Sand Hill Wind Repowering Project

Appendix A-1. Assessment of Turbines 1 through 10

March 2019

Turbine 1

Turbine 1 has two alternative locations: Site 1A (the location for layouts 1, 2, and 3); and Site 1B (the location for layout 4). Site 1A is approximately 150 feet east of Site 1B (Figure A-1).

Topographical Description

Both sites are located near the western end of a broad, open, shallow east-west valley that gently slopes (<5%) down toward the east. The ascending westward slope is somewhat steeper, leading to a saddle between two hills about 600 feet southwest of Site 1A (Plate 1). There is a shallow swale approximately 200 feet north and a somewhat steeper upward slope (10%) within approximately 200 feet south of both sites (Plate 2). Otherwise the topography at both sites is relatively flat and open with little topographical relief relative to the surrounding area.

Topographical features that may influence raptor movement are primarily the ascending slopes to the south and west, the ravine/swale to the north, and particularly the saddle southwest (typically upwind) of both sites.

Proximity to Other Potential Risk Factors

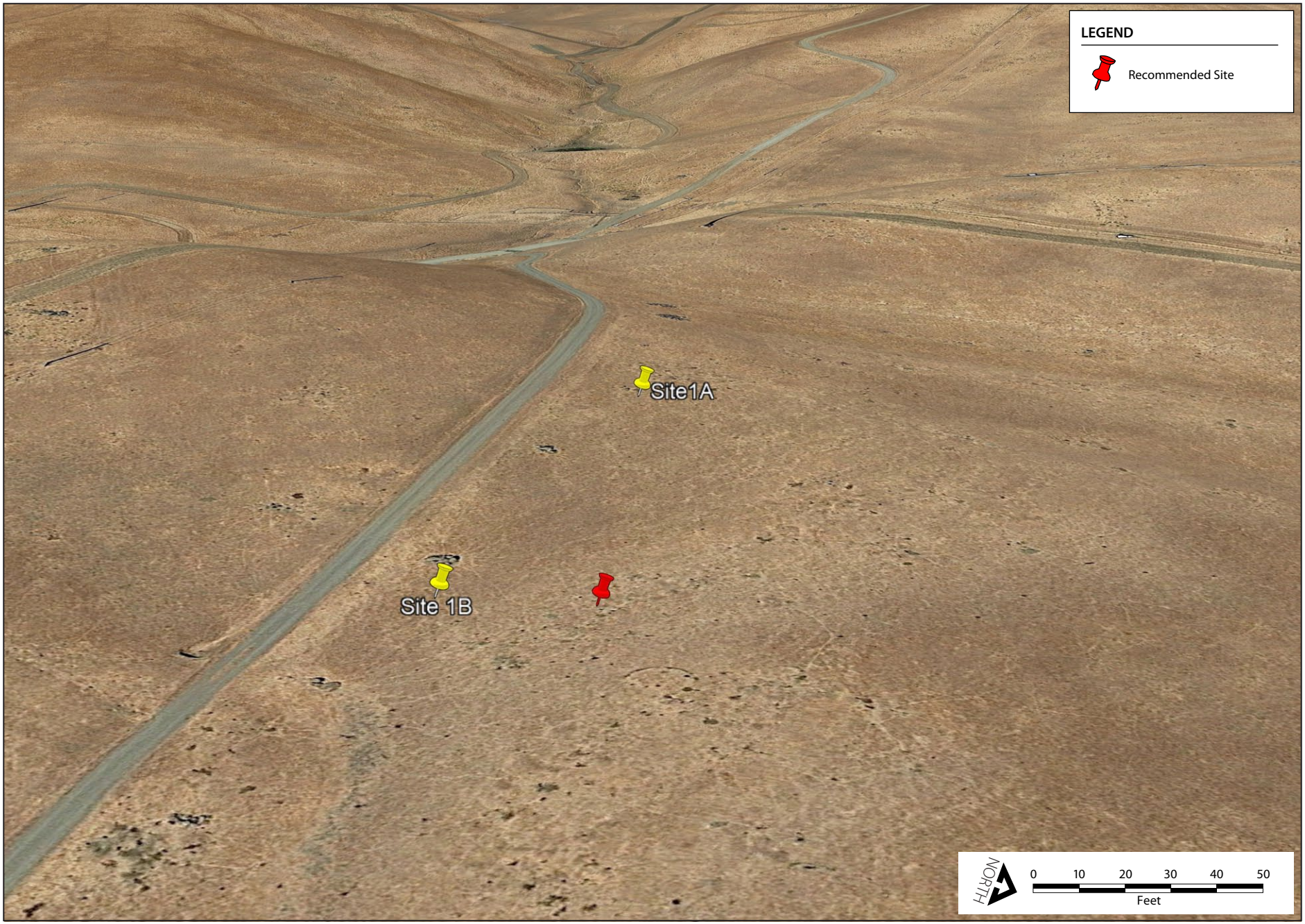
There are two small rockpiles within approximately 50 feet of both sites and two large rockpiles within 250-feet of Site 1A, and a small rock pile within 30 feet of Site 1B. There is an overhead powerline within 300 feet and several old-generation turbines on the neighboring property and a transmission line within 600 feet of both sites. There is also substantial ground squirrel activity in the immediate vicinity of both sites. With existing road access and relatively flat terrain, turbine pad construction and road improvements in this area are not expected to substantially alter the local topography and influence raptor use or behavior.

Relative Risk and Determination

Risk is considered relatively low to moderate at both sites due mainly to the open and fairly flat terrain in the immediate vicinity of the sites; however, Site 1B is a slight improvement due to its more eastward location away from the upslope and saddle to the southwest. Raptor movement is likely somewhat influenced by the topography to the north, south, and west, and particularly through the saddle to the southwest. But both sites may be sufficiently distant from these features to have a substantial increase in risk. Given the extent of ground squirrel activity, the area likely receives substantial raptor foraging use, which also increases overall risk. However, foraging movement in this area is unpredictable due to the low-profile terrain.

