APPENDIX 7b

Groundwater Model to Evaluate the Potential Impact from the Proposed WVWRF Percolation Basins

GROUNDWATER MODEL TO EVALUATE THE POTENTIAL IMPACT FROM THE PROPOSED WEST VALLEY WATER RECLAMATION FACILITY PERCOLATION BASINS

WEST VALLEY WATER RECLAMATION FACILITY
Desert Hot Springs, California

September 7, 2018

Prepared for

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GROUNDWATER MODEL TO EVALUATE THE POTENTIAL IMPACT FROM THE PROPOSED WEST VALLEY WATER RECLAMATION FACILITY PERCOLATION BASINS

West Valley Water Reclamation Facility
Desert Hot Springs, California

September 7, 2018

This report has been prepared by *EnviroLogic Resources, Inc*., of Signal Hill, California.

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GROUNDWATER MODEL TO EVALUATE THE POTENTIAL IMPACTS FROM THE PROPOSED WEST VALLEY WATER RECLAMATION FACILITY

WEST VALLEY WATER RECLAMATION FACILITY
Desert Hot Springs, California

EXECUTIVE SUMMARY

This report presents the results of a preliminary groundwater model for the Mission Springs Water District's (MSWD) proposed West Valley Water Reclamation Facility (WVWRF) located in Desert Hot Springs, Riverside County, California. The purpose is to evaluate the potential impact to the beneficial use of groundwater by constituents of concern, specifically the potential impact from the use of WVWRF percolation basins to production at Well 33. The proposed WWVRF is located just north of Interstate 10 and west of Little Morongo Road in the northern area of the Coachella Valley.

The lithology under the plant is Quaternary alluvium deposits that are comprised of sand and gravel mixtures varying in composition and thicknesses and a depth to water of approximately 180 feet below ground surface. The Quaternary alluvium deposits are underlain by a thicker fanglomerate aquifer that provide the MSWD with drinking water supply. A numerical, finite difference, 3-dimensional groundwater flow and transport model is used for the evaluation. The purpose is to track the potential for secondary-treated effluent to effect Well 33. The model was not designed to specifically evaluate the effect on beneficial uses of groundwater because very conservative parameters were used to model the flow from percolation ponds. In the model, one chemical constituent, nitrogen as nitrate, is modeled as a surrogate for other constituents of the secondary treated wastewater. Nitrate mass is generally conserved in the subsurface and its movement through the groundwater system is not subject to retardation effects. Modeling nitrate allows for a conservative estimation of potential effects at Well 33. Nitrate is established in a fixed source concentration in the percolation basins at various discharge rates over a 100-year duration. The nitrate is tracked by a particle path line and a chemical concentration in the outputs presented at specified times correlating to specified increases in the amount of discharge introduced into the percolation basins.

The results of the groundwater model predict that a particle pathline and the nitrate migration from the induced recharge from the simulated percolation basins are toward the south and southeast, away from Well 33. According to the model results, the predicted drawdown influence of the pumping Well 33 does not overcome the natural groundwater gradient at the distance of the proposed percolation basins for scenarios where hydraulic conductivity is at the lower end of estimates, as observed in specific capacity data from Well 33. If hydraulic conductivity is larger, and at larger recharge rates from larger discharges envisioned beginning in year 30 of operation, some impact to Well 33 is observed in the model output.

1.0 INTRODUCTION

Mission Springs Water District (MSWD) is proposing a West Valley Water Reclamation Facility (WVWRF) in Desert Hot Springs, Riverside County, California. The WVWRF is proposed to serve Desert Hot Springs and surrounding communities, and in its proposed configuration will have an initial design treatment capacity of 1.5 million gallons per day (MGD) and a future design treatment capacity of 3.0 MGD. A preliminary groundwater model has been constructed at the request of the MSWD in order to evaluate the potential impact to a nearby well, Well 33, from the operation of the percolation basins at the proposed WVWRF. The model was not designed to specifically evaluate the effect on beneficial uses of groundwater because very conservative parameters were used to model the flow from percolation ponds. A regional site vicinity map is presented on Figure 1. A drawing showing the layout of the proposed WVWRF is presented on Figure 2.

The purpose of this report is to present the results of a groundwater flow and transport model to evaluate of the effects of introducing treated wastewater into the unconfined aquifer in the Garnet Hill Subbasin from the proposed WVWRF.

2.0 REGIONAL HYDROGEOLOGIC SETTING

The proposed WVWRF is located in the Garnet Hill Subbasin of the Coachella Valley Groundwater Basin. This section briefly summarizes the geologic and hydrologic properties of the Garnet Hill and Coachella Valley groundwater basins. The California Department of Water Resources (DWR) defines a groundwater basin as an alluvial aquifer or a stacked series of alluvial aquifers with reasonably well-defined boundaries in a lateral direction and having a definable bottom. A groundwater subbasin is defined as a subdivision of a groundwater basin created by dividing the basin into smaller units using geologic and hydrologic conditions or institutional boundaries (DWR, 2003).

The Coachella Valley lies in the northwestern portion of the Salton Trough, which extends from the Gulf of California in Mexico northwesterly to the Cabazon area. The basin is bounded on the north and east by crystalline bedrock of the San Bernardino and Little San Bernardino Mountains and on the south and west by the crystalline rocks of the Santa Rosa and San Jacinto Mountains. The basin is bounded on the west end of the San Gorgonio Pass groundwater divide, in Beaumont. The southern boundary is the Salton Sea. Geologic faults and structures generally divide the basin into subbasins (Tyley, 1974); these faults limit or impede groundwater flow between the subbasins. The main local subbasins include: San Gorgonio Pass, Whitewater (Indio), Garnet Hill, Mission Creek, and Desert Hot Springs Subbasins.

The primary aquifer system in the Coachella Valley is unconsolidated Pleistocene-Holocene valley fill. Groundwater recharge is primarily runoff from the surrounding mountains, local precipitation, irrigation return, stream flow from the Whitewater River and other rivers and creeks, and from imported Colorado River and Canal Water supplied to spreading grounds throughout the Coachella Valley. Groundwater discharge is to evapotranspiration, underflow to the Salton Sea and Imperial Valley areas, and to pumping wells.

The Garnet Hill Subbasin is located in the Upper Coachella Valley. A geologic map of the area is presented on Figure 3. The Banning Fault and Garnet Hill Fault bound the northern and southern edges of the subbasin, respectively, and are the major groundwater controls. Both act to limit groundwater movement as these faults have folded sedimentary deposits, displaced water-bearing deposits, and caused once permeable sediments to become impermeable (DWR, 1964). To the west, the subbasin is bounded by the San Bernardino Mountains and to the east by the Indio Hills and the Mission Creek Fault.

The Garnet Hills Subbasin is naturally recharged by surface and subsurface flow from the Mission Creek, Dry, and Big Morongo Washes, the Painted Hills, and surrounding mountain drainages. Irrigation return flow and discharges from municipal and individual subsurface wastewater disposal systems also contribute to recharge.

Similar to the Garnet Hill Subbasin, the Mission Creek Subbasin is filled with Holocene and late Pleistocene unconsolidated sediments eroded from the San Bernardino and Little San Bernardino Mountains. There are three significant water-bearing sedimentary deposits recognized in both subbasins: Pleistocene Cabazon Fanglomerate, Pleistocene to Holocene Older alluvium, and Recent alluvial deposits. These deposits are generally coarse sand and gravel and poorly sorted alluvial fan deposits that coalesce with one another. The Mission Creek Subbasin is considered an unconfined aquifer with a saturated thickness of 1,200 feet or more and an estimated total storage capacity on the order of 2.6 million acre-feet. The depth to crystalline bedrock in the area of the WVWRF is shown on Figure 4. Natural inflow has been supplemented with artificial recharge of imported water since 2003. Average annual natural inflow to the Mission Creek Subbasin is estimated at 9,340 acre-feet (Krieger & Stewart, 2015).

According to the Layne Christensen Co. drillers log for Well 32 (GSI/water,2005), the unsaturated sediments from ground surface to approximately 200 feet below ground surface are generally composed of sand and sand and gravel.

The depth to groundwater is approximately 200 feet below ground surface according to well soundings and historical data. The depth to water at the Well 33 has ranged from 170 to 190 feet below ground surface since 2007. A hydrograph showing the variation in groundwater level in Well 33 is presented on Figure 5.

The percolation basins of the proposed WVWRF are located in the Garnet Hill Subbasin as is Well 33. The Garnet Hill Subbasin is bounded on the north by the Banning Fault and the Mission Creek Subbasin and on the South by the Garnet Hill Fault and the Whitewater River Subbasin.

3.0 FACILITY DESCRIPTION

The proposed West Valley Water Reclamation Program is a wastewater collection, treatment, and disposal system and is proposed to provide sewerage service for the City of Desert Hot Springs and surrounding communities. The primary component of the program is the WVWRF. An appropriate level and type of treatment process will be selected based on the required effluent quality as determined through the permitting process. The WVWRF is expected to provide secondary treatment consisting of influent pumping, preliminary treatment (screening and de-gritting), conventional activated sludge secondary treatment (aeration and sedimentation), aerated sludge holding tanks, and biosolids dewatering. The proposed WVWRF will have an initial design treatment capacity of 1.5 MGD and a future design treatment capacity of 3.0 MGD. A drawing showing the layout of the proposed WVWRF is presented on Figure 2.

The groundwater model conservatively simulates the use of two percolation basins, located in the southeast 1/4 of the northeast 1/4 of Section 6, Township 3 South, Range 5 East, San Bernardino Baseline and Meridian. Each percolation basin is created with dimensions of 220' by 220'. The modeled percolation basins are located about 1,800 feet from Well 33, while it is likely that percolation basins about 2,300 feet from Well 33 would be developed first.

4.0 GROUNDWATER FLOW AND TRANSPORT MODEL CONSTRUCTION

The groundwater model is constructed using Visual MODFLOW Build 4.6.0.168. The model uses MODFLOW 2005, a public domain numerical model created by the United States Geologic Survey. The model uses MODPATH for particle tracking and MT3DMS for the mass transport. Zone Budget calculates the flow budgets in and out of storage, wells, and recharge.

The base maps used for the model are the Desert Hot Springs and Seven Palms USGS 7.5 minute quadrangle topographic maps. The ground elevation is set at an elevation of 800 feet. The basement bedrock is set at a depth of -3,600 feet (Figure 4). A model with 112 rows, 108 columns, and 4 layers was constructed on the basis of the Groundwater Flow Model of the Mission Creek, Garnet Hill, and Upper Whitewater River Subbasins (Psomas, 2013).

In order to reduce model run time and refine the input and output data to the area of the percolation ponds and wells in the vicinity of the study area, inactive flow and transport cells are created. These cells are identified in Figure 2 in Appendix A as light green and block the view of the map areas that are inactive.

4.1 MODEL PROPERTIES

The following describes the input parameters used to construct the model.

4.1.1 INITIAL HEADS

The initial heads for the model are based on 1936 heads from Psomas (2013), which are originally from Tyley (1974). These heads represent a reasonable initial condition and the overall groundwater flow direction is similar to current conditions.

4.1.2 HYDRAULIC CONDUCTIVITY

The hydraulic conductivity (K) used in the model is an average of the range of values presented in Psomas (2013). For the Desert Hot Springs Subbasin, a horizontal hydraulic conductivity of 25 ft/day and a vertical hydraulic conductivity 2.5 ft/day are used. For the Mission Creek Subbasin, a horizontal conductivity of 59 ft/day and a vertical hydraulic conductivity of 5.9 ft/day are used. For the Whitewater Subbasin, horizontal hydraulic conductivity of 52 ft/day and a vertical hydraulic conductivity of 5.2 ft/day are used.

For the Garnet Hill Subbasin in the vicinity of the proposed WVWRF hydraulic conductivity was calculated from pumping discharge volume and drawdown of Well 33. This results in a specific capacity which is used to determine transmissivity using the following formula:

$$\frac{Q}{s} = \frac{T}{1500}$$ for an unconfined aquifer.

Hydraulic conductivity is calculated using:

$$K = \frac{T}{b}$$

where b = aquifer thickness (1100 feet).

Hydraulic conductivity in gallons per day per feet^2 is then reduced to ft/day by converting gallons into cubic feet. Based on this calculation a horizontal hydraulic conductivity of 1.3 ft/day and a vertical hydraulic conductivity of 0.13 ft/day are used for the Garnet Hill Subbasin in the model. This value agrees with the range of hydraulic conductivity used by Psomas in the Garnet Hill Subbasin, 1 ft/d to 8 ft/d. The range of values is evaluated in a sensitivity analysis of the groundwater flow model using storage, and hydraulic conductivity. The sensitivity analysis is presented in Section 5.9.

4.1.3 STORAGE COEFFICIENT

A storage coefficient value of 0.15 was used on the basis of values presented in Psomas (2013), which is derived from Tyley (1974).

4.2 WELLS

Simulated wells are wells 27, 29, 31, 32, 33, and 37 in the MSWD and Coachella Valley Water District wells 11A2_3405, 12C1_3406, 12F1_3410, 12H1_3409. Well 33 is simulated to pump at 750 gallons per minute, 24 hours per day. Based on MSWD records Well 33 production averages about 700 gallons per minute for only about 12 hours per day. Therefore, the simulated 750 gallons per minute, 24 hours per day, is considered a worst case scenario.

4.3 BOUNDARIES

Boundaries types simulated in the model include recharge from rainfall and percolation basins, and flow across fault boundaries.

4.3.1 RECHARGE

Annual rainfall is about 4.7-5 inches per year and the evaporation rate is 60-100 inches per year. In the model, recharge from precipitation/evaporation is considered negligible. There is no simulated recharge from constant head boundaries, in order to produce worst case scenario results.

4.3.2 PERCOLATION BASINS

The WVWRF's two simulated percolation basins are each 220 feet by 220 feet for a total of 96,800 ft^2 area. In order to create a worst case scenario, the percolation basins simulate continuous recharge with no rotation. Based on information provided in the draft PDR-inprogress, for an initial design flow of 1.5 mgd, two infiltration basins plus 1 spare basin for redundancy for a total of three basins are identified. Each basin has dimensions of 220 feet square and are loaded to a maximum of one foot of water depth. The rotation cycle is a best guess at this point and will depend on actual percolation performance. As a starting point for the purpose of groundwater modeling, we can assume the ponds receive effluent in sequence. One pond receives effluent (active) while the other two ponds do not receive effluent (rest). The rotation schedule for each pond is assumed to be two weeks "active" followed by four weeks of "rest". The loading frequency, number and sizes of ponds, and pond locations (WVWRF site and/or the alternative pond site) can be adjusted during the modeling if a more optimal configuration can be determined.

Recharge is assigned to the two percolation basins, at rates presented in Table 1. The recharge rates are based on the anticipated wastewater flows to the WVWRF presented in TKE (2017). Initially, the WVWRF will have an average daily flow of 0.232 MGD. The average daily flows are projected to gradually increase to 0.597 MGD by Year 5, 1.034 MGD by Year 7, and 1.243 MGD Year 10. The WVWRF's selected Phase 1 capacity of 1.5 MGD would take the plant capacity up to the flow projections for Year 14 (TKE, 2017); with the next phase increasing WVWRF capacity to 3.0 MGD. The average daily flows are projected to continue gradually increasing to 1.863 MGD by Year 20 and to 3.0 MGD by Year 30.

TABLE 1
RECHARGE RATES APPLIED TO PERCOLATION BASINS

TIME (YEARS)	VOLUME MILLION GALLONS PER DAY (MGD)	RECHARGE RATE (INCHES PER YEAR)
0 - 5	0.232	1400
5 -7	0.597	3610
7-10	1.034	6250
10-14	1.243	7520
14-20	1.5	9070
20-30	1.863	11270
30-100	3.000	18150

NOTE: TIME AND VOLUME SCHEDULE PROVIDED BY MSWD

A constant nitrate concentration of 10 mg/L is used for the recharge into the percolation basins; based on typical permitted effluent requirements from the Colorado River Regional Water Quality Control Board for total nitrogen.

4.3.4 HORIZONTAL FLUX BOUNDARIES

The subbasins in the northern Coachella Valley are separated by strike-slip faults that strike in a west by northwest direction. The faults impede the groundwater flow. In order to represent the faults, the Horizontal Flux Boundary package is used. Based on the acre-feet per year indicated in the groundwater model by Psomas (2013), the hydraulic conductivity for each fault using the HFB package was calculated from the length of the fault represented in the Psomas model and a thickness of 1,100 feet for the unconfined, unconsolidated aquifer.

The value used for hydraulic conductivity across the Mission Creek fault is 0.0049 ft/day. The value used for the hydraulic conductivity across the Banning fault is 0.017 ft/day. The value used for the hydraulic conductivity across the Garnet Hill fault is 0.0387 ft/day.

TABLE 2
SUMMARY OF TRANSIENT MODEL INPUT PARAMETERS

LAYERS	4
HYDRAULIC CONDUCTIVITY (HORIZONTAL)	1.3 ft/day
HYDRAULIC CONDUCTIVITY (VERTICAL)	0.13 ft/day
STORAGE	0.15
WELL 33 PUMPING RATE	750 GPM
FAULTS (HORIZONTAL FLUX BOUNDARIES)	
Mission Creek fault	0.0049 ft/day
Banning fault	0.017 ft/day
Garnet Hill fault	0.0387 ft/day.

5.0 MODEL SIMULATIONS

Model simulation output graphics are correlated to the recharge schedule presented in TABLE 1. The pumping of Well 33 is sustained at 750 gallons per minute for the duration of the simulation - 100 years. Output files present a particle tracking output using MODPATH and a mass transport output using MT3DMS for Layer 1 and a chemical concentration using MT3DMS for Layer 1. Cross sections are presented with a vertical exaggeration of 2. These results are shown in Appendix B.

5.1 5 YEARS

The volume simulated into the percolation basins from 0 to 5 years is 0.232 MGD. The output of the simulation at the end of 5 years shows that the particle begins to track south and the chemical concentration under the recharge percolation basins begins to enlarge to the south.

5.2 7 YEARS

The volume simulated into the percolation basins from 5 to 7 years is 0.597 MGD. The output of the simulation at the end of 7 years shows that the particle begins to track south and the area affected by nitrate under the recharge percolation basins grows larger.

5.3 10 YEARS

The volume simulated into the percolation basins from 5 to 10 years is 1.034 MGD. The output of the simulation at the end of 10 years shows that the particle continues to track south and the chemical concentration under the recharge percolation basins enlarges.

5.4 14 YEARS

The volume simulated into the percolation basins from 10 to 14 years is 1.243 MGD. The output of the simulation at the end of 14 years shows that the particle continues to track south and the chemical concentration under the recharge percolation basins enlarges toward the south.

5.5 20 YEARS

The volume simulated into the percolation basins from 14 to 20 years is 1.5 MGD. The output of the simulation at the end of 20 years shows that the particle continues to track south southeast in a down gradient direction and the chemical concentration under the recharge percolation basins enlarges toward the south. Figures in Appendix B present a zoom in of the area in order to present more identifiable chemical concentrations.

5.6 30 YEARS

The volume simulated into the percolation basins from 20 to 30 years is 1.863 MGD. The output of the simulation at the end of 30 years shows that the particle continues to track south southeast in a down gradient direction and the chemical concentration under the recharge percolation basins enlarges toward the south. A northward migration can also be observed in the cross section, although nitrate has not traveled as far as Well 33 by this time.

5.7 50 YEARS

The volume simulated into the percolation basins from 30 to 50 years is 3.0 MGD. Continued southward migration of impacted groundwater is observed by 50 years. As shown in a cross section, the water containing the nitrate reaches Well 33 to the north of the WVWRF. The increase in recharge volume to the percolation ponds from the growing WVWRF operations after year 30 makes a significant difference in the groundwater flow system as a result of increased mounding.

5.8 100 YEARS

The volume simulated into the percolation basins from 50 to 100 years is 3.0 MGD. The output of the simulation at the end of 100 years shows that the concentration continues to track south southeast in a down gradient direction and the nitrate concentration under the recharge percolation basins enlarges toward the south. Nitrate has reached Well 33 in the output for 50 years and continues to affect Well 33 at the continuing larger rates of discharge to the percolation basins. Figures include a profile of the column with the highest concentration under the percolation basins, showing the "mounding" created by the recharge of the basins. The drawdown from the well does not appear to sufficiently influence the hydraulic gradient in the vicinity of the percolation basins, the natural hydraulic gradient is the driving force of the direction of groundwater flow and the concentration in the recharge as it is moving away from the well to the south and southeast. However, mounding does occur and continued northward migration of water from the percolation basins is predicted.

5.9 SENSITIVITY ANALYSIS

The response of the model is evaluated using a sensitivity analysis. The parameters of the storage coefficient and hydraulic conductivity (horizontal) were changed and the model was run with the revised parameters; the lower and upper values of the Garnet Hill Subbasin for the transient calibration in Psomas (2013). In various sensitivity analysis runs, the storage coefficient was changed to 0.1 and the hydraulic conductivity (horizontal) to 1.0 feet/day, then the storage coefficient was changed to 0.2 and the hydraulic conductivity (horizontal) to 7.6 feet per day. The vertical hydraulic conductivity was modeled as 0.10 of the horizontal conductivity value in another simulation.

Sensitivity analyses results indicate that a lower storage coefficient limit, 0.1, and a lower limit hydraulic conductivity (horizontal), 1.0 feet/day, result in a slightly lower velocity of the groundwater from the percolation basins. The water from the percolation basin begins an observed northward migration in the output at 30 years and impacts Well 33 in the 50 year output. Using the upper storage limit, 0.2, and the upper hydraulic conductivity, 7.6 feet/day (horizontal), results indicate an increase in the velocity of the impacted groundwater in a downgradient direction and the groundwater from the percolation basins does not impact Well 33. The results of the model output using the lower and upper limits for the storage and hydraulic conductivity for 5, 10, 20, 30, 50 and 100 years are presented in APPENDIX C.

Additional sensitivity is shown using a lower recharge rate in the percolation basins. In simulation with a lower recharge rate, the impacted groundwater did not extend to Well 33.

