APPENDIX A14

WATER QUALITY TECHNICAL MEMORANDUM

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April 2020
By Wood Environment & Infrastructure Solutions, Inc.

INTRODUCTION AND BACKGROUND

The I-70 West Vail Pass Auxiliary Lanes project (Project) is located in Eagle and Summit Counties, with the eastern terminus just east of the Vail Pass Rest Area and the western terminus in the Town of Vail. The project study limits include eastbound (EB) and westbound (WB) I-70 from mile post (MP) 179.5 to MP 191.5. The project location and approximate study area are shown in **Figure 1**.

As part of the initial National Environmental Policy Act (NEPA) analysis, a Tier 1 Environmental Impact Statement (EIS) for the I-70 Mountain Corridor (C-470 to Glenwood Springs) was completed in 2011. This EIS, the *I-70 Mountain Corridor Programmatic Final Environmental Impact Statement* (PEIS), recommended the addition of auxiliary lanes EB and WB on the west side of Vail Pass from MP 180 to MP 190 as part of the Preferred Alternative's Minimum Program of Improvements. The PEIS also identified the potential for an elevated Advanced Guideway System (AGS) for transit along the I-70 corridor, including the West Vail Pass project corridor. A follow-up AGS Feasibility Study in 2014 analyzed potential alignments and costs for an AGS system and determined there were three feasible alignments for future AGS. While AGS is not part of the West Vail Pass Auxiliary Lanes project, the AGS Feasibility Study was used to ensure the project did not preclude the favored alignment of the three, which would be partially within CDOT right-of-way (ROW).

A Tier 2 NEPA analysis is the next step required to move highway improvements forward. The project is following the Colorado Department of Transportation (CDOT) and Federal Highway Administration (FHWA) NEPA process to confirm the needs for improvements to the West Vail Pass, identify a Proposed Action, investigate the anticipated benefits and impacts of the proposed improvements (through an Environmental Assessment), produce conceptual design plans, and make funding, scheduling, and phasing recommendations.

This memorandum describes the evaluation of potential water quality impacts to surface water, groundwater, and drinking water supplies from the Project. CDOT conducts an evaluation of the potential water quality impacts to comply with CDOT's Environmental Stewardship Guide, which ensures that the statewide transportation system is constructed and maintained in an environmentally responsible, sustainable, and compliant manner; and complies with federal laws and executive orders, state laws, and FHWA technical guidance. The mitigation measures identified at the end of this memo are consistent with the mitigation strategies identified in the *I-70 Mountain Corridor Record of Decision*. The term "control measures" is used throughout the memo instead of "best management practices" or BMPs.

A separate memorandum has been developed for the Context Sensitive Solutions (CSS) process, which includes an Issue Task Force specific to the Stream and Wetland Ecological Enhancement Program (SWEEP) Memorandum of Understanding (MOU) for the I-70 Mountain Corridor. The CSS memo documents stakeholder input for all CSS requirements. The commitments in this memo are compliant with the SWEEP MOU.

Legislation

Applicable legislation is included in the section below to highlight the governing requirements for water quality analysis of the Proposed Action.

Clean Water Act (Sections 401 and 402)

- Established the basic structure for regulating discharges of pollutants into navigable waters. It provides the statutory basis for the National Pollutant Discharge Elimination System (NPDES) permit program and the basic structure for regulating the discharge of pollutants into waters of the US. Section 401 regulates the compliance with applicable requirements and certification by the state for discharges. Section 402 regulates the specific permits for discharges.

Safe Drinking Water Act (40 CFR Parts 141–143)

- Protects public health by regulating the nation's public drinking water supply and protecting drinking water and its sources. CDOT is a stakeholder in the Colorado Source Water Assessment and Protection program mandated by the Safe Drinking Water Act.

Erosion and Sediment Control on Highway Construction Projects (25 CFR 650 Subpart B)

- All highways funded in whole or in part by FHWA must be designed, constructed, and operated according to standards that will minimize erosion and sediment damage to the highway and adjacent properties and abate pollution of surface and groundwater resources.

Colorado Water Quality Control Act (Colorado Revised Statutes Title 25, Article 8)

- Protects and maximizes the beneficial uses of state waters and regulates water quality (Colorado Department of Public Health and Environment (CDPHE), 2013)

Colorado Discharge Permit System (CDPS)

- Section 402 of the Clean Water Act (CWA) outlines the regulations for complying with the NPDES (implemented by Colorado as the Colorado Discharge Permit System or CDPS). Under NPDES, states were required to "phase in" Environmental Protection Agency (EPA) regulations aimed at reducing point source pollution to Waters of the State, which encourage states to develop a variety of programs to reduce point source and stormwater runoff pollution from construction projects during both the construction and operation phases of those projects.

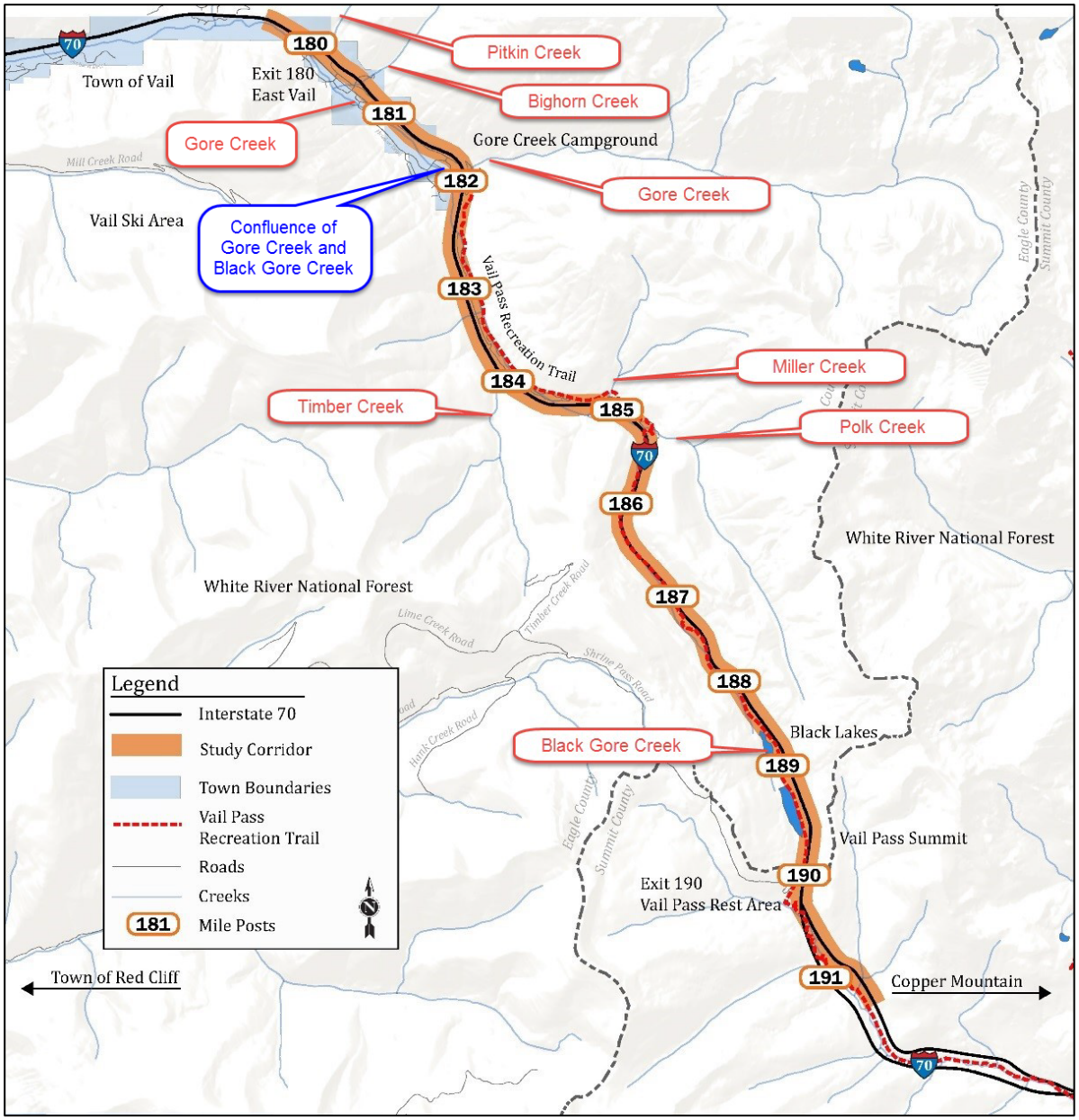
Water Quality Control Regulation (Water Quality Control Commission (WQCC))

- Regulation 42 governs the water quality standards for groundwater while Regulation 93 lists the all streams on the impaired waters and monitoring and evaluation list.
- Regulation No. 61 outlines the requirements for the CDPS as described above and the requirements for stormwater discharges for which permits are required.
- These regulations are implemented by the CDPHE.

Study Area

The study area for the Project extends between MP 179.5 to MP 191.5. The streams included in the Project's study area include Gore Creek and Black Gore Creek. Water quality improvements will be located along the corridor approximately between MP 180 and MP 190. This includes the entirety of Black Gore Creek from the headwaters, through the Black Lakes, to its confluence with Gore Creek, and Gore Creek from the tributary with Black Gore Creek through the downstream end of the project. Other tributaries to Black Gore Creek and Gore Creek within the Project area include Pitkin Creek, Bighorn Creek, Timber Creek, Miller Creek, and Polk Creek. These streams are labeled below on **Figure 1.**

Figure 1. Project Location and Study Area



Source: DEA Project Team

Purpose and Need

The purpose of the project is to improve safety and operations on EB and WB I-70 on West Vail Pass.

This project is needed to address safety concerns and operational issues due to geometric conditions (steep grades and tight curves) and slow-moving vehicle and passenger vehicle interactions that result in inconsistent and slow travel times along the corridor. The I-70 Mountain Corridor PEIS identified safety and mobility issues on West Vail Pass related to speed differentials due to slow-moving vehicles. *(Mobility is defined as the ability to travel along the I-70 Mountain Corridor safely and efficiently in a reasonable amount of time.)*

- Safety Concerns: A high number of crashes occur along the corridor related to speed, tight curves, narrow roadway area, and inclement weather/poor road conditions. Speed differentials between passenger vehicles and slow-moving vehicles cause erratic lane changes and braking maneuvers resulting in crashes and spin outs. Emergency response is hampered by vehicular speeds and lack of roadway width to provide room for emergency vehicles to pass.
- Operational Issues: The steep grades and resulting speed differentials causes slow and unreliable travel times through the corridor. Tight curves also cause drivers to slow down. The corridor is frequently closed by vehicle incidents, due to lack of width to maintain a single lane of traffic adjacent to emergency responders, resulting in substantial traffic backups and delays. During winter months, the travel lanes and shoulders are severely impacted by snow accumulation, impacting the overall capacity of the corridor. *(Operations is intended to describe the flow of traffic at desirable speeds given the geometric and prevailing weather conditions.)*

No Action Alternative

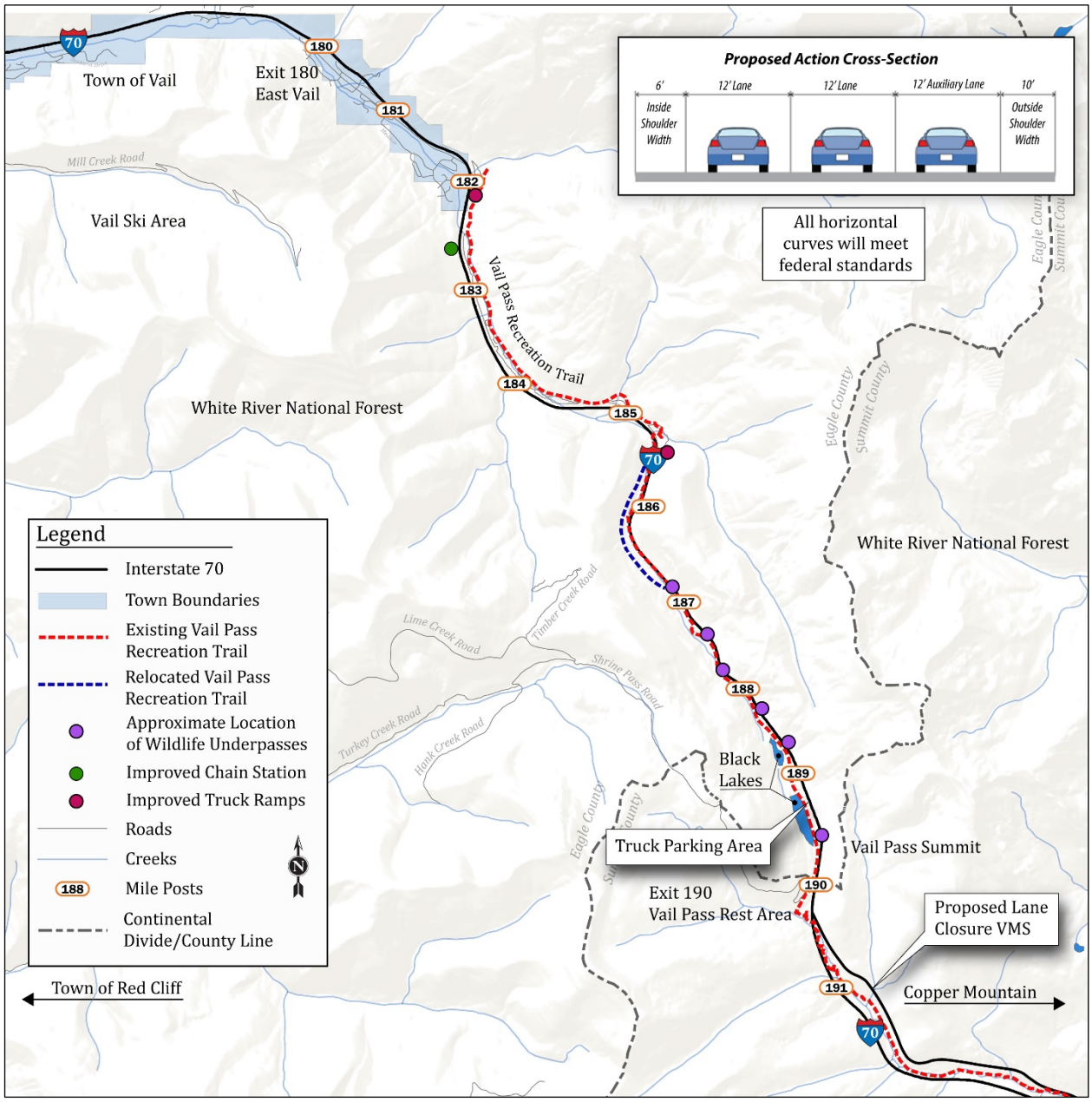
The No Action Alternative is included as a baseline for comparison to the action alternative. Under the No Action Alternative, only programmed projects that are planned and funded by CDOT or other entities would be completed. Currently, there are no large-scale transportation projects to add safety improvements, operational improvements, vehicular capacity, and multimodal facilities along I-70 within the project area. The No Action Alternative would leave West Vail Pass as it currently is configured and would not provide substantial improvements beyond typical current maintenance (e.g. resurfacing and plowing) activities. The roadway would remain the same, with 2 EB and 2 WB lanes (each 12 feet in width), an inside shoulder typically 4 feet in width, and an outside shoulder typically 10 feet in width.

