



West Vail Pass Maintenance Manual



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1. Introduction

1.1 Purpose

The purpose of this Maintenance Manual (Manual) is to recommend optimal maintenance procedures for sediment control infrastructure on Interstate 70 (I-70) along the West Vail Pass corridor for Colorado Department of Transportation (CDOT) maintenance personnel. CDOT Maintenance personnel currently use multiple documents/procedures that address sediment maintenance, as follows:

- *Manual for Maintenance Procedures* (CDOT, 2021)
- 2020/2021 Winter Operations Statewide Plan
- West Vail Pass Winter Operations Plan (CDOT, 2020)
- *Plant Maintenance Field Manual* (CDOT, 2019)
- CDOT Work Order System

This manual does NOT replace these documents. This manual provides a more succinct and focused summary of procedures and record keeping specific to the Vail Pass corridor. It is intended to be a guidance document not a specification.

In addition to the documents listed below, Maintenance personnel follow local agency, federal, and state laws, regulations, and guidelines as applicable. One document of note is the *Guidelines for Senate Bill 40 Wildlife Certification Developed and Agreed Upon By Colorado Parks and Wildlife and the Colorado Department of Transportation* (CPW and CDOT, 2022). This guideline describes procedures to be followed by CDOT when working in streams or riparian areas.

Given the elevation steep grades, and tight curves of this corridor, CDOT uses various products on the road for safety including traction sand, rock salt, and liquid magnesium chloride during winter conditions. This results in sediment loading. CDOT has constructed and maintains a number of sediment Control Measures (CMs) to address this loading and prevent transport of sediment local waterways.

This manual describes CMs and methods to maintain them. Specifically, the document includes past and current maintenance practices, existing and proposed sediment CMs, maintenance access and procedures, schedule and inspection recommendations, and recommendations for ongoing documentation and maintenance activities.

Existing and new sediment CMs are presented in CDOT's West Vail Pass Sediment Control Action Plan (SCAP) (CDOT, 2022) **Appendices E** (Sediment Control Measure Table) and **F** (Map Book), which will be updated as new CMs are constructed.

This manual provides guidance for optimal inspection timing and maintenance of sediment CMs, and it supplements the current *West Vail Pass Winter Operations Plan*

(CDOT, 2020). This manual is published solely for the information and guidance for CDOT employees.

1.2 Background and Location

The West Vail Pass Auxiliary Lane Environmental Assessment (EA) (FHWA and CDOT, 2020) (**Figure 1.1**) was conducted to evaluate proposed improvements along I-70. The Proposed Action of the West Vail Pass I-70 Auxiliary Lanes Project, as outlined in the EA, includes the addition of a 12-foot auxiliary lane, both eastbound (EB) and westbound (WB), for 10 miles from approximately the East Vail exit (mile post [MP] 180) to the Vail Pass Rest Area exit (MP 190). All existing curves will be modified as needed to meet current federal design standards. Other additional elements of the proposed action include the following:

- Intelligent transportation system components, including variable message signs (VMS), variable speed limit (VSL) signs, and remote lane closure system
- Relocation of the Vail Pass Recreation Trail in various locations
- Upgrading two runaway truck ramps to current design standards
- Inclusion of six wildlife underpasses
- Additional truck parking capacity
- Widened shoulders for emergency parking in various areas
- Improvements to median turn around areas for emergency use
- Chain Station improvements
- Avalanche protection

Several of these elements will add impervious area to the I-70 corridor along West Vail Pass. Mitigation commitments in the EA (FHWA and CDOT, 2020) include creating an updated SCAP and this Maintenance Manual.

Implementing the EA preferred alternative increases the travel lane area by 50%, resulting in applying more sand, salt, and deicing liquids. Increasing use of traction sand requires more sediment CMs. The SCAP (CDOT, 2022) provides recommendations for new sediment CMs to carry and capture sediment along the I-70 roadway. This manual provides recommendations to improve efficiency of maintaining the new and existing CMs.

Maintenance procedures in this manual are for **Zone 1**, which is the area **within 30 feet of edge of pavement, or within the purview of CDOT Maintenance**.

