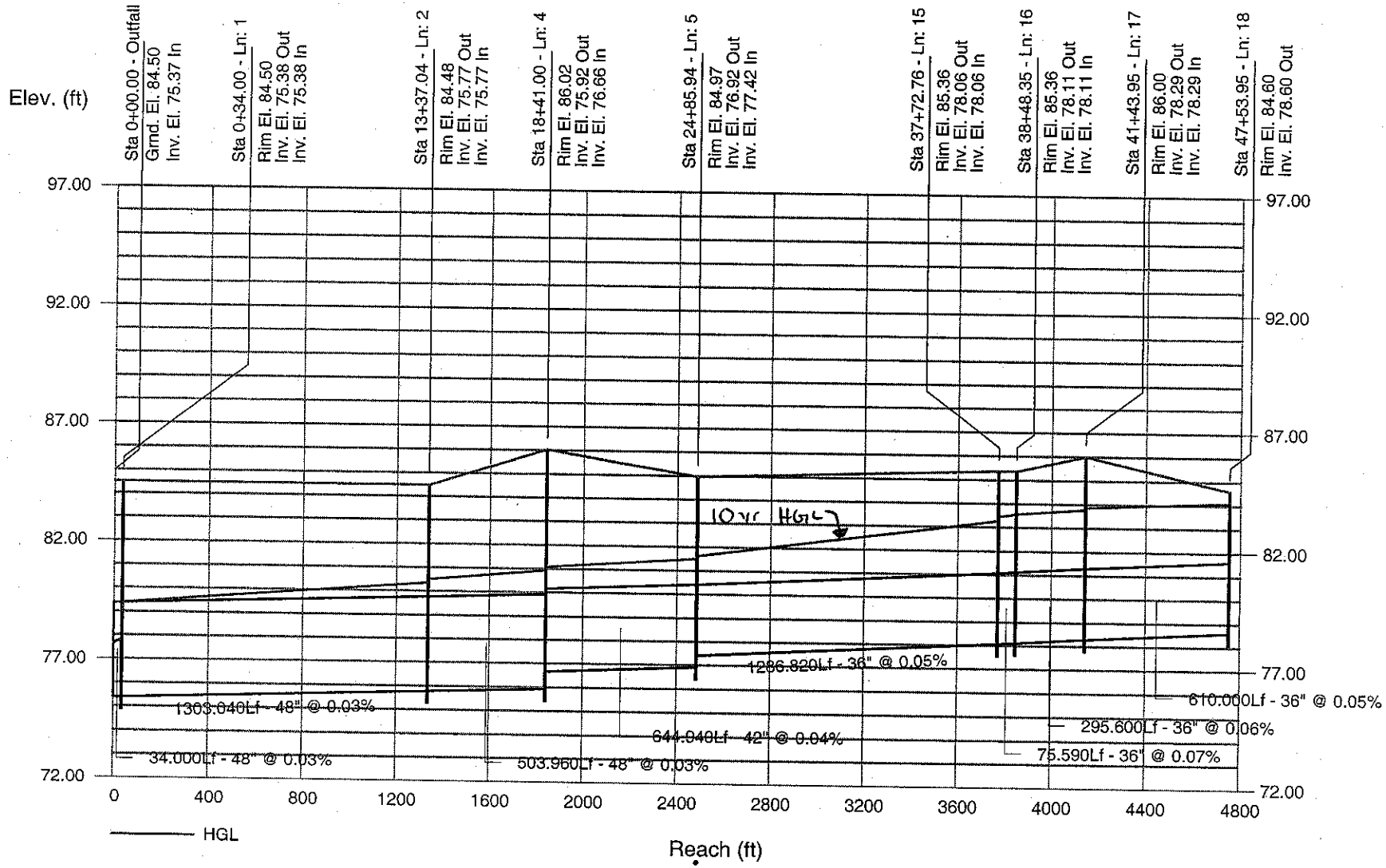
# Storm Sewer Profile

Proj. file: Pike-17.stm



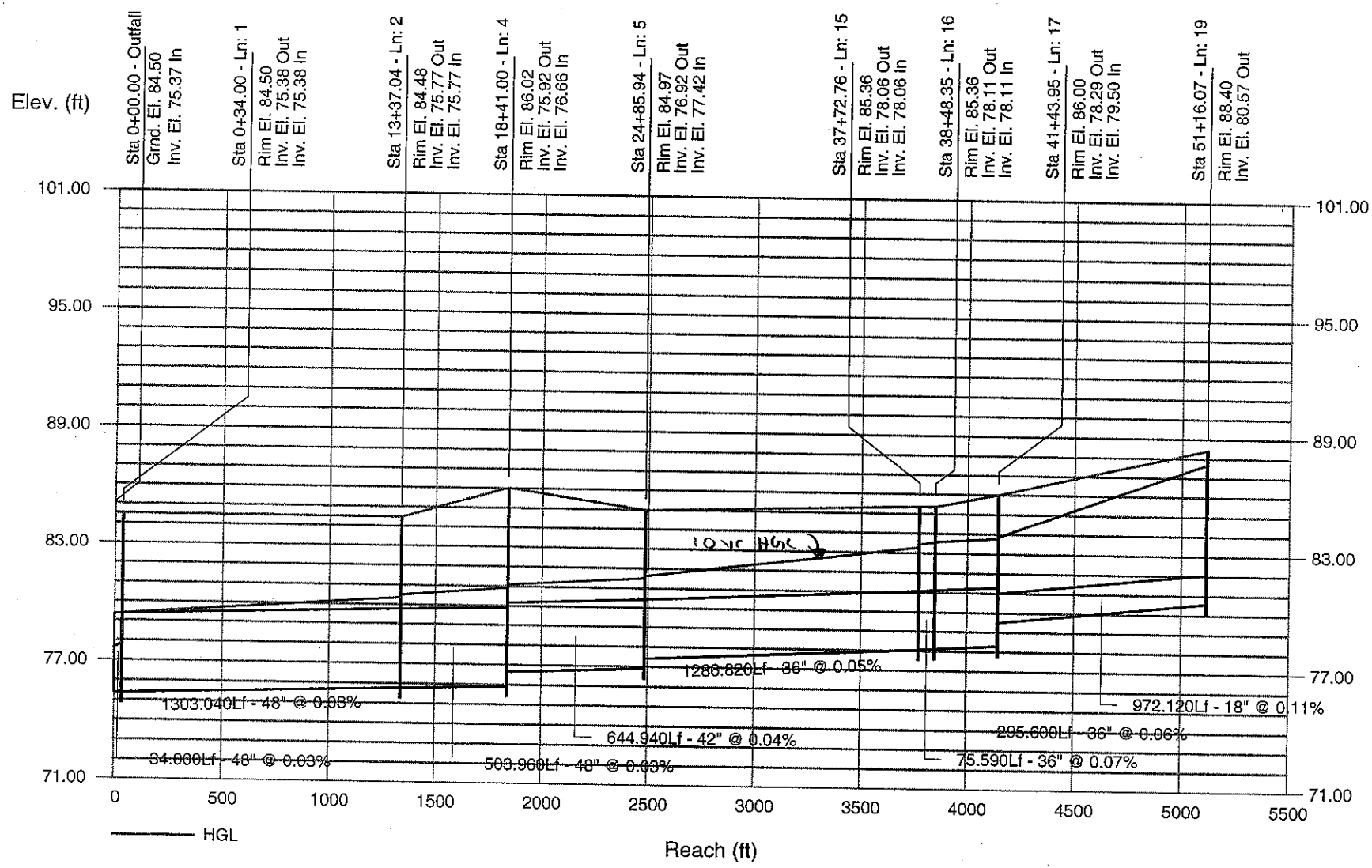
# Storm Sewer Profile

Proj. file: Pike-17.stm



# Storm Sewer Profile

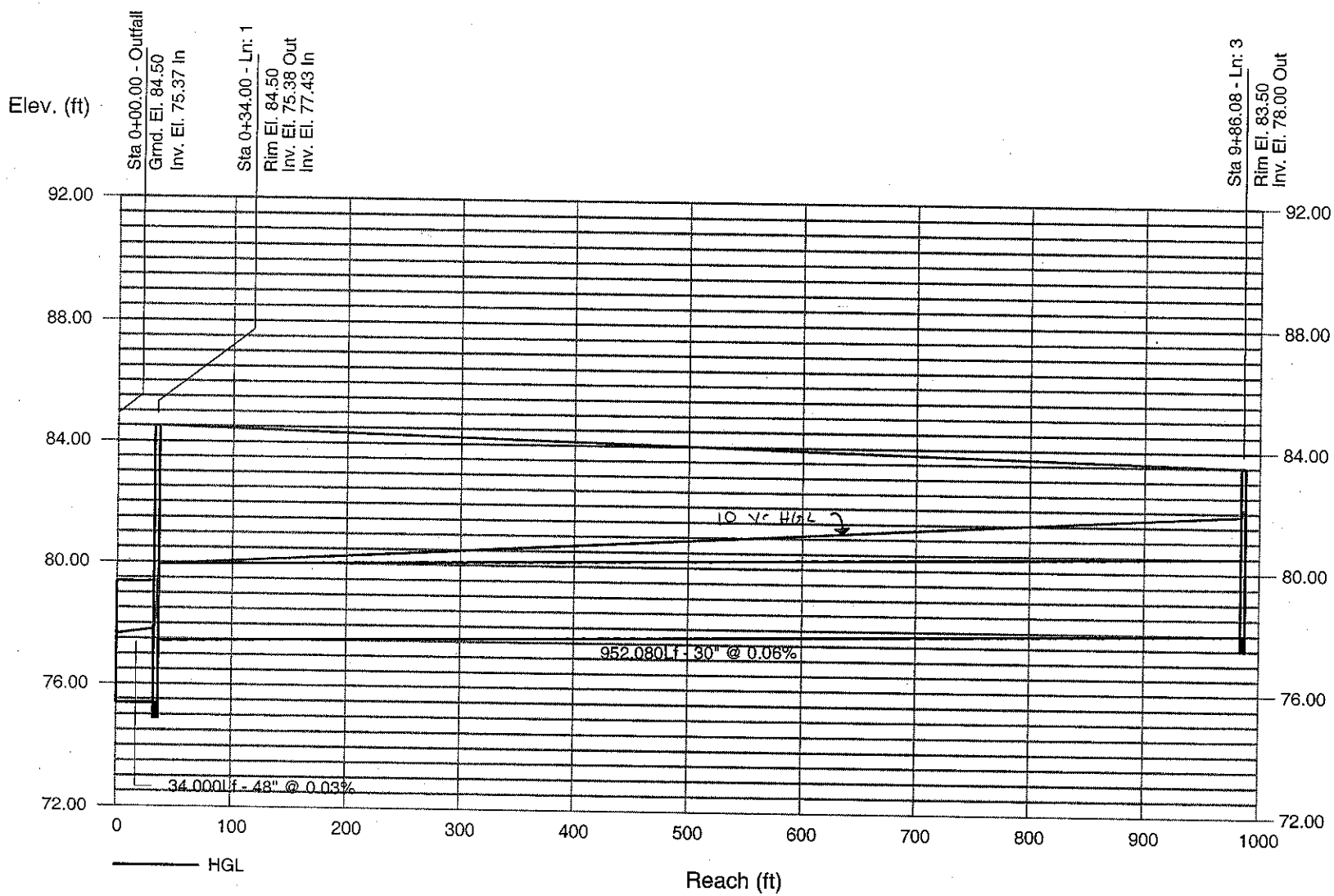
Proj. file: Pike-17.stm



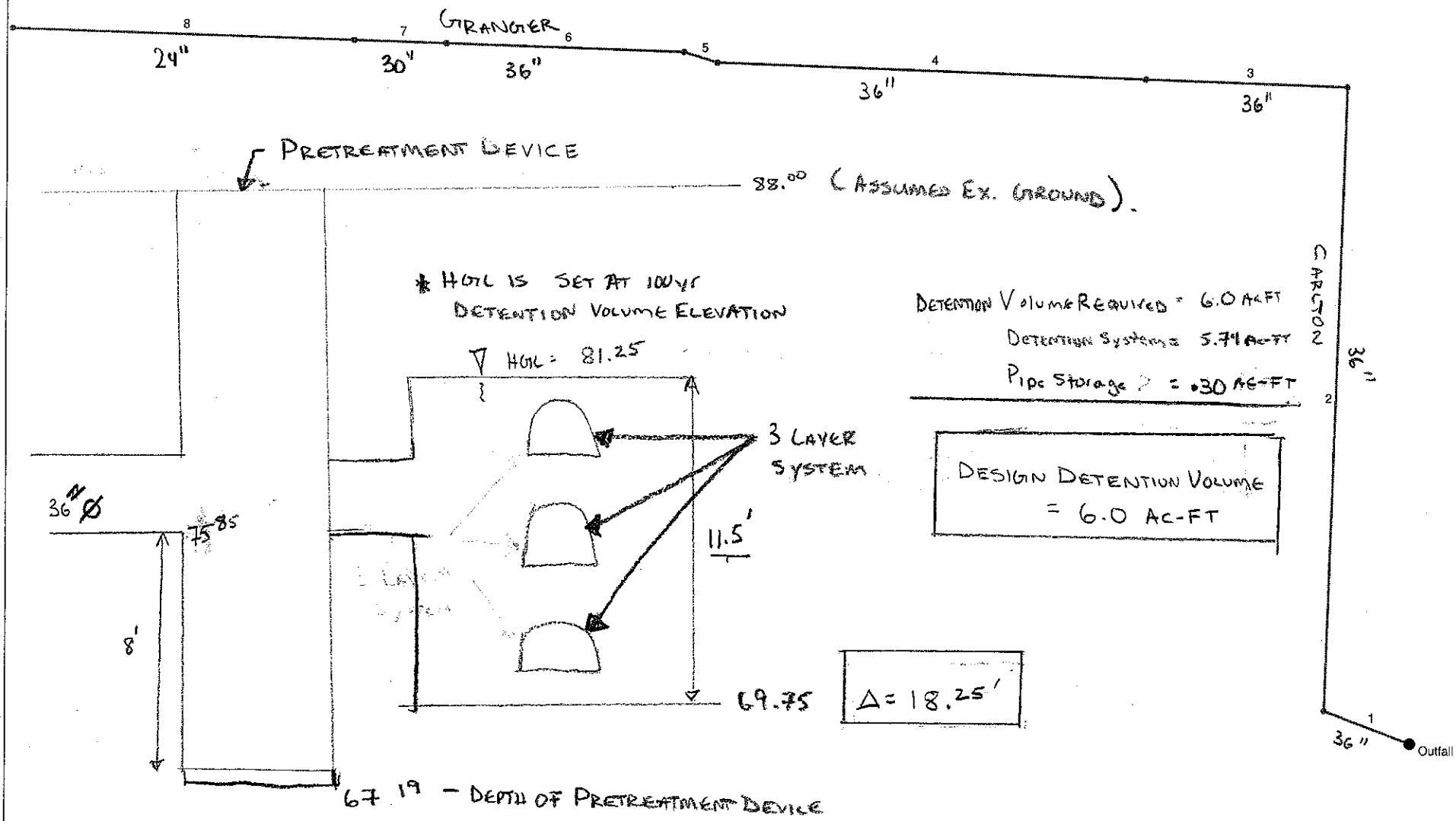

Hydraflow Storm Sewers Extension

# Storm Sewer Profile

Proj. file: Pike-17.stm



# Hydraflow Storm Sewers Extension for AutoCAD® Civil 3D® 2009 Plan




| Project File: Roosevelt Park-12.stm | Number of lines: 8 | Date: 10-08-2009 |
|---|---|---|

# Storm Sewer Tabulation



| Station | | Len | Drng Area | | Rnoff coeff | Area x C | | Tc | | Rain (I) | Total flow | Cap full | Vel | Pipe | | Invert Elev | | HGL Elev | | Grnd / Rim Elev | | Line ID |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Line | To Line | | Incr | Total | | Incr | Total | Inlet | Syst | | | | | Size | Slope | Dn | Up | Dn | Up | Dn | Up | |
| | | (ft) | (ac) | (ac) | (C) | | | (min) | (min) | (in/hr) | (cfs) | (cfs) | (ft/s) | (in) | (%) | (ft) | (ft) | (ft) | (ft) | (ft) | (ft) | |
| 1 | End | 94.270 | 0.00 | 41.96 | 0.00 | 0.00 | 25.18 | 0.0 | 21.3 | 1.2 | 29.81 | 43.44 | 4.22 | 36 | 0.42 | 75.85 | 76.25 | 81.25 | 81.44 | 88.40 | 88.35 | |
| 2 | 1 | 653.240 | 0.00 | 41.96 | 0.00 | 0.00 | 25.18 | 0.0 | 17.6 | 1.3 | 32.28 | 43.43 | 4.57 | 36 | 0.42 | 76.25 | 79.02 | 81.70 | 83.23 | 88.35 | 87.00 | |
| 3 | 2 | 206.270 | 3.59 | 41.96 | 0.60 | 2.15 | 25.18 | 10.0 | 16.5 | 1.3 | 33.15 | 43.29 | 4.69 | 36 | 0.42 | 79.02 | 79.89 | 83.56 | 84.07 | 87.00 | 87.45 | Area 33 |
| 4 | 3 | 441.740 | 6.52 | 38.37 | 0.60 | 3.91 | 23.02 | 10.0 | 14.0 | 1.4 | 32.16 | 14.88 | 4.55 | 36 | 0.05 | 79.94 | 80.16 | 84.12 | 85.15 | 87.45 | 86.35 | Area 34 |
| 5 | 4 | 36.130 | 9.87 | 31.85 | 0.60 | 5.92 | 19.11 | 10.0 | 13.8 | 1.4 | 26.83 | 15.69 | 3.80 | 36 | 0.06 | 80.16 | 80.18 | 85.25 | 85.30 | 86.35 | 86.35 | Area 32 |
| 6 | 5 | 245.490 | 9.76 | 21.98 | 0.60 | 5.86 | 13.19 | 10.0 | 12.5 | 1.5 | 19.16 | 14.75 | 2.71 | 36 | 0.05 | 80.18 | 80.30 | 85.37 | 85.58 | 86.35 | 86.45 | Area 37 |
| 7 | 6 | 95.340 | 6.55 | 12.22 | 0.60 | 3.93 | 7.33 | 10.0 | 12.0 | 1.5 | 10.80 | 10.29 | 2.20 | 30 | 0.06 | 80.80 | 80.86 | 85.59 | 85.66 | 86.45 | 86.20 | Area 15 |
| 8 | 7 | 351.830 | 5.67 | 5.67 | 0.60 | 3.40 | 3.40 | 10.0 | 10.0 | 1.6 | 5.28 | 6.38 | 1.68 | 24 | 0.08 | 81.36 | 81.64 | 85.67 | 85.86 | 86.20 | 86.80 | Area A |

Project File: Roosevelt Park-12.stm

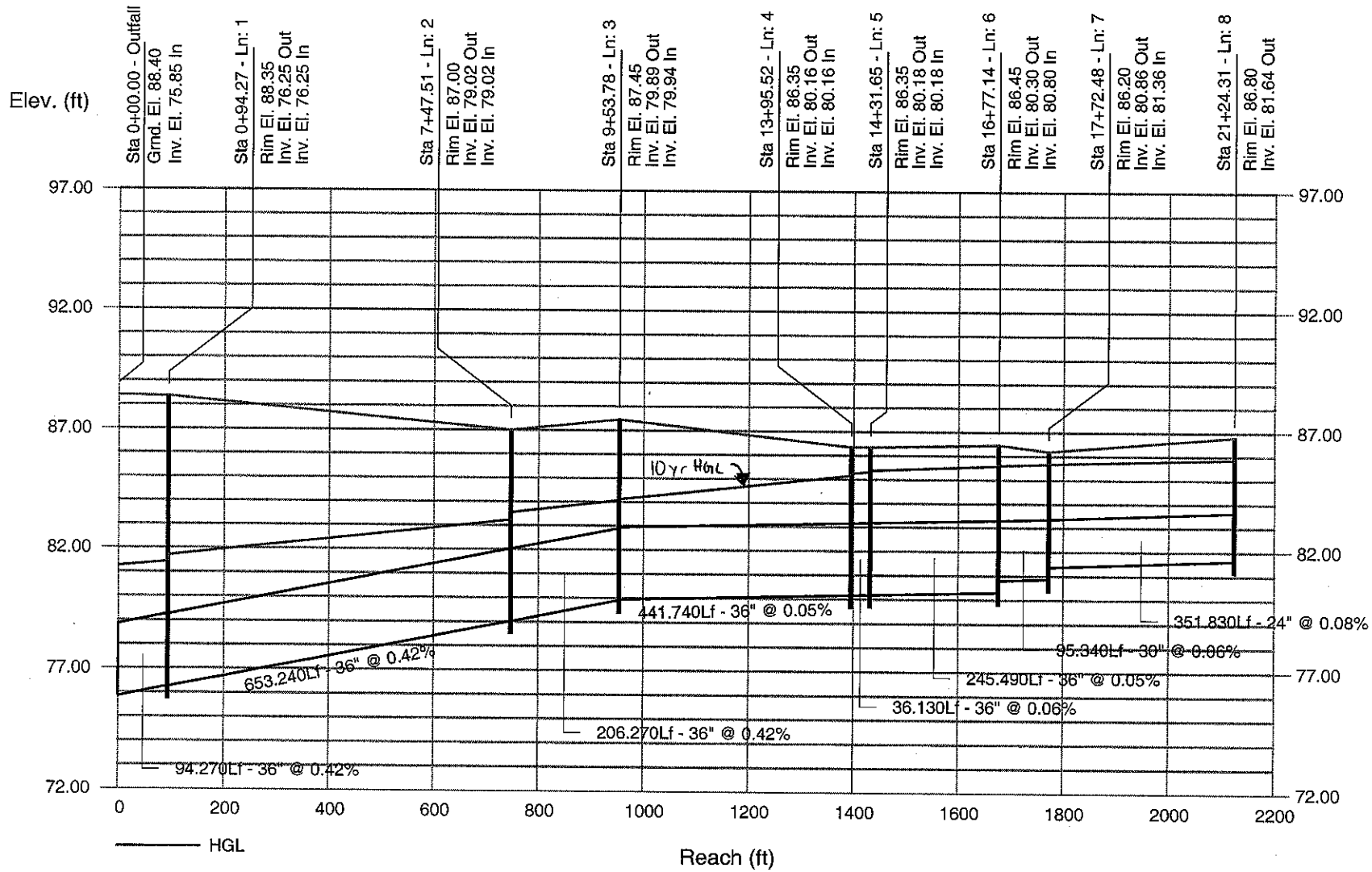
Number of lines: 8

Run Date: 10-08-2009

NOTES: Intensity = 61.96 / (Inlet time + 27.10) ^ 1.02; Return period = 10 Yrs. ; c = cir e = ellip b = box

# Storm Sewer Profile

Proj. file: Roose Park-12.stm




Hydraflow Storm Sewers Extension

# APPENDIX D

## INITIAL STUDY CHECKLIST

# Environmental Checklist Form

1. **Project title: Modesto Area II Storm Drainage Cross Connection Removal Project**

2. Lead agency name and address:
   **City of Modesto**
   **Public Works Department**
   **PO Box 642**
   **Modesto, CA 95353**

3. **Contact person and phone number:**
   **David Felix, Engineer**
   **City of Modesto**
   **Public Works Department**
   **(209) 577-5488**

4. Project location: **Modesto, CA**
   **The project is generally bound by Rumble Road to the north, Prescott Road / 9th Street to the west, Coldwell Avenue to the South and the Virginia Corridor (former Union Pacific Railroad) to the east.**

5. Project sponsor's name and address:
   **City of Modesto**
   **Public Works Department**
   **PO Box 642**
   **Modesto, CA 95353**

6. General plan designation:

7. Zoning: **N/A**

8. **Project Description:**

The City of Modesto is proposing to remove twenty-one (21) stormwater to sewer cross-connections which drain an area of approximately 158 acres. The 21 cross-connections provide stormwater drainage for residents and businesses within the defined 158 acres area. These connections capture excess stormwater which then flows to the City's primary wastewater treatment facility. These storm drain/sanitary sewer connections reduce localized neighborhood flooding and they increase the volume of wet weather flows in the sanitary sewers and treatment plants. During storm events, these connections reduce capacity in the sanitary sewer collection system and wastewater treatment plants. The removal of these 21 cross connections will alleviate some of the wet weather flows experienced by the sanitary sewer system, thereby meeting the intent established by the City's 2007 Wastewater Master Plan to increase the City's sewer capacity.

