Appendix 5.15G
Groundwater Modeling Technical Memorandum
July 20, 2011

Technical Memorandum

Cardno ENTRIX

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Date July 20, 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, Josh Epting (Cardno ENTRIX)

RE: **BrightSource Energy Analytical Groundwater Modeling**

1.0 Introduction

The BrightSource Energy (BSE) Hidden Hills project (Project) is a proposed solar power generating facility utilizing BSE's proprietary LPT solar thermal energy system. Cardno ENTRIX is evaluating the sustainability of groundwater resources as the water supply for the facility and to determine potential effects from the proposed groundwater use. Cardno ENTRIX has conducted preliminary analytical groundwater modeling to assess potential Project drawdown impacts on existing users and within and outside the project area.

2.0 Project Demands and Water Resource Availability

The proposed Hidden Hills facility will depend upon groundwater as the sole water source. The water will be derived from one or more on-site supply wells. Based on the proposed system design, a supply of 140 acre-feet per year (approximately 125,000 gallons per day) is needed to meet the site's water demand.

Two aquifers of regional importance underlie the Pahrump Valley: the Basin-Fill aquifer and the Lower Carbonate aquifer. The Lower Carbonate aquifer has only been tapped by a few wells because of its substantial depth and the associated expense and the technical difficulties in constructing wells to such depths. The Basin-Fill aquifer can be tapped by wells to several hundred feet in depth and is considered the appropriate groundwater supply source for the project. The Basin-Fill aquifer is composed of basin fill and alluvial sediments ranging from 650 to over 9,800 feet thick and is the predominant source of groundwater supply for the Pahrump Valley. In the project area, wells of 300-400 feet deep are likely sufficient to provide the required yields for the Project.

The groundwater resources near the Project have not been well studied because of limited aquifer hydraulic testing of the Basin-Fill aquifer in the vicinity of the project site. An aquifer performance test (APT) conducted by Geotechnical Consultants (1966) estimates the transmissivity of the aquifer to be 7,225 gallons per day per foot (gpd/ft). Another APT located within or very near the project site conducted by Broadbent and Associates (2003) estimates the transmissivity of the aquifer to be 4,675 gpd/ft. Due to the limited duration of the pumping test and the lack of properly located monitoring wells, a reliable storage coefficient or leakance value could not be obtained.

3.0 Model Description and Simulations

Typically, several hydraulic aquifer coefficients and parameters are required when creating a groundwater model. These parameters include transmissivity, storage, specific yield, boundary conditions such as leakance, aquifer thickness, recharge, and depth of the pumping wells. For this site only an approximate measurement of transmissivity is available. This lack of detailed aquifer property information constrains the modeling approach that can be employed to only a simplified model package that assumes homogeneous aquifer properties.

Cardno ENTRIX conducted preliminary modeling based on the available data. Three modeling scenarios were conducted to account for the uncertainty of the model input parameters. The transmissivity value, which is a measure of the aquifer's ability to yield water, was adjusted in each scenario in order to evaluate how possible ranges of the transmissivity value would impact the simulated drawdown. Scenario 1 used the transmissivity value reported from the Geotechnical Consultants (1966) APT of 7,225 gpd/ft. Scenario 2 used a transmissivity of 3,612 gpd/ft, which is one-half the reported value. Scenario 3 used a transmissivity of 14,450 gpd/ft, which is two times the reported value. This range was assumed to bracket the likely range of the aquifer transmissivity value.

A storage coefficient of 0.01 (unitless) was assumed for all scenarios to represent a typical semi-confined condition. The Theis (1935) solution for a confined aquifer was used to simulate drawdown. A constant pumping rate of 140 acre-feet per year for the site (approximately 125,000 gpd) was split between two wells. One well was located at each proposed tower site. A southwest groundwater gradient of 0.01 (unitless) taken from regional water table maps was applied to the model. Pumping durations of 1 year, 10 years, and 25 years were run for each transmissivity value.

4.0 Model Results and Discussion

Tables 1, 2, and 3 and Figures 1 through 9 provide a summary of model parameters and results for scenarios 1, 2, and 3, respectively.

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

Pumping Duration (years)	Transmissivity (gpd/ft)	Storage (unitless)	Maximum Drawdown (feet)	Extent of 1-foot Drawdown (Miles)	Drawdown Contours Shown on Figure
1	7,225	0.01	3.4	1.3	1
10	7,225	0.01	6.3	4.2	2
25	7,225	0.01	7.9	6.9	3

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

Pumping Duration (years)	Transmissivity (gpd/ft)	Storage (unitless)	Maximum Drawdown (feet)	Extent of 1-foot Drawdown (Miles)	Drawdown Contours Shown on Figure
1	3,612	0.01	6.1	1.1	4
10	3,612	0.01	11.8	4.1	5
25	3,612	0.01	14.9	6.4	6

