# Appendix A - Relative Cost Comparison

For comparison purposes at this level of analysis, the following unit costs were used in developing opinions of probable costs. All costs shown include construction costs + "soft costs" (permitting, engineering, construction management) and a contingency.

| Description | Unit | Probable Cost per Unit |
|---|---|---|
| **Capital Costs** | | |
| **Pipe Lines - no paving** | | |
| 18" PVC Water Main - no paving | mile | $ 1,490,000 |
| 24" PVC Water Main - no paving | mile | $ 1,610,000 |
| 36" PVC Water Main - no paving | mile | $ 1,840,000 |
| **Pipe Lines - with paving** | | |
| 8" PVC Water Main - with paving | mile | $ 1,350,000 |
| 18" PVC Water Main - with paving | mile | $ 1,860,000 |
| 20" PVC Water Main - with paving | mile | $ 1,910,000 |
| 24" PVC Water Main - with paving | mile | $ 2,010,000 |
| **Pipe Crossings** | | |
| Pipe river crossing, trenched installation - 24" diameter pipe | feet | $ 1,020 |
| Pipe river crossing, HDD installation - 24" diameter pipe | feet | $ 2,775 |
| **Pump Stations** | | |
| Pump Station, 2.7 MGD (3,000 AFY) | each | $ 810,000 |
| Pump Station, 5.7 MGD (6,300 AFY) | each | $ 1,700,000 |
| **Storage** | | |
| Tank, Site Improvements and Appurtances | gallon | $ 2.00 |
| **Connections** | | |
| Inteconnection Facility, 2.7 MGD | each | $ 15,000 |
| Inteconnection Facility, 5.7 MGD | each | $ 30,000 |
| CCWA Turnout | each | $ 500,000 |
| **Intake/Discharge Structures** | | |
| Well, 0.89 MGD | each | $ 175,000 |
| Ocean Outfall, 2.7 MGD | each | $ 18,900,000 |
| Ocean Outfall, 5.7 MGD | each | $ 21,500,000 |
| Percolation Basin improvements (no land cost) | acre | $ 100,000 |
| **Treatment Facilities** | | |
| Reverse Osmosis Plant, Stand Alone, 2.7 MGD (3,000 AFY) | each | $ 15,800,000 |
| Reverse Osmosis Plant, Stand Alone, 5.7 MGD (6,300 AFY) | each | $ 23,000,000 |

| Description | Unit | Probable Cost per Unit |
| --- | --- | --- |
| Enlarge planned 2MGD SSLOCSD facility by 2.7 MGD | LS | $ 12,000,000 |
| Enlarge planned 2MGD SSLOCSD facility by 5.7 MGD | LS | $ 18,000,000 |
| Chloramination Facilities at existing NCSD wells | LS | $ 1,100,000 |
| Clorine Contact Treatment at Southland WWTP | each | $ 2,319,000 |
| Coag/Filt Plant, 2.7 MGD (1800 gpm) (3,000 AFY) | each | $ 3,900,000 |
| Coag/Filt Plant, 5.7 MGD (3900 gpm) (6,300 AFY) | each | $ 7,800,000 |
| **O&M Costs** | | |
| Electricity | kWh | $ 0.13 |
| Reverse Osmosis Plant, Stand Alone, 2.7 MGD (3,000 AFY) | acre-feet | $ 1,200 |
| Reverse Osmosis Plant, Stand Alone, 5.7 MGD (6,300 AFY) | acre-feet | $ 1,100 |
| Coagulation and Filtration Treatment Cost | acre-feet | $ 200 |
| Chloramination Treatment Costs | acre-feet | $ 20 |

# Appendix B – Hydrogeology Constraints Analyses

SAIC, Inc., Technical Memoranda:

June 1, 2007, Yield of State Water Project water for Central Coast Water Authority and San Luis Obispo County

June 1, 2007, Yield of Aquifer Storage and Recovery

June 5, 2007, Santa Maria River Underflow

*SCIENCE APPLICATIONS INTERNATIONAL CORPORATION*
*WATER RESOURCES ENGINEERING - CARPINTERIA*

# TECHNICAL MEMORANDUM

**TO:** **Mike Nunely**

**FROM:** **Brad Newton**

**RE:** **Questions 1-6: Yield of State Water Project water for Central Coast Water Authority and San Luis Obispo County, SAIC Project Number: 01-0236-00-9785**

**DATE:** **June 1, 2007**



## INTRODUCTION

On February 13, 2007, SAIC entered into a contractual agreement with Boyle Engineering Corporation (Boyle) to provide hydrogeologic services related to evaluating alternative water supplies to Nipomo Community Services District (the District). The District's Board would like to assess, as an alternative water supply, the availability of State Water Project (SWP) water for purchase or an exchange to be conveyed through the SWP pipeline. Subsequently, Boyle requested SAIC address specific questions contained in a memorandum dated May 9, 2007. Provided below and in the attachments hereto is a preliminary assessment of SWP water deliveries based on historical hydrology and Table A amounts for the Central Coast Water Authority (CCWA) and San Luis Obispo County (SLO).

## RESULTS

The following are the questions Boyle presented regarding the yield of the State Water Project water:

1. Based on past experience, what is the probability distribution of water available to CCWA? (e.g., "There is an X% probability that during any year available water will exceed YY acre feet.);
2. How much water will be available to CCWA annually on a long-term average basis?;
3. How much will be available in "wet" years?;
4. How much will be available in "dry" years?;
5. Same questions for the San Luis Obispo County SWP entitlement.

The following two sections present the answers to these questions regarding the Central Coast Water Authority, and the County of San Luis Obispo.

### Yield of State Water Project for the Central Coast Water Authority (CCWA)



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The CCWA State Water Project Table A amount is 45,486 acre-feet per year (AFY). On a long-term average basis roughly 34,500 AFY of SWP water is available to the CCWA (Table 1). In a "wet" year about 43,500 acre-feet (AF) of SWP water is available and in a "dry" year about 29,500 AF of SWP water is available to the CCWA (Table 1). There is a 50% probability that during any year available SWP water will exceed 38,000 AF (Figure 1).

**Yield of State Water Project for San Luis Obispo County (SLO)**

The SLO State Water Project Table A amount is 25,000 AFY. On a long-term average basis roughly 19,000 AFY of SWP water is available to SLO (Table 2). In a "wet" year about 24,000 AF of SWP water is available and in a "dry" year about 16,500 AF of SWP water is available to SLO (Table 2). There is a 50% probability that during any year available SWP water will exceed 21,000 AF (Figure 2).

**METHODOLOGY**

The Table A amounts for the Central Coast Water Authority (45,486 AFY) and San Luis Obispo County (25,000 AFY) are based on the SWP Delivery Reliability Report (DWR, 2005). The hydrologic water year type classification is based on the California Department of Water Resources Sacramento Valley index (DWR, 2005). The simulated delivery as a percentage (Column 3 in Tables 1 and 2) for Water Year 1922 through Water Year 1994 is based on Table B-7 of the SWP Delivery Reliability Report (DWR, 2005). The simulated delivery in acre-feet (Column 4 in Tables 1 and 2) is computed by multiplying the simulated delivery as a percentage (Column 3 in Tables 1 and 2) with the Table A amount of 45,486 AFY for the CCWA and 25,000 AFY for SLO. The long-term average delivery is the average of simulated deliveries (as a percentage) over the period from Water Year 1922 through Water Year 1994. The "dry" year and "wet" year delivery is the average of the deliveries made in each respective hydrologic year types. The probability distribution figures of SWP Delivery to CCWA and SLO are based on the simulated deliveries in acre-feet (Column 4 in Tables 1 and 2).

