CSA #5
EROSION CONTROL PROJECT
PHASE 3

Project Feasibility Report - Draft

JN 95157

August 2020

Prepared By:

County of El Dorado

Department of Transportation

Tahoe Engineering Unit

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1.0 Introduction

The Feasibility Report (Report) has been developed pursuant to the Storm Water Quality Improvement Committee (SWQIC) guidelines for erosion control projects in the Lake Tahoe Basin and has been prepared by the County of El Dorado Community Development Agency, Transportation Division (Transportation). This Report includes an analysis of the existing conditions and an analysis of potential alternatives for the CSA 5 Phase III Erosion Control Project (Project).

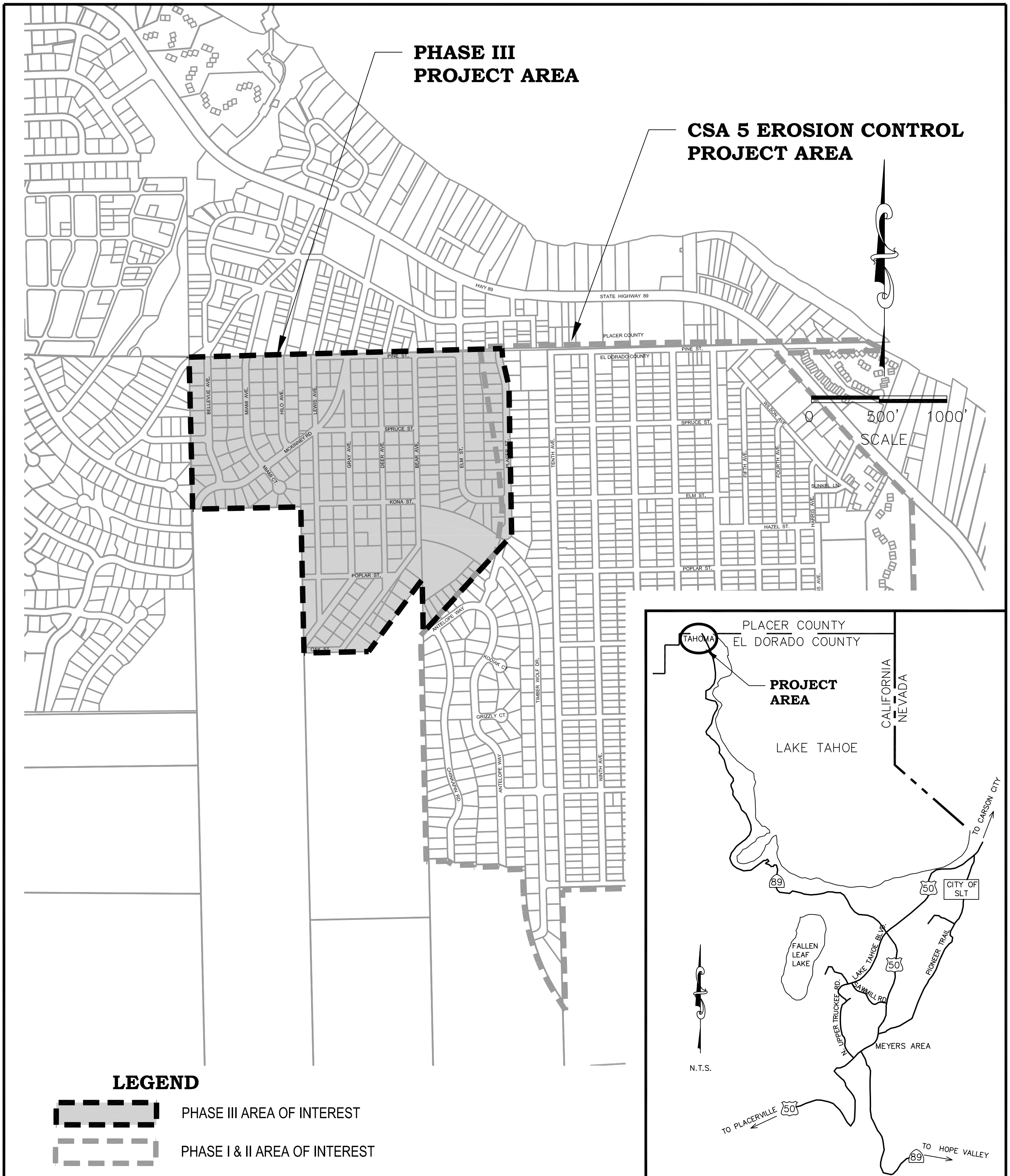
The Project area is located in Tahoma on the west shore of Lake Tahoe, and is bounded by Placer Ave to the east, the El Dorado/Placer County line at Pine Ave to the north, McKinney Rd and Bellevue Ave to the west and undeveloped USFS and CTC owned lots to the south (Figure 1). The Project area is identified in the Tahoe Regional Planning Agency's (TRPA) Environmental Improvement Project (EIP) list as project number 01.01.01.0067 (formally No. 10062) and is located within both TRPA designated Priority 2 Watershed 56 (General Creek) and TRPA designated Priority 1 Watershed McKinney Creek.

The Project was initiated due to the analysis completed in the 2009 Transportation's Pollutant Load Reduction Strategy (PLRS) Report. The report focused on assessing discharges to surface waters for the Total Maximum Daily Load (TMDL) and the County's National Pollutant Discharge Elimination System (NPDES) permit. As part of that analysis, the County identified three watersheds outfalls which were connected to Lake Tahoe: 1) the outfall from the Gray Basin (located in Placer County) which drains to McKinney Creek; 2) the 36 inch diameter storm drain pipe which conveys storm water runoff from a portion of the subdivisions in the Project area directly into Lake Tahoe with minimal infiltration or treatment; and 3) a surface channel which drains the remaining portions of the subdivisions in the Project area.

In 2011 Transportation requested and received funds from the USFS to develop the Planning, Environmental, and Preliminary Engineering documents for the CSA #5 area. In 2013 Transportation requested and received Site Improvement funding from the USFS to construct future improvements which would address the identified water quality issues within the Project area. In 2014, the County received site improvement funds from the California Tahoe Conservancy (CTC) to construct the CSA 5 - Upper Area Erosion Control Project (Phase 1) . The improvements consisted of modifications to a small subset of structures and conveyance features within the existing storm drain system, in order to provide water quality treatment through infiltration and sediment capture. In 2016, the remaining improvements were constructed as part of the CSA #5 Erosion Control Project (Phase 2) with USFS SNPLMA and CSA 5 Assessment funds.

The intent of the current Project (Phase 3) is to address areas of interest that were not addressed by the Phase 1 and 2 projects (Figure 1). The project will focus on water quality improvements primarily within the County owned right of way and County owned parcels, exploring outside options where needed. The County will engage the public on the project to solicit input and to evaluate existing flooding and water quality impacts in the area. The proposed improvements for the Project will also include modifications to existing infrastructure to better control erosion and sediment capture as a result of stormwater runoff within the County rights-of-way. The County will evaluate the Project's potential effects on the environment and significance of those effects as part of this study.

This Report provides the background on existing information concerning the Project and outlines how Transportation identifies potential water quality, erosion control, and storm water hydrologic and pollution problems. Transportation utilized the CTC's Preferred Design Approach (PDA)



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CSA 5 - Phase 3
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LOCATION MAP

FIGURE

1

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guidelines[1], the SWQIC process[2] and the County of El Dorado Drainage Manual[3] to develop this Report.

2.0 Project Overview

The primary problems to be addressed with this Project are defined under CTC guideline categories as Source Control (SC), Hydrologic Design (HD), or Treatment (T). These categories include, but are not limited to, the following sub-categorically defined areas:

1. Untreated direct discharge of storm water runoff and snow melt via culverts or watercourses into Lake Tahoe.
2. Eroding roadside ditches along the County rights-of-way (ROW).
3. Sediment accumulations along roads with subsequent discharge into watercourses.
4. Poor surface runoff water quality.
5. Sediment migrating from private parcels to County ROW.

To discuss the Project and obtain agency input, a project development team (PDT) meeting with agency and utility company staff has been held. A public meeting is scheduled for September 10, 2020 to discuss problems and alternatives.A summary of public comments received to date can be found in Appendix F.

2.1 Tahoe Basin Goals and Objectives

The five key milestones within the development of storm water and erosion control goals and objectives within recent Tahoe regulatory history include:

1. Pursuant to the requirements of Section 208 of the Clean Water Act, the TRPA prepared a Water Quality Management Plan (208 Plan) in 1978 for the Lake Tahoe Basin and revised the plan again in 1988.[4] The 208 Plan identifies erosion, runoff, and disturbance resulting from development, such as subdivision roads, as primary causes of the decline of Lake Tahoe's water quality. The 208 Plan also mandates that capital improvement projects such as this Project be implemented to bring all County roads into compliance with Best Management Practices (BMPs) by the year 2008.

2. In the early 1980's, Lahontan adopted a Basin Plan that also mandated that BMPs be implemented within the Tahoe Basin to protect the water quality of Lake Tahoe and its tributaries (See Chapter 5 of the Basin Plan).

3. In 1987, the CTC completed a report entitled "A Report on Soil Erosion Control Needs and Projects in the Basin," that further identified specific project areas for BMP retrofit.

4. In 1997, the TRPA developed a Basin-wide EIP that defined various projects in need of BMP retrofits. This list of projects with assigned project numbers was also linked to the 1987 CTC Report.

5. In 2011 the Lake Tahoe Total Maximum Daily Load (TMDL) was adopted by the California Regional Water Quality Control Board – Lahontan Region. One of the requirements of the TMDL is for local California jurisdictions within the Lake Tahoe Basin to take appropriate measures to decrease pollutant loading to Lake Tahoe from urbanized areas.

2.2 Project Goals and Objectives

The overall goal of this Project is to improve the water quality of runoff to Lake Tahoe and its tributaries by reducing erosion and sediment transport originating from the CSA 5 Project Area.

The Project goals and extent could be expanded during the Project Development Process - Scoping Phase to accommodate the Project Development Team (PDT) endorsed Work Plan. The Project objectives represent physical conditions that can be measured to assess the success of the Project in achieving the Project goals. The Project will conform to the Preferred Design Approach as detailed in the SWQIC process.

The Project goals and objectives are as follows:

Goals		Objectives
1.	Reduce the amount of very fine inorganic sediment by 12%, fine inorganic sediment by 25%, and coarse inorganic sediment by 33% from the urbanized watershed bounded by the Project boundary or to the maximum extent practicable prior to discharging into Lake Tahoe. Very fine sediment is defined as particles with a diameter of 20 microns or less (<20 μm), fine sediment is defined as particles which pass a #200 sieve (<74 μm), and coarse sediment is defined as particles retained on or greater than the #200 sieve (>74 μm).	Stabilize eroding slopes with County approved slope stabilization (Source Control) BMPs; Stabilize eroding channels/ditches with County approved channel or road treatment source control BMPs; Utilize various County approved sediment trapping BMPs (Sediment Traps, Infiltration, Sediment Basins, etc.) to capture sediment from impervious surfaces and eroding areas; Capture de-icing abrasives tracked in from local roads and highways to prevent discharge to watercourses; and, Define and increase the sweeping frequency within the ROW as funding and resources are available. Current County sweeping frequency is a minimum of once per year.
2.	Reduce the 25-year, 1-hour storm surface water volume from the urbanized watershed bounded by the Project boundary by 33% or to the maximum extent practicable prior to discharging into Lake Tahoe.	Utilize County ROW and publicly owned parcels to capture, store, and infiltrate a portion of the 25-year, 1-hour volume, which are at main discharge points within the watersheds; and, Utilize various County approved infiltration and storage BMPs prior to discharging into Lake Tahoe.

3.	Reduce the 25-year, 1-hour storm surface water peak flow from the urbanized watershed bounded by the Project boundary by 33% or to the maximum extent practicable prior to discharging into Lake Tahoe.	Utilize County ROW and publicly owned parcels to detain, spread, and infiltrate the storm water within the watershed prior to discharging into Lake Tahoe without violating drainage laws; and Utilize various storm water drainage systems, which increase the time of concentration and reduce the peak discharge to the main discharge points into Lake Tahoe.
4.	Complete a comprehensive BMP Retrofit Watershed Master Plan which will include private BMP development as part of the Project Delivery Process (PDP). Achieve 25% participation with the private homeowners within the limits of the Project.	Utilize the TRPA Home Landscaping Guide for evaluating and developing BMP solutions for each driveway within the limits of the Project area; and Coordinate the private BMP's design within ROW with the Tahoe Resource Conservation District (TRCD)/Natural Resources Conservation District (NRCS).

2.3 Measures of Progress

The County is now using TRPA performance measures (PM) to monitor the effectiveness of the key thresholds associated with the Environmental Improvement Program (EIP). This Project (EIP No. 01.01.0067) has four (4) separate performance measures with corresponding definitions:

<u>4 - Parcels with Storm Water Retrofits</u>

The number of developed parcels in the Tahoe Basin that are retrofitted with best management practices (BMPs) that emphasize removal of fine sediment particles and nutrients. This PM also tracks the number of facilities retrofitted with stormwater BMPs on property belonging to large, public landowners. To qualify, all parcels and facilities must have appropriate operations and maintenance plans. Installing and maintaining BMPs is mandated by regional ordinances, reduces pollutant loads and benefits the clarity of Lake Tahoe.

<u>5 - Miles of Road Treated</u>

The amount of city, county, state, and federal roads that are retrofitted or obliterated to reduce stormwater pollution through capital improvements. Operations and maintenance activities are captured by other PMs. This PM is reported in three categories of treatment priority based on water quality risk. Treating high-priority roads reduces stormwater pollution and cost-effectively improves the clarity of Lake Tahoe.

<u>6 - Miles of Street Sweeping</u>

Miles of city, county, and state roads that are swept to reduce stormwater pollution during each EIP reporting year as part of regular operations and maintenance procedures. Capital stormwater infrastructure improvement activities are captured by other PMs. Sweeping streets reduces a major source of pollutants in stormwater runoff that flows to Lake Tahoe and works toward reducing clarity loss.

The threshold units for this Project are:

PM	PM Indicator	PM Unit of Benefit	Project Amount
4	Parcel Type	# of Parcels	48
5	Road Priority	Miles Retrofitted	Up to 2.57
6	Sweeper Type	Miles Swept	Up to 2.57

Note that threshold values do not take into account the relative connectivity of a watershed.

2.4 General Site Description

The Project area is located in Tahoma on the west shore of Lake Tahoe, in portions of Section 18, Township 14 North, Range 17 East, Mount Diablo Meridian. The Project area is bounded by Placer Ave to the east, the El Dorado/Placer County line at Pine Ave to the north, McKinney Rd and Bellevue Ave to the west and undeveloped USFS and CTC owned lots to the south (Figure 1).

The total Project area is approximately 86 acres and encompasses County lots and ROW, CTC, USFS, and privately owned residential lots and includes the Westlake Village Unit Nos. 1, 2, 3, 4, 5, and 9 subdivisions. Improvements within the Project area include paved County roads within 40 to 56 foot wide ROW, unpaved roads, rock slope protection, curb and gutter, AC dike, AC swales, solid wall and perforated pipe storm drain systems, infiltrating sediment basins, channels, and overhead and underground utilities. Portions of the paved County roads may not be centered within the ROW.

Within the Project area approximately 16% of the parcels are publicly owned by the CTC, USFS, or El Dorado County. The majority of the privately owned parcels have been developed with single-family residences.

3.0 Existing Site Characteristics

3.1 Topography

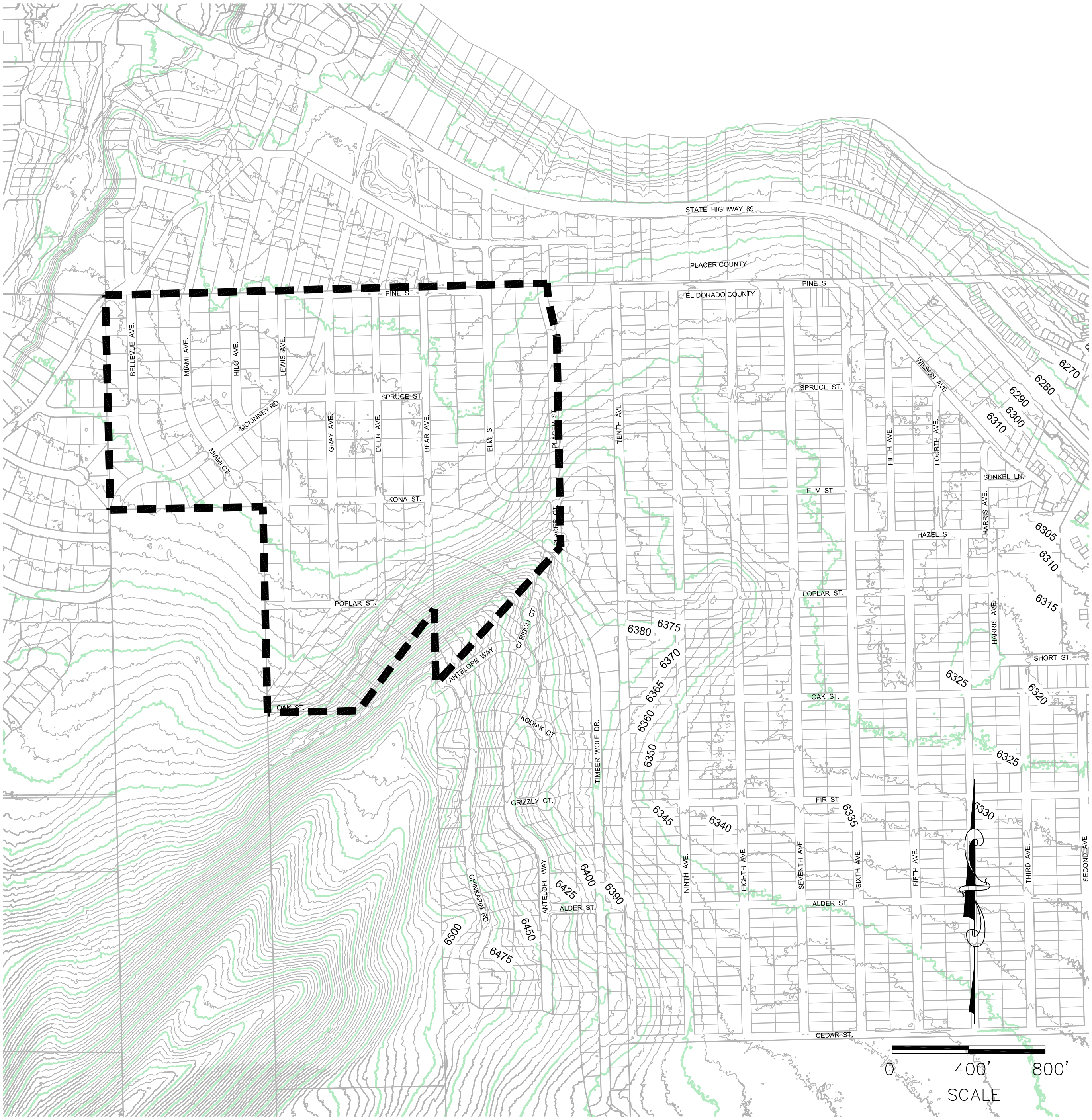
As presented on Figure 2, the approximate elevation range of the Project area is from 6,290 to 6,495 feet above mean sea level (NGVD 1929). Project area topography consists of sloping terrain with typical slopes ranging from 0% to 10% with some areas exceeding 38% as shown on Figure 3.

