7 SOIL CONSERVATION

7.1 INTRODUCTION

This chapter discusses soil conservation impacts associated with the implementation of all four alternatives of the TRPA Shoreline Plan. The section includes discussion regarding existing shorezone conditions and applicable soil conservation regulations for the portion of the shorezone above the Lake Tahoe high water mark. The potential effects to the portion of the shorezone below the high-water mark are discussed in Chapter 6, "Hydrology and Water Quality." While this chapter addresses TRPA regulated land coverage, impacts to stream environment zone habitat are described in Chapter 15, "Terrestrial Biological Resources." The primary soil conservation issues raised during public scoping regarding implementation of the Shoreline Plan included concerns about increased soil erosion and rock removal due to increase access to the shorezone.

The evaluation of potential soil conservation impacts in this section is based on a review of documents pertaining to the Lake Tahoe shorezone, including California Geologic Survey and U.S. Geologic Survey technical guides and maps; the Natural Resource Conservation Service (NRCS) 2007 Soil Survey; TRPA regulations and planning documents that evaluate impacts to the stream environment zones (SEZs) and land coverage changes; existing TRPA land coverage and land capability documentation; background reports prepared for plans and projects in the vicinity; and published and unpublished shorezone, soil, and geologic literature. The information obtained from these sources was reviewed and summarized to understand existing conditions and to identify potential environmental effects, based on the significance criteria identified below in Section 7.4.2. 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.

7.2 REGULATORY SETTING

7.2.1 Federal

U.S. ARMY CORPS OF ENGINEERS

The U.S. Army Corps of Engineers has jurisdiction over navigable bodies of water and other waters of the United States, including Lake Tahoe and its tributaries. Section 404 of the Clean Water Act establishes a program to regulate the discharge of dredged or fill material into waters of the United States. The basic premise of the program is that no discharge of dredged or fill material may be permitted if: (1) a practicable alternative exists that is less damaging to the aquatic environment or (2) the nation's waters would be significantly degraded. The U.S. Army Corps of Engineers also reviews the navigational safety of structures placed below elevation 6,229.1 feet Lake Tahoe Datum to ensure no more than minor individual and cumulative impacts would occur to the aquatic environment.

U.S. BUREAU OF RECLAMATION

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public. The Truckee River outlet dam at Tahoe City, California has been regulated since 1874 and has been under federal control since 1915. The maximum water level was set at 6,229.1 feet and the minimum lake elevation was set at 6,223.0 feet (Lake Tahoe Datum) in 1935 pursuant to the Truckee River Operating Agreement. The federal water master, as needed to maintain court-decreed rates of flow for the Truckee River, can release the six feet between the minimum level and the top of the dam. The Truckee-Carson-Pyramid Lake Water Rights

River Settlement Act (Public Law 101-618) and the Truckee River Operating Agreement control use of the lake's waters.

7.2.2 Tahoe Regional Planning Agency

THRESHOLDS

Through adoption of Resolution 82-11, 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. The latest TRPA Threshold evaluation was completed in 2015. 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

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, etc.). Soft coverage may allow limited infiltration into the soil (e.g. dirt walking trails, unpaved dirt driveways, etc.). 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 based on soil type, erosional hazard, soil drainage, and other features. The nine separate land capability classes 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. Land coverage is not calculated for development below the high-water mark of Lake Tahoe. The remainder of the shorezone (the backshore) is treated as LCD 1b, with a coverage limit of one percent.

For the 2015 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. This analysis showed that all land capability classes are in attainment of the threshold except for land capability class 1b and 2 (Table 7.1).

The LCD 1b target is not expected to be attained soon, given the magnitude of change and funding that would be needed to achieve this threshold. The rate of coverage removal from LCD 1b lands from 2011-2015 averaged 2.5 acres annually. At this rate the 1b target would not be attained for 264 years. Impervious coverage in LCD 2 lands is currently 43 acres above the target level. Removing 43 acres of coverage is potentially achievable within 10 to 15 years if sufficient funding is available and focused on attainment of the Class 2 target.

Stream Environment Zones

SEZs are defined by hydrology, soil, and water-associated vegetation. 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., 2015:11). The SEZ threshold includes preserving existing functioning SEZ lands in their natural hydrologic condition, restoring all disturbed SEZ lands in undeveloped, unsubdivided lands, and restoring 25 percent of the SEZ lands that have been identified as disturbed, developed or subdivided, to attain a 5 percent total increase in naturally functioning SEZ lands.

Table 7-1 Soil Conservation Threshold Status

Indicator Reporting Category	Threshold Standard and Estimated Status	Status Determination
SC-1 Land coverage (impervious cover) with a threshold standard to comply with allowable land coverage limitations established in the Land-Capability Classification of the Lake Tahoe Basin, California-Nevada: A Guide to Planning (Bailey 1974). This threshold indicator reporting category consists of nine separate standards for nine separate land capability classes.	Land Capability District:	
	1a (1% allowable cover) – 0.7% estimated impervious cover	Considerably better than target
	1b (1% allowable cover) – 6.8% estimated impervious cover	Considerable worse than target
	1c (1% allowable cover) – 0.9% estimated impervious cover	At or somewhat better than target
	2 (1% allowable cover) – 1.2% estimated impervious cover	Somewhat worse than target
	3 (5% allowable cover) – 2.1% estimated impervious cover	Considerably better than target
	4 (20% allowable cover) – 3.9% estimated impervious cover	Considerably better than target
	5 (25% allowable cover) – 10.7% estimated impervious cover	Considerably better than target
	6 (30% allowable cover) – 9.1% estimated impervious cover	Considerably better than target
	7 (30% allowable cover) – 23.3% estimated impervious cover	At or somewhat better than target
SC-2 Stream Environment Zone (SEZ) threshold to restore 25% of the SEZ lands that have been identified as disturbed, developed or subdivided to attain a 5% increase in the area of naturally functioning SEZ lands.	Preserve existing naturally functioning SEZ lands in their natural hydrologic condition: Overall region-wide policies and programs are in place that recognize and protect the myriad of critical functions of SEZs. This standard is in attainment. Restore 25% of the SEZ lands that have been identified as disturbed, developed, or subdivided: If only SEZ restoration inside urban areas is used to assess standard attainment, the target is about 50 percent achieved; thus, the threshold standard status is designated "considerably worse than target." If all SEZ restoration contributes to target attainment, the target is 83 percent achieved; thus, the threshold standard status is designated "somewhat worse than target." Restore all disturbed SEZ lands in undeveloped, un-subdivided lands: The status is "unknown due to insufficient data." Attain a 5% total increase in the area of naturally functioning SEZ lands: Since the standard was adopted, 924 acres of SEZ have been restored. This standard is "at or somewhat better than target" and is in attainment.	Overall: Considerably worse than target

Source: TRPA 2016

The status of this threshold indicator is considerably worse than target. The standards for SEZ restoration are evaluated individually below (Table 7-1). The standards include a management standard and three numerical standards for SEZ restoration. The numeric SEZ restoration standards are written as percentage-based targets that have historically been evaluated against an estimate of the extent of SEZ in the Basin from 1991. There have been numerous attempts to develop maps of SEZ in the Basin (Roby et al., 2015:34), but TRPA has not formally adopted an SEZ map. Basin wide maps of SEZ are often referred to as "potential" SEZ areas because many of the mapped SEZ lands have not been field verified. The lack of a detailed uniformly accepted SEZ map or potential SEZ map for the region means that the percentage targets are subject to change as the estimated extent of SEZ in the region is revised based on new information. The individual subparts of the standard are numbered and evaluated in Table 7.1.

GOALS AND POLICIES

Goals and Policies of the TRPA Regional Plan that relate to soil conservation play a critical role in contributing to the water quality, vegetation, and wildlife goals of the region and generally:

- direct the location of impervious cover and limit its extent,
- prevent soil erosion from the region's watersheds by focusing development on more suitable soil types and requiring that construction activities occur when soils are less susceptible to erosion, and

- protect existing SEZ and restore modified SEZ.

A condensed list of the Regional Plan goals and policies that relate to soil conservation are included below:

GOAL LU-2: Direct the amount and location of new land uses in conformance with the environmental threshold carrying capacities and the other goals of the Tahoe Regional Planning Agency Bi-State Compact.