**Table 1. Estimated SWP Deliveries to CCWA (Water Years 1922-1994)**

| Year of Simulation (Water Year) 1 | Hydrologic Year Type 2 | Simulated Delivery (% of Full Table A) 3 | Simulated Delivery to CCWA (Acre-Feet) 4 |
|---|---|---|---|
| 1922 | AN | 98% | 44,576 |
| 1923 | BN | 89% | 40,483 |
| 1924 | C | 24% | 10,917 |
| 1925 | D | 35% | 15,920 |
| 1926 | D | 69% | 31,385 |
| 1927 | W | 98% | 44,576 |
| 1928 | AN | 79% | 35,934 |
| 1929 | C | 26% | 11,826 |
| 1930 | D | 66% | 30,021 |
| 1931 | C | 26% | 11,826 |
| 1932 | D | 45% | 20,469 |
| 1933 | C | 48% | 21,833 |
| 1934 | C | 38% | 17,285 |
| 1935 | BN | 90% | 40,937 |
| 1936 | BN | 89% | 40,483 |
| 1937 | BN | 77% | 35,024 |
| 1938 | W | 100% | 45,486 |
| 1939 | D | 83% | 37,753 |
| 1940 | AN | 96% | 43,667 |
| 1941 | W | 99% | 45,031 |
| 1942 | W | 100% | 45,486 |
| 1943 | W | 87% | 39,573 |
| 1944 | D | 84% | 38,208 |
| 1945 | BN | 86% | 39,118 |
| 1946 | BN | 92% | 41,847 |
| 1947 | D | 63% | 28,656 |
| 1948 | BN | 63% | 28,656 |
| 1949 | D | 64% | 29,111 |
| 1950 | BN | 70% | 31,840 |
| 1951 | AN | 97% | 44,121 |
| 1952 | W | 100% | 45,486 |
| 1953 | W | 95% | 43,212 |
| 1954 | AN | 93% | 42,302 |
| 1955 | D | 43% | 19,559 |
| 1956 | W | 100% | 45,486 |
| 1957 | AN | 74% | 33,660 |
| 1958 | W | 98% | 44,576 |
| 1959 | BN | 84% | 38,208 |
| 1960 | D | 49% | 22,288 |
| 1961 | D | 68% | 30,930 |
| 1962 | BN | 76% | 34,569 |
| 1963 | W | 98% | 44,576 |
| 1964 | D | 74% | 33,660 |
| 1965 | W | 78% | 35,479 |
| 1966 | BN | 93% | 42,302 |
| 1967 | W | 98% | 44,576 |
| 1968 | BN | 87% | 39,573 |
| 1969 | W | 99% | 45,031 |
| 1970 | W | 95% | 43,212 |
| 1971 | W | 99% | 45,031 |
| 1972 | BN | 66% | 30,021 |
| 1973 | AN | 89% | 40,483 |
| 1974 | W | 100% | 45,486 |
| 1975 | W | 99% | 45,031 |
| 1976 | C | 67% | 30,476 |
| 1977 | C | 20% | 9,097 |
| 1978 | AN | 95% | 43,212 |
| 1979 | BN | 85% | 38,663 |
| 1980 | AN | 84% | 38,208 |
| 1981 | D | 82% | 37,299 |
| 1982 | W | 100% | 45,486 |
| 1983 | W | 100% | 45,486 |
| 1984 | W | 99% | 45,031 |
| 1985 | D | 80% | 36,389 |
| 1986 | W | 73% | 33,205 |
| 1987 | D | 69% | 31,385 |
| 1988 | C | 24% | 10,917 |
| 1989 | D | 70% | 31,840 |
| 1990 | C | 28% | 12,736 |
| 1991 | C | 24% | 10,917 |
| 1992 | C | 28% | 12,736 |
| 1993 | AN | 97% | 44,121 |
| 1994 | C | 74% | 33,660 |
| **Long-term Average (1922-1994)** | | **76%** | **34,488** |

| Sacramento Valley Water Year Hydrologic Classification: | | Average Simulated Delivery for Year Type Water Years 1922 through 1994 (% of Full Table A) | Average Simulated Delivery for Year Type Water years 1922 through 1994 (Acre-feet) |
|---|---|---|---|
| W | Wet year type | 96% | 43,645 |
| AN | Above normal year type | 90% | 41,028 |
| BN | Below normal year type | 82% | 37,266 |
| D | Dry year type | 65% | 29,680 |
| C | Critical year type | 36% | 16,185 |

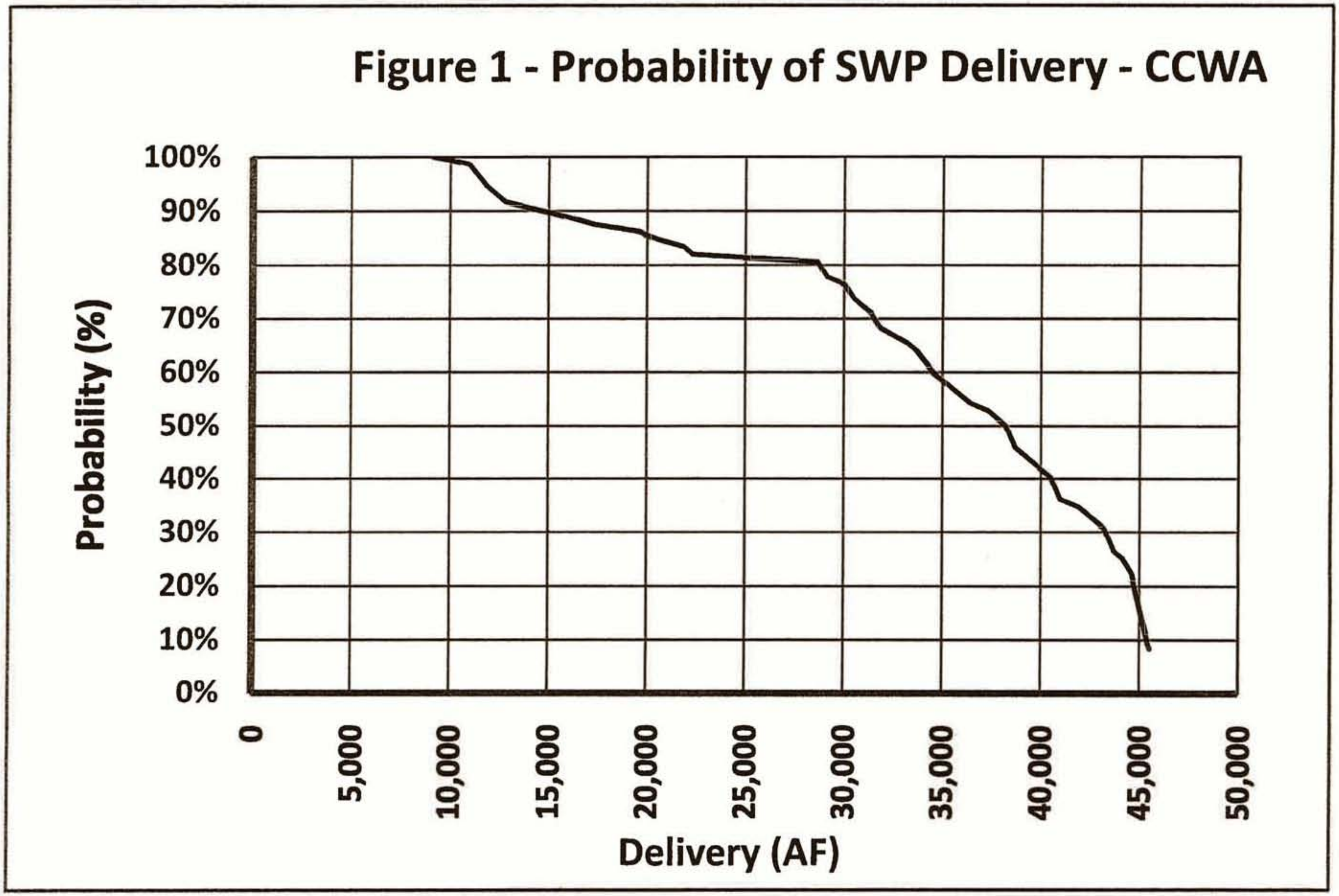


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Table 2. Estimated SWP Deliveries to SLO (Water Years 1922-1994)

