Appendix D:
Construction Control Measures Guidance

Contents

1.0 Introduction

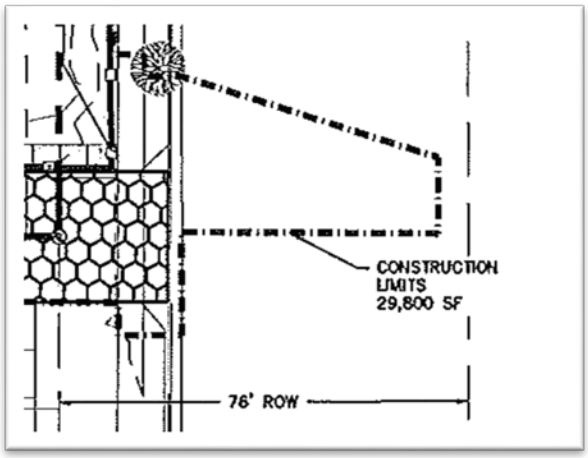
This Appendix serves as a supplement to the erosion control requirements outlined Chapters 2, 3 and 4 of this Manual. Included are examples, clarifications, and additional information that may be useful in helping to satisfy the requirements set forth in this Manual.

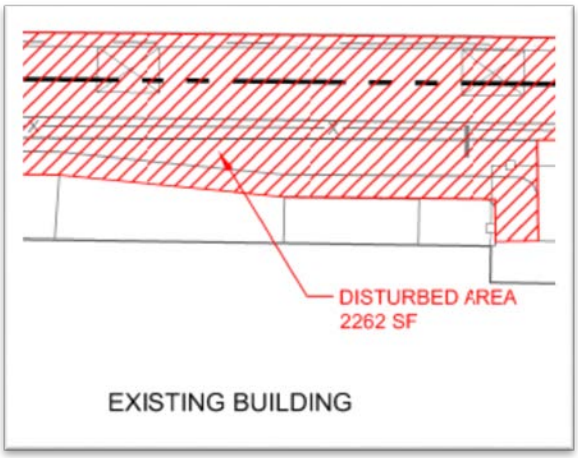
This Appendix may be referenced to clarify the Chapter requirements and may be particularly useful if the person(s) preparing the Erosion Control Materials are unfamiliar with Fort Collins regulations or need a more prescriptive explanation of the submittal document requirements. In addition, this Appendix provides some practical directions on planning ahead for the specific Control Measures warranted for the specifics of the project, and what Construction Control Measures are to be used in Fort Collins to protect waterways from erosion and sediment. Although the specific requirements are found within the Chapters of the Manual, this Appendix is intended to provide insight into the City's expectations in meeting the requirements.

2.0 Request for Project Clarification to Confirm Applicability of Requirements

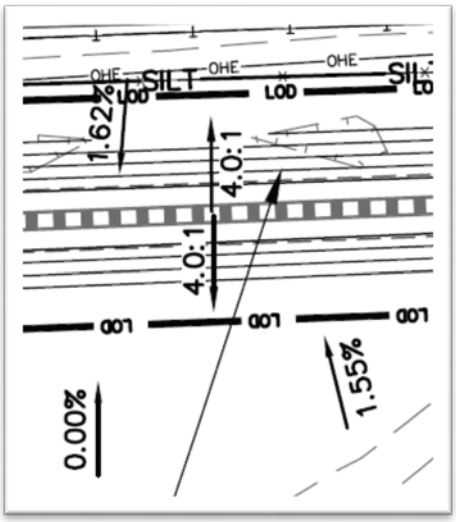
The following are examples of how informational proof may be presented in a request for clarification regarding the requirements of Section 6.1.2 of Chapter 4.

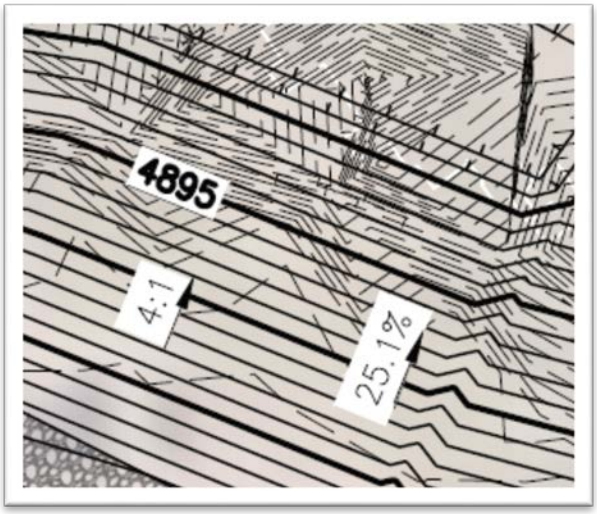
Examples of calculated areas of disturbance



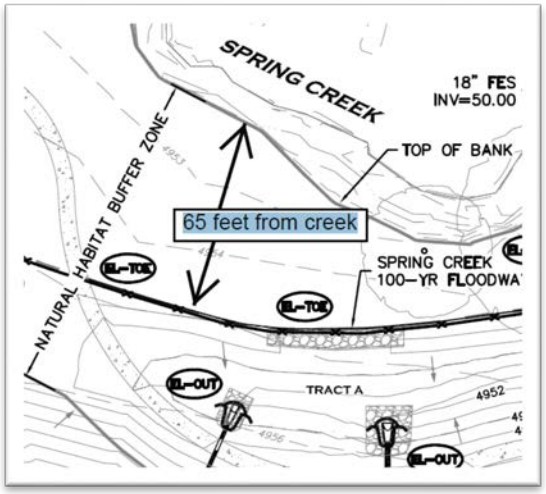


Examples of steepest slope arrow





Example of shortest distance line from the disturbed area to a sensitive area (if within 75ft)



A useful resource or tool for designers or smaller projects that may not have AutoCAD drawings or capabilities is the City's Mapping System, FCMaps.

3.0 Chart or Table of Calculations

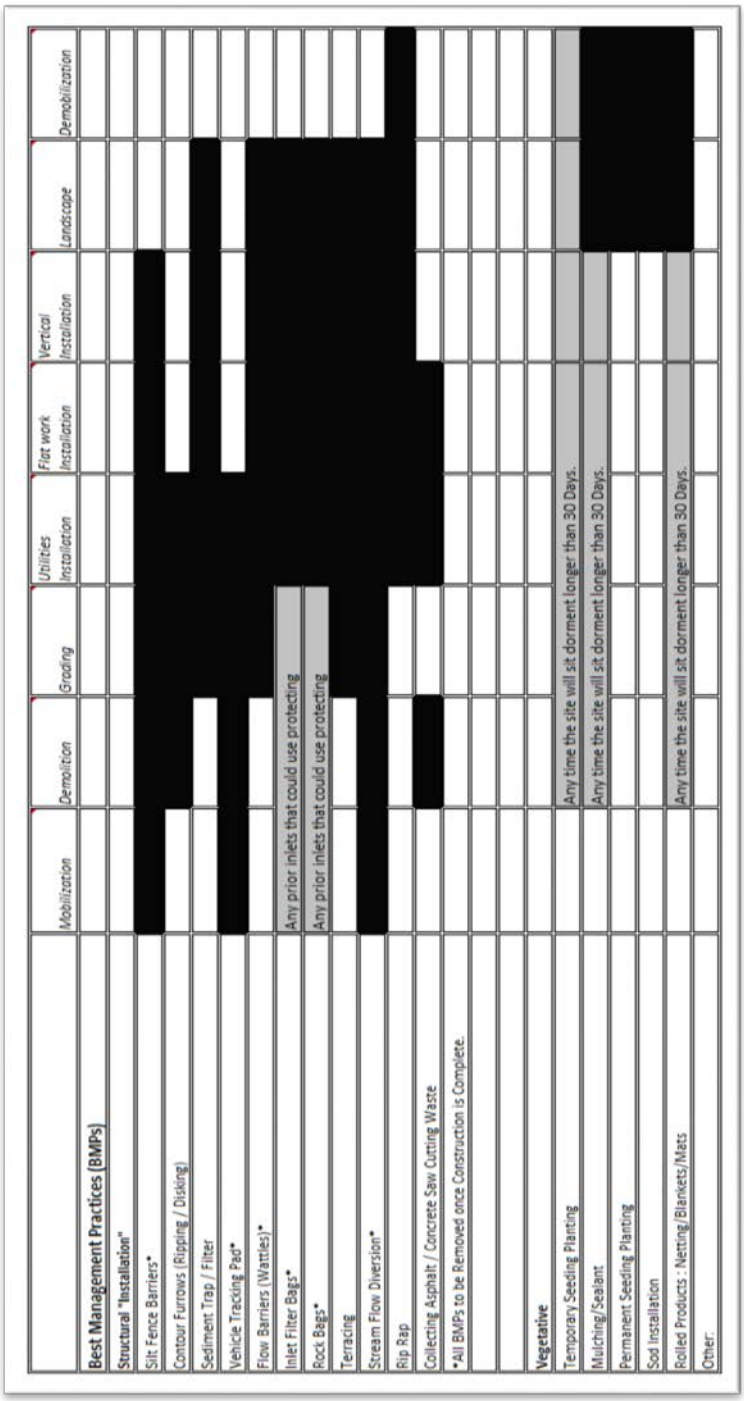
Example of a calculations chart

Total Disturbed Project Area	2.17	Acres
Total "Onsite" Area of Disturbance	1.50	Acres
Total "Offsite" Area of Disturbance	0.55	Acres
Total Storage/Staging Area	0.12	Acres
Total Haul Roads Area	N/A	
Construction vehicle traffic Area	N/A	
Est. Percent of Project Area Exposed	100%	
Est. Percent Vegetative Cover	~87%	Density
Existing Soil Type	Type C	Sandy Loam
Groundwater Depth	15	Feet
Number of Phases w/ Project	N/A	
Total volume of imported (+) / exported (-) materials	-30	Cubic Yds.
Total area of stockpiling of fill or borrow areas off site	100	Sq. Feet
Steepest Slope	5:1	H:V
Distance from a riparian area or sensitive area	65	Feet

4.0 Elements for an Erosion Control Plan

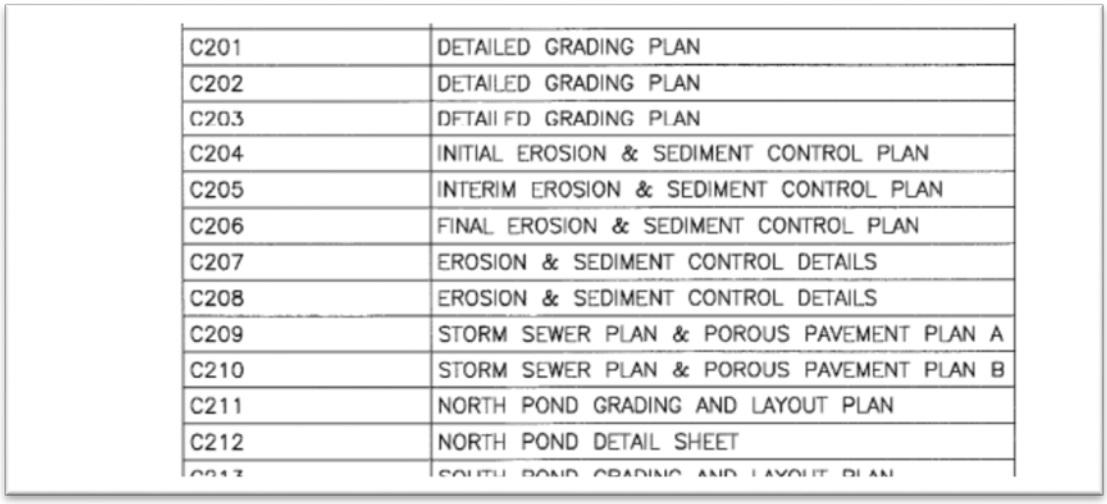
4.1 Project Sequencing

Example of construction and BMP installation sequencing chart



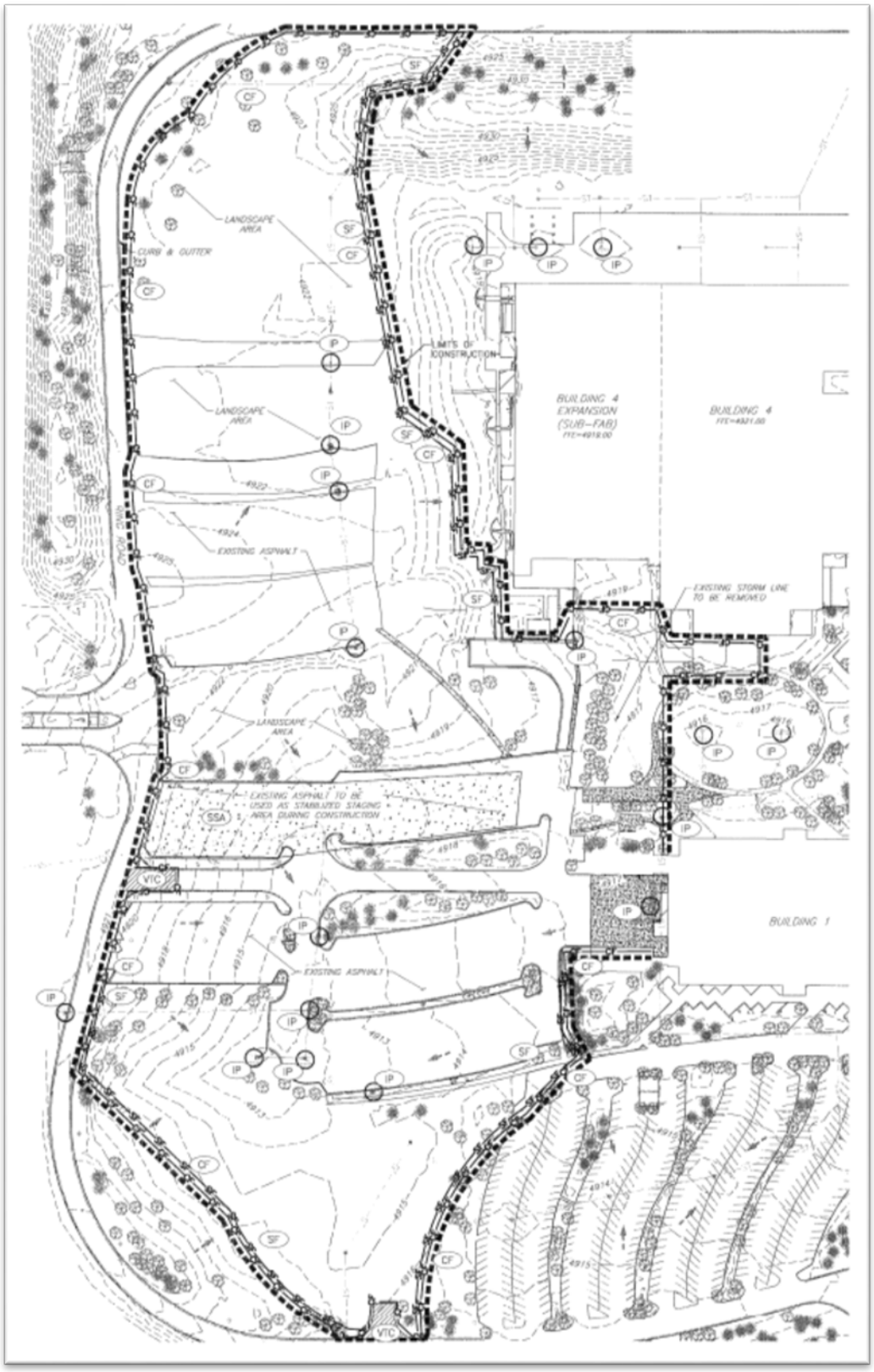
A copy of this sequence chart can be found at www.fcgov.com/Erosion

