North Carolina Botanical Garden
Native Plant Studies Program: Independent Study Project

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Title: Shallow Groundwater Hydrology and Wetland Vegetation in a Field in the Mason Farm Biological Reserve

Introduction:

The purpose of the project was to measure the depth and seasonal fluctuations of the shallow water table at an abandoned farm field in the Mason Farm Reserve using installed groundwater wells and rainfall data. This information, together with species data collected through vegetation surveys of the field to determine the extent of existing wetland-classified vegetation, along with a soil evaluation, will help gauge both the suitability of this particular field for a future wetland restoration project, and help make suitable recommendations as to any potential planted wetland species or restoration design. The site of interest is a cleared former farm field approximately 5.5 acres in size located in the Mason Farm Biological Reserve near Morgan Creek in Orange County, NC (Figure 1).

Wetlands provide many important benefits to a watershed, including nutrient and pollutant reductions, water storage during flood events, and wildlife habitat. Unfortunately, many acres of wetlands have historically been filled or drained for development or agricultural use. Over time, this reduction has had a measurable impact in watersheds, with increased incidents of harsher flooding, greater pollutant loading into adjacent streams, decreased wildlife diversity and numbers, and increased streambank erosion from elevated stream flow volumes during storm events. In the past few decades, scientists and governments have recognized this as a serious problem and have begun encouraging the preservation, restoration, and/or creation of new wetlands to replace those lost in our watersheds.

Methods and Materials:

To begin collecting water table data, six shallow groundwater wells were installed on September 8, 2007. This just happened to be in the middle of an intense drought affecting the entire southeastern United States throughout that summer and autumn. Each well was a 5' long, 2” diameter slotted PVC screen with a 4” long pointed bottom end cap and a flat screw-on top cap (Figure 2). Each of the wells had a seamless polyester mesh filter sleeve or 'filter sock' covered over them to help prevent fine sediments from clogging the slots along the screen.

The wells were fairly evenly distributed throughout the field, though a slightly greater concentration was emphasized on the southern end as I initially suspected this would be the most marginally ‘wet’ portion and wanted more data to be collected here (Figure

3). They were each approximately 4' deep, with about 12" sticking up above ground. The extremely dry soil at this depth at the time of installation began to collapse the hole at around the 4' depth as so I was unable to place them any deeper, thus I was unable to determine any groundwater table depths below 4 feet. The remaining space around each well was then backfilled with #2 coarse sand up to the top 6", at which point bentonite clay 'hole-plug' was used the rest of the way to the surface to create a seal to prevent surface runoff from flowing into the well (Figure 4).

Once installed, the wells were checked at least once a month, although often more frequently, to measure the depth to water table (36 times in 21 months by the conclusion of the measuring effort). A tape measure and flashlight were all that were needed to determine water depth.

As a complement to the groundwater well data, I kept a log of the rainfall for the site using the State Climate Office's Multi-Sensor Precipitation Estimate (MPE) program. Given the latitude and longitude of any location in the state, this program uses information from virtually of all of the atmospheric weather stations across North Carolina to give an accurate estimate of the precipitation that fell there. Using this data, I was going to try and identify seasonal trends or relationships between the two.

In addition to the groundwater data, I conducted two informal vegetation surveys in 2008 (one in the Spring and one in the Summer) with Mr. Mike Kunz of the NC Botanical Garden staff. We informally divided up the field into 6 general areas and attempted to identify as much of the vegetation growing there as possible, marking down how dominant each species was at that location. I chose the particular timing of the walkovers to hopefully coincide with the flowering/blooming of as many species as possible. Once completed, I then consulted the EPA’s wetland vegetation manual for our region and marked down each species’ wetland indicator status. Basically, much of the vegetation in every region of the United States is classified along a gradient of how frequently it usually occurs in a wetland as follows:

OBL > FACWet > FAC+ > FAC > FAC- > FACUp > UPL
Wetter   Wet   Neutral   Dry   Drier

Once each plant was identified with its wetland indicator status, I simply looked to see what percentage of the total number of species identified were FAC or wetter, as per the US Army Corps of Engineers 1987 Wetland Delineation Manual procedure. Using this information I attempted to correlate groundwater table depths with the incidence of wetland vegetation present for various locations around the site.

I have also included the soils information for the site as available online from Web Soil Survey. Although now available for free on the internet, the soils data found here is the same as from the older county soil survey manuals, simply in a more convenient format. Quick, routine soil sampling conducted on the farm field in the summer of 2008 generally confirmed the findings from the survey.
Web Soil Survey link: http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm

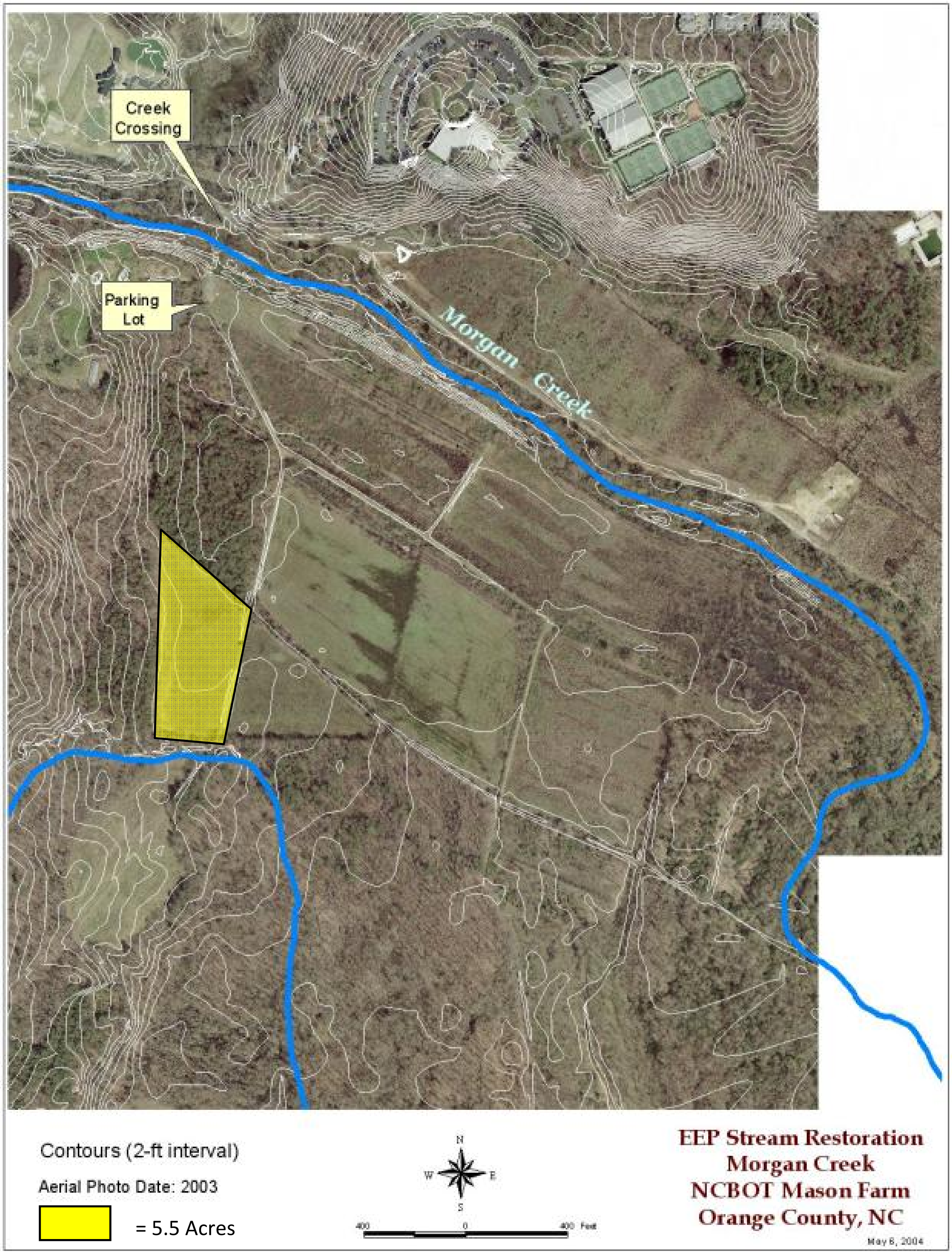


Figure 1. Mason Farm Biological Reserve field vicinity map

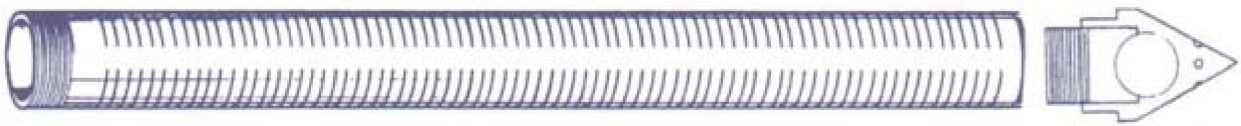


Figure 2. A diagram of a slotted groundwater well with end cap

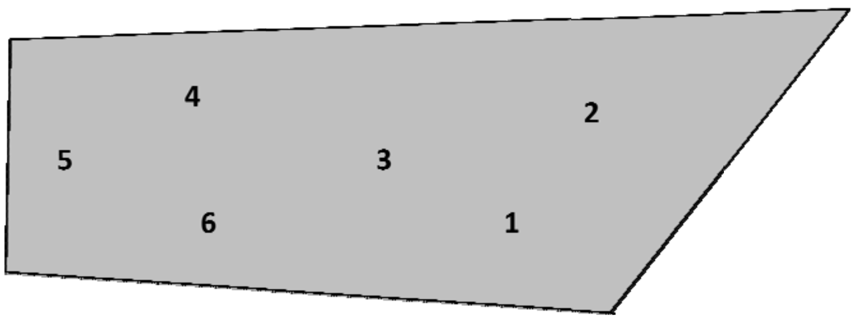


Figure 3. General Locations of Installed Wells in the Field

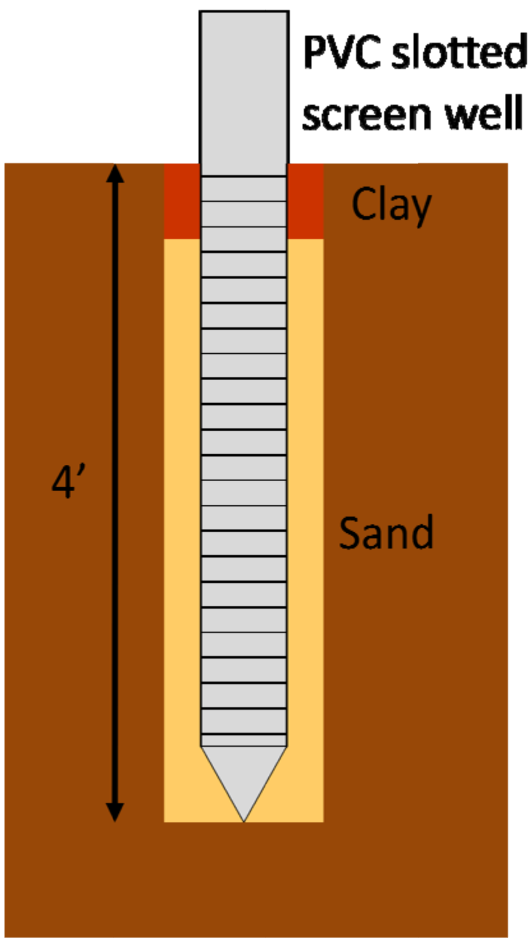


Figure 4. A diagram of an installed slotted screen groundwater well

Results and Discussion:

