6 HYDROLOGY AND WATER QUALITY

6.1 INTRODUCTION

The Shoreline Plan will regulate new and redeveloped boating facilities on Lake Tahoe, which may result in increased boat use on Lake Tahoe. This chapter evaluates the effects of both new structures and the subsequent increase in boating activity on Lake Tahoe's water quality from the Shoreline Plan alternatives. The primary issues raised during scoping efforts and coordination meetings with the Shoreline Plan's Joint Fact-Finding Committee regarding potential boating impacts are grouped into the following categories:

- sediment resuspension and turbidity,
- air pollutant deposition on the lake, and
- direct contamination from hydrocarbon and other contaminants.

In addition to potential impacts related directly to boat use, construction and maintenance of shoreline facilities under the different Shoreline Plan alternatives (e.g., new pier construction, dredging) could adversely affect water quality. Construction of new shoreline facilities or the modification of existing shoreline facilities could alter wave and current patterns within the shorezone and disrupt littoral drift processes. This chapter evaluates the potential effects on Lake Tahoe water quality from construction and maintenance of shoreline facilities, and potential alterations on littoral drift processes by shoreline facilities.

Section 6.2, "Regulatory Setting," describes the existing regulations that protect Lake Tahoe's water quality. Section 6.3, "Affected Environment," discusses the existing conditions and status of Lake Tahoe water quality and pollutant load reduction efforts relative to regulatory requirements and standards. The potential water quality and hydrodynamic impacts (e.g., littoral drift) resulting from implementation of a Shoreline Plan alternative are identified and assessed in Section 6.4, "Environmental Consequences and Mitigation Measures." Mitigation measures are recommended in Section 6.4 for any significant or potentially significant impacts on water quality or littoral drift processes.

6.2 REGULATORY SETTING

6.2.1 Federal

FEDERAL ANTIDEGRADATION POLICY

The U.S. Environmental Protection Agency (EPA) has designated Lake Tahoe an Outstanding National Resource Water (ONRW). ONRWs are provided the highest level of protection under the EPA Antidegradation Policy, stipulating that states may allow temporary and short-term changes to water quality but that such changes should not adversely affect existing uses or alter the essential character or special uses for which the water was designated an ONRW. EPA interprets this provision to mean that no new or increased discharges to ONRWs shall be permitted if that discharge would result in lower or poorer long-term water quality.

CLEAN WATER ACT

The federal Water Pollution Control Act, commonly referred to as the Clean Water Act (CWA), provides for the restoration and maintenance of the physical, chemical, and biological integrity of the nation's waters. Applicable sections of the CWA are summarized below.

Section 404

Section 404 of the CWA prohibits the discharge of fill material into waters of the United States, including wetlands, except as permitted under separate regulations by the U.S. Army Corps of Engineers (USACE) and EPA. To discharge dredged or fill material into waters of the United States, including wetlands, Section 404 requires projects to receive authorization from the Secretary of the Army, acting through USACE. Waters of the United States are generally defined as "waters which are currently used, or were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters which are subject to the ebb and flow of the tide; territorial seas and tributaries to such waters." Under Section 404 of the CWA, Lake Tahoe is considered waters of the United States.

Section 401

Section 401 of the CWA requires certification of activities through a federal license or permit for discharges of a pollutant into waters of the United States. The certification must be obtained from the state in which the discharge would originate or, if appropriate, from the interstate water pollution control agency with jurisdiction over the affected waters at the point where the discharge would originate. Therefore, all projects that have a federal component and may affect state water quality (including projects that require federal agency approval, such as issuance of a Section 404 permit) must also comply with Section 401. Water quality certification requires evaluation of potential impacts considering water quality standards and CWA Section 404 criteria governing discharge of dredged and fill materials into waters of the United States. EPA delegates water pollution control authority under Section 401 to the states.

Section 402

Section 402 of the CWA establishes the National Pollutant Discharge Elimination System (NPDES) permit program to regulate discharges of pollutants into waters of the United States. An NPDES permit sets specific discharge limits for point source discharges of pollutants into waters of the United States and establishes monitoring and reporting requirements, as well as special conditions. EPA delegates water pollution control authority under Section 402 to the states.

Section 303(d)

Section 303(d) of the CWA requires states to develop lists of water bodies that do not attain water quality objectives after implementation of required levels of treatment by point source dischargers (municipalities and industries). Section 303(d) requires that a state develop a total maximum daily load (TMDL) for each of the listed pollutants. A TMDL is the amount of an identified pollutant that a water body can receive and still comply with water quality objectives. A TMDL is also a plan to reduce loading of a specific pollutant from various sources to achieve compliance with water quality objectives. EPA must either approve a TMDL prepared by a state or disapprove a state's TMDL and issue its own. A TMDL represents a goal that may be implemented by adjusting pollutant discharge requirements in individual NPDES permits or by establishing nonpoint source controls. NPDES permit limits for listed pollutants must be consistent with the waste load allocation prescribed in the TMDL. After implementation of a TMDL, it is anticipated that the problems that led to placement of a given pollutant on the Section 303(d) list would be remediated.

6.2.2 Tahoe Regional Planning Agency

TRPA was designated as an areawide planning agency under Section 208 of the CWA in 1974. Under the Tahoe Regional Planning Compact, TRPA has established environmental threshold standards, goals and policies, and ordinances directed at protecting and improving water quality in Lake Tahoe and the Tahoe region. The focus of water quality enhancement and protection is to minimize the effects of human-made disturbances to the watershed and reduce or eliminate pollutants that result from existing and proposed development. The Tahoe Regional Planning Compact includes the following statements and direction related to water quality:

- The waters of Lake Tahoe are threatened with deterioration or degeneration, which endangers the natural beauty and economic productivity of the Region (Article (I)(a)(1));
- TRPA shall develop an enforceable land use plan for, among other purposes, the uses of water and other natural resources within the Region (Article (V)(c)(1));
- The Regional Plan shall provide for attaining and maintaining federal, state, or local water quality standards, whichever are the strictest, in the respective portions of the Region for which the standards are applicable (Article (V)(d)); and
- The Regional Plan shall, by ordinance, identify the means and time schedule by which water quality standards will be attained (Article (V)(d)).

THRESHOLDS

The TRPA Governing Board adopted Resolution 82-11, which established water quality threshold standards for six indicator categories: (1) Lake Tahoe pelagic (deep) waters, (2) Lake Tahoe littoral (nearshore) waters, (3) tributaries, (4) direct surface runoff and stormwater discharge to surface waters, (5) stormwater discharge to groundwater, and (6) other lakes (i.e., lakes in the Tahoe basin other than Lake Tahoe). Resolution 82-11 sets numerical and management standards for water quality. Some of these threshold standards are referenced to state standards, and in other cases, target reference conditions related to specific time periods are noted. The following value statements are used in setting the threshold standards and targets for water quality:

- Attain levels of water quality in the lakes and streams within the Tahoe Region suitable to maintain the identified beneficial uses of Lake Tahoe.
- Restrict algal productivity (rate of growth) to levels that do not impair beneficial uses or deteriorate existing water quality conditions in the Tahoe Region.
- Prevent degradation of the water quality of Lake Tahoe and its tributaries to preserve the lake for future generations.
- Restore all watersheds in the Tahoe Region so that they respond to runoff in a natural hydrologic function.

Water quality threshold standards adopted by TRPA set a target to return the lake to the transparency observed in the late 1960s. Within the six major indicator categories, TRPA uses seven water quality standards to assess the water quality of Lake Tahoe and its tributaries. Table 6-1 lists indicator categories and associated threshold standards applicable to the analysis of Shoreline Plan alternatives. In 2012, the TRPA Governing Board adopted a new standard in the nearshore environment to address attached algae, which is included in Table 6-1. The status and trend of each threshold relative to the associated numerical standard or management standard is described in Section 6.3, “Affected Environment.”

Table 6-1 Applicable TRPA Water Quality Threshold Standards for Shoreline Plan Alternatives

Indicator Category	Standard	Numerical Standard and/or Management Standard
Pelagic Lake Tahoe (deep water)	Annual average transparency	Annual average deep-water transparency as measured by a Secchi disk shall decrease below 29.7 meters (97.4 feet).
Pelagic Lake Tahoe (deep water)	Phytoplankton primary productivity	Annual mean phytoplankton primary productivity shall not exceed 52 grams of carbon per square meter per year.
Littoral Lake Tahoe (nearshore)	Turbidity	Decrease sediment load as required to attain turbidity values not to exceed 3 Nephelometric Turbidity Units (NTUs) in littoral Lake Tahoe. In addition, turbidity shall not exceed 1 NTU in shallow waters of Lake Tahoe not directly influenced by stream discharges.
Littoral Lake Tahoe (nearshore)	Attached algae	Implement policy and management actions to reduce the areal extent and density of periphyton (attached algae) from Lake Tahoe's nearshore.
Stormwater runoff quality	Surface discharge to surface water	Pollutant concentrations in surface runoff discharged to surface water shall not exceed the following concentrations at the 90th percentile: ◢ 0.5 mg/L dissolved inorganic nitrogen as N ◢ 0.1 mg/L dissolved phosphorus as P ◢ 2.0 mg/L grease and oil ◢ 0.5 mg/L dissolved iron ◢ 250 mg/L suspended sediment

Note: mg/L = milligrams per liter.

Source: TRPA 2016

GOALS AND POLICIES

TRPA has established goals and policies related to water quality. Goals include the reduction of sediment and nutrients to Lake Tahoe and the elimination or reduction of other pollutants. The existing goals and policies for water quality protection and shorezone conservation encompass the following regulatory framework (TRPA 2012a):

- Support the Lake Tahoe TMDL program (see Section 6.2.5) in California and Nevada and local government pollutant/stormwater load reduction planning and implementation.
- Regulate developed properties to install and maintain best management practices (BMPs) that reduce erosion and control stormwater runoff.
- Prohibit the discharge of wastewater, toxic waste, and solid waste into Lake Tahoe, its tributaries, and groundwater resources.
- Regulate the placement and design of shorezone structures to avoid degradation of fish habitat and interference with littoral drift.

CODE OF ORDINANCES

The TRPA Code of Ordinances (TRPA Code) contains the requirements and standards intended to achieve water quality thresholds, and the goals and policies of the TRPA Regional Plan Chapter 60 of the TRPA Code is directed specifically at water quality protection. Chapters 80–85 of the TRPA Code contain provisions related to permissible uses, activities, and placement of structures within the shorezone (Table 6-2).

Table 6-2 Code Requirements Related to Water Quality Protection and Shorezone Structures

Code Section	Requirements
Chapter 33	Sets standards for grading and excavation.
Chapter 60.1	Sets discharge standards for runoff to surface water and groundwater.
Chapter 60.2	Sets requirements that new residential, commercial, and public projects completely offset their water quality impacts.
Chapter 60.3	Contains regulations pertaining to recognition of source water, prevention of contamination to source water, and protection of public health relating to drinking water.
Chapter 60.4	Sets standards for installation of BMPs for the protection or restoration of water quality.
Chapter 80	Sets forth findings that must be made by TRPA prior to approving a project in the shorezone.
Chapter 81	Identifies permissible uses and accessory structures in the shorezone.
Chapter 82	Sets requirements for maintenance, repair, or expansion of existing structures in the shorezone.
Chapter 84	Regulates the placement of new piers, buoys, and other structures in the shorezone to avoid interference with littoral drift; sets BMP compliance standards for new marinas or marina expansions; sets conditions for permittable filling and dredging activities; and sets standards for operation of motorized watercraft.
Chapter 85	Sets standards and policies for projects and activities in the backshore.

Note: BMP = best management practice.

Source: TRPA 2012b

BMP HANDBOOK

The TRPA Best Management Practices Handbook (BMP Handbook, 2014) provides guidance for selecting and implementing water quality BMPs that reduce or prevent the pollutants of concern identified in the Lake Tahoe TMDL program (see Section 6.2.5) and other pollutants from entering surface and ground waters. Chapter 8 of the BMP Handbook defines the standards and criteria for the planning, design, and expected performance of potential shorezone projects and activities, which include:

- dredging;
- turbidity curtains;
- boating discharge control and marina maintenance; and
- boat ramp construction and vehicle source control methods and design.

The guidance in Chapter 8 of the BMP Handbook was developed to be consistent with industry standards represented in the U.S. Army Corps of Engineers (USACE) Coastal Engineering Manual (2008), which is the USACE's most up to date and comprehensive guidance for coastal and lake shore engineering.

6.2.3 California

LAHONTAN REGIONAL WATER QUALITY CONTROL BOARD

The Porter-Cologne Water Quality Control Act (Porter-Cologne Act) created the California State Water Resources Control Board (SWRCB) and nine regional water quality control boards (RWQCBs) in California. The SWRCB protects water quality by setting statewide policy, coordinating and supporting RWQCB efforts, and reviewing petitions that contest RWQCB actions. The RWQCBs issue waste discharge permits, take enforcement action against violators, and jointly administer federal and state laws related to water quality in coordination with EPA and USACE.

The Tahoe Region is located within the jurisdiction of the Lahontan Regional Water Quality Control Board (Lahontan Water Board). On the California side of the Tahoe Region, the Lahontan Water Board implements

the CWA, the California Water Code (including the Porter-Cologne Act), the California Lake Tahoe TMDL, and a variety of laws related to control of solid waste and toxic and hazardous wastes. The Lahontan Water Board has authority to set and revise water quality standards and discharge prohibitions. It issues federal permits, including NPDES permits and Section 401 water quality certifications, and state waste discharge requirements or waivers of waste discharge requirements. Its planning and permitting actions require compliance with the California Environmental Quality Act.

Water Quality Control Plan for the Lahontan Region

Water quality standards and control measures for surface water and groundwater within the Lahontan Region are contained in the Water Quality Control Plan for the Lahontan Region (Basin Plan). The Basin 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 Basin Plan, "Water Quality Standards and Control Measures for the Tahoe Region," summarizes a variety of control measures for the protection and enhancement of Lake Tahoe.