6.0 CONCLUSIONS & RECOMMENDATIONS

Based on the results of groundwater flow and transport modeling output presenting the particle path line tracking and mass transport results for Layer 1 and Layer 2, the treated water discharged to the percolation basins is predicted to potentially impact the production Well 33 after 30 years of operation if hydraulic conductivity is at the lower end of estimated values and recharge rates increase as currently estimated. At higher hydraulic conductivity values, more southward migration of recharge from the percolation ponds is observed in the modeled results. The model was not designed to specifically evaluate the effect on beneficial uses of groundwater because very conservative parameters were used to model the flow from percolation ponds. The groundwater monitoring system for the WVWRF should be constructed to provide observations of the growth of the groundwater mound beneath the percolation ponds and early warning data to protect Well 33.

7.0 LIMITATIONS

These results are limited by the quality and quantity of the data provided. The greater the data entered, the more accurate the analysis.

A limitation is due to the fact that the modeled constituent of concern, nitrate, in groundwater has several possible sources other than the discharge from the WVWRF. For example, septic leachate from private residences, fertilizer, and in situ decomposition of organics are potential sources of nitrate. Additionally, other potential constituents of concern such as total dissolved solids or chloride were not modeled.

The analysis is geologically limited by the lithology and hydraulic conductivity assumed in the construction of the model.

Changes in groundwater elevation and direction may have an impact on the results.

8.0 REFERENCES

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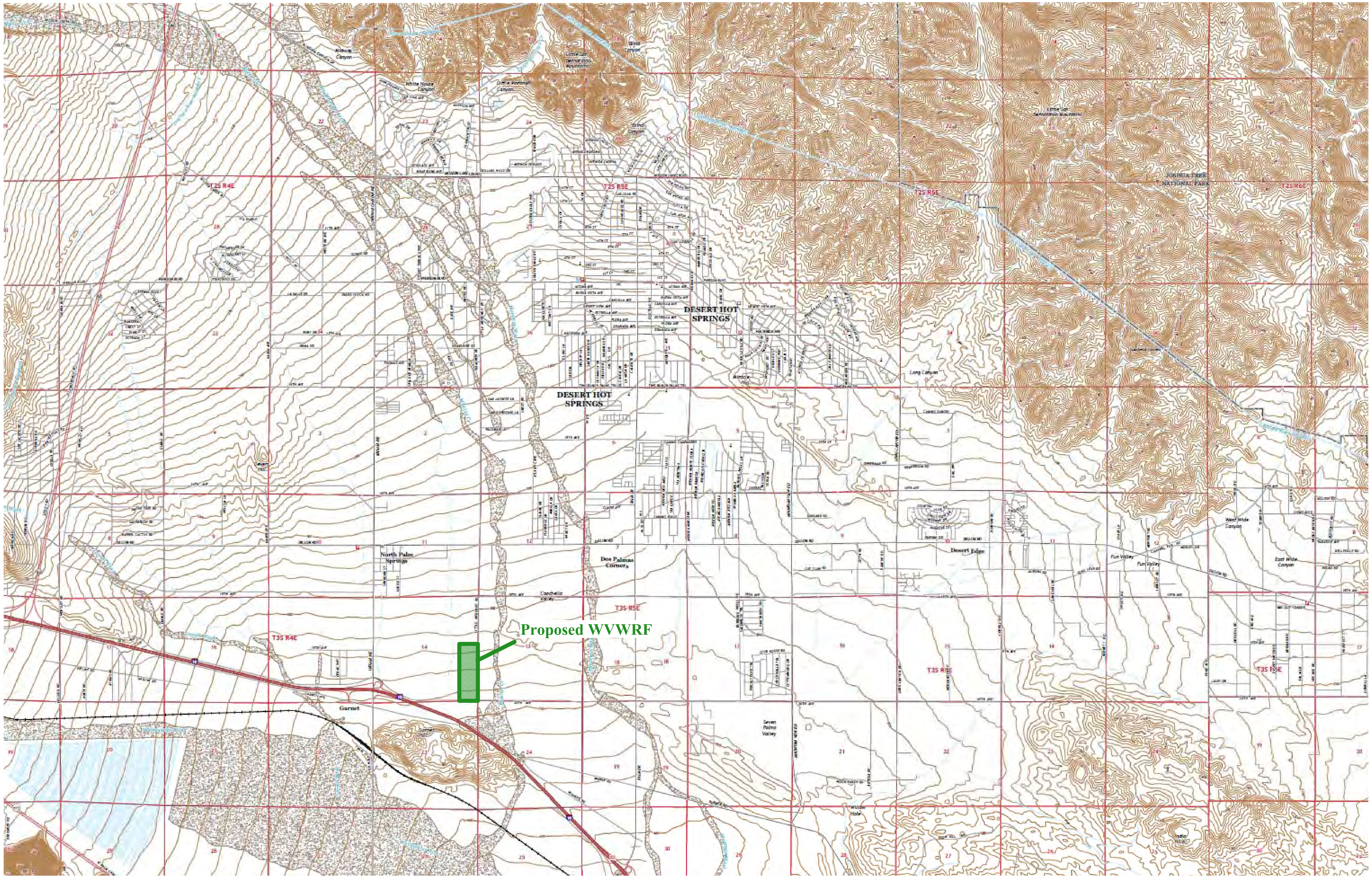
FIGURES



Map Base: Desert Hot Springs and Seven Palms Valley Topographic Maps, USGS, 2015

MISSION SPRINGS WATER DISTRICT

PROPOSED WEST VALLEY WATER RECLAMATION FACILITY

North

Scale: 1 Inch = Approximately 1 Mile

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FIGURE 1
SITE VICINITY MAP

Desert Hot Springs, California

PROPOSED
WEST VALLEY WATER RECLAMATION FACILITY

Desert Hot Springs, California

Map Base: Overall Plant Layout (AECOM, 2017)

North

Scale: 1 Inch = Approximately 200-feet

FIGURE 2
SITE LAYOUT

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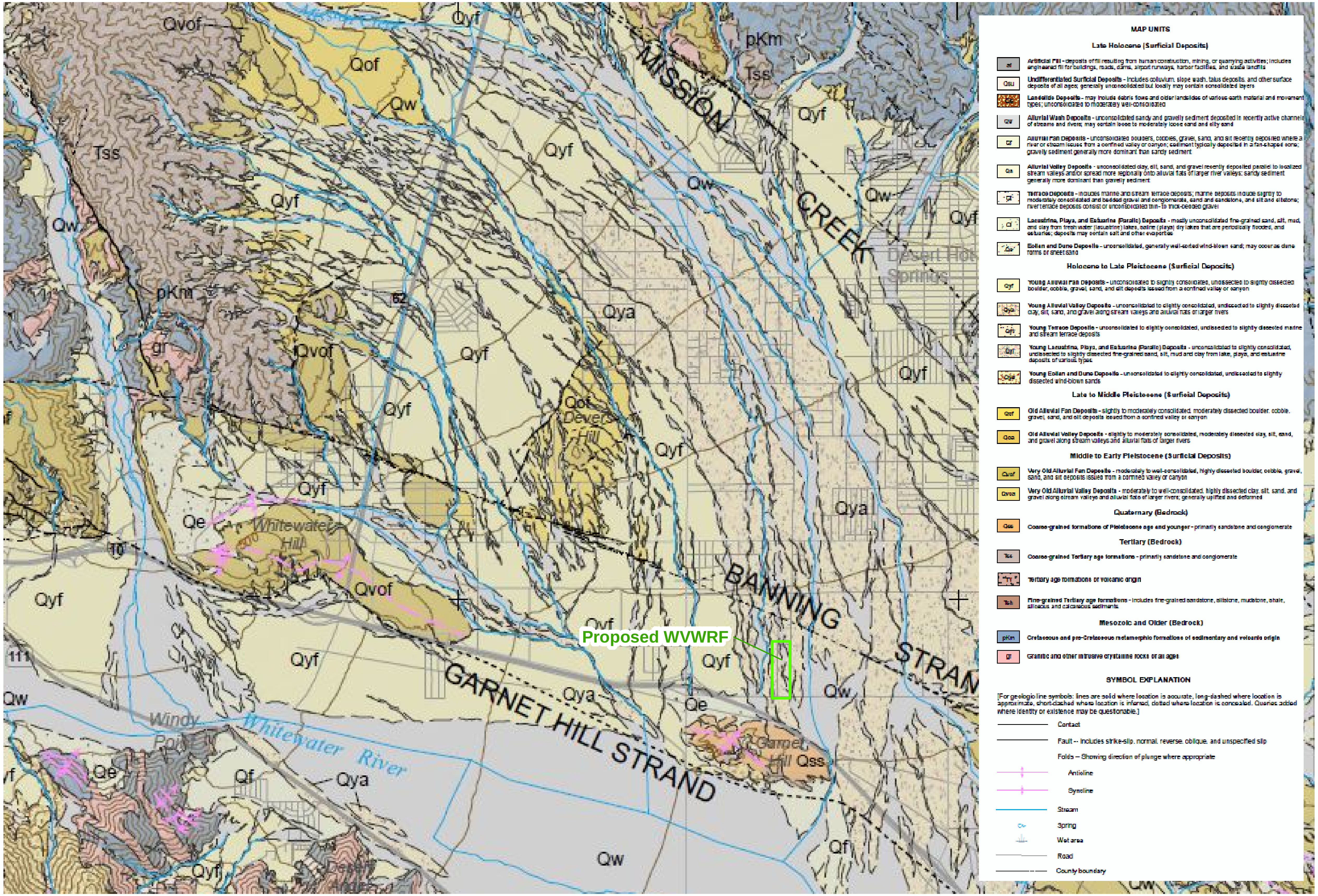

T3S, R5E
San Bernardino Meridian
Riverside County, California

PROPOSED WEST VALLEY WATER RECLAMATION FACILITY

1 inch = 1 mile

0 0.25 0.5 0.75 1 Miles

FIGURE 3
AREAL GEOLOGY

Mission Springs Water District
Desert Hot Springs, California

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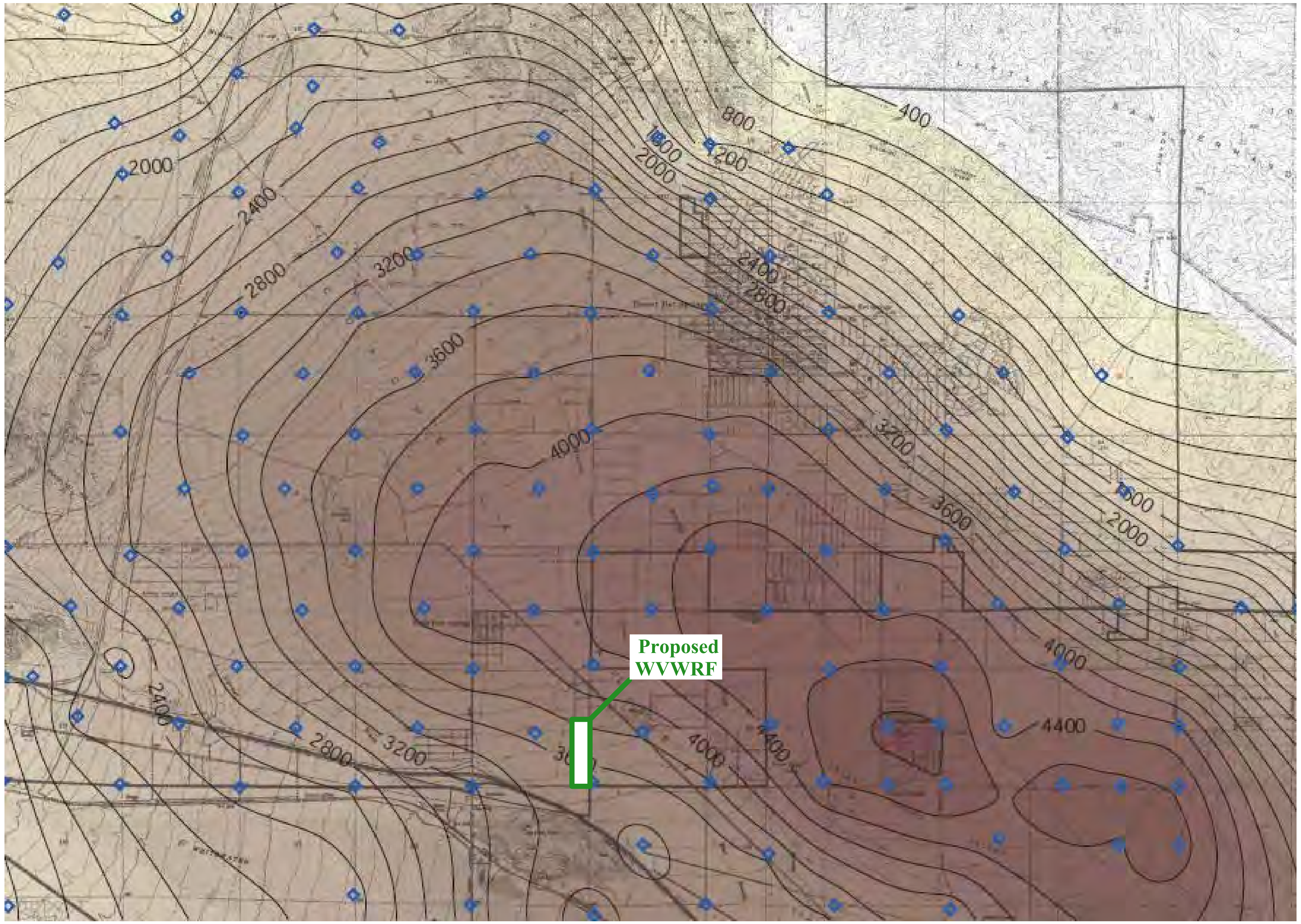
This map was prepared for the purpose of identifying the location of general site features and water resources only and is not intended to provide a legal description or location of property ownership lines.

World Geodetic System (WGS)
Datum of 1984
Prepared: March 23, 2018

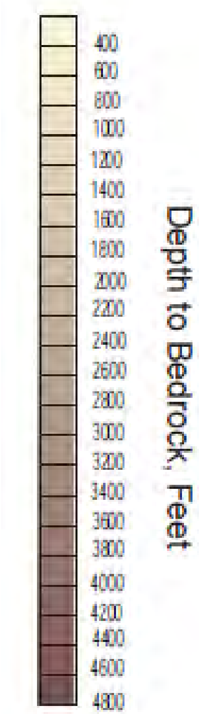
Sources: CGS Preliminary Geologic Map of Quaternary Surficial Deposits in Southern California Palm Spring 30' x 60' Quadrangle (CGS Special Report 217, Plate 24, 2012)

PROPOSED
WEST VALLEY WATER
RECLAMATION FACILITY

Desert Hot Springs, California



Map Base: Individual Depth to Crystalline Bedrock (GSI/Water, 2003)



North

Scale: 1 Inch = Approximately 6,000-feet

FIGURE 4
DEPTH TO
CRYSTALLINE
BEDROCK

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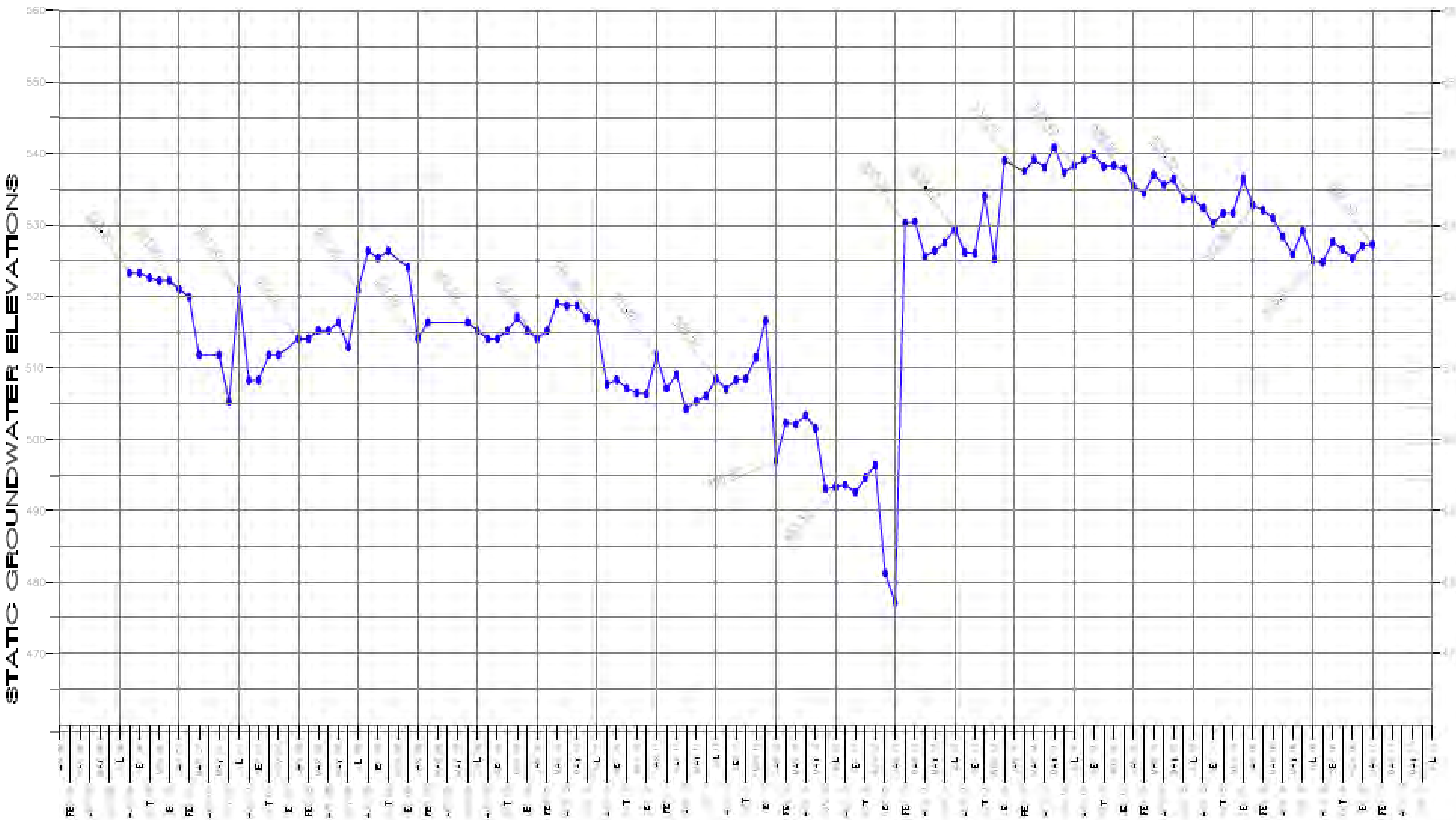

PROPOSED
WEST VALLEY WATER
RECLAMATION FACILITY

Desert Hot Springs, California

Source: Well Graphs (TKE Engineering, 2017)

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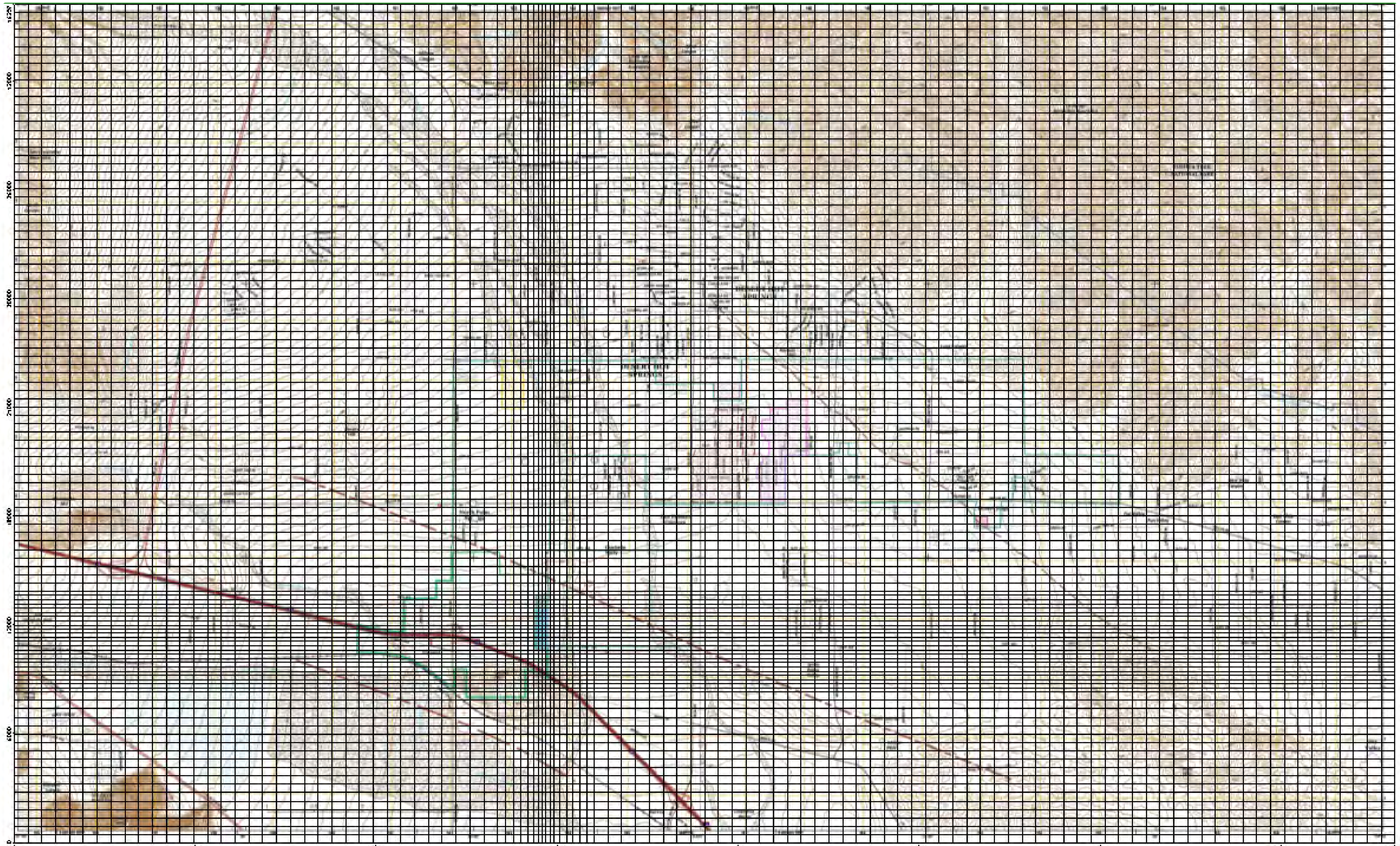
FIGURE 5
WELL 33 HYDROGRAPH

APPENDIX A

Appendix A presents graphics that describe the groundwater model set up, initial conditions, and boudndary conditions.