The cross-connections removal project will eliminate over 35 million gallons of annual run-off that is currently treated at the City's wastewater treatment plant. The project proposes to remove pipes with various sizes that connect to the sewer system. These pipes will be replaced with approximately 24,000 feet of new storm drain lines within existing City road right-of-ways and property.

The City proposes to re-route the storm water runoff to four (4) existing neighborhood parks. The parks affected are Catherine Everett Park, Garrison Park, JM Pike, and Roosevelt Park. The stormwater will be channeled through underground pipes to an underground storage systems located within these parks. These storage systems will provide detention/retention of stormwater for a 100 year storm event  Stormwater will be pre-treated to remove trash, sediment, oil, grease, and other substance prior to infiltration and eventual recharge of groundwater for retention systems. Any stormwater flows that are detained will be pumped into existing City of Modesto storm drains through force mains. Roosevelt and JM Pikes are the parks tentatively indicated as parks that will be a detention only facility.

Approximately 6 acres of park land will be affected by this proposed project. The areas affected include the removal of turf areas and irrigation systems. The placement of underground storage facilities may also require the removal of some play structures and trees.  Upon completion of the underground detention/retention storage facilities, the parks will be rehabilitated with new turf and irrigation systems. Any play structures that are removed will be replaced. Any trees removed will be replaced on-site with a 1:1 mitigation ratio or another standard established by the city such as the heritage tree ordinance, whichever is greater. Replacement trees shall be consistent with the City's adopted Tree Master Planting List.

The 100-year storm drainage retention volume for Catherine Everett Park is 5.5 acre feet and Garrison Park is 5.0 acre feet. These calculations are based on a rainfall depth of 5.6 inches. The design percolation rate for Catherine Everett Park is 7.6 inches per house and Garrison Park is 4.5 inches per hour.

The 100 year storm design detention volume for Roosevelt Park is 6.0 acre feet and JM Pike Park is 1.4 acre feet. These figures are based on a rainfall depth of 2.88 inches. The design pumping rate to evacuate the detention basins in 48 hours is 1.5 cubic feet per second for Roosevelt Park and 3.1 cubic feet per second for JM Pike.

9. **Surrounding land uses and setting: Briefly describe the project's surroundings:**

Construction activities will take place in surrounding existing residential neighborhoods, parks and schools.  The residential land uses are predominately single family residential uses with some duplex and medium density residential uses near some of the existing cross connection removal areas. There is a commercial and industrial area near cross connection #2 south of JM Pike Park.

10. **Other public agencies whose approval is required (e.g., permits, financing approval, or participation agreement.)**

City of Modesto Public Works-approval of permits for each project
City of Modesto Parks and Recreation Division-approval of site plans for park

construction/replacement of turf areas, trees, and any play structures due to removal; National Pollutant Discharge Elimination System (NPDES) permit(s).

ENVIRONMENTAL FACTORS POTENTIALLY AFFECTED:

The environmental factors checked below would be potentially affected by this project, involving at least one impact that is a "Potentially Significant Impact" as indicated by the checklist on the following pages.

| | | |
|---|---|---|
| ☐ Aesthetics | ☐ Agriculture Resources | ■ Air Quality |
| ☐ Biological Resources | ☐ Cultural Resources | ☐ Geology /Soils |
| ☐ Hazards & Hazardous Materials | ■ Hydrology / Water Quality | ☐ Land Use / Planning |
| ☐ Mineral Resources | ☐ Noise | ■ Population / Housing |
| ☐ Public Services | ☐ Recreation | ☐ Transportation/Traffic |
| ☐ Utilities / Service Systems | ☐ Mandatory Findings of Significance | |

DETERMINATION: (To be completed by the Lead Agency)

On the basis of this initial evaluation:

☐ I find that the proposed project COULD NOT have a significant effect on the environment, and a NEGATIVE DECLARATION will be prepared.

☐ I find that although the proposed project could have a significant effect on the environment, there will not be a significant effect in this case because revisions in the project have been made by or agreed to by the project proponent. A MITIGATED NEGATIVE DECLARATION will be prepared.

☐ I find that the proposed project MAY have a significant effect on the environment, and an ENVIRONMENTAL IMPACT REPORT is required.

☐ I find that the proposed project MAY have a "potentially significant impact" or "potentially significant unless mitigated" impact on the environment, but at least one effect 1) has been adequately analyzed in an earlier document pursuant to applicable legal standards, and 2) has been addressed by mitigation measures based on the earlier analysis as described on attached sheets. An ENVIRONMENTAL IMPACT REPORT is required, but it must analyze only the effects that remain to be addressed.

■ I find that although the proposed project could have a significant effect on the environment, because all potentially significant effects (a) have been analyzed adequately in an earlier EIR or NEGATIVE DECLARATION pursuant to applicable standards, and (b) have been avoided or mitigated pursuant to that earlier EIR or NEGATIVE DECLARATION, including revisions or mitigation measures that are imposed upon the proposed project, nothing further is required.

| | |
|---|---|
| Signature | Date |
| Signature | Date |

EVALUATION OF ENVIRONMENTAL IMPACTS:

1) A brief explanation is required for all answers except "No Impact" answers that are adequately supported by the information sources a lead agency cites in the parentheses following each question. A "No Impact" answer is adequately supported if the referenced information sources show that the impact simply does not apply to projects like the one involved (e.g., the project falls outside a fault rupture zone). A "No Impact" answer should be explained where it is based on project-specific factors as well as general standards (e.g., the project will not expose sensitive receptors to pollutants, based on a project-specific screening analysis).

2) All answers must take account of the whole action involved, including off-site as well as on-site, cumulative as well as project-level, indirect as well as direct, and construction as well as operational impacts.

3) Once the lead agency has determined that a particular physical impact may occur, then the checklist answers must indicate whether the impact is potentially significant, less than significant with mitigation, or less than significant. "Potentially Significant Impact" is appropriate if there is substantial evidence that an effect may be significant. If there are one or more "Potentially Significant Impact" entries when the determination is made, an EIR is required.

4) "Negative Declaration: Less Than Significant With Mitigation Incorporated" applies where the incorporation of mitigation measures has reduced an effect from "Potentially Significant Impact" to a "Less Than Significant Impact." The lead agency must describe the mitigation measures, and briefly explain how they reduce the effect to a less than significant level (mitigation measures from Section XVII, "Earlier Analyses," may be cross-referenced).

5) Earlier analyses may be used where, pursuant to the tiering, program EIR, or other CEQA process, an effect has been adequately analyzed in an earlier EIR or negative declaration. Section 15063(c)(3)(D). In this case, a brief discussion should identify the following:
   a) Earlier Analysis Used. Identify and state where they are available for review.
   b) Impacts Adequately Addressed. Identify which effects from the above checklist were within the scope of and adequately analyzed in an earlier document pursuant to applicable legal standards, and state whether such effects were addressed by mitigation measures based on the earlier analysis.
   c) Mitigation Measures. For effects that are "Less than Significant with Mitigation Measures Incorporated," describe the mitigation measures which were incorporated or refined from the earlier document and the extent to which they address site-specific conditions for the project.

6) Lead agencies are encouraged to incorporate into the checklist references to information sources for potential impacts (e.g., general plans, zoning ordinances). Reference to a previously prepared or outside document should, where appropriate, include a reference to the page or pages where the statement is substantiated.

7) Supporting Information Sources: A source list should be attached, and other sources used or individuals contacted should be cited in the discussion.

8) This is only a suggested form, and lead agencies are free to use different formats; however, lead agencies should normally address the questions from this checklist that are relevant to a project's

environmental effects in whatever format is selected.

9) The explanation of each issue should identify:
   a) the significance criteria or threshold, if any, used to evaluate each question; and
   b) the mitigation measure identified, if any, to reduce the impact to less than significance

| | Potentially Significant Impact | Less Than Significant with Mitigation Incorporation | Less Than Significant Impact | No Impact |
|---|---|---|---|---|
| I. AESTHETICS -- Would the project: | | | | |
| a) Have a substantial adverse effect on a scenic vista? | ❒ | ❒ | ❒ | ■ |
| b) Substantially damage scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a state scenic highway? | ❒ | ❒ | ❒ | ■ |
| c) Substantially degrade the existing visual character or quality of the site and its surroundings? | ❒ | ❒ | ■ | ❒ |
| d) Create a new source of substantial light or glare which would adversely affect day or nighttime views in the area? | ❒ | ❒ | ❒ | ■ |

**Explanation**:
a), b) This project is not located within a scenic vista or scenic highway.

c) Removal of cross-connections and the addition of new storm drainage pipelines would be underground. Any new pump station or other facilities will also be placed underground. The use of excavation equipment for construction purposes will be temporary and thus not constitute a significant visual impact.

d) No new above ground structures are proposed, thus no impacts will be generated.

| | Potentially Significant Impact | Less Than Significant with Mitigation Incorporation | Less Than Significant Impact | No Impact |
|---|---|---|---|---|
| II. AGRICULTURE RESOURCES: In determining whether impacts to agricultural resources are significant environmental effects, lead agencies may refer to the California Agricultural Land Evaluation and Site Assessment Model (1997) prepared by the California Dept. of Conservation as an optional model to use in assessing impacts on agriculture and farmland. Would the project: | | | | |
| a) Convert Prime Farmland, Unique Farmland, or Farmland of Statewide Importance (Farmland), as shown on the maps prepared pursuant to the Farmland Mapping and Monitoring Program of the California Resources Agency, to non-agricultural use? | ❒ | ❒ | ❒ | ■ |
| b) Conflict with existing zoning for agricultural use, or a Williamson Act contract? | ❒ | ❒ | ❒ | ■ |
| c) Involve other changes in the existing environment which, due to their location or nature, could result in conversion of Farmland, to non-agricultural use? | ❒ | ❒ | ❒ | ■ |

**Explanation**:
a), b), c) This project on or near agriculture resources. This project is located is considered an infill/utility project. No impacts to agriculture will be created.

| | Potentially Significant Impact | Less Than Significant with Mitigation Incorporation | Less Than Significant Impact | No Impact |
|---|---|---|---|---|
| III. AIR QUALITY -- Where available, the significance criteria established by the applicable air quality management or air pollution control district may be relied upon to make the following determinations. Would the project: | | | | |
| a) Conflict with or obstruct implementation of the applicable air quality plan? | ❒ | ❒ | ■ | ❒ |
| b) Violate any air quality standard or contribute substantially to an existing or projected air quality violation? | ■ | ❒ | ❒ | ❒ |
| c) Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is non-attainment under an applicable federal or state ambient air quality standard (including releasing emissions which exceed quantitative thresholds for ozone precursors)? | ❒ | ❒ | ■ | ❒ |
| d) Expose sensitive receptors to substantial pollutant concentrations? | ❒ | ❒ | ❒ | ■ |
| e) Create objectionable odors affecting a substantial number of people? | ❒ | ❒ | ❒ | ■ |

**Explanation:**

a),b),c)

$PM_{10}$ and $PM_{2.5}$ emissions are considered by the California Air Resources Board to be the greatest pollutant of concern associated with construction activities. The San Joaquin Valley Air Quality District's approach to CEQA analyses of construction impacts is to emphasize implementation of effective and comprehensive control measures rather than detailed quantification of emissions. The District recognizes that construction equipment emits carbon dioxide and ozone precursors; however, these emissions are accounted for in the PM10 Attainment Demonstration Plan and are not expected to impede attainment of the standard in the SJAVB. From the District's perspective, quantification of construction emissions is not necessary. The District has not developed pollution-specific quantitative threshold values for air emissions from construction activities. If all the PM10 control measures developed by the District are implemented, as appropriate, then the District considers air emissions from construction activities a less than significant impact (mitigation measures G.1. for construction plans for each group of building permits, City of Modesto Wastewater Master Plan Update). However, the City of Modesto considers any net increase in PM10 emissions a significant impact.

The Cross-Connection removal project shall follow the Mitigation Measures developed for the City of Modesto Wastewater Master Plan Air Quality Section, where applicable. Implementation of these mitigation measures would reduce the impacts of construction-related PM10 and impacts of ozone precursors from construction equipment exhaust to the extent possible, for a temporary amount of time. However, this would still result in a net increase in emissions. Therefore, the City's criterion regarding

a net increase in emissions, the impact would remain significant and unavoidable. With the certification of the City's Wastewater Master Plan Master EIR, and the adoption of a statement of overriding considerations regarding air quality, no additional action will be required.

d),e)
The project will not expose receptors to substantial pollutants concentrations nor will create objectionable odors affecting a substantial number of people. With the exception of temporary construction, all facilities will be placed underground and will not emit pollutants or odors.

| | Potentially Significant Impact | Less Than Significant with Mitigation Incorporation | Less Than Significant Impact | No Impact |
|---|---|---|---|---|
| IV. BIOLOGICAL RESOURCES -- Would the project: | | | | |
| a) Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Game or U.S. Fish and Wildlife Service? | ❒ | ❒ | ❒ | ■ |
| b) Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, regulations or by the California Department of Fish and Game or US Fish and Wildlife Service? | ❒ | ❒ | ❒ | ■ |
| c) Have a substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means? | ❒ | ❒ | ❒ | ■ |
| d) Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites? | ❒ | ■ | ❒ | ❒ |
| e) Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance? | ❒ | ■ | ❒ | ❒ |
| f) Conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan? | ❒ | ❒ | ❒ | ■ |

**Explanation**:

a),b),c)

No identified special status species, habitat, riparian areas or wetlands have been identified at or near the project sites, thus no impact.

d)

The cross-connection removal shall implement mitigation measures in E.3 identified in the 2007 Master EIR for the City's Wastewater Master Plan. Implementation ensures that create that are less than significant. Those mitigation measures covered the following:

*Mitigation Measure E.3.1*
Avoidance of nesting raptors. To the extent practicable, construction shall be scheduled to avoid the nesting season, which extends from January through August.

*Mitigation Measure E.3.2*
If it is not possible to schedule construction between August and January, then one of the following options shall be implemented:

- With approval of the CDFG, trees containing known or potential raptor nest sites may be removed to discourage future attempts on the condition that no raptor pair is currently utilizing the site; or

- Pre-construction surveys for nesting raptors would be disturbed during project implementation. A pre-construction survey shall be conducted prior to the initiation of demolition/construction activities during the early part of the breeding season (January through April) and prior to the initiation of these activities during the late part of the breeding season (May through August). During this survey, the qualified person shall inspect all trees in and immediately adjacent to the impact areas for raptor nests. If an active raptor nest is found close enough to the construction area to be disturbed by these activities, the ornithologist, in consultation with CDFG, shall be determine the extent of a construction-free buffer zone to be established around the nest.

e)
The City of Modesto currently in the process of adopting a heritage tree ordinance. If construction activities occur after adoption of the ordinance, than the City shall follow the provisions contained in that ordinance regarding existing tree removal. The trees that are removed will be replaced at ratio consistent with City Standards or at a 1:1 ratio, whichever is greater. New trees will be planted on-site consistent with the City's master tree planting list. This impact is considered less than significant with incorporated mitigation.

f)
There are no known habitat conservation plans or similar plan that has been adopted for parcels affected by this project.

| | Potentially Significant Impact | Less Than Significant with Mitigation Incorporation | Less Than Significant Impact | No Impact |
|---|---|---|---|---|
| V. CULTURAL RESOURCES -- Would the project: | | | | |
| a) Cause a substantial adverse change in the significance of a historical resource as defined in '15064.5? | ❒ | ❒ | ❒ | ■ |
| b) Cause a substantial adverse change in the significance of an archaeological resource pursuant to '15064.5? | ❒ | ❒ | ■ | ■ |
| c) Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature? | ❒ | ❒ | ❒ | ■ |
| d) Disturb any human remains, including those interred outside of formal cemeteries? | ❒ | ❒ | ■ | ❒ |

**Explanation:**

a), c)

There are no known significant historical resource(s) within the project area. In addition, there are no known paleontological resources or unique geological feature within the project site. There will be no impact to either of these resources.

b,d)

The project is outside the City's archaeological resource study area. In the event of an accidental discovery of archaeological resources during construction, the City's General Plan Section VII.F.2.f shall apply to the project. Policy Section VII.F.2.f states:

"For all proposed development within an archaeological resource study area a combination of archival research, particularly through the Central California Information Center at Turlock, and preliminary surface field reconnaissance as well as consultations with the Native American Heritage Commission (NAHC) and those individuals and organizations identified by the NAHC shall be employed to identify any areas that may have been used by Native Americans. Areas containing prehistoric deposits shall be recorded and mapped. Only in those areas where proposed development might affect the resources will an evaluation of their significance be necessary (Modesto General Plan)"

Compliance with Section VIIF.2.f of the General Plan would ensure that the project impact to any related archaeological resources would be less than significant.

| | Potentially Significant Impact | Less Than Significant with Mitigation Incorporation | Less Than Significant Impact | No Impact |
|---|---|---|---|---|
| VI. GEOLOGY AND SOILS -- Would the project: | | | | |
| a) Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving: | | | | |
| i) Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? Refer to Division of Mines and Geology Special Publication 42. | ❒ | ❒ | ❒ | ■ |
| ii) Strong seismic ground shaking? | ❒ | ❒ | ■ | ❒ |
| iii) Seismic-related ground failure, including liquefaction? | ❒ | ❒ | ❒ | ■ |
| iv) Landslides? | ❒ | ❒ | ❒ | ■ |
| b) Result in substantial soil erosion or the loss of topsoil? | ❒ | ❒ | ■ | ❒ |
| c) Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse? | ❒ | ❒ | ■ | ❒ |
| d) Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property? | ❒ | ❒ | ❒ | ■ |
| e) Have soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewers are not available for the disposal of waste water? | ❒ | ❒ | ❒ | ■ |

**Explanation:**

ai)

The project is not located in an known fault zone, thus there is no impact.

aiii), aiv)

No structures are proposed. The project site is not conducive to landslides due the generally level Modesto Area with a regional slope of approximately 0.1 percent. The only active fault is the Telsa-

Ortigalita Fault, located approximately 20 miles southwest of Modesto. The project site is located an area with the maximum intensity MMS level if VII. Since there will be no structures constructed, there is no impact.

a), aii),b),c)
The impact of geology and seismicity on the project were deemed less than significant and no mitigation measures would be necessary based on the adopted 2007 Wastewater Master Plan Master EIR. The statement included the following:

The project facilities would not be subject to landslides, erosion, expansive soils or subsidence. The project would not contribute to any seismic activity nor be subject to landslides induced by seismic activity. Liquefaction induced by seismic activity would be prevented by incorporating site-specific geological data in design of structures, to which this project proposes none. Therefore, the impact of geology and seismicity on the proposed project would be less than significant and no mitigation measures would be necessary.

d)
The project and underground pipes are located on low risk expansive and subsidence soils. (insert soil type) is not classified as expansion, thus no impact.

e)
This project does not involve the use of septic tanks or other waste water disposal systems. No impact.

| VII. HAZARDS AND HAZARDOUS MATERIALS B Would the project: | Potentially Significant Impact | Less Than Significant with Mitigation Incorporation | Less Than Significant Impact | No Impact |
|---|---|---|---|---|
| a) Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials? | ❒ | ❒ | ❒ | ■ |
| b) Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment? | ❒ | ■ | ❒ | ❒ |
| c) Emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school? | ❒ | ❒ | ❒ | ■ |
| d) Be located on a site which is included on a list of hazardous materials sites compiled pursuant to Government Code Section 65962.5 and, as a result, would it create a significant hazard to the public or the environment? | ❒ | ❒ | ❒ | ■ |
| e) For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project result in a safety hazard for people residing or working in the project area? | ❒ | ❒ | ❒ | ■ |
| f) For a project within the vicinity of a private airstrip, would the project result in a safety hazard for people residing or working in the project area? | ❒ | ❒ | ❒ | ■ |
| g) Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan? | ❒ | ❒ | ❒ | ■ |
| h) Expose people or structures to a significant risk of loss, injury or death involving wildland fires, including where wildlands are adjacent to urbanized areas or where residences are intermixed with wildlands? | ❒ | ❒ | ❒ | ■ |

**Explanation:**

a)

This project will not create a significant hazard
transport, use, or disposal of hazardous materia

b)
Consistent with the City's adopted Wastewater Master Plan Master EIR, mitigation measures K.1.a-K.1.f, where applicable, shall be followed to reduce the excavation for installation of improvements that could encounter contaminated soil and/or groundwater exposure to workers and the public to hazardous substances to a less than significant threshold. Those policies are listed below.

