NAVIGATOR HEARTLAND GREENWAY PIPELINE SYSTEM: APPLICATION SUBMITTED UNDER SDCL CHAPTER 49-41B

EXHIBIT E

Environmental Construction Guidance

Navigator CO_2

HEARTLAND GREENWAY

ENVIRONMENTAL CONSTRUCTION GUIDANCE

September 2022

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1.0 INTRODUCTION

Navigator CO_2 Ventures LLC (Navigator) is committed to avoiding, minimizing and mitigating environmental impacts and complying with the applicable environmental rules and regulations of federal, state, and local governments. Navigator's goal is to meet or exceed these requirements in the pursuit of conducting its operations in a manner that protects natural & cultural resources.

Recognizing this goal, it is Navigator's policy that all activities be conducted in a safe manner that avoids, minimizes, and/or mitigates impacts on stream and wetland ecosystems, wildlife habitat, cultural resources and the human environment. To this end, this Environmental Construction Guidance (ECG) was developed based on decades of construction experience for linear infrastructure and cross-country pipelines. It is intended to communicate Navigator's standards that enable compliance with federal, state, tribal, and local environmental protections, erosion control requirements, specifications, and practices. The ECG is designed to address typical circumstances that may be encountered during the construction of the Heartland Greenway Pipeline System (Project). Project-specific plans, permit conditions and/or landowner agreements may supersede general practices described in this document. This document may be edited as warranted based on additional information gathered during the design and permitting phase of the project.

1.1 ROLES AND RESPONSIBILITIES

1.1.1 Environmental Inspector

The Environmental Inspector (EI) is responsible for documenting construction activities with respect to environmental rules, regulations and permit conditions (including specific landowner environmental and restoration requirements), offer guidance and corrective actions to ensure compliance, and have the authority to stop work to prevent a activities from damaging human health or the environment. The number of EI's will be determined by the size of construction spreads. Due to the nature of the landscape across the Project; Agricultural Inspectors (AIs) may be utilized; this document collectively refers to them as EIs.

At a minimum, the Environmental Inspector(s) shall be responsible for:

- Inspecting construction activities for compliance and ensuring compliance with the requirements this ECG and any permits, landowner agreements or other certificates obtained for the Project;
- Identifying, communicating, documenting and overseeing corrective actions, as necessary to prevent a non-compliance and/or bring an activity back into compliance;
- Keeping records of compliance with the environmental conditions federal or state environmental permits during construction and restoration;
- Keeping records of the mitigation measures proposed or approved as part environmental permit requirements during active construction and restoration;
- Inspection and documentation of the contractor yards compliance of storing new and spent fuels and hazardous materials
- Verifying that the limits of authorized construction work areas and locations of access roads are properly marked and maintained throughout construction;

- Verifying the location of signs and visible flagging marking the boundaries of wetlands, waterbodies other sensitive resource areas, or areas with special requirements along the construction work area as identified on alignment sheets;
- Verifying proper flagging/marking of the location of drainage and irrigation systems;
- Identifying areas for additional or enhanced erosion/sediment control and stabilization needs;
- Verifying that trench dewatering activities are properly monitored and do not result in the deposition of sand, silt, and/or sediment near the point of discharge into a wetlands or waterbodies, cultural resource sites, and sensitive habitats.
- Advising when conditions (such as wet weather or frozen soils) make it advisable to restrict construction activities in agricultural areas;
- Documenting and providing guidance as warranted of top-soil stripping and segregation activities to prevent the mixing with subsoils.
- Verifying that any soils and natural ECDs imported for agricultural or residential use are noxious weed and soil pest free, unless otherwise approved in writing;
- Documenting that erosion controls are properly installed and maintained to prevent sediment flow into sensitive environmental resource areas (wetlands, waterbodies, cultural resource sites, and sensitive species habitats) and onto roads, and recommending additional erosion control devices;
- Inspecting, or directing the inspection of, temporary erosion control measures as prescribed in state construction stormwater permits. This responsibility may be transferred to field operations after construction is complete but before restoration is successful;
- Documenting the timely repair of ineffective temporary erosion control measures, or as soon as conditions allow if corrections would result in greater environmental impacts;
- Identifying areas that should be given special attention to ensure stabilization and restoration after the construction phase;
- Properly responding to areas of suspected contamination in accordance with the Spill Prevention Control and Countermeasures Plan (SPCC) or Unanticipated Discovery Plan (UDP).
- Verifying decompaction activities occurred by the testing of subsoil and topsoil in agricultural and residential areas to measure compaction and determine the need for corrective action;
- Documenting restoration of contours and topsoil;
- Verifying the locations for any disposal of excess construction materials for beneficial reuse comply with applicable laws and regulation, as well as landowner stipulations.

2.0 GENERAL BEST MANAGEMENT PRACTICES

2.1 SPILL PREVENTION AND REMEDIATION

The Contractor is responsible for developing a SPCC plan for EPA regulated volumes and types of materials in accordance with applicable regulations; largely for applicable to contractor/storage yards. Most of this section applies to non-regulated volumes of petroleum or hazardous materials.

Spills of any amount of petroleum products or polluting materials are to be prevented. All fuels and other hazardous materials must be properly handled in accordance with applicable regulations, including training of personnel as warranted. All equipment should be in good operating order and inspected regularly for signs of excessive wear or leaks. The following measures help avoid spills and minimize the impact of a spill that may occur:

- Install adequate spill containment measures, such as containment dikes, combined with impervious lining before fuel storage tanks are filled and maintained throughout the Project. Bulk quantities of hazardous liquids (e.g., solvents and lubricants) should be stored at designated locations in contractor/storage yards.
- Fuel can be stored at the equipment staging areas and as much equipment as practical should be refueled there.
- Locate fuel storage areas 100+ feet from streams, ponds, or wetlands; 200+ feet from active private water wells, and 400+ feet from municipal water wells.
- Refueling activities should also follow the setbacks recommended for fuel storage areas. If needed to be performed within those setback, first seek approval from the EI.
    - If approved the refueling activity must be monitored and diapers/sorbent material/containment will accompany movement of the spigot and be proactively placed under the fill port, and the spigot will be moved with sorbent material under the nozzle. Care will be taken during refueling not to overfill or spill fuel onto the housing of equipment.
- Use of hazardous materials for vehicle maintenance should follow the same requirements mentioned above for equipment refueling. Impervious materials will be placed under the work area before the work begins and sorbent materials will also be readily available. The work site and the vehicle will be checked by an inspector after the maintenance work is complete to ensure that all hazardous materials are properly contained. All waste material, including partially used or empty containers, discarded parts, clean up rags, and used sorbent materials, as well as discarded hazardous materials containers (e.g., used oil, oil cans, grease tubes), will be collected for proper disposal.
- All motor fuel, lube oil, chemicals, and other polluting substances will be tightly sealed and properly labeled during transportation and storage.
- Sorbent booms and clean-up kits will be kept at all storage locations and readily available at all times.
- Fuel trucks, pumps, mechanics' vehicles, the contractor's foremen's vehicles and Inspectors' vehicles, and each construction crew will be equipped with appropriate sized spill kits containing

absorbent materials approved for petroleum products and have sufficient tools and material to stop leaks.

- Construction equipment will not be washed in any body of water or wetland, nor will runoff resulting from washing operations directly enter any body of water or wetland area.
- Construction equipment, vehicles, materials, hazardous materials, chemicals, fuels, lubricating oils, and petroleum products will not be parked, stored, or serviced within 100 feet of all bodies of water and wetlands. These activities can occur closer if the Environmental Inspector determines there are no reasonable alternatives and appropriate steps are taken to prevent spills and provide prompt cleanup in the event of a spill.
- Pumps operating in or within 100 feet of a waterbody or wetland must utilize appropriate secondary containment systems.
- All equipment should be checked daily for leaks. Steps will be taken to repair or remove the leaking or faulty equipment before commencing work.

2.1.1 Spill Cleanup

Spills occurring during construction are to be reported immediately upon discovery to the EI and Construction Manager (CM). The Navigator Environmental Manager will be responsible for contacting the appropriate agencies.

If a spill should occur, immediate action should be taken to minimize the impact of the spill, and promptly implement appropriate cleanup action, provided it is safe to do so.

- the source should be immediately stopped by picking up the tipped container, closing the open port, etc;
- the spill should be contained by placing sorbent booms and/or constructing dikes;
- the spill should be collected with sorbent materials, skim water surfaces with booms, and/or the contaminated soil will be excavated; and
- the waste materials will be properly contained, labeled, stored and disposed.

The affected areas will be restored as closely as practical to their previous condition.

2.2 DUST MANAGEMENT

Dust resulting from exposed soils during construction and driving vehicles on rock and/or dirt roads will be managed to comply with applicable regulations. Efforts will be made to control dust in proximity to residential areas, road crossings and sensitive resource areas. Water trucks can be used as warranted to dampen the work area if dust becomes problematic on or off the ROW. Vehicles should travel at slower speeds on unpaved roads such that dust clouds are not excessive, typically 10 mph is recommended. Stockpiled spoils should be seeded or protected with tackifier to limit wind erosion creating dust.

2.3 WEED MANAGEMENT

Minimize the potential introduction and/or spread of undesirable species (i.e., invasive species, noxious weeds, or crop diseases) along the construction ROW due to pipeline construction activities to the extent

practicable. Avoiding the establishment of undesirable species is primarily accomplished by minimizing the time duration between from initial disturbance and/or temporary or permanent seeding. Additionally, when soils are imported for agricultural or residential, they should be noxious weed and soil pest free.

In some instances, specific procedures will be required by regulation or to comply with specific permit conditions. The following prevention and control measures facilitate weed management:

- Construction equipment should be cleaned prior to arriving at the Project site. Cleaning consists of, but not limited to, removing visible dirt from the equipment and blowing loose material from equipment using compressed air.
- Prior to clearing and grading of the construction right-of-way (ROW), pending landowner permission and dependent on the time of year, major infestation areas identified during pre-construction surveys or by inspectors may be treated with the recommended herbicides or their equivalents as identified through consultation with local weed authorities and in accordance with any licenses and manufacturer recommendations. Efforts will be made to limit off-ROW overspray and proper documentation of the locations where the herbicides have been used should be kept.
- Full construction ROW topsoil segregation (i.e. including over the travel lane) facilitates weed control by allowing equipment to work through the area on subsoils after topsoil has been stripped to prevent tracking of root or seedbank along the ROW.
- To prevent the spread of noxious weeds and invasive species during construction, mulch used on the Project should be composed of weed-free material.
- Stockpiled soil that will remain or has been in place for greater than 14-days should be stabilized with a temporary seed, mulch, and/or tackifier. Navigator will provide regional seed mixes and application rates based on time of year and location prior to commencing construction and based on consultations with local NRCS of land managing agencies.

2.4 WASTE MANAGEMENT

All waste material must be managed in accordance with applicable laws, rules, regulations and permit conditions. By implementing the following measures the contractor can help ensure that waste is properly managed:

- Daily housekeeping; collect all waste materials (e.g. general household refuse, oil or other waste liquids generated as a result of equipment maintenance) daily in suitable or approved containers (i.e., labeled and meeting any relevant regulatory requirements).
- Proper use, storage, handling, labeling, transportation, and disposal of all solid and hazardous materials and wastes used or generated by the Contractor as a result of the Project.
- The Contractor is to determine if the materials and wastes associated with the Project classify as hazardous materials and/or wastes in accordance with applicable federal and/or state criteria.
- Upon request, the Contractor will provide documentation to substantiate findings of the regulatory status of materials and/or wastes used and/or generated as a result of the Project.

- Any release of hazardous materials is to be immediately reported to the IE and Navigator EMP and impact should be rectified to the satisfaction of Navigator and applicable regulatory agencies.
- No wastes are to be left on Navigator property, along the ROW, or buried in an excavation. The Contractor should arrange for proper off-site disposal of all wastes generated during the Project.
- Temporary portable sanitary facilities will be installed during construction in areas where crews are present and will be routinely managed.

2.4.1 ABRASIVE BLAST DEBRIS

The Contractor should:

- Contain and collect spent abrasive blast materials as required by local or state laws or ordinances and place the spent material into appropriate containers.
- Cover the containers with appropriate means of rainwater and stormwater control to prevent said waters from entering or exiting the container.
- Collect samples and perform analysis of spent blast media as needed to ensure compliance with applicable laws and regulations.
- Transport and dispose of the spent abrasive in accordance with applicable federal, state and local regulatory requirements.

2.5 NOISE IMPACT MITIGATION

Construction equipment will be properly muffled and maintained to avoid producing excessive noise. Particular attention should be exercised when working near noise sensitive areas including residential areas, schools, churches, cemeteries, hospitals, farms, camping facilities and outdoor amphitheaters and playgrounds. Additionally, be aware that local ordinances and regulations may prompt the implementation of additional noise mitigation practices (i.e. sound barriers, curtains, time of day restrictions, etc.).

2.6 UNANTICIPATED DISCOVERY

While surveys are performed to identify and address physical and environmental conditions along the route, the possibility for unanticipated discovery of materials that need to be managed still exist. The following measures should be implemented in the unlikely event of unearthing an unexpected cultural resource or contaminated media.

2.6.1 Cultural Resource

In the event a foreign object is observed during clearing, grading, or trenching activities, it has the potential to be an artifact that may be of cultural significance. Each state that the project traverses will have a project specific Unanticipated Discovery Plan that was developed in conjunction with the USACE permit, respective state historic preservation officer, and tribes that have elected to participate in the project. Generally, the following general protocols are put in place, material edits would address state regulations and notification lists specific to the respective project area.

- ground disturbing construction activities should stop in the immediate vicinity (typically 100 – 300 feet in either direction) and the EI and CM whould be notified.
- The EI will observe the material and notify the Environmental Manager.

- If the material is suspected to be human remains, the respective coroner, police authority, and state historic preservation officer and other appropriate state regulatory authorities, respective tribal communities, and the landowner would be notified and an osteologist may be called upon to assist in identification and timeline. Actions that follow would align with applicable federal and state regulations. Construction activity in the area would not resume until released by the property authority and Navigator's expressed approval.

- If the material is suspected to be a cultural artifact(s), an archeologist should be called to the site to evaluate, communicate with appropriate regulatory authorities and the landowner, perform any warranted investigation and appropriate next steps would be identified which may include: material is not culturally significant and activities can resume, material is potentially significant and additional studies are needed, and/or a route deviation or alternate installation method is warranted and appropriate approvals for such would be sought prior to resuming activities.

- When practical and not a threat to the resource, a travel lane should remain so that activities may continue outside of the restricted area.

2.6.2 Contamination

If evidence of possible contamination is observed during construction (e.g. odor, sheen, buried suspect refuse) cease activities in the immediate area (typically 100 feet downstream from the occurrence) and notify the EI and CM. The EI will observe the area and if suspect contamination is present, the EI will notice CM and EPM. If the contamination is determined to be potentially hazardous, an experienced waste contractor will be mobilized to categorize and handle the waste. The hazardous waste contractor will implement health and safety protocols for working in hazardous environments. Work should not resume until authorized by Navigator Environmental Manager and PM

3.0 PRECONSTRUCTION

3.1 COMPLIANCE DOCUMENTS AND TRAINING

Prior to construction Navigator Environmental Manager will assemble all documents containing permit conditions, plans, and commitments made on behalf of the project for distribution to construction contractor management and inspection staff as appropriate to ensure communication of expectations and requirements for compliance. Navigator will deliver or cause to be delivered pre-construction training to construction contractor management and inspection staff, likely on a spread-by-spread basis, on all environmental and regulatory related conditions and commitments. Additional construction personnel and inspection staff will be briefed on necessary compliance requirements as they are onboarded through the duration of construction and restoration.

3.2 CONSTRUCTION ROW FLAGGING AND PROJECT SIGNAGE

Prior to clearing the ROW surveying activities will be conducted to locate, flag and stake the pipeline centerline and the construction workspace boundaries. Stakes should be placed along the ROW as appropriate to maintain line-of-sight from one stake to the next. All known underground utilities identified through 811 program (e.g., gas and water pipelines, fiber optic cable, telephone lines, etc.), drain tiles, and overhead crossings (power lines) will be located and marked to prevent accidental damage during construction.

3.3 IDENTIFICATION OF AVOIDANCE AREAS

Signs and/or flagging will be posted, typically in conjunction with survey activities, identifying sensitive features such as wetlands, waterbodies, and exclusion areas (e.g. protected habitats and cultural resources). These indicators will be maintained throughout construction and replaced as necessary. An example of signage typical of these projects is below and will be finalized prior to construction in coordination and compliance with all obtained permits, clearance, agency requirements and landowner agreements.

Table 3.3-1
Typical Construction Signage

Sign	Description
No Refueling Zone	at restricted work areas such as wetlands, streams, wells, and environmentally sensitive areas.
Approved Access Road	Project-related access roads will be identified.
No Access	Roads that lead to the ROW and could be confused with approved access roads but are not approved for use will be identified.
Exclusion Zone	Exclusion areas where equipment and personnel are not permitted to enter will be identified with signs posted on the ROW boundary and often accompanied by fencing.
Waterbody	Waterbodies will be identified; typical waterbody procedures or site-specific plans will apply at these waterbodies.
Wetland	Wetlands where wetland procedures will apply will be identified.

3.4 CONSTRUCTION LINE LIST

A document that addresses special requirements on a tract basis (e.g., timber salvage, topsoil segregation, restoration measures, fencing requirements, etc.) as identified in landowner agreements will be created and communicated to the contractor to adhere to. The construction line list (CLL) may include but is not limited to the following:

- Conservation easements,
- Drain tiles,
- Irrigation systems,
- Terraces,
- Wells,
- Above and below ground water lines and utilities,
- Grazing deferment plans,
- Fence cutting and bracing stipulations,
- Livestock information,
- Approved access roads,

These factors are considered in addition to the regulatory requirements and permit conditions for compliance.

4.0 GENERAL PIPELINE CONSTRUCTION PROCEDURES

Project related ground disturbance typically consists of the construction ROW, extra workspace areas, and access roads.

- In non-forested upland areas, the pipeline will be installed using a construction ROW varying in width from 100 feet to 125 feet wide depending on the diameter of the pipelines (see Appendix A, Figure HGS-BMP-029 and 030). The construction ROW for 6-, 8-inch diameter pipelines will be 100 feet wide and the construction ROW for 12-, 16-, and 20-inch diameter pipelines will be 125 feet wide.,
- Additional temporary workspace may be required to facilitate crossings of other utilities, roads, railways, waterbodies, and wetlands, etc.
- Generally, 50 feet of the construction ROW will be secured for permanent easement to facilitate pipeline operations, inspection, and integrity management.
- Fee owned lands have been or will be secured for all pump stations. ATWS at these locations will be acquired as necessary.

In addition, there may be instances where extra work areas are needed that include, but are limited to, the following:

- topsoil conservation,
- side hill construction,
- equipment staging,
- pipe and material storage,
- borrow and/or disposal areas,
- temporary and permanent access,
- and other related construction activities.

Such activities should be identified in the project plans and undergo all required environmental and cultural resources review prior to use. In contrast, pipelines may be constructed through confined areas such as extremely steep and narrow ridges. Alternate construction methods may be required in narrow construction work area situations to safeguard workers, equipment, the pipeline, and the environment.

4.1 ROW ACCESS AND REQUIREMENTS

- Access to the ROW is largely from public roadways and approved private access roads only.
- Signs and project maps will be used to identify approved access roads in the field and to ensure that access is confined to only the approved roads.
- Vehicle tracking of soil from the construction site will be minimized by installation and maintenance of BMPs such as stone pads, timber mats, reducing equipment/vehicle access to the construction ROW where practicable (i.e. off-ROW parking), or the equivalent.
- Installation of stone or timber mat access pads will be in accordance with applicable permits and state/federal specifications.

- If BMPs are not adequately preventing sediment from being tracked off the ROW, street sweeping or other equivalent means of collecting sediment may be warranted; and accumulated material should be returned to the construction ROW within an upland area as soon as practical.
- Construction equipment and vehicles will be confined to the approved construction footprint and access routes.
- Construction personnel are limited to the areas required to conduct these activities and are not be allowed off-ROW unless landowner permission is granted or emergency conditions dictate it.

4.2 CLEARING

Following the completion of surveys, the construction ROW is cleared of large vegetation (trees, brush, crops) and debris to the width specified in the ROW agreements and/or permit authorizations. During clearing operations, brush and trees are felled into the construction work area to prevent off-construction work area damage to trees and structures.

The clearing crew and related equipment necessary for installation of equipment crossings typically complete a single pass through water features prior to equipment crossing installations unless the stream contains rare or protected species.

Should substantial soil disturbance take place during clearing install temporary erosion and sedimentation controls as described in section 4.4.

4.2.1 Wood Products

The following shall apply to the management of wood products generated during clearing:

- Landowner agreements may dictate how and where to manage wood products. If landowner requests salvage of these materials or approves wood products to be stockpiled and left on site, they will typically be windrowed/stockpiled just off the edge of the construction work area, and typically not within 15 feet of streams, floodplains, or wetlands.
- Equipment stockpiling the wood products will not leave the construction work area.
- Merchantable timber will be managed in accordance with landowner agreements.
- Off-site disposal in other than commercially operated disposal locations is subject to review by Navigator's land and environmental teams and as approved by the project manager.
- Wood may be chipped and stockpiled for restoration, and/or spread across the ROW or stabilization during construction, and/or hauled off for proper disposal. When spread across the ROW for stabilization, it should be no more than approximate 2-inch layer. Application of the equivalent of 11 lbs/acre available nitrogen (at least 50 percent of which is slow release) is warranted to encourage decomposition.

4.2.2 Brush

All cleared brush should be disposed of by one of the following methods:

- Brush may be piled just off the edge of the construction work area but not within 25 feet of streams, floodplains or wetlands.
- Equipment stacking the brush will not leave the construction work area.

- Brush piles that are not burned typically do not exceed 12 feet in width and are not typically higher than approximately 4 feet high (compacted), and should have periodic breaks approximately every 200 feet to permit wildlife travel.
- Breaks should be no smaller than 4ft wide to allow wildlife travel.
- Brush piles should be kept separate from usable timber and care should be taken to prevent mixing of soil and brush. The landowner should be consulted to determine acceptable brush pile locations along the construction work area. Landowner approval is required for this method.
- Brush may be burned where permitted by law. The necessary burning permits will be obtained. Fires will be of reasonable size and located and patrolled so that they will not spread off the construction work area. Local authorities will be notified in advance of planned burned activities and fire suppression tools/materials will be readily available.
- The brush may be chipped and given away, buried, or thinly spread (less than 2 inches thick) over the construction work area or blown off the construction work area (per landowner agreement and approvals) except in agricultural lands or within 25 feet of streams, floodplains, or wetlands.
- Brush may be hauled off-site. Off-site disposal in other than commercially operated disposal locations is subject to compliance with all applicable survey, landowner approval and mitigation requirements.

4.2.3 Fence Crossings

Where fence removal becomes necessary the following shall apply:

- Temporary fences or gates should be installed at the time of cutting, or in accordance with landowner agreement.
- Temporary fences or gates should be kept closed, except when necessary for construction purposes or per landowner agreement.
- All fences that have been cut or removed will be permanently repaired during restoration to match the original type of the fence as practical, or gated, in accordance with landowner agreements.

4.3 GRADING

Grading is necessary to provide a smooth and even surface for safe and efficient operation of construction equipment. Grading should be kept to the minimum amount necessary and includes prompt installation of erosion control devices such as interceptor diversions, sediment filter devices, and equipment crossings at streams to minimize soil loss and subsequent sedimentation.

4.3.1 Tree Stump and Rock Removal and Disposal

Tree stumps and large rocks will be cut, graded or removed as necessary to permit construction and to provide adequate clearance for mechanical equipment and other vehicles. Tree stumps that are adjacent to roads should be cut close to the ground or removed for traffic safety.

Stumps and large rocks may be hauled from the site and disposed of in an approved landfill or other suitable area. Off-site disposal in other than commercially operated disposal locations is subject to landowner approval, review by land and environmental and as approved by the project manager. With the landowners' permission, they may be windrowed just off the edge of the construction work area;

windrows are typically approximately up to 12 feet wide with periodic breaks approximately every 200 feet or less.

4.3.2 Temporary Road Entrances

The following applies to temporary road entrances:

- Should be installed during grading in places of ingress/egress from public roads to the ROW to maintain safe conditions and to prevent tracking soil and mud onto public roads as per applicable permits or local guidelines. These installations are designed to remove mud from vehicle tires and tracks before accessing the road.
- Minimize the use of tracked equipment on public roadways and use protective material when tracked equipment on pavement is necessary (e.g. relaying rubber tires under the tracks).
- Geotextile fabric may be used as the base material for the access pad as illustrated in Figure HGS-BMP-001.
- If necessary, up to 6 inches of soil may be removed prior to installation of the temporary road entrance to ensure a hard base for geotextile fabric and rock placement.
- Geotextile fabric is not required at existing, graveled access road entrances.
- gravel will be of size and specification as approved by permitting authority or Navigator specification.
- If gravel is to be left after construction appropriate agency authorization and landowner approval is required.
- If a road ditch is present, install a properly sized culvert that will allow for highest expected flow and not bottleneck the water conveyance; it should be covered with rock or equipment matts to prevent crushing.
- Erosion control measures should be installed across the ROW excepting access pads at road crossings Figure HGS-BMP-001.

4.4 TEMPORARY EROSION CONTROL

Where necessary to contain disturbed soils and to minimize potential erosion and sedimentation, temporary erosion control devices (ECDs) will be installed and maintained throughout construction. Temporary ECDs include, but are not limited to, slope breakers, sediment barriers (i.e., silt fence, straw bales, bio-logs, etc.), stormwater diversions, trench breakers, mulch, soil tackifier, and temporary seeding of exposed soils (see Appendix A).

ECDs will be maintained as required in Project construction documents and in compliance with all applicable plans and permits. ECDs will typically be installed after initial clearing and selected grading activities and be replaced by permanent ECDs (if needed) as restoration is completed.

Temporary ECDs should be installed and maintained in accordance with the measures specified in Appendix A.

4.4.1 Temporary Stabilization

Temporary stabilization measures will be initiated promptly, pending weather conditions, in portions of the ROW where construction activities have temporarily or permanently ceased. If activities will resume within 21 days from when the activities ceased in any given area, temporary stabilization measures are not required.

In the event construction is completed more than 30 days before the seeding season for perennial vegetation, areas adjacent to waterbodies should be mulched with 2 tons/acre of straw, or its equivalent, or erosion control netting, to a minimum of 100 feet on either side of the waterbody. A temporary seed mix or cover crop may be applied when the native/preferred seed mix cannot be planted until the next growing season. Recommendations for cover crop seeding will be sought from the local soil conservation district or other land management agency.

Temporary sediment barriers may be removed from an area when that area is successfully revegetated per the SWPPP permit conditions or it is replaced with a permanent sediment barrier.

4.4.2 Mulch

Mulch (weed-free straw, wood fiber, hydromulch, or a functional equivalent) may be applied to disturbed areas during restoration and seeding (except for actively cultivated land and wetlands) in accordance with landowner agreements, or as specified by an applicable permits or licenses. Mulch is a suitable ECD in combination with other restoration techniques:

- On slopes greater than 5 percent;
- In areas of dry, sandy or highly erodible soils that can blow or wash away.
- All mulch should be free of noxious weeds as specified in applicable state laws.
- Mulch, when needed, should be applied at a minimum rate of 2 tons per acre to cover at least 75 percent of the ground surface.
- If mulch is to be applied before seeding, the rate shall be increased to 3 tons per acre on slopes within 100 feet of waterbodies and wetlands unless otherwise stipulated by permit conditions.
- Mulch may be uniformly distributed by a mechanical mulch blower or by hand.
- Mulch should be anchored/crimped using a mulch-anchoring tool, disc set in the straight position to minimize loss by wind and water as site conditions allow or other acceptable means to achieve the desired cover.

4.4.3 Slope Breakers

Temporary slope breakers are installed diagonally across the ROW generally pitched at 2- to 8- degree angles perpendicular to the slope on slopes greater than 5 perfect to control erosion by shortening the slope length and reducing the velocity and concentration of runoff on the ROW (see Appendix A, Figure HGS-BMP-014) . Temporary slope breakers may be constructed of materials such as subsoil (never topsoil), staked straw bales, sediment logs or silt fence.

The following spacing or closer is recommended for slope breakers:

Table 4.4-1 Spacing of Slope Breakers	
Slope (percent)	Spacing (feet)
5 to 15 percent	300 feet
15 to 25 percent	200 feet
>30 percent	100 feet or closer if warranted

The outfall of each temporary slope breaker should be directed to a stable, well vegetated area or into an energy-dissipating device at the end of the slope breaker and off the construction ROW. The outfall of each temporary slope breaker should be positioned so as to prevent sediment discharge into wetlands, waterbodies or other sensitive resources.

4.4.4 Sediment Barriers

Sediment barriers are intended to stop the flow of sediments and to prevent the deposition of sediments into sensitive resources. Barriers may be constructed of materials such as silt fence, staked straw bales, logs, compacted earth (i.e., drivable berms), sand bags or other appropriate materials (see Appendix A). Where silt fence is used, J-hooks should be installed at outlets.

At a minimum, temporary sediment barriers should be installed:

- Across the entire construction ROW at the base of slopes greater than 5 percent where the base of the slope is less than 50 feet from a waterbody, wetland, or road crossing until construction is complete.
- Adequate room should be left between the base of the slope and the sediment barrier to accommodate ponding of water and sediment deposition.
- Where wetlands or waterbodies are adjacent to and downslope of construction work areas, sediment barriers may be installed along the edge of the ROW at these areas to prevent sediment flow into the wetland or waterbody.
- In travel lanes, drivable berms may be installed rather than removable sediment barriers such as straw bales.

4.5 TRENCHING

Trenching involves excavation of a ditch for pipeline placement and is accomplished through the use of a trenching machine, backhoe, or similar equipment. Trenching would occur after necessary clearing and grading, with applicable ECD's installed.

4.5.1 Trenching Specifications

Topsoil segregation and conservation activities are discussed below in Section 5.1.1 and 5.1.2. Trench spoil is typically deposited alongside the non-working side of the trench within the construction work area (see the typical ROW construction drawings in Appendix A, Figures HGS-BMP-028 and 029). Gaps should be

left between the soil piles to facilitate natural drainage patterns and to prevent stormwater runoff from backing up or flooding adjacent areas.

The trench will be excavated to a sufficient depth to allow for a minimum of 5 feet of cover over the pipe. The width at the top of the trench will vary to allow the side slopes to be adapted to local conditions at the time of construction for safety and compliance.

4.5.2 Trench Breakers and Plugs

Trench breakers are temporary devices used as needed when a trench is left open and water flowing within the trench line poses a potential concern upstream of a wetland/waterbody or sensitive resource. They are also used to facilitate migration of wildlife and movement of livestock. Trench plugs are permanent plugs installed on slopes to slow the flow of subsurface water along the trench and prevent subsurface subsidence and at the entrance/exit of wetland features to restore/maintain hydrology

Trench plugs are typically constructed of subsoil and occasionally sand bags or polyurethane foam. Trench breakers are typically constructed of materials such as Sakrete, sand bags or polyurethane foam. Topsoil will not be used to construct a trench breaker. A typical figure showing trench breaker installation is provided in Appendix A, Figure HGS-BMP-017.

Trench plugs should be installed in the following locations for wildlife and livestock:

- Visible wildlife game trails as identified by an EI or wildlife agency
- Livestock watering trails as identified by landowner that intersect the trench line to allow cattle and wildlife to cross the trench.
- Gaps should be left in spoil and topsoil stockpiles at all trench plugs to permit unimpeded movement of wildlife and livestock.
- Suitable ramps should be installed from the bottom of trench to the top with a minimum of 5-foot wide open path across the trench plug.
- A corresponding gap in the welded pipe string should be left at each trench plug.

Trench breaker locations generally coincide with slope breakers as discussed in Sections 4.4.3. At a minimum, a trench breaker should be installed at the base of slopes greater than 5 percent where the base of the slope is less than 50 feet from a waterbody or wetland, and typically at the enterance/exit of a wetland/waterobdy and where needed.

4.5.3 Shallow Bedrock Conditions and Blasting

When shallow bedrock conditions are encountered the following measures should be implemented. Although blasting is not anticipated, it is addressed in Section 7.

- Topsoil and unconsolidated subsoil will be stripped and stored on the ROW as separate lifts from the underlying paralithic bedrock.
- Mechanical rippers should be used to fracture rock prior to excavation if too consolidated for a trencher or backhoe bucket.
- Rock should be stockpiled along the edge of the construction ROW and either used as backfill to the approximate height of the bedrock in the trench profile (rock guard or other

protective measures used to protect the pipe and coating), used during reclamation, or disposed of off-site or in accords with landowner agreements.

- Rock will not be permanently windrowed along the edge of the construction work area, unless specifically requested by the landowner to keep the rock.

4.6 TRENCH DEWATERING, LOWERING-IN, AND BACKFILLING

When water accumulates in the trench or a bore pit (via groundwater infiltration or precipitation), it is dewatered using pump(s) and/or well pointing. The following procedures apply to trench dewatering:

- The water should be discharged to a well vegetated upland area where the water can filter back into the ground.
- Water impounded in the trench should not be released directly into any waterbody or wetland; discharges should be at least 25' from these features and through an appropriate filtering device (e.g., filter bag, dewatering structure)
- Dewater the trench in a manner that does not cause erosion and does not result in heavily silt laden water flowing into a waterbody or wetland.
- Dewatering devices are typically be located on the edge of the construction ROW.

Typical sediment filtration/ energy dissipated devices include:

- Sediment trap
- Sediment filter bag
- Terra tubes
- Filter sock
- Flocculent logs
- Straw bale containment structure

Prior to lowering-in, the trench is visually inspected to ensure that it is free of rock and other debris that could damage the pipe or coating.

In rocky areas, padding material such as finer grain sand, soil, or gravel are typically placed in the bottom of the trench to protect the pipeline. Topsoil will not be used as padding material. The pipeline may also be wrapped in a rock shield, typically made of fabric or screen.

Prior to backfilling, permanent trench breakers will be installed where necessary to minimize the potential for water movement along the ditch causing potential subsequent subsidence or erosion (see Section 4.9.1). Excavated soils will be replaced in the opposite order it was removed and returned to the horizon in which they originally occurred.

4.7 CLEANUP AND ROUGH/FINAL GRADING

The following procedures shall apply to clean up and final grade activities:

- Construction debris on the ROW will be properly disposed of at off-site facilities.
- Subsequent to backfill, all work areas are graded and restored to pre-construction contours with appropriate crowning over the trenchline.

- During cleanup, a travel lane may be temporarily left open to allow access by construction traffic.
- Interim ECDs will be inspected and maintained during this period.
- When access is no longer required, the travel lane will be removed and the ROW fully restored.

Access to the newly created ROW may be restricted from unauthorized vehicles at public access points by installing gates, boulders, or other barriers.

4.7.1 Soil Decompaction

Both topsoil and subsoil may be decompacted per landowner stipulations or applicable permits. Soils that have received substantial construction traffic may be tested at the conclusion of construction activities in disturbed areas using penetrometers or other appropriate devices. Similar soil types under similar moisture conditions may be examined in disturbed areas and in undisturbed, off-ROW areas to evaluate compaction on the ROW.

Areas with compacted subsoils (where subsurface rock does not interfere with ripping) may be scarified or ripped to a depth up to 18 inches in lands used for crop production and to a depth up to 12 inches in other agricultural lands using rippers, chisel plow, para-plow, or other similar tillage equipment until the soil density is comparable to adjacent areas off the construction ROW. If ripped, the ripper shanks will be set apart 12 to 18 inches. Topsoil will be replaced after decompaction is completed. Sandy soils will not be scarified. Topsoils exhibiting compaction will be decompacted prior to seeding and mulching, as needed.

4.7.2 Stone removal

In cultivated or rotated cropland and managed pasture, stones equal to or larger than 4 inches in diameter will be removed from the upper 12 inches of topsoil or as specified in permit conditions, contract documents, or landowner agreements. During topsoil replacement, stone removal efforts will cease when the size and density of stones on the construction ROW are similar to undisturbed areas adjacent to the construction ROW as necessary. Excess rock will be piled in landowner approved areas or hauled off-site.

4.7.3 Permanent Slope Breakers

- Permanent slope breakers are intended to reduce runoff velocity, divert water off the construction ROW, and prevent sediment deposition into non-affected areas and sensitive resources.
- Permanent slope breakers are typically constructed of materials such as soil, sand bags, or a functional equivalent.
- With landowner permission, slope breakers may extend slightly (about 4 feet) beyond the edge of the construction ROW to effectively drain water off the disturbed area.
- Spacing for permanent slope breakers are typically the same as those for temporary slope breakers, however, land use and landowner specifications may alter the configuration and spacing.
- Slope breaker spacing may also be modified to correspond with slope breakers from adjacent facilities (see Appendix A).

- In the absence of stable, adjacent areas, energy-dissipating devices should be constructed at the end of the breaker.

4.7.4 Restoration of Pre-construction Contours

Rough grading should generally occur within approximately 14 days of backfill, weather permitting. The construction ROW will be restored to its pre-construction conditions as practical. In upland areas, a crown will be graded over the trench with subsoils to account for expected settling of trench backfill. Permanent erosion control devices including interceptor diversion/slope breakers should be at least roughed in during rough grade.

4.8 HYDROSTATIC TESTING

The pipeline will be hydrostatically tested to ensure the integrity of the line. The pipeline system will be broken into test segments based on final design, water availability, permitting requirements, and terrain. Water for hydrostatic testing may be obtained from groundwater, surface water and/or municipal sources in accordance with all applicable regulations and permit conditions. The withdrawal of the surface water will be performed in a manner that minimizes impacts to aquatic life (screened intake hoses suspended within the water column) and maintains sufficient water for downstream withdrawals by existing users. Water from state designed *high quality streams* or *exceptional value waters*, waterbodies which provide habitat for federally listed threatened or endangered species, or streams utilized as public water supplies will not be used unless permitted by the appropriate federal, state or local agency.

Following testing, the hydrostatic test water will be discharged in a manner that minimizes erosion and is in accordance with applicable permit requirements. The energy of the released test water will be dissipated by discharging the water:

- Through a dissipation device (e.g. t-pipe) into a well-vegetated upland area;
- into a holding or frac tank(s)
- into a body of water (with all required permits and meeting all conditions); or
- through sediment filter devices or a sediment trap to filter out various particulate matter or allow it to infiltrate through the soil.

Monitoring of the discharge to document compliance with applicable permits and observe for the off-site deposition of sand, silt, and/or sediment. If such deposition is occurring, the dewatering activity shall be stopped and the design of the discharge shall be changed to prevent reoccurrence; and verifying that dewatering structures are removed after completion of dewatering activities;

4.9 FINAL GRADE, RESTORATION AND STABILIZATION PROCEDURES

After construction activities, disturbed areas are stabilized with either (1) final grading and restoration; or (2) temporary stabilization measures in order to prevent erosion and sedimentation until final grading and restoration can be completed.

4.9.1 Final Grade

Final grading will be completed within approximately 14 calendar days from rough grade, weather and soil conditions permitting. Should unsuitable soil conditions persist, or are expected to persist, for more than 20 calendar days, the Inspector will record the conditions and installation of temporary stabilization

measures should occur while final grading and restoration is delayed. Final grading should never be delayed beyond the end of the next recommended seeding season.

- If final grade can be established, but conditions are not ideal for permanent seeding, the EI will recommend application of temporary stabilization measures (including temporary seeding) and may also consider concurrent application of final seed mix and mulch per reseeding mix or as provided by the local conservation authority.

- A travel lane may be left open temporarily to allow access by construction traffic if the temporary erosion control structures are installed, inspected, and maintained. When access is no longer needed, the travel lane must be removed, and the ROW restored.

- Grade the construction ROW to restore pre-construction contours.

- During final grading, soil over the trench may be mounded to allow for future settling.

- Where fill in the trench or major depressions have settled below ground level, additional fill should be added as needed for the are to be brought back to pre-construction grade.

- The EI may approve a temporary travel lane in the construction work area where needed to facilitate the remainder of construction and/or restoration. This travel lane must be restored when access through the area is no longer required.

- Segregated topsoil is returned during final grading.

- All construction debris from all work areas must be removed unless the landowner or land managing agency approves leaving materials onsite for beneficial reuse, stabilization, or habitat restoration.

- Permanent erosion control devices including interceptor diversion/slope breakers should be completed such that water does not pond in them and is conveyed off the ROW

- Sediment filter devices needed to protect off-construction work area resources should be installed or rebuilt promptly after final grading.

- Final interceptor diversions will not be installed in agricultural or pastureland without landowner's consent.

