Cover Page

Annual Report #1 (2013)

Crowland Mitigation through Restoration

of the Tamarack Bog, Bath Nature Preserve. Summit County Ohio.

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Completed July xx 2014

Appendices

Appendix A: VIBI Background Page ?????

Appendix B: Copies of all Field data sheets

Appendix C: List of Vouchers and Voucher numbers collected

The restoration plan and funding for this project were secured in October 2013. Because the original monitoring design assumed that monitoring would begin in early summer 2013, progress on some objectives was limited. Furthermore, delays in well installation prevented reporting on that work until Summer 2014.

Monitoring Methods and Results

VIBI Modules- Methods. We used a modified VIBI methodology (Mack 2007) to evaluate wetland quality. Our modifications largely involve the shape of individual modules to accommodate the challenging terrain, thick shrub vegetation, and sensitive habitat (especially in the core bog area). We modified the standard 10x10m VIBI module layout as shown in Figure 1. In this modified design we first established a central 25x1m access lane, then sampled 2m on either side of this lane. This design minimized trampling while allowing good access to the 4x25m sampling area.

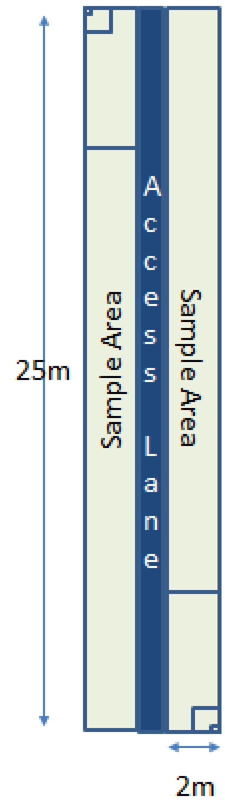


Figure 1. Modified VIBI intensive module design used in the tamarack bog project. Two sample areas of 2x25m are on either side of a central 1x25m access lane. In two of the outside corners we established nested quadrats of 10m², 1 m², and 0.1m².

We established 11 such modules (Figure 2): 3 in the core bog area, 4 adjacent to the wetland edge (near the delineated boundary of the wetland), and 4 that are potential areas of wetland expansion. Our intent was to: 1) use the core modules to evaluate whether the existing bog maintains its status during the restoration. 2) use the wetland Edge modules to evaluate whether conditions at the edge improve (e.g., become more boglike, and experience spread of sphagnum or other bog specialists). 3) use the Expansion modules (which generally had a noticeably peaty soil with a 'bounce', and seemed likely to improve if hydrology was restored) to evaluate wetland quality and the extent of responses to the restoration. We denoted each module in the field with permanent markers, and recorded gps coordinates. We sited modules to include representative habitat of each of the areas listed above.

In each module we used standard VIBI methods to assess presence and percent cover of herbaceous vegetation, along with both percent cover and stem abundance of different size classes of woody plants. We summarized these data using the OEPA's VIBI spreadsheet calculator available online.

VIBI Modules- Results**.** In 2013 we sampled all 11 100M^2 plots during August. We identified 178 taxa during our survey, including many peatland specialists (Table 1), but also substantial cover by undesirable (e.g., Red Maple, Crabapple), and invasive species (e.g., Buckthorn).

***Figure** 2 – Approximate locations of major landscape elements of the tamarack bog restoration. Yellow and orange dashed lines indicate approximate boundaries of major plant communities. Boxes indicate the 11 VIBI modules. The orange boxes are 'core' modules, the yellow boxes are 'edge' modules, and the green boxes are 'enhancement' modules. The 8 green lines indicate vegetation transects. The red T's indicate locations of the 8 tamarack trees.*

***Table 1.** Dominant plants (mean relative cover over 5%) from 2013 VIBI plots in each wetland area (mean relative cover for each species in parentheses)*

Enhancement (98 taxa)	**Wetland Edge (92 taxa)**	**Core (98 taxa)**
Acer rubrum (0.26)	*Pyrus coronaria (0.11)*	*Rhamnus frangula (0.13)*
Carya ovata (0.26)	*Acer rubrum (0.11)*	*Impatiens capensis (0.09)*
Acer saccharum (0.16)	*Impatiens capensis (0.09)*	*Osmunda cinnamomea (0.08)*
Parthenocissus quinquefolia (0.07)	*Rubus hispidus (0.07)*	*Alnus incana (0.08)*
	Thuidium delicatulum (0.07)	*Thuidium delicatulum (0.06)*
	Fraxinus pennsylvanica (0.06)	*Vaccinium corymbosum (0.06)*
	Pyrus sp. (0.05)	*Toxicodendron vernix (0.05)*

VIBI scores (based on the mean of the 3 or 4 100m^2 modules in each wetland area) were high for both Core and Edge habitats, and substantially lower for the Expansion area (Figure zz, Table 2). FQAI values (which summarize the weighted coefficient of conservatism across species from the VIBI analysis) showed the same trend but with less of a difference between the Expansion areas and the other two. The Core and Edge habitats scored high, but the Enhancement areas did not and have much more scope for improvement.

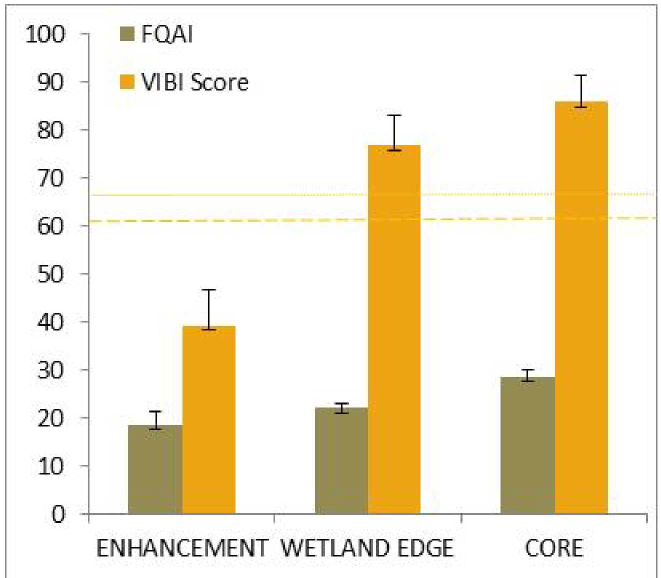


Figure zz. *FQAI and VIBI Scores for the three wetland areas. Values shown are means and SD; the two dashed lines represent performance standards set in the 401 permit – VIBI score of 66 for bog, and 61 for forested wetland; alternatively a 10 point improvement is also acceptable*

All three modules in the core bog had both *Sphagnum* sp. and Tamarack (*Larix laricina*), and two included *Carex atlantica* ssp *capillacea*. None of the modules in other areas contained those taxa. *Rubus hispidus* was present in 10 of 11 plots, being absent from only one enhancement area plot.