PROPOSED
WEST VALLEY WATER
RECLAMATION FACILITY

Desert Hot Springs, California



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Scale: 1 Inch = Approximately 6,000-feet

FIGURE 1
MODEL GRID

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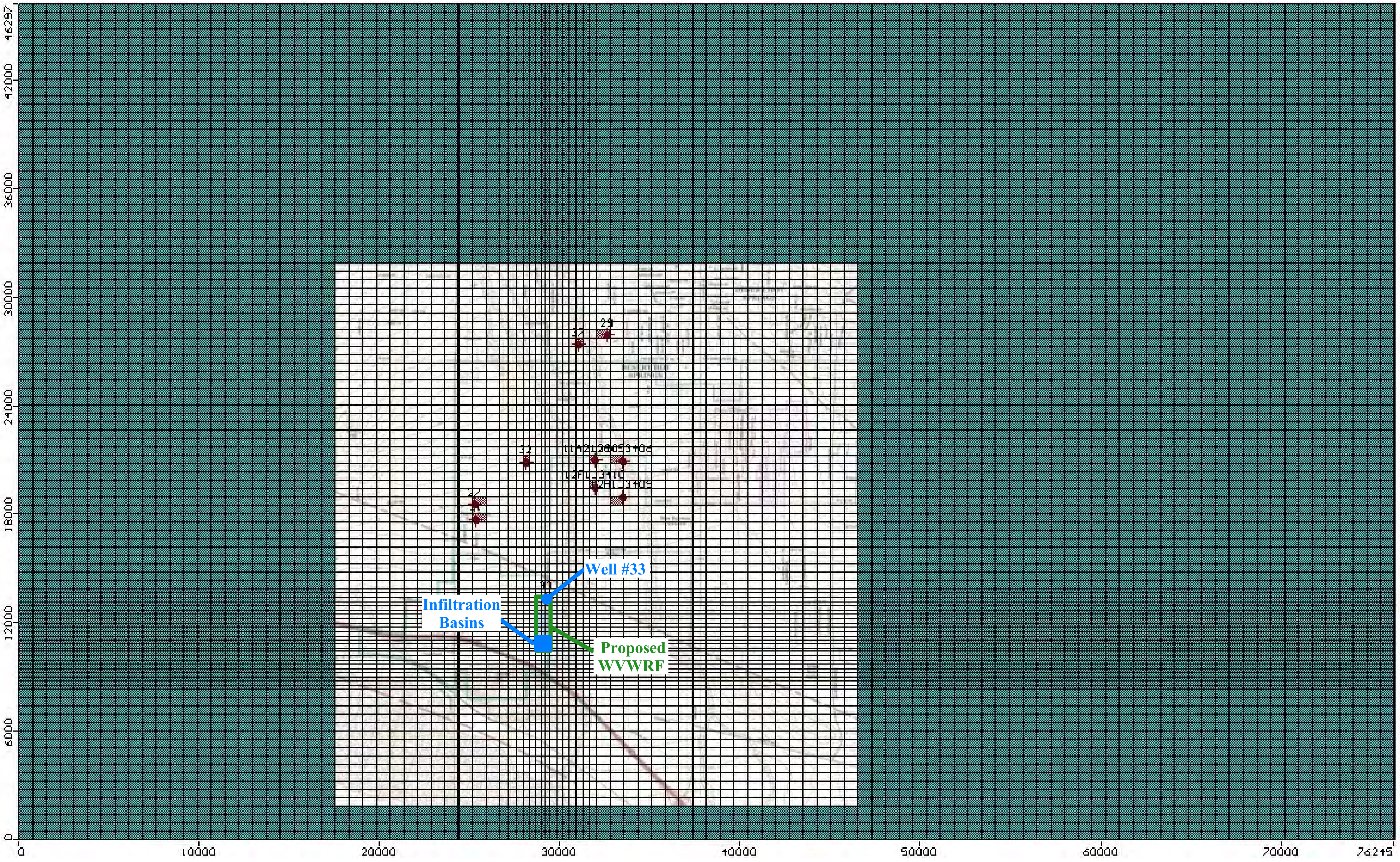
WEST VALLEY WATER
RECLAMATION FACILITY

Desert Hot Springs, California



Map Base: MODFLOW finite-difference grid on topographic map domain

North

Scale: 1 Inch = Approximately 6,000-feet

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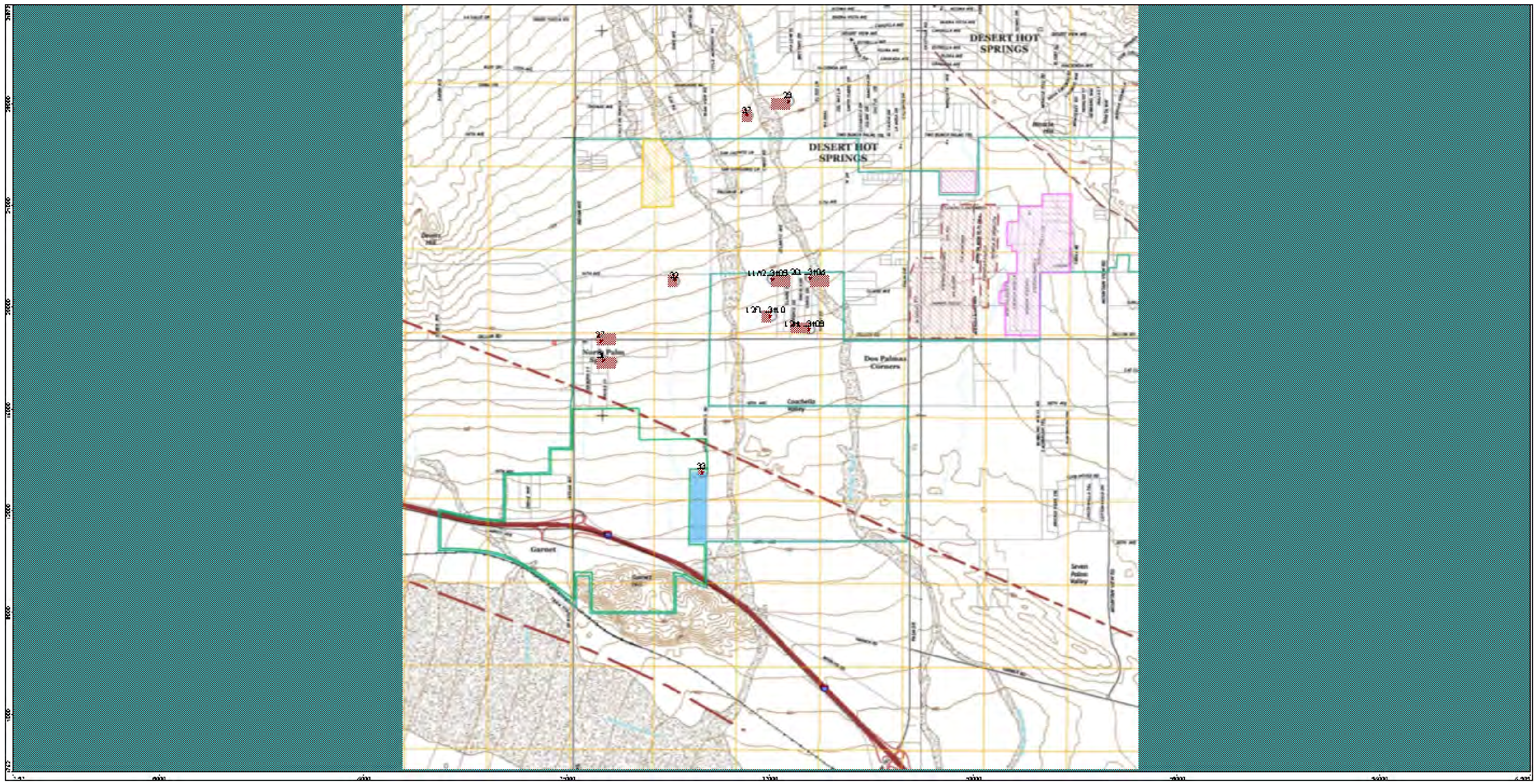
FIGURE 2
INACTIVE FLOW

PROPOSED
WEST VALLEY WATER
RECLAMATION FACILITY

Desert Hot Springs, California



North

Scale: 1 Inch = Approximately 6,000-feet

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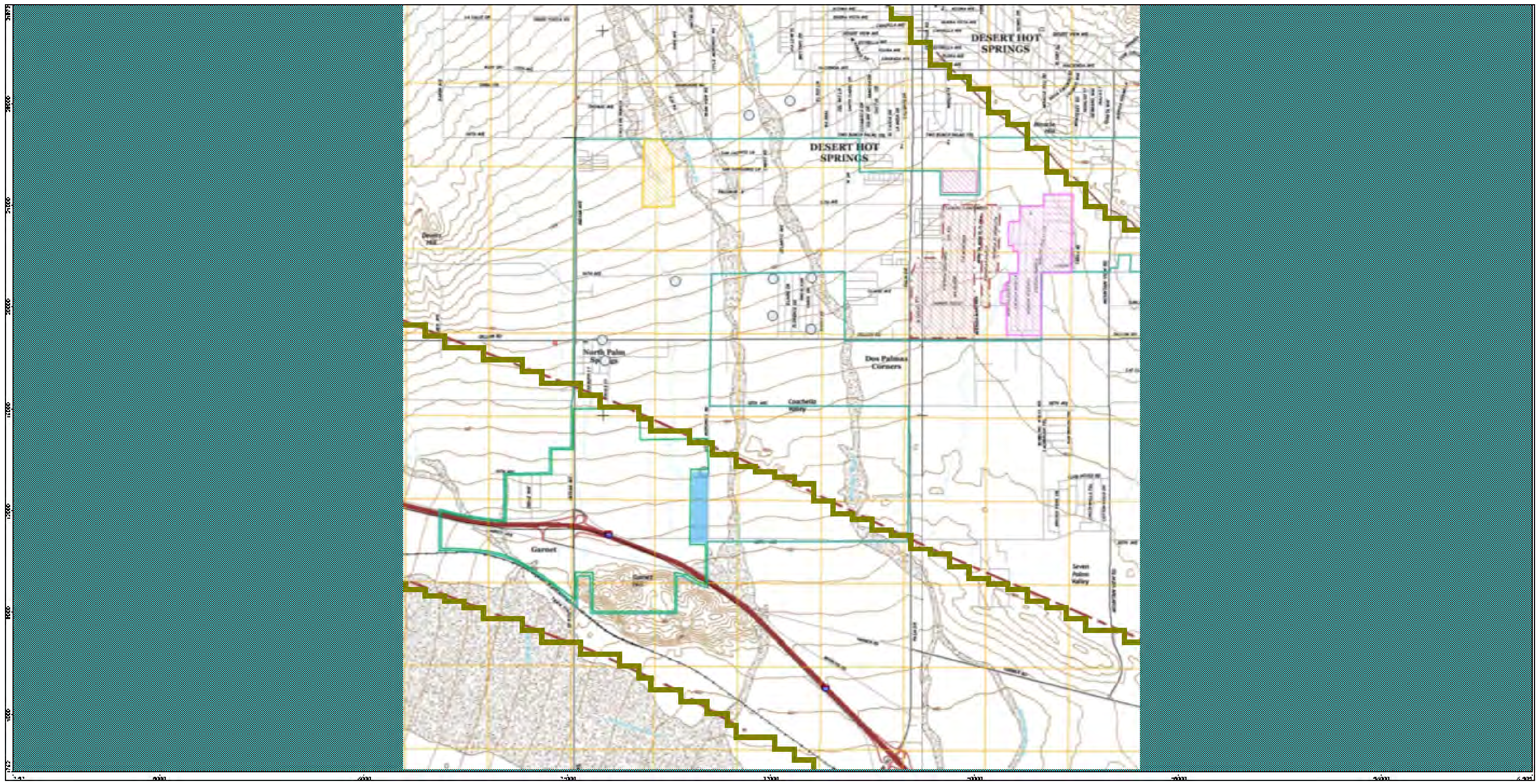
FIGURE 3
WELLS

PROPOSED
WEST VALLEY WATER
RECLAMATION FACILITY

Desert Hot Springs, California



North

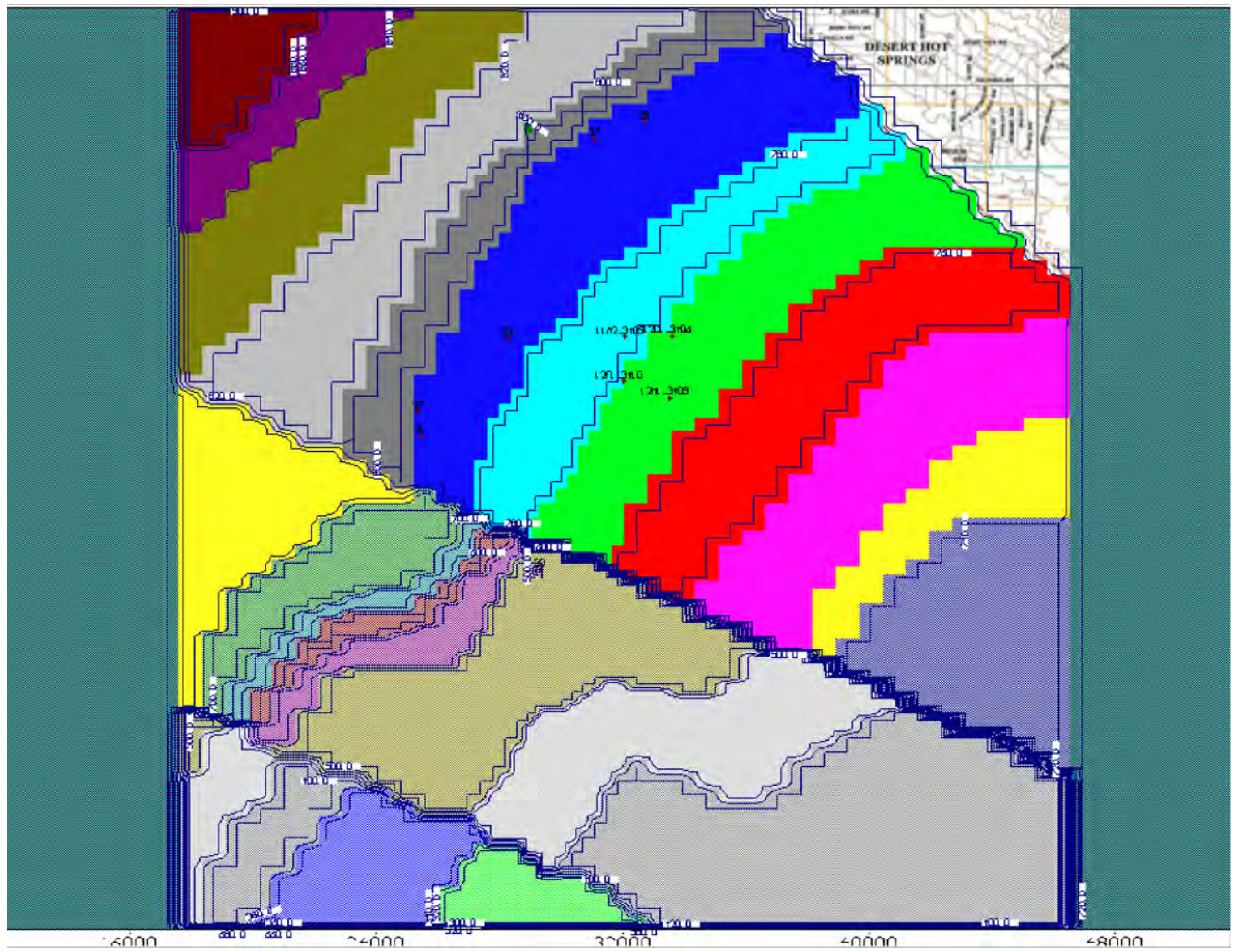
Scale: 1 Inch = Approximately 6,000-feet

EnviroLogic Resources, Inc.
ENVIRONMENTAL · WATER RESOURCES SCIENTISTS

FIGURE 4
HORIZONTAL FLUX
BOUNDARIES

PROPOSED
WEST VALLEY WATER RECLAMATION FACILITY

Desert Hot Springs, California



North

Scale: 1 Inch = Approximately 6,000-feet

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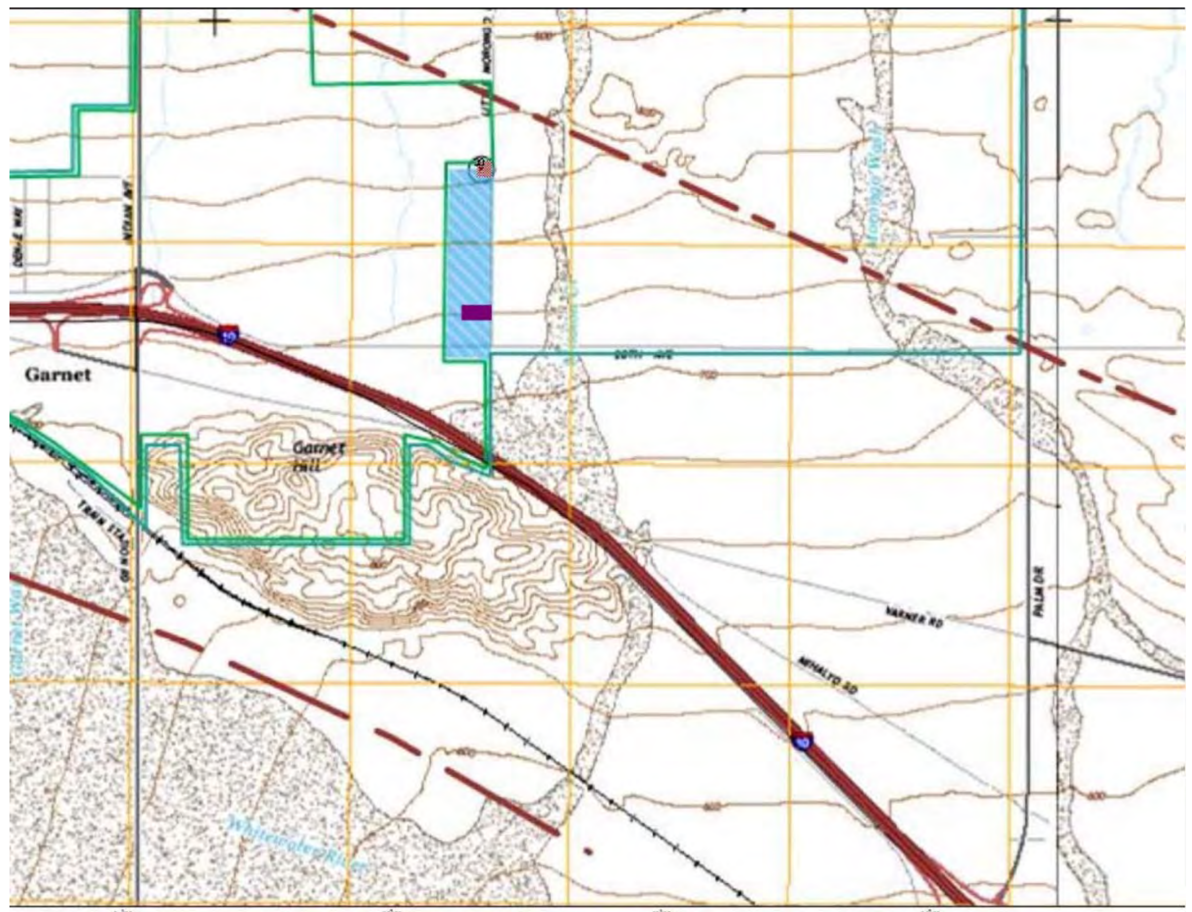
FIGURE 5
INITIAL HEADS

PROPOSED
WEST VALLEY WATER
RECLAMATION FACILITY

Desert Hot Springs, California



North

Scale: 1 Inch = Approximately 3,000-feet

FIGURE 6
PERCOLATION
PONDS

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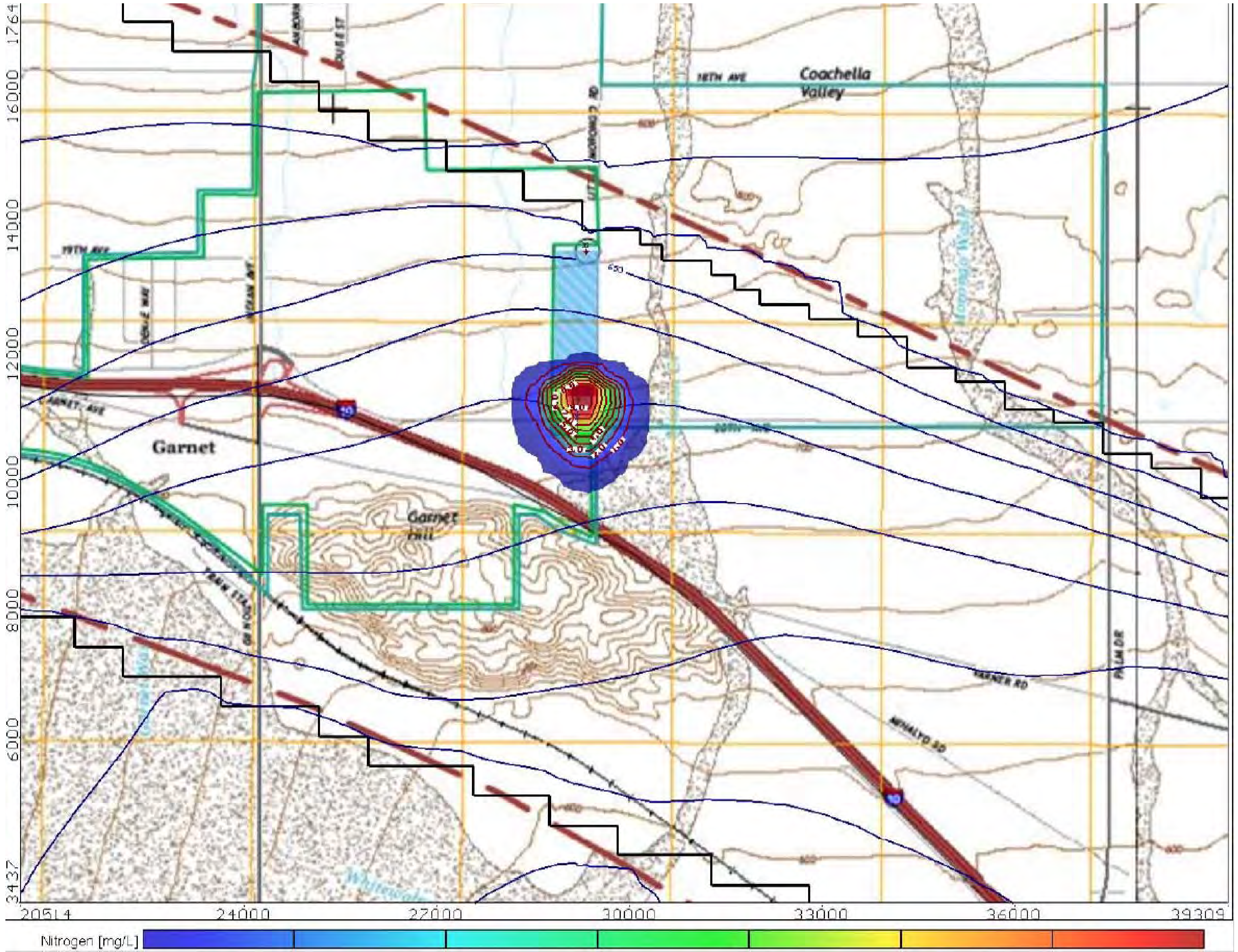
APPENDIX B

Appendix B presents graphics that show the output from the groundwater model for the assumed scenario of volumes discharged to percolation basins with model parameters that are derived from Psomas (2013).

