Coordinated Watershed Management Strategy for the Middle Truckee River:

A watershed management plan for the reduction of potentially harmful non-point source sedimentation and appropriate restoration of riparian, aquatic and wetland habitat.

December 2004

Truckee River Watershed Council

PO Box 8568

Truckee CA 96162

(530) 550-8760

www.truckeeriverwc.org

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ADVISORY COMMITTEE

- University of California Sagehen Creek Field Station, Jeff Brown
- California Association of Business, Property and Resource Owners, Pat Davison
- Kathleen Eagan
- Mountain Area Preservation Foundation, John Eaton
- Placer County Resource Conservation District, Rich Gresham
- Carl Gustafson
- DMB/Highlands Group, Martyn Hoffmann
- CalTrans, John Holder
- California Department of Fish & Game, Susan Levitsky
- Squaw Valley Ski Corporation, Mike Livak
- Placer County Resource Conservation District, Katie Maloney
- Lahontan Regional Water Quality Control Board, Cadie Olsen
- DMB/Highlands, Ron Parr
- US Forest Service, Joanne Roubique
- Placer County Planning, Edmund Sullivan
- Sierra Watch, Kathy Welch
- US Forest Service, Randy Westmoreland

CITATION

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LEAD AUTHORS

Kerri L. Timmer
Sierra Connections
Grass Valley, CA
kvtimmer@yubanet.com

Lisa Wallace
Truckee River Watershed Council
Truckee, CA
www.truckeeriverwc.org

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The* **Coordinated Watershed Management Strategy for the Middle Truckee River** *was reviewed by the participants of the Truckee River Watershed Council.

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Preface

SCOPE

The Coordinated Watershed Management Strategy for the Middle Truckee River provides a strategic approach for reducing potentially harmful non-point source[1] sedimentation and appropriately restoring riparian, aquatic and wetland habitat in the Middle Truckee watershed. The document is based on and limited by the mission statement [2] and organizational objectives of the Truckee River Watershed Council and is the product of an 18-month analytical process to address water quality issues in the Middle Truckee watershed.

The U.S. Environmental Protection Agency provided funding for this project as part of the federal Clean Water Act (CWA). Grants awarded under this program focus on reducing, eliminating or preventing water pollution and/or enhancing water quality in target watersheds around the country. The Middle Truckee River is considered a target watershed because it has been listed under CWA section 303(d) as impaired due to sedimentation.

As a result, the management strategies developed for the Middle Truckee watershed under this grant address those issues related specifically to water quality. They do not deal with other important and related watershed health issues, such as forest habitat, upland habitat, species diversity, nutrients, temperature, dissolved oxygen and the like. Similarly, the projects identified in this document focus on water quality issues; as such, they reflect only a subset of the work and activities of the Watershed Council and its individual stakeholders.

PURPOSE

The *Coordinated Watershed Management Strategy* reflects the input of and was reviewed by members of the Advisory Committee. It carries no planning or regulatory authority nor is it legally binding on the Council, its stakeholders or any other agency or entity. Instead, it is intended as a compilation of information, including management strategies and on-the-ground project ideas, to help achieve desired conditions in the watershed related to water quality and riparian, aquatic and wetland habitat. The Truckee River Watershed Council offers the document as an informational

[1] According to the Environmental Protection Agency, *point source* means direct inputs such as sewage treatment plant discharges directly into a waterbody; *nonpoint sources*, such as non-point source sedimentation, are more indirect inputs, such as runoff from fields, streets, range, or forest land.
[2] The Truckee River Watershed Council was founded in May 1998 to develop and implement local public-private collaborative solutions to protect and improve water quality and biological resources for the sustainable environmental and economic health of the Middle Truckee River watershed.

resource for its stakeholders and other interested organizations and individuals in the community.

BASELINE ASSESSMENT

The coordinated watershed management strategy development process began with completion of a *Baseline Assessment*, a summary of existing scientific and cultural information on key watershed conditions and trends in the watershed.

COLLABORATIVE PROCESS

Both the *Baseline Assessment* and the *Coordinated Watershed Management Strategy* documents were developed through a collaborative process involving a broad range of stakeholders in the watershed, including businesses, industry, property owners, recreationists, conservationists and local, state and federal resource management agencies. There are other stakeholders actively involved in the Watershed Council who chose not to become involved in the development of this document.

For the *Coordinated Watershed Management Strategy* document, in particular, the Truckee River Watershed Council agreed to a modified consensus decision-making process that aimed to reach agreement by gathering, discussing and analyzing information and combining ideas or developing new solutions to address the interests and concerns of all participants. In those instances where total agreement could not be reached, participants indicated varying levels of support: enthusiastic, moderate, general, "can live with it," "can't tolerate it," and "willing to stand aside." If all participants supported a decision at some level, could live with it or were willing to stand aside, the decision or agreement moved forward. In the more contentious discussions, stakeholders worked hard toward agreements that met a criterion of "I/my organization can live with it."

To honor the widely divergent points of view represented on the committee – considered by most to be one of the key strengths of the Truckee River Watershed Council – participants also recognized that there are likely to be instances where individual members agree conceptually on an issue but differ as to project-specific or site-specific application or implementation.

Before becoming part of the Advisory Committee for purposes of developing the *Coordinated Watershed Management Strategy*, individuals agreed to a set of principles outlining roles, responsibilities and expectations for involvement. At four key points in the process, those individuals and organizations that agreed to the Principles of Participation provided input to and reviewed key work products, including the Work Practices document (April 2003), the Project Overview (April 2003), the Draft and Final reports (September 2004 and October 2004), and the public presentation script and materials (December 2004) used for outreach to the wider community.

DOCUMENT ORGANIZATION

The *Coordinated Watershed Management Strategy* contains seven chapters plus appendices covering the natural and land use history of the watershed, current and desired conditions, recommended management strategies, proposed projects, a monitoring plan and summary recommendations. The *Coordinated Watershed Management Strategy* document is meant to be a living document that will be updated as conditions change in the watershed.

FUTURE REVISIONS

The Truckee River Watershed Council, through its Coordinating Committee, will review the *Coordinated Watershed Management Strategy* every two years as part of its regular organizational planning process. It may not be necessary to revise the document at each review.

Factors for consideration in the review process for this document will be cataloged over time and could include such things as:

- list of issues identified for consideration by stakeholders;
- changes in watershed condition(s);
- funding availability;
- completion of other planning or regulatory efforts, such as the Truckee River Operating Agreement, that may impact this document or its contents;
- new or revised data or reports.

If one or more of these factors is present, the Coordinating Committee will decide whether or not an overall plan update is necessary, based on timing, funding availability, etc. Current Advisory Committee members and current and future stakeholders will be notified and invited to participate in the review process.

The projects list is the exception to this policy. The projects list will be reviewed and potentially updated annually, as needed.

The *Coordinated Watershed Management Strategy* document is available in hard copy by contacting the Truckee River Watershed Council at 530-550-8760 or electronically through the Council's website at www.truckeeriverwc.org.

1 Natural and Land Use History

1 Natural and Land Use History

> *The scenery is so varied and picturesque that even the most stoical old traveler would occasionally go into ecstasies. The tall frowning rock piles, the grassy river bottom, the deep, dark forests, the weird side canyons and the snow-hooded mountain crests form shifting panoramic views of unsurpassed beauty and sublimity. The river is everywhere the chief attraction. Here it is a foaming cascade, or succession of cascades, there it widens into a quiet lake. In one place it is shallow and noisy, at another so deep and still that its green waters seem currentless. The trees stand so close together that the telegraph wire which extends from Truckee to the Grand Central Hotel is strung almost wholly to their trunks instead of upon poles.*
>
> *C.F. McGlashan, "Resources and Wonders of Lake Tahoe,"*
> **From the Desk of Truckee's C.F. McGlashan**

This chapter of the *Coordinated Watershed Management Strategy* addresses natural history and land use history in the Middle Truckee watershed through approximately 1960. The purpose of this "Natural and Land Use History" chapter is to identify and characterize key resources and describe the inception of various land uses in the watershed that may have contributed to conditions in the watershed today.

The next chapter, titled "Current Conditions," will look at some of the impacts of both historic and more modern land uses on the key resources over the past few decades leading up to the present day. Not every element discussed will fall neatly into the pre-1960 versus post-1960 category; but it is the intent of this chapter to focus primarily on the history of the watershed and let the next chapter address impacts and current conditions.

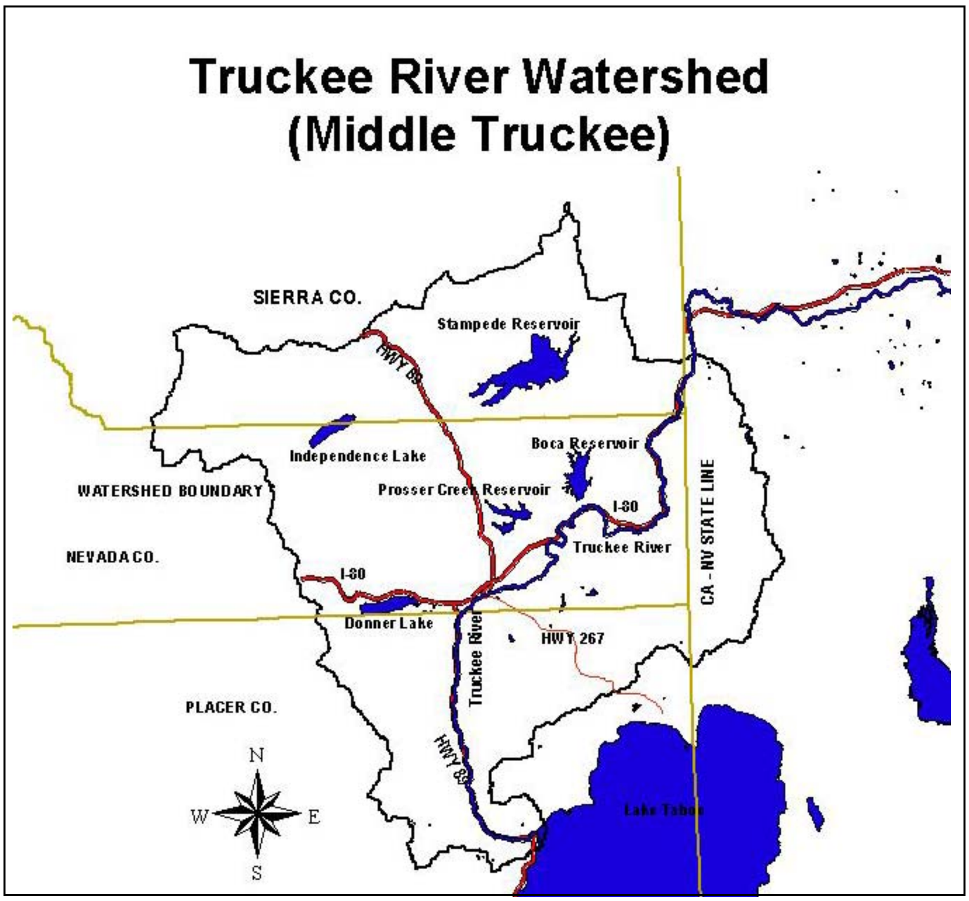
As an example, the "Natural and Land Use History" chapter looks at fire in terms of actual fire events that took place in the watershed over time, as recorded by different state and federal agencies. The next chapter, "Current Conditions," addresses the potential for future fires and outlines the potential impacts of such fires based on the current condition of the forested areas, the degree of urban-wildland interface that exists today, the location of future planned development in relationship to the forests, etc.

NATURAL HISTORY

PHYSICAL CHARACTERISTICS

Watershed Boundary

The Truckee River system begins in the mountains of the Sierra Nevada above South Lake Tahoe. The "upper" Truckee drains into and mixes with the waters of Lake Tahoe. The "middle" Truckee comes out of the lake at Tahoe City and flows for 35 miles to the California/Nevada border and then continues as the "lower" Truckee another 80+ miles across Washoe County, Nevada, to its terminus at Nevada's Pyramid Lake.[3]

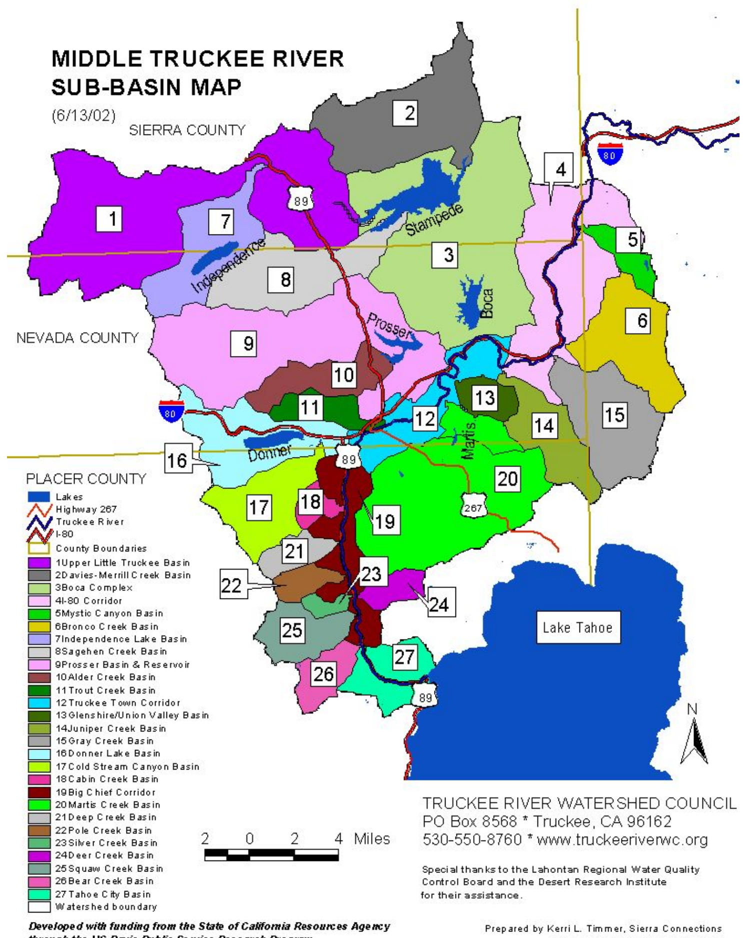


[3] Division of the river into "upper," "middle," and "lower" sections varies by state. For Nevada's purposes, the "upper" Truckee River is considered to be anything upstream of the Reno/Sparks area, also called Truckee Meadows. For our purposes, however, the "upper" Truckee is considered to be that portion of the river that flows into Lake Tahoe from the mountains around South Lake Tahoe. The "middle" Truckee is that portion from the lake's single outlet at Tahoe City to the California/Nevada border. The "lower" Truckee, then, is the segment of river flowing from the state line to the river's terminus at Pyramid Lake.

The portion of the river system addressed in this *Coordinated Watershed Management Strategy* is the Middle Truckee River watershed, from the outflow at Tahoe City to the California/Nevada border – covering approximately 435 square miles or 285,000 acres of land. Most of this portion of the watershed is in California. About 16% of the watershed, including primarily the Gray and Bronco Creek drainages, sits across the state line in Nevada.

Sub-Basin Boundaries

The Middle Truckee watershed is made up of 27 sub-basins in three different California counties, including Placer, Nevada and Sierra, and Washoe County in Nevada. Each sub-basin drains a different area of the watershed. Sub-basins include (from the northwest): Upper Little Truckee, Davies-Merrill, Boca Complex, I-80 Corridor, Mystic Canyon, Bronco Creek, Independence Lake, Sagehen Creek, Prosser Basin & Reservoir, Alder Creek, Trout Creek, Truckee Town Corridor, Glenshire/Union Valley, Juniper Creek, Gray Creek, Donner Lake, Cold Stream Canyon, Cabin Creek, Big Chief Corridor, Martis Creek, Deep Creek, Pole Creek, Silver Creek, Deer Creek, Squaw Creek, Bear Creek, and the Tahoe City basin.



Geology

The geology of this area is fairly complex. The following two sub-sections on the formation of the Sierra Nevada and Lake Tahoe are reprinted from *Geology and Natural History of Lake Tahoe*, Tahoe Center for a Sustainable Future: www.ceres.ca.gov/tcsf.

The Formation of The Sierra Nevada Mountains

During the Paleozoic Era (575 to 270 million years ago) the region now occupied by the Sierra Nevada Mountains lay beneath the sea receiving sediments from the North American continent to the east. Tens of thousands of feet of sediments formed sedimentary rocks and extended the shoreline to the west. Toward the end of the Paleozoic Era the North American continental plate began to drift away from the super-continent of Pangea and moved westward. It began to override the Pacific Ocean Plate that was drifting eastward. The Pacific plate was forced to dive underneath the continental plate. The incredible pressure and friction melted portions of both the Pacific plate and the North American plate and granites distilled which rose to intrude the overlying sedimentary and metamorphic rocks. This plug of magma eventually cooled and solidified to form the granites exposed as the Sierras today. Pushing, grinding, heat and pressure continued to lift and fold the Sierra area until about 10 million years ago. The old sedimentary rocks and volcanic rocks were transformed by heat and pressure into a new form called metamorphic rocks. Today, throughout California, sedimentary, metamorphic and volcanic rocks can be found in a variety of locations, relationships, and formations.

Beginning about 130 million years ago, through erosion, the block of granite that was to become the Sierra became exposed to the elements and began to erode. To account for the vast amount of eroded sediments found in the Central Valley, the pre-Sierra mountains must have been at least 15,000 feet high before finally being eroded into gently rolling uplands about 65 million years ago.

About 30 million years ago, an era of volcanism began in the Sierras that was of massive proportions by today's standards. Here in the Northern Sierra around Lake Tahoe, the Sierra was covered by thick layers of volcanic ash and volcanic rock (andesite and rhyolite) expelled by the volcanoes.

In the middle of this era, about 10 million years ago, the Sierra began uplifting. Staggered, parallel faults formed along the eastern edge of the range. The area to the west rose, and to the east, what is now the Carson Valley, dropped. Even though the eastern slopes of the Sierra rise sharply from the Carson Valley, the valley has filled with sediments obscuring the real consequences of this uplift. While the mountains rise about 9,000 to 11,000 feet above the valley, total uplift was about 19,000 feet!

The Formation of Lake Tahoe

The Tahoe Basin, like the Carson Valley, has dropped between two uplifted blocks, The Sierra crest on the west and the Carson Range on the east. This is a relatively recent development, occurring within the last several million years. Magma generated by the pressures and temperatures that also caused the faulting and uplifting welled up through gaps in the faults. A prominent area of this volcanic area occurred just north of the lake. Andesite flows from these vents bisected and dammed the valley. Eventually, as the lake rose the Truckee River was able to cut through these flows and find its present course around the volcanics to the lowlands of Nevada. Subsequent glacial (2 million to 20,000 years ago) action just downstream of the lake (from the Alpine Meadows and Squaw Valley canyons) dammed the river and so the level of the lake has fluctuated drastically over time. The maximum lake level during glaciation approached 800 feet higher than its present level. Large sedimentary terraces perched above the lake remain as evidence of the old shore.

Three major periods of glaciation occurred in the northern Sierras during the last ice age (10,000 years ago). Rather than the regional "ice sheets" that covered much of North America the ice age manifested itself as individual glaciers forming at the highest elevations. These glaciers carved out individual valleys during their downward movement. Donner Lake, Emerald Bay on Lake Tahoe and Fallen Leaf Lake have the elongated shapes characteristic of glacial valleys. The ice dams across the Truckee River canyon floated several times and broke apart releasing walls of water that carried immense boulders downstream which are now found along the Truckee River canyon and in the Reno area. These floods also carved through the glaciers surrounding Truckee and eroded channels through their glacial debris.

In the future… Mountain building processes have ceased so in the near future (relatively) we can expect continued weathering, erosion and subsequent lowering of the Sierra. Lake Tahoe will continue to fill in at the rate of one foot for every 3200 years, becoming a meadow in about 3,158,400 years (989' average depth times 1ft/3200 years).

Ancient Lake Truckee

Between 25 and 13 million years ago, a basalt lava flow plugged the Truckee River approximately two miles downstream of the confluence of the Little Truckee and Truckee Rivers, where the community of Hirschdale, CA, sits today. This lava dam created a lake, Lake Truckee, with a surface area of approximately 73 square miles and a maximum depth of 465 feet, according to Samuel G. Houghton in his *A Trace of Desert Waters: The Great Basin*

Story. Lake Truckee lasted through part of the glacial period, until the river finally wore down the lava plug and drained the lake.[4]

From 2 million to 500,000 years ago, the ancient fault line in the Sierra Nevada was carved and filled by glaciers and glacial melt. This process created Lake Tahoe and the Lake Tahoe Basin.[5] From 75,000 to 10,000 years ago, during an era known as the Wisconsin age, the area of the lower Truckee River was covered by the pre-historic Lake Lahontan. Cooler temperatures and higher precipitation kept Lake Lahontan and her sister lake, Lake Bonneville (covering northwestern Utah and parts of eastern Nevada) full. Today, Pyramid Lake represents the vestiges of Lake Lahontan, while the Great Salt Lake is what's left of Lake Bonneville.[6]

Underlying Geology

According to a *Hydrologic Condition Assessment of the Middle Truckee River Watershed*, authored by James A. Bergman of the Tahoe National Forest, the western boundary of the watershed formed by the Sierra Nevada crest consists mainly of granitic basement rocks capped by basaltic lava flows. The watershed's southern boundary contains volcanic deposits which have formed a natural dam across the fault-formed northern end of Lake Tahoe.[7]

What is now the Sierra Nevada was once ocean floor, generating thousands of feet of sediment that was transformed into metamorphic sedimentary rock. As the Sierra formed, this bedrock tilted up on its east side, then was elevated further by intrusion of granitic batholiths. Periodic glaciers ground away the top (metamorphic) layer, while periodic granitic incursions and volcanic eruptions continued. The result is that the original bedrock has been largely ground away but is still visible in the Fallen Leaf Lake area and in the form of roof pendants on some of the southern peaks.[8] What remains is mostly granitic basement rocks capped by deposits of basalt, andesite and other flow-rocks. This activity created a chain of volcanic peaks from Mt.

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[4] Houghton, S. G. (1994). A Trace of Desert Waters: The Great Basin Story. Reno, NV, University of Nevada Press. p. 62. See also Horton, G. (1997). Truckee River Chronology: A Chronological History of Lake Tahoe and the Truckee River and Related Water Issues. Carson City, NV, Nevada Division of Water Planning - Department of Conservation and Natural Resources. p. II-1.
[5] Houghton, S. G. (1994). A Trace of Desert Waters: The Great Basin Story. Reno, NV, University of Nevada Press., p. 52. See also Horton, G. (1997). Truckee River Chronology: A Chronological History of Lake Tahoe and the Truckee River and Related Water Issues. Carson City, NV, Nevada Division of Water Planning - Department of Conservation and Natural Resources. p. II-1.
[6] Horton, G. (1997). Truckee River Chronology: A Chronological History of Lake Tahoe and the Truckee River and Related Water Issues. Carson City, NV, Nevada Division of Water Planning - Department of Conservation and Natural Resources. p. II-1.
[7] Bergman, J. A. (2001). Middle Truckee River Watershed Hydrologic Condition Assessment, Tahoe National Forest**:** 1-64. p. 7.
[8] Whitney, S. (1979). A Sierra Club Naturalist's Guide to the Sierra Nevada. n.l., Sierra Club Books. pp. 48-52. See also Hill, M. (1975). Geology of the Sierra Nevada. Berkeley, CA, University of California Press. pp. 49-58.

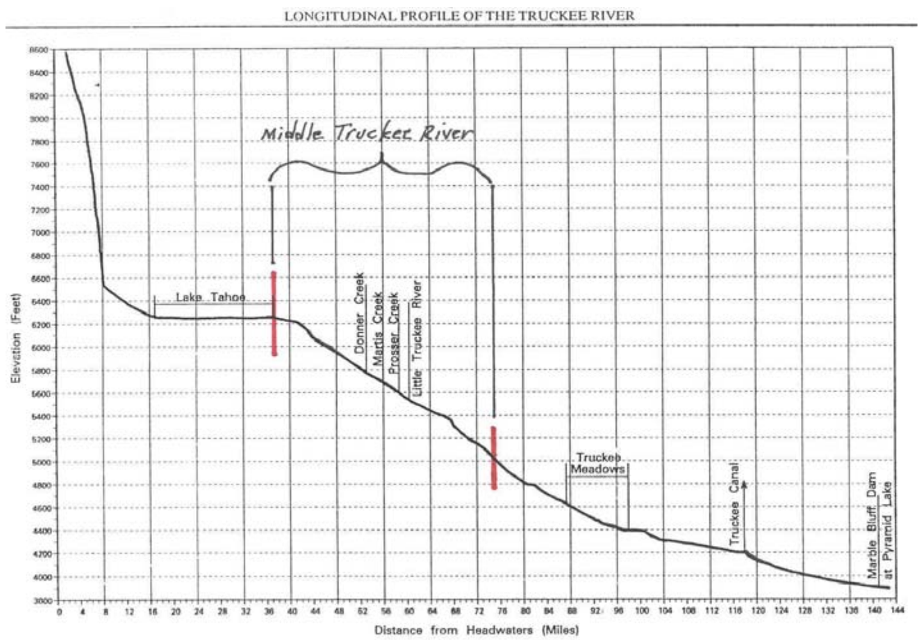
Lola to Squaw Peak. Several cinder deposits found at various locations in the watershed attest to the watershed's volcanic beginnings.[9]

[9] Bergman, J. A. (2001). Middle Truckee River Watershed Hydrologic Condition Assessment, Tahoe National Forest**:** 1-64. p. 7.

PHYSICAL PROCESSES

River Hydrograph

The Middle Truckee watershed landform ranges from a low elevation of 5,050 feet at the California-Nevada state line to a high elevation of 10,778 feet at the top of Mount Rose. The river course itself runs from approximately 6,200 feet at the Lake Tahoe outlet down to 5,000 feet at the state line. This change in elevation has contributed to a wide range of soil/geology/ vegetation types, population densities, species diversity, land uses, and other characteristics over time – both historic and modern – all of which need to be understood in order to plan effectively for the future.



Source: used with permission from ***Truckee River Atlas****, California Department of Water Resources, 1991.*

Hydrology

Outflow at Tahoe City (gaging station 10337500)[10]

Average Annual Runoff Volumes[11]

Type of Water Year	**Volume** *(in Acre-Feet per Year)*	**Average Flow** *(in Cubic Feet per Second)*
Average	161,450	223
Low	110	0.15
High	832,570	1,150

[10] Horton, G. (1997). Truckee River Chronology: A Chronological History of Lake Tahoe and the Truckee River and Related Water Issues. Carson City, NV, Nevada Division of Water Planning - Department of Conservation and Natural Resources. p. I-7.

[11] Gaging station runoff volumes are based on average annual rates of flow in cubic feet per second. The Tahoe City gaging station (#10337500) figures are based on years of record 1909-1995 with high water year in 1983 and low water year in 1994 (Horton, *Chronology*, p. I-7).

Flows in the Truckee River have differed dramatically over time, including both extreme lows and extreme highs. For example, the chart above shows the volume in an average year based on records from 1909 to 1995. The average volume over those 85 years is 161,450 acre-feet, while the lowest year on record (1994) dropped to only 110 acre-feet and the highest year on record (1983) released some 832,570 acre-feet into the Middle Truckee. Such unpredictability has made sorting out water allocations for different uses extremely difficult over the years.

Water Budget

Unlike most rivers that join other rivers and ultimately empty into the ocean, the Truckee River watershed is a closed system. The so-called *Upper Truckee* springs from the mountains above South Lake Tahoe and gathers water from precipitation and tributary streams before flowing into Lake Tahoe. The outflow from Lake Tahoe flows through the *Middle Truckee* watershed, where it collects more volume from additional precipitation and tributary drainages. Some water is diverted from tributaries of the Middle Truckee to Sierra Valley in the adjacent Feather River watershed. In the *Lower Truckee*, which is what the river is called from the California/Nevada border to the river's terminus in the desert at Pyramid Lake, additional water is taken out of the river to fulfill historic agreements for agricultural and municipal water for the city of Reno and other parts of Nevada [see *Water Development* under the *Historic Land Uses* section for more information on water diversions]. In addition to these historic diversions, water volume is lost due to infiltration and evaporation from the surface of the different water bodies making up the watershed.

The inflow from Lake Tahoe and various tributary streams in the Middle and Lower portions of the watershed minus overall evaporation and the various diversions from the watershed and Pyramid Lake make up what is called the Truckee River's "water budget." Studies of the water budget show that more water has been leaving the system than enters the system, meaning that the system is in deficit.[12] In other words, more water has been leaving the river through infiltration, surface evaporation and diversions than has been coming into it from precipitation, Lake Tahoe and the tributary streams; thus, the water level at Pyramid Lake has decreased over time.

A 1970 study by the Pyramid Lake Task Force, a group formed to study problems associated with the decline of Pyramid Lake, estimated that Pyramid Lake suffered an average water deficit of approximately 135,000 acre-feet per year over the 40-year period from 1929 to 1969.[13] As a result, the lake level dropped by some 80 feet (mean sea level) and salinity levels

[12] Horton, G. (1997). Truckee River Chronology: A Chronological History of Lake Tahoe and the Truckee River and Related Water Issues. Carson City, NV, Nevada Division of Water Planning - Department of Conservation and Natural Resources. p. I-12.
[13] This estimation was based on annual Truckee River inflows of 250,000 acre-feet per year, lake surface precipitation of 55,000 acre-feet per year, and annual surface evaporation of 440,000 acre-feet, as outlined in the Task Force's Final Report, p. vi.

increased.[14] More recent estimates developed by looking at actual gaging station records for the water entering Pyramid Lake and estimated precipitation and surface evaporation still shows a deficit, although a smaller one, of some 28,000 acre-feet a year. Using volume and surface elevation tables, calculations indicate that for a normal series of water years, the lake would be expected to decline by one foot of surface elevation every four years.[15]

To the east of Pyramid Lake is a dry alkali lakebed that used to be Winnemucca Lake. Both Pyramid and Winnemucca lakes are remnants of ancient Lake Lahontan, which once covered much of the Great Basin. In the late 1800s, enough water flowed through the Middle Truckee River into Pyramid Lake during high-water seasons to create overflow into Winnemucca Lake. But as Pyramid Lake levels began to decline in the early 1900s, likely as a result of changing water management and diversions from the Truckee River, Winnemucca Lake began drying up. Winnemucca Lake was all but gone by 1938 or 1939.[16]

Floods/Droughts

High and low water flows are a common part of normal watershed functioning. Different precipitation levels at different times of year, plus weather conditions, stream channel configurations, surrounding land uses and other factors, determine the potential impacts of high and low flows within the watershed over time.

A full list of all historic flood and drought events in the watershed is beyond the scope of this chapter. However, anecdotal information describes a large water year in 1890 that caused flooding in the Truckee River and a number of its tributaries. Mud coming from Gray Creek during that event was blamed for making the Truckee River run red through the city of Reno for over a week. After the flooding of 1890, people began realizing the need for upstream flood control on the Truckee's major tributaries, including especially the Little Truckee River, Martis Creek and Prosser Creek.[17]

Based on streamflow recordings beginning in 1900, the Nevada Division of Water Planning's *Truckee River Chronology* timeline identifies additional "significant" historic floods in 1907, 1909, 1928, 1937, 1950, 1955, and

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[14] Horton, G. (1997). Truckee River Chronology: A Chronological History of Lake Tahoe and the Truckee River and Related Water Issues. Carson City, NV, Nevada Division of Water Planning - Department of Conservation and Natural Resources. p. I-12.
[15] Ibid., p. I-12.
[16] Department of Water Resources (1991). Truckee River Atlas. Sacramento, CA, California Resources Agency. pp. 22-24.
[17] Horton, G. (1997). Truckee River Chronology: A Chronological History of Lake Tahoe and the Truckee River and Related Water Issues. Carson City, NV, Nevada Division of Water Planning - Department of Conservation and Natural Resources. p. II-37.

1963.[18] More recent events are described in the next chapter on Current Conditions.

The most significant drought from a water supply standpoint occurred from 1928 to 1934 or 1935, according to the *Truckee River Atlas*. Lake Tahoe fell below its natural rim, and average annual flows measured at Farad were 303,240 acre-feet per year during that time.[19] More recent drought periods are described in the next chapter on Current Conditions.

Fires

Fire, whether human-caused or naturally occurring, has played a large role in the history of this watershed. All or part of what is now known as the Town of Truckee burned many times in the late 1800s and into the early 1900s, due to the close proximity of wooden buildings and the use of arson as a tool of racial persecution. Forest fires started frequently in the outlying areas, as well, due to sparks from log chutes and other logging equipment. The so-called "litter" or "duff" on the forest floor, resulting from accumulation of organic material at rates exceeding the rate of natural decomposition, also provided an extensive ignition source over the years for both human- and lightening-caused fires.

The Middle Truckee River Watershed Hydrologic Condition Assessment estimates that a major fire occurs in this watershed about every 10 to 40 years.[20] Based on records from the Tahoe and Toiyabe National Forests, it appears that many of the subwatersheds in the Middle Truckee have experienced fire. According to Forest Service data, individual fires recorded from 1908 to 1959 ranged in size from 29 acres to 14,670 acres and together burned a total of 41,234 acres in 15 of the 27 sub-basins in the Middle Truckee watershed. Those sub-basins that don't show up in historical records likely had fires – the fires simply occurred prior to comprehensive record-keeping. For example, a U.S. Geological Survey study of forest conditions in the northern Sierra Nevada, dated 1902, states "[t]here is not a great deal of forest land in the portion of the [Truckee River] basin examined which does not show clearly traces of fire." [21]

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[18] Ibid., p. III-24.
[19] Department of Water Resources (1991). Truckee River Atlas. Sacramento, CA, California Resources Agency. p. 34; see also Horton, G. (1997). Truckee River Chronology: A Chronological History of Lake Tahoe and the Truckee River and Related Water Issues. Carson City, NV, Nevada Division of Water Planning - Department of Conservation and Natural Resources. p. III-41.
[20] Bergman, J. A. (2001). Middle Truckee River Watershed Hydrologic Condition Assessment, Tahoe National Forest**:** 1-64. p. 13.
[21] Lieberg, J. B. (1902). Forest Conditions in the Northern Sierra Nevada, California. Washington, DC, U.S. Geological Survey. p. 181.

Forests

The same 1902 U.S. Geological Survey report on forest conditions describes the Truckee basin area as completely forested, consisting primarily of yellow pine below the 7,000-foot elevation and Shasta fir (or Red Fir) in the higher elevations or on north-facing slopes at slightly lower elevations. "The tracts sparsely timbered or which now carry no mill timber are such only temporarily, owing to logging or fire," the report states. [22]

The forests around Lake Tahoe and the Truckee River became well-known in the mid-1800s, especially to timber fallers, for the "choice pines" that grew there – including ponderosa pine, Jeffrey pine and sugar pine. Sugar pine was a favorite of the lumber mills due to its soft white wood that was easy to mill and finish. In fact, Theodore Judah, the civil engineer who surveyed the Sierra in the mid-1800s to identify the best route for the railroad, wrote very enthusiastically about sugar pine in the Truckee basin, saying: the sugar pine... often runs 125 feet high without a limb, and often measures 8 feet through at the base."[23] By the time the U.S. Geological Survey report came out in 1902, the forests of the Truckee basin had been "logged throughout," with large and medium-sized sugar pine being all but "exterminated."[24]

Due to the semiarid conditions of the northern part of the watershed, the yellow pine stands at the time contained mostly yellow pine, white fir and incense cedar, with some lodgepole pine and Western juniper. At the time of the 1902 U.S. Geological Survey report, white fir comprised the largest percentage within the type; but the report hypothesizes that prior to logging operations in the basin, yellow pine was likely the predominant component. The author of the report also points out that "[t]he forest, where not logged or much burned, is open and park like." [25]

At higher elevations, the Shasta fir forest appeared along the main range with Shasta fir comprising the main portion of the type and white pine, Patton hemlock (or mountain or western hemlock) and lodgepole pine making up the balance.[26]

Forest Animals

The Middle Truckee watershed has been home to a wide range of wildlife species over time, including large mammals such as mule deer, black bear, mountain lions, bobcats, coyotes, and foxes, and small mammals such as marmots, snowshoe hare, bats, and porcupines. The watershed has also

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[22] Ibid., p. 176.
[23] Wilson, D. (1992). Sawdust Trails in the Truckee Basin: A History of Lumbering Operations. Nevada City, CA, Nevada County Historical Society. p. 25.
[24] Lieberg, J. B. (1902). Forest Conditions in the Northern Sierra Nevada, California. Washington, DC, U.S. Geological Survey. p. 177.
[25] Ibid., p. 177.
[26] Ibid., p. 177.

hosted raptors, songbirds and game birds, as well as a number of amphibian and reptile species.[27]

Lahontan Cutthroat Trout

Because of extensive recovery efforts planned for the Lahontan cutthroat trout, a good deal is known about this species and its history in the watershed.

Historically, Pyramid Lake cutthroat trout (a sub-species of the Lahontan cutthroat trout) existed throughout the Middle and Lower Truckee River watersheds. These large fish (compared in size to Columbia River salmon by John C. Fremont in 1844) lived in Pyramid Lake but would travel up the length of the Middle Truckee River to Donner Lake and Lake Tahoe to lay their eggs and spawn.[28]

In 1875 a lumber mill in Verdi, Nevada, built a large dam to divert the river into a holding pond that could catch logs being floated downstream. This dam proved to be too much for most fish to get around, cutting off much of the Pyramid Lake cutthroat trout spawning runs up the Middle Truckee. Since few fish were getting beyond this point, upstream logging operators stopped building fish ladders on their impoundment facilities.[29] And because few, if any, fish were making it past Verdi, the California Fish Commission released the first non-native fish species – brook trout and whitefish – into the river above Boca.[30]

By 1880 the Pyramid Lake sub-species of cutthroat trout had disappeared in the Middle Truckee watershed above the Verdi dam. The California Fish Commission replaced this species of cutthroat trout in the Middle Truckee with an imported species from the McCloud River, along with Eastern brook trout and other non-native species.[31]

In 1896 the California Fish Commission stopped stocking the Truckee River in California because the fish could successfully go down the river but, due to

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[27] Bergman, J. A. (2001). Middle Truckee River Watershed Hydrologic Condition Assessment, Tahoe National Forest**:** 1-64. p. 12.

[28] Horton, G. (1997). Truckee River Chronology: A Chronological History of Lake Tahoe and the Truckee River and Related Water Issues. Carson City, NV, Nevada Division of Water Planning - Department of Conservation and Natural Resources. p. I-18.

[29] Ibid., p. II-26; See also Townley, J. M. (1980). The Truckee Basin Fishery, 1844-1944. Reno, NV, Desert Research Institute, University of Nevada. pp. 12-13.

[30] Horton, G. (1997). Truckee River Chronology: A Chronological History of Lake Tahoe and the Truckee River and Related Water Issues. Carson City, NV, Nevada Division of Water Planning - Department of Conservation and Natural Resources. p. II-26; See also Townley, J. M. (1980). The Truckee Basin Fishery, 1844-1944. Reno, NV, Desert Research Institute, University of Nevada. p. 22.

[31] Horton, G. (1997). Truckee River Chronology: A Chronological History of Lake Tahoe and the Truckee River and Related Water Issues. Carson City, NV, Nevada Division of Water Planning - Department of Conservation and Natural Resources. p. II-30; See also Townley, J. M. (1980). The Truckee Basin Fishery, 1844-1944. Reno, NV, Desert Research Institute, University of Nevada. p. 8.

the dams and poor state of fish ladders in the lower watershed, none could come back up the following season.[32]

In Lake Tahoe, a separate lake-based strain of native cutthroat trout became extinct over the period of 1922 to 1928, due in large part to the fact that the trout's spawning streams were so heavily impacted and also, some believe, as a result of the introduction of the Mackinaw (lake) trout species in 1885.[33]

The Pyramid Lake cutthroat trout was finally driven to extinction in the lower watershed, as well, sometime between 1938 and 1944[34] by a number of factors, including over-fishing, introduction of non-native species, various dams built for irrigation, logging and hydropower, debris covering the upstream gravel beds used for spawning, pollution from mills and other processing facilities, and reduced inflows to Pyramid Lake, which resulted in higher salinity and higher water temperatures than the fish could tolerate.[35]

LAND USE HISTORY

HUMAN SETTLEMENT

According to the *Truckee River Chronology*, evidence of human existence in the area dates back 11,200 years, based on findings of human and animal bones in Fishbone Cave on the eastern shore of Winnemucca Lake's dry lakebed.[36] Later, various tribes of Paiute, Shoshone and Washoe people lived in the Lake Tahoe Basin and different parts of the Truckee River watershed.

Native American Community

The Washoe claimed to be the first people in the area, according to Chief Wa-na-ni-pa[37] in "Indians of the Lake," a story in David Stollery's *Tales of Tahoe*. In the winter months, the Washoe lived in the Carson and Washoe Valley areas of present-day Nevada. But as the weather warmed up in the spring, the tribe would return to the shores of Lake Tahoe and the Middle Truckee River watershed. Some would take trails around the southern end of the lake, by way of Fallen Leaf Lake or Emerald Bay. Others would follow the

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32 Horton, G. (1997). Truckee River Chronology: A Chronological History of Lake Tahoe and the Truckee River and Related Water Issues. Carson City, NV, Nevada Division of Water Planning - Department of Conservation and Natural Resources. p. II-390; See also McQuivey, R. (1996). Habitat and Fisheries Historical Fact File. Reno, NV, Department of Conservation and Natural Resoruces - Nevada Division of Wildlife, Habitat Bureau.

33 Horton, G. (1997). Truckee River Chronology: A Chronological History of Lake Tahoe and the Truckee River and Related Water Issues. Carson City, NV, Nevada Division of Water Planning - Department of Conservation and Natural Resources. p. III-12-13.

34 Ibid., p. III-18; See also Townley, J. M. (1980). The Truckee Basin Fishery, 1844-1944. Reno, NV, Desert Research Institute, University of Nevada. p. 80.

35 Horton, G. (1997). Truckee River Chronology: A Chronological History of Lake Tahoe and the Truckee River and Related Water Issues. Carson City, NV, Nevada Division of Water Planning - Department of Conservation and Natural Resources. p. I-18.

36 Ibid., p. II-3.

37 The Chief is described by David Stollery as a descendent of the Washoe who inhabited the area, who shared with Stollery the stories of his people, many of which are printed in Stollery's *Tales of Tahoe*.

north shore to the lake's outlet at the Truckee River, where the fishing was plentiful and easy.[38]

Other tribes would come to the lake, including Paiutes and Monos; but the Washoe would typically drive other tribes away. Although not a war-like people, the Washoe used their hunting prowess and larger numbers to keep other tribes out of the area.[39]

> *[At Meeks Bay] [t]here were Washoe Indians here when we came [in 1872]. The Diggers [Paiutes] weren't allowed, as the Washoes and the Diggers fought, and the Diggers were afraid.*
> – as told by settler George Murphy in David J. Stollery Jr.'s *Tales of Tahoe*.

In 1868, an informal census by the Superintendent of Indian Affairs for Nevada indicated that there were approximately 1,000 natives on the Pyramid Lake Paiute Indian Reservation (as reported in *Carson Daily Appeal* at the time). The census was referring to how many Indians there were who were fishing and earning two cents per pound of fish they sold.[40] A conflicting estimate appearing in an article in the *Nevada State Journal* reported 6,000 Indians in and around the Pyramid Lake area.[41]

Trappers and Explorers

Beginning in the mid-1820s, fur trappers such as Jedediah Smith and Peter Ogden traversed the area around Winnemucca and the Humboldt River on their way to and from their headquarters at the Great Salt Lake in the Utah territory. Their growing familiarity with the region set the stage for this area becoming a key component of the Overland and Emigrant Trails used by early emigrants some 40 years later on their way to California and the gold fields.[42]

Just before the Gold Rush, in 1844, John C. Fremont was commissioned to conduct an exploratory expedition to the area to find and map the supposed San Buenaventura River, a mythical river believed to drain from the Great Salt Lake and run west across the desert and through the Sierra Nevada to the Pacific Ocean. Since he was looking for a river running east-west, he

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[38] Stollery, D. J., Jr. (1969). Tales of Tahoe: Lake Tahoe History, Legend and Description. Grass Valley, CA, Stollery's Books. p. 121.
[39] Ibid., p. 121.
[40] Horton, G. (1997). Truckee River Chronology: A Chronological History of Lake Tahoe and the Truckee River and Related Water Issues. Carson City, NV, Nevada Division of Water Planning - Department of Conservation and Natural Resources. p. II-18; See also McQuivey, R. (1996). Habitat and Fisheries Historical Fact File. Reno, NV, Department of Conservation and Natural Resources - Nevada Division of Wildlife, Habitat Bureau.
[41] Horton, *Chronology*, p. II-24; See also McQuivey, R. (1996). Habitat and Fisheries Historical Fact File. Reno, NV, Department of Conservation and Natural Resources - Nevada Division of Wildlife, Habitat Bureau.
[42] Horton, G. (1997). Truckee River Chronology: A Chronological History of Lake Tahoe and the Truckee River and Related Water Issues. Carson City, NV, Nevada Division of Water Planning - Department of Conservation and Natural Resources. p. II-4.

abandoned the Truckee River at the point where it turns north toward Pyramid Lake (so-named by Fremont because of a pyramid-shaped rock on the lake's eastern shore).[43]

Later that year the Stevens-Murphy-Townsend emigrant party crossed the desert and, instead of turning toward the Carson River, as Fremont had done, continued along the Truckee River to Donner Lake and Donner Pass, as their native guide suggested. Legend has it that the guide was named Truckee, so they called the river *Truckee* after him in gratitude for his assistance.[44] A competing legend reports that when the emigrants were greeted by a local Paiute chief, he let them know he was peaceful by yelling out "tro-kay, tro-kay," meaning *everything is all right*. They thought he was telling them his name. So when he indeed showed the travelers the path that followed the river, they honored him by naming the river after what they thought was his name.[45]

The somewhat more famous emigrant party followed a couple of years later. The Donner Party left Missouri in May 1846 and arrived at Truckee Meadows, near present-day Reno, in mid-October of that year. As they tried to continue across Donner Pass, an early and very heavy snow stopped them in their tracks around Donner Lake. Some of the group made shelters near the lake to wait out the winter, while others sheltered east of Donner Lake near the junction of Prosser and Alder creeks. Of 87 original members in the party, only 47 were eventually rescued alive, some six months after getting caught by the early and severe winter weather. As one might imagine, word of the Donner Party's fate diminished use of the direct route along the Truckee River for some time.[46]

Early Settlers

With the discovery of gold at Sutter's Mill in 1848, growing numbers of fortune-seekers headed to California, some using the Truckee River route across Donner summit.

The discovery of silver – the Comstock Lode, as it came to be called – in Nevada brought a tremendous influx of people and commerce to the Truckee Meadows area (present-day Reno and Sparks), which also increased the demand for natural resources such as lumber and water.

The Truckee-Donner area began attracting settlers in the 1860s, primarily related to logging activity and the construction of the railroad. One of the first settlers to arrive was Joseph Gray. In 1863 he built a log cabin near the turnpike that was being built from Dutch Flat to the Truckee Basin to supply

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[43] Ibid., p. II-5.
[44] Ibid., p. II-6.
[45] Browne, J. K. (1983). Nuggets of Nevada County History. Nevada City, CA, Nevada County Historical Society. p. 88.
[46] Horton, G. (1997). Truckee River Chronology: A Chronological History of Lake Tahoe and the Truckee River and Related Water Issues. Carson City, NV, Nevada Division of Water Planning - Department of Conservation and Natural Resources. p. II-7.

construction of the Central Pacific railroad. His cabin also served as a stop for workers and travelers, so it became known as Gray's Station.[47]

Another early settler was S.S. Coburn, who constructed more buildings to accommodate the increasing traffic through the area by those going to and from the silver mines in Nevada. What used to be Gray's Station took on Coburn's name, becoming known as Coburn Station. By 1868, the usual assortment of saloons, stores and lodging houses were built to accommodate the arrival of the railroad construction crews. Unfortunately, these all burned down in a fire. But new buildings went up and a new town was created nearby. This town was called Truckee.[48]

As a means of encouraging settlement of the western frontier, President Abraham Lincoln signed the Homestead Act in 1862. This Act initially allowed US citizens (heads of family, at least 21 years old, or veterans of 14 days or more of active service in the US armed forces) to settle 160 acres of government-owned land and take possession to title of that land after five years of residence. There were certain requirements regarding cultivation of the land, but no requirements or restrictions regarding development of water resources. The Homestead Act was amended several times to change terms of residence, etc., but remained in effect until 1977. [49]

The Homestead Act, in combination with the coming of the railroad and other land entry acts, such as the 1877 Desert Land Act, generated great influxes of people to the area, which, in turn, added to the increasing demands being placed on the area's natural resources.

The Transcontinental Railroad was completed in 1869, making westward migration much less daunting and setting the stage for the growth of agriculture and other industries that could ship products from the fertile valleys of California and Nevada to eastern markets via the railroad.

Chinese Community

The Chinese population arrived in Truckee in the mid-1860s when Charles Crocker, one of the "Big Four" who financed the Central Pacific Railroad, brought Chinese labor from Canton to augment the largely Irish work force building the railroad.[50] It is said that the Chinese laid all but 35 miles of the Central Pacific tracks between Sacramento and Promontory, Utah.[51] Once the Sierra Nevada portion of the railroad was finished in 1868, the Chinese stayed in Truckee and found other ways of making a living. By 1880 the

[47] Browne, J. K. (1983). Nuggets of Nevada County History. Nevada City, CA, Nevada County Historical Society. p. 89.
[48] Ibid., pp. 88-89.
[49] Horton, G. (1997). Truckee River Chronology: A Chronological History of Lake Tahoe and the Truckee River and Related Water Issues. Carson City, NV, Nevada Division of Water Planning - Department of Conservation and Natural Resources. p. II-14.
[50] Lord, P. A., Jr. (1981). Fire and Ice: A Portrait of Truckee. Truckee, CA, Truckee Donner Historical Society. p. 15.
[51] Ibid., p. 16.

Chinese population numbered approximately 1,000 – about one-third of Truckee's total population at the time.[52]

Unfortunately, the Chinese were treated like second-class citizens, as they were in many places throughout the Sierra. In Truckee they were relegated to a shanty town area first located behind and west of today's Commercial Row, across from where High Street comes into Spring Street. Chinese men were willing to work for lower wages than their Caucasian counterparts, so they were viewed as "stealing" logging and ice harvesting jobs away from white men. This made the Chinese community a target for violence and other harassment.[53]

Numerous fires burned through this first Chinatown area in 1872, 1874, 1875 and again in 1878. Using fire hazard as the excuse, the white population evicted the Chinese the following year and forced them to move to an area across the river and east of the bridge, along what is now South River Street.[54] This land was purchased from railroad magnate Charles Crocker by four prominent white employers of Chinese labor to facilitate the move.[55]

In 1883 the relocated Chinese community burned down again. Arson was just one symptom of widespread anti-Chinese sentiment in Truckee and throughout the Sierra. So-called "Caucasian Leagues" sprang up around the state, using violence to try to drive the Chinese out. When these groups fell into disrepute because of their brutal tactics, local anti-Chinese committees formed with the intent of passing exclusionary laws to reach the same end.[56]

By 1886 the Chinese were gone from Truckee, chased out by continued harassment, boycotts, and a serious mob action, known as "running the Chinamen out of town."[57]

Settlement Patterns

Cheap land provided a big incentive for both individuals and industries to locate in the Truckee area. The federal government granted Central Pacific railroad alternate sections of land through a strip 20 miles wide on each side of the railroad right-of-way to dispose of as the railroad saw fit. The railroad was selling this land in the 1860s for $1.25 an acre as a means of encouraging settlement (and creating markets for products to be transported

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[52] Ibid., p. 13.
[53] McGlashan, M. N. (1977). Give Me a Mountain Meadow: A Biographical Account of a Remarkable Man. Fresno, CA, Valley Publishers. p. 60.
[54] Lord, P. A., Jr. (1981). Fire and Ice: A Portrait of Truckee. Truckee, CA, Truckee Donner Historical Society. p. 13.
[55] Ibid., p. 80.
[56] McGlashan, M. N. (1977). Give Me a Mountain Meadow: A Biographical Account of a Remarkable Man. Fresno, CA, Valley Publishers. p. 142.
[57] Ibid., p. 186.

by the railroad) and as a way of getting prime timber into the hands of loggers who could harvest it to supply the timber needs of the railroad.[58]

The Homestead Act was another source of cheap land (and cheap timber). As long as the homesteaders met certain minimal requirements and paid the filing fee, they were given up to 160 acres of land for free. In some areas, homesteaders would sell their parcels to timber operators for consolidation into larger holdings. Although this was a violation of the letter of the law, it was a widely accepted practice. And it provided the basis for the cattle industry that came later. Lower elevation homesteads that were cut over by timber owners were often turned into thriving livestock operations later.[59]

Municipalities

Truckee. Truckee started as a small stage stop along the road from Dutch Flat, which was built by the Central Pacific railroad to transport supplies for construction of the railroad. Joseph Gray and his family were the first Europeans to settle in the area, building a cabin near the wagon road in 1863. With the addition of a few more buildings by another settler, designed to serve the growing number of travelers through the area, the name was changed to Coburn's Station. As the railroad was being built up and over the Sierra crest, Central Pacific chose Coburn's Station for the main depot on the developing rail line running from Sacramento to Ogden, Utah. It was Central Pacific that renamed the area "Truckee" for the adjacent river.[60]

Hobart Mills. In the 1870s and '80s, larger sawmills began producing secondary wood products, such as shingles, boxes, doors and window frames, charcoal, etc. This expansion led to the development of individual settlements or communities – "company towns" – with housing for employees, company stores, hotels, repair shops, stage depots and other goods and services on site.[61] Hobart Mills is one of many such towns that initially grew up around a successful mill.

When local timber supplies started dwindling in the late 1880s and '90s, a number of the mills closed down. Without the "company," many of these company towns – such as Boca, Franktown, Galena, Ophir, etc. – also dried up and disappeared. They remain as place names on a map, but no town exists in these locations today. Hobart Mills is an exception, along with Truckee, Verdi, Tahoe City and a

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[58] Wilson, D. (1992). Sawdust Trails in the Truckee Basin: A History of Lumbering Operations. Nevada City, CA, Nevada County Historical Society. p. 26.
[59] Ibid., p. 26.
[60] Browne, J. K. (1983). Nuggets of Nevada County History. Nevada City, CA, Nevada County Historical Society. pp. 88-89.
[61] Wilson, D. (1992). Sawdust Trails in the Truckee Basin: A History of Lumbering Operations. Nevada City, CA, Nevada County Historical Society. pp. 34-36.

handful of other timber centers that survive today largely because they focused on other activities as timber supplies were exhausted.[62]

Tahoe City. According to prominent Truckee resident C.F. McGlashan (1875), Tahoe City was "destined to be the most important center of business and travel on the lake."[63] For one thing, Tahoe City was a terminus for stage roads and later the narrow gauge railroad that ran between Truckee and Lake Tahoe, making it the jumping-off point for people and goods approaching the lake from the travel hub of Truckee. Early on, Tahoe City boasted luxurious restaurants and hotels, complete with "carriages, horses and boats, a bowling alley, bath rooms, croquet grounds and all that can tend to the rational enjoyment of lake tourists."[64]

Major mine owners also chose Tahoe City for their summer residences or cottages; mail from four different post offices around the lake was collected and distributed from Tahoe City; major stores set up shop, bringing in food and merchandise for sale to area residents and businesses; and steamer tours were available to take visitors around the lake.[65]

In more modern times the opening of Interstate 80, the first "all-weather" highway across the summit, greatly reduced travel time from Sacramento and the Bay Area and also allowed for year-round travel. With the ease of travel, people began looking at the Truckee/Tahoe area as a prime location for a second home. Large, outlying recreational subdivisions, such as Tahoe Donner and Northstar, became the trend starting in the early 1970s. As a result, Truckee's population is made up of a significant number of second-home owners who are seasonal residents.[66]

The move toward large recreational subdivisions changed the historical growth pattern of Truckee and the surrounding area, in which mixed uses and different housing types had typically been located around a commercial core. Most of the area's newer developments consisted of single-family residential – often vacation – homes surrounding a ski hill, lake or other outlying recreational facility. The newer neighborhoods typically had little or no mixed use or commercial components, meaning that residents or vacationers had to drive some miles for goods and services.[67]

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[62] Ibid., p. 48.
[63] McGlashan, M. N. and Betty H. McGlashan, Eds. (1986). From the Desk of Truckee's C.F. McGlashan. Truckee, CA, Truckee Donner Historical Society. p. 172.
[64] Ibid., p. 172.
[65] Ibid., p. 172.
[66] Town of Truckee Community Development Dept., D. C. & E. Design, Inc., et al. (2003). Truckee General Plan Update Briefing Book. Truckee, CA, Town of Truckee: 1-45. p. 8.
[67] Ibid., pp. 9-10.

