# VIEWSHED TECHNICAL SUMMARY

## WARD LAKE QUARRY
## LASSEN COUNTY, CALIFORNIA

*Prepared for*

**Hat Creek Construction**

*Prepared by*


**VESTRA Resources Inc.**
5300 Aviation Drive
Redding, California 96002


**NOVEMBER 2020**

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**71305**

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# 1.0 INTRODUCTION

## 1.1 Background

The project site is located approximately 11.5 miles east of the city of Susanville and is situated approximately 3 miles north of Highway 395. The general site location is shown on Figure 1. The existing visual character of the site vicinity is that of high desert shrubland. Topography in project area is sloped toward the Susan River to the south.

This visual analysis is provided for CEQA review of the proposed mining operations and was conducted to present the change in visual quality associated with the project.

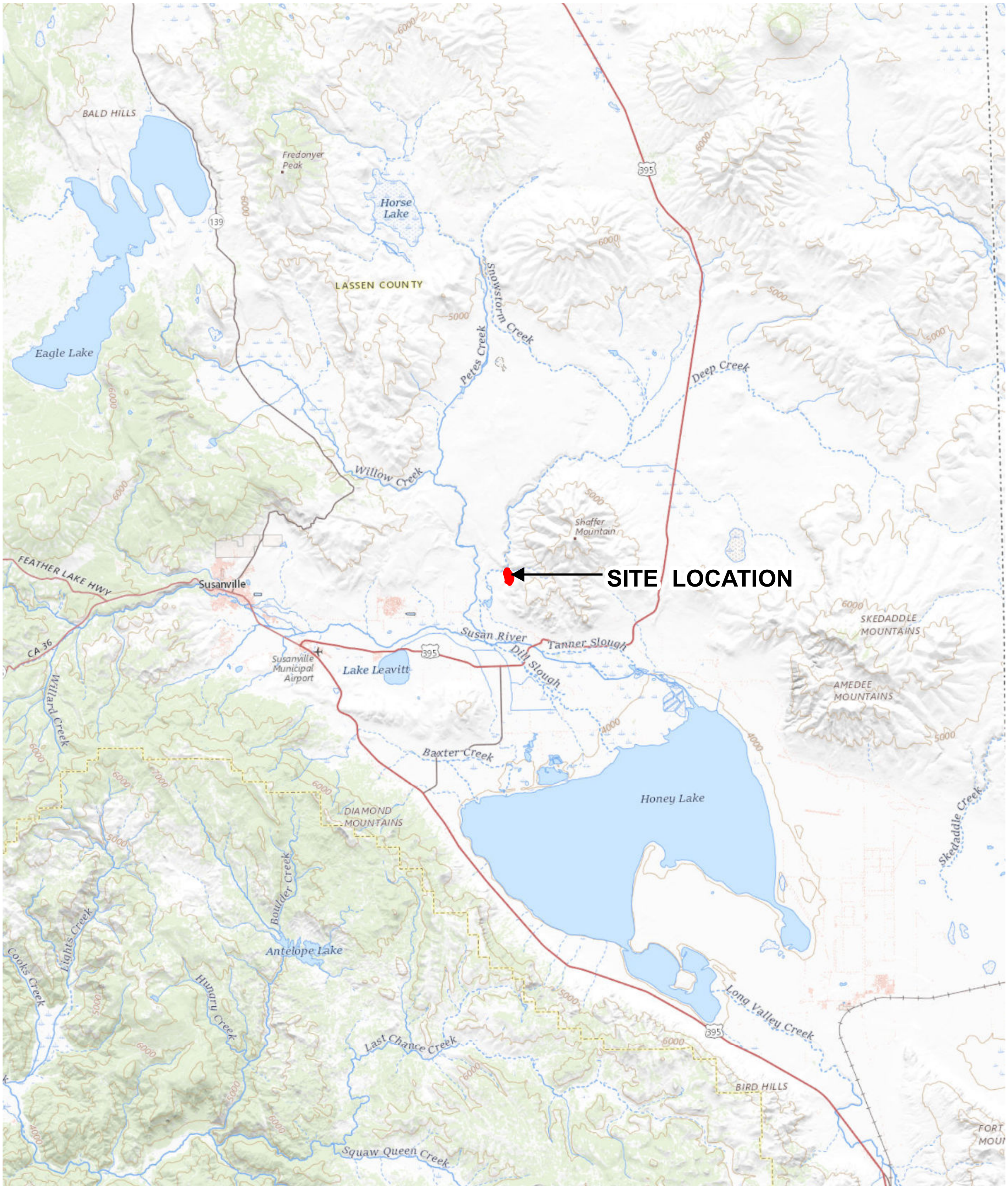
