SOIL SCIENTIST EVALUATION

FINAL

UNC Bingham WWTF

Land Application System Receiver Site

Orange County
North Carolina

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Executive Summary

A soil and site investigation was completed for the UNC Bingham Facility Wastewater Treatment (UNCBWWTF) land application system in Orange County, NC. The purpose of the investigation was to determine the potential of this property to receive secondary treated irrigation water. The soil scientist evaluation was conducted according to mandates set forth by the North Carolina Division of Water Quality (NCDWQ), Aquifer Protection Section and specifically, 15 NCAC 02T .0500. Field investigations were conducted to describe the existing receiver site according to the soils, existing vegetation crop, geologic features, physiographic region, topography, hydrology, wetlands, and landscape position. Water quality data and the most limiting site characteristics were utilized for hydraulic and liquid loading calculations and recommendations. Hydraulic loading recommendations were determined after consideration of site characteristics such as soils, in situ saturated hydraulic conductivity measurements, hydrology, vegetation, landscape position, and any other site limiting factors (Table 1). Loading recommendations are provided in this report for a land application irrigation system on the proposed receiver site and soil areas (Table 2). Hydraulic loadings were calculated based on site specific data and accepted professional guidelines for waste disposal (NCDWQ). Soil fertility was analyzed by a regional agronomic services laboratory (Table 4).

Recommendations in this report are provided for the establishment of a forest or forage land application wastewater irrigation system including results from a detailed water balance and hydraulic loading rate analysis (Edwin Andrews & Assoc., PC, 2011). Soil analyses of the proposed irrigation site indicate there are some nutrient deficiencies on the proposed receiving silt loam and sandy loam soils (Table 4). The existing wastewater irrigation constituents will provide supplemental nutrients and a consistent source of water to growing crops, in this case a mixed hardwood forest and/or forage crop system.

Table 1: Soil Areas, Recommended Hydraulic Loading Rates for the UNCBWWTF Land Application System Receiver Site, Orange County, NC.

Soil Area	**acres[1]**	**in/wk[2]**	**gpd[3][4][5]**	**Seasonal**
1	3.56	.157	2,182	Yes
2	2.15	.157	1,318	Yes
Design (SA 1 and SA2) 3,500 gpd	5.71*		3,500	Yes

1] Acreages account for setbacks from waterways, wetlands, streams, property lines, dwellings, and water supply wells for a 3,500 gpd system.

2] Rate based on recommended application rates calculated by a comprehensive Water Balance (Edwin Andrews & Assoc., PC, 2011).

3] Based on a 7 day irrigation week.

4] Recommended maximum hydraulic loading over an entire irrigation year including constraints from storage.

5] Irrigation rate shown is the maximum that should be used in computing receiver site capacity unless or until a higher loading rate is shown to be sustainable based on actual field performance and storage capacity limitations. Use of forest cover crop may result in higher than estimated transpiration and drainage rates. Operators at a minimum need the permit flexibility to apply irrigation water at

a rate high enough to sustain plant growth without causing runoff or ponding, which during extended dry periods (drought conditions) could exceed the rates shown in the table.
* - Actual irrigable area utilized in Water Balance Report (Edwin Andrews & Assoc., PC, 2011).

Table 2: UNCBWWTF Land Application System Receiver Site Soil Areas, Associated Soils, and Existing Vegetation.

Soil Area	Predominant Soil Series	Existing Vegetation
SA-1	Georgeville	Grass, Mixed Pine/Hardwood
SA-2	Herndon	Grass

Approximately 57 acres of uplands with potential to receive municipal wastewater irrigation were evaluated and similar soils were grouped into Soil Areas (SA). Two different soil areas were identified within these areas, each with specific loading rates totaling 5.71 irrigable acres utilizing a secondary treated water source. Soil Areas account for buffers from waters of the State, property lines, as well as other site limitations such as bedrock, shallow soils, depressions, and disturbed areas.

It should be noted that final hydraulic loading rates are based off a detailed water balance and in situ saturated hydraulic conductivity measurements. This water balance accounts for storage and other factors (Edwin Andrews & Assoc., PC, 2011) and local rainfall conditions. The receiver site investigated for this evaluation was approved by a nationally and state licensed soil scientist in North Carolina. It should be noted that soil systems are quite variable and the actual system performance and operations can be adjusted during operation to accommodate site variabilities. Hydraulic recommendations are based on site specific data, and attempt to account for these site variabilities. With that understanding, maximum hydraulic and nutrient loadings are given. This report is based on the professional recommendations and judgment of a nationally and North Carolina licensed soil scientist (SWE Group, 2011), and reviewed for incorporation into the permit application submittal to NCDWQ by a North Carolina licensed professional engineer (McKim & Creed 2011). Overall, the Bingham Facility Land Application System is a viable alternative to discharging treated wastewater into nearby surface waters. The irrigation of the treated wastewater will ultimately increase soil fertility and productivity of the cover crop vegetation and will enhance adjacent wetlands and low lying areas with increased base flow. The information contained in this report will aid with management of a land application irrigation system for the Bingham Facility receiver site.

1.0 Introduction

Under Section 02T .0500 Rules – Waste Not Discharged to Surface Waters set forth by the North Carolina Division of Water Quality, municipalities, and publicly owned treatment works (POTWs) can divert their treated effluent to land application irrigation receiver sites. Land applying wastewater or reclaimed water will provide additional treatment, and is consistent with the total maximum daily load (TMDL) program promoted by federal and state regulatory agencies. Many county governments, municipalities, and industries are facing similar situations with finding alternatives for wastewater and reclaimed water treatment and disposal in nutrient sensitive regions. The proposed receiver site is a viable alternative to a point source discharge for wastewater produced by the UNC Bingham Wastewater Treatment Facility (UNCBWWTF) and will provide an excellent source of irrigation water for growing forage grasses and/or tree crops.

2.0 Objectives

The objectives of this report are to describe the existing receiver site according to the soils, vegetation and/or crop cover, geologic features, topography, hydrology, wetlands, and landscape position. Recommendations will be provided for the establishment of a land based irrigation system. In addition, a standard soil fertility analysis will be provided and analyzed with an accompanying Agronomist Report (SWE Group, 2011).

3.0 Methodology

Per regulations set forth by the North Carolina Division of Water Quality (NCDWQ) the purpose of this evaluation was to determine the potential and suitability of selected receiver areas to receive treated irrigation water and use this information in the permitting of the facility receiver areas.

The soil scientist evaluation was conducted according to 15A NCAC 02T .0504(b). Field investigations were conducted to describe the potential wastewater receiver site according to the soils, existing vegetation / crop, geologic features, topography, hydrology, wetlands, and location. Anticipated wastewater quality data and the most limiting site characteristics were utilized for hydraulic loading calculations and recommendations. Hydraulic loading recommendations were determined after consideration of site characteristics such as soils, hydrology, vegetation, landscape position, and any other site limiting factors. Hydraulic loadings were calculated based on site specific data and NCDWQ guidelines for waste disposal (Water Balance Report: Edwin Andrews & Assoc. 2011). Soil fertility was analyzed by a regional soils analysis laboratory at NCDA (Table 4).

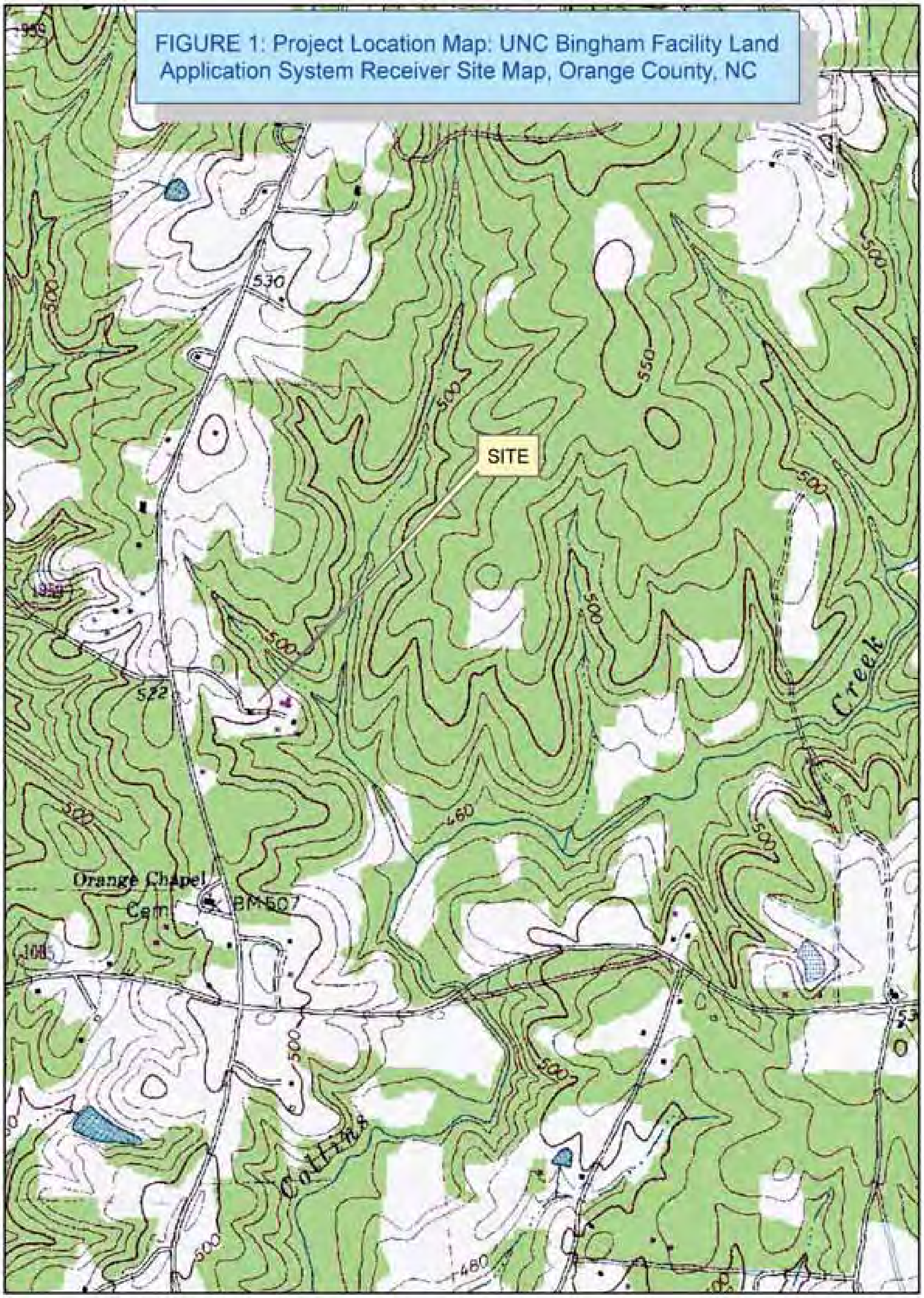
4.0 Site Description

The UNCBWWTF is located in Orange County near the town of White Cross in the Bingham Township off Orange Chapel Clover Garden Road (SR 1956) (Figure 1). The property consists of several agricultural hay fields currently out of production, adjacent and abutting regenerating and mature pine fringe forest, hardwood forest, and adjacent mature mixed pine and hardwood forest. Existing facility structures occur on the site as well as in entrance road, existing wastewater irrigation system and infrastructure, and a newly constructed expansion wastewater irrigation system, storage lagoon, and irrigation infrastructure. Several intermittent stream, wetland, and floodprone complexes occur on the north and east sides of the receiver site. Several drainages course through the property draining upland areas into Collins Creek, a tributary to the Haw River. The site is located in the Piedmont Physiographic Province in the vicinity of the Haw River that is characterized by rolling topography bisected by narrow perennial and intermittent streams.

The soils present on the proposed receiver sites, according to the Orange County Soil Survey (USDA, GIS 2010), are mapped as Georgeville silt loam, Herndon silt loam, as well as lowland loam soils consisting of Chewacla series soils. These mapping units were found on the site in similar locations indicated by the Orange County Soil Survey. Several small ephemeral, intermittent, and perennial drainages extend away from the receiver site connecting water conveyances on and off the site. These drainages were delineated and appropriate setbacks established to calculate irrigable soil areas (Biohabitats, 2010). These drainage areas will be protected from irrigation application with vegetative buffers that will capture and utilize subsurface irrigation water and rainfall runoff.

Soils in the upland areas are typical of piedmont Carolina Slate Belt series soils with considerable variability within the catena and within each soil series including depth, color, and texture. Topography is rolling near drainages with slopes ranging from 2 to 6 percent. Shallow soils were found on ridges and areas historically farmed and now in pine forest vegetation. Soils in the lowland areas are typical of floodplain soils with periodic flooding and inundation characteristics, but very well drained adjacent to the water conveyance.

The vegetation on the proposed forested land application areas consist of upland pine and hardwoods including: yellow poplar (*Liriodendron tulipifera*), hickory (*Carya* sp.), northern red oak (*Quercus rubra*), white oak (*Quercus alba*), red maple (*Acer rubrum*), black cherry (*Prunus serotina*), black gum (*Nyssa sylvatica*), sweetgum (*Liquidambar styraciflua*), sugar maple (*Acer saccharum)*, Loblolly pine (*Pinus taeda*), Shortleaf pine (*Pinus echinata*), Virginia pine (*Pinus virginiana*), sassafras (*Sassafras albidum*), and other small understory woody species. Vegetation in the fields and open areas consist of a variety of herbaceous grasses, forbs, and broadleaf species. Fields will either be kept



Source: NCDOT USGS 1:24,000 (GIS, 2010)

open and planted with perennial forage grasses such as coastal Bermuda or fescue, or will be planted with an appropriate tree species selected for the soil, proposed liquid loadings, and landscape position.

4.1 Wetlands, Streams, and Groundwater Wells:

A field investigation of the receiver site revealed areas of wetlands and drainage ways that have been delineated to avoid impacts from the irrigation system (Biohabitats, 2010). According to regulations (Section .0500 – Waste not discharged to surface waters) concerning wastewater land application systems using treated effluent, irrigation spray shall not influence within 25 feet of surface waters not classified SA (shellfish waters), including jurisdictional wetlands. Groundwater wells have been located and buffered accordingly. Additional 100 foot Jordan Lake buffers were also included in these setbacks on appropriate surface waters.

4.2 Soils Investigation:

A soils investigation was accomplished across the proposed receiver site. A series of 3.5 in. hand auger borings were done across the site to maximum depths ranging from 36 - 84 in. (Appendix A – Figure 2: Site Investigation Map). These borings were done to characterize the depth of each of the horizons, the color of the soil material at each of the various depths, the texture, structure, consistence of the soil material within each of the horizons, and depth to bedrock or other limiting horizon. These augerings were also done to verify the boundaries of mapping units indicated in the USDA soil survey for Orange County, NC (USDA GIS, 2010). Descriptions of the augerings are included in the Appendix (Appendix C: Soils Descriptions) and were utilized to make a field determination of the specific soil mapping unit and subsequent recommended hydraulic and liquid loadings.

The USDA Orange County Soil Survey for the site shows two (2) predominant series present within the irrigable soil areas: Georgeville silt loam and Herndon silt loam. Considerable variability in depth, color, and texture was evident across the site depending on landscape position and historical agricultural land use. These variations resulted in subsequent variations in hydraulic loading potentials between the two soil series but not within soil series sampling. Field investigations revealed similar locations for the soil series relative to the NRCS soil survey. The soils described and delineated in the field were separated into different Soil Areas each representing a different proposed hydraulic loading rate. These loading rates were determined in part by detailed soils descriptions including texture, structure, mineralogy, and consistence. In addition these Soil Areas and corresponding potential hydraulic loadings were determined by site topography and site specific saturated hydraulic conductivity (Ksat) measurements.

Uplands and lowlands were examined for the potential for land application. Soils in the uplands are typical of piedmont Carolina Slate Belt series soils with silt loam textures, deep soils on side and toe slopes, shallow soils on ridges, and considerable variability across the site. Topography is flat to rolling near drainages with slopes ranging from 2 to

6 percent. Potential hydraulic loading rates will be limited by the soil with the lowest Ksat within each proposed Soil Area.

The hand auger borings confirmed that the soils mapped on the site according to NRCS (USDA) are present in the proposed receiver areas. The majority of the soils on the proposed receiver site consist of Georgeville and Herndon silt loam soils, with the remainder of the lowlands consisting of Chewacla loam soils. Soil Area 1 (SA1) soils on the receiver site consist of Georgeville silt loam soils. Slopes range from 2-6%. These soils are very deep, well drained, moderately permeable soils that formed in material mostly weathered from fine-grained metavolcanic rocks of the Carolina Slate Belt. Seasonal high water is typically >6 ft. SA1 soils comprise approximately 62% (3.56 ac) of the total receiver site acreage (5.71 ac).

Soil Area 2 (SA2) soils on the receiver site consist of Herndon silt loam soils. Slopes range from 2-6%. These soils are very deep, well drained, moderately rapid permeability soils that formed in material mostly weathered from fine-grained metavolcanic rock of the Carolina Slate Belt. Seasonal high water is typically >6 ft, however soil variabilities across the site indicate some seasonal perching conditions closer to the surface, probably indicative of slower permeable inclusions. SA2 soils comprise approximately 37% (2.15 ac) of the total receiver site acreage (5.71).

A description of the soil areas including predominant soil series, and existing vegetation is summarized in Table 3.

Table 3: UNCBWWTF Land Application System Receiver Site Soil Area Descriptions.

Soil Area	Predominant Soil Series	Existing Vegetation
SA-1	Georgeville	Grass, Mixed Pine/Hardwood
SA-2	Herndon	Grass

4.3 Soils Analysis:

A composite sample of the top 0-12 inches of soil representing the irrigable upland areas was collected and analyzed for nutrient composition by NCDA (Table 4). Soil analyses of the proposed irrigation site indicate that there are nutrient deficiencies, especially nitrogen and phosphorus. This conclusion is based on the potential crop response to particular nutrients if fertilizer is applied to the site. The cation exchange capacity (CEC) and base saturation (BS%) are low as well. The addition of wastewater to the site will improve soil fertility and consequently the growing conditions and productivity of this site. Additional agronomy recommendations are found in the Agronomist Report (SWE Group, 2011)

Table 4: Composite Soil Analysis of Uplands (N=22) at the UNCBWWTF Receiver Site, Orange County, NC (2010)[1].

