

**Appendix 5.15F**  
**Groundwater Modeling Technical Memorandum**  
**July 12, 2011**

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# Technical Memorandum

**Date:** July 12, 2011

**To:** Peter J. Kiel  
Ellison, Schneider & Harris L.L.P.

**cc:** Michael Rojansky, BrightSource Energy  
Clay Jensen, BrightSource Energy

**From:** John Jansen, Tim Thompson, Rahul John (Cardno ENTRIX)

**RE:** **BrightSource Energy Analytical Groundwater Modeling – Phase 2  
Cardno ENTRIX No. 33153001.00**

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## 1.0 Background

The objective of this study is to assess potential drawdown due to groundwater withdrawal during construction at the proposed Hidden Hills facility. It is estimated that the site will use between 200 acre-feet/year (178,430 gallons per day) and 280 acre-feet/year (249,802 gallons per day) of water for 2 to 3 years from two wells.

Cardno ENTRIX previously developed an analytical model to assess drawdown impacts due to proposed post-development groundwater withdrawal of 140 acre-feet/year (124,900 gallons per day). The model served as a base model for this study. The set-up and results of the original model were discussed in a previously submitted technical memorandum (dated June 3, 2011).

## 2.0 Model Simulations

The model inputs are consistent with the original model developed by Cardno ENTRIX for the site. The inputs that changed include well pumping rates and time discretization. Cardno ENTRIX conducted six modeling scenarios. The parameters used for each scenario are summarized below.

- Scenario 1: Transmissivity = 7,225 gallons per day/feet (gpd/ft), Pumping rate = 200 acre-feet/year, Storativity = 0.01.
- Scenario 2: Transmissivity = 3,612 gpd/ft, Pumping rate = 200 acre-feet/year, Storativity = 0.01.

- Scenario 3: Transmissivity = 14,450 gpd/ft, Pumping rate = 200 acre-feet/year, Storativity = 0.01.
- Scenario 4: Transmissivity = 7,225 gpd/ft, Pumping rate = 280 acre-feet/year, Storativity = 0.01.
- Scenario 5: Transmissivity = 3,612 gpd/ft, Pumping rate = 280 acre-feet/year, Storativity = 0.01.
- Scenario 6: Transmissivity = 14,450 gpd/ft, Pumping rate = 280 acre-feet/year, Storativity = 0.01.

For all the scenarios, the pumping rates were split equally between two wells. The Theis (1935) solution for a confined aquifer was used to simulate drawdown. A southwest groundwater gradient of 0.01 (unitless) taken from regional water table maps was applied to the model. Pumping durations of 2 years and 3 years were run for each transmissivity value.

### 3.0 Model Results

Tables 1 to 6 and Figures 1 to 12 provide a summary of model parameters and results of scenarios.

**Table 1. Scenario 1. Summary of Model Parameters and Estimated Drawdown**

Pumping Duration (years)	Transmissivity (gpd/ft)	Storage (unitless)	Project Withdrawal Rate (acre-ft/year)	Maximum Drawdown (feet)	Approximate Extent of 1-foot Drawdown (Miles)	Drawdown Contours Shown on Figure
2	7,225	0.01	200	10.0	1.4	1
3	7,225	0.01	200	10.7	2.1	2

**Table 2. Scenario 2. Summary of Model Parameters and Estimated Drawdown**

Pumping Duration (years)	Transmissivity (gpd/ft)	Storage (unitless)	Project Withdrawal Rate (acre-ft/year)	Maximum Drawdown (feet)	Approximate Extent of 1-foot Drawdown (Miles)	Drawdown Contours Shown on Figure
2	3,612	0.01	200	18.4	1.3	3
3	3,612	0.01	200	19.8	1.9	4

**Table 3. Scenario 3. Summary of Model Parameters and Estimated Drawdown**

Pumping Duration (years)	Transmissivity (gpd/ft)	Storage (unitless)	Project Withdrawal Rate (acre-ft/year)	Maximum Drawdown (feet)	Approximate Extent of 1-foot Drawdown (Miles)	Drawdown Contours Shown on Figure
2	14,450	0.01	200	6.2	1.4	5
3	14,450	0.01	200	6.5	1.9	6

**Table 4. Scenario 4. Summary of Model Parameters and Estimated Drawdown**

Pumping Duration (years)	Transmissivity (gpd/ft)	Storage (unitless)	Project Withdrawal Rate (acre-ft/year)	Maximum Drawdown (feet)	Approximate Extent of 1-foot Drawdown (Miles)	Drawdown Contours Shown on Figure
2	7,225	0.01	280	20.5	1.9	7
3	7,225	0.01	280	21.6	2.6	8

**Table 5. Scenario 5. Summary of Model Parameters and Estimated Drawdown**

Pumping Duration (years)	Transmissivity (gpd/ft)	Storage (unitless)	Project Withdrawal Rate (acre-ft/year)	Maximum Drawdown (feet)	Approximate Extent of 1-foot Drawdown (Miles)	Drawdown Contours Shown on Figure
2	3,612	0.01	280	32.4	1.6	9
3	3,612	0.01	280	34.4	2.2	10

**Table 6. Scenario 6. Summary of Model Parameters and Estimated Drawdown**

Pumping Duration (years)	Transmissivity (gpd/ft)	Storage (unitless)	Project Withdrawal Rate (acre-ft/year)	Maximum Drawdown (feet)	Approximate Extent of 1-foot Drawdown (Miles)	Drawdown Contours Shown on Figure
2	14,450	0.01	280	7.6	2.1	11
3	14,450	0.01	280	8.1	2.7	12

