Appendix 8.5-4

Groundwater Impact Analysis

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MEMORANDUM

To:	Lyn Garver Jim Richards	**CC:**	
From:	Matt Zidar	**Date:**	April 13, 2007
Subject:	**Parlier Power Plant Groundwater Impact Analysis**		
Project Reference:	200.T01.00		

INTRODUCTION

The Kings River Conservation District (KRCD) is proposing the development of a 500-megawatt natural gas Community Power Plant (Power Plant) near the city of Parlier. WRIME was retained to evaluate and quantify the potential groundwater effects of the Power Plant using the Kings Basin Integrated Groundwater Surface Water Model (Kings IGSM) to compare the 'no project' conditions with two scenarios that assume use of different water sources. The proposed Plant will need a constant and reliable water source for Power Plant processing water, estimated to be approximately 3,485 AF/year. Two possible water sources for the plant have been identified as:

- Shallow groundwater that is pumped from extraction wells to be installed at the Power Plant; and
- Reclaimed domestic wastewater from the Sanger and Parlier wastewater treatment plants (WWTPs).

The secondary treated wastewater is currently discharged to Parlier and Sanger disposal ponds. Figure 1 shows the location of the proposed Power Plant and the locations of the Parlier WWTP disposal pond and the Sanger WWTP disposal pond.

Using either water source will cause a net reduction in groundwater recharge to the basin by approximately 3,485 AF/year. Pumping at the Power Plant is expected to lower groundwater levels near the Plant, where pumping is occurring. The use of WWTP water is expected to lower groundwater levels near the WWTP disposal ponds, because less water will be recharged to groundwater. This analysis is intended to determine these effects.

PROCEDURE

The Kings Basin IGSM model was used to analyze the potential effects of the Power Plant operation. Three different scenarios were set up:

- **No Project**: No Power Plant operation;
- **Scenario 1** - Power Plant use of groundwater; and
- **Scenario 2** – Power Plant use of reclaimed water from Sanger and Parlier WWTP. Groundwater pumping would be used to make up the deficit if Plant demands are greater than the available WWTP effluent.

The 'No Project' and the two scenarios were evaluated for two different Development Levels (2005 and 2040). This was done to analyze the effects of the Plant operations under current WWTP capacity (2005 level), and under future build out WWTP capacity (2040 level).

The assumptions for population and wastewater generation were as presented in Table 3.3 of the "Water Resources Analysis for the KRCD Community Power Plant" (KRCD, 2006). Table 1 presents the assumptions for each scenario and the two Development Levels. The Kings IGSM was run using the 1964 to 2004 hydrologic records to represent likely future conditions.

Table 1. Average Annual Quantities of Groundwater and Wastewater Effluent (AFY)

Run	WWTP Effluent	Scenario	Sanger WWTP Water to Power Plant	Parlier WWTP Water to Power Plant	GW Pumping to Power Plant	Total Supply to Power Plant	Sanger WWTP Water Recharged	Parlier WWTP Water Recharged
1	2005 Level	No Project 2005	0	0	0	0	1,903	1,670
2	2005 Level	1 - Groundwater	0	0	3,485	3,485	1,903	1,670
3	2005 Level	2 - Wastewater	1,771	1,636	199	3,485*	132	34
4	2040 Level	No Project 2040	0	0	0	0	4,618	4,052
5	2040 Level	1 - Groundwater	0	0	3,485	3,485	4,618	4,052
6	2040 Level	2 - Wastewater	1,807	1,807	0	3,485*	2,811	2,245

*Supply for the WWTP must be at 3.6% higher than needed to account for the filter backwash water at the tertiary treatment plant

To analyze the effects of the Power Plant operations on regional groundwater levels, groundwater level contours were produced for the end of the forty-year simulation period for each of the scenario. The water level contours were then used to calculate the difference in water levels between the No Project and project conditions, and to compare the effects of using either groundwater or reclaimed wastewater. Groundwater level hydrographs for each scenario were also produced for specific locations.

RESULTS AND CONCLUSIONS

Figures 2 through 5 show the expected effects that the Power Plant operations have on groundwater levels at the end of the 40-yearsimulation for both Scenario 1 (Groundwater), and Scenario 2 (Wastewater), at the two levels of development and effluent generation (2005 and 2040).

Figure 2 shows the change in groundwater levels due to Power Plant operations when only groundwater is used. When meeting the demands of the Power Plant with only groundwater pumping, groundwater levels around the plant are estimated to be 5 feet lower than under existing, No Project conditions, with a 2 foot drop in groundwater levels estimated as far as 2 miles away.