PROPOSED
WEST VALLEY WATER
RECLAMATION FACILITY

Desert Hot Springs, California



North

Scale: 1 Inch = Approximately 1,750-feet

FIGURE 1
5 YEARS
NITROGEN
CONCENTRATION

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PROPOSED
WEST VALLEY WATER
RECLAMATION FACILITY

Desert Hot Springs, California

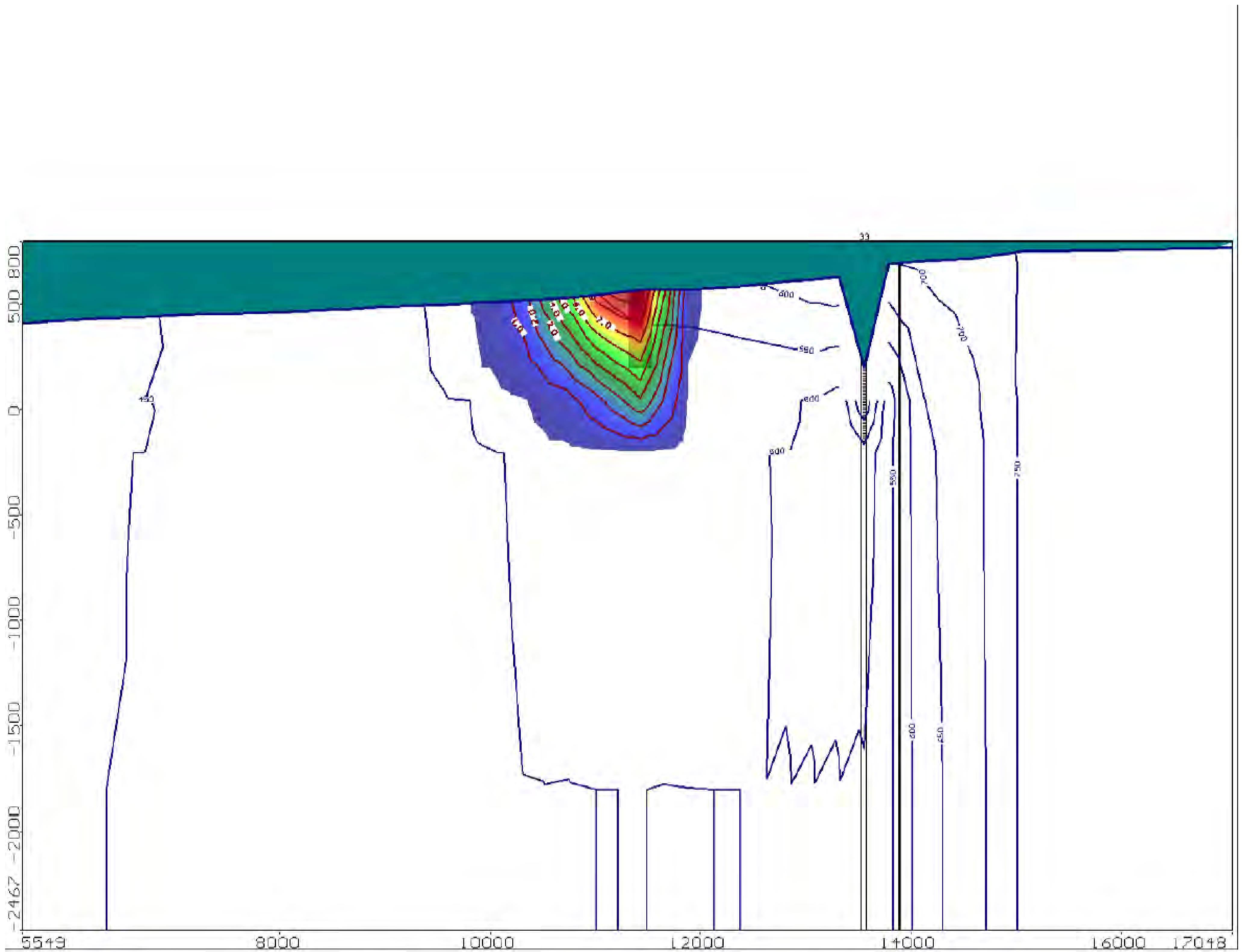

FIGURE 2
5 YEARS
NITROGEN
CONCENTRATION
CROSS-SECTION

EnviroLogic Resources, Inc.
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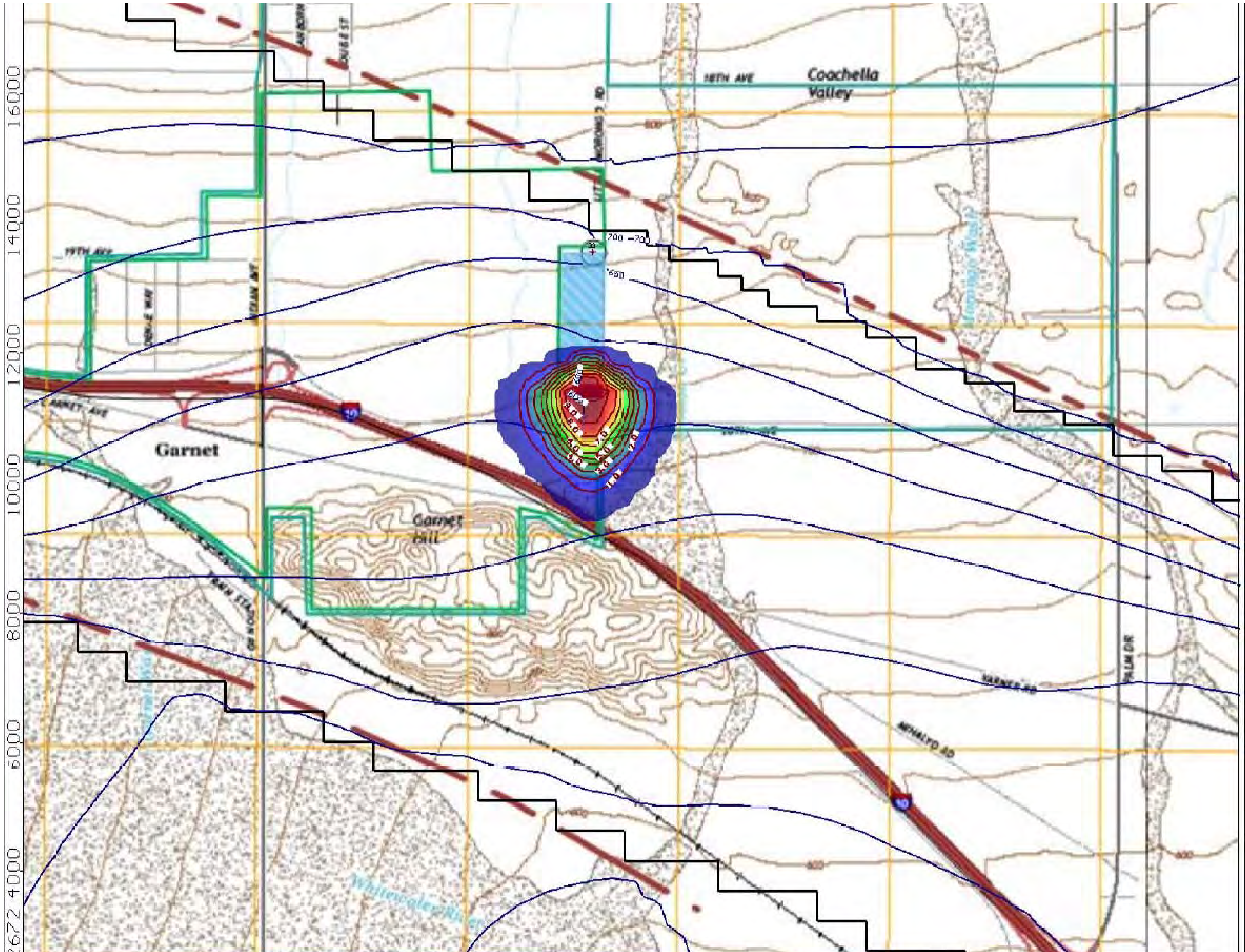

PROPOSED
WEST VALLEY WATER
RECLAMATION FACILITY

Desert Hot Springs, California

North

Scale: 1 Inch = Approximately 1,750-feet

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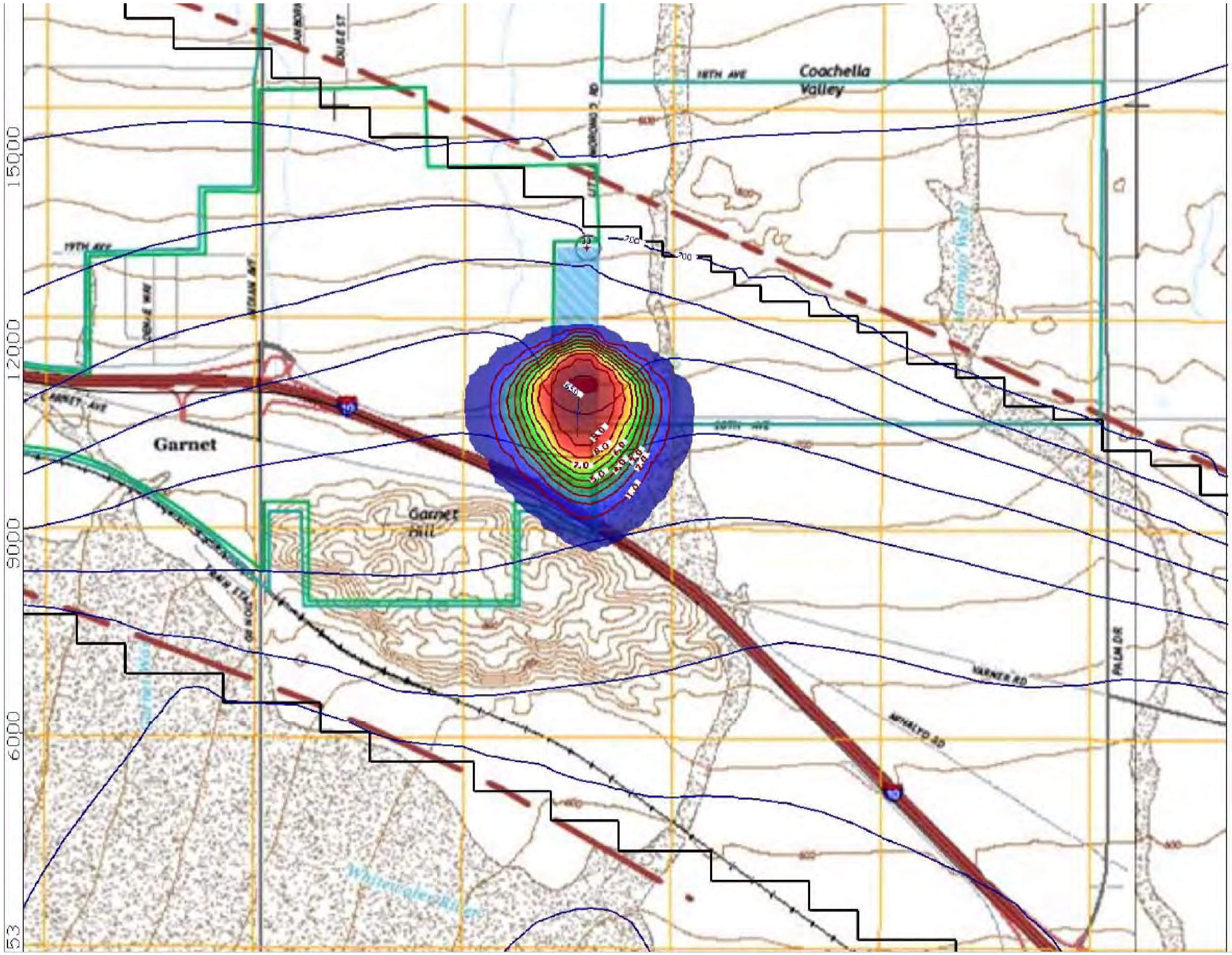
FIGURE 3
7 YEARS
NITROGEN
CONCENTRATION

PROPOSED
WEST VALLEY WATER
RECLAMATION FACILITY

Desert Hot Springs, California



North

Scale: 1 Inch = Approximately 1,750-feet

FIGURE 4
10 YEARS
NITROGEN
CONCENTRATION

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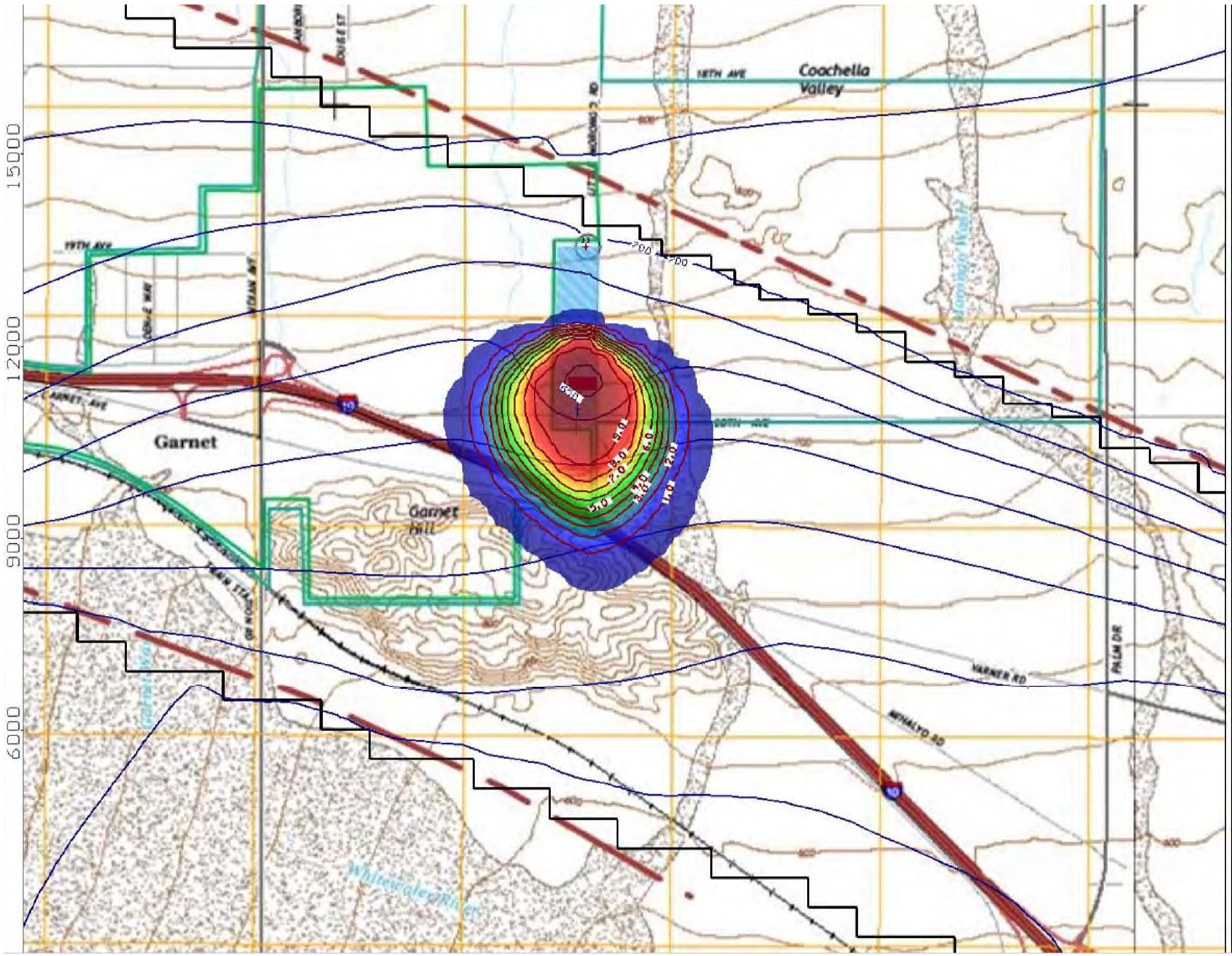
ENVIRONMENTAL · WATER RESOURCES SCIENTISTS

