Stafford Landfill Vegetation Description

Species Cover and Composition

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Purpose: Documentation is needed to characterize the Stafford Township landfill restoration (Figure 1). The landfill received a series of closure treatments finalized by capping and seeding of the soils with a mixture of various grasses. The seeding occurred in late 2007 and early 2008. The initial mixture included three native warm season species. The mixture included switch grass (*Panicum virgatum*), Indian grass (*Sorgastrum nutans*) and little blue stem (*Schizachyrium scoparium*). The mixture was divided between the species, using a combination of 45% switch grass, 35% little blue stem and 20% Indian grass. This mixture was drilled into the prepared surface substrate. A second separate planting involving common drought tolerant soil erosion control grasses occurred on the same landfill cap. Ryegrass, fescues and bent grasses were part of this second planting. Today, the landfill cap is in the initial stages of grass cover recovery.

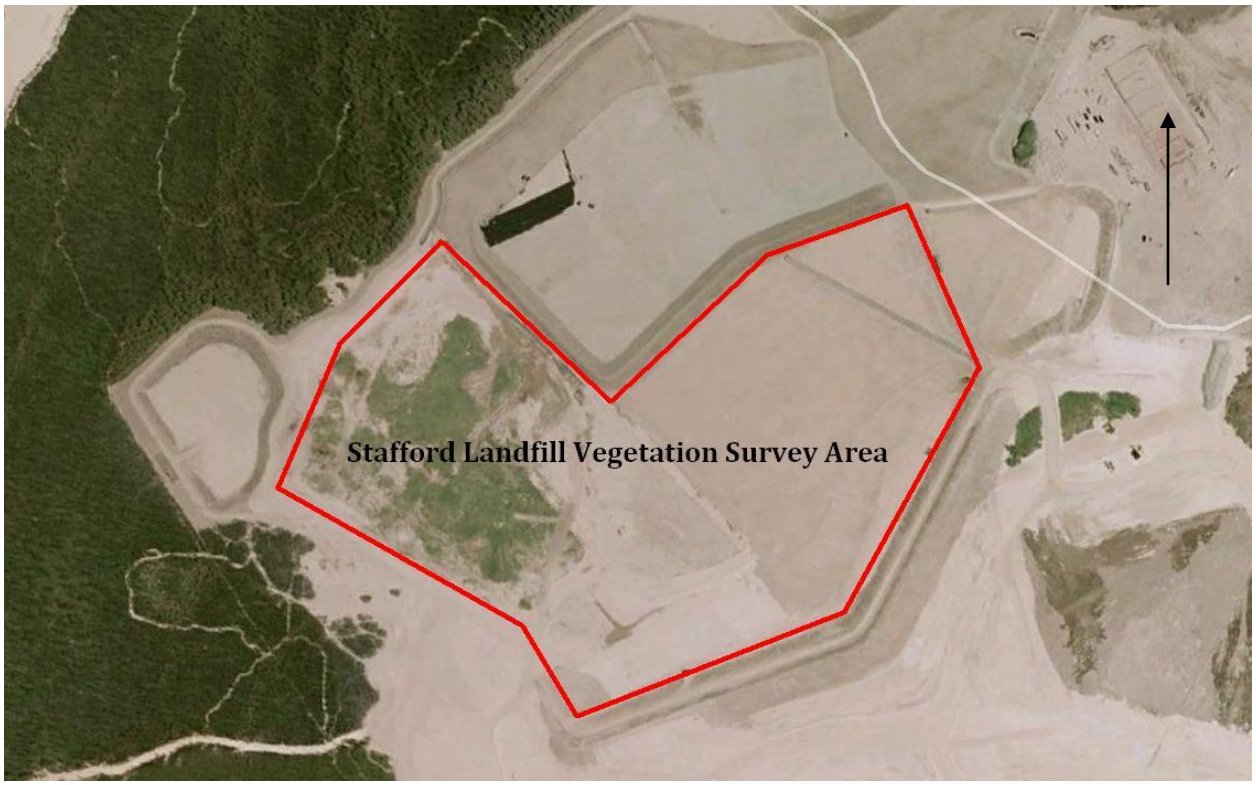


Figure 1: Vegetation Survey Area on 2007 Color Photograph

Recovery effort successes and failures are important to document. Data collection that would assist this determination would include a sense of species composition and cover measurements that would provide a baseline for making the planting determinations. The task to describe the current vegetation was assigned to Joseph Arsenault. The description would assist the current landfill developer, The Walters Homes, Inc., determine the success of the grass plantings and provide data for potential impacts from propositions associated with other site uses.