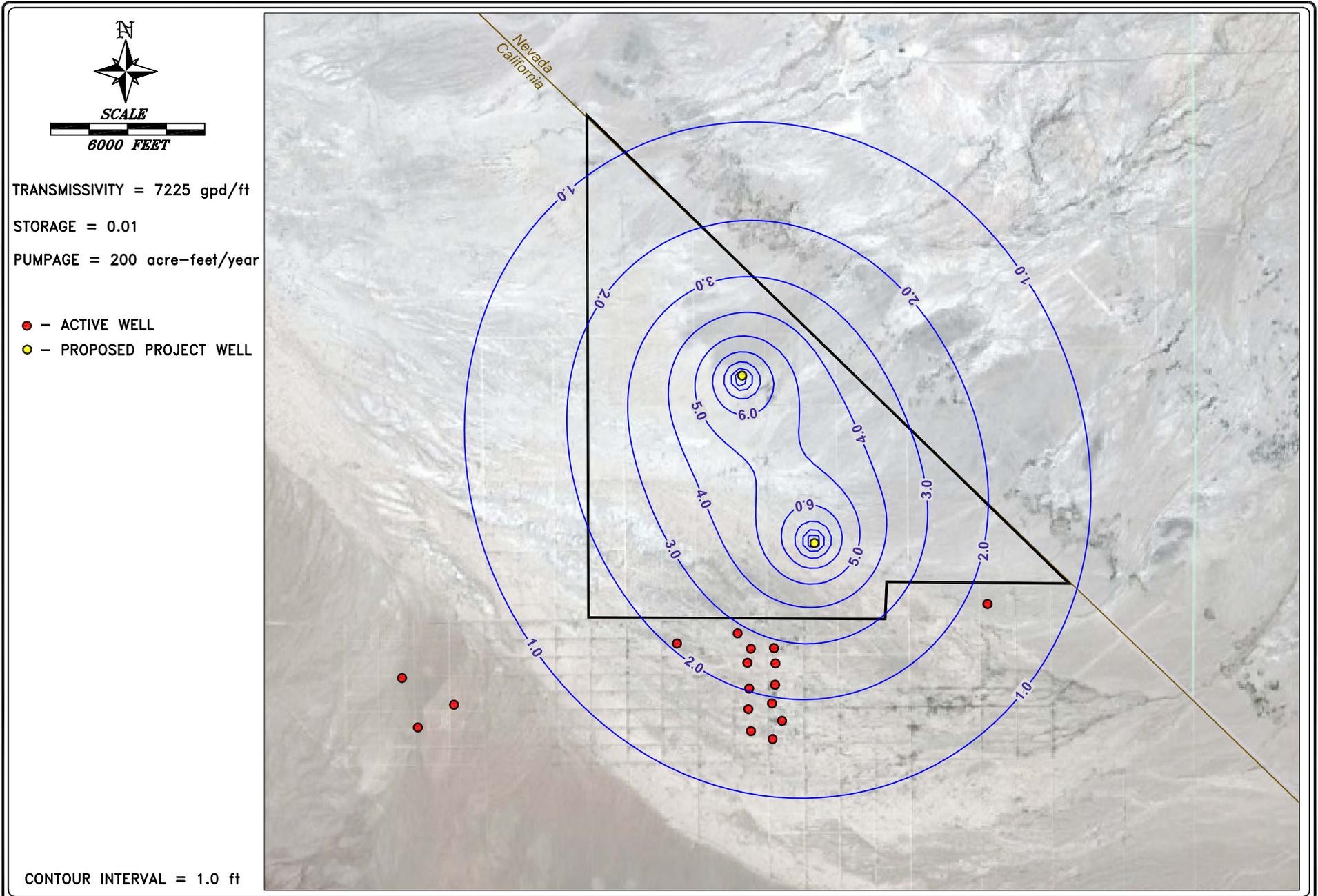
Model results indicate that the maximum drawdown at the end of 2 years due to withdrawal of 200 acre feet of water ranges between 6.2 feet (Scenario 3) and 18.4 feet (Scenario 2). The simulated maximum drawdown at the end of 3 years due to withdrawal of 200 acre feet of water ranges between 6.5 feet (Scenario 3) and 19.8 feet (Scenario 2).

The maximum simulated drawdown at the end of 2 years due to withdrawal of 280 acre feet of water ranges between 7.6 feet (Scenario 6) and 32.4 feet (Scenario 5). The maximum drawdown at the end of 3 years due to withdrawal of 280 acre feet of water ranges between 8.1 feet (Scenario 6) and 34.4 feet (Scenario 5).

Disclaimer: The model simulations carried out for this project have inherent assumptions typical of modeling studies. The results are only intended to provide guidance relative to future site development and do not constitute a guarantee from Cardno ENTRIX regarding predicted groundwater flow and/or levels.

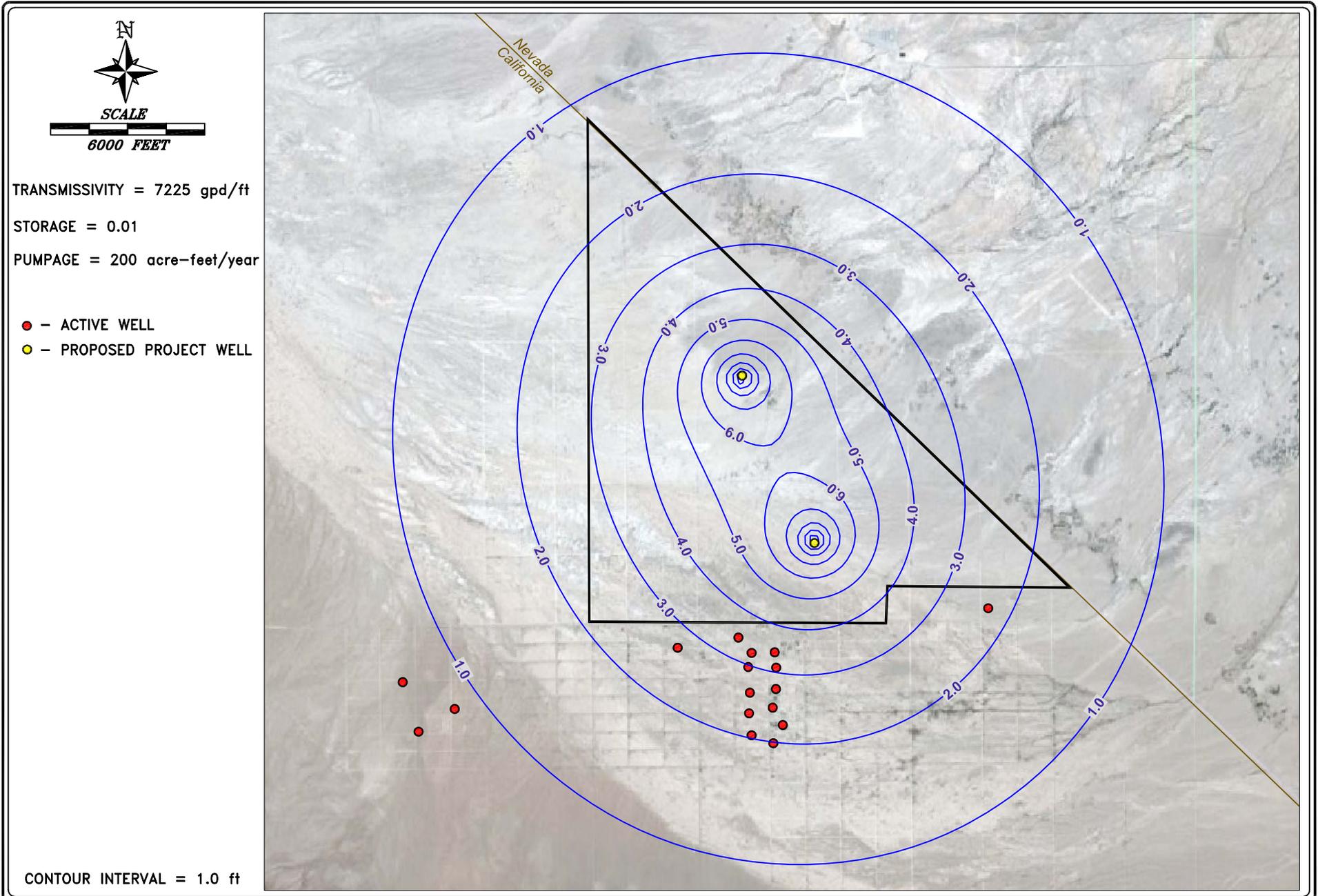
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# Figures 1-12