Depth	pH	Phosphorus ppm (Index) [2]	Potassium ppm (Index)	Calcium ppm (%)	Magnesium ppm (%)	CEC [3]	BS% [4]
Uplands							
0-6 in.	**4.8**	**23.4 (19.5)**	**69.1 (35.4)**	**211.6 (33.1)**	**94.3 (14.7)**	**6.1**	**50.7**
6-12 in.	**5.0**	**4.8 (4.0)**	**55.0 (28.1)**	**166.7 (29.8)**	**100.9 (17.7)**	**5.4**	**49.9**

[1] Laboratory Soil Test Reports (2010).
[2] Index values reported by NCDA (2010) http://www.ncagr.com/agronomi/pdffiles/ustr.pdf
[3] Cation exchange capacity (meq/100g) – defined as the amount of cations adsorbed on soil-particle surfaces per unit mass of the soil under chemically neutral conditions.
[4] Base saturation – defined as the percentage of the CEC occupied by base cations

5.0 Hydrology

5.1 Liquid Loadings

The liquid loading limit represents the amount of liquid (in/wk), which can be applied to land receiver sites, including nutrients. These values are represented as the annual, monthly, weekly, and hourly maximum loadings that can be assimilated on a wastewater receiver site. A water balance was calculated for each Soil Area to determine suitable liquid loadings according to the in-situ properties of the site that most influence these loadings.

The soils present are generally silt loam soils with slopes ranging from 2-6% on Soil Areas 1 and 2. Wastewater should not be applied at an instantaneous rate exceeding 0.5 in/hr on Soil Area 1 and 2. The maximum instantaneous loading rate was determined utilizing published infiltration rate data for the particular soil and landscape position at the existing wastewater receiver site (Sprinkler Irrigation, 1969). However, these numbers are somewhat conservative given the acceptable range of maximum instantaneous loading rate for these soils and ideal site conditions and can be increased up to 50% under ideal conditions (Table 5).

Table 5: Typical Ranges of Soil Infiltration Rates by Soil Texture and Slope.

	Basic Infiltration Rate (in/hr[1])		
	Slope		
Texture	**0-3%**	**3-9%**	**9+%**
Sands	1.0+	0.7+	0.5+
loamy sands	0.7-1.5	0.5-1.0	0.4-0.7
sandy loams and fine sandy loams	0.5-1.0	0.4-0.7	0.3-0.5
very fine sandy loam and silt loam	0.3-0.7	0.2-0.5	0.15-0.3

sandy clay loam and silty clay loam	0.2-0.4	0.15-0.25	0.1-0.15
clay and silty clay	0.1-0.2	0.1-0.15	<0.1

Source: Sprinkler Irrigation Association, Sprinkler Irrigation (1969)

1. For good vegetative cover, these rates may be 25-50% greater. For poor surface conditions, rates may be as much as 50% less.

During the soils investigation, the most restrictive soil horizons were noted to determine the appropriate Soil Areas and to estimate or measure saturated hydraulic conductivity in these restrictive horizons. Saturated hydraulic conductivity (K_{sat}) values were obtained from 22 sample points across the receiver site using a portable constant head permeameter (CHP) (Table 6). Test locations for soil hydraulic conductivity are shown on the site investigation map in Appendix A. From the site specific data, the Ksats for Soil Areas 1 and 2 were determined to have a geometric mean of 0.04 in/hr and 0.033 in/hr respectively (Appendix B – Saturated Hydraulic Conductivity Data) (Water Balance Report – Edwin Andrews & Assoc., 2011). Due to site variabilities and to improve site operations, the lowest geomean Ksat was selected to represent both soil areas. Therefore, both soil areas will be loaded at the same rate across the site at .033 in/hr (Edwin Andrews and Associates, 2011). These values represented the soil hydraulic characteristics of the irrigable soils and were incorporated into a comprehensive water balance. (Edwin Andrews & Assoc., PC, 2011).

It should also be noted that a forested land application system design was selected for a portion of this receiver site to maximize evapotranspiration, and improve soil quality; including structure and vertical and horizontal hydraulic conductivities. Root channels from the tree cover crop effectively improve the hydraulic conductivities of soils found on site above what can typically be calculated from discreet CHP data points and as reflected in the Ksat values used for each soil area in the water balance.

Table 6: Average Saturated Hydraulic Conductivity (Ksat) Data for the UNCBWWTF Receiver Site.

Soil Area	Horizon	Average Depth (in.)	cm/hr [1]	in/hr *
1	Bt	19.8	.08	0.034
2	Bt	19.3	.07	0.033
SA1 & SA2				.033

1.] Based off Ksat data collected across the project site for each Soil Area (Appendix B – Saturated Hydraulic Conductivity Data) (SWE Group, 2010 and Edwin Andrews & Associates, 2010)

*Water Balance conducted by Edwin Andrews and Associates, 2011.

Depending on zone layout and design it is recommended that some type of automated system be installed to allow efficient use of varying soil areas and irrigable areas. All irrigable soils (Figure 3 – Irrigable Soils Map) should be managed for irrigation according to antecedent rainfall and time of year to minimize ponding and runoff potential.

5.2 Wastewater Characterization:

The proposed secondary effluent irrigation water can be described as containing varying levels of essential plant nutrients, organic compounds, trace minerals, and potentially phytotoxic compounds. Each of these wastewater constituents are assimilated or transformed on a receiver site through physical, chemical, and biological processes. The irrigation water proposed for application on this system will go through a series of pretreatment stages preparatory to slow rate irrigation on a dedicated receiver site.

Additional sampling and monitoring of wastewater and soils on the receiver site is recommended to ensure optimal performance of the proposed irrigation system. Irrigation water should have SAR values ≤ 10 to avoid potential salting problems in the soil. Periodic application of gypsum may be required as a corrective measure if the SAR is consistently above 10. Proposed data from the design facility indicates low levels for N and P in treated effluent. Therefore, supplemental nutrients may be required.

5.3 Wastewater Remediation:

Irrigation water will be utilized in several ways on the receiver site. Some water will be lost directly by evaporation of the water from the sprinkler heads. Water will be lost through transpiration by vegetation, evaporation from the vegetation and soils surface, and percolation through the soil profile. Any excess nutrients in the wastewater will be treated through microbial processes, plant uptake, adsorption to soil solids, and biologically mediated chemical transformations (i.e. denitrification). Based on the wastewater analysis, there is little potential for percolation of nutrients below the root zone.

5.4 Water Budget:

A water balance was calculated by Edwin Andrews & Assoc., PC based on specific site data and utilized as an aid for system design. This water balance can be represented by:

Evapotranspiration + Natural Runoff + Drainage = Precipitation and Irrigation

Drainage rate was estimated based on qualitative observations, soil chemical and physical data, and site specific hydraulic conductivity data (K_{sat}). Long-term precipitation values used in the water balance represent the wet-year for the region (Chapel Hill, NC). Evapotranspiration data was utilized from data determined by the Thornthwaite method for calculating PET, one appropriate method for the Southeastern region.

The estimated water balance calculations illustrate the amount of wastewater that can be applied to the receiver site under wet rainfall year conditions, given there are no nutrient limitations. The facility should be designed to handle larger flow volumes when antecedent moisture conditions allow for additional irrigation such as during dry rainfall years. When irrigation water cannot be sprayed due to weather or site conditions, the water is put into storage. The water balance is used to optimize wastewater loadings and allow removal from storage. The drainage rate used is based on the K_{sat} of the soils. In determining the water balance, the percolation rate (Pw) was estimated to be conservatively, .04% of K_{sat} for Soil Areas 1 and 2. The EPA method (EPA, 1981) adopted by NCDWQ recommends that the drainage rate used is between 4-10% of the saturated hydraulic conductivity (K_{sat}) of the soils. This percolation rate is recommended for this system based on the potential accumulation of organic matter and migration of fine soil particles during the operation of this system, as well as the time of year that saturated hydraulic conductivity measurements occurred. The K_{sat} used to determine drainage represents this expression of organic material and soil fines, as well as the existing soil characteristics such as structure and texture found at the proposed receiver site and soil moisture conditions at the time of measurement.

It should be noted that K_{sat} values for discrete locations in Soil Areas can understate or overstate actual hydraulic dynamics across the site due to extensive tree root systems, root channels, and improved soil quality characteristics from these root systems; such as soil structure, % organic matter, and soil macro fauna channels.

The water losses are evapotranspiration (ET), drainage, and rainfall runoff. The potential additions are rainfall and irrigation. The method used for the water balance uses the wettest conditions over a long-term period as measured by the 80^{th} percentile precipitation data for each month. Actual irrigation rates can double under drier conditions than those used for the water balance. In addition, ET would increase with decreasing rainfall and thus increase the amount of irrigation water that can be utilized. It should be noted that expected ET values for the forest system are much higher than ET data used in water balance calculations. Operators should be given sufficient permit flexibility to allow additional hydraulic loadings to take full advantage of the benefits provided by the forest or forage cover crop and to ultimately meet the maximum potential hydraulic capacity of the system without resulting in runoff or ponding.

6.0 Environmental Effects

When managed properly, there will be no adverse environmental effects from the use and operation of the proposed UNCBWWTF land application system receiver site. The irrigation water used will be effectively treated by the receiver site and growing crops before these waters enter surface and/or groundwaters. The use of this irrigation water will ultimately increase soil fertility and productivity of the site, as indicated by soils analysis and crop productivity, and will enhance adjacent wetlands and low lying areas with increased base flow. If managed properly, the existing wastewater land application system will have no adverse impacts to groundwater supplies or surface water supplies. The addition of water and nutrients to the site will benefit wildlife through increased biological activity in adjacent wetlands and low lying areas, and the irrigation operation may actually contribute to base flow in this river system.

7.0 Results / Discussion

The soils investigated at the UNCBWWTF land application system receiver site are suitable for wastewater application. The best soils are deep, well-drained, and have moderate permeabilities. The soils were grouped into two (2) separate soil areas, each with specific loading rates (Table 7). A geometric mean loading rate was utilized using the most conservative soils on site thereby combining all soil areas into one design Soil Area.

Table 7: Soils, Irrigable Area, and Recommended Wastewater Loadings for the UNCBWWTF Land Application System Receiver Site.

Soil Area	Predominant Soils	acres[1]	in/wk[2]	gpd[3][4][5]	Seasonal
1	Georgeville	3.56	.157	2,182	Yes
2	Herndon	2.15	.157	1,318	Yes
Design *	SA1 & 2	5.71	.157	3,500	Yes

1] Acreages account for setbacks from waterways, wetlands, streams, property lines, dwellings, and water supply wells for a 3,500 gpd system.

2] Rate based on recommended application rates calculated by a comprehensive Water Balance Report (Edwin Andrews & Assoc., PC, 2010) and local wet rainfall year data.

3] Based on a 7 day irrigation week.

4] Recommended hydraulic loading over an entire irrigation year including storage constraints.

5] Irrigation rate shown is the maximum that should be used in computing receiver site capacity unless or until a higher loading rate is shown to be sustainable based on actual field performance and storage capacity limitations. Use of forest cover crop may result in higher than estimated transpiration and drainage rates. Operators at a minimum need the permit flexibility to apply irrigation water at a rate high enough to sustain plant growth without causing runoff or ponding, which during extended dry periods (drought conditions) could exceed the rates shown in the table.

* Actual irrigable area utilized in Water Balance Report (Edwin Andrews & Assoc., PC, 2011).

Saturated hydraulic conductivity tests were performed to determine the permeability of the most restrictive horizon. These measurements were obtained from selected sample points across the site. These values were used to determine the hydraulic loading capacity of the receiver site. The most restrictive horizon in these soils have saturated hydraulic conductivities ranging from .29 to 0.01 in/hr for all Soil Areas. The most restrictive saturated hydraulic conductivities were determined in the Bt horizons of all Soil Areas.

According to the final Water Balance Report (Edwin Andrews & Assoc., PC, 2011) for the selected receiver site, existing soils and vegetation can accept maximum hydraulically limited liquid loadings of 8.2 in/yr applied to Soil Areas 1 and 2 (3,500 gpd). Recommended weekly application is .157 in/wk for both soil areas based on local wet year rainfall data. Actual loadings may be adjusted in the future according to site specific characteristics, system operation, and storage modifications.

Overall, the site is a viable option for wastewater application. The irrigation water applied will provide supplemental nutrients and a consistent source of water to growing crops capable of producing large amounts of biomass and providing favorable soil conditions to enhance adsorption and denitrification of phosphorous and nitrogen respectively. With proper site management, hydraulic and nutrient loading management, the site will perform as a means to treat and assimilate wastewater irrigation water and protect surface waters entering the nearby river basins.

8.0 References

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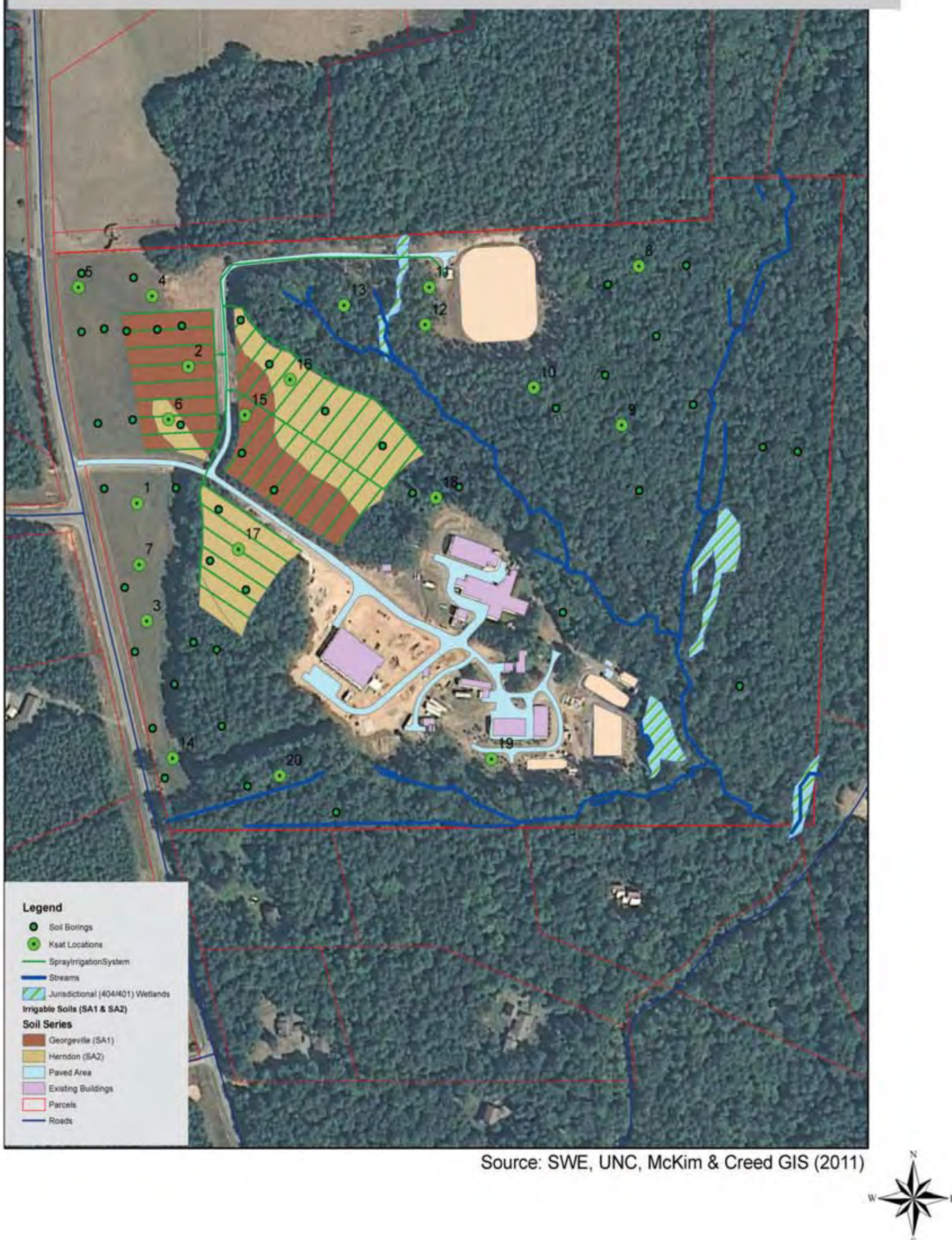
APPENDIX