- **Policy LU-2.9** Allowable land coverage in the Tahoe Region shall be set forth in accordance with the land capability district classification methodology and district based land coverage limitations set forth in "the Land Capability Classification of the Lake Tahoe Basin, California - Nevada, a guide for planning, bailey, 1974."

- **Policy LU-2.10** Allowed base land coverage for all new projects and activities shall be calculated by applying the bailey coefficients to the applicable area within the parcel boundary.

GOAL NH-1: Risks from natural hazards (e.g., flood, fire, avalanche, earthquake, seiche) will be minimized.

- **Policy NH-1.2** Prohibit additional development, grading, and filling of lands within the 100-year flood plain and in the area of wave run-up except for public recreation facilities, public service facilities, necessary crossings, restoration facilities, and as otherwise necessary to implement the goals and policies of the plan. Require all facilities located in the 100-year flood plain and area of wave run-up to be constructed and maintained to minimize impacts on the flood plain.

GOAL VEG-2: Provide for the protection, maintenance and restoration of such unique eco-systems as wetlands, meadows, and other riparian vegetation.

- **Policy VEG-2.1** Riparian plant communities shall be managed for the beneficial uses of passive recreation, groundwater recharge, and nutrient catchment, and as wildlife habitats.

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 for impervious land coverage.

- **Policy S-1.2** No new land coverage or other permanent disturbance shall be permitted in LCDs 1-3. This policy provides exceptions for certain public recreation and public service facilities where LCDs 1-3 cannot be avoided; impacts are fully mitigated; and LCD 1-3 lands are restored in the amount of 1.5 times the area of LCD 1-3 lands that are disturbed. Special provisions are also allowed for nonmotorized pubic trails.

- **Policy S-1.4** TRPA shall develop specific policies to limit land disturbance and reduce soil and water quality impacts of disturbed areas.

- **Policy S-1.5** Prioritize watersheds or other areas impaired by excess land coverage and incentivize the removal and transfer of coverage from appropriate locations within priority watersheds.

- **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.

- **Policy S-1.7** All existing natural functioning stream environment zones shall be retained as such and disturbed stream environment zones shall be restored whenever possible and maybe treated to reduce the risk of catastrophic wildfire.

GOAL SZ-1: Provide for the appropriate shorezone uses of Lake Tahoe, Cascade Lake, and Fallen Leaf Lake while preserving their natural and aesthetic qualities.

- **Policy SZ-1.1** All vegetation at the interface between the backshore and foreshore zones shall remain undisturbed unless allowed by permit for uses otherwise consistent with the shorezone policies.
- **Policy SZ -1.2** Construction activity should be set back to ensure no disturbance of the interface between high capability backshore and unstable cliff areas.
- **Policy SZ -1.3** The use of lawns or ornamental vegetation in the shorezone shall be discouraged.
- **Policy SZ -1.4** Class 1 capability shorezones shall be managed consistent with the goals and policies of the stream environment zone subelement.
- **Policy SZ -1.5** Disturbance of class 2 and class 3 capability shorezones shall be minimized to avoid accelerated backshore erosion or cliff collapse.
- **Policy SZ -1.6** Low to moderate intensity dwelling and recreational uses should be allowed in the stable and high capability backshore areas of class 4 and 5 capability shorezones.
- **Policy SZ -1.7** Water dependent recreational facilities and residential buildings are acceptable uses in class 6, 7, and 8 capability shorezones so long as such uses (1) provide for the natural equilibrium of the shoreline interface, (2) do not accelerate nearshore shelf erosion, (3) minimize disturbance of vegetation, (4) consider visual amenities, and (5) comply with other relevant policies of this subelement.
- **Policy SZ -1.8** Stream channel entrances to the lake shall be maintained to allow unobstructed access of fishes to upstream spawning sites.
- **Policy SZ -1.9** The agency shall regulate the placement of new piers, buoys, and other structures in the foreshore and nearshore to avoid degradation of fish habitats, creation of navigation hazards, interference with littoral drift, interference with the attainment of scenic thresholds, and other relevant concerns.
- **Policy SZ -1.10** Provisions should be made to allow multiple-use piers when such uses are intended to reduce the number of single-use piers existing on adjoining properties.
- **Policy SZ-1.11** The agency shall regulate the maintenance, repair, and modification of piers and other structures in the nearshore and foreshore.
- **Policy SZ -1.13** allow public access to the shorezone where lawful and feasible on public lands.
- **Policy SZ-1.15** TRPA may designate shorezones as man-modified.

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

- **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 except for those uses as noted in a, b, c, d, e and f. SEZ-1.6 replacement of existing coverage in stream environment zones may be permitted where the project will reduce impacts on stream environment zones and will not impede restoration efforts.

- **Policy SEZ-1.7** Where feasible, encourage and incentivize the removal or retrofitting of existing stream corridor impediments to help reestablish natural conditions and allow for the evolution of natural fluvial processes (such as stream migration) within SEZ lands.

- **Policy SEZ-1.8** Encourage and support public acquisition of SEZ lands by land banks and public entities in order to restore, retire coverage on, and deed restrict SEZ lands for protection from future development and disturbance.

CODE OF ORDINANCES

Standards listed in the TRPA Code of Ordinances (TRPA Code) that relate to soil conservation include the following:

- backshore stabilization requirements;
- pedestrian and vehicular access restrictions;
- drainage and/or modification to wetlands prohibitions;
- land coverage and disturbance restrictions in the backshore (including restrictions on coverage and disturbance of Be (beach) soils, and other areas of SEZ)
- protection and management of SEZ vegetation and habitat at the mouths of rivers and creeks within the backshore;
- preservation and replanting of native backshore vegetation;
- permeability requirements in the nearshore and foreshore*;*
- plan area/tolerance district regulation of uses and structures; and
- placement standards for shorezone facilities and marinas.

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 describes the various standards and regulations that protect the environment against significant adverse effects from excavation, filling, and clearing due to such conditions as exposed soils, unstable earthworks, or groundwater interference.

33.6. Vegetation Protection During Construction

33.6.9. Standards for Soil and Vegetation Protection:

a) The location and type of protective fencing shall be shown on approved plans.

b) No material or equipment shall enter or be placed in the areas protected by fencing or outside the construction areas without prior approval from TRPA.

c) Protective fencing for soil and vegetation shall be constructed with metal posts and industry-standard mesh fencing that is least four feet tall, unless an alternative protection method is approved by TRPA.

d) All protective fencing shall be adequately maintained and provide a functional barrier during construction.