4.9.2 Restoration

Restoration includes fertilizing, liming, disking, seeding and mulching, and crimping mulch or use of hydro mulch. Reseeding mixes and rates, and soil enhancements should account for recommendation from the local NRCS offices, landowner stipulations or other land managing agency.

The following restoration practices should be implemented:

- Ensure that excessive competitive cover from invasive weed species is not present. If undesirable vegetation is present, it should be removed prior to seeding. Spot herbicide application may be appropriate provided a U.S. Environmental Protection Agency (USEPA) approved formulation is used consistent with labeled instructions by a licensed applicator. If herbicides are to be used or

have been applied to areas to be seeded within the last 4 years, consult with restoration specialists or the local NRCS office for information concerning planting timing after spraying.

- Fertilizer and lime should be disked into the soil (except rocky soils) typically to a depth of 3 to 4 inches to prepare a seedbed.
- In rocky soils, fertilizer and lime may be incorporated into the soil with tracked equipment.
- Seeding and mulching the construction work area should promptly follow seedbed preparation.
- Ensure that any mulch used is adequately anchored to minimize loss due to wind and water.
- Mulch tackifiers used in accordance with the manufacturers recommendations may be used as an alternative to anchoring.
- Limit use of liquid mulch binders within 100 feet of wetlands or waterbodies.
- Rates for lime, fertilizer, seed and mulch will be developed in consultation with the local SWCD or other lang managing agency unless a ROW agreement or permit provides site-specific requirements.
- If mulching before seeding, increase mulch application on all slopes within 100 feet of waterbodies and wetlands to a rate of 3 tons/acre of straw or equivalent.
- Scarify the seedbed to facilitate lodging and germination of seed.
- Uniformly apply and cover seed in accordance with the written recommendations of the local soil conservation authorities or land management agencies.
- Typically, base seeding rates on Pure Live Seed and maximize use of seed within 12 months of seed testing. Treat legume seed with an inoculate specific to the species using the manufacturer's recommended rate of inoculant appropriate for the seeding method. If the above recommendations are not available for conventional seeding, typically use 4 times the manufactures recommended rate of inoculate. For hydroseeding, typically use 10 times the recommended rate of inoculate.
- In the absence of recommendations from the local NRCS authority, a seed drill equipped with a cultipacker is typically used for application, but broadcast or hydroseeding can be used at double the seeding rates.
- Where seed is broadcast, firm the seedbed with a cultipacker, roller or other suitable means after seeding. In rocky soils or where site conditions may limit the effectiveness of this equipment, other alternatives may be approved by the environmental inspector or restoration specialist.
- Restoration should be avoided during excessively wet conditions such as spring thaw.
- Grazing deferment plans may be negotiated with landowners, grazing permittees, and land management agencies as appropriate to minimize grazing disturbance of revegetation efforts.

- Seed and planting materials should meet state quality standards. All seed analyses must be conducted in accordance with pertinent State rules / laws which specify the kind and amount of weed seed permitted, the requirements for a current analysis report and labeling of all seed to show its purity, germination, date of last germination test, and weed content When seed is purchased and shipped across state lines, the germination test is valid for 5 months after the end of the month the test was made, according to Federal Seed Law.

- Reseeding, liming, and fertilizing may be performed by the landowner.

- Restore all turf, ornamental shrubs, and specialized landscaping in accordance with the landowner's request, or compensate the landowner.

- Restoration work should be performed by personnel familiar with local soil and growth practices.

- Jute netting or equivalent approved by the Inspector may be used on steep slopes to help stabilize the slope.

- Avoid use of synthetic monofilament mesh/netted erosion control materials (e.g. curlex) in areas designated as sensitive wildlife habitat, unless the product is specifically designed to minimize harm to wildlife.

- Anchor erosion control fabric with staples or other appropriate devices.

- Restoration shall be considered successful if the ROW surface condition is similar to adjacent undisturbed lands, construction debris is removed (unless requested otherwise by the landowner or land managing agency), revegetation is successful, and proper drainage has been restored.

- Revegetation in non-agricultural areas shall be considered successful if upon visual survey the density and cover of non-nuisance vegetation are similar in density and cover to adjacent undisturbed lands. In agricultural areas, revegetation shall be considered successful if crop yields are similar to adjacent undisturbed portions of the same field, unless the easement agreement specifies otherwise.

4.9.3 Fertilizer and Soil Amendments

In general, soil additives or amendments (specifically fertilizing) are not recommended to establish native seed mixes as they can enhance exotic grasses and annual weed growth, thereby reducing the chances of successful desirable revegetation. Should potentially problematic soil characteristics be identified during pre-construction surveys or during post-construction restoration activities, soils may be assessed for nutrient balance and soil nutrient amendments should be applied as needed to meet specific restoration objectives. In areas of improved pasture or active agricultural, Navigator should work in advance with landowners to achieve their specific revegetation goals, which may require soil amendments.

Soil amendments will not be utilized in wetlands and/or other sensitive environmental features without the express recommendation of resource and/or permitting agencies.

5.0 SPECIAL PIPELINE CONSTRUCTION PROCEDURES

5.1 AGRICULTURAL AREAS

The following discusses practices to minimize and mitigate impacts to agricultural lands. Some state may require specific agricultural mitigation plan, in which case practices in those plans supersede anything in this ECG.

5.1.1 Topsoil Conservation

Prevent the mixing of topsoil with subsoil by stripping topsoil from either the full work area or from the trench and subsoil storage area (ditch plus soil side method) in actively cultivated or rotated croplands and pastures (including hayfields); residential areas; wetlands and other areas per landowner agreements or land managing agency's requirements. Figures HGS-BMP-028 and 029 illustrates topsoil conservation techniques.

Where necessary the following topsoil conservation measures will be implemented:

- In deep soils (more than 12 inches of topsoil), segregate at least 12 inches of topsoil. In soils with less than 12 inches of topsoil make every effort to segregate the entire topsoil layer.
- Stripped topsoil will be stockpiled separately from all subsoil and will be replaced last during backfilling and **final grading**.
- Additional erosion control devices shall be installed as warranted to protect are needed in topsoil storage areas.
- Stabilize topsoil pile and minimize loss due to wind and water erosion with the use of sediment barriers, mulch, temporary seeding, tackifiers, or functional equivalents, where warranted and/or required by environmental permits.
- Topsoil will not be used to construct trench breakers, temporary slope breakers, to improve or maintain roads, or to pad the pipe.
- Gaps will be left and ECDs installed where stockpiled topsoil and spoil piles intersect with water conveyances (i.e., ditches, swales and waterways) to maintain natural drainage and avoid loss of topsoil.

5.1.2 Triple Ditch Methods

Alternate soil handling-procedures may be necessary in areas where the aforementioned topsoil segregation procedures may result in mixing of dramatically different topsoil layers, or when parent material is encountered below the subsoil material, thereby warranting additional handling procedures to avoid reducing soil productivity. In these areas:

- The "first lift" (either topsoil or the higher organic matter layer of deep topsoil) would be salvaged according to the warranted depth and stockpiles typically along the edge of the working side of the ROW.
- The "second-lift" material (either the lower organic matter layer of deep topsoil or the subsoil material beneath the topsoil layer) would then be salvaged and windrowed typically on the opposite side of the ROW from the topsoil.

- The "third lift" (either the subsoil material under the 2 segregated topsoil layers OR parent material under the subsoil layer) would then be placed typically as close to the trench as practical while accounting for the travel lane and strung pipeline while being separate from either of the other two stockpiled soils.
- Following construction, the soils would be replaced in the opposite order of extraction and would be feathered across the proposed Project route area.

5.1.3 Drain Tile and Irrigation Facilities

The following shall apply to drain tiles and irrigation systems and as depicted in Figures HGS-BMP-025 and 026:

- Attempt to locate existing drain tiles and irrigation systems during pre-construction design, discussions with landowners and drainage districts.
- Mark locations of drain tiles damaged during construction, marking to remain until permanent repairs are made.
- Retain local, qualified drain tile specialists to conduct or monitor repairs to drain tile systems affected by construction.
- Temporary repairs should be made immediately if water is flowing at the time the line is cut and before the next anticipated precipitation evert if permanent repairs are not expected to be complete by then.

5.1.4 Irrigation Systems

Pivot irrigation systems may be encountered along parts of the route. Identify water and power supply from landowner or tenant when available and mark during pre-construction surveys. Maintain water flow in active fields by leaving gaps in spoil piles and trench plugs or plates across open trenches, unless shut off or other arrangements are made with the affected parties.

5.1.5 Grazing Areas

Navigator will work with each landowner/tenant with livestock to ensure proper measures are in place to protect livestock from construction. Ideally the livestock would be able to utilize a field that is not planned to be crossed by the project. Alternately we would install exclusion fencing along the disturbed ROW separating the animals from construction.

- Each fence crossed by construction crews should be braced and secured to prevent slacking of the wire.
- The opening created will be closed when construction crews leave the project area to prevent passage of livestock.
- Any gaps in natural barriers used for livestock control created by construction activity will be fenced according to landowner or lease holder agreements.
- All fences, gates, irrigation ditches, cattle guards, and reservoirs will be maintained during construction and repaired to pre-construction conditions.
- Following construction and restoration, temporary fences will be removed and livestock will be allowed to graze and roam freely over the permanent ROW, ideally after reseeding is established.

5.1.6 Repair of Damaged Conservation Practices

Restore all soil conservation practices (e.g., terraces, grassed waterways, etc.) that are damaged by the pipeline construction to preconstruction conditions. Perform in accordance with Consult local NRCS guidelines

5.2 WETLAND CROSSINGS

This section addresses how non-farmed wetlands should be managed. The main objective of these wetland crossing is to construct the pipeline and restore the original contour of the wetland. This section provides baseline mitigation measures for minimizing the extent and duration of project-related disturbance.

- Clearly mark wetlands along the alignment as previously delineated by a knowledgeable person prior to the start of construction with signs and/or highly visible flagging until construction is complete, these field markings should remain throughout construction.
- The method of pipeline construction in wetlands depends largely on the stability of the soils at the time of construction.
- If wetland soils are not saturated at the time of construction and can support construction equipment on equipment mats, construction may occur in a manner similar to conventional upland construction techniques.
- Standard construction ROW width in non-agricultural wetlands is typically restricted to 75 feet for <12-inch diameter pipe and 85 feet for 12-inch diameter or greater diameter pipe; unless as approved by the respective permitting agency and as depicted on the project alignment sheets.
- ATWS areas necessary on both sides of wetland crossings to stage construction, fabricate the pipeline, and/or store materials, should be located in upland areas a typically 25 feet from the wetland edge pending site specific conditions.
- Construction equipment working in wetlands should be limited to that essential for proper installation. In areas where there is no reasonable access to the ROW except through wetlands, non-essential equipment will be allowed to travel along the prescribed travel path across wetlands.
- The refueling of equipment, storage of fuel, lubricants or hazardous materials within 100 feet of a wetland should not to be conducted unless no reasonable alternative exists and additional containment measures are implemented.

5.2.1 Clearing and grading

- Clearing of vegetation in wetlands is largely limited to trees and shrubs, which should be cut flush with the surface of the ground and removed from the wetland (leaving the existing root systems in place).
- Grading in wetlands should be the minimum necessary for safe and efficient equipment operation.
- Generally stump removal, grading, topsoil segregation, and excavation is limited to the area immediately over the trenchline, unless determined necessary for safe and efficient operation of equipment.

- In unsaturated wetlands, topsoil from the trenchline and spoil pile area is stripped up to 12-inches deep and stored separately from subsoil. Topsoil segregation is generally not feasible in saturated soils.
- Where wetlands are adjacent to and down gradient from the construction ROW, install sediment barriers along the edge of the construction work area as necessary to prevent sediment flow into the wetland. Remove these sediment barriers after successful restoration has occurred.
- Sediment filter devices should be installed promptly across the construction work area after grading at any wetland edge and maintained until construction work area revegetation is complete. Temporary interceptor diversions may be installed adjacent to wetlands to prevent sedimentation.
- ECDs such as silt fence and staked straw bales are installed and maintained as necessary to minimize the potential for sediment runoff into wetlands.
- Sediment barriers should be installed across the full width of the construction ROW at the base of 5-degree slopes adjacent to wetland boundaries.
- ECDs installed across the working side of the ROW may be removed during active construction but are replaced after each pass or at the end of the working day. Alternatively, drivable berms may be installed and maintained across the ROW.
- Sediment barriers may also be installed within wetlands along the edge of the ROW, where necessary, to minimize the potential for sediment to run off the construction ROW and into wetland areas outside the work area with appropriate gaps to allow for appropriate surface water flow and preventing impounding water on the ROW.
- If trench dewatering is necessary in wetlands, silt-laden trench water will be discharged into an energy dissipation/sediment filtration device, such as a geotextile filter bag or straw bale structure, to minimize the potential for erosion and sedimentation.

5.2.2 Crossing Methods

ECDs can be temporarily removed from the trench line to allow trenching activities to proceed. Spoil piles should be protected with sediment filter devices, if determined necessary by the Inspector, to prevent the flow of spoil off the construction work area.

Limit construction equipment operating in wetland areas to that needed to clear the construction work area, dig the trench, fabricate and install the pipeline, backfill the trench, and restore the ROW. All other construction equipment shall use access roads located in upland areas to the maximum extent practicable. Where access roads in upland areas do not provide reasonable access, limit all other construction equipment to one pass through the wetland using the construction work area

The following provide a description of typical wetland crossing methods:

- The construction ROW may be used for access when the wetland soil is firm enough to avoid rutting or the construction ROW has been appropriately stabilized to avoid rutting (e.g., with timber matting, prefabricated equipment mats, or terra mats), In wetlands that cannot be appropriately stabilized, all construction equipment other than that needed to install the wetland crossing shall use access roads located in upland areas.

- Where wetland soils are saturated and/or inundated, the pipeline may be installed using the push-pull technique. The push-pull technique involves stringing and welding the pipeline outside of the wetland and excavating and backfilling the trench using a backhoe supported by equipment mats or timber riprap. The prefabricated pipeline is installed in the wetland by equipping it with buoys and pushing or pulling it across the water-filled trench. After the pipeline is floated into place, the floats are removed and the pipeline will sink into place. Most pipe installed in wetlands are coated with concrete or equipped with set-on weights to provide negative buoyancy. Additionally, trench plugs are often installed at the entry and exit points of the feature to facilitate restoration of the subsurface hydrology and prevent the pipeline trench from inadvertently draining the feature.

- If standing water or saturated soils are present or if construction equipment causes ruts or mixing of the topsoil and subsoil, use low-ground-weight construction equipment, or operate normal equipment on timber matting (up to 2 layers), prefabricated equipment mats or terra mats. Timber matting must be in good condition and not have large holes in it where sediment could enter the wetland. Tree stumps, rock, gravel, soil imported from outside the wetland or brush will not be used to stabilize the construction work area or as equipment pads in wetlands. Remove all equipment mats, and timber matting during restoration of the wetland.

A typical wetland crossing is illustrated in Figure HGS-BMP-037.

5.2.3 Backfilling

If trench dewatering is required, the water will be filtered and discharged through a sediment trap (Figure HGS-BMP-009) and/or filter bag (Figure HGS-BMP-013) and/or a series of sediment logs or into a heavily vegetated area outside the wetland (where the water will filter back into the ground), to prevent heavily silt-laden water from directly entering a wetland or waterbody. Remove any dewatering structure as soon as practicable after the completion of dewatering activities. Spoil from the trench will be used as backfill. The surface will be recontoured as closely as practical to the original condition so that drainage patters are restored. The conserved topsoil layer will be returned to the surface after backfilling.

- Concrete coating activities will not take place within 100 feet of any wetland.

- Prior to backfilling, trench breakers will be installed where necessary to restore wetland hydrology and prevent subsurface drainage of water from wetlands.

- In areas where topsoil has been segregated from subsoil, the subsoil will be backfilled first, followed by the topsoil

- ECDs will be promptly installed after backfilling.

5.2.4 Restoration

- Upon completion of construction in wetland areas with standing water or saturated soils, access improvements will be promptly removed provided travel across them to other areas is no longer needed.

- Typically, wetlands are not reseeded and are revegetated via natural succession. In wetlands where no standing water is present, the construction ROW may be seeded with annual rye or be allowed to revegetate naturally based on site conditions, landowner agreements, and respective permits.

- Fertilizer, lime, or mulch will not be used in wetlands unless required in writing by the appropriate federal or state agency. Asphaltic emulsions and liquid mulch binders should not be used to stabilize within 100 feet of wetlands.

5.3 WATERBODY CROSSINGS

The main objective of any waterbody crossing is to construct the pipeline in a manner which minimizes erosion and subsequent sedimentation into the waterbody. Crossings should be constructed perpendicular to the waterbody channel as practicable. Adequate downstream flow rates will be maintained throughout construction to protect aquatic life and prevent the interruption of existing downstream uses. All permit conditions will be adhered too and supersede statements made in this plan.

Applicable notifications will be made for waterbody crossings to entities including potable water intake authorities as required by local laws and/or permit conditions.

Avoid commencing in-stream activities when water levels are temporarily high.

- There should be no refueling of equipment, storage of fuel, lubricants or hazardous materials within 100 feet of a waterbody unless no reasonable alternative exists and additional protective measures are implemented.

- Locate ATWS 25 feet away from the water's edge where practicable, except where the adjacent upland consists of actively cultivated or rotated cropland or other disturbed land. If 25 feet cannot be maintained due to site specific conditions, located at least 10 feet from the top of bank or water's edge and limited to the size needed to construct the crossing. Pipe assembly for the waterbody crossing is usually performed in the extra work areas prior to or concurrently with trenching.

- Waterbody buffers (e.g., refueling restrictions) should be clearly marked in the field with signs and/or highly visible flagging until construction related ground disturbing activities are completed.

- Many waterbodies crossed by the Project have ephemeral to intermittent flows. If these waterbodies are dry when crossed, conventional upland construction techniques may be used.

- If the waterbodies are flowing when crossed, the open-cut, flume, or dam and pump methods, described below are typically used be used. The HDD method is used to cross larger waterbodies and in other areas where conventional installation is not ideal due to conditions such as topography, saturation or proximity to other sensitive features. All construction activities in waterbodies will be expedited to the extent practicable to minimize impacts.

5.3.1 Equipment Bridges

Generally, only clearing equipment and equipment necessary for installation of equipment bridges are allowed one pass through a waterbody prior to bridge installation. During the clearing and grading efforts, temporary bridges may be installed across waterbodies to allow construction equipment to cross prior to a more stabilized and properly designed equipment mat is installed. For proper culvert installation, grading/excavating equipment will be allowed to work from the water as necessary. Equipment bridges are not required at minor waterbodies (for example, agricultural or intermittent drainage ditches). However, if an equipment bridge is used, it must be constructed in accordance with this guidance document.

Equipment bridges typically consist of one of the following See Figures HGS-BMP-041, 042, and 043:

- clean rock placed over flume pipes,
- prefabricated construction mats with or without a culvert,
    - the mats should be in good condition, with no large holes that could allow sediment to enter the waterbody,
    - rails and/or geofabric or other wrapping may be warranted to prevent sediment entering the waterbody
- rail cars placed over the waterbody with or without a culvert
- flexi-float or other temporary bridging deemed appropriate for site and permit conditions.

Additional measures for equipment bridges:

- Equipment bridges must be able to withstand and pass the highest flow expected to occur while the bridge is in place.
- constructed to allow unrestricted flow and to prevent soil from entering the waterbody. Soil should not be used to construct or stabilize equipment bridges. Bridges should be removed as soon as practical after restoration.
- Align culverts to prevent bank erosion and streambed scour.
- Remove as soon as practicable and restore banks or areas of footings as appropriate.

5.3.2 Clearing and Grading

Clearing and grading is generally be restricted from a 25-foot buffer from waterbodies outside of the travel lane to the extent practicable to limit erosion and sedimentation into the feature. Tree and brush clearing within this vegetative buffer may occur provided root masses remain in place and/or temporary stabilization measures are implemented (temp seed, mulch, etc).

- Cleared vegetation is generally be stockpiled in ATWSs approximately 25-feet from water's edge with ECD's installed as appropriate, and never left a waterbody.
- Grading equipment should not enter the water to grade the banks and waterbody banks should be graded only where and as much necessary to permit safe and efficient operation of construction equipment.
- During grading operations, sediment filter devices are installed across the disturbed construction ROW promptly.
- Removable sediment filter devices and/or drivable berms will be installed across the travel lane. These removable sediment filter devices, if removed during the day, must be re-installed by the end of the work day or when heavy precipitation is imminent.

- Spoil from grading will be piled at least 10 feet from the stream banks and protected with sediment filter devices to avoid erosion and sedimentation into the waterbody as warranted.

For proper culvert installation, the Inspector may permit grading/excavating equipment to enter the water. Equipment bridges are not required at minor waterbodies (for example, agricultural or intermittent drainage ditches). However, if an equipment bridge is used, it must be constructed in accordance with this ECS.

5.3.3 Trenching

- Prior to trenching within the waterbody, water impounded in the upland trench will be pumped into a sediment trap, filter bag, sediment logs, and/or a vegetated upland area to minimize erosion and sedimentation.

- Prevent the flow of spoil or heavily silt-laden water into any waterbody (outside of any temporary dams constructed for a dry crossing). If little vegetation is present, add a straw bale or filter sock containment around the filter bag for additional sediment control.

- Sediment filter devices for trench spoil should be installed prior to commencing trenching activities and temporarily removed to allow trenching activities to proceed.

- All spoil from minor and intermediate waterbody crossings, and upland spoil from major waterbody crossings, must be placed in the construction ROW at least 10 feet from the water's edge or in additional extra work areas.

- Trench plugs may be used at non-flumed waterbody crossings to prevent diversion of water into upland portions of the pipeline trench and to keep any accumulated trench water out of the waterbody. Trench plugs must be of sufficient size to withstand upslope water pressure.

- For dry ditch method crossings, use sand bag or sand bag and plastic sheeting diversion structure or equivalent to develop an effective seal and to divert stream flow through the flume pipe (some modifications to the stream bottom may be required in to achieve an effective seal). In addition, do not remove flume pipe during trenching, pipelaying, or backfilling activities, or initial streambed restoration efforts.

5.3.4 Open Cut Crossing Method

For open-cut crossings, clearing adjacent to waterbodies should be limited to the removal of trees and brush from the construction ROW and ATWS areas for a 25' buffer of the feature. Sediment barriers should be installed at the top of the streambank if no herbaceous strip exists. Initial grading of the herbaceous strip should be limited to the extent needed to create a safe approach to the waterbody and to install a bridge.

During clearing, sediment barriers should be installed and maintained across the ROW adjacent to a waterbody and within ATWS areas to minimize the potential for sediment runoff (see Appendix A). Silt fence and/or straw bales located across the working side of the ROW can be removed during the day when vehicle traffic is present and be replaced each night. Alternatively, drivable berms may be installed and maintained across the ROW in lieu of silt fence and/or straw bales.

Once the trench is excavated, the prefabricated segment of pipe is installed in the trench. Most pipe installed under a waterbody will be coated with concrete or equipped with set-on weights to provide negative buoyancy.

5.3.5 Flume Crossing Method

The flume crossing method involves diverting the flow of water across the trenching area through one or more flume pipes placed in the waterbody (see Figure HGS-BMP-040).

- The first step in the flume crossing method involves placing a sufficient number of adequately sized flume pipes in the waterbody to accommodate the anticipated flow during construction.

- After placing the flume pipes in the waterbody, sand or pea gravel bags, water bladders, or metal wing deflectors are placed in the waterbody upstream and downstream of the proposed trench to dam the stream in order to seal the waterbody and divert the water flow through the flume pipes, thereby isolating the water flow from the construction area between the dams.

- Leakage from the dams, or subsurface flow from below the waterbody bed, may cause water to accumulate in the isolated area. As water accumulates in this area, it may be periodically pumped out and discharged into upland areas away from the water's edge. Trackhoes located on the bank(s) of the waterbody will excavate the trench under the flume pipe in the dewatered streambed.

- Spoil excavated from the waterbody trench is placed or stored a minimum of 10 feet from the edge of the waterbody, or in accordance with applicable permit conditions.

- Once the trench is excavated, the pipe is installed beneath the flume pipes.

- The trench is then backfilled with the native spoil and banks stabilized before removing the dams and flume pipes and returning flow to the waterbody channel.

5.3.6 Dam and Pump Crossing Method

The dam and pump crossing method is an alternative to the flume crossing method where pumps and hoses are used instead of flumes to move water around the construction work area (see Figure HGS-BMP-039).

- The technique involves damming the waterbody with sandbags, steel plates, water bladders or the like upstream and downstream of the trench area.

- Pumps will be set up at the upstream dam with the discharge line routed across the ROW, discharging water immediately downstream of the downstream dam.

- The intake will be screened to prevent entrainment of aquatic species, and suspended in the water column to reduce uptake of sediment and the benthic community.

- Water flow will be maintained through all but a short reach of the waterbody at the actual crossing.

- The pipeline will be installed in the isolated area between the dams at least 5 feet below the streambed.

- After backfilling, the dams are removed and the banks restored and stabilized.

5.3.7 Backfilling

Waterbody bottoms will be returned as near as practical to their original contours. Excavated native streambed spoil from the trench will be used as backfill, unless expressly permitted or approved otherwise by the appropriate regulatory agency. Clean gravel or native cobbles may be used for the final one-foot of fill in the backfilled trench. The sediment filter devices removed at the stream will be promptly reinstalled after backfilling.

5.3.8 Restoration

The preferred restoration method is to achieve final grade and restore the waterbody, its banks, and 50-foot buffers within 24 hours of backfilling.

- For each waterbody crossed, install a permanent interceptor diversion/slope breaker and a trench breaker at the base of slopes near the waterbody. Locate the trench breaker immediately upslope of the interceptor diversion/slope breaker. In some areas, with the approval of the Environmental Inspector, an earthen berm may be suitable as a sediment barrier adjacent to the waterbody

- If conditions do not permit the preferred method, the construction work area not in use for access will be promptly rough graded and stabilized.

- For dry-ditch crossings, complete streambed and bank stabilization before returning flow to the waterbody channel.

- All equipment bridges will be removed once access in the area is no longer required.

- Return all waterbody banks to preconstruction contours or to a stable angle of repose as approved by the Environmental Inspector. If the waterbody banks are such that an unstable final soil grade would result and vegetative stabilization is inadequate, the mechanical stabilization of the waterbody banks may be warranted and includes riprap, gabions, jute netting, etc. Riprap may only be done with the approval of the Environmental Manager.

- To provide additional erosion control, erosion control fabrics (e.g., jute matting, straw blankets with plastic netting, or curlex) may be used on the banks of washes and waterbodies where steep slopes are present and as warranted in other locations.

- Application of riprap must comply with the US Army Corps of Engineers, or its delegated agency, permit terms and conditions. In general, riprap and my be approved by the EMP prior to installation if not already permitted. Typically consists of field or quarry run stone, which is hard and durable. The riprap should be large enough to prevent normal waterbody current from moving it, typically 6-inch rock for slow moving waterbodies and 12 inch or larger rock for others. The riprap should be placed at least 18 inches thick and generally thicker at the base. The riprap slope should not be steeper than 1:1 and should conform to the remainder of the waterbody bank slopes where they are flatter than 1:1.

- Install erosion control fabric, Figure 16, such as jute netting or bonded fiber blankets at a minimum, on waterbody banks at the time of final bank re-contouring. Synthetic monofilament

mesh/netted erosion control blanket cannot be used in areas designated as sensitive wildlife habitat unless the product is specifically designed to minimize harm to wildlife. Anchor the erosion control fabric with staples or other appropriate devices.

- Sediment filter devices will be removed once permanent revegetation is successful.
- The banks of perennial streams may be seeded with mixes recommended by the conservation agency or according to landowner agreements. Dry wash bottoms will not be seeded. If warranted, temporary fences will be installed at the edges of waterbodies to prevent grazing cattle from disturbing the area before a mature vegetative cover is established and the banks stabilized
- Disturbed riparian areas should be reseeded with conservation grasses and legumes or native plant species, preferably woody species.
- Liquid mulch binders should be avoided within approximately 100 feet of waterbodies.

5.4 TRENCHLESS INSTALLATION

Trenchless installation is utilized to avoid direct impacts to sensitive features, provide efficient and safe installation across major waterbodies, and is used in areas where topography, soils, or other constraints deem conventional techniques unsuitable. In addition to sensitive environmental features trenchless installation methods will generally be used at major paved roads, highways, and railroads. There will be little or no disruption to traffic at road, highway or railroad crossings that are bored or HDD'd.

Construction across waterbodies, wetlands, public roads, highways, and railroads will be in accordance with the requirements of permit conditions. Major paved roads, highways and railroads generally will be crossed by bores or horizontal directional drilling (HDD) completed (see Appendix A). Geotechnical surveys, including geotechnical bores, are completed during the design phase to evaluate the success potential of an HDD at each particular location.

5.4.1 Bore

Boring requires the excavation of a pit on each side of the feature, the placement of boring equipment in the pit, then boring a hole under the feature/road at least equal to the diameter of the pipe. Once the hole is bored, the pipe will be pulled through the borehole.

5.4.2 HDD

An HDD requires a drill rig to be set up on one side to drill a small-diameter pilot hole from one side of the crossing (entry side) to the other (exit side).

- Drilling is achieved using a powered drill bit. The drilling fluid, commonly referred to as mud, is a mixture of water and bentonite (a naturally occurring clay mineral), which is pumped into the drill hole through the drill pipe during the drilling process.
- The pressure of the drilling mud will transmit hydraulic power through the drill bit, transport cuttings to the surface, lubricate the drill bit and stabilize the drill hole.
- Water, the main ingredient of drilling mud, may be obtained from the waterbody during drilling or trucked in from another source.

- Water use permits will be obtained prior to uptake as applicable.
- Small pits are dug at or near the entry and exit holes to temporarily store the mud and cuttings.
- The mud and cuttings is pumped from the temporary storage and properly disposed.

As drilling the pilot hole progresses, segments of drill pipe is inserted into the pilot hole to extend the length of the drill across and under the waterbody.

- The drill bit will be steered and monitored throughout the process to maintain the designated path of the pilot hole.
- Once the pilot hole is complete, a larger reaming tool will be attached to the end of the drill pipe on the exit side of the hole.
- The reamer is then drawn back through the pilot hole to the drill rig (entry side).
- Drill pipe sections are added to the rear of the reamer as it progresses toward the rig, thereby allowing a string of drill pipe to remain in the hole at all times.
- Multiple passes of consecutively larger reaming tools may be required before the hole is of sufficient size to pull though the pipeline segment.

The pipeline segment to be installed beneath the waterbody will be fabricated into one section on the ROW on the exit side of the crossing.

- The pipe segment is radiographically inspected and hydrostatically tested prior to installation.
- After the hole is completed, the pipeline segment will be attached to the drill pipe on the exit side of the hole and pulled through the drill hole toward the drill rig.

Once the pipeline is installed, excess drilling mud will be collected and disposed of in accordance with applicable permits and regulations. If water is left over from the drilling process, it may be discharged into a well-vegetated upland area utilizing the appropriate energy dissipation/sediment filtration device.

5.4.3 Inadvertent Returns

Ideally, the HDD process involves no disturbance to the bed or bank of the waterbody being crossed. However, if a natural fracture or void in the ground is encountered, an unexpected release of drilling mud could occur:

- Unconsolidated gravel, coarse sand, and fractured bedrock present paths that can run laterally or vertically and allow the flow of drilling mud.
- If drilling mud moves laterally, the release may not be evident on the ground whereas a flow path extending vertically from the drill hole to the surface may be visible.

- The volume of mud released will be dependent on a number of factors, including the size of the fault, the permeability of the geologic material, the viscosity of the drilling mud, and the pressure of the hydraulic drilling system.

Releases to surface generally occur above or near the drill path. In the event drilling mud is released on surface, including within a wetland, it could be readily contained with straw bales, silt fence, or berms. A small pit may be dug at the release site to contain its spread, and a pump be used to transfer the drilling mud from the pit and into a containment vessel.

A drilling mud release to a waterbody could be more difficult to contain because mud may be quickly dispersed into the water and carried downstream. In the event of a release to a waterbody:

- An attempt may be made to plug the escape route by lowering the drilling pressure and thickening the drilling mud with additional bentonite, or other non-hazardous materials that are compatible with the drill equipment being used.

- In-stream sediment barriers such as silt screens or small coffer dam type structures may be deployed to minimize impacts and facilitate remediation.

The contractor will develop a site specific Horizontal Directional Drilling Contingency Plan which describes the typical prevention, detection, monitoring, notification and corrective action procedures in the event of an inadvertent release of drilling fluid. These include monitoring of pressures and mud returns by qualified professionals for indications that mud may reach the surface, monitoring along the surface of drill path for visual signs of mud reaching the surface, and implementing appropriate mitigation measures. Mitigation measures can include incorporating an additive to the mud to decrease its viscosity and reducing down hole pressure.

In most cases, horizontal directional drilling can be completed in spite of an inadvertent drilling mud release. However, in rare situations, an HDD may be unsuccessful and crossing the waterbody with this method may be viable. The presence of outwash interspersed with boulders and cobbles, fractured bedrock, or non-cohesive coarse sands and gravels increase the likelihood an HDD may fail due to refusal of the drill bit or collapse of the bore hole in non-cohesive, unstable substrate.

5.5 DIFFICULT SOILS

To promote the optimum regrowth potential for areas with difficult soils, a detailed analysis of soils along the pipeline route should be conducted to assess areas which contain shallow soils, saline/sodic soils, droughty soils, highly erodible soils, and those with a high potential for flooding.

Slope, geomorphologic features, and vegetative cover should also be accounted for. U.S. Department of Agriculture Natural Resources Conservation Service field offices and other applicable state regulatory agencies can also provide knowledge of problem areas near the project and provide recommendations for site-specific mitigation and seed mixes which are best suited to produce a stable ROW and maximize regrowth potential.

5.5.1 Shallow Soils and Steep Soils

On steep slopes, shallow soils can be extremely erosive, limiting root depths and water storage capacity. These areas are referred to as shallow bedrock, and bedrock outcrop areas.

- Special site treatment during construction will allow the best chance of successful post-construction restoration.

- Special measures in these areas could consist of installation of erosion control blankets, maintaining topsoil through stripping/segregation, and hydroseeding, in addition to normal best management practices on slopes.

5.5.2 Salinity/Sodicity

Saline soils are the result of accumulated soluble salts in concentrations that can prevent plants from taking water and therefore severely limit germination potential. Sodic soils are the result of accumulated sodium which crusts at the ground surface.

- Plant germination and the potential for root penetration is typically greatly reduced in these areas.

- In many areas these soils are found together and are therefore discussed together in this plan.

- Depending on conditions, these soils may require that the non-saline topsoil, non-saline subsoils, and saline subsoil and/or rock be kept separate.

- This determination will be made prior to construction based on a soil salinity map prepared from the SSURGO2 digital Soil Survey.

- Soil amendments or topsoil supplementation will be evaluated on a case-by-case basis in these areas to ensure successful revegetation.

5.5.3 Droughty Soils and Flooding Soils

Droughty soils occur as a result of soil texture, landscape position, aspect and slope and occur in several areas along the pipeline route. They typically occur in south and west aspects, sandy flat areas, and steep slope areas with limited water holding capacity where run off is a problem. Flooding soils include waterbody "low bottoms", floodplains, and wetlands. These areas are addressed as flooding or unstable areas. Construction procedures used to minimize impacts in droughty soils and flooding soils are addressed by implementing ECDs in respective areas and addressed throughout this document.

5.6 SIDE SLOPE CUTTING AND STEEP TERRAIN

Side slope cutting may be necessary in rough, steep terrain, and in areas where rerouting the pipeline is not feasible due to mitigating factors such as sensitive resource avoidance, collocation, etc.

- Where the pipeline crosses laterally along the side of a slope, cut and fill grading (two-tiered ROW) may be required to obtain a safe, flat work terrace. See Figure HGS-BMP-032.

- Temporary sediment barriers such as silt fence and straw bales would be installed during clearing to prevent the movement of disturbed soil into wetlands, waterbodies, or other environmentally sensitive areas in steep terrain.

- Temporary slope breakers would be installed across and along the ROW during grading where warranted and maintained throughout construction and sometimes permanently during restoration.

- Where topsoil is salvageable (i.e. more than a few inches and able to be segregated for use in restoration) would be stripped from the entire ROW and stockpiled prior to cut-and-fill grading on steep terrain.

Generally, on steep side slopes, soil from the high side of the ROW will be excavated and moved to the low side of the ROW to create a safe and level work surface.

In forested areas the ROW will generally be 85 feet in width to minimize clearing of woody vegetation. In forested areas with steep slopes the ROW may be increased to up to 150 feet in width as necessary to provide safe working conditions.

After the pipeline is installed, the soil from the low side of the ROW will be returned to the high side, and the slope's original contours will be restored to the extent practical. See Appendix A for workspace requirements and layout.

5.6.1 Stockpiling

On steep slopes where topsoil, debris, and rock cannot be conventionally stockpiled at the edges of the construction ROW, the material may be pushed to near-by ATWS until used during restoration or hauled offsite for disposal and replaced with hauled-in topsoil (the latter of which is not anticipated for the Heartland Greenway).

5.6.2 Temporary and Permanent Slope Breakers and Trench Breakers

Temporary slope breakers and trench breakers in areas of steep terrain and side slope cuts will be spaced at intervals as necessary (see Figure HGS-BMP-014 and 015). A temporary breaker may be installed 10 to 30 feet from the crest of a slope to act as a reference point for spacing the remaining breakers. Temporary slope breakers may be omitted where the surface is predominately rock and the potential for erosion is minimal.

Permanent slope and trench breakers will be installed on steep slopes similarly to those described for temporary slope and trench breakers. Where the ground surface is naturally rocky and resistant to erosion, permanent breakers may be omitted or the spacing increased as feasible.

5.6.3 Recontouring and Slope Reduction

Special attention will be given to shaping the construction ROW to direct runoff into existing drainages off the ROW.

- Cut and fill slopes may have the slope reduced to 3:1 or 4:1 ratio or to match the adjacent utility ROW to aid in reclamation and stabilization.

- If necessary, energy dissipation devices will be installed at the bases of cut and fill slopes to prevent scour in adjacent steep banks not located in the construction ROW.

5.6.4 Rock Mulch

Rock mulch may be used to control erosion in areas that have a native gravel, cobble, boulder, or bedrock surface or extremely shallow soils. While not expected on the Heartland Greenway, the following measures should be included if warranted.

- Rock salvaged and stockpiled from these areas during construction will be distributed over the construction ROW during restoration and seeded with broadcast seeder.

- The gaps in the rocks will provide a micro environment beneficial to seed germination by allowing moisture to collect and provide protection from wind.

- A rock cover will also blend the construction ROW into undisturbed areas.

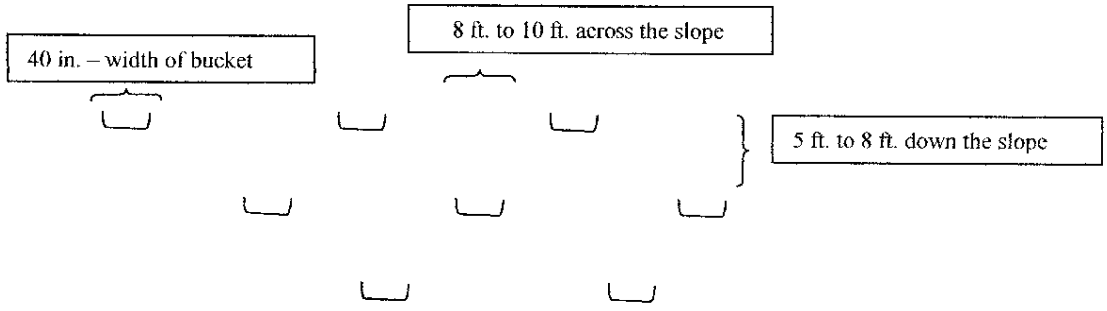
5.6.5 Pocking

In areas where slope is 10 percent or greater, a technique called pocking is often used in lieu of mulch and erosion control fabrics may not be used. Pocking creates a seedbed which is conducive to the establishment of permanent vegetative cover that will stabilize steep areas, provide forage for wildlife, and create an aesthetically compatible reclaimed ROW to that of adjacent areas.

- Pocking involves creating a series of regularly spaced depressions, or mini terraces, using a backhoe.

- The depressions are the width of a standard backhoe bucket and are approximately 8 inches to 12 inches in depth.

- The following schematic outlines generally how the pocking technique occurs.



- The small depressions retain water runoff, creating a more mesic site to facilitate seed germination and subsequent seedling establishment.

- They also minimize the potential for rill and gullies to form by diverting runoff and retaining a large portion of collecting precipitation.

- The depressions are offset from one another in order to minimize the potential that lower terraces would fail should a terrace above it fail.

- Where pocking is used, permanent slope breakers will typically not be used.