Goals and Objective: The goal of this report is to document the vegetation by identifying and quantifying the existing plants that occur on top of the Stafford Township landfill. The documentation includes species composition, species cover and height. It is this report's objective to provide an accurate vegetation description for use by the current managers.

Methods

The landfill plant cover was sampled using a meter square quadrant method to estimate the species cover and species composition. Twenty two 1-meter square quadrants (Figure 2: *Approximate Quadrant Locations;* Table 1: *Sample Locations*) were evenly spaced on the flat landfill uplands. This area is bisected by three storm-water swales that conveniently provide obvious breaks within the otherwise broad landfill expanse. Individual sample quadrants were placed on a long transect between each swale. This quadrant data is supplemented with a running tally of all plants observed on the landfill during the sample effort. The plant names recorded for the site follow commonly applied nomenclature derived from texts such as Fernald (1950), Gleason and Cronquist (1991) and Kartesz (1999). The data was documented with a written tally as well as a photographic record of each quadrant and the general landscape found on the reclaimed landfill.

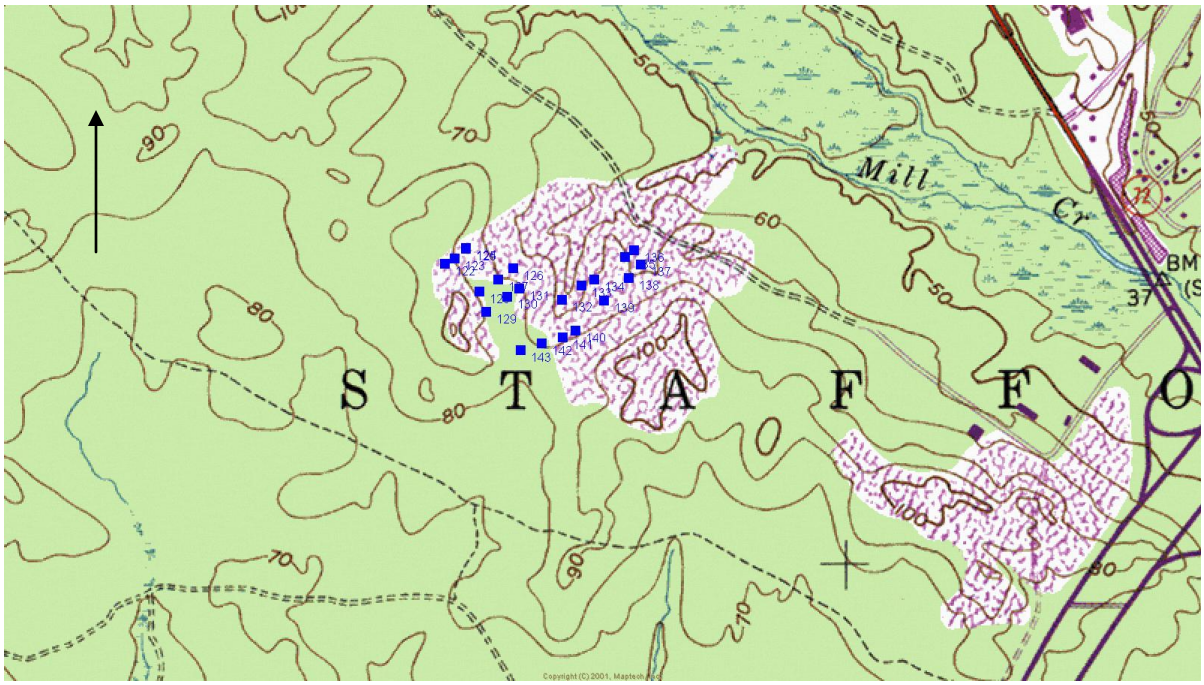
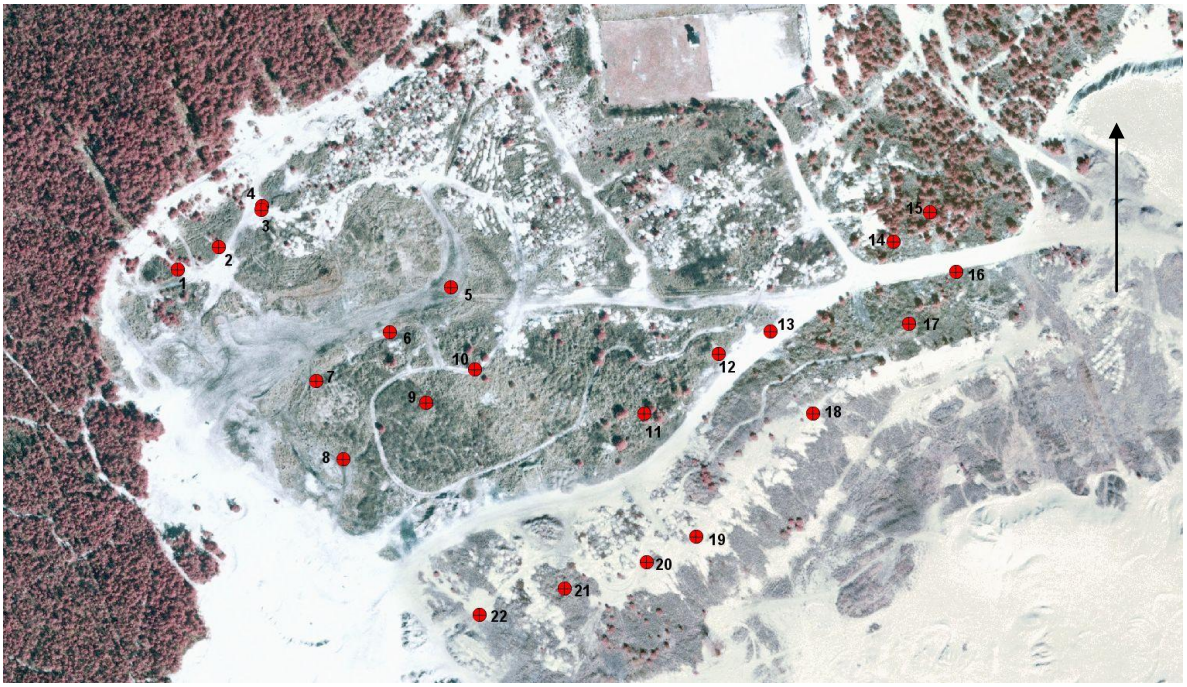


Figure 2: Approximate quadrant locations 1-22, West Creek, NJ USGS Topographic Quadrangle

Table 1: Meter Squared Grass Sample Plot Locations

Sample #	Latitude	Longitude	Sample #	Latitude	Longitude
Sample 1	39.71531868	-74.30307993	Sample 12	39.71483052	-74.29904052
Sample 2	39.71545279	-74.30277416	Sample 13	339.71495926	-74.29865428
Sample 3	39.71568882	-74.30245229	Sample 14	39.71548498	-74.29773160
Sample 4	39.71567273	-74.30245765	Sample 15	39.71564591	-74.29746338
Sample 5	39.71521676	-74.30104145	Sample 16	39.71530795	-74.29726490
Sample 6	39.71495926	-74.30149742	Sample 17	39.71500754	-74.29761895
Sample 7	39.71469104	-74.30204996	Sample 18	39.71448183	-74.29833778
Sample 8	39.71422970	-74.30184611	Sample 19	39.71378982	-74.29921218
Sample 9	39.71456230	-74.30122920	Sample 20	39.71363962	-74.29958233
Sample 10	39.71475542	-74.30086442	Sample 21	39.71347332	-74.30019923
Sample 11	39.71449792	-74.29959842	Sample 22	39.71332848	-74.30083224