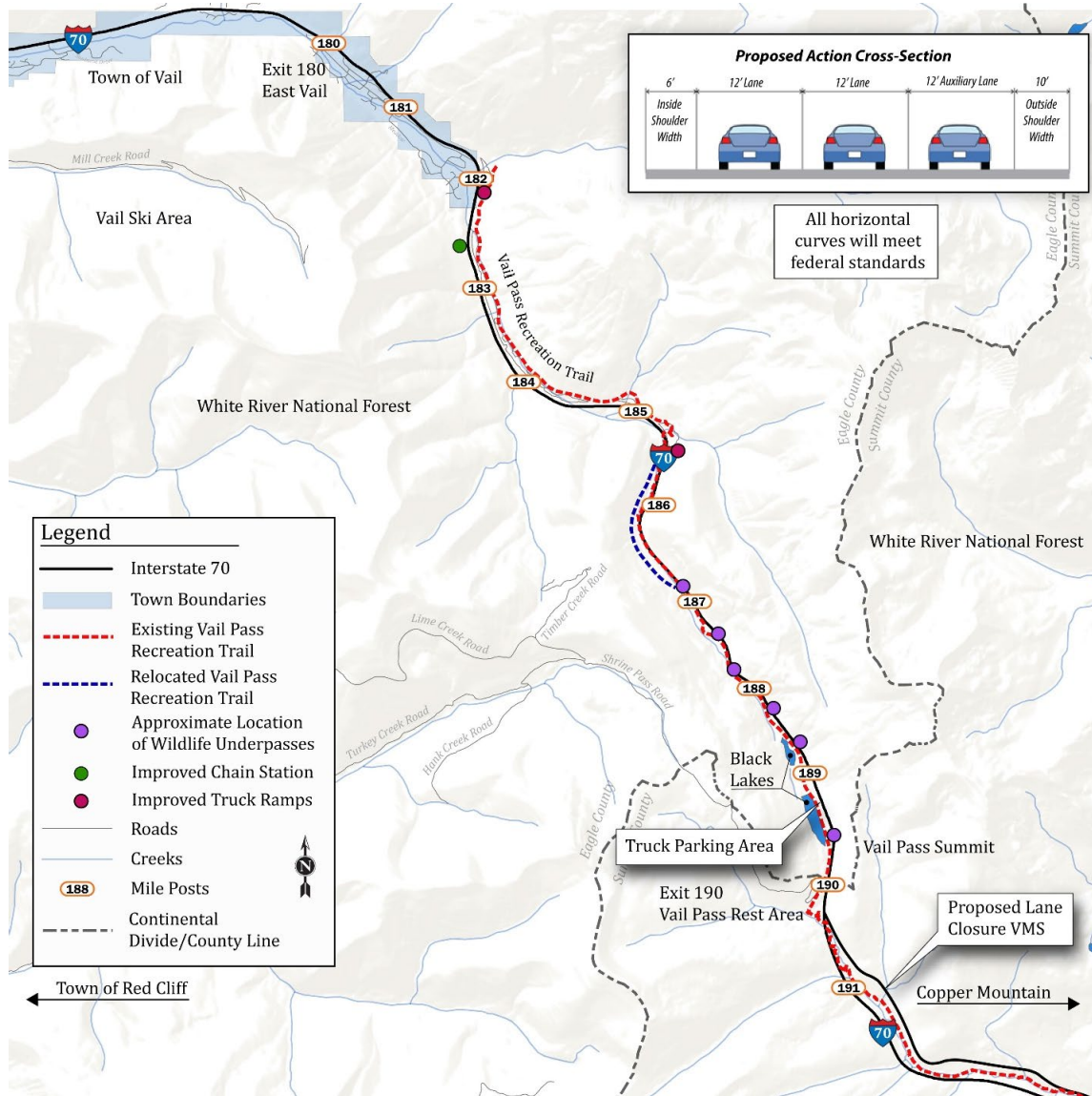


Figure 1.1. West Vail Pass Auxiliary Lanes Proposed Action Alternative

Source: CDOT 2020f

1.3 Winter Maintenance and Sediment Cleanup Practices

Existing winter maintenance practices are based on the *West Vail Pass Winter Operations Plan* (CDOT, 2020) and annual documentation of product use and sediment removal. Deicer use over time demonstrates the shift from traction sand toward liquid deicers. To better understand existing CDOT maintenance practices, a questionnaire was developed which was completed by current CDOT maintenance team members (Appendix A). Responses that relate specifically to maintenance of sediment CMs are noted. Guidelines for designing structural sediment CMs is provided in the SCAP (CDOT, 2022).

1.3.1 Existing Winter Operations

Existing winter operations are based on the *West Vail Pass Winter Operations Plan* (CDOT, 2020). Historic and current product use is based on internal annual reporting. The main reporting source since around 2002 is the Maintenance SAP record for MP 180 to MP 190.

Definitions of product terms:

- **Sand Slicer (also known as Traction Sand):** a mixture of traction sand and salt. In Patrol 40, the mix is 90% sand and 10% salt. Extra ice slicer can be added to the sand for more extreme storms.
- **Liquid deicer:** either magnesium chloride or another brine; sprayed onto the road. Liquid deicer can also be mixed with the Sand Slicer to create wetted sand/hot sand.
- **Ice Slicer:** solid salt, mostly sodium chloride, but including magnesium and calcium chloride. A small amount of red clay gives this granular material a reddish color.

CDOT Region 3 (R3) deicers are chloride based. Alternatives have been studied by CDOT (CDOT, 2009), other state departments of transportation, and by national researchers (National Academies of Science, 2004). Findings suggest alternative products have negative environmental impacts (e.g., excess oxygen depletion from acetate deicers), do not perform as well (e.g., experimental beet juice-only deicer), are too expensive, or all these options. CDOT deicers are subject to strict limits on various metals, phosphorous, ammonia, and cyanide (**Table 3.3** of the SCAP [CDOT, 2022]).

Table 1.1 shows the historic and current use of products on the roadway. The changes in product usage were in response to Black Gore Creek being listed as impaired for sediment by the Colorado Water Quality Control Commission in 2000. Since then, CDOT has invested \$7.2 million into building sediment CMs and \$2.7 million into maintenance and cleanout of those CMs. CDOT has removed 190,000 tons of material from the CMs. The remainder of this section discusses the types of sediment CMs along West Vail Pass and what CMs the Maintenance crews find easier to maintain.

Table 1.1. Winter Maintenance Product Use and Sediment Cleanup Averages, 1989-2020^[a]

Years	Average Snow and Ice Control Abrasives (Granular products) per Year (tons) ^[b]	Average Liquid Deicers (magnesium chloride, brine) per Year (gallons)	Estimated Average Sand Placed Per Year (tons) ^[b]	Average Sand Cleanup per Year (tons)	Estimated Average Sand Minus Salt Cleanup per year (tons)
1989-1999	13,457	7,343	12,113	N/A	N/A
1999-2005	10,695	180,385	9,626	12,537	130%
2005-2012	12,169	185,304	10,952	12,193 ^[c]	111%
2014-2020	6,066	612,656	5,459	3,929	72%

^[a] Sources: CDOT, 2002 (Table 1); Maintenance SAP records, Patrol 40, MP 180 to MP 190.

^[b] Total includes sand with 10% salt; Estimate sand = 90% of total granular product. This is a conservative estimate; total sand is likely to be less.

^[c] 2005-2012 average includes 26,400 tons removed from Basin of Last Resort in CDOT 2009; 2014-2020 average includes 2,443 tons removed from the Basin of Last Resort in 2019.

With 189 inches of snow falling, on average, at the top of West Vail Pass, keeping I-70 open is a constant challenge (CDOT, 2002a). During winter months, the Maintenance crews swell to 25, from a total of 8 in the summer months (CDOT personal communication, April 30, 2021). Crews and managers refer to the Material Application Decision Matrix to know which material to apply under the different snow conditions during winter (CDOT, 2020). Use of abrasives ranges from 250 to 500 pounds per mile per truck trip.

There are four problematic areas along the pass (CDOT, 2020):

- **Ping-Pong Alley** (MP 187 to MP 189, WB)
- **The WB Narrows** (MP 185.9 to MP 186.5 WB), which includes that avalanche-prone area (approximately MP 186, per CDOT 2020)
- **The EB Narrows** (MP 185.9 to MP 186.4 EB)
- **Blowing Snow Area** (MP 182 to MP 183.5, both EB and WB)

These areas have required additional application of traction sand and deicing solutions due to steep slopes, tight curves, narrow shoulders and/or higher-than-average blowing snow, and the most accidents. The blowing snow area requires sanding because liquids tend to freeze after application. In these areas, widening the roadway and shoulders, and smoothing the curves should help, and should mean less winter maintenance product per lane mile on the pass.

In addition, several areas along the pass are considered to be sensitive to sediment:

- Black Lakes area, west side of the lakes
- Wildlife crossing areas
- Stream crossings
- Bridges
- Windrows under bridges
- Wetlands

Refer to SCAP Section 5.3, Areas of Special Attention (CDOT, 2022), for a more detailed description of the sensitive areas. These are high priority areas for inspections to assess sediment accumulation and for sediment CM cleanout. Avoid driving heavy equipment on wetlands. Inspect windrows regularly after vegetation is established (**Table 3.1**). Refer to Table 3.1 for inspection and cleanout frequency. Areas of Special Attention are prioritized during inspection and cleanout activities.

1.3.2 Maintenance Questionnaire Responses

This section summarizes CDOT Maintenance members' responses to the questionnaire (**Appendix A**), about both existing practices and preferred future practices. A few responses to follow-up questions are also noted. Winter maintenance practices are discussed first; sediment CMs and cleanout practices are discussed second. The recommendations in **Sections 3** and **4** consider these responses.