Example of a title page with sequence sheets labeled

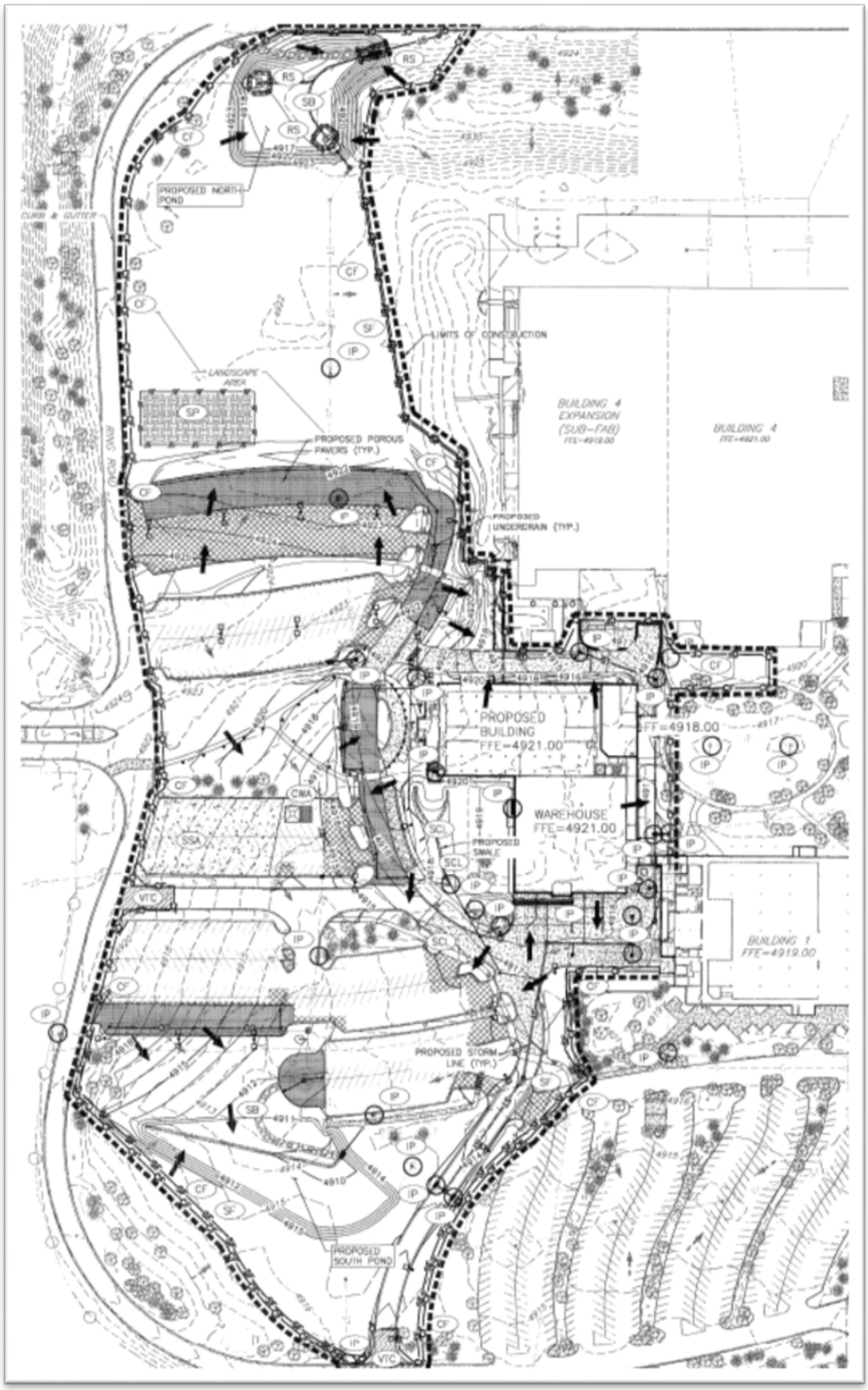


C201	DETAILED GRADING PLAN
C202	DETAILED GRADING PLAN
C203	DETAILED GRADING PLAN
C204	INITIAL EROSION & SEDIMENT CONTROL PLAN
C205	INTERIM EROSION & SEDIMENT CONTROL PLAN
C206	FINAL EROSION & SEDIMENT CONTROL PLAN
C207	EROSION & SEDIMENT CONTROL DETAILS
C208	EROSION & SEDIMENT CONTROL DETAILS
C209	STORM SEWER PLAN & POROUS PAVEMENT PLAN A
C210	STORM SEWER PLAN & POROUS PAVEMENT PLAN B
C211	NORTH POND GRADING AND LAYOUT PLAN
C212	NORTH POND DETAIL SHEET
C213	SOUTH POND GRADING AND LAYOUT PLAN

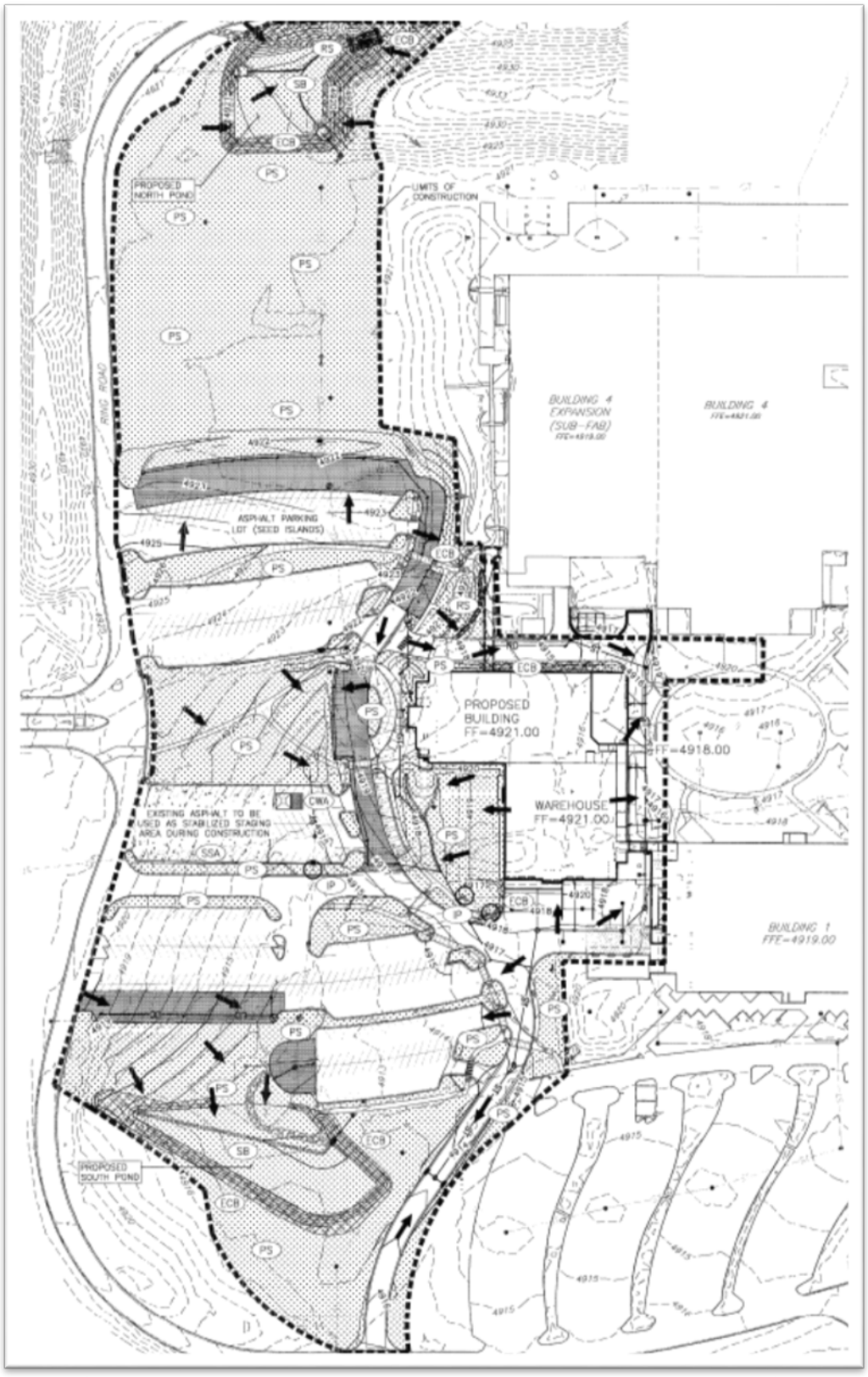
Example of an initial sequence sheet



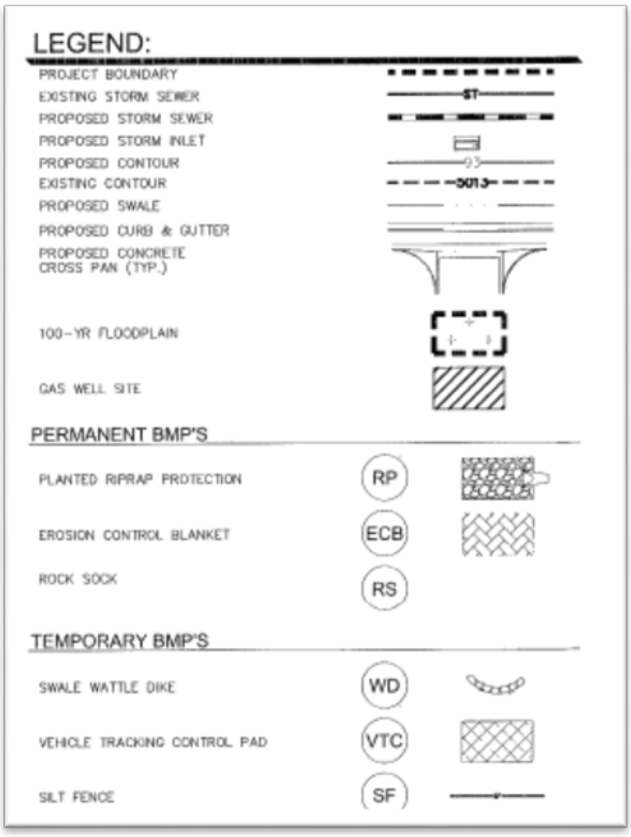
Example of an interim sequence sheet

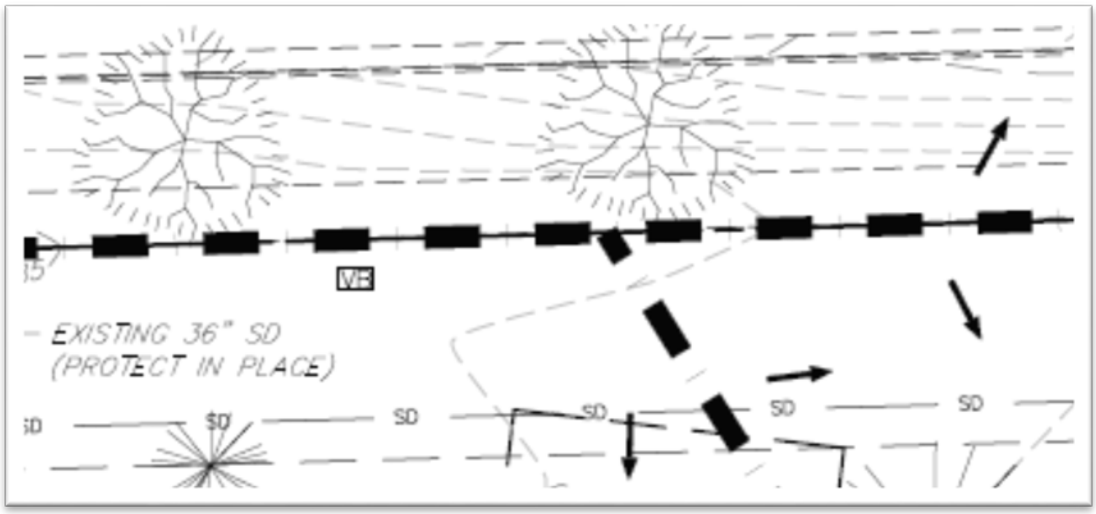


Example of a final sequence sheet



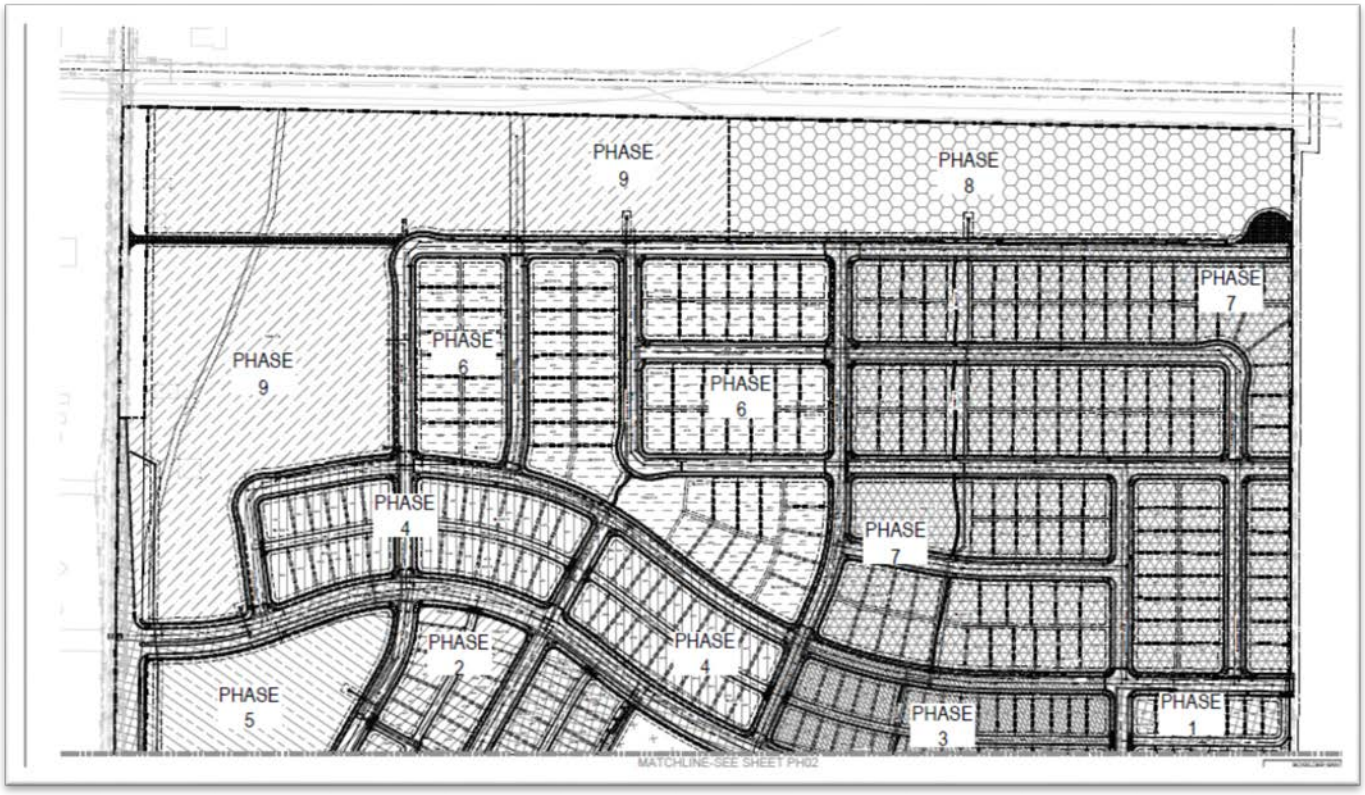
Example of a legend





4.2 Phasing and Large Sites

Example of a project phasing sheet

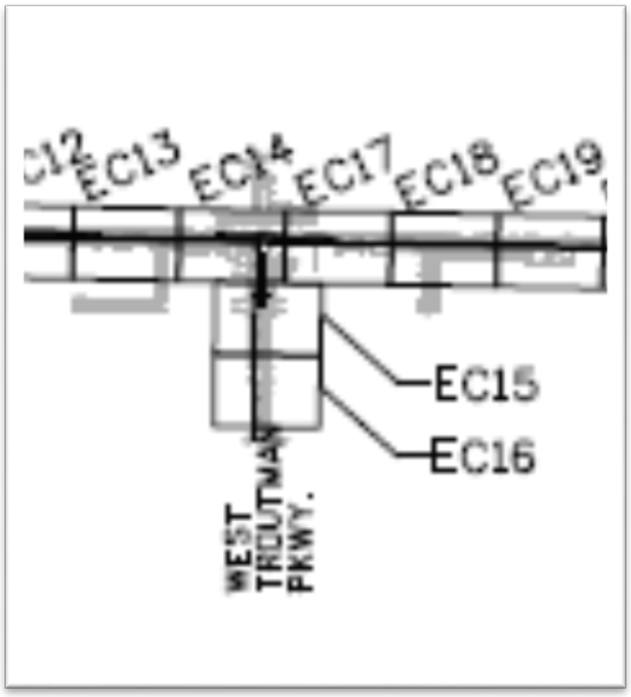


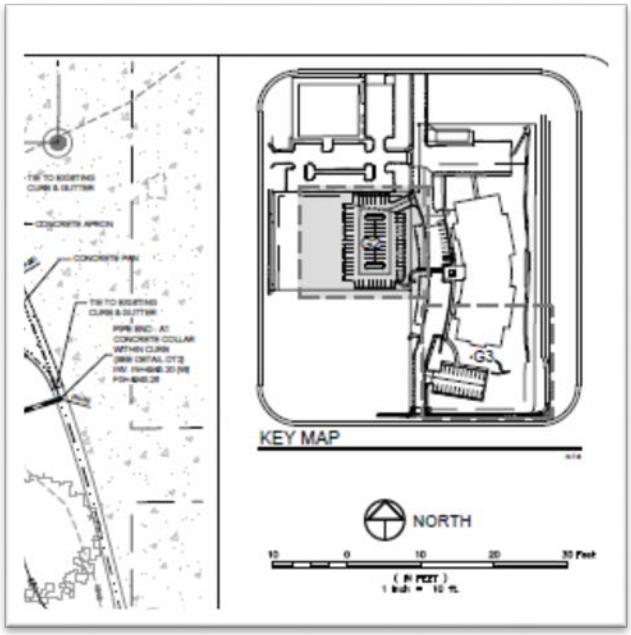
Example of phase 1 of an erosion control plan

Example of phase 2 of an erosion control plan

Example of phase 3 of an erosion control plan

Example key maps (shall indicate a to-scale view window)





5.0 Elements of an Erosion Control Report

5.1 Table of Contents (Chapter 2, Section 6.1.4.2)

The Table of Contents page should be laid out in the following style with sections labeled as shown below and should be kept in relatively the same order and grouping. By providing materials in this fashion, review is made easier and can be speed up the review time.

- Project Description and Nature of Construction
    - Site Location
    - Existing Site Condition
    - Proposed Construction Activities
- Potential Pollutant Sources
    - All disturbed and stored soils
    - Vehicle tracking of sediments
    - Management of contaminated soils
    - Loading and unloading operations
    - Outdoor storage of construction site materials, building materials, fertilizers, and chemicals
    - Bulk storage of materials
    - Vehicle and equipment maintenance and fueling
    - Significant dust or particulate generating processes
    - Routine maintenance activities involving fertilizers, pesticides, detergents, fuels, solvents, and oils
    - On-site waste management practices
    - Concrete truck/equipment washing, including the concrete truck chute and associated fixtures and equipment
    - Dedicated asphalt and concrete batch plants
    - Non-industrial waste sources such as worker trash and portable toilets
    - Saw cutting and grinding
    - Other non-stormwater discharges including construction dewatering not covered under the Construction Dewatering Discharges general permit and wash water that may contribute pollutants to the MS4
- Construction Control Measures
- Installation and removal sequence of construction measures
- Phasing (if applicable)
- Maintenance and inspection requirements
- Final vegetation and stabilization

If any additional sections are added to this report to help clarify or address other issues or requirements of other permits, then add section before or after the relevant section yet leave the titles of the other

sections intact to speed up review of the required materials. The more differences there are from the standard criteria, the turnaround time for review is directly increased.