## 1.2 Project Area

The current Ward Lake mine area is approximately 160 acres, 100 acres of which are used for quarry operations. The facility includes the mining of rock, crushing, scales, office, truck shop, cement plant, asphalt plant, settling ponds, fuel storage, and material stockpiles. The project also includes various sediment control structures. The area surrounding the site is used for agriculture, mineral extraction, and open space.

The proposed expansion of Ward Lake Quarry includes the addition of approximately 51 acres to the mine boundary, a portion of which would be used for quarry operations. Access roads currently exist within the remaining area. The proposed expansion area is shown on Figure 2.

## 1.3 Current Condition

The current visual condition of the site is undeveloped open space. Vegetation is sparse due to the nature of the geology and soils in the area as well as agricultural practices including grazing. This lack of vegetation is part of the current view.




Miles
0 2.5 5 10

VESTRA

FIGURE 1
**GENERAL SITE LOCATION**
WARD LAKE QUARRY
LASSEN COUNTY, CALIFORNIA

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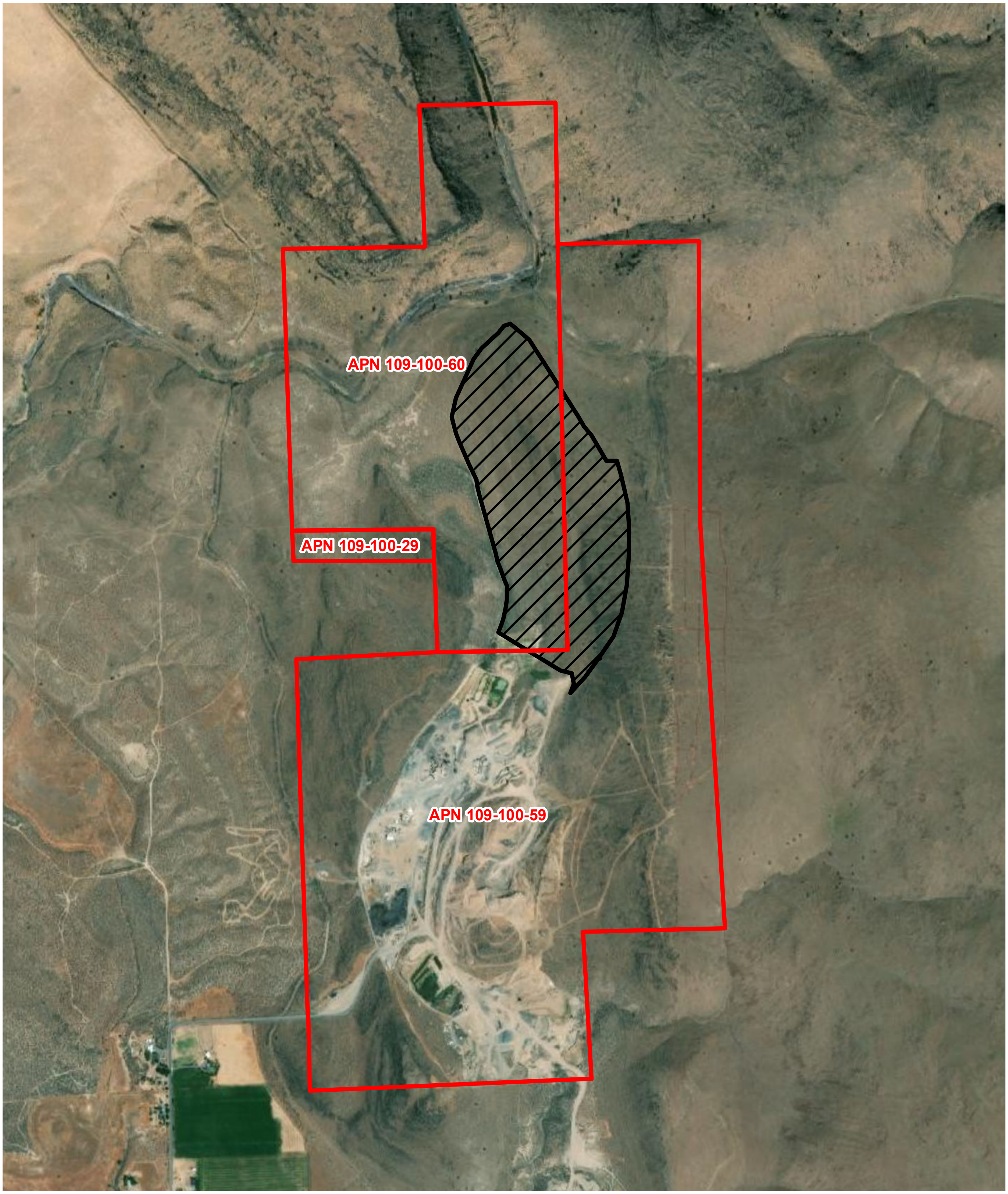