General snow removal and winter maintenance practices include the following:

- Historically, plows threw snow to the right side of the roadway, as far as 50 feet to the side. Snow blowers threw snow up to 60 feet. (Maintenance is working to keep the snow within **30 feet** of the edge of pavement to avoid going beyond existing or proposed sediment basins.)
- Changing from using abrasives or Ice Slicer to liquid deicer depends more on temperature and snowpack than on elevation. Placement of sand and deicer changes with each storm. Higher wind and lower temperature tend to increase sand use, while the opposite tend to increase liquid deicer use.
- Liquid deicer is not put down before storms. It is used at the start of and during a storm. The liquid deicer is designed to dilute in the melting snow for optimal anti-icing.
- Snow is stored on the **right shoulders** along the entire pass in both directions. Some snow is used to build a berm on WB I-70 at the avalanche area around MP 186.
- Areas with greater snow include:
 - **WB** MP 185.5, MP 186-avalanche area (build berm), and MP 184 to MP 190
 - **EB** MP 183 to MP 184, MP 185.5, MP 184 to MP 190, MP 185.5 to MP 186.5 (on bike path by road)

- Areas where wider shoulders would help with storing more snow are:
 - **WB** MP 185-190, Narrows (MP 186 to MP 186.5), avalanche area (MP 186) and MP 189.1
 - **EB** MP 182 to MP 184, MP 182 to MP 188, and MP 183 to MP 186
- Many of the areas where more snow is stored are the areas that crews want to be widened.

Ideas for reducing winter maintenance product use, while keeping Vail Pass open during winter storms, include the following:

- **Training and coaching:** Increase training and regularly scheduled reminders for crews on how to efficiently place deicing solutions and traction sand to meet the desired level of service.
- **Pre-storm meetings:** Hold pre-storm meetings with maintenance crews to discuss what is appropriate for that storm and to coach how much sand to use at different places. Include discussions about snow-packed road versus “wet” road, which could be black ice. Include discussions of problem areas that may require higher sand application versus those that do not.
- **Variable-rate sand dispensers:** Variable sand dispensers are preferred to adjust to changing conditions and to allow for higher sanding rates in the problematic areas listed in **Section 1.3.1**. Use only variable-rate sand dispensers on West Vail Pass.
- **Spot Sanding:** Sand steep grades, corners, and bridges instead of the entire road; use less sand along flatter and straighter portions of the roadway.

General cleanup practices for sediment after winter ends include sweeping, using a vacuum truck to clean out sediment vault inlets (which capture sediment in sumps) and removing sediment from some basins, behind guardrails, and under bridges. Some of the cleanup is managed under an annual contract. All cleanings are taken to build the large berm in East Vail, just off WB I-70.

Current cleanup practices:

- Crews sweep the corridor once or twice a year, mainly from May through September. (This depends on when snow begins in the fall and when it finishes melting in the spring.)
- Crews remove sediment from behind guardrails and sweep valley pans and shoulders.
- Sediment ponds/basins are typically cleaned out once a year, between May and September. Depth and width of ponds/basins is often not well delineated.
- The existing CDOT equipment is sufficient to clean out most basins.
- Cleaning under bridges is variable, depending on time and whether there is safe access. Areas under high bridges with no access are not cleaned.

- Equipment used for cleaning up sediment includes backhoes, skid steers, loaders, sweeper, and the vacuum truck. Graders may be used to smooth out tops of soft-sided sediment basins.
- Maintenance also has several loaders with 10-foot blades (necessary information for knowing how wide to make any hard-sided sediment basins).

Characteristics of preferred sediment CMs:

- Hard-sided ponds that can be accessed by a loader are preferred to have an interior width that allows 1 foot on each side of the most common loader blade. A minimum interior width of 12 feet would fit the existing 10-foot loaders.
- Larger ponds accessed from the highway are preferred over any ponds accessed from the recreation path, because the distance to dump trucks is shorter.
- Optimally, valley pans would be at least 4 feet wide. This width allows for easier equipment access, while providing enough volume to manage runoff (based on hydraulic analysis).
- Ideally, any valley pans behind walls would be 4 feet wide to allow for equipment access, and would have no exposed dirt or seams between the valley pan and Jersey Barrier concrete. Water gets under and erodes the valley pans where there is dirt (CDOT, personal communication, April 30, 2021).
- Wider shoulders for sweeping could be used instead of adding more sediment ponds.
- Sediment ponds with rip rap are preferred over engineered inlets.
- Modified Type D special inlets (inlets with sumps, screens and/or orifice plates) are not preferred and can clog within weeks of being emptied. (Most are individual inlets and hold 6.67 cubic yards, not inlets-in-series, as recommended in SCAP design guidelines.) The screens to catch sediment are hard to remove for cleaning, and they can get stuck from rusting. More recent designs for sediment vault inlets can hold as much as 12 cubic yards.

Based on responses to the questionnaire, the following CMs are easier to maintain: ponds near the highway, ponds that drain properly, and paved shoulders for sweeping.

1.3.3 Lessons Learned for Optimal Maintenance

Key lessons learned from existing winter operations and questionnaire responses are:

1. Training and continual communication are critical to winter operations and to limiting traction sand and deicer liquid use to what is needed.
2. Most existing equipment is sufficient to maintain sediment CMs. However, a reliable sweeper would be preferred.
3. When replacing equipment, consider equipment size relative to the sediment CM size.

2. Proposed Sediment Control Measures

CMs for West Vail Pass are grouped into three categories: prevention, conveyance, and treatment. Prevention CMs reduce erosion and prevent overuse of deicing materials through ongoing training and technology updates. Conveyance CMs carry runoff and sediment to treatment CMs. Treatment CMs capture sand for removal during cleanout activities. **Table 2.1** lists these categories and divides them into structural and non-structural CMs (CDOT, 2022).

Table 2.1. Proposed Sediment Control Measures

Type	Classification	Structural	Non-Structural
Prevention	Design	Clean water diversion ^[a]	<ul style="list-style-type: none"> Slope stabilization/revegetation^[a] Vegetated berms Coir logs^[b]
Prevention	Maintenance	Clean water diversion ^[a]	<ul style="list-style-type: none"> Maintenance staff training appropriate application rate and materials Improved sanding practices anti-/deicing improvements Technology updates Street sweeping and disposal
Conveyance	Maintenance	<ul style="list-style-type: none"> Ditches/swales^[a] Valley pans or curb-and-gutter^[a] Drainage rundowns^[a] Culvert outlet protection^[a] Culvert repair/replacement^[a] Shoulder/embankment Paving^[a] Kneewall with french or underground drains^[a,c] Separated snow storage/graded areas^[a,c] 	None



Type	Classification	Structural	Non-Structural
Treatment	Maintenance	<ul style="list-style-type: none">• Sediment basins: ^[a]<ul style="list-style-type: none">○ Soft-sided with infiltration○ Loading dock traps○ Hard-sided with infiltration^[b]○ Bench traps^[c]• Sediment vault inlets^[a]• Roadside ditches or swales^[a,c]	<ul style="list-style-type: none">• Riparian corridor enhancement^[a]• “Polishing wetlands”^[b]

^[a] CMs noted in EA (FHWA and CDOT, 2020).

^[b] CMs that have been added since the EA and have been approved by the SWEEP ITF (as of May 24, 2021).

^[c] CMs that are **not** preferred for West Vail Pass for at least one of several reasons.

- They are difficult to access or maintain
- There is not enough room to include them
- They are not efficient
- They do not fit the aesthetics of this corridor.

These CMs are not discussed in the maintenance section, because they are not anticipated.

