3.7 GEOLOGY AND SOILS

This section describes current conditions relative to geology and soils at the Meeks Bay Restoration Project area. It includes a description of soils and mineral resources, analysis of environmental impacts, and recommendations for mitigation measures for any significant or potentially significant impacts.

3.7.1 Regulatory Setting

TAHOE REGIONAL PLANNING AGENCY

TRPA was designated as an areawide planning agency under Section 208 of the CWA in 1974. Under the Tahoe Regional Planning Compact, TRPA has established environmental threshold standards, goals and policies, and ordinances directed at protecting and improving land coverage and soils in Lake Tahoe and the Tahoe region.

Thresholds

TRPA has established threshold standards and indicators for nine resource areas including soil conservation. TRPA threshold standards are minimum standards of environmental quality to be achieved in the Tahoe Region. Every 4 years, TRPA evaluates the attainment status of all TRPA threshold standards. There are two TRPA threshold indicator reporting categories related to soil conservation which direct development towards less sensitive lands and establish restoration goals to reverse impacts of existing development in SEZs: Land Coverage and SEZs.

<u>Land Coverage</u>

Impervious cover, or land coverage, is an indicator of land disturbance. Impervious coverage alters surface hydrology and modifies groundwater recharge regimes. There are two types of coverage defined by TRPA: hard and soft coverage, which are distinguished by their degree of imperviousness. Hard coverage is completely impervious to infiltration of water into the soil (e.g., roofs, asphalt pavement, concrete sidewalks). Soft coverage is defined as disturbed or degraded soils not covered by a structure or paved surface that have water infiltration rates that are up to 75 percent of their natural value. Examples of soft coverage include soil compacted by vehicles, unpaved roads, dirt walking trails, and unpaved dirt driveways. The TRPA impervious cover threshold is guided by the Land Capability classification system for the Lake Tahoe Basin, California-Nevada (Bailey 1974). Land capability districts (LCDs) are defined based on their Bailey classification, which is a function of soil type, erosional hazard, soil drainage, position in the landscape, and other features. The nine separate LCDs reflect the amount of development an area can support without soil or water quality degradation. Under this system, TRPA allows landowners to cover 1, 5, 20, 25, or 30 percent of their parcel with impervious surfaces, depending on its environmental sensitivity as defined by the Bailey classification system (Table 3.7-1).

Table 3.7-1 Description, Allowable Cover, and Status of Bailey Land Capability Districts

Land Capability District	Description	Allowable Cover	Status
1a	steep uplands (> 30%, very shallow soil)	1%	Considerably better than target
1b	streams, marshes, floodplains, meadows	1%	Considerably worse than target
1c	Mountainous uplands, no soil	1%	At or somewhat better than target
2	soil mantled (slope > 30%)	1%	Somewhat worse than target
3	low elevation moderately steep slopes (9-30%)	5%	Considerably better than target
4	moderately steep mountain slopes	20%	Considerably better than target
5	flat areas around Lake Tahoe	25%	Considerably better than target
6	gently sloping north side of Lake Tahoe	30%	Considerably better than target
7	dense forest, little erosion potential	30%	At or somewhat better than target

Note: Land Capability District and Bailey Land Capability Class are identical.

Source: LT Info 2022a.

For the 2019 Threshold Evaluation, estimates of impervious coverage were produced by land capability type using high-resolution Light Detection and Ranging (LiDAR) data compared with the TRPA land capability map (LT Info 2022b).

Stream Environment Zones

Hydrology, soil, and water-associated vegetation define SEZ areas. SEZs only constitute a small portion of the total land area in the Lake Tahoe Region but perform many ecosystem services such as nutrient cycling and sediment retention, flood attenuation, infiltration and groundwater recharge, open space, scenic and recreational enjoyment, wildlife habitat, and wildfire abatement (Roby et al. 2015). The SEZ threshold includes preserving existing functioning SEZ lands in their natural hydrologic condition and restoring 25 percent of the SEZ lands that have been identified as disturbed, developed, or subdivided, to attain a five percent total increase in naturally functioning SEZ lands.

Tahoe Regional Plan

Goals and policies of the Regional Plan that are related to soil erosion and land coverage are located in the Conservation Element. Goals and policies for water quality are located in the Land Use Element. Relevant excerpts are included below.

GOAL S-1: Minimize soil erosion and the loss of soil productivity.

- Policy S-1.1: Allowable impervious land coverage shall be consistent with the Threshold Standard for impervious land coverage.
- Policy S-1.6: Maintain seasonal limitations on ground disturbing activities during the wet season (October 15 to May 1) and identify limited exceptions for activities that are necessary to preserve public health and safety or for erosion control.

GOAL SEZ-1: Provide for the long-term preservation and restoration of stream environment zones (SEZs).

- Policy SEZ-1.1: Restore all disturbed stream environment zone lands in undeveloped, unsubdivided lands, and restore 25 percent of the SEZ lands that have been disturbed, developed, or subdivided.
- Policy SEZ-1.2: SEZ lands shall be protected and managed for their natural values.
- Policy SEZ-1.5: No new land coverage or other permanent land disturbance shall be permitted in stream environment zones with some exceptions described in the regional plan.

GOAL WQ-2: Reduce or eliminate point sources of pollutants which affect, or potentially affect, water quality in the Tahoe region.

- Policy WQ-3.1: Reduce loads of sediment, nitrogen, and phosphorus to Lake Tahoe; and meet water quality thresholds for tributary streams, surface runoff, and groundwater.

Code of Ordinances

The TRPA Code of Ordinances implements the Regional Plan Goals and Policies. The following TRPA ordinances are most relevant to the geology, soils, and land capability and coverage aspects of the proposed project.

Chapter 30: Land Coverage Standards

The chapter sets forth regulations for the permissible amount of land coverage in the region. It implements provisions of the Goals and Policies concerning the land capability system, land capability districts, prohibition of additional land coverage in certain land capability districts, and transfer and mitigation of land coverage.

30.4.1 Base Allowable Land Coverage

The base allowable land coverage shall be determined by using the coefficients set forth in Land Capability Classifications of the Lake Tahoe Basin (Bailey 1974). The backshore area is treated as LCD 1b, high hazard land, which has a base allowable coverage percent of one percent.

30.5. Prohibition of Additional Land Coverage in LCDs 1a, 1c, 2, 3, And 1b (Stream Environment Zones)
No additional land coverage or other permanent land disturbance shall be permitted in Land Capability Districts 1a, 1c, 2, 3, and Land Capability District 1b (Stream Environment Zone), with some exceptions provided for public recreation and public service facilities.

Chapter 33: Grading and Construction
Chapter 33 of the TRPA Code describes the various standards and regulations that protect the environment against significant adverse effects from excavation, filling, and clearing, because of such conditions as exposed soils, unstable earthworks, or groundwater interference.

Chapter 83: Shorezone Tolerance Districts
The shorezone tolerance district classification was developed based on evaluation of the shorezone's sensitivity to physical, biological, and visual disturbance, specifically focusing on how human activities have altered the shorezone (Orme 1972). Eight shorezone tolerance districts are defined in Chapter 83 of the TRPA Code of Ordinances. The districts reflect the physical ability of the shorezone to support use and development. District 1 is the most sensitive to use and development and district 8 is the least sensitive. Table 3.7-2 provides a definition for each of the eight districts.

Table 3.7-2 Shorezone Tolerance Districts

Shorezone Tolerance District	Characteristics
1	Barrier beach shorezone with low, narrow ridges of mobile sand backed by wetlands. This District is considered SEZ in the TRPA Code.
2	Volcanic and morainic shorezone with slopes over 30 percent and alluvial shorezone of 9–30 percent slope.
3	Armored granite shorezone with slopes exceeding 30 percent.
4	Volcanic and morainic shorezone with 15–30 percent slopes and alluvial shorezone with slope of 0–9 percent.
5	Armored granite shorezone with slopes of 15–30 percent.
6	Shorezone of volcanic rock and morainic debris with 5–15 percent slopes.
7	Shorezone of morainic and alluvial materials of 0–9 percent slope.
8	Gently sloping (0–9 percent) armored granite shorezone.

Source: TRPA 2004.

STATE

Additional appliable regulations are discussed in Section 3.6, "Hydrology and Water Quality." These include National Pollutant Discharge Elimination System Permits and Stormwater Pollution Prevention Plans and the Water Quality Control Plan for the Lahontan Region.

Alquist-Priolo Earthquake Fault Zoning Act (PRC Section 2621 et seq.)
This act provides policies and criteria to assist cities, counties, and state agencies in the exercise of their responsibilities to prohibit the location of developments and structures for human occupancy across the trace of active faults. The act also requires site-specific studies by licensed professionals for some types of proposed construction within delineated earthquake fault zones.