Recommendation

Further reduce risk by moving the site at least 60 feet north of Site 1B (37.767137/121.619948). This moves it further from the upward slope to the south, centers it better within the broad



3/28/2019

SOURCE: Google Earth 2018.

Figure A-1
Location of Alternative Sites for Turbine 1 at the Sand Hill Wind Project

valley, and moves it further from rock piles and overhead powerlines. At this location, there are no topographical features in the immediate vicinity that would influence raptor movement. This recommendation is generally consistent with Smallwood and Neher (2018).

Plate 1. Looking southwest from Site 1A. Note the proximity to the shallow saddle on the right, rock piles, ground squirrel activity, and overhead power lines.

Plate 2. Looking east from Site 1B. Better than Site 1A, but improved by moving an additional 60 feet north (left).

Turbine 2

Turbine 2 has only one location (Site 2A) for the four layouts (Figure A-2).

Topographical Description

Located within relatively flat terrain – Site 2A is near the top of a low plateau (Plate 3). In this area, between 8 and 10 feet separate the high elevation from the low elevation. The site is on a very gentle (<5% west-southwest ascending slope). This area is characterized by a series of low plateaus separated by shallow swales, one of which is approximately 300 feet south of Site 2A.

Proximity to Other Potential Risk Factors

The nearest rockpile is approximately 500 feet from Site 2A. The nearest overhead powerline is approximately 550 feet away. There are no other topographical features or risk factors in the immediate vicinity. Additional road construction will be required to access this site; however, because of the relatively low topographical relief, road and turbine pad construction is not expected to substantially alter the local topography or influence raptor use or behavior.

Relative Risk and Determination

Site 2A is considered a relatively low-risk site due to the low topographical relief. Raptor movement in this area is associated less with topographical features compared to areas with greater complexity, and thus specific flight patterns are less predictable.

Recommendation

Site 2A is the recommended site. There is no recommendation for relocation. This is generally consistent with Smallwood and Neher (2018).

1/03/2019

SOURCE: Google Earth 2018.

Figure A-2
Location of Alternative Sites for Turbine 2 at the Sand Hill Wind Project

Plate 3. Looking northeast toward Site 2A.

Turbine 3

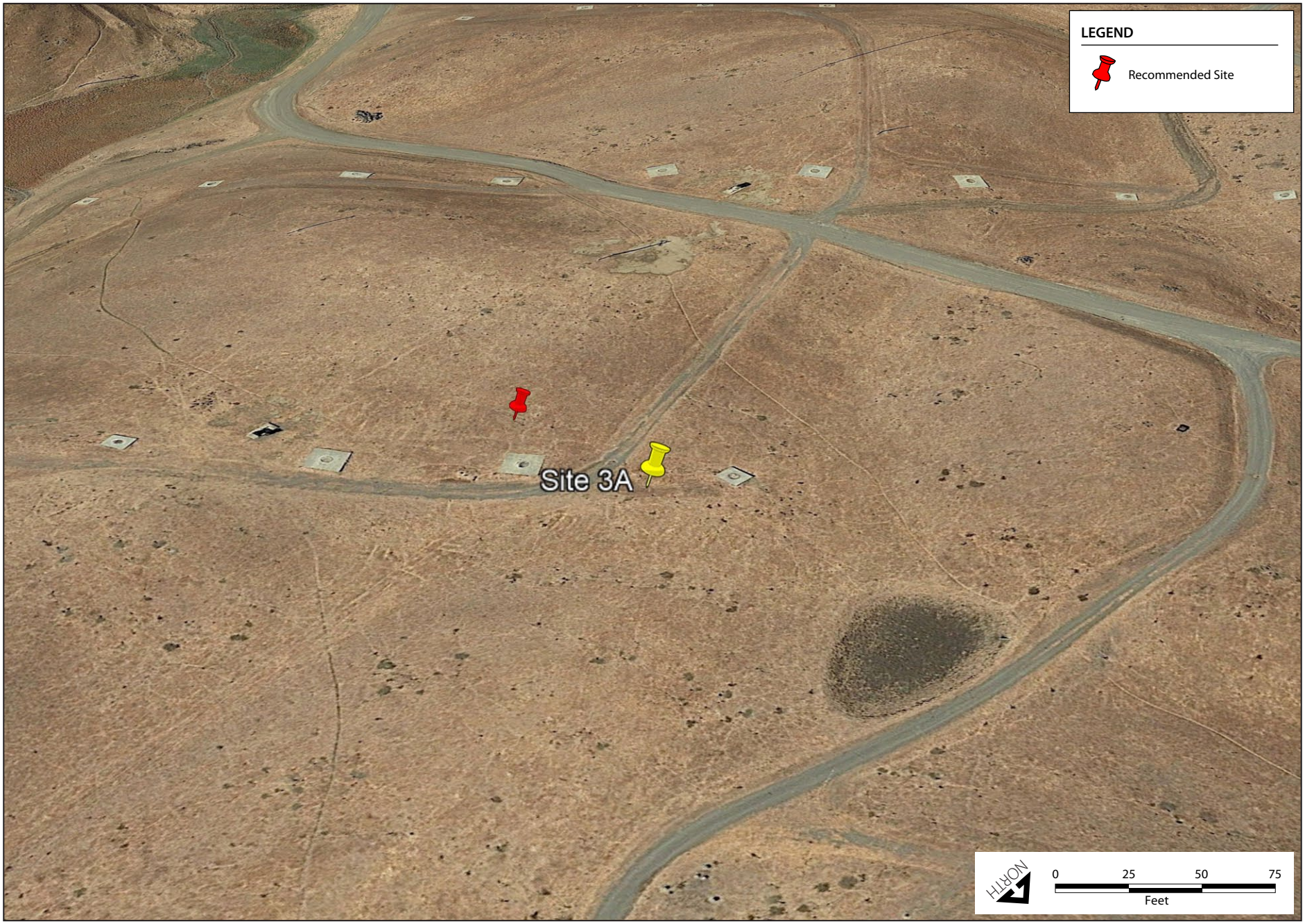
Turbine 3 has only one location (Site 3A) for the four layouts (Figure A-3).