Water Table Data

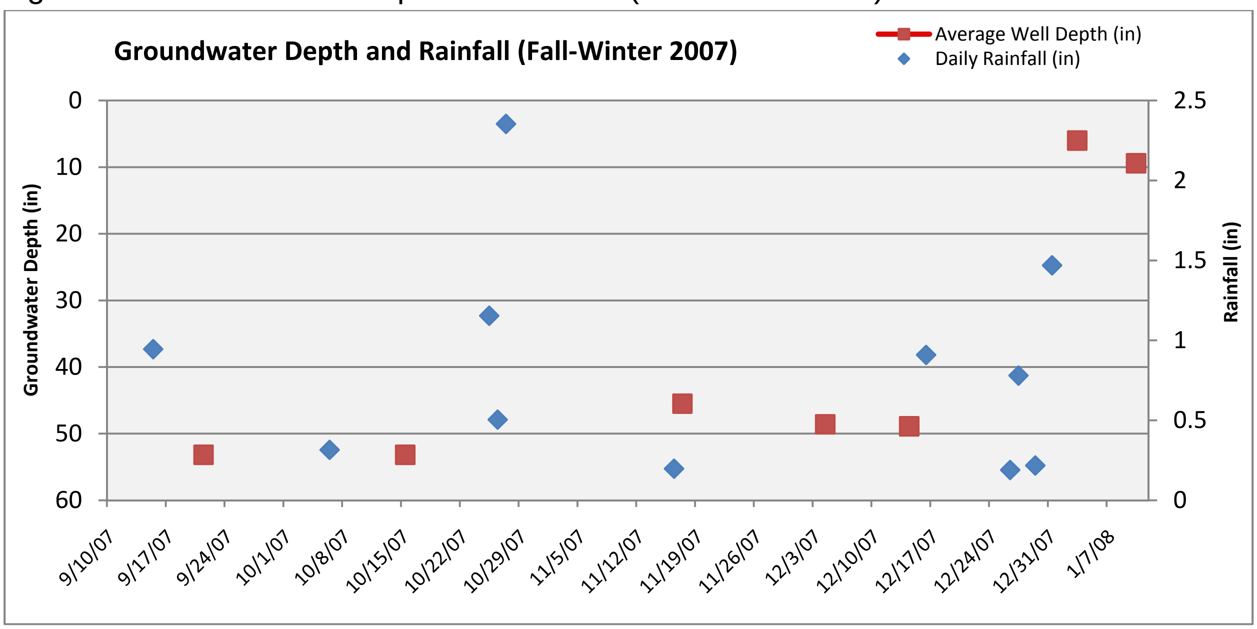
In Figures 5, 6, and 7 (located at the end of the report in the Attachments section due to their large size) we see the complete data set for each of the wells and the rainfall events. The sheer size of each set makes it very difficult to understand what is going on for anything beyond the 'big picture'. So, in order to more clearly understand what is taking place in the field, and due to the highly correlated nature of the well measurements, I have elected to average the well depths and compare them to rainfall events to observe any trends or connections between or among rainfall, the season, and then groundwater table.

Figures 8, 9 and 10 (also located in the Attachments section) show overall average groundwater depths for all six wells overlayed with daily rainfall amounts, total weekly, and then total monthly rainfall events. I had hoped this would make the data easier to evaluate but was quite disappointed with the results. I then decided to look at things even more closely, using the seasons as general blocks of time to analyze the data.

A complete set of the entire data string generated for this project can be found in a Microsoft Excel file attached as a CD associated with this report. This file also contains the data for all other aspects of this project as well.

Fall-Winter 2007 (Figure 11):
The water table monitoring effort began in the fall of 2007 during the midst of one of the worst droughts the southeast had experienced in decades. As such, little rainfall was recorded throughout the summer and fall (a total of just 8.4" from 7/1/07 to 12/15/07!) and not surprisingly water table levels remained quite deep (about 50"). However, beginning in mid-December 2007 a series of rain events totalling 3.5" broke the drought and the water table climbed up to 6" by early January where it remained fairly high over the remainder of the winter. Over this 20 day period, the water table rose a total of 43" or an average of 2.2" per day - most impressive!

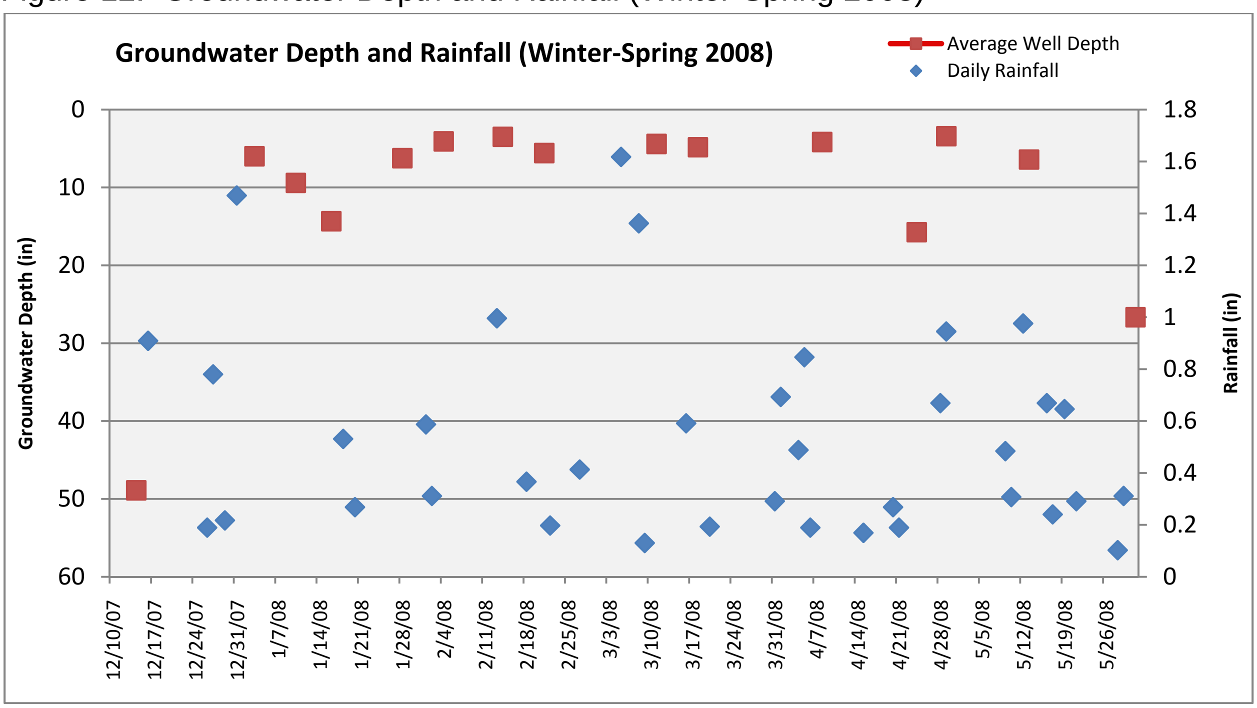
Figure 11. Groundwater Depth and Rainfall (Fall-Winter 2007)



Winter-Spring 2008 (Figure 12):

In observing the average well depth in Mason Farm field over the winter and spring of 2007-2008, notice how initially in mid-December 2007 it was still very deep (49") but that after a series of heavy storm events (totally about 3.5") it rose dramatically to just 6" below the surface. During the dry period that followed, the water table slowly fell over two weeks to 14", for an average drop of 0.6" per day! Soon after, a couple of rains totally 0.8" led to a subsequent water table rise back to 6" below the surface over a 12 day period. From this point forward the water table remained consistently high (above 6" depth) with consistent winter rainfall throughout. Finally over a two week period in April 2008, a total of 0.7" fell and yet the water table fell to 16" (the deepest level since the previous autumn), though heavier rainfall (1.6" over 2 days) pushed it back up to 3" below. The affects of springtime plant uptake were apparently dominant by now however as even 1.8" of rain in the 3 days immediately prior to measurement resulted in a slight drop in the water table over the first two weeks of May. By the end of May, the water table had fallen to 27" despite 2.3" of rainfall!

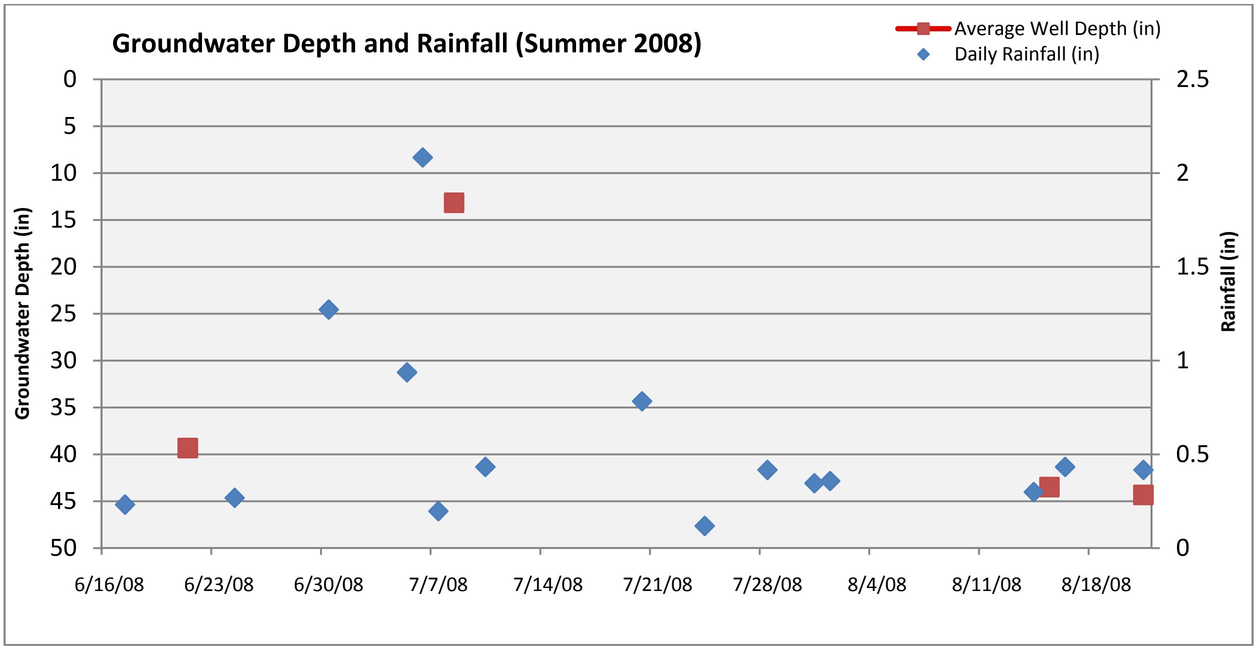
Figure 12. Groundwater Depth and Rainfall (Winter-Spring 2008)



Summer 2008 (Figure 13):

In the summer of 2008, we observe that the average water table is quite low (40-44" deep), which is to be expected during this time of the year. However, an unusually high water table of just 13" deep was recorded after an intense 3.2" of rain hit the site over the 3 days prior to well measurement. In this observation we have evidence that the field is capable of rapid change in water table as a result of rainfall.