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

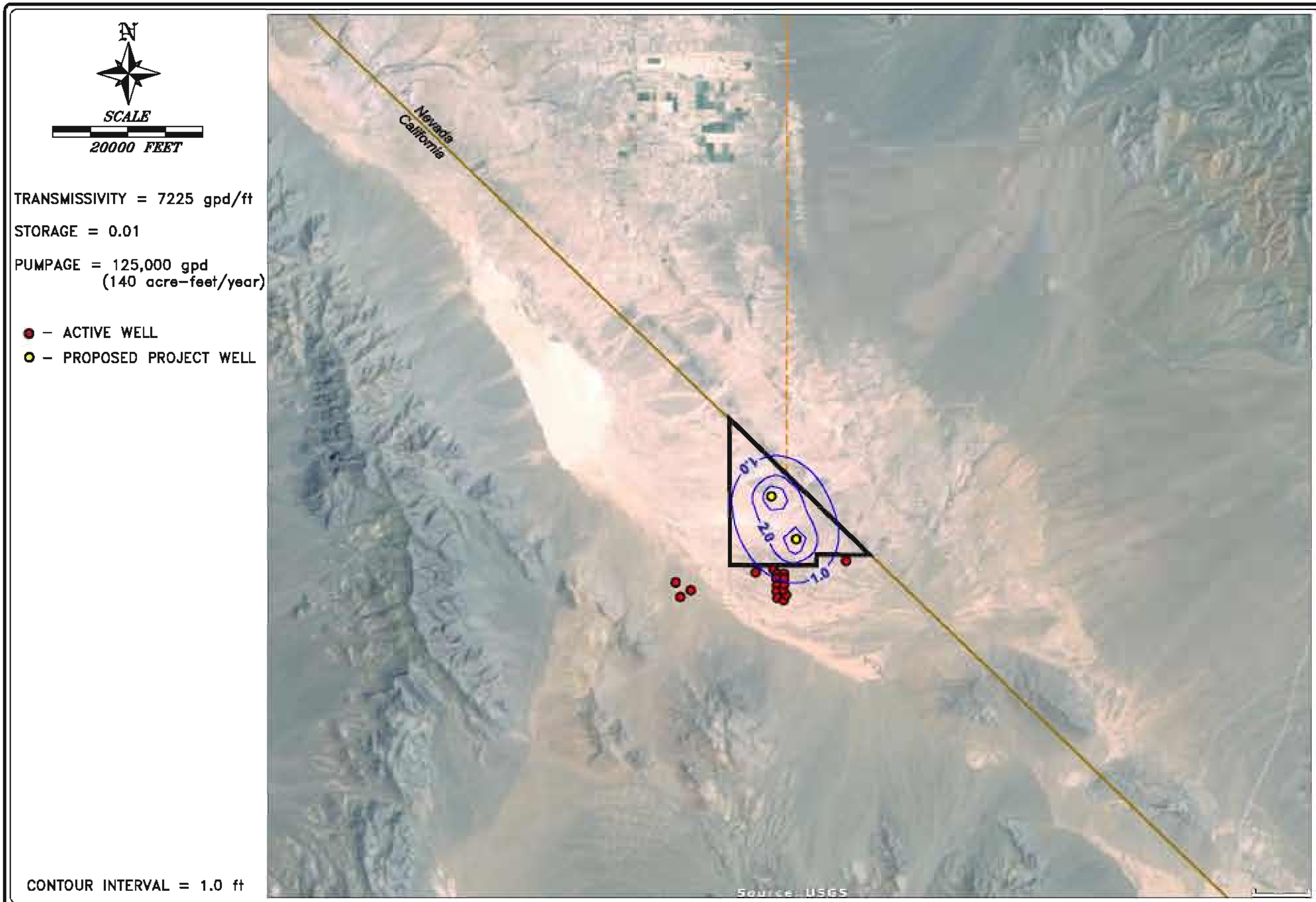
Pumping Duration (years)	Transmissivity (gpd/ft)	Storage (unitless)	Maximum Drawdown (feet)	Extent of 1-foot Drawdown (Miles)	Drawdown Contours Shown on Figure
1	14,450	0.01	0.8	1.0	7
10	14,450	0.01	2.2	3.7	8
25	14,450	0.01	5.2	6.1	9

When assuming a transmissivity of 7,225 gpd/ft (Scenario 1), the maximum estimated drawdown after 25 years of continuous pumping is approximately 7.9 feet, and the extent of the 1-foot drawdown is approximately 6.9 miles. When assuming a transmissivity of 3,612 gpd/ft (Scenario 2), the maximum estimated drawdown after 25 years of continuous pumping is approximately 14.9 feet, and the extent of the 1-foot drawdown is approximately 6.4 miles. When assuming a transmissivity of 14,450 gpd/ft (Scenario 3), the maximum estimated drawdown after 25 years of continuous pumping is approximately 5.2 feet, and the extent of the 1-foot drawdown is approximately 6.1 miles. The maximum estimated drawdown for each scenario represents the simulated drawdown within approximately 50 feet of the Project pumping wells after 25 years of continuous pumpage. Offsite drawdown at greater distances from the Project pumping wells, as well as simulated drawdown at 1-year and 10-year intervals, are significantly less than the maximum estimated drawdown. Figures 1 through 9 illustrate the drawdown for scenarios 1, 2, and 3, at 1-year, 10-year, and 25-year intervals.

