PREDICTING VISUAL IMPACTS FROM THE PROPOSED ROCK CREEK GOLD MINE

FINAL REPORT

Prepared for:

Kelley Hegarty & Associates, L.L.C.
Community and Regional Planning Consultants
1320 Gull Road
Fairbanks, Alaska 99712

Prepared by

Matthew J. Macander
Charles T. Schick

ABR, Inc.—Environmental Research & Services
P.O. Box 80410
Fairbanks, AK 99708

and

P.O. Box 240268
Anchorage, AK 99524

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INTRODUCTION

Alaska Gold Company is proposing to develop a gold mine in the Rock Creek area near Nome, Alaska. Current plans call for developing up to 3.5 km^2 along the upper reaches of Rock Creek, which would include an open-pit mine, mill site, tailings storage area, and overburden and waste rock storage areas. As part of the environmental work being conducted in support of this project, ABR, Inc., was enlisted by Kelley Hegarty & Associates, L.L.C., to assess visual resources and predict the impacts to those resources in the landscape surrounding the proposed mine. This report has been prepared for inclusion in the larger Environmental Assessment document being produced for the proposed Rock Creek Mine, and therefore the report is divided into two major sections: Affected Environment and Environmental Consequences.

AFFECTED ENVIRONMENT: VISUAL RESOURCES

Visual resources in the Rock Creek Gold Mine project area are described based on the approach described in the U.S. Forest Service publication, *Landscape Aesthetics: a Handbook for Scenery Management* (USFS 1995). The analysis conducted here uses two of the primary landscape elements described in USFS (1995), landscape character and visual absorption capability, to describe the visual resources in the project area. A viewshed analysis was conducted to determine the visibility of the proposed mine within the existing landscape. A detailed landscape architectural analysis involving the mapping of landscape elements was not conducted.

Landscape character identifies the particular attributes of a landscape that give it a visual image and make it identifiable or unique. Topography, vegetation, and existing land uses were used as the attributes to define the landscape character surrounding the proposed Rock Creek Mine.

Visual absorption capability is described using three physical factors: slope, vegetation (including landscape texture), and geology (landform dissection). Visual absorption capability classifies the relative ability of a landscape to accept human alterations without a loss of landscape character or scenic quality.

The viewshed analysis describes the visibility of the project from the surrounding area, in this case using the cumulative visibility from local roads, publicly and privately held properties, and the city of Nome. Viewer position, viewshed type, and view distance were all considered in this analysis. The viewshed analysis is the primary mechanism used to describe the visual impacts from the project (see Environmental Consequences below).

LANDSCAPE CHARACTER

The proposed Rock Creek Gold Mine is in the foothills of the Kigluaik Mountains, approximately 11 km north of Nome (Figure 1). The project area lies on the east side of the broad Snake River valley, and the landscape character in this area is defined in part by the gently-rolling terrain and low foothills mountains (<550 m elevation) on either side of the valley bottom. The area is covered by a mixture of low shrub and graminoid-dominated tundra (<0.5 m tall) and patches of low willow (*Salix* spp.) and shrub birch (*Betula nana*) thickets (<1 m tall). Tall willow thickets also occur in patches on slopes, but are most common in the lower riparian areas where the plants range from 2–3 m in height. The existing landscape in the project area is typified by gently-sloping terrain on the lower slopes of Mount Brynteson (536 m elevation). Mount Brynteson itself rises above the proposed mine and is the prominent visual feature in the local area. On the lower slopes of the mountain, there are locally steep slopes above creek beds, and farther downslope, a broad, flat floodplain occurs in the confluence area of Rock Creek, Glacier Creek, and the Snake River.

The existing landscape character in this area is largely defined by natural features although alterations from human land uses are clearly evident. In particular, the existing Glacier Creek Road traverses the slope below the proposed mine and evidence of disturbance from past strip mining and exploration activities, and old mining roads are prominent in the Rock Creek and Glacier Creek drainages. Using terms described in USFS (1995), the landscape would be classified as Natural Appearing, defined as a “landscape character that expresses predominantly natural evolution, but

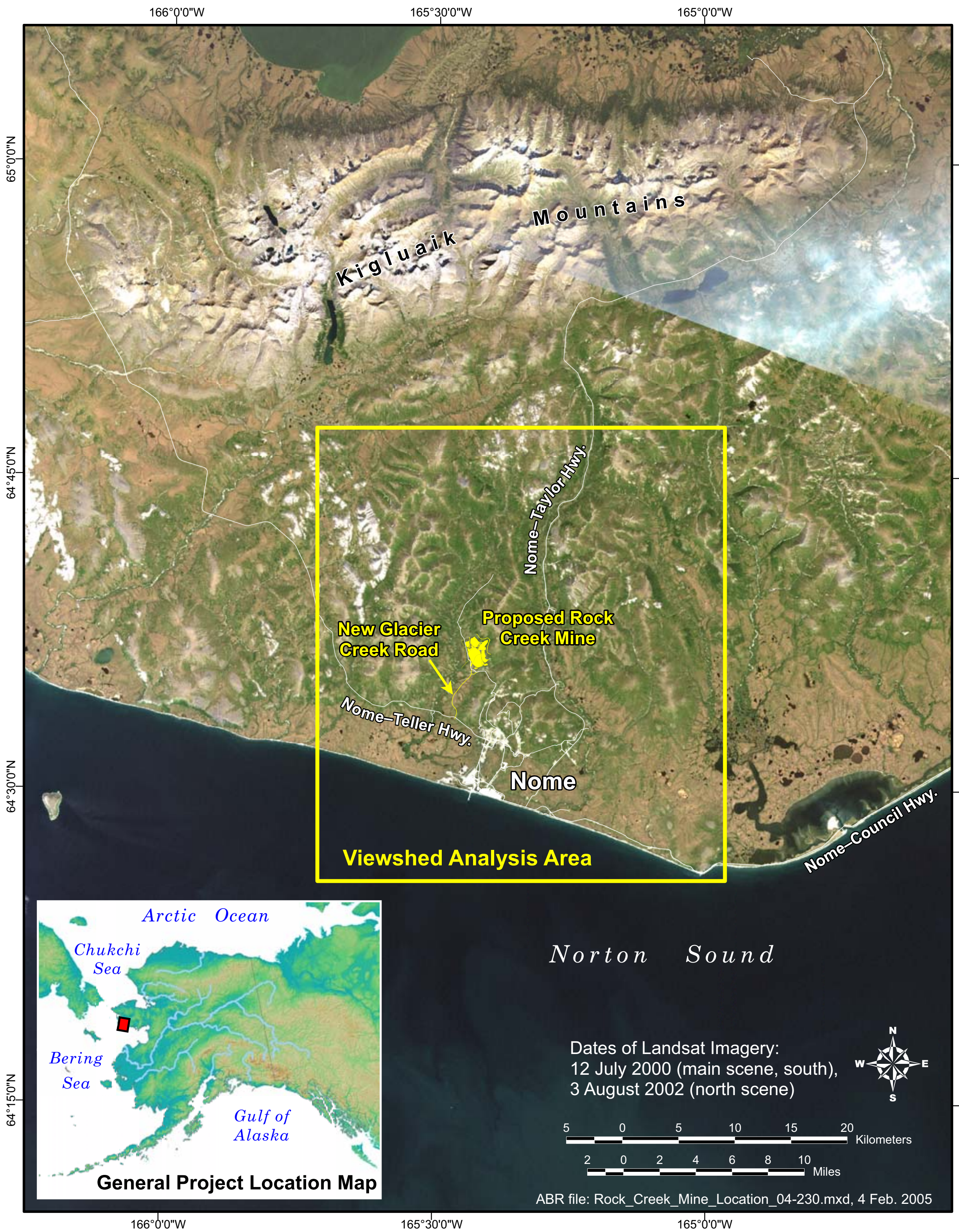


Figure 1. Location of the proposed Rock Creek Mine, near Nome, Alaska. The spatial extent of the viewshed analysis also is indicated.

also human intervention including cultural features and processes" (USFS 1995, p. 5-5).

If we consider landscape character within a larger regional context (the greater Nome area), we would want to augment the conclusions above to account for the prevalence of human activities in that larger area. The existing landscape in the Nome area has been strongly influenced by mining. Mining was the original stimulus for economic development in the area and active mining equipment as well as historic remnants remain prominent features on the landscape (Figure 2).

This evidence of mining is part of the tourist attraction for Nome, and even at some distance from the city, cuts and water collection channels from past mining operations are evident on some hillslopes and even old mining equipment is often left in place. Incorporating this information, the landscape character in the greater Nome area could be classified as mix of Natural Appearing (Figure 2) and Historic, the latter defined as a "landscape character expressing valued historic features that represent events and period of human activity in the landscape" (USFS 1995, p. 5-5).

VISUAL ABSORPTION CAPABILITY

The visual absorption capability of the landscape surrounding the proposed Rock Creek Mine is largely driven by slope and vegetation with geology also contributing. The location of the proposed mine on the slopes of Mount Brynteson affords little visual screening, and similarly the low tundra and shrub vegetation would not provide effective visual screening for human alterations on the landscape (Figure 3). This is as opposed to a landscape on relatively flat ground where tall forest vegetation would provide more effective visual screening (for viewers from the ground).