| Year of Simulation (Water Year) 1 | Hydrologic Year Type 2 | Simulated Delivery (% of Full Table A) 3 | Simulated Delivery to SLO (Acre-Feet) 4 |
|---|---|---|---|
| 1922 | AN | 98% | 24,500 |
| 1923 | BN | 89% | 22,250 |
| 1924 | C | 24% | 6,000 |
| 1925 | D | 35% | 8,750 |
| 1926 | D | 69% | 17,250 |
| 1927 | W | 98% | 24,500 |
| 1928 | AN | 79% | 19,750 |
| 1929 | C | 26% | 6,500 |
| 1930 | D | 66% | 16,500 |
| 1931 | C | 26% | 6,500 |
| 1932 | D | 45% | 11,250 |
| 1933 | C | 48% | 12,000 |
| 1934 | C | 38% | 9,500 |
| 1935 | BN | 90% | 22,500 |
| 1936 | BN | 89% | 22,250 |
| 1937 | BN | 77% | 19,250 |
| 1938 | W | 100% | 25,000 |
| 1939 | D | 83% | 20,750 |
| 1940 | AN | 96% | 24,000 |
| 1941 | W | 99% | 24,750 |
| 1942 | W | 100% | 25,000 |
| 1943 | W | 87% | 21,750 |
| 1944 | D | 84% | 21,000 |
| 1945 | BN | 86% | 21,500 |
| 1946 | BN | 92% | 23,000 |
| 1947 | D | 63% | 15,750 |
| 1948 | BN | 63% | 15,750 |
| 1949 | D | 64% | 16,000 |
| 1950 | BN | 70% | 17,500 |
| 1951 | AN | 97% | 24,250 |
| 1952 | W | 100% | 25,000 |
| 1953 | W | 95% | 23,750 |
| 1954 | AN | 93% | 23,250 |
| 1955 | D | 43% | 10,750 |
| 1956 | W | 100% | 25,000 |
| 1957 | AN | 74% | 18,500 |
| 1958 | W | 98% | 24,500 |
| 1959 | BN | 84% | 21,000 |
| 1960 | D | 49% | 12,250 |
| 1961 | D | 68% | 17,000 |
| 1962 | BN | 76% | 19,000 |
| 1963 | W | 98% | 24,500 |
| 1964 | D | 74% | 18,500 |
| 1965 | W | 78% | 19,500 |
| 1966 | BN | 93% | 23,250 |
| 1967 | W | 98% | 24,500 |
| 1968 | BN | 87% | 21,750 |
| 1969 | W | 99% | 24,750 |
| 1970 | W | 95% | 23,750 |
| 1971 | W | 99% | 24,750 |
| 1972 | BN | 66% | 16,500 |
| 1973 | AN | 89% | 22,250 |
| 1974 | W | 100% | 25,000 |
| 1975 | W | 99% | 24,750 |
| 1976 | C | 67% | 16,750 |
| 1977 | C | 20% | 5,000 |
| 1978 | AN | 95% | 23,750 |
| 1979 | BN | 85% | 21,250 |
| 1980 | AN | 84% | 21,000 |
| 1981 | D | 82% | 20,500 |
| 1982 | W | 100% | 25,000 |
| 1983 | W | 100% | 25,000 |
| 1984 | W | 99% | 24,750 |
| 1985 | D | 80% | 20,000 |
| 1986 | W | 73% | 18,250 |
| 1987 | D | 69% | 17,250 |
| 1988 | C | 24% | 6,000 |
| 1989 | D | 70% | 17,500 |
| 1990 | C | 28% | 7,000 |
| 1991 | C | 24% | 6,000 |
| 1992 | C | 28% | 7,000 |
| 1993 | AN | 97% | 24,250 |
| 1994 | C | 74% | 18,500 |
| Long-term Average (1922-1994) | | 76% | 18,955 |

| Sacramento Valley Water Year Hydrologic Classification: | | Average Simulated Delivery for Year Type Water Years 1922 through 1994 (% of Full Table A) | Average Simulated Delivery for Year Type Water years 1922 through 1994 (Acre-feet) |
|---|---|---|---|
| W | Wet year type | 96% | 23,988 |
| AN | Above normal year type | 90% | 22,550 |
| BN | Below normal year type | 82% | 20,482 |
| D | Dry year type | 65% | 16,313 |
| C | Critical year type | 36% | 8,896 |

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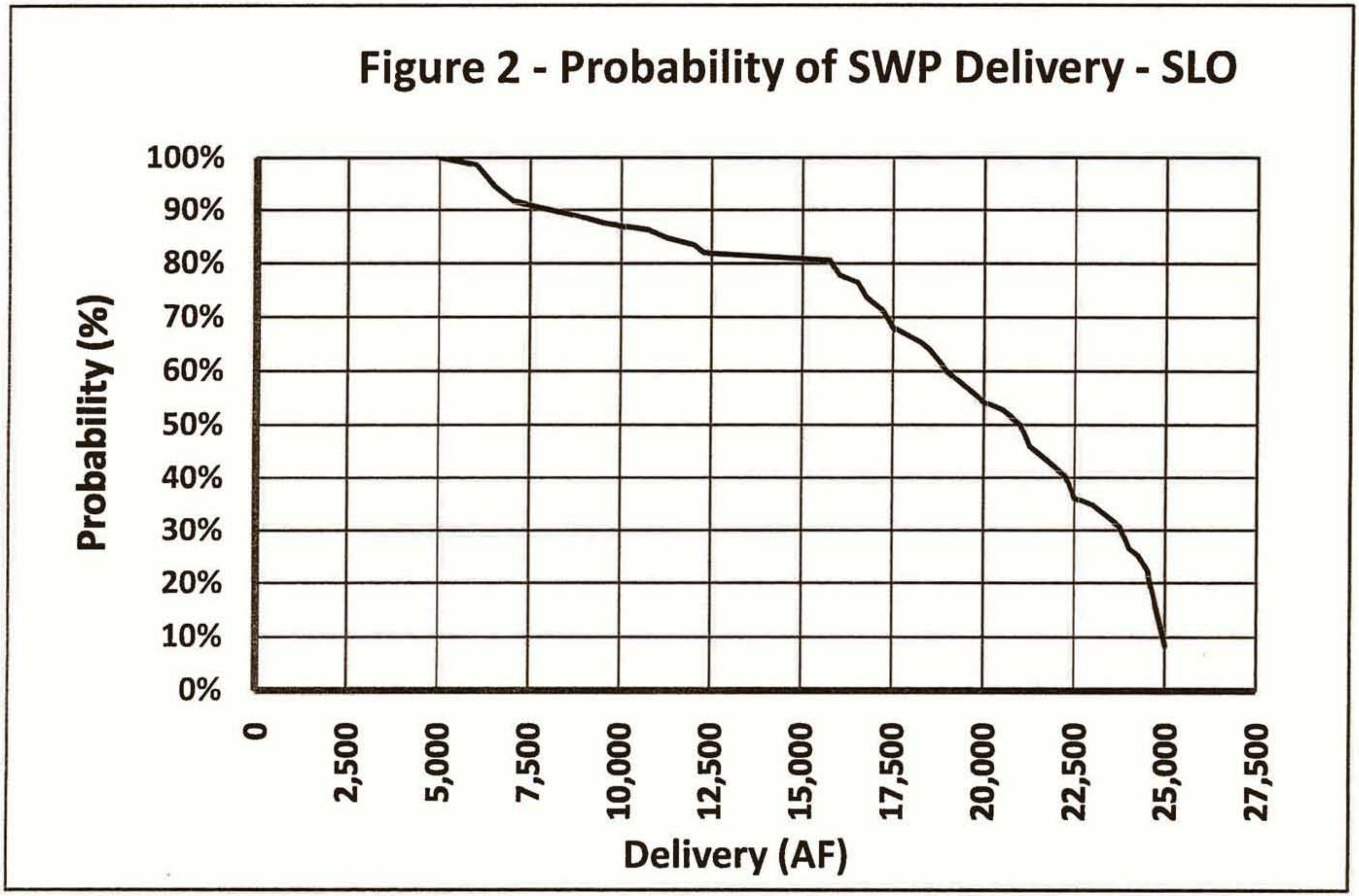


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# TECHNICAL MEMORANDUM

**TO:** Mike Nunely

**FROM:** Brad Newton

**RE:** Questions 12-17: Yield of Aquifer Storage and Recovery, SAIC Project Number: 01-0236-00-9785

**DATE:** June 1, 2007



## INTRODUCTION

Programmatic development of an aquifer storage and recovery system requires an overall understanding of the local and regional hydrogeology. The District is currently investigating the opportunities to develop recharge basins on the Nipomo Mesa to augment the native supply of water to the principal production aquifer, typically the unconsolidated alluvial deposits of the Paso Robles Formation. Cause for concern over the lack of geologic understanding of the Nipomo Mesa is warranted, specifically in that recent sentinel monitoring well observations for sea water intrusion at the coast documented artesian conditions for all three well depths. These observations strongly suggest that a confining layer exists, however its depth, location and areal extent is not currently understood. Additionally, the presence of the Santa Maria River Fault has been interpreted to impede the lateral flow of groundwater, however the data reviewed during this investigation does not support nor deny this hypothesis.