HISTORIC LAND USES

Please see **Appendix A**: Primary Land Use Activities and Events (Pre-1960) by Subwatershed for a matrix showing which of the following historic activities took place in each subwatershed.

Water Development

In order to get to the underground silver deposits of the Comstock Lode, discovered in 1859, miners had to dig down deep into the earth, unleashing underground thermal waters into the mine shafts. Getting the water out of the shafts and away from the mines began a process of water diversions and interbasin water transfers that persists today.[68]

In addition to clearing the mines of water, dams and diversions were built to help float sawlogs to the mill, to lessen the impacts of flood events, to store water for downstream use, and in a few cases, to generate electricity. The chart beginning on the following page shows the major dams, diversions and storage facilities in the Middle Truckee watershed. [Note: certain dams built after 1960 are represented in the chart in order to provide a complete discussion of water development in the watershed, most of which was completed prior to 1960.]

[68] Horton, G. (1997). Truckee River Chronology: A Chronological History of Lake Tahoe and the Truckee River and Related Water Issues. Carson City, NV, Nevada Division of Water Planning - Department of Conservation and Natural Resources. p. II-11.

Major Dams / Diversions / Storage Facilities[69]

Dam	**Date Built**	**Drainage Area** *(sq.mi.)*	**Storage** *(acre-ft)*	**Owner**	**Operator**	**Use**	**Min Flow** *(cfs)*
Lake Tahoe Dam	1913 (original timber-crib dam built in 1870)	506	744,600	US Bureau of Reclamation (BOR) under an easement with Sierra Pacific Power Co.	Truckee-Carson Irrigation District (TCID) for the Newlands Project	maintain Floriston rates (to supplement natural runoff and Boca Dam releases)	50-70
Donner Lake Dam	1929 (original wooden crib dam built in 1859)[70]	14	9,500	Originally the Donner Lake Company; purchased by Sierra Pacific Power Co (SPPCo) & TCID in 1943	Originally Donner Lake Company; as of 1943, Sierra Pacific Power Co & TCID	Private - SPPCo: to supplement Truckee and Reno-Sparks municipal & industrial use; TCID: supplement Newlands irrigation	2-3
Martis Creek Reservoir	1971	40	20,400	US Army Corps of Engineers (ACOE)	ACOE	Flood control (only temporary storage allowed due to leaking dam)	n/a
Prosser Creek Reservoir	1962	50	29,800	BOR	BOR	Flood control; Floriston rates when can't get from Lk Tahoe; species support (cui-ui, LCT)	5

[69] Ibid., p. I-20-22.
[70] California Department of Parks and Recreation (2002). Donner Memorial State Park Preliminary General Plan/Draft EIR. Sacramento, CA, California Department of Parks & Recreation, Northern Service Center. p. 42.

Dam	**Date Built**	**Drainage Area** *(sq.mi.)*	**Storage** *(acre-ft)*	**Owner**	**Operator**	**Use**	**Min Flow** *(cfs)*
Independence Lake	1929 (enlarged in 1937 to create 17,500 acre-feet of storage up from original 3,000 acre-feet)	8	17,500	Originally built by Hobart Estate Company; later acquired by SPPCo	Originally operated by Hobart Estate Company; later acquired and operated by SPPCo	Private – supplement Reno-Sparks municipal & industrial use; addit storage once Floriston rates and other diversions met	2
Stampede Reservoir	1970	136	226,500	BOR	BOR	ESA; flood control; addit storage once Floriston rates and diversions met, Boca full, Independence full	30
Boca Reservoir	1939 (original reservoir built in 1868 for ice harvest)	172 (incl. headwaters of Stampede & Indep.)	40,800	BOR	Washoe Co Water Conservation District	Maintain Floriston rates; flood control; addit storage after Floriston rates met, Independ. Lk full	0
Floriston diversion dam						Diverts water into flume to be used 1.8 mi downstream at Farad powerhouse	
Fleish diversion dam						Diverts water to Fleish power station	

Some of these dams had different uses initially. The Lake Tahoe dam at Tahoe City, for example, was first built in 1870 to control flows in order to help float sawlogs down the river to Truckee. Once the federal government decided to “reclaim” desert lands for agriculture and settlement, as a result of the National Reclamation Act passed in 1902, the government tried to purchase the rock-filled timber-crib dam from the timber company. Downstream power companies, knowing that the owner of the dam would control flow into the Truckee River from Lake Tahoe, beat the government to the punch. They had already entered into negotiations for purchase of this dam.[71] In 1902 the Truckee River General Electric Company (predecessor to today's Sierra Pacific Power Company of Reno, Nevada) completed negotiations and bought the dam and surrounding property for $40,000, thereby securing the flow they needed for their power operations.[72] The timber-crib structure was replaced in 1913 by a concrete slab structure with gates to control flow.[73]

Similarly with the Boca dam, it was originally built in 1868 to create a small reservoir for ice harvesting. Only later was it rebuilt to create a larger reservoir for flood control, some water storage, and, most importantly, maintenance of the required Floriston rates, which allows water from other sources, including Lake Tahoe, to be used for irrigation in Nevada.

In 1954 the Bureau of Reclamation issued a feasibility study for construction of additional upstream storage on both the Truckee River and the Carson River to provide more storage for agricultural needs and to provide for flood control and power generation. Projects targeted for the Middle Truckee included Prosser Creek Dam and Stampede Dam.[74]

In addition, a number of interim channel improvements were approved for flood control purposes, including enlarging the Truckee River from the Lake Tahoe Dam downstream approximately 3,200 feet and intermittent channel improvements along the course of the river from Tahoe City to Reno. Work on these projects began in 1959 and most were completed by 1963.[75]

Key Issues

Two key issues in the Truckee River watershed date back to the mid-1800s when gold, silver and the railroad brought more and more settlers to the area: 1.) water quality and 2.) water quantity/use.

In the early days, water quality issues arose from the dumping of sawdust and other material into the Middle Truckee River, along with sedimentation

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[71] Horton, G. (1997). Truckee River Chronology: A Chronological History of Lake Tahoe and the Truckee River and Related Water Issues. Carson City, NV, Nevada Division of Water Planning - Department of Conservation and Natural Resources., p. III-2; See also Townley, J. M. (1977). Turn this Water into Gold: The Story of the Newlands Project. Reno, NV, Nevada Historical Society. p. 47.

[72] Horton, G. (1997). Truckee River Chronology: A Chronological History of Lake Tahoe and the Truckee River and Related Water Issues. Carson City, NV, Nevada Division of Water Planning - Department of Conservation and Natural Resources., p. III-2; See also the Department of Water Resources (1991). Truckee River Atlas. Sacramento, CA, California Resources Agency. p. 44.

[73] Horton, G. (1997). Truckee River Chronology: A Chronological History of Lake Tahoe and the Truckee River and Related Water Issues. Carson City, NV, Nevada Division of Water Planning - Department of Conservation and Natural Resources., p. III-10.

[74] Ibid., p. III-21.

[75] Ibid., p. III-21.

from eroding hillsides left bare when timber was clear-cut to supply mines and the railroad.

Quantity or use issues at the time revolved around who had access to the water and for what purposes. For example, in 1865 a civil engineer from San Francisco named Alexis Von Schmidt tried to secure water from Lake Tahoe and the Truckee River to supply San Francisco via aqueduct and tunnel.[76] Those plans were largely foiled by the California Legislature, which granted the local Donner Lumber and Boom Company the right to build a dam and make channel improvements on the Truckee River from Lake Tahoe to the state line.[77] Potential investors in Von Schmidt's scheme, including the mayor of San Francisco, apparently feared legal suits over competing water rights and, therefore, chose not to support the project.[78]

Early Water Rights

In 1850, California became a state with authority over waters in the state and the use of those waters. The State created the California Doctrine to govern water rights. This doctrine contained a mixture of a.) common law riparian water rights, meaning that people who owned land adjacent to water were allowed to make "reasonable" use of that water, and b.) appropriative water rights, which assigned water rights to owners of land along waterways that had not been passed from government ownership into private ownership. Appropriative rights, however, are subject to pre-existing riparian rights upstream and downstream. This combination of authorities regarding water rights has led to much controversy over the years.[79]

In 1859 the US General Land Office withdrew the lands around Pyramid Lake from the public domain, preserving them for the native Paiute. This withdrawal date ultimately became the "priority date" for determining future water rights. As a result, Pyramid Lake Indian Reservation water rights became the oldest water rights on the Truckee River. It should be noted that at the time of granting, water rights were intended for irrigation only, not for restoration or preservation of the lake or its habitat.[80]

Then, in 1864, the Nevada Territory was admitted into the Union as the 36th state. In 1885 the state would adopt the "prior appropriation doctrine"

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[76] Ibid. p. II-16; See also Strong, D. H. (1984). Tahoe: An Environmental History. Lincoln, NE, University of Nebraska Press. p. 95.
[77] Horton, G. (1997). Truckee River Chronology: A Chronological History of Lake Tahoe and the Truckee River and Related Water Issues. Carson City, NV, Nevada Division of Water Planning - Department of Conservation and Natural Resources. p. II-16; See also Department of Water Resources (1991). Truckee River Atlas. Sacramento, CA, California Resources Agency. p. 43.
[78] Horton, G. (1997). Truckee River Chronology: A Chronological History of Lake Tahoe and the Truckee River and Related Water Issues. Carson City, NV, Nevada Division of Water Planning - Department of Conservation and Natural Resources., p. II-23; See also Strong, D. H. (1984). Tahoe: An Environmental History. Lincoln, NE, University of Nebraska Press. p. 97.
[79] Horton, G. (1997). Truckee River Chronology: A Chronological History of Lake Tahoe and the Truckee River and Related Water Issues. Carson City, NV, Nevada Division of Water Planning - Department of Conservation and Natural Resources. p. II-9.
[80] Ibid., p. II-12.

regarding regulation of water rights. This doctrine allowed that the first person to take surface water, and later groundwater, and put it to some "beneficial use" had first rights, or a higher priority than any subsequent users of that water, including those who had riparian rights simply by virtue of living on land next to water.[81]

The idea of *prior appropriation* originated in the western states to support mining operations that took water out of a stream and moved it to other areas to work mining claims on land that wasn't next to a stream. Such land wouldn't have riparian water rights, since it wasn't located adjacent to a body of water, so the miners had to find another way to guarantee the supply of water they needed. The 1885 decision made Nevada one of only eight states in the West to operate exclusively under the prior appropriation doctrine. Other states, like California, used a combination of prior appropriation and riparian rights to regulate water use. [82]

This difference between California's recognition of riparian rights for lakeshore property owners in Lake Tahoe versus Nevada's recognition only of appropriative rights or rights of actual use would become a major concern in the late 1880s and early 1890s as different entities began looking at the possibility of "reclaiming" desert land in Nevada's Lahontan Valley by providing irrigation water from Lake Tahoe and Donner Lake in California.[83]

Truckee River Compact

The Truckee River's source waters, along with most of its water storage facilities, are in California, while neighboring Nevada generates most of the demand for the water. This creates an "extreme geographic imbalance"[84] between the area supplying the water and the area demanding and using the resource. To help codify water rights on the Truckee River, the State Legislatures in California and Nevada signed the California-Nevada Interstate Compact in 1970-71, which allocates approximately 90 percent of the river's water to Nevada.[85] The Compact also established the Tahoe Regional Planning Agency, or TRPA, to oversee land use planning and environmental issues in the Tahoe Basin.

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[81] Ibid., p. II-16.

[82] Shamberger, H. A. (1991). Evolution of Nevada's Water Laws, as Related to the Development and Evolution of the State's Water Resources, From 1866 to About 1960. Carson City, NV, US Department of the Interior, Geological Survey, in cooperation with the Nevada Division of Water Resources, Department of Conservation and Natural Resources. pp. 4-5.

[83] Horton, G. (1997). Truckee River Chronology: A Chronological History of Lake Tahoe and the Truckee River and Related Water Issues. Carson City, NV, Nevada Division of Water Planning - Department of Conservation and Natural Resources., p. II-36; See also Townley, J. M. (1980). The Orr Ditch Case, 1913-1944. Reno, NV, Desert Research Institute - University of Nevada System.. p. 17.

[84] Horton, G. (1997). Truckee River Chronology: A Chronological History of Lake Tahoe and the Truckee River and Related Water Issues. Carson City, NV, Nevada Division of Water Planning - Department of Conservation and Natural Resources. p. I-1.

[85] Ibid., p. I-1.

In terms of the water coming out of Lake Tahoe, the Interstate Compact allows diversion from all sources of up to 34,000 acre-feet per year total, with 23,000 acre-feet of that total allocated to the State of California and 11,000 acre-feet per year allocated to Nevada.[86] Other water entering the system through tributaries to the Truckee River and stored in a number of reservoirs throughout the system meets the remainder of Nevada's needs.

Due to certain language in the final Compact, especially that which stated "the use of waters by the federal government... was to be credited against the use by the state in which it was made," kept Congress from ratifying the Compact.[87] The states of California and Nevada, however, agreed to implement its terms under individual state legislation.[88]

Flow issues are complicated in the Truckee system, given the many needs and uses of Truckee River water resources and the long-established flow agreements governing operation of the dam at the Truckee River outlet of Lake Tahoe. From wastewater treatment to support of endangered species, municipal use to power generation, recreation to agricultural irrigation – the Truckee River has supported and continues to support many different and often competing uses.

<u>Floriston Rates</u>

Truckee River flows are regulated by a number of historic agreements, decrees, and river operating requirements extending as far back as the turn of the last century, including:

1. the 1908 Floriston rates;
2. the 1915 Truckee River General Electric Decree;
3. the 1935 Truckee River Agreement; and
4. the 1944 Orr Ditch Decree.[89]

Measured at the Farad powerhouse USGS gaging station, the so-called "Floriston rates" are the flow rates required as part of the original dam operating agreement made in 1908 between the Truckee River General Electric Company (actual owner of the Tahoe City dam and predecessor to today's Sierra Pacific Power Company of Reno, NV), the Floriston Land and Power Company and the Floriston Pulp and Paper Company. This agreement was made to ensure certain minimum flows from the Lake Tahoe dam at Tahoe City to supply the needs of these entities for their operations, and it remains the primary operational criterion of the Middle and Lower Truckee River from its outlet at Lake Tahoe to its terminus at Pyramid Lake.[90]

Based on that original agreement, a mean flow of at least 500 cubic feet per second (cfs) must flow at Floriston from March 1 to September 30 and a

[86] Ibid., p. I-1.
[87] Ibid., p. III-27.
[88] Ibid., p. III-27.
[89] Ibid., p. I-27.
[90] Ibid., p. I-9.

mean of at least 400 cfs from October 1 through the last day of February each year.[91]

These Floriston rates were later incorporated into additional operating agreements, including:

- The Truckee River General Electric Decree in 1915, which settled the controversy at the time over control of the outflow from Lake Tahoe at the Tahoe City dam. The Truckee River General Electric Company owned the dam, but the U.S. Reclamation Service (renamed the Bureau of Reclamation in 1923) wanted control over the dam and the waters of Lake Tahoe to assure reliable flows for diversion into the Truckee-Carson Irrigation Project – later called the Newlands Project. To try to gain control over Lake Tahoe flows, the Reclamation Service had begun condemnation proceedings against the dam's owners in 1909. Under threat of the condemnation lawsuit, the dam's owners entered into negotiations with the Department of the Interior. However, a final agreement, in the form of the Truckee River General Electric Decree of 1915 couldn't be reached for six more years.[92]

  The 1915 Decree gave control of the dam's operation to the federal government in exchange for $139,500, half the cost of building a new dam structure,[93] and enforcement of the previously established Floriston rates to guarantee the Electric Company minimum year-round flows for use in generating electrical power at its powerhouse facilities along the Truckee River.[94] No change of title occurred; the government had an easement to operate the dam and 14 acres of adjoining property at the outlet of Lake Tahoe in Tahoe City.[95]

- The Truckee River Agreement (1935), which serves as the current basis for operation of the Truckee River, including its tributaries and diversions. Involved parties include: Truckee-Carson Irrigation District for the Newlands Project, Sierra Pacific Power Company for municipal and industrial water for Reno-Sparks, and the Washoe County Water Conservation District serving agricultural water users in Truckee Meadows, along with the federal government.

  Under this agreement, upstream reservoirs, those in the Middle Truckee watershed, are supervised by a Federal Water Master who administers flow requirements developed under the 1944 Orr Ditch

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[91] Ibid., p. I-27.
[92] Ibid., p. III-8; See also Townley, J. M. (1977). Turn this Water into Gold: The Story of the Newlands Project. Reno, NV, Nevada Historical Society., pp. 49-50; and Strong, D. H. (1984). Tahoe: An Environmental History. Lincoln, NE, University of Nebraska Press., p. 101.
[93] Horton, G. (1997). Truckee River Chronology: A Chronological History of Lake Tahoe and the Truckee River and Related Water Issues. Carson City, NV, Nevada Division of Water Planning - Department of Conservation and Natural Resources. p. III-11.
[94] Ibid., p. I-9.
[95] Ibid., p. III-11.

Decree – including those needed to provide the Floriston rates described above. The Truckee River Agreement, in addition to requiring operations to satisfy these rights, required the building of Boca Dam and reservoir to supplement flows coming from Lake Tahoe. Water may only be stored in Lake Tahoe and Boca Reservoir when these rates are being met. Floriston rates can be reduced as low as 300 cfs when the surface elevation of Lake Tahoe is reduced due to drought conditions.[96]

This Agreement also: prohibited the creation of any other outlets from Lake Tahoe; prohibited pumping from Lake Tahoe (or removal of water by any means other than gravity) for irrigation, power production, sanitary or domestic uses; defined "natural conditions" in the bed and banks of Lake Tahoe and of the Truckee River near the outlet at Tahoe City; and prohibited alteration of such natural conditions without the approval of the Attorney General of California.[97]

- The Orr Ditch Decree (1944), which incorporated the Truckee River Agreement, including operating requirements of various storage facilities to meet water rights needs, and affirmed various individual water rights (municipal, industrial and agricultural) for entities in Nevada using the Truckee River's waters.[98] Work on this agreement began back in 1913 when the US Reclamation Service brought suit against upstream water users, including the Orr Ditch Water Company, to resolve water rights issues on the Truckee River.[99]

What this means, essentially, is that the Floriston rates have come to represent the main operational objective of the system, the Orr Ditch Decree defines the individual water rights for downstream users, and the Truckee River Agreement determines the operational mechanisms to be used to satisfy those rights.

The Newlands Project

The Newlands Project has had a definite impact on the Middle Truckee watershed since its inception in 1905. The Newlands Irrigation Project is made up of various dams, diversions, ditches, canals and other facilities built in the first half of the 20th century to take water out of the Truckee River and distribute it to various irrigation clients in the Fallon, Nevada, area.[100] Among those are lakes, dams and reservoirs in the Middle Truckee

[96] Ibid., p. I-28.
[97] Ibid., p. I-28.
[98] Ibid., p. I-29.
[99] Ibid., p. III-10; see also Townley, J. M. (1980). The Orr Ditch Case, 1913-1944. Reno, NV, Desert Research Institute - University of Nevada System., p. 15.
[100] Horton, G. (1997). Truckee River Chronology: A Chronological History of Lake Tahoe and the Truckee River and Related Water Issues. Carson City, NV, Nevada Division of Water Planning - Department of Conservation and Natural Resources., p. I-19.

watershed, including Lake Tahoe and the Lake Tahoe dam, Donner Lake, Prosser Creek Reservoir, and Boca Reservoir. Operation of the Middle Truckee facilities to meet the needs of the Newlands Project has impacted storage levels and flows coming down the tributaries of the Middle Truckee River for decades.

Timber Harvesting

According to a 1902 report by the U.S. Geological Survey on the condition of forests in the northern Sierra Nevada, by 1902 nearly 59% of the forest land in the Truckee basin had been "logged clean or culled." Uncut areas were typically those where access was difficult or where the timber was not of an appropriate grade or use.[101]

> *Nearly all of the terraces bordering Lake Tahoe and the accessible mountain slopes and canyons have been logged, the cut varying from 10 to 99 per cent. All of the sound sugar and yellow pine and most of the Shasta fir reaching 12 inches in diameter has been cut. The white fir, being largely defective, was left by the loggers, but is now being cut for fuel.... The summits and slopes of Mount Pluto Ridge from Mount Pluto eastward have been logged, with the exception of a few hundred acres on the crest of ridges directly north of Agate Bay. The timber on those summits was exclusively Shasta fir, 70 per cent logged. On the lower northern slopes of Mount Pluto Ridge the cut has been from 70 per cent to nearly total, culls of white fir being the only species of tree left. From the lake outlet down the canyon of Truckee River, on all the areas between Truckee and Mount Pluto Ridge, on all the areas northeast from the town of Truckee to Stampede Valley, and on the high ridge of which Crystal Peak forms the culminating point, the cut of merchantable timber has been total. On the last-named ridge, near the crest and running down the western slope, a strip of uncut forest, containing about 30 per cent yellow pine, the balance white fir and incense cedar, still remains. The eastern declivities of the ridge and the adjoining slopes of Truckee Canyon have been entirely stripped of their mill timber. Between Truckee and Donner Pass 99 per cent of the mill timber has been cut. North of Truckee the cut has not been so uniform. On some tracts all the mill timber has been cut; others have been culled of their yellow pine and the white fir is left standing, whilc some blocks have remained uncut. The northern area of the basin still has some good bodies of uncut timber, but they are not likely to remain long.*[102]

A more recent study of lumbering operations in the area, titled *Sawdust Trails in the Truckee Basin*, published in 1992, estimates that lumber companies in the entire Truckee Basin (including both Nevada and California) harvested some seven billion board-feet of saw logs and 10 million cords of fuel wood from the Truckee Basin by 1881.[103] The author describes what that amount of wood might look like:

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[101] Lieberg, J. B. (1902). Forest Conditions in the Northern Sierra Nevada, California. Washington, DC, U.S. Geological Survey. p. 178.
[102] Ibid., p. 178.
[103] Wilson, D. (1992). Sawdust Trails in the Truckee Basin: A History of Lumbering Operations. Nevada City, CA, Nevada County Historical Society. p. ix.

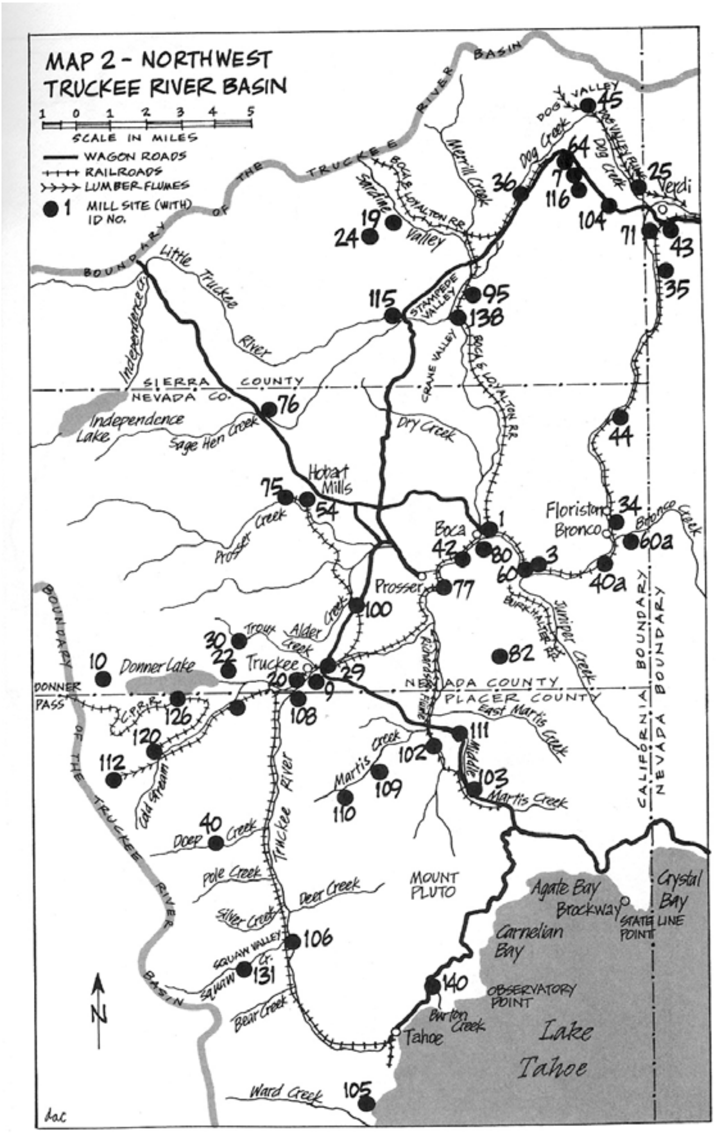

Figure 1 (from *Sawdust Trails in the Truckee Basin*, by Dick Wilson)

...enough wood, if all had been converted to planks and slabs four inches thick, to build a boardwalk thirty feet wide around the earth.[104]

Timber harvesting began in the area to supply the silver mines in Northern Nevada. These mines made use of a "square-set" timbering method that replaced excavated material from a mine shaft with sizeable timber structures to brace the newly created underground caverns.

Beginning in 1859, this system led to an incredible demand for timber, which was cut from the forests in surrounding areas, including the Truckee River watershed and the Lake Tahoe basin.[105]

The earliest mill to open in the area was Orson Hyde's mill, near the Mormon settlement of Franktown, Nevada, in 1856.[106] Most of the first mills were located on the eastern side of the watershed, in Nevada, as it was easier and less expensive to use wood milled closer to the mines.

But when the Comstock lode hit a slump in the late 1860s, some mill operators decided to move their operations over to Truckee to take

[104] Ibid., p. ix.
[105] Horton, G. (1997). Truckee River Chronology: A Chronological History of Lake Tahoe and the Truckee River and Related Water Issues. Carson City, NV, Nevada Division of Water Planning - Department of Conservation and Natural Resources. p. II-11.
[106] Wilson, D. (1992). Sawdust Trails in the Truckee Basin: A History of Lumbering Operations. Nevada City, CA, Nevada County Historical Society. p. 6.

advantage of the railroad's need for timber to make ties, provide fuel and build housing.[107]

It took a few years, but as the map shows, many lumber mills concentrated in areas of the Middle Truckee watershed where they could be close to good timber as well as to moving water. This minimized the distance and cost of hauling the cut timber and allowed the use of water to power milling machinery, supply boilers and, in some cases, to float the logs or timber from the cut to the mill or from the mill to the market.[108]

In 1867 the Truckee Lumber Company formed in the Donner Lake area (Site #10 on map), when E.J. Brickell purchased an interest in the sawmill of George Geisendorfer. Thanks to a contract with the Central Pacific Railroad, this operation produced 10,000 railroad ties and two million feet of bridge timbers in its first year. This same mill was one of 12 in the immediate vicinity that, together, milled 66 million board-feet of timber in 1867. The Truckee Lumber Company provided 12% of that total.[109]

The Truckee Lumber Company used the river to float logs down to its mill in Truckee (Site #9 on the map). Steep canyons limited access for timber harvesting; most early timber was taken from the tops of the mountains and sent down chutes or "skids," long troughs that were built from the mountain-top cuts down to the river. Loggers would load logs at the top and slide them down the skids – where, in some cases, logs would build up enough speed to catch fire and smoke due to the friction of the bark against the wooden chutes.[110]

The Central Pacific Railroad connected the town of Truckee, California, with the city of Reno, Nevada, in 1868, following a route parallel to the Truckee River. Other railroads also operated in the area during this time. Many were built by logging companies, such as the Carson and Tahoe Lumbering and Fluming Company, to move large timber from the mountain sides to the river or to Lake Tahoe.[111] These generated the need for more timber and helped to launch paper and pulp mills and other early forms of commercial enterprise in the area.[112]

The use of timber harvested from the Truckee basin changed over time, from building the mineshafts for the Comstock mines, to fueling the fires that ran stamp mills and other mining processes, to building the tracks and running

[107] Ibid., p. 11.
[108] Ibid., p. 10.
[109] Ibid., p. 29; See also Horton, G. (1997). Truckee River Chronology: A Chronological History of Lake Tahoe and the Truckee River and Related Water Issues. Carson City, NV, Nevada Division of Water Planning - Department of Conservation and Natural Resources. p. II-17.
[110] McGlashan, M. N. and Betty H. McGlashan, Eds. (1986). From the Desk of Truckee's C.F. McGlashan. Truckee, CA, Truckee Donner Historical Society. p. 165.
[111] Ibid., p. 168.
[112] Horton, G. (1997). Truckee River Chronology: A Chronological History of Lake Tahoe and the Truckee River and Related Water Issues. Carson City, NV, Nevada Division of Water Planning - Department of Conservation and Natural Resources. p. II-18.

the locomotives that pulled the railroad cars, to constructing buildings in cities and on farms throughout the West.[113]

Logging techniques changed over time, as well. In the early days of timber harvesting, teams of horses or oxen dragged the logs from the stump to the mill and then transported sawn logs by wagon from the mill to market. In the 1870s, many mills were changing over or being constructed to use steam power, and, in many places, flumes were replacing wagons for delivering timber to market. Some flume structures were built to collect water from tributary streams and funnel it into the main transportation flume in order to have enough water to float the logs.[114]

As can be seen on the map, the Middle Truckee watershed had sawmills on almost every major tributary and in many smaller tributaries, as well. Those areas without mills likely contained skid trails, flumes and/or roads for transporting felled timber to nearby mills. And, while land prices were on the rise (increasing from $1.25 an acre in the 1860s to up to $10 an acre in the 1880s), timber operators were able to buy up some of the best timberlands in the west at very reasonable prices.[115]

With the railroad complete and the mines playing out, the more astute mills, such as Hobart Mills and the Truckee Lumber Company, branched out into the manufacture of other wood products, such as furniture, roofing and siding shingles, doors and window frames, boxes, charcoal, and other items. These were shipped to markets well beyond the mining communities and even the growing cities of California – Truckee wood products made it as far as Utah, Texas and even Central America.[116]

By the late 1800s into the early 1900s, timber supplies in the Middle Truckee watershed and elsewhere throughout the Tahoe basin were beginning to dwindle. Many timber companies, large and small, shut down as a result. Land exchanges, buyouts and other tools helped a few companies stay in business a bit longer; but many of the industry leaders shut down operations.[117]

Those that stayed in business took advantage of new technology, such as more efficient steam engines and better chute designs, to move logs off the mountain and down to the mill. Individual steam, or “donkey” engines, as they were called, gave way to actual locomotives and railways for transporting logs to the mill. The addition of band saws in the mills also sped up operations, allowing for even more timber to be processed and sold.[118]

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[113] Wilson, D. (1992). Sawdust Trails in the Truckee Basin: A History of Lumbering Operations. Nevada City, CA, Nevada County Historical Society. p. ix.
[114] Ibid., p. 18.
[115] Ibid., p. 29.
[116] Ibid., p. 36.
[117] Ibid., p. 50.
[118] Ibid., pp. 53-54.

Along with the innovation came setbacks. Sparks from donkey engines or cable skidding were known to start many a fire in the watershed; and slash and early second growth on recently cut areas would add to the blaze. Other fires started thanks to sparks from wood-burning locomotives or combustion of sawdust and other flammable material stored at the different mill sites. Firefighting equipment, even when available, was usually inadequate to fight such large fires; so most were left to burn out on their own, either by running out of fuel or by dousing once the fall rains arrived.[119]

By the 1920s, most of the logging companies, and those who had made their money from logging, were gone. Of the large competitors, only Hobart Mills had land holdings with enough timber to sustain production beyond the '20s. Even Hobart had to shut its doors by 1936, signaling the end of the primary logging era in the Middle Truckee watershed. Smaller companies continued to eke out an existence, mainly cutting second growth; but they typically cut no more than half a million feet annually and stayed in business only a few years.[120]

Agriculture

Many of the water diversions in the lower watershed were established to supply irrigation water for agricultural uses in reclamation projects located in Nevada. However, there was not much in the way of agriculture in the California portion of the watershed due to the area's cold climate and short growing season. Some of the larger valleys, such as Stampede Valley (now inundated by Stampede reservoir) and Martis Valley (much of which is now held as a flood control reserve area for Martis Creek reservoir), were irrigated for pasture land. Other high meadow areas supported seasonal pasture as well.[121]

Ranching

Year-round cattle were primarily located in the lower watershed below Reno, in what was known as Truckee Meadows. But the Middle Truckee watershed saw some seasonal use when sheep, dairy and cattle ranchers from the foothill areas would drive their herds into the Truckee basin to feed in the high-elevation meadows along the Truckee and its many tributaries.[122] Good forage was also available in previously forested areas that had been cutover for timber harvest.[123]

Sheep were herded up into the Truckee basin where they were fed and sheared so their fleece could be shipped to market via the railroad. The

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[119] Ibid., p. 56-57.
[120] Ibid., pp. 60-61.
[121] Department of Water Resources (1991). Truckee River Atlas. Sacramento, CA, California Resources Agency. p. 71.
[122] Browne, J. K. (1983). Nuggets of Nevada County History. Nevada City, CA, Nevada County Historical Society. p. 91.
[123] Wilson, D. (1992). Sawdust Trails in the Truckee Basin: A History of Lumbering Operations. Nevada City, CA, Nevada County Historical Society. p. 45.

flocks, numbering 100,000 to 150,000 a year, would be taken back down into the lowlands in October.[124]

Dairy and beef cattle were moved on roughly the same schedule. Some claimed that the meat from Truckee-fed cattle was tough due to all the climbing the poor cows had to do. But the butter from dairy cattle in the valleys of Martis Creek, Prosser Creek and the Sierra Valley was very popular. In fact, the 15-20 dairy farms near Truckee were producing 60,000 pounds of mountain butter each year by the 1880s. Some of it went to mining camps or fancy restaurants and hotels around Lake Tahoe; but much of it was used by the logging mills to "grease the skids" to help logs travel down the wooden transport chutes faster.[125]

According to the 1902 U.S. Geological Survey study, "all of the [Truckee] basin, whether under fence or unenclosed, is utilized for pasture. The slopes and summit of the main range are closely pastured by sheep, the levels by cattle. All the unenclosed flats along Prosser Creek, Little Truckee River, and in Martis Valley have been overpastured and their grass eaten out long ago, only sagebrush remaining."[126]

Mining

Although the Sierra Nevada is well-known for its gold mining, the Middle Truckee watershed has been mined using a variety of techniques – including placer, underground and surface mining – for a variety of substances, including sand and gravel, pumice stone, molybdenum, and even uranium; and, of course, gold. Based on data from the State of California, at least 11 of the watershed's sub-basins have experienced some mining activity, with the heaviest concentration found along the main stem of the Truckee River. A number of these mines are no longer in production, and others were experimental or "raw" prospects. The Current Conditions chapter will discuss in more detail the legacy impacts of mining in the watershed.

Ice Harvesting

Late 19th century and early 20th century logging in the Middle Truckee watershed spawned a number of related industries. Ice harvesting was one of these. Ponds or reservoirs used by loggers to store and later transport logs froze solid in the winter, making them perfect for the production of block ice. Horses would pull saws that cut partway through the ice; then workers broke the ice blocks loose and floated them to storage sheds.[127]

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[124] Browne, J. K. (1983). Nuggets of Nevada County History. Nevada City, CA, Nevada County Historical Society., p. 91.
[125] Ibid., p. 92.
[126] Lieberg, J. B. (1902). Forest Conditions in the Northern Sierra Nevada, California. Washington, DC, U.S. Geological Survey. p. 175.
[127] Department of Water Resources (1991). Truckee River Atlas. Sacramento, CA, California Resources Agency. p. 21.

Donner Lake, the original Boca Reservoir, and other water bodies were used for ice harvesting beginning in 1868. The Boca Mill and Ice Company built a small dam to create a pond for floating logs into the mill, which they then used to harvest ice in the winter time. Sawdust from the mill helped insulate the ice while in transit. As others saw how successful the Boca operation was, a number of other companies formed to build dams and ice houses on smaller streams in the watershed. Small settlements grew up around these companies.[128]

Ice from these locations was used to offset the heating effects of the geothermal waters in and around the silver mines in Nevada, as well as for preserving agricultural products being shipped by rail from the Sacramento and San Joaquin Valley to eastern markets, once the Transcontinental Railroad was completed in 1869. The Truckee area boasted some 20 ice harvesting companies in the industry's heyday. Ice harvesting continued until 1927 or so, when mechanized refrigeration replaced the need for naturally harvested ice.[129]

Commercial Fishing

The Middle Truckee watershed once supported a thriving commercial Lahontan cutthroat trout fishery, beginning with members of the Paiute and Washoe tribes who traded the fish for goods from hunters and gold-seekers traveling through the watershed. Then, as early settlers began establishing trading posts, demand for the tasty fish grew. The discovery of silver in the Comstock Lode of present-day Nevada drove demand even higher. "Commercial fishing to feed miners in Virginia City became a bustling industry," according to Leo Poppoff in an article on the history of the Lahontan cutthroat trout.[130] The fish, gathered in pools below the growing number of diversion dams on the river, were harvested by hand, by gaff, or by dynamite ("[a] single stick of dynamite yielded hundreds of pounds of trout with no effort,"[131]). Once the trans-continental railroad reached the area in 1868, the commercial fishery was off and running.

> *It required only a short time for the fifty-pound express boxes laden with dressed trout to become familiar delicacies from San Francisco to Ogden.*
> *[Poppoff, quoting Townley,* The Truckee Basin Fishery, 1844-1944*]*

However, the fishery was depleted by the 1940s as a result of the growing number of physical impediments to upstream spawning, river pollution,

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128 Browne, J. K. (1983). Nuggets of Nevada County History. Nevada City, CA, Nevada County Historical Society. p. 90.
129 Horton, G. (1997). Truckee River Chronology: A Chronological History of Lake Tahoe and the Truckee River and Related Water Issues. Carson City, NV, Nevada Division of Water Planning - Department of Conservation and Natural Resources. p. II-20.
130 Poppoff, L. (2003). "They Thought the Supply was Endless." Basin Watch.
131 Poppoff, "They Thought the Supply was Endless," quoting Nevada historian John Townley from his 1980 report, titled *The Truckee Basin Fishery, 1844-1944*.

sawdust covering spawning beds, introduction of non-native species and overfishing during critical spawning periods.[132]

Pulp and Paper

In 1899 the Floriston Pulp and Paper Company, owned by the Fleishhacker banking and investment firm in San Francisco, was constructed on the Truckee River at Floriston. The mill used white and red fir – readily available species not favored for lumber – to produce pulp for paper.[133] The plant discharged up to 150,000 gallons of "highly acidic" waste directly into the river for more than thirty years, until its closure in 1930.[134] During its term of operation, this plant was the largest source of pollution on the river, degrading water quality and impacting aquatic wildlife and habitat downstream.[135]

Transportation

Starting with Native American trails, the overland emigrant trails (Truckee Route past Donner Lake, Henness Pass Route along the Little Truckee River, Scott's Route through Squaw Valley) and following with wagon roads, stage toll roads and turnpikes, the railroad, highways for the automobile, and, of course, the river, the Truckee area was established as an important transportation hub early on.

Up until 1868, there wasn't much in the way of a town at what is now Truckee. Gray's Station, and then Coburn's Station, was just a stage stop on the old Dutch Flat-Donner Lake Wagon Road that provided the supply route for construction of the Central Pacific railroad across the Sierra. But in 1868, the Central Pacific Railroad chose Coburn's Station as a terminus on its Sacramento to Ogden, Utah, line, building a depot and other buildings east of the few scattered homes and shops of Coburn's Station, and renaming the area "Truckee," after the river. Shortly after, the whole village burned down; but all was rebuilt parallel to and facing the railroad depot.[136]

In 1899 the Bliss family, major timber company and landowners on the east side of Lake Tahoe, saw Tahoe City as "the coming metropolis" for the Tahoe basin. Since demand for timber on the east side of Lake Tahoe had waned,

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[132] Horton, G. (1997). Truckee River Chronology: A Chronological History of Lake Tahoe and the Truckee River and Related Water Issues. Carson City, NV, Nevada Division of Water Planning - Department of Conservation and Natural Resources. p. III-18.
[133] Wilson, D. (1992). Sawdust Trails in the Truckee Basin: A History of Lumbering Operations. Nevada City, CA, Nevada County Historical Society. p. 59.
[134] Horton, G. (1997). Truckee River Chronology: A Chronological History of Lake Tahoe and the Truckee River and Related Water Issues. Carson City, NV, Nevada Division of Water Planning - Department of Conservation and Natural Resources., p. I-9; See also Joplin, M. and Hal Fiore (1995). Gray Creek Watershed Monitoring Project, USDA Forest Service.
[135] Horton, G. (1997). Truckee River Chronology: A Chronological History of Lake Tahoe and the Truckee River and Related Water Issues. Carson City, NV, Nevada Division of Water Planning - Department of Conservation and Natural Resources. p. 1-9.
[136] McGlashan, M. N. (1977). Give Me a Mountain Meadow: A Biographical Account of a Remarkable Man. Fresno, CA, Valley Publishers. p. 64.

the Bliss family decided to move its narrow gauge railroad equipment over to Tahoe City to start a passenger/freight line between Tahoe City and Truckee. The Bliss' Lake Tahoe Railway and Transportation Co. was up and running by the summer of 1900 and actively carried tourists and goods until 1942, when the automobile, shipping by truck and the advent of World War II made the railroad uneconomical to continue. Then-owner Southern Pacific (who bought the railway company from the Bliss family in 1927) discontinued operations and tore up the tracks for scrap.[137]

The first automobile is said to have arrived in Truckee in 1903[138]; but, according to a story in David J. Stollery, Jr.'s *Tales of Tahoe*, the first road for automobiles opened on the west side of the lake in 1910 or 1912. George Murphy, a settler who lived in Meeks Bay from 1872 until his death at age 93, described the road this way: "[i]t was a one-way road, with turning-out places to wait for a car to pass if it could be seen down the road. In those days, if three automobiles passed over the road in a day it was considered quite a crowd."[139]

The next focus was on opening a road from Truckee to Reno. Somewhere between 1915 and 1918 the road between Wadsworth, Nevada, and Donner Summit in California became part of the Lincoln Highway – the nation's first coast-to-coast highway, later known as Highway 40. The route, established as part of the San Francisco Exposition, reduced transportation time and made road transport competitive with rail transport. This is the route that would later serve as the basis for Interstate 80.[140]

Interstate 80 was constructed in the late 1950s and opened over Donner Pass in 1964. Unfortunately for the town of Truckee, the interstate routed traffic away from the downtown area, causing financial hardship. By the late 1960s, nearly half of Truckee's commercial space sat empty. But in the 1970s, with the renewed interest in tourism and historical preservation, Truckee began experiencing another boom.[141]

Recreation

General Recreation

As word spread about the beauty of the area, more and more people starting coming to the Tahoe-Truckee area. Fishermen drawn by extraordinary

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[137] Stollery, D. J., Jr. (1969). Tales of Tahoe: Lake Tahoe History, Legend and Description. Grass Valley, CA, Stollery's Books. pp. 64-65.
[138] Lord, P. A., Jr. (1981). Fire and Ice: A Portrait of Truckee. Truckee, CA, Truckee Donner Historical Society. p. 40.
[139] Stollery, D. J., Jr. (1969). Tales of Tahoe: Lake Tahoe History, Legend and Description. Grass Valley, CA, Stollery's Books. p. 52.
[140] Horton, G. (1997). Truckee River Chronology: A Chronological History of Lake Tahoe and the Truckee River and Related Water Issues. Carson City, NV, Nevada Division of Water Planning - Department of Conservation and Natural Resources. p. III-11.
[141] Lord, P. A., Jr. (1981). Fire and Ice: A Portrait of Truckee. Truckee, CA, Truckee Donner Historical Society. p. 47.

opportunities in the Truckee River as well as Donner, Independence and Webber Lakes, started flocking to the area. Others came for steamboat rides on Donner Lake. And still others traveled through on their way to Lake Tahoe. But Truckee's "rough and tumble" reputation as a railroad/timber town kept many from actually stopping. That is, until Charles F. McGlashan gave birth to the idea of "winter recreation" in 1893-94.[142]

Starting with a 60-foot man-made icicle and continuing with construction of an "Ice Palace" across the river that hosted winter carnivals and other diversions, McGlashan[143] is credited with starting what became a long and lucrative history of winter recreation in the Truckee area. People from San Francisco and throughout California boarded Southern Pacific excursion trains to see for themselves this grand attraction.[144]

More recently, recreational activities on public land have become popular, including camping, hiking, fishing, bicycle riding, etc. And recreation on private facilities, such as pools and golf courses associated with recreational subdivision development, has grown in popularity as well.[145]

Winter Sports

Many people think of the area's winter sports industry as getting its start primarily with the 1960 Winter Olympics in Squaw Valley. However, tourists and locals alike were enjoying snow sports such as skiing, tobogganing, snowshoeing, skating, and dog-sledding in Truckee and surrounding areas dating back to the turn of the last century.

> *According to the Truckee paper, from 1910 to 1917 the annual winter carnivals and winter sports facilities in Truckee were increasingly better, larger, and more successful. Promoters continued to boost and boast – claiming that Truckee was fast becoming one of the nation's greatest winter sports areas. [***Nuggets of Nevada County History**, p. 97]*

And even before that, as early as 1850, "snowshoes" (Norwegian-style long skis with a single pole) were used first by adventurers and later by local residents as a means of getting around in the snow. As people became more proficient with skis, Nordic-style skiing took on a fun, competitive edge. Ski clubs formed, followed by ski courses and cross-country races offering up to $1,000 in gold coin as the prize.[146]

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[142] Browne, J. K. (1983). Nuggets of Nevada County History. Nevada City, CA, Nevada County Historical Society. p. 93-94.
[143] Charles F. McGlashan is perhaps most well-known as the author of *The History of the Donner Party*, one of the definitive works on the tragic event based on interviews with survivors and rescue parties.
[144] Browne, J. K. (1983). Nuggets of Nevada County History. Nevada City, CA, Nevada County Historical Society. p. 95.
[145] Department of Water Resources (1991). Truckee River Atlas. Sacramento, CA, California Resources Agency. p. 38.
[146] Scott, E. B. (1960). Squaw Valley: Pictorial History of the Squaw Valley-Sierra Nevada Region. Crystal Bay-Lake Tahoe, NV, Sierra-Tahoe Publishing Co. pp. 63-65.

By 1916, the Truckee snow carnivals, or “Fiesta of Snows,” as they became known, were famous throughout the country, attracting between 20,000 and 30,000 visitors annually.[147] Truckee booster (and, some say, “father” of winter sports in Truckee) C.F. McGlashan went to San Francisco to arrange for special trains and excursion rates to attract tourists from Stockton, San Francisco, Oakland and Sacramento for the winter carnivals.[148]

To ensure the continued success of winter sports in Truckee, C.F. McGlashan cautioned the Truckee Chamber of Commerce in 1930 to invest in “reserve locations for use when conditions in town [a]re unfavorable.” He rightly pointed out that weather conditions in Truckee could often be either too mild or too severe support the winter activities people had become accustomed to. But by purchasing or leasing higher-elevation “reserve locations,” Truckee could solidify its place as the winter-weather wonderland of the West Coast.[149]

There are “miles and miles of hard-packed snowfields… always to be found at Donner Lake, the Grouse Lodge country, between Schaffer’s Mill and Lake Tahoe, on Juniper Creek, at dozens of nearby, perfectly accessible locations,” he reminded the Chamber. He even warned that “Los Angeles capitalists have become enthused with the prospect of investing in snow-sports, winter resorts and other features that will appeal to our visitors.”[150] But apparently the Chamber of Commerce did not follow McGlashan’s advice. Winter resorts were built by “outside interests,” and Truckee lost the spotlight as the center of winter sports activity in the Sierra. The town remained a stopover point and, therefore, continued to receive some benefit. But such benefit could have been much greater had the town invested in the growing industry.[151]

Truckee’s snow carnivals set the stage for the larger winter sports industry that eventually grew up in Lake Tahoe and the surrounding area, beginning with the carnivals and moving on to dog-sled races, ski jumping, mechanical ski lifts, statewide and national ski tournaments in Truckee and Tahoe City in the 1930s, and finally to the premier ski resorts designed to rival those of the East Coast and Europe, starting with Squaw Valley in the 1950s.

Olympics

In 1955 Squaw Valley’s owner, Alexander Cushing, flew to Europe and successfully bid to have Squaw Valley host the 1960 Winter Olympics. The following year the California Legislature appropriated millions of dollars for

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[147] Browne, J. K. (1983). Nuggets of Nevada County History. Nevada City, CA, Nevada County Historical Society. p. 99.
[148] Lord, P. A., Jr. (1981). Fire and Ice: A Portrait of Truckee. Truckee, CA, Truckee Donner Historical Society. p. 41.
[149] McGlashan, M. N. and Betty H. McGlashan, Eds. (1986). From the Desk of Truckee's C.F. McGlashan. Truckee, CA, Truckee Donner Historical Society. p. 192.
[150] Ibid., p. 193.
[151] Ibid., p. 189.

additional development to support the Olympics.[152] As a result, growth in the Truckee-Tahoe Basin area intensified.

For example, Highway 89 running along the Truckee River between Truckee and Squaw Valley was extensively graded and widened to accommodate the influx of visitors.[153] Backroads were paved, parking areas built, 18 miles of telephone cable buried underground, and new roads constructed, along with new Olympic venues, such as the very first Olympic-sized artificially iced speed skating oval and ski jumps, lifts and athlete housing and dining facilities. Privately owned chalet-style vacation homes sprang up in the Valley, too.[154]

Angling

Some of the same mill ponds and reservoirs used to harvest ice in the winter were also used in the other seasons to raise trout.[155] Much of the trout was shipped out to restaurants in San Francisco and elsewhere; but an early tourist industry grew up around the trout farms, with fishermen from all over coming to the area to try their luck in the Truckee River and surrounding lakes and reservoirs.[156]

Filmmaking

Before there was Hollywood, there was Truckee. According to *Fire & Ice: A Portrait of Truckee*, in the years between 1910 and 1924 more than 60 film production companies came to Truckee to film. The boom started with Selig Polyscope Company in January 1910 and continued with the likes of D.W. Griffiths ("Marja"), Charlie Chaplin ("The Gold Rush"), and King Vidor. Vidor, in fact, is quoted as saying: "I cannot conceive of any locality that offers more varied and limitless selections of scenery [than Truckee]."[157]

Gaming

In 1931 gaming became legal in Nevada, luring 5,000 tourists to Reno from California in the first week of legalized gambling.[158]

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152 Scott, E. B. (1960). Squaw Valley: Pictorial History of the Squaw Valley-Sierra Nevada Region. Crystal Bay-Lake Tahoe, NV, Sierra-Tahoe Publishing Co. p. 27.
153 Horton, G. (1997). Truckee River Chronology: A Chronological History of Lake Tahoe and the Truckee River and Related Water Issues. Carson City, NV, Nevada Division of Water Planning - Department of Conservation and Natural Resources. p. III-23.
154 Scott, E. B. (1960). Squaw Valley: Pictorial History of the Squaw Valley-Sierra Nevada Region. Crystal Bay-Lake Tahoe, NV, Sierra-Tahoe Publishing Co. pp. 27-31.
155 Wilson, D. (1992). Sawdust Trails in the Truckee Basin: A History of Lumbering Operations. Nevada City, CA, Nevada County Historical Society. p. 45.
156 Browne, J. K. (1983). Nuggets of Nevada County History. Nevada City, CA, Nevada County Historical Society. p. 93.
157 Lord, P. A., Jr. (1981). Fire and Ice: A Portrait of Truckee. Truckee, CA, Truckee Donner Historical Society. p. 39.
158 Horton, G. (1997). Truckee River Chronology: A Chronological History of Lake Tahoe and the Truckee River and Related Water Issues. Carson City, NV, Nevada Division of Water Planning - Department of Conservation and Natural Resources. p. III-15; See also Horton, G. A. (n.d.). Nevada: A Historical

Brewing

The Truckee area was also well-known in the late 1800s for its beer, brewed with natural spring water by the Boca Brewing Company. The brewery was constructed in 1876 and burned down in 1893. Although it had a relatively short tenure, the Boca Brewing Company brewed more beer in its heyday than the 14 other Nevada County breweries combined. Boca beer had a nationwide following and was even featured at the 1883 World's Fair in Paris.[159]

ENVIRONMENTAL REGULATION

Long before the era of environmental regulation, early logging activities resulted in relatively heavy pollution of the Truckee River from debris discharges and erosion from hillsides left bare after logging to supply the mines and the railroad.[160]

Many people consider the Sawyer decision of 1884 to be the first so-called environmental law in California. The Sawyer Decision, by Judge Lorenzo Sawyer, prohibited the dumping of mining debris into rivers and streams. This decision virtually halted the practice of hydraulic mining, which had been sending silt down the neighboring Yuba River and flooding lower lying farmlands in California's Central Valley.

According to the *Truckee River Chronology*, neighboring Nevada (then a *territory*, not yet a state) came up with its first environmental law some 23 years earlier when the Nevada Territorial Legislature "made it 'unlawful to catch fish in any of the waters within the Territory of Nevada, by the use of any drag, or any kind of net, or any fish basket, or pot, pond or weir, or by any poison or by any deleterious substance, or by obstructing, in any manner, the natural transit of fish.'"[161]

The following year, in 1862, the Nevada Territorial Legislature also passed a law prohibiting sawmills, slaughterhouses, breweries or tanneries to obstruct the natural flow of water in any stream or to allow "offensive matter," such as sawdust, chips, shavings, offal, refuse, etc., to enter the stream and damage water quality.[162] Like California's Sawyer Decision, this law was focused on water purity as it related to irrigation and agriculture, not fish and wildlife. But it had a positive effect on the watershed nonetheless.

Perspective of the State's Socioeconomic, Resource, Environmehtal, and Casino Gaming Development. Reno, NV, Business & Economic Research Associates.pp. 20-21.

[159] Browne, J. K. (1983). Nuggets of Nevada County History. Nevada City, CA, Nevada County Historical Society. p. 93.

[160] Horton, G. (1997). Truckee River Chronology: A Chronological History of Lake Tahoe and the Truckee River and Related Water Issues. Carson City, NV, Nevada Division of Water Planning - Department of Conservation and Natural Resources. p. II-13.

[161] Ibid. p. II-14; See also McQuivey, R. (1996). Habitat and Fisheries Historical Fact File. Reno, NV, Department of Conservation and Natural Resoruces - Nevada Division of Wildlife, Habitat Bureau.