Seismic Hazards Mapping Act
The intention of the Seismic Hazards Mapping Act of 1990 (PRC Section 2690–2699.6) is to reduce damage resulting from earthquakes. While the Alquist-Priolo Act addresses surface fault rupture, the Seismic Hazards Mapping Act addresses other earthquake-related hazards, including ground shaking, liquefaction, and seismically induced landslides. The act's provisions are similar in concept to those of the Alquist-Priolo Act: The State is charged with identifying and mapping areas at risk of strong ground shaking, liquefaction, landslides, and other corollary hazards, and cities and counties are required to regulate development within mapped Seismic Hazard Zones. Under the Seismic Hazards Mapping Act, permit review is the primary mechanism for local regulation of development.

California Building Code

The California Building Code (CBC) (California Code of Regulations, Title 24) is based on the International Building Code. The CBC has been modified from the International Building Code for California conditions, with more detailed and/or more stringent regulations. Specific minimum seismic safety and structural design requirements are set forth in Chapter 16 of the CBC. The CBC identifies seismic factors that must be considered in structural design. Chapter 18 of the CBC regulates the excavation of foundations and retaining walls, while Chapter 18A regulates construction on unstable soils, such as expansive soils and areas subject to liquefaction. Appendix J of the CBC regulates grading activities, including drainage and erosion control. The CBC contains a provision that provides for a preliminary soil report to be prepared to identify "…the presence of critically expansive soils or other soil problems which, if not corrected, would lead to structural defects." (CBC Chapter 18 Section 1803.1.1.1).

3.7.2 Environmental Setting

REGIONAL GEOLOGY

The Tahoe Basin is located in the northern Sierra Nevada geomorphic province, between the Sierra crest to the west and the Carson Range to the east, and is one of the most prominent mountain ranges in California. Faulting and volcanism created the Tahoe Basin over 2 million years ago, and as a result, the basin contains granitic, metamorphic, and volcanic rock (Saucedo 2005). The predominant bedrock in the Tahoe Basin is Cretaceous granodiorite of the Sierra Nevada batholith. Cretaceous rock formed during the later period of the Mesozoic Era, characterized by the development of flowering plants and ending with the sudden extinction of the dinosaurs and many other forms of life. Pre-Cretaceous metamorphic rocks are found in localized areas.

Over the past 1.5 million years, the Tahoe Region has been altered by glacial activity, and most of the landforms surrounding the lake are a result of glaciation. During glacial activities, valley glaciers dammed the Truckee River Canyon, raising the water level of Lake Tahoe. Lakebed sediments were deposited in the bays and canyons around the lake as a result of the rising lake levels. The faulting, folding, and in some cases overturning of rock formations that has taken place during various periods of geologic activity, in combination with erosion, deposition, and subsequent cementation of rock materials that occurred during relatively quiet periods, have left a complex arrangement of geologic rock types and structures in the area. However, the extraordinary clarity of Lake Tahoe is related to the prevalence of resistant granitic bedrock in the Tahoe Basin and the unusually small drainage basin relative to the size of Lake Tahoe.

LOCAL GEOLOGY

The Meeks Creek Watershed in its current drainage pattern formed over the past two million years during the two most recent periods of glaciation. During both of these periods, glacial ice accumulated in the high western side of the watershed (in present day Desolation Wilderness) and flowed eastward toward Lake Tahoe. The glaciers carved deep into the bedrock, leaving a canyon in the upper watershed with numerous lakes, and a wide flat valley floor in the lower watershed, underlain by glacial till and a variety of outwash deposits and lake deposits. The upper watershed is primarily underlain by exposed granitic rock with patches of glacial till and recent stream deposits. The valley floor in the lower two miles of the watershed is a complex of glacial sediments, fine texture lake sediments deposited in glacial lakes, peat soils formed in organic marshes, and cobble and boulder deposits. This variety of sediments and landforms has created a diverse set of soil and hydrologic conditions. This diversity is reflected in the mosaic of vegetation communities found throughout the lower watershed, including conifer uplands, peat marshes, riparian areas, and variously seasonally and perennially wet meadow systems (Swanson 2006).

TOPOGRAPHY AND DRAINAGE

The project area is located in the lowest reaches of the Meeks Bay Watershed immediately adjacent to Lake Tahoe. The topography is nearly level but slopes gently toward Lake Tahoe. Meeks creek has incised into the meadow surface upstream from the SR 89 bridge. Below the SR 89 bridge, Meeks creek has been channelized and modified to accommodate the development of the resort and marina.

GROUNDWATER

Meeks creek is located within the Tahoe City/West Shore groundwater aquifer, which extends from Dollar Point on the north to Rubicon Point on the south. Glacial processes have dissected the west shore portion of the aquifer into eight watersheds, each underlain by glacial outwash and stream deposits (mostly sands and gravels) that overlay volcanic rocks. Ridges separating the watersheds consist of intrusive volcanic rocks (such as granite) capped by glacial moraines. Aquifer depths range from 56 to 805 feet and the pumping capacity of wells in the aquifer ranges from 0.1 to 30 gallons per minute per foot (Plume, Tumbusch, and Welborn 2009).

Above SR 89, most of Meeks Creek remains connected to its floodplain and shallow groundwater levels maintain wetlands, meadows and riparian vegetations. Below SR 89, Meeks Creek is highly degraded due to channel incision induced by the dredging of Meek Bay Marina in 1960 (Swanson 2006). The presence of fixed structures and marina dredging combined with placement of up to four feet of fill over former marsh areas has exacerbated channel incision and lowered groundwater levels so that the area no longer supports wetland and marsh habitats (Swanson 2006).

SOILS

Mapped soil units within the project area consist of the Celio loamy coarse sand, Marla loamy coarse sand, Meeks gravelly loamy coarse sand, the Tahoe complex, and beaches. Additionally, some of the project area near Meeks creek was covered with imported fill material during the development of the resort and construction of the Marina (Swanson 2006). Figure 3.7-1 shows the distribution of soil mapping units within the project area. Table 3.7-3 provides information on the properties of soils discussed in the following topics.

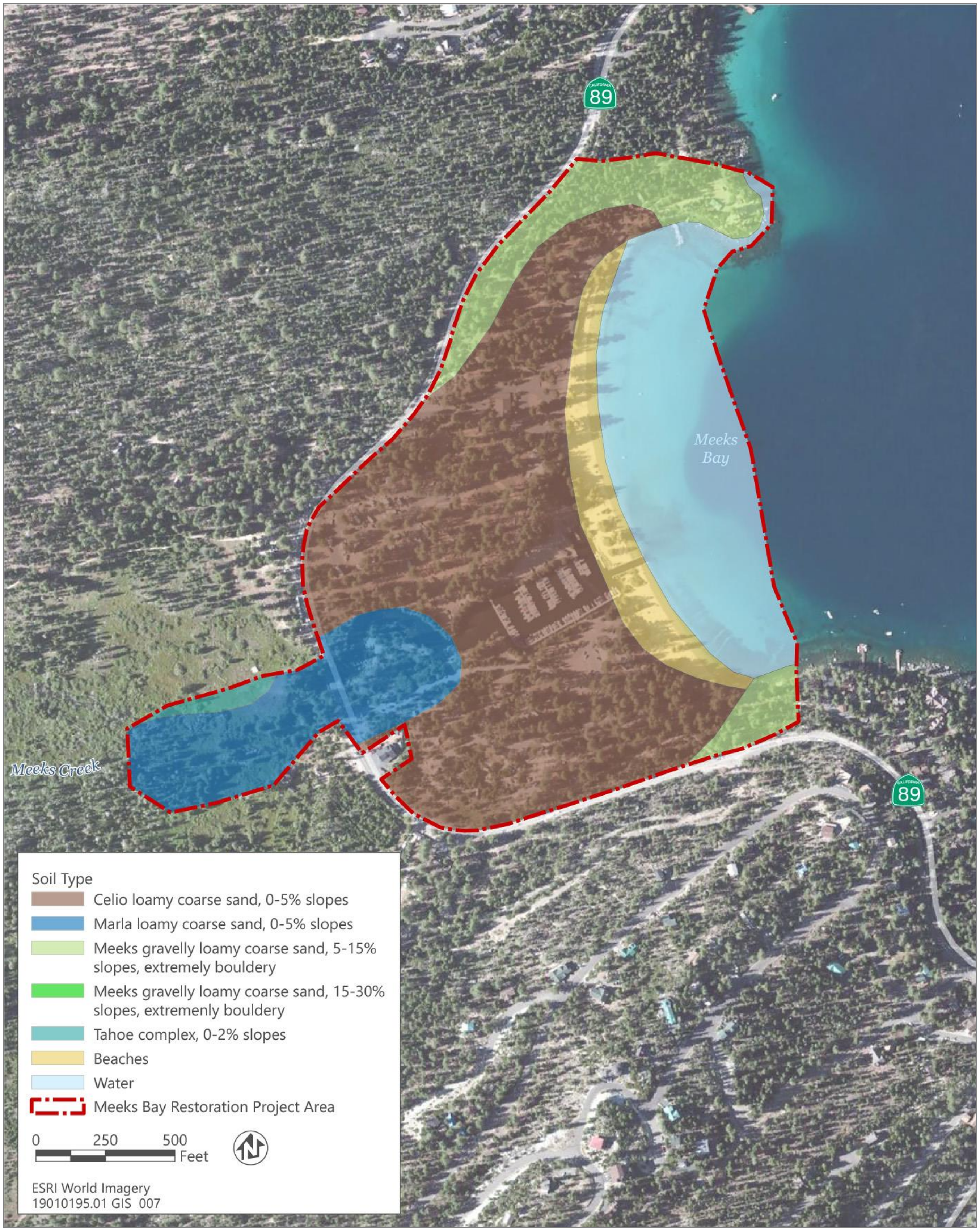
Table 3.7-3 Properties of Project Area Soils

Soil Name	Erosion Potential	Linear Extensibility	Area within the Project Area
Celio loamy coarse sand, 0-5% slopes	Slight	1.5	36.6 acres (53.4% of project area)
Marla loamy coarse sand, 0-5% slopes	Slight	0.6	8.8 acres (12.8% of project area)
Meeks gravelly loamy coarse sand, 5-15% and 15-30% slopes, extremely bouldery	Severe	1.5	5.4 acres (7.9% of project area)
Tahoe complex, 0-2% slopes	Slight	1.5	0.6 acres (0.9% of project area)
Beaches	Slight	0	5.2 acres (7.5% of project area)

Source: NRCS 2007.