The Basin Plan was first adopted in 1975 and was most recently updated in 2016. It contains both narrative and numeric water quality objectives for the region. The Basin Plan amendments include additional language related to "mixing zones" for dilution of discharged water, compliance schedules for NPDES permits, discharge prohibition exemptions, simplification of existing prohibition exemptions, and the removal of language describing programs administered by TRPA (Lahontan Water Board 2016).

Both the Basin Plan and TRPA Code prohibit new construction of shorezone structures in prime fish habitat. If the selected Shoreline Plan alternative resulted in an amendment to location standards for shorezone structures under the TRPA Code, a similar amendment would be necessary for the Basin Plan to retain consistency with the TRPA Code.

6.2.4 Nevada

NEVADA DIVISION OF ENVIRONMENTAL PROTECTION

The Nevada Division of Environmental Protection (NDEP) Bureau of Water Quality Planning is responsible for several water quality protection functions, including collecting and analyzing water data, developing standards for surface waters, publishing reports, providing water quality education, and implementing programs to address surface water quality. The Bureau of Water Quality Planning is divided into the water quality standards branch, monitoring branch, Nonpoint Source Pollution Management Program, and Lake Tahoe Watershed Program unit. The branches are responsible for the following duties and responsibilities:

- The water quality standards branch is responsible for developing and reviewing water quality standards, determining wasteload allocations from point sources, and determining TMDLs and load allocations from nonpoint sources.
- The monitoring branch is responsible for administering the state's water quality monitoring program. This branch maintains and updates water quality data for the national water quality database (Water Quality Exchange Network) and is responsible for preparing Nevada's Water Quality Assessment Report, which is required under Section 305(b) of the CWA.
- The Nonpoint Source Pollution Management Program leads the control of nonpoint sources of pollution in Nevada. Nonpoint source pollution results from a variety of diffuse and dispersed human activities.
- The Lake Tahoe Watershed Program unit developed and manages the Nevada Lake Tahoe TMDL (see Section 6.2.5).

6.2.5 Lake Tahoe TMDL

The Lake Tahoe TMDL was developed in a partnership between the Lahontan Water Board and NDEP to address the declining transparency and clarity of Lake Tahoe, which results from light scatter from fine sediment particles (primarily particles less than 16 micrometers in diameter) and light absorption by phytoplankton (algae). The addition of phosphorus and nitrogen to Lake Tahoe contribute to phytoplankton growth. Because fine sediment particles, phosphorus, and nitrogen are responsible for the decline in lake transparency and clarity, Lake Tahoe is listed under Section 303(d) of the CWA as impaired by the input of these three pollutants of concern.

California and Nevada must comply with, administer, and enforce their own state laws and policies. In addition, each state has separate Section 303(d) filings with EPA for the Lake Tahoe TMDL that vary as follows:

- California's Lake Tahoe TMDL, dated November 2010 and approved by EPA in 2011, requires attainment of the California transparency objective for Lake Tahoe over a 65-year implementation period. California has identified Lake Tahoe's lack of transparency as the primary basis for its impaired status under its Section 303(d) impaired water listings filed with EPA. To comply with California's Lake Tahoe transparency standard, a Secchi disk would need to be visible 29.7 meters (97.4 feet) below the surface of Lake Tahoe on an average annual basis.

  Based on California law, the Lahontan Water Board has the obligation to implement and enforce the California Lake Tahoe TMDL through NPDES discharge permits (over which EPA has jurisdiction) issued to California government entities that include Placer County, El Dorado County, the City of South Lake Tahoe, and the California Department of Transportation.

- Nevada's Lake Tahoe TMDL, dated August 2011 and approved by EPA in 2011, is a modified version of the California Lake Tahoe TMDL. The Nevada Lake Tahoe TMDL clarifies Nevada's regulatory structure and approach to implementation and emphasizes that the proposed implementation timelines may need to be adjusted for a variety of reasons, but particularly based on the availability of future funding. NDEP's stated plan for implementing the Lake Tahoe TMDL for Washoe County and Douglas County is through memoranda of agreement (MOA) with each jurisdiction. MOAs are a collaborative, legally nonbinding approach to implementing a TMDL. NDEP regulates the Nevada Department of Transportation and the Stateline Stormwater Association with NPDES discharge permits (over which EPA has jurisdiction).

  Nevada has identified Lake Tahoe's lack of clarity as the primary basis for its impaired status under its Section 303(d) impaired water listings filed with EPA. Clarity is the quantitative measure of the vertical extinction of light (VEC) per meter of depth. A lower VEC reading indicates more clarity to the water. To comply with Nevada's Lake Tahoe clarity standard, a VEC of 0.08 per meter is necessary.

6.3 AFFECTED ENVIRONMENT

The Tahoe basin was formed approximately 2–3 million years ago by geologic faulting and volcanic activity. Geologic faults running in a north-south direction allowed the formation of a valley between the uplifting Sierra Nevada and the Carson Range. The northern portion of the valley was blocked and dammed by volcanic activity that created the 506-square-mile basin that lies along the California-Nevada border. Precipitation and runoff eventually filled a portion of the basin to create Lake Tahoe, which has a water surface area covering nearly two-fifths of the total basin area (191 square miles).

Lake Tahoe is fed by 63 tributary streams and intervening zones that drain directly to the lake. The largest tributary is the Upper Truckee River, which accounts for 25 percent of the annual inflow to Lake Tahoe. The Truckee River is the lake's only outlet, flowing to Pyramid Lake in Nevada. A dam constructed at Tahoe City in the early 1900s regulates water flow to the Truckee River from the natural rim at 6,223.0 feet above sea

level to the maximum legal lake level of 6,229.1 feet (Lake Tahoe Datum). The lake is 12 miles wide and 22 miles long with 72 miles of shoreline.

Regional topography is characterized by steep mountain slopes at higher elevations, transitioning to more moderately sloped terrain near the lakeshore. A notable precipitation gradient exists from the western boundary of the Tahoe Region along the crest of the Sierra Nevada to the eastern boundary at the crest of the Carson Range. The west shore of Lake Tahoe averages about 35 inches per year of precipitation, while the east shore averages about 20 inches per year. Most precipitation in the Tahoe Region falls between October and May as snow at higher elevations and as a mixture of snow and rain at lake level. In the higher elevations, peak stream runoff from snowmelt occurs in May or June, while the snowpack near lake level melts a few weeks earlier.

The Shoreline Plan alternatives have the potential to affect the quality and movement of Lake Tahoe's waters. The affected environment described below summarizes the conditions of Lake Tahoe waters separated into discussions of Lakezone Water Quality (Section 6.3.1) and Nearshore Water Quality (Section 6.3.2). The shorezone diagram (Exhibit 2-2) illustrates the boundaries of each zone as defined by TRPA Code (Chapter 83). Shorezone structures are typically located within the backshore and foreshore zones, although some structures, such as piers, extend into the nearshore. Shorezone structures have the potential to adversely affect littoral draft, which is a potential impact analyzed in this chapter. Chapter 2 of this EIS, "Project Description," provides a discussion of existing shorezone facilities and structures.

6.3.1 Lakezone Water Quality

The TRPA Code defines Lake Tahoe's lakezone as all waters lakeward of a bottom elevation of 6,193 feet (Lake Tahoe Datum), or more than 350 feet from the shoreline (Exhibit 2-2), whichever is further. The lakezone encompasses Lake Tahoe's deeper waters, also referenced herein and by TRPA Code as the lake's pelagic waters. TRPA threshold standards for pelagic waters strive to attain and then maintain exceptional transparency and clarity.

The Lake Tahoe TMDL was developed collaboratively by the Lahontan Water Board and NDEP as the framework for comprehensive water quality restoration planning to address identified pollutant sources and ultimately achieve the Lake Tahoe transparency and clarity water quality objectives for pelagic waters (Lahontan Water Board and NDEP 2010:1-1).

The following subsections summarize the identified sources of pollutants of concern for lake transparency and the status of Lake Tahoe TMDL planning and implementation for pelagic waters.

POLLUTANTS OF CONCERN FOR LAKE TRANSPARENCY

Lake Tahoe is classified by limnologists as an oligotrophic lake, which means the lake has very low concentrations of nutrients that can support algal growth, leading to clear water and high levels of dissolved oxygen (TERC 2011:6.15). The exceptional transparency of Lake Tahoe results from naturally low inputs of nutrients and sediment from the surrounding watershed.

Scientific research points to inorganic fine sediment particles (defined as particles less than 16 micrometers in diameter) as the primary pollutant of concern impairing the lake's transparency. This finding is based on the ability of inorganic fine sediment particles to efficiently scatter light and decrease observed transparency. Swift et al. (2006) determined that light scattering by inorganic particles for the period between 1999 and 2002 was responsible for roughly 55–60 percent of measured light attenuation in the lake. Organic particles (algae) were responsible for about 25 percent of measured light attenuation, primarily through adsorption of light. The remaining 15–20 percent of measured light attenuation was attributable to natural absorption of light by water molecules.

The addition of the nutrients phosphorus and nitrogen to Lake Tahoe can stimulate algal growth in the lake's nutrient-poor waters, which can increase light absorption by algae and degrade Lake Tahoe transparency. Presently, scientific research indicates that algal growth may be dependent on the availability of both phosphorus and nitrogen, but in many months of the year, algal growth is predominantly controlled by the availability of phosphorus (TERC 2011:10.7).

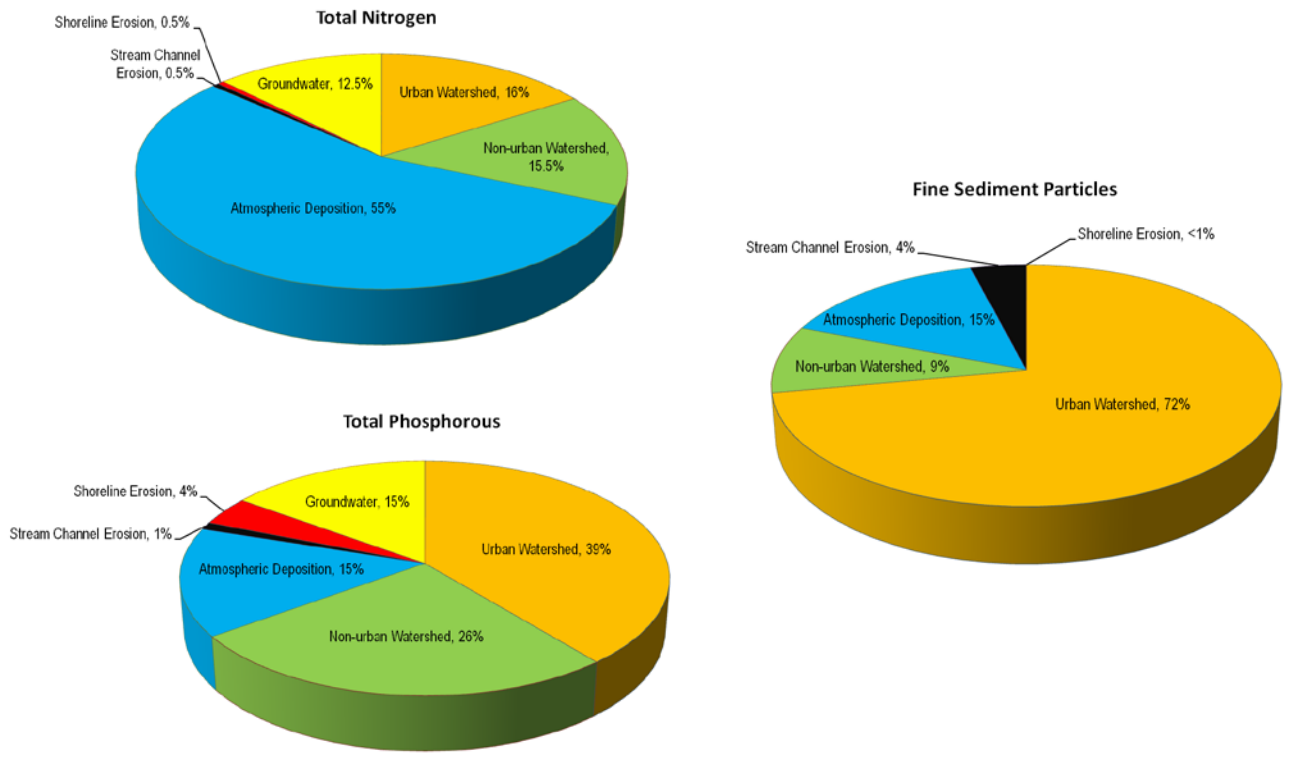
LAKE TAHOE TMDL QUANTIFICATION OF SOURCES FOR POLLUTANTS OF CONCERN

The science and analysis supporting the Lake Tahoe TMDL was a collaborative, multiagency, multiyear effort that developed an extensive body of scientific research that (1) identifies the load, or mass, of pollutants of concern responsible for the decline in Lake Tahoe's transparency (fine sediment particles, phosphorus, and nitrogen); (2) quantifies the sources of pollutants of concern to the lake; and (3) establishes load reduction milestones that can be used to develop policies and stormwater/pollutant load reduction plans to progress toward achievement of water quality objectives. The collection, analysis, and interpretation of information supporting the Lake Tahoe TMDL included the following actions (Lahontan Water Board and NDEP 2010:14-3 to 14-4):

- analysis of data sets on:
  - 1) long-term lake clarity and transparency and related limnological characteristics;
  - 2) stream hydrology and nutrient and sediment concentrations/loading;
  - 3) stormwater runoff concentrations;
  - 4) atmospheric deposition;
- assessment of numerous scientifically accepted documents on Lake Tahoe and the Tahoe Region; and
- development, calibration, and validation of models using Tahoe-specific data.