2002 NJ DEP FC/IRC with Vegetation Sample Waypoints 1 - 22

Species cover is recorded as a visual estimate using a modified *Daubenmire Cover Scale* for the individual species within each sample quadrant. The Daubenmire method was selected because it is specifically used for cover. It is also known as the canopy coverage method (Bonham, 1989). The estimated cover scale is modified to use the following cover values: T = trace, or single/small specimen; 1=0-5%; 2=6-15%; 3=16-25%; 4=26-50%; 5=51-75%; 6=76-100%. The results are tallied and interpreted to describe the dominant species and other important vegetation characteristics.

Results

Vegetation Description

Landscape Position

The reclaimed landfill is located approximately 1-mile north-north-west of the intersection between New Jersey Highway Route 72 and the Garden State Parkway. This places the landfill on New Jersey's Outer Coastal Plain. This part of New Jersey is situated on a base geology characterized by the Cohansey Formation. The surface geology is more complex. Prior to the creation of the landfill the parcel supported Upland Gravel (lower phase). This native substrate graded horizontally into Cape May, unit 1 sediments and vertically into weather coastal plain sediments consistent with the base Cohansey Formation. Prior to the landfill, the landscape also supported Woodmansie soils. Woodmansie is a characteristic core Pine Barrens soil derived from the Upland Gravel, a segment of the Beacon Hill gravel formation.

The landfill is within Ocean County's eastern Pine Barrens ecosystem. The surrounding undisturbed landscape supports a complete suite of plant communities across a typical hydrologic gradient. Immediately adjacent to the landfill is a pitch pine upland landscape with bear oak and black oak understory; black jack oak and post oak are occasional canopy constituents. The landfill sampled for this report supports an upland plant community, with a restored grass-dominated association similar to tall grass prairies and native old fields. Within this manmade environment are small isolated pockets of moist soils in shallow depressions capable of supporting facultative wetland plants.

Plant Cover: A July 21, 2010 field investigation found Stafford Township's landfill supports a cover dominated by warm season grasses. The grass cover varies dependent on the age of the planting and the suitability and quality of the substrate. The grasses form a cover with a visible presence that range from estimated values of 25% and approximately 100% or near complete coverage. 54.5% of the sample plots had cover estimates that were less than 50%. Two sample plots (9%) had cover values less than 30% (estimated at 25%). These were the least mature areas near the landfill's southeastern corner. Four plots had cover estimates that were estimated to be greater than 60%. The plant cover ranges appear to be associated with various conditions, but primarily due to soil variations found on the restored landfill.

Landfill Surface Substrates

The grass cover has established on a substrate composed of stock piled native sand and manmade organic materials. Sand and gravel are the major soil constituents, blended to create the soil that is used to cap the landfill. The landfill topography is relatively level to provide a positive gradient and eliminate storm water infiltration. The surface micro topographic conditions, however, include slight depressions and dips which capture water, creating a mosaic of mesic pockets within an otherwise xeric upland landscape. These mesic pockets support the higher cover estimates and have

the most robust specimens. Many support facultative wet species such as lurid sedge, soft rush and wool grass. Each is known for early establishments on soils with mesic conditions. Their presence does not constitute wetlands, rather an expression of a seed bank presence in the newly spread surface substrates.

Panicum virgatum, switch grass

The dominant landfill species are the warm season and soil erosion grasses planted during the landfill closure. A brief stroll across the landfill cap provides visual evidence of planting. There are clearly visible drilled lines where the grasses were planted and many of the grasses follow this regular pattern. *Panicum virgatum*, switch grass, was found to be the most successful planted grass. It is the most significant grass species on the landfill by way of area occupied, number of plants, height of plants, and distribution of plants. Switch grass was found to have the highest coverage values as well as being the most frequently sampled species. The species was found in every quadrant as either the dominant or co-dominant. Little blue stem and Indian grass are present, but their distribution is such that they were sampled infrequently. Both species are best represented on the eastern side of the landfill.