Proposed Action Alternative

The Proposed Action (**Figure 2**) will add a 12-foot auxiliary lane, both EB and WB, for 10 miles from approximately the East Vail exit (MP 180) to the Vail Pass Rest Area exit (MP 190). Existing lanes will be maintained at 12 feet and the shoulders would be widened to a minimum of 6 feet for inside shoulders and will be maintained at 10 feet for outside shoulders. All existing curves will be modified as needed to meet current federal design standards.

Intelligent Transportation System (ITS) equipment will also be installed along the I-70 project corridor, consistent with recent study recommendations. Additional variable message signs (VMSs) will be installed at key locations to warn drivers of upcoming curves, grades, and incidents. Additional variable speed limit signs will be installed to manage driver speeds to conditions. Automated lane closure signage will be installed approaching the East Vail exit on EB I-70 and approaching the WB I-70 Vail Pass Rest Area exit to quickly and efficiently close lanes when needed.

Figure 2. I-70 West Vail Pass Auxiliary Lanes Proposed Action Alternative



Source: DEA Project Team

Additional elements of the Proposed Action include:

- The Vail Pass Recreation Trail will be directly impacted by the addition of the I-70 auxiliary lane and therefore relocated for approximately two miles from MP 185 to MP 187.
- Existing emergency truck ramps, located at approximately MP 182.2 and 185.5, will be upgraded to current design standards.
- Six wildlife underpasses and wildlife fencing will be constructed throughout the corridor.
- Additional capacity will be added to the existing commercial truck parking area at the top of Vail Pass.
- Widened shoulders (minimum of eight feet of additional width beyond the 10' shoulder) at multiple locations to accommodate emergency pull-offs, emergency truck parking, and staging for tow trucks.
- Improved median emergency turnaround locations to accommodate emergency and maintenance vehicle turnaround maneuvers.
- Improved chain station located at approximately MP 182.5 with additional parking, signage, lighting, and separation from the I-70 mainline.
- Avalanche protection located at approximately MP 186.

Methodology

The SWEEP MOU, an appendix to the PEIS served as the foundation for the water quality recommendations and future commitments documented in this memo. The MOU documents an agreement between CDOT and other parties with the goal to "improve stream and wetland conditions in the I-70 Mountain Corridor" and provides procedural guidelines to achieve that goal on future I-70 Mountain Corridor projects. Part of this process is the development of a SWEEP Issue Task Force (ITF) for projects on the I-70 Mountain Corridor. The ITF meetings and coordination are used to document commitments and general stream and wetland condition goals within the project area. Two ITF meetings were held for this project and invitees included representatives from:

- CDOT Region 3 and Headquarters
- Colorado Parks and Wildlife (CPW)
- FHWA
- Colorado Trout Unlimited
- Eagle River Watershed Council (ERWC)
- US Fish and Wildlife Service
- Western Rivers Institute
- EPA
- Colorado Headwaters Land Trust
- Eagle River Water and Sanitation District (ERWSD)
- Eagle County
- Town of Vail
- CDPHE
- United States Army Corps of Engineers
- United States Forest Service (USFS).

These ITF meetings were held to discuss existing conditions and concerns; present and receive feedback on the Proposed Action and potential control measures; and discuss the timing of specific control measure implementation, Sediment Control Action Plan (SCAP) update, and future SWEEP ITF coordination. Documentation from these meetings can be found in the *I-70 West Vail Pass Auxiliary Lanes CSS Technical Memorandum*.

In addition to the SWEEP ITF meetings, several CDOT departments and specialty units were consulted on this Project, including staff from CDOT Region 3 environmental, hydraulics, maintenance, bridge, and roadway. Interviews with CDOT maintenance personnel who are responsible for maintaining I-70 over Vail Pass were conducted to gather information on the various maintenance activities within the corridor including: sweeping, trash collecting, plow driver training, technology advances in deicing and traction sand applications, and product storage practices. These interviews were conducted to get first-hand feedback from the maintenance crews on what is effective and what is not regarding existing control measures and maintenance activities. Preferred types of control measures were discussed for ease of maintenance and problem areas were documented for future incorporation into the design.

For this Environmental Assessment (EA), the existing 2002 SCAP was reviewed along with documentation from a variety of sources and the CDPHE WQCC 303(d) List of Impaired Waters was consulted to evaluate the status for Gore Creek and Black Gore Creek. Specifically, the documents described below were referenced to provide background information and to help contextualize the project and provide additional insight into the I-70 Corridor. References to the "basin" throughout this memo refer to the tributary basin to the project area, including Black Gore Creek and Gore Creek.

- **Sediment Control Action Plan - Black Gore Creek I-70 Corridor, 2002** – The SCAP, produced by CDOT, identified sediment concerns and issues and recommended control measures and improvements to address the sediment problems. It provided hydrologic and hydraulic information within the basin and outlined current practices to control sediment from entering nearby streams. The 2002 SCAP for Black Gore Creek outlined the 2002 existing conditions and provided suggested improvements for the corridor to improve water quality. The SCAP indicates three zones along the roadway. Zone 1 is the immediate travel corridor within 30 feet of the travel lanes, Zone 2 is the adjoining slopes and valley areas, and Zone 3 is the receiving water body and riparian corridor. The original SCAP provided recommendations for improvements within Zone 1 of the travel way. The SCAP also provided baseline recommended improvements to the corridor, several of which have been implemented and are identified in **Appendix A**.
- **Data Summary Report Interstate 70 Mountain Corridor Storm Event/Snowmelt Water Quality Monitoring 2000-2016** – The Data Summary Report produced by Clear Creek Consultants summarizes the water quality data for suspended sediment, phosphorus, dissolved salts, and trace metals from runoff from I-70. The report also highlights the stream water quality data for nearby streams including Black Gore Creek and a summary and recommendations for future monitoring within the area.

- **I-70 Clear Creek Corridor Sediment Control Action Plan, 2013** - The 2013 SCAP for the Clear Creek Corridor produced by CDOT is the latest SCAP in the area near the project and is from a local watershed east of the Black Gore Creek watershed. This document was used as a comparison and source for updated control measure technology and approaches that could be implemented within the project area.
- **Sediment Control Action Plan Straight Creek I-70 Corridor, 2002** – CDOT's 2002 SCAP for the Straight Creek Corridor, a watershed adjacent to Black Gore Creek, was used as a comparison to the analysis on Black Gore Creek and any relevant approaches or ideas from this report were incorporated into the overall approach.
- **Eagle River Water Quality Management Plan, 2012** – The Eagle River Water Quality Management Plan was developed by the Northwest Colorado Council of Governments (NWCCOG) and was reviewed for data relevant to Gore Creek and Black Gore Creek. This plan included data on the 1987 EA, which enlarged Black Lake Reservoir Number 1. The plan also referenced a 1993 study completed by Resource Consultants and Engineers, Inc., which examined Black Gore Creek above Gore Creek and used it as a baseline for comparison with Straight Creek. Recommendations and guidance from this document were reviewed for applicability to the Project.
- **I-70 Mountain Corridor PEIS Water Resources Technical Report, 2010** – This Technical Report produced for the I-70 Mountain Corridor PEIS provides an assessment of the No Action and Action Alternatives regarding their impacts on water quality. The report outlined basin-wide water quality modeling efforts and outlined potential impacts of various alternatives through the entire mountain corridor.
- **State of the Rivers: Annual Water Quality Report WY 2011-2013** – This report was published through the ERWC and summarizes water quality data collected across the watershed from numerous agencies and organizations. It provides analysis to inform stakeholders on the relationship between water quality conditions and the range of water uses.
- **Gore Creek Water Quality Improvement Plan (2013)** – This report was prepared for the Eagle River Watershed Urban Runoff Group (URG) and included recommendations for improving water quality within the basin by incorporating several documents, including the 2002 SCAP, into one combined document. The URG is a "stakeholder group that recognizes the importance of source water protection for human health and the socioeconomic vitality of the communities of Eagle County".

Documents produced by other departments of transportation (DOTs) and other groups were researched, and a list of comprehensive "menu" of control measures was developed, which is included in **Appendix B**. Two types of control measures were developed: control measures specifically for conveyance, such as grass-lined swales, and treatment control measures such as sedimentation ponds. Only feasible control measures were selected to be included in the menu of control measures options. Feasibility was checked by determining if there was adequate space to place the control measure within the corridor and if the control measure was appropriate to treat the pollutants of concern. Permanent water quality measures will be incorporated into the project based on the SWEEP MOU. The process and timing of implementation is outlined in the flowchart provided in **Appendix C**.

EXISTING CONDITIONS

GENERAL WATERSHED INFORMATION

There are two reservoirs within the basin referred to as Black Lake No. 1 and Black Lake No. 2, collectively as Black Lakes, on the mainstem of Black Gore Creek and adjacent to I-70. The Black Lakes have a small tributary area as they are located very near the Continental Divide. The Black Lakes are located on USFS land, managed by CPW, and are utilized by the ERWSD for water supply purposes. The primary receiving waterbodies for the Project are Black Gore Creek (including the Black Lakes) and Gore Creek. Black Gore Creek originates near the summit of Vail Pass and parallels I-70, flowing northwest for approximately eight miles to its confluence with Gore Creek near East Vail. I-70 continues to run parallel with Gore Creek to the project termini in East Vail. Black Gore Creek basin ranges in elevation from mountain peaks above 12,000 feet above sea level on Vail Pass to approximately 8,700 feet above sea level at the confluence with Gore Creek, and has a drainage area of approximately 20 square miles. The hydrology for Black Gore Creek and Gore Creek are dominated by the annual cycle of snowmelt runoff occuring between May and June each year. Streamflow is perennial, generally receding following the summer months with lower flows in the fall and winter. Both Black Gore Creek and Gore Creek are gaining streams, meaning that flows increase from tributary inflow as the streams progress downstream. From the confluence of Black Gore Creek with Gore Creek, the Gore Creek corridor ranges in elevation from 8,700 feet above sea level to 8,300 feet above sea level and contributes an additional drainage area of approximately 30 square miles.

The I-70 corridor is largely composed of sub-alpine forest and bisects five ecosystems including Engelmann Spruce-Subalpine fir, lodgepole aspen, shrub, wet meadow, and dry meadow. Approximately 3% of the total watershed is impervious surface, concentrated primarily around I-70 and East Vail.

SEDIMENT CONTROL ACTION PLAN

The 2002 SCAP for Black Gore Creek along the I-70 Corridor provides an evaluation of I-70 sediment sources, volume estimates, a hydraulic and drainage analysis, and existing maintenance practices. The SCAP also summarizes previously conducted studies, including water quality moniroting of Polk, Miller, and Black Gore Creeks. This information was used to develop strategy for addressing sediment loading from I-70, including strutural and non-structural sediment control measures. The SCAP identified three impact zones, stretching from I-70 to Black Gore Creek. Zone 1 is the immediate I-70 travel corridor, Zone 2 is the adjoining slopes and valley area, and Zone 3 is the recieveing water body and riparian corridor. The SCAP exclusively addressess Zone 1, which was defined as generally 30-feet from edge of pavement, with the understanding that it would be wider in areas (e.g. where the recreation trail is adjacent to I-70 or other areas maintained by CDOT).