EROSION POTENTIAL AND HAZARD RATING

The NRCS soil surveys provide a rating of Erosion Hazard resulting from disturbance of non-road areas. This rating is based on slope and soil erosion factor (K). The predicted soil loss is caused by sheet or rill erosion (which occurs when shallow flows of water causing sheet erosion to coalesce into rills and thus increase both in velocity and scouring capacity) in off-road or off-trail areas where 50 to 75 percent of the surface has been exposed by some kind of disturbance. The hazard is described as “slight,” “moderate,” “severe,” or “very severe.” A rating of “slight” indicates that erosion is unlikely under ordinary conditions; “moderate” indicates that some erosion is likely and that erosion-control measures may be needed; “severe” indicates that erosion is very likely and that erosion-control measures, including revegetation of bare areas, are advised; and “very severe” indicates that significant erosion is expected, loss of soil productivity and off-site damage are likely, and erosion-control measures are costly and generally impractical (NRCS 2007). The erosion potential for the soils within the project area is rated as “Slight” with the exception of the Meeks gravelly loamy coarse sand, which has an erosion hazard rating of severe. No ground disturbing project components are located in the Meeks gravelly loamy coarse sand.



Source: data downloaded from NRCS in 2019.

Figure 3.7-1 Soils in the Project Area

EXPANSIVE SOILS

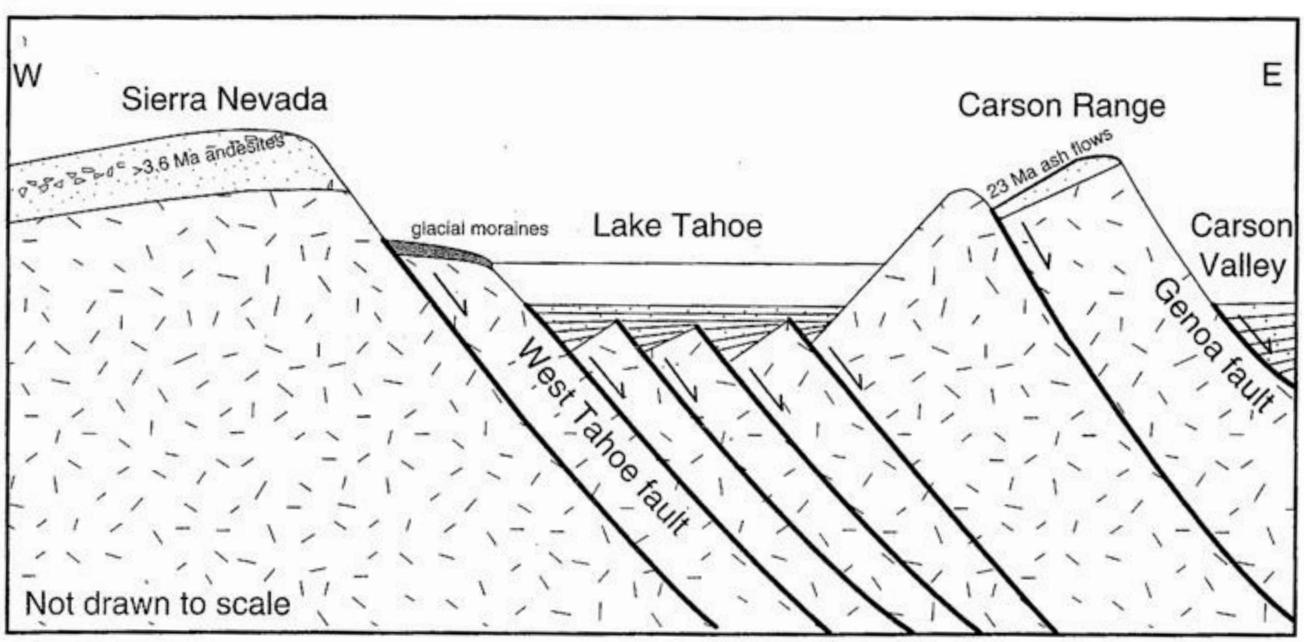
Expansive soils contain shrink-swell clays that are capable of absorbing water. As water is absorbed the clays increase in volume. This change in volume is capable of exerting enough force on buildings and other structures to damage foundations and walls. Damage can also occur as these soils dry out and contract. One measure of the shrink-swell potential of soils is linear extensibility. Linear extensibility refers to the change in length of an unconfined clod as moisture content is decreased from a moist to a dry state. The volume change is reported as percent change for the whole soil. The amount and type of clay minerals in the soil influence volume change. The shrink-swell potential is low if the soil has a linear extensibility of less than 3 percent, moderate if 3 to 6 percent, high if 6 to 9 percent, and very high if more than 9 percent. Table 3.7-1 lists the linear extensibility of the dominant soil component for the soil mapping units within the project area as determined by the NRCS soil survey of the Lake Tahoe Basin (NRCS 2007). As shown, all mapped soils in the project area have low shrink-swell potential.

SEISMICITY

An earthquake is classified by the amount of energy released, which traditionally has been quantified using the Richter scale. Recently, seismologists have begun using a moment magnitude (M) scale because it provides a more accurate measurement of the size of large earthquakes. For earthquakes of less than M 7.0, the moment and Richter magnitude scales are nearly identical. For earthquakes greater than M 7.0, readings on the moment magnitude scale are slightly higher than the corresponding Richter magnitude.

The intensity of seismic shaking, or strong ground motion, during an earthquake is dependent on the distance and direction from the epicenter of the earthquake, the magnitude of the earthquake, and the geologic conditions of the surrounding area. Ground shaking could potentially result in the damage or collapse of buildings and other structures. Most earthquakes occur along faults, which are fractures or geological areas of weakness, along which rocks on one side have been displaced with respect to those on the other side. Most faults are the result of repeated displacement that may have taken place suddenly and/or by slow creep (Bryant and Hart 2007:3).

Faulting was a key element in the formation of Lake Tahoe. The Tahoe Basin lies in a graben (a trench between two faults) between the Sierra Nevada and the Carson Range (as shown in Figure 3.7-2). The outlet of the Tahoe Basin was repeatedly dammed by volcanic eruptions and glacial ice dams (Schweickert et al. 2000).



Source: Schweickert et al. 2000.

Figure 3.7-2 Model of Lake Tahoe Basin Half-Graben

The nature of the seismic hazard in the Tahoe Region was not appreciated for many years because the active faults within the Tahoe Basin are covered by the lake itself. The portions of the Tahoe Basin faults that show the greatest activity and strain are underwater, with activity diminishing as they move on-shore (Seitz and Kent 2004). Additionally, recent work analyzing sediment cores from the bottom of Lake Tahoe show that local earthquakes trigger landslides in the Lake (Seitz 2013). It is likely that many of the landslides evident with the Tahoe Basin (including the ancient, catastrophic, 5-mile-wide landslide that formed McKinney Bay) were triggered by earthquakes (Dingler 2007).

The State Mining and Geology Board defines an active fault as one that has had surface displacement within the last 11,000 years (CGS 2008). Three active faults occur within the Tahoe Basin: The West Tahoe-Dollar Point Fault (the longest at 45 km long); the Stateline-North Tahoe Fault; and the Incline Village Fault (Brothers et al. 2009). Recent studies indicate that all three of these faults have experienced large rupture events within recent geologic time (Dingler 2007; Seitz and Kent 2004). Of the three faults, the West Tahoe-Dollar Point Fault (located 1.3 miles east of the project area) has the fastest slip rate (the rate at which two faults pass each other or build tension) and its most recent confirmed rupture event was approximately 4,000 years ago (Brothers et al. 2009). The high slip rate, the height of scarps (earthquake generated breaks in topography) and the length of time since the last event indicate that the West Tahoe-Dollar Point Fault could generate an earthquake with a magnitude greater than 7 (Brothers et al. 2009). The height of scarps along the Incline Village fault show that this fault has experienced several magnitude 7 events and that it last ruptured approximately 575 years ago (Schweickert et al. 2000; Seitz et al. 2005).