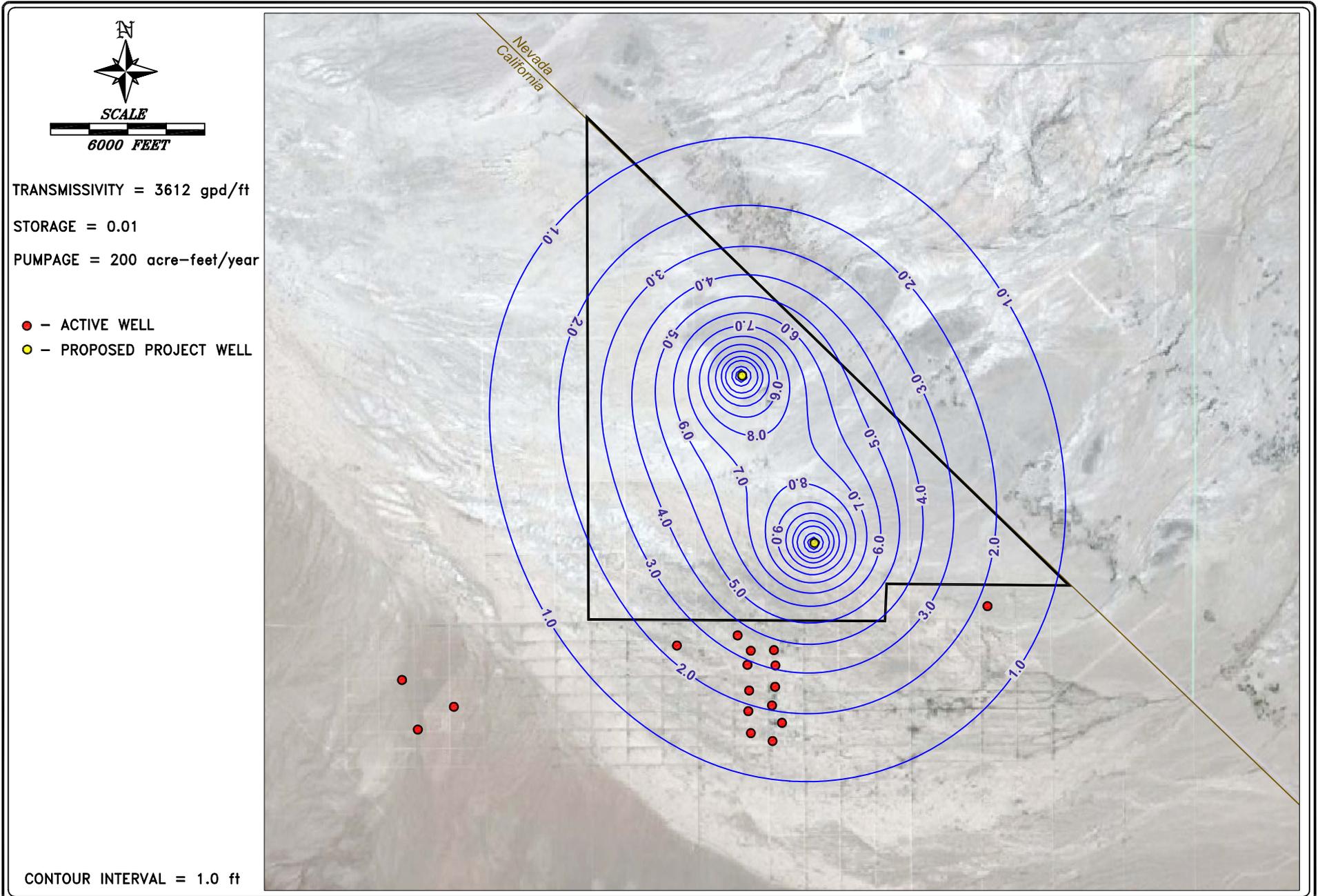
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	PROJECT NUMBER: <b>P3153001.00</b>	DATE: <b>06/12/11</b>

FIGURE 1. MAP SHOWING SIMULATED DRAWDOWN DUE TO PUMPING 200 ACRE-FEET/YEAR FOR 2 YEARS. TRANSMISSIVITY = 7225 gpd/ft



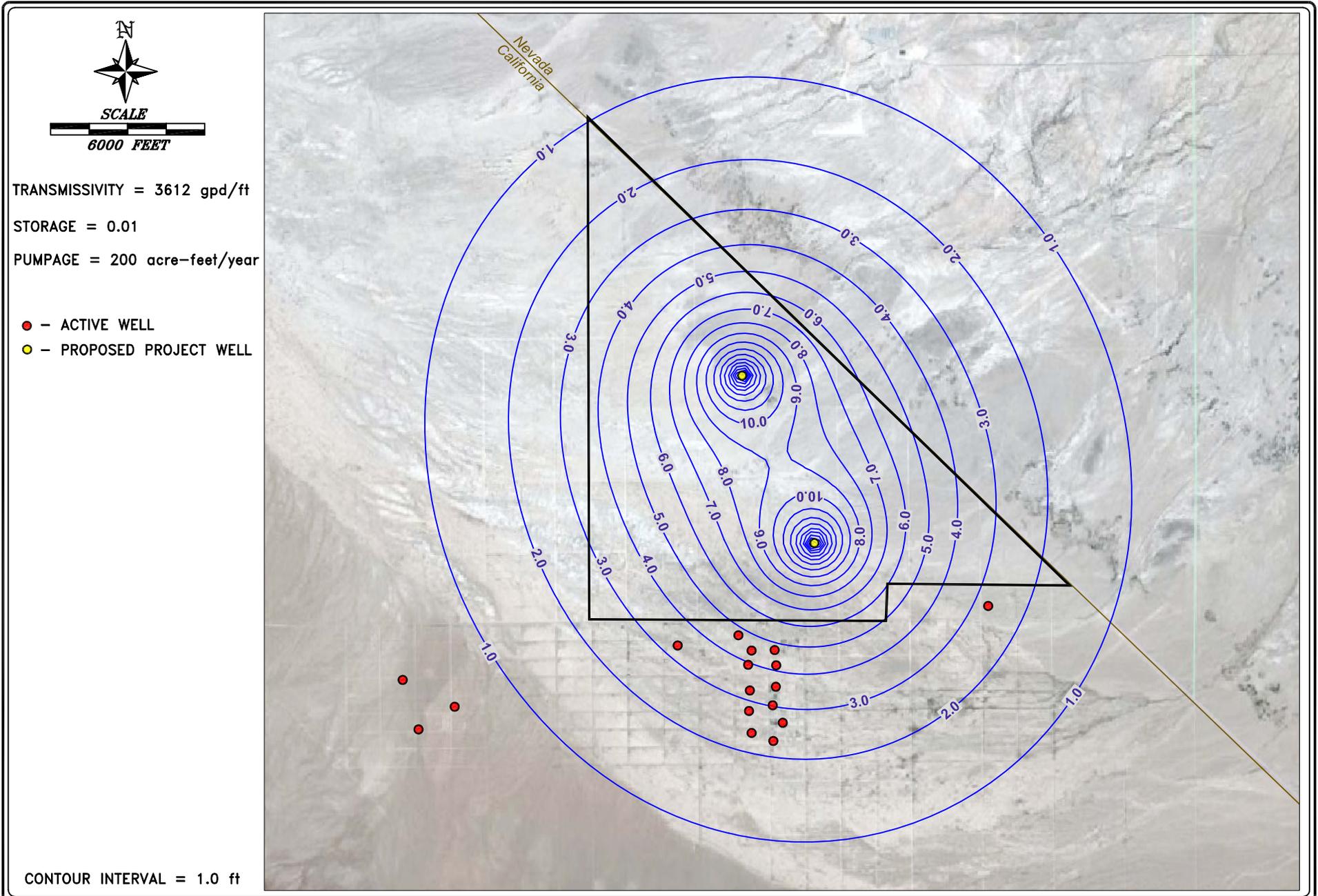
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	PROJECT NUMBER: P3153001.00	DATE: 06/12/11