Table 2 – *VIBI-F metric scores (10 point scale), and overall score (100 point scale). Boldface for significant differences among areas via ANOVA (N=11).*

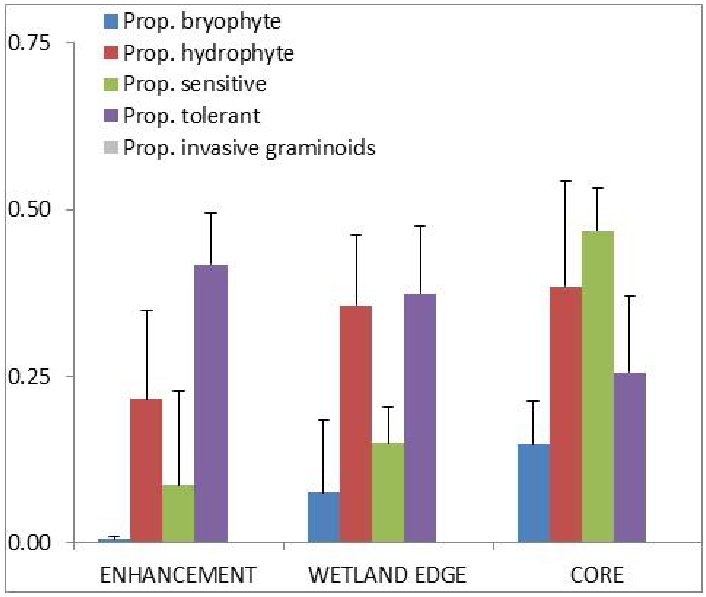
	Enhance-ment	Wetland Edge	Core	P value (ANOVA)
N Native Shade Spp. (Shade)	6.8	7.8	10.0	0.15
N Seedless Vascular Plant Spp. (SVP)	**5.8**	**10.0**	**10.0**	**0.03**
FQAI Score	**5.0**	**7.0**	**10.0**	**0.005**
Prop. Bryophyte Cover	**0.0**	**5.8**	**10.0**	**0.0007**
Prop. Hydrophyte Cover	6.0	9.3	9.0	0.27
Prop. Sensitive Plant Spp.	2.5	6.0	10.0	0.68
Prop. Tolerant Plant Spp.	2.3	3.3	6.7	0.14
Rel. Density Small Trees (Pole Timber)	5.0	10.0	6.7	0.34
Mean IV of Native Shade & Fac Shade subcanopy Spp. (subcanopy IV)	**1.8**	**9.3**	**7.7**	**0.02**
Mean IV of Canopy Spp. (canopy IV)	4.3	8.5	5.7	0.12
SCORE	**39.3**	**76.8**	**85.7**	**0.0001**

***TABLE 3**. Summary table for VIBI Metric values (raw scale) for Baseline Scores (2013). . Values shown are means for the modules in each area. Boldface for significant differences between areas using ANOVA.*

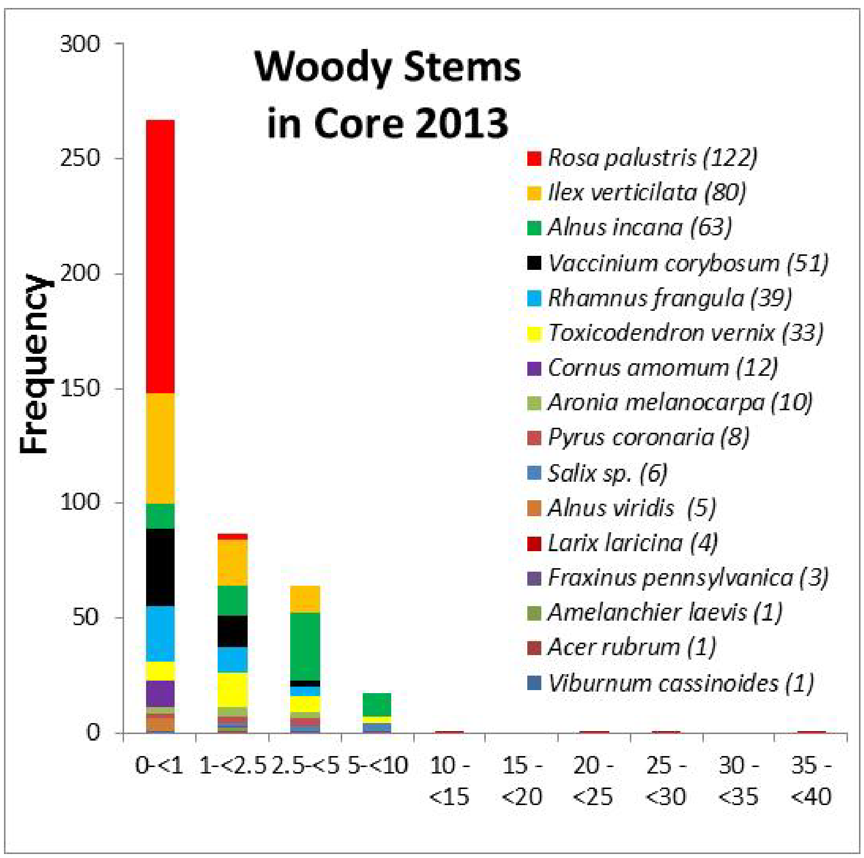
Metric	Enhancement (N=4)	Wetland Edge (N=4)	Core (N=3)
N Carex spp.	**3.50**	**2.25**	**4.00**
N Cyperaceae spp.	**3.50**	**2.25**	**4.00**
N native dicot spp.	24.75	31.00	33.00
N native shrub spp.	**1.00**	**6.00**	**7.33**
N native wetland shrubs (hydrophyte)	**14.00**	**25.00**	**33.67**
Ratio of annual to perennial spp. (A/P ratio)	0.18	0.23	0.19
Relative cover of invasive graminoids	0.0002	0.0000	0.0000
stems/ha wetland trees	800	1100	533
stems/ha wetland shrubs	**475**	**5,850**	**29,667**
Rel. cover annual & unvegetated (%unvegetated)	0.1216	0.1826	0.0980
Relative cover of buttonbush	0.0000	0.0005	0.0000
%perennial native hydrophytes	0.3901	0.4764	0.5840
Relative cover of adventives	0.0502	0.0307	0.1310
Relative cover of open water	0.00	0.00	0.00
Relative cover of unvegetated open water	0.00	0.00	0.00
Relative cover of bare ground	0.00	0.00	0.00
VIBI-F Metric 1- shade	***17.00***	***20.00***	***24.33***
VIBI-F Metric 2- SVP	***1.75***	***4.00***	***3.67***
VIBI-F Metric 3- FQAI	***18.44***	***22.08***	***28.47***
VIBI-F Metric 4- %bryophyte	*0.01*	*0.07*	*0.15*
VIBI-F Metric 5- %hydrophyte	*0.22*	*0.36*	*0.39*
VIBI-F Metric 6- %sensitive	***0.09***	***0.15***	***0.47***
VIBI-F Metric 7- %tolerant	*0.42*	*0.37*	*0.26*
VIBI-F Metric 8- small tree	*0.04*	*0.03*	*0.00*
VIBI-F Metric 9- subcanopy IV	***0.02***	***0.19***	***0.16***
VIBI-F Metric 10- canopy IV	*0.21*	*0.13*	*0.16*