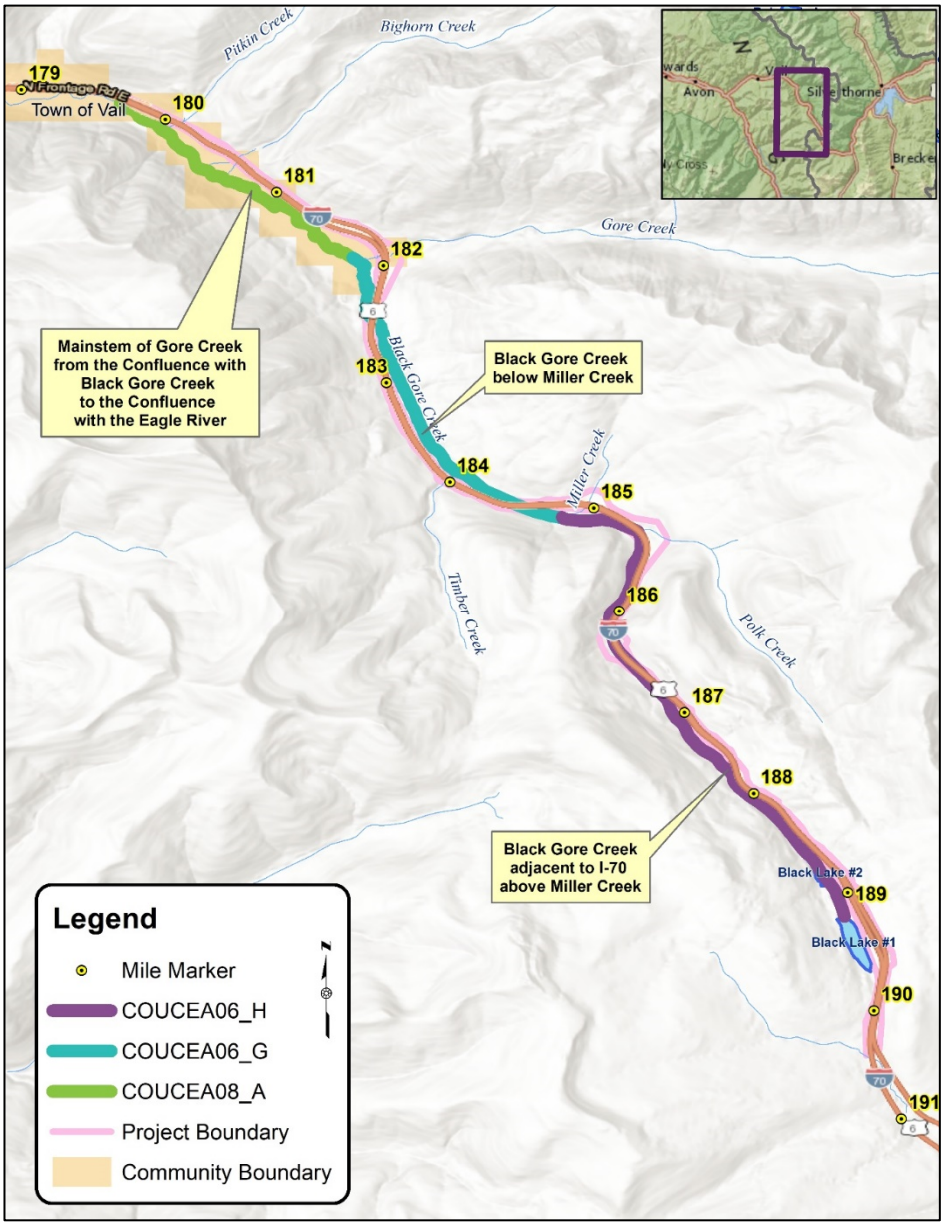
POLLUTANTS

Primary pollutants from the operation of I-70 include various substances from vehicles and winter maintenance operations. **Table 1** below describes the types of pollutants commonly seen from highway runoff that may be present in the study area. **Figure 3** shows the project area, the segments on the 303(d) list and the Black Lakes.

Table 1. Common Pollutants

SOURCE	POLLUTANT
Leaks, spills, crashes	Oil, gasoline, diesel, grease, VOCs, chemicals, other potentially hazardous materials
Vehicle traffic	Oils, grease, gasoline, diesel, benzenes and derivatives, aromatic hydrocarbons, coolants, rust (iron), heavy metals (lead, zinc, iron, chromium, cadmium, nickel, copper), rubber, asbestos
Winter sanding	Sediment, sodium, chloride
Deicing	Calcium, sodium, magnesium, chloride
Erosion	Sediment

Figure 3. 303(d) Listed Stream Segment Map



Soils

Soils in the basin consist primarily of glacial deposits of till and stratified dirt. Alluvial deposits are found on the valley floor of the streams within the basin. The alluvium is well sorted, stratified gravel sand and silts and varies in depth from a few feet to 50 feet thick. Additional information on soils and bedrock can be found in the I-70 West Vail Pass Auxiliary Lanes Geology Technical Memo.

Historic and Current Development

Prior to the construction of I-70, US 6 was the primary highway used to access the Vail Valley from the east. Cut and fill construction methods were used to build I-70 through the steep mountainous terrain. About 50% of the highway was constructed on existing landslide areas within Vail Pass. In several locations, shallow groundwater was exposed by cut and can particularly be seen in the spring and summer in the Black Gore Creek corridor. Conversely, some fill slopes have buried former groundwater springs, altering the hydraulic route groundwater would enter the corridor.

Streams through the corridor were not channelized by the construction of I-70 and were left primarily in their natural locations. Channel alterations were required in the lower portion of Black Gore Creek between MPs 182.5 and 182.7, where five drop structures and one stream sedimentation pond were installed.

A CDOT maintenance facility is located on the north (WB) side of I-70 at the summit of Vail Pass along with rest areas facilities on the south side of I-70. Traffic through the corridor has been increasing over the years as the population in the foothills has also increased.

Maintenance

Routine maintenance is currently being performed on all existing permanent water quality structures along Vail Pass and includes debris removal, street sweeping, sediment collection, and other practices. Sediment basins are cleared every few years when the capacity diminishes. A vacuum truck is used for maintenance along the corridor to extract sediment from inlets, vaults, and other sediment traps 2-4 times per year depending on flow and loading. Mechanical brooms and skid-steer loaders are used to collect sediment off the shoulder.

Based on recent monitoring data, concentrations of traction sand have been decreasing likely due to mitigation measures being implemented by CDOT. Use of deicers is increasing but is being controlled due to increased driver training and the improvement of practices and techniques used by the drivers. CDOT has also been more stringent on the suppliers of its deicer and has been selecting products with less harmful environmental effects in order to mitigate the impacts caused by the application of the deicer (Lewis, 1999). Since the 2002 SCAP was implemented, one stream segment adjacent to the roadway (COUCEA06_H - Black Gore Creek adjacent to I-70 above Miller Creek) was delisted from the 303(d) list for sediment due to refinement of the extent of impairment.

CDOT has been tracking the application of traction sand and other materials to the roadway and recovery volumes when sediment ponds and other control measures are maintained. CDOT has also implemented numerous recommended projects outlined in the 2002 SCAP (**Appendix A**).

MONITORING

CDOT has voluntarily provided water quality monitoring for the project area since 2000 with the latest report being published in 2017 by Clear Creek Consultants. These reports are typically produced every two years. These monitoring studies have reported that Total Suspended Sediment (TSS) and phosphorus concentrations were low in I-70 study streams during non-runoff conditions, but high concentrations were found during runoff conditions, especially at higher elevations. The primary source of TSS was identified to be traction sand deposited on I-70 that mobilized and was transported into streams via snowmelt and rainfall runoff. The high suspended solids concentrations in I-70 runoff correlated with elevated total phosphorus concentrations. The study found a correlation coefficient of 0.87 for the 67 sample data pairs used. This indicates that sediment loading is a reasonable indicator of phosphorous concentrations. These results also suggest that, because the phosphorus is primarily in particulate form associated with sediment, implementation of standard sediment control measures would be effective in reducing total phosphorus transport from I-70 to receiving streams.

Rill and gully erosion at culvert outlets also contribute to sediment deposition. The report identifies many of these sources could be remedied through effective highway sediment control measures, such as implementing standard sediment control measures. This report also noted that while the concentrations were still elevated, there is a decreasing trend in dissolved salts and trace metal concentrations on Black Gore Creek.

The most recent external water quality report was published in 2015 by a joint venture between the ERWC and the USGS to collect annual biomonitoring data. Sediment source monitoring has been conducted biannually since 2013. As a result, every two years an inventory and assessment of the sedimentation and watershed conditions are evaluated. This monitoring is being encouraged to continue to examine water quality conditions within the area.

WQCC REGULATIONS

Surface water within the basin has been assigned use classifications and water quality standards by the WQCC. Gore Creek and Black Gore Creek are listed on Colorado's 303(d) list of impaired water bodies for aquatic life use impairment. **Monitoring stations** can be found along Black Gore Creek and Gore Creek.

Table 3 provides a list of steam gages along the streams within the project area. Field/Lab Water-Quality Samples includes information on a wide range of water quality parameters unique to each station. Though parameters vary from station to station, monitored pollutants of concern include specific conductance, dissolved solids, and suspended sediment.

Table 2 provides a full list of all impaired streams within the project area. Segment COUCEA08_A includes the portion of Gore Creek running through the entirety of the Town of Vail. Based on the Gore Creek Strategic Action Plan produced by the Town of Vail, there are several "diverse urban runoff pollutant sources [which] contribute to aquatic life impairments on Gore Creek and its Tributaries".

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Table 2. Water Bodies Requiring TMDLs or Identified for Monitoring and Evaluation

WBID	Segment Description	Portion	Colorado's Monitoring & Evaluation Parameter(s)	Clean Water Act Section 303(d) Impairment	303(d) Priority
COUCEA06_G	All tributaries to the Eagle River, including all wetlands, from the compressor house bridge at Belden to a point immediately below the confluence with Lake Creek, except for the specific listings in Segments 1, 7a, 7b, and 8.	Black Gore Creek, below Miller Creek	Aquatic Life Water Supply	Sediment Arsenic (Total)	H L
COUCEA06_H		Black Gore Creek, adjacent to I-70 above Miller Creek	Water Supply	Arsenic (Total)	H
COUCEA08_A		Mainstem of Gore Creek from the confluence with Black Gore Creek to the confluence with the Eagle River.	Aquatic Life	Macroinvertebrates (provisional)	L

Table 3. Stream Gages near Project Area

Maintained By	Gage Name	Gage Number	Field/Lab Water-Quality Samples		
			Begin year	End year	Count
USGS	Black Gore Creek Near Minturn, CO	09066000	1963	2012	424
USGS	Black Gore Creek Near Vail, CO	09066050	1973	2001	100
USGS	Gore Creek Above Red Sandstone Creek at Vail, CO	09066325	1999	2018	43
USGS	Gore Creek at Mouth Near Minturn, CO.	09066510	1995	2019	351
USGS	Gore Creek at Upper Station, Near Minturn, CO	09065500	1963	2019	485
USGS	Gore Creek at Vail, CO	09066250	1973	1996	101

Drinking Water Sources, Wellhead Protection Areas

Black Gore Creek supplies surface water to the Gore Valley Drinking Water Facility in East Vail. The ERWSD operates the Black Lakes, located approximately between MP 190 and 188.5 on the west side of I-70. These lakes deliver water during low flow periods to Black Gore Creek, Gore Creek, Eagle River, and eventually to the Colorado River. Vail is primarily served by seven groundwater wells that operate year-round and vary in depth from 70 to 200 feet. Combined, they produce approximately 1 billion gallons of drinking water per year. The Upper Eagle Regional Water Authority operates ten groundwater wells on a seasonal basis to serve the needs of the communities west of Vail. Well depths vary from 60 to over 500 feet and supplement the surface water sources within the Upper Eagle Regional Water Authority.

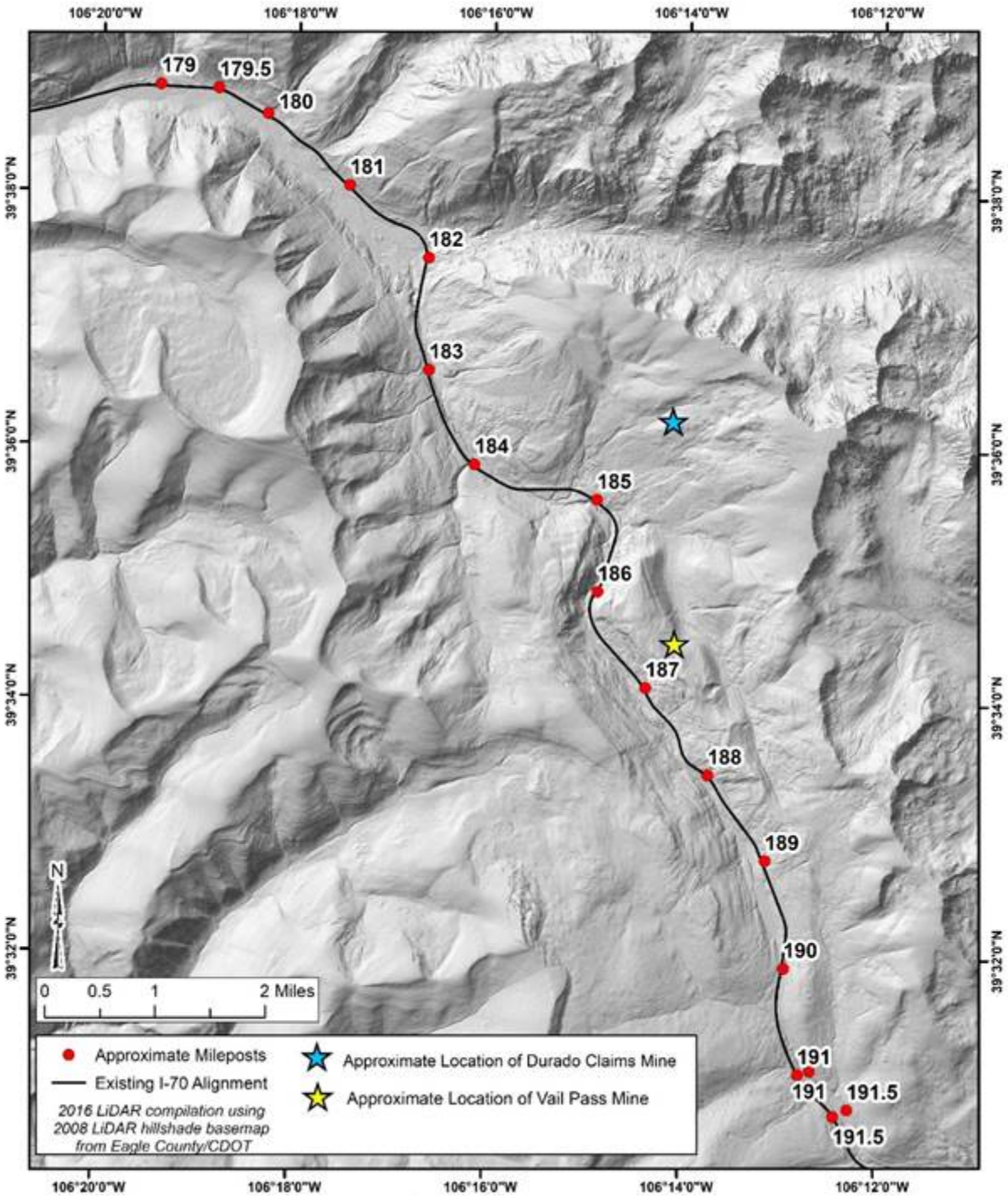
Fish and Threatened and Endangered (T&E) Species Habitat

Black Gore Creek below Miller Creek is currently on Colorado's 303(d) list of impaired waters and monitoring and evaluation list for sedimentation and contamination, resulting in a negative impact to the health and environment supporting the fish and invertebrate population within Black Gore Creek. The lower 4 miles of Gore Creek above the confluence with the Eagle River downstream of the project area (~MP 175.25-171.25) have been designated a gold medal trout fishery in recognition of the stream's high recreational value and the productive brown trout community. This segment of stream is five miles downstream of the Project and on other side of the Town of Vail. Native cutthroat trout may have habitat within the project area that may be impacted by the Project. All other listed species reflect water depletions from the Upper Colorado Basin, which will not occur as part of this Project. Currently there are barriers in place at various locations on Black Gore Creek to keep the brook trout from encroaching on the habitat to the areas of the native cutthroat trout. The Biological Assessment for the project specifically addresses T&E species impacts for the project. Additional information on impacts to fish and T&E species can be found in the Biological Assessment and Biological Evaluation reports for the Project.