FIGURE 2. MAP SHOWING SIMULATED DRAWDOWN DUE TO PUMPING 200 ACRE-FEET/YEAR FOR 3 YEARS. TRANSMISSIVITY = 7225 gpd/ft



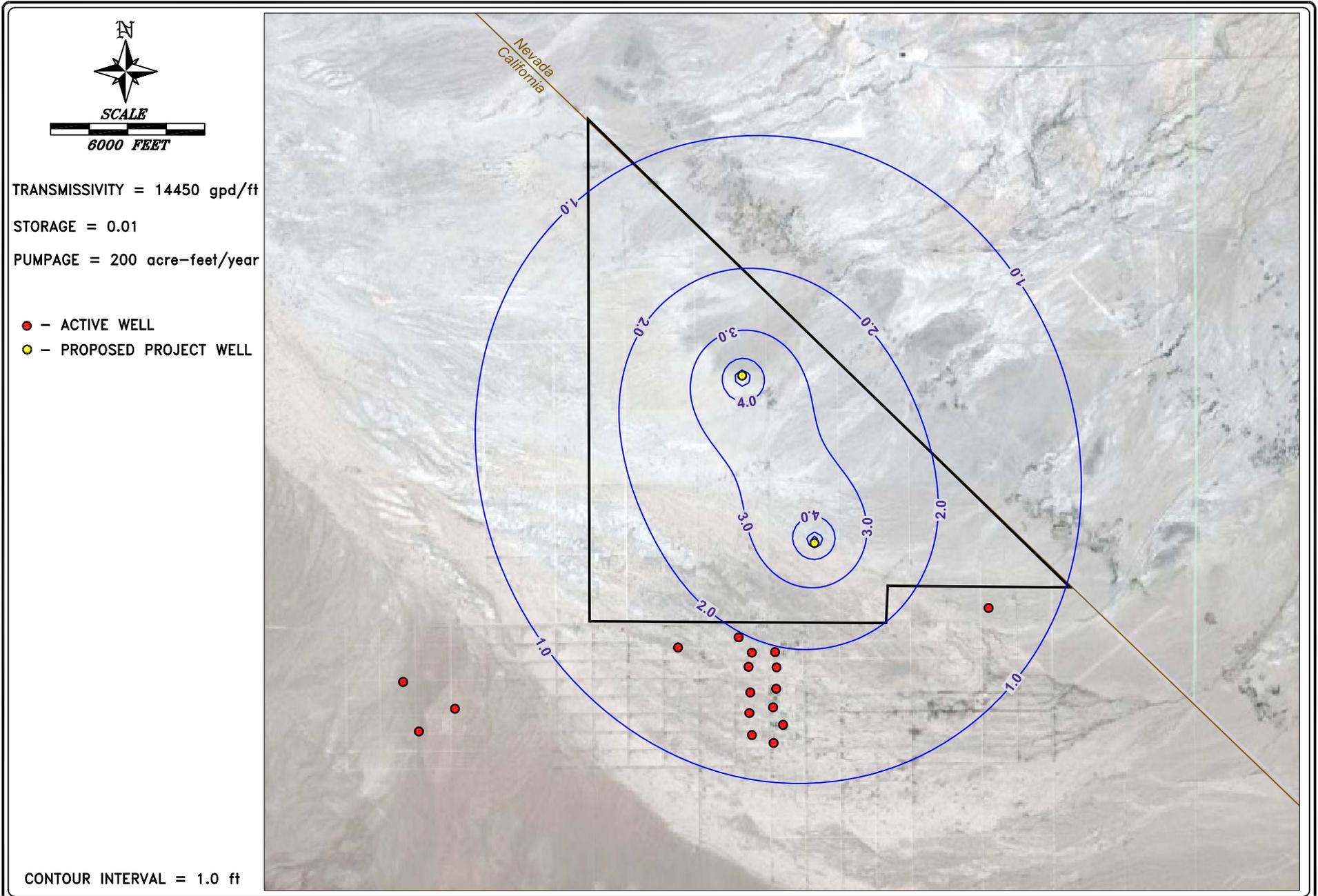
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	PROJECT NUMBER: <b>P3153001.00</b>	DATE: <b>06/12/11</b>