PROPOSED
WEST VALLEY WATER
RECLAMATION FACILITY

Desert Hot Springs, California

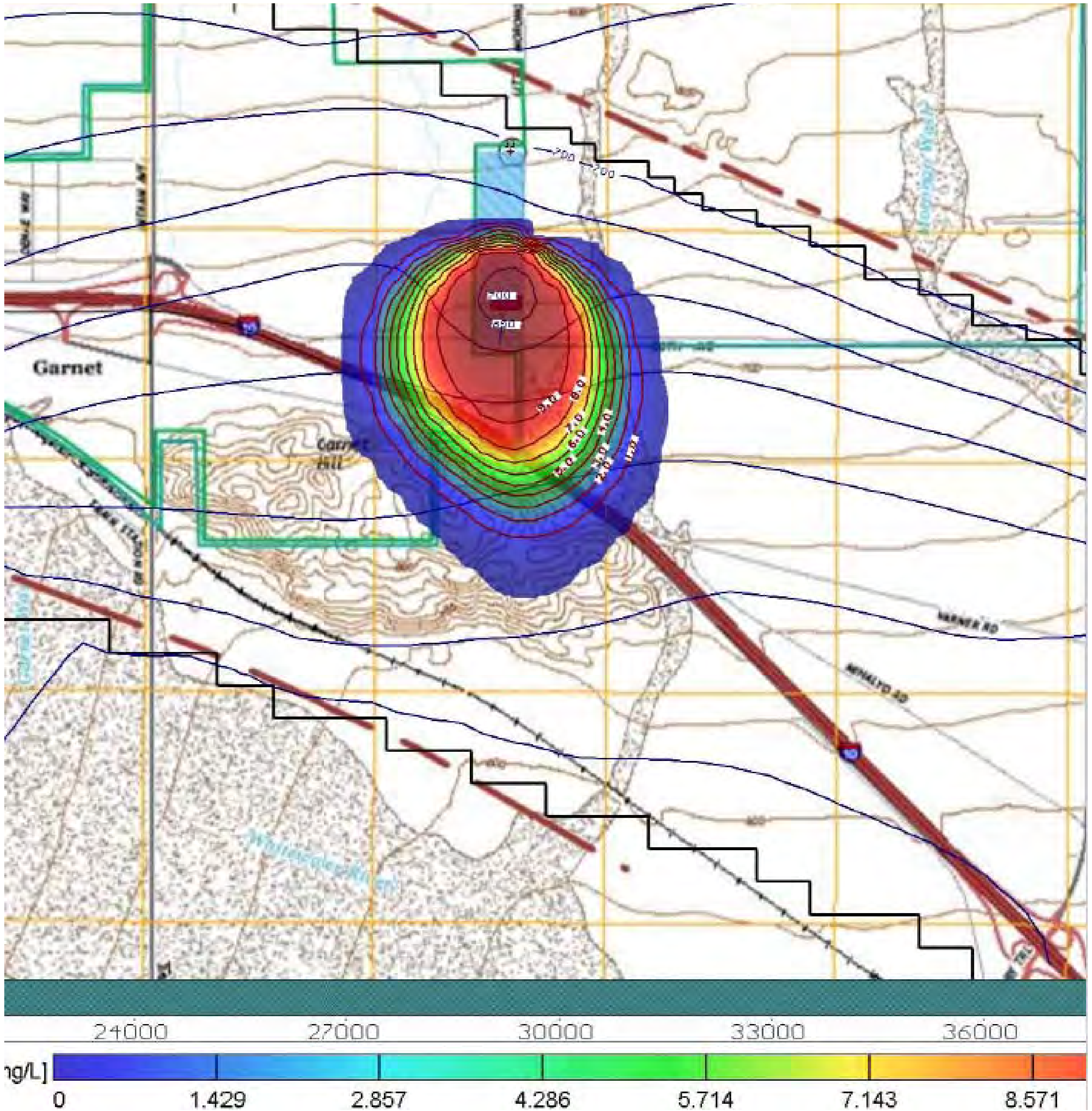


North

Scale: 1 Inch = Approximately 1,750-feet

FIGURE 5
14 YEARS
NITROGEN
CONCENTRATION

EnviroLogic Resources, Inc.
ENVIRONMENTAL · WATER RESOURCES SCIENTISTS



PROPOSED
WEST VALLEY WATER
RECLAMATION FACILITY

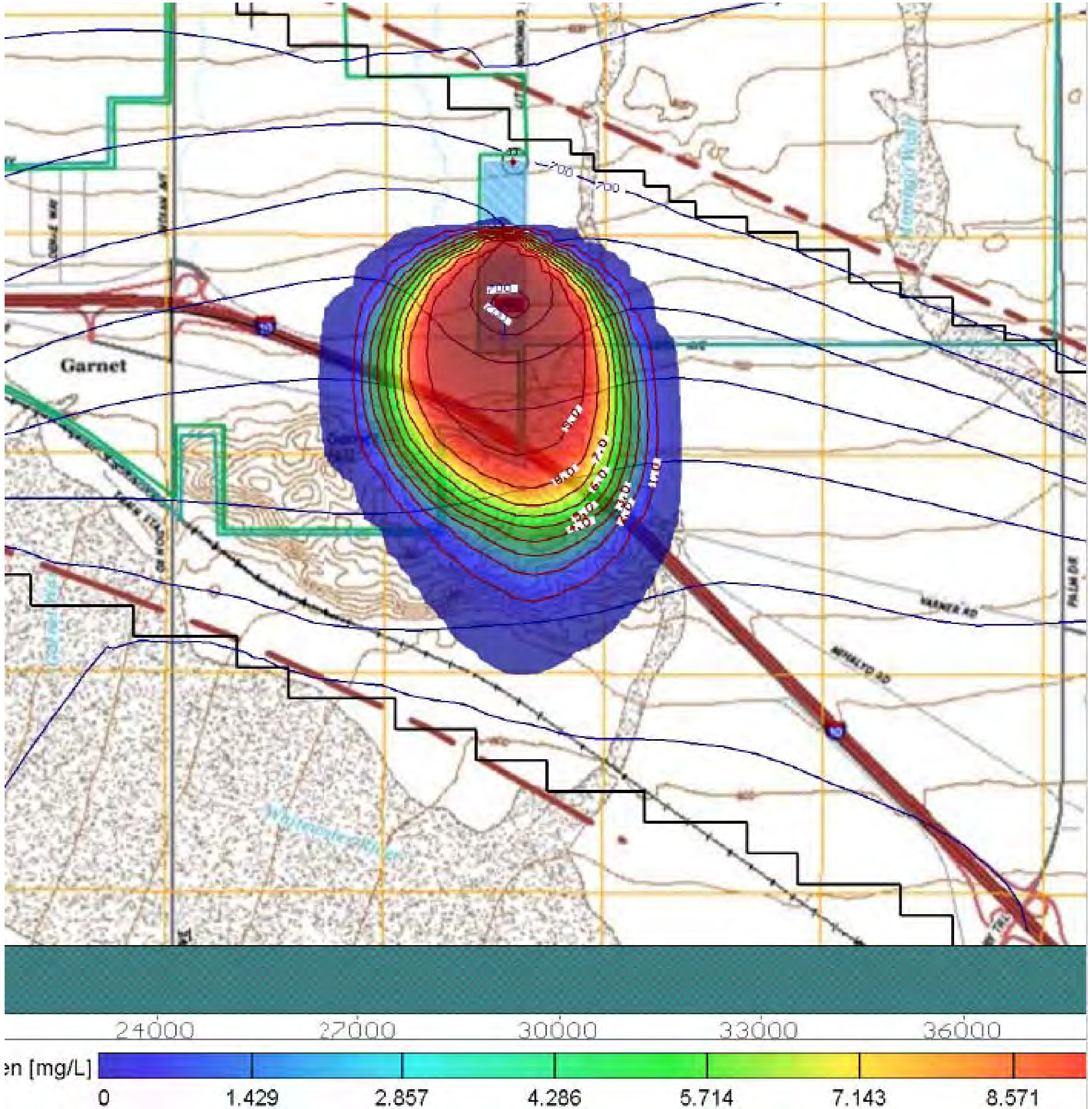
Desert Hot Springs, California

North

Scale: 1 Inch = Approximately 1,750-feet

FIGURE 6
20 YEARS
NITROGEN
CONCENTRATION

EnviroLogic Resources, Inc.
ENVIRONMENTAL · WATER RESOURCES SCIENTISTS



PROPOSED
WEST VALLEY WATER
RECLAMATION FACILITY

Desert Hot Springs, California

North

Scale: 1 Inch = Approximately 1,750-feet

FIGURE 7
30 YEARS
NITROGEN
CONCENTRATION

EnviroLogic Resources, Inc.
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PROPOSED
WEST VALLEY WATER
RECLAMATION FACILITY

Desert Hot Springs, California

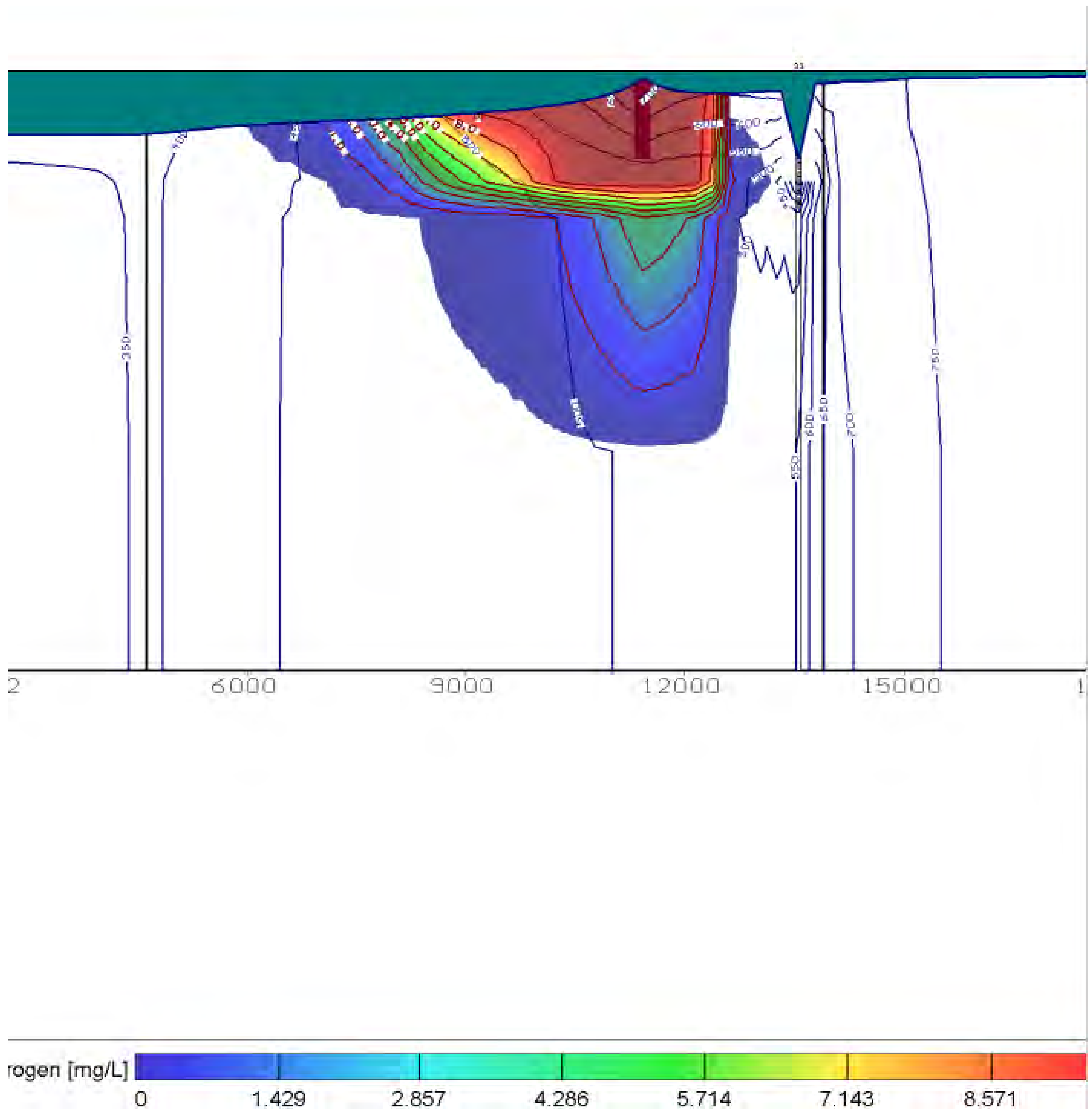

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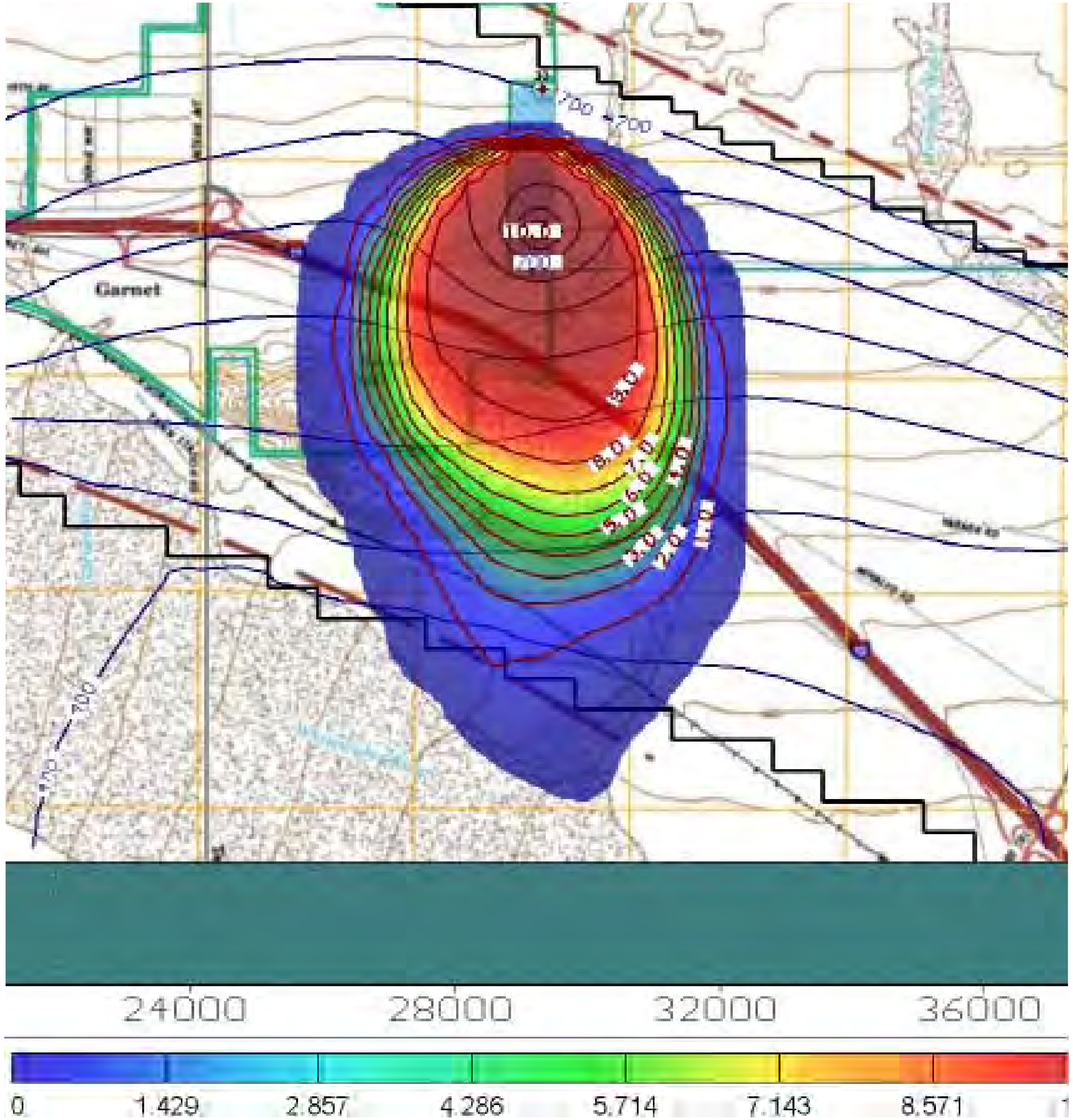
FIGURE 8
30 YEARS
NITROGEN
CONCENTRATION
CROSS-SECTION



PROPOSED
WEST VALLEY WATER
RECLAMATION FACILITY

Desert Hot Springs, California

North

Scale: 1 Inch = Approximately 1,750-feet

FIGURE 9
50 YEARS
NITROGEN
CONCENTRATION

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PROPOSED
WEST VALLEY WATER
RECLAMATION FACILITY

Desert Hot Springs, California

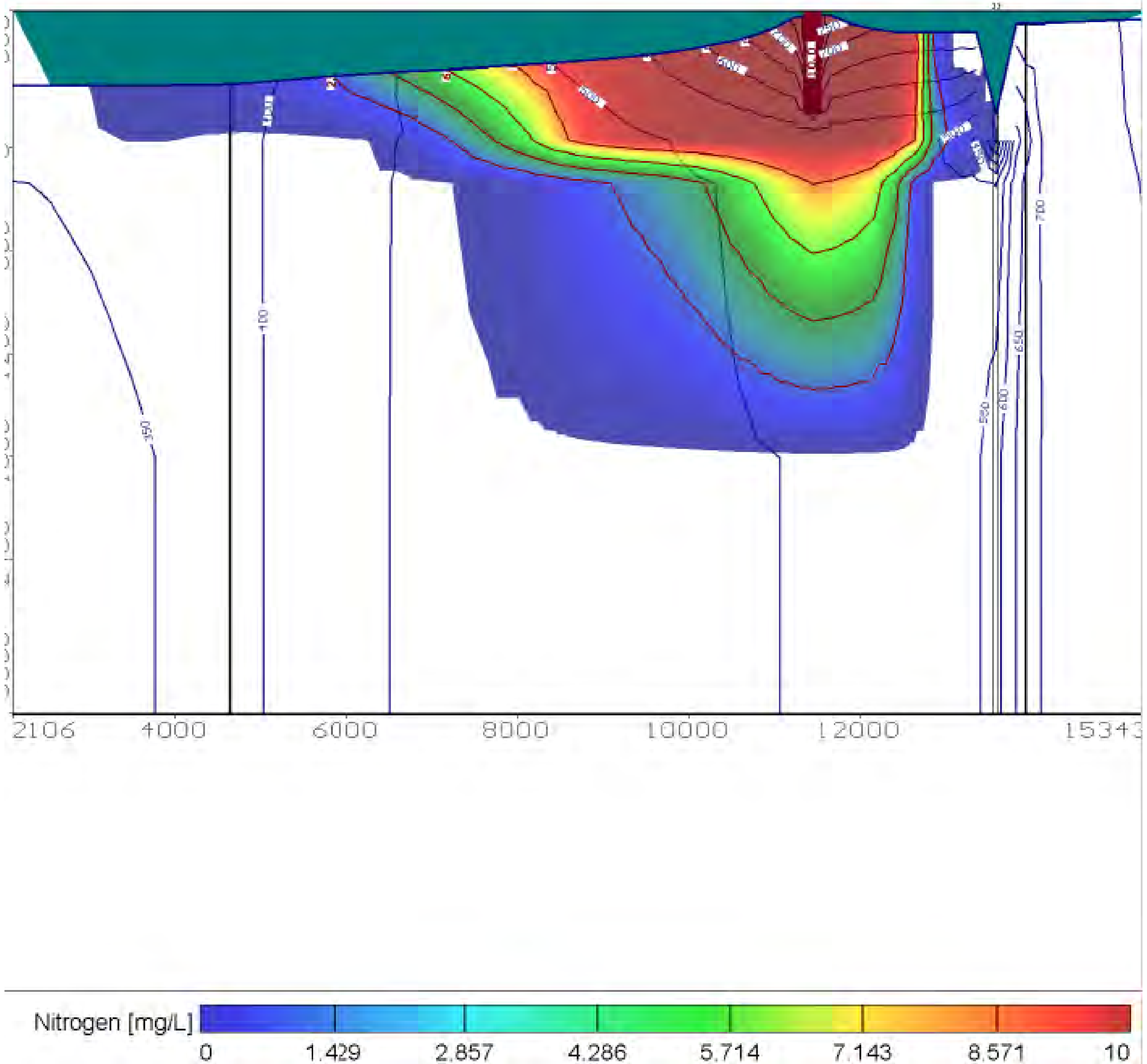

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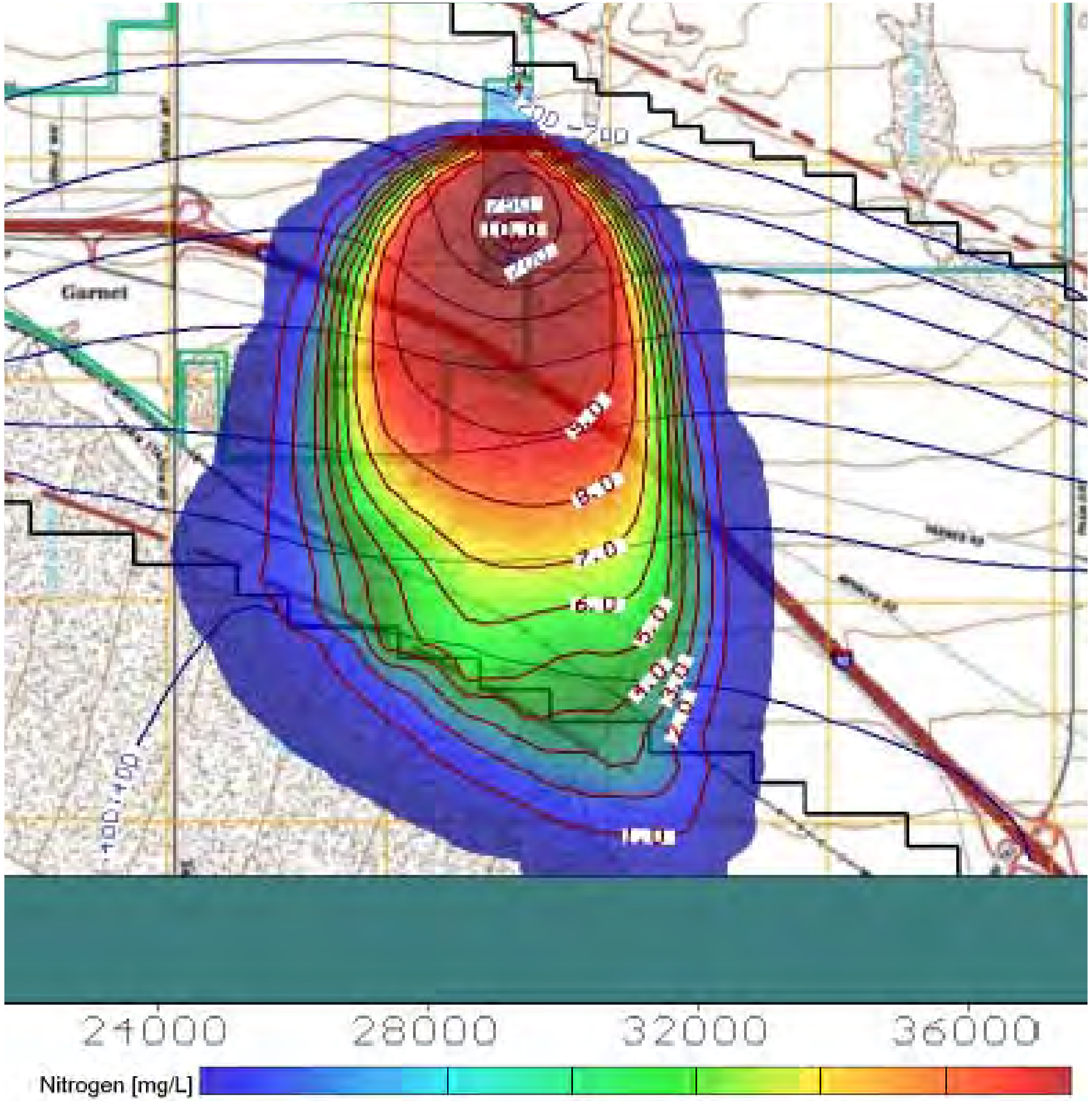
FIGURE 10
50 YEARS
NITROGEN
CONCENTRATION
CROSS-SECTION



PROPOSED
WEST VALLEY WATER
RECLAMATION FACILITY

Desert Hot Springs, California

North

Scale: 1 Inch = Approximately 1,750-feet

FIGURE 11
100 YEARS
NITROGEN
CONCENTRATION

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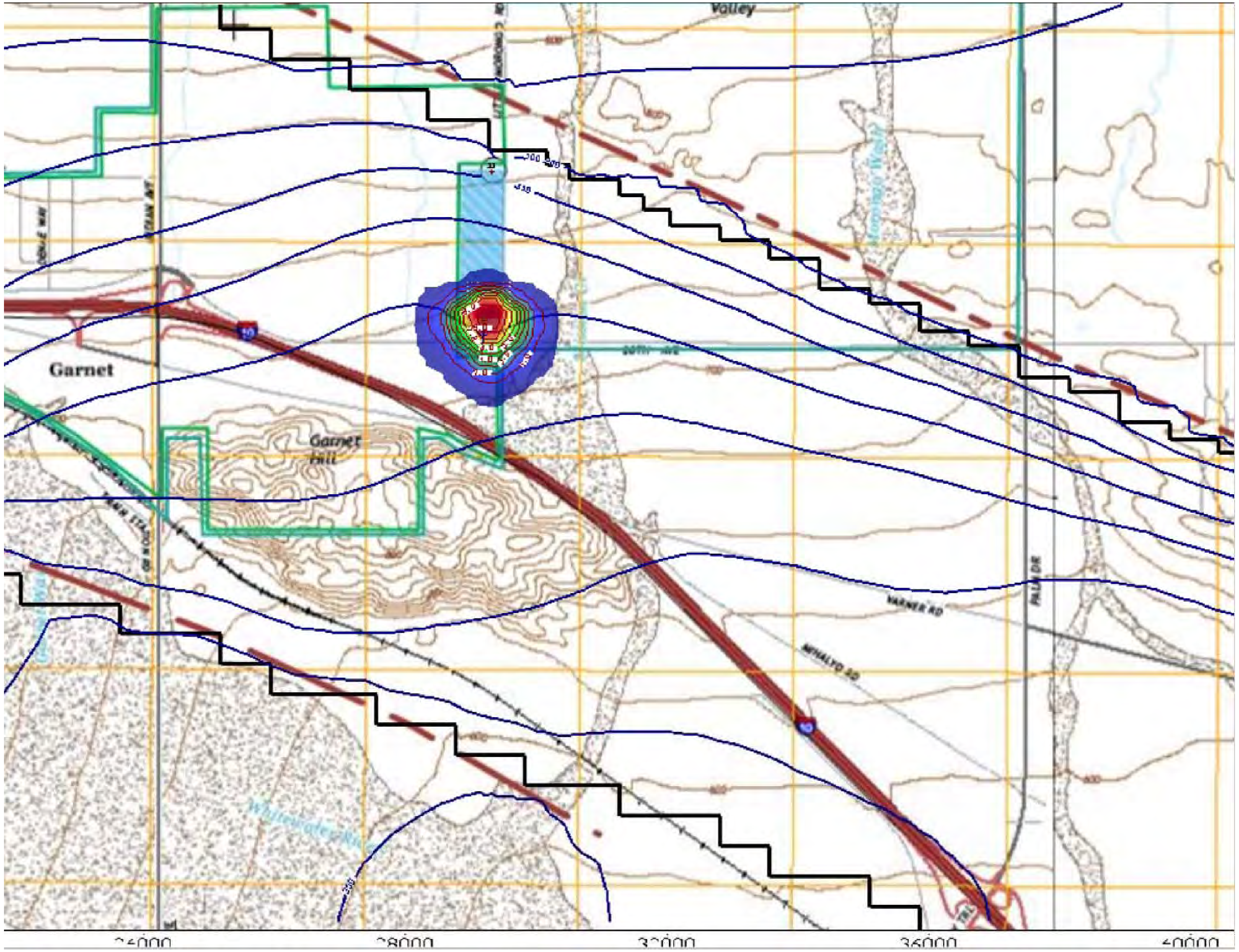
APPENDIX C

Appendix C presents graphic output for various sensitivity analysis runs.