Existing and planned structural sediment CMs are located on the GIS-based SCAP Map Book included in the SCAP (CDOT, 2022). Please refer to those maps for locations and types of CMs. The CMs are also listed in a SCAP appendix, with notes about access to the CMs. Both resources should be updated with each design/construction phase on West Vail Pass. Please refer to the R3 Maintenance Superintendent and R3 Eagle Resident Engineer for updates of the Map Book and Table.

3. Recommended Maintenance Procedures for Control Measures

Recommended maintenance procedures for sediment CMs are presented in **Table 3.1**. Proposed procedures reflect the optimum timing and level of activities to control sediment along this corridor. The table includes maintenance actions recommended for each type of CM and anticipated equipment for each action. Descriptions of the CMs follow the table. Additional details are provided in the SCAP Section 5 (CDOT, 2022).

Prevention CMs include cleanwater diversions, slope stabilization/revegetation, vegetated berms, and coir logs.

- **Cleanwater Diversions:** Cleanwater diversions are pipes that collect and convey the stream water from above the roadway prism to below the roadway and the 30-foot area of sand accumulation. These pipes may also carry stream water to another culvert outside the roadway impact zone (**Zone 1**). Cleanwater diversions extend beyond the roadway on either side, and should be inspected regularly. Keep sediment away from the diversions and prevent snow from being thrown beyond their endpoints.
- **Slope Stabilization/Revegetation:** Slope stabilization/revegetation and vegetated berms also require regular inspection. If sections of cut- or fill-slopes lose vegetation or increase in erosion or rill formation, note those locations and alert the LTC Ops. LTC Ops should alert R3 Environmental Unit to address revegetation areas.
- **Coir Logs:** Coir logs are made from the fibrous husks of coconut shells and are used for slope stabilization. They are used to prevent sand from migrating down steep slopes or into adjacent streams, and to keep sediment in “windrows” below bridges from entering adjacent streams. Inspect to ensure that they remain, with rounded middle toward the stream and ends curled around the windrow sediment. Coir logs last up to 5 years and should remain in place (unlike erosion control logs). Maintenance entails regular inspection and reporting of areas that are being reburied by sand and need to be reseeded. Refer to Table 3.1.

Table 3.1. Recommended Maintenance of Sediment Control Measures

Type	CM Type	Action	Equipment
Prevention	Clean Water Diversion	<ul style="list-style-type: none"> • Avoid throwing snow beyond pipe endpoints • Regular inspection; alert LTC Ops of any issues 	Snow plows and snow blower
Prevention	Slope Stabilization/Revegetation; Vegetated Berms	Annual inspection; alert LTC Ops if reseeding is needed	Not applicable
Prevention	Coir Logs	Annual inspection; alert LTC Ops if reseeding is needed or coir log has slipped out of place	Not applicable
Prevention	Street Sweeping and Disposal	<ul style="list-style-type: none"> • Twice a year (spring just after melting and fall); combine with sweeping paved shoulders, valley pans and gutters 	<ul style="list-style-type: none"> • Sweeper • Dump trucks for haulage • Traffic control
Conveyance	Ditches/Swales	<ul style="list-style-type: none"> • Biannual inspection of ditches and swales • Annual sediment removal 	Backhoe ^[a] or grade-all
Conveyance	Valley Pans or Curb-and-Gutter	<ul style="list-style-type: none"> • Biannual inspection • Annual sweeping of valley pans and gutters, combined with roadway and paved shoulders • Remove sediment from behind Jersey barriers 	<ul style="list-style-type: none"> • Sweeper • Dump trucks for haulage • Traffic control • Behind Jersey barrier, use backhoe^[a] or vacuum truck
Conveyance	Shoulder/Embankment, Paving	<ul style="list-style-type: none"> • Biannual inspection • Annual sweeping, combine with sweeping paved shoulders, valley pans and gutters 	<ul style="list-style-type: none"> • Sweeper and dump trucks for haulage • Traffic control

Type	CM Type	Action	Equipment
Conveyance	Drainage Rundowns Culvert Outlet Protection Culvert Repair/ Replacement	<ul style="list-style-type: none"> • Biannual inspection; alert LTC Ops to ask for engineering inspection 	Not applicable
Treatment	Sediment Basins: <ul style="list-style-type: none"> • Soft-sided • Loading dock traps • Hard-sided 	<ul style="list-style-type: none"> • Biannual inspection and annual cleanout, by maintenance crews or contract • Cleanout of Basin of Last Resort (MP 182.5) every 2 to 3 years 	<ul style="list-style-type: none"> • Small basins less than 12 feet wide interior: backhoe^[a] or skid steer • Loading dock or hard-sided/curbed with push wall: 10-foot-bucket loaders • Dump trucks for haulage • Traffic control as needed
Treatment	Basins with infiltration (includes soft-sided and hard-sided with infiltration slot)	<ul style="list-style-type: none"> • Biannual inspection (spring - inspection; fall - cleanout and inspections) • Removal of fines if they cover the base • Scarify the base as needed (approximately every 3 years) to minimum 4 inches 	<ul style="list-style-type: none"> • Backhoe^[a] or skid steer to remove fines • Dump truck to haul fines • Backhoe^[a] or other toothed equipment that fits slot or basin to break through base
Treatment	Sediment Vault Inlets	Annual cleanout and inspection	<ul style="list-style-type: none"> • Vacuum truck • Equipment to open grates and/or to pull screens • Traffic control

^[a] R3 Maintenance does not have this equipment. The annual sediment cleanout contract for R3 could require that a backhoe or grade-all be included in equipment to address these needs.

Conveyance CMs include ditches/swales, valley pans, and shoulder and embankment paving.

- **Ditches and swales:** Ditches and swales will likely be vegetated, so no specific maintenance is needed unless they become choked with sediment. Regular inspection is the main maintenance procedure. If ditches are clogged with sediment and require a backhoe to clean them out, include cleaning in the annual sediment contract.
- **Valley pans:** Valley pans or curb-and-gutter are paved, and some valley pans will be located behind retaining walls.
- **Equipment:** Sweeping of valley pans and curb-and-gutter is preferred on the roadway side of any walls and where walls are absent. For valley pans behind walls, use either a backhoe or vacuum truck to remove sediment. Ideally, valley pans would be swept twice a year, including just before cleanout of sediment vault inlets.
- **Shoulder/embankment paving:** Shoulder/embankment paving provides added width for vehicle pull-offs and for snow storage. Ideally, paved shoulders would be swept at least twice a year, including just before cleanout of sediment vault inlets.

Conveyances that carry runoff to the receiving stream are drainage rundowns, culvert outlet protection, and culvert repair/replacement. Remove sediment from drainage culverts with the vacuum truck. Optimally, culverts would be inspected annually, and cleaned out every 2 to 3 years. Report any disintegrating culverts to the LTC Ops who will alert R3 engineers. Engineering is responsible for decisions regarding repair or replacement of culverts.

Treatment CMs include sediment basins and inlets with a sump (sediment vault inlets). Each of these treatment types has several subtypes. Sediment basins include small to medium, soft-sided basins, steep-sided loading dock traps, and basins with curbs and push-walls.

Sediment basins vary from small, narrow, shallow, and soft-sided to large and soft-sided, as well as medium to large loading docks (with high walls) and hard-curbed basins. **Access** to these basins is from both the I-70 roadway and the Vail Pass recreation path. Optimally, access would not require passing through gates, and all access would support heavily loaded equipment.

