Albany Rapp Road Landfill
Ecosystem Mitigation, Restoration & Enhancement Plan

City of Albany, New York

Onsite forested dune & old field lowland complex proposed for restoration & enhancement

Studying existing conditions onsite.

Pine Bush Vernal Pond reference study area.

April 2009

Applied Ecological Services, Inc.™

Albany Rapp Road Landfill Ecosystem Mitigation, Restoration & Enhancement Plan

City of Albany, New York

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April 2009

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Preface

In this document we provide a detailed ecosystem-based restoration plan and specifications partly for addressing the mitigation needs for unavoidable impacts associated with the Eastern Expansion of the City of Albany Rapp Road Landfill to wetlands and Waters of the United States (WOUS) and to New York State Department of Environmental Conservation (DEC) regulated wetlands and partly as an opportunity for the City, a member of the Albany Pine Bush Preserve Commission (APBPC), to leverage funding from the expansion in order to propose and take part in the implementation of a vision for the Preserve to link eastern pine barrens with western pine barrens and give back the landfill itself to the Pine Bush from which it came many years ago. The plan is comprised of a detailed narrative and an appended series of stand alone documents, including: a **Plan Set** (Appendix 1 references the accompanying plan set), which contains the construction drawings showing the existing land cover and plans for grading, restoration, planting, stream restoration, erosion and sedimentation control, salvage and closure, wetland impacts, trails, phasing, monitoring, and pest management; **Construction Specifications** (Appendix 2), which provide details on general construction requirements and techniques, earthwork and site preparation, seed and plant materials and installation techniques, management requirements for the restored landscapes, and reporting requirements during construction and restoration phases; a **Monitoring Plan & Performance Criteria** (Appendix 3), which provides requirements and protocols for measuring the performance of the restoration program; an **Integrated Pest and Invasive Species Management Plan** (Appendix 4 references this accompanying document), which provides methods and materials for removing and controlling target species of management concern; and a **Third-Party Monitor Quality Assurance Plan** (Appendix 5), which provides the qualifications and scope of responsibilities of a third-party monitor for overseeing and reporting on regulated activities in wetlands and other restored, enhanced, and created plant communities within the project area. The restoration plan was developed following extensive ecological site investigations that are documented in the Supplemental Draft Environmental Impact Statement (SDEIS) prepared by Clough Harbour & Associates, and we have excerpted and referenced selected information from the SDEIS pertaining to existing conditions and the intended outcomes of the restoration program, to provide background in support of the restoration plan.

The City of Albany acknowledges that to successfully undertake a restoration program within the context of the ecologically significant Albany Pine Bush will require a committed team and close coordination with the Albany Pine Bush Preserve Commission (APBPC), Technical Committee and staff, DEC, and other locally knowledgeable experts. In addition, the City recognizes that implementing such a unique restoration program will require the services of a highly qualified construction team guided by restoration ecologists. Draft contractor qualifications are provided in Appendix 6. The City's existing consultant team meets these qualifications and will be considered, among others. It is further recognized that a strong working relationship between the selected consulting team and the APBPC and DEC staff will be essential to successfully completing the project to the satisfaction of regulators and APBPC. To this end, the City will prepare a Memorandum of Understanding that will be used to define the commitments regarding the governance and administration of the restoration, management, and monitoring program during the life of the project.

A. Introduction

The proposed landfill project involves the expansion of the existing Rapp Road Landfill onto City-owned lands located east of the existing landfill (Eastern Expansion) in order to continue to meet the solid waste disposal needs of City residents and businesses as well as the communities that make up the Capital Region Solid Waste Management Partnership (CRSWMP) Solid Waste Management Planning Unit, and the Capital Region as a whole. CRSWMP is comprised of a consortium of communities that include the cities of Albany, Rensselaer, and Watervliet, the towns of Berne, Bethlehem, East Greenbush, Guilderland, Knox, New Scotland, Rensselaerville, and Westerlo, and the Villages of Green Island, Voorheesville, and Altamont.

The Eastern Expansion of the landfill involves an overfill of approximately 23 acres of the existing landfill and a lateral expansion of approximately 15 acres that includes 7 acres within the existing landfill operations area (disturbed/developed lands) and 8 acres within undeveloped City-owned property directly to the northeast. Existing landfill infrastructure including offices, the recycling building, and other accessory uses will be relocated to three parcels totaling approximately 3.5 acres located directly east of the landfill entrance road off of Rapp Road. Plans in Appendix 1 illustrate the general layout of the expansion.

An integral part of the Eastern Expansion proposal is the restoration program. There is a significant opportunity to re-establish habitat linkages from west to east in the APBP through the existing mobile home park property and over portions of the closed landfill. Implementation of the restoration plan would be an ongoing process, beginning with native grassland demonstration plots on the existing landfill, and continuing with wetland mitigation and stream restoration on the mobile home park property and habitat restoration efforts on closed portions of the existing landfill, as well as surrounding areas of currently degraded habitat. It is envisioned that the landfill can be blended into the APBP landscape, providing critical habitat for rare ecological communities and threatened and endangered species.

The plan is also designed to address other influences on the natural communities within the APBP. These influences include the mobile home park and the grading and sand mining that removed Pine Bush habitat and changed the landscape, the relocation and channelization of natural streams that are tributary to Lake Rensselaer, and the draining and ditching of large wetland areas for past agricultural purposes, all of which contribute to poor water quality and the loss of natural/native Pine Bush communities.

The restoration program and the Eastern Expansion are intertwined in terms of construction phasing, financing, and closure. Restoration, mitigation, and enhancement activities will begin during the first year of the landfill expansion and will be phased over the anticipated 6.5-year life of the expansion, and will continue into the final 3-year phase as a component of the closure plan. The end result converts the entire Rapp Road Landfill complex and surrounding lands, with the exception of landfill operations structures that will be needed to continue to address gas and leachate collection, odor abatement, and possible transfer station operations, into Pine Bush habitat. This expansion project provides the financial means to restore and enhance over 250 acres of land. With limited State and local funding sources, the ability of the APBPC to achieve the goals of the restoration program is significantly diminished if not impossible. The intent of the City is to make this win-win scenario a reality.

The restoration plan is proposed in concert with the Eastern Expansion to restore and enhance pine bush ecology within degraded areas north of the landfill, to reconnect viable pine bush east and west of the mobile home park, to integrate the landfill itself back into the pine bush, to improve downstream water quality, and to compensate for the direct, unavoidable impacts to State and federally regulated wetlands and a stream.

B. Plan Overview

1. Statement of Purpose, Goals & Objectives

The restoration plan is prepared in recognition that the landfill is an important public facility providing an essential waste disposal service to residents, businesses, and institutions throughout the Capital Region (see purpose and need statement for the Rapp Road Landfill Eastern Expansion in the SDEIS). Because the restoration plan will ultimately result in converting the vast majority of the landfill and surrounding City properties into restored Pine Bush habitats, the timing of the continued operational needs of the landfill is important to understand. The additional capacity that will be realized by the proposed Eastern Expansion will provide the time needed to plan, site, and develop the next generation of waste management facilities for the Capital Region. At current rates of disposal, the Eastern Expansion will provide 6.5 years of landfill life. However, unlike previous expansion efforts, the option for an additional future expansion will be foreclosed due both to the fact that all surrounding lands are dedicated to the APBP and because the proposed restoration plan will be phased in during construction and operation of the expansion, with the last phase of the restoration encompassing the Eastern Expansion after closure. The result would be a landfill transformed into Pine Bush habitat with some remaining landfill infrastructure such as landfill offices, a possible future transfer station, and gas-to-energy facilities. Therefore, the majority of the landfill, as well as the surrounding lands, will be committed to habitat, leaving no room for further expansion.

The overriding purpose of the restoration plan is to reclaim the landfill and the mobile home park as a part of the Pine Bush ecology and improve upon the water quality of the Lake Rensselaer watershed. Therefore, with the exception of the obvious topographic difference, the intent is to blend the landfill and vicinity back into Pine Bush habitat, and to restore and enhance surrounding lands to create viable Pine Bush and re-establish the habitat connection between viable Pine Bush to the east and west. The plan is designed to address the following goals and objectives:

- Replace ecological functions and benefits of impacted wetlands and aquatic resources in accordance with a wetland mitigation plan that reconnects and restores natural tributary streams and creates new riparian wetlands and vernal ponds.
- Restore the ecology, diversity, and beauty of native plant communities in low quality existing upland and lowland plant and animal communities in locations that are currently highly degraded environments, such as the mobile home park,

the current and future closed landfill surface, and the existing degraded (tile and ditch-drained hydrology) wetlands found in neighboring DEC properties.

- Create an ecologically meaningful and sizable restoration project that can serve as an important wildlife habitat area and that can link currently fragmented landscapes in and adjacent to the APBP that have not been maintained due to the proximity of development and past private land ownership.
- Reduce the landfill "edge effect" by collecting, treating and diverting landfill stormwater runoff.
- Provide for public use and enjoyment of the expanded restored natural resource areas and open space.

The plan outlines a program for restoring and managing native plant communities in a comprehensive mitigation, restoration, and enhancement package proposed for the Eastern Expansion. The plan document details the restoration and management design and work plan, as well as provides the specifications for implementing the plan, and a monitoring program for measuring restoration effectiveness and success.

2. Summary of Impacts & Mitigation

Summary of Impacts

The impacts of the proposed Eastern Expansion (landfill expansion, expansion area) are thoroughly discussed in Section 3.0 of the SDEIS. Here we expand upon the ecological impacts and the proposed mitigation opportunities including the creation, restoration, and enhancement of both wetland and upland habitats in the expansion area as well as the proposed restoration area.

The proposed landfill expansion will result in the unavoidable taking of 5.05 acres of forested wetlands (see the SDEIS for the wetland delineation and other reports that document the condition of the proposed impacted wetlands), as well as 0.38 acres of impact outside of the landfill expansion area within the restoration area associated with filling the existing *Phragmites*-dominated channelized tributary stream (tributary to Lake Rensselaer) for construction of a biofilter wetland, and an additional 3.68 acres of wetland vegetation to be disturbed by grading for wetland restoration. A total of 51.81 acres of wetland will be mitigated and enhanced, including 22.18 acres to be *created* (wetlands derived from disturbed/poor quality upland areas through grading, planting and other means to modify hydrology and encourage the growth of native wetland species), 3.68 acres to be *restored* (existing wetlands to be graded and modified to higher quality wetlands), and 25.95 acres to be *enhanced* (existing wetlands to be slightly modified through less invasive measures in order to eliminate invasive species and improve overall functions and benefits). A total of 207.62 acres of upland Pine Bush grassland, barrens, and forest community will also be restored and enhanced as part of the restoration program. A summary of the proposed wetland impact and mitigation acreages are presented in Table 1.

Table 1. Disturbed and Mitigation Acreages for the Rapp Road Landfill Project.

	Permanent Impacts		Temporary Impacts	Mitigation		
	Landfill Expansion Area	Restoration Area	Restoration Area	Landfill & Restoration Area		
Community Type	**Acres Filled**	**Acres Filled**	**Acres Graded**	**Acres Created**	**Acres Restored**	**Acres Enhanced**
Degraded Wetlands						
Ditch/ Wet Old Field		0.06	1.89			
Disturbed Forested Wetland	5.05	0.24	1.66			
Subtotals	**5.05**	**0.3**	**3.55**			
Restored Wetlands						
Pine Barrens Vernal Pond				1.12		
Sedge Meadow				0.63		
Forested Wetland (Red Maple Hardwood Swamp)				11.34	2	27.59
Forested Riparian Wetland (Red Maple Hardwood Swamp)				6.04	0.82	
Biofilter Wetland				0.69	0.73	
Subtotals	**5.05**	**0.3**		**19.82**	**3.55**	**27.59**
Totals	**5.35**		**3.55**	**50.96**		
Streams						
Ditch (from upland)			690 lf			
Ditched Stream	1490 lf		600 lf			
Restored Stream				3169.75 lf		
Totals	**1490 lf**		**1290 lf**	**3169.75 lf**		
Restored & Enhanced Uplands						
Dry Prairie/Sand Flat Dune and Dune Barrens					49.55	
Pitch Pine-Scrub Oak Barrens						121.93
Pitch Pine-Oak Forest Buffer Enhancement						30.92
Native Nursery				1.44		
Totals				**203.84**		

Mitigation

Our vegetation and habitat assessment conducted in the project study area (see SDEIS, Section 3.0) revealed that the expansion area and all the areas proposed for restoration are degraded ecological communities, having been modified by past land uses such as farming, sand mining, and development (Fox Run), as well as by exotic species invasions and exclusion of natural fire disturbance regimes. All of these changes have impacted drainage, soils, and native vegetative communities to the extent that we believe conversion of the expansion area to landfill and the work necessary to restore, mitigate and enhance natural communities in the restoration area will have no significant impact on any rare, threatened or endangered species.

Expansion & Facilities Areas

Most of the proposed Eastern Expansion will involve an overfill of existing landfill (23 acres) and a lateral expansion into the existing landfill operations area now used for the detention pond and the recycling facility (2 acres). The lateral expansion will also extend into approximately 7 acres of currently disturbed lands used for landfill operations and an additional 8 acres of undeveloped land, including 5.05 acres of forested wetland and 3 acres of black locust-cherry-oak forest. Our previously mentioned vegetative and habitat investigations in this area revealed no rare or vulnerable species or communities, and therefore we believe loss will be to common wildlife species and degraded and invasive plant communities. In addition, residential property to the southeast of the landfill at the current landfill entrance will be used to provide adequate space for the landfill operations and infrastructure, which will impact approximately 1.5 acres of Appalachian oak-pine forests, much of which is dominated by black locust. The remaining land is lawn, buildings, and driveways. Given the disturbed nature of this area, no significant impact to wildlife or important vegetative communities is anticipated.

The loss of 5.05 acres of forested wetland associated with the channelized tributary stream will require regulatory approval from the U.S. Army Corps of Engineers (USACE). Approximately 1,490 linear feet of the channelized stream will be filled and relocated outside of the expansion area (see proposed restored South Stream location in Sheets S0, S2 and S3 in the accompanying Plan Set). Another 750 linear feet of ditch that was dug along the west side of the mobile home park to divert drainage from the north to the channelized tributary stream will be eliminated as part of the process of restoring a north tributary channel across the mobile home park (see proposed restored North Stream location in Sheets S2 and S3 in the accompanying Plan Set).

Design alternatives discussed in detail in Section 5.0 of the SDEIS and in a stand-alone report in SDEIS Appendix L entitled Analysis of Wetland Impact Avoidance, Minimization and Alternatives thoroughly address the Section 404(b)(1) guidelines, providing documentation for the conclusion that the proposed Eastern Expansion is the least damaging practicable alternative.

The primary mitigation for wetland loss will be the relocation of the North and South stream channels and creation of broad riparian corridors, restoration of floodplain forests, and improved water quality and habitat. In addition, there are opportunities to create a pine barrens vernal pond, sedge meadow, and red maple hardwood forest. And, unlike many mitigation plans that do not have the opportunity to connect to other significant areas of protected habitat, the potential for over 22 acres of wetland creation will be part of the 259 acre restoration and enhancement project that will further connect to hundreds of acres of preserved lands.

Key to the success of restoring Pine Bush terrestrial and aquatic communities is the study of high quality reference areas within the Preserve. Detailed vegetation, soils and hydrology data have been collected and analyzed from the reference areas and compared to records in an extensive literature search. Additional hydrology monitoring critical for the success of the wetland communities, is ongoing and includes groundwater elevations, vernal pool/pond surface water elevations, and stream flow and water quality. Surface and groundwater monitoring methodology is discussed in the SDEIS.

Acceptable mitigation for the loss of wetland is the replacement of the lost wetland functions and values or for State purposes, functions and benefits. The restoration plan provides the opportunity to replace and improve upon the lost functions and to provide much higher quality habitat over the existing conditions that provide numerous benefits to habitat and water quality.

The proposed acreages for the various aquatic ecological communities appear to be sufficient to meet the typical regulatory compensation ratios of 2:1 for forested wetland, with stream channel loss replaced in kind and enhanced. It is also important to note that all of the mitigation efforts have a purpose in the overall restoration of Pine Bush habitat. All of the existing communities and in particular the wetland communities have been modified. The restoration plan in its conceptual form was not created with regulatory mitigation requirements as the primary focus. Rather, the intent of the proposed aquatic communities within the proposed pine barrens and enhanced forested habitats was to improve water quality, restore the health of existing wetlands and former stream channels, diversify habitat, and reintroduce rare communities (pine barrens vernal pond). And by conducting detailed field analysis at the beginning of the concept stage, all of this work will be done with the utmost sensitivity to the important existing rare communities associated with the Pine Bush.

No significant secondary impacts to wetlands and other waters of the U.S. have been identified for the project. Existing wetland corridors to the north of the proposed expansion area will maintain hydrology through their use as the re-established stream corridors, as identified in the restoration plan as shown in Plan Set sheets R.0-R.3. The existing power line easement will be relocated onto the proposed landfill expansion area (toe of the landfill) and will not be relocated onto undeveloped lands. Therefore, no trees and other vegetation will be cut for this relocation.

Restoration Area

The proposed restoration area includes plant communities in varying degrees of degradation. In areas with highly disturbed conditions, such as the developed mobile home park and adjacent old fields with poor quality vegetation and limited habitat opportunities, and where soils have been scraped or spoiled, full restoration is proposed. Activities such as brush removal, re-grading of soils, and seeding and planting, required to restore Pine Bush habitat and proposed wetlands, are not likely to impact rare or vulnerable plant and animal species under the current degraded conditions. Less degraded forested communities within the restoration area will require more or less extensive treatment to achieve greater habitat benefits, depending on the degree of exotic shrub and herbaceous species invasion and shading effects from fire exclusion. Such forested communities are targeted for less extensive restoration intervention, requiring only brushing, invasive species control, prescribed burning, and limited seeding and planting, to enhance biodiversity and habitat quality. These areas are referred to in the restoration plan as Pitch Pine/Oak Forest Buffer Enhancement.

Past agricultural ditching and draining of the wetland located to the east of the proposed expansion (State land) has allowed for the introduction of invasive species and degraded water quality. Modifications to this system (enhancement) will improve/restore the hydrology of this wetland and eliminate the invasives in favor of native wetland species and improved habitat. This work is not intended to significantly change the hydrology to the extent that the community type changes from forest to meadow, for example. Careful manipulation of the hydrology based on data collected in the field will assure the forested wetland remains forested. Work on these State lands will require a Temporary Revocable Permit from the State.

The western extent of the restoration area occurs within disturbed sands that were part of the mobile home park construction activities. There are some remnant dunes in the very western portions of this area that will not be disturbed by the restoration work. The intent is to focus solely on the disturbed and degraded portions of this area. Concern was raised over the rare communities and species known to occur in the vicinity of the P-4 mitigation wetland and pond. A small population of wild lupine and a population of the frosted elfin are known to occur in this area. These habitats occur outside the proposed restoration areas. However, their proximity warrants careful construction activities to ensure these existing, important communities are protected. The purpose of the restoration plan is to restore the rare Pine Bush communities that once occurred throughout this area in support of the existing rare communities and species and to expand their range. This work will be done with the utmost care and respect for existing rare communities and species. Actual work areas will be evaluated and delineated to prevent any unintended impacts. All work will be monitored by experienced ecologists.

C. Existing Conditions & Opportunities for Ecosystem Restoration

Several previous attempts to establish some types of Pine Bush communities at the landfill have met with mixed success. For example, vegetative test plots were installed on the landfill clay cap but did not establish well, as the soil types were not the more recently understood and necessary sand soils found in the Pine Bush. The mobile home park to the north of the landfill was dedicated to the APBP by the City. However, there was never an obligation on the part of the City to restore the mobile home park to Pine Bush habitat and, until more recently when concepts were developed by the City's consultants and discussed with APBPC and DEC staff as the result of the current landfill expansion proposal, no comprehensive plan existed for how that parcel would be restored and managed.

The current Eastern Expansion proposal presents a unique opportunity to look at the landfill, the mobile home park, and surrounding Preserve lands as a whole. As a result, the City retained Applied Ecological Services, Inc. (AES), a nationally recognized ecological restoration firm with specific expertise in pine barrens communities. After an initial field visit, AES identified issues and concerns within the landfill and surrounding areas and developed restoration concepts that were used to begin a dialog with the APBPC technical staff. Next, the project team began detailed investigations of the vegetation, soils, and hydrology within project impact areas, degraded areas, and high quality reference areas (see results in Section 3 of the SDEIS), and used this data to refine concepts and to further engage the APBPC technical staff. This process provided the foundation for developing the Ecosystem Mitigation, Restoration & Enhancement Plan.

Following is a summary of the important issues we identified during our investigations that provide the basis for undertaking ecosystem restoration to address the mitigation needs of the project.

1. Existing Hydrology and Degraded Water Quality

Two streams once originated in the Pine Bush and were tributary to Lake Rensselaer. The remnants of these tributaries exist today and are generally in their natural state east of Rapp Road. However, agriculture and development activities to the west of Rapp Road have significantly changed the character of the streams.

As noted above, the southern tributary of Lake Rensselaer flows through the wetland on State land to the east of the landfill. This stream has been relocated and channelized or ditched as a result of agriculture and development and is currently connected to a pond located on APBP lands west of the landfill. The result of the ditching and draining of this stream within the wetland east of the landfill is a quicker decay of the organic soils that comprise the majority of the wetland. This releases nutrients to the surface water and contributes to nutrient loading down-stream, which may well be a major cause of eutrophication within Lake Rensselaer.

Evidence of the draining effect of the ditching is visible in the orange-colored iron flocculent present in the ditch. It is likely that the flocculated iron results from the high-iron content of the soil weathered under oxygen-rich conditions (due to soil dewatering), forming free iron oxide (Fe_2O_3) that is only weakly bound to the sandy soil. Water moving through the sands can displace the flocculated iron and leach it in solid form into the stream. As long as the stream retains high dissolved oxygen content, the iron flocs will be noticeable in the stream. This process is naturally-occurring in areas with iron rich soils and ground water and a high level of reducing and oxidizing conditions that will affect the solubility, mobility, and reformation of iron compounds.

In many locations within the proposed restoration areas, iron loving bacteria participate in precipitating the iron flocculent material, creating gelatinous masses of orange, iron-rich material along the shorelines of lakes, wetlands, and streams where ground water seeps and springs are found. This is most evident on State-owned lands to the east of the landfill where the dredged and channelized former agricultural ditch was previously excavated (by farmers approximately 50 years ago or more) deep into the underlying soils, intercepting the iron rich ground water and precipitating the flocculent behavior in the dredged channel locations.

The northern tributary once passed through the area that is now the mobile home park. The stream was ditched west of the mobile home park and redirected to the southern tributary. It originates in a wetland located near the northwest corner of the mobile home park. There is no evidence that the ditch is receiving drainage from the lands to the north of the railroad tracks in this location—no culvert was found. East of the mobile home park, the stream was ditched and collects drainage from the northeast corner of the mobile home park and possibly from areas on the north side of the railroad. The drainage is conveyed east and south to a man-made pond, through a culvert and back to an open ditch out to Rapp Road.

The manipulation of drainage through construction of the mobile home park, access road, and the railroad have significantly changed the natural characteristics of the streams and have decreased water quality by providing sources of pollutants.

2. Existing Community Types

The expansion area located northeast of the existing landfill includes two community types, a forested wetland and a forested upland. The forested wetland is dominated by red maple (*Acer rubrum*) with an understory of green ash (*Fraxinus pennsylvanica*), black cherry (*Prunus serotina*), and Japanese barberry (*Berberis thunbergii*). The herb layer dominants include clearweed (*Pilea pumila*), common reed (*Phragmites australis*), cinnamon fern (*Osmunda cinnamomea*), and spotted touch-me-not (*Impatiens capensis*). Although soils are dewatered by ditching allowing invasion by black cherry an upland tree, this community corresponds generally to the Red Maple-Hardwood Swamp classification used by the New York Natural Heritage Program (Reschke, C. 1990. Ecological communities in New York State, New York Natural Heritage Program, New York State Department of Environmental Conservation, Latham, New York.) The upland forest consists of a canopy dominated by black cherry, northern red oak (*Quercus rubra*), and black locust (*Robinia pseudoacacia*), with black cherry and blackberry (*Rubus allegheniensis*) in the shrub layer. The herb layer dominants include white snakeroot (*Eupatorium rugosum*), garlic mustard (*Alliaria petiolata*), Kentucky bluegrass (*Poa pratensis*), and oriental bittersweet (*Celastrus orbiculatus*), the latter two being aggressive exotic invasives. The composition of the upland forest corresponds to Successional Southern Hardwood Forest according to the Natural Heritage Program classification.

With the exception of the developed portions of the residential properties located southeast of the landfill, the lands proposed for facility relocation are forested with a mix of oaks, black cherry, black locust, and remnant pitch pine (*Pinus rigida*).

As previously mentioned, the habitat assessment performed for the project study area revealed that the Expansion Area and all the areas proposed for restoration are degraded ecological communities, having been modified by past land uses such as farming, mining, and development (Fox Run), as well as by fire exclusion. All of these activities have impacted drainage, soils, and native vegetative communities. A detailed discussion of the condition of the existing habitats is presented in Section 3 of the SDEIS. The Monitoring Plan (Sheet M.0) in the accompanying Plan Set (Appendix 1) shows the location of permanent vegetation study transects established in the expansion area from which baseline data has been gathered and from which future monitoring activities are proposed.

3. Existing Soils

The project area, including the restoration areas, are comprised of Colonie loamy fine sand, Elnora loamy fine sand, Granby loamy fine sand, Pits, Gravel, Stafford loamy fine sand, Udipsamments, and Adrian muck. These soils series are generally described by deep, excessively drained loamy fine sand to sand, with variations between horizons stemming from small gradations in texture and/or organic matter content. The soil horizons are deep, typically much greater than 60 inches and are generally described in the following sequence:

0 to 12 inches (± 3 inches):	loamy fine sand
12 to 25 inches (± 5 inches):	fine sand to loamy fine sand
25 to 60+ inches:	sand to fine sand

Soil samples from the lowland and upland series were collected throughout the project area and in ecological reference areas (examples of high quality ecological communities proposed to be replicated within the project area). The results of the soil study are included in the SDEIS. A summary of the soil analysis results is presented in Appendix 2 Construction Specifications addressing soil mitigation requirements. In general, lowlands mapped include soils found in wetlands, typically where water flows and collects, or where the topographical aspect is low and intercepts the water table, creating perennially wet conditions. The typical upland soils in the Albany Pine Bush were found on ridge tops and side slopes.

4. Disturbed Pine Bush

In late 1960's or early 1970's, prior to the creation of the Albany Pine Bush Preserve and the APBP Commission, the City began land filling at the Greater Albany Landfill (GAL). About this time, Fox Run Estates (formerly known as Whitestone) mobile home park was constructed. Prior to that, lands north of the landfill were mined for the sand. These activities had a direct impact on Pine Bush habitat and also contributed to a suite of other habitat barriers now found on the land between Pine Bush habitat to the east and west resulting from other development in the area.

Overall, the landfill is but one use within the Pine Bush landscape that has directly impacted or fragmented Pine Bush habitat. Long before the landfill was constructed, other development consumed large areas of the Pine Bush. The fact that the Pine Bush was not officially recognized as important habitat until the mid-1970's when the State, City of Albany and other municipalities purchased lands for preservation, and that the Albany Pine Bush Preserve Commission was not established until 1988 led to the current fragmentation of the remaining habitat.

Additionally, the detailed evaluations of habitat adjacent to the Rapp Road Landfill and archeological investigations revealed the historic uses in this area that created east-west habitat fragmentation long before the landfill and mobile home park were created. Historic photos, the ditched drainage, and remnant drain tiles revealed the agricultural activities that occurred in the large wetland area located east of the landfill.

There is a long history of disturbance and fragmentation within the current Pine Bush boundaries as defined by APBP and beyond. The restoration plan provides an opportunity to begin to erase a century or more of separation between east and west.

Other secondary impacts have included edge effects where the Pine Bush habitat has degraded due to lack of fire maintenance and the migration of imported landfill soils from the landfill slopes into the Pine Bush-landfill interface, changing chemistry and promoting more invasive species.

Other properties to the east of the mobile home park and the landfill were originally in private ownership and were not maintained as Pine Bush communities. In particular, the State-owned land to the east of the landfill was farmed at one time and later considered for commercial office development. It was this development project that spurred the State to propose a land swap, preserving the parcel. During the period of time the land was farmed, the large wetland area was tiled and drained to the southern, unnamed tributary of Lake Rensselaer that flows directly through the property. The stream was ditched (widened and deepened) to promote drainage, which has degraded the wetland.

D. Restoration & Mitigation Approach & Design

1. Ecosystem Restoration & Adaptive Management

Ecosystem Restoration

The intent of ecosystem restoration is to create ecologically functioning biological communities within the context of a developed or disturbed landscape. The goal of restoration, enhancement, and creation—creating a quality environment—is represented by the plant life in the form of native plant communities. The assumption is that if the plant communities are restored and managed, wildlife populations, ecological functioning, and human enjoyment will be enhanced. This restoration plan provides information that will serve as a baseline for assessing the effectiveness of future activities and management efforts.

This project focuses on creating and restoring diverse ecological systems in existing, lower quality forested wetlands and other altered lands including former agricultural lands now called forested wetlands and owned by the State of New York. Historic vegetation, along with other information on the existing conditions of the land was used as a reference to guide the restoration work. It is the intent of this project to create plant communities that are native to the area, and to the site. Changes in the landscape and existing conditions preclude the possibility of re-creating the original landscapes present 150-200 years ago, and not the intent of this restoration plan.

Where plant communities are adjacent to developed or traditionally landscaped areas, the plan will integrate the native planting with the adjacent lands, by creating transition areas that act as buffers to protect these areas, and to visually transition between the differing land uses. Properly designed and maintained native plantings of shrubs, wildflowers, and grasses will result in an intriguing, often stunning display of color and form. These will blend into the more natural conservation areas or provide a transition from restored plant communities to the developed areas.

Adaptive Management

The mitigation enhancement and management program needs to be flexible because of the variability exhibited by the temporal and spatial resources addressed by the plan. Programs need at times to be changed in response to new data and derived insights. For these reasons, the restoration program should be viewed as being neither conclusive nor absolute. The performance commitments, in other words, the diversity and plant communities targeted as outcomes are firm, but the planting zone acreages of each may vary from the plan. For instance, depending on final hydrology, less emergent acreage and greater wet meadow acreage may result. This should not be thought of as a failure or an unwanted outcome. Plans on a map need to be flexible. This program is a starting point in an ongoing process of restoring the site's biodiversity and natural processes. Regular monitoring during the management and monitoring phase anticipated to begin in 2010 will provide feedback on the program's effectiveness and generate information to evaluate and justify the need for changes. This process of evaluation, adjustment, refinement, and change is called "adaptive management." Adaptive management is a tool that is fundamental to the restoration, management, and maintenance needs of the site.

2. Functional Benefits

Restoration, enhancement, and creation of native plant communities will improve the health of ecosystems, including wildlife habitat and ecological function (e.g. stormwater management). The restructuring and management of integrated native woodland, wetland, prairie, and savanna vegetation complexes, with increased biodiversity and productivity, provides an opportunity to preserve and enhance the richness and productivity of native breeding birds, invertebrates, mammals, and other species that are present, that have been present, or that could be attracted to the restored project site.

By fostering and planting deep-rooted and fibrous rooted plants, the installation and enhancement of native plant communities stabilizes and improves soil, captures and slows runoff from current agricultural lands, and speeds the absorption of water into the soil and groundwater. Reduction of shade increases the light reaching the ground, stimulating shade suppressed native grasses, sedges, and wildflowers to bloom and grow more vigorously. Hidden from view, but as important, the leaching of nitrogen and phosphorus that typically occur in agricultural lands can be a major contributor to water pollution and algae blooms. This process will be slowed and water quality downstream improved by planting diverse wetlands and prairies. Other functions, from seed bank replenishment to the provision of food for wildlife, are enhanced by restoration.

3. Habitat Creation, Restoration & Enhancement

Creation as applied to wetlands is the process of making a new wetland in lands that were not previously occupied by wetlands. Wetland creation requires the most extensive construction and manipulation to achieve appropriate soil and hydrological conditions to support wetland vegetation. The most successful created wetlands are constructed adjacent to existing wetland or aquatic communities. Pine Bush Vernal Pond and sedge meadow wetland creation is planned to take place in old field areas west of the mobile home park. This created system will be linked to existing restored wetlands to provide improved habitat quality.

Restoration refers to the process of re-establishing an ecological community type that once existed in a given area but was previously eliminated in favor of other uses. By this definition, restoration is planned to take place on the landfill and within the mobile home park. Both areas are developed, and successful reestablishment of Pine Bush ecology will require the establishment of the appropriate soils, hydrology, and vegetation.

Enhancement is the process of improving upon the ecological elements already present and involves far less construction and site manipulation than restoration. For degraded Pine Bush, enhancement will involve the removal of invasive and other non-fire tolerant species to reestablish pine barrens. Within the wetland located on State land east of the landfill, enhancement will include the reestablishment of hydrology that was manipulated many years ago through ditching and the installation of drain tiles.

4. Repair of Degraded Aquatic Resources

Natural drainage in the restoration and expansion areas has been impacted by construction of historic drainage ditching, the landfill and mobile home park, existing old agricultural tile and soil drainage activities, and the railroad and other development to the north and south. Lake Rensselaer and the two tributary stream corridors that cross the property have been significantly manipulated over the years as well. It is the intent of the restoration plan to reconnect the streams across the existing trailer park, restore riparian corridors and wetlands, and improve water quality. Presently, the water has been diverted into ditches around the trailer park. The ditches are eroding and a source of impaired water quality that enters at least the southern arm of Lake Rensselaer.

As a result of reconnecting both streams across the mobile home park through restored riparian wetland corridors, the land now occupied by the mobile home park will be integrated back into the Preserve. The southern stream currently originates from a pond located on Preserve lands to the west. Its new channel will meander through a riparian floodplain relocated to the north of the proposed landfill expansion area. The stream will eventually reconnect to its existing channel within the wetland located on State lands to the east of the landfill. From its reconnection to the culvert at Rapp Road, the stream bed will be partially filled to eliminate the draining effect it is having on the wetland. Weirs will also be installed in selected locations along the stream to further promote an extended hydro period. The purpose of this effort is to re-saturate the organic soils comprising the wetland and reduce the accelerated decay of organic material that is a primary suspect for nutrient loading and a potential cause of eutrophication in Lake Rensselaer.

The northern stream will reconnect to the forested wetland located on the west side of the mobile home park. Drainage from the wetland area southward to the southern stream will be eliminated in order to separate these two streams. The northern stream will pass through a forested riparian corridor that will improve water quality above that of the current road and mobile home park runoff.

5. Reducing Habitat Edge Effects

The primary ecological issues associated with the interface between the landfill and the Preserve from an ecological perspective is the impacts of stormwater runoff, lack of fire maintenance, and the presence of invasive plant species. The plan has optimized the set back from state lands by varying amounts. This was determined based upon the land that is available and the activities anticipated to occur within these set backs, as well as to create habitat continuity across the landscape, minimize landfill construction and operational impacts over the life of the expansion period, and ensure that the seamless restoration and management of habitats can occur during and after closure of the landfill expansion.

Stormwater runoff will be addressed by the design and installation of a stormwater management system that will collect runoff from the landfill slopes and redirect it to a biofilter that will treat the runoff before it enters the Preserve. The current issues with stormwater runoff are associated with earlier phases of landfilling (Greater Albany Landfill – GAL) when stormwater and landfill regulations did not require the capture and treatment of runoff.

Lack of management along the landfill edge, particularly to the west of the landfill has resulted in the spread of poplar (*Populus* spp.) and black locust. Fire management has not been used in this area on the belief that methane was migrating from the landfill. This belief has since been shown to be unfounded. Recent conversations between APBPC staff and landfill personnel suggest that controlled burning is possible in the area. Therefore, between the elimination of stormwater runoff impacts and the renewed potential for maintenance by APBPC staff, the "edge effect" could be significantly reduced. Restoration efforts on the landfill cap will further contribute to a blending of existing pine barrens with the created habitat.

Criteria have been established and used in the restoration design for minimizing impacts from construction. Continued analysis of the "edge effect" will be conducted during site monitoring. The protocols for sampling have been established and will use the same methods used in establishing the baseline study of reference natural areas and in specifications attached to the restoration plan. These methods include sampling of soils, hydrology, topography, vegetation, and the development of criteria for minimizing impacts to the Pine Bush with future mitigation plans. The following specific evaluations will be provided by the methods that have been established with the base line study protocols:

- Soil chemistry impact evaluation
- Vegetation and invasive plant impact evaluation
- Fire suppression impact evaluation
- Buffer effectiveness evaluation

6. Mitigating Direct Expansion Impacts

Mitigation is an essential component of the Plan. The project will impact approximately 5.05 acres of existing forested riparian wetland associated with the ditched stream and dewatered hydric soils that occur in the expansion area. This loss can be compensated through the creation of new forested riparian corridors associated with the reconnected streams through the trailer park. By integrating new restored wetlands with proposed stream reconnections there will be reduced erosion of stream banks, providing the opportunity to beneficially improve water quality, in addition, to significantly improved habitat in the enlarged and continuous habitat features that will be restored in the present trailer park location.

Other opportunities for wetland creation and enhancement include the creation of a new Pine Bush Vernal Pond system on the disturbed sands located to the west of the mobile home park. This unique community type is present, but rare in the Pine Bush ecosystem.

In total, it is estimated that approximately 22 acres of wetland communities can be created with an additional 29 acres of wetland restoration and enhancement. An important point is that all this mitigation is tied into a restoration and enhancement plan addressing the larger issue of large scale habitat connectivity within the Preserve. At the end of 10 years, when the landfill closure is completed, there will be a total of approximately 259 acres of restoration, mitigation and enhancement, all of which will be permanently protected.

7. Proposed Mitigation Wetlands & Restored Upland Ecosystems

Forested Wetland Enhancement (Red Maple Hardwood Swamp)—27.59 acres
This broadly defined, highly variable hardwood swamp features a variety of hardwood species, many of which produce hard mast (acorns and nuts) which are high quality browse for many species of wildlife. In addition to this, the growth in the sapling and small tree canopy provides extensive bud and bark browse for animals during the winter months. This community also contains or adjoins community elements of the riverine system, the vernal pool community type, and nearly every other palustrine and terrestrial community of the restoration area. The highly diverse community interactions and the diverse internal species structure of this community indicate that it can be a productive community in the site for wildlife.

However, the existing forested wetlands found in the State property are highly degraded and continue to demonstrate a modified hydrology and associated vegetation systems. And the restoration and enhancement plans are focused on reversing these trends. Currently, remnant agricultural drain tiles were found to be functioning and are located throughout this property on ~20-30 foot centers. These clay tiles drain the upper 18-24 inches of the hydric soils present in the wetland to the dredged agricultural ditch also present in this property. The dredged ditch has further eroded down into underlying substrates and this downcutting and the presence of the tiles both act to exacerbate the dewatering effect on the adjoining wetlands. This dewatering effect is not only contributing to impaired water quality (e.g. runoff in the ditch contains exfoliating, dewatered muck substrates that are eroding from the ditch banks, and also the entrenched ditch has encountered an iron rich and red-ochre discolored ground water found to be present below the surface soils which is now freely flowing into the surface waters of the ditch) but also allowing for invasive plant species such as garlic mustard, reed canary grass and even multiflora rose to colonize into the dewatered nutrient rich substrates.

Restoration will install several log grade control structures that will prevent the further down-cutting of this ditch, will help reverse this down-cutting by creating locations where the existing delivery of eroded substrates from the banks will be used by the stream to naturally backfill entrenched locations and to again bury the source of the discolored iron rich ground water. In addition, we will disable the tile systems which along with the surcharging of water in the ditch created by the small grade control structures will surcharge the hydrology again into the dewatered soils. This surcharging of water will prevent the further colonization by invasive plant species that require the dewatered soils presently found in the property. In addition, restoration will also be focused on directly managing to remove and reduce the invasive species that have already colonized the degraded site conditions.

We will also stabilize the eroding dredge spoil piles on both sides of the ditch by planting wetland grasses and other plants that can grow in such shaded environments in these soil types.

The restoration activities will not reduce the tree cover in the NYDEC property and are focused on affecting the positive hydrology and vegetation restoration outcomes. They will also have the direct effect of improved water quality downstream.

<u>Forested Wetland (Red Maple-Hardwood Swamp)—11.34 acres created, 2.0 acres restored; Forested Riparian Wetland (Red Maple-Hardwood Swamp)—6.04 acres created, 0.82 acres restored</u>

Observations made within the larger contiguous portions of this community showed that in some areas, including within the riparian corridor, red maple is the only canopy dominant. In other areas it was seen as a co-dominant with one or more other species of hardwoods, but most typically with swamp white oak or silver maple. Forested wetlands created in the mobile home park will be designed to have similar functions as the other more mature forested wetlands on the property. While in a "start-from-scratch" restoration, this community type will often require numerous years of forest growth to achieve the functions and values of the existing forested communities, this plan proposes a strategy to accelerate this establishment process. For example, the use of salvaged substrates and root masses of trees will immediately introduce tree, shrub and seed stock that will quickly and vigorously sprout and grow. Within a period of several years a closed sapling canopy from these sprouts will result. However, during this transitional phase the created wet forests will provide habitat cover, some food sources, and a lush ground cover to assist in infiltration and provide some if not all of the functional values of the successional disturbed substrate swamp found in the area to be impacted for the landfill expansion.

As this community matures, the hardwood swamp will be dominated by red maple, green ash, swamp white oak, and American elm. The oaks will produce hard mast (acorns) which are high quality browse for many wildlife species. In addition, the dense growth in the sapling and small tree canopy will provide extensive bud and bark browse for animals during the winter months. The highly diverse community interactions and the diverse internal species structure of this community suggest this community type will become one of the most productive communities of the landfill property for wildlife.

<u>Biofilter Wetland—0.69 acres created, 0.73 acres restored</u>

The biofilter wetlands are primarily installed within the restoration plan to receive stormwater runoff waters from the landfill surface in the operational interim and after the landfill closure and restoration of the surface acreage occurs. This community is targeted to provide a basic diversity of appropriate native plant species that will act to slow and contribute to cleansing the runoff waters from the landfill surface and from service roads around the landfill. While this biofilters system will provide some food and cover for wildlife, this is a secondary outcome and not the primary purpose of the vegetation plantings in the biofilters. Wetland vegetation will absorb and adsorb some nutrients and thus reduce nutrient inputs entering the restored stream and associated restored riparian forests found downstream of the biofilters wetlands. The biofilters also are sized and planted to provide floodwater storage when high water and high rainfall events occur. The wetland plant community will provide aesthetic beauty and recreational opportunities for local residents and others who visit the site for activities such as bird watching and wildlife viewing.

An aggressive maintenance program will be focused on removing invasive plants (e.g. *Phragmites communis*) from the biofilters wetlands, and also debris and sediments that are likely to accumulate during the landfill interim operational period over the next 6-7 years before the landfill operations are closed and stabilized with native vegetation plantings as described below.

<u>Pine Barrens Vernal Pond—1.12 acres created; 0.35 acres existing P4 Wetland Mitigation managed to control invasives only and not included in wetland credits for this project</u>
The plan proposes to create a pine barrens vernal pond in a dry depression between forested and open sand dunes west of the trailer park. This area may have supported such a community prior to the filling, ditching, and regrading disturbance that occurred during construction of the trailer park. The creation of a vernal pond is a valuable opportunity for the Preserve to expand this rare habitat type important to amphibians and other faunal species of the Preserve. Pieziometric water data we have collected over the past several years have identified the variability of ground water surface elevations in the proposed restoration area. This data will be used during construction to set grades to intercept the shallow ground water allowing appropriate seasonal fluctuations and permanently saturated conditions that will support the reintroduced vernal pond vegetation. Plant species will include the dominant and characteristic mosses, sedges, grasses, and forbs, as well as shrubs such as meadow-sweet, hardhack, high bush blueberry, black chokecherry, and leatherleaf.

<u>Sedge Meadow—0.63 acres created</u>
The sedge meadow community will provide a diversity of plant species and will provide wildlife food and cover. This sedge-dominated community will provide a vegetative transition zone between the pine barrens vernal pond and the restored native riparian forest communities along the restored stream. The sedge community and associated vernal pond are two of the rarest communities in the APBP and restoration of these communities in this location provides an asset of increasing value as local communities of these types are lost to continued land development around the Preserve.

Several non-wetland plant communities integral to the overall success of the restoration and mitigation program will also be restored or enhanced.

<u>Dry Prairie/Sand Flat—45.0 acres restored; Dune and Dune/Barrens—4.55 acres restored; Native Plant Nursery—1.44 acres created</u>
Reconnecting the APBP across the property currently occupied by the operational landfill, the trailer park and adjacent degraded old fields (e.g. west of the trailer park) will be primarily accomplished by re-establishing dry prairies and dune systems growing with dry prairie grasses and other native plant species. Initially, a small portion (1.44 acres) of the trailer park will be devoted to a native plant nursery to produce seed for the restoration, but later will be converted to dry prairie. The majority of the closed landfill surface will be restored to dry prairie (and scrub community–see below) and this represents a large acreage that will in the future provide ecological benefits to the Preserve. In particular, the restoration of these communities will be focused on reestablishing the plant communities that are important and necessary for expanding the Karner Blue Butterfly habitat in the APBP landscape. The dry

prairie and dune restoration areas will be created in graded flats and created dune structure areas which are planted with little bluestem grass, lupines and numerous other plant species found in the reference area studies elsewhere in the Preserve. The expansion of these community types presents another unique outcome of the restoration program and increases the acreage and continuity of these very important and needed ecological communities in the Preserve.

<u>Pitch Pine-Scrub Oak Barrens—121.93 acres enhanced; Pitch Pine-Oak Forest Buffer—30.92 acres enhanced</u>

A matrix community type we refer to as Pitch Pine-Scrub Oak Barrens will be comprised of a native grass dominated vegetation with varying shrub and tree cover and woody species composition. Variants included within this matrix can include the true grass dominated barrens, along with the Pitch Pine/Scrub Oak Thicket and Pitch Pine/Oak Forest types which essentially are the same but which reflect differing time periods since last restructured by prescribed fire.

The pine barrens habitat is a dynamic landscape occupied by dry grasslands where fire frequencies and intensities restrict scrub oaks and tree growth. In slopes and draws and extensive flats, trees and scrub oaks have colonized, and while these are regularly managed with prescribed fire, they persist and are a part of the landscape plant community mosaic. The restoration plan includes the restoration of these forest and thicket communities in some locations to compliment the mosaic and connectivity desired over the Preserve. These areas will be restored by planting the same matrix of dry prairie grassland as described above, and then by modifying the fire management program and planting oaks, native shrubs, and many of the other herbaceous and graminoid plant species found in reference natural areas of the Preserve. Some existing upland forested areas that provide a buffering function against the New York State Thruway and developed lands to the east will be enhanced as Pitch Pine-Oak Forest. Where these forested communities are highly degraded with few pine and oak canopy trees (adjacent to the highway), invasive species will be removed and native tree species will be reintroduced over time. Less degraded forested uplands will require understory enhancement of the herb layer.

8. Restoration Program Summary

The activities associated with the restoration program will each and collectively result in significantly improved wetland functions over the existing degraded landscape and in locations which currently do not contain any desirable ecological conditions. Falling into the last category would be the trailer park and landfill surfaces, and degraded areas such as the ditch and tile drained former agricultural lands. The degraded water quality and accelerated stormwater releases currently generated from these lands will be reversed with the restoration of ecosystem functions that will allow the land to hold water, reducing downstream flooding and improving water quality. Wildlife habitat that is currently restricted or non-existent for many species, including special status species such as the Karner blue butterfly, buck moth, eastern spade foot toad, and others, will be greatly and significantly expanded under the restoration program.

Restoration will involve earth moving in the mobile home park to remove existing imported topsoils that support ornamental and invasive plants, to create the landform and hydrology relationships that will support the desired restored wetlands and also the establishment of the dry prairie and pine barrens with sparse inclusions of scrub-forested uplands.

Restoration will also involve changing the cover on the landfill surface to desirable native dry prairie and scrub ecosystem as a part of the site closure. This will require killing the existing nonnative weeds and cover plantings, establishing a nutrient poor sandy rooting medium on top of the approved landfill cap, and planting dry prairie and scrub community into this new rooting medium.

Later sections of the restoration plan layout the overall restoration philosophy to be employed, phasing strategies and plans, detailed construction specifications and grading plans, monitoring and maintenance programs, and ongoing management and restoration needs during the life of the restoration program. In addition, performance terms are defined to ensure that expectations are clearly understood among all parties, and most importantly, that triggers for success and any rollover of the perpetual responsibilities for management, maintenance, and monitoring occur in a logical, sequenced, and orderly fashion.

We are committed to restoring all areas with the use of local-genotype native plant seeds and plants, and by use of management techniques that will stimulate any remnant seed bank that is present in some of the soil systems. These plant communities will be restored and created on bare soil, free of invasive non-native plant species by planting seeds, live plants, and other plant propagules and by using salvaged substrates from the wetlands that will be impacted as a part of landfill expansion.

There are opportunities for native plant (e.g. tree and shrub) and propagule (e.g. seed and acorn) salvage on the landfill Expansion Area. Salvage includes removing live trees and shrubs, gathering native plant seeds, acorns, and other fruits, and transplanting plants and soil from one location to another on site. From an ecological standpoint, this is beneficial because it preserves local genetic material that is adapted to local climate and soil conditions, thus, improving the chances for long-term survival of the planted material. It is also valuable from a cultural perspective because it attempts to preserve and transplant desirable native vegetation representing a natural history legacy, which would otherwise be lost in this area due to activities including construction and agriculture.

Acorns could also be harvested on site and directly seeded in restoration and enhancement areas, or if not germinating, over-wintered in cold storage and planted in the spring. Soil containing desirable native propagules or plants will be scraped from areas to be disturbed and spread in restoration and enhancement areas. While salvaging existing native vegetation from the new landfill Expansion Area site is not required for successful execution of a restoration plan, the opportunity to use this beneficial technique does exist and has been incorporated into the plans.

In 2009, if selected by the City for plan implementation/construction, we would propose to start to coordinate an expansion of the existing local seed collecting program in the APBP and other appropriate locations using AES nursery operations. Seed would be used to establish an onsite native plant nursery in a portion of the trailer park for bulk seed production of selected species (see proposed nursery location on Plan Set Sheet R.3). Protocols for collecting seed within the Preserve would follow strict APBP guidelines for protecting native seed stock from depletion and for maintaining genetic relevance (i.e. limit seed collection to within a 50-mile radius). Specifications and guidelines for seed collection and processing will be detailed in a native plant nursery plan to be reviewed and approved by APBPC and others collaborating on the management team.

On similar large scale projects where AES has conducted such an effort, we have quickly and successfully initiated a substantial seed collection program and very large quantities of locally derived native plant seeds for eventual use in restoration. For example, at the Seneca Meadows Landfill near Seneca Falls, NY seeds for nearly 100 species were collected for propagation and use in the restoration of the property. And for The Nature Conservancy in Indiana, AES seed collection crews (and local hired high school and other students and neighbors) collected over 300 species and thousands of pounds of seed annually for use in the Kankakee Sands restoration project. This strategy creates the best possible outcomes for local employment and community engagement, the development of a substantial local supply of seeds for species that are part of the diversity of places such as the APBP but that are often not commercially available from regional nurseries, and also establishes immediate conservation-based relationships between the City and land owners who have remnant Pine Bush habitat on their property.

In some projects we have paid adjacent landowners fees for allowing the collecting of seeds resulting in private landowners becoming committed to conservation of their lands. The lists of targeted species are provided in the Restoration Planting Schedule in the attached plan set. These lists are comprised largely of species recorded in baseline studies of reference Pine Bush communities, and augmented with species based on review of regional and local floras. Refinement of these lists will be made in collaboration with APBP experts and further research of Pine Bush floras [e.g. D. Rittner (ed). 1976. Pine Bush: Albany's Last Frontier; Barnes, J.K. 2003. Natural History of the Albany Pine Bush: Field Guide and Trail Map. NYS Museum Bulletin 502, Albany, 245p (contains Vascular Plant Species List compiled and edited by George R. Robinson and Kathleen Moore, State University of New York at Albany)].

E. Restoration & Mitigation Work Plan

1. Program Structure and Implementation

Ecological restoration occurs in two general phases:

a) ***Restoration Phase***: The restoration phase is the period when major efforts are undertaken to restore, enhance, and create vegetation and biological diversity. This begins the process of restoring ecological functions. Tasks during this phase include reducing non-native and undesirable native species, restoring hydrology, mowing, seeding and planting of native plant species, and performing routine management activities.

b) ***Management and Maintenance Phase***: After achieving initial goals, the restoration, enhancement, and creation processes shift to a lower-cost, reduced-intervention management and maintenance program. Tasks during this phase include spot herbicide treatments, remedial planting, and other approved management activities. This may provide an opportunity for long-lasting personal involvement by local residents and/or employees in land stewardship. Direct involvement in site stewardship and conducting plant monitoring and bird-use assessments can provide an important, meaningful way to engage the community in the restoration project.

To conduct the native plantings and enhancements, ecological concepts and prescriptions are written and scheduled over a multi-year period for each of the several management units at the site. Management units are typically ecologically significant groupings of plant communities that are convenient to access and manage. After restoration is underway, and recovery of native plant communities ensured, the management plans are solidified and the management phase begins. Tasks are performed on a regular schedule, guided by annual ecological monitoring. Management strategies are usually completed on a rotational basis. For example, areas to be managed are often split into management units demarcated by existing and convenient breaks, such as hiking trails or surface water features. While certain management tasks will occur only in particular management units in a given year, the annual monitoring and other annual management tasks will occur throughout the entire wetland mitigation project area. Appendices 2 and 3 provide details for implementing the management and monitoring activities required throughout the restoration area.

2. Scheduling

The planting and management schedule developed for the site is designed to produce healthy and sustainable ecological systems in the site's conservation areas. This program outlines an initial two-year construction and installation period followed by a ten-year management program with the option of making adjustments if necessary. Appendices 2 and 3 include monitoring methods, management methods, and performance standards. In this way the plan helps to ensure that the site will support healthy ecological systems over a long period of time.

3. Ecological Monitoring

Ecological monitoring provides important data about the effectiveness of the restoration and management program. Monitoring requires that the response of the native plant communities and often fish and wildlife use be checked regularly by measuring ecological indicators of plant and animal community recovery (Appendix 3). Effectiveness is judged against the goals and objectives of the project design. Goals can be modified over time as a result of this feedback. The results of annual monitoring are used to direct the management activities for the upcoming year. Photography will be used to document a chronosequence of ecological change during restoration and management. Baseline ecological monitoring as a part of the permit requirements was conducted in 2006 and these reports are provided in the SDEIS.

4. Reporting

Management reports detailing locations and dates of restoration and management efforts undertaken will be completed annually during the restoration phase of the project. Summary reports will be prepared for the restoration program. During the permit compliance period, a proposed 10-year period after restoration is complete for each of the settings to be restored; annual monitoring and reporting will be conducted as outlined in Appendices 2 and 3.

5. Construction Phasing

The construction phasing of the Rapp Road Landfill Eastern Expansion and the restoration earth moving needs will be coincident. It is the intention of the City to use the design team or equivalent to oversee and build the restoration programs included in this plan. Oversight by a highly qualified team of the grading activities will be essential to ensure that the very specialized grading needs associated with the ecosystem restoration areas is completed accurately. Immediately upon concluding the grading for the restoration areas (pine barrens vernal pond, sedge meadow, new stream channels, etc) the salvaged wetland soils and included selected areas with native plant stock materials found in the eastern expansion areas will be salvaged and then immediately placed in the receiving locations in the restoration zones. Minimal stockpiling of the salvaged materials is desirable or anticipated with the construction phasing plans proposed in this program.

The Phasing Plan depicted in the Plan Set illustrates the anticipated phasing of the project. The first phase will occur in Year 1 and will be concurrent with construction of the first landfill cell that will include overfill and expansion onto other currently disturbed lands. Wetland impact will be avoided in this phase and therefore wetland mitigation will not be the primary focus. However, this phase will provide the opportunity to prepare for wetland mitigation and the rescue of desirable species from the Expansion Area. During this phase, ecologists will begin the process of identifying and preparing species for transfer. A nursery will be established on the mobile home park site where some species will be transferred. For those trees that will stump sprout, roots will be cut and the trees will be allowed to adjust before it is transplanted.

Restoration during Phase 1 will focus on the establishment of test plots comprised of grasses and forbs characteristic of the pine barrens planted in varying depths of sandy substrate on portions of the closed landfill. The goal of these test plots is to determine the minimum depth of sand in which these species will thrive, results which will inform the amount of sand used in subsequent plantings on the landfill. The test plots shall be designed in conjunction with the other members of the project's management team.

Phase 2 is identified as years 2 and 3 and will provide some very substantive results by restoring much of the mobile home park to pine barrens and riparian wetland, reconnecting streams, restoring wetland hydrology, enhancing degraded wetlands, and improving water quality. Most of the wetland and stream mitigation work will occur in this phase.

Phase 3 (years 3 and 4) will again take on some significant restoration and enhancement efforts, particularly on the landfill, creating the pitch pine buffer along the Thruway, addressing stormwater and invasive species issues on the western edge of the landfill, and completing the east-west habitat connection with the restoration of pine barrens in the northeast portion of the project area.

Phases 4 & 5 (years 5-6 and 7-10) will focus on the landfill cap, restoring pine barrens to currently closed portions in Phase 4. Phase 5 will be part of the final closure of the landfill.

In order to support the unique ecological communities of the Pine Bush, the sands should come from the Pine Bush or possibly from other areas within the region with similar soils. The results of the detailed soils analysis performed as part of this SDEIS may also allow for the chemical modification of sands taken from other sources should there be no other options. Sands will be stockpiled and used as needed.

The success of this undertaking will depend partly on continued cooperation between the City and various stakeholders such as the APBPC, The Nature Conservancy, and regulatory agencies, as well as on the input received from the public during the SEQR and permit processes.

6. Closure Plan

When the Eastern Expansion reaches capacity, the landfill will be closed with the construction of a multi-layered cover system including a cushion layer, a barrier layer, a drainage layer, a barrier protection layer, and a topsoil layer. The restoration and re-vegetation plan, as well as stormwater controls will also be included in the closure construction. No modifications to the closure cover system components summarized as follows are proposed:

Cushion Layer
The cushion soil layer will consist of a six inch layer of soil containing no particles larger than one inch in diameter. The purpose of this layer is to provide a uniform surface for support of the barrier layer.

Barrier Layer
The barrier layer will consist of a 40 mil textured LLDPE geomembrane. The main function of the geomembrane is to prevent percolation of water into the waste mass and prevent the generation of leachate.

Drainage Layer
The drainage layer constructed above the barrier layer will consist of geocomposite drainage net. The geocomposite will consist of an HDPE core net with a non-woven geotextile fabric bonded to each side. The function of the geocomposite is to promote rapid horizontal drainage of water that percolates to the geomembrane barrier surface in order to prevent saturation of the overlying cover soil and maintain stability of the cover system.

Barrier Protection Layer
The barrier protection layer will consist of a two foot thick layer of soil containing no particles larger than one inch in diameter. The purpose of this layer is to provide protection of the barrier layer from frost action, root penetration, and physical impact.

Topsoil Layer
The topsoil layer will consist of sands capable of supporting Pine Bush communities. The top soil layer is proposed to be sand substrates found locally that meet the chemistry and physical specifications that have been designed in coordination with the Pine Bush Preserve Staff and based on measured chemistry from reference natural areas in the Pine Bush Preserve. The specifications for soils are included in Attachment 2.

To restore the landfill cap, an average depth of approximately 2 feet of clean Pine Bush Preserve quality sand will be placed over the existing surface and roughly graded to provide microtopography as is found in natural conditions. Some areas will have more sand depth, others will be slightly thinner in depth. Soils are a critical element for the success of the restoration project. The simplest way to ensure proper soil conditions is to use the existing Pine Bush soils. Some of the soils are expected to come from the expansion area but more soil will be needed. Since the project will be phased over the 6-7 year life of the landfill expansion, it is anticipated that soils can be "collected" from other areas within the Pine Bush Preserve study area as projects occur. These soils would be stockpiled and used as each phase progresses.

Vegetation and Erosion Controls
Initially, non-aggressive and short lived cover crop plantings will be used to stabilize the slopes and top of the closed landfill where the new topsoil layer has been applied. We will simultaneously seed and plant native grasses and other vegetation to create the ecosystem types on the restoration plans and developed from reference-area data collected from native plant communities in the Albany Pine Bush Preserve. Temporary erosion controls such as straw mulch, silt fence, and diversion swales and other strategies will provide stabilization of the landfill slopes.

The overall intent is to create dry prairie and pine barrens habitat across the landfill cap to provide Karner blue butterfly (*Lycaeides melissa samuelis*) habitat for this federally and State listed endangered species, as well as habitat for other State listed species unique to the pine barrens community. This community type includes dry grasslands punctuated by occasional pitch pine trees and scrub oak (*Quercus ilicifolia* and *Q. prinoides*)

Demonstration Plots
The demonstration plots will be the early testing grounds for the larger restoration, enhancement and mitigation efforts. Examples of former restoration and demonstration programs for testing invasive species management and restoration strategies will be provided under separate cover. A specific demonstration and testing program plan will be further developed throughout the SEQR process and finalized prior to permit issuance, following the program layout in Appendix 3.

Implementation
Details of the ecological restoration plan will be developed following the SEQR process when the best alternative has been identified and the layout finalized. Design standards for the restoration plan have been developed and are provided under separate cover. These are a result of the fall 2006 detailed field sampling of soils, hydrology, topography and vegetation in reference natural areas in the Pine Bush, the results of which are included in Appendix 7.

These data have been analyzed and summarized in simple technical memoranda that are the design standards for use in all restoration and mitigation elements in this project. The design standards created by this analysis include technical specifications and standards for:

- soil chemistry, stratigraphy and texture;
- shallow ground water and surface water dynamics;
- topography data providing water entry grades for wetland restorations, stream profiles, and correlated soils, hydrology and vegetation along cross sections; and
- vegetation structure, composition and diversity by woody and herbaceous strata.

7. Construction Specifications

Construction Specifications are presented in Appendix 2.