FIGURE 3. MAP SHOWING SIMULATED DRAWDOWN DUE TO PUMPING 200 ACRE-FEET/YEAR FOR 2 YEARS. TRANSMISSIVITY = 3612 gpd/ft



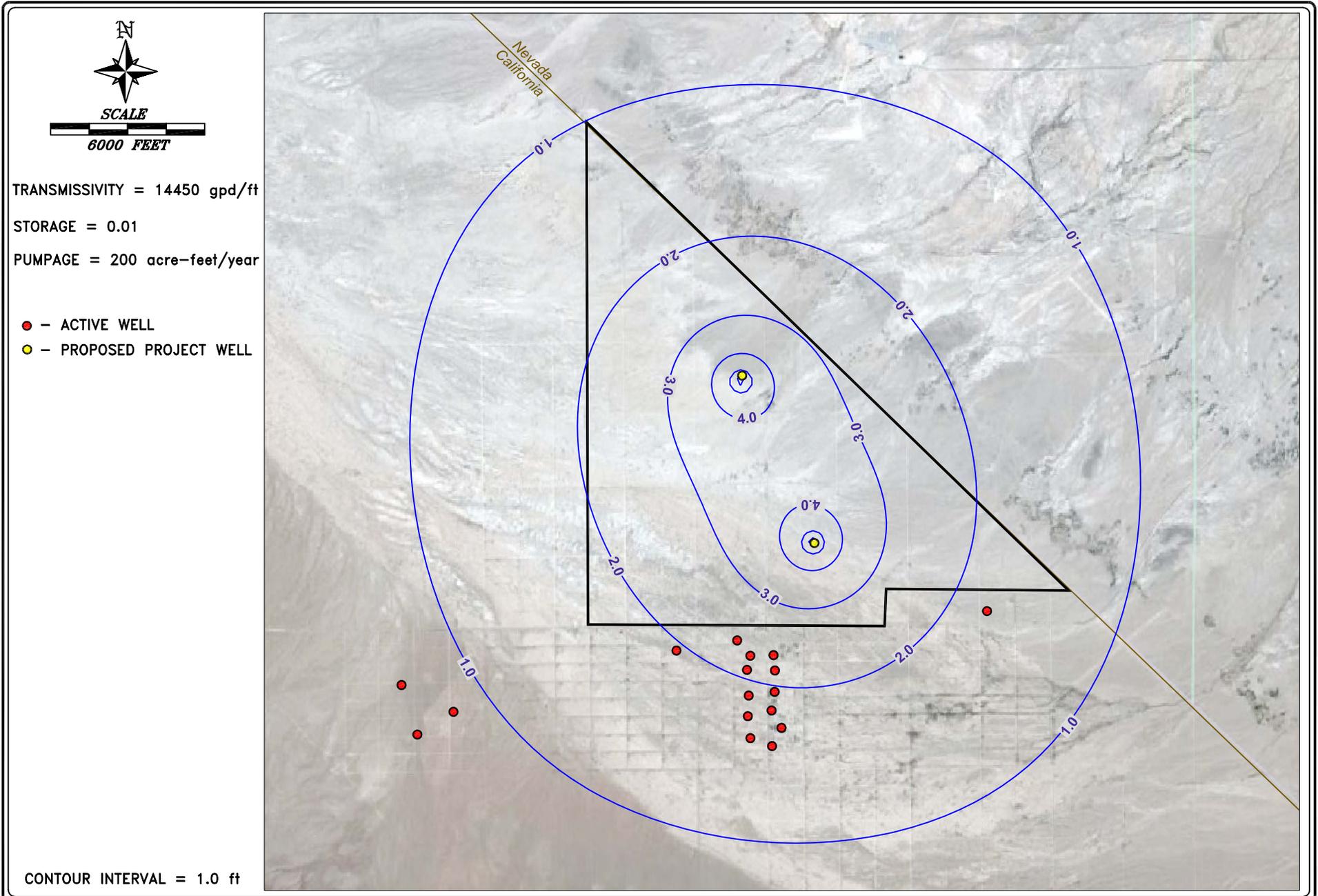
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	PROJECT NUMBER: <b>P3153001.00</b>	DATE: <b>06/12/11</b>

FIGURE 4. MAP SHOWING SIMULATED DRAWDOWN DUE TO PUMPING 200 ACRE-FEET/YEAR FOR 3 YEARS. TRANSMISSIVITY = 3612 gpd/ft



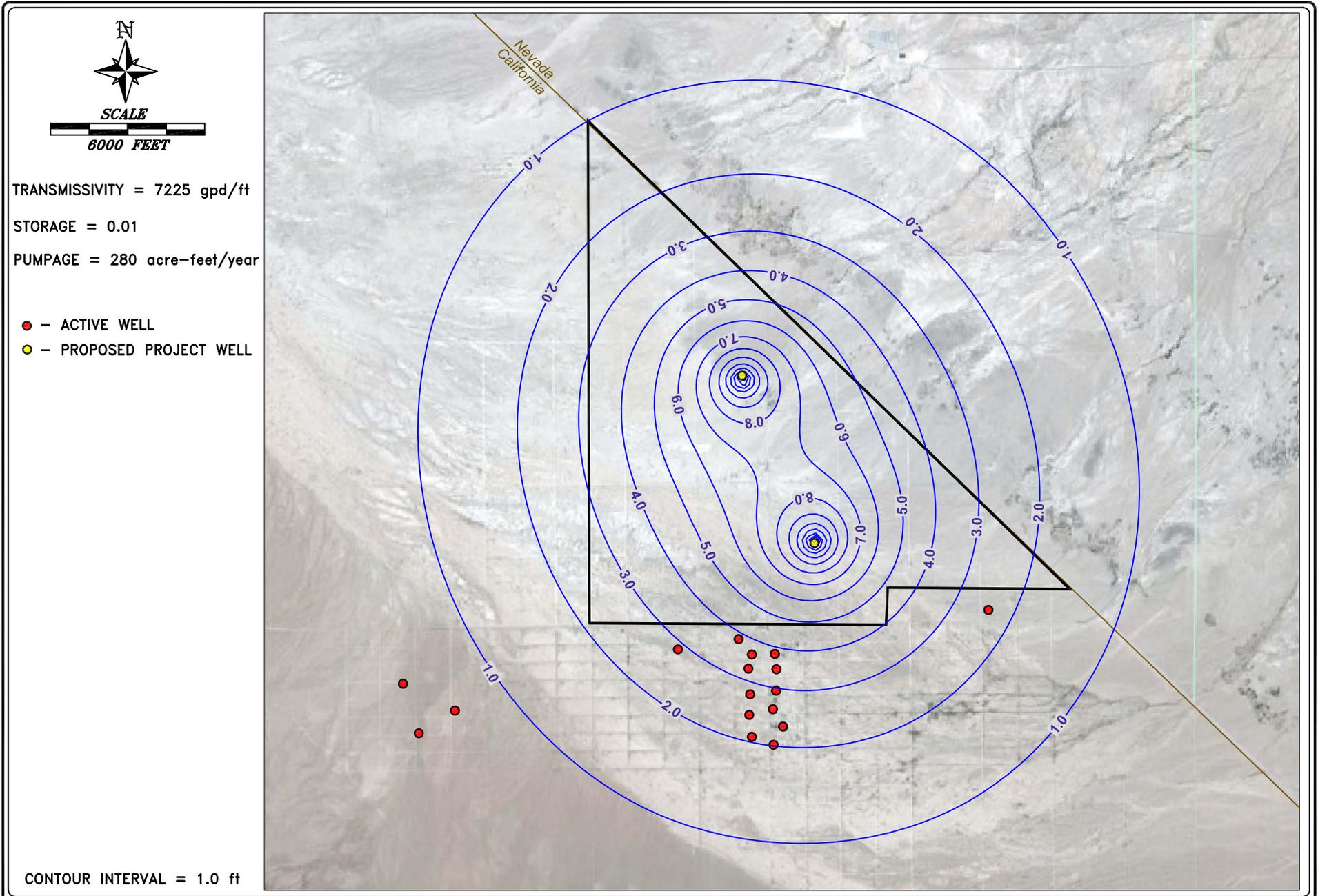
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	PROJECT NUMBER: <b>P3153001.00</b>	DATE: <b>06/12/11</b>