East of the Tahoe Basin, the Carson Range fault system, one of the Region's largest, runs for 60 miles along the east face of the Carson Range from Reno to Markleeville. The probability of at least one magnitude ≥6.0 event occurring in the Reno-Carson City urban corridor over a 50-year period is estimated to be between 34 percent and 98 percent, the probability of a magnitude ≥6.6 event between 9 percent and 64 percent, and the probability of a magnitude ≥7.0 event between 4 percent and 50 percent. These probabilities are relatively high and are similar to many parts of California (dePolo et al. 1997:3).

The nearest mapped Alquist-Piolo Earthquake Fault Zone is located in the Minden-Gardnerville, NV area, approximately 15 miles east of the project area (CGS 2010).

Liquefaction and Lateral Spreading

Liquefaction is a phenomenon in which loose, saturated, granular soil deposits lose a significant portion of their shear strength because of excess pore water pressure buildup. An earthquake typically causes the increase in pore water pressure and subsequent liquefaction. These soils are behaving like a liquid during seismic shaking and re-solidify when shaking stops. The potential for liquefaction is highest in areas with high groundwater and loose, fine, sandy soils at depths of less than 50 feet. The project area is underlain by fine lake sediments and sandy river outwash and contains areas of high groundwater. Although no terrestrial liquefaction events have been documented in the Lake Tahoe basin in recent history, over the last 11,000 years multiple large earthquakes (magnitude 7 or greater) have triggered liquefaction of lake sediments and associated terrestrial landslides (Brothers et al 2009). Therefore, a large earthquake along the West Tahoe fault or another fault in the Basin could result in liquefaction of sediments in and adjacent to the project area.

Liquefaction may also lead to lateral spreading. Lateral spreading (also known as expansion) is the horizontal movement or spreading of soil toward an "open face," such as a streambank, the open side of fill embankments, or the sides of levees. It often occurs in response to liquefaction of soils in an adjacent area. The potential for failure from lateral spreading is highest in areas where there is a high groundwater table, where there are relatively soft and recent alluvial deposits, and where creek banks are relatively high. The potential for lateral spreading may exist in the project area along the steep and eroding banks of Meeks creek and the marina lagoon.

Tsunami and Seiche

A tsunami is a wave or series of waves that may result from a major seismic event that involved the displacement of a large volume of water (such as rupture of a major fault) and may occur in any large body of water. A seiche is a periodic oscillation of an enclosed or restricted water body, typically a lake or reservoir, produced by seismic shaking. The action of a seiche is similar to the sloshing of a bathtub, with waves bouncing back and forth across the water body. Seiche waves can continue for hours following a tsunami inducing earthquake, causing extensive damage. Modeling of potential earthquakes occurring beneath Lake Tahoe indicate that a fault rupturing seismic event of magnitude 7.0 could trigger a tsunami, followed by seiche with waves of up to 30 feet high along the shoreline of Lake Tahoe (Ichinose et al. 2000).

LAND CAPABILITY AND COVERAGE

Since the late 1970s, TRPA has used a land capability classification system based on the ability of areas of soil to tolerate use without resulting in environmental damage (Bailey 1974). The Bailey map was based, primarily, on the best available soil, slope, and geomorphic hazard information available in 1974, when the classification system was created. The soil survey used to create the Bailey map was intended for use at a minimum scale of 1:24,000, which is suitable for comparing large areas for general land uses. This level of detail is not appropriate for planning the management of small sites or the locations of roads, buildings, or other structures (NRCS 2007). For this reason, TRPA uses the Bailey map as the starting point to determine the land capability and allowable coverage for a site on which a project is proposed. The actual land capability is determined through a land capability verification or challenge process, which uses an on-the-ground assessment and other available information to adjust the land capability districts as shown in the Bailey map. A land capability verification confirms and/or adjusts the soil type and LCD presented in the Bailey map, whereas a land capability challenge may allow for the identification of an entirely different soil type and LCD than presented in the Bailey map.

Land capability and coverage in the northern portion of the project area (above Meeks Creek) was verified by TRPA in 2005 while the areas south of Meeks Creek have not been verified and will need to be prior to project implementation. The following assessment of land capability and coverage relies on the combination of the TRPA LCD verification and Bailey LCD mapping, as shown in Figure 3.7-3. The LCD mapping developed by Bailey will be adjusted and refined during LCD verification completed as part of project permitting.

The Bailey Land Capability system assigns LCDs based primarily on soil characteristics and slope. The LCDs reflect the amount of development the site can support without experiencing soil or water quality degradation. The LCDs range from 1 to 7, with 1 being the most environmentally sensitive and 7 being most suitable for supporting development. LCD 1b is applied to land that is influenced by surface water or high groundwater and is also referred to as “Stream Environment Zone” or SEZ. The amount of compacted or impervious surface, known as Coverage, allowed with a given parcel is limited by its LCD. The amount of existing and allowable land coverage within the Plan Area is shown in Table 3.7-4 below. Existing coverage categories includes impervious areas such as campsites, bike trail, boat ramp, cabins, day use areas, parking, roads, structures, and soft coverage (i.e., compacted dirt parking areas). Existing land coverage as show in Table 3.7-4 was estimated using a combination of TRPA verified land coverage where available and TRPA’s 2010 high resolution LiDAR data set and high-resolution aerial imagery in areas where coverage has not yet been verified.

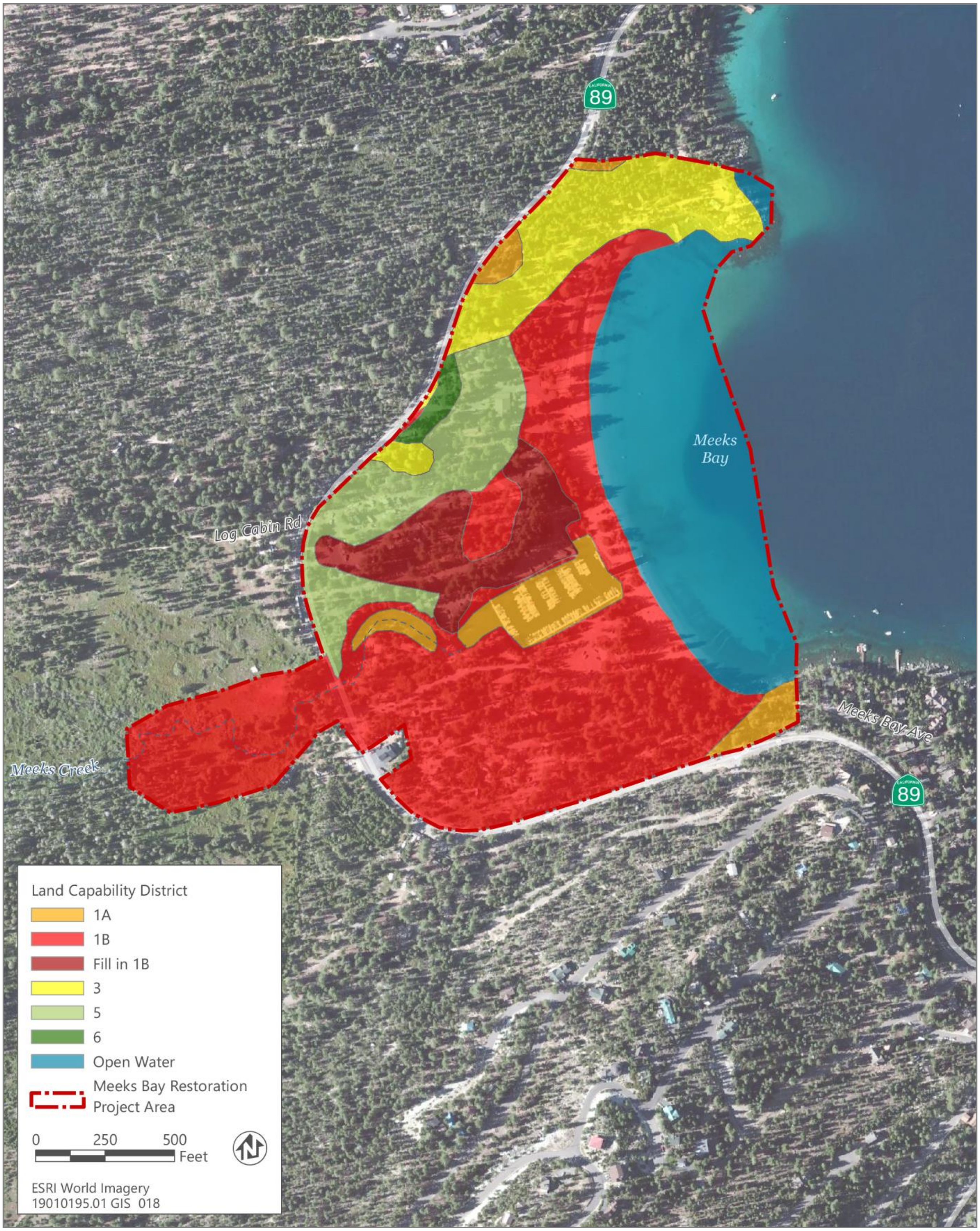
Table 3.7-4 Existing Approximate Land Capability and Coverage within the Project Area

Land Capability District[1]	Total Area (acres)	Base Allowable Coverage	Allowable Coverage (acres)	Existing Coverage (acres)	Available Coverage (acres)
1a	4.49	1%	0.04	0.13	-0.09
1b	32.06	1%	0.32	5.05	-4.72
Fd (1b)[2]	5.38	1%	0.05	2.82	-2.77
3	7.25	5%	0.36	2.16	-1.79
5	6.76	25%	1.69	2.30	-0.61
6	0.61	30%	0.18	0.30	-0.12
Total	56.55		2.66	12.76	-10.10

[1] Land capability districts and existing land coverage has not been field verified for the entire project area. Field verification will be required prior to issuance of a permit from TRPA.

