Teaneck Creek Conservancy Park

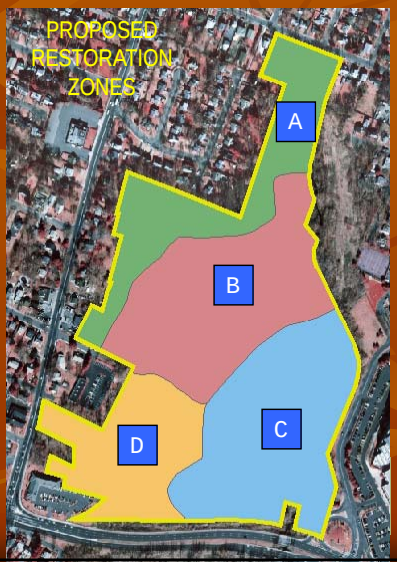
A Project of
Bergen County Department of Parks
&
Teaneck Creek Conservancy, Inc.

Wetlands Research and Restoration Design
Presented to the Wetlands Mitigation Council
May 2008

Applied Research Approach

- This project provided a unique opportunity for applied research in the field of urban wetland restoration
- Hydrology, water quality, vegetation and soil expertise were brought together from Rutgers and USGS to address these challenges
- Funding provided for this project by NJ WMC was leveraged with funds from EPA, USGS, Rutgers University and the NJ Agricultural Experiment Station
- Cooperative efforts resulted in the collection of scientific data that were needed to complete the wetlands design while training future water resource professionals in restoration techniques in urban wetlands

Wetlands Research & Restoration Design Site Overview



Wetlands Applied Research Project Outputs - Hydrology

- Calibrated and validated SWMM model of the urban stormwater inputs to the system
- Future simulations using the SWMM model to demonstrate effective water budget for proposed wetlands
- Identified major sources of nutrients to the wetlands
- Used SWMM model to identify best areas for restoration to maximize wetland creation

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Wetlands Applied Research
Hydrologic Characterization

- Identified clay lens layer underlying wetlands which severely limits interaction between deep groundwater and surface water wetlands
- Primary source of water to the wetland is direct precipitation and stormwater runoff from surrounding urban areas
- Surrounding urban developed areas are more than 90% impervious which creates flashy hydrology resulting in high erosive flows into the wetlands
- Developed accurate predictions of runoff from surrounding areas using calibrated model
- Due to the limited groundwater interaction, wetlands experience a net loss of water volume during dry summer months and gains during spring and fall wet seasons

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Wetlands Applied Research
Soils Characterization

- Native hydric organic soils limited to northern reaches of Zone A near Fycke Lane
- Presence of dredge fill clay berms along the creek limit groundwater and surface water interactions between the wetland system and the creek
- Extensive areas of existing wetlands are underlain with a heavy clay soil layer
- Extensive areas of site filled with unconsolidated soils/dredge spoils
- Wetland system functions as a “perched bog” rather than a typical riparian wetland

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Wetlands Applied Research
Vegetation Characterization

- Presence of diverse wetland plant communities observed in areas with undisturbed soils and tree canopy cover
- Identified areas of limited diversity resulting from summer drought conditions
- Dominant stands of invasive species (*Phragmites*) are predominantly located on dredge/fill soils
- Floristic quality mapping used to generate site-specific planting regime for the restoration
- Minimize land disturbance in areas that had high floristic quality scores

Teaneck Creek
Restoration Design Approach

- To protect the identified high-quality areas remaining on the site
- To restore new wetland areas through the removal of identified fill materials
- To lower surface elevations in filled areas, reestablishing hydrologic connections between Teaneck Creek and the interior wetlands
- To make the site accessible to the local community and residents of Bergen County

Teaneck Creek
Restoration Zone A - Overview

- Approx. 9 acres
- Existing high quality forested wetland vegetation matrix
- Restoration efforts to focus solely on:
  - Management/removal of existing colonies of invasive species
  - Preventing future invasive species incursion
  - Reestablishing additional native forested wetland plant communities

Teaneck Creek
Restoration Zone A - Activities

- Restore 2.5 acres of Flood Plain Forest, canopy trees, understory shrubs and forbs
- Planting 48 trees, 1,100 shrubs, 2,000 herbaceous plugs
- Ongoing maintenance of invasive species, with specific focus on Japanese Knotweed along Teaneck Creek, Multiflora Rose in existing wooded areas, and invasive vines in the Outdoor Classroom restoration area
- Includes approximately 1/3 acre of *Phragmites* removal and wetland restoration in Outdoor Classroom area near native wetlands managed and maintained by TCC Weed Warrior volunteers

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Teaneck Creek
Restoration Zone B - Overview

- Approx. 15 acres
- Area dominated by *Phragmites australis*
- Restoration efforts to target:
  - Containing and preventing the spread of *Phragmites australis*
  - Management regime to focus on cutting and herbicide application (final approach and extent of use to be discussed with WMC staff)
  - Minimal earth disturbance proposed due to limited access to area without extensive disturbance so adjacent high quality habitat

Teaneck Creek
Restoration Zone B - Activities

- Management of *Phragmites* through select cutting and herbicide treatment in approximately 5 acres of perimeter and habitat island areas of existing wetland basin
- Restore 5 acres of Flood Plain Forest, canopy trees, understory shrubs and forbs
- Planting 248 trees, 3,400 shrubs, 4,000 herbaceous plugs in perimeter and habitat island areas
- Ongoing invasive species management in restoration planting areas to monitor and contain spread of *Phragmites*

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Teaneck Creek
Restoration Zone C - Overview

- Approx. 14 acres
- Area proximate to Teaneck Creek
- Restoration efforts to include:
  - Excavate connections through the existing berm along Teaneck Creek
  - Reestablish hydrologic connections to provide flushing of wetland areas during small, frequent storm events
  - Connect wetland areas in Zones B & D to Teaneck Creek

Teaneck Creek
Restoration Zone C - Activities

- Management of *Phragmites* through select cutting and herbicide treatment in approximately 1.5 acres of perimeter and habitat island areas of existing wetland basin
- Creating 5 acres of wetland basins
- Restore 1.5 acres Flood Plain Forest
- Restore 1 acre of Shrub Swamp understory shrubs in wetland restoration areas
- Restore 1.25 acres of Shrub Swamp grasses and forbs community in wetland restoration areas
- Restore 1.25 acres of Emergent Marsh in wetland restoration areas
- Planting 70 native Flood Plain Forest trees, 4,000 shrubs and 22,000 herbaceous plugs