Topographical Description

Site 3A is located along an old-generation turbine string on relatively flat terrain with little topographical relief compared with the surrounding landscape. The ground slopes upward slightly to the southwest with a minor dip to the north-northwest, and a dip to the east. The most significant topographical feature is a swale extending eastward from approximately 200 feet east of Site 3A and dropping down into a larger swale/ravine (Plate 4). There is also a deep ravine 600-800 feet south and southeast of the site.

Proximity to Other Potential Risk Factors

There is a decommissioned meteorological tower approximately 300 feet west and a dry stock pond 100 feet north of the site. An overhead powerline also occurs within 250 feet west and south of the site; however, it would be removed. There is also substantial ground squirrel activity in the immediate area. With existing road access and relatively flat terrain, turbine pad construction and road improvements in this area are not expected to substantially alter the local topography and influence raptor use or behavior.



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SOURCE: Google Earth 2018.

Figure A-3
Location of Alternative Sites for Turbine 3 at the Sand Hill Wind Project

Relative Risk and Determination

This site is considered a relatively low- to moderate-risk site due to the low topographical relief. However, although Site 3A is set back approximately 200 feet from the top of the swale just east of the site, this feature may influence raptor movement and because Site 3A is at the top of this swale, it may pose some risk to raptors flying up through this feature.

Recommendation

Although the risk is not considered high in its current location, relocating Site 3A approximately 105 feet south (37.753410/121.611207) along the old turbine string and further from the swale to the east may slightly reduce collision risk. This is generally consistent with Smallwood and Neher (2018); however, they did not recommend relocation.

Plate 4. Looking east from Site 3A. Note the saddle at the top of the swale in the foreground. The site may be sufficiently distant from this dip to influence potential risk, but a slight movement of the site to the southeast may slightly reduce risk.

Turbine 4

Turbine 4 has two alternative locations: Site 4A (the location for layouts 1, 2, and 3); and Site 4B (the location for layout 4). Site 4A is approximately 275 feet north-northeast of Site 4B (Figure A-4).

Topographical Description

Site 4A is on a steep (25%) northwest-facing slope shoulder at the end of an old-generation turbine string. It descends steeply into a deep ravine on the northwest with a more gradual slope into the same ravine on the northeast. The slope ascends southward toward the top of the hill (Plate 5). Site 4B is 258 feet south of Site 4A on the same northwest-facing slope, but it is approximately 40 vertical feet higher on a northwest-facing slope shoulder. The slope descends sharply to the northwest and ascends southward toward the top of the hill (Plate 6).

Proximity to Other Potential Risk Factors

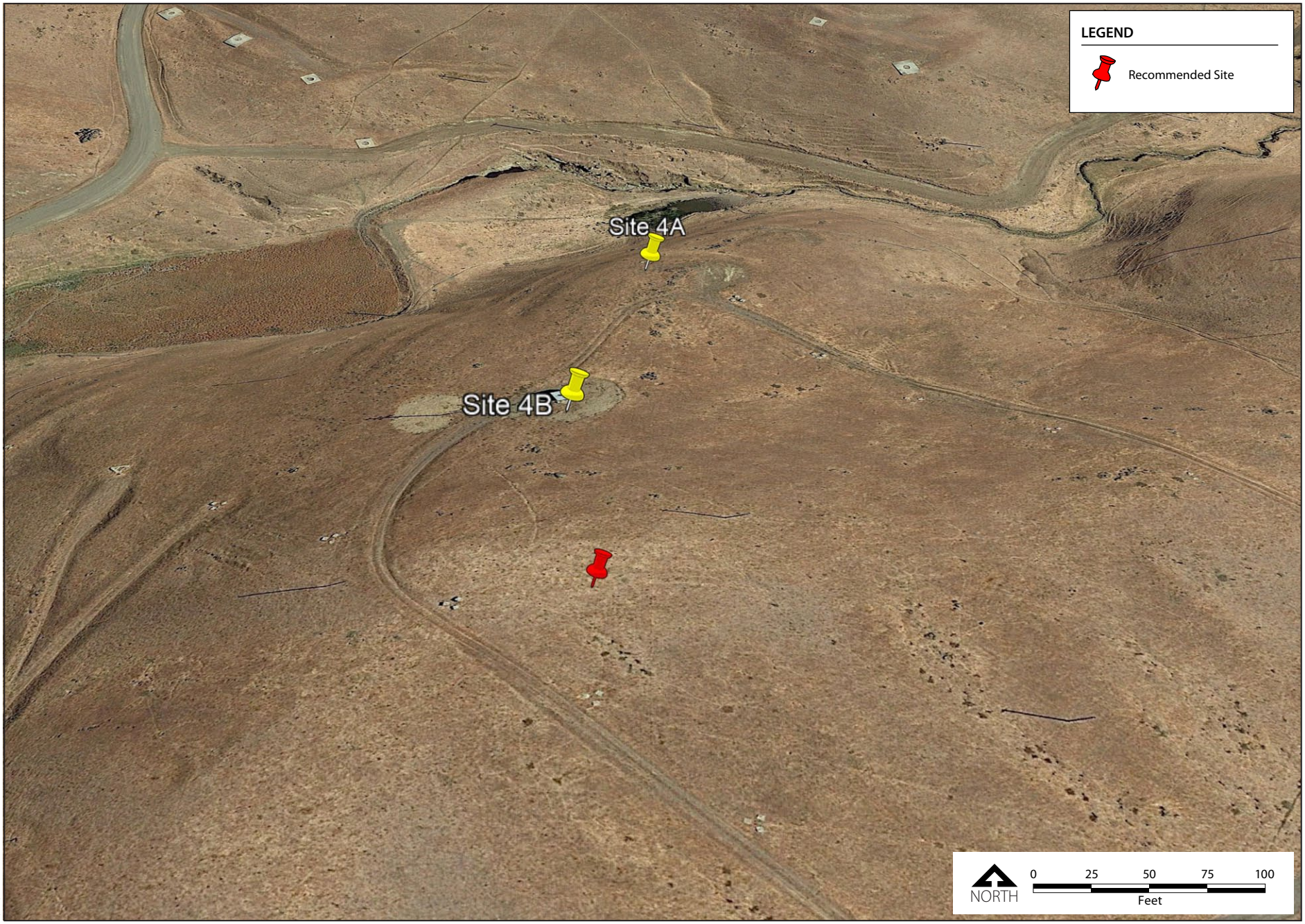
There is a stock pond about 230-feet north of Site 4A and 470-feet north of Site 4B. There is also a decommissioned meteorological tower about 300 feet west and overhead distribution lines within 100-feet of both sites, which would be removed as part of the project. There are also several rock piles within 60-70 feet of both sites.