On February 13, 2007, SAIC entered a contractual agreement with Boyle Engineering Corporation (Boyle) to provide hydrogeology services related to evaluating alternative water supplies to Nipomo Community Services District (the District). The District's Board requested an assessment of the yield of aquifer storage and recovery for the main production aquifer contained within the Nipomo Mesa Management Area (NMMA). Subsequently, Boyle requested SAIC address specific questions contained in a memorandum dated May 9, 2007. This technical memorandum constitutes a partial deliverable (Questions 12 – 17) to be included in Boyle's TM #1 Constraints Analysis to the District. Provided below and in the attachments herewith is a preliminary assessment of the plausibility of aquifer storage and recovery.

Several independent lines of evidence reviewed and interpreted herein support a proposed conceptual model of the hydrogeology within the NMMA. Groundwater surface elevations above ground surface at the sentinel monitoring well location on the beach support the geologic interpretation of a confining layer west of NMMA. Twitchell Reservoir water releases operational strategy to enhance groundwater recharge of the principal production aquifer supports the geologic interpretation of a confining layer that extends westward from the Bonita School Road crossing within the Santa Maria River corridor. The presence of Black Lake



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Canyon supports the interpretation that a confining layer exists from the coastal dunes to the east of the canyon head. Drilling logs and well casing records also support the presence of confining layer from the western area of municipal production to Omiya well where the confining layer abruptly thins. Additional drilling logs and casing records would be needed to strengthen the confidence of the presence and extent of a regional confining layer in the western half of the NMMA.

The proposed conceptual model of the hydrogeology within the NMMA is preliminary and may be changed upon reviewing additional data. For the purposes of this constraints analysis, and foregoing any additional data review, the proposed conceptual model provides the context for evaluating the following questions presented in the Boyle memorandum dated May 9, 2007.



**RESULTS**

12. How will the use of aquifer storage and recovery change the answers to the previous questions 1-5?

The available space of groundwater storage in the aquifer (approximately 400,000 acre-feet [AF]) is sufficient to accommodate the volume of water obtainable from the SWP to meet the District's target additional maximum supply of 6,300 acre-feet per year (AFY). Therefore, the answers to question 1-5 would not change.

13. How much water can be stored in the aquifer underlying the NMMA?

The aquifer underlying the NMMA has an estimated available storage of 400,000 AF above sea level. However, the proposed conceptual model of the hydrogeology constrains the available area for storage capacity to approximately one-quarter of the total 20,000 acres on NMMA as the target recharge area. This target area is bound by the confining layer to the west, the Black Lake Canyon to the north, the topographic boundary to the south, and the Santa Maria River Fault trace to the east, although little is known regarding lateral flow across the fault. The storage of 6,300 AF of water within 5,000 acres area would likely cause an increase in the groundwater surface elevation by approximately 10 feet over the 5,000 acres.

14. Where are the best places to locate percolation/aquifer storage facilities?

The proposed preliminary target area is east of Omiya well, southwest of Santa Maria Fault, and north of the mesa topographic boundary. The ideal location of recharge ponds will be places with high percolation rates and no confining layer or low hydraulic conductivity zones at depth. The proposed preliminary target area is bound by the confining layer to the west, the Black Lake Canyon to the north, the topographic boundary to the south, and the Santa Maria River Fault trace to the east.

15. If percolation ponds are used, what area would be required?

Based on a typical percolation rate of 6 inches per day, approximately 50 acres of ponds would be required to recharge 6,300 AFY.

16. How many new wells would be needed to recapture the stored water?

Based on wells currently operated by the Nipomo Community Services District (NCSD) five extraction wells with a production rate of 800 gallons per minute (gpm) would be required to capture 6,300 AFY of water.

17. Where should these wells be installed (location and depth)?

We recommend locating the wells east of Highway 1, south of the Black Lake Canyon, west of Santa Maria River Fault, and north of the Woodlands development. This general area will distribute pumping across the NMMA providing for a more even access to the water resource. These wells should be screened in zones that produce large volumes of high quality water, likely within the Paso Robles Formation.

**DISCUSSION**

The Paso Robles Formation is overlain by dune sands and younger alluvium, and overlies the Careaga Formation, an accumulation of unconsolidated to well-consolidated, shallow-water marine sands. The Paso Robles Formation is highly variable in color and texture, ranging from gavel and clay, sand and clay, gravel and sand, silt and clay. Most of it is fluvial in origin and in most places correlation between individual beds is not possible. The Careaga Formation is the lower most fresh water bearing formation and water quality is typically poor.

Identifying potential recharge sites on the Nipomo Mesa is contingent upon understanding the geology, the available land for recharge facilities construction, and the existing conveyance facilities or the need for new facility construction. The geologic conditions specific to recharge site identification on the Nipomo Mesa is poorly documented; however, anecdotal information, a few well logs, and existing reports have been reviewed and summarized herein to provide the basis for our current understanding. In general, recharge facilities are constructed over sediments where no confining layer exists in an effort to maximize percolation and therefore recharge to the groundwater aquifer. Set forth below is the summary of document reviews, geologic and topographic map evaluations, site visits, and well logs which indicates the likelihood of a confining layer and location of its inland margin.

Black Lake Canyon is an east-west trending topographic feature resulting from the erosion and transport of unconsolidated sand dune sediments westward to the active dune complex at the ocean. No river exists upstream of the canyon head, and the local surface drainage area at the canyon head is small. Surface water exists along much of the length in the canyon bottom and a terminal lake exists at the canyon mouth in the margin of the active beach dune complex.

No existing reports reviewed during this investigation explained the occurrence or physical processes that created the Black Lake Canyon. However, fine-grained layers in the upper portion of the Paso Robles Formation beneath dune sands are reported to function as a perching layer, and that some of the shallow groundwater that percolates downward within the permeable Nipomo Mesa dune sands is diverted laterally along these low-permeability layers and discharges into Black Lake Canyon and supports Black Lake and other systems of coastal drainages and lakes west of Nipomo Mesa (Papadapolas & Associates, 2004). While not specifically inferred in these reports, the laterally diverted perched shallow groundwater emerging at the ground surface can cause seepage erosion and over time develop a channel head which is likely to migrate up stream. This mechanism may explain the existence of Black Lake Canyon, and substantiate the occurrence of a confining layer above the principle production aquifer.

Santa Maria Valley Water Conservation District releases water stored in Twitchell Reservoir to enhance groundwater recharge by optimizing percolation to the principle production aquifer under the Santa Maria River. Reservoir water is released when there is no water flowing in the Sisquoc River as reported at the gage near Garey. Reservoir water is released at a steady flow rate, typically 300 cubic feet per second (cfs), to maximize groundwater recharge. This flow rate maintains a wetted reach up to but not beyond the Bonita School Road crossing. Anecdotal information suggests that a wetted reach beyond the crossing does not promote groundwater recharge to the principle aquifer because of the occurrence of confining layers at depth.

Drilling logs and well casing documentation may improve the understanding of the subsurface geology. The District provided this information for seven District production wells (Figure 1). Drilling logs were evaluated and correlations were made between well locations in order to identify the existence of a confining layer or sequence of layers. Well completion data documents the depth of the screened interval which is presumably located within the Paso Robles Formation (Table 1). General trends in the lithologies of each drilling log and the position of the screened interval were noted. The occurrence of a sequence of layers with a greater proportion of clay was identified and is interpreted as a confining sequence (Figure 2). The east-west transect of production well log data describes the presence of a confining layer directly above the screened interval in each well, however, the thickness of the confining sequence abruptly thins between the Omiya and Olympic wells. The occurrence of a thin clay layer at the Olympic well may indicate the eastern margin location of the regional confining layer that extends westerly to the ocean.