APPENDIX A

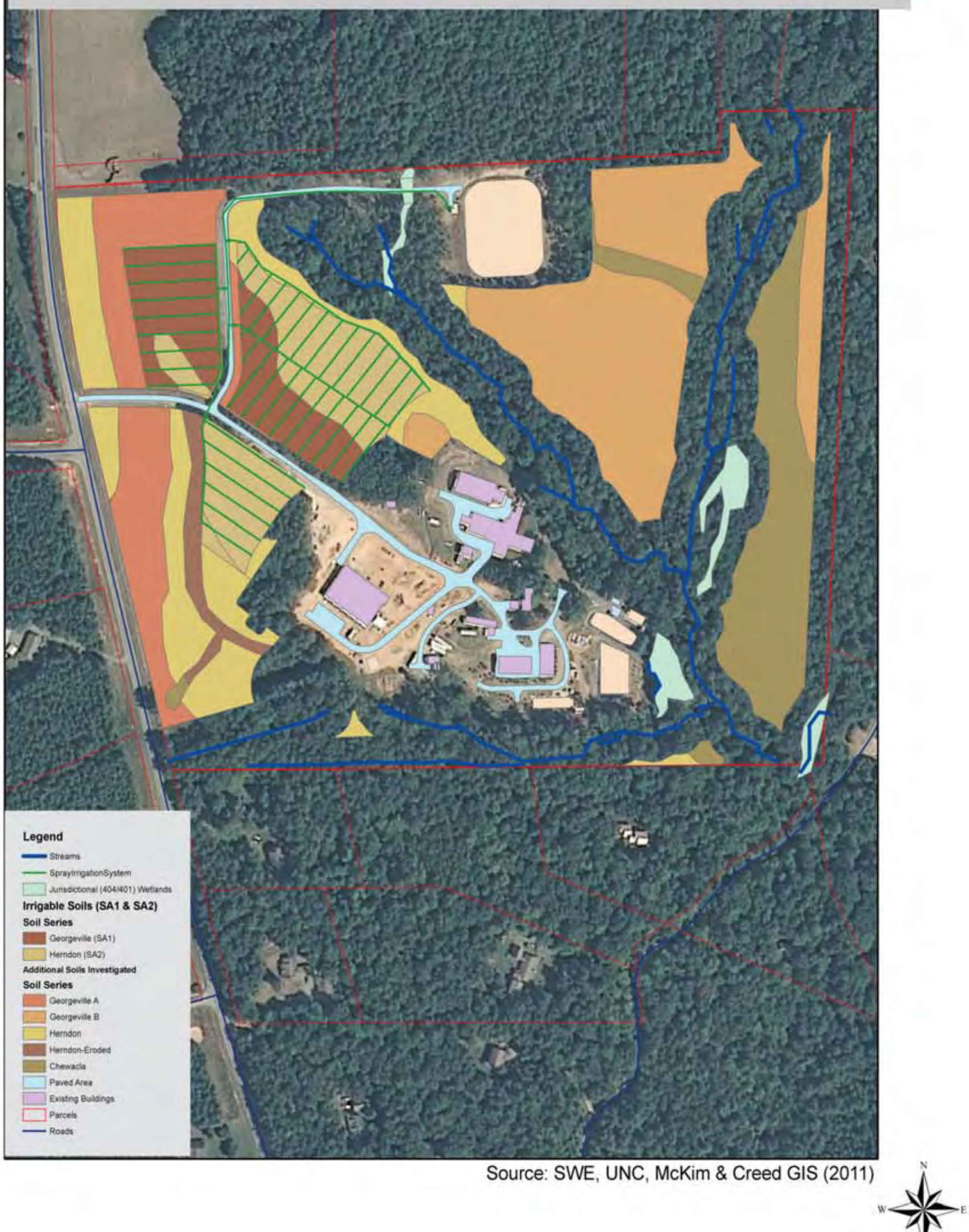
Maps

FIGURE 2: UNC Bingham Facility Land Application System Site Investigation Map



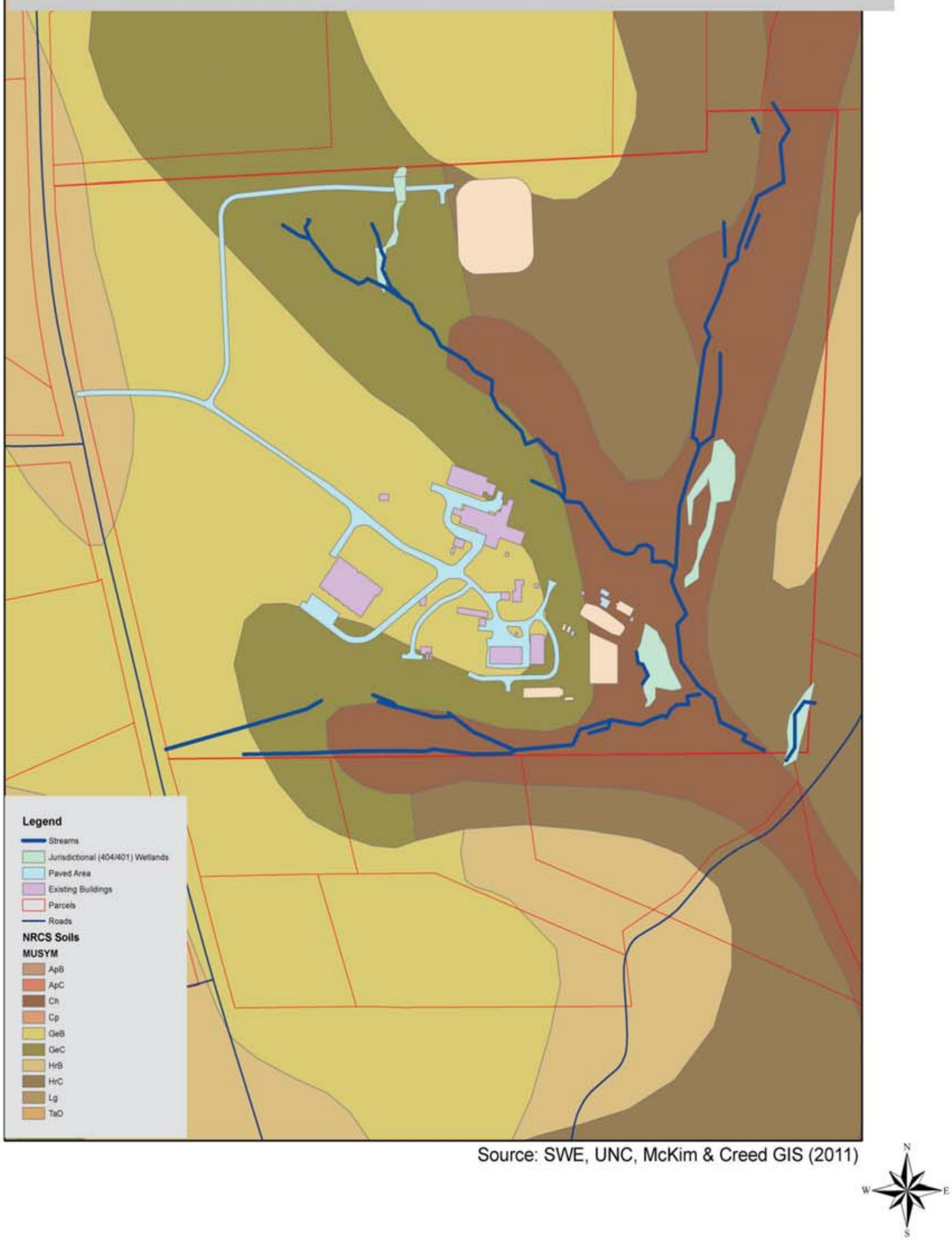
Source: SWE, UNC, McKim & Creed GIS (2011)

FIGURE 3: UNC Bingham Facility Land Application System Irrigable Soils Map



Source: SWE, UNC, McKim & Creed GIS (2011)

FIGURE 4: UNC Bingham Facility Land Application System NRCS (USDA) Soils Map



Source: SWE, UNC, McKim & Creed GIS (2011)

APPENDIX B

Saturated Hydraulic Conductivity Data

Ksat Data Sheet

Plot:	Ksat-1	Conducted By:	SJF
Location:	Bingham, road	Date:	4/6/10
Weather:	sunny	Temp:	75
Soil Series/Horizon:	Georgeville	Source of Water:	tap

Plot	hd	r	rs	D	Hi	H/r	di	$dsur_i$	1-ON	2-ON	$dsur_f$	df	Hf	Mri	Ti	MRf	Tf	Δ MR	Δ T	V	CF	Q (cm^3/min)	Q (cm^3/h)	Ksat (cm/h)	Ksat (cm/d)	Ksat (in/h)	Ksat (in/d)
1/Bt	48	3.0	10	58	15	5	43	33	yes		33	43	15	34.3	10:43:00	32.2	11:13:00	2.1	0:30:00	42	20	1.4	84.0	0.089	2.13	0.03	0.84
	48	3.0	10	58	15	5	43	33	yes		33	43	15	32.2	11:13:00	31.0	11:43:00	1.2	0:30:00	24	20	0.8	48.0	0.051	1.22	0.02	0.48
	48	3.0	10	58	15	5	43	33	yes		33	43	15	31.0	11:43:00	30.5	12:13:00	0.5	0:30:00	10	20	0.3	20.0	0.021	0.51	0.01	0.20
	48	3.0	10	58	15	5	43	33	yes		33	43	15	30.5	12:13:00	29.5	12:43:00	1.0	0:30:00	20	20	0.7	40.0	0.042	1.01	0.02	0.40
	48	3.0	10	58	15	5	43	33	yes		33	43	15	29.5	12:43:00	28.5	13:13:00	1.0	0:30:00	20	20	0.7	40.0	0.042	1.01	0.02	0.40
	48	3.0	10	58	15	5	43	33	yes		33	43	15	28.5	13:13:00	27.5	13:43:00	1.0	0:30:00	20	20	0.7	40.0	0.042	1.01	0.02	0.40
	48	3.0	10	58	15	5	43	33	yes		33	43	15	27.5	13:43:00	26.5	14:13:00	1.0	0:30:00	20	20	0.7	40.0	0.042	1.01	0.02	0.40
																								0.0423	**1.0141**	**0.0166**	**0.3993**
2/Bc	99	3.0	10	109	15	5	94	84		yes	84	94	15	38.8	11:05:00	37.2	11:50:00	1.6	0:45:00	168	105	3.7	224.0	0.237	5.68	0.09	2.24
	99	3.0	10	109	15	5	94	84		yes	84	94	15	37.2	11:50:00	34.2	12:20:00	3.0	0:30:00	315	105	10.5	630.0	0.666	15.97	0.26	6.29
	99	3.0	10	109	15	5	94	84		yes	84	94	15	34.2	12:20:00	30.6	12:50:00	3.6	0:30:00	378	105	12.6	756.0	0.799	19.17	0.31	7.55
	99	3.0	10	109	15	5	94	84		yes	84	94	15	30.6	12:50:00	27.2	13:20:00	3.4	0:30:00	357	105	11.9	714.0	0.754	18.10	0.30	7.13
																								0.7321	**17.5694**	**0.2416**	**5.7992**

hd = Hole depth (cm)
r = Radius of the hole (dia./2) (cm)
rs = Distance between reference level and soil surface (cm)
D = Distance from the hole bottom to the reference level (hd+rs) (cm)
Hi = Initial desired water depth (head) in hole (cm)
H/r = Ratio of head to radius of hole (must be ≥ 5)
di = Constant-head tube setting, initial d measured in hole (di = D-Hi) (cm) - usually 1 cm less than calculated di
$dsur_i$ = Initial distance from water surface to ground (hd - Hi)
1-ON = 3-way valve turned to 1-ON (CF = 20, multiply CF times Δ MR to obtain volume of flow)
2-ON = 3-way valve turned to 2-ON (CF = 105, multiply CF times Δ MR to obtain volume of flow)
$dsur_f$ = Final distance from water surface to ground (steady state)
df = Final d measured in hole ($dsur_f$ + rs) (cm) - should be within 1-2 cm of di
Hf - Final water depth in hole (Hf = D-df) (cm)
MRi = Initial measuring reservoir reading (cm)
Ti = Initial time to record measuring reservoir level drop (min.)
MRf = Final measuring reservoir reading (cm)
Tf = Final time to record measuring reservoir level drop (min.)
Δ MR = Change in measuring reservoir level (cm)
Δ T = Change in time for measuring reservoir water drop (min.)
V = flow volume (cm^3)

Ksat Data Sheet

Plot:	Ksat-2	Conducted By:	SJF
Location:	Bingham - field/road	Date:	4/6/10
Weather:	sunny	Temp:	75
Soil Series/Horizon:	Ge	Source of Water:	tap

Plot	hd	r	rs	D	Hi	H/r	di	$dsur_i$	1-ON	2-ON	$dsur_f$	df	Hf	Mri	Ti	MRf	Tf	Δ MR	Δ T	V	CF	Q (cm^3/min)	Q (cm^3/h)	Ksat (cm/h)	Ksat (cm/d)	Ksat (in/h)	Ksat (in/d)
1/Bt	43	3.0	10	53	15	5	38	28	yes		28	38	15	36.3	11:06:00	35.4	11:36:00	0.9	0:30:00	18	20	0.6	36.0	0.038	0.91	0.01	0.36
	43	3.0	10	53	15	5	38	28	yes		28	38	15	35.4	11:36:00	34.7	12:06:00	0.7	0:30:00	14	20	0.5	28.0	0.030	0.71	0.01	0.28
	43	3.0	10	53	15	5	38	28	yes		28	38	15	34.7	12:06:00	34.1	12:36:00	0.6	0:30:00	12	20	0.4	24.0	0.025	0.61	0.01	0.24
	43	3.0	10	53	15	5	38	28	yes		28	38	15	34.1	12:36:00	33.5	13:06:00	0.6	0:30:00	12	20	0.4	24.0	0.025	0.61	0.01	0.24
	43	3.0	10	53	15	5	38	28	yes		28	38	15	33.5	13:06:00	32.9	13:36:00	0.6	0:30:00	12	20	0.4	24.0	0.025	0.61	0.01	0.24
	43	3.0	10	53	15	5	38	28	yes		28	38	15	32.9	13:36:00	32.3	14:06:00	0.6	0:30:00	12	20	0.4	24.0	0.025	0.61	0.01	0.24
																								0.0254	**0.6085**	**0.0100**	**0.2396**
2/BC	60	3.0	10	70	15	5	55	45		yes	45	55	15	42.9	11:00:00	42.8	11:45:00	0.1	0:45:00	10.5	105	0.2	14.0	0.015	0.35	0.01	0.14
	60	3.0	10	70	15	5	55	45		yes	45	55	15	42.8	11:45:00	42.7	12:15:00	0.1	0:30:00	10.5	105	0.3	21.0	0.022	0.53	0.01	0.21
	60	3.0	10	70	15	5	55	45		yes	45	55	15	42.7	12:15:00	42.6	12:45:00	0.1	0:30:00	10.5	105	0.4	21.0	0.022	0.53	0.01	0.21
	60	3.0	10	70	15	5	55	45		yes	45	55	15	42.6	12:45:00	42.3	13:15:00	0.3	0:30:00	31.5	105	1.1	63.0	0.067	1.60	0.03	0.63
	60	3.0	10	70	15	5	55	45		yes	45	55	15	42.3	13:15:00	41.9	13:45:00	0.4	0:30:00	42	105	1.4	84.0	0.089	2.13	0.03	0.84
	60	3.0	10	70	15	5	55	45		yes	45	55	15	41.9	13:45:00	24.9	8:57:00	17.0	16:48:00	1785	105	1.8	106.3	0.112	2.69	0.04	1.06
	60	3.0	10	70	15	5	55	45		yes	45	55	15	24.9	8:57:00	24.4	9:27:00	0.5	0:30:00	52.5	105	1.8	105.0	0.111	2.66	0.04	1.05
	60	3.0	10	70	15	5	55	45		yes	45	55	15	24.4	9:27:00	23.7	10:07:00	0.6	0:40:00	63	105	1.6	94.5	0.100	2.40	0.04	0.94
	60	3.0	10	70	15	5	55	45		yes	45	55	15	24.4	10:07:00	23.7	10:37:00	0.6	0:30:00	63	105	2.1	126.0	0.133	3.19	0.05	1.26
																								0.1122	**2.69**	**0.0442**	**1.0605**

hd = Hole depth (cm)
r = Radius of the hole (dia./2) (cm)
rs = Distance between reference level and soil surface (cm)
D = Distance from the hole bottom to the reference level (hd+rs) (cm)
Hi = Initial desired water depth (head) in hole (cm)
H/r = Ratio of head to radius of hole (must be ≥ 5)
di = Constant-head tube setting, initial d measured in hole (di = D-Hi) (cm) - usually 1 cm less than calculated di
$dsur_i$ = Initial distance from water surface to ground (hd - Hi)
1-ON = 3-way valve turned to 1-ON (CF = 20, multiply CF times Δ MR to obtain volume of flow)
2-ON = 3-way valve turned to 2-ON (CF = 105, multiply CF times Δ MR to obtain volume of flow)
$dsur_f$ = Final distance from water surface to ground (steady state)
df = Final d measured in hole ($dsur_f$ + rs) (cm) - should be within 1-2 cm of di
Hf - Final water depth in hole (Hf = D-df) (cm)
MRi = Initial measuring reservoir reading (cm)
Ti = Initial time to record measuring reservoir level drop (min.)
MRf = Final measuring reservoir reading (cm)
Tf = Final time to record measuring reservoir level drop (min.)
Δ MR = Change in measuring reservoir level (cm)
Δ T = Change in time for measuring reservoir water drop (min.)
V = flow volume (cm^3)

Ksat Data Sheet

Plot:	Ksat 3	Conducted By:	SJF
Location:	Bingham - front road	Date:	4/23/10
Weather:	cloudy	Temp:	60
Soil Series/Horizon:	Ge	Source of Water:	tap

Plot	hd	r	rs	D	Hi	H/r	di	$dsur_i$	1-ON	2-ON	$dsur_f$	df	Hf	Mri	Ti	MRf	Tf	Δ MR	Δ T	V	CF	Q (cm^3/min)	Q (cm^3/h)	Ksat (cm/h)	Ksat (cm/d)	Ksat (in/h)	Ksat (in/d)
1/Bt	52	3.0	10	62	15	5	47	37		yes	37	47	15	42.5	10:18:00	41.6	10:48:00	0.9	0:30:00	94.5	105	3.2	189.0	0.200	4.79	0.08	1.89
	52	3.0	10	62	15	5	47	37		yes	37	47	15	41.6	10:48:00	41.0	11:18:00	0.6	0:30:00	63	105	2.1	126.0	0.133	3.19	0.05	1.26
	52	3.0	10	62	15	5	47	37		yes	37	47	15	41.0	11:18:00	40.6	11:48:00	0.4	0:30:00	42	105	1.4	84.0	0.089	2.13	0.03	0.84
	52	3.0	10	62	15	5	47	37		yes	37	47	15	40.6	11:48:00	40.2	12:18:00	0.4	0:30:00	42	105	1.4	84.0	0.089	2.13	0.03	0.84
	52	3.0	10	62	15	5	47	37		yes	37	47	15	40.2	12:18:00	39.6	12:48:00	0.6	0:30:00	63	105	2.1	126.0	0.133	3.19	0.05	1.26
	52	3.0	10	62	15	5	47	37		yes	37	47	15	39.6	12:48:00	39.1	13:18:00	0.5	0:30:00	52.5	105	1.8	105.0	0.111	2.66	0.04	1.05
	52	3.0	10	62	15	5	47	37		yes	37	47	15	39.1	1:18:00	38.4	1:48:00	0.7	0:30:00	73.5	105	2.5	147.0	0.155	3.73	0.06	1.47
	52	3.0	10	62	15	5	47	37		yes	37	47	15	38.4	1:48:00	38.4	2:18:00	0.0	0:30:00	0	105	0.0	0.0	0.000	0.00	0.00	0.00
																								0.1183	**2.8395**	**0.0466**	**1.1179**

hd = Hole depth (cm)
r = Radius of the hole (dia./2) (cm)
rs = Distance between reference level and soil surface (cm)
D = Distance from the hole bottom to the reference level (hd+rs) (cm)
Hi = Initial desired water depth (head) in hole (cm)
H/r = Ratio of head to radius of hole (must be ≥ 5)
di = Constant-head tube setting, initial d measured in hole (di = D-Hi) (cm) - usually 1 cm less than calculated di
$dsur_i$ = Initial distance from water surface to ground (hd - Hi)
1-ON = 3-way valve turned to 1-ON (CF = 20, multiply CF times Δ MR to obtain volume of flow)
2-ON = 3-way valve turned to 2-ON (CF = 105, multiply CF times Δ MR to obtain volume of flow)
$dsur_f$ = Final distance from water surface to ground (steady state)
df = Final d measured in hole ($dsur_f$ + rs) (cm) - should be within 1-2 cm of di
Hf - Final water depth in hole (Hf = D-df) (cm)
MRi = Initial measuring reservoir reading (cm)
Ti = Initial time to record measuring reservoir level drop (min.)
MRf = Final measuring reservoir reading (cm)
Tf = Final time to record measuring reservoir level drop (min.)
Δ MR = Change in measuring reservoir level (cm)
Δ T = Change in time for measuring reservoir water drop (min.)
V = flow volume (cm^3)