Groundwater

Classifications for the groundwater include domestic use-quality and agricultural use-quality per WQCC Regulation 42. The groundwater quality standards included in Table 1 - 4 of the "Basic Standards for Ground Water" 41.0 (5 CCR 1002-41) are assigned to all confined and unconfined groundwater in the specified area. Areas regulated by Regulation 42 within the project area include the first mile and a half at the northern part of the project area approximately between MP 180 and 181.5. In addition, previous and active mining sites can affect groundwater, depending on the type and location of the mine. Near MP 185, northeast of I-70, there is a mine site above the highway. The Dorado group of claims were filed on a uranium deposit in the Minturn Formation during the 1950's. Additionally, near MP 186.5 the Vail Pass Mine was established on an extension of the same deposit in 1956. The claims cover a uranium deposit that is on the hillside north of the highway (Hughes, 2003), approximate locations shown in **Figure 4.**

Figure 4: Mine Sites Located Near Project Area



IMPACTS

NO ACTION ALTERNATIVE

As stated previously, the No Action Alternative would leave West Vail Pass as it is currently configured and would not provide substantial improvements beyond typical current maintenance (e.g. resurfacing and plowing) activities. Existing eroded areas will continue to degrade and areas of sheet flow will continue to lead to erosion problems and sediment deposition. Winter maintenance activities will continue to occur as they currently do and deposit traction sand and deicers to the roadway. Sediment accumulation from erosion and traction sand in runoff will continue in the Black Lakes, under bridges, and other inaccessible areas, impacting vegetation and water quality in the immediate vicinity.

PROPOSED ACTION ALTERNATIVE

SEDIMENT RUNOFF AND EROSION

PERMANENT IMPACTS

Two forms of sediment originate from the roadway, traction sand and sediment loss due to embankment erosion, especially at the outlets of culverts or other drainage structures. Both forms of sediment have a potential to impact the Black Lakes and the receiving streams nearby to the project.

Currently, CDOT Maintenance uses deicing solutions and traction sand on the roadway as part of winter maintenance operations. The volume of deicing solutions and traction sand has varied significantly over the years. The Proposed Action will likely increase sediment load due to the increase in impervious surface as the application rates will be generally consistent with current rates.

The additional impervious surface will also increase runoff flows from the roadway. Both new and existing control measures will continue to collect sediment and require ongoing monitoring and maintenance.

While CDOT will revegetate and stabilize previously eroded areas, embankment erosion could occur again, or new eroded areas could develop during future heavy rain events. Localized erosion may occur on embankments and at the downstream end of new or replaced culverts.

The additional impervious surface, and therefore more storm runoff, will likely result in additional phosphorus loading. As previously mentioned, monitoring has indicated that high suspended solids concentrations in I-70 runoff correlate with elevated total phosphorus concentrations. This indicates that sediment loading is a reasonable indicator of phosphorous concentrations.

TEMPORARY IMPACTS

Temporary impacts during construction include working adjacent to or within water resources and runoff from construction activities, which may have a greater potential of impacting Gore Creek and Black Gore Creek. Without mitigation, sediment and/or pollutants from construction activity may reach Gore Creek and Black Gore Creek.

SEDIMENT ACCUMULATION

PERMANENT IMPACTS

Areas under bridges have historically been the collection point for traction sand leaving the roadway. Due to the steep slopes and other field conditions, this sand has been difficult to remove. Sediment accumulation will continue under the bridges and other inaccessible areas and impact existing

vegetation and nearby wetlands and waterways. Sediment accumulation will continue under bridges and other inaccessible areas and additional sediment will be deposited, impacting vegetation and water quality in the immediate vicinity.

Temporary Impacts

During construction, areas under bridges and other inaccessible areas may see additional sediment loading caused by construction or will be disturbed by construction, resulting in the sediment moving further downstream.

Drinking Water Sources, Wellhead Protection Areas

Permanent Impacts

While highway runoff may reach the Black Lakes, the impact of the sediment loading is anticipated to be minor due to the limited tributary area above the lakes and not directly impact water quality. No specific standards exist for sediment from highway runoff or roadway expansion adjacent to drinking water facilities. Impacts to wells and drinking water extractions from Gore Creek and Black Gore Creek are not anticipated from this project.

Temporary Impacts

Construction activities may increase sedimentation of Black Lakes, Black Gore Creek, and Gore Creek. There are no anticipated construction impacts to wells.

Hazardous Material Spills

Many spills of vehicle fluids are caused by crashes within the corridor; the Proposed Action will reduce the number of crashes, and therefore would reduce the number of these spills. The auxiliary lane would aid crews in cleaning up spills and discharges from crashes to mitigate the risk of these pollutants from entering nearby streams. Additional information regarding impacts and mitigation from hazardous materials can be found in the *I-70 West Vail Pass Auxiliary Lanes Hazardous Material Technical Memorandum.*

Mitigation Measures and Best Management Strategies

The Project does not fall within the state designated Municipal Separate Storm Sewer System (MS4) area, so the project is not subjected to the Permanent Water Quality (PWQ) guidelines or PWQ Evaluation and Tracking (PET) form. However, due to sensitive nature of this area, and the SWEEP MOU, and the existing Black Gore Creek SCAP, permanent water quality features will be installed on this project. Based on the conceptual design of the Proposed Action and the review of the 2002 SCAP, there are numerous viable locations for permanent control measures to be installed. Once the design phase starts, after the completion of the EA, the SWEEP ITF will be reconvened and specific control measures will be selected from the Control Measures Menu (**Appendix B**) and implemented into the design as appropriate. In addition, existing sediment trap sizes and functionality will be verified and, if necessary, replaced. Additional information on mitigation measures is described on the following pages and in **Table 5**.

Sediment Runoff and Erosion

Permanent

In conjunction with final design and prior to the construction of any new impervious surface, (e.g. shoulders, auxiliary lanes), the SCAP update process will begin, including reconvening the SWEEP ITF from this EA. In addition to including previously completed water quality improvements from the previous SCAP, the SCAP update will include the following tasks:

- Site visits with the SWEEP ITF, CDOT Maintenance, and wetland and wildlife specialists to identify specific opportunities and constraints relating to specific areas of concern and opportunities for enhancement.
- Hydraulic and hydrology analysis
- Creation of a maintenance manual for application of winter roadway maintenance materials and maintenance of structural control measures for use by CDOT Maintenance
- Identification of new project-specific conveyance and treatment control measures, including sediment basins, and existing sediment trap sizes and functionality will be verified and, if necessary, replaced. (Zone 1)
- Identification of additional projects that are outside the scope of the I-70 West Vail Pass Auxiliary Lanes project (Zones 2 and 3)
- Identification of partnerships between stakeholders for future water quality improvement projects.

Due to limited construction funding, the Proposed Action will likely be implemented in phases. As these phases move into final design, the SCAP recommendations will be incorporated into the final design plans for that phase of the project. CDOT will continue to adhere to the SWEEP MOU commitments and will continue to hold SWEEP ITF meetings during future design phases of the project. The implementation flow chart included in **Appendix C** shows the timing of the SCAP update as it relates to the EA and future design phases.

Improvements identified in the West Vail Pass SCAP as Project control measures will be constructed as mitigation in areas of new construction where there are impacts of additional traction sand and additional runoff. Based on previous study results, implementation of the sediment control measures will likely also reduce the amount of phosphorus that is entering Black Gore Creek as runoff within the study area.

Culverts and other stormwater infrastructure will be designed to accommodate the additional runoff from the added impervious surface. The infrastructure will include riprap aprons or other appropriate control measures at the downstream outlets to reduce erosion. Sheet flow will be channelized where possible and directed to dedicated discharge locations also protected with riprap or other control measures. Areas with greater slopes will have a higher priority to implement this control measure because these areas will produce higher runoff velocities, thus having a higher potential to experience erosion. Areas of steep roadway grade will also be investigated for possible control measure placement to ensure the higher velocity flow exiting the roadway does not cause erosion. CDOT will achieve permanent stabilization through grading and revegetation with native species, mitigating concentrated flows from affecting slopes and continual maintenance of permanent erosion controls. Permanent control measures will be implemented in areas of historic erosion or suspected future erosion.

Table 4 lists the control measures that were identified as part of the SWEEP ITF and a description of the corridor location for which they are most appropriate. These control measures will be refined during final design. Additional information regarding the control measures can be found in **Appendix B.**

Table 4. Potential Project Control Measures

CONTROL MEASURE	SUITABLE CORRIDOR LOCATION(S)
Conveyance Control Measures	
Roadside Swales/Ditches	• Along shoulders of roadway where space allows throughout the project area • In areas with noted sheet flow and rill erosion to concentrate the flows to a point source
Curb and Gutter/Valley Pan	• In areas with extended shoulders, out of the way of the plow trucks • Do not use in areas with w-beam guardrail systems due to risk of vaulting or under riding the barrier • As far as possible away from the active travel lanes
Dedicated Snow Storage Areas	• In areas with extended paved shoulders • In areas behind jersey barriers or guard rails separated from traffic
Drainage Rundowns	• In areas with steep slopes down the roadway embankment • In partnership with knee walls, curb and gutter, valley pans or swales to control sheet flow across the roadway and rill erosion on the embankment to help convey flow down the embankment
Culvert Repair/Replacement	• In all existing culvert locations.
Slope Stabilization/Revegetation	• In areas with noticeable rill erosion and sheet flow conditions • Large cut or fill slopes • In areas disturbed or impacted by construction
Clean Water Diversion	• In areas with run-on sheet flows or concentrated flows, used in conjunction with upslope intercepting ditches/swales • Natural drainage features
Knee Wall	• Areas with steep cut slopes on uphill side of roadway with or without a drainage swale at the toe of the slope.
Shoulder/Embankment Paving	• Shallow slopes where noted rill/gully erosion has occurred especially near the roadway.
Treatment Control Measures	
CDOT Modified Type D Water Quality Inlet	• Paved shoulder areas • Median areas • Areas easily accessible by vacuum truck

Control Measure	Suitable Corridor Location(s)
	• At the end of sheet flow control measures, such as valley pans or swales/ditches with energy dissipation at the outlet
Detention/Sediment Basins	• In large open areas within the ROW • At the outfall of roadside ditches/swales, valley pan, curb and gutter, etc. • Below a large tributary area with or without other control measures
Loading Dock Sediment Trap	• In large areas of ROW where access to the control measure is possible • In areas of high sediment loading • Areas with large tributary area or downstream of multiple conveyance control measures
Bench Trap	• Wide paved/unpaved shoulder areas
Roadside Swales/Ditches	• Along shoulders of roadway where space allows throughout the project area
Riparian Corridor Enhancement	• Under bridges where improvements are being installed and where there is noticeable sedimentation with detrimental impacts to vegetation or erosion

Temporary

Temporary control measures will be required within the disturbance area during construction to minimize disturbed sediment from entering the adjacent creeks. A Stormwater Construction Permit (SCP) through CDPHE will need to be obtained prior to construction. Temporary construction impacts will be mitigated through the approved control measures and stormwater management plan (SWMP) through observations and updates to the plan during construction. CDOT will implement appropriate control measures for erosion and sediment control according the CDOT Erosion Control and Storm Water Quality Guide (CDOT, 2002, revised 2014), CDOT Specifications, CDOT M&S Standards, and SCP requirements.

Sediment Accumulation

Permanent

During design of the Proposed Action, maintenance access to areas of current sediment accumulation in Zone 1 as identified in the SCAP will be further investigated. CDOT will work to identify opportunities to improve maintenance access to these areas by incorporating improvements into the roadway and structure design. During construction of the Proposed Action, collected sediment in these areas will be removed where feasible and the areas will be revegetated. Areas that are suitable for riparian or wetland enhancement have been identified and will be further evaluated for enhancement feasibility as part of the CWA Section 404 permitting process, as discussed in the *I-70 West Vail Pass Auxiliary Lanes Wetlands Technical Memorandum*.

Temporary

CDOT will work to identify methods to mitigate disturbance to deposits during construction including, but not limited to, remediation practices under bridges (in areas impacted by construction activities), sediment removal, and stabilization practices. Practices will be employed where possible and only in areas where the situation can be improved by intervening.

Drinking Water Sources, Wellhead Protection Areas

Permanent

Permanent control measures will be designed and installed to minimize the amount of sediment entering the Black Lakes.

Temporary

Temporary control measures during construction will be installed to minimize the amount of sediment entering the Black Lakes, Black Gore Creek, and Gore Creek.

Table 5. Resource Mitigation Measures

CONTEXT
The primary receiving waterbodies from the Project are Black Gore Creek and Gore Creek. Black Gore Creek supplies surface water to the Gore Valley Drinking Water Facility in East Vail. There are two reservoirs referred to as Black Lake No. 1 and Black Lake No. 2 within the watershed. Black Gore Creek, below Miller Creek is on Colorado's Monitoring and Evaluation (M&E) List for aquatic life water supply and on the Clean Water Act 303(d) list for sediment and arsenic (total). Black Gore Creek, adjacent to I-70 above Miller Creek is on the M&E list for water supply and on the 303(d) list for arsenic (total). The mainstem of Gore Creek from the confluence with Black Gore Creek to the confluence with the Eagle River is on the M&E list for aquatic life and on the 303(d) list for macroinvertebrates (provisional).