Approximate Parcel Boundary

Proposed Expansion Area

0 0.125 0.25 0.5 Miles

VESTRA

SOURCE: MAXAR 2019 AERIAL PHOTOGRAPH

FIGURE 2
**GENERAL SITE LAYOUT**
WARD LAKE QUARRY
LASSEN COUNTY, CALIFORNIA

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# 2.0 VISUAL SIMULATION ANALYSIS

## 2.1 Process

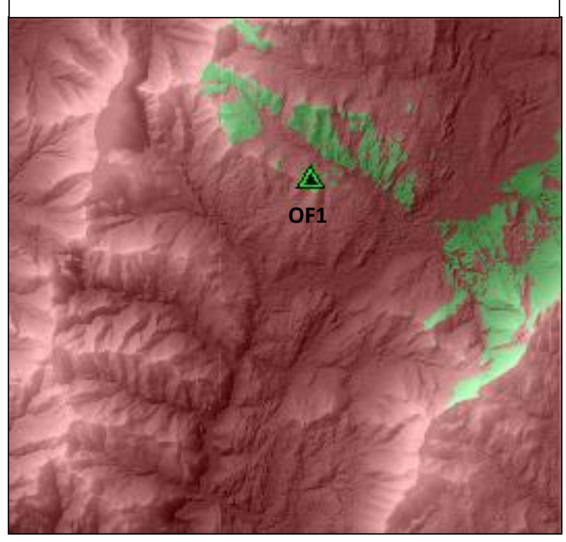
The shape of a terrain surface affects which portions of the surface area can be seen from any given point. To assess the visual components of this project, Geographic Information Systems (GIS) was used to evaluate visibility across the project area from various locations. GIS is a collection of computer hardware, software, and geographic data for capturing, managing, analyzing, and displaying all forms of geographically referenced information. ArcGIS is a Geographic Information System package developed by Environmental Systems Research Institute (ESRI).