PROPOSED
WEST VALLEY WATER
RECLAMATION FACILITY

Desert Hot Springs, California



North

Scale: 1 Inch = Approximately 1,750-feet

EnviroLogic Resources, Inc.
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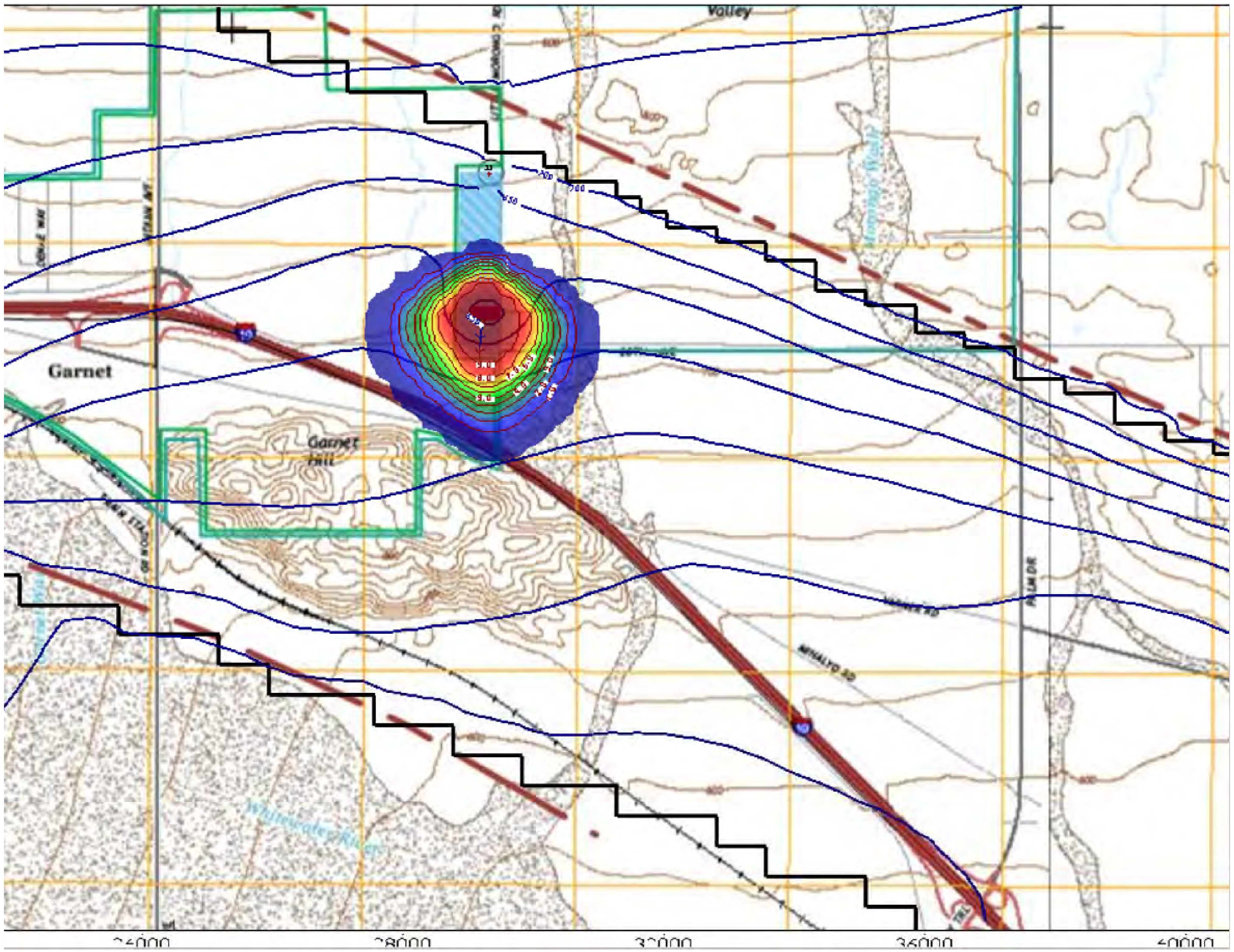
FIGURE 1
5 YEARS NITROGEN
CONCENTRATION (LOWER
LIMIT SENSITIVITY)

PROPOSED
WEST VALLEY WATER
RECLAMATION FACILITY

Desert Hot Springs, California



North

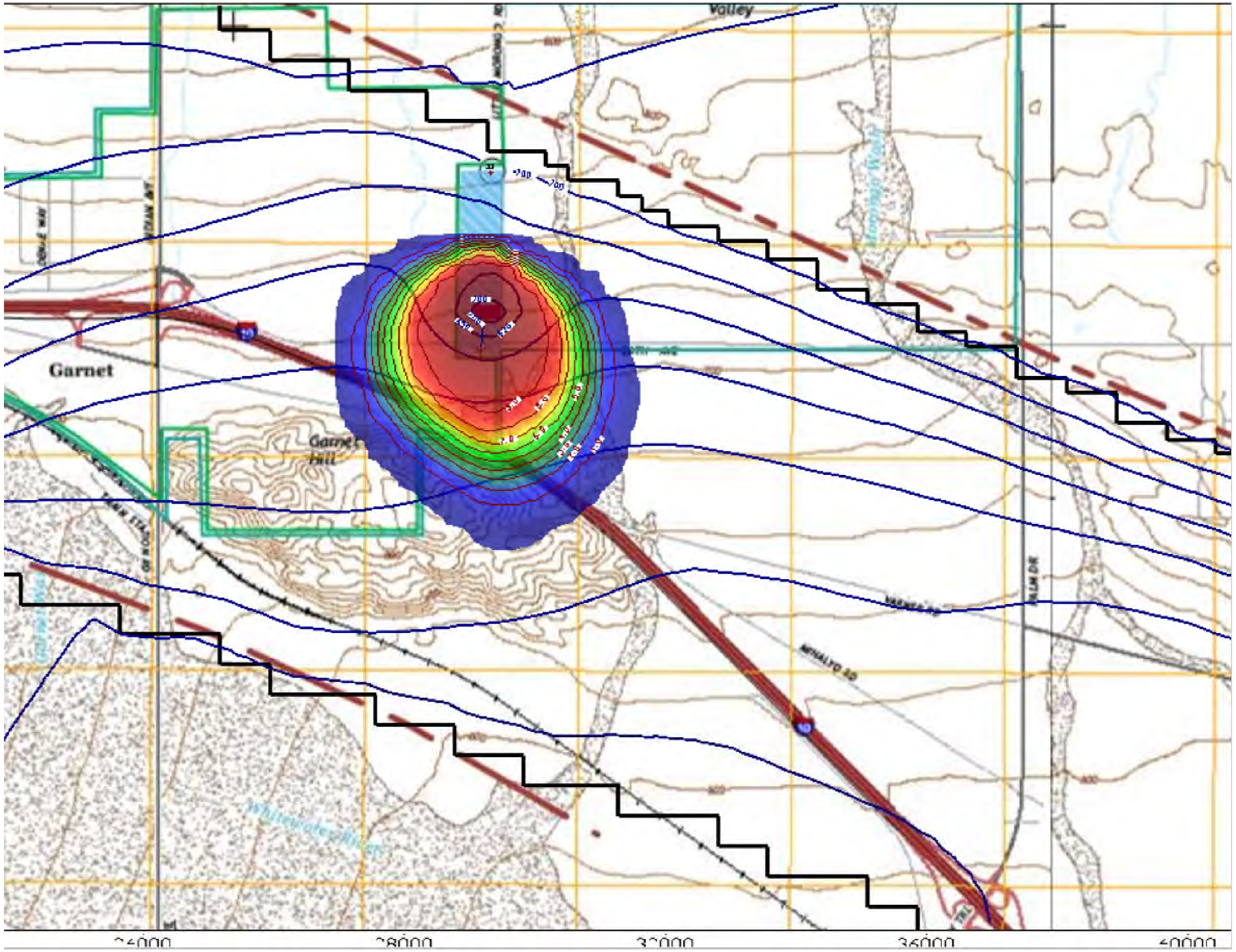
Scale: 1 Inch = Approximately 1,750-feet

EnviroLogic Resources, Inc.
ENVIRONMENTAL · WATER RESOURCES SCIENTISTS

FIGURE 2
10 YEARS NITROGEN
CONCENTRATION (LOWER
LIMIT SENSITIVITY)

**PROPOSED
WEST VALLEY WATER
RECLAMATION FACILITY**

Desert Hot Springs, California



Scale: 1 Inch = Approximately 1,750-feet

**FIGURE 3
20 YEARS NITROGEN
CONCENTRATION (LOWER
LIMIT SENSITIVITY)**

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PROPOSED
WEST VALLEY WATER
RECLAMATION FACILITY

Desert Hot Springs, California

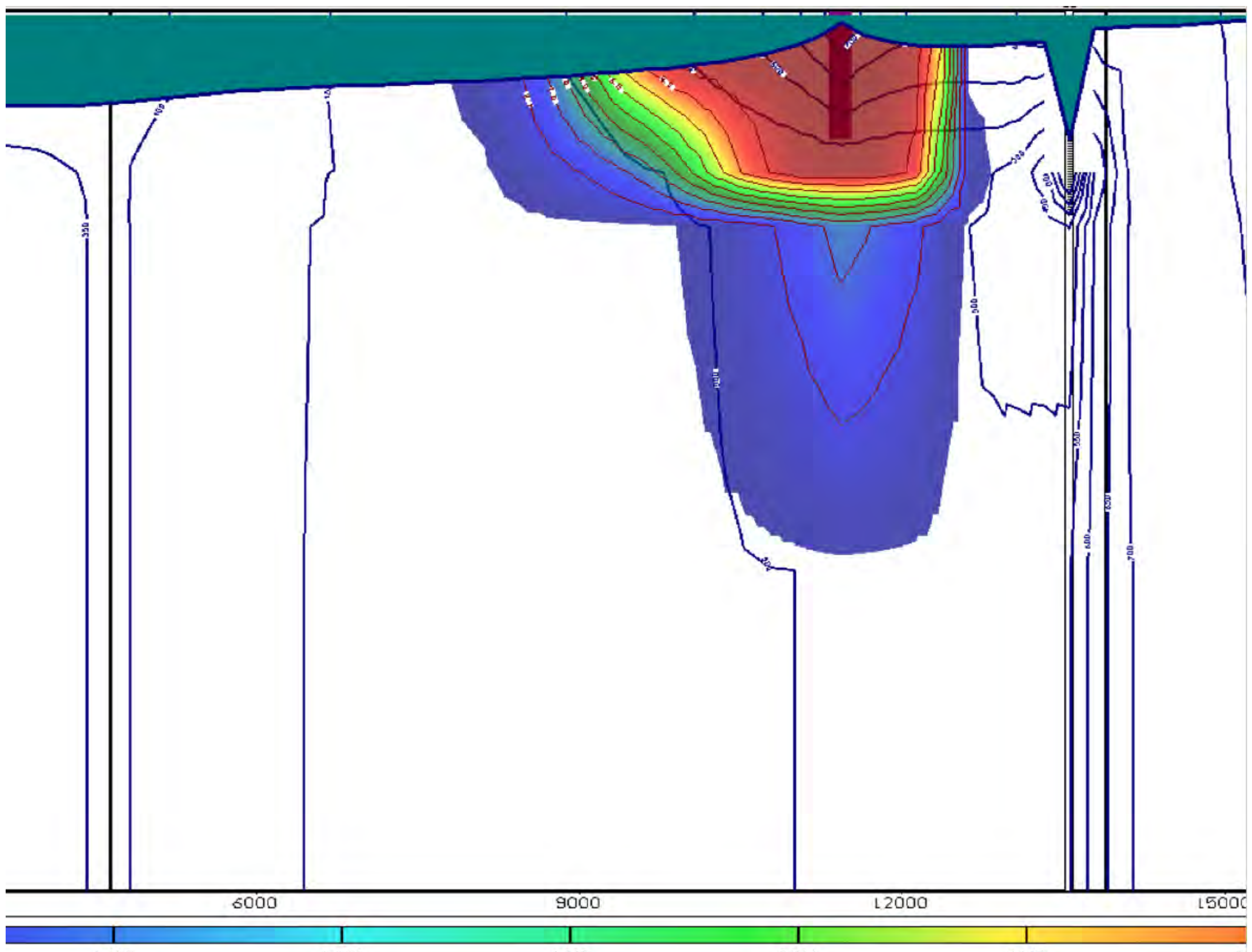
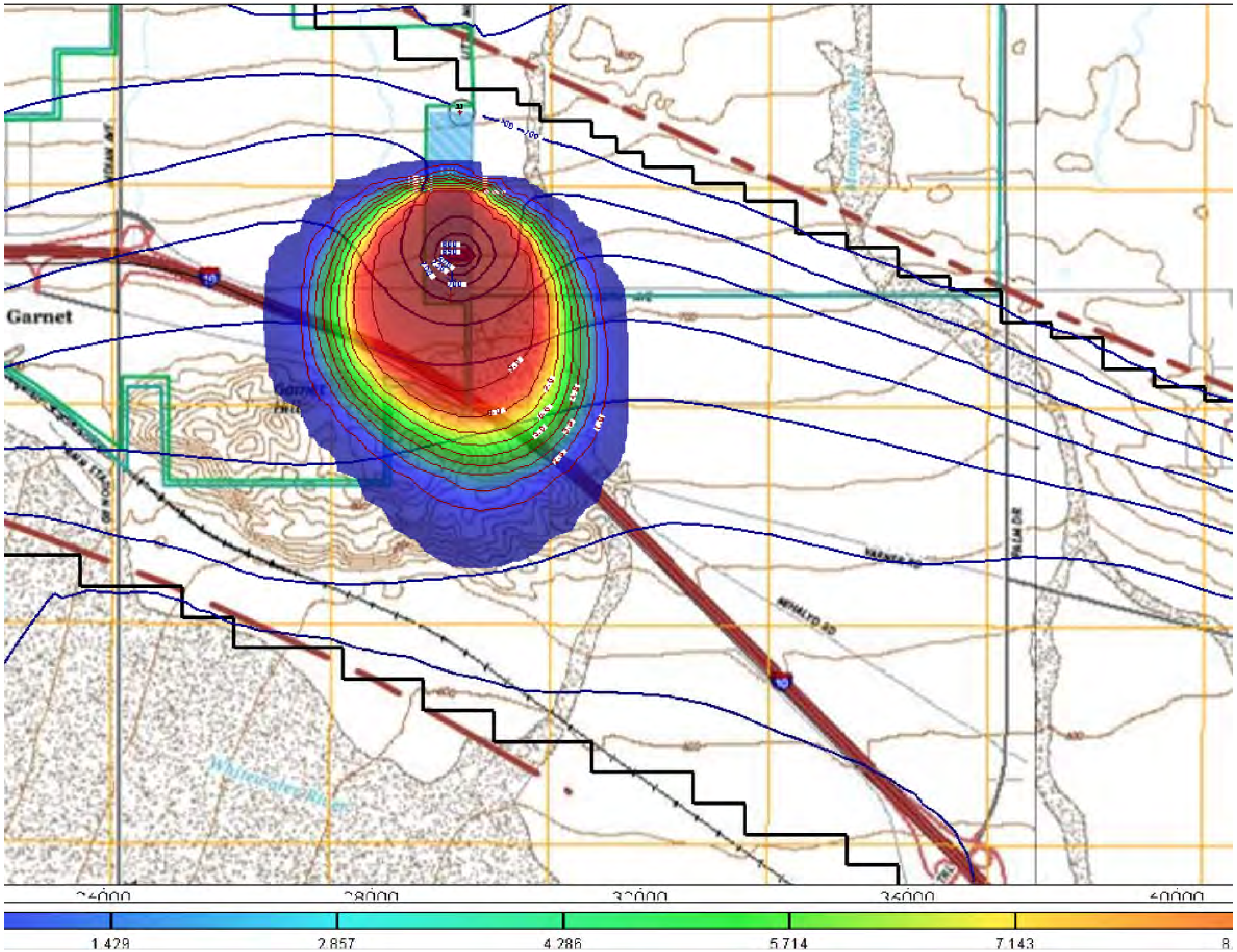


FIGURE 4
20 YEARS NITROGEN
CONCENTRATION CROSS-SECTION
(LOWER LIMIT SENSITIVITY)

EnviroLogic Resources, Inc.
ENVIRONMENTAL · WATER RESOURCES SCIENTISTS

PROPOSED
WEST VALLEY WATER
RECLAMATION FACILITY

Desert Hot Springs, California



North

Scale: 1 Inch = Approximately 1,750-feet

FIGURE 5
30 YEARS NITROGEN
CONCENTRATION (LOWER
LIMIT SENSITIVITY)