LEGEND

PARCEL BOUNDARY, COUNTY, OR CALTRANS RIGHT-OF-WAY

PROJECT AREA

6225 CONTOUR WITH ELEVATION



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CSA 5 - Phase 3
EROSION CONTROL PROJECT

CONTOUR MAP

FIGURE 2

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LEGEND
PARCEL BOUNDARY, COUNTY, OR CALTRANS RIGHT-OF-WAY
PROJECT AREA

SURFACE SLOPE DATA

NUMBER	MINIMUM SLOPE	MAXIMUM SLOPE	COLOR	NUMBER	MINIMUM SLOPE	MAXIMUM SLOPE	COLOR
1	0%	5%		4	15%	25%	
2	5%	10%		5	25%	35%	
3	10%	15%		6	35%	> 35%	

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SLOPE MAP

FIGURE 3

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3.2 Geology

A preliminary review of regional geology within the Project area reveals this geomorphic unit has a moderate slope comprised of two main geologic map units as shown on Figure 4.[5]

3.2.1 Tahoe Glacial Till (Ql)

This soil type makes up approximately 64% of the Project area. Lake deposits of thin-bedded sandy silts and clay.

3.2.2 Tahoe Glacial Till (Qta)

This soil type makes up approximately 36% of the Project area. Unconsolidated bouldery till with a distinct yellow-brown weathered matrix. The deposits are preserved as larger moraines with more rounded and broader crests. Locally may include outwash deposits.

3.3 Hydrology

The United States Geological Survey (USGS) has divided the Tahoe Basin into 110 hydrologic basins and intervening areas contributing to outflow from Lake Tahoe.[6] The Project area is located within USGS Basins 95 (Intervening Area) and 96 (McKinney Creek at mouth), which have corresponding drainage areas of 0.1 and 0.3 square miles. The watersheds drain directly into Lake Tahoe through established storm drain and surface channel systems. The USGS basins are depicted in Figure 5.

Runoff from the Project area is directed toward drainage facilities within the County ROW and is generally conveyed along existing road shoulders or rock-lined channels, into storm drain systems. These storm drain systems consist of inlet and junction structures that provide no treatment and solid wall or perforated corrugated metal pipes (CMP). Transportation has divided the Project area into 2 primary watersheds using topographic maps based on LiDAR developed in 2013[7] and field surveys. Both of the watersheds are conveyed in a storm drain system into the Gray Basin, north of the County line.

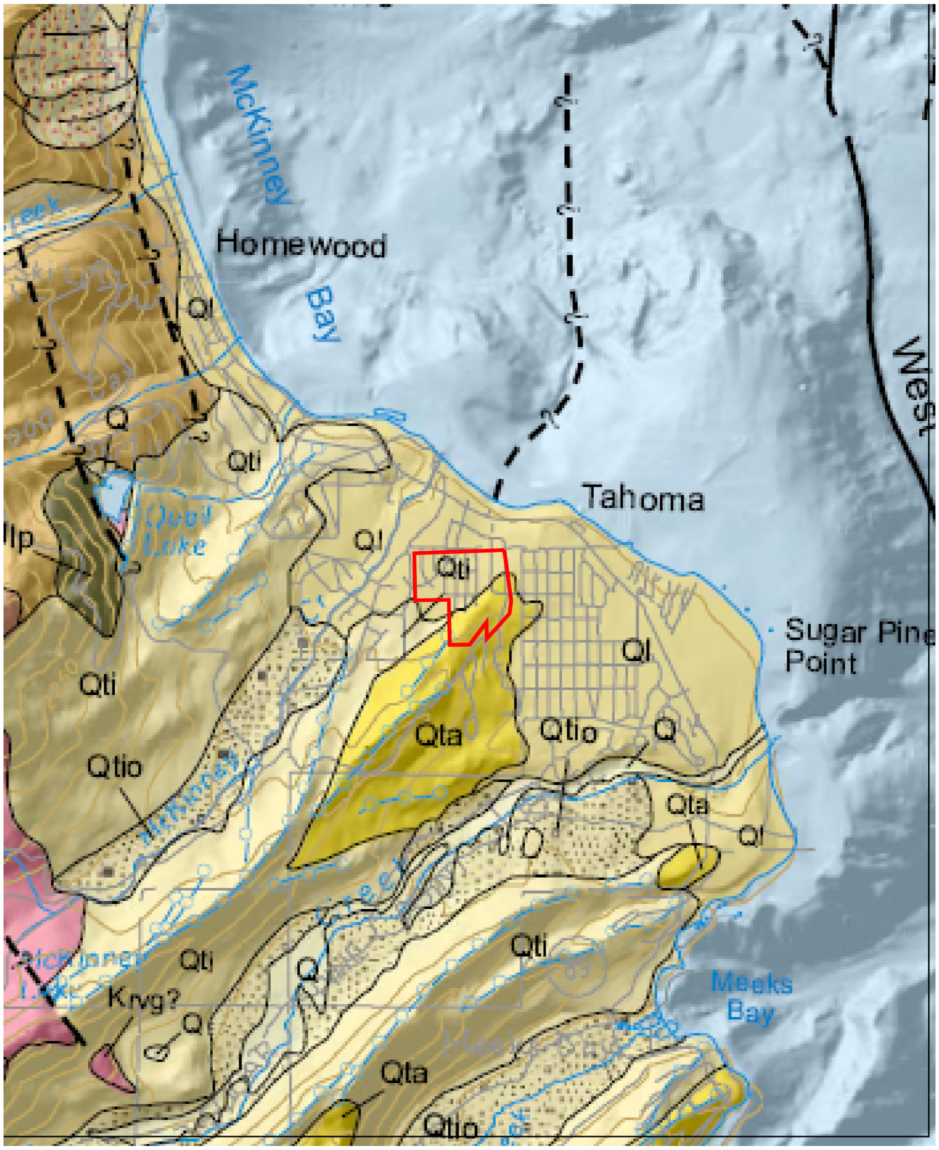
A comprehensive hydrological analysis of the Project area is found in Section 4.

3.4 Soils

The 2007 Natural Resources Conservation Service (NRCS) soil survey data for the El Dorado County Tahoe Basin Area was used to determine the primary soils units within the Project area.[8] The soils found within the Project area boundary are presented on Figure 6 and are described below.

- Tallac gravelly coarse sandy loam, 5 to 15 percent slopes, very stony (7521). This soil consists of colluvium over till derived from mixed sources. Average total available water in the top five feet of soil is 3.2 inches. Hydrologic soil group is A and runoff class is low. Water table is present within the soil profile.

- Tallac gravelly coarse sandy loam, 15 to 30 percent slopes, very stony (7522). This soil consists of colluvium over till derived from mixed sources. Average total available water in the top five feet of soil is 3.2 inches. Hydrologic soil group is A and the runoff class is medium. Water table is present within the soil profile.



LEGEND

Ql Lake deposits (Holocene)

Q Alluvium (Holocene and Pleistocene)

Tioga glacial deposits (Pleistocene)

Qti Till

Qtio Outwash deposits

Tahoe glacial deposits (Pleistocene)

Qta Till

Granitic rocks

Krvg Rockbound Valley granodiorite (Cretaceous)

Project Area (Approximate)

Fault - solid where well located; dashed where approximately located; short dash where inferred; dotted where concealed; queried where continuation or existence is uncertain. Ball and bar on downthrown side. *(The age and location of the faults in the lake bottom and cutting Quaternary deposits should be considered preliminary interpretations.)*

NOT TO SCALE

EL DORADO COUNTY DEPARTMENT OF TRANSPORTATION	CSA 5 - Phase III EROSION CONTROL PROJECT GEOLOGY MAP	FIGURE 4
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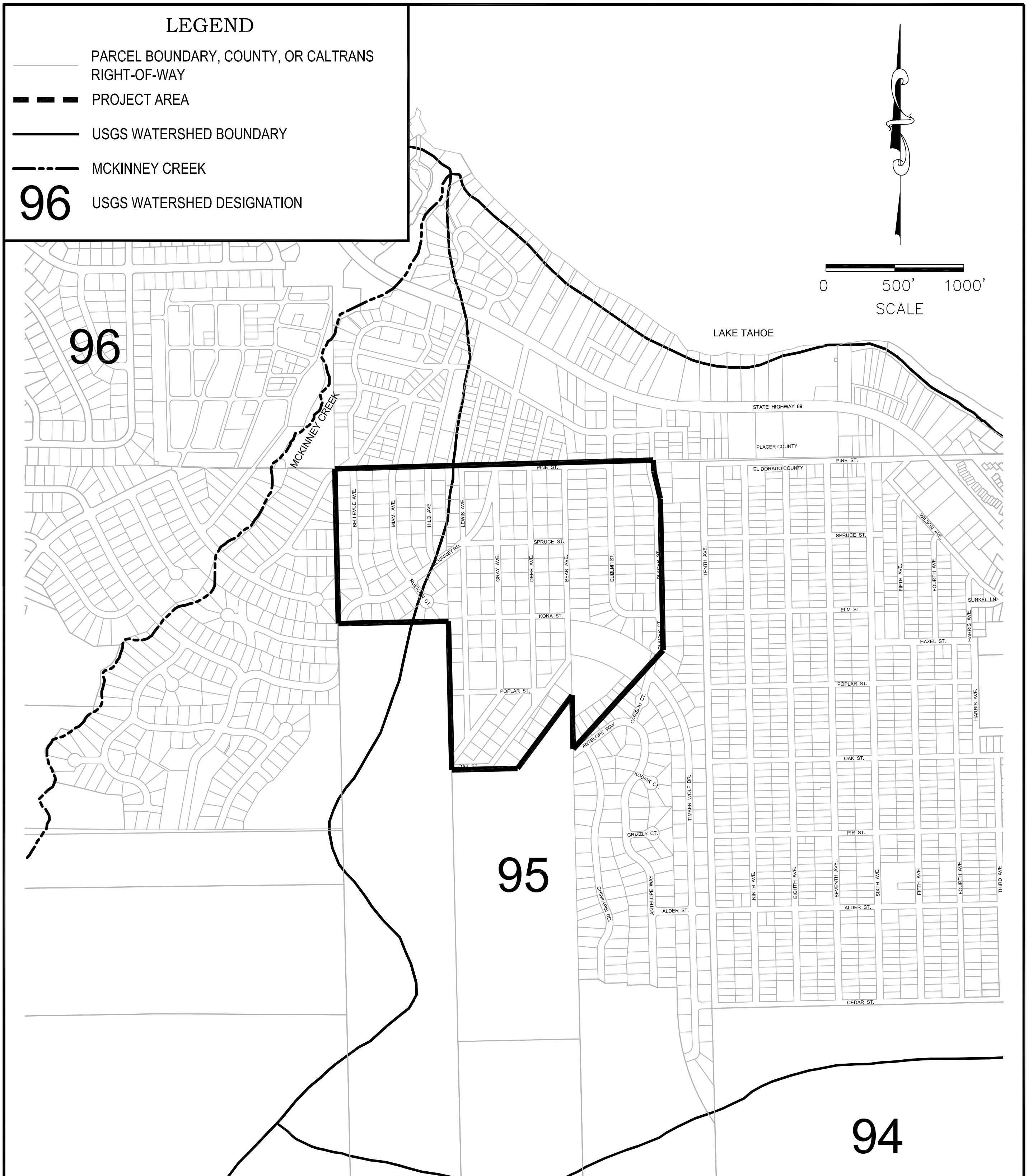

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USGS WATERSHED MAP

FIGURE 5

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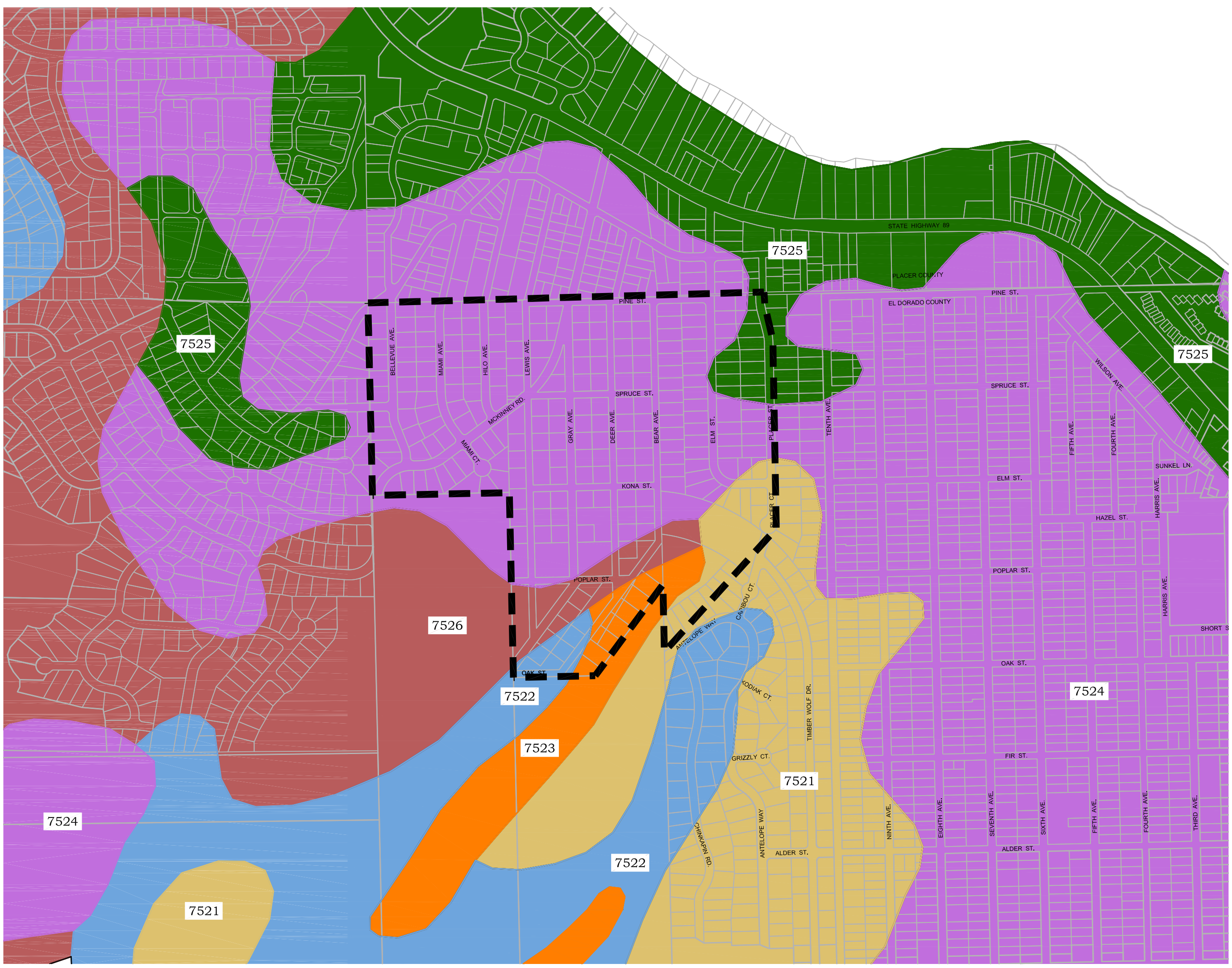
LEGEND

MAP UNIT COLOR/SYMBOL	MAP UNIT NAME
7521	TALLAC GRAVELLY COARSE SANDY LOAM, 5% TO 15% SLOPES, VERY STONY
7522	TALLAC GRAVELLY COARSE SANDY LOAM, 15% TO 30% SLOPES, VERY STONY
7523	TALLAC GRAVELLY COARSE SANDY LOAM, 30% TO 70% SLOPES, VERY STONY
7524	TALLAC GRAVELLY COARSE SANDY LOAM, MODERATELY WELL DRAINED, 0% TO 5% SLOPES
7525	TALLAC GRAVELLY COARSE SANDY LOAM, MODERATELY WELL DRAINED, 5% TO 9% SLOPES
7526	TALLAC GRAVELLY COARSE SANDY LOAM, MODERATELY WELL DRAINED, 2% TO 9% SLOPES, RUBBLY
9011	OXYAQUIC CRYORTHENTS-AQUIC XERORTHENTS-TAHOE COMPLEX, 0% TO 15% SLOPES
	PARCEL BOUNDARY, COUNTY, OR CALTRANS RIGHT-OF-WAY
	PROJECT AREA

0 500' 1000'

SCALE



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SOILS MAP

FIGURE 6

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- Tallac gravelly coarse sandy loam, 30 to 70 percent slopes, very stony (7523). This soil consists of colluvium over till derived from mixed sources. Average total available water in the top five feet of soil is 3.2 inches. Hydrologic soil group is A and runoff class is medium. Water table is present within the soil profile.

- Tallac gravelly coarse sandy loam, moderately well drained, 0 to 5 percent slopes (7524). This soil consists of colluvium over till derived from mixed sources. Average total available water in the top five feet of soil is 3.2 inches. Hydrologic soil group is A and runoff class is very low. Water table is present within the soil profile.

- Tallac gravelly coarse sandy loam, moderately well drained, 5 to 9 percent slopes (7525). This soil consists of colluvium over till derived from mixed sources. Average total available water in the top five feet of soil is 3.2 inches. Hydrologic soil group is A and runoff class is low. Water table is present within the soil profile.

- Tallac gravelly coarse sandy loam, moderately well drained, 2 to 9 percent slopes, rubbly (7526). This soil consists of colluvium over till derived from mixed sources. Average total available water in the top five feet of soil is 3.2 inches. Hydrologic soil group is A and runoff class is low. Water table is present within the soil profile.

3.5 Land Capability

The TRPA developed the land capability system currently used in the Tahoe Basin. All the lands within the basin are divided into seven classes based on soil types, potential for erosion, and other related characteristics.[9] Lands with a ranking of 1 have the highest potential for erosion and 7 the lowest. Level 1 is also subdivided into three categories: 1a – least tolerance for use; 1b – poor natural drainage in a stream environmental zone (SEZ); and 1c – fragile flora and fauna. There are four land capability classes within the Project area (Table 1 and Figure 7). Land capability groups were based on TRPA Plan Area Statement maps. A request for Verification of Land Capability by TRPA staff will be forwarded shortly for those areas where work is proposed.

Table 1 – Area Distribution by Land Capability Class

Land Capability Class	Percent
1a	3%
1c	6%
3	1%
5	90%

3.6 Land Use

The Project area boundary lies within the TRPA Plan Area Statement (PAS) 154 – Tahoma Residential (Figure 7). For PAS 154, the land use classification is residential, the management strategy is mitigation, and the special designation is preferred affordable housing area.