6.0 WINTER CONSTRUCTION

Winter weather conditions present unique circumstances that should be accounted for in how construction, stabilization, and installation is executed. Heartland Greenway anticipates construction to be well underway in advance of winter weather conditions, which include snow, frozen soils, and cold weather. However, the construction schedule is dependent on the timing necessary permits are issued. The definition of winter construction is variable based on the region and typically applies when any of the following conditions occur:

- The ground is frozen and plating of topsoil occurs;
- Equipment slippage from operating on frozen ground results in scalping plant root systems;
- Vehicles slide outside established ROW clearing limits;
- Road crossings cannot be adequately compacted;
- Topsoil is frozen and cannot be separated from sub-grade material;
- Stockpiled backfill material freezes to the extent that adequate compaction becomes difficult;
- Topsoil stockpiles are frozen and cannot be uniformly redistributed across disturbed areas.

Generally, the following procedures and considerations are implemented during frozen soil conditions, defined as when frost has penetrated the depth of the boundary between topsoil and subsoil on most agricultural lands.

6.1 SNOW AND COLD WEATHER MANAGEMENT

- Snow, when present, may be stored over the trench line prior to excavation to prevent deep frost penetration in areas requiring excavation. Remove this snow and stockpile separately prior to topsoil removal and trenching activities.
- Snow not packed or used to prevent deep frost should be graded/pushed off the ROW to ensure sufficient workspace. Gaps in the windrowed snow should be left at obvious drainage crossings.
- Snow may be removed from the travel lane prior to grading to improve driving conditions.
- Additional ATWS may be warranted to manage snow piles which would be stockpile much like soil is managed.
- Soils and snow should not be mixed.
- Gaps should be left in windrowed snow at drainage crossings in access roads.
- Limit snow removal from the spoil side until trenching activities begin.
- Place subsoil on straw layer to minimize soil mixing in the event the spoil pile freezes and is left over winter.
- Remove excess snow that could interfere with trench backfilling operations.
- Special attention to equipment and parts and hoses that may be prone to freezing.

6.2 SOIL HANDLING AND TRENCHING

- Complete topsoil segregation in advance of frozen conditions when practical. If not practical, limit frozen topsoil stripping activities to equipment capable of accurately stripping variable depths of topsoil. Specialized equipment such as soil rippers may be warranted to effectively segregate topsoil.
- Include breaks at drainage crossings in the topsoil or spoil piles left over-winter to allow runoff and snowmelt to be diverted and minimize interference with spring runoff.
- Suspend final clean-up activities and topsoil placement if stored/reserved topsoil is frozen and cannot be uniformly redistributed across the ROW until conditions allow for proper management.
- Apply temporary ROW stabilization procedures as ground conditions permit
- Where final clean up and restoration has not been completed, leave the ROW in a significantly roughened condition to reduce potential for erosion during snowmelt.
- Minimize the amount of open trench to prevent the result of winter weather conditions penetrating trench walls.

6.3 TEMPORARY AND PERMANENT EROSION CONTROL METHODS

Type, installation method and placement of ECDs may be modified for effectiveness.

- Install additional ECDs in advance of frozen conditions for ease and effectiveness of installation
- When soils are frozen, utilize erosion control measures such as diversion berms made from excavated soil dykes across slope, mulching, silt fence, straw bales, and/or sandbags.
- Install silt fence in frozen soils with “ditch witch” trencher, placing silt fence and wooden stakes (hammered below frost line) in the narrow trench, then backfill and effectively tamp with trench cuttings.
- Anchor hay bales with rebar instead of wooden stakes as needed.
- Install ECDs at locations indicated in the erosion control procedures (Section 4.4). Consider winter/spring rains and snowmelt when sizing, locating, and installing and ECDs.
- Unreclaimed soil surfaces and remaining soil piles left over winter or expected to be in place during thaw conditions should be stabilized with weed free straw mulch applied at a rate of 2.0 tons per acre and sprayed with water to freeze in in lieu of crimping. If significant snow cover exists, the decision to apply mulch may be determined by the EIs.
- Remove temporary bridges and mats before the contractor leaves the ROW for the winter as practical and store on the ROW in a secure upland area near the crossing for spring re-installation.
- Design equipment crossings remaining in place for spring/summer cleanup to be stable in thawing conditions and to handle maximum predicted spring runoff flows.
- Maintain ECDs for effectiveness throughout the winter season even if active construction is not occurring, paying particular to areas of slope instability and areas where notable erosion is occurring or could occur.

6.4 LOWERING IN AND BACKFILL

If installation is nearing or complete prior to winter conditions and restoration will resume in spring, complete as much backfill and rough grading prior to deep freezing freezing/snow to minimize soil erosion (leaving roughened ground conditions).

If working into or through winter conditions consider the following:

- Perform lowering in as soon as practical after trenching to minimize the time the trench is open and can prevent the result of winter weather conditions penetrating trench walls.
- Clear the trench of excessive snow prior to lowering in while limiting the mixing of snow with spoil material.
- Backfill trench with unfrozen soil as practical. The first several inches of frozen subsoil may have to be removed from the spoil piles to expose unfrozen soil.
- If subsoil is substantially frozen, first break it up as much as practical for backfilling the trench. These areas should be inspected and settled areas repaired the following spring using remaining spoil or by regrading.
- Backfilling activities should directly follow lowering-in activities to prevent the infill of snow in the trench and reduce excessive freezing of spoil piles. Regrade ROW immediately following backfilling.
- The final clean-up schedule will vary, depending on ground conditions and time of construction. The EI should determine if spring thaw reclamation activities are required.

6.5 TRENCH DEWATERING AND HYDROSTATIC TEST DISCHARGES

Discharged water will not percolate into frozen ground the same way it would during non-frozen conditions. Additional considerations should be made when dewatering during winter weather conditions.

- Water appropriation from surface water streams may be limited due to reduces winter flow conditions. Withdrawal only in accords with permit conditions; if no permit is required, coordinate with the EI and CM to ensure withdrawal rate and volume is practical and will not negatively impact downstream conditions. Alternately secure a different source.
- Carefully consider the locations where discharged water is being done and where the water may the runoff potential. Be mindful that water may run beneath snow piles causing erosion. Consider permits to direct discharge clean water into surface features if feasible.
- Filter bags may be subject to freeze and straw bale dewatering structures may need to be replaced regularly due to freezing.
- Consider the volume of water discharged and the resulting frozen temporary pond, which may remain until spring thaw.
- Consider broadcast dewatering in lieu of or in combination with dewatering structures
- Consult with ROW and respective landowners to obtain permission for winter discharge of dewatering or hydrostatic test water.

6.6 MONITORING OVERWINTER AND POST-CONSTRUCTION

- Monitor and maintain ECDs for effectiveness throughout the winter season even if active construction is not occurring, paying particular to areas of slope instability and where significant levels of erosion can or are are occurring.
- The extent of inspections should be based on precipitation events, runoff amounts, and anticipated or experienced thawing. When snow melts or the ground thaws, the potential for erosion increases and the frequency of inspections should also increase.
- Corrective actions may be deferred until spring where no sensitive resources are impacted, where access is not feasible, or where damage from accessing the site would outweigh the benefits of correcting the issue during the winter (e.g. install extra silt fence or hay bales to manage areas of rill erosion until equipment can travel/operate on soils when not excessively wet, of when bridges are reinstalled to gain access to areas warranting repairs).

6.7 SPRING THAW CONDITIONS

- Avoid working in excessively wet soils with heavy equipment.
- Use lighter equipment, equipment mats, or defer work until conditions are more suitable
- Postpone construction activities until evening or early morning in problem areas, when ground conditions are frozen.
- Suspend construction in unsuitable areas.

6.8 WET WEATHER SHUTDOWN AND RUTTING

During construction, certain activities may be suspended in wet soil conditions and largely based on consideration of the following factors:

- extent of surface ponding;
- extent and depth of potential rutting and mixing of soil horizons;
- areal extent and location of potential rutting and compaction (i.e., can traffic be rerouted around wet area); and
- type of equipment and nature of the construction operations proposed for that day.

The EIs, in collaboration with chief inspectors and construction management, will ultimately decide if wet weather shutdown is necessary in a given location.

In areas where topsoil has not been removed, rutting from construction equipment should be considered excessive if greater than 4 inches. Topsoil removal techniques may be modified to remedy topsoil rutting. Rutting stipulations should not apply in areas where topsoil removal has occurred.

7.0 BLASTING

While blasting is not anticipated for proper, safe, or efficient construction of the Project, if deemed necessary the following measures can be implemented to minimize impacts.

- Site specific blast plan including explosives safety program will be developed, inspected/monitored for compliance.
- Occur only in areas where the rock cannot be economically excavated by conventional means
- No blasting within a min of 200 feet of existing pipeline or structures
- Residents within a min of 1,300 feet of the blast will be notified one day before the blast day. No evacuation would be expected as that is typically reserved for occupation within 50 feet and there are no occupants within 200+ feet of the project.
- Necessary measures should be taken to exclude livestock from the blasting area. During the normal safety check prior to blasting, the area will be checked for both livestock and wildlife. The blast will not be initiated until the area is clear.
- All shots will be designed by a licensed blaster to ensure safety, and also supervised by the licensed blaster.
- Measures to control fly rock will be implemented and may include matting and/or padding, non-bridging minus 3/8" crushed rock stemming material
- Seismograph machines should be used during monitoring of the blast and strategically placed at a 'point of interest' (i.e. well, foundation, utility lines), and peak particle velocity recorded.

Following the required waiting period after each shot, the blast area will be inspected for any indication of fire or fire hazard.

8.0 ABOVE GROUND FACILITIES

For above ground facility locations, booster stations and launcher/receiver sites, the size and configuration of workspace and permanent footprint may vary and is dependent site specific conditions including land use, topography and facility design. If the facility parallels a waterbody, attempt to maintain at least 15 feet of undisturbed vegetation between the waterbody and the ROW except at the crossing location. Where waterbodies are adjacent to the construction ROW, install sediment barriers along the edge of the construction ROW as necessary to contain spoil and sediment within the ROW; maintain ECDs until restoration is successful or in compliance with applicable permits.

Booster stations are approximately 10 acres and launcher/receiver sites vary based on the number of equipment to be installed and vary between 2 and 4 acres. Construction activities at each of these types of facilities are similar and include a standard sequence of activities. These include clearing and grading, installing foundations, underground connections, and installation of equipment.

Impacts to workspace used for facilities is materially similar to how it is used and includes clearing and grading (including topsoil segregation where appropriate). And restoration includes regrading, decompaction and topsoil replacement where necessary, and revegetation as warranted.

Sites are cleared of vegetation and graded as necessary to create a safe, efficient, generally level surface for maneuvering construction equipment and to prepare the area for any foundations. ECDs will be installed and maintained where warranted and in accordance with permits, plans and landowner agreements to minimize erosion and sedimentation.

Topsoil should be stripped and segregated from disturbed areas, especially in areas that are likely to be used for non-industrial purposes following completion of construction. Reserve soil stored on site should be stabilized as described for pipeline construction.

All disturbed areas will be restored. Areas outside the facility footprint should be regraded, decompacted, and revegetated as necessary. Areas within the footprint of the facility that are not paved nor foundations will be rocked or revegetated.

9.0 POST CONSTRUCTION

9.1 MONITORING

Following completion of the project, follow-up inspections of disturbed areas are conducted to determine the success of revegetation in accordance with applicable rules, regulations and permit conditions. Monitoring can take place via pedestrian, aerial, and/or drone surveillance and consists of observations for revegetation, drainage, subsidence, erosion, contouring. Problem areas should be timely addressed taking into consideration land use, soil and weather conditions/time of year (e.g. in agricultural areas accounting for planting and harvesting timing, seasonal timing for reseeding, avoiding wet weather conditions to protect soil structure, etc).

- Revegetation in non-agricultural areas is considered successful if upon visual survey the density and cover of non-nuisance vegetation are similar in density and cover to adjacent undisturbed lands; and in agricultural areas, revegetation shall be considered successful when crop growth and vigor are similar to adjacent undisturbed portions of the same field.
- The ROW surface condition should appear similar to adjacent undisturbed lands, absent of construction debris.
- Restoration of drainage patterns as observed by contours materially reflecting pre-construction conditions and aligning with adjacent undisturbed areas, lack of notable areas of settling, ponding, crowning, erosion on ROW or downstream adjacent to the ROW (surface) or up/downstream ponding reflecting subsurface drain tile.

Records will be kept that identify by tract or milepost:

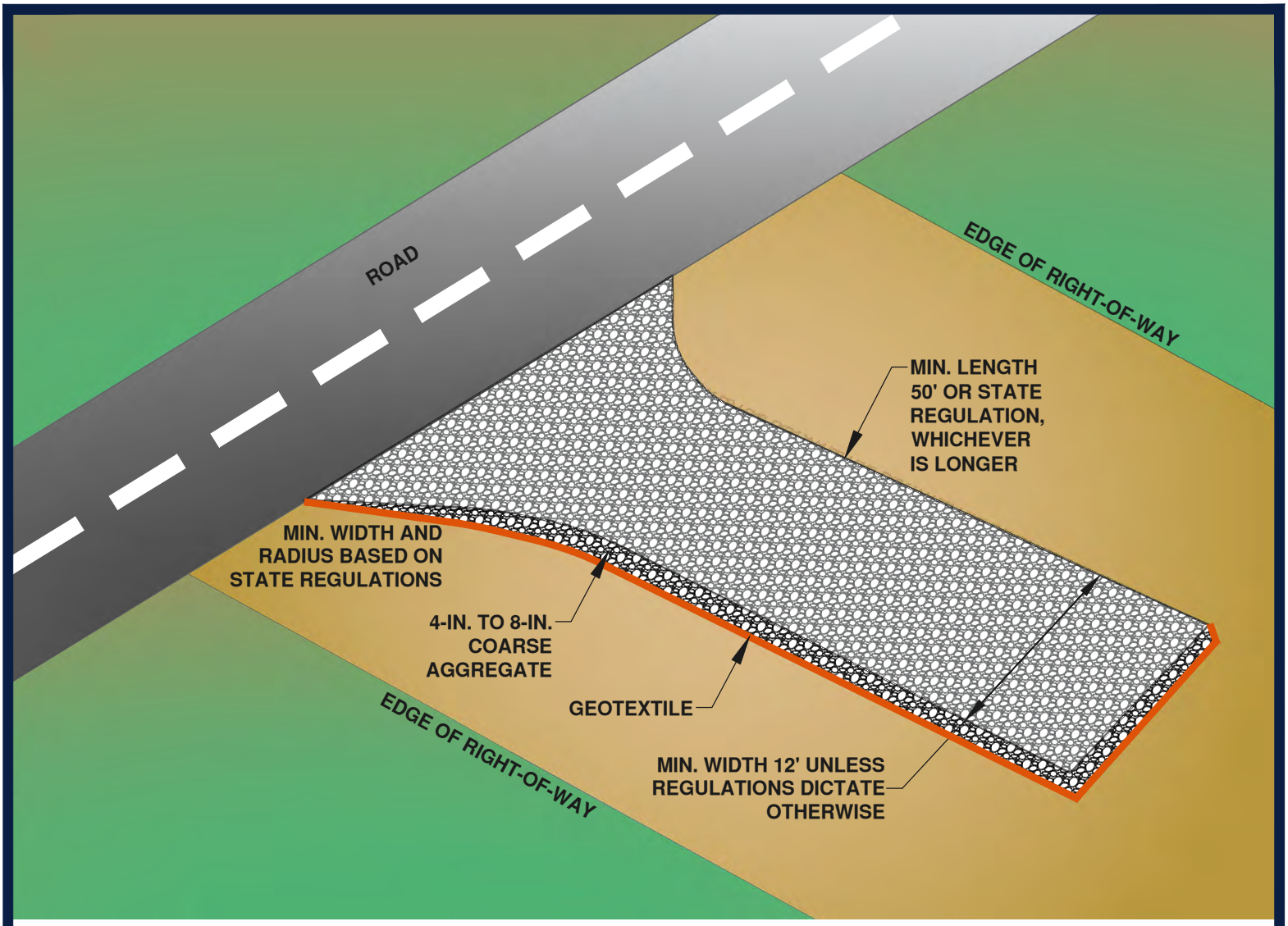
- method of application, application rate, and type of fertilizer, pH modifying agent, seed, and mulch used;
- acreage treated;
- dates of backfilling and seeding;
- names of landowners requesting special seeding treatment and a description of the follow-up actions;
- the location of any subsurface drainage repairs or improvements made during restoration; and
- any problem areas and how they were addressed.

9.2 MAINTENANCE

Routine vegetation mowing or clearing over the partial width of the permanent ROW in non-agricultural uplands is typically not done more frequently than every 3 years. However, to facilitate periodic corrosion/leak surveys, a corridor generally 10 feet in width centered on the pipeline may be cleared at a higher frequency to maintain the 10-foot corridor in an herbaceous state.

Appendix A

Best Management Plan Figures



NOTES:

1. REMOVE TOPSOIL PRIOR TO INSTALLATION OF STABILIZED CONSTRUCTION ENTRANCE. EXTEND ROCK OVER FULL WIDTH OF ENTRANCE.

2. DRIVABLE BERM SHALL BE INSTALLED WHEREVER OPTIONAL CULVERT PIPE IS USED AND PROPER PIPE COVER AS SPECIFIED BY MANUFACTURER IS NOT OTHERWISE PROVIDED. PIPE SHALL BE SIZED APPROPRIATELY FOR SIZE OF DITCH CROSSED.

3. MAINTENANCE: STABILIZED CONSTRUCTION ENTRANCE THICKNESS SHALL BE CONSTANTLY MAINTAINED TO SPECIFIED DIMENSIONS BY ADDING ROCK. ALL SEDIMENT DEPOSITED ON PAVED ROADWAYS SHALL BE ROUTINELY REMOVED AND RETURNED TO THE CONSTRUCTION SITE.

4. IF EXCESSIVE AMOUNTS OF SEDIMENT ARE DEPOSITED ON ROADWAY, EXTEND LENGTH OF STABILIZED CONSTRUCTION ENTRANCE BY 50-FT INCREMENTS UNTIL CONDITION IS ALLEVIATED OR INSTALL WASH RACK. WASHING THE ROADWAY OR SWEEPING DEPOSITS INTO ROADWAY DITCHES, OR OTHER DRAINAGE COURSES REQUIRES ADDITIONAL EROSION CONTROL DEVICES TO PROTECT DOWNSTREAM OF THE DITCH; SWEEPING INTO SEWERS IS NOT ALLOWED.

5. INSTALL CULVERTS, IF NECESSARY. CULVERT SIZE SHOULD MATCH THOSE UPSTREAM OR DOWNSTREAM OF INSTALLATION LOCATION, AND TO FACILITATE EXPECTED FLOW VOLUMES, AND/OR PER COUNTY SPECIFICATIONS.

EXAMPLE PHOTOGRAPH

HEARTLAND GREENWAY

HGS-BMP-001

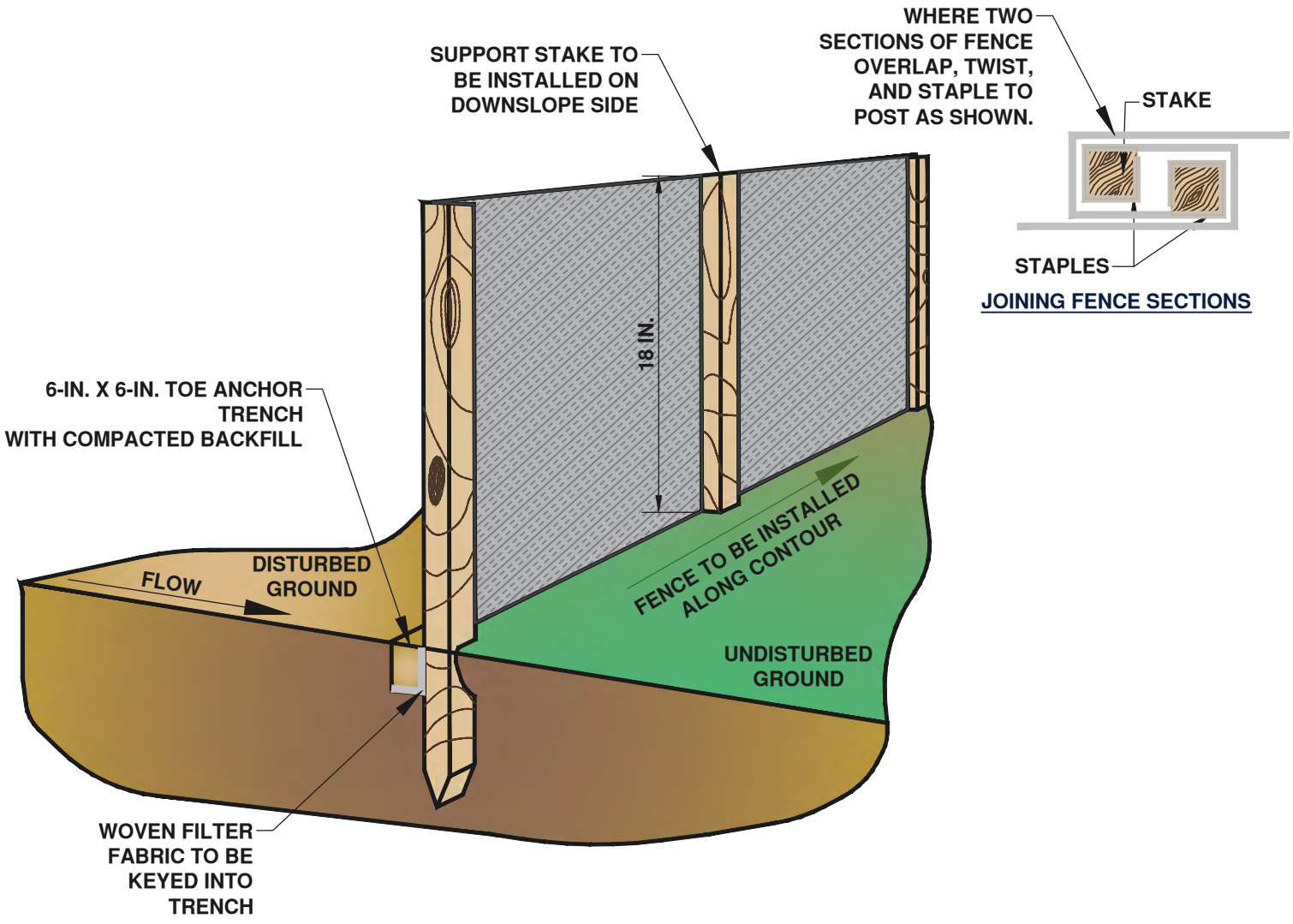
STABILIZED CONSTRUCTION ENTRANCE

NOT TO SCALE

Navigator CO_2

TYPICAL CONSTRUCTION DETAIL

MAY 2022



JOINING FENCE SECTIONS

NOTES:

1. FABRIC WIDTH SHALL BE 30 IN. MIN. STAKES SHALL PLACED AT MAX. 8-FT. INTERVALS. STAKES SHALL BE HARDWOOD (2-IN. X 2-IN. [+/- 3/8-IN.]) OR EQUIVALENT STEEL (U OR T) STAKES.
2. SILT FENCE SHALL BE PLACED AT LEVEL EXISTING GRADE, ON CONTOUR. BOTH ENDS OF THE FENCE SHALL BE EXTENDED AT LEAST 8 FT. UP SLOPE AT 45 DEGREES TO THE MAIN FENCE ALIGNMENT.
3. SEDIMENT SHALL BE REMOVED WHEN ACCUMULATIONS REACH HALF THE ABOVE-GROUND HEIGHT OF THE FENCE.
4. ANY UNDERMINED OR TOPPED SECTION OF SILT FENCE SHALL BE IMMEDIATELY REPLACED WITH A ROCK FILTER OUTLET.
5. FENCE SHALL BE REMOVED AND PROPERLY DISPOSED OF WHEN TRIBUTARY AREA IS PERMANENTLY STABILIZED.

EXAMPLE PHOTOGRAPH

HEARTLAND GREENWAY

HGS-BMP-002

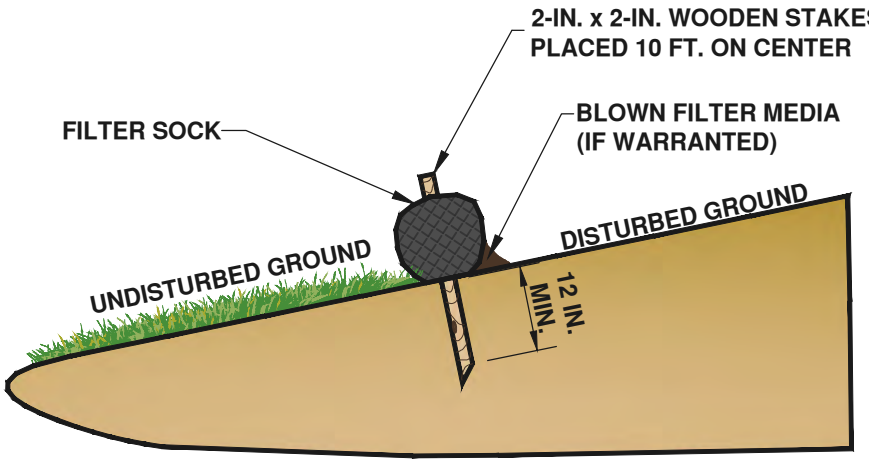
STANDARD SILT FENCE (18" HIGH)

NOT TO SCALE

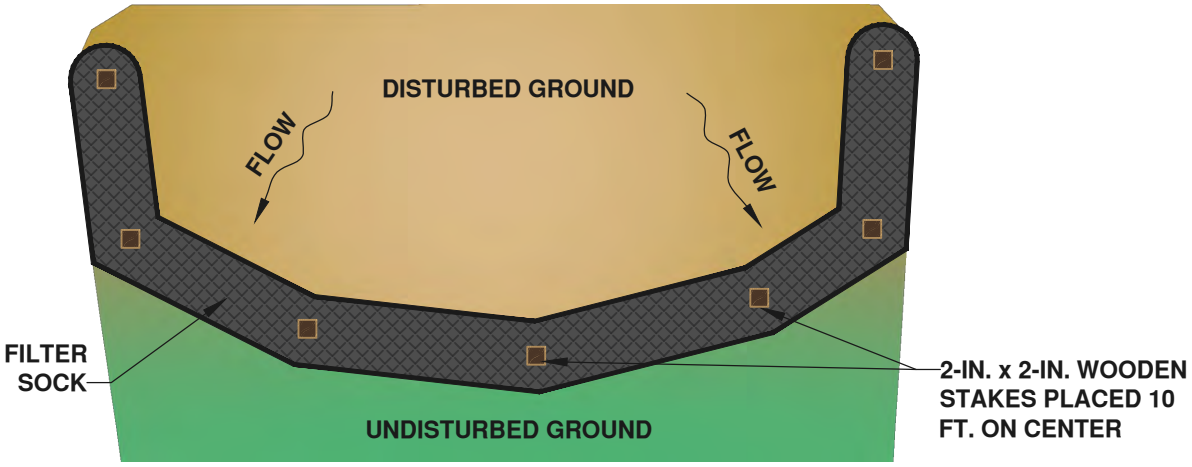
Navigator CO_2

TYPICAL CONSTRUCTION DETAIL

MAY 2022



SECTION VIEW



PLAN VIEW

NOTES:

1. FILTER SOCK SHALL BE PLACED AT EXISTING LEVEL GRADE. BOTH ENDS OF THE BARRIER SHALL BE EXTENDED AT LEAST 8 FT. UP SLOPE AT 45 DEGREES TO THE MAIN BARRIER ALIGNMENT. MAXIMUM SLOPE LENGTH ABOVE ANY BARRIER SHALL NOT EXCEED THAT SPECIFIED FOR THE SIZE OF THE SOCK AND THE SLOPE OF ITS TRIBUTARY AREA.
2. PROHIBIT TRAFFIC FROM CROSSING FILTER SOCKS.
3. ACCUMULATED SEDIMENT SHALL BE REMOVED WHEN IT REACHES 1/2 THE ABOVE-GROUND HEIGHT OF THE BARRIER AND DISPOSED IN THE MANNER DESCRIBED ELSEWHERE IN THE PLAN.
4. DAMAGED SOCKS SHALL BE REPAIRED ACCORDING TO MANUFACTURER'S SPECIFICATIONS OR REPLACED WITHIN ~24 HOURS OF IDENTIFICATION.
5. BIODEGRADABLE FILTER SOCKS SHALL BE REPLACED AFTER APPROXIMATELY 6 MONTHS; PHOTODEGRADABLE SOCKS AFTER APPROXIMATELY 1 YEAR. POLYPROPYLENE SOCKS SHALL BE REPLACED ACCORDING TO MANUFACTURER'S RECOMMENDATIONS.
6. UPON STABILIZATION OF THE UPLAND AREA OF THE RIGHT-OF-WAY, THE SOCK AND STAKES SHALL BE REMOVED. THE SOCK MAY BE LEFT IN PLACE AND VEGETATED OR REMOVED. IN THE LATTER CASE, THE MESH SHALL BE CUT OPEN AND THE MULCH SPREAD AS A SOIL SUPPLEMENT.
7. COMPARED TO FILTER SOCK, SWITCHSOCK HAS THE SAME SEDIMENT CAPACITY AND NETTING AND IS AVAILABLE PRE-FILLED FOR 8-IN. THROUGH 24-IN. DIAMETERS. THE ASSOCIATED WEIGHT PER PALLET FOR A SWITCHSOCK IS 650 LB. VERSUS 1750 LB. FOR A PALLET OF SIMILARLY SIZED SILTSOCK, AND AS SUCH IS TYPICALLY PREFERRED IN AREAS WHERE THE PROXIMAL DISTANCE FOR BMP INSTALLATION IS LARGE.
8. FOR SIZING SPECIFICATIONS REFER TO DETAIL #04

EXAMPLE PHOTOGRAPH

HEARTLAND GREENWAY

HGS-BMP-003

FILTER SOCK

NOT TO SCALE

Navigator CO_2

TYPICAL CONSTRUCTION DETAIL

MAY 2022

MATERIAL TYPE	3 mil HDPE	5 mil HDPE	5 mil HDPE	MULTI-FILAMENT POLYPROPYLENE (MFPP)	HEAVY-DUTY MULTI-FILAMENT POLYPROPYLENE (HDMFPP)
MATERIAL CHARACTERISTICS	PHOTO-DEGRADABLE	PHOTO-DEGRADABLE	BIO-DEGRADABLE	PHOTO-DEGRADABLE	PHOTO-DEGRADABLE
SOCK DIAMETERS	12" & 18"	12", 18", 24", 32"	12", 18", 24", 32"	12", 18", 24", 32"	12", 18", 24", 32'
MESH OPENING	3/8"	3/8"	3/8"	3/8"	1/8"
TENSILE STRENGTH	26 PSI	26 PSI	26 PSI	44 PSI	202 PSI
UV STABILITY % ORIGINAL STRENGTH (ASTM G-155)	23% AT 1000 HR.	23% AT 1000 HR.	23% AT 1000 HR.	100% AT 1000 HR.	100% AT 1000 HR.
MINIMUM FUNCTIONAL LONGEVITY	6 MONTHS	9 MONTHS	6 MONTHS	1 YEAR	2 YEARS
TWO-PLY SYSTEMS					
INNER CONTAINMENT NETTING	HDPE BIAXIAL NET CONTINUOUSLY WOUND FUSION-WELDED JUNCTURES 3/4" X 3/4" MAXIMUM APERTURE SIZE				
OUTER FILTRATION MESH	COMPOSITE POLYPROPYLENE FABRIC (WOVEN LAYER & NON-WOVEN FLEECE MECHANICALLY FUSED VIA NEEDLE PUNCH) 3/16" MAXIMUM APERTURE SIZE				

Compost Sock Fabric Minimum Specifications

MATERIAL TYPE	3 mil HDPE	5 mil HDPE	5 mil HDPE	MULTI-FILAMENT POLYPROPYLENE (MFPP)	HEAVY DUTY MULTI-FILAMENT POLYPROPYLENE (HDMFPP)
MATERIAL CHARACTERISTIC	PHOTO-DEGRADABLE	PHOTO-DEGRADABLE	BIO-DEGRADABLE	PHOTO-DEGRADABLE	PHOTO-DEGRADABLE
SOCK DIAMETERS	12" 18"	12" 18" 24" 32"	12" 18" 24" 32"	12" 18" 24" 32"	12" 18" 24" 32"
MESH OPENING	3/8"	3/8"	3/8"	3/8"	1/8"
TENSILE STRENGTH	26 psi	26 psi	26 psi	44 psi	202 psi
UV STABILITY % ORIGINAL STRENGTH (ASTM G-155)	23% AT 1000 hr.	23% AT 1000 hr.	23% AT 1000 hr.	100% AT 1000 hr.	100% AT 1000 hr.
MINIMUM FUNCTIONAL LONGEVITY	6 MONTHS	9 MONTHS	6 MONTHS	1 YEAR	2 YEARS
TWO-PLY SYSTEMS					
INNER CONTAINMENT NESTING	HDPE BIAXIAL NET CONTINUOUSLY WOUND FUSION-WELDED JUNCTURES 3/4" X 3/4" MAX APERTURE SIZE				
OUTER FILTRATION MESH	COMPOSITE POLYPROPYLENE FABRIC (WOVEN LAYER AND NON-WOVEN FLEECE MECHANICALLY FUSED VIA NEEDLE PUNCH 3/16" MAX APERTURE SIZE				

Filtrexx & JMD

Compost Standards

ORGANIC MATTER CONTENT	80% - 100% (DRY WEIGHT BASIS)
ORGANIC PORTION	FIBROUS AND ELONGATED
pH	5.5 - 8.0
MOISTURE CONTENT	35% - 55%
PARTICLE SIZE	98% PASS THROUGH 1" SCREEN
SOLUBLE SALT CONCENTRATION	5.0 dS/m (mmhos/cm) MAXIMUM

Filtrexx

Slope Percent	Maximum Slope Length above Sediment Control in Feet					
	5" Sock	8" Sock	12" Sock	18" Sock	24" Sock	32" Sock
2 or less	180	300	375	500	650	850
5	120	200	250	275	325	400
10	60	100	125	150	200	275
15	42	70	85	100	160	225
20	30	50	65	70	130	180
25	24	40	50	55	100	150
30	18	30	40	45	65	100
35	18	30	40	45	55	75
40	18	30	40	45	50	60
45	12	20	25	30	40	50
50	12	20	25	30	35	40
All lengths are based on a 2"-24 hour rainfall event						
Adapted from Filltrexx Table 1.4						

HEARTLAND GREENWAY

HGS-BMP-004

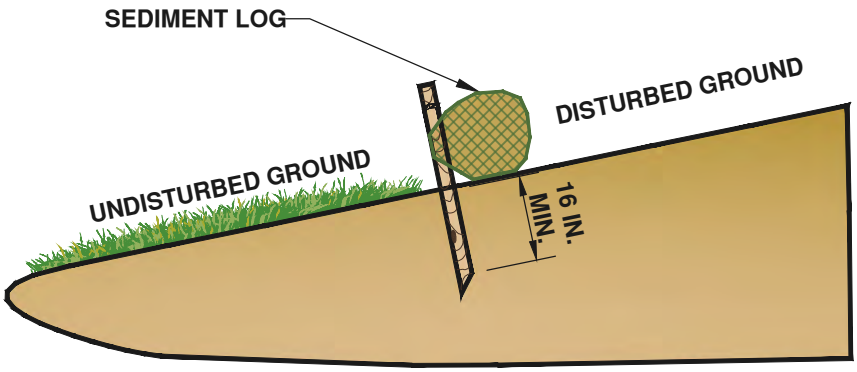
FILTER SOCK SIZING AND SPECIFICATIONS

NOT TO SCALE

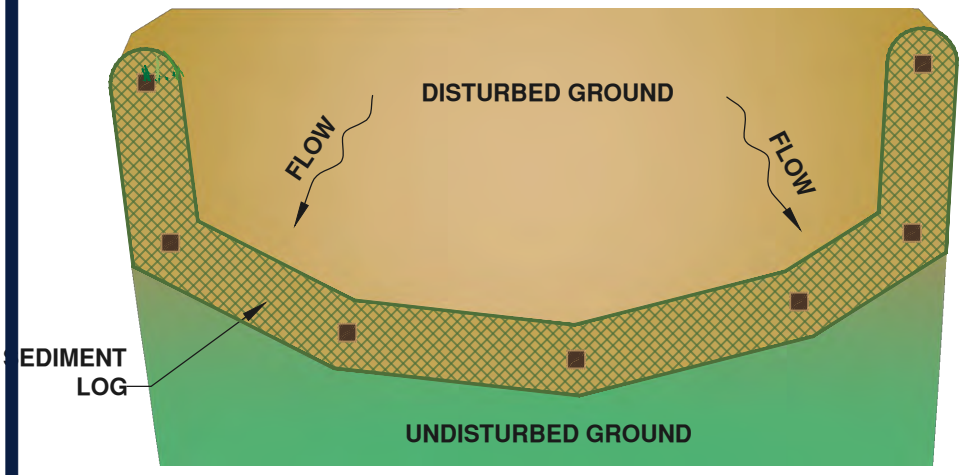
Navigator CO_2

TYPICAL CONSTRUCTION DETAIL

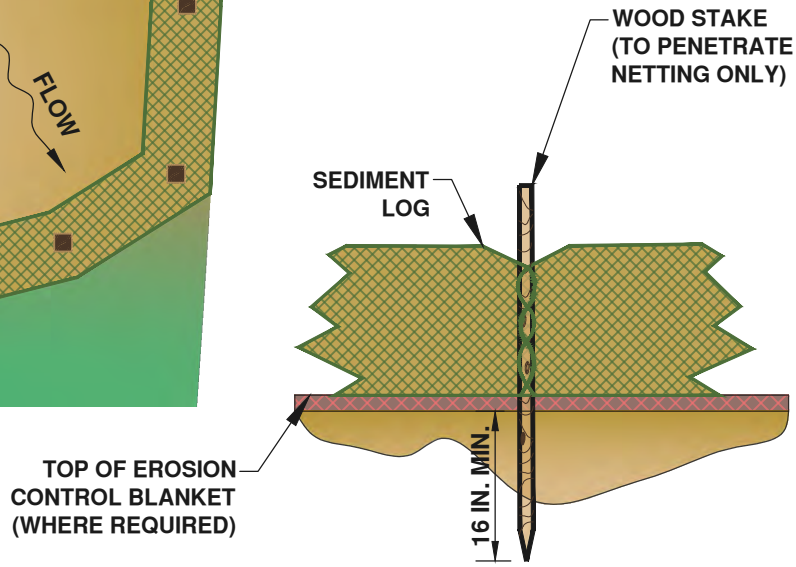
MAY 2022



SECTION VIEW



PLAN VIEW



STAKING DETAIL

NOTES:

1. STAKES SHALL BE WOODEN 1 $\frac{1}{8}$ IN. WIDE BY 1 $\frac{1}{8}$ IN. THICK BY A MINIMUM OF 30 IN. LONG FOR 6 IN. 9 IN. AND 12 IN. CURLEX SEDIMENT LOGS AND 48 IN. LONG FOR 20 IN. SEDIMENT LOGS.
2. 6 IN. AND 9 IN. SEDIMENT LOGS MAY ALSO BE ANCHORED WITH E-STAPLES, 1 IN. BY 6 IN. U SHAPED, 11 GAUGE WIRE STAPLES. STAKES MAY BE USED IN CONJUNCTION WITH STAPLES FOR ADDITIONAL ANCHORING OF 6 IN. AND 9 IN.L CURLEX SEDIMENT LOGS AS DEEMED NECESSARY BY THE ENGINEER.
3. WOOD STAKE INSTALLATION SHALL ONLY PENETRATE THE NETTING AND NOT THE CURLEX SEDIMENT LOG MATERIAL.
4. FOR ADDITIONAL SPECIFICATIONS SEE DETAIL #29.