Figure 3 shows the expected effects on groundwater levels due to Power Plant operations when meeting the demands of the Power Plant by supplying wastewater from the Sanger and Parlier and reducing the recharge to groundwater at the disposal ponds. Groundwater levels around the ponds drop up to 4 feet at each pond with a 2-foot drop in groundwater levels estimated as far away as 2 miles. This means that the groundwater mound that results from the recharge of secondary treated wastewater would be reduced.

To simulate the effects of the Power Plant during future build-out conditions, the difference between water levels in the No Project and the project scenarios 1 and 2 were calculated using 2040 conditions. In addition to the increase in wastewater generation in 2040 shown in Table 1, the 2040 conditions also increase urban demand and groundwater pumping for Sanger and Parlier to reflect the increase in population.

Figure 4 shows the change in groundwater levels under 2040 conditions due to the Power Plant operations when only groundwater is used. Figure 5 shows the change in groundwater levels under 2040 conditions due to Power Plant operations with wastewater from the Sanger and Parlier and reducing the recharge to groundwater at the disposal ponds.

The groundwater level differences are very similar in Figure 2 and 4, as well as very similar in Figures 3 and 5. The amount of effluent produced by the WWTPs does not have a significant influence on the effects the Power Plant would have on groundwater levels. As population increases and the WWTP produce more wastewater, the effects of the Power Plant on groundwater levels remain relatively similar, since the Power Plant demand does not change.

Figures 6 though 8 show the groundwater level hydrographs at the Sanger WWTP, the Parlier WWTP, and the proposed Power Plant location. Each hydrograph shows the groundwater levels for the "No Project", Scenario 1 (Groundwater), and Scenario 2 (Wastewater), under 2005 levels. These figures indicate that the change in groundwater levels due to the effects of the

Plant operations occur within the first few months of the simulation. In addition, after the first few months, the change in groundwater levels due to the Plant operations remain relatively constant throughout the varying hydrology.

Table 2 further explores the effects of the Plant operations due to varying hydrology under 2005 levels. Table 2 shows the difference in groundwater levels for a dry year, multiple dry years, multiple wet years, and end of the simulation. The maximum difference in the change in groundwater levels due to hydrology difference between wet and dry periods is about one and a half feet.

Table 2. Effect of the Varying Hydrology on the Plant Operations

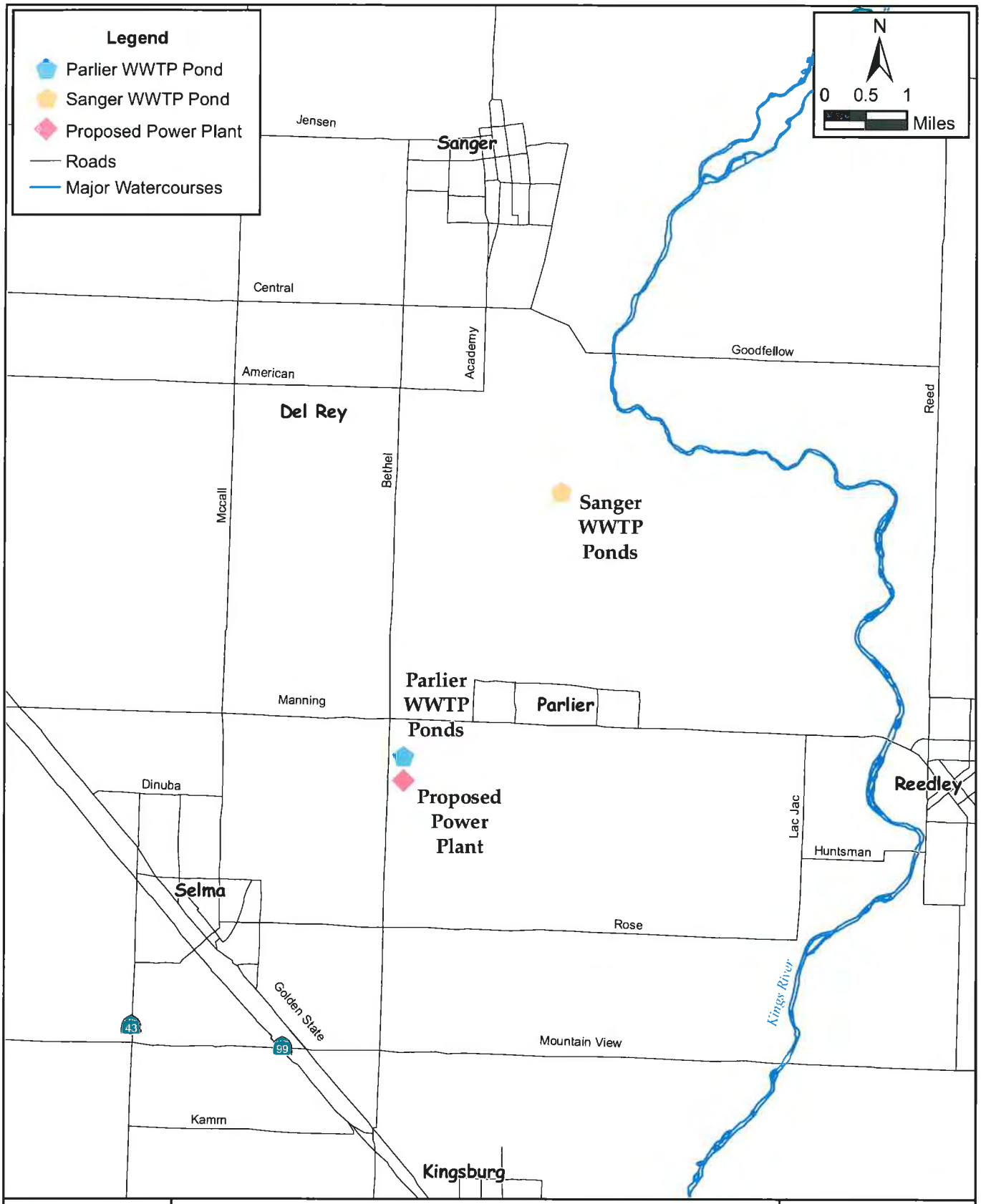
Power Plant Water Supply	Dry Year[1]	Multiple Dry Years[2]	Multiple Wet Years[3]	40th Year Projection[4]	Average
At Power Plant					
Scenario 1 - Groundwater	-6.7	-6.7	-5.1	-5.1	-5.4
Scenario 2 - Wastewater	-3.9	-4.0	-3.2	-3.5	-3.3
At Sanger WWTP					
Scenario 1 - Groundwater	-0.9	-1.0	-0.9	-1.0	-0.8
Scenario 2 - Wastewater	-3.7	-4.0	-2.6	-4.0	-3.1
At Parlier WWTP					
Scenario 1 - Groundwater	-4.7	-4.9	-4.0	-4.3	-4.1
Scenario 2 - Wastewater	-4.7	-5.3	-3.9	-4.2	-4.1