IMPACT TYPE	NO ACTION ALTERNATIVE	PROPOSED ACTION ALTERNATIVE	MITIGATION
Sediment Runoff and Erosion	**Permanent Impacts:** • Existing eroded areas will continue to degrade • Areas of sheet flow will continue to lead to erosion problems and sediment deposition. • Winter maintenance activities will continue to occur and deposit traction sand and deicers to the roadway. • Control measures will continue to collect sediment and require ongoing monitoring and maintenance.	**Permanent Impacts**: • Increased sediment load from traction sand due to additional impervious surface. • Increased runoff flows from the roadway due to additional impervious surface. • Control measures will continue to collect sediment and require ongoing monitoring and maintenance. • Previously eroded areas will be stabilized, but erosion could occur again, or new eroded areas develop. • Localized erosion may occur on embankments and at the downstream end of new or replaced culverts. • Increase in impervious surface, and therefore more storm runoff, will likely result in additional phosphorus loading.	**Permanent:** • In conjunction with final design and prior to the construction of any new impervious surface, the Black Gore Creek SCAP will be updated, in coordination with the SWEEP ITF. SCAP control measures will be implemented as appropriate when an improvement feature triggers the need for sediment collection, such as an increase in impervious area. • Improvements identified in the SCAP update will be designed and constructed as mitigation in areas of new construction where there are impacts of additional traction sand and additional runoff. • Riprap aprons or other appropriate control measures will be used below outlets of stormwater infrastructure.

Impact Type	No Action Alternative	Proposed Action Alternative	Mitigation
Sediment Runoff and Erosion, continued		**<u>Temporary Impacts:</u>** During construction, sheet flow may pick up additional sediment caused by construction activities and could also cause rill erosion in areas.	• Sheet flow will be consolidated into channels and swales, where feasible, and conveyed to dedicated discharge points through a sediment control measure to reduce riling/rutting of the slope. • Utilize grading and revegetation with native species to achieve permanent stabilization. • Permanent control measures will be implemented in areas of historic erosion or suspected future erosion. **<u>Temporary:</u>** • Temporary control measures will be required within the disturbance area during construction to minimize disturbed sediment from entering the adjacent creeks. • An SCP through CDPHE will be obtained prior to construction. • A stormwater management plan (SWMP) will be prepared and implemented through observations and updates to the plan during construction. • CDOT will implement appropriate control measures for erosion and sediment control according the CDOT Erosion Control and Storm Water Quality Guide, CDOT Specifications, CDOT M&S Standards, and SCP requirements.

Impact Type	No Action Alternative	Proposed Action Alternative	Mitigation
Sediment Accumulation	**Permanent Impacts:** Sediment accumulation will continue under bridges and other inaccessible areas and additional sediment will be deposited impacting vegetation and water quality in the immediate vicinity.	**Permanent Impacts**: Sediment accumulation will continue under bridges and other inaccessible areas and additional sediment will be deposited, impacting vegetation and water quality in the immediate vicinity. **Temporary Impacts:** During construction, areas under bridges and other inaccessible areas may see additional sediment loading caused by construction or will be disturbed by construction resulting in the sediment moving further downstream.	**Permanent:** • As part of the SCAP update, CDOT will identify opportunities to improve maintenance access to these areas by incorporating improvements into the roadway and structure design. • During construction of the Proposed Action, collected sediment in these areas will be removed where feasible and the areas will be revegetated. Alternative stabilization measures will be evaluated for use in shaded areas where vegetation may not grow. Areas that are suitable for riparian or wetland enhancement have been identified and will be further evaluated for enhancement feasibility as part of the CWA Section 404 permitting process, as discussed in the *I-70 West Vail Pass Auxiliary Lanes Wetlands Technical Memorandum*. **Temporary:** • See temporary mitigation measures under Sediment Runoff and Erosion. • SWMP will identify methods to mitigate disturbance to deposits during construction including, but not limited to, remediation practices under bridges (in areas impacted by construction activities), sediment removal, and stabilization practices. Practices will be employed where possible and only in areas where the situation can be improved by intervening.

IMPACT TYPE	NO ACTION ALTERNATIVE	PROPOSED ACTION ALTERNATIVE	MITIGATION
Drinking Water Supplies and Wastewater Treatment Facilities	**Permanent Impacts**: Sediment will continue to accumulate in the Black Lakes.	**Permanent Impacts**: Sediment loading in Black Lakes is anticipated to be minor and will not directly impact water quality. No impacts to drinking water extraction from Black Gore Creek and Gore Creek are anticipated. **Temporary Impacts:** Construction activities may increase sedimentation of Black Lakes, Black Gore Creek, and Gore Creek.	**Permanent**: Permanent control measures will be designed and installed to minimize the amount of sediment entering the Black Lakes. **Temporary:** Temporary control measures during construction installed to minimize the amount of sediment entering the Black Lakes, Black Gore Creek, and Gore Creek.

Permits

Permits related to water quality that may be required for this Project include, but are not limited to, the following:

- Stormwater Permit associated with Construction Activities (Colorado Discharge Permit System [CDPS])
- Construction Dewatering or Remediation Permit

REFERENCES

"25 CFR Subpart B - Service Line Agreements." (n.d.). Legal Information Institute, Legal Information Institute, <https://www.law.cornell.edu/cfr/text/25/part-169/subpart-B> (Nov. 11, 2019).

CDPHE-WQCC, 2017a. "Regulation No. 33 – Classifications and Numeric Standards for Upper Colorado River Basin and North Platte River Basin." CDPHE-WQCC. June 30, 2018. Accessed July 2019. (https://www.epa.gov/sites/production/files/2014-12/documents/cowqs-no38-2006.pdf)

CDPHE-WQCC, 2017b. "Regulation No. 42 – Site-Specific Water Quality Classifications and Standards for Groundwater." CDPHE-WQCC. June 30, 2018. Accessed July 2019. (https://www.epa.gov/sites/production/files/2014-12/documents/cowqs-no38-2006.pdf)

CDPHE-WQCC, 2017c. "Regulation No. 93 – Colorado's Section 303(d) List of Impaired Waters and Monitoring and Evaluation List." CDPHE-WQCC. January 8, 2018. Accessed July 2019. (https://www.epa.gov/sites/production/files/2014-12/documents/cowqs-no38-2006.pdf)

CEQ, 1997. "Environmental Justice: Guidance under the National Environmental Policy Act." Council on Environmental Quality (CEQ). December 10, 1997. Accessed June 2019. (https://www.epa.gov/sites/production/files/2015-02/documents/ej_guidance_nepa_ceq1297.pdf)

Chelan County Public Works. "Sand vs. Salt-Salt is a More Reliable Tool for De-Icing." WSDOT Information Brochure.

City of Gresham, Oregon, 2011. "Erosion Prevention and Sediment Control Manual." Watershed Division Department of Environmental Services.

Colorado Department of Transportation, 2002. "Sediment Control Action Plan Black Gore Creek I-70 Corridor." In Cooperation with Clear Creek Consultants and J.F. Sato & Associates.

Colorado Department of Transportation, 2002. "Sediment Control Action Plan Straight Creek I-70 Corridor." In Cooperation with Clear Creek Consultants and J.F. Sato & Associates.

Colorado Department of Transportation, 2011a. "Erosion Control and Stormwater Quality Field Guide." Colorado Department of Transportation (CDOT). 2002. Accessed June 2019. (https://www.codot.gov/programs/environmental/landscape-architecture/erosion-storm-quality)

Colorado Department of Transportation and U.S. Department of Transportation Federal Highway Administration, 2011b. "I-70 Mountain Corridor Final Programmatic Environmental Impact Statement." Project IM 0703-244.

Colorado Department of Transportation, 2011c. "I-70 Mountain Corridor PEIS Water Resources Technical Report August 2010 With Corrections March 2011."

Colorado Department of Transportation, 2013. "I-70 Clear Creek Corridor Sediment Control Action Plan."

Colorado Department of Transportation, 2014. "Historic Context Interstate-70 Mountain Corridor." Prepared by: Mountain States Historical and CH2M Hill.

Colorado Department of Transportation, 2017a. "CDOT NEPA Manual." CDOT, August 2017. Accessed July 2019. (https://www.codot.gov/programs/environmental/nepa-program/nepa-manual)

Colorado Department of Transportation, 2017b. "Permanent Water Quality Program Manual." CDOT. March 1, 2017. Accessed July 2019. (https://www.codot.gov/programs/environmental/water-quality/documents/permanent-water-qualityprogram/ cdot-permanent-water-quality-program-manual.pdf/view)

Colorado Department of Transportation, 2017c. "Data Summary Report Interstate 70 Mountain Corridor Storm Event/Snowmelt Water Quality Monitoring 2000-2016." Prepared by Clear Creek Consultants, INC.

Colorado Department of Public Health and Environment, 2005. "Implementation Guidance for Determining Sediment Deposition Impacts to Aquatic Life in Streams and Rivers." Developed in Conjunction with the Colorado Sediment Task Force.

Colorado Department of Public Health and Environment -WQCC, 2017a. "Colorado Water Quality Control Act." Colorado Department of Public Health – Water Quality Control Commission (CDPHE-WQCC). September 2017. Accessed June 2019. (https://www.colorado.gov/pacific/sites/default/files/Act2017.pdf)

Colorado Revised Statues Title 25. "Public Health and Environment". 2017.

Davis County Storm Water Coalition, 2006. "A Guide to Stormwater Best Management Practices." Information Brochure.

Eagle River Watershed Council, 2013. "State of the Rivers: Annual Water Quality Report WY 2011-2013." Prepared by S.K. Mason Environmental, LLC.

Eagle River Watershed Urban Runoff Group, 2013. "Gore Creek Water Quality Improvement Plan." Prepared by: Leonard Rice Engineers INC., Eagle River Watershed Council, Alpine Engineering INC., and Timberline Aquatics INC.

Kintsch, J.,P. Singer, M. Huijser, J. Crane, and A Huyett, 2011. "A Regional Ecosystem Framework for Terrestrial and Aquatic Wildlife Along the I-70 Mountain Corridor in Colorado: An Eco-Logical Field Test." Report to the Federal Highway Administration and the Colorado Department of Transportation. Denver, CO.

Lang, A. J., Aust, W. M., Bolding, M. C., Mcguire, K. J., and Schilling, E. B, 2018. "Best Management Practices Influence Sediment Delivery from Road Stream Crossings to Mountain and Piedmont Streams." Forest Science, 64(6), 682–695.

Lewis, William M. 1999. "Studies of Environmental Effects of Magnesium Chloride Deicer in Colorado." Report No. CDOT-DTD-R-99-10.

Lorch, Brian, 1998. "Transport and Aquatic Impacts of Highway Traction Sand and Salt Near Vail Pass, Colorado." Department of Earth Resources-Watershed Sciences. Colorado State University.

Maine DOT, 2008. "Best Management Practices for Erosion and Sedimentation Control"

Maine Snow and Ice Control Best Practices Working Group, 2015. "Maine Environmental 'Best Management Practices' Manual for Snow and Ice Control." Version 1.0.

Montana DOT, 2004. "Recommendations for Winter Traction Materials Management on Roadways Adjacent to Bodies of Water." Western Transportation Institute.

National Cooperative Highway Research Program, 2004. "Snow and Ice Control: Guidelines for Materials and Methods." Report 526. ISBN 978-0-309-08799-5. DOI 10.17226/13776.

National Cooperative Highway Research Program, 2007. "Guidelines for the Selection of Snow and Ice Control Materials to Mitigate Environmental Impacts." Report 577. ISBN 978-0-309-42233-8. DOI 10.17226/23178.

Northwest Colorado Council of Governments, 2012. "2012 Eagle River Water Quality Management Plan."

Staples, James M., Gamradt, Laura., Stein, Otto., and Shi, Xianming, 2004. "Recommendations for Winter Traction Materials Management on Roadways Adjacent to Bodies of Water." Report No. FHWA/MT-04-008/8117-19

The Clean Water Act as amended by the Water Quality Act of 1987. (1988)., U.S. G.P.O., Washington, D.C.

The Denver Post, 2000. "Choked by road sand Years of buildup clogging creeks, killing trees along I-70." News: pA-01.

The Safe Drinking Water Act. July 10, 1974. Washington, DC.

The Salt Institute, 2013. "Snowfighter's Handbook: Safe and Sustainable Snowfighting."

Town of Vail, 2016 "Restore the Gore, Gore Creek Strategic Action Plan" March 2016. Accessed September 2019. (https://lovevail.org/wp-content/uploads/2017/06/Gore-Creek-Strategic-Action-Plan.pdf)

Western Transportation Institute, 2015. "Manual of Environmental Best Practices for Snow and Ice Control." Project 99006/CR13-01.

Wynn, Kirby H., Bauch, Nancy J., and Driver, Nancy E, 2001. "Gore Creek Watershed, Colorado—Assessment of Historical and Current Water Quantity, Water Quality, and Aquatic Ecology, 1968–98." USGS. Water-Resources Investigations Report 99–4270.