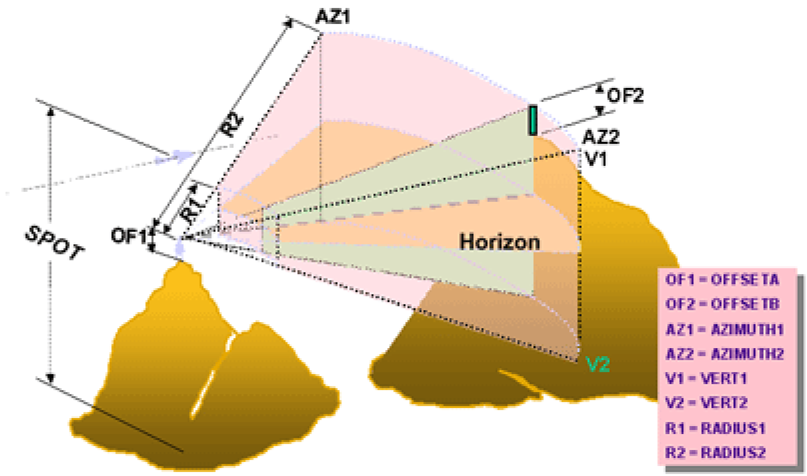
A viewshed identifies the locations in a given area that can be seen from one or more observation points. The elevation data used to perform viewshed analyses are raster-based data. Raster data is data in which a surface is divided into a grid and each cell in the grid contains an elevation value. The resolution of raster data is the distance, in surface units, of the sides of each cell in the grid. An example of this is the elevation data provided by the U.S. Geological Survey (USGS) for use in GIS. These data sets are commonly provided at either a 10-meter or 30-meter resolution. Viewshed analysis provides a value that indicates how many observer points can be seen from each location. If you have only one observer point, each cell from which the observer point can be seen is given a value of one. All cells from which the observer point cannot be seen are given a value of zero. Observer points can be points or linear features.

A viewshed is useful when you want to know how visible objects might be. Not only can you determine which cells can be seen from the observation point, if you have several observation points, you can also determine which observers can see each observed location. Knowing which observer can see which locations can affect decision making.

The image below graphically depicts how a viewshed analysis is performed. The observation point is on the mountaintop to the left (at OF1 in the image). The direction of the viewshed is within the cone looking to the right. You can control how much to offset the observation point from the surface (for example, the height of the tower), and the direction(s) to look in both the horizontal and vertical dimensions.

Displaying a hillshade underneath the elevation and the output from a Viewshed Analysis is a useful technique for visualizing the relationship between visibility and terrain.

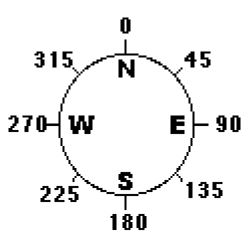




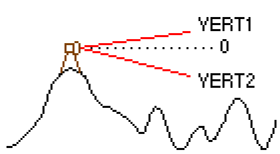

Nine characteristics of the viewshed are controlled as follow:

1. The surface elevations for the observation points (Spot)
2. The vertical distance in surface units to be added to the z-value of the observation points (OffsetA)
3. The vertical distance in surface units to add to the z-value of each cell as it is considered for visibility (OffsetB)

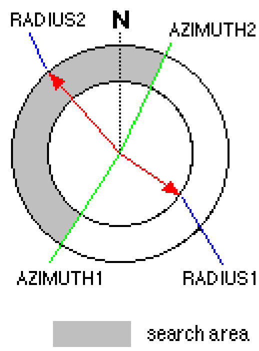

4. The start of the horizontal angle to limit the scan (Azimuth1)
5. The end of the horizontal angle to limit the scan (Azimuth2)




6. The top of the vertical angle to limit the scan (Vert1)
7. The bottom of the vertical angle to limit the scan (Vert2)



8. The inner radius that limits the search distance when identifying areas visible from each observation point (Radius1)
9. The outer radius that limits the search distance when identifying areas visible from each observation point (Radius2)




In order to perform a viewshed analysis, the elevation data should be as detailed as possible. For the Skyline project, the elevation data was derived from the USGS 10-meter digital elevation model (DEM) that is interpolated into a grid format.