8. Monitoring Plan and Performance Criteria

A detailed monitoring plan describing the monitoring requirements and performance standards for the wetland restorations and enhancements in the expansion and restoration areas is presented in Appendix 3. The layout of monitoring stations and study transects is presented in the Monitoring Plan (Sheet M.0) of the accompanying Plan Set (Appendix 1).

9. Integrated Pest Management Plan

An integrated pest and invasive species management plan is included in Appendix 4. It provides details for controlling invasive species throughout the short and long term management periods.

The first two to three years of the restoration, enhancement, and creation process are the most critical for ensuring the favored native plants are allowed to firmly take hold, by helping them to compete against established and invading noxious weeds. Therefore, an important challenge for the restoration project is to eliminate or significantly reduce existing invasive vegetation including exotic species and to control and manage future invasions. Of particular concern is common reed (*Phragmites australis*) which presently dominates the landfill slopes. Two primary characteristics of these slopes explain the presence of this highly aggressive species: wet and disturbed soils. Common reed prefers wet soils and is a well-known wetland invasive. Runoff from the landfill has created seeps along the slopes that provide the suitable hydrology to support this species. Furthermore, the soils consist of fill material that this tolerant plant can easily colonize.

The restoration plan will first eliminate the common reed by excavating the area and implementing a stormwater management plan that will capture, redirect, and treat runoff. Sufficient sand will be placed on the affected areas to the extent that the hydrology that supports the common reed is eliminated and replaced by xeric (dry) conditions that will support the dry prairie and pine barrens habitat, and not *Phragmites*.

10. Third-Party Monitor Quality Assurance Plan

A Third-Party Monitor Quality Assurance Plan is included in Appendix 5. This document provides the qualifications and scope of responsibilities of a third-party monitor for overseeing and reporting on regulated activities in wetlands and other restored, enhanced, and created plant communities within the project area.

F. Site Protection and Financial Assurances

The Ecological restoration plan requires a significant effort and commitment of money and resources to implement and is contemplated by the City only as a component of the landfill expansion project. The expansion will provide the financial capability to undertake this massive effort over time. Since a portion of the landfill would remain active for 6-7 years as a result of the proposed expansion, the restoration will occur in phases over this time period. Detailed cost estimates will be prepared as the plan becomes refined towards construction drawings. Site protection and financial assurances are being discussed with DEC.

G. Deed Restrictions and Easements

The City intends to deed over all City-owned lands to the APBPC that are part of the restoration plan and others that are currently dedicated to the Preserve to ensure protection and preclude any potential for future landfill expansions.

APPENDIX 1.

ALBANY RAPP ROAD LANDFILL PLAN SET

(See Plan Set accompanying this document)

APPENDIX 2.

CONSTRUCTION SPECIFICATIONS

ALBANY RAPP ROAD LANDFILL
ECOSYSTEM MITIGATION, RESTORATION & ENHANCEMENT PLAN

CITY OF ALBANY, NEW YORK

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April 2009

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SECTION 01 35 43

ENVIRONMENTAL PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Requirements for environmental protection of air, water, and land resources during construction of Albany Landfill wetland mitigation and restoration project complete in all respects.

B. The CONTRACTOR shall furnish all labor, equipment, and materials required for environmental protection during and as the results of construction operations.

1.2 REGULATORY REQUIREMENTS

A. The CONTRACTOR shall comply with all applicable Federal, State, and local laws and regulations concerning environmental protection, as well as the specific requirements stated in this Section and elsewhere in the Specifications.

PART 2 - PRODUCTS

2.1 GENERAL

A. All material shall be in accordance with the CONTRACTOR's plan for environmental protection.

PART 3 - EXECUTION

3.1 PROTECTION OF LAND RESOURCES

A. Alteration, damage, or impacts of any kind on the land resources outside the limits of work are strictly prohibited. If the land resources outside the limits of work are affected by the work, such affected areas shall be restored to a condition after completion of construction that is equal to existing conditions.

B. The CONTRACTOR shall confine his construction activities to the area defined on the Drawings or in the Specifications except with written approval of the OWNER and OWNER'S REPRESENTATIVE. In no case shall wetlands be disturbed in any manner inconsistent with the Drawings and Specifications, and all disturbances shall be in accordance with the conditions of the permits referenced in Section 1.2 above.

C. Limits of working area include areas for storage of construction equipment and material, and shall be cleared in a manner which will not negatively affect the environment during or after the construction period. The CONTRACTOR shall not enter beyond the limits of the working area except with written approval of the OWNER and OWNER'S REPRESENTATIVE.

D. The location of storage of the CONTRACTOR'S equipment and materials for the performance of the work shall be limited to staging areas approved by the OWNER.

E. The CONTRACTOR shall remove all temporary construction facilities and unused materials and equipment from the work site prior to final acceptance of the work. Disturbed storage areas shall be graded and filled as required to prevent ponding of surface water.

3.2 PROTECTION OF WATER RESOURCES

A. All work shall be performed in accordance with the Stormwater Pollution Prevention Plan (SWPPP) for the project. The Stormwater Pollution Prevention Plan will be provided by the OWNER to the CONTRACTOR prior to the start of work. The CONTRACTOR shall become familiar with the requirements of the Stormwater Pollution Prevention Plan prior to the start of work and shall be prepared to implement the plan in accordance with the requirements contained therein.

B. The CONTRACTOR shall not pollute streams, lakes, or reservoirs with fuels, oils, or other harmful materials. It is the responsibility of the CONTRACTOR to investigate and comply with all applicable Federal, State, County, and Municipal laws concerning pollution of rivers, streams and impounded water. All work shall be preformed in such a manner that objectionable conditions will not be created in streams through, or bodies of water adjacent to, the project area.

C. Surface drainage from cuts and fills within the construction limit, whether or not completed, shall be graded to control erosion within acceptable limits.

D. Measures shall be taken to prevent chemicals, fuels, oils, grease, waste washings, and other harmful materials from entering public waters. Should any spillage into public waters occur, the CONTRACTOR shall immediately notify the proper authorities? The CONTRACTOR will be responsible for any and all cost associated with the cleanup of spillages.

E. Disposal of any materials, wastes, trash, garbage, oil, grease, chemical, etc., in areas adjacent to streams or other waterways shall be strictly prohibited. If any such material is dumped in an unauthorized area, the CONTRACTOR shall remove the material and restore the area to its original condition. If necessary, contaminated soils and vegetation shall be excavated, properly disposed of and replaced with suitable fill material, compacted and finished with topsoil, all at the expense of the CONTRACTOR.

3.3 PROTECTION OF FISH AND WILDLIFE

A. The CONTRACTOR shall take such steps as required to prevent any interference or disturbance to fish and wildlife. The CONTRACTOR will not be permitted to alter water flows or otherwise disturb native habit adjacent to the project area.

B. Fouling or polluting of waters will not be permitted. Wash waters and wastes shall be processed, filtered, ponded, or otherwise treated prior to their release into streams or other waterways, and if not adequately treated shall be properly disposed of off site. Should polluting or fouling of any watercourse occur, the CONTRACTOR shall immediately notify the proper authorities. The CONTRACTOR will be responsible for any and all costs associated with the cleanup of polluted or fouled waters.

3.4 MAINTENANCE

A. The CONTRACTOR shall dispose of all debris and waste in a manner approved by the OWNER’S REPRESENTATIVE. Toilet facilities shall be kept clean and sanitary at all times. Services shall be performed at such time and in such manner to least interfere with site operations.

B. The CONTRACTOR shall frequently remove materials no longer required on the site so that at all times, the site, access routes to the site and any other areas disturbed by the CONTRACTOR’S operations shall present a neat, orderly, workmanlike appearance.

C. Before final payment, the CONTRACTOR shall remove all surplus material and debris of every nature resulting from the CONTRACTOR’s operations. The CONTRACTOR shall restore the site to a neat and orderly condition satisfactory to the OWNER.

3.5 DUST CONTROL

A. The CONTRACTOR shall maintain all excavation, embankments, stockpiles, haul roads, permanent access roads, borrow areas, and all other work areas within the project boundaries free from dust which would cause a hazard or nuisance, or which would contribute to surface water contamination.

B. Approved temporary methods for dust control include the spraying of water and the removal of dried soil from land or roadway surfaces with self-loading motor sweepers or vacuum trucks. Spraying water shall be repeated at such intervals as to keep the disturbed areas dampened. The use of additives must be approved by the OWNER’S REPRESENTATIVE prior to application. Penetrating asphaltic materials are prohibited for use in dust control at the site. Dust control is to be performed daily as required to prevent nuisance or hazardous conditions.

3.6 NOISE AND VIBRATION CONTROL

A. The CONTRACTOR shall use every effort and means to minimize noise caused by the CONTRACTOR’s operations. The CONTRACTOR shall provide working machinery equipped with adequate muffler systems. The CONTRACTOR is responsible for maintaining compliance with all applicable noise regulations and all State and local noise ordinances.

3.7 P PROHIBITED CONSTRUCTION PROCEDURES

A. The CONTRACTOR is advised that the disposal of any material in unauthorized areas, including but not limited to wetlands and stream corridors is strictly prohibited.

B. The CONTRACTOR shall, at a minimum, be prohibited from performing the following construction procedures:

- Dumping of spoil material into any stream corridor, wetland, surface water or specified location.
- Indiscriminate, arbitrary or capricious operation of equipment in any stream corridor, wetland, or surface water.
- Pumping of silt-laden waters from excavation into any natural surface waters, stream corridor, or wetland.
- Damaging vegetation adjacent to, or outside of, the limit of work.
- Disposal of trees, brush, and other debris in any stream corridor, wetland, surface water or unspecified locations.
- Permanent or unspecified alteration of the flow line of any stream outside the limit of work shown on the Drawings.
- Open burning of project debris.
- Location of storage stockpile areas in environmentally sensitive area.

END OF SECTION

SECTION 01 56 39

PROTECTION OF EXISTING VEGETATION

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes the protection of all vegetation to remain undisturbed during completion of earthwork required for construction of the Albany Landfill wetland mitigation and restoration project, complete in all respects. All vegetation outside the limits of work defined on the drawings shall be protected and not disturbed. Any disturbance by the CONTRACTOR of vegetation outside of the limits of work shall be restored in kind and in accordance with the vegetative planting requirements in these specifications, at no additional cost to the OWNER.

B. Related Sections:
1. Section 31 13 13 – Selective Woody Brush Removal,
2. Section 31 13 14 – Herbaceous Species Removal,
3. Section 31 22 00 – Excavation and Fill

1.2 REGULATORY REQUIREMENTS

A. Perform all work in accordance with applicable Federal and State wetlands regulations

1.3 QUALITY ASSURANCE

A. Provide at least one person responsible for this portion of the work, who shall be thoroughly familiar with the vegetation to be preserved, and means and methods of preservation. Said person shall direct the work performed under this section.

1.4 SUBMITTALS

A. Materials: Prior to delivery of any materials to the site, submit to the OWNER a complete list of materials to be used during this portion of the work. Include complete data on source, size and quality. This submittal shall in no way be construed as permitting substitution for specific items described on the plans or in these specifications unless approved in writing by the OWNER.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Red or fluorescent pink vinyl flagging.

B. Fencing, 48" tall, high density polyethylene (HDPE) with nominal mesh opening size of 1.25" x 1.25", orange, and mounted on metal T posts, minimum 72" in length, or approved equal.

PART 3 - EXECUTION

3.1 GENERAL

A. Demarcate limits of vegetation to be protected, using flagging, fencing, or other approved means, in accordance with the requirements of the drawings and specifications, permits referenced in Section 1.2, and in accordance with the Stormwater Pollution Prevention Plan and Part 360 permit and associated engineering design drawings governing the limits of and sequence of work.

B. No work of any kind shall be performed within protected areas demarcated in accordance with A. No vehicles, equipment, or material shall be stored, placed, deposited, etc. in protected areas.

C. Demarcation limits shall be maintained in a clearly visible manner during the course of the work. Means of demarcation shall be promptly repaired, as needed.

3.2 CLEAN-UP, REMOVAL AND REPAIR

A. Clean up: after work is complete, clean up any remaining materials, debris, trash, etc. Keep the protected area free from construction and other debris at all times.

B. Removal: after all work has been completed remove any remaining flagging, fence, posts, ties and all other debris. Restore the ground to a condition similar to prior to work, or the condition of surrounding ground after work is complete.

C. Repair: Repair any damage caused by the CONTRACTOR during completion of the work described in this Section.

3.3 INSPECTION

A. Prior to the commencement of any other work, the CONTRACTOR shall schedule with the OWNER a provisional acceptance inspection of fencing.

B. The CONTRACTOR shall conduct inspections of fencing to ensure that it is maintained in an upright position, at least daily in areas of active work.

END OF SECTION

SECTION 31 10 00

SITE CLEARING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Clearing, grubbing and removal of debris at the work site shown on the Drawings.

B. Related Sections:
   1. Section 01 35 43 – Environmental Protection
   2. Section 31 23 00 – Excavation and Fill

1.2 REGULATORY REQUIREMENTS

A. Conform to all applicable codes for disposal of debris. Burning of debris is prohibited.

PART 2 - PRODUCTS

2.1 MATERIALS

A. None under this Section.

PART 3 - EXECUTION

3.1 CLEARING AND GRUBBING

A. No clearing, grubbing, or stripping of surficial soil shall commence until the CONTRACTOR has staked out the proposed work, except for the work that may be required to complete the stakeout survey.

B. Except as otherwise directed, the CONTRACTOR shall cut, grub, remove and dispose of all objectionable material such as trees, stumps, stones, brush, shrubs, roots, rubbish, and debris within the limits of the clearing as defined in the Drawings. All such material shall be removed from areas to be occupied by structures, roads, or any other appurtenant construction, and from areas designated for stripping. No stumps, trees, limbs or brush shall be buried in any areas not designated to receive such material.

C. When so designated by the OWNER'S REPRESENTATIVE, the CONTRACTOR shall protect adjacent wetlands vegetation, trees or groups of trees, monitoring wells, property markers, survey control monuments or other site features from damage by any construction operations by erecting suitable barriers, or by other approved means, and as specified in Specification 01 56 39. The CONTRACTOR shall make every effort not to damage common native trees and shrubs, other than those he is permitted to cut, within or adjacent to the limits of work. Areas outside the limits of clearing shall be protected. No equipment or materials shall be stored in or allowed to damage these areas.

D. The CONTRACTOR will dispose of all trees, brush, stumps and roots off-site or as directed by the OWNER'S REPRESENTATIVE.

3.2 STRIPPING

A. Stripping of Topsoil shall be performed in accordance with Specification 31 23 00.

3.3 CLEAN-UP, REMOVAL, AND REPAIR

A. After site clearing work is complete, any remaining materials, debris, and trash shall be cleaned and removed from the site by the CONTRACTOR. All areas damaged by the CONTRACTOR during this work shall be repaired by the CONTRACTOR and all areas outside of the construction limits disturbed by construction shall be restored to pre-construction conditions.

END OF SECTION

SECTION 31 13 13

SELECTIVE WOODY BRUSH REMOVAL

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes the selective cutting and disposal of woody brush including trees and shrubs, as necessary for construction of the Albany Landfill mitigation project, complete in all respects. This section documents methods also presented in the Integrated Pest and Invasive Species Management Plan for this project.

B. Related Sections:
1. Section 31 13 14 – Herbaceous Species Removal
2. Section 32 92 19 – Seeding
3. Section 32 93 13 – Perennial Plantings

1.2 REGULATORY REQUIREMENTS

A. Perform all work in accordance with applicable Federal and State wetlands regulations

1.3 QUALITY ASSURANCE

A. Provide at least one person during execution of this portion of the work that shall be thoroughly familiar with this type of work, means and methods, and the type of materials being used. Said person shall be competent at identification of plant materials to be cut and to be preserved during the season work is to be completed. Said person shall also direct the work performed under this section.

B. All materials used during this portion of the work shall meet or exceed applicable federal, state, county and local laws and regulations. The use of any herbicide shall follow directions given on the herbicide label. In the case of a discrepancy between these specifications and the herbicide label, the label shall prevail.

1.4 SUBMITTALS

A. Materials: Prior to delivery of any materials to the site, submit to the OWNER a complete list of all materials to be used during this portion of the work. Include complete data on source, amount and quality. This submittal shall in no way be construed as permitting substitution for specific items described on the plans or in these specifications unless approved in writing by the OWNER'S REPRESENTATIVE.

B. Licenses: Prior to any herbicide use the CONTRACTOR shall submit to the OWNER a current copy of the appropriate State of New York pesticide applicator's license for each person who will be applying herbicide at the project site. A copy of each pesticide applicator's license must be maintained on site at all times during completion of the work.

C. Equipment: Prior to commencement of any work, submit to the OWNER a written description of all mechanical equipment and its intended use during the execution of the work.

D. Permits: Prescribed burning will not be permitted without the prior written approval of the OWNER. If prescribed burning is permitted, prior to the commencement of any prescribed burning, the CONTRACTOR shall submit copies of all required open burn permits to the OWNER.

PART 2- PRODUCTS

1.5 MATERIALS

A. Herbicide to be used for basal applications shall be triclopyr: 3,5,6-trichloro-2-pyridinyloxyacetic acid, butoxyethyl ester, trade name Garlon 4 or equivalent as approved in writing by the OWNER.

B. Herbicide to be used for foliar applications shall be triclopyr: 3,5,6-trichloro-2-pyridinyloxyacetic acid, butoxyethyl ester, trade name Garlon 3 or equivalent as approved in writing by OWNER.

PART 2 - EXECUTION

2.1 GENERAL

A. The CONTRACTOR will cut all woody species designated for removal with hand tools including, but not necessarily limited to, gas-powered chain saws, gas-powered clearing saws, bow saws, and loppers.

B. All stumps shall be cut flat with no sharp points, and to within two inches of surrounding grade.

C. Removal of undesirable woody species shall preferentially occur when the ground is frozen. Vegetation removal at times other than the winter season, from November 1 through March 14, is prohibited without the prior written approval of the OWNER. The OWNER shall grant such approval only if consistent with the provisions of the permits referenced in Section 1.2.

D. Stumps shall be left in the ground and not removed. All stumps shall be treated with an approved herbicide mixed with a marking dye.

E. Girdling may also be used in combination with cutting and stump herbicide treatment if approved in writing by the OWNER. Trees to be girdled shall have a one inch deep notch cut completely around the trunk approximately 36” above surrounding grade. A basal application of an approved herbicide shall also be used following label directions.

F. All brush shall be removed from the entire work area and disposed of by the OWNER or CONTRACTOR in accordance with all applicable laws and regulations.

G. A supply of chemical absorbent shall be maintained at the project site. Any chemical spills shall be properly cleaned up and reported to the OWNER within 24 hours.

H. The CONTRACTOR shall maintain copies at the project site of all current pesticide applicator's licenses, herbicide labels, and MSDS's (Material Safety Data Sheets) for all chemicals utilized during completion of the work.

I. Species designated for removal are:

COMMON NAME	**SCIENTIFIC NAME**	**DISPOSITION**
Amur Honeysuckle	*Lonicera maackii*	Remove all
Black locust	*Robinia pseudoacacia*	Remove all
Box elder	*Acer negundo*	Remove all
Common buckthorn	*Rhamnus cathartica*	Remove all
Elms	*Ulmus* spp	As necessary
Green ash	*Fraxinus pennsylvanica subintegerrima*	As necessary
Multiflora Rose	*Rosa multiflora*	Remove all
Native shrubs		As necessary
Red maple	*Acer rubrum*	As necessary
Russian Olive	*Elaegnus angustifolia*	Remove all
Tartarian Honeysuckle	*Lonicera tatarica*	Remove all

2.2 CLEAN-UP, REMOVAL, AND REPAIR

A. Clean up: The work area shall be kept free of debris by the CONTRACTOR. At no time shall empty herbicide containers, trash, or other material be allowed to accumulate at the project site. All tools shall be kept in appropriate carrying cases, tool boxes, etc. Parking areas, roads, sidewalks, paths and paved areas shall be kept free of mud and dirt.

B. Removal: After work has been completed remove tools, empty containers, and all other debris generated by the CONTRACTOR and properly dispose of all waste and empty containers.

C. Repair: Repair any damages caused by the CONTRACTOR during completion of the work described in this Section. Said damages may include, but are not limited to, tire ruts in the ground, damage to vegetation outside of the prescribed work limits, etc. In the event any vegetation designated to be preserved is damaged, notify the OWNER within 24 hours. The CONTRACTOR shall be liable for remedying said damages to plant materials, at no additional cost to the OWNER.

2.3 INSPECTION

A. After completion of selective woody brush removal, the CONTRACTOR shall schedule with the OWNER a provisional acceptance inspection of the work.

B. After provisional acceptance of selective woody brush removal, the CONTRACTOR shall conduct an inspection of work areas one year following provisional acceptance.

Within five business days of the inspection, the CONTRACTOR shall notify the OWNER in writing of the results of the inspection, and noting any stumps that have re-sprouted.

END OF SECTION

SECTION 31 13 14

HERBACEOUS SPECIES REMOVAL

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section includes the eradication of herbaceous species, including grasses and forbs, as required for construction of the Albany Landfill mitigation project, complete in all respects, as shown on the drawings and as required by these specifications. This section documents methods also presented in the Integrated Pest and Invasive Species Management Plan for this project.

B.

1.2 RELATED SECTIONS

A. Section 32 91 13 – Soil Preparation

B. Section 32 92 19 – Seeding

C. Section 32 93 13 – Perennial Plantings

1.3 QUALITY ASSURANCE

A. Qualifications of workmen: Provide at least one person during execution of this portion of the work that shall be thoroughly familiar with this type of work, means and methods, and the type of materials being used. Said person shall be competent at identification of plant materials to be removed and to be preserved during the season (summer, winter) work is to be completed. Said person shall direct the work performed under this section.

B. Standards: All materials used during this portion of the work shall meet or exceed applicable federal, state, county and local laws and regulations. The use of any herbicide shall follow directions given on the herbicide label. In the case of a discrepancy between these specifications and the herbicide label, the label shall prevail.

1.4 SUBMITTALS

A. Materials: Prior to delivery of any materials to the site, submit to the OWNER a complete list of all materials to be used during this portion of the work. Include complete data on source, amount and quality. This submittal shall in no way be construed as permitting substitution for specific items described on the plans or in these specifications unless approved in writing by the OWNER'S REPRESENTATIVE.

B. Licenses: Prior to any herbicide use the Contractor shall submit to the OWNER a current copy of the appropriate State of New York pesticide applicator's license for each person who will be applying herbicide at the project site. A copy of each pesticide applicator's license must be maintained on site at all times during completion of the work.

C. Equipment: Prior to commencement of any work, submit to the OWNER a written description of all mechanical equipment and its intended use during the execution of the work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Herbaceous species to be removed in areas without standing water or saturated soils shall be treated with Glyphosate, N-(phosphonomethyl) Glycine, trade name Roundup or equivalent as approved in writing by OWNER.

B. Herbaceous species to be removed in areas with standing water or saturated soils shall be treated with Glyphosate, N-(phosphonomethyl) Glycine in a form approved for aquatic applications such as Rodeo or equivalent as approved in writing by OWNER.

C. Selective grass herbicides and other specialty herbicides may also be used in appropriate locations, but only with the prior written approval of the OWNER. For any materials not specifically called for herein, CONTRACTOR shall submit complete identifying information including manufacturer's literature, manufacturer's recommendations for use, restrictions on use, MSDS, and any other information requested by the OWNER. Alternatives to specified materials will not be used in the work unless approved by the OWNER in writing.

PART 3 - EXECUTION

3.1 METHOD

A. The CONTRACTOR will treat all vegetation within targeted areas with an approved herbicide. Herbicide application instructions given on the label shall be followed at all times.

B. Targeted areas will be located in the field by the OWNER. Contractor shall not proceed with any herbaceous species removal until the areas of the work have been clearly identified and marked.

C. Care shall be taken not to affect vegetation outside of target areas. If areas outside the limits of work are affected, such areas shall be restored in kind at no additional cost to the OWNER.

D. A supply of chemical absorbent shall be maintained at the project site. Any chemical spills shall be properly cleaned up and reported to the Owner within 24 hours.

E. The CONTRACTOR shall maintain copies at the project site of all current pesticide applicator's licenses, herbicide labels, and MSDS's (Material Safety Data Sheets) for all chemicals utilized during completion of the work.

F. Herbicide may be applied using a backpack sprayer, a hand-held wick applicator, or a vehicle mounted high pressure spray unit.

3.2 CLEAN-UP, REMOVAL AND REPAIR

A. Clean up: The work area shall be kept free of debris by the CONTRACTOR. At no time shall empty herbicide containers, trash, or other material be allowed to accumulate at the project site. All tools shall be kept in appropriate carrying cases, tool boxes, etc. Parking areas, roads, sidewalks, paths and paved areas shall be kept free of mud and dirt.

B. Removal: After work has been completed remove tools, empty containers, and all other debris generated by the CONTRACTOR and properly dispose of all waste and empty containers.

C. Repair: Repair any damages caused by the Contractor during completion of the work described in this Section. Said damages may include, but are not limited to, tire ruts in the ground, damage to vegetation outside of the prescribed work limits, etc. In the event any vegetation designated to be preserved is damaged, notify the OWNER within 24 hours. The Contractor shall be liable for remedying said damages to plant materials, at no additional cost to the OWNER.

3.3 INSPECTION

After completion of herbaceous species removal, the Contractor shall schedule with the OWNER a provisional acceptance inspection of the work.

END OF SECTION

SECTION 31 23 00

EXCAVATION AND FILL

PART 1 - GENERAL

1.1 DESCRIPTION

A. Excavation and fill shall include topsoil stripping, soil excavation, topsoil replacement, subsoil replacement, excavation and topsoil material stockpiling construction, and appurtenant items as shown on the Drawings and as detailed in these specifications, for construction of the Albany Landfill mitigation project, complete in all respects.

1.2 RELATED SECTIONS

A. Section 32 92 19 – Seeding

B. Stormwater Pollution Prevention Plan (under separate cover)

C. CONTRACTOR is also referred to the standard technical detail drawings for the soil preparation needs for the vernal pond, dunes, new stream channel, and landfill rooting medium installation that is shows in the Plan Set found in APPENDIX 1.

1.3 QUALITY ASSURANCE

A. Qualifications of workmen: provide at least one person who shall be present during execution of this portion of the work and who shall be thoroughly familiar with the type of equipment being used and the Drawings and Specifications. Said person shall direct the work performed under this section.

B. Standards: All materials, equipment, and procedures used during this portion of the work shall meet or exceed applicable federal, state, county and local laws and regulations.

1.4 SUBMITTALS

A. Materials: Prior to delivery of any materials to the site, CONTRACTOR shall submit to the OWNER a complete list of all materials to be used during this portion of the work. The list shall include complete data on source, size and quality. For earth or stone materials not originating on site, CONTRACTOR shall provide a sample of the material, and an affidavit with supporting test data certifying that the material is clean. Submittals shall in no way be construed as permitting substitution for specific items described on the Drawings or in these specifications unless approved in writing by the OWNER.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Topsoil

1. Topsoil shall be suitable organic soil obtained from on site excavation work performed for the Albany Landfill mitigation project. All topsoil shall be stockpiled in accordance with the provisions of the Stormwater Pollution Prevention Plan for the project, and shall be accepted by the OWNER'S REPRESENTATIVE prior to use in the work.

2. Topsoil from other on-site sources on the OWNER'S property may be used in the work provided the material is supplied by the OWNER from contiguous property, and the OWNER's authorization for supplemental topsoil use is obtained in writing, in advance.

3. Topsoil from off-site sources shall not be used in the work unless the CONTRACTOR first provides information on organic content, pH, gradation, and soluble salt content for review and approval by the ONWER'S REPRESENTATIVE. Off-site sources of topsoil shall only be accepted for use in the work if they are suitable for wetlands application, as determined by a qualified wetlands ecologist, and with the prior written approval of the OWNER.

B. Unclassified Excavation - Unclassified excavation shall consist of all soil, which is not topsoil. All unclassified excavation shall be from within the limits of work for the Albany Landfill mitigation project, and shall be re-used on site.

C. Stormwater Pollution Prevention Plan Materials and Appurtenances – The final Stormwater Pollution Prevention Plan (bound under separate cover) contains additional requirements for earthwork and soil erosion and sediment control practices. The CONTRACTOR shall conform to the requirements of the Stormwater Pollution Prevention Plan in executing the work shown on the drawings and specified herein.

PART 3 - EXECUTION

3.1 GENERAL

A. The CONTRACTOR shall provide temporary means of preventing erosion of excavated materials into any watercourse, and shall comply with the Stormwater Pollution Prevention Plan for the project.

B. The CONTRACTOR shall provide control and grade stakes for the grading construction. The CONTRACTOR shall arrange for staking with the OWNER and will be responsible for protecting the stakes.

C. Grade all natural planting areas as identified on the drawings to within 0.30 foot (4 inches $\pm$ 1 inch). More exacting accuracy is not desired, to reduce or minimize soil compaction.

D. Site grading is based on the assumption of a net cut and fill balance, and CONTRACTOR shall plan the work to achieve a balance. CONTRACTOR may vary final grades to achieve a cut and fill balance; however, such alteration of grades shall be permitted only in areas approved, in advance, in writing, by the OWNER. Revised grading shall be otherwise subject to the tolerances specified herein. CONTRACTOR shall not create a grading plan that requires importation of additional fill. If regrading is required to achieve cut and fill balance, CONTRACTOR shall do so at no additional cost to the OWNER.

3.2 TOPSOIL

A. Topsoil excavation shall consist of the stripping of existing topsoil from the excavation areas and the stockpiling of the topsoil material necessary to provide topsoil replacement.

1. Topsoil shall mean the upper portion (A-horizon) of native soil that is a friable loam, generally dark brown to black in color, and containing organic matter, typically in the range of 2-6 percent.

2. Prior to topsoil removal, CONTRACTOR shall confirm removal depth with the OWNER'S REPRESENTATIVE.

3. CONTRACTOR shall remove heavy growths of grass or vegetation from areas of work, prior to stripping.

4. Topsoil shall be stripped so as not to mix with subsoil.

5. Topsoil shall be stockpiled in locations approved by the OWNER, and shall be in compliance with the project Stormwater Pollution Prevention Plan. Stockpiles shall be free from brush, trash, large stones, and other extraneous material.

6. CONTRACTOR shall stockpile sufficient topsoil to replace on the disturbed areas with vegetation, as shown on the Drawings.

B. Topsoil replacement shall consist of re-spreading the topsoil over disturbed areas to be revegetated and the preparation of the topsoil for planting.

C. Finish grading shall be completed in a manner and time frame to minimize compaction during equipment operation. Contractor shall not run equipment traffic across completed areas with topsoil and subsoil replaced. Topsoil and subsoil shall not be worked when moisture content is so great that excessive compaction will occur, nor when it is so dry that dust will be generated or clods produced which will not break readily. Apply water, if necessary, to bring soil to an optimum moisture content for tillage by typical farming equipment.

D. The fill areas shall be graded with uniform slope between points where elevations are given or between such points and existing grades. Finish grading operations shall be perpendicular to the slope. In the excavated locations for emergent or wet prairie wetlands the grading shall be generally uniform between elevation points, but slope irregularity below the proposed water line is allowable.

E. Use equipment of appropriate size and type to achieve a uniform soil surface free of high areas, depressions and tracks, and place in a manner that will minimize settlement. Excessive or differential settlement shall be repaired by the CONTRCTOR, as determined solely by the OWNER, at no additional cost.

F. Do not compact the topsoil over subsoil or re-spread wetland substrates greater than 50 PSI or the value for adjacent undisturbed topsoil, whichever is higher. Follow the cone penetrometer methods outlined in the American Society of Agricultural and Biological Engineers Standards S313.3 and EP542. Use an applicable penetrometer to test soil compaction. If excess compaction of the replaced topsoil or wetland substrates occurs, the CONTRACTOR shall present a plan to the OWNER or OWNER'S representative to eliminate compaction through ripping (at the optimum moisture content) or other approved methodology. The compaction alleviation shall be completed by the CONTRACTOR, at no additional cost.

G. Care shall be exercised in conducting restoration, reclamation and landscaping operations near utilities. If at any time the CONTRACTOR damages the utilities in place, the CONTRACTOR shall pay for the full cost of or repair such damages.

3.4 EXCAVATION

A. Excavation shall consist of the removal of all materials (except topsoil) lying above the topsoil replacement elevation. Unclassified excavation shall proceed as follows:

1. Excavated soil to be re-used shall be used directly in the work to the extent practicable, or when not practicable shall be stockpiled as directed by the OWNER and in conformance with the Stormwater Pollution Prevention Plan.

2. Excavation shall be to the lines and grades shown on the Drawings and to the tolerances in Section 3.1.

3. Over-excavation shall be remedied by replacing with like material, properly compacted and graded, and at no additional cost to the OWNER.

4. Excavation shall be confined to the work limits and all equipment traversing the area of the excavation either for removal of soil or for transport to fill areas or to temporary stockpiles shall be restricted to the limits of work. Any disturbance of areas outside the limits of work shall be restored in kind at no additional cost to the OWNER.

5. Stormwater management during excavation shall be in strict conformance with the Stormwater Pollution Prevention Plan for the project.

6. Unfinished excavation areas shall be properly protected with signs, warning tape, or fences, as necessary to restrict access.

3.5 WATER MANAGEMENT

A. All stormwater shall be managed in accordance with the Stormwater Pollution Prevention Plan.

B. Grading for the project includes the construction of vernal pond, streams, and wetland areas. In accordance with the Stormwater Pollution Prevention Plan, water that accumulates on site may be discharged to an adjacent pond for temporary stormwater management to provide dewatered access for pond excavation or final grading. Under no circumstances shall the CONTRACTOR discharge such water except through a soil erosion and sediment control structure constructed in accordance with the Stormwater Pollution Prevention Plan.

C. Excavation and fill is for the construction of dunes, vernal pond, streams, wetlands and, therefore, water (both surface and ground water) may be present at various times. CONTRACTOR is responsible for all necessary water management, in accordance with the Stormwater Pollution Prevention Plan, necessary to perform the work in the proper manner, and in accordance with the drawings and these specifications.

D. CONTRACTOR shall not discharge any water from the site, except in accordance with the Stormwater Pollution Prevention Plan.

3.6 CLEAN-UP, REMOVAL, AND REPAIR

A. After excavation and fill work is complete, any remaining materials, debris, and trash shall be cleaned and removed from the site by the CONTRACTOR. All waste material shall be properly disposed of in accordance with all applicable laws and regulations. All areas damaged by the CONTRACTOR during the execution of this work shall be repaired by CONTRACTOR and all areas outside of the construction limits disturbed by construction shall be restored to the pre-construction conditions, at no additional cost to the OWNER.

3.7 INSPECTION

A. Prior to the commencement of planting construction, the CONTRACTOR shall obtain a provisional acceptance of the grading from the OWNER. The CONTRACTOR shall be responsible for scheduling a provisional acceptance inspection with the OWNER.

END OF SECTION

SECTION 31 25 00

EROSION AND SEDIMENT CONTROL

PART 1 PART 1 - GENERAL

1.1 SUMMARY

A. The work in this Section shall include construction and maintenance of temporary and permanent erosion control measures as shown on the Drawings and for all areas disturbed by the CONTRACTOR for the implementation of the Albany Landfill mitigation project. The work will include, but is not necessarily limited to installation and maintenance of all of the measures presented in the Stormwater Pollution Prevention Plan, and generally consists of the following measures:

1) Seeding and mulching
2) Silt fences
3) Sediment traps
4) Sediment basins
5) Drainage swales
6) Appurtenances

B. Related Sections:

1. Section 01 35 43 – Environmental Protection
2. Section 31 23 00 – Excavation and Fill
3. Section 32 92 19 – Seeding
4. Section 32 92 13 – Hydromulching
5. CONTRACTOR is also referred to the standard technical detail drawings for the soil preparation needs for the vernal pond, dunes, new stream channel, and landfill rooting medium installation that is shows in the Plan Set found in APPENDIX 1.

1.2 REGULATORY REQUIREMENTS AND REFERENCES

A. All work for this Section shall be executed in accordance with the New York State Standards and Specifications for Erosion and Sediment Control dated August 2005, or current version.

B. Selected materials specified in Section 2.1 below shall meet the material requirements of the New York State Department of Transportation Standard Specifications for Construction and Materials (NYSDOT) were applicable.

C. The CONTRACTOR shall work in accordance with all State and federal permits.

1.3 OTHER STANDARDS

A. Work performed under this Section will follow the requirements provided in the Stormwater Pollution Prevention Plan (SWPPP) for the project.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Storage areas shall be stable, dry, relatively flat, and well drained and located outside the waterway's floodplain.

PART 2 - PRODUCTS

2.1 SILT FENCE FABRIC

A. Silt fence fabric shall be woven and consist of monofilaments of polypropylene treated with ultraviolet light stabilizers. The fabric shall have sleeves through which either steel or two-inch square wood posts can be inserted.

B. Silt fence fabric shall be inert to chemicals commonly found in soils and to hydrocarbons.

C. Silt fence fabric shall be resistant to mildew, rot, insects, and rodent attack.

D. Silt fence fabric shall be supported by 14 gauge minimum, galvanized welded wire mesh or polymeric mesh.

2.2 SILT FENCE POSTS

A. Wood shall be composed of sound quality hardwood.

B. Wood posts shall be a minimum of 36 inches long.

C. Steel posts shall be standard T & V section weighing not less than one pound/linear foot.

2.3 MULCH

A. See Section 32 92 13 – Hydromulching of these Specifications

2.4 SEED

A. See Section 32 92 19 – Seeding of these Specifications

2.5 RIP-RAP

A. Rip-Rap shall be of sizes shown on the Drawings and shall be of natural, hard, durable material, rounded or angular. Stone shall be reasonably free of shale or shaley stone. Stone shall be reasonably free of laminations, seams, cracks and other structural defects or imperfections tending to affect its resistance to weather and flows.

B. Where a size specification is supplied as a minimum, at least 90% of the stones shall be of the size specified. Where a size specification is supplied as a maximum no more than 10% of stones may be larger than specified, and the maximum dimension of larger stones shall be subject to the approval of the OWNER'S REPRESENTATIVE.

Where a D_{50} size specification is provided, a minimum of 50% of stones shall be of the size specified or larger.

2.6 SEDIMENT BASIN AND SEDIMENT TRAP SOILS

A. Sediment basins and traps shall be constructed of on-site soil materials, but basin containment berms shall not be constructed of pervious materials including Unified Soil Classification System classes GW, GP, SW or SP.

B. Soil used for berm construction shall be free of organic matter, oversized particles, debris, or other objectionable materials and shall be unfrozen when placed.

2.7 GEOTEXTILE

A. Geotextile shall be non-woven, minimum 12 oz/sy material, with an AOS of no larger than 100 sieve, and shall be manufactured of virgin polypropylene or polyester. Geotextile shall be Mirafi 1120, or equivalent as approved by the OWNER.

2.8 APPURTENANCES

A. Appurtenances include, but are not limited to, sediment basin spillway pipe, anti-seep collars, drain piping, anti-vortex plates, stabilized construction entrance, and miscellaneous concrete.

B. Corrugated metal pipe shall conform to the relevant requirements of NYSDOT Specification 603. Drain piping shall conform to the relevant requirements of NYSDOT Specification 605.

C. Stabilized construction entrance shall conform to the relevant requirements of NYSDOT Specification 209.

D. Concrete used in incidental construction shall conform to the relevant requirements of NYSDOT Specification 501, and have a minimum 28-day compressive strength of 3,000 psi. Reinforcing steel used in incidental construction shall conform to the relevant requirements of NYSDOT Specification 556.

PART 3 - EXECUTION

3.1 GENERAL

A. The CONTRACTOR shall perform all work under this Contract in such a manner that objectionable conditions will not be created in water courses through or adjacent to the project area.

B. The CONTRACTOR shall install the erosion control devices required to control erosion and sedimentation in accordance with applicable requirements based on the sequencing of work and miscellaneous construction activities. The CONTRACTOR shall inspect all erosion and sedimentation control devices on a daily basis and maintain, adjust, relocate and supplement devices to ensure complete control of erosion and prevention of water pollution.

C. The CONTRACTOR shall install erosion and sedimentation control devices prior to soil or vegetation disturbance other than that soil and vegetation disturbance required to install the subject erosion and sedimentation control devices.

D. Temporary erosion and sedimentation control devices shall be maintained in working order throughout the project duration.

E. Soil erosion and sediment control devices shall be constructed at the locations shown on the drawings, and to the lines and grades shown on the drawings.

F. All soil erosion and sediment control devices shall conform to the requirements of the Stormwater Pollution Prevention Plan, which is incorporated by reference and made a part of these specifications.

G. All soil erosion and sediment control devices shall be maintained in accordance with the requirements of the Stormwater Pollution Prevention Plan, including necessary repairs, and removal and proper disposal of accumulated sediment, at the predetermined terms as described in the Plan.

3.2 EARTHWORK

A. Fill for sediment basin or sediment trap construction shall be placed on a scarified subgrade.

B. Embankment fill shall be placed at moisture content permitting proper compaction.

C. Embankment fill shall be placed in lifts of approximately six to eight inches, and compacted with the earthmoving equipment so that the entire surface of a lift is traversed by at least one pass of a wheel or tread track.

D. Embankment shall be constructed to 10% above design elevation to account for settlement.

E. Stone fill shall be placed and compacted with earthmoving equipment to a non-movement condition under the equipment load.

F. Rip-rap shall be dumped stone or hand placed, as required, and shall be placed so that stones are uniformly supported and are distributed in size throughout the area. Stones shall be place to the dimensions and thickness indicated on the drawings.

G. Geotextile used in earthwork shall be placed on suitable subgrade that will not damage the geotextile, and adjoining panels shall be overlapped a minimum of 12 inches.

H. Drainage swales shall be excavated to the dimensions required in the Stormwater Pollution Prevention Plan, to the line and grade shown, and shall maintain positive drainage.

3.3 SEEDING AND MULCHING

A. See Section 32 92 19 – Seeding and Section 32 92 13 – Hydromulching of these Specifications.

3.4 SILT FENCES

A. Silt fence shall be installed to follow ground contours and in the locations shown on the Drawings down slope of any area before disturbance by construction activities. The silt fence fabric panels shall be installed loosely with adjacent panels overlapped a minimum of 12 inches. Silt fence material shall be embedded at least six inches beneath ground surface and shall extend upward at least 16 inches above the disturbed area ground surface. The top edge of the fabric shall be reinforced or shall have a one-inch tuck.

END OF SECTION

SECTION 32 91 13

SOIL PREPARATION

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes preparation of soil used in the construction Albany Landfill mitigation project, prior to seeding and/or planting.

B. Related Sections

1. Section 32 92 19 – Seeding
2. Section 32 93 23 – Perennial Plantings
3. CONTRACTOR is also referred to the standard technical detail drawings for the soil preparation needs for the vernal pond, dunes, new stream channel, and landfill rooting medium installation that is shows in the Plan Set found in APPENDIX 1.

1.2 QUALITY ASSURANCE

A. Provide at least one person during execution of this portion of the work that shall be thoroughly familiar with the type and operation of equipment being used. Said person shall direct the work performed under this Section.

B. All materials used during this portion of the work shall meet or exceed all applicable federal, state, county, and local laws and regulations.

1.3 SUBMITTALS

A. Prior to commencement of any work, submit to the OWNER a written description of all mechanical equipment and its intended use during the execution of the work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. None under this Section

PART 3 - EXECUTION

3.1 GENERAL

3.2 A. Protection of Existing Conditions:

1. General: Use every possible precaution to prevent damage to existing conditions to remain such as structures, utilities, plant materials and walks on or adjacent to the site of the work.

2. Barriers: Provide barricades, fences or other barriers to protect existing conditions to remain from damage during construction.

3. Operations: Do not store materials or equipment, does not allow burning of debris, or operate or park equipment under the branches of existing plants to remain.

4. Notification of damages: Give written notification of damaged plants and

structures immediately.

B. Environmental Requirements:
1. Do not work soil when moisture content is so great that excessive compaction will occur, nor when it is so dry that dust will form in the air or those clods will not break readily. Apply water, if necessary, to bring soil to an optimum moisture content for tilling.

2. Do not work soil when muddy or frozen.

3. Do not apply chemicals and pesticides if wind conditions will cause hazardous drift to people or property.

3.3 Surface Preparation:

3.4 Prior to seeding and planting, check compaction of topsoil (0-6" depth). Chisel plowing shall be done in areas of soil compaction. All re-graded surfaces shall be chisel plowed to a depth of approximately 12" prior to topsoil placement.

3.5 Upland Prairie and Wetland Planting: Disc or rotovate, and drag to produce a fine seedbed. Re-check soil compaction as described above after tillage. Repeat treatment until ninety percent or more of penetrometer readings are less than five pounds per square inch.

3.6 The CONTRACTOR shall submit a report including test locations and penetrometer readings at the OWNER's request.

3.7 Remove foreign matter from the areas to be seeded and/or planted.

3.8 CLEAN-UP, REMOVAL, AND REPAIR

A. After soil preparation is complete, clean up any remaining materials, debris, trash, etc. CONTRACTOR shall not drive over finished areas. If additional compactive effort is imparted to finished areas as result of equipment traffic, CONTRACTOR shall repeat penetrometer testing and confirm compliance with these specifications. If soil exceeds compaction requirements, CONTRACTOR shall re-work soil per Section 31 23 00 Part 3.2.

B. The CONTRACTOR shall repair any damages caused by the CONTRACTOR during completion of the work described in this Section at no cost to the OWNER.

END OF SECTION

SECTION 32 91 14

SOIL CHEMISTRY PARAMETERS

Soil – Chemical Parameters and Restoration Requirements

The project area, including the restoration areas, are comprised of Colonie loamy fine sand, Elnora loamy fine sand, Granby loamy fine sand, Pits, Gravel, Stafford loamy fine sand, Udipsamments, and Adrian muck. These soils series are generally described by deep, excessively drained loamy fine sand to sand, with variations between horizons stemming from small gradations in texture and/or organic matter content. The soil horizons are deep, typically much greater than 60 inches and are generally described in the following sequence:

0 to 12 inches (± 3 inches):	loamy fine sand
12 to 25 inches (± 5 inches):	fine sand to loamy fine sand
25 to 60+ inches:	sand to fine sand

Soil samples from the lowland and upland series were collected throughout the project area and in ecological reference areas (examples of high quality ecological communities proposed to be replicated within the project area).

Lowland - The lowlands mapped include soils found in wetlands, typically where water flows and collects, or where the topographical aspect is low and intercepts the water table, creating perennially wet conditions.

Uplands - The typical upland soils in the Albany Pine Bush were found on ridge tops and side slopes.

Laboratory Analytical Results

Soil samples were collected for laboratory analyses of the following parameters: texture (percent sand, silt, and clay), pH, percent organic matter, phosphorous, potassium, calcium, magnesium, and cation exchange capacity. A total of fifteen lowland soils and twenty-six upland soils were analyzed. The results of the analysis follow:

Statistical Parameter	Soil Texture	pH	OM %	P ppm	K ppm	Ca ppm	Mg ppm	CEC
Lowland Soils								
Average	varies from sand to loam	5.2	15.8	49	49	1942	116	18
Standard Dev		0.9	14.1	59	41	2176	127	21
Max		7.6	45.8	193	151	6201	363	60
Min		3.9	1.4	4	16	49	5	1
Upland Soils								
Average	varies from sand to loamy sand	5.5	4.0	59	38	1092	68	7
StDev		0.8	3.0	53	20	1194	66	8
Max		7.3	14.2	177	87	6067	343	42
Min		4.1	0.7	5	19	21	7	1

Restoration Requirements

Topsoil will be removed prior to disturbance and replaced after grading is completed in the restoration areas. Removed lowland and upland soils shall be stockpiled separately and shall be replaced on the same type of land after restoration. The replaced surface soil shall be analyzed to determine if its chemical parameters are within the standard deviation of the average value in the preceding table. If needed, the soil shall be amended to bring the replaced soil within the standard deviation for the average value for an individual chemical property.

END OF SECTION

SECTION 32 92 13

HYDROMULCHING

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section includes hydromulching of seeded areas disturbed for the Albany Landfill mitigation project, which are revegetated, where shown on the drawings or called for in these specifications, or called for in the Stormwater Pollution Prevention Plan.

1.2 RELATED SECTIONS

A. Section 32 92 29 – Seeding

1.3 QUALITY ASSURANCE

A. Qualifications of workmen: Provide at least one person during execution of this portion of the work that shall be thoroughly familiar with the type and operation of equipment being used. Said person shall direct the work performed under this section.

B. Standards: All materials used during this portion of the work shall meet or exceed applicable federal, state, county and local laws and regulations.

1.4 SUBMITTALS

A. Materials: Prior to delivery of any materials to the site, submit to the OWNER a complete list of all materials to be used during this portion of the work. Include complete data on source, quantity and quality. This submittal shall in no way be construed as permitting substitution for specific items described on the plans or in these specifications unless approved in writing by the OWNER'S REPRESENTATIVE.

B. Equipment: Prior to commencement of any work, submit to the OWNER a written description of all mechanical equipment and its intended use during the execution of the work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Wood fiber mulch shall be 100% recycled wood fiber, minimum 99% organic content, such as Re-Fiber Wood manufactured by Wood Recycling, Inc. or equivalent if approved in writing by the OWNER.

B. Tackifier shall be a Polyacrylamide-based product (PAM), with more than 100,000 monomer units per molecule, moderately anionic (18% active sites), such as cf2000 by Construction Fabrics and Materials or equivalent if approved in writing by the OWNER.

PART 3 - EXECUTION

3.1 METHOD

A. The CONTRACTOR shall use 25 pounds of tackifier and 1,000 pounds of wood fiber mulch per acre to be treated. A minimum of 1,000 gallons of slurry, mixed in a tank with a mechanical agitator shall be applied per acre.

B. Hydromulch designated areas with a uniform, even coat of slurry after seeding. Take care not to spray adjacent areas, existing vegetation, pavement, and open water.

3.2 CLEAN-UP, REMOVAL AND REPAIR

A. Clean up: CONTRACTOR shall keep the work area free of debris. After the work is complete, clean up any remaining materials, debris, trash, etc. Do not drive or walk over hydromulched area, to minimize disturbance.

B. Removal: After work has been completed remove any tools, equipment, empty containers, and all other debris generated by the CONTRACTOR.

C. Repair: Repair any damages caused by the CONTRACTOR during completion of the work described in this section at no additional cost to OWNER. If hydromulch is spread beyond limits of work on to existing vegetation, CONTRACTOR shall, at the direction of the OWNER, remove the hydromulch and restore existing vegetation in kind, at no additional cost to the OWNER.

3.3 INSPECTION

A. After completion of hydromulching, the CONTRACTOR shall schedule with the OWNER a final acceptance inspection of the work.

END OF SECTION

SECTION 32 92 19

SEEDING

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes the seeding of areas with native plant seeds, as necessary for the Albany Landfill mitigation project, as shown in the Plan Set found in APPENDIX 1 (Restoration Plans and Planting Schedules).

A. Related Sections

1. Section 32 91 13 – Soil Preparation
2. Section 32 93 13 – Perennial Plantings

1.2 QUALITY ASSURANCE

A. Provide at least one person during execution of this portion of the work that shall be thoroughly familiar with the type and operation of equipment being used. Said person shall direct the work performed under this section.

B. All materials used during this portion of the work shall meet or exceed applicable federal, state, county and local laws and regulations. All seed shall be free from insects and disease. Species shall be true to their scientific name as specified.

1.3 SUBMITTALS

A. Prior to delivery of any materials to the site, submit to the OWNER a complete list of all seed to be used during this portion of the work, including a certified affidavit from the seed supplier attesting to the quantity, quality, source, and composition of the seed in each of the supplied containers. This submittal shall in no way be construed as permitting substitution for specific items described on the plans or in these specifications unless approved in writing by the OWNER.

B. Prior to commencement of any work, submit to the OWNER a written description of all mechanical equipment and its intended use during the execution of the work.

C. After the work is complete submit to the OWNER record drawings including a listing of all species installed, and quantities installed.

PART 2 - PRODUCTS

2.1 MATERIALS

A. All grass species shall be supplied as pure live seed (PLS). Submit to the OWNER lab germination test results.

B. Seed of all species native to New York shall be from within a 300-mile radius of the project site. If certain species are unavailable within this radius, substitute species and/or sources outside of the 300-mile radius may be used, but only with the prior written approval of the OWNER'S REPRESENTATIVE.

C. Straw or hay for erosion control shall be clean, seed-free hay or threshed straw of wheat, rye, oats, or barley.

D. Native plant species and quantities shall be as shown on the Drawings.

PART 3 - EXECUTION

3.1 GENERAL

A. Seeds shall have proper stratification and/or scarification to break seed dormancy for spring planting.

B. All legumes shall be inoculated with proper rhizobia at the appropriate time prior to planting.

C. Seeding shall be preferentially conducted as a late fall dormant seeding (after November 1) or in early spring (as soon as the soil is free of frost and in workable condition, but no later than June 15).

D. All seed shall be installed with a rangeland type grain drill or no-till planter, such as by Truax, or equivalent as approved in writing by the OWNER, or by hydroseeding.

E. If soil is too wet to install seed using grain drill or no-till methods, a mechanical broadcast seeder, such as by Cyclone, or hydroseeding/hydromulching may be used. Hand broadcasting of seed may also be employed. Within 24 hours or as soon as site conditions permit, broadcast seeded areas shall be rolled or dragged perpendicular to the slope.

F. Within seven days of seeding, crimp 2,000 pounds per acre of straw or hay into seeded areas for erosion control or hydromulch in accordance with Specification 32 92 13. Crimp mulch immediately after application. Crimp with a straight disc or specialized crimping roller pulled at right angles to slopes. Keep equipment and vehicle traffic off mulched and seeded areas.

G. If area to be seeded was treated with herbicide, seeding shall occur no less than 14 days after herbicide application.

H. Staking Perimeter of Seed Zones: Stake the perimeter of zones determined by different seed mix types at the locations shown on the drawings with 3 feet long wood lath stakes at 100-300 feet on center. Spray paint top 6 inches of each stake on both sides. Tie ribbons securely to stake 6 inches below top of stake. Color code paint and ribbon to correspond with each planting mix.

   1. Review of Seed Mix Locations: Ecologist will review and adjust layout to meet field conditions without additional cost to owner prior to the commencement of seeding.

   2. Notification of Review: Notify the ecologist within at least 3 days prior to the anticipated date for review of the seed mix locations, for the purpose of adjusting the seed mix locations.

I. Prior to starting work, calibrate and adjust seeding equipment to sow seeds at the proper seeding rate. Equipment shall be operated in a manner to insure complete coverage of the entire area to be seeded.

   1. Prepare soil and restore grading work where existing cover crop has been disturbed.

   2. Drill-seed across slope parallel with the contours; <u>not</u> up and down slope.

   3. Drill wildflower and grass seeds no deeper than 1/2 inch depth.

4. Implement and maintain erosion control measures within planting areas.

5. Maintain erosion control installed materials until grasses and wildflowers are established and throughout the maintenance period.

3.2 CLEAN-UP, REMOVAL, AND REPAIR

A. The work area shall be kept free of debris by the CONTRACTOR. After seed installation is complete, clean up any remaining materials, debris, trash, etc. Do not drive over seeded areas, to minimize disturbance.

B. After work has been completed remove any tools, equipment, empty containers, and all other debris generated by the CONTRACTOR.

C. Repair any damage caused by the CONTRACTOR during completion of the work described in this section, at no cost to the OWNER.

END OF SECTION

SECTION 32 92 20

COVER CROP SEEDING

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section includes installation of cover crop seed in any area of disturbed soil required for the construction of the Albany Landfill mitigation project, which may or may not be final planting to native plantings and species.

1.2 RELATED SECTIONS

A. Section 31 12 02 – Herbaceous Species Removal

B. Section 32 91 13 – Soil Preparation

C. Section 32 93 13 – Perennial Plantings

1.3 QUALITY ASSURANCE

A. Qualifications of workmen: provide at least one person during execution of this portion of the work that shall be thoroughly familiar with the type and operation of equipment being used. Said person shall direct the work performed under this section.

B. Standards: all materials used during this portion of the work shall meet or exceed applicable federal, state, county and local laws and regulations. All seed shall be free from insects and disease. Species shall be true to their scientific name as specified.

1.4 SUBMITTALS

A. Materials: Prior to delivery of any materials to the site, submit to the OWNER a complete list of all seed to be used during this portion of the work. Include complete data on source, quantity and quality. This submittal shall in no way be construed as permitting substitution for specific items described on the plans or in these specifications unless approved in writing by the OWNER.

B. Equipment: Prior to commencement of any work, submit to the OWNER a written description of all mechanical equipment and its intended use during the execution of the work.

D. After the work is complete submit to the OWNER record drawings including a listing of all species installed, and quantities installed.

PART 2 - PRODUCTS

2.1 UPLAND NATIVE GRASSLAND COVER CROP SPECIES LIST

SCIENTIFIC NAME	**COMMON NAME**	**POUNDS/ACRE**
Avena sativa (Spring)	Oats	30.00
Lolium multiflorum (Spring)	Annual rye	30.00
Secale cereale (Fall)	Winter rye	40.00

2.2. WETLAND COVER CROP SPECIES LIST

SCIENTIFIC NAME	**COMMON NAME**	**POUNDS/ACRE**
Echinochloa crusgalli	Barnyard grass	0.50
Lolium multiflorum	Annual rye	20.00
Polygonum spp.	Smartweed	0.50

2.3. NEW STREAM CHANNEL COVER CROP

SCIENTIFIC NAME	**COMMON NAME**	**POUNDS/ACRE**
Echinochloa crusgalli (Spring)	Barnyard grass	20.00
Lolium multiflorum (Spring)	Annual rye	20.00
Secale cereale (Fall)	Winter rye	60.00

2.4 TREE PLANTING AREA COVER CROP

SCIENTIFIC NAME	**COMMON NAME**	**POUNDS/ACRE**
Lolium multiflorum (Spring/fall)	Annual rye	30.00
Echinochloa crusgalli (Spring)	Barnyard grass	20.00

2.5 MATERIALS

A. All grass species shall be supplied as pure live seed. Submit to the OWNER lab germination test results.

B. Straw or hay for erosion control shall be clean, seed-free hay or threshed straw of wheat, rye, oats, or barley.

PART 3 - EXECUTION

3.1 METHOD

A. Seeds shall have proper stratification and/or scarification to break seed dormancy for spring planting.

B. Seeding shall be preferentially conducted as a late fall dormant seeding (after November 1) or in early spring (as soon as the soil is free of frost and in a workable condition but no later than June 15).

C. All seed shall be installed with a rangeland type grain drill or no-till planter, such as by Truax, or equivalent as approved in writing by the OWNER, or by hydroseeding/hydromulching.

D. If soil is too wet to install seed by grain drill or no till methods, a mechanical broadcast seeder, such as by Cyclone, or hydroseeding, may be used. Hand broadcasting of seed may also be employed. Within 24 hours, or as soon as site conditions permit, broadcast seeded areas shall be rolled or dragged perpendicular to the slope.

E. Within seven days of seeding, crimp 2,000 pounds per acre of straw or hay for erosion control onto slopes greater than one foot horizontal to five foot vertical (1:5), or hydromulch in accordance with specification 32 92 13.

F. If area to be seeded was treated with herbicide, seeding shall occur no less than 14 days after herbicide application.

3.2 CLEAN-UP, REMOVAL AND REPAIR

A. Clean up: the work area shall be kept free of debris by the CONTRACTOR. After seed installation is complete, clean up any remaining materials, debris, trash, etc. Do not drive over seeded areas to minimize disturbance.

B. Removal: after work has been completed remove any tools, equipment, empty containers, and all other debris generated by the CONTRACTOR .

C. Repair: repair any damages caused by the CONTRACTOR during completion of the work described in this section.

END OF SECTION

SECTION 32 93 13

PERENNIAL PLANTINGS

PART 1 – GENERAL

1.1 DESCRIPTION

A. This section includes installation of live herbaceous perennial plants, as required for construction of the Albany Landfill mitigation project.

1.2 RELATED SECTIONS

A. Section 32 91 13 – Soil Preparation

B. Section 32 92 19 – Seeding

1.3 QUALITY ASSURANCE

A. Qualifications of workmen: provide at least one person during execution of this portion of the work that shall be thoroughly familiar with the type and operation of equipment being used. Said person shall direct the work performed under this section.

B. Standards: all materials used during this portion of the work shall meet or exceed applicable federal, state, county and local laws and regulations. All live herbaceous perennial plants, tubers, bulbs, and dormant rootstocks of herbaceous perennial plants shall be free from insects and disease.

1.4 SUBMITTALS

A. Materials: Prior to delivery of any materials to the site, CONTRACTOR shall submit to the OWNER a complete list of all live herbaceous perennial plants, tubers, bulbs, and dormant rootstocks of herbaceous perennial plants to be used during this portion of the work. The list shall include a certified affidavit from the plant supplier attesting to the plant source, quantity and quality. This submittal shall in no way be construed as permitting substitution for specific items described on the plans or in these specifications unless approved in writing by the OWNER's representative.

B. Equipment: Prior to commencement of any work, submit to the OWNER a written description of all mechanical equipment and its intended use during the execution of the work.

C. After the work is complete submit to the OWNER record drawings including a listing of all species installed, and quantities installed.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Live herbaceous perennial plants shall be from within a 300-mile radius of the project site and native to New York. Species shall be true to their scientific name as specified. If certain species are unavailable within this radius, substitute species and/or sources outside of the 300-mile radius may be used, but only with the prior written approval of the OWNER'S REPRESENTATIVE.

B. All live herbaceous perennial plants shall be nursery grown stock unless approved in writing by the OWNER.

C. A percentage of trees and shrubs will be planted as Root Production Method (RPM) grown material. At a minimum, 50% of the trees and shrubs will be RPM grown stock.

D. Plant species and quantities shall be as shown on the Drawings.

PART 3 - EXECUTION

3.1 METHOD

A. Planting of all live herbaceous perennial plants, tubers, bulbs, and dormant rootstocks of herbaceous perennial plants shall be completed after May 15 but no later than July 15. Herbaceous perennial plants, trees, and shrubs can be installed after August 30 until October.

B. All live herbaceous plants shall be potted, nursery grown stock unless approved in writing by the OWNER. Do not remove container-grown stock from containers until planting time. All plant material, included collected stock, shall comply with New York State and Federal laws with respect to inspection for plant diseases and insect infestations.

C. All live herbaceous perennial plants, tubers, bulbs, and dormant rootstocks of herbaceous perennial plants shall be approved by the OWNER prior to installation.