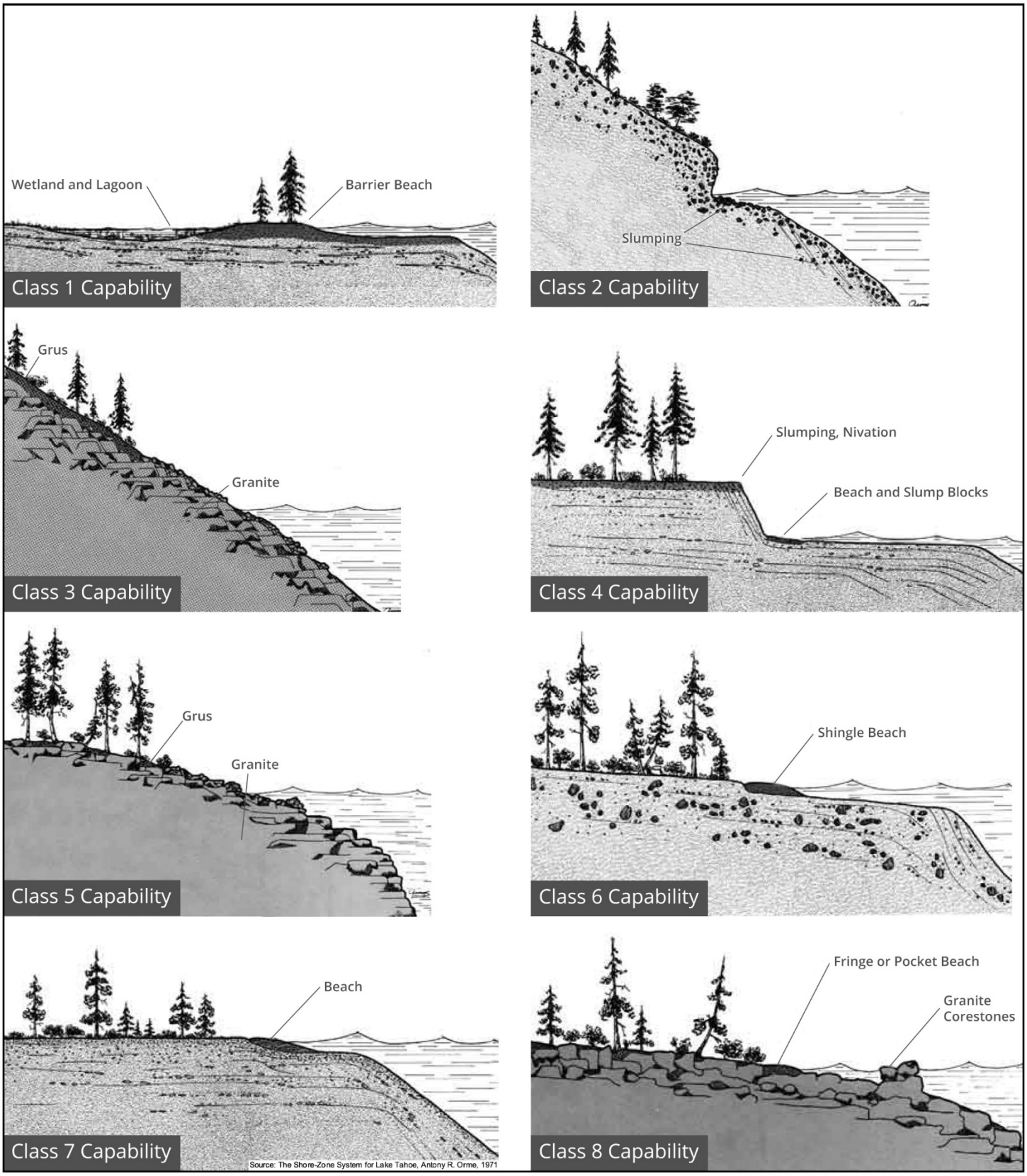
Chapter 83: Shorezone Tolerance Districts

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). The shorezone was divided into four generalized geologic units where 34.4 percent of the shorezone is classified as armored granitic (east shore except for pocket beaches), 6.8 percent as volcanic, 23.8 percent as glacial moraines and similar rock debris, and 35.0 percent as alluvial, colluvial, lakebed, and glacial outwash deposits (south shore) (Adams 2002:638). These units were again divided based on slope and erosivity. 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. The typical landforms associated with the eight shorezone tolerance districts are illustrated in Exhibit 7-1, and their mapped locations along the shores of Lake Tahoe are shown on Exhibit 7-2. Table 7-2 provides a definition for each of the eight districts. As described in Chapter 2, "Description of the Proposed Project and Alternatives," provisions related to shorezone tolerance districts would remain unchanged under all alternatives.

Table 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.

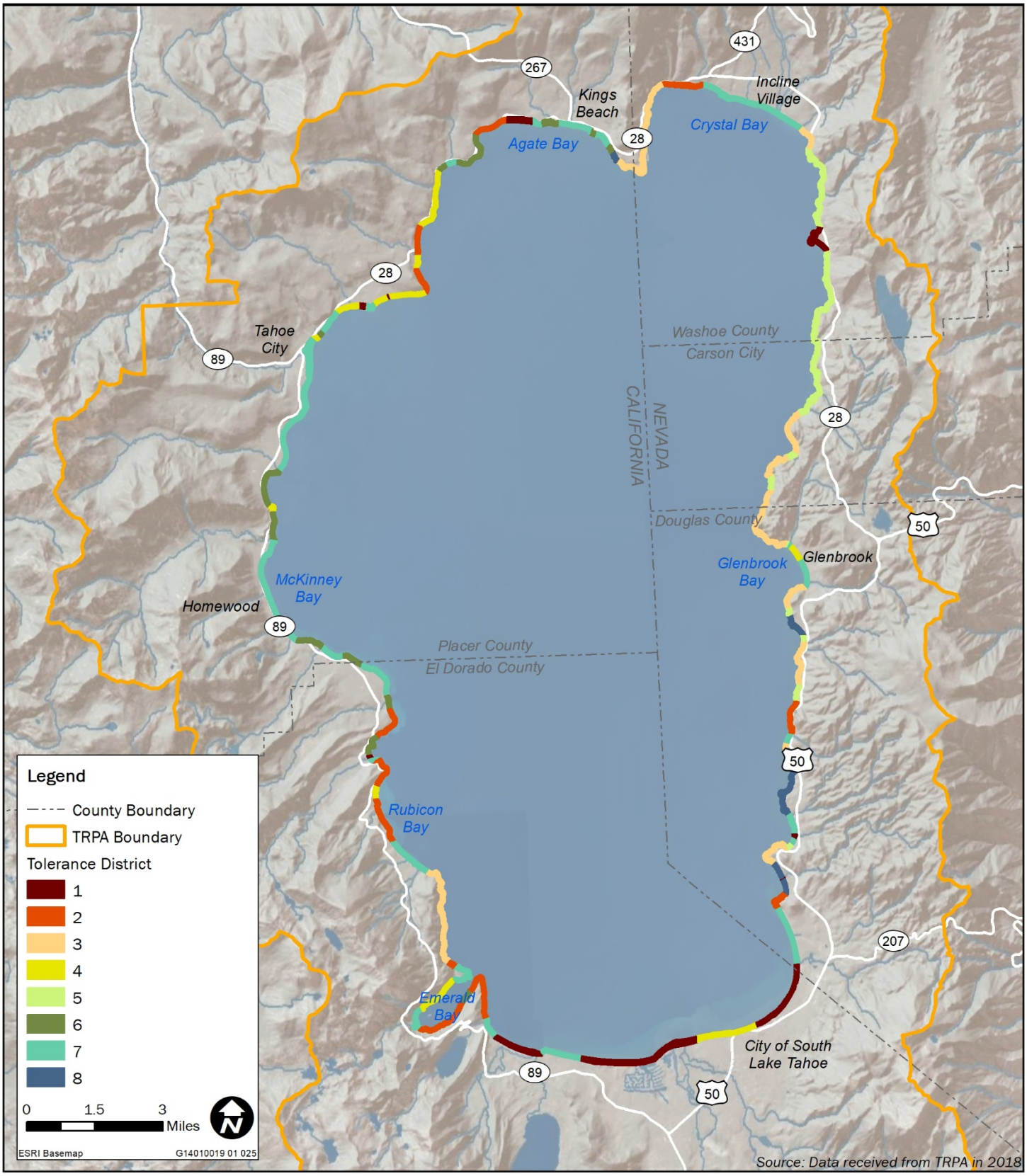
Source: TRPA 2004



TAHOE REGIONAL PLANNING AGENCY

Exhibit 7-1 Shorezone Tolerance District Landforms

SHORELINEPLAN
Enhancing Recreation & Protecting Lake Tahoe's 72 Miles of Shoreline



TAHOE REGIONAL PLANNING AGENCY

Exhibit 7-2 Shorezone Tolerance Districts

SHORELINEPLAN
Enhancing Recreation & Protecting Lake Tahoe's 72 Miles of Shoreline

7.2.3 California

CALIFORNIA DEPARTMENT OF FISH AND WILDLIFE

Fish and Game Code Section 1602 requires an entity to notify the California Department of Fish and Wildlife prior to commencing any activity that may:

- substantially divert or obstruct the natural flow of any river, stream or lake;
- substantially change or use any material from the bed, channel or bank of any river, stream, or lake; or
- deposit debris, waste or other materials that could pass into any river, stream or lake.

The California Department of Fish and Wildlife requires a Lake and Streambed Alteration Agreement when it determines that the activity may substantially adversely affect existing fish or wildlife resources. A Lake and Streambed Alteration Agreement includes measures necessary to protect existing fish and wildlife resources. The primary focus is the protection of fish habitat from suspended sediments, turbidity, and alteration of the lakebed.

LAHONTAN REGIONAL WATER QUALITY CONTROL BOARD

The Lahontan Regional Water Quality Control Board (LRWQCB) is a regulatory agency with the mission to preserve, enhance, and restore the quality of California's water resources and drinking water. The Clean Water Act Section 401 program regulates discharges of fill and dredged material to all waters of the state, including waters of the U.S. under the Clean Water Act of Section 401 and the Porter-Cologne Water Quality Control Act. Lahontan sometimes serves as the lead agency for CEQA compliance. TRPA has a Memorandum of Understanding with LRWQCB for maintenance dredging projects.