Interpolation is a method of creating raster data specifically designed for the creation of hydrologically correct DEMs. It is based on the ANUDEM program developed by Michael Hutchinson (1988, 1989). See Hutchinson and Dowling (1991) for an example of a substantial application of ANUDEM and for additional associated references. A brief summary of ANUDEM and some applications are given in Hutchinson (1993). The version of ANUDEM used is 4.6.3.

The interpolation procedure has been designed to take advantage of the types of input data commonly available and the known characteristics of elevation surfaces. This method uses an iterative finite difference interpolation technique. It is optimized to have the computational efficiency of local interpolation methods, such as inverse distance weighted (IDW) interpolation, without losing the surface continuity of global interpolation methods, such as Kriging and Spline. It is essentially a discretized thin plate spline technique (Wahba, 1990), for which the roughness penalty has been modified to allow the fitted DEM to follow abrupt changes in terrain, such as streams and ridges. It is also the only ArcGIS interpolator specifically designed to work intelligently with contour inputs.

Contours are the most common method for storage and presentation of elevation information. Unfortunately, this method is also the most difficult to properly utilize with general interpolation techniques. The disadvantage lies in the undersampling of information between contours, especially in areas of low relief.

At the beginning of the interpolation process, ArcGIS uses information inherent to the contours to build a generalized drainage model. By identifying areas of local maximum curvature in each contour, the areas of steepest slope are identified and a network of streams and ridges is created (Hutchinson, 1988). This information is used to ensure proper hydrogeomorphic properties of the output DEM and can also be used to verify accuracy of the output DEM.

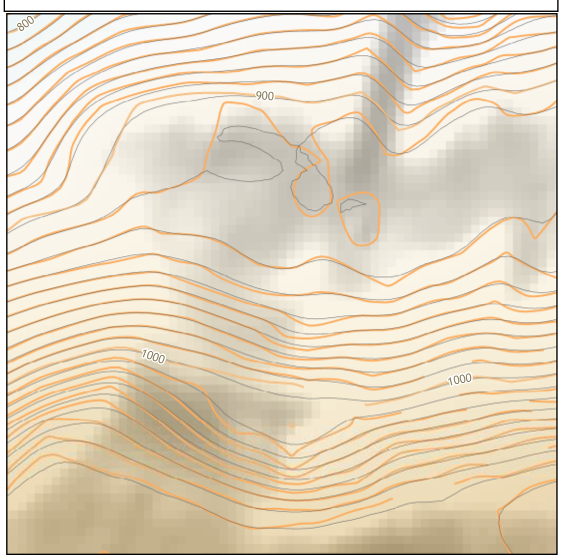
After the general morphology of the surface has been determined, contour data is also used in the interpolation of elevation values at each cell. When the contour data is used to interpolate elevation information, all contour data is read and generalized. A maximum of 50 data points are read from these contours within each cell. At the final resolution, only one critical point is used for each cell. For this reason, having a contour density with several contours crossing output cells is redundant.

Before using in a viewshed analysis, created surfaces should be evaluated to ensure that the data and parameters supplied to the program result in a realistic representation of the surface. There are many ways to evaluate the quality of an output surface, depending on the type of input available to create the surface.

The most common evaluation is to create contours from the new surface and compare them to the input contour data. It is best to create these new contours at one-half the original contour interval to examine the results between contours. Drawing the original contours and the newly created contours on top of one another can help identify interpolation errors.

In the example shown below, the contours created from the new surface are shown with the original 10-foot interval contour data for comparison (1:1,000 scale).

Original 10-foot interval contours compared to contours created from the new surface.