5.2 Project Description and Nature of Construction (Chapter 2, Section 6.1.4.3)

5.2.1 Example of project description and project site map

2.2 Nature of Construction Activity

The proposed project will include new construction of a 69,685 gross square foot transitional senior rehabilitation facility including drive aisles, parking areas and associated appurtenances. Utilities will be installed in support of the new building, along with appropriate stormwater facilities. Water quality to mitigate and treat stormwater runoff from the site is provided in an on-site basin located in the southeast corner of the property. Concurrently, the project also includes new construction of a 1,250 foot extension of Precision Drive including pavement, curbing and associated utilities.

Example of project site map

- A written description of the site using bounding elements (roads, railroad, creeks, etc) of the project along the limits of the project: Example: The site is bound on the north by Spring Creek the east by Timberline and south and west by the Great Western Railway.
- Legal Description or Public Land Survey System "PLSS" Using Township, Range, Section, Quarter. Example: The site is located at T07N R68W S19 Q1.
- Land Parcel Number as shown in the Larimer County Assessors. Example: The site is located on the parcel of land # 8719111904.

- Site Address. Example: 2600 S. County Rd 11
- Global Positioning System "GPS" in decimal degrees of latitude and, longitude. Example: 40.566059, -105.039771

5.2.2 Existing Site Condition

The existing site conditions in these sections of the report shall at a minimum address the following:

- Physical soil properties
  - Soil names
  - Soil types
  - Typical particle size
  - Density
  - Permeability
- Hydraulic soil properties
  - Hydrologic soil group
  - Soil structure
  - Soil erodibility
- Soil features
  - Texture
  - Depth
  - Existing site drainages and discharge points
- Pathway to the nearest State Water
  - This should not only identify the location where the water leaves the site, it should also describe the path it will follow into the storm sewer and the path to reach the nearest State water with an estimated distance to reaching the State water. This would also be the path that would need to be cleaned if a spill or other discharge was to leave this project and require clean up.
- Existing vegetated areas to impervious areas
  - *pervious area to total area*
- Estimated percent vegetative ground cover
  - Think density and how thick the grass is in those areas, 0% being bare dirt and 100% being sod.
- Existing groundwater depth
  - This should be taken when ground water is at its highest not lowest or frozen.
- Summary of ground contamination if known
  - Typically a Phase 1, Phase 2, or Environmental assessment of a site

Many of these requirements may have reports or supporting documents. When referencing these documents the information should be referenced and attached in the appendix of the erosion control report.

These items should be kept in a short description with just enough summary information to give a clear understanding or overview as to what the current site condition is before construction.

Based upon the supplied information above, a summary of the soil erosion potential shall be provided that describes the site specific soil and the potential that the soil will be displaced and suspended from rainfall impact, concentrated flows/runoff, and wind.

5.2.3 Proposed Construction Activities

This part of the Erosion Control Plan is for Construction Activities and is not the place to describe the Control Measures to be used. The Control Measures that will be used during each Construction Activity should be broken down in the "Construction Control Measures" and "Installation and Removal Sequence of Control Measures". The Construction Activities described here should be similar if not identical to the same activities described in the project sequencing included in the Erosion Control Plan Section 6.1.3.2 of Chapter 2.

- Examples of possible environmental impacts:
  - Wetlands
  - Streams
  - Threatened or Endangered Species

- Examples of possible State and Federal permits to be aware of (not an all-encompassing list)
  - State CDPHE Stormwater Permit associated with Construction Activities
  - US Army Corps of Engineers 404 Permits for Stream Crossing
  - State CDPHE Construction Dewatering Permits
  - State CDPHE Air Pollution Emission Notification (APEN) Permit
  - NEPA Regulations
  - State CDPHE 401 Water Quality Certifications Stream Crossing
  - State Division of Water Resources Dewatering and other water use permits

5.3 Potential Pollutant Sources (Chapter 2, Section 6.1.4.4)

Based upon the described Construction Activities various sources of pollutants will be present on a construction site. Below are the most commonly identified potential pollutant sources:

1) All disturbed and stored soils Section 5.3.1 of this Appendix

2) Vehicle tracking of Sediments Section 5.3.2 of this Appendix

3) Management of contaminated soils Section 5.3.3 of this Appendix

4) Loading and unloading operations Section 5.3.4 of this Appendix

5) Outdoor storage of construction site materials, building materials, fertilizers, and chemicals Section 5.3.5 of this Appendix

6) Bulk storage of materials Section 5.3.6 of this Appendix

7) Vehicle and equipment maintenance and fueling Section 5.3.7 of this Appendix

8) Significant dust or particulate generating processes Section 5.3.8 of this Appendix

9) Routine maintenance activities involving fertilizers, pesticides, detergents, fuels, solvents, and oils Section 5.3.9 of this Appendix

10) On-site waste management practices Section 5.3.10 of this Appendix

11) Concrete truck/equipment washing, including the concrete truck chute and associated fixtures and equipment Section 5.3.11 of this Appendix

12) Dedicated asphalt and concrete batch plants Section 5.3.12 of this Appendix

13) Non-industrial waste sources such as worker trash and portable toilets Section 5.3.13 of this Appendix

14) Saw Cutting and Grinding Section 5.3.14 of this Appendix

15) Other non-stormwater discharges including construction dewatering not covered under the Construction Dewatering Discharges general permit and wash water that may contribute pollutants to the MS4 Section 5.3.15 of this Appendix

16) Other areas or operations where spills can occur Section 5.3.16 of this Appendix

The potential pollutant source section shall, at a minimum, identify whether these pollutant sources will be present on the project. A simple “yes” it is present or anticipated to be present, or “no” it is not anticipated to be present on the project. Any other identified sources should also be included in this section.

Each identified source has the potential to result in runoff from a project and end up in the local storm sewer and result in discharge directly to the river untreated.

Each source identified shall describe the source, evaluate its potential to contribute to runoff and prescribe what Control Measures are necessary to be implemented on the project to reduce the potential pollutant source from contributing to a site discharge.

5.3.1 All Disturbed and Stored Soils

Describe the location of disturbed and stored soils on the project, evaluate the potential to contribute to runoff, and prescribe Control Measure to prevent.

Consider administrative controls such as sweeping and scraping activities, as well as identifying and protecting all inlets to the exposed dirt. Other examples could be minimizing disturbed area, surface roughening, and terracing, rounding top of cuts, temporary crimping and mulching, and education, along with the other structural and non-structural practices to minimize the effects of site disturbance.

Example:

> Disturbed and Stored Soil – Yes – Approximately 85% percent of this 3 acre site will be disturbed with the Construction Activities. Once soils have been disturbed they do not retain the same compaction as in their native state, therefore surface runoff can cause more soil erosion than was historically observed. Based upon the site design this site will not disturb all areas of construction until it is required to as part of the Construction Activities (phasing). Once exposed those areas of exposed soils will be kept in a roughened condition (surface roughening). In the event that these erosion control practices do not keep sediment on site a structural barrier (silt fence) will be used and is called out for on the perimeter. If soil manages to migrate from the disturbed areas onto the hard surfaces it will be swept or scraped (street sweeping) to prevent the migration of sediment. In case that sediment is washed away too quickly the curb inlets will need protection (rock sock style inlet protection). Stockpiles in the same respect do not retain the same compaction and are more susceptible to soil erosion. Stockpiles on this site shall be placed in or near the center of the site and away from any drainage swales to not require perimeter run off controls (Materials/Site Management Control). The stock pile will be kept loose, not compacted, and watered as needed to prevent dust issues (site watering). The stockpile will be monitored for signs of erosion displacement and sediment accumulation and if conditions warrant it, the stockpile will be structurally covered or if it is going to sit a long while will be reseeded (temporary seeding).

Vehicle tracking of Sediments

Describe the site access locations on the project, evaluate the potential to contribute to runoff, and prescribe Control Measure to prevent vehicle tracking from contributing to a site discharge.

Consider administrative controls such as sweeping and scraping activities, as well as identifying and protecting the closest inlet to the tracking location. Other examples could be, minimizing site access, gravel parking, paved area restriction for vehicles, wash racks, education, along with the other structural and non-structural practices to minimize track out.

Example:

Vehicle Tracking of Sediment – Yes -- Vehicle tracking of sediment may occur throughout the construction process and along all areas where the pavement meets the disturbed dirt. This occurs most often after any melt off or rain conditions when mud collects on vehicles tires and is tracked out onto the road consequently leaving site. This increases the possibility of sediment discharging to the storm system. To prevent tracking, construction fence (site barrier/site management control) will be used site wide to limit the access by the contractor and their subs to only two construction entrances (vehicle tracking pads to be installed) on the east of the site and the west of the site. There will be a gate at the entrance that will be closed before contractors come on site during the muddy days (site management control) and will only be opened to let larger deliveries drop off, otherwise subcontractor parking will be kept to the street. All contractors have signed contracts that will have them clean the streets if they are found to be tracking dirt onto the street. (site management control). The tracking pad will be monitored visually every day and if track-out becomes a significant problem a larger or more robust tracking pad may be installed. Otherwise, all track-out that reaches the street will be scraped and swept (street sweeping). Secondary controls at the closest affected combination inlets will have protection (drop inlet protection) to capture sediment not swept up in a timely manner.

5.3.2 Management of Contaminated Soils

Based upon the summarized description of site contamination in Section 5.2.2 of this Appendix, if contamination or a suspect material is identified as a possible issue, then they should be identified in this section. This section should describe what the material is, where it is anticipated to be encountered, and what quantity of material is anticipated. Evaluate the potential of the material to leave the site and prescribe procedures on how and where it will be stored on site, how it will be prevented from leaving the site, and ultimately the means of disposal along with how long it is anticipated to be retained on site once exposed.

Based upon the summarized description of site contamination in Section 5.2.2 of this Appendix, if no known contamination or a suspect material is identified as a possible issue, then this section should declare that there is none anticipated with this Construction Activity and that if inadvertently discovered on site, describe how the contractor will identify what it is and find appropriate procedures, and controls for the proper handling, management and lawful disposal of that material.

Example:

Management of Contaminated Soil – No -- Soil borings do not indicate an existing contamination and all data about the site shows that there is no known contamination on the site. If encountered, the contractor will have the material stored in a covered area (materials management control) as to not mix with the stormwater until the material can be identified and proper classification and disposal methods can be determined in accordance with the various waste laws and with good construction safety and practices.

5.3.3 Loading and unloading operations

Describe the site's traffic operations as it pertains to loading and unloading of material on site. Evaluate the potential for those operations to contribute to runoff and prescribe Control Measures to be taken to minimize potential pollutant source from contributing to a site discharge.

Example:

> Loading and Unloading Operations – Yes – During this project there will be a diverse amount of loading and unloading going on. There will be a significant amount of export leaving the site, the foundation workers will have to deliver forms to the site and deliver premixed concrete. Building materials will have to be staged around the site and Landscapers will have to pile the materials on site to complete the landscape work. Though the loading and loading vehicles will be contributing to the track out of materials, depending on the material being delivered to the site they may have a significant spill potential. In addition to the vehicle tracking of sediments section of this report, (VTC, Sweeping, etc.) contractors will be required to park their vehicles on the adjacent roadways (site management control). The only vehicles allowed on site will be fork lifts, concrete trucks, and the like (site management control). Where the project is mostly dirt and not stable semi-trailers will be directed to pull alongside the project and site loaders will be used to off load the trailers. Where the trailers must access the site an attempt will be made to keep the vehicle on the VTC or other stabilized storage areas. Where the site parking lot and private drives have been installed materials will be placed in piles along the hardscape the use of site forklifts will be more heavily used. When loading and unloading is occurring, depending on the materials, there may be an increased problem of containers being dropped, punctured, or broken. These off-loading activities will be done under roofs or awnings where possible, locating away from storm drains and will have nearby spill kits accessible. Spills on site will be addressed using spill prevention and response procedures.

5.3.4 Outdoor Storage of Construction Site Materials, Building Materials, Fertilizers, and Chemicals

Describe the location of storage activities on the project, evaluate the potential for those stored materials to contribute to runoff, and prescribe Control Measures to prevent those stored materials from contributing to a site discharge.

Example:

> Outdoor Storage Activities – Yes – It is anticipated that inert material like wood, shingles, tiles, siding insulation and stone will be stored on site and outside in the elements. It is also anticipated that materials that do not weather well (cement, mortar, etc.) will also be located outside. Chemicals are not anticipated to be left outside. As the inert materials have a lower potential to leave the site they will be monitored during inspection to make sure they are not being impacted by the exposure to the elements. (site management control) The materials that will need added attention are the cements and mortars as they quickly mix with water and cause pollution issues. These materials when not

stored inside will be placed on pallets to get above potential surface runoff and covered with tarps or plastic to prevent mixing with stormwater (materials management control). Very small quantities of chemical are needed to contaminate stormwater so the fertilizers, paints, form oils, petroleum products, and other typical chemicals, will be stored in the construction connex box, trailers, vehicles, or the like out of contact with precipitation (materials management control). If not stored in a location as described, secondary containment will be required.

5.3.5 Bulk storage of materials

Describe the location of bulk storage structures and any liquid chemical of more than 55 gallons. Evaluate the potential for those bulk liquid storage areas to contribute to runoff, and prescribe Control Measure to prevent those stored materials from contributing to a site discharge. (Note: the requirement for a single containment system is that it must have sufficient volume capacity to contain the largest container plus an additional 10%)

Example:

Bulk storage of Materials – Yes – The spray foam insulation used for the interior will be provided in a 55 gallon drum. The drum has little chance to contribute to runoff as the liquid would quickly turn to foam and solidify thus having little to no discharge from the site. However these materials should be stored in an area that if a rupture would occur, it is figured that the 55 gallon drum would need 1300 square feet of space to expand so the storage area will need to be located away from the drainage areas and area inlets (site management / materials management). The drums will be stored in secondary containment area with a fence so that if a spill were to happen the foam would pool in the bottom of the area and if it started to over flow the construction fence would act as a net and allow the foam to expand into the fence keeping it in the location (materials management).

5.3.6 Vehicle and equipment maintenance and fueling

Describe the location of vehicle and equipment maintenance and fueling. Evaluate the potential for those activities to contribute to runoff, and prescribe Control Measure to prevent those stored materials from contributing to a site discharge.

Example:

Vehicle and equipment maintenance and fueling – No – Based on the size of the site and the short window of activities vehicle fueling and vehicle maintenance is highly unlikely. As fueling and equipment maintenance usually result in small spills of petroleum products it is important to monitor these activities carefully. (site management control) Some grading companies will employee a fuel truck to fill the heavy equipment on site or require the maintenance of a broken machine. In those cases where the vehicle is not able to be maintained off site, these activities will be done in the least detrimental way possible. The maintenance and fueling will be located as far from stormwater

features as possible and at least 50 feet from a stormwater feature (site management/materials management). The fueling activity will have spill materials nearby and a bucket or other container and shovel located nearby to hang a hose after filling to catch drips, and to scoop up any dirt that inadvertently mixed with the soil (materials management). That container will have a lid and be disposed of when the activity is completed. The maintenance work will be done on a tarp or other material to prevent the residual oils and greases from mixing with the dirt (materials management).

5.3.7 Significant dust or particulate generating processes; describe the processes

Describe the particulate generation potential based on activities that may contribute to runoff, and prescribe Control Measure to prevent those stored materials from contributing to a site discharge. It is important to reference the Fugitive Dust Control Ordinance No. 044, 2016, §12-150 - §12-160 and the projects requirements to be in compliance with the ordinance.

Example:

Significant Dust or Particulate Generating Processes – Yes – This project will result in earth moving activities, street sweeping, and track-out and carry out, bulk materials transport, and saw cutting. As these activities will result in offsite transport of atmospheric pollution reasonable precautions shall be taken. The project will follow all required "BMPs" articulated in the Fugitive Dust Manual and a least one additional BMP included during each of the identified activities in accordance with City Ordinance No. 044,2016. Also a copy of the Dust Control Manual will be kept in the trailer during construction for reference. Such activities will include but not limited to watering the site, covering trucks, slower site speeds and vehicle tracking mentioned above.

5.3.8 Routine Maintenance Activities Involving Fertilizers, Pesticides, Detergents, Fuels, Solvents, Oils, Etc.

Describe the routine maintenance activities as they pertain to the construction of the site. Evaluate the potential to contribute to runoff, and prescribe Control Measures to prevent those maintenance activities from contributing to a site discharge.

Example:

Routine Maintenance Activities (Fertilizer, Pesticides, Detergents, Fuels, Solvents, Oils, etc.) – Yes – Fertilizers and Pesticides will be used during the later phases of the project when trying to establish a healthy vegetation. These chemicals are highly water soluble and are easily and unnoticeably carried in the stormwater. Proper application rates and recommended timing of application will be strictly followed and not on days, or the next day, where the weather is calling for precipitation (materials management control). As most of these types of chemicals will be brought on by the Landscaper they will be required to keep these products in their vehicles until time of application and not be allowed

to leave these materials on the site (site management control). If these materials are stored on site they shall be kept inside or outside covered and above the ground to prevent the materials from mixing with water and runoff (materials management control). Detergents, paints, acids, cement, grout, and solvents will be prevalent in the interior work of the building (materials management). These materials also are typically easily mixed with water yet are typically noticeable by discolored, cloudy, or sudsy water. As such, the contractor will always keep an eye out for these types of differences in water around the site (site management control). However these materials are to be handled, operated, and cleaned up all within the inside of the structure, where external use is concerned these materials will be stored in the construction connex box, trailers, vehicles, or the like out of contact with precipitation (materials management). If not stored in a location as described secondary containment will be required (materials management). Fuels and oils might be associated with the smaller equipment used on site, chainsaws, pumps, generators, etc. As petroleum products are easily suspended in water and are spread across the top of the water surface. These products when located in water have rainbow sheen on them. They are also monitored during construction (site management controls). These products will be stored in the construction connex box, trailers, vehicles, or similar structure that will minimize contact with precipitation (materials maintenance controls). If not stored in a location as described secondary containment will be required (materials maintenance). Any untreated runoff from these activities can be detrimental to wildlife if not cleaned up.