[162] Horton, G. (1997). Truckee River Chronology: A Chronological History of Lake Tahoe and the Truckee River and Related Water Issues. Carson City, NV, Nevada Division of Water Planning - Department of Conservation and Natural Resources. p. II-15.

Unfortunately the law did not apply upstream in California, where releases of sawdust and other debris into the river were still rampant.

The Territorial Legislature in Nevada continued its record of environmental regulation in 1864 by initiating a “closed season” for fishing to protect trout during their spawning activity in the shallow gravels from January to April. This was in response to growing concern for the sustainability of the trout fishery in the Truckee River and Pyramid and Tahoe lakes. As reported in the *Virginia Daily Union* of Virginia City:

> *Like Lake Tahoe, this stream [the Truckee River] is in danger of losing its former reputation…. Hitherto it has been the resort of such multitudes of finny beauties, that to take large quantities of them required neither skill nor patience… between the wholesale slaughter in the [Pyramid] lake and at the dam…, they are like “angel's visits”… this course persisted will soon render them a thing of the past, and cannot be too highly censured.*[163]

Unfortunately, the Nevada State Legislature reversed this protection of spawning trout in 1866 by re-opening the river and lakes to fishing during the important spawning months of January through March.[164]

Despite the weakening of the trout protections, the Nevada Legislature did recognize early-on the problems associated with pollution of the river. Harking back to the Territorial Legislature's 1862 law prohibiting the dumping of “offensive matter” into the river (referring specifically to wastes from sawmills, slaughterhouses, breweries or tanneries), one of the first actions of the new Nevada State Legislature in 1865 was to re-enact the 1862 territorial statute prohibiting dumping of sawdust in state waters.[165]

Four years later, in 1869, the Nevada Legislature passed a joint resolution asking the California Legislature to protect upstream waters from the dumping of sawdust. This joint resolution marks the first acknowledgement that protection of resources (the fishery) and the need to address pollution in the river were interstate issues.[166] And it likely set the stage for many future agreements (and disagreements) between the states of California and Nevada.

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[163] Ibid. p. II-15; See also McQuivey, R. (1996). Habitat and Fisheries Historical Fact File. Reno, NV, Department of Conservation and Natural Resoruces - Nevada Division of Wildlife, Habitat Bureau.

[164] Horton, G. (1997). Truckee River Chronology: A Chronological History of Lake Tahoe and the Truckee River and Related Water Issues. Carson City, NV, Nevada Division of Water Planning - Department of Conservation and Natural Resources. p. II-16; See also Townley, J. M. (1980). The Truckee Basin Fishery, 1844-1944. Reno, NV, Desert Research Institute, University of Nevada. p. 4.

[165] Horton, G. (1997). Truckee River Chronology: A Chronological History of Lake Tahoe and the Truckee River and Related Water Issues. Carson City, NV, Nevada Division of Water Planning - Department of Conservation and Natural Resources. p. II-16; See also Townley, J. M. (1980). The Truckee Basin Fishery, 1844-1944. Reno, NV, Desert Research Institute, University of Nevada. p. 4.

[166] Horton, G. (1997). Truckee River Chronology: A Chronological History of Lake Tahoe and the Truckee River and Related Water Issues. Carson City, NV, Nevada Division of Water Planning - Department of Conservation and Natural Resources. p. II-20; See also Townley, J. M. (1980). The Truckee Basin Fishery, 1844-1944. Reno, NV, Desert Research Institute, University of Nevada. p. 4.

Five years after that, in 1874, the city of Reno also petitioned the California Legislature for protection against the dumping of sawdust and other logging debris into the river, claiming that sawdust deposits from upstream milling operations were blocking the entrance to Pyramid Lake and keeping fish from heading upstream to spawn.[167] This continued to be an issue of critical concern to Nevadans and the Nevada Legislature, with an additional petition sent to California in 1877, and again in 1883, and again in 1887. In the meantime, the Nevada State Journal in Reno reported in 1880 that California was considering a law that would make it illegal (a misdemeanor) for anyone to put "deleterious substances" that would harm fish into the waters of California. However, for purposes of that law, sawdust was deemed not "deleterious."[168]

Taking matters into its own hands, the Nevada Legislature in 1887 appointed a committee and appropriated funds to meet with California to resolve the "sawdust matter in the Truckee River."[169] The committee must have been effective, because in 1889 California finally passed an anti-sawdust statute, although John Townley reports in his *Truckee Basin Fishery* study that it took another five years to effectively halt discharges of logging debris and construct required fish ladders at dams in the California portion of the watershed.

In addition to sawdust, timber harvesting had other impacts on the rivers, towns and forests of the Middle Truckee. For example, timber companies that used the rivers and streams for transporting their logs to the mill often spent thousands of dollars each season to widen and/or deepen stream channels to allow easier movement of the logs.[170] In other cases, logging companies would build temporary restraining dams to hold back water until there was enough built up to release and float sawlogs downstream to the waiting mills. Such alterations to the stream channel and flow affected fish and other creatures.[171]

Fires ignited by sparks from engines or combustion of sawdust and other flammable material would devastate forest lands and residential areas. Because firefighting equipment was typically inadequate to handle these incidents, the fires were most often left to burn out on their own, taking

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[167] Horton, G. (1997). Truckee River Chronology: A Chronological History of Lake Tahoe and the Truckee River and Related Water Issues. Carson City, NV, Nevada Division of Water Planning - Department of Conservation and Natural Resources. p. II-24; See also Townley, J. M. (1980). The Truckee Basin Fishery, 1844-1944. Reno, NV, Desert Research Institute, University of Nevada. p. 5.

[168] Horton, G. (1997). Truckee River Chronology: A Chronological History of Lake Tahoe and the Truckee River and Related Water Issues. Carson City, NV, Nevada Division of Water Planning - Department of Conservation and Natural Resources. p. II-29.

[169] Ibid., p. II-34; See also McQuivey, R. (1996). Habitat and Fisheries Historical Fact File. Reno, NV, Department of Conservation and Natural Resoruces - Nevada Division of Wildlife, Habitat Bureau.

[170] Wilson, D. (1992). Sawdust Trails in the Truckee Basin: A History of Lumbering Operations. Nevada City, CA, Nevada County Historical Society. p. 39.

[171] Stollery, D. J., Jr. (1969). Tales of Tahoe: Lake Tahoe History, Legend and Description. Grass Valley, CA, Stollery's Books. p. 114.

towns, millsites, virgin forest, and second growth in cutover areas with them.[172]

Certain logging practices, such as skidding on bare ground, coupled with fires that burned up new growth, delayed regeneration in the forests of the Middle Truckee. A member of the U.S. Bureau of Forestry visiting the basin in 1904 reported: "The forest is much reduced in density; brush and reproduction are competing for possession of the openings. The sugar pine has disappeared almost entirely…. The finest of the Jeffrey pine and yellow pine and white fir has been removed."[173] In some places, the damage was so severe that timber has never come back. In many cases this is because a higher-elevation area was clear-cut, leaving no trees for seed stock to generate second growth.[174]

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172 Wilson, D. (1992). Sawdust Trails in the Truckee Basin: A History of Lumbering Operations. Nevada City, CA, Nevada County Historical Society. pp. 56-57.
173 Ibid., p. 57; See also Sterling, E. A. (1904). Report on the Forest Condition in the Lake Tahoe Region, California. Berkeley, CA, University of California Forestry Library.
174 Wilson, D. (1992). Sawdust Trails in the Truckee Basin: A History of Lumbering Operations. Nevada City, CA, Nevada County Historical Society. p. 61.

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2 Current Conditions

2 Current Conditions

INTRODUCTION

This chapter of the *Coordinated Watershed Management Strategy* addresses current land use and hydrologic, geomorphic and other ecosystem conditions in the Middle Truckee watershed from approximately 1960 to the present. The purpose of this "Current Conditions" chapter is to determine which areas are stable, at risk, and/or degraded.

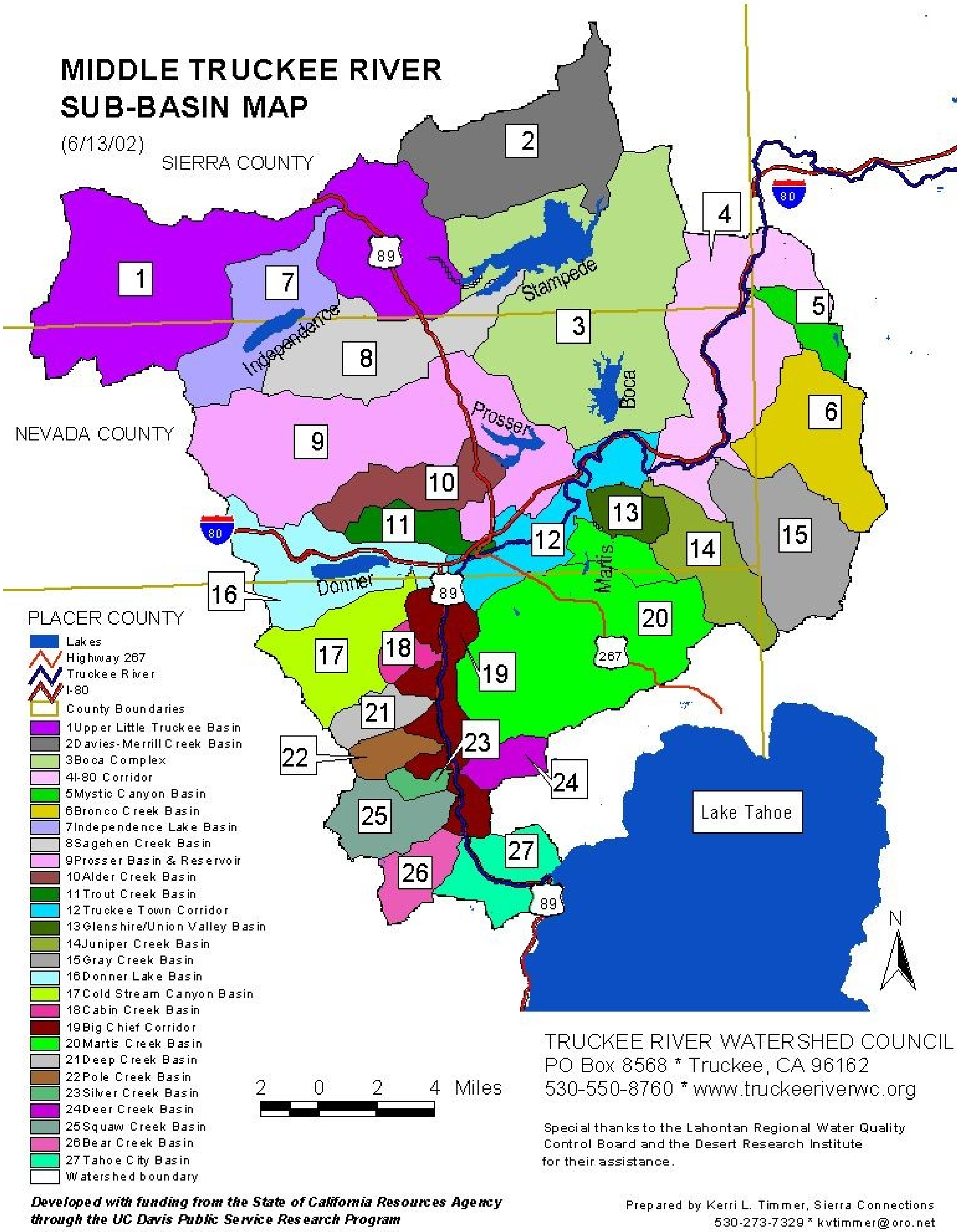
The previous chapter, titled "Natural and Land Use History," looks at key natural processes and resources and describes the inception of various land uses (prior to 1960) in the watershed that may have contributed to conditions in the watershed today. The Natural and Land Use History chapter provides useful background for this Current Conditions chapter.

WATERSHED AND SUB-BASIN BOUNDARIES

The Middle Truckee watershed – the area draining into the Middle Truckee River – covers approximately 435 square miles, or 285,000 acres of land, most of which is in California. The area includes the 35-mile stretch of river that runs northeast from Tahoe City to the California/Nevada state line.

About 16% of the Middle Truckee drainage, including the eastern portions of the Gray and Bronco creek drainages, sits across the state line in Nevada. The so-called "lower" portion of the watershed continues beyond the state line, where the river flows for another 80+ miles to its terminus in Pyramid Lake, Nevada.

The Middle Truckee watershed is made up of 27 sub-basins in three different California counties, including Placer, Nevada and Sierra, and Washoe County in Nevada. Sub-basins boundaries are shown in the following map.


MIDDLE TRUCKEE RIVER
SUB-BASIN MAP
(6/13/02)
SIERRA COUNTY
NEVADA COUNTY
PLACER COUNTY
Stampede
Independence
Prosser
Boca
Donner
Martis
Lake Tahoe
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
80
89
267
N
Lakes
Highway 267
Truckee River
I-80
County Boundaries
1 Upper Little Truckee Basin
2 Davies-Merrill Creek Basin
3 Boca Complex
4 I-80 Corridor
5 Mystic Canyon Basin
6 Bronco Creek Basin
7 Independence Lake Basin
8 Sagehen Creek Basin
9 Prosser Basin & Reservoir
10 Alder Creek Basin
11 Trout Creek Basin
12 Truckee Town Corridor
13 Glenshire/Union Valley Basin
14 Juniper Creek Basin
15 Gray Creek Basin
16 Donner Lake Basin
17 Cold Stream Canyon Basin
18 Cabin Creek Basin
19 Big Chief Corridor
20 Martis Creek Basin
21 Deep Creek Basin
22 Pole Creek Basin
23 Silver Creek Basin
24 Deer Creek Basin
25 Squaw Creek Basin
26 Bear Creek Basin
27 Tahoe City Basin
Watershed boundary
2 0 2 4 Miles
TRUCKEE RIVER WATERSHED COUNCIL
PO Box 8568 * Truckee, CA 96162
530-550-8760 * www.truckeeriverwc.org
Special thanks to the Lahontan Regional Water Quality Control Board and the Desert Research Institute for their assistance.
Developed with funding from the State of California Resources Agency through the UC Davis Public Service Research Program
Prepared by Kerri L. Timmer, Sierra Connections
530-273-7329 * kvtimmer@oro.net

WATERSHED CONDITION

To understand the relative condition of the 27 sub-basins of the Truckee River Watershed, the University of California at Davis, through the Information Center for the Environment (ICE) and Public Service Research Program (PSRP), analyzed the sub-basins, combining GIS data layers assembled from stakeholders (Truckee River Watershed Council Final Data Index, April 2003). The analysis focused on natural resources of each sub-basin including soils and sediment, hydrology and water quality, and riparian, wetland and meadow habitat. [Note: the analysis did not include socio-economic data.]

The analysis yields three relative rankings of the sub-basins, shown in the following three maps.

- Priority
- Resource Value
- Resource Risk

The GIS-based ranking system used for this analysis evaluated and ranked individual subwatersheds in the larger Middle Truckee watershed based on the overall goal of identifying areas with significant watershed-related resources (resource value) and developing management strategies to maintain, protect and restore those resources, where appropriate.

The process looks at physical, biological and other parameters in each subwatershed – including the presence of rare vegetation types, road density in streamside zones, relative parcel sizes and population densities, degree of public land ownership, and existing populations of plant or animal species – and uses these indicators or surrogates to rank each subwatershed based on its relative potential for future stewardship and management.

Specific data sets used for this particular analysis included: land use, wilderness, old growth, Lahontan cutthroat trout recovery areas, wetland areas, wild and scenic eligibility, species, vegetation types, miles of roads, road/stream crossings, average population, water quality impairment, floodplain, urban development, fire threat and erosion hazard.

The scores for the individual parameters are then added up within each subwatershed, leading to both a set of individual parameter scores and an overall composite ranking for each subwatershed. The composite is designed to indicate any given sub-basin's relative resource value as compared to other sub-basins in the watershed. The sub-basins with higher overall scores can then be considered to be higher priorities for whatever intended action the group is considering, such as further detailed survey work, specific restoration work, or other management activities.

The analysis reflects data available in 2003. The rankings are a tool intended to assist stakeholders in understanding the extensive amounts of information available about the watershed and sub-basins. The rankings will also assist in determining priorities for future projects and funding.

The point of the analysis is to have a relatively objective, natural resource-based way to identify what areas in the Middle Truckee watershed are important in terms of potential management and project activity. The Watershed Council wanted an analysis that used good science, could be replicated if new information became available and could have its results verified on the ground.

Another benefit of this process is that once a specific sub-basin has been determined to be important or valuable overall, the process can be reversed to identify what specific characteristics contributed to that sub-basin's ranking. Once the contributing scoring factors are identified, the individual analysis can be taken even farther by field-checking to a.) verify that the GIS data indicators match what is on the ground, and b.) identify more specifically within the sub-basin where those indicator resources are located.

TRUCKEE RIVER WATERSHED SUB-BASIN OVERALL PRIORITY ANALYSIS

This ranking reflects a combination of the Resource Value and Resource Risk analyses described above.

Very High Priority Sub-basins:

- Upper Little Truckee
- Independence Creek
- Boca Complex
- Town of Truckee Corridor
- Trout Creek
- Big Chief Corridor

High Priority Sub-basins:

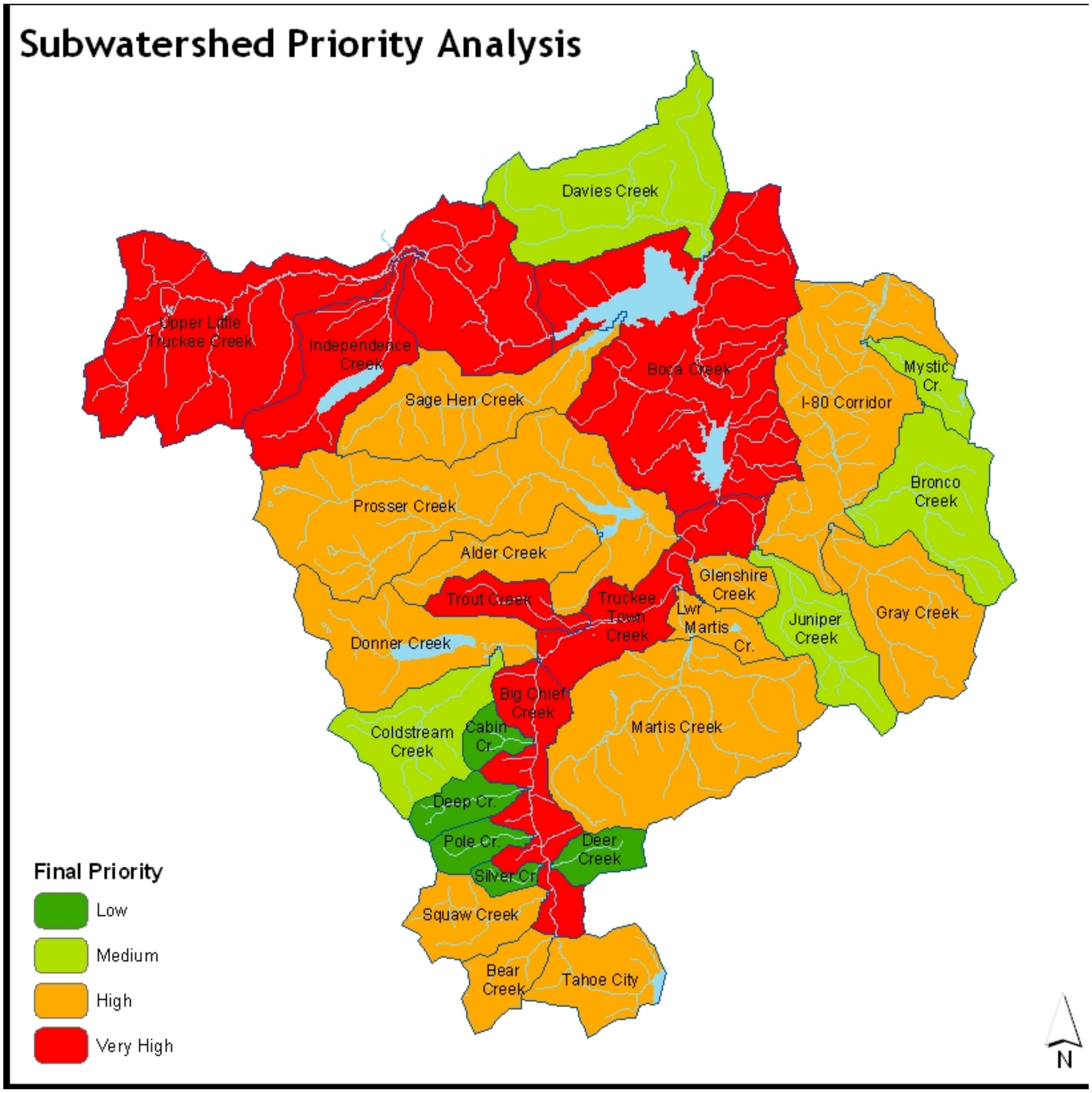
- Sagehen Creek
- Prosser Creek
- Alder Creek
- Donner Creek
- I-80 Corridor
- Gray Creek
- Glenshire / Union Valley Basin
- Martis Creek and Lower Martis Creek
- Squaw Creek
- Bear Creek
- Tahoe City

Medium Priority Sub-basins are:

- Davies-Merrill Creek
- Mystic Creek
- Bronco Creek
- Juniper Creek
- Coldstream Canyon

Low Priority Sub-basins:

- Cabin Creek
- Deep Creek
- Pole Creek
- Silver Creek
- Deer Creek


Subwatershed Priority Analysis
Davies Creek
Upper Little Truckee Creek
Independence Creek
Sage Hen Creek
Boca Creek
Mystic Cr.
I-80 Corridor
Bronco Creek
Prosser Creek
Alder Creek
Trout Creek
Truckee Town Creek
Glenshire Creek
Lwr Martis Cr.
Juniper Creek
Gray Creek
Donner Creek
Big Chief Creek
Coldstream Creek
Cabin Cr.
Martis Creek
Deep Cr.
Pole Cr.
Deer Creek
Silver Cr.
Squaw Creek
Bear Creek
Tahoe City
Final Priority
Low
Medium
High
Very High
N

TRUCKEE RIVER WATERSHED SUB-BASIN RESOURCE VALUE ANALYSIS

This ranking reflects analysis using data on riparian, wetland and meadow habitat; soil; vegetation; species; and land use.

Very High Resource Value Sub-basins:

- Upper Little Truckee
- Independence Creek
- Sagehen Creek

High Resource Value Sub-basins:

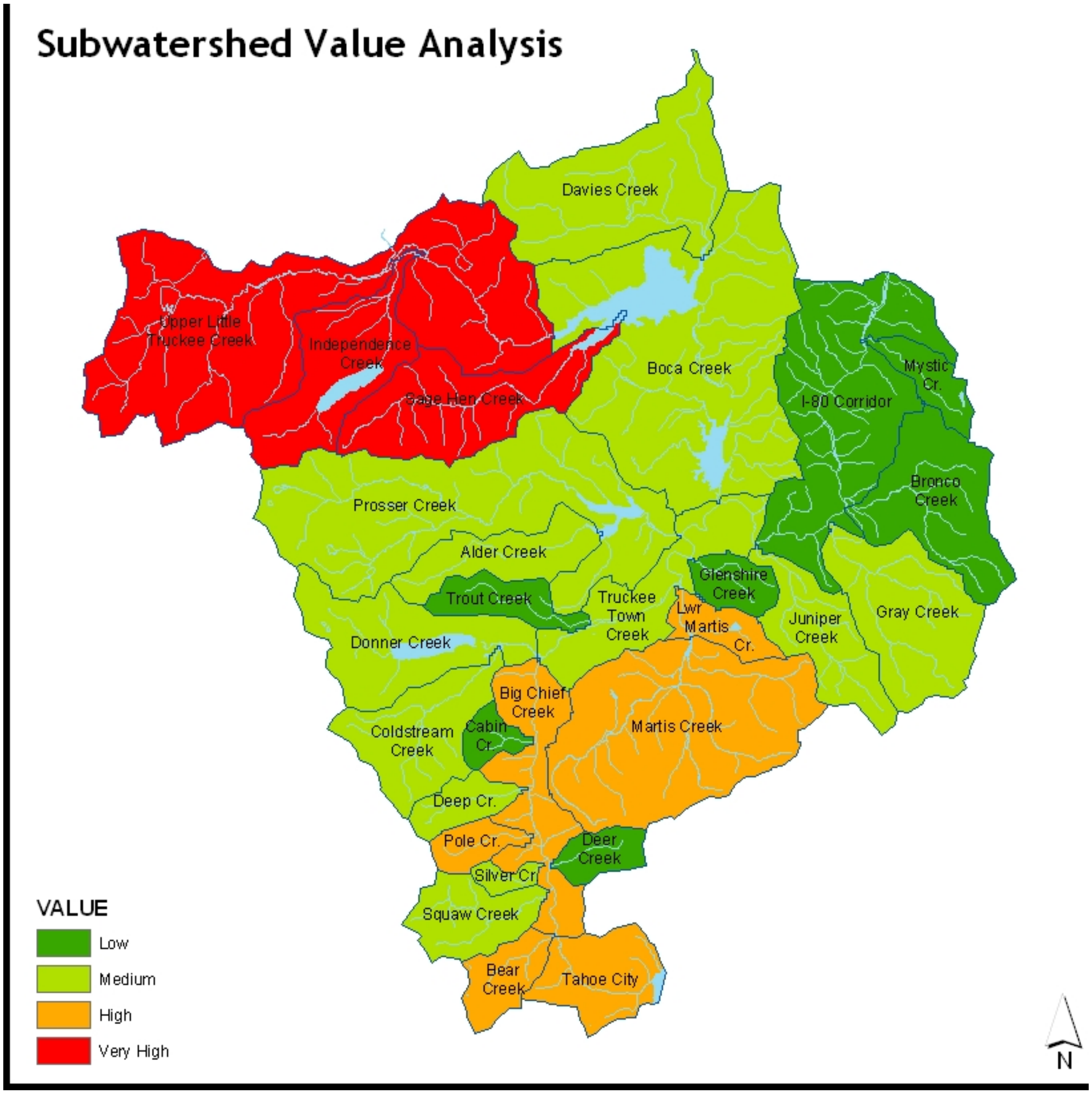
- Martis Creek and Lower Martis Creek
- Big Chief Corridor
- Pole Creek
- Bear Creek
- Tahoe City

Medium Resource Value Sub-basins:

- Davies-Merrill Creek
- Boca Complex
- Prosser Creek
- Alder Creek
- Donner Creek
- Town of Truckee Corridor
- Coldstream Canyon
- Deep Creek
- Silver Creek
- Squaw Creek
- Gray Creek
- Juniper Creek

Low Resource Value Sub-basins:

- I-80 Corridor
- Mystic Creek
- Bronco Creek
- Glenshire / Union Valley Basin
- Trout Creek
- Cabin Creek
- Deer Creek



Collaborative solutions to protect, enhance and restore the Truckee River watershed

TRUCKEE RIVER WATERSHED SUB-BASIN RISK ANALYSIS

This ranking reflects analysis using data on soil; vegetation; and land use.

Very High Risk Sub-basins:

- Boca Complex
- I-80 Corridor
- Town of Truckee Corridor
- Trout Creek
- Big Chief Corridor

High Risk Sub-basins:

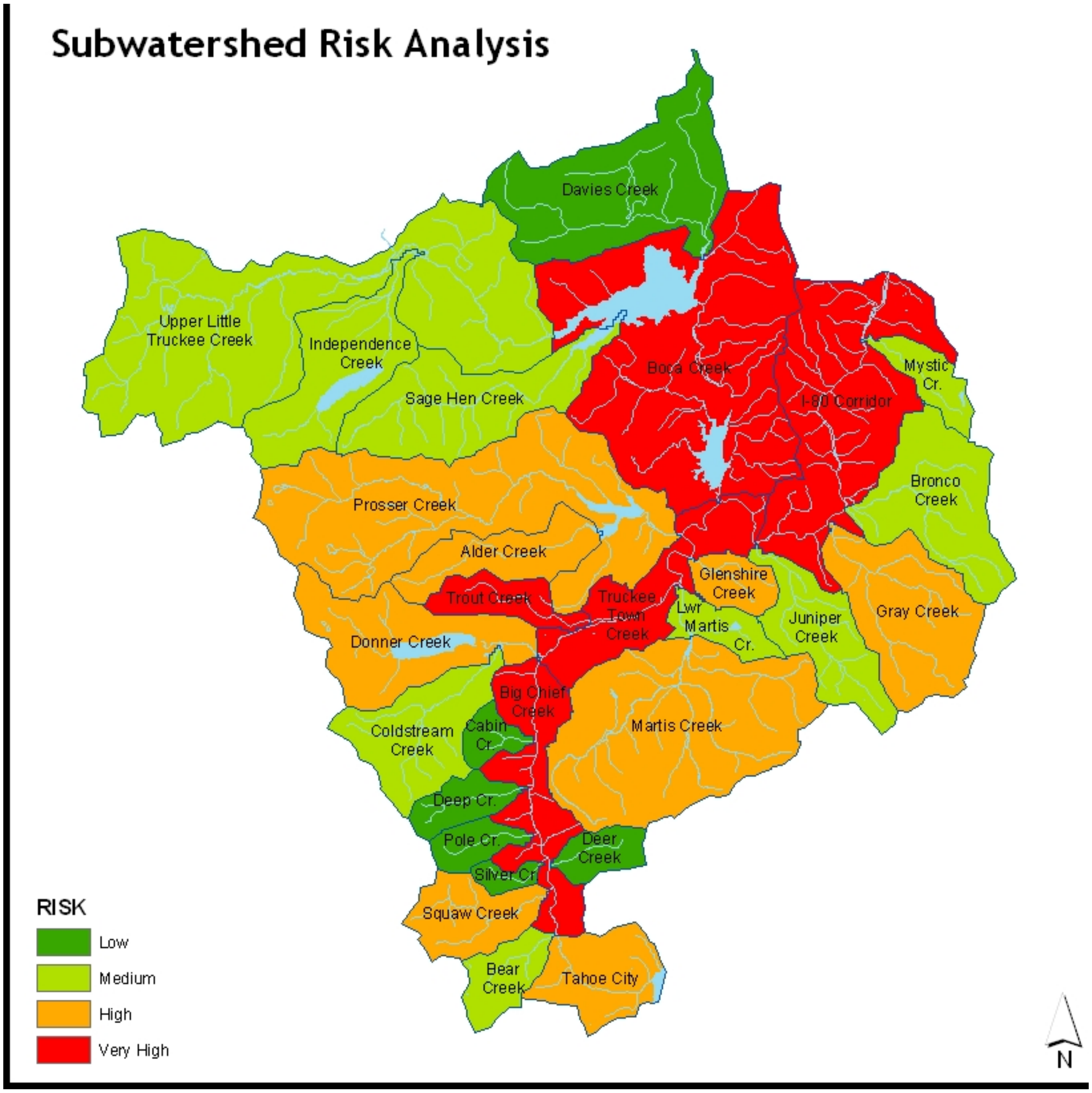
- Prosser Creek
- Alder Creek
- Donner Creek
- Gray Creek
- Glenshire / Union Valley Basin
- Martis Creek
- Squaw Creek
- Tahoe City

Medium Risk Sub-basins:

- Upper Little Truckee
- Independence Creek
- Sagehen Creek
- Mystic Creek
- Bronco Creek
- Juniper Creek
- Lower Martis Creek
- Coldstream Canyon
- Bear Creek

Low Risk Sub-basins:

- Davies-Merrill Creek
- Cabin Creek
- Pole Creek
- Silver Creek
- Deer Creek
- Deep Creek



Collaborative solutions to protect, enhance and restore the Truckee River watershed

CHAPTER 2 SOURCES CITED

Truckee River Watershed Council. April 2003. Final Data Index. Truckee, CA.

University Of California At Davis, Information Center For The Environment (ICE) And Public Service Research Program (PSRP). 2004. *Truckee River Watershed Resource Value and Risk Analysis*. Davis, CA

3 Desired Conditions

3 Desired Conditions

INTRODUCTION

The Middle Truckee River watershed supports diverse resources and activities. Meadows are important for maintaining water quality and providing habitat for endemic plants and rangeland for local ranchers. The Truckee River and its tributaries provide habitat for aquatic plants and animals and are intensively managed for water supply and flood control. Private and public open spaces provide highly developed and dispersed recreation opportunities.

The *Coordinated Watershed Management Strategy for the Middle Truckee River*, a watershed management plan for the reduction of potentially harmful non-point source sedimentation and appropriate restoration of riparian, aquatic and wetland habitat, is designed to assist stakeholders in clearly identifying issues and developing recommendations to improve watershed health. It is based on and limited by the mission statement and organizational objectives of the Truckee River Watershed Council.

Given the complexity of the watershed, the Truckee River Watershed Council (Council) has chosen to focus on water quality and riparian, aquatic and wetland habitat as key factors in determining watershed health. The goal of the *Coordinated Watershed Management Strategy*, therefore, is to reduce potentially harmful non-point source sedimentation and maintain and restore riparian, aquatic and wetland habitats in the watershed, as appropriate.

Sustaining the watershed's diversity and improving its health will be a complex undertaking. The Council recognizes that achieving the stated goal will require stakeholder support and science-based solutions that successfully integrate the natural, human, and economic environments.

DESIRED CONDITIONS

The Forest Service provides a useful definition of *desired conditions* in its Sierra Nevada Forest Plan Amendment (SNFPA): *desired condition* is "a statement describing a common vision for a specific land area." As the Forest Service explains, desired condition statements are made in the present tense indicating a condition that management will be designed to maintain or move toward. "Statements of desired condition take into account the natural range of variability typical for the Sierra Nevada landscape, the uncertainty of natural disturbances, effects of past management, unique features or opportunities… and human desires and uses of the land." [January 2004 *Record of Decision*, p. 36.]

To evaluate progress toward achieving the Truckee River Watershed Council's goal of reducing potentially harmful levels of non-point source sedimentation and maintaining and appropriately restoring riparian, aquatic and wetland habitats, the Council looked to assessments and strategies in other watershed studies to help identify key elements for desired conditions.[175] Based on that background, the Council chose the following key elements: watershed and sub-basins; soils and sediment; hydrology, water management and water quality; riparian and wetland systems; channel modification/geomorphology; and watershed condition.

Desired conditions for these elements can be identified in a number of different ways – some of which require a great deal of new research, and others which rely primarily on synthesis of existing data. The Council chose to take advantage of the large body of information available from public agencies that have already studied water quality and riparian, aquatic and wetland habitat in the Middle Truckee watershed and developed desired conditions, goals or policies with some level of peer and/or public review.[176] The Council then selected those desired conditions it considered to be most relevant to the primary goals of the *Coordinated Watershed Management Strategy*. The Council also developed additional desired conditions for areas of interest not covered by the agencies and entities consulted, such as, for example, the outreach/education component and collaborative problem-solving listed under *Watershed Condition*.

The targets established by other agencies and entities are variable and include different scales of measurement based on the individual entity's focus or mission. For example, the Lahontan Regional Water Quality Control Board has very specific desired conditions based on water quality and beneficial use definitions established by law. Other agencies like the Bureau of Land Management, US Forest Service or the counties have broader, more generalized goals as outlined in their land management or General plans.

Together the various standards or desired conditions of other agencies provide a basis for the Truckee River Watershed Council to identify desired conditions and recommend management strategies to achieve its water quality and aquatic, riparian and wetland habitat goals in the Middle Truckee watershed.

[175] The structure of this chapter, as well as the rest of the document, is based on a review of watershed assessments from around the state available through the Information Center for the Environment at the University of California, Davis. http://ice.ucdavis.edu/

[176] Agencies consulted for this purpose include: the US Forest Service, the US Fish and Wildlife Service, California Department of Fish and Game, two of the three counties and various cities or communities with General or Community Plans, and other entities whose plans had some degree of peer and/or public review.

WATERSHED AND SUB-BASIN BOUNDARIES

DESIRED CONDITION:

1. State and federal agencies acknowledge, incorporate and are using amended sub-basin boundaries developed by TRWC (through accepted changes to the CalWater database).

As mentioned in the previous chapters, the Middle Truckee watershed is made up of 27 sub-basins, including: (1) Upper Little Truckee, (2) Davies-Merrill, (3) Boca Complex, (4) I-80 Corridor, (5) Mystic Canyon, (6) Bronco Creek, (7) Independence Lake, (8) Sagehen Creek, (9) Prosser Basin & Reservoir, (10) Alder Creek, (11) Trout Creek, (12) Truckee Town Corridor, (13) Glenshire/Union Valley, (14) Juniper Creek, (15) Gray Creek, (16) Donner Lake, (17) Cold Stream Canyon, (18) Cabin Creek, (19) Big Chief Corridor, (20) Martis Creek, (21) Deep Creek, (22) Pole Creek, (23) Silver Creek, (24) Deer Creek, (25) Squaw Creek, (26) Bear Creek, and (27) the Tahoe City basin

Sub-basin boundaries are determined by the State using a computer analysis process called CalWater 2.2. The Truckee River Watershed Council submitted slightly revised sub-basin boundaries to the State to correct anomalies created by the analysis.

LAND USE AND JURISDICTIONS

DESIRED CONDITIONS:

2. TRWC has successfully helped to bridge differences in the management strategies of different jurisdictions through this Coordinated Watershed Management Strategy, *with the result that land use policies and guidelines adopted by the various local, state and federal entities with jurisdiction in the Middle Truckee watershed move watershed health toward the desired conditions outlined in the remaining sections of this chapter.*

A number of different entities govern land use in the Middle Truckee watershed, including city, county, state and federal agencies and their associated departments. Most have land use plans of some sort with policies and guidelines for the future development and/or protection of different parts of the watershed.

Cities and counties, for example, have General Plans and Zoning Codes that govern development typically over 20-year blocks of time; unincorporated areas can have their own general plans, sometimes called “Community Plans,” that are used in conjunction with County general plans to provide more detail on a specific geographic region within a county; state agencies have wildlife recovery, water management and habitat management plans that also lay out management guidelines into the future; and federal agencies use Federal Land Management Plans and other specific resource management planning tools for the same purpose.

The Truckee River Watershed Council reviewed six local government plans and eight state and federal government plans to better understand other agencies' goals and policies related to future water quality and riparian/ wetland habitat conditions in the watershed. General goals, visions or guidelines from these plans are summarized below, with more specific policies highlighted in the individual chapter sections that follow.

LOCAL PLANS

Land use planning is the process cities and counties use to determine what gets built where on the landscape. Such determinations typically address the relative intensity of uses in different locations, as well as the physical arrangement of different uses within and among locations.

According to California's Planning, Zoning and Development Laws, land is an exhaustible resource. As a result, counties and cities are required by law to have a general plan with general policies to guide the physical development of the community. Government Code section 65300 *et seq*. outlines the requirements for what a general plan should contain and offers additional guidelines for optional elements, update schedules, etc.[177]

Zoning ordinances, authorized by California Government Code §65850 *et seq.*,[178] are the tools used by counties and cities to implement the general plan. Zoning codes translate the general plan's broad land use policies into more specific requirements that apply to individual parcels on the ground. In essence, zoning divides all the land in a city or county into different *zones*, each of which has a particular permitted use or set of uses (*e.g.* residential, commercial, agricultural, industrial, etc.). In addition, the zoning codes outline certain standards for development within each of these use areas, such as, for example, the minimum parcel size or the maximum number of units per acre within a particular residential zone or the maximum height of buildings allowed in certain commercial zones.

The Truckee River Watershed Council reviewed the general plans of two of the three counties with jurisdiction in the watershed, including Placer and Nevada, as well as plans covering the incorporated town of Truckee and unincorporated areas, including Tahoe City, Martis Valley and Squaw Valley, to get a sense for the policies and desired conditions set by these entities for water quality and aquatic, riparian and wetland habitat in the Truckee River watershed. Listed below are general vision or goal statements related specifically to the Truckee River or to the Council's key interest areas of water quality and aquatic, riparian and wetland ecosystems. Specific policies

[177] General Plan Law. Government Code.
[178] Ibid.

or desired conditions are discussed in more detail in the subsequent sections of this chapter.

PLACER COUNTY

Placer County approved its most recent general plan in 1994. The 1994 General Plan provides an overall framework for the "wise, efficient, and environmentally-sensitive use of Placer County lands to meet the present and future needs of [the County's] residents and businesses." [179] While there is no overarching vision statement in this General Plan regarding the Truckee River or its watershed, the County has as a primary goal the intent to "protect and enhance the natural qualities of Placer County's streams, creeks, and groundwater," [180] including protection of wetland communities and related riparian areas.

NEVADA COUNTY

Nevada County based its most recent general plan (1995) on four central themes, rather than a particular vision statement, all of which influence the County's policies and guidelines affecting water quality and aquatic, riparian and wetland habitat in the Truckee River and other waterways. These include: [181]

1. fostering a rural quality of life;
2. sustaining a quality environment;
3. development of a strong diversified, sustainable local economy; and
4. planned land use patterns [that] will determine the level of public services appropriate to the character, economy and environment of each region.

The County's primary goal specific to water quality and riparian, aquatic and wetland habitat is to "identify, protect and manage for sustainable water resources and riparian habitats." [182]

Nevada County is currently undergoing a five-year General Plan review and update that may generate new or different policies. For more information on this process, please visit http://new.mynevadacounty.com/planning/.

THE TOWN OF TRUCKEE

The Town of Truckee's 1995-2014 General Plan does include a vision statement that provides specific recognition of the Truckee River as one of

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[179] Placer County, C. M. Starr, et al. (1994). Placer County General Plan Update. Auburn, CA, Placer County. **Policy Document:** 1-148., p. 35.
[180] Ibid., p. 104.
[181] Harland & Bartholomew & Associates, I. (1995). Nevada County General Plan Volume 1: Goals, Objectives, Policies and Implementation Measures. Nevada City, CA, Nevada County Board of Supervisors. p. 1.
[182] Ibid., p. 141.

the community's prime assets. The statement, intended to provide overall guidance for the General Plan, states: "the Town of Truckee is uniquely situated in a valley containing the Truckee River surrounded by the majestic Sierra Nevada…. As Truckee residents, we cherish our natural environment and are dedicated to safeguarding this precious resource…. Future plans will recognize the Truckee River as one of the Town's primary assets.[183]

The Truckee General Plan is also undergoing an update process that is expected to be completed after publication of this *Coordinated Watershed Management Strategy* document, so certain elements, goals and/or policies may change based on the update. For more information on the Town of Truckee General Plan update process, please visit www.truckee2025.org or www.townoftruckee.org.

TAHOE CITY

Tahoe City sits at the outlet where the Middle Truckee River exits Lake Tahoe and begins its journey northeast past the Town of Truckee and on toward the state line. In its 1994 Community Plan (similar to a general plan but more specifically focused on a smaller geographic area), Tahoe City focuses on developing as a commercial node and "destination" tourist area;[184] so its goals, objectives and policies regarding the Truckee River relate more specifically to recreational use, public access and scenic quality.

MARTIS VALLEY

Martis Valley is another area that has developed a Community Plan to provide more specific guidance on development of a particular location – the Placer County portion of Martis Valley. Martis Valley is an unincorporated area of approximately 70 square miles, or 44,800 acres, adjacent to and including portions of the Town of Truckee and stretching almost to the California/Nevada border on the east, the Lake Tahoe Basin to the south, and the Truckee River to the north and west. The Placer County portion covers approximately 25,570 acres, or roughly 57% of the total acreage.

Martis Creek, one of the Truckee River's major tributaries, flows through this area on its way to the confluence with the Truckee River in the Town of Truckee. The Martis Valley Community Plan, in conjunction with the Placer County General Plan, sets forth goals, policies, assumptions, guidelines, standards and implementation measures to guide the physical, social and economic development of the Placer County portion of the Valley to 2020.

Martis Valley had a previous plan, approved in 1975, which is updated and superceded by the 2003 plan. Because of Martis Valley's prime location, it is

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[183] Town of Truckee Community Development Department (1995). Town of Truckee General Plan 1995-2014. Truckee, CA, Town of Truckee Community Development Department. **I: Goals and Policies:** 1-181. p. 2.

[184] Tahoe City Community Plan Team, P. County, et al. (1994). Tahoe City Community Plan. Tahoe City, CA, Placer County and Tahoe Regional Planning Agency**:** I-103. p. I-4.

viewed by Placer County, in particular, as a logical place to support summer and winter recreation and first home/second home and workforce housing.[185] As a result, many of the plan's objectives and policies are geared toward that kind of development, with the acknowledgement that important environmental values, including aesthetic, ground water, and habitat, will need to be protected in the process.

SQUAW VALLEY

Squaw Valley is another area within the watershed for which the Placer County Planning Department created an additional location-specific general plan to guide development. Squaw Valley is perhaps most well-known as the site of the 1960 Winter Olympics. The Valley's first general plan was approved in 1958; that plan was superceded by an update in 1972 and another in 1983.[186] The purpose of the 1983 plan is to "establish the planning framework to ensure that Squaw Valley is developed into a top quality, year-round destination resort… without adversely impacting the unique aesthetic and environmental assets of Squaw Valley. [Squaw Valley General Plan, p. 4] Like Martis Valley, this area is slated for recreational and primary/secondary residential development related to the ski resort. It, too, has important environmental values related to Squaw Creek, another major tributary to the Truckee River, which the community wants to protect: "[t]he goals of this Plan are to improve the quality of water in Squaw Creek, its tributaries, and the Truckee River." [Squaw Valley General Plan, 1983, p. 15.]

STATE AND FEDERAL MANAGEMENT PLANS

THE USDA FOREST SERVICE

The Forest Service manages roughly 50% of the Middle Truckee watershed. The Forest Service recently undertook a regional planning effort, called the Sierra Nevada Forest Plan Amendment (SNFPA), to update management direction for the 11 National Forests in the Sierra Nevada. The initial Plan and Record of Decision for the Amendment process were released in January 2001.

Subsequently, Regional Forester Jack Blackwell conducted further review of certain elements of the 2001 Plan, bringing new information to bear on concerns about (1) old forest ecosystems and associated species, (2) aquatic, riparian and wetland ecosystems and associated species, and (3) fire

[185] Placer County, P. M. Consultants, et al. (2003). Martis Valley Community Plan (Public Review Draft). Auburn, CA, Placer County: 1-143. p. 2. As of the publication of this *Coordinated Watershed Management Strategy for the Middle Truckee River*, approval of the 2003 Martis Valley Community Plan is being challenged in court. The Truckee River Watershed Council is not involved in the litigation.
[186] Placer County Planning Department (1983). Squaw Valley General Plan Final Environmental Impact Report. Auburn, CA, Placer County Planning Department: 1-131.

and fuels management in the Sierra forests. As a result, some changes were made to the 2001 Plan.

These changes are reflected in a new 2004 Record of Decision (2004 ROD), which replaces, in its entirety, the 2001 ROD, and a final Sierra Nevada Forest Plan Amendment Supplemental Environmental Impact Statement (SEIS) that amends and supplements the 2001 Final Environmental Impact Statement (FEIS). The amendments offer new standards and guidelines and, in some cases, change or clarify how certain standards and guidelines should be applied to achieve the goals and desired conditions outlined in the 2001 Plan.

The goal of the Sierra Nevada Forest Plan Amendment, with respect to the Council's key interests of water quality and aquatic, riparian and wetland habitat, is to protect and restore desired conditions and provide for the viability of species associated with those ecosystems. [2004 ROD, pp. 32]

According to the Forest Service, "condition" is determined as follows:[187]

- **stream/riparian areas** – determined by water quality, stream channel condition (including floodplain connectivity), in-channel sediment, condition of stream banks, vegetation successional stages present in the riparian zone, riparian zone vegetation canopy and structural characteristics (both vertical and horizontal), stream flow patterns on regulated systems, watershed connectivity, and watershed condition;
- **meadows** – determined by ecological status and hydrologic function;
- **wetlands** – determined by plant species composition, plant community composition, ground cover, water table, and extent of each site (to determine whether site size is shrinking).

As a result, many of the Forest Service's desired condition statements address the elements explored in this chapter and are reflected in the desired conditions agreed upon by the Council.

STATE WATER RESOURCES CONTROL BOARD (STATE BOARD) / LAHONTAN REGIONAL WATER QUALITY CONTROL BOARD (REGIONAL BOARD)

The State Board and Regional Board govern water quality in the Truckee watershed. The State Board sets statewide policy for implementation of state and federal water quality laws and regulations [188] (along with state Health and Safety, Fish and Game, and Food and Agriculture codes).

[187] USDA Forest Service (2001). Final Environmental Impact Statement, Vol. 4. Sierra Nevada Forest Plan Amendment, USDA Forest Service. pp. E-81 - E-85.
[188] such as the federal Clean Water Act, the state Porter-Cologne Water Quality Control Act, the federal Safe Drinking Water Act, Toxic Substances Control Act, Resource Conservation and Recovery Act,

The Regional Board adopts and implements specific water quality control plans, called Basin Plans, which take into account regional differences in natural water quality, beneficial uses, and water quality problems associated with human activities in the watershed. [189] The *Lahontan Region Basin Plan* sets forth water quality standards for the surface and ground waters of the region, which include both designated beneficial uses that must be protected and narrative and numerical objectives and recommended control measures for protecting those uses.[190] Specific policies or guidelines are discussed in the *Hydrology and Water Quality* section below.

THE CALIFORNIA DEPARTMENT OF FISH AND GAME

The Department of Fish and Game worked with the U.S. Forest Service from 1987 to 1995 to conduct fish habitat evaluations throughout the Truckee River system. [191] The evaluations identified habitat distribution, species life-stage distribution and the relationship between flow and habitat utility. Using a computer model to determine how water development and management, including changes in water flow, might affect habitat conditions for fish species, the Department of Fish and Game produced a report with recommendations for modifying existing channel and flow requirements to optimize conditions for rainbow and brown trout, two species that are considered "public trust" resources in the river. [192] Specific recommendations are highlighted in the Hydrology and Channel Modification sections below.

In addition, the Department of Fish and Game has various habitat-oriented management and/or recovery plans, based either on specific locations or on different species. The Truckee River watershed contains a number of designated wildlife areas, for example, including: the Boca Unit, the Polaris & West River Units, the Union Ice Unit, and the Donner Creek Public Access. Each unit has general management guidance geared primarily toward managing public access and day-use while protecting the surrounding habitat for wildlife. [193]

Endangered Species Act, and CERCLA or the "Superfund" and Superfund Amendment and Reauthorization Act

[189] Bergman, J. A. (2001). Middle Truckee River Watershed Hydrologic Condition Assessment, Tahoe National Forest**:** 1-64. pp. 33-34.

[190] Lahontan Regional Water Quality Control Board (1994). Water Quality Control Plan for the Lahontan Region (Basin Plan). So. Lake Tahoe, Regional Water Quality Control Board. p. 1-1.

[191] Including the mainstem Truckee River from Lake Tahoe to the California-Nevada state line and various reaches of three of its primary tributaries: Donner Creek downstream of Donner Lake, Prosser Creek downstream of Prosser Reservoir, and the Little Truckee River between Stampede and Boca Reservoir and between the confluence of Independence Creek and Stampede Reservoir. Independence Creek downstream of Independence Lake was also included.

[192] California Department of Fish & Game (1996). Instream Flow Requirements, Truckee River Basin, Lake Tahoe to Nevada. Rancho Cordova, CA, California Department of Fish & Game, Environmehtal Services Division, Stream Flow and Habitat Evaluation Program**:** 1-34, plus appendices. pp. 4-5.

[193] California Department of Fish & Game (n.d.). Truckee River Wildlife Area. Rancho Cordova, CA, California Department of Fish & Game, Sacramento Valley Central Sierra Region**:** n.p.

THE U.S. FISH AND WILDLIFE SERVICE

The U.S. Fish and Wildlife Service approved a *Short-Term Action Plan* for the recovery of the Lahontan cutthroat trout (Oncorhynchus clarki henshawi) in the Truckee River Basin. The actions in this plan, developed by the Truckee River Basin Recovery Implement Team (TRIT) in August 2003, are intended to help eliminate or minimize threats that have impacted Lahontan cutthroat trout (LCT). The specific threats were identified by the larger LCT recovery plan developed by the U.S. Fish and Wildlife Service in 1995. [194]

The *Short-Term Action Plan* asserts that "[h]istorically LCT in the Truckee River basin functioned as a networked population where different life stages and year classes of fish utilized different habitats and repopulation of extirpated areas occurred from other locations within the river system." [195] The overall goal of the plan, then, is to remove LCT from the federal Endangered Species Act's list of Threatened and Endangered species. One of the assumptions of the short-term plan is that water quality and quantity, especially temperature, significantly limit the habitat for LCT in portions of the Truckee River, as do habitat degradation and the presence of non-native fish species. So the plan contains recommendations regarding water flow, among other things, to help better meet lifecycle and habitat needs of the LCT. Those recommendations are discussed in more detail under the *Hydrology* section below.

SOILS AND SEDIMENT

DESIRED CONDITIONS:

3. Soils in the watershed have favorable infiltration characteristics and diverse vegetative cover that can absorb and filter precipitation and sustain favorable streamflow conditions.

4. Sediment that negatively impacts proper functioning conditions or beneficial uses in the Truckee River and its tributaries is reduced by minimizing disturbance or employing appropriate mitigation, knowledge and use of Best Management Practices (and related strategies) for ground-disturbing activities that can cause sediment, and improvement or appropriate restoration of physical structure and condition of stream banks and shorelines in areas currently known to contribute harmful levels of sediment.

Runoff and sediment yield are typically functions of rainfall intensity and infiltration capacity of surface soils (coupled with characteristics of underlying

[194] Truckee River Basin Recovery Implementation Team (2003). Short-Term Action Plan for Lahontan Cutthroat Trout in the Truckee River Basin. Reno, NV, US Fish and Wildlife Service: 1-71. p. 1.
[195] Ibid., p. 3.

soils and bedrock).[196] For this reason it is important to maintain the infiltration capacity of and reduce compaction to surface soils, so that water can percolate through and be released more slowly instead of pooling on top and running off the surface at a faster rate, which may lead to or exacerbate erosion.

Different soil types, each with varying characteristics and different sensitivities to disturbance, are found in the diverse landscapes of the watershed. The primary landscape elements in the Middle Truckee watershed include high- and low-relief hillslopes (with varying degrees of slope), valley floors (commonly associated with glacial features and typically containing riparian and wet meadow vegetation), fluvial terraces (along larger tributary watersheds, including the mainstem Truckee), and stream channels.[197]

Generally speaking, hillslopes have a moderate to high sensitivity to disturbance depending on site-specific soil characteristics and degree of vegetative cover; valley floor areas have low to moderate sensitivity; fluvial terraces range from low to high, depending on the relative degree of soil development and the positioning of the terrace in the landscape; and glacial deposits have moderate to high sensitivity due to the homogeneous nature of the soils in these areas.[198]

Sedimentation can be an issue for rivers and streams because of the potential negative impacts too much sediment can have on water quality and other values. Native plants and animals are capable of withstanding a range of sediment variability; but adding sediment in excess of that range can cause adverse reactions and impair the proper functioning of the ecosystem.

Excess sediment can, for example, change channel shape and water velocity, both of which can limit the migration and movement of various aquatic organisms as well as reduce a stream's ability to safely absorb and/or disperse flood waters. Sediment can also clog water treatment facilities, causing them to shut down their intake systems or spend more on treatment. If too much sediment covers spawning gravels in the streambed, trout and other fish can't successfully reproduce. Increased sediment can also affect the natural ability of meadows and wetlands to settle, treat and store stormwater and flood runoff, including any natural sediment or pollutants that might be carried by such runoff.[199]

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[196] McGraw, D., A. McKay, et al. (2001). Water Quality Assessment and Modeling of the California Portion of the Truckee River Basin. Reno, Division of Hydrologic Sciences, Desert Research Institute, University and Community College System of Nevada, Las Vegas**:** 1-167. p. 56.
[197] Ibid., p. 61.
[198] Ibid., p. 57.
[199] McGraw, D., A. McKay, et al. (2001). Water Quality Assessment and Modeling of the California Portion of the Truckee River Basin. Reno, Division of Hydrologic Sciences, Desert Research Institute, University and Community College System of Nevada, Las Vegas**:** 1-167. pp. 7-8.