The comparison shows that the contours do differ in some areas, but the difference in this case is acceptable as the distance between the two sets of contour lines rarely exceeds 5 feet in length.

The product of the interpolation of the field survey contour data was the creation of 10-foot-resolution, hydrologically correct digital elevation model (DEM). It has been shown that there is a minor bias in the interpolation algorithm that causes the raster dataset to have slight variations from the input contours. This variation can result in a slight variation in the results when calculating the profile curvature of the output surface but is otherwise not noticeable, and does not affect the overall intended use in a viewshed analysis.

## 2.2 Observer Locations

The observer location points used in the viewshed analysis were determined using two observer points located at high and low site elevations. Using the viewshed analysis, the proposed mining operation was determined to be intermittently visible from areas along Highway 395. These segment locations and proposed mining area are shown on Figure 3.

## 2.3 General Map Reference Data

A number of GIS data layers were obtained as reference data for the maps and figures created as a result of the viewshed analysis. Most of vector (linear) data layers are existing data sets from VESTRA's in-house GIS data catalog, which is a compilation of data from various federal, state, county, and municipal sources.

The primary display data layer of aerial imagery utilizes National Agriculture Imagery Program (NAIP) data. The NAIP acquires imagery during the agricultural growing seasons in the continental U.S. The 2018 NAIP imagery for Lassen County has a 50-centimeter ground sample distance (GSD) with a horizontal accuracy that matches within five meters of a reference ortho image.


Highway Segment Potentially Visible from Ward Lake Quarry

Highway

Project Area

Miles

0 0.75 1.5 3

VESTRA

SOURCE: DIGITALGLOBE 2018 AERIAL PHOTOGRAPH

FIGURE 3

**HIGHWAY SEGMENTS AND PROPOSED PROJECT AREA**

WARD LAKE QUARRY

LASSEN COUNTY, CALIFORNIA

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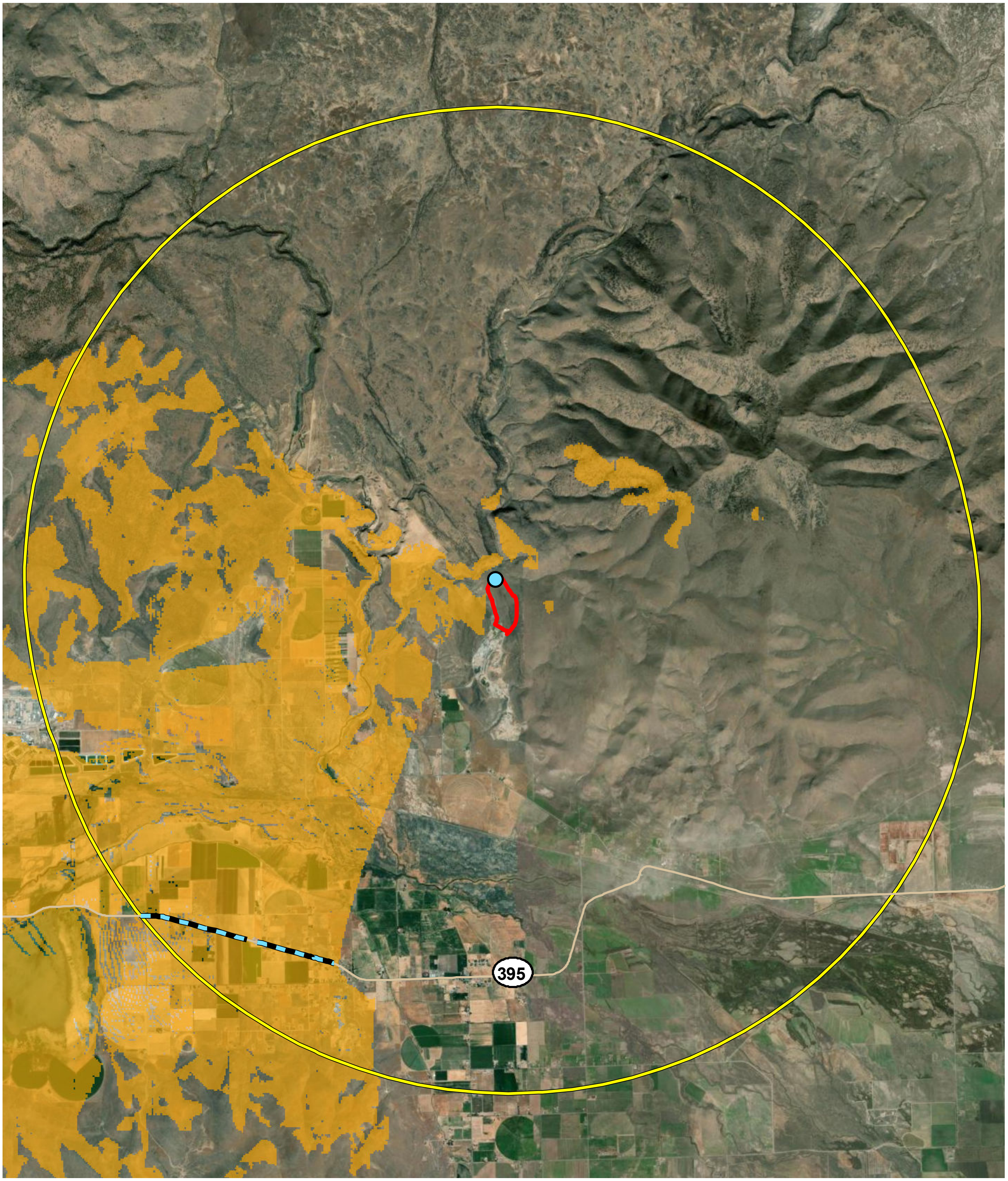
## 3.0 VIEWSHED ANALYSIS RESULTS