FIGURE 5. MAP SHOWING SIMULATED DRAWDOWN DUE TO PUMPING 200 ACRE-FEET/YEAR FOR 2 YEARS. TRANSMISSIVITY = 14450 gpd/ft



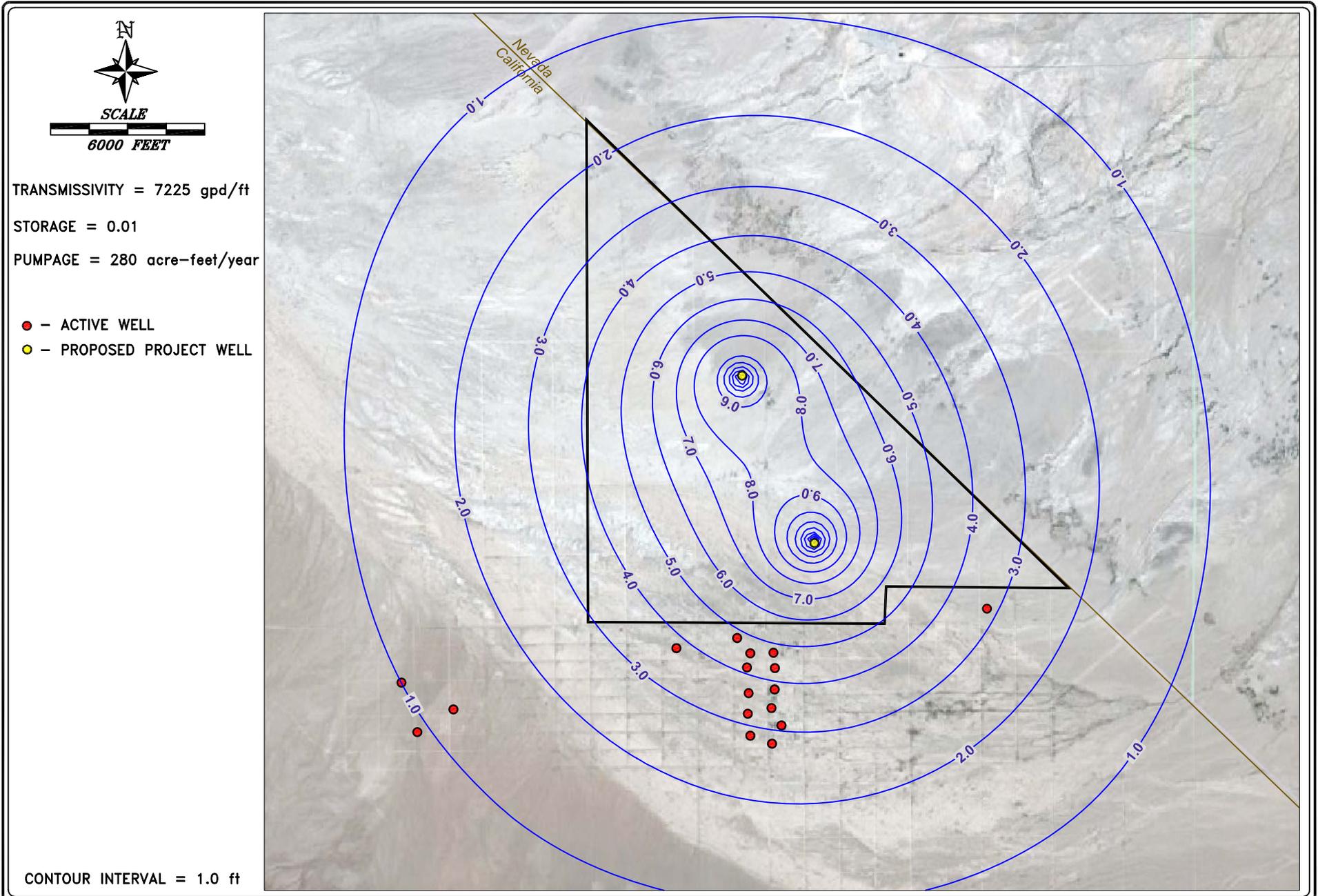
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	PROJECT NUMBER: P3153001.00	DATE: 06/12/11

FIGURE 6. MAP SHOWING SIMULATED DRAWDOWN DUE TO PUMPING 200 ACRE-FEET/YEAR FOR 3 YEARS. TRANSMISSIVITY = 14450 gpd/ft



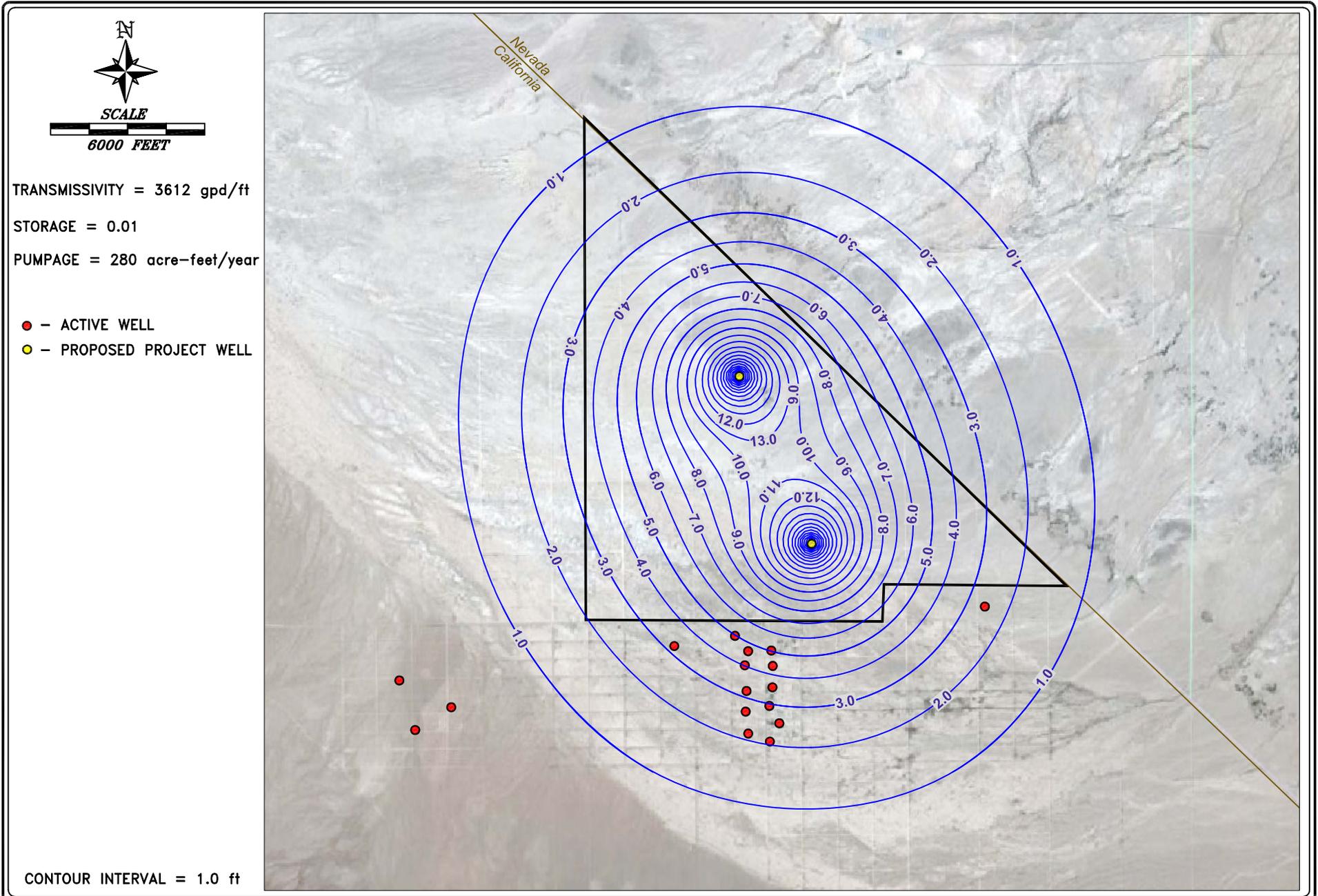
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	PROJECT NUMBER: <b>P3153001.00</b>	DATE: <b>06/12/11</b>