*Mitigation Measure K.1a*
Prior to activities involving soil disturbance for the improvements to the wastewater collection and treatment systems, the City shall use reasonable means to determine the presence of soil or groundwater contamination. Those reasonable means may consist of soil gas surveys, soil or groundwater sampling, and/or Phase I environmental Site Assessment conducted by a qualified professional (e.g. a California-registered environmental assessor, Professional Geologist, or Professional Engineer). Any Phase I environmental site assessment shall be performed in conformance with the most recent standard adopted by ASTM Internal for Phase I site assessments, and shall present recommendations for further investigation of the site, if necessary.

*Mitigation Measure K.1b*
If warranted, conduct soil and groundwater sampling and analysis. If the investigation activities in Mitigation Measure K.1a were to indicate that a release of hazardous materials could have affected the location(s) where soil disturbance would occur, a Soil and/or Groundwater Investigation shall be conducted prior to soil disturbance by a qualified environmental professional to asses the presence and extent of contamination at the site and the potential risk to human health and public safety from the contamination (if any). The soil and/or groundwater investigation shall be conducted in accordance with state and local guidelines and regulation, and the most recent ASTM International Standard for Phase II Environmental Site Assessments, with oversight from a regulatory agency (Stanislaus County Environmental Resources Department). The findings of the investigation shall be documented in a written report and submitted to the regulatory agency and the City.

*Mitigation Measure K.1c*
If warranted, prepare a site remediation plan and health and safety plan. If the results of the subsurface investigation(s) indicate the presence of hazardous materials, the Stanislaus County Department of Environmental Resources shall be notified and site remediation may be required by the applicable state or regulatory agency or the County Department of Environmental Resources Site Mitigation Unit, Specific remedies would depend on the extent and magnitude of contamination and the requirements of the regulatory agencies. Under the direction of the regulatory agencies and the City, a Site Remediation Plan shall be prepared, as required, by the contractor(s). The Plan shall; 1) specific measures to be taken to protect workers and the public form exposure to the potential site hazards, and 2) certify that the proposed remediation measures would clean up the waste, dispose the wastes, and protect public health in accordance with federal, state and local requirements.

*Mitigation Measure K.1.d*
Where any activity would be performed at a contaminated site or where hazardous materials are suspected, the City's contractor shall prepare a project-specific Health and Safety Plan prior to any site work. The Health and Safety Plan shall be prepared by the contractor(s) filled with the City and

regulatory agencies (as required). The Plan shall include required worker health and safety provisions for all workers potentially exposed to contraindicated materials at the site, identification of hazardous materials present, monitoring to be performed during the site activities (as appropriate), required training for workers, identification of appropriate personal protective equipment and emergency response procedures, and designation of personnel responsible for Plan implementation.

*Mitigation Measure K.1.e*
Prepare a waste disposal and hazardous materials transportation plan. The contractor(s) shall prepare a waste disposal and hazardous materials transportation plan prior to construction activities where hazardous wastes or materials requiring off-site disposal would be generated. The plan shall include a description of analytical methods for characterizing wastes and handling methods required to minimize the potential for exposure, and shall establish procedures for the safe storage of contaminated materials, stockpiling of soils, and storage of dewatered groundwater (as appropriate). The required disposal method for contaminated materials (including any lead-based paint, asbestos, or other hazardous materials requiring disposal) and the approved disposal site shall be indicated in the plan. The Plan shall also identify specific routes to bused for transport of hazardous materials and waste to and from the project site, or specific routes to be avoided during transport. Routes shall be selected to minimize proximity to sensitive receptors to the greatest practical degree. Elements of the Plan regarding transportation of hazardous materials wad wastes shall be reviewed and approved by the City Fire Department.

*Mitigation Measure K.1.f*
In the event that previously unidentified contamination is encountered (e.g. identified by odor or visual staining) during soul disturbance activities or any underground storage tanks, abandoned drums, or other hazardous materials or wastes are encountered during construction, the contractor(s) shall have prepared a contingency plan for sampling and analysis of potentially hazardous substances and coordination with appropriate regulatory agencies. The plan shall be submitted to the City prior to project activities involving soil disturbances. Any site investigations or remedial activities shall be performed in accordance with applicable laws under the direction of a regulatory agency and the City, in accordance with Mitigation Measures K.1.c through K.1.e above.

c)
This project will not emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school. No impact.

d)
The project is not located on any sites included on a list of hazardous materials sites compiled pursuant to Government Code Section 65962.5. No impact.

e), f)
This project is not located near an airfield, thus no impact.

g)
The cross connection removal project will not affect an emergency response plan or emergency evacuation plan. Improvements are planned for residential streets with multiple neighborhood

connections. No impact.

h)
The project is an infill project with no structures being proposed. The project sites are not located near wildland areas. No impact.

| | Potentially Significant Impact | Less Than Significant with Mitigation Incorporation | Less Than Significant Impact | No Impact |
|---|---|---|---|---|
| VIII. HYDROLOGY AND WATER QUALITY -- Would the project: | | | | |
| a) Violate any water quality standards or waste discharge requirements? | ■ | ❒ | ❒ | ❒ |
| b) Substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (e.g., the production rate of pre-existing nearby wells would drop to a level which would not support existing land uses or planned uses for which permits have been granted)? | ❒ | ❒ | ❒ | ■ |
| c) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial erosion or siltation on- or off-site? | ❒ | ❒ | ❒ | ■ |
| d) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site? | ❒ | ❒ | ❒ | ■ |
| e) Create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff? | ❒ | ❒ | ■ | ❒ |
| f) Otherwise substantially degrade water quality? | ❒ | ❒ | ■ | ❒ |
| g) Place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map? | ❒ | ❒ | ❒ | ■ |
| h) Place within a 100-year flood hazard area structures which would impede or redirect flood flows? | ❒ | ❒ | ❒ | ■ |
| i) Expose people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of a levee or dam? | ❒ | ❒ | ❒ | ■ |

| | Potentially Significant Impact | Less Than Significant with Mitigation Incorporation | Less Than Significant Impact | No Impact |
|---|---|---|---|---|
| j) Inundation by seiche, tsunami, or mudflow? | ❒ | ❒ | ❒ | ■ |

**Explanation:**

a) With the certification of the City's Wastewater Master Plan Master EIR, and the adoption of a statement of overriding considerations regarding water quality, no additional action will be required. However, the City is still required to follow NPDES permit standards set forth through this permit for discharges into waters of the US. The City currently has additional capacity that allows for additional discharges and shall follow the rules and regulations regarding discharges.

b)
The cross connection removal project will not have any impact on withdrawing from local aquifers. This project proposed will recharge groundwater via the systems that provide retention for stormwater runoff after pre-treatment. Detention systems will carry stormwater runoff to other areas of the City for disposal via the City existing storm drainage system. No impact.

c)
The project will not substantially alter the existing drainage pattern. This project will help alleviate local flooding in the project area where cross-connections will be removed. No natural water course will be affected by the project. No impact.

e),f)
Consistent with the City's adopted Wastewater Master Plan Master EIR, mitigation measures D.1-D.4 shall be followed to reduce the impacts of water runoff and water quality to a less than significant threshold. Those measures include the following:

Mitigation Measure D.1.
The City shall prepare a SWPPP designed to reduce potential impacts to surface water quality through the construction period of all the project components. The SWPPP shall emphasize measures designed to minimize erosion and off-site sedimentation during improvements to the collection system installation. If is not requires that the SWPPP be submitted to the RWCQB, but must be maintained on-site and made available to the RWCQB staff upon request. The SWPPP shall include:

Specific and detailed BMPs designed to mitigate construction-related pollutants. At a minimum, BMPs shall include practices to minimize the contact of construction materials, equipment, maintenance supplies with stormwater. The SWPPP shall specify properly design, centralized storage areas that keep these materials out of the rain.

| | Potentially Significant Impact | Less Than Significant with Mitigation Incorporation | Less Than Significant Impact | No Impact |
|---|---|---|---|---|
| IX. LAND USE AND PLANNING - Would the project: | | | | |
| a) Physically divide an established community? | ❒ | ❒ | ❒ | ■ |
| b) Conflict with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the project (including, but not limited to the general plan, specific plan, local coastal program, or zoning ordinance) adopted for the purpose of avoiding or mitigating an environmental effect? | ❒ | ❒ | ❒ | ■ |
| c) Conflict with any applicable habitat conservation plan or natural community conservation plan? | ❒ | ❒ | ❒ | ■ |

**Explanation:**

a) The cross connection does not include any structures that will physically divide an existing community. No Impact.

b) The cross-connection removal project does not propose any above ground facilities and new facilities would be located underground, therefore would not cause any long-term changes in existing land uses.

c)
The proposed project is not in an adopted habitat conservation planning area nor natural community conversation planning area. No impact.

| | Potentially Significant Impact | Less Than Significant with Mitigation Incorporation | Less Than Significant Impact | No Impact |
|---|---|---|---|---|
| X. MINERAL RESOURCES -- Would the project: | | | | |
| a) Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state? | ❒ | ❒ | ❒ | ■ |
| b) Result in the loss of availability of a locally-important mineral resource recovery site delineated on a local general plan, specific plan or other land use plan? | ❒ | ❒ | ❒ | ■ |

**Explanation:**

a),b)
There are no known mineral resources within the cross-connection removal project area. No impact.

| | Potentially Significant Impact | Less Than Significant with Mitigation Incorporation | Less Than Significant Impact | No Impact |
|---|---|---|---|---|
| XI. NOISE--Would the project result in: | | | | |
| a) Exposure of persons to or generation of noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies? | ❒ | ❒ | ■ | ❒ |
| b) Exposure of persons to or generation of excessive groundborne vibration or groundborne noise levels? | ❒ | ■ | ❒ | ❒ |
| c) A substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project? | ❒ | ❒ | ■ | ❒ |
| d) A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project? | ❒ | ■ | ❒ | ❒ |
| e) For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project expose people residing or working in the project area to excessive noise levels? | ❒ | ❒ | ❒ | ■ |
| f) For a project within the vicinity of a private airstrip, would the project expose people residing or working in the project area to excessive noise levels? | ❒ | ❒ | ❒ | ■ |

**Explanation:**

a), b), c),d)
Consistent with the City's adopted Wastewater Master Plan Master EIR, mitigation measure H.1 shall be followed to reduce the impacts of temporary noise due to construction activities to a less than significant threshold.

*Mitigation Measure H.1*
In areas where there are sensitive receptors, the City shall ensure that contractors implement the following practices:

- To the extent feasible, construction activities shall be restricted to the hours between 7:00am and 9:00 pm, Monday through Friday, and between 9:00am and 9:00pm, Saturday and Sunday and state or federal holidays; minor construction equipment servicing and maintenance shall be excepted from this restriction.

- Construction equipment and vehicles should be equipped with mufflers, and impact tools

should be equipped with shrouds or shields.

- Stationary noise sources and construction staging areas shall be located as far as possible from existing residences, hospitals, schools, churches, and parks (preferably at least 200 feet), or contractors shall be required to provide additional noise-reducing engine enclosures (with the goal of achieving approximately 10 dBA of reduction compared to uncontrolled engines).

- Construction vehicle access routes shall be designed to minimize the impact on sensitive land uses such as schools and residential areas.

e), f)
The project is not located within an airport land use plan, near a private airfield, or is not within 2 miles of a public airport. No impact.

| | Potentially Significant Impact | Less Than Significant with Mitigation Incorporation | Less Than Significant Impact | No Impact |
|---|---|---|---|---|
| XII. POPULATION AND HOUSING -- Would the project: | | | | |
| a) Induce substantial population growth in an area, either directly (for example, by proposing new homes and businesses) or indirectly (for example, through extension of roads or other infrastructure)? | ■ | ❒ | ❒ | ❒ |
| b) Displace substantial numbers of existing housing, necessitating the construction of replacement housing elsewhere? | ❒ | ❒ | ❒ | ■ |
| c) Displace substantial numbers of people, necessitating the construction of replacement housing elsewhere? | ❒ | ❒ | ❒ | ■ |

**Explanation:**

a)
The project is consistent and an identified project in the 2007 Wastewater Master Plan Master EIR. This project will not result in additional significant impacts related to growth that were not already identified in the City of Modesto's Final Master EIR and adopted statement of overriding considerations.

b),c)
No displacement of existing housing or replacement of housing is proposed by this project. No impact.

| | Potentially Significant Impact | Less Than Significant with Mitigation Incorporation | Less Than Significant Impact | No Impact |
|---|---|---|---|---|
| XIII. PUBLIC SERVICES | | | | |
| a) Would the project result in substantial adverse physical impacts associated with the provision of new or physically altered governmental facilities, need for new or physically altered governmental facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response times or other performance objectives for any of the public services: | | | | |
| Fire protection? | ❒ | ❒ | ❒ | ■ |
| Police protection? | ❒ | ❒ | ❒ | ■ |
| Schools? | ❒ | ❒ | ❒ | ■ |
| Parks? | ❒ | ❒ | ■ | ❒ |
| Other public facilities? | ❒ | ❒ | ❒ | ■ |

**Explanation:**

a)

Four neighborhood parks will be affected in the cross-connection removal project. These parks will either be partially closed or entirely closed for a temporary duration of time to allow for construction of the underground detention/retention storage facilities. Any affected facilities such as turf areas, play structures, etc. that is removed during construction will be moved to a temporary location on-site and be placed back to its original location or other suitable location as determined by the Parks and Recreation Department upon completion of construction of the detention/retention system. Turf areas will be replaced with new turf and vegetation as well. With the replacement of turf areas and any play structures and the closures of parks temporary in nature, this impact is deemed less than significant.

This project will otherwise not affect fire and police protection, schools, or other public facilities. Thus, no impact.

| | Potentially Significant Impact | Less Than Significant with Mitigation Incorporation | Less Than Significant Impact | No Impact |
|---|---|---|---|---|
| XIV. RECREATION -- | | | | |
| a) Would the project increase the use of existing neighborhood and regional parks or other recreational facilities such that substantial physical deterioration of the facility would occur or be accelerated? | ❒ | ❒ | ■ | ❒ |
| b) Does the project include recreational facilities or require the construction or expansion of recreational facilities which might have an adverse physical effect on the environment? | ❒ | ❒ | ❒ | ■ |

**Explanation:**

a)

The proposed cross-connection removal project will affect four neighborhood parks that are identified in the project description. These parks will have portions of them excavated to install an underground detention/retention storm drainage system. This excavation will include removal of turf areas and other landscaping, irrigation system and potentially play structures, if warranted. These passive recreation areas are primarily used by neighborhood residents for local recreation opportunities. Upon completion the underground stormwater retention/detention system, new turf, irrigation, landscaping will be constructed restoring parks to their original condition. Any play structures that are removed will be relocated to a temporary, on-site location. Upon completion of the project, any affected play structure will be placed back at its original location, or a location suitable to the City's Parks and Recreation Department that provides for safe play area. The installation of new turf and irrigation systems will extend the life of the affected park facilities. Any affected play structure would be replaced with new, more modern play structures that meet current safety standards established by the City and various other regulatory agencies. Because the closure of these parks is temporary, and any affected portion of these parks will be replaced, this impact is deemed less than significant.

b) No expansion or additional facilities are proposed as a part of this project. No impact.

| | Potentially Significant Impact | Less Than Significant with Mitigation Incorporation | Less Than Significant Impact | No Impact |
|---|---|---|---|---|
| XV. TRANSPORTATION/TRAFFIC -- Would the project: | | | | |
| a) Cause an increase in traffic which is substantial in relation to the existing traffic load and capacity of the street system (i.e., result in a substantial increase in either the number of vehicle trips, the volume to capacity ratio on roads, or congestion at intersections)? | ☐ | ☐ | ☐ | ■ |
| b) Exceed, either individually or cumulatively, a level of service standard established by the county congestion management agency for designated roads or highways? | ☐ | ☐ | ☐ | ■ |
| c) Result in a change in air traffic patterns, including either an increase in traffic levels or a change in location that results in substantial safety risks? | ☐ | ☐ | ■ | ☐ |
| d) Substantially increase hazards due to a design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment)? | ☐ | ☐ | ☐ | ■ |
| e) Result in inadequate emergency access? | ☐ | ☐ | ☐ | ■ |
| f) Result in inadequate parking capacity? | ☐ | ☐ | ■ | ☐ |
| g) Conflict with adopted policies, plans, or programs supporting alternative transportation (e.g., bus turnouts, bicycle racks)? | ☐ | ☐ | ☐ | ■ |

**Explanation:**

a),b)
This project will not cause an increase in traffic that is substantial in relation to the existing traffic load and capacity. No impact.

c), f)
The proposed cross-connection removal project will have a temporary effect on traffic due to temporary lane closures and limiting the amount of on-street parking within neighborhoods during construction periods. The 2007 Wastewater Master Plan Master EIR identified the City's standard conditions for construction activities in roadways as a way to reduce these impacts to less than significant levels. This project will follow these standard conditions, thus these impacts would be less than significant.

d)
There will be no substantial design feature that affects the existing roadway network. No impact.

e)
This project does not propose structures nor effect emergency access to neighborhoods. No impact.

f)
No additional parking is proposed for this project. This project affects underground utilities. No impact.

g)
This project does not conflict with adopted policies, plans or programs for supporting alternative transportation. No impact.

| XVI. UTILITIES AND SERVICE SYSTEMS B Would the project: | Potentially Significant Impact | Less Than Significant with Mitigation Incorporation | Less Than Significant Impact | No Impact |
|---|---|---|---|---|
| a) Exceed wastewater treatment requirements of the applicable Regional Water Quality Control Board? | ❒ | ❒ | ❒ | ■ |
| b) Require or result in the construction of new water or wastewater treatment facilities or expansion of existing facilities, the construction of which could cause significant environmental effects? | ❒ | ❒ | ■ | ❒ |
| c) Require or result in the construction of new storm water drainage facilities or expansion of existing facilities, the construction of which could cause significant environmental effects? | ❒ | ❒ | ■ | ❒ |
| d) Have sufficient water supplies available to serve the project from existing entitlements and resources, or are new or expanded entitlements needed? | ❒ | ❒ | ❒ | ■ |
| e) Result in a determination by the wastewater treatment provider which serves or may serve the project that it has adequate capacity to serve the project=s projected demand in addition to the provider=s existing commitments? | ❒ | ❒ | ❒ | ■ |
| f) Be served by a landfill with sufficient permitted capacity to accommodate the project=s solid waste disposal needs? | ❒ | ❒ | ❒ | ■ |
| g) Comply with federal, state, and local statutes and regulations related to solid waste? | ❒ | ❒ | ❒ | ■ |

**Explanation:**

a) The cross-connections removal project will not provide any additional wastewater to existing facilities. It will alleviate existing conditions at facilities. No impact.

b)
The cross-connection removal project will improve the capability of the wastewater treatment plant by removing some of the stormwater flow that currently enters the plant during storm events. This would thereby increase capacity of the wastewater treatment plant and may be a growth inducing impact. This project will not result in additional significant impacts related to growth that were not already identified in the City of Modesto's Final Master EIR and adopted statement of overriding considerations.

c)
The proposed cross-connect removal project will construct new stormwater drainage facilities to accommodate existing stormwater flow from existing neighborhoods and remove its connection with the City's sewer system. The construction of the facilities involves the installation of underground pipes connecting to a detention/retention system below four neighborhood parks. This system will filter out trash, sediment, oil, grease, and other substances prior to any infiltration into ground water on systems that are designed that are retention. Detention systems will also filter out sediments prior to being pumped to the City storm drainage system. This stormwater flow will eventually discharge in the San Joaquin River consistent with the approved NPDES permit obtained by the City of Modesto.

d),e),f),g)
No additional water, wastewater, or solid waste will be generated by this project. No impact.

| | Potentially Significant Impact | Less Than Significant with Mitigation Incorporation | Less Than Significant Impact | No Impact |
|---|---|---|---|---|
| XVII. MANDATORY FINDINGS OF SIGNIFICANCE -- | | | | |
| a) Does the project have the potential to degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, reduce the number or restrict the range of a rare or endangered plant or animal or eliminate important examples of the major periods of California history or prehistory? | ❒ | ❒ | ❒ | ■ |
| b) Does the project have impacts that are individually limited, but cumulatively considerable? ("Cumulatively considerable" means that the incremental effects of a project are considerable when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects)? | ■ | ❒ | ❒ | ❒ |
| c) Does the project have environmental effects which will cause substantial adverse effects on human beings, either directly or indirectly? | ❒ | ❒ | ❒ | ■ |

**Explanation:**

a)
The cross-connection removal project will not degrade or have the potential to degrade habitat, history or pre-history of California, fish and wildlife levels, etc. This project will improve the capability to handle neighborhood flooding, and free up capacity in the City's sewer system. No Impact.

b)
The cross-connection removal project identified in the city's 2007 Wastewater Master Plan is just one of many improvement projects to the City's wastewater treatment system to implement the City's adopted General Plan. The cumulative effects of the General Plan have been examined in the City's Final Master EIR. The City determined that the benefits of growth outweighed the significant environmental effects of and adopted a statement of overriding considerations. This project would not result in any additional significant impacts related to cumulative effects on growth, air quality, hydrology and water that we not identified in the City's Final Master EIR or the Final 2007 Wastewater Master Plan.

c)
The cross-connection removal project will have no substantial adverse effects on human beings either directly or indirectly. No impact.