5.3.9 Onsite Waste Management Practices (Waste Piles, Liquid Wastes, Dumpsters, Etc.

Describe the likelihood of waste on the site and their locations on the project. Evaluate how industrial waste has the potential to contribute to runoff. Prescribe Control Measures to prevent waste from contributing to site discharges.

As long as no materials are unearthed during excavation and grading then site waste will primarily be of concern once the building begins to go vertical. Wastes have ability to leachate both into the soil and with precipitation and will pollute water. These wastes also tend to float and are carried away off site frequently. Many of these wastes are also easily suspended in air and are carried away to the nearest fence line. Liquid waste should be collected and stored in a covered in a leak proof container until it can be disposed of properly.

Example:

On-site waste management practices (Waste Piles, Liquid Wastes, Dumpsters, etc.) – Yes –All large and heavy weighted waste piles (concrete chunks, excavated pipes, etc.) will be kept in a neat grouped pile until the material is to be disposed of properly. These piles will only be stored a short duration 5-10 days and will be kept 50 feet from any drainage course or inlet (Administrative Control). All dry wastes will be maintained through dumpsters and monthly hauler removal (hauler will be notified if dumpster becomes full and hauled off as needed). Where available by the hauling company the dumpster will be covered. If not practical or available by the haul company, an increased removal schedule will be followed and the “Max fill line” on the dumpster will be strictly

followed. Corners of the dumpsters will be monitored for "Dumpster Juice" leaking into the soil in dry conditions and rain/melt off conditions looking for it mixing with the runoff. Dumpsters, like the waste piles, will be located at least 50 feet from any drainage course or inlet. Workers will be sent around at the end of the day to collect trash to prevent trash being left out overnight. No construction debris (including broken concrete) will be buried on site.

5.3.10 Concrete Truck/Equipment Washing, Including the Concrete Truck Chute and Associated Fixtures and Equipment

Describe the concrete washing and evaluate its potential to contribute to runoff. Prescribe Control Measure to prevent wash activities and waters from contributing to site discharges.

Example:

Concrete Truck/Equipment washing – Yes – Concrete will be a large portion of this project. It is anticipated that it will be used with the joints around the manholes, pour in place inlets, curb and gutter installation, sidewalks, and foundations. Pre mixed concrete trucks will be used in this process and will be delivered to the site and when pouring the foundation a pump truck will be used all of which will need to be maintained through the washing of their chutes and pump arms to prevent the concrete from hardening and ruining the equipment. This concrete wash water has a high alkaline content which is hazardous material to terrestrial and aquatic wildlife. A section of dirt near the entrance will be excavated and compacted around the sides formed to retain the concrete wash water on site (as an acceptable practice by the State) so long as the wash water is kept in the washout (concrete washout). There will be a rock pad for the truck to park on while washing as to prevent tracking from this washout (VTC). The placement of this washout will be located at least 50 feet from any drainage course or inlet. Later in the project after the parking lots curb and gutter has been poured the use of a mobile washout facility will be used on site in a similar location and after the ground has been leveled (concrete washout – mobile). The contractor (including all masonry and concrete tradesmen) shall clean out equipment within the washout area so that the runoff is not allowed to leave the washout. The only exception would be for them to wash in the next day's pour location. All concrete workers will be made aware of the where they are to wash (site management controls & education)., If there is a significant amount of spillage when the transfer from concrete truck to pump truck occurs, a tarp or other ground cloth should be used to collect spillage. (ground cover control)

5.3.11 Dedicated asphalt and concrete batch plants

This is typically for projects with little access to a concrete or asphalt plant. As Fort Collins has no issue with access, this is typically not a concern. As most of these plants already have an alternate CDPS permit coverage they will not need to be included in the Erosion Control Report. However, if the project does intend to have an asphalt or concrete batch plant associated with the construction; describe the applicability of an asphalt or concrete batch plant to this project, evaluate its potential to contribute to

runoff, and prescribe Control Measure to batch plant activities from contributing to site discharges, or else simply state that there is none associated with the project.

Example:

> Dedicated asphalt or concrete batch plant – No – there will be no dedicated asphalt or concrete batch plants erected onsite for this project. Premixed concrete and paving materials will be delivered to the site and placed.

5.3.12 Non-industrial waste sources such as worker trash and portable toilets

Describe the worker trash and portable toilets and the potential to contribute pollutants to runoff. Prescribe Control Measure to prevent these from contributing to offsite discharges.

Example:

> Non-industrial waste sources (Worker Trash and Portable Toilets) —Yes – Since facilities are not located nearby for workers to use, trash and sanitary facilities will be required on the site. Worker trash will be comingled with the industrial trash and will follow the same controls with the caveat that a trashcan will be located near the entrance of the site as the contractor will need to dump their trash from lunch, etc. and this will be emptied weekly or more frequently, if needed. If tipped over and when being cleaned, portable toilet facilities become a potential discharge if not cleaned up. If human waste is spilled, it will need to be treated as a biological hazard of untreated sewage and will need to be cleaned up in accordance with Larimer County Health Department Guidance. The toilets will be staked in a way to prevent tipping on a dirt surface and located at least 50 feet from a drainage course or inlet. If the site cannot accommodate a portable toilet on dirt, a containment pan or other secondary containment will be provided. They will also be anchored prevent from tipping. All materials shall be properly disposed of in accordance with the law.

5.3.13 Saw Cutting and Grinding

Describe the saw cutting and grinding as it applies to the site and how that potential pollutant will be controlled to prevent offsite discharges.

Example:

> Saw Cutting and Grinding – Yes – The trench work will require cutting into the City street and some of the landscape rocks will be specially cut. This project will need the use of hardened saws. These saws generate a significant amount of dust. Watering the cutting surface to prevent airborne particulates (BMP in the City's Fugitive Dust Manual) is required. The cutting slurry has a high content of fine particulates (Silica Dust, Metals, etc.) that is not allowed to discharge as runoff from the site. To

prevent slurry from discharging offsite, contractors will use the minimum amount of water needed to prevent dust and blades from overheating (site management control). Cutting slurry will be collected via vacuum or allowed to dry out and be scraped and swept up after the cutting has finished (saw cutting).

5.3.14 Other non-stormwater discharges including construction dewatering not covered under the Construction Dewatering Discharges general permit and wash water that may contribute pollutants to the MS4

Other identified pollutants might be groundwater dewatering, waterline flushing, irrigation return flows, irrigation to establish grass, dust mitigation, compaction activities, surfacing springs, large volumes of run-on water, wetland impacts, or flood plain changes. Describe the other identified source(s) as it applies to the site and how it has a potential to pollute or contribute to runoff. Then prescribe the means to control offsite discharges.

Example:

Ground Water Dewatering – No – Based upon the geotechnical data, ground water levels indicate that it will be significantly lower (about 12 feet) than the bottom of the deepest excavation. However, if encountered, dewatering activities may be required. Groundwater has in most excavations mixed with the dirt and as they are pumped they will add an increased velocity coming out of the out flow end contributing to erosion and speeding the transport of the suspended sediment particles. Also, construction dewatering activities must be identified in the Erosion Control Report if they are to be infiltrated on site. If the material is anticipated to be pumped to a stormwater conveyance the proper Construction Dewatering Permit must be pulled from the State of Colorado. If pumping activities are to occur on the site, the use of rock packs on the intake end of the pump will be used and a silt bag will be used on the outflow end of the pump to reduce the silt and sediment from leaving the activity (dewatering Control Measure). If this will be under a Dewatering Permit water samples will be collected in accordance with that permit.

5.3.15 Other areas where spills can occur

Other identified pollutants that might apply to the site and how those potential pollutant will be controlled to prevent offsite discharges.

5.4 Control Measures

For further clarification please see Section 6.1.4.5 in Chapter 2.

Example of a Control Measure would be as described below. Each Control Measure used on the site should include a description.

Example:

Vehicle Tracking Control Pads (VTC) - Vehicle tracking control pads shall be provided to minimize tracking of mud and sediment onto paved surfaces and neighboring roadways. Location of vehicle tracking control pads will be located at any vehicle accesses. These locations will primarily be dictated by gates or openings in the temporary construction fencing that is expected to be installed. Vehicle tracking pads should be inspected for degradation and aggregate material should be replaced as needed. If the area becomes clogged, excess sediment should be removed. Aggregate material should remain rough, and at no point should aggregate be allowed to compact in a manner that causes the tracking pad to stop working as intended.

5.5 Installation and Removal Sequence of Control Measures

For further clarification please see Section 6.1.4.6 in Chapter 2.

The sequence schedule should be focused around the identified Control Measures Section 6.1.4.5 of Chapter 2 and when they should be installed for the various Construction Activities in Chapter 12 Section 6.1.4.3 of Chapter 2. The schedule shall be simple to follow, clear, and concise.

This can be done with a paragraph of each Control Measure with the anticipated activity that would trigger installation and activity that would trigger removal. This should match the Erosion Control Plan (sequence chart or sequence sheet)

Example:

Vehicle Tracking Pad (Site Mobilization – Completion of Flat work)
All vehicle tracking control pads shall be installed prior to any Construction Activity (stockpiling, stripping, grading, etc.) being used during any of the future construction phases. Vehicle tracking control pads are to be installed prior to site excavation or earthwork activities. Tracking pads shall be removed once activities that require going from dirt to hardscape stop on the project.

The description of the Control Measure and the installation/removal sequencing of Control Measures may be combined. (Section 6.1.4.5 of Chapter 2 and Section 6.1.4.6 of Chapter 2)

Example:

Vehicle Tracking Pad (Site Mobilization – Completion of Flat work)
Vehicle tracking control pads shall be provided to minimize tracking of mud and sediment onto paved surfaces and neighboring roadways. All vehicle tracking control pads shall be installed prior to any Construction Activity (stockpiling, stripping, grading, etc.). Vehicle tracking control pads will be located at any and all existing and future vehicle accesses being used during any of the construction phases. These locations will primarily be dictated by gates or openings in the temporary

construction fencing that is expected to be installed. Vehicle tracking control pads are to be installed prior to site excavation or earthwork activities. Vehicle tracking pads should be inspected for degradation and aggregate material should be replaced as needed. If the area becomes clogged, excess sediment should be removed. Aggregate material should remain rough, and at no point should aggregate be allowed to compact in a manner that causes the tracking pad to stop working as intended. Tracking pads shall be removed once activities that require going from dirt to hardscape stop on the project.

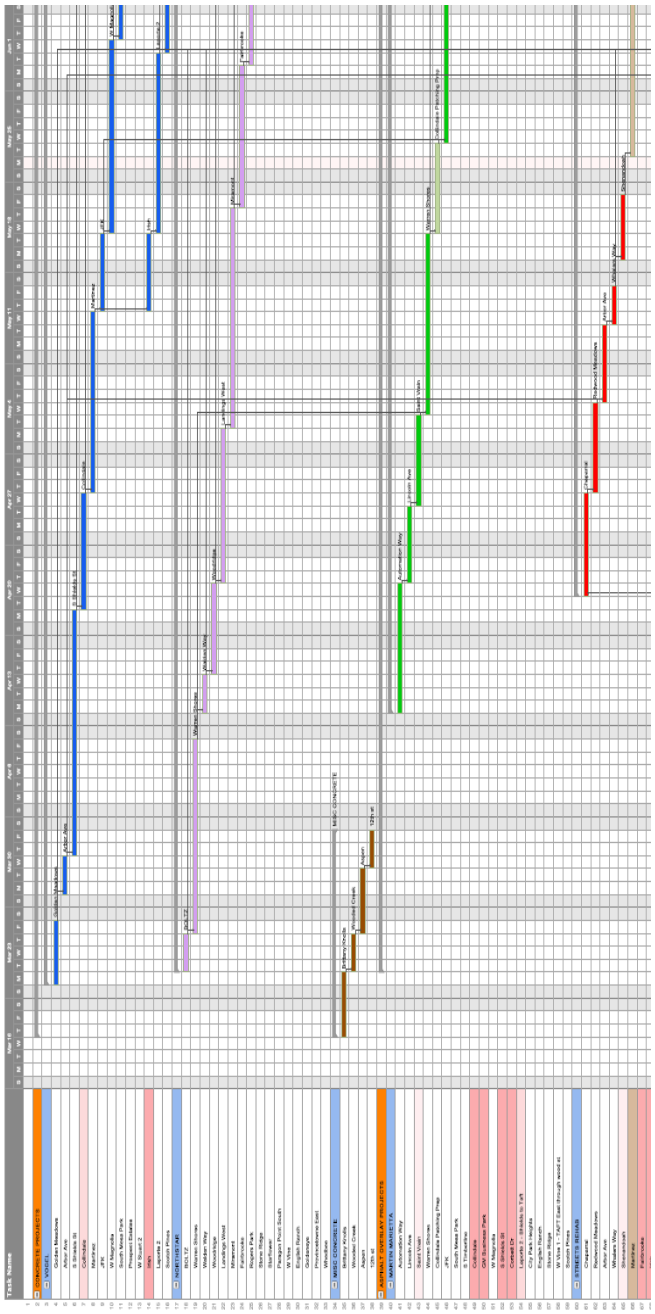
The requirements of this section can also be done in a matrix. This should only be done if the content can be simply followed and understood for when the Control Measures are to be implemented/ installed and when they can conclude/ removed throughout the entirety of the project. The following is an example of such a chart.

Control BMP and Application	Symbol	Description	BMP as Designed	In use on site	Sequence: Initial 1	Interim 2	Interim 3	Interim 4	Interim 5	Interim 6	Final 7
Dust Control	DC	Provides minor detention of sediment.	X		x	x	x	x	x	x	x
Erosion Control Blanket/Temp or Final Stabilization	ECB	A fibrous blanket of straw, jute, coconut, or excelsior material trenched in and staked down over prepared, seeded soil. The blanket reduces both wind and water erosion to help establish vegetation.									
Mulching	M	Placed as a surface cover for erosion control and or seeding establishment to limit soil detachment. Typically includes laying and crimping of straw or spraying the disturbed and/or seeded area with a fiber bonded slurry (i.e. hydromulch).									
Preservation of Vegetation	PV	Used to protect existing stable cover and minimize impact to vegetation.	X		x	x	x	x	x	x	x
Protection of Trees/Protected Resources	TP	Placed prior to construction to protect existing vegetation to remain.	X		I	M	M	M	M	M	R
Scheduling	SC	Provides plan to minimize disturbance and minimize area of disturbance.	X		x	x	x	x	x	x	x
Seeding	S	Provide soil protection through new plant growth (i.e. native seed). Can be drilled and/or broadcast and raked into the prepared soil.									
Sod/Landscape Stabilization	LS	Provide soil protection through new plant growth (sod), plantings, trees, mulching (rock or wood mulching).	X								I,M
Soil Binder		Placed as surface treatment to provide temporary erosion control									
Stabilized Construction Road	SCR	A temporary stabilized roadway (i.e. granular material surface) method to control sediment runoff, vehicle tracking, and dust from heavily used roads during construction activities.									
Staging Area	SSA	Consists of spreading a layer of granular material (gravel, roadbase), or utilizing existing stabilized area (i.e. paved, graveled, etc.). Location for construction management functions (office trailers), storage of materials, location of equipment refueling and maintenance activities.	X		I	M	M	M	M	R	
Surface Roughening	SR	Creating a series of grooves or furrows on the contour in disturbed, graded areas to trap rainfall and reduce the formation of rill and gully erosion. Also, used to minimize sediment transport via wind.									
Sweeping	SW	Utilized to remove sediment on pavement surface and to prevent sediment from entering storm drainage system.	X		x	x	x	x	x	x	x
Turf Reinforcement Mat/ Final Stabilization	TRM	Placed in channels or on slopes for erosion control, channel liner and seeding establishment .									
Vegetative Buffer	VB	Filter sediment laden runoff from disturbance area.									
Other											

Use Legend: I - Install, M - Maintain, R - Remove, E - Utilize and Maintain Existing Measure

Sequences: 1 - Pre-Disturbance & Site Access, 2 - Demolition, 3 - Clearing, Grubbing, Grading, and Excavation, 4 - Utility and Infrastructure Construction and Paving, 5 - Building Construction, 6 - Final Grading, 7 - Landscaping & Installation of Final Stabilization Measures

This requirement can also be fulfilled in a project Gantt chart. This should only be done if the content can be simply followed and understood for when the Control Measures are to be implemented/ installed and when they can conclude/ removed throughout the entirety of the project. The following is an example of such a chart.



5.6 Final Vegetation and Stabilization

For further clarification please see Section 6.1.4.9 of Chapter 2.

This section should include a short description of how the site will be stabilized. Areas should include any xeriscape, sod, temporary seed, lawn/irrigated seed, native seed, rock beds, streets, sidewalks, buildings, road base, etc.

These areas are usually exemplified in the Landscape plans and may be referenced to in this section. A convenience copy of the landscape plans, if referenced, shall be kept in the appendix of the Erosion Control Report.