EXAMPLE PHOTOGRAPH

HEARTLAND GREENWAY

HGS-BMP-005

SEDIMENT LOG

NOT TO SCALE

Navigator CO_2

TYPICAL CONSTRUCTION DETAIL

MAY 2022

Specified Expected Values			
Diameter	**10 ft. length**	**20 ft. length**	**25 ft. length**
9"	25.0 lbs. 2.5 lbs/ft 5.8 lbs/ft^3	50.0 lbs. 2.5 lbs/ft 5.7 lbs/ft^3	62.5 lbs. 2.5 lbs/ft 5.7 lbs/ft^3
12"	30.0 lbs. 3.0 lbs/ft 4.0 lbs/ft3	60.0 lbs. 3.0 lbs/ft 3.9 lbs/ft3	75.0 lbs. 3.0 lbs/ft 3.9 lbs/ft3
18"	50.0 lbs. 5.0 lbs/ft 3.0 lbs/ft^3	100.0 lbs. 5.0 lbs/ft 2.9 lbs/ft^3	125.0 lbs. 5.0 lbs/ft 2.9 lbs/ft^3
20"	50.0 lbs. 5.0 lbs/ft 2.4 lbs/ft3	100.0 lbs. 5.0 lbs/ft 2.4 lbs/ft3	125.0 lbs. 5.0 lbs/ft 2.3 lbs/ft3

Netting	
Fiber Composition	High Altitude Machine Curled Aspen Excelsior
Fiber Dimensions	80% greater than 6"
Netting	0.50" x 0.50" Heavy Duty Synthetic
Configuration	Cylindrical with closed ends
End Closure	Hog ring or tied

Property	Value
Product Name	6" 9" 12" 20"
Minimum Diameter	5.5" 8.0" 11" 18.0"
Log Density[e] (± 10%)	6" (2.44 lb/ft^3) 9" (2.26 lb/ft^3) 12" (2.54 lb/ft^3) 20" (21.38 lb/ft^3)
Fiber Length	≥6.0"
Log Dimensions (WxL) (± 10%)	6" x 25' 9"x 25' 12" x 10' 20" x 10'

[e] Weight and density are based on a dry fiber weight basis at the time of manufacturing. Baseline moisture content of Great Lakes Aspen Excelsior is 22%

HEARTLAND GREENWAY

HGS-BMP-006

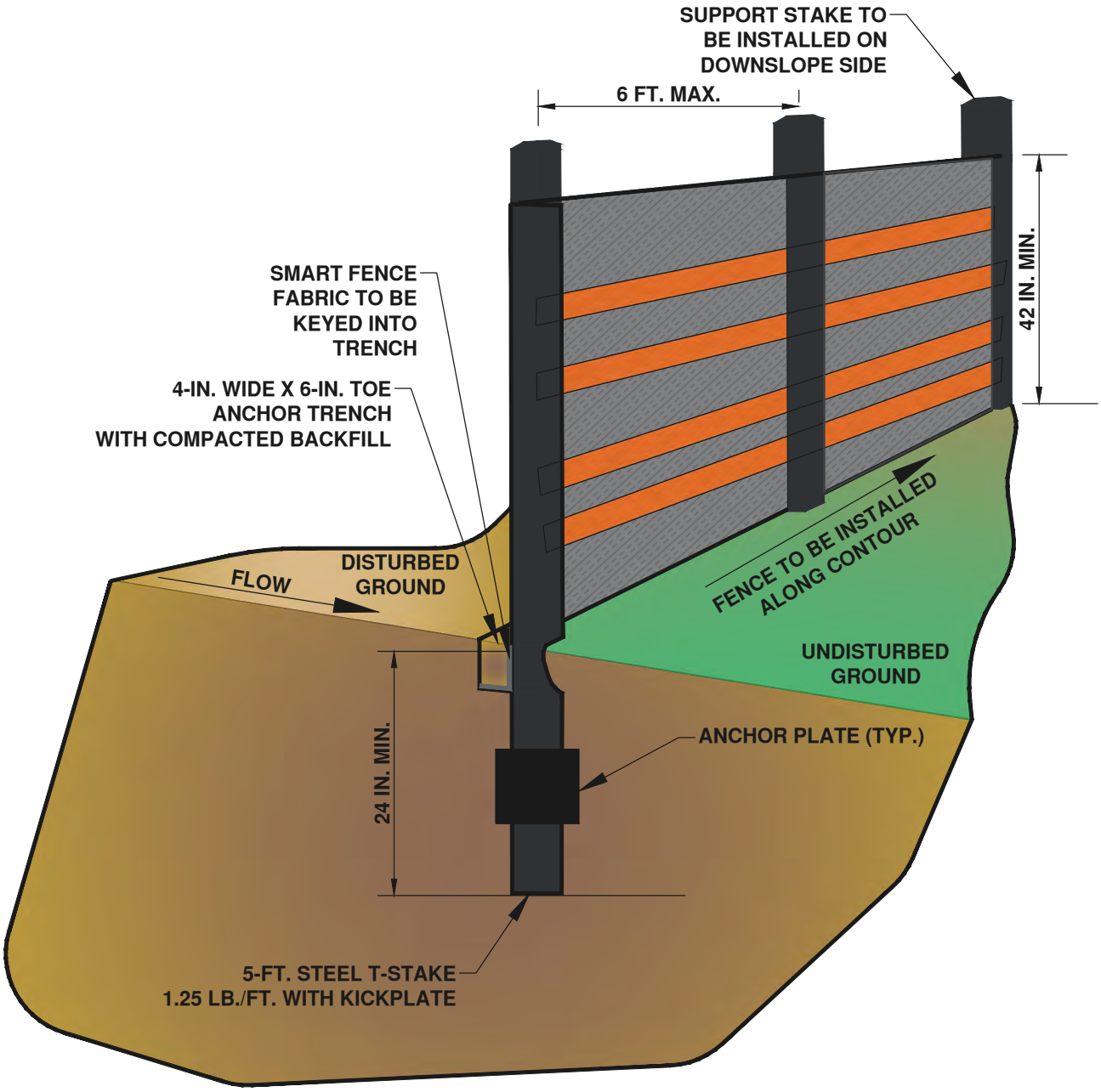
SEDIMENT LOG SPECIFICATIONS

NOT TO SCALE

Navigator CO_2

TYPICAL CONSTRUCTION DETAIL

MAY 2022



NOTES:

1. TRENCH FOR PLACEMENT MUST BE 4 IN. WIDE AND 6 IN. DEEP MIN.
2. STUDDED METAL T-POSTS SHOULD BE ANCHORED WITH PLATES HAVING A MIN. WEIGHT OF 1.25 LB./FT. AND A MIN. 72 -IN. LENGTH.
3. POSTS MUST BE DRIVEN INTO THE GROUND 24 IN. MIN. AND SPACING BETWEEN POSTS CANNOT EXCEED 6 FT.
4. ACCEPTABLE METHODS FOR SECURING FENCE TO THE METAL T POSTS INCLUDE 16-GAGE WIRE ATTACHMENT USING 16-GAGE 304 SS WIRE WITH MITERED ENDS OR USING 8-IN. NYLON HEAVY-DUTY, UV-STABILIZED CABLE TIES WITH MIN. 120-LB. TENSILE STRENGTH BY PUNCTURING DUAL OPENINGS AT A 0.25-IN. SPACING.
5. A MIN. OF 10 IN. OF FABRIC (6 IN. DEEP AND 4 IN WIDTH) MUST BE PLACED WITHIN THE ANCHOR TRENCH. TRENCH SHALL BE BACKFILLED AND COMPACTED FOLLOWING INSTALLATION.

EXAMPLE PHOTOGRAPH
https://www.erosioneel.com/smartfence.htm

HEARTLAND GREENWAY

HGS-BMP-007

SMARTFENCE

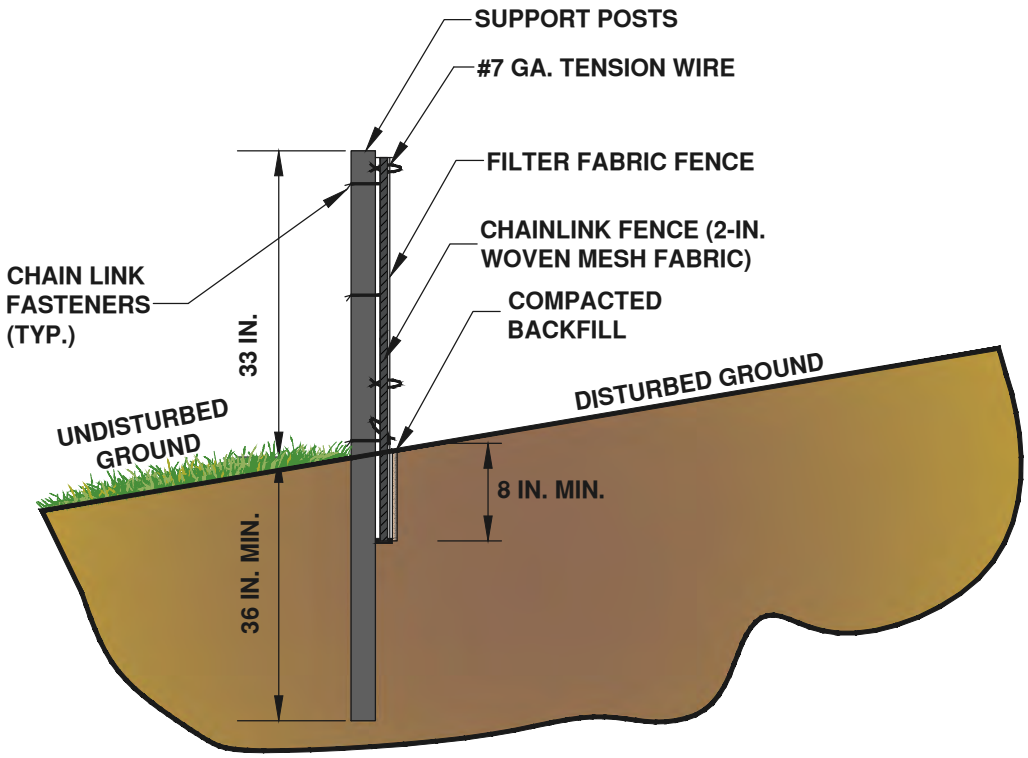
(42" HEIGHT)

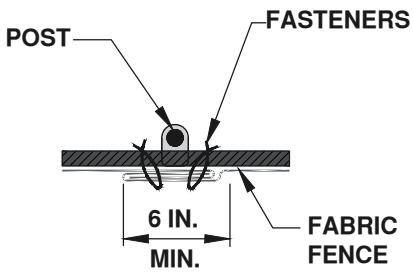
NOT TO SCALE

Navigator CO_2

TYPICAL CONSTRUCTION DETAIL

MAY 2022





JOINING FENCE SECTIONS

NOTES:

1. SUPPORT POSTS SPACED AT 10 FT. MAX. USE 2 $\frac{1}{2}$ -IN. DIA. GALVANIZED OR ALUMINUM POSTS. SUPPORT POSTS MUST BE INSTALLED BY A POST HOLE DRILL.
2. CHAINLINK TO POST FASTENERS SPACED AT 14 IN. MAX. USE NO. 6 GA. ALUMINUM WIRE OR NO. 9 GALVANIZED STEEL PRE-FORMED CLIPS. CHAINLINK TO TENSION WIRE FASTENERS SPACED AT 60 IN. MAX. USE NO. 10 GA. GALVANIZED STEEL WIRE. FILTER FABRIC TO CHAINLINK FASTENERS SPACED AT 24 IN. MAX. C.C.
3. NO. 7 GA. TENSION WIRE INSTALLED HORIZONTALLY AT TOP AND BOTTOM OF CHAINLINK FENCE.
4. FILTER FABRIC FENCE MUST BE PLACED AT EXISTING LEVEL GRADE. BOTH ENDS OF THE BARRIER MUST BE EXTENDED AT LEAST 8 FT. UPSLOPE AT 45 DEGREES TO THE MAIN BARRIER ALIGNMENT.
5. SEDIMENT MUST BE REMOVED WHEN ACCUMULATIONS REACH 1/2 THE ABOVE-GROUND HEIGHT OF THE FENCE.
6. WHEN TWO SECTIONS OF FILTER FABRIC ADJOIN EACH OTHER, OVERLAP BY 6 IN. AND FOLD.
7. ACCUMULATED SEDIMENTS SHALL BE REMOVED AS REQUIRED TO MAINTAIN FENCE FUNCTION. IN ALL CASES, REMOVE DEPOSITS WHERE ACCUMULATIONS REACH HALF OF THE ABOVE-GROUND HEIGHT OF THE FENCE.
8. ADHERE TO ANY MANUFACTURER'S RECOMMENDATIONS FOR REPLACING WEATHERED FILTER FABRIC FENCE.

Fabric Property	Minimum Acceptable Value	Test method
Grab Tensile Strength (lb)	120	ASTM D1682
Elongation at Failure (%)	20% Maximum	ASTM D1682
Mullen Burst Strength (psi)	200	ASTM D1682
Trapezoidal Tear Strength (lb)	50	
Puncture Strength (lb)	40	ASTM D751 (modified)
Slurry Flow Rate (gal/min/sf)	0.3	ASTM 5141
Equivalent Opening Size	30	US Standard Sieve CW-02215
Ultraviolet Radiation Stability (%)	80	ASTM G-26

EXAMPLE PHOTOGRAPH

HEARTLAND GREENWAY

HGS-BMP-008

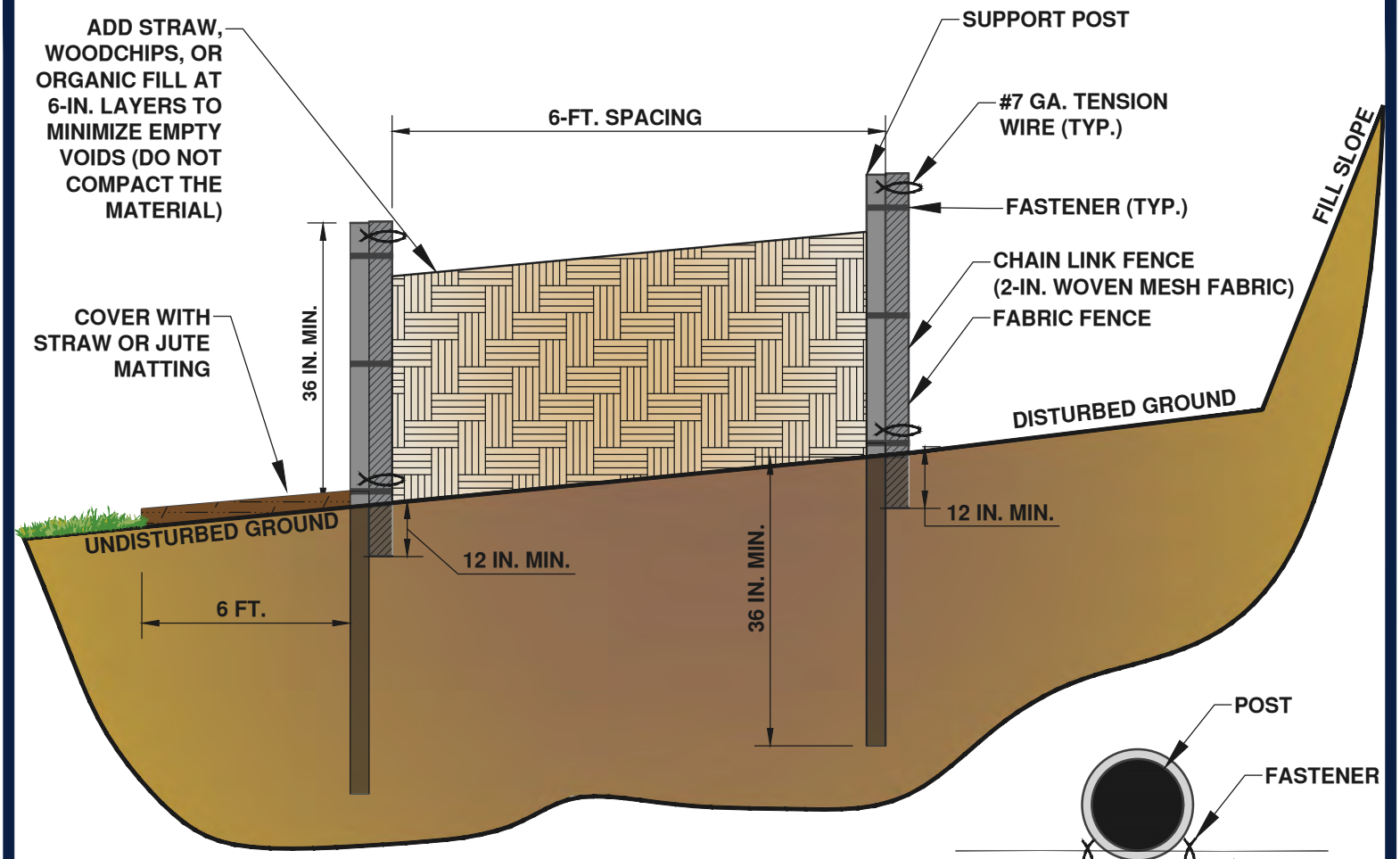
SUPER SILT FENCE

NOT TO SCALE

Navigator CO_2

TYPICAL CONSTRUCTION DETAIL

MAY 2022



JOINING FENCE SECTIONS

NOTES:

1. POSTS SPACED AT 10 FT. MAX. USE 2 1/2-IN. DIAMETER HEAVY DUTY GALVANIZED OR ALUMINUM POSTS.
2. SECURELY FASTEN CHAIN LINK FENCE TO THE FENCE POSTS WITH WIRE TIES OR STAPLES. FASTEN GEOTEXTILE FABRIC SECURELY TO THE CHAIN LINK FENCE WITH TIES SPACED EVERY 24 IN. AT THE TOP AND MID SECTION.
3. TWO ADJOINING SECTIONS OF GEOTEXTILE FABRIC ARE OVERLAPPED BY 6 IN. AND FOLDED.
4. INSTALL IN AREAS WHERE STORMWATER LARGE STOCKPILES HAVE HIGH POTENTIAL FOR SEDIMENT TO EXIT THE SITE, KEEPING THE INSTALLATION AS LEVEL AS POSSIBLE; FILL LOW SPOTS AS NECESSARY.
5. PLACE BARRIER PERPENDICULAR TO FLOW.
6. THE SILT FENCE SHOULD BE DESIGNED TO ALLOW WATER TO PASS THROUGH IT AT A RATE OF 70 GPM/ft² OR GREATER.
7. PLACE TWO PARALLEL ROWS OF SILT FENCE 3 FT. APART. PLACE LOOSE STRAW OR MULCH 3 FT. DEEP BETWEEN THE SILT FENCES (DO NOT COMPACT).
8. STABILIZE THE SOIL BEHIND THE SEDIMENT RETENTION BARRIER WITH STRAW OR JUTE MATTING.

EXAMPLE PHOTOGRAPH

HEARTLAND GREENWAY

HGS-BMP-009

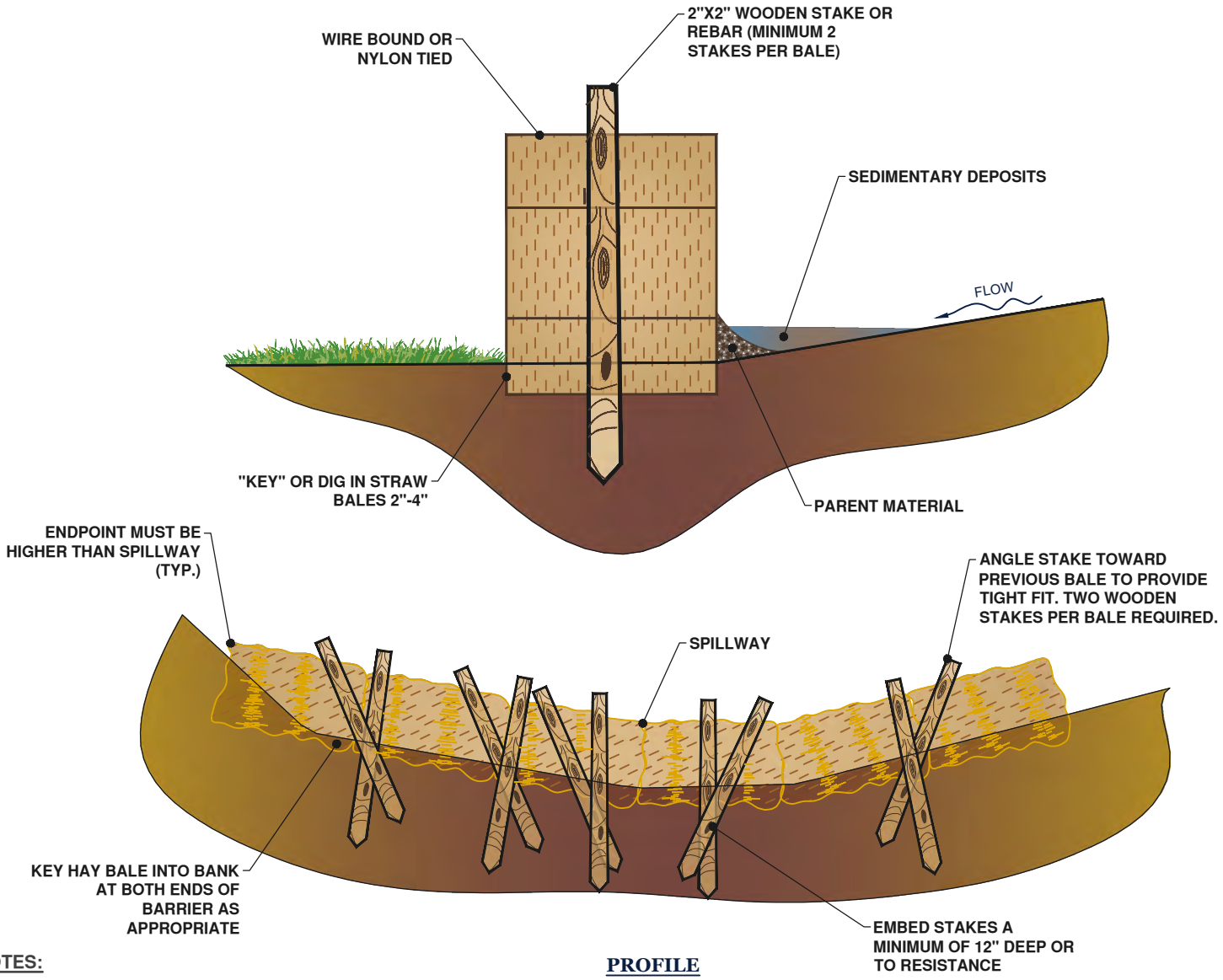
SEDIMENT RETENTION BARRIER

NOT TO SCALE

Navigator CO_2

TYPICAL CONSTRUCTION DETAIL

MAY 2022



PROFILE

NOTES:

1. STRAW BALE SEDIMENT BARRIERS SHALL CONSIST OF A ROW OF STRAW BALES PLACED ON THE FIBER-CUT EDGES (TIES NOT IN CONTACT WITH THE GROUND). BALES SHALL BE TIGHTLY ABUTTED TO ONE ANOTHER. THE BARRIER SHALL BE ONE BALE HIGH AND ONLY CERTIFIED "NOXIOUS WEED FREE" STRAW SHALL BE USED.

2. ENTRENCH ("KEY") STRAW BALES INTO THE GROUND TO A DEPTH OF 2" EXCEPT IN FROZEN, SATURATED, OR EXTREMELY ROCKY SOILS. PLACE PARENT MATERIAL ON UPSTREAM SIZE OF STRAW BALES TO PREVENT UNDERMINING.

3. WALK ON STRAW BALES TO ENSURE ADEQUATE BALE-TO-SOIL CONTACT.

4. ANCHOR STRAW BALES SECURELY IN PLACE WITH TWO WOODEN OR STEEL REBAR STAKES DRIVEN THROUGH THE TOPS OF THE BALES TO A MINIMUM OF 12" DEEP OR UNTIL AN IMPERMEABLE LAYER IS ENCOUNTERED.
   - ** THE FIRST, CENTER, AND END BALES OF THE BARRIER SHALL HAVE STAKES DRIVEN VERTICALLY THROUGH THE BALE.
   - ** BALES, OTHER THAN THOSE LOCATED AT THE ENDS OR CENTER OF THE BARRIER SHALL HAVE THE FIRST STAKE DRIVEN THROUGH THE TOP OF THE BALE AT AN ANGLE SO THAT THE STAKE PASSES THROUGH THE TOP OF THE BALE AT AN ANGLE AND THROUGH THE PREVIOUSLY PLACED BALE, IN ORDER TO PROVIDE TIGHT CONTACT BETWEEN BALES. THE SECOND STAKE SHALL BE DRIVEN VERTICALLY THROUGH THE TOP OF THE BALE.

EXAMPLE PHOTOGRAPH

HEARTLAND GREENWAY

HGS-BMP-010

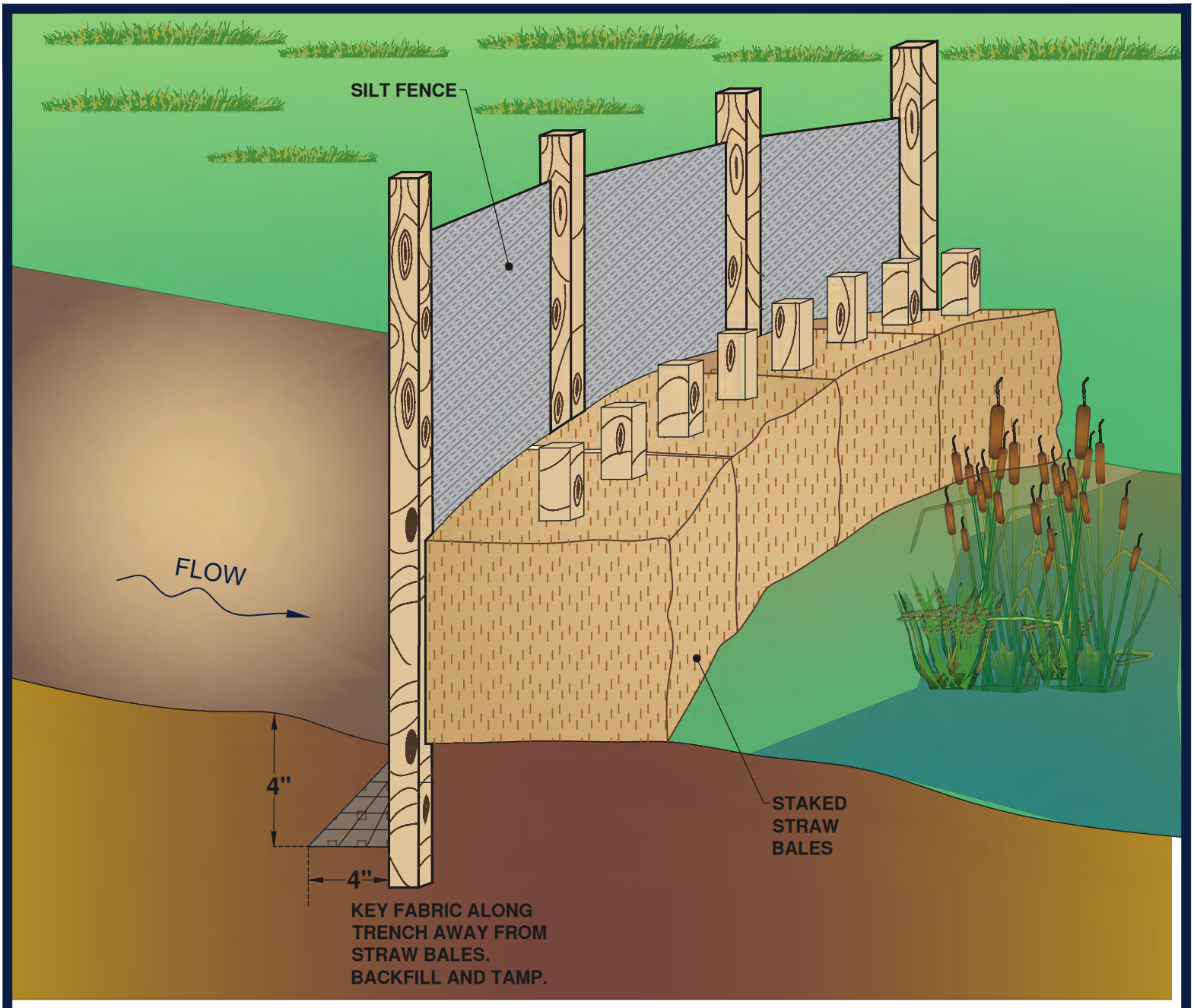
STRAW BALE SEDIMENT BARRIER

NOT TO SCALE

Navigator CO_2

TYPICAL CONSTRUCTION DETAIL

MAY 2022



NOTES:

1. WHERE EXTREMELY ERODIBLE SOIL CONDITIONS EXIST AND AT THE DIRECTION OF THE INSPECTOR, A COMBINED STRAW BALE AND SILT FENCE SEDIMENT BARRIER CONTROL SHALL BE INSTALLED.
2. ALL CONTROL DEVICES SIMILAR TO SILT FENCE OR FIBER ROLLS MUST BE REPAIRED, REPLACED, OR SUPPLEMENTED WHEN THEY BECOME NONFUNCTIONAL OR THE SEDIMENT REACHES $\frac{1}{3}$ OF THE HEIGHT OF THE DEVICE. THESE REPAIRS MUST BE MADE WITHIN 24 HOURS OF DISCOVERY OR AS SOON AS FIELD CONDITIONS ALLOW ACCESS.
3. STRAW BALE SHALL BE PLACED ON LEVEL CONTOUR TO PREVENT UNDERMINING.

EXAMPLE PHOTOGRAPH

HEARTLAND GREENWAY

HGS-BMP-011

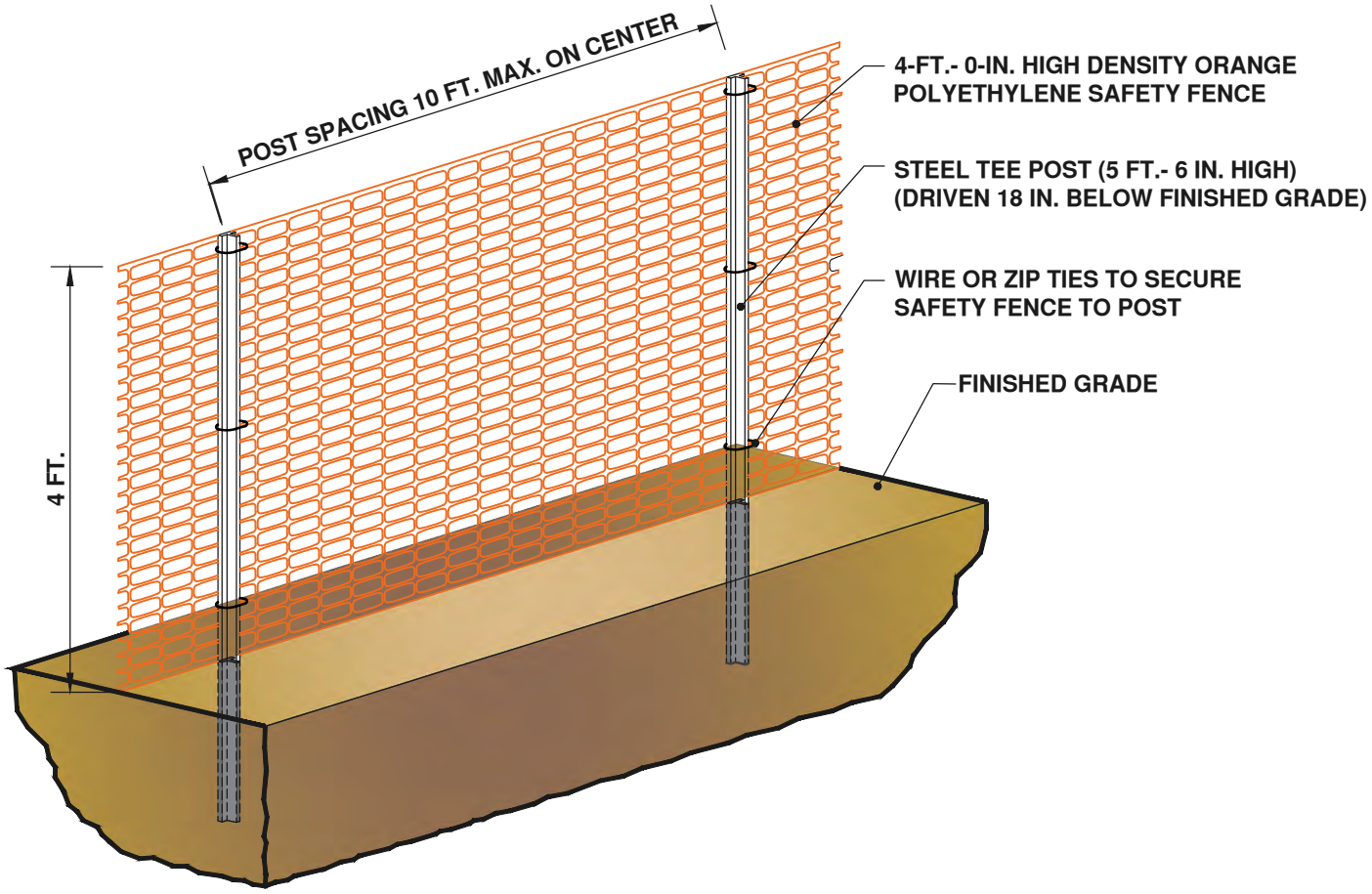
STRAW BALE AND SILT FENCE SEDIMENT BARRIER

NOT TO SCALE

Navigator CO_2

TYPICAL CONSTRUCTION DETAIL

MAY 2022



NOTES:

1. THE CONSTRUCTION FENCE SHALL BE SECURELY FASTENED TO THE TOP, MIDDLE, AND BOTTOM OF EACH POST.
2. CONSTRUCTION FENCE SHALL BE REPAIRED IMMEDIATELY WHEN ANY WEAR, SAGS, GAPS, RIPS, AND /OR TEARS ARE FOUND.
3. GRADING, DUMPING, STORAGE, AND PEDESTRIAN OR VEHICULAR TRAFFIC ARE PROHIBITED IN THE AREA BEHIND THE LIMITS DELINEATED BY TEMPORARY CONSTRUCTION FENCE.
4. WHEN CONSTRUCTION FENCE IS REMOVED, ANY DISTURBED AREAS ASSOCIATED WITH THE INSTALLATION, MAINTENANCE, AND/OR REMOVAL OF THE CONSTRUCTION FENCE SHALL BE ROUGHENED, SEEDED, MULCHED, AND CRIMPED.

EXAMPLE PHOTOGRAPH

HEARTLAND GREENWAY

HGS-BMP-012

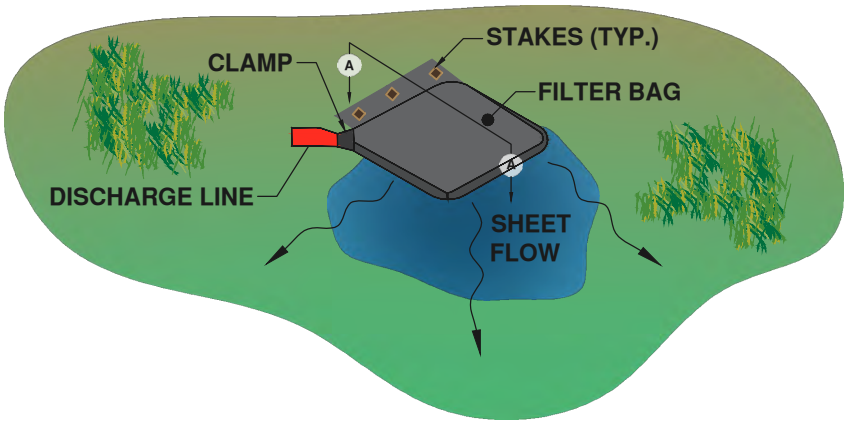
EXCLUSION AREA FENCING

NOT TO SCALE

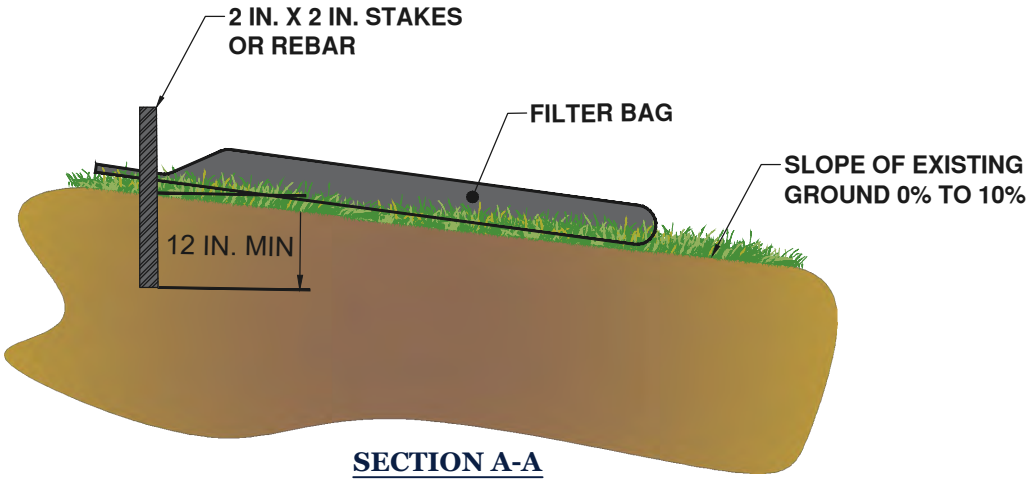
Navigator CO_2

TYPICAL CONSTRUCTION DETAIL

MAY 2022



PLAN VIEW



SECTION A-A

NOTES:

1. INSTALL A DEWATERING GEOTEXTILE FILTER BAG AS DIRECTED BY THE COMPANY REPRESENTATIVE TO PREVENT THE FLOW OF HEAVILY SILT LADEN WATER INTO WATERBODIES OR WETLANDS.
2. DISCHARGE SITE SHALL BE WELL VEGETATED AND THE TOPOGRAPHY OF THE SITE SUCH THAT WATER WILL FLOW AWAY FROM ANY WORK AREAS. THE AREA DOWN SLOPE FROM THE DEWATERING SITE MUST BE REASONABLY PLANE OR STABILIZED BY VEGETATION OR OTHER MEANS TO ALLOW THE WATER TO CONTINUE AS SHEET FLOW, AND SHOULD BE GREATER THAN 25 FT. FROM ANY RECEIVING WATER UNLESS APPROVED BY PERMIT.
3. INSTALL EROSION CONTROL DEVICES AS APPROPRIATE DOWNSTREAM OF OUTFLOW TO AVOID EROSION AND SEDIMENTATION.
4. TO ATTACH THE DISCHARGE HOSE, CUT A CORNER OF THE BAG, INSERT DISCHARGE HOSE, AND SECURE THE HOSE TO THE BAG WITH BAND CLAMPS.
5. A SINGLE FILTER BAG SHOULD NOT BE USED FOR FLOWS GREATER THAN 600 GALLONS PER MINUTE.
6. REPLACE FILTER BAG BEFORE IT IS COMPLETELY FILLED WITH SEDIMENT. MONITOR DISCHARGE TO AVOID OVER PRESSURING DUE TO PLUGGING, WHICH MAY RESULT IN RUPTURE.
7. DISPOSE OF USED FILTER BAGS AT A PIPELINE DESIGNATED LOCATION IN A TIMELY MANNER.

