Northeast Utilities

Best Management Practices Manual

Connecticut

Construction & Maintenance Environmental Requirements

Prepared For:

Northeast Utilities
Transmission Group

December 2007

Tighe&Bond

TABLE OF CONTENTS

Tighe&Bond

TABLE TOC-1
List of BMP Figures

TABLE TOC-2
List of BMP Photographs

TABLE TOC-2
List of BMP Photographs (continued)

Photograph ID (Section-#)	Description
11-1	Example of good housekeeping[1]
11-2	Example of good housekeeping[1]
11-3	Example of good housekeeping[1]
12-1	Typical view of light mulching atop unstable, seeded soils
12-2	Erosion control blanket and coir logs used to restore a streambed and banks

[1] Indicates photo provided courtesy of BSC Group.
All other photos provided courtesy of Tighe & Bond, Inc.

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Section 1

1.1 NORTHEAST UTILITIES STATEMENT OF POLICY

As a matter of company policy regarding environmental stewardship and in accordance with local, state, and federal regulations, all transmission construction and maintenance projects shall use environmentally sound best management practices (BMPs) to minimize or eliminate environmental impacts that may result from construction activities. Regardless of whether a specific permit is needed for the work, construction and maintenance projects must follow clear and enforceable environmental performance standards, which is why these BMPs have been compiled. In most cases, maintenance activities are exempt from regulatory authorization. Permits are typically required for new work. Contractors will be provided with copies of any project specific permits, and may be required to certify in writing their receipt of and agreement to adhere to any and all provisions of the permit(s). Permit conditions that are more detailed than the BMPs outlined in this manual should always be given deference. However, where certain construction elements are not addressed by permit conditions, or where permitting is not required, or not prudent (i.e., emergencies), these BMPs shall be considered as NU's standards. In some cases, and at the discretion of the NU Management, the BMPs presented herein may be modified to be more appropriate for site-specific conditions.

1.2 SCOPE AND APPLICABILITY

These BMPs primarily address the disturbance of soil, water, and vegetation incidental to construction within on- and off-road utility corridors, substations, including the establishment of access roads and work areas, in and near wetlands, watercourses, or other sensitive natural areas, including storm drain systems (e.g. catchbasins). Types of construction include, but are not limited to, underground and overhead utilities, substations and other facilities, and maintenance activities. Other common construction issues such as noise, air pollution, oil spill procedures, handling of contaminated soils, and work safety rules are addressed in other NU documents.

1.2.1 Definitions

The following definitions are provided to clarify use of common terms throughout this document. Additionally, a list of acronyms and abbreviations used throughout this document is provided in Appendix A.

New construction, also referred to as capital projects, are required to go through a full permit review by the NU Siting and Permitting Department.

Maintenance projects typically consist of activities limited to the repair and/or replacement of existing and lawfully located electrical utility structures and/or facilities

where no change in the original structure or footprint is proposed. Maintenance activities also include vegetation management.

Emergency projects are limited to actions needed to maintain the operational integrity of the system or activities necessary to maintain or restore public health and safety in response to a sudden and unexpected event. Determinations of emergency status will be made by the NU project manager in consultation with NU environmental staff. Some emergency response actions may require after-the-fact permitting with regulatory agencies.

1.3 NU CONTACTS

A list of NU subject matter experts is provided in Table 1-1 on the following page.

TABLE 1-1
NU Contacts (Berlin, CT)

Group/Location	Phone
Transmission Siting & Permitting	(860) 665-6953
Transmission Safety & Environmenal Programs	(860) 665-6664

1.4 BMP REFERENCES

The following table lists the public guidance documents utilized during the preparation of this BMP manual.

TABLE 1-1

Document Title
Best Management Practices (BMPs) Manual for Access Road Crossings of Wetlands and Waterbodies, EPRI, Palo Alto, CA: 2002. 1005188.
Gas Research Institute. Horizontal Directional Drilling Best Management Practices Manual. 2002. ENSR Corporation, Westford, MA and Trenchless Engineering Corp., Houston, TX.
Connecticut Department of Transportation (ConnDOT). ConnDOT Drainage Manual (October 2000) http://www.ct.gov/dot/cwp/view.asp?a=1385&Q=260116
Connecticut Standard Specifications for Roads, Bridges and Incidental Construction, FORM 815 METRIC VERSION,1995.
Connecticut Department of Environmental Protection. Connecticut Guidelines for Erosion and Sediment Control. 2002.
Connecticut Department of Environmental Protection, Bureau of Natural Resources, Division of Forestry. Best Management Practices for Water Quality While Harvesting Forest Products. 2007. http://www.ct.gov/dep/lib/dep/forestry/best_management_practices/best_practicesmanual.pdf

Section 2

Many projects are required to go through a full permit review by the NU Siting and Permitting Department. A summary of potentially applicable laws and regulations is provided in Appendix B of this document.

2.1 WETLAND IDENTIFICATION AND DELINEATION

Prior to commencement of new construction, all jurisdictional wetland areas within the work corridor should be delineated by a qualified soil scientist. The specialist shall delineate areas in accordance with the General Statutes of Connecticut (revised January 1, 2007) as set forth at Title 22a Chapter 440 "Inland Wetlands and Watercourses Act", the U.S. Army Corps of Engineers 1987 Wetland Delineations Manual, and any local wetlands ordinances or bylaws that may exist. Wetland areas shall be clearly demarcated using appropriate flagging tape or similar means. It is important to note that certain jurisdictional wetland areas can actually occur in uplands, such as floodplains. In addition, Upland Review Areas generally apply to work activities. This makes consultation with a wetland specialist particularly important.

2.2 WETLAND TYPES

Wetland areas common to New England include, but are not limited to, the following:

Forested Wetlands

Forested wetlands, which are dominated by trees 20 feet or taller, are typically drier wetlands with standing water during periods of seasonal high groundwater, high precipitation, and/or snowmelt and runoff (early spring through mid summer). Tree species typical of this type of wetland include red maple (*Acer rubrum*) and eastern hemlock (*Tsuga canadensis*). "Pit and mound" topography is common in forested wetlands, where mature trees grow on the higher and drier mounds and obligate wetland species are found in the lower pits.

Scrub-Shrub Wetlands

Scrub-shrub wetlands are dominated by woody vegetation less than 20 feet tall, and may include peat bogs. Typical bog species include leatherleaf (*Chamaedaphne calyculata*), cotton grasses (*Eriophorum* sp), cranberry (*Vaccinium macrocarpon, V. oxycoccus*), and black spruce (*Picea marina*). Other non-bog scrub-shrub wetlands are characterized by buttonbush (*Cephalanthus occidentalis*), alders (*Alnus* sp), dogwoods (*Cornus* sp), and arrowwoods (*Viburnum* sp).

Marshes

Marshes are dominated by erect, herbaceous vegetation and appear as grasslands or stands of reedy growth. These wetlands are commonly referred to by a host of terms,

including marsh, wet meadow, fen.. These areas are flooded all or most of the year and, in New England, tend to be dominated by cattails (*Typha* sp).

Wet Meadows

Typical wet meadow species include grasses such as bluejoint (*Calamagrostis canadensis*) and reed canary grass (*Phalaris arundinacea*), sedges (*Carex* sp) and rushes (*Juncus* sp), and various other forbs such as Joe-Pye-weeds (*Eupatorium* sp) and asters (*Aster* sp).

Streams

A stream is any natural flowing body of water that empties to any ocean, lake, pond or other river. Perennial streams, or rivers, have flows throughout the year. Intermittent streams do not have surface flows throughout the year, though surface water may remain in isolated pockets.

Vernal Pools

Vernal pools are typically contained basin depressions lacking permanent aboveground outlets. These areas fill with water with the rising water table of fall and winter and/or with the meltwater and runoff of winter and spring snow and rain. The pools contain water for a few months in the spring and early summer. Due to periodic drying cycles, vernal pools do not support breeding fish populations and can thus serve as breeding grounds for a variety of amphibians, including some rare and protected species of frogs and salamanders.

Other Considerations

Other regulated factors taken into consideration during the project planning process include the presence of protected (i.e. threatened, rare or endangered) species, non-native invasive plant species and/or historical and archaeological. Special requirements may need to be evaluated as part of new construction and/or some maintenance activities.

2.3 AVOIDANCE AND MINIMIZATION

Measures should always be taken to avoid impacts to wetlands, waterways, and sensitive areas. If avoidance is not possible, then measures should be taken to minimize the extent of impacts. Alternate access routes or staging areas should always be considered. Below is a list of methods that should be considered where impacts are unavoidable:

- Minimize the width of typical access roads through wetlands (wider than 16 feet is generally not necessary);

- Use low-impact vehicles and/or vehicles with low ground pressure when driving through wetlands;
- Coordinate timing of work to cause the least impacts (e.g. during the regulatory low-flow period (July 1 – September 30), when water/ground is frozen, after the spring songbird nesting season);
- Use swamp, timber, or similar mats in wetlands to minimize soil disturbance and rutting when work needs to occur during non-frozen ground conditions; and
- Conduct work manually, whenever possible.

2.4 MEETINGS

Pre-construction meetings are typically held prior to the commencement of all work to appoint responsible parties, discuss timing of work, and further consider options to avoid and/or minimize impacts to sensitive areas. These meetings can occur on or off-site and should include all the willing and available stakeholders (i.e., NU, contractors, consultants, inspectors and/or monitors, and regulatory agency personnel). A brief **Pre-job briefing** would suffice for smaller maintenance projects.

Pre-iob briefings are daily or otherwise routine meetings that are conducted on-site with the work crew throughout the duration of work. These meetings are a way of keeping everyone up to date, confirming there is consensus on work methods and responsibilities, and ensuring that tasks are being fulfilled with as little impact to the environment as possible.

2.5 NEW CONSTRUCTION OVERSIGHT/MONITORING

Some new construction project may require an environmental inspector. This is a way to keep a chronological record of pre-construction site conditions, progress, and changes that are made, as well as to document problems and authorized solutions.

If work will occur in a wetland resource area or an area mapped or otherwise designated as rare or endangered species habitat, permit conditions may dictate that construction be monitored by a qualified and pre-approved wetland or wildlife specialist.

2.6 SIGNAGE

Where appropriate (e.g. during new construction projects), signage shall be installed that makes clear where critical boundaries (i.e. the limits of jurisdictional wetland resource areas and/or rare species habitat) and setbacks occur, regulatory authorization

by agencies, and issues prohibitions of certain uses on ROWs, such as off-road vehicle (ORV) traffic.

PHOTOGRAPHS FOR SECTION 2

Photographs 2-1 and 2-2 Examples of signage at wetlands.

Section 3

During all project activities (e.g. maintenance, new construction), federal, state, and local regulatory authorities require steps be taken to avoid, minimize, and/or mitigate environmental impacts. BMPs have been developed to aid in this process and should be carefully selected and implemented based on the proposed activities and the nature of sensitive area(s) encountered at each site.

Proper selection of BMPs should take into consideration the project goals, permit requirements, and site specific information. Once an assessment of the area has been made and requirements of the project have been established, all plausible BMPs should be considered.

Table 3-1 summarizes BMP types and their associated applications, limitations, and relative, qualitative costs. Sections 4 through 12 provide detailed information on specific BMPs, with drawings and representative photographs provided at the ends of each section, as appropriate.

Table 3-1
Summary of BMPs

	BMP Type	Figure No.	Applications	Limitations	Relative Costs
SECTION 4	Hay (or Straw) Bales	4-1	erosion control; mulch	frozen ground (for installing stakes); generally only effective for 3-6 months (hay) or 6-12 months (straw) before replacement	low to moderate
	Silt Fencing	4-2	sedimentation control; work limits; temporary animal barrier	frozen or rocky ground; may prevent critical movements of sensitive wildlife species; disposal	low
	Erosion Control Blankets	4-3	slope stabilization	not recommended for very steep (i.e. greater than 15%) slopes or on rocky soils	moderate
	Straw Wattles	4-4	erosion and sedimentation control	not recommended for slopes greater than 3%	low
	Wood Chip Bags	4-5	erosion and sedimentation control	not recommended for slopes greater than 5%, unless doubled up	low
	Temporary Swales	4-6	stormwater management	need to have adequate bottom stabilization to prevent scouring	moderate
	Water Bars	4-7	stormwater management; erosion control	can impede vehicular movement	low
	Temporary Sediment Basins	4-8	stormwater management; dewatering	need to be adequately sized based on expected rain events and the contributing drainage area	moderate
SECTION 5	Swamp Mats – as Bridges	5-1	stream crossings	need to be installed with heavy machinery	moderate
	Culverts	5-2	stream crossings	may pose an obstacle to fish and aquatic wildlife; only effective for narrow spans	low-high
	Poled Fords	5-3	stream crossings	should not be used to cross previously undisturbed streams and banks	low
	Swamp/Timber Mats	5-4	wetland crossings/rut minimization	need to be installed with heavy machinery	moderate to high
	AlturnaMATS®	5-5	wetland crossings/rut minimization	none	moderate
	Low Ground Pressure Equipment	--[1]	wetland crossings/rut minimization	may be site-specific limitations; otherwise none	moderate
	Wide Tires	--[1]	wetland crossings/rut minimization	may be site-specific limitations; otherwise none	moderate
	Rubberized Tracks	--[1]	wetland crossings/rut minimization	may be site-specific limitations; otherwise none	moderate
	Lightweight Equipment	--[1]	wetland crossings/rut minimization	may be site-specific limitations; otherwise none	moderate
	Timing of Work	--[1]	overall minimization/avoidance of impacts	not always possible due to other constraints in project schedule	N/A[2]
	Manual Access	--[1]	overall minimization/avoidance of impacts	safety may be a concern	low
	Overhead/Aerial Access	--[1]	overall minimization/avoidance of impacts	high costs	high
SECTION 6	Construction Entrance Track Pads	6-1	prevention of roadway damage	none	low
SECTION 9	Inlet/Catch Basin Sediment Filters	9-1	dewatering	ineffective for very silty water; may require authorization from local government for discharge to municipal system	low
	Discharge Hose Filter Socks	9-2	dewatering	ineffective for very silty water	low
	Frac Tanks	--[1]	dewatering; managing contaminated groundwater	may be site-specific limitations (e.g. extremely unlevel ground); expensive; may require proper disposal at a regulated facility (in cases of contaminated groundwater)	moderate to high
	Coffer Dam and Stream Bypass Pumping	9-3	dewatering/diversions	only effective for very small streams during periods of little to no rain	moderate
	Coffer Dam and Stream Bypass via Gravity	9-4	dewatering/diversions	pipes need to be adequately sized to accommodate heavy rain events	low
SECTION 12	Mulching with Hay/Straw/Woodchips	12-1	erosion control; site restoration	may be site-specific limitations (e.g. permit or State requirements); otherwise none	low
	Coir Log Use for Bank Stabilization	12-2	bank stabilization; site restoration	need to be installed with heavy machinery	low to moderate

Notes:
--[1] Indicates that a figure/typical drawing has not been prepared for this BMP. Refer to the BMP Manual Section indicated in the left column for a detailed discussion of the BMP.
N/A[2] = Not Applicable

Section 4

Adequate sedimentation and erosion control management measures shall be installed and properly maintained to reduce erosion and retain sediment on site during and after construction. These devices shall be capable of preventing erosion, collecting sediment (suspended and floating materials) and filtering fine sediment. Sediments collected by these devices shall be removed and placed in an upland location beyond buffer zones and any other regulatory setbacks preventing later migration into a waterway or wetland. Once work has been completed, all areas shall be stabilized with erosion control blankets and/or robust vegetation and erosion control devices shall then be removed. Note that stormwater management is an important part of sedimentation and erosion control. Accordingly, temporary stormwater management measures are also outlined in this section.

4.1 HAY BALES

Hay bales should be placed end-to-end to form a temporary sedimentation control barrier. This barrier should run perpendicular to the slope and direction of runoff and should be installed downgradient of the disturbed site (i.e., construction area). Hay bales are intended to slow the velocity of flows and trap sediments behind them preventing siltation of sensitive areas – most specifically downgradient areas with open and/or flowing water. Once the project is complete and soils are stabilized with erosion control blankets and/or robust vegetation, barriers should be removed.

Installation and Maintenance

See Figure 4-1 at the end of this Section for an illustration of proper hay bale barrier installation.

- Install hay bales end-to-end lengthwise along the toe of a slope or along a slope contour being sure the bales are butted tightly against each other without gaps between them. The outer ends of the barrier should be turned slightly upslope. If additional protection is needed, hay bales can be set in a shallow trench and backfilled on the upslope and down-slope side to ensure better contact with the ground, so that sediment passage through or beneath them is further reduced.
- Each hay bale should be staked into the ground by two stakes each approximately 3 feet long (see staking location in Figure 4-1).
- If a silt fence is being used with the hay bale barrier, position the silt fence downgradient of the hay bales (see Photograph 4-1 at the end of this Section).
- Since hay bales degrade quickly, barriers should be checked often and replaced as needed. In addition, sediment buildup should be routinely removed and disposed of in a stable upland area.

- The hay bale barrier should be as far away from downgradient sensitive areas, and as close to the work areas as construction limitations allow, in order to minimize the total work area and disturb as little area as possible.
- Accumulated sediment should be removed and properly disposed outside sensitive areas when it has reached a thickness of ½ to ⅔ the height of the bale.
- Once the project is complete and soils are stabilized, hay bales should generally be compacted and allowed to rot in place, as their height can provide an obstacle to movements of smaller wildlife and spreading them around a site as mulch could introduce weed seeds. Using hay as mulch is not generally problematic if the site is already colonized by invasive species. Photograph 4-1 at the end of this Section depicts proper usage of a hay bale barrier.

4.1.1 Straw Bales

Straw bales are often favored over hay bales for use as erosion control barriers. Since straw bales are composed of the dried stalks left over after a grain is harvested, they do not contain the plant's seeds and therefore will not spread growth of such species, some of which may be exotic or otherwise undesirable. Hay bales are generally less expensive, but consist of the seed heads and the upper, thinner portion of the stems which generally rot faster than straw.

For straw bales, follow the usage and installation information noted above for hay bales.