LEGEND

155	TRPA PAS NUMBER
	PAS BOUNDARY
	PARCEL BOUNDARY, COUNTY, OR CALTRANS RIGHT-OF-WAY
	PROJECT AREA
	LAND CAPABILITY CLASS 1a
	LAND CAPABILITY CLASS 1b
	LAND CAPABILITY CLASS 1c
	LAND CAPABILITY CLASS 3
	LAND CAPACILITY CLASS 5
	LAND CAPACILITY CLASS WATER BODY

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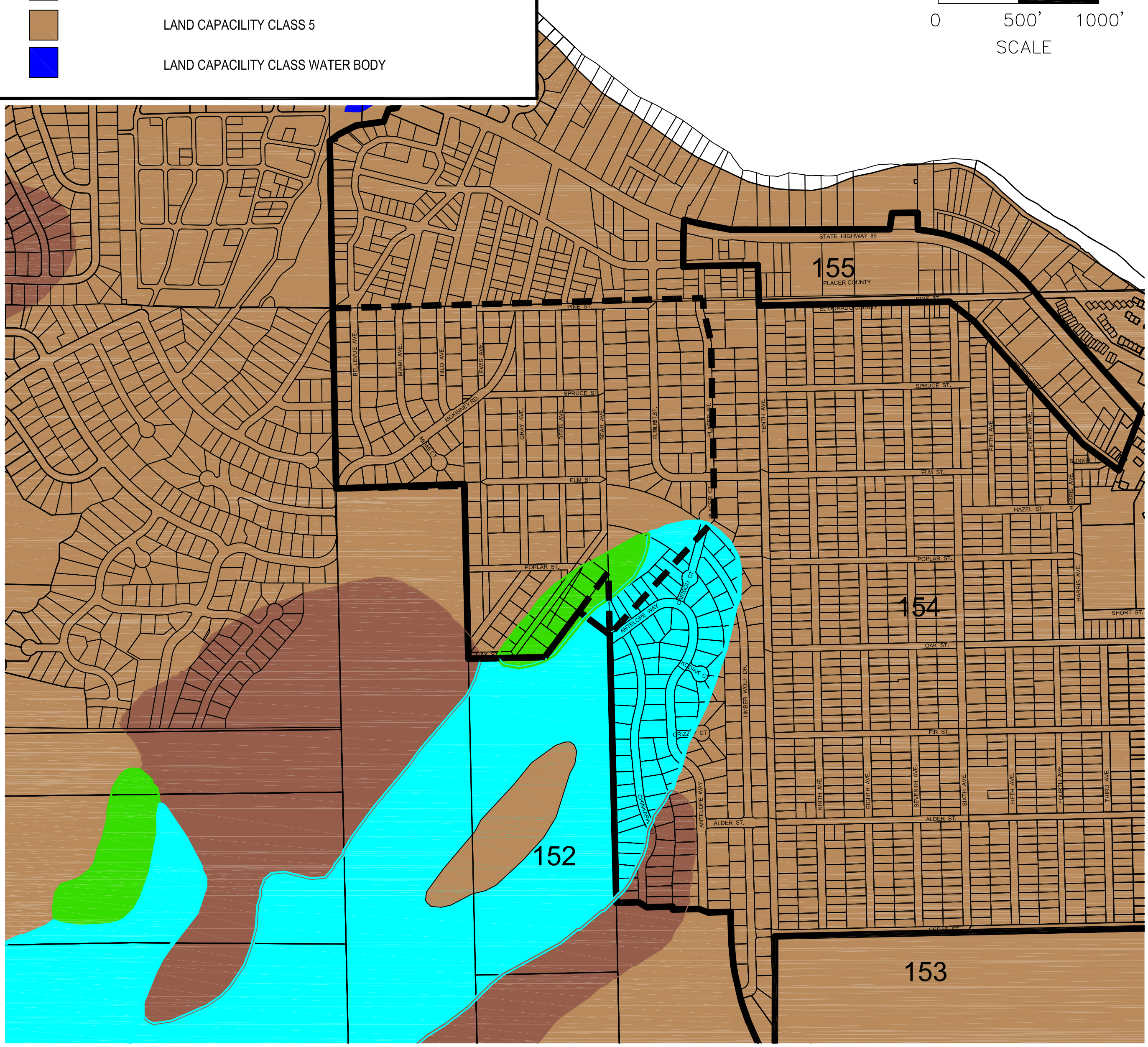
SCALE



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LAND CAPABILITY AND LAND USE MAP

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FIGURE 7

Within PAS 154, the existing uses are a mixture of residential uses ranging from higher density condominiums to low density single family dwellings. The shoreline is in private ownership and the area is 70% built out[10].

3.7 Biological Resources

3.7.1 Wetlands

Jurisdictional waters of the U.S. are classified into multiple types based on topography, edaphics (soils), vegetation, and hydrologic regime. Primarily, the U.S. Army Corps of Engineers establishes two distinctions: Wetland and non-wetland waters of the U.S. Non-wetland waters are commonly referred to as other waters.

If necessary, Transportation will retain a consultant to determine the presence of jurisdictional wetlands.

3.7.2 Vegetation

Transportation retained NCE to determine the presence of special status plant species, vegetation classifications, and invasive/noxious weed species within a one-half mile radius of the Project area.[11] [12] NCE found Tahoe yellow cress is documented to be within the Phase 1 and 2 Project boundaries in an area where no improvements were proposed.

If work will be completed in undisturbed areas outside of the County right of way Transportation will retain a consultant to determine the presence of special status plant species and invasive/noxious weed species.

3.7.3 Wildlife

Transportation retained NCE to determine the presence of special status wildlife species and habitat within a one-half mile radius of the Project area.[13] Background research found detections of four special status species within the one-half mile radius boundary; however, NCE adds that habitat found within the Phase 1 and 2 Project areas was marginal and would not support the reproductive requirements of special status species.

If work will be completed in undisturbed areas outside of the County right of way Transportation will retain a consultant to determine the presence of special status wildlife species and habitats. The Consultants findings and any limited operating periods would then be considerations in the preferred alternative design and construction schedule.

3.8 Property Network

The Project property network was developed from field survey, ROW, and recorded subdivision maps and depicts County and Caltrans road ROW and property lines. The purpose of this property network is to depict a best-fit representation of the subdivisions based on the respective found monuments such that Transportation can identify the properties and ROW affected by the erosion control projects for engineering and design purposes.

Figure 8 presents the Project area which is comprised primarily of private lots containing single family dwellings. There is a small portion of commercial lots that front Highway 89 and the area by the lake shore is condominiums. No attempt was made to resolve any mathematical discrepancy with the individual property lines or ROW within the project area. Additional surveying and analysis would be required to provide specific and final resolution for any given property line. All planned improvements are within the existing County ROW or publically owned parcels. If determined necessary, Transportation will begin the process of ROW acquisition for easements, special use permits, and license agreements for any affected parcels during the development of the preferred design alternative.

3.9 Existing Utilities

Numerous underground and overhead utilities are within the Project area. The Existing Utilities Map (Figure 9) was developed using available record information and shows the approximate location and utility type. Utility owners are listed in Table 2.

Table 2 – Utility Owner List

Utility Type	Owner	Owner Address	Contact Name
Telephone	AT&T	12824 Earhart Ave. Auburn, CA 95602	Astrid Willard
Electricity	Liberty Energy	933 Eloise Avenue, S. Lake Tahoe, CA 96150	Andrew Gregorich
Water / Sewer	TCPUD	P.O. Box 5249 Tahoe City, CA 96145	Tony Laiotis
Cable Television	Suddenlink Communications	10607 West River St., Bldg 3, Unit D, Truckee, CA 96161	Bart Givens
Natural Gas	Southwest Gas	1740 D Street, Unit No.4 South Lake Tahoe, CA 96150	Jimmy Smith

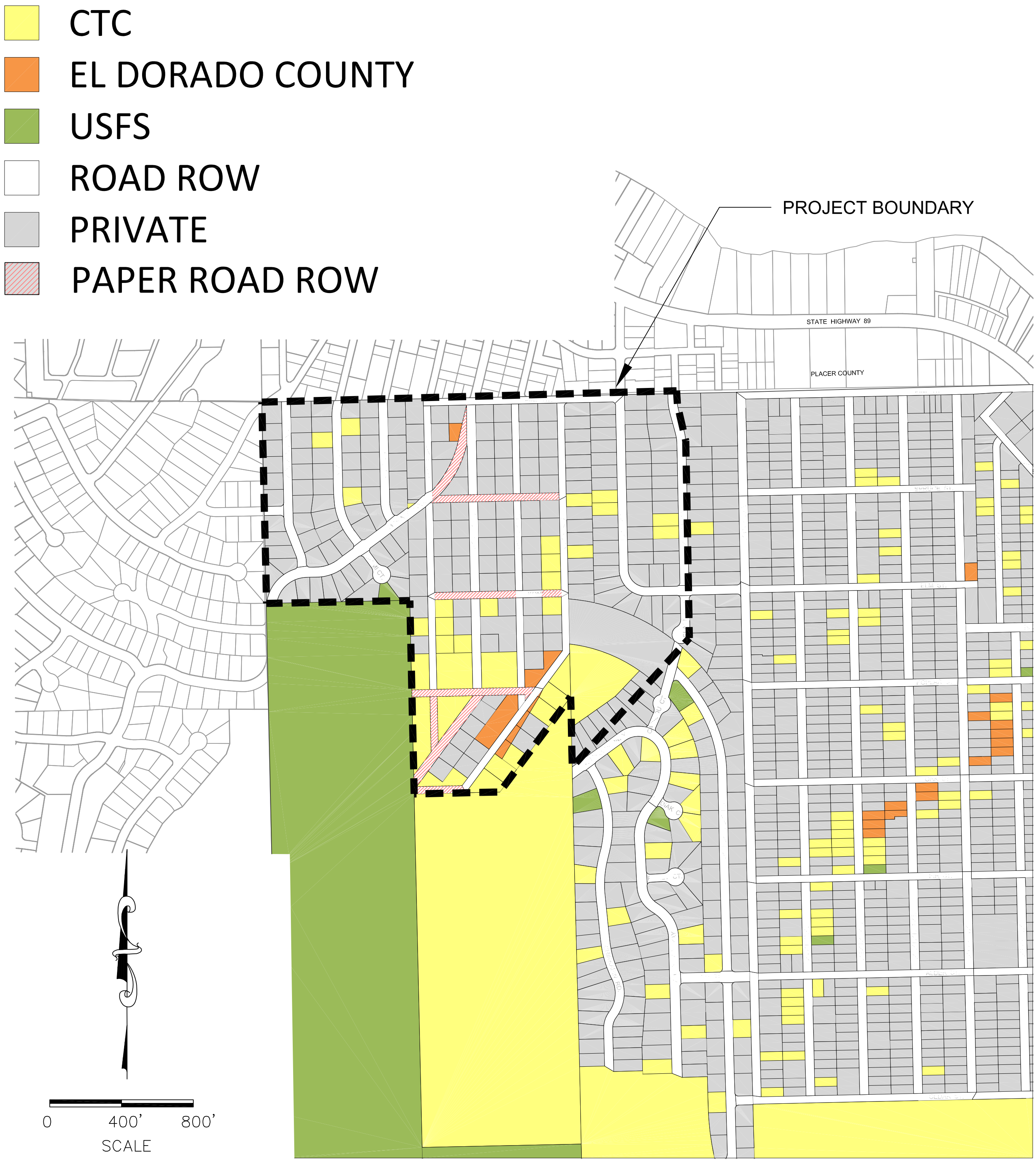
3.10 Driveway and Private BMP Inventory

A driveway and BMP inventory was not completed for this Project.

3.11 Maintenance

During the winter months, the County of El Dorado Maintenance Division removes snow by plowing within and adjacent to the Project limits on an as-needed basis. Snow is plowed along every street of the Project area with snow storage occurring at the ends of streets or cul-de-sacs where stacked snow does not interfere with driveway access. Transportation road maintenance activities in the winter are primarily limited to snow removal. However, in extreme conditions, road abrasives are applied as required on the steeper sections of roadways. Sweeping of the roads and directing runoff into existing basins and catchment structures are currently the primary methods of collecting sediment generated by road abrasives, naturally occurring sediment, or sediment tracked into the Project area.

PROPERY OWNERSHIP



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PUBLIC PROPERTY MAP

FIGURE

8

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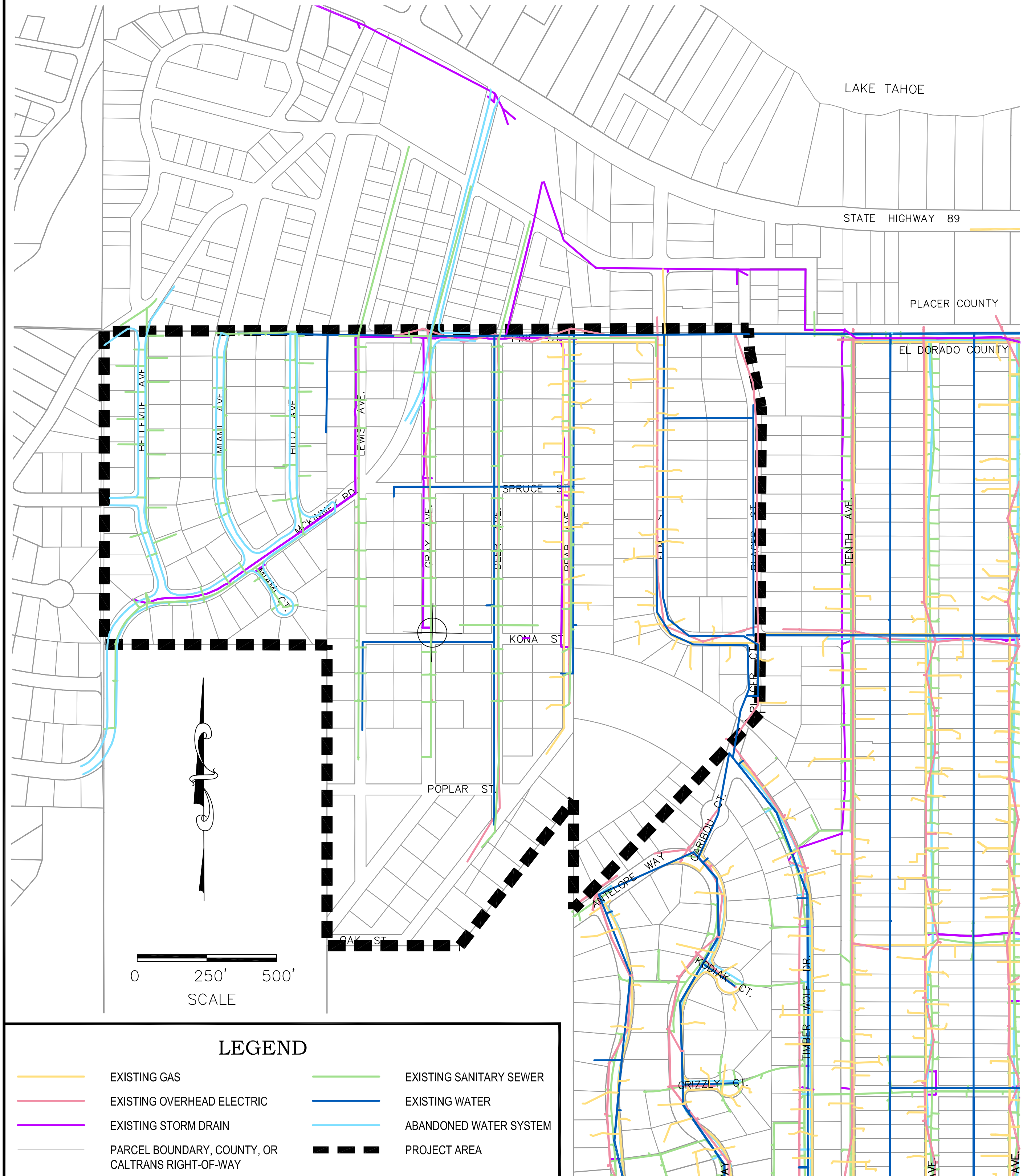

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CSA 5 - Phase 3
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UTILITY MAP

FIGURE 9

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4.0 Hydrology Summary

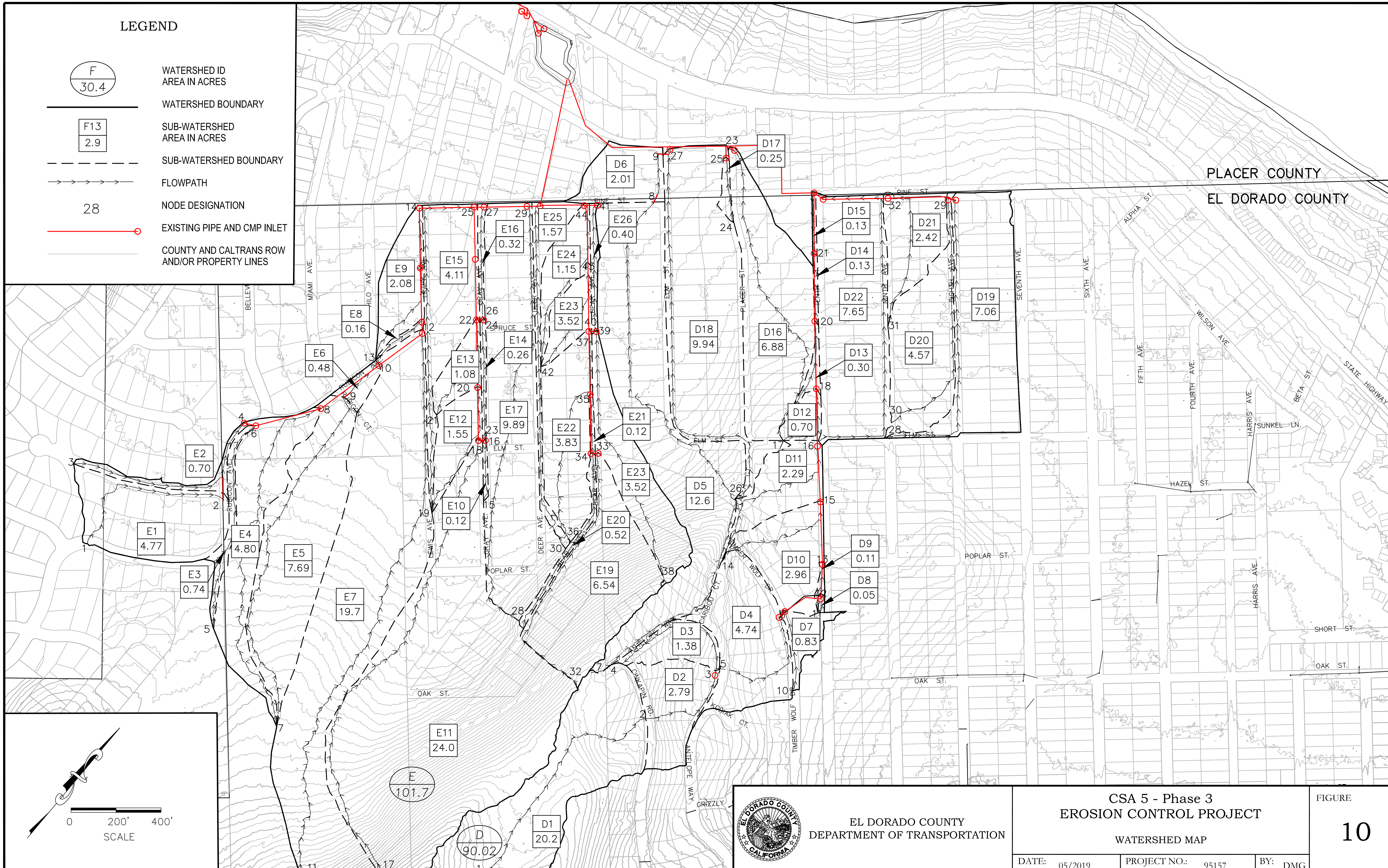
The hydrologic characteristics of the Project area were analyzed in accordance with techniques outlined in the 1995 El Dorado County Drainage Manual (Drainage Manual).[14] The Drainage Manual includes precipitation information through 1989. Since that time, additional updates have been completed for the precipitation record including an update of the precipitation Mean Annual Precipitation Map.[15]

4.1 Watershed Characteristics

Runoff generally flows from the southwest to the northeast. Using topographic mapping based on recent field and aerial survey data collected, Transportation has defined 2 primary watersheds within the Project area (Figure 10).