Relative Risk and Determination

Both Sites 4A and 4B are considered relatively high-risk sites due their location on a steep slope bench and above a steep northwest-facing slope. Steep slopes and benches on steep slopes are generally considered high risk areas due to their influence on raptor movement and behavior, particularly golden eagles and American kestrels. Road construction to access either of these sites and turbine pad construction will further increase risk by creating larger slope benches and berms. Although both are considered high-risk sites, Site 4B may be slightly less risky than Site 4A, which is further downslope and would require additional access road construction along the slope compared with Site 4A. Although prevailing winds in the APWRA are most often from the southwest, northwest winds are also common. The northwest-facing slope has potential for slope-accelerated winds and a turbine on the edge of the slope is a potential risk to raptors, particularly red-tailed hawks, that hunt in these conditions by hovering and kiting.

Recommendation

As a general rule to reduce potential raptor fatalities, siting locations on steep slopes should be relocated to the ridge or hill top above the slope. To reduce risk, Turbine 4 should be relocated approximately 225 feet due south of Site 4B to the top of the hill (37.749771/121.610541). This also moves the site further off of the northwest-facing slope edge. Smallwood and Neher (2018) note the high-risk conditions at these sites but do not make a recommendation for relocation.



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SOURCE: Google Earth 2018.

Figure A-4
Location of Alternative Sites for Turbine 4 at the Sand Hill Wind Project

Plate 5. Looking upslope from Site 4A.

Plate 6. Looking upslope to the west from Site 4B toward the recommended relocation site.

Turbine 5

Turbine 5 has three alternative locations: Site 5A (the location for layouts 1, 2, and 3); Site 5B (the location for layout 4); and Site 5C (the proposed alternative to the recommended location as per the February 4-5 site visit by sPower engineers). Site 5A is approximately 210 feet northeast of Site 5B and Site 5C is approximately 50 feet east of Site 5B (Figure A-5).

Topographical Description

The topography in this area is gently rolling with only moderate relief. Site 5A is located within a shallow north-south swale near its northern terminus. There is a gradual ascending slope to the north and west, and a slight descending slope to the east and south (Plate 7). Site 5B is slightly upslope from Site 5A, on level ground and at the top of a west-facing steeper descending slope. Site 5C is similar to Site 5B but is 50 feet further back from the west-facing slope (Plate 8).