Woody stems counts showed a very strong gradient in wetland shrub abundance across habitat types, with nearly 30,000 stems/ha in the core, 20% of that in the edge, and under 500/ha in the expansion zone. Both the Core and Wetland Edge areas meet the standard expressed in the mitigation documents (400/acre = 1000/ha). However, the Enhancement area is at about half of that value (475).

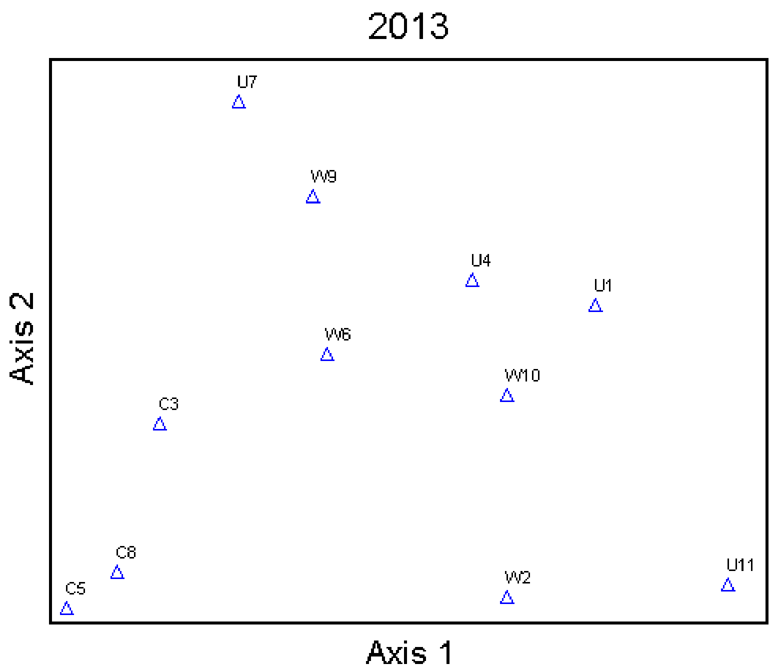
Proportion bryophytes, hydrophytes, and sensitive plants were lowest in the enhancement areas, and increased into the wetland edge and bog areas. In contrast, tolerant plants were least common in the bog core and more abundant in the enhancement zone. Almost no invasive graminoids were present in any modules.



Woody stems in the Core bog area were dominated by high quality wetland plants. *Rosa palustris* was almost exclusively <1cm DBH, and very common. *Ilex verticilata, Alnus incana, Vaccinium corymbosum*, and *Toxicodendron vernix* were the major components of the larger stem classes. The invasive *Rhamnus frangula* was next most abundant in total stem count, and was almost always under 2.5cm dbh (perhaps reflecting control efforts by volunteers over the past 5 years). Tamaracks were the only trees in the core areas with dbh over 10cm.



Ordination: We used Nonmetric multidimensional scaling analysis (PCORD-6.15; McCune and Mefford 2011) of relative cover values for the 2013 plots for ordination analysis. This revealed strong clustering of species similarity based on location, with the **C**ore plots tightly packed in one region (lower left), and the **W**etland edge and Enhancement (=**U**pland) plots distinctly different from them. The Enhancement plots were a very heterogenous group, but generally less similar to the Core plots than to the Wetland Edge plots?



A Cluster analysis of the same data reveals that although the core plots cluster together, the W and U plots have a more complicated set of similarity relationships.