# APPENDIX E

## GEOTECHNICAL REPORT

# PRELIMINARY GEOTECHNICAL REPORT
# INFILTRATION TESTING

For

## Area 2 Storm Drain Project

Prepared by:

BLACKBURN CONSULTING
1720 G Street
Modesto, CA 95354

June 2009

For:

RRM Design Group
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Geotechnical ▪ Construction Services ▪ Forensics

June 12, 2009
BCI File No. 1721.1

Mr. William Strand
RRM Design Group
210 East F Street
Oakdale, CA 95361

Subject: **Preliminary Geotechnical Report - Infiltration Testing**
Area 2 Storm Drain Project
Modesto, California

Dear Mr. Strand,

In accordance with our agreement dated April 27, 2009 and discussions with you, we completed our evaluation of soil conditions and infiltration testing for the City of Modesto, Area 2 Storm Drain to Sanitary Sewer Cross Connections Removal, Preliminary Design Project.

This report summarizes our observation of subsurface soil and groundwater conditions, in-situ infiltration test results, and laboratory testing.

We appreciate the opportunity to provide these services. Please call if you have questions or require additional information.

Sincerely;

**BLACKBURN CONSULTING**

REGISTERED PROFESSIONAL ENGINEER
BENJAMIN D. CRAWFORD
No C68457
Exp. 9/30/09
CIVIL
STATE OF CALIFORNIA

Patrick Fischer, P.G., C.E.G.
Engineering Geologist, Principal

Benjamin D. Crawford, P.E.
Engineer, Principal

**PRELIMINARY GEOTECHNICAL REPORT**

Area 2 Storm Drain to Sanitary Sewer Cross Connections Removal Project

Modesto, California

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**FIGURES**

Figure 1 – Vicinity Map

Figure 2A to 2D – Boring and Test Location Map

**APPENDIX A**

Field Exploration Summary

Boring Log Legend

Logs of Borings

**APPENDIX B**

Laboratory Testing Summary

Laboratory Test Results

## INTRODUCTION

### Purpose

The purpose of our geotechnical evaluation is to provide RRM Design Group with subsurface data for preliminary design of infiltration basins/trenches at four City of Modesto park sites for the Area 2 Storm Drain to Sanitary Sewer (SDSS) Cross Connections Removal, Preliminary Design Project. The proposed project involves four park sites, Roosevelt, Catherine Everett, Garrison, and JM Pike. The requested geotechnical information for each park site includes soil profiles, groundwater depth, infiltration rates for preliminary design, and construction considerations.

### Scope of Services

To provide geotechnical information for preliminary project design, Blackburn Consulting (BCI) completed the following:

- Reviewed available geologic mapping and subsurface data in the project area
- Drilled, logged and sampled at deep borings (31.5 to 41.5 feet) at each park site (total of 5 borings) to determine the general soil profile and depth to groundwater
- Completed infiltration testing at 2 to 4 test locations within each proposed infiltration site (total of 15 tests)

## PROJECT DESCRIPTION

In some areas of the City, excess stormwater runoff drains directly into the sanitary sewer collection system by means of cross connections via surface inlets (catch basins). In order to mitigate existing surcharging and potential overflow conditions along a portion of the sewer system (Emerald Trunk Sewer), cross connections within Area 2 (north-central section of the City) would be removed and stormwater would be directed to neighboring City parks for underground storage and infiltration.

## SITE DESCRIPTION

The City parks identified for this project are:

- Catherine Everett
- Garrison
- JM Pike
- Roosevelt

The parks are located in the north-central portion of the City of Modesto. We show the location of each park site on Figure 1, Vicinity Map. The infiltration locations within the parks are generally level, grass covered, and/or dirt ball fields. Sidewalk and trees typically border the areas. We show each park site and the proposed infiltration locations, as provided by RRM Design Group, on Figure 2A through 2D.

## FIELD EXPLORATION

To characterize the subsurface conditions at the site, BCI drilled and sampled 5 deep exploratory borings and 16 shallow infiltration test locations between May 18 and 26, 2009. We show the boring locations on Figures 2A through 2D and provide detailed information on the borings in Appendix A.

## LABORATORY TESTING

BCI performed Grain Size Distribution testing (ASTM D-422) and Plasticity Index testing (ASTM D4318) on selected soil samples retrieved from the borings. We attach laboratory results in Appendix B.

## SUBSURFACE CONDITIONS

The soil we encountered during our subsurface exploration are consistent with published geologic mapping[1] that shows the area as underlain by young (Pleistocene age) alluvial sediments of the Modesto Formation. The general soil profile at all parks is similar with loose to medium dense, silty sand (SM) in the upper 6 to 8 feet, underlain by medium dense to dense, fine to medium grained sand and silty sand (SP and SM) to the maximum depth of our exploration (41.5 feet). There are some intervening clays and silts at depth; Catherine Everett, JM Pike, and Roosevelt parks all have a clay layer, 5 to 6 feet thick, at depths greater than 18 feet. Roosevelt Park has additional fine-grained soils (sandy clay) between depths of 11 to 16 feet.

The soil profile we describe above is generalized; therefore, refer to the logs of the borings in Appendix A for the soil conditions that we logged at specific locations. On the logs, we indicate the observed soil type, color, moisture, consistency, and Unified Soil Classification Symbol. Classification of the soils is based on our field representative's estimate of soil properties and results of laboratory tests.

## GROUNDWATER

We encountered groundwater in our borings at the following depths and approximate elevations:

**TABLE 1**

| OBSERVED GROUNDWATER IN BORINGS | | | |
|---|---|---|---|
| **Location** | **Boring No.** | **Groundwater Depth (ft)** | **Groundwater[2] Approx. Elev. (ft)** |
| Catherine Everett Park | B-1 | 28.0 | 55 |
| J.M. Pike Park | B-2 and B-3 | 33.0 | 50 |
| Roosevelt Park | B-4 | 38.5 | 51 |
| Garrison Park | B-5 | 32.0 | 50 |

[1] Wagner, D.L., Bortugno, E.J., and McJunkin, R.D., 1990, Geologic Map of the San Francisco-San Jose Quadrangle; California Department of Conservation, Division of Mines and Geology, Regional Geologic Map Series, Map No. 5A.
[2] Mean Sea Level (based on approximate USGS elevations)

The depth to groundwater that we observed is consistent with State of California, Department of Water Resources (DWR) data for groundwater elevation in the area (Modesto Sub-basin). The DWR shows groundwater elevations between 50 to 60 feet in the area of the parks for Spring of 2000, 2005, and 2006. The groundwater gradient is to the west-southwest.

## INFILTRATION RATES

Based on potential facility depths of 9 to 15 feet, infiltration at the parks will be primarily into fine to medium grained sands and silty sands. Based on the soil types that we logged and sampled, we would expect infiltration rates of 0.5 to 30+ inches per hour (moderate to very high rates). Roosevelt Park had some shallow fine-grained soils at depths of 11 to 23 feet, which are expected to have slow infiltration rates (on the order of less than 1/8-inch per hour).

We reviewed approximate infiltration rates based on grain size distribution (see Appendix B for laboratory test results). Based on the Hazen equation, which uses the grain size for which 10% of the sample is finer ($d_{10}$) to estimate hydraulic conductivity, the poorly graded sands (not fine grained soils) at potential facility depths will have infiltration rates ranging between 3.7 to 6.3 inches per hour.

To field test infiltration rates, BCI completed constant head tests in uncased boreholes. We coordinated test depths with RRM Design Group based on proposed facility depths. We used an infiltration test method and calculations based on the US Bureau of Reclamation field manual for gravity testing[3]. The following summarizes the general test method we used:

- Drilled a 6-inch diameter hole to test depth
- Developed (cleaned) the borehole with water and a bailer (using water fed into the hole)
- Placed a layer of coarse gravel at the bottom of the hole (minimum of 6 inches), and set a water feed pipe and an observation pipe (each 2-inch in diameter)
- Saturated the bottom of the hole with approximately 50 gallons or more of water
- Provided a metered supply of water into the feed pipe until a minimum of three successive measurements of the water level, taken at 5-minute intervals, were within 0.2 feet of each other. The water flow rate was adjusted to obtain a stabilized water level within the hole.

Normally, the test water height within the hole is a minimum of 5 times the borehole diameter to reduce influence from the bottom of the hole. We used a reduced height of water to increase bottom of the hole influence and obtain an infiltration rate more representative of the basin bottom (rather than lateral infiltration such as at basin sides). In Table 2 below, we summarize the test data and infiltration values that we obtained.

[3] United States Bureau of Reclamation, 1998, Engineering Geology Field Manual, Second Edition, Vol. 2

**TABLE 2**

| INFILTRATION TEST DATA SUMMARY | | | | | | |
|---|---|---|---|---|---|---|
| **Park Name** | **Test Hole No.** | **Hole Btm. Depth (ft)** | **Depth to Test Water (ft)** | **Approx. Boring Diam. (ft)** | **Constant Flow Rate (gpm)** | **Infiltration Rate (inches/hr)** |
| Catherine Everett | C1 | 12.5 | 10.6 | 0.67* | 0.84 | 5.16 |
| Catherine Everett | C2 | 12.5 | 11.0 | 0.5 | 2.65 | 24.29 |
| Catherine Everett | C3 | 12.4 | 11.0 | 0.5 | 1.0 | 9.82 |
| Catherine Everett | C3 | 12.4 | 8.6 | 0.5 | 4.5 | 11.12 |
| Catherine Everett | C4 | 12.2 | 11.0 | 0.5 | 0.08 | 1.03 |
| | | | | | | |
| JM Pike | J1 | 10.2 | 9.33 | 0.5 | 1.0 | 17.70 |
| JM Pike | J2 | 10.2 | 9.4 | 0.5 | 1.65 | 31.76 |
| JM Pike | J3 | 10.2 | 9.4 | 0.5 | 0.77 | 14.82 |
| JM Pike | J4 | 10.2 | 9.75 | 0.5 | 0.45 | 15.40 |
| JM Pike | J5 | 10.2 | 8.92 | 0.5 | 0.04 | 0.47 |
| JM Pike | J6 | 10.2 | 9.3 | 0.5 | 1.23 | 21.05 |
| | | | | | | |
| Garrison | G1 | 12.2 | 11.33 | 0.5 | 0.16 | 2.83 |
| Garrison | G2 | 15.2 | 14.0 | 0.5 | 0.38 | 4.88 |
| Garrison | G3 | 12.2 | 11.25 | 0.5 | 0.36 | 5.84 |
| Garrison | G4 | - Hole filled by Parks Dept prior to testing - | | | | |
| | | | | | | |
| Roosevelt | R1 | 9.2 | 8.0 | 0.5 | 4.17 | 53.52 |
| Roosevelt | R2 | 12.2 | 10.33 | 0.5 | 0.02 | 0.14 |

* Some caving at base of hole caused an increase in diameter (estimated) at test depth

Our field tests show generally high to very high infiltration rates (approximately 5 to >14 inches per hour) for most of the sands at proposed facility depth. We also recorded moderate rates (1 to 3 inches per hour) in isolated locations (C4 at Catherine Everett, and G1 at Garrison) that likely reflect higher fines content at or near the test depth. We recorded slow rates (less than 0.5 inches per hour) at JM Pike Park in Test Hole J5, and at Roosevelt Park in Test Hole R2. The slow test results likely represent a soil horizon with substantial amounts of fine grained soil, which we did observe in our borings (silty sand/silt at JM Pike and clayey sand at Roosevelt).

The infiltration rates we provide above can be used in preliminary design of the proposed facilities. Consider the rates as approximate and use an appropriate safety factor in design. Due to the alluvial nature of the soils underlying the sites, there can be significant lateral and vertical variation in soil type and infiltration rates (as shown by isolated locations with significantly lower rates). Consider further evaluation of soil profiles and infiltration rates for final design.

## CONSTRUCTION CONSIDERATIONS

### Excavation Sloping

Native soil located within 12 to 15 feet of the surface at all sites generally consists of loose to medium dense granular soil. Excavation of these soils can be accomplished with conventional equipment. Excavations greater than 5 feet deep must be sloped or shored to prevent failure. In accordance with sloping guidelines (Federal Register, 29 CFR, Part 1926), we expect the soil to be classified as Type C (granular soils including gravel, sand, and loamy sand). Excavations in Type C soils must be sloped no steeper than a gradient of 1.5:1 (H:V). Surcharge loads such as trench spoils, equipment, etc. should not be placed adjacent to an open excavation (within a distance of ½ the height of the slope).

The above is guideline information only. The excavation contractor is always responsible for site safety and final excavation/shoring design and construction based on actual excavation conditions encountered during construction.

### Construction Verification

When the infiltration areas are open to the planned infiltration surface, the soils should be reviewed to for confirmation of anticipated conditions. Infiltration rate verification should be completed at that time. Depending on the outcome of verification testing, design modifications and/or overexcavation of some soils may be necessary.

### Fill and Compaction

Minimize equipment travel on the excavated surface of the infiltration area. If the surface becomes compacted prior to placement of drainage materials, thoroughly scarify to a minimum depth of 12 inches.

Native soil will be suitable as excavation backfill. Compact all fill material to a minimum of 90% relative compaction in accordance with ASTM D1557. In open park spaces, the upper 2 feet of fill can be compacted to between 85% and 90% relative compaction to facilitate vegetative growth.

## LIMITATIONS

BCI bases this report on current site conditions. We assume the soil and groundwater conditions that we logged are representative of the subsurface conditions at the sites. Actual conditions between subsurface probes can be different.

BCI considers this report of conditions to be preliminary. Additional exploration and testing may be necessary for final design.

BCI performed services in accordance with generally accepted geotechnical engineering principles and practices currently used in this area. We do not warranty our services.

The lines designating the interface between soil materials on the logs are approximate. The transition between materials may be abrupt or gradual. The final logs represent our interpretation of the field logs, laboratory testing, and general knowledge of the area and geologic conditions.

# FIGURES

Figure 1 – Vicinity Map
Figure 2A to 2D – Boring and Test Location Map

NO SCALE

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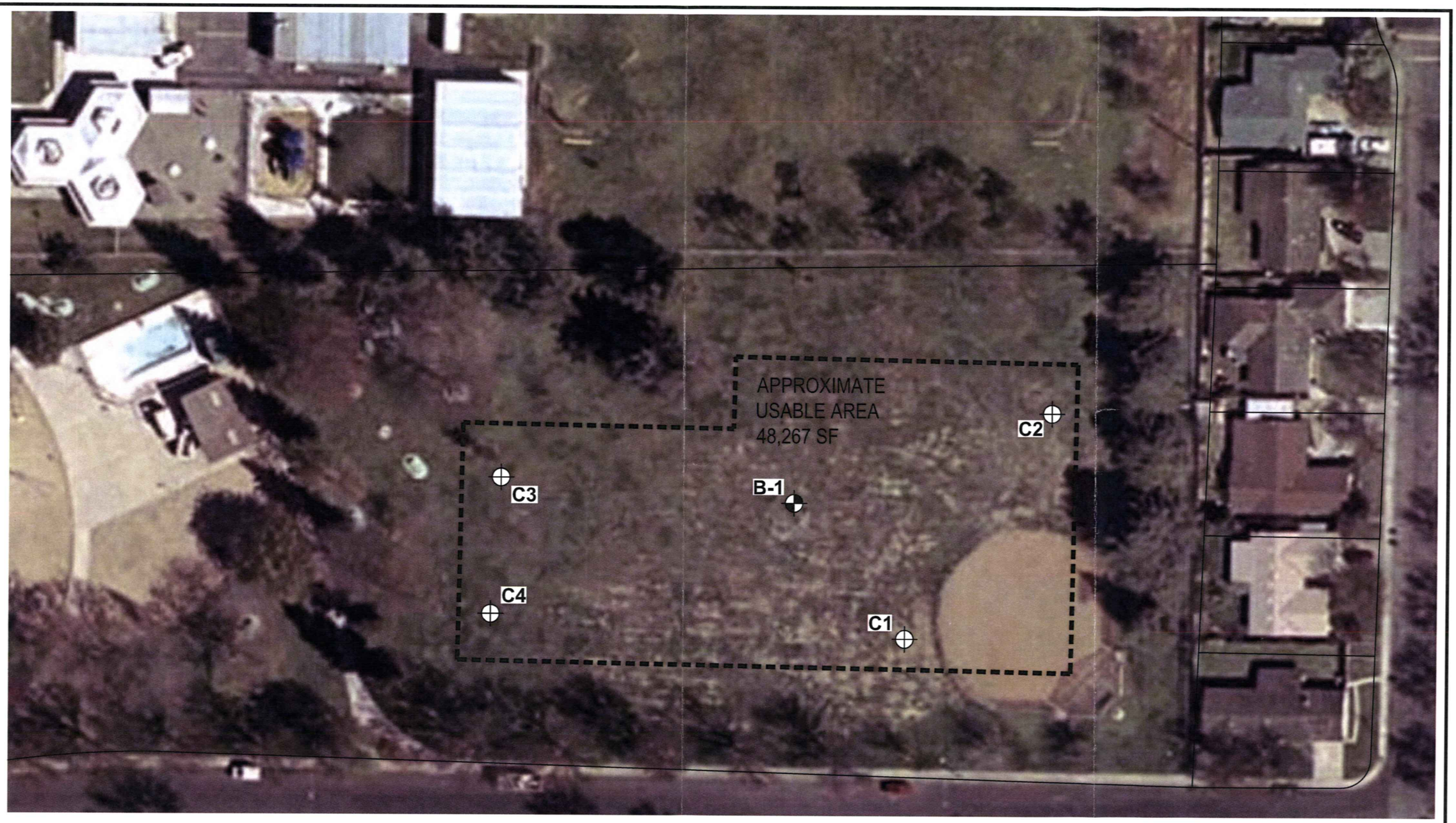
# VICINITY MAP
Area 2 Storm Drain Project
Modesto, California

File No. 1721.1

June 2009

Figure 1

6/8/2009 1721.1 Area 2 Storm Drain Project Figure 1.dwg




## LEGEND

B-1 Approximate Boring Location

C1 Approximate Infiltration Test Boring Location

Source: Topography and aerial mapping from rrm design group, dated March, 2009.

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# BORING AND TEST LOCATION MAP

Area 2 Storm Drain Project
Catherine Everett Park
Modesto, California

SCALE: 1"=50'

File No. 1721.1

June 2009

Figure 2A

6/11/2009 1721.1 Area 2 Storm Drain Project Figure 2.dwg

**LEGEND**

B-2 Approximate Boring Location

J1 Approximate Infiltration Test Boring Location

N

Source: Topography and aerial mapping from rrm design group, dated March, 2009.

SCALE: 1"=100'

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# BORING AND TEST LOCATION MAP

Area 2 Storm Drain Project
JM Pike Park
Modesto, California

File No. 1721.1
June 2009
Figure 2B

6/11/2009 1721.1 Area 2 Storm Drain Project Figure 2.dwg

**LEGEND**

B-4 Approximate Boring Location

R1 Approximate Infiltration Test Boring Location

Source: Topography and aerial mapping from rrm design group, dated March, 2009.

SCALE: 1"=100'

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# BORING AND TEST LOCATION MAP

Area 2 Storm Drain Project
Roosevelt Park
Modesto, California

File No. 1721.1

June 2009

Figure 2C

6/11/2009 1721.1 Area 2 Storm Drain Project Figure 2.dwg

**LEGEND**

B-5 Approximate Boring Location

G1 Approximate Infiltration Test Boring Location

N

Source: Topography and aerial mapping from rrm design group, dated March, 2009.

SCALE: 1"=100'

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# BORING AND TEST LOCATION MAP

Area 2 Storm Drain Project
Garrison Park
Modesto, California

File No. 1721.1
June 2009
Figure 2D

6/11/2009 1721.1 Area 2 Storm Drain Project Figure 2.dwg

# APPENDIX A

Field Exploration Summary
Boring Log Legend
Logs of Borings

## FIELD EXPLORATION

BCI drilled and sampled 5 deep (31.5 to 41.5 feet) exploratory borings and 16 shallow (9 to 15 feet) test locations between May 18 and 26, 2009. We show the boring locations on Figures 2A through 2D and attach logs of the borings in this Appendix.