Proximity to Other Potential Risk Factors

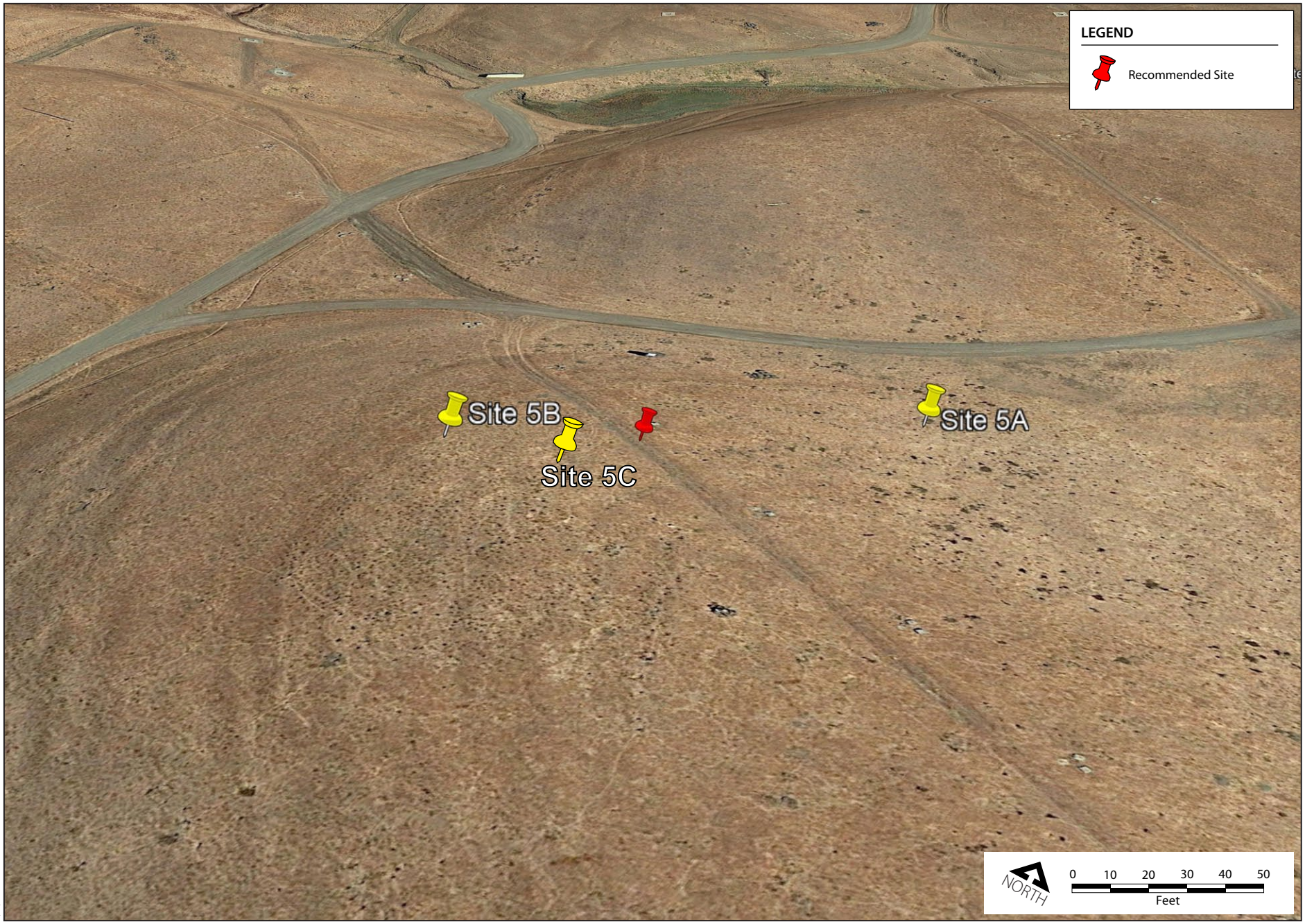
There is one rock pile within 80 feet of Site 5A and 160 feet of Site 5B. There are above-ground distribution lines approximately 450 feet northeast of Site 5A and approximately 600 feet west of Site 5B. There is also substantial ground squirrel activity in the area. With the moderate topographical relief and close proximity to existing access roads, road and turbine pad construction at these sites is not expected to substantially alter local topography and raptor use or movements.

Relative Risk and Determination

Site 5A is relatively low- to moderate-risk due to its location within and near a shallow swale. However, the topographical relief is not extreme around the site, and although raptor movement may be influenced by the swale, it is likely not significant, particularly given the size the turbine. Site 5B relocates the site outside and above the swale onto higher and more even ground, which would generally be considered a somewhat less risky site compared with Site 5A. However, the location is also near the edge of a relatively steep southwest-facing slope (Figure A-5). This is a location where slope-accelerated winds from the southwest may encourage kiting by raptors, particularly red-tailed hawks, and increase the potential for collision as birds hunt along this slope. As a result, this site is also considered low-to moderate-risk. Site 5C is similar to Site 5B and is also considered low- to moderate-risk, but considered slightly less risky because it is further away from the west-facing slope.

Recommendation

Move Site 5B about 80 feet northeast near the existing access road to keep the turbine further from the edge of the southwest-facing slope while still on the higher ground slightly above Site 5A (37.748025/121.610605). This is consistent with Smallwood and Neher (2018).



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SOURCE: Google Earth 2018.

Figure A-5
Location of Alternative Sites for Turbine 5 at the Sand Hill Wind Project

Plate 7. Site 5A, looking southeast

Plate 8. Site 5B, looking southwest above the southwest-facing slope. The recommendation is to move the site northeast to increase the distance from this slope and possible slope-accelerated winds.

Turbine 6

Turbine 6 has only one location (Site 6A) for the four layouts (Figure A-6).

Topographical Description

Site 6A is located near the west end of an east-west-oriented ridge. The ridge apex is fairly narrow and relatively level, although descending slightly along the ridge. Site 6A is located at the highest point on the west end. The ridge slopes down to deep ravines on the north, south, and west. The site is near the edge of the west-facing slope (Plate 9).

Proximity to Other Potential Risk Factors

There is one large rock pile within 100 feet of the site and an overhead powerline with 220 feet, which would be removed as part of the project. There is also substantial ground squirrel and pocket gopher activity in this area.

Relative Risk and Determination

Site 6A is considered a moderate risk site due primarily to the narrow ridge top. The west face is fairly narrow and therefore less subject to slope-accelerated winds from the west and southwest compared with Turbine Site 5B. However, due to the narrow ridge apex, the turbine rotors will extend out over the slopes and may pose some moderate level of risk for raptors funneling through the deep ravines on the north and south. Construction of the turbine pad and an access road up the steep slope to the site will alter the topographical conditions somewhat, but because Site 6A is on the highest point on the ridge, corresponding potential changes in raptor movement may not further increase risk at this site. The exception would be if a large bench would need to be constructed to accommodate the turbine pad, and the turbine pad ends up lower than the ridge to the east. This would effectively create a large slope bench, which raptors may use to cross the ridge slope and thereby increase risk.

Recommendation

There are limited opportunities to reduce risk at this site. Site 6A is probably the most appropriate location on the ridge. This is consistent with Smallwood and Neher (2018). However, to avoid creating a slope bench at the end of the ridge, the turbine pad should not be constructed below the elevation of the ridge.

1/03/2019

SOURCE: Google Earth 2018.

Figure A-6
Location of Alternative Sites for Turbine 6 at the Sand Hill Wind Project

Plate 9. Looking west-southwest from Site 6A.

Turbine 7

Turbine 7 has two alternative locations: Site 7A (the location for layouts 1, 2, and 3); and Site 7B (the location for layout 4). Site 7A is approximately 40 feet south of Site 7B (Figure A-7).