Ksat Data Sheet

Plot:	Ksat-4	Conducted By:	SJF
Location:	Bingham, road	Date:	4/7/10
Weather:	sunny	Temp:	75
Soil Series/Horizon:	Ge (shallow)	Source of Water:	tap

Plot	hd	r	rs	D	Hi	H/r	di	$dsur_i$	1-ON	2-ON	$dsur_f$	df	Hf	Mri	Ti	MRf	Tf	Δ MR	Δ T	V	CF	Q (cm^3/min)	Q (cm^3/h)	Ksat (cm/h)	Ksat (cm/d)	Ksat (in/h)	Ksat (in/d)
1/Bt	47	3.0	10	57	15	5	42	32		yes	32	42	15	36.0	9:40:00	35.5	10:10:00	0.5	0:30:00	52.5	105	1.8	105.0	0.111	2.66	0.04	1.05
	47	3.0	10	57	15	5	42	32		yes	32	42	15	35.5	10:10:00	34.9	10:50:00	0.6	0:40:00	63	105	1.6	94.5	0.100	2.40	0.04	0.94
	47	3.0	10	57	15	5	42	32		yes	32	42	15	34.9	10:50:00	34.4	11:20:00	0.5	0:30:00	52.5	105	1.8	105.0	0.111	2.66	0.04	1.05
	47	3.0	10	57	15	5	42	32		yes	32	42	15	34.4	11:20:00	34.0	11:50:00	0.4	0:30:00	42	105	1.4	84.0	0.089	2.13	0.03	0.84
	47	3.0	10	57	15	5	42	32		yes	32	42	15	34.0	11:50:00	33.6	12:20:00	0.4	0:30:00	42	105	1.4	84.0	0.089	2.13	0.03	0.84
	47	3.0	10	57	15	5	42	32		yes	32	42	15	33.6	12:20:00	33.2	12:50:00	0.4	0:30:00	42	105	1.4	84.0	0.089	2.13	0.03	0.84
	47	3.0	10	57	15	5	42	32		yes	32	42	15	33.2	12:50:00	32.8	13:20:00	0.4	0:30:00	42	105	1.4	84.0	0.089	2.13	0.03	0.84
																								0.0887	**2.1296**	**0.0349**	**0.8384**

hd = Hole depth (cm)
r = Radius of the hole (dia./2) (cm)
rs = Distance between reference level and soil surface (cm)
D = Distance from the hole bottom to the reference level (hd+rs) (cm)
Hi = Initial desired water depth (head) in hole (cm)
H/r = Ratio of head to radius of hole (must be ≥ 5)
di = Constant-head tube setting, initial d measured in hole (di = D-Hi) (cm) - usually 1 cm less than calculated di
$dsur_i$ = Initial distance from water surface to ground (hd - Hi)
1-ON = 3-way valve turned to 1-ON (CF = 20, multiply CF times Δ MR to obtain volume of flow)
2-ON = 3-way valve turned to 2-ON (CF = 105, multiply CF times Δ MR to obtain volume of flow)
$dsur_f$ = Final distance from water surface to ground (steady state)
df = Final d measured in hole ($dsur_f$ + rs) (cm) - should be within 1-2 cm of di
Hf - Final water depth in hole (Hf = D-df) (cm)
MRi = Initial measuring reservoir reading (cm)
Ti = Initial time to record measuring reservoir level drop (min.)
MRf = Final measuring reservoir reading (cm)
Tf = Final time to record measuring reservoir level drop (min.)
Δ MR = Change in measuring reservoir level (cm)
Δ T = Change in time for measuring reservoir water drop (min.)
V = flow volume (cm^3)

Ksat Data Sheet

Plot:	Ksat-5	Conducted By:	SJF
Location:	Bingham, road	Date:	4/12/10
Weather:	sunny	Temp:	60
Soil Series/Horizon:	yellow brown (Herndon)	Source of Water:	tap

Plot	hd	r	rs	D	Hi	H/r	di	$dsur_i$	1-ON	2-ON	$dsur_f$	df	Hf	Mri	Ti	MRf	Tf	Δ MR	Δ T	V	CF	Q (cm^3/min)	Q (cm^3/h)	Ksat (cm/h)	Ksat (cm/d)	Ksat (in/h)	Ksat (in/d)
1/Bt	40	3.0	10	50	15	5	35	25		yes	25	35	15	46.0	10:00:00	44.5	10:30:00	1.5	0:30:00	157.5	105	5.3	315.0	0.333	7.99	0.13	3.14
	40	3.0	10	50	15	5	35	25		yes	25	35	15	44.5	10:30:00	43.4	11:00:00	1.1	0:30:00	115.5	105	3.9	231.0	0.244	5.86	0.10	2.31
	40	3.0	10	50	15	5	35	25		yes	25	35	15	43.4	11:00:00	42.3	11:30:00	1.1	0:30:00	115.5	105	3.9	231.0	0.244	5.86	0.10	2.31
	40	3.0	10	50	15	5	35	25		yes	25	35	15	42.3	11:30:00	41.6	12:00:00	0.7	0:30:00	73.5	105	2.4	147.0	0.155	3.73	0.06	1.47
	40	3.0	10	50	15	5	35	25		yes	25	35	15	38.9	12:20:00	38.0	12:50:00	0.9	0:30:00	94.5	105	3.2	189.0	0.200	4.79	0.08	1.89
	40	3.0	10	50	15	5	35	25		yes	25	35	15	38.0	12:50:00	37.3	13:20:00	0.7	0:30:00	73.5	105	2.5	147.0	0.155	3.73	0.06	1.47
	40	3.0	10	50	15	5	35	25		yes	25	35	15	37.3	13:20:00	36.6	13:50:00	0.7	0:30:00	73.5	105	2.4	147.0	0.155	3.73	0.06	1.47
	40	3.0	10	50	15	5	35	25		yes	25	35	15	36.6	13:50:00	35.9	14:20:00	0.7	0:30:00	73.5	105	2.5	147.0	0.155	3.73	0.06	1.47
																								0.1553	**3.7268**	**0.0611**	**1.4673**

hd = Hole depth (cm)
r = Radius of the hole (dia./2) (cm)
rs = Distance between reference level and soil surface (cm)
D = Distance from the hole bottom to the reference level (hd+rs) (cm)
Hi = Initial desired water depth (head) in hole (cm)
H/r = Ratio of head to radius of hole (must be ≥ 5)
di = Constant-head tube setting, initial d measured in hole (di = D-Hi) (cm) - usually 1 cm less than calculated di
$dsur_i$ = Initial distance from water surface to ground (hd - Hi)
1-ON = 3-way valve turned to 1-ON (CF = 20, multiply CF times Δ MR to obtain volume of flow)
2-ON = 3-way valve turned to 2-ON (CF = 105, multiply CF times Δ MR to obtain volume of flow)
$dsur_f$ = Final distance from water surface to ground (steady state)
df = Final d measured in hole ($dsur_f$ + rs) (cm) - should be within 1-2 cm of di
Hf - Final water depth in hole (Hf = D-df) (cm)
MRi = Initial measuring reservoir reading (cm)
Ti = Initial time to record measuring reservoir level drop (min.)
MRf = Final measuring reservoir reading (cm)
Tf = Final time to record measuring reservoir level drop (min.)
Δ MR = Change in measuring reservoir level (cm)
Δ T = Change in time for measuring reservoir water drop (min.)
V = flow volume (cm^3)

Ksat Data Sheet

Plot:	Ksat-6	Conducted By:	SJF
Location:	Bingham, road	Date:	4/12/10
Weather:	sunny	Temp:	60
Soil Series/Horizon:	ylw. brn. (Herndon)-swale	Source of Water:	tap

Plot	hd	r	rs	D	Hi	H/r	di	$dsur_i$	1-ON	2-ON	$dsur_f$	df	Hf	Mri	Ti	MRf	Tf	Δ MR	Δ T	V	CF	Q (cm^3/min)	Q (cm^3/h)	Ksat (cm/h)	Ksat (cm/d)	Ksat (in/h)	Ksat (in/d)
1/Bt	54	3.0	10	64	15	5	49	39		yes	39	49	15	44.3	10:15:00	43.8	10:45:00	0.5	0:30:00	52.5	105	1.8	105.0	0.111	2.66	0.04	1.05
	54	3.0	10	64	15	5	49	39		yes	39	49	15	43.8	10:45:00	43.4	11:15:00	0.4	0:30:00	42	105	1.4	84.0	0.089	2.13	0.03	0.84
	54	3.0	10	64	15	5	49	39		yes	39	49	15	43.4	11:15:00	43.2	11:45:00	0.2	0:30:00	21	105	0.7	42.0	0.044	1.06	0.02	0.42
	54	3.0	10	64	15	5	49	39		yes	39	49	15	43.2	11:45:00	43.0	12:15:00	0.2	0:30:00	21	105	0.7	42.0	0.044	1.06	0.02	0.42
	54	3.0	10	64	15	5	49	39		yes	39	49	15	43.0	12:15:00	42.8	12:45:00	0.2	0:30:00	21	105	0.7	42.0	0.044	1.06	0.02	0.42
	54	3.0	10	64	15	5	49	39		yes	39	49	15	42.8	12:45:00	42.6	13:15:00	0.2	0:30:00	21	105	0.7	42.0	0.044	1.06	0.02	0.42
																								0.0444	**1.0648**	**0.0175**	**0.4192**

hd = Hole depth (cm)
r = Radius of the hole (dia./2) (cm)
rs = Distance between reference level and soil surface (cm)
D = Distance from the hole bottom to the reference level (hd+rs) (cm)
Hi = Initial desired water depth (head) in hole (cm)
H/r = Ratio of head to radius of hole (must be ≥ 5)
di = Constant-head tube setting, initial d measured in hole (di = D-Hi) (cm) - usually 1 cm less than calculated di
$dsur_i$ = Initial distance from water surface to ground (hd - Hi)
1-ON = 3-way valve turned to 1-ON (CF = 20, multiply CF times Δ MR to obtain volume of flow)
2-ON = 3-way valve turned to 2-ON (CF = 105, multiply CF times Δ MR to obtain volume of flow)
$dsur_f$ = Final distance from water surface to ground (steady state)
df = Final d measured in hole ($dsur_f$ + rs) (cm) - should be within 1-2 cm of di
Hf - Final water depth in hole (Hf = D-df) (cm)
MRi = Initial measuring reservoir reading (cm)
Ti = Initial time to record measuring reservoir level drop (min.)
MRf = Final measuring reservoir reading (cm)
Tf = Final time to record measuring reservoir level drop (min.)
Δ MR = Change in measuring reservoir level (cm)
Δ T = Change in time for measuring reservoir water drop (min.)
V = flow volume (cm^3)

Ksat Data Sheet

Plot:	Ksat-7	Conducted By:	SJF
Location:	Bingham- orad	Date:	4/23/10
Weather:	Cloudy	Temp:	60
Soil Series/Horizon:	Ge	Source of Water:	tap

Plot	hd	r	rs	D	Hi	H/r	di	$dsur_i$	1-ON	2-ON	$dsur_f$	df	Hf	Mri	Ti	MRf	Tf	Δ MR	Δ T	V	CF	Q (cm^3/min)	Q (cm^3/h)	Ksat (cm/h)	Ksat (cm/d)	Ksat (in/h)	Ksat (in/d)
1/Bt	38	3.0	10	48	15	5	33	23		yes	23	33	15	45.9	10:08:00	44.5	10:38:00	1.4	0:30:00	147	105	4.9	294.0	0.311	7.45	0.12	2.93
	38	3.0	10	48	15	5	33	23		yes	23	33	15	44.5	10:38:00	43.5	11:08:00	1.0	0:30:00	105	105	3.5	210.0	0.222	5.32	0.09	2.10
	38	3.0	10	48	15	5	33	23		yes	23	33	15	43.5	11:08:00	43.1	11:38:00	0.4	0:30:00	42	105	1.4	84.0	0.089	2.13	0.03	0.84
	38	3.0	10	48	15	5	33	23		yes	23	33	15	43.1	11:38:00	42.6	12:08:00	0.5	0:30:00	52.5	105	1.8	105.0	0.111	2.66	0.04	1.05
	38	3.0	10	48	15	5	33	23		yes	23	33	15	42.6	12:08:00	41.8	12:38:00	0.8	0:30:00	84	105	2.8	168.0	0.177	4.26	0.07	1.68
	38	3.0	10	48	15	5	33	23		yes	23	33	15	41.8	12:38:00	41.3	13:08:00	0.5	0:30:00	52.5	105	1.8	105.0	0.111	2.66	0.04	1.05
	38	3.0	10	48	15	5	33	23		yes	23	33	15	41.3	1:08:00	40.8	1:38:00	0.5	0:30:00	52.5	105	1.8	105.0	0.111	2.66	0.04	1.05
	38	3.0	10	48	15	5	33	23		yes	23	33	15	40.8	1:38:00	40.3	2:08:00	0.5	0:30:00	52.5	105	1.8	105.0	0.111	2.66	0.04	1.05
																								0.1109	**2.66**	**0.04**	**1.05**

hd = Hole depth (cm)
r = Radius of the hole (dia./2) (cm)
rs = Distance between reference level and soil surface (cm)
D = Distance from the hole bottom to the reference level (hd+rs) (cm)
Hi = Initial desired water depth (head) in hole (cm)
H/r = Ratio of head to radius of hole (must be ≥ 5)
di = Constant-head tube setting, initial d measured in hole (di = D-Hi) (cm) - usually 1 cm less than calculated di
$dsur_i$ = Initial distance from water surface to ground (hd - Hi)
1-ON = 3-way valve turned to 1-ON (CF = 20, multiply CF times Δ MR to obtain volume of flow)
2-ON = 3-way valve turned to 2-ON (CF = 105, multiply CF times Δ MR to obtain volume of flow)
$dsur_f$ = Final distance from water surface to ground (steady state)
df = Final d measured in hole ($dsur_f$ + rs) (cm) - should be within 1-2 cm of di
Hf - Final water depth in hole (Hf = D-df) (cm)
MRi = Initial measuring reservoir reading (cm)
Ti = Initial time to record measuring reservoir level drop (min.)
MRf = Final measuring reservoir reading (cm)
Tf = Final time to record measuring reservoir level drop (min.)
Δ MR = Change in measuring reservoir level (cm)
Δ T = Change in time for measuring reservoir water drop (min.)
V = flow volume (cm^3)

Ksat Data Sheet

Plot:	Ksat-8	Conducted By:	SJF
Location:	Bingham, New site	Date:	4/13/10
Weather:	sunny	Temp:	65
Soil Series/Horizon:	Pacolet	Source of Water:	tap

Plot	hd	r	rs	D	Hi	H/r	di	$dsur_i$	1-ON	2-ON	$dsur_f$	df	Hf	Mri	Ti	MRf	Tf	Δ MR	Δ T	V	CF	Q (cm^3/min)	Q (cm^3/h)	Ksat (cm/h)	Ksat (cm/d)	Ksat (in/h)	Ksat (in/d)
1/Bt	47	3.0	11	58	15	5	43	32		yes	32	43	15	41.1	10:07:00	40.8	10:40:00	0.3	0:33:00	31.5	105	1.0	57.3	0.061	1.45	0.02	0.57
	47	3.0	11	58	15	5	43	32		yes	32	43	15	40.8	10:40:00	40.5	11:10:00	0.3	0:30:00	31.5	105	1.0	63.0	0.067	1.60	0.03	0.63
	47	3.0	11	58	15	5	43	32		yes	32	43	15	40.5	11:10:00	40.2	11:40:00	0.3	0:30:00	31.5	105	1.0	63.0	0.067	1.60	0.03	0.63
	47	3.0	11	58	15	5	43	32		yes	32	43	15	40.2	11:40:00	39.9	12:10:00	0.3	0:30:00	31.5	105	1.1	63.0	0.067	1.60	0.03	0.63
																								0.0650	**1.5609**	**0.0256**	**0.6145**

hd = Hole depth (cm)
r = Radius of the hole (dia./2) (cm)
rs = Distance between reference level and soil surface (cm)
D = Distance from the hole bottom to the reference level (hd+rs) (cm)
Hi = Initial desired water depth (head) in hole (cm)
H/r = Ratio of head to radius of hole (must be ≥ 5)
di = Constant-head tube setting, initial d measured in hole (di = D-Hi) (cm) - usually 1 cm less than calculated di
$dsur_i$ = Initial distance from water surface to ground (hd - Hi)
1-ON = 3-way valve turned to 1-ON (CF = 20, multiply CF times Δ MR to obtain volume of flow)
2-ON = 3-way valve turned to 2-ON (CF = 105, multiply CF times Δ MR to obtain volume of flow)
$dsur_f$ = Final distance from water surface to ground (steady state)
df = Final d measured in hole ($dsur_f$ + rs) (cm) - should be within 1-2 cm of di
Hf - Final water depth in hole (Hf = D-df) (cm)
MRi = Initial measuring reservoir reading (cm)
Ti = Initial time to record measuring reservoir level drop (min.)
MRf = Final measuring reservoir reading (cm)
Tf = Final time to record measuring reservoir level drop (min.)
Δ MR = Change in measuring reservoir level (cm)
Δ T = Change in time for measuring reservoir water drop (min.)
V = flow volume (cm^3)

Ksat Data Sheet

Plot:	Ksat-9	Conducted By:	SJF
Location:	Bingham, New site	Date:	4/13/10
Weather:	sunny	Temp:	65
Soil Series/Horizon:	Pacolet	Source of Water:	tap