- **Soft-sided basins:** Many existing sediment basins on West Vail Pass are soft-sided, have riprap outlets, and are poorly defined (**Figures 3.1 and 3.2**). A few of these basins (**Figure 3.2**) need to be skid steer due to poor access. **Access:** Look for basin marker with a milepost number. The marker is usually next to or below the riprap outlet. Ideally, existing basins would have delineators at the front and back corners to indicate where to dig sediments



Figure 3.1. Soft-sided Sediment Basin No. 30 on Eastbound I-70



Figure 3.2. Soft-sided Sediment Basin No. 26 on Westbound I-70

- **Hard-sided basins:** One design option (Figure 3.3), includes concrete curbs and apron, concrete push wall with V-shaped center (to allow water to drain better) and gabion basket outlet (to slow clogging). The minimum interior width of these basins is 12 feet, to allow a 10-foot loader room to work in them. Sides above the curbs are likely to be soft, but curbs and apron will guide the equipment operator to horizontal and vertical limits of the basin. **Access:** These basins have delineators at the start of the concrete apron and either delineators or large boulders at the entry corners. Since the entry is soft, look for the base of the delineator or boulder for a guide or where to stop digging.

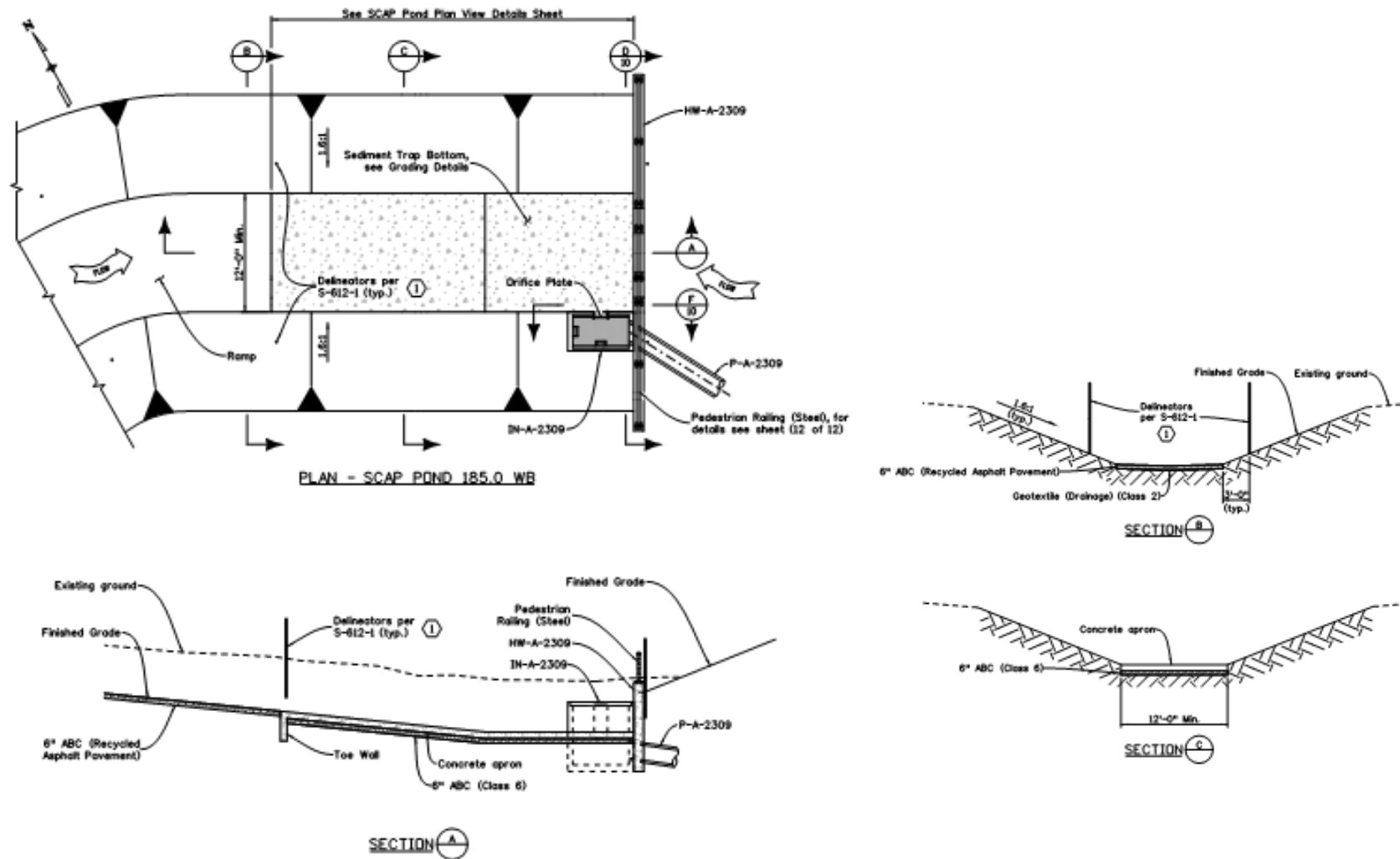


Figure 3.3. Example of a West Vail Pass Curbed Sediment Basin

- **Loading dock traps:** These basins have tall, vertical concrete sidewalls, a concrete entry and base, and a push wall (**Figure 3.4**). The outlet may be on the side of a wall, but should be flush with the wall. Ideally these would have a minimum interior width of 12 feet to accommodate 10-foot loader buckets. The entry and base are easy to see because they are concrete. **Access** is from the end opposite the push wall. Start removing sediment where the concrete begins.



Figure 3.4. Loading Dock Trap (Berthoud Pass East)

- **Infiltration:** Some basin design options include a pervious cutout, or a 4-foot-wide slot in the middle of the push wall apron (**Figure 3.3, Plan View**). Most water flows through the outlet, but the last few inches may not. The remaining water seeps into the ground. Over time, fine sediment will clog the cutout. Existing basins with soft sides and bases also allow for some infiltration. Where possible, remove the fines layer on the bottom of soft-based basins during cleanout. Optimally, basins with infiltration would be inspected annually after sediment is removed. If water remains, that basin would be added to the next year's sediment cleanout contract to use toothed equipment (e.g., backhoe) to scarify or rip the underlying material and to remove fines that a loader cannot. Estimated time between scarifying is estimated to be 3 years. However, annual inspections will provide more accurate timing for individual basins. **Access:** see access for different basin types.
- **Sediment vault inlets:** These concrete box inlets with steel bar or mesh grates vary in size and type. All have sumps to hold sediment. Some have screens while others have weirs and/or orifice plates. Type D inlets should be cleaned with a vacuum truck. **Inlet and adjacent area cleaning should occur prior to the inlets being full;** clean at least annually. Ideally, screens or orifice plates would be removed and cleaned at the same time; inspect at least annually. **Access** is from the roadway. Where shoulders are wide enough, only shoulder closures are needed, but lane closure and traffic control are needed where equipment and crews are 12 feet or less away from the travel lane edge (white line).