The landscape in the Rock Creek Mine area does show some texture in the repeated patterns of open graminoid/low shrub tundra alternating with taller willow thickets (Figure 3). This texture, however, is rather modest and does not substantially break up the visual continuity of landscape alterations such as the existing roads and disturbances from past mining activity. Similarly the landforms in the rolling terrain of the local project are not heavily dissected with steep slopes or exposed rock faces that could help to break up the visual continuity of landscape alterations.

Figure 2. Historical remnants and active mining equipment in Nome, Alaska.

Figure 3. Typical vegetated landscapes in the proposed Rock Creek Mine area near Nome, Alaska.

Considering these factors, the landscape in the area of the proposed project can be described as having a low level of visual absorption capability. In other words, the landscape is relatively sensitive to visual alterations.

ENVIRONMENTAL CONSEQUENCES: VISUAL IMPACTS

The major components of the proposed mine that would affect visual resources include the open pit mine, two rock dumps, a tailings storage facility, five overburden stockpiles, three diversion channels, connecting roads, and a gravel pad containing ore processing equipment. These mine components would be located on the southwest slopes of Mount Brynteson (536 m elevation), between Lindblom Creek and Glacier Creek, and would cover the lower stretches of Rock Creek and its tributary, Albion Creek. A diversion channel at 170 m elevation would be the highest feature of the project, and the mine pit would reach as high as 144 m up the slope. Most of the other project components would be below 118 m elevation and above the Glacier Creek Road (~30 m elevation), on the gentle lower slopes of Mount Brynteson. The infiltration zone roads would be lower, on the broad floodplain near the confluence of the Snake River and Glacier Creek. The footprint of the mine as currently proposed would be approximately 3.5 km^2. Not including the upper diversion channel or the lower road, the proposed mine development would cover a horizontal distance of about 2 km from top to bottom (northeast to southwest), and would be about 2.7 km wide (northwest to southeast; Figure 4).

VIEWSHED ANALYSIS METHODS

A viewshed analysis was performed to determine the locations from which an observer could see the proposed Rock Creek Mine. The analysis was performed using *ArcInfo 9.0* and *ArcGIS 3D Analyst 9.0*. The analysis determined from which locations the mine would be visible to an observer, how much of the mine site could be seen, and which components of the proposed project would be visible.

PROJECT AREA ELEVATION MODEL

For analysis, the digital project layout drawings from Smith Williams Consulting, Inc. (in

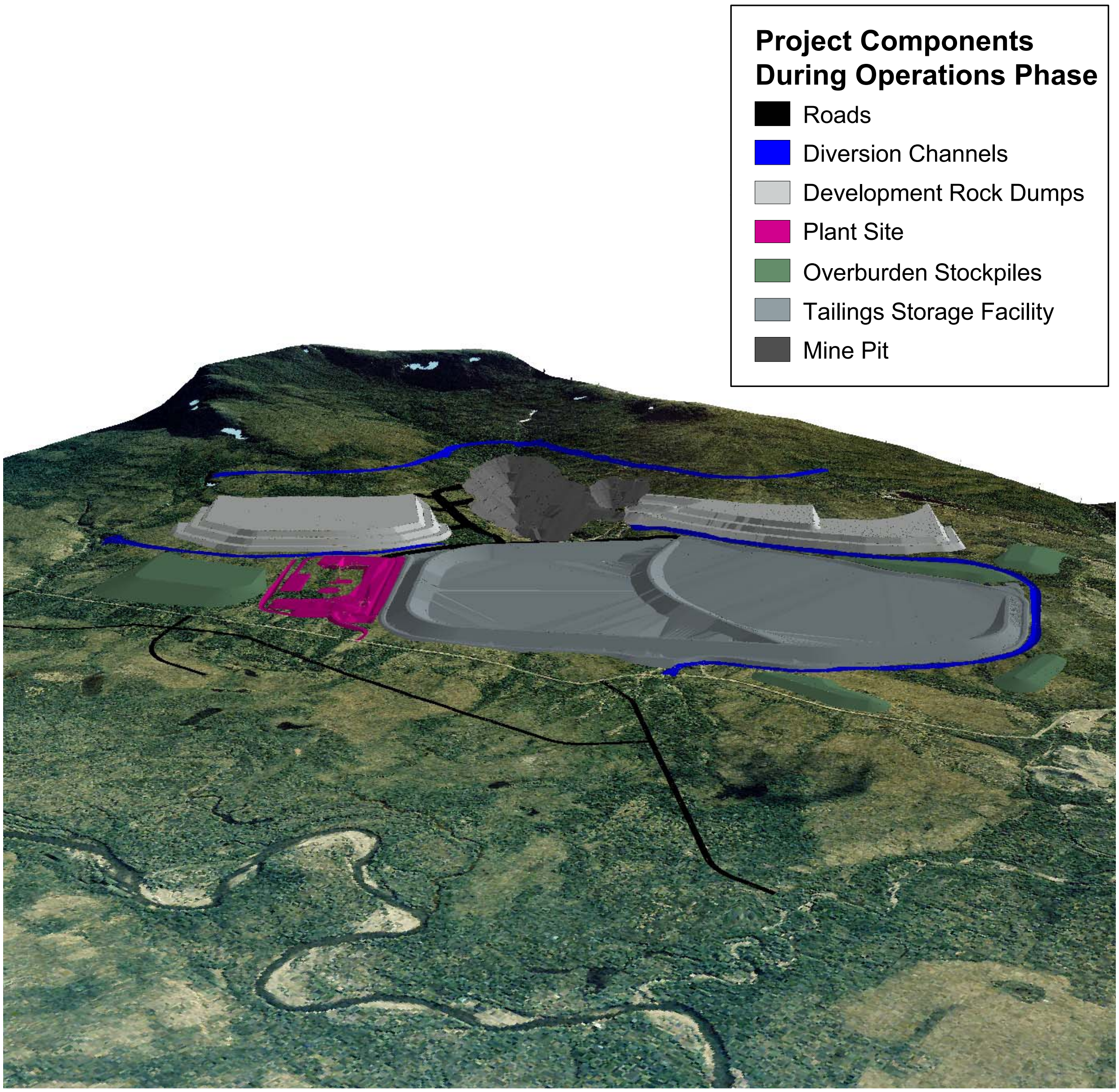


Figure 4. Project components (during operations phase) of the proposed Rock Creek Mine, near Nome, Alaska.

AutoCAD format), were converted to a three-dimensional surface model. The project layout included elevation contours for the existing terrain, the proposed mine pit, and all other project components. The existing terrain data were extracted first, and converted from contour lines to a Triangular Irregular Network (TIN) elevation model. Next, the project components were extracted and converted to a second TIN, and then inserted into the baseline (terrain) TIN to create an elevation model of the fully-developed project area. Finally, the TIN of the complete proposed development was converted to a three-dimensional polygon layer for analysis and visual simulation (Figure 4).

REGIONAL ELEVATION MODEL

The elevation model derived from the *AutoCAD* drawings described above contained fine-resolution elevation data for the immediate project area. Such fine-scale elevation data, however, were not available for the entire study area used in the viewshed analysis. The viewshed analysis software requires elevation data at a consistent post-spacing for the entire area being analyzed. For this purpose, Digital Elevation Model (DEM) data at 2 arc-second resolution were downloaded from the USGS National Elevation Dataset website (http://seamless.usgs.gov/). The DEM data were projected into the coordinate system of the engineering drawings (UTM Zone 3, North American Datum of 1927) at 25-m horizontal resolution; vertical units also were in meters (North American Vertical Datum of 1929).

Next, the detailed project area elevation model was merged with the regional elevation model. The project area TIN was interpolated to a DEM at 25-m horizontal resolution, which was then superimposed on the regional DEM in the area where the two overlapped. This procedure incorporated the more accurate and detailed, post-development elevation data (in reduced resolution form) into the regional DEM.

POINT MESH

The viewshed analysis computes the line of sight from each input point to every grid cell of the elevation model and is a computationally intensive process. To simplify the analysis and reduce excess computation, a mesh of points was generated that would allow the project components to be sampled as discrete units. Smaller features with more variation in elevation, such as roads, were sampled 2–8 times more frequently, while larger, more homogeneous features were sampled less often. Most features were sampled using a regularly spaced grid of 25–50 m, while a few narrow, linear features with high elevation variation were sampled every 25 m along their length. Each point then was assigned a spot elevation, using the higher elevation from either the detailed project area elevation model or from the reduced resolution, merged regional elevation model.

VIEWSHED CALCULATION

The viewshed calculation was then computed once for each set of points (Table 1). The resulting output grids were coded with whole number values, from zero up to the total number of points in the set, at the same resolution as the DEM. These numbers represent the number of points that could be "seen" from each cell in the DEM. For example, the edge of the proposed mine pit was represented by 162 points; cells coded with zero in the "Pit Edge" output grid could not see any portion of the edge of the mine pit, while cells coded with 8 could see approximately 5% of this feature.