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Teaneck Creek
Restoration Zone D - Overview

- Approx. 8 acres
- Construct ~5 acres of additional wetland storage and supporting habitat areas
- Restoration efforts to include:
  - Widen and deepen disturbed/filled channels and basin areas to provide hydrology needed to support desired wetlands vegetation matrix
  - Excavate approximately 3,000 to 6,000 cubic yards of debris from existing wetlands areas
  - Reestablish hydrologic connections to Teaneck Creek
  - Extend residence time of surface water flows into the area to provide necessary hydrology to support desired wetland system

Teaneck Creek
Restoration Zone D - Activities

- Creating 4.25 acres of wetlands and native flood plain habitat
- Restore 1.5 acres Flood Plain Forest trees and shrubs
- Restore 1 acre of Shrub Swamp understory shrubs in wetland restoration areas
- Restore 0.5 acres of Shrub Swamp grasses and forbs community in wetland restoration areas
- Restore 1.25 acres of Emergent Marsh in wetland restoration areas
- Planting 78 native trees, 3,500 shrubs and 12,000 herbaceous plugs

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Teaneck Creek Restoration Activities

PROPOSED RESTORATION ACTIVITY	Zone A	Zone B	Zone C	Zone D	TOTALS
Phragmites Management Areas (Acres)		5.00	1.50		6.50
Wetlands Restoration Areas (Acres)					
Flood Plain Forest	2.50	5.00	1.50	1.50	10.50
Shrub Swamp (Shrubs)	0.00	0.00	1.00	1.00	2.00
Shrub Swamp (Herbaceous)	0.00	0.00	1.25	0.50	1.75
Emergent Marsh (Herbaceous)	0.00	0.00	1.25	1.25	2.50
TOTAL ACRES	2.50	5.00	5.00	4.25	16.75
Wetland Plantings					
Trees	48	248	70	78	444
Shrubs	1100	3400	4000	3500	12000
Herbaceous	2000	4000	22000	12000	40000

Overview

Rutgers University, the US Geological Survey (USGS) and TRC Environmental collected data over a three-year period to characterize existing conditions of the Teaneck Creek Conservancy site. This characterization was critical in designing a successful wetland restoration as the site has experienced multiple hydrologic and soil alterations, particularly since the mid-20th century. (For a complete site history, see Arnold, A Historical Perspective on the Urban Wetlands of the Teaneck Creek Conservancy.) Critical components in the baseline characterization included documentation of the current hydrology through surface water and groundwater monitoring, defining existing soil conditions, and completing a detailed survey of native and non-native vegetation species and patterns across the 46-acre site. Hydrologic studies provided data that was incorporated into a USEPA Surface Water Management Model (SWMM) to develop a water budget for the wetlands system and to describe water movement into and through the site. Soils were characterized based upon observations of the presence of predominately native soils, dredge-clay material, or unconsolidated fill and the locations of these various soil types were mapped. Plant species were classified and mapped to show the location of desirable native species as opposed to areas that are dominated by invasive vegetation.

This project provided a unique opportunity for applied research in the field of urban wetland restoration. Hydrology, water quality, vegetation and soils expertise were brought together from Rutgers and USGS to address these particular challenges. Funding provided for the research was leveraged with additional funds from the EPA, USGS,

Rutgers University and the NJ Agricultural Experiment Station. This cooperative effort resulted in the collection of scientific data needed to complete the wetlands design as well as build upon the knowledge of urban wetland restoration. This project provided an educational opportunity to train future water resource professionals in restoration techniques for urban wetland systems.

Hydrology Summary

Surface water samples were collected quarterly over a two year period to identify major sources of nutrients to the wetlands (January, 2005 – February, 2007). These samples were analyzed by USGS to determine nitrogen and phosphorus concentrations and loadings. Flow measurements were obtained under low and high (stormwater) flows. Groundwater wells were installed at over 40 locations and water levels were monitored weekly for a year. Deep groundwater levels were monitored in a set of previously installed monitoring wells around the perimeter of the site, but our hydrologic analyses indicate that the deep groundwater table has little influence on the shallow perched water table across much of the site. A pressure transducer was placed in the Teaneck Creek to assess frequency of potential flooding events, "flashiness" of the hydrology and influence of a downstream tide gate. Additionally, a calibrated SWMM model was designed to predict urban stormwater inputs into the system. Simulations were used to demonstrate an effective water budget for the proposed wetlands, to identify the best areas for restoration and to maximize wetland creation. (For a discussion of the complete system hydrologic data see Obropta et al., Restoration of a Forested Riparian Wetland Ecosystem: Modeling Urban Wetland Hydrology).

Use of the applied research provided the following hydrologic characterization:

- Identification of a clay lens layer underlying wetlands which severely limits interaction between deep groundwater and surface water wetlands
- Determination that the primary source of water to the wetland system is direct precipitation and stormwater runoff from surrounding urban areas
- Identified surrounding urban developed areas as more than 90% impervious creating a flashy hydrology resulting in high erosive flows into the wetlands
- Using the calibrated model provided a more accurate prediction of runoff into the system from surrounding areas than traditional engineering methods
- Due to the limited groundwater interaction, wetlands are experiencing a net loss of water volume during dry summer months and net gains during the spring and fall wet seasons

In addition to the research driving the on-site restoration plan, water quality data collected during the hydrologic evaluation indicated that high nitrogen inputs were occurring upstream of the site. Water quality data enabled the project partners to identify Holy Name hospital as the source of these nitrogen loads. The hospital agreed to address this problem that is being created when they use urea to de-ice their parking structure. Rutgers University donated design and engineering services for a rain garden to treat the hospital's parking lot runoff, and the hospital administration has agreed to implement this NJDEP-approved BMP.

Soils Summary

Soil samples collected throughout TCC were found to consist of organic wetland (hydric) soils, red clay dredge material, and unconsolidated fill materials that were previously deposited on the site. The soil quality was characterized by the soil type and source of the dominant substrate material (native, dredge-fill, fill with debris, and mixed) within 29 sampling grids. Specific locations were also identified where debris piles are located within the existing wetland configuration. (For more information on the soil quality analysis, see Ravit et al., Restoration of a Forested Riparian Wetland Ecosystem: A Vegetation Survey of Teaneck Creek Wetlands.)