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ENVIRONMENTAL · WATER RESOURCES SCIENTISTS

PROPOSED
WEST VALLEY WATER
RECLAMATION FACILITY

Desert Hot Springs, California

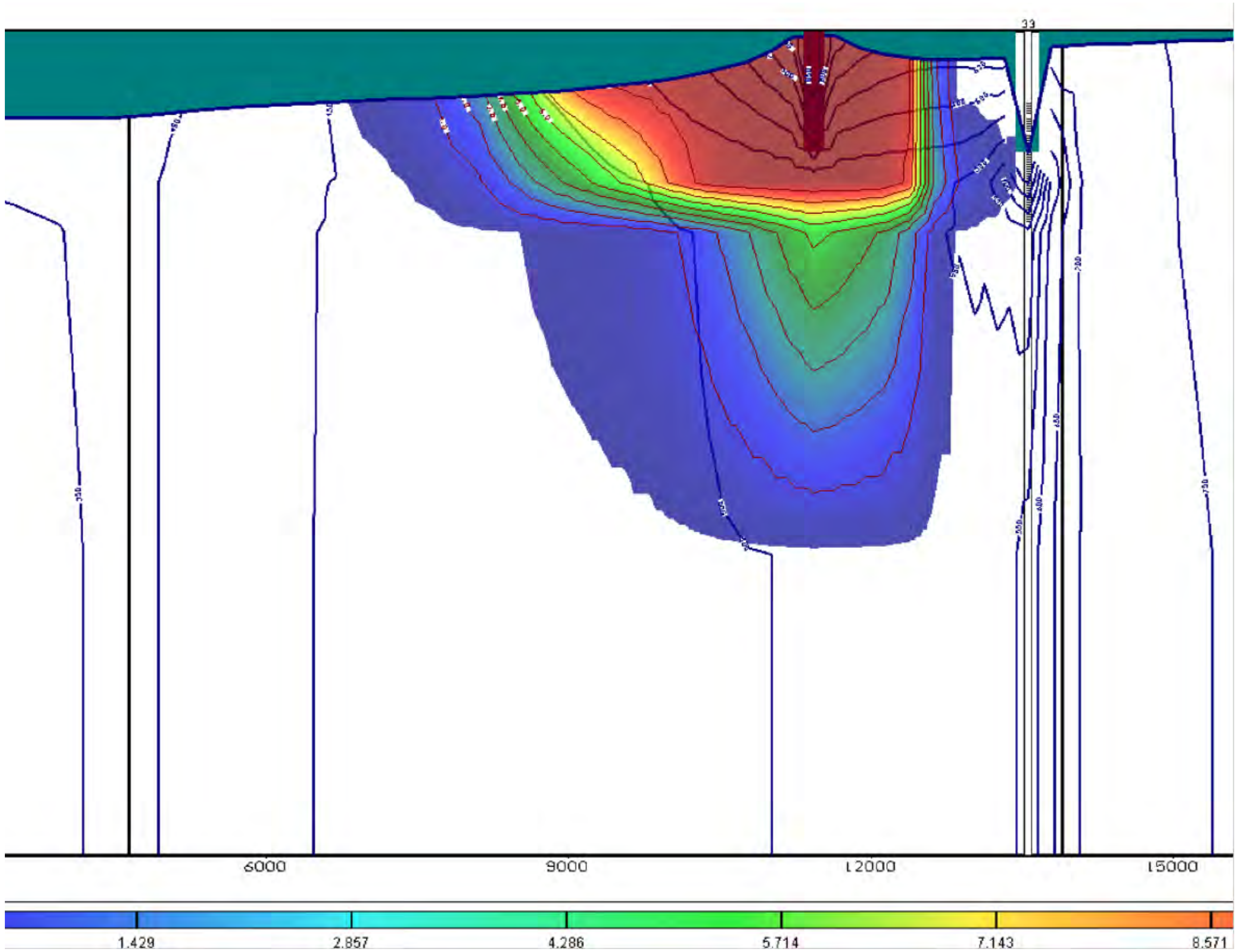

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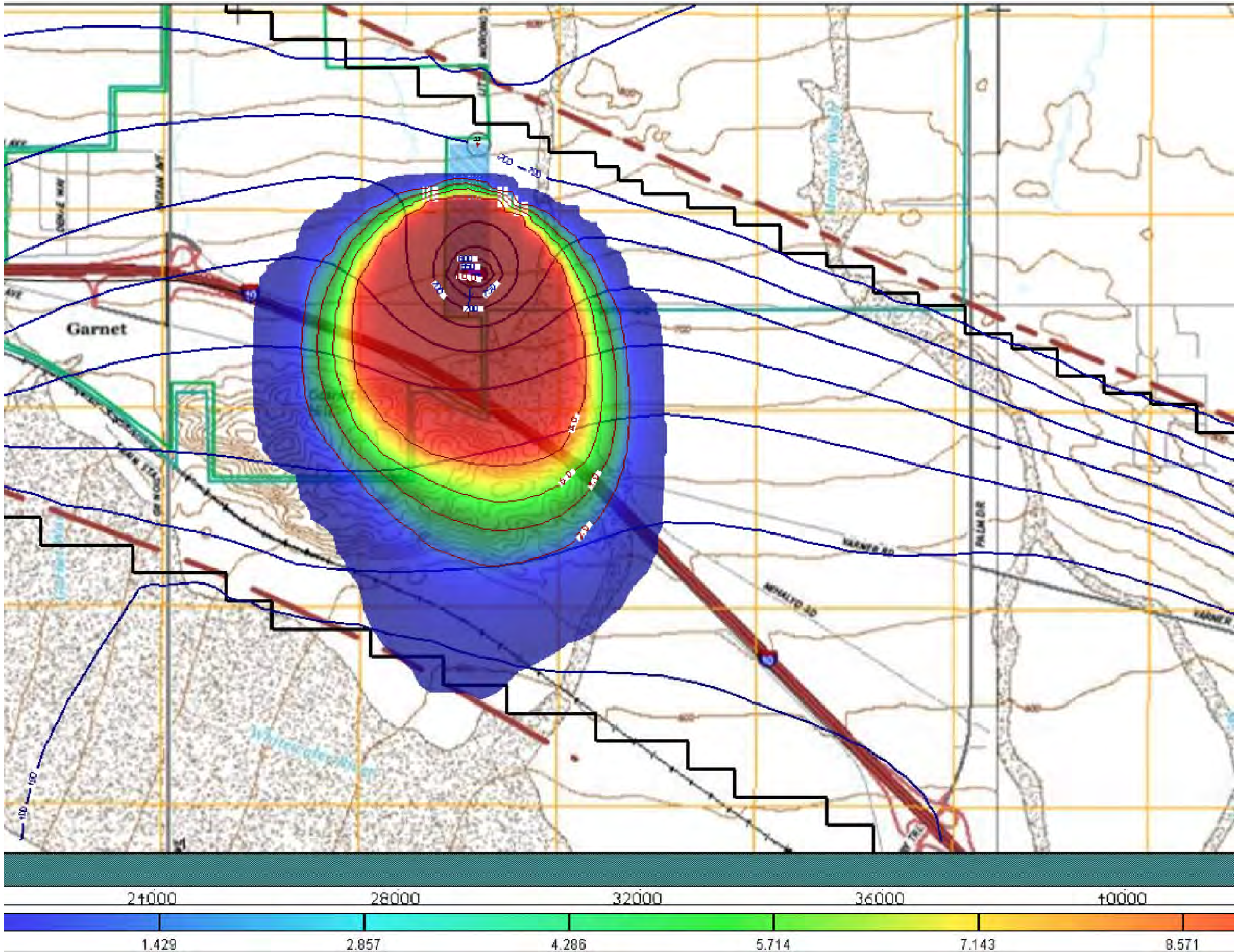
FIGURE 6
30 YEARS NITROGEN
CONCENTRATION CROSS-SECTION
(LOWER LIMIT SENSITIVITY)



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**PROPOSED
WEST VALLEY WATER
RECLAMATION FACILITY**

Desert Hot Springs, California

North

Scale: 1 Inch = Approximately 1,750-feet

**FIGURE 7
50 YEARS NITROGEN
CONCENTRATION (LOWER
LIMIT SENSITIVITY)**

PROPOSED
WEST VALLEY WATER
RECLAMATION FACILITY

Desert Hot Springs, California

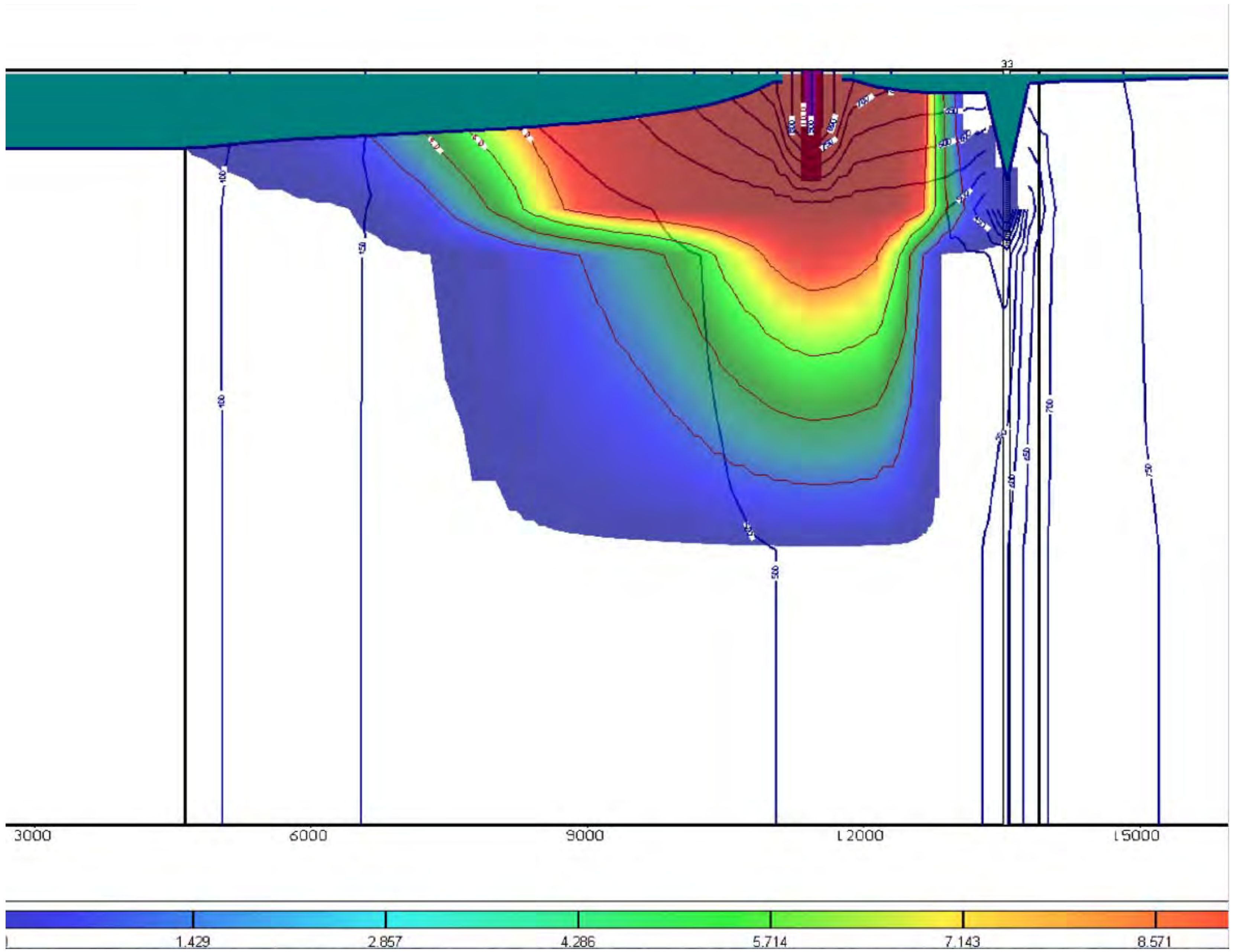

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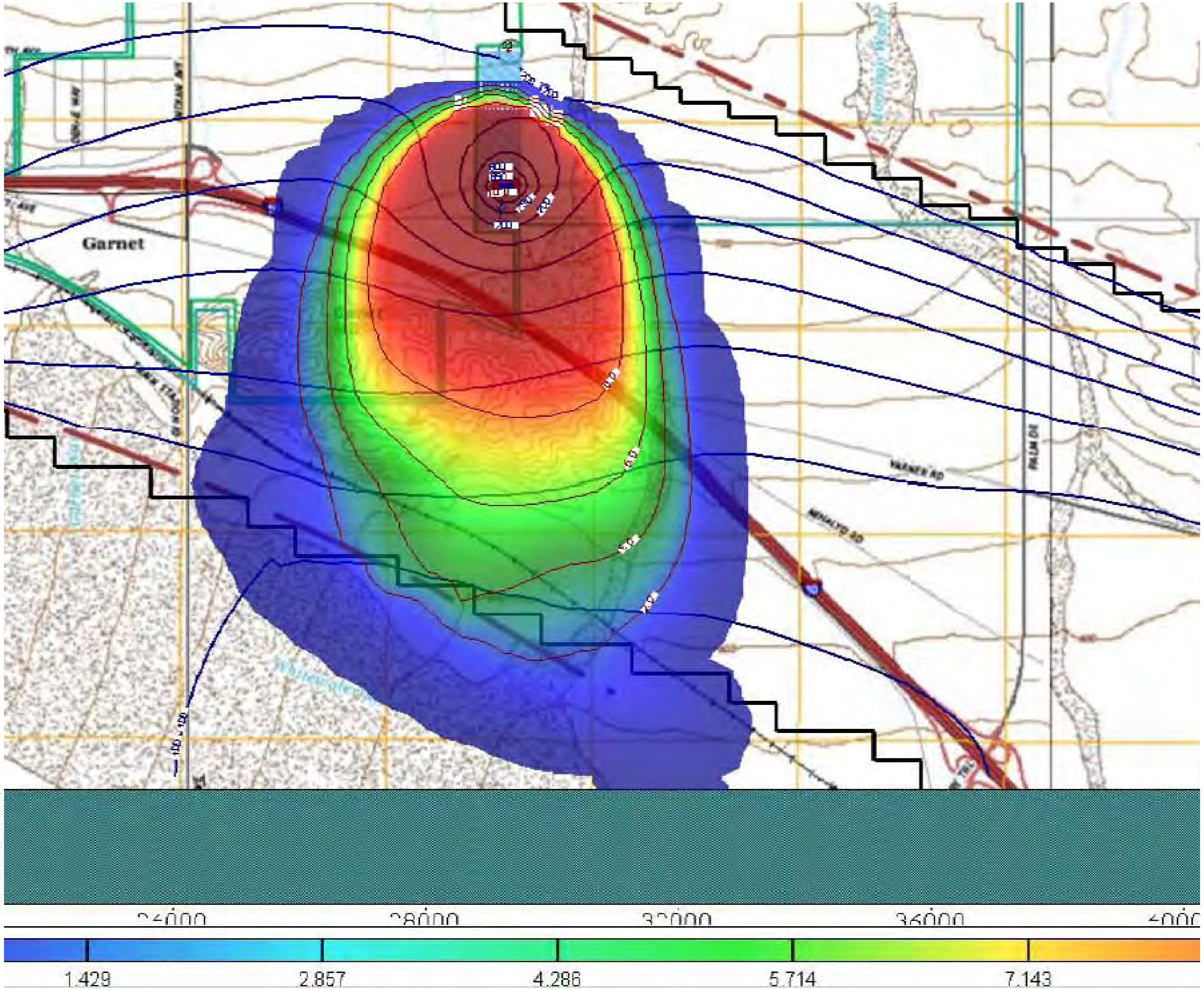
FIGURE 8
50 YEARS NITROGEN
CONCENTRATION CROSS-SECTION
(LOWER LIMIT SENSITIVITY)



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PROPOSED
WEST VALLEY WATER
RECLAMATION FACILITY

Desert Hot Springs, California

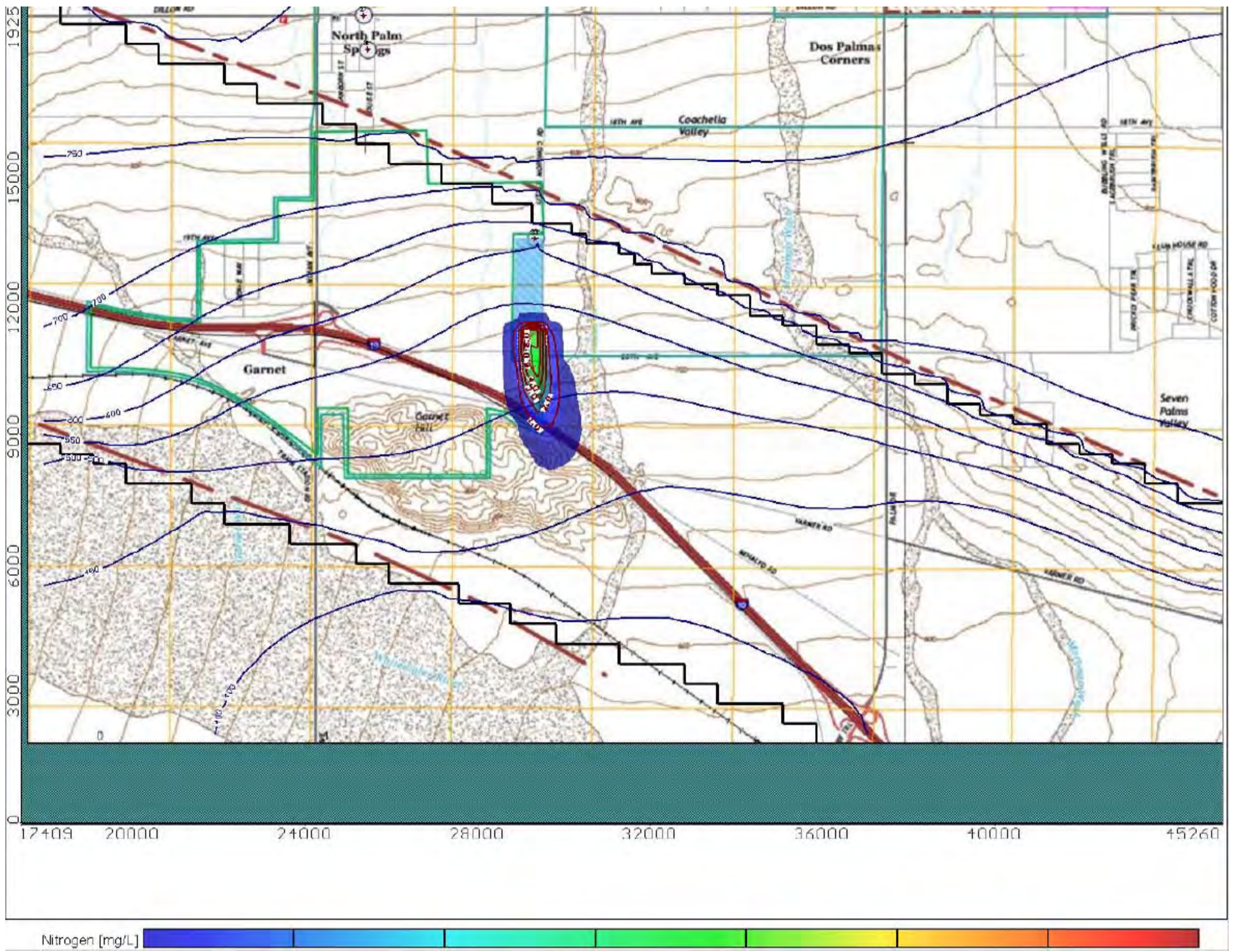
North

Scale: 1 Inch = Approximately 1,750-feet

FIGURE 9
100 YEARS NITROGEN
CONCENTRATION (LOWER
LIMIT SENSITIVITY)

PROPOSED
WEST VALLEY WATER
RECLAMATION FACILITY

Desert Hot Springs, California



North

Scale: 1 Inch = Approximately 3,500-feet

FIGURE 10
5 YEARS NITROGEN CONCENTRATION (UPPER LIMIT SENSITIVITY)

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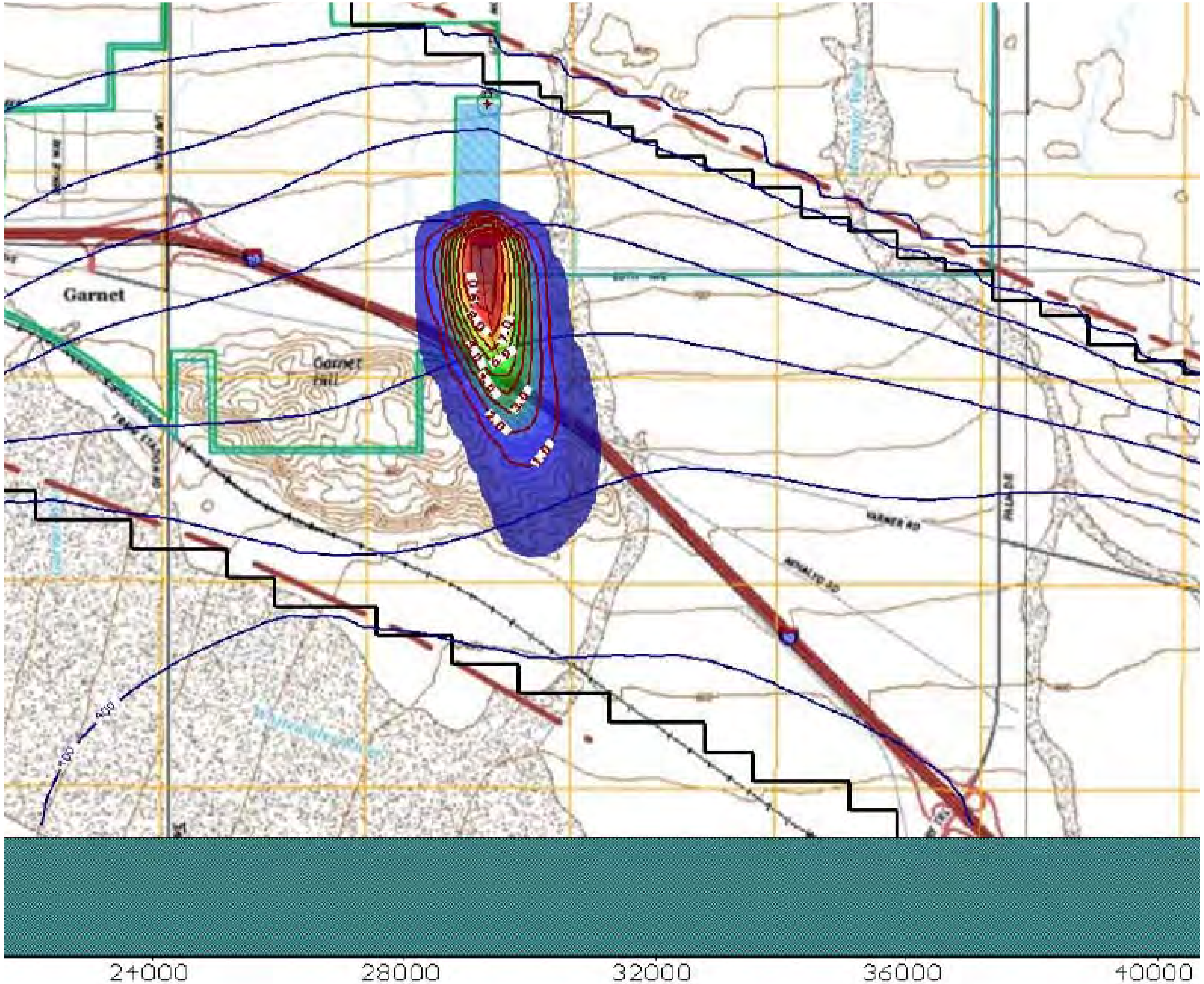
ENVIRONMENTAL · WATER RESOURCES SCIENTISTS



**PROPOSED
WEST VALLEY WATER
RECLAMATION FACILITY**

Desert Hot Springs, California

North

Scale: 1 Inch = Approximately 1,750-feet

**FIGURE 11
10 YEARS NITROGEN
CONCENTRATION (UPPER
LIMIT SENSITIVITY)**

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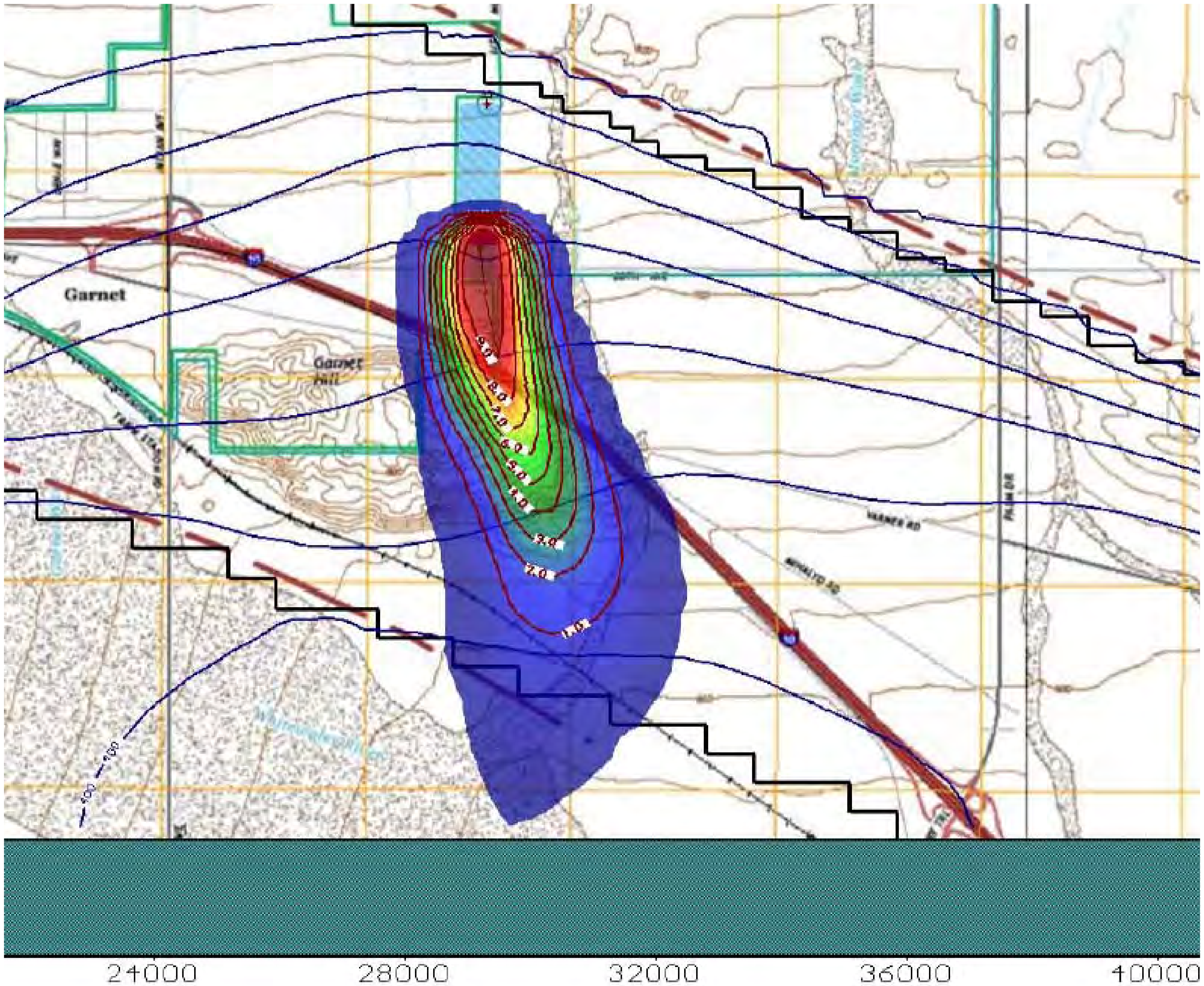
PROPOSED
WEST VALLEY WATER
RECLAMATION FACILITY