The potential introduction of harmful levels of sediment into waterways – from both natural and man-made causes – is an issue of concern in the Middle Truckee watershed, especially given the fact that the river is currently listed as impaired for sediment under the federal Clean Water Act [for more information on this topic, please see the *Clean Water Act/TMDL* section below]. As a result, the Truckee River Watershed Council's overall desired condition relating to sediment is to minimize sedimentation that negatively impacts proper functioning condition or beneficial uses in the Truckee River and its tributaries.

PLAN REVIEW

As it turns out, a portion of the sedimentation in the Truckee watershed is caused by natural features, such as unstable soils on steep slopes being washed into the river during seasonal rains and snowmelt. Other sources include human-caused sedimentation from decades-old development (referred to as "legacy issues"), as well as activities such as road sanding in winter, roads and trails too near streams and ground disturbance from development projects. Due to the negative impact sedimentation can have on proper functioning condition or beneficial uses in the watershed, all General Plans and other plans consulted contain policies or other direction to protect streams, rivers, and associated wetland and riparian communities as much as possible from harmful human-caused soil erosion.

For example, the General Plans for Placer County, Nevada County, Town of Truckee and Squaw Valley, as well as the Tahoe City and Martis Valley Community Plans, contain one or more policies requiring the separation of urban development from sensitive habitat areas to reduce erosion or other runoff impacts. For those places where development does occur in proximity to sensitive resources, all entities require some sort of buffer or setback. Placer County, for example, requires a buffer of 100 feet from the centerline of perennial (year-round) streams and 50 feet from intermittent (seasonal, or not year-round) streams [*Policy 6.A.1*]. The Town of Truckee has an even larger buffer for areas within its jurisdiction, prohibiting all commercial, residential and industrial development within 150 feet of either side of the Truckee River and within 100 feet of both permanent and seasonal tributaries [*Conservation and Open Space Policies 1.2 and 1.6*]. And in the wildland areas, the Forest Service's Sierra Forest Plan Amendment calls for evaluating each situation separately, using setbacks of 300 feet on each side of perennial streams, 150-foot setbacks on each side of seasonally flowing streams (intermittent and ephemeral), and 300 feet from the edge of any special aquatic feature or riparian vegetation as a starting point. Adjustments to the suggested buffer widths (larger or smaller) can be made on a case-by-case basis depending on factors unique to the situation. [2004 ROD, p. 42]

Another example is “clustering” [200] — a tool included in the Nevada County, Placer County, Town of Truckee and Martis Valley plans [201] – that recognizes the benefits of minimizing impacts on sensitive resources. For purposes of water quality protection, a buffer from waterways, where the land-altering aspects of development could affect important habitat or water quality values, is encouraged.

In addition, all local government plans include a list of specific erosion control or “soil conservation” measures to help minimize potentially harmful sedimentation, including:

- minimizing land alteration and vegetation removal;
- limiting cuts and fills;
- limiting grading to the smallest area possible or necessary to implement approved projects, and in some cases prohibiting grading on particularly sensitive areas (such as steep slopes) or during certain times of year when precipitation is high;
- temporarily or permanently replanting graded areas prior to the next rainy season;
- requiring grading to conform to natural contours;
- use of Best Management Practices to mitigate potential impacts from development activity;
- implementing street cleaning and/or de-icing methods that minimize the amount of dirt and debris created.

The Sierra Nevada Forest Plan Amendment also includes standards for new road construction, such as designing stream crossings to withstand at least the 100-year flood and using techniques that minimize the diversion of streamflow out of the channel, minimally disrupt natural hydrologic flow, avoid wetlands or minimize effects to wetlands, and avoid barring fish passage. [FEIS Vol. 1, Ch. 2, p. 62]

Such design criteria are important both to minimize future impacts as well as to help correct so-called “legacy” effects of prior land management, such as railroad construction in the late 1800s, improper timber harvesting in certain areas, inappropriate or inadequately constructed bridges or other stream crossings, etc. Also, by designing new construction to handle large storm events, such as the 100-year flood, agencies are addressing the fact that higher-magnitude or higher-intensity storms can create larger-scale problems, including mass wasting, slumping and downstream flooding that can damage property and habitat.

While many local government plans encourage the use of erosion control measures to minimize sedimentation during construction of *new* roads and

[200] *Clustering* is a design practice that places dwelling units in closer proximity than usual.
[201] As of the publication of this *Coordinated Watershed Management Strategy for the Middle Truckee River*, approval of the 2003 Martis Valley Community Plan is being challenged in court. The Truckee River Watershed Council is not involved in the litigation.

trails, there is little mention of maintaining or improving the condition of *existing* roads and trails that negatively impact adjacent resources. For example, compacted road surfaces can concentrate and accelerate water flow into drains and ditches, thereby increasing erosion in the road drainage system or below drainage outlets or in downstream tributaries. [Bergman, p. 59] The Truckee River Watershed Council believes existing road maintenance and improvement is an important element to consider as a means of reducing harmful levels of human-caused erosion in the watershed.

The Sierra Nevada Forest Plan Amendment provides an example, offering a range of options for road system management, including:

- construction, reconstruction, relocation and maintenance for needed roads to minimize sediment delivery to aquatic systems; and
- full or partial (e.g. seasonal or temporary) decommissioning, closure or conversion to trails for high-risk and un-needed roads whose sediment delivery can't be mitigated by reconstruction or maintenance. [FEIS Vol. 1, Ch. 2, p. 60]

All plans except the Town of Truckee General Plan also provided some direction regarding restoring areas – particularly streamside areas – that have been modified or altered through the development process. Appropriate restoration activities can also be used to help correct "legacy" effects of prior land management decisions.

Other entities, such as the Lahontan Regional Water Quality Control Board, the U.S. Forest Service's Pacific Southwest Region, the U.S. Bureau of Land Management, and the California Department of Transportation, have some sort of water quality management plans that also include policies or guidelines designed to minimize sedimentation. The Lahontan Regional Water Quality Control Board, for example, adopted an order calling for the minimization of discharges of storm water runoff and erosion from small construction projects in the watershed. [202] An attachment to the order, "Lahontan Region Project Guidelines for Erosion Control," provides guidance for use of temporary and permanent best management practices to prevent or minimize erosion. Management strategies and best management practices are discussed in more detail in the following chapter.

ADDITIONAL RESEARCH

CLEAN WATER ACT/TOTAL MAXIMUM DAILY LOAD (TMDL)

The Truckee River has been identified by the State Water Resources Control Board (State Board) as "impaired" under Section 303(d) of the Clean Water Act primarily for excess sediment in violation of water quality standards. As a result, the Lahontan Regional Water Quality Control Board (Lahontan

[202] (2003). General Waste Discharge Requirements. Board Order NO. R6T-2003-2004**:** 1-9.

Regional Board) was initially directed to develop and implement a Total Maximum Daily Load (TMDL) for the Truckee River.

> *A TMDL is a tool for implementing federal Clean Water Act and other state and federal water quality standards. It works by identifying thresholds for certain pollutants that affect water quality and developing best management practices to reduce the levels of those pollutants to below threshold levels.*[203]

The TMDL tool consists of both the identified thresholds and a plan for how to achieve those threshold levels.

Best professional judgment of staff at the Lahontan Regional Board indicates that sediment levels in the river may be damaging the so-called "beneficial uses" of Truckee River water identified by the State Board. [204] But in response to concerns expressed by stakeholders in the watershed, the Regional Board conducted a more in-depth review and analysis of existing data regarding sediment loads in the Truckee River and concluded that further quantifiable research is necessary to determine the extent of sedimentation and verify whether or not a TMDL is necessary. That study is scheduled for completion within the next two years.

DESERT RESEARCH INSTITUTE (DRI) STUDY

In preparation for beginning the TMDL process, the Lahontan Regional Water Quality Control Board contracted with the Desert Research Institute (DRI) at the University of Nevada, Las Vegas, to conduct a preliminary water quality assessment of the Middle Truckee River using a computer model that incorporated a synthesis of historic data and proxy data from similar watersheds. The goal of the study was to characterize existing and desired watershed conditions, assess the degree of impairment from sediment, and identify and evaluate potential land management and appropriate restoration actions that could be used to help reduce sedimentation in the river, in order to achieve compliance with water quality objectives. [205]

DRI's computer analysis and review evaluated general sources of sediment in the basin in two ways:

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[203] Bergman, J. A. (2001). Middle Truckee River Watershed Hydrologic Condition Assessment, Tahoe National Forest**:** 1-64. p. 37

[204] Beneficial uses of Truckee River water, as identified by the Lahontan Regional Water Quality Control Board, include: agricultural supply, preservation of biological habitats of special significance, cold freshwater habitat, commercial and sportfishing, flood peak attenuation/flood water storage, freshwater replenishment, groundwater recharge, industrial service supply, migration of aquatic organisms, municipal and domestic supply, navigation (on the lakes/reservoirs), hydropower generation, rare/threatened/endangered species habitat, recreation (water contact and non-contact), fish and wildlife spawning/reproduction/development, wildlife habitat, and water quality enhancement. Complete definitions of these uses can be found in Appendix D.

[205] McGraw, D., A. McKay, et al. (2001). Water Quality Assessment and Modeling of the California Portion of the Truckee River Basin. Reno, Division of Hydrologic Sciences, Desert Research Institute, University and Community College System of Nevada, Las Vegas**:** 1-167. p. ii.

1.) through collection and synthesis of historic sediment and flow records for the main stem of the Truckee River and 10 of its main tributaries (Bear Creek, Squaw Creek, Donner Creek, Trout Creek, Martis Creek, Little Truckee River, Prosser Creek, Juniper Creek, Gray Creek, and Bronco Creek), and
2.) through development of a computer-based watershed model to estimate sediment loadings under various land use conditions.

The study began by using the computer model to show how the 10 sub-basins might benefit from the application of different sediment-reduction management tools – such as increasing the number of large trees and removing dirt roads – as a way of showing how water quality might be improved under different management regimes.

For this exercise, DRI used a computer model capable of estimating sediment loads based on historic data and conditions entered by the DRI researchers.

The model compared current sediment levels (derived using sedimentation data collected in 1997 from each of the 10 sub-basins being studied), with target levels or "desired" sediment loads (generated from computer approximations of how much naturally occurring sediment would be expected in a similar basin with a specific tree canopy coverage and no dirt roads). [206]

Results of this study were preliminary. DRI is currently updating the study to include modifications to the model and more recent "real-time" sediment data collected from various tributaries in the watershed that will help test the validity of indicators and the potential impacts of different management tools on sedimentation in the watershed.[207] The updated DRI study and conclusions are due to be released by the Lahontan Regional Water Quality Control Board sometime after April 2004.

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[206] An increase in canopy cover is meant to simulate recovery of an area that experienced removal of vegetation (e.g. timber harvest, avalanche, etc.); similarly, presence or absence of dirt roads simulates different runoff conditions associated with the potential for excess sedimentation in the watershed.

[207] For more information on the model used, please refer to the *Water Quality Assessment and Modeling* report, available from the Lahontan Regional Water Quality Control Board at: http://www.swrcb.ca.gov/rwqcb6/TMDL/Truckee/Truckee_Index.htm.

HYDROLOGY, WATER MANAGEMENT AND WATER QUALITY

DESIRED CONDITIONS:

5. Water resources are managed to preserve and improve existing water quality and quantity by:

a. reducing potentially harmful runoff (including point- and non-point) into the streams and rivers of the watershed;
b. mitigating impacts of use and development on domestic, commercial, and environmental water supplies;
c. meeting those goals, objectives and standards for water quality and habitat protection set by local, state and federal agencies that are agreed to by all TRWC stakeholders;
d. replicating natural flows to the extent possible, including both amount and timing, to sustain desired conditions of riparian, aquatic and wetland habitats and to mimic the natural sediment regime with which the aquatic and riparian plants and animals in the watershed evolved;
e. actively participating as a member of the Truckee River Basin Group and other appropriate committees or groups to educate participants on flow management that can achieve desired conditions.

Hydrology – or the flow of water both above- and below-ground, from the top to the bottom of the watershed – and water quality are key components of the future condition of the Truckee River. Timing and amount of water flow is important in terms of both assuring sufficient supply for consumption and habitat needs and protecting lives, property and resource values from damage due to storm water runoff and/or floods. Water quality is critical to consumption, habitat and protection of lives, property and resource values, as well. First, plants and animals – including people – depend on clean water, as defined by the relevant regulatory agencies, for consumption and habitat needs; but we are also affected by what may be in water that gets into our creeks and streams from storm runoff, including flood events. As a result, most jurisdictions consulted include goals and policies addressing water quality and flow (primarily stormwater runoff and flood flows).

PLAN REVIEW

All plans are concerned with ensuring high water quality and sufficient quantity into the future and contain one or more goals related to providing flood protection. In some cases these goals are treated more as public facilities/services issues and in other cases more as a natural resource issue. But either way, all jurisdictions recognize the need to assure high quality water and adequate flow for the residents, businesses and habitats that rely on water for their existence.

In general, all plans call for managing water resources to preserve existing water quality, and some have policies calling for actual water quality improvements through reductions in harmful runoff. Most also specify that development adjacent to bodies of water serving domestic water supply adequately mitigate potential water quality impacts. This is accomplished using some of the same tools and techniques described under *Soils and Sedimentation* above, including development setbacks, limited grading, limited paving of surfaces that can lead to runoff, use of Best Management Practices, etc., as well as other limits, such as on the application of fertilizers and other chemicals, discharge of mining wastewater, and others. Placer County and Martis Valley also require that runoff from urban and suburban development be mitigated by construction of artificial wetlands, infiltration/sedimentation basins, riparian setbacks, and other practices.

Three of the six local government plans also call for coordinating efforts with other agencies to ensure adequate water supply, protect water quality and provide flood protection. Martis Valley requires proponents of new development projects to demonstrate the availability of a "long-term, reliable and adequate supply of pure, wholesome, healthful, and potable water as well as any necessary water for irrigation or other purposes" [*Public Facilities and Services Policy 6.C.1*]. In addition, the Martis Valley plan includes a policy requiring project proponents to address water needs for activities such as snowmaking, golf course irrigation and other recreational support uses in its supply assessment. And the Truckee plan calls for reservoir managers to consider habitat issues when determining reservoir releases.

The Forest Service's Sierra Nevada Forest Plan Amendment calls for protecting and restoring desired conditions of aquatic, riparian and wetland ecosystems and providing for the viability of species associated with those ecosystems. [2004 ROD, p. 10] These goals are achieved through the creation and management of Critical Aquatic Refuges[208], Riparian Conservation Areas, and through the Forest Service's Aquatic Management Strategy, which are discussed in more detail in the next chapter on management strategies. With regard to hydrology or streamflow, however, the SNFPA focuses on maintaining and restoring in-stream flows sufficient to sustain desired conditions of riparian, aquatic and wetland habitats and keep sediment regimes as close as possible to those with which aquatic, riparian and wetland biota evolved. [2004 ROD, p. 33]

OTHER RESEARCH

TRUCKEE RIVER BASIN RECOVERY IMPLEMENTATION TEAM

[208] subwatersheds, generally ranging between 10,000 to 40,000 acres, that contain: (1) known locations of threatened, endangered, or sensitive species, (2) highly vulnerable populations of native plant or animal species, or (3) localized populations of rare native aquatic- or riparian-dependent plant or animal species. [2004 ROD, p. 43]

In 1998, the Truckee River Basin Recovery Implementation Team (TRIT) came together to develop a strategy for Lahontan Cutthroat Trout (LCT) restoration and recovery efforts in the Truckee River. TRIT developed a set of short-term actions (over the next five years) the team believes are necessary to 1.) develop information on LCT species requirements, and 2.) address threats to the LCT's persistence in the watershed. The team developed the recommended actions based on a number of assumptions, including: [209]

- The Truckee River basin is significantly fragmented due to water and human development.
- The historic use of the Truckee River basin by LCT has been, and currently is, compromised.
- Recovery of LCT will be a long-term effort that will require monitoring, review and evaluation.
- Water quality and quantity, especially temperature, significantly limits the habitat for LCT in portions of the Truckee River system.
- The State of California has initiated some recovery efforts in selected areas of the Truckee River basin.
- The Pyramid Lake Paiute Tribe has management and jurisdictional authority of the Truckee River and Pyramid Lake within the exterior boundaries of the Pyramid Lake Indian Reservation.
- Habitat degradation and presence of non-native fish species in the Truckee River basin currently limits the potential success for recovery of LCT.
- Non-native salmonid fisheries are an important recreational use in the Truckee River basin.
- Historically LCT in the Truckee River basin functioned as a networked population where different life stages and year classes of fish utilized different habitats and repopulation of extirpated areas occurred from other locations within the river system.

With the overall goal of assisting LCT recovery to the point where the Lahontan Cutthroat Trout can be removed from the Endangered Species Act's List of Threatened and Endangered Wildlife and Plants, TRIT recommended the following criteria or desired conditions for recovery:

1. A self-sustaining, networked LCT population is established, composed of wild, indigenous strains, in streams, lakes, mainstem and tributaries of the Truckee River basin.

[209] Truckee River Basin Recovery Implementation Team (2003). Short-Term Action Plan for Lahontan Cutthroat Trout in the Truckee River Basin. Reno, NV, US Fish and Wildlife Service**:** 1-71. p. 3.

2. Physical connectivity exists between spawning and rearing habitats in lakes, mainstem and tributaries of the Truckee River basin to support natural LCT reproduction and recruitment and restore self-sustaining lacustrine LCT in the Truckee River basin.
3. A self-sustaining lacustrine population shall be considered to be naturally reproducing with a stable age-class structure consisting of at least four year classes and a stable or increasing population size with documented reproduction and recruitment. These conditions must be demonstrated to have been met for a minimum period of 20 years.
4. Water is obtained through water right purchases or other means to protect and secure a stable Pyramid Lake ecosystem and meet life history and habitat requirements of LCT.
5. A flow regime for the Truckee River is implemented which facilitates LCT migration, life history and habitat requirements.
6. A commitment is secured to develop and maintain opportunities for fish passage within the basin in a manner that facilitates migration and reproductive behavior of LCT.
7. Threats to LCT and its habitat have been reduced or modified to a point where they no longer represent a threat of extinction or irreversible population decline.

One of the key conditions for LCT recovery is appropriate river flows. Native fish species evolved, at least since the last ice age, with a more variable flow regime that fluctuated with seasonal and annual weather changes. Today's flows, however, are more controlled based on decades' worth of agreements and pacts to provide a consistent, reliable water supply for agricultural and municipal uses. To sustain and perpetuate native habitat and species, a managed flow regime would need to mimic natural patterns of variation as closely as possible. [210] According to TRIT, management of Stampede Reservoir and uncommitted water in Prosser Reservoir could provide the opportunity to implement instream flows that more closely resemble the natural hydrography, or flow pattern, of the Truckee. [211]

Based on these assumptions, the US Fish & Wildlife Service (USFWS) funded research and development of recommendations for potentially altering instream flow to improve native habitat and species survival. A working group [212] reviewed existing literature and research, analyzed stream flows in unregulated "surrogate" streams located in areas of the Sierra with similar weather and geologic characteristics, and consulted existing operational and other watershed models to develop eight different flow regimes reflecting

[210] Ibid., p. 12.
[211] Ibid., p 13.
[212] The Ecosystem Flow Working Group consisted of representatives of the USFWS, Otis Bay Ecological Consultants, Stetson Engineers, and Pyramid Lake Paiute Tribe.

different water availability scenarios ranging from "very wet" to "extreme dry" conditions.

The recommendations are designed month-by-month so that a particular regime can be selected in March, based on conditions at that time, but can be re-evaluated and potentially altered on a monthly basis depending on water supply.[213] The results of the working group's efforts are illustrated in the following chart, included here to give the reader a sense for the recommended flow amounts and timing. The Council has not reviewed the working group's results in detail and, therefore, does not present them as specific desired conditions at this time.

Truckee River ecosystem flow regime recommendation[214]

Month	Very Wet	Wet	Above Average	Average	Below Average	Dry	Very Dry	Extreme Dry
Regime #	WET 1	WET 2	1	2	3	4	5	6
January	>200	>200	160	150	120	110	100	90
February	>200	>200	160	150	120	110	100	90
March	>450	>350	290	220	200	160	160	140
April	>1000	>800	590	490	420	350	300	200
May	>3000	>2700	>1000	800	600	530	400	300
June	>3500	>3000	800	600	500	400	270	170
July	>1700	>1000	300	210	300	200	150	120
August	>300	>300	200	170	200	200	150	110
September	>300	>300	170	170	110	110	120	100
October	>200	>200	160	150	120	110	100	100
November	>200	>200	160	150	120	110	100	90
December	>200	>200	160	150	120	110	100	90
Acre-Feet	>680,000	>570,000	>249,000	211,800	176,400	150,000	121,000	96,000

TRUCKEE RIVER BASIN WATER GROUP

The Truckee River Basin Water Group,[215] an advisory body to the California Department of Water Resources made up of representatives from local governments, water purveyors and other agencies, went through a similar exercise to develop sample flow guidelines to show how the river might be

[213] Truckee River Basin Recovery Implementation Team (2003). Short-Term Action Plan for Lahontan Cutthroat Trout in the Truckee River Basin. Reno, NV, US Fish and Wildlife Service**:** 1-71. pp. 35-38.
[214] Ibid., p. 29.
[215] The Truckee River Basin Water Group consists of representatives from: Nevada County, Placer County, Sierra County, Town of Truckee, Alpine Springs County Water District, Northstar CSD, North Tahoe PUD, Placer County Water Agency, Poulsen Land Company, Sierra Valley Water Company, Squaw Valley Public Service District, Squaw Valley Mutual Water Company, Tahoe City PUD, Tahoe Resource Conservation District, Truckee Donner PUD, Truckee Donner Recreation & Park District, and Tahoe Truckee Sanitation Agency, per personal communication with Kathleen Eagan, February 11, 2004.

operated under TROA, the Truckee River Operating Agreement, once it is adopted.

The guidelines recommend minimum, preferred and maximum flows out of Lake Tahoe, in the Truckee River below Donner Creek, in the Truckee River below Boca, out of Donner Lake, out of Prosser Reservoir, out of Independence Lake, and into and out of Stampede Reservoir. The sample guidelines are based on hydrologic conditions forecasted in the March 25, 2002 United States Bureau of Reclamation, Truckee River Operation Study, which includes anticipated water demands from Nevada water right holders in the Truckee River basin. [DRAFT of Sample California Guidelines (January 2003), p. 2]

The Truckee River Watershed Council is not a member of this advisory body and has no control over instream flows for the Truckee River. The Council also acknowledges that different needs for existing beneficial uses may conflict, as do existing water rights and certain beneficial uses. Because the Council has no regulatory authority, the role it can take is one of study and participation in discussions about potential changes to the existing flow regime.

LAHONTAN REGIONAL WATER QUALITY CONTROL BOARD

Water quality in the Truckee watershed is governed by the State Water Resources Control Board (State Board) and the Lahontan Regional Water Quality Control Board (Regional Board). The State Board sets statewide policy for implementation of state and federal laws and regulations governing water quality, such as the federal Clean Water Act, the state Porter-Cologne Water Quality Control Act, the federal Safe Drinking Water Act, Toxic Substances Control Act, Resource Conservation and Recovery Act, Endangered Species Act, and CERCLA or the “Superfund” and Superfund Amendment and Reauthorization Act, along with state Health and Safety, Fish and Game, and Food and Agriculture codes. [216]

The Regional Board adopts and implements specific water quality control plans, called Basin Plans, which take into account regional differences in natural water quality, beneficial uses, and water quality associated with human activities in the watershed.[217]

The federal Clean Water Act requires that standards be defined both for the beneficial uses of water and for the water quality objectives needed to protect those uses – both for ground water and surface waters. For the Basin Plan, water quality objectives are defined more specifically as “the allowable limits or levels of water quality constituents or characteristics which

[216] Bergman, J. A. (2001). Middle Truckee River Watershed Hydrologic Condition Assessment, Tahoe National Forest: 1-64. p. 34.
[217] Ibid., p. 33.

are established for the reasonable protection of beneficial uses of water or the prevention of nuisance within a specific area." [218]

These water quality standards, then, can be considered the "desired future conditions" that the agency is trying to achieve or maintain.

Beneficial uses

Beneficial uses are important as a way of identifying what the Lahontan Regional Board deems appropriate for water quality to sustain downstream uses, now and in the future. The Middle Truckee River watershed sustains almost all of the beneficial uses listed for the Lahontan region – 18 of 22 uses overall – ranging from municipal supply for communities to groundwater recharge for future extraction, from navigation (in the lakes and reservoirs) to recreation, habitat support and flood protection. The chart in Appendix D lists all of the beneficial uses identified for the Truckee River and many of its tributary waterbodies, including lakes, reservoirs, and wetlands.

Water Quality Objectives

Water quality objectives are numerical or narrative definitions of the upper limit of certain constituents allowed in the water before each constituent would be deemed detrimental to the specified beneficial uses of the water. They are established first by designating the beneficial uses for the water and then selecting and quantifying the water quality parameters necessary to protect the most vulnerable or sensitive uses. The primary parameters identified by the Regional Board include: ammonia, bacteria/coliform, biostimulatory substances, chemical constituents, chlorine/total residual, color, dissolved oxygen, floating materials, oil/grease, nondegradation of aquatic communities and populations, pesticides, pH, radioactivity, sediment, settleable materials, suspended materials, taste/odor, temperature, toxicity, and turbidity.

For each parameter or physical/chemical constituent, the Regional Board has identified specific objectives or limits. Factors considered in setting these objectives include: potential impact of the parameter on the most sensitive or vulnerable beneficial uses, environmental and economic considerations specific to each area, the need to develop and use recycled water, and the level of water quality that *could* be achieved through coordinated control of all factors affecting water quality (e.g. actions, conditions or circumstances resulting from human activities). In other words, it may not be enough simply to maintain a status quo; the water quality objectives may take into consideration the desire to improve certain conditions through better control of disparate actions.[219]

Water Quality Objectives for surface waters are divided into three categories:

[218] Lahontan Regional Water Quality Control Board (1994). Water Quality Control Plan for the Lahontan Region (Basin Plan). So. Lake Tahoe, Regional Water Quality Control Board. p. 3-1.
[219] Ibid., p. 3-1 – 3-2.

1. objectives that apply to <u>all</u> surface waters;
2. additional or more restrictive objectives that apply to <u>specific water bodies</u> (including Little Truckee River and Truckee River); and
3. those that apply specifically for fisheries management using Rotenone.

The first and second categories apply to the Truckee watershed.[220]

<u>Objectives for All Surface Waters.</u>

(NOTE: in most cases the exact numerical limit is a formula based on varying conditions; for more information on the specific formulas, please see Chapter 3 of the Lahontan Basin Plan, which can be accessed on the Lahontan Regional Water Quality Control Board's website at: www.swrcb.ca.gov/rwqcb6/BasinPlan/Index.htm.)

<u>Ammonia</u>: limits based on concentrations under varying temperature and pH conditions;

<u>Bacteria/coliform</u>: limits based on concentrations of coliform organisms attributable to human and livestock waste detected over a 30-day period (not to exceed a log mean of 20/100 ml nor shall more than 10% of all samples collected during any 30-day period exceed 40/100 ml);

<u>Biostimulatory substances</u>: limits based on concentrations of substances such as nitrogen or phosphorous that promote aquatic growths that cause nuisance or adversely affect water for beneficial uses;

<u>Chemical constituents</u>: limits based on concentration levels of substances such as arsenic, mercury, pesticides, hydrocarbons, etc., that affect the beneficial uses of water for agricultural purposes and other beneficial uses;

<u>Chlorine/total residual</u>: limits based on concentrations detected in daily measurements taken within any six-month period (not to exceed either a median value of 0.002 mg/L or a maximum of 0.003 mg/L);

<u>Color</u>: limit based on coloration that causes nuisance or adversely affects water for beneficial uses;

<u>Dissolved Oxygen</u>: limits based on concentrations as a percent saturation for different beneficial uses (not to be depressed by more than 10% nor shall the minimum concentration be less than 80% of saturation; different standards apply for COLD, COLD with SPWN, WARM and WARM with SPWN uses);

<u>Floating materials</u>: limit based on concentrations of solids, liquids, foams or scum that cause nuisance or adversely affect water for beneficial uses;

[220] Ibid., p. 3-3.

Oil and grease:limits based on concentrations that result in a visible film or coating on the water's surface or on objects in the water or that cause nuisance or otherwise adversely affect water for beneficial uses;

Nondegradation of aquatic communities and populations (wetlands): limits based on level of substances attributable to wastewater or other discharges that produce adverse physiological responses in humans, animals or plants or which lead to the presence of undesirable or nuisance aquatic life;

Pesticides:limits based on concentrations of pesticides (defined as insecticides, herbicides, rodenticides, fungicides, piscicides and other poisons used to prevent, repel, destroy or mitigate damage from insects, rodents, predatory animals, bacteria, fungi or weeds) that exceed the lowest detectable levels using the most recent detection procedures available; no increase in pesticide concentrations are allowed in bottom sediments and no detectable increases in the amount of pesticides found in the tissues of aquatic life (called *bioaccumulation*) are allowed; specific thresholds for drinking water and other municipal uses are identified in Title 22 of the California Code of Regulations (Table 64444-A of Section 64444 – Organic Chemicals), incorporated by reference into this plan;

pH: limits based on changes in normal ambient pH levels (not to be depressed below 6.5 nor raised above 8.5, except for COLD or WARM uses, in which changes shall not exceed 0.5 pH units); compliance is determined on a case-by-case basis by the Regional Board to accommodate natural pH levels that may exist outside of so-called normal ranges;

Radioactivity: limits based on concentrations of radionuclides that are deleterious to human, plant, animal or aquatic life or which result in the accumulation of readionuclides in the food web to an extent that presents a hazard to same; specific thresholds for drinking water and other municipal uses are identified in Title 22 of the California Code of Regulations (Table 4 of Section 64443 – Radioactivity), incorporated by reference into this plan (additional restrictions apply to waters listed for MUN benefits);

Sediment: limits based on suspended sediment load and discharge rates that cause nuisance or adversely affect water for beneficial uses;

Settleable materials: limits based on concentrations that result in deposition of material that causes nuisance or adversely affects the water for beneficial uses;

Suspended materials: limits based on concentrations that cause nuisance or adversely affect water for beneficial uses;

Taste and odor: limits based on concentrations of taste or odor-producing substances that impart undesirable tastes or odors to fish or other edible products of aquatic origin, that cause nuisance or that adversely affect water for beneficial uses;

Temperature:limits based on natural receiving water temperatures, which shall not be altered unless it can be demonstrated to the satisfaction of the Regional Board that such an alteration does not adversely affect the water for beneficial uses (not to be altered by more than 5 degrees Fahrenheit above or below the natural temperature for WARM uses; not to be altered at all for COLD uses);

Toxicity: limits based on concentrations of toxic substances that are toxic to or that produce detrimental physiological responses in human, plant, animal, or aquatic life; compliance is determined by use of indicator organisms, analyses of species diversity, population density, growth anomalies, bioassays of appropriate duration and/or other appropriate methods specified by the Regional Board;

Turbidity[221]: limits based on changes in turbidity (a measure of the amount of light that is scattered or absorbed by water) that cause nuisance or adversely affect water for beneficial uses (not to exceed natural levels by more than 10%).[222]

Additional Objectives for Little Truckee and Truckee River.

The second category of water quality objectives is directed toward protection of surface waters in *specific areas of the watershed with special needs*. There are two such areas in the Middle Truckee watershed, including the ***Little Truckee River Hydrologic Unit*** (636.00) and the ***Truckee River Hydrologic Unit*** (635.00). Site-specific objectives for certain constituents supercede the limits in the previous list.

Little Truckee River Hydrologic Unit

Algal growth potential: limits based on alterations of mean monthly algal growth discernible at the 10% significance level (see Appendix E for the *Lahontan Basin Plan's definition of* ***10% significance level***[223]);

Biostimulatory substances: limits based on concentrations that could produce an increase in aquatic biomass to the extent that such increases are discernible at the 10% significance level;

Color – limits based on exceeding an 8 Platinum Cobalt Unit mean of monthly means (see *Lahontan Basin Plan*, Chapter 3, for more information);

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[221] The turbidity limits established by Lahontan Regional Water Control Board are included for information purposes only; members of the TRWC have not reached consensus on the appropriateness and application of these limits; therefore, TRWC does not represent them as "desired condition" for the watershed.

[222] Lahontan Regional Water Quality Control Board (1994). Water Quality Control Plan for the Lahontan Region (Basin Plan). So. Lake Tahoe, Regional Water Quality Control Board., p. 3-3 – 3-7.

[223]The 10% significance level established by Lahontan Regional Water Control Board is included for information purposes only; members of the TRWC have not reached consensus on the appropriateness and application of these limits; therefore, TRWC does not represent this as a "desired condition" for the watershed.

Dissolved oxygen: limits based on concentrations and specific saturation levels, which cannot be depressed by a.) more than 10%, b.) below 80% saturation, or c.) below 7.0 mg/L at any time, whichever is more restrictive;

pH: limit based on changes in normal ambient pH levels in excess of 0.5 units;

Species composition: limit based on alteration of species composition of aquatic organisms discernible at the 10% significance level;

Taste and odor: limit based on no alteration of taste and color;

Turbidity[224] – limit based on not exceeding a rise in the mean of monthly means above 3 Nephelometric Turbidity Units (NTU).[225]

Truckee River Hydrologic Unit

Algal growth potential: limits based on alterations in mean monthly algal growth discernible at the 10% significance level (except for Martis Creek, which is not covered by this objective; no nuisance or pollution levels of algal growth potential shall be discernible at these stations);

Biostimulatory substances: limits based on concentrations that could produce an increase in aquatic biomass to the extent that such increases are discernible at the 10% significance level (except for Martis Creek and Truckee River stations downstream of Martis Creek, which are not covered by this objective; no nuisance or pollution levels of algal biomass shall be discernible at Martis Creek or the Truckee River stations downstream of Martis Creek at any time);

Color: limit based on exceeding an 8 Platinum Cobalt Unit mean of monthly means;

Dissolved oxygen: limits based on concentrations and specific saturation levels, which cannot be depressed by a.) more than 10%, b.) below 80% saturation, or c.) below 7.0 mg/L at any time, whichever is more restrictive

pH: based on changes in normal ambient pH levels in excess of 0.5 unit

Species composition: limit based on alteration of species composition of aquatic organisms discernible at the 10% significance level (except for Martis Creek or the Truckee River stations downstream of Martis Creek, which are not covered by this objective; alterations in species composition which result in a nuisance or pollution shall not be discernible at these stations at any time.)

Taste and odor: limits based on no alteration of taste and odor

Turbidity[226]: limit based on not exceeding a rise in the mean of monthly means above 3 Nephelometric Turbidity Units (NTU).[227]

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[224] The turbidity limits presented here are included for information purposes only; members of the TRWC have not reached consensus on the appropriateness and application of these limits; therefore, TRWC does not represent them as “desired condition” for the watershed.

[225] Lahontan Regional Water Quality Control Board (1994). Water Quality Control Plan for the Lahontan Region (Basin Plan). So. Lake Tahoe, Regional Water Quality Control Board., p. 3-8.

RIPARIAN, WETLAND AND MEADOW SYSTEMS

DESIRED CONDITIONS:

6. Structure and ecological function of riparian, wetland and meadow systems are protected and enhanced by:

a. widespread knowledge and agreement on location of aquatic, riparian and wetland areas of natural resource value;
b. minimizing disturbance or employing appropriate mitigation in high sediment producing areas, knowledge and use of Best Management Practices (and related strategies) for ground-disturbing activities that can cause sediment, and improvement or appropriate restoration of physical structure and condition of stream banks and shorelines in areas currently known to contribute harmful levels of sediment;
c. improving or restoring structural diversity of plant and animal communities to maintain or improve proper functioning condition and perpetuate the unique functions of these areas;
d. in wildland areas, working toward establishing late-seral stage for meadow vegetation (defined as 50% or more of the relative cover of the herbaceous layer as late successional [228]);
e. maintaining essential habitats at the local level and connective networks between sub-basins to ensure the viability of these areas and the plant and animal species associated with them;
f. supporting existing "no net loss" policies for riparian and wetland system areas in the watershed.

Riparian[229], wetland[230] and meadow[231] systems are recognized as some of the most important habitat types in the watershed due to the connection of different terrestrial habitats, vegetation zones and fluvial processes, the

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226 The turbidity limits presented here are included for information purposes only; members of the TRWC have not reached consensus on the appropriateness and application of these limits; therefore, TRWC does not represent them as "desired condition" for the watershed.

227 Lahontan Regional Water Quality Control Board (1994). Water Quality Control Plan for the Lahontan Region (Basin Plan). So. Lake Tahoe, Regional Water Quality Control Board., p. 3-8 – 3-9.

228 USDA Forest Service (2001). Final Environmental Impact Statement, Vol. 1. Sierra Nevada Forest Plan Amendment, USDA Forest Service. p. 51.

229 *Riparian areas* are defined by the USDA Forest Service in its Sierra Nevada Forest Plan Amendment documents as "areas containing aquatic ecosystems and lands adjacent to perennial, intermittent, and ephemeral streams as well as around wetlands, ponds, lakes, fens, springs, bogs, vernal pools, and other water bodies." [2001 *FEIS* Vol. 1, p. 45.]

230 *Wetlands* are one of a number of special aquatic habitats (along with springs, seeps, fens, bogs, vernal pools, etc.) that are defined by the Sierra Nevada Forest Plan Amendment as "small, irregularly distributed aquatic and riparian habitats in the Sierra Nevada." [2001 *FEIS* Vol. 4, p. E-84.]

231 *Meadows* are defined by the Sierra Nevada Forest Plan Amendment as areas varying "along a moisture gradient from wet meadows with water tables less than 50 cm deep to dry meadows with water tables greater than 100 cm deep." [2001 *FEIS* Vol. 4, p. E-83.]

number and variety of species that typically live in or use these areas for water, food or shelter, their sensitivity to change, and the “ecosystem services” such areas provide in terms of water storage, movement and filtration. These areas also happen to be used for a variety of human purposes, from recreation and cattle forage to road construction and other forms of development. As a result, most plans consulted include a number of goals and policies designed specifically to protect and, in some cases, enhance, riparian, wetland and meadow systems.

PLAN REVIEW

Three of six local government plans reviewed include one or more policies geared toward identifying areas with significant natural resource values in *advance* of development and incorporating project design standards to protect those areas from harm. For the most part these plans recognized riparian, wetland and meadow areas, as well as “floodplains,” as significant and in some cases “unique” natural resources.

In these plans, the first line of defense is to avoid development in areas “rich in wildlife or of a fragile ecological nature” altogether [*Placer County Land Use Policy 1.I.2*]. They also encourage specific zoning designation (e.g. open space), purchase of sensitive lands or easements on those lands to permanently protect them from future development, or use of clustering, siting, setbacks or other tools as the means for guiding land-altering development to areas suitable for development.

If development does encroach on riparian, wetland or meadow areas, the plans typically call for project design guidelines that limit vegetation removal and require on-site mitigation or off-site restoration (e.g. through mitigation banking) or other practices to minimize disturbance of the natural processes and protect the important resources. The Placer County, Nevada County and Martis Valley plans also explicitly support the “no net loss” policy for wetland areas regulated by the U.S. Army Corps of Engineers, the U.S. Fish and Wildlife Service, and the California Department of Fish and Game, and call for coordination with these agencies to ensure appropriate mitigation, when necessary. In some cases, such as Placer County, jurisdictions may call for a higher replacement for any wetlands loss, meaning that for every acre lost, more than one acre must be created or otherwise mitigated for.

Most plans also view riparian/wetland areas as “floodplains” or “natural drainage courses” that should be protected as a means of providing flood control and/or groundwater recharge when storm or flood events occur. Placer County goes so far as to recognize the potential for “stormwater of adequate quality to replenish local groundwater basins, restore wetlands and riparian habitat and irrigate agricultural lands” [*Public Facilities and Services Policy 4.E.3*] and for flood waters to “be used for waterfowl habitat, aquifer recharge, fishery enhancement, agricultural water supply, and other suitable uses” [*Public Facilities and Services Policy 4.F.8*].

The Sierra Nevada Forest Plan Amendment provides specific goals for aquatic, riparian and wetland habitats as part of an Aquatic Management Strategy, including: [2004 ROD, pp. 32-33]

- **Water Quality**: Maintain and restore water quality to meet goals of the Clean Water Act and Safe Drinking Water Act, providing water that is fishable, swimmable, and suitable for drinking after normal treatment.
- **Species Viability**: Maintain and restore habitat to support viable populations of native plant, invertebrate, and vertebrate riparian-dependent species. Prevent new introductions of invasive species. Where invasive species are adversely affecting the viability of native species, work cooperatively with appropriate State and Federal wildlife agencies to reduce impacts to native populations.
- **Plant and Animal Community Diversity**: Maintain and restore the species composition and structural diversity of plant and animal communities in riparian areas, wetlands, and meadows to provide desired habitats and ecological functions.
- **Special Habitats**: Maintain and restore the distribution and health of biotic communities in special aquatic habitats (such as springs, seeps, vernal pools, fens, bogs, and marshes) to perpetuate their unique functions and biological diversity.
- **Watershed Connectivity**: Maintain and appropriately restore spatial and temporal connectivity for aquatic, riparian and wetland species within and between watersheds to provide physically, chemically and biologically unobstructed movement for their survival, migration and reproduction.
- **Floodplains and Water Tables**: Maintain and restore the connections of floodplains, channels, and water tables to distribute flood flows and sustain diverse habitats.
- **Watershed Condition**: Maintain and restore soils with favorable infiltration characteristics and diverse vegetative cover to absorb and filter precipitation and to sustain favorable conditions of stream flows.
- **Streamflow Patterns and Sediment Regimes**: Maintain and restore in-stream flows sufficient to sustain desired conditions of riparian, aquatic and wetland habitats and keep sediment regimes as close as possible to those with which aquatic, riparian and wetland biota evolved.
- **Stream Banks and Shorelines**: Maintain and restore the physical structure and condition of stream banks and shorelines

to minimize potentially harmful erosion and sustain desired habitat diversity.

CHANNEL MODIFICATION / GEOMORPHOLOGY

DESIRED CONDITIONS:

7. Changes to channel shape and structure that could negatively affect proper functioning condition or beneficial uses are minimized through:

a. use of natural or non-structural flood control facilities where feasible;

b. preserving the integrity of and minimizing disruption of critical water courses;

c. use of non-disturbing stream crossing technologies that don't impair natural stream characteristics;

d. maintenance of natural conditions within the 100-year floodplain wherever feasible.[232]

Channel morphology means the shape and structural features of a stream channel. Those features most important in influencing aquatic habitat conditions are: pool/riffle ratio, channel bank steepness and stability, channel width/depth and gradient, and floodplain capacity and function. These features are influenced by local geology and climate, which help determine the amount and size of sediment, the duration and size of peak stream flows, stream gradient, and channel bank steepness. They are also affected by natural disturbances and land management activities.

PLAN REVIEW

Because of the critical role streams and rivers play in terms of providing water, habitat, flood control, etc., most jurisdictions include policy direction to minimize channel and floodplain disturbance or modification. Placer County, for example, promotes the use of natural or non-structural flood control facilities; Nevada County calls for preserving the integrity and minimizing the disruption of watersheds and identified critical water courses; Tahoe City requires that crossings of a natural streams bed not impair natural stream characteristics; and Martis Valley calls for maintenance of potential natural conditions within the 100-year floodplain of all rivers and

[232] exceptions include: (1) where work is required to manage and maintain the stream's drainage characteristics and where such work is done in accordance with the Placer County Flood Damage Prevention Ordinance, Department of Fish and Game regulations, and Clean Water Act provisions administered by the US Army Corps of Engineers; or (2) for the construction of bridges or other similar drainage crossings; or (3) where recreational facilities can be safely and sensitively located. [Public Facilities and Services Policy 6.F.5]

streams (with some exceptions) [233]. Other jurisdictions including the State Water Resources Control Board, the California Department of Fish and Game and the U.S. Army Corps of Engineers, also review channel and floodplain modifications.

As mentioned in the previous section, the Forest Service includes specific goals in its Aquatic Management Strategy regarding channel modification or geomorphology, including maintaining and restoring the physical structure and condition of stream banks and shorelines to minimize erosion and sustain desired habitat diversity.

WATERSHED CONDITION

DESIRED CONDITIONS:

8. Habitat supports viable populations of native riparian-, aquatic- and wetland-dependent species.

9. New introductions of invasive and non-native species are prevented.

10. Where invasive species are adversely affecting the viability of native species, agencies and entities work together to eradicate the invasive species or reduce their negative impacts on native species.

11. Connectivity over space and time is maintained or improved to ensure movement of riparian-, aquatic- and wetland-dependent species within the watershed for survival, migration and reproduction.

12. Academic research is identifying and filling important data gaps in the watershed.

13. The Truckee River Watershed Council continues to maintain a high level of public interest in the well-being of the Truckee River and its tributaries.

14. The Truckee River Watershed Council expands its role as a participant in collaborative efforts geared toward improving the health of the Middle Truckee River watershed.

The future condition of the watershed as a whole is largely dependent on the specific elements mentioned above – soils/sediment, hydrology/water quality, riparian/wetland/meadow systems, and channel modification – and how humans in the watershed choose to interact with these elements. The

[233] exceptions include: (1) where work is required to manage and maintain the stream's drainage characteristics and where such work is done in accordance with the Placer County Flood Damage Prevention Ordinance, Department of Fish and Game regulations, and Clean Water Act provisions administered by the US Army Corps of Engineers; or (2) for the construction of bridges or other similar drainage crossings; or (3) where recreational facilities can be safely and sensitively located. [Public Facilities and Services Policy 6.F.5]

ultimate goal is to find ways for residents and visitors in the watershed to respect and balance the needs of the natural environment with their own.

PLAN REVIEW

Most of the watershed condition policies contained in the plans reviewed address the need for different types of development to be designed and implemented in such a way as to minimize and/or adequately mitigate environmental and aesthetic impacts. Many such policies are mentioned in the previous sections. Additional policies in this section include those specifically related to mining operations, forest management, timber harvesting, public facilities, private recreational and other facilities, impacts of vegetation removal, the need for restoration or revegetation of disturbed sites, requirements regarding landscaping and/or use of native plants, and other guidance geared toward protecting and enhancing the natural qualities and resources of rivers, streams, creeks, groundwater and other watershed elements.

All plans incorporated numerous policies regarding the identification and protection and, in some cases, expansion, of habitat supporting fish and wildlife species, as well, including habitat for endangered and threatened species. Each plan reviewed had six to eight such goals or policies relating to protecting habitat for species.

In the wildland areas of the watershed managed by the Forest Service, special management is established to maintain and enhance suitable habitat conditions for the recovery and long-term viability of a number of threatened or sensitive aquatic-dependent species, including the Lahontan cutthroat trout (listed as threatened under the Endangered Species Act by the US Fish & Wildlife Service), Mountain yellow-legged frog (Petitioned for federal listing under the Endangered Species Act), Little willow flycatcher (Forest Service Sensitive Species) and Great Basin willow flycatcher (Forest Service Sensitive Species). [FEIS, Vol. 1, Chapter 2, pp. 42-43]

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4 Management Strategies

4 Management Strategies

INTRODUCTION

The Truckee River Watershed Council's approach to dealing with sedimentation and its impact on the watershed is to increase awareness about the issue and encourage voluntary implementation of management strategies and best management practices to improve conditions in the watershed.

The management strategies in this chapter will help the Truckee River Watershed Council (TRWC) coordinate its efforts with those of agencies and other non-profit organizations, as well as facilitating outreach and activities with private landowners in the watershed. The *Coordinated Watershed Management Strategy for the Middle Truckee River* also furthers the work of the Truckee River Watershed Council's *Baseline Assessment* – a summary of existing scientific and cultural information that formed the basis for development of this watershed management strategies plan – by creating an action plan for implementing appropriate non-point source sedimentation reduction and riparian, aquatic and wetland habitat restoration projects in the watershed.

Local, state and federal agencies with jurisdiction in the watershed regulate specific land uses, site designs, and other land use planning and implementation decisions in the watershed. Cities and counties, for example, have General Plan land use policies and zoning regulations that require compliance with certain standards, such as erosion control measures for development activities [h, i, k] or revegetation of disturbed surface areas. [g, h, i, l] The Lahontan Regional Water Quality Control Board, an agency of the state, regulates water quality and impacts of certain physical and chemical constituents on beneficial uses of water in the region through permitting and other mechanisms. And federal agencies, like the US Forest Service and the Bureau of Land Management, have additional guidelines and regulations affecting development and use of the lands they manage.

In this chapter, the Watershed Council presents a set of management strategies for achieving desired conditions in the watershed over time, based on the Truckee River Watershed Council's organizational mission and objectives and the tools available to government agencies. [For more information on *Desired Conditions*, please see the preceding chapter.] Specific projects recommended by the Watershed Council to help implement these strategies follow in the next chapter.

The strategies fall into five primary categories:

- Education/Outreach
- Collaboration/Convening
- Resource Protection, Restoration and Conservation
- Monitoring/Data/Research
- Regulatory Framework.

GUIDING PRINCIPLES FOR IMPLEMENTATION

The list below is not intended to indicate relative importance; all items are weighted equally.

a. Promote a wide range of practices for control of potentially harmful non-point source sedimentation.

b. Promote opportunities for protection, appropriate restoration, sustainable utilization and conservation.

c. Maintain beneficial uses.

d. Safeguard human health. [b]

e. Sustain a healthy ecology and a healthy economy. [b]

f. Encourage collection and use of site-specific scientific data.

g. Continue to raise awareness and appreciation of the Middle Truckee River and its tributaries through access, education and outreach. [b]

h. Strengthen collaborative partnerships with local, state and federal agencies and other entities [b, f]

i. Strengthen the Truckee River Watershed Council as a coordinating body for strategy implementation. [b, f]

j. Respect private property rights and public resource values (e.g. water quality and aquatic, riparian and wetland health) in the watershed.

MANAGEMENT STRATEGIES

> The following strategies reflect the Watershed Council's best thinking, at this time, based on the data presented in previous chapters. The Council will regularly review and evaluate these strategies for effectiveness and may modify them with stakeholder input and review as new monitoring data and other information becomes available.

EDUCATION/OUTREACH

1. Increase awareness and understanding among all stakeholders and the general public regarding potentially harmful non-point source sedimentation and aquatic, riparian and wetland ecosystem health, [b] along with current and desired conditions for the watershed and potential management strategies agreed upon by the Watershed Council.

> ***CASE STUDY* – COMMUNITY EDUCATION AND INVOLVEMENT**
> ***Red Lodge, MT***
>
> **Project Description –** Located 70 miles north of Yellowstone National Park, Red Lodge has been experiencing a population increase and influx of tourists. In 1992, residents concerned about changes in their community organized a Successful Communities Workshop to develop a vision for the future. The workshop brought together ranchers, developers, business leaders, and other concerned citizens. Participants defined a vision for the community and established the Beartooth Front Community Forum, a local citizens group dedicated to preserving and enhancing Red Lodge's quality of life.
>
> The Forum sponsored briefings on conservation easements and other private conservation tools that helped convince three ranchers to donate easements on more than 10,000 acres of working ranchland. In 1996, the Forum succeeded in getting the city council to approve a land-use plan that will acquire land on the city's fringes, encourage environmentally sustainable industries to locate in Red Lodge, and uphold Red Lodge's architectural traditions. The plan, produced at low cost due to the level of volunteer labor contributed, received an award from the Western Planners Association. Additional programs of the Forum set up a local water quality monitoring program, helped build a new youth center, and convinced the US Postal Service to keep its office downtown.

Lessons Learned – A challenge for any community stewardship initiative is to achieve tangible successes early on. Red Lodge residents identified and worked on both short- and long-term priorities. Inclusiveness and communication also have been important hallmarks of success. Beginning with the workshop, the community has kept all interested parties engaged in the process. The Forum has continued this tradition by actively seeking input from groups, particularly those who might not be able to attend meetings in town.

Contact
Beartooth Front Community Forum, (406) 446-2388
(from Resources For Community Collaboration, www.sonoran.org)

2. Increase awareness and understanding among area schoolchildren (K-12) regarding non-point source sedimentation and aquatic, riparian and wetland ecosystem health through existing programs and other outreach.

COLLABORATION/CONVENING

1. Promote coordination among jurisdictions and between jurisdictions and landowners to encourage: understanding, compatibility and implementation of "best management practices" for water quality and erosion control, as well as implementation of outreach, education, restoration, rehabilitation, enhancement, monitoring, joint funding and other projects, as appropriate.

2. Identify opportunities to partner with local, regional and national organizations whose programs align with the Truckee River Watershed Council's in the development of localized outreach, education and appropriate restoration programs – especially those organizations and/or programs that involve people who live, work and recreate along the Middle Truckee and its tributaries.

3. Convene public forums to discuss key non-point-source sedimentation, watershed resources, ecosystem health, aquatic, riparian and wetland habitat and other issues of interest in the watershed.

CASE STUDY – COLLABORATIVE PROBLEM-SOLVING
Healthy Mountain Communities in Roaring Fork, CO

Description: Founded in 1993, Healthy Mountain Communities (HMC) has carried out research and brought local representatives together to talk about everything from watershed health to how to cope with fire hazards to regional indicators of progress.

One of the group's major successes was the launching of a regional transportation program to address transit problems in the area. Although transportation is not necessarily an issue specifically related to water quality or watershed health, the education/outreach process used by the group is instructive.

HMC started by hosting a regional roundtable on transportation issues and conducting a sophisticated travel patterns study to build a common understanding of transportation problems among stakeholders in the community. Based on the relationships and trust developed through the roundtable meetings, local elected officials asked their state representative to sponsor legislation that permits the creation of a rural transportation authority. The roundtable also facilitated the adoption of a joint support resolution from the region's 12 local governments.

The region now has the only regional transportation authority outside of Metro Denver and has the organizational and fiscal infrastructure to connect the region through transit and trails. As a regional nonprofit, HMC was able to act as a catalyst and build the trust necessary for local governments to act together faster than they might have otherwise.

Contact:
Colorado Center for Health Communities
www.coloradocenter.org or www.coloradotrust.org
(*from* Investing for Prosperity, *Sierra Business Council, www.sbcouncil.org*)

4. Support and expand the Truckee River Watershed Council's existing volunteer program for water quality, habitat restoration and other on-the-ground projects in the watershed.

RESOURCE PROTECTION, RESTORATION AND CONSERVATION

1. Organize, coordinate and/or participate in appropriate aquatic, riparian and wetland habitat restoration and enhancement and water quality improvement projects in the watershed.

CASE STUDY – SEDIMENT REDUCTION THROUGH RESTORATION

Feather River Coordinated Resource Management Group, Plumas Co., CA

Project Description – In 1985, sediment had reduced the capacities of two PG&E reservoirs on the Feather River by 46% and 56% respectively and was interfering with operations as well as accelerating turbine wear. At first PG&E proposed to dredge and dispose of the sediment, at a cost of $7 million. But concerns about continued upstream erosion, cost, and disposal of the dredge material led creative thinkers in the community to consider addressing the source of the erosion through upstream restoration rather than just treating the symptoms by dredging. Thus was born the Feather River Coordinated Resource Management (CRM) Group.

One of the first projects conducted by the Feather River CRM Group was a meadow restoration project on private ranchland where, after years of human activities, Red Clover Creek had cut a 10-foot deep channel with vertical, eroding banks.