The borings were drilled with a truck-mounted drill rig using 6-inch diameter hollow-stem augers. Sampling was accomplished by dropping a 140-pound hammer, 30 inches for each blow. The hammer was used to advance a 2.5-inch I.D., Modified California (MC) sampler lined with 6-inch long brass tubes. We recorded the number of hammer blows required to drive the sampler 18 inches. The final 12 inches is recorded as the field blow count. We retrieved relatively undisturbed soil samples from the borings in the brass liners. We also obtained bulk soil samples from the cuttings as the drilling progressed.

A BCI geologist logged the borings and retrieved samples for laboratory testing. We used plastic caps to seal and label the 6-inch long brass tubes retrieved from MC sampling. We also retrieved bulk soil samples from auger cuttings, placed this material in zip-lock bags, and labeled for laboratory identification.

We located borings in the field by measuring from nearby landmarks and estimating from the aerial base map provided by RRM Design Group. Elevations are estimated from USGS topographic mapping and are considered approximate.

# UNIFIED SOIL CLASSIFICATION (ASTM D 2487-06)

| MATERIAL TYPES | CRITERIA FOR ASSIGNING SOIL GROUP NAMES | | | GRAPHIC SYMBOL | GROUP SYMBOL | SOIL GROUP NAMES |
|---|---|---|---|---|---|---|
| COARSE-GRAINED SOILS >50% RETAINED ON NO. 200 SIEVE | GRAVELS >50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE | CLEAN GRAVELS <5% FINES | Cu ≥ 4 AND 1 ≤ Cc ≤ 3 | | GW | WELL-GRADED GRAVEL |
| | | | Cu < 4 AND/OR 1 > Cc > 3 | | GP | POORLY-GRADED GRAVEL |
| | | GRAVELS WITH FINES >12% FINES | FINES CLASSIFY AS ML OR MH | | GM | SILTY GRAVEL |
| | | | FINES CLASSIFY AS CL OR CH | | GC | CLAYEY GRAVEL |
| | SANDS <50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE | CLEAN SANDS <5% FINES | Cu ≥ 6 AND 1 ≤ Cc ≤ 3 | | SW | WELL-GRADED SAND |
| | | | Cu < 6 AND/OR 1 > Cc > 3 | | SP | POORLY-GRADED SAND |
| | | SANDS WITH FINES >12% FINES | FINES CLASSIFY AS ML OR MH | | SM | SILTY SAND |
| | | | FINES CLASSIFY AS CL OR CH | | SC | CLAYEY SAND |
| FINE-GRAINED SOILS >50% PASSING NO. 200 SIEVE | SILTS AND CLAYS LIQUID LIMIT <50 | INORGANIC | PI>7 AND PLOTS ON OR ABOVE "A" LINE | | CL | LEAN CLAY |
| | | | PI>4 AND PLOTS BELOW "A" LINE | | ML | SILT |
| | | ORGANIC | LL (oven dried)<0.75/LL (not dried) | | OL | ORGANIC CLAY OR SILT |
| | SILTS AND CLAYS LIQUID LIMIT >50 | INORGANIC | PI PLOTS ON OR ABOVE "A" LINE | | CH | FAT CLAY |
| | | | PI PLOTS BELOW "A" LINE | | MH | ELASTIC SILT |
| | | ORGANIC | LL (oven dried)<0.75/LL (not dried) | | OH | ORGANIC CLAY OR SILT |
| HIGHLY ORGANIC SOILS | | PRIMARILY ORGANIC MATTER, DARK COLOR, ORGANIC ODOR | | | PT | PEAT |

NOTE: $Cu = D_{60}/D_{10}$

$Cc = (D_{30})^2 / D_{10} \times D_{60}$

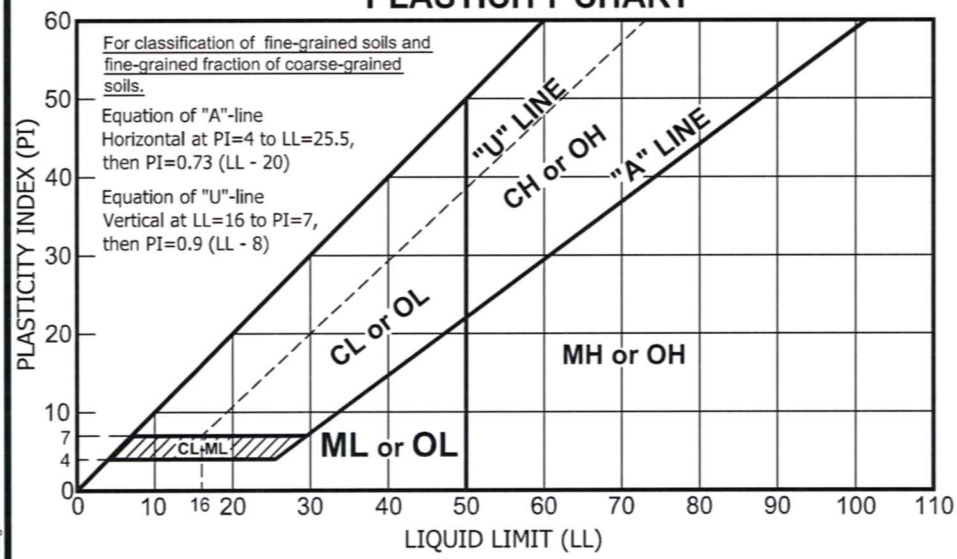
## BLOW COUNT

The number of blows of a 140-lb. hammer falling 30-inches required to drive the sampler the last 12-inches of an 18-inch drive. The notation 50/0.4 indicates 4-inches of penetration achieved in 50 blows.

## SAMPLE TYPES

- Auger or backhoe cuttings
- Modified California
- Shelby tube
- Rock core
- Standard Penetration (SPT)

## PLASTICITY CHART




## ADDITIONAL TESTS

- C - Consolidation
- CP - Compaction Curve
- CR - Corrosivity Testing
- CU - Consolidated Undrained Triaxial
- DS - Direct Shear
- EI - Expansion Index
- P - Permeability
- PA - Partical Size Analysis
- PI - Plasticity Index
- PP - Pocket Penetrometer
- R - R-Value
- SE - Sand Equivalent
- UC - Specific Gravity
- SL - Shrinkage Limit
- SW - Swell Potential
- TV - Pocket Torvane Shear Test
- UC - Unconfined Compression
- UU - Unconsolidated Undrained Triaxial

## GROUND WATER LEVELS

- Later water level after drilling
- Water level at time of drilling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# BORING LOG / TEST PIT LEGEND AND SOIL DESCRIPTIONS

9/5/2008 Boring Test Pit Legend with Graphics.dwg

# LOG OF BORING B-1

FILE NO.: 1721.1
PROJECT: Area 2 Storm Drain Project
LOCATION: Modesto
CLIENT: RRM Design Group

DRILLING DATE: 5/18/09
DRILLING METHOD: Hollow-stem Auger
LOGGED BY: AGW
CHECKED BY: BDC

ELEVATION: ±83
DATUM:
WATER DEPTH: 28 feet
READING TAKEN: 5/18/09

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| FIELD | | | | | | | LABORATORY | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (FEET) | SAMPLE | SAMPLE NO. | N-VALUE | POCKET PEN. (TSF) | GRAPHIC LOG | DESCRIPTION | DRY DENSITY (PCF) | MOISTURE CONTENT (%) | % <200 SIEVE | PLASTICITY INDEX | DIRECT SHEAR C (PSF) | DIRECT SHEAR ANGLE | ADDITIONAL TESTS |
| | | | | | | **Silty Sand (SM);** loose, reddish yellow, moist, fine to medium sand | | | | | | | |
| 5 | X | B1-1 | 8 | | | | | | | | | | |
| | | | | | | **Poorly Graded Sand (SP);** medium dense, gray, dry, fine to medium sand | | | | | | | |
| 10 | X | B1-2 | 13 | | | color changes to yellowish brown | | | 1 | | | | |
| 15 | X | B1-3 | 26 | | | | | | | | | | |
| | | | | | | color change to gray | | | | | | | |
| 20 | X | B1-4 | 18 | | | | | | | | | | |
| | | | | | | **Sandy Lean Clay (CL);** stiff, gray, wet, fine sand | | | | | | | |
| 25 | X | B1-5 | 13 | | | | | | | | | | |
| | | | | | | **Poorly Graded Sand (SP-SM);** dense, yellowish brown, wet, fine to medium sand with silt | | | | | | | |
| 30 | X | B1-6 | 42 | | | | | | | | | | |
| | | | | | | Total Depth = 31.5 feet<br>Groundwater Encountered at 28 feet | | | | | | | |

LOG OF BOREHOLE 1721.1 AUBURN AREA 2 STORM DRAIN.GPJ BLACKBRN.GDT 6/12/09

# LOG OF BORING B-2

FILE NO.: 1721.1
PROJECT: Area 2 Storm Drain Project
LOCATION: Modesto
CLIENT: RRM Design Group

DRILLING DATE: 5/18/09
DRILLING METHOD: Hollow-stem Auger
LOGGED BY: AGW
CHECKED BY: BDC

ELEVATION: ±83
DATUM:
WATER DEPTH: 33 feet
READING TAKEN: 5/18/09

| FIELD | | | | | | | LABORATORY | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (FEET) | SAMPLE | SAMPLE NO. | N-VALUE | POCKET PEN. (TSF) | GRAPHIC LOG | DESCRIPTION | DRY DENSITY (PCF) | MOISTURE CONTENT (%) | % <200 SIEVE | PLASTICITY INDEX | DIRECT SHEAR C (PSF) | DIRECT SHEAR ANGLE | ADDITIONAL TESTS |
| | | | | | | **Silty Sand (SM);** medium dense, reddish yellow, moist, fine to medium sand | | | | | | | |
| 5 | | B2-1 | 18 | | | | | | | | | | |
| | | | | | | **Poorly Graded Sand (SP);** loose to medium dense, yellowish brown, dry, fine to medium sand | | | | | | | |
| 10 | | B2-2 | 7 | | | | | | 3 | | | | |
| | | | | | | medium dense and fine sand | | | | | | | |
| 15 | | B2-3 | 34 | | | | | | | | | | |
| | | | | | | **Sandy Lean Clay (CL);** hard, strong brown, moist, fine sand | | | | | | | |
| 20 | | B2-4 | 46 | | | | | | | | | | |
| | | | | | | **Silty Sand (SM);** very dense, olive gray, dry, slightly cemented | | | | | | | |
| 25 | | B2-5 | 70 | | | | | | | | | | |
| | | | | | | **Poorly Graded Sand (SP);** very dense, medium brown, moist, fine to medium sand with silt | | | | | | | |
| | | | | | | slightly cemented | | | | | | | |
| 30 | | B2-6 | 75 | | | | | | | | | | |
| 35 | | B2-7 | 62 | | | | | | | | | | |
| | | | | | | Total Depth = 36.5 feet<br>Groundwater Encountered at 33 feet | | | | | | | |

LOG OF BOREHOLE 1721.1 AUBURN AREA 2 STORM DRAIN.GPJ BLACKBRN.GDT 6/12/09

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# LOG OF BORING B-3

FILE NO.: 1721.1
PROJECT: Area 2 Storm Drain Project
LOCATION: Modesto
CLIENT: RRM Design Group

DRILLING DATE: 5/19/09
DRILLING METHOD: Hollow-stem Auger
LOGGED BY: AGW
CHECKED BY: BDC

ELEVATION: ±83
DATUM:
WATER DEPTH: 33 feet
READING TAKEN: 5/19/09

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| FIELD | | | | | | | LABORATORY | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (FEET) | SAMPLE | SAMPLE NO. | N-VALUE | POCKET PEN. (TSF) | GRAPHIC LOG | DESCRIPTION | DRY DENSITY (PCF) | MOISTURE CONTENT (%) | % <200 SIEVE | PLASTICITY INDEX | DIRECT SHEAR C (PSF) | DIRECT SHEAR ANGLE | ADDITIONAL TESTS |
| | | | | | | **Silty Sand (SM);** loose to medium dense, medium brown, moist, fine to medium sand | | | | | | | |
| 5 | X | B3-1 | 12 | | | | | | | | | | |
| | | | | | | **Poorly Graded Sand (SP);** medium dense, yellowish brown, moist, fine to medium sand | | | | | | | |
| | | | | | | sand becomes fine to coarse | | | | | | | |
| 10 | X | B3-2 | 18 | | | | | | 4 | | | | |
| 15 | X | B3-3 | 33 | | | | | | | | | | |
| | | | | | | **Silty Sand (SM);** medium dense, yellowish brown, moist, fine sand | | | | | | | |
| 20 | X | B3-4 | 21 | | | | | | | | | | |
| 25 | X | B3-5 | 13 | | | | | | | | | | |
| 30 | X | B3-6 | 58 | | | **Silty Sand (SM);** dense, dark brown, moist, fine to medium sand, slightly cemented | | | | | | | |
| 35 | X | B3-7 | 54 | | | | | | | | | | |
| | | | | | | **Sandy Silt (ML);** hard, medium brown, moist, fine sand | | | | | | | |
| | | | | | | Total Depth = 36.5 feet<br>Groundwater Encountered at 33 feet | | | | | | | |

LOG OF BOREHOLE 1721.1 AUBURN AREA 2 STORM DRAIN.GPJ BLACKBRN.GDT 6/12/09

# LOG OF BORING B-4

FILE NO.: 1721.1
PROJECT: Area 2 Storm Drain Project
LOCATION: Modesto
CLIENT: RRM Design Group

DRILLING DATE: 5/19/09
DRILLING METHOD: Hollow-stem Auger
LOGGED BY: AGW
CHECKED BY: BDC

ELEVATION: ±89.5
DATUM:
WATER DEPTH: 38.5 feet
READING TAKEN: 5/19/09

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| FIELD | | | | | | | LABORATORY | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (FEET) | SAMPLE | SAMPLE NO. | N-VALUE | POCKET PEN. (TSF) | GRAPHIC LOG | DESCRIPTION | DRY DENSITY (PCF) | MOISTURE CONTENT (%) | % <200 SIEVE | PLASTICITY INDEX | DIRECT SHEAR C (PSF) | DIRECT SHEAR ANGLE | ADDITIONAL TESTS |
| | | | | | | **Silty Sand (SM);** medium dense to dense, gray, dry, fine sand | | | | | | | |
| 5 | X | B4-1 | 45 | | | | | | | | | | |
| | | | | | | **Poorly Graded Sand (SP);** medium dense, gray, dry, fine sand | | | | | | | |
| 10 | X | B4-2 | 12 | | | | | | 3 | | | | |
| | | | | | | **Lean Clay with Sand (CL);** stiff to very stiff, olive gray, moist, fine sand | | | 78 | 8 | | | |
| 15 | X | B4-3 | 23 | | | | | | | | | | |
| | | | | | | **Clayey Sand (SC);** medium dense, olive gray, moist, fine sand | | | | | | | |
| | | | | | | **Sandy Lean Clay (CL);** hard, medium brown, moist, fine sand | | | | | | | |
| 20 | X | B4-4 | 60 | | | | | | | | | | |
| | | | | | | **Poorly Graded Sand (SP);** dense, yellowish brown, dry, fine to medium sand | | | | | | | |
| 25 | X | B4-5 | 44 | | | becomes reddish brown and moist | | | | | | | |
| | | | | | | **Silty Sand (SM);** very dense, dark brown, moist, fine sand | | | | | | | |
| 30 | X | B4-6 | 62 | | | | | | | | | | |
| | | | | | | **Poorly Graded Sand (SP);** dense, yellowish brown, moist, fine to medium sand | | | | | | | |
| 35 | X | B4-7 | 37 | | | | | | | | | | |
| 40 | X | B4-8 | 36 | | | | | | | | | | |
| | | | | | | Total Depth = 41.5 feet<br>Groundwater Encountered at 38.5 feet | | | | | | | |

LOG OF BOREHOLE 1721.1 AUBURN AREA 2 STORM DRAIN.GPJ BLACKBRN.GDT 6/12/09

**Blackburn Consulting**

# LOG OF BORING B-5

FILE NO.: 1721.1
PROJECT: Area 2 Storm Drain Project
LOCATION: Modesto
CLIENT: RRM Design Group

DRILLING DATE: 5/20/09
DRILLING METHOD: Hollow-stem Auger
LOGGED BY: AGW
CHECKED BY: BDC

ELEVATION: ±82
DATUM:
WATER DEPTH: 32 feet
READING TAKEN: 5/20/09

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| FIELD | | | | | | | LABORATORY | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (FEET) | SAMPLE | SAMPLE NO. | N-VALUE | POCKET PEN. (TSF) | GRAPHIC LOG | DESCRIPTION | DRY DENSITY (PCF) | MOISTURE CONTENT (%) | % <200 SIEVE | PLASTICITY INDEX | DIRECT SHEAR C (PSF) | DIRECT SHEAR ANGLE | ADDITIONAL TESTS |
| | | | | | | **Silty Sand (SM);** medium dense, yellowish brown, moist, fine sand | | | | | | | |
| 5 | X | B5-1 | 25 | | | | | | | | | | |
| | | | | | | **Silt (ML);** very stiff, olive gray, moist | | | | | | | |
| | | | | | | **Silty Sand (SM);** medium dense, olive gray, moist, fine sand | | | | | | | |
| 10 | X | B5-2 | 14 | | | | | | | | | | |
| | | | | | | **Poorly Graded Sand (SP);** medium dense, yellowish brown, dry, fine sand | | | 2 | | | | |
| | | | | | | **Silty Sand (SM);** medium dense, medium brown, moist, fine sand | | | | | | | |
| 15 | X | B5-3 | 28 | | | | | | 38 | | | | |
| | | | | | | becomes very dense | | | | | | | |
| 20 | X | B5-4 | 83 | | | | | | | | | | |
| | | | | | | **Clayey Sand (SC);** very dense, medium brown, moist, fine to medium sand, slightly cemented | | | | | | | |
| 25 | X | B5-5 | 108 | | | | | | | | | | |
| | | | | | | **Silty Sand (SM);** medium dense to dense, dark yellowish brown, moist, fine sand | | | | | | | |
| 30 | X | B5-6 | 32 | | | | | | | | | | |
| | | | | | | **Poorly Graded Sand (SP);**dense, yellowish brown, moist, fine to coarse sand | | | | | | | |
| 35 | X | B5-7 | 51 | | | | | | | | | | |
| | | | | | | **Silt (ML);** hard, olive gray, moist | | | | | | | |
| | | | | | | Total Depth = 36.5 feet<br>Groundwater Encountered at 32 feet | | | | | | | |

LOG OF BOREHOLE 1721.1 AUBURN AREA 2 STORM DRAIN.GPJ BLACKBRN.GDT 6/12/09

**Blackburn Consulting**

# LOG OF BORING C1

FILE NO.: 1721.1
PROJECT: Area 2 Storm Drain Project
LOCATION: Modesto
CLIENT: RRM Design Group

DRILLING DATE: 5/26/09
DRILLING METHOD: Hollow-stem Auger
LOGGED BY: AGW
CHECKED BY: PFF

ELEVATION: ±83
DATUM:
WATER DEPTH: none
READING TAKEN:

blackburn consulting

| FIELD | | | | | | | LABORATORY | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (FEET) | SAMPLE | SAMPLE NO. | N-VALUE | POCKET PEN. (TSF) | GRAPHIC LOG | DESCRIPTION | DRY DENSITY (PCF) | MOISTURE CONTENT (%) | % <200 SIEVE | PLASTICITY INDEX | DIRECT SHEAR C (PSF) | DIRECT SHEAR ANGLE | ADDITIONAL TESTS |
| | | | | | | **Silty Sand (SM);** (loose to medium dense), medium brown, moist, fine to medium sand | | | | | | | |
| 5 | | | | | | **Poorly Graded Sand (SP);** (loose to medium dense), yellowish brown, moist, fine to medium sand | | | | | | | |
| 10 | | | | | | | | | | | | | |
| | | | | | | Total Depth = 12.5 feet<br>Groundwater not observed | | | | | | | |

LOG OF BOREHOLE 1721.1 AUBURN AREA 2 STORM DRAIN.GPJ BLACKBRN.GDT 6/12/09

# LOG OF BORING C2

FILE NO.: 1721.1
PROJECT: Area 2 Storm Drain Project
LOCATION: Modesto
CLIENT: RRM Design Group

DRILLING DATE: 5/26/09
DRILLING METHOD: Hollow-stem Auger
LOGGED BY: AGW
CHECKED BY: PFF

ELEVATION: ±83
DATUM:
WATER DEPTH: none
READING TAKEN:

blackburn consulting

| FIELD | | | | | | | LABORATORY | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (FEET) | SAMPLE | SAMPLE NO. | N-VALUE | POCKET PEN. (TSF) | GRAPHIC LOG | DESCRIPTION | DRY DENSITY (PCF) | MOISTURE CONTENT (%) | % <200 SIEVE | PLASTICITY INDEX | DIRECT SHEAR C (PSF) | DIRECT SHEAR ANGLE | ADDITIONAL TESTS |
| | | | | | | **Poorly Graded Sand (SP);** (loose to medium dense), yellowish brown, moist, fine to medium sand | | | | | | | |
| 5 | | | | | | | | | | | | | |
| 10 | | | | | | | | | | | | | |
| | | | | | | Total Depth = 12.5 feet<br>Groundwater not observed | | | | | | | |

LOG OF BOREHOLE 1721.1 AUBURN AREA 2 STORM DRAIN.GPJ BLACKBRN.GDT 6/12/09

**Blackburn Consulting**

# LOG OF BORING C3

FILE NO.: 1721.1
PROJECT: Area 2 Storm Drain Project
LOCATION: Modesto
CLIENT: RRM Design Group

DRILLING DATE: 5/26/09
DRILLING METHOD: Hollow-stem Auger
LOGGED BY: AGW
CHECKED BY: PFF