D. Provide healthy, vigorous live herbaceous perennial plants; provide freshly dug tubers, bulbs, and dormant rootstocks of herbaceous perennial plants. Do not use materials that have been in cold storage for longer than 45 days. 5. Plants shall be free from insects and diseases and must show appearance of normal health and vigor.

E. Deliver live herbaceous perennial plants, tubers, bulbs, and dormant rootstocks of herbaceous perennial plants to project site after preparations for planting have been completed.

F. Live herbaceous perennial plants, tubers, bulbs, and dormant rootstocks of herbaceous perennial plants shall be packed in such a manner as to insure adequate protection against wind damage, desiccation, and other physical damage while in transit.

G. If planting is delayed more than four hours after delivery, keep plants in refrigerated container or set plants in shade protected from weather and mechanical damage, and keep moist and cool.

H. Live herbaceous perennial plants, tubers, bulbs, and dormant rootstocks of herbaceous perennial plants shall be installed in areas shown on the Drawings.

I. If planting into an area treated with herbicide, plant materials shall be installed not less than 14 days after herbicide treatment.

J. Emergent wetland plantings shall be protected from geese herbivory. Cages or other proposed protection methods will be submitted in writing and approved by project ecologist shall be used in emergent zones.

3.2 CLEAN-UP, REMOVAL AND REPAIR

A. Clean up: the work area shall be kept free of debris by the CONTRACTOR. After the work is complete, clean up any remaining materials, plant containers, debris, trash, etc. Do not drive or walk over planted areas, to minimize disturbance.

B. Removal: after work has been completed remove any tools, equipment, empty containers, and all other debris generated by the CONTRACTOR.

C. Repair: repair any damages caused by the CONTRACTOR during completion of the work described in this section.

3.3 INSPECTION

A. After completion of planting, the CONTRACTOR shall schedule with the OWNER a provisional acceptance inspection of the work.

END OF SECTION

SECTION 32 93 43

TREES AND SHRUBS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. This section includes planting of native trees and shrubs.

B. Related Sections:

Selective Woody Brush Removal	31 13 13
Seeding	32 92 19
Perennial Plantings	32 93 13

1.3 DEFINITIONS

A. Backfill: The earth used to replace or the act of replacing earth in an excavation.

B. Finish Grade: Elevation of finished surface of planting soil.

C. Sub-grade: Surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill, before placing planting soil.

D. Topsoil: Natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 4 inches in diameter.

E. Manufactured Soil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.

F. Planting Soil: Native or imported topsoil, manufactured topsoil, or surface soil modified to become topsoil; mixed with soil amendments.

G. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

H. Balled and Burlapped Stock: Trees and shrubs dug with firm, natural balls of earth in which they are grown, with ball size not less than diameter and depth recommended by ANSI Z60.1 for type and size of tree or shrub required; wrapped, tied, rigidly supported, and drum laced as recommended by ANSI Z60.1.

1. Clump: Three or more young trees planted in groups that have grown together as a single tree having three or more main stems or trunks.

2. Container-Grown Stock: Healthy, vigorous, well-rooted trees and shrubs grown in a container with well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of exterior plant required.

3. Multi-Stem: Three or more main stems emerging from a single root crown or at a point right above the root crown.

1.4 SUBMITTALS

A. Qualification Data: For qualified Contractor.

B. Product Data: For each type of product indicated.

C. Samples for Verification: For each of the following:

1. 1 lb (0.45 kg) of mineral mulch for each color and texture of stone required, in labeled plastic bags.

2. 1 lb (0.45 kg) samples of all wood mulch types that will be used, in labeled plastic bags.

D. Planting Schedule: Indicating anticipated planting dates for trees and shrubs.

E. Materials: Prior to delivery of any materials to the site, submit to the Owner a complete list of all trees and shrubs to be installed during this portion of the Work. Include complete data on source, quantity and quality.

1. This submittal shall in no way be construed as permitting substitution for specific items described on the Plan set or in these Specifications unless approved in writing by the Owner.

F. Planting Schedule: Indicating anticipated planting dates for each type of planting.

G. Equipment: Prior to commencement of any work, submit to the Owner a written description of all mechanical equipment and its intended use during the execution of the work.

H. Post Construction Drawings: After the work is complete submit to the Owner "as-built" plans including a listing of all species installed, and quantities installed. Mark in red ink on the original Plan set any field changes or deviations from the original Plan set.

I. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of trees and shrubs during a calendar year.

1. Submit before expiration of required maintenance periods.

J. Warranty: Sample of special warranty.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A qualified Contractor whose work has resulted in successful establishment of trees and shrubs.

1. Installer's Field Supervision: The Contractor is required to maintain an experienced full-time supervisor on Project site when planting is in progress.

B. Supervisor Qualifications: Provide at least one person who shall be present at all times during execution of this portion of the work; that shall be thoroughly familiar with the type and operation of equipment being used. Said person shall direct all work performed under this section.

C. Standards: All materials used during this portion of the Work shall meet or exceed applicable federal, state, county and local laws and regulations. All plant materials shall be free from insects and disease. Species shall be true to their scientific name as specified.

1. Do not use materials that have been dug more than 30 days in advance.

2. No trees or shrubs dug with a ball shall be accepted if the ball is broken before or during planting operations, except by special approval of the Owner.

3. Trees and shrubs with broken major branches, or badly bruised or damaged bark, are not acceptable and may be rejected by the Owner.

4. All trees and shrubs are to be installed in accordance with the standard specifications shown on the Plan, except as modified herein.

D. Materials: The Contractor shall submit to the Owner for approval a complete list of all materials to be used during this portion of the Work prior to delivery of any materials to the site.

1. Include complete data on source, amount and quality.

2. This submittal shall in no way be construed as permitting substitution for specific items described on the Plans or in these Specifications unless approved in writing by the Owner.

3. Notify the Owner of sources of planting materials 10 days in advance of delivery to site. Provide healthy, vigorous, freshly dug plant materials.

E. Provide quality, size, genus, species, and variety of trees and shrubs indicated, complying with applicable requirements in ANSI Z60.1, "American Standard for Nursery Stock."

1. Substitutions will not be permitted without the approval of the Owner.

2. If proof is submitted that any tree or shrub specified is not obtainable, a proposal will be considered for use of nearest equivalent size or variety, with an equitable adjustment to the contract price. Such proof shall be substantiated in writing to the Owner.

3. All aspects of this project have been designed to work together; native plant arrangements and restorations are carefully designed for the planting site conditions as well as species compatibility. Changes to the plans or specifications must be approved in writing by Applied Ecological Services (AES) or the Owner. AES is in no way responsible for problems resulting from any changes to the design made by any party without the written permission of AES.

F. Observation: The Owner may inspect trees and shrubs either at place of growth or at site before planting for compliance with requirements for genus, species, variety, size, and quality. The Owner retains right to inspect trees and shrubs further for size and condition of balls and root systems, insects, injuries, and latent defects and to reject unsatisfactory or defective material at any time during progress of work.

G. Remove rejected trees or shrubs immediately from Project site.

H. Pre-installation Conference: Conduct conference at the Project Site in order to coordinate equipment movement within planting areas and to avoid soil compaction. Review underground utility location maps and plans. This meeting shall be coordinated by the Construction Project Manager.

I. Equipment utilized in planting areas shall have low unit pressure ground contact.

1. Topsoil compaction shall not exceed 70% standard proctor density (ASTM D698).

2. Subsoil compaction shall not exceed 92% standard proctor density (ASTM D698).

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver trees and shrubs freshly dug.

1. Immediately after digging up bare-root stock, pack root system in wet straw, hay, or other suitable material to keep root system moist until planting.

B. Do not prune trees and shrubs before delivery except as approved by Owner.

C. Protect bark, branches, and root systems from sun scald, drying, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering for all trees and shrubs during delivery.

D. Do not drop trees or shrubs during delivery and handling.

E. Handle planting stock by root ball.

F. Deliver trees and shrubs after preparations for planting have been completed and install immediately. If planting is delayed more than six hours after delivery, set trees and shrubs and trees in shade, protected from weather and mechanical damage, and keep roots moist.

1. Heel-in bare-root stock. Soak roots that are in dry condition in water for two hours. Reject dried-out plants.

2. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or mulch.

3. Do not remove container-grown stock from containers before time of planting.

4. Water root systems of trees and shrubs stored on-site with a fine-mist spray. Water as often as necessary to maintain root systems in a moist condition.

1.7 PROJECT CONDITIONS

A. Planting Restrictions: Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion.

1. Planting of trees and shrubs shall be completed between September 15 and November 15.

B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed according to manufacturer's written instructions and warranty requirements.

1. When conditions are such that, by reason of drought, excessive moisture, or other factors, satisfactory results are not likely to be obtained, the Work will be stopped by the Owner or AES and shall be resumed only when directed.

C. Coordination with Seeded Areas: Plant trees and shrubs after finish grades are established and before planting seeded areas unless otherwise acceptable to AES or Owner.

1. When planting trees and shrubs after lawns, protect lawn areas and promptly repair damage caused by planting operations.

1.8 WARRANTY

When warranties are required, verify with Owner's Counsel that special warranties stated in this article are not less than remedies available to Owner under prevailing local laws.

A. Special Warranty: Contractor's standard form in which Contractor agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Death and unsatisfactory growth, except for defects resulting from lack of adequate maintenance, neglect, abuse by Owner, or incidents that are beyond Contractor's control.

b. Structural failures including plantings falling or blowing over.

2. Warranty Periods from Date of Substantial Completion:

a. Trees and shrubs in formalized landscape portions of the Site as defined in the Plans: One year

b. Trees and shrubs in restoration portions of the Site as defined in the Plans: Three years

3. Include the following remedial actions as a minimum:

a. Remove dead plants immediately. Replace immediately unless required to plant in the succeeding planting season.

b. Replace plants that are more than 30 percent dead or in an unhealthy condition at end of warranty period.

c. A limit of one replacement of each plant will be required except for losses or replacements due to failure to comply with requirements.

d. Provide extended warranty for replaced plant materials; warranty period equal to original warranty period.

1.9 MAINTENANCE SERVICE

A. Initial Maintenance Service for Trees and Shrubs: Provide full maintenance by skilled employees of the Contractor. Maintain as required in Part 3. Begin maintenance immediately after each area is planted and continue until plantings are healthy, well established, and Provisional Acceptance has been achieved but for not less than maintenance period below.

1. Maintenance Period for formalized landscape portions of the Site as defined in the Plans: One year from date of Provisional Acceptance.

2. Maintenance Period for restoration portions of the Site as defined in the Plans: Three years from date of Provisional Acceptance.

B. Continuing Maintenance Proposal: Contractor shall submit to the Owner, in the form of a standard yearly (or other period) maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

PART 2 - PRODUCTS

2.1 MATERIAL

A. General: Furnish nursery-grown trees and shrubs complying with ANSI Z60.1, with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock free of disease, insects, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.

B. Provide trees and shrubs of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of trees and shrubs required. Trees and shrubs of a larger size may be used if acceptable to Owner, with a proportionate increase in size of roots or balls.

C. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which shall begin at root flare according to ANSI Z60.1. Root flare shall be visible before planting.

D. Label at least one tree and one shrub of each variety and caliper with a securely attached, waterproof tag bearing legible designation of botanical and common name.

E. Where formal arrangements or consecutive order of trees or shrubs is shown, select stock for uniform height and spread, and number label to assure symmetry in planting.

F. The original parent generation of plants shall be from within a 200-mile radius of the project site. Species shall be true to their scientific name as specified and native to New York.

G. Tree and Shrub Measurements: Measure according to ANSI Z60.1 with branches and trunks or canes in their normal position. Do not prune to obtain required sizes. Take caliper measurements 6 inches (150 mm) above the ground for trees up to 4 inch (100-mm) caliper size, and 12 inches (300 mm) above the ground for larger sizes. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip-to-tip.

2.2 SHADE AND FLOWERING TREES

A. Shade Trees: Single-stem trees with straight trunk, well-balanced crown, and intact leader, of height and caliper indicated, complying with ANSI Z60.1 for type of trees required.

1. Provide balled and burlapped trees for all shade trees over 2" caliper or ≥ 6' height.

2. Branching Height: One-half of tree height.

B. Small Trees: Branched or pruned naturally according to species and type, with relationship of caliper, height, and branching according to ANSI Z60.1; stem form as follows:

1. Stem Form: Single trunk or multi-trunk as specified in the planting schedule.

2. Provide balled and burlapped or container-grown trees, for all trees under 2" caliper or ≤ 6' height.

2.3 DECIDUOUS SHRUBS

A. Form and Size: Shrubs with not less than the minimum number of canes required by and measured according to ANSI Z60.1 for type, shape, and height of shrub.

1. Shrub sizes indicated are sizes after pruning.

2. Provide balled and burlapped or container-grown shrubs.

2.4 CONIFEROUS EVERGREENS

A. Form and Size: Normal-quality, well-balanced, coniferous evergreens, of type, height, spread, and shape required, complying with ANSI Z60.1.

B. Form and Size: Specimen quality as described symmetrically shaped coniferous evergreens.

1. Shearing Designation: Natural, never sheared.

2. Provide balled and burlapped trees for all trees over 6' height.

2.5 BROADLEAF EVERGREENS

A. Form and Size: Normal-quality, well-balanced, broadleaf evergreens, of type, height, spread, and shape required, complying with ANSI Z60.1.

B. Form and Size: Specimen quality as described symmetrically shaped broadleaf evergreens.

1. Shearing Designation: Natural, never sheared.

2. Provide balled and burlapped or container-grown trees and shrubs.

2.6 SOIL PREPARATION

A. Topsoil: All planting areas should have a minimum of 3 inches of topsoil, ASTM D 5268, pH range of 5.5 to 7, a minimum of 3-5 percent organic material content. Acceptable topsoil shall consist of loose friable loam, free of heavy clay, refuse, stumps and large roots, rocks over 2 inches (50 mm) in diameter, brush, weeds and weed seeds, or other material which would be detrimental to the proper development of vegetative growth.

1. Source: Reuse surface soil stockpiled on-site. Verify suitability of stockpiled surface soil to produce topsoil. Clean surface soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth.

a. Supplement with imported or manufactured topsoil from off-site sources when quantities are insufficient. Obtain topsoil displaced from naturally well-drained construction or mining sites where topsoil occurs at least 4 inches (100 mm) deep; do not obtain from agricultural land, Pine Bush Vernal Ponds or marshes.

2. Prior to planting, confirm topsoil placement by the Earthwork Contractor in all planting zones as specified in the grading specifications.

3. Prior to planting, examine the compaction of topsoil (0-6" depth) and normal subsoil depth (6-12" depth). A 150 lb. person should leave no greater than a ¼" deep footprint.

B. Areas which have been excavated into subsoil should be amended by the Earthwork Contractor in the following process: Over excavate to 6 inches below the final elevations shown on plans Apply and spread evenly enough topsoil achieve final grades as specified in the grading plans.

C. Undulation or irregularities in the surface that would interfere with the Contractor's operations or maintenance shall be leveled before the next specified operation.

D. In areas with a slope greater than 10:1, ensure that disc tracks run parallel to the contour so as not to encourage rilling.

2.7 ORGANIC SOIL AMENDMENTS

A. Compost: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 3/4-inch; soluble salt content of 5 to 10 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:

1. Organic Matter Content: 50 to 60 percent of dry weight.

B. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, and material harmful to plant growth.

2.8 FERTILIZER

A. Fertilizer: 'Mag-Amp' (7-40-6) or equal, complete, slow-release granular type fertilizer; or Agri-Form Prolonged Nitrogen Release (20-10-5) containing the following percentages by weight: 20 percent nitrogen, 10 percent phosphorous, and 5 percent potash; incorporated into the soil with granular fertilizer ('corn' fertilizer 0-46-10), containing the following percentages by weight: 0 percent nitrogen, 46 percent phosphorous, 10 percent potash.

1. These fertilizers shall be used together according to manufacturer's rate instructions; or 'Woodace' Slow-release tablet fertilizers (14-3-3) by Estech, Inc. Corp.

2.9 MULCHES

A. Mulch as specified in plans.

B. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:

1. Shredded Hardwood Mulch: Shall be twice shredded hard wood mulch of uniform texture and size, and shall be a slow decomposing, all organic material. The mulch shall be dark brown in color and free of foreign material.

C. Mineral Mulch: Hard, durable stone, washed free of loam, sand, clay, and other foreign substances, of following type, size range, and color:

1. Type: Rounded riverbed gravel or smooth-faced stone.

2. Size Range: 2 inch maximum, 3/4 inch minimum.

3. Color: Uniform tan-beige color range acceptable to Owner.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive trees and shrubs for compliance with requirements and conditions affecting installation and performance.

B. Ensure that finish grades slope to drain, are free of depressions or other irregularities after thorough settlement and compaction of soil, and are uniform in slope between grading controls and the elevations indicated on Drawings.

1. If finish grades are determined by the Contractor and the Project Coordinator to be insufficient for planting, the Site Clearing and Earthwork Contractor shall re-grade areas as directed by the Project Coordinator.

C. Ensure topsoil was uniformly distributed in a quantity sufficient to provide at least 3 inches of topsoil after subgrading and compaction and was spread, cultivated, lightly compacted to prevent future settlement, dragged, and graded to finish grade.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities, and lawns and existing trees and shrubs from damage caused by planting operations.

B. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

C. See Plans for location of trees and shrubs.

D. Locate and space trees and shrubs as specified in the Plans.

E. Deliver trees and shrubs to project site after preparations for planting have been completed.

F. Trees and shrubs shall be transported and stored in such a manner as to insure adequate protection against wind damage, desiccation, and other physical damage.

G. Lay out individual tree and shrub locations and areas for multiple plantings.

1. Stake locations, outline areas, adjust locations when requested, and obtain Owner's acceptance of layout before planting.

2. Make minor adjustments as required; minor adjustments will be accommodated at no cost to the Owner.

3.3 EXCAVATION FOR TREES AND SHRUBS

A. Pits and Trenches: Excavate circular pits with sides sloped inward. Trim base leaving center area rose slightly to support root ball and assist in drainage. Do not further disturb base. Scarify sides of plant pit smeared or smoothed during excavation.

1. Excavate approximately three times as wide as ball diameter for balled and burlapped and container-grown stock.

B. Subsoil removed from excavations may be used as backfill.

C. Obstructions: Notify Owner immediately if unexpected rock, obstructions, or adverse drainage detrimental to trees or shrubs are encountered in excavations.

1. Hardpan Layer: Drill 6 inch diameter holes, 24 inches apart, into free-draining strata or to a depth of 10 feet, whichever is less, and backfill with free-draining material.

D. Drainage: Notify Owner if subsoil conditions evidence unexpected water seepage or retention in tree or shrub pits.

E. Fill excavations with water and allow water to percolate away before positioning trees and shrubs.

3.4 TREE AND SHRUB PLANTING

A. Before planting, verify that root flare is visible at top of root ball according to ANSI Z60.1.

B. Do not place trees or shrubs closer than ½ the diameter of crown, sized at time of planting, from all planting bed edges.

C. Set balled and burlapped stock plumb and in center of pit or trench with top of root ball 2 inches above adjacent finish grades.

1. Remove burlap and wire baskets from tops of root balls and partially from sides, but do not remove from under root balls.

2. Remove pallets, if any, before setting.

3. Do not use planting stock if root ball is cracked or broken before or during planting operation.

4. Place planting soil mix around root ball in layers, tamping to settle mix and eliminate voids and air pockets.

5. When pit is approximately one-half backfilled, water thoroughly before placing remainder of backfill.

6. Repeat watering until no more water is absorbed.

7. Water again after placing and tamping final layer of planting soil mix.

D. Set container-grown stock plumb and in center of pit or trench with top of root ball 1 inch above adjacent finish grades.

1. Carefully remove root ball from container without damaging root ball or plant.

2. Place planting soil mix around root ball in layers, tamping to settle mix and eliminate voids and air pockets.

3. Do not use planting stock if root ball is cracked or broken before or during planting operation.

4. When pit is approximately one-half backfilled, water thoroughly before placing remainder of backfill.

5. Repeat watering until no more water is absorbed.

6. Water again after placing and tamping final layer of planting soil mix.

E. Inspect tree trunks for injury, improper pruning, and insect infestation; take corrective measures required before wrapping.

F. Handle trees and shrubs in accordance with best horticultural practices.

1. Lift ball and burlap materials from the bottom of root ball only.

G. If planting is delayed more than four hours after delivery, set trees and shrubs in shade, protected from weather and mechanical damage, mulch and water root balls, and keep trees and shrubs moist and cool.

H. Plant trees and shrubs as specified in the details in the Plans.

I. When conditions detrimental to plant growth are encountered during excavation such as rubble fill, adverse drainage, or other obstructions, notify Owner immediately, before planting.

3.5 TREE AND SHRUB PRUNING

A. Remove only dead, dying, or broken branches. Do not prune for shape.

B. Prune, thin, and shape trees and shrubs as directed by AES

C. Prune, thin, and shape trees and shrubs according to standard horticultural practice.

D. Prune trees to retain required height and spread.

E. Unless otherwise indicated by AES, do not cut tree leaders; remove only injured or dead branches from flowering trees.

F. Prune shrubs to retain natural character.

3.6 TREE STABILIZATION

A. Staking is not required. However, the Contractor will be responsible for any damage to trees or shrubs.

1. If the Contractor wishes to stake trees, a detail of the proposed staking method must be submitted and approved by the Owner.

B. Contractor will be responsible for the removal of stakes when trees and shrubs are established.

3.7 PLANTING BED MULCHING

A. Mulch backfilled surfaces of planting beds and other areas indicated. Provide mulch ring around trees in lawn areas.

1. Organic Mulch: Apply 3 inch average thickness of organic mulch, and finish level with adjacent finish grades. Do not place mulch against plant stems.

2. Mineral Mulch: Apply 3 inch average thickness of mineral mulch, and finish level with adjacent finish grades. Do not place mulch against plant stems.

B. Mulch trees with a 4 foot diameter mulch ring and shrubs with a 3 foot diameter mulch ring within 48 hours of planting.

1. Trees and shrubs planted in masses shall be mulched as a continuous bed with mulch extending 2 feet beyond the base of outermost shrubs.

3.8 PLANT MAINTENANCE

A. Tree and Shrub Maintenance: Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, restoring planting saucers, adjusting and repairing, and resetting to proper grades or vertical position, as required to establish healthy, viable plantings.

1. Water all trees and shrubs within 12 hours of planting.

2. Apply water until soil is thoroughly saturated during planting. No irrigation is required or desired in the natural areas that are restored under the project plan.

However, any woody plantings on the landfill will need to be irrigated until initial establishment is assured..

3. Continue to water trees and shrubs on the landfill surface per recommendation of Irrigation Plan for the Site.

3.9 CLEANUP AND PROTECTION

A. During planting, keep adjacent paving and construction clean and work area in an orderly condition.

B. Protect trees and shrubs from damage due to landscape operations, operations by other contractors and trades, and others.

1. Maintain protection during installation and maintenance periods.

2. Treat, repair, or replace damaged plantings.

C. Clean up: The work area shall be kept free of debris by the Contractor. Parking areas, roads, sidewalks, paths, trails, and paved areas shall be kept free of mud and dirt at all times.

1. The Contractor shall at all times keep the premises free from accumulations of waste materials or rubbish caused by their employees or their work.

D. All tools shall be stored in appropriate carrying cases, toolboxes, etc., while not in use.

E. Avoid driving over planted areas to minimize disturbance.

F. Removal: After work has been completed remove any tools, equipment, empty containers, and all other debris generated by the Work.

G. Repair: The Contractor shall repair any damages that occurred during completion of the Work described in this section. Damages may include, but are not limited to, tire ruts, damage to planted areas, damage to seeded areas, damage to lawn areas, etc.

1. All areas outside of the construction limits disturbed or damaged by construction by the Contractor shall be restored to the pre-construction conditions.

2. All areas damaged by the Contractor during the execution of this Work shall be repaired by Contractor and restored to the conditions shown on the Plans at no additional cost to the Owner.

H. The Contractor is not responsible for damage to planting areas that are the result of negligence by other trades or Contractors operating on the Site.

3.10 DISPOSAL

A. Disposal: Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off Owner's property.

3.11 INSPECTION

A. After completion of the work, the Contractor shall schedule with the Owner a provisional acceptance inspection of the work.

3.12 ACCEPTANCE AND GUARANTEE

A. Provisional Acceptance: The Work shall be considered 90% complete after initial planting, mulching, removal, and repair as described above is completed.

B. Final Acceptance: The Work shall be 100% complete after the Contractor has met or exceeded the Work as outlined above, including the 1 year warranty.

C. Final Acceptance: The Work shall be 100% complete after the Contractor has met or exceeded the Work as outlined in 3.12.C of this section, and has completed all required clean up, removal, and repair as described in 3.9 of this section, including the warranty described in 1.8 of this section.

D. The Contractor shall guarantee planted areas will meet or exceed the following performance criteria one full year after Provisional Acceptance.

1. 100% survivorship of all trees and shrubs shown in formalized landscape portions of the Site as defined in the Plans based on qualitative visual inspection, with all species present within all planted areas one year after provisional acceptance.

2. 75% survivorship of all trees and shrubs shown in restoration portions of the Site as defined in the Plans based on qualitative visual inspection, with all species present within all planted areas one year after provisional acceptance.

3. Tree or shrub determined by the Owner to be equal to or greater than 1/3 dead or likely to be greater than ½ dead within the next 12 months will not be accepted.

E. The Contractor shall guarantee planted areas will meet or exceed the following performance criteria two full years after Provisional Acceptance.

4. 70% survivorship of all trees and shrubs shown in restoration portions of the Site as defined in the Plans based on qualitative visual inspection, with all species present within all planted areas one year after provisional acceptance.

5. Tree or shrub determined by the Owner to be equal to or greater than 1/3 dead or likely to be greater than ½ dead within the next 12 months will not be accepted.

F. The Contractor shall guarantee planted areas will meet or exceed the following performance criteria three full years after Provisional Acceptance.

6. 60% survivorship of all trees and shrubs shown in restoration portions of the Site as defined in the Plans based on qualitative visual inspection, with all species present within all planted areas one year after provisional acceptance.

7. Tree or shrub determined by the Owner to be equal to or greater than 1/3 dead or likely to be greater than ½ dead within the next 12 months will not be accepted.

END OF SECTION

SECTION 32 94 50

LANDSCAPE MAINTENANCE PERIOD

PART 1. GENERAL

1.1 SUMMARY

A. This Section Includes the management activities for maintaining the native plant communities created, restored and enhanced on the Albany Rapp Road Landfill Property.

B. Related Sections:
1. Section 32 91 13 -- Soil Preparation
2. Section 32 92 19 -- Native Plant Seeding
3. Section 32 93 13 -- Perennial Plantings
4. Section 32 93 43 -- Trees and Shrubs

1.2. REGULATORY REQUIREMENTS:

A. Perform all work in accordance with applicable Federal and State wetland regulations.

1.3 QUALITY ASSURANCE

A. Contractor Qualifications:
1. Maintenance Management CONTRACTOR: Minimum 10 years experience in maintenance of similar landscape projects.

2. Maintenance Supervisor: Minimum of 10 years experience in landscape maintenance supervision, with experience or training in prairie management, entomology, pest control, soils, fertilizers and plant identification.

3. Labor Force: Familiar with and trained in the work to be accomplished and perform the task in a competent, efficient manner acceptable to the Owner. All laborers applying herbicide must have commercial herbicide applicators license.

4. Supervision: The Project Superintendent shall directly employ and supervise the work force.

5. Notification of Change in Supervision: Notify OWNER of changes in supervision.

6. Identification: Provide proper identification for landscape firm's labor force.

PART 2 PRODUCTS

2.1 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Labeling: Furnish standard products in unopened manufacturer's standard containers bearing original labels showing quantity, analysis and name of manufacturer.

B. Storage: Store products with protection from weather or other conditions, which would damage or impair the effectiveness of the product. Products requiring state permits or licensing, such as herbicides, will be stored in an approved facility in compliance with applicable laws and regulations.

C. Handling: Do not lift or handle container plants by tops, stems or trunks at any time. Do not bind or handle plants with wire or rope at any time.

D. Anti-Desiccant: At contractor's option, spray evergreen or deciduous plant material in full leaf immediately before transporting with anti-desiccant. Apply an adequate film over trunks, branches, twigs and foliage.

E. Digging: Dig ball and burlap (B & B) plants with firm, natural balls of earth of diameter meeting requirements of ANSI Z60.1, and of sufficient depth to include the fibrous and feeding rots.

2.2 SEQUENCING AND SCHEDULING

A. Work Schedule:

1. Work Hours: Perform maintenance during hours accepted by OWNER.

2. Maintenance: Work force shall be present at the project site at least once per month during the first year's growing season for observation and/or as often as necessary to perform specified maintenance in accordance with the accepted maintenance schedule.

2.3 MATERIALS

A. Herbicides, Insecticides, and Fungicides: Legal commercial quality non-staining materials with original manufacturers' containers, properly labeled with guaranteed analysis, as recommended by licensed applicators and ecologist.

PART 3. EXECUTION

3.1 GENERAL

A. Protection of Existing Conditions:

1. General: Use every possible precaution to prevent damage to existing conditions to remain such as structures, utilities, plant materials and walks on or adjacent to the site of the work.

2. Barriers: Provide barricades, fences or other barriers as necessary to protect existing conditions from damage during maintenance operations.

3. Hazardous Operations: Do not store materials or equipment, does not allow burning, or operate or park equipment under the branches of existing plants.

4. Notification: Give written notification of damaged plants and structures.

5. Replacement of plant material: Replace existing plants which are damaged during maintenance with plants of the same species and size as those damaged at no cost to the OWNER.

3.2 MAINTENANCE PERIOD

A. The maintenance requirements are also discussed in section 2.1 of the Monitoring Plan and Performance Criteria in Appendix 3, where the first 10 year period following seeding and planting is referred to as the short-term and long-term management periods.

1. The maintenance period shall be 10 years. First year of maintenance shall be the year when substantial seeding and planting has been completed and trees and shrub installed. Currently the tentative year for beginning the ten years of maintenance is 2010 for the first phase of the restoration plan (see plan set). Subsequent phases will have different maintenance start and end dates, commensurate with this ten year period of time. This is contingent on the construction schedule and substantial completion of the seeding and planting. Ongoing maintenance as necessary during the construction phase will also occur. Table 1 provides a ten-year restoration, management and monitoring schedule for this project. Proposed quarterly dates for restoration tasks are target dates. Adjustments to these dates will need to be made to address site needs and responses to adaptive management.

3.3 GRASSES AND WILDFLOWERS MAINTENANCE AND MANAGEMENT

A. Mowing:

1. Prior to mowing install highly visible flags outlining zones to be mowed.

2. Mowing shall be required if weed cover is determined to be a problem for establishment of native grasses and wildflowers. Ecologist will determine if and when mowing will be required. Mowing, direct plant herbicide application, and hand pulling are the primary methods of weed control to be dexercised. Mowing to a height of 8-10 inches in mid June-July may be conducted during years 1-3 in all upland planting sites. Mowing will be authorized annually as necessary. It is anticipated that 1-2 times annually will be required at the recommendation by the Ecologist. The contractor performing the native areas weed management is to supply the Ecologist

with a letter report on weed control efforts performed from July through September of each year.

3. Use a rotary type mower to prevent creation of mats of clippings.

4. Use appropriate low profile equipment for slope conditions to minimize the damage to soils and vegetation.

5. Do not mow shorter than 6-8 inch height, unless written approval from Ecologist.

B. Noxious Weed Management:

1. Control of plants deemed to be undesirable (either listed as noxious weeds, or undesirable because of ecological characteristics that create or effect undesirable outcomes in the native species landscaping) by the Ecologist shall be conducted by the landscape contractor. Roundup or equivalent applied by wick treatment may be required annually for the 10-year period.

2. Ecologist will determine if and when approved herbicide application is required.

C. Brush Management:

1. Restored wetlands that are invaded by non-native shrub and invasive tree species shall be brushed by cutting stems close to ground level and herbiciding cut stems with an approved herbicide to reduce and remove these shrubs and trees. All non-native trees and shrubs will be removed and up to 50% of native invasive trees, such as box elder.

2. Trees and shrubs to be cut, will be field flagged by project ecologist and zones mapped. Cut trees and shrubs shall be cut and dropped on site or chipped. Chips may be removed and properly disposed of, or reused as mulch on site as determined by the project ecologist. Some trees and shrubs may be left standing and basal bark treated at the direction of project ecologist.

3. All cut stumps shall be treated by a certified and licensed herbicide applicator with the herbicides Roundup, Garlon 4A or a suitable substitute. For control of invading woody vegetation, treating stumps and girdles and foliar or wick apply plants using the following methods: a) Application of Garlon 4 will follow the "cut stump treatment" listed on the label using 30 gallons of Garlon 4 to make 100 gallons of equivalent spray mixture, or b) Use a 40% solution of Garlon 4 and 40% Tordon 101 mixed with 20% basal oil, or, c).

4. Brushing work performed in regulated wetlands shall be conducted during late fall (Nov. 2) to late winter (March 14).

5. Performance required for acceptance is that 90% of cut and herbicided stumps have no evidence of re-sprouting or re-growth 1 year after treatment.

6. Any tree or shrub species to not be cut and treated shall be field flagged by the project Ecologist.

D. Forest and Shrub Plantings

1. The reforestation and restoration plantings may need to be maintained against damage from the following problems:

1. Deer browsing damage.
2. Rabbit and mouse girdling damage.
3. Goose browsing
4. Disease and insect infestation.

2. Herbivore browsing damage to tree and shrubs require preventative strategies. These include appropriate stem wraps, and other techniques as necessary to allow trees and shrubs to continue normal growth and development.

3. Disease and insect infestations that may threaten tree and shrub will be addressed during the initial 10-year establishment period. Integrated pest control management techniques including use of strategies allowed by USDA, Forest Service and State Agricultural extension will be the preferred methods on the project site.

E. Herbicide Application

1. Applying the herbicide will be done as to conform with all Federal, State and local regulations and label guidelines and by trained licensed applicators. Use listed product label mixes as specified unless options call for varied approved mixes. Use Roundup in a 50:50 mix, or, d) Use Rodeo in a 50:50 mix for use in or near aquatic systems wetlands.

2. Herbicide can be applied: a) with sponges to prevent the herbicide from coming into contact with the ground or other existing vegetation (a heavy duty floor sponge is recommended). A sponge applicator is effective on stem densities of 1" and less. The cut surface of the stump the sides and are treated thoroughly, but not to the point of runoff, or, b) use an extremely low pressure manual sprayer to apply the herbicide to the cut surface of the stump and the sides of the stump and root collar, until thoroughly wet, but not to the point of runoff, or, c) Use fine mist application spray as a foliar spray. Other methods, proposed by the herbicide contractor, must be approved by the project ecologist.

3. Herbicide mixture needs to be applied completed around the entire cambium layer of the cut stump or girdle.

4. Treatment shall be done within 2 hours of cutting the brush or trees and before any mud or dirt gets onto the cut surface.

5. Use adequate dye to provide visual record of treated stumps to avoid untreated stumps.

6. All herbicide shall be mixed and filled according to the following requirements:

A. An applicable tracer colorant shall be used in all chemical mixes. The contractor shall inform the Owner of the color to be used.

B. Filling of containers or mixing of herbicides shall be done at a point away from any natural area, trees, shrubs, herbaceous, woody growth or body of water.

C. A tarp beneath a cutoff 55-gallon plastic drum (or similar device) shall be utilized to guard against any spills being leaked onto the ground. All mixing shall be done in or directly above the drum. The method for spill prevention <u>must</u> be approved by the Owner.

D. Cleaning of all equipment shall be done away from plantings or any surrounding natural areas. will be required where herbicides are used. On this project, it is anticipated that herbicides will be used primarily to control invading woody vegetation. Spot noxious weed management is also anticipated.

E. Herbicides should not be transported into the working area in any container except the container designated as an application tool, or in the manufacturer's original container.

F. Drift should be minimized by not applying herbicide in unsuitable weather conditions according to label directions and by using low pressure spray techniques.

G. Water will be brought to the site by the contractor, or pumped carefully from natural sources.

H. A sufficient supply of chemical absorbent shall be available for spill containment.

I. Any spill will be treated with absorbent and reported to the project ecologist. All clean up shall be according to the best management practices as required by agreed upon by local, state, and federal guidance.

J. Applicator shall have on the premises the appropriate herbicide labels and MSDS (Material Safety Data Sheets) for the chemicals being applied.

3.4 CLEAN-UP, REMOVAL AND REPAIR

A. All debris generated by the work crews (food wrappers, beverage containers, cigarette butts, oil cans, etc.) shall be routinely removed. A routine inspection shall be made by the project ecologist to insure that this is occurring.

3.5 INSPECTION

A. Preliminary Inspection:

1. Upon the complete installation of the landscape work, request a review by the ecologist to determine whether landscape work conforms to the requirements of the contract documents.

B. Preliminary Acceptance:

1. When the ecologist determines that the landscape work conforms to the requirements of the contract documents the landscape contractor will receive a written notification of preliminary acceptance.

2. The maintenance period will commence upon the date specified by the notification of preliminary acceptance. Currently it is anticipated that the maintenance period will begin in 2010.

C. Final Review:

1. At the end of the maintenance period, request a review by the ecologist to determine whether landscape and maintenance work conforms to the requirements of the contract documents.

D. Final Completion:

1. When the ecologist determines that the landscape and maintenance work conforms to the requirements of the contract documents the landscape contractor will receive a written notification of final completion.

2. The Owner will accept maintenance responsibility upon the date specified by the notification of final completion.
3. Continue maintenance of landscape work until the date that the owner accepts maintenance as specified by the written notification of final completion.

END OF SECTION

SECTION 32 95 50

LOG BASED CHANNEL STABILIZATION

PART 1. GENERAL

1.1 DESCRIPTION

A. This section includes log cross vane, overflow logs, and gravel/cobble stream bed construction.

1.2 RELATED SECTIONS

1.3 QUALITY ASSURANCE

A. Qualifications of Workers: provide at least one person who shall be present at all times during execution of this portion of the Work, who shall be thoroughly familiar with the type and operation of equipment being used. Said person shall direct all Work performed under this section.

B. Standards: all materials, equipment, and procedures used during this portion of the Work shall meet or exceed applicable federal, state, county, and local laws and regulations.

1.1 SUBMITTALS

A. Materials: It is intended that logs used for construction of the cross vanes will be obtained from onsite areas. Prior to commencing construction, Contractor will meet with Owner and Owner's representative to define sources for this rock material. Gravel and cobble materials used for streambed construction may be obtained from onsite sources as available. Contractor should obtain additional material from offsite as part of the work. Overflow logs shall be obtained from onsite sources as available.

B. Equipment: With submittal of a bid the Contractor shall provide a list of equipment and a description and location of its intended use, and a list of said persons performing the Work and their qualifications for operating and maintaining the listed equipment.

C. After the Work is completed the Contractor shall submit to the Owner "post construction" plans. Mark in red ink on the original Plans any field changes or deviations from the original Plans.

PART 2. PRODUCTS

2.1 MATERIALS

A. Logs for cross vanes shall be solid and freshly cut. .

B. Gravel and alluvium backfill shall be reasonably free organics, sticks, or other materials that might Decay.

C. Geotextile fabric for overflow log shall be 12 oz/yd^3, non-woven, needle-punched polypropylene, such as 1120N by T.C. Mirafi, or equivalent if approved by Owner.

PART 3. EXECUTION

3.1 CROSS-VANES AND GRADE CONTROLS

A. A trench shall be dug conforming to the shape of the cross-vane or grade control across the entire bankfull width of the stream. The depth of the trench shall be greater than or equal to 3 times the height of the log controlling the invert elevation of the structure.

B. Footer logs and alluvium backfill shall be precisely placed with an excavator equipped with a hydraulic thumb. Footer logs shall be placed first with the header rocks placed upstream and overlapping the top 1/3 of the footer logs prior to backfilling the trench.

3.2 CLEAN-UP, REMOVAL AND REPAIR

A. Clean up: the Work area shall be kept free of debris by the Contractor. At no time shall trash or other material be allowed to accumulate at the project site. All tools shall be kept in appropriate carrying cases, tool boxes, etc. Parking areas, roads, sidewalks, paths, trails, and paved areas shall be kept free of mud and dirt.

B. Removal: after Work has been completed remove tools and all other debris generated by the Contractor.

C. Repair: The Contractor shall repair any damages that occurred during completion of the Work described in this section. Said damages may include, but are not limited to, tire ruts in the ground, damage to planted areas, damage to trails, etc. All areas damaged by the Contractor during the execution of this Work shall be repaired by Contractor and restored to the conditions shown on the Plans at no additional cost to the Owner. All areas outside of the construction limits disturbed by construction shall be restored to pre-construction grades and stabilized with turf, except where native seed, shrubs, and/or trees are designated on the Planting Plan.

3.1 INSPECTION

A. After completion, the Contractor shall schedule with the Owner a final acceptance inspection of the Work.

3.2 ACCEPTANCE AND GUARANTEE

A. Final acceptance: the Work shall be considered 100% complete after construction of cross-vanes, grade controls, and gabion basket walls and after the Contractor has completed all clean-up, removal and repair as described in 3.3 of this section.

END OF SECTION

Table 1. General Ten Year Management and Monitoring Schedule for Albany Rapp Road Landfill Ecosystem Mitigation, Restoration & Enhancement.

		Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
1.	Weed Management and Site Inspection	1[2][3]4	1[2][3]4	1[2][3]4	1[2][3]4	1[2][3]4	1[2][3]4	1[2][3]4	1[2][3]4	1[2][3]4	1[2][3]4
Assess site condition, identify threats, i.e. purple loosestrife, reed canary grass. Recommend mowing where necessary and/or design herbicide application plan.											
2.	Mowing.	1[2][3]4	1[2][3]4	1[2][3]4	1234	1234	1234	1234	1234	1234	1234
Conducted twice annually for weed control. Continue mowing as needed for each phase involving prairie establishment and selective weed control.											
3.	Herbicide Management	1[2][3]4	1[2][3]4	1[2][3]4	1[2][3]4	1[2][3]4	1[2][3]4	1[2][3]4	1[2][3]4	1[2][3]4	1[2][3]4
Wick application to non-native invasions, purple loosestrife, reed canary grass, woody invasives such as buckthorn and honeysuckle.											
4.	Additional Management Techniques	1[2][3]4	1[2][3]4	1[2][3]4	1[2][3]4	1[2][3]4	1[2][3]4	1[2][3]4	1[2][3]4	1[2][3]4	1[2][3]4
Annual report to client to provide specifics on activity and recommendations.											
5.	Summary Report	123[4]	123[4]	123[4]	123[4]	123[4]	123[4]	123[4]	123[4]	123[4]	123[4]
Annual report to client to provide specifics on activity and recommendations.											
6.	Vegetation Monitoring	1[2]3[4]	1[2]3[4]	1[2]3[4]	1[2]3[4]	1[2]3[4]	1[2]3[4]	1[2]3[4]	1[2]3[4]	1[2]3[4]	1[2]3[4]
Biannual field sampling and report for submittal to USACOE and NYSDEC.											
7.	Hydrologic Monitoring Equipment	1[2]34	1234	1234	1234	1234	1234	1234	1234	1234	1234
Installation of automatic water level recorders.											
8.	Hydrologic Monitoring	12[3][4]	[1][2][3][4]	[1][2][3][4]	[1][2][3][4]	[1][2][3][4]	[1][2][3][4]	[1][2][3][4]	[1][2][3][4]	[1][2][3][4]	[1][2][3][4]
Quarterly data retrieval and report for submittal to USACOE and NYSDEC.											

APPENDIX 3.

MONITORING PLAN & PERFORMANCE CRITERIA

ALBANY RAPP ROAD LANDFILL
ECOSYSTEM MITIGATION, RESTORATION & ENHANCEMENT PLAN

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April 2009

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1. INTRODUCTION

The following sections describe the monitoring requirements and performance standards for the wetland restorations and enhancements associated with the eastern expansion of the Albany Rapp Road Landfill. This document also includes a common understanding of the measurement systems that will be used to document restoration program success and trigger points for final acceptance of the restoration areas. Readers are referred to the plan set in **Appendix 1** which contains a **Monitoring Plan Sheet (M.0)** that shows the locations of monitoring transects and other measurement locations proposed throughout this document.

2. MONITORING REQUIREMENTS & PERFORMANCE STANDARDS

Table 1 provides the monitoring requirements, sampling methods, and performance standards for the Rapp Road Landfill Eastern Expansion Mitigation Project. Annual vegetative monitoring will begin prior to construction (baseline 2007), continue in 2010 in conjunction with the landfill expansion into permitted wetlands for an anticipated period of 10 years (beyond the initiation of the final restoration phase), and end at the time of issuance of a Certificate of Completion or another mutually agreed upon time.

The qualitative plant and faunal goals for the wetland mitigation area are listed below:

1. Plants and Birds Response to Restoration and Enhancements

- There will be a measured increase in richness in plants and birds.
- There will be an increase in habitat availability to support wider use by native plants and birds after restoration.
- The trailer park properties once restored will harbor richer plant and bird communities during breeding and migratory seasons than the current trailer park lands.
- The new habitat areas will provide breeding and migratory season habitat-use opportunities.
- The restored plant communities will meet the compositional and diversity criteria in the restoration specifications.

2. Herpitile Response to Restoration and Enhancements

- There will be a measured increase in richness in herpitiles (reptiles and amphibians).
- There will be an increased habitat availability to support wider use by herpitiles.
- The new habitat areas will provide breeding and migratory seasonal habitat-use opportunities.

These qualitative goals will be used as the framework for analysis over the 10-year monitoring reporting periods.

2.1 Restoration Milestones

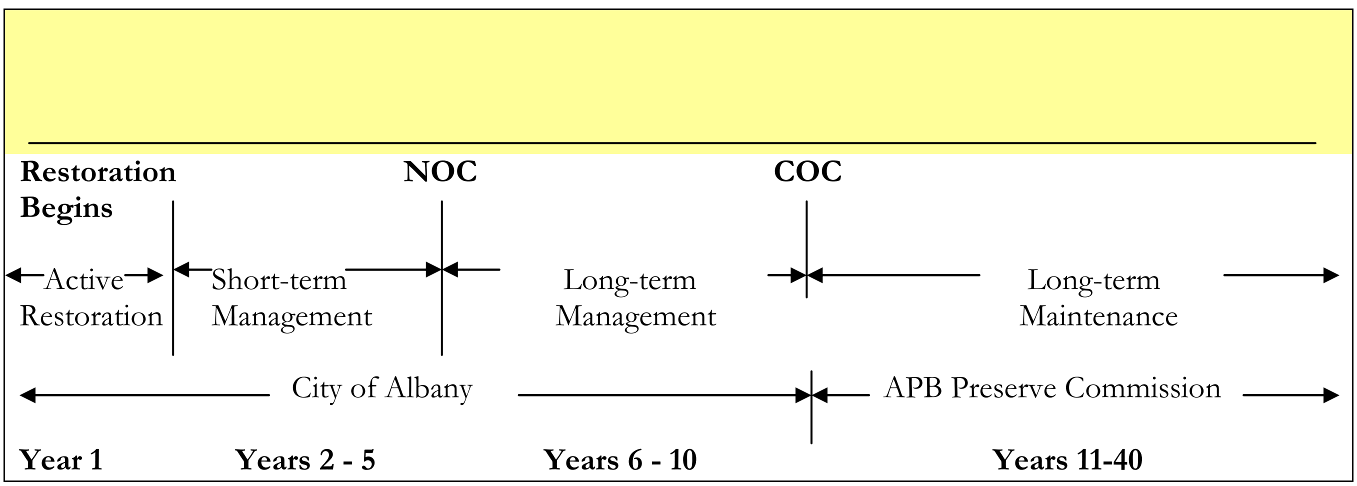
To better understand the timing of the restoration process, it is necessary to differentiate the periods of active restoration, short-term and long-term management, and long-term maintenance (Figure 1). Active restoration includes that time period during which activities such as surface contouring, topsoil placement, initial seeding and live plant installation, and general site stabilization are conducted. Short-term management is considered that period of time following active restoration and the submittal of a

Notice of Completion (NOC) of restoration. The short-term management period requires an intensive level of site management to ensure site stability. Long-term management is considered that period of time between the NOC and the issuance of a Certificate of Completion (COC) or other standard agency documentation. The long-term management period requires a moderate level of site management activity on an annual basis to achieve the following:

- Development of the restored native plant communities consistent with naturally occurring plant communities
- Establishment and support of native volunteer species wherever possible
- Management of all target vegetation types using approved methods

Long-term maintenance is considered that period of time that extends beyond the COC during which time appropriate methods will be used to maintain the targeted restored vegetative conditions. The principal method for long-term maintenance will be prescribed burning, with other methods applied periodically as needed including brush treatments, spot herbicide application, mowing, and other approved activities.

Figure 1. Proposed Management/Maintenance Definition and Timeline



2.2 Performance Standards

As part of the wetland mitigation concept, a set of performance criteria has been developed for the property to assess the success of wetland and other plantings. Annual quantitative vegetation monitoring and data analysis to measure performance and determine compliance will be according to the following standards. The performance criteria used for evaluating the subject property are presented in italics below.

HYDROLOGY

Wetland status

Jurisdictional Status: Wetlands created or restored for credit shall meet the criteria for wetlands detailed in the 1987 Corps of Engineers Wetland Delineation Manual, or other such Federal manual used by the Corps at the time the mitigation bank was established.

The 1987 US Army Corps Wetland Delineation Manual indicates that an area exhibits wetland hydrology if it is inundated or saturated within 12 inches of the surface on consecutive days for at least 12.5% of the growing season (Primary Hydrology Indicator). If an area is inundated or saturated for between 5% and 12.5% of the growing season the area must meet at least one primary hydrology indicator and/or two secondary hydrology indicators to exhibit wetland hydrology. Areas inundated or saturated for less than 5% do not exhibit wetland hydrology and therefore, are not wetlands.

According to the local NRCS Office, the average growing season in Albany County is 147 days (May 15th – October 25). If inundation or saturation is within 12 inches of the surface for a minimum 19 consecutive days in Albany County the primary hydrology criteria has been achieved. If not, additional data will be analyzed and the use of additional primary and secondary hydrology criteria will be evaluated.

Telogs will be used as the primary means to measure inundation and saturation (Primary Hydrology Indicator). In addition to Telogs, soil moisture recorders, and a soil moisture probe will also used to measure for soil saturation.

Sixteen automatic water level recorders (i.e. Telogs) and 6 soil moisture level recorders will be installed at the site in areas designed to be wetlands to measure the water levels above and below ground and the soil moisture. The automatic water level recorder will provide a constant record of water level through electronic measurements via a pressure sensitive transducer.

Soil Moisture Recorders

The soil moisture recorders provide an electronic measurement of the level of moisture in the soil. The data will be downloaded from the automatic water level recorders and soil moisture recorders and graphically displayed. The soil moisture recorder measures the dielectric constant of soil in order to determine its volumetric water content. Six soil moisture recorders will be installed on the site. There will be two different probe depths in each unit. One will record data at 6 inches below the ground's surface and the second will record data at 12 inches below the surface. During operation, values of 0.0 to 0.4 m^3/m^3 are possible. A value of 0.0 to 0.1 m^3/m^3 indicates oven dry to dry soil, respectively. A value of 0.3 to 0.4 m^3/m^3 indicates wet to saturated soil. Thus, any value of 0.3 or greater will be indicative of a saturated soil. These soil saturation levels, which will promote the growth of a predominance of hydrophytic vegetation, will have a value 0f 0.3 or greater within 12" of the ground surface for a minimum of 19 consecutive days in Albany County.

Soil Moisture Meter Probe

A Soil Moisture probe will also be used along several transects to measure the soil moisture content within 12 inches of the soil surface in areas between the Telogs and soil moisture meters. Several transects will start in an existing wetland and will extend upslope to an upland zone. Following calibration of the moisture meter in 100% saturated soils, the probe will record soil moisture values every 20 meters along each transects to a depth of 12 inches. Each point will be surveyed using a hand-held GPS unit. A soil moisture meter probe value of 0 represents Dry (0% saturation) soil; values of 2-4 represent Average to Dry soil; values of 4-6 represent Average soil moisture, and values greater than 7 generally represent saturated soils. Data collected will be summarized and provide supporting data for achievement of the hydrology performance standard.

Primary and Secondary Hydrology Indicators
The Corps 1987 Wetland Delineation manual states a site must exhibit one or more "Primary Hydrology Indicators" and/or two or more "Secondary Hydrology Indicators" to meet wetland hydrology requirement.

Primary and secondary hydrology indicators such as drainage patterns, soil survey data, and hydrophytic vegetation dominance (Fac-Neutral Test) will also be evaluated for achievement of the hydrology performance standard.

Local Hydric Soil Map.
The historic Albany County Soil Survey maps showed nearly all lower ground soils in the Trailer park to have been former hydric soils that have been filled with the sand mining and subsequent land leveling created to support the existing trailer park. These soil types are somewhat poorly drained and hydric soils in the County. These soil types were confirmed during site visits. The presence of mapped hydric soils is another secondary indicator of hydrology.

A wetland delineation with a GPS boundary survey of wetlands and natural community mapping will be conducted in the spring, beginning in year 2 and be conducted again in years 3, 4, 6, 8, and 10 of the ten monitoring period that is tentatively scheduled to begin in 2010 (Table 2).

VEGETATION

Species Composition
Species selected for the planting shall be native to the county where the mitigation site is located and shall be appropriate for the hydrologic zone to be planted. A minimum number of native perennial species proposed for establishment must be present within each plant community to meet performance standards are as follows:

-Pine barrens vernal pond minimum of 12 native perennial species
-Sedge meadow/wet prairie minimum of 20 native perennial species
-Dry prairie (buffer) minimum of 20 native perennial species
-Forested wetland minimum of 12 native perennial species

In addition, at least 50% of the required minimum number of species must occur at a 10% frequency or greater by year 5.

Species Dominance
Dominance shall be determined by calculating importance values (IV), with at least two parameters, frequency and cover, used to calculate species importance. Cattails (*Typha* spp), reed canary grass (*Phalaris arundinacea*), and non-native species shall cumulatively comprise not more than 20% of the total dominance measure for each community for which credit is granted. The native perennial species within each wetland plant community shall represent at least 70% of the total dominance measure.

3. THE MONITORING PROGRAM

Typifying or representative areas from the major restoration zones will be monitored using the following program.

The following quantitative ecological methods (please see Table 1 and Bibliography for technical literature citations) have been selected to address each of the aforementioned monitoring performance standards:

Percent cover

- Line transects and nested 1 square meter sample quadrats
- Permanent transects comparison with annually randomized transects

Diversity

- Line transects and nested 1 square meter sample quadrats
- Comparison between permanent and annually randomized transects
- Timed meander search
- Nested belt transects-cover intercept and diameter breast height
- Point-plot avian census technique
- Derived measures
- Frequency of occurrence
- Importance value
- Richness
- Habitat rating

4. MEASUREMENT METHODS AND TECHNIQUES

This section provides a description of each method proposed to measure the restoration outcomes for the Property. Table 1 identifies each monitoring requirement, the methods of measurement to meet performance standards, sampling sufficiency determinations, and the technical literature citations pertinent to the methods of sampling and data analyses and interpretations for each monitoring requirement.

4.1 Line Transects and Nested 1 Square Meter Sample Quadrats

An approximate location map of Transects, water monitoring wells, bird study stations, and water quality and stream gage Stations for collection of the annual monitoring data as part of the 10 years of ecological monitoring beginning in 2010 (Table 2) is found in found in Figure 1 of this attachment. Transect direction will be established with randomly generated compass bearings. Starting from each randomly chosen grid point, a 100-meter measuring tape will be pulled taut along the randomly chosen compass bearing. The transect end points will be GPS surveyed and permanently marked with ground flush steel rebar rod.

Sample quadrats will be placed at 10-meter increments along each transect. At 10-meter increments along the measuring tape, a circular meter square quadrat will be centered over the tape and the herbaceous plant percent cover (a measure of the vertical projection of photosynthetic leaf area) will be measured in each quadrat:

The recorded data at each quadrat will include:

- Percent cover by species including all woody plants of less than 1.0-meter height
- Percent cover by substrate type (fine litter, 1 hour combustible fuels), coarse litter (>1 hour combustible fuels), rock, bare soil, and bryophytes (mosses, lichens, liverworts, etc.)

The following information and results will be derived from the data collected from each quadrat:

- Frequency of occurrence (percent of the total number of sample quadrats in which each species occurs)
  Richness (number of plant species)
- Erosion control effectiveness (average +- St. Deviation for percent bare soil and percent total plant and substrate cover/quadrat)
- Absolute and relative cover
- Frequency of occurrence
- Importance Value (IV), the summation of relative cover and frequency of occurrence for a given species
  IV, percent cover, and frequency of occurrence data will be calculated for each plant species for each transect, community type, and overall site performance level

In addition, a timed meander search, described below, will be used to help develop plant species richness and plant diversity in the wetlands and upland plant communities.

4.2 Timed Meander Search Technique

Plant species richness and diversity in each community type will be sampled using the Timed Meander Search (TMS) technique[5]. The TMS technique involves slowly walking though each plant community type and listing new plant species while blocking the search into increments of time. The TMS sampling technique will cover representative areas of the site. The TMS method develops time-equated plant species lists. The data contribute to the development of total plant species lists and help quantify diversity for each plant community. The data contribute not only to the species lists and diversity measurements, but statistics can be used to help characterize community development and compare different areas within the same community type.

4.3 Nested Belt Transects-Cover Intercept and DBH

Woody vegetation equal to or greater than 1.0-meter height will be sampled along the identical 50-meter linear study transects laid out for percent cover as described above. Parallel belts, two meters wide and nested within the 100-meter transects, will be laid out on both sides of a study transect. The woody plants ≥ 1.0-meter encountered within each 4-meter wide x 100-meter linear belt transect will be measured for:

- Percent canopy intercept (vertical projection of photosynthetic leaf area, over measured lineal distance of transect tape)
- Survivorship (measured as alive or dead canopy intercept)
- Diameter and if appropriate, Diameter at Breast Height [DBH- 4.5 feet above ground]
- Number of stems for each woody plant species

4.4 Permanent Transects Comparison With Annually Randomized Transects In Representative Community Types

Along with the permanent transects used to measure vegetation (e.g. annual use of identical quadrat and belt transect locations), a number of different randomized transects will be installed each year. An appropriate number of the additional random transects will be determined statistically. These random transects will be sampled in the same way as the permanent transects. Data will be summarized, analyzed and compared statistically with the analysis from the permanent transects. The statistical comparison will evaluate whether the paired samples are from significantly similar populations, and if so, confirm the assumption of random sampling, which strengthens statistical robustness.

5. FAUNAL SURVEYS

5.1 Bird Surveys

Above and beyond the proposed wildlife habitat evaluation procedure, City of Albany intends to document and characterize breeding bird use of the habitats created through surface restoration activities. Therefore, breeding birds will be sampled as a measure of wildlife habitat quality. Bird surveys were conducted during the baseline year (2007) and will be surveyed again in Years 1, 2, 3, 4, 5, 6, 8, and 10 (Table 2). Richness (number of species of birds), breeding bird density (number of breeding pairs by species) and spatial and habitat-use affinities (mapped locations of bird use relative to habitat types) are the avian variables that will be measured. Sampling will be conducted during the period late May through late June during the breeding season. An additional sampling for bird species will occur in spring and fall for detecting migratory bird species. Sampling points will be spatially correlated or may coincide with transect end points and habitat types.

Representative study locations will be chosen throughout the Property after an initial reconnaissance of the property. Locations to be studied on the site will be identified once a fundamental understanding of the complexity, patchiness, and types of avian habitat present on the landfill site has been ascertained. Study points must be spaced sufficiently throughout the site to ensure independence of data from other study points. A preliminary location of potential bird sampling areas is shown in the monitoring point location map in Figure 1 of this attachment.

Avian surveys will use modified methods[15] designed for quantification of richness and relative abundance of bird species. At each study point birds will be surveyed daily at dawn through mid-morning over four consecutive days during summer breeding under suitable meteorological conditions. Arrival at each study point will be followed by one-to-two minutes of acclimation while data sheets are being labeled as to time, date, surveyor, study point number, and survey identification. During timed surveys (using stopwatch) the bird species heard or observed each minute will be recorded and locations mapped. Surveys will be continued until no additional species are recorded at each study point, often requiring 15-20 minutes of total survey time. Only after at least four consecutive minutes with no new-recorded species are surveys complete at each point and the survey is terminated. The modification of the Reynolds et al. (Ibid.) method is similar to the Goff's proposal for surveying plants. Additional listings of birds observed or heard in the property but not at study points will be noted while moving between study points. Identification and nomenclature for birds follows Robbins[16] and the American Ornithological Union[2].

All raw field data will be entered into a database to create a list of birds as well as for summary and analysis. This study will determine the breeding status of species identified during surveys. Avian breeding status on the site will follow the criteria adopted by the Illinois Department of Conservation (IDOC) for the Breeding Bird Atlas Project[7] or other appropriate criteria. These criteria will be used to document the status and distribution of breeding birds and are adopted for use in this study. Criteria are:

1). Observed: A species, male or female, was observed during the breeding season, but no evidence exists to indicate the species is breeding.

2). Possible: A species, male or female, was observed in suitable habitat and at a time during the breeding season that indicated it was possible that breeding occurred. Singing males often indicate possible breeding.

3). Probable: Several types of observations are available that would indicate the species is probably breeding. Multiple males singing in suitable habitat, a pair (male and female) observed in suitable habitat, a permanent territory is identified by multiple observations of a singing male, or male/male conflicts, courtship or copulation is observed, or agitated behavior.

4). Confirmed: This is the most important level of classification. Observation in this category indicates direct evidence that the species is breeding at the site. Nest building by species other than wrens or woodpeckers, physiological breeding evidence, distraction displays, a used nest or eggshells, recently fledged young, an occupied nest, adults carrying a fecal sac or food, a nest with eggs, or a nest with young seen or heard.