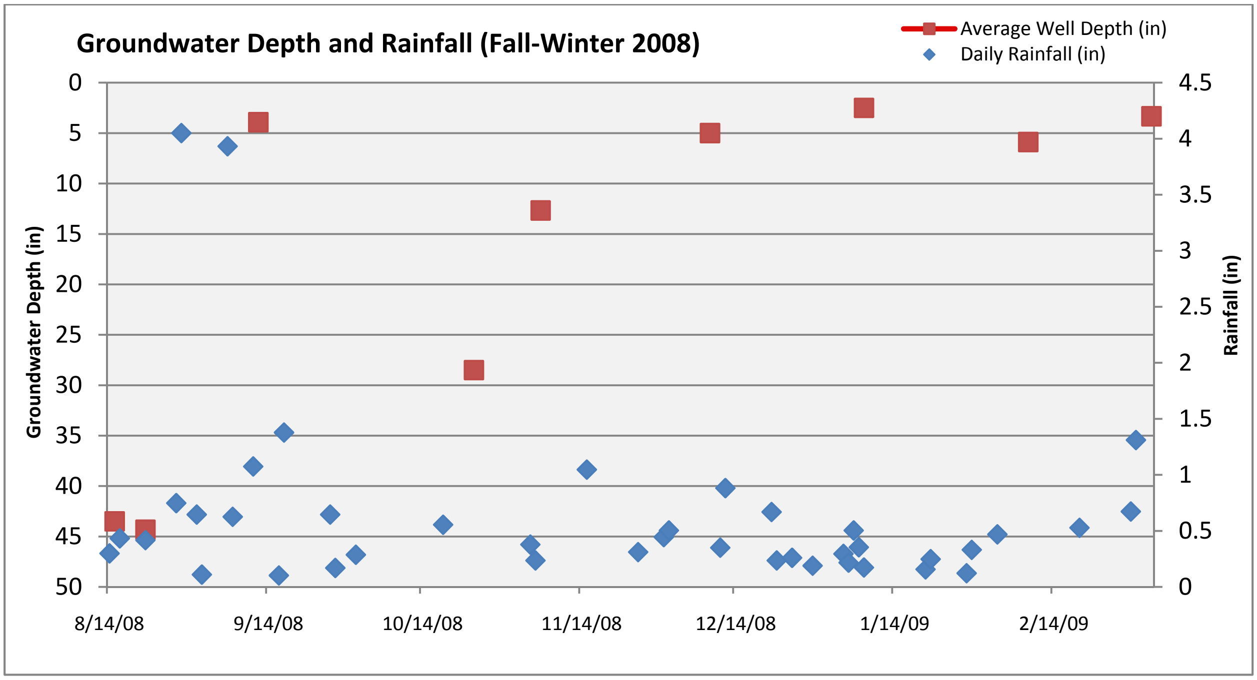
Figure 13. Groundwater Depth and Rainfall (Summer 2008)



Fall-Winter 2008 (Figure 14):

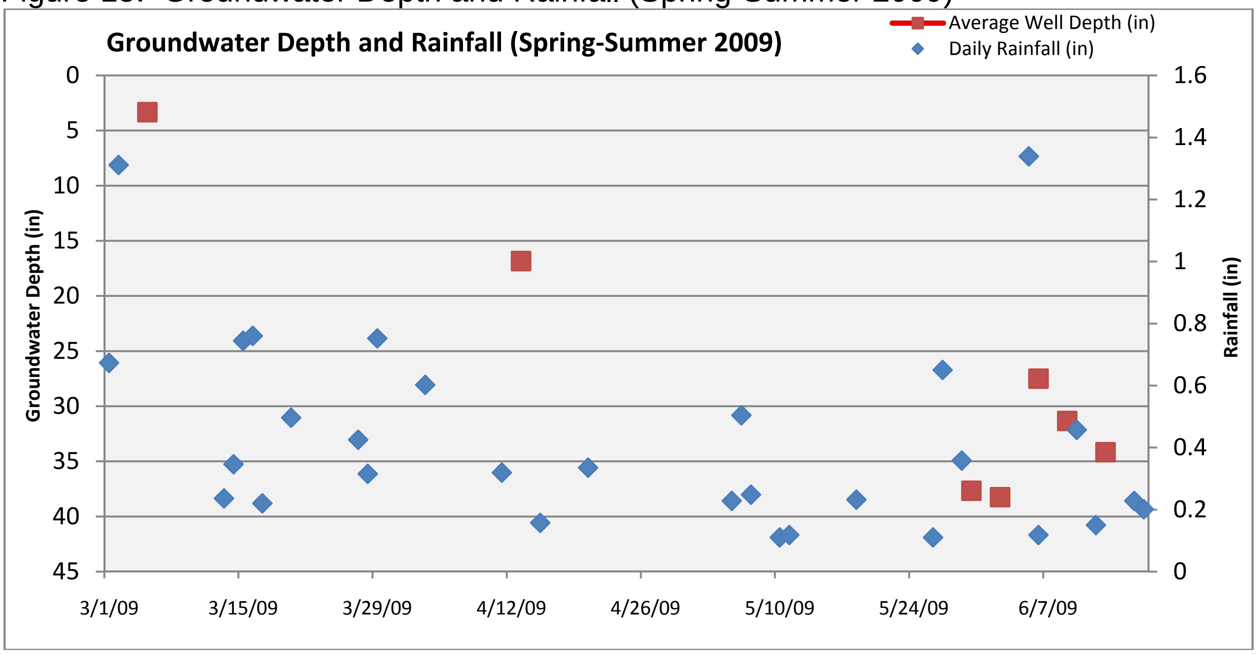
In late summer to early fall of 2008, the average water table was quite low but jumped dramatically up to just 4" below the surface following a period of heavy rainfall (10" over 22 days). It subsequently fell again over the next month but not nearly as deep as before. As the season progressed and plant water uptake fell, the water table gradually rose to very near the surface, where it remained until the spring of 2009.

Figure 14. Groundwater Depth and Rainfall (Fall-Winter 2008)



Spring-Summer 2009 (Figure 15):
As spring arrived throughout March, April and May of 2009, the water table fell dramatically despite good rainfall (9.1"), indicating the effect of plant water uptake. Of particular interest is the effect of rainfall on the water table over the end of May to early June. The average water table rapidly rose 10" on June 6th in response to the 1.4" of rain received during the previous day! Furthermore, it fell 3.8" over the following 3 days during which time there was no rainfall, then falling another 3" over the next 4 days despite rainfall totaling over 0.7".

Figure 15. Groundwater Depth and Rainfall (Spring-Summer 2009)



So it appears from evaluating all of the data that the groundwater table in this field has the capacity to quickly fluctuate. Given the sandy nature of the upper soil profile present on much of the site, this is not a surprising find. However, it does appear to rise much more rapidly than it falls, as dry periods without much rain never appeared to result in any precipitous drop in the water table.

Groundwater Table / Rainfall Correlation

The following scatterplot graphs (Figures 16-21) show overall average groundwater depths as compared to the weekly rainfall volume for the week leading up to the groundwater measurement. This was an attempt to quantitatively determine if rainfall and water table were correlated in the field. Given all the other variables involved it seemed highly unlikely any correlation would be determined given the fact that while rainfall certainly contributes to water table levels, natural seasonal differences and the rate of affect (i.e. how quickly rainfall or lack of rainfall alters water table levels) between the two would surely skew the numbers away from any correlation. For example, a single week of no rain never appeared to result in a precipitous drop in water table depths if it was an otherwise 'wet' time of year where the water table had been high.

A combined graph was made for all of the measurements (Figure 16) and showed virtually no correlation (R^2=.14). Note the number of incidences where small/no rainfall still resulted in a very high water table. An 'idealized' correlation graph (R^2=1.0) was also created to demonstrate for the sake of clarity what a perfect correlation between the two variables would look like (Figure 17).

Figure 16. Combined Well Depth and Rainfall Correlation

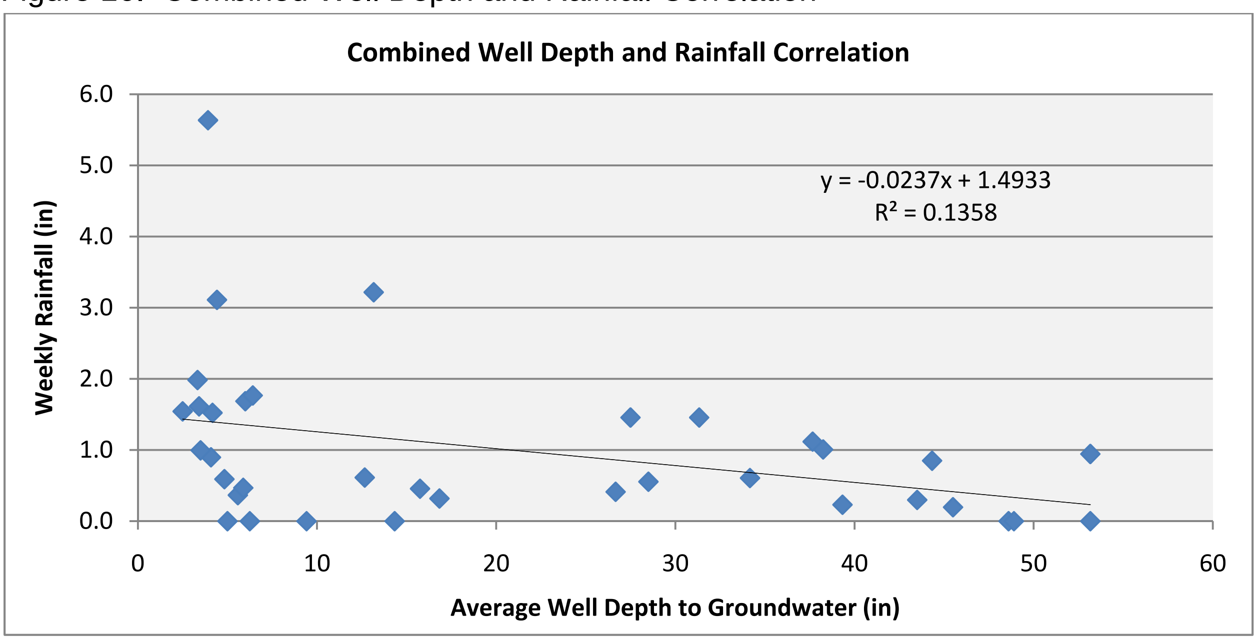
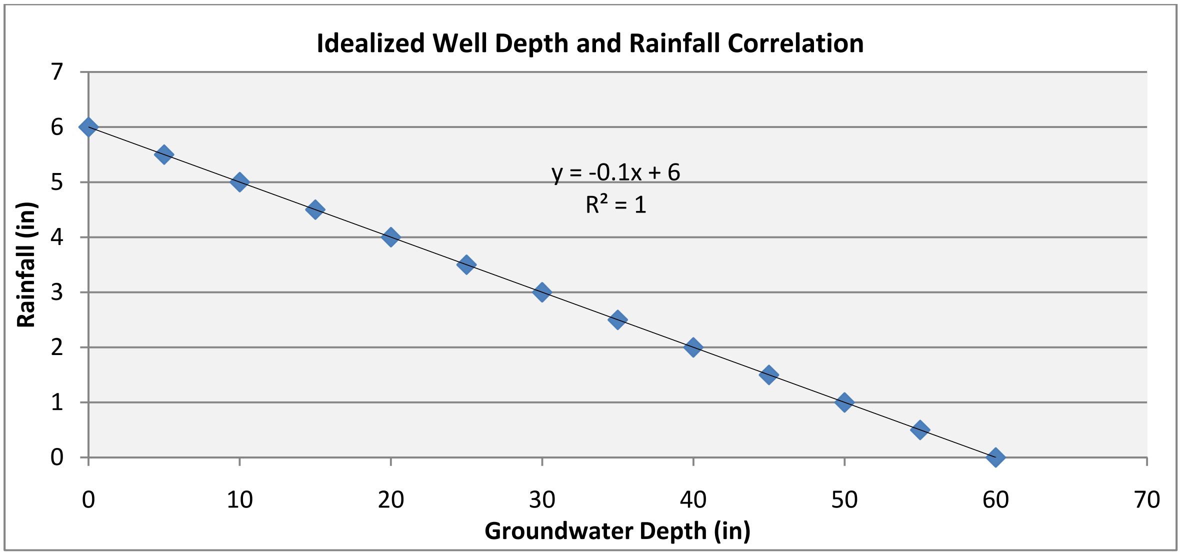