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                    Distance (Objective Function)
        0.013           0.245           0.478           0.710           0.943
          |-------+-------+-------+-------+-------+-------+-------+-------+
                    Information remaining (%)
    100.000         75.000          50.000          25.000           0.000
          |-------+-------+-------+-------+-------+-------+-------+-------+
C3        -|
           |-----------|
C8        -|           |-------------|
                       |             |
C5        -------------|             |-------|
                                     |       |
W6        ---------|                 |       |
                   |-----------------|       |---------------------------|
W9        ---------|                         |                           |
                                             |                           |
U7        -----------------------------------|                           |
                                                                         |
W2        -------------------|                                           |
                             |---------------------------|               |
U11       -------------------|                           |               |
                                                         |---------------|
W10        |                                             |
           |----|                                        |
U1         |    |----------------------------------------|
                |
U4        -----|
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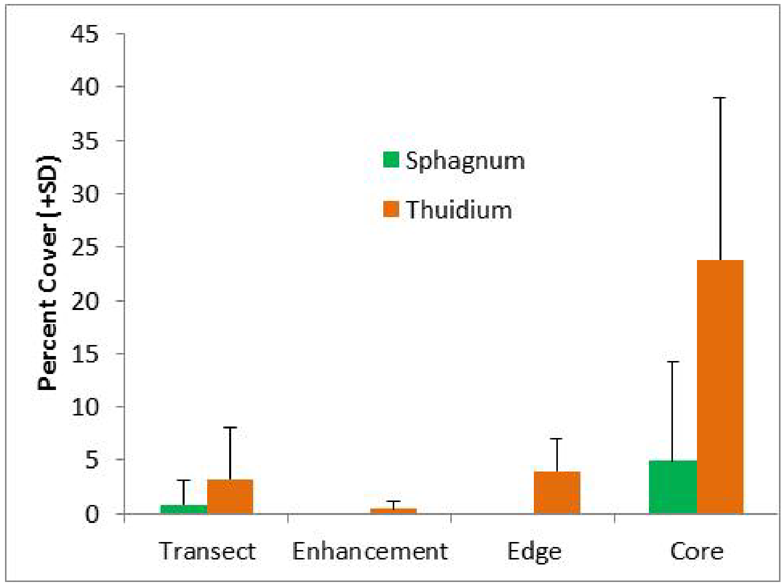
Sphagnum Reach. To evaluate coverage and potential expansion of *Sphagnum* moss, we established permanent 2x2m quadrats. We placed these quadrats at the permanent markers for the 11 VIBI plot corners (N=4×11=44), and on the wetland end of each of the 8 transects (N=1×8=8), for a total of 52 quadrats. In each quadrat we mapped the cover of sphagnum moss to quantify percent cover. Based on our observations during prior work in this bog we also decided to map and quantify cover of the fern moss *Thuidium delicatulum*, as well as cover of leaf litter on the ground surface. We found strong and significant (P<0.001 ANOVA) differences in all of these attributes. Sphagnum was not common overall, accounting for only 5% coverage in the Core areas, and almost none elsewhere. Overall, 11 of the 52 quadrats had any *Sphagnum*; 10 of 12 Core quadrats, and 1 of 8 Transect quadrats. *Thuidium* was much more abundant overall, and was also much more common in the core areas. Leaf litter differed dramatically among areas. Core bog areas had less than 3% leaf litter cover, while Edge and Enhancement areas had 71 and 77% cover respectively. The transect plots (all near the wetland delineation edge) had 43% litter coverage.



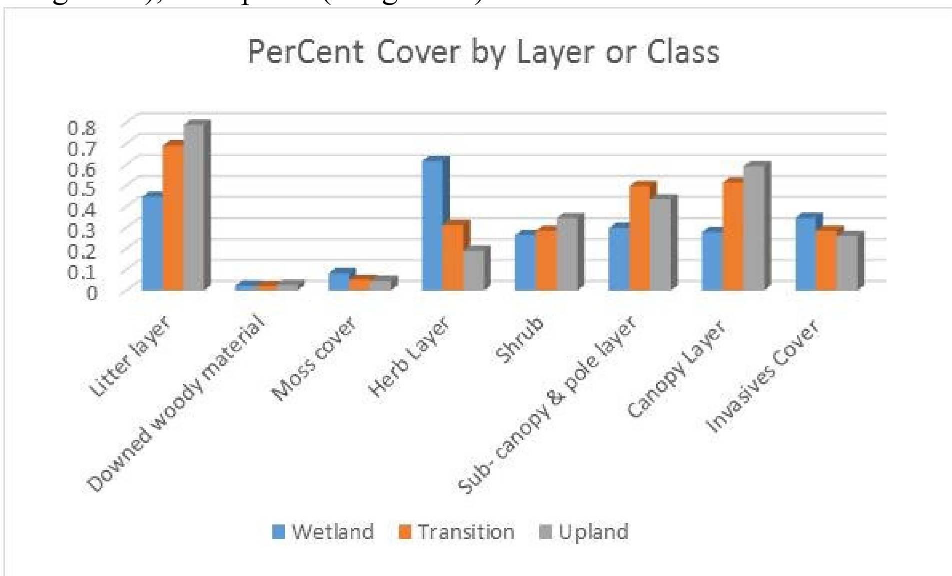
To develop a baseline for the current extent of sphagnum coverage we also recorded GPS positions for the most 'exterior' (furthest toward the upland area) sphagnum clumps along the perimeter of the bog. As of 2013 these points roughly coincide with the 'core bog' outline in Figure 1 (orange dashed line), and we will monitor whether the *Sphagnum* area expands over the course of the restoration.

DBH for living tamarack trees	N trees
15-20cm	3
20-25cm	0
25-30cm	2
30-35cm	1
35-40cm	2

Tamaracks. We searched for and found 8 living tamarack trees in the area (although Miletti et al. (2005) reported only 6 trees, all 8 we found were large and established (well over 8 years old), and so two were probably overlooked in that study). We targeted areas with tamarack trees when siting the VIBI plots, and gathered GPS and DBH data from them. There is also one slender dead tree that appears to have been a tamarack, and has been dead for some time (perhaps 5 years?), and several older standing dead that appear to be tamarack trees. We found no seedlings or other evidence of recruitment. All trees had produced at least some cones this year.