The Lake Tahoe TMDL research included an analysis of pollutant sources to identify the magnitude of pollutant loads to Lake Tahoe from various source categories. These pollutant sources are defined as surface runoff from developed lands (urban watershed), atmospheric deposition, forested runoff (nonurban watershed), stream channel erosion, groundwater, and shoreline erosion.

Exhibit 6-1 displays the relative distribution of average annual pollutant loading to Lake Tahoe for each pollutant of concern among the source categories (Lahontan Water Board and NDEP 2010:7-2 to 7-3). As shown in Exhibit 6-1, the Lake Tahoe TMDL identifies surface runoff from developed lands (urban watershed) as the most significant source of pollutant loading for fine sediment particles (the primary pollutant of concern) and phosphorus. Surface runoff from developed lands is estimated to deliver more than 70 percent of the average annual fine sediment particle load and roughly 40 percent of the average annual phosphorus load to the lake. For nitrogen, atmospheric deposition is identified as the most significant source of loading to the lake, contributing 55 percent of the average annual load.



Source: Adapted from Lahontan Water Board and NDEP 2010:7-2 and 7-3

Exhibit 6-1 Sources of Pollutants of Concern to Lake Transparency

Stormwater/Pollutant Load Reduction Milestones

The Lake Tahoe TMDL indicates that to achieve TRPA's transparency standard, total basinwide loads of fine sediment particles, phosphorus, and nitrogen need to be reduced by 65 percent, 35 percent, and 10 percent, respectively (Lahontan Water Board and NDEP 2010:10-4). Load reductions are expressed as a percentage of baseline pollutant loads calculated for conditions in the year 2004.

Through the Lake Tahoe TMDL, Lahontan Water Board and NDEP have established 5-year load reduction milestones to help assess progress toward meeting overall load reduction goals. The Lake Tahoe TMDL sets an interim goal for the year 2026, termed the Clarity Challenge, to reduce basinwide loading from all sources for fine sediment particles, phosphorus, and nitrogen by 32 percent, 17 percent, and 4 percent, respectively. Attainment of the Clarity Challenge is estimated to return the lake to an average annual transparency of 78.7 feet, or 24 meters (Lahontan Water Board and NDEP 2010:8-7).

Given that the majority of pollutant loads for fine sediment particles and phosphorus are delivered to the lake from developed lands (urban watershed), the Lahontan Water Board and NDEP have prioritized this source category as the greatest opportunity for pollutant control. Pollutant load allocations and load reduction targets are specified for each jurisdiction in the Tahoe Region through NPDES permits for El Dorado County, Placer County, the City of South Lake Tahoe, and the California Department of Transportation. For local jurisdictions in Nevada (Washoe County and Douglas County), NDEP has developed MOAs that set load reduction goals and guide the implementation of projects and actions to achieve Lake Tahoe TMDL milestones. NDEP defines pollutant load allocations and load reduction targets for the Nevada Department of Transportation through an NPDES permit. Through either an NPDES permit or an MOA, each jurisdiction has developed stormwater/pollutant load reduction plans that prioritize water quality projects and actions to reduce loading from developed lands to meet Lake Tahoe TMDL milestones. Upcoming milestones are provided in Table 6-3.

Table 6-3 Upcoming Load Reduction Milestones from Developed Lands[1]

Pollutant of Concern	2021 Target	2026 Clarity Challenge	Standard Attainment
Fine sediment particles	21%	34%	71%
Total phosphorus	14%	21%	46%
Total nitrogen	14%	19%	50%

[1] Load reductions are expressed as percent reductions of baseline pollutant loads calculated for conditions in 2004. Percent reductions shown are for the developed lands source category (i.e., stormwater runoff), which differs from load reductions expressed as percent reductions for basinwide loads from all sources.

Source: Adapted from Lahontan Water Board and NDEP 2010:10-4

Stormwater/Pollutant Load Reduction Progress (2016 Milestone Reporting)

The Lake Clarity Crediting Program (Crediting Program) was developed by Lahontan Water Board and NDEP as an accounting system to track progress toward load reduction milestones defined by the Lake Tahoe TMDL (Table 6-3). Lake Clarity Credits (credits) are obtained by using a set of tools and protocols to estimate stormwater/pollutant load reductions achieved by implementing and maintaining water quality improvements or pollutant controls. Credits are calculated and awarded based on the mass of fine sediment particle reduction relative to a defined baseline condition in the year 2004. While credits are currently awarded and tracked based on fine sediment particle reduction, each jurisdiction reports on progress for reducing total loads for all three pollutants of concern (fine sediment particles, total phosphorus, and total nitrogen).

The seven jurisdictions identified above work through the Crediting Program to register pollutant controls to attain credits. The 2016 target for each jurisdiction, corresponding with the first 5-year milestone enumerated in the Lake Tahoe TMDL for developed lands, required the following baseline load reduction:

- 10 percent reduction in fine sediment particles,
- 7 percent reduction in total phosphorous, and
- 8 percent reduction in total nitrogen.

Through the 2016 water year, 23 registrations have been submitted through the Crediting Program by the jurisdictions and have been reviewed and certified by either the Lahontan Water Board or NDEP. In total, the seven jurisdictions have accrued 1,340 credits, which is 205 credits (18 percent) over the total requirement of 1,135 credits to achieve the 2016 load reduction milestone (Lahontan Water Board and NDEP 2017:4).

Table 6-4 shows the published load reductions through water year 2016, expressed as a mass (pounds per year) and as a percent relative to the baseline condition, for each pollutant of concern.

Table 6-4 2016 Milestone for Developed Lands Source Category: Pollutant Load Reduction Progress Reporting

Pollutant	2016 Milestone Load Reduction Target (lbs/year)	Water Year 2016 Certified Load Reduction (lbs/year)	2016 Milestone Load Reduction Target Relative to Baseline (%)	Water Year 2016 Certified Load Reduction Relative to Baseline (%)
Fine sediment particles	227,896	268,508	10	12
Total phosphorus	629	768	7	8.5
Total nitrogen	2,825	2,150	8	6

Note: lbs/year = pounds per year.

Source: Lahontan Water Board and NDEP 2017:5

Load reductions achieved from Crediting Program registrations exceeded the 5-year fine sediment particle and total phosphorus milestones. Registration of load reductions for total nitrogen fell short of the 2016 milestone, but attainment of the Clarity Challenge focuses on fine sediment particle reductions and long-

term strategies for attaining total nitrogen objectives will rely more heavily on atmospheric source reductions (Lahontan Water Board and NDEP 2017:4).

6.3.2 Nearshore Water Quality

The TRPA Code defines Lake Tahoe's nearshore as the low-water elevation of 6,223 feet to a lake bottom elevation of 6,193 feet (Lake Tahoe Datum), but in any case, a minimum lateral distance of 350 feet measured from the shoreline (Exhibit 2-2). The nearshore is the portion of the lake that residents and visitors to the Tahoe Region interact with most, and nearshore conditions have received increased attention and scrutiny over the last decade. The increased focus on nearshore conditions is primarily driven by perceived, anecdotal changes to nearshore clarity, periphyton growth (attached algae), and the presence of invasive species.

Compared to long-term data collection and the science supporting the Lake Tahoe TMDL, which focuses on understanding Lake Tahoe's pelagic waters, the scientific approaches and long-term data sets for investigating and understanding the factors that influence Lake Tahoe's nearshore conditions are still under development. A collaboration between the Desert Research Institute, University of California at Davis, and the University of Nevada at Reno produced the Lake Tahoe Nearshore Evaluation and Monitoring Framework Report (Heyvaert et al. 2013). The report presents a conceptual understanding of nearshore processes, identifies deficiencies in the data available to characterize the status of the nearshore, and proposes a set of monitoring metrics. The report emphasizes the heterogenous and inherently complex environment of the nearshore and highlights the spatial variability of observed environmental conditions through review of available data. Factors influencing the observed variability are hypothesized based on literature review and available data assessments to include adjacent land uses and urban stormwater inputs, nonpoint pollutant inputs, boat activity, proximity to stream inputs, water movement and wave action, water depth, substrate type, and localized features of the lake bottom.

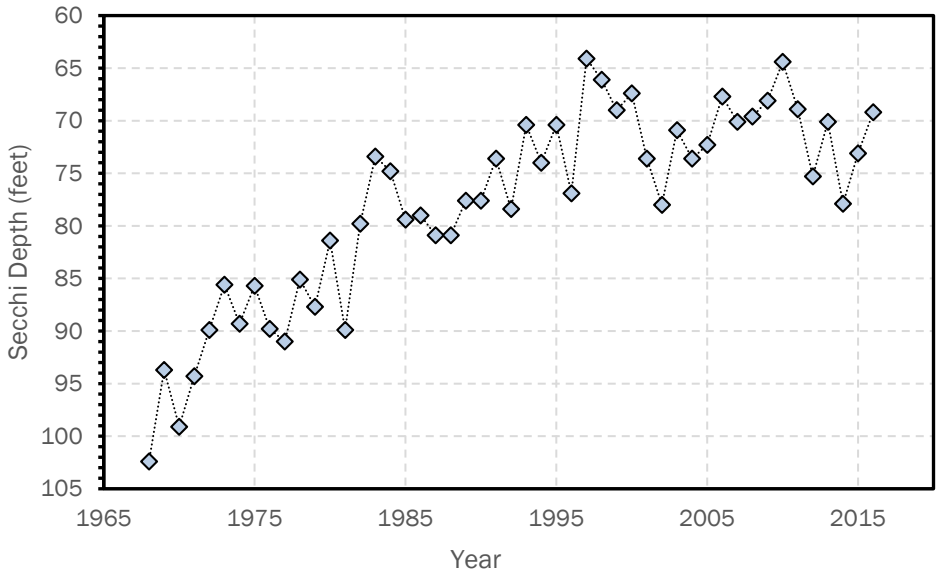
The Lake Tahoe Nearshore Evaluation and Monitoring Framework Report notes that pollutant sources affecting the nearshore conditions are generally the same as those identified in the Lake Tahoe TMDL. Therefore, management actions resulting in pollutant load reductions associated with the Lake Tahoe TMDL will also provide benefits to clarity and related characteristics to nearshore conditions (Heyvaert et al. 2013:55–56).

6.3.3 Status of Relevant Lake Tahoe Water Quality Thresholds

This section summarizes the status and trends of indicator categories and associated standards applicable to Lake Tahoe water quality and the analysis of Shoreline Plan alternatives.

PELAGIC LAKE TAHOE WATER QUALITY: SECCHI DEPTH TRANSPARENCY

Transparency in the lake is measured every 7–10 days by submerging a Secchi disk, a 10-inch white, circular plate, and recording the depth at which the plate is no longer visible to the human eye. These readings, or Secchi depths, suggest the relative transparency of the lake increases with deeper measurements of Secchi depth. Lower readings of Secchi depths occur as the plate's visibility is impaired by the light-scattering effects of inorganic particles (e.g., sediment) and the light absorption of organic particles (e.g., algae) in the lake. The TRPA numerical standard for average annual Secchi depth is 97.4 feet (29.7 meters). Researchers from the Tahoe Environmental Research Center (TERC) have collected measurements of Secchi depth since 1968. Average annual values for Secchi depth from 1968 through 2016 are presented in Exhibit 6-2.



Source: Adapted from TERC 2017

Exhibit 6-2 Average Annual Secchi Depth

The 2016 value of 69.2 feet (21.1 meters) is 5.1 feet greater than the lowest average annual Secchi depth (64.1 feet, 19.5 meters) recorded in 1997. The 2016 value is approximately 28 feet below attainment of the TRPA numerical standard. The 2015 TRPA Threshold Evaluation (TRPA 2016) reports the status of Secchi depth for the TRPA numerical standard as somewhat worse than the target, with the trend categorized as having little or no change. Statistical analysis of the data shown in Exhibit 6-2 indicates that the decline in Lake Tahoe's transparency has slowed in recent years. For over a decade, the average annual transparency has hovered around 70 feet, but sizable interannual and seasonal variability is observed.

PELAGIC WATER QUALITY: RATE OF PHYTOPLANKTON GROWTH

Phytoplankton (i.e., algae) decreases water clarity by absorbing light; thus, the growth rates of algal blooms in the lake indicate the progress of efforts to improve transparency. An algal growth rate, or phytoplankton primary productivity, of 52 grams of carbon per square meter per year ($gC/m^2/year$) was set by TRPA in 1982 as the numerical threshold standard, based on data collected from 1968 through 1971. Samples collected by TERC continuously since 1968 show that phytoplankton primary productivity has remained well above the standard since its adoption.

In 2016, primary productivity was 225 $gC/m^2/year$, or 4.3 times greater than the standard. The 2015 TRPA Threshold Evaluation (TRPA 2016) reports the status of phytoplankton primary productivity as considerably worse than the target, and the trend as rapidly worsening. However, one contributor to the accelerated productivity may be a long-term shift toward smaller algal species that can process nutrients faster (TERC 2015).

LITTORAL WATER QUALITY: TURBIDITY

The quality of water in the nearshore area is tracked by measuring turbidity, which is an indication of the cloudiness of water expressed in Nephelometric Turbidity Units (NTUs). Higher turbidity measurements indicate cloudier water. TRPA maintains standards for nearshore turbidity of 3 NTU in areas influenced by stream discharge and 1 NTU in areas not influenced by stream discharge.