Watershed D is approximately 90 acres divided into 22 sub-watersheds. Most of this runoff originates from undeveloped, mountainous terrain. Watershed D is conveyed through the subdivision via pipe, sheet flow, roadside ditches, AC swales, or AC dike to CMP inlets. A pipe system connects the CMP inlets and conveys runoff to the north. Some pipes were perforated to allow for infiltration under the roads and dirt shoulders. The runoff accumulates and is conveyed out of the project area to an infiltration basin (Gray Basin) located within Placer County for treatment.

Watershed E includes approximately 102 acres divided into 26 sub-watersheds. The runoff from this watershed originates within the subdivision and is conveyed via pipe, sheet flow, roadside ditches, AC swales, or AC dike to CMP inlets and channels. Some pipes connecting CMP inlets were perforated to allow for infiltration under the roads and dirt shoulders. The runoff from Watershed E accumulates and is conveyed out of the project area into an infiltration basin (Gray Basin) located within Placer County where it combines with runoff from watershed D for treatment. The outfall from Gray Basin enters an existing Placer County stormwater system which outfalls into McKinney Creek.



0 200' 400'

SCALE

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CSA 5 - Phase 3
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WATERSHED MAP

FIGURE

10

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4.2 Storm Frequency

A variety of storm frequency requirements have been recommended for erosion control projects within the Lake Tahoe Basin in various publications. Transportation utilizes the Drainage Manual as a guide for hydrologic and hydraulic design within the Tahoe Basin. The Drainage Manual requires that drainage facilities be designed to safely convey storm water runoff from an event with an average recurrence interval of 100-years for areas greater than 100 acres, and an average recurrence interval of 10-years for areas less than 100 acres.[16]

The TRPA Code of Ordinances stipulates an infiltration requirement for the 20-year, 1-hour storm runoff volume.[17] The TRPA Code of Ordinances also states that drainage conveyance facilities shall be designed for at least a 10-year, 24-hour storm and that drainage conveyance through a SEZ shall be designed for a minimum 50-year storm. The Lahontan Water Quality Control Plan states that the "design storm" for storm water control facilities in the Lake Tahoe Basin is the 20-year, 1-hour storm event.[18]

For the two watersheds, Watershed D is less than 100 acres and Watershed E is approximately 102 acres which exceeds the 100 acre threshold. Therefore, within Watershed E, any proposed design locations where the cumulative contributing watershed area exceeds 100 acres within the Project's areas of interest (Figure 1) will have to convey storm water runoff from an event with an average recurrence interval of 100 years. The NRCS soil survey and the Land Capability and Land Use Map (Figure 7) do not identify any SEZ within the Project area, therefore the conveyance improvements will not need to meet the requirements to meet or exceed the 50-year storm within SEZ areas pending the TRPA Land Capability verification. For evaluation of hydraulic drainage structure conveyance, the Project design storm frequency is defined as the 10-year event with the storm duration equal to the time of concentration.[19] In addition, Transportation will analyze the peak runoff for the 100-year, 24-hour return period storm event.

4.3 Precipitation Values

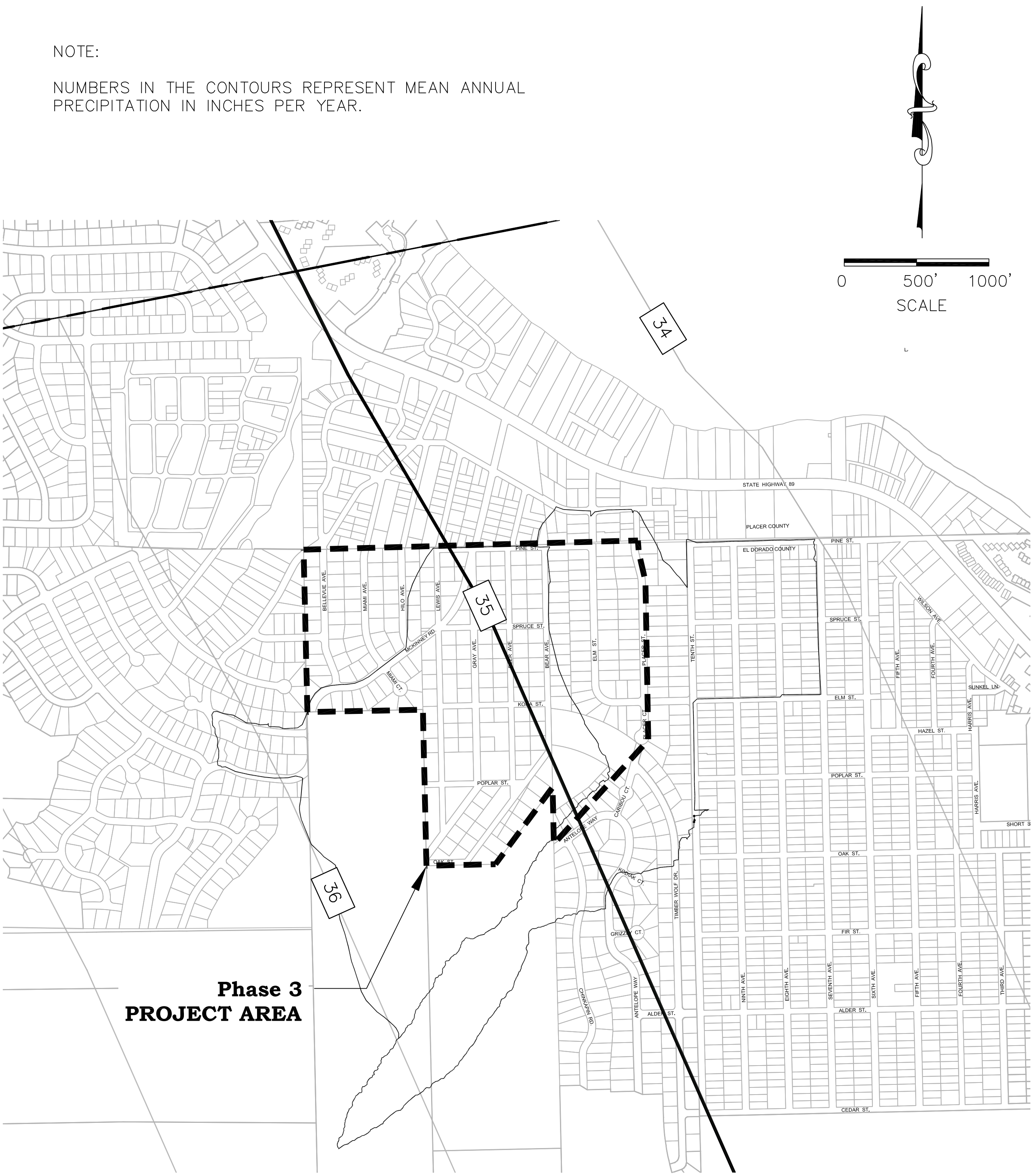
The mean annual rainfall for Watersheds D and E is 35 inches (Figure 11) and the 1-hour rainfall depth is equal to 0.94 inches and 1.10 inches (Figure 12) for 10-year and 25-year return periods, respectively.[20] The 100-year, 1-hour rainfall depth is equal to 1.33 inches.[21] The TRPA Code of Ordinances stipulates that an average rain intensity of 1-inch per hour can be used for the 20-year, 1-hour storm for water quality evaluation.[22] The Lahontan Water Quality Control Plan states that for the Mammoth Lakes area, the 1-hour design storm is equal to 1 inch of rainfall.[23] Based on the location of the Project, the Project design rainfall intensity for the 1-hour storm is accepted as 1.10 inches to represent a storm event with a return period of 25-years. For evaluation of hydraulic drainage structures, the Project design precipitation value is based on the hydrologic response characteristics of the basin with the storm duration equal to the time of concentration.[24]

4.4 Hydrologic Methods

The objective of the hydrologic analysis is to estimate the peak flow and the total runoff volume for the Project design storm and precipitation values. Two hydrologic techniques were used; the Rational Method and the SCS Unit Hydrograph Method. An Excel spreadsheet was used to calculate peak flows and velocities using the Rational Method and the computer program *Hydrologic Engineering Center - Hydrologic Modeling System, HEC-HMS*, version 4.2.1, was used to calculate peak flows and volumes using the SCS Unit Hydrograph Method. The results from these analyses were accepted to represent design storm peak flow and volumes without the presence of base flow.

NOTE:

NUMBERS IN THE CONTOURS REPRESENT MEAN ANNUAL PRECIPITATION IN INCHES PER YEAR.



EL DORADO COUNTY
DEPARTMENT OF TRANSPORTATION

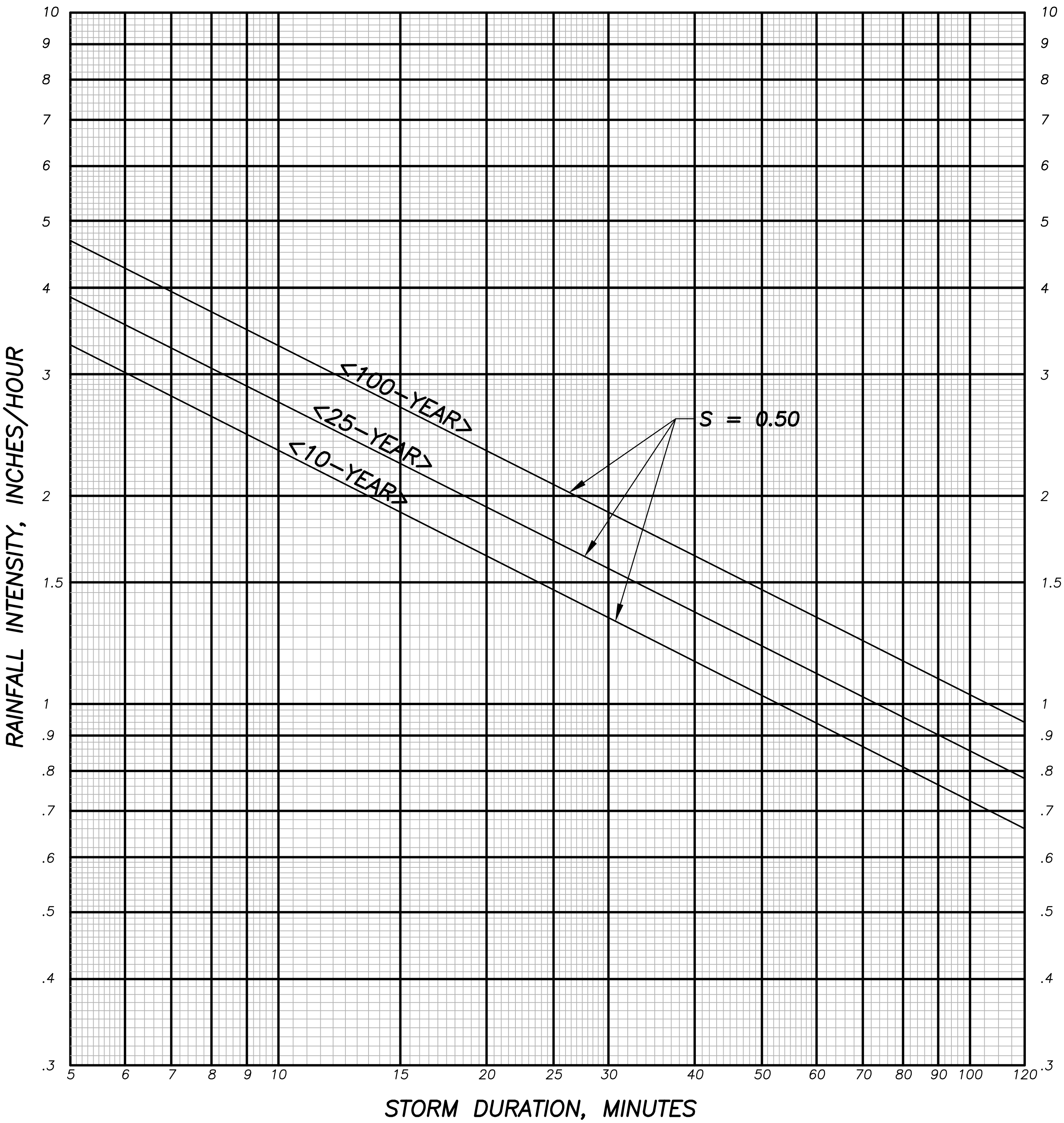
CSA 5 - Phase 3
EROSION CONTROL PROJECT

MEAN ANNUAL RAINFALL

FIGURE 11

DATE: 06/2019 | PROJECT NO.: 95157 | BY: DMG

RAINFALL INTENSITY DURATION FREQUENCY CURVE



SOURCE: COUNTY OF EL DORADO DRAINAGE MANUAL, 1995
UPDATED FROM EL DORADO COUNTY DESIGN RAINFALL, GOODRIDGE 2008
MEAN ANNUAL RAINFALL – ISOHYET 35 IN.

EL DORADO COUNTY DEPARTMENT OF TRANSPORTATION	CSA 5 - Phase 3 EROSION CONTROL PROJECT RAINFALL INTENSITY-DURATION-FREQUENCY CURVES	FIGURE 12
	DATE: 06/2019 · PROJECT NO.: 95157 · BY: DMG	

Watersheds D and E were divided into sub-watersheds in order to estimate the peak flow and volume at specific locations such as existing drainage structures and existing stormwater treatment locations.

4.4.1 Rational Method

The Rational Method was used to calculate the peak discharge from the Project area based on the 25-year Project design rainfall intensity. This method relies on four input variables and was calculated using equation 1:[25]

$$Q = C \cdot C_f \cdot I \cdot A \quad (1)$$

Where Q is peak discharge in cfs, C is the runoff coefficient, C_f is the runoff coefficient frequency adjustment factor, I is the rainfall intensity in inches per hour, and A is the area of the watershed in acres. For the Project area an unadjusted runoff coefficient C of 0.1 was selected based on the type of drainage area being unimproved. For this Project design rainfall return period of 100-years, a runoff coefficient frequency adjustment factor C_f of 1.25 was applied to the runoff coefficient.[26] The rain intensity I of the design storm was dependent on the duration and the area A of the sub-watershed varied by location.

The flow paths for the Project watersheds were segregated into overland sheet flow on the unimproved areas and shallow concentrated flow along the County roads for paved and unpaved surfaces. The times of concentration were calculated for each watershed to determine the time required for runoff to travel from the hydraulically most distant part of the watershed to the outlet from the Project area. For this Project area, the overland-flow roughness coefficient was estimated to be 0.40 based on woods with light underbrush.

The travel time for sheet flow was calculated using the kinematic-wave equation and is presented as equation 2:[27]

$$T_t = 0.007 \frac{(n \cdot L)^{0.8}}{P^{0.5} \cdot S^{0.4}} \quad (2)$$

Where T_t is sheet flow time of travel in hours, n is overland-flow roughness coefficient, L is length of overland flow in feet (300 foot maximum), P is rainfall depth in inches, and S is land slope in feet per feet. The velocity of shallow flow over unpaved surfaces was estimated based on equation 3:[28]

$$V_U = 16.1345 \cdot S_O^{\ 0.5} \quad (3)$$

Where V_U is flow velocity in feet per second and S_0 is land slope in feet per feet. The velocity of shallow flow over paved surfaces was estimated based on equation 4:[29]

$$V_P = 20.3283 \cdot S_O^{\ 0.5} \quad (4)$$

Where V_P is flow velocity in feet per second and S_0 is land slope in feet per feet. The times of concentration for shallow flow over unpaved and paved surfaces were calculated by dividing the flow path length by the velocity. The watershed time of concentration for each of these flow path segments was summed to determine the total time.

4.4.2 SCS Unit Hydrograph Method (HEC-HMS)

The SCS Unit Hydrograph Method is commonly used for determining the peak flow (Q) and the hydrograph from relatively large watersheds (up to 10 sq. mi.). Transportation used the unit hydrograph for an entire watershed tributary to its outflow. This method was used to determine the peak runoff rates for the Project watersheds.

The program requires input parameters and variables such as a Basin Model, Meteorological Model, and a Control Storm. The Basin Model parameters include input of the drainage area, lag time, percent impervious, initial abstraction I_a, and any base flow information. The lag time is the product of 0.6 multiplied by the time of concentration derived from the Rational Method.[30] The impervious coverage was estimated using existing aerial topographic mapping for each watershed along with the land use maps developed for the recently updated NPDES Permit.[31] The initial abstraction was calculated using equation (5):

$$I_a = 0.2\left(\frac{1000}{RI} - 10\right) \quad (5)$$

With the runoff index (*RI*) being equivalent to a weighted curve number (CN). For the Meteorological Model, the Soil Conservation Services (SCS) method was chosen with a Type 1A storm, per the Drainage Manual (Ford 1995).

Output results for HEC-HMS are contained in Appendix B.

4.5 Hydrologic Results

Based on the results of the Rational Method, the peak discharge for the watersheds is presented in Table 3. The peak discharge for the sub-watersheds within each watershed is presented in Table 4.

Table 3 – Watershed Characteristics & Peak Flow Summary (Rational)

WS	Area (ac)	Parameters			Q Peak (cfs)			% Impervious
		C[1]	Tc (min)	I[2] (in/hr)	10-Yr, 6-Hr	25-Yr, 1-Hr	100-Yr, 24-Hr	
D	90.0	0.23	61	1.09	19.5	22.8	132	16
E	101.7	0.22	80	0.95	14.4	16.8	25.4	9

Notes:
1. For 100-year events, value increased by 25%.
2. Only 25-year event is listed here.