Collaborative Process – The project was voluntary and initiated by the landowner. Because it brought together people who had been in conflict previously, the CRM group set ground rules that encouraged people to express diverse opinions and discouraged personal attacks.

Pooled Resources and Expertise – A wide variety of individuals and agencies supported the Red Clover Creek project, including: the landowner, PG&E and the U.S. Forest Service. In addition to on-the-ground projects like Red Clover Creek, the CRM group also sponsored studies to develop a common understanding of the erosion problems on the Feather River. These studies helped target restoration efforts where they could yield the most benefit.

Today on Red Clover Creek, you'll find cows up to their knees in green grass – even after a long, dry summer. Because the meadow groundwater table has risen significantly, more productive rangeland species have replaced sagebrush. In 16 years, the CRM has accomplished similar outcomes on nearly 60 watershed projects covering more than 14 miles of stream. Rainbow trout have returned to streams they'd been absent from for over 30 years. In some projects, waterfowl numbers are up by 650%.

Contact

Plumas Corporation, 530-283-3739, www.feather-river-crm.org/
(from Investing for Prosperity, *Sierra Business Council, www.sbcouncil.org)*

2. Partner with the Forest Service, local landowners, and other agencies and public and private entities on prevention, early treatment, containment and eradication of non-native species that harm water quality native species viability. [r]

3. Promote appropriate risk-balanced use of pesticides/herbicides. This is especially important near amphibian sites to reduce negative impacts on water quality, vegetation and aquatic, riparian and wetland habitat. [r]

4. Consistent with TRWC's mission to protect and improve water quality and riparian and wetland habitat resources in the watershed, encourage stakeholders, through outreach and education processes, to focus on avoiding or limiting disturbance of soils and vegetation in riparian, wetland and meadow systems, wherever feasible. If avoidance or minimization is not possible, encourage sufficient mitigation and/or appropriate restoration to repair or otherwise compensate for harmful impacts. [b]

5. Encourage incorporation of sediment control measures in fuels treatment and fire safety practices. [r]

6. Encourage all stakeholders to keep their practices, regulations and/or guidelines up-to-date to reflect changing conditions and techniques.

7. Encourage incorporation of sediment control measures into the maintenance of existing roads and trails and construction of new roads and trails.

MONITORING/DATA/RESEARCH

1. Partner with the TRWC Monitoring Committee, Truckee River Aquatic Monitors (TRAM), and other entities to expand the Watershed Council's voluntary monitoring program to gather needed data at the sub-basin level and evaluate the effectiveness of different actions and strategies (see *Monitoring* chapter for more information).

Case Study – CITIZEN WATER QUALITY MONITORING
Nevada County, CA

Yuba River Monitoring Program

The Yuba River Monitoring Program is as a citizen- and community-based program working to make the watershed healthy for fish and wildlife and safe for fishing, swimming and drinking. The program uses water quality monitoring and analysis, research, observations, education, advocacy, and collaboration as tools.

Why is a Monitoring Program Needed? Crystal clear water in the North, Middle, and South Yuba Rivers starts high in the Sierra Nevada mountain range and flows downward encountering hydropower facilities that alter water flows and temperatures, dams that block salmon and steelhead migration, historic mining areas that have caused mercury and other metals contamination in the sediment and soils, logging practices in and around riparian zones which cause erosion and siltation of spawning gravels for trout, and chemical and bacterial contamination caused by stormwater runoff.

What do the Citizen Monitors do? Participants in the monitoring program travel to one of 27 field sites to gather real data which is then analyzed to determine impacts on the watershed. The data is then used to work with agencies, local landowners, and other stakeholders to collaborate, problem-solve, and ultimately clean up and restore the Yuba River basin. Volunteer monitors dedicate one day per month to sample a site on the river.

How will the public know the results? The monitoring program releases an annual publication called "The State of the Yuba." This publication brings together the results of the water quality monitoring with other data in the watershed and gives a general assessment of the health of the watershed.

Contact:
South Yuba River Citizens League
www.syrcl.org

2. Improve the scientific and technical body of knowledge about watersheds, watershed issues and management tools.

3. Ensure access to and use of data collected by TRWC, consistent with our data acquisition and distribution policies [see Appendix F for copies of these policies]. [u]

REGULATIONS

While local organizations like the Truckee River Watershed Council can have an impact on non-point source sediment control by supplementing existing regulations with additional recommendations and/or initiating on-the-ground sediment reduction projects, there are many regulations in place from the federal level to the local town level. In discussing the management of potentially harmful non-point source sedimentation management, we have grounded our strategy recommendations in a clear understanding of the existing regulatory framework.

FEDERAL

A number of federal agencies are responsible for regulating water quality and sedimentation in our rivers and streams, including the US Army Corps of Engineers, the US Fish and Wildlife Service, the US Environmental Protection Agency, and the US Forest Service. For example, the Army Corps of Engineers and the U.S. Environmental Protection Agency are charged with implementing the Clean Water Act, passed in 1972 to protect the nation's water quality. They do this by regulating discharges into our waters – including sedimentation – and overseeing the permitting of various structural projects affecting navigable waterways. [w]

The US Fish and Wildlife Service is the principal federal agency responsible for ensuring compliance with the Endangered Species Act and the National Environmental Policy Act (NEPA) on all water resource projects. The US Fish and Wildlife Service consults with the Corps of Engineers on certain project permitting processes. The US Forest Service is also subject to NEPA for projects within its jurisdiction. [w]

STATE

California also has a variety of laws and agencies regulating water quality in the state. The Porter-Cologne Act, for example, established the State Water Quality Control Board and the nine regional water boards, including the Lahontan Regional Water Quality Control Board, to govern the control, conservation and utilization of the state's water resources and to protect water quality for the use and enjoyment of the people of the state. [x]

The State Water Resources Control Board has a number of departments that administer the state's water quality, water pollution control and water rights functions. In addition, the regional water boards prepare, update and enforce specific water quality control plans for their basins, as well as serving as the primary permitting agency for pollution discharge permits and certain federal Clean Water Act provisions, such as the Total Maximum Daily Load (TMDL) requirements for impaired waterways. [w]

Another agency, the Department of Fish and Game, is in charge of permitting for any project work that occurs in, on, over, or under a waterway, through its Streambed Alteration Permitting process.

The California Environmental Quality Act (CEQA) is another state law designed to provide protection for wetlands, riparian areas and waterways (along with other environmental values in the state) by: a.) directing government agencies to identify the significant environmental effects of their proposed actions and b.) requiring avoidance of significant effects and mitigation of unavoidable impacts (or, if avoidance or mitigation is not feasible, providing reasons of overriding consideration for not doing so). [y]

LOCAL

The Town of Truckee and the counties of Sierra, Nevada and Placer also have their own policies, ordinances and zoning requirements regarding impacts to water quality and wetland or riparian habitats [see the *Desired Conditions* chapter for detailed information on specific policies at the local level].

1. TRWC recognizes that federal, state and local jurisdictions have standards or regulations to deal with sediment and water quality. The Truckee River Watershed Council intends to help facilitate outreach, education and consistency across the following jurisdictions:

    a. The US Forest Service and its Forest Plan Amendment; [r]

    b. Lahontan Regional Water Quality Control Board and its Basin Plan; [f]

    c. California Department of Fish and Game and its water quality and other programs;

    d. California Department of Parks and Recreation and its water quality and other programs;

    e. Individual cities, towns and counties and their General Plans and zoning codes and ordinances. [g, h, i, k, l, m]

Case Study – BETTER STORM WATER MANAGEMENT
Flossmoor, Illinois

Description: When communities become aware of benefits provided by their local wetlands, they more readily collaborate to protect them. As an example, 20 years ago floods began to strike seven communities in the Butterfield Creek watershed, 25 miles south of Chicago. Since then the communities have cooperated with local, regional, state, and federal organizations to combat the flooding problem.

A watershed study revealed several facts: (1) the existing floodplain maps underestimated floods; (2) existing detention requirements for construction did not prevent increased flooding; and (3) the watershed had large undeveloped wetlands areas that stored storm water, and developing those areas could increase flooding by 500 percent.

In addition to developing a model storm water management code, the communities are implementing wetland restoration projects throughout the watershed that not only increase storage capacity and protect against future floods but also function as enhanced wildlife areas, recreational sites, and outdoor classrooms.

Contact:
U.S. EPA Office of Wetlands, Oceans and Watersheds
www.epa.gov/owow/wetlands

(*from* U.S. EPA Sustainable Communities: Putting Wetlands to Work in Your Watershed, *EPA 843-F-01-002k, September 2001, www.epa.gov/owow/wetlands*)

2. Focus on control of sediment at the source whenever feasible, as opposed to water treatment after the fact, as treatment outcomes are sometimes hard to quantify and can be costly. [f]

3. Encourage consideration within and across jurisdictions of no net loss of valuable natural wetlands. [v]

CHAPTER 4 SOURCES CONSULTED OR CITED:

a. California Department of Fish and Game Instream Flow Requirements Truckee River Basin Lake Tahoe to Nevada (1996)

b. Elizabeth River (VA) Restoration and Conservation A Watershed Action Plan (09.08.02)

c. Fraser Basin Council (British Columbia) 5 Year Action Plan (1999-2004)

d. Lahontan Regional Water Quality Control Board Lahontan Region Project Guidelines for Erosion Control (1994)

e. Lahontan Regional Water Quality Control Board Lahontan Region General Waste Discharge Requirements for Small Construction Projects (Board Order No. R6T-2003-200401.08.03) – including "Best Management Practices Plan" Attachment E

f. Lahontan Regional Water Quality Control Board Water Quality Control Plan for the Lahontan Region (Basin Plan) (1994) (see if appears in doc)

g. Martis Valley Community Plan (2003)

h. Nevada County General Plan Goals, Objectives, Policies and Implementation Measures (1995)

i. Placer County General Plan Policy Document (1994)

j. Santa Clara Valley (CA) Water District Coyote Watershed Stream Stewardship Plan Executive Summary (Feb. 2002)

k. Squaw Valley General Plan and Land Use Ordinance (1983)

l. Tahoe City Community Plan (1994)

m. Town of Truckee General Plan Goals and Policies (1995)

n. TRWC Watershed Management Strategy Overview (10.01.02; rev. 3.12.03)

o. US Fish and Wildlife Service/Truckee River Basin Recovery Implementation Team Short-Term Action Plan for Lahontan Cutthroat Trout in the Truckee River Basin (2003)

p. Truckee River Basin Water Group SAMPLE California Guidelines for Truckee River Reservoir Operations to Meet Instream Flow and Recreation Objectives (2003)

q. US Forest Service Sierra Nevada Forest Plan Amendment Draft Supplemental Environmental Impact Statement (June 2003)

r. US Forest Service Sierra Nevada Forest Plan Amendment Final Supplemental Environmental Impact Statement Record of Decision (January 2004)

s. US Forest Service Sierra Nevada Forest Plan Amendment Final Supplemental Environmental Impact Statement Volume I (January 2004)

t. TRWC member comments at Projects Committee meetings, based on best professional judgment

u. Staff/consultant recommendations, based on best professional judgment

v. Protecting Local Wetlands - A Toolbox for Your Community, Save San Francisco Bay Association, 2000. pp. 7-13.

w. California Association of Resource Conservation Districts Guide to Watershed Permitting for the State of California (2002) http://www.carcd.org/permitting/navigate.htm

x. State Water Resources Control Board Porter-Cologne Water Quality Control Act, California Water Code, Division 7 (with additions and amendments effective January 1, 2004) http://www.swrcb.ca.gov/water_laws/docs/portercologne.pdf.

y. Resources Agency CEQA: The California Environmental Quality Act (PRC §21000 *et seq*.) http://www.ceres.ca.gov/ceqa/.

5 Projects

5 Projects

INTRODUCTION

In this chapter, the Watershed Council presents a set of projects to implement the management strategies of the preceding chapter. Monitoring to determine the effectives of the projects (and management strategies) follows in the next chapter.

The projects listed in this chapter will help the Truckee River Watershed Council coordinate its efforts with those of agencies and other non-profit organizations, as well as facilitating outreach and activities with private landowners in the watershed.

The *Coordinated Watershed Management Strategy for the Middle Truckee River*, a watershed management plan for the reduction of potentially harmful non-point source sedimentation and appropriate restoration of riparian, aquatic and wetland habitat, reflects the input of and was reviewed by members of the Advisory Committee. It is intended to serve as an information source and action plan for the Council, Council participants and other interested parties in the watershed.

The projects fall into four primary categories:

- Education/Outreach
- Collaboration/Convening
- Resource Protection, Restoration and Conservation
- Monitoring/Data/Research.

As staff seeks funding for implementation of individual programs and projects, such as K-12 education, staff will inform stakeholders in the Watershed Council through the Projects Committee. The Committee will be given the opportunity to develop and approve the project-specific objectives and materials. Where appropriate, a work group may be formed to further develop a given project or program for review by stakeholders not in the work group.

PROJECTS

Note: Please assume all projects below relate to non-point source sediment and aquatic, riparian and wetland habitat. For ease in reading, these phrases have not been repeated in each project listing.

> The following project lists reflect the Watershed Council's best thinking, at this time, based on the data presented in previous chapters. Most projects on this list are not currently funded. Staff will use this list to solicit funding from a variety of sources, including but not limited to agency and other partners as well as private foundations and government granting programs. The Council will continue to review and evaluate these projects annually for effectiveness and may add new projects or modify existing ones with stakeholder input and review as new monitoring data and other information becomes available.

EDUCATION/OUTREACH

2. Increase awareness and understanding among all stakeholders and the general public regarding potentially harmful non-point source sedimentation and aquatic, riparian and wetland ecosystem health along with current and desired conditions for the watershed and potential management strategies agreed upon by the Watershed Council.

PROJECTS:

a) Raise awareness with homeowners associations, via, for example, presentations to board of directors, architectural standards committees, and annual meetings; brochures with Best Management Practices and related strategy diagrams and articles targeted to homeowners; newsletter articles;
b) Publish articles in local newspapers;
c) Produce TV shows for local cable;
d) Produce radio spots for local radio;
e) Host media field trips to TRWC project sites;
f) Sponsor an annual awards program to recognize individuals, businesses and/or entities who exemplify projects and approaches in non-point source sediment reduction and enhancement of aquatic, riparian and wetland health;
g) Develop a comprehensive watershed education program, with a substantial component on non-point source sediment;
h) Host an annual symposium on the science of watershed health and sediment science for researchers and the community;
i) Implement a Speaker's Bureau;
j) Develop a specific program to increase awareness of "Legacy Issues" impacting non-point source sediment.

2. Increase awareness and understanding among area schoolchildren (K-12) regarding non-point source sedimentation and aquatic, riparian and wetland ecosystem health through existing programs and other outreach.

PROJECTS:

a) Non-point source sediment education program, with classroom projects and field trips;
b) Promote groups like Adopt-a-Watershed (AAW) to teach K-12 about watershed health and non-point source sediment.

COLLABORATION/CONVENING

5. Promote coordination among jurisdictions and between jurisdictions and landowners to encourage: understanding, compatibility and implementation of "best management practices" for water quality and erosion control, as well as implementation of outreach, education, restoration, rehabilitation, enhancement, monitoring, joint funding and other projects, as appropriate.

PROJECTS:

a) Promote coordination among jurisdictions through, for example, Watershed Issues Forums, *Truckee Currents* newsletter, and other vehicles;
b) Develop a watershed-specific Best Management Practices Certification Program with voluntary participation of appropriate stakeholders (see Maine Department of Environmental Protection's *Voluntary Contractor Certification Program* (VCCP) as one example of such a program);
c) Facilitate partnerships among stakeholders to seek funding to implement these projects;
d) Identify potential content for and facilitate different levels (entry, intermediate, advanced) of professional training and public workshops for key agency staff and other stakeholders;
e) Promote programs to manage use of public resources to minimize impacts to natural resources leading to sediment problems.

6. Identify opportunities to partner with local, regional and national organizations whose programs align with the Truckee River Watershed Council's in the development of localized outreach, education and appropriate restoration programs – especially those organizations and/or programs that involve people who live, work and recreate along the Middle Truckee and its tributaries.

PROJECTS:

a) Develop a watershed-specific Best Management Practices Certification Program with voluntary participation of appropriate stakeholders (see

Maine Department of Environmental Protection's *Voluntary Contractor Certification Program* (VCCP) as one example of such a program);
b) Promote groups like Adopt-a-Watershed (AAW) to teach K-12 about watershed health and non-point source sediment.

7. Convene public forums to discuss non-point source sedimentation, watershed resource, ecosystem health, aquatic, riparian and wetland habitat and other issues of interest in the watershed.

PROJECTS:

a) Convene Watershed Issues Forum on issues of importance relating to sediment and aquatic, riparian and wetland habitat; invite scientists, engineers and professionals to speak; encourage dialogue of differing views;
b) Convene an annual Best Management Practices Forum.

8. Support and expand the Truckee River Watershed Council's existing volunteer program for water quality, habitat restoration and other on-the-ground projects in the watershed.

PROJECTS:

a) Maintain an annual Truckee River Day as a large-scale community/volunteer event;
b) Maintain and expand Truckee River Aquatic Monitors (TRAM) as a citizen-based water quality monitoring program;
c) Maintain and expand Snapshot Day (local implementation of the nationwide Clean Water Team program).

RESOURCE PROTECTION, RESTORATION AND CONSERVATION

8. Organize, coordinate and/or participate in appropriate aquatic, riparian and wetland habitat restoration and enhancement and water quality improvement projects in the watershed.

PROJECTS:

Assessment, restoration & monitoring plans

a) Roads and Culverts – detailed assessment status of roads and culverts, using State Parks and US Forest Service assessment protocols; prioritize based on sediment production (and fish passage);
b) Conduct a Cottonwood flow recruitment study;
c) Conduct sub-basin assessment and restoration plan for Deer Creek;
d) Conduct sub-basin assessment and restoration plan for Pole Creek;
e) Conduct sub-basin assessment and restoration plan for Donner Creek (in particular the 1-80 and Donner Creek crossing);

f) Conduct sub-basin assessment and appropriate restoration for Coldstream Canyon (include road system and railroad);
g) Conduct sub-basin assessment and appropriate restoration for Euer Valley and Prosser Creek;
h) Conduct sub-basin assessment and appropriate restoration for the Little Truckee River and Perazzo Stream;
i) Convene stakeholders to discuss monitoring protocols and participate in non-regulatory project-specific monitoring planning and other activities, as appropriate.

Culverts and slope stabilization

j) Restore road cuts and stabilize slopes of Highway 267 from Brockway Summit to Northstar entrance;
k) Restore road cuts, stabilize slopes, and replace culverts on Highway 89 north and south of Truckee;
l) I-80 Canyon slope stabilization.

Restoration and rehabilitation

m) Restore eroding stream banks of Merrill Pond in Coldstream Canyon (use biotechnical protection to prevent cutting into pond; re-grade area around lower pond to create more wetland habitat);
n) Restore stream banks of Teichert Pond in Coldstream Canyon (creek confined at bridge and is very close to the ponds, lengthen bridge, layback and revegetate stream banks and protect from capture);
o) Rehabilitate CalTrans sand piles in Coldstream Canyon;
p) Implement Trout Creek stream restoration plan;
q) Restore the meadow at Highway 267 Guard station;
r) Implement Martis Valley Wildlife Area trails and stream restoration and public education program;
s) Truckee River Canyon Flood Plain Restoration: conduct topographic re-contouring of disturbed fill;
t) Restore stream bank (and relocated trail) along lower Sagehen Creek;
u) Implement Merrill - Davies Meadow and Riparian Restoration plan;
v) Donner Memorial State Park – Lake View Canyon Road and Trails Watershed Rehabilitation: a) create GPS/GIS map of the road and trail network; b) conduct detailed assessment of sediment production and erosion; c) remove and restore unneeded trails and roads; d) upgrade or replace failed culverts and bridges to protect and restore stream crossings;
w) Donner Memorial State Park – Coldstream and Emigrant Canyon Road and Trails Watershed Rehabilitation: a) create GPS/GIS map of the road and trail network; b) conduct detailed assessment of sediment production and erosion; c) remove and restore unneeded trails and roads; d) upgrade or replace failed culverts and bridges to protect and restore stream crossings;
x) Promote pine needle use for erosion control;

y) Complete Truckee River Canyon parcel acquisition;
z) Complete Gray Creek acquisition and appropriate restoration.

2. Partner with the Forest Service, local landowners, and other agencies and public and private entities on prevention, early treatment, containment and eradication of non-native species that harm water quality and native species viability.

PROJECTS:

a) Support a prevention program via education and outreach for invasive species such as the New Zealand Mud Snail, Eurasian Mille-foil, tall white top and other species;
a) Support invasive plant eradication efforts;
b) Encourage early treatment/removal of infestations;
c) Establish call-in point to report infestations.

3. Promote appropriate risk-balanced use of pesticides/herbicides. This is especially important near amphibian sites to reduce negative impacts on water quality, vegetation and aquatic, riparian and wetland habitat.

4. Consistent with TRWC's mission to protect and improve water quality and riparian and wetland habitat resources in the watershed, encourage stakeholders, through outreach and education processes, to focus on avoiding or limiting disturbance of soils and vegetation in riparian, wetland and wetland systems, wherever feasible. If avoidance or minimization is not possible, encourage sufficient mitigation and/or appropriate restoration to repair or otherwise compensate for harmful impacts.

5. Encourage incorporation of sediment control measures in fuels treatment and fire safety practices.

PROJECTS:

a) Take neutral convener role for development of community fire safety plan (which should also protect water quality);
b) Take neutral convener role for fire and fuels projects (which should also protect water quality);
c) Assist in development of water quality protocols for use in fire and fuels projects;
d) Assist in appropriate restoration and rehabilitation actions after fire.

6. Encourage all stakeholders to keep their practices, regulations and/or guidelines up-to-date to6 reflect changing conditions and techniques.

PROJECTS:

a) Collaborate with groups to provide forums for updating and discussing new concepts, practices, guidelines and techniques.

7. Encourage incorporation of sediment control measures into the maintenance of existing roads and trails and construction of new roads and trails.

MONITORING/DATA/RESEARCH

4. Partner with the TRWC Monitoring Committee, Truckee River Aquatic Monitors (TRAM), and other entities to expand the Watershed Council's voluntary monitoring program to gather needed data at the sub-basin level and evaluate the effectiveness of different actions and strategies (see *Monitoring* chapter for more information).

PROJECTS:

a) Maintain Truckee River Aquatic Monitoring macroinvertebrate water quality monitoring;
b) Develop a basin-wide citizens water quality monitoring program for chemical and physical monitoring;
c) Develop a comprehensive water quality monitoring plan/protocol;
d) Convene the TRWC Monitoring Committee to oversee the *Coordinated Watershed Management Strategy* monitoring plan as well as project monitoring plans;
e) Retrieve existing and historic monitoring data and determine its validity as baseline data.

5. Improve the scientific and technical body of knowledge about watersheds, watershed issues and management tools.

PROJECTS:

a) Continue the CA Department of Water Resources continuous turbidity sampling (every 15 min at 4 locations); develop and apply protocol for correlation of turbidity with other sediment measurements; develop a database and data sharing protocols for turbidity sampling and data;
b) Encourage all stakeholders (including academic centers) to use Sagehen Creek GIS Center as their data hub for Truckee River watershed research;
c) Encourage peer review for all monitoring data;

d) Highlight monitoring data that has been peer reviewed;
e) Encourage, support and/or participate in research on key information gaps and questions;
f) Encourage all stakeholders to collect, format, distribute and catalogue watershed and project data, using standards and libraries such as CERES.

6. Ensure access to and use of data collected by TRWC, consistent with our data acquisition and distribution policies [see Appendix F for copies of these policies].

PROJECTS:

a) Make monitoring data available via the Truckee River Watershed Council website (www.truckeeriverwc.org);
b) Promote opportunities for researchers to share their data and research with each other and the public.

6 Monitoring Plan

6 Monitoring Plan

INTRODUCTION

As the Truckee River Watershed Council initiates individual projects, we will build in appropriate project monitoring components and will seek funding for such monitoring as an integral part of project implementation. Any study design would have to follow generally accepted scientific design guidelines to control for variables. The Watershed Council will also use monitoring information to determine the cumulative effectiveness, or lack thereof, of the overall strategy.

Because monitoring is expensive, time consuming and difficult to fund, our monitoring recommendations focus primarily on tasks or projects related to Management Strategy III: Resource Protection, Restoration and Conservation.

Secondary monitoring priorities will focus on Management Strategies I and II, Education/Outreach and Collaboration/Convening. Monitoring for these kinds of activities can include opinion surveys, stakeholder feedback, etc. These more "social" activities, as opposed to on-the-ground projects, are often more difficult to monitor because the outcomes are not as readily measurable; however, Truckee River Watershed Council can evaluate or monitor selected activities using additional indicators such as: number of meetings, number of people reached, range of stakeholders reached, etc.

An additional monitoring step will include determining whether the data we are collecting and analyzing answers our questions about sediment reduction and quality of riparian and aquatic habitat, based on statistical or other appropriate scientific data collection and analysis protocols established prior to the start of any monitoring program.

MONITORING PLAN PURPOSE

A monitoring plan is the tool we use to document and track our efforts. In this chapter we try to identify those things we can observe or measure that can tell us whether we are meeting our goals and achieving desired conditions for the watershed relative to non-point source sedimentation and aquatic, riparian and wetland habitat.

The purpose of data collection for summary or monitoring is to better understand the changing conditions in our watershed – whether at the project level, the management strategy level or the overall watershed health level. By collecting information about specific, targeted conditions over time, we can develop a more accurate understanding of the status of water quality, non-point source sediment and aquatic, riparian and wetland habitat and identify changes in watershed health criteria or indicators based on the different management strategies employed. In addition, members of the Truckee River Watershed Council, local decision-makers and other interested stakeholders can use the information to inform their decisions about management actions and other activities in the watershed.

Monitoring plans need to take into account who will be using the information and for what purposes. The *Coordinated Watershed Management Strategy*, its projects and the monitoring information are designed primarily for use by Truckee River Watershed Council stakeholders, including state, local and federal agencies, local businesses, development companies, property owners associations, environmental and conservation groups, utility companies, local schools, recreation providers and interested citizens.

We anticipate that data collected and information generated as part of the Monitoring Plan will be used by Watershed Council stakeholders to evaluate the effectiveness of our projects and different restoration and protection strategies in achieving the goal of reducing the impacts of sediment on water quality and aquatic, riparian and wetland habitat. Such information can be useful in weighing options or looking at the pros and cons of different management actions or other future decisions.

In general, monitoring plans for projects will address such topics as:

- Development of hypotheses and identification of physical, chemical and/or biological indicators or measurable features that can tell us whether we are meeting our water quality and aquatic, riparian and wetland habitat goals;
- Timing of monitoring activities, based on the specific indicators chosen;
- Monitoring locations, based on whether we're looking for information on a specific problem area or whether we're trying to get general trend or condition information over time;
- Methods for data collection and analysis, including identification of existing and available data as well as new data needed;
- Audiences that will likely have an interest in the data we collect and the information that comes from it;
- Ways in which the data and information can be used;
- Quality assurance to be sure the data we collect and analyze is valid and useful;
- Data analysis, summarization and presentation;
- Data management for storing, retrieving, updating and otherwise managing the data we collect and summarize.

CURRENT AND HISTORIC SEDIMENT MONITORING ACTIVITIES

The project-oriented monitoring options or techniques included in the rest of this chapter were developed based on a series of interviews with professionals on sediment monitoring and issues specific to the Truckee system (see Appendix G for list of interviewees, their affiliations, and the interview questions). Recommendations for types of post-implementation monitoring are also included in this chapter. A number of interviewees had suggestions for additional baseline monitoring studies, as well, which are also included.

It is important to recognize past and present monitoring activities so that future monitoring plans can most effectively build upon the framework in place. A summary of monitoring on the Middle Truckee River and tributaries is included in the 2001 Desert Research Institute (DRI) report, *Water Quality Assessment and Modeling of the California Portion of the Truckee River Basin* (McGraw, et al., 2001; pages 87-109). The information most relevant for sediment monitoring is summarized in Appendix H. The tables in Appendix H are adapted from those found in the DRI report, but are re-organized and updated to reflect monitoring that has occurred since 2000.

Although many monitoring efforts are either underway or have been conducted in the past, not all were designed specifically for assessing sediment load or the effects of excessive sedimentation. The studies are referenced in this document so that future monitoring efforts designed specifically for answering questions about sediment loads can build upon existing work to the extent possible.

MONITORING DESIGN

TECHNICAL STUDY DESIGN

> *Note: The citizen monitoring activities described below fall under the protocols described in the Tahoe/Truckee Quality Assurance Project Plan (QAPP), Second edition, SWRCB 2001.*

Reference Monitoring

- 1.0 Understanding "Natural" Sediment Loads and Identification of Reference Conditions
- 2.0 Background Literature Review on Sediment Effects on Biota
- 3.0 Bioassessment
- 4.0 Event Sampling for Suspended Sediment Loads and Identification of Reference Conditions
- 5.0 Automated Samplers for Collecting Suspended Sediment Samples
- 6.0 Continuation of Continuous Turbidity Measurements
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When developing a monitoring plan, it is important to determine reference levels of the constituents of concern against which we can measure change over time. Reference sediment data exists for the Middle Truckee, but various stakeholders and those interviewed for this document feel that there could be a more accurate characterization of potential impairment from sedimentation if we had more comprehensive and up-to-date information. This section contains a list of suggestions for studies that could help to characterize the current sediment load in the Middle Truckee River, improve understanding of historical sediment levels, and/or aid in determining impacts on beneficial uses. For each study, an explanation of the proposed work, the advantages of doing the proposed work, and the disadvantages of the approach are presented.

1.0 Reference Monitoring: Understanding "Natural" Sediment Loads and Identification of Reference Conditions

As with many systems, establishing the historic or "natural" level of sediment in the Truckee presents difficulties. Often reference streams that are similar to the study stream in size and geomorphology are used to define acceptable or sustainable levels of a certain constituent, such as non-point source sediment. In the case of the Truckee, there is no identified reference stream that would be appropriate for comparing various sediment loads. Thus, a few different approaches to gaining an understanding of natural sediment loads and determining appropriate reference conditions in the Truckee River were suggested by interviewees.

Modeling Approach. One approach is to use the erosion hazard analyses that have been run for current conditions (AnnAGNPS) with assumptions about pre-settlement land cover (Herbst, 2004) as a way of gaining a better understanding of so-called "historic" or pre-settlement conditions. The first study done by the Desert Research Institute (McGraw et al., 2001) included runs of the analysis with current land use conditions as well as with increased canopy cover, decreased road sand, and decreased dirt road density, but not with any assumptions about pre-settlement land use.

> Advantages: Erosion hazard analysis is a relatively cost effective method to consider different assumptions about land use and to give an estimate about what sediment load would be expected to be found in the Truckee River given varying levels of disturbance.
>
> Disadvantages: Erosion hazard analysis in the Truckee watershed to date has been done with AnnAGNPS. This analysis process was formulated for use in agricultural systems and it may not directly apply to forested systems. Research is underway to develop a better fit for forested systems (Herbst, 2004). If the analysis output is used for

comparative purposes such as determining the relative amount of sediment reduction that could result from particular changes in land use, the output could be useful if there is a consistent linear bias (i.e. the analysis either consistently over- or underestimates erosion hazard by a set amount). However, if there is a fundamental flaw to applying this process to forested systems so that the output is not necessarily consistently biased or linear (i.e. the amount the analysis is off varies drastically based upon the input) then this approach would not generate useful information for understanding prior watershed conditions.

Additionally, it would be unwise to take the model output as the absolute value for sediment load under historic conditions. The model output could be used as an estimate or as one piece of additional evidence in trying to understand how much of the sediment input in the Middle Truckee might be considered “naturally occurring” as opposed to that which is caused or exacerbated by activities that could potentially be managed differently.

Sediment Core Study. Careful studies of sediment cores obtained from reservoirs or lakes can help to determine the historic patterns of sediment deposition in a watershed. One suggestion was to do a study of sediment cores from the reservoirs in the Middle Truckee watershed (Burrows, Lico, Rowe, 2004), which would give a relatively recent history of sedimentation. Another suggestion was to do a sediment core study of Pyramid Lake (the terminus of the Truckee River) to look at historic deposition (Kirchner, 2004).

Advantages: Examining sediment cores from the different reservoirs within the Truckee watershed would give a history of sediment deposition for those sub-watersheds. It is likely that relatively undisturbed cores could be obtained for reconstructing the deposition record. This would give quantitative data on actual sediment loads throughout time. There are six reservoirs within the Middle Truckee watershed: Martis Lake, Prosser Reservoir, Boca Reservoir, Stampede Reservoir, Donner Lake, and Independence Lake. Donner and Independence Lakes were both natural lakes prior to damming in 1929, so the sediment core studies in those basins would be different than in the other reservoirs. Examining sediment cores from Pyramid Lake would give a long-term picture of the history of deposition for the entire watershed.

Disadvantages: One limitation of analyzing sediment cores from the reservoirs in the Truckee basin is that information would only be obtained for the sub-basins where reservoirs are located. Additionally, the cores would only represent the period of time after the dams were built (Table 1). Most of the Truckee River watershed was extensively logged, however most major logging operations ceased by the late 1800s. Some legacy effects of this land use may be reflected through increased erosion as compared to undisturbed conditions.

Donner Lake and Independence Lake are located within largely granitic sub-basins. The most erosive soils within the Truckee watershed are the ones of volcanic origin (Kirchner, 2004), therefore historic erosion rates derived from Donner and Independence Lakes would not be as valuable for this particular study as from reservoirs located in volcanic dominated sub-basins.

Analyzing sediment cores from Pyramid Lake would capture the entire historic record but would also give the sediment deposition record for the entire Truckee watershed. Separating sediment contributions from the Middle and Lower Truckee River could be difficult. The two reaches have very different geomorphic characteristics, which could make assigning historic loads to the different reaches difficult.

Table 1. Reservoirs in the Middle Truckee River Watershed

Reservoir	*Date of establishment*
Independence Lake	1929
Donner Lake	1929
Boca Reservoir	1939 (smaller reservoir for ice harvest in 1868)
Prosser Reservoir	1962
Stampede Reservoir	1970
Martis Lake	1971

2.0 Reference Monitoring: Background Literature Review on Sediment Effects on Biota

Beyond the concerns of understanding "naturally occurring" sediment loads, there are also concerns about how much sediment it takes to actually cause impacts on water quality, habitat and other beneficial uses. In the Middle Truckee, beneficial uses directly related to biota that are thought by the Lahontan Regional Water Quality Control Board to be impaired include: Cold Freshwater Habitat; Wildlife Habitat; Rare, threatened or endangered species; migration of aquatic organisms; spawning, reproduction, and development[234]. Some experimental studies have been conducted that look explicitly at the physiological response of organisms to different sediment loads (Herbst, 2004). Many of these studies have investigated the effects of

[234] The Middle Truckee River supports the following beneficial uses in addition to those listed in the document: Municipal and Domestic Supply; Agricultural Supply; Groundwater Recharge; Water Contact Recreation; Non-Contact Recreation; Commercial and Sport Fishing; Freshwater Replenishment; Hydropower Generation; Water Quality Enhancement; Flood Peak Attenuation/ Flood Water Storage.

sediment on fish and fish egg survival. Compiling the results from any such studies in one location would help in the efforts to detect at what level impacts to beneficial uses might actually occur in the Truckee River. The type of literature review being suggested here would be a comprehensive undertaking and is outside the scope of this document.

Advantages: Conducting a literature review would allow for a characterization of what other studies have determined to be threshold levels for impairment of biological function by sedimentation. Additionally, the range of variation between studies would be useful to understand for establishing allowable limits for the Truckee River. Stakeholders in the Truckee TMDL process have expressed the desire for more quantitative data regarding impairment. Compiling the information already available would help the public to understand the effects of excessive sedimentation.

Disadvantages: Tracking down published reports of experiments can be extremely time consuming. It can also be difficult to find funding for this type of research. Some of the older reports may not be useful, especially the ones related to effects on aquatic macroinvertebrates, due to lack of taxonomic resolution (Herbst, 2004).

3.0 Reference Monitoring: Bioassessment

Bioassessment is the process of evaluating the biological condition of a water body using surveys and other direct measurements of resident biota in surface waters. Because bioassessment is a direct measure of biological response, it can be a powerful tool for evaluating impacts to aquatic systems. Algae (or periphyton), fish, and macroinvertebrates are all used as biological indicators. Macroinvertebrates (primarily aquatic insects) are the most common group of organisms used. They are easier to sample than fish, and easier to identify than algae. They are also relatively sedentary and have long enough life spans to integrate information about water quality and other factors (*i.e.*: seasonal population fluctuations or other effects) with the bioassessment data at one locale over a period of time. When bioassessment is done, the effects on the entire community are measured, which gives a much better indicator of function than a single species study. As with all methods, it is important in bioassessment to state the hypothesis and to design and control for potentially confounding variables.

Above and Below Approach. At present a proposal is being developed for a study of macroinvertebrates in the mainstem of the Truckee River to help to establish existing conditions against which to measure change in the future (Herbst, 2004). One approach is to sample the Truckee River above and below tributaries that are known or suspected sediment sources. The paired samples (one above, one below a tributary) would be taken concurrently. The “above” sample would be used as the control against which to compare the "below" sample. The communities found in each of the two samples would be compared.

Physical habitat data would be collected at the sampling sites as well. Ideally actual loads or quantitative measures of deposition could be computed or estimated for correlating sediment with the biological response data. In a natural community it would be expected that there would be a threshold level of sediment load that would trigger a biological response. Sediment loads below that threshold would have little or no detectable effect on the community. Once the threshold was reached, the response of the macroinvertebrate community would show degradation. If enough tributaries are sampled, it may be possible to generate an actual stressor response curve with biological community condition as the response variable and sediment load across the X-axis.

> Advantages: Using an above/below approach avoids the complications of finding appropriate control streams and also avoids between-year variation because the samples would be collected at the same time. Bioassessment has an advantage over some other monitoring methods in that the actual biological response to a stressor is being measured. Impairment to the beneficial uses most directly related to biological condition (e.g., COLD, SPAWN, RARE) can be best assessed this way.
>
> Disadvantages: It is possible that no difference will be detected between control and treatment sites. This could happen because the communities present in the Truckee River have been exposed to excessive sedimentation previously and the macroinvertebrate community at any point along the river is already pre-adapted to sediment. It could also be that the effects of sediment downstream from the selected tributaries on biological communities are not strong enough to be detected by the analytical methods used.

Before and After Approach. A different type of approach to bioassessment would be to sample the same location before and after a sediment pulse and compare the communities (Herbst, 2004). This type of approach would allow for comparisons of the same stream reach before it is affected by sediment deposition and after the sediment has entered the reach. Sampling locations would be located below significant tributaries to the Truckee River. An analysis of the actual sediment load as described for the "above/below" approach would also be included.

> Advantages: The Truckee system has a relatively predictable annual sediment event when the majority of the snow pack melts in the spring. A sample collected before spring runoff would be used as the control sample and a sample collected immediately after spring runoff would be used as the treatment sample. Communities of benthic

macroinvertebrates can change rapidly in response to changes in the environment, so a shift in composition may be detected between the two sampling events.

Disadvantages: One potential drawback to taking a "before and after" approach is that it would be possible to miss the appropriate sampling time windows. Spring snowmelt is more predictable than other types of events (such as summer thunderstorms) and is usually the most important sediment event of any water year. The same concerns as with an "above and below" approach about pre-adaptation of the community to sediment loads and inability to detect a difference with the sampling design used would also apply to a "before and after" design.

Experimental Approach. It has also been proposed to take a purely experimental approach to develop a dose-response curve for sediment on stream communities (Herbst, 2004). An experimental stream could be established that contains a macroinvertebrate community, and the amount of sediment entering the system could then be controlled. The community would be sampled after additions of sediment, and changes in composition could then be correlated directly to the amount of sediment entering the stream.

Advantages: An experimental approach would allow for a quantitative relationship to be developed between sediment load and effect on stream community. Experimental studies to date have primarily looked at the response of single species to sediment (Herbst, 2004). Looking at the community response under controlled conditions would allow for a better understanding of exactly how a community responds to sediment stress. An appropriate experimental stream set up is located at the Sierra Nevada Aquatic Research Lab.

Disadvantages: The community that is found in the experimental stream reach when the experiment is begun will have had some level of exposure to sediment, so again, the question of having organisms that are already adapted to sediment loads could lead to a skewing of the results. It would be difficult to know how much exposure the organisms may have already had. An experimental approach to assessing sediment effects on stream communities would be costly and funding could be difficult to find.

4.0 Reference Monitoring: Event Sampling for Suspended Sediment Concentration

The biggest sediment flushes happen during storm events and snow melt in the Truckee system. Effective sampling during an event can be tricky because a sample needs to be taken during the peak of the hydrograph, or at the maximum flow. The amount of sediment transported during any given event can be extremely variable given the discharge during that event. For example, the amount of sediment available for transport will depend upon how recently a large event has occurred. During a large runoff event, high enough flows are produced to flush the existing sediment out of the system. A much smaller load is therefore available for transport during the following event. It can be difficult to predict when exactly the peak for any given event will occur. A study is presently being conducted by Desert Research Institute to further refine a rating curve between turbidity measurements and suspended sediment concentration (Dana, 2003). Some event sampling has been done in conjunction with this study at Floriston, at the lower end of the watershed.

Advantages: In order to be able to understand this variability, data need to be collected during a wide array of runoff events. Increasing efforts for event sampling would allow for characterization of this variation. Collecting sediment samples at locations other than Floriston during events would also help to build an understanding of sediment sources within the watershed.

Disadvantages: Storm sampling is extremely difficult due to the unpredictability of storms and the challenge of predicting the peak of the hydrograph. Sampling crews need to be on-call, especially for summer thunderstorms. In the case of summer storms, by the time a crew is mobilized for sample collection, the storm may be over and the sediment pulse missed. Some interviewees did not think that event sampling was the best use of time and money (McGraw, 2003).

5.0 Reference Monitoring: Automated Samplers for Collecting Suspended Sediment Samples

Automated samplers are capable of collecting suspended sediment samples from streams. There are no automated samplers currently in place on the Middle Truckee.

> Advantages: The primary benefit of using automated samplers is that data used for calculating sediment load can be collected much more efficiently during events than if a work crew is used. Automated samplers can be programmed to take samples at either a set river height or a set turbidity level, so a sample should be collected close to the peak of the hydrograph for any given storm event.

> Disadvantages: Typically automated samplers are used in smaller systems than the Truckee; therefore, using automated samplers on the mainstem of the Truckee may present logistical challenges. The samplers themselves are not prohibitively expensive, but it does take significant labor to find an appropriate spot to locate the sampler (Kirchner, 2004). If the sampler is not located properly, it may be swept away during a flood event or could be vandalized. It is best to pair the sampler with a turbidity meter. The locations of the existing turbidity sensors (Figure 2) may or may not be appropriate for locating an automatic sampler.

6.0 Reference Monitoring: Continuation of Continuous Turbidity Measurements

Several turbidity meters are in place along the Truckee River. The meters are operated by California Department of Water Resources (CalDWR). Desert Research Institute is collaborating with CalDWR to use these data to develop a relationship between sediment load and turbidity. Turbidity data are easier and more cost effective to collect than suspended sediment data, so it is beneficial to be able to use turbidity as a surrogate for sediment. Most of the interviewees recommended continuing to operate the continuous turbidity meters that are already in place. Figure 2 shows the locations of the meters.

> Advantages: Turbidity data are much easier to collect and more cost effective than collecting suspended sediment concentration data. Having as much pre-implementation data from this source as possible would help to understand the current variation in sediment load, using the relationship being developed by Desert Research Institute between turbidity and suspended sediment load. The sensors are relatively cost effective to operate, and collect other data besides turbidity (such

as temperature and dissolved oxygen). It would be valuable to continue to collect and summarize these data through TMDL project implementation to be able to assess changes throughout the process.

Disadvantages: Some of the interviewees expressed concern with using turbidity as a correlate for suspended sediment (Burrows, Lico, Rowe, 2004). Their opinion was that that when it is really critical to get accurate numbers for sediment loads, the actual sediment data need to be collected instead of using a surrogate measure. Other interviewees were more comfortable with using the turbidity data (Dana, 2003; McGraw, 2003) or felt that turbidity worked relatively well as a correlate for fine sediment which is primarily the size class of concern (Kirchner, 2004). When a rating curve is developed to use turbidity as a surrogate for suspended sediment, the relationship depends upon the sensors remaining in the exact same location. Therefore, in order to continue to use the data from the existing turbidity sensors, they must remain in their current locations.

Turbidity sensors have an upper detection limit, so when turbidity levels are extremely high, the reading can plateau lower than the actual turbidity level in the stream (Kirchner, 2004). It is fairly easy to examine the data to see if a sensor is hitting its maximum reading level.

7.0 Reference Monitoring: Increase Resolution of GIS Layers for Erosion Hazard Models

Increasing the resolution of data that can be entered into erosion hazard models (such as the AnnAGNPS model used by Desert Research Institute) improves the output that is generated by the model. The modeling efforts conducted thus far are limited by the resolution of the GIS layers (McGraw, 2003).

Advantages: Being able to detect which sub-basins within the watershed are likely to have high erosion potential is useful. However, being able to detect specific areas within each basin that pose the greatest risk (and therefore the greatest opportunity for restoration) would aid in developing the Total Maximum Daily Load implementation plan.

Disadvantages: Gathering the field data to increase the resolution of the current GIS layers is an extremely time consuming task and would require significant financial resources. It would be difficult to increase the resolution in the entire Middle Truckee watershed. Increasing the resolution in targeted areas may be more practical.

8.0 Reference Monitoring: Better Experimental Understanding of Erosion by Land Use and Effectiveness of Best Management Practices

It is commonly understood that soil-disturbing activities lead to erosion, which, at certain levels, can negatively affect water quality, aquatic, riparian and wetland habitat and other important elements of watershed health and beneficial uses. However, limited experimental work has been done specifically addressing the relationship between land use and erosion (Hogan, 2003). Best Management Practices or BMPs are frequently prescribed as measures for controlling erosion from roads or development. Some experimental testing of the effectiveness of these erosion control measures has occurred, but further analysis is needed. Gaining an understanding of what types of land use cause sediment transport and which measures are most effective at preventing potentially harmful erosion would aid in developing non-point source sedimentation reduction plans.

A literature search on existing research regarding BMP effectiveness should also accompany this task.

> Advantages: Having data on the relative risk of erosion based on certain types of land uses will focus efforts to apply Best Management Practices where they are most needed. Additionally, understanding which BMPs are most appropriate for different situations will increase cost effectiveness by reducing the number of superfluous measures that are taken for erosion control and focusing on measures that are known to be effective. Reviewing existing published studies regarding BMP effectiveness will help to focus restoration efforts as well.
>
> Disadvantages: Designing good experiments that would lead to a better understanding of erosion processes and land use could be labor intensive and costly.

9.0 Reference Monitoring: Snapshot Event on Entire System During Snowmelt

Used in this context, a “snapshot” event is a one-day water quality sampling event during which many sites are sampled at approximately the same time. This allows for a characterization of the quality of an entire water body because samples are obtained simultaneously from throughout the river.

> Advantages: Doing a snapshot event during snowmelt would help to give a better understanding of where exactly sediment is coming from in the watershed (McGraw, 2003). The entire Middle Truckee reach could be sampled at points below all major tributaries. The results from such a study would help identify which tributaries need to be targeted for restoration/implementation measures.

Disadvantages: Previous snapshot day events on the Truckee River have been conducted with volunteer labor. In order to recruit and train volunteers for the event, the date has to be set several months in advance, which makes it difficult to judge the timing just right to catch the peak of spring runoff. Additionally, because of safety concerns it would not be appropriate to have volunteers sample in the main stem of the river during the high flows encountered during snowmelt. Traditionally, volunteers have primarily sampled tributaries. A snapshot event could be done with paid professionals to circumvent safety concerns, however it would be expensive to capture the number of samples necessary for a complete characterization of the Middle Truckee.

10.0 Reference Monitoring: Incorporation of Climate Data to Analysis of Sediment

Climate data related to the snow pack, such as snow depth and snow water equivalent, are important drivers in the Truckee system, so including these climate data into any hydrologic analyses would be valuable (McGraw, 2003). Adding weather stations in the Truckee Basin would aid in developing an understanding of the hydrology of the system, which directly affects sediment transport.

Advantages: Long-term climate data exist for some locations within the watershed. The amount of snow in any given year will affect the amount sediment that is mobilized and deposited during snowmelt.

Disadvantages: Climate patterns are extremely localized in the Middle Truckee watershed. To be able to accurately capture that variation, several weather stations would need to be added and monitored. It would be misleading to extrapolate across the whole basin from the few existing stations.

11.0 Reference Monitoring: Gain Better Understanding of Importance of Timing of Sediment Pulses

In an “undisturbed” system, sediment pulses would be expected to occur during large storm events and during spring snowmelt. In a more disturbed system, the negative impacts from sediment could be from the timing of the pulses, not necessarily the magnitude of the pulses (Kirchner, 2004). Sediment is likely to be transported from disturbed land during a much lower intensity storm event than from soil that has good vegetative cover and good infiltration properties. Under disturbed conditions, sediment would therefore reach the river in less severe storm events than under undisturbed conditions. During very large events, discharge into the river increases enough to carry fine sediment and little or no deposition is seen. In a less intense event that produces a small increase in discharge, sediment will deposit on the riverbed. This is likely to be biologically significant: deposition of fine sediment impacts fish reproduction, and other aquatic organisms may not be adapted to sediment pulses during lower flows. Examining the pattern of deposition of fine sediments for storm events of different magnitudes would help to test the hypothesis that the critical impact to biological systems is occurring during lower-intensity flow events.

> Advantages: Examining patterns of sediment deposition as related to magnitude of storm events would provide a basic understanding of the impacts to beneficial uses. If the proposed mechanism of sediment deposition is found, management/implementation measures that focus on reducing runoff during medium-intensity events could be incorporated into the implementation plan.
>
> Disadvantages: Sediment deposition data would need to be collected after a variety of different storm events in order to develop a robust relationship between magnitude of event and impacts on beneficial uses.

Post-Implementation Monitoring

1.0 Sediment Monitoring Plans Developed et al
2.0 Goals
3.0 Parameters to Monitor
4.0 Schedule for review and Revisions
5.0 Responsible Parties
6.0 Measurable Targets and Time Frames

It is difficult to outline a complete post-implementation monitoring plan before implementation measures have been decided upon. However, because the cause of impairment in the system is generally understood to be from excessive sedimentation, based on Clean Water Act 303(d) listing criteria, it can be assumed that various types of source controls including appropriate restoration, installation of Best Management Practices or other sediment-reducing measures will be proposed for various sites throughout the watershed. Included in this next section are tools that have been suggested by interviewees for effective assessment of implementation measures. The monitoring activities will depend upon the sediment control measures implemented.

The Environmental Protection Agency states that a follow-up monitoring plan for sediment should include the following elements: monitoring goals and hypotheses, parameters to be monitored, locations and frequency of monitoring, monitoring methods, schedule for review and potential revision, parties responsible for implementing the plan, and measurable targets including time frames (USEPA, 1999).

1.0 Post-Implementation Monitoring: Sediment Monitoring Plans Developed for Other Regions

Sediment monitoring plans for other watersheds were researched during the development of this document to see if elements from these plans would be useful to incorporate into the Truckee sediment monitoring plan. A bibliography of monitoring plans from other regions can be found in Appendix I. In general, many sediment monitoring plans were lacking in detail, however examples of types of targets used in other regions were useful. The more effective examples are included in Section 6 below. Building upon monitoring plans that have been shown to be effective elsewhere should help in developing a Middle Truckee plan.

2.0 Post-Implementation Monitoring: Goals

The purpose of the monitoring plan is to measure progress toward achieving established goals of reducing sediment's potential negative impacts on water quality and aquatic, riparian and wetland habitat.

3. 0 Post-Implementation Monitoring: Parameters to Monitor

The EPA suggests several different parameters that can be useful to monitor when developing sediment monitoring plans: channel condition and bed material assessments; stream alignment using aerial photography; suspended load, bedload, flow data to assess changes in sediment concentration and mass loads; biological indicators; riparian and stream bank indicators; hillslope erosion features; drainage features; and calibrated models (USEPA, 1999). This list is not intended to be exhaustive, nor is it assumed that each of these parameters is appropriate for every situation. Interviewees were asked which of these parameters would be most appropriate to include in a post-implementation sediment monitoring plan for the Middle Truckee River. The responses were mixed as to which of these parameters would be most valuable to monitor. There were also several other suggestions or clarifications for parameters that would be valuable to monitor to detect changes in sedimentation.

Biological Indicators – Macroinvertebrates and Fish Populations. Bio-assessment is being more commonly used as a tool for monitoring changes in water quality, and many interviewees thought that bioassessment was a potentially powerful tool for assessing impacts (or reduction of impacts) to function (Dana, 2003; McGraw, 2003; Burrows, Lico, Rowe, 2004; Herbst, 2004). Examples of types of quantitative bioassessment targets that have been used in other regions and that may be appropriate for the Truckee are included in the *Measurable Targets and Timeframes* section of this chapter.

Monitoring related to fish population health should be considered as well as macroinvertebrate monitoring. Spawning is thought to be impaired in the Middle Truckee, so conducting redd surveys may be appropriate. Coldwater fisheries are also thought to be impaired, so sampling of fish populations may also be appropriate. California Department of Fish and Game conducts periodic electrofishing on the Middle Truckee. These data may be appropriate to build on for post-implementation monitoring.

> Monitoring Locations: Post-implementation monitoring of macroinvertebrate community composition would be most effective in locations where reference data have been collected so that the community response to changes in the watershed could be best measured. If certain watersheds are proposed for restoration or other

activity, collecting and summarizing pre-project data from the mainstem below these tributaries prior to project implementation would also be sufficient for using macroinvertebrate community composition for assessing reductions in sediment load.

Collecting and summarizing follow-up or post-project macroinvertebrate monitoring data from tributaries where restoration has taken place would also help to assess the effectiveness of implementation methods. A citizen's group, the Truckee River Aquatic Monitors (TRAM) has collected data from numerous tributaries within the watershed (Appendix H, Table 4) and these data would also be appropriate for use as reference data in these tributaries. The samples analyzed by TRAM volunteers are not to the same taxonomic level as those done by Herbst; however, the collected samples are all archived and available for analysis at a finer taxonomic resolution. Tributary sampling would be appropriate for smaller scale restoration projects that may not have a large enough effect to show a sediment reduction in the mainstem of the Truckee, but do show an improvement on a smaller scale.

Monitoring data related specifically to fish would most likely be collected on the mainstem of the Truckee. For follow-up surveys of actual fish populations, electrofishing could be repeated in sites that have been previously surveyed. Fish biologists (US Forest Service or California Department of Fish & Game) should identify appropriate sites for monitoring spawning redds.

Monitoring Frequency: Annual sampling for macroinvertebrates may be appropriate for some locations, partially to address between-year variation in flows that may affect biological communities. Performing bioassessment more than annually is not typically done and would not be expected to yield additional data. Aquatic macroinvertebrate communities tend to react quickly to changes in the stream environment, so it is possible to see changes in metrics as soon as one to two years after non-point source sediment reduction implementation measures have occurred.

Fish populations may be monitored every other year or even longer intervals. Spawning redd counts may be conducted as frequently as annually.

Suspended Sediment. With sediment reduction as a goal, monitoring suspended sediment load should be considered for post-implementation monitoring. Installation of automated samplers to obtain suspended sediment samples may help for assessing sediment loads during high flows. Continuation of the current Desert Research Institute sampling regime (field collection of horizontally and vertically integrated samples) could also be considered during spring runoff for follow up monitoring.