5.2 Fish Surveys

Fish sampling using seining techniques with a 6-15 mm seine net mesh diagonal size by 10-15 meter long and 2 meter deep net will be used every 2 years in wetland P4 during the period that the restoration plan is under construction. The goal of this sampling is to verify the absence of especially predaceous fish species that may present a threat to use of the wetland by some amphibians and other biota. A brief memorandum of findings shall be provided within 90 days of sampling to document findings. In the event that predaceous fish are found, a remedial action plan to again treat the wetland to eliminate the fish will be prepared and submitted for the management team review and considerations in advance of any fish removal treatments. In addition to the above mentioned techniques for the sampling of the presence or lack thereof of predaceous fish, minnow traps will be installed in wetland P4 to assess the presence of minnows. 10 traps will be inserted twice a year for a 2 week period in the spring and fall for the duration of the project.

5.3 Lepidoptera Surveys

The section of the monitoring plan includes the monitoring methods for Karner Blue Butterfly, Frosted Elfin, and for determining habitat suitability for these threatened and endangered species. Monitoring protocols for the inland barrens buckmoth, a diurnal Special Concern species are also described. Nocturnal Special Concern moths will be sampled with standard nocturnal black-lighting methods, timed for their spring and summer emergence periods per mutual agreement with Pine Bush Staff. We acknowledge in this method that a likely requirement of any TRP issued for restoration on Preserve lands may include diurnal butterfly and nocturnal moth sampling and we propose to include more detailed methods for the other species in association with the annual work plans.

<u>Survey Protocols</u>

Some butterfly's have a single and the Karner blue butterfly has two broods and flight periods per year; the first flight normally begins in mid- to late May and ends in mid- to late June and the second flight normally begins in mid-July and ends in mid-August. However, the timing of the flight periods for Karner and other butterfly species can vary by as much as 2-3 weeks from year to year and/or site to site due to weather and microclimatic influences. The length of the flight periods may also vary from year to year (generally 2-5 weeks). Since it cannot be known when the flight periods commence until field observers begin to report sightings of the butterflies, discussions with the Service/State are necessary prior to conducting surveys for either species to refine the survey window for any particular year. Surveys shall be conducted by an individual knowledgeable in identification of the butterflies (see descriptions and photographs in the Recovery Plan for the Karner blue butterfly attached below). Identification photographs of butterflies can also be obtained from the State/Service. Please note that scientific collector permits are required by the State for butterfly surveys. Please allow for adequate processing time to ensure that permits are in place prior to the first flight period.

Determining Butterfly Presence and Abundance: Intensive Search Method

- Survey all potential habitat areas for the butterflies. This includes all lupine patches as well as nectar and grassy areas that may provide adult food and/or shelter for butterflies.

  − All of the lupine, nectar, and nearby grass habitat should be carefully searched by slowly walking over it, gently prodding vegetation with butterfly net or meter stick, and/or stopping frequently and scanning the area for movement. The search should criss-cross all of the potential habitat area until the surveyor can be confident that all potential habitats have been searched. If more than five individuals are found, a zigzag transect may be done in later surveys to establish butterfly abundance (see Zigzag Transect Methods below). However, if the zigzag method is subsequently employed and such surveys do not pick up butterflies regularly, the intensive search should be conducted to continue to confirm presence.

- · To determine butterfly presence, conduct a minimum of 5 surveys per Karner blue butterfly flight period with a total of 10 surveys needed to establish baseline conditions for the Karner blue butterfly (weather permitting) (call the State to confirm the start and finish of flight periods at nearby locations). At least 2 of the surveys should be conducted during mid- to late May to overlap with the frosted elfin flight period.

- Visits should be spaced so that no more than 2 days pass between visits unless weather is unsuitable. This reduces the potential for missing peak butterfly abundance in each brood. If poor weather is predicted, consider making visits the day before if waiting until after the bad weather will cause more than 3 days to pass between visits. If bad weather is expected part of a monitoring day, try to survey that day by adjusting the monitoring schedule accordingly.

- We recommend conducting all 10 surveys, even if butterfly presence is documented during an earlier survey, to document the use of nectar areas and get the best possible peak count of butterflies within each flight period. This will assist the Service/State with determining an initial index count of butterflies within the site, which can be monitored over time to determine the effects of the proposed management actions.

- Conduct surveys during optimal time and weather conditions as listed below:
  − between 8:00 a.m. and 6:00 p.m.
  − when temperatures are above 65°F
  − when temperatures are between 65-70°F, surveys should only be conducted under mostly sunny skies with calm to light wind
  − when temperatures are above 70°F, no restrictions on cloud cover
  − when eye-level winds are less than 20 mph

- Additional weather notes:

– do not survey under drizzly or rainy conditions, however surveys can continue through very light rain if the sun is shining and the temperature is 75°F or higher.
– delay surveying after heavy rain until the vegetation and the butterflies have had a chance to dry

- Time Keeping:
  – Record the duration of each survey. For sites with more than one transect, record duration of each transect and provide a total time (and total butterflies) as a separate data sheet entry. Duration must be recorded to the second. Do not round off minutes! Record time of day in military time. Record the time of day you visit the site even if you use a stop watch to time the duration. If you are not using a stopwatch, record your start time and end times in military time and include the second (*e.g.*, 1417:00 - 1418:23). It helps to start at 00 seconds or 30 seconds to make it easier to subtract out later. Include duration of search even for zigzag and exhaustive searches.

<u>Determining Butterfly Presence and Abundance: Zigzag Transects Method</u>

Establishing Transects

– As reported in McCabe (1993), zigzag transects should be designed to cover each site. Transects should remain constant from day to day and for both broods. If monitoring longer term, transects should also remain constant from year to year so that data can be accurately compared through time. If the transect needs to be expanded (i.e., due to expansion of lupine population), it should be segmented so that data collected from the original transect can continue to be compared to that of previous years.

– The distance between zigzags shall be sufficient to avoid counting an individual butterfly more than once. The distance between zigzags can be increased in areas where high butterfly densities would have resulted in many butterflies being counted more than once.

• Standard Methods

– Observers walk at a comfortable pace gently swinging a butterfly net above the vegetation to stir the butterflies into motion. All butterflies seen, both at rest and in flight, are counted and their numbers recorded on a data sheet. Butterflies that fly into areas not yet walked are to be counted only if they fly no further than one zigzag ahead. Butterflies which fly farther than one zigzag ahead are left to be counted later in the walk-through (McCabe 1993). Butterflies that fly out of the census area are counted.

– The sex of a butterfly should be recorded during the walk if it is obvious to the observer (*i.e.*, a butterfly sitting in the path of the observer with its wings open). However, sexing butterflies during the transect walk should be done judiciously so as not to change the length of time necessary to walk the site or introduce inaccuracies caused by losing track of counted butterflies. A separate walk-through should be conducted in order to determine the sex ratio of the butterflies.

– After completing the transect walk and sex ratio determination, Karner blue butterfly nectar species should be noted and the number of butterflies observed to be nectaring recorded. Other plants in bloom and weather notes should also be recorded on the data sheet.

– Follow weather and time protocols listed above.

– Marked transects may be along a continuous line or in zigzags, as long as they cover the entire potential habitat on a site.

– Keep eyes forward a short distance ahead but regularly glance toward your feet and about 10 feet ahead. This will help you to stay on the transect and avoid trampling too much lupine. Also sometimes the butterflies won’t fly up as you step over them.

- Keep walking at a steady pace, about one heart beat per step. Avoid the tendency to slow down as you get into a lot of butterflies and speed up when there isn't much lupine. If you wander off the transect route by more than a few feet, start over again. Do not try to slow down or speed up to keep your time exactly the same, but practice your pace to try to keep it steady enough that you are doing the transect within 10-15 seconds of the same duration each time.

- **NOTE:** CENSUS NUMBERS SHOULD NOT BE INTERPRETED AS THE ABSOLUTE NUMBER OF KARNER BLUE BUTTERFLIES IN A GIVEN SUB-POPULATION. RATHER THEY REPRESENT AN INDEX FOR THE SIZE OF AN INDIVIDUAL SUB-POPULATION THAT CAN BE COMPARED FROM YEAR TO YEAR. ONLY IN INSTANCES WHERE THE SUB-POPULATION IS QUITE SMALL AND CONFINED TO A WELL-DEFINED AREA THAT CAN BE CENSUSED THOROUGHLY DO CENSUS NUMBERS APPROACH THE ABSOLUTE NUMBER OF KARNER BLUES IN A GIVEN SUB-POPULATION AT A GIVEN DAY.

• Zigzag surveys (for sites too small to effectively monitor with marked transects)
  - Monitors should strive to walk the same areas each time, but essentially should cover the entire habitat without counting butterflies twice. The zigzag surveys for unmarked transects should be done as described above for marked transects.

5.4 Reptile and Amphibian (Herpitile) Surveys

No Baseline reptile and amphibians studies have been conducted but we propose to use similar techniques to develop sampling protocol are used to identify and evaluate herpetological communities in the Wetland Mitigation site (Table 2).

Beginning in year 1 of the 10 year monitoring program, a site reconnaissance will be conducted to relocate the previous sampling stations if possible. Depending on the habitat type, sampling stations will be defined by transects or by individual habitat features (e.g., pond or stream shorelines), or by random searches through a distinct habitat type. Sampling stations associated with stream channels and pond areas will be established by walking the edges and shallow portions of the water bodies for a known distance.

Several survey techniques will be employed in order to effectively sample a wide variety of habitats and attempt to encounter as many species as possible. The primary method to be used will be visual encounter surveys. Visual encounter surveys are timed, systematic visual searches of suitable habitat. Shoreline and other appropriate habitats will be walked slowly and visually searched for herps. In addition, any frogs or toads heard calling in the immediate vicinity of a sampling station also will be noted during visual encounter surveys. Visual encounter surveys will be conducted during both daytime and nighttime in order to maximize the likelihood of detecting nocturnal species.

Dip netting, seining, cover turning, and aquatic funnel traps will be used as appropriate to complement visual encounter surveys. These additional sampling approaches will be employed to maximize the possibility of detecting species that generally remain hidden in vegetation, underneath cover, or in other areas where they may go undetected during visual searches.

Cover turning is the lifting and turning of cover objects, such as rocks, logs, boards, and other large objects under which animals can find shelter. Cover objects encountered at a sampling station will be turned and then returned to their original position after being searched. Aquatic funnel traps, consisting of standard minnow traps, will be used to sample amphibian larvae and adults in pond and stream habitats.

All collected or encountered herps will be identified to species and counted. Numbers of organisms occurring in large aggregations, such as tadpoles or calling frogs, will be estimated, with representative individuals being collected for identification. All collected herps will be released unharmed in the vicinity of their point of capture following identification and enumeration, with the exception of a few representative specimens of tadpoles, which may have to be retained.

5.5 Hydrology Monitoring

The hydrologic monitoring conducted will include wells (Telogs), continuous soil moisture recorders, hand held manual soil moisture meter probes, and the observation of primary and secondary hydrologic characteristics (the prevalence of vegetation which is adapted for anaerobic soil conditions and other secondary characteristics) to determine hydrology for the site.

Telog
The Telog monitoring wells will consist of a single PVC pipe protected by a steel shaft. The 2' diameter x 48" PVC well is fitted with a Telog unit consisting of an electronic data logger with a pressure sensitive transducer to provide constant water level monitoring. Sixteen Telog recorders will be installed. Each Telog will be downloaded monthly from April-October.

The criteria for establishing if wetland hydrology is being achieved for Telog data is to determine the maximum number of consecutive growing season days the water in the wells is within 12" of the ground surface. The 1987 Corps Manual indicates that a predominance of vegetation which is indicators of hydrology should grow when the water level (100% soil saturation) is within 12" of the ground surface between 5% and 12.5% of the growing season. The average growing season in Albany County runs from May 1—Oct 20. The actual growing season in wetland areas is slightly longer and begins on approximately April 15 resulting in a 189-day growing season. The water levels which will promote the growth of a predominance of hydrophytic vegetation should be within 12" of the ground a minimum of 10 days to two weeks in Albany County.

Soil Moisture Recorders
The soil moisture recorder measures the dielectric constant of soil in order to determine its volumetric water content. Six soil moisture recorders will be installed on the site. There will be two different probe depths in each unit. One will record data at 6 inches below the ground's surface and the second will record data at 12 inches below the surface. During operation, values of 0 to 0.4 m^3/m^3 are possible. A value of 0.0 to 0.1 m^3/m^3 indicates oven dry to dry soil, respectively. A value of 0.3 to 0.4 m^3/m^3 normally indicates wet to saturated soil. Thus, any value of 0.3 or greater will be indicative of a saturated soil. These soil saturation levels, which will promote the growth of a predominance of hydrophytic vegetation, will have a value 0f 0.3 or greater within 12" of the ground surface for a minimum of 19 consecutive days in Albany County.

Soil Moisture Probe
The Soil Moisture Probe consists of a hand held unit with a moisture sensor that is calibrated on site by placing the sensor into soil that is known to be 100% saturated and calibrating the probe to 100%. Several transects will be established that both begin in the existing wetland and extend upslope to an upland area. The unit will be driven into soils every 20 meters to a depth of 12 inches. The unit has meter reading categories related to the amount of moisture in the ground at the level of the sensor. A reading of 0 equals Dry (0% saturation); 2-4 equals Average Dry; 4-6 equals Average, 6-8 equals Average Wet; and 10 equals Wet (100% saturation). The criteria for establishing the hydrology criteria via the Soil

Moisture probe is when the meter reads between 7 and 10+ within 12" of the surface a minimum of 19 days (12.5% of growing season) throughout the growing season.

Primary and Secondary Hydrology Indicators
According to the Corp 1987 Wetland Delineation Manual, a site must exhibit one or more "Primary Hydrology Indicators: and/or two or more "Secondary Hydrology Indicators" to meet wetland hydrology requirements. The hydrology on a site determines the type of plants that grow and the soils that develop. When hydrology is present, hydrophytic plants dominate. The Corp 1987 manual states that the hydrophytic vegetation criteria for wetland classification is met when greater than 50% of the dominant plant species are hydrophytes. The indicator status of plant species is expressed in terms of the estimated probabilities of that species occurring in wetland conditions within a given region. Hydrophytes include all plants classified as "FAC" (with the exception of "FAC-"), "FACW" or "OBL". According to the 1987 manual, a dominance of hydrophytes is also a secondary indicator of hydrology (Fac neutral test). Vegetation data will be collected throughout areas designed as wetlands and the percentage of plants having wetland status determined.

When wetland hydrology is present for given periods of time, hydric soils begin to form. County soil survey maps include the location of hydric soil units that can be used to determine if hydric soils are present on a site even if previously existing wetlands are no longer present. In addition in field soil sampling to determine the soils chroma will be evaluated. Soils with a chroma value of 1 or less meet the wetland soils criteria. In addition soils with a chroma value of 2 and have mottling also meet the wetland soils criteria. The presence of a hydric soil and the presence of mapped hydric soil is also a secondary indicator of wetland hydrology.

6. SCHEDULES FOR IMPLEMENTATION

6.1 Construction Phase On-site Monitoring

CITY OF ALBANY is committed to the highest quality of workmanship and creating a successful mitigation program outcome. On-site third party monitoring and oversight personnel with commensurate qualifications and appropriate wetland restoration experience will be involved in oversight of layout, final grading and other critical construction activities in the mitigation project areas on an as-needed basis. The on-site monitor will provide appropriate documentation of accomplishments to CITY OF ALBANY, photo-document construction activities and be available for discussion and updates during the construction phase with the agencies. CITY OF ALBANY anticipates that a full time availability commitment will be required by the onsite monitor during the critical construction phases of the Wetland Mitigation Project for compliance with permit conditions and approved agency(ies) plans.

Implementation schedules are projected for all monitoring tasks and years for the restored wetlands in Table 2. This table identifies the likely quarter of each year when each of the tasks and performance measures will be implemented. There are two primary sampling periods for vegetation: Early summer and mid-to-late summer. Timed Meander Search (TMS) will occur in both early summer and mid-to-late summer. Quadrat analysis will occur in mid-to-late summer. A single breeding avian sampling period will occur in late May-to-late June, concurrent with the early season TMS and migratory bird surveys will also occur in early spring and Fall in years scheduled in Table 2. Herpitile and fish surveys will be conducted spring of scheduled years (Table 2).

7. DATA ANALYSIS AND STATISTICS

Plant data usefulness is directly related to the statistical design and quality of the data collected. Sampling strategies, plot design and layout, and data collection methods proposed in this report ensure that assumptions of statistical analysis to be employed are understood and integrated. The strategies and methods follow standard procedures as detailed in Greig- Smith[6], Sokal and Rohlf[19], and Zar[26].

- For all sample plots, standardized, and reproducible primary and secondary methods of data summary and analysis will be employed
- Plots will be laid out to provide measures of trend analysis (repeated sampling strategies) or plots will be partitioned or split to establish separate controlled replicated opportunities which provides for the use of the most robust non-parametric statistics and the use of standard statistical software for analysis such as SPSS, SAS, Systat, etc.
- Multivariate statistical analyses (cluster analysis, ordination, etc.) provide powerful methods for illustrating relationships among data and variables
- Automatic water level data will be periodically downloaded and graphically displayed in annual monitoring reports

Sampling of the variables in each community type and use of sampling sufficiency analysis during the field work will be used to determine the number of transects required to meet 90% confidence limits for the key variables measured. All plant identifications will follow Gleason[4] as the taxonomic authority for this monitoring program.

8. REPORTING

8.1 Baseline Condition Documentation

CITY OF ALBANY will continue developing baseline documentation of biological resources in restoration and mitigation areas and use these baseline condition measurements for tracking and future comparison of biological performance in annual reporting of mitigation success. CITY OF ALBANY will conduct baseline ecological monitoring for the Wetland Mitigation Project as described in Table 1 and at a frequency outlined in Table 2 prior to the commencement of construction activities required to provide the required hydrological zones in the Wetland Mitigation Project. Ecological monitoring will not occur during the construction period, but will begin after a record topographic map is submitted. Hydrological monitoring equipment will be installed after site construction and then the seeding plan will be submitted and planting will begin. This will constitute year 1 as shown in the attached Table 2 and continue for a total of ten years.

8.2 Contingency Planning for Poor or Biological Non-performance of the Mitigation Project

CITY OF ALBANY will prepare contingency plans for areas of the Wetland Mitigation Project site that are in substantial non-compliance with the performance criteria established for each vegetation restoration zone. Substantial non-compliance is defined to occur when the measured performance of the monitored vegetation variables for which quantitative performance criteria have been established (see attached Table 1) are not being met or anticipated to be met on the timeline in the plan. Contingency plans will provide the process to resolve poor and non-performance issues and locations.

Plans will be delivered to CITY OF ALBANY by its consultant/contractor after the annual monitoring reports are reviewed where the poor and non-performance is an acknowledged trend decisively shown in the monitoring data. CITY OF ALBANY will deliver the contingency plan to NYDEC and USACOE to inform agencies on the intended direction to reconcile the biological non-performance. Commensurate monitoring and reporting will be provided by the CITY OF ALBANY to document resolution of biological non-performance.

8.3 Milestones and Performance Requirements for the Mitigation Project

The initiation of the mitigation restoration timeline is triggered with the generation of a record topographic survey of restoration phase areas. The hydrological milestone accomplishment (Section 2.2 Hydrology) is anticipated to be provided (by CITY OF ALBANY) to NYDEC and USACOE no later than the end of year 2 of the ecological monitoring period. Acceptance of hydrological performance sooner than two years may be allowed at the NYDEC's and USACE's discretion to allow for flexibility and will be exhibited in any linked decisions found elsewhere in the permit.

Other performance milestones are outlined in attached Table 1. A series of floral, faunal, and hydrological parameters will be monitored (Table 2) by the CITY OF ALBANY restoration team and when milestones are achieved, CITY OF ALBANY will notify NYDEC and USACOE and request a field visit and appropriate responses including annual concurrence on achieved milestones, and ultimate notice and certificate of completion.

Annual restoration monitoring reports will be provided no later than December 31st each year, unless an extension date is requested in writing to the regulatory agency(ies).

8.4 Schedule and Variables for Monitoring and Reporting

CITY OF ALBANY proposes to monitor the biological and hydrological parameters and report and annual findings in the Wetland Mitigation Project following the schedule in Table 2. The target timeline for proposed agency approvals and signoff are also included in this table.

8.5 Integrated Pest Management Plan for Restoration and Mitigation Lands

CITY OF ALBANY will provide an integrated pest management plan to address exotic species issues, both existing and unforeseen, after the first year of restoration implementation.

8.6 Adaptive Management

The CITY OF ALBANY application is focused on following an adaptive management process throughout the life of the restoration program. CITY OF ALBANY will provide documentation on adaptive management needs of this program in the annual reporting to NYDEC and USACOE. Adaptive management is defined as the day to day, season to season refinements in restoration programming needed for CITY OF ALBANY to achieve success against the performance criteria. This adaptive refinement is not considered critical, and does not require a contingency plan, as this refinement is an anticipated normal process on restoration and mitigation projects. Adaptive management is intended to take advantage annually, and from time to time, of the latest scientific and technological techniques for successfully accomplishing restoration and mitigation projects. This is a regular and routine process that CITY OF ALBANY will follow.

CITY OF ALBANY is fully responsible for the performance of the Wetland Mitigation Project wetlands during the life of this project. CITY OF ALBANY assumes full responsibility for following the adaptive management protocols and documenting the process used and proposed.

8.7 Notice of Completion and Certificate of Completion

CITY OF ALBANY intends to successfully complete all restoration and provide supporting documentation including annual restoration reports in favor of the submittal of a Notice of Completion (NOC) to NYDEC. Certificate of Completion (COC) request is projected to be at the end of the tenth year, assuming that the substantial completion of the plant installation is designated as year 1 (2010).

8.8 Annual Restoration Report Content

The following report outline highlights the primary elements that the monitoring information and data analysis will focus upon.

8.9 Guild Tracking and Reporting

CITY OF ALBANY will document in the annual monitoring report the trends of guilds of faunal groups and plants. For example, bird guilds are defined as species that have similar foraging behaviors and needs, such as birds that drill on wood for insects (called timber drillers), and birds that forage on the ground (called ground brush foragers). For plants, we propose that two major guilds be distinguished (native and non-native). As wetland restoration is an important component of the mitigation plan these two main plant sub-groups will also be designated as to the likelihood of occurring in wetlands or upland communities. The National List of Vascular Plant Species that Occur in Wetlands (USFWS 1996) will be used to designate plants as either upland (UPL), facultative upland (FACU), facultative (FAC), facultative wet (FACW) or obligate (OBL). For herpitile and fish guilds will be developed in consultation with NYDEC and USACE following completion of the first year of biological baseline data collection. As with the bird and plant guilds, the amphibian and fish guilds will be used in reporting annual results on biological performance in the wetland mitigation and enhancement areas.

The performance standards to be used for fish and herpitiles during the restoration monitoring phase of the site include successfully completing the surveys per the methods, schedule and sampling design layout, and generating the richness and location data for amphibians, and richness and physical habitat conditions for future comparisons to the 2007 baseline conditions being surveyed at the wetland mitigation site.

For faunal groups, the performance standards will be to ensure that the monitoring work and reporting is completed successfully. As a part of this performance requirement, the annual reports will provide an analysis of trends by species, by guild and by community, using richness, frequency of occurrence, and habitat-use mapping, depending on the group.

I. Documentation and Reporting

<u>Documentation Goals</u>:

A. Erosion control effectiveness.
B. Plant community development and trajectory.

C. Habitat development and trajectory.
D. Key wildlife group use and trajectory.
E. Statistical summary of re-vegetation success as compared to permit performance standards.
   - Achievement of vegetation and hydrology milestones.

II. Reporting Frequency

A. Annually, by December 31st, the annual restoration report, and
B. Concludes upon issuance of the Certificate of Completion.
C. Monthly, hydrological reports beginning in May during construction years 1 and 2, as to the properties wetland areas achievement of the hydrology performance standards.

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Table 1. Proposed Ecological Monitoring, Performance Standards, Sampling Methods, and Sampling Sufficiency Determinations for the Rapp Road Landfill Eastern Expansion, City of Albany, New York.

Monitoring Requirement	Performance Standard	Sampling Method	References[1]	Sampling Sufficiency Determination
Percent cover	• 70% at 90% Confidence Interval • Total cover • Measured annually in August or September • Correlated with Aerial Photography • 200+ $1m^2$ quadrats • Sampled throughout, wetland, grassland and woodland communities	• Line transect nested $1m^2$ quadrats • Compare permanent and annual random transects	4, 6	Standard error of means
Diversity	• Frequency of occurrence by species • Minimum 15 species per grassland, wetland and woodland, minimum of 12 species in forested wetland enhancement	• Line transect nested $1m^2$ quadrats • Compare permanent and annual random transects • TMS • Nested belt transects-cover intercept and DBH	4,5,13,14,17,21,22,23,27	
Birds	• Richness • Breeding density • Spatial habitat location	• Point plot • Flush plot • Mapping	1, 2, 3, 7,8,9,10,15,16,17,18,24,25	
Fishes	• Presence/ Absence	• Visual observation (habitat) • Backpack electroshocking • Seining/ Minnow traps	**	
Herpitiles (Amphibians & Reptiles)	• Richness • Habitat location	• Visual encounter survey • Sampling station • Night survey • Ripnet • Seining • Funnel Traps	*	

Monitoring Requirement	Performance Standard	Sampling Method	References[1]	Sampling Sufficiency Determination
Lepidoptera	• Presence/ Absence • Relative abundance • Species diversity • Habitat suitability	• Visual encounter survey • Sampling station • Night survey • Habitat suitability using PB/ DEC/ USFWS methods	See Karner Blue Recovery Plan	
Hydrology	• USACE hydrology criteria • ECL Article 24	• Telogs		Standard error of means and repeatability

[1] See Bibliography

Table 2

CITY OF ALBANY RAPP ROAD LANDFILL EASTERN EXPANSION RESTORATION MONITORING SCHEDULE—TO BE APPLIED TO EACH PHASE OF THE RESTORATION

						Active Restoration Including Construction & Post-construction Seeding & Planting					Short-term Management																	Long-term Management (>10 Years Long-term Maintenance)																			
	Task	Baseline (2007)				Site Construction	Year 1				Year 2				Year 3				Year 4				Year 5				Year 6				Year 7				Year 8				Year 9				Year 10			
	Quarter	1	2	3	4		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
1	**Vegetation**																																													
a	Diversity		X	X				X	X			X	X			X	X			X	X			X	X			X	X			X	X			X	X			X	X			X	X	
b	Percent Cover		X	X				X	X			X	X			X	X			X	X			X	X			X	X			X	X			X	X			X	X			X	X	
c	Woody Plant Dist.		X	X				X	X			X	X			X	X			X	X			X	X			X	X			X	X			X	X			X	X			X	X	
d	Wetland Delineation											X				X				X								X								X								X		
2	**Birds**																																													
a	Breeding Surveys		X					X				X				X				X				X				X								X								X		
b	Spring Migratory		X					X				X				X				X				X				X								X								X		
c	Fall & Winter Migratory			X	X				X	X			X	X			X	X			X	X			X	X			X	X			X	X			X	X			X	X			X	X
3	**Amphibians**		X					X				X				X				X				X				X								X								X		
4	**Lepidoptera**		X	X		X		X	X			X	X			X	X			X	X			X	X							X	X							X	X			X	X	
5	**Fishes**		X	X				X				X				X				X				X				X								X								X		
6	**Hydrology**	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
7	**Reporting**		X		X			X		X		X		X		X		X		X		X		X		X		X		X		X		X		X		X		X		X		X		X
8	**Target Date Notice of Completion (Application)**																																												X	
9	**Target Dates Certification of Completion (Agencies)**																																													X
10	**HGM/HEP or other Model**				X									X									X							X							X									X
11	**Agency review and approved release**																																													

APPENDIX 4. (See IPM Plan stand alone accompanying document)

INTEGRATED PEST AND INVASIVE SPECIES MANAGEMENT PLAN

ALBANY RAPP ROAD LANDFILL
ECOSYSTEM MITIGATION, RESTORATION & ENHANCEMENT PLAN

CITY OF ALBANY, NEW YORK

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APPENDIX 5.

Albany Rapp Road Landfill
Ecosystem Mitigation Restoration
And Enhancement Project
Albany, New York

Third-Party Monitor
Quality Assurance Plan

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April 2009

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SECTION 1.0

INTRODUCTION

The City of Albany currently owns and operates a New York State permitted 6NYCRR Part 360 Solid Waste facility in Albany, New York. As a pat of the proposed expansion of this facility, the City of Albany has applied for wetlands permits from both the New York State Department of Environmental Conservation (NYSDEC) and the US Army Corps of Engineers (USACE). As part of both the NYSDEC and the USACE application submittal, the City of Albany is providing an independent, third-party monitor Quality Assurance Plan for regulated activities in wetlands and other restored, enhanced and created plant communities associated with the Landfill Expansion Project. This third-party quality assurance plan is being submitted for review and approval. This plan has been organized as follows:

- Section 2.0 – Scope of Third Party Monitor Quality Assurance discusses the activities covered under this plan.
- Section 3.0 – Management Organization, presents the structure of the third-party quality assurance personnel, personnel qualifications, and lines of communication.
- Section 4.0 – Observation, discusses the means and methods of the third-party monitor(s).
- Section 5.0 – Documentation and Record Keeping, discusses the means by which quality assurance activities will be documented.

This plan will be updated on an as-needed basis during the course of implementation of the various work efforts covered by the permits, to maintain compliance with the USACE, and NYSDEC issued permits and/or provide for effective third-party quality assurance of regulated activities.

SECTION 2.0

SCOPE OF THIRD-PARTY QUALITY ASSURANCE

In general, the regulated activities covered by this third-party quality assurance plan include work in wetlands regulated by the USACE and NYSDEC and other areas of restoration and enhancement of properties for the following:

- Mobile Home Park and associated land's restoration and enhancement areas
- One acre parcel of land owned by the State of New York (NYDOT)
- Proposed Landfill Expansion Construction and Restoration Areas owned by the City of Albany
- Albany Pine Bush Preserve

Within each of these broadly defined regulated activities, the following specific regulated activities are covered by this plan:

- Establishing limits of disturbance for the various activities that will be undertaken in/or immediately adjacent to wetlands (i.e., flagging the limits of disturbance prior to clearing of vegetation or other disturbances),
- Installation and maintenance of erosion and sediment control measures within and/or adjacent to regulated wetlands;
- Initial clearing activities in regulated wetlands;
- Construction of temporary access roads and temporary waterway crossings associated with the Albany Rapp Road Ecosystem Mitigation, Restoration and Enhancement Project as necessary to conduct restoration and enhancement activities;
- Woody vegetation cutting and removal associated within restored and enhanced forested areas (i.e., vegetation removal that does not involve earthwork);
- Initial earthwork activities in regulated wetlands (i.e., grubbing, grading, and/or initial excavation (i.e., removal and stockpiling of topsoil) within the limits of disturbance permitted by the USACE and NYSDEC permits;
- Grading for mitigation wetland and wetland biofilter construction (i.e., establishing grades conducive to wetland function); and
- Wetland and upland plantings for mitigation, restoration and enhancement areas for the Albany Rapp Road Landfill Ecosystem Mitigation, Restoration and Enhancement project.

For the purpose of this plan, third-party Quality Assurance (QA) is defined as follows:

A series of activities which provides a methodology for confirmation that the project was constructed as specified in the design documents. Confirmation that the mitigation activities are in conformance with the permit conditions, specifically in relation to work activities conducted in and adjacent to regulated wetlands. Only authorized disturbances of wetlands will occur. Third-party quality assurance includes inspections, verification, and evaluation of materials and workmanship necessary to assess and document the quality of the constructed project in terms of wetland protection, enhancement and restoration, and including upland habitat restoration and enhancement. Third-party Quality Assurance (QA) refers to measures taken by a third-party QA organization to assess whether the native landscape installer or earth work contractor is in compliance with the plans, specifications and any governing wetland permits for the project. This can also include quality control for those actions taken before construction so that the materials chosen and workmanship comply with the approved plans, reports, specifications, and governing wetlands permits, where applicable.

Under the anticipated requirements of the permits in accordance with the design documents (e.g., drawings and specifications) and in accordance with the City of Albany's existing landfill standard operating procedures, the Landfill Expansion projects will be subject to Construction Quality Assurance (CQA) and Construction Quality Control (CQC) for a variety of activities not specifically related to work in wetlands. For example, following initial earthwork disturbance for expansion area berm and liner work and the construction of the liner system within the bounds of previously disturbed areas, which may include wetlands, will continue for an extended period of time. CQA/CQC will be performed for this liner work by independent entities other than the third-party monitor described in this plan to verify that baseliner grades, compacted clay liner construction, geo-membrane construction, drainage layer construction, and cushion materials placement is in accordance with the approved design and the Part 360 permit. The third-party quality assurance described in this plan is not intended to supplant or duplicate the CQA/CQC for activities unrelated to protection of wetlands and conformance with the conditions of the wetlands permits.

SECTION 3.0

MANAGEMENT ORGANIZATION

The City of Albany will retain independent, qualified, third-party personnel to provide on-site monitoring of activities occurring within and/or adjacent (i.e., within buffer zone) to regulated wetlands and other upland ecosystem restoration and enhancement activities. The Quality Assurance (QA) management organization to be utilized for the third-party monitor quality assurance activities within and/or adjacent to regulated wetlands is shown on Figure 1 and is described below. Before construction is started, the USACE and NYSDEC staff will be notified in writing of the persons/entities that will be the responsible parties identified in Figure 1. The regulated activities, which require the oversight by a third-party monitor, will most likely span different elements of the restoration and enhancement project, and will have the potential to occur during the same time period. It is the responsibility of the City of Albany to retain the required personnel to provide an appropriate level of oversight consistent with the activities being undertaken at any given time within and/or adjacent to regulated wetlands and other restoration and enhancement areas.

An initial pre-construction meeting is anticipated to be held prior to the start of construction activities with the designated representative of the City of Albany, Design Engineer(s), Project Engineer(s), Contractor(s), project CQA/CQC staff, Third-Party Monitor, and USACE and NYSDEC staff. The following will occur at the pre-construction meeting:

- Provide the Third-Party Monitor(s) with relevant design reports, specifications, engineering drawings, and permits relating to work to be conducted within and/or adjacent to wetlands and other upland restoration and enhancement areas including those relevant to wetland and Pine barrens restoration activities. This list will be revised as other documents relating to work to be conducted within and/or adjacent to wetlands are developed or as current documents are updated;

- Review the responsibilities, authorities, and lines of communication for each of the involved entities;

- Review governing permit terms and conditions;

- Review the methods and means for decision making and/or resolution of problems;

- Review methods for documenting and reporting inspection data;

- Discuss the procedures for storage and protection of construction materials on-site;

- Discuss the procedures for protection of regulated wetlands;

- Discuss any contingency plan procedures (i.e., in the event of poor weather, equipment breakdown, etc.); and

- Conduct a brief site tour to review the project layout and familiarize third party monitors and agency staff with site conditions.

3.1 Qualifications

The third-party monitor will be inter-related to the overall CQA/CQC management organization. The pertinent qualifications, experience requirements, and responsibilities of the third-party monitor, as shown in Figure 1, are described below.

The third-party monitor(s) will be contracted by the City of Albany, but will be independent of the City, its affiliates, and construction contractors under a separate Professional Services contract with the City of Albany. The third-party monitor(s) will observe construction activities occurring within and/or adjacent to regulated wetlands and other areas being restored and enhanced as part of the mitigation project, as described in Section 3 of this plan. The particular third-party monitor individual(s) or firm(s) will have the following qualifications:

- Knowledge of materials and methods for work associated with wetland vegetation protection, soil erosion and sediment control measures, wetland planting, and wetland restoration;

- Knowledge of materials and methods for work associated with upland vegetation protection, upland restoration and enhancement of prairies and Pine Barrens.

- Familiarity with the types of applicable governing permits related to wetland disturbance, wetland and water quality protection, project construction drawings, CQA/CQC plans, SWPPP, and specifications;

- Familiarity with the identification of plant and tree species, particularly wetland species that are native to New York State and existing species found on the landfill property, APBP and NYSDEC (NYDOT) property.

- Familiarity with the identification of plants and tree species native to New York and native to the Albany Pine Bush Preserve.

- Familiarity with invasive plant species within the APBP ecosystem.

The third-party monitor will have an appropriate college degree in a relevant field of science or engineering (i.e., environmental science, environmental engineering, biological science, forestry, etc.) and/or equivalent field experience of at least ten years on similar types of projects or at least three other projects of similar types. The lead third-party monitor in charge may be on site or may direct the efforts of other third-party monitors, as necessary. The qualifications of other third-party monitors, supporting the individual in responsible charge will be as follows:

- Familiarity with the activities being undertaken (e.g., vegetation identification, earthmoving, soil erosion and sediment controls) at the time the monitor is on site;

- Familiarity with the types of construction being undertaken (landfill, wetlands mitigation, upland ecosystem restoration); and

- A degree in a relevant field of science or engineering (i.e., environmental science, environmental engineering, biological science, forestry, etc.) or five years of equivalent experience.

3.2 Responsibilities

The third party monitor will have the following responsibilities:

- Observe the progress of the regulated activities for compliance with the wetlands permits and approved engineering design mitigation, restoration and enhancement documents, as further described in Section 4;

- Communicate problems or non-compliance issues directly to the City of Albany Project Manager, the NYSDEC Division of Fish and Wildlife and Marine Resources, and the USACE;

- Communicate field changes, if any, or problems (e.g., adverse weather conditions that affect schedule or quality assurance) issues directly to the City of Albany Project Manager, the NYSDEC Division of Fish and Wildlife and Marine Resources, and the USACE;

- Communicate with the City of Albany Project Manager to resolve problems or address concerns in a timely manner;

- Prepare daily and weekly reports and submit such reports as described in Section 5 of this plan; and

- Maintain documentation, as discussed in Section 5 of this plan, showing work was performed in compliance with the wetlands permits and approved engineering design documents or if issues occurred, how such issues were rectified, and incorporate relevant documentation in pertinent record reports of construction.

SECTION 4.0

OBSERVATION

The quality assurance observation protocol to be used by the third-party monitor during work on regulated activities may be segregated into (1) full-time and (2) part-time observation. Each of these aspects of the third-party observation protocol is discussed below.

4.1 Full-Time Third-Party Observation

The third-party monitor will provide full-time observation during activities where the limits of disturbance in wetlands are being established, where the construction activities represent the initial disturbance of wetlands covered by the permits, and initially when other restoration and enhancement activities is associated with the mitigation plan begin. More specifically, full-time observation will occur during the following types of activities:

- Establishing limits of wetland disturbance for the various regulated activities;
- Initial clearing activities in regulated wetlands, including the installation of temporary access roads;
- Woody vegetation cutting and removal and tree removal associated with the wetland and upland forest enhancement;
- Installation of erosion and sediment control measures within and/or adjacent to regulated wetlands; and
- Initial earthwork and construction activities in regulated areas, including wetlands until initial wetland area disturbance is complete, the limits of disturbance are confirmed, and measures in place to delineate and protect areas to remain undisturbed.

4.2 Part-Time Third-Party Observation

The third-party monitor will provide an appropriate level of oversight (i.e., part-time) for regulated activities that continue within previously disturbed wetlands where the boundaries of the areas to be protected are clearly demarcated. More specifically, part-time observation will occur during the following types of activities:

- Maintenance of temporary access roads within areas of established wetland disturbance limits and temporary waterway crossings associated with the Rapp Road Landfill ecosystem mitigation, restoration and enhancement work;
- Inspection of installed erosion and sediment control measures within and/or adjacent to regulated wetlands, behind which earthwork or other construction elements (e.g., liner systems, bridge) for various landfill projects may be continuing on previously disturbed wetlands covered by the permits;

- Mitigation grading (wetlands and uplands) to confirm that final grades (e.g., review of survey data) are in accordance with the approved mitigation design; and

- Restoration planting and planting material inspection either on site or at the facility where plant material is propagated or processed.

4.3 Third-Party Monitor Tasks

During the regulated activities noted above, the third-party monitor will perform the following:

- Check that work within and/or adjacent to regulated wetlands has been performed in accordance with the NYSDEC and USACE wetland permits;

- Check that work within and/or adjacent to regulated areas, including wetlands is performed in accordance with Stormwater Pollution Prevention Plans;

- Check that the limits of wetland disturbance are in accordance with the approved engineering drawings and that there are no unauthorized wetland disturbances outside of those boundaries during construction activities;

- Confirm that the appropriate areas are marked for protection in accordance with the project specifications;

- Verify that the soil erosion and sediment control measures, including temporary access waterway crossings, temporary construction access roads, and construction stabilized entrances, are constructed, installed, and maintained in accordance to the project Specifications, project Stormwater Pollution Prevention Plans, and the NYSDEC Standards and Specifications for Erosion and Sediment Control, latest revision;

- Confirm that the Contractor performs clearing, grubbing, or stripping of surficial soil after the proposed work area limits have been established and the appropriate soil erosion and sediment control measures have been installed;

- Check the work is not performed and/or storage of equipment and/or materials does not occur within areas outside the permitted limits of disturbance;

- Check that the proper plant species are removed from the designated wetland areas as described in the Albany Rapp Road Landfill Ecosystem Mitigation, Restoration, and Enhancement Plan;

- Check that the wetland restoration seed and plant materials, along with planting schedules, methods, and planting area meet the design and specifications set forth in the plan also;

- Check that the Contractor(s) does not dispose of material within regulated wetlands, streams or other water bodies or cause spills or leaks of fuel, oil, or other potentially harmful material; and;

- Take representative photographs of regulated activities for use in preparing inspection reports.

For periods of time not requiring full-time inspection, the third-party monitor will conduct an overall site inspection approximately once every 14 calendar days during the times that regulated activities are continuing adjacent to wetlands to remain and within previously disturbed wetland areas covered by the NYSDEC and USACE wetland permits. The third-party monitor may adjust the frequency of such site inspections based on observations made. During a site inspection, the Third-Party Monitor will complete the applicable sections of the Daily Field Report form and indicate that the form is being used for a site inspection (i.e., part-time weekly third-party monitor oversight level). A sample of a Daily and Weekly Field Report form is attached in Appendix A and B.

SECTION 5.0

DOCUMENTATION AND RECORD KEEPING

The third-party monitor will be responsible for the compilation, review, and preparation of the following reports to document the quality assurance activities undertaken in accordance with this plan:

- Daily Third-Party Monitor Reports, and
- Weekly Third-Party Monitor Summary Reports

During periods of part-time observation, if only one inspection occurs within a week or greater time period, the daily report will be annotated to indicate that it also represents a summary report and the period of time represented by the summary report.

5.1 Daily Third-Party Monitor Reports

A daily inspection report, sketches, and photo-documentation as necessary, summarizing the day's QA documentation related to regulated activities within and/or adjacent to regulated wetlands (collectively referred to as daily third-party monitor reports) will be prepared by the third-party monitor at the conclusion of each day's construction activities at the site, for which third-party monitoring is necessary. The information provided in the daily third-party monitor reports will include the following:

- Description of the day's activities and associated wetland protection, and other habitat protection measures implemented, as applicable;
- Drawings, sketches, photographs or maps showing work completed along with the relationship of the work area to remaining wetlands;
- Identification of potential field modifications to design or method of implementation of work, if any;
- Documentation of discussions, decisions, or recommendations involving the Contractor(s), Subcontractor(s), City of Albany, Project Manager, NYSDEC, USACE, and representatives of the Project Engineer relating to modification of the work or design for activities within or adjacent to regulated wetlands; and
- Problems encountered if any, and a description of the resolution of such problems and the schedule for resolution of the problem.

A sample daily report is included in Appendix A for reference. The reports may be in paper or electronic form. This report may be modified as necessary to suit conditions encountered in the field, as the work progresses.

The daily third-party monitor reports will be provided to the City of Albany Project Manager, USACE, NYSDEC, and other project members as determined at the pre-construction meeting, if any, by the morning following each day that the third party monitor is in the field. The daily reports will either be e-mailed to the various parties or posted to a secure website for download at the various parties' convenience. The method of submitting the daily reports will also be confirmed at the pre-construction meeting. If more than one third-party monitor is required to cover multiple regulated activities, each third-party monitor will prepare and submit a separate daily third-party monitor report.

5.2 Weekly Third-Party Monitor Summary Reports

Weekly third-party monitor summary reports will be prepared by the close of business on the first working day after the conclusion of the previous working week. The information presented in these reports will be a summary of the previous week's daily third-party monitor reports and will be submitted as a standard form, an example of which is attached in Appendix B. The weekly third-party monitor summary reports will include the following information:

- Description of the previous week's work activities conducted within and/or adjacent to wetlands and other regulated plant communities;
- Description of methods implemented for the protection of wetland areas to remain within and/or adjacent to the previous week's work areas;
- Summary of performance of installed soil erosion and sediment control measures in relation to the protection of wetlands and other regulated plant communities;
- Summary of recommended potential field modifications to design or construction methods, if any;
- Summary of discussions held among the parties (NYSDEC, USACE etc.) and decisions reached; and
- Problems encountered, if any, resolution of such problems, and schedule for resolutions of the problem.

The weekly third-party monitor summary report will be submitted to the City of Albany, NYSDEC, USACE and other parties as appropriate, in the same manner as the daily reports. If more than one third-party monitor provided observation of regulated activities during the previous week, the daily third-party monitoring reports for each monitor will be combined into a single weekly summary report.

WETLANDS PERMIT APPLICATIONS

New York State Department of Environmental Conservation, Rapp Road Landfill, Application No. 4-010/171.

U.S. Army Corps of Engineers, Clean Water Act Section 404 Permit Application No. _______.

Albany Rapp Road Landfill Ecosystem Mitigation, Restoration and Enhancement

Albany Rapp Road Landfill Ecosystem Mitigation, Restoration and Enhancement Plan, prepared by Applied Ecological Services, Inc. September, 2008.

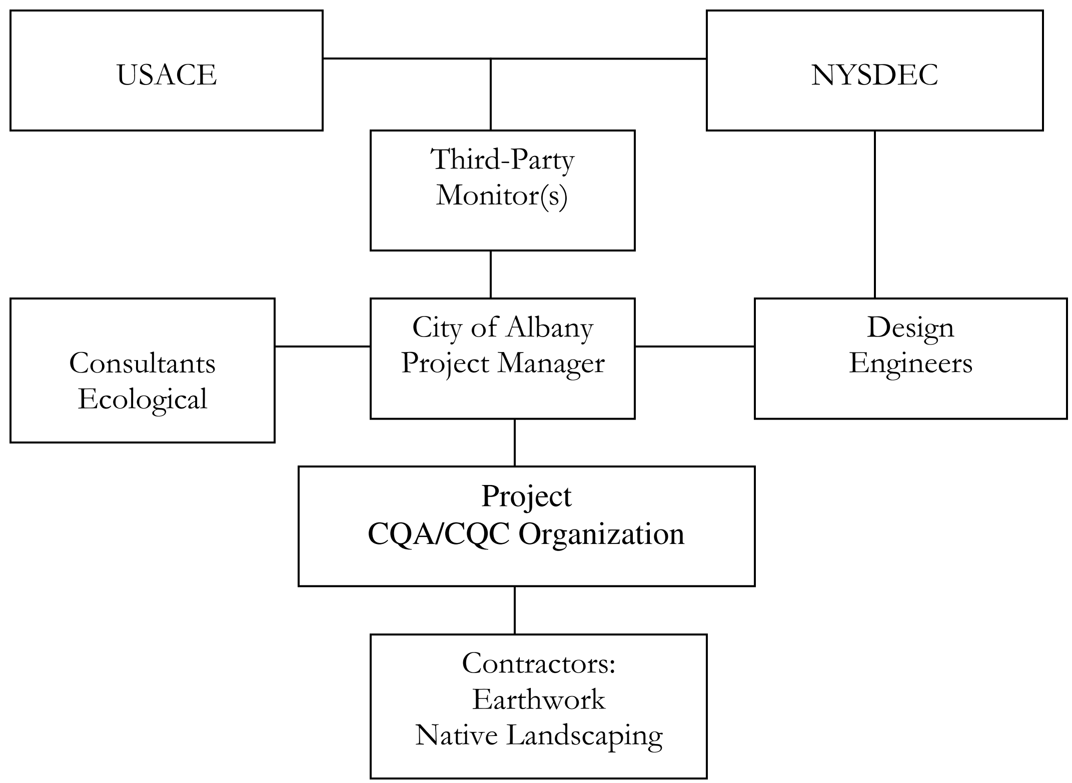
- Attachment 2: Construction Specifications, prepared by Applied Ecological Services, Inc. September 2008.

Stormwater Pollution Prevention Plan Rapp Road Solid Waste Management Facility Restoration Plan, prepared by Clough Harbour Associates, LLP, September, 2008.

Proposed Landfill Expansion

6NYCRR Part 360 Permit Application, Albany Rapp Road Landfill Expansion, Engineering Design Drawings, prepared by Clough Harbour Associates, LLP.

Figure 1. Third-Party Monitor, Quality Assurance Management Organization



Applied Ecological Services, Inc.™

Appendix A.

Applied Ecological Services, Inc.
17921 Smith Road, PO Box 256 • Brodhead, WI 53520-256
608-897-8641 • info@appliedeco.com • www.appliedeco.com
Specialists in Environmental Research, Planning, Construction and Management

THIRD-PARTY MONITOR DAILY FIELD REPORT

Project:______________________________ Date:____________ Field Report No.:_____________

Project Code:________________ Weather::________________________ Page 1 of ____________

Arrived at Site:__________ Contractor:____

Reporting Time Period:____
Third-Party Monitor Oversight Level: □ Full-time □ Part-time □ Part-time weekly

Equipment Used:_________________________________: On-site personnel___________________

____

____

Regulated Activities (check all that apply)	
	Demarcation of limits of disturbance
	Soil erosion and sediment control measure installation
	Vegetation clearing and grubbing
	Restoration earthwork activities
	Enhancement vegetation removal
	Temporary access road construction
	Temporary waterway crossing construction
	Mitigation site grading
	Maintenance of erosion and sediment control measures
	Maintenance of temporary access roads and temporary access waterway crossings
	Native landscaping (discing, seeding, planting, etc.)
	Ecological management (mowing, herbiciding, burning, etc)
	Other (list)
Description of permitted/regulated activities completed:	
Summary:	

THIRD-PARTY MONITOR DAILY FIELD REPORT

Project: ____________________ Date: ______________ Field Report No.______________
Page 2 of _____

Description of Problems Encountered:

Problem Resolution:

Problem Encountered	Resolution	Schedule

Identification of Design/Field Modifications:

Attachments: (check all that apply)

- □ Photographs
- □ Sketches
- □ Maps
- □ Telephone Conversation Records
- □ Meeting Minutes
- □ Field Notes
- □ Other (list)

Departed Site:	Inspector:
Contractor's Hours:	Inspector's Signature:

Appendix B.

Applied Ecological Services, Inc.

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Specialists in Environmental Research, Planning, Construction and Management

THIRD-PARTY MONITOR WEEKLY FIELD REPORT

Project(s):______________________________ Date:____________ Weekly Report No.:__________

Project Code(s):________________ Page 1 of _______________

Contractor(s):____

Reporting Time Period:________________

Third-Party Monitor Oversight Level: ☐ Full-time
During previous construction week: ☐ Part-time
(Check all that apply)

Permitted/regulated activities that occurred in previous construction week (check all that apply)	
	Demarcation of limits of disturbance
	Soil erosion and sediment control measure installation
	vegetation clearing and grubbing
	Restoration earthwork activities
	Enhancement vegetation removal
	Temporary access road construction
	Temporary waterway crossing construction
	Mitigation site grading
	Maintenance of erosion and sediment control measures
	Maintenance of temporary access roads and temporary access waterway crossings
	Native landscaping (discing, seeding, planting, etc.)
	Ecological management (mowing, herbiciding, burning, etc)
	Other (list)
Summary of Regulated Activities Completed in Previous Construction Week:	

Page 2

THIRD-PARTY MONITOR WEEKLY FIELD REPORT

Project: Date: Field Report No.
Page 2 of _____

Description of Design or Field Modifications:

Summary of Problems Encountered and Planned/Implemented Resolutions:

Problem Encountered	Resolution	Schedule

Summary of Discussions:

Inspector(s)

Inspector(s) Signature(s)

APPENDIX 6.

MINIMUM CONTRACTOR QUALIFICATIONS

ALBANY RAPP ROAD LANDFILL
ECOSYSTEM MITIGATION, RESTORATION & ENHANCEMENT PLAN

CITY OF ALBANY, NEW YORK

Prepared by.
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April 2009

Minimum Contractor Qualifications

The City of Albany, Albany Pine Bush Preserve Commission, and Federal and State agencies have all suggested that the City of Albany have rigorous and strict definition(s) for soliciting or sole sourcing the professional services, contracting, oversight, and monitoring work efforts necessary to successfully undertake the restoration plan proffered with the landfill expansion application. The following are the minimum requirements of a restoration contractor and the on-staff, full time ecological support, documented below, that is required for this project. The restoration contractor will have a key role in working with permitting agencies and the technical management and restoration team to present restoration progress and results.

1. Contractor has certified senior ecologists, registered with the ecological society of America, who have > 20 years of field experience in restoration in oak-pine and prairie communities and is formally a part of the contracting company, not a subcontractor.

2. At least one such full time, on staff certified senior ecologist who has been on staff with the restoration contracting firm for a minimum of 10 years is required and must be documented as a qualification.

3. The staff certified ecologist shall be directly assigned to this project to provide oversight, daily direction on an as needed basis, to work with the restoration contracting crew foreman and be available for daily interaction remotely or in person with project implementation status, daily decisions, etc.

4. The restoration contracting firm and senior ecologists must be recognized leaders nationally in the restoration of sand barrens, oak-pine savanna, and wetlands and must be recognized in the restoration literature through at least 5 publications in peer reviewed journals and conferences on this subject matter.

5. The restoration contracting firm and senior ecologist must have a documented, long established relationship in design and implementation of other similar restoration projects with The Nature Conservancy.

6. The senior ecologist must have a well documented, exemplary speaking presence and must be respected, clear and practical in performing the following:
    - articulating restoration progress,
    - organizing and participating in meetings with the Albany Pine Bush Preserve Commission and technical restoration team, and
    - communicating progress and decisions to the public, including groups that might oppose the landfill expansion.

    The senior ecologist must have presented to each of these groups at least once prior to the solicitation date on this RFP.

7. The restoration contractor must have at least 20 years of documented involvement is successfully restoring prairie, savanna, oak-pine barren communities of a similar nature as the Albany Pine Bush preserve.

8. The restoration contractor must have at least 20 years of documented experience and direct responsibility for harvesting, propagation and amplifying the quantity of seed for locally derived native genetic resources for hundreds of native forbs, grasses, sedges, and moss as found in pine-oak savanna, native prairie grasslands, wetlands (sedge meadows, bogs, vernal ponds, etc) and riparian and forested floodplain restoration experience in glacial outwash sand plains similar to the Albany Pine Bush Preserve.

9. The company ecologists, engineers, land planners, and contractor crews must have on-site experience specifically within the Albany Pine Bush Preserve in working with the plant and animal communities' present, researching restoration, studying hydrology, and in the measurement of the conditions of reference natural areas in the Pine Bush Preserve.

10. The restoration contractor must be positioned and must demonstrate success in at least 5 similar projects, to offer the long term reliable services on this design-build restoration project and have demonstrated success in similar scaled and complexity projects.

11. The restoration contractor must provide evidence of the successful completion or on-going experience on at least 5 similar restorations of similar complexity and with similar permitting requirements with other non-profit organizations and working with the same federal and state agencies involved in review and formal approval of this restoration at the Albany Pine Bush Preserve.

12. The restoration contractor must demonstrate similar successful experience in restoring land with state and federal endangered plant and animal species, and in successfully working with federal and state agencies to achieve success in address these special status species during the process.

13. The restoration contractor must have a working relationship with the engineer of record and a demonstrated experience working successfully with this engineer of record on at least 2 other restoration projects.

14. The City of Albany will not accept any substitute qualifications or credentials that do not meet the above minimum requirements. In addition, the City may impose greater requirements above these minimums as requested by State and Federal Agencies, the Albany Pine Bush Commission and staff. Under no conditions can the City reduce the minimum requirements sought and that must be met by the restoration contractor.

15. The restoration contractor must demonstrate they can meet the project's rigorous bonding requirements, timelines for execution of the restoration, reporting requirements, needs for on-site daily contractor foreman and oversight, and demonstrate the on-time and on-budget delivery of a minimum of 5 other complex restoration projects for which performance was required by state and federal permits.

APPENDIX 7.