Desert Hot Springs, California



North

Scale: 1 Inch = Approximately 1,750-feet

FIGURE 12
20 YEARS NITROGEN
CONCENTRATION (UPPER
LIMIT SENSITIVITY)

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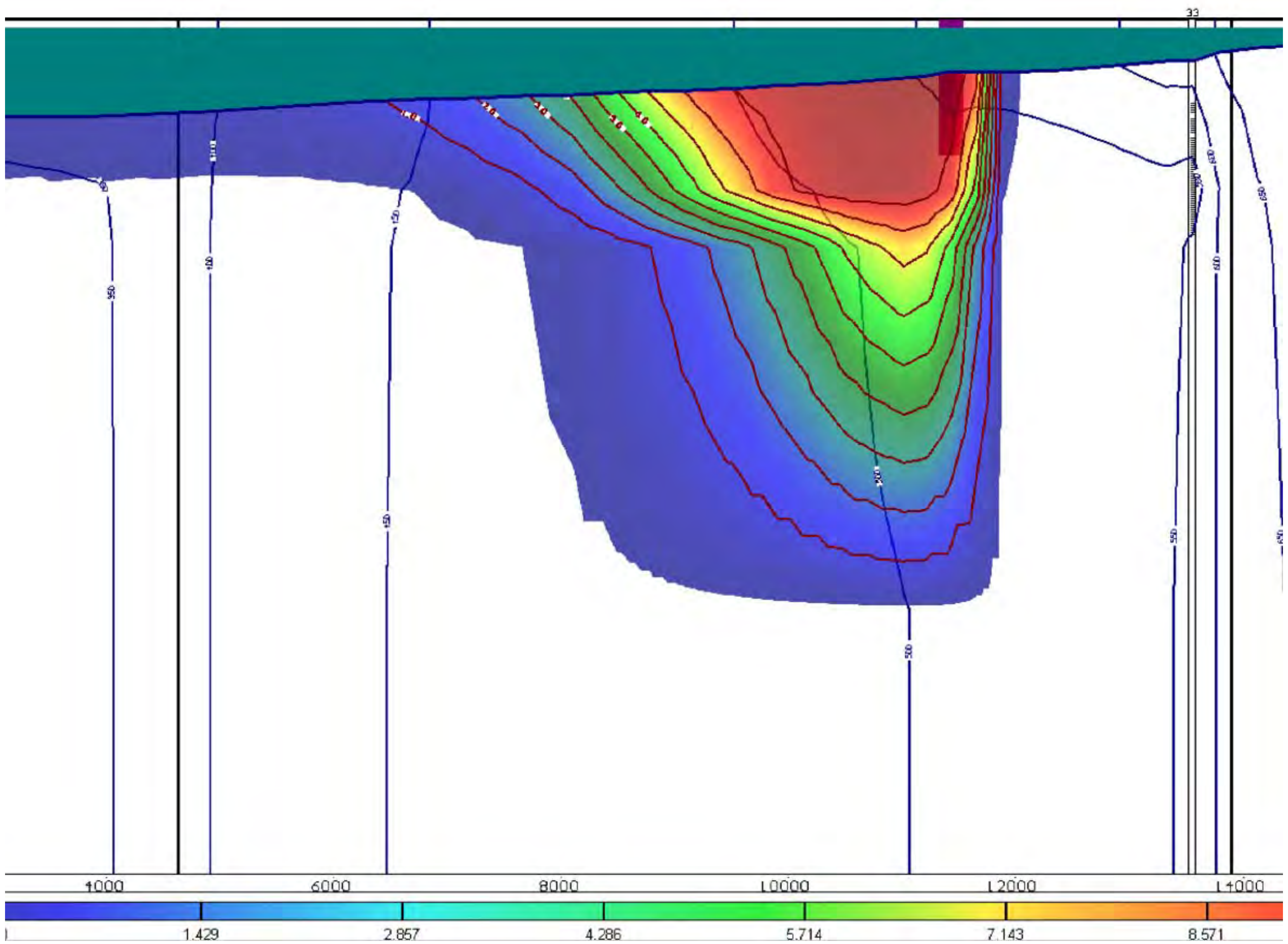
PROPOSED
WEST VALLEY WATER
RECLAMATION FACILITY

Desert Hot Springs, California



EnviroLogic Resources, Inc.
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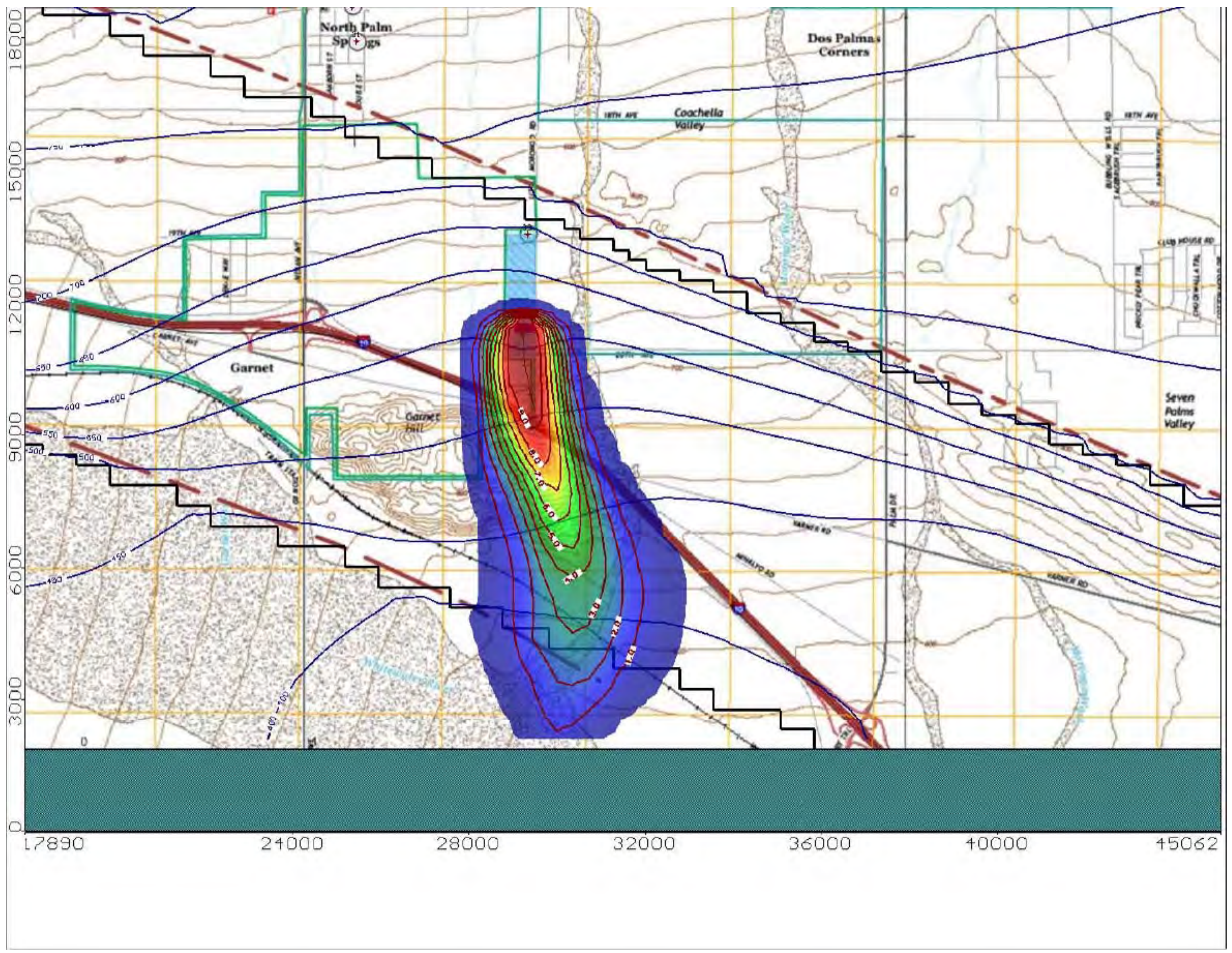
FIGURE 13
20 YEARS NITROGEN
CONCENTRATION CROSS-SECTION
(UPPER LIMIT SENSITIVITY)

PROPOSED
WEST VALLEY WATER
RECLAMATION FACILITY

Desert Hot Springs, California



North

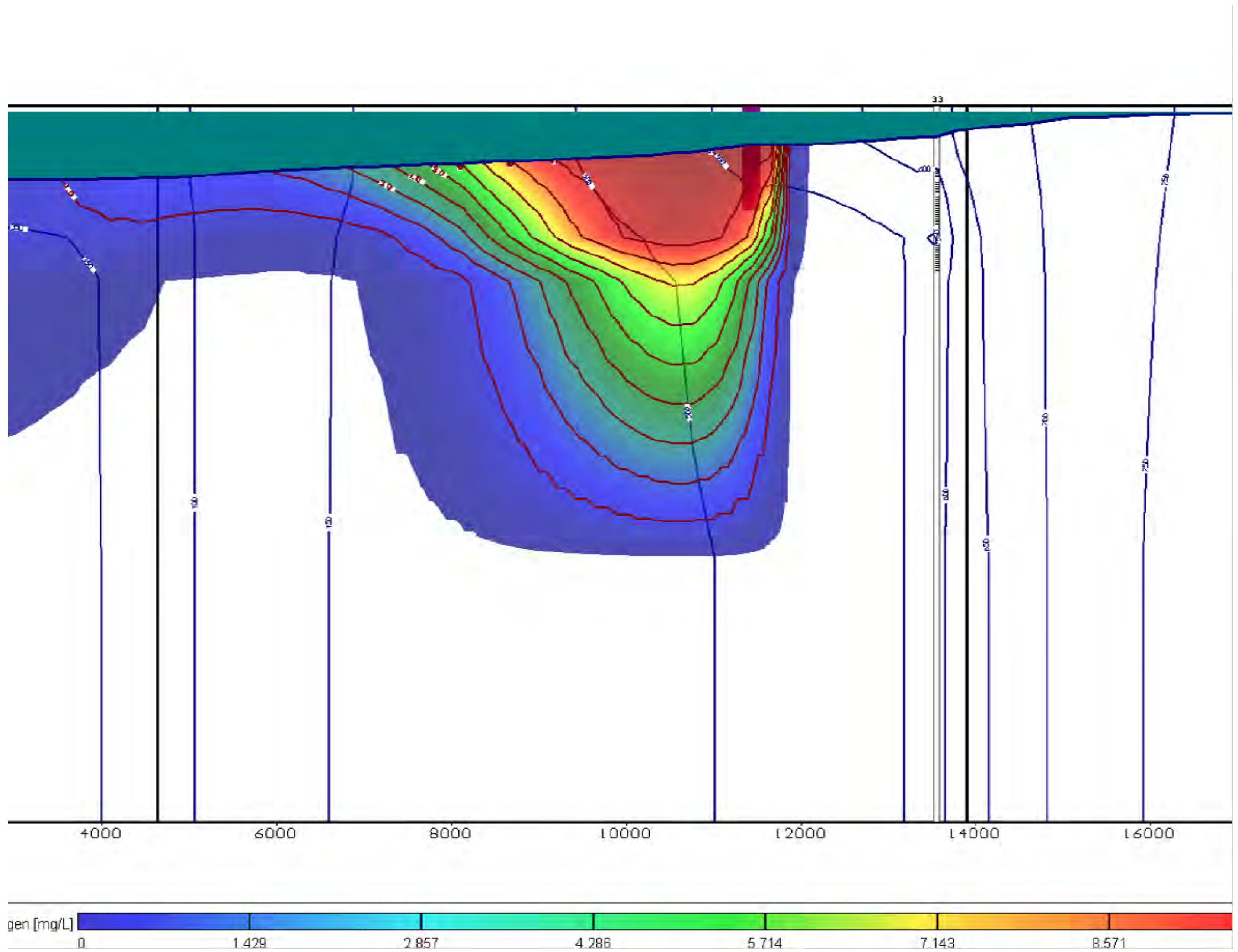
Scale: 1 Inch = Approximately 3,500-feet

FIGURE 14
30 YEARS NITROGEN
CONCENTRATION (UPPER
LIMIT SENSITIVITY)

EnviroLogic Resources, Inc.
ENVIRONMENTAL · WATER RESOURCES SCIENTISTS

PROPOSED
WEST VALLEY WATER
RECLAMATION FACILITY

Desert Hot Springs, California

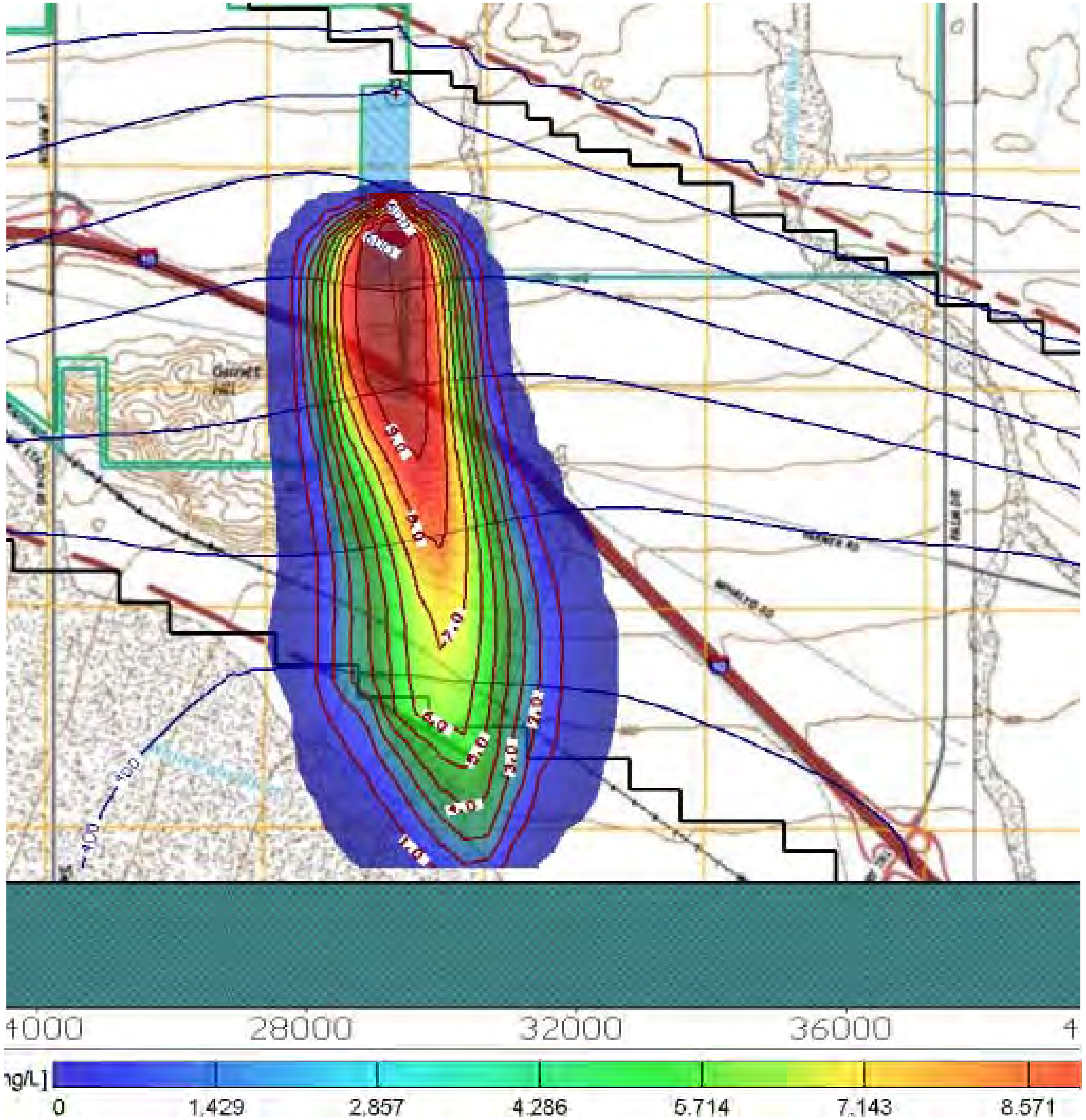


EnviroLogic Resources, Inc.
ENVIRONMENTAL · WATER RESOURCES SCIENTISTS

FIGURE 15
30 YEARS NITROGEN
CONCENTRATION CROSS-SECTION
(UPPER LIMIT SENSITIVITY)

PROPOSED
WEST VALLEY WATER
RECLAMATION FACILITY

Desert Hot Springs, California

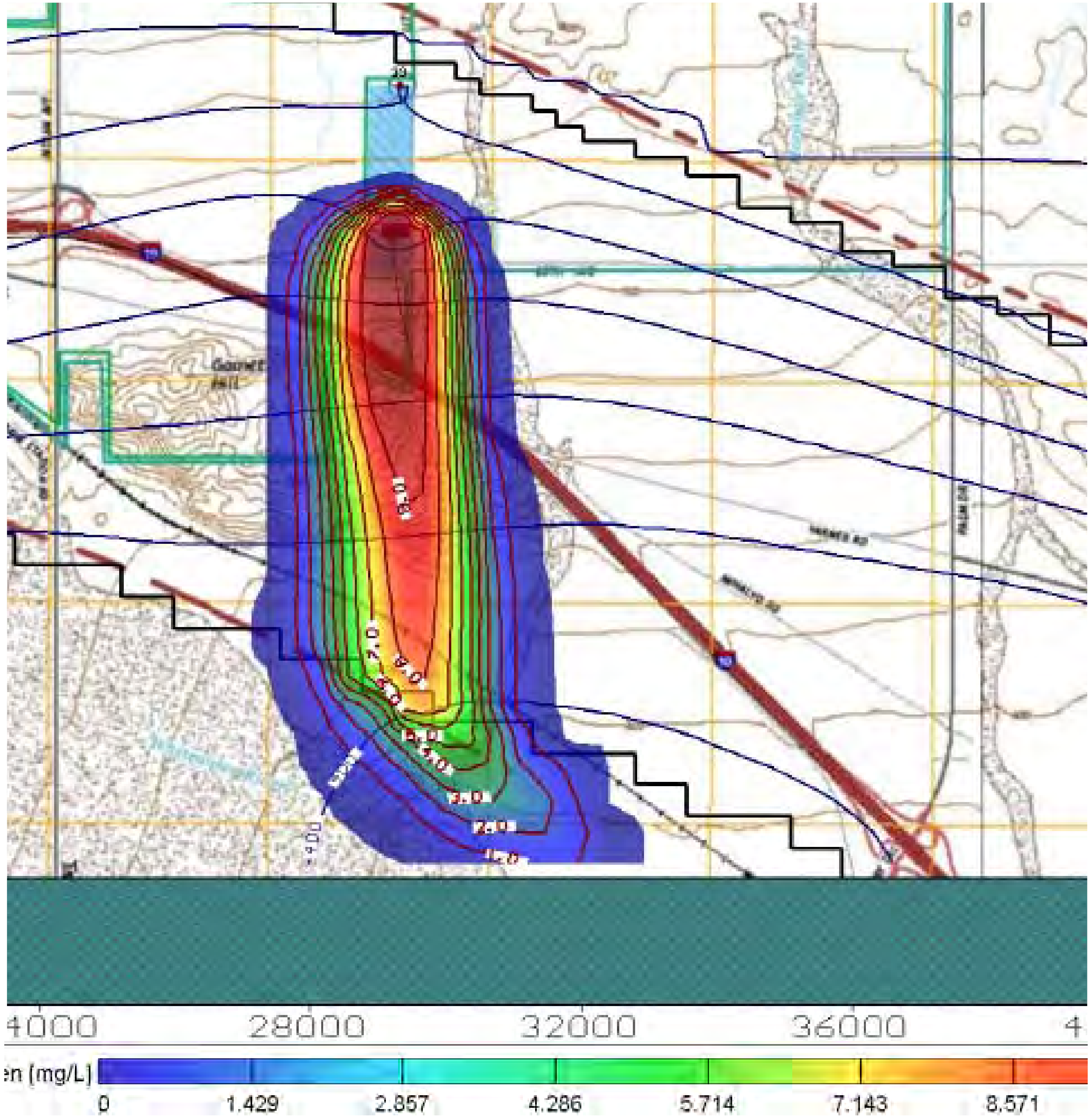


North

Scale: 1 Inch = Approximately 1,750-feet

FIGURE 16
50 YEARS NITROGEN
CONCENTRATION (UPPER
LIMIT SENSITIVITY)

EnviroLogic Resources, Inc.
ENVIRONMENTAL · WATER RESOURCES SCIENTISTS



PROPOSED
WEST VALLEY WATER
RECLAMATION FACILITY

Desert Hot Springs, California

North

Scale: 1 Inch = Approximately 1,750-feet

FIGURE 17
100 YEARS NITROGEN
CONCENTRATION (UPPER
LIMIT SENSITIVITY)

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