Use of the applied research provided the following soils characterization:

- Native hydric organic soils are limited to the northern reaches of Zone A near Fycke Lane
- The presence of dredge fill clay berms along the creek limit groundwater and surface water interactions between the wetland system and the creek
- Extensive areas of existing wetlands are underlain with a heavy clay soil layer
- Extensive areas of the site are filled with unconsolidated soils/dredge spoils
- The wetland system functions as a “perched bog” rather than a typical riparian wetland

Vegetation Survey Summary

To obtain a coarse-scale view of the existing vegetation at the site, the grid system used in the soil analysis was employed for the vegetation survey, and all plant species were identified within each grid square. As part of this observation, an estimate was made

of the abundance of each plant species based on a five-level scale (rare, occasional, frequent, common, and abundant). After the vegetation in each sampling unit was completed, the New Jersey Coefficient of Conservation was applied to each species. This coefficient describes the habitat requirements for a particular species, including its sensitivity to disturbance. The Coefficient for all species within each sample grid was used to calculate a Floristic Quality Assessment Index for the grid. (For a complete discussion on the vegetation survey, see Ravit et al., Restoration of a Forested Riparian Wetland Ecosystem: A Vegetation Survey of Teaneck Creek Wetlands.)

Use of the applied research provided the following vegetation characterization:

- Diverse wetland plant communities were identified in areas with undisturbed soils and tree canopy cover
- Results identified areas of limited diversity resulting from summer drought conditions
- Dominant stands of invasive species (*Phragmites australis*) were predominantly located on dredge/fill soils
- Vegetation survey and floristic quality mapping provided a detailed species matrix used to generate a site-specific planting regime for the proposed restoration emphasizing species that are flourishing in various areas of the site
- Mapping results were used to minimize proposed disturbance in areas with high floristic quality scores

Restoration Design Approach

The proposed restoration design is based upon conclusions reached after analysis of the data, mapping, and modeling completed during the research phase of the project. The goal of the design approach is:

- To protect the identified high quality areas remaining on the site
- To restore new wetland areas through the removal of identified fill materials
- To lower surface elevations in filled areas, reestablishing hydrologic connections between the Teaneck Creek and the interior wetlands
- To make the site accessible to the local community and residents of Bergen County

Restoration activities have been proposed in four distinct zones across the site. These zones were determined using the information generated by the hydrologic modeling, soil characterization, and vegetation surveys. Specific restoration and management initiatives have been developed for each zone.

Zone A (~ 9 acres)

The vegetation survey identified this area as containing the highest quality forested wetland vegetation matrix on the site. In addition, the soil survey identified native hydric organic soils in this zone. Due to the existing vegetation and soil type in this zone, restoration efforts in this area will be focused solely on management and removal of existing colonies of invasive species, preventing any invasive species incursion into the area, while reestablishing native forested wetland plant communities.

The Puffin Outdoor Classroom was built in Zone A in an area that was highly

disturbed and covered by *Phragmites*. This area is adjacent to the highest quality natural resources on the property to enable schoolchildren to appreciate the natural beauty and diversity of riparian wetlands. With help from volunteers, invasive vegetation was removed, native wetland vegetation and seeds were planted, and additional native vegetation grew from the seed bank. The classroom that opened to the public in May 2006 overlooks the native vegetation of the remnant wetland. The restored wetland acreage in the outdoor classroom has met one of the wetland restoration and enhancement project deliverables funded through the N.J. Wetlands Mitigation Council grant supporting this project.

Zone B (~ 15 acres)

The hydrologic model clearly identified the sources of water into this wetlands basin and system as stormwater runoff from surrounding off-site areas. The area is currently dominated by an extensive stand of *Phragmites*, which in typical restoration projects would be removed. However, in the TCC site, the presence of *Phragmites* has been identified as beneficial because the plant is known to be effective in removing excess nutrients and sequestering contaminants commonly found in stormwater runoff. The plant is thriving in large ponded areas that have formed due to the inflow of runoff into low-lying depressions located in the middle of the property. Under drought conditions the model shows that the ponded areas will dry out. *Phragmites* can withstand lack of water, however obligate wetland species cannot. Restoration efforts in this zone are targeted to containing the spread of the invasive plant species. The restoration goal is to retain the beneficial role that *Phragmites* might be playing in this system, while

utilizing cutting and appropriate herbicide applications to contain further spread of the plant in perimeter areas. In addition, the restoration plan proposes to install a native shrub and canopy tree buffer to provide shade and contain the *Phragmites*. This zone will be established around the perimeter of the basin and in several select habitat islands that can be readily accessed for routine maintenance and monitoring. Large scale earth disturbance or earth moving activities are not recommended in this zone as access to this area is limited, and would require extensive disturbance to identified high quality habitats in surrounding areas.

Zone C (~ 14 acres)

The vegetation and soil evaluations revealed that this area of the site contains both forested wetland habitat as well as large stands of *Phragmites*. This location is proximate to Teaneck Creek. However, the hydrologic study determined that a hydrologic connection between Teaneck Creek and the site's surface and groundwaters does not currently exist due to the presence of clay-fill material beneath large areas of the site and on berms adjacent to the creek. Restoration efforts in this zone will reestablish hydrologic connections through breaks in the existing berm. As shown by the long-term transducer data, this approach will promote regular flushing of wetland areas during smaller, more frequent storm events. Topographic maps have been used to determine the appropriate surface elevations to support establishment of new forested wetland areas behind the existing berm. Invasive species management, including containment of *Phragmites australis* as well as removal of *Phragmites* and *Polygonum cuspidatum,* is necessary along with debris removal and localized excavation to support the proposed

wetland enhancement and creation in Restoration Zone D.

Zone D (~ 8 acres)

The research revealed that this area was the most affected by historical disturbance to soils and hydrology. Much of this region of the site has been filled with debris and/or contains historic fill/dredge material. While the vegetation survey showed pockets of native vegetation, these areas are cut off from adjacent communities by extensive stands of invasive species such as colonies of Japanese knotweed and *Phragmites* in addition to scattered piles of debris and lack hydrologic connections due to the large areas of fill and debris. This area also receives extensive surface water runoff from the surrounding urban watershed during storm events.

The proposed wetland expansion is being planned for the southern portion of the property, where the fill material has raised the elevation of riparian wetland areas. The restoration plan requires extensive clearing and disturbance of approximately 5-6 acres of vegetation and soils near the southern portion of the site. Areas currently filled and/or dominated by *Phragmites australis* are to be restored to a variety of hydrologic conditions to increase residence time and mitigate "flashy" hydrograph responses. This zone will also be re-connected hydrologically with Teaneck Creek, which will increase the diversity of habitats through variations in the existing hydrologic regime. Invasive species management will include removal of extensive areas of *Phragmites australis* and *Polygonum cuspidatum*. The proposed system will support a variety of healthy native plant communities.