As with any model, results are dependent on the aquifer properties used in the model. Results of the three scenarios indicate that the model is sensitive to changes in transmissivity. Increasing the transmissivity of the model lessens the predicted drawdown while decreasing transmissivity increases the predicted drawdown. Results of the modeling scenarios indicate the estimated drawdown in the aquifer after 25 years of continuous Project withdrawals may range from approximately three feet to 15 feet near the production wells.

Actual impacts to the aquifer as a result of the Project's withdrawals may be greater or lesser than the estimated range of drawdown provided in this memo. This range was determined by varying the transmissivity value of the model. Transmissivity is just one of many aquifer properties that effect model predictions. Varying the model's storage coefficient and leakance value will likely also affect the model results.

Figures 1-9



Cardno ENTRIX	PROJECT NAME: BRIGHTSOURCE ENERGY HIDDEN HILLS	DWG. NUMBER: P3153001gs2
	PROJECT NUMBER: P3153001.00	DATE: 06/03/11

FIGURE 1. MAP SHOWING SIMULATED DRAWDOWN DUE TO PUMPING 125,000 GALLONS PER DAY FOR 1 YEAR. TRANSMISSIVITY = 7225 gpd/ft

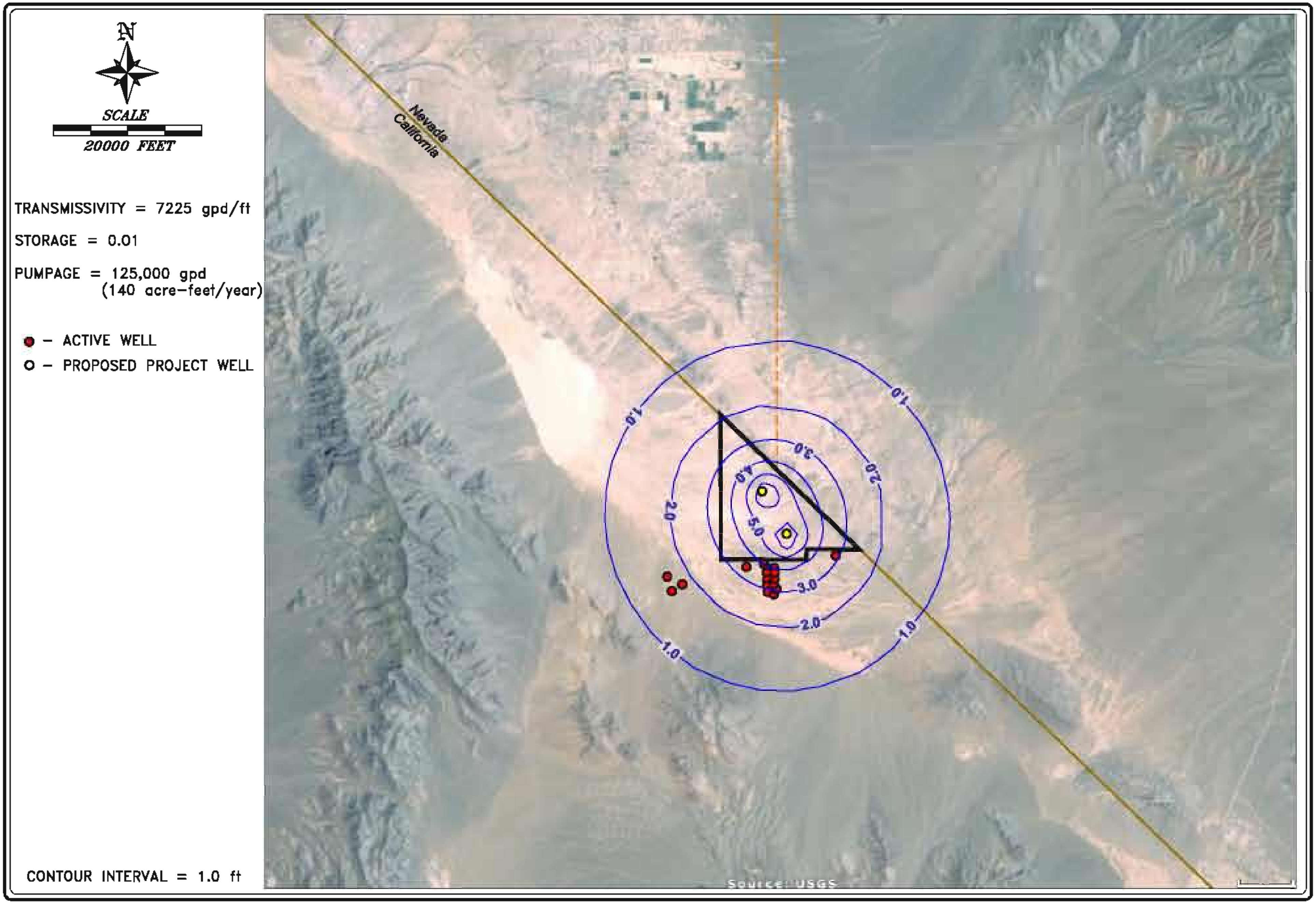


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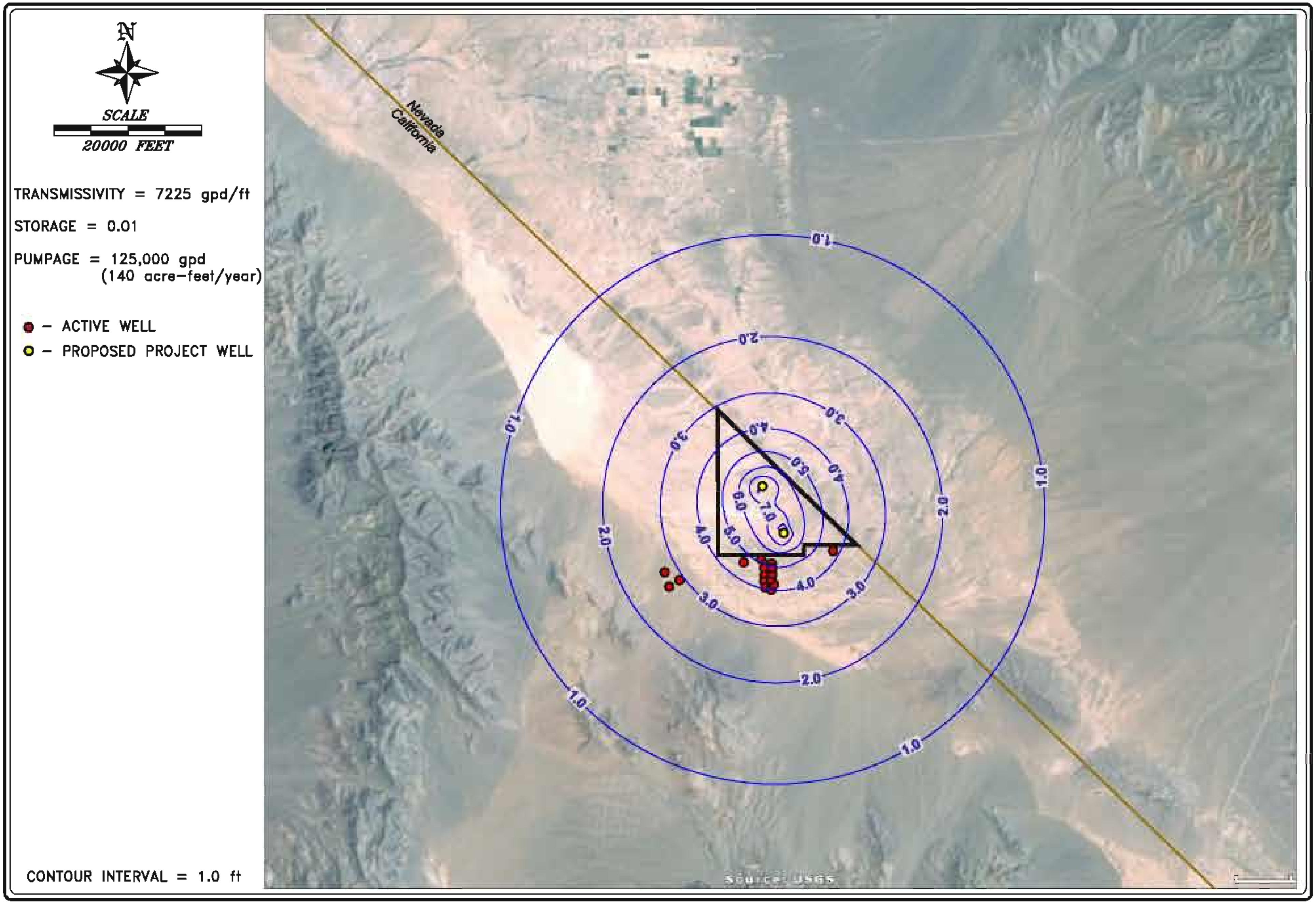
FIGURE 2. MAP SHOWING SIMULATED DRAWDOWN DUE TO PUMPING 125,000 GALLONS PER DAY FOR 10 YEARS. TRANSMISSIVITY = 7225 gpd/ft



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	PROJECT NUMBER: P3153001.00	DATE: 07/20/11

FIGURE 3. MAP SHOWING SIMULATED DRAWDOWN DUE TO PUMPING 125,000 GALLONS PER DAY FOR 25 YEARS. TRANSMISSIVITY = 7225 gpd/ft