FIGURE 7. MAP SHOWING SIMULATED DRAWDOWN DUE TO PUMPING 280 ACRE-FEET/YEAR 2 YEARS. TRANSMISSIVITY = 7225 gpd/ft



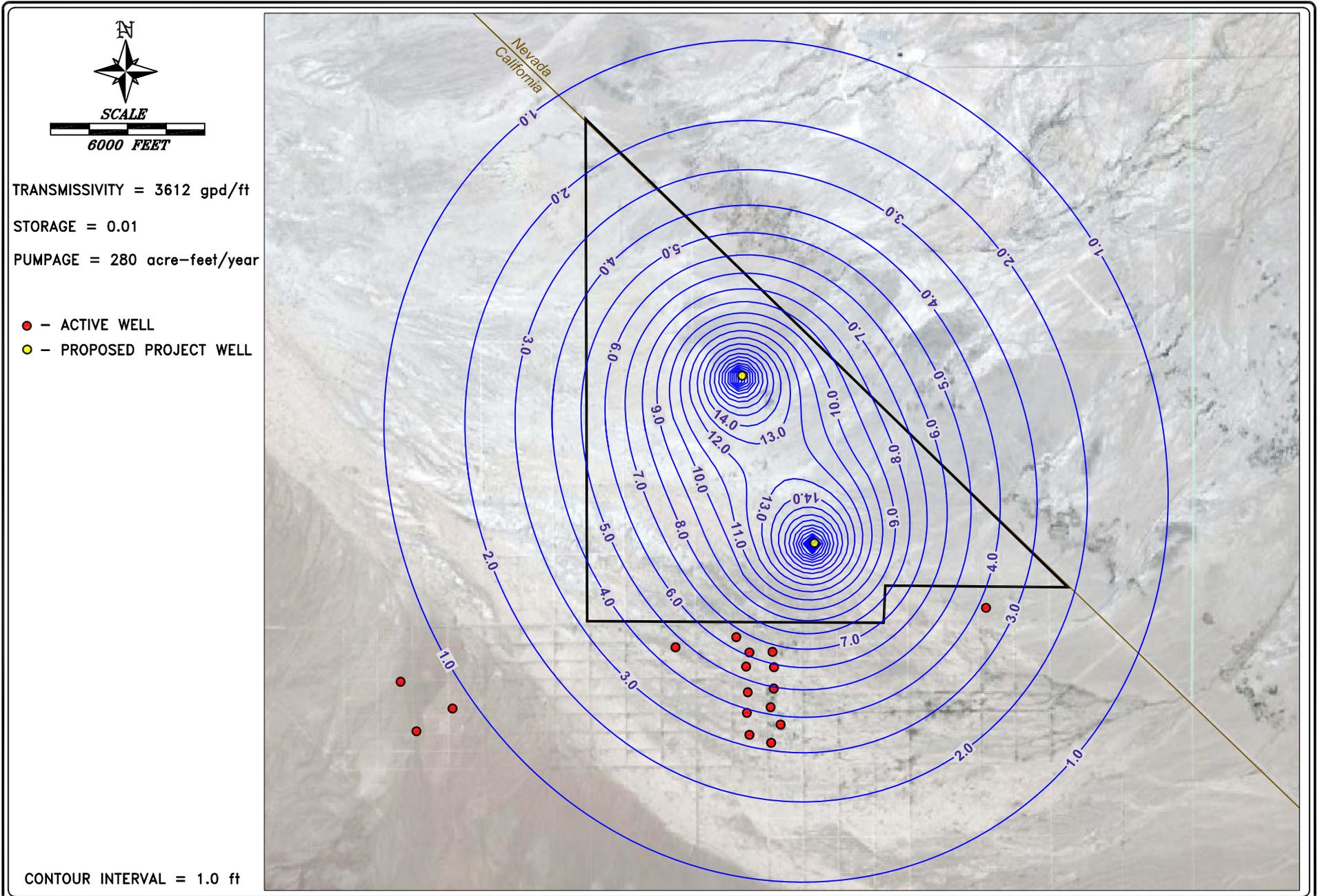
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	PROJECT NUMBER: <b>P3153001.00</b>	DATE: <b>06/12/11</b>

FIGURE 8. MAP SHOWING SIMULATED DRAWDOWN DUE TO PUMPING 280 ACRE-FEET/YEAR FOR 3 YEARS. TRANSMISSIVITY = 7225 gpd/ft



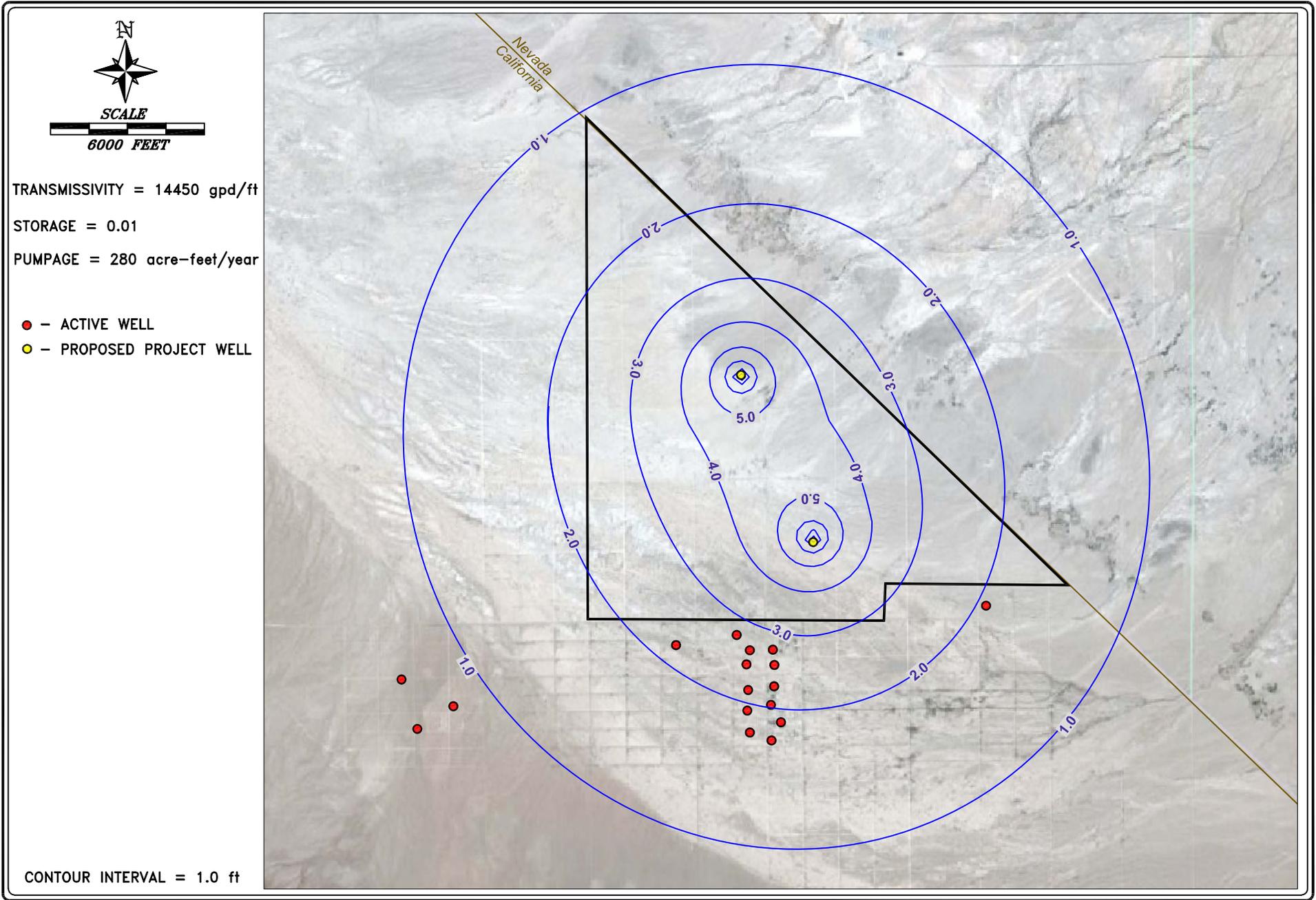
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	PROJECT NUMBER: <b>P3153001.00</b>	DATE: <b>06/12/11</b>