This area will require the greatest disturbance in order to meet the restoration

goals established for the TCC site. Upland woodland areas totaling nearly three (3) acres will be preserved, while nearly five (5) acres of this zone located at the southern portion of the property proximate to DeGraw Avenue will be cleared and reconfigured into a series of wetland basins. The location and topography of the new basins was determined based on the Rutgers hydrologic model and water budget and the long-term transducer data from Teaneck Creek. As part of the planned wetlands habitat enhancement program, existing channels and basins will be widened and deepened to provide the hydrology needed to support native vegetation in the previously disturbed areas. To create these wetland channels and basins, excavation of an estimated 3,000 to 6,000 cubic yards of soil (characterized as historic fill, dredge spoils, or sediments) in an area totaling approximately five (5) acres is required. These wetlands extend the residence time of stormwater flowing onto the site, thus providing the hydrology necessary to support a more diverse riparian forested wetland ecosystem.

LEGEND

- EXISTING MINOR CONTOURS
- EXISTING MAJOR CONTOURS
- PROPERTY LINE
- STREAM
- RUNOFF FLOW PATH
- WETLAND 2006 DELINEATION
- WETLAND 2006 BUFFER
- SHRUB SWAMP (SHRUBS)
- SHRUB SWAMP (HERBACEOUS)
- EMERGENT MARSH (HERBACEOUS)
- FLOOD PLAIN FOREST (HERBACEOUS/SHRUBS)

SCALE

TEANECK CREEK WETLANDS RESTORATION PROJECT
LANDSCAPE PLAN (NORTH)

PROJECT LOCATION
Block 3719, Lot 1
Borough of Teaneck
Bergen County, New Jersey

Date

TRC ENVIRONMENTAL CORP.

SCALE: AS SHOWN | DATE: MAY 13, 2008 | SHT. NO. 1 of 4

LEGEND

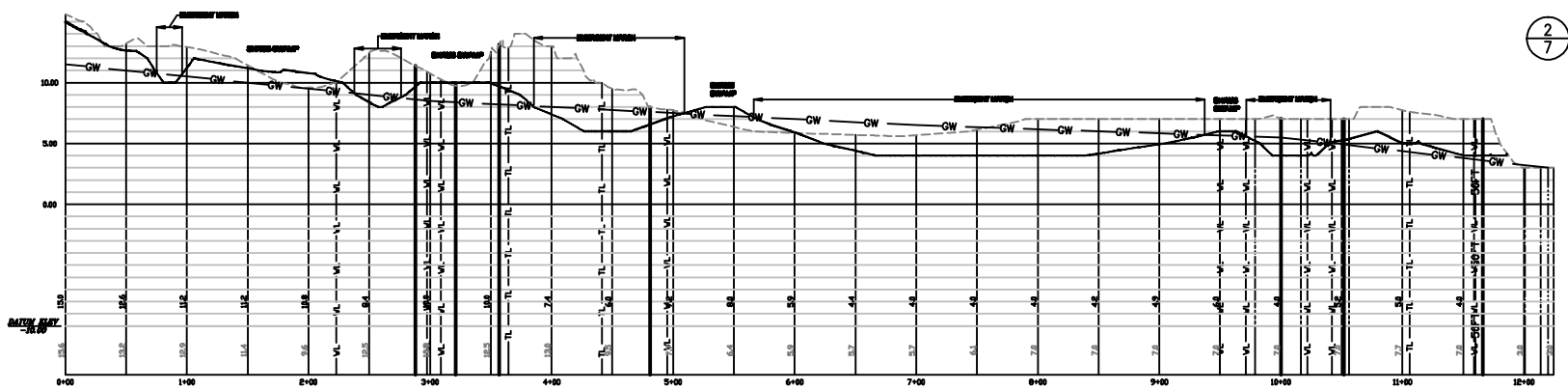
- EXISTING MINOR CONTOURS
- EXISTING MAJOR CONTOURS
- PROPERTY LINE
- STREAM
- RUNOFF FLOW PATH
- WETLAND 2006 DELINEATION
- WETLAND 2006 BUFFER
- SHRUB SWAMP (SHRUBS)
- SHRUB SWAMP (HERBACEOUS)
- EMERGENT MARSH (HERBACEOUS)
- FLOOD PLAIN FOREST (HERBACEOUS/SHRUBS)

TEANECK CREEK WETLANDS RESTORATION PROJECT
LANDSCAPE PLAN (SOUTH)

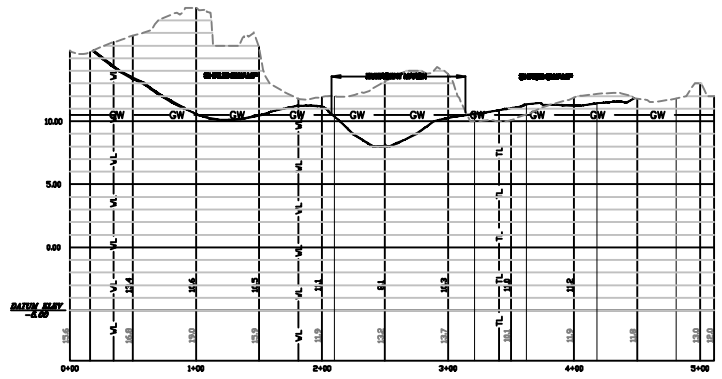
PROJECT LOCATION
Block 3718, Lot 1
Borough of Teaneck
Bergen County, New Jersey

TRC ENVIRONMENTAL CORP.