4.2 SILT FENCING

Silt fencing is constructed of a permeable geotextile fabric secured by wooden stakes driven into the ground and installed as a temporary barrier to prevent sediments from flowing into an unprotected and/or sensitive area from a disturbed site. A silt fence should be installed downgradient of the work area. See Figure 4-2 at the end of this Section. Photograph 4-2 at the end of this Section illustrates proper installation of silt fence. Once the project is complete and soils are stabilized, silt fence materials (i.e., geotextile fabric and wooden stakes) should be removed and properly disposed off-site. Silt fences pose a serious long-term obstacle to movement of smaller, more sensitive wildlife, as they degrade very slowly.

Installation and Maintenance

- Install silt fence along the toe of a slope or along a fairly level contour with the outermost ends directed upslope. The fabric should be laid into a 6-inch wide by 6-inch deep trench dug on the upslope side of the fence and tamped down with fill material to ensure a sturdy base and so sediments will not flow beneath the fabric. Use of a Ditch Witch® or similar equipment is suggested for this task (see Photograph 4-3 at the end of this Section).
- The silt fence stakes should be driven into the ground until secure (≥6 inches below grade).
- If a hay bale or straw bale barrier is being used with the silt fence, position the silt fence downgradient of the bales.
- The silt fence should be as far away from down-gradient sensitive areas, and as close to the work areas as construction limitations allow, in order to disturb as little area as possible.

Silt fence should be inspected often and replaced or repaired as needed, especially during long-term projects. In addition, sediment buildup up should be routinely removed and properly disposed in a stable upland area. Sediment should be removed and properly disposed outside sensitive areas when it has accumulated to a thickness of ½ the height of the silt fence.

4.3 EROSION CONTROL BLANKETS

Erosion control blankets are generally composed of biodegradable or synthetic materials and are used as a temporary or permanent aid in the stabilization of disturbed soil on slopes. These blankets are used to prevent erosion, stabilize soils, and protect seeds from foragers while vegetation is recolonized. Representative erosion control blanket photos (Photograph 4-2 and 4-3) are included at the end of this Section.

Installation

See Figure 4-3 at the end of this Section for proper installation techniques.

- Always follow manufacturer's instructions for properly installing erosion control blankets. Different composition blankets are recommended for site-specific conditions (e.g. slope grades, contributing watershed areas) and use requirements (e.g. biodegradable, photodegradable, permanent).
- Prior to installation, the slope should be cleared of any rocks, branches, or other debris.

- Blankets should be rolled out in a downward direction starting at the highest point of installation and should be secured above the crest of the slope by a berm tamped down along the top of the disturbed area.
- Blankets should be tacked down with stakes or staples every 11 to 12 inches (or closer) horizontally and every 3 feet (or closer) vertically.

Each section of the blanket should overlap the next section horizontally by approximately 2 or 3 inches. Vertical overlaps should be approximately 6 inches, with the upslope section overlaying that of the down-slope section.

4.4 STRAW WATTLES

Straw wattles are used as an erosion control device to slow runoff velocities, entrain suspended sediments, and also promote vegetation growth until an area is stabilized. They are not generally intended for steep slopes, but rather, to stabilize low to moderate grades where there is a broad area of disturbance. They should be placed lengthwise, perpendicular to the direction of runoff. Straw wattles may also be used along small stream banks to protect areas before vegetation has stabilized the soils. The wattles are constructed from a biodegradable netting sock stuffed with straw and may be left in place once a project is complete. For an illustration of the proper installation of straw wattles, see Figure 4-4 at the end of this Section.

Installation

- The spacing of each row of wattles on a slope depends on the angle of the slope, and typically ranges from about 10 to 40 feet apart. Additionally, the texture of the soil should also be taken into consideration – for soft, loamy soils, wattles should be placed closer together; for coarse, rocky soils, they may be placed further apart.
- The ends of each row of wattles on a slope should be slightly turned downhill to prevent ponding behind them.
- Where straw wattles are installed end-to-end, the wattles should be butted tightly together so as not to allow water/sediments to flow between them.
- Straw wattles should be placed in a shallow trench to assure stabilization and soil should be packed against the wattle on the uphill side.
- Straw wattles should be staked securely to the ground by driving a stake directly through the wattle approximately every four feet. A portion of each stake should remain approximately 2 to 3 inches above the wattle.

4.5 WOOD CHIP BAGS

Wood chip bags can stabilize soils in a number of applications. They may be left in place as they eventually photo-degrade, as long as they do not pose a barrier to small animal movements. See Figure 4-5 at the end of this Section. Photograph 4-7, provided at the end of this Section, illustrates proper installation and typical usage.

4.6 TEMPORARY SWALES

Temporary drainage swales are used to intercept, redirect, and convey surface flows in order to prevent erosion in unprotected areas. They usually consist of a ditch lined with rip rap, trap rock, erosion control blankets, or other materials. Temporary swales act as drainage channels and are used during construction or at a disturbed site to divert the flows from an unstable area to one that is not as vulnerable to erosion, prior to discharge of storm flows to natural receiving waters – such as wetlands or streams.

Installation

See Figure 4-6 and Photograph 4-8, provided at the end of this Section, for proper construction and typical usage of a temporary swale.

- Depth and spacing of swales should be dependent on runoff conditions of the specific site.
- Swales should be routinely maintained to prevent brush/sediment buildup.
- Check dams (see Section 4.9) constructed of hay bales, rip rap, or other materials can be used to slow flows along certain reaches of a swale, if desired.
- Swales should be lined with appropriate diameter stone, rip rap, or erosion control blankets;
- Temporary swales should be removed once construction is complete or once areas are stabilized. If, however, leaving swales in place will allow for long-term benefits and be compatible with the ultimate use of the site, then they may remain in place.

4.7 WATER BARS

Water bars are linear features constructed across an access way to redirect water flow off of the road surface to prevent erosion. They consist of a shallow trench just upgradient of a berm and should be installed at a downward sloping angle across the road. Water bars usually must be reinstalled at the beginning of each construction season, due to invariable damage.

Installation

See Figure 4-7, provided at the end of this Section, for proper water bar construction.

- Water bars should consists of a trench dug at least 6 inches below grade followed by an earthen mound at least 6 inches above grade.
- Water bars need to be constructed at appropriate intervals along the access way, based on slope, soil type, and surrounding land use. Highly erodable soils or areas with steeper slopes will dictate closer spacing of water bars.
- Construction of water bars may include the use of hardwood logs to provide structural stability.

Since they can be damaged by traffic, water bars should be routinely checked and maintained. Routine inspection will also determine if the original spacing is adequate.

4.8 TEMPORARY SEDIMENT BASINS

Sediment basins allow sediment in runoff to be filtered out before water is released into a wetland or other unprotected and/or sensitive area and may be used for drainage areas of various sizes. A temporary sediment basin should ideally consist of a forebay where debris and some sediment begins to settle out of the water; a check dam constructed of stone or hay bales which water must flow through, filtering out more sediments; and the actual sediment basin, which is a pool with a slow enough velocity that sediments have time to settle out of the water column before the water flows over the dam at the outlet and is released. Sediment basins are often a critical stormwater management component for larger construction sites, and/or those with poorly drained upland soils. If compatible with the eventual (post-construction) site use, it may be appropriate to leave sediment basins in place indefinitely.

Installation

See Figure 4-8 at the end of this Section for a temporary sedimentation basin diagram.

- Construction of temporary sediment basins should occur before primary construction on a project begins.
- Sediment basins should be sized to provide a minimum of 12 to 24 hours of detention to maximum expected runoff amounts for the duration of the project.

4.9 CHECK DAMS

Check dams are structures placed across a drainageway to reduce the velocity of concentrated stormwater flows, thereby reducing erosion of the drainageway and/or to

temporarily pond stormwater runoff to allow sediment in the water column to settle out. Permanent or long-term check dams are typically constructed of rip rap or other stone material. Short-term check dams can be constructed of rip rap or staked hay bales.

Installation

See Figure 4-6 and Photograph 4-8 at the end of this Section for a check dam diagram.

- Place stone by hand or machine, making side slopes no steeper than 1:1 with a maximum height of 3 feet at the center of the check dam. A geotextile may be used under the stone to provide a stable foundation and/or to facilitate removal of the stone.
- The minimum height of the check dam shall be the flow depth of the drainageway, but shall not exceed 3 feet at the center.
- The width of the check dam shall span the full width of the drainageway, plus 18 inches on each side leaving the center of the check dam approximately 6 inches lower than the height of the outer edges.
- The maximum spacing between check dams shall be such that the toe of the upstream check dam is at the same elevation as the top of the center of the downstream check dam.

For permanent stone check dams, inspect and maintain the check dam in accordance with the standards and specifications provided in the design for the site. For temporary check dams, inspect at least once per week and within 24 hours of the end of a precipitation event of 0.5 inches or more to determine maintenance needs. Maintenance may include, but are not limited to, the replacement of stone, repair of erosion around or under the structure, and/or the removal and proper disposal of accumulated sediment.

4.10 SOIL STOCKPILE MANAGEMENT

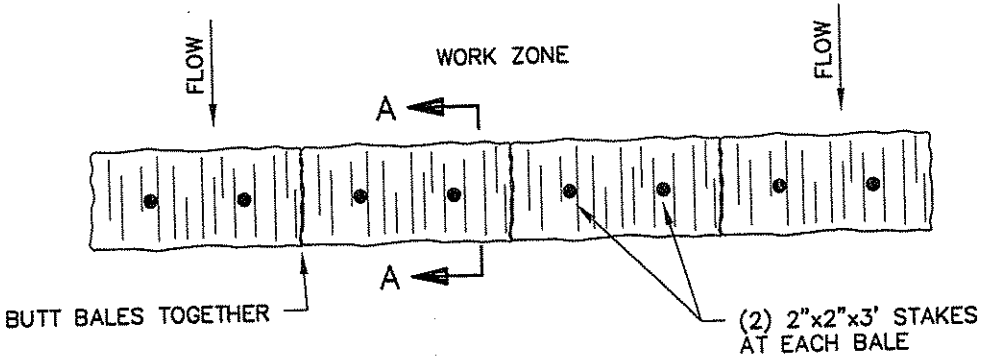
Some projects may involve excavation and stockpiling of soil. Stockpiles should be located outside sensitive areas to the extent practicable and managed to prevent erosion and sedimentation of adjacent areas. Typical measures include the installation of protective measures (e.g. siltation fence and/or haybales) around the perimeter of the stockpile. See Photograph 4-9 at the end of this section.

4.10.1 Polluted/Contaminated Soil

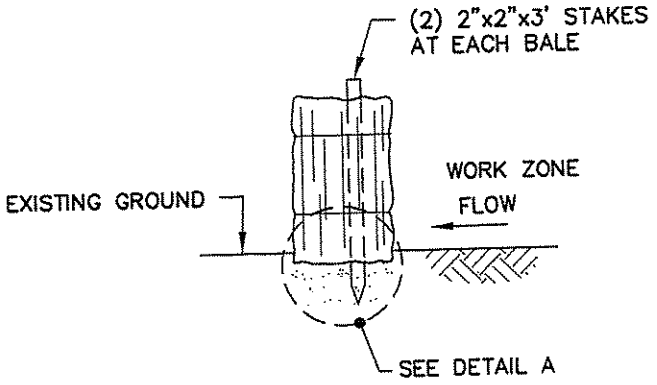
When polluted/contaminated soil is encountered, it must be handled in accordance with the appropriate regulatory requirements. In addition to the measures discussed above,

contaminated soils should be stockpiled on and covered by polyethylene sheeting. Sheeting used to cover the stockpile should be weighted down to prevent the wind migration of contaminated dust.

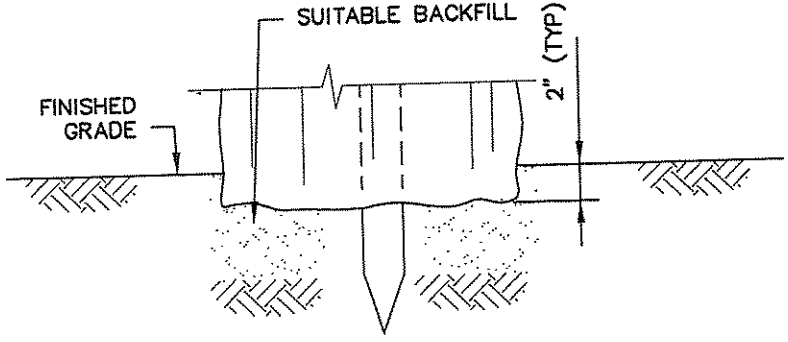
FIGURES FOR SECTION 4



PLAN



SECTION A–A



DETAIL A

FIGURE 4-1

TYPICAL
HAY BALES USAGE

TIGHE & BOND CONSULTING ENGINEERS
WESTFIELD, MASSACHUSETTS

SCALE: NONE

DATE: 2007

NOTE:
STRAW BALES MAY BE SUBSTITUTED FOR HAY BALES.

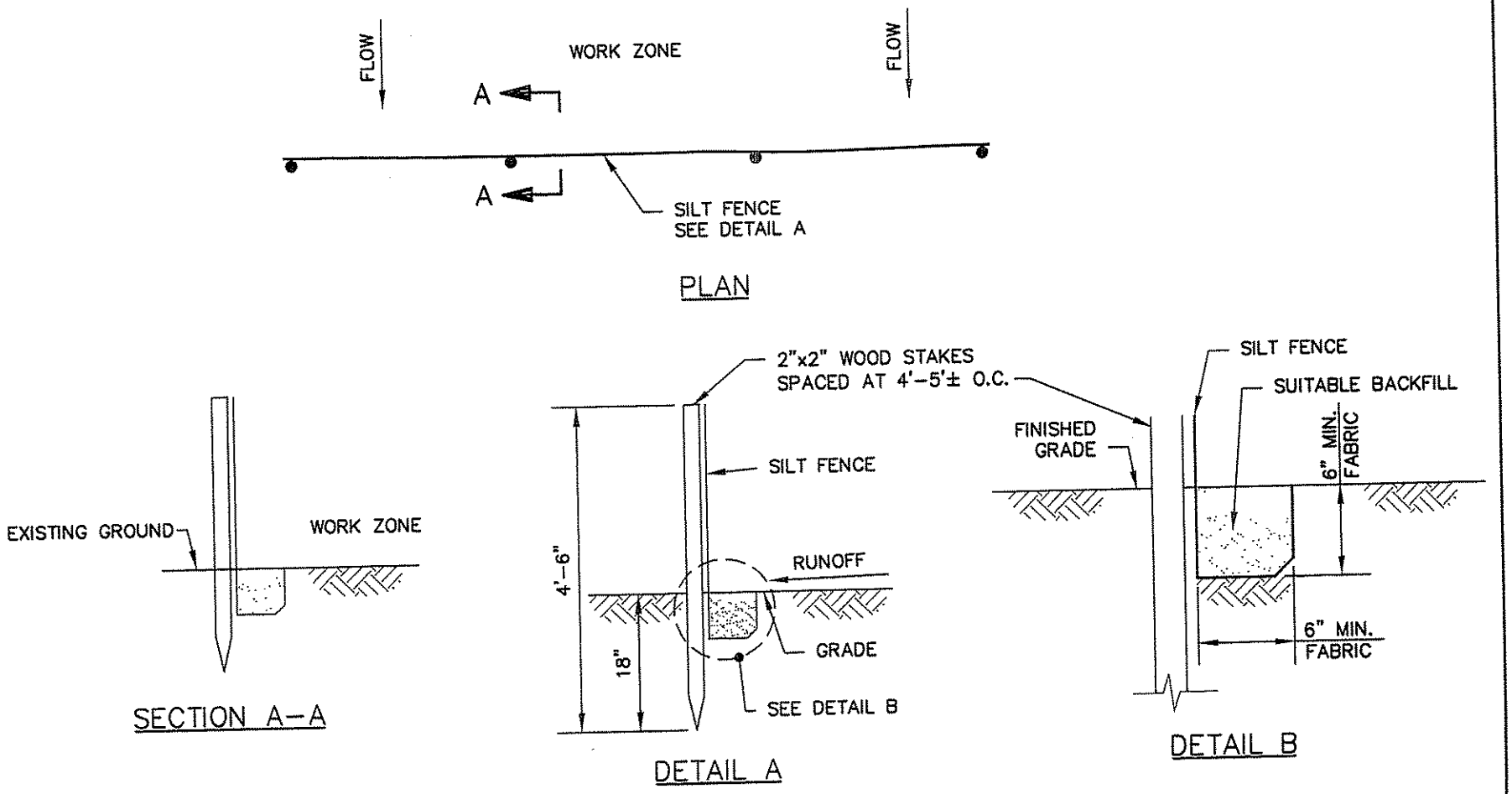


FIGURE 4-2

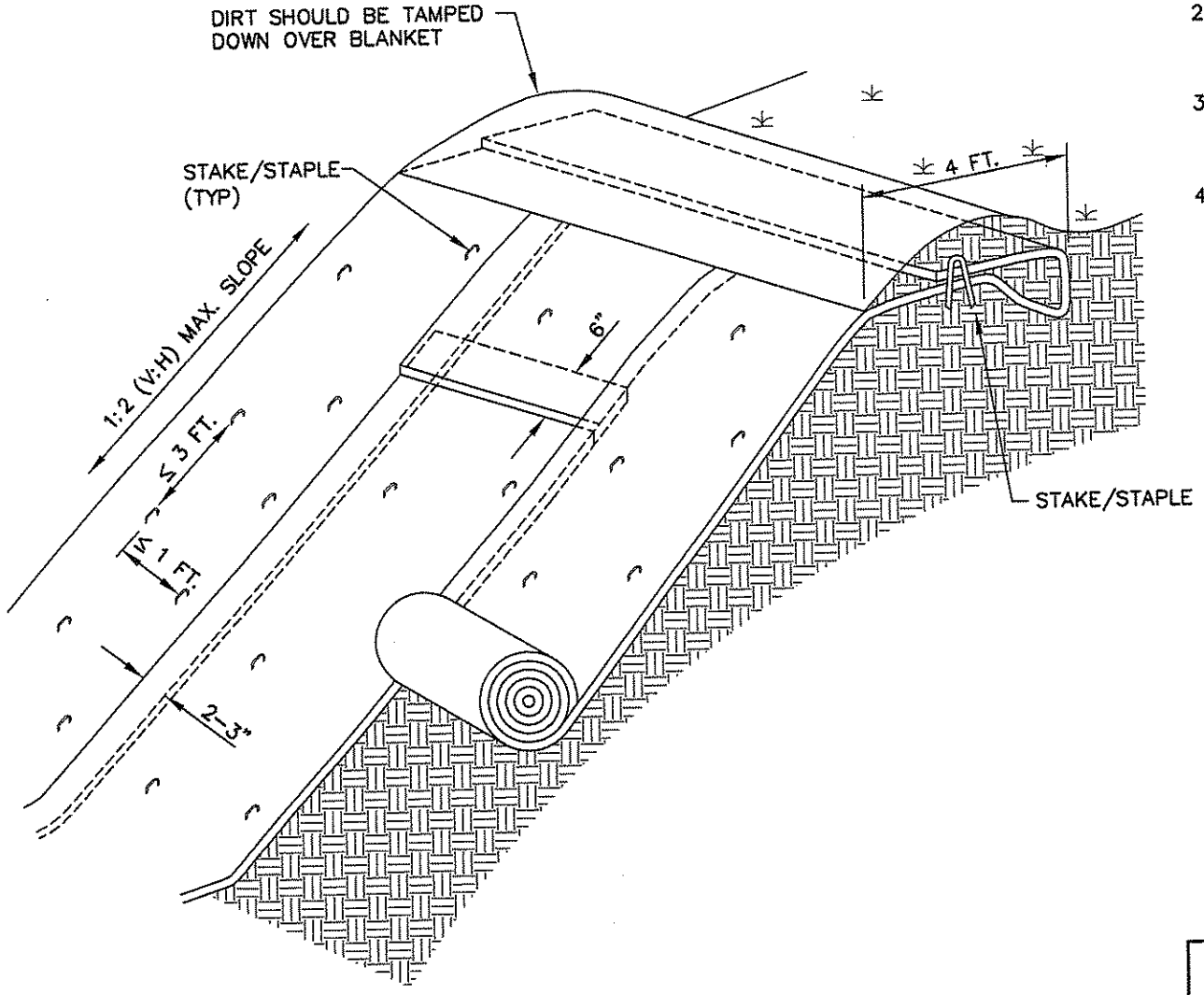
TYPICAL
SILT FENCE USAGE

TIGHE & BOND CONSULTING ENGINEERS
WESTFIELD, MASSACHUSETTS

SCALE: NONE

DATE: 2007

8/8/07 B0368/EROSION CONTROL/FIG5–2



NOTES:

1. EROSION CONTROL BLANKET SHOULD BE INSTALLED VERTICALLY DOWNSLOPE.
2. STAKES/STAPLES SHOULD BE PLACED NO MORE THAN 3 FT. APART VERTICALLY, AND 1 FT. APART HORIZONTALLY.
3. SLOPE SURFACE SHOULD BE FREE OF STICKS, ROCKS, AND OTHER OBSTRUCTIONS.
4. BLANKETS SHOULD BE ROLLED OUT LOOSELY AND STAKED/STAPLED TO MAINTAIN DIRECT SOIL CONTACT. DO NOT STRETCH THE BLANKETS.

FIGURE 4-3

TYPICAL EROSION CONTROL BLANKETS

TIGHE & BOND CONSULTING ENGINEERS
WESTFIELD, MASSACHUSETTS

SCALE: NONE

DATE: 2007

8/8/07 B0368/EROSION CONTROL/FIG5-3

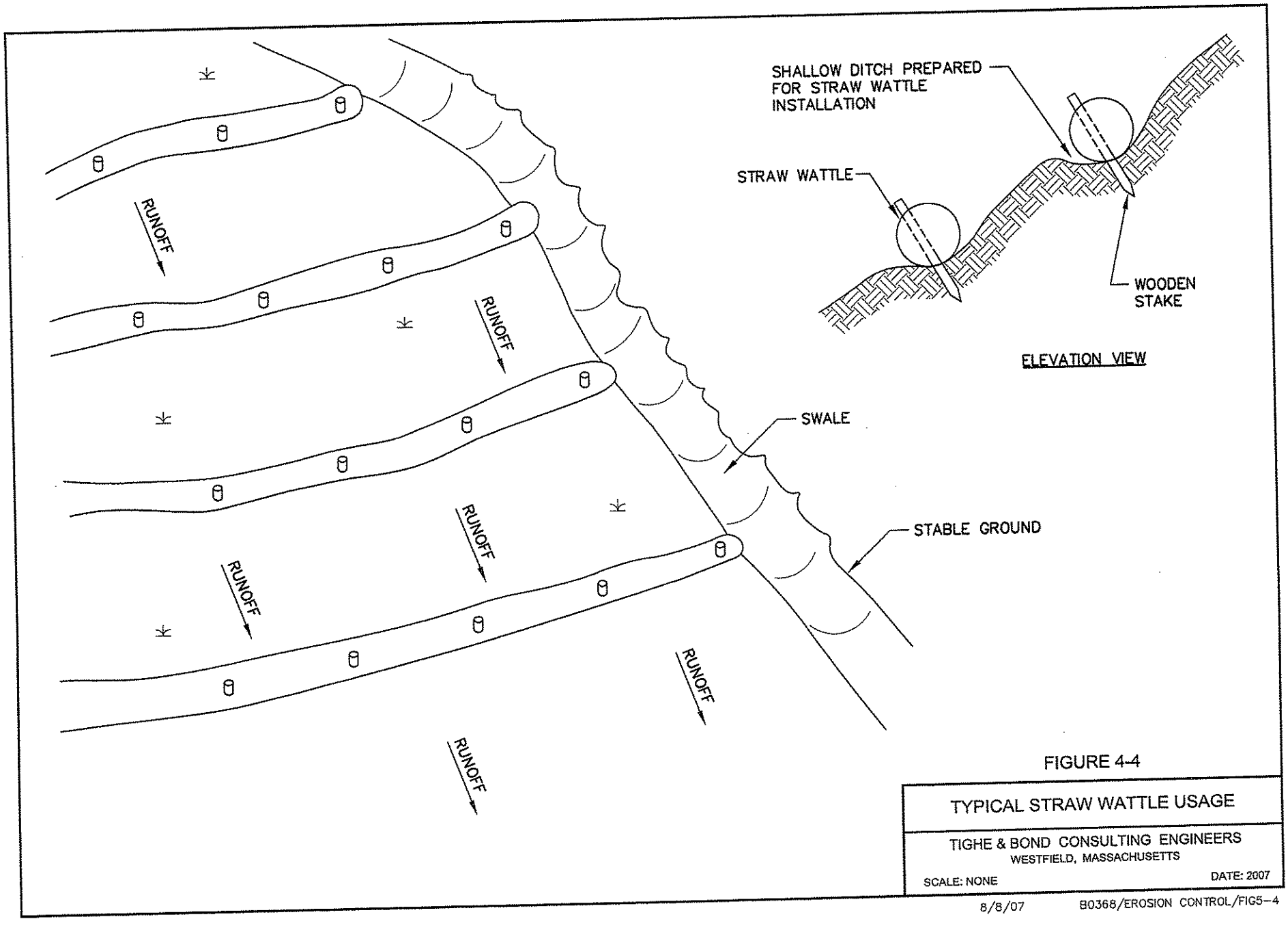


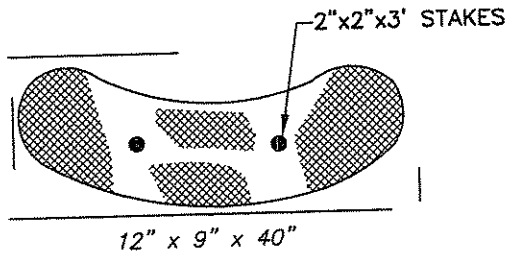
FIGURE 4-4

TYPICAL STRAW WATTLE USAGE

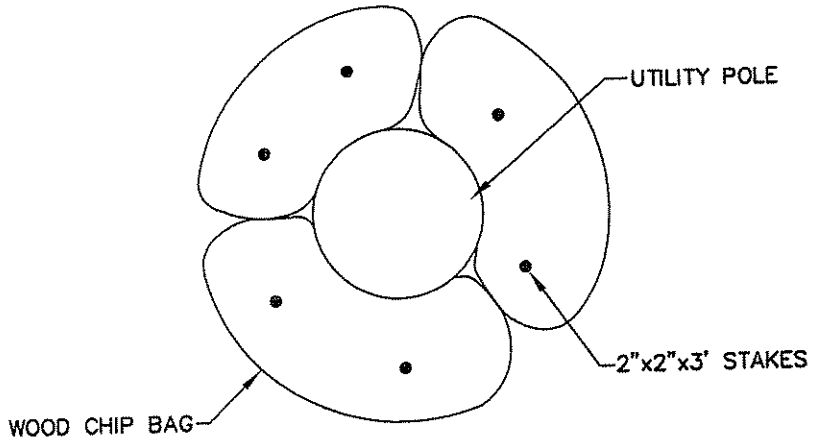
TIGHE & BOND CONSULTING ENGINEERS
WESTFIELD, MASSACHUSETTS

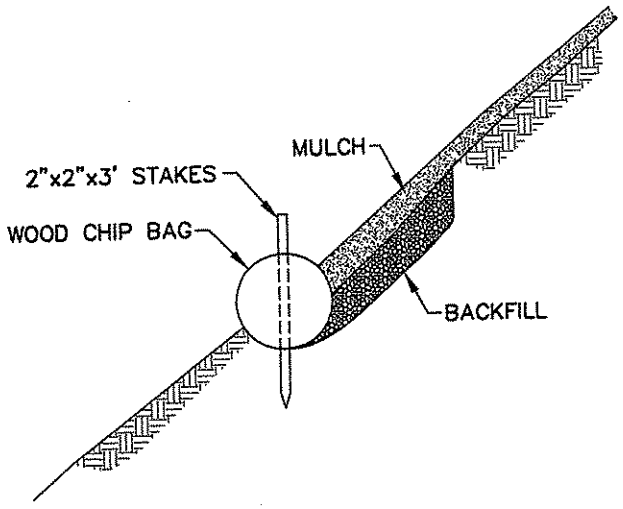
SCALE: NONE DATE: 2007

8/8/07 80368/EROSION CONTROL/FIG5-4



PLAN





ENTRENCHED ON SLOPE

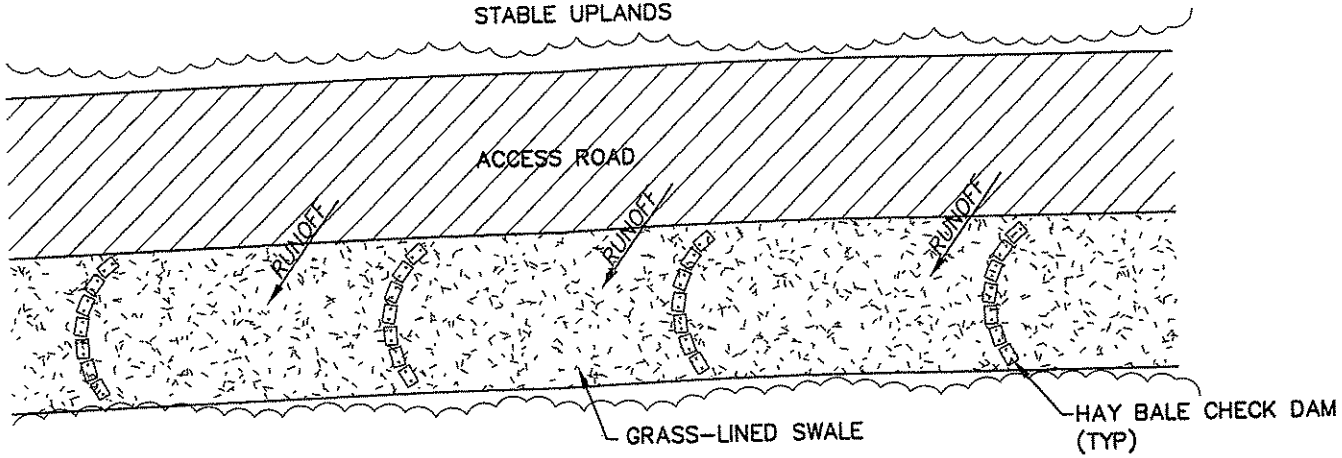
NOTE:
1. A MINIMUM OF TWO (2) WOOD STAKES ARE REQUIRED PER WOOD CHIP BAG.