Figure 17. Idealized Well Depth and Rainfall Correlation



Finally, four plots (Figures 18-21) were made from all the data from each season combined in an attempt to see if there were any times of the year when rainfall had a more distinct affect on water table. While winter and spring showed little to no correlation (R^2=.21 and .25 respectively), surprisingly summer and fall did demonstrate some level of correlation with R^2 values of .83 and .47 respectively. So perhaps during these periods of the year when the water table is at its seasonal low point and vegetation is taking up substantial groundwater, rainfall does have a greater affect upon water table levels, providing a more immediate, if still somewhat temporary impact.

Figure 18. Winter Correlation Plot

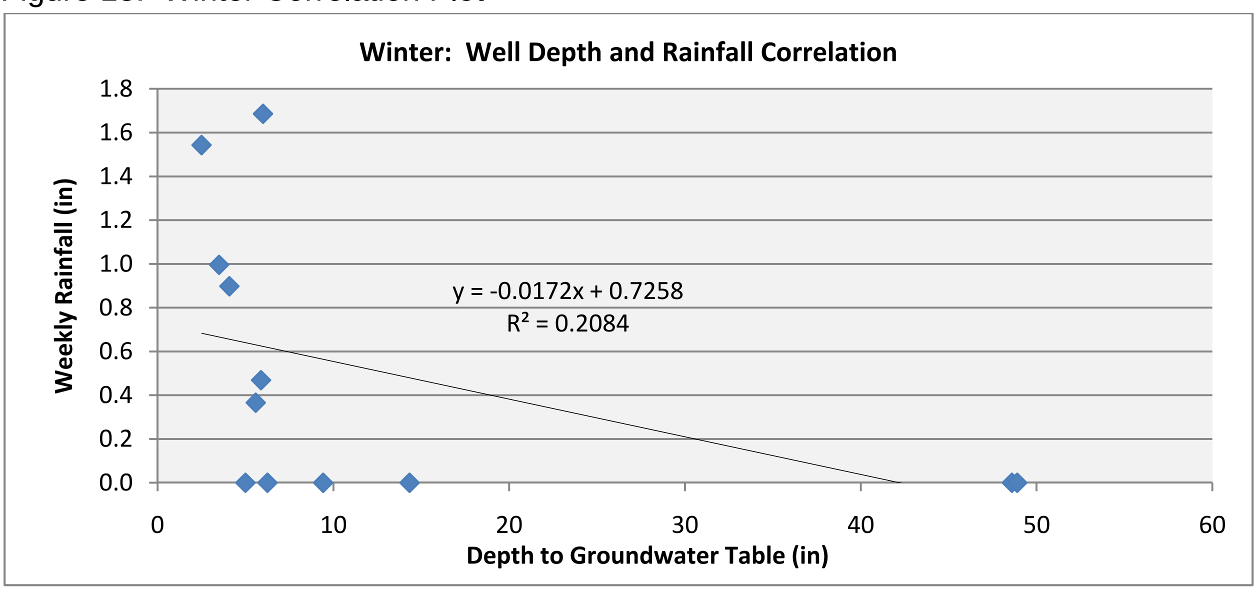


Figure 19. Spring Correlation Plot

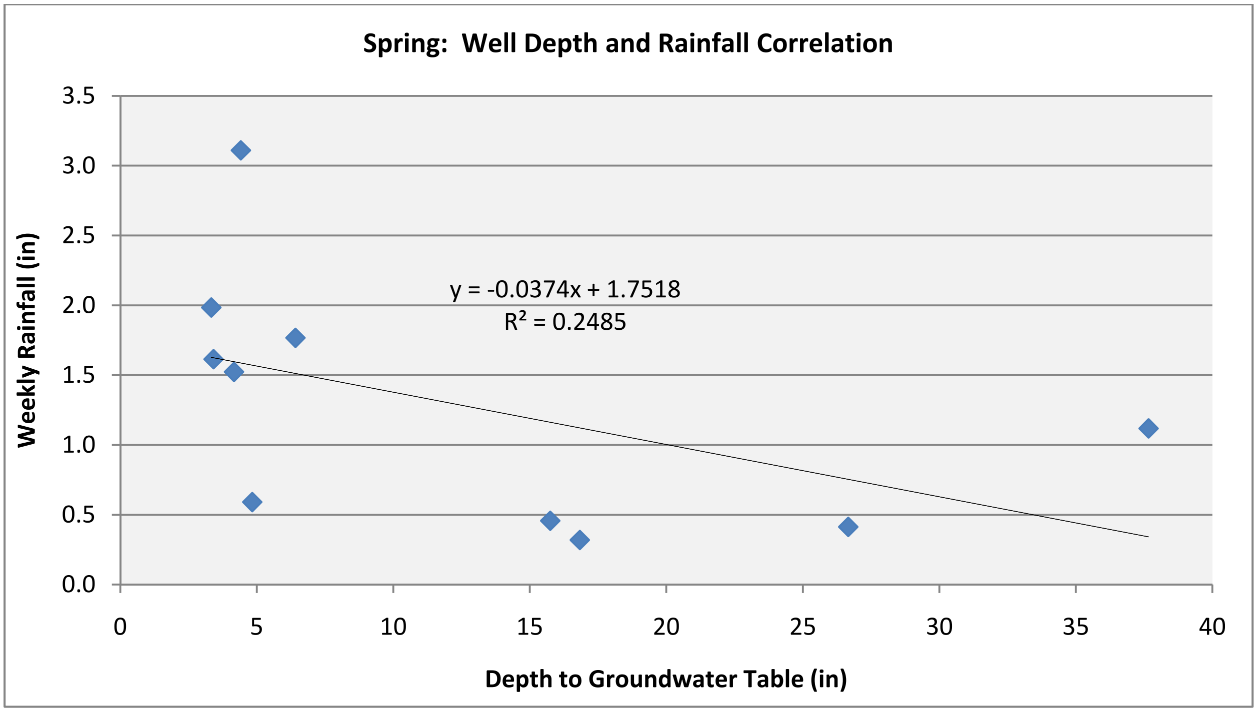


Figure 20. Summer Correlation Plot

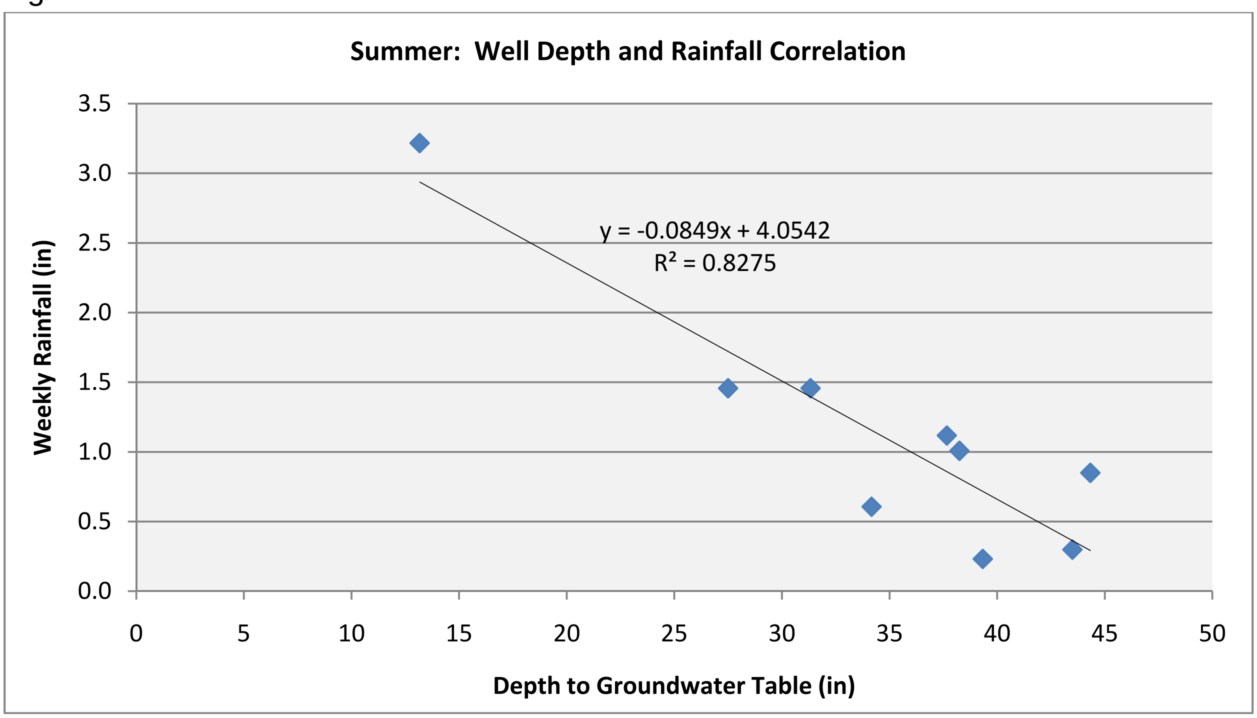
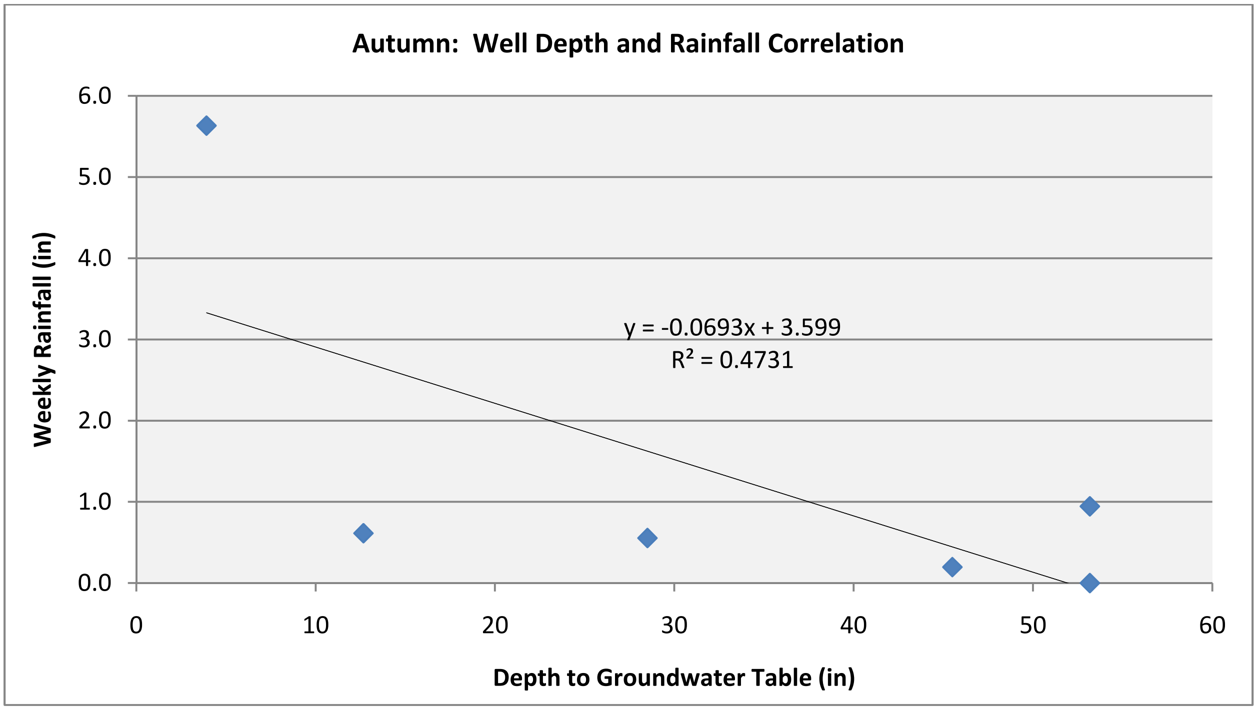