EXAMPLE PHOTOGRAPH

HEARTLAND GREENWAY

HGS-BMP-013

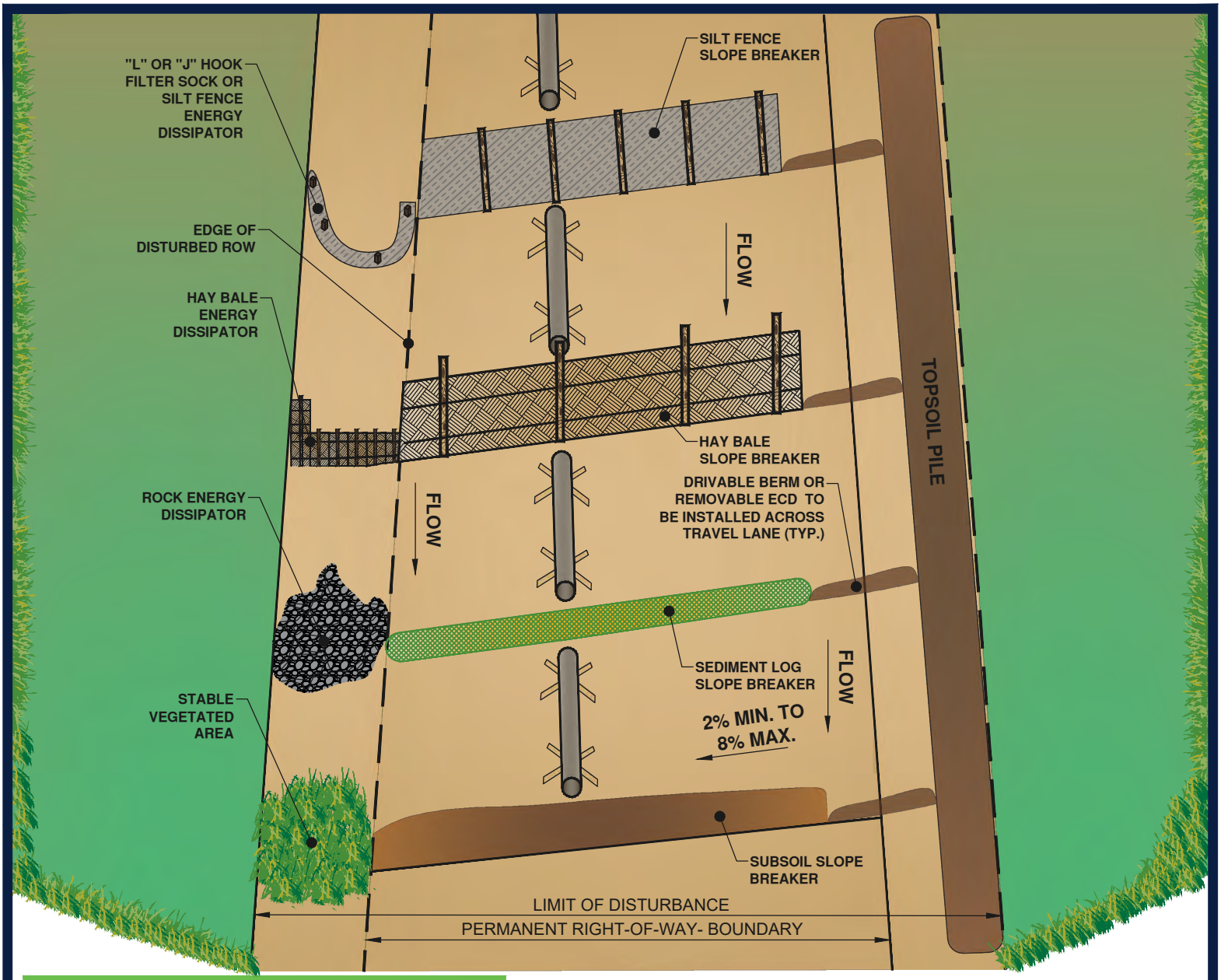
GEOTEXTILE FILTER BAG FOR DEWATERING

NOT TO SCALE

Navigator CO_2

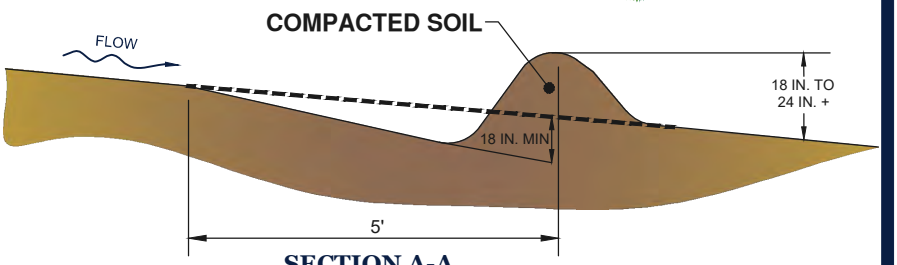
TYPICAL CONSTRUCTION DETAIL

MAY 2022



Spacing Chart

Slope (%)	Maximum Spacing Between Slope Breakers (ft.)
5%-15%	300 ft.
>15%- 30%	200 ft.
>30% -50%	100 ft.
>50%	50 ft.



SECTION A-A

NOTES:

1. BREAKER MAY BE CONSTRUCTED OF HAYBALES, SEDIMENT LOGS, SUB SOIL, SILT FENCE, FILTER SOCK, OR ANY COMBINATION THEREOF AND OUTFALL TO A WELL VEGETATED OR STABILIZED AREA.
2. SLOPE BREAKERS SHALL BE CONSTRUCTED AT LOCATIONS AS NEEDED AND IN COMPLIANCE WITH THE SWPPP PERMIT.
3. SLOPE BREAKERS SHALL BE ORIENTED AS SHOWN OR OTHER PATTERN AS DIRECTED BY THE COMPANY'S REPRESENTATIVE TO DIRECT WATER OFF OF THE RIGHT OF WAY.
4. SLOPE BREAKERS SHALL BE CONSTRUCTED AT A MINIMUM OF 2% SLOPE UP TO A MAXIMUM OF 8% SLOPE ACROSS THE RIGHT OF WAY. DRIVABLE BERMS OR REMOVEABLE EROSION CONTROL DEVICES SHALL BE PLACED ACROSS THE TRAVEL LANE.

HEARTLAND GREENWAY

HGS-BMP-014

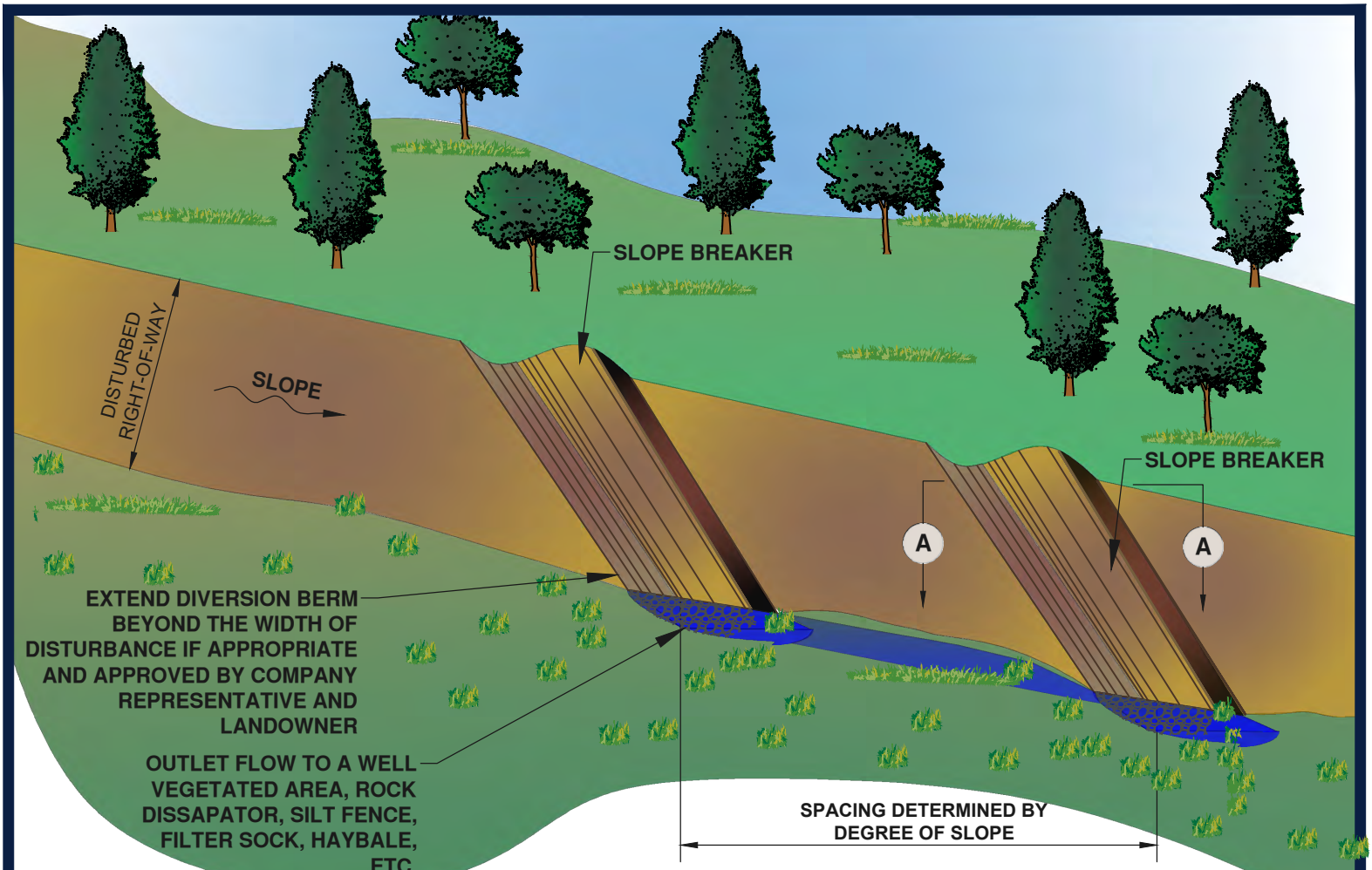
TEMPORARY SLOPE BREAKER

NOT TO SCALE

Navigator CO_2

TYPICAL CONSTRUCTION DETAIL

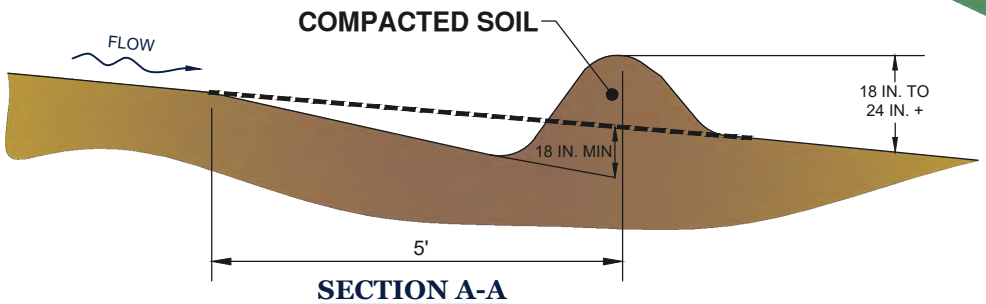
MAY 2022



PLAN VIEW

NOTES:

1. PERMANENT SLOPE BREAKERS TO PROVIDE POSITIVE DRAINAGE TO A STABILIZED OUTLET USING A CROSS SLOPE OF NO LESS THAN 2% AND NO GREATER THAN 8% UNLESS OTHERWISE SPECIFIED IN THE STATE REGULATIONS, WHICH WILL GOVERN.
2. INSTALLATION SPECIFICATIONS TO BE MODIFIED BY THE PROJECT AS NECESSARY TO SUIT ACTUAL SITE CONDITIONS.
3. INSTALL TEMPORARY AND PERMANENT SLOPE BREAKERS ON SLOPES GREATER THAN APPROXIMATELY 5% ON ALL DISTURBED LANDS USING THE STATE REGULATION FOR THAT PROJECT AREA, OR THE CHART ON THIS PAGE.
4. PERMANENT SLOPE BREAKERS ARE NOT TO BE INSTALLED IN ACTIVE AGRICULTURAL FIELDS.



SECTION A-A

Spacing Chart	
Slope (%)	Maximum Spacing Between Slope Breakers (ft.)
5%-15%	300 ft.
>15%- 30%	200 ft.
>30% -50%	100 ft.
>50%	50 ft.

EXAMPLE PHOTOGRAPH

HEARTLAND GREENWAY

HGS-BMP-015

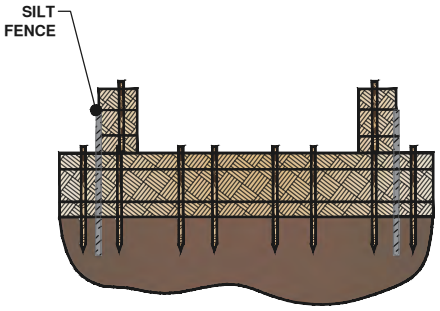
PERMANENT WATERBARS OR SLOPE BREAKERS

NOT TO SCALE

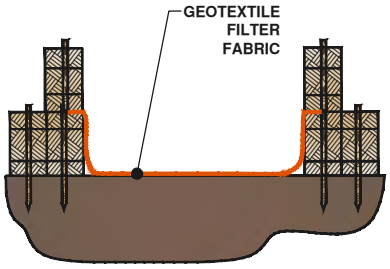
Navigator CO_2

TYPICAL CONSTRUCTION DETAIL

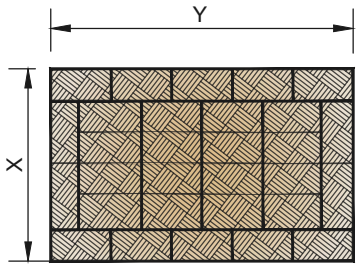
MAY 2022

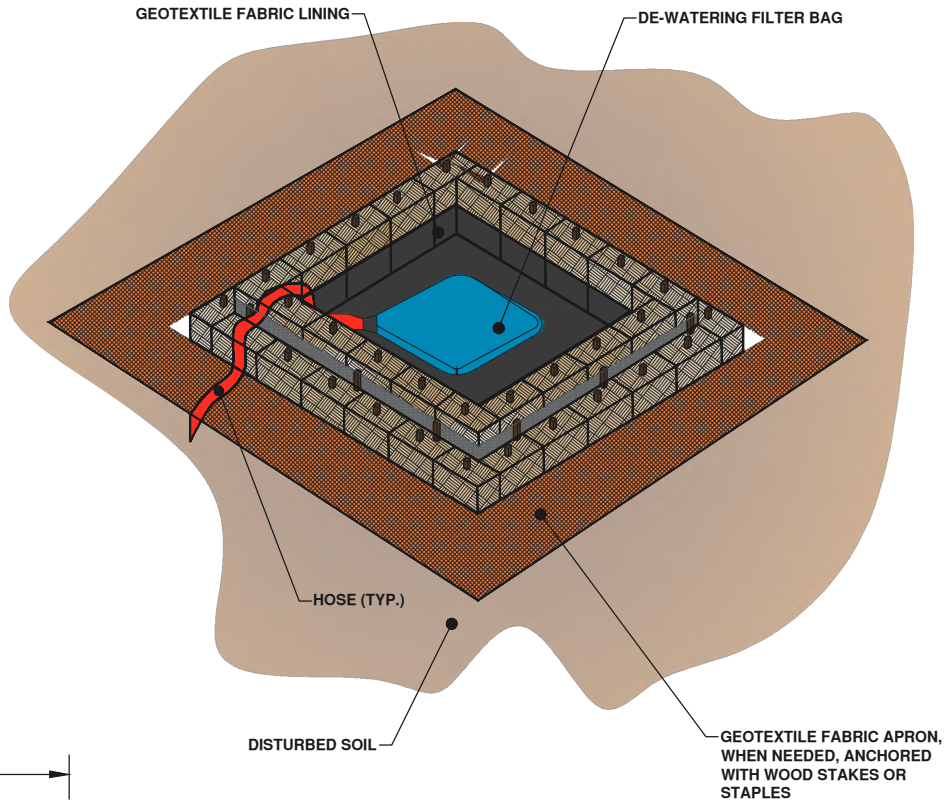


OPTION 1



OPTION 2





PERSPECTIVE VIEW

NOTES:

1. INSTALL A STRAW BALE DEWATERING STRUCTURE WHEREVER IT IS NECESSARY AND AS DIRECTED BY THE INSPECTOR TO PREVENT THE FLOW OF SEDIMENT LADEN WATER INTO WATERBODIES OR WETLANDS.
2. DISCHARGE SITE SHALL BE WELL VEGETATED AND THE TOPOGRAPHY OF THE SITE SUCH THAT WATER WILL FLOW AWAY FROM ANY WORK AREAS. THE AREA DOWN SLOPE FROM THE DEWATERING SITE MUST BE REASONABLY PLANE OR STABILIZED BY VEGETATION OR OTHER MEANS TO ALLOW THE FILTERED WATER TO CONTINUE AS SHEET FLOW. IF A VEGETATED AREA IS NOT AVAILABLE, USE A GEOTEXTILE FABRIC APRON TO MINIMIZE EROSION.
3. IF BOTTOM OF STRUCTURE IS NOT LINED WITH STRAW BALES, IN AREAS OF HIGHLY ERODIBLE SOILS, LINE ENTIRE STRUCTURE WITH GEOTEXTILE FILTER FABRIC OR PLASTIC SHEETING.
4. USE THE RECOMMENDED DIMENSIONS BY PUMPING RATE UNLESS SITE CONDITIONS WARRANT A CHANGE IN SPECIFIED DIMENSIONS.
5. DISCHARGE RATES SHALL BE SUCH THAT WATER WILL NOT OVERFLOW THE TOP OF THE STRUCTURE.
6. INSTALL AN ENERGY DISSAPATOR IF THE DISCHARGE VELOCITY IS ERODING THE SOIL OR STRESSING THE SIDES OF THE STRUCTURE (SEE DETAIL #24)

Maximum Sump Dimensions (ft.)	
X	Y
10	20
15	20
20	20
20	25
25	25
25	30
30	30

Maximum Pumping Rate
Gallons per Minute
300
350
400
450
500
550
600

EXAMPLE PHOTOGRAPH

HTTP://WWW.ALEXRAMSAY.CA

HEARTLAND GREENWAY

HGS-BMP-016

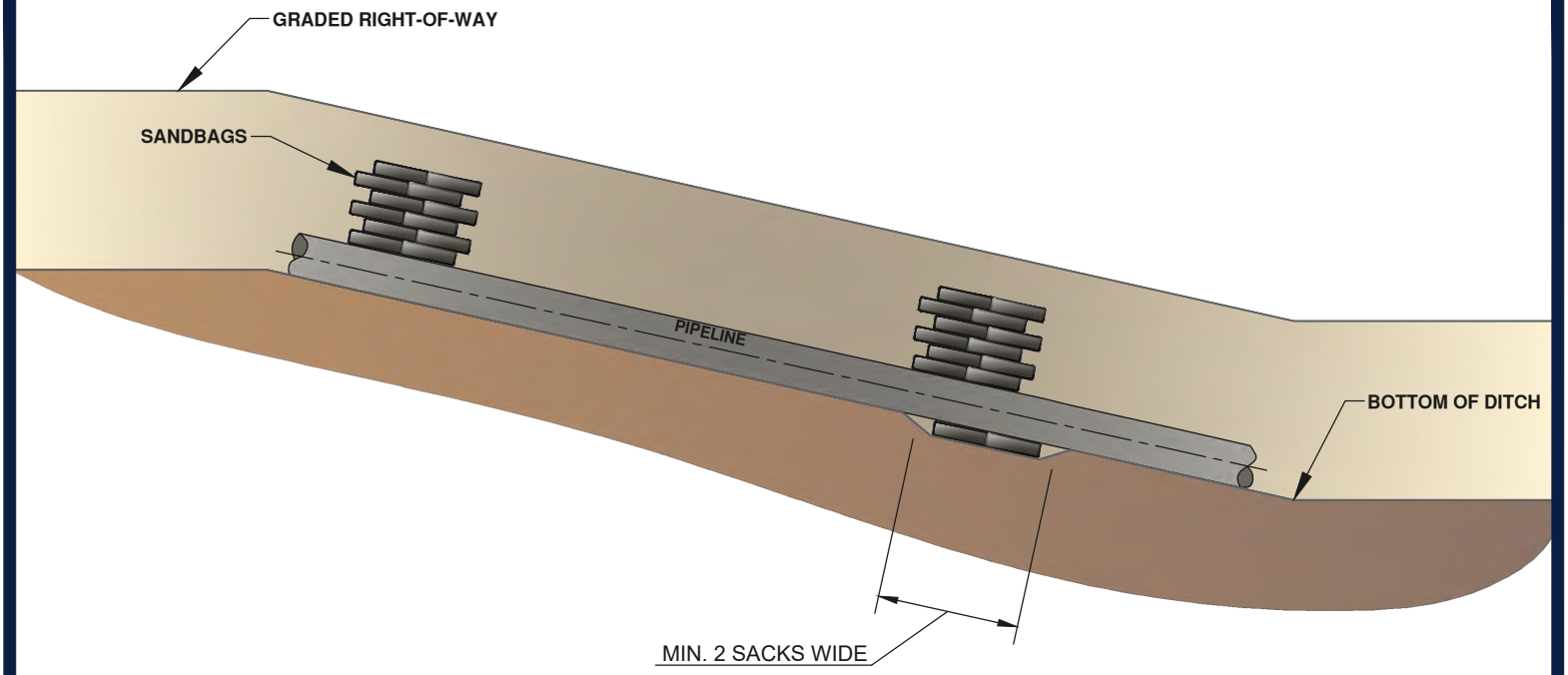
STRAW BALE DE-WATERING STRUCTURE

NOT TO SCALE

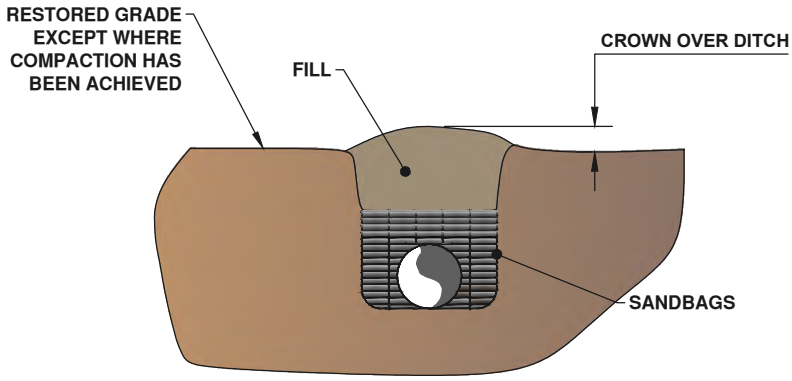
Navigator CO_2

TYPICAL CONSTRUCTION DETAIL

MAY 2022



SIDE VIEW CROSS SECTION



END VIEW CROSS SECTION

NOTES:

1. CONSTRUCT ON SLOPPING TERRAIN, AT BASE OF SLOPES ADJACENT TO WATERBODIES, AND AT BOTH SIDES OF WETLAND AND WATERBODY CROSSINGS.
2. PRIOR TO LOWERING IN PIPE REMOVE ALL DECOMPOSABLE MATERIAL AND LARGE ROCKS.
3. BREAKERS MAY BE COMPOSED OF SANDBAG, FOAM, SAKRETE, OR OTHER APPROVED MATERIALS.
4. MINIMUM 12 TO 24 INCHES COVER OVER SANDBAGS IN ALL CASES.
5. PERMANENT WATERBARS, IF WARRANTED, SHOULD BE CONSTRUCTED ON TOP OF TRENCH PLUGS.

Degrees	Spacing
5-15	300 ft. MAX
15-30	200 ft. MAX
>30	100 ft. MAX

HEARTLAND GREENWAY

HGS-BMP-017

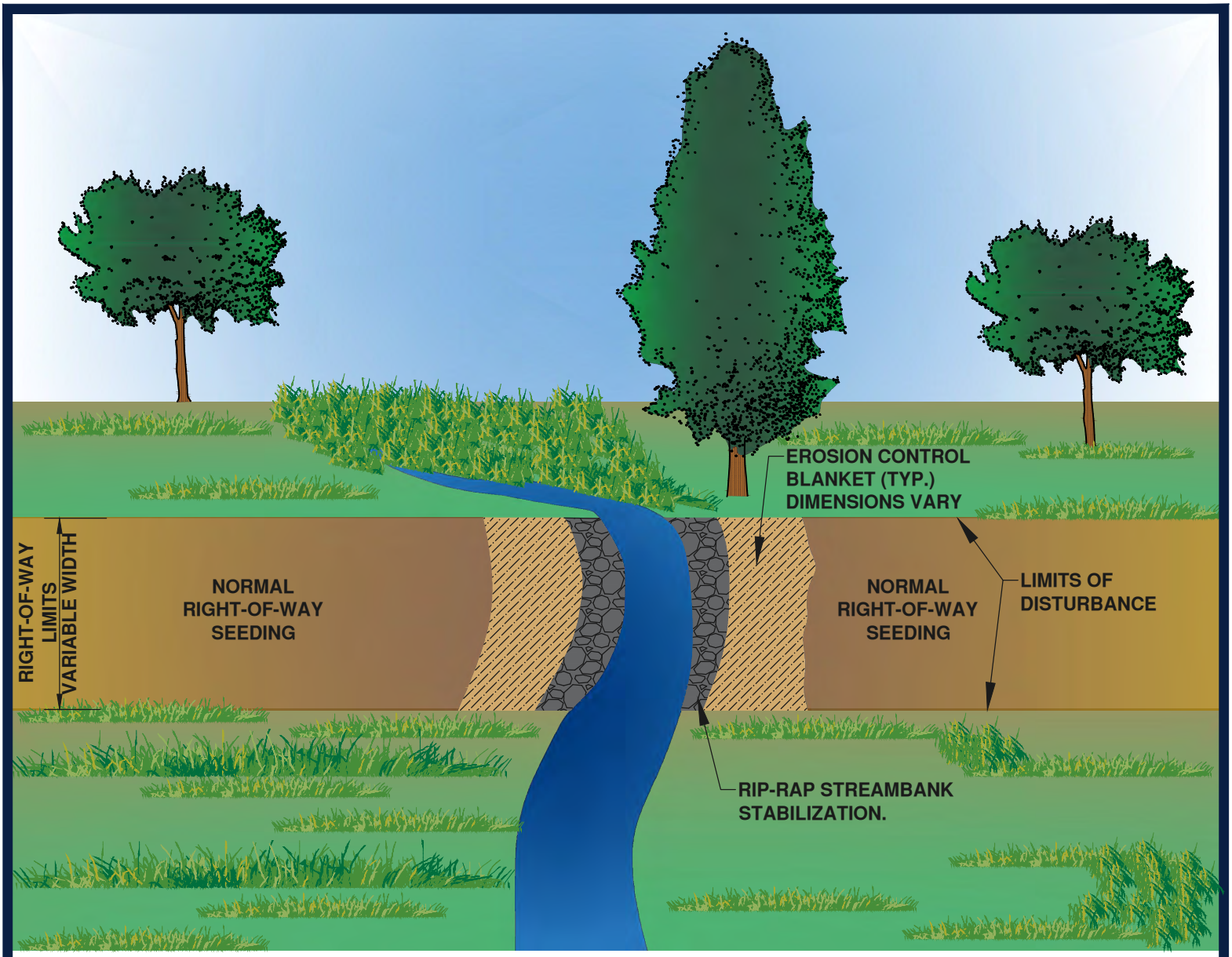
TEMPORARY TRENCH PLUG INSTALLATION

NOT TO SCALE

Navigator CO_2

TYPICAL CONSTRUCTION DETAIL

MAY 2022



NOTES:

1. PLACE EROSION CONTROL BLANKET A MINIMUM OF 1 FT. UNDER RIP RAP. EXTEND JUTE BLANKET FROM MEAN HIGH WATER MARK LEVEL TO SEVERAL FEET BEHIND HIGH BANK.
2. RIP RAP REQUIREMENTS ARE DETERMINED BY PERMIT CONDITIONS.
3. RIP RAP TO BE INSTALLED ON A SITE-SPECIFIC BASIS AND ONLY IN ACCORDANCE WITH PERMIT CONDITIONS.

EXAMPLE PHOTOGRAPH

HEARTLAND GREENWAY

HGS-BMP-018

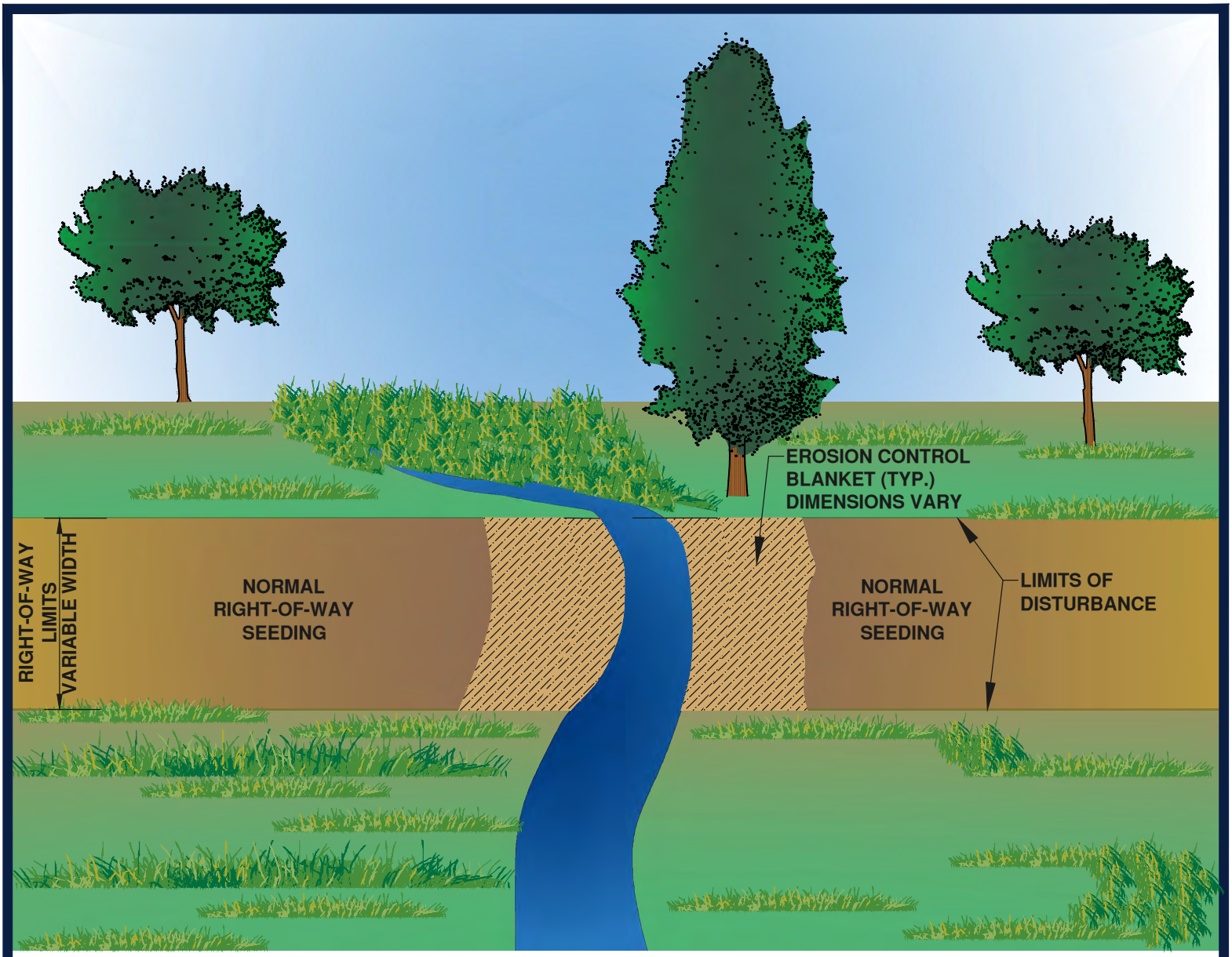
RIPRAP STREAMBANK STABILIZATION

NOT TO SCALE

Navigator CO_2

TYPICAL CONSTRUCTION DETAIL

MAY 2022



NOTES:

1. RESTORE BANKS TO PRE-CONSTRUCTION CONTOURS AS PRACTICAL.
2. PLACE EROSION CONTROL BLANKET A MINIMUM OF 1 FT. UNDER RIP RAP. EXTEND JUTE BLANKET FROM MEAN HIGH WATER MARK LEVEL TO SEVERAL FEET BEHIND HIGH BANK.
3. ANCHOR EROSION CONTROL BLANKET A MINIMUM OF 1 FT. BEYOND THE TOP OF THE BANK TO BE STABILIZED.

EXAMPLE PHOTOGRAPH

HEARTLAND GREENWAY

HGS-BMP-019

EROSION CONTROL MATTING STREAMBANK STABILIZATION

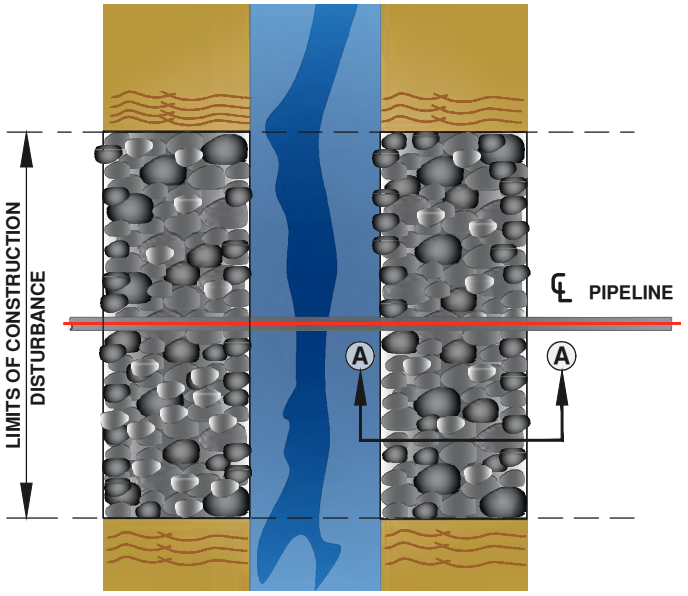
NOT TO SCALE

Navigator CO_2

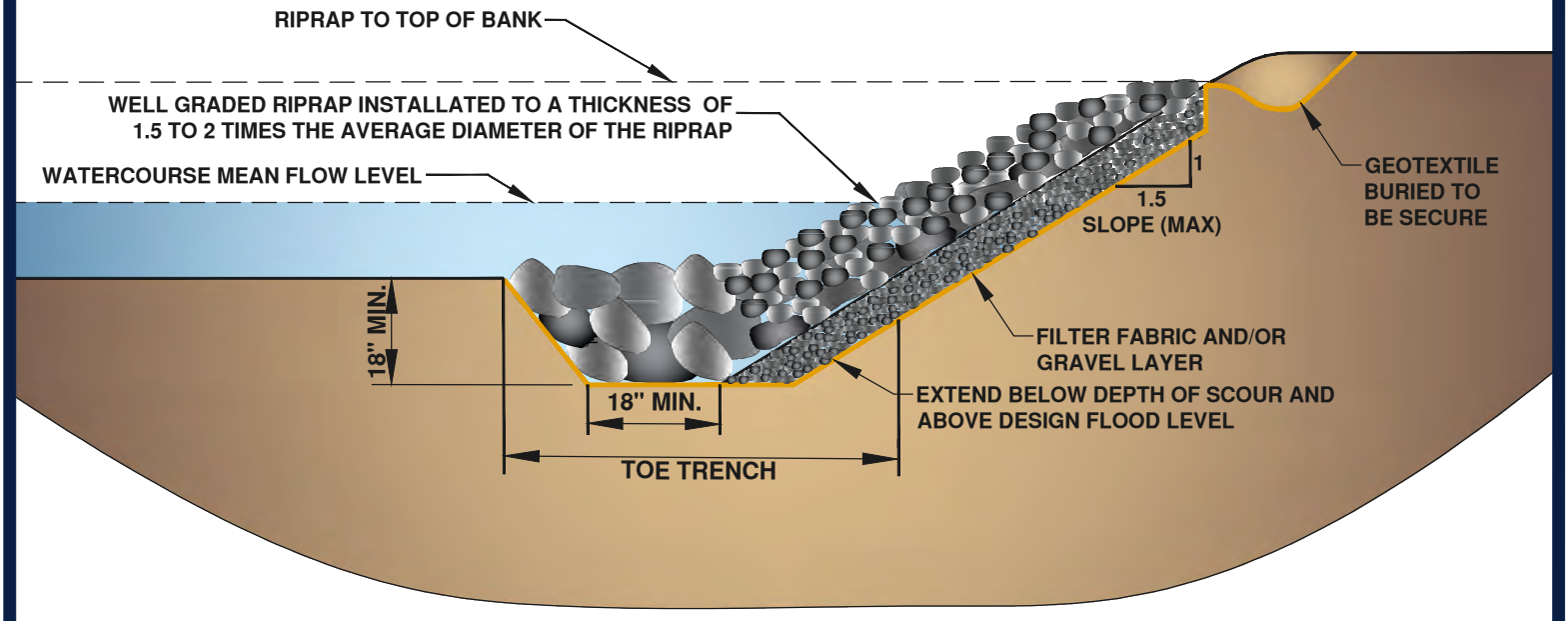
TYPICAL CONSTRUCTION DETAIL

MAY 2022

Riprap Gradations					
Grade I		Grade II		Grade III	
Size (in.)	Percent Smaller	Size (in.)	Percent Smaller	Size (in.)	Percent Smaller
20	100	28	100	36	100
18	70-90	22	30-80	29	55-85
15	40-60	16	20-50	24	35-50
10	0-10	10	0-5	10	10-15
6	0-2	6	0-2	6	0-2



PLAN VIEW



SECTION A-A

NOTES:

1. STREAM BANK RIPRAP STRUCTURES SHALL CONSIST OF A LAYER OF STONE UNDERLAIN WITH APPROVED GEOTEXTILE FILTER FABRIC OR A GRAVEL FILTER BLANKER DESIGNED TO PROTECT AND STABILIZE AREAS PRONE TO EROSION.

2. GRAVEL FILTER BLANKET SHALL MEET THE FOLLOWING SPECIFICATIONS;
   - HAVE A PERMEABILITY GREATER THAN THAT OF THE SUGRADE SOIL;
   - IF A WELL-GRADED GRAVEL OR SAND-GRAVEL LAYER IS USED, THE LAYER SHALL BE A MINIMUM OF 6" THICK AND SPREAD IN A UNIFORM LAYER OVER THE SUBGRADE;
   - IF WATER TURBULENCE COULD RESULT IN EROSION OF BANK MATERIAL BETWEEN LARGE ROCKS (AS DETERMINED BY THE REPRESENTATIVE ENVIRONMENTAL INSPECTOR), A GEOTEXTILE FABRIC SHALL BE USED BETWEEN THE GRAVEL LAYER AND THE RIPRAP.

3. THE GEOTEXTILE FILTER FABRIC SHALL BE PERMATEX 4000 SERIES OR AN APPROVED EQUIVALENT MEETING THE FOLLOWING SPECIFICATIONS:
   - BE A COMMERICAL QUALITY NONWOVEN FABRIC DESIGNED FOR RIPRAP UNDERLAYMENT;
   - BE A MINIMUM OF 20 MILS IN THICKNESS;
   - HAVE A GRAB STRENGTH BETWEEN 90 AND 120 POUNDS;
   - HAVE A GREATER THAN 4% OPEN AREA (U.S. STANDARD SIEVE NUMBER 100 (0.15MM);
   - HAVE A DENSITY GREATER THAN 8 oz. PER SQUARE YARD.

4. THE USE OF RIPRAP SHALL BE LIMITED TO AREAS WHERE FLOWING CONDITIONS PREVENT EFFECTIVE VEGETATIVE STABILIZATION TECHNIQUES.

HEARTLAND GREENWAY

HGS-BMP-020

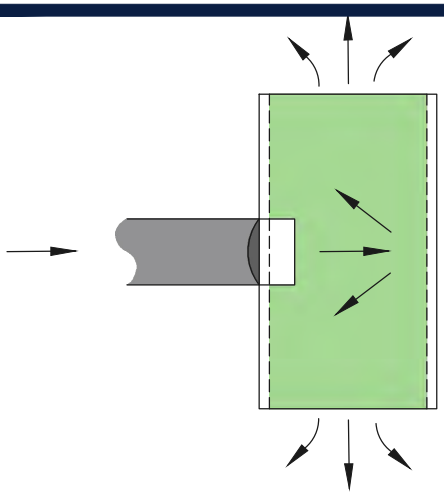
EROSION CONTROL RIPRAP AT WATERBODY BANKS

NOT TO SCALE

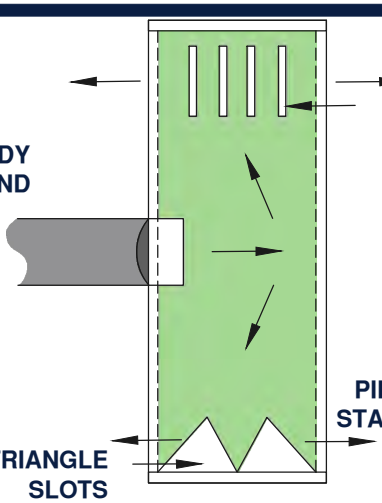
Navigator CO_2

TYPICAL CONSTRUCTION DETAIL

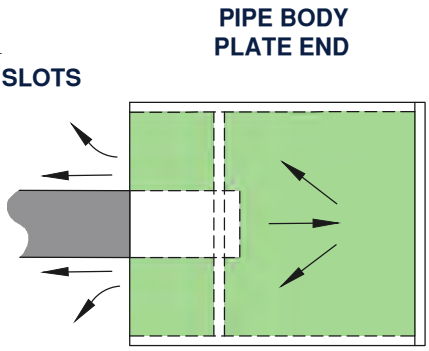
MAY 2022



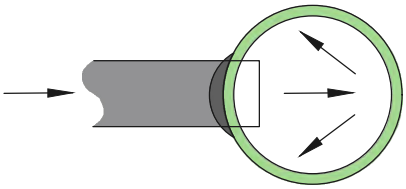
PLAN



PLAN

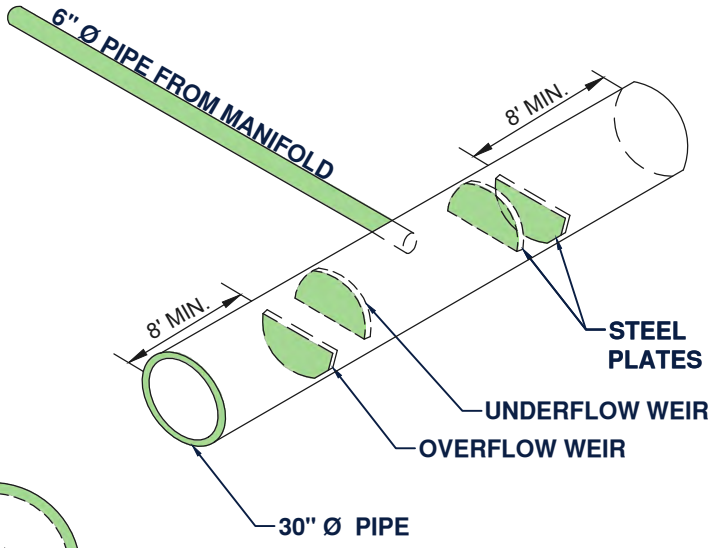


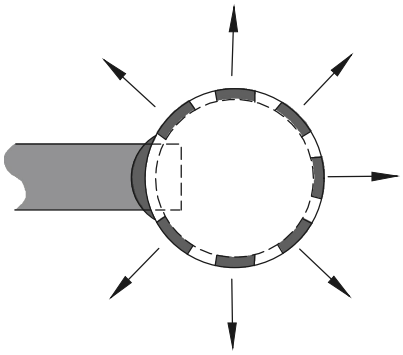
PLAN



PROFILE

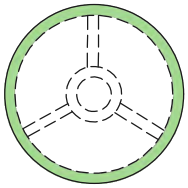
BASIC SPLASH PUP





PROFILE

BASIC SPLASH PLATE



END VIEW

PUP-PLATE COMBINATION

NOTES:

1. AN ENERGY DISSIPATOR SHALL BE UTILIZED WHENEVER WATER DISCHARGE VELOCITIES MAY CAUSE EROSION OR STRESS THE DISCHARGE STRUCTURE.
2. THE DESIGN AND EFFECTIVENESS OF THE ENERGY DISSIPATOR IS THE RESPONSIBILITY OF THE CONSTRUCTION CONTRACTOR.
3. ENERGY DISSIPATORS ARE UTILIZED IN CONJUNCTION WITH A DEWATERING STRUCTURE SUCH AS A SETTLING BASIN OR HAY BALES WITH A SILT FENCE.