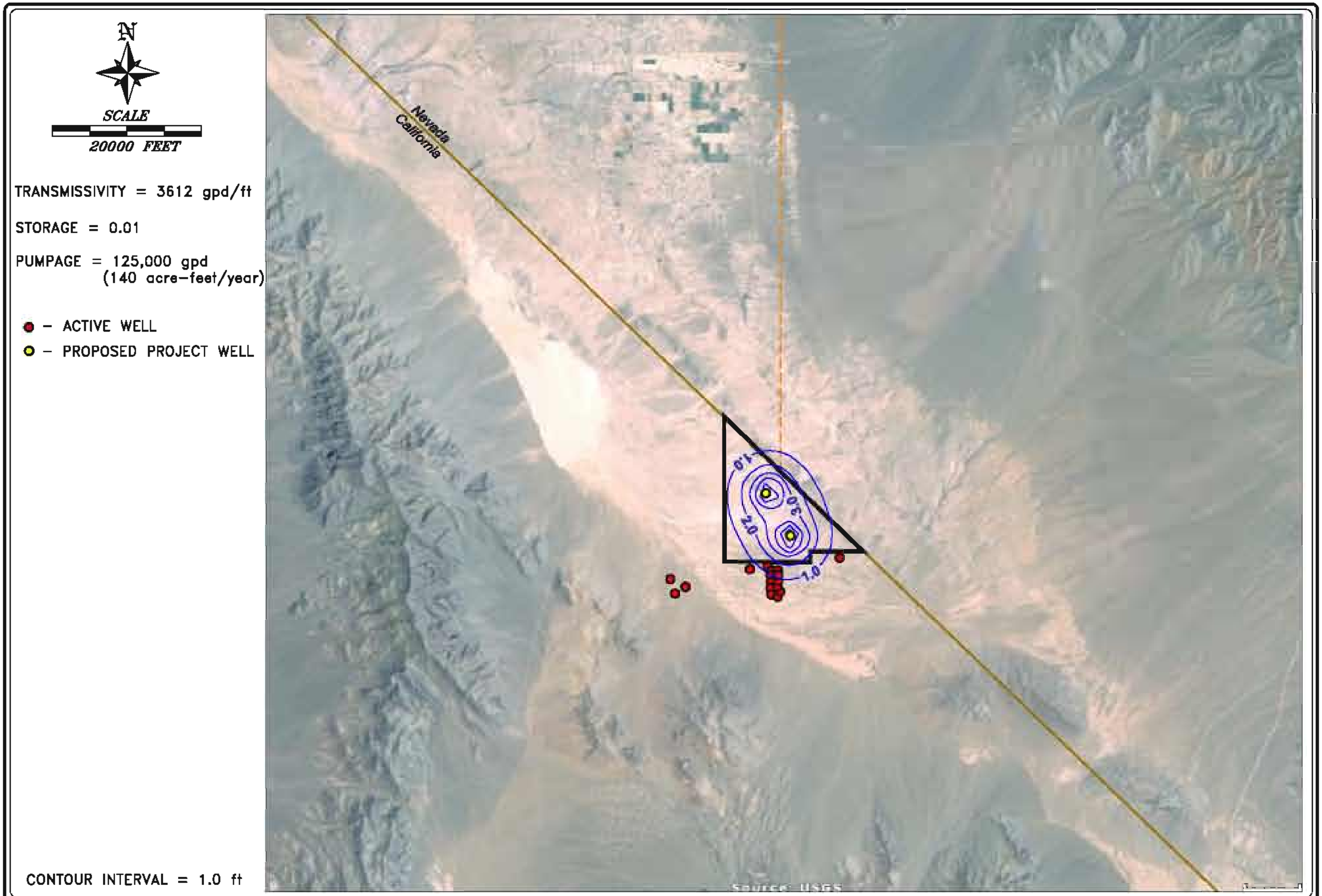

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FIGURE 4. MAP SHOWING SIMULATED DRAWDOWN DUE TO PUMPING 125,000 GALLONS PER DAY FOR 1 YEAR. TRANSMISSIVITY = 3612 gpd/ft