The outputs of the viewshed calculation then were aggregated to two summary grids: (1) a simple summary of all of the individual grids, depicting the degree of overall visibility; and (2) a grid that highlights the particular components of the proposed mine that would be visible from different areas.

To determine the overall visibility, the cell point counts were weighted by the sampling density of each feature (Table 1). This ensured that larger, homogenous features (which were sampled less frequently, in the interest of efficient calculation) received a weight in the overall visibility roughly in proportion to their total footprint.

To determine the visibility of particular components, encoded grids were generated for the diversion channels, tailings storage, rock dumps, stockpiles, roads, and pit. The binary encoding was conducted manually, and the primary finding was that 83% of the areas from which the mine is at all

Table 1. The approximate footprint of the various components of the proposed Rock Creek Mine, near Nome, Alaska. The number of points for each feature used in the viewshed analysis and the weighting factor used to produce the overall visibility grid also are indicated.

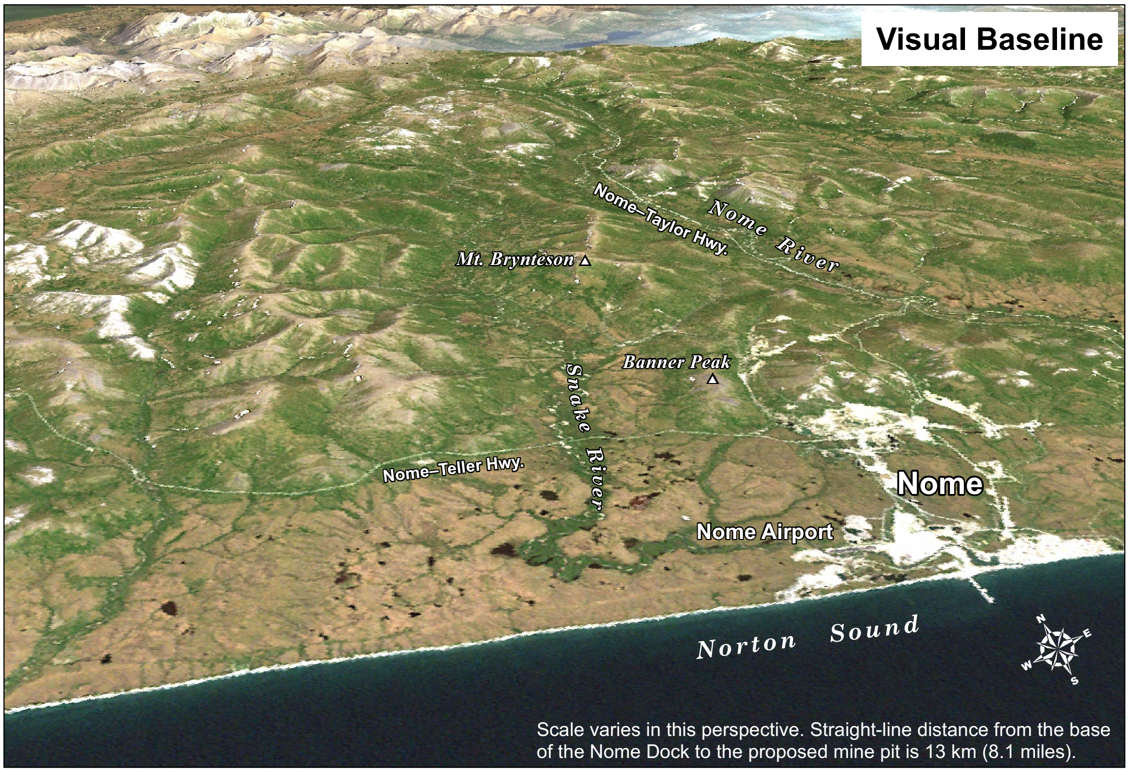
Mine Component	Approximate Footprint (ha)	Number of Points	Point Density (Points/ha)	Weighting Factor	Weighted Number of Points
Diversion Channels					
Lower North Diversion Channel	3.7	53	14.2	1	53
Lower South Diversion Channel	8.4	131	15.7	1	131
Upper Diversion Channel	12.1	193	16.0	1	193
Plant Site	13.3	0	0		0
Roads					
Lower Mine Roads	4.8	158	33.0	0.5	79
Mine Trunk Roads	8.7	136	15.7	1	136
Development Rock Dumps					
North Development Rock Dump	49.2	198	4.0	4	792
South Development Rock Dump	34.5	139	4.0	4	556
Stockpiles					
Organic Overburden Soil Stockpile #1	16.0	64	4.0	4	256
Organic Overburden Soil Stockpile #2	3.3	247	16.1	1	247
Organic Overburden Soil Stockpile #3	2.5				
Organic Overburden Soil Stockpile #4	5.0				
Organic Overburden Soil Stockpile #5	4.4				
Tailings Storage Facility					
Tailings Storage Facility Phase 1	67.2	270	4.0	4	1080
Tailings Storage Facility Phase 2	77.2	308	4.0	4	1232
Mine Pit	44.4	162	3.7	4	648
Total	354.7	2059			5403

visible will afford a view of all the major mine components.

To allow an analysis of the entire viewshed, the highly-detailed project area elevation model was incorporated into the viewshed analysis at a reduced resolution (25-m). This process resulted in narrow ridges within the project area (such as elevated roads and the tops of berms) being smoothed and lowered. Some narrow elevated features block the view of other mine components behind them, and by smoothing these narrow elevated features, their screening ability is slightly diminished. Therefore the visibility of some individual mine components may be slightly overstated because the capability of foreground mine components to visually screen background mine components is underestimated. Determinations of the visibility of the overall mine project and the overall determination of visibility from any particular location are not affected.

VISUAL SIMULATION

The output of the viewshed calculations was visualized using *ESRI ArcGlobe 9.0*. First, a Landsat Enhanced Thematic Mapper+ (ETM+) satellite mosaic was draped over the elevation models. Next, a baseline visualization was created, showing a birds-eye view of the landscape in its current state (as of July 2000, when the image over the proposed mine site was acquired). Then, from the same viewpoint, the footprint of the mine and the overall visibility grid were depicted on top of the baseline image (Figure 5). This figure depicts the location of the mine project, the location of



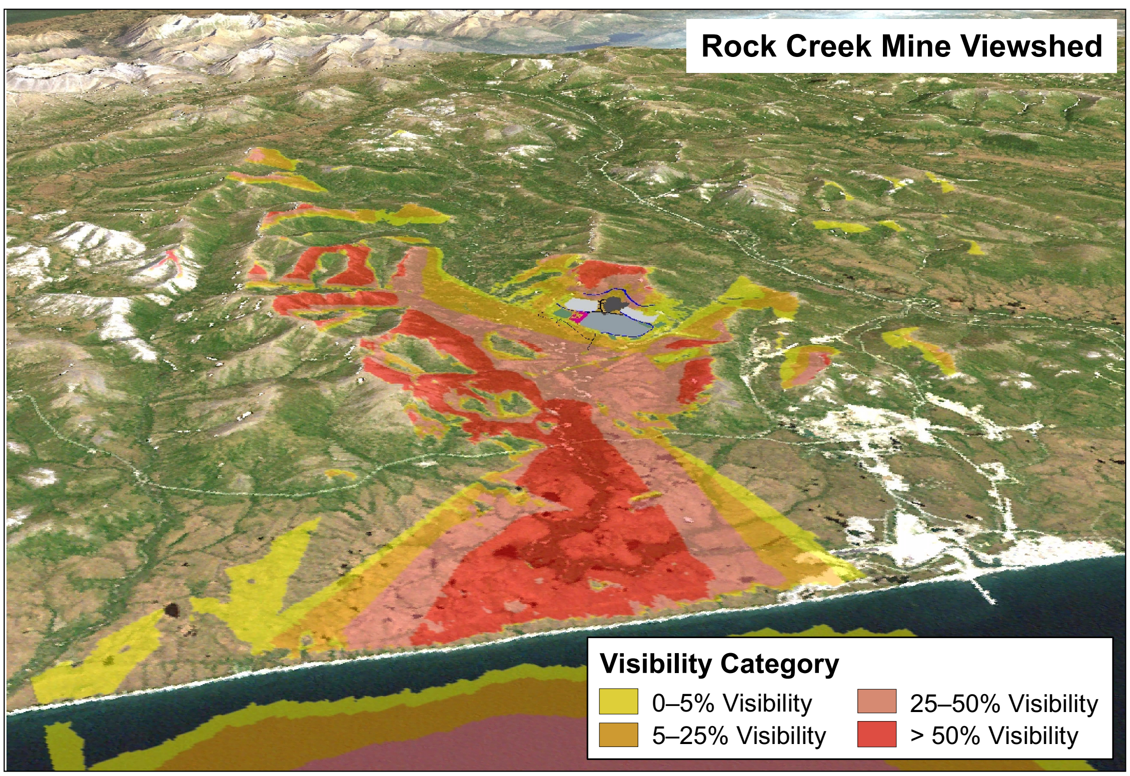


Figure 5. Perspective view of Nome, Alaska, the proposed Rock Creek Mine, and the surrounding area. The top figure depicts the landscape in July 2000. The bottom figure depicts the footprint of the proposed Rock Creek Mine, and the areas from which various percentages of the mine project would be visible.

areas within its viewshed, and categorizes the overall visibility of the project at different locations. Similarly, the visibility-by-component grid was depicted over the baseline image, with the more common combinations of project components identified using a color key (Figure 6).