EXAMPLE PHOTOGRAPH

HEARTLAND GREENWAY

HGS-BMP-021

ENERGY DISSAPATOR

NOT TO SCALE

Navigator CO_2

TYPICAL CONSTRUCTION DETAIL

MAY 2022

Application Rates

Slope Condition	English	SI
≤ 4H to 1V	2500 lb/acre	2800 kg/hectare
>4H to 1V and ≤ 3H to 1V	3000 lb/acre	3400 kg/hectare
>3H to 1V and ≤ 2H to 1V	3500 lb/acre	3900 kg/hectare
>2H to 1V and ≤ 1H to 1V	4000 lb/acre	4500 kg/hectare
>1H to 1V[1]	4500 lb/acre	5100 kg/hectare
Below ECB or TRM	1500 lb/acre	1700 kg/hectare
As infill for TRM[2]	3500 lb/acre	3900 kg/hectare

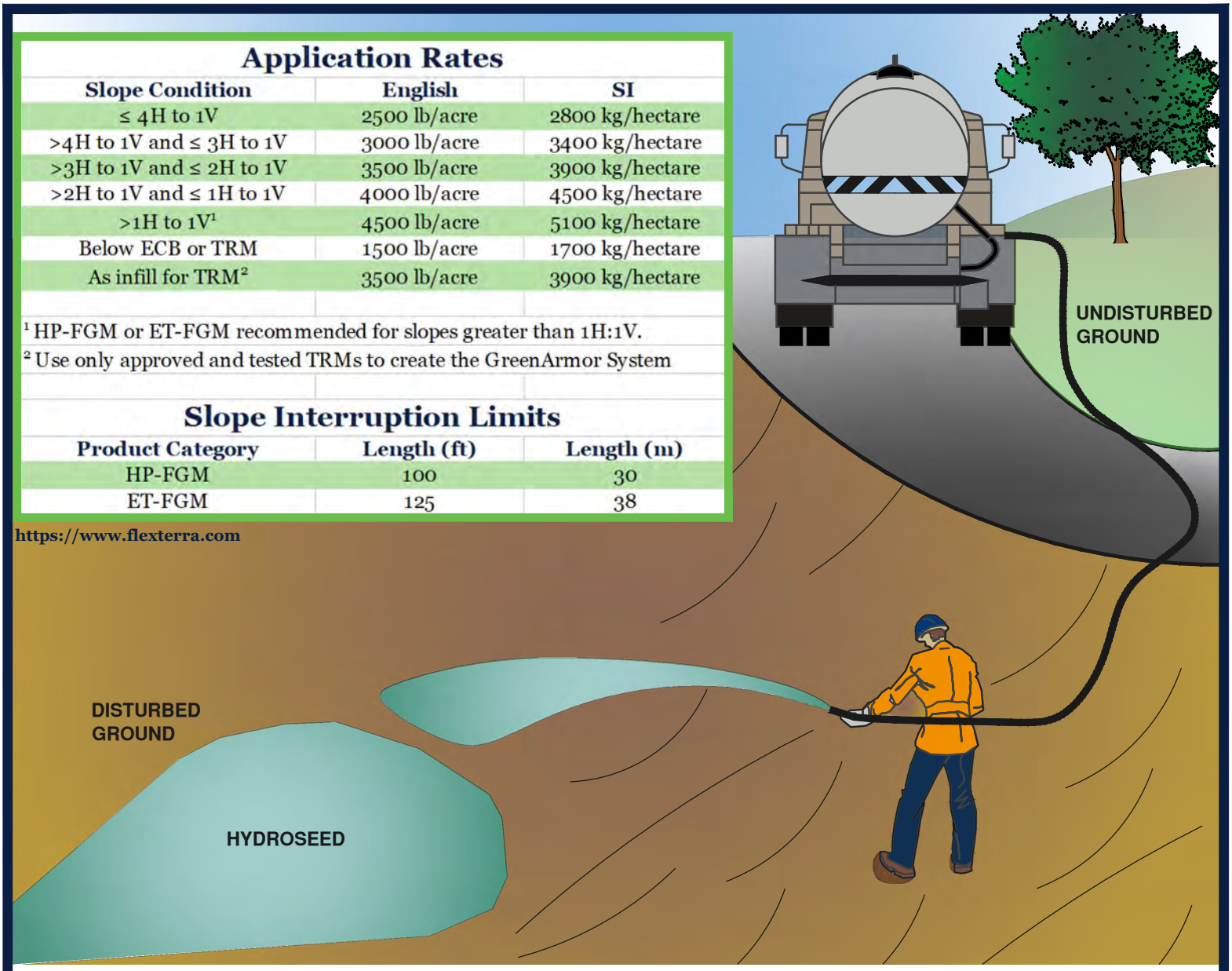
[1] HP-FGM or ET-FGM recommended for slopes greater than 1H:1V.

[2] Use only approved and tested TRMs to create the GreenArmor System

Slope Interruption Limits

Product Category	Length (ft)	Length (m)
HP-FGM	100	30
ET-FGM	125	38

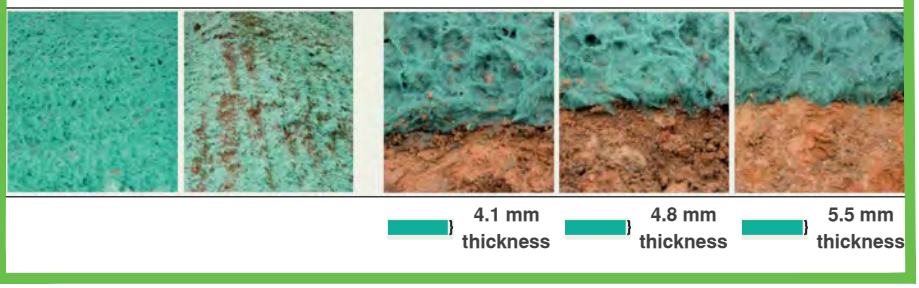
https://www.flexterra.com



NOTES:

1. COMPLY WITH EQUIPMENT MANUFACTURER'S INSTALLATION INSTRUCTIONS AND RECOMMENDATIONS.

Visual Key for Proper Application
(Flexterra HP-FGM shown below)



https://www.flexterra.com

EXAMPLE PHOTOGRAPH

HEARTLAND GREENWAY

HGS-BMP-022

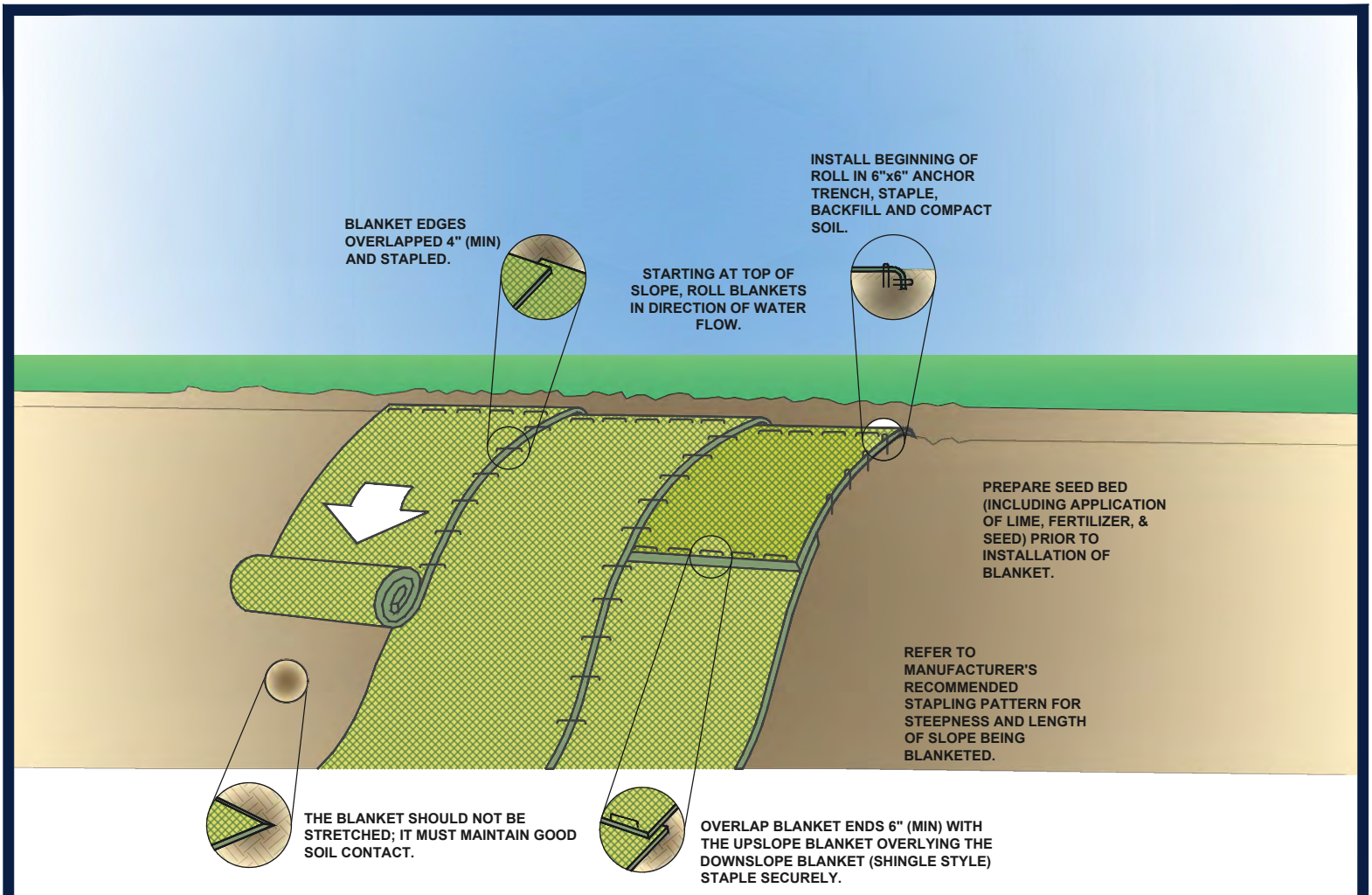
HYDROSEEDING

NOT TO SCALE

Navigator CO_2

TYPICAL CONSTRUCTION DETAIL

MAY 2022



NOTES:

1. SEED AND SOIL AMENDMENTS SHALL BE APPLIED ACCORDING TO THE RATES IN THE PLAN DRAWINGS PRIOR TO INSTALLING THE BLANKET.
2. PROVIDE ANCHOR TRENCH AT TOE OF SLOPE IN SIMILAR FASHION AS AT TOP. SLOPE SURFACE SHALL BE FREE OF ROCKS, CLODS, STICKS, AND GRASS.
3. BLANKET SHALL HAVE GOOD CONTINUOUS CONTACT WITH UNDERLYING SOIL THROUGHOUT ENTIRE LENGTH, LAY BLANKET LOOSELY AND STAKE OR STAPLE TO MAINTAIN DIRECT CONTACT WITH SOIL. DO NOT STRETCH BLANKET.
4. STAPLING OF THE BLANKET SHALL BE DONE IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS.
5. BLANKETED AREAS SHALL BE INSPECTED WEEKLY AND AFTER EACH RUNOFF EVENT UNTIL PERENNIAL VEGETATION IS ESTABLISHED TO A MINIMUM UNIFORM 70% COVERAGE THROUGHOUT THE BLANKETED AREA. DAMAGED OR DISPLACED BLANKETS SHALL BE RESTORED OR REPLACED WITH IN 5 CALENDAR DAYS.

HEARTLAND GREENWAY

HGS-BMP-023

EROSION CONTROL BLANKETING

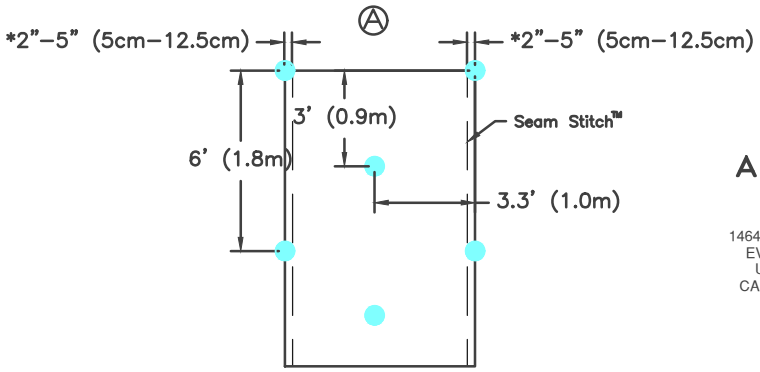
NOT TO SCALE

Navigator CO_2

TYPICAL CONSTRUCTION DETAIL

MAY 2022

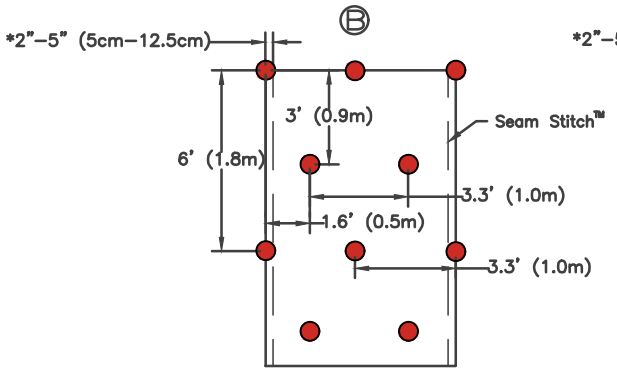
STAPLE PATTERN GUIDE



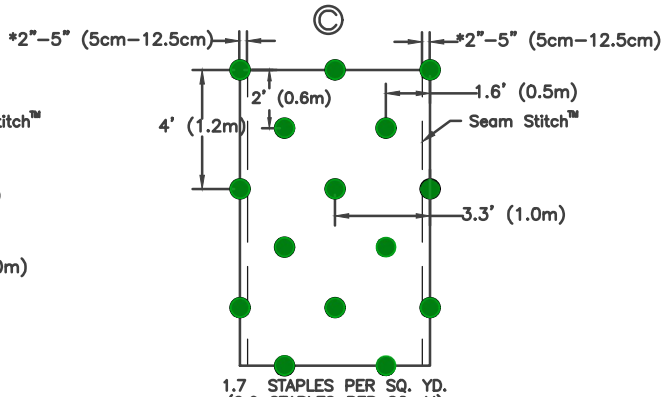
0.7 STAPLES PER SQ. YD.
(0.8 STAPLES PER SQ. M)
For blankets with the optional North American Green DOT System™ place staples/stakes through each of the BLUE colored dots.

NORTH AMERICAN GREEN

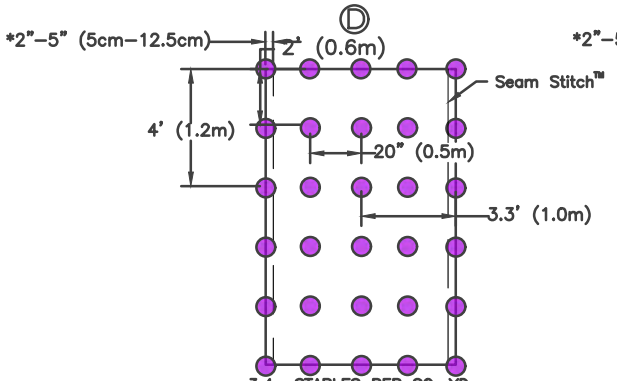
14649 HIGHWAY 41 NORTH
EVANSVILLE, IN 47725
USA 1-800-772-2040
CANADA 1-800-448-2040
www.nagreen.com



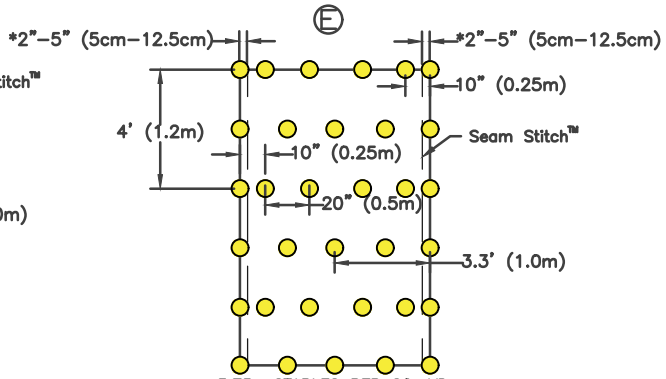
1.15 STAPLES PER SQ. YD.
(1.35 STAPLES PER SQ. M)
For blankets with the optional North American Green DOT System™ place staples/stakes through each of the RED colored dots.



1.7 STAPLES PER SQ. YD.
(2.0 STAPLES PER SQ. M)
For blankets with the optional North American Green DOT System™ place staples/stakes through each of the GREEN colored dots.



3.4 STAPLES PER SQ. YD.
(4.1 STAPLES PER SQ. M)
For blankets with the optional North American Green DOT System™ place staples/stakes through each of the PURPLE colored dots.



3.75 STAPLES PER SQ. YD.
(4.5 STAPLES PER SQ. M)
For blankets with the optional North American Green DOT System™ place staples/stakes through each of the YELLOW colored dots.

*Location of Seam Stitch™ will vary depending on North American Green product type:

HEARTLAND GREENWAY

HGS-BMP-024

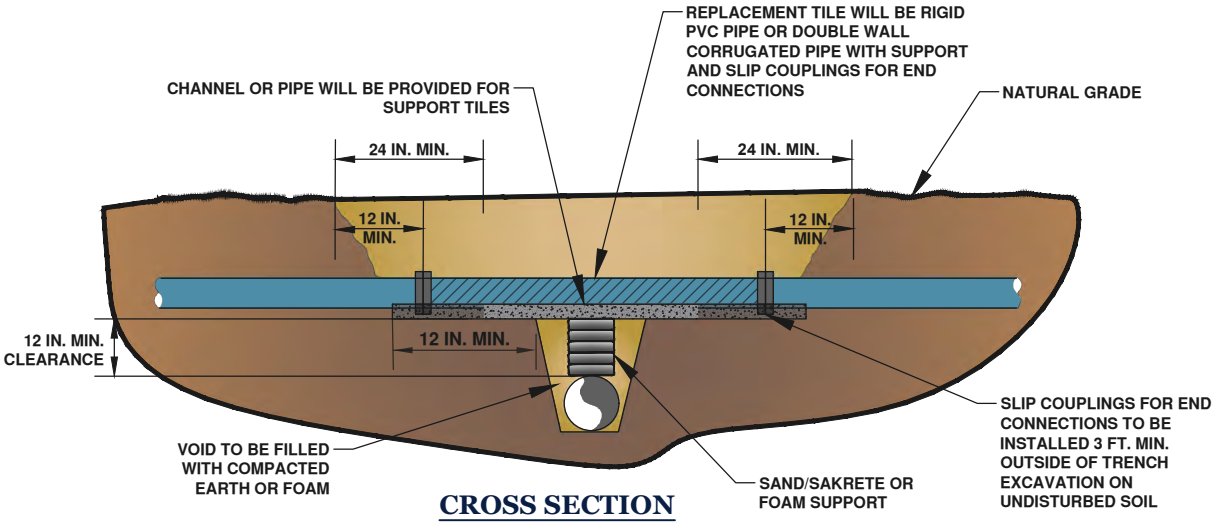
EROSION CONTROL BLANKETING- STAPLING

NOT TO SCALE

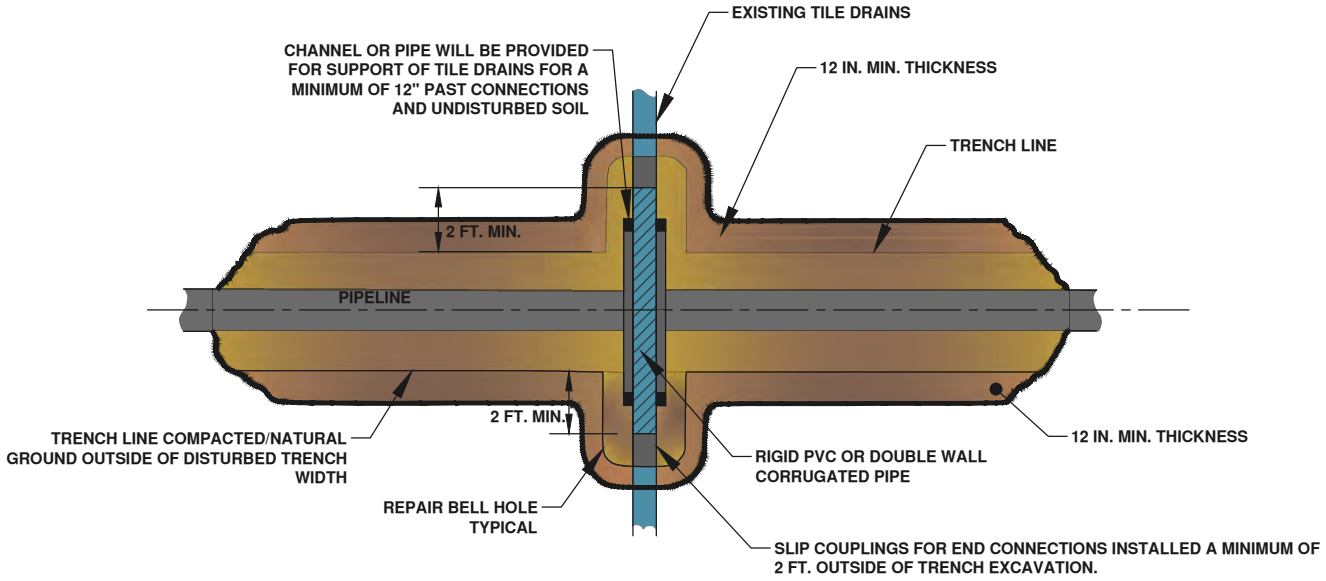
Navigator CO_2

TYPICAL CONSTRUCTION DETAIL

MAY 2022



CROSS SECTION



PLAN VIEW

NOTES:

1. IF WATER IS FLOWING THROUGH THE TILE AT TIME OF TRENCHING, IMMEDIATELY REPAIR TILE. IF NO WATER IS FLOWING FROM THE TILE, THE UPSTREAM EXPOSED TILE LINE SHALL BE SCREENED OR OTHERWISE PROTECTED TO PREVENT THE ENTRY OF FOREIGN MATERIAL AND SMALL ANIMALS INTO THE TILE SYSTEM. THE DOWNSTREAM TILE LINE ENTRANCE SHALL BE CAPPED OR FILTERED TO PREVENT ENTRY OF MUD OF FOREIGN MATERIAL.
2. CHANNEL OR PIPE MADE OF CORRUGATED GALVANIZED STEEL, PVC, OR ALUMINUM WILL BE USED FOR SUPPORT OF DRAIN TILE SPANS.
3. INDUSTRY STANDARDS SHALL BE FOLLOWED TO ENSURE PROPER SEAL OF REPAIRED DRAIN TILES.

HEARTLAND GREENWAY

HGS-BMP-025

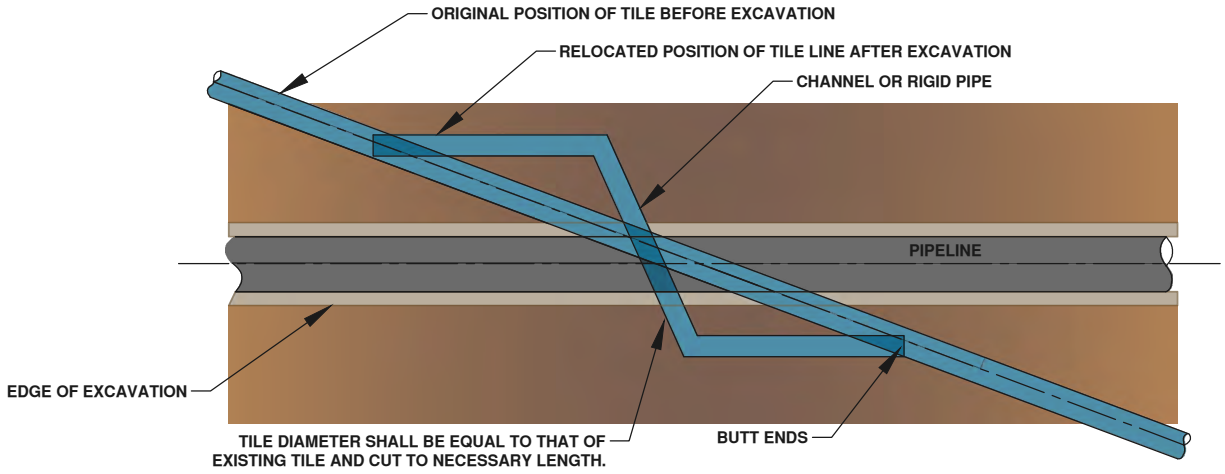
TEMPORARY TILE DRAIN REPAIR

NOT TO SCALE

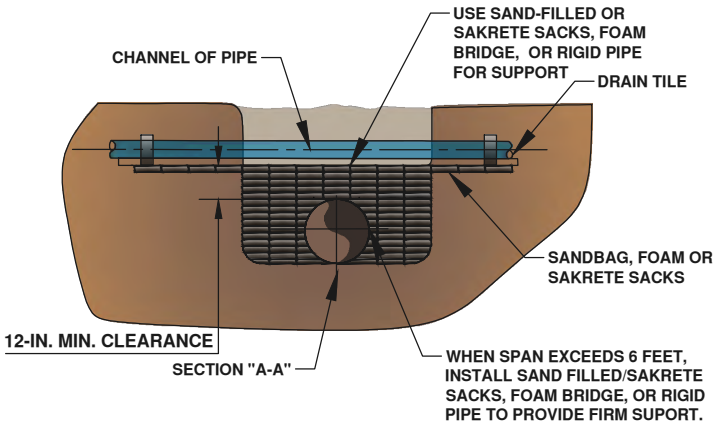
Navigator CO_2

TYPICAL CONSTRUCTION DETAIL

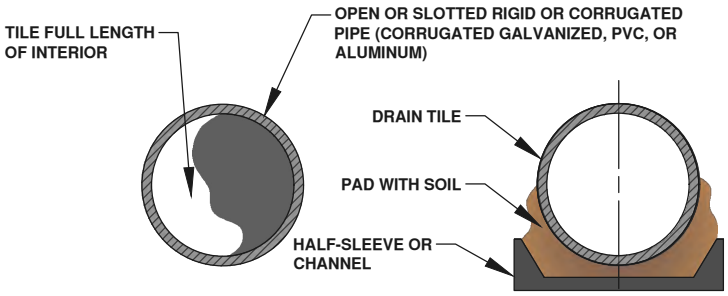
MAY 2022



PLAN VIEW



SECTION VIEW



SECTION A-A
RIGID OR DOUBLE WALL CORRUGATED PIPE OR CHANNEL

Minimum Support Table

Tile Size	Pipe Size
3"	4" Standard Wt.
4"-5"	6" Standard Wt.
8"-9"	10" Standard Wt.
10"	12" Standard Wt.

Channel Schedule

Tile Size	Channel Size
3"	4" @ 5.4 lb.
4"-5"	5" @ 6.7 lb.
8"-9"	7" @ 9.8 lb.
10"	10"@ 15.3 lb.

NOTES:

1. PRACTICAL TILE REPAIR AND REPLACEMENT SHALL MAINTAIN ORIGINAL ALIGNMENT GRADIENT AND WATER FLOW TO THE GREATEST EXTENT POSSIBLE. IF RELOCATION IS REQUIRED, THE INSTALLATION ANGLE MAY VARY DUE TO SITE SPECIFIC CONDITIONS AND LANDOWNER RECOMMENDATIONS.

2. 2-FT. MIN. LENGTH OF CHANNEL OR RIGID PIPE SHALL BE SUPPORTED BY UNDISTURBED SOIL, OR IF CROSSING IS NOT AT 90 DEGREES TO PIPELINE, EQUIVALENT LENGTH PERPENDICULAR TO TRENCH. SHIM WITH SAKRETE, SANDBAGS, OR FOAM TO UNDISTURBED SOIL. OTHER METHODS OF SUPPORTING DRAIN TILE MAY BE USED IF ALTERNATE PROPOSED EQUIVALENT IN STRENGTH AND IF APPROVED BY COMPANY REPRESENTATIVES AND LANDOWNER IN ADVANCE.

3. DRAIN TILES WILL BE PERMANENTLY CONNECTED TO EXISTING DRAIN TILES 2 FT. MIN. OUTSIDE OF EXCAVATED TRENCH LINE USING INDUSTRY STANDARD TO ENSURE PROPER SEAL OF REPAIRED DRAIN TILES, INCLUDING SLIP COUPLINGS.

4. DIAMETER OF RIGID PIPE SHALL BE OF ADEQUATE SIZE TO ALLOW FOR THE INSTALLATION OF THE TILE FOR THE FULL LENGTH OF RIGID PIPE. SITE SPECIFIC ALTERNATIVE SUPPORT SYSTEM TO BE DEVELOPED BY COMPANY REPRESENTATIVES AND FURNISHED TO CONTRACTOR FOR SPANS IN EXCESS OF 20', TILE GREATER THAN 10', AND HEADER SYSTEMS.

5. PRIOR TO REPAIRING TILE, CONTRACTOR SHALL PROBE LATERALLY INTO THE EXISTING TILE TO FULL WIDTH OF THE RIGHT-OF-WAY TO DETERMINE IF ADDITIONAL DAMAGE HAS OCCURRED. ALL DAMAGED TILE SHALL BE REPAIRED TO ORIGINAL GRADE AND CONDITION.

6. RELOCATION OF DRAIN TILE IS ONLY TO OCCUR WHEN THE ANGLE OF THE PROPOSED PIPE TO THE EXISTING DRAIN TILE IS LESS THAN 20°. IN THESE CIRCUMSTANCES, THE RELOCATED TILE SHALL BE 45° FOR THE ENTIRETY OF THE NORMAL TRENCH WIDTH. IN AREAS WHERE THE TRENCH WIDTH ITSELF EXCEEDS NORMAL WIDTH, THE RELOCATED DRAIN TILE TO PIPELINE MAY EXCEED 45°.

HEARTLAND GREENWAY

HGS-BMP-026

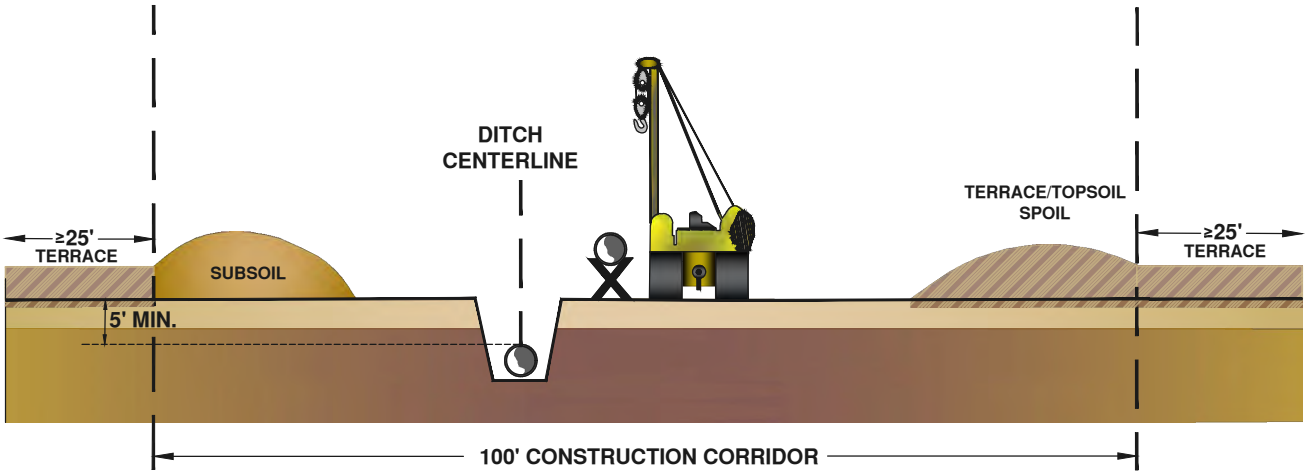
PERMANENT TILE DRAIN INSTALLATION/REPAIR

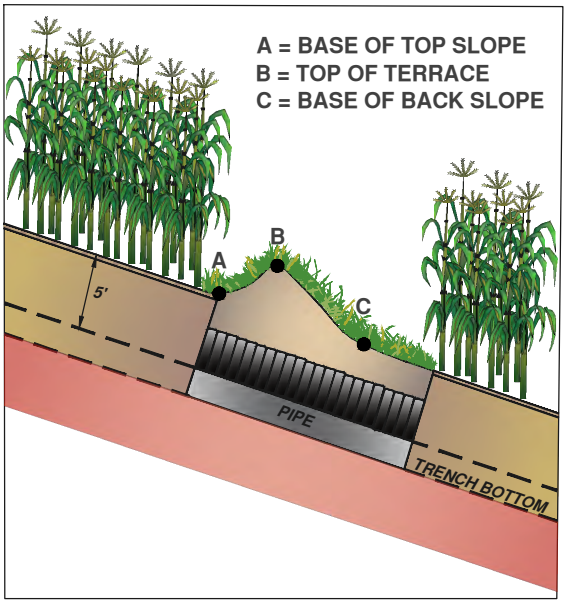
NOT TO SCALE

Navigator CO_2

TYPICAL CONSTRUCTION DETAIL

MAY 2022





TOPSOIL
COMPACTED BACKFILL
SAKRETE, SANDBAG, FOAM, ETC.
PIPE
STANDARD BACKFILL SOIL
UNDISTURBED SOIL

SIDE VIEW
RESTORATION CROSS SECTION

EXAMPLE PHOTOGRAPH (NRCS)

NOTES:

1. CAPTURE PRE-CONSTRUCTION ELEVATIONS AT A, B, AND C, AND RESPECTIVE SLOPES AT 2 OR MORE LOCATIONS (ONE WITHIN, ONE OUTSIDE THE ROW) TO ENSURE PROPER PROFILE WILL BE RESTORED
2. BACKFILL WITHIN THE LIMITS OF THE TERRACE PROFILE SHOULD BE IN 9" LIFTS *
3. EACH LIFT SHOULD TRENCH COMPACTION FOR TERRACE CONSTRUCTION SHALL BE COMPACTED BY EXERTING A PRESSURE OF AT LEAST 100 POUNDS PER SQUARE INCH *
4. CONSTRUCTION FOAM/SAKRETE/SAND BAGS MAYMAY BE USED IN THE TRENCH BENEATH THE TERRACE SO LONG AS THE SOIL ABOVE THE FOAM IS PROPERLY COMPACTED BY EXERTING A PRESSURE OF AT LEAST 100 POUNDS PER SQUARE INCH
5. USE LANDOWNER DRAWINGS OR SPECIFICATIONS IF AVAILABLE.

* SOURCE: PART 650 ENGINEERING FIELD HANDBOOK. CHAPTER 8 TERRACES. NATURAL RESOURCES CONSERVATION SERVICES, UNITED STATES DEPARTMENT OF AGRICULTURE, FEBRUARY 2021. WWW.DIRECTIVES.SC.EGIV.USDA.GOV/OPENNONWEBCONTENT.ASPX?CONTENT=46257.WBA

HGS-BMP-027

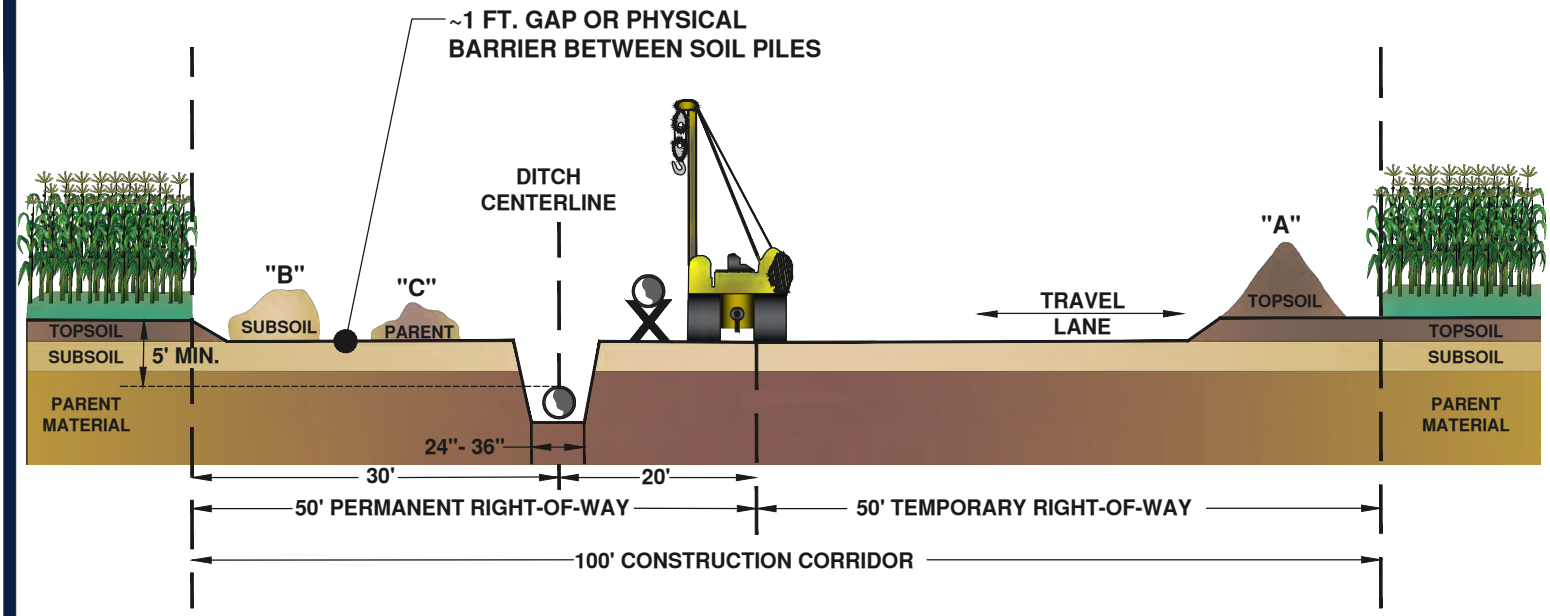
TERRACE TYPICAL
SMALL DIAMETER (<12" Ø) PIPE

NOT TO SCALE

Navigator CO_2

TYPICAL CONSTRUCTION DETAIL

AUGUST 2022



NOTES:

1. STRIP TOPSOIL ("A") ACCORDING TO THE TOPSOIL DEPTHS BASED ON RESULTS FROM THE TOPSOIL SURVEYS. PLACE "A" ALL THE WAY TO THE FAR SIDE OF THE TRAVEL LANE . IN AREAS OF THICKER "A" HORIZONS, "A" MAY BE SPLIT TO BOTH FAR SIDES OF THE RIGHT-OF-WAY IF NEEDED AND APPROVED BY THE AGRICULTURAL INSPECTOR.