BASELINE STUDY RESULTS

ALBANY RAPP ROAD LANDFILL
ECOSYSTEM MITIGATION, RESTORATION & ENHANCEMENT PLAN

CITY OF ALBANY, NEW YORK

Prepared by.
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April 2009

<u>Species Search Lists – Timed Wander Approach</u>

Disturbed Oak Pine Forest (30-70 years)
Eupatorium rugosum
Agropyron repens
Solidago canadensis
Celastrus orbiculatus
Acer rubrum
Poa pratensis
Rhus radicans
Pinus strobus
Quercus velutina
Rhamnus cathartica
Prunus serotina
Lonicera tatarica
Dactylis glomerata
Chenopodium album
Alliaria officinalis
Oxalis stricta
Parthenocissus inserta
Plantago lanceolata
Galium asprellum
Solanum dulcamara
Ambrosia artemisiifolia elatior
Rubus allegheniensis
Aster laevis
Panicum sp.
Rubus occidentalis
Hackelia virginiana
Vitis riparia
Quercus coccinea
Acer rubrum
Pinus rigida
Symplocarpus foetidus
Polygonum persicaria
Polygonum punctatum
Onoclea sensibilis
Circaea luteiana
Polygonum lapathifolium
Impatiens capensis
Populus deltoides
Robinia pseudoacacia
Rhus radicans
Lonicera maackii
Rubus sp.
Phytolacca americana
Cardamine pensylvanica
Agrostis perennans
Veronica americana
Sorbus americana
Quercus coccinea

Quercus velutina
Quercus rubra
Athyrium filix-femina
Podophyllum peltatum

Forested Wetland (30-50 years)
Osmunda claytoniana
Athyrium filix-femina
Impatiens pallida
Prunus serotina
Eupatorium perfoliatum
Eupatorium rugosum
Acer rubrum
Osmunda regalis
Parthenocissus inserta
Celastrus orbiculatus
Vitis riparia
Pilea pumila
Acalypha rhomboidea
Rosa multiflora
Symplocarpus foetidus
Lindernia benzoin
Polygonum virginianum
Carex stricta
Quercus rubra
Cornus racemosa
Quercus coccinea
Populus deltoides
Viburnum dentatum
Aster simplex
Rubus occidentalis
Rubus allegheniensis
Amphicarpaea bracteata
Thalictrum dasycarpum
Clematis virginiana
Thelypteris noveboracensis
Fraxinus pennsylvanica
Lonicera tatarica
Polygonum virginianum
Trillium flexipes
Hepatica americana
Arisaema triphyllum
Solidago gigantea
Solidago patula
Circaea lutieana
Viola lanceolata
Carex bebbii
Lycopus americanus
Aster laevis
Geranium maculatum
Populus deltoides

Fraxinus nigra
Solanum dulcamara
Ribes missouriense
Cardamine pensylvanica
Ulmus americana
Veronica americana
Thalictrum dasycarpum hypoglaucum
Oxalis stricta

Upland Mesic Forest
Prunus serotina
Acer rubrum
Lindera benzoin
Thelypteris noveboracensis
Prunus virginiana
Tilia americana
Osmunda claytoniana
Alliaria officinalis
Rhus radicans
Onoclea sensibilis
Fraxinus americana
Parthenocissus inserta
Aralia nudicaulis
Celastrus orbiculatus
Rosa multiflora
Onoclea sensibilis
Cardamine pensylvanica
Veronica americana
Carex sparganioides
Polygonum virginianum
Prunus virginiana
Spiraea alba
Carex blanda
Rubus allegheniensis
Quercus rubra
Corylus americana
Lysimachia terrestris
Glyceria striata
Carex sp.
Lonicera tatarica
Betula populifolia
Quercus velutina
Viola sp.
Mitchella repens
Viola striata
Solidago patula
Aster laevis
Thalictrum dasycarpum
Nemopanthus mucronata

Disturbed Mesic Forest (20-30 years)
Osmunda cinnamomea
Eupatorium rugosum
Impatiens capensis
Alliaria officinalis
Acer rubrum
Solanum dulcamara
Osmunda regalis
Rubus allegheniensis
Celastrus orbiculatus
Pilea pumila
Onoclea sensibilis
Polygonum virginianum
Symplocarpus foetidus
Athyrium filix-femina
Carex sp.
Prunus serotina
Carex pensylvanica
Thalictrum dasycarpum
Oxalis stricta
Acalypha rhomboidea
Solidago canadensis
Glyceria striata
Eupatorium purpureum
Polygonella articulata
Phytolacca americana
Onoclea sensibilis
Clematis virginiana
Apios americana
Cornus amomum
Polygonum virginianum
Thelypteris noveboracensis
Geum canadense
Populus grandidentata
Rosa multiflora
Osmunda regalis
Amphicarpaea bracteata
Aster puniceus
Cirsium arvense
Echinocystis lobata
Urtica dioica
Carex stricta

North Powerline Easement
Impatiens capensis
Osmunda claytoniana
Alliaria officinalis
Celastrus orbiculatus
Eupatorium rugosum
Cirsium arvense

Acer rubrum
Pilea pumila
Polygonella articulata
Phragmites communis
Solidago canadensis
Rubus allegheniensis
Polygonum convolvulus
Glyceria striata
Sambucus canadensis
Urtica dioica
Rhus glabra
Phytolacca americana
Geum canadense
Oxalis stricta
Lobelia siphilitica
Symplocarpus foetidus
Prunella vulgaris
Erigeron annuus
Solidago graminifolia
Polygonum punctatum
Juncus tenuis
Galium sp.
Corylus americana
Eupatorium purpureum
Polygonum arifolium pubescens
Lythrum salicaria
Aster pilosus
Agrostis stolonifera
Rubus occidentalis
Vitis riparia

Powerline Corridor
Rubus allegheniensis
Solidago graminifolia
Solidago canadensis
Polygonum orientale
Phytolacca americana
Osmunda claytoniana
Osmunda regalis
Asclepias syriaca
Celastrus orbiculatus
Prunus serotina
Parthenocissus inserta
Clematis virginiana
Galium aparine
Alliaria officinalis
Impatiens capensis
Cornus racemosa
Pilea pumila
Spiraea alba
Vitis riparia

Amphicarpaea bracteata
Geum canadense

Older Forested Wetlands (Part of Forested Wetland polygon; area around transects E2-E3)
Eupatorium rugosum
Vitis riparia
Arctium lappa
Impatiens capensis
Pilea pumila
Geum canadense
Alliaria officinalis
Thalictrum dasycarpum
Solanum dulcamara
Symplocarpus foetidus
Eupatorium purpureum
Prunus serotina
Phragmites communis
Rubus allegheniensis
Parthenocissus inserta
Osmunda claytoniana
Clematis virginiana
Athyrium filix-femina
Lindera benzoin
Solidago canadensis
Acer rubrum
Osmunda regalis
Trillium flexipes
Celastrus orbiculatus
Viburnum opulus
Carex sp.
Cornus amomum
Ulmus americana
Aster umbellatus
Glyceria striata
Polygonum virginianum
Fraxinus americana
Circaea lutieana
Viburnum dentatum
Thelypteris noveboracensis
Osmunda regalis spectabilis
Carex pensylvanica
Maianthemum canadense
Hamamelis virginiana
Sambucus canadensis
Aster cordifolius
Carex blanda
Quercus rubra
Viburnum dentatum
Geranium maculatum
Streptopus roseus

Smilacina racemosa
Polystichum acrostichoides
Corylus americana
Carpinus caroliniana
Arisaema triphyllum
Mitchella repens
Carex sp.
Brachyelytrum erectum
Ostrya virginiana
Carex pensylvanica
Galium sp.
Sassafras albidum
Populus deltoides
Rhus radicans
Onoclea sensibilis
Adiantum pedatum
Prunus serotina
Quercus alba
Betula papyrifera
Solidago flexicaulis
Aralia nudicaulis
Rubus flagellaris

Pines Stand/Old Pasture
Pinus strobus
Prunus serotina
Solidago canadensis
Solidago ulmifolia
Gaultheria procumbens
Acer rubrum
Aster divaricatus
Veronica americana
Vaccinium angustifolium
Mitchella repens
Hamamelis virginiana
Quercus alba
Agrostis perennans
Carex pensylvanica
Rubus occidentalis
Solidago caesia
Fraxinus americana
Lonicera tatarica
Rhamnus cathartica
Celastrus orbiculatus
Aster laevis
Athyrium filix-femina michauxii
Carex blanda
Clematis virginiana
Lotus corniculatus
Galium sp.
Viola papilonacea

Parthenocissus inserta
Solidago graminifolia nuttallii
Betula populifolia
Festuca rubra
Aster laevis
Populus deltoides
Potentilla simplex
Osmunda claytoniana
Dianthus armeria
Solidago sp.
Hieracium florentinum
Oxalis stricta
Dactylis glomerata
Lobelia inflata
Viola sagittata
Hypericum perforatum
Solidago nemoralis
Rumex acetosella
Alliaria officinalis
Fraxinus americana
Maianthemum canadense interius
Amelanchier sp.
Monotropa uniflora
Agrostis perennans
Solidago nemoralis
Juncus tenuis
Dactylis glomerata
Danthonia spicata

Northern Drainage Ditch system
Solanum dulcamara
Leersia oryzoides
Epilobium coloratum
Impatiens capensis
Aster umbellatus
Eupatorium perfoliatum
Scirpus cyperinus
Berberis thunbergii
Symplocarpus foetidus
Aster laevis
Lonicera tatarica
Bidens frondosa
Glyceria striata
Vitis riparia
Onoclea sensibilis
Iris versicolor
Betula populifolia
Aster divaricatus
Equisetum arvense

Old field
Prunella vulgaris
Quercus rubra
Solidago caesia
Agrostis perennans
Hieracium florentinum
Phleum pratense
Solidago canadensis
Sassafras albidum
Viburnum opulus
Galium sp.
Rudbeckia hirta
Prunus serotina
Andropogon gerardii
Panicum cryptandous
Quercus alba
Solidago graminifolia nuttallii
Lonicera tatarica
Rubus allegheniensis
Quercus coccinea
Lespedeza hirta
Andropogon scoparius
Spiraea alba
Elaeagnus angustifolia
Salix sp.
Populus tremuloides
Centaurea maculosa
Rhus radicans
Vicia cracca
Eragrostis spectabilis
Poa pratensis
Plantago lanceolata
Dactylis glomerata
Aster pilosus
Asclepias syriaca
Daucus carota
Solidago juncea
Cornus racemosa
Juniperus virginiana
Asparagus officinalis
Onoclea sensibilis
Vitis riparia
Eupatorium purpureum
Lysimachia ciliata
Solidago nemoralis
Aster ericoides
Quercus velutina
Juncus tenuis

City Disturbed Forest
Eupatorium rugosum
Viburnum dentatum
Osmunda claytoniana
Solidago gigantea
Alliaria officinalis
Impatiens capensis
Cornus racemosa
Acer rubrum
Athyrium filix-femina michauxii
Viola sp.
Juncus tenuis
Onoclea sensibilis
Prunus serotina
Fraxinus americana
Viburnum lentago
Convallaria majalis
Celastrus orbiculatus
Trillium flexipes
Symplocarpus foetidus
Ulmus americana
Osmunda regalis
Pilea pumila
Carex pensylvanica
Parthenocissus inserta
Rhus radicans
Pinus rigida
Aralia nudicaulis
Carex blanda
Mitchella repens
Rhamnus cathartica
Corylus americana
Maianthemum canadense
Boehmeria cylindrica
Thelypteris noveboracensis
Fraxinus americana
Lindera benzoin
Pilea pumila
Geum canadense
Glyceria striata
Carex sp
Pinus strobus
Pinus resinosa
Thalictrum dasycarpum
Prunus virginiana
Solanum dulcamara
Apios americana
Vitis riparia
Polygonum virginianum
Rhus radicans
Lonicera tatarica

Carex bebbii
Veronica americana
Lysimachia ciliata
Polygonum punctatum
Carex sp.
Quercus alba
Quercus prinoides
Aster lateriflorus
Phragmites communis

Red Maple Stand East of Trailer Park
Alliaria officinalis
Impatiens capensis
Acer rubrum
Prunus serotina
Celastrus orbiculatus
Rubus allegheniensis
Eupatorium rugosum
Rubus allegheniensis
Rubus occidentalis
Vitis riparia
Polygonum virginianum
Ulmus americana
Pilea pumila
Carex sp.
Streptopus roseus
Rubus flagellaris
Arctium lappa
Sorbus americana
Athyrium filix-femina
Lonicera tatarica
Juncus tenuis
Fraxinus americana
Glyceria striata
Fragaria virginiana
Geum canadense
Symplocarpus foetidus

Degraded Oak/Pine Forest
Carex pensylvanica
Quercus alba
Carex stricta
Polygonum punctatum
Lonicera tatarica
Alliaria officinalis
Parthenocissus inserta
Prunus serotina
Trillium flexipes
Eupatorium rugosum
Aster laevis
Carex blanda

Chenopodium murale
Celastrus orbiculatus
Quercus velutina
Pinus rigida
Rubus occidentalis
Rubus allegheniensis
Quercus macrocarpa
Hackelia virginiana
Polygonum pensylvanicum
Oxalis stricta
Polygonum convolvulus
Cornus racemosa
Quercus muhlenbergii
Polygonum pensylvanicum
Solidago juncea
Sorbus americana
Catalpa speciosa.
Erechtites hieracifolia
Malus sp.
Betula populifolia
Osmunda regalis
Arisaema triphyllum

Trailer Park
Picea pungens
Pinus resinosa
Festuca elatior
Vitis riparia
Poa pratensis
Celastrus orbiculatus
Picea abies
Salix babylonica
Acer rubrum
Acer saccharinum
Taraxacum officinale
Poa pratensis
Hackelia virginiana
Lonicera tatarica
Rhamnus cathartica
Achillea millefolium
Verbascum thapsus
Asclepias syriaca
Daucus carota
Populus deltoides
Lythrum salicaria
Cirsium arvense
Lepidium virginicum
Setaria glauca
Oxalis stricta
Plantago major
Betula papyrifera

Juglans nigra
Aster laevis
Athyrium filix-femina michauxii
Asclepias syriaca
Malus sp.
Oenothera biennis
Festuca rubra
Catalpa speciosa
Aristida purpurascens
Acalypha rhomboidea
Verbena bracteata
Bromus japonicus
Centaurea maculosa
Echinochloa crusgalli
Panicum capillare
Leptochloa indica
Erechtites hieracifolia
Brassica kaber
Polygonum aviculare
Erigeron annuus
Berteroa incana
Ulmus pumila
Dactylis glomerata
Sporobolus vaginiflorus
Cyperus strigosus
Ambrosia artemisiifolia elatior
Galium sp.
Eragrostis neomexicana
Rumex crispus
Rosa multiflora
Erigeron canadensis
Agropyron repens
Phytolacca americana
Spiraea tomentosa rosea
Robinia pseudoacacia
Panicum villosissimum
Eragrostis spectabilis
Andropogon scoparius
Setaria faberi
Lotus corniculatus
Lythrum salicaria
Mock orange bush
Lespedeza capitata
Hypericum perforatum
Rudbeckia hirta
Physostegia virginiana
Panicum virgatum
Quercus alba
Festuca rubra
Ceanothus americanus
Carex sp.

Digitaria sanguinalis
Potentilla simplex
Iris siberica
Panicium sp.
Trifolium arvense
Thuja occidentalis
Panicum dichotomiflorum
Salsola kali
Artimis sp.
Forsythia sp.
Ligustrum vulgare
Bromus inermis
Campsis radicans
Gleditsia triacanthos
Cirsium vulgare
Melilotus officinalis
Eupatorium perfoliatum
Erechtites hieracifolia
Viola papilonacea
Melilotus officinalis
Eragrostis pectinacea
Acer negundo
Leonurus cardiaca

Black Locust/Wild Black Cherry dominated area
Prunus serotina
Robinia pseudoacacia

(no other species described)

Old Field/Scattered Cottonwoods on Spoil Piles
Populus deltoides

(no other species described)

Quaking Aspen/Dense Shrub area
Populus tremuloides
Rubus sp.
Cornus racemosa

(no other species described)

Red Oak Dominated area
Quercus rubra

(no other species described)

STREAM HABITAT AND AQUATIC MACROINVERTEBRATE ASSESSMENT

Albany Pine Bush Landfill Project

December 6, 2006

(AES Project # 06-0590)

Prepared by:

Applied Ecological Services, Inc.
120 West Main Street
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(847) 844-9385

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1.0 INTRODUCTION

On September 26th, 27th and 28th, 2006 Applied Ecological Services, Inc. (AES) and Clough Harbour & Associates (CHA) ecologists conducted comprehensive baseline surveys of stream habitat and sampled aquatic macroinvertebrate communities in onsite and offsite (reference) stream and wetland systems as a component of the Albany Pine Bush Landfill Project in Albany County, New York. The purpose of this investigation is to provide baseline data that can be used to identify existing conditions and provide information needed to conduct restoration activities on the site. Two stream systems and four wetlands complexes were investigated. The first stream is an unnamed tributary to Rensselaer Lake that originates at a wetland mitigation pond and flows southeast just east of the Rapp Road Landfill. The second stream is an offsite reference tributary to Rensselaer Lake located to the east. Macroinvertebrates were sampled from three wetlands complexes just north of the landfill including a mitigation pond, button bush swamp, and bog/vernal pool. Macroinvertebrates in a fourth, offsite reference sedge meadow, were also sampled. Figures 1 and 2 depict the location of the streams and wetlands discussed above. The offsite reference sedge meadow is not shown on the figures.

Prior to conducting the field reconnaissance, the unnamed stream just east of the landfill was divided into six reaches from southeast to northwest beginning at the streams intersection with Rapp Road and continuing upstream to the mitigation pond (Figure 1). A stream reach is defined as a stream segment having fairly homogenous hydrology, geomorphology, and riparian cover as well as land use characteristics. This method of lumping portions of the stream with similar characteristics into reaches allows for more useful collection, analysis, and comparison of the data.

2.0 METHODS

2.1 Aquatic Habitat Assessment

Habitat within each stream reach comprising the unnamed tributary was assessed using the Qualitative Habitat Evaluation Index (QHEI). The index was developed by the Ohio EPA for streams and rivers in Ohio but is also useful throughout most other parts of the country. The QHEI is a repeatable physical habitat index designed to provide empirical, quantified evaluation of the general lotic macrohabitat characteristics of a stream segment that are important to warm water faunas such as fish and macroinvertebrates. Studies using QHEI scores and fish/macroinvertebrate data have shown high correlation; poor QHEI scores generally have poor fish/macroinvertebrate communities and vise versa. The QHEI is composed of six metrics including substrate composition, in-stream cover, channel morphology, riparian zone and bank erosion, pool/glide and riffle-run quality, and map gradient. Each metric is scored individually then summed to provide the total QHEI score. The best possible score is 100. QHEI scoring sheets for each stream reach can be found in Appendix A.

QHEI scores greater than 60 generally support average quality fish and macroinvertebrate communities. Scores greater than 80 typify pristine habitat conditions that have the ability to support exceptional warm water faunas. Table 1 below summarizes the QHEI score classifications. Areas with habitat scores lower than 60 may support warm water faunas but usually have significant degradation.

Table 1. QHEI score classifications

QHEI	Class	Usual Characteristics
80-100	Excellent	Comparable to pristine conditions; exceptional assemblage of habitat types; sufficient riparian zone
60-79	Good	Impacts to riparian zone
30-59	Fair	Impacts to riparian zone; channelization; most in-stream habitat gone
0-29	Poor	All aspects of habitat in degraded state

2.2 Macroinvertebrate Sampling

Macroinvertebrates were sampled using a standard D-frame kick net that was also used for jabbing, dipping, and sweeping around instream habitat. In addition to D-frame sampling, macroinvertebrates were hand picked from instream habitat using forceps. Each site and/or stream reach was sampled for approximately 10-15 minutes. All collected organisms were placed in small plastic containers with rubbing alcohol for preservation and later identification in a laboratory.

In the laboratory, all organisms obtained from each sampling site and/or stream reach were identified to at least the family level by CHA and recorded on data sheets (see Appendix B). A reference collection was also assembled by CHA and checked by AES for consistency among identifications. The resulting data was used to evaluate the general overall water quality and biological health of the stream and wetland systems by using known tolerance to organic pollution for each taxa. Macroinvertebrates provide valuable information related to pollution because they integrate cumulative effects of sediment/nutrient pollution and respond to habitat degradation.

3.0 RESULTS

3.1 Aquatic Habitat Assessment

QHEI scores along the stream Reaches 1-5 comprising the unnamed tributary ranged from a high of 55 (Fair) at Reach 2 to a low of 40 (Fair) at Reach 6 (Table 2; Appendix A). Other reaches scored between 43.5 and 50 (Fair). The offsite reference reach scored 47.5, a result comparable to conditions documented along the onsite unnamed tributary. Stream Reach 6 is a very small tributary that joins the unnamed tributary just south and east of the landfill. Because of its small size, a QHEI was not conducted on this reach. A general description of the criteria used to complete the QHEI analysis and conditions observed are summarized below.

Table 2. QHEI scores for Reaches 1-5 on unnamed tributary and offsite reference stream reach.

Reach	Substrate Score	In-stream Cover Score	Channel Morphology Score	Riparian/ Bank Erosion Score	Pool Score	Riffle Score	Gradient Score	Total Score
Max. Possible Score	**20**	**20**	**20**	**10**	**12**	**8**	**10**	**100**
Reach 1	9	11	14	10	3	0	8	**55**
Reach 2	9	6	8	9.5	3	0	8	**43.5**
Reach 3	9	5	7	8	3	0	8	**40**
Reach 4	9	10	10	9	3	0	8	**49**
Reach 5	8	10	10	6.5	3	0	8	**45.5**
Offsite Reference Reach	16	6	6	8.5	3	0	8	**47.5**

Note: No QHEI completed for stream Reach 6.

Substrate: The substrate among all reaches comprising the unnamed tributary stream is considered average quality at best. The most common substrates are muck/silt and sand but they do not appear to cover or embed other substrates. The offsite reference reach has slightly higher substrate value because it contains less silt and a variety of different substrate types.

Instream Cover: In-stream cover is less than adequate in most reaches to support high quality aquatic faunas. Although cover is between 25% and 75% of the stream along most reaches, most of this comes from logs/woody debris. The offsite reference reach also follows this instream cover pattern.

Channel Morphology: Channel morphology refers to the quality of the stream channel that relates to the creation and stability of habitat. Channel morphology is poor within all reaches (including the offsite reference stream) except Reach 1 where natural meanders are still present. Poor conditions are the result of low to no sinuosity, poor riffle-pool development, and low channel stability that appear to be the result of past channelization activities.

Riparian Condition: The riparian zones are generally wide (> 150 feet) and comprised primarily of open or forested floodplain. Bank erosion associated with riparian areas is minimal to moderate in most reaches.

Riffles and Pools: High quality riffles and pools are almost non-existent within the study reaches. This is common in sand and silt dominated steams. Where small riffles do exist, they are shallow and not adequate to support fishes and other faunas.

Gradient: Stream gradient was calculated from a USGS 7.5-minute topographic map by measuring the elevation change through a reach. Low gradient streams generally change in elevation between 0 feet and 5 feet over a mile. Moderate and high gradient streams change an average of 5 feet to 30 feet. All of the stream reaches, including the reference reach, drop about 6 feet in elevation over a mile. This represents a rather low gradient stream.

3.2 Macroinvertebrate Sampling

Table 3 presents macroinvertebrate taxa richness and general tolerance to pollution of the overall macroinvertebrate community at each location. Tolerance values were obtained from the "Quality Assurance Work Plan for Biological Steam Monitoring in New York State" produced by the New York State Stream Biomonitoring Unit: NYS Department of Environmental Conservation. According to the document, most tolerance values used are derived from calculations made by Hilsenhoff (1987) that were used to calculate the Hilsenhoff Biotic Index (HBI). The HBI was designed to rapidly assess the degree of organic pollution in streams. It is calculated by multiplying the number of organisms collected by their tolerance value, summing the products, and dividing by the total number of organisms collected. While the HBI was developed to measure organic pollution, it has been applied to evaluate general impairment of aquatic insect communities because insects that are tolerant of organic pollution are often tolerant of thermal and siltation as well. The reverse is also true; insects that are intolerant of organic pollution are often intolerant of other types of pollution including thermal and siltation. Table 3 correlates the HBI score with water quality. Tables 4 and 5 present the taxa richness and HBI scores for each survey site and/or stream reach.

The results of the macroinvertebrate survey indicate that stream reaches exhibit fair to poor water quality while the wetland complexes exhibit good to very good water quality despite having fewer overall taxa richness than streams. Poor conditions documented in the stream reaches could also be the result of poor habitat conditions and low oxygen levels that have resulted from channelization activities.

Table 3. Water Quality Correlation to Hilsenhoff Biotic Index.

Biotic Index	Water Quality	Degree of Organic Pollution
0.00-3.75	Excellent	Organic pollution unlikely
3.76-4.25	Very Good	Possible slight organic pollution
4.26-5.00	Good	Some organic pollution probable
5.01-5.75	Fair	Fairly substantial pollution likely
5.76-6.50	Fairly Poor	Substantial pollution likely
6.51-7.25	Poor	Very substantial pollution likely
7.26-10.00	Very Poor	Severe organic pollution likely

TABLE 4. Macroinvertebrate taxa richness and pollution tolerance of macroinvertebrate communities within stream Reaches.

	Reach 1	Reach 2	Reach 3	Reach 4	Reach 5	Reach 6	Offsite Reference Reach
Taxa Richness (# species)	13	12	12	10	10	8	5
Hilsenhoff Biotic Index	7.23 (Poor)	5.87 (Fairly Poor)	5.35 (Fair)	5.08 (Fair)	6.73 (Poor)	5.57 (Fair)	6.5 (Fairly Poor)

TABLE 5. Macroinvertebrate taxa richness and pollution tolerance of macroinvertebrate communities within wetland complexes.

	Mitigation Pond	Button Bush Swamp	Bog/Vernal Pond	Offsite Reference Sedge Meadow
Taxa Richness (# species)	8	8	7	10
Hilsenhoff Biotic Index	4.47 (Good)	4.03 (Very Good)	4.94 (Good)	4.68 (Good)

4.0 SITE PHOTOGRAPHS

Photo 1. Stream Reach 1 facing upstream.

Photo 2. Stream Reach 2 facing upstream.

Photo 3. Stream Reach 3 facing upstream.

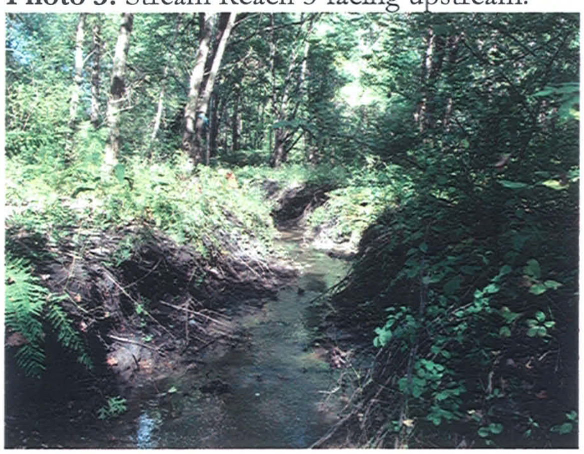


Photo 4. Stream Reach 4 facing upstream.

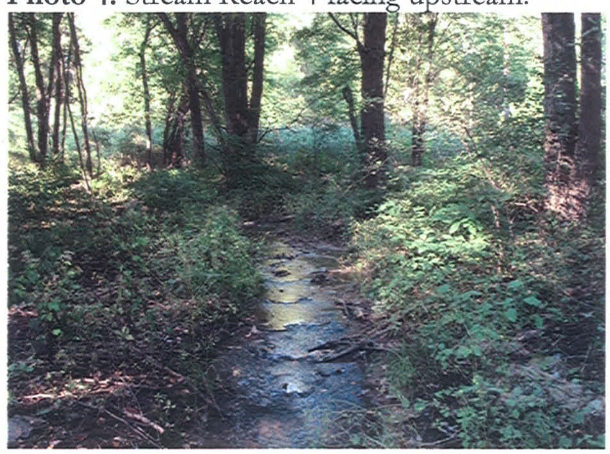


Photo 5. Stream Reach 5 facing upstream.

Photo 6. Stream Reach 6 (tributary to Reach 2)

Photo 7. Offsite Reference Stream

Photo 8. Wetland # 1: Mitigation Pond

Photo 9. Wetland # 2: Buttonbush Swamp

Photo 10. Wetland # 3: Bog facing north.

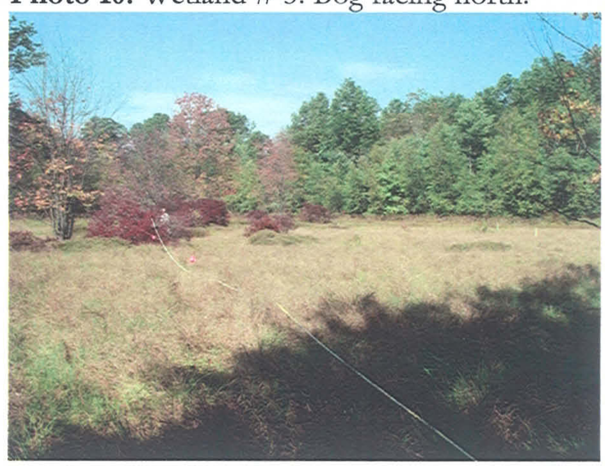
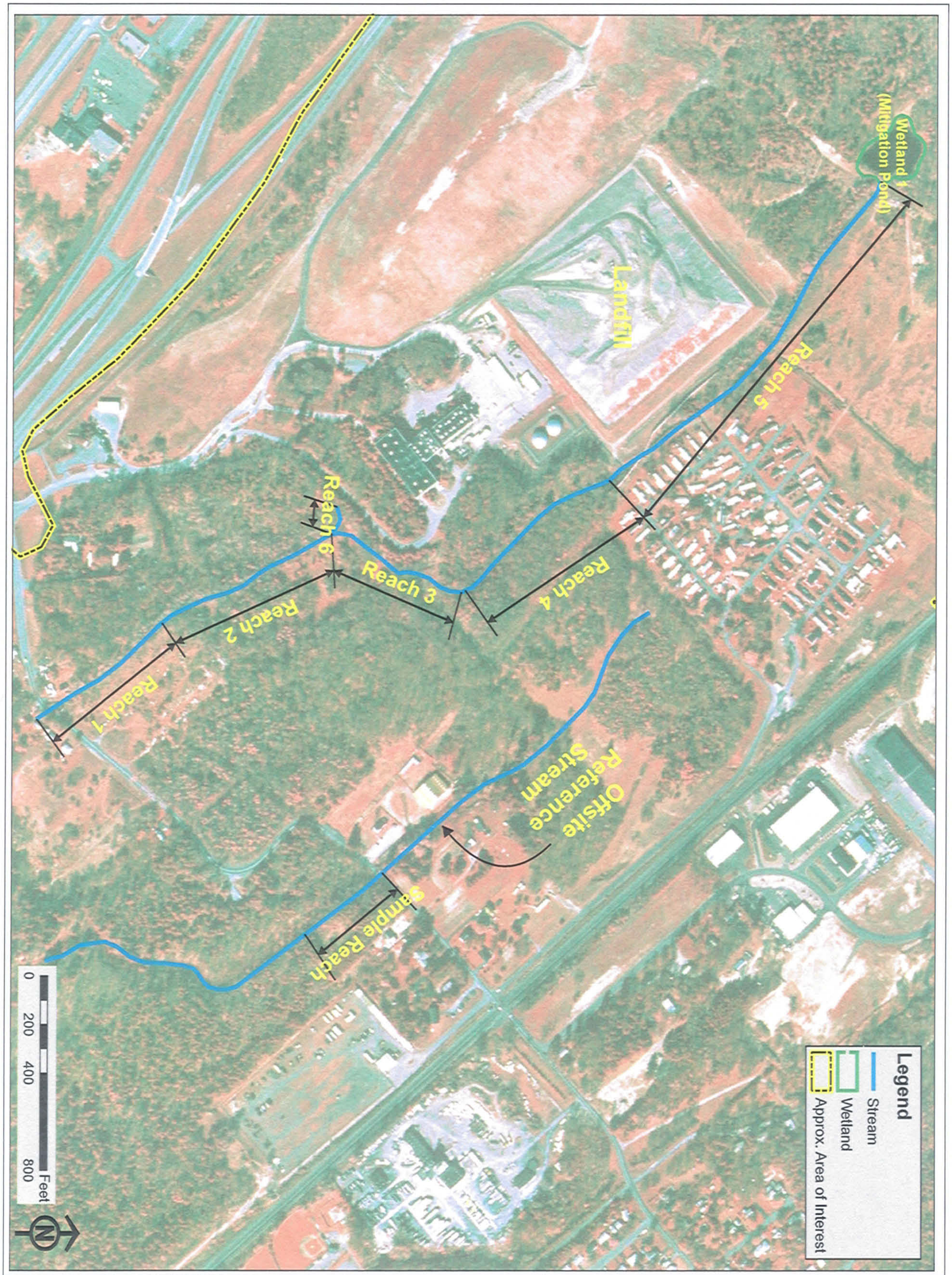


Photo 11. Offsite reference sedge meadow.

Figure 1. Stream Reach Locations



1 inch equals 175 feet
When Printed at 24 X36

Data
Source/Date: NRCS, 1994-1997 mosaic
Aerial Published 2002

Coordinate System
UTM
North American Datum (NAD) 83
Zone 18 N
Units meters

Revisions:			
No	By	Date	Description
1			
2			
3			
4			
5			

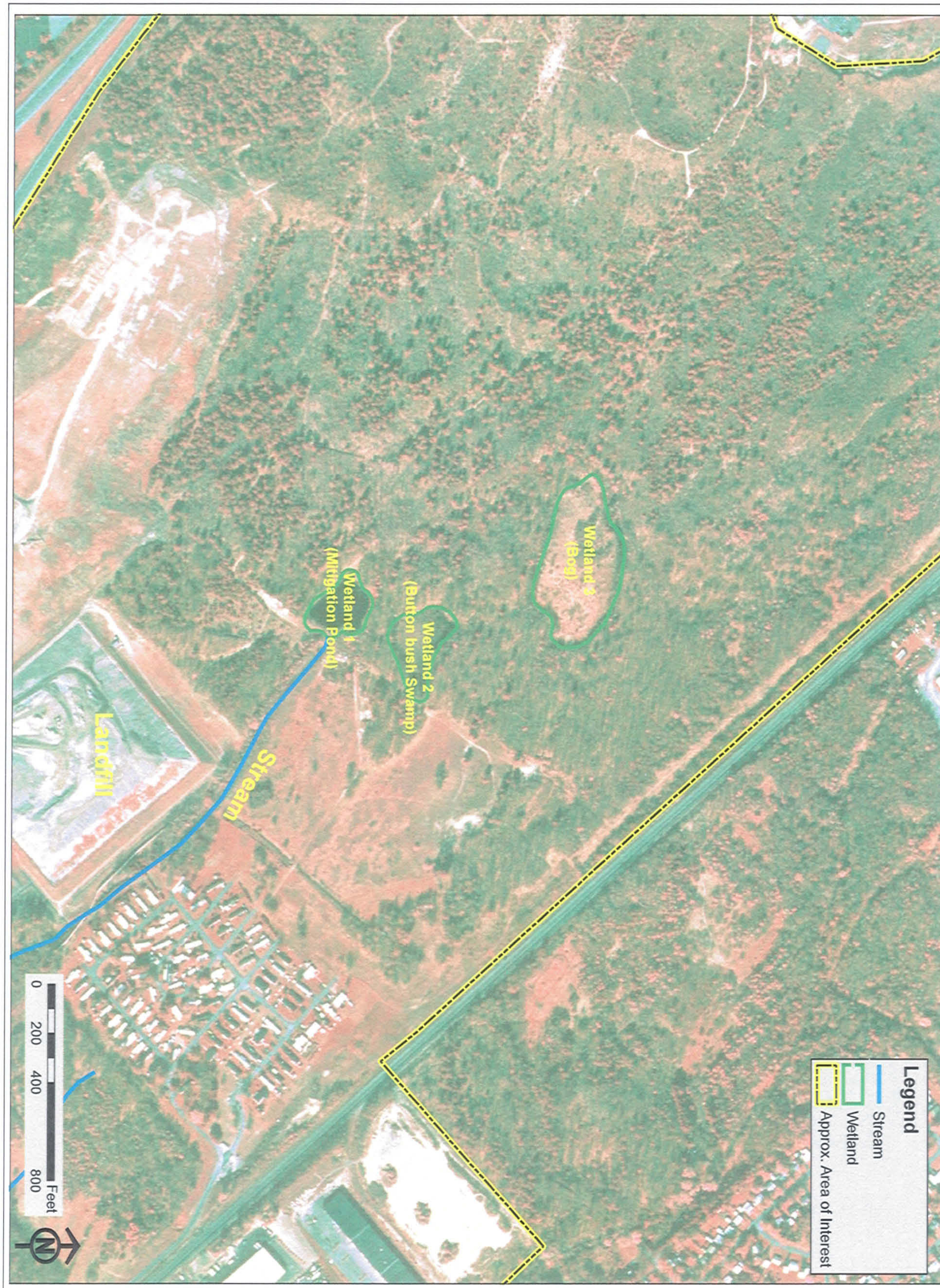
Albany Pine Bush Landfill
Albany County, New York
Clough Harbour & Associates, LLP
III Winners Circle, P.O. Box 6259
Albany, New York 12205-0269

Figure 1. Stream Reach Locations

Mapped by: jlc	AES Project Number: 06-0590
Field Work:	File Name: topo2of2.mxd
Checked by:	Date: 11.29.06

Applied Ecological Services, Inc.

Figure 2. Wetland Locations



Albany Pine Bush Landfill

Albany County, New York

Clough Harbour & Associates, LLP

III Winners Circle, P.O. Box 6259
Albany, New York 12205-0269

Figure 2. Wetland Locations

Revisions:

No.	By	Date	Description
1			
2			
3			
4			
5			

Coordinate System
UTM
North American Datum (NAD) 83
Zone: 18 N
Units: meters

Data
Source/Date: NRCS, 1994-1997 mosaic
Aerial Published 2002

1 inch equals 175 feet

When Printed at 24"X36"

Mapped by: jlc	AES Project Number: 06-0590
Field Work:	File Name: topo1of2.mxd
Checked by:	Date: 11.29.06

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APPENDIX A

QHEI SCORE SHEETS

STREAM: Offsite Reference **RIVER MILE:** ______ **DATE:** 9/27/2006 **QHEI SCORE** 47.50

1) SUBSTRATE: (Check ONLY Two Substrate Type Boxes: Check all types present) SUBSTRATE SCORE 16.00

TYPE			POOL	RIFFLE				POOL	RIFFLE
[ ]	[ ]	BLDER/SLAB(10)			[ ]	[ ]	GRAVEL(7)	X	
[ ]	[ ]	BOULDER(9)			[X]	[X]	SAND(6)		
[ ]	[ ]	COBBLE(8)			[ ]	[ ]	BEDROCK(5)		
[ ]	[ ]	HARDPAN(4)			[ ]	[ ]	DETRITUS(3)	X	
[ ]	[ ]	MUCK/SILT(2)	X		[ ]	[ ]	ARTIFIC(0)	X	

SUBSTRATE ORIGIN (all): [ ] LIMESTONE(1) [ ] RIP/RAP(0) [X] TILLS(1) [ ] HARDPAN(0) [ ] SANDSTONE(0) [ ] SHALE(-1) [ ] COAL FINES(-2)

SILT COVER (one): [ ] SILT-HEAVY(-2) [ ] SILT-MOD(-1) [X] SILT-NORM(0) [ ] SILT-FREE(1)

Extent of Embeddedness (check one): [ ] EXTENSIVE(-2) [ ] MODERATE(-1) [ ] LOW(0) [X] NONE(1)

TOTAL NUMBER OF SUBSTRATE TYPES: [X] >4(2) [ ] <4(0)

NOTE: (Ignore sludge that originates from point sources: score is based on natural substrates)

COMMENTS:

2) INSTREAM COVER: COVER SCORE 6.00

TYPE (Check all that apply)

[ ] UNDERCUT BANKS(1) [ ] DEEP POOLS(2) [ ] OXBOWS(1)
[X] OVERHANGING VEGETATION(1) [ ] ROOTWADS(1) [ ] AQUATIC MACROPHYTES(1)
[ ] SHALLOWS (IN SLOW WATER)(1) [X] BOULDERS(1) [X] LOGS OR WOODY DEBRIS(1)

AMOUNT (Check only one or Check 2 and AVERAGE)

[ ] EXTENSIVE >75%(11)
[ ] MODERATE 25-75%(7)
[X] SPARSE 5-25%(3)
[ ] NEARLY ABSENT <5%(1)

COMMENTS: Boulders are artificial (riprap near bridge)

3) CHANNEL MORPHOLOGY: (Check ONLY ONE per Category or Check 2 and AVERAGE) CHANNEL SCORE 6.00

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY	MODIFICATION/OTHER	
[ ] HIGH(4)	[ ] EXCELLENT(7)	[ ] NONE(6)	[ ] HIGH(3)	[ ] SNAGGING	[ ] IMPOUND
[ ] MODERATE(3)	[ ] GOOD(5)	[ ] RECOVERED(4)	[X] MODERATE(2)	[ ] RELOCATION	[ ] ISLAND
[X] LOW(2)	[ ] FAIR(3)	[ ] RECOVERING(3)	[ ] LOW(1)	[ ] CANOPY REMOVAL	[ ] LEVEED
[ ] NONE(1)	[X] POOR(1)	[X] RECENT OR NO RECOVERY(1)		[X] DREDGING	[X] BANK SHAPING
				[ ] ONE SIDE CHANNEL MODIFICATION	

COMMENTS:

4) RIPARIAN ZONE AND BANK EROSION: (Check ONE box or Check 2 and AVERAGE per bank) RIPARIAN SCORE 8.50

River Right Looking Downstream

RIPARIAN WIDTH (per bank)

L	R	(per bank)
[ ]	[X]	WIDE >150 ft.(4)
[X]	[ ]	MODERATE 30-150 ft.(3)
[ ]	[ ]	NARROW 15-30 ft.(2)
[ ]	[ ]	VERY NARROW 3-15 ft.(1)
[ ]	[ ]	NONE(0)

EROSION/RUNOFF-FLOODPLAIN QUALITY

L	R	(most predominant per bank)	L	R	(per bank)
[X]	[X]	FOREST, SWAMP(3)	[ ]	[ ]	URBAN OR INDUSTRIAL(0)
[ ]	[ ]	OPEN PASTURE/ROW CROP(0)	[ ]	[ ]	SHRUB OR OLD FIELD(2)
[ ]	[ ]	RESID.,PARK,NEW FIELD(1)	[ ]	[ ]	CONSERV. TILLAGE(1)
[ ]	[ ]	FENCED PASTURE(1)	[ ]	[ ]	MINING/CONSTRUCTION(0)

BANK EROSION

L	R	(per bank)
[ ]	[ ]	NONE OR LITTLE(3)
[X]	[X]	MODERATE(2)
[ ]	[ ]	HEAVY OR SEVERE(1)

COMMENTS:

5) POOL/GLIDE AND RIFFLE/RUN QUALITY NO POOL = 0 POOL SCORE 3.00

MAX.DEPTH (Check 1)

[ ] >4 ft.(6)
[ ] 2.4-4 ft.(4)
[ ] 1.2-2.4 ft.(2)
[X] <1.2 ft.(1)
[ ] <0.6 ft.(Pool=0)(0)

MORPHOLOGY (Check 1)

[ ] POOL WIDTH>RIFFLE WIDTH(2)
[X] POOL WIDTH=RIFFLE WIDTH(1)
[ ] POOL WIDTH<RIFFLE WIDTH(0)

POOL/RUN/RIFFLE CURRENT VELOCITY (Check all that Apply)

[ ] TORRENTIAL(-1) [ ] EDDIES(1)
[ ] FAST(1) [ ] INTERSTITIAL(-1)
[X] MODERATE(1) [ ] INTERMITTENT(-2)
[ ] SLOW(1)

COMMENTS:

RIFFLE SCORE 0.00

RIFFLE/RUN DEPTH

[ ] GENERALLY >4 in. MAX.>20 in.(4)
[ ] GENERALLY >4 in. MAX.<20 in.(3)
[ ] GENERALLY 2-4 in.(1)
[X] GENERALLY <2 in.(Riffle=0)(0)

RIFFLE/RUN SUBSTRATE

[ ] STABLE (e.g., Cobble,Boulder)(2)
[ ] MOD.STABLE (e.g., Pea Gravel)(1)
[ ] UNSTABLE (Gravel, Sand)(0)
[X] NO RIFFLE(0)

RIFFLE/RUN EMBEDDEDNESS

[ ] EXTENSIVE(-1) [ ] NONE(2)
[ ] MODERATE(0) [X] NO RIFFLE(0)
[ ] LOW(1)

COMMENTS:

6) GRADIENT (FEET/MILE): 6.00 **% POOL** 5.00 **% RIFFLE** 0.00 **% RUN** 95.00 **GRADIENT SCORE** 8.00

STREAM: Rapp Road Landfill Ditch RIVER MILE: Reach 1 DATE: 9/26/2006 QHEI SCORE 55.00

1) SUBSTRATE: (Check ONLY Two Substrate Type Boxes: Check all types present) SUBSTRATE SCORE 9.00

TYPE		POOL	RIFFLE		POOL	RIFFLE
[ ] [ ] BLDER/SLAB(10)				[ ] [ ] GRAVEL(7)		
[ ] [ ] BOULDER(9)				[X] [ ] SAND(6)	X	
[ ] [ ] COBBLE(8)				[ ] [ ] BEDROCK(5)		
[ ] [ ] HARDPAN(4)				[ ] [ ] DETRITUS(3)	X	
[X] [ ] MUCK/SILT(2)		X		[ ] [ ] ARTIFIC(0)		

SUBSTRATE ORIGIN (all): [ ] LIMESTONE(1) [ ] RIP/RAP(0) [X] TILLS(1) [ ] HARDPAN(0) [ ] SANDSTONE(0) [ ] SHALE(-1) [ ] COAL FINES(-2)

SILT COVER (one): [ ] SILT-HEAVY(-2) [X] SILT-MOD(-1) [ ] SILT-NORM(0) [ ] SILT-FREE(1)

Extent of Embeddedness (check one): [ ] EXTENSIVE(-2) [ ] MODERATE(-1) [ ] LOW(0) [X] NONE(1)

TOTAL NUMBER OF SUBSTRATE TYPES: [ ] >4(2) [X] <4(0)

NOTE: (Ignore sludge that originates from point sources: score is based on natural substrates)

COMMENTS: No gravel or cobble to measure embeddedness

2) INSTREAM COVER: COVER SCORE 11.00

TYPE (Check all that apply)

[X] UNDERCUT BANKS(1) [ ] DEEP POOLS(2) [ ] OXBOWS(1)
[X] OVERHANGING VEGETATION(1) [X] ROOTWADS(1) [ ] AQUATIC MACROPHYTES(1)
[ ] SHALLOWS (IN SLOW WATER)(1) [ ] BOULDERS(1) [X] LOGS OR WOODY DEBRIS(1)

AMOUNT (Check only one or Check 2 and AVERAGE)

[ ] EXTENSIVE >75%(11)
[X] MODERATE 25-75%(7)
[ ] SPARSE 5-25%(3)
[ ] NEARLY ABSENT <5%(1)

COMMENTS:

3) CHANNEL MORPHOLOGY: (Check ONLY ONE per Category or Check 2 and AVERAGE) CHANNEL SCORE 14.00

SINUOSITY: [ ] HIGH(4) [X] MODERATE(3) [ ] LOW(2) [ ] NONE(1)

DEVELOPMENT: [ ] EXCELLENT(7) [ ] GOOD(5) [X] FAIR(3) [ ] POOR(1)

CHANNELIZATION: [X] NONE(6) [ ] RECOVERED(4) [ ] RECOVERING(3) [ ] RECENT OR NO RECOVERY(1)

STABILITY: [ ] HIGH(3) [X] MODERATE(2) [ ] LOW(1)

MODIFICATION/OTHER: [ ] SNAGGING [ ] IMPOUND [ ] RELOCATION [ ] ISLAND [ ] CANOPY REMOVAL [ ] LEVEED [ ] DREDGING [ ] BANK SHAPING [ ] ONE SIDE CHANNEL MODIFICATION

COMMENTS:

4) RIPARIAN ZONE AND BANK EROSION: (Check ONE box or Check 2 and AVERAGE per bank) RIPARIAN SCORE 10.00

River Right Looking Downstream

RIPARIAN WIDTH (per bank) — L R (per bank): [X] [X] WIDE >150 ft.(4) [ ] [ ] MODERATE 30-150 ft.(3) [ ] [ ] NARROW 15-30 ft.(2) [ ] [ ] VERY NARROW 3-15 ft.(1) [ ] [ ] NONE(0)

EROSION/RUNOFF-FLOODPLAIN QUALITY — L R (most predominant per bank): [X] [X] FOREST, SWAMP(3) [ ] [ ] OPEN PASTURE/ROW CROP(0) [ ] [ ] RESID.,PARK,NEW FIELD(1) [ ] [ ] FENCED PASTURE(1)

L R (per bank): [ ] [ ] URBAN OR INDUSTRIAL(0) [ ] [ ] SHRUB OR OLD FIELD(2) [ ] [ ] CONSERV. TILLAGE(1) [ ] [ ] MINING/CONSTRUCTION(0)

BANK EROSION — L R (per bank): [X] [X] NONE OR LITTLE(3) [ ] [ ] MODERATE(2) [ ] [ ] HEAVY OR SEVERE(1)

COMMENTS:

5) POOL/GLIDE AND RIFFLE/RUN QUALITY NO POOL = 0 POOL SCORE 3.00

MAX.DEPTH (Check 1): [ ] >4 ft.(6) [ ] 2.4-4 ft.(4) [ ] 1.2-2.4 ft.(2) [X] <1.2 ft.(1) [ ] <0.6 ft.(Pool=0)(0)

MORPHOLOGY (Check 1): [ ] POOL WIDTH>RIFFLE WIDTH(2) [X] POOL WIDTH=RIFFLE WIDTH(1) [ ] POOL WIDTH<RIFFLE WIDTH(0)

POOL/RUN/RIFFLE CURRENT VELOCITY (Check all that Apply): [ ] TORRENTIAL(-1) [ ] EDDIES(1) [ ] FAST(1) [ ] INTERSTITIAL(-1) [X] MODERATE(1) [ ] INTERMITTENT(-2) [ ] SLOW(1)

COMMENTS: No riffles. Pool witdth measrued against run width.

RIFFLE SCORE 0.00

RIFFLE/RUN DEPTH: [ ] GENERALLY >4 in. MAX.>20 in.(4) [ ] GENERALLY >4 in. MAX.<20 in.(3) [ ] GENERALLY 2-4 in.(1) [X] GENERALLY <2 in.(Riffle=0)(0)

RIFFLE/RUN SUBSTRATE: [ ] STABLE (e.g., Cobble,Boulder)(2) [ ] MOD.STABLE (e.g., Pea Gravel)(1) [ ] UNSTABLE (Gravel, Sand)(0) [X] NO RIFFLE(0)

RIFFLE/RUN EMBEDDEDNESS: [ ] EXTENSIVE(-1) [ ] NONE(2) [ ] MODERATE(0) [X] NO RIFFLE(0) [ ] LOW(1)

COMMENTS:

6) GRADIENT (FEET/MILE): 6.00 **% POOL** 15.00 **% RIFFLE** 0.00 **% RUN** 85.00 **GRADIENT SCORE** 8.00

STREAM: Rap Road Landfill Ditch **RIVER MILE:** Reach 2 **DATE:** 9/26/2006 **QHEI SCORE** 43.50

1) SUBSTRATE: (Check ONLY Two Substrate Type Boxes: Check all types present)

SUBSTRATE SCORE 9.00

TYPE			POOL	RIFFLE	TYPE			POOL	RIFFLE
		BLDER/SLAB(10)					GRAVEL(7)		
		BOULDER(9)			X		SAND(6)		
		COBBLE(8)					BEDROCK(5)		
		HARDPAN(4)					DETRITUS(3)		
X		MUCK/SILT(2)	X				ARTIFIC(0)		

TOTAL NUMBER OF SUBSTRATE TYPES: [ ] >4(2) [X] <4(0)

NOTE: (Ignore sludge that originates from point sources: score is based on natural substrates)

SUBSTRATE ORIGIN (all)
- [ ] LIMESTONE(1)
- [X] TILLS(1)
- [ ] SANDSTONE(0)
- [ ] SHALE(-1)
- [ ] COAL FINES(-2)
- [ ] RIP/RAP(0)
- [ ] HARDPAN(0)

SILT COVER (one)
- [ ] SILT-HEAVY(-2)
- [ ] SILT-NORM(0)
- [X] SILT-MOD(-1)
- [ ] SILT-FREE(1)

Extent of Embeddedness (check one)
- [ ] EXTENSIVE(-2)
- [ ] LOW(0)
- [ ] MODERATE(-1)
- [X] NONE(1)

COMMENTS: No gravel or cobble to measure embeddedness

2) INSTREAM COVER:

COVER SCORE 6.00

TYPE (Check all that apply)
- [ ] UNDERCUT BANKS(1)
- [X] OVERHANGING VEGETATION(1)
- [ ] SHALLOWS (IN SLOW WATER)(1)
- [ ] DEEP POOLS(2)
- [X] ROOTWADS(1)
- [ ] BOULDERS(1)
- [ ] OXBOWS(1)
- [ ] AQUATIC MACROPHYTES(1)
- [X] LOGS OR WOODY DEBRIS(1)

AMOUNT (Check only one or Check 2 and AVERAGE)
- [ ] EXTENSIVE >75%(11)
- [ ] MODERATE 25-75%(7)
- [X] SPARSE 5-25%(3)
- [ ] NEARLY ABSENT <5%(1)

COMMENTS:

3) CHANNEL MORPHOLOGY: (Check ONLY ONE per Category or Check 2 and AVERAGE)

CHANNEL SCORE 8.00

SINUOSITY
- [ ] HIGH(4)
- [ ] MODERATE(3)
- [X] LOW(2)
- [ ] NONE(1)

DEVELOPMENT
- [ ] EXCELLENT(7)
- [ ] GOOD(5)
- [X] FAIR(3)
- [ ] POOR(1)

CHANNELIZATION
- [ ] NONE(6)
- [ ] RECOVERED(4)
- [ ] RECOVERING(3)
- [X] RECENT OR NO RECOVERY(1)

STABILITY
- [ ] HIGH(3)
- [X] MODERATE(2)
- [ ] LOW(1)

MODIFICATION/OTHER
- [ ] SNAGGING
- [ ] RELOCATION
- [ ] CANOPY REMOVAL
- [X] DREDGING
- [ ] ONE SIDE CHANNEL MODIFICATION
- [ ] IMPOUND
- [ ] ISLAND
- [ ] LEVEED
- [X] BANK SHAPING

COMMENTS:

4) RIPARIAN ZONE AND BANK EROSION: (Check ONE box or Check 2 and AVERAGE per bank)

RIPARIAN SCORE 9.50

River Right Looking Downstream

RIPARIAN WIDTH (per bank)

L	R	(per bank)
X	X	WIDE >150 ft.(4)
		MODERATE 30-150 ft.(3)
		NARROW 15-30 ft.(2)
		VERY NARROW 3-15 ft.(1)
		NONE(0)

EROSION/RUNOFF-FLOODPLAIN QUALITY

L	R	(most predominant per bank)	L	R	(per bank)
X	X	FOREST, SWAMP(3)			URBAN OR INDUSTRIAL(0)
		OPEN PASTURE/ROW CROP(0)			SHRUB OR OLD FIELD(2)
		RESID.,PARK,NEW FIELD(1)			CONSERV. TILLAGE(1)
		FENCED PASTURE(1)			MINING/CONSTRUCTION(0)

BANK EROSION

L	R	(per bank)
X		NONE OR LITTLE(3)
	X	MODERATE(2)
		HEAVY OR SEVERE(1)

COMMENTS:

5) POOL/GLIDE AND RIFFLE/RUN QUALITY

NO POOL = 0 POOL SCORE 3.00

MAX.DEPTH (Check 1)
- [ ] >4 ft.(6)
- [ ] 2.4-4 ft.(4)
- [ ] 1.2-2.4 ft.(2)
- [X] <1.2 ft.(1)
- [ ] <0.6 ft.(Pool=0)(0)

MORPHOLOGY (Check 1)
- [ ] POOL WIDTH>RIFFLE WIDTH(2)
- [X] POOL WIDTH=RIFFLE WIDTH(1)
- [ ] POOL WIDTH<RIFFLE WIDTH(0)

POOL/RUN/RIFFLE CURRENT VELOCITY (Check all that Apply)
- [ ] TORRENTIAL(-1)
- [ ] FAST(1)
- [X] MODERATE(1)
- [ ] SLOW(1)
- [ ] EDDIES(1)
- [ ] INTERSTITIAL(-1)
- [ ] INTERMITTENT(-2)

COMMENTS: No riffles. Pool width measured against run width

RIFFLE SCORE 0.00

RIFFLE/RUN DEPTH
- [ ] GENERALLY >4 in. MAX.>20 in.(4)
- [ ] GENERALLY >4 in. MAX.<20 in.(3)
- [ ] GENERALLY 2-4 in.(1)
- [X] GENERALLY <2 in.(Riffle=0)(0)

RIFFLE/RUN SUBSTRATE
- [ ] STABLE (e.g., Cobble,Boulder)(2)
- [ ] MOD.STABLE (e.g., Pea Gravel)(1)
- [ ] UNSTABLE (Gravel, Sand)(0)
- [X] NO RIFFLE(0)

RIFFLE/RUN EMBEDDEDNESS
- [ ] EXTENSIVE(-1)
- [ ] MODERATE(0)
- [ ] LOW(1)
- [ ] NONE(2)
- [X] NO RIFFLE(0)

COMMENTS:

6) GRADIENT (FEET/MILE): 6.00

% POOL 5.00 % RIFFLE 0.00 % RUN 95.00 GRADIENT SCORE 8.00

STREAM: Rapp Road Landfill Ditch RIVER MILE: Reach 3 DATE: 9/26/2006 QHEI SCORE 40.00

1) SUBSTRATE: (Check ONLY Two Substrate Type Boxes: Check all types present) SUBSTRATE SCORE 9.00

TYPE			POOL	RIFFLE				POOL	RIFFLE
		BLDER/SLAB(10)					GRAVEL(7)		
		BOULDER(9)			X		SAND(6)	X	
		COBBLE(8)					BEDROCK(5)		
		HARDPAN(4)					DETRITUS(3)		
X		MUCK/SILT(2)	X				ARTIFIC(0)		

SUBSTRATE ORIGIN (all): [ ] LIMESTONE(1) [ ] RIP/RAP(0) [X] TILLS(1) [ ] HARDPAN(0) [ ] SANDSTONE(0) [ ] SHALE(-1) [ ] COAL FINES(-2)

SILT COVER (one): [ ] SILT-HEAVY(-2) [X] SILT-MOD(-1) [ ] SILT-NORM(0) [ ] SILT-FREE(1)

Extent of Embeddedness (check one): [ ] EXTENSIVE(-2) [ ] MODERATE(-1) [ ] LOW(0) [X] NONE(1)

TOTAL NUMBER OF SUBSTRATE TYPES: [ ] >4(2) [X] <4(0)

NOTE: (Ignore sludge that originates from point sources: score is based on natural substrates)

COMMENTS: No gravel or cobble to measure embeddedness

2) INSTREAM COVER: COVER SCORE 5.00

TYPE (Check all that apply)

[ ] UNDERCUT BANKS(1) [X] OVERHANGING VEGETATION(1) [ ] SHALLOWS (IN SLOW WATER)(1)
[ ] DEEP POOLS(2) [ ] ROOTWADS(1) [ ] BOULDERS(1)
[ ] OXBOWS(1) [ ] AQUATIC MACROPHYTES(1) [X] LOGS OR WOODY DEBRIS(1)

AMOUNT (Check only one or Check 2 and AVERAGE)

[ ] EXTENSIVE >75%(11) [ ] MODERATE 25-75%(7) [X] SPARSE 5-25%(3) [ ] NEARLY ABSENT <5%(1)

COMMENTS:

3) CHANNEL MORPHOLOGY: (Check ONLY ONE per Category or Check 2 and AVERAGE) CHANNEL SCORE 7.00

SINUOSITY: [ ] HIGH(4) [ ] MODERATE(3) [X] LOW(2) [ ] NONE(1)

DEVELOPMENT: [ ] EXCELLENT(7) [ ] GOOD(5) [ ] FAIR(3) [X] POOR(1)

CHANNELIZATION: [ ] NONE(6) [ ] RECOVERED(4) [X] RECOVERING(3) [ ] RECENT OR NO RECOVERY(1)

STABILITY: [ ] HIGH(3) [ ] MODERATE(2) [X] LOW(1)

MODIFICATION/OTHER: [ ] SNAGGING [ ] RELOCATION [ ] CANOPY REMOVAL [ ] DREDGING [ ] ONE SIDE CHANNEL MODIFICATION [ ] IMPOUND [ ] ISLAND [ ] LEVEED [ ] BANK SHAPING

COMMENTS:

4) RIPARIAN ZONE AND BANK EROSION: (Check ONE box or Check 2 and AVERAGE per bank) RIPARIAN SCORE 8.00

River Right Looking Downstream

RIPARIAN WIDTH (per bank)

L	R	(per bank)
X	X	WIDE >150 ft.(4)
		MODERATE 30-150 ft.(3)
		NARROW 15-30 ft.(2)
		VERY NARROW 3-15 ft.(1)
		NONE(0)

EROSION/RUNOFF-FLOODPLAIN QUALITY

L	R	(most predominant per bank)	L	R	(per bank)
X	X	FOREST, SWAMP(3)			URBAN OR INDUSTRIAL(0)
		OPEN PASTURE/ROW CROP(0)			SHRUB OR OLD FIELD(2)
		RESID.,PARK,NEW FIELD(1)			CONSERV. TILLAGE(1)
		FENCED PASTURE(1)			MINING/CONSTRUCTION(0)

BANK EROSION

L	R	(per bank)
		NONE OR LITTLE(3)
		MODERATE(2)
X	X	HEAVY OR SEVERE(1)

COMMENTS: Headcut at upstream point of reach

5) POOL/GLIDE AND RIFFLE/RUN QUALITY NO POOL = 0 POOL SCORE 3.00

MAX.DEPTH (Check 1): [ ] >4 ft.(6) [ ] 2.4-4 ft.(4) [ ] 1.2-2.4 ft.(2) [X] <1.2 ft.(1) [ ] <0.6 ft.(Pool=0)(0)

MORPHOLOGY (Check 1): [ ] POOL WIDTH>RIFFLE WIDTH(2) [X] POOL WIDTH=RIFFLE WIDTH(1) [ ] POOL WIDTH<RIFFLE WIDTH(0)

POOL/RUN/RIFFLE CURRENT VELOCITY (Check all that Apply): [ ] TORRENTIAL(-1) [ ] FAST(1) [X] MODERATE(1) [ ] SLOW(1) [ ] EDDIES(1) [ ] INTERSTITIAL(-1) [ ] INTERMITTENT(-2)

COMMENTS: No true riffles. Pool width measured against run width

RIFFLE SCORE 0.00

RIFFLE/RUN DEPTH: [ ] GENERALLY >4 in. MAX.>20 in.(4) [ ] GENERALLY >4 in. MAX.<20 in.(3) [ ] GENERALLY 2-4 in.(1) [X] GENERALLY <2 in.(Riffle=0)(0)

RIFFLE/RUN SUBSTRATE: [ ] STABLE (e.g., Cobble,Boulder)(2) [ ] MOD.STABLE (e.g., Pea Gravel)(1) [ ] UNSTABLE (Gravel, Sand)(0) [X] NO RIFFLE(0)

RIFFLE/RUN EMBEDDEDNESS: [ ] EXTENSIVE(-1) [ ] MODERATE(0) [ ] LOW(1) [ ] NONE(2) [X] NO RIFFLE(0)

COMMENTS:

6) GRADIENT (FEET/MILE): 6.00 % POOL 5.00 % RIFFLE 0.00 % RUN 95.00 GRADIENT SCORE 8.00

STREAM: Rapp Road Landfill Ditch RIVER MILE: Reach 4 DATE: 9/26/2006 QHEI SCORE **49.00**

1) SUBSTRATE: (Check ONLY Two Substrate Type Boxes: Check all types present) SUBSTRATE SCORE **9.00**

TYPE		POOL	RIFFLE			POOL	RIFFLE
[ ]	[ ] BLDER/SLAB(10)			[ ]	[ ] GRAVEL(7)		
[ ]	[ ] BOULDER(9)			[X]	[ ] SAND(6)	X	
[ ]	[ ] COBBLE(8)			[ ]	[ ] BEDROCK(5)		
[ ]	[ ] HARDPAN(4)			[ ]	[ ] DETRITUS(3)		
[X]	[ ] MUCK/SILT(2)	X		[ ]	[ ] ARTIFIC(0)		

SUBSTRATE ORIGIN (all)
- [ ] LIMESTONE(1)
- [ ] RIP/RAP(0)
- [X] TILLS(1)
- [ ] HARDPAN(0)
- [ ] SANDSTONE(0)
- [ ] SHALE(-1)
- [ ] COAL FINES(-2)

SILT COVER (one)
- [ ] SILT-HEAVY(-2)
- [X] SILT-MOD(-1)
- [ ] SILT-NORM(0)
- [ ] SILT-FREE(1)

Extent of Embeddedness (check one)
- [ ] EXTENSIVE(-2)
- [ ] MODERATE(-1)
- [ ] LOW(0)
- [X] NONE(1)

TOTAL NUMBER OF SUBSTRATE TYPES: [ ] >4(2) [X] <4(0)

NOTE: (Ignore sludge that originates from point sources: score is based on natural substrates)

COMMENTS: No gravel or cobble to measure embeddedness

2) INSTREAM COVER: COVER SCORE **10.00**

TYPE (Check all that apply)
- [ ] UNDERCUT BANKS(1)
- [X] OVERHANGING VEGETATION(1)
- [ ] SHALLOWS (IN SLOW WATER)(1)
- [ ] DEEP POOLS(2)
- [X] ROOTWADS(1)
- [ ] BOULDERS(1)
- [ ] OXBOWS(1)
- [ ] AQUATIC MACROPHYTES(1)
- [X] LOGS OR WOODY DEBRIS(1)

AMOUNT (Check only one or Check 2 and AVERAGE)
- [ ] EXTENSIVE >75%(11)
- [X] MODERATE 25-75%(7)
- [ ] SPARSE 5-25%(3)
- [ ] NEARLY ABSENT <5%(1)

COMMENTS:

3) CHANNEL MORPHOLOGY: (Check ONLY ONE per Category or Check 2 and AVERAGE) CHANNEL SCORE **10.00**

SINUOSITY
- [ ] HIGH(4)
- [ ] MODERATE(3)
- [X] LOW(2)
- [ ] NONE(1)

DEVELOPMENT
- [ ] EXCELLENT(7)
- [ ] GOOD(5)
- [X] FAIR(3)
- [ ] POOR(1)

CHANNELIZATION
- [ ] NONE(6)
- [ ] RECOVERED(4)
- [X] RECOVERING(3)
- [ ] RECENT OR NO RECOVERY(1)

STABILITY
- [ ] HIGH(3)
- [X] MODERATE(2)
- [ ] LOW(1)

MODIFICATION/OTHER
- [ ] SNAGGING
- [ ] RELOCATION
- [ ] CANOPY REMOVAL
- [X] DREDGING
- [ ] ONE SIDE CHANNEL MODIFICATION
- [ ] IMPOUND
- [ ] ISLAND
- [ ] LEVEED
- [X] BANK SHAPING

COMMENTS:

4) RIPARIAN ZONE AND BANK EROSION: (Check ONE box or Check 2 and AVERAGE per bank) RIPARIAN SCORE **9.00**

River Right Looking Downstream

RIPARIAN WIDTH (per bank)

L	R	(per bank)
X	X	WIDE >150 ft.(4)
		MODERATE 30-150 ft.(3)
		NARROW 15-30 ft.(2)
		VERY NARROW 3-15 ft.(1)
		NONE(0)