Individual view simulations were created using *ESRI ArcScene 9.0* to characterize the view of the proposed Rock Creek Mine from several different likely viewing locations (Figure 7). For each view simulation, the scene was visualized with the mine, and without it. Views were constructed from the Nome–Teller Highway just east of the Snake River crossing (Figure 8); from the New Glacier Creek Road on its approach to the mine site (Figure 9); from the Glacier Creek Road as it approached the mine from the east (Figure 10); and from an unnamed peak west of the Snake River, directly across from the proposed mine (Figure 11). The intent of these view simulations is to depict which project components would be visible, what their shape(s) would look like, and how much of each view they would occupy. The different components are color coded following the key in Figure 5. These simulations are not intended to be accurate depictions of the color and texture of the proposed mine project.

VISUAL BASELINE PHOTOGRAPHY

A series of digital photos was acquired in March 2004, documenting the winter landscape in and around Nome, focusing in particular on the approaches to the proposed Rock Creek Mine. Photos were acquired approximately every 400 m along several routes (Figure 7). At each location, a GPS waypoint was acquired and photos were taken facing north, south, east, and west. Routes covered were from downtown Nome, out Center Creek Road to the Nome–Teller Highway; the Nome–Teller Highway to the New Glacier Creek Road; the old Glacier Creek Road from the Nome–Teller Highway to about 500 m past Rock Creek (~500 m from the proposed plant site access road); and the entire length of the New Glacier Creek Road (Figure 7). The complete set of photos acquired is included in Appendix A.

Two of the view simulations described above originated at coordinates corresponding to the winter visual baseline photography. At these two locations, the visualization view direction was adjusted to correspond to the appropriate photo, and the actual and simulated views were depicted side by side (Figures 9 and 10). In addition, the simulated mine components were superimposed on both scenes.

VIEWSHED ANALYSIS RESULTS

The results of the overall visibility calculation are depicted in Figure 5. The proposed Rock Creek Mine would not be visible from the city of Nome, except at the western edge of town beyond the airport. Banner Peak and Bonanza Hill would block the view of the Rock Creek mine facilities from most of Nome. The mine would not be visible from the Nome–Taylor Highway or the Nome–Council Highway either. The proposed mine would be highly visible from the lower Snake River Valley, including from the Nome–Teller Highway where it crosses the valley. From several surrounding hillsides an observer would have a complete view of the proposed mine, including the south-facing slopes of Mount Brynteson, the northwest slopes of Banner Peak and Bonanza Hill, the peak of Anvil Mountain, the southwest slopes of Twin Mountain, and several other unnamed peaks and ridges to the west and north of the mine. Along most of the New Glacier Creek Road (being constructed largely to provide access to the mine project), an observer would have clear views of the mine. The Old Glacier Creek Road runs up the Anvil Creek valley for the first 6 km, and on this approach the mine would not be visible until the road crested the shoulder of Bonanza Hill.

Portions of the proposed mine project would be visible from the middle Snake River valley below the mine, and from the Glacier Creek Road as it traverses the base of the mine project. Visibility would diminish as the viewer moves northward, until the mine would disappear from view behind the western shoulders of Mount Brynteson.

From Boulder Creek, lower Sledge Creek, and lower Glacier Creek, an observer would

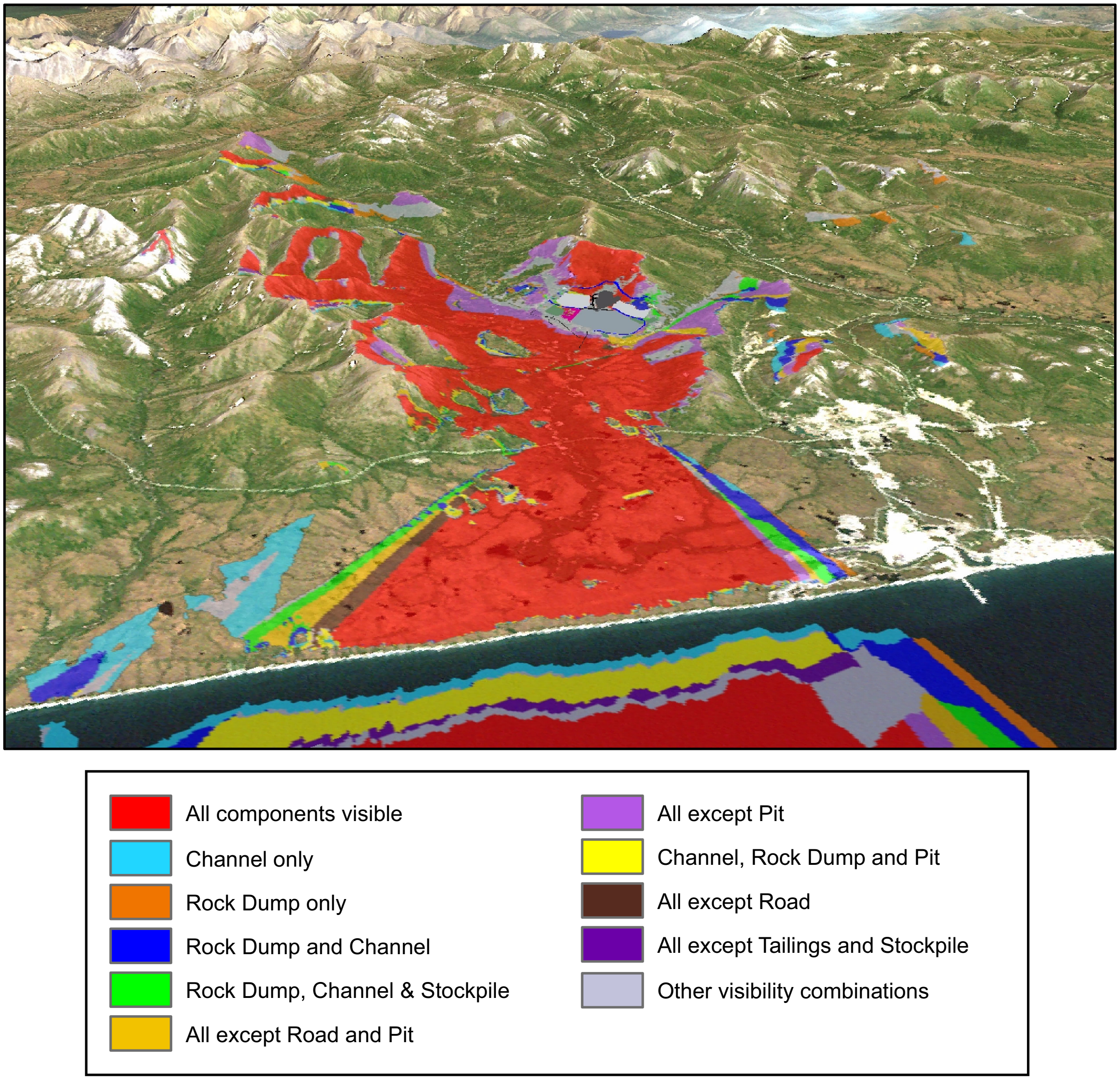


Figure 6. Perspective view of Nome, Alaska, depicting the visibility of major mine components. In 83% of those locations where any portion of the mine would be visible, a viewer would see all major components of the mine. More distant locations and locations near the edge of visibility would provide views of only some project components. For locations close to the proposed mine, the foreground mine components would block the view of components in the background.