FIGURE 4-5

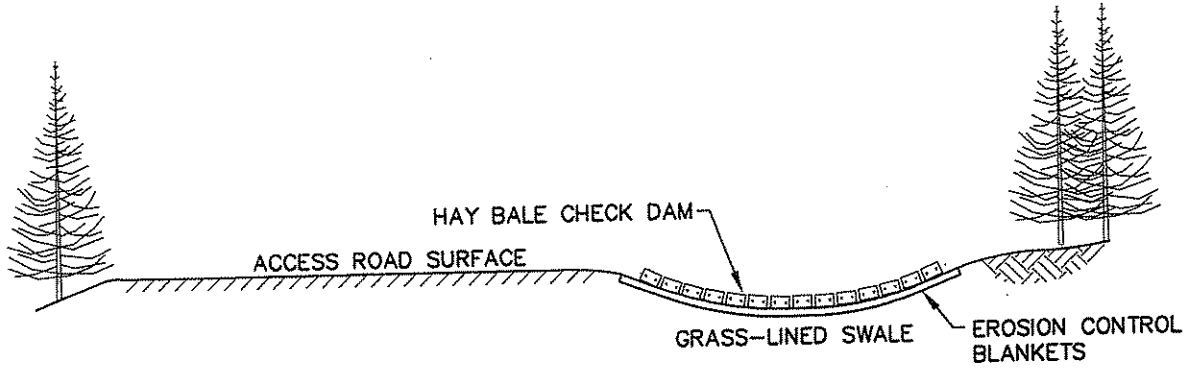
TYPICAL
WOOD CHIP BAG USAGE

TIGHE & BOND CONSULTING ENGINEERS
WESTFIELD, MASSACHUSETTS

SCALE: NONE DATE: 2007



PLAN VIEW



ELEVATION VIEW

FIGURE 4-6

GRASS-LINED SWALE

TIGHE & BOND CONSULTING ENGINEERS
WESTFIELD, MASSACHUSETTS

SCALE: NONE

DATE: 2007

8/8/07 B0368/EROSION CONTROL/FIG5-6

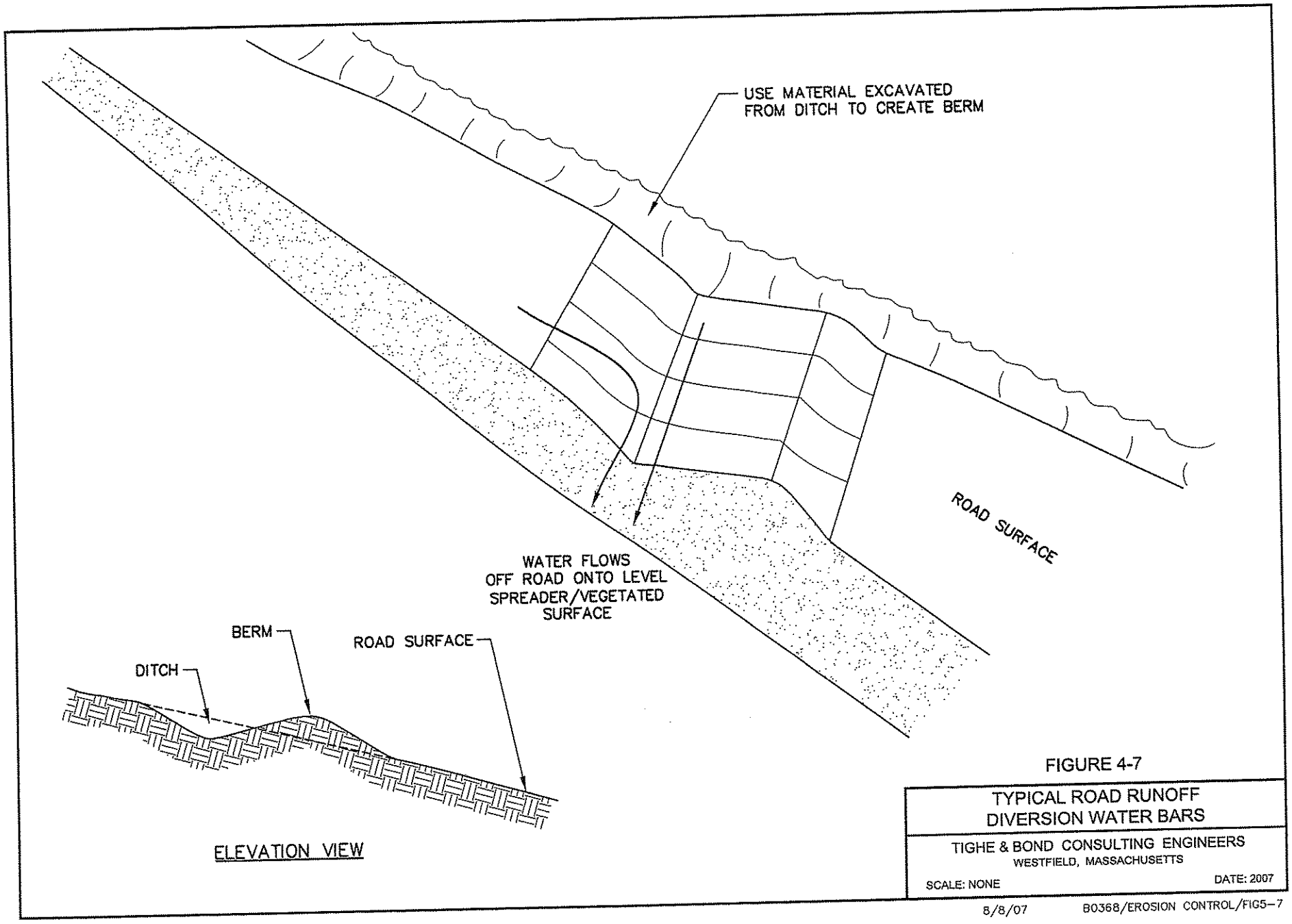


FIGURE 4-7

TYPICAL ROAD RUNOFF
DIVERSION WATER BARS

TIGHE & BOND CONSULTING ENGINEERS
WESTFIELD, MASSACHUSETTS

SCALE: NONE

DATE: 2007

8/8/07 B0368/EROSION CONTROL/FIG5-7

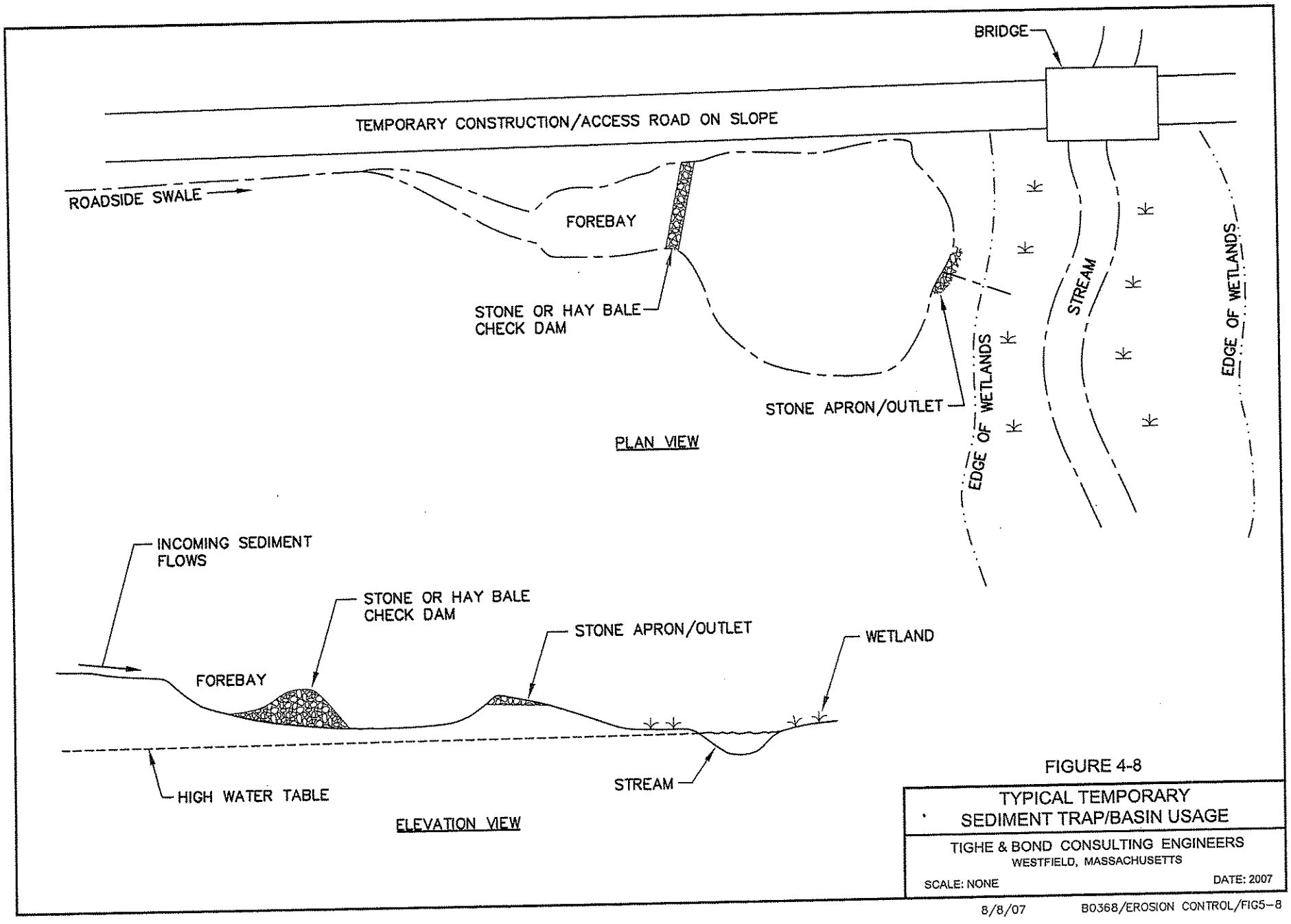


FIGURE 4-8

TYPICAL TEMPORARY
SEDIMENT TRAP/BASIN USAGE

TIGHE & BOND CONSULTING ENGINEERS
WESTFIELD, MASSACHUSETTS

SCALE: NONE DATE: 2007

8/8/07 B0368/EROSION CONTROL/FIG5-8

PHOTOGRAPHS FOR SECTION 4

Photograph 4-1 Properly installed hay bale barrier with silt fence. Direction of flow indicated by blue arrow.

Photograph 4-2 Properly installed and functioning silt fence. Direction of flow indicated by blue arrow.

Photograph 4-3 Using a Ditch Witch® to quickly make a trench for proper silt fence installation.

Photograph 4-4 Hay bale barrier with double-row of silt fence. Direction of flow indicated by blue arrow.

Photograph 4-5 Installing erosion control blanket on an unstable slope.

Photograph 4-6 View of properly installed erosion control blankets.

Photograph 4-7 Wood chips in photo-degradable bags used to stabilize soils.

Photograph 4-8 Grass-lined swale underlain with erosion control blanket and containing hay-bale check dams; used to quickly stabilize soils along a construction access road subjected to significant stormwater runoff. Blue arrow indicates direction of flow.

Photograph 4-9 [Polluted/contaminated] soil stockpile management.

Section 5

Wetlands and other sensitive areas should be avoided whenever possible. However, some work may require entrance into to these areas in order to access a work site. This section discusses measures that should be taken to minimize impacts to sensitive areas during work area access if disturbance is unavoidable.

5.1 STREAM CROSSINGS

There are a number of BMPs that can be selected to minimize impacts to streams. Each situation should take the current site and project needs into consideration in order to select the best method which will be most cost-effective and incur the fewest secondary impacts. Additional erosion and sedimentation controls (e.g. hay or straw bales) may be required in conjunction with the following stream crossing BMPs to protect sensitive areas.

Swamp Mats as Temporary Bridge

Swamp mats may be used as a temporary bridge over a stream to allow construction vehicles access to the work site (see Figure 5-1 and Photograph 5-1 at the end of this Section). Small sections of mat are placed within and along the stream parallel to the flow of water. These act as supports. Mats may then be placed perpendicular to the stream, resting on top of the initial swamp map supports. It may be necessary to place a large steel plate along the top of the swamp mats for extra stability and to minimize the amount of sediment that could fall between the spaces of each timber.

Culvert Crossings

For slightly longer-term projects, a temporary culvert crossing may be more appropriate and cost-effective to support vehicles and to ensure the flow of water beneath. See Figure 5-2 and Photograph 5-2 at the end of this Section for an illustration of a proper temporary culvert crossing. Culvert(s) should be adequately sized to accommodate maximum anticipated flows during the expected use of the culvert. See Section 7 for more information on culvert installation. Some crossings may require hydraulic calculations and design performed by a Professional Engineer.

Poled Fords

In rare situations, it may be acceptable for equipment to simply travel (perpendicularly) through a stream. Such crossings are generally considered acceptable where there is: 1) an intermittent flow; 2) a stable stream bottom where an historic access road has already established a perpetual disturbance; and/or 3) where the crossing is at a relatively narrow reach of the stream and any adjacent wetlands. To further minimize disturbance in those areas, wood poles or saw logs of sufficient length and diameter should be lain in the streambed parallel to the floor. In such cases, the road should be gently sloping into and out of the stream at a maximum ration of 1:5 (V:H).

Engineering fabric covered by an aggregate bed should be installed in the access road at the approach and exit, to limit disturbance to the resource area. Refer to Figure 6-3 at the end of this Section for an illustration of a poled ford.

5.2 WORK IN VEGETATED WETLANDS

Mats

Swamp and/or timber mats are used in areas where the ground surface is unstable due to shallow, standing water, saturated soils, or other substrates and not suitable for heavy vehicles. For proper swamp mat installation and usage, refer to Figure 6-4 and Photograph 6-3 at the end of this Section. Swamp mats should be placed along the travel area so that the individual boards are resting perpendicular to the direction of traffic. No gaps should exist between mats and they should be used far enough on either side of the resource area so as not to result in ruts when equipment enters and exits a sensitive area. Swamp mats should be removed by "backing" out of the site, removing mats one at a time and regrading soils to pre-existing contours while taking care not to compact soils. **Note: In Connecticut, swamp mats, and similar devices, are considered fill in wetlands per the Connecticut Programmatic General Permit (CTPGP) and must be included as fill in all wetland impact calculations.**

Lightweight, easy to maneuver alternatives to traditional mats, such as AlturnaMATS®, are also available. AlturnaMATS® are half-inch thick polyethylene slip-resistant ground protection mats. They are available in dimensions up to 4 feet by 8 feet and range in weight from 21.5 to 86 pounds (see Figure 5-5 and Photograph 5-4 at the end of this Section).

Equipment Selection and Usage

- **Low ground pressure equipment**. Using equipment that reduces the pressure it exerts on the ground can minimize impacts to sensitive areas. Employing the use of equipment with wide tires, rubberized tracks, and low ground pressure (<3 psi) can help minimize soil compaction.
- **Wide tires**. Increasing the width of tires will increase traveling surface area and therefore reduce the amount of ground compaction that the equipment will cause. Ultimately, this will reduce rutting, and allow for easier maneuvering of the vehicle. However, wide tires may be costly and will require a wider travel area.
- **Rubberized tracks**. Equipment with rubberized tracks spreads the weight of the vehicle over a much larger surface, reducing ground pressure and enabling the vehicle to move more freely through wet substrates. Each track can be between 1.5 and 3 feet wide, length depending on the width of the vehicle. This

can greatly reduce rutting and allow the vehicle to move with less difficulty through wet substrates.

- **Lightweight equipment**. Impact in a wetland area can be lessened by reducing the size of equipment used in sensitive areas. This reduces the amount of pressure to the travel surface as well as the necessary width of access ways.

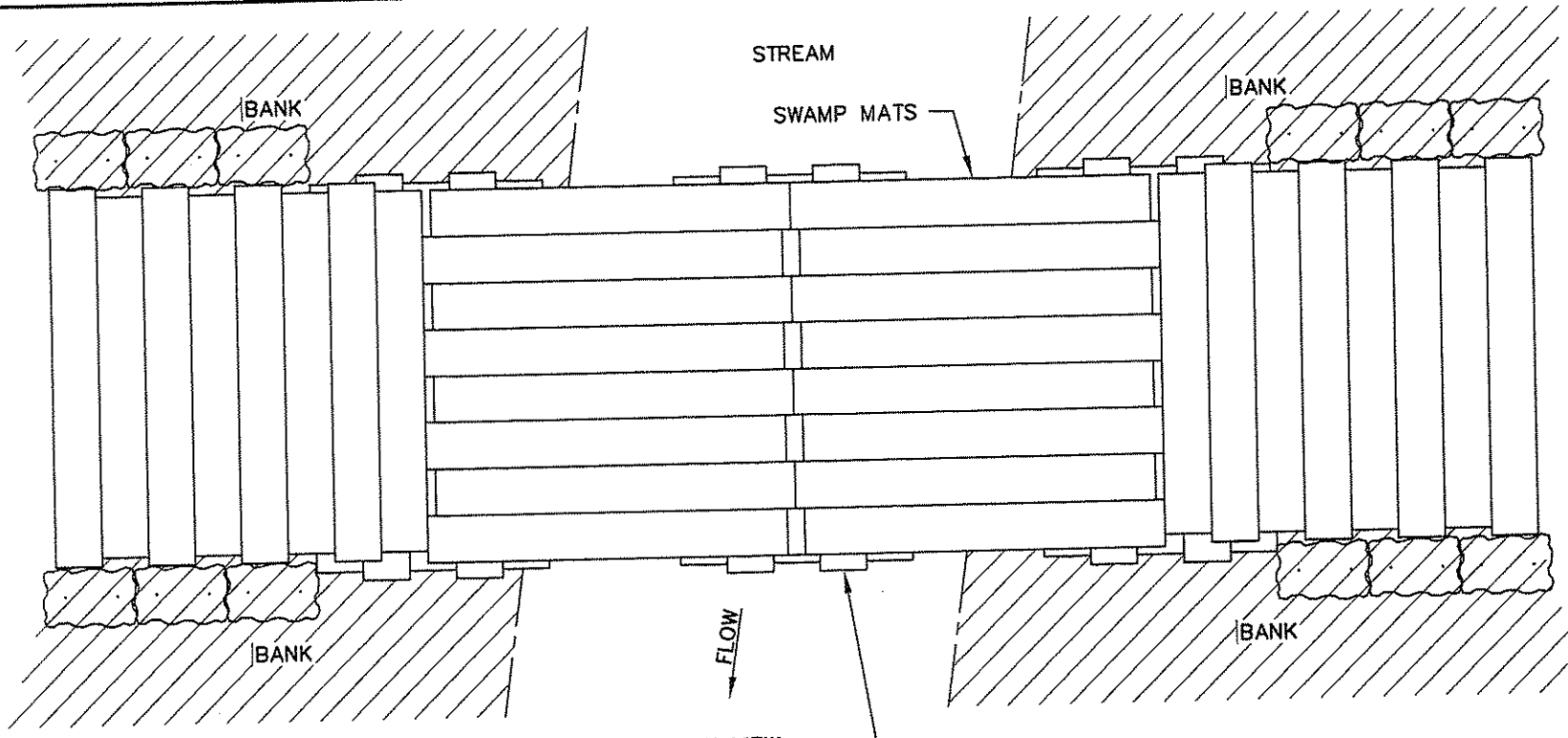
Timing of Work

- **Work during frozen conditions**. Activities conducted once wetland areas are frozen can minimize rutting and other impacts to the surrounding environment. Work during this time also generally reduces disturbance of aquatic and terrestrial wildlife movement by avoiding sensitive breeding and nesting seasons.
- **Work during the "low flow" period**. The U.S. Army Corps of Engineers regulatory low flow period is designated as July 1 through September 30. Conducting work during the low flow period can reduce impacts to surface water and generally avoids spawning and breeding seasons of aquatic organisms.

Alternate Access

- **Manual access**. In some cases such as for smaller projects, work areas can be accessed manually – on foot through terrestrial areas, and by boat through open water or ponded areas. Small projects, such as repairs of individual structures, or parts of structures, that do not categorically require the use of heavy machinery, should be accessed manually to the greatest extent practicable.
- **Use of overhead/aerial access**. Using overhead or aerial equipment can be expensive and is not always feasible, but it may be appropriate in some situations in order to get vehicles and other equipment to a site that may be otherwise very difficult to access. The use of overhead and/or aerial equipment may be beneficial for work in areas where large water bodies, deep crevices, or mountainous areas hinder ground access (see Photograph 5-5 at the end of this Section).

FIGURES FOR SECTION 5



NOTES:
1. SWAMP MATS SHOULD BE PLACED CLOSELY TOGETHER SO THERE ARE NO GAPS BETWEEN EACH MAT SECTION.
2. ADDITIONAL MEASURES MAY BE REQUIRED.

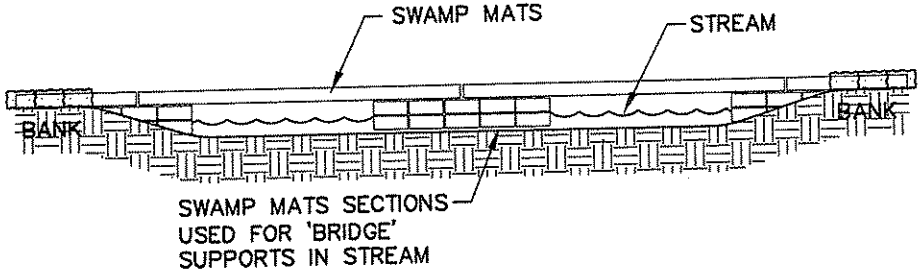


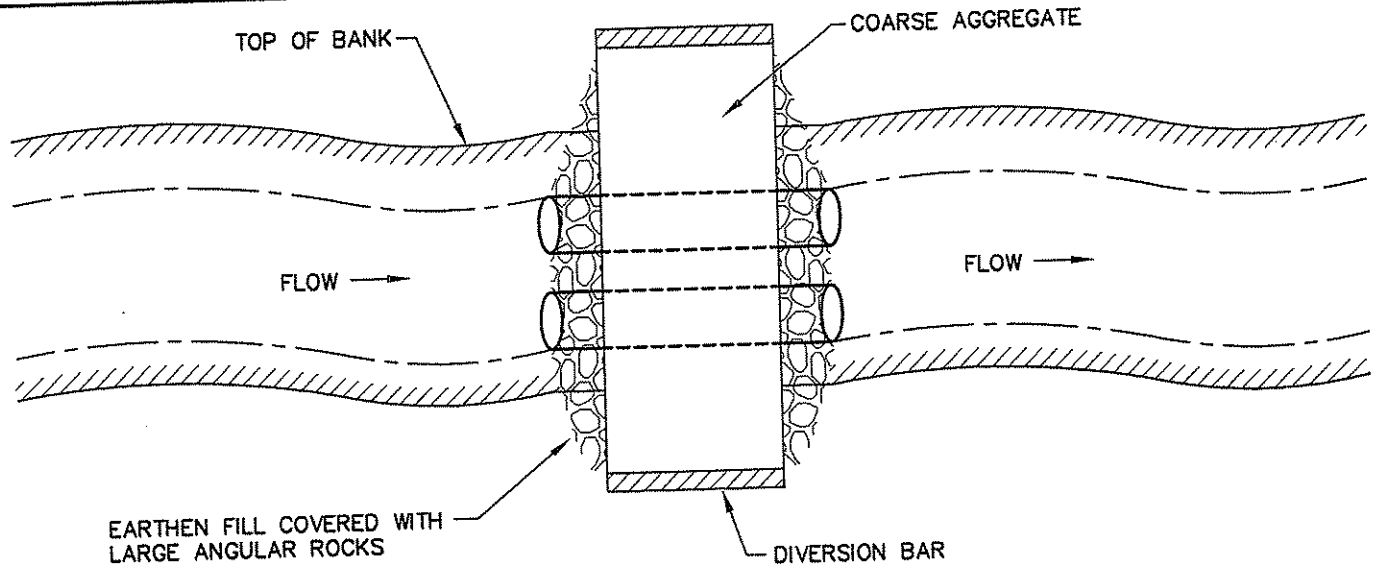
FIGURE 5-1

TYPICAL SWAMP MAT BRIDGE FOR TEMPORARY STREAM CROSSING

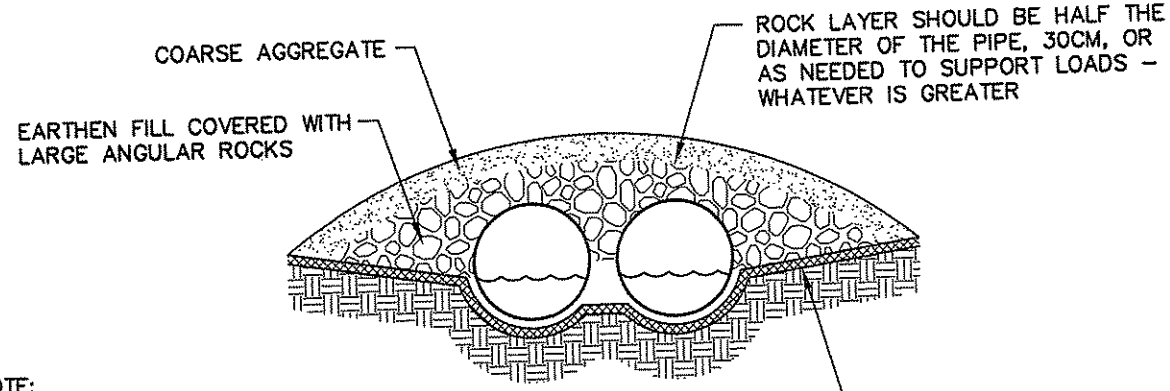
TIGHE & BOND CONSULTING ENGINEERS
WESTFIELD, MASSACHUSETTS

SCALE: NONE DATE: 2007

12/12/07 B0368/EROSION CONTROL/FIG6-1



PLAN VIEW



ELEVATION VIEW

NOTE:
CAPACITY OF PIPES COMBINED SHOULD ACOUNT FOR SIGNIFICANT STORM EVENTS.