2. EXCAVATE TRENCH. ENSURE DIFFERENT SOIL HORIZONS ("B" AND "C") ARE IN SEPARATE STOCKPILES. STOCKPILE THE "B" SPOIL (AND "C" IF PRESENT) SUCH THAT IT IS ON EXISTING SUBSOIL AND NOT ON TOP OF TOPSOIL. MAINTAIN A VISUAL SEPARATION FROM AND/OR OR A PHYSICAL BARRIER BETWEEN THE "B" AND THE "A" STOCKPILES.

3. STOCKPILING SHALL ALLOW FOR REPLACEMENT OF SOIL HORIZONS BACK TO ORIGINAL SEQUENCES WITHOUT LOSS OF SOIL. MAINTAIN A VISUAL SEPARATION (APPROXIMATELY 1-FT.) OR PHYSICAL BARRIER (SILT FENCE, MULCH, FABRIC, ETC.) BETWEEN STOCKPILES AT ALL TIMES. WHEN PARENT MATERIAL IS PRESENT IN THE TRENCH PROFILE, ENSURE IT IS STOCKPILED SEPARATELY, USING A VISUAL SEPARATION OR PHYSICAL BARRIER, FROM OTHER STOCKPILED SOILS AND IS NEVER STOCKPILED ON TOP OF EXISTING TOPSOIL/ NATURAL GRADE.

4. LEAVE GAPS IN TOPSOIL AND SPOIL PILES AT OBVIOUS DRAINAGE PATHWAYS.

5. TOPSOIL AND TRENCH SPOIL PILES RELATIVE POSITIONS CAN BE EDITED WITH AGREEMENT OF THE AGRICULTURAL INSPECTORS OR COMPANY REPRESENTATIVE.

6. TO AVOID WIND EROSION, TEMPORARILY SUSPEND TOPSOIL HANDLING OPERATIONS DURING INORDINATELY WINDY CONDITIONS UNTIL MITIGATIVE MEASURES CAN BE IMPLEMENTED OR CONDITIONS CALM.

7. STABILIZE TOPSOIL (TEMPORARY SEED, TACKIFIER, MULCH) THAT WILL REMAIN FOR MORE THAN 14 DAYS IN COMPLIANCE WITH RESPECTIVE WEED PLAN OR AGRICULTURAL MITIGATION PLAN.

FOR CONSTRUCTION OF LESS THAN 12" OUTSIDE DIAMETER

HEARTLAND GREENWAY

HGS-BMP-028-SDP

FULL WIDTH TOPSOIL SEGREGATION

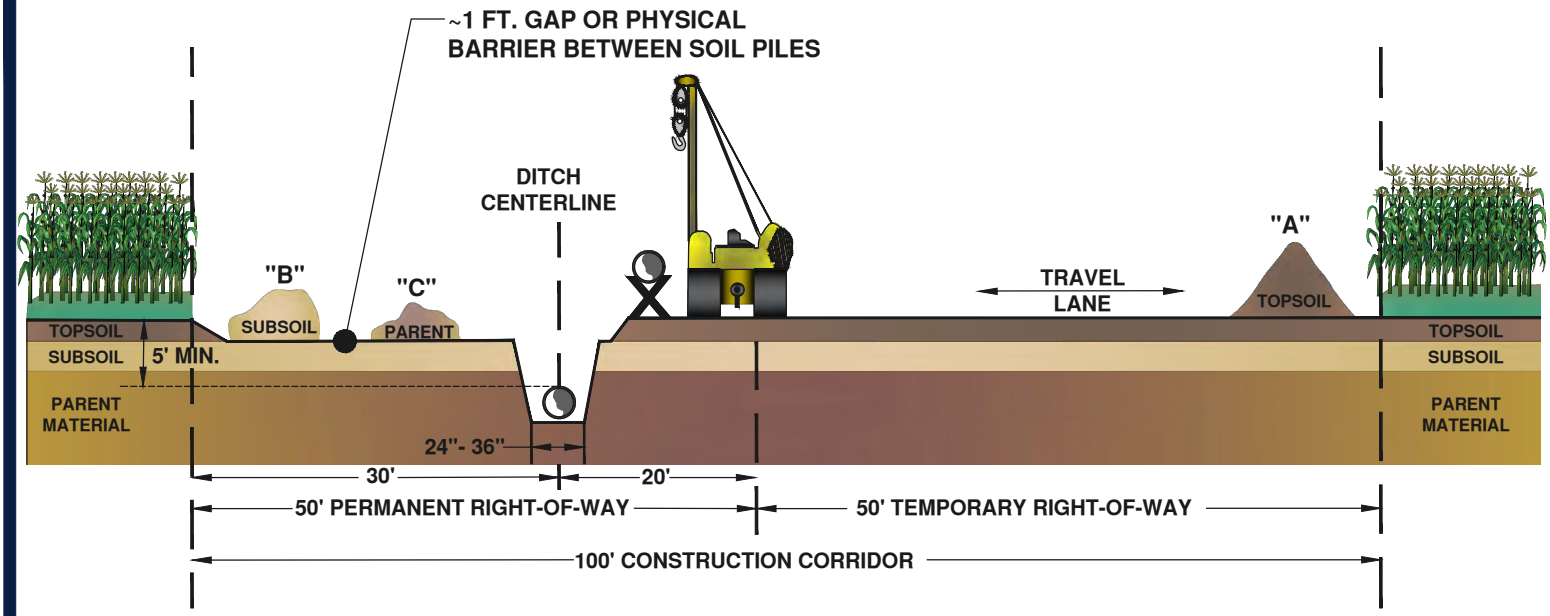
SMALL DIAMETER (<12"Ø) PIPE

NOT TO SCALE

Navigator CO_2

TYPICAL CONSTRUCTION DETAIL

MAY 2022



NOTES:

1. STRIP TOPSOIL ("A") ACCORDING TO THE TOPSOIL DEPTHS BASED ON RESULTS FROM THE TOPSOIL SURVEYS. PLACE "A" ALL THE WAY TO THE FAR SIDE OF THE TRAVEL LANE . IN AREAS OF THICKER "A" HORIZONS, "A" MAY BE SPLIT TO BOTH FAR SIDES OF THE RIGHT-OF-WAY IF NEEDED AND APPROVED BY THE AGRICULTURAL INSPECTOR.

2. EXCAVATE TRENCH. ENSURE DIFFERENT SOIL HORIZONS ("B" AND "C") ARE IN SEPARATE STOCKPILES. STOCKPILE THE "B" SPOIL (AND "C" IF PRESENT) SUCH THAT IT IS ON EXISTING SUBSOIL AND NOT ON TOP OF TOPSOIL. MAINTAIN A VISUAL SEPARATION FROM AND/OR OR A PHYSICAL BARRIER BETWEEN THE "B" AND THE "A" STOCKPILES.

3. STOCKPILING SHALL ALLOW FOR REPLACEMENT OF SOIL HORIZONS BACK TO ORIGINAL SEQUENCES WITHOUT LOSS OF SOIL. MAINTAIN A VISUAL SEPARATION (APPROXIMATELY 1-FT.) OR PHYSICAL BARRIER (SILT FENCE, MULCH, FABRIC, ETC.) BETWEEN STOCKPILES AT ALL TIMES. WHEN PARENT MATERIAL IS PRESENT IN THE TRENCH PROFILE, ENSURE IT IS STOCKPILED SEPARATELY, USING A VISUAL SEPARATION OR PHYSICAL BARRIER, FROM OTHER STOCKPILED SOILS AND IS NEVER STOCKPILED ON TOP OF EXISTING TOPSOIL/ NATURAL GRADE.

4. LEAVE GAPS IN TOPSOIL AND SPOIL PILES AT OBVIOUS DRAINAGE PATHWAYS.

5. TOPSOIL AND TRENCH SPOIL PILES RELATIVE POSITIONS CAN BE EDITED WITH AGREEMENT OF THE AGRICULTURAL INSPECTORS OR COMPANY REPRESENTATIVE.

6. TO AVOID WIND EROSION, TEMPORARILY SUSPEND TOPSOIL HANDLING OPERATIONS DURING INORDINATELY WINDY CONDITIONS UNTIL MITIGATIVE MEASURES CAN BE IMPLEMENTED OR CONDITIONS CALM.

7. STABILIZE TOPSOIL (TEMPORARY SEED, TACKIFIER, MULCH) THAT WILL REMAIN FOR MORE THAN 14 DAYS IN COMPLIANCE WITH RESPECTIVE WEED PLAN OR AGRICULTURAL MITIGATION PLAN.

FOR CONSTRUCTION OF LESS THAN 12" OUTSIDE DIAMETER

HEARTLAND GREENWAY

HGS-BMP-029-SDP

DITCH AND SPOIL TOPSOIL SEGREGATION

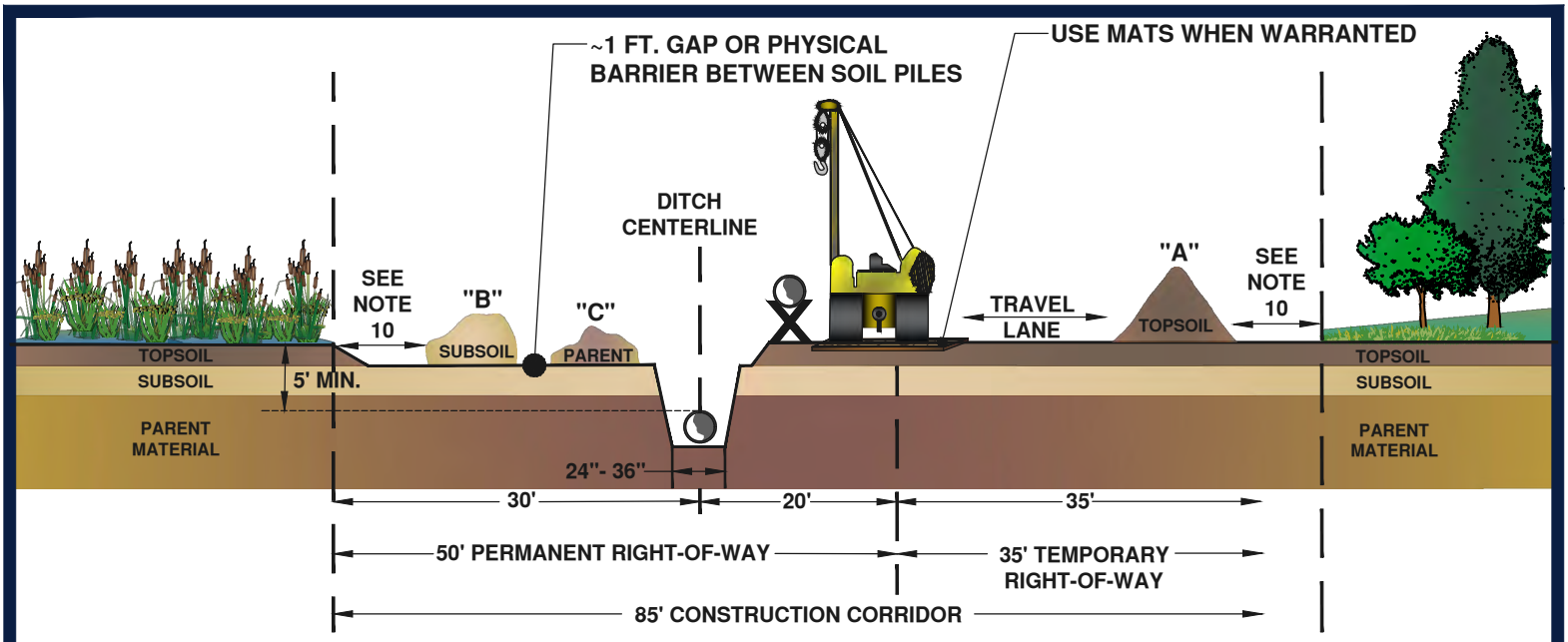
SMALL DIAMETER (<12"Ø) PIPE

NOT TO SCALE

Navigator CO_2

TYPICAL CONSTRUCTION DETAIL

MAY 2022



NOTES:

1. STRIP TOPSOIL ("A") ACCORDING TO THE TOPSOIL DEPTHS BASED ON RESULTS FROM THE TOPSOIL SURVEYS. PLACE "A" ALL THE WAY TO THE FAR SIDE OF THE TRAVEL LANE . IN AREAS OF THICKER "A" HORIZONS, "A" MAY BE SPLIT TO BOTH FAR SIDES OF THE RIGHT-OF-WAY IF NEEDED AND APPROVED BY THE AGRICULTURAL INSPECTOR.

2. EXCAVATE TRENCH. ENSURE DIFFERENT SOIL HORIZONS ("B" AND "C") ARE IN SEPARATE STOCKPILES. STOCKPILE THE "B" SPOIL (AND "C" IF PRESENT) SUCH THAT IT IS ON EXISTING SUBSOIL AND NOT ON TOP OF TOPSOIL. MAINTAIN A VISUAL SEPARATION FROM AND/OR OR A PHYSICAL BARRIER BETWEEN THE "B" AND THE "A" STOCKPILES.

3. STOCKPILING SHALL ALLOW FOR REPLACEMENT OF SOIL HORIZONS BACK TO ORIGINAL SEQUENCES WITHOUT LOSS OF SOIL. MAINTAIN A VISUAL SEPARATION (APPROXIMATELY 1-FT.) OR PHYSICAL BARRIER (SILT FENCE, MULCH, FABRIC, ETC.) BETWEEN STOCKPILES AT ALL TIMES. WHEN PARENT MATERIAL IS PRESENT IN THE TRENCH PROFILE, ENSURE IT IS STOCKPILED SEPARATELY, USING A VISUAL SEPARATION OR PHYSICAL BARRIER, FROM OTHER STOCKPILED SOILS AND IS NEVER STOCKPILED ON TOP OF EXISTING TOPSOIL/ NATURAL GRADE.

4. LEAVE GAPS IN TOPSOIL AND SPOIL PILES AT OBVIOUS DRAINAGE PATHWAYS.

5. TOPSOIL AND TRENCH SPOIL PILES RELATIVE POSITIONS CAN BE EDITED WITH AGREEMENT OF THE AGRICULTURAL INSPECTORS OR COMPANY REPRESENTATIVE.

6. TO AVOID WIND EROSION, TEMPORARILY SUSPEND TOPSOIL HANDLING OPERATIONS DURING INORDINATELY WINDY CONDITIONS UNTIL MITIGATIVE MEASURES CAN BE IMPLEMENTED OR CONDITIONS CALM.

7. CONSTRUCTION IN WET CONDITIONS SHOULD NOT COMMENCE OR CONTINUE AT TIMES WHEN, OR LOCATIONS WHERE, THE PASSAGE OF HEAVY CONSTRUCTION EQUIPMENT MAY CAUSE RUTTING TO THE EXTENT THAT THE TOPSOIL AND SUBSOIL ARE MIXED OR UNDERGROUND DRAINAGE STRUCTURES MAY BE DAMAGED.

8. USE TIMBERMATTING WHERE WARRANTED FOR SAFE OPERATION WITHIN THE SENSITIVE AREA OR IN WET CONDITIONS TO PREVENT TOPSOIL AND SUB SOIL MIXING ON WORKING PLATFORM.

9. STABILIZE TOPSOIL (TEMPORARY SEED, TACKIFIER, MULCH) THAT WILL REMAIN FOR MORE THAN 14 DAYS IN COMPLIANCE WITH RESPECTIVE WEED PLAN OR AGRICULTURAL MITIGATION PLAN.

10. SETBACK DISTANCE TO BE BASED ON CHARACTERISTICS OF THE SENSITIVE AREA ADJACENT TO THE RIGHT OF WAY. REFER TO DETAIL #37 AND #38 FOR SETBACK DIMENSIONS.

FOR CONSTRUCTION OF LESS THAN 12" OUTSIDE DIAMETER

HEARTLAND GREENWAY

HGS-BMP-030-SDP

SENSITIVE AREAS

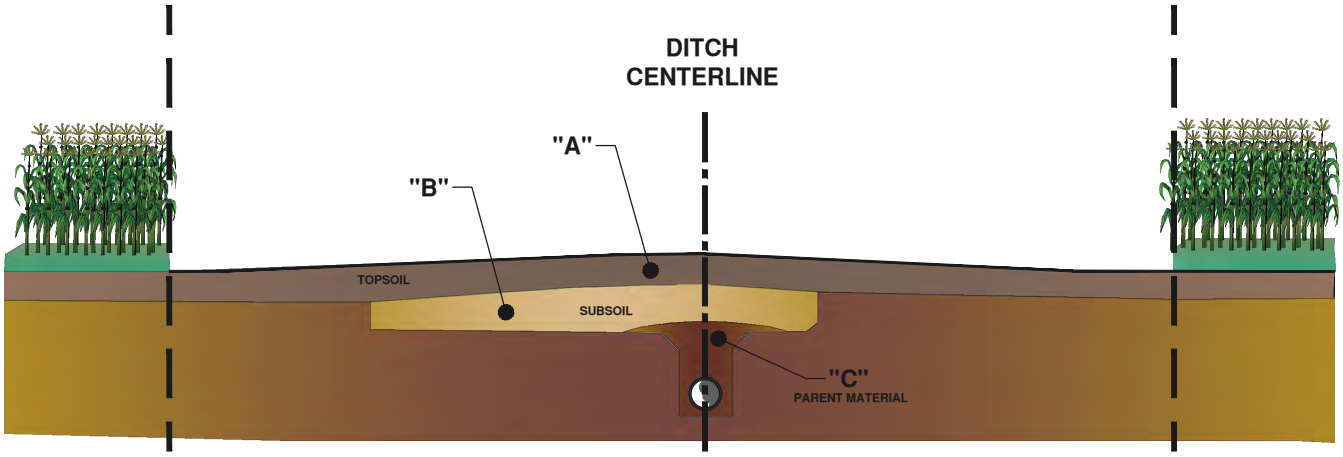
SMALL DIAMETER (<12" Ø) PIPE

NOT TO SCALE

Navigator CO_2

TYPICAL CONSTRUCTION DETAIL

MAY 2022



NOTES:

1. REPLACE SPOIL PILES IN THE REVERSE ORDER THEY WERE REMOVED SUCH THAT PARENT MATERIAL, IF PRESENT, IS REPLACED FIRST; FOLLOWED BY SUBSOIL.

2. COMPACT SPOIL DURING REPLACEMENT.

3. SUBSOIL DE-COMPACTION OF AGRICULTURAL LANDS TO BE PERFORMED IN ACCORDANCE WITH STATE AGRICULTURAL MITIGATION PLAN OR LANDOWNER SPECIFICATION IN LINE LIST.

4. PRIOR TO DE-COMPACTION, APPLY SOIL ENHANCEMENTS AS DETAILED IN THE AGRICULTURAL MITIGATION PLAN. INCORPORATE SOIL ENHANCEMENTS VIA DE-COMPACTION PROCEDURES.

5. CROWN TRENCH WITH SPOIL MATERIALS TO ACCOUNT FOR ANTICIPATED SETTLING OVER THE TRENCH.

6. REPLACE TOPSOIL IN AN EFFORT TO REFLECT PRE-CONSTRUCTION DEPTHS, AS PRACTICAL.

HEARTLAND GREENWAY

HGS-BMP-031

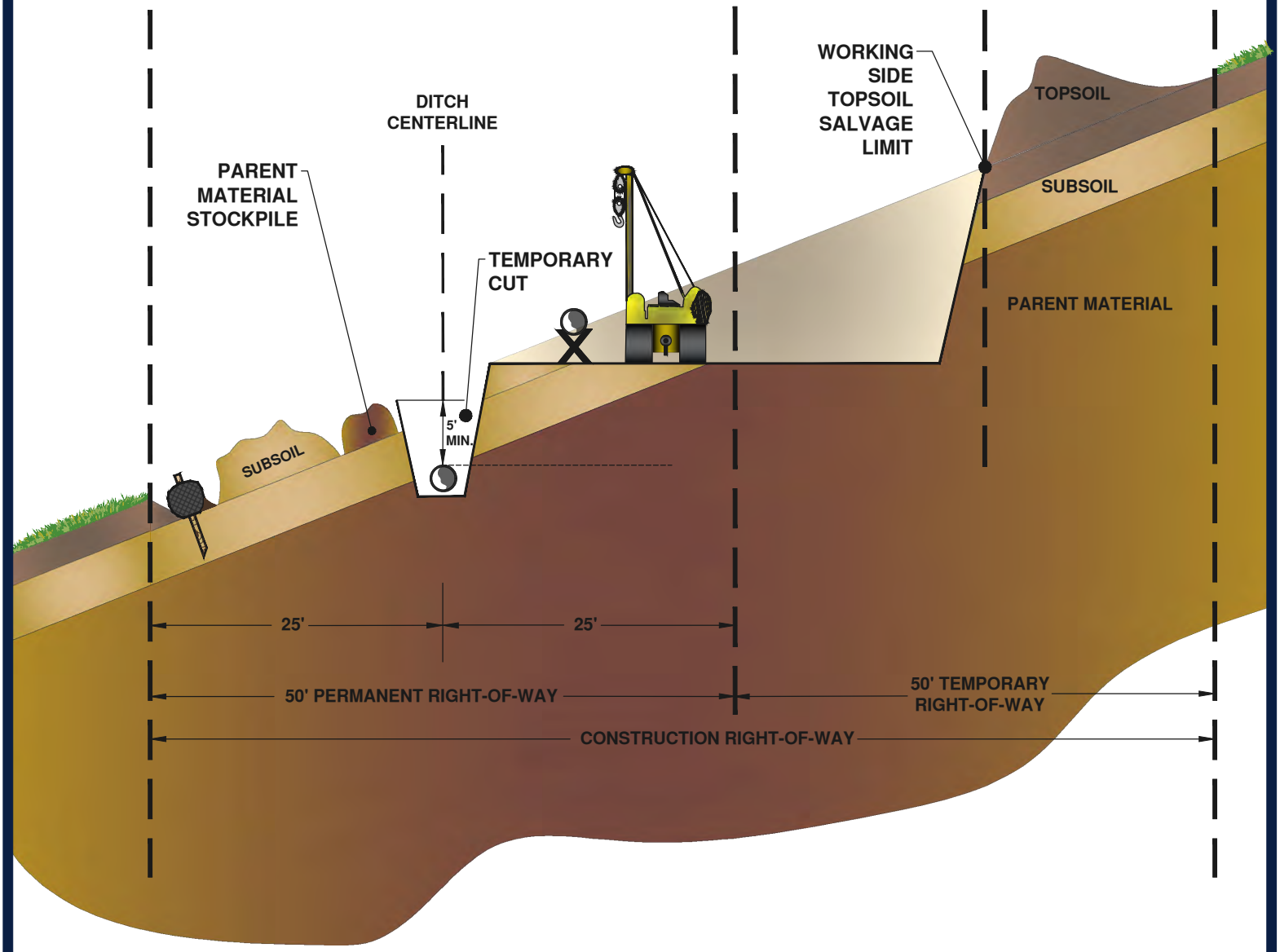
DITCH RESTORATION AND BACKFILL

NOT TO SCALE

Navigator CO_2

TYPICAL CONSTRUCTION DETAIL

MAY 2022



NOTES:

1. DEPTH OF TOP SOIL SEGREGATED BASED UPON SITE SPECIFIC CONDITIONS; THE AGRICULTURAL MITIGATION PLAN AND LANDOWNER AGREEMENT.
2. EROSION CONTROL DEVICES ARE TO BE INSTALLED PERPENDICULAR TO THE SLOPE.

HEARTLAND GREENWAY

HGS-BMP-032

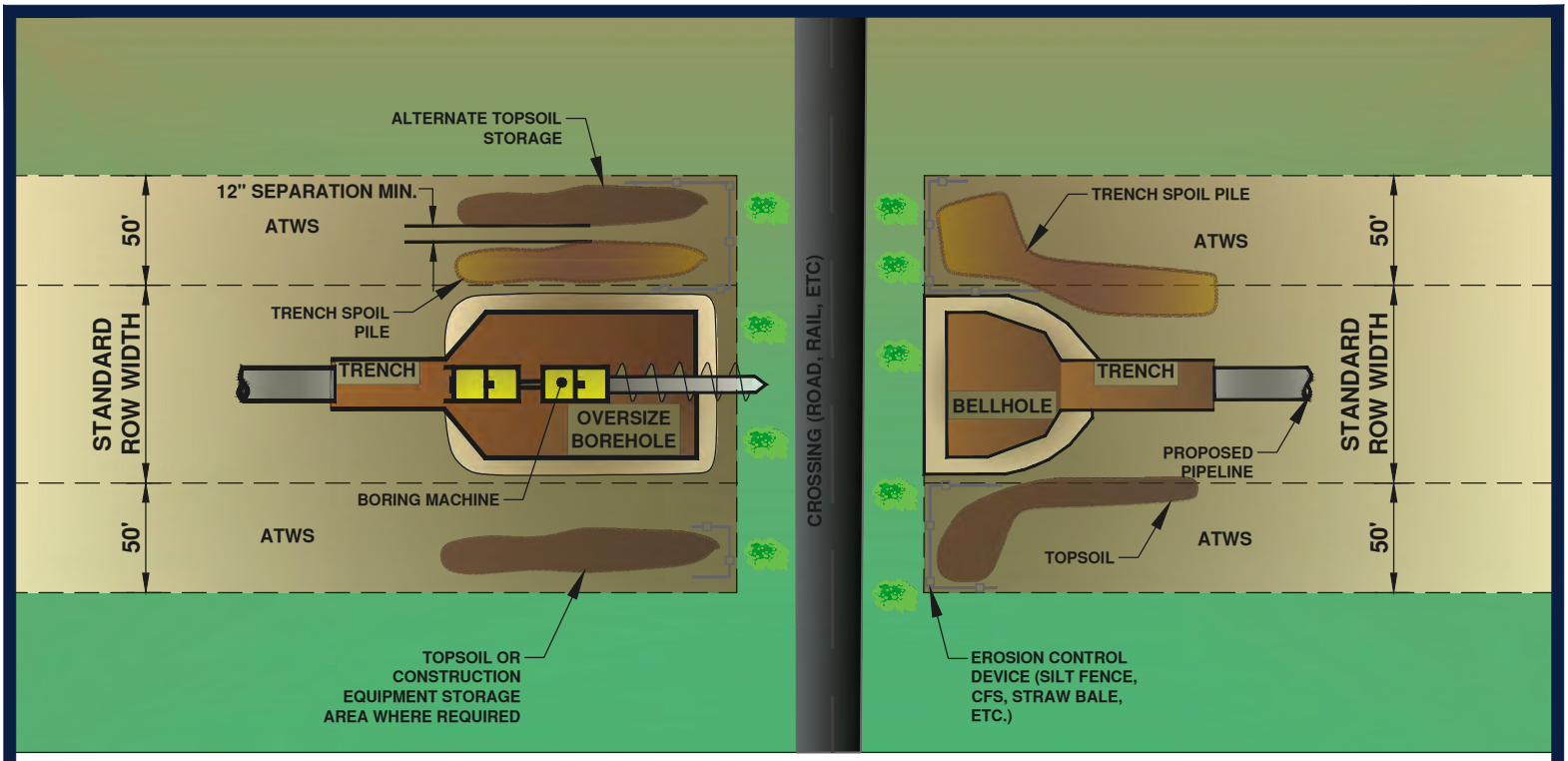
SIDE SLOPE CONSTRUCTION

NOT TO SCALE

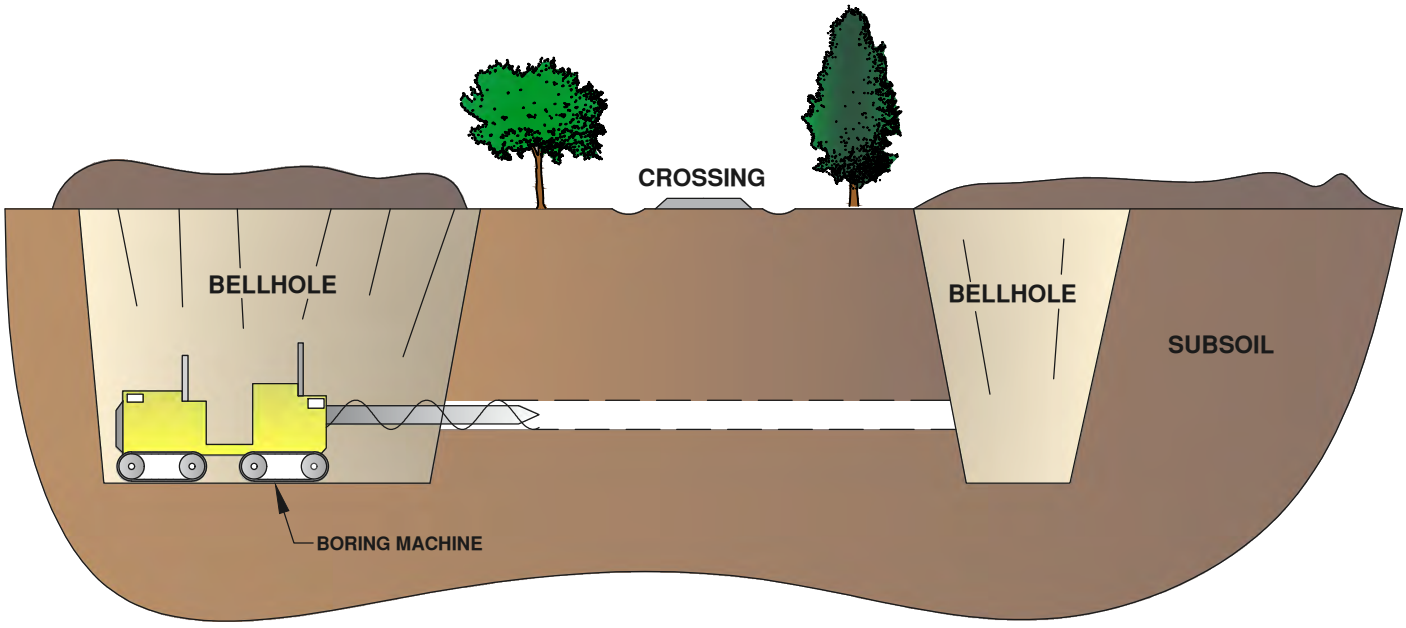
Navigator CO_2

TYPICAL CONSTRUCTION DETAIL

MAY 2022



PLAN VIEW



PROFILE VIEW

NOTES:

1. STRIP TOPSOIL FROM BELLHOLE AREA IN UNMANAGED WOODLANDS. STRIP TOPSOIL FROM THE BELLHOLE AND SPOIL STORAGE AREA ON AGRICULTURAL LAND.
2. EXCAVATE BELLHOLE, STORING TRENCH SPOIL ON THE OPPOSITE SIDE OF RIGHT-OF-WAY FROM TOPSOIL, OR ADJACENT TO TOPSOIL MAINTAINING A 12" MINIMUM SEPARATION TO AVOID MIXING TOPSOIL AND TRENCH SOIL.
3. AFTER COMPLETION OF PIPE TIE-INS, BACKFILL AND COMPACT. LEAVE A CROWN TO ALLOW FOR SUBSIDENCE.
4. INSTALL TEMPORARY EROSION CONTROL PROCEDURES AS SPECIFIED BE THE PIPELINE INSPECTOR.

HEARTLAND GREENWAY

HGS-BMP-033

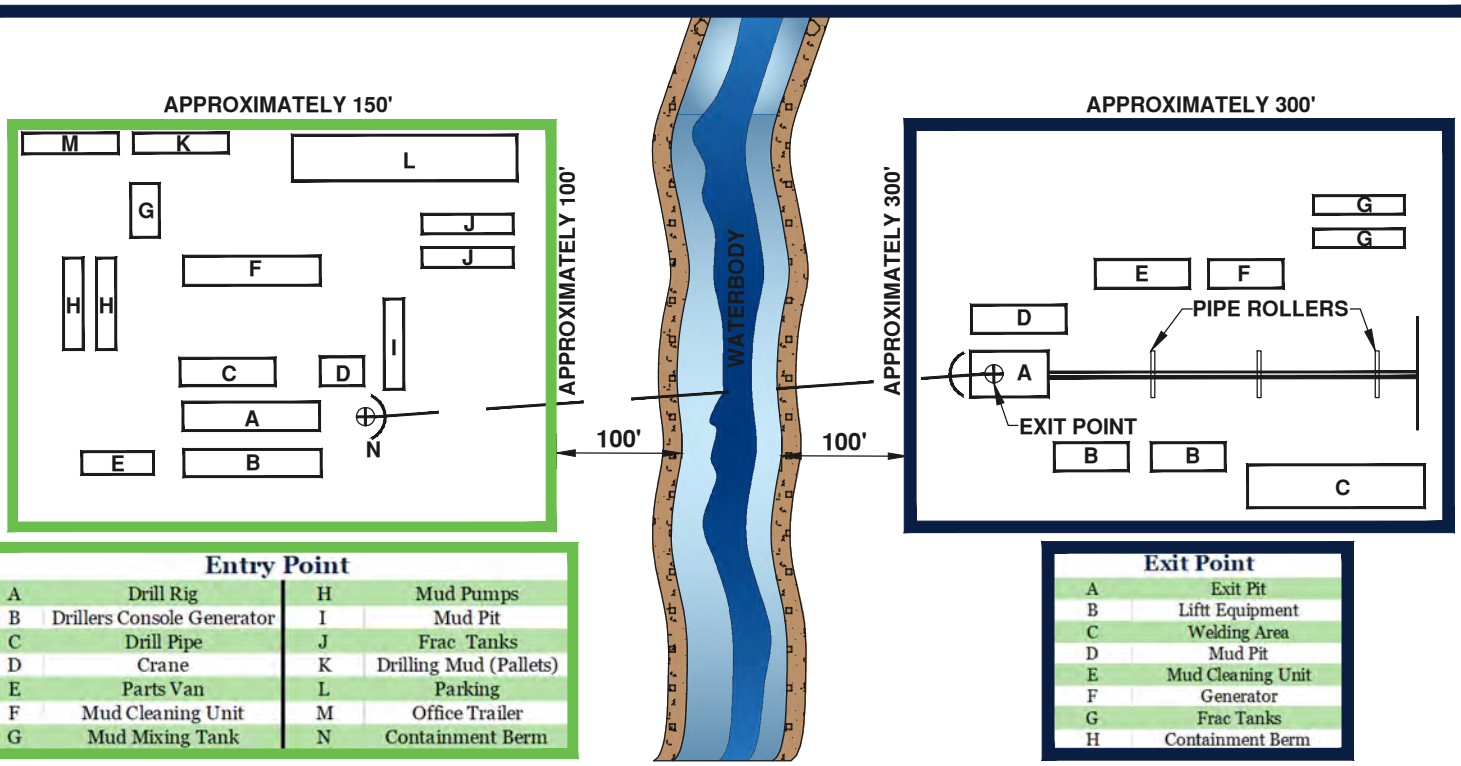
TOPSOIL SALVAGE CROSSING BORE (CB)

NOT TO SCALE

Navigator CO_2

TYPICAL CONSTRUCTION DETAIL

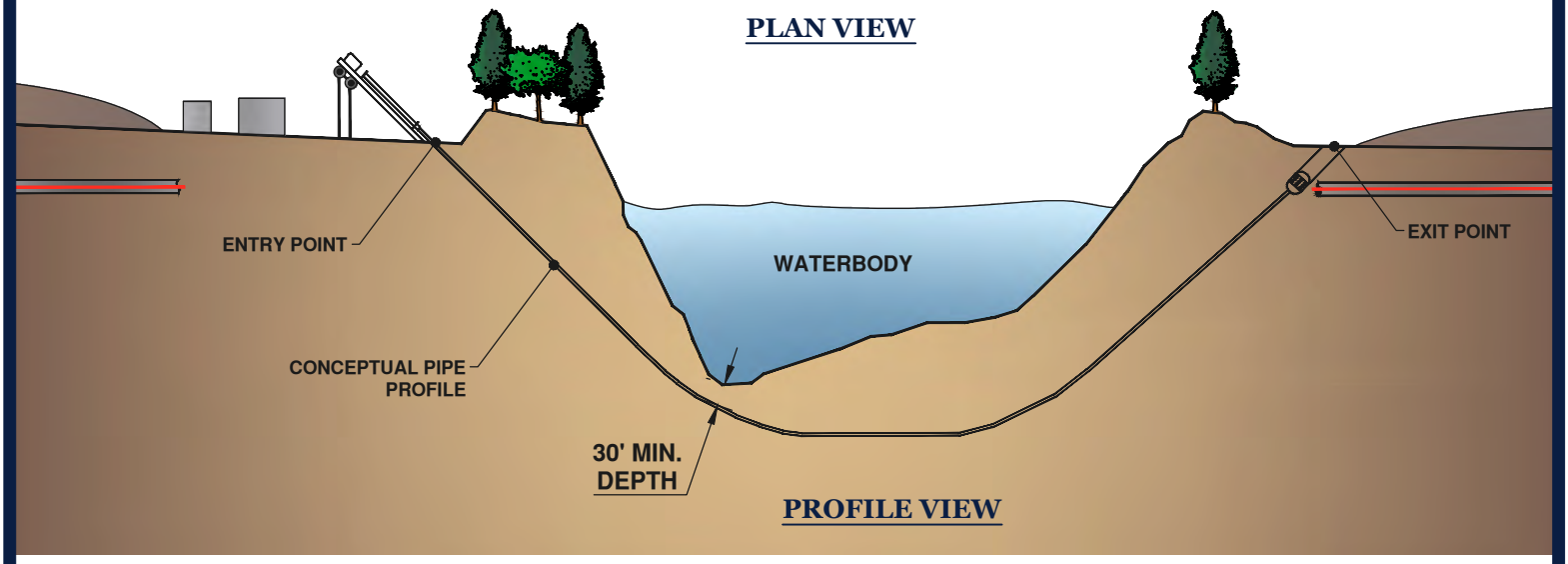
MAY 2022



Entry Point			
A	Drill Rig	H	Mud Pumps
B	Drillers Console Generator	I	Mud Pit
C	Drill Pipe	J	Frac Tanks
D	Crane	K	Drilling Mud (Pallets)
E	Parts Van	L	Parking
F	Mud Cleaning Unit	M	Office Trailer
G	Mud Mixing Tank	N	Containment Berm

Exit Point	
A	Exit Pit
B	Liftt Equipment
C	Welding Area
D	Mud Pit
E	Mud Cleaning Unit
F	Generator
G	Frac Tanks
H	Containment Berm

PLAN VIEW



PROFILE VIEW

NOTES:

1. LIMIT GROUND DISTURBANCE AS INDICATED ON PERMIT DRAWINGS AND.OR ON INDIVIDUAL HDD PLANS.
2. DRILLING MUD ADDITIVES MUST BE APPROVED BY NAVIGATOR PRIOR TO USE.
3. DISPOSE OF DRILLING MUD IN ACCORDANCE WITH EASEMENTS, PERMIT PLANS AND REGULATORY REQUIREMENTS.
4. ROUTINELY MONITOR FOR INADVERTENT RETURNS. IF FOUND, REPORT TO EI/AI AS SOON AS PRACTICAL.