Pilot-scale implementation of optical (clarity and transmissivity) monitoring protocols recommended in the Lake Tahoe Nearshore Evaluation and Monitoring Framework Report (Heyvaert et al. 2013) were conducted

in 2014 and 2015 (Heyvaert et al. 2016). The pilot monitoring effort completed five nearshore surveys from November 2014 through November 2015, using flow-through (in-situ) sensors mounted to a research vessel that followed a consistent path-line around the nearshore at approximately the 7-meter depth contour. The following findings and observations were reported (Heyvaert et al. 2016:iii–iv):

- No single turbidity measurement exceeded the existing TRPA threshold standard of 1 NTU. However, the measurements were conducted during non-storm periods, and elevated turbidity would likely be expected during times of increased stormwater runoff.
- The highest turbidity, while still below the existing TRPA threshold standard, was typically observed near urban areas along the south shore, northeast shore, and northwest shore. However, attempts to correlate the density of urban development to turbidity measurements within the nearshore produced a weak correlation (R2 = 0.214). The weak correlation could be influenced by a lack of notable stormwater runoff from urban areas during the monitoring period.
- Transmissivity measurements used to identify the status and trend of nearshore clarity are theoretically promising given the near linear relationship between transmissivity and clarity. However, the collected transmissivity data demonstrated disparate results in certain areas from unknown factors.

Based primarily on the data summarized above, the 2015 TRPA Threshold Evaluation reports the status of turbidity as somewhat better than the target, with insufficient data to determine a trend attributable to a lack of a long-term monitoring program and associated data (TRPA 2016).

LITTORAL WATER QUALITY: NEARSHORE ATTACHED ALGAE

In 2012, the TRPA Governing Board adopted a new standard in the nearshore environment to address attached algae (periphyton) growing to submerged surfaces in the lake such as lake substrate, rocks, buoys, and piers. The adopted TRPA standard for nearshore attached algae is qualitive and focuses on supporting policy and management actions to reduce the areal extent and density of attached algae in the nearshore. The 2015 TRPA Threshold Evaluation reports the status and trend for attached algae could not be assessed due to insufficient data given the lack of defined numerical targets (TRPA 2016).

6.4 ENVIRONMENTAL CONSEQUENCES AND MITIGATION MEASURES

6.4.1 Methods and Assumptions

The evaluation of potential water quality and hydrodynamic impacts from the Shoreline Plan alternatives is based on a review of documents pertaining to Lake Tahoe and the shorezone, including previous Lake Tahoe water quality studies, previous environmental impact statements/reports, existing regulations and ordinances, and published and unpublished literature focused on the water quality effects of motorized boating. The information obtained from these sources was reviewed and summarized to understand existing conditions and to identify potential environmental effects, based on the significance criteria defined below. In determining the level of significance, the analysis assumes that the Shoreline Plan alternatives would comply with relevant federal, state, and local laws and regulations and TRPA regulations and ordinances.

ENVIRONMENTAL EFFECTS ANALYZED ELSEWHERE

The following potential environmental effects have linkages to water quality but are analyzed in other sections of this EIS and are not discussed or analyzed in this chapter:

- Aquatic Invasive Species: Increased boat use could introduce and spread aquatic invasive species, which could lead to alterations in the water quality of Lake Tahoe. This chapter assesses possible direct

effects on water quality from the Shoreline Plan alternatives. Effects on related resources, such as the potential introduction or spread of aquatic invasive species from Shoreline Plan alternatives, are evaluated in other chapters of this EIS.

- Boat Emissions Affecting Air Quality: The Shoreline Plan will regulate new and redeveloped boating facilities on Lake Tahoe, which may result in increased boat use. Emission estimates from changes in boating activity under the Shoreline Plan alternatives are developed and presented in Chapter 10, "Air Quality." This chapter uses the emission estimates to estimate and assess the proportion of emissions that enter Lake Tahoe's water through direct exchange at the water surface and atmospheric deposition. However, the methods and assumptions used to derive estimated emissions from boating activities are not discussed in this chapter.

6.4.2 Significance Criteria

Significance criteria relevant to hydrology and water quality are summarized below. The applicable TRPA threshold standards, the water quality and hydrology criteria from the TRPA Initial Environmental Checklist, and other relevant information were considered in the development of the significance criteria. Implementation of a Shoreline Plan alternative would result in a significant adverse effect on water quality or hydrodynamics (e.g., littoral drift) if new or redeveloped boating facilities and associated changes in boating activity would:

- cause substantial short-term accelerated soil erosion and/or release of pollutants to water bodies associated with construction or maintenance of a shoreline facility,
- substantially increase fine sediment resuspension and turbidity,
- increase atmospheric deposition of pollutants onto the surface of Lake Tahoe,
- substantially increase pollutant discharges of hydrocarbons or other contaminants into Lake Tahoe, or
- cause substantial interference with or adverse effects on littoral processes.

6.4.3 Environmental Effects of the Project Alternatives

Impact 6-1: Soil erosion and/or release of pollutants to Lake Tahoe from shorezone facility construction or maintenance activities, including dredging

All four Shoreline Plan alternatives would allow new construction and dredging within the shorezone. Construction activities could affect water quality by accelerating soil erosion and sedimentation while also releasing pollutants. Dredging for new construction or maintenance dredging for existing facilities could affect water quality by increasing turbidity and releasing nutrients into the surrounding water. Existing state, federal, and TRPA regulations mitigate potential short-term impacts from construction activities in the shorezone. TRPA policies require the implementation and maintenance of temporary BMPs to protect water quality during maintenance dredging within the shorezone. Under Alternatives 1 and 3, TRPA would revise code standards (Section 84.15.3) to be consistent with federal standards for new dredging (nondegradation) under Section 404 of the CWA as regulated by USACE. However, the federal standards under Section 404 are mandatory for dredging in Lake Tahoe regardless of the TRPA Code provisions and are therefore applicable to all four alternatives. Dredging activities would also need to comply with each state's Section 401 water quality certification requirements. Because construction and dredging activities associated with any proposed or existing facility under all four Shoreline Plan alternatives would be required to conform to applicable state, federal, and TRPA regulations for the protection of water quality, this impact would be **less than significant**.

Alternative 1: Proposed Shoreline Plan

Construction activity permitted under Alternative 1 could adversely affect water quality in the shorezone by accelerating soil erosion and sedimentation, increasing turbidity, and releasing pollutants. Use of heavy equipment in and adjacent to the water's edge could produce dust and temporarily disturb and resuspend lake sediments in the water column, thus increasing turbidity in the immediate vicinity of the construction site. Additionally, operating heavy equipment such as pile drivers and their associated barges could cause sediment plumes during in-water construction. Construction equipment operating in the nearshore zone can also destroy native aquatic plants and disrupt the natural layering of sand and surface armor, which contributes to turbidity. Alternative 1 would allow for the construction of 138 new piers (10 public, 128 private) and two new boat ramps. Construction would also occur at locations where TRPA allows the relocation of existing boat ramps to new sites that are better suited to low lake levels, or where public ramps may be extended farther into the lake to allow for operation over a wider range of water level conditions. Relocation or extension of boat ramps would be subject to environmental review and applicable permit conditions. For relocated boat ramps, this would include removal of all derelict structures at the existing site and restoration to predevelopment conditions.

No new marinas would be allowed under the proposed Shoreline Plan. However, marina reconfigurations or expansions would be allowed if the marina is certified as a "clean marina" by the Clean Marina Program, an organization that educates, assists, and certifies marina compliance with BMPs to reduce the potential for pollution. Existing marinas must also demonstrate compliance with water quality and BMP requirements under TRPA Code Section 60.4.

The TRPA Code defines dredging as the rearrangement of any material below elevation 6,229.1 feet (Lake Tahoe Datum). Dredging in Lake Tahoe is performed to facilitate the maintenance and continued use of shorezone facilities. TRPA differentiates between maintenance dredging and new dredging. Maintenance dredging is most commonly performed to maintain lake access and is defined as the dredging of areas that have been previously dredged to maintain legally established lake bottom elevations and dimensions. Under Alternative 1, maintenance dredging would continue to be allowed. New dredging would be allowed at the following general locations:

- marinas,
- five county-designated and U.S. Coast Guard public health and safety facilities (see Chapter 2, "Project Description," Section 2.6.9), and
- public boat ramps where increased functionality of the ramp can be demonstrated.

Existing state, federal, and TRPA regulations mitigate potential short-term impacts from construction activities in the shorezone. In the case of marina expansions, TRPA may require applicants to demonstrate that the expanded project would result in a reduced need for dredging.

TRPA's Standard Conditions of Approval for Shorezone Projects (TRPA Permit Appendix S) would be implemented prior to and during construction in the shorezone, including placement of erosion control devices and sediment barriers. The BMP Handbook (TRPA 2014) details required steps and procedures for dredging applications. Before approval of a dredging activity, the dredging application must demonstrate that environmental conditions have been evaluated and the best set of feasible management practices have been selected for the setting and activity. This includes analysis of lake bed material, locations of spawning habitats, and assessment of any seasonal limitations imposed by severe weather or spawning. Based on this information, potential BMPs are then ranked according to criteria such as their effectiveness, logistical feasibility, and cost. For example, turbidity curtains may be used during pile driving and other lakebed disturbing activities. A turbidity curtain is a floating barrier consisting of relatively impervious fabric, used to prevent the transport of fine and coarse suspended sediment away from areas of water-based construction activities. Additionally, depending on site-specific conditions, use of caissons (i.e., watertight retaining structures that isolate piers during construction) during pier construction may be warranted. These retaining

structures would allow water to be removed from the pile installation location, allowing pile installation to occur in the dry during pier construction. Other best management practices for shorezone construction include:

- checking turbidity curtains frequently and repairing or replacing them if necessary,
- for periods of high wind and wave action, ceasing construction activities causing degraded water quality within the curtained area under weather conditions improve,
- defining limits on the extents of turbid waters permitted to escape the dredging area or co-mingle with the nearshore water of Lake Tahoe (typically 20 NTU),
- using water trucks or baker tanks used to transport dredging spoils, if they are not properly dewatered, to prevent discharge of sediment-laden water to roadways,
- providing oil booms on-site for use in cleanup in case of spills,
- providing training to construction personnel for response procedures to address spills, and
- requiring specialized dredging equipment designed to reduce impacts on water quality if necessary.

In addition to implementation of project-specific BMPs, water quality monitoring is required for all shorezone dredging activities. The frequency and duration of measurements are defined on a project-specific basis by the responsible state and federal authorities and TRPA. A water quality monitoring plan must be developed and approved prior to dredging activities with clear quality assurance/quality control protocols and contingency plans in the case of adverse weather (TRPA 2014:8-61).

TRPA dredging standards under Alternative 1 would be revised to include performance standards consistent with those of Section 404 of the CWA, which are standards that all facilities must comply with, regardless of whether TRPA revises TRPA Code standards under Section 84.15.3. Under the terms of Section 404, USACE is charged with reviewing applications for dredging to determine that steps have been taken to avoid or minimize impacts on waters of the United States. Dredging activities would also need to comply with each state's Section 401 water quality certification requirements. Because implementation of best management practices, including TRPA's standard conditions, would avoid or minimize suspended sediment and turbidity-related impacts near construction areas, and construction and dredging associated with any project in the shorezone would be required to conform to all applicable state, federal, and TRPA regulations pertaining to protection of water quality from construction-related discharges, this impact would be **less than significant**.

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

Alternative 2 would retain the existing shorezone regulations of the TRPA Code (Code Chapters 80–86). Under Alternative 2, all littoral parcels in existence as of July 1, 1987, would be eligible for one new pier, except for properties that are served by or eligible to be served by a multiple-use facility (such as a homeowners association [HOA] pier). However, no piers would be allowed within TRPA-designated prime fish habitat or stream mouth protection areas. Maintenance dredging would be allowed in previously dredged areas where it is necessary to continue an existing use. New dredging would be allowed only if TRPA finds that it is beneficial to shorezone conditions, water quality, and clarity.

Alternative 2 assumes that up to two new marinas could be authorized based on an assessment of eligible locations and property ownership. Any proposal for a new marina would require the preparation of a marina master plan and a project-specific environmental analysis. Because any new marina proposal would require its own analysis of environmental effects relative to federal, state, and local laws and regulations, as well as TRPA regulations, and because mitigation measures would be required to address identified impacts as a condition of project approval, the continued allowance for new marina applications under Alternative 2 would not result in an adverse impact on the environment.

Any construction or maintenance dredging associated with a proposed project under Alternative 2 would be subject to existing state, federal, and existing TRPA regulations pertaining to protection of water quality from construction-related discharges as described for Alternative 1. For the same reasons described above for Alternative 1, this impact would be **less than significant**.

Alternative 3: Limit New Development

Alternative 3 would authorize five new public piers, one new public boat ramp, and 86 new private, multiple-use piers. As with Alternative 1, TRPA would allow the relocation of existing boat ramps to new sites that are better suited to low lake levels. Expansions of existing marinas would be allowed under the same stipulations as Alternative 1. Maintenance dredging would continue to be allowed. New dredging would be allowed only at marinas, at five essential public health and safety facilities, and at previously approved public boat ramps. New dredging could be approved as a component of an environmental improvement project.

Construction associated with proposed shoreline structures under Alternative 3 would be subject to the same requirements and regulations described for Alternative 1. As with the proposed Shoreline Plan under Alternative 1, TRPA would adopt regulations for new dredging performance standards that are consistent with Section 404 of the CWA for new dredging (nondegradation). Dredging activities would also need to comply with each state's Section 401 water quality certification requirements. For the same reasons described above for Alternative 1, this impact would be **less than significant**.

Alternative 4: Expand Public Access and Reduce Existing Development

Alternative 4 would allow for the construction of 15 new public piers. Any construction associated with a proposed project under Alternative 4 would be subject to the same requirements and regulations described for Alternative 2.

Under Alternative 4, dredging would be regulated in the same manner as in Alternative 2. Maintenance dredging would be allowed in previously dredged areas where it is necessary to continue an existing use. New dredging would be allowed only if TRPA finds that it is beneficial to shorezone conditions, water quality, and clarity. For the same reasons described above for Alternative 2, this impact would be **less than significant**.

Mitigation Measures

No mitigation is required.