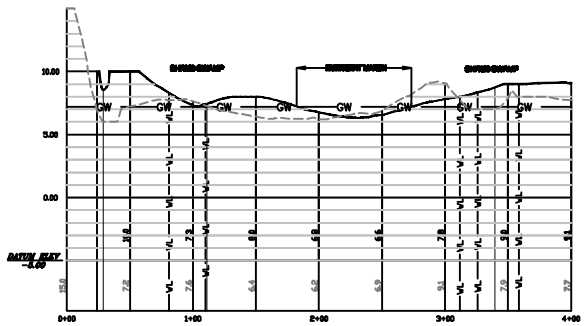
SCALE: AS SHOWN | DATE: MAY 13, 2008 | DWG: LS-2 | SHT. NO. 2 of 4



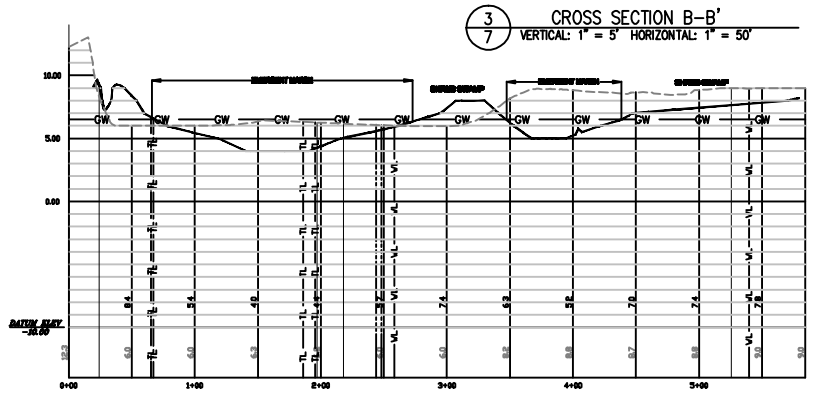
1/7 WETLAND FLOW PATH PROFILE
VERTICAL: 1" = 5' HORIZONTAL: 1" = 50'



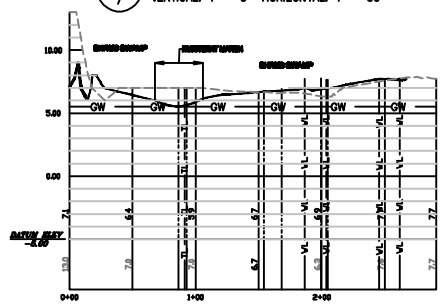
2/7 CROSS SECTION A–A'
VERTICAL: 1" = 5' HORIZONTAL: 1" = 50'



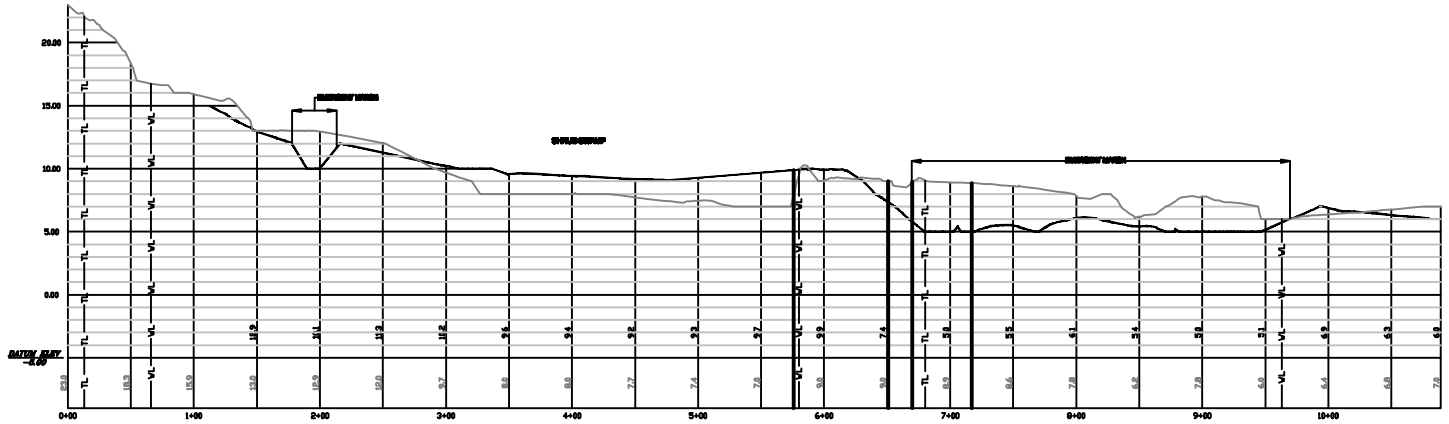
3/7 CROSS SECTION B–B'
VERTICAL: 1" = 5' HORIZONTAL: 1" = 50'



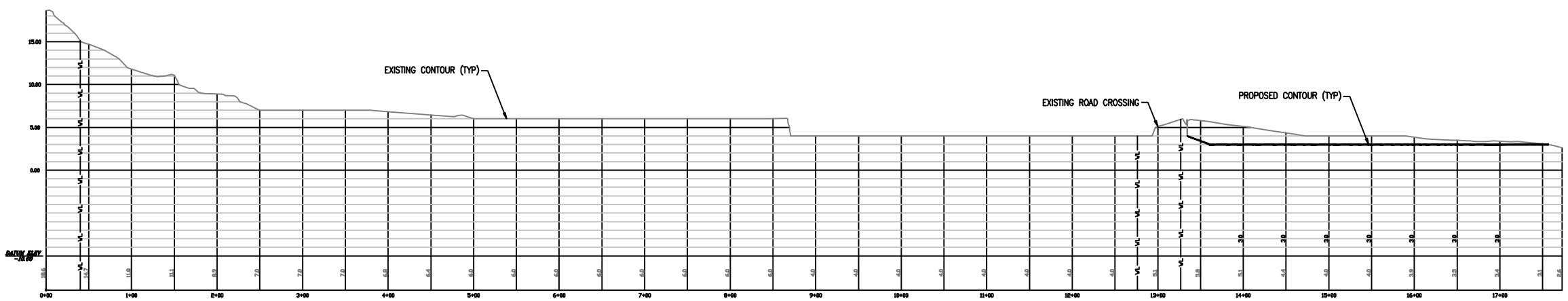
4/7 CROSS SECTION C–C'
VERTICAL: 1" = 5' HORIZONTAL: 1" = 50'



5/7 CROSS SECTION D–D'
VERTICAL: 1" = 5' HORIZONTAL: 1" = 50'



1/7 WETLAND FLOW PATH PROFILE
VERTICAL: 1" = 5' HORIZONTAL: 1" = 50'



1/7 WETLAND FLOW PATH PROFILE
VERTICAL: 1" = 5' HORIZONTAL: 1" = 50'

LEGEND

- EXISTING CONTOURS
- PROPOSED CONTOURS
- GROUNDWATER ELEVATION (GW)
- HISTORIC TIDAL CLAIMS
- EXISTING STREAM
- EXISTING WETLAND DELINEATION (VL)
- EXISTING WETLAND BUFFER (TL)
- EXISTING 50FT STREAM SETBACK (50FT)
- PROPERTY LINE
- DEBRIS PILE