Plot	hd	r	rs	D	Hi	H/r	di	$dsur_i$	1-ON	2-ON	$dsur_f$	df	Hf	Mri	Ti	MRf	Tf	Δ MR	Δ T	V	CF	Q (cm^3/min)	Q (cm^3/h)	Ksat (cm/h)	Ksat (cm/d)	Ksat (in/h)	Ksat (in/d)
1/Bt	42	3.0	10	52	15	5	37	27		yes	27	37	15	44.0	10:27:00	43.7	11:00:00	0.3	0:33:00	31.5	105	1.0	57.3	0.061	1.45	0.02	0.57
	42	3.0	10	52	15	5	37	27		yes	27	37	15	43.7	11:00:00	43.3	11:30:00	0.4	0:30:00	42	105	1.4	84.0	0.089	2.13	0.03	0.84
	42	3.0	10	52	15	5	37	27		yes	27	37	15	43.3	11:30:00	42.9	12:00:00	0.4	0:30:00	42	105	1.4	84.0	0.089	2.13	0.03	0.84
	42	3.0	10	52	15	5	37	27		yes	27	37	15	42.9	12:00:00	42.5	12:30:00	0.4	0:30:00	42	105	1.4	84.0	0.089	2.13	0.03	0.84
																								0.0887	**2.1296**	**0.0349**	**0.8384**

hd = Hole depth (cm)
r = Radius of the hole (dia./2) (cm)
rs = Distance between reference level and soil surface (cm)
D = Distance from the hole bottom to the reference level (hd+rs) (cm)
Hi = Initial desired water depth (head) in hole (cm)
H/r = Ratio of head to radius of hole (must be ≥ 5)
di = Constant-head tube setting, initial d measured in hole (di = D-Hi) (cm) - usually 1 cm less than calculated di
$dsur_i$ = Initial distance from water surface to ground (hd - Hi)
1-ON = 3-way valve turned to 1-ON (CF = 20, multiply CF times Δ MR to obtain volume of flow)
2-ON = 3-way valve turned to 2-ON (CF = 105, multiply CF times Δ MR to obtain volume of flow)
$dsur_f$ = Final distance from water surface to ground (steady state)
df = Final d measured in hole ($dsur_f$ + rs) (cm) - should be within 1-2 cm of di
Hf - Final water depth in hole (Hf = D-df) (cm)
MRi = Initial measuring reservoir reading (cm)
Ti = Initial time to record measuring reservoir level drop (min.)
MRf = Final measuring reservoir reading (cm)
Tf = Final time to record measuring reservoir level drop (min.)
Δ MR = Change in measuring reservoir level (cm)
Δ T = Change in time for measuring reservoir water drop (min.)
V = flow volume (cm^3)

Ksat Data Sheet

Plot:	Ksat-10		Conducted By:	SJF
Location:	Bingham - new site		Date:	4/13/10
Weather:	sunny		Temp:	65
Soil Series/Horizon:	Pacolet		Source of Water:	tap

Plot	hd	r	rs	D	Hi	H/r	di	$dsur_i$	1-ON	2-ON	$dsur_f$	df	Hf	Mri	Ti	MRf	Tf	Δ MR	Δ T	V	CF	Q (cm^3/min)	Q (cm^3/h)	Ksat (cm/h)	Ksat (cm/d)	Ksat (in/h)	Ksat (in/d)
1/Bt	41	3.0	10	51	15	5	36	26		yes	26	36	15	45.9	10:38:00	44.8	11:15:00	1.1	0:37:00	115.5	105	3.1	187.3	0.198	4.75	0.08	1.87
	41	3.0	10	51	15	5	36	26		yes	26	36	15	44.8	11:15:00	44.2	11:45:00	0.6	0:30:00	63	105	2.1	126.0	0.133	3.19	0.05	1.26
	41	3.0	10	51	15	5	36	26		yes	26	36	15	44.2	11:45:00	43.9	12:15:00	0.3	0:30:00	31.5	105	1.1	63.0	0.067	1.60	0.03	0.63
	41	3.0	10	51	15	5	36	26		yes	26	36	15	43.9	12:15:00	43.6	12:45:00	0.3	0:30:00	31.5	105	1.0	63.0	0.067	1.60	0.03	0.63
	41	3.0	10	51	15	5	36	26		yes	26	36	15	43.6	12:45:00	43.3	13:15:00	0.3	0:30:00	31.5	105	1.1	63.0	0.067	1.60	0.03	0.63
																								0.0666	**1.5972**	**0.0262**	**0.6288**

hd = Hole depth (cm)
r = Radius of the hole (dia./2) (cm)
rs = Distance between reference level and soil surface (cm)
D = Distance from the hole bottom to the reference level (hd+rs) (cm)
Hi = Initial desired water depth (head) in hole (cm)
H/r = Ratio of head to radius of hole (must be ≥ 5)
di = Constant-head tube setting, initial d measured in hole (di = D-Hi) (cm) - usually 1 cm less than calculated di
$dsur_i$ = Initial distance from water surface to ground (hd - Hi)
1-ON = 3-way valve turned to 1-ON (CF = 20, multiply CF times Δ MR to obtain volume of flow)
2-ON = 3-way valve turned to 2-ON (CF = 105, multiply CF times Δ MR to obtain volume of flow)
$dsur_f$ = Final distance from water surface to ground (steady state)
df = Final d measured in hole ($dsur_f$ + rs) (cm) - should be within 1-2 cm of di
Hf - Final water depth in hole (Hf = D-df) (cm)
MRi = Initial measuring reservoir reading (cm)
Ti = Initial time to record measuring reservoir level drop (min.)
MRf = Final measuring reservoir reading (cm)
Tf = Final time to record measuring reservoir level drop (min.)
Δ MR = Change in measuring reservoir level (cm)
Δ T = Change in time for measuring reservoir water drop (min.)
V = flow volume (cm^3)

Ksat Data Sheet

Plot:	Ksat-11	Conducted By:	SJF
Location:	behind pump house	Date:	4/13/10
Weather:	sunny	Temp:	65
Soil Series/Horizon:	yellow brown transition	Source of Water:	tap

Plot	hd	r	rs	D	Hi	H/r	di	$dsur_i$	1-ON	2-ON	$dsur_f$	df	Hf	Mri	Ti	MRf	Tf	Δ MR	Δ T	V	CF	Q (cm^3/min)	Q (cm^3/h)	Ksat (cm/h)	Ksat (cm/d)	Ksat (in/h)	Ksat (in/d)
1/Bt or Bc ?	62	3.0	10	72	15	5	57	47		yes	47	57	15	36.7	12:30:00	36.3	13:05:00	0.4	0:35:00	42	105	1.2	72.0	0.076	1.83	0.03	0.72
	62	3.0	10	72	15	5	57	47		yes	47	57	15	36.3	13:05:00	36.2	13:35:00	0.1	0:30:00	10.5	105	0.3	21.0	0.022	0.53	0.01	0.21
	62	3.0	10	72	15	5	57	47		yes	47	57	15	36.2	13:35:00	36.1	14:05:00	0.1	0:30:00	10.5	105	0.4	21.0	0.022	0.53	0.01	0.21
	62	3.0	10	72	15	5	57	47		yes	47	57	15	36.1	14:05:00	36.0	14:35:00	0.1	0:30:00	10.5	105	0.4	21.0	0.022	0.53	0.01	0.21
	62	3.0	10	72	15	5	57	47		yes	47	57	15	36.0	14:35:00	35.8	15:05:00	0.2	0:30:00	21	105	0.7	42.0	0.044	1.06	0.02	0.42
	62	3.0	10	72	15	5	57	47		yes	47	57	15	35.8	15:05:00	35.7	15:35:00	0.1	0:30:00	10.5	105	0.3	21.0	0.022	0.53	0.01	0.21
																								0.0266	**0.6389**	**0.0105**	**0.2515**

hd = Hole depth (cm)
r = Radius of the hole (dia./2) (cm)
rs = Distance between reference level and soil surface (cm)
D = Distance from the hole bottom to the reference level (hd+rs) (cm)
Hi = Initial desired water depth (head) in hole (cm)
H/r = Ratio of head to radius of hole (must be ≥ 5)
di = Constant-head tube setting, initial d measured in hole (di = D-Hi) (cm) - usually 1 cm less than calculated di
$dsur_i$ = Initial distance from water surface to ground (hd - Hi)
1-ON = 3-way valve turned to 1-ON (CF = 20, multiply CF times Δ MR to obtain volume of flow)
2-ON = 3-way valve turned to 2-ON (CF = 105, multiply CF times Δ MR to obtain volume of flow)
$dsur_f$ = Final distance from water surface to ground (steady state)
df = Final d measured in hole ($dsur_f$ + rs) (cm) - should be within 1-2 cm of di
Hf - Final water depth in hole (Hf = D-df) (cm)
MRi = Initial measuring reservoir reading (cm)
Ti = Initial time to record measuring reservoir level drop (min.)
MRf = Final measuring reservoir reading (cm)
Tf = Final time to record measuring reservoir level drop (min.)
Δ MR = Change in measuring reservoir level (cm)
Δ T = Change in time for measuring reservoir water drop (min.)
V = flow volume (cm^3)

Ksat Data Sheet

Plot:	Ksat-12	Conducted By:	SJF
Location:	behind lagoon	Date:	4/13/10
Weather:	sunny	Temp:	65
Soil Series/Horizon:	Bt/Bc yellow brown, transition	Source of Water:	tap

Plot	hd	r	rs	D	Hi	H/r	di	$dsur_i$	1-ON	2-ON	$dsur_f$	df	Hf	Mri	Ti	MRf	Tf	Δ MR	Δ T	V	CF	Q (cm^3/min)	Q (cm^3/h)	Ksat (cm/h)	Ksat (cm/d)	Ksat (in/h)	Ksat (in/d)
1/Bt or Bc?	58	3.0	10	68	15	5	53	43		yes	43	53	15	39.6	12:50:00	39.3	13:20:00	0.3	0:30:00	31.5	105	1.1	63.0	0.067	1.60	0.03	0.63
	58	3.0	10	68	15	5	53	43		yes	43	53	15	39.3	1:20:00	39.1	1:50:00	0.2	0:30:00	21	105	0.7	42.0	0.044	1.06	0.02	0.42
	58	3.0	10	68	15	5	53	43		yes	43	53	15	39.1	1:50:00	38.8	2:20:00	0.3	0:30:00	31.5	105	1.1	63.0	0.067	1.60	0.03	0.63
	58	3.0	10	68	15	5	53	43		yes	43	53	15	38.8	2:20:00	38.4	2:50:00	0.4	0:30:00	42	105	1.4	84.0	0.089	2.13	0.03	0.84
	58	3.0	10	68	15	5	53	43		yes	43	53	15	38.4	2:50:00	38.0	3:20:00	0.4	0:30:00	42	105	1.4	84.0	0.089	2.13	0.03	0.84
																								0.0813	**1.9522**	**0.0320**	**0.7686**

hd = Hole depth (cm)
r = Radius of the hole (dia./2) (cm)
rs = Distance between reference level and soil surface (cm)
D = Distance from the hole bottom to the reference level (hd+rs) (cm)
Hi = Initial desired water depth (head) in hole (cm)
H/r = Ratio of head to radius of hole (must be ≥ 5)
di = Constant-head tube setting, initial d measured in hole (di = D-Hi) (cm) - usually 1 cm less than calculated di
$dsur_i$ = Initial distance from water surface to ground (hd - Hi)
1-ON = 3-way valve turned to 1-ON (CF = 20, multiply CF times Δ MR to obtain volume of flow)
2-ON = 3-way valve turned to 2-ON (CF = 105, multiply CF times Δ MR to obtain volume of flow)
$dsur_f$ = Final distance from water surface to ground (steady state)
df = Final d measured in hole ($dsur_f$ + rs) (cm) - should be within 1-2 cm of di
Hf - Final water depth in hole (Hf = D-df) (cm)
MRi = Initial measuring reservoir reading (cm)
Ti = Initial time to record measuring reservoir level drop (min.)
MRf = Final measuring reservoir reading (cm)
Tf = Final time to record measuring reservoir level drop (min.)
Δ MR = Change in measuring reservoir level (cm)
Δ T = Change in time for measuring reservoir water drop (min.)
V = flow volume (cm^3)

Ksat Data Sheet

Plot:	Ksat-13	Conducted By:	SJF
Location:	across wetlands	Date:	4/13/10
Weather:	sunny	Temp:	65
Soil Series/Horizon:	Bt/Bc yellow brown red mottles	Source of Water:	tap

Plot	hd	r	rs	D	Hi	H/r	di	$dsur_i$	1-ON	2-ON	$dsur_f$	df	Hf	Mri	Ti	MRf	Tf	Δ MR	Δ T	V	CF	Q (cm^3/min)	Q (cm^3/h)	Ksat (cm/h)	Ksat (cm/d)	Ksat (in/h)	Ksat (in/d)
1/ Bt or Bc	41	3.0	12	53	15	5	38	26		yes	26	38	15	40.5	1:40:00	40.1	2:10:00	0.4	0:30:00	42	105	1.4	84.0	0.089	2.13	0.03	0.84
	41	3.0	12	53	15	5	38	26		yes	26	38	15	40.1	2:10:00	40.0	2:40:00	0.1	0:30:00	10.5	105	0.4	21.0	0.022	0.53	0.01	0.21
	41	3.0	12	53	15	5	38	26		yes	26	38	15	40.0	2:40:00	39.9	3:10:00	0.1	0:30:00	10.5	105	0.4	21.0	0.022	0.53	0.01	0.21
	41	3.0	12	53	15	5	38	26		yes	26	38	15	39.9	3:10:00	39.8	3:40:00	0.1	0:30:00	10.5	105	0.4	21.0	0.022	0.53	0.01	0.21
																								0.0222	**0.5324**	**0.0087**	**0.2096**

hd = Hole depth (cm)
r = Radius of the hole (dia./2) (cm)
rs = Distance between reference level and soil surface (cm)
D = Distance from the hole bottom to the reference level (hd+rs) (cm)
Hi = Initial desired water depth (head) in hole (cm)
H/r = Ratio of head to radius of hole (must be ≥ 5)
di = Constant-head tube setting, initial d measured in hole (di = D-Hi) (cm) - usually 1 cm less than calculated di
$dsur_i$ = Initial distance from water surface to ground (hd - Hi)
1-ON = 3-way valve turned to 1-ON (CF = 20, multiply CF times Δ MR to obtain volume of flow)
2-ON = 3-way valve turned to 2-ON (CF = 105, multiply CF times Δ MR to obtain volume of flow)
$dsur_f$ = Final distance from water surface to ground (steady state)
df = Final d measured in hole ($dsur_f$ + rs) (cm) - should be within 1-2 cm of di
Hf - Final water depth in hole (Hf = D-df) (cm)
MRi = Initial measuring reservoir reading (cm)
Ti = Initial time to record measuring reservoir level drop (min.)
MRf = Final measuring reservoir reading (cm)
Tf = Final time to record measuring reservoir level drop (min.)
Δ MR = Change in measuring reservoir level (cm)
Δ T = Change in time for measuring reservoir water drop (min.)
V = flow volume (cm^3)

Ksat Data Sheet

Plot:	Ksat-14	Conducted By:	SJF
Location:	Bingham- front road	Date:	4/23/10
Weather:	cloudy	Temp:	60
Soil Series/Horizon:	wet silty clay	Source of Water:	tap

Plot	hd	r	rs	D	Hi	H/r	di	$dsur_i$	1-ON	2-ON	$dsur_f$	df	Hf	Mri	Ti	MRf	Tf	∆ MR	∆ T	V	CF	Q (cm^3/min)	Q (cm^3/h)	Ksat (cm/h)	Ksat (cm/d)	Ksat (in/h)	Ksat (in/d)
1/Bt	35	3.0	10	45	15	5	30	20		yes	20	30	15	43.4	10:28:00	43.0	10:58:00	0.4	0:30:00	42	105	1.4	84.0	0.089	2.13	0.03	0.84
	35	3.0	10	45	15	5	30	20		yes	20	30	15	43.0	10:58:00	42.6	11:28:00	0.4	0:30:00	42	105	1.4	84.0	0.089	2.13	0.03	0.84
	35	3.0	10	45	15	5	30	20		yes	20	30	15	42.6	11:28:00	41.6	12:58:00	1.0	1:30:00	105	105	1.2	70.0	0.074	1.77	0.03	0.70
	35	3.0	10	45	15	5	30	20		yes	20	30	15	41.6	12:58:00	41.3	13:28:00	0.3	0:30:00	31.5	105	1.1	63.0	0.067	1.60	0.03	0.63
	35	3.0	10	45	15	5	30	20		yes	20	30	15	41.3	1:28:00	41.0	1:58:00	0.3	0:30:00	31.5	105	1.0	63.0	0.067	1.60	0.03	0.63
																								0.0666	**1.5972**	**0.0262**	**0.6288**

hd = Hole depth (cm)
r = Radius of the hole (dia./2) (cm)
rs = Distance between reference level and soil surface (cm)
D = Distance from the hole bottom to the reference level (hd+rs) (cm)
Hi = Initial desired water depth (head) in hole (cm)
H/r = Ratio of head to radius of hole (must be ≥ 5)
di = Constant-head tube setting, initial d measured in hole (di = D-Hi) (cm) - usually 1 cm less than calculated di
$dsur_i$ = Initial distance from water surface to ground (hd - Hi)
1-ON = 3-way valve turned to 1-ON (CF = 20, multiply CF times ∆ MR to obtain volume of flow)
2-ON = 3-way valve turned to 2-ON (CF = 105, multiply CF times ∆ MR to obtain volume of flow)
$dsur_f$ = Final distance from water surface to ground (steady state)
df = Final d measured in hole ($dsur_f$ + rs) (cm) - should be within 1-2 cm of di
Hf - Final water depth in hole (Hf = D-df) (cm)
MRi = Initial measuring reservoir reading (cm)
Ti = Initial time to record measuring reservoir level drop (min.)
MRf = Final measuring reservoir reading (cm)
Tf = Final time to record measuring reservoir level drop (min.)
∆ MR = Change in measuring reservoir level (cm)
∆ T = Change in time for measuring reservoir water drop (min.)
V = flow volume (cm^3)