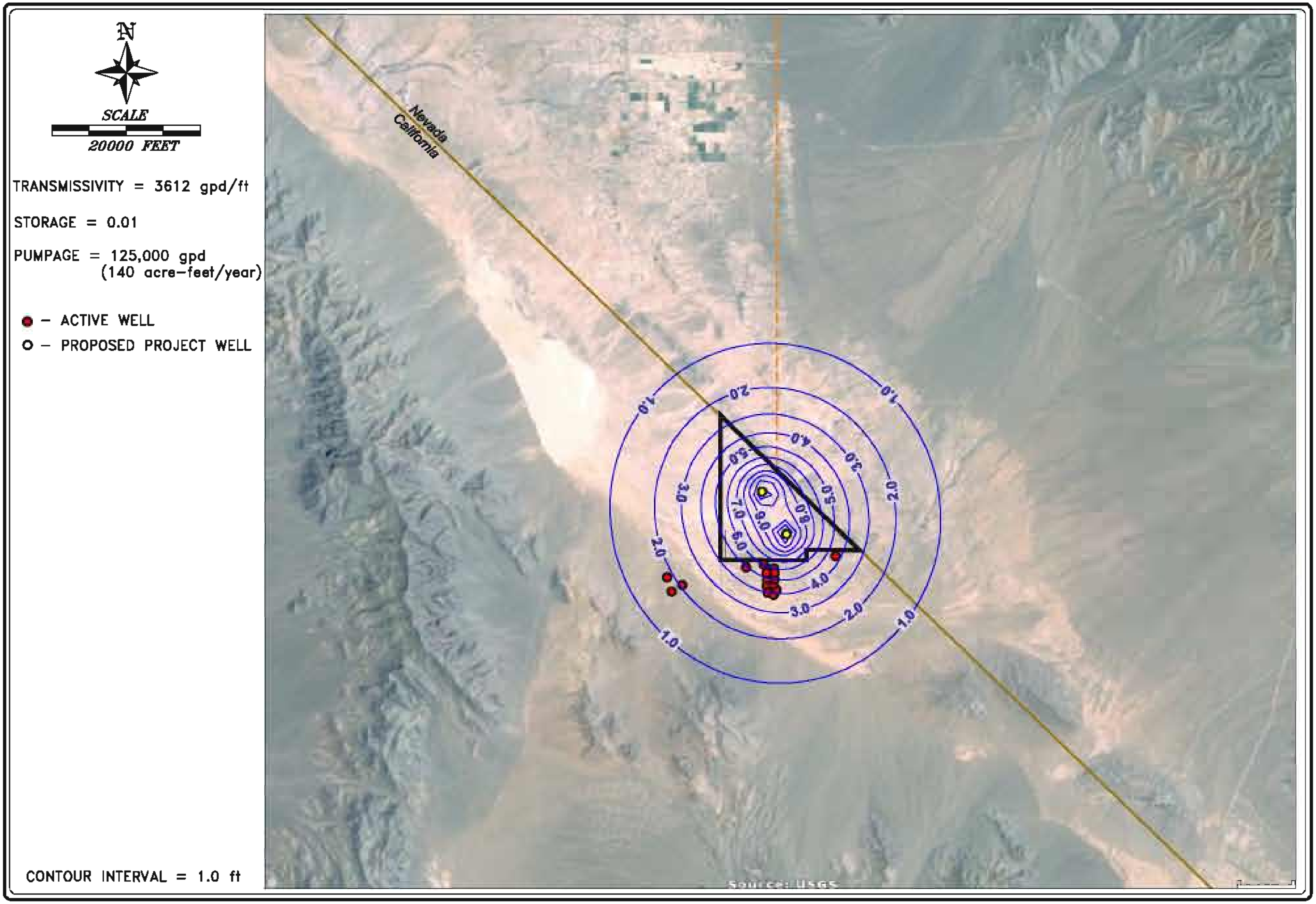

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FIGURE 5. MAP SHOWING SIMULATED DRAWDOWN DUE TO PUMPING 125,000 GALLONS PER DAY FOR 10 YEARS. TRANSMISSIVITY = 3612 gpd/ft