Monitoring Locations: Reference sediment load data for the development of the turbidity-suspended sediment rating curve have been collected at Floriston, at the lower end of the watershed. Post-implementation monitoring data should be collected at the same point because of the nature of the watershed, two significant contributing tributaries are located immediately upstream of the sampling site, Gray Creek and Bronco Creek. Both of these streams are currently 303(d) listed for sediment. If further data are collected and summarized for assessment of reference conditions at other locations, then it may be appropriate to conduct additional follow-up monitoring elsewhere.

Monitoring Frequency: Annual monitoring during spring snowmelt may be appropriate. One interviewee suggested monitoring two times per week during this period, taking into account how quickly snow is melting in any one year (McGraw, 2003). Another interviewee thought that multiple samples per day during snowmelt might be appropriate (Rockwell, 2003).

Discharge. The USGS operates several flow gages. Discharge data are necessary for assessing sediment load so maintaining these gages would be extremely beneficial for any future sediment monitoring efforts.

Monitoring Locations: The locations of the existing gages are included in Appendix H.

Monitoring Frequency: USGS flow meters automatically report data at 15 minute intervals.

Sediment Deposition. Monitoring actual deposition of fine sediments on the streambed may be appropriate, especially in the case of impairment of spawning habitat. One method used to assess deposition of fine sediments is pebble counts, which yield data regarding median particle size. Taking measurements of the portion of a pool filled with fine sediments is another method commonly employed to determine the extent of sediment deposition in a stream. This measurement is called V*.

Monitoring Location: Monitoring of deposition of fine sediment would be most appropriate in areas that are known to be important for spawning. Locations below significant tributaries may also be appropriate monitoring locations.

Monitoring Frequency: Sediment deposition would probably be collected annually or at multi-year intervals.

Turbidity. General consensus among the interviewees is that maintaining the continuous turbidity sensors would be an excellent monitoring tool. Even given the concerns about using turbidity as a correlate for suspended sediment expressed by some interviewees (Burrows, Lico, Rowe, 2004), it was recognized that these data have value for monitoring overall trends.

Monitoring Locations: The locations of the sensors are indicated in Figure 2. In order for the rating curve between turbidity and suspended sediment concentration being developed by Desert Research Institute to be accurate, the turbidity sensors must remain in their current locations. Adding sensors to the system could help to focus on specific implementation measures but calibration and development of a rating curve would need to happen for each addition to the system. The length of time and financial resources needed to collect the data and perform the analysis are likely to be prohibitive at this point in the process.

Monitoring Frequency: The turbidity sensors report data hourly. Maintenance occurs approximately every 2-4 weeks.

Aerial Photographs. Aerial photographs are useful for assessing changes in stream morphology as related to sediment transport. If a time series of aerials is available, analyzing the changes through time is not extremely time consuming. Some interviewees thought it was useful to at least look at aerials if they were available (Burrows, Lico, Rowe, 2004).

Monitoring Location: Reaches that have potential for significant change would be appropriate for this type of analysis. Much of the Middle Truckee River is constrained by topography or anthropogenic structures, so the pattern of the river is not likely to change. Analysis of aerial photographs may be most helpful for analyzing patterns of erosion along the river course. Examining photographs from sections that have traditionally experienced mass wasting or other erosional processes could be useful.

Monitoring Frequency: Changes are unlikely to be apparent over short time intervals, except in the case of an extreme event. Analysis of aerial photographs would probably not occur at a shorter interval than every five years.

Upland & Soils Measurements. Monitoring upland processes could aid in evaluating sediment sources. It can be assumed that many implementation measures will concentrate on areas away from the immediate riparian areas.

To determine if these measures are effective, monitoring closer to the implementation site may be helpful for assessing effectiveness. Several of the interviewees stressed the importance of monitoring for improvement on the appropriate scale (Dana, 2003; Hogan, 2003; Rockwell, 2003). If a specific Best Management Practice is put in place in the watershed as part of the reduction implementation plan for potentially harmful non-point source sediment, the effects of that BMP will not necessarily be seen by collecting and analyzing water quality data in the mainstem of the Truckee. However, specifically monitoring the localized effects can show if the measure is effective or not. Several soil characteristics were suggested for monitoring that are indicative of ecological processes that affect erosion potential (Hogan, 2003).

Analysis of soil nutrients and nutrient cycling potential on disturbed sites prior to project implementation will give a better understanding of the current conditions at a particular project site (Hogan, 2003). Healthy soils are better able to support vegetation and resist erosion. Nutrients to include in the analysis are total nitrogen, total carbon, and different forms of nitrogen. Mineralizable nitrogen has been found to be an important indicator of nutrient cycling in a soil sample. After a restoration project or BMP has been implemented it is expected that natural soil chemistry should return, so an increase in nutrient cycling potential should be observed if function is actually restored.

Vegetation monitoring is commonly used as a technique to assign success to a restoration project. Vegetation helps an area to resist erosion. Trained observers can obtain relatively reliable results with point monitoring or other techniques.

The ability of soil to hold moisture is directly related to the amount of runoff that will be produced in a storm event. Directly measuring the capability of an area to resist erosion can help to assess if proper function is being restored to an area. One approach to examining the resistance of soil to erosion is to use a rainfall simulator to replicate the conditions that would be seen during different types of storm events (Hogan, 2003). Rainfall simulation is fairly labor intensive and therefore costly. Current research is underway to use soil density measures as a surrogate for rainfall simulation measurements (Hogan, 2003). Soil density measures can be quickly and inexpensively obtained using a "soil penetrometer." If the measurements obtained with the penetrometer are good at predicting under what conditions runoff will be produced, this could be a highly effective monitoring tool.

4.0 Post-Implementation Monitoring: Schedule for Review and Revision

Explicitly incorporating allowances for periodic revision to management practices is an important aspect of any monitoring plan. Monitoring data should be collected and analyzed to assess progress toward a management goal. If the monitoring data being collected are not showing the expected progress towards defined goals, then management measures as well as monitoring techniques should be re-evaluated. Typically, once a monitoring plan is defined, it is important to continue with the same methods so that data are comparable across time, so changes to established monitoring schemes should not be undertaken lightly. However, adding or refining techniques may be appropriate to consider under certain circumstances.

5.0 Post-Implementation Monitoring: Responsible Parties

The entities responsible for conducting monitoring activities cannot be fully identified at this point. Funding availability and the types of monitoring that will greatly influence the agencies or individuals responsible. Providing that appropriate funding were available, probable monitoring partners would include: US Geological Survey, University of Nevada, Reno Desert Research Institute, California Department of Water Resources, US Forest Service, and California Department of Fish & Game.

Some monitoring activities may be appropriate for volunteer groups to conduct or assist with. Bioassessment data are routinely collected by volunteer groups, and a robust protocol has been developed specifically for use by volunteers (Harrington & Born, 2000). At present, a citizens group in the Truckee watershed (TRAM) collects samples from 5-10 streams per year in the Truckee watershed. California Department of Fish and Game works with volunteers during their electrofishing surveys in the Truckee area. Monitoring plans developed for other regions train volunteers to collect erosion-related data such as photo-documentation, water quality samples, and surveys for direct evidence of erosion (Lawton, et al., 2002). Forming partnerships with different types of volunteer based organizations to conduct monitoring where appropriate may be a cost-effective option to examine for the Middle Truckee River.

6. 0 Post-Implementation Monitoring: Measurable Targets and Time Frames

The EPA suggests that incremental, measurable targets consistent with specific implementation actions and time frames for implementation should be included in any sediment monitoring plan (USEPA, 1999). Types of targets that are established for the Truckee River will depend upon the monitoring parameters that are selected. For each of the parameters suggested in the *Parameters to Monitor* section above, numeric targets could be developed. Specific targets cannot be developed at this point, so the focus of this section of the document is to present some types of targets that have been used in other regions and may be relevant to consider for the Middle Truckee River. As with developing targets, the development of time frames for achieving incremental and ultimate goals would be difficult to recommend at this point.

<u>Biological Targets.</u>

<u>Macroinvertebrates</u>: There are two primary approaches to macroinvertebrate data analysis: multimetric and the use of an Index of Biological Integrity (IBI). Multimetric analyses are more commonly used because they are easier to calculate. However, the interpretation is less straightforward because a number of metrics relating to community composition must be compared between different streams.

Using an IBI yields a single score that can be compared across streams to judge biological condition. However, IBIs are region-specific. No IBI currently exists that could be used in the Truckee system. Several entities, such as the Lahontan Regional Water Quality Control Board, the Nevada Division of Environmental Protection, Tetratech, the Desert Research Institute, and Oregon State University (Bob Hughes), are working toward developing an IBI for the Truckee River and/or the Eastern Sierra Nevada. The Nevada Division of Environmental Protection recently published a draft IBI for the lower reach of the Truckee River (July 2004). It can take several years to complete the data collection and perform the analyses for an IBI. Data collected and analyzed using a multimetric approach can be re-analyzed, so if an IBI is eventually developed that would be applicable to the Middle Truckee River, previously collected data could be used to monitor changes in condition based on IBI scores.

One example of how community composition data was used as a numeric target for sediment comes from Box Canyon, Colorado (CDPH&E, 2000a). The target was based on a simple metric calculated when doing a multi-metric type analysis: % EPT. The target was for the macroinvertebrate community composition to have a ratio of EPT:C of 0.5 or greater. EPT refers to the proportion of the sample made up of organisms in the orders Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies). C refers to the proportion of the sample made up of members of the Dipteran family Chironomidae (midges). Typically, mayflies, stoneflies, and caddisflies are found in relatively unimpacted waters. Chironomids can be indicative of excessive sediment in a stream.

In the Truckee, this exact metric would not be ideal because some mayflies in the family Baetidae tolerate excessive sediment fairly well (and are found in significant numbers in streams known to have excessive sedimentation such as Gray Creek) so the ratio of EPT:C would not reflect response to sediment accurately. *However, enough is known about the local aquatic insect communities that a similar type* *of numeric targets based on community composition could be developed for the Truckee.*

Fish Populations: One example of a numeric target for sediment monitoring based upon the fish population comes from Straight Creek: five or more size classes of brook trout present in the stream (CDPH&E, 2000b). For the Truckee, consideration of the on-going Lahontan Cutthroat Trout recovery effort should be considered if a numeric target is established.

Physical Targets.

Suspended Sediment Load: A numeric target for the annual sediment load can be established based on a multi-year rolling average. For example, the sediment load target for Heavenly Creek, CA is based on a 5-year rolling average in order to capture between-season and between-year variation (CRWQCB-LR, 2002b).

Turbidity: At present the Lahontan Basin Plan (CRWQCB-LR, 1995) establishes a turbidity criteria based upon mean of monthly means. Some interviewees expressed concern over using mean of monthly means to calculate the average turbidity level since this measurement can be strongly affected by data collection methods and timing of sampling (Rockwell, 2003; Kirchner, 2004), such as, for example, 15-minute interval automated turbidity monitoring versus weekly or monthly grab-samples. Different criteria for establishing a quantitative target for turbidity could be considered in the final sediment monitoring plan. For a more detailed discussion of mean of monthly means analysis, please see the Lahontan Regional Water Quality Control Board's website at: http://www.swrcb.ca.gov/rwqcb6/index.htm.

Substrate Composition: Fine sediment deposition on the streambed can be measured using pebble counts; the Wolman method appears to be the most commonly used technique. An example of a type of numeric goal that could be used for data collected in this method is an increase in D50 particle size. D50 refers to the median particle size found in a stream. An increase in D50 shows that the amount of fine sediment in a stream has decreased.

Estimations of embeddedness also are used to look the amount of fine sediment that is deposited on a streambed. Embeddedness refers to the degree to which the stream substrate is surrounded or covered by fine sediment. Excessive embeddedness interferes with the ability of fish to spawn. Typically embeddedness is measured in quartiles: 0-25%, 25-50%, 50-75%, 75-100%. One example of a specific numeric target comes from the Garcia River: decreasing embeddedness over a 10-year rolling average (CRWQCB-NCR, 2001).

Measurement of pool volume filled by fine sediment is sometimes used as a numeric target. This measurement is called V*, which specifically is a numerical value representing the proportion of fine sediment occupying the scoured residual volume of a pool.

Geomorphic Characters. Width to depth ratio is one example of a type of geomorphic measurement that could be used for a numeric target (CDPH&E, 2000b; CRWQCB-NCR, 2001). "Ideal" width to depth ratios can be established using the Rosgen stream classification system.

Actual streambank erosion can be measured using channel cross-sections and bank erosion pins per Rosgen technique. In a sediment monitoring plan developed for Big Creek, MT (Sirucek, et al., 2003) a numeric target established for bank erosion was, "approximately the same amount of streambank erosion occurring (for several years running) within the impaired sensitive reaches, as occurs in similar non-impaired reaches upstream and downstream…. A successful measure of this target would be that the erosion rate of the monitored impaired reaches is not significantly greater than 125% of the erosion rate of the monitored reference reaches, based on a statistically valid comparison."

INFORMATION AND ACCOUNTABILITY DESIGN

Data collected and summarized and information generated as part of this Monitoring Plan will be managed locally by the Truckee River Watershed Council and will be posted statewide by the Information Center for the Environment at UC Davis. TRWC will post as much information as possible on its website (www.truckeeriverwc.org).

In addition, we will report all our projects and project outcomes to a centralized watershed project database housed at the Information Center for the Environment at UC Davis. That website is: http://ice.ucdavis.edu.

Information generated under this monitoring plan will be reported back to TRWC members as part of the formal reporting process TRWC uses for each restoration project we undertake. Monitoring information will also be available for dissemination based on TRWC's approved data acquisition and distribution policies (see Appendix F for copies of these policies). Where specific projects are funded by state or federal agencies, any data collected is reported back to those agencies for their use, as stipulated in the project contract.

Data is different from "information;" we need to be sure we're collecting and analyzing useful information, not just data for data's sake. What we will be looking for is information that can be used to identify patterns, develop systems to address the patterns and change people's thinking regarding their actions, rather than just reacting to occurrences or events individually.

TASKS

Reference Studies

	Task	Subtask
	Modeling of reference conditions	Define assumptions of land cover under "naturally occurring" conditions
		Conduct analysis
	Sediment core study 4-6 reservoirs Pyramid Lake	Collect sediment cores and duplicates
		Analyze sediment samples
	Literature review- sediment effects on biota	Collect references
		Synthesize and present data
	Bioassessment – "Above and Below" macro-invertebrate study	Field collection of macroinvertebrates – 2 samples/ selected tributary (one above, one below)
		Laboratory analysis of macroinvertebrate samples
		Sediment data – field collection
		Laboratory analysis of sediment data
		Data analysis – integration of sediment and macroinvertebrate data with other known conditions or impacts at the data collection sites
	Bioassessment – "Before and After" macro-invertebrate study	Field collection of macroinvertebrates – one sample/selected tributary pre-snowmelt, one sample/selected tributary post-snowmelt
		Laboratory analysis of macroinvertebrate samples
		Sediment data – field collection
		Laboratory analysis of sediment data
		Data analysis – integration of sediment and macroinvertebrate data with other known conditions or impacts at the data collection sites
	Experiment – sediment effects on stream macroinvertebrate communities	Design experiment
		Conduct experiment – several sediment pulses
		Sample analysis
	Event sampling (SSC)	Field collection (# events depends on water year)
		Laboratory analysis
	Automated samplers (SSC)	Purchase samplers
		Calibrate samplers
		Sample analysis
	Turbidity meter operation	Maintenance, data management
	Add turbidity meters	Purchase meters

		Calibrate meters
		Develop rating curve for new meters
	Improve resolution of GIS layers	Collect field data
		Update existing GIS layers
	Experiments- Erosion by land use	Design experiments
		Conduct experiments
		Data analysis
		Background literature search
	Snapshot event	Train or hire field collection crew
		Purchase collection equipment
		Sample analysis
	Climate analysis	Establish additional weather stations
		Maintain weather stations
		Data retrieval and management
		Data analysis
	Timing of sediment pulses	Design study
		Collect precipitation data – several events
		Measure sediment deposition – several events
		Data analysis
Post-Implementation Monitoring		
	Bioassessment – macroinvertebrates	Field collection
		Laboratory analysis
	Electrofishing	Equipment maintenance
		Field data collection
		Data analysis
	Redd surveys	Field data collection
		Data analysis
	Automated samplers (SSC)	Equipment maintenance
		Data analysis
	Sediment deposition- median particle size	Field data collection
		Data analysis
	Sediment deposition- V* measurements	Field data collection
		Data analysis
	Turbidity sensors	Maintenance
	Aerial photography	Analysis
	Soil properties studies	Nutrient cycling potential analysis
		Rainfall simulation
		Soil density measurements
	Vegetation monitoring	Monitoring design
		Field data collection
		Data analysis

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7 Summary and Recommendations

7 Summary and Recommendations

The Truckee River Watershed Council was founded in May 1998 to identify and implement locally developed public-private collaborative solutions to protect and improve water quality and biological resources for the sustainable environmental and economic health of the Truckee River watershed.

The Truckee River Watershed Council (TRWC) staff and Advisory Committee have worked together on an 18-month analytical process designed to better understand water quality and habitat issues in the Middle Truckee watershed. The culmination of that process is this *Coordinated Watershed Management Strategy for the Middle Truckee River*, which provides a strategic approach for reducing potentially harmful non-point source sedimentation and maintaining and restoring riparian, aquatic and wetland habitats in the watershed as appropriate. The *Coordinated Watershed Management Strategy* is designed to assist stakeholders in clearly identifying issues and developing recommendations to improve watershed health, based on and limited by the group's mission statement and organizational objectives.

> The goal of the *Coordinated Watershed Management Strategy* is to reduce potentially harmful non-point source sedimentation and maintain and appropriately restore riparian, aquatic and wetland habitats in the watershed.

Taken together, the chapters of the *Coordinated Watershed Management Strategy* outline the natural and land use history of the watershed, current and desired conditions, recommended management strategies, proposed projects, and a monitoring plan – all geared toward reducing potentially harmful non-point source sedimentation and maintaining and appropriately restoring riparian, aquatic and wetland habitat in this watershed.

MIDDLE TRUCKEE RIVER WATERSHED

The Middle Truckee watershed, the area of land that drains into the Middle Truckee River or any of its 27 major tributaries, covers approximately 435 square miles, or 285,000 acres of land, most of which is in the eastern portions of three California counties: Placer, Nevada and Sierra. The area includes the 35-mile stretch of river that runs northeast from Tahoe City to the California-Nevada state line. About 16% of the Middle Truckee drainage, including the eastern portions of the Gray and Bronco creek sub-basins, sits across the state line in Nevada.

The watershed ranges from a low elevation of 5,050 feet at the California-Nevada state line to a high elevation of 10,778 feet at the top of Mount Rose. The change in the river's elevation from the outlet at Tahoe City [elev. 6,200 ft.] to the state line [elev. 5,050 ft.], contributes to a wide range of land uses, soil/geology/vegetation types, population densities, species diversity, and other characteristics within the watershed.

The watershed is home to approximately 25,000 year-round residents and provides aquatic, riparian and wetland habitat for many plants and animals, including a number of special status species or species of concern identified by state or federal land management agencies.

The area around the Middle Truckee River, especially the town of Truckee, is well-known to many due to its colorful history as a mining, railroad, timber and, now, recreational Mecca. However, the Town of Truckee, with its legacy impacts, and areas surrounding Truckee, including residential developments, resorts, timber and grazing lands, Lake Tahoe and other recreational areas, together have had a major influence on the watershed.

The Middle Truckee River is listed as “impaired” for sediment under Section 303(d) of the federal Clean Water Act. Hydrologic modification, including alteration of wetlands and fisheries habitat, has occurred in connection with dam and reservoir construction, resource extraction, road and railroad construction, urban development and intensive organized, as well as informal, recreational use. In addition, the pattern of managed releases from multiple dams has weakened natural resistance to erosion. The watershed once supported a superior Lahontan cutthroat trout fishery but, as the possible result of flow and habitat modification, competitor species and/or temperature changes, the fishery resource has been severely diminished. A combination of field assessments, professional judgment and GIS analysis point to the cumulative effect of these past practices as potentially causing high levels of sediment production, loss of runoff attenuation, and significant loss and degradation of riparian, aquatic and wetland habitats.

DEVELOPMENT OF THE *COORDINATED WATERSHED MANAGEMENT STRATEGY*

The advisory committee met during the first portion of the TRWC Projects and Assessments Committee meetings, reviewing all draft and final work products of the *Coordinated Watershed Management Strategy for the Middle Truckee River*. This committee provided a vehicle for soliciting wider stakeholder input on ideas and recommendations, fostered coordination and cooperation between and among different agencies and jurisdictions, and provided input on potential projects, guidelines and the vision for the future of the watershed. As needed, workgroups met in between the regular review meetings.

To be sure the *Coordinated Watershed Management Strategy* met the Watershed Council's purpose and objectives, reflected the perspectives of the different members and represented the most accurate body of knowledge available, the Truckee River Watershed Council encouraged interested individuals to participate at whatever level they could. Between 15 and 20 people regularly attended monthly meetings and additional work sessions throughout the process. Another five to eight individuals contributed data, feedback, and/or written comments on all draft work products, even though they weren't able to attend regular meetings.

The TRWC used a modified-consensus decision-making process geared toward reaching agreement by gathering, discussing and analyzing information and, when necessary, combining ideas and/or developing totally new solutions to best meet the needs of all the people involved. In those instances where total agreement could not be reached, participants indicated varying levels of support: enthusiastic, moderate, general, "can live with it," "can't tolerate it," and "willing to stand aside." If all participants supported a decision at some level, could live with it or were willing to stand aside, the decision or agreement moved forward. In the more contentious discussions, stakeholders worked hard toward agreements that met a criterion of "I/my organization can live with it."

JURISDICTIONS

A number of different entities govern land use in the Middle Truckee watershed, including city, county, state and federal agencies and their associated departments (see list below). Most have land use plans of some sort with policies and guidelines for the future development and protection of different parts of the watershed.

Local organizations like the Truckee River Watershed Council can augment existing regulations through recommendations and/or on-the-ground sediment reduction projects. But the Watershed Council has no regulatory or land use authority nor are the recommendations in the *Coordinated Watershed Management Strategy* legally binding on the Council, its stakeholders or any other agency or entity. The purpose of this strategy document is to provide a compilation of information, including recommended management strategies and project ideas, to help achieve desired conditions in the watershed related to water quality and riparian, aquatic and wetland habitat.

Agency/Entity	Area(s) of Jurisdiction
Town of Truckee	Local land use, development standards, fire protection

Placer, Nevada and Sierra counties	Local land use, development standards, fire protection
Truckee-Carson Irrigation District	Water rights, flow rates
Sierra Pacific Power Company	Municipal/irrigation water use
Washoe Co. Water Conservation District	Flood control, municipal/irrigation water use
California State Water Resources Control Board	Surface and groundwater quality, beneficial uses of water
Lahontan Regional Water Quality Control Board	Surface and groundwater quality, beneficial uses of water
California Department of Water Resources	Water rights, flow rates
California Department of Forestry and Fire Protection	Fire protection, resource protection
California Department of Fish & Game	Species, habitat, public trust resources
Donner Memorial State Park	Management and restoration of ecosystem and recreational resources in the Park
California EPA	Drinking water quality and safety
US Fish & Wildlife Service	Threatened or endangered species, specifically recovery of the endangered Lahontan cutthroat trout and the Cui-ui
US Forest Service	Management of the forested public lands in the watershed;
US Army Corps of Engineers	Flood control
US Bureau of Reclamation	Water rights, flood control, water for endangered species

GOALS, DESIRED CONDITIONS AND MANAGEMENT STRATEGIES

The overall goal of the *Coordinated Watershed Management Strategy* is to reduce potentially harmful non-point source sedimentation and maintain and appropriately restore riparian, aquatic and wetland habitats in the watershed.

Sustaining the watershed's diversity and improving its health will be a complex undertaking. The Council recognizes that achieving the *Coordinated Watershed Management Strategy*'s goals will require stakeholder support and science-based solutions that successfully integrate the natural, human, and economic environments.

This *Coordinated Watershed Management Strategy* takes advantage of the large body of information available from public agencies that have already studied water quality and riparian, aquatic and wetland habitat in the Middle Truckee watershed and developed desired conditions, goals or policies with some level of peer and/or public review. Together, the various standards or desired conditions provided a basis for the Truckee River Watershed Council to identify its desired conditions or objectives for the Middle Truckee watershed.

DESIRED CONDITIONS

Watershed and Sub-Basin Boundaries

1. State and federal agencies acknowledge, incorporate and are using amended sub-basin boundaries developed by TRWC (through accepted changes to the CalWater database).

Land Use and Jurisdictions

2. TRWC has successfully helped to bridge differences in the management strategies of different jurisdictions through this *Coordinated Watershed Management Strategy*, with the result that land use policies and guidelines adopted by the various local, state and federal entities with jurisdiction in the Middle Truckee watershed move watershed health toward the desired conditions outlined in the remaining sections of this chapter.

Soils and Sediment

3. Soils in the watershed have favorable infiltration characteristics and diverse vegetative cover that can absorb and filter precipitation and sustain favorable streamflow conditions.

4. Sediment that negatively impacts proper functioning conditions or beneficial uses in the Truckee River and its tributaries is reduced.

Hydrology, Water Management and Water Quality

5. Water resources are managed to preserve and improve existing water quality and quantity.

Riparian, Wetland and Meadow Systems

6. Structure and ecological function of riparian, wetland and meadow systems are protected and enhanced.

Channel Modification / Geomorphology

7. Changes to channel shape and structure that could negatively affect proper functioning condition or beneficial uses are minimized.

Watershed Condition

8. Habitat supports viable populations of native riparian-, aquatic- and wetland-dependent species.

9. New introductions of invasive and non-native species are prevented.

10. Where invasive species are adversely affecting the viability of native species, agencies and entities work together to eradicate the invasive species or reduce their negative impacts on native species.

11. Connectivity over space and time is maintained or improved to ensure movement of riparian-, aquatic- and wetland-dependent species within the watershed for survival, migration and reproduction.

12. Academic research is identifying and filling important data gaps in the watershed.

13. The Truckee River Watershed Council continues to generate a high level of public interest in the well-being of the Truckee River and its tributaries.

14. The Truckee River Watershed Council expands its role as a participant in collaborative efforts geared toward improving the health of the Middle Truckee River watershed.

The committee used the desired conditions as the foundation for developing recommended management strategies for achieving the Council's vision for the watershed. The strategies fall into five primary categories:

- Education/outreach
- Collaboration/convening
- Resource protection, restoration and conservation
- Monitoring/data/research
- Regulatory framework.

The group also developed a set of guiding principles for implementing the management strategies, including:[235]

k. Promote a wide range of practices for control of potentially harmful non-point source sedimentation.
l. Promote opportunities for protection, appropriate restoration, sustainable utilization and conservation.
m. Maintain beneficial uses.
n. Safeguard human health.
o. Sustain a healthy ecology and a healthy economy.
p. Encourage collection and use of site-specific scientific data.
q. Continue to raise awareness and appreciation of the Middle Truckee River and its tributaries through access, education and outreach.
r. Strengthen collaborative partnerships with local, state and federal agencies and other entities
s. Strengthen the Truckee River Watershed Council as a coordinating body for strategy implementation.
t. Respect private property rights and public resource values (e.g. water quality and aquatic, riparian and wetland health) in the watershed.

POTENTIAL PROJECTS

The committee has identified a suite of potential projects, programs and other activities to help implement the management strategies. Not all of

[235] the list is not intended to indicate relative importance; all items are weighted equally.

these are ripe for implementation immediately; some may take additional funding or cultivation of other outside resources. But taken together, these 72 projects, grouped under four categories, will help move the watershed over time toward the desired conditions for water quality and aquatic, riparian and wetland habitat identified by the Truckee River Watershed Council.

EDUCATION/OUTREACH – 12 projects to raise awareness among stakeholders and the general public about non-point source sedimentation and aquatic, riparian and wetland ecosystem health.

COLLABORATION/CONVENING – 12 projects to promote coordination among jurisdictions and landowners regarding erosion control "best management practices," identify partnership opportunities for localized outreach and support TRWC's existing volunteer programs in the watershed.

RESOURCE PROTECTION, RESTORATION AND CONSERVATION – 34 projects to protect, restore and conserve important resources related to water quality and aquatic, riparian and wetland habitat (including assessment, appropriate restoration and monitoring plans, road cut and slope stabilization, streambank restoration, habitat rehabilitation, non-native invasive species prevention or eradication, sediment control during post-fire rehabilitation, existing road/trail maintenance and new road/trail construction, etc.).

MONITORING/DATA/RESEARCH – 14 projects to expand TRWC's data gathering and analysis activities and to improve the scientific and technical body of knowledge about watershed issues and tools, including data use and access.

FUTURE UPDATES OF THE COORDINATED WATERSHED MANAGEMENT STRATEGY / DATA GAPS

Future research efforts, including US Forest Service stream surveys, US Fish & Wildlife Service stream surveys, Placer County's Truckee River Access Plan, US Army Corps of Engineers research, the Placer County Habitat Conservation Plan/Natural Communities Conservation Plan (HCP/NCCP), the Truckee River Total Maximum Daily Load process, the Truckee River Operating Agreement and others, will yield data which may be relevant to the *Coordinated Watershed Management Strategy for the Middle Truckee River*.

When new data becomes available, staff or stakeholders can bring the information to the attention of the Truckee River Watershed Council's Coordinating Committee. The Coordinating Committee will catalog such information over time for use in a full review of the document every two years. Based on the nature of the information, and its potential impact on the *Coordinated Watershed Management Strategy*, the Coordinating Committee will decide whether or not an overall plan update is necessary.

The Projects List portion of the document, however, will be reviewed and updated annually, as needed. Current Advisory Committee members and current and future stakeholders of the Watershed Council will be notified and invited to participate in the review process. Any changes will be made using the same Work Practices processes used to create the original document.

CONCLUSION

The process of going through this 18-month planning exercise demonstrated that it is, in fact, possible for the wide range of stakeholders in the Middle Truckee watershed to work together constructively on issues of importance to the economic and ecological health of our community. While the focus of this study was on sediment, we know there are many other aspects of watershed health to be considered in the future. The Watershed Council will focus its energies on this ambitious plan to reduce potentially harmful sediment and maintain or appropriately restore aquatic, riparian and wetland habitat in this, our Truckee River watershed.

Appendix A: Historic Use Matrix

PRIMARY LAND USE ACTIVITIES AND EVENTS (PRE-1960) BY SUBWATERSHED

The purpose of this matrix is to give an overview of historic uses and events in the watershed. For more information on the specific uses and/or events displayed by subwatershed below, please refer to the narrative section of the same name in the foregoing chapter.

Subwatershed	Fires[1]	Floods[2]	Water Development [3]	Timber Harvesting[4]	Agriculture & Ranching[5]	Ice Harvesting[6]	Mining[7]	Commercial Fishing[8]	Residential & Commercial Development[9]	Recreation [10]
(1) Upper Little Truckee	X		X	X	X			X	X	(a) (c) (e) (g) (i) (j)
(2) Davies-Merrill	X			X	X		X			(a) (c) (e) (g) (i) (j)
(3) Boca Complex	X	X	X (*)	X	X	X		X	X	(a) (c) (e) (g) (h) (i) (j)
(4) I-80 Corridor	X	X	X	X	X		X	X	X	(a) (e) (g) (i) (j)
(5) Mystic Canyon	X									(a) (e) (g)
(6) Bronco Creek	X			X			X		X	(a) (e) (g)
(7) Independence Lake	X	X	X					X		(a) (c) (e) (g)
(8) Sagehen Creek	X		X	X	X		X		X	(a) (c) (e) (f) (g) (i) (j)
(9) Prosser Basin & Reservoir	X	X	X (*)	X	X			X	X	(a) (c) (e) (g) (i) (j)
(10) Alder Creek	X	X							X	(a) (c) (d) (e) (i) (j)
(11) Trout Creek			X	X		X	X		X	(a) (e)
(12) Truckee Town Corridor	X	X		X	X	X	X	X	X	(a) (b) (e) (f) (l) (i)
(13) Glenshire/ Union Valley	X		X	X	X				X	(a) (e) (f) (i) (j)
(14) Juniper Creek	X			X	X		X		X	(a) (e) (f) (i) (j)
(15) Gray Creek	X	X		X	??	X				(a) (e) (g)
(16) Donner Lake	X	X	X	X	X	X			X	(a) (c) (e) (i)
(17) Cold Stream Canyon	X	X		X			X		X	(a) (e) (i) (j)
(18) Cabin Creek	X			X	X					(a) (e) (i) (j)
(19) Big Chief Corridor	X	X		X			X	X	X	(a) (c) (e) (f) (i)
(20) Martis Creek	X	X	X (*)	X	X	X	X		X	(a) (c) (d) (e) (i) (l)
(21) Deep Creek				X	X					(a) (e)
(22) Pole Creek				X	X					(a) (e) (g) (i)
(23) Silver Creek				X	X					(a) (e) (g)
(24) Deer Creek				X	X					(a) (e) (g)
(25) Squaw Creek		X	X	X	X		X		X	(a) (b) (c) (d) (e) (f) (g) (i) (j) (l)
(26) Bear Creek		X	X		X	X			X	(a) (e) (f) (i) (l)
(27) Tahoe City		X	X	X	X			X	X	(a) (c) (e) (l) (i)

1 **Fires**: GIS data from the Tahoe National Forest and Toiyabe National Forest cataloguing fire occurrences in the watershed between 1908 and 1959 (minimum acreage recorded was a 29-acre fire in 1950 and maximum 14,670 acres in 1924), and narrative source information.
2 **Flood**: GIS data from the Federal Emergency Management Agency (FEMA) identifying flood plain areas in the watershed (based on flood risk data from FEMA Flood Insurance hydrologic and hydraulic studies that identify Special Flood Hazard Areas subject to inundation by a flood having a one percent or greater probability of being equaled or exceeded during any given year), and narrative sources.
3 **Water Development**: GIS data identifying dams in the watershed, narrative information from the *Truckee River Chronology* identifying principal dams, diversions and water storage facilities, and anecdotal information.
4 **Timber Harvesting**: narrative sources and anecdotal information on location of mills, harvest sites, logging flumes, transport roads, etc. used to harvest and move timber to sawmills.
5 **Agriculture & Ranching**: narrative source information on agriculture and sheep/cattle ranching in the watershed.
6 **Ice Harvesting**: narrative sources on location of ice ponds in the watershed.
7 **Mining**: State of California GIS data identifying mines by name (including type of mine, principal commodity being mined and current status), and narrative sources.
8 **Commercial Fishing**: narrative sources and anecdotal information regarding the harvesting of Lahontan Cutthroat Trout for commercial use.
9 **Residential & Commercial Development**: GIS data, including county land use designations, and narrative and anecdotal sources identifying areas of residential or commercial development requiring some level of infrastructure as well as major roads and the railroad.
10 **Recreation**: narrative and anecdotal sources identifying areas where winter sports and other recreational activities occurred prior to 1960. Note: activities are represented in the matrix as follows:

- (a) Angling
- (b) Ballfields
- (c) Campgrounds
- (d) Golf
- (e) Hiking
- (f) Horseback riding
- (g) Hunting
- (h) Motorized boating
- (i) Mountain biking
- (j) OHV
- (k) Rafting
- (l) Skiing

(*) Certain dams built after 1960 are represented in the matrix, as they were in the narrative, in order to provide a complete discussion of water development in the watershed, most of which was completed prior to 1960.

Appendix B: TRWC Data Layer List

For a list of TRWC data layers, please call the Watershed Council at (530) 550-8760 or visit our website (http://www.truckeeriverwc.org/index.cfm?s=comm&c=mon).

Appendix C – General Plan Policy Chart

Policy Summary Statement	Placer Co. General Plan	Nevada Co. General Plan	Truckee General Plan	Tahoe City General Plan & Community Plan	Martis Valley Community Plan	Squaw Valley Ge & Land Use Ordi
SOILS & SEDIMENT						
Separate urban development from sensitive habitat areas where the land-altering aspects of development itself and/or the secondary effects (e.g. runoff from pavement carrying pollutants) may degrade important habitat areas. Protect and enhance the natural qualities of the watershed's creeks, groundwater, vegetation and other natural resources.	[Natural Resources Policy 6.A.1] The County shall require the provision of sensitive habitat buffers which shall, at a minimum be measured as follows: 100' from the centerline of perennial streams; 50' from the centerline of intermittent streams; 50' from the edge of sensitive habitats to be protected, including riparian zones, wetlands, old growth woodlands, and the habitat of rare, threatened or endangered species. Based on more detailed information supplied as a part of the review for a specific project, the County may determine that such setbacks are not applicable in a particular instance or should be modified based on the new information provided. [p. 104] Land Use Buffer Zone Standards: Sensitive Habitat Buffers are required to separate any type of urban development from such sensitive habitat areas as stream corridors, wetlands, sensitive species habitats, and old growth forests, where the land-altering aspects	[Land Use Policy 1.18] Clustering of development is an effective and direct means to provide for… protection of environmental resources which are important to Nevada County. Therefore, submittal of a clustering option of all land divisions shall be required [*within certain land use designations*] … in order to… protect environmental features by preserving areas containing such features as Open Space…. In addition, submittal of a clustering option shall be required in these land use designations and clustering encouraged for all discretionary projects where environmentally sensitive resources, as defined in Policy 1.17, are present. [p. 39] [Open Space Policy 6.1] The General Plan recognizes the importance of open space serving one ore more of the following purposes: a.) preservation of natural resources areas…; d.) delineation of open space for public health and safety…; e.)	[Conservation and Open Space Policy 1.2] Establish an Open Space Zone District along both sides of the Truckee River outside of the Downtown Study Area which prohibits all commercial, residential, and industrial development within a minimum of 150 feet of either side of the River. The Development Code shall establish clear, consistent criteria for measuring this setback. [p. 77] [Conservation and Open Space Policy 1.6] In the Development Code establish a development setback of 100 feet from each side of all blue line permanent and seasonal waterways as shown on the USFS maps, exclusive of the Truckee River, which is covered by Policy 1.2. [p. 78] [Conservation and Open Space Policy 6.1] Minimize the loss of groundwater recharge areas from paving. In the Development Code establish coverage limitations and encourage the use of	[GP Geology Policy 1] Discourage development in areas subject to adverse environmental influences, such as slides or slope failures. [p. 65] [GP Hydrology, SEZ and Water Quality Policy 2] The stream environment zone (SEZ), here defined as the 100-year flood plain of any year-round watercourse, shall not be affected by development activities except as permitted by Policy 4 and 5. [p. 66]	[Land Use Policy 1.A.6] As development projects are proposed in the area east of SR267, it will be a goal of the County to require the clustering of units to accomplish a number of objectives, including: a.) conserve large, intact, and interconnected areas of natural open space that contribute to the last remaining habitat linkage between the Sierra Nevada and the Mount Rose Wilderness Area in the Carson Range; b.) minimize habitat fragmentation by development and roads to protect open space from human encroachment; c.) maintain open space that captures an adequate representation of the biological diversity in the region and that includes a diverse representation of physical and other	[Setbacks Sectio All structures shall outside the limits c stream environme and 100-year flood except as provided 115.23. Where the flood plain has not established, struct not be located with the center line of a waterway. [p. 82]

	of development itself, and/or the secondary effects of development (e.g., runoff from pavement carrying pollutants, air pollution emissions, traffic, noise, glare, increased pedestrian access) may degrade important habitat areas. <u>Buffer Dimensions</u>: see policy 6.A.1 above). <u>Uses Allowed in Buffer</u>: Open space and recreational uses including undeveloped greenbelts, nature preserves, parks, hiking trails and bicycle paths. No land use allowed within the buffer that involves grading or the removal of natural vegetation shall be located any closer than 50' to the top of a stream bank or to the outermost extent of riparian vegetation, wetland, or other identified habitat, whichever is greater. [p. 22] [Natural Resources Policy 6.A.9] The County shall require that newly-created parcels include adequate space outside of watercourses' setback areas to ensure that property owners will not place improvements (e.g. pools, patios, and appurtenant structures), within areas that require protection. [p. 105]	provision of open spaces to create a buffer which may be landscaped to minimize the adverse impact of one land use on another. [p. 97] [Open Space Policy 6.2] The County may utilize clustering of development, as provided in the Land Use policies, to preserve open space… and to encourage creation of open space which will enhance visual, habitat and other open space values. Such open space may be permanently secured and preserved as open space through permanent easements, dedication to a public agency, permanent trust or other irrevocable means. [p. 98] [Open Space Policy 6.9] … These [Development] standards shall provide for consideration of non-disturbance of, and open space setbacks from, identified sensitive environmental, biological, or cultural resources, e.g. 100-year floodplains, wetlands, slopes in excess of 30% (excepting access across slopes up to 30%), lakes, ponds,… critical wildlife areas, minimization of land disturbance, consistency with the landforms and aesthetic context of the site, temporary and permanent erosion and sedimentation controls, and vegetation retentions,	permeable paving materials. [p. 80] [Conservation and Open Space Policy 6.2] Protect surface and groundwater from contamination through runoff by implementing the Regional Water Quality Control Board, Lahontan Region's, Best Management Practices. [p. 80] [Housing Goal 4] Balance the need and provision of housing in the community with its impacts on the environment and needed public facilities and services. [p. 154] [Housing Policy 4.2] Encourage residential development design that clusters units to reduce infrastructure costs and other development costs, as well as to preserve and enhance important environmental resources and to maintain important areas as open space. [p. 154] [Housing Policy 4.2.1] Adopt standards for residential cluster areas and mechanisms for the long term protection and maintenance of the open space areas within their residential cluster areas. [p. 154]		environmental conditions; d.) conserve and maintain natural hydrological, water quality, and biological functions of wetlands, headwaters, stream systems, and their watersheds; e.) encourage opportunities for recovery or rare, threatened, and endangered species and for restoration of the habitats that support them; f.) provide protected habitat connections between open space areas to allow intergenerational dispersal of animals and plants, both within and adjacent to the planning area. [p. 15] [Land Use Policy 1.D.2] The County shall seek to locate new public facilities… outside areas subject to natural or build environment hazards. [p. 18] [Natural Resources Policy 9.D.1] The County shall require the provision of sensitive habitat buffers which shall, at a minimum be measured as follows: 100' from the centerline of	

		replacement and enhancement. [p. 99] [Wildlife and Vegetation Objective 13.1] Discourage intrusion and encroachment by incompatible land uses in significant and sensitive habitats. [p. 152]			perennial streams; 50' from the centerline of intermittent streams; 50' from the edge of sensitive habitats to be protected, including riparian zones, wetlands, old growth woodlands, and the habitat of rare, threatened or endangered species. In some cases, buffers shall be required which are substantially larger than notes above. Conversely, based on more detailed information supplied as a part of the review for a specific project, the county may determine that such setbacks are not applicable in a particular instance or should be modified based on the new information provided…. [p. 114] [Natural Resources Policy 9.D.5] The County shall continue to require the use of both temporary and permanent Best Management Practices (BMPs) with every development project, to protect streams from the adverse effects of construction activities and urban runoff and to require the use of BMPs for recreational developments, such as ski areas, golf courses, bicycling facilities,	

					hiking and equestrian trails, and other recreational uses. [p. 115] [Natural Resources Policy 9.D.7] The County shall prohibit grading activities during the rainy season, unless adequately mitigated, to avoid sedimentation of creeks and damage to riparian habitat. [p. 116] [Natural Resources Policy 9.E.3] The County shall support the conservation of a healthy forest including outstanding areas of native vegetation, including, but not limited to, open meadows, riparian areas, Great Basin Sage Scrub, Mixed Coniferous Forest, Montane Chaparral, Montane Meadow, and Red Fir Forest. [p. 116] [Natural Resources Policy 9.E.10] The County shall require that new development avoid ecologically-fragile areas (e.g. areas of rare or endangered species of plants, riparian areas). Where feasible, these areas and heritage trees should be protected through public acquisition of fee title or conservation easements to	

					ensure protection. [p. 117]	
Allow only low-intensity forms of development in areas with sensitive environmental resources.	[Land Use Policy 1.A.2] The County shall permit only low-intensity forms of development in areas with sensitive environmental resources or where natural or human-caused hazards are likely to pose a significant threat to health, safety, or property. [p. 35]	[Land Use Policy 1.6] Within these Rural Regions, growth is provided for only those types and densities of development which are consistent with the open, pastoral character which exists in these areas. These uses require and support lower levels of service and through low density and intensity of use provide mutual benefits for the maintenance of a rural character and preservation of natural resources. [p. 28] [Open Space Policy 6.1 (cont'd)] …The uses of land under the Open Space designation and implementing zoning are limited to those which have minimal impact on the natural character and environmental features of the land. [p. 97] [Open Space Policy 6.4] Protect areas supporting renewable natural resources from incompatible or disruptive development or land uses through very low density General Plan designation…. Identified lakes and reservoirs shall be designated as water areas in the General Plan. [p. 98]			[Land Use Policy 1.A.2] The County shall permit only low-intensity forms of development in areas with sensitive environmental resources or where natural or human-caused hazards are likely to pose a significant threat to health, safety, or property. [p. 14]	
Employ sound soil	[Land Use Policy 1.K.4] The County shall require that new	[Circulation Objective 4.16] Protect the natural environment	[Circulation Policy 2.3] New roads and roadway	[GP Soils and Land Capability Policy 1] Encourage	[Community Design Policy 4.B.4] The County shall	[Development Co Section 110.10] A

conservation practices and minimization of land alterations.	development incorporates sound soil conservation practices and minimizes land alterations. Land alterations should comply with the following guidelines: a. limit cuts and fills; b. limit grading to the smallest practical area of land; c. limit land exposure to the shortest practical amount of time; d. replant graded areas to ensure establishment of plant cover before the next rainy season; and e. create grading contours that blend with the natural contours on site or with contours on property immediately adjacent to the area of development. [p. 42] [Land Use Policy 1.K.6] The County shall require that new development on hillsides employ design, construction, and maintenance techniques that: a. ensure that development near or on portions of hillsides does not cause or worsen natural hazards such as erosion, sedimentation, fire, or water quality concerns; b. include erosion and sediment control measures including	in development and maintenance of the transportation system. [p. 86] [Circulation Policy 4.37] Nevada County shall continue to require environmentally sound practices for transportation facility construction and maintenance. New roads or improvements to the existing road system and all trails and pathways shall be located, constructed and maintained in a manner compatible with the environment. [p. 86] [Circulation Policy 4.38] Encourage Caltrans' efforts to reduce impacts to vegetation, wildlife and water quality through the use of salt substitutes, or other environmentally compatible materials for road de-icing. [p. 86] [Open Space Policy 6.7] Nevada County encourages the location and development of motorized off-road facilities on lands where such use can be accommodated. [p. 98] [Water Policy 11.9A] Approve only those grading applications and development proposals that are adequately protected from flood hazards and which do not	improvements shall be located, constructed, and maintained in a manner which prevents adverse impacts to water quality and significant biological, scenic, and historic resources. [p. 71] [Conservation and Open Space Policy 7.1] Discretionary development shall be clustered away from slopes in excess of 30%. Discretionary development on all slopes in excess of 20% shall have a site specific review of soil type, vegetation, drainage, slope, and building placement to determine proper site design. [p. 80] [Conservation and Open Space Policy 7.2] On discretionary projects that require earthwork and grading, including cuts and fills for roads, developers shall be required to minimize erosion and sedimentation by conforming with the natural contours, maximizing retention of natural vegetation, and implementing Best Management Practices. [p. 81] [Conservation and Open Space Policy 7.3] Work with the RCD to identify existing critical erosion problems and to pursue funding to resolve these problems. [p. 81]	development to be designed in accordance with adopted TRPA standards in terms of permitted land coverage and best management practices. [p. 65] [GP Soils and Land Capability Policy 2] Continue to require review of grading activity through the Grading Permit process, and restricting grading activity between the dates of October 15 to May 1. [p. 66]	require that new development incorporates sound soil conservation practices and minimizes land alterations. Land alterations should comply with the following guidelines: a.) limit cuts and fills; b.) limit grading to the smallest practical area required by the development; c.) limit land exposure to the shortest practical amount of time; d.) replant graded areas to ensure establishment of plant cover before the next rainy season; and e.) create grading contours that blend with the natural contours on site or with contours on property immediately adjacent to the area of development. [p. 39] [Community Design Policy 4.B.6] The County shall require that new development on hillsides employ design, construction, and maintenance techniques that: a. ensure that development near or on portions of hillsides does not cause or worsen natural	which presents on of the following lim factors shall not be to development ex provided in Sectio 110.14. a. Natural sl greater th b. Soils iden having a h erosion po c. Potential avalanche areas d. Stream er zone of ar watercour 64]. [Erosion Control 118.10] All develo shall be planned, c constructed and m so that existing he and native vegetat site are preserved maximum extent fe are protected by a means during cons [p. 66] [Erosion Control 118.12] A sedime erosion control pla required when gra proposed which di a. an area than 1,(b. slopes than 25 c. a strea

	temporary vegetation sufficient to stabilize disturbed areas; c. minimize risk to life and property from slope failure, landslides, and flooding; and d. maintain the character and visual quality of the hillside. [p. 42] [Public Facilities and Services Policy 4.E.9] The County shall encourage good soil conservation practices in agricultural and urban areas and carefully examine the impact of proposed urban development with regard to drainage courses. [p. 87] [Public Facilities and Services Policy 4.F.13] The County shall continue to implement and enforce its *Grading Ordinance*. [p. 89] [Natural Resources Policy 6.A.4] Where creek protection is required or proposed, the County should require public and private development to: a. preserve creek corridors and creek setback areas through easement or dedications…; b. designate such easement or dedication areas… as open space; c. protect creek corridors and their habitat value by actions	add flood damage potential. This may include the requirement for foundation design which minimized displacement of flood waters, as well as other mitigation measures. [p. 144] [Water Policy 11.9B] Require new utilities, critical facilities and non-essential public structure to be located outside the 100-year flood plain unless such facilities are necessary to serve existing uses, there is no other feasible location, and construction of these structures will not increase hazards to life or property within or adjacent to the floodplains. [p. 144] [Soils Goal 12.1] Minimize adverse impacts of grading activities, loss of soils and soil productivity. [p. 146] [Soils Objective 12.1] Minimize earth movement and disturbance. [p. 146] [Soils Policy 12.1] Enforce Grading Ordinance provisions for erosion control on all new development projects by adopting provisions for ongoing monitoring of project grading. [p. 146] [Soils Policy 12.2] Enforce Grading Ordinance requirements for grading or	[Conservation and Open Space Policy 7.5] Evaluate and implement methods for street cleaning that will minimize dust and sedimentation impacts, including a reduction in the amount of dirt and debris deposited in drainage channels. [p. 81]		hazards such as erosion, sedimentation, fire, or water quality concerns; b. include erosion and sediment control measures including temporary vegetation sufficient to stabilize disturbed areas; c. minimize risk to life and property from slope failure, landslides, avalanches, and flooding; and d. maintain the character and visual quality of the hillside. [p. 39] [Community Design Policy 4.B.7] The County shall require the number and extent of roadway cuts and fills required in construction, reconstruction, and road maintenance be kept to a minimum consistent with standard design practices. [p. 39] [Community Design Policy 4.B.8] The County shall require that roads, trails, and paths be designed and constructed to minimize erosion and other disturbances to the natural terrain and vegetation. Such	environ [p. 66] [Erosion Control 118.14] Sediment erosion control pla address both cons related and long-te control measures a be submitted for re approval to the De of Public Works. [p [Erosion Control 118.16] The contr sedimentation and may include any c of mechanical or v measures approve county, including b limited to those ide *Erosion and Sedin* *Control Guidelines* *Developing Areas* *Sierra Foothills an* *Mountains* prepare High Sierra RC&D November, 1981. [

	such as: 1.) providing an adequate creek setback, 2.) maintaining creek corridors in an essentially natural state, 3.) employing creek restoration techniques where restoration is needed to achieve a natural creek corridor, 4,) utilizing riparian vegetation within creek corridors, and where possible, within creek setback areas, 5.) prohibiting the planting of invasive, non-native plants within creek corridors or creek setbacks, and 6.) avoiding tree removal within creek corridors; d. provide recreation and public access near creeks consistent with other General Plan policies; e. use design, construction, and maintenance techniques that ensure development near a creek will not cause or worsen natural hazards… and will include erosion and sediment control practices such as: 1.) turbidity screens and other management practices, which shall be used as necessary to minimize siltation, sedimentation, and erosion, and shall be left in place until disturbed areas; and/or are stabilized with permanent vegetation that	vegetation removal not associated with a development project. Exempted from this requirement are actions necessary for evaluation of soils and other environmental characteristics, and for control of fire fuels, and for agricultural and timber production. [p. 146] [Soils Objective 12.2] Minimize erosion due to road construction and maintenance. [p. 147] [Soils Policy 12.4] Require erosion control measures as an element of all County contracts, discretionary projects, and ministerial projects. [p. 147] [Soils Objective 12.3] Minimize vegetation removal. [p. 147]			facilities shall be designed for economical maintenance. [p. 39] [Public Facilities and Services Policy 6.E.3] The County shall continue to implement and enforce its Grading Ordinance and Flood Damage Prevention Ordinance. [p. 79] [Natural Resources Policy 9.A.4] The County shall ensure that areas of slope instability are adequately investigated and that any development in these areas incorporates appropriate design provisions to prevent landsliding. [p. 112] [Natural Resources Policy 9.A.5] In landslide hazard areas, the County shall prohibit alteration of land in a manner that could increase the hazard, including concentration of water through drainage, irrigation, or septic systems; removal of vegetative cover; and steepening of slopes and undercutting the bases of slopes. [p. 113] [Natural Resources Policy 9.A.6] The county shall require drainage plans for development in mountainous and sloping areas that direct	

	will prevent the transport of sediment off site; and 2.) temporary vegetation sufficient to stabilize disturbed areas; f. provide for long-term creek corridor maintenance by providing a guaranteed financial commitment to the County which accounts for all anticipated maintenance activities. [p. 104] [Natural Resources Policy 6.A.5] The County shall continue to require the use of feasible and practical best management practices to protect streams from the adverse effects of construction activities and urban runoff. [p. 105] [Natural Resources Policy 6.A.7] The County shall discourage grading activities during the rainy season, unless adequately mitigated, to avoid sedimentation of creeks and damage to riparian habitat. [p. 105] [Health and Safety Policy 8.A.5] In landslide hazard areas, the County shall prohibit avoidable alteration of land in a manner that could increase the hazard, including concentration of water through drainage, irrigation, or septic systems; removal of vegetative cover;				runoff and drainage away from unstable slopes. [p. 113] [Natural Resources Policy 9.A.9] The County shall limit development in areas of steep (in excess of 30% or in some cases between 20 and 30%) or unstable slopes to minimize hazards caused by landslides … and to reduce grading and disturbance to such slopes. [p. 113] [Natural Resources Goal 9.C] To promote the conservation of soils as a valuable natural resource. [p. 113] [Natural Resource Policy 9.C.1] The county shall support and encourage existing special district, state, and federal soil conservation and restoration programs. [p. 113]	

	and steepening of slopes and undercutting the bases of slopes. [p. 127] [Health and Safety Policy 8.A.6] The County shall require the preparation of drainage plans for development in hillside areas that direct runoff and drainage away from unstable slopes. [p. 127] [Health and Safety Policy 8.A.8] The County shall continue to support scientific geologic investigations which refine, enlarge, and improve the body of knowledge on… unstable areas… and other hazardous conditions in Placer County. [p. 127]					
Restore damaged areas.	[Natural Resources Policy 6.A.8] Where the stream environment zone has previously been modified by channelization, fill, or other human activity, the County shall require project proponents to restore such areas by means of landscaping, revegetation, or similar stabilization techniques as part of development activities. [p. 105] [Natural Resources Policy 6.C.5] The County shall require mitigation for development projects where isolated segments of stream habitat are unavoidably altered.	[Public Facilities and Services Policy 3.21] Where water, sewer, and other underground utilities are extended through undeveloped natural areas, consideration shall be given to restoration of areas of cut, back-fill, and grading. All surfaces shall be revegetated with appropriate ground covers and plant materials. [p. 69] [Wildlife and Vegetation Policy 13.4A] No net loss of habitat functions or values shall be caused by development where rare and endangered species and wetlands of over 1 acre, in aggregate, are		[GP Hydrology, SEZ and Water Quality Policy 3] Where the stream environment zone has previously been modified by channelization, fill, or other human activity, such areas shall be restored by means of landscaping, revegetation, or similar stabilization techniques as a part of development activities on adjoining properties. [p. 66] [CP SEZ Implementation Strategy] TRPA thresholds require restoration of 25% of disturbed SEZs in the Region within the 20-year life of the Regional Plan. Tahoe City	[Natural Resources Policy 9.D.8] Where the stream environment zone has previously been modified by channelization, fill, or other human activity, the County shall require project proponents to restore such areas to a more natural condition which may include landscaping, revegetation, or similar stabilization techniques. [p. 116]	[Drainage/Water Section 115.20] stream environme has previously bee by channelization, other human activi areas shall be rest means of landscap revegetation, or si stabilization techni part of developme on adjoining prope 65] [Erosion Control 118.18] All surfac disturbed by veget removal, grading, or other constructi