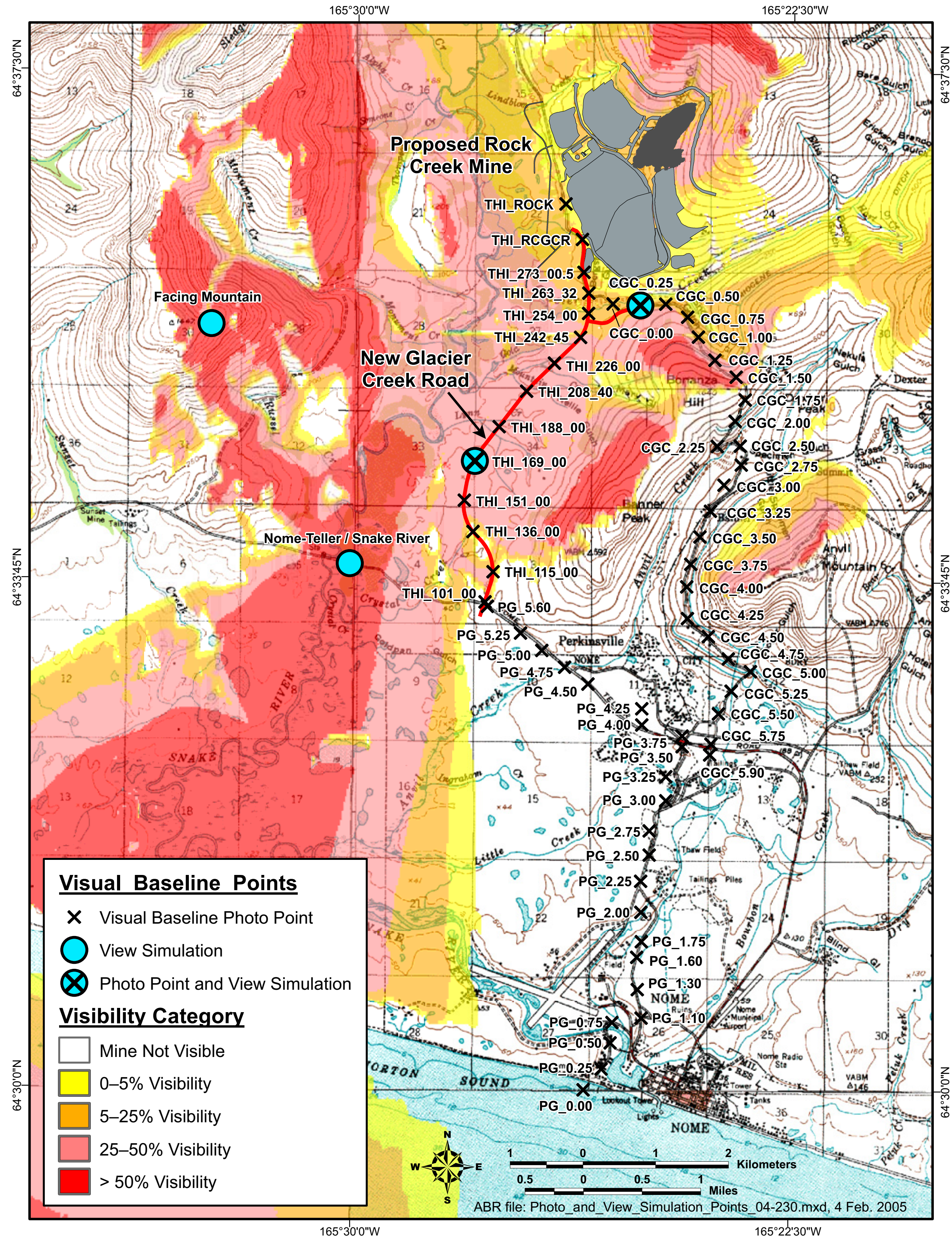


Figure 7. Locations of visual baseline photography points and view simulations, overlain on overall visibility contours for the proposed Rock Creek Mine, near Nome, Alaska.

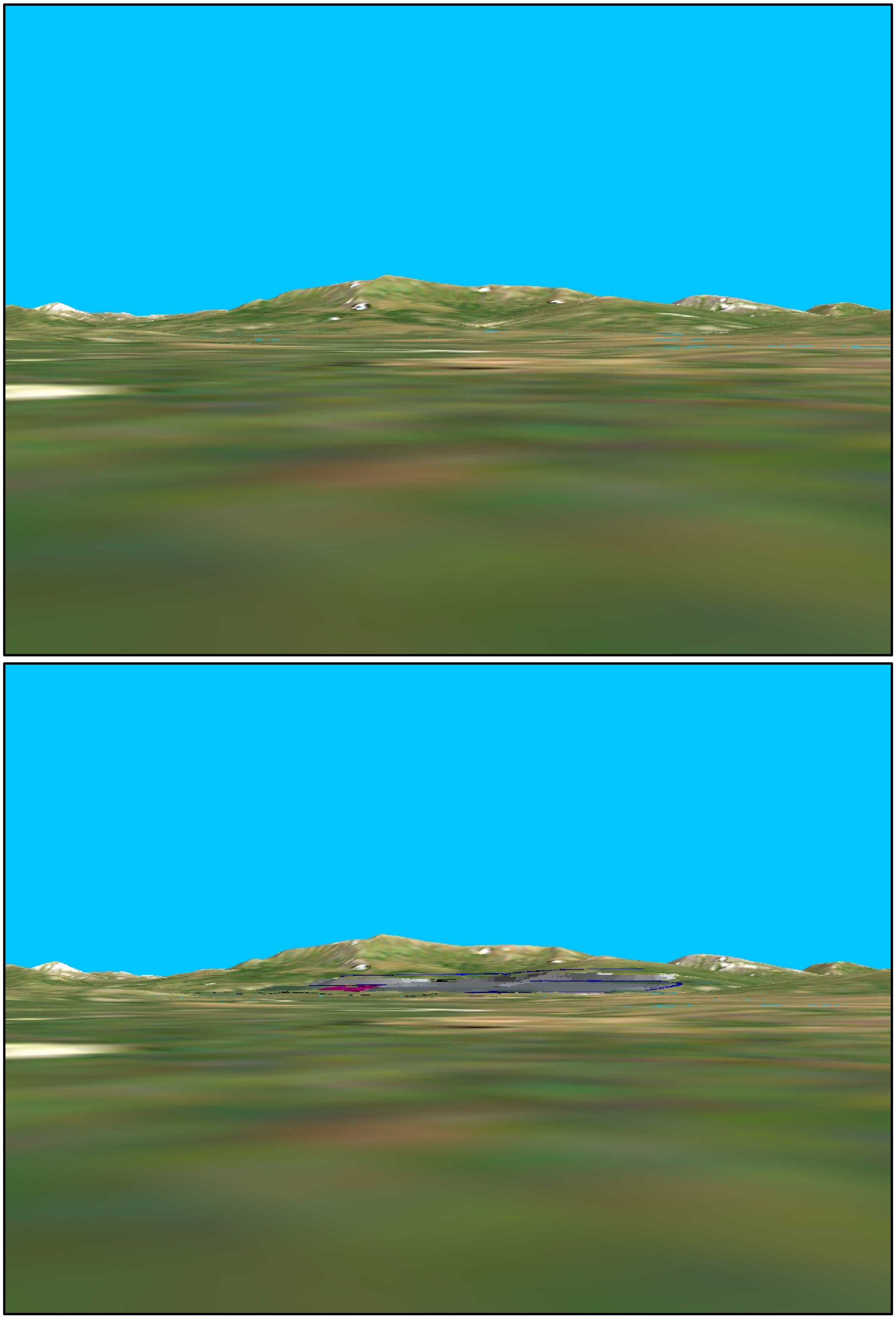


Figure 8. Simulated views of the proposed Rock Creek Mine project area near Nome, Alaska, from the Nome–Teller Highway just east of the Snake River bridge.

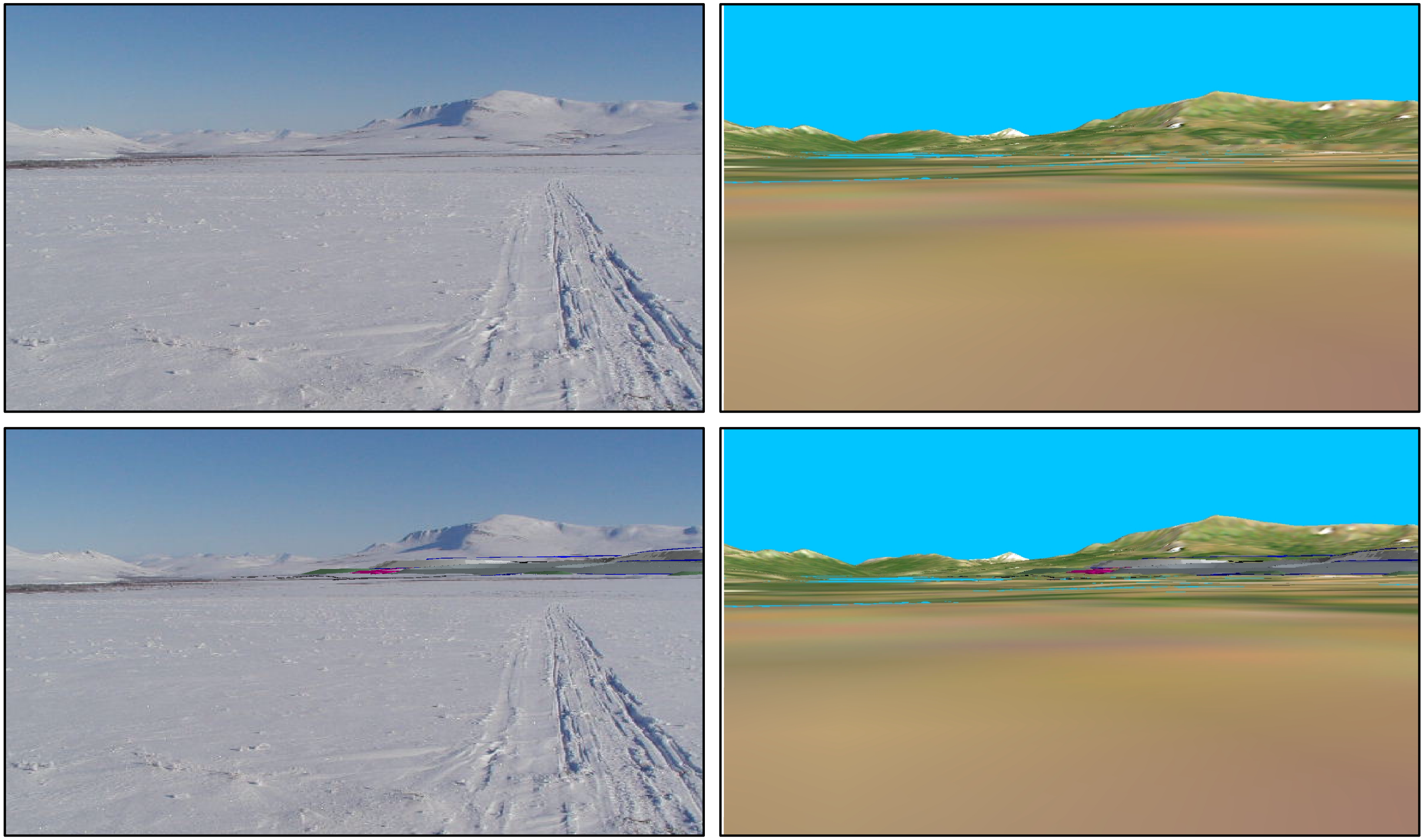


Figure 9. Winter photographs (left) and simulated summer views (right) of the proposed Rock Creek Mine project area near Nome, Alaska, from the New Glacier Creek Road, 2.1 km (1.3 miles) from the Nome–Teller Highway. These simulations do not depict the recently constructed New Glacier Creek Road, although it would be seen from this location.