APPENDIX A

COMPLETED PROJECTS SINCE 2002 SCAP

2002 Vail Pass SCAP Recommended BMPs Table

Location		Structure ID.	SCAP BMP Description	Comments
MP	Lane			
		Constructed Recommended BMPs as of March 2018		
		Partially Constructed Recommended BMPs as of March 2018		
		Non-Constructed Recommended BMPs as of March 2018		
190.40-190.60	WB	1	Pave shoulder to toe cut slope and install knee wall barrier	
		2	Install series B grade sediment traps above culvert inlets	
189.75-189.85	WB	3	Pave to crest of hillslope and install snow storage zone Type 7 barriers (WB189.8)	
		4	Install 2 large sediment basins at 189.75	
189.40-189.75	WB	5	Route all highway runoff 189.55 to sediment basin at 189.75	Basin not yet constructed
		6	Pave to toe cut slope and and install knee wall barrier	
		7	Provide snow storage zone	At CDOT Maintenance Shed?
		8	Prevent sediment transport to three clean ephermeral tributaries	
		9	Install in series 4 Bgrade traps at 189.4	
189.60-189.90	EB	10	Install 4 Bgrade traps at 189.65	Pond constructed
		11	Install culvert rundown from Bgrade traps at 189.65 to 1 large sediment basin at US-6 ditch	
		12	Pave to crest of hillslope and install snow storage zone Type 7 barriers and valley pan drain (189.7)	Pond constructed, basin constructed
		13	Install Culvert rundown to US-6 1 large sediment basin at US-6 ditch (BGL2A)	
189.3-189.6	EB	14	Install type 4 barrier along crest of hillslope at truck rest area to reduce migration of sediment over the slope	

2002 Vail Pass SCAP Recommended BMPs Table

Location		Structure ID.	SCAP BMP Description	Comments
MP	Lane			
		Constructed Recommended BMPs as of March 2018		
		Partially Constructed Recommended BMPs as of March 2018		
		Non-Constructed Recommended BMPs as of March 2018		
Vail Pass Maintenance Facility Area		15	Lower height of the existing spoil pile, remove boulders, regrade and revegetate berm, pave and install sediment basin for sand shed area runoff (completed 2001)	Basin paved by ERWSD
		16	Remove sand dump deposits along wetlands, install topsoil berm, and revegetate (VPSSSANDBERM2)	
		17	Design and install clean ephemeral tributary bypass channel - the ephemeral tributary behind the sand storage shed needs to be routed through a designed channel behind the restrooms and into the natural drainage channel at 189.1 to prevent contamination (VPSS2, VPSS3, VPSSCHANNEL1, WB189.25)	
		18	Install 2 large sediment basins in series at 189.15 to 189.2 (WB189.15, WB189.2)	4 ponds, pipeline, channel, ditch and rundown constucted
		19	The lowermost basin must include runoff from the entrance ramp median, so existing culvert outlet must be cut back to accommodate the basin	
		20	Provide energy dissipation at the basin inlets (and side culvert inflow)	
189.05-189.15	WB	21	Remove excess sand and pave shoulder to crest of hillsope above clean perennial tributary (189.1)	
		22	Install snow storage/valley pan drain/Type 7 barrier extending beyond sign to 189.05 (WB189.05B, 189.1C) to direct sheet flow from highway	
		23	Install culvert rundown to 2 large sediment basins in series at 189.05 (WB189.05, WB189.05B)	

2002 Vail Pass SCAP Recommended BMPs Table

Location		Structure ID.	SCAP BMP Description	Comments
MP	Lane			
		Constructed Recommended BMPs as of March 2018		
		Partially Constructed Recommended BMPs as of March 2018		
		Non-Constructed Recommended BMPs as of March 2018		
188.65-189.0	WB	24	Pave shoulder to toe slope and install knee wall barrier/valley pan drain (WB189.0, WB189.95B, WB188.8, WB188.8b, WB188.7)	
		25	Install 2 large sediment basins in series at 188.65 (WB188.65, WB188.65B)	Basins 6A-6B
		26	Route median runoff at 188.75 to sediment basins at 188.65	Roadside swale
		27	Route flows from from 188.6 to basin at 188.65	
		28	Bypass clean ephemeral tributaries at 188.75 and 188.95 (WB188.75, WB188.95)	
	EB	29	Pave to crest of hillslope or toeslope and install snow storage zone Type 7 barriers 189.05 to 189.3 (EB188.9)	
		30	Install valley pan drain to 2 large sediment basins at 189.05 with outlet control and culvert rundown (EB189.05)	Sediment basin at end of ditch paving
		31	Pave to crest of hillslope or toeslope and install snow storage zone Type 7 barriers (EB188.9)	
		32	Install valley pan drain to 6 Bgrade traps at 188.65	
		33	Install culvert rundonwn to sediment basin at bike path 188.65 (EB188.7)	
188.55-188.65	WB	34	Pave shoulder to toe slope and install knee wall barrier/vally pan drain	
		35	Route highway runoff to sediment basin at 188.65 (WB188.6), by bypassing clean ephemeral tributary culvert at 188.6	
	EB	36	Pave to crest of hillslope or toeslope and install snow storage zone Type 7 barriers (EB188.55)	
		37	Install valley pan drain to inlet and route highway runoff to culvert rundown at 188.65 (EB188.6)	

2002 Vail Pass SCAP Recommended BMPs Table

Location		Structure ID.	SCAP BMP Description	Comments
MP	Lane			
		Constructed Recommended BMPs as of March 2018		
		Partially Constructed Recommended BMPs as of March 2018		
		Non-Constructed Recommended BMPs as of March 2018		
188.35-188.55	WB	38	Pave shoulder to toe slope and install knee wall barrier/valley pan drain (WB188.5)	
		39	Install 3 large sediment basins in series at 188.35 (WB 188.35, WB188.3D, WB188.3)	Basin 7 currently at 188.33
		40	Bypass all existing culvert inlets from 188.55 to 188.35 basins	
		41	Pave shoulder and install vegetated berm from 188.25 to 188.4 (WB188.3C)	
		42	No action on natural red sanstone depression/pond (WB188.3B)	
	EB	43	Pave to crest of hillslope or toeslope and install snow storage type 7 barriers/valley pan drain (EB188.55)	
		44	Install 2 large sediment basins at 188.45 with rundown (EB188.45)	
188.0-188.35	WB	45	Pave shoulder to toe slope and install knee wall barrier/valley pan (WB188.2)	
		46	Install 2 large sediment basins at 188.15 (WB188.15)	Previously installed but filled in
		47	Bypass clean ephemeral tributaries at 188.2 and route highway runoff to basins/culvert at 188.15	
		48	Regrade and bypass clean ephemeral tributary culvert at 188.05 (WB188.05, WB188.1) and route highway runnoff to basins at 188.15 (from MP188)	
	EB	49	Pave to crest of hillslope or toeslope and install snow storage zone type 7 barriers (EB188.4)	
		50	Install valley pan drain bypassing ephemeral tributaries at 188.2 and 188.3 to culvert rundown at 188.15 (EB188.15B)	New sediment basin, rundown
		51	Install 3 large sediment basins along bike path at 188.15 (EB188.2, EB188.15)	

2002 Vail Pass SCAP Recommended BMPs Table

Location		Structure ID.	SCAP BMP Description	Comments
MP	Lane			
		Constructed Recommended BMPs as of March 2018		
		Partially Constructed Recommended BMPs as of March 2018		
		Non-Constructed Recommended BMPs as of March 2018		
187.8-188.0	WB	52	Pave shoulder to toe slope and install knee wall barrier/valley pan drain (WB188.0)	500' of shoulder/ditch paved
		53	Install 5 Bgrade traps at 187.8 (WB187.85)	1 trap currently installed
		54	Connect trap overflow to EB sediment basin at 187.8	
	EB	55	Pave to crest of hillslope or toeslope and install snow storage zone Type 7 barriers (EB187.9, EB 188.0)	
		56	Install valley pan drain to 5 Bgrade traps and culvert rundonwn at 187.8	
		57	Install 1 large sediment basin at bike path 187.8 (WB187.85)	
187.45-187.8	WB	58	Pave shoulder to toeslope and install knee wall barrier/valley pan drain (WB187.5)	>1500' shoulder/ditch paved
		59	Install 6 Bgrade traps follwed by 1 large sediment basin in series at 187.45 (WB187.7B)	2 sand traps installed
	EB	60	Pave to crest of hillslope or toeslope and install snow storage zone Type 7 barriers (EB187.6B, EB187.8)	1 new basin below distressed culvert
		61	Install valley pan drain to 3 Bgrade traps and culvert rundown at 187.6 (EB187.6)	
		62	Install 1 large sediment basin at bike path 187.6	

2002 Vail Pass SCAP Recommended BMPs Table

Location		Structure ID.	SCAP BMP Description	Comments
MP	Lane			
		Constructed Recommended BMPs as of March 2018		
		Partially Constructed Recommended BMPs as of March 2018		
		Non-Constructed Recommended BMPs as of March 2018		
187.3-187.8	WB	63	Pave shoulder to toeslope and install knee wall barrier/valley pan drain	
		64	Install 1 large sediment basin at 187.35 (WB187.35)	
		65	Connect basin outlet to EB culvert rundown at 187.25	
	EB	66	Pave to crest of hillslope or toeslope and install snow storage zone Type 7 barriers (EB187.4)	
		67	Install 3 large sediment basins in series at 187.3 to 187.35 (EB187.3)	3 ponds constructed
		68	Install valley pan drain to new culvert rundown at 187.25 (EB187.25)	Rundown/ditch constructed
187.0-187.3	WB	69	Pave shoulder to toeslope and install knee wall barrier/valley pan drain (WB187.2)	
		70	Install 3 large sediment basins in series at 187.0 (WB187.05)	
		71	Bypass existing culvert inlets to 187.0 basins	
		72	Connect basin outlet to new culvert rundown at 187.0	
	EB	73	Pave to crest of hillslope or toeslope and install snow storage zone Type 7 barriers (EB187.2)	
		74	Install 5 Bgrade traps and 1 large sediment basin in series at 187.0 (WB187)	
		75	Install valley pan drain to new culvert rundown at 187.0 (EB187.05)	2 Riprap rundowns constructed

2002 Vail Pass SCAP Recommended BMPs Table

Location		Structure ID.	SCAP BMP Description	Comments
MP	Lane			
		Constructed Recommended BMPs as of March 2018		
		Partially Constructed Recommended BMPs as of March 2018		
		Non-Constructed Recommended BMPs as of March 2018		
186.7-187.0	WB	76	Pave shoulder to toeslope and install knee wall barrier/valley pan drain	>300' shoulder/ditch paved
		77	Install 8 Bgrade traps in series at 186.7	1 Sand trap
		78	Bypass existing culvert inlets to 186.7 basins	
		79	Connect basin outlet to new culvert rundown at 186.7	
	EB	80	Pave to crest of hillslope or toeslope and install snow storage zone Type 7 barriers	
		81	Install 8 Bgrade traps with valley pan drain to culvert rundown at 186.7	
		82	Install new culvert rundonwn at 186.85	
186.4-186.7	WB	83	Pave shoulder to toeslope and install knee wall barrier/valley pan drain (WB186.9)	>1500' of shoulder/ditch paved
		84	Install 8 Bgrade traps in series with drainage to existing culvert at 186.4 (WB186.6, WB186.6B)	1 sediment trap
	EB	85	Pave to crest of hillslope or toeslope and install snow storage zone Type 7 barriers (EB186.95/186.9B)	
		86	Install barrier between bike path and I-70 for safety (EB186.9/186.5/186.55)	
		87	Install 8 Bgrade traps with valley pan drain to new culvert rundown at 186.4 (EB186.85)	

2002 Vail Pass SCAP Recommended BMPs Table

Location		Structure ID.	SCAP BMP Description	Comments
MP	Lane			
		Constructed Recommended BMPs as of March 2018		
		Partially Constructed Recommended BMPs as of March 2018		
		Non-Constructed Recommended BMPs as of March 2018		
186.1-186.4	WB	88	Pave shoulder to toeslope and install knee wall barrier/valley pan drain (WB186.2)	
		89	Install 8 Bgrade traps in series at 186.1 (WB186.2B)	
		90	Bypass existing culvert inlets from 186.1 to 186.4	
	EB	91	Pave to crest of hillslope or toeslope and install snow storage zone Type 7 barriers (EB186.3)	
		92	Install barrier between bike path and I-70 for safety (EB186.5)	
		93	Install valley pan drain to 2 large sediment basins with culvert rundown at 186.1 (EB186.2, 186.1/B)	1 pond constructed
185.9-186.1	WB	94	Pave shoulder to toeslope and install knee wall barrier/valley pan drain (WB185.9)	
		95	Install 2 large series sediment basins at 185.9 (WB185.9)	
		96	Route highway runoff from basin at 185.9 to EB culvert rundown	
	EB	97	Pave to toe of cutslope and install knee wall barrier/valley pan drain (EB185.7/65)	
		98	Pave to crest of hillslope and install Type 7 barrier	
		99	Install barrier between bikepath and I-70 for safety (EB186.0/B)	
		100	Install valley pan drains to new culvert rundowns at 185.9 and 185.6	
		101	Install 1 large sediment basin at 185.95 with inlet/outlet protection (EB185.95/B)	1 pond constructed
		102	Install 1 large sediment basin at 185.85 with new culvert rundown (EB185.85B/85)	
		103	Install 1 small sediment basin at 185.8 (EB185.8)	

2002 Vail Pass SCAP Recommended BMPs Table

Location		Structure ID.	SCAP BMP Description	Comments
MP	Lane			
		Constructed Recommended BMPs as of March 2018		
		Partially Constructed Recommended BMPs as of March 2018		
		Non-Constructed Recommended BMPs as of March 2018		
185.6-185.9	WB	104	Install 3 large sediment basins in series at 185.6 and 185.65 (WB185.65/6)	
		105	Route runnoff from basin at 185.6 outlet to EB culvert rundown	
	EB	106	Install 4 Bgrade traps and 1 small sediment basin at 185.6 with new culvert rundown (EB185.6)	Pond and rundown constructed
185.3-185.6	WB	107	Route springs from 185.5 through exising culvert (WB185.5B)	
		108	Pave shoulder to toe of cutslope and install knee wall (WB 185.4B)	
		109	Route sping flows behing knee wall to wetlands (WB 185.45B/D)	
		110	Install emergency spill containment at runaway truck ramp No. 1	
		111	Protect wetlands in depression at 185.45 and allow clean water flow through existing culvert	
		112	Pave shoulder to crest fillslope and install Type 7 barrier/valley pan drain to protect perennial tributary at 185.45 (WB 185.4)	
		113	Pave shoulder to toeslope and install knee wall barrier/valley pan drain (WB185.45)	
		114	Install 3 large sediment basins in series at 185.3 above Polk creek bridge abutment (WB185.3/35)	1 pond w/ rip rap channel constructed
	EB	115	Pave to toeslope/install valley pan drain and utilize bike path as snow storage zone with Type 7 barriers (EB 185.4)	
		116	Install snow storage/valley pan drain 185.3 to 185.45	
		117	Install 5 Bgrade traps at 185.4 (EB185.35)	