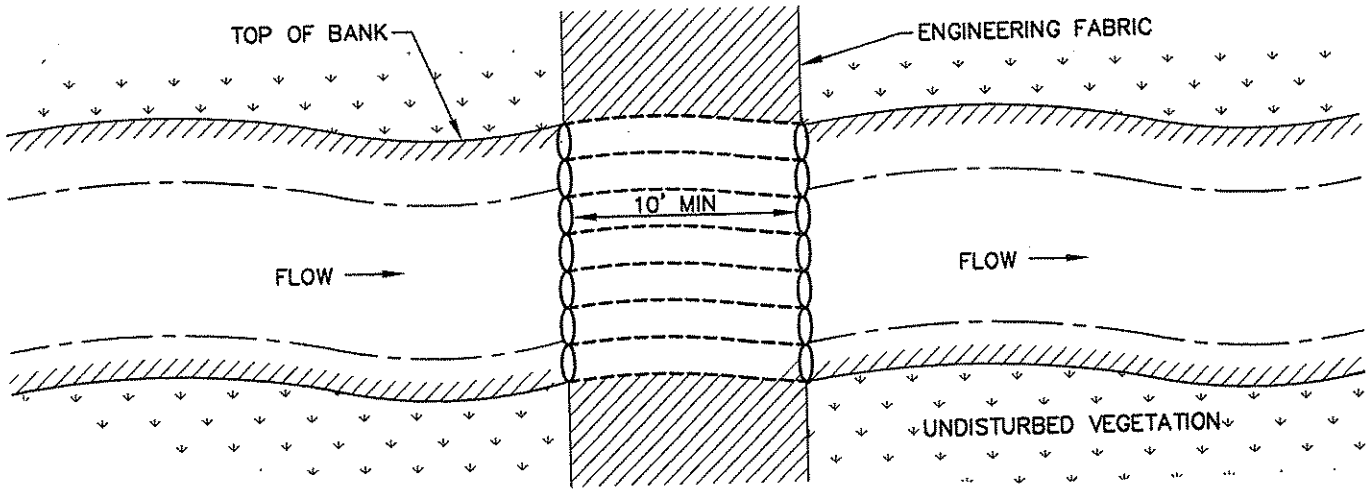
FIGURE 5-2

TYPICAL CULVERT CROSSING FOR LONGER-TERM BUT TEMPORARY ACCESS

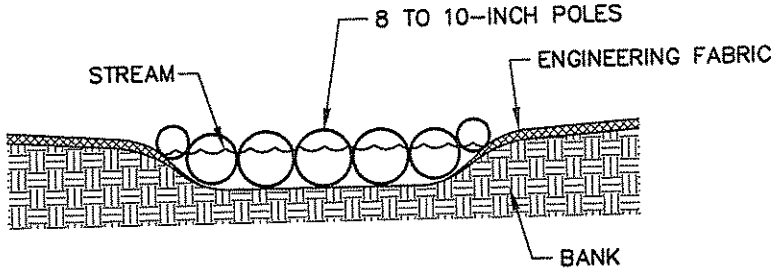
TIGHE & BOND CONSULTING ENGINEERS
WESTFIELD, MASSACHUSETTS

SCALE: NONE

DATE: 2007



PLAN VIEW



ELEVATION VIEW

NOTES:

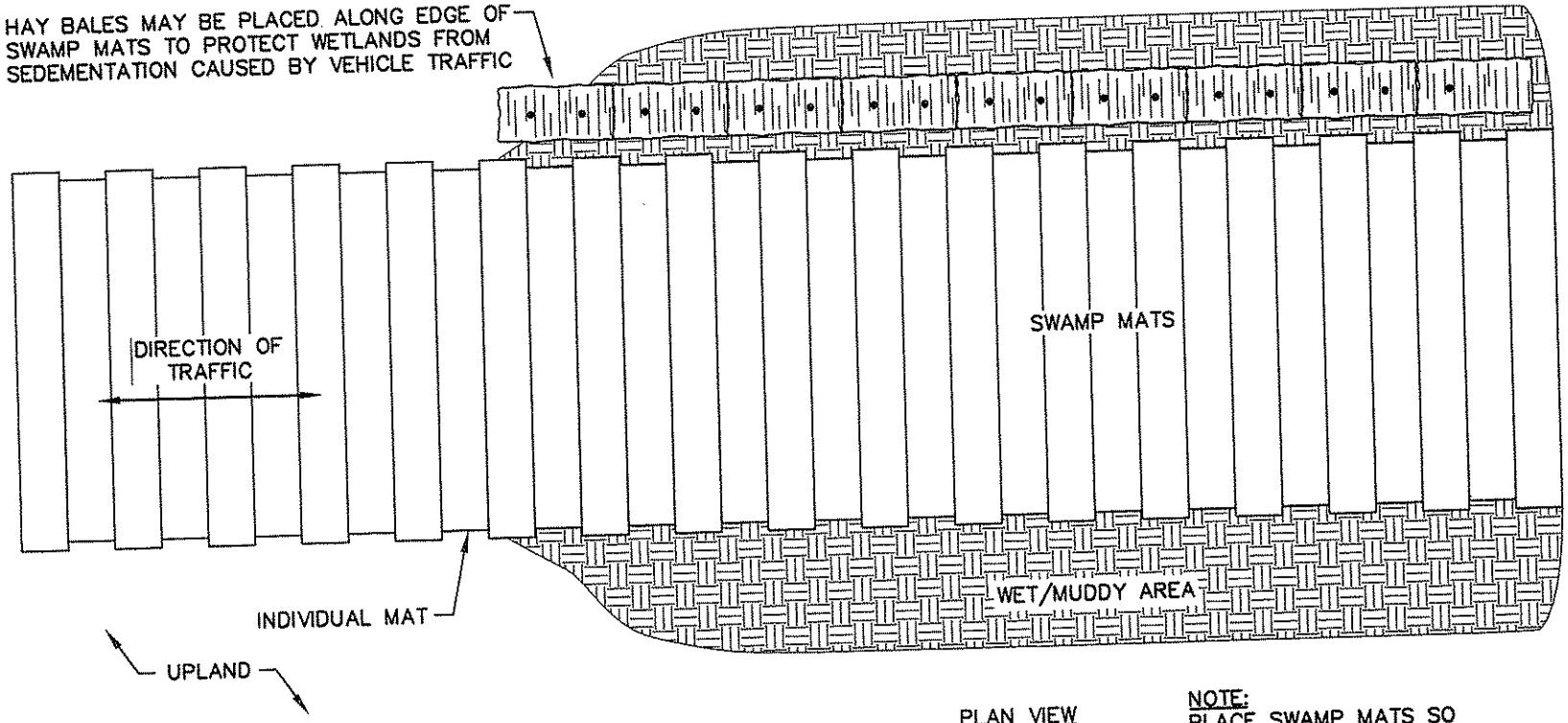
1. POLES MUST BE REMOVED IMMEDIATELY AFTER USE.
2. LENGTH OF POLES SHALL BE AT LEAST 10 FEET.

FIGURE 5-3

TYPICAL POLED FORD FOR TEMPORARY STREAM CROSSING

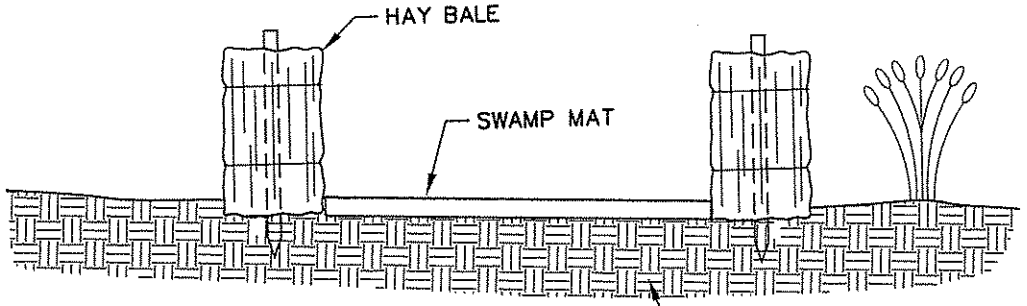
TIGHE & BOND CONSULTING ENGINEERS
WESTFIELD, MASSACHUSETTS

SCALE: NONE DATE: 2007



PLAN VIEW

NOTE:
PLACE SWAMP MATS SO PLANKS ARE PERPENDICULAR TO DIRECTION OF TRAFFIC.



ELEVATION VIEW

FIGURE 5-4

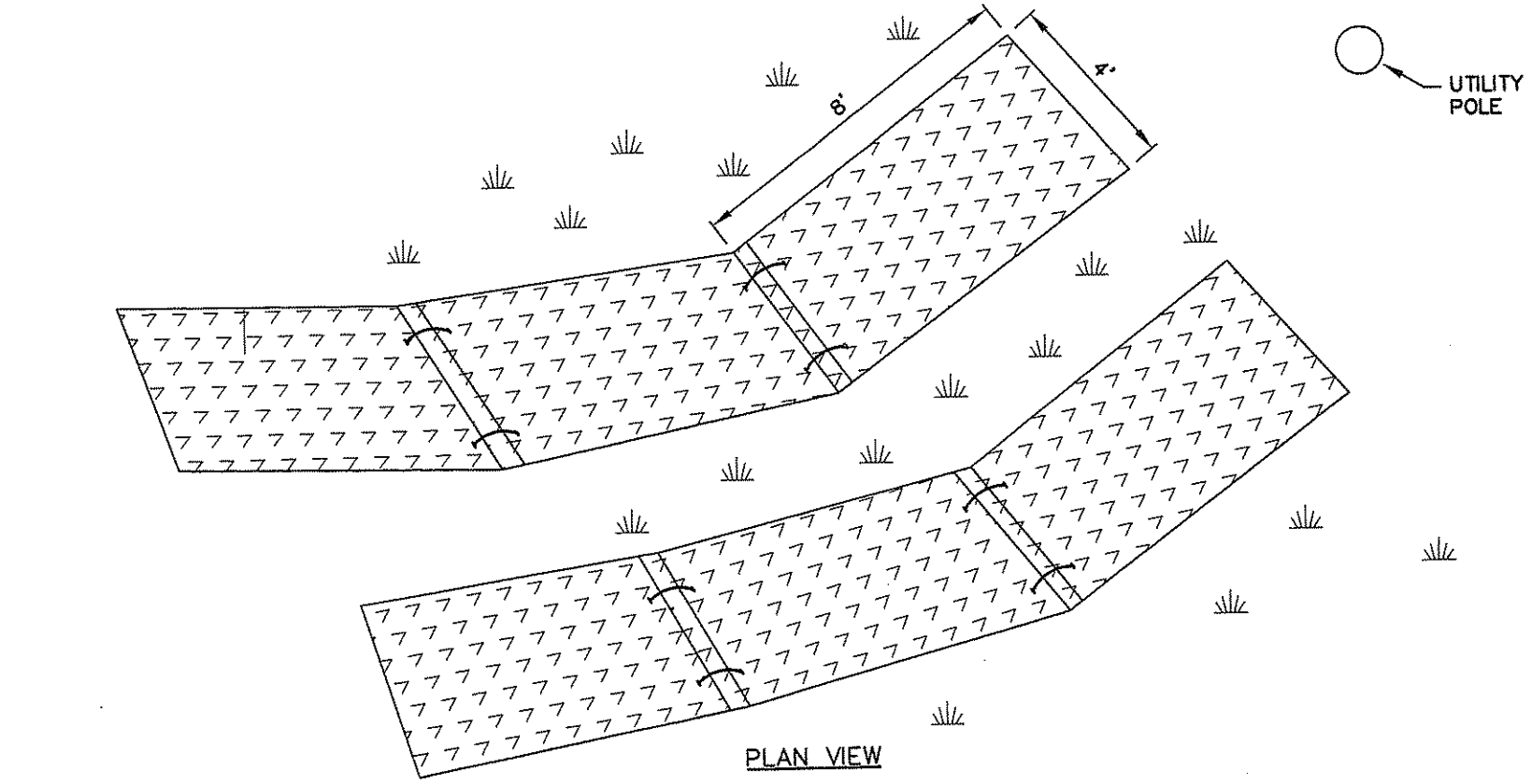
TYPICAL
SWAMP MAT USE

TIGHE & BOND CONSULTING ENGINEERS
WESTFIELD, MASSACHUSETTS

SCALE: NONE

DATE: 2007

8/9/07 B0368/EROSION CONTROL/FIG6-4



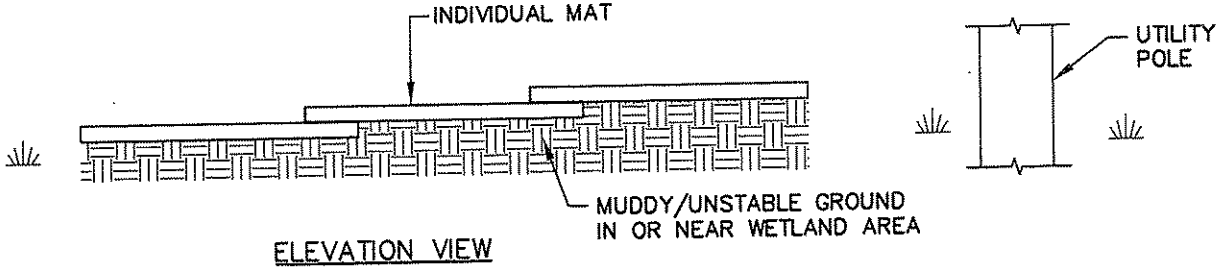


FIGURE 5-5

TYPICAL ALTURNAMAT® USE

TIGHE & BOND CONSULTING ENGINEERS
WESTFIELD, MASSACHUSETTS

SCALE: NONE

DATE: 2007

8/15/07 B0368/EROSION CONTROL/FIG6-5

PHOTOGRAPHS FOR SECTION 5

Photograph 5-1 Swamp mat bridge.

Photograph 5-2 Temporary (long-term) culvert and rip rap for stream crossing.

Photograph 5-3 Swamp mat access road.

Photograph 5-4 AlturnaMAT® tracks to utility pole in wetland.

Photograph 5-5 Use of aerial equipment for transmission line construction.

Section 6

Construction access roads are unpaved roadways which work crews use to access a site. During wet weather these roadways can generate significant quantities of sediment if not constructed with adequate stormwater management and erosion control measures.

6.1 EXISTING ACCESS ROADS

Use only designated roads. Travel by construction equipment and general traffic to reach a particular portion of right-of-way must be via the designated access road and route. Changes in the location of the access road or the use of alternate roads must be approved by the NU Representative prior to their construction or use. Access road routes have been selected to prevent degradation of the utility corridor, and must be constructed, used, and maintained in accordance with this manual, as well as federal, state, and local regulations, and other project plans.

Though in some situations they may be necessary, constructing duplicate roadways should be avoided to the greatest extent possible. Some appropriate reasons for suggesting alternate routes are:

- Poor site conditions along preferred route because of weather or season;
- Property rights constraints, or owner's preference;
- Clearly unanticipated equipment requirements;
- Clearly unanticipated off-site access limitations along existing roads; and/or
- Unanticipated access opportunities (e.g., ice, snow, other developments) which may avoid environmental impact and/or reduce cost.

6.2 NEW ACCESS ROADS

General Design

Construction access roads that require new grading and/or filling, or are to be heavily used require the creation of a stable, tractable, load-bearing surface resistant to erosion. If the existing soil and subsoil are not well drained, it may be necessary to import an aggregate road base (i.e., gravel borrow) such as that meeting the requirements of aggregate found in the Connecticut *Standard Specifications for Roads, Bridges and Incidental Construction*, section M1.02. When the construction access road follows the same route as the permanent design road, constructing the grades and subgrade for the permanent roadway early in the construction sequence is recommended.

Construction access roads shall typically not exceed 14 feet in width except for passing points, where necessary. Subgrading shall not extend beyond the space required for the finished road and normal side slopes.