Table 4 – Sub-Watershed Characteristics & Peak Flow Summary (Rational)

WS	Sub WS	Area (ac)	Parameters			Q Peak (cfs)			% Impervious
			C[1]	Tc (min)	I[2] (in/hr)	10-Yr, 6-Hr	25-Yr, 1-Hr	100-Yr, 24-Hr	
D	D1	20.2	0.13	38	1.39	3.2	3.7	5.6	4

WS	Sub WS	Area (ac)	Parameters			Q Peak (cfs)			% Impervious
			C[1]	Tc (min)	I[2] (in/hr)	10-Yr, 6-Hr	25-Yr, 1-Hr	100-Yr, 24-Hr	
D	D2	2.8	0.27	8	3.22	2.8	2.5	3.8	22
	D3	1.4	0.32	9	2.99	1.1	1.3	2.0	28
	D4	4.7	0.27	9	2.88	3.2	3.7	5.6	22
	D5	12.6	0.23	24	1.76	4.4	5.2	7.8	17
	D6	2.0	0.36	1	8.22	5.1	6.0	9.0	33
	D7	0.8	0.35	10	2.76	0.7	0.8	1.2	31
	D8	0.05	0.44	7	3.45	0.1	0.1	0.1	43
	D9	0.1	0.43	23	1.80	0.1	0.1	0.1	42
	D10	3.0	0.22	9	2.89	1.6	1.9	2.8	15
	D11	2.3	0.27	9	2.83	1.5	1.8	2.7	22
	D12	0.7	0.36	7	3.17	0.7	0.8	1.2	32
	D13	0.3	0.39	8	3.13	0.3	0.4	0.6	36
	D14	0.1	0.70	7	3.22	0.3	0.3	0.4	75
	D15	0.1	0.57	7	3.24	0.2	0.2	0.4	58
	D16	6.9	0.25	50	1.21	1.8	2.1	3.2	19
	D17	0.3	0.41	7	3.19	0.3	0.3	0.5	38
	D18	9.9	0.26	0	2.24	69.2	82.0	123.0	20
	D19	7.1	0.23	16	2.17	3.0	3.5	5.3	16
	D20	4.6	0.20	48	1.24	1.0	1.1	1.7	12
	D21	2.4	0.26	56	1.14	0.6	0.7	1.1	20
	D22	7.7	0.30	14	2.27	4.5	5.3	8.0	26
E	E1	4.8	0.25	55	1.15	1.2	1.4	2.1	19%
	E2	0.7	0.5	1.7	6.6	2.0	2.4	3.6	52%
	E3	0.7	0.50	44	1.30	0.4	0.5	0.7	50%
	E4	4.8	0.14	48	1.23	0.7	0.8	1.3	5%
	E5	7.7	0.11	49	1.22	0.9	1.0	1.5	1%

WS	Sub WS	Area (ac)	Parameters			Q Peak (cfs)			% Impervious
			C[1]	Tc (min)	I[2] (in/hr)	10-Yr, 6-Hr	25-Yr, 1-Hr	100-Yr, 24-Hr	
E	E6	0.5	0.46	1	8.33	1.6	1.8	2.8	45%
	E7	19.7	0.13	36	1.42	3.2	3.7	5.6	4%
	E8	0.2	0.52	8	3.11	0.2	0.3	0.4	52%
	E9	2.1	0.25	12	2.53	1.1	1.3	2.0	19%
	E10	0.1	0.64	8	3.08	0.2	0.2	0.4	67%
	E11	24.0	0.10	30	1.56	3.3	3.9	5.8	0%
	E12	1.6	0.19	53	1.17	0.3	0.3	0.5	11%
	E13	1.1	0.20	68	1.03	0.2	0.2	0.3	13%
	E14	0.3	0.59	11	2.61	0.3	0.4	0.6	61%
	E15	4.1	0.25	18	2.03	1.8	2.1	3.2	19%
	E16	0.3	0.57	10	2.80	0.4	0.5	0.8	59%
	E17	9.9	0.20	41	1.34	2.3	2.7	4.0	13%
	E18	1.6	0.36	16	2.17	1.0	1.2	1.8	32%
	E19	6.5	0.15	26	1.67	1.4	1.7	2.5	7%
	E20	0.5	0.48	9	2.95	0.6	0.7	1.1	48%
	E21	0.1	0.39	8	3.01	0.1	0.1	0.2	36%
	E22	3.8	0.21	40	1.35	0.9	1.1	1.6	14%
	E23	3.52	0.21	30.39	1.56	0.97	1.14	1.72	13.5
	E24	1.15	0.27	65.91	1.05	0.28	0.32	0.49	20.8
	E25	1.57	0.23	78.52	0.96	0.30	0.35	0.53	16.5
	E26	0.40	0.55	11.30	2.57	0.48	0.56	0.85	56.2

Notes:
1. For 100-year events, value increased by 25%.
2. Only 25-year event listed here.

Based on the results of the HEC-HMS model, the peak discharge and volumes for the 25-year, 1-hour storm for the watersheds are presented in Table 5.

Table 5 – Watershed Peak Flow Summary [25-yr, 1-hr] (Unit Hydrograph)

WS	Area (acres)	Area (sq mi)	Q Peak (cfs)	Volume (ac-ft)	Volume (ft^3)
D	90.0	0.141	15.4	1.318	57,412
E	101.7	0.159	8.3	0.850	37,026

Exhibit 1 of Appendix B depicts the location of Gray Basin, an infiltrating sediment basin located at the outfalls of the storm drain systems of both watersheds D & E. This basin is located outside of the project boundary as it is an El Dorado County owned parcel within Placer County. Table 6 presents the results of the HEC-HMS model peak discharge and volumes for the 25-year, 1-hour storm at the Gray Basin.

Table 6 – Infiltration Basin Peak Flow Summary [25-yr, 1-hr] (Unit Hydrograph)

Basin	Tributary Sub-WS	Area (acres)	Area (sq mi)	Q Peak (cfs)	Volume (ac-ft)	Volume (ft^3)
GRAY BASIN	D & E	191.7	0.30	23.3	2.168	94,438

The peak discharge based on the Rational Method is greater than the results from the HEC-HMS model. The differences can be attributed to the different parameters required for the calculations. For watersheds less than 100 acres, Transportation utilizes the Rational Method results for analyzing existing and proposed storm drain systems. The Unit Hydrograph modeling provides the runoff volumes required for confirming compliance with permitting requirements and analyzing existing and proposed infiltration/detention systems.

4.6 Hydrologic Validation

Hydrologic validation will be performed once the selection of the alternative has been finalized.

5.0 Hydraulics Summary

The intent of the hydraulic analysis is to confirm whether the existing storm drain systems are adequate for conveyance of the calculated runoff, whether inlet conditions accommodate that runoff, and to evaluate erosion conditions within the Project area. Infrastructure within the projected area includes solid wall and perforated pipes, channels, CMP and rectangular concrete drainage inlets, and storm drain manholes (Exhibits 1 and 2, Appendix B). These improvements continue below the project area and discharge to an infiltrating sediment basin. These facilities were installed as subdivision infrastructure or as part of erosion control projects constructed in 1987 and 2014. This analysis will be limited to only those systems in the areas of work shown on Alternative 1, as discussed in Sections 8 and 9.

5.1 Pipe Characteristics

The pipe systems within the Project's areas of interest (Figure 13) are comprised of 12", 18", 24", 30", 36", and 42" diameter CMP, 18" and 24" PCMP (perforated), and 24"x35", 42"x29", and 49"x33" arch CMP. The pipes were installed during subdivision development or as part of the 1987 Storm Drain Erosion Control and Street Improvement Program for County Service Area No. 5 Project. The Manning's roughness coefficient (n) of the CMP was estimated to be 0.024.[32]

5.2 Shoulder Characteristics

Drainage along the existing road shoulders is conveyed by AC dike, AC swale, dirt swale, or sheet flow. Evidence of erosion along the shoulders is apparent on Placer Street and Elm Street. Elsewhere, erosion along the shoulders is minimal, but enough that most of the CMP inlets have accumulated sediment around the structures. The main sources of sedimentation are typically unpaved driveways, bare shoulder, and winter sanding operations.

5.3 Hydraulic Methods

For circular pipes, the full capacity of the pipe was calculated using the Manning's equation which is presented as equation 5:[33]

$$Q = 0.463 \cdot \frac{D^{8/3} \cdot S_f^{1/2}}{n} \qquad (5)$$

Where Q is discharge in cubic feet per second, D is pipe diameter in feet, S_f is slope of the energy grade line in feet/feet, and n is Manning's roughness coefficient. For arch CMP, the equation was used for the equivalent circular pipe size. The hydraulic capacity of the existing pipes was compared to the results of the hydrologic analysis for the design storm.

5.4 Hydraulic Results

Based on the Rational Method results, a majority of the pipes within the Project area were found to be sized correctly for the 25-year, 1-hour event. Table 7 contains a summary of the existing pipes, inflows, and capacities of pipes which were determined to be at or to have exceeded 74% capacity. A complete list can be found in the hydraulics section of Appendix B.

Table 7 – Existing Pipe Characteristics [25-yr, 1-hr] (Rational)

WS & Pipe ID	Pipe Size & Material	Inlet / Outlet Facility	Q Capacity (cfs)	Q 25-yr, 1-hr (cfs)	% Capacity
D 2935	18" CMP	CMP Inlet / PIPE 2936	4.8	4.4	92
D 381	18" CMP	CMP Inlet / CMP Inlet	8.4	6.6	78
D P P&E[1]	18" CMP	CHANNEL / CHANNEL	5.1	5.2	101

[1] Pipes are within Placer County and located outside the project are, and are, connected to the storm drain system which contributes to Gray Basin

WS & Pipe ID	Pipe Size & Material	Inlet / Outlet Facility	Q Capacity (cfs)	Q 25-yr, 1-hr (cfs)	% Capacity
D P E&EDO[1]	18” CMP	CMP Inlet / PIPE 444	4.2	5.1	123
D 1697	18” CMP	CMP Inlet / CMP Inlet	5.7	6.9	122
D 462	18” PMP	PIPE 462 / CMP Inlet	5.3	6.9	131
D 463	18” PMP	CMP I / CMP Inlet	7.0	7.6	109
D 2608[1]	18” CMP	DI / SDMH	12.8	10.8	85
D 2612[1]	30” CMP	CHANNEL / UNKNOWN	14.5	14.4	99
D 2609[1]	42”X29” CMP	SDMH / SDMH	17.5	16.1	92
D 2607[1]	42”X29” CMP	SDMH / SDMH	18.1	22.8	126
D 2606[1]	49”X33” CMP	SDMH / SDMH	27.9	22.8	82
D 2605[1]	42” CMP	SDMH / SDMH	27.6	22.8	83
D 2604[1]	42” CMP	SDMH / GRAY BASIN	30.9	22.8	74
E 1606	12” CMP	CMP Inlet / CMP Inlet	1.7	1.7	96
E 1610	18” CMP	CMP / PIPE 1610	4.8	3.8	79

Pipe located outside the project area, and within Placer County, but connected to the storm drain system which contributes to Gray Basin

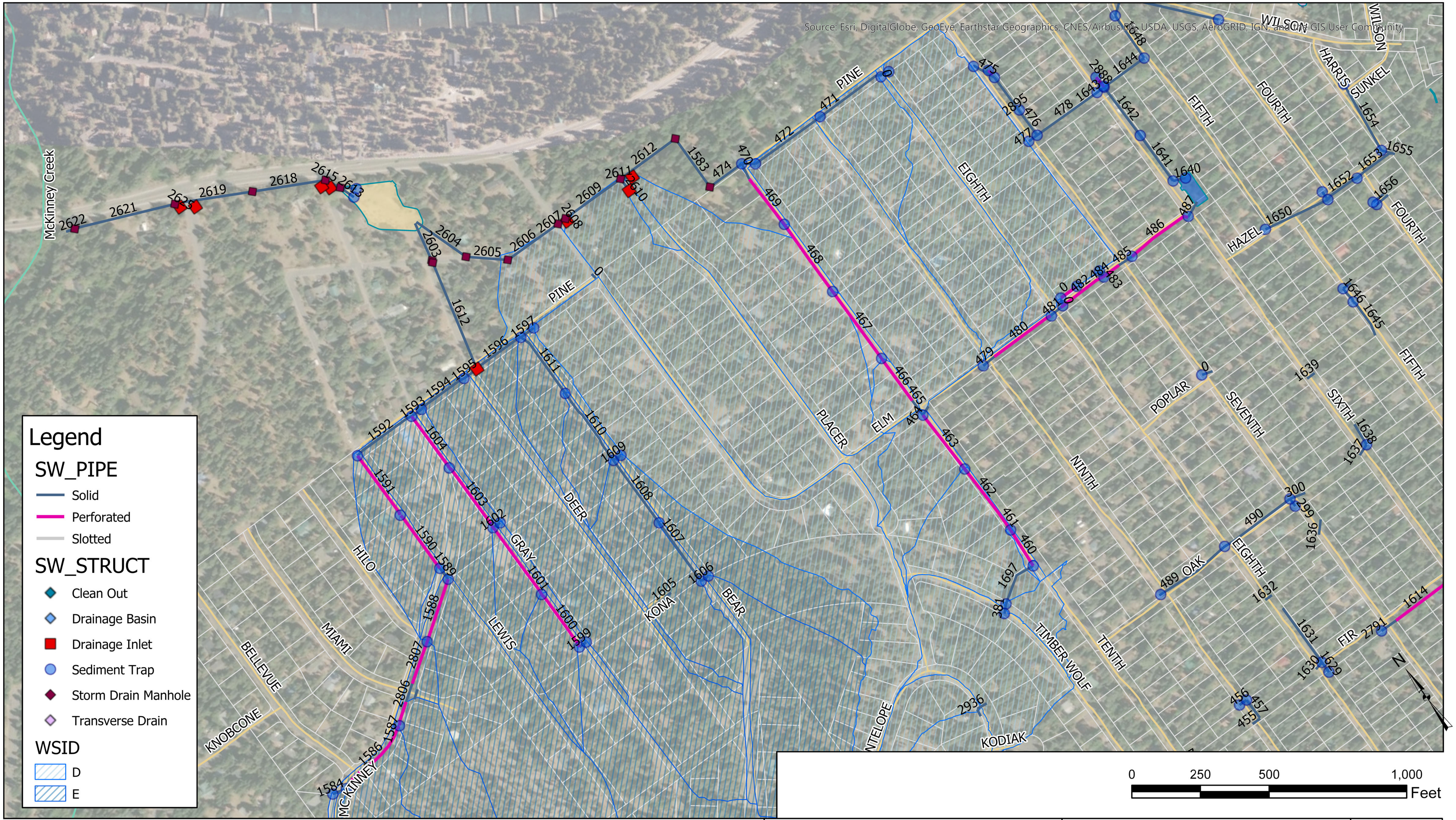
There are six locations where the County has estimated that runoff of a 25 year-1hour storm will exceed the capacities of the respective pipes. Updated watershed parameters could be attributed to this change or the previous design may have been based on a 10-year, 6-hour event which would be a valid approach with the tributary watershed areas being less than 100 acres. The County is not aware of any issues during past storm events were capacity has been an issue. Another consideration is the existing systems were designed for infiltration and detention, which Transportation is not accounting for in this analysis. During development of the Design Report, Transportation will conduct a more thorough analysis for those specific areas of work identified in the preferred alternative.

6.0 Storm Water Quality and Loading Summary

6.1 Water Quality Monitoring Plan

Transportation has developed a Water Quality Monitoring Plan for the Project area which includes visual and photographic documentation of storm water runoff before and after construction of this erosion control project. In addition, the Water Quality Monitoring Plan outlines methods which will be utilized to record the peak flow, and volume and water quality characteristics of runoff into Gray Basin. The pre-construction and post-construction results will be analyzed on an annual basis with technical memos summarizing monitored storm events.

The primary goal of the monitoring plan is to quantify the existing sediment load and determine the hydrologic reduction in runoff peak flows and volume of runoff to Lake Tahoe based on the water quality loading benefits of this erosion control project. The monitoring results will be used to calibrate and validate technical watershed models and pollutant reduction and treatment analyses. The current specific water quality effluent objectives for runoff from the Project area after construction are based on TRPA and Lahontan water quality limits as presented in Table 8.[34] One of the goals of this Project is to meet these water quality limits by providing source control, hydrologic design, and treatment BMPs within the Project area for the 25-year 1-hour runoff event.



COUNTY OF EL DORADO
COMMUNITY DEVELOPMENT SERVICES
DEPARTMENT OF TRANSPORTATION

CSA #5
WATER QUALITY PROJECT
PHASE 3
STORMWATER PIPE AND STRUCTURE SYSTEM

DATE: 05/2019	PROJECT NO: 95157	BY: DWK

FIGURE
13

Table 8 – TRPA and Lahontan Water Quality Limits

Constituent	Surface Waters		Infiltration Systems	
	Lahontan	TRPA	Lahontan	TRPA
Total Nitrogen as N	0.5 mg/l		5 mg/l	
Dissolved Nitrogen as N		0.5 mg/l		5 mg/l
Total Phosphate as P	0.1 mg/l		1 mg/l	
Dissolved Phosphate as P		0.1 mg/l		1 mg/l
Total Iron	0.5 mg/l		4 mg/l	
Dissolved Iron		0.5 mg/l		4 mg/l
Turbidity	20 NTU		200 NTU	
Suspended Sediment		250 mg/l		
Grease & Oil	2 mg/l	2 mg/l	40 mg/l	40 mg/l

6.2 Storm Water Loading Summaries

6.2.1 Modeling Results

Load analysis from this Project was estimated using the Pollutant Load Reduction Model (PLRM) developed by NHC.[35] The PLRM utilizes a model to estimate average annual pollutant loads from the individual Project watersheds based on the following factors: watershed size, slope, land uses, road condition, shoulder condition, estimated connectivity of the roadway section, roadway maintenance practices, and number of private BMP's installed. A PLRM analysis was completed on the combined tributary areas of watersheds D & E (Table 9).[36]

Table 9 – Annual Pollutant Load (PLRM) – Existing Condition

BPC	UPC Outfall	WS	Area (acres)	Volume (Acre-Ft / Year)	FSP[1] (lbs/yr)	TP[1] (lbs/yr)	TN[1] (lbs/yr)
1	01	D & E	199.4	1.6	842	3	12

1. Based on Characteristic Runoff Concentrations as a funtion of land use.

A detailed analysis of the estimated average annual pollutant load will be completed as part of the Design Report.

6.2.2 Sampling Results

The Implementers Monitoring Program (IMP) was developed jointly by the California and Nevada implementing jurisdictions in order to collectively fulfill the National Pollutant Discharge Elimination System (NPDES) Permit requirements.[37] The IMP is a partnership between the Tahoe Resource Conservation District, El Dorado County, Placer County, the City of South Lake Tahoe, Douglas County, Washoe County, the Nevada Tahoe Conservation District, NDOT, and Caltrans. The Tahoe Resource Conservation District is the lead in working on behalf of the local jurisdictions to implement coordinated monitoring. The IMP has established multiple monitoring sites around Lake Tahoe to monitor either outfalls or BMP effectiveness. One of the sites selected is the 36" outfall pipe at the end of the condominium access road (referred to in the IMP as the Tahoma pipe).