EROSION/RUNOFF-FLOODPLAIN QUALITY

L	R	(most predominant per bank)	L	R	(per bank)
X	X	FOREST, SWAMP(3)			URBAN OR INDUSTRIAL(0)
		OPEN PASTURE/ROW CROP(0)			SHRUB OR OLD FIELD(2)
		RESID.,PARK,NEW FIELD(1)			CONSERV. TILLAGE(1)
		FENCED PASTURE(1)			MINING/CONSTRUCTION(0)

BANK EROSION

L	R	(per bank)
		NONE OR LITTLE(3)
X	X	MODERATE(2)
		HEAVY OR SEVERE(1)

COMMENTS:

5) POOL/GLIDE AND RIFFLE/RUN QUALITY NO POOL = 0 POOL SCORE **3.00**

MAX.DEPTH (Check 1)
- [ ] >4 ft.(6)
- [ ] 2.4-4 ft.(4)
- [ ] 1.2-2.4 ft.(2)
- [X] <1.2 ft.(1)
- [ ] <0.6 ft.(Pool=0)(0)

MORPHOLOGY (Check 1)
- [ ] POOL WIDTH>RIFFLE WIDTH(2)
- [X] POOL WIDTH=RIFFLE WIDTH(1)
- [ ] POOL WIDTH<RIFFLE WIDTH(0)

POOL/RUN/RIFFLE CURRENT VELOCITY (Check all that Apply)
- [ ] TORRENTIAL(-1)
- [ ] FAST(1)
- [X] MODERATE(1)
- [ ] SLOW(1)
- [ ] EDDIES(1)
- [ ] INTERSTITIAL(-1)
- [ ] INTERMITTENT(-2)

COMMENTS: No riffles. Pool width compared to run width

RIFFLE SCORE **0.00**

RIFFLE/RUN DEPTH
- [ ] GENERALLY >4 in. MAX.>20 in.(4)
- [ ] GENERALLY >4 in. MAX.<20 in.(3)
- [ ] GENERALLY 2-4 in.(1)
- [X] GENERALLY <2 in.(Riffle=0)(0)

RIFFLE/RUN SUBSTRATE
- [ ] STABLE (e.g., Cobble,Boulder)(2)
- [ ] MOD.STABLE (e.g., Pea Gravel)(1)
- [ ] UNSTABLE (Gravel, Sand)(0)
- [X] NO RIFFLE(0)

RIFFLE/RUN EMBEDDEDNESS
- [ ] EXTENSIVE(-1)
- [ ] MODERATE(0)
- [ ] LOW(1)
- [ ] NONE(2)
- [X] NO RIFFLE(0)

COMMENTS:

6) GRADIENT (FEET/MILE): 6.00 **% POOL** 10.00 **% RIFFLE** 0.00 **% RUN** 90.00 **GRADIENT SCORE** **8.00**

STREAM: Rapp Road Landfille Ditch RIVER MILE: Reach 5 DATE: 9/28/2006 QHEI SCORE 45.50

1) SUBSTRATE: (Check ONLY Two Substrate Type Boxes: Check all types present) SUBSTRATE SCORE 8.00

TYPE		POOL	RIFFLE			POOL	RIFFLE
[ ]	[ ] BLDER/SLAB(10)			[ ]	[ ] GRAVEL(7)		
[ ]	[ ] BOULDER(9)			[X]	[ ] SAND(6)		
[ ]	[ ] COBBLE(8)			[ ]	[ ] BEDROCK(5)		
[ ]	[ ] HARDPAN(4)			[ ]	[ ] DETRITUS(3)	X	
[X]	[ ] MUCK/SILT(2)	X		[ ]	[ ] ARTIFIC(0)		

TOTAL NUMBER OF SUBSTRATE TYPES: [ ] >4(2) [X] <4(0)

NOTE: (Ignore sludge that originates from point sources: score is based on natural substrates)

SUBSTRATE ORIGIN (all): [ ] LIMESTONE(1) [ ] RIP/RAP(0) [X] TILLS(1) [ ] HARDPAN(0) [ ] SANDSTONE(0) [ ] SHALE(-1) [ ] COAL FINES(-2)

SILT COVER (one): [ ] SILT-HEAVY(-2) [X] SILT-MOD(-1) [ ] SILT-NORM(0) [ ] SILT-FREE(1)

Extent of Embeddedness (check one): [ ] EXTENSIVE(-2) [ ] MODERATE(-1) [X] LOW(0) [ ] NONE(1)

COMMENTS:

2) INSTREAM COVER: COVER SCORE 10.00

TYPE (Check all that apply)

- [ ] UNDERCUT BANKS(1)
- [X] OVERHANGING VEGETATION(1)
- [ ] SHALLOWS (IN SLOW WATER)(1)
- [ ] DEEP POOLS(2)
- [X] ROOTWADS(1)
- [ ] BOULDERS(1)
- [ ] OXBOWS(1)
- [ ] AQUATIC MACROPHYTES(1)
- [X] LOGS OR WOODY DEBRIS(1)

AMOUNT (Check only one or Check 2 and AVERAGE)

- [ ] EXTENSIVE >75%(11)
- [X] MODERATE 25-75%(7)
- [ ] SPARSE 5-25%(3)
- [ ] NEARLY ABSENT <5%(1)

COMMENTS:

3) CHANNEL MORPHOLOGY: (Check ONLY ONE per Category or Check 2 and AVERAGE) CHANNEL SCORE 10.00

SINUOSITY: [ ] HIGH(4) [ ] MODERATE(3) [X] LOW(2) [ ] NONE(1)

DEVELOPMENT: [ ] EXCELLENT(7) [ ] GOOD(5) [X] FAIR(3) [ ] POOR(1)

CHANNELIZATION: [ ] NONE(6) [ ] RECOVERED(4) [X] RECOVERING(3) [ ] RECENT OR NO RECOVERY(1)

STABILITY: [ ] HIGH(3) [X] MODERATE(2) [ ] LOW(1)

MODIFICATION/OTHER: [ ] SNAGGING [ ] IMPOUND [ ] RELOCATION [ ] ISLAND [ ] CANOPY REMOVAL [ ] LEVEED [X] DREDGING [X] BANK SHAPING [ ] ONE SIDE CHANNEL MODIFICATION

COMMENTS:

4) RIPARIAN ZONE AND BANK EROSION: (Check ONE box or Check 2 and AVERAGE per bank) RIPARIAN SCORE 6.50

River Right Looking Downstream

RIPARIAN WIDTH (per bank)

L	R	(per bank)
[ ]	[ ]	WIDE >150 ft.(4)
[ ]	[ ]	MODERATE 30-150 ft.(3)
[ ]	[ ]	NARROW 15-30 ft.(2)
[X]	[X]	VERY NARROW 3-15 ft.(1)
[ ]	[ ]	NONE(0)

EROSION/RUNOFF-FLOODPLAIN QUALITY

L	R	(most predominant per bank)	L	R	(per bank)
[ ]	[X]	FOREST, SWAMP(3)	[ ]	[ ]	URBAN OR INDUSTRIAL(0)
[ ]	[ ]	OPEN PASTURE/ROW CROP(0)	[X]	[ ]	SHRUB OR OLD FIELD(2)
[ ]	[ ]	RESID.,PARK,NEW FIELD(1)	[ ]	[ ]	CONSERV. TILLAGE(1)
[ ]	[ ]	FENCED PASTURE(1)	[ ]	[ ]	MINING/CONSTRUCTION(0)

BANK EROSION

L	R	(per bank)
[X]	[X]	NONE OR LITTLE(3)
[ ]	[ ]	MODERATE(2)
[ ]	[ ]	HEAVY OR SEVERE(1)

COMMENTS:

5) POOL/GLIDE AND RIFFLE/RUN QUALITY NO POOL = 0 POOL SCORE 3.00

MAX.DEPTH (Check 1): [ ] >4 ft.(6) [ ] 2.4-4 ft.(4) [ ] 1.2-2.4 ft.(2) [X] <1.2 ft.(1) [ ] <0.6 ft.(Pool=0)(0)

MORPHOLOGY (Check 1): [ ] POOL WIDTH>RIFFLE WIDTH(2) [X] POOL WIDTH=RIFFLE WIDTH(1) [ ] POOL WIDTH<RIFFLE WIDTH(0)

POOL/RUN/RIFFLE CURRENT VELOCITY (Check all that Apply): [ ] TORRENTIAL(-1) [ ] EDDIES(1) [ ] FAST(1) [ ] INTERSTITIAL(-1) [X] MODERATE(1) [ ] INTERMITTENT(-2) [ ] SLOW(1)

COMMENTS:

RIFFLE SCORE 0.00

RIFFLE/RUN DEPTH: [ ] GENERALLY >4 in. MAX.>20 in.(4) [ ] GENERALLY >4 in. MAX.<20 in.(3) [ ] GENERALLY 2-4 in.(1) [X] GENERALLY <2 in.(Riffle=0)(0)

RIFFLE/RUN SUBSTRATE: [ ] STABLE (e.g., Cobble,Boulder)(2) [ ] MOD.STABLE (e.g., Pea Gravel)(1) [ ] UNSTABLE (Gravel, Sand)(0) [X] NO RIFFLE(0)

RIFFLE/RUN EMBEDDEDNESS: [ ] EXTENSIVE(-1) [ ] NONE(2) [ ] MODERATE(0) [X] NO RIFFLE(0) [ ] LOW(1)

COMMENTS:

6) GRADIENT (FEET/MILE): 6.00 % POOL 20.00 % RIFFLE 0.00 % RUN 80.00 GRADIENT SCORE 8.00

APPENDIX B

MACROINVERTEBRATE DATA SHEETS

LABORATORY DATA SHEET

River/Stream/Wetland: Rapp Road Landfill Stream

Station Number: Reach 1

Date: September 26, 2006

Sample Type: D-framed kick net

Subsample: entire ½ ¼ 100

Sorted by: David MacDougall, October-November 2006

	Sub.	Total		Sub.	Total
Nemertea			Coleoptera		
			Dytiscidae		3
Platyhelminthes					
Oligochaeta			Megaloptera		1
Hirundinea			Trichoptera		
			Hydropsychidae		7
Mollusca			Glossosomatidae		1
Physella integra		278			
Planarbula armigera		5			
Sphaerium sp.		1	Other Diptera		
Musculium sp.		1	Tipulidae		10
Crustacea					
Isopoda		15			
			Chironomidae larvae		37
			pupae		5
Ephemeroptera			total		42
Plecoptera					
Other Insecta					
Hemiptera – Gerris remigis		3			
Arachnida - Araneae		2			

LABORATORY DATA SHEET					
River/Stream/Wetland: Rapp Road Landfill Stream					
Station Number: Reach 2					
Date: September 26, 2006					
Sample Type: D – framed kick net					
Subsample: entire ½ ¼ 100					
Sorted by: David MacDougall, October – November 2006					
	Sub.	Total		Sub.	Total
Nemertea			Coleoptera		
			Dytiscidae		5
Platyhelminthes					
Oligochaeta			Megaloptera		
Hirundinea			Trichoptera		
			Hydropsychidae		1
Mollusca					
Planorbula armigera		1			
Physella integra		15			
Musculium sp.		1	Other Diptera		
Sphaerium sp.		1	Athericidae		1
Lymnaea stagnalis		1	Tipulidae		1
Crustacea					
Isopoda		27			
			Chironomidae larvae		1
			pupae		
Ephemeroptera			total		
Plecoptera					
Other Insecta					
Hemiptera – *Gerris remigis*		3			

LABORATORY DATA SHEET					
River/Stream/Wetland: Rapp Road Landfill Stream					
Station Number: Reach 3					
Date: September 26, 2006					
Sample Type: D – framed kick net					
Subsample: entire ½ ¼ 100					
Sorted by: David MacDougall, October-November 2006					
	Sub.	Total		Sub.	Total
Nemertea			Coleoptera		
			Dytiscidae		3
Platyhelminthes					
Turbellaria - Planaria		9			
Oligochaeta			Megaloptera		
Hirundinea			Trichoptera		
			Hydropsychidae		4
Mollusca			Limnephilidae		2
Physella integra		2			
Musculium sp.		2			
			Other Diptera		
			Tipulidae		4
			Stratiomyidae		3
Crustacea					
Isopoda		15			
			Chironomidae larvae		3
			pupae		
Ephemeroptera			total		
Baetidae		1			
Plecoptera					
Other Insecta					
Hemiptera – *Gerris remigis*		1			

LABORATORY DATA SHEET					
River/Stream/Wetland: Rapp Road Landfill Stream					
Station Number: Reach 4					
Date: September 26, 2006					
Sample Type: D – framed kick net					
Subsample: entire ½ ¼ 100					
Sorted by: David MacDougall, October – November 2006					
	Sub.	Total		Sub.	Total
Nemertea			Coleoptera		
Platyhelminthes					
Turbellaria - Planaria		23			
Oligochaeta			Megaloptera		4
Hirundinea			Trichoptera		
			Glossosomatidae		1
Mollusca			Hydropsychidae		1
Lymnaea stagnalis		1			
			Other Diptera		
			Tipulidae		9
			Athericidae		1
Crustacea					
Isopoda		83			
			Chironomidae larvae		2
			pupae		
Ephemeroptera			total		
Baetidae		3			
Plecoptera					
Other Insecta					

LABORATORY DATA SHEET
River/Stream/Wetland: Rapp Road Landfill Stream
Station Number: Reach 5
Date: September 26, 2006
Sample Type: D – framed kick net
Subsample: entire ½ ¼ 100
Sorted by: David MacDougall, October-November

	Sub.	Total		Sub.	Total
Nemertea			Coleoptera		
			Dytiscidae		5
Platyhelminthes					
Oligochaeta		1	Megaloptera		3
Hirundinea			Trichoptera		
Mollusca					
Musculium sp.		100			
Sphaerium sp.		82			
			Other Diptera		
			Ptychopteridae		68
			Stratiomyidae		2
Crustacea					
Isopoda		1			
			Chironomidae larvae		2
			pupae		
Ephemeroptera			total		
Plecoptera					
Other Insecta					
Hemiptera – *Gerris remigis*		1			

LABORATORY DATA SHEET

River/Stream/Wetland: Rapp Road Landfill Stream

Station Number: Reach 6

Date: September 28, 2006

Sample Type: D – framed kick net

Subsample: entire ½ ¼ 100

Sorted by: David MacDougall, October – November 2006

	Sub.	Total		Sub.	Total
Nemertea			Coleoptera		
Platyhelminthes					
Oligochaeta			Megaloptera		
Hirundinea			Trichoptera		
Mollusca					
Planorbula armigera		1			
Sphaerium sp.		20			
Musculium sp.		8	Other Diptera		
Lymnaea stagnalis		3			
Physella integra		8			
Crustacea					
Isopoda		62			
			Chironomidae larvae		5
			pupae		
Ephemeroptera			total		
Plecoptera					
Other Insecta					
Hemiptera – *Gerris remigis*		1			

LABORATORY DATA SHEET
River/Stream/Wetland: Rapp Road Landfill – Offsite Reference Stream
Station Number: N/A
Date: September 26 & 27, 2006
Sample Type: D – framed kick net
Subsample: entire ½ ¼ 100
Sorted by: David MacDougall, October – November 2006

	Sub.	Total		Sub.	Total
Nemertea			Coleoptera		
Platyhelminthes					
Oligochaeta			Megaloptera		
Hirundinea			Trichoptera		
Mollusca					
Physella integra		1			
			Other Diptera		
			Ptychopteridae		2
			Tipulidae		1
Crustacea					
			Chironomidae larvae		3
			pupae		1
Ephemeroptera			total		4
Plecoptera					
Other Insecta					
Hemiptera: Notonectidae		1			

LABORATORY DATA SHEET					
River/Stream/Wetland: Rapp Road Landfill - Mitigation Pond					
Station Number: Wetland # 1					
Date: September 27, 2006					
Sample Type: D – framed kick net					
Subsample: entire ½ ¼ 100					
Sorted by: David MacDougall, October – November 2006					
	Sub.	Total		Sub.	Total
Nemertea			Coleoptera		
			Dytiscidae		2
Platyhelminthes					
Oligochaeta			Megaloptera		
Hirundinea			Trichoptera		
Mollusca					
			Other Diptera		
			Dixidae		33
Crustacea					
			Chironomidae larvae		
			pupae		
Ephemeroptera			total		
Plecoptera					
Other Insecta					
Hemiptera: Notonectidae		30			
Hemiptera: Corixidae		31			
Odonata: Anisoptera: Aeshnidae		18			
Odonata: Anisoptera: Libellulidae					
Celithemis sp.		9			
Odonata: Zygoptera: Lestidae		72			
Hemiptera: Belostomatidae		1			

LABORATORY DATA SHEET					
River/Stream/Wetland: Rapp Road Landfill – Button Bush Swamp					
Station Number: Wetland # 2					
Date: September 27, 2006					
Sample Type: D – framed kick net					
Subsample: entire ½ ¼ 100					
Sorted by: David MacDougall, October – November 2006					
	Sub.	Total		Sub.	Total
Nemertea			Coleoptera		
			Dytiscidae		1
Platyhelminthes					
Oligochaeta			Megaloptera		
Hirundinea			Trichoptera		
Mollusca					
Planorbula armigera		10			
			Other Diptera		
			Dixidae		9
Crustacea					
			Chironomidae larvae		
			pupae		
Ephemeroptera			total		
Plecoptera					
Other Insecta					
Odonata: Anisoptera: Aeshaidae		4			
Hemiptera: Notonectidae		11			
Hemiptera: Corixidae		1			
Odonata: Zygoptera: Lestidae		3			
Odonata: Anisoptera: Libellulidae					
Libellulinae: *Leucorrhinia sp.*		2			

LABORATORY DATA SHEET

River/Stream/Wetland: Rapp Road Landfill – Bog/Vernal Pond Reference Site

Station Number: Wetland # 3

Date: September 27, 2006

Sample Type: D – framed kick net

Subsample: entire ½ ¼ 100

Sorted by: David MacDougall, October – November 2006

	Sub.	Total		Sub.	Total
Nemertea			Coleoptera		
			Dytiscidae		2
Platyhelminthes					
Oligochaeta			Megaloptera		
Hirundinea			Trichoptera		
			Phryganeidae - *Ptilostomis*		2
Mollusca					
			Other Diptera		
			Dixidae		1
Crustacea					
			Chironomidae larvae		
			pupae		
Ephemeroptera			total		
Plecoptera					
Other Insecta					
Odonata: Anispotera: Aeshnidae		10			
Hemiptera: Notonectidae		36			
Hemiptera: Belostomatidae		1			
Odonata: Zygoptera: Coenagrimidae		1			

LABORATORY DATA SHEET
River/Stream/Wetland: Rapp Road Landfill – Offsite Reference Sedge meadow
Station Number: Wetland # 4
Date: September 27, 2006
Sample Type: D – framed kick net
Subsample: entire ½ ¼ 100
Sorted by: David MacDougall, October – November 2006

	Sub.	Total		Sub.	Total
Nemertea			Coleoptera		
			Dytiscidae		19
Platyhelminthes					
Oligochaeta			Megaloptera		
Hirundinea			Trichoptera		
Mollusca					
Planorbula armigera		8			
			Other Diptera		
			Dixidae		3
Crustacea					
			Chironomidae larvae		
			pupae		
Ephemeroptera			total		
Plecoptera					
Other Insecta					
Hemiptera: *Ranatra elongata*		3			
Odonata: Anisoptera: Aeshnidae		4			
Hemiptera: Notonectidae		21			
Hemiptera: Corixidae		29			
Odonata: Anisoptera: Libellulidae					
Libellulinae: *Leucorrhinia sp.*		12			
Odonata: Anisoptera: Libellulidae					
Libellulinae: *Libellula sp.*		2			
Odonata: Zygoptera: Lestidae		16			

H:060590:012207

A review of the impacts and risks for use of native grass, forb, shrub and tree species plantings when used to stabilize and close domestic solid waste landfill caps.

prepared for

The Albany, New York Landfill

by

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INTRODUCTION

This is a technical review of the scientific literature to address the following questions and purposes:

- Can native prairie grasses, wildflowers, forbs and trees be used safely for the final revegetation and stabilization of the Albany landfill cap?
- Will native species grow on geotextile protected clay caps?
- Will these plant species contribute, cause, or exacerbate failure of the geotextile clay cap? If so, by what proven mechanisms?
- Are native plant species equal or superior to stabilize and reduce the risks of failure of geotextile clay caps?
- What are the growth and survival characteristics of native prairie grasses, flowers, shrubs and trees that confirm native species are compatible with landfill cap closure?
- What characteristics of soil and landfill cap management will augment or detract from native species use for landfill cap closures?

OVERVIEW OF SITE CLOSURE PLAN

When landfills are closed with a geotextile clay liner (GCL) and upper barrier protection subsoils to prevent water entry and subsequent mobilization of contaminants, the long-term integrity of the cap system is the paramount concern. Usually, GCLs are covered by a minimum of three or four 6 inch soil lifts that are compacted in place, after clean compacted fill soil of variable thickness was placed on top of the waste. In general, above the waste a lower barrier protection layer of fill soil, often 24” thick, supports a composite plastic liner of 60 mils thickness. On top of the composite liner, a gravel or drainage composite layer is connected to a subsurface drainage system within the cap to move water off the landfill cap safely. Then an upper barrier protection layer (UPBL) of 18 to 24 inches of more permeable soils with an uppermost layer of six inches of humified topsoil completes the cap. Sometimes the geotextile membrane is a bentonite blanket contained between 2 woven geotextile fabric layers rather than a synthetic plastic membrane. The majority of landfill closures then plant the surface to a typical aggressive lawn or roadside grass mix that is not native. When a cap's barrier is either compacted clay or a bentonite blanket, it is important to regulate shrink/swell potential of these soil materials to lower the risk of failure of the clay barrier during cycles of drought and re-wetting. In arid environments, irrigation has been used to control clay shrinkage by moisture and maintain the integrity of the clay layer.

After closure and stabilization, some landfill caps have been converted to open space, parks, even parking lots. Recreational facilities, bicycle paths, walking trails, irrigated lawn, and even floating slab buildings have been installed on thicker caps even those without synthetic or compacted barriers to water penetration, especially in Europe. Presently, North America's largest closed domestic landfill at Fresh Kills, Staten Island, New York is being planned for a succession of land uses that will include the required facilities and infrastructure for recreational uses on a thousand acres of waste footprint of that closed landfill facility. The Penn and Fountain landfill closures on Long Island also feature a close integration with the Jamaica Bay recreational area through the use of specialized soils in the cap above the impermeable layers created to promote the growth of native species. These facilities depart significantly from the typical closure model in three ways: (1) Native species only are used in the vegetation of the caps; the strategy is to promote native species reclamation and retard invasion by alien plant species that prefer rich agronomic soils, (2) Exceptional care has been taken to mimic the chemical and physical qualities of the native subsoil and topsoils of the region in these caps, and (3) Native grasses, forbs, shrubs and trees are the landfill cap vegetation in place of the customary lawn grass.

ASSUMPTIONS

Several assumptions were made during this review as follows:

If native species can be used for site stabilization rather than the common alien grasses this may reduce long term maintenance, obviate any need for irrigation or other annual maintenance and will provide a more attractive successor land use. We assumed it is desirable to naturalize landfills with native vegetation in park-like settings as this will also attract native wildlife that the public deems to be valuable. One explicit goal is to convert perceived public liabilities into valued public assets.

Review of Technical Literature

We summarize the relevant published technical literature and AES experience that addresses the questions and information needs that respond to the questions posed in the introduction.

Demonstration of Regulatory Compliance

This report explores if a native landscape design is consistent with the closure and regulatory intent for this site. The use of native grass, forb, tree, and shrub plantings on caps must provide stabilization and safe conditions before enhancement of the closed site. Regulators require that closure engineering, plant ecological/soil conditions, and ecological restoration strategies are reviewed for appropriateness (e.g. Viessman and Hammer 1985; Northeastern Illinois soil erosion and sedimentation control steering committee 1989; Mariner and Mertz-Irwin 1991; Spooner et al. 1992 etc.) The USEPA often addresses non-point source water quality management (USEPA 1983; Cunningham 1988). In some cases the US Fish and Wildlife Service or state Department of Natural Resources may become involved if there are rare, threatened or endangered species, wetland or watershed issues at a site. The typical regulatory concerns usually includes a point by point discussion of the performance of conventional vs. alternative native planting landscape designs with criteria associated with site closure, to wit:

- **Vegetation shall be promoted on all reconstructed surfaces to minimize wind and water erosion of the final protective covers**.

  Stabilization against wind and water erosion, and protection of the capping system, to prevent exposure of the geomembrane and drainage structure is of primary concern during site planning, design and regulatory reviews. Soil bioengineering using locally adapted native plants create stronger and more stable plantings. Native plants are adapted and grow best under the local conditions of ecological severity and extremes as exist on a clay cap slope or top. Native species have shown the most success in stabilization of extreme slopes and poor substrates during wind and water erosion events and especially during extreme drought. Consequently, natives have been recommended for regional use in stressed growing conditions that include road cuts, landfills, mined lands, and other severely-stressed settings, (Horton 1949; Weaver 1954; Plummer 1970; Johnson et al 1971; USDA Soil Cons. Svs. 1972; Gillick and Scott 1975; Hall and Ludwig 1975; USEPA 1975; Edmunson 1976; Dehgan et al 1977; Bennet et al 1978; Kuenstler et al 1978; Monsen 1978; Leone et al 1979; Schiechtl 1980; Diekelmann and Schuster 1982; Hunt 1983; Shimell 1983; Bowen 1985; Peven 1985; Henderson 1987; Gray and Leiser 1989; Apfelbaum 1991; Mariner and Mertz-Irwin 1991, etc.). The excellent performance of native species under severe drought stress is especially significant because the underdrain layer above the geomembrane below the UPBL restricts the available reserves of soil pore water to only the water storable in the permeable soils of this UPBL layer and whatever topsoil has been applied. Typically, the UPBL soils are permeable silty sands with a modest capacity for water storage (i.e. the field capacity) between precipitation events, typically 1.5 – 2.0 inches per foot. In natural soil profiles, there is a measurable capacity to renew this supply by upward wicking of waters from deep subsoils during droughts. This does not exist in landfill caps because the drainage layer above the geomembrane does not store water and the geomembrane or compacted clay barrier prevents access to any pore waters under this barrier.

Limited end-use opportunities often result from the design criteria for plantings done only to lower the risk of failure of the cap. Recently, a series of projects to design closure plantings for multiple benefits and uses have proceeded in the country, most notably in the boroughs of New York. The recently completed Penn and Fountain projects in Brooklyn and the planned Fresh Kills Lifescape project on Staten Island illustrate the direction of landfill capping and closures in New York State. These regional projects are building on experiences at the St. Johns Landfill in Portland, Oregon and Countryside Landfill in Grayslake, Illinois, all of which have used soil bioengineering and plantings with native grasses, wildflowers, shrubs and trees to achieve site stabilization, improved plant and animal diversity and numerous new recreational end-use opportunities that conventional alien species plantings and standard soil caps do not provide. These and other plantings on high risk sites with steep slopes or severe conditions have very favorable outcomes without loss of the engineering integrity of the design and no environmental or regulatory concerns (Handel 1989; Wong and Yu 1989; AES 2004).

- **Vegetation shall be compatible with the climatic conditions.**

The use of native grasses, forbs, shrubs and trees for slope stabilization to address the regional climatic swings typical of New York growing seasons provides a very different end product and opportunity set. A closure planting program for the Albany site could use native species best adapted to the high exposure, windswept, and extreme droughty slopes and regional climate (Tables

1 and 2). Allowance for the droughty conditions typical of the rare scrub oak-long-leaf pine association next to the landfill is possible with native species that grow, prosper, and flower under all local conditions. Conventional landfill closure plantings of alien cool season grass species, such as tall fescue (*Festuca elatior*) and Eurasian brome (*Bromus inermis*) actively grow only in spring and fall under cool moist conditions and are dormant or have minimal growth at other times of the year unless irrigated. One consequence of a cool season community that shuts down in droughts of summer is a habitat that is not nearly as attractive to wildlife as compared to native landscapes because food sources, particularly insect populations, tend to collapse under drought in the cool season communities.

The adaptability of native plants to drought, very wet conditions, extreme winter exposures and very poor nutrition is documented thoroughly in hundreds of technical papers (Hilgard 1906; Hursh and Haasis 1931; Biswell 1935; Weaver and Albertson 1936; Albertson and Weaver 1942; Albertson 1943; Weaver and Weaver and Albertson 1944; Partch 1949; Osaki et al. 1998; etc). Native species have much higher tolerance to variable and extreme climatic conditions (Weaver 1954; 1956; and 1968). Weaver's (1968) "Prairie Plants and Their Environment" is a masterful reference that details summaries of fifty years of research on hundreds of native species through out the Midwest including the response of the prairie ecological system to the great drought and severe wet periods. Without equivocation, this study documents the unprecedented tolerance and survivability of many of the native grasses and wildflowers included in the example planting plan lists (Table 1). The studies also document the death and failures of many cool season grasses, including bluegrass (*Poa pratensis*) and brome grass, during drought. Native species are the clear choice for the stressful condition of landfill caps.

- **Vegetation shall require little maintenance.**

  Native grasses, forbs, shrubs, and trees not only survive and prosper in inhospitable environments, but they require very little maintenance, compared to cool season plantings especially during later years after establishment (Breyer and Pollard 1980; Duebbert 1981; Diekelmann and Schuster 1982; Mariner and Mertz-Irwin 1991; etc). Some clay-capped landfills require seasonal mowing, noxious weed control and regular fertilization programs to maintain cool season grass stands. Native species stands are not nearly as vulnerable to noxious weed invasions; often, alien weeds establish dense monocultures on landfills planted with cool season grasses (Apfelbaum, personal observations; AES 2004). Native grasses and wildflowers are well-adapted to withstand stress and resist mortality that open landfill surfaces to weed invasions. For example, the major native grasses have a photosynthetic pathway (C4) that conserves water (unlike cool season grasses) and have leaf stomata adapted to conserve water. They also have pubescence and revolute leaf margins that contribute to greater water conservation. They require less energy for cooling, sustained growth and basal metabolic needs (Weaver 1968). These adaptations decrease maintenance needs, such as mowing or irrigation. A typical landfill management for native grass and wildflower plantings is mowing to the height of 6 inches when the vegetation reaches about one foot during the first growing season. This prevents most alien weeds from producing seeds. However, perennial native grasses and flowers are too small to be injured by a 6 inch mowing. No watering or fertilizing is recommended, because this benefits the weedy species. Native perennials are adapted to the natural conditions and require no watering or fertilizer (Larson 1991). During the second growing season mowing to a height of 6 inches should continue if weed species have survived. Since soil disturbance is essential for the weeds to continue to survive, it is only rarely used. Areas vacated by a mature annual weed leaves a disturbed soil from which many weed seeds in the soil can emerge (Larson 1991). After year two, mowing can be conducted but only to control noxious weeds that may be present. Otherwise, direct herbicide treatment on persistent noxious weeds becomes the principal management strategy after the fist few years, but this is needed very rarely in native species plantings.

- **Vegetation shall consist of a diverse mix of native and introduced species that is consistent with the post closure land use.**

A native planting program integrates the best characteristics of quick establishing nonnative cool season annual nurse grasses (e.g. oats (*Avena sativa*) and barley (*Hordeum vulgare*)) with long-lived and durable native species plantings. This combination is proven to accomplish early success and stabilization of the capped landfill slopes and top. It will also provide the rapid amelioration of site conditions required for the success of plantings. The plantings will succeed from quick growing annual cover crops as dominants within several weeks after planting, through a cool season growth phase to succeed into a native plant community dominated by grasses and wildflower. A cool season grass understory with successional natives (e.g. Canada wildrye, *(Elymus canadensis*)) will be retained to provide early spring greenups.

The native species planting strategy provides a quality, diverse landscape and wildlife habitat that will support light recreational uses including a regional greenway trail system integrated with the project site. The high diversity of species used in native landscaping provides a complimentary, interesting, and aesthetically pleasing setting for greenway trails, attractive to native wildlife which improves recreational experiences. The resulting biodiversity of a native-restored site is very important for maintenance of the regionally rare populations of many plants and animals. The native species cap closure planting design is consistent with national proposals for protection and restoration of biological diversity (Beecher 1942; Jacobs 1975; Wilson 1988; etc.). Also, because of the very low maintenance needs of established native plant cover, little disruption of the planting will occur. The potential to disrupt recreational uses is low. Reduced maintenance of the planting during the initial establishment period leads to less soil compaction owing to mowing conventional covers to create a low growing community. Conventional mowing management of the slopes underlain by heavy clay substrates can damage soil profiles, promote weedy vegetation and limit human uses, (e.g. surface soil sheer during mowing vehicle turns, compaction and rutting and potential surface water routing changes [See Goran et al. 1983.]). These problems are reduced markedly in low maintenance native species plantings.

The native plant species recommended for caps have high wildlife food and cover values (See Tables 1, 2.); most native prairie grass and wildflower species have moderate to high wildlife cover and food value. The information used to generate these tables is from personal observations and years of site monitoring of native species and conventionally-planted caps for numerous clients (Apfelbaum, Applied Ecological Services, Inc. 2004, unpublished observations and data) and from a plethora of articles, books, and technical papers on the wildlife value of native grasses and wildflowers. Example information sources are identified in the Bibliography and include: Weaver 1968;

Robel 1981; Diekelmann and Shuster 1982; Dove 1983a, 1983b, 1984a, 1984b Farmland Committee 1985; Henderson 1987; etc).

- **Vegetation shall be tolerant of the outgassing often generated in capped sites.**

  Most research projects comparing the vulnerability of plants to landfill out-gas have suggested that native prairie grasses and flowers are more tolerant than cool season grasses (Flower et al 1981; Peven 1985; Card 1992;). However, with well designed clay and geomembrane capping systems, vegetative covers are subjected to little out-gas exposure except near well heads for the recovery of landfill gas. Native species also are often the most tolerant plants to other environmental contaminants including excess heavy metals and insufficient trace elements (Lepper 1978; Kabata-Pendia and Pendia 1984; Peven 1985; Eisler 1990; Arthur et al. 1992).

  Studies conducted on out-gas and plant relationships suggest if caps are built to specifications, vegetation establishment, growth and success are unaffected. In poorly capped landfills some plant species have died and failed to provide long-term soil stability (Deuber 1936; Arthur et al 1981). In fact, plant mortalities are used to detect gas leaks on landfills and from gas pipelines (Eyon 1967). Tolerance to gas in the soil relates directly to its composition and concentration, timing of exposures, plant phenology and the presence of other metabolic gases such as oxygen and carbon dioxide as well as toxic gases such as methane and hydrogen sulfide. If seed sources are near, native prairie plants are often the first to invade landfill environments. Some observers have concluded that not only are some native plants tolerant of landfill gasses, but also to other stressful environmental conditions on landfills. (Leonard and Pinckard 1946; Gilman et al 1978; Flower et al. 1978,1981; Gilmanm et al 1981; Morgan and Sullivan 1981; Shimell 1983, etc).

Crook (1992) investigated the feasibility of planting trees on clay-capped landfills and other containment sites. He concluded that planting even trees on sites is unlikely to violate clay caps in an out-gassing environment or over heavily compacted clay caps because most tree species require a soil atmosphere with 18% oxygen or more and die with less than 12% soil oxygen. He identified that carbon dioxide, methane, or ethylene in concentrations of 5-10% or greater in soil voids will kill most trees. Stonell (1986) identified that clay caps can become weakened in drought and that tree roots are capable of drying clays below the moisture content which induces cracking. They found tree roots generally confined to the top 300 mm of soil, but others have suggested that roots can desiccate to soil depths of 700 mm. They recommended that if trees planted on a clay cap, that they only be planted in locations with soil or rooting medium of a minimum 1 meter in thickness. In Britain, the Department of Environment (1984) reports that it is possible to control tree root growth on landfills by maintaining low fertility in deeper soil layers, or by compacting the base layers of final soil cover. Robinson and Handel (1995) showed there is no theoretical or empirical basis to disallow tree plantings on clay-capped sites. They excavated 30 trees and shrubs growing on a clay-lined municipal sanitary landfill invaded by trees for seven years after closure. All trees had shallow roots, including species that grow typically with tap roots. Only occasionally were small feeder roots found in the upper 1 cm of the clay caps. They concluded that thorough compaction of a clay cap created a substrate with material densities well above those roots will penetrate. Compaction alone stopped root growth; mean penetrometer resistance values above 2.0 Mpa control root potential penetration (Hermann 1977; Atkinson and Mace-Dawson 1991; McMichael and Persson 1991; and Atwell 1993). (Glinski and Lipiec 1990; Campbell and O'Sullivan 1991; Bennie 1991; and Bengough 1991). Dobson and Moffat (1995) reached the same conclusions regarding the root growth for trees or shrubs on compacted clay caps. In friable native soils, they found 90% of trees and shrub roots in the upper 0.6 meters of soils, and substantially less on compacted clay caps roots. They also concluded that tree roots and subsequent evapotranspirational water losses are extremely unlikely to be the primary cause of dessiccation cracking in a clay cap owing to their inability to extract more than a few percent of the total moisture held in clays with sufficient density to have the requisite low permeability of 1 x 10^{-7} to 10^{-9} cm/s. Where high density polyethelene liners or mineral materials were used in caps and the upper barrier protection material was compacted to a bulk density of 1.8 grams/cubic centimeter, there was no evidence that tree or other plant roots were able to penetrate. The authors conclude that with proper planning and installation, trees and shrubs may be grown successfully without violating clay cap integrity. In addition they contend that clay capped facilities can be designed to provide more ecologically diverse and valuable vegetation, if this is a discrete goal of closure projects, and is supported by good bioengineering, design, and site examination.

April and Sims (1990) examined the usefulness of providing enhanced treatment of toxic organic chemicals using eight deep rooted prairie grasses (big and little bluestems, indian grass, switch grass, Canada wild rye, side oats grama, western wheat grass and blue grama). This study involved planting prairie grasses on a highly permeable sand top soil over a site with four polycyclic aromatic hydrocarbons (PAHs). The extent of PAH disappearance in vegetated soil was significantly greater than in unvegetated soils. They concluded that where deep soil penetration is desired, these plants can be a low cost, effective, and low maintenance alternative for addressing PAH contaminated soils. They believed increased soil-microbial activity, improved physical and chemical properties of the contaminated soils, and increased the contact between microbes associated with the root and the toxic compounds in the contaminated soils were the primary mechanisms of detoxification.

Native prairie grasses and wildflowers have typically not been used on landfills or clay capped sites. We believe this has occurred because of the simplicity, lower seed cost and convention of using nonnative grasses and clovers in all aspects of re-vegetation associated with disturbed landscapes, especially mined lands and road right-of-ways. The misconception that the root penetration depth or required rooting depth is too deep, has also prevented the use of native plants until recently. This misconception may have led professionals to conclude native plant materials would compromise the clay cap and contribute to its failure. Cool season and native prairie grasses experience different opportunities for root growth and achieve different rooting depths depending on the nature of the substrate in which they grow (Weaver 1968; Bohm 1979; Atkinson and Mackie-Dawson 1991). In loose uncompacted soils both native and alien species may grow roots many meters deep. However, in heavily compacted soils and even where mere inches of topsoil and subsoil occur on impermeable bedrock, cool season and native prairie grasses and forbs will grow but will have poor vertical root development. Under compacted soil conditions, such as on a clay cap, the major difference between these groups of plants is the markedly greater and denser root mass of native plants that increases the ability of these plants to tolerate physiological stresses, such as drought, (Atkinson and Mackie-Dawson 1991) and may contribute to greater cap stability (Browning 1990). A primary focus of much recent research has been on rooting depth and potential violation of the integrity of the landfill cap (Flower et al 1978; Gilman 1979; Leone et al 1979; Stalter 1979; Gilman 1980; Lutton 1982; Gilman et al 1985; Ettala

1987; Attala 1988; Wong and Yu 1989, etc). These studies have generally indicated that root penetration of clay caps does not occur for a number of reasons:

High Compaction of clay substrates impedes root penetration of caps except perhaps in cracks that develop in the caps because of thermal contraction (Andersland and Al-Moussawi 1987).

Prevailing research results suggest that root growth does not represent a threat to clay caps. In fact, a geomembrane system only reinforces resistance to root penetration. Based on studies of how roots direct growth, and how root morphology changes in response to natural soil profile changes, we believe strongly that well compacted clay caps (even without the presence of a geomembrane system) will provide an effective barrier to root penetration. In order to grow, a root pushes through the soil with an extending root tip with a diameter of 0.1 to 3mm. To move through soil, which generally contains pores of 0.002 to 0.2 mm or less, the root grows by turgor (osmotic-hydraulic) pressure. It must therefore push aside soil materials. Consequently, nonporous soils (such as compacted clays (even without a geomembrane barrier) represent a formidable barrier. On engineered clay caps with heavy soil compaction and on compacted mined sites, the lack of woody plant and herbaceous plant growth is related to the inability of roots to penetrate the substrates. Various methods for subsoil ripping and other soil preparation treatments are required to reduce compaction before plant growth will even occur, (Brown et al 1968; Brandshaw and Chadwick 1980; Malcom 1990; Apfelbaum 1991, etc). High Bulk densities in naturally occurring soils ≥ 1.5-1.8 mg/cm^2 retard root growth profoundly. On compacted landfill caps, bulk densities may be much greater and thus would be expected to be an effective barrier to root penetration. Resistance to root growth is also related to the average soil pore sizes. Soils with high bulk density values, especially highly compacted clay substrates, have a very small average soil pore size that restricts root penetration on caps. Resistance to root penetration increases directly in the vicinity of root growth owing to displaced soil materials. This increased soil compaction in the growing region in an already compacted soil environment results in cessation of continued root growth in the direction of increased bulk density. This limits root growth to upper shallow topsoils. Typically, plant root growth is restricted to spreading in these environments.

At the Fresh Kills landfill, research documented that even where thermal expansion related soil cracks formed in the landfill cap, root invasion did not occur for a number of reasons. Apparent impediments to root growth into existing landfill cap cracks were correlated with the layer of anoxic, nutrient poor sand, (drainage layer), probably suffused with methane, carbon dioxide, and other inhibitory gasses. Research found that thin probing taproots might penetrate through breaks or pores in the clay cap but that they would die back rather than increase in length or thickness. In fact, if gases are present in the fractured soils in sufficient concentration, root growth even above the clay cap is inhibited. Rather than the plant challenging the integrity of the clay cap, in a typical clay cap, plants cannot overcome these stressful conditions. Since clay caps are also nutrient poor, but inhibit nutrient uptake (owing to clay colloid binding capacity [Brady 1974]), root growth into caps should be minimal. Depth of root growth has demonstrated that root architecture is almost always controlled by the nature of the substrate in which the plants grow. Deep rooting plants in native soils have been well documented (Meinzer 1927; Coile 1951; Kreutzer 1961; Bibelriether 1966; Sutton 1969,1991; Russell 1973; Savill 1976; Foster 1993), while extreme shallow-surficial roots have been documented in compacted or geologically constrained soils.

Heavily compacted soils have been altered by tillage and subsoil loosening to achieve substantially greater rooting depth, plant production, increased soil porosity, and increased hydraulic conductivity (Harrison, Cameron and McLaren 1994). These techniques are the opposite of those used on GCC and GCL capped sites. These and other studies have demonstrated benefits of subsoil loosening and tillage are reversible by engineered compaction, altering soil textural composition, and by altering the chemistry of soil (CEC, pH, etc.). Native uncompacted soils and subsoils compared to engineered soil cap systems, will sustain very different plant growth by the same plant species. Root growth and above ground plant growth are significantly diminished in compacted soils, whether native or engineered.

- **Temporary erosion control measures, including but not limited to mulch straw, netting and chemical soil stabilizers, shall be undertaken while vegetation is being established.**

  The site stabilization strategy employed on most clay capping projects includes use of short lived and quickly establishing annual cover crops and a mulching system involving several options. The annual plants are seeded simultaneously with biennial and long and short lived perennial species. With this planting strategy, all species are potentially seeded simultaneously and will consequently respond to conditions for germination as they become suitable. Because of the seasonal nature for planting native prairie grass and flower species, if slopes are readied for final planting but the season is not proper for planting natives, then a cover cropping system is included. Once established, the native prairie seeded will be no-till drilled. The drilling of the native species seeds will be conducted directly into the established cover crop grass to cause minimal soil disruption.

  This same planting strategy was employed in the reclamation and revegetation of mined lands in Wisconsin; it has been very successful in the extreme environment of high waste rock dumps which have the same risk of erosion and plant exposure as on regional landfill tops and slopes, especially south and west aspect slopes (Ludwig and Apfelbaum, In Press; Burris and Apfelbaum 1992).

The mulching system can include erosion netting, erosion bats, and straw checks and blown straw if and where necessary to maximize erosion control. If hydromulching does occur, a tackifier such as Guar Gum is a very effective soil and mulch stabilizer. This tackifier produces a wet-resistant surface which reduces soil saturation, potential effects of slope failure from mass wasting and solufluction, and greatly reduces erosion of mulch and seed.

- **What evidence exists for root penetration of Geotextile clay caps and liners?**

Investigations of root penetration of GCL's and GCC's were done in lab and field settings. Melchior (1997) found lawn grasses, and weeds with fine roots (≤1 mm diameter) did penetrate bentonite mats during the first year where the GCC were installed over gravel and sand underdrainage layers. During year two, some liginified larger roots were also found to grow into the GCC. They speculated that if larger diameter lignified roots died and decomposed, then the remaining void could form open flow channels through the matting. However, they were not able to demonstrate this to occur in either field or laboratory experiments. The GCC was found to crack during drought but reseal during rehydration. Fine roots of grasses and weeds grew during wet periods, and ceased during dry down periods when the GCC developed vertical and horizontal "cracks". Under the experimental conditions, they found fine roots to grow completely through the mat in the first growing season.

They concluded that there is still a lack of convincing evidence and documented proof that bentonite mats (GCC and GCL) will work in caps. Use must be considered on a case by case basis. They also stated that new GCLs made with two bentonite layers divided by a middle geotextile, and prehydrated bentonite with organic additives, will improve performance. The lack of drying of the bentonite layer does not prevent root penetration by lawn grasses and other plants. They also identified a problem with GCC mats that did lead to failures that were completely unrelated to plant materials. They found that sodium in the sodium bentonite clay used in the GCC was prone to fail if irrigated with moderate to high carbonate waters containing calcium and magnesium. Then, the sodium cations were replaced by the calcium or magnesium; these chemical reactions reduced resealability of the GCC after modest or severe drought.

Technical Data Sheets for Geosynthetic clay lines (GCL's) (__Unpublished CETCO TR-310) found during a "tank scale" study that primary tap roots of weeds did not penetrate the GCL. Roots traveled directly downward, then turned 90 degrees upon encountering the GCL, and grew parallel to the surface of the GCL. They concluded the woven geotextile covering was "apparently sufficiently tightly knit to prevent penetration by tap roots". The study did find that fine root hairs that branched from the tap root were able to penetrate the GCL. The geotextile did not appear stretched or damaged by root penetration. They also tested permeability of the penetrated mat and found even with penetration that the permeability of the penetrated mat was consistent with "virgin" unpenetrated GCL.

Kargbo, Fanning, Inyang, and Duell (1993) have cautioned that the permeability of GCC and GCL's will increase in clay soils with the potential to produce acid sulfate. Where the potential for acid sulfate generation at the substrate interface with the underside of the GCC/GCL exists, this can increase permeability of the liner, result in mortality of vegetation exposed to strong acids, and enhance erosion risks of the cap. They suggest testing substrates that the GCC/GCL will be bedded on to ensure acid sulfate generation will not occur. Mobilization of metals from soils is typically associated with pyritic and other sulfur bearing minerals; under irrigated or excessively wet aerobic conditions in the near surface environment, the production of free sulfuric acid can occur. This study found that where clay acidification occurred below the GCC or GCL, topsoils failed to support the plant species applied as stabilization cover. Non-native species, such as lawn grasses, roadside, highway grass and clover mixes were especially intolerant of acidification. In fact, some of the most tolerant plant species included the native grasses such as little bluestem (*Andropogon scoparius*). Considerable work has been done on Geotextile Clay liners beneath landfilled materials. These studies have focused narrowly on the permeability of the liners and the chemical influence of leachates on liner performance and efficiency (Hoeks, Glas, Hofkamp and Ryhiner 1987).

Koerner and Daniel (1992) summarized the performance of all of the major categories of capping systems including GCC and GCL caps. They rated each cap and closure performance under environmental factors that complicate their design and influence success. Included were temperature extremes (freezing and thawing to significant depths), wet/dry cycles, potential for penetration by plant roots, burrowing animals (e.g. worms, insects, etc.), total differential settlement caused by compression of the waste or foundation soils, temporary or permanent surcharge by stockpiling materials, downslope slippage or creep, vehicle movements that drive over caps, wind and water erosion, deformation caused by earthquakes, long-term moisture changes if water moves in or out of wastes, and alterations caused by gas derived from volatile or decomposable wastes. Ratings presented in this paper suggested that GCL and GCC designs are marginally acceptable, or not recommended for use if any of these variables presents a threat to the barrier layer material. In combination with a geomembrane, a two layer barrier system (GCL and GCC) is acceptable and recommended as feasible and cost effective. This study also suggests that a single-layered geomembrane system will out-perform a geosynthetic clay liner and a clay capped liner system and may cost less in the long-term.

Bowerman and Redente (1998) document that few capping and liner systems employed anywhere in the world can escape biointrusions of the protective barriers especially in arid regions. They state that mice, ants, ground squirrels, prairie dogs, some plants pose a threat to barrier integrity and waste isolation and that engineered caps have been designed without consideration of the ecological principals and processes, which can be crucial to their performance. They stress that incorporation of ecological processes into barrier design is essential to lower risk of failure (Waugh and Richardson 1997). These authors summarize some newer capping technologies that include thicker caps, use of slow release herbicides to prevent root growth and other new ideas (Wing and Gee 1994).

CONCLUSIONS:

Biointrusion into a Geotextile clay cap or liner lacking the 24” fill soil and drainage layer above a GCL can occur, but such cap designs are now illegal for domestic waste landfills. Plants can violate a poorly compacted cap or if otherwise not constructed to specifications. Plant and animals have influenced water infiltration, channeling, soil pore space, aeration, physical and chemical properties, and the community eventually established on native soils and reclaimed mine sites. There is no reason to believe they cannot do the same on capped sites (Ellison 1946; Edwards and Lofty 1978, 1980; Kalisz and Stone 1984; Nyhan 1989; Sejkora 1989; Blom 1990; Blom et al. 1994; Gonzales et al. 1995). Compacted subsoils can be a temporal and spatial barrier to cap penetration. Some authors question the longevity of capping systems not designed with ecological processes in mind, contending that biointrusion is likely and perhaps inevitable. However, at the Albany landfill site, the probability of cap failure by root penetration is very remote; a far greater risk is likely if poor construction practices are allowed. While the chemical environment of the Albany cap including subsoil pH and acidification tendencies could be deleterious to GCC and GCL integrity, that is equally unlikely owing to soil chemistry.

Plant growth on the Albany cap will occur during wet periods then decrease or cease as cap desiccation occurs. Root die back can occur often during periods of desiccation. Roots will not grow into cracks, because root growth stops and cracking occur simultaneously during desiccation. During rehydration, the GCL reseals before plant root growth can respond to rewetting. Native vegetation has substantially higher rates of precipitation interception compared to the usually specified lawn species for the typical cap site. These interception rates substantially reduce the total annual water available for infiltration or runoff (Apfelbaum in preparation; Weaver 1968). Native vegetation is substantially more drought tolerant and survives extreme drought much better compared to alien cool season grass species.

Lawn grass species need fertilizer and irrigation in capped settings; native vegetation does not need these amendments, nor regular maintenance; this reduces maintenance costs. Fertilizer and irrigation water chemistries can alter the chemistry and physical integrity of the GCC or GCL altering pH, calcium-sodium ratios in the bentonite clay of the GCC or GCL. Native vegetation which does not require fertilization or irrigation, does not present these risks.

If acidification problems manifest on this site, native species are substantially more adaptable. Natives can endure greater changes in substrate chemistry than alien species. An acidified soil may resist replanting.

Native prairie vegetation has higher root mass densities than cool season nonnative lawn grasses; this allows prairie vegetation to provide greater soil stabilization. Native plants are especially resistant to downhill creep and mass soil movement. This can be important on landfills where material settlement occurs routinely.

Lawn and cool season grasses can encourage the presence of burrowing mammals, because no root structure is present in the subsoils. Prairie vegetation provides more above ground plant mass that is habitat cover. This attracts animals that utilize surface cover, rather than encourage burrowing species. Some mammals (e.g. woodchucks *Marmota monax*) burrow regardless of the above ground vegetation cover, especially along slope breaks and on side slopes. For these species, greater resistance to burrowing owing to the dense root masses below ground of native plants are important.

All vegetation covers on capped sites, even highly maintained lawn associations, will be invaded by weedy plants (Robinson and Handel 1993). This occurs rapidly if sources for bird and mammal disseminated seeds are present, or seeds/propagules can wash in during floods. Many weedy species are most invasive into highly maintained low diversity plantings such as lawns in contrast to native species plantings with dense root masses, and competitive growth forms. The current site design does not take into account this potential and tendency for site invasion and potential biointrusion.

Many native plant species representing low to tall, spring-fall flowering, unique colorization and texture are available for use in the final cover planting on the Albany site (Tables1A, 1B and 2). Some areas on the site may also be suitable for planting of trees and shrubs.

The depth of top soil and fill soil types envisioned for the Albany landfill suggests only fine roots will penetrate the GCL. These are very small diameter non-lignified roots. The capacity of the GCL to reseal will not be compromised by these roots and root hairs. The probability of GCL failure from penetration is very very low! All prairie plants, including shrubs and trees (Tables 1A, 1B, 2) are expected to be compatible with the proposed capping system.

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TABLE 1: This table summarizes the performance of representative herbaceous and woody) plant species that may be included in the sites planting plans. The criteria for valuing each species by the various attributes are identified in the Vegetation Criterion Key. The experience of ecologists with Applied Ecological Services and a multitude of references were used to classify species (see bibliography).

TABLE 1A. Identification of vegetation criteria used in evaluating compatibility with GCC/GCL.

CLAY CAP
VEGETATION CRITERIA KEY

COMPATIBILITY WITH THE DESIGN INTENT

1. Presence in the Region

   H – Found in the presettlement landscape.
   M – Was not found in the region at presettlement but has naturalized.
   L – Was not found in the region during presettlement.

2. Native

   Y – Plant native to the area.
   N – Plant is not native to the area

3. Habitat Value for Food

   H – Provides excellent food source for many species (i.e. seed, nectar).
   M – Provides food source for a few wildlife species.
   L – Provides no source of food for wildlife.

4. Habitat Value for Cover

   H – Provides excellent cover for nesting, breeding and protection.
   M – Provides some cover.
   L – No cover.

5. Seasonal Interest

   H – Colorful flowers, texture or stature.
   M – Compliments dominants
   L – Subdominant, not conspicuous

6. Non-Invasive

   H – Does not invade.
   M – Does invade if certain conditions are met.
   L – Invades areas by reseeding or root growth.

7. Soil Types

   B – Broad Range of Tolerance
   C – Clay Types
   L – Loam Types
   P – Peat Types
   S – Sand Types

ADAPTABILITY TO THE CAPPED SITE ENVIRONMENT

1. Root system type/depth

   B – Bulb
   R – Tap root
   R – Rhizome
   F – Fibrous
   S – Shallow 1-12”
   D – Deep 8-24”

2. Susceptibility to Gases

   H – Plant will not survive exposure to some gas.
   M – Plant may be affected by exposure to some gas.
   L – Plant is tolerant to gas.

3. Reaction to Higher Ground Temperatures

   H – Plant growth and survivability is strongly affected.
   M – Plants may be stressed.
   L – Plants are not affected.

4. Susceptibility to Ground Water Pollution

   H – Plants growth and survivability is strongly affected.
   M – Plants may be stressed.
   L – Plants are not affected.

5. Susceptibility to Surface Settlement

   H – Plant mortality due to root zone shearing.
   M – Plants may be stressed.
   L – Plants are not affected by root zone shearing.

6. Susceptibility to Wind Throw

   H – Plants are very sensitive to high winds.
   M – Plants may be stressed.
   L – Plants are not affected.

7. Adaptability to Soil Compaction

   H – Plants will adapt.
   M – Plants may adapt.
   L – Plants will not adapt.

8. Tolerance of Low Soil Oxygen Conditions

   H – Plants tolerate low oxygen conditions.
   M – Plants may be stressed by low oxygen conditions
   L – Plants will not survive low oxygen conditions.

9. Tolerance of Cover Soil Nutrients and pH.

   H – Plants tolerant to variable nutrient and soil pH conditions.
   M – Plants tolerate to certain conditions.
   L – Plants restricted to a narrow range of conditions.

10. Adaptability to side Slope Conditions

   Y – Plants tolerate side slope conditions.
   N – Plants will not tolerate side slope conditions.

11. Height at Maturity

   " – inches
   ' – feet

12. Erosion Control

   H – Plant provides highly stable soil in the root zone.
   M – Plant may provide erosion control.
   L – Plant provides no soil stabilizing in root zone.

13. Resistant to Drought

   H – Plant is highly adapted to drought conditions.
   M – Plant may adapt to certain drought conditions.
   L – Plant is not adapted to drought.

<u>MAINTENANCE</u>

1. Rate of Growth

   F – Fast
   M – Medium
   S – Slow

2. Establishment Period

   1 – One growing season.
   1.5 – One and one half growing Seasons
   2 – Two growing Seasons.

3. Longevity

   L – Long lived perennial.
   M – Short lived perennial.
   S – Annual or biannual.

4. Susceptibility to Desiccation

   H – Plants are highly susceptible to desiccation.
   M – Plants may be susceptible to desiccation.
   L – Plants are not susceptible to desiccation.

5. Susceptibility to Rodent/Rabbit Damage

   H – Plants are vulnerable.
   M – Plants may be vulnerable.
   L – Plants are not vulnerable.

6. Susceptibility to disease and Insects

   H – Plants are vulnerable.
   M – Plants may be vulnerable.
   L – Plants are not vulnerable.

7. Compatibility with the Climate

   H – Plants are highly compatible.
   M – Plants may be compatible.
   L – Plants are not compatible.

TABLE 1B
CRITERIA AND SCORING USED IN TABLE 2

	1	2	3
EROSION CONTROL			
Rooting Depth	Deep	Shallow	Surface
Rooting Structure	Course	Fibrous	Densely fibrous
Rooting Habit	Horizontal Condensed	Horizontal Dispensed	Trailing clonal, stoloniferous, rhizomes
Adaptability to Gradient	Intolerant to gradient	May adapt	Rapid establishment
CLIMATE COMPATIBILITY			
Winter Extremes	Intolerant	Moderately tolerant	Tolerant
Summer Extremes	Intolerant	Moderately tolerant	Tolerant
MAINTENANCE			
Drought Tolerance	Intolerant	Moderately tolerant	Tolerant
Tolerance to Compacted Soils	Intolerant	Moderately tolerant	Tolerant
Disease/Insect Resistance	Vulnerable	Moderately resistant	Resistant
Longevity	Short-lived	Moderately-lived	Long-lived
DESIGN, POST-CLOSURE LAND USE			
Native to NE	Non-native	Native-rare	Native-common
Common to NE	Not present	Present	Common-naturalized
Habitat – Food Value	No value	Supports a few species	Supports many species
Habitat – Shelter	No value	Some cover	Excellent for nesting, protection
Seasonal interest	Not conspicuous	Showy flower or fruit display	Showy flower and fruit display
TOLERANCE OF GAS			
Tolerance of Low Soil Oxygen	Will not survive	Possibly stressed	Tolerant
Tolerance of Gases	Will not survive	Possibly stressed	Tolerant
Native to NE	Non-native	Native-rare	Native-common
PROTECTION OF COVER SYSTEM			
Root System Depth	Deep	Shallow	Surface

TABLE 2: An assessment of the suitability/compatibility of native prairie grasses and wildflowers and exemplenry trees and shrubs for planting in clay capped sites including sites with GCC and GCL. Rankings follow the criteria in Table 1A and 1B.

TABLE 2.