Drilling logs record the total drilling depth and a description of the lithology. All logs report that drilling ceased upon drilling into a blue clay lithology. This lithology is interpreted as the Franciscan Formation. Well casing is generally installed to total depth with the screened interval at bottom, directly above the Franciscan Formation. The elevation of the top of the Franciscan Formation is 100 feet lower on the west side of the Oceano Fault relative to the east side (Figure 2). The Sundale well is more consistent with the geology west of the Oceano Fault than the geology on the east side of the fault. Reviewing additional drilling logs and casing records may improve the understanding of the vertical offset along the Oceano Fault.

The principle production aquifer under the NMMA has an estimated total storage capacity 500,000 AF of groundwater above sea level (DRW, 2002). Currently, generally 90,000 AF (SAIC, 2007) of water is stored above sea level in the aquifer. Therefore, approximately 400,000 AF of groundwater storage is available in the Nipomo Mesa groundwater basin. The district currently is interested in obtaining at most 6,300 AFY of supplemental water from an alternative water supply. Based on these estimates, there is sufficient available storage to accommodate the 6,300 AFY of supplemental water supply.

The Southland Wastewater Treatment Facility (WWTF) operated 3 recharge basins covering 2.8 acres during the period of 1988 to 1992. The aggregate percolation during this 5 year period was 760 AFY (Lawrance, 1993). This is equivalent to 53.6 AFY per acre or 1.8 inches per day per acre. This includes rotation of the ponds between filling, percolating and drying. Typical long-term percolation rates are on the order of 6 inches per day. It is reasonable to expect effective percolation rates for a recharge facility to be less when considering pond rotations for drying and maintenance, typically 2 of 3 ponds are wet at any time. Approximately 50 acres of recharge ponds would be required in order to bank 6,300 AFY. However, this is programmatically less efficient than to firstly utilize the 6,300 AFY of water in direct deliveries, while reducing pumpage, then secondly, to recharge the un-deliverable water in percolation ponds.

The number of wells needed to capture this volume of water can be estimated from current production data. The three most productive wells operated by the NCSD are the Eureka Well, Sundale Well and the Via Choncha Well. The respective capacity of these wells is 850 gpm, 1000 gpm and 700 gpm (Boyle 2002). Assuming an average capacity per well of 850 gpm, it is expected that a properly install production well will produce 1370 AFY. This value takes into account normal well operations such as downtime and maintenance. It is assumed that similar pumping operations would be implemented. To capture 6,300 AFY of water would require approximately 5 wells.

Geologic features present in the basin will dictate the optimal locations for new extraction wells. The wells should be located seaward of the recharge areas with sufficient distance to allow for mixing and natural filtration of the recharged water. However, wells should be placed far enough away from the coast to avoid causing seawater intrusion. We recommend locating the wells in areas where little pumping currently exists, east of Highway 1, south of the Black Lake Canyon, west of Santa Maria River Fault, and north of the Woodlands development. This general area will distribute pumping across the NMMA providing for a more even access to the water resource. These wells should be screened in zones that produce large volumes of high quality water, likely within the Paso Robles Formation.

**REFERENCES:**

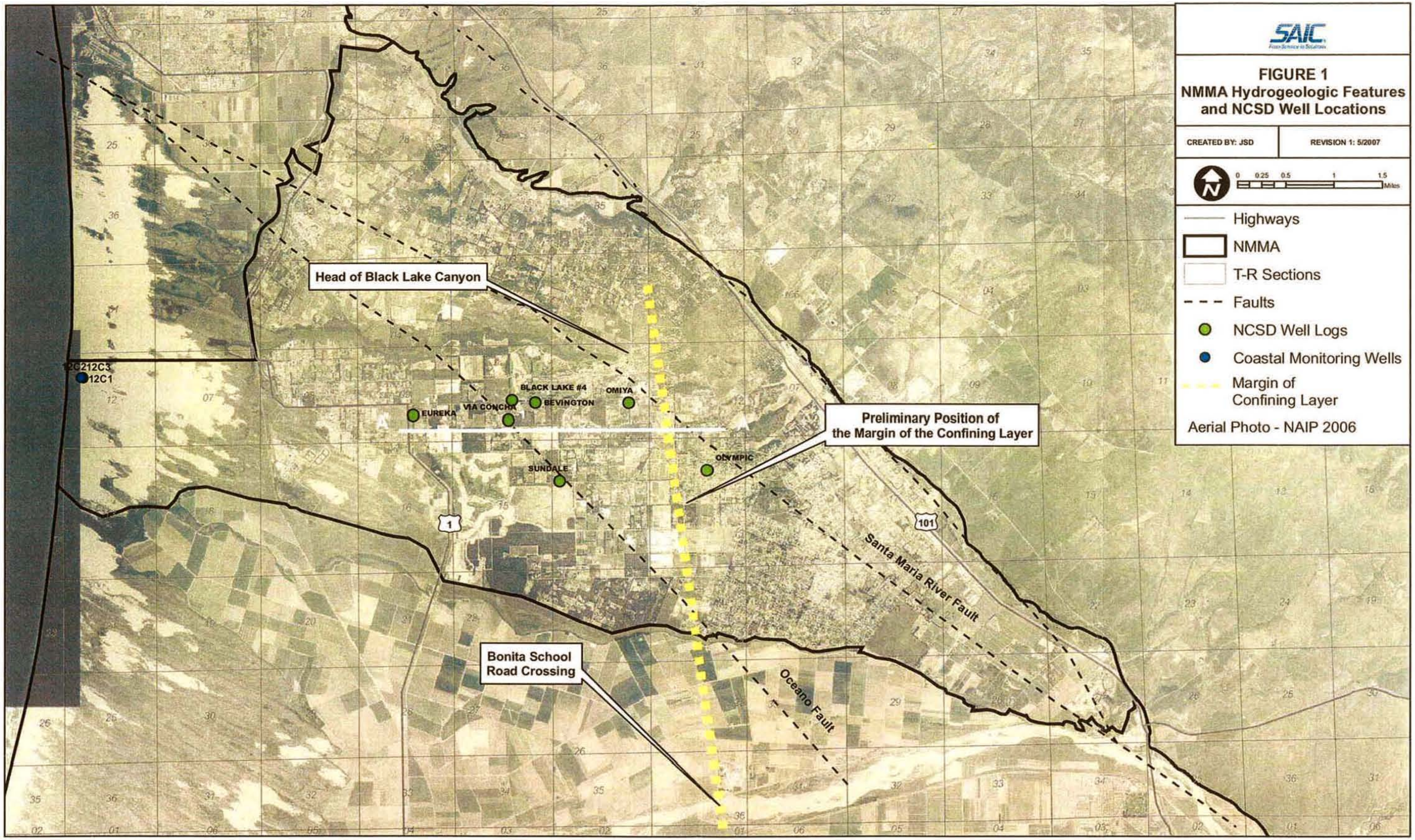
Boyle Engineering Corporation, (Boyle, 2002), Water and Sewer System Master Plan 2001, prepared for Nipomo Community Services District, update, March 2002.

Department of Water Resources, (DWR, 2002), Water Resources of the Arroyo Grande – Nipomo Mesa Area, 2002.

Lawrance, Fisk & McFarland, INC., (Lawrance, 1993), Engineering Considerations of Groundwater Yields and Rights on the Nipomo Mesa Sub-Area, San Luis Obispo, California, October 20, 1993.

Science Application International Corporation, (SAIC, 2007), Technical Memorandum #4 Update to Groundwater in Storage NMMA, May 23, 2007.

S.S. Papadapolas & Associates, INC., (Papadopulos et al. 2004), Nipomo Mesa Groundwater Resources Capacity Study, San Luis Obispo County, California, prepared for the County of San Luis Obispo, 2004.