1. Dry Year - represented by hydrology in Water Year 1978.
2. Multiple Dry Years – represented by hydrology in Water Years 1987 – 1992.
3. Multiple Wet Years – represented by hydrology in Water Years 1995 – 1999.
4. 40th Year Projection – represented by hydrology in Water Year 2004.

REFERENCES

King River Conservation District, *Water Resources Analysis for KRCD Community Power Plan*, 2006.

City of Sanger 2000 Urban Water Management Plan.



ORIME

Parlier Power Plant and Related Facilities

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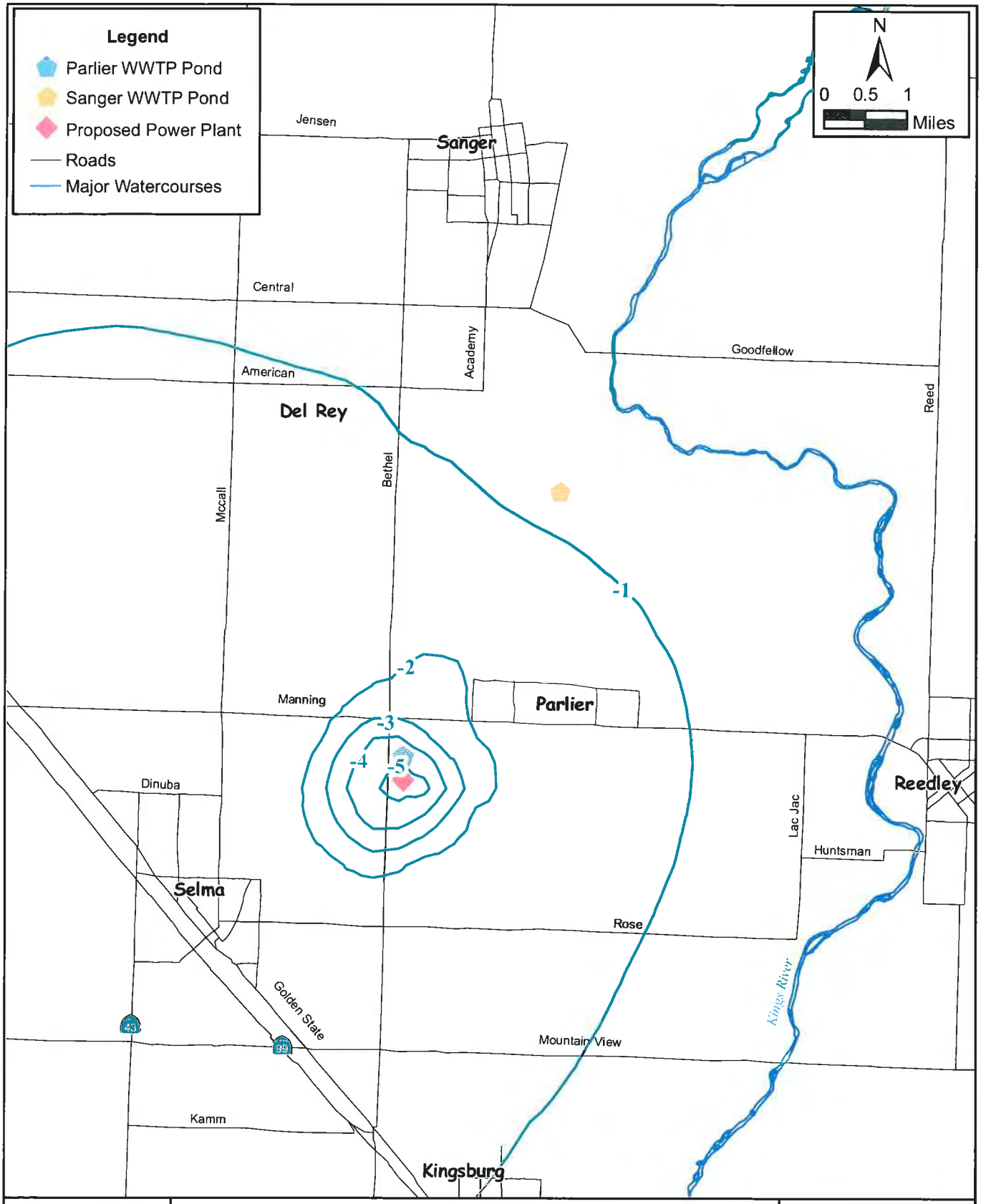
Figure 1



End of 40-Yr. Simulation Change in GW Levels Due to Power Plant Operation

Source of Water: ***Groundwater***

WWTP Capacity: ***2005 level***

Contours show groundwater level difference in feet, between Scenario 1 and "No Project 2005"

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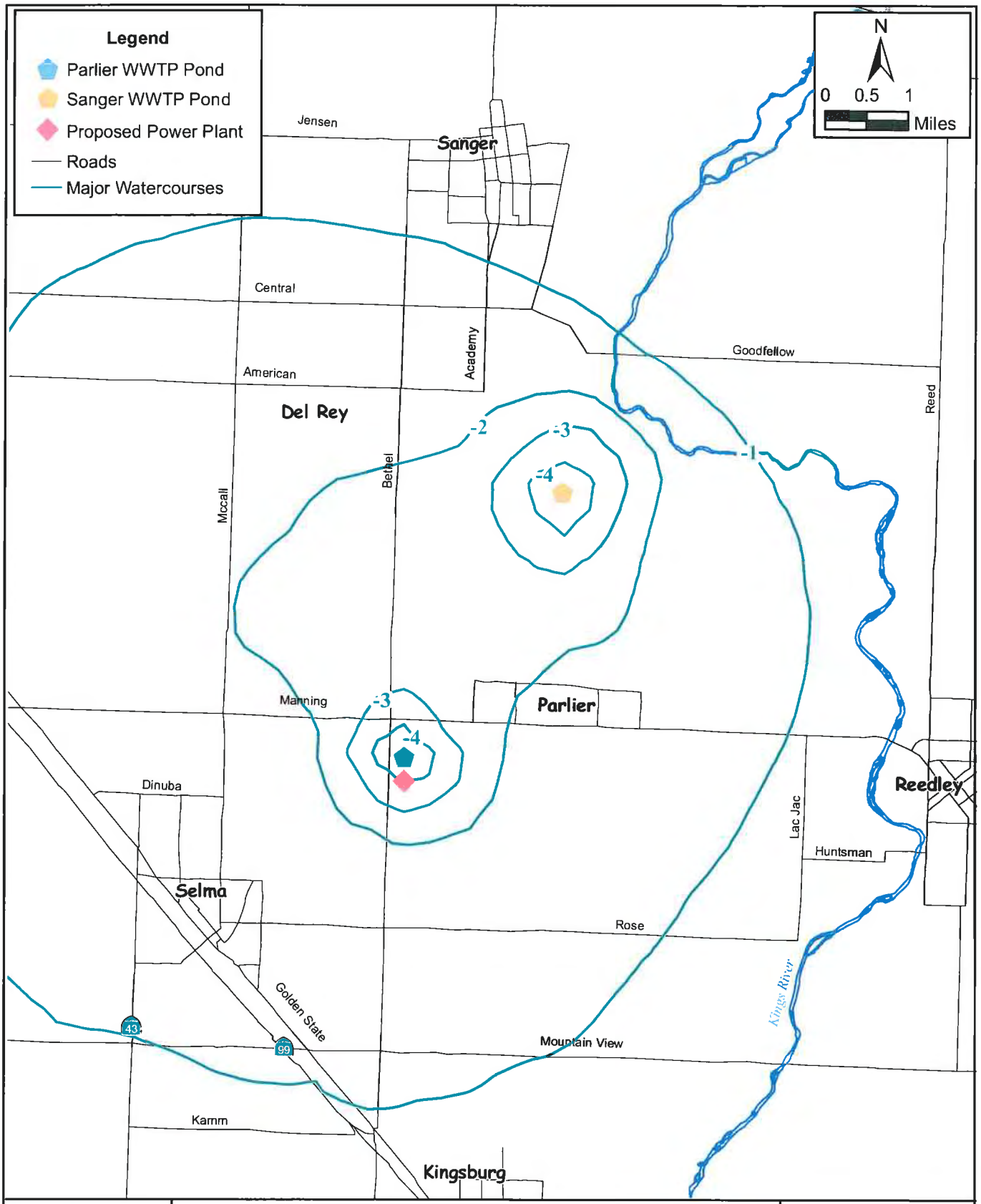
Figure 2