HEARTLAND GREENWAY

HGS-BMP-034

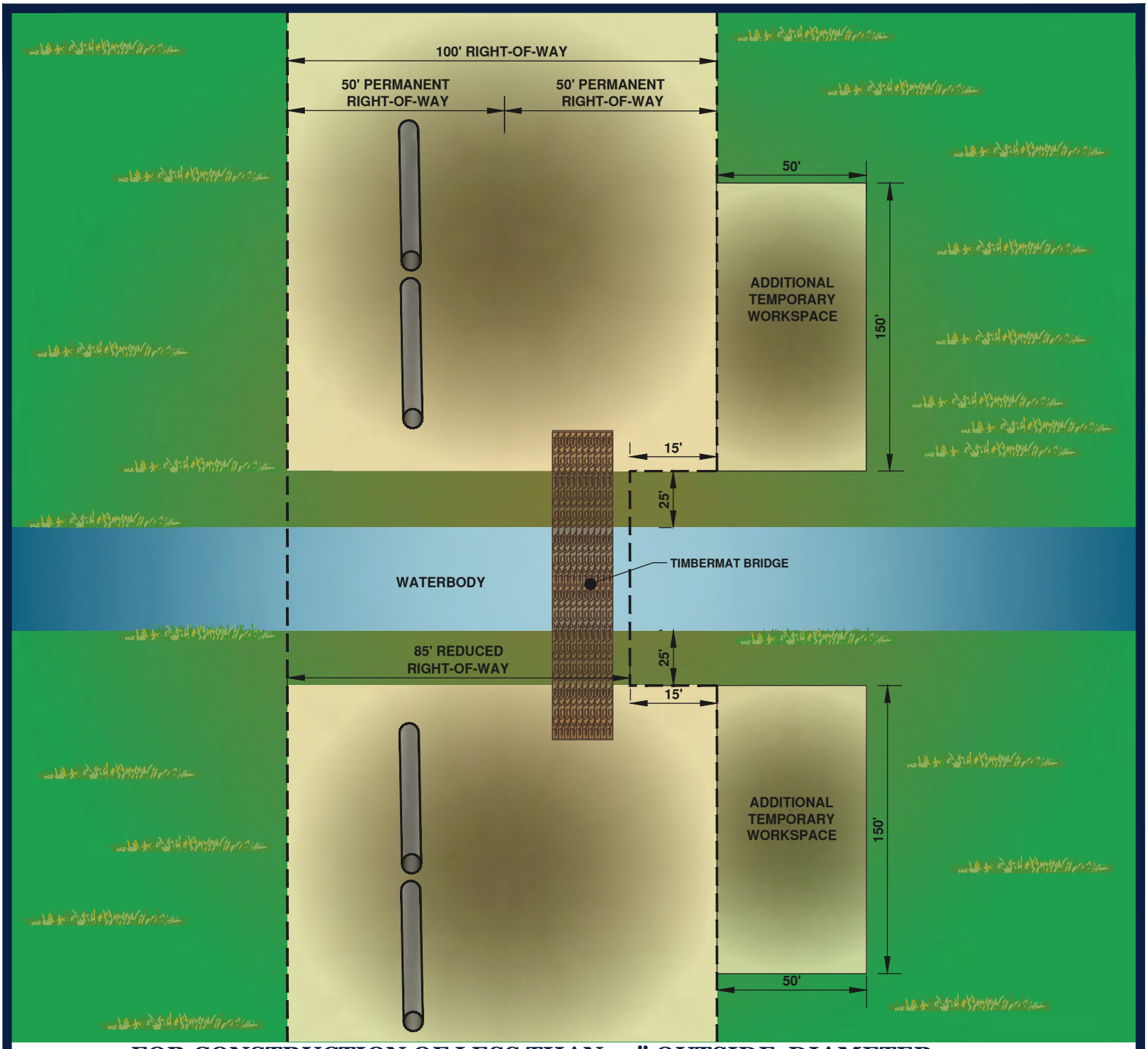
WATERBODY CROSSING HORIZONTAL DIRECTIONAL DRILL

NOT TO SCALE

Navigator CO_2

TYPICAL CONSTRUCTION DETAIL

MAY 2022



FOR CONSTRUCTION OF LESS THAN 12" OUTSIDE DIAMETER

NOTES:

1. REDUCE ROW FROM 100' TO 85' ACROSS WATERBODIES.
2. EXTEND ROW REDUCTION FOR 25' ON EITHER SIDE OF THE WATERBODY AS MEASURED FROM TOP OF BANK.
3. ATWS SHOULD BE SETBACK 25' FROM THE WATERBODY AS MEASURED FROM TOP OF BANK.
4. LEAVE AN APPROXIMATE 25' VEGETATED BUFFER ON EITHER SIDE OF THE WATERBODY AS MEASURED FROM THE TOP OF BANK. THIS BUFFER IS ONLY TO BE DISTURBED DURING CROSSING OF THE WATERBODY. WOODY VEGETATION MAY BE REMOVED FROM THE VEGETATION BUFFER, PROVIDED ROOT STRUCTURE REMAINS FOR EROSION CONTROL.
5. BUFFER AND SETBACK DISTANCES MAY BE ADJUSTED ON A SITE SPECIFIC BASIS BASED ON TOPOGRAPHY OR OTHER FACTORS.

HEARTLAND GREENWAY

HGS-BMP-035-SDP

TYPICAL WATERBODY CROSSING

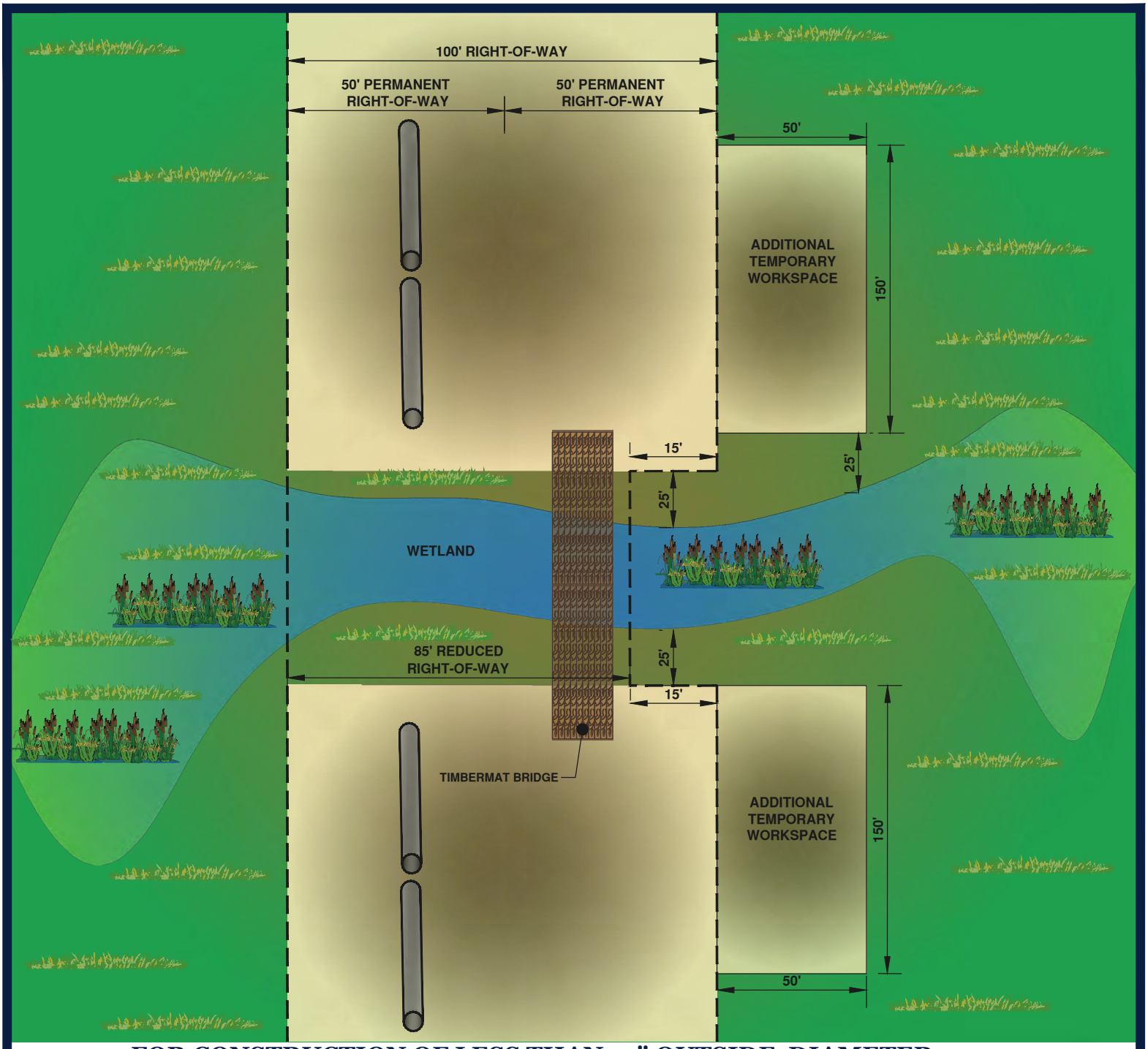
SMALL DIAMETER (<12" Ø) PIPE

NOT TO SCALE

Navigator CO_2

TYPICAL CONSTRUCTION DETAIL

MAY 2022



FOR CONSTRUCTION OF LESS THAN 12" OUTSIDE DIAMETER

NOTES:

1. REDUCE ROW FROM 100' TO 85' ACROSS WETLANDS.
2. EXTEND ROW REDUCTION FOR 25' ON EITHER SIDE OF THE WETLAND BOUNDARY.
3. ATWS SHOULD BE SETBACK 25' FROM THE WETLAND BOUNDARY.
4. LEAVE AN APPROXIMATE 25' VEGETATED BUFFER ON EITHER SIDE OF THE WATERBODY AS MEASURED FROM THE WETLAND BOUNDARY. THIS BUFFER IS ONLY TO BE DISTURBED DURING CROSSING OF THE WETLAND. WOODY VEGETATION MAY BE REMOVED FROM THE VEGETATION BUFFER, PROVIDED ROOT STRUCTURE REMAINS FOR EROSION CONTROL.
5. BUFFER AND SETBACK DISTANCES MAY BE ADJUSTED ON A SITE SPECIFIC BASIS BASED ON TOPOGRAPHY OR OTHER FACTORS.

HEARTLAND GREENWAY

HGS-BMP-036-SDP

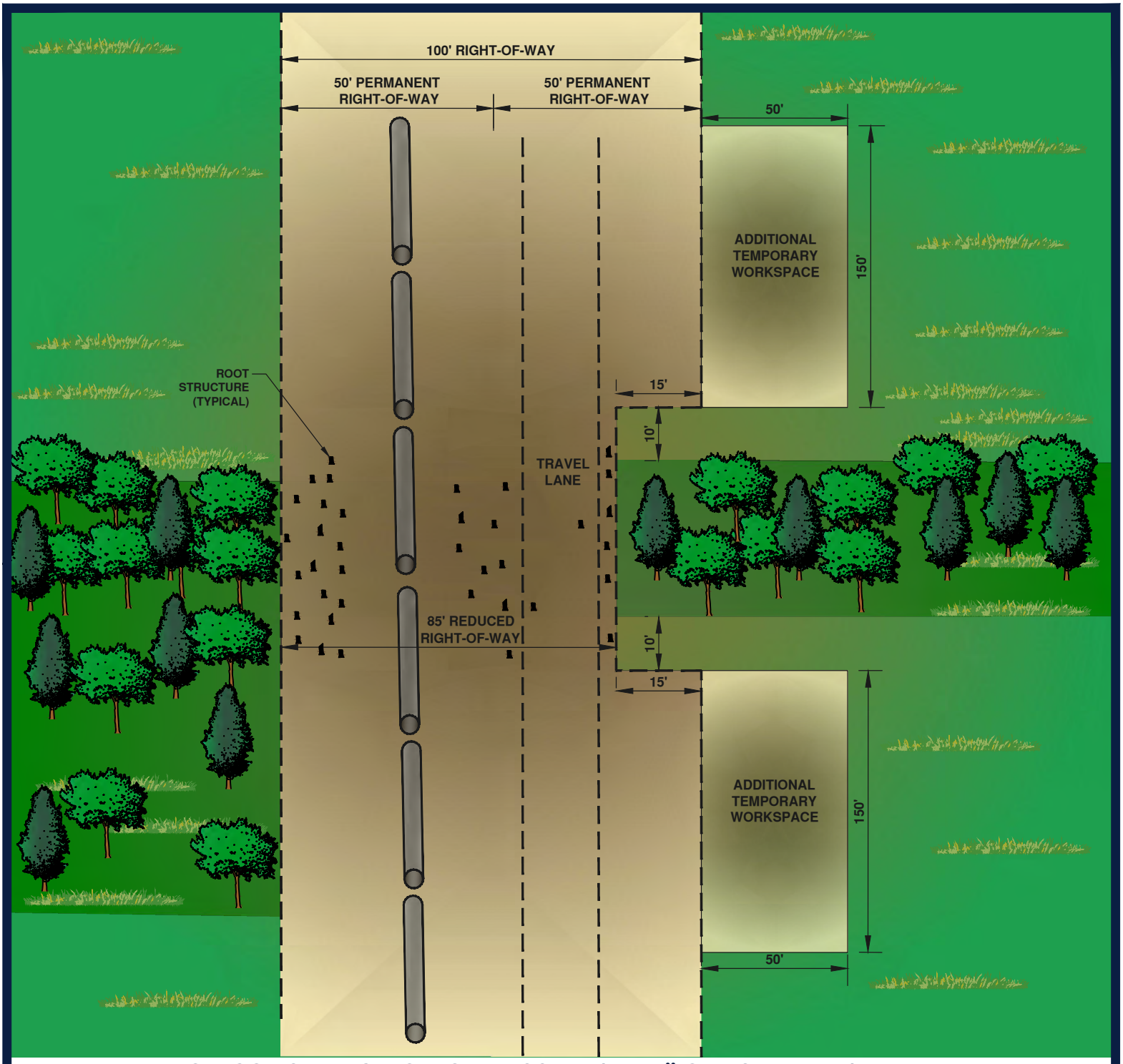
TYPICAL WETLAND CROSSING SMALL DIAMETER (<12" Ø) PIPE

NOT TO SCALE

Navigator CO_2

TYPICAL CONSTRUCTION DETAIL

MAY 2022



FOR CONSTRUCTION OF LESS THAN 12" OUTSIDE DIAMETER

NOTES:

1. REDUCE ROW FROM 100' TO 85' ACROSS FORESTED AREAS.
2. EXTEND ROW REDUCTION FOR 10' ON EITHER SIDE OF THE FORESTED AREA.
3. ATWS SHOULD BE SETBACK 10' FROM THE TREELINE.
4. LIMIT CLEARING OF ROOT STRUCTURES TO THAT WHICH IS NECESSARY TO INSTALL THE PIPELINE, IDEALLY ONLY OVER THE TRENCH LINE. ROOT STRUCTURES MAY BE REMOVED IN AREAS WHERE GRADING IS NEEDED, OR TO ENSURE SAFE OPERATION OF EQUIPMENT.
5. BUFFER AND SETBACK DISTANCES MAY BE ADJUSTED ON A SITE SPECIFIC BASIS BASED ON TOPOGRAPHY OR OTHER FACTORS.

HEARTLAND GREENWAY

HGS-BMP-037-SDP

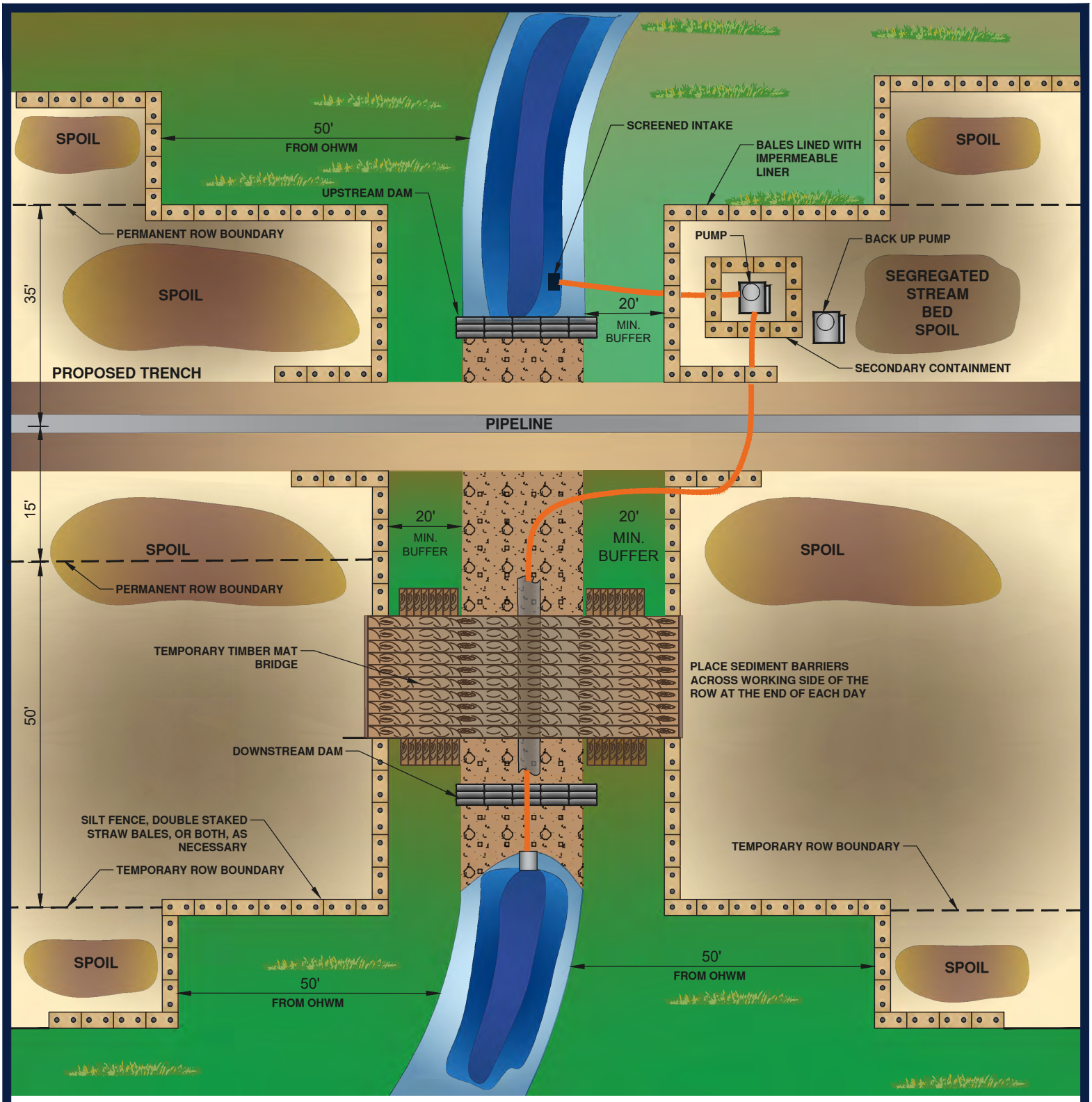
TYPICAL FORESTED CROSSING SMALL DIAMETER (<12"Ø) PIPE

NOT TO SCALE

Navigator CO_2

TYPICAL CONSTRUCTION DETAIL

MAY 2022



NOTES:

1. CONTRACTOR SHALL MAINTAIN STREAM FLOW AT ALL TIMES.
2. ALL WATER BARRIERS SHALL BE REMOVED AFTER INSTALLATION OF CROSSING AND STREAM BED AND BANKS SHALL BE RESTORED TO ORIGINAL SHAPE AND ELEVATION.
3. SIZE OF PUMPS AND STREAM BYPASS LINE MUST BE SUFFICIENT FOR FLOW.

HEARTLAND GREENWAY

HGS-BMP-038

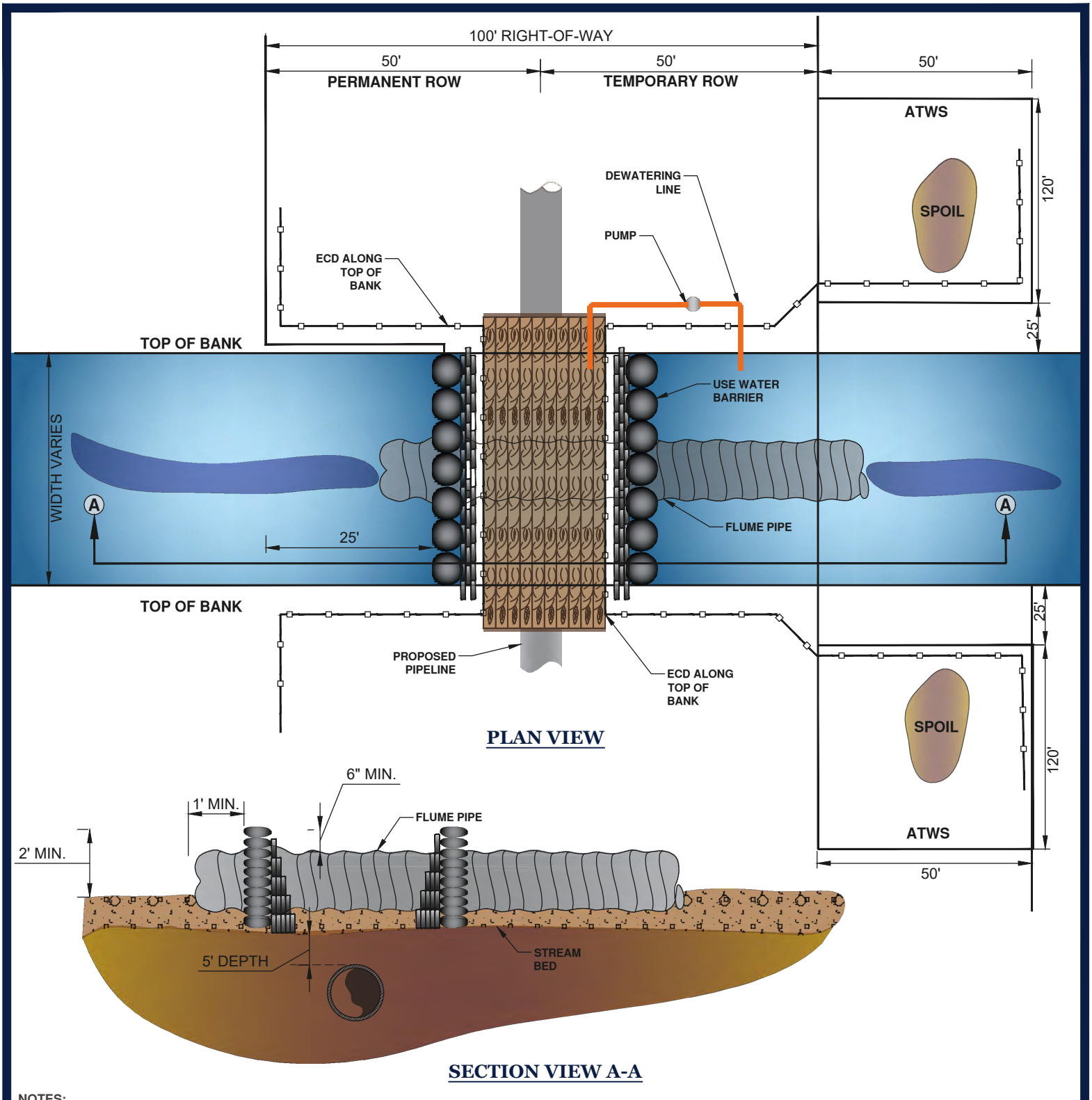
TYPICAL WATERBODY CROSSING DAM AND PUMP AROUND

NOT TO SCALE

Navigator CO_2

TYPICAL CONSTRUCTION DETAIL

MAY 2022



PLAN VIEW

SECTION VIEW A-A

NOTES:

1. CONTRACTOR SHALL MAINTAIN STREAM FLOW AT ALL TIMES.
2. ALL WATER BARRIERS SHALL BE REMOVED AFTER INSTALLATION OF CROSSING AND STREAM BED AND BANKS SHALL BE RESTORED TO ORIGINAL SHAPE AND ELEVATION.
3. SIZE OF FLUME PIPE MUST BE SUFFICIENT FOR FLOW.
4. MULTIPLE FLUMES CAN BE USED TO FACILITATE FLOW.

HEARTLAND GREENWAY

HGS-BMP-039

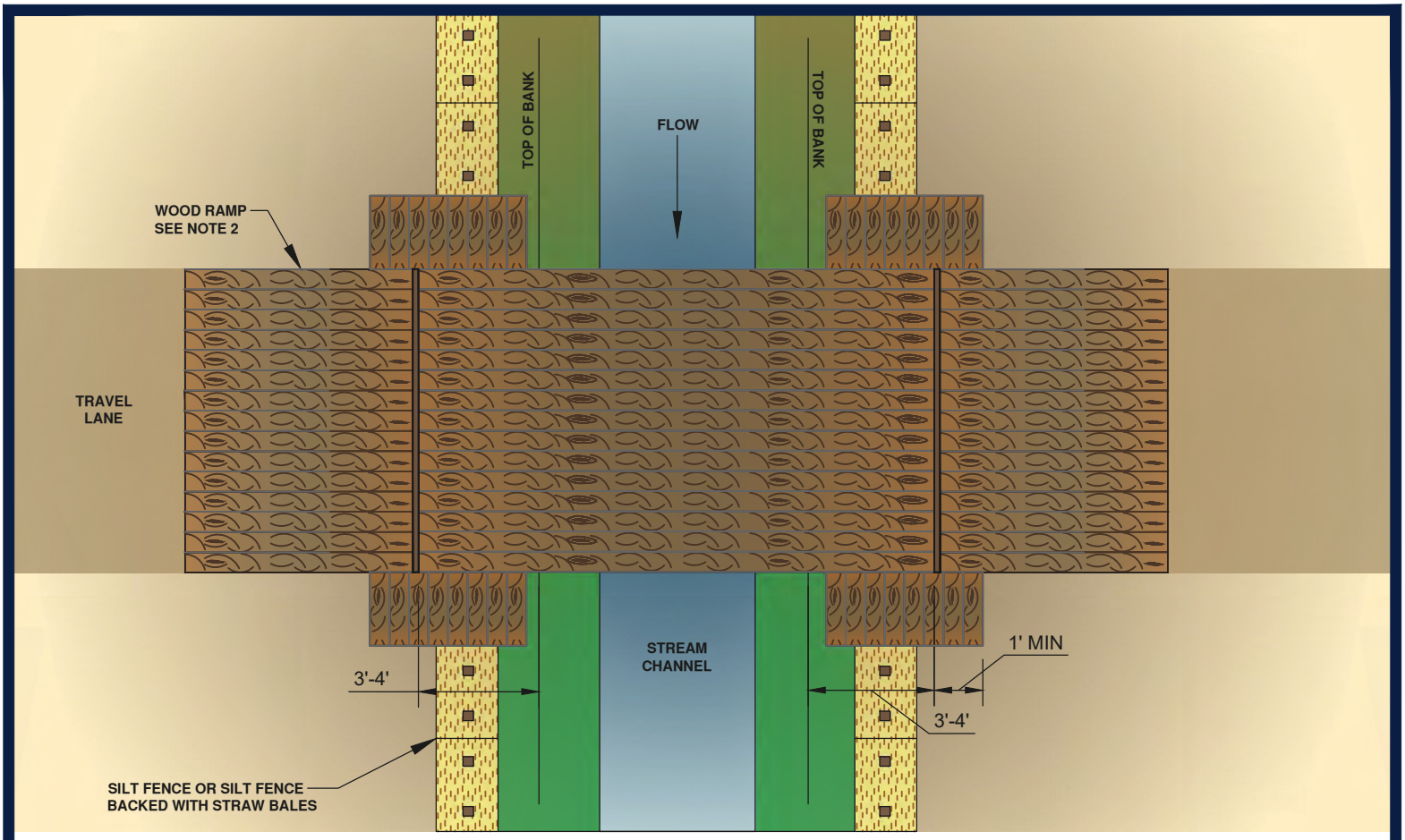
FLUME WATERBODY CROSSING

NOT TO SCALE

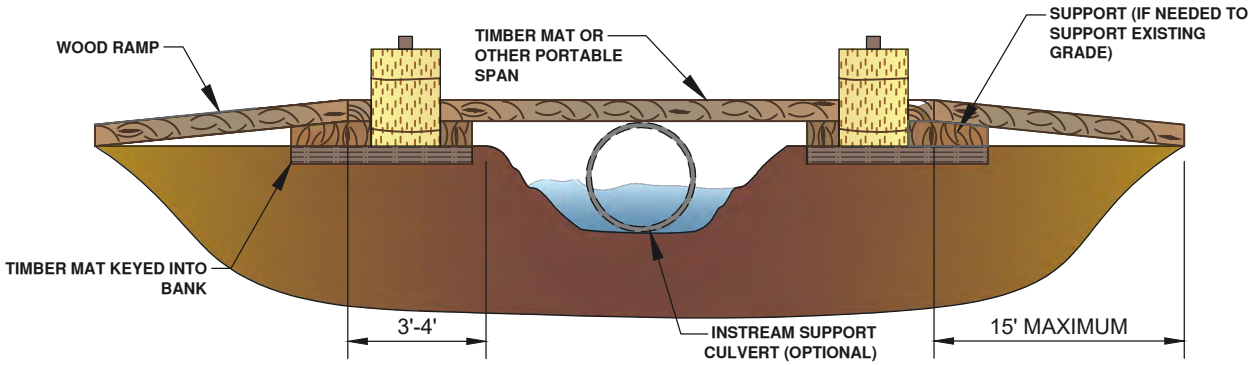
Navigator CO_2

TYPICAL CONSTRUCTION DETAIL

MAY 2022



PLAN VIEW



PROFILE VIEW

NOTES:

1. INSPECT BRIDGE OPENING PERIODICALLY AND REMOVE ANY DEBRIS RESTRICTING FLOW AND DEPOSIT IT AT AN UPLAND SITE OUTSIDE OF FLOODPLAIN
2. IF PHYSICAL CIRCUMSTANCES PROHIBIT WOOD OR METAL RAMPS, EARTHEN RAMPS OR BERMS MAY BE USED AS APPROVED
3. INSPECT BRIDGE ELEVATION SO BRIDGE REMAINS SUPPORTED ABOVE HIGH BANK AND DOES NOT SINK INTO BANK.
4. CULVERT SUPPORT, IF USED, MUST BE ANCHORED TO THE STREAM BOTTOM AND MAY NOT BE SUPPORTED WITH FILL.
5. THE BRIDGE MUST SPAN FROM TOP OF BANK TO TOP OF BANK AND BE INSTALLED HIGH ENOUGH TO ACCOUNT FOR THE LARGEST EXPECTED RAIN FALL.
6. ADDITIONAL SUPPORT MUST BE ADDED IN TOP OF BANK AND UNDER SPAN IF INITIAL SUPPORT STARTS TO SETTLE.
7. EROSION AND SEDIMENTATION CONTROL MEASURES SHALL BE INSPECTED AND MAINTAINED IN ACCORDANCE WITH PERMITS.

HEARTLAND GREENWAY

HGS-BMP-040

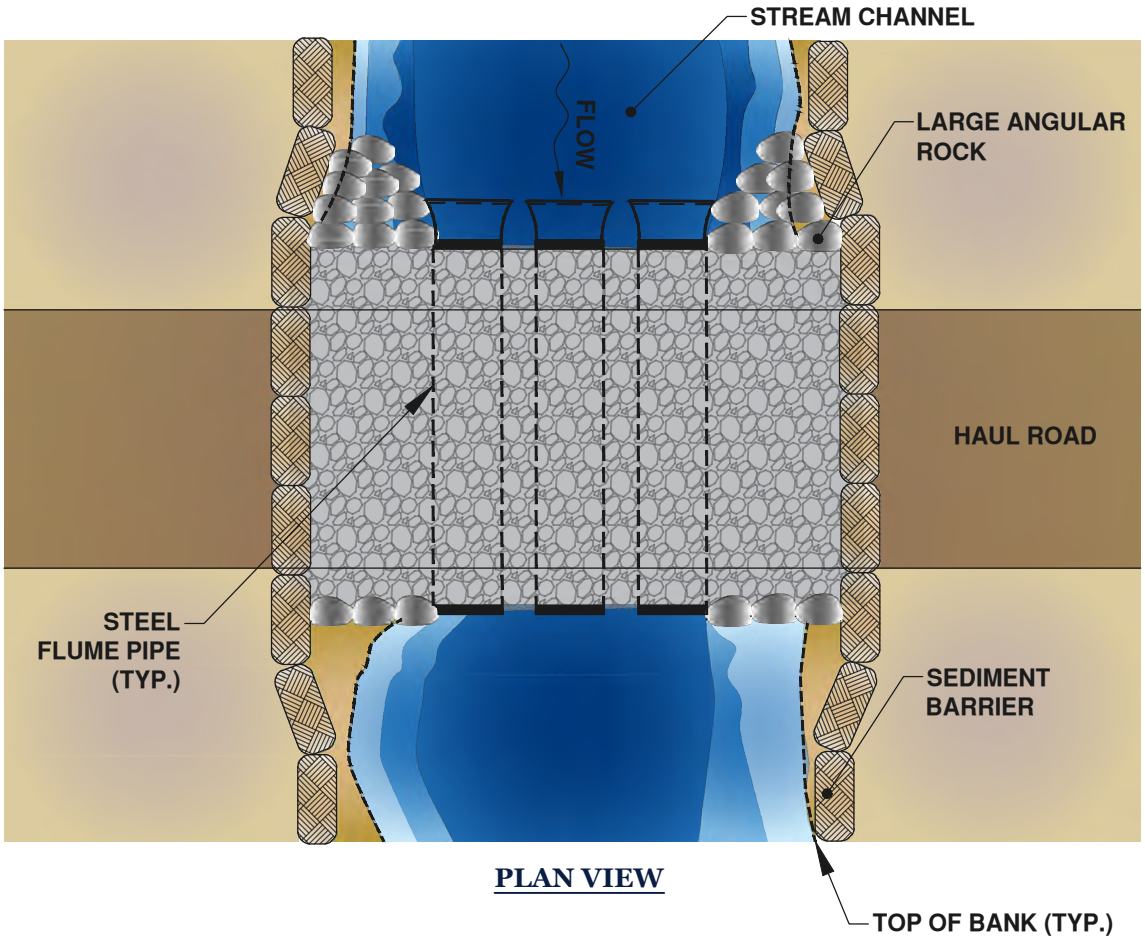
TYPICAL SPAN TYPE BRIDGE W/WOUT INSTREAM SUPPORT (TIMBERMAT)

NOT TO SCALE

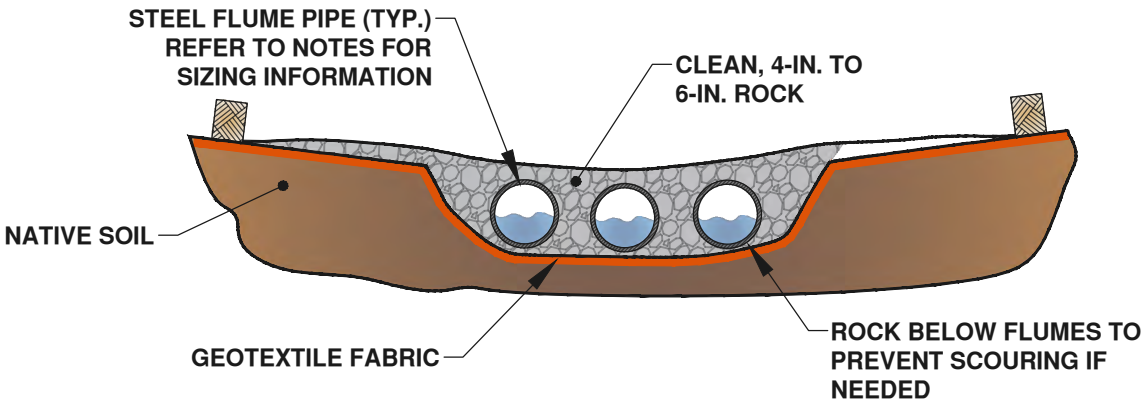
Navigator CO_2

TYPICAL CONSTRUCTION DETAIL

MAY 2022



PLAN VIEW



CROSS SECTION

NOTES:

1. SEDIMENT BARRIERS TO BE REPLACED ACROSS HAUL ROAD AT WORKDAY'S END.
2. STEEL FLUME PIPES ARE SIZED TO ALLOW FOR STREAM FLOW AND EQUIPMENT LOAD.
3. STRAW BALES, OR SILT FENCE OR EQUIVALENT BEST MANAGEMENT PRACTICE (BMP) SHALL BE PLACED ACROSS BRIDGE ENTRANCE EVERY NIGHT.

HEARTLAND GREENWAY

HGS-BMP-041

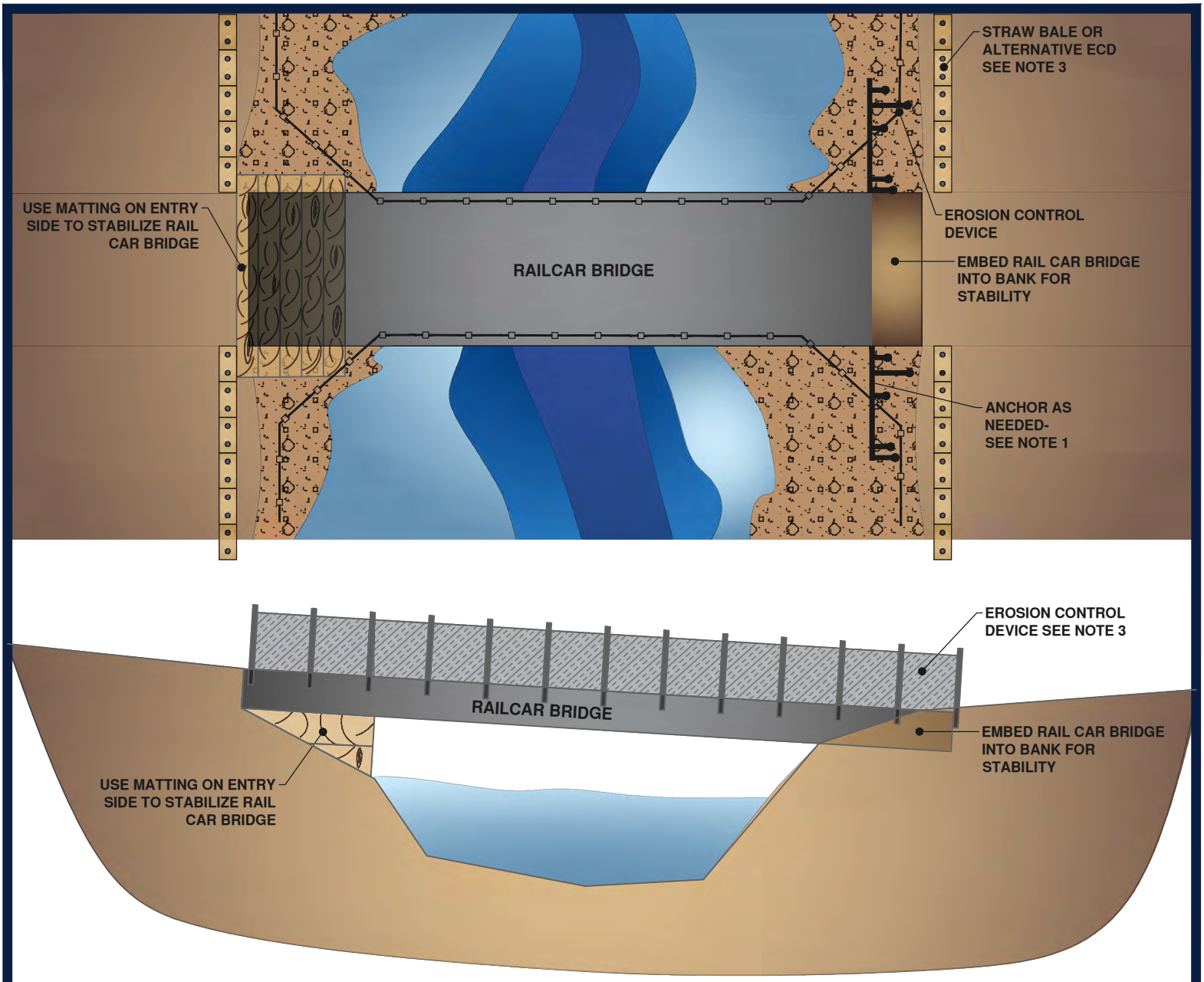
ROCK FLUME BRIDGE

NOT TO SCALE

Navigator CO_2

TYPICAL CONSTRUCTION DETAIL

MAY 2022



NOTES:

1. BRIDGE SHALL BE ANCHORED AND/OR TIED TO ANCHOR BLOCKS FOR STABILITY.
2. IF REQUIRED, UTILIZE APPROACH FILLS OF CLEAN ROCK MATERIAL, MATS, SKIDS, OR OTHER SUITABLE MATERIALS TO AVOID CUTTING THE BANKS WHEREVER FEASIBLE. ENSURE ADEQUATE FREEBOARD. ENSURE THAT FILL MATERIAL, IF USED, DOES NOT SPILL INTO WATERCOURSE.
3. CONSTRUCT SEDIMENT BARRIERS ACROSS THE ENTIRE CONSTRUCTION R.O.W. TO PREVENT SILT LADEN WATER AND SPOIL FROM FLOWING BACK INTO WATERBODY. BARRIERS MAY BE TEMPORARILY REMOVED TO ALLOW CONSTRUCTION ACTIVITIES BUT MUST BE REPLACED AT THE END OF EACH WORK DAY. EROSION CONTROL DEVICES (SILT FENCE, RAILS, STRAW BALES, SANDBAGS, FILTER SOCK, OR SEDIMENT LOGS) MAY BE USED INTERCHANGEABLY.
4. REMOVE BRIDGES AS SOON AS PRACTICAL AFTER PERMANENT SEEDING.
5. RESTORE AND STABILIZE BED AND BANKS TO PRE-CONSTRUCTION CONDITIONS AS PRACTICAL.

HEARTLAND GREENWAY

HGS-BMP-042

CLEAR SPAN BRIDGE WITH RAILCAR

NOT TO SCALE

Navigator CO_2

TYPICAL CONSTRUCTION DETAIL

MAY 2022