Repeat photography – because of the late start on this project we have not yet established repeat photography sites

Transects. To evaluate habitat status and future expansion outside of the core bog we established 8 transects radiating out from the bog (see Figure 1, green lines). Each transect extended from ~10m inside the delineated wetland boundary to upland habitat (determined by elevation and vegetation). Transects ranged from 40 to 100m in length. Every 10m along each transect we scored canopy coverage, hydrology, and soils. We considered each 10m portion of a transect as a 'segment'. We grouped the data across transects using soil description into wetland (19 segments), transition (13 segments), and upland (7 segments). In most cases the transect results match expectations, with clear gradients along the transition from wetland to upland habitat: litter increased, mosses decreased, herbs decreased, and canopy increased. Surprisingly, invasives decreased further from the bog, reflecting the high abundance of crabapples in the bog edge.



Invasives occurred in 32 of 44 10m segments along the transects. Crabapples and multiflora rose were the most common invasives; to our surprise they were each over twice as common as Buckthorn.

Invasives in transects		
Species	N blocks	% of blocks
Pyrus sp.	21	47.7
Rosa multiflora	18	40.9
Alliaria petiolata	12	27.3
Rhamnus frangula	11	25.0
Acer rubrum	10	22.7
Euonymous alatus	7	15.9
Ligustrum vulgare	6	13.6
Lonicera sp.	4	9.1
Phytolacca americana	1	2.3

Hydrological monitoring – Methods (From Dr. Ira Sasowsky and Karyna Mezentseva, UA Geology).

Dates: 12/03/13 and 12/05/13. A total of 11 borings were made using Geoprobe direct push method. Initial probing was done using a 2.25" diameter probe that collects a 1.25" diameter sample. Samples were collected from all borings using clear acrylic liners, 48 inches in length. The boring numbers and status are given in the summary table. The liners were cut open in the field for examination. All samples were photographed. The samples were later closed up, and wrapped in Saran wrap for preservation and later testing. It was typical that the first 4' push returned <4' of sample (compression). It was also typical that deeper samples would fill a 4' core with only 3' of push (expansion). The typical sampling core-column was organic matter on top, followed by brown clay, and then gray clay. The gray clay had occasional pebbles in it. A few holes had sand or gravel layers. Many holes were dry. Wells that were completed (i.e. screen and pipe installed) are 1.5" inner diameter white PVC, with pre-packed screens of 5' length. They are installed in a 3.25" diameter pushed hole. Riser pipe is screwed together. Sand was poured in to the annulus after screens were placed, and a weighted line was used to try and allow 2' of sand above top of screen. Annulus was then backfilled to surface with granular bentonite.

Date: 03-15-2014. The purpose of field work was to install several hand-drilled wells within the bog boundaries for water level and chemical monitoring. Possible auger well locations were previously selected. Map with wells positions was created in a GIS program Global Mapper. Disto laser distance meter and tape measure along with Brunton bearing (corrected for 8 degree declination) were used to get the approximate position for the new borings. A 4.2 feet long and 0.3 foot width bucket auger, with 3 feet extensions, was used for creating the borings.

Total number of installed augured was wells 5. Two wells at different depth (long and shorter) were installed at the spot # 7 and 8 in order to calculate hydraulic gradient at those places. Boreholes were made by twisting an auger directly into the peat with subsequent placing of PVC 1" x1'SDR-21 PR 200 PSI pipes (outer and inner diameter s are1.25 and 1.125 inches, respectively). Filters made of dense cotton thread were designed by Tom Quick (Research Associate at the Department of Geosciences, the University of Akron) and attached to the bottoms of the PVC pipes in order to prevent pipes from clogging by sediment. Total length of filter was 13.5". Mud and peat samples were laid out on the yellow cloth, described, collected in Ziploc bags, appropriately labeled. All samples were photographed. Generally, samples made of somewhat muddy layer on the top that gradually changes into wet partially decomposed organic layer sometimes abundant with woody fragments. Consistently graded medium grit sand Arena Mediana and granular bentonite were poured into the annulus to isolate the sampling interval in the wells. Due to the unstable nature of the borehole walls, and the small annular space, it was not possible to quantify the height of sand placed in the screened intervals.

Auger wells characteristics

Well #	Total depth of probing, (ft)	Length of the tube, (ft)	Stick-up, (ft)	Notes
7	23 ft	21 ft 1.5 in	1 ft 10 in	Whole profile made of some mud and peat on the top up to 8-10 feet, other part of borehole just a body of water without any sediment recovery below13 feet depth.
7A	7 ft 3 in	11 ft 1 in	3 ft 10 in	Bad sample recovery due to the abundance of roots along the whole profile.
8	16 ft	15 ft 8.5 in	1 ft 9.25 in	Good recovery for each sample.
8A	7 f 2.5 in	11 ft 1.5 in	3 ft 11 in	Pretty dry well, no standing water was found up to the depth 5 feet,
9	7 ft 11.5 in	11 ft 1.5 in	3 f 1 in	All sample are very resistant and dense

Well #	# of interval	Depth interval, ft	Total depth of section (segment), ft	Sediment description
7A	1	0-2 ft 5 in	2 ft 5 in	Very wet mud with roots
	2	2 ft 5 in-3 ft 2 in	9 in	Very wet mud with roots
	3	3 ft 2 in- 5 ft 9 in	2 ft 7 in	Very moist undecomposed peat with a lot of roots
	4	5 ft 9 in – 7 f 3 in	1 ft 6 in	Very moist undecomposed peat with a lot of roots
8	1	0-11 in	11 in	Dark wet saturated mud with organic material
	2	11 in-3 ft 9 in	2 ft 10 in	Dark moist mud with organics
	3	3 ft 9 in-4 ft 1 in	4 in	Dark moist mud with organics
	4	4 ft 1 in-6 ft 2 in	2 ft 1 in	Dark undecomposed peat
	5	6 ft 2 in-7 ft 2 in	1 ft	Dark undecomposed peat
	6	7 ft 2 in- 8 ft 4 in	1 ft 2 in	Dark undecomposed peat
	7	8 ft 4 in – 8 ft 8 in	4 in	Peat with a lot of woody fragments
	8	8 ft 8 in-9 ft 10 in	1 ft 2 in	Resistant peat full of woody fragments
	9	9 ft 10 in-13 ft 4 in	3 ft 6 in	Organic dark peat
	10	13 ft 4 in-16 ft 4 in	3 ft	Organic dark peat
9	1	0-10 in	10 in	Dump granular mud
	2	10 in -1ft 10 in	1 ft	Moist mud, dense
	3	1 ft 10 in-2 ft 11 in	1 ft 1 in	Wet mud, very resistant
	4	2 ft 11 in-3 ft 11 in	1 ft	Moist ark organic peat
	5	3 ft 11 in - 4 ft 3 in	4 in	Dense black peat with a lot of woody fragments
	6	4 ft 3 in – 5 ft 2 in	11 in	Moist peat with some woody fragments
	7	5 ft 2 in -5 ft 9 in	7 in	Moist peat
	8	5 ft 9 in -6 ft 5 in	8 in	Moist dense peat, very resistant
	9	6 ft 5 in -7 ft 11 in	1 ft 6 in	Dark dense moist peat