Example:

> *Exposed dirt in areas that contain Hardscapes, Buildings, and Rock bed will be considered to be stabilized immediately upon installation and would prevent future Erosion to those areas. Those areas where sod will be installed as per design, will require soil amending in accordance with §12-132 and irrigated as a permanent feature to the project. Upon installation of those sod areas they will be considered stabilized and will prevent further Erosion to those areas. Those areas would then be under warranty. All areas to be seeded as outlined in the Final Landscape Plan, or required by the City in the disturbance of other properties, will have the area amended in accordance with §12-132 of City Municipal Code and be seeded based upon the specs called out in the landscape plan. A convince copy is provided below. All seeded areas will be crimped and mulched same day or next day after seeding in accordance with the Temporary and Permanent Seeding Details associated with this project as seen in the appendix, and in accordance with the City of Fort Collins Erosion Control Criteria. Once installed there will be no temporary irrigation system so all seeding will be monitored until the site has reached a vegetative cover (density) of 70%. It is anticipated that this site will be seeded in the spring of 2017 and will be fully established in the fall of 2018. At the point the vegetation has reached 70% density, and confirmed by the City of Fort Collins, the warranty period for Erosion Control will begin, all stormwater infrastructure will be cleans and removed of any sediment deposits and any remaining temporary Control Measures will be removed.*

Species	*Common Name*	*Seed Rate (lbs/acre)*	*Pure Live Seed (PLS)/Acre*	*Drill Depth*
Nassella Viridula (Trin.)	*Green Needle Grass*	*1*	*181,000*	*½ - ¾ inches*

6.0 Erosion Control Escrow

6.1 Example of Erosion Control Escrow Calculation for Phasing

The following is an example of a phased Erosion Control Escrow calculation.

Erosion and Sediment Control Escrow/Security Calculation for The City of Fort Collins

4/23/2014

Project: [redacted] **Phase #1** **Disturbed Acres:** **28.30**

BMP Amount				
EROSION CONTROL BMPs	**Units**	**Estimated Quantity**	**Unit Price**	**Total Price**
Check Dam	LF	36.288	$24.00	$870.91
Concrete Washout Area	EA	2.016	$1,000.00	$2,016.00
Curb Socks	EA	6.8544	$20.00	$137.09
Inlet Protection - All types	EA	16.128	$300.00	$4,838.40
Perimeter Erosion Control BMPs (Lot)	EA	1.2096	$500.00	$604.80
Outlet Protection	EA	3.2256	$250.00	$806.40
Sediment Control Log	LF	2016	$3.00	$6,048.00
Sediment Trap	EA	1.6128	$600.00	$967.68
Silt Fence	LF	0.8064	$1,700.00	$1,370.88
Vehicle Tracking Control	EA	1.6128	$1,000.00	$1,612.80
Mobilization (required on all projects)	LS	1	$2,016.00	$2,016.00
Street Maintenance	LM	0.6048	$1,500.00	$907.20
Maintenance	LS	1	$5,549.04	$5,549.04
(add all other BMPs for the site in this list)			Sub-Total:	$27,745.20
			1.5 x Sub-Total:	$41,617.80
			Amount of security:	***$41,617.80***

Reseeding Amount			
		Total Acres x Price/acre:	$42,378.34
Unit Price of Seeding per acre:	$1,497.27	Sub-Total:	$42,378.34
		1.5 x Sub-Total:	$63,567.50
		Amount to Re-seed:	***$63,567.50***

Miniumum Escrow Amount		
	Minimum escrow amount:	***$3,000.00***

Final Escrow Amount		
	Erosion Control Escrow:	***$63,567.50***

"The amount of the security must be based on one and one-half times the estimate of the cost to install the approved measures, or one and one-half times the cost to re-vegetate the disturbed land to dry land grasses based upon unit cost determined by the City's Annual Revegetation and Stabilization Bid, whichever is greater. In no instance, will the amount of security be less than one thousand five hundred dollars ($1,500) for residential development or three thousand dollars ($3,000) for commercial development"

Erosion and Sediment Control Escrow/Security Calculation for The City of Fort Collins

4/23/2014

Project: [redacted] **Phase #2** **Disturbed Acres:** **13.13**

BMP Amount				
EROSION CONTROL BMPs	**Units**	**Estimated Quantity**	**Unit Price**	**Total Price**
Check Dam	LF	16.839	$24.00	$404.14
Concrete Washout Area	EA	0.9355	$1,000.00	$935.50
Curb Socks	EA	3.1807	$20.00	$63.61
Inlet Protection - All types	EA	7.484	$300.00	$2,245.20
Perimeter Erosion Control BMPs (Lot)	EA	0.5613	$500.00	$280.65
Outlet Protection	EA	1.4968	$250.00	$374.20
Sediment Control Log	LF	935.5	$3.00	$2,806.50
Sediment Trap	EA	0.7484	$600.00	$449.04
Silt Fence	LF	0.3742	$1,700.00	$636.14
Vehicle Tracking Control	EA	0.7484	$1,000.00	$748.40
Mobilization (required on all projects)	LS	1	$935.50	$935.50
Street Maintenance	LM	0.28065	$1,500.00	$420.98
Maintenance	LS	1	$2,574.96	$2,574.96
(add all other BMPs for the site in this list)			Sub-Total:	$12,874.82
			1.5 x Sub-Total:	$19,312.22
			Amount of security:	***$19,312.22***

Reseeding Amount		
	Total Acres x Price/acre:	$19,665.15
Unit Price of Seeding per acre: $1,497.27	Sub-Total:	$19,665.15
	1.5 x Sub-Total:	$29,497.72
	Amount to Re-seed:	***$29,497.72***

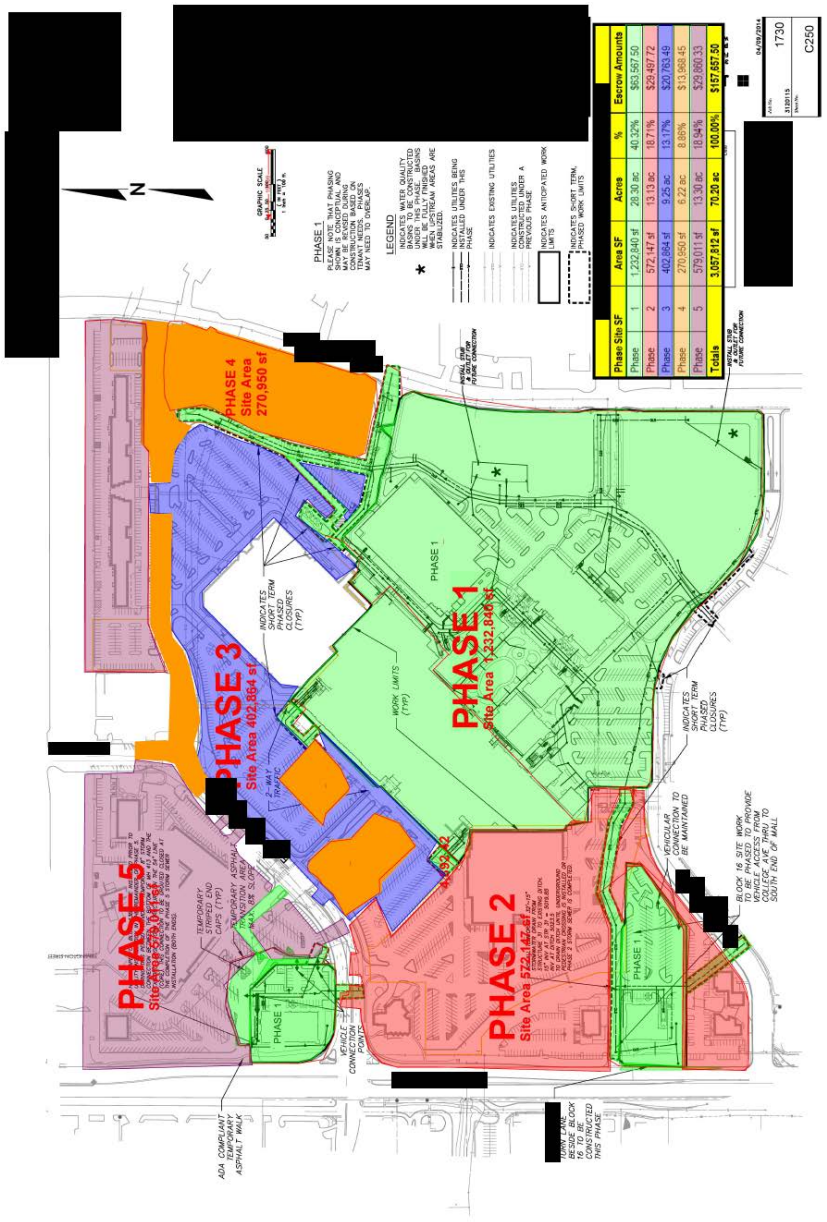
Miniumum Escrow Amount		
	Minimum escrow amount:	***$3,000.00***

Final Escrow Amount		
	Erosion Control Escrow:	***$29,497.72***

"The amount of the security must be based on one and one-half times the estimate of the cost to install the approved measures, or one and one-half times the cost to re-vegetate the disturbed land to dry land grasses based upon unit cost determined by the City's Annual Revegetation and Stabilization Bid, whichever is greater. In no instance, will the amount of security be less than one thousand five hundred dollars ($1,500) for residential development or three thousand dollars ($3,000) for commercial development"

6.2 Example Phasing Map for the Erosion Control Escrow for an Exhibit in the DA

The following is an example of a phasing map.



Control Measure Selection and Planning

For further clarification please see Section 5.0 of Chapter 4.

Effective construction site stormwater management planning involves the following:

Identify all the pollutant sources

Collecting and analyzing site-specific information and environmental concerns through a site assessment may identify various environmental concerns or clarify an increased/ or decreased need based upon the project's existing site conditions. To select appropriate Control Measures for a site, you must identify the pollutants of concern.

Brainstorm all the Construction Activities that will occur on site and the associated possible pollutants might be.

- Ex. Grading would expose dirt, track sediment, require maintenance and fueling, have minor repairs, possible leaks and spills, and possibly kick up dust.

- Ex. Interior construction might have worker parking, materials loading and unloading, material storage, portable toilets, possible spills, and wash water locations (painting and cleaning tools)

The State of Colorado has identified typical pollutant sources. Start with the identified pollutant sources from Section 6.1.4.4 of Chapter 2 (a site may have additional pollutant sources or some pollutants may not apply) and work from there to describe the methods to control that material.

Ask the following questions:

- Will there be exposed area?
- Will there be storing of materials on site (i.e. stockpile)?
- Will vehicles be coming on and off my site?
- Will there be worker parking?
- Will delivery trucks be dropping off materials?
- Will those materials likely have vehicle tracking in order to get the materials stored on site?

Each of these activities results in potential pollutants. The overall goal is to prevent pollutants from leaving the construction site and impacting the Poudre River and its tributaries.

Remove identified pollutant sources where practical

Is this material really needed on the site and are there ways these materials can be removed completely? If pollutant source not on site, or has no exposure, it will not need Control Measures.

In some cases vehicle tracking can be prevented by not allowing vehicles on or offsite and only leaving a fork lift and a few lifts on-site that can off load material from vehicles on the street. In these cases by not allowing any site traffic on and off site the pollutant source of vehicle tracking can be a real option that results in less Control Measures and reduced maintenance.

Another example would be when chemicals are used on a project and are simply being kept inside trucks, trailers, connex, and or work offices, will prevent the pollutant from mixing with stormwater.

Where practical with the type of Construction Activity, an effective stormwater planner asks: do we need this on site? If so, where can we store the pollutant material that prevents it from coming in contact with stormwater and site drainage?

Address each pollutant source when it can't be removed from a project

Since this <insert pollutant sources > is needed for this project now we have to address it. The following questions should be addressed in the report:
What can we do to reduce the material exposure to stormwater?
What is being done to promote the stormwater to infiltrate?
What can we do to reduce flows from concentrating and facilitating the transportation of pollutants?
What can we do to prevent the materials from moving from where we want them?
What will we do if the material is transported?

Control Measures will attempt to do at least one of the following: reduce the impact to soil, promote the infiltration of stormwater in place, slow flows and increase infiltration time, and/or control the stormwater. The Control Measures Control Measureshould be implemented in that order as the prior controls are more effective than the latter at slowing run-off and sediment transport. If only stormwater flows are controlled, the sediment is already suspended in stormwater and potentially flowing offsite.

Construction Control Measures shall be selected, designed, installed, maintained, and removed based upon site-specific conditions and in accordance with good engineering, hydrologic, and pollutant control practices. Identify the Control Measures that can solve those environmental concerns Section 8.2 of this Appendix

Control Measures shall be selected based on the physical layout and site conditions that will exist during each stage (sequence) of construction. Because site conditions change through the various stages of construction, the Control Measures will also need to change. It is important to predict the appropriate timing of installing and removing Control Measures for each sequence and in each phase of the project.

The Erosion Control Material shall be consistent with other plans because as they change so too shall the Erosion Control Materials. Ensure plans are consistent with other design documents (Section 8.4 of this Appendix).

Effective construction stormwater management should also review contractual mechanisms to ensure the contractors will be taking the correct steps to prevent erosion, sediment and pollutant discharges from the site.

Sites with work in waterways, linear projects, underground trenching, and native seed, all have unique cases that should be evaluated based upon their unique conditions and the nature of their Construction Activities.

6.3 Site Assessment

Early awareness of site-specific factors that make a site particularly prone to erosion problems can prevent serious problems later during the construction process. A site assessment should include attention to these factors, prior to selection of Control Measure:

- Visit the site, take pictures, and know the physical characteristics of the site.

- **Tributary Area/Catchment Size/ Drainage Basin**: The overall size of these areas should be evaluated prior to design. As these areas will contribute and be a key determining factor in selecting the types, sizes, spacing and other design requirements for sediment controls appropriate for each drainage area. If drainage flows are inundating the site, there will be a need to responsibly calculate the volumes and handle those flows. This can be solved by diverting flows around the site or through the project site in a fashion that minimizes the runon from making contact with the exposed dirt (i.e. the use of a pipes, lined diversion, pumps, etc.). Where diverted flows cannot be removed from interacting with the exposed dirt, consider slowing velocities (i.e. through rock check dams or other velocity dissipaters, and rolled blankets). As a last resort, the use of Sediment removal devices such as wattles, gabion structures, sediment traps, and sediment basins may be used. Any flows in contact with construction site pollutants are the Developer's responsibility to manage. The less stormwater that makes contact with pollutant sources, including dirt, the fewer Control Measures (and costs) will be needed to control the pollutant.

- **Slopes/Topography and Topographic Changes Due to Grading**: Slope length and steepness are two key factors in identifying the types and placement of both Erosion and Sediment Control Measures. Where possible, slope lengths should be shallower as the steeper the slopes the more costly to protect and reestablish the site. Also the Design Engineer should evaluate slopes as they change throughout the various sequences of construction as grading is conducted. This may change Control Measures used on the perimeter or when inlet protection is implemented or the need for onsite basins.

  For example, if an area has no run off at the beginning of the project but by the middle of the project will have a run off that area will need to add runoff Control Measures mid-project. The opposite can be said if an area that once drained off a project now clearly drains back onto the project. There may no longer be a need for runoff perimeter controls, however now those flows

will be directed to a ditch, swale, rain garden, LID or detention facility which may require additional changes to the control method for the new flows.

Understanding the hydrology of a site is important in the design of Erosion and Sediment Control Measures. Consider water flow onto the site. Offsite run-on as well as drainage patterns within the site should be thoroughly assessed, thinking about concentrated flows and where those flows will cause scouring erosion and where they will slow and deposit sediment. The configuration of hill slope areas and waterways, in the context of planned roads and buildings, will determine which Erosion and Sediment Controls will be needed and at each sequence of construction that they should be implemented.

- **Soils**: Regardless of soil type, all disturbed soils require Erosion Control Measures. NRCS soil maps and geotechnical reports for the development, as covered in Section 6.1.4.3 in Chapter 2, can be used to identify soil conditions where erosion may be particularly difficult to control. For example, in silt and clay soils dirt particles stay suspended in water for longer times and may require more substantial Control Measures to reduce the discharge of sediment laden water from a project. Knowing the soil composition of a site allows proper design Control Measures and additional layers of protection to drop out as much of the suspended dirt as possible.

- **Preserving Vegetation:** Onsite vegetation should be left undisturbed as long as possible. Vegetative areas should be clearly identified in the Erosion Control Materials and/or the construction plans. Construction fence or other access control should be installed to avoid disturbance and compaction of these areas. This is particularly important for protection of mature trees, natural riparian buffers and wetlands, natural open space, or other areas specifically identified to be protected from compaction as part of Low Impact Development (LID) designs. Maintaining a vegetative buffer, in combination with other perimeter Control Measures, can be effective for minimizing transport of Sediment off-site.

- **Sensitive Site Conditions**: Where construction occurs in sensitive aquatic habitat, impaired waters, upstream of drinking water supplies, or near areas where threatened and endangered species are of concern, additional layers of protection may be specified by the City, the State or the Federal government. These may include additional redundant Control Measures or restrictions on times, or times of year, that Construction Activities are allowed.

- **Do your homework**: Look out for any former environmental studies conducted on the project. Document and keep copies of your research findings. Consider, based upon those environmental studies, if the site will have a difficult time keeping impacted materials from discharging off site. Those sites, depending on the contamination, may require baseline water quality measurements to demonstrate a reduction in off-site transport of the pollution after construction improvements occur. There also might be abandoned debris or old trash heaps under a project. Determine steps to be taken to assess site debris, garbage, or pollution that exists prior to construction, and what will be needed to deal with those abandoned materials in a responsible fashion. Is there a disposal plan?

- **Existing site conditions can considerably affect costs**. For example, when there are steep slopes, additional measures or more costly measures on a steep site will need to be planned for ahead of time. Another example is a project near a floodplain. The project may have to plan work around times of the year that are not "flood season." Areas exposed during flood season will need to be protected with added thought to prevent large inundations of flood waters, which usually mean more robust controls and higher cost for the control. If a project encounters asbestos contaminated soils or an abandoned underground tank, those too can affect the costs of a project by orders of magnitude.

- **Social Awareness/Social Climate or atmosphere around the site**: How close are neighbors and how sensitive might they be to various Construction Activities is important when planning. Is dust or air pollution a consideration, will they complain, what steps might be taken to reduce those impacts? Will working on weekends or at night cause noise pollution and an added layer of tension? What steps can be planned for a head of time to reduce citizen impact and complaint potential? Do the neighbors support this project or do they see it as blight? It might be needed to structure the erosion control and subsequent contract bids accordingly as neighbors can cause increased responsibility and attention to a site and will require extra controls or workers time to remedy.