Beginning in January 2014, as part of the IMP, storm water samples have been collected from the Tahoma pipe. During the 2014 water year measured turbidities were in the range of 1,500 to 2,500 NTU for Fall/Winter events and 400 to 700 NTU for Spring events. It was hypothesized that the increase in Fall/Winter was due to the presence of road sands.[38] The results recorded at this site will be used for comparative purposes for tributary flows into the Gray Basin.

7.0 Existing Conditions Problem Summary

Most of the terrain within the project area is gently sloping to the north toward Highway 89 with steeper slopes on the southeastern edge of the Project boundary. Roads in the steeper locations were constructed with steep cut and fill slopes.

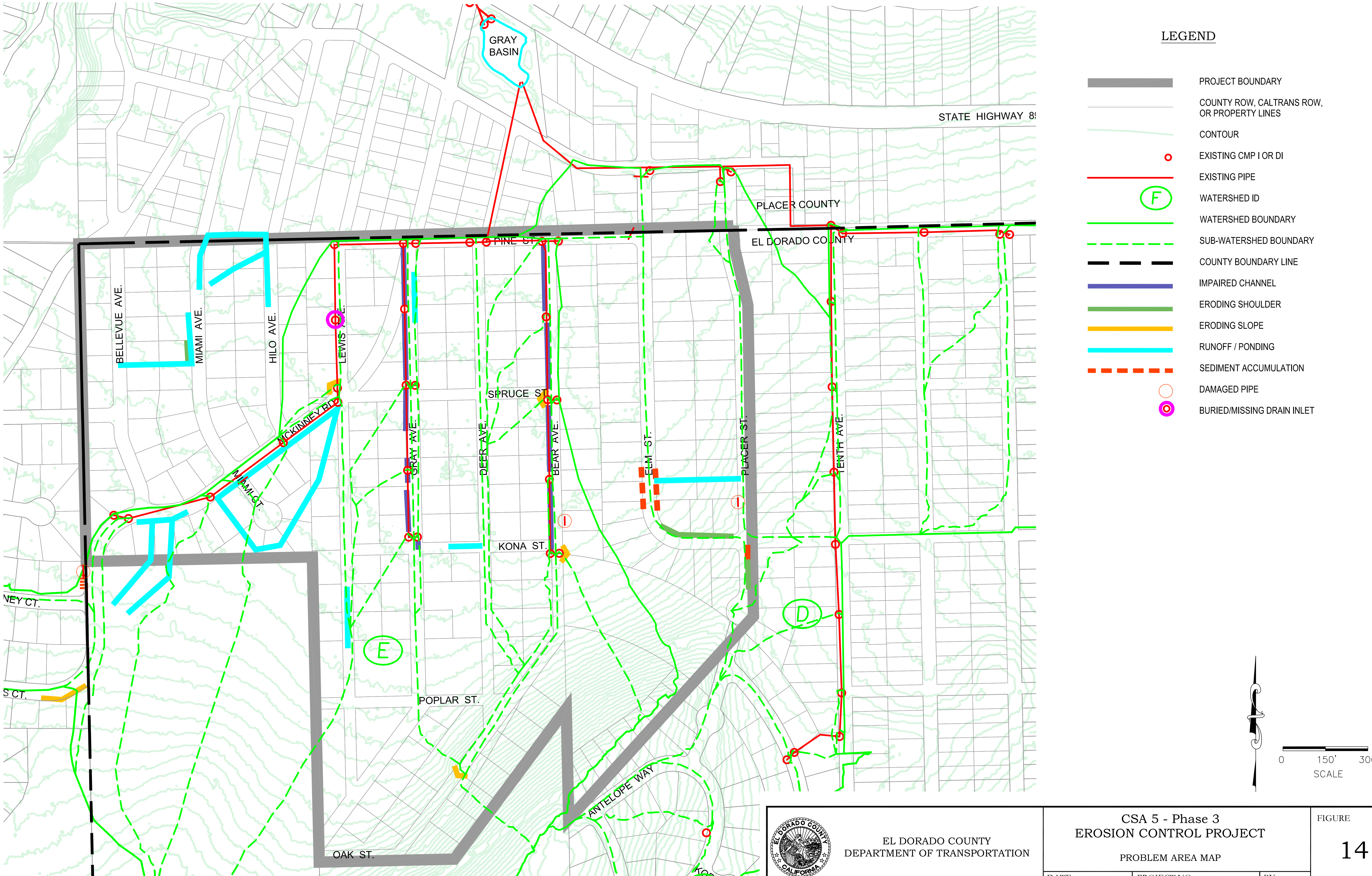
The existing erosion control and water quality measures within the Project boundary consist of AC dike, AC swales, roadside ditches, revegetation, solid wall and perforated pipes, rock-lined channels, and an infiltrating sediment basin (Gray Basin). With the construction of the improvements in 1987 (and 2014), infiltration of urbanized runoff has been increased within the CSA #5 area with the exception of the Phase 3 limits. This Project is intended to stabilize any remaining locations exhibiting erosion and add more infiltrating elements prior to runoff reaching Lake Tahoe.

7.1 Problem Areas, Opportunities, and Constraints

The problem areas depicted on Figure 14 are typical of older residential subdivisions within the Tahoe Basin. Eroding cut slopes and roadside ditches, unpaved driveways and vehicle parking on the dirt road shoulders are main contributors to sediment deposition. Photographic documentation of general problems found in the subdivision is included in Appendix C.

7.1.1 Eroding Road Shoulders

PROBLEM: The road shoulder along the east side of Placer Street, south of Elm Street is eroded moderate to severe. Placer Street slopes at approximately 10.5% between Timber Wolf Drive and Elm Street. Due to the steepness of the road the maintenance division applies traction abrasives to this section of Placer St. The sediment laden runoff flows across the intersection at Elm St in a northwestern direction and continues down the north and east side of Elm St around the bend in the road. The slope is approximately 11% down this portion of Elm St until it flattens out north of the bend. The sediment settles out within the shoulder and driveway encroachments at 484 and 490 Elm St as well as across the street at 485 and 491 Elm St. There are currently no existing facilities with sediment trapping capabilities in these areas.



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DEPARTMENT OF TRANSPORTATION

CSA 5 - Phase 3
EROSION CONTROL PROJECT

PROBLEM AREA MAP

DATE: 08/2020	PROJECT NO.: 95157	BY: DMG

FIGURE 14

OPPORTUNITY: For the steep portions of Elm St and Placer Street, there is opportunity for source control, improved hydraulic conveyance, and treatment improvements. All three can be accomplished with the construction of rolled curb or armored channels and installing infiltrating CMP inlets with sediment trapping capabilities.

CONSTRAINT: Determining the location of the paved roadway relative to the County's rights-of-way and whether dike, swales, or channels can be constructed while maintaining a standard road width needs to be confirmed. Subsurface conflicts, such as existing utilities, may impact installation of the sediment trapping facilities.

7.1.2 Eroding Slopes

PROBLEM: At the southern end of Bear Ave, there is an eroding slope where the paved road ends and a dirt path begins. The sediment migrating from this slope has the potential to migrate into the tributary storm drain system.

Throughout the project area, there are cut slopes surrounding inlets that need to be stabilized. Erosion from the cut slopes has a high potential for sediment migrating into the inlet.

On Spring St, within Placer County and just outside of the project area, there is an eroding slope which can contribute sediment into the storm drain system on McKinney Rd.

OPPORTUNITY: The solution to this problem is through source control. By installing rock slope protection or planting suitable vegetation, soil erosion can be greatly minimized and, in some cases, eliminated.

CONSTRAINT: The location of the eroding slopes relative to the County's rights-of-way needs to be determined. If the slope is beyond the right-of-way, an easement would be required. Another constraint is that not all locations are suitable for vegetation and rock can be considered by some to be aesthetically unappealing. Soil conditions, slope steepness, and intense sun exposure are non-conducive to establishing vegetation. Cost can also be a constraint when choosing a material for slope stabilization.

The eroding slope on Spring St, within Placer County, is outside of the County jurisdiction but is directly connected to the County stormwater drainage system.

7.1.3 Sedimentation of Roadside Ditches

PROBLEM: Throughout the subdivision, roadside ditches convey runoff from the paved roads. Most of these ditches are stable, either by proper compaction or vegetation. However, a few locations exhibit sedimentation and ponding possibly caused by disturbance from vehicles parking on the dirt shoulders. Even though the roadside ditches appear stable, over time sediment has accumulated around the CMP inlets and vegetation has grown in the sediment which inhibits runoff from entering these systems. Near the house at 7022 Lewis Ave, the 1987 improvement plans show a previously existing 36" CMP inlet with pipes, but this inlet is not visible on the surface and the plans do not indicate if it was removed or abandoned.

OPPORTUNITY: The solution to this problem is through source control and improved hydraulic conveyance. By reestablishing a flow path and compacting the shoulder or through revegetation of bare soil, the areas can be stabilized. At Lewis Ave, reestablishing the drainage inlet may help alleviate ponding that occurs in that location.

CONSTRAINT: If the source of sedimentation is beyond the County's rights-of-way, an easement would be required. Measures for preventing vehicle parking in dirt shoulders in established subdivisions are often unpopular with residents.

7.1.4 Aging Infrastructure

PROBLEM: Infiltrating systems lose effectiveness over time due to sedimentation and other factors. The storm drain system from 1987 included perforated CMP for the infiltration of urban runoff and to reduce the volume of runoff discharging into Lake Tahoe. The service life of CMP is approximately 50 years. After almost 30 years of service there are no indications that the pipes are not adequately conveying the runoff; however, it can be assumed that the infiltrating capacities have been reduced.

Basin and channel infiltration can become impaired over time through soil compaction, sediment accumulation, and excessive vegetative matting.

Although the CMP inlets are adequate for accepting and conveying runoff, there are no sumps within the structures and therefore no sediment capturing capabilities.

OPPORTUNITY: There is opportunity for improved hydraulic conveyance and increased treatment for this problem. This can be accomplished by replacing CMP inlets with infiltrating inlets that have sediment trapping capabilities and replacing the infiltrating CMP system with a smooth wall HDPE pipe system.

To reestablish maximum infiltration in the basin and channels, clearing of sediment and debris and scarifying to loosen the soil would be performed. Any rock lining the channels would be restored, disturbed areas revegetated and, if applicable, blanket placed for stabilization of the seeded areas.

CONSTRAINT: Replacement of the inlets and infiltrating pipe system would increase land disturbance and may be cost prohibitive. Subsurface conflicts, such as existing utilities, may impact installation of the CMP inlets. Existing utilities and the locations of the existing storm drain pipes may impact the size and placement of the infiltration galleries.

7.1.4 Localized Flooding and Ponding

PROBLEM: There are areas within the subdivision which incur localized ponding of runoff with potential for flooding of the surrounding properties during heavy rains and snow melt in the spring. There are not adequate conveyance structures in these areas to ensure the runoff is conveyed into the storm drain system where it can be captured and infiltrated within the Gray Basin.

The properties at 551 and 545 McKinney Rd, adjacent to the Project area boundary, become inundated with runoff generated from the USFS lot to the south of them. The property owner at 551 McKinney Rd commented that this situation did not exist prior to the tree thinning within this area in 2010. Runoff generated from the USFS lots flows around and between these properties and pools within the County right-of-way and the driveway encroachments before eventually flowing over the road and across the street.

The properties on Miami Ct also experience local ponding and potential flooding from runoff generated from the USFS lot behind them. Miami Ct does not have adequate roadside conveyance to move the runoff toward McKinney Rd. Additionally, the roadside conveyance along the southeastern side of McKinney Rd from the intersection of Miami Ct to the intersection of Lewis Ave does not adequately convey the runoff to the inlet on the corner of Lewis Ave and McKinney Rd. During heavy rains and spring snowmelt, the runoff will pond along Miami Ct and McKinney Rd which inundates the properties at 7075, 7082, 7083, 7085 Miami Ct and 493, 503, 509 McKinney Rd.

Properties at the northern end of Miami Ave and Hilo Ave experience local ponding and potential flooding during heavy rains and spring snowmelt. Runoff generated from Bellevue Ave and west of the county line flows east until it reaches Miami Ave and flows north toward the end of the street at the county line. Runoff also flows north down Hilo Ave and combines with the flows from Miami Ave. The runoff ponds between the properties at 416 Miami Ave (Placer County), 7001 Miami Ave, 7000 Hilo Ave and 7008 Hilo Ave. The runoff does eventually flow north toward Placer County but will inundate these properties well into the summer months during large events.

OPPORTUNITY: There is opportunity for improved hydraulic conveyance and additional treatment for these problems. This can be accomplished by diverting the runoff with a berm before it reaches the problem areas. Additional inlets connected to the existing storm drain system will alleviate ponding and convey runoff to Gray Basin. Enhancing roadside conveyance ditches could also alleviate ponding and ensure runoff is able to reach the existing inlets.

For the areas at the north end of Miami Ave and Hilo Ave, there is opportunity to install additional storm drain infrastructure and connect to the existing storm drain infrastructure on Lewis Ave in order to relieve the ponding and convey the runoff to Grey Basin for treatment. Alternatively, there is opportunity to work in conjunction with Placer County and utilize public lands north of the El Dorado County line. Constructing conveyance channels connected to linear basins constructed within the paper roads may relieve the ponding and allow the runoff to infiltrate where compaction and space are not constraints.

CONSTRAINT: Installation of new inlets and conveyance pipes would increase land disturbance and may be cost prohibitive. Subsurface conflicts, such as existing utilities, may impact installation of the CMP inlets. Existing utilities and the locations of the existing storm drain pipes may impact the size and placement of the inlets and connecting pipes.

The proposed berms would be constructed on USFS lands. The County would need to obtain a special use permit with the USFS to construct any type of improvement on their lands.

The runoff impacting the properties at the north end of Miami Ave and Hilo Ave ultimately leaves the County and enters Placer County. Currently there are no drainage easements through the affected areas where a storm drain would need to be installed to connect to the existing storm drain system at Lewis Ave. The County would need to procure easements through the privately owned parcels at additional costs to the County. Alternatively, the County would need to work with Placer County to determine if Placer County is willing and able to construct the proposed treatments with separate funds and resources from this Project.

Miami Ct is relatively flat and the section of McKinney Rd between Miami Ct and Lewis Ave slopes at approximately 2% toward Lewis Ave. Achieving proper drainage within relatively flat areas can be challenging and impediments become more of an issue. The County will need to analyze this area to determine the best form of conveyance to ensure the runoff impacting this area is conveyed to the inlet at Lewis Ave.

7.1.5 Summarization of Opportunities and Constraints

Table 10 summarizes the opportunities and constraints for each of the problem areas discussed in Section 7.

Table 10 – Summary of Opportunities and Constraints

Problem	Opportunity	Constraint	PDA Category
Eroding road shoulder	Stabilize shoulder with dike, swale, channel, or AC pavement	Location of road in relation to right-of-way	SC
Eroding slopes	Stabilize sediment sources with rock or vegetation.	Location of slopes in relation to right-of-way, easements, material aesthetically unappealing, capital cost.	SC
Sedimentation of roadside ditches	Stabilize sediment sources, improve drainage, and inhibit parking.	Location of work in relation to right-of-way, easements.	SC, HD
Aging infrastructure	Replace existing system; increase sediment capture, hydraulic capacity, and infiltration.	Subsurface conflicts, increased land disturbance, easements, capital costs.	HD, T
Localized flooding and ponding	Divert runoff; enhance conveyance; install additional inlets to stormwater system	Subsurface conflicts, increased land disturbance, easements, capital costs, county jurisdiction, slope.	SC, HD,T

8.0 Formulating Alternatives

In order to satisfy the goals of the Project, two alternatives were formulated to mitigate specific erosion and storm water runoff water quality problems within the Project area. A third "do nothing" alternative does not satisfy the Project goals or objectives and is therefore not a viable alternative for consideration.

The alternatives were developed using the BMP categories of source control, hydrologic design, and treatment of runoff. Many BMPs satisfy more than one category. Appendix D contains detailed BMP toolbox sheets for each specific facility and treatment proposed.

Important design considerations in formulating alternatives were ROW constraints, capital costs of the proposed improvements, relative cost vs effectiveness of the proposed improvements, and the relatively high cost of easement acquisition on private property. Suitable BMPs chosen for consideration for the Project alternatives include:

Revegetation

Revegetation is a proven source control mitigation measure. In order for revegetation to be successful as a soil stabilization BMP, the characteristics of the application need to be tailored to the specific conditions of each site. These characteristics should include selection of a soil stabilization material and developing an appropriate plan for the growth of vegetation. Revegetation alone is not expected to be successful for all areas of bare soil. This is primarily due to the dryness of some sites, granitic characteristics of the soil, and the depth to groundwater.

Channels and Swales

Hard armored channels and vegetated swales have been constructed on numerous erosion control projects. Rock-lined channels are a proven source control, hydrologic design, and treatment alternative for conveying and treating runoff. The suspended sediments settle into the voids between the rock and runoff is infiltrated into the in situ soils beneath the channel.

When located in the correct environment, seed and blanket channels and grass-lined swales are a proven source control, hydrologic design, and treatment alternative for conveying runoff, stabilizing roadside ditches, and treating runoff. Once established, suspended sediments are stabilized within the root system and runoff is infiltrated into the in situ soils beneath the channel. Seed and blanket-lined channels and grass-lined swales have been constructed on numerous erosion control projects with varying degrees of success, primarily due to location.

AC Dike and AC Swales

AC dike and AC swales are successful source control mitigation alternatives which have been used on similar erosion control projects. The costs, benefits, and limitations have been established and demonstrated on past projects. This alternative is successful in stabilizing bare shoulders, eroding shoulders, and roadside ditches and reduces the mobilization of sediment from roadside shoulders. AC dike and AC swales can potentially increase connectivity of impervious surface area; increasing runoff volumes and peak flow.

Asphalt Concrete (AC) Pavement

AC pavement is a proven technique for stabilizing bare soil and has successfully been implemented on past erosion control projects. AC pavement can be either permeable or impermeable. Permeable pavement meets the criteria for source control, hydrologic design, and treatment BMP in that it is very effective in stabilizing dirt surfaces, can be used to redirect flow, and is effective in decreasing runoff peak flow and volume; however, it is best suited for grades of 2 percent or flatter. Impermeable pavement meets the criteria for source control and hydrologic design BMP in that it is very effective in stabilizing dirt surfaces and can be used to redirect flow; however, runoff peak flow and volume is increased.

Drainage Inlets and CMP Inlets

A drainage inlet is primarily a hydrologic design BMP as is typically used to convey runoff from a paved surface into a pipe. A CMP inlet functions in the same manner except that runoff is often from off-road conveyance as well as paved surfaces. When constructed with infiltration and sediment capture capabilities, these facilities meets the criteria for treatment BMP with the reduction of suspended sediment through retention, the reduction of runoff volume through infiltration, and treatment of runoff through infiltration. Reduction of suspended sediment and the reduction in peak flow is dependent on the infiltration rate of the in situ soils, the runoff volume, and the volume of infiltration storage. The distance from the bottom of the infiltrating facility to groundwater and the rate of infiltration of the in situ soils is a factor in determining whether or not a proposed drainage inlet can be used for infiltration.