TEANECK CREEK WETLANDS RESTORATION PROJECT
CROSS SECTIONS AND PROFILE

PROJECT LOCATION
Block 3719, Lot 1
Borough of Teaneck
Bergen County, New Jersey

NO.	REVISION	DATE

Date

TRC ENVIRONMENTAL CORP.
Certificate of Authorization #24GA28000000
900 BEAR TAVERN RD
SUITE 104
TRENTON, NJ 08628
TEL: (609) 883-7764
FAX: (609) 883-7775

DRAWN BY: AMY | PROJ. NO.: 106823
CHECKED BY: JDS | DWG.: X
SCALE: AS SHOWN | DATE: MAY 13, 2008
SHT. NO. 3 of 4

PLANTING SCHEDULES

TOPSOILING, SEEDING AND MULCHING NOTES

1. ANY UNDISTURBED AREA ON WHICH ACTIVITY HAS CEASED AND WHICH WILL REMAIN EXPOSED FOR MORE THAN 20 DAYS MUST BE SEEDED AND MULCHED IMMEDIATELY. DURING NON-GERMINATING PERIODS, MULCH MUST BE APPLIED AT THE REQUIRED RATES. DISTURBED AREAS WHICH ARE NOT AT FINISHED GRADE AND WHICH WILL BE REDISTURBED WITHIN 1 YEAR SHALL BE SEEDED AND MULCHED WITH A QUICK GROWING TEMPORARY SEEDING MIXTURE AND MULCH. DISTURBED AREAS WHICH ARE EITHER AT FINISHED GRADE OR WILL NOT BE REDISTURBED WITHIN 1 YEAR MUST BE SEEDED AND MULCHED WITH A PERMANENT SEED MIXTURE AND MULCH.

2. DIVERSIONS, CHANNELS, SEDIMENTATION BASINS, SEDIMENT TRAPS, AND STOCKPILES MUST BE SEEDED AND MULCHED IMMEDIATELY.

3. GRADED AREAS SHALL BE TEMPORARILY SEEDED AND MULCHED IMMEDIATELY FOLLOWING EARTH MOVING PROCEDURES. TEMPORARY SEED SHALL BE ANNUAL RYE GRASS APPLIED AT A RATE OF 3 LBS. PER 1000 SQ. FT.

4. AFTER SEEDING, HAY OR STRAW MULCH MUST BE APPLIED AT A RATE OF AT LEAST 3.0 TONS PER ACRE. MULCH SHALL BE ANCHORED BY EITHER CRIMPING WITH A COULTER IMPLEMENT, OR BY STAPLING BIODEGRADABLE NETTING TO THE SURFACE.

5. SITE PREPARATION TO UPLAND AREAS: APPLY 1 TON OF AGRICULTURAL-GRADE LIMESTONE PER ACRE PLUS 10-20-10 FERTILIZER AT THE RATE OF 500 LB. PER ACRE. WORK IN WHERE POSSIBLE.

6. TOPSOIL SHALL BE A CLEAN FRIABLE LOAM WITH SUFFICIENT ORGANIC CONTENT (2.75%) TO PROMOTE PLANT VIGOR. AMENDMENTS SHALL BE ADDED AS NEEDED TO IMPROVE DEFICIENT SOILS. TOPSOIL SHALL BE RETURNED AT A LOOSE DEPTH OF FIVE INCHES TO ALLOW FOR SETTLEMENT.

7. ESTABLISH PERMANENT SEEDING AS SOON AS POSSIBLE AFTER FINAL GRADING IS COMPLETE. UNLESS OTHERWISE INDICATED, PERMANENT SEEDING SHALL BE SEED MIXTURE SPECIFIED IN TABLE.

8. SEE TABLES FOR SEED SPECIES MIXTURE AND APPLICATION RATES.

9. SEED MIXES ARE AVAILABLE AT ERNST CONSERVATION SEEDS IN MEADVILLE, PA. WEBSITE: WWW.ERNSTSEED.COM OR PHONE: 1-800-873-3321.

10. NATIVE TREES AND SHRUBS ARE AVAILABLE AT PINELANDS NURSERY AND SUPPLY, COLUMBUS, NJ. WEBSITE: WWW.PINELANDSNURSERY.COM OR PHONE: 1-800-667-2729.

GENERAL LANDSCAPING NOTES

1. All plant materials shall conform to the American Association of Nurserymen's American Standard for Nursery Stock (latest edition).

2. Inspection of Planting Beds – the Landscape Architect shall inspect all planting areas before any topsoiling or planting is begun to insure that adequate drainage exists. If any areas to be landscaped show evidence of poor drainage, the Landscape Architect shall notify the Owner immediately for corrective action.

3. The Landscape Architect shall approve all plant material and staked plant locations prior to installation.

4. All trees, shrubs, and groundcover planting areas shall be stabilized.

5. All trees, shrubs, and groundcovers shall be as specified and shall be installed In accordance with the details and comments noted on the Drawings.

6. Topsoil for planting is available at the site. Topsoil shall be relocated by the Landscape Contractor for planting pits according to the details.

7. All removed soil is to be stockpiled as per Bergen County Soil Conservation District standards and replaced on site such that the soil does not become compacted. The Contractor is to ensure that actual topsoil and subgrade soils remain separate to the extent that actual topsoil is the growing medium in which the plants will be placed after the soil has been replaced on site.

8. All disturbed areas within 10 feet of the water's edge are to be seeded with Seed Mix 1 and stabilized with erosion control mat.

9. All disturbed areas between 10 and 30 feet of the water's edge (including all shrub planting areas) are to be seeded with Seed Mix 2 and stabilized with straw mulch.

10. When removing the Japanese Knotweed, the contractor will take care to remove the leaf and stem material as well as ground material containing the plant's roots.

11. Contractor is to place goose fencing around all herbaceous plantings.

12. All plantings are to be installed between the following dates: September 15th to November 15th or April 15th to May 30th.

1/3 SHALLOW EMERGENT MARSH
N.T.S.