Ksat Data Sheet

Plot:	Ksat-15	Conducted By:	SJF
Location:	fence	Date:	4/27/10
Weather:	sunny	Temp:	65
Soil Series/Horizon:	Ge (shallow)	Source of Water:	tap

Plot	hd	r	rs	D	Hi	H/r	di	$dsur_i$	1-ON	2-ON	$dsur_f$	df	Hf	Mri	Ti	MRf	Tf	Δ MR	Δ T	V	CF	Q (cm^3/min)	Q (cm^3/h)	Ksat (cm/h)	Ksat (cm/d)	Ksat (in/h)	Ksat (in/d)
1/Bt	46	3.0	10	56	15	5	41	31		yes	31	41	15	41.7	11:08:00	38.9	11:38:00	2.8	0:30:00	294	105	9.8	588.0	0.621	14.91	0.24	5.87
	46	3.0	10	56	15	5	41	31		yes	31	41	15	38.9	11:38:00	35.8	12:08:00	3.1	0:30:00	325.5	105	10.9	651.0	0.688	16.50	0.27	6.50
	46	3.0	10	56	15	5	41	31		yes	31	41	15	35.8	12:08:00	33.5	12:38:00	2.3	0:30:00	241.5	105	8.0	483.0	0.510	12.25	0.20	4.82
	46	3.0	10	56	15	5	41	31		yes	31	41	15	33.5	12:38:00	31.3	13:08:00	2.2	0:30:00	231	105	7.7	462.0	0.488	11.71	0.19	4.61
	46	3.0	10	56	15	5	41	31		yes	31	41	15	31.3	13:08:00	29.0	13:38:00	2.3	0:30:00	241.5	105	8.1	483.0	0.510	12.25	0.20	4.82
																								0.5028	**12.0678**	**0.1980**	**4.7511**

hd = Hole depth (cm)
r = Radius of the hole (dia./2) (cm)
rs = Distance between reference level and soil surface (cm)
D = Distance from the hole bottom to the reference level (hd+rs) (cm)
Hi = Initial desired water depth (head) in hole (cm)
H/r = Ratio of head to radius of hole (must be ≥ 5)
di = Constant-head tube setting, initial d measured in hole (di = D-Hi) (cm) - usually 1 cm less than calculated di
$dsur_i$ = Initial distance from water surface to ground (hd - Hi)
1-ON = 3-way valve turned to 1-ON (CF = 20, multiply CF times Δ MR to obtain volume of flow)
2-ON = 3-way valve turned to 2-ON (CF = 105, multiply CF times Δ MR to obtain volume of flow)
$dsur_f$ = Final distance from water surface to ground (steady state)
df = Final d measured in hole ($dsur_f$ + rs) (cm) - should be within 1-2 cm of di
Hf - Final water depth in hole (Hf = D-df) (cm)
MRi = Initial measuring reservoir reading (cm)
Ti = Initial time to record measuring reservoir level drop (min.)
MRf = Final measuring reservoir reading (cm)
Tf = Final time to record measuring reservoir level drop (min.)
Δ MR = Change in measuring reservoir level (cm)
Δ T = Change in time for measuring reservoir water drop (min.)
V = flow volume (cm^3)

Ksat Data Sheet

Plot:	Ksat-16	Conducted By:	SJF
Location:	W corner 'old site'	Date:	4/27/10
Weather:	sunny/cloudy	Temp:	65
Soil Series/Horizon:	Slope/transition yellow brown	Source of Water:	tap

Plot	hd	r	rs	D	Hi	H/r	di	$dsur_i$	1-ON	2-ON	$dsur_f$	df	Hf	Mri	Ti	MRf	Tf	Δ MR	Δ T	V	CF	Q (cm^3/min)	Q (cm^3/h)	Ksat (cm/h)	Ksat (cm/d)	Ksat (in/h)	Ksat (in/d)
1/Bt	50	3.0	10	60	15	5	45	35		yes	35	45	15	43.3	11:28:00	41.5	11:58:00	1.8	0:30:00	189	105	6.3	378.0	0.399	9.58	0.16	3.77
	50	3.0	10	60	15	5	45	35		yes	35	45	15	41.5	11:58:00	41.3	12:28:00	0.2	0:30:00	21	105	0.7	42.0	0.044	1.06	0.02	0.42
	50	3.0	10	60	15	5	45	35		yes	35	45	15	41.3	12:28:00	40.5	12:58:00	0.8	0:30:00	84	105	2.8	168.0	0.177	4.26	0.07	1.68
	50	3.0	10	60	15	5	45	35		yes	35	45	15	40.5	12:58:00	39.7	13:28:00	0.8	0:30:00	84	105	2.8	168.0	0.177	4.26	0.07	1.68
	50	3.0	10	60	15	5	45	35		yes	35	45	15	39.7	13:28:00	38.9	13:58:00	0.8	0:30:00	84	105	2.8	168.0	0.177	4.26	0.07	1.68
																								0.1775	**4.2592**	**0.0699**	**1.6769**

hd = Hole depth (cm)
r = Radius of the hole (dia./2) (cm)
rs = Distance between reference level and soil surface (cm)
D = Distance from the hole bottom to the reference level (hd+rs) (cm)
Hi = Initial desired water depth (head) in hole (cm)
H/r = Ratio of head to radius of hole (must be ≥ 5)
di = Constant-head tube setting, initial d measured in hole (di = D-Hi) (cm) - usually 1 cm less than calculated di
$dsur_i$ = Initial distance from water surface to ground (hd - Hi)
1-ON = 3-way valve turned to 1-ON (CF = 20, multiply CF times Δ MR to obtain volume of flow)
2-ON = 3-way valve turned to 2-ON (CF = 105, multiply CF times Δ MR to obtain volume of flow)
$dsur_f$ = Final distance from water surface to ground (steady state)
df = Final d measured in hole ($dsur_f$ + rs) (cm) - should be within 1-2 cm of di
Hf - Final water depth in hole (Hf = D-df) (cm)
MRi = Initial measuring reservoir reading (cm)
Ti = Initial time to record measuring reservoir level drop (min.)
MRf = Final measuring reservoir reading (cm)
Tf = Final time to record measuring reservoir level drop (min.)
Δ MR = Change in measuring reservoir level (cm)
Δ T = Change in time for measuring reservoir water drop (min.)
V = flow volume (cm^3)

Ksat Data Sheet

Plot:	Ksat-17	Conducted By:	SJF
Location:	inside fence	Date:	4/27/10
Weather:	cloudy	Temp:	65
Soil Series/Horizon:	yellow brown (shallow)	Source of Water:	tap

Plot	hd	r	rs	D	Hi	H/r	di	$dsur_i$	1-ON	2-ON	$dsur_f$	df	Hf	Mri	Ti	MRf	Tf	Δ MR	Δ T	V	CF	Q (cm^3/min)	Q (cm^3/h)	Ksat (cm/h)	Ksat (cm/d)	Ksat (in/h)	Ksat (in/d)
1/Bt	42	3.0	10	52	15	5	37	27		yes	27	37	15	40.9	11:50:00	40.5	12:20:00	0.4	0:30:00	42	105	1.4	84.0	0.089	2.13	0.03	0.84
	42	3.0	10	52	15	5	37	27		yes	27	37	15	40.5	12:20:00	40.1	12:50:00	0.4	0:30:00	42	105	1.4	84.0	0.089	2.13	0.03	0.84
	42	3.0	10	52	15	5	37	27		yes	27	37	15	40.1	12:50:00	39.7	13:20:00	0.4	0:30:00	42	105	1.4	84.0	0.089	2.13	0.03	0.84
	42	3.0	10	52	15	5	37	27		yes	27	37	15	39.7	13:20:00	39.4	13:50:00	0.3	0:30:00	31.5	105	1.1	63.0	0.067	1.60	0.03	0.63
																								0.0832	**1.9965**	**0.0328**	**0.7860**

hd = Hole depth (cm)
r = Radius of the hole (dia./2) (cm)
rs = Distance between reference level and soil surface (cm)
D = Distance from the hole bottom to the reference level (hd+rs) (cm)
Hi = Initial desired water depth (head) in hole (cm)
H/r = Ratio of head to radius of hole (must be ≥ 5)
di = Constant-head tube setting, initial d measured in hole (di = D-Hi) (cm) - usually 1 cm less than calculated di
$dsur_i$ = Initial distance from water surface to ground (hd - Hi)
1-ON = 3-way valve turned to 1-ON (CF = 20, multiply CF times Δ MR to obtain volume of flow)
2-ON = 3-way valve turned to 2-ON (CF = 105, multiply CF times Δ MR to obtain volume of flow)
$dsur_f$ = Final distance from water surface to ground (steady state)
df = Final d measured in hole ($dsur_f$ + rs) (cm) - should be within 1-2 cm of di
Hf - Final water depth in hole (Hf = D-df) (cm)
MRi = Initial measuring reservoir reading (cm)
Ti = Initial time to record measuring reservoir level drop (min.)
MRf = Final measuring reservoir reading (cm)
Tf = Final time to record measuring reservoir level drop (min.)
Δ MR = Change in measuring reservoir level (cm)
Δ T = Change in time for measuring reservoir water drop (min.)
V = flow volume (cm^3)

Ksat Data Sheet

Plot:	Ksat-18		Conducted By:	SJF
Location:	Old site		Date:	4/27/10
Weather:	cloudy		Temp:	65
Soil Series/Horizon:	Bt Pacolet		Source of Water:	tap

Plot	hd	r	rs	D	Hi	H/r	di	$dsur_i$	1-ON	2-ON	$dsur_f$	df	Hf	Mri	Ti	MRf	Tf	Δ MR	Δ T	V	CF	Q (cm^3/min)	Q (cm^3/h)	Ksat (cm/h)	Ksat (cm/d)	Ksat (in/h)	Ksat (in/d)
1	42	3.0	10	52	15	5	37	27		yes	27	37	15	24.2	2:34:00	23.6	3:04:00	0.6	0:30:00	63	105	2.1	126.0	0.133	3.19	0.05	1.26
	42	3.0	10	52	15	5	37	27		yes	27	37	15	23.6	3:04:00	23.0	3:34:00	0.6	0:30:00	63	105	2.1	126.0	0.133	3.19	0.05	1.26
	42	3.0	10	52	15	5	37	27		yes	27	37	15	23.0	3:34:00	22.4	4:04:00	0.6	0:30:00	63	105	2.1	126.0	0.133	3.19	0.05	1.26
	42	3.0	10	52	15	5	37	27		yes	27	37	15	22.4	4:04:00	21.8	4:34:00	0.6	0:30:00	63	105	2.1	126.0	0.133	3.19	0.05	1.26
																								0.1331	**3.1944**	**0.0524**	**1.2576**

hd = Hole depth (cm)
r = Radius of the hole (dia./2) (cm)
rs = Distance between reference level and soil surface (cm)
D = Distance from the hole bottom to the reference level (hd+rs) (cm)
Hi = Initial desired water depth (head) in hole (cm)
H/r = Ratio of head to radius of hole (must be ≥ 5)
di = Constant-head tube setting, initial d measured in hole (di = D-Hi) (cm) - usually 1 cm less than calculated di
$dsur_i$ = Initial distance from water surface to ground (hd - Hi)
1-ON = 3-way valve turned to 1-ON (CF = 20, multiply CF times Δ MR to obtain volume of flow)
2-ON = 3-way valve turned to 2-ON (CF = 105, multiply CF times Δ MR to obtain volume of flow)
$dsur_f$ = Final distance from water surface to ground (steady state)
df = Final d measured in hole ($dsur_f$ + rs) (cm) - should be within 1-2 cm of di
Hf - Final water depth in hole (Hf = D-df) (cm)
MRi = Initial measuring reservoir reading (cm)
Ti = Initial time to record measuring reservoir level drop (min.)
MRf = Final measuring reservoir reading (cm)
Tf = Final time to record measuring reservoir level drop (min.)
Δ MR = Change in measuring reservoir level (cm)
Δ T = Change in time for measuring reservoir water drop (min.)
V = flow volume (cm^3)

Ksat Data Sheet

Plot:	Ksat-19	Conducted By:	SJF
Location:	Grounds	Date:	4/27/10
Weather:	cloudy	Temp:	65
Soil Series/Horizon:	Ud	Source of Water:	tap

Plot	hd	r	rs	D	Hi	H/r	di	$dsur_i$	1-ON	2-ON	$dsur_f$	df	Hf	Mri	Ti	MRf	Tf	Δ MR	Δ T	V	CF	Q (cm^3/min)	Q (cm^3/h)	Ksat (cm/h)	Ksat (cm/d)	Ksat (in/h)	Ksat (in/d)
1/Ud	33	3.0	10	43	15	5	28	18		yes	18	28	15	36.7	2:49:00	36.3	3:19:00	0.4	0:30:00	42	105	1.4	84.0	0.089	2.13	0.03	0.84
	33	3.0	10	43	15	5	28	18		yes	18	28	15	36.3	3:19:00	36.2	3:49:00	0.1	0:30:00	10.5	105	0.3	21.0	0.022	0.53	0.01	0.21
	33	3.0	10	43	15	5	28	18		yes	18	28	15	36.2	3:49:00	36.1	4:19:00	0.1	0:30:00	10.5	105	0.4	21.0	0.022	0.53	0.01	0.21
	33	3.0	10	43	15	5	28	18		yes	18	28	15	36.1	4:19:00	36.0	4:49:00	0.1	0:30:00	10.5	105	0.4	21.0	0.022	0.53	0.01	0.21
																								0.0222	**0.5324**	**0.0087**	**0.2096**

hd = Hole depth (cm)
r = Radius of the hole (dia./2) (cm)
rs = Distance between reference level and soil surface (cm)
D = Distance from the hole bottom to the reference level (hd+rs) (cm)
Hi = Initial desired water depth (head) in hole (cm)
H/r = Ratio of head to radius of hole (must be ≥ 5)
di = Constant-head tube setting, initial d measured in hole (di = D-Hi) (cm) - usually 1 cm less than calculated di
$dsur_i$ = Initial distance from water surface to ground (hd - Hi)
1-ON = 3-way valve turned to 1-ON (CF = 20, multiply CF times Δ MR to obtain volume of flow)
2-ON = 3-way valve turned to 2-ON (CF = 105, multiply CF times Δ MR to obtain volume of flow)
$dsur_f$ = Final distance from water surface to ground (steady state)
df = Final d measured in hole ($dsur_f$ + rs) (cm) - should be within 1-2 cm of di
Hf - Final water depth in hole (Hf = D-df) (cm)
MRi = Initial measuring reservoir reading (cm)
Ti = Initial time to record measuring reservoir level drop (min.)
MRf = Final measuring reservoir reading (cm)
Tf = Final time to record measuring reservoir level drop (min.)
Δ MR = Change in measuring reservoir level (cm)
Δ T = Change in time for measuring reservoir water drop (min.)
V = flow volume (cm^3)

Ksat Data Sheet

Plot:	Ksat-20	Conducted By:	SJF
Location:	Neighbor fence	Date:	4/27/10
Weather:	cloudy	Temp:	65
Soil Series/Horizon:	transition/yellow brown	Source of Water:	tap

Plot	hd	r	rs	D	Hi	H/r	di	$dsur_i$	1-ON	2-ON	$dsur_f$	df	Hf	Mri	Ti	MRf	Tf	∆ MR	∆ T	V	CF	Q (cm^3/min)	Q (cm^3/h)	Ksat (cm/h)	Ksat (cm/d)	Ksat (in/h)	Ksat (in/d)
1/Bt	46	3.0	10	56	15	5	41	31		yes	31	41	15	35.9	3:00:00	35.5	4:00:00	0.4	1:00:00	42	105	0.7	42.0	0.044	1.06	0.02	0.42
	46	3.0	10	56	15	5	41	31		yes	31	41	15	34.4	4:00:00	33.9	4:30:00	0.5	0:30:00	52.5	105	1.8	105.0	0.111	2.66	0.04	1.05
	46	3.0	10	56	15	5	41	31		yes	31	41	15	33.9	4:30:00	33.4	5:00:00	0.5	0:30:00	52.5	105	1.8	105.0	0.111	2.66	0.04	1.05
																								0.0887	**2.1296**	**0.0349**	**0.8384**

hd = Hole depth (cm)
r = Radius of the hole (dia./2) (cm)
rs = Distance between reference level and soil surface (cm)
D = Distance from the hole bottom to the reference level (hd+rs) (cm)
Hi = Initial desired water depth (head) in hole (cm)
H/r = Ratio of head to radius of hole (must be ≥ 5)
di = Constant-head tube setting, initial d measured in hole (di = D-Hi) (cm) - usually 1 cm less than calculated di
$dsur_i$ = Initial distance from water surface to ground (hd - Hi)
1-ON = 3-way valve turned to 1-ON (CF = 20, multiply CF times ∆ MR to obtain volume of flow)
2-ON = 3-way valve turned to 2-ON (CF = 105, multiply CF times ∆ MR to obtain volume of flow)
$dsur_f$ = Final distance from water surface to ground (steady state)
df = Final d measured in hole ($dsur_f$ + rs) (cm) - should be within 1-2 cm of di
Hf - Final water depth in hole (Hf = D-df) (cm)
MRi = Initial measuring reservoir reading (cm)
Ti = Initial time to record measuring reservoir level drop (min.)
MRf = Final measuring reservoir reading (cm)
Tf = Final time to record measuring reservoir level drop (min.)
∆ MR = Change in measuring reservoir level (cm)
∆ T = Change in time for measuring reservoir water drop (min.)
V = flow volume (cm^3)

Saturated Hydraulic Conductivity Data - DRAFT (UNC Bingham)