The product of the viewshed analyses of was the creation of 10-meter-resolution raster data layers showing visibility from two locations in the proposed mining area. This is from the proposed mining area outward (rather than from the outside looking inward toward the proposed mining area). The resulting projected data is shown on Figures 4 and 5. Table 1 shows the total linear feet from the viewshed analysis where the proposed mining area is visible from Highway 395 within five miles of the proposed project area.

**Table 1**
**VIEWSHED STATISTICS**

| Observation Location | Linear Feet of Highway 395 within Five Miles of Project Area |
|---|---|
| North Observation Point | 10,702 |
| South Observation Point | 5,974 |

In summary, the proposed mining area will be visible from portions of Highway 395. This area is not subject to changes in vegetation as the vegetation at the proposed mining area is sparse. No scenic highways or rivers are located in the project vicinity.




North Observation Location

Highway

Segment of Highway Visible from North Observation Location

Viewshed Area Visible from North Observation Location

5-Mile Buffer Around Project Area

Project Area

VESTRA

0 0.75 1.5 3 Miles

SOURCE: DIGITALGLOBE 2018 AERIAL PHOTOGRAPH

FIGURE 4

**VIEWSHED ANALYSIS WITHIN FIVE MILES OF NORTH OBSERVATION LOCATION**

WARD LAKE QUARRY

SUSANVILLE, CALIFORNIA

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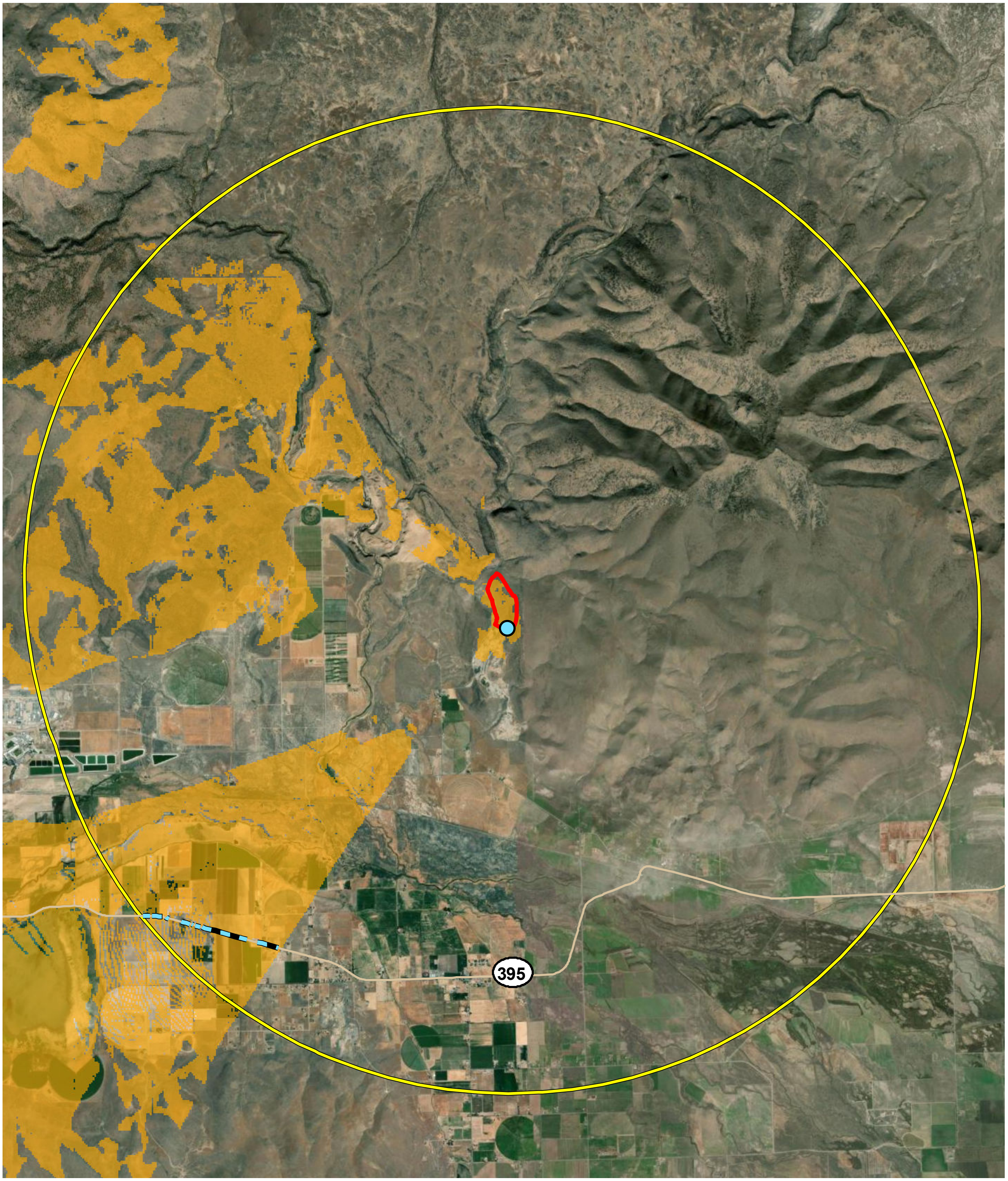


South Observation Location

Highway

Segment of Highway Visible from South Observation Location

Viewshed Area Visible from South Observation Location

5-Mile Buffer Around Project Area

Project Area

VESTRA

0 0.75 1.5 3 Miles

SOURCE: DIGITALGLOBE 2018 AERIAL PHOTOGRAPH

FIGURE 5

**VIEWSHED ANALYSIS WITHIN FIVE MILES OF SOUTH OBSERVATION LOCATION**

WARD LAKE QUARRY

SUSANVILLE, CALIFORNIA

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