6.3.1 Using the Revised Universal Soil Loss Equation

The "Revised Universal Soil Loss Equation" (RUSLE) and the "Modified Universal Soil Loss Equation" (MUSLE) are two erosion prediction methods that have evolved over time by empirical research of erosion and sediment transportation from sites. A detailed discussion of R/MUSLE factors is beyond the scope of this Manual, however, it is important these equations set up a method to help break down and deal with various aspects of exposed soils to reduce off site transport of materials. Neither the RUSLE or MUSLE equation is required for submittal but is a useful tool to use in some circumstances.

The big take away from these equations are, although construction managers have no control over the Rainfall runoff erosivity factor, the slope length, slope steepness, cover and effectiveness of the Control Measure can be altered by implementing practices that reduce sediment loading.

One technique to reduce the slope length and steepness is to terrace. For example, if a portion of a construction area has a slope length of 500 feet it can be terraced into three or four equal sections to reduce the erosivity of the water coming down the slope. This factor can also be used to guide placement distances for silt fence, wattles and other practices that serve to break up the slope length.

To better clarify that section of slope length please refer to Section 7.1.2 of this Chapter on "Slope–length and runoff considerations".

As another example, construction managers can vary cover management practices to decrease the impact to the soil and reduce sediment transport. Cover values vary, depending on the type of cover (grass, matting, mulch) implemented.

6.3.2 Slope-Length and Runoff Considerations

Cut-and-fill slopes should be designed and constructed to minimize erosion. This requires consideration of the length and steepness of the slope, the soil type, upslope drainage area, groundwater conditions and other applicable factors. Slopes found to be eroding excessively will require additional slope stabilization until the problem is corrected. The following guidelines should assist site planners and plan reviewers in developing an adequate design:

- Roughen soil surfaces enhance infiltration and/or lengthen the travel path or runoff, reducing runoff velocity. See the Surface Roughening Control Measure Fact Sheet in Appendix E.

- Temporary diversion dikes should be constructed at the top of long or steep slopes. Diversion dikes or terraces reduce slope length within the disturbed area. See the Earth Dikes and Drainage Swales Control Measure Fact Sheet in Appendix E

Temporary diversion dikes should be provided whenever:
$S^2L > 2.5$ for undisturbed tributary areas; Equation 7-1
$S^2L > 1.0$ for disturbed tributary areas; Equation 7-2
$S^2L > 0.25$ for paved tributary areas; Equation 7-3

where:

S = slope of the upstream tributary area (feet/foot)
L = length of the upstream slope (feet)

As an example, runoff from a developed area runs on to an area that will be disturbed. A diversion dike would be required if the length of the flow path was greater than 625 feet and the slope of the flow path was 2%.

- Concentrated stormwater (e.g., pipe outflow, channel, swale) should not be allowed to flow down cut or fill slopes unless contained within an adequately-sized temporary channel diversion, a permanent channel, or temporary slope drain. See the Temporary Slope Drain and Diversion Ditches/Channels Control Measure Fact Sheet in Appendix E

- Wherever a slope face crosses a water seepage plane that endangers the stability of the slope, adequate drainage should be provided.

- Provide Sediment basins or barriers (silt fence) at or near the toe of slopes to trap sediment or to reduce slope lengths. When flows are concentrated and conveyed down a slope using a slope drain or channel, energy dissipation measures will be required at the conveyance outlet at the toe of the slope. At no time should silt fence be used in these concentrated flows. See the Sediment Control Measure Fact Sheet in Appendix E for several options for controlling sediment at the base of slopes.

6.4 Control Measure Functions

Understanding the intended function of a Control Measure is critical to proper Control Measure selection. Control Measures should be selected based on both the intended function of the Control Measure and consideration of whether the Control Measure can provide the desired function based on the site-specific conditions. It is also important to understand how Control Measures' functions are related to maintenance. For example, when silt fence is initially installed, it provides a filtration function, but over time, the fabric can become clogged, leading to ponding and sedimentation behind the fence as the primary function rather than filtration.

Sediment Control Measures such as sediment basins can provide some settling of sediment from runoff, but must be combined with Erosion Control Measures throughout the site in order to be effective. Sediment basins, inlet protection, and other Sediment Control Measures should not be solely relied upon as "end-of-pipe" treatment systems.

Detailed Construction Control Measure Fact Sheets are provided in Appendix E and contains information on each Control Measures' applicability, installation, maintenance, and design details, along with notes.

The fact sheets are intended to be stand-alone documents that can be used for reference or inserted directly into submitted Erosion Control Materials.

Knowing a Control Measures strengths and specifications is only one layer in selecting the Control Measure.

Thoughts and feedback from the contractors is important too and should be gathered when using any product as they are the ones who will install, and maintain the Control Measure and have seen where and how Control Measures fail in differing circumstances.

Many products should be selected or avoided based upon some of the following:

- Ease of proper installation (and vs improper installation): Some Control Measures are easily installed while others require time and effort and are very difficult to install correctly to begin with and to specification.

- Productivity concerns: Some Control Measures are counterproductive to the work occurring on site and get in the way.

- Minimal maintenance / reduced labor costs: Some Control Measures require more intensive maintenance and cannot be left unattended for extended periods. Others vary in cost of installation.

- Size of application: Some Control Measures are better suited for larger application and some are more effective in smaller locations.

- Accessibility to the product: Some products are not available or cost prohibitive to import to the site.
- Does the City/State/Federal authorities allow or prohibit the use of this product? Not all Control Measures are accepted in all areas
- Is it even effective at preventing erosion or stopping sediment? Not every Control Measure on the market is effective or as effective as another control.
- Cost of the control: Some Control Measures cost substantially more than others or vary based upon the initial investment costs and long term and replacement costs
- Product Resiliency: Some Control Measures will hold up for years some only a month
- High turnover rates of contractors: how easy is it to teach contractors to use a Control Measure. If something is overly complicated, it may take more time teaching others how to maintain the control rather than another control.
- Redundancy: Some Control Measures will not function as a stand-alone Control Measure and multiple treatments or treatment trains are needed. Other times an entire treatment train can be eliminated just by the use of a different Control Measure.
- Disposability and end of use life cycle: Some Control Measures can be simply cut open, or left in place to bio or photodegrade, while others require full removal and revegetation application after.
- Appearances: Some Control Measures contribute to a site appeal and can increase the value of the units. Some Developers want a nice clean looking jobsite and many times the Control Measures add to the curb appeal.

One comparison example would be Silt Fence vs Straw Wattle as a perimeter surface runoff control.

Silt Fence	**Straw Wattle 8”**
More time associated with installation	Usually installed incorrectly
Difficult barrier work around	Can drive right over
Maintain typically after wind storms	Maintain after being driven over
Small – Large Sites	Small – Medium Sites
Easy to obtain	Easy to obtain
City of Fort Collins Acceptable	City of Fort Collins Acceptable on any residential and Acceptable on any commercial site with a method to prevent being driven over (typically a construction fence)
When installed correctly and maintained is highly effective	When installed and maintained is fairly effective
About $2-3/LF Might replace a few sections here or there about every half a year.	About $1-2/LF Might replace many sections every few weeks depends on construction controls
Lasts about 4-6 months without maintenance then maintenance can be intensive and technical to get right. Has been observed working for 2-3 years plus before breaking down to the elements.	Lasts about 1-2 weeks as contractors tend to drive over and busts open the straw every few days and can be easily installed with minimal technical skill. Has been observed working for a year before breaking down to the elements.
Must be removed and in some cases the dirt trench will need reseeding.	Can have the stakes remove and in some cases cut open and let the straw help as an added benefit in the reseeding or dirt areas.

As you can see, there are pros and cons to each of these Control Measures and many more that are not listed here. The silt fence might be more practical if you have larger residential or medium commercial sites that may be open for a long time, whereas a straw wattle may be more practical on an infill housing operation or a site with a quick construction schedule that would go straight to landscaping.

6.5 Stages, Sequences, and Phasing

Determine sequencing of construction: The schedule of construction will determine what areas must be disturbed at various stages throughout the development plan. The number of stages (or sequences) that should be addressed in the Erosion Control Materials depends completely on the type of Construction Activities that will result in increased pollutants being present and thereby increasing the potential of discharge.

These sequences typically include mobilization, demolition, overlot grading, import and export, utilities installation, flat work (streets, curbs, gutters, and sidewalk), vertical work (foundations, framing, interior and exterior facades), final grading, landscaping and final stabilization. Not all of these are present in every

project. For projects including all of these activities, the sequences can be lumped together when it comes to their impacts.

Select Control Measures needed for each stage of the construction project. Each stage will have different demands for the controls of erosion and sedimentation. For example, overlot grading will encompass disturbed dirt and stockpiling, vehicle maintenance and traffic and particulate generation and would require one variety of controls. Whereas when the structure is being built, the focus will be on contractor traffic, chemical containments, concrete washing activities, tile cutting, painting, framing, trash control, etc. and would require an entirely different set of Control Measures because when individual homes are being built and lots are disturbed after the streets and drainage systems are in place creating new perimeters to protect.

As new pipes are installed and the inlets and outlets get tied in, those need to be protected once installed.

All perimeters where hardscape (curbs, streets, sidewalks) and soft scape (raw exposed dirt) meet is a form of perimeter protection. This shall include hardscapes that are installed as part of the project. After such hardscapes are installed perimeter protection shall be installed too and if site grades to the hardscape a Sediment barrier will need to be installed with the perimeter protection.

The simplest way to understand the sequencing needs of a particular project is once the Control Measure has been selected to address the identified pollutant, use Control Measure by Control Measure to create a reasonable timeline based upon the timeframe the pollutant will be on the construction site.
One example would be the pollutant source of concrete washing. The method of control for that activity would be a concrete wash out station.

Mobilization	Not Applicable
Demolition	Not Applicable
Over-lot Grading	Not Applicable
Import and Export	Not Applicable
Utilities Installation	Rare on occasion would be Applicable
Flat Work (Streets, Curbs, Gutters, and Sidewalk),	Applicable
Vertical Work (Foundations, Framing, Interior and Exterior Facades),	Applicable
Final Grading, Landscaping and Final Stabilization	Rare on occasion and for repair/warranty work

This would be different if we were to compare it to the pollutant source of vehicle tracking with the method of control being a Vehicle Tracking Pad.

Mobilization	Applicable
Demolition	Applicable
Over-lot Grading	Applicable
Import and Export	Applicable
Utilities Installation	Applicable
Flat Work (Streets, Curbs, Gutters, and Sidewalk),	Applicable
Vertical Work (Foundations, Framing, Interior and Exterior Facades),	Sometimes applicable if vertical is prior to flat work
Final Grading, Landscaping and Final Stabilization	Rare on occasion and usually in localized spot conditions

This would be different if we were to compare these two to the pollutant source of disturbed dirt with the method of control being an inlet protection.

Mobilization	Applicable only on Existing Inlets that would be impacted by construction
Demolition	Applicable only on Existing Inlets that would be impacted by construction
Over-lot Grading	Applicable only on Existing Inlets that would be impacted by construction
Import and Export	Applicable only on Existing Inlets that would be impacted by construction
Utilities Installation	Applicable on all new and existing inlets impacted by construction
Flat Work (Streets, Curbs, Gutters, and Sidewalk),	Applicable on all new and existing inlets impacted by construction
Vertical Work (Foundations, Framing, Interior and Exterior Facades),	Applicable on all new and existing inlets impacted by construction
Final Grading, Landscaping and Final Stabilization	Applicable on all new and existing inlets impacted by construction

Determine the Phasing of construction: Evaluate ways to maximize permanent erosion controls (existing vegetation) as much as possible to reduce the amount of exposed dirt that would be susceptible to transport materials from the site and subsequently reduce the frequency of maintenance on the sediment control. The opportunity for phasing cut-and-fill operations to minimize the period of exposure of soils needs to be assessed and then incorporated into the Erosion Control Materials. If less area is disturbed, then less area will have to be maintained, and there is less possibility of non-compliant issues or violations both by City inspections as well as State and Federal inspections.

Phasing is a key component to a successful project and once the area is disturbed, temporary erosion controls are helpful before the final site stabilization. Surface roughening, crimping and mulching, and temporary seeding have various times shown to be effective Measures where permanent erosion controls

are not practical as there will be later Construction Activities that require grubbing those existing vegetation areas.

6.6 Consistency with Other Plans

Prior to selection of Control Measures for the Erosion Control Materials, it is important to cross-check other construction planning documents for consistency and/or opportunities for increased efficiencies and effectiveness.

6.6.1 Drainage Plans

The Erosion Control Materials should be prepared with due consideration of the final drainage plan for a development. As permanent drainage features are constructed, temporary Sediment Control Measures should be located and designed to both protect and complement these final drainage features. Temporary controls should be staged and removed at the appropriate time relative to the completion of permanent drainage features. Special care is necessary for permanent structures (Water Quality Structure or Low Impact Development (LIDs)) that rely on infiltration such as bio-retention, permeable pavements, sand filters, and others. These BMPs will clog if they are not adequately protected during construction (or constructed after tributary areas have been stabilized).

Coordination of temporary and post-construction Control Measures is important for several reasons. In some cases, post construction Control Measures such as extended detention basins can be modified to serve as sedimentation basins during construction. In other cases, such as in the case of rain gardens or infiltration-oriented post construction controls, it is critically important to protect the post-construction facilities from sediment loading during construction. Also, as previously noted, if an area is targeted for preservation in an uncompact, natural condition under a LID design, it is critical to keep heavy equipment and staging of materials out of these areas.

6.6.2 Air Quality Plans

Properly implemented Erosion and Sediment Control Measures are beneficial in minimizing wind erosion. For example, surface stabilization measures that help to reduce precipitation-induced erosion help to reduce windborne dust and sediment. Additional controls, such as road watering (to moisten roads but not to the extent that runoff results) and/or soil binders may be necessary to fully comply with fugitive dust regulations at a construction site.

Contact the appropriate local agency for air quality requirements during construction.
http://www.fcgov.com/airquality/fugitive-dust.php and Municipal Code §12-150

6.6.3 Landscape Plans

Add sections or notes in the Erosion Control Materials to ensure protection of trees, shrubs, and mature vegetation.

Ensure that the landscape plans include the appropriate soil amendments requirements and any temporary or permanent seed mixes.

Also verify that the seeded areas are shown in the erosion control plans so that all areas exposed in the Construction Activities are planned for a proper final stabilization. This will also create reasonable expectations as to what areas will take the longest to reach final stabilization.

6.7 Contractual Awareness

The better and more complete the prepared Erosion Control Materials are the less confusion around what can be expected on a construction site. This also leads to a better evaluation of the costs on a project and can ensure better contract bids.

When these Control Measures are included in the bid, there is less confrontation about what it takes to maintain environmental compliance, less stress by all parties because the funds will have been budgeted a head of time, and a clear understanding of the requirement are fostered in order to meet the City's criteria and prevent delays in construction schedules at the end of the job.

Recent projects have erosion control roles and responsibilities written into the contract language for who is going to install the materials, who is going to write the inspections, who is going to pull permits, who will be will be removing and disposing of the materials once the site is stabilized, which has eased the burden, blame, and confusion as to who is responsible for what.

Planning these roles and responsibilities and getting the right specialty services, or trained staff on a project, and selecting the right contractor who has a great track record for environmental compliance, these all will go a long way reducing the risks for, notices of violation, work stoppages, and fines.

6.8 Construction Dewatering

Dewatering is typically necessary during Construction Activities that involve deep excavations, instream work, pumped surface diversions, and open trench operations. In Colorado, construction dewatering frequently requires a dewatering permit from the Colorado Water Quality Control Division (WQCD) with monitoring and the completion of Discharge Monitoring Reports (DMRs), and may require dewatering permits from the Colorado Division of Water Resources.

Carefully check state permit requirements to determine when dewatering can be conducted without additional permitting.

When dewatering can be conducted without discharging surface runoff from the site, it may be possible to conduct such activities under the CDPS General Permit Stormwater Discharges Associated with Construction Activity, when no known ground contamination is present.

Some commonly used methods to handle the pumped water without surface discharge include land application to vegetated areas through a perforated discharge hose (i.e., the "sprinkler method") or dispersal from a water truck for dust control.

Construction dewatering Control Measures generally include practices to minimize turbidity in the pumped water. Representative practices that may help to reduce turbidity in various types of dewatering applications include:

- Using perimeter well points outside of the excavated area to draw down the water table rather than dewatering directly from the excavation;
- Placing a submersible pump in a perforated bucket filled with gravel for short-term pumping;
- Constructing a filtering sump pit for pumping groundwater below the excavation grade for multiple day operations;
- Using a flotation collar or other flotation device to pump from the surface of a sediment basin to avoid the silt that can accumulate on the bottom of the basin; and
- Placing the outflow end of the pump in a velocity dissipating device along with sediment containing Control Measures.

Guidance on Control Measures for construction dewatering is provided on the Dewatering Operations Fact Sheet in Appendix E.

6.9 Considerations for Unique Projects

Construction in waterways is often required for projects; this includes bridge construction, utility construction, streambank stabilization, grade control, and temporary / permanent stream crossings, which all have unique considerations that should be taken into account, see Section 7.7.1 of this Appendix.

Linear projects involving utilities, streets, highways, railways, and other transportation-related projects can pose some unique stormwater management challenges during construction. Section 7.7.3 of this Appendix identifies special considerations and approaches that may be beneficial to linear projects, and Section 7.7.2 of this Appendix provides criteria for trenching for underground utility lines.

6.9.1 Construction in Waterways

Construction in waterways requires a high standard of care in order to avoid and minimize damage to waterways, habitat and aquatic life.

In addition to the construction phase permits already discussed, this work can also require a Clean Water Act Section 404 Permit from USACE, U.S. Fish and Wildlife Service (USFWS) threatened and endangered species permitting, floodplain permitting and/or other Federal, State and Local permits. Some required permits may restrict construction to certain times of the year.