IB*	Soil Series	Horizon	Soil Area	Depth (cm)	Depth (in)	Ksat (cm/hr)	Ksat (in/hr)	Gpd/ft^2	SHWT (in)	
New Site										
1	Ge	Bt	1	48.0	18.9	**0.04**	0.02	0.25	>84 in	
1a	Ge	BC	1	99.0	39.0	**0.73**	0.29	4.31	>84 in	
2	Ge	Bt	1	43.0	16.9	**0.03**	0.01	0.15	>84 in	
2a	Ge	BC	1	60.0	23.6	**0.11**	0.04	0.66	>84 in	16 hr test
3	Ge	Bt	1	52.0	20.5	**0.12**	0.05	0.70	>84 in	
4	Ge (shallow)	Bt	1	47.0	18.5	**0.09**	0.03	0.52	>84 in	
5	Herndon	Bt	2	40.0	15.7	**0.16**	0.06	0.91	>84 in	
6	Herndon (swale)	Bt	2	54.0	21.3	**0.04**	0.02	0.26	>84 in	
7	Ge	Bt	1	38.0	15.0	**0.11**	0.04	0.65	>84 in	
14 (new)	Herndon (swale)	Bt	3	35.0	13.8	**0.07**	0.03	0.39	~24-30 in	
Old Site										
8	Ge	Bt	1	47.0	18.5	**0.07**	0.03	0.38	>84 in	
9	Ge	Bt	1	42.0	16.5	**0.09**	0.03	0.52	>84 in	
10	Ge	Bt	1	41.0	16.1	**0.07**	0.03	0.39	>84 in	
11	Herndon	Bt	2	62.0	24.4	**0.03**	0.01	0.16	>36 in	
12	Herndon	Bt	2	58.0	22.8	**0.08**	0.03	0.48	>36 in	
13	Herndon	Bt	2	41.0	16.1	**0.02**	0.01	0.13	>36 in	
17	Herndon	Bt	2	42.0	16.5	**0.08**	0.03	0.49	>84 in	
18	Ge	Bt	1	42.0	16.5	**0.13**	0.05	0.78	>84 in	
Inside Facility										
15	Ge (shallow)	Bt	1	46.0	18.1	**0.50**	0.2	3.0	>84 in	
16	Herndon	Bt	2	50.0	19.7	**0.18**	0.1	1.0	>48 in.	
19	Ud	Ud	4	33.0	13.0	**0.02**	0.009	0.1	>24 in.	
20	Herndon	Bt	2	46.0	18.1	**0.09**	0.035	0.5	>36 in.	
			Avg	SA1	19.8					
			Avg	SA2	19.3					
					New Site					
				GEOMEAN	SA1	**0.07**	0.03	0.39		
					SA2	**0.08**	0.03	0.49		
					Old Site					
					SA1	**0.07**	0.03	0.43		
					SA2	**0.04**	0.01	0.21		
					Inside Facility					
					SA1	**0.50**	0.20	2.96		
					SA2	**0.07**	0.03	0.41		
					SA1	**0.11**	**0.04**			
					SA2	**0.07**	**0.03**			
					GEOMEAN	**0.09**	**0.03**			

APPENDIX C

Soils Descriptions

UNCBWWTF Land Application System Soils Descriptions

Soil, Water, & Environment Group

Soil Investigation Data Sheet

Soil Boring:	Ksat-1			
Location:	Bingham road		Date:	4/6/2010
County:	Orange		Investigator(s):	SJF
Lat./Long.:			Elev.:	
Parent Material:	Slate		Drainage (Wetness) Class:	well
Moisture Status:	moist		Slope (%):	2%
Classification:	Ge		Vegetative Cover:	fallow field
Aspect:	SE		Water Table:	>7'
Landscape Position:	side slope		S.H.W.T.:	

					Structure						
Horiz.	**Depth (in.)**	**Main Colors (moist)**	**Mottles**	**Texture**	**Grade**	**Class**	**Type**	**Moist & Wet Consist.**	**Ped Coatings**	**Hoizon Boundary**	**Other Remarks**
Ap	0-2	10YR 4/6 dark yellowish brown	-	silt loam	moderate	fine	subangular blocky	friable	-	-	many fine roots, thick root mat
E	2-8	10YR 5/6 yellowish brown	-	silty clay	moderate	fine	subangular blocky	friable	-	-	few rocks/pebbles
Bt1	8-22	5YR 4/6 yellowish red	-	clay	moderate	medium	subangular blocky	friable/silt firm/slightly sticky plastic	-	-	few fine roots
Bt2	22-38	5YR 4/6 yellowish red	10YR 7/6 yellow	sillty clay	moderate	medium	subangular blocky	friable/slightly firm	-	-	
BC	38-52	5YR 4/6 yellowish red	7.5YR 6/8 yellowish red	silty clay loam	moderate	medium	subangular blocky	friable	-	-	~25% saprolitic, deep profile
C	52-84+	10YR 6/6 brownish yellow	7.5YR 5/8 strong brown	silty clay loam	weak	fine	subangular blocky	friable	-	-	good structure, multi-colored, manganese nodules/hematite

Soil Investigation Data Sheet

Soil Boring:	Ksat-2		
Location:	Bingham road	Date:	4/6/2010
County:	Orange	Investigator(s):	SJF
Lat./Long.:		Elev.:	
Parent Material:	Slate	Drainage (Wetness) Class:	well
Moisture Status:	moist	Slope (%):	1%
Classification:	Georgeville	Vegetative Cover:	fallow field
Aspect:	SE	Water Table:	>7'
Landscape Position:	side slope	S.H.W.T:	

					Structure						
Horiz.	**Depth (in.)**	**Main Colors (moist)**	**Mottles**	**Texture**	**Grade**	**Class**	**Type**	**Moist & Wet Consist.**	**Ped Coatings**	**Hoizon Boundary**	**Other Remarks**
Ap	0-2	5YR 5/3 red brown	-	loam	moderate	fine	subangular blocky	friable	-	-	thick root mat, many fine roots
Bt1	2-8	2.5YR 4/8 red	7.5YR 6/6 red/yellow	silty clay loam	moderate	medium	subangular blocky	slightly firm/friable	-	-	disturbed
Bt2	8-22	2.5YR 4/8 red	7.5YR 8/6 red/yellow	clay	moderate	medium	subangular blocky	firm, slightly sticky, slightly plastic	-	-	many fine, distinct red yellow mottles
BC	22-40	2.5YR 6/8 light red	2.5YR 7/3 light reddish brown	silty clay loam	moderate	fine	subangular blocky	friable	-	-	~35% saprolite
CR	40-56	7.5YR 6/2 reddish yellow	7.5YR 8/3 pink, 7.5YR 5/8 strong brown, 5YR 4/6 yellowish red	silty clay loam	weak	fine	subangular blocky	friable	-	-	multi-colored
CR2	56-84+	multi-colored saprolite	-	silty clay loam	weak	fine	subangular blocky	friable	-	-	good structure, mottled, multicolored rock

Soil Investigation Data Sheet

Soil Boring:	Ksat-3		
Location:	Bingham front road	Date:	4/23/2010
County:	Orange	Investigator(s):	SJF
Lat./Long.:		Elev.:	
Parent Material:	Slate	Drainage (Wetness) Class:	well
Moisture Status:	moist	Slope (%):	3%
Classification:	Ge	Vegetative Cover:	fallow field
Aspect:	SE	Water Table:	>84"
Landscape Position:	side slope	S.H.W.T:	

					Structure					
Horiz.	**Depth (in.)**	**Main Colors (moist)**	**Mottles**	**Texture**	**Grade**	**Class**	**Type**	**Moist & Wet Consist.**	**Ped Coatings**	**Hoizon Boundary**	**Other Remarks**
Ap	0-3	10YR 4/3 brown	-	sandy loam	weak	fine	subangular blocky	friable	-	-	fine roots, trafficked
E	3-8	10YR 5/4 yellowish brownn	-	sandy loam	weak	fine	subangular blocky	friable	-	-	
Bt1	8-18	10YR 6/6 brownish yellow	-	sandy clay	moderate	medium	subangular blocky	friable/firm	yes	-	fine roots
Bt2	18-28	5YR 5/8 ylws. red	10YR 7/6 yellow	sandy clay	moderate	medium	subangular blocky	slightly sticky	yes	-	
BC	28-66	7.5YR 5/6 strong brn	10YR 7/6 yellow	sandy clay loam	moderate	medium	subangular blocky	friable/firm	yes	-	15-20% saprolite
C	66-84+	5YR 5/3 reddish brn	2.5Y 7/6 pale yellow	sandy loam	weak	fine	granular/ subangular blocky	fiable	-	-	multicolored rock

Soil, Water, & Environment Group

Soil Investigation Data Sheet

Soil Boring:	Ksat-4		
Location:	Bingham road	Date:	4/7/2010
County:	Orange	Investigator(s):	SJF
Lat./Long.:		Elev.:	
Parent Material:	Slate	Drainage (Wetness) Class:	well
Moisture Status:	moist	Slope (%):	3%
Classification:	Ge (shallow)	Vegetative Cover:	fallow field
Aspect:	East	Water Table:	>84"
Landscape Position:	side slope	S.H.W.T:	

					Structure						
Horiz.	**Depth (in.)**	**Main Colors (moist)**	**Mottles**	**Texture**	**Grade**	**Class**	**Type**	**Moist & Wet Consist.**	**Ped Coatings**	**Hoizon Boundary**	**Other Remarks**
Ap	0-2	10YR 4/3 brown	-	sandy loam	weak	fine	subangular blocky	friable	-	-	fine roots
E	2-10	10YR 5/4 yellowish brownn	-	sandy loam	weak	fine	subangular blocky	friable	-	-	gravelly 10-15% large sb b/k gravel quartz
Bt1	10-22	10YR 6/8 brownish yellow	-	sandy clay	moderate	medium	subangular blocky	friable/firm	yes	-	some fine roots
Bt2	22-38	7.5YR 5/6 strong brown	10YR 7/6 yellow 5YR 5/8 yellowish red	sandy clay	moderate	medium	subangular blocky	slightly sticky	yes	-	
BC	38-60	5YR 5/8 yellowish red	10YR 7/6 yellow	sandy clay loam	moderate	medium	subangular blocky	friable/firm	yes	-	25-30% saprolite
C	60-84+	2.5Y 7/6 yellow	2.5Y 7/6 pale yellow	sandy loam	weak	fine	granular/ subangular blocky	fiable	-	-	multicolored rock, black Mn fragments

Soil Investigation Data Sheet

Soil Boring:	Ksat-5		
Location:	Bingham road	Date:	4/12/2010
County:	Orange	Investigator(s):	SJF
Lat./Long.:		Elev.:	

Parent Material:	Slate	Drainage (Wetness) Class:	well
Moisture Status:	moist	Slope (%):	3%
Classification:	Herndon	Vegetative Cover:	fallow field
Aspect:	East	Water Table:	>84"
Landscape Position:	side slope	S.H.W.T.:	

					Structure						
Horiz.	**Depth (in.)**	**Main Colors (moist)**	**Mottles**	**Texture**	**Grade**	**Class**	**Type**	**Moist & Wet Consist.**	**Ped Coatings**	**Hoizon Boundary**	**Other Remarks**
Ap	0-2	10YR 4/3 brown	-	sandy loam	weak	fine	subangular blocky	friable	-	-	fine roots, shallow
E	2-10	10YR 5/4 yellowish brownn	-	silt loam	weak	fine	subangular blocky	friable	-	-	
BE	10-18	10YR 5/6 ylws brn	-	silt loam	moderate	fine	subangular blocky	friable			
Bt1	18-26	5YR 5/8 ylws red	few 10YR 7/6 ylw	silty clay	moderate	medium	subangular blocky	friable/firm	yes	-	
Bt2	26-36	7.5YR 5/6 strong brown	10YR 7/6 yellow 5YR 5/8 yellowish red	clay	moderate	medium	subangular blocky	friable	yes	-	
Bt3	36-60	7.5YR 8/6 reddish ylw		silty clay	moderate	medium	subangular blocky	friable	yes	-	
C	60-84+	10YR 8/6 yellow	5 YR 5/8 red, 7.5YR 5/8 stng brn	silt loam	weak	fine	granular/ subangular blocky	fiable	-	-	multicolored rock, >50% sap

Soil, Water, & Environment Group

Soil Investigation Data Sheet

Soil Boring:	Ksat-6		
Location:	Bingham road (field)	Date:	4/12/2010
County:	Orange	Investigator(s):	SJF
Lat./Long.:		Elev.:	
Parent Material:	Slate	Drainage (Wetness) Class:	well
Moisture Status:	moist	Slope (%):	3%
Classification:	Herndon (swale)	Vegetative Cover:	fallow field
Aspect:	East	Water Table:	>84"
Landscape Position:	side slope	S.H.W.T:	

					Structure						
Horiz.	**Depth (in.)**	**Main Colors (moist)**	**Mottles**	**Texture**	**Grade**	**Class**	**Type**	**Moist & Wet Consist.**	**Ped Coatings**	**Hoizon Boundary**	**Other Remarks**
Ap	0-2	10YR 4/3 brown	-	sandy loam	weak	fine	subangular blocky	friable	-	-	fine roots, shallow
E	2-7	10YR 5/4 yellowish brownn	-	silt loam	weak	fine	subangular blocky	friable	-	-	
BE	7-20	10YR 5/6 ylws brn	-	silt loam	moderate	fine	subangular blocky	friable			
Bt1	20-26	5YR 5/8 ylws red	few 10YR 7/6 ylw	silty clay	moderate	medium	subangular blocky	friable/firm	yes	-	
Bt2	26-48	7.5YR 5/6 strong brown	10YR 7/6 yellow 5YR 5/8 yellowish red	clay	moderate	medium	subangular blocky	friable	yes	-	
Bt3	48-60	10YR 6/4 light ylws brn		silty clay	moderate	medium	subangular blocky	friable	yes	-	
C	60-84+	10YR 6/3 pale brn	10YR 8/2 v pal brn	silt loam	weak	fine	granular/ subangular blocky	fiable	-	-	crushed rock

Soil Investigation Data Sheet

Soil Boring:	Ksat-7		
Location:	Bingham road	Date:	4/23/2010
County:	Orange	Investigator(s):	SJF
Lat./Long.:		Elev.:	
Parent Material:	Slate	Drainage (Wetness) Class:	well
Moisture Status:	moist	Slope (%):	3%
Classification:	Ge	Vegetative Cover:	fallow field
Aspect:	East	Water Table:	>84"
Landscape Position:	side slope	S.H.W.T.:	

					Structure						
Horiz.	**Depth (in.)**	**Main Colors (moist)**	**Mottles**	**Texture**	**Grade**	**Class**	**Type**	**Moist & Wet Consist.**	**Ped Coatings**	**Hoizon Boundary**	**Other Remarks**
Ap	0-3	10YR 4/3 brown	-	sandy loam	weak	fine	subangular blocky	friable	-	-	fine roots
E	3-10	10YR 5/4 yellowish brownn	-	sandy loam	weak	fine	subangular blocky	friable	-	-	
Bt1	10-23	10YR 6/8 brownish yellow	5YR 5/8 ylws red	sandy clay	moderate	medium	subangular blocky	friable/firm	yes	-	
Bt2	23-38	7.5YR 5/6 strong brown	10YR 7/6 yellow 5YR 5/8 yellowish red	sandy clay	moderate	medium	subangular blocky	slightly sticky	yes	-	
BC	38-52	5YR 5/8 yellowish red	10YR 7/6 yellow	sandy clay loam	moderate	medium	subangular blocky	friable/firm	yes	-	15% sap
C	52-84+	2.5Y 7/6 yellow	2.5Y 7/6 pale yellow	sandy loam	weak	fine	granular/ subangular blocky	fiable	-	-	fine crushed rock

Soil Investigation Data Sheet

Soil Boring:	Ksat-8		
Location:	New Spray Site	Date:	4/13/2010
County:	Orange	Investigator(s):	SJF
Lat./Long.:		Elev.:	
Parent Material:	Slate	Drainage (Wetness) Class:	well
Moisture Status:	moist	Slope (%):	3%
Classification:	Ge or Pacolet	Vegetative Cover:	forest
Aspect:	South	Water Table:	>84"
Landscape Position:	side slope	S.H.W.T:	

					Structure						
Horiz.	**Depth (in.)**	**Main Colors (moist)**	**Mottles**	**Texture**	**Grade**	**Class**	**Type**	**Moist & Wet Consist.**	**Ped Coatings**	**Hoizon Boundary**	**Other Remarks**
Ap	0-2	10YR 4/3 brown	-	sandy loam	weak	fine	subangular blocky	friable	-	-	fine roots
E	2-8	10YR 5/4 yellowish brownn	5 YR 5/6 ylws red	sandy loam	weak	fine	subangular blocky	friable	-	-	fine and med. roots
Bt1	8-24	10YR 5/8 ylws red	-	sandy clay	moderate	medium	subangular blocky	friable/firm	yes	-	fine and med. roots
Bt2	24-50	5YR 5/8 ylws red	10YR 7/6 yellow	sandy clay	moderate	medium	subangular blocky	slightly sticky	yes	-	
BC	50-76	5YR 5/8 yellowish red	10YR 7/6 yellow	sandy clay loam	moderate	medium	subangular blocky	friable/firm	yes	-	
C	76-84+	5 YR 6/1 gray	2.5Y 7/6 pale yellow	sandy loam	weak	fine	granular/ subangular blocky	fiable	-	-	fine crushed rock

Soil Investigation Data Sheet

Soil Boring:	Ksat-9			
Location:	New Spray Site		Date:	4/13/2010
County:	Orange		Investigator(s):	SJF
Lat./Long.:			Elev.:	
Parent Material:	Slate		Drainage (Wetness) Class:	well
Moisture Status:	moist		Slope (%):	4%
Classification:	Ge (shallow)		Vegetative Cover:	forest
Aspect:	South		Water Table:	>84"
Landscape Position:	side slope		S.H.W.T.:	

					Structure						
Horiz.	**Depth (in.)**	**Main Colors (moist)**	**Mottles**	**Texture**	**Grade**	**Class**	**Type**	**Moist & Wet Consist.**	**Ped Coatings**	**Hoizon Boundary**	**Other Remarks**
Ap	0-4	10YR 4/3 brown	-	sandy loam	weak	fine	subangular blocky	friable	-	-	fine roots
Bt1	4-18	5 YR 4/6 ylws red	-	sandy clay	moderate	medium	subangular blocky	friable/firm	yes	-	
Bt2	18-40	7.5YR 5/6 strong brown	10YR 7/6 yellow 5YR 5/8 yellowish red, 5 YR 8/1 white	sandy clay	moderate	medium	subangular blocky	friable	yes	-	crushed rock fragments
BC	40-78	5YR 7/4 pink	5YR 8/1 white, 7.5YR 5/6	sandy clay loam	moderate	medium	subangular blocky	friable	yes	-	crushed rock fragments, floaters, 25% sap
C	78-84+	2.5Y 7/6 yellow	5 YR 8/1 white	sandy loam	weak	fine	granular/ subangular blocky	fiable	-	-	crushed rock, small floaters

Soil, Water, & Environment Group

Soil Investigation Data Sheet

Soil Boring:	Ksat-10		
Location:	New Spray Site	Date:	4/13/2010
County:	Orange	Investigator(s):	SJF
Lat./Long.:		Elev.:	
Parent Material:	Slate	Drainage (Wetness) Class:	well
Moisture Status:	moist	Slope (%):	4%
Classification:	Ge	Vegetative Cover:	forest
Aspect:	SW	Water Table:	>48" auger refusal
Landscape Position:	side slope	S.H.W.T:	

					Structure						
Horiz.	**Depth (in.)**	**Main Colors (moist)**	**Mottles**	**Texture**	**Grade**	**Class**	**Type**	**Moist & Wet Consist.**	**Ped Coatings**	**Hoizon Boundary**	**Other Remarks**
Ap	0-2	10YR 4/3 brown	-	sandy loam	weak	fine	subangular blocky	friable	-	-	fine roots
E	2-13	10YR 6/3 pale brn	5 YR 5/6 ylws red	sandy loam	weak	fine	subangular blocky	friable	-	-	fine and med. roots
Bt1	13-28	10YR 5/8 ylws red	-	sandy clay	moderate	medium	subangular blocky	friable/firm	yes	-	fine and med. roots
Bt2	28-34	7.5YR 5/6 strong brown	10YR 7/6 yellow 5YR 5/8 yellowish red, 5 YR 8/1 white	sandy clay	moderate	medium	subangular blocky	friable	yes	-	crushed rock fragments
BC	34-48	5YR 5/8 yellowish red	10YR 7/6 yellow	sandy clay loam	moderate	medium	subangular blocky	friable/firm	yes	-	
C	48-84+	5 YR 6/1 gray	2.5Y 7/6 pale yellow	sandy loam	weak	fine	granular/ subangular blocky	fiable	-	-	fine crushed rock, auger refusal at 50 in.