Impact 6-2: Sediment resuspension and turbidity associated with the hydrodynamic effects of motorized boating

The hydrodynamic effects from motorized boating can disturb and resuspend lakebed sediment through propeller wash and boat wake, potentially leading to increased turbidity and reductions in nearshore clarity. Hydrodynamic effects from propeller wash and boat wake are generally limited to shallower areas, with little or no effects for water depths less than 7 feet and no effects for water depths greater than 10 feet (Beachler and Hill 2003; USACE 1993). TRPA Code Section 84.17.1 requires a no-wake zone within 600 feet of the shore with a 5-mile-per-hour (mph) speed limit. Most of Lake Tahoe's shallower depths are within the existing no-wake zone, with notable exceptions being the nearshore areas adjacent to the City of South Lake Tahoe and Tahoe City.

Lake Tahoe's nearshore presents complex environment conditions and factors that may influence nearshore clarity in an interrelated manner that varies by location and with time (Taylor 2002). In addition to natural wind effects generating water movement, wave motion, and natural littoral processes, factors influencing the observed variability in nearshore clarity may include: adjacent land-uses and urban stormwater inputs, other nonpoint pollutant inputs, boating activity, proximity to stream inputs, water depth, substrate type, and localized features of the lake bottom. Among these interrelated factors the potential contribution of boating activities to degrade nearshore clarity is difficult to isolate or quantify.

Alternatives 1, 2, and 3 are projected to generate a peak-day increase in boating activity. On peak days, increased boat use could increase wave action and turbulence generated by boat wake. The shallower portions of the nearshore outside existing no-wake zone regulations are likely more susceptible to short-term and temporary declines in clarity because of increased wave action. During summertime periods with low winds and low inputs of streamflow and stormwater runoff, Lake Tahoe waters would typically be quiescent with low wave action in the nearshore. Because Alternatives 1, 2, and 3 would increase boating activity on peak days, the increased potential for boat wake to induce additional wave action in shallow nearshore areas most susceptible to elevated turbidity would also increase; therefore, the potential frequency of exceeding the nearshore threshold turbidity standard may also increase for limited portions of the nearshore. This would be a **potentially significant** impact under Alternative 2. With Alternatives 1 and 3, TRPA would increase boater education and enforcement of the no-wake zone, expand the existing nearshore monitoring network to assess whether boating activity has adverse impacts on water clarity from the anticipated increase in boating activity attributable to these alternatives, and implement management actions informed by research to avoid or offset potential impairments to nearshore clarity from the anticipated increase in boating, if necessary. For these reasons, this impact would be **less than significant** for Alternatives 1 and 3.

Alternative 4 would not increase boating activity. Consequently, Alternative 4 would have **no impact** on sediment resuspension and short-term clarity declines in the nearshore.

Alternative 1: Proposed Shoreline Plan

The hydrodynamic effects from motorized boating can disturb and resuspend lakebed sediment, potentially leading to increased turbidity and reductions in nearshore clarity. Lakebed sediment can be disturbed from boating activities in two ways: propeller wash and boat wake.

Propeller wash is created from the thrust of a boat propeller that transfers energy to the water column, which in turn creates turbulence. When a propeller is operating at a high speed in shallow waters, the turbulence created can interact with the lakebed and scour and resuspend sediments. The specific water depth at which propeller wash will resuspend lakebed sediments is dependent on boat dimensions, applied motor power, and sediment grain size (Yousef 1974). Lab and field tests have found that the energy from propeller wash rapidly diminishes beyond a situation-specific threshold (Gucinski 1982) and for recreational watercraft, has limited impacts below 7 feet and generally no effects for water depths greater than 10 feet (Beachler and Hill 2003; USACE 1993). Hoverson and McGinley (2007), in their experiments on marl-dominated sediments, found that impacts from recreational boats operated at no-wake speeds were undetectable.

Boat wake is the pattern of waves generated as a boat moves and displaces surrounding water. The size and associated energy of boat wake depend on boat dimensions, motor power, and boat speed. Gucinski (1982) highlights that the combined constructive and destructive interference from multiple boat wakes makes predicting cumulative effects difficult. Hydrodynamic effects from boat wake are limited to shallower areas of a lake, such as the nearshore of Lake Tahoe, where boat wake can either contribute to the resuspension of lakebed sediment or contribute to shoreline erosion.

Increased boat use is projected to occur under Alternative 1. By the buildout year of 2040, average annual boat engine hours under Alternative 1 would increase by roughly 77,600 hours with a peak-day increase of roughly 1,600 hours (Table 6-5). On peak days, increased boat use could increase wave action and turbulence generated by boat wake and propeller wash.

Table 6-5 Alternative 1 – Projected Change in Boat Engine Hours

	Baseline Condition	Alternative 1 Incremental Effect	Alternative 1 Baseline plus Project
Peak-day boat engine-hours	12,512	1,580	14,093
Annual boat engine-hours	489,155	77,638	566,793

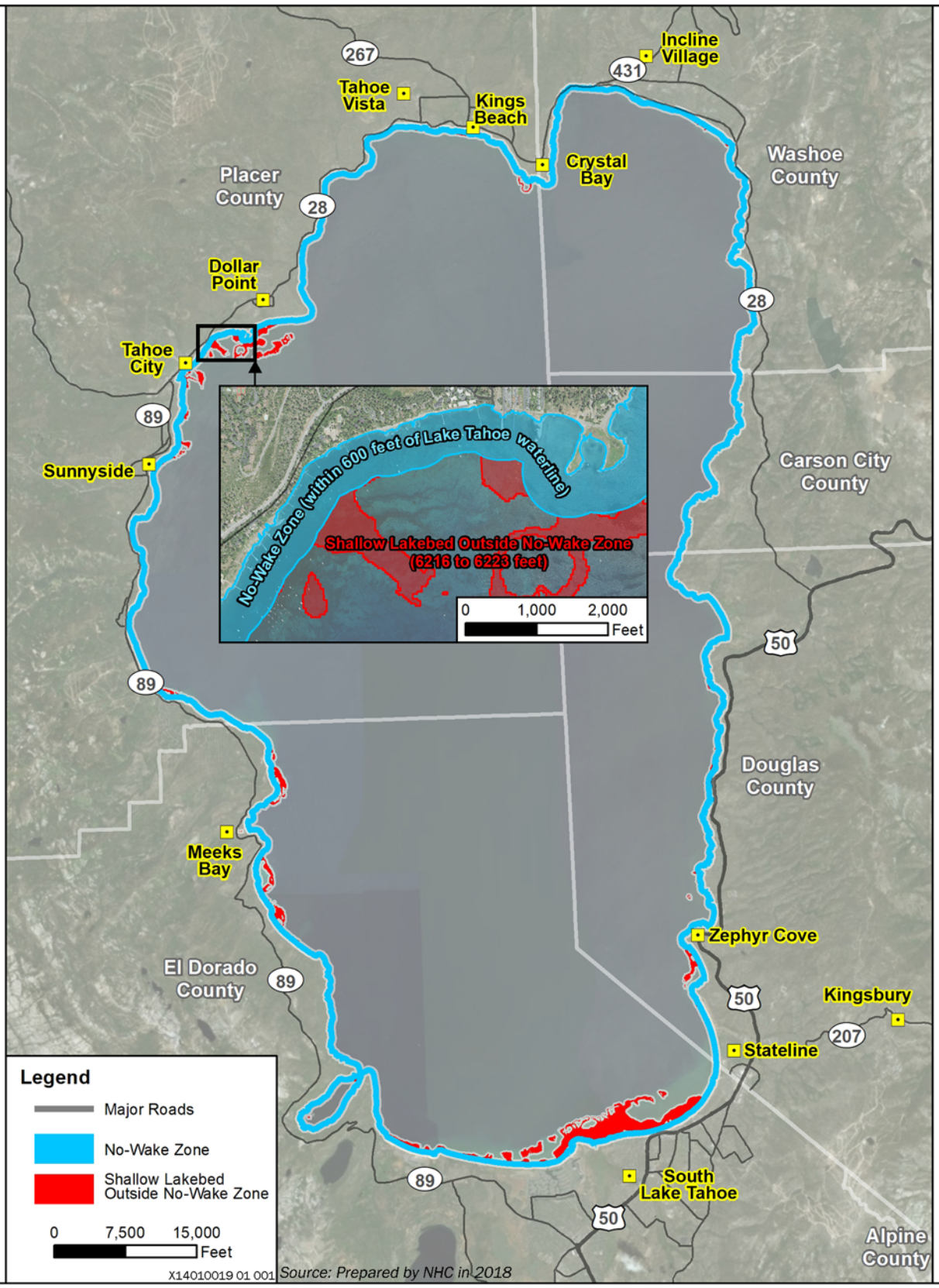
Source: Boat use estimates compiled by the Joint Fact-Finding Committee (Appendix A)

TRPA Code Section 84.17.1 requires a no-wake zone within 600 feet of the shore with a 5-mph speed limit. Under Alternative 1, the existing no-wake zone would be expanded so that all areas within Emerald Bay would be designated a no-wake zone. The speed limit in Emerald Bay would be limited to 5 mph with an exception of 7 mph for tour boats. Alternative 1 also includes provisions for increased boater education and enforcement of the no-wake zone, for example:

- Enforcement of the no-wake zone would be increased with a new boat launch fee generating funding for an additional TRPA boat and crew to expand the amount of no-wake zone education and enforcement patrols.
- Boat inspectors would educate watercraft owners and operators during boat inspections. Watercraft owners and operators would be educated about the no-wake zone, and appropriate watercraft operations and maintenance, including fueling practices, bilge and sewage operations to prevent discharges into the lake, and appropriate engine tuning and propeller selection to reduce emissions during high-elevation boating.
- Signs and other public information would be provided at public boat ramps and other public access points along the shoreline. The information would educate boaters and other shoreline users about the no-wake zone, AIS preventions strategies, and public safety considerations.
- Staff at marinas and motorized watercraft rental concessions would receive training on appropriate watercraft operations and maintenance, including fueling practices, bilge and sewage operations, and appropriate engine tuning and propeller selection. In addition, staff at marinas and motorized watercraft rental concessions would be required to educate customers about the no-wake zone and appropriate watercraft operations.

To assess the effects that the current no-wake zone regulations have on potential impacts from propeller wash, a geographic information system (GIS) analysis of the shoreline and bathymetry was conducted (Exhibit 6-3). A buffer zone was created 600 feet from the shoreline to represent the current no-wake zone. Next, lakebed elevations from 6,223 feet to 6,216 feet (Lake Tahoe Datum) were identified to determine the maximum spatial extents of lakebed that could be affected by high-speed boating activities outside the current no-wake zone, assuming potential impacts could occur to water depths up to 7 feet (Beachler and Hill 2003; USACE 1993). A lakebed elevation of 6,223 feet was used as the upper limit because this elevation corresponds to the natural rim of Lake Tahoe and the lake level is typically higher than 6,223 feet. Based on analysis of lake elevation data from USGS gage 10337000 at Tahoe City, Lake Tahoe's water surface elevation has been above 6,223 feet roughly 87.5 percent of the time since daily recording began in 1957. Furthermore, Reardon et al. (2016:142) concluded that the maximum areal extent of shallow nearshore area susceptible to lakebed sediment resuspension occurs at a lake level equal to the natural rim.

The GIS analysis shown in Exhibit 6-3 produced similar results to the work of Alexander and Wigart (2013, Figure 1), which identifies nearshore areas most at risk of elevated turbidity attributable to the shallow lakebed. Specifically, the GIS analysis identified the following areas outside the no-wake zone but shallow enough to be at risk for propeller-generated resuspension of lakebed sediment during periods of low lake level: (1) the south shore nearshore area from the Upper Truckee River mouth east to Stateline Marina, (2) the Tahoe City nearshore area, (3) Marla Bay, and (4) a small portion of Rubicon Bay. These shallow lakebed locations also generally match regions of the nearshore identified by Taylor (2002) to have elevated turbidity. Taylor (2002) found higher turbidity along the shoreline in South Lake Tahoe, Tahoe City, and, to a lesser degree, Kings Beach.



TAHOE REGIONAL PLANNING AGENCY

Exhibit 6-3 **Lakebed Elevations Potentially Affected by Propeller Wash**

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

Scientific approaches for investigating and understanding the factors influencing Lake Tahoe's nearshore conditions are still emerging. TERC's Nearshore Water Quality Network was recently deployed and currently comprises 11 stations around the shore of Lake Tahoe and Cascade Lake. Each station measures water quality variables every 30 seconds at a water depth of approximately 7 feet and at a location several inches above the lake bed (TERC 2017). However, the data collection effort is a relatively new endeavor and long-term data sets are not available to assess trends for nearshore clarity (TRPA 2016:4-40).

Under Alternative 1, TRPA will support research to assess the effectiveness of the current no-wake zone boundaries by expanding the Nearshore Water Quality Network or other efforts to include monitoring stations located within areas of shallow lakebed but outside the no-wake zone. If research concludes that the increase in boating activities attributable to Alternative 1 would contribute to an exceedance of TRPA's nearshore thresholds, TRPA would implement management actions to avoid this impairment. Such management actions could include:

- expanding the no-wake zone based on scientific findings and recommendations for nearshore areas identified to be susceptible to reduced clarity from boating activities; or,
- enacting a nearshore water quality mitigation fee on recreational watercraft and using the revenue to fund compensatory mitigation projects that reduce other sources of nearshore water quality impairment.

Previous studies of Lake Tahoe turbidity have shown differing and sometimes inconclusive relationships between decreased water clarity and potential drivers for observed nearshore conditions.