ELEVATION: ±83
DATUM:
WATER DEPTH: none
READING TAKEN:

blackburn consulting

| FIELD | | | | | | | LABORATORY | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (FEET) | SAMPLE | SAMPLE NO. | N-VALUE | POCKET PEN. (TSF) | GRAPHIC LOG | DESCRIPTION | DRY DENSITY (PCF) | MOISTURE CONTENT (%) | % <200 SIEVE | PLASTICITY INDEX | DIRECT SHEAR C (PSF) | DIRECT SHEAR ANGLE | ADDITIONAL TESTS |
| | | | | | | **Poorly Graded Sand (SP);** (loose to medium dense), yellowish brown, moist, fine to medium sand | | | | | | | |
| 5 | | | | | | | | | | | | | |
| 10 | | | | | | | | | | | | | |
| | | | | | | Total Depth = 12.4 feet<br>Groundwater not observed | | | | | | | |

LOG OF BOREHOLE 1721.1 AUBURN AREA 2 STORM DRAIN.GPJ BLACKBRN.GDT 6/12/09

**Blackburn Consulting**

# LOG OF BORING C4

FILE NO.: 1721.1
PROJECT: Area 2 Storm Drain Project
LOCATION: Modesto
CLIENT: RRM Design Group

DRILLING DATE: 5/26/09
DRILLING METHOD: Hollow-stem Auger
LOGGED BY: AGW
CHECKED BY: PFF

ELEVATION: ±83
DATUM:
WATER DEPTH: none
READING TAKEN:

| FIELD | | | | | | | LABORATORY | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (FEET) | SAMPLE | SAMPLE NO. | N-VALUE | POCKET PEN. (TSF) | GRAPHIC LOG | DESCRIPTION | DRY DENSITY (PCF) | MOISTURE CONTENT (%) | % <200 SIEVE | PLASTICITY INDEX | DIRECT SHEAR C (PSF) | DIRECT SHEAR ANGLE | ADDITIONAL TESTS |
| | | | | | | **Silty Sand (SM);** (loose to medium dense), yellowish brown, moist, fine to medium sand | | | | | | | |
| 5 | | | | | | | | | | | | | |
| | | | | | | **Poorly Graded Sand (SP);** (loose to medium dense), yellowish brown, moist, fine to medium sand | | | | | | | |
| 10 | | | | | | | | | | | | | |
| | | | | | | Total Depth = 12.2 feet<br>Groundwater not observed | | | | | | | |

LOG OF BOREHOLE 1721.1 AUBURN AREA 2 STORM DRAIN.GPJ BLACKBRN.GDT 6/12/09

**Blackburn Consulting**

# LOG OF BORING G1

FILE NO.: 1721.1
PROJECT: Area 2 Storm Drain Project
LOCATION: Modesto
CLIENT: RRM Design Group

DRILLING DATE: 5/26/09
DRILLING METHOD: Hollow-stem Auger
LOGGED BY: AGW
CHECKED BY: PFF

ELEVATION: ±82
DATUM:
WATER DEPTH: none
READING TAKEN:

| FIELD | | | | | | | LABORATORY | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (FEET) | SAMPLE | SAMPLE NO. | N-VALUE | POCKET PEN. (TSF) | GRAPHIC LOG | DESCRIPTION | DRY DENSITY (PCF) | MOISTURE CONTENT (%) | % <200 SIEVE | PLASTICITY INDEX | DIRECT SHEAR C (PSF) | DIRECT SHEAR ANGLE | ADDITIONAL TESTS |
| | | | | | | **Silty Sand (SM);** (loose to medium dense), gray, moist, fine sand | | | | | | | |
| 5 | | | | | | | | | | | | | |
| 10 | | | | | | | | | | | | | |
| | | | | | | Total Depth = 12.2 feet<br>Groundwater not observed | | | | | | | |

LOG OF BOREHOLE 1721.1 AUBURN AREA 2 STORM DRAIN.GPJ BLACKBRN.GDT 6/12/09

**Blackburn Consulting**

# LOG OF BORING G2

FILE NO.: 1721.1
PROJECT: Area 2 Storm Drain Project
LOCATION: Modesto
CLIENT: RRM Design Group

DRILLING DATE: 5/26/09
DRILLING METHOD: Hollow-stem Auger
LOGGED BY: AGW
CHECKED BY: PFF

ELEVATION: ±82
DATUM:
WATER DEPTH: none
READING TAKEN:

blackburn consulting

| FIELD | | | | | | | LABORATORY | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (FEET) | SAMPLE | SAMPLE NO. | N-VALUE | POCKET PEN. (TSF) | GRAPHIC LOG | DESCRIPTION | DRY DENSITY (PCF) | MOISTURE CONTENT (%) | % <200 SIEVE | PLASTICITY INDEX | DIRECT SHEAR C (PSF) | DIRECT SHEAR ANGLE | ADDITIONAL TESTS |
| | | | | | | **Silty Sand (SM);** (loose to medium dense), medium brown, moist, fine sand | | | | | | | |
| | | | | | | **Poorly Graded Sand (SP);** (loose to medium dense), yellowish brown, moist, fine sand | | | | | | | |
| 5 | | | | | | | | | | | | | |
| 10 | | | | | | | | | | | | | |
| 15 | | | | | | | | | | | | | |
| | | | | | | Total Depth = 15.2 feet<br>Groundwater not observed | | | | | | | |

LOG OF BOREHOLE 1721.1 AUBURN AREA 2 STORM DRAIN.GPJ BLACKBRN.GDT 6/12/09

**Blackburn Consulting**

# LOG OF BORING G3

FILE NO.: 1721.1
PROJECT: Area 2 Storm Drain Project
LOCATION: Modesto
CLIENT: RRM Design Group

DRILLING DATE: 5/26/09
DRILLING METHOD: Hollow-stem Auger
LOGGED BY: AGW
CHECKED BY: PFF

ELEVATION: ±82
DATUM:
WATER DEPTH: none
READING TAKEN:

| FIELD | | | | | | | LABORATORY | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (FEET) | SAMPLE | SAMPLE NO. | N-VALUE | POCKET PEN. (TSF) | GRAPHIC LOG | DESCRIPTION | DRY DENSITY (PCF) | MOISTURE CONTENT (%) | % <200 SIEVE | PLASTICITY INDEX | DIRECT SHEAR C (PSF) | DIRECT SHEAR ANGLE | ADDITIONAL TESTS |
| | | | | | | **Silty Sand (SM);** (loose to medium dense), yellowish brown, moist, fine sand | | | | | | | |
| 5 | | | | | | | | | | | | | |
| 10 | | | | | | | | | | | | | |
| | | | | | | Total Depth = 12.2 feet<br>Groundwater not observed | | | | | | | |

LOG OF BOREHOLE 1721.1 AUBURN AREA 2 STORM DRAIN.GPJ BLACKBRN.GDT 6/12/09

**Blackburn Consulting**

# LOG OF BORING G4

FILE NO.: 1721.1
PROJECT: Area 2 Storm Drain Project
LOCATION: Modesto
CLIENT: RRM Design Group

DRILLING DATE: 5/26/09
DRILLING METHOD: Hollow-stem Auger
LOGGED BY: AGW
CHECKED BY: PFF

ELEVATION: ±82
DATUM:
WATER DEPTH: none
READING TAKEN:

blackburn consulting

| FIELD | | | | | | | LABORATORY | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (FEET) | SAMPLE | SAMPLE NO. | N-VALUE | POCKET PEN. (TSF) | GRAPHIC LOG | DESCRIPTION | DRY DENSITY (PCF) | MOISTURE CONTENT (%) | % <200 SIEVE | PLASTICITY INDEX | DIRECT SHEAR C (PSF) | DIRECT SHEAR ANGLE | ADDITIONAL TESTS |
| | | | | | | **Silty Sand (SM);** (loose to medium dense), yellowish brown, moist, fine sand | | | | | | | |
| 5 | | | | | | | | | | | | | |
| 10 | | | | | | | | | | | | | |
| 15 | | | | | | | | | | | | | |
| | | | | | | Total Depth = 15.2 feet<br>Groundwater not observed | | | | | | | |

LOG OF BOREHOLE 1721.1 AUBURN AREA 2 STORM DRAIN.GPJ BLACKBRN.GDT 6/12/09

**Blackburn Consulting**

# LOG OF BORING J1

FILE NO.: 1721.1
PROJECT: Area 2 Storm Drain Project
LOCATION: Modesto
CLIENT: RRM Design Group

DRILLING DATE: 5/26/09
DRILLING METHOD: Hollow-stem Auger
LOGGED BY: AGW
CHECKED BY: PFF

ELEVATION: ±83
DATUM:
WATER DEPTH: none
READING TAKEN:

| FIELD | | | | | | | LABORATORY | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (FEET) | SAMPLE | SAMPLE NO. | N-VALUE | POCKET PEN. (TSF) | GRAPHIC LOG | DESCRIPTION | DRY DENSITY (PCF) | MOISTURE CONTENT (%) | % <200 SIEVE | PLASTICITY INDEX | DIRECT SHEAR C (PSF) | DIRECT SHEAR ANGLE | ADDITIONAL TESTS |
| | | | | | | **Clayey Sand (SC);** (loose to medium dense), medium brown, moist, fine sand | | | | | | | |
| 5 | | | | | | | | | | | | | |
| | | | | | | **Poorly Graded Sand (SP);** (loose to medium dense), reddish brown, moist, fine to coarse sand | | | | | | | |
| 10 | | | | | | | | | | | | | |
| | | | | | | Total Depth = 10.2 feet<br>Groundwater not observed | | | | | | | |

LOG OF BOREHOLE 1721.1 AUBURN AREA 2 STORM DRAIN.GPJ BLACKBRN.GDT 6/12/09

**Blackburn Consulting**

# LOG OF BORING J2

FILE NO.: 1721.1
PROJECT: Area 2 Storm Drain Project
LOCATION: Modesto
CLIENT: RRM Design Group

DRILLING DATE: 5/26/09
DRILLING METHOD: Hollow-stem Auger
LOGGED BY: AGW
CHECKED BY: PFF

ELEVATION: ±83
DATUM:
WATER DEPTH: none
READING TAKEN:

| FIELD | | | | | | | LABORATORY | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (FEET) | SAMPLE | SAMPLE NO. | N-VALUE | POCKET PEN. (TSF) | GRAPHIC LOG | DESCRIPTION | DRY DENSITY (PCF) | MOISTURE CONTENT (%) | % <200 SIEVE | PLASTICITY INDEX | DIRECT SHEAR C (PSF) | DIRECT SHEAR ANGLE | ADDITIONAL TESTS |
| | | | | | | **Silty Sand (SM);** (loose to medium dense), yellowish brown, moist, fine sand | | | | | | | |
| 5 | | | | | | (Trace of clay in upper 7 feet) | | | | | | | |
| 10 | | | | | | | | | | | | | |
| | | | | | | Total Depth = 10.2 feet<br>Groundwater not observed | | | | | | | |

LOG OF BOREHOLE 1721.1 AUBURN AREA 2 STORM DRAIN.GPJ BLACKBRN.GDT 6/12/09

**Blackburn Consulting**

# LOG OF BORING J3

FILE NO.: 1721.1
PROJECT: Area 2 Storm Drain Project
LOCATION: Modesto
CLIENT: RRM Design Group

DRILLING DATE: 5/26/09
DRILLING METHOD: Hollow-stem Auger
LOGGED BY: AGW
CHECKED BY: PFF

ELEVATION: ±83
DATUM:
WATER DEPTH: none
READING TAKEN:

| FIELD | | | | | | | LABORATORY | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (FEET) | SAMPLE | SAMPLE NO. | N-VALUE | POCKET PEN. (TSF) | GRAPHIC LOG | DESCRIPTION | DRY DENSITY (PCF) | MOISTURE CONTENT (%) | % <200 SIEVE | PLASTICITY INDEX | DIRECT SHEAR C (PSF) | DIRECT SHEAR ANGLE | ADDITIONAL TESTS |
| | | | | | | **Clayey Sand (SC);** (loose to medium dense), medium brown, moist, fine to medium sand | | | | | | | |
| 5 | | | | | | | | | | | | | |
| | | | | | | **Poorly Graded Sand with Silt (SP);** (loose to medium dense), reddish brown, moist, fine to medium sand | | | | | | | |
| 10 | | | | | | | | | | | | | |
| | | | | | | Total Depth = 10.2 feet<br>Groundwater not observed | | | | | | | |

LOG OF BOREHOLE 1721.1 AUBURN AREA 2 STORM DRAIN.GPJ BLACKBRN.GDT 6/12/09

**Blackburn Consulting**

# LOG OF BORING J4

FILE NO.: 1721.1
PROJECT: Area 2 Storm Drain Project
LOCATION: Modesto
CLIENT: RRM Design Group

DRILLING DATE: 5/26/09
DRILLING METHOD: Hollow-stem Auger
LOGGED BY: AGW
CHECKED BY: PFF

ELEVATION: ±83
DATUM:
WATER DEPTH: none
READING TAKEN:

| FIELD | | | | | | | LABORATORY | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (FEET) | SAMPLE | SAMPLE NO. | N-VALUE | POCKET PEN. (TSF) | GRAPHIC LOG | DESCRIPTION | DRY DENSITY (PCF) | MOISTURE CONTENT (%) | % <200 SIEVE | PLASTICITY INDEX | DIRECT SHEAR C (PSF) | DIRECT SHEAR ANGLE | ADDITIONAL TESTS |
| | | | | | | **Silty Sand (SM);** (loose to medium dense), brown, dry, fine to medium sand | | | | | | | |
| 5 | | | | | | | | | | | | | |
| 10 | | | | | | | | | | | | | |
| | | | | | | Total Depth = 10.2 feet<br>Groundwater not observed | | | | | | | |

LOG OF BOREHOLE 1721.1 AUBURN AREA 2 STORM DRAIN.GPJ BLACKBRN.GDT 6/12/09

**Blackburn Consulting**

# LOG OF BORING J5

FILE NO.: 1721.1
PROJECT: Area 2 Storm Drain Project
LOCATION: Modesto
CLIENT: RRM Design Group

DRILLING DATE: 5/26/09
DRILLING METHOD: Hollow-stem Auger
LOGGED BY: AGW
CHECKED BY: PFF

ELEVATION: ±83
DATUM:
WATER DEPTH: none
READING TAKEN:

| FIELD | | | | | | | LABORATORY | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (FEET) | SAMPLE | SAMPLE NO. | N-VALUE | POCKET PEN. (TSF) | GRAPHIC LOG | DESCRIPTION | DRY DENSITY (PCF) | MOISTURE CONTENT (%) | % <200 SIEVE | PLASTICITY INDEX | DIRECT SHEAR C (PSF) | DIRECT SHEAR ANGLE | ADDITIONAL TESTS |
| | | | | | | **Clayey Sand (SC);** (loose to medium dense), medium brown, moist, fine to medium sand | | | | | | | |
| 5 | | | | | | **Silty Sand (SM) with interbedded Silt (ML);** (loose to medium dense and soft to stiff), dark gray, moist, fine sand | | | | | | | |
| 10 | | | | | | | | | | | | | |
| | | | | | | Total Depth = 10.2 feet<br>Groundwater not observed | | | | | | | |

LOG OF BOREHOLE 1721.1 AUBURN AREA 2 STORM DRAIN.GPJ BLACKBRN.GDT 6/12/09

**Blackburn Consulting**

# LOG OF BORING J6

FILE NO.: 1721.1
PROJECT: Area 2 Storm Drain Project
LOCATION: Modesto
CLIENT: RRM Design Group

DRILLING DATE: 5/26/09
DRILLING METHOD: Hollow-stem Auger
LOGGED BY: AGW
CHECKED BY: PFF

ELEVATION: ±83
DATUM:
WATER DEPTH: none
READING TAKEN:

blackburn consulting

| FIELD | | | | | | | LABORATORY | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (FEET) | SAMPLE | SAMPLE NO. | N-VALUE | POCKET PEN. (TSF) | GRAPHIC LOG | DESCRIPTION | DRY DENSITY (PCF) | MOISTURE CONTENT (%) | % <200 SIEVE | PLASTICITY INDEX | DIRECT SHEAR C (PSF) | DIRECT SHEAR ANGLE | ADDITIONAL TESTS |
| | | | | | | **Silty Sand (SM);** (loose to medium dense), yellowish brown, moist, fine to medium sand | | | | | | | |
| 5 | | | | | | **Poorly Graded Sand with Clay (SP-SC);** (loose to medium dense), medium brown, moist, fine to coarse sand | | | | | | | |
| 10 | | | | | | | | | | | | | |
| | | | | | | Total Depth = 10.2 feet<br>Groundwater not observed | | | | | | | |

LOG OF BOREHOLE 1721.1 AUBURN AREA 2 STORM DRAIN.GPJ BLACKBRN.GDT 6/12/09

**Blackburn Consulting**

# LOG OF BORING R1

FILE NO.: 1721.1
PROJECT: Area 2 Storm Drain Project
LOCATION: Modesto
CLIENT: RRM Design Group

DRILLING DATE: 5/26/09
DRILLING METHOD: Hollow-stem Auger
LOGGED BY: AGW
CHECKED BY: PFF

ELEVATION: ±89.5
DATUM:
WATER DEPTH: none
READING TAKEN:

blackburn consulting

| FIELD | | | | | | | LABORATORY | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (FEET) | SAMPLE | SAMPLE NO. | N-VALUE | POCKET PEN. (TSF) | GRAPHIC LOG | DESCRIPTION | DRY DENSITY (PCF) | MOISTURE CONTENT (%) | % <200 SIEVE | PLASTICITY INDEX | DIRECT SHEAR C (PSF) | DIRECT SHEAR ANGLE | ADDITIONAL TESTS |
| | | | | | | **Clayey Sand (SC);** (loose to medium dense), medium brown, moist, fine to medium sand | | | | | | | |
| 5 | | | | | | **Poorly Graded Sand with Clay (SP-SC);** (medium dense), yellowish brown, moist, fine to medium sand | | | | | | | |
| | | | | | | **Poorly Graded Sand (SP-SC);** (loose to medium dense), yellowish brown, dry, fine to medium sand | | | | | | | |
| | | | | | | Total Depth = 9.2 feet<br>Groundwater not observed | | | | | | | |

LOG OF BOREHOLE 1721.1 AUBURN AREA 2 STORM DRAIN.GPJ BLACKBRN.GDT 6/12/09

# LOG OF BORING R2

FILE NO.: 1721.1
PROJECT: Area 2 Storm Drain Project
LOCATION: Modesto
CLIENT: RRM Design Group

DRILLING DATE: 5/26/09
DRILLING METHOD: Hollow-stem Auger
LOGGED BY: AGW
CHECKED BY: PFF

ELEVATION: ±89.5
DATUM:
WATER DEPTH: none
READING TAKEN:

blackburn consulting

| FIELD | | | | | | | LABORATORY | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (FEET) | SAMPLE | SAMPLE NO. | N-VALUE | POCKET PEN. (TSF) | GRAPHIC LOG | DESCRIPTION | DRY DENSITY (PCF) | MOISTURE CONTENT (%) | % <200 SIEVE | PLASTICITY INDEX | DIRECT SHEAR C (PSF) | DIRECT SHEAR ANGLE | ADDITIONAL TESTS |
| | | | | | | **Lean Clay (CL);** (soft), dark brown, moist | | | | | | | |
| | | | | | | **Clayey Sand (SC);** (loose to medium dense), yellowish brown, moist, fine sand | | | | | | | |
| 5 | | | | | | | | | | | | | |
| | | | | | | **Poorly Graded Sand (SP);** (loose to medium dense), yellowish brown, dry, fine to medium sand | | | | | | | |
| 10 | | | | | | **Clayey Sand (SC);** (loose to medium dense), yellowish brown, dry, fine sand | | | | | | | |
| | | | | | | Total Depth = 12.2 feet<br>Groundwater not observed | | | | | | | |

LOG OF BOREHOLE 1721.1 AUBURN AREA 2 STORM DRAIN.GPJ BLACKBRN.GDT 6/12/09

**Blackburn Consulting**

# APPENDIX B

Laboratory Testing Summary
Laboratory Test Results

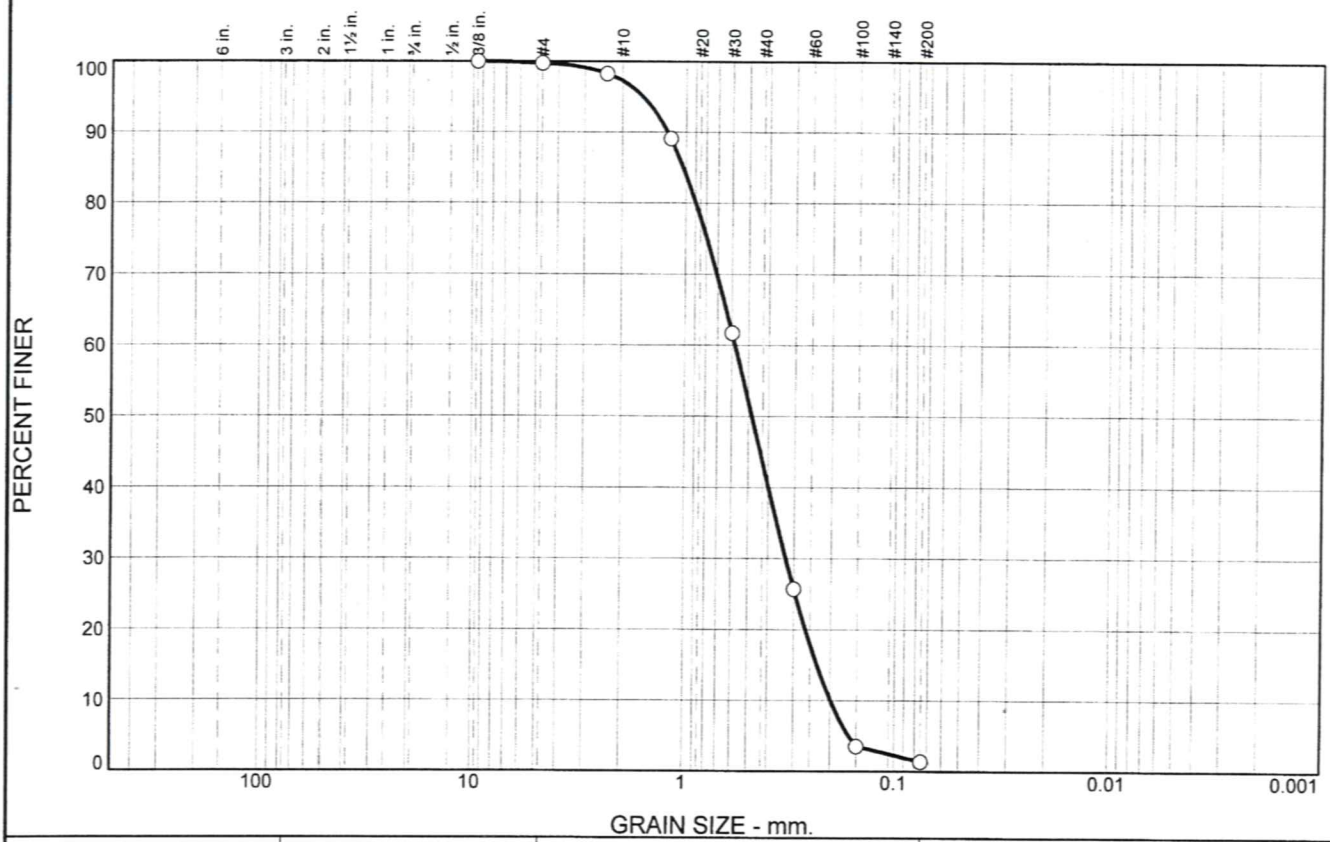
## LABORATORY TESTING

Samples obtained from the field exploration were contained in sealed brass tubes or bulk sample bags depending on the technique used during sampling. These samples were shipped to our laboratory for testing. The following tests were performed on selected samples:

### Laboratory Soil Classification

Our field classification is verified in the laboratory by visual examination and by ASTM methods, in accordance with the Unified Soil Classification System. Classification tests performed are Particle-Size Analysis (ASTM D422) and Liquid Limit, Plastic Limit, and Plasticity Index of Soils (ASTM D4318). We show the final soil classification on the logs of the borings and attach test results.