SAIC
FIGURE 1
NMMA Hydrogeologic Features and NCSD Well Locations
CREATED BY: JSD
REVISION 1: 5/2007
0 0.25 0.5 1 1.5 Miles
Highways
NMMA
T-R Sections
Faults
NCSD Well Logs
Coastal Monitoring Wells
Margin of Confining Layer
Aerial Photo - NAIP 2006
Head of Black Lake Canyon
Preliminary Position of the Margin of the Confining Layer
Bonita School Road Crossing
Santa Maria River Fault
Oceano Fault
BLACK LAKE #4
OMIYA
VIA CONCHA
BEVINGTON
EUREKA
SUNDALE
OLYMPIC
12C2
12C3
12C1
1
101

# Well Completion Table

## Nipomo Mesa Management Area

| Well ID | Latitude | Longitude | Ground Surface Elevation (ft msl) | Total Depth (ft msl) | Screen (ft msl) | | Screen Interval (ft) | Comments | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Confining Layer (ft msl) | | Confining Layer Interval (ft) |
| | | | | | Top | Bottom | | Top | Bottom | |
| Eureka 11N35W09K05 | 35° 02' 44.20" | 120° 34' 04.93" | 174 | -546 | -46 | -401 | 355 | 31 | -71 | 102 |
| Via Concha 11N35W10L01S | 35° 02' 40.61" | 120° 33' 02.26" | 264 | -464 | -126 | -426 | 300 | -4 | -54 | 50 |
| Sundale 11N35W15H01S | 35° 02' 07.01" | 120° 32' 29.11" | 251 | -459 | -129 | -329 | 200 | -19 | -119 | 100 |
| | | | | | -379 | -419 | 40 | | | |
| Black Lake #4 | 35° 02' 51.19" | 120° 32' 59.53" | 301 | -299 | -59 | -219 | 160 | 207 | 111 | 96 |
| Bevington #2 11N35W10J02S | 35° 02' 49.57" | 120° 32' 43.93" | 317 | -329 | -13 | -253 | 240 | 47 | -93 | 140 |
| Omiya #2 11N35W11J02S | 35° 02' 11.17" | 120° 30' 52.05" | 390 | -260 | 0 | -75 | 75 | 255 | 10 | 245 |
| Olympic 11N35W13G01S | 35° 02' 48.30" | 120° 31' 42.57" | 346 | -129 | -19 | -109 | 90 | 46 | 28 | 18 |

Notes:

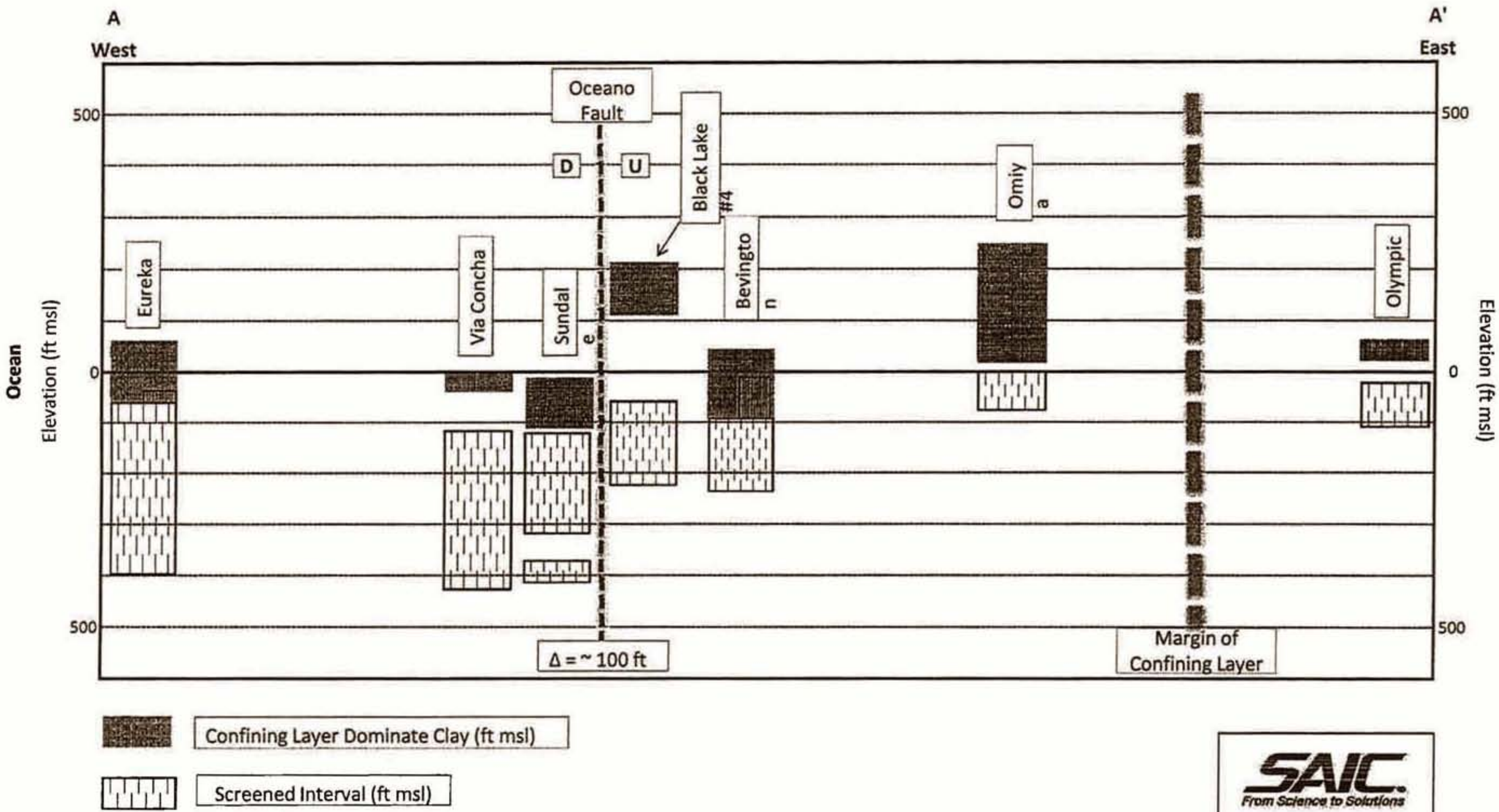
Information based on review of driller logs provided by NCSD

W:\Boyle - NCSD (9785)\Technical\Yield of Aquifer Storage and Recovery\
2007-05-31_Recharge techmemo table I.xlsx

**DRAFT**

**Table 1**
6/1/2007

# Hydrogeology of Nipomo Mesa Mangement Area
## Conceptual Model




Note:
All well data is projected to line (Figure 1)

SAIC
From Science to Solutions

FIGURE 2
DRAFT

# TECHNICAL MEMORANDUM

**TO:** Mike Nunley

**FROM:** Nivan Bhuta, Brad Newton

**RE:** Response to Boyle Engineering Questions 6-11 - Santa Maria River Underflow
SAIC Project Number: 01-0236-00-9785

**DATE:** June 5, 2007

## INTRODUCTION

On February 13, 2007, SAIC entered a contractual agreement with Boyle Engineering Corporation (Boyle) to provide hydrogeologic services related to evaluating alternative water supplies to Nipomo Community Services District (the District). The District's Board requested an assessment of the Santa Maria River underflow as an alternative water supply. Subsequently, Boyle requested SAIC address specific questions contained in a memorandum dated May 9, 2007. Provided below is a preliminary assessment of Santa Maria River underflow and Santa Maria groundwater basin characteristics.

## FINDINGS

Santa Maria River underflow recharges the Santa Maria groundwater basin. The Santa Maria groundwater basin is currently undergoing adjudication. The District must enter into an agreement with the parties entitled to receive water from the Santa Maria groundwater basin in order to obtain additional water supply from Santa Maria River underflow.

## RESULTS

6. What are the typical depths to groundwater and the range of depths observed in the relevant record?

Data showing the depth to groundwater and range of depths to groundwater are not available for Santa Maria River underflow. The average depth to groundwater for the entire basin is 281 feet (ft) with a range of 16 ft to 1,220 ft based on domestic wells (DWR, 2002).

7. What is the quantity of water available?

The quantity of Santa Maria River underflow is not known. Estimates of annual streamflow loss for the Santa Maria River are provided in question number 10. As indicated in the Santa Maria Groundwater Adjudication the native yield of the entire Santa Maria groundwater basin was estimated by GEOSCIENCE to be 60,000 acre-feet per year (AFY) before implementation of the Twitchell Reservoir Project in 1960. This estimate of native yield



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includes 47,300 AFY of streamflow loss, 12,500 AFY of recharge from rainfall and 200 AFY of subsurface inflow to the Santa Maria groundwater basin.