HERBACEOUS SPECIES

QUANTITY	KEY	SCIENTIFIC NAME	COMMON NAME	SIZE
1,000	ANV	*Andropogon virginicus*	broomsedge	2-inch plug
175	ASI	*Asclepias incarnata*	swamp milkweed	2-inch plug
175	ANA	*Aster novae-angliae*	New England aster	2-inch plug
175	ANB	*Aster novi-belgii*	New York aster	2-inch plug
175	CAP	*Caltha palustris*	Marsh marigold	2-inch plug
500	CAC	*Carex crinita*	fringed sedge	2-inch plug
500	CAL	*Carex lurida*	shallow sedge	2-inch plug
500	CAV	*Carex vulpinoidea*	fox sedge	2-inch plug
500	CAS	*Carex stricta*	tussock sedge	2-inch plug
175	CHG	*Chelone glabra*	turtlehead	2-inch plug
175	CIA	*Cinna arundinacea*	wood reed	2-inch plug
175	EUM	*Eupatorium maculatum*	joe-pye weed	2-inch plug
175	EUP	*Eupatorium perfoliatum*	boneset	2-inch plug
175	HIM	*Hibiscus moscheutos*	swamp rose-mallow	2-inch plug
1,000	IRV	*Iris versicolor*	blue flag iris	2-inch plug
2,000	JUC	*Juncus canadensis*	Canada rush	2-inch plug
2,000	JUE	*Juncus effusus*	soft rush	2-inch plug
175	LOC	*Lobelia cardinalis*	cardinal flower	2-inch plug
175	LOS	*Lobelia siphilitica*	blue lobelia	2-inch plug
175	ONS	*Onoclea sensibilis*	sensitive fern	2-inch plug
175	OSC	*Osmunda cinnamomea*	cinnamon fern	2-inch plug
175	OSR	*Osmunda regalis*	royal fern	2-inch plug
175	POC	*Pontederia cordata*	pickerelweed	2-inch plug
175	SAL	*Sagittaria latifolia*	duck potato	2-inch plug
500	SCA	*Scirpus atrovirens*	green bulrush	2-inch plug
500	SCC	*Scirpus cyperinus*	woolgrass	2-inch plug
175	VEN	*Vernonia noveboracensis*	New York ironweed	2-inch plug

2/3 SHRUB SWAMP
N.T.S.

HERBACEOUS SPECIES

QUANTITY	KEY	SCIENTIFIC NAME	COMMON NAME	SIZE
400	ASI	*Asclepias incarnata*	swamp milkweed	2-inch plug
400	ANA	*Aster novae-angliae*	New England aster	2-inch plug
400	CAP	*Caltha palustris*	marsh marigold	2-inch plug
1,000	CAC	*Carex crinita*	fringed sedge	2-inch plug
2,000	CAV	*Carex vulpinoidea*	fox sedge	2-inch plug
1,000	CAS	*Carex stricta*	tussock sedge	2-inch plug
400	CHG	*Chelone glabra*	turtlehead	2-inch plug
400	EUP	*Eupatorium perfoliatum*	boneset	2-inch plug
400	HIM	*Hibiscus moscheutos*	swamp rose-mallow	2-inch plug
3,000	JUC	*Juncus canadensis*	Canada rush	2-inch plug
4,000	JUE	*Juncus effusus*	soft rush	2-inch plug
400	LOC	*Lobelia cardinalis*	cardinal flower	2-inch plug
400	LOS	*Lobelia siphilitica*	blue lobelia	2-inch plug
400	ONS	*Onoclea sensibilis*	sensitive fern	2-inch plug
400	OSC	*Osmunda cinnamomea*	cinnamon fern	2-inch plug
400	OSR	*Osmunda regalis*	royal fern	2-inch plug
2,000	SCA	*Scirpus atrovirens*	green bulrush	2-inch plug
2,000	SCE	*Scirpus expansus*	wood bulrush	2-inch plug
400	VEN	*Vernonia noveboracensis*	New York ironweed	2-inch plug

SHRUB SPECIES

QUANTITY	KEY	SCIENTIFIC NAME	COMMON NAME	SIZE
600	AA	*Aronia arbutifolia*	red chokeberry	18"-24", #2 Container
600	AM	*Aronia melanocarpa*	black chokeberry	18"-24", #2 Container
600	CO	*Cephalanthus occidentalis*	buttonbush	18"-24", #2 Container
600	CA	*Clethra alnifolia*	sweet pepperbush	18"-24", #2 Container
1,000	CM	*Cornus amomum*	silky dogwood	18"-24", #2 Container
1,000	CR	*Cornus racemosa*	grey dogwood	18"-24", #2 Container
600	LB	*Lindera benzoin*	spicebush	18"-24", #2 Container
600	RV	*Rhododendron viscosum*	swamp azalea	18"-24", #2 Container
1,000	SD	*Salix discolor*	pussy willow	18"-24", #2 Container
1,000	SC	*Sambucus canadensis*	elderberry	18"-24", #2 Container

3/3 FLOODPLAIN FOREST
N.T.S.

HERBACEOUS SPECIES

QUANTITY	KEY	SCIENTIFIC NAME	COMMON NAME	SIZE
450	ASI	*Asclepias incarnata*	swamp milkweed	2-inch plug
450	ANA	*Aster novae-angliae*	New England aster	2-inch plug
450	ANB	*Aster novi-belgii*	New York aster	2-inch plug
1,000	CAR	*Carex crinita*	fringed sedge	2-inch plug
1,000	CAV	*Carex vulpinoidea*	fox sedge	2-inch plug
450	CHG	*Chelone glabra*	turtlehead	2-inch plug
450	EUM	*Eupatorium maculatum*	joe-pye weed	2-inch plug
450	EUP	*Eupatorium perfoliatum*	boneset	2-inch plug
450	LOC	*Lobelia cardinalis*	cardinal flower	2-inch plug
450	LOS	*Lobelia siphilitica*	blue lobelia	2-inch plug
450	ONS	*Onoclea sensibilis*	sensitive fern	2-inch plug
450	OSC	*Osmunda cinnamomea*	cinnamon fern	2-inch plug
1,000	SCA	*Scirpus atrovirens*	green bulrush	2-inch plug
450	VEN	*Vernonia noveboracensis*	New York ironweed	2-inch plug

SHRUB SPECIES

QUANTITY	KEY	SCIENTIFIC NAME	COMMON NAME	SIZE
450	AA	*Aronia arbutifolia*	red chokeberry	18"-24", #2 Container
450	AM	*Aronia melanocarpa*	black chokeberry	18"-24", #2 Container
450	CO	*Cephalanthus occidentalis*	buttonbush	18"-24", #2 Container
450	CA	*Clethra alnifolia*	sweet pepperbush	18"-24", #2 Container
450	CM	*Cornus amomum*	silky dogwood	18"-24", #2 Container
450	LB	*Lindera benzoin*	spicebush	18"-24", #2 Container
450	RV	*Rhododendron viscosum*	swamp azalea	18"-24", #2 Container
450	SD	*Salix discolor*	pussy willow	18"-24", #2 Container
450	SC	*Sambucus canadensis*	elderberry	18"-24", #2 Container
450	VD	*Viburnum dentatum*	arrowwood	18"-24", #2 Container

TREE SPECIES

QUANTITY	KEY	SCIENTIFIC NAME	COMMON NAME	SIZE
65	AR	*Acer rubrum*	red maple	6'-10', #5 Container or B&B
89	AS	*Acer saccharinum*	silver maple	6'-10', #5 Container or B&B
50	BN	*Betula nigra*	river birch	6'-10', #5 Container or B&B
30	CO	*Celtis occidentalis*	hack berry	6'-10', #5 Container or B&B
62	FP	*Fraxinus pennsylvanica*	green ash	6'-10', #5 Container or B&B
33	LS	*Liquidambar styraciflua*	sweetgum	6'-10', #5 Container or B&B
47	PO	*Platanus occidentalis*	sycamore	6'-10', #5 Container or B&B
69	QB	*Quercus bicolor*	swamp white oak	6'-10', #5 Container or B&B

4/3 SEED MIXES
N.T.S.