Figure 21. Fall Correlation Plot



Vegetation Surveys

Vegetation surveys were conducted twice in 2008 - once in the spring and once in the summer, both times with the much appreciated help of Mr. Mike Kunz of the NC Botanical Garden. The field was divided into 6 general areas (as marked on the map below – Figure 22) and as many species as possible were identified within each. The wetland facultative status was then determined for each species, if possible. Each species that had a designation of FAC or wetter was highlighted in blue (see Tables 1 and 2 below), which then allowed each area to be classified as having predominantly wetland vegetation or not, as per the US Army Corps of Engineers Wetland ID 1987 Manual guidelines.

Figure 22. Vegetation Survey Areas

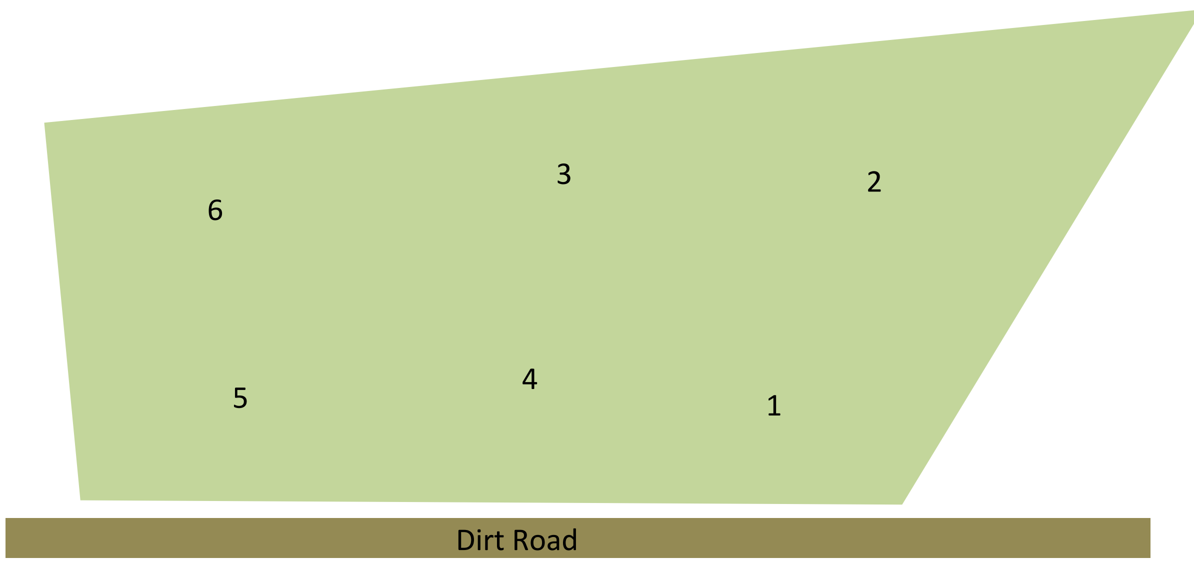


Table 1. Vegetation Survey - Spring 2008 (04/29/08)

Plant	Area	Frequency	Wetland FAC status
Juncus effusus	1	dominant	OBL
Plantago virginica	1	few	FACU-
Rubus argutus	1	common	FACU+
Penstemon digitalis (formerly laevigata)	1	dominant	FAC
Toxicodendron radicans	1	common	FAC
Eupatorium capillifolium	1	common	FACU
Campsis radicans	1	few	FAC
Geranium carolinianum	1	few	-
Cornus amomum	1	few	FACW+
Oxalis grandis	1	few	FACU

Liquidambar styraciflua	1	few	FAC+
Apocynum cannabinum	1	common	FAC-
Lespedeza cuneata	1	few	NI
Carax spp	1	few	
Ranunculus sardous	1	few	FAC+
Allium ampeloprasum	1	few	FAC
Rosa multiflora	2	few	UPL
Quercus phellos	2	few	FACW-
Sisyrinchium angustifolium	2	few	FAC
Carex spp	2	common	
Rubus argutus	2	common	FACU+
Juncus effusus	2	common	OBL
Liquidambar styraciflua	2	dominant	FAC+
Krigia dandelion	2	few	FACU
Diospyros virginiana	2	few	FAC
Geranium carolinium	2	common	-
Ulmus alata	2	few	FACU+
Oenothera fruticosa	2	few	FACU
Platanus occidentalis	3 / 4	few	FACW-
Pycnanthemum tenuifolium	3 / 4	few	FAC-
Houstonia caerulea	3 / 4	common	FAC
Andropogon virginicus	3 / 4	few	FAC-
Diospyros virginiana	3 / 4	few	FAC
Lonicera japonica	3 / 4	few	FAC-
Stellaria media	3 / 4	few	FACU
Fraxinus pennsylvanica	3 / 4	few	FACW-
Plantago virginica	3 / 4	common	FACU-
Quercus falcata	3 / 4	few	FACU-
Juniperus virginiana	3 / 4	few	FACU-
Ligustrum sinense	3 / 4	few	FAC
Sisyrinchium angustifolium	3 / 4	few	FAC
Pinus taeda	5 / 6	few	FAC
Houstonia caerulea	5 / 6	common	FAC
Liquidambar styraciflua	5 / 6	common	FAC+
Fraxinus pennsylvanica	5 / 6	few	FACW-
Hypericum sp	5 / 6	few	-
Dichanthelium scoparium	5 / 6	few	FACW
Juncus effusus	5 / 6	few	OBL
Rhus glabra	5 / 6	few	NI
Rosa multiflora	5 / 6	few	UPL
Diospyros virginiana	5 / 6	common	FAC
Vitis rotundifolia	5 / 6	few	FAC
Ranunculus pusillus	5 / 6	few	FACW+

Table 2. Vegetation Survey - Summer 2008 (07/21/08)

Plant	Area	Frequency	Wetland FAC status
Rubus argutus	1	dominant	FACU+
Senna hebecarpa	1	few	FAC+
Campsis radicans	1	common	FAC
Dichanthelium scoparium	1	few	FACW
Liquidambar styraciflua	1	few	FAC+
Lespedeza cuneata	1	few	NI
Eupatorium serotinum	1	few	FAC
Penstemon digitalis (formerly laevigata)	1	common	FAC
Solidago rugosa	1	common	FAC
Andropogon virginicus	1	common	FAC-
Apocynum cannabinum	1	few	FAC-
Toxicodendron radicans	1	common	FAC
Rosa multiflora	1	few	UPL
Dichanthelium scoparium	1	few	FACW
Juncus effusus	1	dominant	OBL
Rumex spp	1	few	-
Mimulus sp	1	few	-
Lespedeza cuneata	2	dominant	NI
Erigeron annuus	2	few	FACU
Cyperus esculentus	2	common	FAC
Campsis radicans	2	common	FAC
Rubus argutus	2	dominant	FACU+
Juncus effusus	2	dominant	OBL
Diospyros virginiana	2	few	FAC
Liquidambar styraciflua	2	few	FAC+
Lactuca canadensis	2	few	FACU-
Eupatorium serotinum	2	dominant	FAC
Ampelopsis brevipedunculata	2	few	-
Penstamin digitalis	2	few	FAC
Solidago rugosa	2	common	FAC
Rhus copallina	2	few	NI
Apocynum cannabinum	2	few	FAC-
Hypericum sp	3	few	-
Dichanthelium clandestinum	3	few	FACW
Pseudognaphalium obtusifolium	3	few	-
Pycnanthemum tenuifolium	3	common	FAC-
Juniperus virginiana	3	few	FACU-
Ulmus alata	3	few	FACU+
Campsis radicans	4	common	FAC
Liquidambar styraciflua	4	few	FAC+
Lespedeza cuneata	4	dominant	NI
Rubus argutus	4	common	FACU+
Penstemon digitalis	4	few	FAC

Erigeron annuus	4	few	FACU
Lamium amplexicaule	4	few	-
Dicanthelium sp	4	few	-
Pycnanthemum tenuifolium	4	few	FAC-
Quercus sp	4	few	-
Hypericum sp	4	few	-
Senna hebecarpa	4	few	FAC+
Eupatorium serotinum	4	common	FAC
Fraxinus pennsylvanica	5	few	FACW-
Hypericum sp	5	few	-
Eupatorium serotinum	5	common	FAC
Diospyros virginiana	5	few	FAC
Liquidambar styraciflua	5	few	FAC+
Penstemon digitalis	5	few	FAC
Solidago rugosa	5	common	FAC
Lespedeza cuneata	5	common	NI
Dichanthelium scoparium	5	few	FACW
Ipomoea purpurea	5	few	FACU
Lonicera japonica	5	few	FAC-
Ligustrum sinense	5	few	FAC
Rosa multiflora	5	few	UPL
Pycnanthemum tenuifolium	6	few	FAC-
Penstemon digitalis	6	few	FAC
Solidago pinetorum	6	few	-
Diospyros virginiana	6	few	FAC
Solidago rugosa	6	common	FAC
Pinus taeda	6	few	FAC
Microstegium vimineum	6	common	FAC+
Apocynum cannabinum	6	few	FAC-