End of 40-Yr. Simulation Change in GW Levels Due to Power Plant Operation

Source of Water: *Wastewater*

WWTP Capacity: *2005 level*

Contours show groundwater level difference in feet, between Scenario 2 and "No Project 2005"

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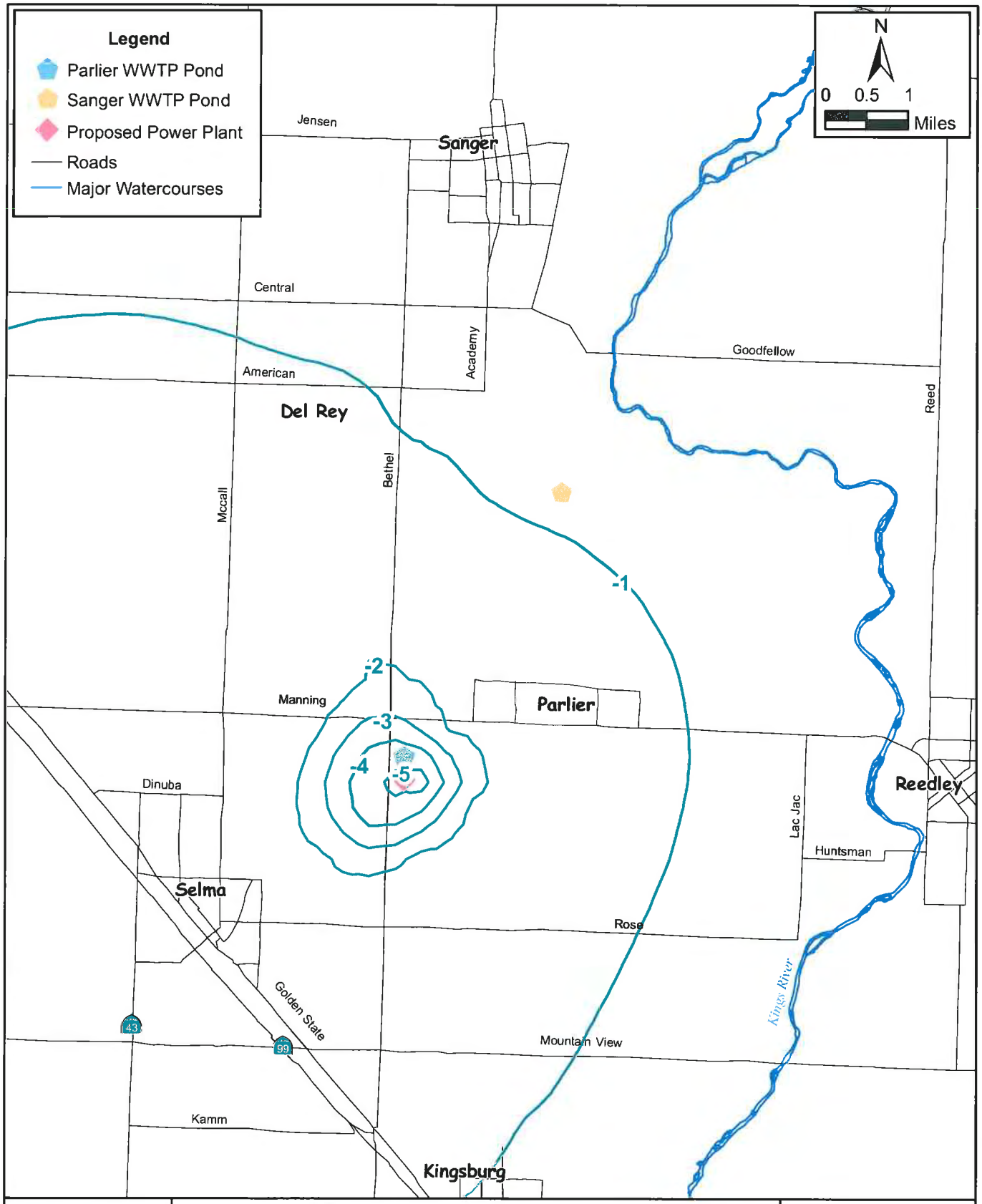
Figure 3