[2]Fd soil in the project area are native 1b soils covered by fill material. This area was designated as 1b by the TRPA coverage verification.

Source: prepared by Ascent Environmental in 2021.



Source: data downloaded from TRPA in 2021.

Figure 3.7-3 Mapped Land Capability Districts in the Project Area

3.7.3 Environmental Impacts and Mitigation Measures

METHODOLOGY

The evaluation of coverage and potential geologic and soil impacts is based on a review of documents pertaining to the project study area including CGS and USGS technical guides, the NRCS Soil Survey, TRPA regulations and planning documents, environmental impact reports, background reports prepared for plans and projects in the vicinity, and published and unpublished geologic literature. This analysis also incorporates portions of the Meek Bay Restoration Project, Hydrology and Geomorphology Specialist Report (Balance Hydrologics 2021). The information obtained from these sources was reviewed and summarized to understand existing conditions and to identify potential environmental effects, based on the thresholds of significance. In determining the level of significance, the analysis assumes that the proposed project would comply with relevant, federal, state, and local laws, regulations, and ordinances.

Potential soil and geologic effects associated with the project alternatives can be classified as temporary or permanent. Temporary impacts generally include effects associated with construction activities, such as ground disturbance and short term increases in turbidity. Permanent impacts would be associated with proposed facilities, such as new impervious land coverage and deep soil and geologic disturbance.

THRESHOLDS OF SIGNIFICANCE

The thresholds of significance were developed in consideration of the State CEQA Guidelines, TRPA Thresholds, TRPA Initial Environmental Checklist, LTBMU Forest Plan, and other applicable policies and regulations. Under NEPA the significance of an effect must consider the context and intensity of the environmental effect. The factors that are taken into account under NEPA to determine the context and intensity of its effects are encompassed by the thresholds of significance. An alternative would have a significant effect on geology, soils, and mineral resources if it would:

- compact or cover soil beyond the limits allowed in the land capability districts;
- cause a substantial change in the topographic features of a site in a manner inconsistent with the natural surrounding conditions;
- substantially change undisturbed soil or native geologic substructures;
- cause a substantial increase in wind or water erosion of soils; or
- expose people or property to geologic hazards such as earthquakes, landslides, backshore erosion, avalanches, mud slides, ground failure, or similar hazards.

ISSUES NOT DISCUSSED FURTHER

As discussed in Section 3.7.2, no expansive soils are found within the project area. This analysis does not evaluate the potential for the proposed project to create instability in the underlying geologic materials, resulting in off-site landslides or subsidence. The project area is located on an alluvial fan with low slope angles that does not have the potential to generate landslides. Furthermore, the types of human activities proposed by the action alternatives do not have the potential to create subsidence. Therefore, these issues are not discussed further.

ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

Impact 3.7-1: Compact or Cover Soil with Impervious Surfaces Beyond the Limits Allowed by the Land Capability Districts

Based on planning level estimates of coverage changes, all of the action alternatives would result in a decrease in land coverage in LCD 1b and a net decrease in coverage across the site due to the removal of soft coverage near the marina and other dispersed parking areas as well as the reconfiguration of parking and roads. Alternative 1 would result in the greatest decrease in coverage and Alternative 3 would result in the smallest decrease in coverage. In addition, the action alternatives would meet all TRPA requirements for coverage management, resource protection, and land coverage mitigation. For these reasons, Alternatives 1, 2, 3, and 4 would have a beneficial effect related to compaction and land coverage. Implementation of the No Action Alternative would result in no impact.

No Action Alternative

Table 3.7-5 provides a summary of land coverage for the No Action Alternative. There is an estimated 9.84 acres of excess land coverage in the project area under existing conditions. The majority of this excess coverage (7.47 acres) occurs in LCD 1b, which is the most protected and sensitive LCD. However, the No Action Alternative would be a continuation of existing conditions and would not result changes in soil compaction or TRPA regulated land coverage. Therefore, the No Action Alternative would have no impact relative to compaction and land coverage.

Table 3.7-5 Summary of Land Coverage for the No Action Alternative

Land Capability District	Existing Conditions (No Action) Allowable Coverage (%)	Existing Conditions (No Action) Allowable Coverage (Acres)	Existing Conditions (No Action) Existing Impervious Area (Acres)	Existing Conditions (No Action) Exempt Coverage (Acres)[2]	Existing Conditions (No Action) Excess Coverage (Acres)
1a	1%	0.04	0.13	0.05	0.04
1b[1]	1%	0.37	7.87	0.03	7.47
3	5%	0.36	2.16	0.18	1.62
5	25%	1.69	2.30	0.02	0.59
6	30%	0.18	0.30	-	0.12
Total		2.66	12.76	0.28	9.84

[1] Includes Fd (fill) areas identified as LCD 1b

[2] Exempt Coverage includes the existing bike trail

Source: prepared by Ascent Environmental in 2021.

Alternative 1: Full Restoration with Boating Pier

As described in the existing condition discussion, precise coverage and LCD data is not yet available for the project area. Planning level data derived from illustrative drawings combined with conservative assumptions regarding the amount of land coverage that could be created by each alternative, was used to develop the following analysis of changes in TRPA regulated land coverage. For coverage purposes, the land-based portions of the proposed boating pier are included in this coverage analysis. Land coverage is not calculated below the high-water mark of Lake Tahoe. A land capability verification that determines the exact coverage verification will be required by the TRPA prior to permit approval.

Implementation of Alternative 1 would result in removal of soft coverage near the marina and other dispersed parking areas as well as the reconfiguration of parking and roads. Based on a planning level estimate of coverage changes, Alternative 1 would decrease impervious coverage in LCDs 1a and 1b while small increases in coverage could occur in LCDs 3, 5, and 6 (see Table 3.7-6). Overall, Alternative 1 would decrease impervious areas by 2.49 acres when compared to the No Action Alternative.

Table 3.7-6 Land Coverage Changes for Alternative 1

Land Capability District	Alternative 1 Change in Impervious Area (Acres)	Alternative 1 Exempt Coverage (Acres)[2]
1a	-0.04	0.04
1b[1]	-2.99	1.01
3	0.03	0.03
5	0.49	0.25
6	0.02	0.02
Total	-2.49	1.35

[1] Includes Fd (fill) areas identified as LCD 1b
[2] Exempt coverage includes only the proposed interpretive trail and the proposed multi-use path
Source: prepared by Ascent Environmental in 2021.

In accordance with TRPA Code Section 30.4.6.D.3, non-motorized public trails are exempt from the calculation of land coverage, subject to siting and design requirements. Specifically, these design requirements call for minimization of disturbance to low capability lands (LCDs 1a, 1b, 1c, 2, and 3). Alternative 1 includes 1.35 acres of exempt coverage from the construction of the non-motorized trail connection between the south campground and the north campground. Because the trail would cross the restored Meeks Creek, the majority of the exempt coverage would be in LCD 1b.

Preliminary coverage data indicates that Alternative 1 would result in a small increase (0.49 acres) of land coverage in LCD 5. As permitted by TRPA Code Section 30.4.4, existing land coverage within LCD 1b would be relocated to LCD 5 to allow for this increase in LCD 5.

The implementation of Alternative 1 would result in the removal of approximately 3 acres of land coverage from LCD 1b and a net reduction in compaction and impervious area of 2.49 acres, when compared to existing conditions. In addition, the project would meet all TRPA requirements for coverage management, resource protection, and land coverage mitigation. For these reasons, Alternative 1 would have a beneficial effect related to compaction and land coverage.

Alternative 2: Full Restoration with Pedestrian Pier

Alternative 2 would create similar changes in land coverage patterns as Alternative 1. A summary of estimated land coverage changes associated with Alternative 2 is provided in Table 3.7-7. Overall, Alternative 2 would remove 0.54 acres less coverage than Alternative 1. Alternative 2 would remove less coverage because it would not relocate the beachfront cabins and would remove a smaller area of road than Alternative 1.