PLANT SPECIES	EROSION CONTROL				CLIMATE COMPATI-BILITY		MAINTENANCE				DESIGN, POST-CLOSURE AND USE						TOLERANCE OF GAS		
DECIDUOUS CANOPY TREES	Rooting Depth	Rooting Structure	Rooting Habit	Adaptability to Gradient	Winter Extremes	Summer Extremes	Drought Tolerance	Tolerance to Compacted Soils	Disease/Insect Resistance	Longevity	Native to N.E.	Common to N.E.	Habitat-Food Value	Habitat-Shelter	Seasonal Interest	Conspicuous Flower/Fruit	Tolerance to Low Soil Oxygen	Tolerance to Gases	Native to N.E.
Acer saccharum	3	3	1	1	3	3	3	3	2	3	3	3	3	2	3	1	3	3	3
Fraxinus americana	2	3	1	2	3	2	2	2	2	3	3	3	1	2	3	1	3	2	3
Fraxinus pennsylvanica	2	3	1	1	3	3	3	3	2	3	3	3	1	2	3	1	3	2	3
Quercus bicolor	2	3	1	1	3	3	3	3	3	3	3	3	3	2	3	2	3	2	3
Salix amygdaloides	2	3	3	1	3	3	3	3	2	1	3	1	3	2	1	1	3	2	3
Salix nigra	2	3	3	1	3	3	3	3	2	2	3	3	3	2	1	1	3	3	3
Tilia americana	1	1	2	3	3	1	1	1	2	3	3	3	1	2	3	1	2	2	3

PLANT SPECIES	EROSION CONTROL				CLIMATE COMPATI-BILITY		MAINTENANCE				DESIGN, POST-CLOSURE AND USE						TOLERANCE OF GAS		
DECIDUOUS UNDERSTORY TREES	Rooting Depth	Rooting Structure	Rooting Habit	Adaptability to Gradient	Winter Extremes	Summer Extremes	Drought Tolerance	Tolerance to Compacted Soils	Disease/Insect Resistance	Longevity	Native to N.E.	Common to N.E.	Habitat-Food Value	Habitat-Shelter	Seasonal Interest	Conspicuous Flower/Fruit	Tolerance to Low Soil Oxygen	Tolerance to Gases	Native to N.E.
Amelanchier canadensis	2	3	3	2	3	1	1	1	3	2	3	2	3	3	3	3	2	2	3
Cercis canadensis	2	3	3	3	2	3	3	2	3	2	2	3	1	2	3	3	2	2	2
Cornus mas	2	2	3	1	2	2	3	2	3	2	1	1	3	3	1	2	2	3	1
Crataegus crus-galli	1	2	1	3	3	3	3	2	2	2	1	3	2	3	3	3	2	2	1
Prunus virginiana	2	3	3	2	3	3	3	1	2	2	3	1	3	2	3	2	2	3	3
Ptelea trifoliata	2	2	3	3	3	3	3	1	3	2	3	1	2	2	2	1	1	3	3
Rhus copallina latifolia	2	1	3	3	2	3	3	1	3	1	1	1	3	2	3	3	2	3	1
Rhus glabra	2	3	3	3	3	3	3	1	3	1	3	3	3	2	3	3	2	3	3
Rhus typhina	2	3	3	3	3	3	3	1	3	1	3	3	3	2	3	3	2	3	3
Salix discolor	2	3	3	1	3	3	3	3	1	1	3	2	3	2	1	3	3	3	3
Viburnum lentago	2	3	3	3	3	3	3	1	3	1	3	2	3	2	3	2	2	3	1
Viburnum prunifolium	2	3	2	3	3	3	3	1	3	2	3	2	3	3	3	3	1	2	3
Zanthoxylum americanum	2	3	3	3	3	3	3	1	3	3	3	3	3	2	2	1	2	3	3

PLANT SPECIES	EROSION CONTROL				CLIMATE COMPATI-BILITY		MAINTENANCE				DESIGN, POST-CLOSURE AND USE						TOLERANCE OF GAS		
DECIDUOUS SHRUBS	Rooting Depth	Rooting Structure	Rooting Habit	Adaptability to Gradient	Winter Extremes	Summer Extremes	Drought Tolerance	Tolerance to Compacted Soils	Disease/Insect Resistance	Longevity	Native to N.E.	Common to N.E.	Habitat-Food Value	Habitat-Shelter	Seasonal Interest	Conspicuous Flower/Fruit	Tolerance to Low Soil Oxygen	Tolerance to Gases	Native to N.E.
Aronia melanocarpa	3	3	3	3	3	3	3	3	3	1	3	2	2	2	3	2	3	3	3
Cornus amomum	3	3	3	1	1	3	3	3	2	1	3	2	3	2	2	2	3	2	3
Cornus racemosa	3	3	3	3	1	3	3	2	3	3	3	3	3	2	2	3	2	2	3
Cornus stolonifera	3	3	3	1	3	3	3	3	2	1	3	3	3	2	3	3	3	3	3
Corylus americana	2	3	3	3	3	2	2	2	3	3	3	2	2	2	2	1	1	3	3
Hamamelis vernalis	2	3	3	1	2	2	2	3	3	2	1	1	1	2	3	2	3	1	1
Rhus aromatica	3	3	3	3	3	3	3	1	2	2	1	2	3	2	3	2	1	3	1
Salix humilis	3	3	2	3	2	3	3	3	3	1	3	3	3	2	1	1	3	3	3
Salix lucida	3	3	2	1	2	3	3	3	1	1	3	2	3	2	1	1	3	3	3
Sambucus canadensis	3	3	3	2	3	3	3	3	2	2	3	3	3	2	1	3	3	3	3
Viburnum acerifolium	3	3	3	3	3	2	2	2	2	3	3	1	3	2	3	2	1	3	3
Viburnum dentatum	3	3	3	1	3	3	3	2	3	3	1	2	3	2	2	2	3	3	1
Viburnum trilobum	3	3	2	3	3	3	3	3	3	3	3	3	3	2	2	3	3	2	3
Viburnum lantana	3	3	3	3	3	3	3	2	3	3	1	1	3	2	1	3	1	3	1

PLANT SPECIES	EROSION CONTROL				CLIMATE COMPATI-BILITY		MAINTENANCE				DESIGN, POST-CLOSURE AND USE						TOLERANCE OF GAS		
PRAIRIE GRASSES AND FORBS	Rooting Depth	Rooting Structure	Rooting Habit	Adaptability to Gradient	Winter Extremes	Summer Extremes	Drought Tolerance	Tolerance to Compacted Soils	Disease/Insect Resistance	Longevity	Native to N.E.	Common to N.E.	Habitat-Food Value	Habitat-Shelter	Seasonal Interest	Conspicuous Flower/Fruit	Tolerance to Low Soil Oxygen	Tolerance to Gases	Native to N.E.
**Andropogon gerardii*	2	3	3	3	3	3	3	3	3	3	3	3	1	3	3	2	3	3	3
**Andropogon scoparius*	2	3	3	3	3	3	3	3	3	3	3	3	1	3	3	2	1	3	3
Anemone cylindrica	1	3	3	3	3	3	3	3	3	3	3	3	2	1	3	2	3	3	3
Argrostis alba	3	3	2	3	3	3	3	3	3	3	1	2	1	3	3		3	3	1
Aster azureus	3	2	2	3	3	3	3	3	3	3	3	3	1	1	3	2	2	2	3
Aster ericoides	3	3	3	3	3	3	3	3	3	3	3	2	2	2	3	2	3	3	3
Aster laevis	3	2	2	3	3	3	3	3	2	3	3	3	1	1	3	2	2	2	3
Aster novae-angliae	3	3	3	3	3	3	3	3	3	3	3	3	1	3	3	2	3	3	3
**Bouteloua curtipendula*	2	3	3	3	3	3	3	3	3	3	3	3	1	3	3	2	3	3	3
**Bouteloua gracilis*	2	3	3	3	3	3	3	3	3	3	3	3	1	3	3	2	3	3	3
**Bouteloua hirsuta*	2	3	3	3	3	3	3	3	3	3	3	3	1	3	3	2	3	3	3
**Buchloe dactyloides*	2	3	3	3	3	3	3	3	3	3	3	3	1	3	3	2	3	3	3
Coreopsis palmata	3	3	3	3	3	3	3	2	3	3	3	3	3	1	3	2	2	3	3
Desmodium canadense	1	1	1	3	3	3	3	3	3	3	2	2	2	1	2	3	3	3	3
Echinacea pallida	1	2	1	3	3	3	3	3	3	3	2	2	2	1	2	3	3	3	3
Elymus canadensis	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	1	3	3	3
Elymus villosus	2	3	3	3	3	3	3	2	3	3	3	3	3	3	3	1	3	1	3
Elymus virginicus	2	3	3	3	3	3	3	2	3	3	3	3	3	3	3	1	3	1	3

* **THESE SPECIES ARE INCLUDED AS EXAMPLES IN THE "DOWNTOWN OMAHA RIVERFRONT DESIGN DEVELOPMENT SUMMARY REPORT (UNEDITED).**

PLANT SPECIES	EROSION CONTROL				CLIMATE COMPATI-BILITY		MAINTENANCE				DESIGN, POST-CLOSURE AND USE						TOLERANCE TO GAS		
PRAIRIE GRASSES AND FORBS	Rooting Depth	Rooting Structure	Rooting Habit	Adaptability to Gradient	Winter Extremes	Summer Extremes	Drought Tolerance	Tolerance to Compacted Soils	Disease/Insect Resistance	Longevity	Native to N.E.	Common to N.E.	Habitat-Food Value	Habitat-Shelter	Seasonal Interest	Conspicuous Flower/Fruit	Tolerance to Low Soil Oxygen	Tolerance to Gases	Native to N.E.
Euphorbia corollata	3	3	3	3	3	3	3	3	3	3	3	3	2	1	3	2	3	3	3
Festuca rubra	3	3	2	3	3	3	3	2	3	3	1	3	1	2	3	1	3	3	1
Helianthus divaricatus	3	3	3	3	3	3	3	2	3	3	3	3	3	2	3	2	2	2	3
Helianthus laetiflorus	3	3	3	3	3	3	3	3	3	3	3	3	3	1	3	2	3	3	3
Lespedeza capitata	1	2	3	3	3	3	3	3	3	3	3	2	2	2	2	3	3	3	3
Monarda fistulosa	3	3	3	3	3	3	3	3	3	3	3	3	1	3	3	2	3	3	3
Panicum virgatum	2	3	3	3	3	3	3	3	3	3	3	3	1	3	3	3	3	3	3
Petalostemum purpureum	1	2	2	3	3	3	2	2	3	3	3	3	3	1	3	3	2	3	3
Phleum pratense	3	3	1	3	3	3	3	3	3	3	2	3	1	3	2	2	3	3	1
Potentilla arguta	3	3	1	3	3	3	3	3	3	3	3	3	3	1	3	2	1	2	3
Ratibida pinnata	3	3	3	3	3	3	3	3	3	2	3	3	3	1	3	2	1	3	3
Rudbeckia hirta	3	3	3	3	3	3	3	3	3	2	3	3	3	1	3	2	1	3	3
Rudbeckia triloba	2	3	3	3	3	3	3	1	3	3	3	3	2	1	3	2	2	2	3
Silphium terebinthinaceum	2	2	1	3	3	3	3	3	2	3	3	3	3	1	3	3	3	1	3
Solidago canadensis	3	3	3	3	3	3	3	3	3	2	3	2	2	2	3	2	3	3	3
Solidago nemoralis	3	3	2	3	3	3	3	3	2	3	3	3	2	1	3	2	1	3	3
Solidago rigida	3	2	1	3	3	3	3	3	3	3	3	3	3	1	3	2	1	3	3
Solidago speciosa	3	3	2	3	3	3	3	3	3	3	3	3	2	1	3	2	1	2	3
Sorghastrum nutans	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	3	1	3

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SPECIALISTS IN ENVIRONMENTAL MANAGEMENT AND RESEARCH

December 5, 2006

TO: AES team
FROM: Bill Young, Ted Hartsig
RE: Soil Characterization Memo Report

Background

The Albany Landfill lies within the Albany Pine Bush, a system so unique and rare that it is ranked G2 (Globally Imperiled thoughout its range due to rarity or highly vulnerable to extinction due to biological factors) and S1 (Critically imperiled in New York State because of extreme rarity (5 or fewer sites or very few remaining individuals) or extremely vulnerable to extirpation from New York State due to biological factors). Pitch pine-scrub oak communities dominate the Albany Pine Bush landscape and have been the focus of conservation efforts to date. Pitch pine (*Pinus rigida*) and its scrub associates depend on frequent disturbance from fire and sandy, low nutrient soils. These communities, in turn, harbor rare animals such as the Buck moth, Karner Blue butterfly and several birds such as rufus-sided towhee, prairie warblers and whip-poor-will.

Gebaurer et al (1996) described three variants of the pitch pine-scrub oak community in the Albany Pine Bush:

1. Pitch pine scrub oak barrens: savannah community with 20-60% cover of pitch pine, scrub oak, huckleberry and blueberry (Schneider et al (1991).
2. Pitch pine scrub oak thickets: resemble barrens as above, but with a much higher density of scrub oak (Quercus ilicifolia and Q. prinoides)
3. Pitch pine scrub oak forests: also contain similar species but also contain White oak (*Quercus alba*), red oak (*Q. rubra*), or black oak (*Q. velutina*). The shrub and herbaceous layers may be sparser than in the two variants described above. (Gebauer et al., 1996).

These rare vegetative communities formed in a unique soils environment; unique not just for its sandy characteristic, but also the chemical and hydrological components that underlie and sustain this ecological system. Soils of the Albany Pine Bush formed in alluvial glacial sands that were modified by wind, creating rolling dunes. During the last ice age (Wisconsin), several rivers emptied into the glacial Lake Albany, carrying sediment ground by glacial advances. Large amounts of sand and gravel were deposited close to the lakeshore where these rivers joined with the lake, forming a large delta. After the glaciers retreated, Lake Albany drained, exposing the sandy delta. Winds further eroded and sculpted the sand into dunes characteristic of the existing soils now found in the Albany Pine Bush [1].

The Albany Pine Bush is dominated by four soils series: Colonie loamy fine sand, Granby loamy fine sand, Stafford loamy fine sand, and Adrian muck. Generally, these series are described by deep, excessively drained loamy fine sand to sand, with variation between horizons stemming from small gradations in texture and/or organic matter content. The soil horizons are deep, typically much greater than 60 inches, and are generally described in the following sequence:

0 to 12 inches (+/- 3 inches):	loamy fine sand
12 to 25 inches (+/- 5 inches):	fine sand to loamy fine sand
25 to 60+ inches:	sand to fine sand

One of the dominant soil series of the Albany Pine Barrens is the Colonie loamy fine sand, of which the horizon description is of loamy fine sand through its entire depth.

This memorandum provides a summary of the characterization and assessment of soils at the Albany Pine Bush and Landfill completed September 28, 2006. The purpose of the soils characterization and assessment was to provide information of the condition of surrounding soils near the landfill, and of native soil characteristics that contribute to the existing vegetative communities in the Pine Barrens at the Albany Landfill. This information will be used for development of restoration plans with expansion of the landfill.

Data Collection

To recreate the specialized plant communities on site, AES studied reference areas and compiled data on soils, vegetation and hydrology. Soils were examined in the area of the planned landfill expansion east and southeast of the current operations, and in reference areas both north and west of the landfill in the Pine Bush. Soil cores were extracted along transects (Transects E-1 through E – 6, and in the former trailer court) established in the expansion area using a 33-inch long soil probe. The soil probe collects a core in an approximate 15-inch open-side barrel. Cores were collected in approximate 15-inch intervals, with cores extracted for evaluation. Photographs (digital) of each core from the 0 to 15-inch depth were recorded, soil profile characteristics were documented onto data sheets (Appendix A), and soil samples collected for analysis of target constituents (calcium, magnesium, phosphorous, potassium, percent organic matter, cation exchange capacity, and pH). Soils were examined along transects established [in the area of the expected landfill expansion north of the current landfill,] in rolling topography dominated by pine woodland, including an adjacent trailer court; and from individual locations selected as representative of the varied vegetative communities in the Pine Bush.

Summary of Results

Essentially, because the soils examined formed in a common parent material, typical profile characteristics are similar across the entirety of the Albany Pine Bush. The primary differences in soil characteristics lay in their relational aspect: Lowland including fens, bogs, and ponds; and uplands on hilltops and sideslopes. This summary describes the results of the soil characterization completed in September related to their relational aspect, with comparison of soil profiles in the expansion area to reference sites.

Detailed field and laboratory data and descriptions of soil characteristics is provided in attachment A. Our initial evaluation of Albany Pine Bush soils focuses on their characteristics by spatial distribution. We then examined soil characteristics in their relationship with plant communities in the Pine Bush. By spatial distribution, lowland and upland soils are described by:

1. Lowland Soils

The lowlands mapped include soils found in fens, bogs, and ponds, typically where water flows and collects, or where the topographical aspect is low and intercepts the water table, creating perennially wet conditions. Typically, the soil underlaying the inundated areas of ponds and bogs was found to consist of muck to depths greater than 40 inches. The soils examined within a sedge meadow, fens, or adjacent to ponds typically consisted of an organic layer (muck or detritus) from 0 to 4 inches thick, underlain by high organic, very fine sand to loamy fine sand to depth of approximately 14 to 24 inches below the ground surface. The A horizon of reference soils in wet areas were generally very dark brown to black (10YR 2/1 to 2.5Y 3/2, for example), had massive or granular structure, and were friable.

The B horizon at the lowland reference sites were found to also be typically dark (10YR 5/3, 10YR 3/2) with gleyed chromas. Generally, these soils were found to be composed of very fine sand and loamy fine sand.

In some locations, the B horizon had relatively low organic matter content, but in all locations, the B horizon was wet to saturated, had massive structure, and was typically friable.

Laboratory data show that the lowland areas typically have a low pH (average 5.2 standard units) and relatively high organic matter (average 15.8 percent). The P concentrations for the low-lying areas averaged 48.8 mg/kg, a value that could be considered high by most native soil standards. The potassium (K), Ca, and magnesium (Mg) concentrations in soils east of the landfill are also substantially higher than soils at the reference sites. In particular, Ca appears to be extraordinarily high in these areas with concentrations ranging from 2,154 mg/kg to 6,201 mg/kg, compared to a range of 49 mg/kg to 1,574 mg/kg at the reference sites. Cation Exchange Capacity (CEC) in the lowland soils averages approximately 18 cmol/kg, with higher CEC values found in soils east of the landfill, generally (but not closely) corresponding with increased organic matter content. Typically, where organic matter content is low, the CEC is also low, the exception being the soil sampled from the bottom of wetland 3, with high organic matter, but low CEC.

2. Upland Soils

The typical upland soils in the Albany Pine Bush were found on ridge tops and sideslopes. Generally, the upland soils had well-developed A horizons and thick B horizons, all consisting of fine sand and sand. In some upland profiles, mottling was noted in the upper reaches of the B horizons indicating periodic inundation or saturation, followed by periods of good aeration. These soils are well-drained, although moderate drainage was found in lower areas close to wet conditions.

The A horizon of the upland soils is typically from 0 to 7 inches (ranges from 4 to 15 inches thick) with relatively high organic matter content notable from the dark brown to black coloration (typical is 10YR 2/2 or 10YR 3/4). The A horizon, being modified by high organic matter, consists generally of very fine sand and fine sand with massive, friable structure. With higher organic matter content, the A horizon soil has a seemingly finer texture.

The B horizon of the upland soils was found to extend from immediately below the A horizon to depths greater than 36 inches (usual limit of sampling). In many locations, there is a sharp, distinct boundary between the A and B horizons, represented by sharply contrasting soil matrix colors. Other locations show a less distinct boundary between horizons, but differentiation in texture and the presence of mottles was more of a discerning factor. The B horizon of the upland soils had few hydric characteristics, generally found as faint to distinct – but few – mottles in the 4 to 10 inch depths below the ground surface (although as deep as 15 inches in one profile). The mottles were high chroma, indicating short periods of saturation/inundation, followed by largely well-aerated conditions. Occasionally, gleyed mottles were noted in the shallow B profile.

In general, laboratory data show that the upland soil characteristics demonstrate moderate acidity, with pH typically between 4.7 and 6.0, with some areas of stronger acidity as low as pH 4.1, or more neutral (five locations between pH 6.0 and 7.3). Organic matter content, typically highest in the A horizon, was generally found to be between 3.0 and 4.5 percent, with some locations with notably higher or lower organic matter concentrations. P concentrations were higher than what is normally expected in native soils (usually average concentrations between 10 to 25 mg/kg P would be a normal range), with concentrations generally between 20 to 80 mg/kg (the middle third of the concentration range). Nearly one-third of the samples did have concentrations below 15 mg/kg, and one-quarter of the samples with more than 80 mg/kg P. In contrast to P concentrations, K concentrations were lower than what would typically be expected in native soils (usually between 150 to 300 mg/kg).

Evaluation of Soils by Vegetative Community

To better understand the relationship of soils and vegetative communities in the Albany Pine Bush, soil data was compiled for evaluation by vegetative community types as determined during the September AES field study. Soil data is detailed in Table 1 on the following page.

Table 1: Comparison of available and total extractable nutrients and trace minerals in Albany Pine Bush Soils.

Mean Concentrations in ppm in dry soil samples.

	pH	%OM	TKN	P	K	Ca	Mg	S	Zn	B	Mn	Fe	Cu	Al	Na
PINE BUSH N = 7															
Available	5.1	4.0		**110**	**29**	**367**	**27**								
Extractable			*2942*	***857***	***828***	***4700***	***1300***	*800*	*40.5*	*5.52*	***345.6***	***15910***	*8.61*	***10666***	*72*
TRAILER PARK N = 2															
Available	7.0	0.8		**48**	**37**	**826**	**35**								
Extractable			*400*	***350***	***750***	***750***	***850***	*300*	*45.3*	*3.05*	***81.3***	***10269***	*2.62*	***7317***	*63*
E TRANSECTS N = 20															
Available	5.3	11.3		**36**	**48**	**2076**	**134**								
Extractable			*3570*	***765***	***980***	***6000***	***1485***	*650*	*41.4*	*4.96*	***374***	***22879***	*10.14*	***8734***	*74*
VERNAL PONDS N = 2															
Available	5.2	3.8		**43**	**36**	**408**	**49**								
Extractable			1300	**600**	**950**	**1550**	**1350**	350	28.9	3.62	**213**	**11785**	6.16	**9746**	67
WETLANDS N = 5															
Wetland 1 N=1															
Available	7.6	2.0		**38**	**17**	**1574**	**50**								
Extractable			*900*	***300***	***1100***	***4200***	***1500***	*300*	*24.9*	*7.48*	***144***	***12237***	*5.05*	***6152***	*74*
Wetlands 2&3 N = 4															
Available	4.3	16.0		**74**	**36**	**376**	**31**								
Extractable			*1550*	***500***	***800***	***2050***	***1775***	*300*	*42.3*	*2.24*	***159.1***	***11161***	*7.28*	***8201***	*69*
LANDFILL CAP N = 1															
Available	6.0	1.6		**78**	**58**	**615**	**70**								
Extractable			10900	**600**	**900**	**2100**	**700**	1900	40.7	5.57	**97.3**	**4538**	55.7	**6489**	70

Table 1 provides broad characterization of the chemical nature of the Albany Pine Bush soils that will provide a basis for restoring an environment similar to the existing conditions that will support re-establishment of the native vegetative communities. For restoration of the Pine Bush as described above, representative soil characteristics are moderately- to strongly acid, with an average pH of 5.1. The average organic matter content (%OM), is 4.0 percent, which may be higher than expected for a "barren" ecological system. Plant nutrients, N, P, and K, as well as Ca, are variable, and could be considered quite low compared to most other ecosystems in New York State. For example, total N (as reflected by Total Kejldahl Nitrogen – TKN) compared to organic matter content demonstrates a carbon-nitrogen ratio (CN ratio) of 15 or greater in all site soils, with the exception of the landfill cover soils. When the CN ratio is greater than 15, N tends to be organically bound and only marginally available for plant uptake. Likewise, while the available P content may be considered high to excessive in many soils, the interaction of P with the very high iron content of the Albany Pine Barren soils may render this nutrient largely unavailable to most plant species.

It is the "barren" of low nutrient, and natural fire cycles that gives rise to such unique species such as scrub oaks and pines. For instance, Pitch pine grows in "sterile sandy soil, pH 3.5 to 6.5 (Olsvig, L., Cryan J., and Whitaker, R 1979). Tolerant of drought, salt. Intolerant of flooding or saturated soil for more than 25% of the growing season; soil compaction; shade index 0-2. New Jersey tea, *Ceanothus americanus*, a common shrub of the Albany Pine Bush, has conditions "open, dry, sterile soil, pH 4.5 to 6. Tolerant of salt, drought. Intolerant of soil compaction, shade. It is our challenge to describe the range of soil conditions that will support our desired plant communities. We can then use this table to assess candidate soils for our program.

In our dialog with the stakeholders, we have been assured that Pine Bush soils are available from on or off site, to help recreate the pine bush ecosystems on top of the closed landfill sections. It will be far more practicable to mine existing soils than attempt to restore them from off-site soil sources. While there is not a substantial variation between the textural characteristics of A and B horizons, it will remain important to segregate soil by horizon while stockpiling it, preserving the integrity of the natural soil constituents for restoration purposes. For example, the top 12 inches of soils on site should be removed and stockpiled separately from soils below 12 inches.

The loamy fine sand soils, by nature of their texture, are excessively drained and droughty. Because they are so deep, in excess of well over 60 inches, water drainage will extend deep into the profile on typical upland soils at the Pine Bush. Restoration of Pine Bush soils on a landfill cap must take into account soil hydrology and drainage characteristics, and how this will affect plant growth. If restored soils are not deep enough, drainage may be sufficiently different from native conditions as to result in alterations of the expected plant communities. Consideration in placement of the soils will be topographical aspect, rooting depth, and soil development over time. For example, placement of restored soils on sideslopes of the landfill cap may present better soil drainage and therefore more native conditions than soils placed on the top of the cover. Controls such as subsurface drain tiles may provide an artificial means of recreating native soil conditions that will best support Pine Bush vegetative communities. Any and all restoration strategies should be examined closely and tested before full-scale restoration design and construction occurs.

After we have obtained and evaluated data of how potential restored soils will interact with the environment (drainage, nutrient levels, OM content, etc.), we will need to estimate feasible depth and placement of the native soils, in loose tip, over the capped landfill. We will need to consider how to undulate the fill to best emulate the Pine Bush reference areas. It will be necessary to make a thorough assessment of sand that is available for the landfill cover and restoring the Pine Bush environment, including determining testing and pre-approval of each stockpile source. Factors include the frequency of testing (1,000 c.y., 2,500 c.y.) depending on the uniformity and results.

Summary

AES characterized the vegetative communities and soil conditions of the Albany Pine Bush for the purpose of restoring this unique ecological community as the end point of the Albany Landfill expansion plans. Our goal is, as described by the New York State Natural Heritage Program, to restore an ecological community described as a Pitch pine-scrub oak barrens: a shrub-savanna community that occurs on well-drained, sandy soils that have developed on sand dunes, glacial till, and outwash plains, in which Pitch pine (*Pinus rigida*) is the dominant tree; the percent cover of pitch pine is variable, ranging from 20 to 60%, and the shrublayer dominants are scrub oaks (*Quercus ilicifolia* and *Q. prinoides*), which often form dense thickets.

To accomplish this goal, we have characterized soil conditions at the Albany Pine Bush, establishing a target upland soil restoration of loamy fine sand to sand, excessively drained, having moderately to strong reaction (pH 5.0 to 5.5), moderate organic matter content, and low nutrient availability. The native soils have demonstrated additional chemical uniqueness, including high iron and manganese content that likely contribute to the vegetative speciation of the Albany Pine Bush and should be retained.

The next step of this process in the development of a detailed restoration plan, including provisions for supplemental studies of the optimal soil restoration strategies that will assure successful restoration of the Albany Pine Bush ecology.

References

1. SIGNIFICANT HABITATS AND HABITAT COMPLEXES OF THE NEW YORK BIGHT WATERSHED; Albany Pine Bush
   http://training.fws.gov/library/pubs5/web_link/text/apb_form.htm

2. Histosols: Their Characteristics, Classification, and Use. SSSA Special Bulletin No. 6. Soil Science Society of America. 1974

Attachment A
Summary Data Tables
Albany Pine Bush Soils

Lowland

The lowlands mapped include soils found in fens, bogs, and ponds, typically where water flows and collects, or where the topographical aspect is low and intercepts the water table, creating perennially wet conditions. Because these areas receive runoff from upland areas, they collect increased amounts of organic detritus in addition to that which grows and collects there. The abundance of organic material contributes to the water-holding capacity of the soil, maintaining poorly-drained conditions. Organic material in these areas is slow to decay, and therefore builds, creating its own horizon, and leaching into lower soil horizons. Organic acids slowly break down the mineral sands into finer sands, silts, and clay that, with silts and clays transported to these low areas, result in lower water transmissivity and higher water holding capacity.

Lowland soils in the area of the landfill expansion typically fit the following description:

A Horizon: The A horizon of the wetland/lowland soils in the expansion area average about 20.5 inches in depth (range from 6 to 38 inches), typically consisting of much intermixed with very fine sand and loamy fine sand. Occasionally, increased silt and clay content was noted, representative of the accumulation of organic materials and fine mineral matter. The A horizon in nearly all of the sampled locations consisted dominantly of organic muck (largely 80 to 100 percent organic material) in an 'O' or organic horizon with an A horizon with increased mineral content (typically fine sand). This horizon is black in color (< 2 chroma and value < 3 on Munsel Soil Color Charts), generally granular or massive in structure, and friable. At all locations, the organic material was always wet to saturated, and loosely-consolidated, sometimes with substantial void spaces.

B Horizon: The B horizon of the wetland/lowland soils in the expansion area is differentiated from the A or O horizons by increased amounts of mineral matter, typically fine sand. The B horizon soil tends to be dark and gleyed (reduced conditions), typically with high amounts of organic material that has leached into the sands. The B horizon was exemplified by thicknesses of 0 to 40 inches, and greater extending to depths beyond 60 inches below the surface. Soil is generally dark rown and dark grayish brown, very fine sand and loamy fine sand, with massive structure and friable. The B horizon was always wet or saturated.

Lowland soils evaluated in the expansion area include sampling points E1-B, E1-C, E1-D, E2-A, E3-C, and E4-B. Table 1 summarizes base information characterizing the sample locations for the lowland soils, and field data sheets are provided in attachment A.

Lowland soils at reference areas were examined in or very near to ponds, bogs, and fens. Soils were sampled both on wet or saturated ground, an in inundated pond/bog beds. Typically, the soil underlaying the inundated areas of ponds and bogs was found to consist of muck to depths greater than 40 inches. The soils examined within a sedge meadow, fens, or adjacent to ponds typically consisted of an organic layer (muck or detritus) from 0 to 4 inches thick, underlain by high organic, very fine sand to loamy fine sand to depth of approximately 14 to 24 inches below the ground surface. The A horizon of reference soils in wet areas were generally very dark brown to black (10YR 2/1 to 2.5Y 3/2, for example), had massive or granular structure, and were friable.

The B horizon at the lowland reference sites were found to also be typically dark (10YR 5/3, 10YR 3/2) with gleyed chromas. Generally, these soils were found to be composed of very fine sand and loamy fine sand. In some locations, the B horizon had relatively low organic matter content, but in all locations, the B horizon was wet to saturated, had massive structure, and was typically friable.

Table 1: Summary of Lowland Soil Profile Characterization

Sample Location	A Horizon Thickness	Color/texture	B Horizon Thickness	Color/texture	Comments
E1-B	0 – 38	2.5Y 6/N Black muck	38 – 42+	2.5Y 6/2 Very fine sand	Largely consisted of organic muck with increasing mineral content with depth.
E1-C	0 – 22	2.5Y 6/N and 10YR 6/1 Muck and silt loam	22 – 42+	10YR 3/3 to 7.5YR 4/6 Silt loam and fine sand	A_O horizon from 0 to 4 inches, very high (histic) horizon to 22 inches. Few faint mottles in B horizon
E1-D	0 – 15	G-2 2.5/N Organic fine sand	15 – 30+	5Y 4/2 – 3 Fine sand, very fine sand	Organic A horizon, underlain by fine and very fine sand. Few, faint mottles were present
E2-A	0 – 24	10YR 2/0 Muck and loamy fine sand	24 – 34+	10YR 3/1 Very fine sand	Very high organic material content throughout the profile. 0 – 18 inch depth is the A_O horizon, all muck, underlain by sand with very high OM content
E3-C					
E4-B	0 – 6	7.5YR 2/0 Organic/fine sand	6 – 30+	10YR 2/1 and 10YR 5/2 Loamy fine sand	
Reference Locations					
Wetland 1A (Pond)	0 – 15	2.5Y 3/0 to 2.5Y 3/2 Muck and fine sand	15 – 36+	2.5Y 3/2 Organic fine sand	No mottles. Very high organic matter content in the entire depth of the sample.
Wetland 2A (Pond)	0 – 6	10YR 2/2 to 10YR 3/2 Organic matter and fine snad	6 – 38+	10YR 5/6 Fine sand	Well-oxidized B horizon, few faint mottles in lower A and upper B horizons. Sample location above pond
Wetland 2A (pond)	0 – 12	10YR 2/2 Muck and fine sand	12 – 24+	10YR 3/2 Loamy fine sand	Organic muck underlain by well consolidated fine sand. Sample from submerged pond location.
Wetland 3A (Bog)	0 – 40	10YR 2/2 Muck and silty clay	NA		Sample collected in submerged area of bog. Organic muck was underlain by stiff silty clay (confining layer).
Wetland 3A (woodland)	0 – 16	10YR 2/1 Organic matter and loamy fine sand	16 – 30+	10YR 5/3 Very fine sand	0 to 3 inches of organic detritus on surface, A horizon is very high in organic matter/muck.
Vernal Pool 1 – Point 0	0 – 8	10YR 2/1 Loamy fine sand	8 – 30+	10YR 6/2 Fine sand	A_O horizon underlain by organic/sandy B horizon. Mottles were common.

Table 1: Summary of Lowland Soil Profile Characterization

Sample Location	A Horizon Thickness	Color/texture	B Horizon Thickness	Color/texture	Comments
Vernal Pool 1 – Point 0+50m	0 – 3	7.5YR 4/3 Fine sand	3 – 28+	7.5YR 4/4 to 7.5YR 6/3 Fine sand	Apparent buried horizon from the 20 to 23 inch depth bgs
Vernal Pool 4	0 – 8	10YR 2/1 to 10YR 2/2 Organic muck and loamy fine sand	8 – 30+	10YR 4/3 to 10YR 5/4 Fine sand and sand	0 to 3 inch depth is an O horizon. Few, very fine mottles noted.
Sedge Meadow PB SM1	0 – 14	10YR 3/1 Fine sandy muck	14 – 30+	10YR 3/2 2.5Y 5/3 Fine sand, very fine sand	Very high organic matter in the A horizon, few faint mottles in B horizon, grayish matrix
RH Fen (PB RHF1)	0 – 24	10YR 4/2 10YR 5/2 Very fine sand and sand	24 – 33+	10YR 5/8 2.5Y 3/6 Sand	Very loosely consolidated material in the A horizon, very high in OM content

Uplands

The typical upland soils in the Albany Pine Bush were found on ridge tops and sideslopes. Generally, the upland soils had well-developed A horizons and thick B horizons, all consisting of fine sand and sand. In some upland profiles, mottling was noted in the upper reaches of the B horizons indicating periodic inundation or saturation, followed by periods of good aeration. These soils are well-drained, although moderate drainage was found in lower areas close to wet conditions.

Upland soils have the following general profile characteristics:

A Horizon: The A horizon of the upland soils is typically from 0 to 7 inches (ranges from 4 to 15 inches thick) with relatively high organic matter content notable from the dark brown to black coloration (typical is 10YR 2/2 or 10YR 3/4). The A horizon, being modified by high organic matter, consists generally of very fine sand and fine sand with massive, friable structure. With higher organic matter content, the A horizon soil has a seemingly finer texture.

The B horizon was found to extend from immediately below the A horizon to depths greater than 36 inches (usual limit of sampling). In many locations, the there is a sharp, distinct boundary between the A and B horizons, represented by sharply contrasting soil matrix colors. Other locations show a less distinct boundary between horizons, but differentiation in texture and the presence of mottles was more of a discerning factor.

The B horizon of the upland soils had few hydric characteristics, generally found as faint to distinct – but few – mottles in the 4 to 10 inch depths below the ground surface (although as deep as 15 inches in one profile). The mottles were high chroma, indicating short periods of saturation/inundation, followed by largely well-aerated conditions. Occasionally, gleyed mottles were noted in the shallow B profile.

Upland soils in the expansion area included sampling points E1-E, E2-B, E2-C, E3-A, E3-B, E3-D, E3-E, E4-A, E4-C, E4-D, E6-B, E6-C, TP-8, TP-40, and DSI-3. Table 2 summarizes base information characterizing the sample locations for the upland soils, and field data sheets are provided in attachment A.

Reference soils in upland areas, including the scrub oak thicket (PBPP-SOT), pine woodland (PBPP-SOF1), and restored prairie (PBKBH1), had relatively shallow, thin A horizons, generally very dark brown (10YR 2/2 or 3/3) or very dark grayish brown (10YR 3/2) soil with fibrous organic matter with fine sand. The A horizons were well drained with massive, friable structure. The B horizons of the reference soils were found to be brown (7.5YR 5/8) to yellowish brown (10YR 4/6 or 5/6) fine sand, typically well-oxidized with occasional leach stains from organic material. No mottling was found in the reference upland soil locations. Soil structure in the B horizons as massive and friable.

Comparison between the reference upland locations and the upland soils in the expansion area show that the soils in the expansion area appear to be more mature with stronger horizon development and indications of more pronounced hydrologic interaction, evidenced by presence of mottles in the shallow B horizons.

Table 2: Summary of Upland Soil Profile Characterization

Sample Location	A Horizon Thickness	Color/texture	B Horizon Thickness	Color/texture	Comments
E1-A					
E1-E	0 – 10	10YR 2/2, fine sand	10 – 26+	10YR 6/2fine sand/very fine sand	Few, distinct mottles from 10 to 12 " depth
E2-B	0 – 9	10YR 2/1, very fine sand	9 – 36+	10YR 6/2 fine sand/ sand	No mottles
E2-C	0 – 6	10YR 3/2, loamy fine sand	6 – 36+	10YR 6/6 loamy fine sand	Common, faint mottles from 6 to 12" depth
E3-A	0 – 4	10YR 5/4,	4 – 30+	10YR 5/4 fine sand	Few, faint mottles
E3-B	0 – 15	10YR 4/3, fine sand	15 – 30+	10YR 5/4 fine sand	No mottles
E3-D	0 – 9	10YR 3/2, very fine sand	9 – 36+	10YR 5/6 to 7.5YR 3/3 fine sand	Few mottles in the lower A horizon, sand is tightly consolidated in lower depths
E3-E	0 – 4	10YR 2/2, fine sand	4 – 36+	10YR 4/3 to 7.5 YR 6/6 fine sand	No mottles
E4-A	0 – 4	7.5YR 2/0, loamy fine sand	4 – 30+	10YR 5/6 – 8 loamy fine sand	No mottles
E4-C	0 – 8	2.5Y 3/3 10YR 3/4 fine sand	8 – 24+	10YR 5/8 fine sand	Distinct, common mottles from 8 to 10 inch depth
E4-D	0 – 4	10YR 3/3 – 4 Loamy fine sand	4 – 24+	10YR 4/4 to 10YR 5/2 fine sand	Few distinct mottles
E6-B	0 – 5	10YR 2/2 fine sand	9 – 20+	10YR 3/3 to 10YR 6/8 fine sand	Few faint mottles, highly oxidized matrix in lower profile
E6-C	0 - 6	10YR 2/0 loamy fine sand	6 – 30+	10YR 4/2 fine sand	No mottles,
DSI – 3	0 – 6	10YR 2/1 fine sand	6 – 30+	2.5Y 4/2 to 2.5Y 5/2 very fine sand	Few faint mottles
TP – 40	0 – 2	2.5Y 3/2 fine sand	2 – 30+	10YR 4/6 to 10YR 5/2 fine sand/ sand	Few faint mottles within an intermixed A/B zone
TP – 8	0 – 4	10YR 3/3 fine sand	4 – 33+	10YR 4/4 fine sand	No mottles

Table 2: Summary of Upland Soil Profile Characterization

Sample Location	A Horizon Thickness	Color/texture	B Horizon Thickness	Color/texture	Comments
Reference sites					
PBPP - SOT	0 – 2	10YR 3/2 Organic/fine sand	2 – 30+	10YR 3/3 to 10YR 5/8 fine sand	Well-oxidized B horizon with no mottles
SOT – 2	0 – 3	10YR 3/4 Organic/fine sand	3 – 30+	10YR 4/6 fine sand	No mottles
PBPP SOF	0 – 1	10YR 2/2 Organic detritus	1 – 30+	10YR 5/6 fine sand	A horizon is an organic A_O horizon underlain by well-oxidized sand
PBKBH1	0 – 4	10YR 3/3 fine sand	4 – 30+	10YR 4/6 fine sand	Lower B horizon is well-oxidized fine sand and sand, no mottles

Laboratory Analytical Results

Soil samples from the A horizon, and occasionally the B horizon, were collected for laboratory analyses of the following parameters: texture (percent sand, silt, and clay), pH, percent organic matter, phosphorous, potassium, calcium, magnesium, percent organic matter, and cation exchange capacity. Table 3 provides a summary of the data, and analytical reports are provided in Attachment B.

The laboratory data shows that soil conditions across the Pine Bush varies substantially. Soil conditions range from sand to loamy texture, with an overall, average textural classification of loamy sand. Soil pH is typically in the range of 5.2 to 5.5 standard units, with an overall range from pH 3.9 to pH 7.6. The lowland, wet areas tend to have higher organic matter and lower pH than the upland sample locations, as would be expected. Concentrations of phosphorus (P) and calcium (Ca) appear to be higher than would be expected in most soils, particularly in eastern woodlands and in sandy soil, and potassium (K) concentrations were generally low. Descriptions of soil characteristics based on laboratory analysis for lowland areas and upland areas are provided below.

Lowland Areas

Based on the laboratory data, lowland areas typically have a low pH (average 5.2 standard units) and relatively high organic matter (average 15.8 percent). The low-lying, wet soils in the area east of the landfill (along transects E1 through E6) tended to have more organic matter in the upper horizons than the low-lying reference sites. The laboratory analysis does not reflect the very high organic matter content in some of the soils in these areas where distinct histosols (organic matter greater than 18 percent by weight[2]) were present, and the upper portions of the horizon were likely greater than 80 percent organic material. In contrast, soils in the reference areas tended to have substantially less organic matter content with the exception of soil/sediment collected from the floor of Wetland 3, a bog northeast of the landfill, north of the trailer park.

The P concentrations for the low-lying areas averaged 48.8 mg/kg, a value that could be considered high by most native soil standards. It is interesting to note the contrast, again, between the soils east of the landfill and those of the reference areas within the Pine Bush. In general, the P levels of soils east of the landfill tend to be lower (average of approximately 10 mg/kg), compared to the average concentration of 53 mg/kg in the reference soils. It is possible that P is bound to the organic matter complexes and/or high calcium concentrations of the soils east of the landfill. The high P concentrations in the reference areas could be related more to the mineral origin of the sandy soils.

The potassium (K), Ca, and magnesium (Mg) concentrations in soils east of the landfill are also substantially higher than soils at the reference sites. In particular, Ca appears to be extraordinarily high in these areas with concentrations ranging from 2,154 mg/kg to 6,201 mg/kg, compared to a range of 49 mg/kg to 1,574 mg/kg at the reference sites. Because the reference sites are assumed to be non-anthropogenically impacted, the increased Ca concentrations east of the landfill could be resultant from limestone applied for odor control at the landfill that drifted onto these areas. The correspondingly high Mg levels could also be attributed to this possibility if the limestone applied to the landfill is a dolomitic limestone.

Cation Exchange Capacity (CEC) in the lowland soils averages approximately 18 cmol/kg, with higher CEC values found in soils east of the landfill, generally (but not closely) corresponding with increased organic matter content. Typically, where organic matter content is low, the CEC is also low, the exception being the soil sampled from the bottom of wetland 3, with high organic matter, but low CEC.

Table 3: Summary of Laboratory Analysis of Soil Samples Collected at the Albany Pine Bush and Landfill

Sample ID	% Sand	% Silt	% Clay	Soil Texture	pH	OM %	P ppm	K ppm	Ca ppm	Mg ppm	CEC
Lowland Locations											
E1-B	82	8	10	Loamy Sand	5.1	35.7	16.0	50.0	4403.0	169.0	60.0
E1-C	75	16	9	Sandy Loam	5.1	36.2	7.0	151.0	3507.0	363.0	43.0
E1-D	41	44	15	Loam	6.3	20.1	16.0	145.0	6201.0	355.0	56.0
E3-C	79	16	5	Loamy sand	5.6	15.8	7.0	45.0	5202.0	206.0	34.0
E4-B	87	8	5	Loamy Sand	5.6	32.3	8.0	35.0	2154.0	291.0	27.0
E4-B B HORIZON	71	24	5	Sandy Loam	5.7	12.2	4.0	17.0	5041.0	185.0	30.0
PBRHF-1 @ 25M	85	8	7	Loamy Sand	5.4	3.8	193.0	35.0	87.0	18.0	1.0
PBSM1-A	81	12	7	Loamy Sand	5.5	5.0	68.0	20.0	228.0	21.0	2.0
PBVP1 40 M TH	83	12	5	Loamy Sand	4.6	8.2	32.0	52.0	755.0	51.0	5.0
VERNAL POOL A	71	24	5	Sandy Loam	5.1	6.1	29.0	43.0	646.0	5.0	5.0
VERNAL POOL B	89	4	7	Sand	5.2	1.4	67.0	28.0	169.0	23.0	1.0
WETLAND 1-A	91	2	7	Sand	7.6	2.0	38.0	17.0	1574.0	50.0	7.0
WETLAND 2 A1	91	4	5	Sand	4.1	5.2	184.0	32.0	78.0	17.0	1.0
WETLAND 2-A	73	22	5	Sandy Loam	5.0	11.4	66.0	16.0	664.0	40.0	7.0
WETLAND 3-A1	87	8	5	Loamy Sand	3.9	11.5	34.0	65.0	49.0	23.0	1.0
WETLAND3-A	75	20	5	Sandy Loam	4.0	45.8	12.0	31.0	313.0	43.0	8.0
Average	**79**	**15**	**7**	***Loamy Sand***	**5.2**	**15.8**	**48.8**	**48.9**	**1942**	**116.3**	**18.0**
	12	**11**	**3**		**0.9**	**14.1**	**58.7**	**41.1**	**2176**	**127.1**	**20.7**
Upland Locations											
DS1-3	79	16	5	Loamy Sand	5.8	4.3	8.0	30.0	1855.0	84.0	10.0
E1-A 24A	87	8	5	Loamy Sand	5.8	4.1	82.0	43.0	1014.0	66.0	6.0
E1-A 24-B					5.7	4.4	97.0	50.0	1088.0	73.0	6.0
E1-E	63	32	5	Sandy Loam	5.1	4.4	6.0	35.0	886.0	93.0	5.0
E2-A	82	8	10	Loamy sand	5.4	14.2	20.0	87.0	6067.0	343.0	42.0
E2-B	65	26	9	Sandy Loam	5.1	6.2	6.0	39.0	1363.0	88.0	8.0
E2-C	71	24	5	Sandy Loam	5.4	7.6	5.0	19.0	1918.0	161.0	11.0
E3-A	89	6	5	Sand	7.3	1.0	74.0	38.0	1212.0	29.0	5.0
E3-B	91	4	5	Sand	5.6	1.4	115.0	35.0	507.0	46.0	2.0
E3-D	71	22	7	Sandy Loam	4.7	6.6	19.0	24.0	656.0	44.0	4.0
E3-E	77	18	5	Loamy Sand	5.0	2.3	45.0	35.0	325.0	34.0	2.0
E4-A	89	6	5	Sand	4.1	8.9	81.0	21.0	367.0	35.0	3.0
E4-C	89	6	5	Sand	5.0	4.2	8.0	29.0	581.0	47.0	3.0
E4-D	77	16	7	Sandy Loam	5.3	2.5	8.0	24.0	563.0	57.0	3.0
E6-B	89	6	5	Sand	4.6	3.3	148.0	24.0	392.0	28.0	2.0
E6-C	73	20	7	Sandy Loam	5.3	7.3	8.0	24.0	2091.0	99.0	13.0
LAND FILL CAP	91	4	5	Sand	6.0	1.6	78.0	58.0	615.0	70.0	3.0
LFTP-1	91	4	5	Sand	6.6	3.0	54.0	75.0	1043.0	66.0	6.0
LFW2 #2	79	16	5	Loamy Sand	6.9	2.0	30.0	86.0	2370.0	107.0	12.0
PBKBH1 50 M	91	4	5	Sand	4.6	3.9	177.0	29.0	176.0	15.0	1.0
PBPPSOT-1	69	26	5	Sandy Loam	4.7	2.2	11.0	23.0	109.0	16.0	1.0
PBPPSOT-2	91	2	7	Sand	5.7	3.5	157.0	22.0	1141.0	61.0	6.0
PPSOF-1 @ OM	69	26	5	Sandy Loam	5.1	1.2	134.0	24.0	21.0	7.0	
RANDOM #1	91	4	5	Sand	5.5	1.9	55.0	45.0	371.0	38.0	2.0
TP-2 @ 40 M	89	4	7	Sand	6.8	0.7	52.0	21.0	418.0	21.0	2.0
TP-8	93	2	5	Sand	7.1	0.9	43.0	53.0	1244.0	48.0	5.0
Average	**82**	**12**	**6**	***Loamy Sand***	**5.5**	**4.0**	**58.5**	**38.2**	**1092**	**68.3**	**6.5**
standard dev.	**10**	**9**	**1**		**0.8**	**3.0**	**52.5**	**19.6**	**1194**	**65.7**	**8.1**

Highlighted values are greater than 1x the standard deviation above or below the mean value

Upland Areas

Soil investigated in the upland areas tend to have relatively consistent characteristics regarding texture, organic matter content, pH, and nutrient concentrations. Analyzed values for pH, organic matter content, P, K, Ca, Mg, and CEC were typically within one standard deviation of the mean values for most of the soil locations, however, it needs to be recognized that high variability establishes correspondingly high standard deviations, and soil constituent levels such as P, Ca, and Mg varied substantially. Unlike the lowland soils that demonstrated variability related to location, the upland soils do not demonstrate similar spatial distribution.

In general, the upland soil characteristics demonstrate moderate acidity, with pH typically between 4.7 and 6.0, with some areas of stronger acidity as low as pH 4.1, or more neutral (five locations between pH 6.0 and 7.3). Organic matter content, typically highest in the A horizon, was generally found to be between 3.0 and 4.5 percent, with some locations with notably higher or lower organic matter concentrations. P concentrations were higher than what is normally expected in native soils (usually average concentrations between 10 to 25 mg/kg P would be a normal range), with concentrations generally between 20 to 80 mg/kg (the middle third of the concentration range). Nearly one-third of the samples did have concentrations below 15 mg/kg, and one-quarter of the samples with more than 80 mg/kg P. In contrast to P concentratins, K concentrations were lower than what would typically be expected in native soils (usually between 150 to 300 mg/kg).

Similar to the lowland soil locations, the high concentrations and variability of Ca in the upland soil is cause for speculation. The highest concentrations of Ca in the upland soils appear to be most closely associated with locations east and near the landfill itself. These concentrations are not as high as found in lowland soils, with the exception of sample location E2-A, located adjacent to the access road less than 150 yards from the landfill itself.

The CEC levels of the upland soils are appropriate for sandy soils with low organic matter. In the few samples with elevated organic matter concentrations, CEC also is shown to be higher.

[need to discuss N content – a different analytical sheet]

Summary

Soil characterization of the Albany Pine Bush and Landfill Expansion area revealed relatively consistent physical attributes of the soils in this area, and strong variability in the chemical (acidity and nutrients) constituents. The soils are typically fine sand and loamy fine sand, very deep, excessively drained, and moderately acid. Upland soils have generally lower organic matter content, but often more developed horizons, showing some hydrologic flux resulting in active reduction/oxidation of the soil. The lowland soils, while sandy and capable of high amounts of water transmissivity, generally intersect the water table, and in some cases have demonstrated water retention that results in high buildup of organic material, develops gleyed conditions, and serves to collect and build organic and mineral content from runoff from higher ground.

Reference soils in the Albany Pine Bush appear to be substantially less developed than soils east and north of the landfill, suggesting that it is possible that hydrologic and possible minor anthropogenic impacts are more direct on the east side of the landfill, a result of the more severe drainages in this area, and from landfill operation and nearby human activities. Whatever the causes, more distinct development of horizons, increased organic matter content, and in some locations higher mineral content (both in silt and clay colloids, and in mineral content) was found to occur in the lower drainages occurring east and north of the landfill.

Attachment B
Supplemental Information

This community is adapted to and maintained by periodic fires; frequency of fires ranges from 6 to 15 years.
Rank: G2 S1 Cryan, J. and Olsvig, L.

From Chapter 15, Vegetational Gradients of the Pine Plains and Barrens of Long Island, NY, Olsvig, Cryan and Whittaker, 1979:

Average Canopy and Soil Characteristics for the Long Island Communities

	Oak-pine	Barrens
No. of stands sampled	4	6
Tot canopy		
Basal area (m^2/ha)	9.88	8.90
Pine basal area	4.56	6.54
Percent pine (%)	46	73
Pine height (n)	13.9	12.7
Soil texture of the B Horizon		
Coarse sand (%)	40.4	38.8
Medium sand (%)	31.2	31.6
Fine sand (%)	9.2	11.8
Silt and clay (%)	18.8	17.6
Soil profile depth (cm)		
O horizon	5.25	4.17
A horizon	7.50	5.83
B horizon	37.6	43.33
Litter biomass (g dry wt/900 cm^3)	852.5	—
Soil nutrients (ppm in the O horizon)		
Phosphorous	207.5	70.0
Potassium	757.5	138.3
Calcium	1850.0	1191.5
Magnesium	525.0	323.0
Percent Organic matter (O horizon)	40.0	37.7

If we are to restore accurate Pine Bush communities atop the landfill, we need to evaluate not only types of soil, but how deep and how to shape and grade the soil. Then we need to decide on a methodology to vegetation the land, whether by seed, plant units or a combination of both. Since we are jump starting the successional process, likely will propose early seral stages. All propagules will be collected locally with a program of partnership with the Albany Pine Bush Commission. We will develop a planting strategy that meets with the Commission Management Plan.

ALBANY BUSH LANDFILL

Hydrologic & Water Quality Monitoring Schedule – April 17, 2007

Monitoring Plan:

The monitoring will include the 32 shallow 2-inch diameter piezometers (60-inch or longer as required) in the areas shown on the aerial photo monitoring plans. These include transect locations, wetland areas, fen, and vernal pond. Ten staff gages will be installed at the locations shown on the aerial photo. The piezometers and staff gages will be monitored once each month to provide data on the shallow groundwater and surface water elevation at the site. The datasondes can fit into the 2-inch diameter piezometers. In addition the datasonde will be used to measure water quality in the piezometer lowest in elevation or closest to the stream. If time permits water quality analysis from all piezometers is desirable.

The surface water will be monitored for flow volume using Telog recorders at two culvert locations on the stream adjacent to the landfill (shown on the aerial photo). One location is culvert 1 under Rapp Road and the other is culvert 3 behind the trailer court. Each telog unit should be placed about 20' upstream from the culvert entrance. The telog units continuously record water elevation at the culverts and using the surveyed culvert data the discharge volume versus time can be estimated. The Telog data will be downloaded monthly when the piezometers and staff gages are recorded.

Water quality will be measured at three stream locations using datasondes which record water temperature, dissolved oxygen, conductivity, pH, ORP (oxidation reduction potential), and chloride concentrations. At culvert 1 a datasonde will be deployed continuously to monitor water quality. The unit should be placed around 20' upstream from the culvert adjacent to the telog unit. The other datasonde will be used to measure water quality at culverts 3 and 8 on a revolving basis. This unit will be used to analyze the piezometer samples in between moves during the middle of the month. These units will be deployed for the time periods shown on the attached bar graph. The datasonde data will be downloaded monthly when the piezometers and staff gages are recorded.

The monitoring plan outlined above will provide both water quality and water discharge volume information from the site. The culvert surveys and discharge information will be used to develop a hydrologic model for the current conditions and the proposed restoration plan. The water quality information will be used to project improvements in water quality that may occur after restoration.

Location	Deployed Monitoring Equipment	1-Apr	Apr 15 to Apr 20	1-May	May 15 to May 20	1-Jun	Jun 15 to Jun 20	1-Jul	Jul 15 to Jul 20	1-Aug	Aug 15 to Aug 20	1-Sep	Sep 15 to Sep 20	1-Oct	Oct 15 to Oct 20	1-Nov	Nov 15 to Nov 20
Culvert 1 (under Rapp Rd)	Datasonde (Approx 20' upstr)																
	Telog (Approx 20' upstr)																
Culvert 3 (behind trailer crt)	Datasonde (Approx 20' upstr)																
	Telog (Approx 20' upstr)																
Culvert 8 (under Rapp Rd)	Datasonde (Approx 20' upstr)																
Piezometers	Datasonde used to take analysis from all piezometers with water																

#06-0590 Albany Bush Landfill - Hydrologic Monitoring Equipment Requirements

As 0f 11/13/2006 **Reference to Monitoring Plan Drawing - mon101106.dwg**

Equipment	Deployment Location	Description	# of units	Location on Drawing
Telog with Casing and datalogger				
Telog	Culvert 1	5 psi -Telog/casing/datalogger	1	yes
	Culvert 4		1	yes
		Total units =	2	

Datasonde Water Quality Monitor (WQM) and datalogger				
WQ Monitoring	Culvert 1	Hydrolab Minisonde MS5 units and Recon logger		yes
	Culvert 4	deployed for extended periods at culverts		yes
	Culvert 8	purchase two MS5 units w/logger	2	yes
	piezometers	water quality analyzed using hydrolab		
		Total units =	2	

Staff Gages				
Staff Gage	Culvert 1	Elevations marked (0-3.33')	1	yes
	Culvert 4	use metal fence or treated 2x4 post to hold gage	1	yes
	Culvert 8	0' at the ground (bottom) level	1	yes
	Wetland Pond		1	yes
	Wetland 2 - Buttonbush		1	yes
	Vernal Pond (VP)		2	yes
	Wetland 2 - Bog		1	yes
	Fen		1	yes
	Sedge Meadow		1	yes
		Total units =	10	
			20	

60-inch Piezometers				
Piezometer	Transect E1	60-inch piezometer	5	yes
	Transect E2		3	yes
	Transect E5		4	yes
	Transect E4		4	yes
	Transect TP2		2	yes
	Transect DS1		2	yes
	Transect WL2 buttonbush		3	yes
	Transect VP		3	yes
	Transect WL 2 Bog		3	yes
	Transect SM		3	
		Total units =	32	

For Calibration
The culverts will require survey elevations at inlet and outlet, length of pipe, and entrance/outlet type.
GPS location on all monitoring locations.
Survey Elevations will be required for the staff gages.
Survey Elevations will be required for the piezometers.

Albany Bush Landfill – culverts (092606 site visit)

Culvert 1

2- 15" CMP pipes under Rapp Road

Culvert 2

24" CMP with bottom 8' sediment covered

Culvert 3

24" CMP

Culvert 4

18" CMP

Culvert 5

24" CMP

Culvert 6

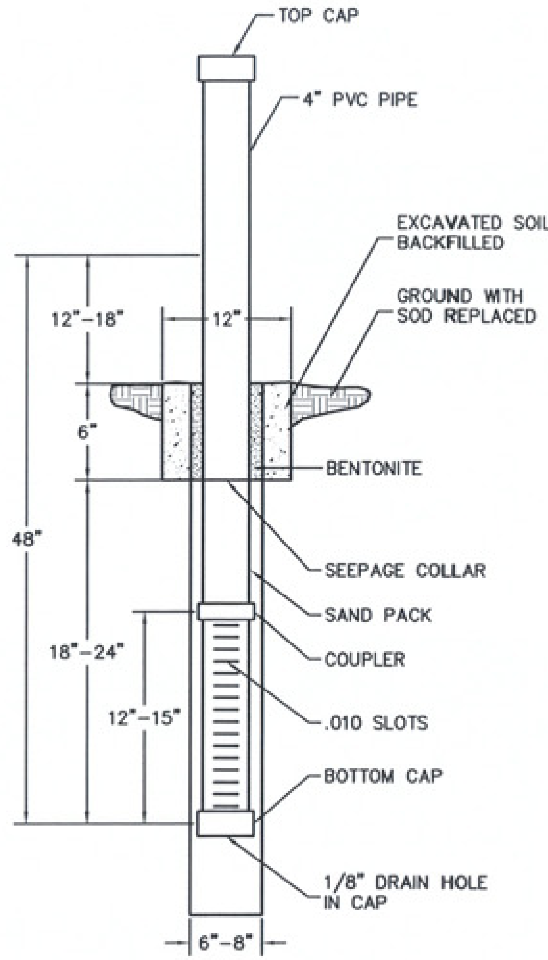
No picture or data

Culvert 7

10x16 rectangular riser (10" above outlet top) discharging through 12" plastic corrugated pipe

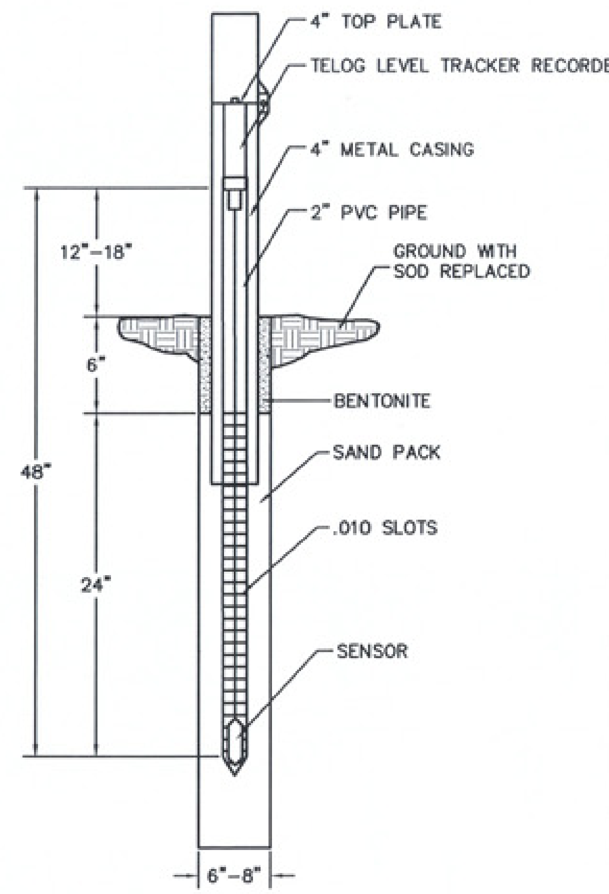
Culvert 8

Stream crossing under Rapp Road. No picture or data.