Between the plantings are naturally invading species. Of the naturalized plants, Japanese clover is almost as frequent as switch grass. It has the second highest coverage species after switch grass. *Kummerowia striata* is second in importance, yet from a distance this plant is barely visible. This low growing broadleaf annual herb is ubiquitous, occupying space throughout the landfill, under the taller and more robust warm season grass clumps. Japanese clover is infrequently a dominant, but there are zones where this plant is most abundant and occupies most available space. It is present as an early succession weed, and it is evenly distributed throughout the landfill and adjacent disturbed upland. It has a low stature, and it is never higher than a few inches so the plant is not a competitor for sunlight. It is, however, a competitor for nutrients and water.

The existing planted grasses exist with a suite of common disturbance species. These are plants tolerant to the harsh landfill environment. Naturalized species such as forked rush, path rush, soft rush and Long's sedge are important in a few of the samples yet are represented by only a trace coverage in many quadrants. Those species that naturally invaded are tolerant of variable conditions associated with the exposed landfill soils. Most of the invasive early invaders are expected to dwindle as the landfill grassland matures and the coverage is dominated by the tufts of perennial warm season grasses. Species such as forked rush and narrow-leaf goldenrod will persist into a mature old field with the warm season grasses.

Species Assemblage: Forty-three plants have been recorded on the landfill. The warm season grasses form the dominant species when measured by the area they occupy and their relative importance to the vegetation. One of the planted soil erosion grass species, *Agrostis gigantea*, red top, has spread to the landfill surface from the slopes and adjacent properties. This species is a non-native that is used to

secure the soil on non-landfill property. It now occupies small discrete patches within the warm season grass clumps. It is most common above the storm water swales and on the landfill's northeastern edge. A species tentatively identified as a selection of *Festuca rubra* is found in many sample plots on the southern edge of the landfill surfaces. This plant is a soil erosion grass, and it is visible in long, narrow rows. The identification is tenuous due to the lack of suitable fruiting culms. It is present primarily as tiny basal rosettes with weak shattered culms. Other plants that are present include *Sorgastrum* and *Schizachyrium.* Both are present throughout. Neither has matured as quickly as switch grass, but both are visible as developing basal rosettes. Twenty herbarium specimens (J.R. Arsenault #s 2312-2332) are preserved of select plants from the sample plots for additional inquiry.


Mile-a-minute as seen in the Stafford Landfill drainage swale

Many of the landfill flora members are non-native, and at least one constituent is an aggressive invasive species (Mile a minute, photo right). *Polygonum perfoliatum* is an aggressive weed that may need maintenance to eliminate this unwanted species. The forty-three landfill plants include 15 non-native (35%), six that were planted (14%), six facultative wet species (14%) and a suite of early opportunistic species characteristic of open disturbed habitats similar to the one created by the landfill closure. The species list includes no unusual or protected species. None of the recorded species have state or Pinelands Commission special status. Non-natives such as *Setaria faberi, Kummerowia striata, Lotus corniculata,* and *Rumex crispus* are early disturbance species that will lose their presence within a season or two. The following list is a plant tally from the July 21, 2010 Stafford Landfill visit. Those plants listed are found within and surround the sample quadrants:

Agrostis gigantean(p)*
Agrostis scabra
Aster pilosus
Avena (?)(p)*
Carex longii
Carex lurida
Chamaecrista fasiculata
Comptonia peregrina
Cyperus retrorsus
*Dianthus ameria**
Dichanthelium clandestinum
Dichanthelium sp. (acuminatum?)
Digitaria sanguinalis
Diodea teres
Eupatorium serotinum
Festuca rubra v. rubra (?)(p)*
Gamochaeta purpurea
*Hypochaeris radicata**
Juncus dichotomus
Juncus effusus
Juncus scirpoides
Juncus subcaudatus
Juncus tenuis
*Kummerowia striata**
*Lespedeza cuneata**
Lespedeza hirta
*Lotus corniculata**
Panicum virgatum (p)
Polygonum lapathifolium
*Polygonum perfoliatum**
*Rumex crispus**
Salix (nigra)
Schizachyrium scoparium (p)
*Setaria faberi**
Scirpus cyperinus
Sorgastrum nutans (p)
Solidago canadensis
Solidago tenuifolia