End of 40-Yr. Simulation Change in GW Levels Due to Power Plant Operation

Source of Water: ***Groundwater***

WWTP Capacity: ***2040 level***

Contours show groundwater level difference in feet, between Scenario 1 and "No Project 2040"

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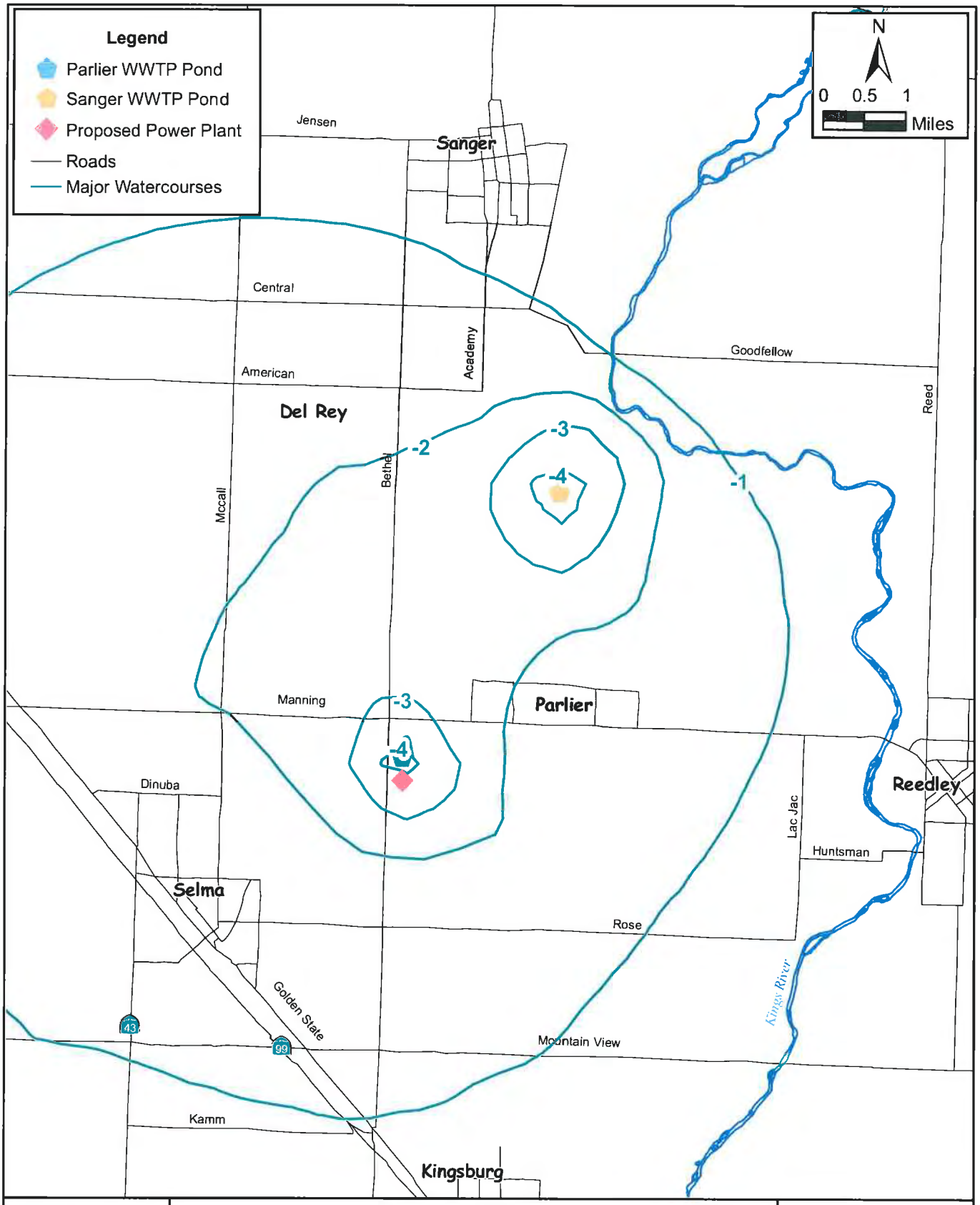
Figure 4