Table 3. Spring 2008 – Wetland Vegetation Status Results

Area	# FAC or wetter	# Total	% FAC or wetter	Result
1	8	16	50	Wetland Veg
2	6	12	50	Wetland Veg
3 / 4	6	13	46	Upland Veg
5 / 6	9	11	82	Wetland Veg

Table 4. Summer 2008 – Wetland Vegetation Status Results

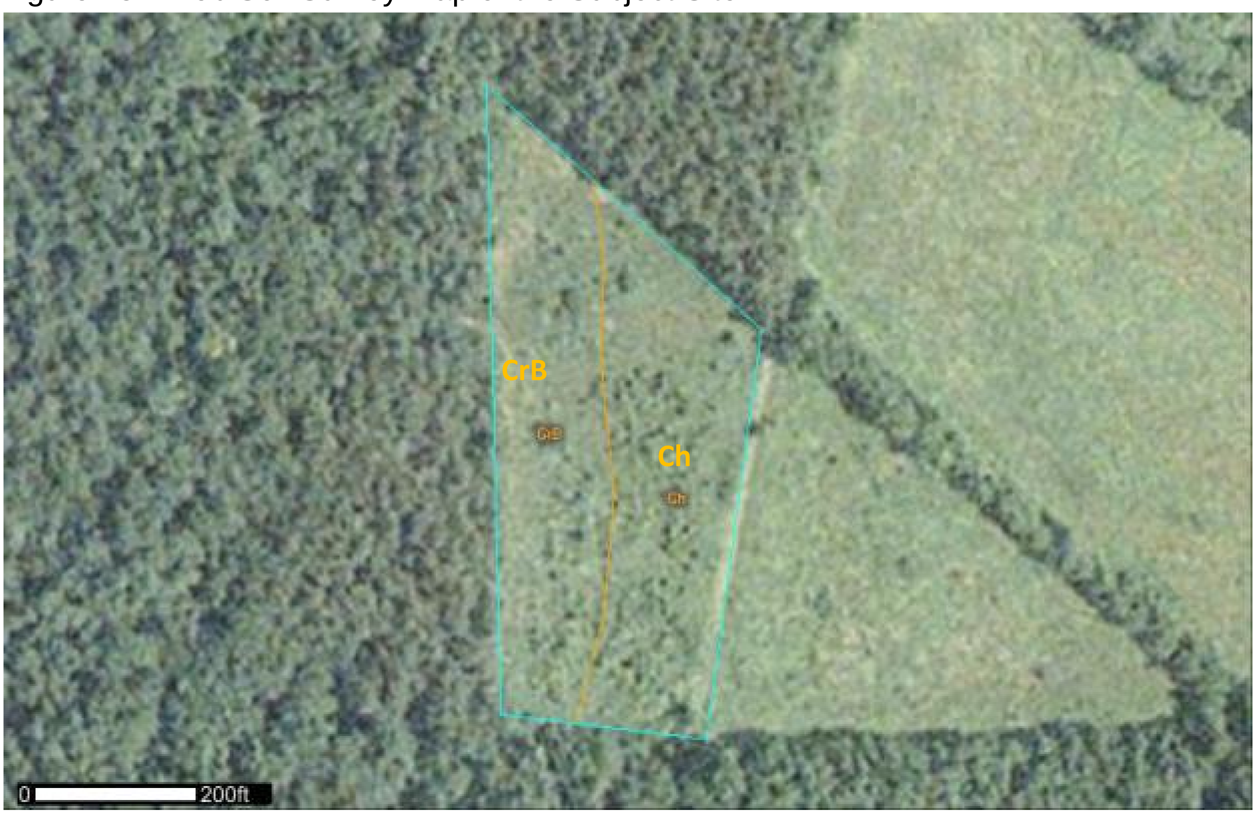
Area	# FAC or wetter	# Total	% FAC or wetter	Result
1	10	17	59	Wetland Veg
2	8	15	53	Wetland Veg
3	1	6	17	Upland Veg
4	5	13	38	Upland Veg
5	8	13	62	Wetland Veg
6	5	8	63	Wetland Veg

The results (Tables 3 and 4) of the calculations reveal that in fact, most of the field appears to have predominance of wetland vegetation! This is not true however for the center portion of the field around vegetation areas 3 and 4. In looking at groundwater elevations for this area (from well #3) we see that in fact it generally had among the highest water tables on the site. Why then, did this one portion of the field apparently not produce as much wetland vegetation as the rest? To confuse matters further, this central portion of the field was also generally marshier with dozens of small shallow pools of standing water present during the wetter portion of the year and after significant rainfall events. These little pools are created by the hummocky micro-topography here, a scattered assortment of indentations and channels found in the central and northeast portions of the site. Typically, they result in the presence of wetland vegetation, and certainly did so in vegetation areas 1 and 2. So then, why not here? The answer may simply be that this area was also maintained by the staff at the UNC Botanical Garden – it was mowed a few times a year in order to maintain most of the field as a wet meadow and not allow it to slowly revert back to a covered forest. As such, many young trees were also removed at a later date after the vegetation surveys were conducted. Nevertheless, mowing down small herbaceous plants, rushes, sedges, and other shrubby non-woody species while not typically destroying them, may have led to other species coming up and outcompeting them, or perhaps they simply weren’t present in any recognizable form at the time of the surveys.

Soil Survey

The soil survey information was generated from the Web Soil Survey website of the USGS National Resource Conservation Service (NRCS). It shows the subject field divided almost right down the middle, dividing the field into an eastern half dominated by Chewacla loam and a western half dominated by Creedmoor fine sandy loam (Figure 23). These soils are generally characterized as being located in fluvial floodplains, being poorly drained, potential for flooding and/or ponding, with moderate to high available water capacities (Tables 5 and 6). These factors are ideal for the conversion of the field to a wetland or for the establishment of water loving, wetland vegetation on site. That is to say, the soils do not appear to be any impediment towards these goals, and would actually seem to contribute to holding water on site for extended periods of time.

Figure 23. Web Soil Survey Map of the Subject Site



Soil Map Legend:
Ch—Chewacla loam
CrB—Creedmoor fine sandy loam

Table 5. Chewacla Soil Data

Chewacla loam

The Chewacla soils are very deep, somewhat poorly drained, moderately permeable soils that formed from alluvium material in the Piedmont. Slopes range from 0 to 2 percent, they may be frequently flooded for very brief to long periods.

TAXONOMIC CLASS: Fine-loamy, mixed, active, thermic Fluvaquentic Dystrudepts

TYPICAL PEDON: Chewacla loam--cultivated. (Colors are for moist soil unless otherwise stated.)

Ap--0 to 4 inches; brown (7.5YR 4/4) loam; weak medium granular structure; friable; common very fine, fine, and medium roots; few fine flakes of mica; very strongly acid; clear smooth boundary. (1 to 10 inches thick)

Bw1--4 to 14 inches; dark yellowish brown (10YR 4/4) silty clay loam; weak medium subangular blocky structure; friable; common fine and medium roots; common fine flakes of mica; few medium faint brown (10YR 5/3) iron depletions; very strongly acid; gradual wavy boundary.

Bw2--14 to 26 inches; dark yellowish brown (10YR 4/4) clay loam; weak medium subangular blocky structure; friable; common fine and medium roots; many fine flakes of mica; common medium faint grayish brown (10YR 5/2) iron depletions and common medium distinct strong brown (7.5YR 4/6) masses of oxidized iron; very strongly acid; gradual wavy boundary.

Bw3--26 to 38 inches; brown (7.5YR 4/4) loam; weak medium subangular blocky structure; friable; common fine roots; many fine flakes of mica; common medium distinct gray (10YR 5/1) iron depletions; very strongly acid; gradual wavy boundary.

Bw4--38 to 47 inches; strong brown (7.5YR 5/8) clay loam; weak medium subangular blocky structure; friable; few fine roots; many fine flakes of mica; common medium distinct gray (10YR 5/1) iron depletions; very strongly acid; gradual wavy boundary.

Bw5--47 to 60 inches; gray (10YR 5/1), strong brown (7.5YR 5/8), and red (2.5YR 5/8) clay loam; weak medium subangular blocky structure; friable; few fine roots; many fine flakes of mica; areas with gray color are iron depletions and areas with red color are masses of oxidized iron; very strongly acid; gradual wavy boundary. (Combined thickness of the Bw horizons is 6 to 60 inches)

C--60 to 80 inches; brown (7.5YR 4/4) and gray (7.5YR 5/1) loam; massive; friable; many fine flakes of mica; areas with gray color are iron depletions very strongly acid.

Table 6. Creedmoor Soil Data

Creedmoor sandy loam

The Creedmoor soils are very deep, moderately well drained to somewhat poorly drained, and very slowly permeable soils that have formed in residuum weathered from Triassic material of the Piedmont uplands. Slopes may range from 0 to 8 percent.

TAXONOMIC CLASS: Fine, mixed, semiactive, thermic Aquic Hapludults

TYPICAL PEDON: Creedmoor sandy loam--forested. (Colors are for moist soil unless otherwise stated.)

Oe--1 to 0 inch; partially decomposed pine needles and forest litter.

A--0 to 2 inches; dark gray (10YR 4/1) sandy loam; weak coarse granular structure; very friable, many fine and medium woody roots; very strongly acid; abrupt smooth boundary. (1 to 9 inches thick)

E--2 to 8 inches; pale brown (10YR 6/3) sandy loam; weak medium granular structure; very friable; few fine and medium woody roots; very strongly acid; clear smooth boundary. (0 to 12 inches thick)

Bt1--8 to 15 inches; pale brown (10YR 6/3) sandy clay loam; weak medium subangular blocky structure; friable, slightly sticky, slightly plastic; few fine woody roots; many fine and medium pores; many coarse faint light yellowish brown (10YR 6/4) masses of iron accumulations; very strongly acid; clear wavy boundary.

Bt2--15 to 19 inches; brownish yellow (10YR 6/6) sandy clay loam; moderate medium subangular blocky structure; friable, slightly sticky, slightly plastic; few fine and medium woody roots; many fine pores; few faint clay films on faces of peds; few medium prominent reddish yellow (5YR 7/8) masses of iron accumulations; very strongly acid; clear smooth boundary.

Bt3--19 to 29 inches; light yellowish brown (10YR 6/4) clay; moderate medium prismatic structure which parts to moderate medium angular blocky structure; firm; very sticky, very plastic; few fine woody roots; common distinct clay films on faces of peds; common medium prominent red (2.5YR 5/8) masses of iron accumulations and gray (10YR 6/1) iron depletions; very strongly acid; clear wavy boundary. (Combined thickness of the Bt horizon is 15 to 50 inches.)

Btg1--29 to 40 inches; light gray (10YR 7/1) clay; moderate medium angular blocky structure; very firm, very sticky, very plastic; common distinct clay films on faces of peds; many coarse prominent brownish yellow (10YR 6/6) and few fine prominent reddish brown (2.5YR 5/3) masses of iron ccumulations; extremely acid; clear wavy boundary.