	Such impacts should be mitigated on-site with in-kind habitat replacement or elsewhere in the stream system through stream or riparian habitat restoration work. [p. 110]	identified…. No net loss shall be achieved through avoidance of the resource, or through creation or restoration of habitat of superior or comparable quality, in accordance with guidelines of the USFWS and DFG. [p. 154] [Wildlife and Vegetation Policy 13.4B] Habitat that is required to be protected, restored, or created as mitigation for a project's impacts shall be monitored and maintained in accord with a County-approved Habitat Management Plan. [p. 154]		Target: The CP Stream Zone Restoration Program targets approximately 25 percent of 13.5 acres for restoration by 2007. The 1997 CP target is 4 acres. [p. IV-8]		that alters the natu vegetative cover, a revegetated to con erosion, unless co impervious surface authorized by appr plans. Such reveg work must be com to October 15th of [p. 67]
HYDROLOGY, WATER MANAGEMENT & WATER QUALITY						
Require that development adjacent to bodies of water adequately mitigate potential water quality impacts on these water bodies.	[Public Facilities and Services Policy 4.C.5] The County shall require that new development adjacent to bodies of water used as domestic water sources adequately mitigate potential water quality impacts on these water bodies. [p. 83] [Public Facilities and Services Policy 4.C.11] The County shall protect the watersheds of all bodies of water associated with the storage and delivery of domestic water by limiting	[Water Objective 11.2] Preserve surface and sub-surface water quality and, where feasible, improve such quality. [p. 141] [Water Policy 11.4] Cooperate with State and local agencies in efforts to identify and reduce to acceptable levels all sources of existing and potential point- and non-point-source pollution to ground and surface waters, including… discharges from storm drains,… parking lots,	[Conservation and Open Space Policy 6.3] Cooperate with state and local agencies in efforts to identify and eliminate all sources of existing and potential point and non-point sources of pollution to ground and surface waters, including… discharges from storm drains,… parking lots, roadways, and logging and mining operations. [p. 80]		[Public Facilities and Services Policy 6.C.4] The County shall require that new development adjacent to surface and subsurface bodies of water adequately mitigate potential water quality impacts on these water bodies. [p. 78] [Public Facilities and Services Policy 6.C.7] The County shall protect the watersheds of all surface and subsurface bodies of water	

Collaborative solutions to protect, enhance and restore the Truckee River watershed

	grading, construction of impervious surfaces, application of fertilizers, and development of septic systems within these watersheds. [p. 84] [Natural Resources Policy 6.A.11] Open space located in watersheds which serve reservoirs is important to the adequate performance of those reservoirs for their intended purposes and should be preserved and protected. The watershed is defined as those lands draining into a reservoir and having an immediate effect upon the quality of water within that reservoir. Those lands located within the watershed and within 5,000 feet of the reservoir shall be considered as having an immediate effect. [p. 106]	roadways, logging and mining operations. [p. 142] [Mineral Management Policy 17.11] Recognize the importance of water conservation and quality for the present and future needs of the County by: 1.) Requiring the conservation of on-site water during mining operations. 2.) Requiring that off-site water discharge complies with State water quality standards. 3.) Requiring that any increase or decrease of off-site discharge is not detrimental to the downstream environment or downstream water users. [p. 181] [Mineral Management Policy 17.23] Prepare a comprehensive plan for river and flood plain development that ensures aggregate operations within rivers and floodplains which have the least impact on the environment are developed before more environmentally-sensitive areas are approved and to also ensure that the environmental impacts of proposed aggregate operations within rivers and floodplains by be more readily assessed. [p. 183]			associated with the storage and delivery of domestic water by limiting grading, construction of impervious surfaces, application of fertilizers, and prohibition on the development of septic systems on lots less than 10 acres in size within these watersheds. [p. 78] [Natural Resources Policy 9.D.9] The County shall encourage the preservation and protection of open space located in watersheds which serve reservoirs due to its importance in the adequate performance of those reservoirs for their intended purposes. The watershed is defined as those lands draining into a reservoir and having an immediate effect upon the quality of water within that reservoir. Those lands located within the watershed and within 5,000 feet of the reservoir shall be considered as having an immediate effect. For Martis Valley, this includes Martis Creek Lake. [p. 116] [Natural Resources Policy 9.G.2] The County shall require the control of residual pesticides, herbicides, and	

					related chemicals such as those used on golf courses, to prevent potential damage to water quality, vegetation, fish, and wildlife. [p. 119]	
Coordinate efforts to ensure adequate water supply, water quality and flood protection.	[Public Facilities and Services Policy 4.F.6] The County shall continue to coordinate efforts with local, state, and federal agencies to achieve adequate water quality and flood protection. [p. 89]		[Safety Policy 2.3] Continue to work with appropriate local, state and federal agencies (particularly FEMA) in maintaining the most current flood hazard and floodplain information as a basis for project review in order to limit development in such areas in accordance with federal, state and local standards. [p. 86] [Conservation and Open Space Policy 8.3] Continually request that local, state, and federal entities that manage local reservoirs and their releases consider recreational and wildlife benefits of local lakes and streams. [p. 81[]		[Public Facilities and Services Goal 6.C] To ensure the availability of an adequate and safe long-term water supply and the maintenance of high quality water in water bodies and aquifers used as sources of domestic supply. [p. 77] [Public Facilities and Services Policy 6.C.1] The County shall require proponents of new development to demonstrate the availability of a long-term, reliable and adequate supply of pure, wholesome, healthful, and potable water as well as any necessary water for irrigation or other purposes. [p. 77] [Public Facilities and Services Policy 6.C.2] Water necessary for snowmaking, golf courses, and other recreational uses, shall be addressed in all water assessments conducted for the Plan area. [Public Facilities and Services Policy 6.C.3] The	

					County shall require that water supplies serving new development meet state water quality standards. [p. 77] [Public Facilities and Services Policy 6.E.11] The County shall identify and coordinate mitigation measures with responsible agencies for the control of storm sewers, monitoring of discharges, and implementation of measures to control pollutant loads in urban storm water runoff. [p. 80] [Public Facilities and Services Policy 6.F.6] The County shall continue to coordinate efforts with local, state, and federal agencies to achieve adequate water quality and flood protection. [p. 81]	
Protect and enhance water quality.	[Public Facilities and Services Policy 4.E.10] The County shall strive to improve the quality of runoff from urban and suburban development through use of appropriate and feasible mitigation measures including, but not limited to, artificial wetlands, grassy swales, infiltration/ sedimentation basins, riparian setbacks, oil/grit separators, and other best management		[Conservation and Open Space Policy 6.2] Protect surface and groundwater from contamination through runoff by implementing the Regional Water Quality Control Board, Lahontan Region's, Best Management Practices. [p. 80]		[Public Facilities and Services Policy 6.E.6] The County shall improve the quality of runoff from urban and suburban development through use of appropriate and feasible mitigation measures including, but not limited to, artificial wetlands, grassy swales, infiltration/sedimentation basins, riparian setbacks, oil/grit separators, and other	[Drainage/Water C Section 115.14] A drainage systems designed so as no increase turbidity, yield, or the discha harmful substance will degrade the qu water. [p. 65]

	practices. [p. 87] [Public Facilities and Services Policy 4.E.12] The County shall encourage project designs that minimize drainage concentrations and impervious coverage and maintain, to the extent feasible, natural site drainage conditions. [p. 87] [Public Facilities and Services Policy 4.E.14] The County shall require projects that have significant impacts on the quantity and quality of surface water runoff to allocate land as necessary for the purpose of detaining post-project flows and/or for the incorporation of mitigation measures for water quality impacts related to urban runoff. [p. 87] [Natural Resources Policy 6.A.4] Where creek protection is required or proposed, the County should require public and private development to: a. preserve creek corridors and creek setback areas through easement or dedications…; b. designate such easement or dedication areas… as open space; c. protect creek corridors and their habitat value by actions such as: 1.) providing an adequate creek setback, 2.)				Best Management Practices. [p. 79] [Public Facilities and Services Policy 6.E.10] The County shall require projects that have significant impacts on the quantity and quality of surface water runoff to allocate land as necessary for the purpose of detaining post-project flows and/or for the incorporation of mitigation measures for water quality impacts related to urban runoff. [p. 80]	

	maintaining creek corridors in an essentially natural state, 3.) employing creek restoration techniques where restoration is needed to achieve a natural creek corridor, 4,) utilizing riparian vegetation within creek corridors, and where possible, within creek setback areas, 5.) prohibiting the planting of invasive, non-native plants within creek corridors or creek setbacks, and 6.) avoiding tree removal within creek corridors; d. provide recreation and public access near creeks consistent with other General Plan policies; e. use design, construction, and maintenance techniques that ensure development near a creek will not cause or worsen natural hazards… and will include erosion and sediment control practices such as: 1.) turbidity screens and other management practices, which shall be used as necessary to minimize siltation, sedimentation, and erosion, and shall be left in place until disturbed areas; and/or are stabilized with permanent vegetation that will prevent the transport of sediment off site; and 2.)					

	temporary vegetation sufficient to stabilize disturbed areas; f. provide for long-term creek corridor maintenance by providing a guaranteed financial commitment to the County which accounts for all anticipated maintenance activities. [p. 104]					
RIPARIAN, WETLAND, MEADOW SYSTEMS						
Identify significant natural and open space resources in advance of development and incorporate into site-specific development project design.	[Land Use Policy 1.I.2] The County shall require that development be planned and designed to avoid areas rich in wildlife or of a fragile ecological nature (e.g. areas of rare or endangered plant species, riparian areas). [p. 40] [Natural Resources Implementation Program 6.14] The County shall develop and maintain a detailed inventory of significant ecological resource areas for use during environmental review to determine potential impacts and monitor cumulative impacts on these resources. [p. 115] [Natural Resources Policy 6.E.1] The County shall support the preservation and enhancement of natural land forms, natural vegetation, and natural resources as open	[Land Use Objective 1.11] Implement development standards which incorporate open space, protect environmentally sensitive land, and allow for resource management. [p. 36] [Land Use Policy 1.17] The County shall prepare and adopt comprehensive Site Development Standards… to provide a consistent approach for addressing [*among other things*]: the presence of sensitive environmental features and/or natural constraints. The County shall prepare and adopt specific and comprehensive Site Development Standards which shall be… protective of the County's unique character, providing guidance for [*among other things*]: protection of environmentally sensitive resources, protection of			[Land Use Policy 1.G.2] The County shall require that significant natural, open space, and cultural resources be identified in advance of development and incorporated into site-specific development project design. [p. 20] [Land Use Policy 1.G.3] The County shall require that development be planned and designed to avoid areas rich in wildlife or of a fragile ecological nature (e.g. areas or rare or endangered plant species, riparian areas). [p. 20]	

	space to the maximum extent feasible. The County shall permanently protect, as open space, areas of natural resource value, including wetlands preserves, riparian corridors, woodlands, and floodplains. [p. 115] [Natural Resources Policy 6.E.2] The county shall require that new development be designed and constructed to preserve the following types of areas and features as open space to the maximum extent feasible: a. high erosion hazard areas; b. scenic and trail corridors; c. streams, streamside vegetation; d. wetlands; e. other significant stands of vegetation; f. wildlife corridors; and g. any areas of special ecological significance. [p. 116]	important agricultural, mineral, and timber resources. The standards shall identify the basic requirements for site development in the County, including, at a minimum, standards to mitigate the impact of development on environmentally sensitive resources as referenced in the following criteria [*including, among others*]: ▪ wetlands (as delineated in the National Wetlands Inventory) ▪ rare and endangered species ▪ riparian corridors within 100 feet of intermittent or perennial water courses ▪ floodplains, as defined by FEMA, precluding development and land disturbance within floodways and restricting development within the floodway fringe, through the establishment of floodplain setbacks and associated development regulations ▪ significant mineral areas ▪ steep slopes (30+%) ▪ areas with high erosion potential ▪ [*and others*]. [p. 37] [Safety Objective 10.6] Land use patterns and development standards shall minimize hazards resulting from flooding,				

		earthquake, slope failure, avalanche, and other natural occurrences. [p. 134] [Safety Policy 10.12] Avoid potential increases in downstream flooding potential by protecting natural drainage and vegetative patterns thought project site plan review, application of Comprehensive Site Development Standards, use of clustered development and project subdivision design. The Comprehensive Site Development Standards shall include measures applicable to all discretionary and ministerial projects to avoid downstream flooding resulting from new development. Such measures shall include, but not be limited to: a.) avoidance of stream channel modifications; b.) avoidance of excessive areas of impervious surfaces; and c.) use of on-site retention or detention of storm water. [p. 134] [Wildlife and Vegetation Policy 13.1] Where significant environmental features, as defined in Policy 1.17, are identified during review of projects, the county shall require all portions of the project site that contain or influence said areas to be retained as non-disturbance open space through clustered development				

		on suitable portions of the project site, or other means where mandatory clustering cannot be achieved. The intent and emphasis of such open space designation and non-disturbance is to promote continued viability of contiguous or inter-dependent habitats by avoiding fragmentation of existing habitat areas and preserving movement corridors between related habitats. Vegetation management for the benefit of habitat preservation or restoration shall be considered consistent with the intent of this policy. [p. 152] [Wildlife and Vegetation Policy 13.2] As part of the Comprehensive Site Development Standards, include standards to minimize removal of existing vegetation and require installation and long-term maintenance of landscaping in setbacks and buffer areas. [p. 152] [Wildlife and Vegetation Policy 13.2A] Project review standards shall include a requirement to conduct a site-specific biological inventory to determine the presence of special status species or habitat for such species that may be affected by a proposed project.				

		The results of the biological inventory shall be used as the basis for establishing land use siting and design tools required to achieve the objective of no not loss of habitat function or value for special status species. [p. 153] [Wildlife and Vegetation Policy 13.4C] The land use designations and associated acreages identified on the proposed General Plan land use maps for Special Development Areas should be modified as necessary at the Specific Plan stage to protect sensitive natural communities and other important biotic resources. [p. 155] [Aesthetics Policy 18.1] The County shall prepare Community Design Guidelines applicable to the various General Plan Designations and zoning classifications, and adopt such guidelines as part of Comprehensive Site Development Standards, to be used in the project site review of all discretionary and ministerial project permits. The guidelines may include, but not be limited to, the following: 1.) community identify, b.) preservation of natural landforms, c.) protection and management of viewsheds, d.) protection and management of river corridors and other				

		significant streams. [p. 188]				
Collect and dispose of stormwater in a manner that reduces potential water-related damage and enhances the environment.	[Public Facilities and Services Policy 4.E.1] The County shall encourage the use of natural stormwater drainage systems to preserve and enhance natural features. [p. 86] [Public Facilities and Services Policy 4.E.3] The County shall consider using stormwater of adequate quality to replenish local groundwater basins, restore wetlands and riparian habitat, and irrigate agricultural lands. [p. 86] [Public Facilities and Services Policy 4.F.2] The County shall recognize floodplains as a potential public resource to be managed and maintained for the public's benefit. [p. 88] [Public Facilities and Services Policy 4.F.8] The County shall, where possible, view flood waters as a resource to be used for waterfowl habitat, aquifer recharge, fishery enhancement, agricultural water supply, and other suitable uses. [p. 89] [Public Facilities and Services Policy 4.F.10] The County shall preserve or enhance the aesthetic qualities of natural drainage courses in their natural or improved state compatible with flood control requirements		[Safety Goal 1] Establish standards to reduce threat of hazards to life and property, and direct new development away from natural hazard areas. [p. 85] [Safety Policy 1.1] In Residential and Residential Cluster designations, new residential development shall be clustered to avoid areas of hazard, including high fire hazard, steep slopes, areas of unstable soils, avalanche, or flooding. [p. 85] [Safety Policy 2.6] Prevent increases in downstream flooding potential through establishment of guidelines which regulate the rate of off-site run-off for projects which require Town review and approval. [p. 86]	[GP Hydrology, SEZ and Water Quality Policy 1] All internal drainage systems shall be designed so as not to increase turbidity, sediment yield, or the discharge of any harmful substances which will degrade the quality of water. [p. 66] [GP Hydrology, SEZ and Water Quality Policy 5] Where development is proposed within an SEZ that has previously been disturbed… it may be approved only if the decision-making body finds that it will: a.) not increase the obstruction of flood waters; and b.) not increase the potential for flood damage to other properties either up or down stream; c.) result in an overall improvement in water quality protection; and d.) an overall improvement to the SEZ. [p. 66] [GP Safety Policy 4] Prohibit construction, grading, and filling of lands within the 100-year flood plain… except as necessary to implement the goals and policies of the plan. Require all public utilities, transportation facilities, and other necessary public uses located in the 100-year flood plain… to be constructed or maintained to prevent damage	[Public Facilities and Services Policy 6.E.1] The County shall encourage the use of natural stormwater drainage systems to preserve and enhance natural features. [p. 79] [Public Facilities and Services Policy 6.E.8] The County shall encourage project designs that minimize drainage concentrations and impervious coverage and maintain, to the extent feasible, natural site drainage conditions. [p. 79] [Public Facilities and Services Policy 6.F.8] The County shall, where possible, view flood waters as a resource to be used for waterfowl habitat, aquifer recharge, fishery enhancement, landscape irrigation, and other suitable uses. [p. 81] [Natural Resources Policy 9.D.2] The County shall require that any permitted disturbance in the 100-year floodplain comply with the provisions of the *Placer County Flood Damage Prevention Ordinance* and any other existing	[Drainage/Water (Section 115.10] A development's inte drainage systems designed that the (and retention capa downstream syste preserved, or that flow, location, and natural drainage sy downstream are ur [p. 65] [Drainage/Water (Section 115.23] W development is pro within a stream en zone that has prev been disturbed, as in Section 115.20 a may be approved (decision-making b that it will: a. not incr obstruc flood w b. not incr potentia damage propert up or do stream; c. result in improve water q protecti d. an over improve the stre

Collaborative solutions to protect, enhance and restore the Truckee River watershed

	and economic, environmental, and ecological factors. [p. 89] [Natural Resources Policy 6.A.2] The County shall require all development in the 100-year floodplain to comply with the provisions of the *Placer County Flood Damage Prevention Ordinance*. [p. 104] [Natural Resources Policy 6.A.3] The County shall require development projects proposing to encroach into a creek corridor or creek setback to do one or more of the following, in descending order of desirability: a. avoid the disturbance of riparian vegetation; b. replace riparian vegetation (on-site, in-kind); c. restore another section of creek (in-kind); and/or d. pay a mitigation fee for restoration elsewhere (e.g. wetland mitigation banking program). [p. 104] [Natural Resources Policy 6.A.12] The County shall encourage the protection of floodplain lands and where appropriate, acquire public easements for purposes of flood protection, public safety, wildlife preservation, groundwater recharge, access and recreation. [p. 106]			from flooding and to not cause flooding. [p. 73] [GP Safety Policy 5] Continue to implement land development policies which minimize potential loss of property and threat to human life caused by flooding. [p. 74]	regulations. [p. 114] [Natural Resources Policy 9.D.3] The County shall require development projects proposing to encroach (where it has been determined to be appropriate) into a creek corridor or creek setback to do one or more of the following, in descending order of desirability: a. avoid the disturbance of riparian vegetation; b. replace riparian vegetation (on-site, in-kind); c. restore another section of creek (in-kind); and/or d. pay a mitigation fee for restoration elsewhere (e.g. wetland mitigation banking program). [p. 114] [Natural Resources Policy 9.D.10] The County shall encourage the protection of flood plain lands and where appropriate, acquire public easements for purposes of flood protection, public safety, wildlife preservation, groundwater recharge, access and recreation. [p. 116]	environ [p. 66]

Protect wetland communities and related riparian areas as valuable resources.	[Natural Resources Policy 6.B.1] The County shall support the "no net loss" policy for wetland areas regulated by the U.S. Army Corps of Engineers, the U.S. Fish and Wildlife Service, and the California Department of Fish and Game. Coordination with these agencies at all levels of project review shall continue to ensure that appropriate mitigation measures and the concerns of these agencies are adequately addressed. [p. 108] [Natural Resources Policy 6.B.2] The County shall require new development to mitigate wetland loss in both regulated and non-regulated wetlands to achieve "no net loss" through any combination of the following, in descending order of desirability: 2.) avoidance; 3.) where avoidance is not possible, minimization of impacts on the resource; or 4.) compensation, including use of a mitigation banking program that provides the opportunity to mitigate impacts to rare, threatened, and endangered species and/or the habitat which supports these species in wetland and riparian areas. [p. 108]	[Water Policy 11.2] Encourage the protection of resources which produce water for domestic and agricultural consumption. [p. 141] [Water Objective 11.3] Preserve and, where economically feasible, restore the density and diversity of water-dependent species and continuous riparian habitats based on sound ecological principles. [p. 143] [Water Policy 11.7] Through the development and application of Comprehensive Site Development Standards, and project environmental review, establish and enforce minimum building setback lines from perennial streams and significant wetlands that are adequate to protect stream and wetland resource values. [p. 143] [Water Policy 11.8] Utilize voluntary clustering of development to preserve stream corridors, riparian habitat, wetlands, and floodplains. [p. 143] [Wildlife and Vegetation Policy 13.2B] Development projects which have the potential to remove natural riparian or wetland habitat of 1 acre or more shall not be		[GP Vegetation Policy 4] Riparian plant communities shall be managed for the beneficial uses of passive recreation, groundwater recharge, nutrient catchment, and wildlife habitats. Such communities shall be restored or expanded, where possible. [p. 67]	[Land Use Policy 1.G.1] The County shall support the preservation and enhancement of natural landforms, native vegetation, and natural resources as open space. The County shall permanently protect, as open space, areas of natural resource value, including open meadows, mixed conifer forest, high montane meadows, riparian corridors, and floodplains. [p. 19] [Natural Resources Policy 9.D.4] The County shall require public and private development to address creeks and riparian corridors as follows: a.) Preserve creek corridors and creek setback areas through easements or dedications. Parcel lines… or easements… shall be located to optimize resource protection…. b.) Designate such easement or dedication areas… as open space. c.) Protect creek corridors and their habitat value by actions such as: 1.) providing an adequate creek setback, 2.) maintaining creek corridors in an	

	[Natural Resources Policy 6.B.3] The County shall discourage direct runoff of pollutants and siltation into wetland areas from outfalls serving nearby urban development. Development shall be designed in such a manner that pollutants and siltation will not significantly adversely affect the value or function of wetlands. [p. 108] [Natural Resources Policy 6.B.4] The County shall strive to identify and conserve remaining upland habitat areas adjacent to wetlands and riparian areas that are critical to the survival and nesting of wetland and riparian species. [p. 109] [Natural Resources Policy 6.B.5] The County shall require development that may affect a wetland to employ avoidance, minimization, and/or compensatory mitigation techniques. In evaluating the level of compensation to be required with respect to any given project, (a) on-site mitigation shall be preferred to off-site, and in-kind mitigation shall be preferred to out-of-kind; (b) functional replacement ratios may vary to the extent necessary to incorporate a	permitted unless: a.) no suitable alternative site or design exists for the land use; b.) there is no degradation of the habitat or reduction in the numbers of any rare, threatened, or endangered plant or animal species as a result of the project; c.) habitat of superior quantity and superior or comparable quality will be created or restored to compensate for the loss; and c.) the project conforms with regulations and guidelines of the USFWS, USACOE, DFG, and other relevant agencies. [p. 153] [Wildlife and Vegetation Policy 13.4A] No net loss of habitat functions or values shall be caused by development where rare and endangered species and wetlands of over 1 acre, in aggregate, are identified…. No net loss shall be achieved through avoidance of the resource, or through creation or restoration of habitat of superior or comparable quality, in accordance with guidelines of the USFWS and DFG. [p. 154] [Wildlife and Vegetation Policy 13.4D] The County shall prepare and implement a Habitat management Plan for rare and endangered species and wetlands habitat while			essentially natural state, 3.) employing creek restoration techniques where restoration is needed to achieve a natural creek corridor, 4.) utilizing riparian vegetation within creek corridors, and where possible, within creek setback areas, 5.) prohibiting the planting of invasive, non-native plants within creek corridors or creek setbacks, and 6.) avoiding tree removal within creek corridors. d.) Provide recreation and public access near creeks consistent with other General Plan policies. e.) Use design, construction, and maintenance techniques that ensure development near a creek will not cause or worsen natural hazards (such as erosion, sedimentation, flooding, or water pollution) and will include erosion and sediment control practices such as: 1.) turbidity screens and other managements	

	margin of safety reflecting the expected degree of success associated with the mitigation plan; and (c) acreage replacement ratios may vary depending on the relative functions and values of those wetlands being lost and those being supplied, including compensation for temporal losses. The County shall continue to implement and refine criteria for determining when an alteration to a wetland is considered a less-than-significant impact under CEQA. [p. 109] [Natural Resources Implementation Program 6.5] The County shall work toward the public acquisition of creek corridors, wetlands, and significant ecological resource areas as public open space where such areas cannot be effectively preserved through the regulatory process. Public protection may take the form of fee acquisition or protective easements and may be carried out in cooperation with other local, state, and federal agencies and private entities. Acquisition should include provisions for maintenance and management in perpetuity. [p. 109] [Natural Resources Implementation Program 6.6]	allowing the preparation of individual project habitat management plans as an alternative, including an offsite ecological reserve. [p. 155]			practices, which shall be used as necessary to minimize siltation, sedimentation, and erosion, and shall be left in place until disturbed areas are stabilized with permanent vegetation that will prevent the transport of sediment off site; and/or 2.) temporary vegetation is established sufficient to stabilize disturbed areas. f.) Provide for long-term creek corridor maintenance. [p. 115] [Natural Resources Policy 9.F.1] The County shall encourage the preservation and enhancement of natural open space within the riparian areas of the watercourses and drainageways found in the Martis Valley as one means of minimizing the adverse effects of land development upon the chemical and physical quality of waters therein. [p. 117] [Natural Resources Policy 9.F.2] The County shall require that natural open space buffers be maintained in non-riparian areas adjacent to drainage swales	

	The County shall consider establishing a resource conservation zone (RCZ) overlay district for application to creek corridors, wetlands, and areas rich in wildlife or of a fragile ecological nature. The program would assist in preserving the natural and social values of significant resources and preserve areas with special environmental significance and high sensitivity to development. [p. 109] [Natural Resources Implementation Program 6.7] The County will establish a wetland mitigation banking program, including an initial pilot project site for evaluation of the program. The program will provide opportunities for off-site mitigation of wetland impacts through the purchase of mitigation "credits" at established mitigation bank sites. [p. 109] [Natural Resources Policy 6.D.3] The County shall support the preservation of outstanding areas of natural vegetation, including, but not limited to, oak woodlands, riparian areas, and vernal pools. [p. 114] [Natural Resources Policy 6.D.7] The County shall				and creeks to reduce erosion and to aid in the natural filtration of runoff waters flowing into these waterways…. [p. 118] [Natural Resources Policy 9.F.3] The County shall support the "no net loss" policy for wetland areas regulated by the U.S. Army Corps of Engineers, the U.S. Fish and Wildlife Service, and the California Department of Fish and Game. Coordination with these agencies at all levels of project review shall continue to ensure that appropriate mitigation measures and the concerns of these agencies are adequately addressed. [p. 118] [Natural Resources Policy 9.F.4] The County shall require new development to mitigate wetland loss and riparian loss in both federal jurisdictional and non-jurisdictional wetlands to achieve "no net loss" through any combination of the following, in descending order of desirability: 1.) avoidance; 2.) where avoidance is not possible, minimization of impacts on the resource; or 3.) compensation,	

	support the management of wetland and riparian plant communities for passive recreation, groundwater recharge, nutrient catchment, and wildlife habitats. Such communities shall be restored or expanded, where possible. [p. 114] [Natural Resources Policy 6.D.14] The County shall require that new development avoid, as much as possible, ecologically-fragile areas (e.g. areas of rare or endangered species of plants, riparian areas). Where feasible, these areas should be protected through public acquisition of fee title or conservation easements to ensure protection. [p. 115]				including use of a mitigation and conservation banking program that provides the opportunity to mitigate impacts to special status, threatened, and endangered species and/or the habitat which supports these species in wetland and riparian areas. Non-jurisdictional wetlands may include riparian areas that are not federal "waters of the United States" as defined by the Clean Water Act. [p. 118] [Natural Resources Policy 9.F.5] The County shall discourage direct runoff of pollutants and siltation into wetland areas from outfalls serving nearby urban development. Development shall be designed in such a manner that pollutants and siltation will not significantly adversely affect the value or function of wetlands. [p. 118] [Natural Resources Policy 9.F.6] The County shall identify and conserve remaining upland habitat	

					areas adjacent to wetlands and riparian areas that are critical to the survival and reproduction of wetland and riparian species. [p. 118]	
CHANNEL MODIFICATION/ GEOMORPHOLOGY						
Minimize channel modification.	[Public Facilities and Services Policy 4.F.12] The County shall promote the use of natural or non-structural flood control facilities, including off-stream flood control basins, to preserve and enhance creek corridors. [p. 89] [Natural Resources Policy 6.C.9] The County shall require new private or public development to preserve and enhance existing native riparian habitat unless public safety concerns require removal of habitat for flood control or other public purposes. In cases where new private or public development results in modification or destruction of riparian habitat for purposes of flood control, the developers shall be responsible for acquiring, restoring, and enhancing at least an equivalent amount of like habitat within or near the project area. [p. 111] [Health and Safety Policy 8.B.8] The County shall require that flood management	[Water Objective 11.4] Preserve the integrity and minimize the disruption of watersheds and identified critical water courses. [p. 143]		[GP Hydrology, SEZ and Water Quality Policy 4] Any crossings of a natural stream bed by road, trail or other transportation facility shall be accomplished so that the natural stream characteristics are not impaired. [p. 66]	[Public Facilities and Services Policy 6.F.11] The County shall promote the use of natural or non-structural flood control facilities, including off-stream flood control basins, to preserve and enhance creek corridors. [p. 81]	[Drainage/Water C Section 115.18] environment zone, defined as the 100 plain of any year-r watercourse, shall affected by develo activities except as by section 115.20 below. [p. 65] [Drainage/Water C Section 115.22] A crossings of a natu bed by road, trail o transportation facil accomplished so t natural stream cha are not impaired. [

	programs avoid alteration of waterways and adjacent areas, whenever possible. [p. 129]					
WATERSHED CONDITION						
Require new development to be designed to minimize and/or adequately mitigate environmental and aesthetic impacts.		[Public Facilities and Services Objective 3.4] Develop and operate public facilities and services in an environmentally sound way. [p. 69] [Recreation Policy 5.20] Encourage proper operation and environmental standards for private facilities on lakes, impoundments, and rivers. [p. 93] [Wildlife and Vegetation Policy 13.7] Require a conditional Use Permit for alteration of significant environmental features (as defined in Policy 1.18) not associated with a development project…. Exempted from this requirement are actions necessary for evaluation of environmental characteristics, and for control of fire fuels. [p. 156] [Mineral Management Objective 17.1] … Promote the proper management of all mineral resource activities in the County and minimize the impact of extraction and processing on neighboring activities and the environment in general. [p. 179]	[Conservation and Open Space Policy 1.1] Monitor the sensitive wildlife and habitat resources of Truckee to ensure the continued effectiveness of General Plan policies intended to protect, preserve and enhance these resources. [p. 77]	[GP Vegetation Policy 2] Revegetation of disturbed sites, as well as landscaping associated with new development, shall require the use of species approved by the County and TRPA. Species selection shall be made so as to de-emphasize long-term irrigation and fertilizer use. [p. 67] [GP Vegetation Policy 3] All proposed actions shall consider the cumulative impact of vegetation removal with respect to plant diversity and abundance, wildlife habitat and movement, soil productivity and stability, and water quality and quantity. [p. 67] [GP Vegetation Policy 6] Forest management practices shall be allowed when consistent with acceptable strategies for the maintenance of forest health and diversity, prevention of fire, protection of water quality, and enhancement of wildlife habitats. [p. 67]	[Land Use Policy 1.J.2] The County shall assure that removal of economic mineral resources does not conflict with surrounding land uses or the stated desire for maintaining the natural environment. [p. 21] [Land Use Policy 1.J.3] The County shall assure the removal of biomass and other commercial forest products is done as a comprehensive resource management activity and does not conflict with surrounding land uses or the stated desire for maintaining the natural environment. [p. 21]	

		[Mineral Management Policy 17.3] All [mining] exploratory operations shall require a reclamation plan unless: a.) less than 1,000 cubic yards of overburden are disturbed, and b.) the size of the operation in any one location is one acre or less. In those instances where a reclamation plan is not required, an erosion control plan… and a grading permit shall be required for those operations in which 50 cubic yards of more of overburden are disturbed. [p. 180] [Mineral Management Policy 17.8] A reclamation plan… is required for all mining operations. Reclamation shall: 1.) Prevent, mitigate, or minimize adverse effects on the environment…. 3.) Provide for the protection and subsequent beneficial use of mined and reclaimed land…. 6.) Avoid the environmental and legal problems created by improperly abandoned mines. [p. 181]				
Protect and enhance the natural qualities/resources of rivers, streams, creeks and groundwater.	[Land Use Policy 1.N.3] The County shall endeavor to protect the natural resources upon which the county's basic economy (e.g. recreation, forestry, agriculture, mining, and tourism) is dependent. [p. 44]	[Land Use Objective 1.3] Provide for a land use pattern compatible with preservation of … environmental values and constraints…. [p. 28] [Water Policy 11.9] Within Rural Regions, maintain the low densities of development	[Donner Lake Community Area Policy 2] Cooperate with the Truckee-Donner Recreation and Park District, the State Department of Parks and Recreation, and the residents at Donner Lake in planning for Donner Lake to minimize conflicts between residential		[Land Use Policy 1.G.6] The County shall require that new development be designed and constructed to protect, enhance, rehabilitate, and restore the following types of areas and features as open space to the maximum extent feasible:	

		allowed in the Rural and Forest General Plan Land Use Designations, in order to protect existing watersheds. [p. 143]	and recreational uses and to protect the natural resource values of the lake. [p. 63] [PC-1 Policy 2] The Specific Plan shall provide adequate setbacks from Cold Creek and other riparian/wetland areas. [p. 63]		a.) high erosion hazard areas; b.) scenic and trail corridors; c.) streams, streamside vegetation; d.) wetlands; e.) wildlife corridors. [p. 20] [Policy 1.K.3] The County shall endeavor to protect the natural resources upon which the Martis Valley's basic economy (e.g. recreation, forestry, and tourism) is dependent. [p. 22]	
Protect, restore, and enhance habitats that support fish and wildlife species.	[Natural Resources Policy 6.C.1] The County shall identify and protect significant ecological resource areas and other unique wildlife habitats critical to protecting and sustaining wildlife populations. Significant ecological resource areas include: wetland areas including vernal pools; stream environment zones; any habitat for rare, threatened or endangered animals or plants; critical deer winter ranges; migratory routes and fawning habitat; large areas of non-fragmented natural habitat; identifiable wildlife movement zones; important spawning areas for anadromous fish. [p. 110] [Natural Resources Policy 6.C.3] The County shall encourage the control of residual pesticides to prevent	[Water Objective 11.5] Support the acquisition, development, maintenance and restoration, where clearly consistent with General Plan policies, of habitat lands for wildlife enhancement. [p. 144] [Water Policy 11.10] Cooperate with State and Federal agencies and public and quasi-public organizations and agencies in the acquisition, restoration, and maintenance of habitat lands. [p. 144] [Water Policy 11.11] Cooperate with and encourage the USFS and BLM to restore/maintain habitat areas on existing owned lands. [p. 144] [Wildlife and Vegetation Goal 13.1] Identify and manage significant areas to achieve	[Land Use Policy 7.1] Residential development shall be clustered to avoid areas of significant natural resources, including wildlife habitat and migration corridors and visual resources. [p. 59] [PC-2 Policy 1] Preserve existing natural features and wildlife habitat. [p. 64] [PC-2 Policy 2] Preserve open space corridors connecting to adjacent open space lands to protect wildlife habitat. [p. 64] [Conservation and Open Space Policy 1.3] Provide for the integrity and continuity of wildlife habitat, and support the permanent protection and restoration of sensitive wildlife habitat and wildlife movement corridors through a variety of tools, including preservation in	[GP Wildlife and Fisheries Goal 1] Maintain suitable habitats for all indigenous species of wildlife without preference to game or non-game species through maintenance and habitat diversity. [p. 68] [GP Wildlife and Fisheries Goal 2] Preserve, enhance, and, where feasible, expand habitats essential for threatened, endangered, rare, or sensitive species found in the basin. [p. 68] [GP Wildlife and Fisheries Goal 3] Improve aquatic habitat essential for the growth, reproduction, and perpetuation of existing and threatened fish resources in the Lake Tahoe Basin. [p. 68] [GP Wildlife and Fisheries	[Land Use Policy 1.E.4] The County shall protect and enhance, through its land use policies and programs, Martis Lake's wild-trout sport-fishery. [p. 19] [Land Use Policy 1.G.4] The County shall support the maintenance of open space and natural areas that are interconnected and of sufficient size to protect biodiversity, accommodate wildlife movement, and sustain ecosystems. The County shall permanently protect Martis Lake's high-quality trout sport-fishery. [p. 20] [Natural Resources Policy 9.G.1] The County shall identify and protect significant ecological resource areas and other	

	potential damage to water quality, vegetation, and wildlife. [p. 110] [Natural Resources Policy 6.C.4] The county shall encourage private landowners to adopt sound wildlife habitat management practices, as recommended by CDFG officials, USFWS, and the Placer County RCD. [p. 110] [Natural Resources Policy 6.C.6] The County shall support preservation of the habitats of rare, threatened, endangered, and/or other special status species. Federal and state agencies, as well as other resource conservation organizations, shall be encouraged to acquire and manage endangered species' habitats. [p. 110] [Natural Resources Policy 6.C.8] The County shall support the preservation or reestablishment of fisheries in the rivers and streams within the county, whenever possible. [p. 110] [Natural Resources Policy 6.C.12] The County shall cooperate with, encourage, and support the plans of other public agencies to acquire fee title or conservation easements to privately-owned lands in order	sustainable habitat. [p. 152] [Wildlife and Vegetation Policy 13.4H] Non-development buffers shall be maintained adjacent to perennial stream corridors through the use of clustering, the designation of a Planned Development, or the implementation of other siting and design tools. Buffers shall be sufficient in size to protect the stream corridor for movement, as well as provide some adjacent upland habitat for foraging. [p. 155] [Wildlife and Vegetation Objective 13.3] Provide for the integrity and continuity of wildlife environments. [p. 155] [Wildlife and Vegetation Objective 13.4] Support the acquisition, development, maintenance and restoration, where feasible, of habitat lands for wildlife enhancement. [p. 155] [Wildlife and Vegetation Objective 13.5] Support, where feasible, the continued diversity and sustainability of the habitat resource through restoration and protection. [p. 156] [Wildlife and Vegetation Objective 13.6] Discourage	open space and the use of planning fee waivers for projects that provide for permanent protection of such areas. "Sensitive wildlife habitat" includes the following: ▪ meadows, wetlands, and riparian corridors ▪ deer migration/wildlife movement corridors ▪ deer fawning areas ▪ habitat for State and Federally listed plant and animal species ▪ large blocks of undeveloped forest. [p. 77] [Conservation and Open Space Policy 1.4] Protect sensitive wildlife habitat from destruction and intrusion by incompatible land uses. Impacts to sensitive habitat shall be identified through the development review process and shall be mitigated through mandatory clustering, project redesign to eliminate impacts, use of non-disturbance easements or open space zoning, and other appropriate protection measures. Offsite habitat restoration may be considered as a mitigation option to the extent that no net loss of habitat values results. Evaluation of wildlife impacts must take into account habitat and movement corridors in the	Policy 1] All proposed activities shall consider impacts on wildlife and fisheries. [p. 68] [GP Wildlife and Fisheries Policy 2] Endangered, threatened, rare, and special interest species shall be protected and buffered against conflicting land uses. [p. 68]	unique wildlife habitats critical to protecting and sustaining wildlife populations. Significant ecological resource areas include the following: wetland areas; stream corridors and associated riparian areas; identified habitat of special status threatened or endangered species; critical deer winter ranges, migratory routes and fawning habitat; large areas of non-fragmented natural habitat, including all types in the Martis Valley Plan area; identifiable wildlife movement zones, including but not limited to non-fragmented stream environment zones, avian and mammalian migratory routes, and known concentration areas of waterfowl within the Pacific Flyway. [p. 119] [Natural Resources Policy 9.G.4] The County shall support preservation of the habitats of rare, threatened, endangered, and/or other special status species. Federal and state agencies, as well as other resource conservation organizations, shall be encouraged to acquire and manage endangered species' habitats. [p. 119]	

	to preserve important wildlife corridors and to provide habitat protection of California Species of Concern and state or federally listed rare, threatened, or endangered plant and animal species. [p. 111] [Natural Resources Policy 6.C.13] The County shall support and cooperate with efforts of other local, state, and federal agencies and private entities engaged in the preservation and protection of significant biological resources from incompatible land uses and development. Significant biological resources include endangered, threatened, or rare species and their habitats, wetland habitats, wildlife migration corridors, and locally-important species/communities. [p. 111]	significant adverse environmental impacts of land development, agricultural, forest and mining activities on important and sensitive habitats. [p. 156]	areas surrounding the project site in order to comprehensively address project impacts. [p. 78] [Conservation and Open Space Policy 8.3] Continually request that local, state, and federal entities that manage local reservoirs and their releases consider recreational and wildlife benefits of local lakes and streams. [p. 81]		[Natural Resources Policy 9.G.6] The County shall support the preservation and/or reestablishment of fisheries in the rivers and streams within Martis Valley. This shall include the protection of Martis Lake as a high quality wild-trout sport-fishery and the protection of the lake's tributary streams as wild-trout habitat. [p. 119] [Natural Resources Policy 9.G.8] The County shall cooperate with, encourage, and support the plans of private entities and other public agencies to acquire fee title or conservation easements to privately-owned lands in order to preserve important wildlife corridors and to provide habitat protection of California Species of Concern and state or federally listed rare, threatened, or endangered plant and animal species. [p. 120] [Natural Resources Policy 9.G.9] The County shall support and cooperate with efforts of other local, state, and federal agencies and private entities engaged in the preservation and protection of significant biological resources from	

					incompatible land uses and development. Significant biological resources include endangered, threatened, or rare species and their habitats, species and their habitats that have recreational value, wetland lacustrine and riverine habitats, wildlife migration corridors, and locally-important species/ communities such as wild trout. [p. 120]	

Prepared by Kerri Timmer, *Sierra Connections*
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Appendix D: Beneficial Uses and Definitions

Beneficial Use Chart and Definitions (Lahontan Regional Water Quality Control Board)

Stream Name*	MUN	AGR	PRO	IND	GWR	FRSH	NAV	POW	REC1	REC2	COMM	AQUA	WARM	COLD	SAL	WILD	BIOL	RARE	MIGR	SPWN	WQE	FLD
SURFACE WATERS																						
Little Truckee River	x	x			x	x		x	x	x	x			x		x		x	x	x		
Webber Lake	x	x			x		x		x	x	x			x		x		x		x		
Cold Stream Creek	x	x			x				x	x	x			x		x		x	x	x		
Independence Lake	x	x			x		x		x	x	x			x		x		x		x		
Indpendence Creek	x	x			x				x	x	x			x		x		x		x		
Stampede Reservoir	x	x			x		x		x	x	x			x		x		x		x		
Sagehen Creek wetlands	x	x			x				x	x	x			x		x	x	x		x	x	x
Sagehen Creek	x	x			x				x	x	x			x		x	x	x		x		
Davies Creek	x	x			x				x	x	x			x		x		x		x		
Boca Reservoir	x	x			x		x		x	x	x			x		x		x		x		
Sardine Meadows wetlands	x	x			x				x	x	x			x		x				x	x	x
Minor surface waters (HU 636)	x	x			x	x			x	x	x			x		x		x				
Minor wetlands (HU 636)	x	x			x	x			x	x	x			x		x	x	x	x	x	x	x
Dog Valley wetlands	x	x			x				x	x	x			x		x		x	x	x	x	x
Dog Valley Creek	x	x			x				x	x	x			x		x		x		x		
Minor surface waters (HU 635.10)	x	x			x	x			x	x	x			x		x	x	x	x	x		
Minor wetlands (HU 635.10)	x	x			x	x			x	x	x			x		x	x	x	x	x	x	x

Truckee River	x	x		x	x	x		x	x	x	x			x		x		x	x	x		
Bear Creek	x	x		x	x				x	x	x			x		x		x	x	x		
Squaw Creek	x	x			x				x	x	x			x		x		x	x	x		
Squaw Valley meadow wetlands	x	x			x				x	x				x		x				x	x	x
Pole Creek	x	x			x				x	x	x			x		x		x	x	x		
Cold Stream Creek	x	x			x				x	x	x			x		x		x		x		
Donner Lake	x	x				x	x		x	x	x			x		x		x		x		
Donner Creek	x	x			x				x	x	x			x		x		x	x	x		
Prosser Creek	x	x			x				x	x	x			x		x		x	x	x		
Prosser Reservoir	x	x			x		x		x	x	x			x		x		x		x		
Martis Creek	x	x			x				x	x	x			x		x		x	x	x		
Martis Creek Reservoir	x	x			x		x		x	x	x			x		x		x		x		
Trout Creek	x	x			x				x	x	x			x		x		x		x		
Alder Creek	x	x			x				x	x	x			x		x		x	x	x		
Juniper Creek	x	x			x				x	x	x			x		x		x		x		
Gray Creek	x	x			x				x	x	x			x		x		x		x		
Bronco Creek	x	x			x				x	x	x			x		x		x		x		
Minor surface waters (HU 635.20)	x	x			x	x			x	x	x			x		x		x		x		
Minor wetlands (HU 635.20)	x	x			x	x			x	x	x			x		x	x	x	x	x	x	x
GROUND WATER																						
Martis Valley	x	x				x																

1. Municipal (MUN): waters used for community, military, or individual water supply systems including, but not limited to, drinking water supply.
2. Agricultural Supply (AGR): waters used for farming, horticulture, or ranching, including, but not limited to, irrigation, stock watering, and support of vegetation for range grazing.
3. Industrial Service Supply (IND): waters used for industrial activities that do not depend primarily on water quality including, but not limited to, mining, cooling water supply, geothermal energy production, hydraulic conveyance, gravel washing, fire protection, and oil well repressurization.
4. Ground Water Recharge (GWR): waters used for natural or artificial recharge of ground water for purposes of future extraction,

maintenance of water quality, or halting of saltwater intrusion into freshwater aquifers.

5. Freshwater Replenishment (FRSH): water used for natural or artificial maintenance of surface water quantity or quality (e.g., salinity).
6. Navigation (NAV): waters used for shipping, travel, or other transportation by private, military, or commercial vessels.
7. Power (POW): water used for hydroelectric power generation.
8. Water Contact Recreation (REC-1): water used for recreational activities involving body contact with water where ingestion of water is reasonably possible. These uses include, but are not limited to, swimming, wading, water-skiing, skin and scuba diving, surfing, white water activities, fishing, and use of natural hot springs.
9. Non-contact Water Recreation (REC-2): waters used for recreational activities involving proximity to water, but not normally involving body contact with water where ingestion of water is reasonably possible. These uses include, but are not limited to, picnicking, sunbathing, hiking, beachcombing, camping, boating, tidepool and marine life study, hunting, sightseeing, and aesthetic enjoyment in conjunction with the above activities.
10. Commercial and Sportfishing (COMM): waters used for commercial or recreational collection of fish or other organisms including, but not limited to, uses involving organisms intended for human consumption.
11. Cold Freshwater Habitat (COLD): waters that support cold water ecosystems including, but not limited to, preservation and enhancement of aquatic habitats, vegetation, fish, and wildlife, including invertebrates.
12. Wildlife Habitat (WILD): waters that support wildlife habitats including, but not limited to, the preservation and enhancement of vegetation and prey species used by wildlife, such as waterfowl.
13. Preservation of Biological Habitats of Special Significance (BIOL): waters that support designated areas or habitats, such as established refuges, parks, sanctuaries, ecological reserves, and Areas of Special Biological Significance (ASBS), where the preservation and enhancement of natural resources requires special protection.
14. Rare, Threatened, or Endangered Species (RARE): waters that support habitat necessary for the survival and successful maintenance of plant or animal species established under state and/or federal law as rare, threatened or endangered.
15. Migration of Aquatic Organisms (MIGR): waters that support habitats necessary for migration, acclimatization between fresh and salt water, or temporary activities by aquatic organisms, such as anadromous fish.

16. Spawning, Reproduction, and Development (SPWN): waters that support high quality aquatic habitat necessary for reproduction and early development of fish and wildlife.
17. Water Quality Enhancement (WQE): waters that support natural enhancement or improvement of water quality in or downstream of a water body including, but not limited to, erosion control, filtration and purification of naturally occurring water pollutants, streambank stabilization, maintenance of channel integrity, and siltation control.
18. Flood Peak Attenuation/Flood Water Storage (FLD): riparian wetlands in flood plain areas and other wetlands that receive natural surface drainage and buffer its passage to receiving waters.

[Basin Plan, Ch. 2, pp. 2-1 – 2-2]

Appendix E: Lahontan Regional Water Quality Control Board *10% Significance Level* Definition

[quoted verbatim from Chapter 3 of the Water Quality Control Plan for the Lahontan Region *(Basin Plan), dated October 1994, p. 3-15]*

References to "10 percent significance level":
A statistical hypothesis is a statement about a random variable's probability distribution, and a decision-making procedure about such a statement is a hypothesis test. In testing a hypothesis concerning the value of a population mean, the null hypothesis is often used. The null hypothesis is that there is no difference between the population means (e.g., the mean value of a water quality parameter after the discharge is no different than before the discharge). First a level of significance to be used in the test is specified, and then the regions of acceptance and rejection for evaluating the obtained sample mean are determined.

At the **10 percent significance level**, assuming normal distribution, the acceptance region (where one would correctly accept the null hypothesis) is the interval which lies under 90 percent of the area of the standard normal curve. Thus, a **level of significance of 10 percent** signifies that when the population mean is correct as specified, the sample mean will fall in the areas of rejection on 10 percent of the time.

If the hypothesis is rejected when it should be accepted, a Type 1 error has been made. In choosing a **10 percent level of significance**, there are 10 chances in 100 that a Type 1 error was made, or the hypothesis was rejected when it should have been accepted (i.e., one is 90 percent confident that the right decision was made.)

The **10 percent significance level** is often incorrectly referred to as the 90 percent significance level. As explained above, the significance level of a test should be low, and the confidence level of a confidence interval should be high.

Appendix F: Monitoring Plan Interviewees and Topics

Monitoring Plan Interviewees

Robert Burrows, USGS Carson City
Gayle Dana, DRI
David Herbst, Sierra Nevada Aquatic Research Laboratory
Michael Hogan, Integrated Environmental Services
James Kirchner, U.C. Berkeley
Michael Lico, USGS Carson City
David McGraw, DRI
Gerald Rockwell, USGS Carnelian Bay
Tim Rowe, USGS Carson City

Interviews

The process of developing the long-range monitoring plan includes interviewing organizations that are currently conducting monitoring on the Truckee River and individuals that have expertise in different sediment monitoring techniques. The plan developed by TRWC is meant as a proposal for an ideal monitoring regime; there is no funding currently in place to implement any monitoring.

Participation in plan development does not imply that any commitment to conduct additional monitoring has been made by interviewed parties.

The interview questions are organized into general topics. The purpose of the interviews is to discuss sediment monitoring and the development of appropriate monitoring plans as well as focusing very specifically on the Truckee River.

Interview Topics

Current Monitoring activities:

Note: these questions all assume sediment monitoring, or monitoring directly related to assessing sediment load.

- What monitoring is your agency conducting now? Location, constituents, methods, & detection limits.
- What monitoring have you done in the past that you are not doing currently?
- What is the period of record for your data?

- Are the data publicly available? If not, are the data available upon request to researchers
- or policy makers?
- What format are your data in?
- What would you add to the existing monitoring your group is doing if money (& time)
- were not a constraint?
- Of the data you are currently collecting, which do you think give the best indication of
- impairment by sediment to beneficial uses for the Truckee?236
- Which data are least valuable for assessing impairment of beneficial uses from excessive
- sediment?

Monitoring Plan Development:

- The EPA suggests that the following concerns be adequately addressed in a monitoring plan. Specific to the Truckee River sediment monitoring plan, how would you begin to answer these questions?
- What are the objectives? The specific elements, specific questions to address
- Linkage between sources and in-stream impacts, how well was this assessed?
- Can you effectively build upon existing monitoring efforts? How?
- The EPA guidance for developing sediment monitoring plans suggests the following types of monitoring approaches. Which of these do you think is most important? Least important? Specify the indicators within each category that you feel would be most useful for monitoring the effectiveness of implementation in the Truckee River. What would you add to this list?

  Channel condition and bed material assessments
  Aerial photography
  Suspended load, bedload, flow data to assess changes in sediment concentration and mass loads
  Biological indicators
  Riparian and streambank indicators
  Hillslope erosion features
  Drainage features
  Calibrated models

- Do you have any examples of monitoring plans for other regions that you would want to pull ideas from for the Truckee River monitoring plan? What are those plans? What is effective about them?

- What are examples of sediment monitoring plans NOT to follow? Why?

Monitoring Costs

- How much does your monitoring program cost now?
- What are the most expensive parameters that you are measuring? Least expensive?
- What do you feel are the most cost effective data that you are collecting?
- How much would it cost to add monitoring that you would like to see happen?

Truckee River Monitoring Plan Development:

- What baseline data do you feel are lacking or insufficient for the Middle Truckee?
- What is your understanding of the specific threat to the Truckee from sediment?
- Based upon your understanding, what would be the best monitoring method or monitoring study design?
- Given that we don't know what the implementation measures are going to be, what would be your suggestions for overall types of monitoring for assessing sediment reduction in the system?
- Supposing that implementation will most likely involve restoration projects in erosive tributaries, erosion control in conjunction with new development and along roads, what would you suggest for monitoring effectiveness of individual projects?
- Do you have any suggestions for implementation projects or areas that could use restoration?