8. What is the quality of water available?

Water quality data for Santa Maria River underflow is not available. For the entire Santa Maria groundwater basin TDS concentrations increase toward the center of the basin beneath the cities of Santa Maria and Orcutt and away from the recharge area of the Santa Maria River (SBCWA 1999; 2001). Nitrate concentrations as high as 240 milligrams per liter (mg/L) have been recorded and some wells sampled from 1990 through 2000 show nitrate concentrations that exceed the minimum contaminant level (DWR, 2002).

9. What is the reliability of this water supply?

While the estimate of native yield for the entire Santa Maria groundwater basin is 60,000 AFY, the volume in storage is on the order of ten times the native yield, therefore providing a reasonable reliability to the annual supply for any one year. The confidence in this reliability estimate is predicated on the understanding that over long periods, annual rainfall totals are occasionally extremely high and therefore the likelihood of replacing groundwater pumpage in excess of the native yield is high.

Winter floodwaters are captured at Twitchell Reservoir annually. Based on USGS gage data (for Water Years 1960 through 1983) releases from Twitchell Reservoir have been made in all but three years since the implementation of the project in 1960. Therefore, Santa Maria River underflow provides a reasonable reliability to the annual supply for any one year.

10. What is a reasonable estimate of its yield?

The estimated annual streamflow loss for the Santa Maria River downstream of the confluence with the Sisquoc River Valley is 60,000 AFY since the implementation of the Twitchell Reservoir Project (Scalmanini, 1997). The estimated yield of the Twitchell Reservoir Project is 35,000 AFY as indicated in the Santa Maria Groundwater Adjudication. The Santa Maria Groundwater Adjudication litigation has concluded, but the court has not rendered a final decision. So, the numbers presented above are still preliminary.

11. What physical connections exist between this water source and other nearby sources that may already be "spoken for"? (i.e., Who else has a reasonable chance of establishing a prior claim to this water?)

Subsurface outflow to the west from the Santa Maria Valley enters the ocean and outflow to the northwest enters the Nipomo Mesa Management Area (NMMA). Cause for concern over changing the subsurface flow dynamics due to an additional pumpage of the Santa Maria River underflow is warranted, specifically in that the current underflow to the NMMA has been historically accounted for in the water supply estimates for the District.

**METHODOLOGY**

The answers to the questions posed in the results section are based upon a review of existing documentation related to the Santa Maria groundwater basin and to the Santa Maria Groundwater Adjudication. Provided below is additional analysis and discussion of the questions presented in the results section.

**DISCUSSION**

The Twitchell Reservoir Project was implemented in 1960 to regulate surface water releases to the Santa Maria River system upstream of the confining layer in order to optimize groundwater recharge to the Santa Maria groundwater basin (Scalmanini, 1997). The Santa Maria Groundwater Adjudication indicates that only Santa Maria Valley parties have paid for, managed and benefited from the Twitchell Reservoir Project. The District would need to purchase a water right from the parties involved in the Twitchell Reservoir Project or make an agreement with parties entitled to water from the Santa Maria groundwater basin in order to access Santa Maria River underflow as an alternative water supply.

6. The depth to groundwater information provided is based on data for the Santa Maria groundwater basin as a whole, including the Northern Cities, the Nipomo Mesa Management Area and the Santa Maria Valley. Data must be collected and analyzed from wells along the Santa Maria River in order to provide a range of depths to groundwater in the vicinity of the Santa Maria River.

7. The quantity of water available (60,000 AFY) presented is for the entire Santa Maria groundwater basin. Previous reports and studies of the Santa Maria groundwater basin have shown varied estimates of native yield. The Santa Maria Groundwater Adjudication litigation has concluded, but the court has not rendered a final decision. So, the estimated native yield for the entire Santa Maria groundwater basin of 60,000 AFY is still preliminary.

The estimated annual streamflow loss for the Santa Maria River downstream of the confluence with the Sisquoc River Valley was 26,000 AFY (for Water Years 1942 through 1959) prior to the Twitchell Reservoir Project and 60,000 AFY (for Water Years 1960 through 1983) after implementation of the Twitchell Reservoir Project (Scalmanini, 1997).

8. The groundwater quality data provided is based on data for the Santa Maria groundwater basin as a whole. Water quality data of Santa Maria River flows and groundwater in the vicinity of the Santa Maria River must be collected and analyzed in order to provide water quality data for the Santa Maria River underflow.

9. The average annual release from Twitchell Reservoir is 39,000 AFY based on USGS gage data (for Water Years 1960 through 1983). Releases have been made in all years since the implementation of the Twitchell Reservoir Project except Water Years 1972, 1976 and 1977.

10. If all releases from Twitchell Reservoir recharged the Santa Maria groundwater basin, then Santa Maria River underflow would yield approximately 65,000 AFY (26,000 AFY streamflow losses prior to Twitchell Reservoir + 39,000 AFY release from Twitchell Reservoir).

11. Geologically the quaternary alluvium that comprises the principal aquifer is composed of an upper fine-grained member consisting of sand and gravel and a lower coarse grained member consisting of boulders and gravel throughout the valley. The upper member toward the Pacific Ocean is much finer grained and consists of predominately silt and clay. This finer grained upper member (confining layer) confines groundwater to the lower member in areas westward of Santa Maria's water treatment plant. Water flowing in the segment of the Santa Maria River above the confining layer does not recharge into the groundwater basin and wastes to the Ocean (Wort, 1951). The Twitchell Reservoir Project was implemented to regulate flows along the lower reaches of the Cuyama River in order to minimize water waste to the Ocean.

# Appendix C – CCAMP Data for Oso Flaco Watershed

This summary of water quality in Oso Flaco Lake and Oso Flaco Creek is based on the following studies and documents:

- Cachuma Resource Conservation District and the Dunes Center. *Draft Nitrate and Sediment Assessment, Oso Flaco Watershed, San Luis Obispo County, California, August 2004.* Report prepared for California Regional Water Quality Control Board, Central Coast Region.
- Central Coast Ambient Monitoring Program (CCAMP). *312 Santa Maria River Hydrologic Unit Draft Report for Sampling Year 2000*

CCAMP water quality data is summarized below for monitoring sites in the Oso Flaco Creek watershed. Maximum Contaminant Levels (MCLs) and Secondary MCLs are also listed for comparison.

Note that water quality standards shown below for municipal supply are in some cases based on source water quality and in other cases based on distribution system water quality. Surface water treatment must meet "performance standards", and the MCL is deemed to be a "treatment technique". For example, the performance standard for turbidity is 0.3 NTU, and the treatment technique to achieve this would be conventional treatment; however, if an alternative filtration technology is used as the treatment technique, the turbidity performance standard is typically 0.1 NTU.

**Table C-1 Water Quality and Maximum Contaminant Levels (MCLs)**

| Primary Constituent | CDHS MCL | USEPA MCL | Oso Flaco Lake @ culvert (Site 312 OFL) | | | Oso Flaco Creek @ Oso Flaco Lake Road (Site 312OFC) | | | Little Oso Flaco Creek (Site 312 OFN) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Max | Min | Mean | Max | Min | Mean | Max | Min | Mean |
| Coliforms, Fecal MPN/100mL | See Note 1 | | 1,300 | 20 | 244 | 35,000 | 1 | 3,586 | 24,000 | 1 | 2,314 |
| Coliforms, Total, MPN/100mL | | | 7,000 | 300 | 2,437 | 190,000 | 199 | 61,425 | 127,000 | 800 | 21,653 |
| Nitrate as Nitrogen, mg/L | | 10 | 37.1 | 28 | 31.4 | 70.2 | 23.8 | 37.1 | 48.8 | 26.5 | 34.5 |
| Nitrate(as N03), mg/L | 45 | | 165 | 125 | 140 | 312 | 106 | 165 | 217 | 118 | 154 |
| Nitrite as Nitrogen, mg/L | 1 | 1 | 0.42 | 0.005 | 0.106 | 0.54 | 0.005 | 0.118 | 0.144 | 0.005 | 0.06 |
| Nitrogen, Total, mg/L | 10 | | 37.1 | 28 | 31.3 | 134 | 26 | 49 | 45.1 | 26.5 | 32.2 |

Note 1: The level of pathogenic organisms present in a surface water sources will establish the degree of treatment required, as defined by the USEPA in the Surface Water Treatment Rule guidance and the Long Term 2 Enhanced Surface Water Treatment Rule.
"empty cell " means not reported / no analysis for this constituent
mg/L = milligrams per liter of sample collected = ppm
ppm = parts per million
MPN/100mL = most probable number per 100 milliliters of sample collected