- Based on turbidity data collected along the lake perimeter throughout 2001, Taylor (2002) identified spatial and temporal variability in turbidity levels, with a correlation identified between elevated turbidity in the summer and shoreline development. Taylor suggested that while boating activity may be one factor for increased turbidity, algal density could also be a key factor stimulated by the influx of nutrients from overland flow, groundwater, or leached from lake sediments. Taylor et al. (2004) conducted further research in the nearshore, finding shallow areas of low turbidity adjacent to areas of high turbidity.
- Alexander and Wigart (2013) conducted a turbidity study from two piers on the south shore during the summer of 2012 to assess the influence of boating activity on nearshore clarity. The study used registered daily boat launches as an indicator of daily boat activity. Alexander and Wigart consistently found lower turbidity in the morning (average of 0.41 NTU) and higher turbidity in the evening (average of 0.84 NTU). With higher evening turbidity levels returning to background levels by the next morning. Alexander and Wigart (2013:253) concluded that the median daily change associated with increasing turbidity correlated with increasing registered boat launches.
- Reardon et al (2016) monitored and modeled the potential for wind waves to resuspend sediment in the nearshore of Lake Tahoe. The study identified a strong summertime diurnal pattern with wind intensity peaking around mid-afternoon each day. Conversely, no regular wind pattern was detectable in the winter with low-wind and high-wind periods sustained for days at a time. The study found that wind-driven surface waves have the potential to resuspend sediment up to a water depth of 9 meters (~30 feet). However, the authors determined that wind waves did not frequently disturb the sediment-water interface at their study site, which was located on the south end of Lake Tahoe at a water depth of 5 meters (~16 feet). Study results suggest that wind-driven nearshore sediment resuspension does not increase particle loading for the size class identified to most negatively impact Lake Tahoe's pelagic deep-water transparency (fine sediment particles with a diameter of 1 to 16 microns). The authors noted that this finding may be related to a lack of fine sediment material available for resuspension as the nearshore is dominated by coarse and granular lakebed sediment.
- While not a study conducted on Lake Tahoe, Asplund (1996) found that although boating appeared to lead to some decrease in water clarity for 10 different Wisconsin lakes, the magnitude of change was small compared to observed differences between sites and seasons. Asplund suggests that boating

impacts are localized and short term and should be assessed in the context of other water quality impacts on lakes.

- After conducting clarity surveys throughout Lake Tahoe and deploying a nearshore autonomous water clarity buoy, Susfalk et al. (2009), echoing suggestions proposed by Taylor et al. (2004), recommended using near-continuous data to observe short- and long-term trends to examine the impact of water-based activities, such as boating, on the nearshore.

- Heyvaert et al. (2016) completed a pilot monitoring effort of five nearshore surveys from November 2014 through November 2015. From that pilot monitoring effort, no single turbidity measurement exceeded the existing TRPA nearshore numerical standard of 1 NTU.

Lake Tahoe's nearshore presents complex environmental conditions and factors that may influence nearshore clarity in an interrelated manner that varies by nearshore location and with time (Taylor 2002). Besides natural wind effects generating water movement, wave motion, and natural littoral processes, factors influencing the observed variability in nearshore clarity may include: adjacent land-uses and urban stormwater inputs, other nonpoint pollutant inputs, boating activity, proximity to stream inputs, water depth, substrate type, and localized features of the lake bottom. Among these interrelated factors the potential contribution of boating activities to degrade nearshore clarity relative to existing standards is difficult to isolate or quantify.

Increased boating activity on peak days has the potential to generate and alter wave action within the shallower portions of the nearshore adjacent to South Lake Tahoe and Tahoe City, the most susceptible locations for short-term and temporary declines in clarity due to sediment resuspension – if such sediments were locally available. Alternative 1 would increase boating activity on peak days (estimated 13 percent increase – see Table 6-5). Because the potential for an incremental increase in boating activities under Alternative 1 to alter existing hydrodynamics of the lake in a manner detrimental to nearshore water clarity cannot be quantified with available data and research, there is no definitive evidence to suggest that the increased boating activity proposed under Alternative 1 would lead to any exceedances of TRPA nearshore threshold standards for clarity; nevertheless, it is possible that the increased boating could produce more turbidity and negatively affect lake clarity to some degree. However, because TRPA would increase boater education and enforcement of the current no-wake zone, expand existing nearshore monitoring to assess drivers of nearshore water clarity conditions and their potential relationship to boating, and implement management actions informed by research to avoid impairments to nearshore clarity from the increase in boating activity from the Shoreline Plan, if necessary, this impact would be **less than significant**.

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

Alternative 2 is projected to generate a peak-day increase of roughly 5,400 boat engine hours, or a 43 percent increase compared to the baseline condition by the projected buildout year of 2040. For the same reasons discussed in Alternative 1, the increased peak-day boat activity under Alternative 2 would increase the potential for boat wake to induce additional wave action in the shallow nearshore areas most susceptible to elevated turbidity. Alternative 2 includes no provisions for expanded no-wake zone education or enforcement, or additional study of nearshore turbidity effects and adaptive management; therefore, the potential frequency of exceeding the nearshore threshold turbidity standard may also increase for limited portions of the nearshore under Alternative 2, which constitutes a **potentially significant** impact.

Alternative 3: Limit New Development

Alternative 3 is projected to generate a peak-day increase of roughly 460 boat engine hours, or a 4 percent increase compared to the baseline condition, by the projected buildout year of 2040. As with the proposed Shoreline Plan under Alternative 1, TRPA would under Alternative 3 increase boater education and enforcement of the current no-wake zone, expand the existing nearshore monitoring network to assess the effects of boating activity on nearshore turbidity, and would implement management actions informed by monitoring and research to avoid or offset potential impairments to nearshore clarity from boating, if necessary. For the same reasons described above for Alternative 1, this impact would be **less than significant**.

Alternative 4: Expand Public Access and Reduce Existing Development

Alternative 4 would not increase boating activity. Consequently, Alternative 4 would have **no impact** on sediment resuspension and short-term clarity declines in the nearshore.

Mitigation Measures

Mitigation Measure 6-2: Study and adaptively manage the effects of boats on nearshore conditions

This mitigation measure would be required for Alternative 2.

TRPA will coordinate with partner agencies and research organizations to complete monitoring and studies that evaluate the effects of boat activity on nearshore clarity and water quality. TRPA will then implement management actions, if needed, based on the results of the studies.

To ensure the completion of nearshore studies, TRPA will enact a nearshore water quality mitigation fee on recreational watercraft. The fee will be assessed on all recreation watercraft, either during aquatic invasive species boat inspections or at launch points. The fee will remain in place for a period of up to ten years to fund scientific research and nearshore monitoring through a program such as the Nearshore Water Quality Network. Revenue generated from the fee will be directed towards research components of nearshore studies tasked with evaluating potential impacts of boat activity on nearshore clarity and water quality. TRPA will set the fee at an amount that is adequate to fund an assessment of recreational boating effects on nearshore water quality and clarity.

If research concludes that the increase in boating activities anticipated under Alternative 2 would contribute to an exceedance of TRPA's nearshore numerical standard of 1 NTU, TRPA will implement management actions to avoid or offset this impairment. Such management actions could include, but are not limited to:

- expand the no-wake zone based on the scientific findings and recommendations for nearshore areas identified to be susceptible to reduced clarity from boating activities; or
- enact a permanent nearshore water quality mitigation fee on recreational watercraft and use the revenue to fund compensatory mitigation projects that reduce other sources of nearshore water quality impairment.

Significance after Mitigation

Mitigation Measure 6-2 would provide for a scientific study to determine if hydrodynamics effects of motorized boating lead to short-term and temporary decreases in nearshore water clarity, among potentially other contributing factors. Based on the results of this study, TRPA would implement necessary management actions to avoid or offset the effects of motorized boating on nearshore water quality. This mitigation would reduce the impact to a **less-than-significant** level for Alternative 2.

Impact 6-3: Direct entrainment or atmospheric deposition of pollutants from boat exhaust

Increased boating activity is projected under Alternatives 1, 2, and 3, which could lead to increased boat emissions. Alternative 4 would not increase boating activity, and therefore would not increase boat emissions. Boat engines emit oxides of nitrogen (NO_X) and particulate matter (PM) during operation, which may be delivered to the lake through direct entrainment in the water column or atmospheric deposition. Total nitrogen and fine sediment particles are pollutants of concern for lake transparency and clarity, and the Lake Tahoe TMDL sets load reduction targets for these pollutants. Therefore, emissions that lead to an increase in loading for these pollutants of concern might extend the timeline needed to achieve the Lake Tahoe TMDL load reduction targets.

The approval of additional boating facilities under Alternatives 1, 2, and 3 leading to the increase in boating activity would be phased through a projected buildout date of 2040. Impact 10-1 in Chapter 10, "Air Quality," assesses potential changes in emissions from increased boating activity under Alternatives 1, 2,

and 3. Impact 10-1 concludes that a net reduction in boating emissions, including emissions of NO_X and PM, would result under Alternatives 1 and 3 as the increased boating hours are offset by fleet turnover, with older boat engines replaced with cleaner and more fuel-efficient boat engines. Because potential impacts on lake transparency and clarity from boat exhaust would be proportional to changes in atmospheric emissions of NO_X and PM, and a net reduction in atmospheric emissions would occur under Alternatives 1 and 3, the additional boating activity would be a **less-than-significant** impact on lake transparency and clarity.

Impact 10-1 in Chapter 10, "Air Quality," concludes that under Alternative 2 changes in emissions from increased boat activity will have mixed results, with a net increase in NO_X and a net decrease in PM. Because Alternative 2 would create a net increase in NO_X loading, and potential impacts on lake transparency and clarity from boat exhaust would be proportional to changes in atmospheric emissions of NO_X, this could extend the timelines needed to achieve the Lake Tahoe TMDL load reduction targets. Therefore, the level of additional boating activity allowable under Alternative 2 represents a **potentially significant** impact. With implementation of Mitigation Measure 6-3, the impact on lake transparency and clarity from Alternative 2 would be **less than significant**.

Alternative 4 would not increase boating activity and would be subject to the same fleet turnover. Consequently, Alternative 4 would have **no impact** on lake transparency and clarity.

Alternative 1: Proposed Shoreline Plan

Oxides of nitrogen (NO_X) and fine particulate matter (PM) are byproducts of exhaust generated from boat engines (see Chapter 10, "Air Quality"). Total nitrogen and fine sediment particles are pollutants of concern for lake transparency and clarity because of the potential for nitrogen to stimulate algal growth and the light scattering properties of fine sediment particles. Phosphorus is also a pollutant of concern for lake transparency and clarity because of its potential to stimulate algal growth, but phosphorus is not a combustion byproduct of boat engines (see Chapter 10, "Air Quality"), and as such, is not analyzed within this impact analysis.

The Lake Tahoe TMDL (Lahontan Water Board and NDEP 2010:10-4) sets load reduction targets of fine sediment particles, total nitrogen, and total phosphorus for in-basin sources, including targets associated with atmospheric deposition of pollutants to the lake surface. The Lake Tahoe TMDL estimates that attainment of load reduction targets will achieve the lake transparency and clarity standards of Lahontan Water Board, NDEP, and TRPA. An action or policy that would increase loading to the lake for pollutants of concern might extend the timeline needed to achieve the Lake Tahoe TMDL load reduction targets or require implementation of additional pollutant controls to offset the increase in loading.

Exhaust from boat engines can introduce NO_X and PM to the surface of the lake through two pathways: (1) entrainment in the water column; and (2) atmospheric deposition:

- Entrainment of NO_X and PM can occur as combustion byproducts pass through the water column after being exhausted from a boat engine at or below the water line. Lab experiments conducted by Hare and Springer (1973) demonstrated that a fraction of both NO_x and PM from boat exhaust remain in solution after the bulk of the exhaust gases bubble into the air. In those tests, the percentage of emissions entrained depended on the applied motor power, and the engine make and model. Hallock and Falter (1987) also observed increases in total inorganic nitrogen after operating powerboats in open-air lake experiments, though no attempt was made to separate contributions from air deposition relative to direct entrainment of exhaust gases.

- Atmospheric deposition of NO_X and PM can occur after boat gases and particulates exhausted into the atmosphere return to the water surface through dry deposition or through entrainment and delivery from a precipitation event (wet deposition). Because the surface area of Lake Tahoe is large (191 square miles) and accounts for two-fifths of the total basin area, atmospheric deposition onto the lake surface for pollutant of concerns can contribute a notable portion of the total loading to the lake. As shown in Exhibit 6-1, the Lake Tahoe TMDL estimates that atmospheric deposition contributes 55 percent of the

total nitrogen and 15 percent of the fine sediment particle loads to the lake annually. Research by Gertler et al. (2006:58) concluded that out-of-basin sources are not major contributors to observed levels of air pollutants in the basin. This finding is supported by Lake Tahoe TMDL science, which found that pollutant loading rates from atmospheric deposition directly to the lake for nitrogen and fine particulate matter are dominated by in-basin sources (Lahontan Water Board and NDEP 2010:B-12).

Average annual boat engine hours under Alternative 1 would increase by roughly 77,600 hours or 16 percent compared to baseline conditions (Table 6-5). The approval of additional boating facilities leading to the estimated increase in boating hours will be phased through a projected buildout date of 2040. Impact 10-1 in Chapter 10, "Air Quality," assesses potential changes in emissions from boating activities under Alternative 1 with the phased implementation approach. Impact 10-1 concludes that peak-day boating emissions of NO_X and PM will decrease under Alternative 1 as the increased boating hours are offset by fleet turnover, by which older boat engines are retired over time and replaced by cleaner and more fuel-efficient models that meet increasingly stringent California and federal emission standards for recreational watercraft as summarized in Table 10-3 of Chapter 10, "Air Quality". Projected decreases in emissions from the year 2017 to 2035 for boats registered in California and active in the Lake Tahoe Air Basin are summarized in Table 10-5 within Chapter 10 (CARB 2017).

Table 6-6 applies the emission rates used in Impact 10-1 to estimate changes in annual boat emissions under Alternative 1 for NO_X and PM_{10} (particulate matter with a diameter of 10 microns or less), which demonstrates a decrease in annual total loading for these pollutants of concern to lake transparency and clarity from boat emissions.