Pipe

Pipe meets the criteria for hydrologic design BMP through conveyance. Pipe can also meet the criteria for source control in areas where runoff has exceeded the capacity of the roadside conveyance and erosion or incising has occurred.

Perforated Pipe

Perforated pipe meets the criteria for hydrologic design and treatment BMP through conveyance and the reduction of suspended sediment, the reduction of runoff volume through infiltration, and treatment of runoff through infiltration. Perforated pipe can also meet the criteria for source control in areas where runoff has exceeded the capacity of the roadside conveyance and erosion or incising has occurred. Perforated pipes installed under an infiltrating facility can intercept and convey flow to down slope facilities for further treatment. Reduction of suspended sediment and peak flow and the treatment of runoff is dependent on the infiltration rate of the in situ soils and the runoff volume. The distance from the bottom of the perforated pipe to groundwater and the rate of infiltration of the in situ soils is a factor in determining suitable locations for this BMP.

Infiltration System

Infiltration systems, or galleries, meet the criteria for a treatment BMP through the reduction of suspended sediment, the reduction of runoff volume through infiltration, and treatment of runoff through infiltration. Reduction of suspended sediment, peak flow, and the treatment of runoff is dependent on the infiltration rate of the in situ soils and the runoff volume. The distance from the bottom of the perforated pipe to groundwater and the rate of infiltration of the in situ soils are factors in determining suitable locations for this BMP.

Rock Slope Protection

Rock slope protection is a successful source control mitigation alternative which has been used extensively in prior erosion control projects in the Tahoe Basin. The costs, benefits, and limitations have been established and demonstrated on past projects. This alternative has a long design life, is resilient to snow removal activities, and is successful in stabilizing eroding slopes.

8.1 Alternatives

The three alternatives formulated to address the erosion, hydrologic, and treatment deficiencies with the Project area are described below.

Alternative 1

Figure 15 depicts the facilities and treatments proposed for Alternative 1. Conditions requiring source control include eroding roadside ditches, eroding slopes, and areas of sediment deposition.

For the storm drain system on Bear Avenue, rock for inlet protection is proposed for each inlet. The conveyance channels connecting the inlets will require some rehabilitation efforts. The Project proposes to stabilize the channels with vegetation or rock armoring.

For the storm drain system on Gray Avenue, rock for inlet protection is proposed for each inlet. The conveyance channels connecting the inlets will require some rehabilitation efforts. The Project proposes to stabilize the channels with vegetation or rock armoring.

At the southeast corner of Placer Street and Elm Street a Corrugated Steel Pipe (CSP) Inlet is proposed for capturing sediment, infiltrating runoff, and providing a clean out for maintenance purposes. The Project also proposes to construct rolled curb & gutter above the inlet on the east side of Placer Street in order to provide a conveyance system for better conveyance of washed off road traction abrasives. The hard conveyance will also provide a surface for street sweepers to collect sediment and traction abrasives.

From the northwest corner of Placer Street and Elm Street, along Elm Street, the Project proposes constructing rolled curb & gutter on both sides of Elm Street ending at new Drainage Inlets (DIs). The DIs will be installed in the County ROW near 490 and 491 Elm Street. The hard conveyance structure will provide capture and conveyance of road traction abrasives applied during winter months and will also provide a surface for street sweepers to collect sediment and traction abrasives. The new CSP inlets will provide a clean out for removing the sediment and abrasives. The curb will also wrap around the corner, onto Placer Street in order to divert runoff from flowing into the parcels between Elm Street and Placer Street and ensure the runoff remains within the conveyance ditch running down Placer St. The conveyance ditch along the west side of Placer Street, at the end of the curb, will be restored to ensure proper conveyance down Placer Street.

Slope protection is proposed for stabilizing the eroding slope at the southern end of Bear Avenue. Rock is preferred, though revegetation will be considered if site conditions will allow for vegetation growth.

Rock armoring is proposed for the CSP inlet at the intersection of McKinney Road and Lewis Avenue.

An existing CSP Inlet near the property at 7022 Lewis Avenue appears to have been abandoned and paved over. The Project proposes to locate and remove the existing inlet and install a new CSP inlet outside of the driveway apron with connections to the existing storm drain system on Lewis Avenue.

At the intersection of Miami Court and McKinney Road, the project proposes removing and replacing an existing 12" CMP pipe with an 18" HDPE pipe connected to a new DI installed on the northern end to allow for sediment capture and infiltration of captured runoff. Rolled curb & gutter is proposed around the Miami Court cul-de-sac continuing from Miami Court on the south side of McKinney Road to the intersection at Lewis Avenue. This will connect to the proposed DI on the corner of Miami Court and improve the runoff drainage around the Miami Court cul-de-sac into the existing CSP inlet at Lewis Avenue.

The properties at 551 and 545 McKinney Road, adjacent to the Project area boundary, are seasonally inundated with runoff from the USFS lot to the south (APN 014-021-010). The project proposes to intercept and divert the runoff toward the conveyance ditch on the east side McKinney Road with a diversion berm constructed on the USFS lot. The conveyance ditch on the southeast side of McKinney Road will be restored to ensure proper conveyance of the runoff into the existing CSP inlet to the west of 551 McKinney Road. A proposed CSP Inlet will be installed between 545 and 541 McKinney Road to intercept additional runoff from beyond these properties, to reduce the flooding that occurs at the location on McKinney Road. Beyond the new CSP Inlet, ditch restoration is proposed along the southern side of McKinney Road to ensure additional runoff is conveyed to the proposed new inlet at Miami Court.

Runoff that flows down Miami Ave and Hilo Ave collects and pools at the north end of the El Dorado County line before eventually flowing north into Placer County. The properties at 416 Miami (Placer County), 7001 Miami, 7000 Hilo, and 7008 Hilo become inundated during spring runoff events. The Project proposes installing CSP inlets connected by pipes to capture and convey the runoff to an existing CSP inlet at the intersection of Lewis Ave and Pine St which ultimately conveys runoff into Grey Basin for treatment. This would require procurement of drainage easements in order for the County to construct and maintain this infrastructure.

The conveyance ditch on the west side of Miami Avenue is proposed to be restored to improve conveyance of runoff.

The driveway culvert at 7081 Bear Avenue is crushed and the Project proposes removing and replacing the existing 12" CMP pipe with a 12" HDPE pipe to convey runoff.

Alternative 2

Figure 16 depicts the facilities and treatments proposed for Alternative 2. Conditions requiring source control include eroding roadside ditches, eroding slopes, and areas of sediment deposition.

For the storm drain system on Bear Avenue, rock for inlet protection is proposed for each inlet. The conveyance channels connecting the inlets will require some rehabilitation efforts. The Project proposes to stabilize the channels with vegetation or rock armoring.

For the storm drain system on Gray Avenue, rock for inlet protection is proposed for each inlet. The conveyance channels connecting the inlets will require some rehabilitation efforts. The Project proposes to stabilize the channels with vegetation or rock armoring.

At the southeast corner of Placer Street and Elm Street a CSP Inlet is proposed for capturing sediment, infiltrating runoff, and providing a clean out for maintenance purposes. The Project also proposes to construct an articulated block channel above the inlet on the east side of Placer Street in order to provide a conveyance system for better conveyance of washed off road traction abrasives. The hard conveyance will also provide a surface for street sweepers to collect sediment and traction abrasives.

From the northwest corner of Placer Street and Elm Street, along Elm Street, the Project proposes constructing an articulated block channel on both sides of Elm Street ending at new CSP Inlets. The inlets will be installed in the County ROW near 490 and 491 Elm Street. The hard conveyance structure will provide capture and conveyance of road traction abrasives applied during winter months and will also provide a surface for street sweepers to collect sediment and traction abrasives. The new CSP inlets will provide a clean out for removing the sediment and abrasives. The articulated block channel will also wrap around the corner, onto Placer Street in order to divert runoff from flowing into the parcels between Elm Street and Placer Street and ensure the runoff remains within the conveyance ditch running down Placer St. The conveyance ditch along the west side of Placer Street, at the end of the curb, will be restored to ensure proper conveyance down Placer Street.

Slope protection is proposed for stabilizing the eroding slope at the southern end of Bear Avenue. Rock is preferred, though revegetation will be considered if site conditions will allow for vegetation growth.

Rock armoring is proposed for the CSP inlet at the intersection of McKinney Road and Lewis Avenue.

An existing CSP Inlet near the property at 7022 Lewis Avenue appears to have been abandoned and paved over. The Project proposes to locate and remove the existing inlet and install a new CSP inlet outside of the driveway apron with connections to the existing storm drain system on Lewis Avenue.

At the intersection of Miami Court and McKinney Road, the project proposes removing and replacing an existing 12" CMP pipe with an 18" HDPE pipe connected to a new CSP inlet installed on the northern end to allow for sediment capture and infiltration of captured runoff. Ditch restoration is proposed around the Miami Court cul-de-sac continuing from Miami Court on the south side of McKinney Road to the intersection at Lewis Avenue. This will connect to the proposed CSP inlet on the corner of Miami Court and improve the runoff drainage around the Miami Court cul-de-sac into the existing CSP inlet at Lewis Avenue.

The properties at 551 and 545 McKinney Road, adjacent to the Project area boundary, are seasonally inundated with runoff from the USFS lot to the south (APN 014-021-010). The project proposes to intercept and divert the runoff toward the conveyance ditch on the east side McKinney Road with a diversion berm constructed on the USFS lot. The conveyance ditch on the southeast side of McKinney Road will be restored to ensure proper conveyance of the runoff into the existing CSP inlet to the west of 551 McKinney Road. A proposed CSP Inlet will be installed between 545 and 541 McKinney Road to intercept additional runoff from beyond these properties, to reduce the flooding that occurs at the location on McKinney Road. Beyond the new CSP Inlet, ditch restoration is proposed along the southern side of McKinney Road to ensure additional runoff is conveyed to the proposed new inlet at Miami Court.

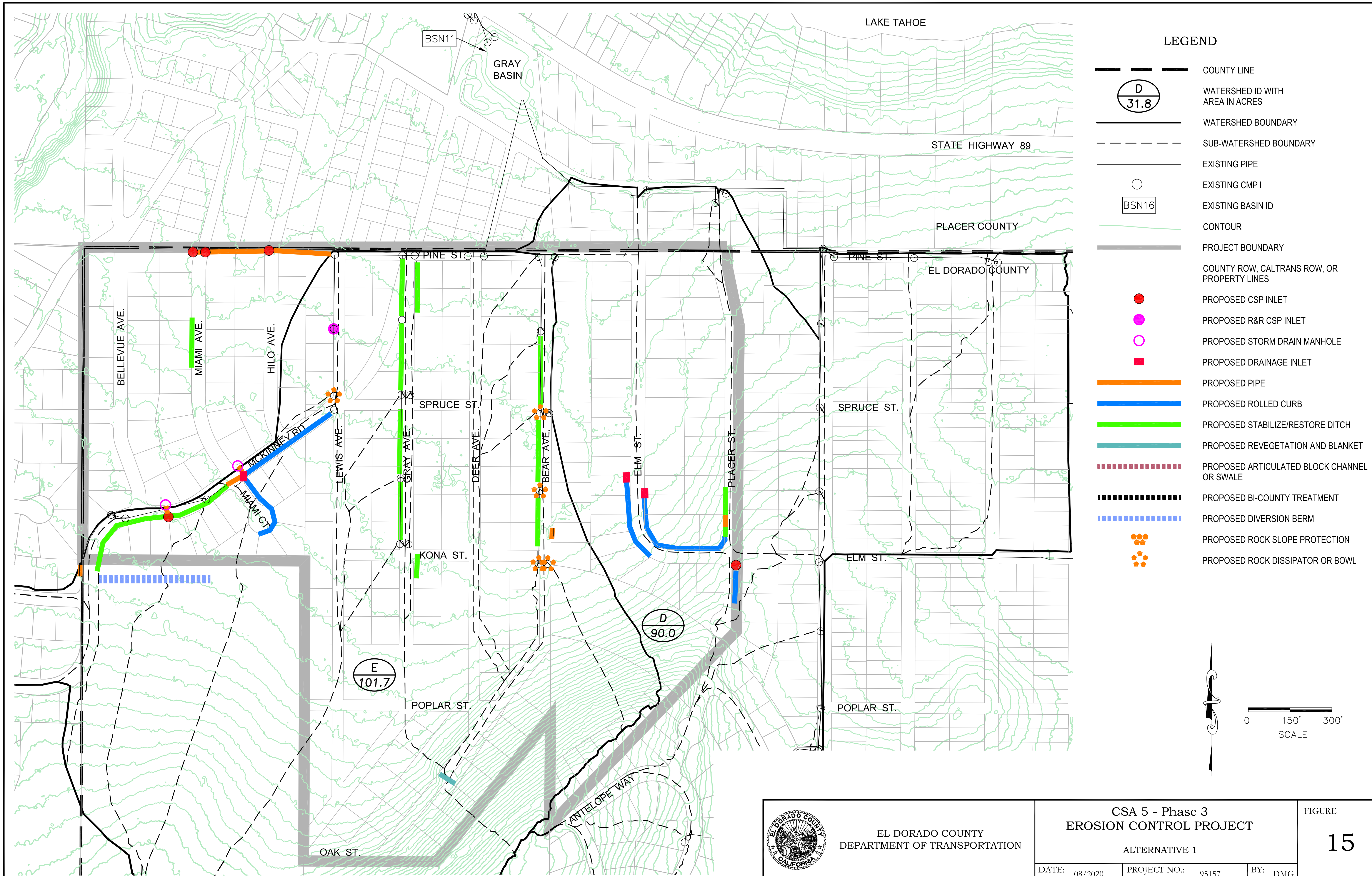
Runoff that flows down Miami Ave and Hilo Ave collects and pools at the north end of the El Dorado County line before eventually flowing north into Placer County. The properties at 416 Miami (Placer County), 7001 Miami, 7000 Hilo, and 7008 Hilo become inundated during spring runoff events. The Project proposes working with Placer County to construct a conveyance ditch to relieve the pooling and convey the runoff to possible new shallow basins constructed within the Placer County Right-of-Way paper roads which extend beyond El Dorado County.

The conveyance ditch on the west side of Miami Avenue is proposed to be restored to improve conveyance of runoff.

The driveway culvert at 7081 Bear Avenue is crushed and the Project proposes removing and replacing the existing 12” CMP pipe with a 12” HDPE pipe to convey runoff.

Alternative 3

The storm drain assets will remain in the current condition. No improvements will be installed or constructed within the Project area.



EL DORADO COUNTY
DEPARTMENT OF TRANSPORTATION

CSA 5 - Phase 3
EROSION CONTROL PROJECT

ALTERNATIVE 1

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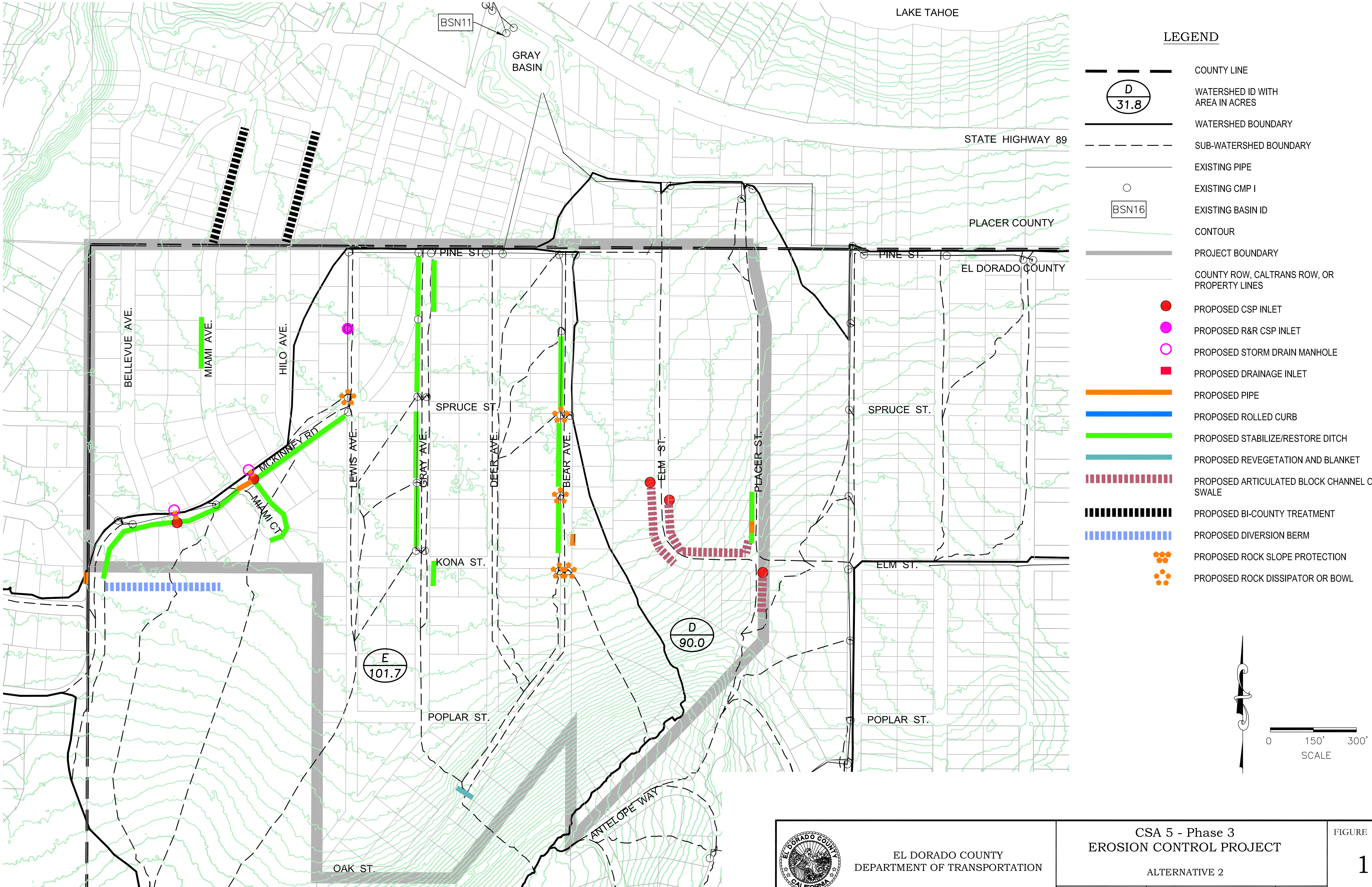
FIGURE 15



EL DORADO COUNTY
DEPARTMENT OF TRANSPORTATION

CSA 5 - Phase 3
EROSION CONTROL PROJECT

ALTERNATIVE 2

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FIGURE
16

8.2 Alternatives Unit Cost for Meeting Goals

The costs to satisfy the goals of the Project were calculated on a unit cost basis for each alternative in order to evaluate and compare each alternative's relative benefit and are presented in Appendix E. For this analysis the capital costs were based on Transportation's Engineer's Estimate database using project bid summaries from 2015 through 2019 for all bids. Maintenance costs were not considered within this Report; however, the maintenance costs will be a factor during the evaluations. The unit costs of each alternative were calculated for the cost to provide source control, the cost to reduce and treat runoff volume and peak flow, and the cost to reduce sediment.