Btg2--40 to 46 inches; light gray (10YR 7/1) clay; weak, coarse angular blocky stucture; very firm, very sticky, very plastic; many medium prominent red (2.5YR 5/8) and few fine prominent yellow (10YR 7/6) masses of iron accumulations; extremely acid; clear wavy boundary. (Combined thickness of the Btg horizon is 0 to 24 inches)

BCg--46 to 56 inches; light gray (10YR 7/1) silty clay; many coarse prominent dusky red (2.5YR 3/2) mottles; weak coarse angular blocky stucture; very firm, sticky, plastic; extremely acid; clear smooth boundary. (0 to 24 inches thick)

Cg--56 to 68 inches; light gray (10YR 7/1) fine sandy loam saprolite; many coarse prominent dusky red (2.5YR 3/2) mottles; massive; firm; common medium distinct yellow (10YR 7/6) masses of iron accumulations; very strongly acid; clear smooth boundary.

Recommendations

Should the Botanical Garden ever decide to actively plant wetland vegetation in this field to enhance its beauty or functionality, or perhaps out of necessity after a hydrologic modification to the drainage in the Mason Farm Preserve makes the site much wetter for much longer and kills off the current vegetation. For whatever the reason, I include here a short list of some common, native wetland plants for consideration. This list is in no way absolute or all-inclusive as there are many, many great species from which to choose! They are merely offered as examples. Also, the exact species selected would vary based on the actual degree of wetness found at the exact planting location. Not every plant is suited for every level of wetness present in the field. I have not included any trees in lieu of the Botanical Garden's desire to keep the field as an open, wet meadow.

Table 7. Common, native wetland plants

Scientific Name	**Common Name**	**Wetland Status**
Shrubs		
Cephanlanthus occidentalis	buttonbush	OBL
Vaccinium corymbosum	blueberry	FACW
Aronia arbutifolia	red chokeberry	FACW
Sambucus canadensis	elderberry	FAW-
Cornus amomum	silky dogwood	FACW+
Rosa palustris	swamp rose	OBL
Itea virginica	Virginia willow	FACW+
Myrica heterophylla	bayberry	FACW
Herbaceous		
Lobelia cardinalis	cardinal flower	FACW+
Iris viginica	southern blueflag	OBL
Woodwardia areolata	netted chain fern	OBL
Osmunda regalis	royal fern	OBL
Impatiens capensis	jewelweed	FACW
Boehmeria cylindrica	false nettle	FACW+
Saururus cernuus	lizards tail	OBL
Grasses/Sedges/Rushes		
Leersia oryzoides	rice cutgrass	OBL
Rhynchospora nitens	shortbeak beaksedge	OBL
Scirpus validus	soft stem bulrush	OBL
Scirpus cyperinus	wool grass	OBL
Carex lupuliformis	false hop sedge	OBL
Eleocharis palustris	common spikerush	OBL
Juncus effusus	common rush	OBL

If the Botanical Garden ever elects for a more intensive wetland restoration, I would recommend blocking up the drainage ditches found along the northern and eastern boundaries of the field. This would surely have the effect of holding much greater volumes of water in the field, though it might have the unfortunate side-effect of flooding the road occasionally unless site topography is closely examined beforehand.

There does not appear to be any field ‘crowning’ on site, an agricultural practice where fields were built up about a foot for drainage purposes to encourage water to flow offsite quickly. That is fortunate as this is would require significant work to remove. As it is, a mild level of grading work in the field could greatly enhance the water storage capacity by roughening up areas, created numerous small indentions in the landscape - shallow pockets where water can be trapped and held more easily and for longer periods of time. This will help the field soak up much more water, leading to saturated soil conditions (ideal for wetland vegetation) as well as help provide wonderful habitat for a wide range of small animals, from insects to small amphibians (Figure 24) as well as plants.

In addition to creating this micro-topography on site, I would suggest creating a few simulated ‘tree-throws’ in the field (Figure 25). These are just larger, deeper pools dug into the landscape that mimic the effects of trees falling. They provide important habitat for species that need more standing water for a longer period of time. The spoil from the hole is simply deposited next the pool, mimicking the adjacent mound left by the root mass of the fallen tree. Finally, a few brush piles placed throughout the field would help provide a different type of habitat for other animals like birds, reptiles, and small mammals.

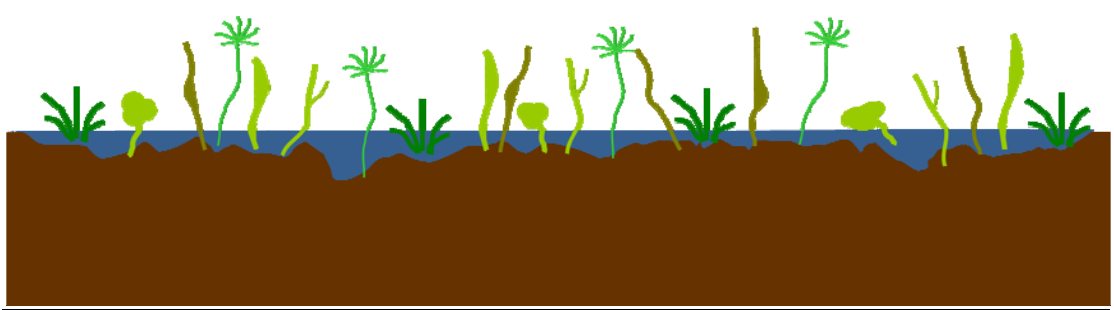


Figure 24. Field diagram showing surface roughening and water holding

Figure 25. Field diagram showing a brush pile and a simulated tree-throw

Attachments:

1) Figures 5-10 (These graphs were too large to include within the body of the text)

2) Select site photos

3) CD with complete data set

Figure 5. Mason Farm Groundwater Depth (in)

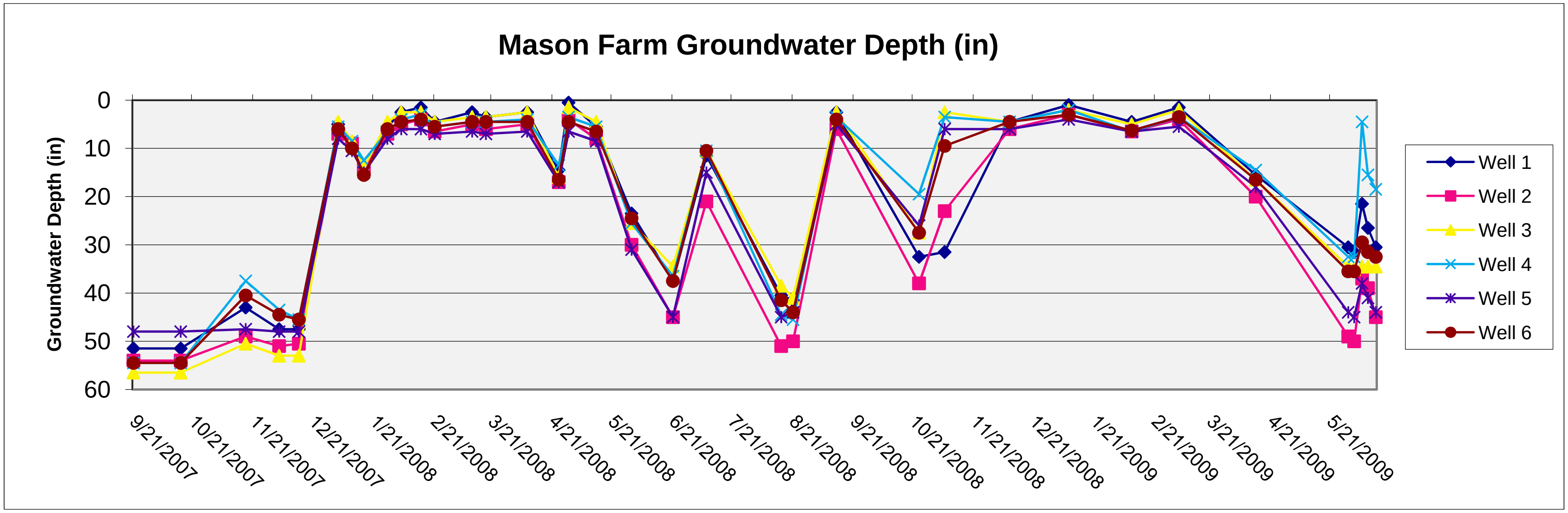


Figure 6. Mason Farm Rainfall Volume (in)

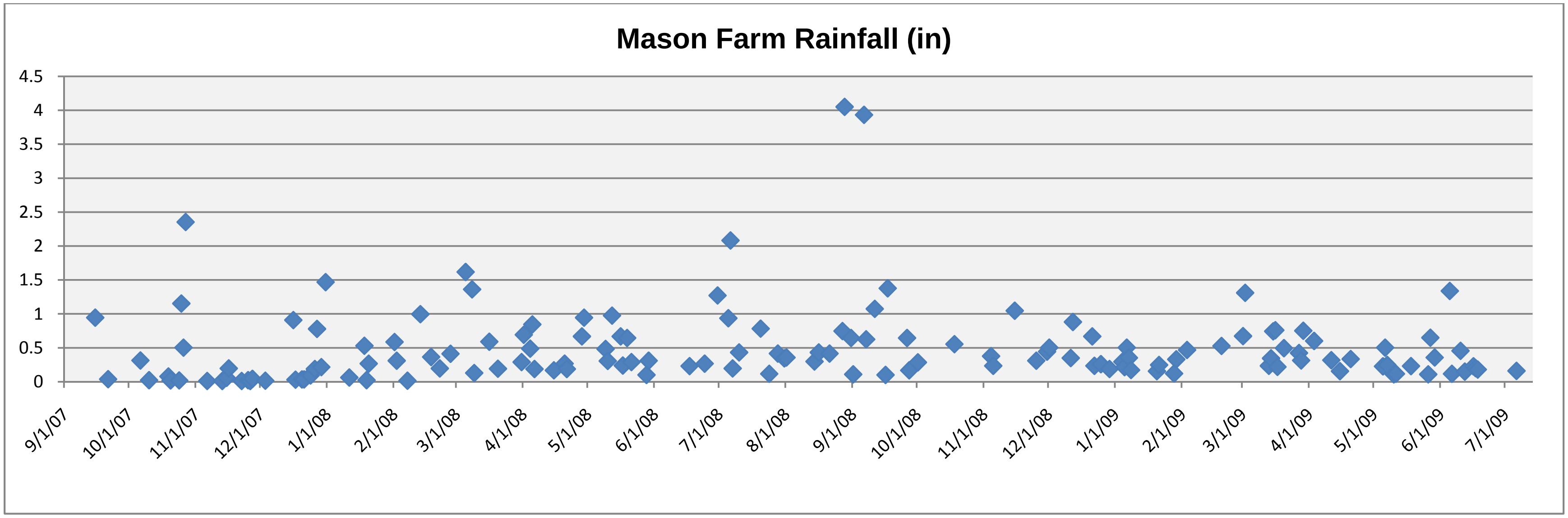


Figure 7. Average Groundwater Depth for Wells (in)