Many of the Control Measures described in Appendix E are used in waterway construction. This section provides guidance on factors to consider and plan for during construction in waterways, as well as guidance on specific Control Measures that should be evaluated for implementation based on site-specific conditions. Other Fort Collins drainage criteria and guidance that are closely related to in-stream work should also be referenced.

Control Measures commonly used when construction occurs in waterways include:

- EC-1 Surface Roughening (SR)
- EC-2 Temporary and Permanent Seeding (TS/PS)
- EC-3 Soil Binders (SB)
- EC-4 Mulching (MU)
- EC-6 Rolled Erosion Control Products (RECP)
- EC-10 Earth Dikes and Drainage Swale (ED/DS)
- EC-13 Streambank Stabilization (SS)
- SC-1 Silt Fence (SF)
- SM-1 Construction Phasing/Sequencing (CP)
- SM-8 Temporary Diversion Channel (TDC)
- SM-10 Dewatering Operations (DW)
- SM-11 Temporary Stream Crossing (TSC)

In addition to criteria specified for these BMPs, the following general principles should be followed:

- Construction vehicles should be kept out of a waterway to the maximum extent practicable.
- Where in-channel work is necessary, steps such as temporary channel diversions must be taken to stabilize the work area and control erosion during construction.
- When in-stream work has been completed, the channel must be stabilized using revegetation practices (often, including use of erosion control matting or turf reinforced mats), riprap, or other permanent stabilization measures as required by the SWMP.
- Where an actively-flowing watercourse must be crossed regularly by construction vehicles, a temporary crossing should be provided. Three primary methods are available: (1) a culvert crossing, (2) temporary bridge, and (3) a stream ford. See the Temporary Stream Crossing Fact Sheet in Appendix E.
- A permit is required for dredging and the placement of fill in the waters of the United States under Section 404 of the Clean Water Act. The local office of the USACE should be contacted concerning the requirements for obtaining a 404 permit. In addition, a permit from USFWS may be needed if threatened or endangered species are of concern in the work area. Typically, the USFWS issues are addressed in conjunction with the 404 permit if one is required. A floodplain development permit and other local permits may also be required.

404 Permit Basics

Section 404 of the Federal Clean Water Act established a program to regulate the discharge of dredged and fill material into waters of the United States, including wetlands. Responsibility for administering and enforcing Section 404 is shared by the U.S. Army Corps of Engineers (USACE) and EPA. USACE administers the day-to-day program, including individual permit decisions and jurisdictional determinations; develops policy and guidance; and enforces Section 404 provisions. EPA develops and interprets environmental criteria used in evaluating permit applications, identifies activities that are exempt from permitting, reviews/comments on individual permit applications, enforces Section 404 provisions, and has authority to veto USACE permit decisions.

A Section 404 permit is typically required when the following activities are conducted in waters of the U.S., including wetlands:

- Construction of roads or paths
- Foundations or amenities for residential, commercial, or recreational developments
- Construction of ponds, dams, dikes or weirs
- Placement of riprap and channel protection
- Laying utility pipes or lines

- When work takes place within a channel, a temporary water diversion to bypass the work area is typically required. See the Diversion Channel/Ditch Control Measure Fact Sheet in Appendix E for criteria and design details.

- To the extent practical, construction in a waterway should be sequenced to begin at the most downstream point and work progressively upstream installing required channel and grade control facilities.

- Complete work in small segments, exposing as little of the channel at a time as practical. Keep equipment operators contained in immediate work area and avoid excessive compacting of the soil surface because it inhibits revegetation.

- Where feasible, it is best to perform in-channel work between October 1 and March 31 in Colorado. This is the period when the chances of flash floods and flows higher than the 2-year flood peak flows are less likely.

- During the process of cut and fill, avoid letting side-cast or waste material enter waterways or placing it on unstable areas. Instead, efficiently move excavated material to areas needing fill or to a stockpile. For stream restoration/stabilization projects, consulting with a fluvial geomorphologist on stream stability issues may be prudent.

When selecting BMPs for in-stream construction, a variety of factors should be considered such as:

- Hydrologic factors (tributary watershed size, length of the overland flow, roughness and slope characteristics, precipitation characteristics, imperviousness, etc.)

- Base flow conditions

- Pollutants that may be delivered to the waterway from the surrounding area

- Extent of existing Erosion, head cutting or bank sloughing

- Condition/type of vegetation and percent cover

- Sources of surface runoff

- Drainage pattern

- Historical events

- Flow regulation (ditch diversions, reservoir releases)

6.9.2 Underground Utility Trenching

Minimize the length of trench open at one time to the extent practical. For most trenching projects, it should be feasible to phase construction so that no more than a few hundred feet of trench are open at any given time. Check local excavation permit criteria, which may specify a maximum length of trench that may be open.

Where consistent with safety and space considerations, place excavated material on the up-gradient side of trenches.

Trench dewatering devices must discharge in a manner that will not cause erosion or adversely affect flowing streams, wetlands, drainage systems, or offsite property. Refer to Appendix E for additional guidance on Control Measures for dewatering.

Provide storm sewer inlet protection whenever soil erosion from the excavated material has the potential to enter the storm drainage system. See Inlet Protection Control Measure Fact Sheet in Appendix E for specific guidance.

Evaluate potential for sediment contributions to inlets or receiving waters that are not in the immediate vicinity of the work area but may be impacted from runoff from the project and implement inlet protection and/or other Control Measures as necessary.

For example, if vehicles access the construction area to remove excavated material or to deliver materials, evaluate the potential for offsite sediment tracking and implement Control Measures such as street sweeping, inlet protection, stabilized access to the construction area, and other BMPs to protect inlets or receiving waters that could be affected by tracked sediment. Another example would be the perimeter controls on the up-gradient side of stockpiles and inlet protection on the opposite side of the crown of the street may be necessary if stockpile height or tracking from accessing stockpiles has the potential to contribute sediment to the opposite side of the street.

6.9.3 General Considerations

General considerations for linear construction projects include:

- Standard details for typical activities: Development of a set of standard Control Measure details for typical construction activities can promote consistent implementation of erosion and sediment Control Measures and more efficient Erosion Control Material preparation. For example, if a utility company frequently installs light poles, it may be beneficial to develop a standard detail showing the typical construction of a light pole and the associated Control Measures. Typical details for construction activities can be used by contractors showing what Control Measures must be used for specific construction activities. Control Measures should be shown on the erosion control drawings when they are installed, or in the City of Fort Collins, it is acceptable to reference the typical detail as an alternative to showing specific

Control Measures on the erosion control drawing. Control Measures must be indicated on the site map if site-specific conditions vary from the conditions assumed for development of the typical construction activity Control Measure detail.

- Construction phasing: By nature, linear construction activities are typically phased. Phasing often will be dictated by the extent of allowable traffic closures and typical requirements for closing trenches at the end of the workday in the right-of-way. For linear construction projects in the public right-of-way, stabilization often can be achieved rapidly as each segment or phase of the project is completed, often by paving or repairing and/or installing sod. For areas where revegetation is from seed, reaching final stabilization (and inactivating stormwater permit coverage) will be a lengthier process.

- Weather and climate: Linear projects such as roadwork may need to consider seasonal weather patterns when scheduling construction. Bridgework over waterbodies should be planned during traditionally low water levels (October 1 to March 31) when possible. Utility projects should attempt to close trenches prior to inclement weather, if feasible, and at the end of each day.

- Space constraints: Select BMPs that work best under the space constraints of the project. Many utility and road construction projects in urban areas have BMPs that are located in active streets.

- Durability: Particularly in active traffic areas, durability of Control Measures (i.e., ability to continue to function properly, even when run over by a vehicle) is an important consideration for Control Measure selection.

- Potential for ponding: Creation of ponded water on roadways may also be a concern. It is important to keep in mind that inlet protection can function in two different ways: filtration and/or ponding. While both of these mechanisms can play a role in sediment removal, typically, inlet protection methods that encourage filtration and limit the amount of ponding are favorable, since ponding typically does not provide enough storage for significant residence time/settling and because ponding can impede travel in streets and highways. Ponding, which occurs to at least some degree with most types of inlet protection, can typically be addressed by selection of the appropriate type of inlet protection, frequent maintenance/sediment removal, and providing an overflow path that will not cause flooding in the event that excessive ponding occurs.

- Temporary access: Unlike a typical residential or commercial development where there are access points that will be used throughout the duration of the project, for linear construction projects it is often necessary to access the work area for limited periods of time at multiple locations throughout the corridor. For utility projects where access through vegetated areas is necessary at multiple locations, but generally only for a limited amount of time at each location, consider alternatives to standard geotextile and rock-lined vehicle tracking control

pads such as construction mats or turf reinforced mats for temporary access to avoid disturbance to vegetation and soil that is typically associated with traditional vehicle tracking control pads.

- Jurisdictional considerations: Linear projects are often multi-jurisdictional. In these cases, it is important to have upfront coordination with the municipalities that are involved to reduce the burden of permitting and Erosion Control Material preparation to the extent practical. For example, it may be possible to prepare Erosion Control Materials/SWMP that will satisfy the requirements of multiple municipalities rather than preparing separate SWMPs for work in only one of the municipalities.

- Permitting considerations: Check all local requirements prior to commencing work on linear construction projects.

- Wildlife considerations: How will animals interact with various materials? Will animals have an entrapment issue with one type of Control Measure vs another?

6.9.4 Special Concerns Around Seeding and Native Vegetation

Analyze the existing site vegetation, is it pristine or native?

Poor quality and substandard applications of seeding, lead to spotty, unpredictable results that may require costly re-vegetation work and over all increasing the cost of project. When seeding however, even some of the best quality and perfect applications can fail simply by the application of a wrong seed. Choosing a revegetation specialist, not just a landscaper, early in the process when determining seed species, drill depths, etc. helps reduce trouble at the end of the project when the site is having its Erosion Control Escrow retained until the seeding has been established and the contractor is wondering why the seeding has failed.

To get the project done right the first time, the designers should take many things into account when determining the types of vegetation, such as: will it control erosion as well as add aesthetic value or both? For example, forbs are generally chosen for visual appeal as they tend to have a variety of colors for each season.

Native plants have already adapted to moisture level, climate, elevation, and soil type and will after grown in, be less expensive to maintain. These native seed plants maybe more successful for permanently stabilizing a site in the long run even though these seeded areas take much longer to establish. Realistic expectations around growing seed in Colorado should be set as seeded areas have a longer than average time tables for establishment. Also, to a naked eye, native areas should not be expected to look like a bright green field at the end of a project. These areas may need an immediate, fast growing cover crop to aid in preventing erosion before the permanent vegetation will fully grow in.

Other key things to consider for a successful application:

- Will the seed selection thrive in the soil?
  - Clay, loam, sand
  - Alkaline or acidic
  - Quality of soil
- What soil amendment would function best to promote seed growth?
- Is the seed located in large amounts of sunlight or shade?
- Is the seed right for the climate zone?
- Is the seed located in transitional zones?
- Is the seed located in a micro climate?
- Is the seed able to effectively grow at this elevation?
- Is there accessibility to moisture?
- Is the seed located in harsh environmental conditions?

- Is the seed going to be planted in drought conditions?
- Is irrigation needed, and if so, how long?

A revegetation specialist takes all of these various factors into account to choose flowers, grasses, Forbes, legumes, annuals, perennials, trees, shrubs and cover crops to give the best mix for any particular application.

Some seeding requires a wide variety of ecologies and should be taken into account to reach maximum success.

When looking at seeding and native seeding applications please consult other City of Fort Collins Departments (Natural Areas, Zoning, Water Conservation, etc.) to verify they do not have conflicting criteria. If any conflict arises please present the issue to the respective Departments so clear direction can be given about what standard should govern the project.

6.10 Developer Inspections

6.10.1 Inspection Records

Requirements are found in Section 2.2.2 of Chapter 3.

Typically, these items can be incorporated into a checklist. Standard checklists may be developed and used for various types of construction projects (e.g., channel work, large-scale phased construction projects, or small urban sites). This kind of tool can help ensure the proper function of BMPs and provide a consistent approach to required documentation.

All evaluations of pollutant sources should consider the following:

- Is this a new pollutant source that will need to be included on the inspection?
- Is this existing pollutant source protected with a Control Measure?
- Is the Control Measure functioning to keep the pollutant source from being transported?
- Is there a need for additional Control Measures?

All evaluations of Control Measures should consider the following:

- Installed per design and matches the Erosion Control Materials/SWMP
- In working condition and should be monitored

- Maintenance needed and should be added to the schedule for repair
- Not effective and should have a more effective Control Measure installed
- No longer needed and should be removed as the pollutant source is no longer present

Repair or corrective measures records should include:

- What was repaired?
- When it was repaired?
- When it was identified in need of repair?
- Who corrected the repair?

As these records can very it is the Developing party's responsibility to find an inspection mechanism that works for their business practices and meets the above criteria.

6.10.2 Erosion Control Administrator

Requirements are found in Section 2.2.3 of Chapter 3.

The Erosion Control Administrator should review the accepted Erosion Control Materials for the project and become familiar with all the documents. If the approved documents were not provided by the Developer or Design Engineer, consultation with them is required.

Any supplemental documents and supporting materials should be gathered by the Erosion Control Administrator. Any additions or amendments of the Erosion Control Materials or SWMP should follow the required process to fully depict and articulate what the project will be doing.

The Erosion Control Administrator is responsible to keep materials up to date and reflect the current field conditions. This means the Control Measures should be accurately located on the map and should be installed to the exact detail specifications. Please note that either the drawing needs to be reflective of the site or the site will need to change to meet the drawings. Either way the site should look identical to the plans.

Modifying the current site map should be initialed and dated next to the modifications and preferably in a color easily identifiable and legible. The site map should be hung in a visible area that can be accessed by site personnel and the inspector if needed. These are typically found in a job trailer or placed in the SWMP mail box.

The Erosion Control Administrator should plan upcoming Construction Activities and anticipate what changes on site are going to occur that may significantly change the pollutant sources on the site and

determine the proper controls to prevent of site discharge of those materials. Most discharge issues can be prevented from the beginning with some forethought.

Effective construction site stormwater management implementation involves the following:

- Consulting the accepted Erosion Control Materials
- Maintaining Control Measures in an effective condition
- Evaluating the Control Measures periodically for effectiveness
- Continual updating the Erosion Control Materials as construction progresses

6.11 Removal of Temporary Measures

Most Control Measures can be removed as soon as possible so long as the contributing drainage no longer has a pollutant discharge potential. Temporary erosion Control Measures should not be removed until all areas tributary to the temporary controls have achieved final stabilization. It may be necessary to maintain some of the Control Measures for an extended period of time, until the up-gradient areas have been fully stabilized, and vegetation has sufficiently matured to provide adequate cover. Trapped sediment and disturbed soil areas resulting from the disposal of temporary measures must be returned to final plan grades and permanently stabilized to prevent further soil erosion.

The Control Measure fact sheets in Section 6.0 of Chapter 4 provide guidance for final disposition of temporary measures. This may be as simple as removing silt fence, or more complex things such as removing accumulated sediment from a construction phase sedimentation basin that will be used as a post-construction extended detention basin. Some biodegradable Control Measures, such as erosion control blankets, are designed to remain in place and would create new areas of disturbance if removed. See the specific Control Measure fact sheets for guidance on if and how the Control Measure may be left in place as a part of final stabilization. For some Control Measures such as sediment control logs/straw wattles, some materials may be biodegradable (straw) but there may be components of the measure that biodegrade slowly (stakes) or not at all (plastic netting). Always check requirements for guidance on construction BMPs that may remain in place.

Whenever post-construction Control Measures are used for temporary Control Measures during construction, the plan should include the steps and actions needed to refurbish these facilities to a fully operational form of the post-construction Control Measure. The final site work will not be accepted by Fort Collins as complete until these permanent controls are in final and acceptable form. This includes lines and grades, volumes, outlet structures, trash racks, landscaping and other measures specified in the site development plans prepared by the Design Engineer.