Hydrological monitoring – Results to date.

Summary table for all wells/borings at the Tamarack Bog, Bath Nature Preserve

ID	Date	*a)* Comp-letion type	Install-ation method	*b)* Position	*c)* Land Elev-ation, ft	*d)* Depth of boring below ground surface, ft	Screen depth below ground surface, ft	*e)* Stick up, ft	*f)* Land elev-ation, ft	*b)* Top of casi ng, ft
1	12/3/13	Boring	Geoprobe	N41 10.706 W81 38.662	1012	17'11"	-*	-	-	1048
1A	12/3/13	Well	Geoprobe	N41 10.695 W81 38.662	1000	27'	7'-12'	2'9"	1039'3"	1042
2	12/3/13	Boring	Geoprobe	N41 10.616 W81 38.692	1011	22'	-	-	-	1055
2A	12/3/13	Well	Geoprobe	N41 10.624 W81 38.678	998	14'	9'-14'	2'5"	992'7"	995
3	12/3/13	Boring	Geoprobe	N41 10.692 W81 38.741	1012	26'	-	-	-	1053
4	12/5/13	Boring	Geoprobe	N41 10.573 W81 38.524	997	21'	-	-	-	984
5	12/5/13	Boring	Geoprobe	N41 10.667 W81 38.524	1024	30'	-	-	-	1036
5A	12/5/13	Boring	Geoprobe	N41 10.652 W81 38.535	1005	24'	-	-	-	1055
5B	12/5/13	Well	Geoprobe	N41 10.646 W81 38.561	995	28'	21' -26'	3'2"	1006'10"	1010
5C	12/5/13	Well	Geoprobe	N41 10.648 W81 38.560	995	16'	10'-15'	2'6"	1000'6"	1003
6	12/5/13	Well	Geoprobe	N41 10.568 W81 38.656	1002	16'	8'-13'	2'01"	993'	995
7	3/15/14	Well	Auger	N41.17723 W 81.64360	995	23'	19'3"- 18'1.5"	1'10"	968'11"	970
7A	3/15/14	Well	Auger	N41.17725 W81.64362	995	7'3''	7'3''- 6'1.5"	3'10.5"	980'1.5"	984
8	3/15/14	Well	Auger	N41.17766 W81.64432	995	16'	13'11.25"- 12'9.75"	1'9.25"	1014'2.5"	1016
8A	3/15/14	Well	Auger	N41.17768 W81.64432	995	7'25"	7'2.5"- 6'1"	3'11"	1034'1"	1038
9	3/15/14	Well	Auger	N41.17681 W 81.64310	995	7'11"	7'11.5"- 6'10"	3' 1"	997'1"	1001

"-" -not applicable,
a – Only select borings were completed as wells,
b – Measured by GPS placed on the top of casing or stake, 100 point average, do not trust,
c – Elevations derived from Lidar data using Global Mapper,
d – Reported by driller,
e – Measured by tape,
f –Determined by subtracting stick up values from top of the casing wells.

Appendix C: List of Vouchers and Voucher numbers (224 specimens total in 2013)

Specimen #	TAXON	Family	Voucher number
2013-101	*Carex sp2*	Cyperaceae	voucher 1-#2
2013-109	*Dryopteris cristata*	Aspleniaceae	Voucher S1.01
2013-111	*Carex bromoides (?)*	Cyperaceae	Voucher S1.02
2013-110	*Ulmus americana*	Ulmaceae	Voucher S1.03
2013-141	*Galium sp.*	Rubiaceae	Voucher s1.04
2013-202	*Leersia virginica*	Poaceae	Voucher S1.06
2013-112	*Spiraea alba (?)*	Rosaceae	Voucher S1.06
2013-104		Aspleniaceae	Voucher S1.07
2013-102	*Solidago uliginosa*	Asteraceae	Voucher s1.08
2013-105	*Ilex verticillata*	Aquifoliaceae	Voucher s1.09
2013-108	*Viburnum dentatum*	Caprifoliaceae	Voucher s1.10
2013-265			Voucher S10.01
2013-266			Voucher S10.02
2013-267			Voucher S10.03
2013-205a	*Pyrus sp*	Rosaceae	Voucher S10.04
2013-206b	*Pyrus sp*	Rosaceae	Voucher S10.05
2013-268			Voucher S11.01
2013-269	*Polytrichum sp*	Polytrichaceae	Voucher S11.02
2013-270			Voucher S11.03
2013-199	*Carex sp.*	Cyperaceae	Voucher S11.04
2013-271			Voucher S11.05
2013-212	*Cornus amomum*	Cornaceae	Voucher S11.08
2013-210	*Ribes hirtellum*	Grossulariaceae	Voucher S11.10
2013-155	*Carex sp.*	Cyperaceae	Voucher S2
2013-157	*Solidago uliginosa*	Asteraceae	Voucher S2.0
2013-275	*Carex sp (serosa?)*	Cyperaceae	Voucher s2.02
2013-154	*Amelanchier fernaldii??*	Rosaceae	Voucher S2.04
2013-166	*Fraxinus sp.*	Oleaceae	Voucher S2.05
2013-238	*Fern 2*	Aspleniaceae	Voucher S2.09
2013-164	*Aster lateriflorus*	Asteraceae	Voucher S2.10
2013-163	*Sium suave*	Apiaceae	Voucher S3.05
2013-165	*Rosa palustris*	Rosaceae	Voucher S3.07
2013-156	*Alnus incana*	Betulaceae	Voucher S3.08
2013-158	*Chelone glabra*	Scrophulariaceae	Voucher S3.09
2013-167	*Carex crinita*	Cyperaceae	Voucher S4.01
2013-168	*Carex cristatella*	Cyperaceae	Voucher S4.02