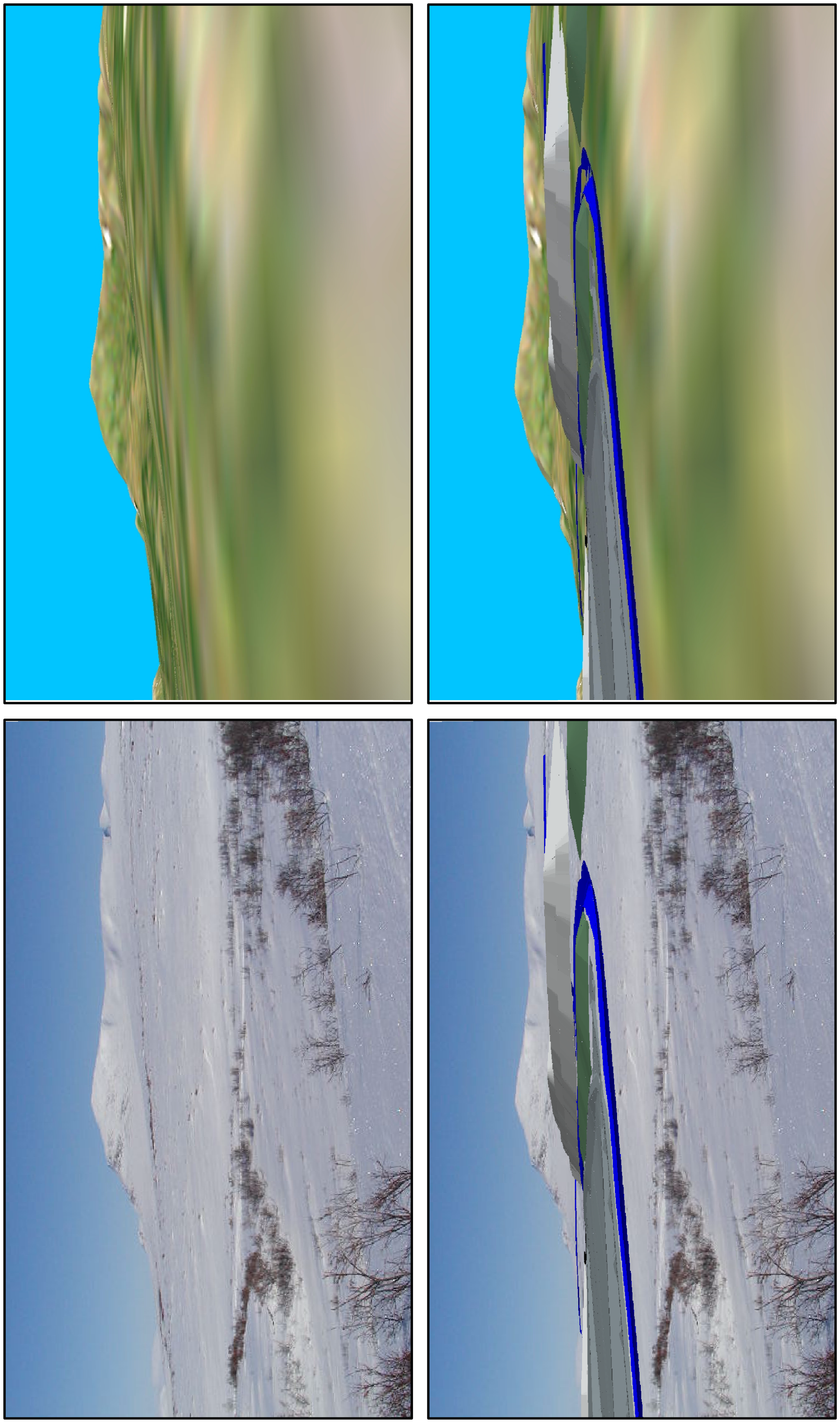


Figure 10. Winter photographs (left) and simulated summer views (right) of the proposed Rock Creek Mine project area near Nome, Alaska, from the Old Glacier Creek Road. The view location is 9.1 km (5.6 miles) from the Nome–Teller Highway and about 350 m south of the proposed lower south diversion channel and tailings storage facility.

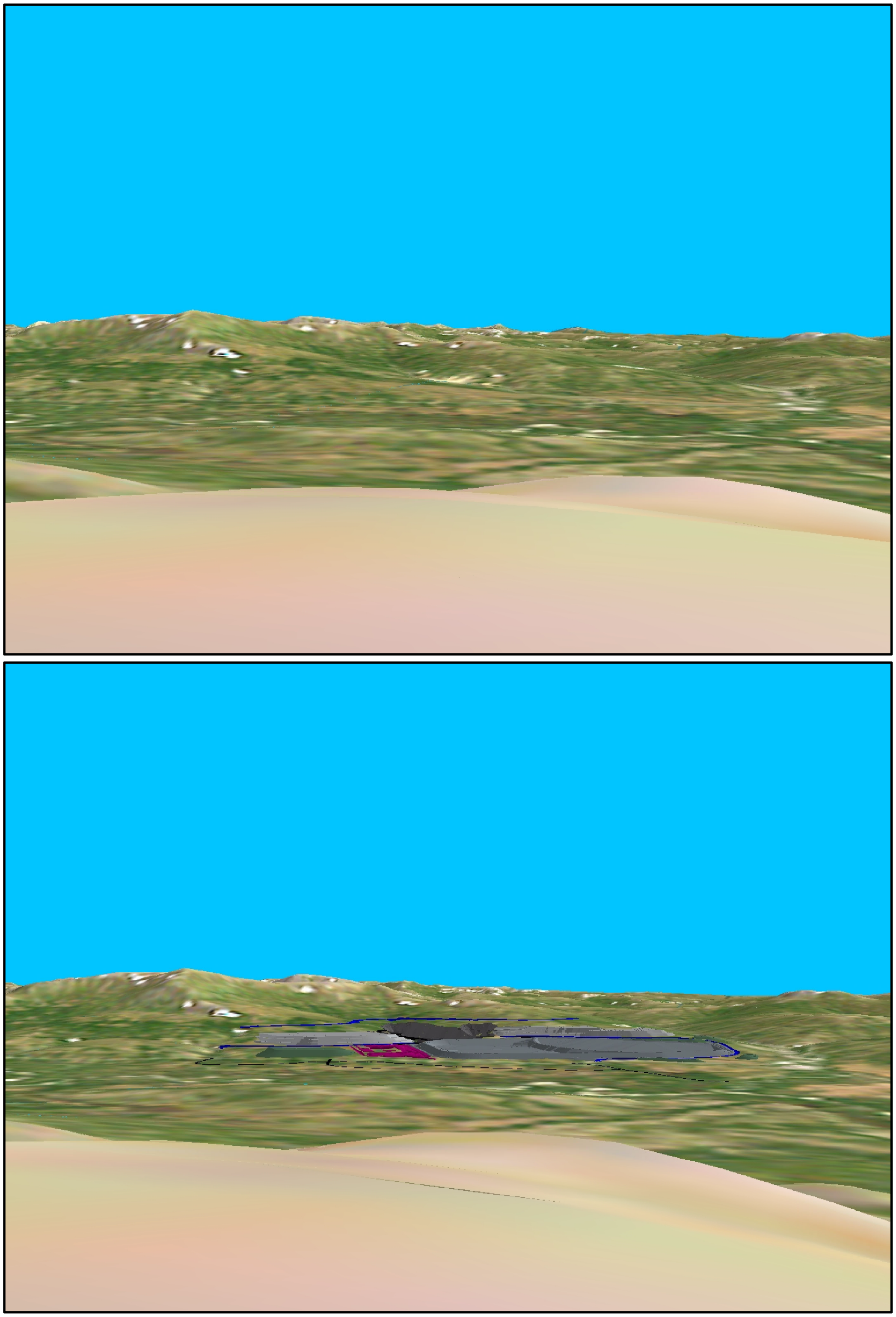


Figure 11. Top view: Simulated existing view from near the summit of an unnamed peak southwest of the proposed Rock Creek Mine. Bottom view: Simulated view of the proposed mine facilities (during operations) from the same unnamed peak.

have clear views of the proposed mine, although the tall willows along the creeks may block some views. The same would be true for several smaller creeks feeding into the Snake River, to the immediate west and south of the mine project area.