Topographical Description

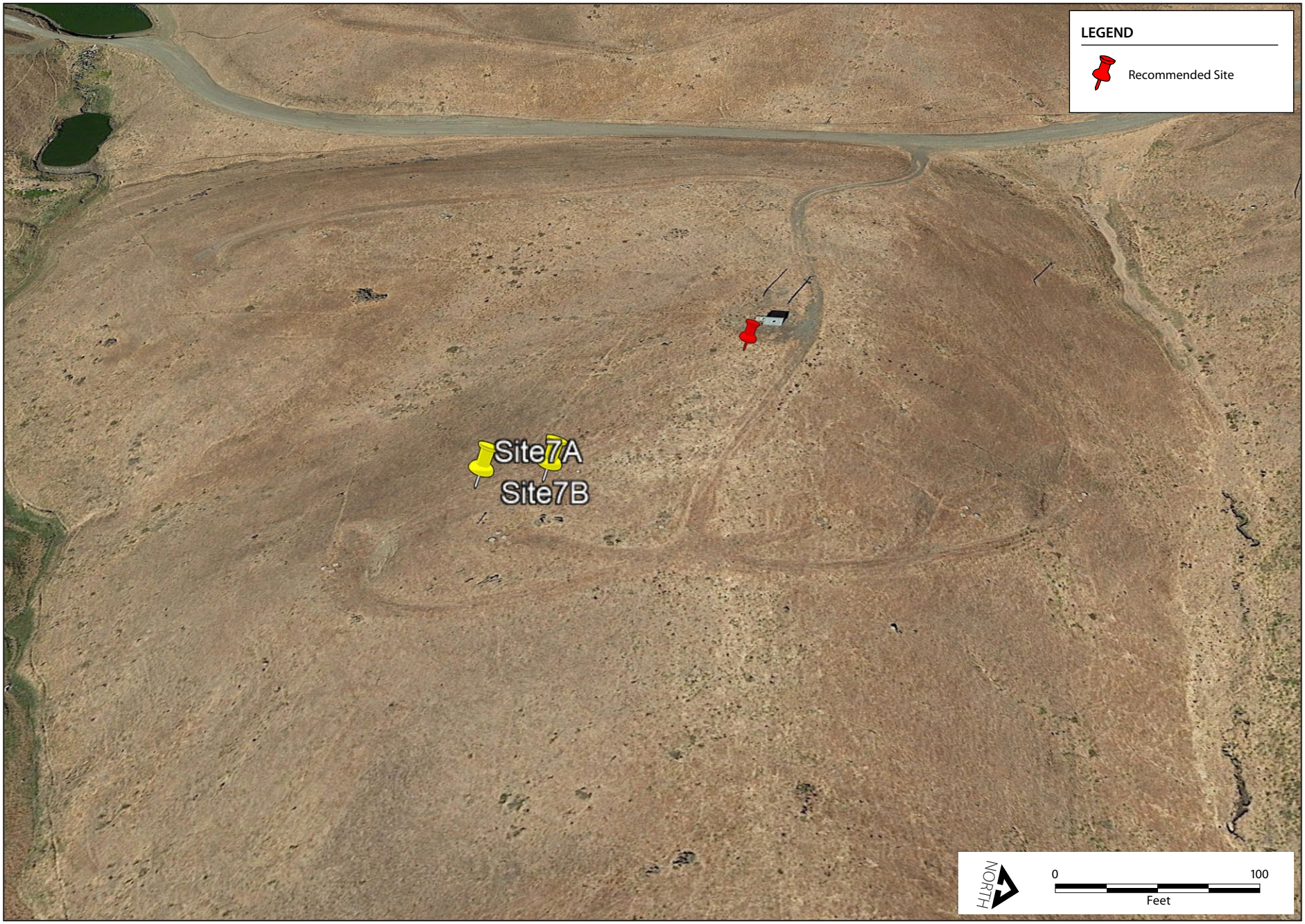
Both Sites 7A and 7B are located on a southeast-facing slope along an east-west-oriented ridge. Both sites are downslope from the ridge top with Site 7A located approximately 40-feet further downslope than Site 7B. The ridge top is narrow and relatively even although descending gradually toward the east. Steep slopes extend down from the narrow apex on the north and south into deep ravines (Plates 10 and 11).

Proximity to Other Potential Risk Factors

There is an overhead powerline within 270 feet, which would be removed by the project.

Relative Risk and Determination

Site 7B is a slight improvement over Site 7A; however, both sides are along the slope of the ridge and are considered moderate-risk. As with all slope locations, construction of the turbine



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SOURCE: Google Earth 2018.

Figure A-7
Location of Alternative Sites for Turbine 7 at the Sand Hill Wind Project

pad will result in a slope bench, which increases risk. Road construction to access these sites may also create a berm along the slope, also increasing risk.

Recommendation

Risk can be reduced by relocating 7B approximately 200 feet northwest to the top of the hill/ridge (37.743994/121.608436). The topography at this location has less influence on raptor movement compared to the slope positions of Sites 7A and 7B. The construction of the turbine pad and access road will also have less influence on potential risk. This is consistent with Smallwood and Neher (2018).

Plate 10. Looking southwest toward Site 7A

Plate 11. Looking southwest toward Site 7B.

Turbine 8

Turbine 8 has two alternative locations: Site 8A (the location for layouts 1, 2, and 3); and Site 8B (the location for layout 4). Site 8A is 15 feet northwest of Site 8B (Figure A-8).

Topographical Description

Both sites are within 15 feet of each other and have the same topographical characteristics. Both are along a fairly broad ridge top, but on the slightly-sloped (<5%) south edge of the ridge top (Plate 12). The east-west-oriented ridge is long and with a fairly broad and flat ridge top that descends gradually to the north and south. The ridge has a slight downward slope to the east, but otherwise is relatively flat and without dips, notches, or saddles.