WETLAND TRANSITION AREA SEED MIX

PCT.	*SCIENTIFIC NAME*	*COMMON NAME*
20	Andropogon gerardii	Big Bluestem
20	Andropogon scoparius	Little Bluestem
10	Juncus effesus	Softrush
10	Scirpus cyperinus	Woolgrass
20	Panicum virgatum	Switch Grass
10	Sorghastrum nutans	Indian Grass
10	Tripsacum dactyloides	Eastern Gama Grass
100		

SEEDING RATE: APPLY AT A RATE OF 2 LB PER 1000 SQ FT
COVER CROP: APPLY ANNUAL RYE AT A RATE OF 3 LB PER 1000 SQ FT

UPLAND SEED MIX

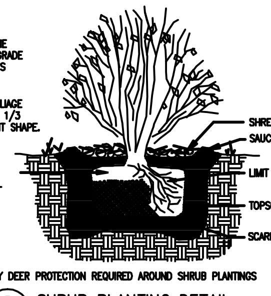
PCT.	*SCIENTIFIC NAME*	*COMMON NAME*
20	Andropogon scoparius	Little Bluestem
20	Andropogon virginicus	Broomsedge
20	Bromus altissumus	Wild Brome Grass
20	Elymus hystrix	Bottlebrush Grass
20	Panicum virgatum	Switch Grass
100		

SEEDING RATE: APPLY AT A RATE OF 2 LB PER 1000 SQ FT
COVER CROP: APPLY ANNUAL RYE AT A RATE OF 3 LB PER 1000 SQ FT

WETLAND MEADOW SEED MIX

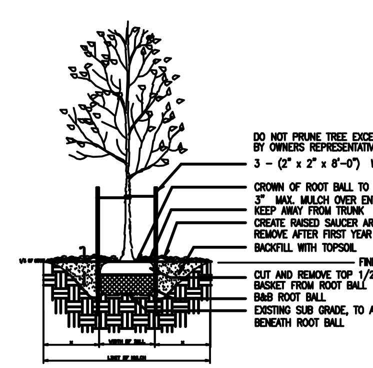
PCT.	*SCIENTIFIC NAME*	*COMMON NAME*
20	Andropogon scoparius	Little Bluestem
5	Carex grayi	Grays Sedge
5	Carex scoparia	Blunt Broom Sedge
5	Carex stipata	Awl Sedge
5	Carex vulpinoidea	Fox Sedge
20	Elymus hystrix	Bottlebrush Grass
10	Juncus canadensis	Canada rush
10	Scirpus cyperinus	Woolgrass
20	Panicum virgatum	Switch Grass
100		

SEEDING RATE: APPLY AT A RATE OF 1 LB PER 1000 SQ FT
COVER CROP: APPLY ANNUAL RYE AT A RATE OF 3 LB PER 1000 SQ FT



NOTE: TEMPORARY DEER PROTECTION REQUIRED AROUND SHRUB PLANTINGS

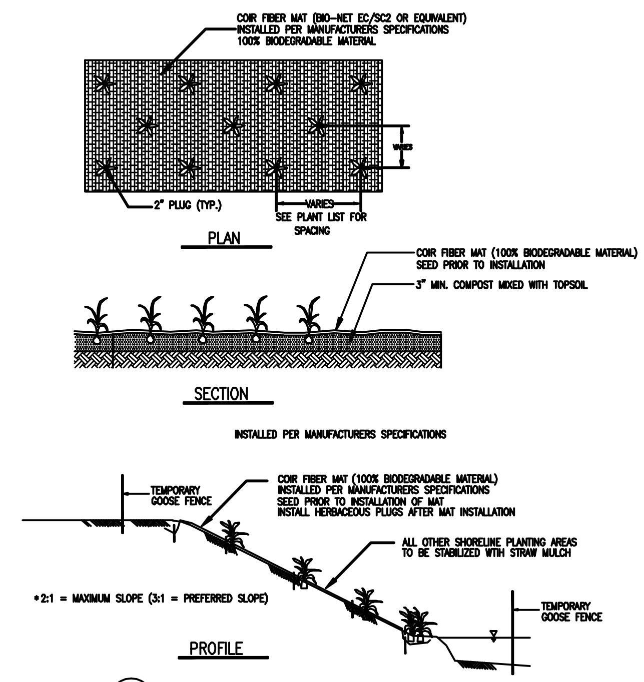
5/3 SHRUB PLANTING DETAIL
N.T.S.



NOTES:

1. DO NOT DAMAGE MAIN ROOTS OR ROOT BALL WHEN INSTALLING TREE STAKE.
3. REMOVE SAUCER AND STAKES TWO YEARS OR LESS AFTER INSTALLATION.
5. TEMPORARY DEER PROTECTION REQUIRED AROUND TREE PLANTINGS.

6/3 TREE PLANTING DETAIL
N.T.S.



7/3 WETLAND BASIN PLANTING DETAILS
N.T.S.

NO.	REVISION	DATE

JEREMIAH D. BERGSTROM
NJ CERTIFIED LANDSCAPE ARCHITECT
LIC. NO. [illegible]

Date

TEANECK CREEK WETLANDS RESTORATION PROJECT
LANDSCAPE DETAILS

PROJECT LOCATION
Block 3710, Lot 1
Borough of Teaneck
Bergen County, New Jersey

TRC ENVIRONMENTAL CORP.

DRAWN BY: MAY	PROJ. NO.: 103885			
CHECKED BY: JDB	DWG: LS-4	SCALE: AS SHOWN	DATE: MARCH 31, 2008	SHT. NO. 4 of 4