Views of the proposed mine from south of the Nome–Teller Highway, including from the coastal plain and the ocean, would be constrained by Banner Creek to the east, and an unnamed ridge to the west. Near the Nome–Teller Highway crossing of the Snake River, the Snake River valley narrows to about 2 km. Here the proposed mine would be more visible, and would be visible from a wider area at an increasing distance to the south, as the Snake River valley approaches the coast. At the same time, however, the apparent size of the mine would diminish as distance increases from the mine. From the ocean, viewers looking up the Snake River valley on a clear day would be able to see the mine. The proposed mine would not be visible from the mouth of the Snake River, in the city of Nome.

Finally, several more distant high ridges and mountain peaks would have limited views of the proposed Rock Creek Mine, including several unnamed peaks west of the Nome River, and some peaks to the north and west, including Mount Distin. The proposed mine likely would be visible from a few peaks outside the area of analysis.

The simulated views depict the shape, orientation, and perceived size of the mine project components, though not their color and texture. From the Nome–Teller Highway, as it crosses the Snake River valley, the entire mine project would be visible; its' width would appear to be equal to the width of Mt. Brynteson from this vantage point, though the mine would only occupy the lower slopes. From this perspective, the previous mining activities near Rock Creek are quite obvious, and the lower slopes of Mt. Brynteson already have visual impacts from mining.

The New Glacier Creek Road approaches the site from the south on the broad floodplain of the Snake River, from a very shallow angle. Again, from this road, the proposed mine would appear as wide as Mount Brynteson, but would only occupy the lower portion of the view of Mount Brynteson. As a viewer traveling the road got closer to the Rock Creek mine site, the tailing storage facility and the rock dumps would look much larger. From this view, too, there is much evidence of previous mining activity, especially in the Rock Creek valley.

Although the Rock Creek Mine would generally not be visible from the Old Glacier Creek Road until cresting Bonanza Hill (see above), the landscape in that area is characterized by active and abandoned mining operations and heavy equipment. After leaving the Anvil Creek valley, the road descends towards Glacier Creek, which is also heavily mined, with prominent gravel berms in the floodplain. The southeast edge of the proposed Rock Creek Mine would be visible on the hillside above Glacier Creek, with the south rock dump, the tailings storage facility, a diversion channel, and two overburden stockpiles in the foreground, and other portions of the project in the background.

From a vantage point on the upper slopes of the unnamed peak directly across from the mine project (at ~370 m elevation), the view includes the lower slopes of the peak in the foreground, the Snake River and Glacier Creek floodplains, the foothills in the distance, and of course, Mount Brynteson and the proposed mine. From this perspective, an observer would view the mine from above, rather than edge-on as with the views from lower roads, and the different components of the mine would be more distinguishable.

VIEWSHED ANALYSIS DISCUSSION

The high visibility ratings of the proposed mine from the Snake River valley are explained by the large size of the mine as viewed in the context of the local topography. The footprint of the mine would be approximately 3.5 km^2. The proposed mine would be sited on the lower slopes of Mount Brynteson, facing down the valley, with an unobstructed view of the ocean at the valley mouth. These lower slopes provide a view up and down the Snake River valley, and several small tributaries. The low shrub and tundra vegetation on the broad floodplain and hills facing the mine project will generally allow unobstructed views of the mine. At the same time, the hilly terrain and the location of the proposed mine on the lower slopes of Mt. Brynteson restricts broader, regional visibility, so that outside the Snake River valley and facing hillsides, the proposed mine would be visible only from rarely-traveled higher elevations.

Viewers of the proposed mine in the Snake River valley are expected to be a diverse group. Some tourists, including birdwatchers, may travel the Glacier Creek Road system in the summer although other road systems in the Nome area likely will receive more use from tourists. Local residents also may travel the Glacier Creek Road system in summer for recreation and berry picking. In the fall, residents of Nome likely will travel by car, by four-wheeler, and on foot in the Snake River valley, especially during moose hunting season. In the winter, numerous off-road trails are used in the Snake River valley by dog mushers and snowmachine riders.

This viewshed impact analysis does not account for affects of vegetation, which could reduce the visual impact of the proposed mine, although only to a negligible extent because of the low height of the existing vegetation in the region (see Affected Environment above). Also, the DEM data for northern Alaska used in this analysis are relatively coarse-scale and this level of accuracy introduces some error into the viewshed estimates. Improvements in the viewshed modeling used here likely would change the details of the visibility results but not their main conclusion: large portions of the proposed mine would be visible from most of the Snake River valley, including most of the private parcels in the lower valley. The proposed mine would be highly visible from the New Glacier Creek Road and portions of the old Glacier Creek Road and Nome–Teller Highway. The proposed mine, however, would not be visible from the city of Nome, except at the western edge.

The visual impact varies for different project components. The plant site would be dwarfed in size by the rock dumps and tailing storage sites, but would be well-lit and would likely be the most prominent feature in low light or darkness. The overburden stockpiles would be planted with grass to reduce erosion, and after several years they should begin to blend at least partially with the vegetated hillsides. The overburden stockpiles will be moved upon mine closure and could be used in reclamation efforts (see Mitigation Considerations below). Long linear features such as roads and diversion channels would be highly visible in daylight unless they were shielded by vegetation planted specifically for that purpose. The rock dumps and tailings storage facilities would be easily visible as they are unvegetated, with tall gravel berms at their lower edges, and they face several likely viewing angles. They also would cover extensive areas at the proposed mine. The visual impact of the mine pit would largely depend on the viewing angle—from the shallower angles of local roads, it may blend in with the rock dumps and tailings storage facilities, which are constructed from material excavated from the pit. From higher view angles on a nearby mountain, or from aircraft, the depth of the pit would become apparent, especially when lit with artificial lights.

This analysis indicates that visual impacts in the Nome area clearly would occur from construction of the Rock Creek Mine. The magnitude and even the direction of the impact (positive or negative) depends, however, upon the viewer's physical position in the region at the time of observation and upon the viewer's perspective on mining in general. In other words, the level of visual impact will depend on location and on the perceptual background of the observer (i.e., the observer's preferences for landscape character, USFS 1995). Those viewers with knowledge of the Nome area and Alaska's mining history likely will not see the proposed mine as a unique landscape alteration that is out of character for the area. However, the large physical size of the alteration will make the mine site stand out clearly in the landscape.

Visual impacts from the proposed mine will be more pronounced during the construction and operations phases (expected to last 8–12 years). During this period, the mine pit, rock dumps, and overburden stockpiles will stand out in the landscape as unvegetated disturbances (or partially vegetated in the case of the overburden stockpiles). Lighting also will contribute to the visual impacts, especially during the long winter nights that occur in this region of northwest Alaska (64° 30' N latitude). After mine closure and reclamation efforts (see Mitigation Considerations below), some of these visual impacts could be lessened. In particular, revegetation efforts in the mine pit and rock dumps will help these areas blend visually with the surrounding terrain, and the cessation of lighting will reduce visual impacts during periods of low light and darkness.

MITIGATION CONSIDERATIONS

We recommend developing mitigation options to reduce the visual impacts of the proposed mine, especially after mine closure. Contouring of mine disturbances to match adjacent terrain topography and incorporating boulders into reclaimed areas to increase surface roughness will help reduce visual impacts. Landscaping will improve conditions for establishing vegetation, which also is important for reducing visual impacts. Plans for stockpiling overburden are in place for use in revegetation efforts, but it also may be prudent to conduct a reclamation soils inventory in the area (if not already done) to assess the availability of soils that have favorable physical and chemical characteristics for use in post-mining revegetation efforts. Revegetation for reducing visual impacts (as well as ecological impacts) will be most successful if an effort is made to revegetate disturbed areas using native species found in the adjacent, undisturbed vegetation, where possible. In this regard, revegetation with willows in moist areas and forbs such as legumes and wormwood (*Artemisia* spp.) in drier areas are feasible options (Densmore and Homes 1987, Kidd et. al. 2001, Muhlberg and Moore 1998). Other mitigation options to consider include removal of the plant site buildings and other structures and equipment after mine closure, along with revegetation efforts in those areas.

SUMMARY OF VISUAL IMPACTS

Geographic Extent: Greater Nome area

Duration and Frequency: Mine life, 8–12 years, followed by reclamation

Likelihood: It is certain this impact will occur.

Magnitude: Overall significant negative visual impacts will occur with development although the degree of negative impact will vary according to each viewer's perceptual experiences; mitigation measures employed, especially after mine construction and operations, will lessen the impacts after mine closure.

REFERENCES

Densmore, R. V., and K. W. Holmes. 1987. Assisted revegetation in Denali National Park, Alaska, U.S.A. Arctic and Alpine Research 19: 544-548.