Proximity to Other Potential Risk Factors

A decommissioned meteorological tower is within 150 feet, but would be removed.

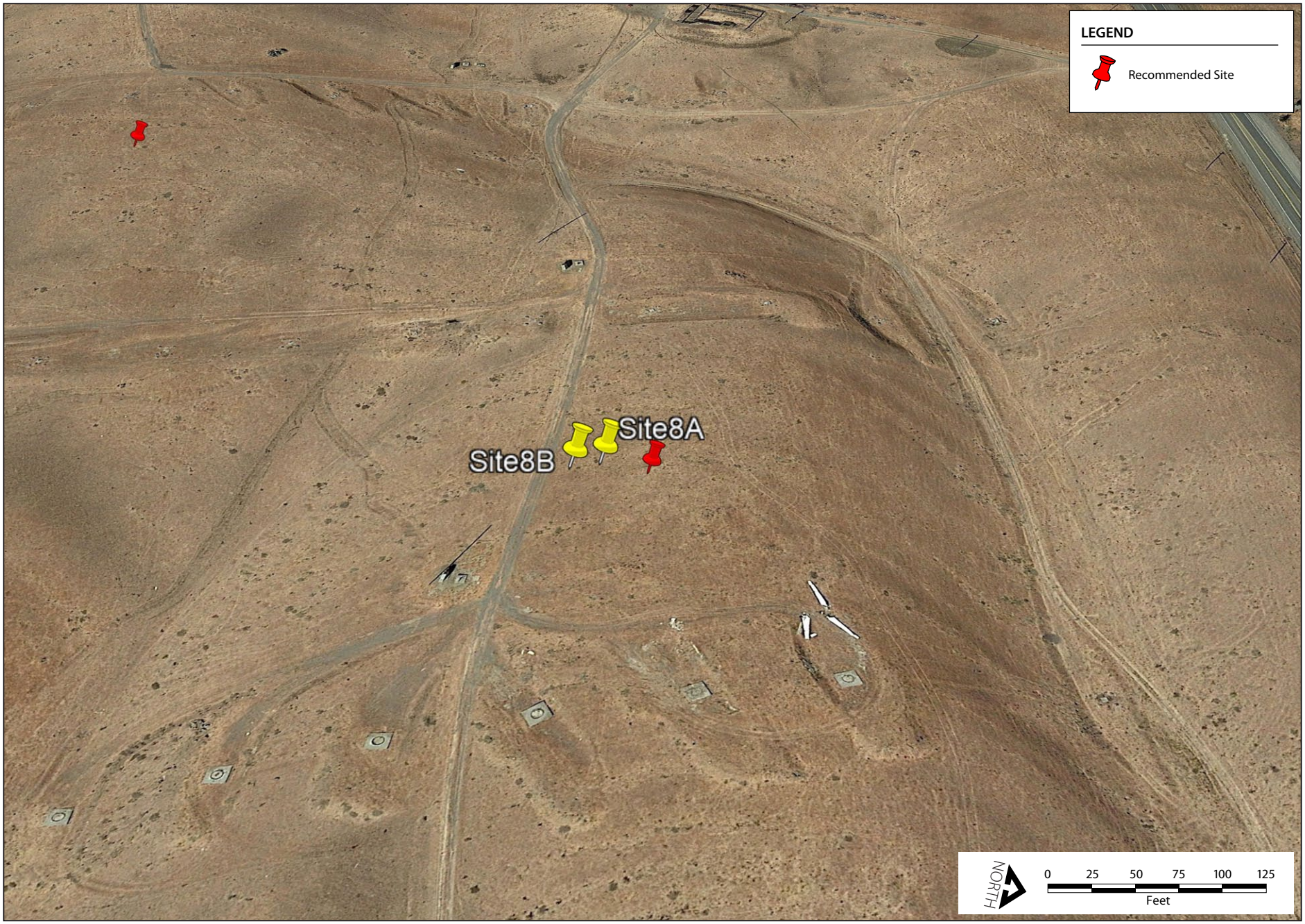
Relative Risk and Determination

Sites 8A and 8B are considered to have relatively low-risk due to their location along the ridge top and located in flat terrain. This is generally consistent with Smallwood and Neher (2018). There are no topographical features in the immediate area that would influence predictable raptor movements. Because of the generally flat topography, access road and turbine pad construction would also not substantially influence raptor use and behavior.

Recommendation

The recommended location is an additional 50 feet north (37.742348/121.601410) of Site 8A to better center it on the ridge top and further from the south-facing slope.

Plate 12. Looking west from Sites 8A and 8B



1/03/2019

SOURCE: Google Earth 2018.

Figure A-8
Location of Alternative Sites for Turbine 8 at the Sand Hill Wind Project

Turbine 9

Turbine 9 has only one location (Site 9A) for the four layouts (Figure A-9).

Topographical Description

Site 9A is midway down a south-facing 8% slope toward a deep ravine (Plate 13). There are a series of slope shoulders approximately 120 feet east and 260-feet west of the site resulting from recently removed old generation turbines. To the north and northwest, the slope increases to the top of the hill, which is fairly broad, open, and relatively flat with few topographical features.

Proximity to Other Potential Risk Factors

None in the immediate vicinity.