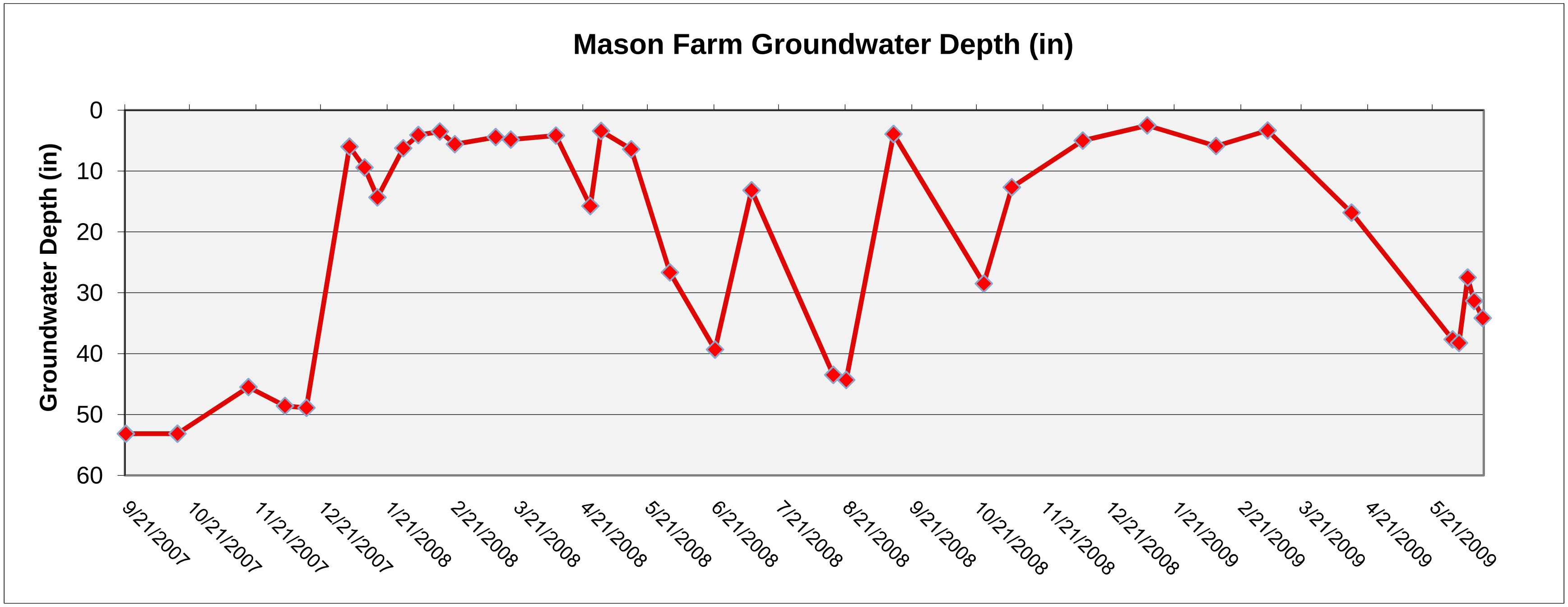


Figure 8. Groundwater Depth and Daily Rainfall (in)

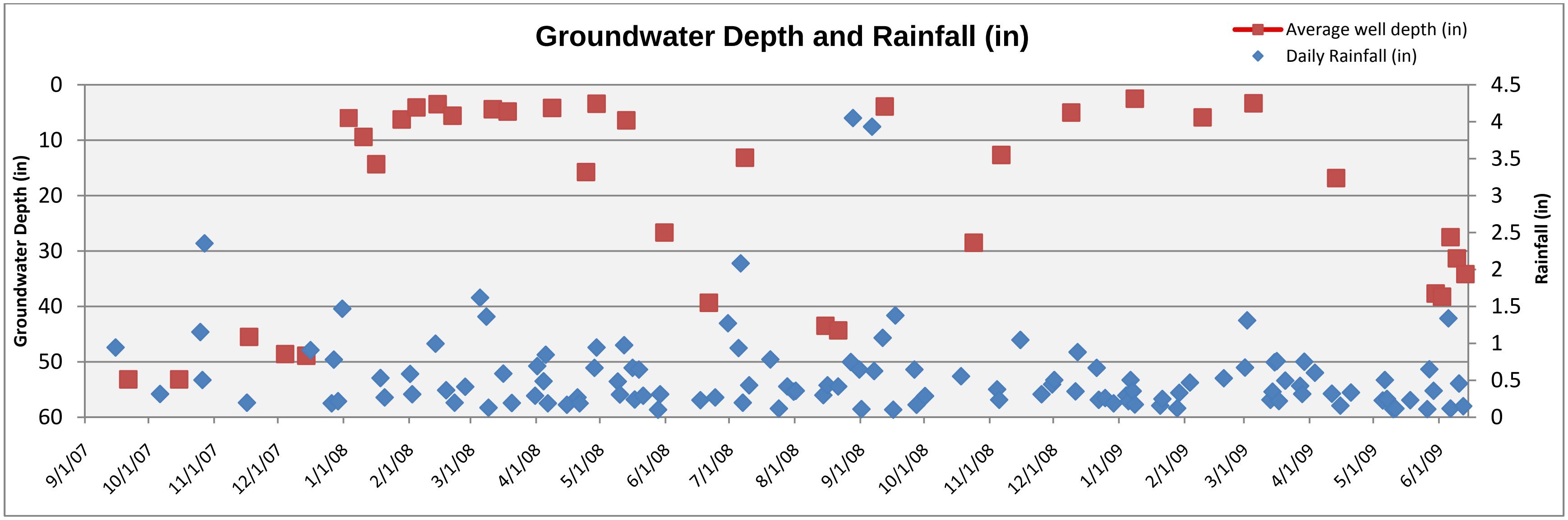


Figure 9. Groundwater Depth and Weekly Rainfall (in)

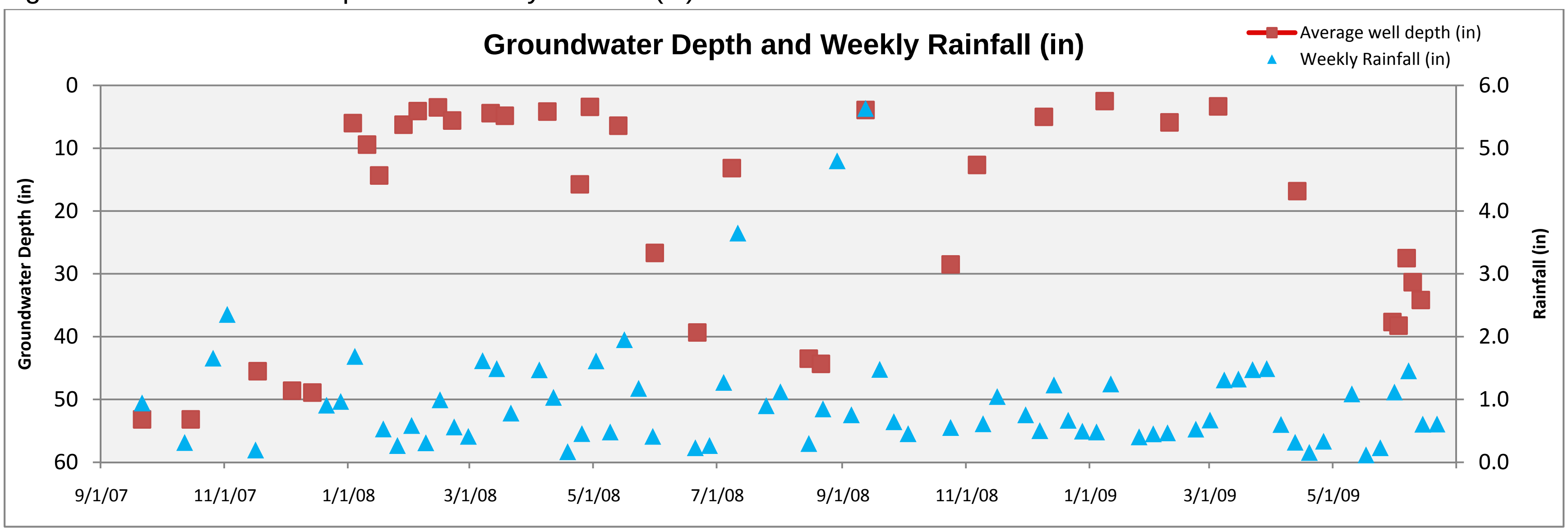
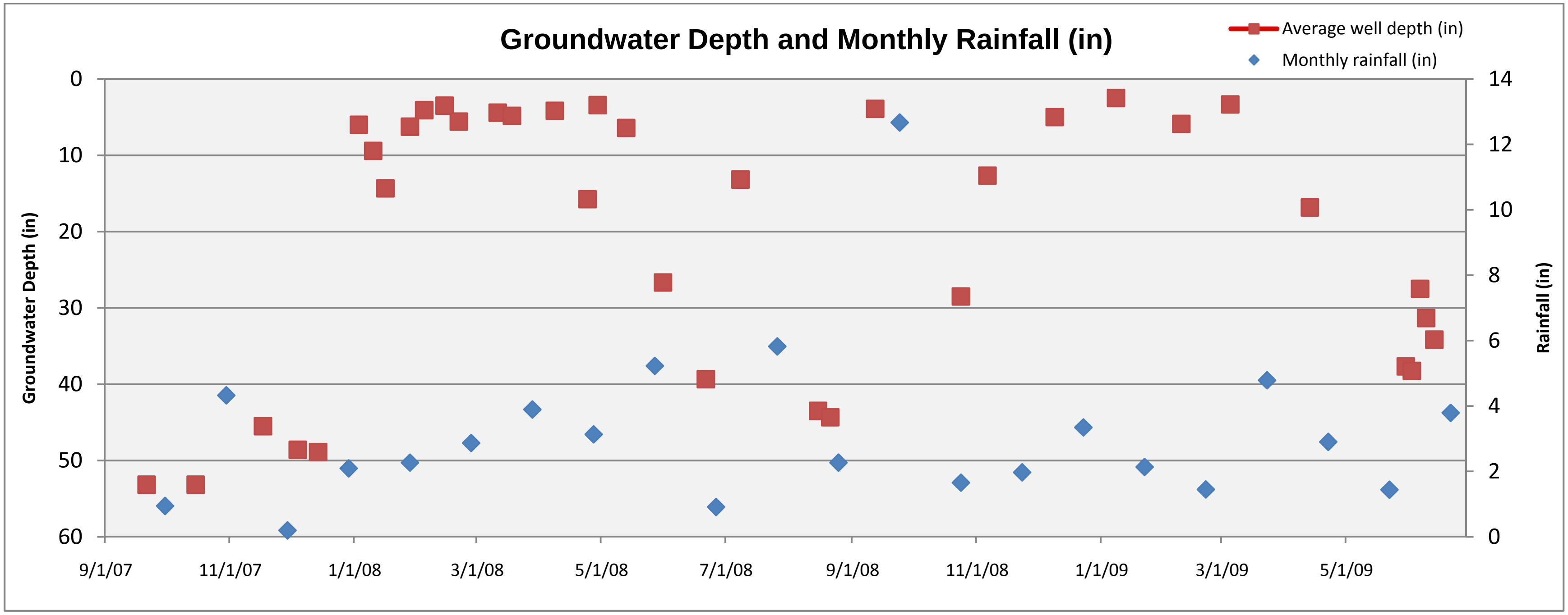


Figure 10. Groundwater Depth and Monthly Rainfall (in)



Site Photos:

4.29.08 – Spring walkover

4.29.08 – Spring walkover

7.21.08 - Summer walkover

7.21.08 - Summer walkover

12.04.07

12.04.07