N

SCALE

20000 FEET

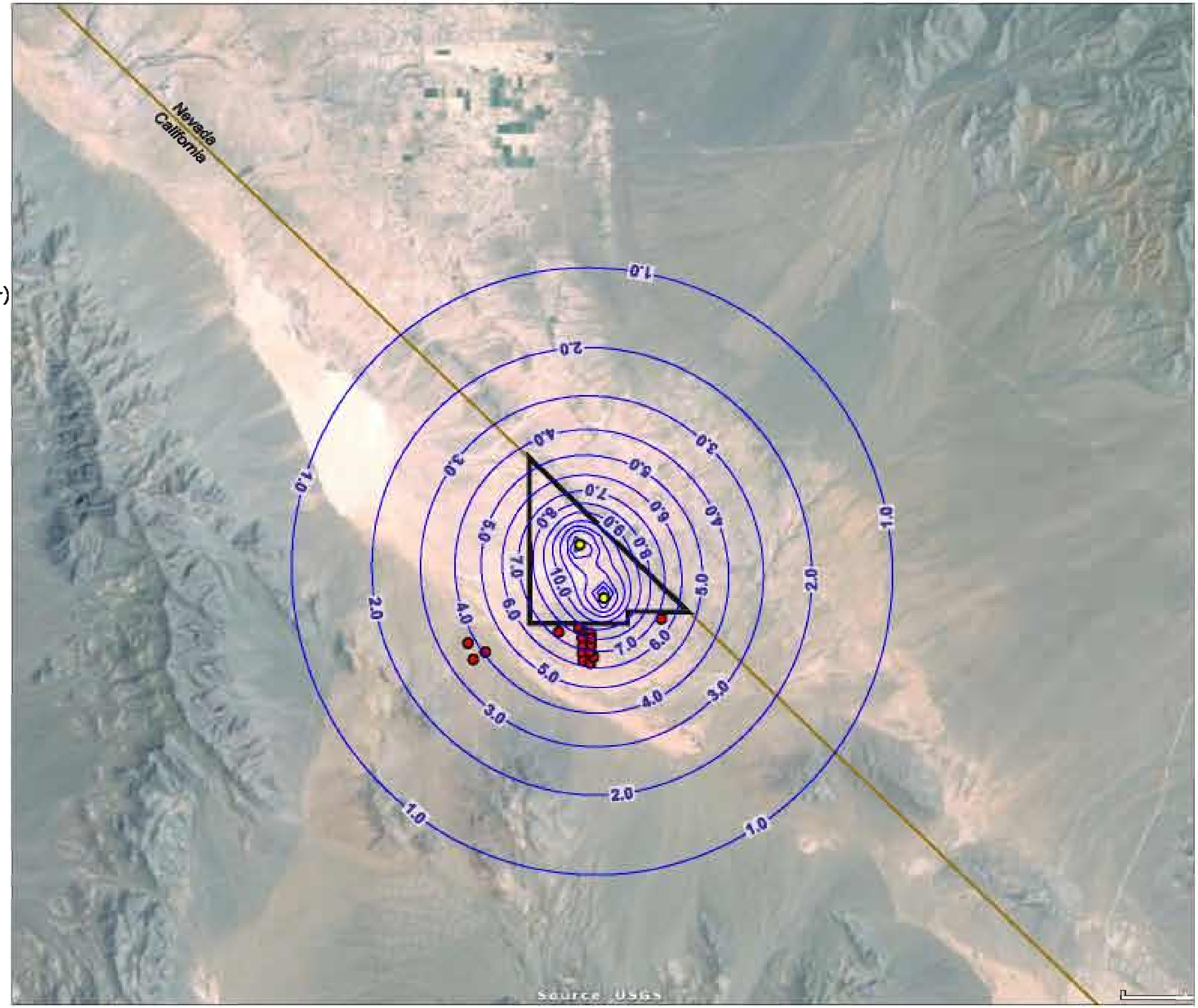
TRANSMISSIVITY = 3612 gpd/ft

STORAGE = 0.01

PUMPAGE = 125,000 gpd
(140 acre-feet/year)

● – ACTIVE WELL

○ – PROPOSED PROJECT WELL



CONTOUR INTERVAL = 1.0 ft

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FIGURE 6. MAP SHOWING SIMULATED DRAWDOWN DUE TO PUMPING 125,000 GALLONS PER DAY FOR 25 YEARS. TRANSMISSIVITY = 3612 gpd/ft

SCALE

20000 FEET

TRANSMISSIVITY = 14450 gpd/ft

STORAGE = 0.01

PUMPAGE = 125,000 gpd
(140 acre-feet/year)

- ACTIVE WELL
- PROPOSED PROJECT WELL

CONTOUR INTERVAL = 1.0 ft

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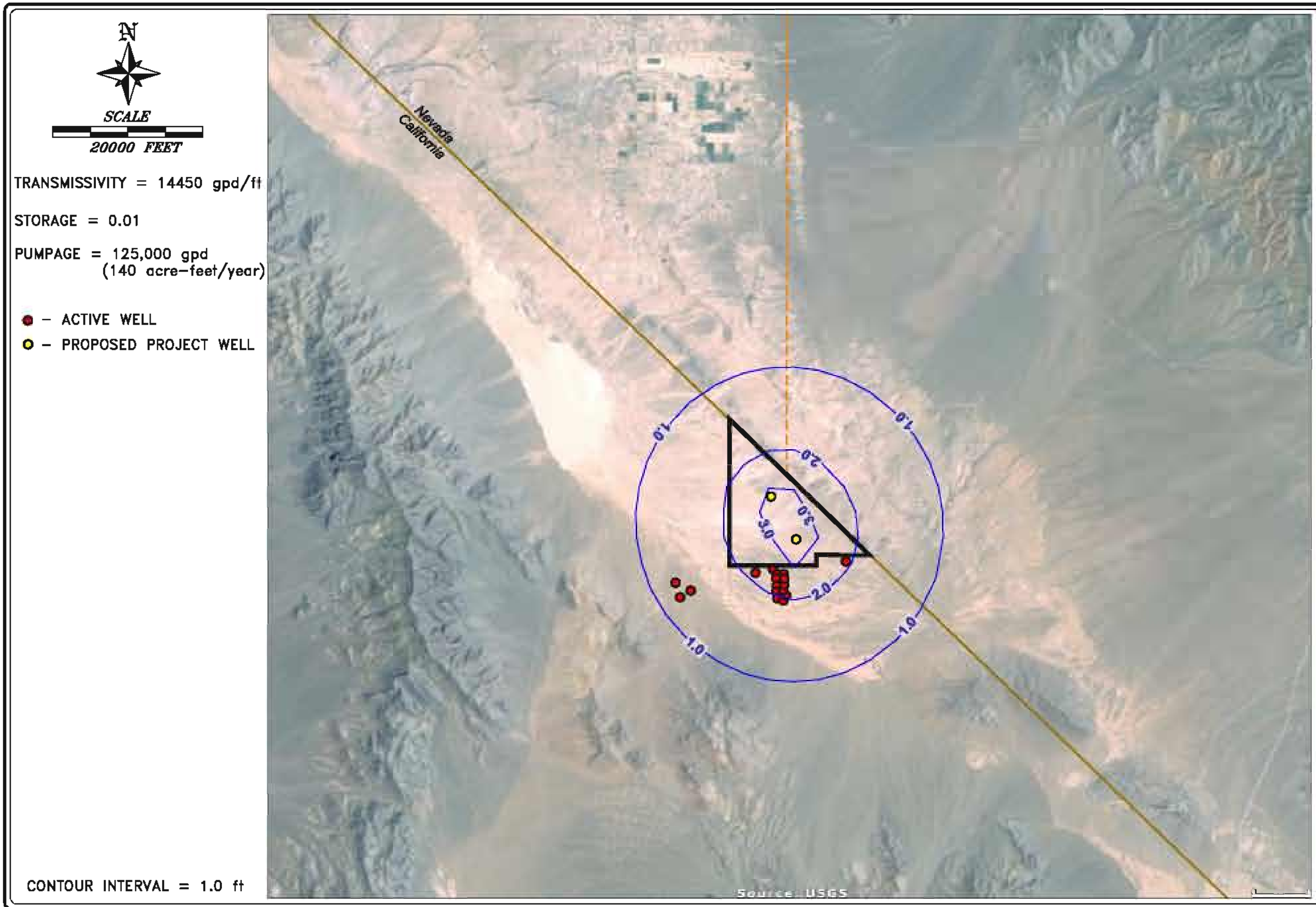
PROJECT NAME: BRIGHTSOURCE ENERGY HIDDEN HILLS