Where possible, construction access roads should conform to the contours of the land, avoiding grades steeper than 10 percent and creating side slopes no steeper than a ratio of 2:1. If the side slopes are steeper than 2:1, then use of engineered slope stabilization methods is imperative (see Stabilization Structures Functional Group, 2002 Connecticut Guidelines for Soil Erosion and Sediment Control). Consider the volume and type of construction traffic as well as the extent that natural ground must be altered to accommodate the traffic. If no grading is required and the construction traffic is very intermittent (e.g., access roads used to maintain utility lines) the measures used may be limited to water bars, or some top dressing with gravel or stone in areas where the vegetation over soft soil is destroyed by traffic.

Inspection of the construction access road and the associated erosion and sedimentation measures should occur at the end of each day the road is used, and repairs to controls made immediately. If the road is not used for more than a week, then inspection of the erosion and sedimentation controls should occur at an appropriate frequency as dictated by the specific measures used and extent of heavy rain events. Repairs may include regrading and/or top dressing the traveled surface with additional aggregate to eliminate ruts, as well as those repairs required by each erosion and sedimentation measure used. After the use roadway is no longer needed, the disturbed area shall be seeded and mulched as required to match preconstruction conditions.

Wetland Considerations

Construction access roads that are constructed in or across wetlands require the following, additional considerations:

- Avoid putting the construction access road in a wetland whenever possible. Explore all feasible and prudent alternatives before determining that a wetland crossing is absolutely necessary. When avoidance is not possible, consider crossings that will result in the least impact. This may involve locating the construction access road so that it crosses the wetland at its narrowest width or uses areas previously disturbed for access or other purposes.
- Minimize the width of the construction access road through the wetlands (generally no wider than 16 feet). It is preferable to have a passing point created before and after the wetland crossing, but internal passing points may be needed if the crossing is very long or critical sight line restrictions exist.
- Consider the soil conditions. Expect deep organic wetland soils to require geotextiles, timber/swamp mats (see Section 5.2), or other materials during use to keep imported road materials separated from wetland soils. In shallow organic, or saturated soils thick plywood sheets or AlturnaMATS® may be sufficient to support a stable travel surface for small, lightweight vehicles.

- Prevent obstructions to surface and subsurface flow across and through the construction access road. Provide adequate drainage. This may require the use of crushed stone, timber mat bridges, or multiple cross culverts, particularly if the wetland does not contain a well-defined watercourse channel and/or the crossing is long. If the wetland soils are susceptible to seasonal high groundwater tables or flooding, then give additional consideration for maintaining flows across and/or over the construction access road without causing erosion or siltation during such times.
- Plan in advance how the construction access road will be removed and the wetland restored. A road stabilization geotextile can facilitate the segregation of imported soils and crushed stone from the native wetland soils and make wetland restoration easier. However, after the end of an extensive project and a highly traveled crossing, stone removal from the wetland surface will still usually have to occur, even when placed in conjunction with geotextile.

Erosion and Sedimentation Control

While discussed in detail in Section 4, construction personnel are reminded to control erosion and flow conditions during access road construction by utilizing the following measures:

- A **construction entrance track pad** should be used where the construction access road meets a paved access point (also see "Control of Tracked Soils" below).
- **Temporary diversions** and/or **temporary lined channels** should be used to control concentrated flows where they enter and cross the construction access road.
- **Temporary stream crossings** should be used to carry concentrated flows beneath the construction access road.
- **Outlet protection**, a **level spreader**, or a **stone check dam** may be used to de-energize concentrated flows from diversions and in temporary channels.
- **Water bars** should be installed to generally maintain natural drainage patterns and break flow lines within the construction access road.
- **Geotextile silt fencing** and **hay-/straw bale barriers** may be utilized to provide protection at the toe of fill slopes and discharges from water bars.
- Side slopes can be protected by installing **erosion control blankets** and **seeding** the area with a fast-growing native or annual grass mix.
- **Dust control** should be employed when construction access road conditions create airborne dust in or near sensitive areas.

Control of Tracked Soils

Where access roads or construction areas connect to paved roads, a stone **track pad** must be installed at the **construction entrance** to prevent construction machinery from tracking soil onto paved roadways (see Figure 6-1 and Photograph 6-1 at the end of this Section). Materials appropriate to construction site soil conditions should be employed and/or replenished, as necessary. Further, muddy conditions may warrant the use of a tire wash station and procedures should be established to ensure soils are not tracked off site. Stone in an entrance track pad may also need to be removed and refreshed and/or cleaned as needed if the pad becomes clogged with soil.

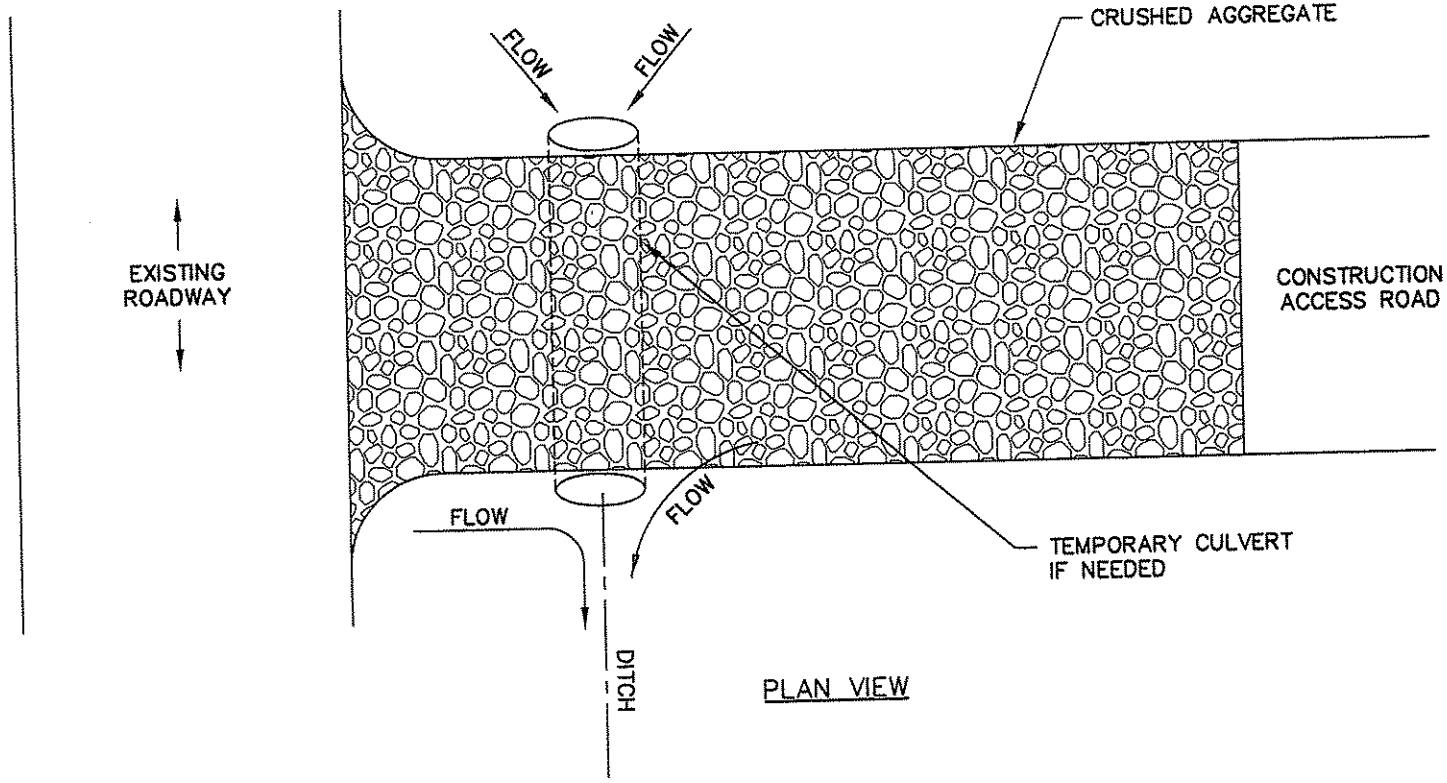
Minor Grading/Stockpile Management

Where access roads or construction areas require grading to mineral soil, the topsoil shall, wherever possible, be preserved through temporarily stockpiling and later re-spread, seeded, and mulched. Topsoil stockpiles must be prevented from eroding into adjacent undisturbed or sensitive areas. Covering topsoil stockpiles with plastic sheeting can accomplish this, and offers the added benefits of preventing soil moisture loss, and isolating the soils from wind-borne weed seeds.

Fences, Gates, and Barricades

No fence on the utility corridor or access routes may be cut or removed without permission of the NU Representative. Fences cut or removed for any temporary purpose shall be repaired immediately upon completion of work. Gates should be left as they were found. Gates providing access to company-owned property must be left closed and locked at the end of each workday. Stone, concrete block, or pole barricades or access control berms that are required to be removed for the conduct of work shall be replaced in equal or better condition immediately after the work is completed. Among other things, the existence of fences and other berriers along NU ROWs minimizes illicit use of these ROWs by off-road vehicles (ORVs), damage to NU and adjacent property owners' land, and helps to minimize liability associated with trespassing.

FIGURES FOR SECTION 6



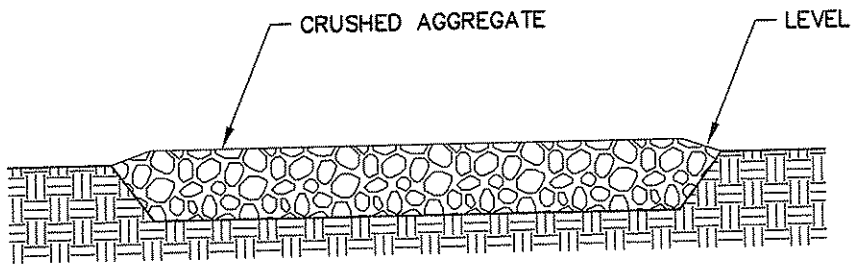


FIGURE 6-1

TYPICAL
CONSTRUCTION ENTRANCE TRACK PAD

TIGHE & BOND CONSULTING ENGINEERS
WESTFIELD, MASSACHUSETTS

SCALE: NONE DATE: 2007

8/9/07 B0368/EROSION CONTROL/FIG7-1

PHOTOGRAPHS FOR SECTION 6

Photograph 6-1 Construction entrance track pads (large site/corridor work).

Section 7

SECTION 7 INSTALLING/REPLACING PERMANENT CULVERTS

7.1 APPLICABILITY

Permanent culverts may be necessary to provide or improve a stream crossing within a frequently used, permanent access road. These culverts should be used for small to medium-sized streams/rivers with defined banks and channels whether or not flow is observed. They should be installed in areas where bridging is not appropriate. Typical culvert figures are provided at the end of Section 5 of this document.

7.2 DESIGN

According to the CTPGP, a number of criteria apply to all waterway crossings and include the following:

- All temporary and permanent crossings of waterbodies shall be suitably culverted, bridged, or otherwise designed to withstand and prevent the restriction of high flows, and to maintain existing low flows, and so as not to obstruct the movement of aquatic life indigenous to the waterbody beyond the actual duration of construction.

- Open bottom arches, bridge spans or embedded culverts are generally preferred over traditional culverts. Project proponents shall consult with the U.S. Army Corps of Engineers if open bottom arches, bridge spans or embedded culverts are not practical.

Permanent stream crossings shall be designed and construction in compliance with applicable Connecticut Department of Transportation (ConnDOT) *Drainage Manual*.

Culvert Size

- The culvert should be a minimum of 18 inches in diameter for non-interstate systems.
- The culvert skew shall be less than a 45 degree angle measured from a line perpendicular to the roadway center line.
- Small structures (e.g. culverts providing waterways for drainage areas less than one square mile in which there is an established watercourse) shall be designed to pass a 50-year frequency discharge.
- The water surface upstream shall not be elevated so as to endanger or damage private property.

Culvert Installation

Culverts shall be designed and installed with minimal disruption to the ecosystem and values unique to the floodplain and stream.

7.3 REGULATORY GUIDELINES/REQUIREMENTS

New culvert installation or existing culvert replacements will require the review and issuance of a permit under the Connecticut Inland Wetlands and Watercourses Act (local Conservation Commission or the Connecticut Department of Environmental Protection – CT DEP), §401 of the Clean Water Act (CT DEP), §404 of the Clean Water Act (US Army Corps of Engineers), or a combination of the three.

7.4 LIMITATIONS

Some downfalls to culverts used in stream crossings include the following:

- Installation requires in-stream work and possible dewatering and sedimentation concerns;
- Culverts are susceptible to washouts, erosion, and failure during heavy wet weather events and flooding;
- Often, culverts become clogged with debris or other obstructions; and
- Culverts require routine and long-term maintenance.

PHOTOGRAPHS FOR SECTION 7

Photograph 7-1 Riprap at outlet of permanent culvert (haybale checkdam in place during construction activities only).

Section 8

When transmission poles are decommissioned or otherwise taken out of service, the entire pole shall be removed. Treated wood pole butts shall be removed completely from the ground and properly disposed at an off-site location.

Locations where the removal of pole butts may cause significant disturbance will be considered for exception to this practice on a site-by-site basis. Each location shall be identified and tracked, and arrangements made for removal during winter months or at a later date when site conditions are more favorable. Pole butts that cannot be removed for environmental or other reasons (e.g., when removal would impact the integrity of the replacement structure) shall be logged and permanent records maintained by Transmission Lines & Contract Services (CL&P & WMECO).

Other exceptions to the pole butt removal practice must have the approval of the Transmission Lines & Contract Services Manager (Massachusetts).

All holes left by pole butts must be backfilled and compacted with appropriate fill material consistent with native soils. Existing material on-site may be reused.

Disposal

Treated and non-treated wood products owned by the Transmission Group shall be stored in an area(s) designated by the Transmission Line Construction/Contract Field Services supervisor until collected by an approved disposal vendor.

Section 9

Dewatering measures may be necessary if groundwater is encountered within an excavation (e.g., during installation or repair of a buried cable, footings, foundations or structure replacement) or other area if the presence of water is incompatible with construction. In rare cases, surface water diversions will be necessary in order to create dry working conditions for subsurface work in water bodies.

Underground vault maintenance activities, including dewatering and removal of accumulated sediment, shall be conducted in accordance with established NU BMP policies.

9.1 DEWATERING

No untreated groundwater shall be discharged to wetlands or water bodies. Below is a discussion of different methods that may be employed to prevent sedimentation due to dewatering.

Overland Flow

Excess water may be discharged overland to well drained, upland areas and allowed to naturally infiltrate into soils.

Use of Catch Basins

Discharge of clean water into municipal system catch basins may be an option for certain sites, however, this activity must be coordinated with the municipality and shall not occur without their written consent. To protect catch basins from excessive sediment, filters can be installed into the basin which are specifically designed for this purpose (see Figure 9-1 at the end of this Section). In addition, hay bales can be placed around the perimeter of the inlet in order to extend the life of the filter by removing much of the sediment before-hand.

In cases of curb drop inlets, additional protective measures (e.g. filter sock, gutter buddy) should be utilized in conjunction with a silt sack.

Sediment Basins

Sediment basins allow sediment in runoff to be filtered out before water is released into a wetland or other unprotected area and may be used for drainage areas of various sizes. When located in proximity of wetlands and waterways, a temporary sediment basin should ideally consist of a forebay where debris and some sediment begins to settle out of the water.

For more information on sediment basins, see Section 4.8.

Discharge Hose Filter Socks

At sites where there isn't sufficient space to construct sediment basins or enough suitable uplands for overland flow and infiltration to be an option, filter "socks" or bags can be affixed to the end for the discharge hose of the pump and used for dewatering. Figure 9-2 at the end of this Section provides an illustration of proper filter sock usage. It is important that enough socks be on hand at the site to accommodate the anticipated need, as they fill fast with more turbid water. Further, additional measures such as hay or straw bales can be installed around the filter device for added protection.

Frac Tank

Frac tanks are pre-fabricated self-contained units that are shipped to construction sites. They contain a series of baffles that allow fine materials to settle out of the water column. Use of frac tanks is most appropriate when work that requires dewatering will occur in an area with contaminated groundwater and/or very silty water.

9.2 DIVERSIONS

Several methods exist for temporary diverting and dewatering surface water from work areas. These methods, which are primarily appropriate during construction of capital projects, are described below.

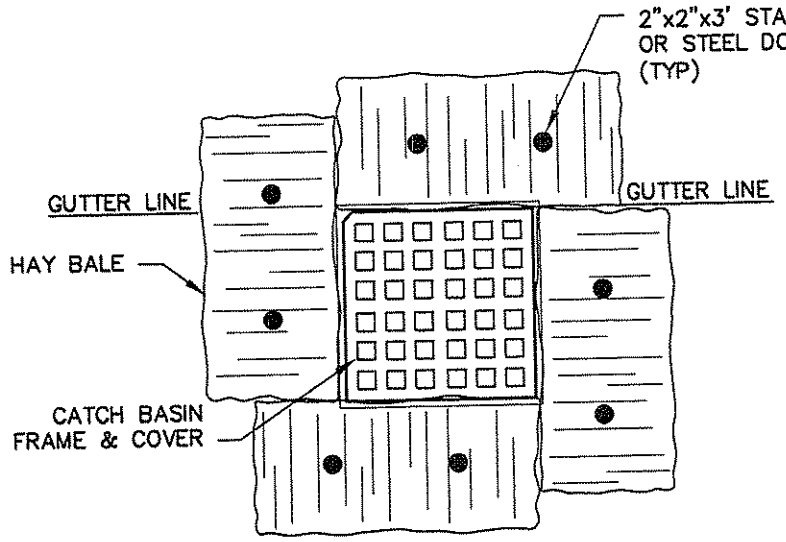
Coffer Dams & Bypass Pumping

Coffer dams may be used to make an impoundment upstream of a work area, and then pumps used to remove the water from inside the dammed (isolated) area, and down beyond the work area (see Figure 9-3 at the end of this Section).