Appendix G: Sediment Monitoring Past and Current

Adapted from McGraw, et al., 2001. Table 17, p. 92, with more recent information added

On-going Sampling Programs

Location	Sampled by	Constituent	Sample Frequency	Reported	Begin	End	Method
Truckee R. near Polaris	TTSA	alk, Cl- , DO, T & F coli, MBNAS, soluble TOC, TKN, turbidity, Fe, pH, OP, TP, TDS, temp	Monthly	Monthly			Grab
Truckee R. Below Martis Creek	TTSA	alk, Cl- , DO, T & F coli, MBNAS, soluble TOC, TKN, turbidity, Fe, pH, OP, TP, TDS, temp	Monthly	Monthly	1978	Present	Grab
Truckee R. at Farad, CA	Sierra Pacific	Turbidity	Hourly	Daily average	1996	Present	Point
Near Stateline	TTSA	alk, Cl- , DO, T & F coli, MBNAS, soluble TOC, TKN, turbidity, Fe, pH, OP, TP, TDS, temp	Monthly	Monthly	1978	Present	Grab
Truckee R. at Farad, CA	DRI	TU	Monthly	Monthly	1/4/79	Present	Grab
Truckee R. at Farad, CA	DRI	TSS	Monthly	Monthly	1/9/80	Present	Grab
Truckee R. above Donner Creek	DRI	TU, TSS	Monthly	Monthly	10/2/91	Present	Grab
Truckee R. @ Verdi, NV	Sierra Pacific	Turbidity	Hourly	Daily average	1/1/96	Present	Point
Truckee R. @ Tahoe City	Cal DWR	Turbidity	Hourly	Hourly	2/18/00	Present	Point
Truckee R. @ Bridge 8	Cal DWR	Turbidity	Hourly	Hourly	3/22/00	Present	
Truckee R. at Farad, CA	Cal DWR	Turbidity	Hourly	Hourly	3/24/00	Present	Point
Truckee River near Truckee	CalDWR	Turbidity	Hourly	Hourly	6/02	Present	Point

Truckee River at Farad	CalDWR	Turbidity	Hourly	Hourly	7/02	Present	Point
Past sampling programs (more than one sample)							
Location	**Sampled by**	**Constituent**	**Sample Frequency**	**Reported**	**Begin**	**End**	**Method**
Gray Creek	DRI	TPO4, OPO4, NO2, NH4, TDS, TSS, TKN, color, TU, pH, EC, HCO3, CO3, Cl, SO4, Na, K, Ca, Mg, Si, NO3	Approx. annually	Approx. annually	5/17/68	7/24/75	Grab
Martis Creek Lake near Truckee	USGS	Sediment			8/16/73	8/12/85	
Location	**Sampled by**	**Constituent**	**Sample Frequency**	**Reported**	**Begin**	**End**	**Method**
Martis Creek Lake near Truckee	USGS	Sediment			8/16/73	8/14/95	
Martis Creek near Truckee	USGS	Sediment			8/16/73	8/14/95	
Sagehen Creek	USGS	Sediment			5/20/68	8/6/96	
Truckee R. @Tahoe City	LRWQCB	Tu, TSS			1/1/96	12/31/96	
Bear Creek	LRWQCB	Tu, TSS			1/1/96	12/31/96	
Squaw Creek	LRWQCB	Tu, TSS			1/1/96	12/31/96	
Truckee R. above Donner Creek	LRWQCB	Tu, TSS			1/1/96	12/31/96	
Donner Creek	LRWQCB	Tu, TSS			1/1/96	12/31/96	
Truckee R. below Donner Creek near Truckee	LRWQCB	Tu, TSS			1/1/96	12/31/96	
Trout Creek	LRWQCB	Tu, TSS			1/1/96	12/31/96	
Truckee R. below Prosser Creek, near Truckee	LRWQCB	Tu, TSS			1/1/96	12/31/96	
Prosser Creek at mouth near Truckee	LRWQCB	Tu, TSS			1/1/96	12/31/96	
Little Truckee River below Boca Dam	LRWQCB	Tu, TSS			1/1/96	12/31/96	
Truckee R. @ Farad, CA	LRWQCB	Tu, TSS			1/1/96	12/31/96	
Martis Creek at Mouth @ Truckee River near Truckee	LRWQCB	Tu, TSS			1/1/96	12/31/96	
Truckee R. above Donner Creek	DRI	TU, SSC			04/01/00	10/01/00	Integrated
Truckee R. above Martis Creek	DRI	TU, SSC			04/01/00	10/01/00	Integrated
Truckee R. Below Martis Creek	DRI	TU, SSC			04/01/00	10/01/00	Integrated
Truckee R. @ Tahoe City	DRI	TU, SSC			04/01/00	10/01/00	Integrated
Truckee R. above Juniper Creek	DRI	TU, SSC			04/01/00	10/01/00	Integrated
Truckee R. at Farad, CA	DRI	TU, SSC			04/01/00	10/01/00	Integrated
Bear Creek	DRI	SSC, Tu			04/01/00	10/01/00	Integrated
Squaw Creek	DRI	SSC, Tu			04/01/00	10/01/00	Integrated
North Fork Squaw Creek	DRI	SSC, Tu			04/01/00	10/01/00	Integrated
Donner Creek	DRI	SSC, Tu			04/01/00	10/01/00	Integrated
Trout Creek	DRI	SSC, Tu			04/01/00	10/01/00	Integrated
Martis Creek	DRI	SSC, Tu			04/01/00	10/01/00	Integrated

Below Prosser Creek Dam	DRI	SSC, Tu			04/01/00	10/01/00	Integrated
Below Boca Dam	DRI	SSC, Tu			04/01/00	10/01/00	Integrated
Juniper Creek	DRI	SSC, Tu			04/01/00	10/01/00	Integrated
Gray Creek	DRI	SSC, Tu			04/01/00	10/01/00	Integrated
Bronco Creek	DRI	SSC, Tu			04/01/00	10/01/00	Integrated
One-time sampling events							
LOCATION	**Sampled by**	**Constituent**	**Sample Frequency**	**Reported**	**Begin**	**End**	**Method**
Upper Little Truckee River @ Stampede	Snapshot Day	Turbidity			5/2/02	5/2/02	
Davies-Merrill Creek near CG	Snapshot Day	Turbidity			5/2/02	5/2/02	
Location	**Sampled by**	**Constituent**	**Sample Frequency**	**Reported**	**Begin**	**End**	**Method**
Worn Mill Creek	Snapshot Day	Turbidity			5/2/02	5/2/02	
Truckee River near Floriston	Snapshot Day	Turbidity			5/2/02	5/2/02	
Bronco Creek near mouth	Snapshot Day	Turbidity			5/2/02	5/2/02	
Independence Creek at road crossing	Snapshot Day	Turbidity			5/2/02	5/2/02	
Prosser Creek near Hwy 89	Snapshot Day	Turbidity			5/2/02	5/2/02	
Alder Creek	Snapshot Day	Turbidity			5/2/02	5/2/02	
Trout Creek near Truckee River	Snapshot Day	Turbidity			5/2/02	5/2/02	
Trout Creek – Upper	Snapshot Day	Turbidity			5/2/02	5/2/02	
Truckee River at Truckee	Snapshot Day	Turbidity			5/2/02	5/2/02	
Donner Creek at Hwy 89	Snapshot Day	Turbidity			5/2/02	5/2/02	
Cold Creek	Snapshot Day	Turbidity			5/2/02	5/2/02	
Cabin Creek	Snapshot Day	Turbidity			5/2/02	5/2/02	
Truckee River below Big Chief	Snapshot Day	Turbidity			5/2/02	5/2/02	
Martis Creek	Snapshot Day	Turbidity			5/2/02	5/2/02	
Pole Creek	Snapshot Day	Turbidity			5/2/02	5/2/02	
Silver Creek	Snapshot Day	Turbidity			5/2/02	5/2/02	
Squaw Creek	Snapshot Day	Turbidity			5/2/02	5/2/02	
Bear Creek	Snapshot Day	Turbidity			5/2/02	5/2/02	
Truckee River near Tahoe City	Snapshot Day	Turbidity			5/2/02	5/2/02	
Bear Creek near Alpine Meadows Road	Snapshot Day	Turbidity			5/10/03	5/10/03	
Truckee River near Tahoe City	Snapshot Day	Turbidity			5/10/03	5/10/03	
Deep Creek near mouth	Snapshot Day	Turbidity			5/10/03	5/10/03	
Squaw Creek near mouth	Snapshot Day	Turbidity			5/10/03	5/10/03	
Pole Creek near mouth	Snapshot Day	Turbidity			5/10/03	5/10/03	
Silver Creek near mouth	Snapshot Day	Turbidity			5/10/03	5/10/03	
Trout Creek near mouth	Snapshot Day	Turbidity			5/10/03	5/10/03	
Martis Creek	Snapshot Day	Turbidity			5/10/03	5/10/03	
Tributary north of Cabin Creek	Snapshot Day	Turbidity			5/10/03	5/10/03	

Truckee River near Goose Meadows	Snapshot Day	Turbidity			5/10/03	5/10/03	
Donner Creek near Hwy 89	Snapshot Day	Turbidity			5/10/03	5/10/03	
Cold Creek near Deerfield Drive	Snapshot Day	Turbidity			5/10/03	5/10/03	
Gray Creek near mouth	Snapshot Day	Turbidity			5/10/03	5/10/03	
Trout Creek at Jibboom St.	Snapshot Day	Turbidity			5/10/03	5/10/03	
Truckee River near Union Creek	Snapshot Day	Turbidity			5/10/03	5/10/03	
Prosser Creek downstream of Hwy 89	Snapshot Day	Turbidity			5/10/03	5/10/03	
Alder Creek @ Emigrant Trail off Alder Creek Dr.	Snapshot Day	Turbidity			5/10/03	5/10/03	
Truckee River @ Truckee Regional Park	Snapshot Day	Turbidity			5/10/03	5/10/03	
Independence Creek @ road crossing	Snapshot Day	Turbidity			5/10/03	5/10/03	
Truckee River at Floriston	Snapshot Day	Turbidity			5/10/03	5/10/03	
Location	**Sampled by**	**Constituent**	**Sample Frequency**	**Reported**	**Begin**	**End**	**Method**
Little Truckee River at Boyington Mill	Snapshot Day	Turbidity			5/10/03	5/10/03	
Little Truckee River below Boca Dam	Snapshot Day	Turbidity			5/10/03	5/10/03	
Davies Merrill Creek at Road Crossing	Snapshot Day	Turbidity			5/10/03	5/10/03	
Worn Mill Creek	Snapshot Day	Turbidity			5/10/03	5/10/03	
Sagehen Creek below Hwy 89	Snapshot Day	Turbidity			5/10/03	5/10/03	

Table 3. Truckee River basin watershed monitoring sites, physical parameters (Adapted from McGraw, et al., 2001. Table 19, p. 100, with more recent information added). Physical parameters include: temperature, specific conductance, electroconductivity, dissolved oxygen, and pH.

On-going Sampling Programs							
Location	**Sampled by**	**Constituent**	**Sample Frequency**	**Reported**	**Begin**	**End**	**Method**
Truckee R. near Polaris	TTSA	alk, Cl- , DO, T & F coli, MBNAS, soluble TOC, TKN, turbidity, Fe, pH, OP, TP, TDS, temp	Monthly	Monthly		Present	Grab
Truckee R. below Martis Creek	TTSA	alk, Cl- , DO, T & F coli, MBNAS, soluble TOC, TKN, turbidity, Fe, pH, OP, TP, TDS, temp	Monthly	Monthly	1978	Present	Grab
Truckee R. near Stateline	TTSA	alk, Cl- , DO, T & F coli, MBNAS, soluble TOC, TKN, turbidity, Fe, pH, OP, TP, TDS, temp	Monthly	Monthly	1978	Present	Grab
Truckee R. @ Farad, CA	DRI	TPO4, OPO4, NO2, NH4, TDS, TSS, TKN, color, TU, pH, EC, HCO3, CO3, Cl, SO4, Na, K, Ca, Mg, Si, NO3	Monthly	Monthly	8/11/66	Present	Grab
Truckee R. above Donner Creek	DRI	TPO4, OPO4, NO2, NH4, TDS, TSS, TKN, color, TU, pH, EC, HCO3, CO3, Cl, SO4, Na, K,Ca, Mg, Si, NO3	Monthly	Monthly	10/4/89	Present	Grab
Truckee R. below Martis Creek	DRI	TPO4, OPO4, NO2, NH4, TDS, TSS, TKN, color, TU, pH, EC, HCO3, CO3, Cl, SO4, Na, K, Ca, Mg, Si, NO3	Monthly	Monthly	10/2/91	Present	Grab
Truckee R. above Martis Creek	DRI	TPO4, OPO4, NO2, NH4, TDS, TSS, TKN, color, TU, pH, EC, HCO3, CO3, Cl, SO4, Na, K, Ca, Mg, Si, NO3	Monthly	Monthly	9/1/99	Present	Grab
Location	**Sampled by**	**Constituent**	**Sample Frequency**	**Reported**	**Begin**	**End**	**Method**
Truckee R. @ Tahoe City	DRI	TPO4, OPO4, NO2, NH4, TDS, TSS, TKN, color, TU, pH, EC, HCO3, CO3, Cl, SO4, Na, K, Ca, Mg, Si, NO5	Monthly	Monthly	9/1/99	Present	Grab

Truckee R. Above Juniper Creek	DRI	TPO4, OPO4, NO2, NH4, TDS, TSS, TKN, color, TU, pH, EC, HCO3, CO3, Cl, SO4, Na, K, Ca, Mg, Si, NO3	Monthly	Monthly	9/1/99	Present	Grab
Past sampling programs (more than one sample)							
Location	**Sampled by**	**Constituent**	**Sample Frequency**	**Reported**	**Begin**	**End**	**Method**
Donner Lake at Sample Point 1 near Truckee	USGS	Physical Property			11/28/72	12/6/73	
Donner Lake at Sample Point 2 near Truckee	USGS	Physical Property			5/16/73	12/6/73	
Bronco Creek	DRI	TPO4, OPO4, NO2, NH4, TDS, TSS, TKN, color, TU, pH, EC, HCO3, CO3, Cl, SO4, Na, K, Ca, Mg, Si, NO3	Approx. annually	Approx. annually	06/02/67	07/24/75	Grab
Gray Creek	DRI	TPO4, OPO4, NO2, NH4, TDS, TSS, TKN, color, TU, pH, EC, HCO3, CO3, Cl, SO4, Na, K, Ca, Mg, Si, NO3	Approx. annually	Approx. annually	05/17/68	7/24/75	Grab
Truckee R at Boca Bridge near Truckee	USGS	Physical property			6/2/80	8/8/80	
Donner Creek at Donner Lake	USGS	Physical Property			6/2/80	8/8/80	
Prosser Creek below Prosser Creek Dam near Truckee	USGS	Physical Property			6/2/80	8/8/80	
Little Truckee River below Boca Dam	USGS	Physical Property			6/2/80	8/8/80	
Truckee R. @ Tahoe City	USGS	Physical property			2/22/78	6/8/83	
Martis Creek at HWY 267 near Truckee	USGS	Physical Property			8/14/73	10/16/85	
Truckee R at HWY 267 near Truckee	USGS	Physical property			6/2/80	10/30/91	
Truckee R at old US 40 Bridge below Truckee	USGS	Physical property			6/2/80	10/30/91	
Truckee R. above Bear Creek near Alpine Meadows	USGS	Physical property			11/19/90	10/30/91	
Location	**Sampled by**	**Constituent**	**Sample Frequency**	**Reported**	**Begin**	**End**	**Method**
Truckee R. at Hwy 89 Bridge near Squaw Valley	USGS	Physical property			11/19/90	10/30/91	
Truckee River above Squaw Creek near Squaw Valley	USGS	Physical Property			11/19/90	10/30/91	
Truckee River below Squaw Creek	USGS	Physical Property			11/19/90	10/30/91	

near Squaw Valley							
Truckee R Tributary 0.4 mi above Pole Creek, near Squaw Valley	USGS	Physical Property			11/19/90	10/30/91	
Truckee River above Rocky wash, near Truckee	USGS	Physical Property			11/19/90	10/30/91	
Rocky wash at mouth, near Truckee	USGS	Physical Property			11/19/90	10/30/91	
Truckee R. near Truckee	USGS	Physical Property			11/19/90	10/30/91	
Truckee R. below Donner Creek near Truckee	USGS	Physical property			11/19/90	10/30/91	
Truckee R above Trout Creek	USGS	Physical property			11/19/90	10/30/91	
Truckee R. at Polaris	USGS	Physical property			11/19/90	10/30/91	
Truckee R below Prosser Creek, near Truckee	USGS	Physical property			11/19/90	10/30/91	
Truckee R below little Truckee R near Truckee	USGS	Physical property			11/19/90	10/30/91	
Truckee R below Juniper Creek near Hirschdale	USGS	Physical property			11/19/90	10/30/91	
Truckee R above Bronco Creek, near Floriston	USGS	Physical property			11/19/90	10/30/91	
Bear Creek at mouth, near Alpine Meadows	USGS	Physical Property			11/19/90	10/30/91	
Squaw Creek at HWY 89 near Squaw Valley	USGS	Physical Property			11/19/90	10/30/91	
Deer Creek 200 feet above mouth, near Squaw Valley	USGS	Physical Property			11/19/90	10/30/91	
Silver Creek at HWY 89 near Squaw Valley	USGS	Physical Property			11/19/90	10/30/91	
Pole Creek at mouth near Squaw Valley	USGS	Physical Property			11/19/90	10/30/91	
Unnamed Tributary upstream of Deep Creek, near Truckee	USGS	Physical Property			11/19/90	10/30/91	
Deep Creek above Mouth, near Truckee	USGS	Physical Property			11/19/90	10/30/91	
Cabin Creek at HWY 89, near Truckee	USGS	Physical Property			11/19/90	10/30/91	
Donner Creek at mouth, near Truckee	USGS	Physical Property			11/19/90	10/30/91	
Trout Creek at mouth, near Truckee	USGS	Physical Property			11/19/90	10/30/91	
Location	**Sampled by**	**Constituent**	**Sample Frequency**	**Reported**	**Begin**	**End**	**Method**
Martis Creek at Mouth at Truckee R near Truckee	USGS	Physical Property			11/19/90	10/30/91	
Union Valley Creek at mouth near Truckee	USGS	Physical Property			11/19/90	10/30/91	
Juniper Creek at mouth near	USGS	Physical Property			11/19/90	10/30/91	

Hirschdale							
Bronco Creek at mouth, near Floriston	USGS	Physical Property			11/20/90	10/30/91	
Truckee R. below Farad Powerhouse @ Farad, CA	USGS	Physical Property			4/1/92	9/2/92	
Martis Creek near Truckee	USGS	Physical Property			8/14/73	8/14/95	
Martis Creek Lake near Truckee	USGS	Physical Property			5/1/74	8/14/95	
Sagehen Creek	USGS	Physical Property			5/16/68	8/6/96	
One-time sampling events							
Location	**Sampled by**	**Constituent**	**Sample Frequency**	**Reported**	**Begin**	**End**	**Method**
Squaw Creek at Squaw Valley Road at Squaw Valley, CA	USGS	Physical Property			8/8/80	8/8/80	
Truckee R. above Donner Creek near Truckee	USGS	Physical property			11/18/90	11/18/90	
Canyon 24 at mouth near Floriston	USGS	Physical Property			11/20/90	11/20/90	
Mystic Canyon at mouth near Floriston	USGS	Physical Property			11/20/90	11/20/90	
Puny Dip Canyon at mouth near Floriston	USGS	Physical Property			11/20/90	11/20/90	
Deep Canyon at mouth near Verdi	USGS	Physical Property			11/20/90	11/20/90	
Truckee R. above Fleish power diversion near Verdi	USGS	Physical Property			11/20/90	11/20/90	
Prosser Creek at mouth near Truckee	USGS	Physical Property			11/20/90	11/20/90	
Dewme TSS Cave near Tahoe City	USGS	Physical Property			5/13/93	5/13/93	
Trout Creek	Snapshot Day	pH			6/2/01	6/2/01	
Truckee River near Glenshire	Snapshot Day	pH, temp			6/2/01	6/2/01	
Squaw Creek	Snapshot Day	DO, pH, temp			6/2/01	6/2/01	
Squaw Creek, Shirley Canyon	Snapshot Day	DO, pH, temp			6/2/01	6/2/01	
Bear Creek	Snapshot Day	Temp			6/2/01	6/2/01	
Truckee River near Tahoe City	Snapshot Day	pH			6/2/01	6/2/01	
Upper Little Truckee River @ Stampede	Snapshot Day	Conductivity, DO, temp, pH			5/2/02	5/2/02	
Davies-Merrill Creek near CG	Snapshot Day	Conductivity, pH			5/2/02	5/2/02	
Worn Mill Creek	Snapshot Day	Conductivity, DO, temp, pH			5/2/02	5/2/02	
Truckee River near Floriston	Snapshot Day	Conductivity, DO, temp, pH			5/2/02	5/2/02	
Bronco Creek near mouth	Snapshot Day	Conductivity, temp, pH			5/2/02	5/2/02	
Independence Creek at road crossing	Snapshot Day	Conductivity			5/2/02	5/2/02	
Location	**Sampled by**	**Constituent**	**Sample Frequency**	**Reported**	**Begin**	**End**	**Method**
Prosser Creek near Hwy 89	Snapshot Day	Conductivity, DO, temp, pH			5/2/02	5/2/02	
Alder Creek	Snapshot Day	Conductivity, DO, temp, pH			5/2/02	5/2/02	
Trout Creek near Truckee River	Snapshot Day	Conductivity, DO, temp, pH			5/2/02	5/2/02	
Trout Creek – Upper	Snapshot Day	Conductivity, pH			5/2/02	5/2/02	

Truckee River at Truckee	Snapshot Day	Conductivity, DO, temp			5/2/02	5/2/02	
Donner Creek at Hwy 89	Snapshot Day	Conductivity, DO, temp			5/2/02	5/2/02	
Cold Creek	Snapshot Day	Conductivity, temp			5/2/02	5/2/02	
Cabin Creek	Snapshot Day	Conductivity, DO, temp, pH			5/2/02	5/2/02	
Truckee River below Big Chief	Snapshot Day	Conductivity, DO, temp, pH			5/2/02	5/2/02	
Martis Creek	Snapshot Day	Conductivity, DO, temp, pH			5/2/02	5/2/02	
Pole Creek	Snapshot Day	Conductivity, DO, pH			5/2/02	5/2/02	
Silver Creek	Snapshot Day	Conductivity, DO, pH			5/2/02	5/2/02	
Squaw Creek	Snapshot Day	Conductivity, temp, pH			5/2/02	5/2/02	
Bear Creek	Snapshot Day	Conductivity, temp			5/2/02	5/2/02	
Truckee River near Tahoe City	Snapshot Day	Conductivity, turbidity			5/2/02	5/2/02	
Bear Creek near Alpine Meadows Rd.	Snapshot Day	Conductivity, DO, temp, pH			5/10/03	5/10/03	
Truckee River near Tahoe City	Snapshot Day	Conductivity, DO, temp, pH			5/10/03	5/10/03	
Deep Creek near mouth	Snapshot Day	Conductivity, DO, temp, pH			5/10/03	5/10/03	
Squaw Creek near mouth	Snapshot Day	Conductivity, DO, temp, pH			5/10/03	5/10/03	
Pole Creek near mouth	Snapshot Day	Conductivity, DO, temp, pH			5/10/03	5/10/03	
Silver Creek near mouth	Snapshot Day	Conductivity, DO, temp, pH			5/10/03	5/10/03	
Trout Creek near mouth	Snapshot Day	Conductivity, DO, temp, pH			5/10/03	5/10/03	
Martis Creek	Snapshot Day	Conductivity, DO, temp, pH			5/10/03	5/10/03	
Tributary north of Cabin Creek	Snapshot Day	Conductivity, DO, temp, pH			5/10/03	5/10/03	
Truckee River near Goose Meadows	Snapshot Day	Conductivity, DO, temp, pH			5/10/03	5/10/03	
Donner Creek near Hwy 89	Snapshot Day	Conductivity, DO, temp, pH			5/10/03	5/10/03	
Cold Creek near Deerfield Drive	Snapshot Day	Conductivity, DO, temp, pH			5/10/03	5/10/03	
Gray Creek near mouth	Snapshot Day	Conductivity, DO, temp, pH			5/10/03	5/10/03	
Trout Creek at Jibboom St.	Snapshot Day	Conductivity, DO, temp, pH			5/10/03	5/10/03	
Truckee River near Union Creek	Snapshot Day	Conductivity, DO, temp, pH			5/10/03	5/10/03	
Prosser Creek downstream of Hwy 89	Snapshot Day	Conductivity, DO, temp, pH			5/10/03	5/10/03	
Alder Creek @ Emigrant Trail off Alder Creek Dr.	Snapshot Day	Conductivity, DO, temp, pH			5/10/03	5/10/03	
Truckee River @ Truckee Regional Park	Snapshot Day	Conductivity, DO, temp, pH			5/10/03	5/10/03	
Independence Creek @ road crossing	Snapshot Day	Conductivity, DO, temp, pH			5/10/03	5/10/03	
Truckee River at Floriston	Snapshot Day	Conductivity, DO, temp, pH			5/10/03	5/10/03	
Little Truckee River at Boyington Mill	Snapshot Day	Conductivity, DO, temp, pH			5/10/03	5/10/03	
Little Truckee River below Boca Dam	Snapshot Day	Conductivity, DO, temp, pH			5/10/03	5/10/03	
Davies Merrill Creek at Road Crossing	Snapshot Day	Conductivity, temp, pH			5/10/03	5/10/03	
Worn Mill Creek	Snapshot Day	Conductivity, temp, pH			5/10/03	5/10/03	
Sagehen Creek below Hwy 89	Snapshot Day	Conductivity, temp, pH			5/10/03	5/10/03	

Table 4. Truckee River basin watershed monitoring sites, biological parameters (Adapted from McGraw, et al., 2001. Table 20, p. 104, with more recent information added)

On-going Sampling Programs							
Location	**Sampled by**	**Constituent**	**Sample Frequency**	**Reported**	**Begin**	**End**	**Method**
Note: TRAM continues to sample selected streams throughout the watershed for macroinvertebrates							
Past sampling programs (more than one sample)							
Location	**Sampled by**	**Constituent**	**Sample Frequency**	**Reported**	**Begin**	**End**	**Method**
Truckee R. @ Tahoe City	USGS	Biological			6/2/80	8/8/80	
Truckee R at HWY 267 near Truckee	USGS	Biological			6/2/80	8/8/80	
Donner Creek at Donner Lake	USGS	Biological			6/2/80	8/8/80	
Prosser Creek below Prosser Creek Dam near Truckee	USGS	Biological			6/2/80	8/8/80	
Little Truckee River below Boca Dam	USGS	Biological			6/2/80	8/8/80	
Sagehen Creek	USGS	Biological			4/23/69	8/6/96	
One-time sampling events							
LOCATION	**Sampled by**	**Constituent**	**Sample Frequency**	**Reported**	**Begin**	**End**	**Method**
Martis Creek near Truckee	USGS	Biological			6/2/80	6/2/80	
Truckee R at old US 40 Bridge below Truckee	USGS	Biological			8/8/80	8/8/80	
Truckee R at Boca Bridge near Truckee	USGS	Biological			8/8/80	8/8/80	
Squaw Creek at Squaw Valley Road at Squaw Valley, CA	USGS	Biological			8/8/80	8/8/80	
Little Truckee River	TRAM	Macroinvertebrates			09/18/99	09/18/99	CSBP
Independence Creek	TRAM	Macroinvertebrates			10/11/99	10/11/99	CSBP
Sagehen Creek	TRAM	Macroinvertebrates			6/22/00	6/22/00	CSBP
Trout Creek	TRAM	Macroinvertebrates			07/08/00	07/08/00	CSBP
Cold Creek (in Coldstream Canyon)	TRAM	Macroinvertebrates			7/31/00	7/31/00	CSBP
Squaw Creek – south tributary	SNARL	Macroinvertebrates			8/00	8/00	Herbst, 2002
Squaw Creek – north tributary	SNARL	Macroinvertebrates			8/00	8/00	Herbst, 2002
Pole Creek	SNARL	Macroinvertebrates			8/00	8/00	Herbst, 2002
Squaw Creek lower meadow	SNARL	Macroinvertebrates			8/00	8/00	Herbst, 2002
Squaw Creek Middle meadow	SNARL	Macroinvertebrates			8/00	8/00	Herbst, 2002
Squwa Creek upper meadow	SNARL	Macroinvertebrates			8/00	8/00	Herbst, 2002
Little Truckee River at Perazzo Creek	SNARL	Macroinvertebrates			8/00	8/00	Herbst, 2002
Cold Creek in Coldstream Canyon	SNARL	Macroinvertebrates			8/00	8/00	Herbst, 2002
Sagehen Creek	SNARL	Macroinvertebrates			8/00	8/00	Herbst, 2002
Prosser Creek	SNARL	Macroinvertebrates			8/00	8/00	Herbst, 2002
Squaw Creek below moraine	SNARL	Macroinvertebrates			8/00	8/00	Herbst, 2002

Location	Sampled by	Constituent	Sample Frequency	Reported	Begin	End	Method
Bear Creek	SNARL	Macroinvertebrates			8/00	8/00	Herbst, 2002
Martis Creek below HWY 267 near Truckee	TRAM	Macroinvertebrates			8/23/00	8/23/00	CSBP
Trout Creek	Snapshot Day	Fecal coliform			6/2/01	6/2/01	
Independence Creek	TRAM	Macroinvertebrates			6/18/01	6/18/01	CSBP
Martis Creek above Hwy 267	TRAM	Macroinvertebrates			6/25/01	6/25/01	CSBP
Squaw Creek south tributary	SNARL	Macroinvertebrates			7/01	7/01	Herbst, 2002
Squaw Creek north tributary	SNARL	Macroinvertebrates			7/01	7/01	Herbst, 2002
Lacey Creek	SNARL	Macroinvertebrates			7/01	7/01	Herbst, 2002
Juniper Creek	SNARL	Macroinvertebrates			7/01	7/01	Herbst, 2002
Squaw Creek lower meadow	SNARL	Macroinvertebrates			7/01	7/01	Herbst, 2002
Squaw Creek middle meadow	SNARL	Macroinvertebrates			7/01	7/01	Herbst, 2002
Little Truckee River at Cold Stream	SNARL	Macroinvertebrates			7/01	7/01	Herbst, 2002
Sagehen Creek	SNARL	Macroinvertebrates			7/01	7/01	Herbst, 2002
Perazzo Creek	SNARL	Macroinvertebrates			7/01	7/01	Herbst, 2002
Independence Creek	SNARL	Macroinvertebrates			7/01	7/01	Herbst, 2002
Martis Creek	SNARL	Macroinvertebrates			7/01	7/01	Herbst, 2002
North Prosser Creek	SNARL	Macroinvertebrates			7/01	7/01	Herbst, 2002
Alder Creek	SNARL	Macroinvertebrates			7/01	7/01	Herbst, 2002
Trout Creek	SNARL	Macroinvertebrates			7/01	7/01	Herbst, 2002
Bear Creek	SNARL	Macroinvertebrates			7/01	7/01	Herbst, 2002
Gray Creek	TRAM	Macroinvertebrates			7/30/01	7/30/01	CSBP
Truckee River at Twin Bridges/Horseshoe Bend	TRAM	Macroinvertebrates			8/24/01	8/24/01	CSBP
Truckee River at Granite Flat	TRAM	Macroinvertebrates			8/24/01	8/24/01	CSBP
Martis Creek above Hwy 267	TRAM	Macroinvertebrates			7/11/02	7/11/02	CSBP
Bear Creek	TRAM	Macroinvertebrates			7/22/02	7/22/02	CSBP
Squaw Creek in meadow	TRAM	Macroinvertebrates			8/5/02	8/5/02	CSBP
Gray Creek	TRAM	Macroinvertebrates			8/24/02	8/24/02	CSBP
Cold Stream (near Perazzo Meadows)	TRAM	Macroinvertebrates			9/8/02	9/8/02	CSBP
Bear Creek	Snapshot Day	Fecal coliform			5/10/03	5/10/03	
Truckee River near Tahoe City	Snapshot Day	Fecal coliform			5/10/03	5/10/03	
Squaw Creek near mouth	Snapshot Day	Fecal coliform			5/10/03	5/10/03	
Trout Creek near mouth	Snapshot Day	Fecal coliform			5/10/03	5/10/03	
Martis Creek near Hwy 267	Snapshot Day	Fecal coliform			5/10/03	5/10/03	
Truckee River near Goose Meadows	Snapshot Day	Fecal coliform			5/10/03	5/10/03	
Donner Creek @ Hwy 89	Snapshot Day	Fecal coliform			5/10/03	5/10/03	
Trout Creek at Jibboom St.	Snapshot Day	Fecal coliform			5/10/03	5/10/03	
Truckee River near Union Creek	Snapshot Day	Fecal coliform			5/10/03	5/10/03	
Prosser Creek downstream of Hwy 89	Snapshot Day	Fecal coliform			5/10/03	5/10/03	
Alder Creek @ Emigrant Trail, Alder Creek Dr.	Snapshot Day	Fecal coliform			5/10/03	5/10/03	

Truckee R. @ Truckee Regional Park	Snapshot Day	Fecal coliform			5/10/03	5/10/03	
Location	**Sampled by**	**Constituent**	**Sample Frequency**	**Reported**	**Begin**	**End**	**Method**
Truckee River @ Floriston	Snapshot Day	Fecal coliform			5/10/03	5/10/03	
Little Truckee River below Boca Dam	Snapshot Day	Fecal coliform			5/10/03	5/10/03	
Prosser Creek below Prosser Dam	TRAM	Macroinvertebrates			5/31/03	5/31/03	CSBP
Davies-Merrill Creek	TRAM	Macroinvertebrates			6/14/03	6/14/03	CSBP
Squaw Creek	TRAM	Macroinvertebrates			7/8/03	7/8/03	CSBP
Perazzo Creek	TRAM	Macroinvertebrates			7/13/03	7/13/03	CSBP
Bear Creek	TRAM	Macroinvertebrates			7/26/03	7/26/03	CSBP
Trout Creek above Truckee River	TRAM	Macroinvertebrates			8/9/03	8/9/03	CSBP
Trout Creek at Bennett Flat	TRAM	Macroinvertebrates			8/9/03	8/9/03	CSBP
Martis Creek above 267	TRAM	Macroinvertebrates			8/23/03	8/23/03	CSBP
East Martis Creek	TRAM	Macroinvertebrates			8/23/03	8/23/03	CSBP
West Martis Creek	TRAM	Macroinvertebrates			8/23/03	8/23/03	CSBP

Table 5. Truckee River basin watershed monitoring sites, discharge (Adapted from McGraw, et al., 2001. Table 21, p. 109, with more recent information added)

On-going Sampling Programs							
Location	**Sampled by**	**Constituent**	**Sample Frequency**	**Reported**	**Begin**	**End**	**Method**
Donner Lake near Truckee	USGS	Discharge			NA	Present	
Prosser Creek Reservoir	USGS	Discharge			NA	Present	
Independence Lake	USGS	Discharge			NA	Present	
Truckee R. @ Farad, CA	USGS	Discharge	15 min	Daily max/min/mean	1/1/09	Present	
Donner Creek at Donner Lake	USGS	Discharge			1/1/29	Present	
Little Truckee River above Boca Dam	USGS	Discharge			09/01/30	Present	
Little Truckee River below Boca Dam	USGS	Discharge			01/01/39	Present	
Prosser Creek below Prosser Creek Dam	USGS	Discharge			07/01/51	Present	
Independence Creek	USGS	Discharge			08/01/68	Present	
Donner Creek @ Hwy 89	USGS	Discharge			3/24/93	Present	
Martis Creek near Truckee	USGS	Discharge			06/16/93	Present	
Truckee R. @ Tahoe City	USGS	Discharge	15 min	Daily max/min/mean	1/1/99	Present	
Past sampling programs (more than one sample)							
Location	**Sampled by**	**Constituent**	**Sample Frequency**	**Reported**	**Begin**	**End**	**Method**
Stampede Reservoir near Boca	USGS	Discharge			NA	NA	
Boca Reservoir near Truckee	USGS	Discharge			NA	NA	
Little Truckee River below Boca Dam	USGS	Discharge			01/01/11	09/30/15	
Prosser Creek below Prosser Creek Dam	USGS	Discharge			10/01/42	12/31/50	
Truckee R. near Truckee	USGS	Discharge	15 min	Daily max/min/mean	12/1/44	9/30/61	
Truckee R. near Truckee	USGS	Discharge	15 min	Daily max/min/mean	06/28/77	9/30/82	
Martis Creek near Truckee	USGS	Discharge			10/01/58	11/04/90	
Location	**Sampled by**	**Constituent**	**Sample Frequency**	**Reported**	**Begin**	**End**	**Method**
Truckee R. near Truckee	USGS	Discharge	15 min	Daily max/min/mean	10/1/92	9/30/95	
Truckee R. @Tahoe City	LRWQCB	Discharge			1/1/96	12/31/96	
Bear Creek	LRWQCB	Discharge			1/1/96	12/31/96	
Squaw Creek	LRWQCB	Discharge			1/1/96	12/31/96	
Truckee R. above Donner Creek	LRWQCB	Discharge			1/1/96	12/31/96	
Donner Creek	LRWQCB	Discharge			1/1/96	12/31/96	
Truckee R. below Donner Creek near Truckee	LRWQCB	Discharge			1/1/96	12/31/96	
Trout Creek	LRWQCB	Discharge			1/1/96	12/31/96	
Truckee R. below Prosser Creek, near Truckee	LRWQCB	Discharge			1/1/96	12/31/96	
Prosser Creek at mouth near Truckee	LRWQCB	Discharge			1/1/96	12/31/96	

Little Truckee River below Boca Dam	LRWQCB	Discharge			1/1/96	12/31/96	
Truckee R. @ Farad, CA	LRWQCB	Discharge			1/1/96	12/31/96	
Martis Creek at Mouth @ Truckee River near Truckee	LRWQCB	Discharge			1/1/96	12/31/96	
Bronco Creek at mouth	USGS	Discharge			4/23/93	10/08/98	
Truckee R. near Truckee	USGS	Discharge	15 min	Daily max/min/mean	10/1/96	9/30/99	
Bear Creek	DRI	Discharge			04/01/00	10/01/00	Integrated
Squaw Creek	DRI	Discharge			04/01/00	10/01/00	Integrated
North Fork Squaw Creek	DRI	Discharge			04/01/00	10/01/00	Integrated
Donner Creek	DRI	Discharge			04/01/00	10/01/00	Integrated
Trout Creek	DRI	Discharge			04/01/00	10/01/00	Integrated
Martis Creek	DRI	Discharge			04/01/00	10/01/00	Integrated
Juniper Creek	DRI	Discharge			04/01/00	10/01/00	Integrated
Gray Creek	DRI	Discharge			04/01/00	10/01/00	Integrated
Bronco Creek	DRI	Discharge			04/01/00	10/01/00	Integrated

Appendix H: Sediment Monitoring Plans

Sample Sediment Monitoring Plans

Alaska Department of Environmental Conservation, Division of Air and Water Quality, 2002. *Total maximum daily load (TMDL) for Sediment and Turbidity in the Waters of Granite Creek in Sitka, Alaska.* Available on-line: http://www.state.ak.us/dec/dawq/tmdl/pdf/granitecreekfinal.pdf.

Comments: Some information about the monitoring program, most of the details are included in the QAPP, "*Quality Assurance Project Plan for the Granite Creek Watershed Recovery Project and Total Maximum Daily Load (TMDL) Determination*", October 2001. (Not available on line)

Bowman, S. N., 2000. *Nutrioso Creek TMDL for Turbidity*. Arizona Department of Environmental Quality. Available on-line: http://www.adeq.state.az.us/environ/water/assess/download/nutrioso.pdf.

Comments: Includes suggestions for parameters to monitor, including use of bank pins to directly measure bank erosion.

Bowman, S. N., 2001. *Verde River TMDL for Turbidity*. Arizona Department of Environmental Quality. Available on-line: http://www.adeq.state.az.us/environ/water/assess/download/verdeturbidity.pdf.

Comments: Very similar to the monitoring recommendations for Nutrioso Creek (Bowman 2000). More information regarding who would be responsible for monitoring, includes sources of potentially useful historic information.

Bullard, T. F., T. Minor, R. Malholland, 2002. *Sediment Source Assessment: Squaw Creek Watershed, Placer County, California*. Desert Research Institute, University and Community College System of Nevada, Las Vegas. Publication No. 9-198-160-0. Available on-line: http://www.swrcb.ca.gov/rwqcb6/TMDL/Squaw/Squaw_Creek_Final_Report_6-02.pdf

Comments: Appendix F, Monitoring and Management Recommendations, contains limited suggestions for monitoring. Detailed source assessment for sediment in the Squaw Creek watershed, very little on monitoring. Included because local example of work done in support of sediment TMDL development.

California Regional Water Quality Control Board, Lahontan Region, 2002. *Adopted Water Quality Control Plan Amendments, Total Maximum Daily Load for Heavenly Valley Creek (including revisions in response to comments and minor non-substantive changes made following* *review by the California Office of Administrative Law).* Available on-line: http://www.swrcb.ca.gov/rwqcb6/BasinPlan/hv_tmdl_1002.pdf.

Comments: Establishment of targeted goals. Monitoring not detailed. Included because example of recent TMDL in Tahoe-Truckee Region.

California Regional Water Quality Control Board, North Coast Region, 2001. *Action Plan for the Garcia River Watershed Sediment TMDL.* Available on-line: http://www.swrcb.ca.gov/rwqcb1/Program_Information/tmdl/tmdl_pdf_docs/081902GarciaActionPlanadopted01-05-02.pdf.

Comments: Most numeric targets have to do with stream hydrology and geomorphology. Monitoring plan is vague.

Colorado Department of Public Health and Environment, Water Quality Control Division, 2000. *Total Maximum Daily Load Assessment, Straight Creek, Summit County, Colorado (DRAFT).* Available on-line: http://www.cdphe.state.co.us/wq/Assessment/TMDL/pdf/tmdl/Straight-Creek-TMDL3.pdf.

Comments: Not very extensive, but has suggestions for geomorphic monitoring, direct measurements of sedimentation, and surveys of fish populations that are interesting.

Endicott, C. L. and T. E. McMahon, 1996. *Development of a TMDL to Reduce NonPoint Source Sediment Pollution in Deep Creek, Montana.* Prepared for the Montana Department of Environmental Quality, March. http://www.deq.state.mt.us/ppa/mdm/TMDL/pdf/DeepCrk.pdf

Comments: Chapter 6. Monitoring, pp. 61-66 contains the information on monitoring. General guidance on types of monitoring to conduct.

Joy, J. and B. Patterson, 1997. *A Suspended Sediment and DDT Total Maximum Daily Load Evaluation Report for the Yakima River.* Washington State Department of Ecology, Environmental Assessment Program, Olympia, Washington, pp. 79-80 for monitoring. Available on-line: http://www.ecy.wa.gov/biblio/97321.pdf.

Comments: Has recommendations for locations for sediment monitoring.

Joy, J., 2002. *Upper Yakima River Basin Suspended Sediment and Organochlorine Pesticide Total Maximum Daily Load Evaluation*. Washington State Department of Ecology, Environmental Assessment Program, Olympia, Washington, pp. 65-66 for monitoring. Available on-line: http://www.ecy.wa.gov/biblio/0203012.html.

Comments: Contains monitoring recommendations, not an actual monitoring plan.

Lawton, R., R. Hunter, and J. Menze, 2002. *Final Report, Volunteer Monitoring of Suspended Sediment Concentration and Turbidity and Watershed Monitoring of Road Remediation in Annadel State Park, Sonoma Creek Watershed, Sonoma County, California*. Prepared for Regional Water Quality Control Board, San Francisco Bay Region, 1515 Clay Street, Suite 1400, Oakland, CA 94612, September. Available on-line: http://www.vom.com/sec/research/supendedsed.html.

Comments: Final report of extensive sediment monitoring conducted by volunteers.

McGraw, D., A. McKay, G. Duan, T. Bullard, T. Minor, J. Kuchnicki. 2001. *Water Quality Assessment and Modeling of the California Portion of the Truckee River Basin*. Division of Hydrologic Sciences, Desert Research Institute, University and Community College System of Nevada, Las Vegas. Publication No. 41170. http://www.truckee.dri.edu/trwa/TRWA.pdf.

Comments: Chapter 4. Proposed Monitoring Plan, pp. 87-112. Describes on-going monitoring within the watershed and contains some recommendations for future monitoring.

Montana Department of Environmental Quality, 2001. Careless Creek Water Quality Restoration Plan, February. Available on-line: http://www.deq.state.mt.us/ppa/mdm/TMDL/pdf/Careless_Creek_FINAL.pdf.

Comments: Contains recommendations for monitoring actions.

New Mexico Environment Department, Surface Water Quality Bureau, 2002. *DRAFT Total Maximum Daily Load for Metals (Chronic and Acute Aluminum), Stream Bottom Deposits, and Turbidity for Listed Reaches in the Red River Watershed.* Available on-line: http://www.nmenv.state.nm.us/swqb/Red_River_Watershed-Draft_TMDL-04-09-2002.pdf.

Comments: All TMDLs for New Mexico contain essentially the same monitoring section. This TMDL has more detail than the other ones available and contains monitoring locations, a description of the modified pebble counts used by the State of New Mexico, and links to reference documents.

Sirucek, D., D. Yashan, R. Ray, and R. Steg, 2003. *Watershed Restoration Plan for Big Creek, North Fork of the Flathead River*. USDA Forest Service, Flathead National Forest. Available on-line: http://www.deq.state.mt.us/ppa/mdm/TMDL/pdf/BigCreekTMDLCBFinal.pdf

Comments: Monitoring section rather vague. Good example of an implementation plan where the TMDL was constructed as a watershed management plan.

Tetra Tech, Inc., 2001. *Report for Blackwood Creek TMDL Feasibility Project, Lake Tahoe, California*. Tetra Tech, Inc. 3746 Mt. Diablo Blvd., Suite 300, Lafayette, CA 94549. Available on-line: http://www.swrcb.ca.gov/rwqcb6/TMDL/Blackwood.

Comments: Section 7, Data Needs and Recommendations for Monitoring Evaluation Plan, contains the information on monitoring. Description of recommended monitoring plan for Blackwood TMDL implementation. Many suggestions may be more applicable to a smaller system like Blackwood.

USDA Forest Service, Blue Mountains Demonstration Area, 2001*. DRAFT Umatilla River Basin long Term Monitoring Plan for TMDL/WQMP Implementation*. Available on-line: http://www.fs.fed.us/bluemountains/docs/uma.pdf

Comments: Very specific monitoring plan with locations and responsible parties.

General Information on Monitoring Plan Development

MacDonald, L., A. W. Smart, and R. C. Wissmer, 1991. *Monitoring guidelines to evaluate effects of forestry activities on streams in the Pacific Northwest and Alaska.* EPA 910/9-91-001. U.S. Environmental Protection Agency, Region 10, Nonpoint Source Section, Seattle, WA. Available on-line: http://www.epa.gov -> Information sources -> NEPIS -> Search -> Simple Search

Comments: Good source of information on general types of monitoring to conduct to assess impacts by sedimentation in aquatic systems.

New Mexico Environment Department, Surface Water Quality Bureau, 2000. *State of New Mexico Procedures for Assessing Standards Attainment for 303(d) List and 305(b) Report, Assessment Protocol.* Available on-line: http://www.nmenv.state.nm.us/swqb/AssessmentProtocol.pdf.

Comments: New Mexico State's protocols for making initial TMDL determination. Contains tables that have good information on the relative quality of different types of assessment data that could be useful in determining which monitoring parameters to use.

U.S. Environmental Protection Agency, 1999. *Protocol for Developing Sediment TMDLs, First Edition.* EPA 841-B-99-004. Office of Water (4503F), United States Environmental Protection Agency, Washington,

D.C. 132 pp. Available on-line: http://www.epa.gov/owow/tmdl/sediment/pdf/sediment.pdf.

Comments: This document spells out the process of developing a sediment TMDL. Chapter 8, Follow-up Monitoring and Evaluation, contains guidance on what should be included in the monitoring section of TMDLs for sediment.

Sediment Monitoring Plans that Are of Limited Use

Colorado Department of Public Health and Environment, Water Quality Control Division, 2000. *Total Maximum Daily Load Assessment Box Canyon Creek, Montezuma County, Colorado*. Available on-line: http://www.cdphe.state.co.us/wq/Assessment/TMDL/pdf/tmdl/BOXTMDLfnl.pdf.

Comments: Limited detail. Monitoring to happen for three years after implementation, TMDL target is in terms of macroinvertebrate community composition (ratio of EPT:Chironimids).

Colorado Department of Public Health and Environment, Water Quality Control Division, 2000. *Total Maximum Daily Load Assessment San Miguel River Segment 3b Sediment, San Miguel County, Colorado.* Available on-line: http://www.cdphe.state.co.us/wq/Assessment/TMDL/pdf/tmdl/sanmig-TMDLfin.pdf.

Comments: Extremely brief monitoring plan, insufficient detail.

Colorado Department of Public Health and Environment, Water Quality Control Division, 2002. *Total Maximum Daily Load Assessment North Fork Cache La Poudre River, Segment 7, Larimer County, Colorado*. Available on-line: http://www.cdphe.state.co.us/wq/Assessment/TMDL/pdf/tmdl/Halligan-Res-sedi.pdf

Comments: Very vague, only mentions frequency of surveys, but no details on what is being monitored.

Colorado Department of Public Health and Environment, Water Quality Control Division, 2002. *Total Maximum Daily Load Assessment, Upper South Platte River, Segment 1A Sediment, Douglas, Jefferson, Park, and Teller Counties.* Available on-line: http://www.cdphe.state.co.us/wq/Assessment/TMDL/pdf/tmdl/COSPUS01a-sedi.pdf.

Comments: No monitoring mentioned in this plan.

Heberling, P. and B. Lindberg, 2001. *Little River Watershed TMDL*. State of Oregon, Department of Environmental Quality. Available on-line: http://www.deq.state.ore.us/wq/TMDLs/LittleRiver/LittleRiverTMDL.pdf

Comments: Monitoring plan contains no details.

New Mexico Environment Department, Surface Water Quality Bureau, 1999. *Total Maximum Daily Load for Turbidity and Stream Bottom Deposits for the Jemez River and the Rio Guadalupe.* Available on-line: http://www.nmenv.state.nm.us/swqb/Turbidity_and_Stream_Bottom_Deposits_TMDLs_for_Jemez_River_and_Rio_Guadalupe.pdf

Comments: Contains the standard monitoring plan for New Mexico TMDLs. Lacks detail, nothing specific to this particular watershed.

New Mexico Environment Department, Surface Water Quality Bureau, 1999. Total Maximum Daily Load for Turbidity, Stream Bottom Deposits, and Total Phosphorus in the Canadian River Basin (Cimarron). Available on-line: http://www.nmenv.state.nm.us/swqb/Stream_Bottom_Deposits-Total_Phosphorus-Turbidity_TMDL_for_Canadian_River_Basin_08-04-1999.pdf.

Comments: Contains the standard monitoring plan for New Mexico TMDLs. Lacks detail, nothing specific to this particular watershed.

New Mexico Environment Department, Surface Water Quality Bureau, 2001. *Total Maximum Daily Load for Turbidity, Stream Bottom Deposits, and Total Phosphorus for Cordova Creek*. Available on-line: http://www.nmenv.state.nm.us/swqb/Stream_Bottom_Deposits-Total_Phosphorus-Turbidity_TMDL_for_Cordova_Creek_12-19-2001.pdf.

Comments: Contains the standard monitoring plan for New Mexico TMDLs. Lacks detail, nothing specific to this particular watershed.

New Mexico Environment Department, Surface Water Quality Bureau, 2001. *Total Maximum Daily Load for Turbidity in Whitewater Creek.* Available on-line: http://www.nmenv.state.nm.us/swqb/Turbidity_TMDL_on_Whitewater_Creek_11-05-01.pdf.

Comments: Contains the standard monitoring plan for New Mexico TMDLs. Lacks detail, nothing specific to this particular watershed.

Oregon Department of Environmental Quality, 2002. *Nestucca Bay Watershed Total Maximum Daily Load (TMDL).* Available on-line: http://www.deq.state.or.us/wq/TMDLs/Nestucca/NestuccaBayTMDL-WQMP.pdf.

Comments: Appendix D – Water Quality Management Plan contains the outline for monitoring. Only suggests that different types of monitoring such as implementation monitoring and effectiveness monitoring should occur, but no actual recommendations for parameters to monitor or monitoring methods.

U.S. Environmental Protection Agency, 1998. *South Fork Trinity River and Hayfork Creek Sediment TMDLs*. Available on-line: http://www.epa.gov/region09/water/tmdl/fsftmdl.pdf.

Comments: One paragraph on monitoring with limited information.

U.S. Environmental Protection Agency, 1998*. Total Maximum Daily Load for Sediment, Redwood Creek, California*. Available on-line: http://www.epa.gov/region09/water/tmdl/rwctmdl.pdf.

Comments: Contains recommendations for what general parameters should be monitored, but no methods or locations.

U.S. Environmental Protection Agency, 1999. *Noyo River Total Maximum Daily Load for Sediment.* Available on-line: http://www.epa.gov/region09/water/tmdl/noyo/noyo.pdf.

Comments: Contains general recommendations for what should be included in the monitoring plan.

U.S. Environmental Protection Agency, 1999*. Van Duzen River and Yager Creek TMDL for Sediment.* Available on-line: http://www.epa.gov/region09/water/tmdl/vanduzen/vanduzen.pdf.

Comments: Very general comments about what should be included in the monitoring plan, only specific recommendation is to repeat sediment source analysis conducted for TMDL development in 5-10 years.

U.S. Environmental Protection Agency, 2000*. Navarro River Total Maximum Daily Loads for Sediment and Temperature*. Available on-line: http://www.epa.gov/region09/water/tmdl/navarro/navarro.pdf.

Comments: Overly general monitoring recommendations.

U.S. Environmental Protection Agency, 2001. *Albion River Total Maximum Daily Load for Sediment.* Available on-line: http://www.epa.gov/region09/water/tmdl/albion/albiontmdl.pdf.

Comments: Overly general monitoring recommendations.

U.S. Environmental Protection Agency, 2001. *Big River Total Maximum Daily Load.* Available on-line: http://www.epa.gov/region09/water/tmdl/big/bigfinaltmdl.pdf.

Comments: Overly general monitoring recommendations.

U.S. Environmental Protection Agency, 2001. *Gualala River Total Maximum Daily Load for Sediment.* Available on-line: http://www.epa.gov/region09/water/tmdl/gualala/gualalafinaltmdl.pdf.

Comments: Appears to be incomplete, monitoring recommendations overly general.

U.S. Environmental Protection Agency, 2001. *Trinity River Total Maximum Daily Load for Sediment.* Available on-line: http://www.epa.gov/region09/water/tmdl/trinity/finaltrinitytmdl.pdf.

Comments: Contains limited specific recommendations for which parameters should be measured.

U.S. Environmental Protection Agency, 2002. *North Fork Eel River Total Maximum Daily Loads for Sediment and Temperature*. Available on-line: http://www.epa.gov/region09/water/tmdl/northfork/final.pdf.

Comments: Overly general monitoring recommendations.

U.S. Environmental Protection Agency, 2003. *Mattole River Total Maximum Daily Loads for Sediment and Temperature*. Available on-line: http://www.epa.gov/region09/water/tmdl/mattole/mattole.pdf.

Comments: Suggests reductions in sedimentation from roads and timber harvesting activities, but monitoring recommendations are too general.

U.S. Environmental Protection Agency, 2003. *Ten Mile River Total Maximum Daily Load for Sediment*. Available on-line: http://www.epa.gov/region09/water/tmdl/tenmile/tenmile.pdf.

Comments: Contains many recommendations for implementation but no monitoring recommendations.