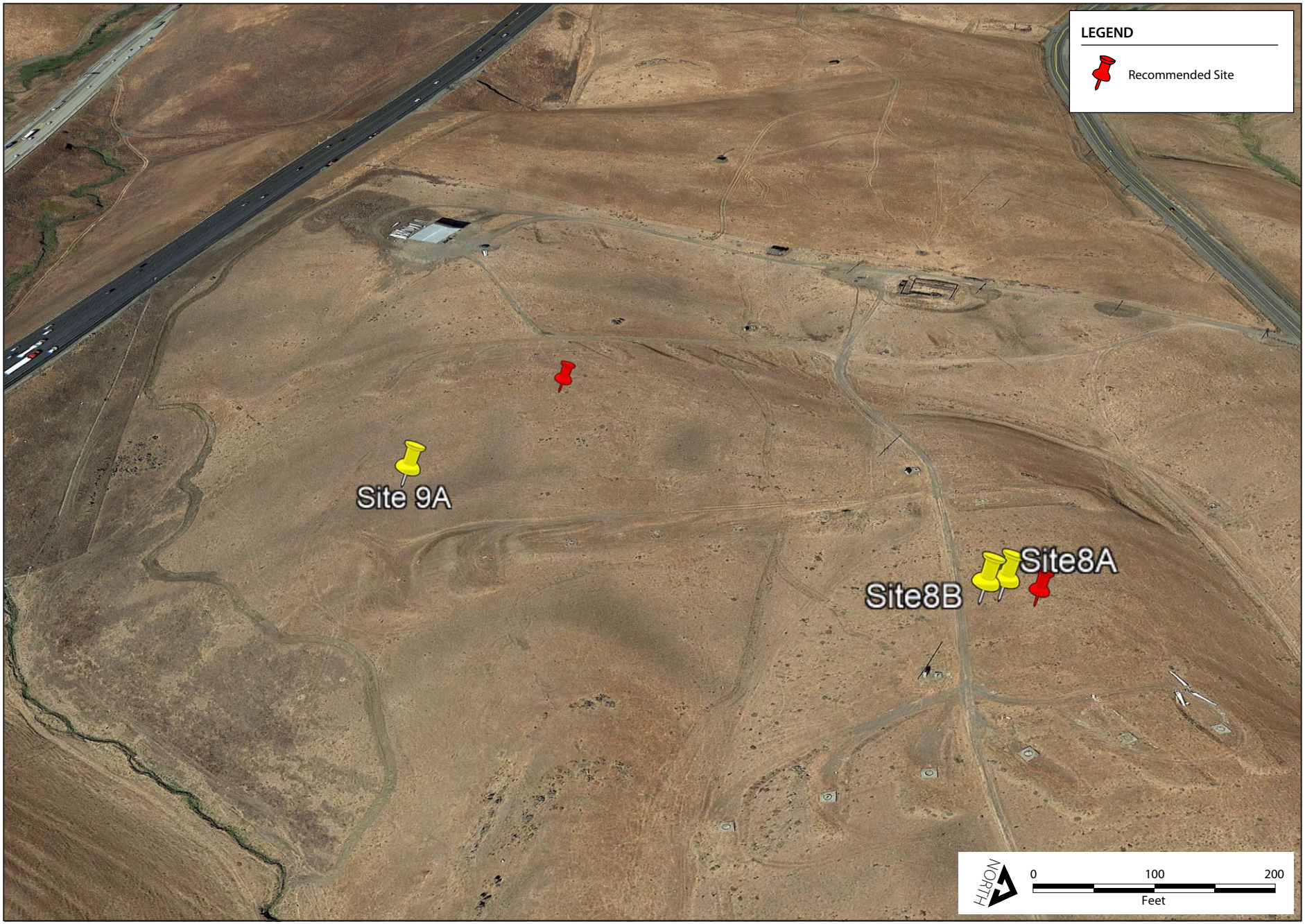
Relative Risk and Determination

Although the south-facing slope is relatively gentle and consistent across most of the south face of the hill (with the exception of the slope shoulders from the early-generation turbine sites), Site 9A is considered a moderate risk site. Raptor flight and movement patterns may be influenced by the slope and the presence of the slope shoulders. Construction of an access road and the turbine pad at this location would also create a bench in the slope and a berm along the road edge, further increasing potential risk at this location.

Recommendation

To reduce risk, relocate Site 9A approximately 280 feet upslope to the northwest to the top of the hill (37.740440/121.602393). This moves the turbine off of the slope and away from the slope shoulders. This is generally consistent with Smallwood and Neher (2018).

Plate 13. Looking east from Site 9A.



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SOURCE: Google Earth 2018.

Figure A-9
Location of Alternative Sites for Turbine 9 at the Sand Hill Wind Project

Turbine 10

Turbine 10 has only one location (Site 10A) for the four layouts (Figure A-10).

Topographical Description

Site 10A is on fairly level ground in a broad, shallow valley. Shallow swales converge here from the west, east, and north, where the ground slopes gently downward. The site is also near the base of a slight ascending slope to the southeast, south, and southwest. The overall landscape in the area is relatively low-profile rolling hills (Plate 14).

Proximity to Other Potential Risk Factors

The site is within approximately 1,000 feet of inlets of Bethany Reservoir to the east and west. A transmission line runs northwest to southeast about 1,100 feet to the west. There is a rock pile within 350 feet and a stock pond within 680 feet of Site 10A. There is also substantial ground squirrel activity in the area.

Relative Risk and Determination

Although Site 10A is located within a low, broad swale and at the base of a long, gradual slope, it is a considered a relatively low-moderate risk site. The breadth and low profile of the site does not confine and has minimal influence on raptor movement, and allows for high visibility. Road and turbine pad construction would not substantially alter topography and influence raptor use and movement in this generally low-profile terrain.

Recommendation

Relocating the site about 300 feet south moves the turbine out of the low plain, but closer to a deep ravine to the south. So, Site 10A is the recommended site. No relocation is recommended. This is generally consistent with Smallwood and Neher (2018).

1/03/2019

SOURCE: Google Earth 2018.

Figure A-10
Location of Alternative Sites for Turbine 10 at the Sand Hill Wind Project

Plate 14. Looking northeast from Site 10A.