Table 3.7-7 Land Coverage Changes for Alternative 2

Land Capability District	Alternative 2 Change in Impervious Area (Acres)	Alternative 2 Exempt Coverage (Acres)[2]
1a	-0.04	0.04
1b[1]	-2.38	0.79
3	0.03	0.03
5	0.42	0.26
6	0.02	0.02
Total	-1.95	1.14

[1] Includes Fd (fill) areas identified as LCD 1b
[2] Exempt coverage includes only the proposed interpretive trail and the proposed multi-use path
Source: prepared by Ascent Environmental in 2021.

Similar to Alternative 1, Alternative 2 would include a non-motorized trail that would be exempt from coverage in accordance with TRPA Code Section 30.4.6.D.3. However, Alternative 2 would make a small alteration to the alignment of the non-motorized trail north of Meeks Creek, which would eliminate 0.22 acres of exempt 1b land coverage when compared to Alternative 1.

Although Alternative 2 would remove less coverage than Alternative 1, the implementation of Alternative 2 would result in the removal of approximately 2.38 acres of land coverage from LCD 1b and a net reduction in compaction and impervious area of 1.95 acres, when compared to existing conditions. In addition, the project would meet all TRPA requirements for coverage management, resource protection, and land coverage mitigation. For these reasons, Alternative 2 would have a beneficial effect related to compaction and land coverage.

Alternative 3: Full Restoration with No Pier

Alternative 3 would create similar changes in land coverage patterns as Alternative 1. A summary of land coverage changes associated with Alternative 3 is provided in Table 3.7-8. Overall, Alternative 3 would remove 2.04 acres less coverage than Alternative 1. This is due to the expansion of the north and south campground areas, retaining the beachfront cabins in their current location, and the addition of an expanded parking area.

Table 3.7-8 Land Coverage Changes for Alternative 3

Land Capability District	Alternative 3 Change in Impervious Area (Acres)	Alternative 3 Exempt Coverage (Acres)[2]
1a	-0.04	0.04
1b[1]	-0.88	0.76
3	0.03	0.03
5	0.43	0.26
6	0.02	0.02
Total	-0.45	1.11

[1]Includes Fd (fill) areas identified as LCD 1b

[2]Exempt coverage includes only the proposed interpretive trail and the proposed multi-use path

Source: prepared by Ascent Environmental in 2021.

Like Alternative 1, Alternative 3 would include an interpretive and multi-use non-motorized trail that would be exempt from coverage in accordance with TRPA Code Section 30.4.6.D.3. Of the four action alternatives, Alternative 3 would remove the least amount of coverage. However, Alternative 3 would result in the removal of approximately 0.88 acres of land coverage from LCD 1b and a net reduction in compaction and impervious area of 0.45 acres, when compared to existing conditions. In addition, the project would meet all TRPA requirements for coverage management, resource protection, and land coverage mitigation. For these reasons, Alternative 3 would have a beneficial effect related to compaction and land coverage.

Alternative 4: Preferred Alternative

Alternative 4 would create similar changes in land coverage patterns as Alternative 1, including relocation of the motel-style cabins, but without a pier. A summary of land coverage changes associated with Alternative 4 is provided in Table 3.7-9.

Table 3.7-9 Land Coverage Changes for Alternative 4

Land Capability District	Alternative 4 Change in Impervious Area (Acres)	Alternative 4 Exempt Coverage (Acres)
1a	-0.04	0.04
1b[1]	-2.74	1.01
3	0.03	0.03
5	0.49	0.25
6	0.02	0.02
Total	-2.27	1.35

[1] Includes Fd (fill) areas identified as LCD 1b

Source: prepared by Ascent Environmental in 2021.

Overall, Alternative 4 would remove the second most coverage of any of the action alternatives. It would remove 0.26 acres less coverage than Alternative 1. This is due to the expansion of the parking area on the south side. Alternative 4 would result in the removal of approximately 2.74 acres of land coverage from LCD 1b and a net reduction in compaction and impervious area of 2.27 acres, when compared to existing conditions. For the same reasons discussed under Alternative 1, Alternative 4 would have a beneficial effect related to compaction and land coverage.

Mitigation Measures

No mitigation is required for this impact.

Impact 3.7-2: Result in Substantial Soil Erosion or Loss of Topsoil

Implementation of the action alternatives would require extensive areas of ground disturbance and excavation for restoration of Meeks Creek, replacement of SR 89 bridge, as well as ground disturbance required for reconfiguring of campgrounds, and recreation facilities. Restoration of Meeks Creek would include partially filling the marina and reconstructing the lagoon, which would result in the largest area of soil disturbance proposed in the project area. Grading, earth moving, and excavation would require permits in accordance with TRPA, Lahontan RWQCB, and El Dorado County regulations. With adherence to existing standard regulations and permit requirements, the potential for substantial soil erosion or loss of topsoil would be less than significant for Alternatives 1, 2, 3, and 4. Implementation of the No Action Alternative would not result in construction and would reduce some sources of erosion through the installation of BMPs. This would be a less-than-significant impact.

<u>No Action Alternative</u>

The No Action Alternative would be a continuation of existing conditions and would not result in ground disturbance and no increase in soil erosion or loss of topsoil is expected. Existing sources of erosion in the creek channel would remain. The No Action Alternative would have a less-than-significant impact relative to soil erosion.

<u>Alternative 1: Full Restoration with Boating Pier</u>

Alternative 1 would include excavation for removal of the motel-style cabins, existing SR 89 bridge, and asphalt paving, a boating pier, as well as minor grading and paving for the reconfiguration of the campgrounds. In addition to disturbance in the upland areas, implementing the restoration design elements would require major ground disturbance in close proximity to Lake Tahoe, as well as a large-scale diversion and dewatering system to temporarily lower lagoon water levels and manage inflow from Meeks Creek during construction. Temporary access routes and staging areas would be required to allow construction equipment and materials to reach stream restoration area. Access routes would be designed to avoid large trees and sensitive resources; however, some vegetation removal would be required. Access routes would be established by driving over the existing terrain with blading, scraping, and ramp building allowed only where it is needed. Staging areas would be delineated in existing disturbed areas and would be located as close to SR 89 as practicable.

The construction activities described above would result in temporary disturbance of soil and would expose disturbed areas to storm events. Rain of sufficient intensity and duration could dislodge soil particles, generate runoff, and cause localized erosion. Soil disturbance during the summer months could result in loss of topsoil due to wind erosion and runoff from thunderstorm events. Additionally, ground disturbance in or adjacent to Meeks Creek and Lake Tahoe, associated with SR 89 bridge construction, multi-use path bridge construction, and restoration elements could lead to accelerated erosion and sediment transport within the stream channel.

Disturbance in Upland Areas (Outside of the Stream Corridor)

The NRCS Erosion Hazard rating estimates the risk of soil loss from sheet and rill erosion (erosion caused by overland flow of water) for disturbed soils where 50 to 75 percent of the soil surface has been exposed (NRCS 2007). Because the soils of the project area have low to moderate runoff potential and the topography (with the exception of the immediate riverbank and channel) is gently sloped, the NRCS described the Erosion Hazard rating at “Slight” for all soil map units within the disturbance area of Alternative 1. This means that substantial erosion would be unlikely under normal conditions.

For areas outside of the stream corridor, this characterization of erosion potential is appropriate. The BMPs required by TRPA and LRWQCB as conditions of construction and grading permits would minimize the potential for soil erosion and protect water bodies and SEZ areas. One condition in the LRWQCB NPDES permit is a storm water pollution prevention plan (SWPPP), prepared by a qualified SWPPP developer. This plan would detail the BMPs that would be implemented to minimize erosion, reduce sediment transport, and control stormwater flow from the project area. In addition, the SWPPP would address grading and slope stabilization methods, as well as construction waste disposal methods. Typical temporary BMPs include properly installed silt fences, sediment logs, detention basins, and inlet protection. Temporary BMPs would be installed prior to beginning site grading and would be maintained throughout construction until permanent erosion control features are functioning. The required elements of a SWPPP are discussed in greater detail in section 3.6 "Hydrology and Water Quality." After construction is completed, temporarily disturbed areas (including access roads and staging areas) would be stabilized and revegetated in accordance with TRPA Code of Ordinances Section 61.4.

Disturbance within the Stream Corridor, Lagoon, and Shorezone

Restoration and bridge replacement/construction activities that take place on the stream bank would have a higher potential of causing soil erosion due to the exposure of steeper slopes and proximity to the creek. Excavation work would expose the soil profile to wind and water erosion. Additionally, removal of the box culvert/bridge, boulders or large cobble would affect the structure of the directly adjacent soil areas, which could result in sloughing or small areas of slope failure. In addition, extensive excavation work would be required for the removal of fill material and boulder banks in the lagoon area, as well as the installation of the multi-use path crossing of the restored creek. Soil erosion could also occur during construction of the shoreline stabilization features as well as the land side of the boating pier.