ALQUIST-PRIOLO EARTHQUAKE FAULT ZONING ACT

The Alquist-Priolo Earthquake Fault Zoning Act (Public Resources Code Sections 2621–2630) (Alquist-Priolo Act) was passed in 1972 to mitigate the hazard of surface faulting to structures designed for human occupancy. The main purpose of the law is to prevent the construction of buildings used for human occupancy on the surface trace of active faults. The law addresses only the hazard of surface fault rupture and is not directed toward other earthquake hazards. The Alquist-Priolo Act requires the State Geologist to establish regulatory zones known as "Earthquake Fault Zones" around the surface traces of active faults and to issue appropriate maps. The maps are used by jurisdictions for planning purposes.

SEISMIC HAZARDS MAPPING ACT

The Seismic Hazards Mapping Act of 1990 (Public Resources Code Sections 2690–2699.6) addresses earthquake hazards from nonsurface fault rupture, including liquefaction and seismically induced landslides. The Act established a mapping program for areas that have the potential for liquefaction, landslide, strong ground shaking, or other earthquake and geologic hazards. The Act also specifies that he lead agency for a project may withhold development permits until geologic or soils investigation are conducted for specific sites and mitigation measures are incorporated into plans to reduce hazards associated with seismicity and unstable soils.

7.2.4 Nevada

NEVADA DIVISION OF ENVIRONMENTAL PROTECTION

The Nevada Division of Environmental Protection (NDEP) is the regulatory agency with responsibilities for water quality on the Nevada side of the Lake Tahoe Basin. Pursuant to the Nevada Revised Statues, NDEP

may issue general or temporary (Working in Waterways) permits for the discharge of pollutants to waters of the State. Additionally, activities requiring a federal permit must "certify" that the proposed work will not violate state water quality standards under Section 401 of the Clean Water Act.

NEVADA DIVISION OF STATE LANDS

The Nevada Division of State Lands administers the excess coverage mitigation program for the Nevada portion of the Lake Tahoe Region, which is funded by excess coverage mitigation fees disbursed from TRPA. The objective of this program is to improve soil functions and the water quality of Lake Tahoe through the retirement of land coverage and restoration of disturbed lands. This program acquires land and land coverage. Acquired lands are protected and are not available for development or disposal. Other Nevada Division of State Lands management goals include clean water, health forests, the reduction of excess fire fuels and hazardous forest conditions, wildlife habitat, and reasonable public access.

7.3 AFFECTED ENVIRONMENT

REGIONAL GEOLOGY

The geologic history of the Lake Tahoe Basin provides an important context for studying the shore zone of the Lake. The Lake Tahoe Basin is located in the Sierra Nevada geomorphic province in eastern California and a small portion of western Nevada. The Sierra Nevada is a tilted fault block with a gradual western slope and a steep eastern escarpment. The Range extends 400 miles from the Mojave Desert in the south to the Cascade Range and Modoc Plateau in the north and is between 50 and 80 miles wide.

Lake Tahoe is located in the northern Sierra Nevada, between the Sierra crest to the west and the Carson Range to the east (Saucedo 2005). 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.

SOILS

NRCS Soil Survey of the Lake Tahoe Basin (NRCS 2018) describes many soil map units around the shorezone of Lake Tahoe. They are differentiated from each other by characteristics such as parent material, landscape position, texture, structure, organic matter content, depth to bed rock, depth to groundwater, and hydrologic function. Frequently, soils from similar parent materials found in similar landscape positions will have many qualities in common. For this analysis, shorezone soils have been grouped by a dominant characteristic that affects the soils use and erosion hazard. Exhibit 7-3 shows the distribution of these soils throughout the Basin.

Volcanic Soils: Volcanic eruptions blanketed much of the Basin in layers of ash, mud, and rubble. Over time these materials developed into the deep nutrient rich soils which dominate the landscape of the northwestern portion of the Basin. Generally, volcanic soils in the Basin are well drained and do not erode easily. Jorge and Tahoma are typical volcanic soils found in northwest portion of the shorezone.

Granitic Soils: Granitic soils formed in the hardened remnants of volcanic material that cooled in place without erupting. Granitic soils tend to be nutrient poor, and generally more susceptible to erosion. Cagwin, Cassenai, and Gefo are typical granitic soils.

Glaciated Soils: The glaciers that followed Tahoe's volcanic period carved out the west shore canyons, leaving behind deep, rubbly, deposits of Glacial till. Soils in till or glacial outwash tend to have a great deal more gravels and cobbles than the alluvial soils often found adjacent to them. Typical glacial soils include Paige, Tallac, and Inville.

Alluvial Soils: After glaciers disappeared from the Tahoe Basin, the rivers and streams became the strongest soil altering force. The alluvial soils in the project area are the product of sediments that were carried by waterbodies and deposited in floodplains. These soils are very different from mountain slope and glacial soils because of the presence of a seasonal high water table that supports an abundance of moisture loving vegetation. Many sensitive ecosystems such as wetlands, meadows, and riparian areas are associated with alluvial soils. The Tahoe and Marla soil types are they dominant alluvial soils in the Basin.

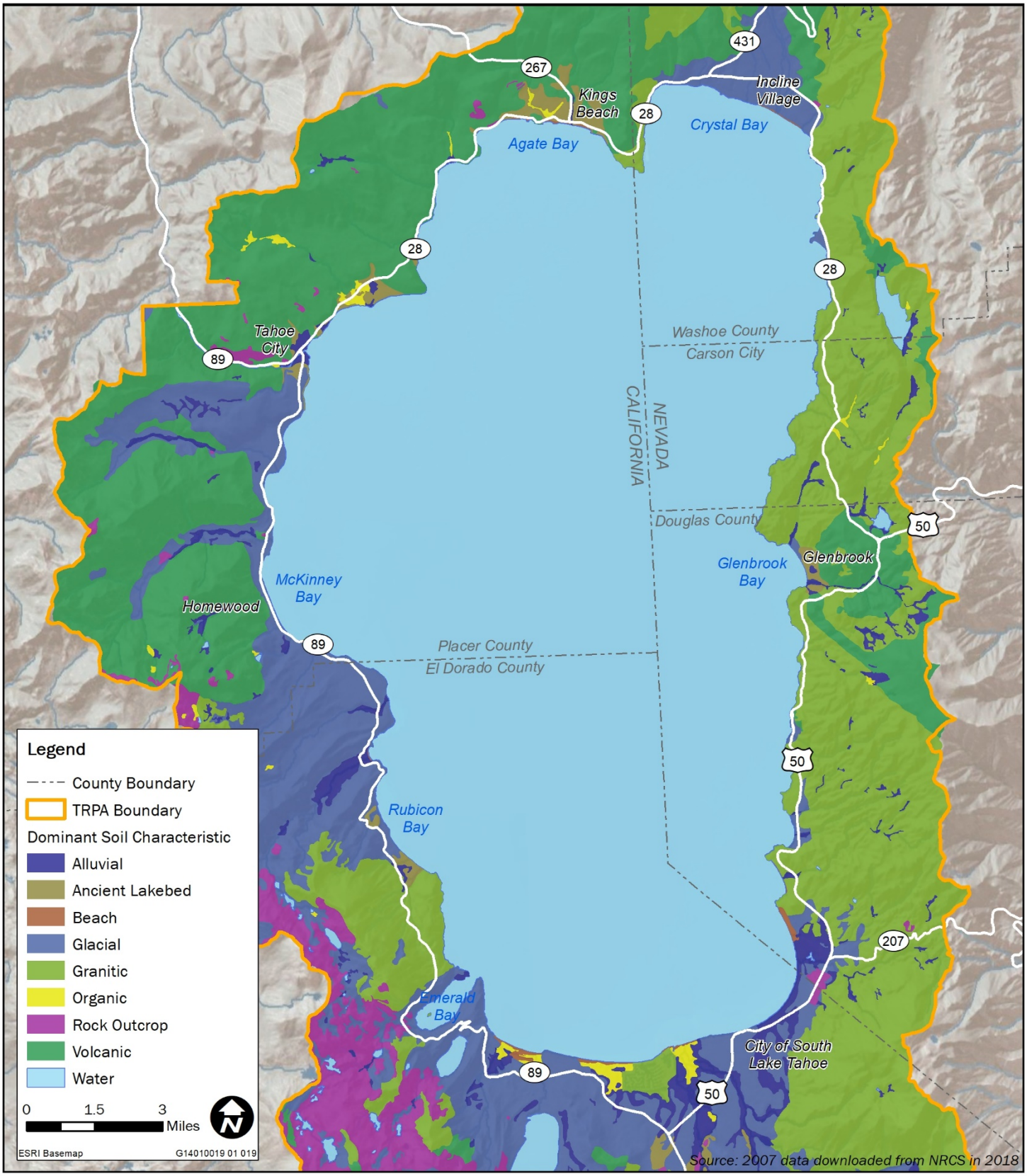
Organic Soils: Organic soils are commonly alluvial soils that developed in an area where a persistently high water table allows the accumulation of organic matter. These highly sensitive soils are found in the wettest areas of meadows and stream margins and are found in pot hole wetlands in the high country. In the shorezone, the dominant organic soil is the Watah peat.

Ancient Lakebed Soils: These soils are the result of fluctuations in the water level in Lake Tahoe and consist of an upper profile of coarse textured volcanic material, which abruptly changes to dense, clay textured lakebed sediments. Although water moves easily through the upper portion of the soil profile, infiltration into the lakebed sediments is very slow creating a "perched" or artificially high water table. As a result, these soils are usually dry for 45 to 75 consecutive days in late summer and are moist for the rest of the year (NRCS 2018). Ancient Lakebed soils are typically associated with alluvial soils and support similar vegetation. The Kingsbeach stony sandy loam is a typical example of an ancient lakebed soil.

Beach Soils. Beaches are characterized by well-drained, homogenous, gravelly coarse sand. Beach sediments take on a variety of characteristics depending on their physical origin and location, including stable beach sediments as well as active littoral deposits that respond to wave action. Beaches account for only a small portion of the shorezone and include younger and older barrier beaches, lakeshore dunes, and lakeshore strand beaches. These landforms are highly prone to erosion when disturbed by either natural or human activity (Orme 1972:52).

SHOREZONE EROSION AND SEDIMENT DELIVERY

Weathering and erosion are active geologic processes that generate sediment within the shorezone. Weathering breaks down material in place while erosion and deposition transport and redistribute the sediments. Erosion is more likely where unconsolidated or poorly consolidated materials such as alluvium, colluvium, sediments from glacial moraines, and outwash materials are exposed to wave action (Adams 2001:10). Eroding shorezone areas commonly occur in front of moderate to high land capability as classified by Bailey (1974). Weathering includes chemical and mechanical processes. Chemical processes are the result of the slightly acidic nature of water which breaks down rock formations over time. Mechanical weathering occurs in the shore zone through front heave, plant root intrusion, wave action, and abrasion which results in the breakdown of bedrock to fine sands, silts, and clays.



TAHOE REGIONAL PLANNING AGENCY

Exhibit 7-3 Dominant Soil Characteristics

SHORELINEPLAN
Enhancing Recreation & Protecting Lake Tahoe's 72 Miles of Shoreline

The total maximum daily load completed in 2010 estimated that the total mass of sediment eroded into Lake Tahoe from the shorezone since 1938 amounts to approximately 429,000 metric tons (MT). Adams et al. (2004:47) estimated that annual sediment contribution because of this erosion was composed of 7150 MT per year (6,000 metric tons of sand, 440 metric tons of silt, and 110 metric tons of clay (Adams 2004:42). The amount of phosphorus and nitrogen loading from shore zone erosion ranks last with respect to the other four nutrient sources (atmospheric deposition, stream loading, direct runoff, and groundwater) but is one of the highest contributors of sediment loading (Adams et al. 2004:47). Thus, shore zone erosion is an important component of the sediment and to a lesser extent, nutrient budget for Lake Tahoe. Wave induced currents and density currents also contributes to the movement of sediment out of the shorezone and into the lakezone (Orme 1971:7). Tributaries are not expected to deposit much coarse material to the shorezone except for the occasional delta formed during a large storm event (Osborne et al. 1985:9).

SHOREZONE LAND COVERAGE

As described in Section 7.2.2, allowable land coverage in the backshore is one percent. Although the entire backshore is treated as LCD 1b, some areas of the backshore may not exhibit a primary indicator of SEZ. Shorezone Tolerance District 1, areas influenced by streams, and areas found to exhibit one primary SEZ key indicator are all classified as SEZ, subject to field verification. Additional land coverage or other permanent land disturbance is not permitted in SEZs except for stream crossings, public outdoor recreation, public service facilities, water quality control facilities (TRPA Code Section 30.5). Additionally, permissible disturbance in Shorezone Tolerance District 1 is limited to planned foot paths which provide access to the shoreline while minimizing disturbance (TRPA Code Section 83.7.2(A)). Removal of indigenous vegetation is not permitted in SEZ. There are additional provisions in the TRPA Code that stipulate that if coverage is created for the uses listed above in an SEZ, restoration in the amount of 1.5 times the area of land covered or disturbed for the project must take place within the same LCD. TRPA Code Section 85.5 prohibits new land coverage or other permanent land disturbance in the backshore (with the exceptions discussed above listed in Code Sections 85.5.1, 85.5.2, 85.5.3, and 85.5.4).

The location of the backshore boundary varies widely and is field verified on an individual parcel basis when requested by property owners. Mapping of verified backshore is sporadic around the lake, so it is too speculative to estimate existing coverage in the backshore. TRPA has estimated the typical width of backshore areas by shorezone tolerance districts based on field verifications (Table 7-3). These typical widths are only approximate and vary greatly based on site-specific characteristics. TRPA will continue to review and assess typical widths of the backshore as field verifications are carried out, and as lake and climatic condition change in the future.

Table 7-3 Typical Widths of the Backshore Areas

Shorezone Tolerance District	Width (feet)	Shorezone Tolerance District	Width (feet)
1	200	5	35
2	40	6	35
3	35	7	100
4	47.5	8	35
1-8 AVERAGE	66		

Source: TRPA 2004

SEISMIC SETTING

Seismic activity is the release of energy in the earth's crust in the form of seismic waves or earthquakes. Earthquakes have the potential to cause ground rupture, landslides, avalanches, liquefaction, and seiche waves in the shorezone of Lake Tahoe. The three major faults in the Tahoe Basin are the West Tahoe Fault, the Stateline Fault, and Incline Faults. The Stateline–North Tahoe, Incline Village, and West Tahoe–Dollar Point

faults all show evidence for large (2+ m) rupture events within the past 11,000 years (Dingler et al. 2009:18). Studies by Brothers et al. (2009:499 and 514) suggest a magnitude-7 earthquake occurs every 2,000 to 3,000 years in the Basin, and that the largest fault in the Basin, West Tahoe, appears to have last ruptured between 4,100 and 4,500 years ago. The shorezone of Lake Tahoe could be affected by seismic activity.

GROUND FAILURE/LIQUEFACTION

Soil liquefaction occurs when ground shaking from an earthquake causes a sediment layer saturated with groundwater to lose strength and take on the characteristics of a fluid. Factors determining the liquefaction potential are soil type, the level and duration of seismic ground motions, the type and consistency of soils, and the depth to groundwater. Loose sands and peat deposits are susceptible to liquefaction, while clayey silts, silty clays, and clays deposited in freshwater environments are generally stable under the influence of seismic ground shaking (CGS 2008: pp. 35-37). Liquefaction poses a hazard to engineered structures. The loss of soil strength can result in bearing capacity insufficient to support foundation loads, increased lateral pressure on retaining or basement walls, and slope instability. Areas of the shorezone underlain by relatively loose sandy soils combined with a shallow groundwater table could be susceptible to liquefaction.

SUBSIDENCE

Land surface subsidence can be induced by both natural and human phenomena. Natural phenomena include: subsidence resulting from tectonic deformations and seismically induced settlements; soil subsidence from consolidation, hydrocompaction, or rapid sedimentation; subsidence from oxidation or dewatering of organic rich soils; and subsidence related to subsurface cavities. Subsidence related to human activity includes subsurface fluid or sediment withdrawal. Lateral spreading 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. The potential for failure from subsidence and 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. In the shorezone, areas around stream mouths and alluvial deposits in areas of high groundwater that could be susceptible to subsidence and lateral spreading.

TSUNAMI/SEICHE

A tsunami is a wave or series of waves that may result from a major seismic event that involves the displacement of a large volume of water and can 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. A seiche results in a potentially damaging wave, similar to a tsunami, which is caused from seismic activity near a large lake. A seiche wave may occur in periods that differ from a tsunami; however, should the period of wave propagation occur simultaneously with a tsunami, it could result in cumulative seismic-related wave effects.

7.4 ENVIRONMENTAL CONSEQUENCES AND MITIGATION MEASURES

7.4.1 Methods and Assumptions

Evaluation of soil conservation impacts were based on a review of documents pertaining to the Lake Tahoe Basin shorezone, including the NRCS soil survey of the Lake Tahoe Basin, California and Nevada, scientific studies, and TRPA regulations and planning documents. The information obtained from these sources was reviewed and summarized to establish existing conditions and to identify potential environmental effects, based on the standards of significance presented in this section.

To calculate backshore coverage estimates, some assumptions were made based on details of the various Shoreline Plan alternatives. The following assumptions were applied:

- For Alternatives 1 and 3, the largest multiple-use pier design standards (see Tables 2-6 and 2-8 in Chapter 2) and were applied to calculate pier footprint. For Alternative 4, the pier design standards for the largest-allowed multiple use pier under Alternative 1 were applied.
- For Alternative 2, multiple-use pier design standards are not specified; therefore, single-use pier design standards were applied (Table 2-7), plus 15 percent to account for potential multiple-use and public pier design deviations.
- For all four alternatives, it was assumed that 35 percent of the overall pier length would be placed in the backshore, and therefore the portion extending into the foreshore and nearshore (over water) would be 65 percent[1].
- Boat ramps for all alternatives were estimated to be 20 feet wide (to accommodate two simultaneous launches), and 75 feet long.
- For all alternatives, it was assumed that 20 feet of boat ramp length would be placed in the backshore.
- Access paths for shorezone structures in the backshore were calculated as follows:
  - Five feet wide and 20 feet long for pier foot paths, and
  - 12 feet wide and 200 feet long (the longest backshore width; see Table 7-3) for boat ramp access roads.

7.4.2 Significance Criteria

Significance criteria relevant to soil conservation are summarized below. The applicable TRPA threshold standards, the soil conservation criteria from the TRPA Initial Environmental Checklist, and other relevant information were considered in the development of the significance criteria. An impact would be considered significant 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.

[1] These coverage estimates do not account for any coverage exemptions that would apply pursuant to TRPA Code Section 30.4.6

7.4.3 Environmental Effects of the Project Alternatives

Impact 7-1: Increase land coverage beyond the limits allows by the Bailey land capability system

All Shoreline Plan alternatives would permit the construction or expansion of structures that would create coverage in the backshore. However, all projects would be required to demonstrate their compliance with existing TRPA land coverage regulations including restoration of 1.5 times the amount of LCD 1b (i.e., backshore) coverage created by the project. Because all projects permitted through Alternatives 1, 2, 3, and 4 would be required to comply with TRPA land coverage regulations and would result in a net decrease in the amount of coverage within LCD 1b, this impact would be **less than significant**.

This impact addresses whether the implementation of the Shoreline Plan alternatives would result in compaction or coverage of soil beyond the limits allowed by TRPA Code. No new impervious cover would be created by new buoys, slips, and pier extensions because these would occur entirely within the nearshore or would be additions to existing facilities that would rely on existing access paths across the backshore. New or modified piers, boat ramps, and marinas would result in new coverage in the shorezone and are discussed in the analysis below.

Alternative 1: Proposed Shoreline Plan

The proposed Shoreline Plan would allow for a total of up to 10 new public piers, 128 private piers, and two new public boat ramps which would each require new access paths in the backshore. These structures would create coverage in the backshore (LCD 1b). The area of new coverage associated with the implementation of Alternative 1 is estimated to be 0.3 acres.

The base allowable coverage associated with the backshore is one percent. TRPA Code Section 81.3.2 allows for boat launching facilities and marinas to be permitted in the backshore and Section 85.5.4 allows land coverage to provide access to an approved or legally existing structure or use in the nearshore or foreshore provided that the coverage is mitigated through application of best management practices (BMPs) and restoration of LCD 1b lands in the amount of 1.5 times the area of backshore disturbed. Further protections are provided for Shorezone Tolerance District 1, which is treated as SEZ for coverage purposes (TRPA Code Section 83.7.2(E)). In Shorezone Tolerance District 1, coverage would only be permitted for planned footpaths which provide access to the shoreline while minimizing environmental impacts. These existing TRPA Code requirements would remain under Alternative 1.

Alternative 1 would encourage the removal of coverage from stream mouths and SEZ areas by encouraging the transfer of existing piers out of stream mouth protection areas through incentives including offering multiple-use design standards consistent with a two-parcel pier for a single-use pier or providing upland scenic credits. When a pier is transferred or relocated, the old pier would be removed, and the area restored to a natural condition. In the case of pier transfers, the sending parcel would become deed-restricted to prevent future pier development.

Projects permitted through Alternative 1 would create land coverage in the backshore (LCD 1b). However, all projects would be required to demonstrate their compliance with existing TRPA land coverage regulations including restoration of 1.5 times the amount of LCD 1b coverage created by the project. Alternative 1 would create an estimated 0.3 acres of new coverage and result in the restoration of an estimated 0.45 acres of coverage for a net reduction of 0.15 acres of coverage within LCD 1b. Because all project permitted through Alternative 1 would be required to comply with TRPA land coverage regulations, this impact would be **less than significant**.

Alternative 2: Maintain Existing TRPA Shorezone Regulations (No Project)

Under Alternative 2, up to 476 new piers and six new boat ramps could be permitted. Existing TRPA Code stipulates design standards for single-use piers but provides for flexibility in design standards for multiple-use and public piers. This is the only alternative that would allow new marinas. Access routes and the

construction or expansion of the piers, boat ramps, and potentially new marinas would create coverage in the backshore. The estimated additional backshore coverage created through the implementation of Alternative 2 is approximately 2.4 acres.

The same TRPA land coverage regulations described for Alternative 1 would also apply to Alternative 2. Alternative 2 would create an estimated 2.4 acres of new coverage and result in the restoration of an estimated 3.6 acres of coverage for a net reduction of 1.2 acres of coverage within LCD 1b. Because all projects would be required to demonstrate their compliance with existing TRPA land coverage regulations including restoration of 1.5 times the amount of LCD 1b coverage created by the project, the implementation of Alternative 2 would have a **less-than-significant** impact relative to TRPA regulated land coverage**.**

Alternative 3: Limit New Development

This alternative would allow the development of five new public piers, one new public boat ramp, and 86 new, multiple-use private piers. These structures and the access routes that serve them would create coverage in the backshore (LCD 1b). The estimated additional backshore coverage created through the implementation of Alternative 3 is approximately 0.2 acres.

The same TRPA land coverage regulations described for Alternative 1 would also apply to Alternative 3. Alternative 3 would create an estimated 0.2 acres of new coverage and result in the restoration of an estimated 0.3 acres of coverage for a net reduction of 0.1 acres of coverage within LCD 1b. Because all projects would be required to demonstrate their compliance with existing TRPA land coverage regulations including restoration of 1.5 times the amount of LCD 1b coverage created by the project, the implementation of Alternative 3 would have a **less-than-significant** impact relative to TRPA regulated land coverage**.**

Alternative 4: Expand Public Access and Reduce Existing Development

This alternative would allow 15 new public piers and no other new shorezone structures. Alternative 4 would include transfer ratios that would allow some private shorezone structures to be removed and rebuilt in different locations provided that the project resulted in a 2:1 reduction in the number of structures, which would not be expected to result in a net increase in coverage. The area of additional backshore coverage associated with the implementation of the Alternative 4 is estimated to be 0.06 acres.

The same TRPA land coverage regulations described for Alternative 1 would also apply to Alternative 4. Alternative 4 would create an estimated 0.06 acres of new coverage and result in the restoration of an estimated 0.09 acres of coverage for a net reduction of 0.03 acres of coverage within LCD 1b. Because all projects would be required to demonstrate their compliance with existing TRPA land coverage regulations including restoration of 1.5 times the amount of LCD 1b coverage created by the project, the implementation of Alternative 4 would have a **less-than-significant** impact relative to TRPA regulated land coverage

Mitigation Measures

No mitigation is required.

Impact 7-2: Increase erosion or degrade soil conditions during construction activities

Implementation of all Shoreline Plan alternatives would permit construction activities in the shorezone that would create ground disturbance and loss of vegetation and would increase the potential for erosion. However, the potential for increased erosion resulting from future projects implemented under the Shoreline Plan alternatives would be reduced through compliance with county, TRPA, and LRWQCB or NDEP code requirements, permit conditions, and regulations. For this reason, implementation of any of the Shoreline Plan alternatives would have a **less-than-significant** impact related to increased soil erosion and degradation during construction.

The addition of new buoys or slips would not affect soil and geologic resources because they do not require construction or modification of land-side infrastructure. However, soils would be affected by construction of new boat ramps and ramp extensions and new piers and pier extensions because they require ground

disturbance in the backshore. The effects of construction activities below the high-water mark are discussed in Chapter 6, "Hydrology and Water Quality," in Impact 6-1. The effects of landside construction activities are discussed in the impact analysis below.

Alternative 1: Proposed Shoreline Plan

The installation of 128 new private piers, 10 new public piers, and two new boat ramps would create construction-related disturbance in the backshore. Ground-disturbing activities such as excavation and grading conducted for development allowed by the proposed Shoreline Plan could produce soil erosion or the loss of topsoil. Removal of soil and vegetation exposes bare earth which becomes unstable resulting in soils that are easily dislodged by equipment and could more easily be carried by water and wind into Lake Tahoe.

The timing, location, and duration of construction activities could result in the temporary disturbance of soil and exposure of disturbed areas to storm events. Construction activities would likely include grading, excavation, cut and fill, and trenching, all of which could alter the existing topography or ground surface of individual sites within the backshore. All proposed projects would be assessed on an individual level and would be required to conform to existing regional and local regulations to minimize grading and soil instability. As discussed in Section 7.2, "Regulatory Setting," and in Impact 6-1 in Chapter 6, "Hydrology and Water Quality," construction projects in the shorezone must meet multiple requirements and regulations of TRPA, LRWQCB (California), NDEP (Nevada), federal, and local (city and county) agencies, which include coverage restrictions (TRPA Code Chapter 30), implementation of BMPs (TRPA Code Chapter 60), and grading and excavation permits (TRPA Code Chapter 33).

Backshore soils have varying degrees of resilience and resistance to erosion as characterized by the TRPA shorezone tolerance districts. Sensitive beach soils in Shorezone Tolerance District 1 are afforded strong protections that effectively limit disturbance to planned footpaths. In the more stable Shorezone Tolerance Districts 2 and 3, projects must demonstrate that they will not accelerate or initiate backshore erosion and may be required to install and maintain stabilizing backshore vegetation. Projects in Shorezone Tolerance Districts 4 and 5 cannot be permitted unless TRPA finds that cliff and beach stability will not be accelerated, and the project must be designed to cause the least possible environmental hard to the backshore. Shorezone Tolerance Districts 6, 7, and 8 include the same protections as 4 and 5 but require that TRPA determine the stability of nearshore geology before permitting boat launching facilities and marinas. Verification of the shorezone tolerance district would occur as part of projects permitting process.

In addition to development restrictions specific to the shorezone, projects implemented through the proposed Shoreline Plan would be required to comply with local jurisdiction codes and with Chapter 33 and Chapters 60 through 68 of the TRPA Code. These requirements include the installation of BMPs for all projects, as specified in Section 60.4 of the TRPA Code. Temporary BMPs which comply with the TRPA *Best Management Practices Handbook* (Handbook) must be implemented on construction sites and maintained throughout the construction period until winterization, and permanent BMPs must be installed once construction has been finalized. Chapter 8 of the TRPA Handbook addresses shorezone specific projects and includes additional guidance for dredging, marina maintenance, boat ramp construction, and backshore stabilization. Improvement plans are submitted for review and approval to ensure conformance with county and TRPA rules, regulations, and ordinances as part of standard conditions of approval. Projects would also need to comply with TRPA's Standard Conditions of Approval for Shorezone Projects which includes specific measures to be implemented to protect environmental resources, including soil resources, from the effects of filling, dredging, grading, clearing of trees, and other activities associated with construction. Examples of standard conditions include:

- Applicants must provide final construction drawings to TRPA for approval. Such plans must include specifications for revegetation, areas to be revegetated, and drainage improvements, and must conform with the TRPA Handbook. Once approved by TRPA, these plans are incorporated as a part of the permit issued to the applicant.

- Applicants must post a security bond with TRPA to ensure compliance with conditions in their permit. All revegetation requirements must be met before release of the bond.
- Prior to construction activities, the applicant must contact TRPA at least 48 hours prior to commencing construction to arrange a pre-grading inspection. The inspection verifies that all erosion, stormwater, and water quality control measures and protective fencing are in place and are properly installed.

Furthermore, all construction projects on the California side of Lake Tahoe with greater than 1 acre of disturbance are required, by LRWQCB, to prepare a stormwater pollution prevention plan (SWPPP) that includes a site-specific Construction Site Monitoring and Reporting Plan pursuant to the National Pollution Discharge Elimination System 2011 Tahoe Construction Stormwater permit. In Nevada, projects are required to comply with NDEP's Stormwater General Permit, which also includes a requirement for the preparation and implementation of a SWPPP. Project SWPPPs are required to describe the site, construction activities, proposed erosion and sediment controls, means of waste disposal, maintenance requirements for temporary BMPs, and management controls unrelated to stormwater. Temporary BMPs to protect water quality would be required during all site development activities. Water quality controls outlined in a SWPPP would be required to be consistent with TRPA requirements. Controls would be required to ensure that runoff quality meets or surpasses TRPA water quality objectives and federal and state antidegradation policies, remains within the TRPA and LRWQCB discharge limits to surface water and groundwater sources, and maintains beneficial uses of Lake Tahoe. Stormwater quality sampling and reporting requirements outlined as a Construction Site Monitoring and Reporting Plan are also part of the SWPPP under the California permit and may also be a requirement in Nevada on a project-specific basis.

Some shorezone structures could require excavation beyond 5 feet in depth, as in the case of placement of landward pier footings. Groundwater is often shallow in the areas adjacent to a surface water and it is likely that groundwater would be intercepted. Excavation beyond 5 feet in depth would be evaluated on a project level basis. TRPA Code Section 33.3.6 allows excavation deeper than 5 feet in limited circumstances, provided that a soils/hydrologic report has been completed that demonstrates that the excavation will not interfere with or intercept groundwater, no damage occurs to mature trees or SEZ vegetation, excavated material is disposed of properly (as defined in Code Section 33.3.4), and the project site's natural topography is maintained.

Although Alternative 1 would permit grading, excavation, and ground disturbing activities in the shorezone, all future development pursuant to the proposed Shoreline Plan would be required to adhere to existing regulations and permit requirements, which reduce the potential for substantial soil erosion or loss of topsoil. Therefore, this impact would be **less than significant**.

Alternative 2: Maintain Existing TRPA Shorezone Regulations (No Project)

Alternative 2 would allow for the construction of 476 new piers, six new boat ramps, and two additional marinas allowed with a master plan. Alternative 2 would likely result in more intensive construction activities and more construction-related ground disturbance within the shorezone than Alternative 1 because of the greater number of structures and potential for development of new marinas. As described for Alternative 1, all future projects implemented through the existing TRPA shorezone regulations would be required to comply with the stringent permit conditions required by TRPA, LRWQCB or NDEP, and local codes. With enforcement of these protections, the potential for Alternative 2 to result in increased erosion or unstable soils would be **less than significant**.

Alternative 3: Limit New Development

Alternative 3 would allow for five new public piers, 86 new private piers, and one new boat ramp. This would result in a smaller amount of construction-related ground disturbance than Alternatives 1 and 2. As described for Alternative 1, all future projects implemented through the existing TRPA shorezone regulations would be required to comply with the stringent permit conditions required by TRPA, LRWQCB or NDEP, and local codes. With enforcement of these protections, the potential Alternative 3 to result in increased erosion or unstable soils would be **less than significant**.

Alternative 4: Expand Public Access and Reduce Existing Development

Alternative 4 only allows for the construction of 15 new public piers. This alternative would result in the least impact to the shorezone from construction because Alternative 4 allows for the fewest structures of any alternative. As described for Alternative 1, all future projects implemented through the existing TRPA shorezone regulations would be required to comply with the stringent permit conditions required by TRPA, LRWQCB or NDEP, and local codes. With enforcement of these protections, the potential Alternative 4 to result in increased erosion or unstable soils would be **less than significant**.

Mitigation Measures

No mitigation is required.

Impact 7-3: Long-term increases in shoreline erosion

All Shoreline Plan alternatives would allow development of new facilities in the shorezone; however, the potential for the operation of these facilities to increase shoreline erosion would be controlled through existing TRPA regulations and permit conditions. Implementation of Alternatives 1, 2, and 3 would result in increased watercraft use on Lake Tahoe and would expand access to portions of the shoreline that are undeveloped or difficult to access without watercraft. Alternative 4 would not result in an increase in boating activity. Depending on the location of the 15 public piers allowed by Alternative 4, there could be an increase in public access to areas that are currently difficult to access (e.g., if a public pier and associated upland facilities were constructed in undeveloped parkland). Notwithstanding this potential, there is no evidence to suggest that such increased use of remote areas would occur as a result of future shorezone projects, nor that use of such areas, if more accessible, would result in long-term increases in erosion of the shoreline. This impact would be **less than significant**.

Alternative 1: Proposed Shoreline Plan

Alternative 1 would result in an estimated 16 percent increase in annual boat trips, which would result in increased pedestrian activity in adjacent areas of the shorezone. Additionally, the increased number of motorized and nonmotorized watercraft on Lake Tahoe could increase recreational use of portions of the shorezone that are difficult to access from landside developments (such as the East Shore beaches). This increase in foot traffic and in the launching and beaching of watercraft at remote beaches could increase erosion and contribute to unstable soil conditions. Shorezone vegetation could be lost due to trampling and disturbance which could further destabilize shorezone soils.

The potential for increased erosion near permitted facilities would be reduced through compliance with existing TRPA code provisions and regulations. As described in Impact 7-2, only planned footpaths would be allowed in Shorezone Tolerance District 1 and projects in Districts 2 through 8 would be required to demonstrate that they will not accelerate or initiate backshore erosion and may be required to install and maintain stabilizing backshore vegetation. Also, projects permitted through the Shoreline Plan would be consistent with the TRPA Handbook, including shorezone specific BMPs. Finally, major structural repairs of permitted facilities would require TRPA verification that the project is not causing shoreline erosion (TRPA Code Section 82.4.4 (C)).

While the potential for increased erosion and loss of shorezone vegetation due to increased use of remote and undeveloped beach areas cannot be controlled by permit conditions or regulatory oversight, there is no evidence to suggest that a 16 percent increase in boating activity over the buildout period of the proposed Shorezone Plan would result in a substantial increase in use of remote beaches and shoreline areas, or that such use would substantially increase erosion of the shoreline over the long term. This would be a **less-than-significant** impact.

Alternative 2: Maintain Existing TRPA Shorezone Regulations (No Project)

Alternative 2 would result in an estimated 53 percent annual increase in the number of boat trips. As discussed for Alternative 1, the potential for the operation and maintenance of new facilities to result in increased erosion would be controlled by existing TRPA permit conditions and regulation. Like the proposed

Shoreline Plan, Alternative 2 would likely result in increased use of remote and undeveloped beaches, but to a greater degree given the much greater increase in boating activity over the buildout period. However, there is no evidence to suggest that the increase in boating activity would result in a substantial increase in use of remote beaches and shoreline areas, or that such use would substantially increase erosion of the shoreline over the long term. This would be a **less-than-significant** impact.

Alternative 3: Limit New Development

Alternative 3 would result in an estimated 4 percent annual increase in boat trips. As discussed for Alternative 1, the potential for the operation and maintenance of new facilities to result in increased erosion would be controlled by existing TRPA permit conditions and regulation. While the increase in boating activity of Alternative 2 over the buildout period is small, Alternative 2 could result in some increased use of remote and undeveloped beaches. This small increase over the buildout period is unlikely to result in any discernable change in levels of use at remote beaches and shoreline areas or degree of shoreline erosion. This would be a **less-than-significant** impact.

Alternative 4: Expand Public Access and Reduce Existing Development

Alternative 4 would allow for the construction of 15 new public piers. As discussed for Alternative 1, the potential for the operation and maintenance of new facilities to result in increased erosion would be controlled by existing TRPA permit conditions and regulation. Alternative 4 would not increase boating activity on Lake Tahoe, and therefore would not result in any increased access to, or use of remote and undeveloped beaches, and would not contribute to increased shoreline erosion. This would be a **less-than-significant** impact.

Mitigation Measures

No mitigation is required.

Impact 7-4: Potential for damage from liquefaction, settlement, tsunami, and seiche

The Shoreline Plan alternatives would permit structures in the shorezone that could be damaged during an earthquake from liquefaction in saturated sand deposits, settlement, tsunami, and seiche. The risk from seismic shaking would be controlled through compliance with the current seismic design requirements of the California Building Standards Code and the International Building Code. Alternatives 1, 2, and 3 would increase the number of boats that could be exposed to inundation by tsunami or seiche; however, while such an event could be catastrophic, the probability of occurrence in any given year, or over the coming decades is very low. The impact would be **less than significant**.

Alternative 1: Proposed Shoreline Plan

The installation of 128 new private piers, 10 new public piers, and two new boat ramps under the proposed Shoreline Plan would result in increased structures in the backshore which could expose people to risk of liquefaction, settlement, tsunami, and seiche while utilizing these structures. These structures and their users could be susceptible to earthquake damage. Additionally, the areas of the shorezone underlain by beach sands could be susceptible to liquefaction during seismic events. The risk to people and structures from seismic shaking would be controlled through compliance with the current seismic design requirements of the California Building Standards Code in California and the International Building Code in Nevada.

The addition of new private and public piers and boat ramps would increase the number of recreationalists to the shorezone area, which is at risk of inundation from a lake tsunami or seiche triggered by a large seismic event. A 2006 study by the U.S. Geological Survey found that between 7,000 and 15,000 years ago, a massive landslide in McKinney Bay on the west shore of Lake Tahoe dropped several cubic miles of the West Shore 1,500 feet to the bottom of the lake and likely generated enormous seiche waves (Moore et al. 2006). Scientists at the University of Nevada, Reno, seismological laboratory studied faults beneath Lake Tahoe and estimate the probability of a large event would be approximately 2–4 percent in the next 50 years (Ichinose et al. 2000). Therefore, while several major faults beneath the lake and in the Tahoe Region are considered active and capable of producing large magnitude earthquakes that could produce destructive

tsunamis and seiches, the probability of such an event in any given year, or in the foreseeable future, is extremely low. This impact would be **less than significant**.

Alternative 2: Maintain Existing TRPA Shorezone Regulations (No Project)

Alternative 2 includes the construction of 476 new piers, six new boat ramps, and up to two new marinas allowed with a master plan. As described for Alternative 1, The risk to people and structures from seismic shaking would be controlled through compliance with the current seismic design requirements of the California Building Standards Code in California and the International Building Code in Nevada. The increase in shorezone facilities would increase the number of people exposed to potential inundation by tsunami or seiche, but the probability of such an event in any given year, or in the foreseeable future, is extremely low. Therefore, this would be a **less-than-significant** impact.

Alternative 3: Limit New Development

Alternative 3 would allow for five new public piers, 86 new private piers, and one new boat ramp. As described for Alternative 1, The risk to people and structures from seismic shaking would be controlled through compliance with the current seismic design requirements of the California Building Standards Code in California and the International Building Code in Nevada. The increase in shorezone facilities would increase the risk to people exposed to potential inundation by tsunami or seiche, but the probability of such an event in any given year, or in the foreseeable future, is extremely low. Therefore, this would be a **less-than-significant** impact.

Alternative 4: Expand Public Access and Reduce Existing Development

Alternative 4 would allow for the construction of 15 new public piers. As described for Alternative 1, The risk to people and structures from seismic shaking would be controlled through compliance with the current seismic design requirements of the California Building Standards Code. Additionally, because Alternative 4 would balance the addition of public piers with removal of private piers, there would be little increase in the exposure to tsunami or seiche which, in any case, is a very low probability event. This impact would be **less than significant.**

Mitigation Measures

No mitigation is required.

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