ORIME	End of 40-Yr. Simulation Change in GW Levels Due to Power Plant Operation Source of Water: ***Wastewater*** WWTP Capacity: ***2040 level*** Contours show groundwater level difference in feet, between Scenario 2 and "No Project 2040"	April 2007 Figure 5

Figure 6. Simulated Groundwater Hydrograph Under Different Scenarios at Sanger WWTP (2005 conditions)

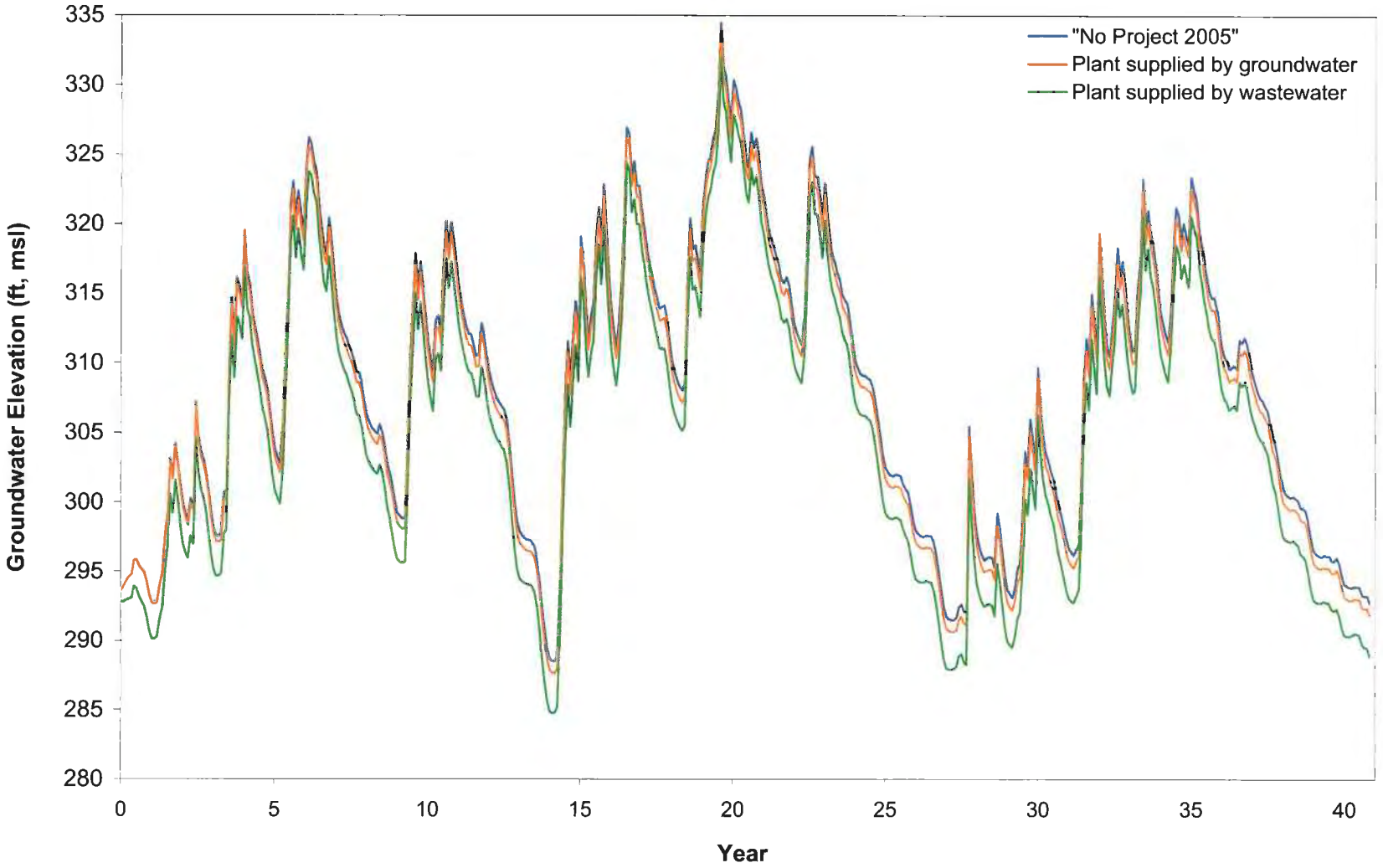


Figure 7. Simulated Groundwater Hydrograph Under Different Scenarios at Parlier WWTP (2005 conditions)