# Particle Size Distribution Report




| % +3" | % Gravel | | % Sand | | | % Fines | |
|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| 0.0 | 0.0 | 0.3 | 2.4 | 53.9 | 42.0 | 1.4 | |

| SIEVE SIZE | PERCENT FINER | SPEC.* PERCENT | PASS? (X=NO) |
|---|---|---|---|
| 3/8" | 100.0 | | |
| #4 | 99.7 | | |
| #8 | 98.2 | | |
| #16 | 89.1 | | |
| #30 | 61.7 | | |
| #50 | 25.7 | | |
| #100 | 3.5 | | |
| #200 | 1.4 | | |

* (no specification provided)

**Material Description**

Yellowish Brown Poorly Graded SAND

**Atterberg Limits**

PL= LL= PI=

**Coefficients**

$D_{90}$= 1.2217 $D_{85}$= 1.0281 $D_{60}$= 0.5804
$D_{50}$= 0.4807 $D_{30}$= 0.3283 $D_{15}$= 0.2318
$D_{10}$= 0.1992 $C_u$= 2.91 $C_c$= 0.93

**Classification**

USCS= SP AASHTO=

**Remarks**

**Sample Number:** B1-2C **Depth:** 11.0-11.5

**Date:** 6-11-09

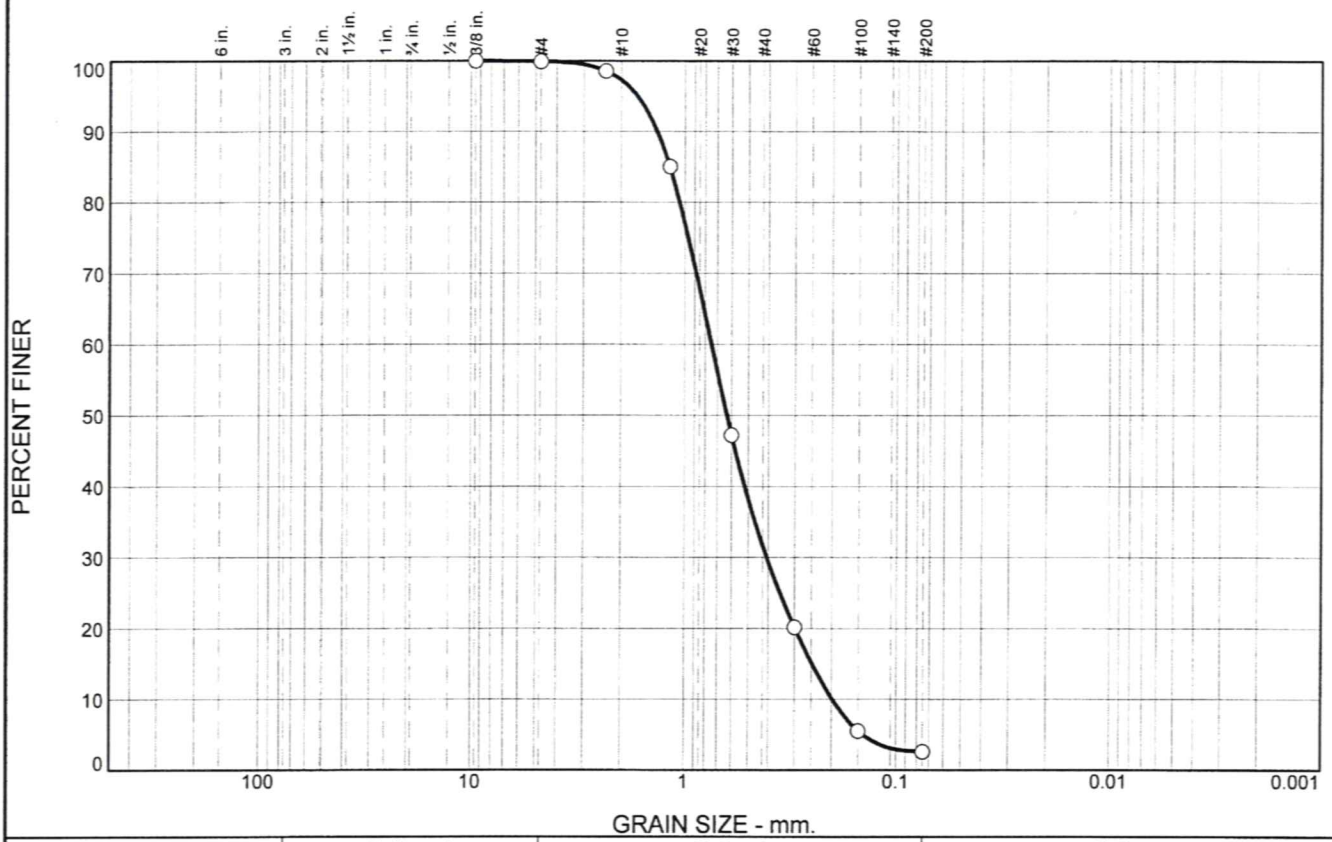
**Blackburn Consulting**

**Auburn, CA**

**Client:** RRM Design Group
**Project:** Area 2 Storm Drain
**Project No:** 1721.1 **Figure**

**Tested By:** KLC **Checked By:** KLC

# Particle Size Distribution Report




| % +3" | % Gravel | | % Sand | | | % Fines | |
|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| 0.0 | 0.0 | 0.1 | 2.6 | 65.7 | 29.0 | 2.6 | |

| SIEVE SIZE | PERCENT FINER | SPEC.* PERCENT | PASS? (X=NO) |
|---|---|---|---|
| 3/8" | 100.0 | | |
| #4 | 99.9 | | |
| #8 | 98.6 | | |
| #16 | 85.1 | | |
| #30 | 47.2 | | |
| #50 | 20.2 | | |
| #100 | 5.5 | | |
| #200 | 2.6 | | |

* (no specification provided)

**Material Description**

Brownish Yellow Poorly Graded SAND

**Atterberg Limits**

PL= LL= PI=

**Coefficients**

$D_{90}$= 1.3528 $D_{85}$= 1.1783 $D_{60}$= 0.7478
$D_{50}$= 0.6310 $D_{30}$= 0.4071 $D_{15}$= 0.2479
$D_{10}$= 0.1986 $C_u$= 3.76 $C_c$= 1.12

**Classification**

USCS= SP AASHTO=

**Remarks**

**Sample Number:** B2-2C **Depth:** 11.0-11.5

**Date:** 6-11-09

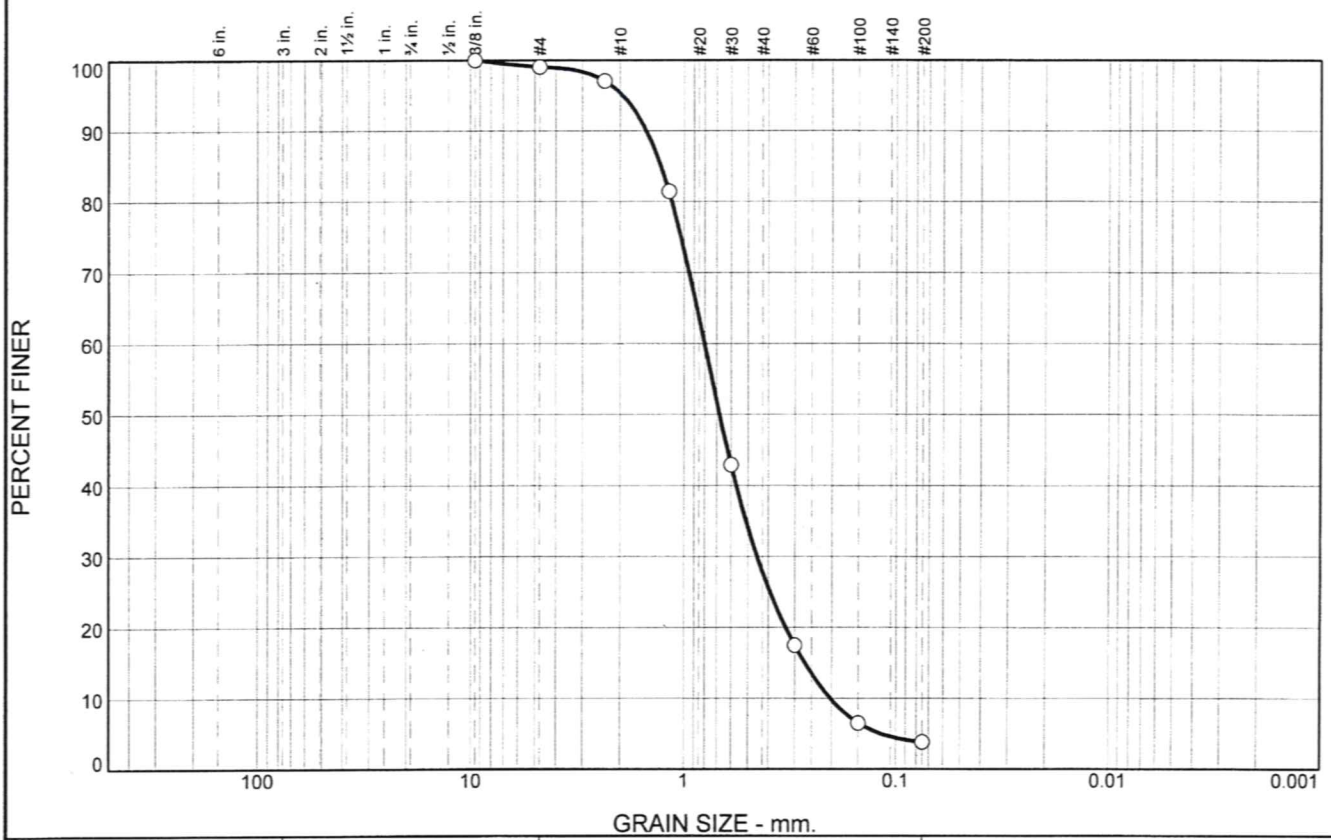
**Blackburn Consulting**

**Auburn, CA**

**Client:** RRM Design Group
**Project:** Area 2 Storm Drain
**Project No:** 1721.1 **Figure**

**Tested By:** KLC **Checked By:** KLC

# Particle Size Distribution Report




| % +3" | % Gravel | | % Sand | | | % Fines | |
|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| 0.0 | 0.0 | 0.9 | 3.7 | 67.7 | 23.9 | 3.8 | |

| SIEVE SIZE | PERCENT FINER | SPEC.* PERCENT | PASS? (X=NO) |
|---|---|---|---|
| 3/8" | 100.0 | | |
| #4 | 99.1 | | |
| #8 | 97.0 | | |
| #16 | 81.4 | | |
| #30 | 42.9 | | |
| #50 | 17.5 | | |
| #100 | 6.5 | | |
| #200 | 3.8 | | |

* (no specification provided)

**Material Description**

Yellowish Brown Poorly Graded SAND

**Atterberg Limits**

PL= LL= PI=

**Coefficients**

$D_{90}$= 1.5057 $D_{85}$= 1.2874 $D_{60}$= 0.8023
$D_{50}$= 0.6803 $D_{30}$= 0.4517 $D_{15}$= 0.2688
$D_{10}$= 0.2033 $C_u$= 3.95 $C_c$= 1.25

**Classification**

USCS= SP AASHTO=

**Remarks**

**Sample Number:** B3-2C **Depth:** 11.0-11.5

**Date:** 6-11-09

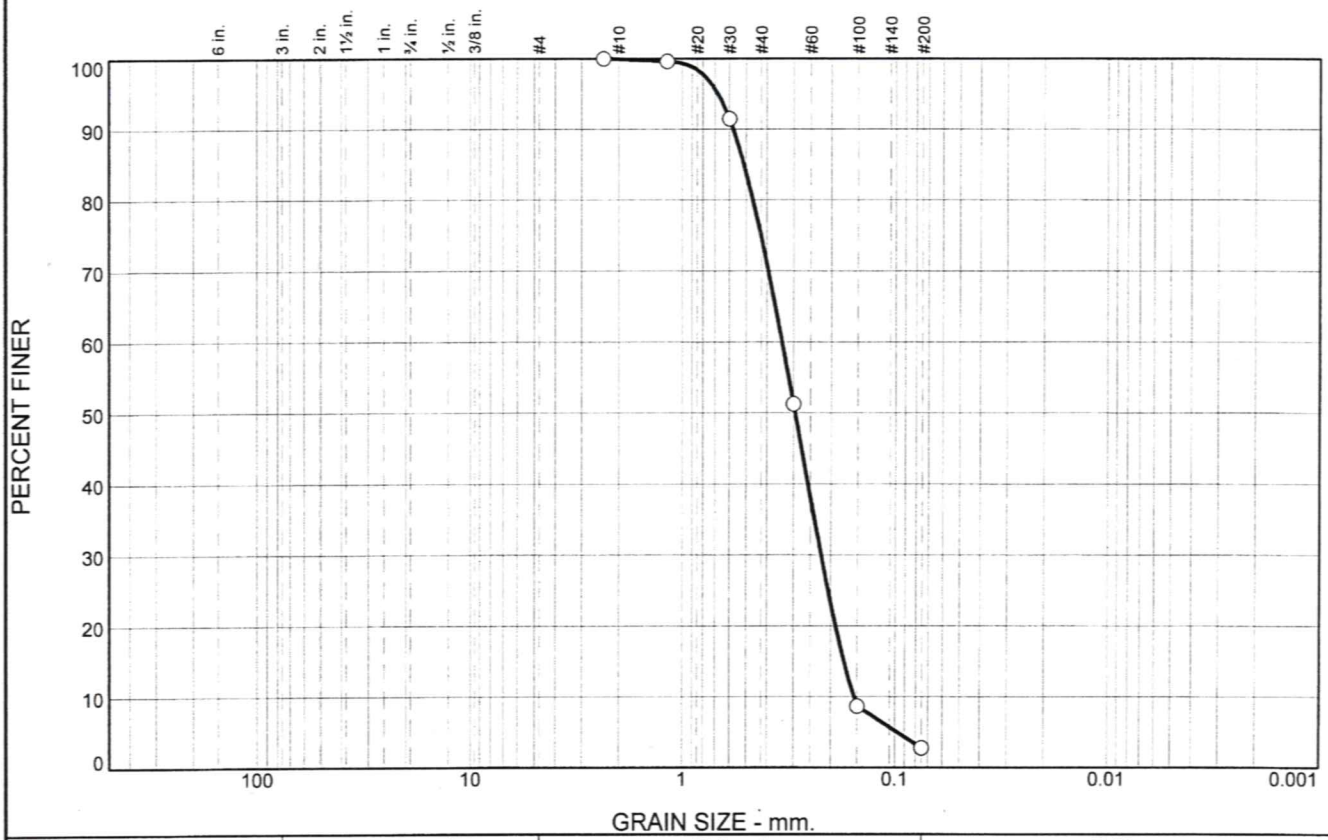
**Blackburn Consulting**

**Auburn, CA**

**Client:** RRM Design Group
**Project:** Area 2 Storm Drain
**Project No:** 1721.1 **Figure**

**Tested By:** KLC **Checked By:** KLC

# Particle Size Distribution Report




| % +3" | % Gravel | | % Sand | | | % Fines | |
|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| 0.0 | 0.0 | 0.0 | 0.1 | 25.1 | 72.0 | 2.8 | |

| SIEVE SIZE | PERCENT FINER | SPEC.* PERCENT | PASS? (X=NO) |
|---|---|---|---|
| #8 | 100.0 | | |
| #16 | 99.6 | | |
| #30 | 91.5 | | |
| #50 | 51.3 | | |
| #100 | 8.7 | | |
| #200 | 2.8 | | |

* (no specification provided)

**Material Description**

Light Gray and Brown Poorly Graded SAND

**Atterberg Limits**

PL= LL= PI=

**Coefficients**

$D_{90}$= 0.5761 $D_{85}$= 0.5129 $D_{60}$= 0.3392
$D_{50}$= 0.2948 $D_{30}$= 0.2226 $D_{15}$= 0.1735
$D_{10}$= 0.1554 $C_u$= 2.18 $C_c$= 0.94

**Classification**

USCS= SP AASHTO=

**Remarks**

**Sample Number:** B4-2B **Depth:** 10.5-11.0

**Date:** 6-11-09

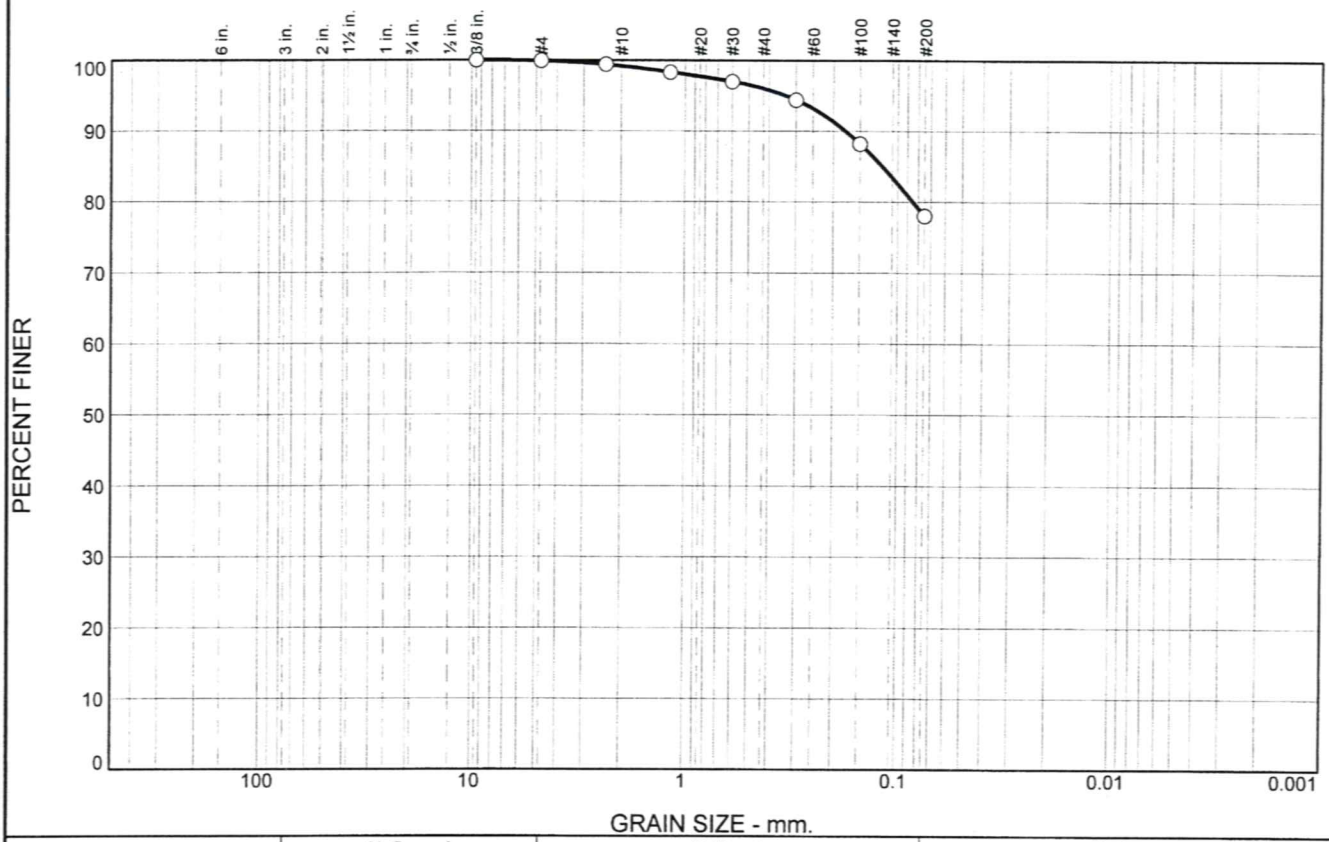
**Blackburn Consulting**

**Auburn, CA**

**Client:** RRM Design Group
**Project:** Area 2 Storm Drain
**Project No:** 1721.1 **Figure**

**Tested By:** KLC **Checked By:** KLC

# Particle Size Distribution Report




| % +3" | % Gravel | | % Sand | | | % Fines | |
|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| 0.0 | 0.0 | 0.1 | 0.7 | 3.2 | 18.0 | 78.0 | |

| SIEVE SIZE | PERCENT FINER | SPEC.* PERCENT | PASS? (X=NO) |
|---|---|---|---|
| 3/8 | 100.0 | | |
| #4 | 99.9 | | |
| #8 | 99.4 | | |
| #16 | 98.3 | | |
| #30 | 97.0 | | |
| #50 | 94.4 | | |
| #100 | 88.2 | | |
| #200 | 78.0 | | |