The final construction documents and SWPPP would include a detailed diversion and dewatering plan and would outline strategies and methods for controlling destabilized soil during construction periods. In general, diversion would likely be necessary for the SR 89 bridge replacement, marina removal, trail bridge construction, and creek restoration work. Depending on the number of project features that are constructed concurrently, diversion would occur in portions of the channel between one and three times. For marina removal, and creek and lagoon restoration, Meeks Creek would be captured upstream of the SR 89 bridge and diverted around the lagoon in a pipe to discharge at a point that eventually drains to Lake Tahoe, a total distance of approximately 1,300 feet (Balance Hydrologics 2021). A temporary cofferdam would be constructed near the SR 89 bridge to direct Meeks Creek away from the bridge opening and into the diversion pipe. Another cofferdam (or bulkhead) at the downstream end of the project (likely at the lagoon mouth) would also be installed to prevent turbid water generated at the project area from directly entering Lake Tahoe (Balance Hydrologics 2021). If the SR 89 bridge replacement and/or trail bridge are not constructed concurrently with the restoration actions, separate diversions would be needed for bridge removal and construction. In these cases, cofferdams would be placed upstream and downstream of the SR 89 bridge and trail bridge to isolate the work areas. Creek flows would be diverted into pipes to bypass the bridge work areas. In all diversions, ground water would be pumped from construction areas, as necessary, and would be infiltrated or otherwise disposed of consistent with measures identified in the SWPPP and approved by Lahontan RWQCB.

The diversion and dewatering system would be an important component in containing pollutants within the construction site, and the Project SWPPP would detail a full suite of BMPs (consistent with the guidelines of the Lahontan RWQCB and the TRPA BMP Handbook) to prevent pollutants from entering surface and ground waters. Construction BMPs would include structural measures (e.g., fencing and fiber rolls) as well as operational prescriptions (e.g., corrective grading and proper equipment fueling procedures). In addition to standard BMPs that are required of most construction projects, the project would need to include additional provisions of the TRPA BMP Handbook specific to the shoreline geomorphic zone. The project will be required to regularly inspect and maintain BMPs, and keep logs of the monitoring and corrective measures.

Conclusion

Because the soils of the disturbance area are not highly susceptible to erosion, temporary and permanent BMPs would be installed as requirements of the necessary TRPA and LRWQCB permits, and areas of temporary disturbance would be revegetated and regraded to match the natural topography of the site, the potential for Alternative 1 to increase erosion or adversely affect the topography of the area would be less than significant.

Alternative 2: Full Restoration with Pedestrian Pier

The ground disturbance associated with Alternative 2 would be similar to the disturbance described above for Alternative 1, however the parking area in the southern campground would be reconfigured and construction of an additional multi-use path bridge crossing of the newly restored creek and floodplain would occur adjacent to the SR 28 bridge. In addition, Alternative 2 would create new road segments in the campgrounds. This would require an additional 0.75 acres of ground disturbance compared to Alternative 1. As described for Alternative 1, the soils within the disturbance area are not highly susceptible to erosion, temporary and permanent BMPs would be installed as requirements of the necessary TRPA and LRWQCB permits, and areas of temporary disturbance would be revegetated and regraded to match the natural topography of the site. Therefore, the potential for Alternative 2 to increase erosion or adversely affect the topography of the area would be less than significant.

Alternative 3: Full Restoration with No Pier

The ground disturbance associated with Alternative 3 would be similar to the disturbance described above for Alternative 1, with three exceptions. First, the north and south campgrounds would be expanded resulting in an additional acre of ground disturbance. Second, an accessible non-motorized launch facility would be constructed on the south end of the project area, which would create ground disturbance. Third, Alternative 3 would involve construction of an additional multi-use path bridge crossing of the newly restored creek and floodplain adjacent to the SR 28 bridge. As described for Alternative 1, the soils within the disturbance area are not highly susceptible to erosion, temporary and permanent BMPs would be installed as requirements of the necessary TRPA and LRWQCB permits, and areas of temporary disturbance would be revegetated and regraded to match the natural topography of the site. Therefore, the potential for Alternative 3 to increase erosion or adversely affect the topography of the area would be less than significant.

Alternative 4: Preferred Alternative

The ground disturbance associated with Alternative 4 would be similar to Alternative 1 except that Alternative 4 would include a nonmotorized launch instead of a pier, and it would include a slightly expanded parking area. Alternative 4 would include a similar amount of ground disturbance than Alternative 1. Because the soils of the disturbance area are not highly susceptible to erosion, temporary and permanent BMPs would be installed as requirements of the necessary TRPA and LRWQCB permits, and areas of temporary disturbance would be revegetated and regraded to match the natural topography of the site, the potential for Alternative 4 to increase erosion or adversely affect the topography of the area would be less than significant.

Mitigation Measures

No mitigation is required for this impact.

Impact 3.7-3: Substantially Increase Exposure of People or Property to Geologic Hazards Such as Earthquakes, Landslides, Backshore Erosion, Avalanches, Mud Slides, Ground Failure, Seiche, or Similar Hazards

The project area is located in a seismically active area which could experience strong seismic shaking in the event of a large earthquake. Additionally, the project area is located within the inundation area of a potential seiche wave generated by seismic shaking or an earthquake triggered landslide. The risk to people and structures from geologic hazards would be reduced through compliance with the current seismic design requirements of the California Building Standards Code. Additionally, implementation of the action alternatives would not alter the exiting threat to life and property from a seismically induced seiche on Lake Tahoe. Therefore, the potential for the project to expose people and structures to seismic and geologic hazards would be a less-than-significant impact for Alternatives 1, 2, 3, and 4. Implementation of the No Action Alternative would result in no impact.

<u>No Action Alternative</u>

The No Action Alternative would be a continuation of existing conditions. No facilities would be removed or constructed. Therefore, the No Action Alternative would not change geologic risks or exposure and would have no impact relative to geologic hazards.

<u>Alternative 1: Full Restoration with Boating Pier</u>

The project area is located in a seismically active area which could experience strong seismic shaking in the event of a large earthquake. Alternative 1 includes the reconstruction of the SR 89 bridge, construction of a pedestrian bridge over Meeks Creek, demolition/reconstruction of beachfront cabins, construction of day use facilities, and the construction of a boating pier. These structures and their users could be susceptible to earthquake damage. Additionally, Meek Bay is underlain by beach sands could be susceptible to liquefaction during seismic events. The risk to people and structures would be reduced through compliance with the current seismic design requirements of the California Building Standards Code.

Seismic damage to piers typically results from liquefaction of marine sediments and failure is usually related to economic loss and loss of functionality rather than structural collapse (SGH 2014). Piers that are accessible to the general public are subject to the seismic design criteria included in American Society of Civil Engineers (ASCE) Standard 61-14, Seismic Design of Piers and Wharves. These standards incorporate soil structure, geotechnical parameters, and earthquake hazard levels to minimize a piers risk of structural damage or failure during a predictable seismic event.

Piers are resilient structures and are not likely to collapse during an earthquake (SGH 2014). Additionally, the proposed pier would not include a superstructure (pier mounted building) that could place users at risk during a large seismic event.

The project area is located within the inundation area of a potential seiche wave generated by seismic shaking or an earthquake triggered landslide. While the potential for a seiche is low in any given year, the damage and loss of life should a seiche occur would be significant. The El Dorado County Local Hazard Mitigation Plan (El Dorado County 2018) recognizes the potential for seiche, acknowledges the significant damage that would occur, but provides no specific action or funding to address the vulnerability. For the purposes of this analysis, implementation of Alternative 1 would not alter the existing threat to life and property from a seismically induced seiche on Lake Tahoe.

The risk to people and structures from geologic hazards would be reduced through compliance with the current seismic design requirements of the California Building Standards Code. Additionally, Alternative 1 would not alter the exiting threat to life and property from a seismically induced seiche on Lake Tahoe. Therefore, the potential for the project to expose people and structures to seismic and geologic hazards would be a less-than-significant impact.

<u>Alternative 2: Full Restoration with Pedestrian Pier</u>

The risks related to geologic hazards would be similar for Alternatives 1 and 2. However, Alternative 2 does not include relocation of two beachfront cabins or the subsequent stabilization of the cabin footprints. As described for Alternative 1, the risk to people and structures from geologic hazards would be reduced through compliance with the current seismic design requirements of the California Building Standards Code. Additionally, Alternative 2 would not alter the exiting threat to life and property from a seismically induced seiche on Lake Tahoe. Therefore, the potential for the project to expose people and structures to seismic and geologic hazards would be a less-than-significant impact.

<u>Alternative 3: Full Restoration with No Pier</u>

The risks related to geologic hazards would be similar for Alternatives 1 and 3. However, Alternative 3 does not include relocation of two beachfront cabins or the subsequent stabilization of the cabin footprints. Additionally, Alternative 3 would construct an accessible non-motorized launch facility rather than a boating pier. As described for Alternative 1, the risk to people and structures from geologic hazards would be reduced through compliance with the current seismic design requirements of the California Building Standards Code. Additionally, Alternative 2 would not alter the exiting threat to life and property from a seismically induced seiche on Lake Tahoe. Therefore, the potential for the project to expose people and structures to seismic and geologic hazards would be a less-than-significant impact.