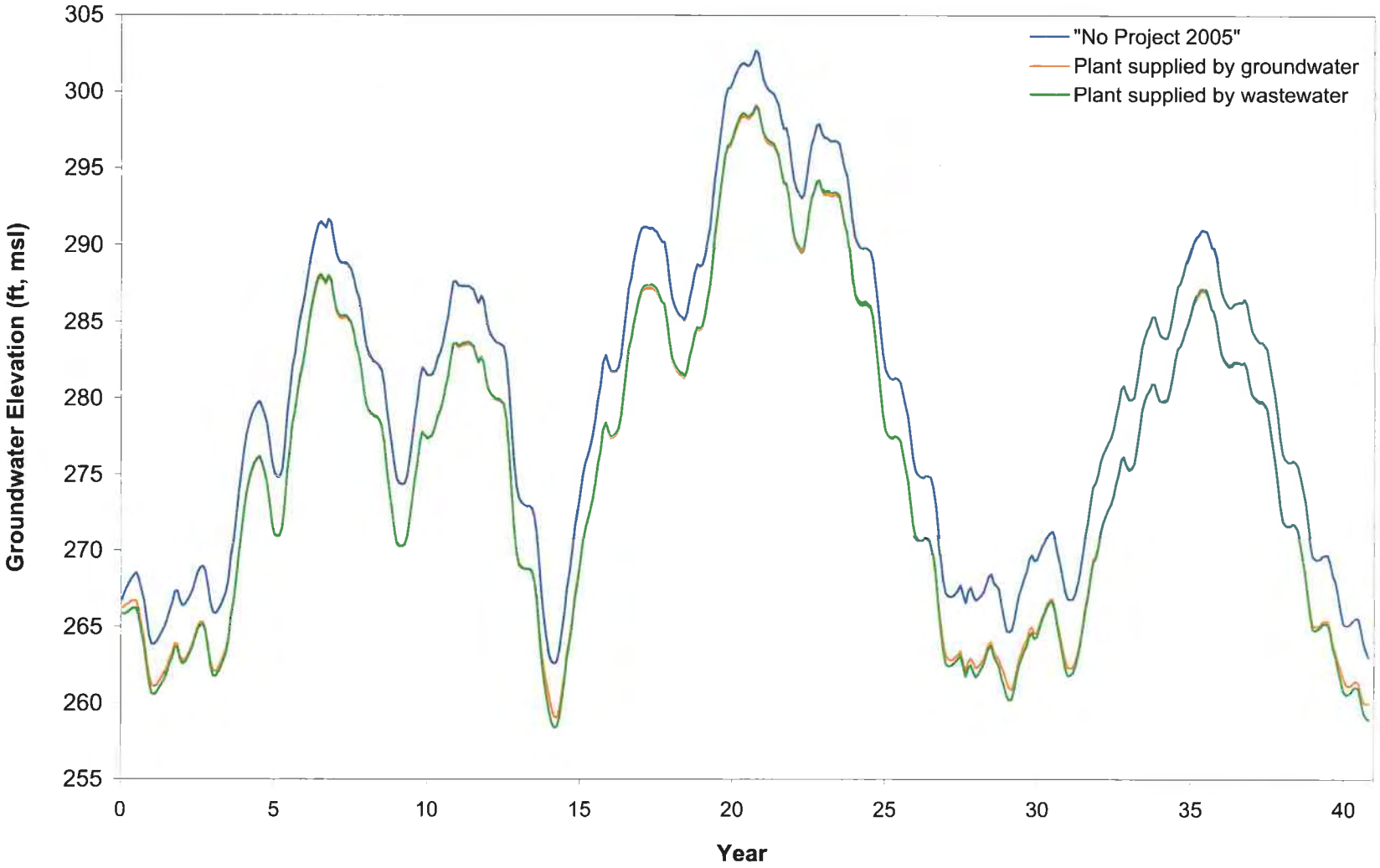


Figure 8. Simulated Groundwater Hydrograph Under Different Scenarios at Proposed Power Plant (2005 conditions)