PROJECT NUMBER: P3153001.00

DWG. NUMBER: P3153001gs2

DATE: 06/03/11

FIGURE 7. MAP SHOWING SIMULATED DRAWDOWN DUE TO PUMPING 125,000 GALLONS PER DAY FOR 1 YEAR. TRANSMISSIVITY = 14450 gpd/ft



PROJECT NAME: BRIGHTSOURCE ENERGY HIDDEN HILLS	DWG. NUMBER: P3153001gs2
PROJECT NUMBER: P3153001.00	DATE: 06/03/11

FIGURE 8. MAP SHOWING SIMULATED DRAWDOWN DUE TO PUMPING 125,000 GALLONS PER DAY FOR 10 YEARS. TRANSMISSIVITY = 14450 gpd/ft

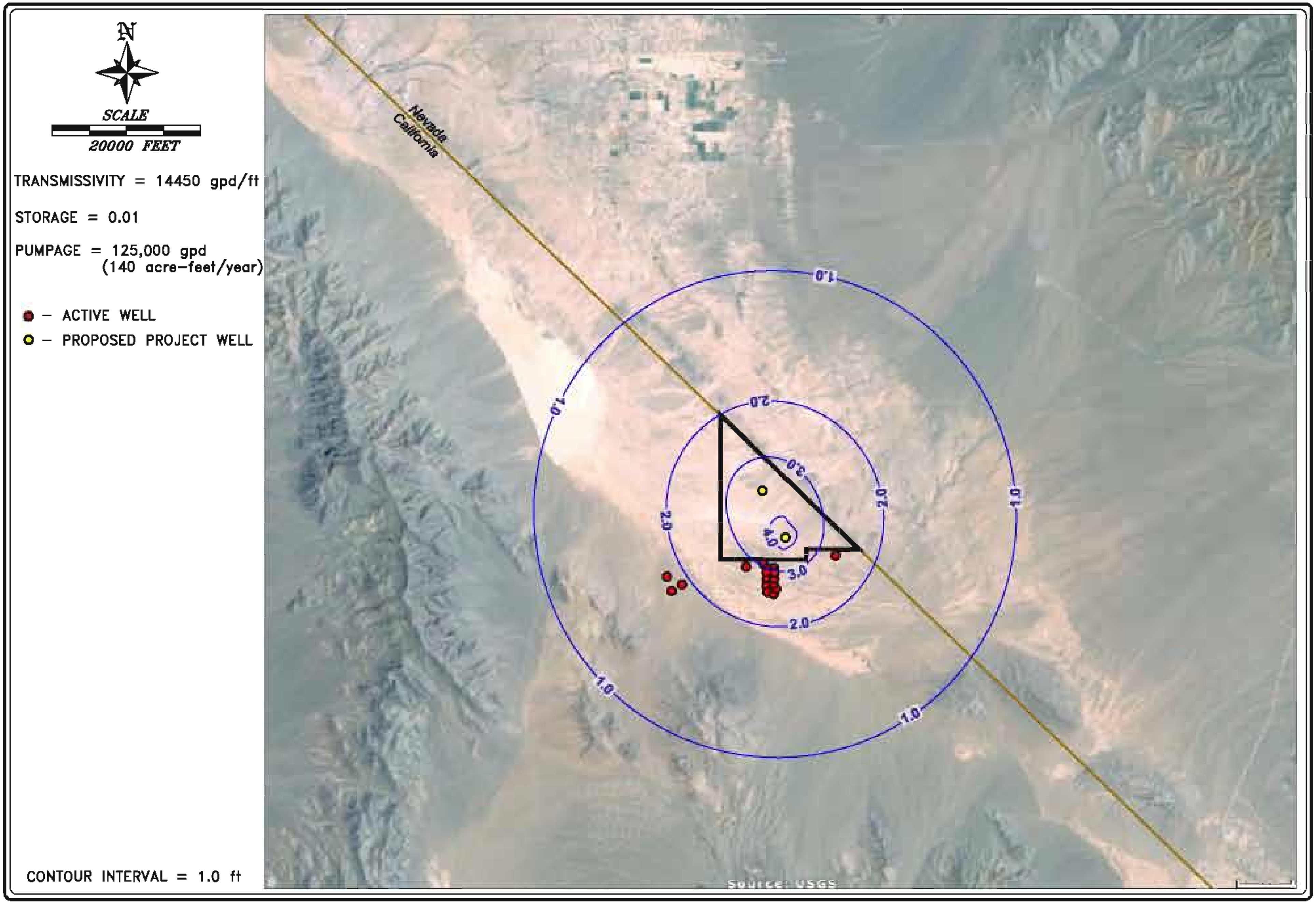


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FIGURE 9. MAP SHOWING SIMULATED DRAWDOWN DUE TO PUMPING 125,000 GALLONS PER DAY FOR 25 YEARS. TRANSMISSIVITY = 14450 gpd/ft