**Table C-2 Water Quality and Secondary Standards**

| Secondary Constituent | Consumer Acceptance Contaminant Levels | | Oso Flaco Lake @ culvert (Site 312 OFL) | | | Oso Flaco Creek @ Oso Flaco Lake Road (Site 312OFC) | | | Little Oso Flaco Creek (Site 312 OFN) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | CDHS | USEPA | Max | Min | Mean | Max | Min | Mean | Max | Min | Mean |
| Chloride, mg/L | 250 | 250 | 133 | 82 | 99 | 247 | 43 | 95 | 110 | 60 | 92 |
| Conductivity, umhos/cm | 900 | | 2,763 | 1,830 | 2,128 | 2,820 | 1,595 | 2,010 | 2,350 | 1,680 | 2,007 |
| Lab Turbidity (NTU) | 5 | | 34.5 | 1 | 9.8 | 526 | 4 | 190 | 85.1 | 2.1 | 17.3 |
| Sulfate mg/L | 250 | 250 | 740 | 640 | 678 | 950 | 440 | 656 | 730 | 568 | 633 |
| Total Dissolved Solids, mg/L | 500 | 500 | 2,040 | 338 | 1,470 | 2,100 | 387 | 1,445 | 2,080 | 969 | 1,576 |
| Turbidity, NTU (See Note 1.) | 5 | | 34.5 | 1 | 9.8 | 526 | 4 | 190 | 85.1 | 2.1 | 17.3 |

Note 1: Acceptable turbidity levels for treated surface water are based on the treatment technique used, typically 0.1 to 0.3 NTU. There are no established limits for turbidity in raw surface water prior to treatment.
"empty cell " means not reported / no analysis for this constituent
mg/L = milligrams per liter of sample collected = ppm
NTU = Nephelometric Turbidity Units
ppm = parts per million
umhos/cm = millisiemens per centimeter

Additional parameters were measured under the CCAMP program for which water quality MCLs and Secondary Standards do not exist. In some cases these measured parameters indicate the presence of a water-borne contaminant. These results are summarized below:

BOYLE

## Table C-3 Sediment Inorganic Chemistry

| Inorganic Constituent in Sediment[2] | Little Oso Flaco Creek (Site 312 OFN) | MCL in Water CDHS[1] | MCL in Water USEPA[1] |
|---|---|---|---|
| Antimony in Sediment (mg/kg) [2] | 1.50 | 0.006 ppm | 0.006 ppm |
| Arsenic in sediment (mg/kg) [2] | 15 | 0.05 ppm | 0.010 ppm |
| Barium, in sediment (mg/kg) [2] | 160 | 1 ppm | 2 ppm |
| Berylliumin in sediment (mg/kg) [2] | 2.70 | 0.004 ppm | 0.004 ppm |
| Cadmium in sediment (mg/kg) [2] | 0.10 | 0.005 ppm | 0.005 ppm |
| Chromium in sediment (mg/kg) [2] | 40.00 | 0.05 ppm | |
| Copper in sediment (mg/kg) [2] | 33 | 1.3 ppm | |
| Lead in sediment (mg/kg) [2] | 20 | 0.015 ppm | |
| Mercury in sediment (mg/kg)[2] | 0.037 | 2 ppb | 2 ppb |
| Nickel in sediment (mg/kg) [2] | 35 | 0.1 ppm | |
| Selenium in sediment (mg/kg) [2] | 4 | 0.05 ppm | 0.05 ppm |
| Thallium in sediment (mg/kg) [2] | 1.00 | 0.002 ppm | 0.002 ppm |
| Vanadium in sediment (mg/kg) [2] | 78 | | |
| Zinc in sediment (mg/kg) [2] | 110 | 5 ppm | 5 ppm |

"empty cell " means not reported / no analysis for this constituent

1 MCL applies to constituents dissolved in water

2 MCL does not apply to constituents bound to fine-grained sediment samples collected within the wetted creek channel or the tissue of fish

## Table C-4 Sediment Organic Chemistry

Organic chemicals detected in the sediment sample collected at Little Oso Flaco Creek (312OFN) in June 2000. Available criteria are shown for reference. Units of measurement are ppb (ug/kg). ND is non-detect. Criteria exceedances are bold. (CCAMP, 2002, from Table 5.1.5c.)

| Site Tag | DDD(p,p') | DDE(p,p') | DDT, Total | Dieldrin | Endrin | Chlorpyrifos | *Total PCB* |
|---|---|---|---|---|---|---|---|
| 312OFN 2000 | 1.0 | 5.3 | 9.3 | 2.6 | 1.4 | ND | ND |
| PEL (freshwater) | **8.51** | **6.75** | **4450** | **6.67** | **62.4** | | **277** |

PEL (probable effect level)

## Table C-5 Metals in Fish Tissue

Site specific assessment of data used to assess impairment of aquatic life uses in the Santa Maria River Hydrologic Unit (HU312). **Yes** - evidence that a problem exists, **No** - no evidence that a problem exists. (CCAMP, 2002, from Table 5.1.5a.)

| Constituent | Arsenic | Chromium | Copper | Lead | Mercury | Selenium | Zinc |
|---|---|---|---|---|---|---|---|
| **Water Contact Recreation Assessment Threshold** | 1.5 | 1 | 20 | 2 | 0.5 | 2 | 45 |
| **Median International Standards (MIS)** | 1.0 | 1.0 | 20.0 | 2.0 | 0.5 | 0.3 | 70 |
| **California's Office of Environmental Health Hazard Assessment (OEHHA)** | 1.0 | | | | 0.3 | 2.0 | |
| **Units** | ppm | ppm | ppm | ppm | ppb | ppb | ppm |
| **Matrix** | Tis | Tis | Tis | Tis | Tis | Tis | Tis |
| **Sites** | | | | | | | |
| **312OFL** | **No** | **No** | **No** | **No** | **No** | **No** | **No** |

## Table C-6 Organic Compounds in Fish Tissue

Organic chemical concentrations in whole fish from Oso Flaco Lake (ng/g or ppb). National Academy of Sciences (NAS) and Food and Drug Administration (FDA) criteria for freshwater fish are shown as exceedances threshold values. Exceedances are **bold**. (CCAMP, 2002, from Table 5.1.4d.)

| Site | Date | Aldrin | Chlordane | Total DDT | Dieldrin | Endrin | Heptachlor | Tot PCB | TOXAP |
|---|---|---|---|---|---|---|---|---|---|
| Oso Flaco Lake | Filet | | 2.2 | **345.1** | **25.5** | 10.5 | < 2.0 | NA | **243.0** |
| NAS [1] | Whole Fish | 100 | 100 | 1000 | 100 | 100 | 100 | 500 | 100 |
| FDA [2] | Filet | 300 | 300 | 5000 | 300 | 300 | 300 | 2000 | 5000 |
| OEHHA [3] | Filet | | 30 | 100 | 2 | 1000 | 4 | 20 | 30 |

Notes:
(1) National Academy of Sciences guidelines
(2) U.S Food and Drug Administration Action Levels
(3) California's Office of Environmental Health Hazard Assessment (OEHHA) fish tissue criteria

**Table C-7 Toxicity Data**

Percent survival of *C. dubia* and *H. azteca* in toxicity tests conducted in the Santa Maria Hydrologic Unit July 2002 through May 2003. Bold numbers indicate survival is significantly different from the control value @ p<0.05. NA=not analyzed. (CCAMP, 2002, Table 5.1.5b. ) This sample contained chlorpyrifos levels that are known to exceed acute toxicity threshold for *C. dubia.*

| Site | *C.dubia* survival Jul-02 | *C.dubia* survival Sept-02 | *C.dubia* survival Mar-02 | *C.dubia* survival May-02 | *H. azteca* survival June-02 | *H. azteca* survival May-03 |
|---|---|---|---|---|---|---|
| 312OFC | 80 | 100 | 100 | **30** | **71** | N/A |

*Tissue Bioaccumulation*

Resident fish tissue samples (from Oso Flaco Lake) did not have any metal concentrations which exceeded published Median International or OEHHA Standards.