FIGURE 9. MAP SHOWING SIMULATED DRAWDOWN DUE TO PUMPING 280 ACRE-FEET/YEAR 2 YEARS. TRANSMISSIVITY = 3612 gpd/ft



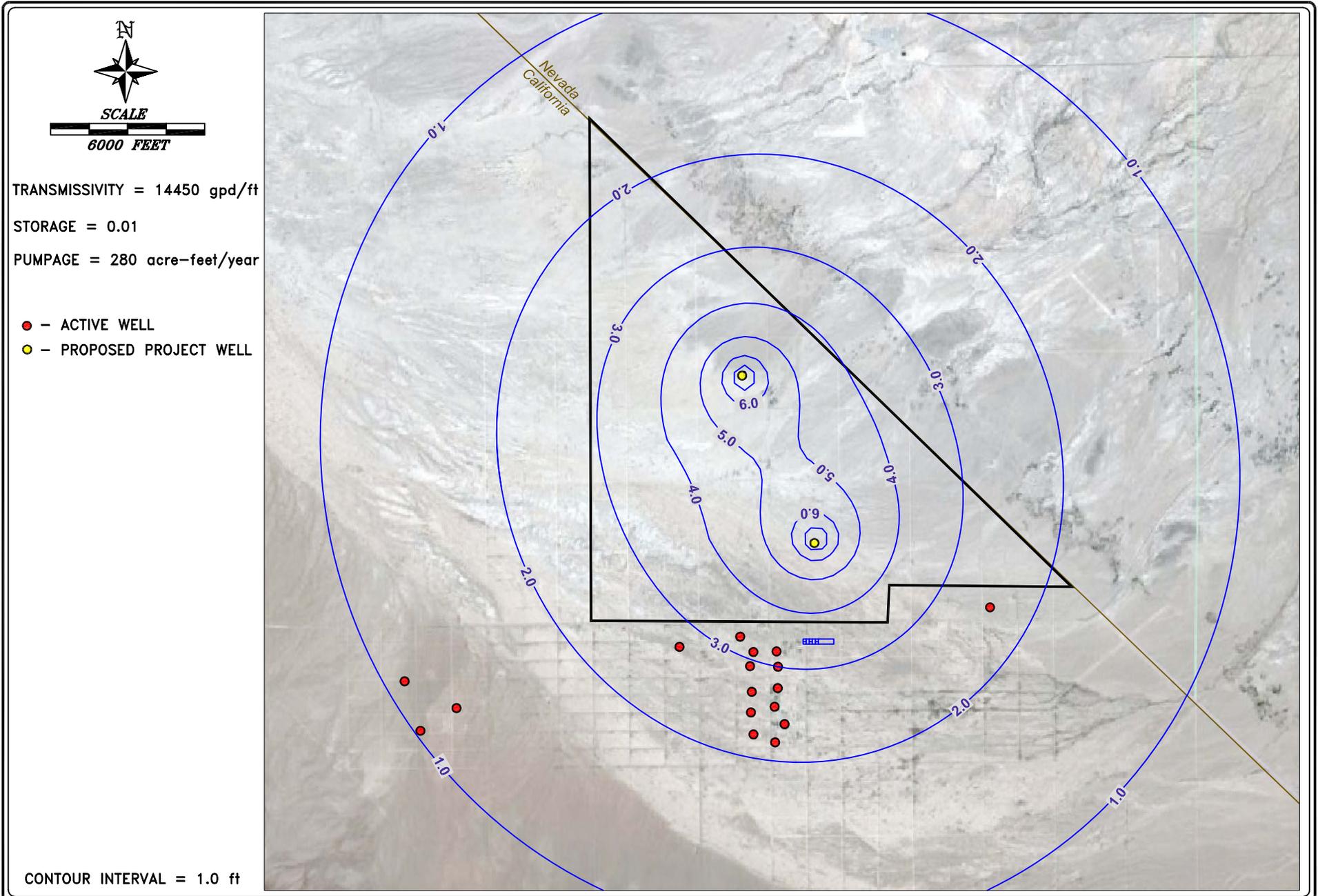
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	PROJECT NUMBER: <a href="#">P3153001.00</a>	DATE: <a href="#">06/12/11</a>

FIGURE 10. MAP SHOWING SIMULATED DRAWDOWN DUE TO PUMPING 280 ACRE-FEET/YEAR FOR 3 YEARS. TRANSMISSIVITY = 3612 gpd/ft



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	PROJECT NUMBER: <b>P3153001.00</b>	DATE: <b>06/12/11</b>

FIGURE 11. MAP SHOWING SIMULATED DRAWDOWN DUE TO PUMPING 280 ACRE-FEET/YEAR FOR 2 YEARS. TRANSMISSIVITY = 14450 gpd/ft



	PROJECT NAME: <b>BRIGHTSOURCE ENERGY HIDDEN HILLS</b>	DWG. NUMBER: <b>P3153001gs3</b>
	PROJECT NUMBER: <b>P3153001.00</b>	DATE: <b>06/12/11</b>

FIGURE 12. MAP SHOWING SIMULATED DRAWDOWN DUE TO PUMPING 280 ACRE-FEET/YEAR FOR 3 YEARS. TRANSMISSIVITY = 14450 gpd/ft