Soil, Water, & Environment Group

Soil Investigation Data Sheet

Soil Boring:	Ksat-11			
Location:	New Spary Site	Date:	4/13/2010	
County:	Orange	Investigator(s):	SJF	
Lat./Long.:		Elev.:		
Parent Material:	Slate	Drainage (Wetness) Class:	well	
Moisture Status:	moist	Slope (%):	3%	
Classification:	Herndon	Vegetative Cover:	forest	
Aspect:	West	Water Table:	>36" ?	auger refusal
Landscape Position:	side slope	S.H.W.T:		

					Structure						
Horiz.	**Depth (in.)**	**Main Colors (moist)**	**Mottles**	**Texture**	**Grade**	**Class**	**Type**	**Moist & Wet Consist.**	**Ped Coatings**	**Hoizon Boundary**	**Other Remarks**
Ap	0-2	10YR 4/3 brown	-	sandy loam	weak	fine	subangular blocky	friable	-	-	fine roots, shallow
E	2-10	10YR 6/2 lt ylws gray	-	silt loam	weak	fine	subangular blocky	friable	-	-	fine roots
BE	10-20	10YR 7/4 v pale brn	-	silt loam	moderate	fine	subangular blocky	friable			
Bt1	20-34	10YR 6/4 lt ylws brn		silt loam	weak/mod	fine/med	subangular blocky	friable	yes	-	auger refusal, few quartz rocks

Soil Investigation Data Sheet

Soil Boring:	Ksat-12		
Location:	New Spray Site	Date:	4/13/2010
County:	Orange	Investigator(s):	SJF
Lat./Long.:		Elev.:	
Parent Material:	Slate	Drainage (Wetness) Class:	well
Moisture Status:	moist	Slope (%):	3%
Classification:	Herndon	Vegetative Cover:	forest
Aspect:	West	Water Table:	>48" auger refusal
Landscape Position:	side slope	S.H.W.T:	

					Structure						
Horiz.	**Depth (in.)**	**Main Colors (moist)**	**Mottles**	**Texture**	**Grade**	**Class**	**Type**	**Moist & Wet Consist.**	**Ped Coatings**	**Hoizon Boundary**	**Other Remarks**
Ap	0-2	10YR 4/3 brown	-	sandy loam	weak	fine	subangular blocky	friable	-	-	fine roots, shallow
E	2-10	10YR 6/2 lt ylws gray	-	silt loam	weak	fine	subangular blocky	friable	-	-	fine roots
BE	10-18	10YR 7/4 v pale brn	-	silt loam	moderate	fine	subangular blocky	friable			
Bt1	18-34	10YR 6/4 lt ylws brn	10YR 8/1 white	silt loam	weak/mod	fine/med	subangular blocky	friable	yes	-	auger refusal, few quartz rocks
Bt2	34-46	7.5YR 5/6 strong brown	10YR 7/6 yellow, 10YR 8/1 white	clay	moderate	medium	subangular blocky	friable	yes	-	
Bt3	46-50+	7.55YR 8/6 reddish ylw		silty clay	moderate	medium	subangular blocky	friable	yes	-	auger refusal

Soil Investigation Data Sheet

Soil Boring:	Ksat-13		
Location:	New Spray Site	Date:	4/13/2010
County:	Orange	Investigator(s):	SJF
Lat./Long.:		Elev.:	
Parent Material:	Slate	Drainage (Wetness) Class:	well
Moisture Status:	moist	Slope (%):	2%
Classification:	Herndon	Vegetative Cover:	forest
Aspect:	SW	Water Table:	~34" perched
Landscape Position:	side slope	S.H.W.T:	

					Structure						
Horiz.	**Depth (in.)**	**Main Colors (moist)**	**Mottles**	**Texture**	**Grade**	**Class**	**Type**	**Moist & Wet Consist.**	**Ped Coatings**	**Hoizon Boundary**	**Other Remarks**
Ap	0-2	10YR 4/3 brown	-	sandy loam	weak	fine	subangular blocky	friable	-	-	fine roots, shallow
E	2-10	10YR 5/4 yellowish brownn	-	silt loam	weak	fine	subangular blocky	friable	-	-	
BE	10-18	10YR 5/6 ylws brn	-	silt loam	moderate	fine	subangular blocky	friable/sticky			
Bt1	18-34	5YR 5/8 ylws red	few 10YR 7/6 ylw	silty clay	moderate	medium	subangular blocky	friable/firm	yes	-	evidence of perched WT at 34 in.
Bt2	34-45	10YR 8/2 v pale brn	10YR 7/6 yellow 5YR 5/8 yellowish red	clay	moderate	medium	subangular blocky	friable/sticky	yes	-	water movement
Bt3	45-50+	10YR 6/6 brns ylw	10YR 7/6 yellow 5YR 5/8 yellowish red, 10YYR 8/1 white	silty clay	moderate	medium	subangular blocky	friable	yes	-	auger refusal at 50 in., rock

Soil Investigation Data Sheet

Soil Boring:	Ksat-14		
Location:	Bingham road	Date:	4/14/2010
County:	Orange	Investigator(s):	SJF
Lat./Long.:		Elev.:	
Parent Material:	Slate	Drainage (Wetness) Class:	well
Moisture Status:	moist	Slope (%):	3%
Classification:	Herndon	Vegetative Cover:	fallow field
Aspect:	SE	Water Table:	>48"
Landscape Position:	side slope	S.H.W.T.:	

					Structure						
Horiz.	**Depth (in.)**	**Main Colors (moist)**	**Mottles**	**Texture**	**Grade**	**Class**	**Type**	**Moist & Wet Consist.**	**Ped Coatings**	**Hoizon Boundary**	**Other Remarks**
Ap	0-2	10YR 4/3 brown	-	sandy loam	weak	fine	subangular blocky	friable	-	-	fine grass roots
E	2-6	10YR 5/4 yellowish brownn	-	silt loam	weak	fine	subangular blocky	friable	-	-	fine roots
BE	6-18	10YR 5/6 ylws brn	-	silt loam	moderate	fine	subangular blocky	friable			fine roots
Bt1	18-30	5YR 5/8 ylws red	few 10YR 7/6 ylw	silty clay	moderate	medium	subangular blocky	friable/firm	yes	-	
Bt2	30-38	7.5YR 5/6 strong brown	10YR 7/6 yellow 5YR 5/8 yellowish red	clay	moderate	medium	subangular blocky	friable/firm	yes	-	
Bt3	38-62	7.55YR 8/6 reddish ylw		silty clay	moderate	medium	subangular blocky	friable	yes	-	evd of water movement
C	62-84+	10YR 8/6 yellow	5 YR 5/8 red, 7.5YR 5/8 stng brn, 10YR 8/1 white	silt loam	weak	fine	granular/ subangular blocky	fiable	-	-	multicolored rock, >50% sap

Soil Investigation Data Sheet

Soil Boring:	Ksat-15		
Location:	Near Old Site	Date:	4/27/2010
County:	Orange	Investigator(s):	SJF
Lat./Long.:		Elev.:	
Parent Material:	Slate	Drainage (Wetness) Class:	well
Moisture Status:	moist	Slope (%):	<1%
Classification:	Ge (shallow)	Vegetative Cover:	forest
Aspect:	NE	Water Table:	>84"
Landscape Position:	side slope	S.H.W.T.:	

					Structure						
Horiz.	**Depth (in.)**	**Main Colors (moist)**	**Mottles**	**Texture**	**Grade**	**Class**	**Type**	**Moist & Wet Consist.**	**Ped Coatings**	**Hoizon Boundary**	**Other Remarks**
Ap	0-2	10YR 4/3 brown	-	sandy loam	weak	fine	subangular blocky	friable	-	-	fine roots, duff
E	2-8	10YR 5/4 ylws brn	-	sandy loam	weak	fine	subangular blocky	friable	-	-	
Bt1	8-28	5YR 5/4 reddish brown	-	sandy clay	moderate	medium	subangular blocky	friable/firm	yes	-	some fine roots, saprolite floaters
Bt2	28-38	7.5YR 5/6 strong brown	10YR 7/6 yellow 5YR 5/8 yellowish red, 10YR 8/2 v pale brn	sandy clay	moderate	medium	subangular blocky	slightly sticky	yes	-	
BC	38-65	5YR 5/8 yellowish red	10YR 7/6 yellow	sandy clay loam	moderate	medium	subangular blocky	friable/firm	yes	-	25-30% saprolite
C	65-84+	2.5Y 7/6 yellow	2.5Y 7/6 pale yellow	sandy loam	weak	fine	granular/ subangular blocky	fiable	-	-	multicolored rock

Soil Investigation Data Sheet

Soil Boring:	Ksat-16		
Location:	Old Site (W corner	Date:	4/27/2010
County:	Orange	Investigator(s):	SJF
Lat./Long.:		Elev.:	

Parent Material:	Slate	Drainage (Wetness) Class:	well
Moisture Status:	moist	Slope (%):	4-8%
Classification:	Herndon	Vegetative Cover:	forest
Aspect:	East	Water Table:	>84"
Landscape Position:	side slope transition	S.H.W.T:	

					Structure						
Horiz.	**Depth (in.)**	**Main Colors (moist)**	**Mottles**	**Texture**	**Grade**	**Class**	**Type**	**Moist & Wet Consist.**	**Ped Coatings**	**Hoizon Boundary**	**Other Remarks**
Ap	0-3	10 YR 3/1 v dk gray	-	sandy loam	weak	fine	subangular blocky	friable	-	-	fine roots, dark, fibrous duff
E	3-8	2.5Y 7/1 lt gray	-	silt loam	weak	fine	subangular blocky	friable	-	-	fine roots
BE	8-38	2.5Y 6/4 lt ylws brn	2.5Y 7/1 lt gray, 2.5Y 8/1 white, charcoal	silt loam	moderate	fine	subangular blocky	friable			charcoal fragments, disturbed soil
Bt1	38-50	7.5YR 6/6 reddish ylw	10YR 6/4 lt ylws brn	silty clay	moderate	medium	subangular blocky	friable/firm	yes	-	
Bt2	50-74	2.5YR 7/4 lt reddish brn		silty clay	moderate	medium	subangular blocky	friable	yes	-	
Bt3	74-84+	7.5YR 5/6 strong brown		silty clay	moderate	medium	subangular blocky	friable	yes	-	saprolite fragments

Soil Investigation Data Sheet

Soil Boring:	Ksat-17		
Location:	Old Spray Site	Date:	4/27/2010
County:	Orange	Investigator(s):	SJF
Lat./Long.:		Elev.:	
Parent Material:	Slate	Drainage (Wetness) Class:	well
Moisture Status:	moist	Slope (%):	6%
Classification:	Herndon	Vegetative Cover:	forested
Aspect:	SE	Water Table:	>72" auger refusal
Landscape Position:	side slope	S.H.W.T:	

					Structure						
Horiz.	**Depth (in.)**	**Main Colors (moist)**	**Mottles**	**Texture**	**Grade**	**Class**	**Type**	**Moist & Wet Consist.**	**Ped Coatings**	**Hoizon Boundary**	**Other Remarks**
Ap	0-2	10YR 4/3 brown	-	sandy loam	weak	fine	subangular blocky	friable	-	-	fine roots, shallow
E	2-10	10YR 7/6 yellow	-	silt loam	weak	fine	subangular blocky	friable	-	-	very dry, fine roots
BE	10-20	10YR 5/6 ylws brn	-	silt loam	moderate	fine	subangular blocky	friable			very dry
Bt1	20-30	10YR 6/4 lt ylws brn		silty clay	moderate	medium	subangular blocky	friable/firm	yes	-	
Bt2	30-60	2.5Y 7/3 pale ylw	2.5Y 8/1 white	silty clay	moderate	medium	subangular blocky	friable	yes	-	
Bt3	60-70+	2.5Y 6/4 lt ylws brn		silty clay	moderate	medium	subangular blocky	friable	yes	-	

Soil, Water, & Environment Group

Soil Investigation Data Sheet

Soil Boring:	Ksat-18		
Location:	Bingham road	Date:	4/27/2010
County:	Orange	Investigator(s):	SJF
Lat./Long.:		Elev.:	
Parent Material:	Slate	Drainage (Wetness) Class:	well
Moisture Status:	moist	Slope (%):	3%
Classification:	Ge (shallow)	Vegetative Cover:	fallow field
Aspect:	East	Water Table:	>84"
Landscape Position:	side slope	S.H.W.T:	

					Structure						
Horiz.	**Depth (in.)**	**Main Colors (moist)**	**Mottles**	**Texture**	**Grade**	**Class**	**Type**	**Moist & Wet Consist.**	**Ped Coatings**	**Hoizon Boundary**	**Other Remarks**
Ap	0-2	10YR 4/3 brown	-	sandy loam	weak	fine	subangular blocky	friable	-	-	fine roots
E	2-10	10YR 5/4 yellowish brownn	-	sandy loam	weak	fine	subangular blocky	friable	-	-	fine and med roots
Bt1	10-36	5YR 5/8 yellowish red	-	sandy clay	moderate	medium	subangular blocky	friable/firm	yes	-	some fine roots
Bt2	36-58	7.5YR 5/6 strong brown	10YR 7/6 yellow 5YR 5/8 yellowish red	sandy clay	moderate	medium	subangular blocky	slightly sticky	yes	-	
BC	58-73	7.5YR 5/6 strong brown	10YR 7/6 yellow	sandy clay loam	moderate	medium	subangular blocky	friable/firm	yes	-	15-25% saprolite
C	73-84+	2.5Y 7/6 yellow	2.5Y 7/4 pale yellow, 7.5YR 5/6 stng brn	sandy loam	weak	fine	granular/ subangular blocky	fiable	-	-	multicolored rock, >50% saprolite

Soil, Water, & Environment Group

Soil Investigation Data Sheet

Soil Boring:	Ksat-19			
Location:	Facility Grounds		Date:	4/27/2010
County:	Orange		Investigator(s):	SJF
Lat./Long.:			Elev.:	

Parent Material:	Slate		Drainage (Wetness) Class:	well
Moisture Status:	moist		Slope (%):	3%
Classification:	Ud	Ge	Vegetative Cover:	landscaped area
Aspect:	South		Water Table:	<36 in. disturbed
Landscape Position:	side slope		S.H.W.T:	

					Structure						
Horiz.	**Depth (in.)**	**Main Colors (moist)**	**Mottles**	**Texture**	**Grade**	**Class**	**Type**	**Moist & Wet Consist.**	**Ped Coatings**	**Hoizon Boundary**	**Other Remarks**
Ud1	0-2	5YR 5/8 ylws red	-	sandy clay	moderate	medium	subangular blocky	friable	-	-	fine roots, very disturbed
Ud2	2-14	2.5Y 6/6 olive ylw	5YR 5/8 ylws red	sandy clay	moderate	medium	subangular blocky	friable/firm	-	-	buried roots, debris
Ud3	14-24+	10YR 6/3 pale ylw	multi colored	sandy clay	moderate	medium	subangular blocky	friable/firm	yes	-	some fine roots

Soil Investigation Data Sheet

Soil Boring:	Ksat-20		
Location:	Bingham road	Date:	4/27/2010
County:	Orange	Investigator(s):	SJF
Lat./Long.:		Elev.:	
Parent Material:	Slate	Drainage (Wetness) Class:	well
Moisture Status:	moist	Slope (%):	3%
Classification:	Herndon	Vegetative Cover:	fallow field
Aspect:	East	Water Table:	>60" auger refusal at 5.5 '
Landscape Position:	side slope	S.H.W.T:	

					Structure					
Horiz.	**Depth (in.)**	**Main Colors (moist)**	**Mottles**	**Texture**	**Grade**	**Class**	**Type**	**Moist & Wet Consist.**	**Ped Coatings**	**Hoizon Boundary**	**Other Remarks**
Ap	0-2	10YR 4/3 brown	-	sandy loam	weak	fine	subangular blocky	friable	-	-	fine roots, med roots, OM
E	2-8	10YR 5/4 yellowish brownn	-	silt loam	moderate	medium	subangular blocky	friable	-	-	
BE	8-18	10YR 5/6 ylws brn	-	silt loam	moderate	fine	subangular blocky	friable			
Bt1	18-26	10YR 5/6 ylws brn	few 10YR 7/6 ylw, 5YR 5/6 ylws red	silty clay	weak/mod	medium	subangular blocky	friable/firm	yes	-	saprolite floaters
Bt2	26-36	5YR 5/2 reddish gry	10YR 7/6 yellow 5YR 5/8 yellowish red	clay	weak/mod	medium	subangular blocky	friable	yes	-	
BC	36-60+	5YR 5/1 gry		silty clay	weak/mod	medium	subangular blocky	friable	yes	-	auger refusal at 5.5 ft on soft rock