2013-151	*Climacium sp*	Climaceaceae	Voucher S4.03
2013-254	*Carex stellulata*	Cyperaceae	Voucher S4.04
2013-146	*Prunus virginiana*	Rosaceae	Voucher S4.05
2013-145	*Moss sp*		Voucher S4.06
2013-255	*Carex sp.*	Cyperaceae	Voucher S4.07
2013-129	*Alnus viridis*	Betulaceae	Voucher S5.03
2013-148	*Rhamnus alnifolia*	Rhamnaceae	Voucher S5.05
2013-257	*Carex sp.*	Cyperaceae	Voucher S5.06
2013-152	*Viburnum cassinoides*	Caprifoliaceae	Voucher S5.09
2013-143	*Salix sp*	Salicaceae	Voucher S5.11
2013-121	*Viburnum dentatum (recognitum)*	Caprifoliaceae	Voucher s5.13
2013-153	*Rumex verticilatus??*	Polygonaceae	Voucher S5.14
2013-149	*Dryopteris marginalis (?)*	Aspleniaceae	Voucher S5.15
2013-150	*Dryopteris marginalis (?)*	Aspleniaceae	Voucher S5.15
2013-122	*Vitis sp.*	Vitaceae	Voucher S6.01
2013-256	*Sporobolus sp??*	Cyperaceae	Voucher S6.03
2013-124	*Galium sp.*	Rubiaceae	Voucher S7.01
2013-123	*Carex sp.*	Cyperaceae	Voucher S7.02
2013-207	*Amphicarpaea bracteata*	Fabaceae	Voucher S7.03
2013-125	*Galium 'bigger'*	Rubiaceae	Voucher S7.05
2013-127	*Clematis virginiana*	Ranunculaceae	Voucher S7.09
2013-258	*Sphagnum sp.*	Sphagnaceae	Voucher S8.01
2013-259			Voucher S8.02
2013-260			Voucher S8.03
2013-261			Voucher S8.04
2013-200	*Galium sp.*	Rubiaceae	Voucher S8.05
2013-209	*Carex sp.*	Cyperaceae	Voucher S8.06
2013-208	*Carex atlantica (capillaceae)*	Cyperaceae	Voucher S8.07
2013-204	*Aster sp*	Asteraceae	Voucher S9.01
2013-262			Voucher S9.02
2013-263			Voucher S9.03
2013-264			Voucher S9.04
2013-203	*Pyrus sp.*	Rosaceae	Voucher S9.06
2013-201	*Populus deltoides*	Salicaceae	Voucher S9.07
2013-183	*Actinomeris alternifolia*	Asteraceae	
2013-037	*Alliaria petiolaris (officinalis)*	Brassicaceae	
2013-225	*Alnus incana*	Betulaceae	
2013-038	*Arisaema atrorubens*	Aracea	

2013-170	*Aronia melanocarpa*	Rosaceae
2013-015	*Aronia melanocarpa*	Aquifoliaceae
2013-030	*Aronia melanocarpa*	Rosaceae
2013-221	*Aronia melanocarpa*	Rosaceae
2013-235	*Aronia melanocarpa*	Rosaceae
2013-233	*Aster parviceps?*	Asteraceae
2013-273	*Atrichum undulatum*	Polytrichaceae
2013-181	*Berberis thunbergii*	Berberidaceae
2013-234	*Betula alleghaniensis*	Betulaceae
2013-229	*Bidens cernua*	Asteraceae
2013-178	*Calamagrostis canadensis*	Poaceae
2013-169	*Carex hystericina?*	Cyperaceae
2013-036	*Carex atlantica*	Cyperaceae
2013-047	*Carex atlantica (capillacea)*	Cyperaceae
2013-032	*Carex atlantica (capillaris)?*	Cyperaceae
2013-028	*Carex atlantica (serosa)*	Cyperaceae
2013-029	*Carex auctata?*	Cyperaceae
2013-033	*Carex bromoides*	Cyperaceae
2013-134	*Carex bromoides (?)*	Cyperaceae
2013-043	*Carex comosa*	Cyperaceae
2013-133	*Carex cristatella*	Cyperaceae
2013-020	*Carex cristatella*	Cyperaceae
2013-042	*Carex gracillima*	Cyperaceae
2013-008	*Carex lacustris*	Cyperaceae
2013-035	*Carex leptalaea*	Cyperaceae
2013-040	*Carex leptalaea*	Cyperaceae
2013-135	*Carex lupulina (or lupliformis)*	Cyperaceae
2013-162	*Carex sp2*	Cyperaceae
2013-031	*Carex stipata*	Cyperaceae
2013-198	*Carpinus caroliniana*	Betulaceae
2013-277	*Carpinus caroliniana*	Betulaceae
2013-216	*Cephalanthus occidentalis*	Rubiaceae
2013-195	*Cephalanthus occidentalis*	Rubiaceae
2013-219	*Chelone glabra*	Scrophulariaceae
2013-173	*Cinna arundinacea*	Poaceae
2013-223	*Cinna arundinacea*	Poaceae
2013-217	*Clematis sp.*	Ranunculaceae
2013-016	*Cornus amomum*	Cornaceae