2002 Vail Pass SCAP Recommended BMPs Table

Location		Structure ID.	SCAP BMP Description	Comments
MP	Lane			
		Constructed Recommended BMPs as of March 2018		
		Partially Constructed Recommended BMPs as of March 2018		
		Non-Constructed Recommended BMPs as of March 2018		
185.25	EB/WB	118	Remove all sand beneath bridge	Polk Creek Bridge
		119	Install retaining walls/sand traps 20-feet wide across slopes on both sides of Polk Creek bridge (WB185.25/B)	Polk Creek Bridge
184.9-185.2	WB	120	Pave shoulder to toeslope and install knee wall barrier/valley pan drain	
		121	Route runoff to 2 large sediment basins in series at 184.95 (WB184.95)	
		122	Reduce size of turnout area and pave shoulder to barrier (WB184.95B)	
		123	Remove sediment, regrade, and revegetate, and close-off Miller Creek bridge abutment (WB184.9B)	
		124	Same treatment for Miller Creek bridge as with Polk creek bridge (WB184.9)	
	EB	125	Pave to crest of hillslope and install snow storage zone Type 7 barriers (EB185.05)	
		126	Install valley pan drain along barrier to new sediment basin and culvert rundown at 184.9 (EB185.05)	1 pond constructed
		127	Pave shoulder and install valley pan drain to 4 small sediment basins or Bgrade traps with culvert rundown (EB184.95/184.9C/184.95B)	Rip rap to ditch, 1 new basin
		128	Same treatment for Miller Creek bridge as with Polk creek bridge (WB184.85, 184.9B, 184.8C)	
		129	Install Bgrade sediment traps in series above median culvert inlet at 184.95 (EB184.95M)	

2002 Vail Pass SCAP Recommended BMPs Table

Location		Structure ID.	SCAP BMP Description	Comments
MP	Lane			
		Constructed Recommended BMPs as of March 2018		
		Partially Constructed Recommended BMPs as of March 2018		
		Non-Constructed Recommended BMPs as of March 2018		
184.45-184.8	WB	130	Pave shoulder to toeslope and install knee wall barrier/valley pan drain (WB184.65)	
		131	Route runoff to 1 small sediment basin or Bgrade trap at 184.75 (WB184.75/184.7)	
		132	Bypass any existing culverts	
		133	Route highway runoff to 3 small series sediment basins or Bgrade traps at 184.55 (WB184.55/184.6)	
		134	Outlet from last basin to exising culvert with new rundown	
		135	Pave shoulder and install Type 7 barrier/valley pan drain, and revegetate at 184.5 (WB184.5)	
		136	Remove sediment, regrade, and revegetate, and install 2 small sediment basins or Bgrade traps and close-off Black Gore Creek bridge abutment	
		137	Same treatment for Black Gore Creek bridge as with other bridges (WB184.3/184.4)	
	EB	138	Pave to crest of hillslope and install snow storage zone Type 7 barriers (EB184.75)	
		139	Install valley pan drain along barrier to 3 small sediment basins or Bgrade traps and culvert rundown at 184.6 (EB184.65)	1 pond constructed
		140	Install valley pan drain along barrier to 2 sediment basins or Bgrade traps and culvert rundown at 184.45 (EB184.6/184.5)	
		141	Install Bgrade sediment traps in series above median culvert inlet at 184.5 (EB184.5M)	
		142	Remove sediment, place barrier on crest of hillslope, and install snow storage zone, and close-off Black Gore Creek bridge abutment (EB184.45)	
		143	No treatment for Black Gore Creek EB bridge - good riparian area (EB184.4)	

2002 Vail Pass SCAP Recommended BMPs Table

Location		Structure ID.	SCAP BMP Description	Comments
MP	Lane			
		Constructed Recommended BMPs as of March 2018		
		Partially Constructed Recommended BMPs as of March 2018		
		Non-Constructed Recommended BMPs as of March 2018		
183.9-184.3	WB	144	Pave shoulder to crest of hillslope and install snow storage zone Type 7 barriers (WB184.2/184.3B)	2 Basins by ERWSD, Snow storage by CDOT
		145	Install valley pan drain to 2 small sediment basins or Bgrade traps at 184.2	
	EB	146	Complete shoulder paving and install Type 7 barrier on edge to reduce sediment migration	Chain up area
		147	Install 3 small sediment basins or Bgrade traps at 184.3 behind exisintg Type 4 at Black Gore Creek bridge abutment to prevent sediment from falling into creek	Chain up area
183.5-183.9	WB	148	Pave shoulder to crest of hillslope and install snow storage zone Type 7 barriers (WB183.7/183.75)	
		149	Install valley pan drain to 4 small sediment basins or Bgrade traps at 183.6 (WB183.6)	1 basin constructed
	EB	150	Pave shoulder to cutslope or crest fillslope and install knee wall or Type 7 barrier and valley pan drain	
		151	Install 2 small sediment basins or Bgrade traps at 183.8 and 183.65	
		152	Install 2 small sediment basins or Bgrade traps at 183.5 to protect wetlands/spring area (EB183.5/183.5WET)	

2002 Vail Pass SCAP Recommended BMPs Table

Location		Structure ID.	SCAP BMP Description	Comments
MP	Lane			
		Constructed Recommended BMPs as of March 2018		
		Partially Constructed Recommended BMPs as of March 2018		
		Non-Constructed Recommended BMPs as of March 2018		
183.0-183.5	WB	153	Pave shoulder to crest of hillslope and install snow storage zone Type 7 barriers	
		154	Install valley pan drain to 3 small sediment basins or Bgrade traps and culvert rundown at 183.35	
	EB	155	Pave shoulder to cutslope or crest fillslope and install knee wall or Type 7 barrier (EB183.3)	
		156	Install valley pan drain or 3 small sediment basins or Bgrade traps at 183.25 (EB183.25)	
		157	Bypass culvert at 183.35	
		158	Protect perennial tributary at 183.25 (EB183.2)	1 pond constructed
		159	Install valley pan drain to 2 small sediment basins or Bgrade traps at 183.05	1 pond on WB side
		160	Install snow storage zone Type 7 barriers to prevent dumping of sand into forest (EB183.1/183.15)	
182.45-183.0	WB	161	Pave shoulder to crest of hillslope and install snow storage zone Type 7 barriers (WB182.5)	
		162	Install valley pan drain to 2 large sediment basins at 182.95 (WB182.45b)	1 basin installed
	EB	163	Pave shoulder to cutslope or crest fillslope and install knee wall or Type 7 barrier (EB 182.65)	
		164	Install Valley pan drain to 3 small series sediment basins or Bgrade traps at 182.8 (EB182.8)	1 basin installed
		165	Install snow storage zone Type 7 barriers to prevent dumping of sand into forest (EB182.6)	
		166	Install Valley pan drain to 4 small series sediment basins or Bgrade traps at 182.45 (EB182.5/182.45B/182.45C)	1 basin installed
		167	Install Bgrade sediment traps in series above median inlet at 182.5	

2002 Vail Pass SCAP Recommended BMPs Table

Location		Structure ID.	SCAP BMP Description	Comments
MP	Lane			
		Constructed Recommended BMPs as of March 2018		
		Partially Constructed Recommended BMPs as of March 2018		
		Non-Constructed Recommended BMPs as of March 2018		
182.0-182.4	WB	168	Pave to cutslope and install toe barrier	
		169	Install valley pan drain to 3 small sediment basins or Bgrade traps at 182.15	1 basin installed
		170	Install 2 small sediment basins of Bgrade traps in series behind existing Type 4 barrier at 182.0 (WB182)	
	EB	171	Pave shoulder to cutslope or crest fillslope and install knee wall or Type 7 barrier/valley pan drain (EB182.2/182.25)	
		172	Install 2 small sediment basins or Bgrade traps at end of Type 4 barrier at 182.3 (EB182.3/182.35)	2 basins installed (one for culvert from WB side)
		173	Install valley pan drain to 4 small series sediment basins or Bgrade traps with culvert rundown at 182.0 (EB182B)	
		174	Install Bgrade sediment traps in series above median inlet at 182.0 (EB182C)	
180.0-182.0	WB	175	Pave shoulder and install 3 small series sediment basins or Bgrade traps at 180.2, 181.0, and 181.25	
		176	Install valley pan drain to culvert inlets	1 basin installed
	EB	177	Pave shoulder to cutslope or crest fillslope and install Type 7 barrier/snow storage zone	
		178	Install sediment basins at culvert outfalls as needed to protect private property	
		179	Install valley pan drain to culvert intlets	

*Completed SCAP items identified by CDOT for being either completed, checked off SCAP list, or reported as completed by the Eagle River Water & Sanitation District (ERWSD). Comments are also from CDOT/ERWSD. These projects and associated comments shown have not been independently confirmed.

APPENDIX B

CONTROL MEASURES MENU

Menu of Structural Control Measures

There are a variety of control measures which have been successfully implemented to aid in the management and mitigation of sediment in a highway environment. This menu highlights many of the tested control measures used on other CDOT projects or in other states. Each menu item includes a synopsis of the control measure concept and information on maintenance requirements and any examples of where they have been implemented. The control measures of focus are summarized below. These are starting points for potential implementation into an updated SCAP for Vail Pass as well as the proposed design documents for the Auxiliary Lanes Project. At this phase, they are intended to be discussion points during the EA process for determination of their mitigation potential of the conceptual impacts to the project area by the proposed project.

Collection System Control Measures:	• Roadside Swales/Ditches • Curb & Gutter/Valley Pan • Dedicated Snow Storage Areas • Drainage Rundowns • Culvert Repair/ Replacement • Slope Stabilization/ Revegetation • Clean Water Diversion • Knee Wall • Shoulder/Embankment Paving
Treatment System Control Measures:	• CDOT Modified Type D Water Quality Inlet • Detention/Sediment Basins • Loading Dock Sediment Trap • Bench Trap • Roadside Swales/Ditches • Riparian corridor enhancement

Collection System Control Measures:

Source: CDOT Clear Creek SCAP, 2013

Roadside Swales / Ditches

- Conveys flow parallel to roadway to nearby control measures or discharge points
- Vegetation within the control measure traps sediment as water is conveyed
- Inexpensive solution for flow conveyance and treatment
- Slows flow to promote infiltration
- Possible location for snow storage

Maintenance and Other Requirements:

- Periodic sediment removal and possible regrading/revegetation.
- Ditches need to be trapezoidal have a bottom width of at least 8 feet if they are to be cleaned with large equipment. Would need to be at least 4 feet if a skid steer was used. Otherwise would need to be cleaned with a backhoe/loader/grader.
- Need to follow AASHTO guidelines for slope grading along highways, otherwise could cause vehicles to roll or increase the severity of accidents.

Possible Locations of Installation:

- Along shoulders of roadway where space allows throughout the project area.
- In areas with noted sheet flow and rill erosion to concentrate the flows to a point source.

Source: CDOT Clear Creek SCAP, 2013

Curb & Gutter/Valley Pan

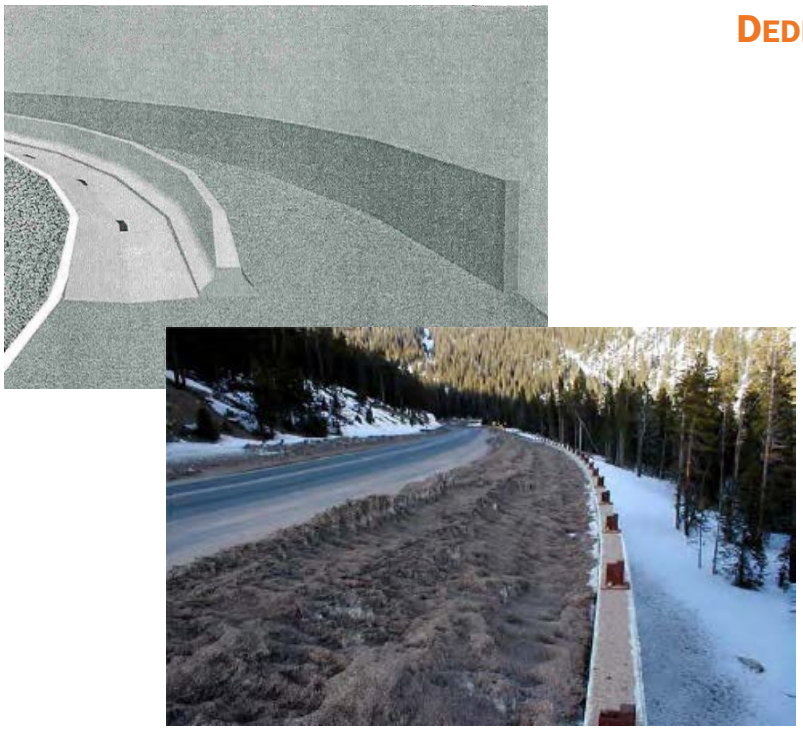
- Directs sheet flow to a point source discharge location
- Prevents rill erosion down slopes behind pan/gutter
- Fits into small locations
- Can cause safety concerns along highspeed roads and with plowing equipment.
- Can be expensive for long reaches.

Maintenance and Other Requirements:

- Needs to be in a location where it will not impact snowplow operation or designed so the snowplow drivers can see it and avoid it under the snow.
- Should be in areas that are easily swept by broom sweepers.
- Should direct flows to a sediment trap or other control measures for treatment.
- Should be sloped or modified to reduce the impact of being struck by a vehicle.

Possible Locations of Installation:

- In areas with extended shoulders, out of the way of the plow trucks.
- Not in conjunction with w-beam guardrail systems due to risk of vaulting or underriding the barrier.
- As far as possible away from the active travel lanes.



Dedicated Snow Storage Areas

- Areas in which snow plow drivers can push cleared snow from the roadway.
- Typically connected to other control measures to collect the sediment contained within the snow.
- Typically used in areas with a wide paved shoulder to allow for sweeping of the area one all the snow melts
- Multiple options and configurations can be used to fit the available space.

Source: CDOT [2002 SCAP and Berthoud Pass]

Maintenance and Other Requirements:

- Needs to be well out of the way of travel lanes yet easily accessible by snow plows.
- Should be in a location to drain away from the roadway or to some sort of ditch or other drainage feature.
- Should have some form of treatment control measure downstream of the storage area.

Possible Locations of Installation:

- In areas with extended paved shoulders.
- In areas behind jersey barriers or guard rails separated from traffic

Source: UDFCD, Smart Ditch

Drainage Rundowns

- Protects embankment from erosion from concentrated flows typically from culvert outfalls or swales/ditches.
- Provides hard surface to dissipate erosive forces down steep embankments or other areas.
- Able to be installed on a variety of slopes
- Typically used in conjunction with an energy dissipation pool or similar structure at the bottom of the rundown to prevent scour of the toe.