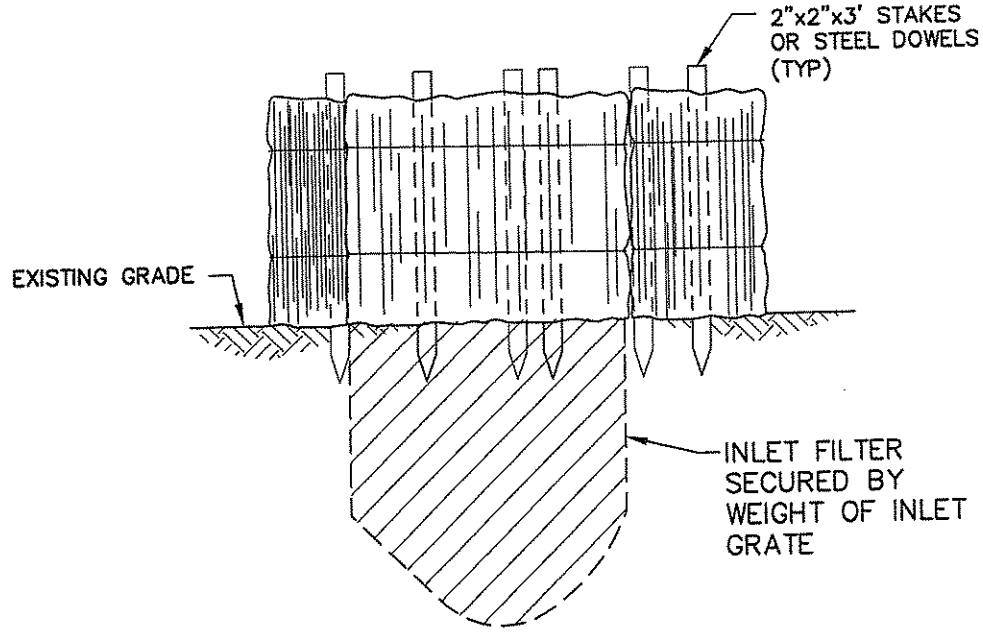
Circumventing Flows

Coffer dams and temporary pipes can also be used to divert flows and dry out a work area where use of pumps is impractical (see Figure 9-4 at the end of this Section).

FIGURES FOR SECTION 9



PLAN VIEW



ELEVATION VIEW

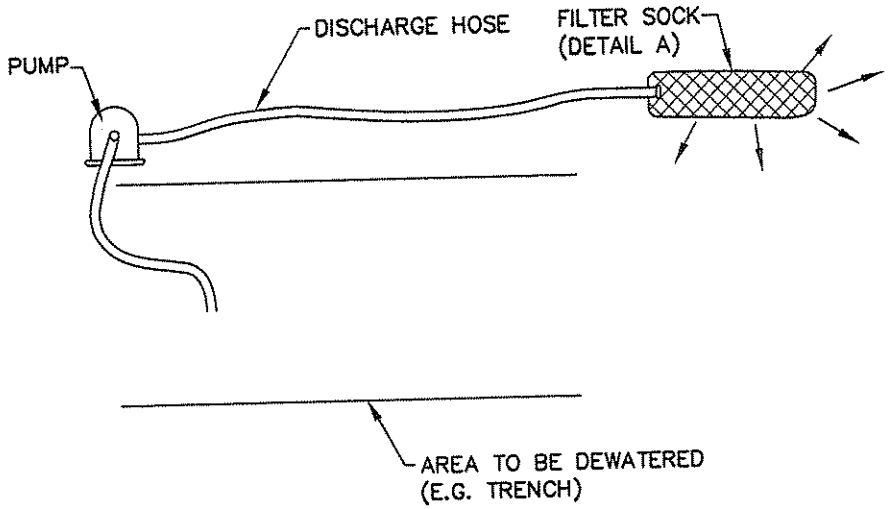
NOTES:
1. A MINIMUM OF TWO WOOD STAKES ARE REQUIRED PER HAY BALE.
2. STEEL DOWELS MAY BE USED WHERE WOOD STAKES CANNOT BE DRIVEN INTO THE GROUND.
3. "SILT SACKS", "DANDY BAG II" OR OTHER SIMILAR SILT RETENTION DEVICE SHALL BE CONSIDERED ACCEPTABLE CATCH BASIN FILTERS.

FIGURE 9-1

TYPICAL
INLET/CATCH BASIN SEDIMENT FILTERS

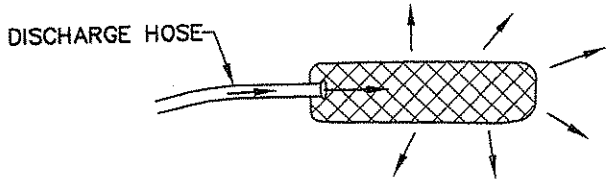
TIGHE & BOND CONSULTING ENGINEERS
WESTFIELD, MASSACHUSETTS

SCALE: NONE DATE: 2007



PLAN VIEW

NOTE:
1. DISCHARGE AWAY FROM WORK AREA/ DEWATERING AREA.



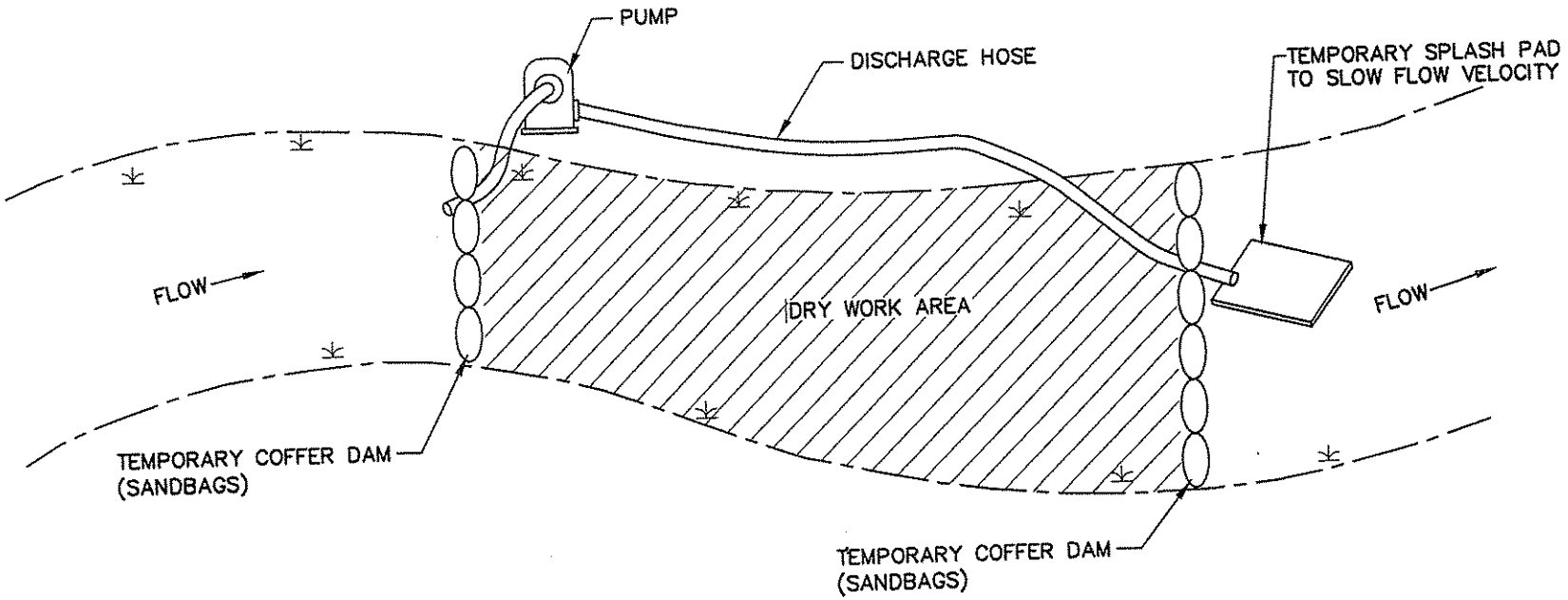
DETAIL A

FIGURE 9-2

TYPICAL
DISCHARGE HOSE FILTER SOCKS

TIGHE & BOND CONSULTING ENGINEERS
WESTFIELD, MASSACHUSETTS

SCALE: NONE DATE: 2007



PLAN VIEW

FIGURE 9-3

TYPICAL COFFER DAM
TO PUMP & DIVERT STREAM FLOWS

TIGHE & BOND CONSULTING ENGINEERS
WESTFIELD, MASSACHUSETTS

SCALE: NONE

DATE: 2007

8/9/07 B0368/EROSION CONTROL/FIG12-3

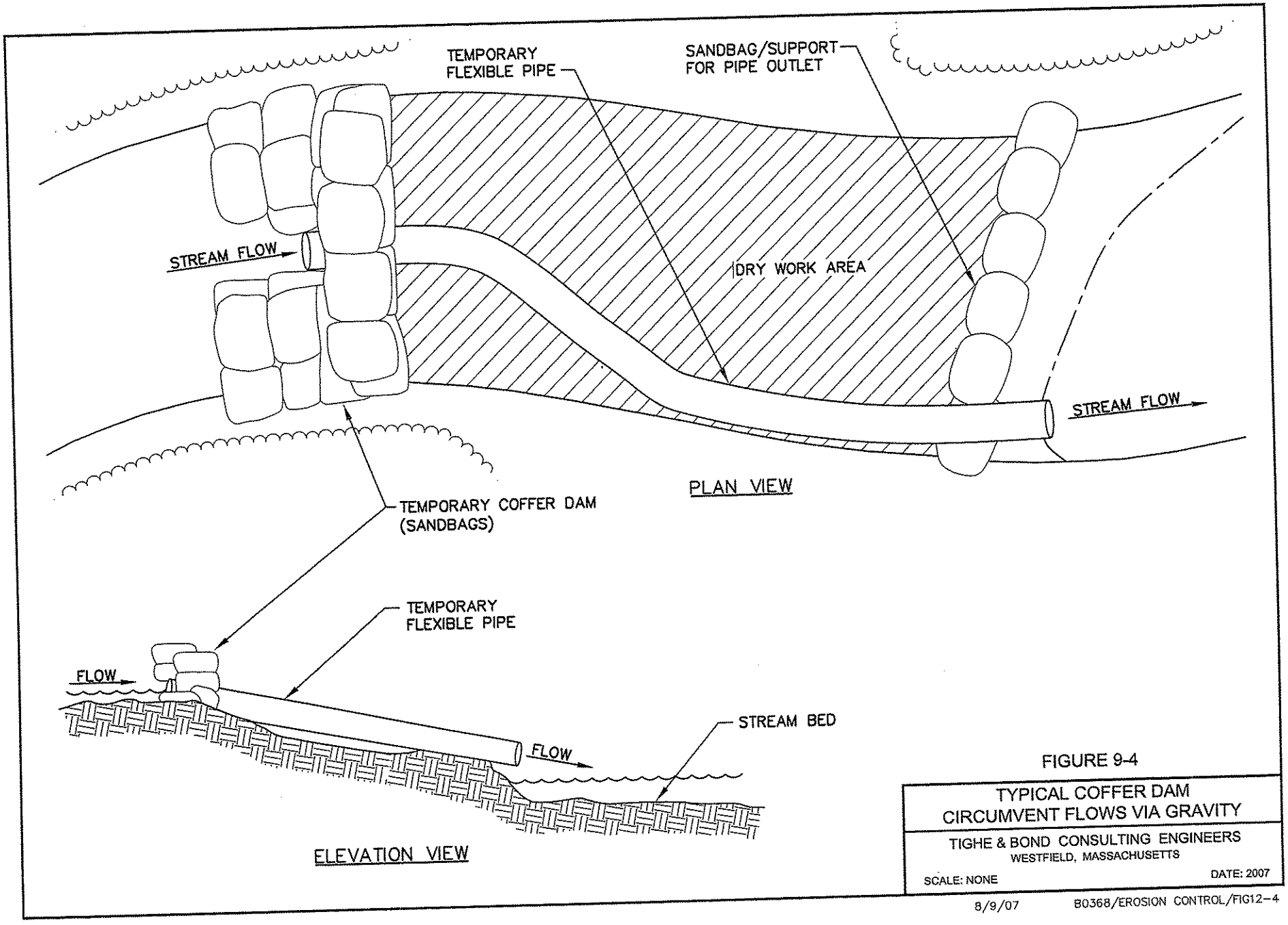


FIGURE 9-4

TYPICAL COFFER DAM
CIRCUMVENT FLOWS VIA GRAVITY

TIGHE & BOND CONSULTING ENGINEERS
WESTFIELD, MASSACHUSETTS

SCALE: NONE

DATE: 2007

8/9/07 B0368/EROSION CONTROL/FIG12-4

PHOTOGRAPHS FOR SECTION 9

Photograph 9-1 Discharge to storm drain system. Catchbasin protected from sedimentation by filter fabric.

Photograph 9-2 Sedimentation basin.

Photographs 9-3 and 9-4 Dewatering to filter "sock" surrounded by haybales (top) and to riprap underlain by geotextile fabric (bottom). Riprap provides velocity dissipation to minimize erosive force of dewatering discharge.

Photograph 9-5 Frac tank on-site for dewatering activities.

Photographs 9-6 and 9-7 Typical underground construction activities where dewatering may be required.

Section 10

SECTION 10 INSPECTION & MAINTENANCE OF BMPS

Routine inspection and maintenance schedules should be prepared and approved prior to the commencement of work for each project and a responsible party should be designated to manage such tasks. It may also be necessary to alter the frequency of inspections and maintenance depending on types of activity and weather events, including as proactive measures when storm events are forecast.

10.1 CONSTRUCTION

Since construction sites and construction access roads are usually in constant use and undergoing continuous change, they should be closely monitored. Construction sites, construction access roads, and the associated erosion and sedimentation controls should be inspected at the end of each day they are used and any damage observed must be repaired immediately. If an access road is not used for more than a week, then inspection should occur at a frequency as required by the specific erosion and sedimentation measures in use and extent of heavy rain events. Repairs may include regrading and/or top dressing the traveled surface with additional aggregate to eliminate ruts as well as those repairs required by each erosion and sedimentation measure used.

All information collected during inspections, regular maintenance, and repair procedures should be documented in written form. In addition, photographic or diagrammatic logs may be kept to help record certain events and for documentation of project progress and any noteworthy observations.

10.2 POST-CONSTRUCTION

Post-construction inspections of restored areas should be conducted at regular intervals throughout the growing season, as required by any applicable permits, and/or after major storm events. Sites should be inspected for success or failure of revegetation, invasive species colonization, and erosion and sedimentation. In the event additional measures are required to achieve site restoration and stabilization, corrective actions shall be identified and implemented.

All information collected during inspections, regular maintenance, and repair procedures should be documented in written form. In addition, photographic or diagrammatic logs may be kept to help record certain events and for documentation of project progress and any noteworthy observations.

Section 11

11.1 MAINTENANCE OF EROSION AND SEDIMENTATION CONTROLS

Spare erosion and sedimentation control materials such as hay/straw bales and silt fencing should be kept on site or readily available. Such materials should be readily available and accessible at all times so they may be replaced if they become non-functional due to deterioration or damaged during a storm, extreme water or wind, or other unexpected event.

11.2 VEHICLE STORAGE, REFUELING AND MATERIAL STAGING

All storage and refueling of vehicles and other equipment must occur outside of and as far away as practical from sensitive areas such as wetlands, streams, and drinking water supplies. A proper location for refueling should be identified and designated before site work begins. In Massachusetts, the recommended minimum distance from wetland areas for refueling is 100 feet. Additionally, equipment should be checked regularly for evidence of leaks. Construction material storage should also be located at least 100 feet from wetlands.

11.3 SPILL KITS

Spill kits consist of emergency cleanup and spill containment materials that can be used in the event of a fuel or other chemical spill. Spill kits should be kept on site and accessible at all times in case of an emergency spill. Such kits should generally contain multiple absorbent socks and/or pillows and wipes and temporary disposal bags. Follow the applicable NU procedures.

11.4 ILLEGAL DUMPING/USE

Management of illegal dumping and use should follow existing NU guideline ERTG-02.

PHOTOGRAPHS FOR SECTION 11

Photograph 11-1 View of site with good environmental controls and housekeeping practices.

Photographs 11-2 and 11-3 Examples of good housekeeping practices (spill containment).

Section 12

At a minimum, all areas disturbed by construction, repair, and maintenance activities shall be restored to pre-construction conditions.

12.1 PRIVATE PROPERTY ACCESS RESTORATION

Access to and along the right-of-way over private property must be improved to the extent necessary to ensure suitable passage for construction equipment, provide erosion control, and maintenance of proper drainage. Upon completion of construction activities, altered areas must be restored to a condition equal to or better than before their use for the construction project.

12.2 UPLAND RESTORATION

The following restoration techniques apply to restoration projects in upland areas.

- Soil excavated during construction and not used as backfill must be evenly spread onto disturbed areas to restore grades, or removed from the site. Topsoil shall be stripped and separated to the greatest extent practical, for re-use. Permanent soil protection shall be provided for all areas disturbed by construction activities.
- Topsoil removed during construction activities will be replaced, seeded, and mulched. If topsoil has not been preserved, a minimum 4-inch thick layer of loam must be imported to the site and spread prior to the application of seed (see Figure 12-1 at the end of this Section).
- All seeded areas shall be treated with a layer of mulch (i.e. hay, but preferably straw) up to one inch thick to enhance moisture retention, dissipate impact from precipitation, and detract songbirds foraging on broadcast seed (see Photograph 12-1 at the end of this Section).
- Rehabilitation of access routes and other areas must be performed as soon as possible after construction is completed, including reestablishment of water bars or other BMPs to control erosion of the access road, and the removal and restoration of temporary wetland or waterway crossings.
    - Temporary breaks in construction activities may warrant seeding and mulching of disturbed areas as interim erosion control measures.
- Erosion control measures shall remain in place until soils are clearly stabilized – either by erosion control blankets, or by robust, growing vegetation. Once soils are stable, erosion controls – especially silt fence, which presents an obstacle to movement of small animals – shall be removed and properly disposed.