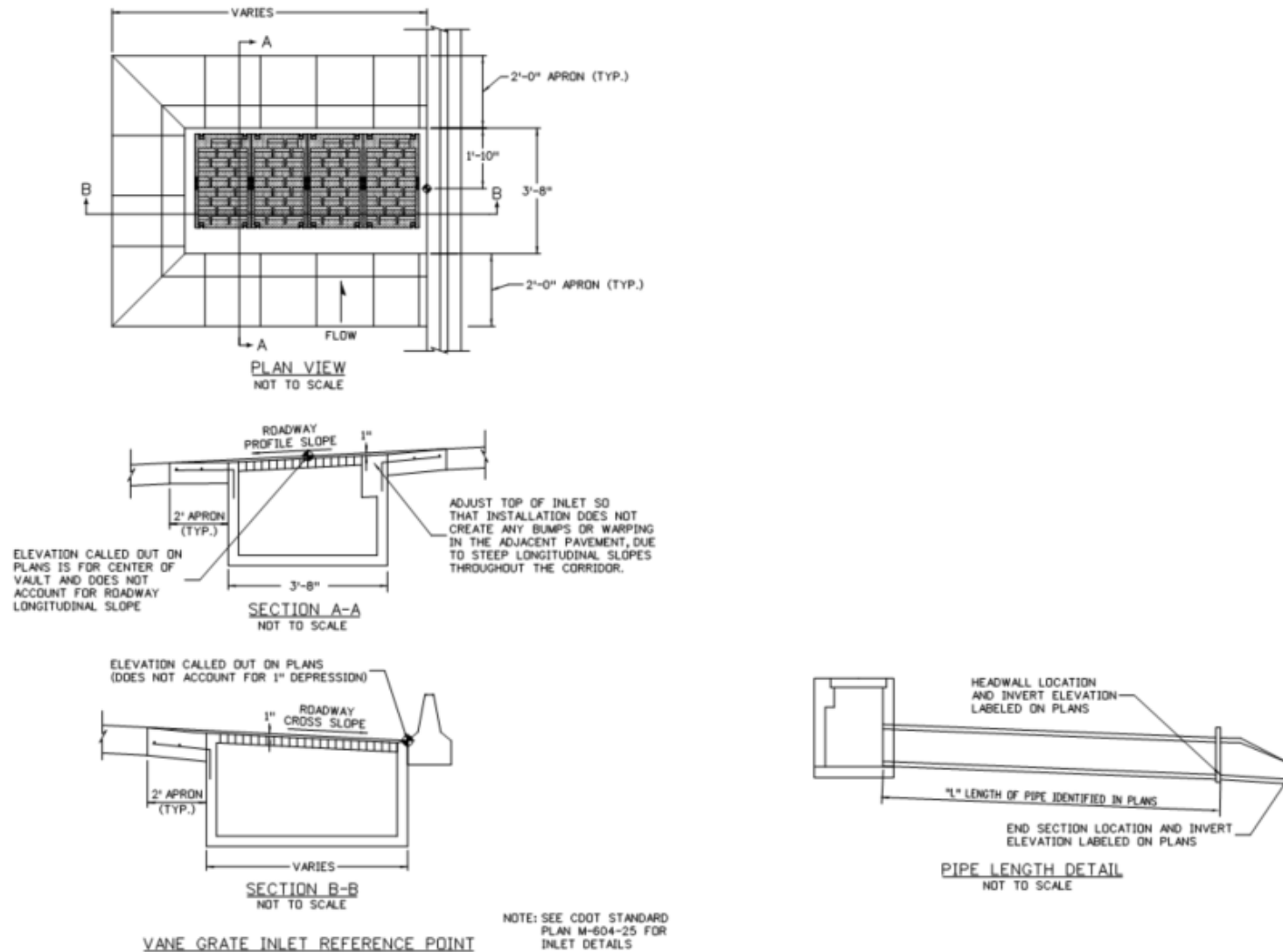


Figure 3.5. Example of Sediment Vault Inlet Plans

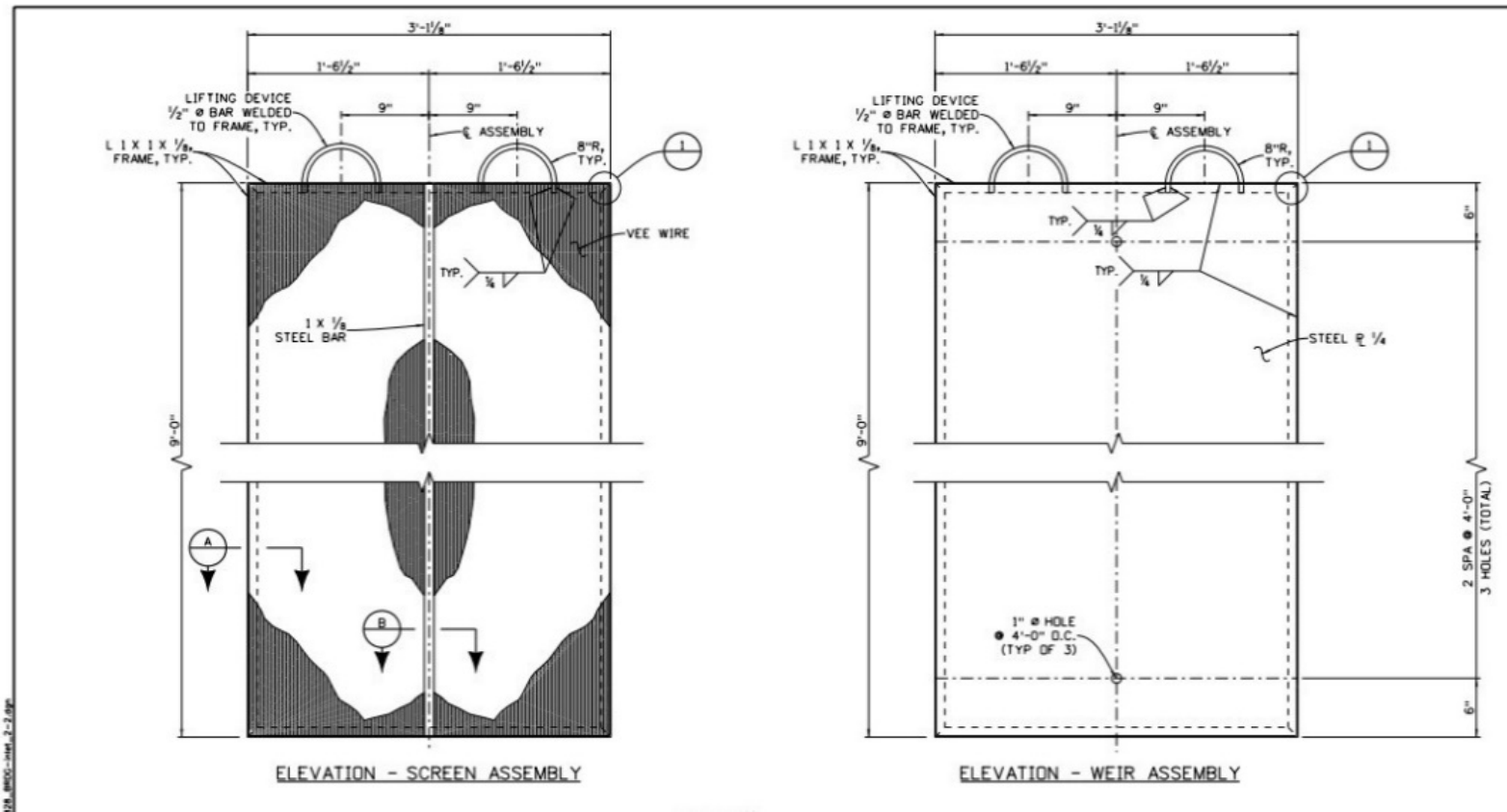


Figure 3.6. Example of Sediment Vault Inlet Screen and Weir Plans



3.1 Sensitive Area Maintenance Recommendations

As listed in **Section 1.3.1**, several sensitive areas exist along West Vail Pass:

- Black Lakes area, west side of the lakes
- Wildlife crossing areas
- Stream crossings
- Bridges
- Windrows under bridges
- Wetlands

These areas take priority for maintenance of associated sediment CMs. Ideally, all CMs will be fully cleaned annually. However, if resources are limited, CMs adjacent to the listed areas must continue to be cleaned out **annually**. Black Lakes No. 1 and No. 2, the six new wildlife crossings (both WB and EB ends), stream crossings, and bridges are easy to locate. Cleaning windrows under bridges depends on access. If access is available, sediment removal should continue annually. Not all windrows will have access. In those cases, coir logs and revegetation are preferred, so annual inspection is needed. For high-value wetland locations, refer to R3 Environmental Staff for which areas need the most protection.

Second-tier priorities for annual cleanout are:

- **Blowing Snow Area** (MP 182 to MP 183.5, both EB and WB)
- **The Narrows** (approximately MP 185.9 to MP 186.5, both EB and WB)

The blowing snow area runs adjacent to Black Gore Creek, with little room for sediment control. CMs in this area will fill quickly and so need to be cleaned out **annually**, even when resources are limited.



4. Documentation and Reporting

CDOT Maintenance currently use Work Orders and Activity Codes detailed in the *Plant Maintenance Field Manual* (CDOT, 2019) to document its activities including plowing and placement of winter maintenance product and sediment cleanout in summer and fall. Types and optimal frequencies of actions related to maintaining sediment CMs are listed in **Table 3.1**. In recognition that resources may be stretched thin, sediment cleanout priorities are noted in **Section 3**.

Activity Codes used for sediment removal (as of the date of this manual) are summarized in Table 4.1. Note that contracted out work may be tracked separately.

Table 4.1. Summary of Sediment Removal/Inspection Activity Codes

Activity Number	Activity Name	Accomplishment
202	Drainage Structure Clean, Repair, Replace or Dirt Removal	each and tons
206	Cleaning and Removing Excess Material from Ditches and Streambeds (includes reshaping of same location)	linear feet
207	Salt and Sand Removal	tons
210	Slope Repair Due to Washout & Erosion, Dirt Drifts, Mud & Rock Slides	cubic yards
220	Sweeping - Machine	pass miles and tons
222	Sweeping - Hand	labor hours
223	Environmental Temporary Best Management Practice	labor hours
224	Environmental Permanent Best Management Practice	labor hours
225	Environmental Inspection	labor hours

Refer to the *Plant Maintenance Field Manual* (CDOT, 2019) for more details.

5. References

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Appendix A. Questionnaire

This questionnaire was completed by interviewing nine Colorado Department of Transportation (CDOT) Maintenance staff from Region 3 and one from CDOT headquarters. The key results are reported in **Section 1.2** of the maintenance manual.

SCAP Questions for Maintenance Staff

Introduction

Thank you for answering these questions! We want to understand how your section(s) of I-70 are maintained during the winter, so that we can build appropriately sized and located sediment ponds to capture the most runoff possible. We also want to make the sediment control measures along I-70 as easy as possible for you to maintain. We understand that you have a *lot* of work to do in order to maintain CDOT's assets. We think that you have the best understanding of the road, and how to maintain it while also keeping the adjacent streams healthy. That is why we are asking you all of these detailed questions. Note: MP stands for mile post. EB stands for eastbound. WB stands for westbound.

General Questions

1. What is your position at CDOT?
2. What Region do you work in today?
3. Did you work previously in Region 3? Yes ____ or No ____ If so, when?
 - a. Start Date _____
 - b. End Date _____
4. What route do you maintain? _____
 - a. What is the start MP of your patrol? ____
 - b. What is the end MP of your patrol? ____
5. What are the landmarks for the start and end of your patrol (e.g. EJMT, Vail Pass interchange, emergency turnaround)? _____

Winter Maintenance Questions

6. When plowing, how far does your plow throw the snow past the edge of the road? ____ [answer in feet]
7. Over a winter season, how much **Ice Slicer** do you put down, relative to a **salt/sand mix**? (These are not distinguished in the tracking form, so we do not know how much of which.)
 - a. ____ All ice slicer
 - b. ____ $\frac{3}{4}$ ice slicer



- c. ____ ½ ice slicer
d. ____ ¼ ice slicer
8. Over a winter season, how much **Ice Slicer** do you put down relative to Liquid Deicer (mag chloride/Apex/brine)?
- a. ____ All ice slicer
b. ____ ¾ ice slicer
c. ____ ½ ice slicer
d. ____ ¼ ice slicer
9. For the sand/salt mixture, what is the percent salt? ____% (Usually between 8% and 18%)
10. Do you change the application rate within your patrol? If so, at what elevation or MP?
- a. ____ Sand mix Elevation _____ or MP _____
b. ____ Slicer Elevation _____ or MP _____
c. ____ Liquid deicer Elevation _____ or MP _____
11. Are any application rate changes programmed in, or do you do that yourself?
- a. ____ Programmed in
b. ____ I change rates as I go, to fit the conditions
12. What conditions or elevation call for sanding?
13. What conditions or elevation call for liquid deicer?
14. What conditions or elevation call for slicer?
15. What is the current policy about putting down liquid deicer:
- a. ____ Before a predicted storm? If so, how many hours in advance?
b. ____ Just as storm is starting
c. ____ Other *[Provide explanation]*
16. Over a winter season, how often do you use liquid deicer versus sand mix versus slicer at the top of the pass?
____% liquid deicer, ____% sand mix, ____% slicer
17. If you don't use it at the top of the pass, where do you start using each of the following:
- a. Sand mix: WB MP ____ EB MP ____
b. Slicer: WB MP ____ EB MP ____
c. Liquid deicer: WB MP ____ EB MP ____
18. Does where you start using liquid deicer vary with each storm? Yes or no.



19. If you had an ideal set of equipment, what would it be, and how would you use it to maintain the pass?
- How would that change how you put down deicing products?
 - How would you plow the road?
20. Do you have any ideas about how to reduce the amount of deicer/salt on the roads, while still keeping them safe? For example, did you get trained on how much to use at what time, or is that all in the computers now?