Table 6-6 Alternative 1 – Estimated Change in Annual NO_X and PM_{10} Loading from Boat Emissions

	Baseline Condition	Alternative 1 Incremental Effect	Alternative 1 Baseline plus Project
Annual Boat Engine-Hours	489,155	77,638	566,793
Annual NO_X load (lbs)	12,589	-1,730	10,859
Annual PM_{10} load (lbs)	3,519	-1,789	1,729

Because potential impacts on lake transparency and clarity from boat exhaust would be proportional to changes in atmospheric emissions of NO_X and PM, and a net reduction in atmospheric emissions is estimated under Alternative 1 as described in Impact 10-1, the additional boating use under Alternative 1 would be a **less-than-significant** impact on lake transparency and clarity.

<u>Alternative 2: Maintain Existing TRPA Shorezone Regulations (No Project)</u>

Alternative 2 is projected to generate an annual increase of 253,000 boat engine hours, or 52 percent compared to the baseline condition, by the projected buildout year of 2040. Impact 10-1 concludes that under Alternative 2 changes in emissions from increased boat activity will have mixed results, with a peak-day increase in NO_X and a peak-day decrease in PM. Table 6-7 applies the emission rates used in Impact 10-1 to estimate changes in annual boat emissions under Alternative 2 for NO_X and PM_{10} (particulate matter with a diameter of 10 microns or less), which demonstrates an increase in annual total loading of NO_X from boat emissions and a decrease in annual total loading for PM_{10} from boat emissions .

Table 6-7 Alternative 2 – Estimated Change in Annual NO_X and PM_{10} Loading from Boat Emissions

	Baseline Condition	Alternative 2 Incremental Effect	Alternative 2 Baseline plus Project
Annual Boat Engine-Hours	489,155	253,026	742,182
Annual NO_X load (lbs)	12,589	1,631	14,219
Annual PM_{10} load (lbs)	3,519	-1,254	2,265

Because Alternative 2 would create a net increase in NO_X loading from boat emissions, and potential impacts on lake transparency and clarity from boat exhaust would be proportional to changes in atmospheric emissions of NO_X, this could extend the timelines needed to achieve the Lake Tahoe TMDL load reduction targets, therefore, the level of additional boating activity allowable under Alternative 2 represents a **potentially significant** impact.

Alternative 3: Limit New Development

Alternative 3 is projected to generate an annual increase of 17,850 boat engine hours, or 4 percent compared to the baseline condition, by the projected buildout year of 2040. For the same reasons discussed in Alternative 1, and because Impact 10-1 concludes that a net reduction in boating emissions, including emissions of NO_X and PM, will result under Alternative 3 as the increased boating hours are offset by fleet turnover, the additional boating use under Alternative 3 is considered a **less-than-significant** impact on lake transparency and clarity.

Alternative 4: Expand Public Access and Reduce Existing Development

Alternative 4 would not increase boating activity and would be subject to the same fleet turnover as described above and in Impact 10-1. leading to a net decrease in emissions relative to baseline conditions. Consequently, Alternative 4 would have **no impact** on lake transparency and clarity.

Mitigation Measures

Mitigation Measure 6-3: Limit the number of moorings and boat ramps to limit emissions from increased motorized watercraft activity

This mitigation measure would be required for Alternative 2.

TRPA shall implement Mitigation Measure 10-1 as described in Chapter 10, “Air Quality,” which limits the number of new moorings and boat ramps (and thus boat emissions) to the maximum number allowed under Alternative 1.

Significance after Mitigation

Because potential impacts on lake transparency and clarity from boat exhaust would be proportional to changes in atmospheric emissions of NO_X and PM, and implementation of Mitigation Measure 10-1 described in Chapter 10, “Air Quality,” would ensure that boat emissions for NO_X do not exceed baseline condition loads, the impact after mitigation would be **less than significant** for Alternative 2.

Impact 6-4: Discharge of hydrocarbons or other contaminants into Lake Tahoe from boating activities and boating facilities

Elevated levels of hydrocarbons or other contaminants in the lake could result from increased boating activity under Alternatives 1, 2, and 3. Gasoline and diesel fuels contain hydrocarbon contaminants, including the group of volatile organic compounds collectively known as BTEX (benzene, toluene, ethylbenzene, and xylene). While also occurring in raw fuel, polyaromatic hydrocarbons (PAHs) are primarily produced during the combustion process in an engine. Hydrocarbons can enter the water from boating activities via exhaust emissions, fueling spills, and other accidental spills. Most outboard engines exhaust beneath the surface of the water, and consequently, all exhaust must pass through the water column, where some hydrocarbons will remain in solution or sorb to particulates and sediments. Given the rapid rate of biodegradation of hydrocarbon compounds, the low levels measured in the lake, and current TRPA regulations pertaining to control of discharges of contaminants from boating facilities, the increased amount of boating activity projected under Alternatives 1, 2, and 3 would have **less-than-significant** impact associated with hydrocarbon and contaminant discharge. Under Alternative 4, no increased boat activity is projected and current TRPA regulations pertaining to control of contaminant discharge from boating facilities and activities would remain in place, resulting in a **less-than-significant** impact.

Alternative 1: Proposed Shoreline Plan

Increased boating activity could result in elevated levels of hydrocarbons or other contaminants in Lake Tahoe from two primary pathways: 1) exhaust of hydrocarbons from motorboat engines; and 2) direct discharge of contaminants from boating activities and facilities, such as fueling spills or accidental leaks.

Exhaust from motorboat engines typically contacts or passes through the surface of the water. While most exhausted hydrocarbons volatize quickly and leave solution, some fraction of both soluble and nonsoluble components remains in the water column (Balloffett and Quinn 2004). Historically, two general classes of motor fuel-related hydrocarbons have been a concern within the lake environment: volatile organic compounds (VOCs) and polycyclic aromatic hydrocarbons (PAHs). In terms of threats posed to water quality from VOC contamination, most attention has been paid to the following compounds:

(1) MTBE – methyl tertiary-butyl ether (fuel additive)
(2) BTEX – the group of benzene, toluene, ethylbenzene and xylene (fuel constituents)

MTBE was historically added to gasoline, particularly during the years 1992–2005, as an oxygenate to promote more complete combustion to reduce emissions and improve air quality (EPA 2013). MTBE was found to create water quality concerns due to its high solubility in water and persistence in the environment. Due to these concerns, MTBE was phased-out of use in California by December 31, 2003 by California Executive Order (D-5-99). Research and water quality sampling from 1998 to 2011 summarized by Rowe (2012:29) demonstrates that MTBE concentrations in the lake have declined to near nondetect levels for samples collected since 2007.

BTEX compounds are part of the chemical make-up of motor fuel. Irwin et al. (1997) cataloged a variety of negative effects linked to BTEX, ranging from toxicity to aquatic life to organ damage in humans. All four BTEX compounds (benzene, toluene, ethylbenzene and xylene) are regulated in drinking water at both the state and federal levels (Table 6-8), but currently there are no numerical standards set for the lake.

Table 6-8 BTEX Maximum Contaminant Levels for Drinking Water (EPA vs California)

Pollutant	EPA Maximum Contaminant Level (mg/L)	California Maximum Contaminant Level (mg/L)
Benzene	0.005	0.001
Toluene	1	0.15
Ethylbenzene	0.7	0.3
Xylene	10	1.75

Source: California EPA 2014

PAH compounds consist of two or more fused benzene rings, and as such, they make up a class of thousands of different molecules. The PAH compounds of concern for the lake are produced during high-temperature pyrolytic reactions, such as those in internal combustion engines (Lico 2004).

Direct discharge of contaminants from boating activities and facilities can occur from several sources, including but not limited to: fueling spills, accidental leaks, bilge water discharges, illicit sewage discharges, and boat washing. Fuel discharges may occur during fueling activities as the result of human error (e.g. overflow) or mechanical malfunction (e.g. malfunction of an automatic shutoff). Marinas are likely the largest potential source of direct discharge of contaminants and have an elevated risk for impaired water quality given the high concentration of boating activities, fueling and washing facilities, and generally poor water circulation patterns.

Alternative 1 would potentially increase the loading of VOCs into the lake but projected additions to current levels would fall well below EPA and California maximum contaminant levels. The presence of VOCs has diminished in the lake since regulations were implemented to reduce the amount of unburnt fuel entering the water directly from boat use. Specifically, carbureted two-stroke engines were banned by TRPA from use

on the lake beginning in October 2001 (TRPA Code 60.1.3E). Lico (2004) found reductions of 40-78 percent in the median concentrations of VOCs in the two years following the two-stroke engine ban. Using toluene as an indicator for BTEX, Rowe et al. (2009) found a steady decline in mean annual concentrations in sampling data from 20 sites around the lake perimeter for the years 2002–2009. This finding was extended by additional monitoring data collected by Rowe in 2010 and 2011 (Rowe 2012). Even during peak boating season (Memorial Day – Labor Day), mean concentrations did not exceed 0.2 ppb (approximately 0.0002 mg/L). These values fall well below California's maximum drinking water contaminant level for toluene of 0.15 mg/L. Rowe (2012) ascribed the decline partly to the greater efficiency of the 4-stroke and direct-injection 2-stroke engines entering the Tahoe boat fleet after the ban on carbureted two-stroke engines.

Increased boating activity under Alternative 1 would lead to an increase in peak daily and annual loading of hydrocarbons, such as PAH. Miller et al. (2003) calculated typical loading rates of PAH for marine engine types (i.e. four-cycle and direct-injection two-cycle) that are currently allowed on the lake. From that data and a contemporary estimate of the fraction of total boat usage represented by four-cycle and direct-injection two-cycle engines on the lake, a composite emission factor of 0.1 g/hour of boat use for PAH was estimated. Table 6-9 shows the results of incremental and total increase in PAH loading that may occur with Alternative 1 resulting directly from increased boating activity. The estimated increases in PAH calculated in Table 6-9 may be overly conservative (high) given the likely possibility that by the buildout date of boating activity allowed under Alternative 1 most boats on Lake Tahoe will be comprised of more fuel-efficient and cleaner motors. Nevertheless, the estimates in Table 6-9 provide context for the magnitude of potential increase in hydrocarbons (PAH) for Alternative 1.

Table 6-9 Alternative 1 – Estimated Change in Annual and Peak Daily PAH Loading

	Baseline Condition	Alternative 1 Incremental Effect	Alternative 1 Baseline plus Project
Peak-day boat engine-hours	12,512	1,580	14,093
Annual boat engine-hours	489,155	77,638	566,793
Peak-day PAH load (lbs)	2.8	0.3	3.1
Annual PAH load (lbs)	108	17	125

The PAH generated by boat traffic from Alternative 1 is an estimated increase of 13 percent during a day of peak boat activity and a nonpersistent annual increase of 16 percent at buildout. PAH is nonpersistent in the environment as surface PAH molecules break down in the presence of natural light, so their potential toxicity is eliminated in less than 24 hours (Miller et al. 2003). Unlike BTEX compounds, PAH concentrations do not appear to have decreased since the ban on carbureted two-stroke engines. However, the levels at which they are found in the lake pose no threat of toxicity to organisms (Lico 2004). Miller et al. (2003) found no phototoxic PAH compounds in any open water areas of Lake Tahoe at concentrations that would be expected to harm aquatic organisms. One sampling site in the Tahoe Keys Marina had concentrations of PAH high enough to potentially cause toxicity to zooplankton and fish larvae (Miller et al. 2003:28).

Under Alternative 1, TRPA Code Section 84.13 and BMP Handbook Section 8.11, Boating Discharge Control and Marina Maintenance, would still apply to marinas requesting an expansion, requiring equipment and BMPs to minimize the possibility of contaminant discharge, including but not limited to:

- pump-out facilities for boat sewage,
- boat washing facilities connected to a sewer system or an acceptable alternative,
- gas pumping facilities including both emergency and standard shut-off systems,
- management and containment procedures for engine oil, transmission fluid, hydraulic oil, and gear oil,
- water treatment systems for waters contained within marinas, and
- trash receptacles.

Furthermore, marina expansions and reconfigurations under Alternative 1 would be allowed only if the marina is certified as a "clean marina" by the Clean Marina Program, an organization that educates, assists, and certifies marina compliance with BMPs to reduce the potential for pollution. Clean Marina certification requires an inspection by an industry review team selected by the Clean Marina Program in the following certification categories: (1) Emergencies; (2) Petroleum Containment; (3) Topside Boat Maintenance; (4) Boat Hull Cleaning; (5) Marina/Yacht Club Operations; (6) Marina/Yacht Club Debris; (7) Boat Sewage Discharge; (8) Solid Waste; (9) Liquid Waste; (10) Fish Waste; (11) Hazardous Materials; (12) Storm Water Runoff; and (13) Environmental Programs. Successful completion of the inspection and "clean marina" status is granted upon receiving 75 percent of the possible inspection points.

Under Alternative 1, TRPA would coordinate with marinas, boat ramp operators, and other partners to implement boater education programs. These programs would educate watercraft operators about applicable regulations and appropriate watercraft operations. Program elements related to water quality include the following:

- Boat inspectors would educate watercraft owners and operators during inspections about appropriate watercraft operations and maintenance including fueling practices, bilge, and sewage operations to prevent discharges into the lake.

- Staff at marinas and motorized watercraft rental concessions would receive training on appropriate watercraft operations and maintenance including fueling practices, bilge and sewage operations, and appropriate engine tuning and propeller selection.

Given the rapid rate of biodegradation of PAH compounds and measured nontoxic levels of PAH in the lake (Miller et al. 2003); low levels of BTEX measured and associated with current boating activity using four-cycle engines (Rowe 2012); nearly nondetect levels measures for MTBE in the lake (Rowe 2012); and current TRPA regulations and Clean Marina certification requirements designed to control discharges of contaminants from boating facilities using BMPs and environmental education; the increased amount of boating activity projected under Alternative 1 associated with hydrocarbon and contaminant discharge would create a **less-than-significant** impact.