Maintenance and Other Requirements:

- Riprap rundowns require filter fabric to be placed under the rock to prevent erosion of small particles through the rock.
- Maintenance access should be considered in areas of substantial sediment loading to ease with sediment removal.
- Should be paired with an energy dissipater to ensure that no erosion occurs at the toe of the slope.

Possible Locations of Installation:

- In areas with steep slopes down the roadway embankment.
- In partnership with knee walls, curb and gutter, valley pans or swales to control sheet flow across the roadway and rill erosion on the embankment to help convey flow down the embankment.

Source: CDOT

Culvert Repair/Replacement

- Many existing culverts are rusted out or in various levels of disrepair and are causing erosion around the culvert.
- Control measure would repair or replace the existing culvert. Repair could include patching, paving, sliplining, pipe eating, pipe bursting, or other CMP rehabilitation techniques.
- Replacement would be done as part of the redesign and construction of the drainage system associated with the project.

Maintenance and Other Requirements:

- Each culvert would need to be assessed to determine whether a repair is feasible or if it needs to be replaced.
- Sediment and debris removal would also likely be required prior to any repair being performed.

Possible Locations of Installation:

- In all existing culvert locations.

Source: CDOT

Slope Stabilization/Revegetation

- Restores eroded slope to vegetated/protected conditions to stop rill erosion and sediment loss.
- Allows for vegetation to trap sediment particles from tributary sheet flow areas.

Maintenance and Other Requirements:

- Need to verify proper stabilization techniques such as erosion blanket or other control measures are used to ensure seed germination.
- Seed disturbed areas with native species appropriate to the elevation and climate zone.

Possible Locations of Installation:

- In areas with noticeable rill erosion and sheet flow conditions.
- Large cut or fill slopes.
- In areas disturbed or impacted by construction.

Source: CDOT Clear Creek SCAP, 2013

Clean Water Diversion

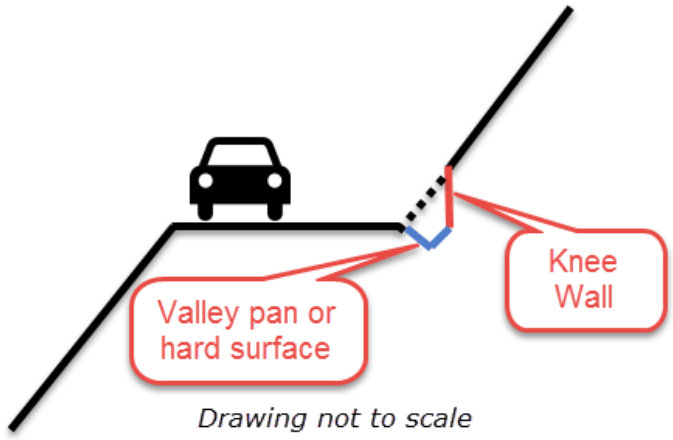
- Directs run-on flow from outside the ROW under or around the roadway to prevent it from picking up sediment or contaminates from the roadway
- Prevents "clean" water from co-mingling with roadway run-off
- Can be in combination with intercepting swales or ditches above or outside the area of influence from the highway
- Reduces total volume of water passing through treatment control measures

Maintenance and Other Requirements:

- Ensure designed structure does not create erosion or sedimentation problems elsewhere.
- Should be sized to convey the design storm safely under the roadway
- Should be connected to natural drainage features where possible.
- Should be coupled with intercepting swales and ditches to collect off-site drainage, reducing the total tributary drainage area of the roadway segment being treated.
- Potential impacts to aquatic species would be assessed prior to implementation.

Possible Locations of Installation:

- In areas with run-on sheet flows or concentrated flows, used in conjunction with upslope intercepting ditches/swales
- Natural drainage features



KNEE WALLS

- Approximately 18" high concrete walls used to stabilize toe of slope and prevent erosion.
- Provides durable surface for cleaning/sediment removal.
- Can be used in conjunction with an extended shoulder or other control measures.

Source: Wood

Maintenance and Other Requirements:

- Install underdrains behind knee walls to allow for groundwater seepage to escape. These flows should be routed to the nearest clean water tributary to avoid picking up sediment from the roadway if possible.
- Durable surface should be frequently swept to remove sediment similarly to roadway and shoulder areas.

Possible Locations of Installation:

- Areas with steep cut slopes on uphill side of roadway with or without a drainage swale at the toe of the slope.

Shoulder/Embankment Paving

- Eliminates erodible surface on slopes and areas adjacent to roadways.
- Limited to slopes traversable by paving equipment.
- Not for sensitive habitat areas.

Source: CDOT

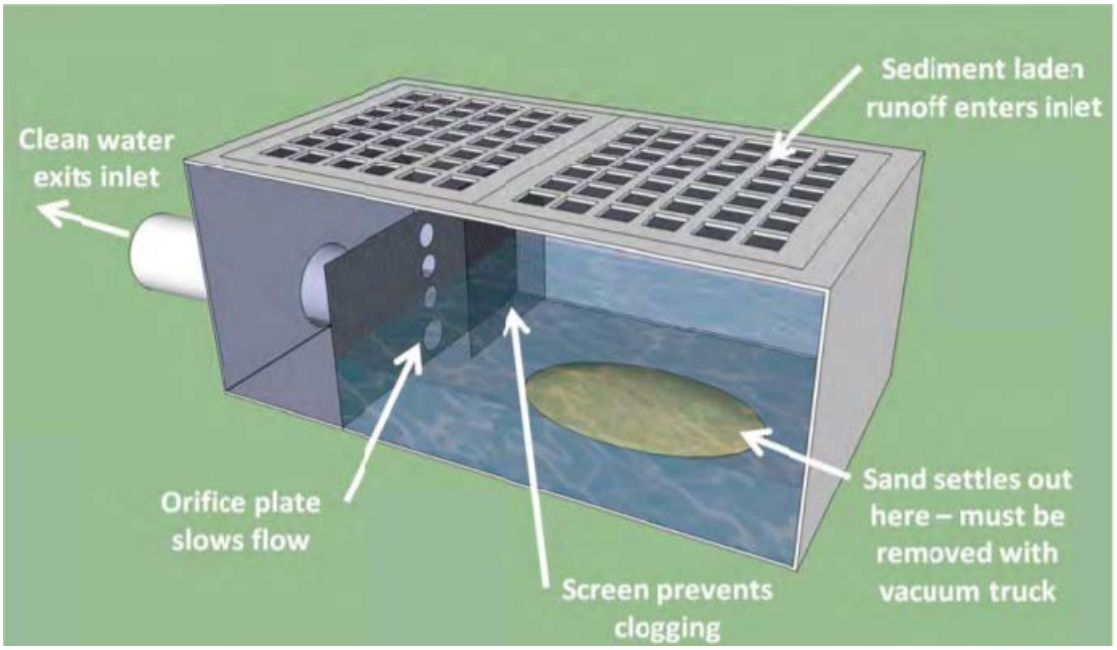
Maintenance and Other Requirements:

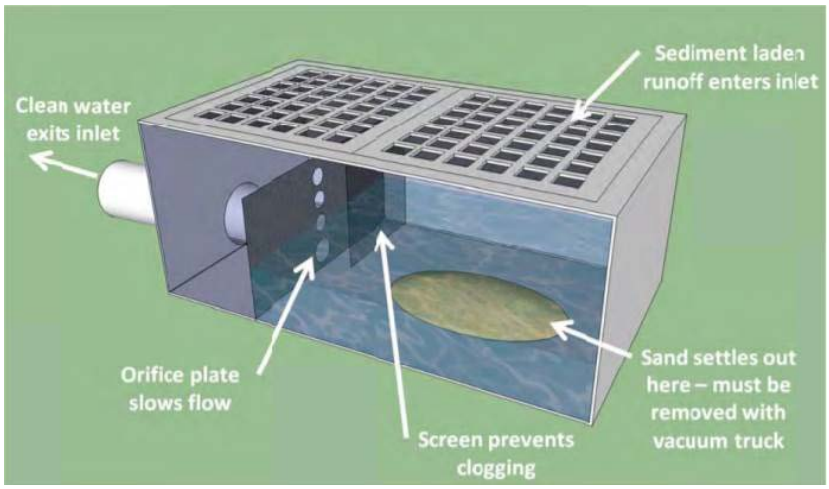
- Requires sweeping to collect sediment deposited on surface.
- Can be used in conjunction with inlet control measures.

Possible Locations of Installation:

- Shallow slopes where noted rill/gully erosion has occurred especially near the roadway.

Treatment System Control Measures:





Source: CDOT Clear Creek SCAP, 2013

CDOT Modified Type D Water Quality Inlet

- Collects sediment laden runoff and allows sediment to settle out while the water can pass to the outlet.
- Provides underground storage area for captured sediment while allowing flows to pass.
- Easy to maintain using a vacuum truck.
- Precast options are available.

Maintenance and Other Requirements:

- Needs regular sediment removal via vacuum truck
- Should be placed on a flat or gentle sloped surface and have local drainage directed to the grate.
- Sediment loading rate should be determined shortly after install to determine maintenance frequency requirements.
- Other inlet and vault configurations are possible depending on space considerations and other factors.

Possible Locations of Installation:

- Paved shoulder areas
- Median areas
- Areas easily accessible by vacuum truck
- At the end of areas of sheet flow mitigation control measures such as valley pans or swales/ditches with energy dissipation at the outlet.

Source: CDOT Clear Creek SCAP, 2013

Detention/Sediment Basins

- Collects sediment laden flow and allows sediment to drop out in basin before being routed to the basin outlet.
- Does not need to be located directly next to highway.
- Treats a large volume of water
- Requires large amount of space
- Can promote infiltration with soft bottom

Maintenance and Other Requirements:

- Requires spillway
- Rubber tired loaders may have a hard time cleaning soft bottom basins
- Ponds must drain fully to comply with water rights issues.
- Access for maintenance equipment
- Consider size of available equipment to be used to remove material in dimensions of basin
- If a concrete structure is used, install a push wall for operator to push bucket against when removing sediment.

Possible Locations of Installation:

- In large open areas within the ROW.
- At the outfall of roadside ditches/swales, valley pan, curb and gutter, etc.
- Below a large tributary area with or without other control measures.

Source: CDOT

Loading Dock Sediment Trap

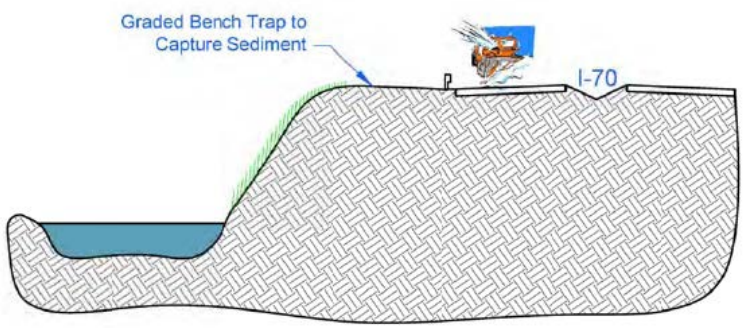
- Collects sediment in a concrete bay which is easily cleanable with machinery.
- Large storage volume reducing the frequency of maintenance.
- Protected by guard rail or concrete barrier.
- Easy to determine when full
- Hard bottom provides stable surface for maintenance operations.
- Require substantial space.

Maintenance and Other Requirements:

- Drainage outlets needs to be kept clear so they don't pond water.
- Should be at least 12' wide to fit a standard loader bucket.
- Requires a maintenance/access road or an extra wide shoulder to ensure access is maintained.
- Should have a concrete wall at the far end to scoop against during maintenance operations.

Possible Locations of Installation:

- In large areas of ROW where access to the control measure is possible.
- In areas of high sediment loading
- Especially useful in areas with large tributary area or downstream of multiple conveyance control measures.



Source: Modified from CDOT Clear Creek SCAP, 2013

Bench Trap

- Collects overland flow and plowed snow in a shallow ditch between the roadway and stream.
- Low cost and easily gradable into the plans
- Requires space between the roadway and stream.

Maintenance and Other Requirements:

- Area is designed to collect shallow flows only, no concentrated flows.
- Should be inspected annually and maintained via excavation and regrading when full of sediment.
- Flow should be allowed to overflow and sheet flow down to the stream.
- Areas of concentrated flow leaving or entering the trap may need to be addressed with a level spreader or a more formal channel or conveyance control measures.

Possible Locations of Installation:

- Wide paved/unpaved shoulder areas.

Source: CDOT Clear Creek SCAP, 2013

Roadside Swales / Ditches

- Conveys flow parallel to roadway to nearby control measures or discharge points
- Vegetation within the control measure traps sediment as water is conveyed
- Cheap solution for flow conveyance and treatment
- Promotes flow infiltration
- Possible location for snow storage

Maintenance and Other Requirements:

- Periodic sediment removal and possible regrading/revegetation.
- Ditches need to be trapezoidal have a bottom width of at least 8 feet if they are to be cleaned with large equipment. Would need to be at least 4 feet if a skid steer was used. Otherwise would need to be cleaned with a backhoe/loader/grader.
- Need to follow AASHTO guidelines for slope grading along highways, otherwise could cause vehicles to roll or increase the severity of accidents.

Possible Locations of Installation:

- Along shoulders of roadway where space allows throughout the project area.

Source: CDOT

Riparian Corridor Enhancement

- Stabilize with vegetation and/or remove accumulated sediment below bridges and in other sensitive areas during applicable construction.
- All work would occur within Zone 1 near the roadway.
- Use construction equipment already present and disturbing the area to make improvements to the corridor.
- Alternative stabilization measures will be evaluated for use in shaded areas where vegetation may not grow.

Maintenance and Other Requirements:

- Activities would only occur during active construction where the disturbance limits would already exist.
- Would focus on sediment removal, regrading, and vegetation enhancement.
- Depending on the severity of degradation in the area and would not be performed in areas where vegetation is stabilized.

Possible Locations of Installation:

- Under bridges where improvements are being installed where there is noticeable sedimentation with detrimental impacts to vegetation or erosion.

APPENDIX C

IMPLEMENTATION FLOW CHART

Sediment Management Implementation Plan