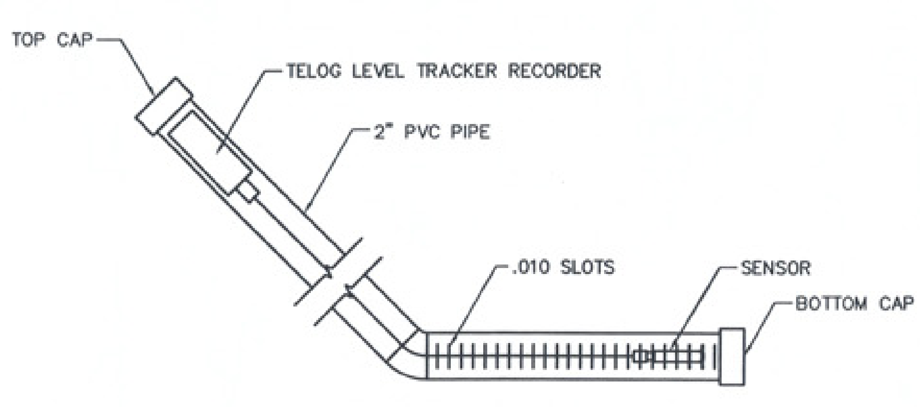
PIEZOMETER DETAIL

NOT TO SCALE



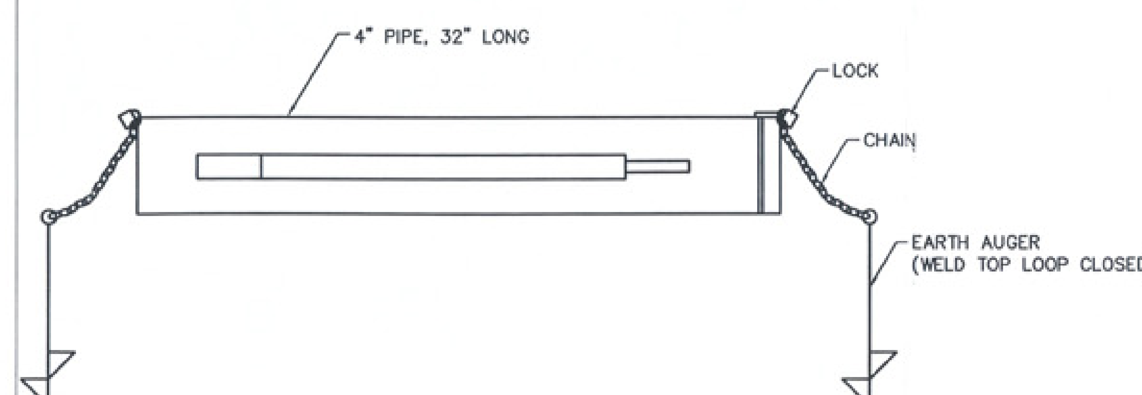
PIEZOMETER WITH TELOG DETAIL

NOT TO SCALE



TELOG HORIZONTAL DEPLOYMENT DETAIL

NOT TO SCALE



HYDROLAB DEPLOYMENT DETAIL

NOT TO SCALE

Revisions:

No.	By	Date	Description
1			
2			
3			
4			
5			
6			
7			
8			
9			

Standard Details

Drawn By: t.e.g. AES Project No.: 06-0590
Checked: File Name: tran100906.dwg
Approved: Date: 10-09-2006

Albany Pine Bush Landfill
Albany, New York
Clough Harbour & Associates, LLP
III Winners Circle, P.O. Box 5269
Albany, New York 12205-0269

Sheet Number
1 of 1

Revisions:

No.	By	Date	Description
1			
2			
3			
4			
5			
6			
7			
8			
9			

Monitoring Plan

Drawn By: t.e.g.
Checked:
Approved:
AES Project No.: 06-0590
File Name: tran100906.dwg
Date: 10-09-2006

Albany Pine Bush Landfill

Albany, New York

Clough Harbour & Associates, LLP
III Winners Circle, P.O. Box 5269
Albany, New York 12205-0269

Sheet Number
1 of 1

Legend

Transect Location

Staff Gauge Location

Piezometer Location

0 300' 600' 1200'

SCALE: 1"= 600'

NORTH

Revisions:

No.	By	Date	Description
1			
2			
3			
4			
5			
6			
7			
8			
9			

Monitoring Plan-West

Drawn By: t.e.g.
Checked:
Approved:

AES Project No.: 06-0590
File Name: tran100906.dwg
Date: 10-09-2006

Albany Pine Bush Landfill

Albany, New York

Clough Harbour & Associates, LLP
III Winners Circle, P.O. Box 5269
Albany, New York 12205-0269

Applied Ecological Services, Inc.

Sheet Number
1 of 1

Groundwater Monitoring Data 2007

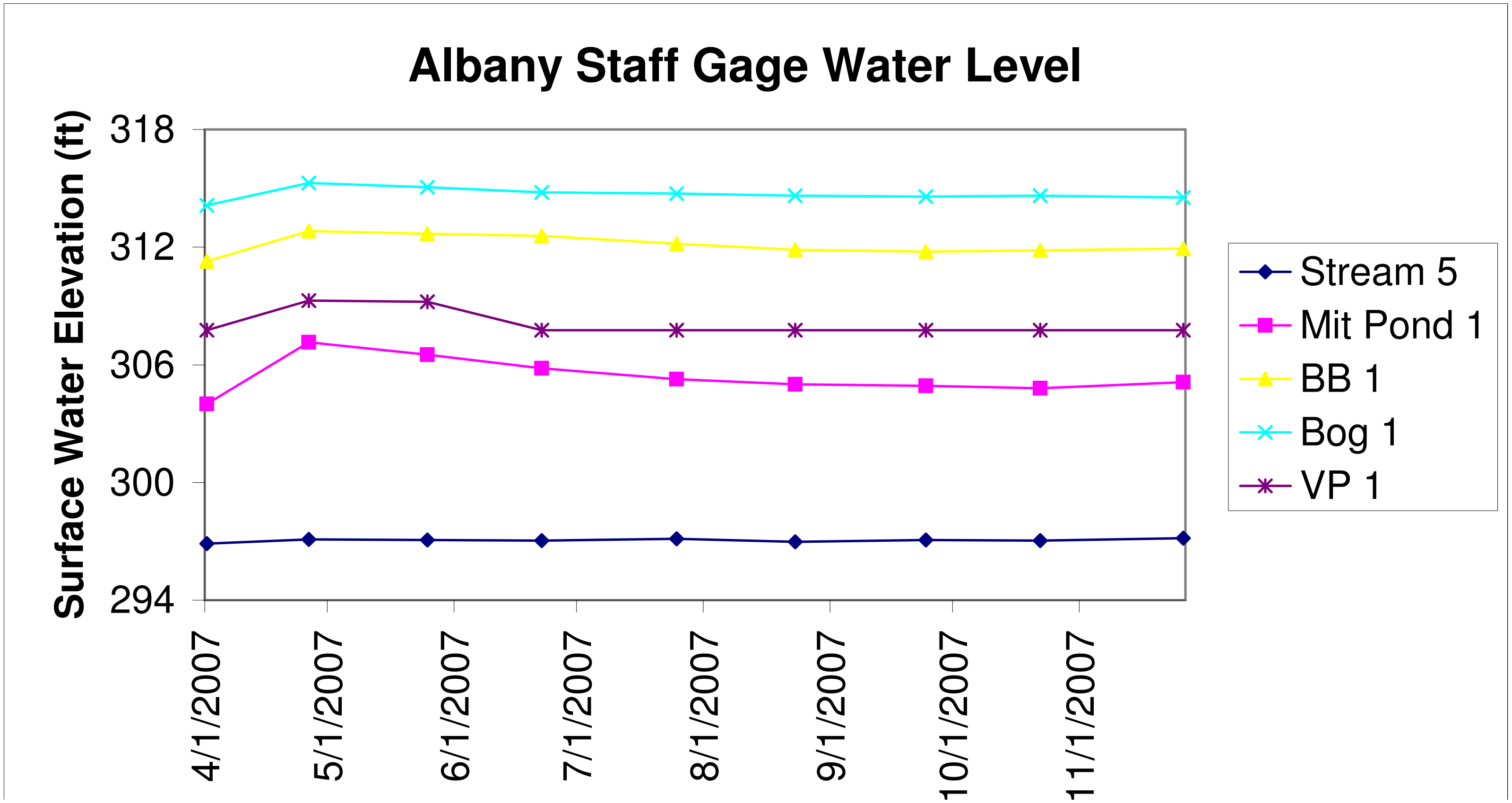
Date	Well #	Top of Monitoring Well to Groundwater (feet)	Top of Monitoring Well to Surface (feet)	Surface to Groundwater (feet)	Approx. Existing Elevation (ft)	Approx. GW Elevation (ft)
5/25/2007	Well 1	2.3	2	0.3	327	326.7
	Well 2	2.4	1.9	0.5	322	321.5
6/22/2007	Well 1	2.45	2	0.45	327	326.55
	Well 2	2.55	1.9	0.65	322	321.35
7/24/2007	Well 1	2.45	2	0.45	327	326.55
	Well 2	2.7	2	0.7	322	321.3
8/23/2007	Well 1	3.25	2.05	1.2	327	325.8
	Well 2	3.6	1.8	1.8	322	320.2
9/21/2007	Well 1	3.5	2	1.5	327	325.5
	Well 2	3.5	1.8	1.7	322	320.3
10/25/2007	Well 1	3.25	2.05	1.2	327	325.8
	Well 2	3.2	1.85	1.35	322	320.65
11/27/2007	Well 1	2.5	2	0.5	327	326.5
	Well 2	2.9	1.8	1.1	322	320.9

Surface Water Data 2007

Date	Gage #	Depth of Water
4/26/2007	SM 1	1.08
5/25/2007	SM 1	1.06
6/22/2007	SM 1	1.02
7/25/2007	SM 1	0.8
8/23/2007	SM 1	0.58
9/21/2007	SM 1	0.5
10/25/2007	SM 1	0.5
11/27/2007	SM 1	0.8

Surface Water Data 2007 (Data available as of 3/6/08)										
	Staff Gage Number									
	Stream 1	**Stream 2**	**Stream 3**	**Stream 4**	**Stream 5**	**Mit Pond 1**	**BB 1**	**Bog 1**	**VP 1**	**SM-1**
Elevation of Gage at Zero (feet)					296.88	304.01	311.28	314.13	307.76	
Date	**Surface Water Level in Feet**									
4/26/2007					297.10	307.15	312.82	315.27	309.28	
5/25/2007					297.06	306.51	312.68	315.05	309.22	
6/22/2007					297.03	305.83	312.58	314.79	307.76	
7/25/2007					297.13	305.27	312.18	314.73	307.76	
8/23/2007					296.98	305.01	311.86	314.63	307.76	
9/24/2007					297.06	304.93	311.78	314.58	307.76	
10/22/2007					297.04	304.81	311.83	314.63	307.76	
11/26/2007					297.16	305.11	311.93	314.53	307.76	

Date	Stream 5	Mit Pond 1	BB 1	Bog 1	VP 1	
4/1/2007	296.88	304.01	311.28	314.13	307.76	dry elev
4/26/2007	297.10	307.15	312.82	315.27	309.28	
5/25/2007	297.06	306.51	312.68	315.05	309.22	
6/22/2007	297.03	305.83	312.58	314.79	307.76	
7/25/2007	297.13	305.27	312.18	314.73	307.76	
8/23/2007	296.98	305.01	311.86	314.63	307.76	
9/24/2007	297.06	304.93	311.78	314.58	307.76	
10/22/2007	297.04	304.81	311.83	314.63	307.76	
11/26/2007	297.16	305.11	311.93	314.53	307.76	



Surface Water Data 2007

Date	Gage #	Depth of Water (feet)	Elevation of Gage at Zero	Water Elevation (feet)	CHA X-Coordinate	CHA Y-Coordinate
4/26/2007	Stream 1	0.66				
	Stream 2	0.56				
	Stream 3	0.42				
	Stream 4	0.3				
	Stream 5	0.22	296.88	297.10	8162.6	10379.55
	Mit Pond 1	3.14	304.01	307.15	8361.29	9373.77
	BB 1	1.54	311.28	312.82	7903.78	9512.17
	Bog 1	1.14	314.13	315.27	7342.59	9170.18
	VP 1	1.52	307.76	309.28	7129.1	9932.8
5/25/2007	Stream 1	0.66				
	Stream 2	0.64				
	Stream 3	0.44				
	Stream 4	0.26				
	Stream 5	0.18	296.88	297.06	8162.6	10379.55
	Mit Pond 1	2.5	304.01	306.51	8361.29	9373.77
	BB 1	1.4	311.28	312.68	7903.78	9512.17
	Bog 1	0.92	314.13	315.05	7342.59	9170.18
	VP 1	1.46	307.76	309.22	7129.1	9932.8
6/22/2007	Stream 1	0.55				
	Stream 2	0.45				
	Stream 3	0.6				
	Stream 4	0.16				
	Stream 5	0.15	296.88	297.03	8162.6	10379.55
	Mit Pond 1	1.82	304.01	305.83	8361.29	9373.77
	BB 1	1.3	311.28	312.58	7903.78	9512.17
	Bog 1	0.66	314.13	314.79	7342.59	9170.18
	VP 1	Dry	307.76	307.76	7129.1	9932.8
7/25/2007	Stream 1	0.6				
	Stream 2	1.15				

	Stream 3	1				
	Stream 4	n/a				
	Stream 5	0.25	296.88	297.13	8162.6	10379.55
	Mit Pond 1	1.26	304.01	305.27	8361.29	9373.77
	BB 1	0.9	311.28	312.18	7903.78	9512.17
	Bog 1	0.6	314.13	314.73	7342.59	9170.18
	VP 1	Dry	307.76	307.76	7129.1	9932.8
8/23/2007	Stream 1	0.22				
	Stream 2	0.96				
	Stream 3	0.15				
	Stream 4	0.1				
	Stream 5	0.1	296.88	296.98	8162.6	10379.55
	Mit Pond 1	1	304.01	305.01	8361.29	9373.77
	BB 1	0.58	311.28	311.86	7903.78	9512.17
	Bog 1	0.5	314.13	314.63	7342.59	9170.18
	VP 1	Dry	307.76	307.76	7129.1	9932.8
9/24/2007	Stream 1	0.52				
	Stream 2	1.8				
	Stream 3	1.2				
	Stream 4	0.16				
	Stream 5	0.18	296.88	297.06	8162.6	10379.55
	Mit Pond 1	0.92	304.01	304.93	8361.29	9373.77
	BB 1	0.5	311.28	311.78	7903.78	9512.17
	Bog 1	0.45	314.13	314.58	7342.59	9170.18
	VP 1	Dry	307.76	307.76	7129.1	9932.8
10/22/2007	Stream 1	0.5				
	Stream 2	1.2				
	Stream 3	0.8				
	Stream 4	0.15				
	Stream 5	0.16	296.88	297.04	8162.6	10379.55
	Mit Pond 1	0.8	304.01	304.81	8361.29	9373.77
	BB 1	0.55	311.28	311.83	7903.78	9512.17
	Bog 1	0.5	314.13	314.63	7342.59	9170.18
	VP 1	Dry	307.76	307.76	7129.1	9932.8
11/26/2007	Stream 1	0.55				

	Stream 2	0.28				
	Stream 3	0.9				
	Stream 4	0.25				
	Stream 5	0.28	296.88	297.16	8162.6	10379.55
	Mit Pond 1	1.1	304.01	305.11	8361.29	9373.77
	BB 1	0.65	311.28	311.93	7903.78	9512.17
	Bog 1	0.4	314.13	314.53	7342.59	9170.18
	VP 1	Dry	307.76	307.76	7129.1	9932.8

Piezometer Groundwater Monitoring Data 2007 (data available as of 3/6/08)

	Piezometer Number																							
	E-1-1	**E-1-2**	**E-1-3**	**E-1-4**	**E-1-5**	**E-2-1**	**E-2-2**	**E-2-3**	**E-5-1**	**E-5-2**	**E-5-3**	**E-4-1**	**E-4-2**	**E-4-3**	**E-4-4**	**TP-1-1**	**TP-1-2**	**DS-1-1**	**DS-1-2**	**BB-1**	**Bog-1**	**VP-1**	**VP-2**	**VP-3**
Ground Surface Elev (feet)	302.69	288.72	288.43	288.13	288.55	289.66	289.46	289.17	292.56	293.13	293.81	292.94	292.8	292.43	293.67	302.78	304.99	303.85	303.62	312.38	313.86	308.65	309.15	309.4
Date	**Piezometer Water Level in Feet**																							
4/26/2007	297.54	287.92	286.43	286.93	287.05	288.06	288.46	288.67	292.06	291.88	291.51	292.09	292.25	292.33	293.47	297.48	299.74	300.05	300.87	312.53	N/A	308.80	308.90	309.55
5/25/2007	297.59	287.57	286.23	286.28	286.00	287.76	287.56	287.57	291.26	290.88	290.51	291.14	291.40	291.58	292.72	297.53	299.74	299.65	300.52	311.88	314.76	308.35	308.70	308.60
6/21/2007	297.59	287.42	286.18	286.08	285.60	287.61	287.26	287.02	290.46	289.98	289.56	290.24	290.40	290.68	292.02	297.48	299.64	299.35	300.02	310.98	314.21	306.45	306.70	307.10
7/24/2007	300.39	287.42	286.13	286.73	285.80	287.66	287.46	287.27	291.01	290.68	290.26	290.94	291.10	291.23	292.32	297.48	299.69	299.45	298.42	310.88	313.71	305.90	306.00	306.85
8/21/2007	297.59	287.02	285.73	285.43	284.50	287.31	286.41	285.92	289.81	289.33	288.91	289.59	289.80	289.98	291.42	297.53	299.69	299.05	299.62	308.48	311.86	304.50	304.60	304.70
9/24/2007	297.59	287.02	285.73	285.48	284.80	287.31	286.56	286.22	289.96	289.58	289.11	289.79	290.00	290.28	291.52	297.53	299.74	299.35	299.72	308.08	311.36	304.70	304.50	304.70
10/22/2007	297.79	287.27	286.03	285.98	285.00	287.56	287.16	286.47	290.56	290.18	289.76	290.39	290.55	290.73	291.52	297.48	299.74	299.30	299.87	308.03	309.96	304.90	304.75	304.80
11/26/2007	297.09	287.42	286.13	286.38	286.00	287.66	286.76	287.47	291.21	290.58	290.11	290.74	291.40	291.48	292.62	297.68	299.79	299.10	299.72	308.28	312.86	307.20	307.10	308.90

APPLIED ECOLOGICAL SERVICES, INC.

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SPECIALISTS IN ENVIRONMENTAL MANAGEMENT AND RESEARCH

MEMO

TO: Steve Apfelbaum

FROM: Brad Herrick & John Larson

DATE: December 21, 2006

RE: Albany Landfill Vegetation Data Summary (AES# 06-0590)

Expansion Area Uplands (data sheet 1)
The understory of uplands are characterized by the native perennial *Eupatorium rugosum*, the aggressive non-native *Alliaria petiolata*, and the non-natives *Poa pratensis* and *Celastrus orbiculatus* with a combined 45% of the relative cover. *Prunus serotina* and *Rubus allegeniensis* dominated the shrub layer and *Prunus serotina*, *Quercus rubra*, and *Robinia pseudoacacia* were the most common tree species encountered. The total canopy intercept of 152% in the upland areas, indicates a dense canopy coverage with a shade suppressed ground story component. *Quercus rubra* is the dominant intercept species followed by *Acer rubrum* and *Prunus serotina*. Few trees have a DBH of greater than 12 inches indicative of a young woods.

Expansion Area Wetlands (data sheet 2)
Pilea pumila, *Phragmites australis*, *Osmunda cinnamomea*, and *Impatiens capensis* constitute almost 50% of the relative cover of the herbaceous vegetation in the wetland areas sampled. *Fraxinus pennsylvanica*, *Prunus serotina*, and the non-native *Berberis thunbergii* are dominant species in the shrub layer with *Acer rubrum* being the most common tree species. Similarly to the upland areas the wetlands display a close canopy system with a total intercept of 156%, with *Acer rubrum* constituting 40% of the relative percent intercept. *Prunus serotina* and *Vitis riparia* represent the second and third dominants in the canopy, respectively. Most trees are less than 12 inches DBH, with a few individuals of red maple, cottonwood and white pine achieving 20 inches DBH or greater. The red maple hardwood swamp community can be considered as a young woods.

Disturbed Areas & Trailer Park (data sheet 3)
The non-native species *Poa pratensis* and *Poa compressa* account for over 40% of the relative cover in the herbaceous layer, while *Celastrus orbiculatus*, *Vitis riparia*, and *Solidago canadensis* made up the next 20%. *Celastrus orbiculatus*, *Rubus strigosus* and to a lesser extent *Vitis riparia* are dominants in the shrub layer. Only four trees were observed within the sampling area, all being *Quercus coccinea*. These areas have an open canopy with only 43% total intercept and are comprised of *Acer rubrum* and the shrub/vine species *Vitis riparia* and *Rubus idaeus strigosus*.

Landfill Restoration and Weeds Transects (data sheet 4)
Panicum virgatum and *Poa pratensis* constitute 63% and 10% relative cover respectively in the prairie restoration plots on the landfill cap. *Poa pratensis*, *Festuca elatior*, and *Coronilla varia* equally account for over 85% combined relative cover in the landfill weed transects. No shrubs or trees were observed in these sampling areas.

Karner Blue Butterfly Prairie Habitat (data sheet 5)
The herbaceous plant community sampled in the Pine Bush prairie is dominated by *Andropogon scoparius* with over 53% relative cover. *Rubus flagellaris* and *Polygonum lapathifolium* account for an additional 28% relative cover. Few shrubs species and only a few individual trees were observed. *Prunus serotina* and *Quercus prinoides* were the most common shrub species. As would be expected, the prairie had a low canopy intercept (21%) with the dominant being *Prunus serotina*.

Lupines were only occasionally observed as most had died back and were dormant at the time of sampling and thus under represented in the data.

Pine Bush Scrub Oak Forest (data sheet 6)
Vaccinium pallidum, *Rubus* sp., *Quercus bicolor*, and *Pteridium aquilinum latiusculum* account for over 87% relative cover of the understory vegetation. The shrub community is comprised almost entirely of *Quercus illicifolia.* Although, only a few small individuals (<10 inch DBH) of *Pinus rigida* were observed along the transect, it is the dominant canopy species in a closed canopy forest (163% total absolute intercept). *Quercus illicifolia* is the second most dominant species, entirely in the shrub layer.

Pine Bush Scrub Oak Thicket (PBSOT 1&2) (data sheet 7)
The herbaceous layer in the scrub oak thicket that has been brushed and burned (PBSOT 1&2) is relatively evenly dominated by Carex sp., *Andropogon scoparius*, *Pteridium aquilinum latiusculum*, *Quercus prinoides*, and *Quercus illicifolia* with a combined relative cover of 77%. *Quercus illicifolia* and *Populus tremuloides* are dominants in the shrub layer. These two species along with Pinus rigida comprise the highest relative canopy intercepts. However overall, this community has a low total canopy intercept (29%) indicative of an open to semi-open system.

Pine Bush Scrub Oak Thicket (not burned or brushed) (data sheet 8)
The unburned and unbrushed oak thicket community is dominated by, *Quercus prinoides*, *Carex pensylvanica*, and *Quercus ilicifolia* (77% relative cover) in the herbaceous layer and *Quercus ilicifolia* and *Quercus prinoides* in the shrub layer. Although only a handful of trees were observed, the shrub layer primarily of *Quercus ilicifolia*, *Quercus prinoides*, and *Quercus rubra* contributed the most to an overall very dense canopy cover (total intercept 163%), indicative of a closed/shady system.

Pine Bush Sedge Meadow (data sheet 9)
Carex stricta and *Rubus hispidus* account for over 56% of the herbaceous species relative cover in the sedge meadow. *Spiraea alba* is the dominant shrub species observed. The sedge meadow has a very low absolute canopy intercept (11%) and is comprised mostly of *Spiraea alba* in the interior and *Quercus prinoides.* towards the periphery.

Pine Bush Hanging Fen (data sheet 10)
Five species, *Carex pellita*, *Andropogon scoparius*, *Carex stricta*, *Rubus allegeniensis*, and *Osmunda regalis spectabilis* account for almost 60% of the relative cover in the hanging fen herbaceous community. *Spiraea alba* and *Rubus idaeus strigosus* are dominant in the shrub layer. These species also have the highest percent intercept although overall the canopy intercept was very low (18%).

Vernal Pool 1 (data sheet 11)
Aralia sp., *Rubus* sp., *Vaccinium corymbosum*, and *Quercus prinoides*, account for almost 75% of the relative cover in the herbaceous layer. *Vaccinium corymbosum* is also dominant in the shrub layer and *Acer rubrum* is the dominant tree species. Vernal Pool 1 has a closed canopy (137% absolute intercept) that is dominated by *Acer rubrum* and *Betula populiflolia.*

Vernal Pool Red Maple Swamp (data sheet 12)
Rubus sp. and *Osmunda regalis spectabilis* account for almost 50% of the herbaceous relative cover. While the shrub layer is minimal, there is a dense canopy (105% absolute intercept) dominated by *Vaccinium corymbosum*, *Acer rubrum*, and *Populus deltoides.*

Wetland (Pond) (data sheet 13)
With 30% relative cover, Osmunda claytoniana is the dominant herbaceous species present. Other important species include, *Vaccinium corymbosum* (10%), Daucus carota (7%) and Carex stricta (7%). *Alnus rugosa* is most common in the shrub layer, however the wetland is relatively void of shrubs. In addition, the canopy is relatively open (58% absolute intercept) with *Acer rubrum* and *Populus deltoides* the most common. Open water comprises over 60% of the transect.

Wetland (Button Bush Swamp) (data sheet 14)
The herbaceous relative cover in this wetland is dominated by *Lemna minor* (42%), *Lycopus americanus* (21%), and *Carex stricta* (17%). *Cephalanthus occidentalis* overwhelmingly dominates the shrub layer with almost the entire total intercept of 129%) comprised of *Cephalanthus occidentalis.*

Wetland (Bog) (data sheet 15)
Dominant herbaceous species in the bog include Sphagnum moss (51%), *Dulichium arundinaceum* (19%), and Carex stricta (19%). *Vaccinium corymbosum* is the only species in the shrub layer. The total canopy intercept (83%) is dominated by trees of *Acer rubrum* and *Betula populifolia.*

Seed Bank Data
Sixteen known species and 60 unknowns (repotted and being grown to an identifiable age) were identified from 41 seed bank samples. As of 12/5/06, 1,075 seedlings were collected. The seed bank samples are being cold-stratified over winter and the greenhouse germination will continue in March.

Expansion Upland Summary   Sheet 1

HERBACEOUS SPECIES*	AF	RF	AC	RC	IV
Eupatorium rugosum	14	6.25	220.00	14.36	20.61
Alliaria petiolata	21	9.38	173.00	11.29	20.67
Poa pratensis	3	1.34	142.00	9.27	10.61
Celastrus orbiculatus	12	5.36	132.00	8.62	13.97
Osmunda cinnamomea	3	1.34	90.00	5.87	7.21
Fraxinus americana	9	4.02	79.00	5.16	9.17
Osmunda claytoniana	3	5.36	53.00	3.46	4.80
Prunus serotina	12	2.68	48.00	3.13	8.49
Athyrium filix-femina	6	0.45	38.00	2.48	5.16
Aster lateriflorus	1	2.27	30.00	1.96	2.40

*top ten species

Canopy Intercept**

Location & Species	Total Absolute % Intercept	Relative % Intercept	Absolute % Intercept
Expansion Area (E) Upland	152		
Quercus rubra		17	38
Acer rubrum		16	37
Prunus serotina		14	32

**top three species

Stem Density				Size Classes (DBH)									
Species	**<2in**	**2-4in**	**4-6in**	**6-8in**	**8-10in**	**10-12in**	**12-14in**	**14-16in**	**16-18in**	**18-20in**	**20in+**	**Total**	**Stems/ha**
Acer rubrum	7(3)	1(1)	2		1	1						12(4)	250(92)
Carpinus caroliniana		1	5									6	79
Celastrus orbiculatus	4											4	105
Cornus racemosa	7											7	184
Corylus americana	3											3	79
Crataegus sp.	3											3	79
Dead unknown	(2)	(1)	(2)									(5)	(92)
Fraxinus americana	5											5	132
Fraxinus pennsylvanica	1(4)	1	1									3(4)	52(105)
Hamamelis virginiana	32	1										33	855
Ilex verticillata	3(1)											3(1)	79(26)
Lindernia benzoin	6											6	158
Lonicera tatarica	4											4	105
Parthenocissus quinquefolia	5	6										11	211
Pinus rigida					1			1				2	26
Pinus strobus	3	8	1	2								14	224
Populus grandidentata					1							1	13
Prunus pennsylvanica	3											3	79
Prunus serotina	52(2)	8(1)	3	5	2							70(3)	1605(66)
Prunus virginiana	13											13	342
Quercus alba			1									1	13
Quercus coccinea				1								1	13
Quercus palustris		1		1								2	26
Quercus rubra	5(1)	4(2)	3		1	3			1		1	18(3)	303(52)
Quercus sp		1										1	13
Quercus velutina		1										1	13
Robinia pseudoacacia	1			1	1	1	2	1			1	8	118
Rubus allegeniensis	47											47	1237
Rubus occidentalis	1											1	26
Sambucus canadensis	1											1	26
Ulmus americana	1		1									1	26
Ulmus rubra	1	1(1)			1							2	39
Viburnum recognitum	1											3(1)	52(13)
Vitis riparia	1											1	26
												1	26
Total	**142(13)**	**20(6)**	**17(2)**	**10**	**8**	**5**	**2**	**2**	**1**	**0**	**2**	**290(21)**	
Total Stems/ ha	**3737(342)**	**263(79)**	**224(26)**	**132**	**105**	**66**	**26**	**26**	**13**	**0**	**26**		**6588(131)**

Expansion Wetland Summary

Sheet 2

HERBACEOUS SPECIES*	AF	RF	AC	RC	IV
Pilea pumila	14	6.11	381.00	18.67	24.78
Phragmites australis	5	2.18	215.00	10.53	12.72
Osmunda cinnamomea	5	2.18	181.00	8.87	11.05
Impatiens capensis	15	6.55	166.00	8.13	14.68
Onoclea sensibilis	16	6.99	137.00	6.71	13.70
Celastrus orbiculatus	16	6.99	113.00	5.54	12.52
Athyrium filix-femina	6	2.62	108.00	5.29	7.91
Alliaria petiolata	10	4.37	68.00	3.33	7.70
Solidago canadensis	5	2.18	65.00	3.18	5.37
Rubus allegheniensis	6	2.62	58.00	2.84	5.46

*top ten species

Stem Density				Size Classes (DBH)									
Species	<2in	2-4in	4-6in	6-8in	8-10in	10-12in	12-14in	14-16in	16-18in	18-20in	20in+	**Total**	**Stems/ha**
Acer rubrum	1		6	1	4	3						**15**	**115**
Berberis thunbergii	10											**10**	**144**
Celastrus orbiculatus	1											**1**	**14**
Fraxinus americana		3	1									**4**	**29**
Fraxinus pennsylvanica	18											**18**	**259**
Lonicera tatarica	2											**2**	**29**
Pinus strobus							1				2	**3**	**22**
Populus deltoides											2	**2**	**14**
Prunus serotina	6							2	1		1	**10**	**115**
Quercus rubra		1										**1**	**7**
Ulmus americana		1										**1**	**7**
Viburnum recognitum	4(2)											**4(2)**	**58(29)**
Total	**38**	**5**	**7**	**1**	**4**	**3**	**1**	**2**	**1**	**0**	**5**	**71(2)**	
Total Stems/ ha	**547(29)**	**36**	**50**	**7**	**29**	**22**	**7**	**14**	**7**	**0**	**22**		**813(29)**

Canopy Intercept**

Location & Species	**Total Absolute % Intercept**	**Relative % Intercept**	**Absolute % Intercept**
Expansion Area (E) Wetland	156		
Acer rubrum		40	63
Prunus serotina		13	21
Vitis riparia		7	11

**top three species

Disturbed Areas & Trailer Park Summary

Sheet 3

HERBACEOUS SPECIES*	AF	RF	AC	RC	IV
Poa pratensis	21	8.50	905.00	22.09	30.60
Poa compressa	12	4.86	785.00	19.17	24.02
Celastrus orbiculatus	7	2.83	268.00	6.54	9.38
Vitis riparia	18	7.29	245.00	5.98	13.27
Solidago canadensis	9	3.64	218.00	5.32	8.97
Phragmites australis	7	2.83	150.00	3.66	6.50
Rubus idaeus strigosus	4	1.62	137.00	3.34	4.96
Digitaria sanguinalis	7	2.83	111.00	2.71	5.54
Festuca elatior	8	3.24	106.00	2.59	5.83
Rubus allegheniensis	3	1.21	80.00	1.95	3.17

*top ten species

Stem Density				Size Classes (DBH)									
Species	<2in	2-4in	4-6in	6-8in	8-10in	10-12in	12-14in	14-16in	16-18in	18-20in	20in+	**Total**	**Stems/ha**
Betula populifolia	1											1	25
Celastrus orbiculatus	96											96	2400
Cornus racemosa	24											24	600
Dead unknown	(1)											(1)	25
Elaeagnus sp	3											3	75
Ligustrum vulgare	13											13	325
Parthenocissus quinquefolia	7											7	175
Populus deltoides	2											2	50
Prunus virginiana	2											2	50
Quercus coccinea					1			2			1	4	50
Rhamnus cathartica	1											1	25
Rhus glabra	1											1	25
Rhus typhina	1											1	25
Rubes allegeniensis	3											3	75
Rubus strigosus	92											92	2300
Salix sp	2											2	50
Vitis riparia	19											19	475
Vitis sp.	27											27	675
Total	294(1)	0	0	0	1	0	0	2	0	0	1	298(1)	
Total Stems/ ha	7350(25)	0	0	0	13	0	0	25	0	0	13		7425

Canopy Intercept**

Location & Species	Total Absolute % Intercept	Relative % Intercept	Absolute % Intercept
DS and TP	48		
Acer rubrum		13	6
Vitis riparia		12	6
Rubus idaeus strigosus		11	6

**top three species

Landfill Prairie Restoration Summary **Sheet 4**

HERBACEOUS SPECIES*	AF	RF	AC	RC	IV
Panicum virgatum	10	16.67	720.00	63.44	80.10
Poa pratensis	5	8.33	115.00	10.13	18.47
Sorghastrum nutans	4	6.67	81.00	7.14	13.80
Andropogon gerardii	3	5.00	52.00	4.58	9.58
Ambrosia artemisiifolia elatior	4	6.67	28.00	2.47	9.13

*top five species

Landfill Weeds Summary

HERBACEOUS SPECIES*	AF	RF	AC	RC	IV
Poa pratensis	8	15.69	32.40	31.67	47.36
Festuca elatior	7	13.73	29.70	29.03	42.76
Coronilla varia	5	9.80	25.40	24.83	34.63
Cirsium arvense	4	7.84	6.90	6.74	14.59
Ambrosia artemisiifolia elatior	2	3.92	5.00	4.89	8.87

*top five species

Pine Bush Karner Blue Butterfly Habitat Summary   Sheet 5

HERBACEOUS SPECIES*	AF	RF	AC	RC	IV
Andropogon scoparius	20	20.41	815.00	53.51	73.92
Rubus flagellaris	5	5.10	229.00	15.04	20.14
Polygonum lapathifolium	5	5.10	206.00	13.53	18.63
Rubus hispidus	5	5.10	94.00	6.17	11.27
Digitaria sanguinalis	8	8.16	85.00	5.58	13.74

*top five species

Stem Density				Size Classes (DBH)									
Species	<2in	2-4in	4-6in	6-8in	8-10in	10-12in	12-14in	14-16in	16-18in	18-20in	20in+	**Total**	**Stems/ha**
Prunus serotina	8			1		(1)						**9(1)**	**425**
Quercus prinoides	13	2										**15**	**350**
Rubus idaeus strigosus	4											**4**	**100**
Vaccinium pallidum	3											**3**	**75**
Total	**27**	**2**	**0**	**1**	**0**	**(1)**	**0**	**0**	**0**	**0**	**0**	**31(1)**	
Total Stems/ ha	**1350**	**50**	**0**	**25**	**0**	**25**	**0**	**0**	**0**	**0**	**0**		**950**

Canopy Intercept**

Location & Species	Total Absolute % Intercept	Relative % Intercept	Absolute % Intercept
Prairie (PBKBH)	21		
Pinus rigida		30	6
Prunus serotina alive		42	9
Prunus serotina dead		16	3

**top three species

Pine Bush Scrub Oak Forest Summary

Sheet 6

HERBACEOUS SPECIES*	AF	RF	AC	RC	IV
Vaccinium pallidum	6	15.38	242.0	36.07	51.45
Rubus (dewberry)	7	17.95	160.0	23.85	41.79
Quercus bicolor	9	23.08	110.0	16.39	39.47
Pteridium aquilinum latiusculum	4	10.26	75	11.18	21.43
Carex sp	2	5.13	22	3.28	8.41

*top five species

Stem Density				Size Classes (DBH)									
Species	<2in	2-4in	4-6in	6-8in	8-10in	10-12in	12-14in	14-16in	16-18in	18-20in	20in+	**Total**	**Stems/ha**
Betula populifolia	1	1										**2**	**150**
Crataegus sp.	2											**2**	**200**
Pinus rigida				2	(1)							**2(1)**	**100(50)**
Populus tremuloides	5	1(1)	(1)			1						**7(2)**	**600(200)**
Quercus illicifolia	53(4)											**53(4)**	**5300(200)**
Quercus prinoides	2											**2**	**200**
Toxicodendrum radicum	1											**1**	**100**
Total	**64(4)**	**2(1)**	**(1)**	**2**	**(1)**	**1**	**0**	**0**	**0**	**0**	**0**	**39(7)**	
Total Stems/ ha	**6400(400)**	**100(50)**	**0(50)**	**100**	**0(50)**	**50**	**0**	**0**	**0**	**0**	**0**		**6650(450)**

Canopy Intercept**

Location & Species	**Total Absolute % Intercept**	**Relative % Intercept**	**Absolute % Intercept**
Scrub Oak Forest (PBSOF1)	163		
Pinus rigida		45	73
Quercus ilicifolia		29	47
Betula populifolia		7	11

**top three species

Pine Bush Scrub Oak Thicket Summary — Sheet 7

HERBACEOUS SPECIES*	AF	RF	AC	RC	IV
Carex sp.	11	13.75	375.0	19.77	33.52
Andropogon scoparius	7	8.75	292.0	15.39	24.14
Pteridium aquilinum latiusculum	15	18.75	279.0	14.71	18.24
Quercus prinoides	10	12.5	274	14.44	26.94
Quercus ilicifolia	6	7.5	250	13.18	20.68

**top five species

Stem Density				Size Classes (DBH)									
Species	<2in	2-4in	4-6in	6-8in	8-10in	10-12in	12-14in	14-16in	16-18in	18-20in	20in+	**Total**	**Stems/ha**
Dead unknown	(1)											**(1)**	**50**
Populus tremuloides	63(6)	2										**65(6)**	**3200(300)**
Quercus illicifolia	140(7)											**140(7)**	**7000(350)**
Quercus prinoides	5											**5**	**250**
Vaccinium pallidum	31											**31**	**1550**
Total	**239(14)**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**241(14)**	
Total Stems/ ha	**11950(700)**	**50**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**		**12050(650)**

Canopy Intercept**

Location & Species	**Total Absolute % Intercept**	**Relative % Intercept**	**Absolute % Intercept**
Brushed Burned Scrub Oak (PPSOT 1&2)	29		
Quercus ilicifolia		50	15
Pinus rigida		21	6
Populus tremuloides		17	5

**top three species

Pine Bush Scrub Oak Thicket (not burned or brushed area) Summary

Sheet 8

HERBACEOUS SPECIES*	AF	RF	AC	RC	IV
Quercus prinoides	4	8.00	145.0	30.21	38.21
Carex pensylvanica	4	8.00	117.0	24.38	32.38
Quercus ilicifolia	8	16.00	109.0	22.71	38.71
Pteridium aquilinum latiusculum	7	14	38	7.92	21.92
Andropogon scoparius	2	4	12	2.5	6.5

*top five species

Stem Density				Size Classes (DBH)									
Species	<2in	2-4in	4-6in	6-8in	8-10in	10-12in	12-14in	14-16in	16-18in	18-20in	20in+	**Total**	**Stems/ha**
Populus grandidentata	1	1(3)										**2(3)**	**150(150)**
Prunus serotina	4											**4**	**400**
Quercus illicifolia	69(5)	3										**72(5)**	**7050(500)**
Quercus prinoides	33											**33**	**3300**
Vaccinium corymbosum	2											**2**	**200**
Total	**109(5)**	**4(3)**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**113(8)**	
Total Stems/ ha	**10900(500)**	**200(150)**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**		**11100(650)**

Canopy Intercept**

Location & Species	Total Absolute % Intercept	Relative % Intercept	Absolute % Intercept
Scrub Oak (PPSOT 3) Not burned or brushed	163		
Quercus ilicifolia		42	68
Quercus prinoides		12	19
Quercus rubra alive		11	18

**top three species

Pine Bush Sedge Meadow Summary Sheet 9

HERBACEOUS SPECIES*	AF	RF	AC	RC	IV
Carex stricta	9	16.07	48.36	44.52	60.59
Rubus hispidus	4	7.14	12.82	11.80	18.94
Spiraea alba	6	10.71	9.55	8.79	19.50
Thelyptris palustris	7	12.50	7.18	6.61	19.11
Vaccinium corymbosum	2	3.57	5.73	5.27	8.84

*top five species

Stem Density				Size Classes (DBH)								
Species	<2in	2-4in	4-6in	6-8in	8-10in	10-12in	12-14in	14-16in	16-18in	18-20in	20in+	**Total**	**Stems/ha**
Spiraea alba	35(9)											**35(9)**	**7000(1800)**
Vaccinium corymbosum	6											**6**	**1200**
Vaccinium pallidum	6											**6**	**1200**
Total	**47(9)**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**47(9)**	
Total Stems/ ha	**9400(1800)**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**		**9400(1800)**

Canopy Intercept**

Location & Species	Total Absolute % Intercept	Relative % Intercept	Absolute % Intercept
Sedge Meadow (PBSM)	11		
Spirea alba		57	6
Quercus prinoides		30	3
Vaccinum sp.		11	1

**top three species

Sloping Fen Summary

Sheet 10

HERBACEOUS SPECIES*		AF	RF	AC	RC	IV
Carex pellita		3	8.82	165.0	17.90	26.72
Andropogon scoparius		2	5.88	160.0	17.35	23.24
Carex stricta		2	5.88	110.0	11.93	17.81
Rubus allegheniensis		4	11.76	102	11.06	22.83
Osmunda regalis spectabilis		1	2.94	80	8.68	11.62

*top five species

Stem Density				Size Classes (DBH)									
Species	<2in	2-4in	4-6in	6-8in	8-10in	10-12in	12-14in	14-16in	16-18in	18-20in	20in+	**Total**	**Stems/ha**
Acer rubrum	1											**1**	**200**
Rubus allegeniensis	5(1)											**5(1)**	**1000(200)**
Rubus strigosus	31(4)											**31(4)**	**6200(800)**
Spiraea alba	53											**53**	**10600**
Total	**90(5)**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**90(5)**	
Total Stems/ ha	**18000(1000)**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**		**18000(1000)**

Canopy Intercept*

Location & Species	**Total Absolute % Intercept**	**Relative % Intercept**	**Absolute % Intercept**
Hanging Fen	18		
Rubus idaeus strigosus		47	8
Spirea alba		33	6
Rubus allegheniensis		13	2

*top three species

Vernal Pool 1 Summary   Sheet 11

HERBACEOUS SPECIES*	AF	RF	AC	RC	IV
Aralia sp.	1	7.69	10.0	22.73	30.42
Rubus sp.	1	7.69	10.0	22.73	30.42
Vaccinium corymbosum	3	23.08	7.0	15.91	38.99
Quercus prinoides	1	7.69	5	11.36	19.06
Carex stricta	1	7.69	3	6.82	14.51

*top five species

Stem Density				Size Classes (DBH)									
Species	<2in	2-4in	4-6in	6-8in	8-10in	10-12in	12-14in	14-16in	16-18in	18-20in	20in+	**Total**	**Stems/ha**
Acer rubrum	1(5)	6(5)	5	6	4							**22(10)**	**2300(1500)**
Betula populifolia	(3)											**(3)**	**600**
Vaccinium corymbosum	17(7)											**17(7)**	**3400(1400)**
Total	**18(15)**	**6(5)**	**5**	**6**	**4**	**0**	**0**	**0**	**0**	**0**	**0**	**39(20)**	
Total Stems/ ha	**3600(3000)**	**600(500)**	**500**	**600**	**400**	**0**	**0**	**0**	**0**	**0**	**0**		**6300(2900)**

Canopy Intercept**

Location & Species	**Total Absolute % Intercept**	**Relative % Intercept**	**Absolute % Intercept**
Vernal Pool 1	137		
Acer rubrum		58	79
Betula populifolia		25	34
Populus grandidentata		9	12

**top three species

Vernal Pool-Red Maple Swamp Summary

Sheet 12

HERBACEOUS SPECIES*	AF	RF	AC	RC	IV
Rubus (dewberry)	1	5.26	40.0	28.70	33.43
Osmunda regalis	1	5.26	25.0	17.61	22.87
Prunus serotina	2	10.53	13.0	9.15	19.68
Lonicera tatarica	1	5.26	10	7.04	12.31
Vaccinium angustifolium	1	5.26	10	7.04	12.31

*top five species

Stem Density				Size Classes (DBH)								
Species	<2in	2-4in	4-6in	6-8in	8-10in	10-12in	12-14in	14-16in	16-18in	18-20in	20in+	Total	Stems/ha
Acer rubrum	2(1)	2										4(1)	600(200)
Betula populifolia	(3)	7(1)										7(4)	700(700)
Lonicera tatarica	8(1)											8(1)	1600(200)
Prunus serotina	4(1)											4(1)	800(200)
Rubus sp.	3											3	600
Total	**17(6)**	**9(1)**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**26(7)**	
Total Stems/ ha	**3400(1200)**	**900(100)**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**		**4300(1300)**

Canopy Intercept**

Location & Species	Total Absolute % Intercept	Relative % Intercept	Absolute % Intercept
Vernal Pool 1 - Red Maple Swamp	105		
Vaccinium corymbosum		27	28
Acer rubrum		24	25
Populus deltoides		16	17

**top three species

Wetland (Pond) Summary

Sheet 13

HERBACEOUS SPECIES*	AF	RF	AC	RC	IV
Osmunda claytoniana	1	3.57	90.0	29.90	33.47
Vaccinium corymbosum	1	3.57	30.0	9.97	13.54
Daucus carota	1	3.57	20.0	6.64	10.22
Carex stricta	1	3.57	20.0	6.64	10.22
Desmodium canadense	1	3.57	15	4.98	8.55
Onoclea sensibilis	1	3.57	15	4.98	8.55

*top six species

Stem Density				Size Classes (DBH)									
Species	<2in	2-4in	4-6in	6-8in	8-10in	10-12in	12-14in	14-16in	16-18in	18-20in	20in+	**Total**	**Stems/ha**
Acer rubrum	2	2				2						**6**	**400**
Alnus rugosa	24											**24**	**2400**
Betula populifolia		3										**3**	**150**
Populus tremuloides		1										**1**	**50**
Rubus allegeniensis	15											**15**	**1500**
Total	**41**	**6**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**45**	
Total Stems/ ha	**4100**	**300**	**0**	**0**	**0**	**100**	**0**	**0**	**0**	**0**	**0**	**4100**	**4500**

Canopy Intercept**

Location & Species	Total Absolute % Intercept	Relative % Intercept	Absolute % Intercept
Wetland 1 (Pond)	58		
Acer rubrum		35	20
Populus deltoides		22	13
Salix nigra		7	4

**top three species

Wetland (Button Bush) Summary

Sheet 14

HERBACEOUS SPECIES*	AF	RF	AC	RC	IV
Lemna minor	6	17.14	285.0	41.67	58.81
Lycopus americanus	6	17.14	145.0	21.20	38.34
Carex stricta	3	8.57	115.0	16.81	25.38
Quercus velutina	1	2.86	20.0	2.92	5.78
Galium sp.	3	8.57	16	2.34	10.91

*top five species

Stem Density				Size Classes (DBH)								
Species	<2in	2-4in	4-6in	6-8in	8-10in	10-12in	12-14in	14-16in	16-18in	18-20in	20in+	**Total**	**Stems/ha**
Betula populifolia		1										**1**	**63**
Cephalanthus occidentalis	602											**602**	**75250**
Corylus americana	6											**6**	**750**
Pinus resinosa											1	**1**	**63**
Quercus alba						1						**1**	**63**
Quercus coccinea					1							**1**	**63**
Quercus illicifolia	1											**1**	**125**
Quercus velutina		1										**1**	**63**
Vaccinium corymbosum	24											**24**	**3000**
Total	**633**	**2**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**1**	**638**	
Total Stems/ ha	**79125**	**125**	**0**	**0**	**63**	**63**	**0**	**0**	**0**	**0**	**63**		**79440**

Canopy Intercept**

Location & Species	Total Absolute % Intercept	Relative % Intercept	Absolute % Intercept
Wetland 2 (Button bush)	129		
Cephalanthus occidentalis		52	67
Quercus alba		15	19
Pinis resinosa		8	11

**top three species

Wetland (Bog) Summary Sheet 15

HERBACEOUS SPECIES*	AF	RF	AC	RC	IV
Sphagnum moss	11	26.19	1005.0	50.83	77.03
Dulichium arundinaceum	5	11.36	405.0	18.60	29.97
Carex stricta	9	21.43	385.0	19.47	40.9
Scirpus cyperinus	5	11.36	185.0	8.50	19.86
Chamaedaphne calyculata	3	6.82	55	2.53	9.34

*top five species

Stem Density				Size Classes (DBH)									
Species	<2in	2-4in	4-6in	6-8in	8-10in	10-12in	12-14in	14-16in	16-18in	18-20in	20in+	**Total**	**Stems/ha**
Betula populifolia		4										**4**	**133**
Nyssa sylvatica			1	1								**2**	**67**
Populus tremuloides			1									**1**	**33**
Vaccinium corymbosum	49											**49**	**3267**
Total	**49**	**4**	**2**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**56**	
Total Stems/ ha	**3267**	**133**	**67**	**33**	**0**	**0**	**0**	**0**	**0**	**0**	**0**		**3500**

Canopy Intercept**

Location & Species	Total Absolute % Intercept	Relative % Intercept	Absolute % Intercept
Wetland 3 (Bog)	83		
Acer rubrum		28	23
Betula populifolia		16	14
Quercus coccinea		14	12

**top three species

APPENDIX 8.

T&E SURVEY PROTOCOLS

ALBANY RAPP ROAD LANDFILL
ECOSYSTEM MITIGATION, RESTORATION & ENHANCEMENT PLAN

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April 2009

PRE-CONSTRUCTION SURVEYS

T&E SURVEYS

Detailed vegetative surveys and informal wildlife surveys, among other site investigations such as soil surveys, groundwater and surface water monitoring, and macroinvertebrate surveys, were conducted over the past 2-3 years within the proposed expansion and restoration areas. This analysis documented highly disturbed conditions in all landfill expansion and restoration areas. Additionally, no protected or other species of concern were identified over the many hours spent in the field by highly qualified biologists. As a result, the data and observations documented in the SEQR and permitting submittals presents a high level of certainty that no threatened, endangered or other species of concern will be impacted by the proposed expansion or the restoration activities. However, in order to address unforeseen circumstances and provide an even higher degree of certainty that no significant impacts will occur, surveys for threatened and endangered species, species of greatest conservation need, and special concern species will be conducted prior to the start of construction. Additionally, qualified ecologists, who will be overseeing construction activities, will continually monitor site conditions to address unforeseen encounters of protected species, providing daily or weekly field reports using an appropriate log format (see sample in Appendix 1). To maximize the chance of detection, surveys will be conducted during periods of 'peak' activity for each species. Table 1 identifies special status species listed in the EIS and provides for peak detection periods. Surveyors will be proficient on field identification of all listed species.

Survey methods will consist of a combination of Point Counts and Timed Meander Searches along Transects. Prior to the survey, transect routes and point count locations will be identified as appropriate for each species.

In order to increase the efficiency of the survey efforts, surveys for more than one species can be conducted concurrently. For example, transects established for butterflies and dragonflies will occur within the same area as a bird survey point count. Additionally while one surveyor is conducting point counts the other may search cover objects for reptiles and amphibians. In order to obtain data during peak detection periods four surveys are proposed: late-May - early June, mid to late July, mid to late August and late September - early October.

Butterfly and Dragonfly Surveys

Modified transect counts using the Pollard Walk Method (1977) will be used to detect Karner blue butterfly and Pine Barrens buck moth. Each route will traverse a range of habitats deemed most representative of the majority of terrain at the site. Routes will also represent a variety of topographical and physical aspects of the Expansion and Restoration areas. Each surveyor will be assigned a transect width and is free to slowly wander at will in active search of productive habitats, nectar sites, within the assigned transect. Efforts will be made to record each individual only once. Surveys will be conducted between 10 am and 5 pm. Optimal field conditions consist of temperatures between 55-64°F, cloud cover not exceeding 50% and no wind.

If identification of a species is difficult, a net may be used to capture the individual. Net dragonflies in flight by swinging at them from behind. Many species will fly a predictable route, so you can watch a while to see the pattern and then set up an ambush at a convenient spot, perhaps where you are partially hidden by a tree or shrub. When perched, approach them with very slow movements. Once in the net, remove the specimen by hand (they don't bite very hard). Hold with its wings held back together and use a hand lens for proper identification.

Equipment needed:

- Binoculars
- GPS
- Butterfly net
- Hand lens
- Data Sheets
- Map
- Field guide
- Wind and temperature meter

Bird surveys

Bird surveys will be conducted using modified USGS Breeding Bird protocols. Survey locations will be identified within each habitat type. If possible suitable habitat for each point survey location will encompass 12 ± acres. Surveys will begin ½ hour before sunrise and be concluded no later than 2 hours after sunrise. Surveys will not be conducted during rain or periods of high wind (greater than 12 mph). Every point will be surveyed during the same day.

Once the observer arrives at the survey point wait 2 minutes before beginning the count. This enables the observer to prepare for the count and allows the birds to calm down and return to normal activity. Surveys will be conducted for a 5-minute period with all birds seen or heard within 100 meters (328 feet) will be recorded. This 3-minute period is divided into two periods; a 3- and a 2-minute period. The observer records the species and number of birds seen or heard during the first 3 minutes, then focus on the listed species only for the remaining 2 minutes.

Record all listed species as less than 25 meters, 25-100 meters or greater than 100 meters away from the survey point. Plot all listed species on a circle map with an abbreviation of the common name. If you observe a listed species before or after the 5-minute survey or between survey points, write it down and mark time and mark the approximate location on a field map.

Equipment needed:

- Binoculars
- GPS
- Stop watch
- Data sheets
- Map
- Field guide
- Wind and temperature meter

Reptile and Amphibian Surveys

Reptile and Amphibian surveys will be conducted in conjunction with any of the other surveys. Any potential cover objects will be recorded and searched. Visual encounters will also be recorded. Optimal survey times are generally between 60-80 or 85° F, partly sunny or cloudy skies, and little to no wind.

Equipment needed:
- GPS
- Snake Hook
- Leather gloves
- Map
- Field guide

Plants
While conducting the above surveys, observers will also conduct random searches for listed and nectar plants. If plants are found and are not in immediate danger of being destroyed, the exact location of the plant will be recorded and flagged in order to locate the plant during the dormant season for transplanting. If the timing is such that the plant will be destroyed by restoration or construction activities outside the preferred transplant season (fall & spring), ecologists will carefully dig up the plant and immediately relocate it to other appropriate areas within the restoration area using all proper precautions.

Notification
If any species listed in Table 1 are found, notification will be made to the proper DEC official. Information to be provided includes location, habitat type, time of observation, number of individuals, and activity (breeding, foraging, resting). If an animal is found which has constrained mobility (e.g. turtles, snakes, amphibians or nesting birds) the appropriate agency will be notified, and it will be relocated to an acceptable area in the PBP. A GPS location will be obtained noting the exact location of the relocation. If species are highly mobile, a GPS location will be obtained and provided to DEC in an annual report. Areas within the PBP suitable for relocation of species will be determined prior to the conducting surveys.

VEGETATIVE SEED COLLECTION
Any discovered special status plants that happen to have viable seeds present during any of the other survey efforts, will be harvested for later use in the restoration. Collection, cleaning, storage protocols will follow those to be developed by AES in conjunction with the development of the on-site nursery.

Field collection forms and GIS will be used to document collection area location, along with other important details such as collection dates and the abundance, distribution and health of parent plants.

Grass
Grass seed will be harvested by stripping or shaking the seeds off of the stem, or by clipping the stem with scissors or small scythes just below the spikelet.

Forbs
Many pods or capsules dehisce when ripe and mature at staggered intervals. Once seeds begin to mature, the entire inflorescence will be cut and allowed to dry in a paper bag.

Shrubs
Shrub seeds will be picked or the shrub will be lightly beaten or shaken to encourage the seeds to drop. Seeds will be captured by laying a tarp underneath the shrub.

All seeds will be collected in paper bags and labeled appropriately with species and date of collection. Seeds from different species will be kept separate. Once seeds are collected they should be placed in a cooler to avoid overheating which will reduce viability of the seed.

Equipment needed:

- GPS
- Leather gloves
- Drop cloths
- Pruning shears
- Paper bags
- Cooler

Seed Storage

As soon as possible after collection, mesh trays will be labeled with species and collection dates and the seeds will be spread out to dry. Following drying the seeds will be cleaned as thoroughly as possible using a combination of graded sieves and air current for removing the chaff. Seeds will then be placed in paper bags, labeled and stored in a refrigerator or in a dark cool (34°F) area.

VEGETATION TRANSLOCATION

Translocation of trees and shrubs will occur when the specimen is dormant usually at the start and end of the growing season.

Removal

Two to three days before transplanting begins shrubs will be watered and trimmed. To remove the plant from its current location a circular trench should be dug about two-thirds that of the branch spread and as deep as possible in order to get as much of the tap root as possible.

While removing the plant do not disturb the root system. Wrap the entire root ball in burlap material and tie closed with the proper cording or string. Water the root ball to prevent it from drying out.

Planting

Dig a hole in the new location that is about twice as big as the root system. Mix compost into the hole. Place plant into the hole, the plant should be placed at the same soil elevation that it was removed from. Fill the hole with native soil and tamp down lightly. Water thoroughly and deeply. Keep moist for 3-4 weeks after planting

Sod Translocation

Areas found where multiple plant species are growing will be salvaged using the specifications in the restoration plans. This may include special status plant species found in a native plant community matrix that can not be avoided. Or, these can simply be native plant community matrix settings. The sod will be dug to a minimum 1 foot depth with front end loaders for larger salvage areas, or by hand for small clumps that are to be salvaged.

Table 1. Time period of greatest observation potential for listed animal species at Albany Landfill.

	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Barrens Dagger Moth												
Karner Blue Butterfly												
Frosted Elfin												
Brook Snaketail												
Common Sanddragon												
Forcipate Emerald												
Mocha Emerald												
Tiger Spiketail												
Eastern Hognose Snake												
Worm Snake												
Eastern Spadefoot toad												
Fowler’s toad												
Jefferson Salamander												
Sharp-shinned hawk												
Cooper’s hawk												
Woodcock												
Wood Thrush												
Blue-winged Warbler												
Golden-winged Warbler												
Black-throated blue Warbler												
Whip-poor-will												
Yellow-breasted chat												
Rufous-sided Towhee												
Indigo Bunting												

Appendix 1. Daily T&E Field Report

APPENDIX 9.

YEAR 1 IMPLEMENTATION SCHEDULE

ALBANY RAPP ROAD LANDFILL
ECOSYSTEM MITIGATION, RESTORATION & ENHANCEMENT PLAN

CITY OF ALBANY, NEW YORK

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April 2009

Draft Work Plan for Year 1, Albany Landfill Expansion, Ecosystem Restoration															
	Month (Assume Start Date April 15, 2009)														Roles/ Responsibilities
General Task/ Specific task	**Apr**	**May**	**June**	**July**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	
1. Invasive Plant Management and Preparation for Restoration															
a. Landfill Phase I areas		X	X	X			X							X	AES/CH team
b. Trailer Park Phase I areas		X	X	X			X							X	AES/CH team
c. Back field Phase I areas (Pine Barrens vernal pond area)		X	X	X			X							X	AES/CH team
d. Sand Borrow locations.		X	X	X			X							X	AES/CH team
2. Nursery, plant/seed procurement															
a. Nursery site preparation	X	X	X												AES/CH team
b. Seed collection		X	X	X	X	X	X						X	X	AES/CH team
c. Seed cleaning						X	X	X							AES/CH team
d. Propagation								X	X	X	X				AES/CH team
e. Nursery direct seeding and transplanting			X	X	X								X	X	AES/CH team
3. Salvage															
a. Landfill phase 1 construction area	X	X													AES/CH team
a1. field survey/flagging for earth moving contractor	X	X													AES/CH team
a2. Salvage and translocation to nursery		X	X	X											AES/CH team
b. Plant, tree, shrub, soil salvage area for demarcation in landfill years 1-2 expansion areas			X	X			X						X	X	AES/CH team
c. Refine planting plans for areas to receive salvage materials during years 1-2.													X	X	AES/CH team

	Month (Assume Start Date April 15, 2009)														Roles/ Responsibilities
General Task/ Specific task	**Apr**	**May**	**June**	**July**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	
d. Wildlife Salvage		X	X	X	X	X									AES/CH team
d1. Survey restoration zones in back field, landfill expansion area, and trailer park for turtles, spadefoot toads, plants, and appropriate soils	X	X	X										X	X	AES/CH team
d2. Trap and remove turtles, toads, etc from expansion areas and arrange to translocates to other areas of pine bush													X	X	AES/CH team
4. Stakeout/Surveying															
a. Stake out year 1 phase areas	X	X													CH surveyors
b. Stakeout year 2 phase areas											X	X	X	X	CH surveyors
c. Affirm acreages	X	X												X	AES/CH team
d. Affirm plant product needs		X												X	AES/CH team
e. Affirm salvaged top soil/seedbank quantities		X											X	X	AES/CH team
f. Affirm salvaged sand quantities for landfill growing medium establishment during year 1, 2 +		X											X	X	AES/CH team
5. Trailer Park Move															
a. Consolidate trailers		X													City/CH team
b. Demolish pads, remove utilities				X	X										AES/CH team
c. Cover cropping of soil disturbance areas					X	X	X								AES/CH team
6. Monitoring/Survey process															
a. Develop baseline vegetation survey for year 1 restoration zones		X	X	X											AES/CH team
b. Install permanent monitoring system for year 1 restoration zones		X	X	X											AES/CH team

	Month (Assume Start Date April 15, 2009)														Roles/ Responsibilities
General Task/ Specific task	**Apr**	**May**	**June**	**July**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	
c. Conduct fish surveys in P4 wetland restoration area		**X**											**X**	**X**	AES/CH team
d. Conduct Breeding and Migratory Bird surveys in expansion areas and restoration areas		**X**	**X**				**X**	**X**					**X**	**X**	AES/CH team
e. Conduct nectary plant surveys in expansion and restoration areas.		**X**	**X**	**X**											AES/CH team
f. Annual Reporting		**X**	**X**	**X**				**X**	**X Final**						AES/CH team
7. Work Plan Development Process for year 2															
a. Draft Work Plan									**X**	**X**					AES/CH team
b. Management Team Review/Annual Field Inspection										**X**					AES/CH team
c. Final Drafting of Annual Work Plan										**X**					AES/CH team
d. DEC/PBC sign-off on annual work plan											**X**				AES/CH team