2013-115	*Cornus amomum*	Cornaceae
2013-139	*Cornus amomum*	Cornaceae
2013-144	*Cornus amomum*	Cornaceae
2013-184	*Cornus racemosa*	Cornaceae
2013-215	*Crataegus sp*	
2013-160	*Cuscuta gronovii*	Convolvulaceae
2013-191	*Cuscuta gronovii*	Convolvulaceae
2013-278	*Cuscuta gronovii*	Cyperaceae
2013-242	*Cystopteris bulbifera*	Aspleniaceae
2013-231	*Decodon verticillatus*	Lythraceae
2013-240	*Dryopteris carthusiana*	Aspleniaceae
2013-253	*Dryopteris cristata*	Aspleniaceae
2013-137	*Epilobium cf glandulosum*	Onagraceae
2013-218	*Epilobium ciliatum*	Onagraceae
2013-174	*Euonymus alatus*	Celastraceae
2013-180	*Eupatorium perfoliatum*	Asteraceae
2013-224	*Fraxinus pennsylvanica*	Oleaceae
2013-044	*Galium*	Rubiaceae
2013-159	*Galium asperellum*	Rubiaceae
2013-279	*Galium asperellum*	Rubiaceae
2013-138	*Galium tinctorium*	Rubiaceae
2013-018	*Geum canadense*	Rosaceae
2013-011	*Glyceria striata*	Poaceae
2013-041	*Glyceria striata*	Poaceae
2013-230	*Glyceria striata*	Poaceae
2013-274	*Hypnum sp.*	Hypnaceae
2013-248	*Ilex verticillata*	Aquifoliaceae
2013-250	*Ilex verticillata*	Aquifoliaceae
2013-014	*Ilex verticillata*	Aquifoliaceae
2013-118	*Ilex verticillata*	Aquifoliaceae
2013-172	*Juncus tenuis*	Juncaceae
2013-246	*Leersia oryzoides*	Poaceae
2013-171	*Leersia virginica*	Poaceae
2013-272	*Leucobryum glaucum*	Leucobryaceae
2013-119	*Lonicera sp. (Maackii?)*	Caprifoliaceae
2013-177	*Lotus corniculatus*	Fabaceae
2013-034	*Luzula acuminata*	Juncaceae
2013-120	*Lycopus americanum?*	Lamiaceae

2013-185	*Lysimachia ciliata*	Myrsinaceae
2013-128	*Lysimachia nummularia*	Lythraceae
2013-046	*Lysimachia thrysiflora*	Lythraceae
2013-194	*Malus coronaria*	Rosaceae
2013-131	*Mentha piperita L.*	Lamiaceae
2013-190	*Mimulus alatus*	Phrymaceae
2013-132	*Ostrya virginiana*	Betulaceae
2013-175	*Panicum*	Poaceae
2013-214	*Phalaris arundinaceae*	Poaceae
2013-017	*Physocarpus opulifolius*	Rosaceae
2013-130	*Phytolacca americana*	Phytolaccaceae
2013-113	*Pilea pumila*	Urticaceae
2013-252	*Pilea pumila*	Urticaceae
2013-136	*Poa sp ?*	Poaceae
2013-193	*Polygonum arifolium*	Polygonaceae
2013-232	*Polygonum arifolium*	Polygonaceae
2013-237	*Polygonum arifolium*	Polygonaceae
2013-188	*Polygonum sagittatum*	Polygonaceae
2013-228	*Polygonum sagittatum*	Polygonaceae
2013-245	*Polygonum sagittatum*	Polygonaceae
2013-103	*Polygonum virginianum*	Polygonaceae
2013-147	*Polytrichum sp*	Polytrichaceae
2013-213	*Populus deltoides*	Salicaceae
2013-222	*Populus grandidentata*	Salicaceae
2013-226	*Prunus virginiana OR amelanchier*	Rosaceae
2013-247	*Pyrus sp*	Rosaceae
2013-012	*Pyrus sp*	Rosaceae
2013-176	*Pyrus sp 3*	Rosaceae
2013-161	*Pyrus sp 3*	Rosaceae
2013-276	*Pyrus sp 3*	
2013-249	*Pyrus sp#2*	Rosaceae
2013-179	*Quercus rubra*	Fagaceae
2013-048	*Rhamnus alnifolia*	Rhamnaceae
2013-049	*Rhamnus frangula*	Rhamnaceae
2013-196	*Rhamnus frangula*	Rhamnaceae
2013-251	*Rhamnus frangula*	Rhamnaceae
2013-114	*Rosa multiflora*	Rosaceae
2013-182	*Rubus allegheniensis*	Rosaceae

2013-241	*Rubus allegheniensis*	Rosaceae
2013-013	*Rubus hispidus*	Rosaceae
2013-236	*Rubus hispidus*	Rosaceae
2013-116	*Rubus occidentalis*	Rosaceae
2013-107	*Salix - perhaps pedicellaris*	Salicaceae
2013-142	*Salix sp*	Salicaceae
2013-021	*Sambucus canadensis*	Caprifoliaceae
2013-244	*Scutellaria lateriflora*	Lamiaceae
2013-186	*Scutellaria laterifolia*	Lamiaceae
2013-039	*Sium*	Apiaceae
2013-189	*Sium suave*	Apiaceae
2013-227	*Solidago patula*	Asteraceae
2013-220	*Symphyotrichum (Aster) puniceus*	Asteraceae
2013-187	*Symplocarpus foetidus*	Araceae
2013-007	*Thuidium delicatulum*	Thuidiaceae
2013-208	*Thuidium delicatulum*	Thuidiaceae
2013-045	*Triadenum fraseri*	Clusiaceae
2013-197	*Trifolium dubium*	Fabaceae
2013-106	*Ulmus americana*	Ulmaceae
2013-192	*Ulmus americana*	Ulmaceae
2013-117	*Urtica procera*	Urticaceae
2013-243	*Vaccinium corymbosum*	Ericaceae
2013-001	*Vaccinium corymbosum*	*Ericaceae*
2013-140	*Verbena urticifolia*	Verbenaceae
2013-019	*Verbesina alternifolia*	Asteraceae
2013-239	*Viburnum dentatum*	Caprifoliaceae
2013-022		Poaceae
2013-211		Poaceae