Sediment Cleanup Questions

21. How much sweeping of roadway and shoulders do you do today and what are the limits?
- ☐ All of the corridor/patrol
 - ☐ Half of corridor/patrol
 - ☐ Only paved shoulders in parts of the corridor/patrol
 - ☐ None, we don't have to sweep the area where I work
 - ☐ Other *[Provide explanation]*
22. If you sweep, how soon after a snowstorm do you sweep?
- ☐ Within 4 days
 - ☐ Within 2 weeks
 - ☐ Whenever possible in the winter, depending on storms and time
 - ☐ The following spring
 - ☐ Never
 - ☐ Other *[Provide explanation]*
23. What sediment capture basins stay wet (standing water) most of the time?
- MP _____ EB _____ or WB _____
 - MP _____ EB _____ or WB _____
 - MP _____ EB _____ or WB _____
 - MP _____ EB _____ or WB _____
 - MP _____ EB _____ or WB _____
24. There are a lot of other places where sediment accumulates. Do you also clean those areas?
- Behind guardrail? Yes or no. If yes, how often? _____ times per year
 - Sweeping the shoulders? Yes or no. If yes, how often? _____ times per year
 - Under bridges? Yes or no. If yes, how often? _____ times per year



- d. Other *[Provide explanation]*
25. Where do you take the material that you clean up?
26. What equipment is used to clean the sediment ponds? Please include the widest blade used for loaders or widest bucket for backhoe.
27. What is the widest loader blade size that you have, if you clean out hard-sided ponds? ____ [answer in feet]
28. How far can the equipment reach into the basin? ____ [answer in feet]
29. Can you reach all of the basins with your equipment? Yes or no. If No, what MPs can't you reach?
- a. MP ____ EB ____ or WB ____
 - b. MP ____ EB ____ or WB ____
 - c. MP ____ EB ____ or WB ____
 - d. MP ____ EB ____ or WB ____
 - e. MP ____ EB ____ or WB ____
30. When are the ponds cleaned? (Provide name of month[s])
31. Does cleaning the structures require traffic control or lane closures? Yes or no. If yes, which ones?
- a. MP ____ EB ____ or WB ____
 - b. MP ____ EB ____ or WB ____
 - c. MP ____ EB ____ or WB ____
 - d. MP ____ EB ____ or WB ____
 - e. MP ____ EB ____ or WB ____
32. Cleaning out the Type D inlets:
- a. How often do you clean them out? ____
 - b. Do you sweep the shoulder above them before ____ or after ____ cleaning the inlets?
 - c. How fast do the inlets fill after you clean them? Provide answer in days, weeks, or months.
 - d. How many minutes total does it take to set up, clean, and reset each inlet?
 - e. What kind of traffic control do you need? Do you need a lane closure?
33. Rank the kinds of sediment capture best management practices from worst (0) to best (6) for ease of maintenance.
- a. ____ Small sediment ponds near the highway
 - b. ____ Large sediment ponds away from the highway, but accessible from it



- c. ___ Large sediment ponds away from the highway, but accessible from a recreation path
 - d. ___ Lots of Type D inlets, cleaned more often
 - e. ___ More paved shoulders, with more sweeping required, but fewer ponds
 - f. ___ More paved shoulders that drain to fewer, larger ponds
34. Here are some different designs of sediment control ponds [Note: survey showed various pictures of the Control Measures from the SWEEP ITF]. What do you like (or not) about them?
35. Along I-70 from EJMT to Dillon, many of the large ponds have engineered outlets. They kept clogging, so screens were put around the inlets. Now the inlet screens clog, and they are hard to pull out and clean. What kind of outlet would you prefer?
- a. ___ Small pond with riprap outlet
 - b. ___ Large pond with screen outlet
 - c. ___ Large pond with heavy riprap outlet
 - d. ___ Small pond with screen outlet (flush to pond edge)
 - e. ___ Other *[Provide explanation]*
36. Do small ponds with riprap outlets drain better than large ponds with screen outlets? Yes or no.
37. Which would you prefer to maintain?
- a. ___ Large ponds with cloggy outlets
 - b. ___ Smaller ponds that dry faster but also fill up faster
38. Where would you rather access ponds from?
- a. ___ The highway
 - b. ___ A recreation path
39. What are your safety concerns when you are sweeping, cleaning out ponds, or vacuuming out Type D inlets? What would you recommend to help you be safer?

Vail Pass-Specific Questions

40. What are the changes in snow fall that you see with elevation change?
- a. At MP ___ is the highest snowfall
 - b. At MP ___ *[add text]*
 - c. At MP ___ *[add text]*
41. How do the weather stations along your patrol help you with plowing and deicing?



42. When plowing, where do you push the snow? (To nearest one-tenth of a mile)

a. Westbound:

- i. MP start: _____, MP stop: _____
- ii. MP start: _____, MP stop: _____
- iii. MP start: _____, MP stop: _____
- iv. MP start: _____, MP stop: _____

b. Eastbound:

- i. MP start: _____, MP stop: _____
- ii. MP start: _____, MP stop: _____
- iii. MP start: _____, MP stop: _____
- iv. MP start: _____, MP stop: _____

43. Where do you store the most snow?

a. Eastbound MP start: _____, MP stop: _____

b. Westbound MP start: _____, MP stop: _____

44. Where on your patrol do you need more room for snow storage?

a. Westbound:

- i. MP start: _____, MP stop: _____
- ii. MP start: _____, MP stop: _____
- iii. MP start: _____, MP stop: _____
- iv. MP start: _____, MP stop: _____

b. Eastbound:

- i. MP start: _____, MP stop: _____
- ii. MP start: _____, MP stop: _____
- iii. MP start: _____, MP stop: _____
- iv. MP start: _____, MP stop: _____

45. Average sanding is about 500 pounds per mile, but the Patrol Plan notes some problem areas where sanding should be heavier. What rates do you use in the following locations?

- a. Ping-Pong Alley (MP 189.5 to MP 183, WB) _____ pounds per mile
- b. Narrows (MP 186.4 to MP 185.9 WB) _____ pounds per mile
- c. Narrows (MP 184.5 to MP 187.5 EB) _____ pounds per mile



46. Patrol 40 Plan notes “build berm” at Narrows, (MP 186.4 to MP 185.9 WB).
 - a. Is that a major snow storage area?
 - b. How far does the blower throw the snow to the side? _____ [answer in feet]
47. Region 3 has funding to contract for removing sediment from ponds. Is that helpful? Yes or no.
48. Does the contract include anything beyond cleaning out sediment ponds? Yes or no. If yes, please provide explanation.
49. Does CDOT clean the ponds on the recreation path, or does the contractor do that?
50. Are the ponds that require access from a recreation path a bigger problem (fill faster/harder to clean) than those that are accessed from the highway? Yes, no, or only under the bridges? If yes or only under the bridges, why?
 - a. ____ They are small and fill faster.
 - b. ____ They are harder to reach and clean.
 - c. ____ Carrying the material back to a dump truck is harder than elsewhere.
 - d. ____ Other *[Provide explanation]*
51. CDOT is likely to build some retaining walls in order to make room for the two new lanes. At least some walls will have gutters behind them. Do you usually clean those gutters? Yes or no. If yes, how wide do the gutters need to be?
52. If yes to the previous question, what equipment do you use or what kind of access do you need?
53. After hearing these questions, do you have any other comments about what you prefer, or not, for keeping Vail Pass open in the winter or for maintaining shoulders, gutters, and sediment basins?