The unit cost to reduce runoff volume, peak flow, and sediment was calculated by assuming that treatment will be provided by each alternative at an annual frequency of 35 storm events per year for the design life of the alternative. The basis for this treatment frequency is the mean annual precipitation at the Project site divided by the 1-inch per hour design storm event. The effectiveness of each BMP was determined by estimating the storage volume, determining the infiltration volume for a 1 hour duration based on 1.25 feet per hour infiltration rate, and estimating the runoff total suspended sediment concentration based on an assumed 150 mg/L.

The estimate of the cost to reduce runoff volume and peak flow assumes that runoff is directed to each BMP throughout the design storm event. The calculation of the cost to reduce sediment assumes that each treatment alternative is maintained throughout the design life and operated in a first flush configuration which results in complete reduction of suspended sediment from the runoff. These conditions will not be satisfied for most storm events experienced during the design life of each BMP; however, since the purpose of this analysis is to evaluate the relative effectiveness of each BMP, these assumptions are accepted for this alternatives comparison.

8.2.1 Calculation of BMP Unit Costs

Source control unit cost was calculated using equation 7:

$$C_C = \frac{U_{bmp}}{D} \tag{7}$$

Where C_C is the unit cost of source control in \$/square feet, U_{bmp} is the unit construction cost of the BMP in \$/square feet, and D is the design life in years.

The volume reduction unit cost was calculated by equation 8:

$$C_V = \frac{U_{bmp} / (D \cdot F)}{V_I + V_S} \tag{8}$$

Where C_V is the unit cost of the reduction in runoff volume in \$/cubic feet, F is the annual frequency of storm events, V_I is the volume of infiltration in one hour per unit in cubic feet, and V_S is the volume of storage per unit in cubic feet.

The peak flow reduction unit cost was calculated by equation 9:

$$C_P = \frac{U_{bmp} / (D \cdot F)}{V_I / 3600} \tag{9}$$

Where C_P is the unit cost of the reduction in peak flow in $/cfs.

The total suspended sediment concentration reduction unit cost was calculated by equation 10:

$$C_S = 16{,}017 \cdot \frac{U_{bmp} / (D \cdot F)}{(V_I + V_S) \cdot C_i} \qquad (10)$$

Where C_S is the unit cost of the reduction of sediment in runoff in $/pounds and C_i is the concentration of total suspended sediment in mg/L.

8.2.2 BMP Unit Costs

The relative unit costs for source control and the reduction in runoff volume, peak flow, and sediment is presented in Table 11. These relative unit costs are presented as one tool for evaluating the relative cost efficiency of the alternatives considered in this analysis and does not represent a complete evaluation of each alternative's overall effectiveness. In addition, depending on site conditions, some BMPs are more appropriate than others for source control, hydrologic design, and treatment of runoff, irrespective of the unit costs. This variable is not represented in the unit cost analysis.

Table 11 – BMP Unit Costs

BMP	Unit	Unit Costs			
		Reduce Volume (per ft^3)	Reduce Peak (per cfs)	Reduce Sediment (per lb)	Source Control (per ft^2)
CSP Inlet	EA	$0.25	$3105.85	$27.09	N/A
Drainage Inlet	EA	$0.32	$5942.86	$34.34	N/A
Rock Dissipator/Bowl	SF	$0.02	$15.54	$0.46	$0.19
Earthen Berm	CY	N/A	N/A	N/A	$0.05
Revegetation	SF	N/A	N/A	N/A	$0.10
Rock Slope Protection	SF	N/A	N/A	N/A	$0.57
Rolled Curb & Gutter	LF	N/A	N/A	N/A	$0.57
Articulated Block Channel	SF	N/A	N/A	N/A	$1.53
Sweeping	---	N/A	N/A	$0.05	N/A

CSP Inlets, drainage inlets, and rock bowls all perform satisfactorily in volume and peak flow reduction and treatment of runoff. The most cost efficient means of satisfying the reduction in volume, peak flow, and suspended sediment goals of the Project are with the rock bowls. However, rock bowls are limited in that they are not suitable for all site conditions and are typically used in conjunction with CSP Inlets. DIs provide less treatment than CSP inlets, at a higher cost, but can be installed in the travel way in-line with the curb & gutter.

Revegetation is a practical and inexpensive means of source control but is not suitable for all site conditions. Rock Slope Protection provides source control at a higher cost but requires minimal maintenance which could offset the unit cost increase.

Rolled Curb & Gutter and Articulated Block Channels provide source control but have a primary function of providing conveyance. Articulated Block Channels are more cost effective than Rolled Curb & Gutter at providing source control.

For the collection of sediment, sweeping costs per pound recovered are significantly less expensive than all other BMPs. The effectiveness of removing fines (<125 microns) with sweeping is in question.[39]

9.0 Evaluating Alternatives

If designed and maintained properly, Alternatives 1 and 2 should meet the objectives of this Project. Alternative 3 proposes no improvements and therefore will not meet the objectives. However, ongoing efforts to sweep the impervious surfaces within the County ROW will continue to reduce the amount of sediment which is available for suspension in runoff thereby reducing the sediment load of runoff. The Preferred Alternative will be outlined in the Preferred Alternative Memorandum and will be selected based on the evaluation of the three alternatives and the degree to which each meets the objectives of the Project as presented in this report.

9.1 Alternatives Summary

Alternative 1 proposes a comprehensive plan with upgrades of existing facilities in select locations and providing mitigation measures for those areas within the Project's areas of interest currently without adequate source control, hydrologic design, and treatment.

Alternative 2 reflects a comprehensive plan with upgrades of existing systems and providing alternative mitigation measures for those areas within the Project's areas of interest currently without adequate source control, hydrologic design, and treatment.

Reduction of Coarse, Fine, and Very Fine Sediments

The reduction of coarse, fine, and very fine sediments by 33%, 25%, and 12%, respectively, is one of the goals of the Project. Table 12 reflects the anticipated reduction in sediment from each facility per storm event. The reduced sediment was calculated by assuming that reduction will be provided by each facility at an annual frequency of 35 storm events per year for the design life of the facility. The basis for this treatment frequency is the mean annual precipitation at the Project site divided by the 1-inch per hour design storm event. The effectiveness of each BMP was determined by estimating the storage volume and estimating the runoff total suspended sediment concentration based on an assumed 150 mg/L.

Table 12 – Anticipated Load Reduction Per Storm Event

BMP	Unit	Reduced Sediment Load (lbs)
CSP Inlet	EA	0.2812
Drainage Inlet	EA	0.1803
Rock Dissipator/Rock Bowl	SF	0.0351

BMP	Unit	Reduced Sediment Load (lbs)
Earthen Berm	CY	N/A
Revegetation	SF	N/A
Rock Slope Protection	SF	N/A
Rolled Curb & Gutter	LF	N/A
Articulated Block Channel	SF	N/A

Taking the values from Table 12 and the proposed facilities from Figures 15, and 16, the total potential sediment load reduction per storm event from Alternative 1 would be 9 lbs. and from Alternative 2, 9.3 lbs. Using the unit costs from Table 11, the cost per pound of sediment load reduction per storm event for each Alternative would be $283.90 and $262.10 respectively.

Reduction in Runoff Volume and Peak Flow

Reduction in total runoff volume and peak discharge leaving the site from a 1-inch/hour storm by 33% is a goal of the Project. Table 13 reflects the anticipated reduction in volume and peak flow from each facility. The reduced runoff volume and peak flow was calculated by assuming that treatment will be provided by each facility at an annual frequency of 35 storm events per year for the design life of the facility. The basis for this treatment frequency is the mean annual precipitation at the Project site divided by the 1-inch per hour design storm event. The effectiveness of each BMP was determined by estimating the storage volume and determining the infiltration volume for a 1 hour duration based on 1.25 feet per hour infiltration rate.

Table 13 – Anticipated Volume and Peak Reduction Per Storm Event

BMP	Unit	Reduced Volume (ft^3)	Reduced Peak (cfs)
CSP Inlet	EA	30.03	0.0025
Drainage Inlet	EA	19.25	0.0010
Rock Dissipator/Bowl	SF	3.75	0.0010
Earthen Berm	CF	N/A	N/A
Revegetation	SF	N/A	N/A
Rock Slope Protection	SF	N/A	N/A
Rolled Curb & Gutter	LF	N/A	N/A
Articulated Block Chnl	SF	N/A	N/A

Capital Costs

Rough Order of Magnitude (ROM) cost estimates, prepared for each of the Project alternatives, can be found in Appendix E. The quantities for each alternative were tabulated based on the proposed improvements shown on Figures 15 and 16. The unit costs for each facility were based on bid summaries from Transportation's erosion control and air quality projects within the Lake Tahoe Basin constructed between 2015 and 2019. Table 14 presents a summary of the ROM construction cost estimates for each of the alternatives.

Table 14 – Alternative ROM Construction Cost Estimate Summary

	Alt-1	Alt-2
Mobilization	$ 27,400	$ 25,900
Traffic Control	$ 20,000	$ 20,000
Sweeping	$ 17,500	$ 17,500
Trench Excavation & Safety	$ -	$ -
Install & Maintain Temp BMPs	$ 25,000	$ 25,000
Remove CMP Inlet	$ 2,000	$ 2,000
CSP Inlet	$ 24,000	$ 48,000
DI	$ 19,500	$ -
12" HDPE Pipe	$ 2,000	$ 2,000
18" HDPE Pipe	$ 16,000	$ 16,000
18" FES	$ 800	$ 800
Storm Drain Manhole	$ 14,000	$ 14,000
Rolled C&G	$ 85,020	$ -
AC Pavement (incl R&R D/Ws)	$ 8,800	$ 8,800
Earthen Berm	$ 7,120	$ 7,120
Articulated Block Channel	$ -	$ 65,560
Rock Slope Protection	$ 25,500	$ 25,500
Rock Bowl/Rock Dissipator	$ 2,592	$ 2,592
Revegetation (Basins)	$ -	$ -
Revegetation (General)	$ 4,500	$ 4,500
California Conservation Corps	$ 12,000	$ 12,000
Project Sign	$ 2,000	$ 2,000
Subtotal	$ 315,732	$ 299,272
Contingency Percentage	20%	20%
Contingency	$ 63,146	$ 59,856
Total	**$ 378,878**	**$359,128**

Planning and Design Costs

Planning and design costs include costs associated with the preparation of environmental documentation and plans and specifications up to the 100% stage. The level of detail and effort necessary for the planning and design for Alternative 2 would be slightly less than for Alternative 1.

Operations and Maintenance Costs

There will be an increase in maintenance of the sediment trapping inlets however, maintenance of the existing facilities will remain necessary, whether replaced or not. The new facilities and treatments are similar with all three alternatives therefore; annual operation and maintenance costs necessary for Alternatives 1 and 2 will be similar.

It is anticipated that each mitigating measure will be relatively inexpensive to operate and maintain.

Design Life

The design life is defined as the number of years the facility is expected to function adequately without new construction. The design life for Alternatives 1and 2 will be similar.

ROW Acquisition

For Alternative 2 It is anticipated that all work will be performed within the County ROW or publically owned parcels. Alternative 1 would require easement acquisition across 2 privately owned El Dorado County parcels and 2 privately owned Placer County parcels.

Impacts to Existing Utilities

Impacts to existing utilities include costs associated with removals or relocations. Potential impacts to existing utilities are similar with all three alternatives.

Disturbance

Disturbance is defined as new temporary and/or new permanent earth disturbance. Work proposed in paved locations and areas exhibiting erosion or other forms of existing disturbance are not considered to be creating new disturbance. Work proposed in areas previously disturbed but restored as well as undisturbed areas is considered new disturbance. Due to the construction of the Earthen Berm and the proposed Rock Slope Protection, all three alternatives will likely cause new disturbance.

Aesthetics

Aesthetics represent the appearance of the completed Project. Each of the three alternatives is comprised of similar erosion mitigation techniques which have equivalent aesthetic characteristics.

Constructability

Constructability reflects the ease of construction of each alternative. The proposals for Alternatives 1 and 2 are such that constructability aspects are similar.

Groundwater Impacts

Groundwater impacts reflect the potential for positive or negative effects to existing groundwater flow patterns, or mixing polluted surface water with groundwater. For the treatment of runoff, all three alternatives rely on infiltration. Any potential impact to groundwater quality will be similar with all three alternatives.

Impervious Surfaces

An impervious surface is a surface that does not allow infiltration of surface water. There is minimal to no change in impervious surface area with all three alternatives.

Road Sand/Cinders

Road sand/cinders are introduced sediments from County operations. The Transportation Maintenance Division routinely applies road sands/cinders within the Project area. The volume of road sand/cinder captured will increase with Alternatives 1 and 2 with the installation of CSP Inlets or DIs with sediment capture capabilities.

Manmade Nutrient Sources

Manmade nutrient sources are from private lands and utilities such as lawn fertilizers and wastewater pipes. The collection, conveyance, and treatment of manmade nutrients are not goals for this Project. For this reason the alternatives were not formulated specifically to address manmade nutrients.

Public Safety

There will be no change to public safety as a result of the implementation of any of the three alternatives.

Wildlife Habitat

Impacts to wildlife habitat within upland and SEZs with thriving native vegetation were studied. With the majority of the work in the County's ROW, it is anticipated there will be no changes to wildlife habitat as a result of the implementation of any of the three alternatives.

Vector Control

During mosquito breeding season, water that is standing for 72 hours or longer could facilitate mosquito production. Each of the three alternatives will be designed and constructed in a manner that standing water will be present for less than 72 hours.[40]

Permitability

The length of time required to obtain the construction permits for Alternatives 1 and 2 will likely be the same and the proposed work for the Earthen Berm on Forest Service lands will require obtaining a special use permit.

Fundability

Fundability considers the number of agencies needed for funding each alternative and the requirements each alternative must meet to receive that funding. With $19,750 separating Alternative 1 from Alternative 2, the construction costs of those two alternatives are relatively similar and the work proposed in Alternatives 1 and 2 provides mitigation measures for areas currently without adequate source control, hydrologic design, and treatment. Alternative 1 would require property owner negotiation to acquire easements. These costs, while unknown at this time, will drive up the cost of the alternative.

9.2 Alternatives Evaluation Summary and Recommendations

The County has looked at the existing conditions in the Project area to identify problems and analyzed potential solutions to address the problems noted. The alternatives selected by the County were those that the County determined will meet the Project goals and objectives.

Implementing Alternative 1 ensures that the Project goals and objectives will be met to the maximum extent practicable. This alternative will mitigate water quality issues not currently addressed with the existing drainage systems and will stabilize areas that are beginning to become a detriment to water quality. Would require new drainage easements to complete.

Implementing Alternative 2 will also meet the goals and objectives for the Project to the maximum extent practicable. This alternative will mitigate water quality issues not currently addressed with the existing drainage systems and will stabilize areas that are beginning to become a detriment to water quality.

Implementation of Alternative 3 will not meet the goals and objectives for the Project to the maximum extent practicable.

10.0 References

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[1] NHC (2004). Northwest Hydraulic Consultants, Formulating and Evaluating Alternatives for Water Quality Improvement Projects, July 2004.

[2] SWQIC (2004). Lake Tahoe Basin Storm Water Quality Improvement Committee (SWQIC), Formulating and Evaluating Alternatives for Water Quality Improvement Projects.

[3] Ford, D. (March 1995). County of El Dorado Drainage Manual.

[4] TRPA (1988). Water Quality Management Plan (208 Plan, Volume 1) for the Lake Tahoe Region.

[5] Saucedo, G. (2005). California Dept. of Conservation California Geological Survey, "Geologic Map of the Lake Tahoe Basin."

[6] Jorgensen, et.al (1978). Jorgensen, L.N., Seacer, A.L., and Kaus, S.J., Hydrologic Basins Contributing to Outflow from Lake Tahoe, California-Nevada: U.S. Geological Survey Hydrologic Investigations Atlas HA-587, 1978, scale 1:62,500.

[7] Data Provided by Tahoe Regional Planning Agency. http://dx.doi.org/10.5069/G9PN93H2

[8] USDA (2007). United States Department of Agriculture, NRCS Soil Survey of the Tahoe Basin Area, California and Nevada, http://soils.usda.gov/survey/printed_surveys/

[9] Foster, K.B. and Hoffman, L.L. Tahoe Land Guide.

[10] TRPA (March 2012). Tahoe Regional Planning Agency, Plan Area Statements.

[11] NCE (September 2015). CSA #5 Erosion Control Project, EIP #01.01.01.0067, Botanical Baseline Report.

[12] NCE (September 2015). CSA #5 Erosion Control Project, EIP #01.01.01.0067, Noxious Weed Risk Assessment.

[13] NCE (September 2015). CSA #5 Erosion Control Project, EIP #01.01.01.0067, Wildlife Baseline Report.

[14] Ford, D. (March 1995). County of El Dorado Drainage Manual.

[15] Goodridge, J. El Dorado County Design Rainfall. Supplement to the El Dorado County Drainage Manual. August 2008.

[16] Ford (1995). Pg 1-8.

[17] Tahoe Regional Planning Authority (TRPA). (December 2002). Code of Ordinances.

[18] Lahontan Region Water Resources Control Board. (1994). Water Quality Control Plan for the Lahontan Region, North and South Basins.

[19] Ford (1995).

[20] Goodridge, J. (August 2008). El Dorado County Design Rainfall. Supplement to the El Dorado County Drainage Manual.

[21] Goodridge (2008).

[22] TRPA. (2002).

[23] Lahontan Region Water Resources Control Board (1994). Water Quality Control Plan for the Lahontan Region, North and South Basins.

[24] Ford (1995).

[25] Mays (2001) Mays, L. W. Storm Water Collection Systems Design Handbook, McGraw-Hill.

[26] Mays (2001).

[27] Ford (1995). Pg 2-17.

[28] Ford (1995). Pg 2-17.

[29] Ford (1995). Pg 2-17.

[30] Ford (1995). Pg 2-17.

[31] Lahontan Regional Water Quality Control Board (LRWQCB) and Nevada Division of Environmental Protection (NDPEP). June 2010. Lake Tahoe Total Maximum Daily Load – Technical Report. Pg 3-5.

[32] Ford (1995). Pg 4-5.

[33] Ford (1995). Pg 4-4.

[34] SWQIC (2004).

[35] NHC (December 2009) Pollutant Load Reduction Model (PLRM) Users Manual.

[36] El Dorado County Baseline Load Update, 2016 Fall Report.

[37] Tahoe Resource Conservation District (TRCD), Implementers' Monitoring Program (IMP), Component of the Regional Storm Water Monitoring Program (RSWMP), submitted to the

Lahontan Regional Water Quality Control Board and the Nevada Division of Environmental Protection on April 30, 2013.

[38] TRCD, Stormwater Monitoring Report WY 2014, March 15, 2015.

[39] Walker, T.A. and T.H.F Wong. Effectiveness of Street Sweeping for Storm water Pollution Control. December 1999.

[40] California Department of Public Health, Statewide Relaxation of 72-Hour Water Detention Policy for Mosquito Prevention in Structural Best Management Practices (BMPs) July 2007.