Muhlberg, G., and N. Moore. 1998. Streambank revegetation and protection: a guide for Alaska. Tech. Rep. No. 98-3, Alaska Dept. of Fish and Game, Alaska Dept. Natural Resources, U.S. Environmental Protection Agency. 57 p.

Kidd, J., C. Thomas, P. Moore, and H. Butler. 2001. Riverine and riparian habitat creation at the Ekati™ Diamond Mine, NT, Canada. Presentation at the First Biannual Northern Latitudes Reclamation Workshop: September 30–October 3, 2001. Whitehorse, Yukon, Canada.

USFS (U.S. Forest Service). 1995. Landscape aesthetics: a handbook for scenery management. Agriculture Handbook No. 701. U.S. Department of Agriculture, National Forest Service, Washington, D.C.

Appendix 1. Photos acquired in March 2004 to document the winter landscape in and around Nome, in particular on the approaches to the proposed Rock Creek Mine. Photo locations are depicted in Figure 5. Photo locations from which a viewer would see the proposed Rock Creek Mine have a shaded caption, and the photo(s) facing the mine have a shaded border. The shading color corresponds to the visibility categories, following Figure 5, illustrating what percentage of the proposed mine development would be visible from each vantage point (yellow = 0–5% of development visible; orange = 5–25% of development visible; pink = 25–50% of development visible; red= >50% of development visible).

START @ PORT GATE 0.00

Gate at Port (Port Rd.)

START @ PORT GATE 0.25
25MPH sign near large tires (Port Rd.)

START @ PORT GATE 0.50

Old State DOT Shop (Port Rd.)

START @ PORT GATE 0.75
"Animal Shelter" blue sign (Sepala Drive)

START @ PORT GATE 1.10

Bypass Rd./Center Creek Rd. intersection

START @ PORT GATE 1.30
Old FAA turnoff (Center Creek Rd.)

START @ PORT GATE 1.60
National Guard Hanger turnoff (Center Creek Rd.)

START @ PORT GATE 1.75
First bend in road passed hangars (Center Creek Rd.)

START @ PORT GATE 2.00
Center Creek Rd.

START @ PORT GATE 2.25
Nome City Monofil turnoff (near old crane) (Center Creek Rd.)

START @ PORT GATE 2.50
North just passed Monofil turnoff (Center Creek Rd.)

START @ PORT GATE 2.75

Center Creek Rd.

START @ PORT GATE 3.00
Just before Anvil Mt. Correctional (Center Creek Rd.)

START @ PORT GATE 3.25
North turnoff of Anvil Mt. Correctional (Center Creek Rd.)

START @ PORT GATE 3.50
Center Creek Rd./Teller Highway intersection

START @ PORT GATE 3.75
Bob Blodgett Nome-Teller Hwy Sign (Nome-Teller Highway)

START @ PORT GATE 4.00

Fist bend in road passed Hwy sign (Nome-Teller Highway)

START @ PORT GATE 4.25
Nome-Teller Highway

START @ PORT GATE 4.50
Nome-Teller Highway

START @ PORT GATE 4.75
Anvil Creek under roadway (Nome-Teller Highway)

START @ PORT GATE 5.00

Nome-Teller Highway

START @ PORT GATE 5.25

Crest of hill on Nome-Teller Highway

END @ GCB/TELLER HWY 5.60
Nome-Teller Highway/Proposed Glacier Creek Bypass Rd.

START @ TELLER HWY INT. 101+00

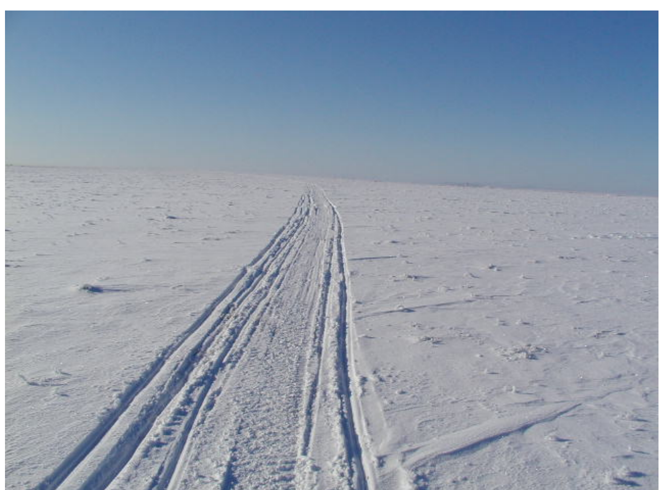
GCB to connection with existing GCR

START @ TELLER HWY INT. 115+00

Survey marker stake, Orange paint with fluorescent pink tape

START @ TELLER HWY INT. 136+00
Survey marker stake, Orange paint with fluorescent pink tape

START @ TELLER HWY INT. 151+00
Survey marker stake, Orange paint with fluorescent pink tape



START @ TELLER HWY INT. 169+00
Survey marker stake, Orange paint with fluorescent pink tape

START @ TELLER HWY INT. 188+00
Survey marker stake, Orange paint with fluorescent pink tape

START @ TELLER HWY INT. 208+40
Survey marker stake, Orange paint with fluorescent pink tape

START @ TELLER HWY INT. 226+00

Survey marker stake, Orange paint with fluorescent pink tape

START @ TELLER HWY INT. 242+45
Survey marker stake, Orange paint with fluorescent pink tape

START @ TELLER HWY INT. 254+00
Gravel pile approximately 50 yds away, Red Cabin in proposed roadway near this position.

START @ TELLER HWY INT. 263+32
Other side of gravel pile, linking proposal to existing GCR

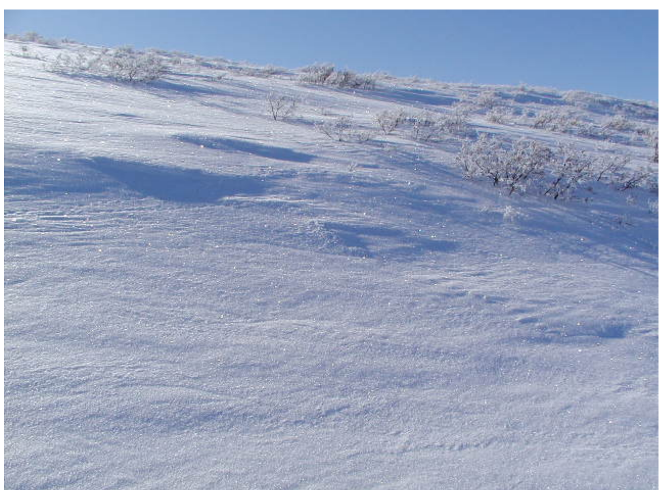
START @ TELLER HWY INT. 273+00.5
Staked along side of existing roadway

Sign @ Rock Creek x GCR
"No Road Maintenance" Sign @ Rock Creek x GCR

END @ GCR x Rocky Outcropping
Rocky Out Cropping

START @ Culvert Glacier Crk. 0.00
Culvert bringing Glacier Creek under GCR

START @ Culvert Glacier Crk. 0.25
Quarter-mile increment along GCR



START @ Culvert Glacier Crk. 0.50
Quarter-mile increment along GCR

START @ Culvert Glacier Crk. 0.75
Quarter-mile increment along GCR

START @ Culvert Glacier Crk. 1.00
Quarter-mile increment along GCR

START @ Culvert Glacier Crk. 1.25
Quarter-mile increment along GCR

START @ Culvert Glacier Crk. 1.50
Quarter-mile increment along GCR

START @ Culvert Glacier Crk. 1.75
Quarter-mile increment along GCR

START @ Culvert Glacier Crk. 2.00

Quarter-mile increment along GCR

START @ Culvert Glacier Crk. 2.25
Banner Hill side of GCR Switchback (S-Curve)

START @ Culvert Glacier Crk. 2.50
Anvil Mt. side of GCR Switchback (S-Curve)

START @ Culvert Glacier Crk. 2.75
Near (visually) heavy construction equipment storage area

START @ Culvert Glacier Crk. 3.00
Beyond (visually) heavy equipment storage area

START @ Culvert Glacier Crk. 3.25
Quarter-mile increment along GCR

START @ Culvert Glacier Crk. 3.50

Quarter-mile increment along GCR

START @ Culvert Glacier Crk. 3.75

Quarter-mile increment along GCR

START @ Culvert Glacier Crk. 4.00
Quarter-mile increment along GCR

START @ Culvert Glacier Crk. 4.25

Quarter-mile increment along GCR

START @ Culvert Glacier Crk. 4.50
Quarter-mile increment along GCR

START @ Culvert Glacier Crk. 4.75
Quarter-mile increment along GCR

START @ Culvert Glacier Crk. 5.00
Near right turn with "Proudly Reclaimed By…" sign posted

START @ Culvert Glacier Crk. 5.25

Quarter-mile increment along GCR

START @ Culvert Glacier Crk. 5.50

Quarter-mile increment along GCR

START @ Culvert Glacier Crk. 5.75
Quarter-mile increment along GCR

END @ GCR xTeller Hwy. Int. 5.90

End at GCR x Teller Hwy Intersection