*Trifolium pretense**
*Trifolium procumbens**
Typha latifolia
*Verbascum blattaria**
*Vicia sp. (tetrasperma?)**
43 Species Total

∗ = 15 non-native
(p) = 6 planted
(Suspected species)
No protected species

Specimen Height: The landfill grasses differ in height depending on the age of the restoration area and the available soil moisture. The older plantings are those more than two seasons. These plants have mature basal leaves and are developing fruiting culms. Many of these culms reach more than 30 inches. Large plants are readily apparent along the northeastern edge of the landfill were the original planting occurred. A similar mature coverage of switch grass and Indian grass exists on the east facing side slopes of the landfill. The taller specimens have multiple vegetative sprouts and multiple fruiting culms. Measurements made at a reference population[1] found switch grass and similar grassland constituents can reach a height of 48" in more favorable conditions. The landfill site is more extreme due to its exposure, upland setting and recent development. The landfill vegetation is expected to achieve the mature height once the individual plants become established, begin to build a larger root mass and accumulate above ground biomass.


36"Switch Grass on slope


Younger warm season grasses with short stature

The younger plantings, those found on the southern and southwestern edge of the landfill, are only a season or two old. These areas support above ground growth of leaves that area no more than 10 inches. The same area also supports a cover that is less than 6 inches due to compressed soils and drought conditions. The grasses are healthy, but do not have the biomass or maturity to produce fruiting stalks this season.

Conclusion

The Stafford Township Landfill supports planted grassland composed of a variety of clump forming warm season species, dominated by switch grass. Three native warm season grasses were planted in 2007. Today these species are succeeding, with the best coverage on the eastern edge of the landfill and on moist substrates. Coverage is variable dependent on habitat extremes, specifically available soil moisture. Switch grass is the most frequent and occupies the most area of any of the recorded species.

[1] Switch grass meadow, south of Burlington County Route 542, Historic Batsto Village

Japanese clover, an invasive annual weed, is second to switch grass, but this plant is not expected to last but a few seasons.

Forty three species currently occupy space on the landfill. More than 30% of the current flora is composed of invasive annual alien species. Most species recorded in this setting are associated with the early succession conditions created by the landfill closure. One aggressive plant alien species, mile-a-minute, may require maintenance to eliminate it from the landfill area. The existing flora is composed of common species without unusual or protected species.

References

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Fernald, M.L. 1950. Grays Manual of Botany: 8th Edition. D. Van Nostrand Co., 1970 Printing.

Gleason, H. and C. Cronquist. 1991. Manual of Vascular Plants of Northeastern United States and Adjacent Canada. Second Edition. The New York Botanical Garden, Bronx, NY.

Kartesz, J. and C. Meacham. 1999. Synthesis of the North American Flora. Second Edition. A digitized checklist.

Appendix

Photographs of Samples and Site Conditions

Sample Data: Excel Spreadsheet Printout

Photo #1: Reference switch grass old field, Batsto Village

Photo #2: Mature switch grass on slopes below landfill cap

Photo #3: Sparse cover representing the lowest coverage areas.

Photo #4: Moderate grass cover at sample #1: Switch grass and fescue clumps.