* (no specification provided)

**Material Description**

Light Gray Lean CLAY with Sand

**Atterberg Limits**

PL= 21 LL= 29 PI= 8

**Coefficients**

$D_{90}$= 0.1754 $D_{85}$= 0.1181 $D_{60}$=
$D_{50}$= $D_{30}$= $D_{15}$=
$D_{10}$= $C_u$= $C_c$=

**Classification**

USCS= CL AASHTO= A-4(5)

**Remarks**

**Sample Number:** B4-2C **Depth:** 11.0-11.5

**Date:** 6-11-09

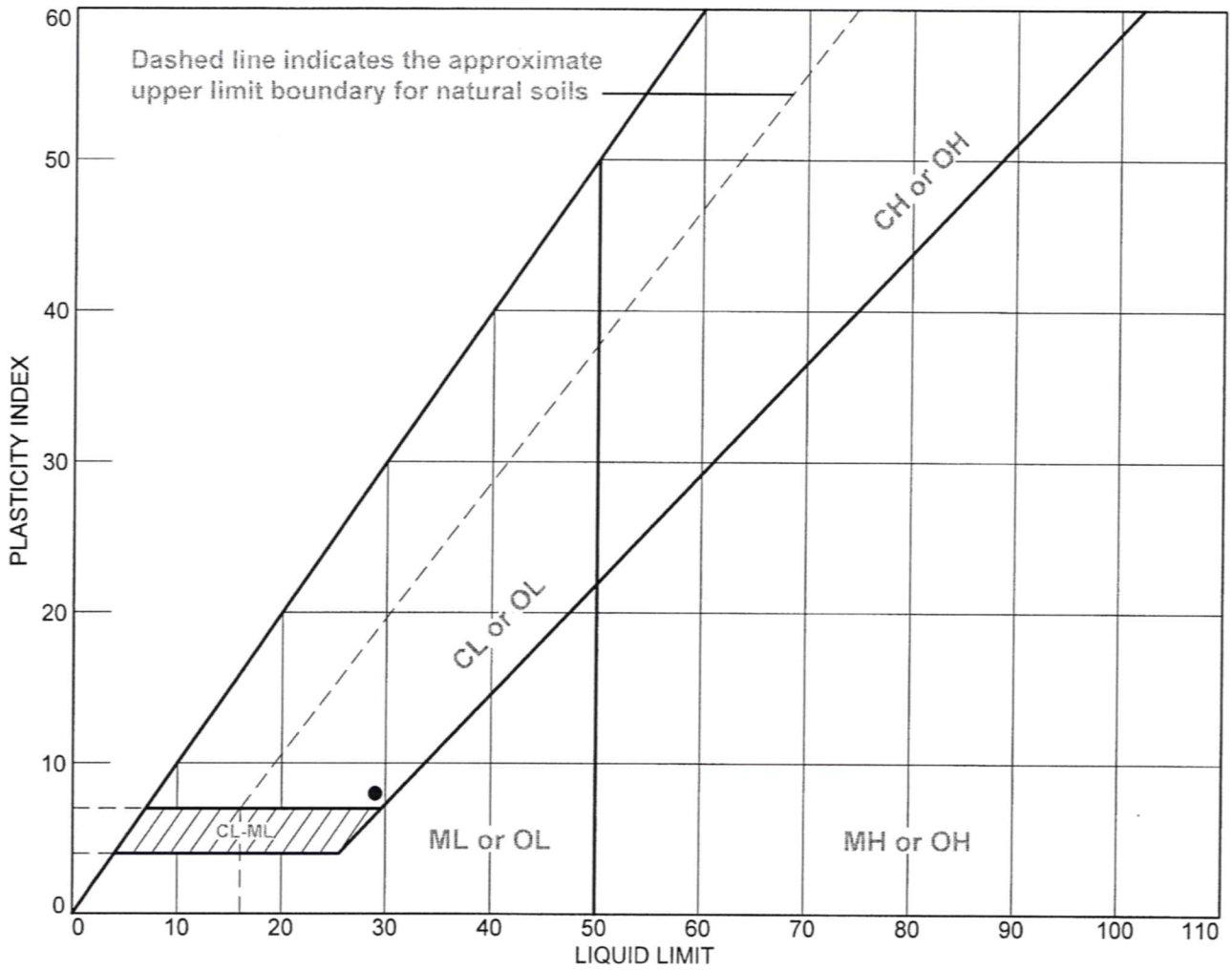
**Blackburn Consulting**

**Auburn, CA**

**Client:** RRM Design Group
**Project:** Area 2 Storm Drain
**Project No:** 1721.1 **Figure**

**Tested By:** KLC **Checked By:** KLC

# LIQUID AND PLASTIC LIMITS TEST REPORT




**SOIL DATA**

| SYMBOL | SOURCE | SAMPLE NO. | DEPTH | NATURAL WATER CONTENT (%) | PLASTIC LIMIT (%) | LIQUID LIMIT (%) | PLASTICITY INDEX (%) | USCS |
|---|---|---|---|---|---|---|---|---|
| ● | | B4-2C | 11.0-11.5 | | 21 | 29 | 8 | CL |

**Blackburn Consulting**

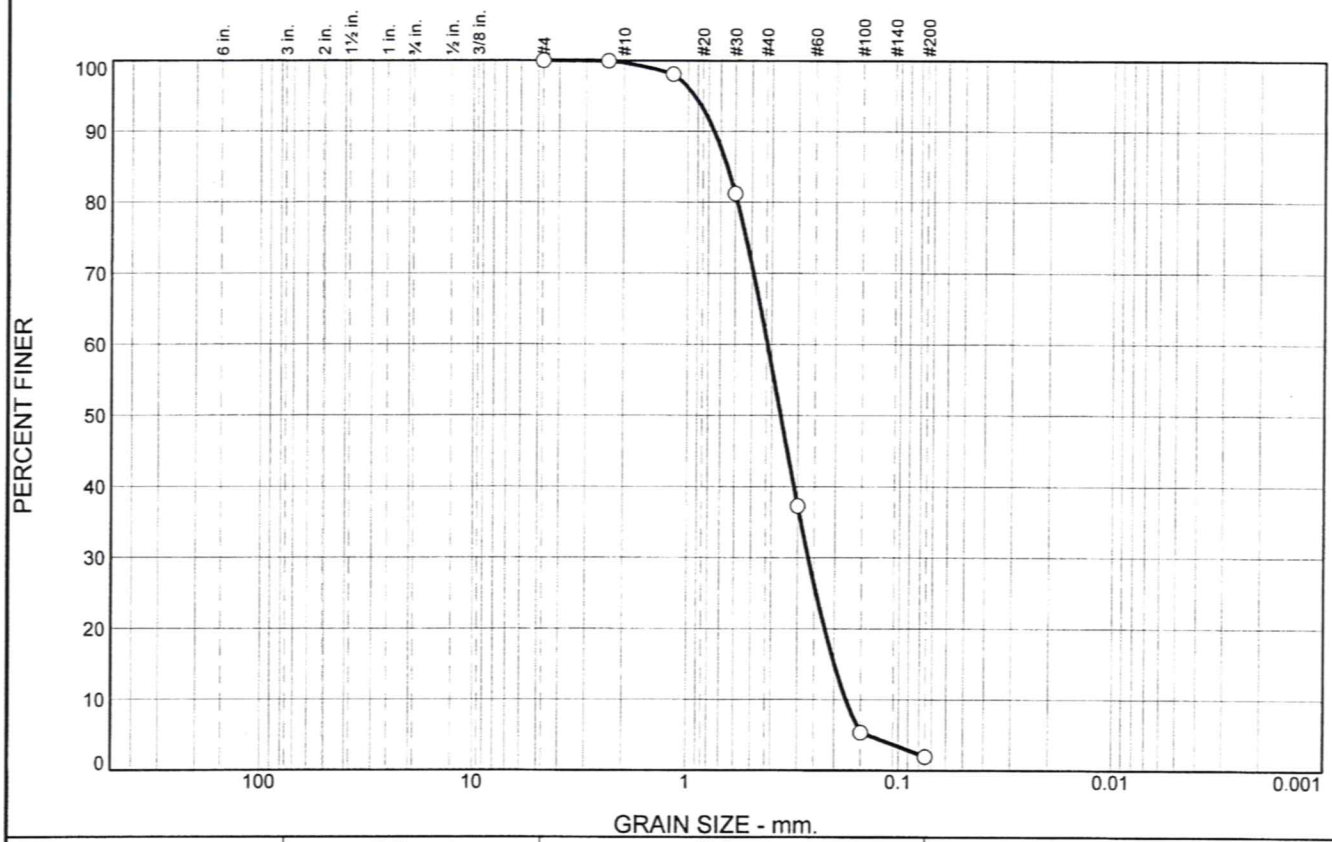
**Auburn, CA**

**Client:** RRM Design Group
**Project:** Area 2 Storm Drain

**Project No.:** 1721.1 **Figure**

**Tested By:** KLC **Checked By:** KLC

# Particle Size Distribution Report




| % +3" | % Gravel | | % Sand | | | % Fines | |
|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| 0.0 | 0.0 | 0.0 | 0.3 | 38.9 | 58.8 | 2.0 | |

| SIEVE SIZE | PERCENT FINER | SPEC.* PERCENT | PASS? (X=NO) |
|---|---|---|---|
| #4 | 100.0 | | |
| #8 | 100.0 | | |
| #16 | 98.1 | | |
| #30 | 81.2 | | |
| #50 | 37.3 | | |
| #100 | 5.4 | | |
| #200 | 2.0 | | |

* (no specification provided)

**Material Description**

Light Brownish Gray Poorly Graded SAND

**Atterberg Limits**

PL= LL= PI=

**Coefficients**

$D_{90}$= 0.7529 $D_{85}$= 0.6533 $D_{60}$= 0.4199
$D_{50}$= 0.3627 $D_{30}$= 0.2667 $D_{15}$= 0.1997
$D_{10}$= 0.1758 $C_u$= 2.39 $C_c$= 0.96

**Classification**

USCS= SP AASHTO=

**Remarks**

**Sample Number:** B5-2C **Depth:** 11.0-11.5

**Date:** 6-11-09

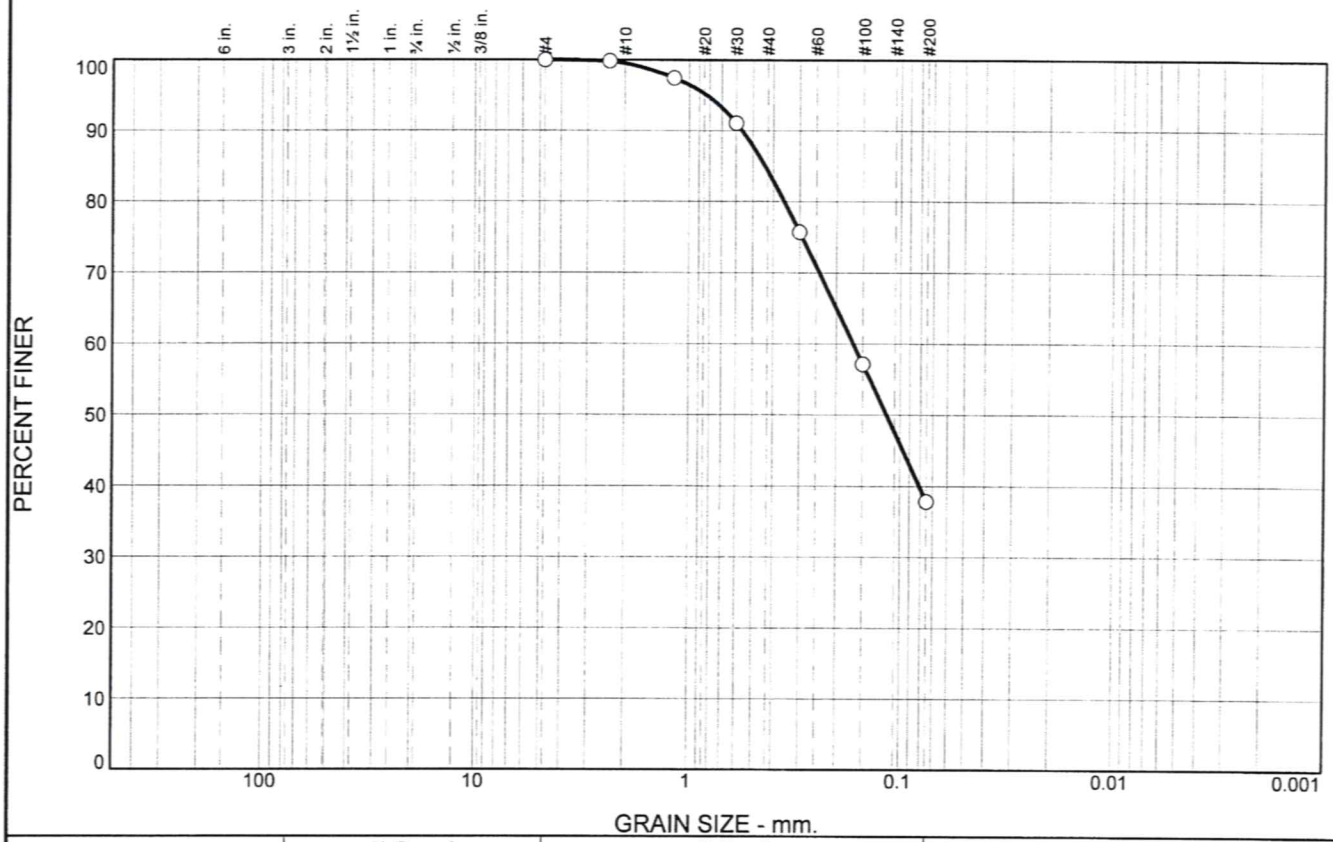
**Blackburn Consulting**

**Auburn, CA**

**Client:** RRM Design Group
**Project:** Area 2 Storm Drain
**Project No:** 1721.1 **Figure**

**Tested By:** KLC **Checked By:** KLC

# Particle Size Distribution Report




| % +3" | % Gravel | | % Sand | | | % Fines | |
|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| 0.0 | 0.0 | 0.0 | 0.5 | 15.2 | 46.5 | 37.8 | |

| SIEVE SIZE | PERCENT FINER | SPEC.* PERCENT | PASS? (X=NO) |
|---|---|---|---|
| #4 | 100.0 | | |
| #8 | 99.9 | | |
| #16 | 97.4 | | |
| #30 | 91.1 | | |
| #50 | 75.7 | | |
| #100 | 57.2 | | |
| #200 | 37.8 | | |

* (no specification provided)

**Material Description**

Light Gray Silty SAND

**Atterberg Limits**

PL= LL= PI=

**Coefficients**

$D_{90}$= 0.5616 $D_{85}$= 0.4380 $D_{60}$= 0.1663
$D_{50}$= 0.1157 $D_{30}$= $D_{15}$=
$D_{10}$= $C_u$= $C_c$=

**Classification**

USCS= SM AASHTO=

**Remarks**

**Sample Number:** B5-3C **Depth:** 16.0-16.5

**Date:** 6-11-09

**Blackburn Consulting**

**Auburn, CA**

**Client:** RRM Design Group
**Project:** Area 2 Storm Drain

**Project No:** 1721.1 **Figure**

**Tested By:** KLC **Checked By:** KLC

# APPENDIX F

## PRETREATMENT PRODUCT LIST AND REFERENCES

**Modesto Area 2**
**List of Potential PreTreatment Options**
**Compiled June 9,2009**

| Company | Product |
|---|---|
| Americast | Filtera |
| AquaShield, Inc. | Aqua-Swirl |
| | Aqua-Filter |
| | Aqua-Auardian |
| Baysavor Technologies inc | Bay Separator |
| Best Management Products | Snout |
| Bio Clean | Nutrient Separating Baffle Box |
| Contech | StormFilter |
| | MFS |
| | Storm Vault |
| | Vortechs |
| | CDS |
| | VortSentry |
| | VortSentry HS |
| | Stormscreen |
| | Envirogaurd |
| Environmental 21 | V2B1 |
| | Puristorm |
| | Unistorm |
| Fabco | Storm Basin |
| Fresh Creek Technologies | Trashmaster |
| | Sitesaver |
| Hydro-International | Up-Flo Filter |
| Hydroscreen, LLC | Screens |
| Imbrium Systems | Jellyfish |
| Ipex, Inc. | Envir Stream |
| KriStar | FloGard Dual Vortex |
| | Perk Filter |
| | Up-Flow Filter |
| | FloGard |
| Modular Wetlands | MWS Linear Underground Vault |
| Rotondo | Sand Filter |
| Suntree Technologies, Inc. | Grate Inlet Skimmer Box |
| | Curb Inlet Basket |
| n/a | Grassy Swale |
| n/a | Sand Filter |

* Note - List developed from internet search for stormwater treatment systems and product advertisements in stormwater publications

**Modesto Area 2**
**List of Potential Disposal Options**
**Compiled June 9,2009**

| Manufacturer | Product |
|---|---|
| ADS | HDPE Pipe |
| Brentwood | Storm Tank |
| Contech | Corrugated Metal Pipe |
| | Plate System |
| | Chamber Max |
| | Con/Storm Vault |
| | Con/Span Vaults |
| | Storm Vault |
| Hydrologic Solution | Storm Chamber |
| Invisible Structure | Rainstore 3 |
| Kristar | CUDO |
| LandSavor | HDPE Arches |
| Layfield Group | Atlantis D |
| Prinsco | HDPE Pipe |
| Rinker | Stormceptor Max |
| Rotondo Environmental Solutions | Precast Conc. Vaults |
| Stormtech | MC3500 |
| | SC-740 |
| Triton Environmental Solutions | Stormwater Chambers |

* Note - List developed from internet search for detention and retention systems and product advertisements in stormwater publications

Project Name: Modesto Area 2 Storm Drain Cross Connection Removal
Project Number: 2108543
Date 29-Oct-09
By: R. Camacho
Checked By: W. Strand

## PRETREATMENT REFERENCE SHEET

| | Unit | | | Unit | | | Unit | | |
|---|---|---|---|---|---|---|---|---|---|
| | VortSentry HS | | | BaySaver | | | CDS | | |
| Company Name | BKF Engineers | BKF Engineers | Landset Engineers | Haaland Group | Haaland Group | Haaland Group | MCR Engineering | MCR Engineering | MCR Engineering |
| Designer / Engineer | Anh Nguyen | Anh Nguyen | Charles Potter | Dale Oritman | Dale Oritman | Dale Oritman | Dan Evanenson | Dan Eavenson | Dan Eavenson |
| Contact Number | 1-408-467-9155 | 1-408-467-9155 | 1-831-443-6970 | 1-805-497-4554 | 1-805-497-4554 | 1-805-497-4554 | 1-209-239-6229 | 1-209-239-6229 | 1-209-239-6229 |
| Project Site | Mowry Retail Center | Sunnyvalle Town Center | Commons at Rogge Road Residential | Office Complex (In Thousand Oaks) | Simivalley Hospital | BMW Dealership | Yosemite Ave Business Park | Rodoni Estates Subdivision | Cozad Trailer |
| Treatment Type | Roof top and Parking lot run-off | Roof top and Parking lot run-off | Roof tops and street run-off | Roof top and Parking lot run-off | Roof top and Parking lot run-off | Roof top and Parking lot run-off | Roof top and Parking lot run-off | Roof tops and street run-off | Roof top and Parking lot run-off |
| Satisfied with units ability to treat run-off | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Number of rainy seasons in operation | 1 | 1 | 1 | 1 | 5 | 1 | 1 | 3.5 | > 1 |
| Maintenance Interval | 1 / year | 1 / year | 1 / year | 1 / year (w/ 2 observations) | 1 / year (w/ 2 observations) | 1 / year (w/ 2 observations) | 1 / year (w/ 2 observations) | 1 / year (w/ 2 observations) | 1 / year (w/ 2 observations) |
| Any known Problems | No | No | No | No | No | No | No | No | No |
| Is the Unit performing to advertised abilities | * Yes | * Yes | * Yes | * Yes | * Yes | * Yes | * Yes | * Yes | * Yes |
| Is the unit removing sediment | * Yes | * Yes | * Yes | * Yes | * Yes | * Yes | * Yes | * Yes | * Yes |
| Would you Promote this unit | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |