3.7 GEOLGY, SOILS, LAND CAPABILITY AND COVERAGE

3.7.1 INTRODUCTION

This section evaluates the potential impacts to geology, soils, land capability and coverage associated with the implementation of the RTP/SCS alternatives. The analysis includes a description of existing conditions, a discussion of any changes in or to geologic conditions, relevant soil properties, and associated elements of land capability and coverage. Planning guidelines established by the Tahoe Regional Planning Agency (TRPA), local jurisdictions, and California Environmental Quality Act (CEQA) guidelines provide the regulatory background that allow for the assessment of potential environmental effects to these resources. Potential environmental effects related to water quality resulting from soil erosion and other stormwater issues are addressed in Section 3.8, Hydrology and Water Quality. Potential impacts of the proposed alternatives are analyzed, and mitigation measures are provided for those impacts determined to be significant. Cumulative impacts to geology, soils, land capability and coverage are addressed in Chapter 4, Cumulative Impacts.

None of the comment letters received on the Notice of Preparation included comments that pertain to Geology, Soils, Land Capability and Coverage within the Region.

3.7.2 REGULATORY BACKGROUND

Regulations protecting the soil resources in the Tahoe Region are enforced by TRPA, the Lahontan Regional Water Quality Control Board (RWQCB) (through water quality regulations), the Nevada Division of Environmental Protection (through water quality regulations), five counties (El Dorado, Placer, Washoe, Carson, and Douglas), and one incorporated city (City of South Lake Tahoe). Other regulations aid in the establishment of safe structures to ensure minimal, if any, impact on earth resources. The following discussion provides the background for applicable earth resource requirements in the Tahoe Region.

TAHOE REGIONAL PLANNING AGENCY

ENVIRONMENTAL THRESHOLD CARRYING CAPACITIES

TRPA has established threshold standards and indicators for nine resource areas: water quality, air quality, scenic resources, soil conservation, fish habitat, vegetation, wildlife, noise, and recreation. TRPA threshold standards are minimum standards of environmental quality to be achieved in the Tahoe Region. Every five years, TRPA evaluates the attainment status of all TRPA threshold standards. The 2011 Threshold Evaluation was completed in 2012 and is being used as the basis of threshold standard status in this EIR/EIS (TRPA 2012a).

TRPA has two soil conservation threshold standard indicator reporting categories, as follows:

- Land coverage (impervious cover) Threshold Standard to comply with allowable land coverage limitations established in the Land Capability Classification of the Lake Tahoe Basin. This threshold standard indicator reporting category consists of nine separate standards for the nine separate land capability classes.
- Stream environment zone (SEZ) Threshold Standard to restore 25 percent of the SEZ lands that have been identified as disturbed, developed or subdivided to attain a 5 percent increase in the area of naturally functioning SEZ lands.

The Tahoe Region’s status in 2011 was as follows for the soil conservation threshold standards:
WATER QUALITY MANAGEMENT PLAN

The Water Quality Management Plan for the Lake Tahoe Region (208 Plan) was prepared by TRPA in compliance with Section 208 of the federal Clean Water Act (CWA). The 208 Plan contains overlapping elements with the TRPA Regional Plan, including, the Handbook of Best Management Practices, the Stream Environment Zone Protection and Restoration Program, and the Capital Improvements Program for Erosion and Runoff Control. The 208 Plan identifies pollution sources, control needs, and management practices to improve water quality. The 208 Plan is scheduled to be updated after adoption of the Regional Plan Update to ensure that overlapping elements of the 208 Plan are consistent with the Regional Plan.

The 208 Plan management programs pertain to: urban runoff and erosion, airborne nutrients, waste management, natural area management, and water quality issues in Lake Tahoe and the shorezone. Programs are implemented through designated management agencies, including TRPA, the U.S. Forest Service, Lake Tahoe Basin Management Unit (USFS LTBMU), the Nevada Division of Environmental Protection, the California Regional Water Quality Control Board – Lahontan (LRWQCB), and local governments. To determine if water quality goals are attained and maintained, water quality programs require continuous scientific monitoring of environmental conditions related to the threshold standards for pelagic Lake Tahoe, littoral Lake Tahoe, tributary streams, surface runoff, groundwater, land coverage, and SEZs. TRPA publishes annual or semi-annual reports on monitoring program implementation and must evaluate the results at least every five years (LRWQCB 2011). For further information on the Water Quality Management Plan for the Lake Tahoe Region, water quality threshold standards, and the potential water quality impacts related to the Regional Plan Update, see Section 3.8, Hydrology and Water Quality.

REGIONAL PLAN

Several components of the Regional Plan address policies and regulations pertaining to geology, soils, land capability, and coverage: Goals and Policies, Code of Ordinances, and Water Quality Management Plan.

Goals and Policies
Goals and policies applicable to geology, soils, land capability, and coverage are included in several elements and subelements of the Goals and Policies document of the Regional Plan. The Natural Hazards Subelement

<table>
<thead>
<tr>
<th>Land Coverage</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land Capability District 1a</td>
<td>Considerably Better than Target</td>
</tr>
<tr>
<td>Land Capability District 1b</td>
<td>Considerably Worse than Target</td>
</tr>
<tr>
<td>Land Capability District 1c</td>
<td>Somewhat Better than Target</td>
</tr>
<tr>
<td>Land Capability District 2</td>
<td>Somewhat Better than Target</td>
</tr>
<tr>
<td>Land Capability District 3</td>
<td>Considerably Better than Target</td>
</tr>
<tr>
<td>Land Capability District 4</td>
<td>Considerably Better than Target</td>
</tr>
<tr>
<td>Land Capability District 5</td>
<td>Considerably Better than Target</td>
</tr>
<tr>
<td>Land Capability District 6</td>
<td>Considerably Better than Target</td>
</tr>
<tr>
<td>Land Capability District 7</td>
<td>Somewhat Better than Target</td>
</tr>
<tr>
<td>Stream Environment Zone Restoration</td>
<td>Considerably Worse than Target</td>
</tr>
</tbody>
</table>

Source: TRPA 2012a
addresses risks from natural hazards (e.g., flood, fire, avalanche, earthquake). Specifically, Goal 1, Policy 2 prohibits new construction on, or disturbance of land within the 100-year floodplain and in the area of wave run-up except as necessary to implement the goals and policies of the plan; and requires all public utilities, transportation facilities, and other necessary public uses located in the 100-year floodplain and area of wave run-up to be constructed or maintained to prevent damage from flooding and to not cause flooding. The Water Quality Subelement includes goals to reduce loads of sediment and algal nutrients to Lake Tahoe; meet sediment and nutrient objectives for tributary streams, surface runoff, and subsurface runoff; and restore 80 percent of the disturbed lands and specifies that the implementation of best management practices (BMPs) shall be required as a condition of approval for all projects. The Soils Subelement addresses soil erosion and loss of soil productivity through policies pertaining to coverage, including allowable coverage for categories of land uses in specific land capability districts (LCDs). This subelement also addresses special regulations regarding construction and soil disturbing activities occurring between October 15 and May 1.

Goals and policies of the Regional Plan that are related to erosion and coverage are located in the Conservation Element.

▲ **SOILS GOAL 1:** Minimize soil erosion and the loss of soil productivity.

- **Policy 1.** Allowable impervious land coverage shall be consistent with the Threshold Standard for impervious land coverage.

- **Policy 2.** No new land coverage or other permanent disturbance shall be permitted in land capability districts 1-3 except for those uses as noted in a, b, and c below:
  a) Single family dwellings may be permitted in land capability districts 1-3 when reviewed and approved pursuant to the Individual Parcel Evaluation System (IPES). (See Goal #1, Policy 2, Development and Implementation Subelement).
  b) Public outdoor recreation facilities may be permitted in land capability districts 1-3 if:
     1) The project is a necessary part of a public agency’s long range plans for public outdoor recreation;
     2) The project is consistent with the recreation element of the Regional Plan;
     3) The project by its very nature must be sited in land capability districts 1-3;
     4) There is no feasible alternative which avoids or reduces the extent of encroachment in land capability districts 1-3;
     5) The impacts are fully mitigated; and
     6) Land capability districts 1-3 lands are restored in the amount of 1.5 times the area of land capability districts 1-3 which is disturbed or developed beyond that permitted by the Bailey coefficients.
  c) Public service facilities are permissible uses in land capability districts 1-3 if:
     1) The project is necessary for public health, safety or environmental protection;
     2) There is no reasonable alternative, which avoids or reduces the extent of encroachment in land capability districts 1-3;
     3) The impacts are fully mitigated; and
     4) Land capability districts 1-3 lands are restored in the amount of 1.5 times the area of land capability districts 1-3 which is disturbed or developed beyond that permitted by the Bailey coefficient.

- **Policy 6.** Grading, filling, clearing of vegetation (which disturbs soil), or other disturbances of the soil are prohibited during inclement weather and for the resulting period of time when the site is covered with snow or is in a saturated, muddy, or unstable condition. Special regulations and construction techniques will apply to all construction activities occurring between October 15 and May 1.
Code of Ordinances

The TRPA Code consists of ordinances needed to implement the Goals and Policies. The following TRPA ordinances are most relevant to the geology, soils, and land capability and coverage aspects of the RTP/SCS.

Chapter 30 – Land Coverage Standards

Since the late 1970s, TRPA has used the land capability classification system known as the Bailey System (Land-Capability Classification of the Lake Tahoe Basin, California-Nevada: A Guide to Planning [Bailey 1974]) to guide land use planning, policy formulation related to the impacts of development on soil erosion and permitting of development. The Bailey System was developed as a threat assessment and planning tool to identify and mitigate adverse impacts to water quality and stream systems that occur from surface runoff and erosion related to development. The Bailey system is the basis of the land coverage standards and limitations set forth in Chapter 30 of the TRPA Code of Ordinances.

Coverage is defined by TRPA as a human-built structure or other impervious surface that prevents normal precipitation from directly reaching the surface of the land underlying the structure, therefore precluding or slowing the natural infiltration of water into the soil (Chapter 90 of the Code). TRPA further defines coverage as impervious surface (hard coverage) or compacted soil (soft coverage). Research has established the connection between impervious surfaces and water quality. Specifically, coverage may affect water quality as it reduces the amount of soil available to infiltrate water and has the potential to result in surface runoff, erosion and delivery of pollutants to receiving waters.

To determine the level of coverage that would be appropriate in the Region, TRPA adopted the Bailey Land Classification system (Bailey 1974). The system assigns land capability districts (LCDs) based primarily on soil characteristics¹ 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 (see Table 3.7-2). 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. New development is allowed in LCDs 4 through 7, and largely prohibited in LCDs 1 through 3 with limited exceptions; particularly in 1b / SEZ. Exceptions for all LCDs 1 through 3 include development related to public outdoor recreation facilities and water quality control facilities. Exceptions are also identified for single-family development under the

<table>
<thead>
<tr>
<th>Capability Levels</th>
<th>Tolerance for Use</th>
<th>Slope Percent</th>
<th>Relative Erosion Potential</th>
<th>Runoff Potential</th>
<th>Disturbance Hazards</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Most</td>
<td>0-5</td>
<td>Slight</td>
<td>Low to moderately low</td>
<td>Low hazard</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>0-16</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>0-16</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>9-30</td>
<td>Moderate</td>
<td>Low to moderately low</td>
<td>Moderate hazard lands</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>9-30</td>
<td></td>
<td>Moderately high to high</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>30-50</td>
<td>High</td>
<td>Low to moderately low</td>
<td>High hazard lands</td>
</tr>
<tr>
<td>1a</td>
<td>Least</td>
<td>30+</td>
<td>High</td>
<td>Moderately high to high</td>
<td></td>
</tr>
<tr>
<td>1b</td>
<td>(Poor Natural Drainage)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1c</td>
<td>(Fragile Flora and Fauna)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Bailey 1974

¹ TRPA currently relies upon the Soil Survey of Tahoe Basin, California-Nevada (Rogers and Soil Conservation Service, 1974), which the Bailey Land Capability system is predicated upon. The NRCS 2007 Soil Survey has not yet been formally adopted by TRPA for use with land capability matters.
Table 3.7-3. Characteristics of Lands by Land Capability District and Suitable Uses Based on Relative Tolerance Levels

<table>
<thead>
<tr>
<th>Land Capability District</th>
<th>General Characteristics</th>
<th>Intensity of Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>LCDs 5-7 (Low hazard lands)</td>
<td>Areas of gently sloping foothills and plains with deep soils.</td>
<td>Generally suited for various development activities as well as for concentrated public occupancy. Access should be high-standard roads and trails. May support most kinds of intensive or mass recreational uses. Facilities include campgrounds, recreation residences, hotels, and resorts or other commercial services where it does not destroy other values.</td>
</tr>
<tr>
<td>LCDs 3 and 4 (Moderate hazard lands)</td>
<td>Characterized by moderately steep mountain slopes. Often provide visual backdrops for low hazard areas.</td>
<td>Recreation use may be varied and concentrated, including campgrounds, picnic areas, and winter sport sites. Access should be by low standard roads and trails. Low-density housing may be permitted, as well as limited forestry.</td>
</tr>
<tr>
<td>LCD 2 High hazard lands</td>
<td>Characterized by steep slopes and a fragile environmental balance with unique plants and animals. Also provide backdrops and foregrounds for surrounding areas.</td>
<td>Suited for limited recreation, restricted grazing, and selective timber harvest due to erosion hazard or very steep slopes. Should remain generally in their natural condition. Access facilities should be restricted to foot and horse trails. Recreation use should be dispersed and limited to hiking, backcountry camping, and fishing. These lands should not be managed for intensive commercial resource use.</td>
</tr>
<tr>
<td>LCD 1 High hazard lands</td>
<td>Includes mountaintops with little to no soil mantle, and very steep slopes with shallow soils. Subclasses (i.e., 1a, 1b, 1c) include marshes, flood plains, meadows, and beaches.</td>
<td>Some of the uses under LCD 2 apply to LCD 1 as well. However, LCD 1 areas are not suitable for development, grazing, or forestry. LCD 1 areas have value for wildlife, recreation, and protection of water supplies.</td>
</tr>
</tbody>
</table>

Source: Data compiled by Ascent from Bailey 1974

Individual Parcel Evaluation System (IPES) and Tyrolian Village in LCDs 1a, 1c, 2, and 3. Stream crossings to access an otherwise-buildable IPES parcel may also be allowed. In most instances, new coverage in LCDs 1-3 must be mitigated at a ratio of 1.5:1 (mitigation to impact). The characteristics and intensity of uses for each LCD (also known as land capability level, or class) are also defined (Table 3.7-3). Under this system, TRPA allows each parcel of land to be covered with between 1 percent and 30 percent of impervious surface depending on the Bailey classification (Table 3.7-4).

Table 3.7-4. Tahoe Regional Planning Agency Base Land Coefficients

<table>
<thead>
<tr>
<th>Land Capability District (LCD)</th>
<th>Allowable Base Percent of Land Coverage</th>
</tr>
</thead>
<tbody>
<tr>
<td>6, 7</td>
<td>30</td>
</tr>
<tr>
<td>5</td>
<td>25</td>
</tr>
<tr>
<td>4</td>
<td>20</td>
</tr>
<tr>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>1a, 1b, 1c</td>
<td>1</td>
</tr>
</tbody>
</table>

The land coverage strategies and regulations in place under the 1987 Regional Plan are summarized below.

**Base Allowable Coverage.** Implements land coverage limitations based on the seven LCDs established by Bailey (1974), as presented in Table 3.7-4. These districts are planning-level delineations that require field verification; they may be challenged and revised based on certain site-specific land capability data.

**Maximum Allowable Coverage.** Implements limitations on maximum allowable land coverage (base allowable plus transferred) based on land use type and designation. The maximum allowable coverage limitations are depicted in Table 3.7-5. For redevelopment of commercial facilities on developed parcels within Community Plans, per Section 30.3.B(2), the maximum allowable coverage is 50 percent on LCDs 4-7. For commercial facilities proposed on vacant lands within Community Plans, the maximum allowable coverage is 70 percent coverage on LCDs 4-7. Allowable coverage within Community Plan areas is 50 percent on LCDs 4-7 for TAU's (5 units for more), public service, and recreation uses (Section 30.3.B[3]). Allowable coverage for residential facilities (1 to 4 units), per Section 30.3.B(1), is based on a sliding scale depending on the location of the project. Allowable coverage outside of Community Plan areas would range from 1 to 30 percent per the Bailey system (Table 3.7-4).

Linear Public Service Facilities are public service facilities that are linear in nature, such as roads, streets, trails, utility transmission and distribution facilities and other similar right-of-ways. This also includes accessory uses to such facilities, including pump houses, lift stations, substations, and success right-of-ways. The maximum land coverage (base allowable plus transferred) for linear public facilities and public health and safety facilities (Section 30.3.B[4]) is limited to the minimum amount needed to achieve their public purpose, provided TRPA makes the following findings:

1. The project is on the list of additional public service facilities if required pursuant to Section 50.7 [required findings for TRPA approval of additional public service facilities];
2. There is no feasible alternative that would reduce land coverage;
3. The project, because of its unusual configuration or service requirement, requires special consideration; and
4. The facility primarily serves the needs of persons other than those who are, or will be, residents of the lands in question, or the owners of the land in question.

<table>
<thead>
<tr>
<th>Land Use Type -----------------------------</th>
<th>Within Community Plans</th>
<th>Outside Community Plans</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commercial Facilities on an existing developed Parcel</td>
<td>50%</td>
<td></td>
</tr>
<tr>
<td>Commercial Facilities on a legal vacant lot of record at time of 1982 Plan adoption</td>
<td>70%</td>
<td></td>
</tr>
<tr>
<td>Tourist Accommodation Facilities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multi-Residential (five or more units)</td>
<td>50%</td>
<td></td>
</tr>
<tr>
<td>Public Service Facilities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recreation Facilities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Linear Public Facilities and Public Health and Safety Facilities</td>
<td>Minimum amount necessary to achieve their public purpose</td>
<td></td>
</tr>
<tr>
<td>Water Quality Control Facilities</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The land coverage for water quality control facilities (Section 30.3.B[8]), such as erosion control projects, habitat restoration projects, wetland rehabilitation projects, stream environment zone restoration projects and similar projects, programs and facilities, that may be permitted is no more than the minimum amount of land coverage needed to achieve their purpose provided there is no reasonable alternative, including relocation, which avoids or reduces the land coverage.

**Eligible Coverage Transfers.** Allows unused allowable base coverage (i.e., potential coverage), soft coverage, and hard coverage to be transferred within hydrologically related areas. (Note: potential and soft coverage may not be transferred to commercial facilities and tourist accommodation uses located in Community Plans.)

**Coverage Transfer Ratios.** Implements a 1:1 ratio for land coverage transfers for all land use types, except for commercial uses in Community Plans. For such uses, 30 to 50% coverage has a transfer ratio of 1:1, while 50 to 70% land coverage has a progressive transfer ratio that rises proportionally from 1:1 to 2:1.

**Coverage Transfer Requirements.** Requires that a parcel or project area receiving a transfer of land coverage be located in the same hydrologically related area (i.e., hydrologic transfer area) as the sending parcel.

**Permissible Uses on Sensitive Lands.** Limits uses on sensitive lands (LCDs 1–3) to public outdoor recreation projects, public service facility projects, and single-family dwellings that meet certain conditional use requirements.

**Sensitive Land Mitigation.** Implements a sensitive lands mitigation program that requires new coverage in LCDs 1a, 1c, 2, and 3 exceeding allowable base coverage to be mitigated by restoring existing hard or soft coverage on sensitive lands at a mitigation-to-impact ratio of 1.5:1, and that requires all new coverage and disturbance in LCD 1b to be mitigated by restoring or enhancing these lands at a mitigation-to-impact ratio of 1.5:1.

**Excess-Coverage Mitigation.** To address the problem of existing coverage in excess of the Bailey coefficients, the amount at which certain land capabilities can be covered, TRPA developed the “Excess Land Coverage Mitigation Program.” It applies to property owners whose property contained more than their allocated amount of coverage in 1987 (i.e., over-coverage). Property owners may retain this over-coverage as long as they do not implement a project requiring a permit from TRPA. However, property owners that seek any type of a TRPA permit must reduce excess coverage, either on-site or off-site, or pay an over-coverage mitigation fee for every square foot of coverage beyond the limit allowed by their land capability. Fees go to the California Tahoe Conservancy and the Nevada Division of State Lands, which use the proceeds to purchase and retire other properties, preventing the creation of additional coverage that would otherwise be allowed, and, in some cases, remove existing coverage.

**Chapter 60 – Water Quality**
Chapter 60 of the TRPA Code of Ordinances sets forth requirements for installation of best management practices (BMPs) for the protection or restoration of water quality and attainment of minimum discharge standards. Projects shall comply with temporary and permanent BMP programs as a condition of project approval.

**Chapter 53 – Individual Parcel Evaluation System**
Chapter 53 of the Code establishes the IPES and related procedures, in accordance with the 1987 Regional Plan Implementation Element (Development and Implementation Priorities, Goal 1, Policy 1). In accordance with Chapter 53, vacant residential parcels within the Region are evaluated, assigned a numerical IPES score, and ranked within each local jurisdiction from most suitable to least suitable for development.

IPES was developed and implemented to respond to the inability to construct new single-family dwellings on sensitive lands (LCDs 1–3). IPES was created through a consensus process and applies to all new single-family
residential development from May 27, 1987, onward. The ability to develop on what would be the equivalent of LCDs 1–3, or sensitive lands, is based on the determination that the local jurisdiction has met numerous other environmental criteria (e.g., the retirement of a specified percentage of sensitive parcels, installation of water quality improvements) that collectively provide enough environmental improvements to offset any impacts. IPES further differs from the Bailey System in that it examines a host of site-specific soil and parcel development criteria and can result in allowable coverage ranging from 1 to 30 percent. Although, at the individual parcel level, allowable coverage under IPES may differ from the Bailey System, the two systems are intended to be equivalent when considered in the aggregate and therefore to meet the coverage Threshold Standard criteria.

TRPA Code 30.4.2.A.1 specifies the maximum amount of coverage (base plus transferred) allowed on residential parcels up to four units. Under this provision, additional coverage may be allowed on the IPES parcel that would be the equivalent of Bailey LCDs 1 through 3.

**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, due to such conditions as exposed soils, unstable earthworks, or groundwater interference.

Section 33.3 describes TRPA’s requirements for grading and construction schedules for certain projects. Submittal and approval of grading and construction schedules may be required, as a condition of approval, for projects presenting special problems with regard to project completion, site development or water quality management, such as crossings of stream environment zones, major earthworks, or major clearing projects.

Chapter 33.4 of the TRPA Code of Ordinances provides for special investigations, reports, and plans, as part of an application or as a condition of project approval as determined to be necessary by TRPA to protect the environment against significant adverse effects from grading projects. The report shall provide information sufficient to determine the grading’s effect on stability, groundwater, or antiquities.

Section 33.4.1 lists the following locations that may be grounds for requiring subsurface investigations and reports:

- fault zones;
- contact zones between two or more geologic formations;
- zones of trapped water or high water tables;
- areas where bodies of intrusive materials, such as rocks or boulders, are prevalent;
- historic landslide areas or where the topography indicates prehistoric landslides;
- adversely-sloped bedding planes, short-range folding areas, overturned folds, fractures, and other geologic formations of similar importance;
- proposed or existing fill slopes above a cut slope;
- proposed or existing cuts exceeding 20 feet in height, unless in competent rock;
- proposed or existing fills exceeding 20 feet in height;
- areas where groundwater from either the grading or adjoining parcels is likely to reduce substantially the subsurface stability;
- areas showing characteristics of seeped soils or areas of water influence; or
- areas in the vicinity of historic resources, as identified by TRPA Historic Resource map, or in other locations where antiquities could be located.
Plan Area Statements and Community Plan
Chapter 11 of the Code, Plan Area Statements (PASs) and Plan Area Maps, requires that all projects and activities be consistent with the provisions of a particular area’s applicable PAS. The Region is divided into 175 separate plan areas. Each PAS is designated as one of five land use classifications: conservation, recreation, residential, commercial and public service, or tourist; and, one of three management strategies; maximum regulations, development with mitigation, or redirection of development.

Community Plans are developed for specific urbanized areas, which are designated in the Goals and Policies document. Community Plans replace the PAS for the areas within the Community Plan boundaries, and may apply more stringent regulations to a variety of topic areas, including: density of use, noise, driveway and parking, outdoor advertising, historic resources protection, and design. Preparation of a Community Plan includes goal refinement, assessment of environmental opportunities and limitations, preparation of environmental compliance documents, and certification by TRPA.

FEDERAL

NATIONAL EARTHQUAKE HAZARDS REDUCTION ACT

The National Earthquake Hazards Reduction Act was passed to reduce the risks to life and property resulting from earthquakes. To accomplish this, the act established the National Earthquake Hazards Reduction Program (NEHRP). The mission of NEHRP includes improved understanding, characterization, and prediction of hazards and vulnerabilities; improved building codes and land use practices; risk reduction through post-earthquake investigations and education; development and improvement of design and construction techniques; improved mitigation capacity; and, accelerated application of research results. The NEHRP designates the Federal Emergency Management Agency (FEMA) as the lead agency of the program and assigns several planning, coordinating, and reporting responsibilities. Other NEHRP agencies include the National Institute of Standards and Technology, National Science Foundation, and the U.S. Geological Survey (USGS).

STATE

CALIFORNIA

California Tahoe Conservancy
The mission of the California Tahoe Conservancy (CTC) is to preserve, protect, restore, enhance and sustain the unique and significant natural resources and recreational opportunities of the Lake Tahoe Region (California Government Code - Title 7.42 Sections 66905. to 66908.3). CTC’s jurisdiction extends throughout the California side of the Lake Tahoe Region, as defined in California Government Code Section 66905.5. In 1987, CTC authorized staff to develop and implement a Land Coverage (Land Bank) Program. Through this program, CTC acquires properties eligible for purchase through willing sellers. The development potential on these properties is retired. All rights and credits acquired by CTC are stored in a Land Bank. Through a Memorandum of Understanding (MOU) with TRPA, CTC is authorized to receive disbursements of TRPA excess coverage mitigation fees to perform coverage reduction through its Land Bank (TRPA/CTC, 1988). The MOU also authorizes CTC to sell coverage rights on the open market and conduct SEZ restoration or mitigation for private or public service projects through the Land Bank.

The benefits of CTC’s Land Coverage Program include: acquisition and restoration of developed areas that have become degraded and that are, or have the potential to, contribute to water quality problems; protecting land prior to the development activities generating the need for mitigation; ongoing management to ensure that resource benefits are sustained; assisting property owners in complying with regional land coverage policies so
they may construct or rehabilitate homes and businesses; and simplifying and expediting public and private projects.

**Alquist-Priolo Earthquake Fault Zoning Act**

The Alquist-Priolo Earthquake Fault Zoning Act (Alquist-Priolo Act) (Public Resources Code Sections 2621–2630) 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, the intersection of a fault with the ground surface, 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 distributed to all affected cities, counties, and state agencies for their use in planning efforts. Before a project can be permitted in a designated Alquist-Priolo Earthquake Fault Zone, cities and counties must require a geologic investigation to demonstrate that proposed buildings would not be constructed across active faults.

**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 the lead agency for a project may withhold development permits until geologic or soils investigations are conducted for specific sites and mitigation measures are incorporated into plans to reduce hazards associated with seismicity and unstable soils.

**National Pollutant Discharge Elimination System Permit**

In California, the State Water Resources Control Board (SWRCB) administers regulations promulgated by the U.S. Environmental Protection Agency (55 Code of Federal Regulations [CFR] 47990) requiring the permitting of stormwater-generated pollution under the National Pollutant Discharge Elimination System (NPDES). In turn, the SWRCB’s jurisdiction is administered through nine regional water quality control boards. Under these federal regulations, an operator must obtain a General Permit through the NPDES Stormwater Program for all construction activities with ground disturbance of one acre or more. The General Permit requires the implementation of best management practices (BMPs) to reduce sedimentation into surface waters and control erosion. One element of compliance with the NPDES permit is preparation of a Storm Water Pollution Prevention Plan (SWPPP) that addresses control of water pollution, including sediment, in runoff during construction. (See Section 3.8, Hydrology and Water Quality, for more information about the NPDES and SWPPPs.)

**Water Quality Control Plan for the Lahontan Region**

Water quality standards and control measures for surface and ground waters of the Lahontan Region are contained in the Water Quality Control Plan for the Lahontan Region (LRWQCB 1995). The 208 Plan designates beneficial uses for water bodies. It establishes water quality objectives, waste discharge prohibitions, and other implementation measures to protect those beneficial uses.

Chapter 5 of the 208 Plan, Water Quality Standards and Control Measures for the Lake Tahoe Basin, summarizes a variety of control measures for the protection and enhancement of Lake Tahoe, which in many cases are more stringent than those applicable elsewhere in the Lahontan Region. Implementation of the 208 Plan is a bistate, interagency effort. Many of the control measures can best be implemented by local governments or the Tahoe Regional Planning Agency, but the LRWQCB and SWRCB are ultimately responsible for implementation. To the extent that other agencies do not make and fulfill implementation commitments, the Regional Board will carry out these control measures. Similar control measures are being implemented by TRPA and the Nevada Division of Environmental Protection in Nevada. Elements of the 208 Plan relevant to Geology, Soils, Land Capability and Coverage are as follows.
**Best Management Practices:** Use of best management practices (BMPs) is mandatory for all new development, must be retrofitted for existing development, and is required for resource management uses (e.g., timber harvest, livestock grazing).

**Land Coverage Restrictions:** The land capability system limits the amount of allowable impervious surface coverage, especially on high erosion hazard lands and in SEZs. This element contains limited exceptions for public projects, coverage transfer, and coverage relocation.

**Roads and Rights-of-Way:** RWQCB permits implement controls for issues related to erosion from new and existing roads, road maintenance activities, and snow and ice control.

**California Building Standards Code**
The state of California provides minimum standards for building design through the California Building Standards Code (California Code of Regulations, Title 24). Where no other building codes apply, Chapter 29 regulates excavation, foundations, and retaining walls. The California Building Standards Code (CBC) applies to building design and construction in the state and is based on the federal Uniform Building Code (UBC) used widely throughout the country (generally adopted on a state-by-state or district-by-district basis). The CBC has been modified for California conditions with more detailed and/or more stringent regulations.

The state earthquake protection law (California Health and Safety Code Section 19100 et seq.) requires that structures be designed to resist stresses produced by lateral forces caused by wind and earthquakes. 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, and Chapter 33 regulates grading activities, including drainage and erosion control and construction on unstable soils, such as expansive soils and areas subject to liquefaction.

**NEVADA**

**Nevada Division of State Lands**
The Nevada Division of State Lands (NDSL) leads the state's programs to protect Lake Tahoe. NDSL 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 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 not available for development or disposal. Management goals include clean water, healthy forests, the reduction of excess fire fuels and hazardous forest conditions, good wildlife habitat, and reasonable public access.

**Nevada Division of Environmental Protection**
The Bureau of Water Quality Planning (BWQP) is part of the Nevada Division of Environmental Protection (NDEP) and is responsible for several water quality protection functions in the state of Nevada. These include collecting and analyzing water data, developing standards for surface waters, publishing informational reports, providing water quality education, and implementing programs to address surface water quality. The BWQP is also responsible for two certification programs. BWQP is divided into three branches: water quality standards, monitoring and nonpoint sources, and ground water protection. (See Section 3.8, Hydrology and Water Quality, for more information about the BWQP.)
LOCAL

CITY OF SOUTH LAKE TAHOE CITY CODE

Drainage Requirements for Building Construction
Chapter 8-6 of the City Code establishes administrative procedures, minimum standards of review, implementation, and enforcement procedures for controlling erosion, sedimentation, and other pollutant runoff. This includes regulation of construction debris and hazardous substances used on construction sites, disruption of existing drainage, and related environmental damage caused by land clearing and grubbing, grading, filling, and land excavation activities.

Grading, Erosion and Sediment Control
Chapter 36 of the City Code provides regulations for grading on both public and private property in the City to ensure safety, to avoid pollution of watercourses with hazardous materials, nutrients, sediments, or other earthen materials, and to ensure consistency with the City’s General Plan and other applicable plans. The chapter also outlines the requirements and process for acquiring a grading permit including the preparation of grading plans and geotechnical investigations. Sections 36-46 through 36-51 provide design standards for excavations and fill placement, compaction, and slopes. Section 36-58 provides specific requirements to control erosion and sediment.

EL DORADO COUNTY GENERAL PLAN

The El Dorado County General Plan (2004) contains the following goals, objective, and policies relevant to geology, soils, and seismicity.

Soil Conservation
▲ GOAL 7.1.: Soil Conservation

◆ Objective 7.1.1: Soils. Long-term productivity.
  ▼ Policy 7.1.1.1. Conserve and maintain soils for existing and potential agricultural and forest uses by limiting non-agricultural/non-forestry development on those soils.

◆ Objective 7.1.2: Erosion/Sedimentation. Minimize soil erosion and sedimentation.
  ▼ Policy 7.1.2.1. Development or disturbance shall be prohibited on slopes exceeding 30 percent unless necessary for access. The County may consider and allow development or disturbance on slopes 30 percent and greater when:
    — Reasonable use of the property would otherwise be denied.
    — The project is necessary for the repair of existing infrastructure to avoid and mitigate hazards to the public, as determined by a California registered civil engineer or a registered engineering geologist.
    — Replacement or repair of existing structures would occur in substantially the same footprint.
    — The use is a horticultural or grazing use that utilizes “best management practices (BMPs)” recommended by the County Agricultural Commission and adopted by the Board of Supervisors.

Access corridors on slopes 30 percent and greater shall have a site specific review of soil type of soil type, vegetation, drainage contour, and site placement to encourage proper site selection and mitigation. Septic systems may only be located on sloped under 30 percent. Roads needed to complete circulation/access and for emergency access may be constructed on such cross sloped if all other standards are met.
Policy 7.1.2.2. Discretionary and ministerial projects that require earthwork and grading, including cut and fill for roads, shall be required to minimize erosion and sedimentation, conform to natural contours, maintain natural drainage patterns, minimize impervious surfaces, and maximize the retention of natural vegetation. Specific standards for minimizing erosion and sedimentation shall be incorporated into the Zoning Ordinance.

Policy 7.1.2.3. Enforce Grading Ordinance provisions for erosion control on all development projects and adopt provisions for ongoing, applicant-funded monitoring of project grading.

EL DORADO COUNTY GRADING, EROSION, AND SEDIMENT CONTROL ORDINANCE

El Dorado Ordinance Chapter 15.14, Grading, Erosion, and Sediment Control (El Dorado County 2007a), regulates grading within the unincorporated area of El Dorado County by establishing administrative procedures for issuance of permits and provides for approval of plans and inspection of grading construction. Tahoe Basin specific regulations are contained in Section 15.14.150 and in the Tahoe Basin Special Conditions Section (Section E.6 Vol III) of the El Dorado County Grading Design Manual (El Dorado County 2007b).

PLACER COUNTY GENERAL PLAN

The Placer County General Plan (1994) contains goals, policies, and implementation programs in the Health and Safety Section that are aimed at reducing seismic and geological hazards. The goals, policies, and implementation programs applicable to the proposed plan are described below:

Seismic and Geological Hazards

GOAL 8.A.: To minimize the loss of life, injury, and property damage due to seismic and geological hazards.

Policy 8.A.1. The County shall require the preparation of a soils engineering and geologic-seismic analysis prior to permitting development in areas prone to geological or seismic hazards (i.e., groundshaking, landslides, liquefaction, critically expansive soils, avalanche).

Policy 8.A.2. The County shall require submission of a preliminary soils report, prepared by a registered civil engineer and based upon adequate test borings, for every major subdivision and for each individual lot where critically expansive soils have been identified or are expected to exist.

Policy 8.A.9. The County shall require that the location and/or design of any new buildings, facilities, or other development in areas subject to earthquake activity minimize exposure to danger from fault rupture or creep.

Policy 8.A.10. The County shall require that new structures permitted in areas of high liquefaction potential be sited, designed, and constructed to minimize the dangers from damage due to earthquake-induced liquefaction.

PLACER COUNTY BUILDING AND DEVELOPMENT ORDINANCES

Placer County Code Article 15.48, “Grading, Erosion and Sediment Control,” contains ordinances enacted for the purpose of regulating grading on property within the unincorporated area of Placer County to safeguard life, limb, health, property and public welfare; to avoid pollution of watercourses with hazardous materials, nutrients, sediments, or other earthen materials generated on or caused by surface runoff on or across the permit area; and to ensure that the intended use of a graded site is consistent with the Placer County General Plan, any specific plans, and applicable Placer County ordinances, including the zoning ordinance, flood damage prevention ordinance (Article 15.52), environmental review ordinance (Chapter 18, Placer County Code), and applicable chapters of the California Building Code.
CARSON CITY

There are no relevant regulations related to geology, soils, and land capability and coverage in Carson City.

DOUGLAS COUNTY MASTER PLAN

The Douglas County Master Plan (2007), Conservation Element, contains the following goals and policies relevant to geology, soils, and seismicity.

Geology/Seismic

▲ GOAL 5.01.: To minimize danger and damage to county residents from natural hazards due to seismic activity, liquefaction, and other geologic hazards.

◆ Policy 5.01.03. Require site specific soils and geologic studies to assess natural and graded slope stability for development proposed in areas which may have moderate to high potential for landsliding, erosion, or other soil or geologic instability and require mitigation through setbacks, special foundation design, etc.

▲ GOAL 5.02.: To minimize hillside development densities, locations, and project designs in order to minimize impacts on the county’s natural resources and aesthetic character, and to protect future residents from safety hazards.

◆ Policy 5.02.06. Erosion control and slope stability measures shall be included within development guidelines and shall consider such things as lifecycle maintenance costs.

DOUGLAS COUNTY BUILDING AND DEVELOPMENT ORDINANCES

Douglas County Consolidated Development Code Title 20, Chapter 20.690, Property Development Standards, contains provisions related to grading activities in hillside areas with slopes of 15% or greater and having a minimum vertical rise of at least 30 feet. Chapter 20.690, Section K(4) requires that a slope analysis and a grading plan, prepared by a Nevada registered professional engineer, be submitted to the Community Development Department for review and approval. The grading plan must include data on proposed slopes, drainage patterns, storm water detention, and cross-section exhibits showing preliminary cut-and-fill areas. An applicant must also submit an erosion control and re-vegetation plan prepared by a Nevada licensed landscape architect, registered forester, or civil engineer. Chapter 20.690, Section K(6) set forth Douglas County grading standards that apply in hillside areas.

WASHOE COUNTY MASTER PLAN

The Washoe County Master Plan, Conservation Element (2010a) outlines constraints on development from soils, erosion hazards, building limitations, topography, earthquake hazards, landslides, and other hazards. The Washoe County Master Plan, Tahoe Area Plan is intended to serve as a guide for the Board of County Commissioners, the Washoe County Planning Commission, and the community on matters of growth and development within the Tahoe planning area. Applicable goals and policies from the Conservation Element are as follows.
Land Resources

GOAL Five: Regulate development in hillside and mountainous areas to mitigate drainage, erosion, siltation, and landslide problems.

Policy C.5.2. Slope management strategies for slopes between 15 and 30 percent will ensure that:

- Development on such slopes incorporates on-site and off-site mitigation measures for impacts to habitat and water quality, and for fiscal effects associated with higher-than-normal costs of infrastructure, public safety facilities, and public safety services;
- Recharge areas are protected; and
- Activities comply with the terms of NPDES permits.

Washoe County Development Code

The Washoe County Development Code (Washoe County 2010b) regulates the subdivision and development of land, and the use of land and structures. Article 424, Hillside Development, establishes provisions for developing, preserving, and protecting hillsides and ridgelines within Washoe County, while also protecting public health, safety, and welfare. Article 438, Grading Standards, sets forth rules and regulations to control grading on private and public property.

3.7.3 Affected Environment

Geology and Soils

Geologic Conditions

The Lake Tahoe Region is located in the Sierra Nevada Range geomorphic province. The Sierra Nevada is a tilted fault block with a gentle western slope and a steep, rugged eastern escarpment. It runs through eastern California, from the Mojave Desert in the south to the Cascade Range and Modoc Plateau on the north, for more than 400 miles and averages 50 to 80 miles wide. The Sierra Nevada geomorphic province is primarily composed of cretaceous granitic plutons and remnants of Paleozoic and Mesozoic metavolcanic and metasedimentary rocks, and Cenozoic volcanic and sedimentary rocks. It is bounded on the west by sedimentary rocks of the Great Valley geomorphic province and on the north by volcanic sheets extending south from the Cascade Range (CGS 2002: p. 2).

The Lake Tahoe Basin is located in the northern Sierra Nevada, 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 (Saucedo 2005: pg. 1). The southern part of the Basin is a flat plain of lakebed deposits, glacial outwash, and glacial moraines bounded by high peaks of granite and metamorphic rock. The northern part is extensive volcanic rocks. Faulting and volcanism created the Lake Tahoe Basin over two million years ago, and as a result, the Basin contains granitic, metamorphic, and volcanic rock (TRPA and USFS 1971: p. 7-8).

Granitic rocks underlie the entire Basin; however, in the northern and northwestern parts, basement rocks are covered by younger Tertiary and Quaternary volcanic rocks derived through erosions of the volcanic and granitic rocks. Younger glacial moraines, tills, glacial outwash, and lakebed sediments form extensive deposits in the southern part of the Basin; similar but less extensive deposits lie to the northwest but are much less common in the eastern part of the Basin in Nevada (TRPA and USFS 1971: pg. 8).
TOPOGRAPHY

Elevations of the peaks surrounding the Tahoe Region vary from approximately 8,000 to almost 11,000 feet above sea level. The Region consists mostly of steeply sloping mountains with a few flat or moderately sloping areas where most of the development has occurred.

SEISMIC SETTING

The potential for seismic activity is related to the proximity of faults, which are fractures or zones of closely associated fractures 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: p. 3).

The Lake Tahoe Region is located in a seismically active area of the United States. The Region lies within a tectonically active, asymmetric half-graben, a depressed block of land bordered by a major fault. Evidence shows that Tahoe Region faults have had pre-historic earthquakes of a magnitude of 7.0 within the past 10,000 years. However, scientists believe that large earthquakes are “rare events” in the Region, meaning quakes of magnitude 6.5 or greater occur on individual faults about every 3,000 to 4,000 years (Segale and Cobourn 2005: p. 1). None of the Tahoe Region’s California counties include Earthquake Fault Zones under the Alquist-Priolo Earthquake Fault Zoning Act of California; the closest mapped fault zone (within two miles of the Region) occurs in Alpine County to the south (California Geological Survey 2010).

East of the Region, the Carson Range fault system is one of the largest fault systems and runs for 60 miles along the east face of the Carson Range from Reno to Markleeville. The probability of at least one magnitude \( \geq 6.0 \) 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 \( \geq 6.6 \) event between 9 percent and 64 percent, and the probability of a magnitude \( \geq 7.0 \) event between 4 percent and 50 percent. These probabilities are relatively high and are commensurate with many parts of California (dePol et al. 1997: p. 3).

According to the Earthquake Potential Map for Portions of Eastern California and Western Nevada (CGS 2005), the Lake Tahoe Region is considered to have relatively low to moderate potential for shaking caused by seismic-related activity. However, earthquakes occurring nearby, such as the Reno-Carson urban corridor, have the potential to trigger secondary hazards in the Basin.

FAULTS AND FAULT RUPTURE

Earthquake Fault Zones are delineated around active faults and are used for planning and construction purposes. Under the Alquist-Priolo Act, an active fault is one that has ruptured in the last 11,000 years (within Holocene time). An early Quaternary fault has had surface displacement during the last 1.6 million years (Quaternary time) and a pre-Quaternary fault has had surface displacement before the Quaternary period. An Alquist-Priolo Earthquake Fault Zone is located within two miles of the Lake Tahoe Region in Alpine County (Bryant and Hart 2007: p. 19).

Table 3.7-6 lists faults that are found within the Lake Tahoe Region that have been sources of magnitude \( > 6 \) earthquakes during the Quaternary (past 1,600,000 years) (USGS 2006). None of these faults or fault zones is located in an Alquist-Priolo Earthquake Fault Zone (Bryant and Hart 2007, p. 3).
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. Sites underlain by relatively loose sandy soils and saturated deposits of fill combined with a shallow groundwater table, which typically are located in alluvial river valleys/basins and floodplains, are susceptible to liquefaction. Liquefaction potential within the Lake Tahoe Region exists in low-lying areas composed of loose, unconsolidated, saturated, clay-free glacial material and certain areas with a high water table.

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. Pumping of water for residential, commercial, and agricultural uses from subsurface water tables causes more than 80 percent of the identified subsidence in the United States (Galloway et al. 1999: p. 1). 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. There is no evidence that the Region has experienced subsidence from groundwater extraction.
SLOPE STABILITY

A landslide is the downhill movement of masses of earth material under the force of gravity. The factors contributing to landslide potential are steep slopes, unstable terrain, and proximity to earthquake faults. This process typically involves the surface soil and an upper portion of the underlying bedrock. Expansive soil on slopes tends to shrink and swell in response to moisture content changes. During this shrinking and swelling process, gravity tends to work the soil downslope. Movement may be very rapid, or so slow that a change of position can be noted only over a period of weeks or years (creep). The size of a landslide can range from several square feet to several square miles. The varied topography within the Region makes many areas susceptible to landslide hazards. The main hazards associated with alpine granitic terrains in the Region are rock falls on steep slopes of massive granite and erosion of decomposed granite on both gentle and steep slopes. However, the Land Use Element, Natural Hazards Subelement, Goal 1, Policy 1 restricts construction, reconstruction, or replacement of structures in identified avalanche or mass instability hazard areas unless precautionary measures can be implemented to insure protection of public health and safety.

EROSION AND LOSS OF TOPSOIL

Erosion is the process in which materials of the earth’s surface (sediment, soil, rock, and other particles) are loosened, dissolved, or worn away, and transported from one place to another by natural agents. Soil erosion includes wind erosion and water erosion. Erosion potential is characterized by steep slopes and loose texture that can be eroded by water or wind forces. Human activity tends to increase erosion potential, primarily through the development of structures and impervious surfaces and the removal of vegetative cover.

There are three primary types of erosion in the Tahoe Region: shoreline erosion, stream channel erosion and upland source erosion. These are summarized as follows.

Shoreline Erosion
Wave action and Lake level fluctuation erode, transport, and redistribute sediment along the Lake Tahoe shoreline. Depending on location along the shoreline, these processes occur at different rates. Studies have indicated that shoreline erosion and accretion have occurred over the last 60 years. It is estimated that approximately 429,000 metric tons of sediment have eroded into Lake Tahoe from the shorezone since 1938 (Roberts and Reuter 2007).

Stream Channel Erosion
The first estimates of stream channel erosion were conducted by the USDA-National Sedimentation Laboratory for the Lake Tahoe Basin Framework Study: Sediment Loadings and Channel Erosion. This research combined detailed geomorphic and numerical modeling investigations of several representative watersheds with field measurements from approximately 300 sites in the Tahoe basin. To better quantify the contributions of fine sediment from stream channel erosion in all 63 tributary stream systems, the USDA-National Sedimentation Laboratory completed additional work contained in Estimates of Fine Sediment Loading to Lake Tahoe from Channel and Watershed Sources. Based on this work, the fine sediment (< 63 μm) load was estimated at 3,800 metric tons per year from stream channels. Additional studies, completed to address the Lake Tahoe TMDL, concluded that the number of fine sediment particles less than 16 micrometers that is from stream channel erosion is 1.67 x 10^19 particles per year (Roberts and Reuter 2007).

Upland Source
Upland sources of erosion are those that originate from the watershed and are delivered to the Lake either by streamflow through tributaries or direct inflow from intervening zones. Uplands, both urban and non-urban (forested) uplands, account for sediment and nutrient inputs from various land uses within the 63 watersheds and intervening zones (where surface water enters the Lake directly). Upland sources include products of anthropogenic influences within the urbanized environment and products of natural surface erosion from
undeveloped areas. Modeling results estimated that the average annual fine sediment particle loads for urban and non-urban upland sources are 4,430 and 4,670 metric tons, respectively (Roberts and Reuter 2007).

TRPA’s Environmental Improvement Program

In 1997, TRPA established the Environmental Improvement Program (EIP) (TRPA Code Chapter 15) to accelerate attainment of environmental threshold standards. TRPA goals include long-term preservation and restoration of SEZs, protection and maintenance of plant communities, preservation and enhancement of wildlife habitats, preservation of fish habitats and access, and reduction of sediment and nutrient loading to Lake Tahoe. As of August 2011, 366 EIP projects have been completed and 166 were ongoing since 1997 (TRPA 2011). Fifty percent of EIP investments has gone into projects with the focus on restoring Lake clarity to 100 feet (TRPA 2007).

As of 2007, the California Department of Transportation (Caltrans) and the Nevada Department of Transportation (NDOT) have treated more than 26 miles of state highways in the Tahoe Basin. These ongoing efforts are crucial to reducing fine sediments and nutrients that contribute to Lake Tahoe’s clarity decline. In 2006, Caltrans completed an EIP plan for retrofitting all of the state’s highways with erosion control measures and NDOT is also proceeding with the implementation of their EIP plan for Tahoe roadways. Both entities continue to plan large erosion control projects that will result in water quality improvements along State Highways 28, 50, 89 and 207. Major efforts are underway involving sand recovery and deicing technology and ongoing water quality monitoring efforts help inform the design and effectiveness of future projects (TRPA 2007).

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.

According to the Swelling Clays Map of the Coterminous United States, the Tahoe Basin falls within an area that is underlain with little to no clays with swelling potential (USGS 1989). However, soil units mapped within the Basin contain soils with low to high shrink/swell potential (NRCS 2007).

LAND COVERAGE

Permanent land disturbance in the Tahoe Basin is measured in terms of land coverage, including impervious surfaces and significantly degraded soil conditions that do not readily self-mitigate after the disturbance has ceased. TRPA defines two types of existing land coverage, “hard land coverage” (i.e. impervious surfaces) and “soft land coverage” (i.e. compacted areas). The Code of Ordinances defines land disturbance as the “alteration of soil, vegetation, surface hydrology, or subsurface hydrology on a temporary or permanent basis, through action including, but not limiting to, grading.” Significant soil disturbance is defined as “damage to soil structure, chemistry and biota through compaction, burning, removal or topsoil, soil contamination or other activities, to the degree that there may be reduced vegetation growth, increased surface runoff or erosion. Soil compaction and other disturbance potential can vary depending upon soil type, rooting depth, soil moisture content, surface litter thickness and compaction forces.”

HARD LAND COVERAGE

Hard land coverage (impervious cover), as defined by Chapter 90 of the TRPA Code, is any man-made structure, improvement, or covering that prevents normal precipitation from directly reaching the surface of the land underlying the structure, improvement, or covering. These typically include, but are not limited to roofs, decks, asphalt, concrete, tennis courts, and patios. A structure, improvement or covering is not considered land coverage by TRPA if it allows at least 75 percent of normal precipitation directly to reach the ground and permits growth of vegetation on the approved species list.
Impervious cover can result in water quality degradation, flooding, and soil erosion. It affects natural hydrology and water quality by diverting subsurface flow to surface runoff. Impervious and compacted areas prevent rainfall and snowmelt from infiltrating into the soil.

**Soft Land Coverage**

Soft land coverage (soil compaction), as defined by Chapter 90 of the TRPA Code, includes artificially compacted areas without man-made structures, where the soil has become sufficiently altered and/or compacted so as to prevent substantial infiltration. Causes may include, but are not limited to, the parking of cars and heavy and repeated pedestrian traffic. Soil compaction inhibits natural water and soil-air storage by reducing pore space in the soil. Reduced soil water storage capacity affects plant growth, increases runoff and sediment export. Soft coverage may allow up to 25 percent infiltration into the soil.

**STREAM ENVIRONMENT ZONES**

Stream Environment Zone (SEZ) is a term used by TRPA to describe perennial, intermittent and ephemeral streams, wet meadows, marshes, and other wetlands; riparian areas; and other areas expressing the presence of surface and groundwater through its biological and physical characteristics.

SEZs are defined by hydrology, hydric soils and/or water-loving or water-tolerant plants. Although SEZ plant communities constitute only a small portion of the Region's total land area, these unique assemblages are extremely rich and productive. SEZs perform a critical role by providing for wildlife habitat, water purification, scenic and recreational enjoyment, and flood attenuation, among many other functions and values. Protecting and restoring SEZs are essential for improving and maintaining the environmental amenities of the Lake Tahoe Region and for achieving environmental threshold standards for water quality, vegetation preservation, and soil conservation.

**EXISTING COVERAGE**

**Existing Coverage Based on Bailey Land Classification Capability Map**

To assist in application of the Bailey Land Classification System, TRPA adopted the Land Capability Overlay Map (Bailey map). 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. 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 LCDs 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.

As applied to the entire Region, the Bailey map results in a maximum allowable coverage of 10,941 acres, or approximately 5.4 percent of the Region’s land area (Table 3.7-7). Based on a preliminary assessment of remote sensing data collected in 2010, approximately 7,254 acres of hard coverage (approximately 3.6 percent of the land area) currently exist in the Region, as illustrated in Exhibit 3.7-1. Based on the Bailey map, the Region as a whole has less than the allowable amount of coverage; however, several land capability classes, including some of the most sensitive lands, currently have more coverage than would otherwise be allowed. As shown in Table 3.7-7, LCD 1a is over covered by 102 acres; LCD 1b (SEZ) is over covered by 1,225 acres; LCD 2 is over covered by 159 acres; and LCD 7 is over covered by 17 acres. Table 3.7-7 identifies the relative amounts of existing coverage per LCD, but likely underestimates the total amount of existing coverage because the remote-sensing data does not include all soft coverage.
Source: TRPA 2011

Exhibit 3.7-1

Existing Impervious Surfaces within Hydrologically Related Areas
## Table 3.7-7. Region-wide Existing and Allowable Coverage by Land Capability District based on Bailey Land Capability Map

<table>
<thead>
<tr>
<th>Land Capability District</th>
<th>Total Area Within LCD (acres)</th>
<th>Allowable Impervious Cover (%)</th>
<th>Impervious Surface Allowed Within LCD (acres)</th>
<th>Estimated Area of Impervious Cover (acres)</th>
<th>Existing Impervious Surface Within LCD (%)</th>
<th>Difference from Allowable (%)</th>
<th>Area Over or Under Covered (acres)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A</td>
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<td>827</td>
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<td>1B (SEZ)</td>
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<td>1,400</td>
<td>8.0</td>
<td>7.0</td>
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<td>(262)</td>
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<td>101</td>
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<td>1,428</td>
<td>639</td>
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<td>(11.1)</td>
<td>(789)</td>
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<td>15,361</td>
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<td>1,447</td>
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<td>(2,393)</td>
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<td>2,575</td>
<td>972</td>
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<td>(18.7)</td>
<td>(1,603)</td>
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<td>910</td>
<td>927</td>
<td>30.6</td>
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<td><strong>Total</strong></td>
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<td><strong>5.4</strong></td>
<td><strong>10,941</strong></td>
<td><strong>7,254</strong></td>
<td><strong>3.6</strong></td>
<td><strong>(1.8)</strong></td>
<td><strong>(3,687)</strong></td>
</tr>
</tbody>
</table>

Source: TRPA (Lewandowski 2012); Aerial LIDAR data collected in summer 2010.

### Existing Coverage Based on NRCS 2007 Soil Survey

In 2007, the USDA Natural Resource Conservation Service (NRCS) completed a new soil survey of the Tahoe Region, and translated the soil survey into LCDs using the Bailey Land Capability System. While the Bailey map is currently used by TRPA as the starting point for the land capability verification and challenge processes, the NRCS 2007 Soils Survey offers much higher resolution. Therefore, the NRCS 2007 Soils Survey is used in addition to the Bailey map in this EIR/EIS analysis to provide an additional estimate of the potential coverage impacts of the RTP/SCS Alternatives.

It is important to note that land capability based on the NRCS 2007 Soil Survey, and therefore allowable coverage, differs from the 1974 Bailey map in several ways. The Bailey map and NRCS 2007 Soil Survey used slightly different map boundaries, resulting in approximately a 200 acre difference in the extent of each map. The land capability map developed by Bailey (1974) was conducted at a large scale and focused on areas where development was likely, rather than on remote public lands. In many cases, areas of high capability lands (as determined by soil type) were fully surrounded by low capability lands. The Bailey map reclassified these areas of high capability soils into the lower capability 1a LCD (i.e. only one percent allowable coverage). The NRCS 2007 Soil Survey does not reclassify land capability classes in this way; it retains the land capability classification as determined by soil type, erodability and slope. This accounts for some of the differences in total area of each land capability class between the Bailey map and the 2007 Soil Survey.

As applied to the entire Region, the 2007 soils survey results in a maximum allowable coverage of 19,984 acres, or approximately 10 percent of the Region’s land area (Table 3.7-8). Based on a preliminary assessment of remote sensing data collected in 2010, approximately 7,263 acres of coverage (approximately 3.6 percent of the land area) currently exist in the Region. Like the Bailey map, the 2007 soil survey shows that the Region as a whole has less than the allowable amount of coverage; however, LCD 1b (SEZ) lands are shown to be over covered by 657 acres (Table 3.7-8).
Table 3.7-8. Region-wide Existing and Allowable Coverage by Land Capability District Based on NRCS 2007 Soils Survey

<table>
<thead>
<tr>
<th>Land Capability District</th>
<th>Total Area Within LCD (acres)</th>
<th>Allowable Impervious Cover (%)</th>
<th>Impervious Surface Allowed Within LCD (acres)</th>
<th>Estimated Area of Impervious Cover (acres)</th>
<th>Existing Impervious Surface Within LCD (%)</th>
<th>Difference from Allowable (%)</th>
<th>Area Over or Under Covered (acres)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A</td>
<td>23,558</td>
<td>1</td>
<td>236</td>
<td>119</td>
<td>0.5</td>
<td>(0.5)</td>
<td>(116)</td>
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<tr>
<td>1B (SEZ)</td>
<td>11,304</td>
<td>1</td>
<td>113</td>
<td>770</td>
<td>6.8</td>
<td>5.8</td>
<td>657</td>
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<td>1C</td>
<td>53,957</td>
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<td>540</td>
<td>435</td>
<td>0.8</td>
<td>(0.2)</td>
<td>(104)</td>
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<td>236</td>
<td>213</td>
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<td>(0.1)</td>
<td>(24)</td>
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<td>3</td>
<td>16,920</td>
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<td>846</td>
<td>257</td>
<td>1.5</td>
<td>(3.5)</td>
<td>(589)</td>
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<tr>
<td>4</td>
<td>32,386</td>
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<td>(15.0)</td>
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<td>(6.9)</td>
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<td>19,984</td>
<td>7,263</td>
<td>3.6</td>
<td>(6.3)</td>
<td>(12,721)</td>
</tr>
</tbody>
</table>

Source: Lewandowski 2012.

3.7.4 ENVIRONMENTAL CONSEQUENCES AND RECOMMENDED MITIGATION MEASURES

METHODS AND ASSUMPTIONS

The following analysis considers how implementation of the proposed RTP/SCS transportation strategy packages, under each alternative, would affect the below-listed significance criteria. Cumulative impacts are discussed in Chapter 4 and consider the transportation strategy packages in combination with the SCS.

SIGNIFICANCE CRITERIA

Implementation of the RTP/SCS would result in a significant adverse effect on geology, soils, land capability and coverage if it would:

- cause a change in the topographic features in a manner inconsistent with the natural surrounding conditions;
- cause a continuation of or an increase in wind or water erosion of soils;
- result in substantial changes in deposition or erosion of beach sand, or substantial changes in siltation, deposition or erosion, including natural littoral processes, which may modify the channel of a river or stream or the bed of a lake;
- allow compaction or coverage of soil with impervious surfaces beyond the limits allowed in the LCDs,
- expose people or property to seismic hazards such as earthquakes, landslides, backshore erosion, avalanches, mud slides, ground failure, liquefaction, lateral spreading, or collapse, or similar hazards;
- allow development in a geologic unit or on soil that is unstable or that would become unstable, potentially resulting in on- or off-site landslide, expansive soils, or subsidence; or
- substantially affect or fail to preserve existing natural stream environment zones (SEZs).
IMPACT ANALYSIS AND MITIGATION MEASURES

**Impact 3.7-1 Site Topography, Grading, and Soil Erosion.** Implementation of the RTP/SCS could expose soils and SEZs to adverse effects from erosion during construction activities related to roadway, bikeway, and trail enhancements. However, grading and earthmoving activities within the Region would be required to obtain grading and excavation permits and approvals in accordance with TRPA Code Chapter 33 and local jurisdictions. Adherence to existing regulations and permit requirements would reduce the potential for substantial soil erosion or loss of topsoil for all alternatives (Alternatives 1, 2, 3, 4, and 5). Therefore, this impact would be **less than significant** for Alternatives 1, 2, 3, 4, and 5.

Soil erosion risk increases with increasing slope, precipitation, ground disturbance, and decreasing vegetative cover. Ground-disturbing activities, including excavation, grading, and other construction activities, conducted as part of the RTP could result in soil erosion or the loss of topsoil. Removal of soil and vegetation exposes bare earth and could cause unstable conditions, resulting in soils that are easily disturbed by equipment and eroded by rain and wind. Additionally, project construction activities on road/trail alignments situated on steep slopes in areas underlain by unstable geology or sensitive soils are prone to higher erosion hazard that could result in erosion of surface soils during construction activities.

Under all alternatives (Alternatives 1, 2, 3, 4, and 5), the timing, location, and duration of construction activities could result in the temporary disturbance of soil, exposure of disturbed areas to storm events, and/or excavation below five feet bgs. Project activities would likely include grading, excavations, cut and fill, and trenching, all of which could alter the existing topography or ground surface of individual sites within the Basin.

As discussed under Impact 3.8-1 in Section 3.8, Hydrology and Water Quality, construction projects in the Tahoe Region must meet multiple requirements and regulations of the TRPA, LRWQCB (California), NDEP (Nevada), federal, and local (city and county) agencies. For example, all construction projects in the California side of the Tahoe Region with greater than one acre of disturbance are required to prepare a SWPPP that includes a site specific Construction Site Monitoring and Reporting Plan (CSMRP) pursuant to the National Pollution Discharge Elimination System (NPDES) 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 would 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, and would be required to ensure that runoff quality meets or surpasses TRPA water quality objectives and the federal and state anti-degradation policies, remains within the TRPA and LRWQCB discharge limits to surface 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.

All RTP alternatives include TMDL-achievement projects and site-specific projects designed to improve erosion control and water quality via advanced stormwater infrastructure, retention and biofilter installations and other water quality protection elements within the context of planned transportation facilities.
**ALTERNATIVE 1: NO PROJECT**

Alternative 1 includes the group of projects listed under Transportation Strategy Package A. Transportation Strategy Package A includes operation and maintenance of the existing transportation system and the construction of projects on the financially constrained project list that are already substantially in progress. Transportation Strategy Package A includes the Lake Tahoe Waterborne Transit Project, City of South Lake Tahoe Aviation Capital Project, Kings Beach Commercial Core Improvement Project, SR 89/Fanny Bridge Community Revitalization Project, various bicycle and pedestrian projects, TMDL projects, Transportation System Management and ITS strategies, and operations and maintenance projects for existing facilities. Transportation Strategy Package A has the fewest bicycle and pedestrian projects of the three Transportation Strategy Packages.

Construction of projects such as the State Route 89/Fanny Bridge Community Revitalization Project and new pedestrian and bicycle trails could require earthmoving activities that could result in the temporary disturbance of soil and/or exposure of disturbed areas to storm events. Projects that could result in the construction of new buildings (Lake Tahoe Waterborne Transit Project and City of South Lake Tahoe Aviation Capital Project) or bridge structures (State Route 89/Fanny Bridge Community Revitalization Project) and some bike trail projects, could include excavation below five feet. Project activities would likely include grading, excavations, cut and fill, and trenching, all of which could alter the existing topography or ground surface of individual project sites within the Region.

All projects included in the RTP/SCS would be assessed on a project-by-project basis and would be required to conform to existing regional and local regulations to minimize excessive grading and soil instability. Slope instability/erosion and grading in the Tahoe Region are primarily regulated through the grading and construction ordinances of TRPA and local jurisdictions. To minimize erosion, as required by TRPA and local jurisdictions, grading and excavation permits and approvals would be obtained. Chapter 33 of the TRPA Code of Ordinances requires the preparation of soil reports to determine the effects of proposed grading activities on soil stability and groundwater where there have been recorded landslides or topographical evidence of landslides and where proposed or existing cuts or fills will exceed 20 feet in height. Chapter 33 of the TRPA Code of Ordinances provides various standards and regulations related to grading to protect against significant adverse effects from excavation, filling, and clearing and prohibits excavation deeper than five feet bgs, or where there exists a reasonable possibility for groundwater interception or interference, except under certain defined and permitted conditions (TRPA Code of Ordinances Section 33.3.6). TRPA requires that final construction plans are submitted for review and conformance with TRPA rules, regulations, and ordinances as part of standard conditions of approval of a project. The existing procedure for granting grading season exceptions would remain unchanged. An assessment of site- and weather-specific conditions is performed prior to issuing grading season exceptions.

Adherence to existing regulations and permit requirements would reduce the potential for substantial soil erosion or loss of topsoil for all projects implemented under Alternative 1. As discussed in Section 3.1, Approach to the Environmental Analysis, these existing regulations and permit requirements specify mandatory and relatively prescriptive actions about how to fulfill the regulatory requirements as part of the project definition, leaving little discretion in their implementation. Therefore, this impact would be less than significant.

**ALTERNATIVE 2: LOW DEVELOPMENT, INCREASED REGULATION**

Alternative 2 includes the group of projects listed under Transportation Strategy Package B. Transportation Strategy Package B represents a scenario that assumes additional revenue in the future. It includes all the projects on the unconstrained list and almost all of the projects on the constrained list, except the Lake Tahoe Waterborne Transit Project and the City of South Lake Tahoe Aviation Capital Project. Transportation Strategy Package B adds the Sierra Boulevard Complete Streets Project from US 50 to Barbara Avenue and US 50 South
Shore Community Revitalization Project (Loop Road) to the other roadway projects in Strategy Package A. In addition, as with Alternative 1, Alternative 2 includes Transit Facilities and Strategies (including BlueGO and TART), Kings Beach Commercial Core Improvement Project, and State Route 89/Fanny Bridge Community Revitalization Project, Transportation System Management and ITS strategies, and operations and maintenance projects for existing facilities. Alternative 2 also includes many additional bicycle and pedestrian projects and TMDL projects from the unconstrained project list. Transportation Strategy Package B has the greatest number bicycle and pedestrian trail projects of the three Transportation Strategy Packages.

Implementation of Alternative 2 would likely include grading, excavations, cut and fill, and trenching, all of which could alter the existing topography or ground surface of individual sites within the Region. Compared to the other alternatives, Alternative 2 poses the greatest potential for impacts because it would implement the greatest number of construction projects. As discussed under Alternative 1, adherence to existing regulations and permit requirements would reduce the potential for substantial soil erosion or loss of topsoil for all projects associated with Alternative 2. These existing regulations and permit requirements specify mandatory and relatively prescriptive actions about how to fulfill the regulatory requirements as part of the project definition, leaving little discretion in their implementation. Therefore, this impact would be less than significant.

**ALTERNATIVE 3: LOW DEVELOPMENT, HIGHLY INCENTIVIZED REDEVELOPMENT**

Alternative 3 includes the group of projects listed under Transportation Strategy Package C. Transportation Strategy Package C represents the financially constrained projects list. Transportation Strategy Package C includes the Lake Tahoe Waterborne Transit Project, City of South Lake Tahoe Aviation Capital Project, Sierra Boulevard Complete Streets Project from US 50 to Barbara Avenue, US 50 South Shore Community Revitalization Project (Loop Road), Transit Facilities and Strategies (Including BlueGO and TART), Kings Beach Commercial Core Improvement Project, State Route 89/Fanny Bridge Community Revitalization Project, various bicycle and pedestrian projects, TMDL projects, Transportation System Management and ITS strategies, and operations and maintenance projects for existing facilities. Transportation Strategy Package C has many more bicycle and pedestrian projects compared to Alternative 1, but fewer than Alternative 2.

Implementation of Alternative 3 would likely include grading, excavations, cut and fill, and trenching, all of which could alter the existing topography or ground surface of individual sites within the Region. Compared to the other alternatives, potential impacts under Alternative 3 would be greater than Alternatives 1 and 5, but less than Alternative 2, and similar to Alternative 4 because of the number of construction projects. As described above, adherence to existing regulations and permit requirements would reduce the potential for substantial soil erosion or loss of topsoil for all projects associated with Alternative 3. These existing regulations and permit requirements specify mandatory and relatively prescriptive actions about how to fulfill the regulatory requirements as part of the project definition, leaving little discretion in their implementation. Therefore, this would be a less-than-significant impact.

**ALTERNATIVE 4: REDUCED DEVELOPMENT, INCENTIVIZED REDEVELOPMENT**

Alternative 4, would include Transportation Strategy Package C, as described under Alternative 3. As in the discussion for Alternative 3, implementation of Alternative 4 would likely include grading, excavations, cut and fill, and trenching, all of which could alter the existing topography or ground surface of individual sites within the Region. Compared to the other alternatives, potential impacts under Alternative 4 would be greater than Alternatives 1 and 5, but less than Alternative 2, and similar to Alternative 3 because of the number of construction projects.

As discussed above, adherence to existing regulations and permit requirements would reduce the potential for substantial soil erosion or loss of topsoil for all projects associated with Alternative 4, and this would be a less-than-significant impact.
ALTERNATIVE 5: SIMILAR RATE OF DEVELOPMENT AND REGULATORY STRUCTURE TO THE 1987 REGIONAL PLAN

Alternative 5 would include Transportation Strategy Package A, as described above under Alternative 1. As in the discussion for Alternative 1, implementation of Alternative 5 would likely include grading, excavations, cut and fill, and trenching, all of which could alter the existing topography or ground surface of individual sites within the Region. Compared to the other alternatives, potential impacts under Alternative 5 would be less than Alternatives 2, 3, and 5 and the same as Alternative 1 because of the number of construction projects.

As discussed above, adherence to existing regulations and permit requirements would reduce the potential for substantial soil erosion or loss of topsoil for all projects associated with Alternative 5, and this would be a less-than-significant impact.

MITIGATION MEASURES

No mitigation is required for any of the alternatives.

| Impact | Seismic hazards. Projects proposed under the RTP could increase risk of injury or property damage from strong ground shaking or seismic-related ground failure caused by unstable soils. Projects implemented as part of the RTP would be designed and constructed in accordance with the current design requirements of Uniform Building Code (UBC) Seismic Zone 3 and local jurisdiction seismic standards, if applicable. In addition, projects would be required to implement seismic design recommendations contained in project-specific geotechnical reports as identified in the TRPA Code of Ordinances. Therefore, there would be no substantial increased risk of injury or property damage from strong ground shaking or seismic-related ground failure. This would be a less-than-significant impact for all RTP alternatives (Alternatives 1, 2, 3, 4, and 5). |

The Lake Tahoe Region lies within a tectonically active, asymmetric half-graben, a depressed block of land bordered by a major fault. Evidence shows that Tahoe Region faults have had pre-historic earthquakes of a magnitude of 7.0 within the past 10,000 years. However, scientists believe that large quakes are “rare events” in the Region, meaning quakes of magnitude 6.5 or greater occur on individual faults about every 3,000 to 4,000 years (Segale and Cobourn 2005: p. 1). The Carson Range fault system is one of the largest fault systems east of the Basin and 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 nine percent and 64 percent, and the probability of a magnitude ≥7.0 event between four percent and 50 percent. These probabilities are relatively high and are commensurate with many parts of California (dePolo et al. 1997: p. 3).

According to the Earthquake Potential Map for Portions of Eastern California and Western Nevada (CGS 2005), the Lake Tahoe Region is considered to have relatively low to moderate potential for shaking caused by seismic-related activity. However, earthquakes occurring nearby, such as the Reno-Carson urban corridor, have the potential to trigger secondary hazards in the Region.

Other potential seismic hazards include tsunami or seiche. A tsunami is a 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 may result 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. Ichinose et al. (1999) show through modeling wave simulations for various earthquake scenarios that if a large earthquake (magnitude >7) were to occur, a potential exists for both tsunami and seiche-related waves up to 30 feet to occur along the shore of Lake Tahoe. Modeling has not been conducted, using wave-run up heights, bottom friction, and topography, to determine land inundation patterns and a minimum level of high ground or safety on the event of a seiche or tsunami.

Slope failure results in landslides and mudslides from unstable soils or geologic units. Slope failure can occur over time as a result of rainfall, seismic activity, or human activity such as earthwork or grading. Landslides are often triggered when the soil’s pore pressure (i.e., water pressure in the ground) reaches a critical level. 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, thus becoming similar to quicksand. 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. 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 walls, and slope instability.

**ALTERNATIVE 1: NO PROJECT**

Alternative 1 would include Transportation Strategy Package A, which would include the fewest number of new bicycle and pedestrian projects, TMDL projects, highway revitalization projects, transit projects, and transportation system management, and Intelligent Transportation Systems (ITS) projects. Potentially active faults in and close to the Region may subject the projects associated with Alternative 1 to seismic hazards, including strong ground shaking. Seismic events can damage transportation and other infrastructure through surface rupture, ground shaking, liquefaction, and landsliding.

Seismic activity can cause damage to existing structures with substandard construction. However, new and recently seismically retrofitted structures designed with current engineering knowledge can reduce the potential damage and harm to and from these structures. One of the objectives of the State Route 89/Fanny Bridge Community Revitalization Project would be to improve the bridge’s structural integrity because the bridge does not meet current seismic design standards. This would result in a beneficial impact related to seismic-related ground failure.

Seismically induced tsunami and seiche waves can damage transportation infrastructure along the shore of Lake Tahoe or ferries on the Lake associated with the Lake Tahoe Waterborne Transit Project. The probability of an earthquake strong enough to cause a seiche in Lake Tahoe is relatively low: only three to four percent in 50 years (Ichinose, et al. 1999), so effects from a tsunami or seiche are not considered likely to occur.

All projects included in the RTP/SCS implemented under Alternative 1 would be assessed on a project-by-project basis and would be designed and constructed in accordance with current building codes and local jurisdiction seismic standards, if applicable. In addition, projects would be required to implement seismic design recommendations that consider the seismicity of the site, soil response at the site, and dynamic characteristics of the project features contained in project-specific geotechnical reports as identified in the TRPA Code of Ordinances (Section 33.4). As discussed in Section 3.1, Approach to the Environmental Analysis, these existing regulations specify mandatory and relatively prescriptive actions about how to fulfill the regulatory requirements as part of the project definition, leaving little discretion in their implementation. Therefore, there would be no substantial increased risk of injury or property damage from strong ground shaking or seismic-related ground failure. This would be a **less-than-significant impact**.
**ALTERNATIVE 2: LOW DEVELOPMENT, INCREASED REGULATION**

Alternative 2 would implement Transportation Strategy Package B, which includes similar types of projects as Transportation Strategy Package A, but with a substantially greater number of bicycle and pedestrian improvements and inter-regional bus services and without the Lake Tahoe Waterborne Transit Project and the City of South Lake Tahoe Aviation Capital Project. Implementation of Alternative 2 would likely include grading, excavations, cut and fill, and trenching, all of which could alter the existing topography or ground surface of individual sites within the Basin. Compared to the other alternatives, Alternative 2 poses the greatest potential for impacts because it would implement the greatest number of construction projects. Potentially active faults in and close to the Region may subject the projects associated with Alternative 2 to seismic hazards, including strong ground shaking. Seismic events can damage both transportation infrastructure through surface rupture, ground shaking, liquefaction, and landsliding.

Seismic activity can cause damage to existing structures with substandard construction. However, new and recently seismically retrofitted structures designed with current engineering knowledge can reduce the potential damage and harm to and from these structures. Seismically induced tsunami and seiche waves can damage transportation infrastructure along the shore of Lake Tahoe. This alternative would not have an additional effect on ferries on the Lake because the Lake Tahoe Waterborne Transit Project would not be included.

All projects included in the RTP/SCS implemented under Alternative 2 would be assessed on a project-by-project basis and would be designed and constructed in accordance with current building codes and local jurisdiction seismic standards, if applicable. In addition, projects would be required to implement seismic design recommendations that consider the seismicity of the site, soil response at the site, and dynamic characteristics of the project features contained in project-specific geotechnical reports as identified in the TRPA Code of Ordinances (Section 33.4). As discussed in Section 3.1, these existing regulations specify mandatory and relatively prescriptive actions about how to fulfill the regulatory requirements as part of the project definition, leaving little discretion in their implementation. Therefore, there would be no substantial increased risk of injury or property damage from strong ground shaking or seismic-related ground failure. This would be a less-than-significant impact.

**ALTERNATIVE 3: LOW DEVELOPMENT, HIGHLY INCENTIVIZED REDEVELOPMENT**

Alternative 3 would implement Transportation Strategy Package C, which includes the financially constrained list of projects for the RTP, including new bicycle and pedestrian facilities, corridor revitalization projects, transit service and capital enhancements, and waterborne transit, but not as many new pedestrian/bicycle facilities as included in Alternative 2. Implementation of Alternative 3 would likely include grading, excavations, cut and fill, and trenching, all of which could alter the existing topography or ground surface of individual sites within the Region. Compared to the other alternatives, potential impacts under Alternative 3 would be greater than Alternatives 1 and 5, but less than Alternative 2, and the same as Alternative 4 because of the number of construction projects. Potentially active faults in and close to the Region may subject the projects associated with Alternative 3 to seismic hazards, including strong ground shaking. Seismic events can damage both transportation infrastructure through surface rupture, ground shaking, liquefaction, and landsliding. All projects included in the RTP/SCS implemented under Alternative 3 would be assessed on a project-by-project basis and would be designed and constructed in accordance with current building codes and local jurisdiction seismic standards, if applicable. In addition, projects would be required to implement seismic design recommendations that consider the seismicity of the site, soil response at the site, and dynamic characteristics of the project features contained in project-specific geotechnical reports as identified in the TRPA Code of Ordinances (Section 33.4). These existing regulations specify mandatory and relatively prescriptive actions about how to fulfill the regulatory requirements as part of the project definition, leaving little discretion in their...
implementation. Therefore, there would be no substantial increased risk of injury or property damage from strong ground shaking or seismic-related ground failure. This would be a less-than-significant impact.

**ALTERNATIVE 4: REDUCED DEVELOPMENT, INCENTIVIZED REDEVELOPMENT**

Alternative 4 would include Transportation Strategy Package C, as described under Alternative 3. As in the discussion for Alternative 3, implementation of Alternative 4 would likely include grading, excavations, cut and fill, and trenching, all of which could alter the existing topography or ground surface of individual sites within the Region.

Compared to the other alternatives, potential impacts under Alternative 4 would be greater than Alternatives 1 and 5, but less than Alternative 2, and the same as Alternative 3 because of the number of construction projects. Potentially active faults in and close to the Basin may subject the projects associated with Alternative 4 to seismic hazards, including strong ground shaking. Seismic events can damage both transportation infrastructure through surface rupture, ground shaking, liquefaction, and landsliding. For the reasons discussed under Alternative 3, this would be a less-than-significant impact.

**ALTERNATIVE 5: SIMILAR RATE OF DEVELOPMENT AND REGULATORY STRUCTURE TO THE 1987 REGIONAL PLAN**

Alternative 5 would include Transportation Strategy Package A, as described under Alternative 1. Compared to the other alternatives, potential impacts under Alternative 5 would be less than Alternatives 2, 3, and 4 and the same as Alternative 1 because of the number of construction projects. Potentially active faults in and close to the Region may subject the projects associated with Alternative 3 to seismic hazards, including strong ground shaking. Seismic events can damage both transportation infrastructure through surface rupture, ground shaking, liquefaction, and landsliding. For the reasons discussed under Alternative 1, this would be a less-than-significant impact.

**MITIGATION MEASURES**

No mitigation is required for any of the alternatives.

| Impact  | Other Geologic Hazards. Projects proposed under the RTP have the potential to be constructed on or through soils or geologic formations susceptible to lateral spreading, subsidence, or collapse, thereby increasing the risk to people and facilities. Projects implemented as part of the RTP would be assessed on a project specific basis and would be required to conform to existing regional and local regulations and standards of design, grading, and construction practices to avoid or reduce hazards associated with other geologic hazards. Therefore, for all RTP/SCS alternatives (Alternatives 1, 2, 3, 4, and 5) there would be no substantial increased risk to people and infrastructure from other geologic hazards. This would be a less-than-significant impact for all alternatives (1, 2, 3, 4, and 5). |

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. 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 (i.e., Holocene deposits approximately 11,000 years old), and where creek banks are relatively high. Settlement problems could also occur as a result of placing structures on man-made fill deposits. 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. Lateral spreading typically occurs as a form of horizontal displacement of relatively flat-lying alluvial material and may often be associated with liquefaction. Soils most susceptible to liquefaction are loose, clean, saturated, uniformly graded, fine-grained sands. Silty sands may also be susceptible to liquefaction.

**ALTERNATIVE 1: NO PROJECT**

Alternative 1 would include Transportation Strategy Package A. Development and infrastructure associated with Alternative 1 may be constructed on soils or geologic formations susceptible to lateral spreading, subsidence, or collapse, thereby increasing the risk to people and facilities. Much of the development would occur in or adjacent to areas with existing development. These areas may have already been tested for unstable conditions. However, even in developed areas, particularly those near mountains, projects can experience unstable conditions. Construction within existing footprints or new sites would likely require grading or earthwork, which would increase the propensity for soils to become unstable. Although unstable soils and slope failure may not be completely avoidable, site-specific analyses would reduce risks associated with future projects.

All projects included in the RTP/SCS under Alternative 1 would be assessed on a project-by-project basis. Through adherence to existing laws and regulations, developments associated with Alternative 1 would be required to undergo site-specific geotechnical analysis (TRPA Code 33.4), and, if applicable, employ all standard design, grading, and construction practices to avoid or reduce other geologic hazards, including those associated with unstable soils and slope failure. Corrective measures such as structural reinforcement and using engineered fill to replace unstable soils would be applied to the design of individual future projects. All site designs would be reviewed and approved by the appropriate agencies. As discussed in Section 3.1, Approach to the Environmental Analysis, these existing laws and regulations specify mandatory and relatively prescriptive actions about how to fulfill the regulatory requirements as part of the project definition, leaving little discretion in their implementation. Therefore, adherence to these laws and regulations would ensure impacts would be **less than significant**.

**ALTERNATIVE 2: LOW DEVELOPMENT, INCREASED REGULATION**

Alternative 2 would include Transportation Strategy Package B. Implementation of Alternative 2 would likely include grading, excavations, cut and fill, and trenching, all of which could alter the existing topography or ground surface of individual sites within the Region. Compared to the other alternatives, Alternative 2 poses the greatest potential for impacts because it would implement the greatest number of construction projects. Development and infrastructure associated with Alternative 2 may be constructed on soils or geologic formations susceptible to lateral spreading, subsidence, or collapse, thereby increasing the risk to people and facilities.

As with Alternative 1, projects included in the RTP/SCS under Alternative 2 would be assessed on a project-by-project basis. Through adherence to existing laws and regulations, developments associated with Alternative 2 would be required to undergo site-specific geotechnical analysis (TRPA Code 33.4), and, if applicable, employ all standard design, grading, and construction practices to avoid or reduce other geologic hazards, including those associated with unstable soils and slope failure. Corrective measures such as structural reinforcement and using engineered fill to replace unstable soils would be applied to the design of individual future projects. All site designs would be reviewed and approved by the appropriate agencies. These existing regulations specify mandatory and relatively prescriptive actions about how to fulfill the regulatory requirements as part of the project definition, leaving little discretion in their implementation. Therefore, adherence to these laws and regulations would ensure impacts would be **less than significant**.
**ALTERNATIVE 3: LOW DEVELOPMENT, HIGHLY INCENTIVIZED REDEVELOPMENT**

Alternative 3 would include Transportation Strategy Package C. Implementation of Alternative 2 would likely include grading, excavations, cut and fill, and trenching, all of which could alter the existing topography or ground surface of individual sites within the Region. Compared to the other alternatives, potential impacts under Alternative 3 would be greater than Alternatives 1 and 5, but less than Alternative 2, and the same as Alternative 4 because of the number of construction projects. Development and infrastructure associated with Alternative 3 may be constructed on soils or geologic formations susceptible to lateral spreading, subsidence, or collapse, thereby increasing the risk to people and facilities. As discussed above under Alternative 1, projects implemented under Alternative 3 would be assessed on a project-by-project basis and adherence to existing laws and regulations would ensure that this impact would be **less than significant**.

**ALTERNATIVE 4: REDUCED DEVELOPMENT, INCENTIVIZED REDEVELOPMENT**

Alternative 4, like Alternative 3, would include Transportation Strategy Package C, which includes new bicycle and pedestrian facilities, corridor revitalization projects, transit service and capital enhancements, and waterborne transit (with the Lake Tahoe Waterborne Transit Project). Compared to the other alternatives, potential impacts under Alternative 4 would be greater than Alternatives 1 and 5, but less than Alternative 2, and the same as Alternative 3 because of the number of construction projects. Development and infrastructure associated with Alternative 4 may be constructed on soils or geologic formations susceptible to lateral spreading, subsidence, or collapse, thereby increasing the risk to people and facilities. As discussed above under Alternative 3, projects implemented under Alternative 4 would be assessed on a project-by-project basis, and adherence to existing laws and regulations would ensure that this impact would be **less than significant**.

**ALTERNATIVE 5: SIMILAR RATE OF DEVELOPMENT AND REGULATORY STRUCTURE TO THE 1987 REGIONAL PLAN**

Alternative 5 would include Transportation Strategy Package A, which would include the fewest number of new bicycle and pedestrian facilities, roadway improvement projects, and waterborne transit (with the Lake Tahoe Waterborne Transit Project). As in the discussion for Alternative 1, implementation of Alternative 5 would likely include grading, excavations, cut and fill, and trenching, all of which could alter the existing topography or ground surface of individual sites within the Region. Compared to the other alternatives, potential impacts under Alternative 5 would be less than Alternatives 2, 3, and 5 and the same as Alternative 1 because of the number of construction projects. As discussed above under Alternative 1, projects implemented under Alternative 5 would be assessed on a project-by-project basis, and adherence to existing laws and regulations would ensure that this impact would be **less than significant**.

**MITIGATION MEASURES**

No mitigation is required for any of the alternatives.
Impact 3.7-4

**Land Coverage.** Implementation of the RTP/SCS would result in removing, relocating, and adding coverage within the Region, potentially resulting in increased coverage. All transportation projects included in the RTP/SCS that result in additional coverage would either be Linear Public Service Facilities; limited to the percent coverage allowed for each LCD set forth in TRPA Code of Ordinances Chapter 30; or required to compensate for added coverage in excess of the base allowable by identifying, purchasing, and transferring coverage from offsite parcels in accordance with TRPA Code of Ordinances Chapter 30. As a result, any increase in the total coverage in the Region would be avoided, compensated, or minimized (for Linear Public Services Facilities), and would be consistent with the Code. Therefore, for all RTP alternatives (Alternatives 1, 2, 3, 4, and 5), the impact to total coverage in the Region would be **less than significant.**

Land capability is defined as “the level of use an area can tolerate without sustaining permanent (environmental) damage through erosion and other causes” (Bailey 1974). Classification of land in this manner recognizes limitations on lands in the Region, and is used to guide the types and intensities of uses on lands while controlling erosion, water quality, and maintaining ecological balances. Impervious cover, or land coverage, such as asphalt, concrete, and roofs, prevents stormwater from absorbing into the ground. When runoff bypasses this natural process, it is not filtered by the soil and does not contribute to local groundwater supplies. Excess runoff can overload stream channels with both sediments and higher water volumes, erode stream banks, and unnecessarily damage vegetation.

Based on a GIS analysis of the conceptual locations of bicycle and pedestrian trails and corridor revitalization projects in relation to land coverage, the acreage of potential additional impervious cover has been estimated for each of the RTP alternatives. The potential impervious cover estimates for these projects are presented in Tables 3.7-9 and 3.7-10. TMDL projects would be located on existing coverage, so no additional coverage is expected. The GIS analysis does not include estimated coverage for transit projects, including the Lake Tahoe Waterborne Transit Project.

**ALTERNATIVE 1: NO PROJECT**

Alternative 1 would include Transportation Strategy Package A. Implementation of these projects has the potential to increase land coverage within the Region, requiring the removal, relocation, or mitigation of additional coverage under the TRPA Code of Ordinances Chapter 30.

All projects included in the RTP implemented under Alternative 1 have the potential to increase coverage in the Region. As shown in Tables 3.7-9 and 3.7-10, potential new coverage across all LCDs from bike, pedestrian, and corridor revitalization projects is estimated to be 33.6 acres (20.5 acres +7.2 acres +5.9 acres, respectively). However, all projects are required to adhere to TRPA Code of Ordinances Chapter 30, Land Coverage, which sets forth regulations for the permissible amount of land coverage in the Region, including LCDs, prohibition of additional land coverage in certain LCDs, and transfer and mitigation of land coverage. Therefore, all projects included in the RTP that result in additional coverage would either be Linear Public Service Facilities; limited to the percent coverage allowed for each LCD set forth in TRPA Code of Ordinances Chapter 30; or required to compensate for added coverage in excess of the base allowable by identifying, purchasing, and transferring coverage from offsite parcels in accordance with TRPA Code of Ordinances Chapter 30. In addition, proposed bicycle and pedestrian facilities could extend into stream environment zones (SEZs) within the Region. TRPA policy generally does not allow any new land coverage within SEZs but does provide certain exceptions, including public outdoor recreation facilities and Linear Public Service Facilities that meet certain criteria. Any future proposed bike trails that would result in new land coverage in an SEZ would be required to meet these specific criteria and to fully mitigate all potential impacts associated with its construction and operation.
Therefore, projects included in the RTP/SCS under Alternative 1 would have a **less-than-significant impact** on land coverage in the Region.

**ALTERNATIVE 2: LOW DEVELOPMENT, INCREASED REGULATION**

Alternative 2 would include Transportation Strategy Package B. Implementation of Alternative 2 would likely include grading, excavations, cut and fill, and trenching, all of which could alter the existing topography or ground surface of individual sites within the Region. Compared to the other alternatives, Alternative 2 poses the greatest potential for impacts because it would implement the greatest number of construction projects. As shown in Tables 3.7-9 and 3.7-10, potential new coverage across all LCDs from bike, pedestrian, and corridor revitalization projects is estimated to be 165.2 acres. Implementation of these projects has the potential to increase land coverage within the Region, requiring the removal, relocation, or mitigation of additional coverage under the TRPA Code of Ordinances Chapter 30.

All projects included in the RTP/SCS implemented under Alternative 2 have the potential to increase coverage in the Region. As discussed under Alternative 1, projects included in the RTP/SCS under Alternative 2 would have a **less-than-significant impact** on land coverage in the Region.

**ALTERNATIVE 3: LOW DEVELOPMENT, HIGHLY INCENTIVIZED REDEVELOPMENT**

Alternative 3 would include Transportation Strategy Package C. Implementation of Alternative 2 would likely include grading, excavations, cut and fill, and trenching, all of which could alter the existing topography or ground surface of individual sites within the Region. Compared to the other alternatives, potential impacts under Alternative 3 would be greater than Alternatives 1 and 5, but less than Alternative 2, and the same as Alternative 4 because of the number of construction projects. As shown in Tables 3.7-9 and 3.7-10, potential new coverage across all LCDs from bike, pedestrian, and corridor revitalization projects is estimated to be 162.7 acres. Implementation of these projects has the potential to increase land coverage within the Region, requiring the removal, relocation, or mitigation of additional coverage under the TRPA Code of Ordinances Chapter 30. As discussed under Alternative 1, projects included in the RTP/SCS under Alternative 3 would have a **less-than-significant impact** on land coverage in the Region.

**ALTERNATIVE 4: REDUCED DEVELOPMENT, INCENTIVIZED REDEVELOPMENT**

Alternative 4, like Alternative 3, would include Transportation Strategy Package C. As in the discussion for Alternative 3, implementation of Alternative 4 would likely include grading, excavations, cut and fill, and trenching, all of which could alter the existing topography or ground surface of individual sites within the Region. Compared to the other alternatives, potential impacts under Alternative 4 would be greater than Alternatives 1 and 5, but less than Alternative 2, and the same as Alternative 3 because of the number of construction projects.

As shown in Tables 3.7-9 and 3.7-10, potential new coverage across all LCDs from bike, pedestrian, and corridor revitalization projects is estimated to be 162.7 acres. Implementation of these projects has the potential to increase land coverage within the Region, requiring the removal, relocation, or mitigation of additional coverage under the TRPA Code of Ordinances Chapter 30. As discussed under Alternative 1, projects included in the RTP/SCS under Alternative 4 would have a **less-than-significant impact** on land coverage in the Region.
### Table 3.7-9. Potential Additional Impervious Cover Based on Conceptual Bike and Pedestrian Projects Locations (acres)

<table>
<thead>
<tr>
<th>LCD</th>
<th>Alternative 1</th>
<th>Alternative 2</th>
<th>Alternative 3</th>
<th>Alternative 4</th>
<th>Alternative 5</th>
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<td>Total Acres</td>
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<td>Total Acres</td>
<td>Total Acres</td>
<td>Total Acres</td>
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<tr>
<td></td>
<td>Existing Impervious Cover Permitted</td>
<td>Existing Impervious Cover Not yet permitted</td>
<td>Existing Impervious Cover Permitted</td>
<td>Existing Impervious Cover Not yet permitted</td>
<td>Existing Impervious Cover Permitted</td>
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<td>1.6</td>
<td>2.5</td>
<td>3.5</td>
<td></td>
</tr>
<tr>
<td>1B</td>
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<td>0.13</td>
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<td>0.0</td>
</tr>
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<td>7.4</td>
<td>3.8</td>
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<td>20.5</td>
<td>129.8</td>
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</table>

Source: GIS analysis conducted by Ascent Environmental, Inc. 2012

Notes: Excludes bike and pedestrian projects that would fall entirely onto existing coverage. After exclusions for projects on existing cover, remaining projects are all Class I Bike Trails. Actual SEZ coverage would be reduced through the project planning and design process.

### Table 3.7-10. Potential Additional Impervious Cover Based on Conceptual Corridor Revitalization Projects Locations (acres)

<table>
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<th>LCD</th>
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<th>Alternative 4</th>
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<td>Existing Impervious Cover Permitted</td>
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<td>5.9</td>
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Source: GIS analysis conducted by Ascent Environmental, Inc. 2012

Notes: Excludes Kings Beach Commercial Core Improvement Project and Sierra Boulevard Complete Streets Project because they would fall entirely onto existing coverage. Remaining projects are SR 89/Fanny Bridge and US 50 Loop Road. Actual SEZ coverage would be reduced through the project planning and design process.
ALTERNATIVE 5: SIMILAR RATE OF DEVELOPMENT AND REGULATORY STRUCTURE TO THE 1987 REGIONAL PLAN

Alternative 5 would include Transportation Strategy Package A. As in the discussion for Alternative 1, implementation of Alternative 5 would likely include grading, excavations, cut and fill, and trenching, all of which could alter the existing topography or ground surface of individual sites within the Region. Compared to the other alternatives, potential impacts under Alternative 5 would be less than Alternatives 2, 3, and 4 and the same as Alternative 1 because of the number of construction projects. As shown in Tables 3.7-9 and 3.7-10, potential new coverage across all LCDs from bike, pedestrian, and corridor revitalization projects is estimated to be 33.6 acres. Implementation of these projects has the potential to increase land coverage within the Region, requiring the removal, relocation, or mitigation of additional coverage under the TRPA Code of Ordinances Chapter 30. As discussed under Alternative 1, projects included in the RTP/SCS under Alternative 5 would have a less-than-significant impact on land coverage in the Region.

MITIGATION MEASURES

No mitigation is required for any of the alternatives.