Photo #5: Switch grass and Japanese clover at sample #11

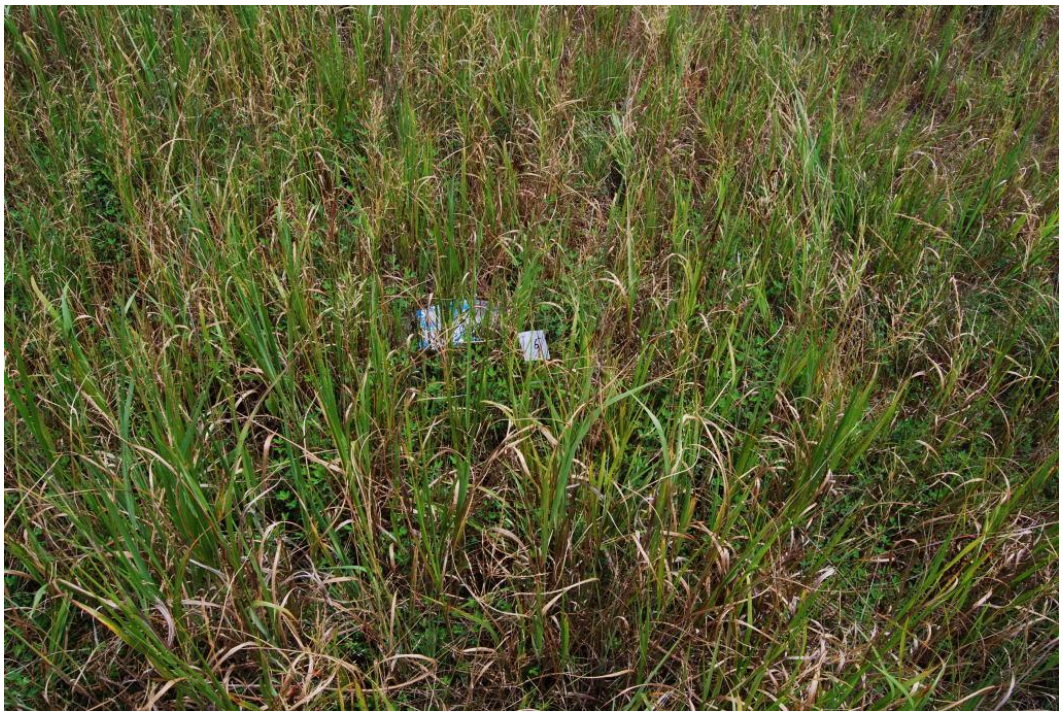

Photo #6: Dense switch grass with Japanese clover under story at sample #9

Photo #7: Mature switch grass on landfill southeast facing slope

Photo #8: Typical view of Stafford landfill grass cover dominated by switch grass.

Species / Sample #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	cover	Freq.	%
Agrostis gigantea	1			t										4	1	3	3						12	6	27.3
Festuca rubra	2	2	1	3	1	t	2	2	t	2										1	1		17	11	50
Panicum virgatum	2	2	1	1	2	1	3	3	2	1	2	3	2	2	3	3	2	1	3	2	2	2	45	22	100
Sorgastrun nutans	1		t		1				t						t							T	2	6	27.3
Kummerowia striata		3	1	t	2	2	2	t	t	1	3	1	3	2	4	3	2	3					32	17	77.3
Juncus dicotomus		1					t	t		t	1												2	5	22.7
Vicia sp.		t																					t	1	4.6
Carex longii			t			t		t	t			t								t			3t	6	27.3
Trifolium pratenses				t							1	t	t				t	t					1	5	22.7
Lespedeza cuneata																	t	1					2	2	9.1
Juncus effusus					2	1																	3	2	9.1
Juncus tenuis					t	t			1	t	t		1				t						2	8	36.4
Setaria faberi							t																t	1	4.6
Solidago tenuifolia								t		t	1						1						2	3	13.4
Solidago canadensis													t										t	1	4.6
Schizachryium scoparium														1	1	2	2	t	2			1	8	7	31.8
annual nurse grass												t			t		t	2					2	4	18.2
Eupatorium serotinum												1											1	1	4.6
Agrostis scabra													t										t	1	4.6
Carex lurida															t								t	1	4.6
Dichanthelium sp.																t							t	1	4.6
Dichanthelium clandestinum																						2	2	2	9.1
Total Cover Value	6	8 + t	3	4 + 2t	8 + t	4 + 3t	8 + t	5 + 3t	3 + 5t	4 + 3t	8 + t	5 + 3t	5 + 3t	9	9+2t	11+t	l0 + 3	7+2t	5	3+t	3	5	133		
cover estimates (%) = ave.	30	40	40	50	50	30	75	40	30	30	50	30	50	60	50	80	60	30	30	25	25	30	42.5		

22 Species in Plots

Mod	Dau Value %
t	trace
1	1 to 5
2	6 to 15
3	16 to25
4	26 to 50
5	50 to 75
6	75to100