12.3 WETLANDS AND WATERWAYS RESTORATION

The following restoration techniques apply to restoration project in wetlands:

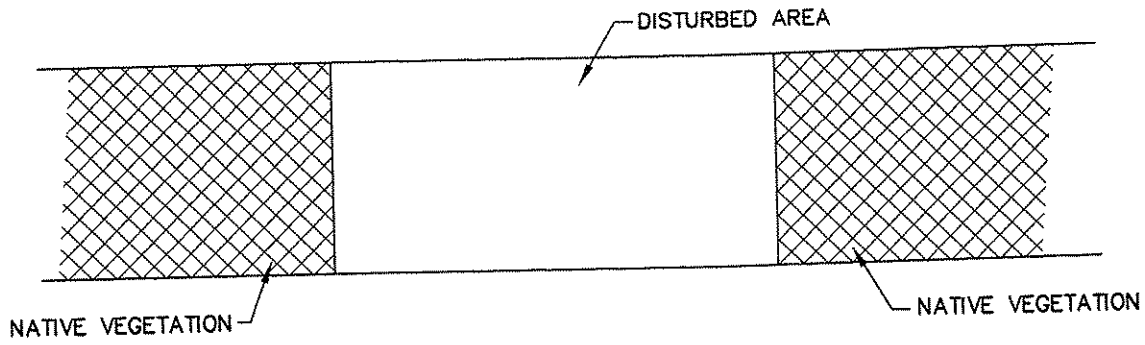
Maintenance, Repair, and Emergency Projects (When No Permit is Required)

- Soils excavated from wetland areas shall be segregated and stockpiled separately (i.e. topsoil/muck apart from mineral subsoil) in a dry/upland area to facilitate restoration activities at least 100 feet from wetland boundaries.
- Excavated wetland soils that have been stockpiled during underground utility installations within wetlands shall be replaced in the same order (i.e. mineral subsoil beneath organic topsoil/muck) to the extent practicable and restored to pre-disturbance grades.
    - Grading activities should include the elimination of ruts within the area to be restored.
- If replacement of soil associated with temporary wetland or watercourse crossings for access roads is necessary, disturbed areas must be restored to pre-disturbance grades, either seeded and mulched, or allowed to revegetate from the natural seed bank.
- Disturbed wetland areas shall generally be allowed to revegetate from the natural seed bank. Measures to discourage the establishment or spread of plant species identified as non-native, invasive species by federal or state agencies shall be considered.
- Any restoration plantings or seed mixes used in restoration shall consist of species native to the project area and, if feasible, from local nursery stock.
- Any stream banks and beds damaged shall be restored through use of geotextile erosion control blankets, and or coir logs (see Figure 12-3 and Photograph 12-2 at the end of this Section).
- All seeded areas shall be treated with a layer of mulch (i.e. hay, but preferably straw) up to one inch thick to enhance moisture retention, dissipate impact from precipitation, and detract songbirds foraging on broadcast seed.

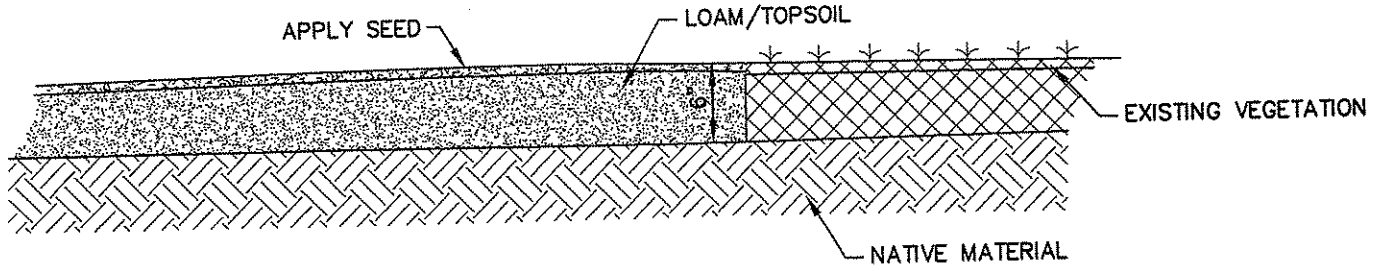
New Projects (When Permit(s) is/are Required)

- Soils excavated from wetland areas shall be segregated and stockpiled separately (i.e. topsoil/muck apart from mineral subsoil) in a dry/upland area to facilitate restoration activities.
- All restoration activities shall be conducted in accordance with the specific conditions of the project permits.

FIGURES FOR SECTION 12



PLAN VIEW



ELEVATION VIEW

NOTE:

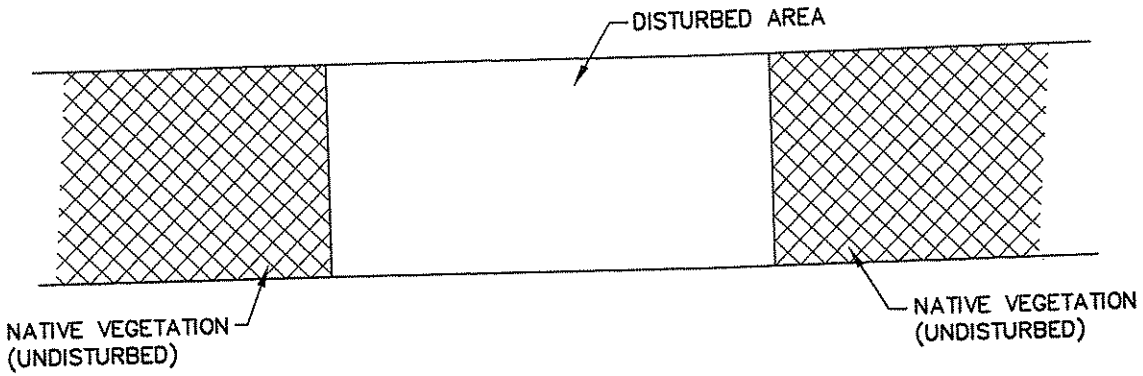
1. SEED MIX APPLICATION IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS.

FIGURE 12-1

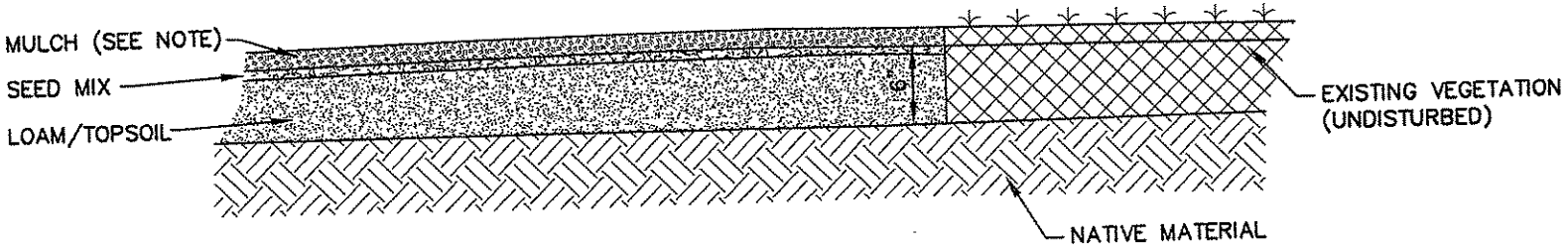
LOAMING AND SEEDING

TIGHE & BOND CONSULTING ENGINEERS
WESTFIELD, MASSACHUSETTS

SCALE: NONE DATE: 2007



PLAN VIEW



ELEVATION VIEW

NOTES:

1. MULCH MAY CONSIST OF HAY, STRAW OR WOODCHIPS.
2. THICKNESS OF MULCH APPLICATION DEPENDS ON MATERIAL USED. RECOMMENDED MAXIMUM THICKNESS PROVIDED BELOW.

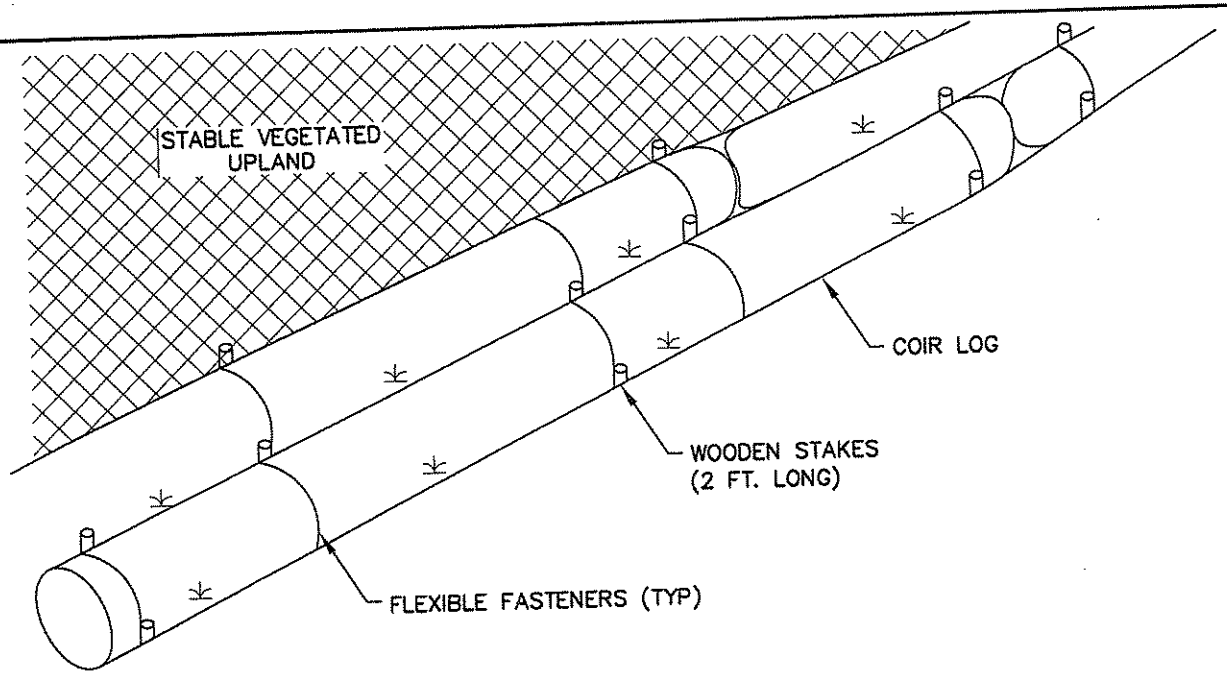
HAY/STRAW	MAX 1 INCH
WOODCHIPS	MAX 3 INCHES (CT)
	MAX 2–7 INCHES (MA)

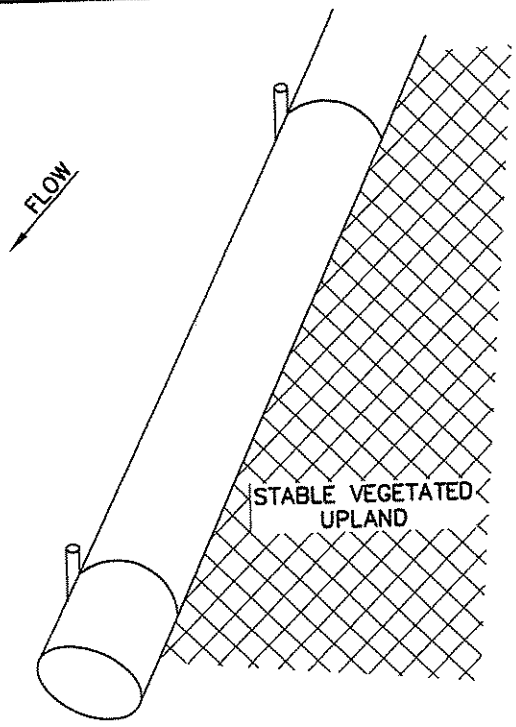
FIGURE 12-2

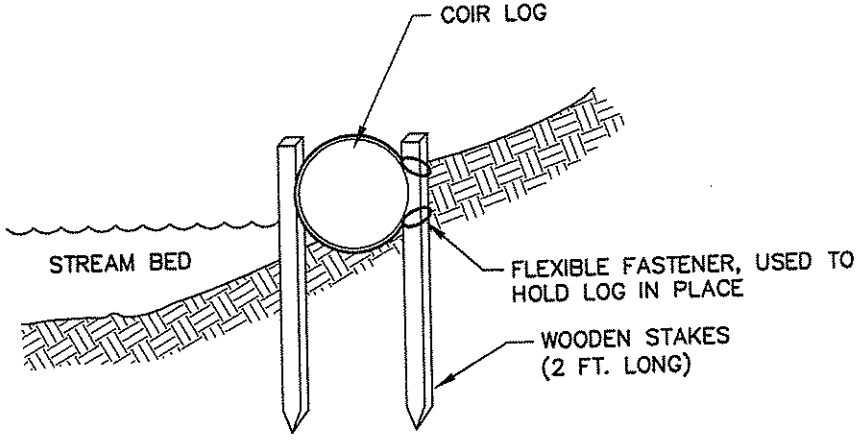
TYPICAL MULCH APPLICATION

TIGHE & BOND CONSULTING ENGINEERS
WESTFIELD, MASSACHUSETTS

SCALE: NONE DATE: 2007







ELEVATION VIEW

FIGURE 12-3

TYPICAL COIR LOG USE FOR BANK STABILIZATION

TIGHE & BOND CONSULTING ENGINEERS
WESTFIELD, MASSACHUSETTS

SCALE: NONE

DATE: 2007

8/9/07

80368/EROSION CONTROL/FIG15-3

PHOTOGRAPHS FOR SECTION 12

Photograph 12-1 Typical view of light mulching atop unstable, seeded soils.

Photograph 12-2 Erosion control blanket and coir logs used to restore a stream bed and banks.

Appendix A

TABLE A-1
List of Acronyms and Abbreviations

BMP	Best Management Practice
CL&P	Connecticut Light and Power
ConnDOT	Connecticut Department of Transportation
CTPGP	Connecticut Programmatic General Permit
e.g.	for example (from the Latin *example gratia*)
i.e.	that is (from the Latin *id est*)
NU	Northeast Utilities
ORV	Off-road vehicle
psi	pounds per square inch
ROW	Right-of-Way
sp.	species
WMECO	Western Massachusetts Electric Company

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Appendix B

1.1 APPLICABLE LAWS/REGULATIONS

In Connecticut, there are no fewer than nine potentially pertinent regulatory programs associated with activities proposed in environmentally sensitive areas. The following list of laws and regulations are most likely to apply to electrical utility projects in the State.

- Connecticut Inland Wetlands and Watercourses Act (C.G.S. §§ 22a-36 through 22a-45a)
- Municipal wetland bylaws (varies by town)
- Stream Channel Encroachment Lines (C.G.S. §§ 22a-342 through 22a-349a)
- Connecticut General Permit for Placement of Utilities and Drainage within Inland Wetlands and Stream Channel Encroachment Lines (C.G.S. §§ 22a-6, 22a-45a through 22a-349a)
- Connecticut Environmental Policy Act (C.G.S. §§ 22a-1a through 22a-1h)
- Connecticut Coastal Management Act (C.G.S. §§ 22a-359 through 22a-363; 22a-28 through 22a-35; 22a-90 through 22a-112; 33 U.S.C. § 1314)
- Connecticut Water Diversion Policy Act (C.G.S. §§ 22a-365 through 22a-379)
- Connecticut Endangered Species Act (C.G.S. §§ 26-303 through 26-315)
- Section 10 of the Rivers and Harbors Act of 1899 (C.G.S. §§ 22a-426; 33 U.S.C. § 403)
- Section 401 of the Clean Water Act (33 U.S.C. § 1251)
- Section 404 of the Clean Water Act (33 U.S.C. § 1344)

1.2 GEOGRAPHIC AREAS SUBJECT TO JURISDICTION

The following areas are subject to regulatory jurisdiction by at least one of the regulatory programs discussed in this section: It is important to note that more than one jurisdictional resource type may be present at any given location.

- Inland wetlands, watercourses (rivers, streams, lakes, ponds), and floodplains
- Areas subject to municipal wetlands bylaws or ordinances. (These vary by town.)
- Coastal Resource Areas (beaches, dunes, bluffs, escarpments, coastal hazard areas, coastal waters, nearshore waters, offshore waters, estuarine embayments,

developed shorefront, intertidal flats, islands, rocky shorefronts, shellfish concentration areas, shorelands, and tidal wetlands)

- Navigable waters
- Essential Fish Habitat (EFH)
- Rare species habitat as mapped by the Connecticut Natural Diversity Database

1.3 APPLICABLE REGULATORY AGENCIES

Activities subject to jurisdiction under the above-referenced programs will generally be subject to review by one or more of the following regulatory agencies:

- Municipal Conservation Commissions
- Connecticut Department of Environmental Protection (CT DEP) Bureau of Water Management, Inland Water Resources Division
- CT DEP Wildlife Division
- CT DEP Office of Environmental Review
- CT DEP Office of Long Island Sound Programs (OLISP)
- United States Army Corps of Engineers (Corps) New England District

1.4 MAINTENANCE, REPAIR, OR EMERGENCY PROJECTS

Most regulatory programs contain provisions that allow normal maintenance of existing structures and/or response to emergency situations that require immediate attention.

Maintenance, Repair, and/or Replacement Projects

Exemptions or considerations for maintenance, repair, and/or replacement of existing electrical utility structures exist in some environmental regulations, but not all. The exemptions are limited to work related to existing and lawfully located structures where no change in the original structure or footprint is proposed. It is not for the selected contractor of a particular project to make a determination as to whether an activity is exempt. This determination will be made prior to work by the NU project manager, in consultation with NU environmental staff.

These exemptions/considerations are afforded at:

- CT Inland Wetlands & Watercourses Act (RCSA § 22a-39-4)
- CT General Permit (Section 3)
- CT Coastal Management Act (RCSA § 22a-363b)

- CT PGP (33 CFR 323.4(a)(2))
- CT Water Diversion Policy Act (RCSA § 22a-377(b)1)

Emergency Projects

Emergency provisions are generally afforded to activities that need to abate conditions that pose a threat to public health or safety. These provisions generally do not allow work beyond what is necessary to abate the emergency condition, and will generally require an after-the-fact permit. It is not for the selected contractor of a particular project to make a determination as to whether an activity is an emergency. This determination will be made prior to work by the NU project manager, in consultation with NU environmental staff.

It is important to note that invocation of an emergency provision does not release the project proponent from reporting requirements.

Emergency provisions are afforded at:

- CEPA (RCSA § 22a-1a-3)
- CT Coastal Management Act (RCSA § 22a-29)
- CT PGP (33 CFR Part 323.4(a)(2))