Alternative 4: Preferred Alternative

Similar to Alternative 1, the risk to people and structures from geologic hazards would be reduced through compliance with the current seismic design requirements of the California Building Standards Code. Additionally, Alternative 4 would not alter the exiting threat to life and property from a seismically induced seiche on Lake Tahoe. Therefore, the potential for the project to expose people and structures to seismic and geologic hazards would be a less-than-significant impact.

Mitigation Measures

No mitigation is required for this impact.

Impact 3.7-4: Substantially Disturb Native Soils and Geologic Structures or Change Topography in a Manner Inconsistent with the Natural Surroundings

The action alternatives would substantially change topography in the restoration areas of the site; however, these changes would involve the restoration of native topography and removal imported fill materials. Additionally, any topography changes associated with upland recreational developments (such as reconfiguring the southern campground and alignment of pedestrian paths) would be minor. Therefore, the implementation of Alternatives 1, 2, 3, and 4 would have a beneficial effect on native soils, geologic structures, and topography. Implementation of the No Action Alternative would result in no impact.

No Action Alternative

The No Action Alternative would be a continuation of existing conditions and would not result in ground disturbance or changes to existing topography. Native soils and topographies would remain buried beneath imported fill materials and restoration of Meeks Creek would not occur. Therefore, the No Action Alternative would have no impact relative to disturbance of native soils, geologic structures, and topography.

Alternative 1: Full Restoration with Boating Pier

The project area is heavily disturbed, and a return to a condition closer to pre-disturbance topography is needed to return healthy ecological function to the creek and lagoon. The restoration design would not be able to fully restore topography of the early 1900s since there are parallel project goals to continue to provide for recreation, existing infrastructure that cannot be disturbed, and an incomplete record of pre-disturbance conditions. However, the project would make a significant move toward returning the site to pre-disturbance topography.

Topographic changes in the areas outside of the stream channel and lagoon areas would be negligible. Minor grading may occur for development of access roads and staging areas, and adjustments to the south side of the campground.

The Meeks Creek channel would be regraded to accommodate the bridge replacement, restore pre-disturbance topography to improve sediment transport, encourage deposition of fine sediment in overbank areas, provide passage for aquatic organisms, and improve long-term stability of the channel and banks. The channel would be raised to transition from the new SR 89 bridge so that there is no drop and no barrier to aquatic organism passage. A weir structure would be incorporated into the channel bed near the bridge to control aquatic organism passage to support recovery of native species. Buried rows of boulders may be included to control the grade of the channel and/or protect underground utility crossings. Bio-engineered bank stabilization treatments would be incorporated to stabilize banks, and may consist of vegetated soil lifts, log cribwalls, willow mattresses, or similar. It should also be noted that downstream portions of the channel reach are intended to be dynamic and may evolve and migrate within the floodplain over time.

Alternative 1 would also include one multi-use path bridge across Meeks Creek. Per the design criteria listed in the project description, the multi-use path should span over the entire Meeks Creek channel (i.e., no abutments on the bank or support piers in channel) and be above the FEMA 100-year flood elevation. The hydraulics of the flow area under the bridge should have velocities that do not exceed those in adjacent reaches upstream or downstream. Biotechnical bank protection should be used in preference to exposed rip rap rock wherever possible. Additionally, the causeway west of the bridge should be elevated to allow for the free flow of overbank flow. This would eliminate the deep fill found along the current alignment, allow for better overbank flow conveyance, and increase meadow area. Various design options including boardwalks, multiple bridge spans and/or multiple culvert openings could be used to provide for floodplain flow conveyance.

Restoring pre-marina topography to the lagoon and barrier beach is anticipated to restore littoral processes that would offer self-maintaining qualities to the beach by helping to replenish beach sand lost to erosion. The lagoon would be restored by removing the remaining marina infrastructure (boat ramp, sheet piling, and maintenance building) and restoring pre-disturbance topography. Historical dredging of the lagoon would be undone by filling with gravel and sand to approximate elevation of 6,224 feet—the elevation of the natural rim of Lake Tahoe. Fill and boulders around the perimeter of the marina would be removed, and the lagoon shoreline would be regraded with variable backfill elevations throughout the new floodplain to support diverse marsh and wetland vegetation. With the sheet piling for the marina inlet removed, the mouth of Meeks Creek would be allowed to interact with backwater from Lake Tahoe and the mouth is expected to periodically close at the barrier beach. The mouth would also be able to migrate laterally within a confined section of the barrier beach.

The rock gabion and concrete shoreline revetment on the north side of the project area would be removed and the steep slope between the access road and the beach would be stabilized with a combination of grading (slope layback), native plantings, and stacked boulders. One or more stairways may be incorporated within the shoreline stabilization features to provide beach access during periods of low water levels in Lake Tahoe. Alternative 1 would also remove two beachfront cabins and replace them with three smaller cabins farther inland. The footprint of the existing cabin areas would be stabilized with a similar slope layback and boulder treatment.

The steep gradient in the vicinity of the shoreline protection features cannot be discerned from historical photos, perhaps because the beach has eroded vertically to create the steep slope that exists today. Assuming the dimensions of the proposed shoreline protection features are similar to the existing features, there would be no changes in topography. If the beach begins to replenish after several years of littoral process recovery, the toe of the shoreline protection features could become buried and the topography would more closely resemble pre-disturbance landforms. However, the protection features would still represent a hardened barrier that could limit the degree of beach replenishment. Shoreline processes would not be fully restored without the full removal of the stabilization structures.

Although Alternative 1 would substantially change topography in the restoration areas of the site, these changes would involve the restoration of native topography and removal imported fill materials. Additionally, any topography changes associated with upland recreational developments (such as reconfiguring the southern campground and alignment of pedestrian paths) would be minor. Therefore, the implementation of Alternative 1 would have a beneficial effect on native soils, geologic structures, and topography.

<u>Alternative 2: Full Restoration with Pedestrian Pier</u>

The ground disturbance and topography changes associated with Alternative 2 would be similar to those described above for Alternative 1. However, Alternative 2 does not include relocation of two beachfront cabins or the subsequent stabilization of the cabin footprints. Alternative 2 includes two multi-use path bridges providing multi-use path crossings of Meeks Creek in the project area. As described for Alternative 1, the major topography changes associated with Alternative 2 would be caused by the restoration of Meeks Creek and removal of imported fill materials. Because Alternative 2 would make a significant move toward returning the site to pre-disturbance topography, the implementation of Alternative 2 would have a beneficial effect on native soils, geologic structures, and topography.

<u>Alternative 3: Full Restoration with No Pier</u>

The ground disturbance and topography changes associated with Alternative 3 would be similar to those described above for Alternative 1. However, Alternative 3 does not include relocation of two beachfront cabins or the subsequent stabilization of the cabin footprints. Alternative 3 also includes two pedestrian bridges providing multi-use path crossings of Meeks Creek in the project area. Additionally, while Alternative 2 would include a universally accessible paddlecraft launch rather than a pier, this change would not result in a meaningful difference in site topography. As described for Alternative 1, the major topography changes associated with Alternative 3 would be caused by the restoration of Meeks Creek and removal of imported fill materials. Because Alternative 3 would make a significant move toward returning the site to pre-disturbance topography, the implementation of Alternative 3 would have a beneficial effect on native soils, geologic structures, and topography.

<u>Alternative 4: Preferred Alternative</u>

The ground disturbance and topography changes associated with Alternative 4 would be similar to those described above for Alternative 1 except for the pier which is not proposed under Alternative 4 and the addition of an expanded parking area. Therefore, there would be similar ground disturbance and topography changes associated with Alternative 4. Because Alternative 4 would make a significant move toward returning the site to pre-disturbance topography, the implementation of Alternative 4 would have a beneficial effect on native soils, geologic structures, and topography.

Mitigation Measures

No mitigation is required for this impact.

3.7.4 Cumulative Impacts

Cumulative impacts related to land coverage, erosion, geologic hazards, soil disturbance and changes to natural topography are considered in the context of the Lake Tahoe watershed. Seismic effects are localized by nature and are not cumulative. Past projects have degraded conditions related to land coverage. Erosion, and soil disturbance through historic development and land use decisions. With TRPA's adoption of soil thresholds and a regional plan to achieve the thresholds, regulations and environmental improvement projects have improved conditions related to land coverage, erosion, and soil disturbance. As a result, all of the TRPA Threshold standards related to soil conservation are either in attainment or have made progress towards attainment in the past several years (TRPA 2021). The cumulative projects described in Table 3-2, as well as the Meeks Bay Restoration Project, would adhere to TRPA and Lahontan RWQCB regulations that would prevent increases in land coverage that exceed land capability limits, require temporary and permanent erosion control BMPs, and protect natural topographic features. Furthermore, as described in Impact 3.7-1, the action alternatives would result in a beneficial impact related to compaction and land coverage resulting from implementation of BMPs, the removal of soft coverage near the marina and dispersed parking areas, and removal of coverage associated with reconfiguration of parking and roads. Because regulations are in place to safeguard geologic and soil resources for all cumulative projects within the Lake Tahoe watershed, the combined cumulative impact associated with the project's incremental effect and the effects of other projects is not significant. Therefore, the alternatives would have a less than cumulatively considerable impact on geology and soils.

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