6.12 Enforcement

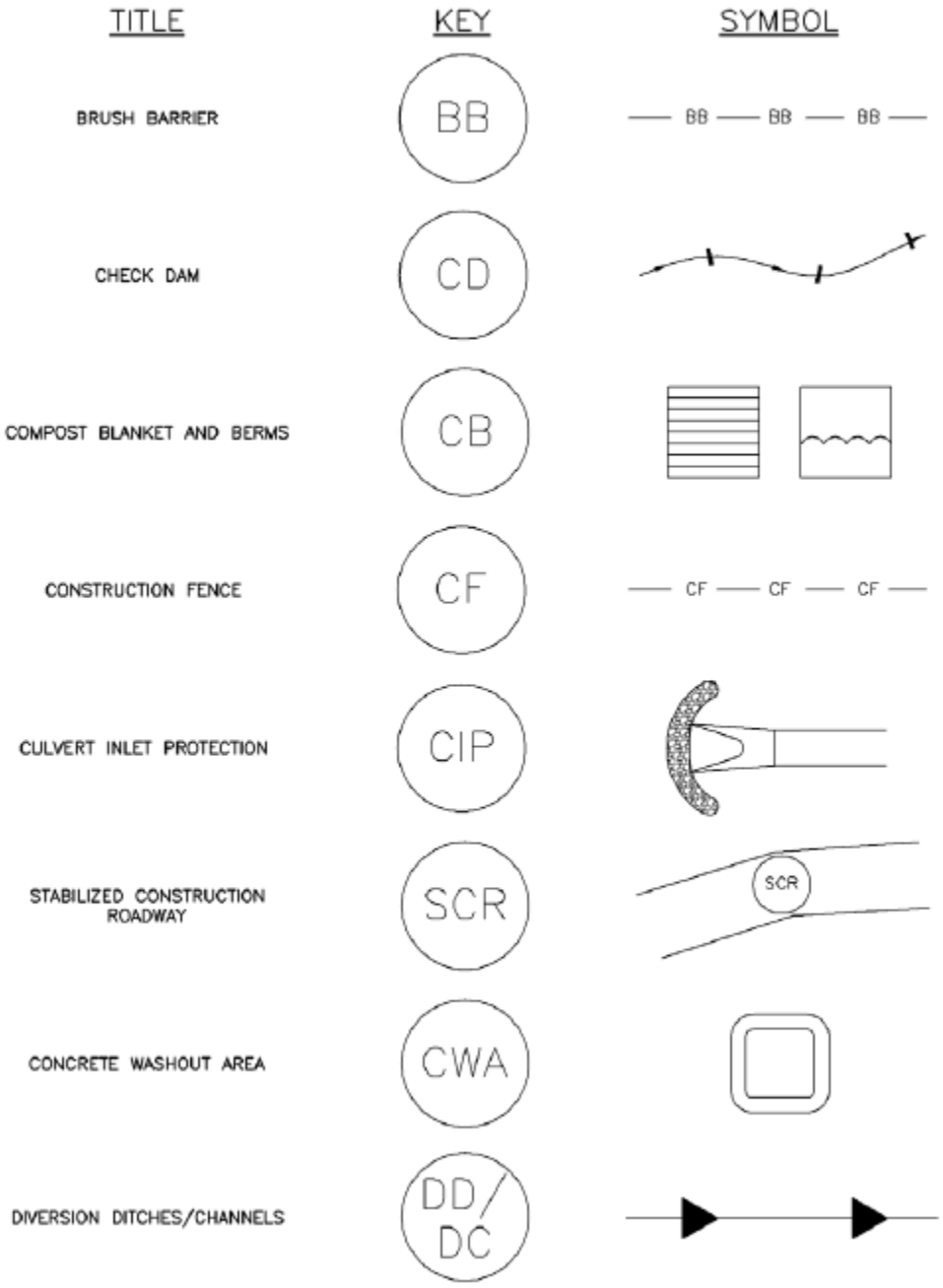
Inspection tips to avoid enforcement

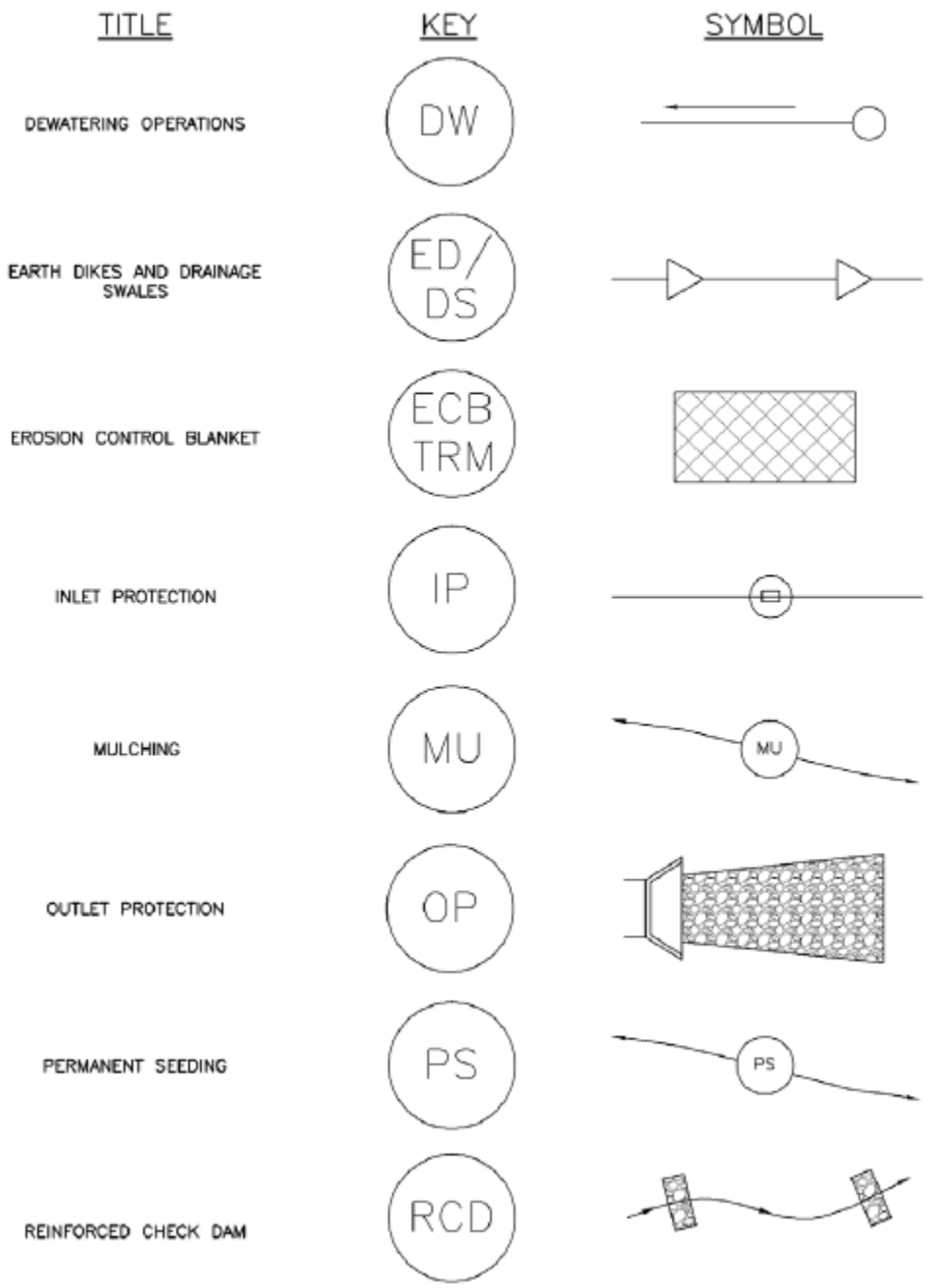
1. Have routine inspections been performed?
2. Do the SWMP and Erosion Control Plans match current site conditions?
3. Have the Control Measures been installed and followed exactly per standards and/or details?
4. Have the Control Measures been properly maintained exactly per design?
5. Are there signs of sediment leaving the site by street or pipe or other conveyance?
6. Are all sensitive areas protected?
7. Are stockpiles and hazardous materials properly contained on site and per design?
8. Is there a Spill Prevention Plan and is it being followed?
9. Are the inactive or completed areas stabilized?
10. Have the corrective actions from previous inspections been addressed?
11. Are the employees, contractors, or sub-contractors adequately trained?
12. Are personal vehicles kept off site?
13. Have all the trash and spills been cleaned up and placed in the appropriate disposal method?
14. Has all the possible chemicals been prevented from making contact with precipitation?
15. Are all the entrances cleaned?
16. All the inlet protection fixed up with no gaps or dislodged?

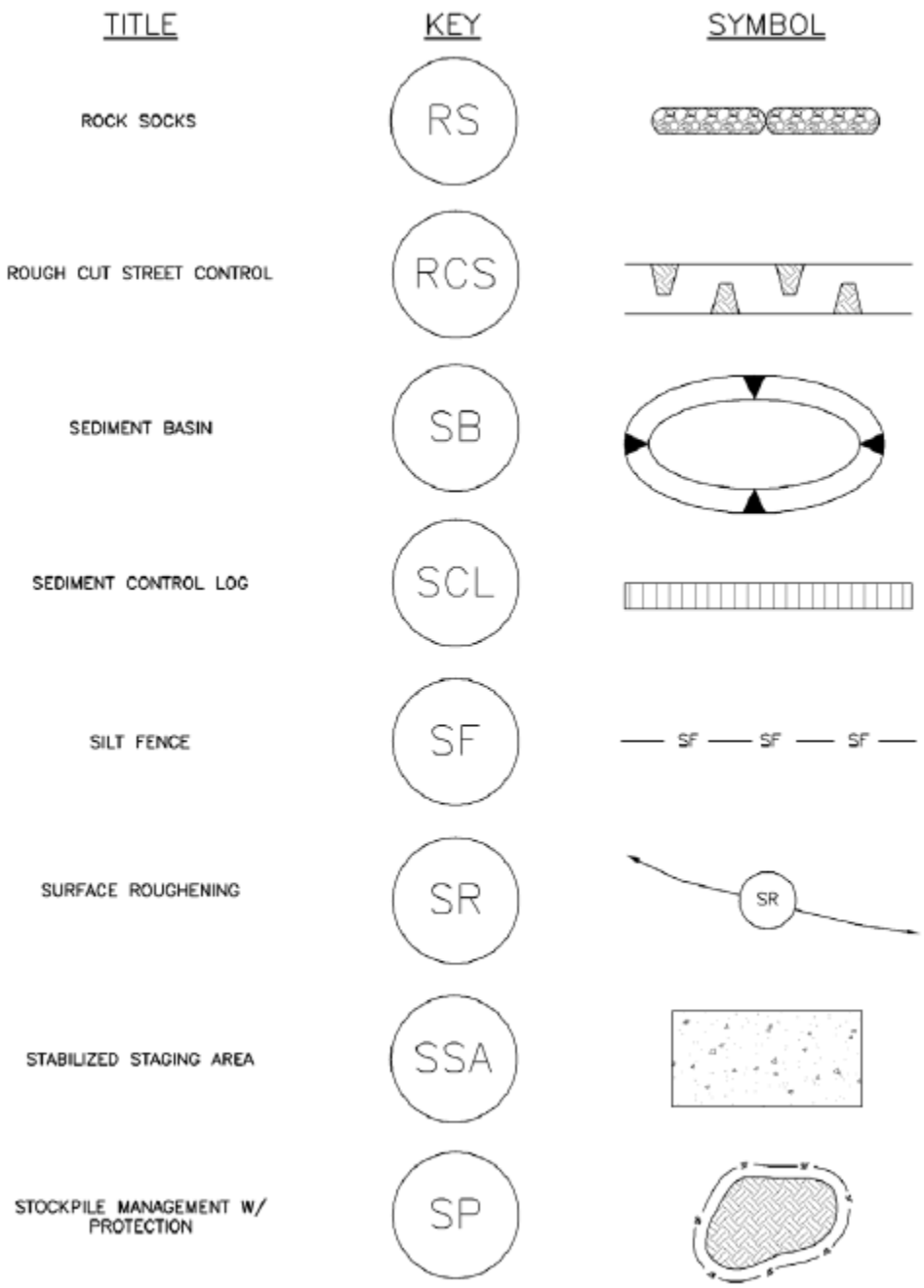
From inspection data the number one issue complained about from citizens is tracking sediment off site. Also from that same data, the number one finding of any Control Measure failures whether it is on installation, maintenance or repair is overwhelmingly inlet protection.

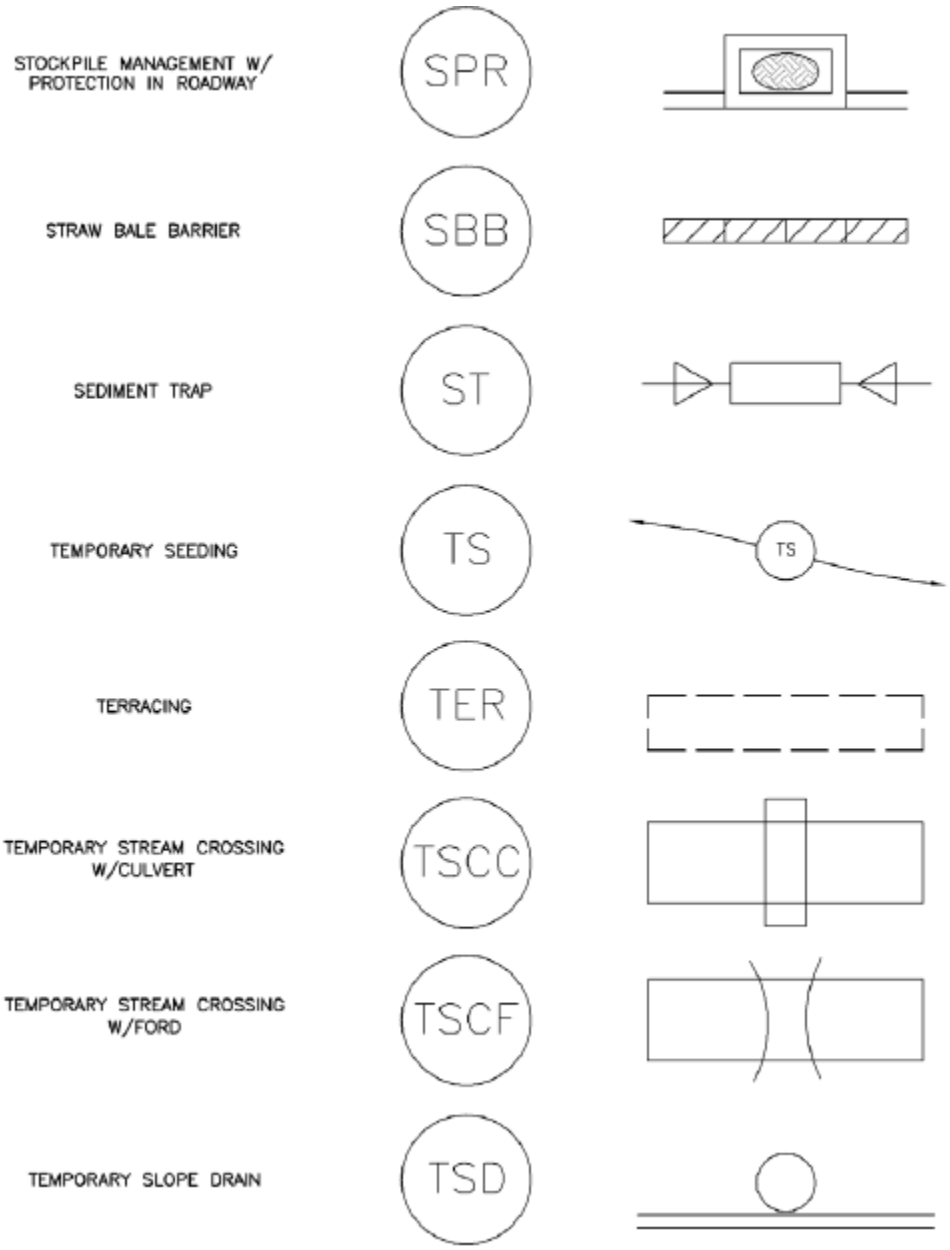
7.0 Construction Plan Symbols

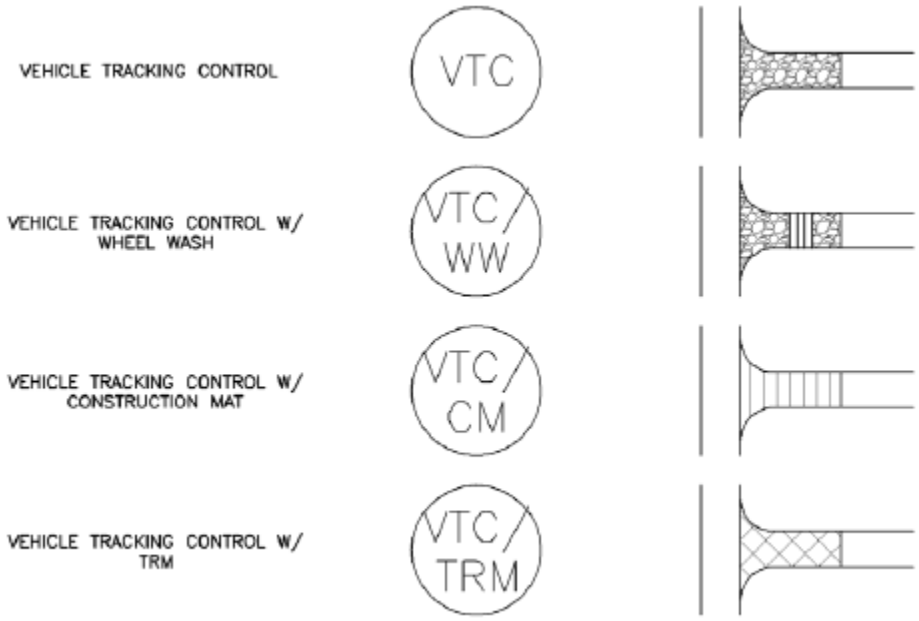
Included is a list of Control Measures with typical symbols and legend keys to clearly identify the Control Measures that are planned on a project.




TITLE
KEY
SYMBOL
DEWATERING OPERATIONS
DW
EARTH DIKES AND DRAINAGE SWALES
ED/ DS
EROSION CONTROL BLANKET
ECB TRM
INLET PROTECTION
IP
MULCHING
MU
MU
OUTLET PROTECTION
OP
PERMANENT SEEDING
PS
PS
REINFORCED CHECK DAM
RCD


TITLE
KEY
SYMBOL
ROCK SOCKS
RS
ROUGH CUT STREET CONTROL
RCS
SEDIMENT BASIN
SB
SEDIMENT CONTROL LOG
SCL
SILT FENCE
SF
SF
SF
SF
SURFACE ROUGHENING
SR
SR
STABILIZED STAGING AREA
SSA
STOCKPILE MANAGEMENT W/ PROTECTION
SP


STOCKPILE MANAGEMENT W/ PROTECTION IN ROADWAY
SPR
STRAW BALE BARRIER
SBB
SEDIMENT TRAP
ST
TEMPORARY SEEDING
TS
TS
TERRACING
TER
TEMPORARY STREAM CROSSING W/CULVERT
TSCC
TEMPORARY STREAM CROSSING W/FORD
TSCF
TEMPORARY SLOPE DRAIN
TSD


VEHICLE TRACKING CONTROL
VTC
VEHICLE TRACKING CONTROL W/ WHEEL WASH
VTC/ WW
VEHICLE TRACKING CONTROL W/ CONSTRUCTION MAT
VTC/ CM
VEHICLE TRACKING CONTROL W/ TRM
VTC/ TRM