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

Alternative 2 is projected to increase hydrocarbon discharges to the lake for the same reasons cited under Alternative 1. The PAH generated by boat traffic from Alternative 2 is estimated to increase by 43 percent (1.2 pounds) during a day of peak boat activity and a nonpersistent annual increase of 52 percent (54 pounds) by the buildout date of boating activity. Estimated increases in hydrocarbon (PAH) discharges are higher relative to Alternative 1 because of the greater number of boats and consequently greater number of operational hours projected under Alternative 2.

Alternative 2 could allow for the authorization of new marinas. However, the provisions for contaminant-prevention facilities in TRPA Code Section 84.13 and BMP Handbook Section 8.11, described under Alternative 1, would still apply.

Given the reasons explained under Alternative 1 regarding current hydrocarbon levels in the lake that the fate of hydrocarbons in the lake, and current TRPA regulations designed to control discharges of contaminants from boating facilities using BMPs; the increased amount of boating activity projected under Alternative 2 associated with hydrocarbon and contaminant discharge would result in a **less-than-significant** impact.

Alternative 3: Limit New Development

Alternative 3 is projected to increase hydrocarbon discharges to the lake for the same reasons cited under Alternative 1. The PAH generated by boat traffic from Alternative 3 is estimated to increase by 4 percent (0.1 pound) during a day of peak boat activity and a nonpersistent annual increase of 4 percent (3.8 pounds) by the buildout date of boating activity. Estimated increases in hydrocarbon (PAH) discharges are lower in

Alternative 3 relative to Alternative 1 and Alternative 2 because of fewer operational hours estimated for boating activities under Alternative 3.

Like Alternative 1, Alternative 3 allows for the expansion of existing marinas, but there would be no requirement to seek certification under the Clean Marina program. However, the provisions for contaminant-prevention facilities in TRPA Code Section 84.13 and BMP Handbook Section 8.11, described under Alternative 1, would still apply.

Given the reasons explained under Alternative 1 regarding current hydrocarbon levels in the lake and current TRPA regulations designed to control discharges of contaminants from boating facilities using BMPs, the increased amount of boating activity projected under Alternative 3 associated with hydrocarbon and contaminant discharge would create a **less-than-significant** impact.

Alternative 4: Expand Public Access and Reduce Existing Development

Alternative 4 would not increase boating activity or allow for the expansion of existing marinas. Alternative 4 would have **no impact** on hydrocarbon and other contaminant discharges into the lake.

Mitigation Measures

No mitigation is required.

Impact 6-5: Interference with littoral processes from new or redeveloped shoreline structures

All Shoreline Plan alternatives would allow for the addition or expansion of piers that could disrupt existing wave and current circulation patterns near the shoreline. Waves and current motion are the primary agents of littoral drift, the process by which sediment is transported and deposited in the nearshore area. Alternatives 1, 3, and 4 propose revisions to existing pier design standards in the TRPA Code (Section 84), but do not define design standards for public piers. Alternatives 2 and 3 would both allow multiple-use piers to deviate from design standards. Other structures, such as jetties, groins, breakwaters, and fences that could affect littoral processes, are generally not allowed under any of the Shoreline Plan alternatives. Alternative 1 may allow for other structures as part of a habitat restoration project or as part of a marina environmental improvement project. Alternative 2 would allow for these structures along the shoreline outside of prime fish habitat if the applicant demonstrated that the structure would not interfere with littoral processes.

Previous analysis (TRPA 2004) demonstrated that significant impacts on littoral drift processes can occur from floating piers. Because Alternatives 1, 2, and 3 do not specify design standards for floating piers such that impacts on littoral drift would be completely avoided, and because none of the Shoreline Plan alternatives define the environmental analysis procedures for assessing littoral drift processes associated with public pier applications or allowable deviations for multiple-use pier applications that include floating pier sections, design standards in their current form could allow for piers that interfere with existing littoral drift processes, which could constituent a **significant** impact. With implementation of Mitigation Measures 6-5a and 6-5b, this impact would be reduced to a **less-than-significant** level for all four Shoreline Plan alternatives.

Alternative 1: Proposed Shoreline Plan

Littoral drift refers to the transportation of sediments along the shoreline, where wave and current actions can affect sediment transport and sediment deposition in the nearshore. Disruption of these actions by shoreline structures can alter the natural process of sediment movement and sediment redistribution along the lakebed and shoreline of Lake Tahoe. Interference with existing littoral drift processes by new or redeveloped shoreline structures would be considered a significant impact.

Alternative 1 would allow for construction along the shoreline of up to 128 new private piers, up to 10 new public piers, and up to 2 new public boat ramps. No new public or private breakwaters, jetties, rock crib piers, or sheet pile piers (or other structures of this type) would be permitted along the shoreline from

Alternative 1, except as part of a habitat restoration project or as part of a marina environmental improvement project. Alternative 1 would allow marinas to use temporary floating pier extensions to provide access for boats when lake levels fall below 6,225 feet (Lake Tahoe Datum).

Public pier design standards are not proposed at part of the project description (Chapter 2). Design standards could deviate from current design standards for public piers under Alternative 1, to the extent necessary to provide a public service, such as for emergency access, public access during low lake conditions, or public transportation. All public pier applications would be subject to environmental review.

Private piers would be required to comply with the applicable design standards presented in Table 2-5 of the project description (Chapter 2). Multiple-use piers would be allowed to comply with varying design standards that relate the number of littoral parcels or HOA units (i.e., residences) served by the pier as shown in Table 2-5. The design standards in Table 2-5 do not specify limitations or conditions for floating piers/platforms/docks (called "floating piers" in this analysis). The placement of new private piers would be restricted to areas outside of stream mouth protection areas and Shorezone Preservation Areas. Boat ramps would be located and designed per Section 84.6 of the TRPA Code or Ordinances. Boat ramps constructed to TRPA standards would not present obstructions to wave and current actions.

The 2004 Lake Tahoe Shorezone Ordinance Amendments Draft EIS (TRPA 2004) evaluated the effects of open pile piers and floating piers on littoral drift processes by reviewing other studies on wave attenuation and floating piers, as well as through review of field observations of effects at three Lake Tahoe locations with existing floating piers: Camp Richardson; Tahoe Vista; and the Hyatt Pier in Incline Village, NV. The 2004 TRPA study concluded that open pile piers constructed to TRPA design standards have no significant adverse impacts on littoral transport or backshore stability (TRPA 2004:3). The study further concluded that floating piers can affect littoral transport if the floating section of the pier is at least 50 percent the length of a wavelength sufficient in size to cause littoral drift. Based on the 2004 TRPA study findings, the shortest wavelength that could cause littoral drift in Lake Tahoe is 50 feet, so a floating pier that is 25 feet or less in length would have no effect on littoral drift along the shoreline. Floating pier sections longer than 25 feet may be acceptable, but the specific wave characteristics along the shoreline would need to be assessed relative to the proposed pier design to determine the acceptable maximum floating pier section that would not affect littoral drift processes (TRPA 2004:13).

The 2004 TRPA littoral drift study further concluded that floating piers rigidly moored to the lake bottom have greater impacts than floating piers allowed to move with wave action (TRPA 2004:15). This conclusion is supported by a technical memorandum prepared by Moory (2012), which found for conditions where a floating pier was attached firmly to the lake bottom that wave heights could be reduced by 50 percent or more when the draft of the floating pier was 20 percent of the incoming wave height, or the length of the floating pier was 20 percent of the wave length. Conversely, floating piers allowed to move with the wave heave reduced wave heights much less. For example, reduction of the wave height by 50 percent did not occur until the draft of the floating pier was 50 percent of the wave height or the length of the floating pier was 50 percent of the wave length.

Under Alternative 1, the design standards for private piers do not specify limitations and provisions for approving floating pier sections. Public pier designs are not subject to specific design standards under Alternative 1 but would be subject to project-level environmental review. The project description (Chapter 2) does not indicate whether the allowance for marinas to extend piers during low lake elevations with floating pier sections would be subject to TRPA environmental review.

Previous analysis developed for the 2004 Lake Tahoe Shorezone Ordinance Amendments Draft EIS (TRPA 2004) demonstrated that significant impacts on littoral drift processes can occur from floating piers. Because Alternative 1 does not specify design criteria for floating piers or limitations and does not define the environmental analysis procedures for assessing littoral drift processes associated with public pier applications, TRPA may not be able to effectively regulate and oversee approval of pier applications that maintain existing littoral drift processes, which could constituent a **significant** impact.

Alternative 2: Maintain Existing TRPA Shorezone Regulations (No Project)
Alternative 2 would retain the existing shorezone regulations in the TRPA Code (Chapters 80–86). All littoral parcels in existence as of July 1, 1987 would be eligible for one new pier, except for properties that are served by or eligible to be served by a multiple-use facility (such as an HOA pier). No piers would be allowed within TRPA designated prime fish habitat or stream mouth protection areas. Section 84.8 of the TRPA Code specifies current location and design standards for floating single-use piers. Among other requirements, single-use pier design standards for floating piers would include the following specifications that would act to reduce changes to the littoral drift regime:

- Floating docks and platforms (floating piers) shall not exceed an area of 100 square feet or a dimension along any side of 15 feet.
- Floating docks and platforms (floating piers) shall not project more than three feet above the surface of a lake or other body of water.

To incentivize multiple-use piers that serve more than one littoral parcel, TRPA would continue to allow multiple-use piers to deviate from single-use pier design standards. Public piers would be considered multiple-use piers and would be subject to the same evaluation criteria as private multiple-use piers. New public and private boat ramps would be allowed and there would be no numeric cap on the total number of ramps. Up to one new boat ramp could be allowed per littoral parcel outside of prime fish habitat and stream mouth protection areas.

Alternative 2 would allow for the approval of other new structures (jetties, breakwaters, rock cribs, and fences). New structures would be required to comply with the design standards in TRPA Code Section 84.12, which requires analyses demonstrating that a proposed structure will not interfere with littoral processes.

Like Alternative 1, Alternative 2 would not prohibit floating piers that are rigidly attached to the lakebed, nor would it define the environmental analysis procedures for assessing littoral drift processes associated with multiple-use and public pier applications with floating pier sections; therefore, TRPA may not be able to effectively regulate and oversee approval of pier applications that maintain existing littoral drift processes, which could constituent a **significant** impact.

Alternative 3: Limit New Development
Alternative 3 would allow for construction along the shoreline of up to 86 new private piers, up to 5 new public piers, and up to 1 new public boat ramp. All new private piers would be multiple-use piers that serve more than one littoral parcel and would be subject to the pier design guidelines in Table 2-7 of the Project Description. TRPA would have discretion to authorize deviations from design guidelines in Table 2-7 based on site conditions, the number of people served by the pier, and the amount of development retired by the application. The placement of new private piers would be restricted to areas outside of stream mouth protection areas and Shorezone Protection Areas. As with Alternative 1, public piers could deviate from design standards that apply to private multiple-use piers to the extent necessary to provide a public service, such as emergency access, public access during low lake conditions, or public transportation. All public pier applications would be subject to environmental review.

Similar to Alternative 1, Alternative 3 does not specify design criteria for floating piers or limitations and does not define the environmental analysis procedures for assessing littoral drift processes associated with public pier applications. Therefore, TRPA may not be able to effectively regulate and oversee approval of pier applications that maintain existing littoral drift processes, which could constituent a **significant** impact.

Alternative 4: Expand Public Access and Reduce Existing Development
Alternative 4 would allow up to 15 new public piers to be constructed along the shoreline. No additional private piers or boat ramps would be authorized, however new multiple-use piers could be constructed if they result in the removal of two existing piers (2:1 reduction in the number of piers). As with Alternative 1, public piers could deviate from design standards that apply to private multiple-use piers to the extent

necessary to provide a public service, such as emergency access, public access during low lake conditions, or public transportation. All public pier applications would be subject to environmental review.

Similar to Alternative 1, Alternative 4 does not specify design criteria for floating piers or limitations and does not define the environmental analysis procedures for assessing littoral drift processes associated with public pier applications. Therefore, TRPA may not be able to effectively regulate and oversee approval of pier applications that maintain existing littoral drift processes, which could constituent a **significant** impact.

Mitigation Measures

Mitigation Measure 6-5a: Specify floating pier design standards

This mitigation measure would be required for Alternatives 1, 2, and 3.

TRPA will augment the design standards summarized in Table 2-5 in Chapter 2, "Project Description," to include the following standard for floating piers:

- Floating pier sections rigidly moored to the lake bottom shall be prohibited.

Mitigation Measure 6-5b: Require littoral drift analyses and incorporate design recommendations for floating piers longer than 25 feet

This mitigation measure would be required for Alternatives 1, 2, 3, and 4.

TRPA will require all new pier and pier extension applications that include floating pier sections longer than 25 feet submit a site-specific littoral drift and wave analysis. The analysis will assess the dimensions of the proposed floating pier section and the ability of waves to initiate and sustain the movement of sediment along the lake bottom under conditions of low lake level (6,223 feet), mid-lake level (6,226 feet), and high lake level (6,229 feet) Lake Tahoe Datum. The lake level condition with the greatest effect on littoral transport and backshore stability shall be used to design the floating pier section. Floating piers may only be approved if they are designed so that wave heights are not reduced by more than 50 percent and the floating pier section is no greater than 50 percent of the length of the site-specific design wavelength.

Significance after Mitigation

Implementation of Mitigation Measure 6-5a would prohibit piers with floating sections from being rigidly fixed to the lakebed, and Mitigation Measure 6-5b would require that pier applications allowed to deviate from those design standards would need to demonstrate no effect on littoral drift along the shoreline through a defined and site-specific analysis. This would avoid the risk of floating pier designs that impeded littoral drift processes. Therefore, the impact after mitigation would be **less than significant** for Alternatives 1, 2, 3, and 4.