STORMWATER MANAGEMENT FEASIBILITY NARRATIVE

THE WHEELER FIELD AT ARDROSSAN FARM

SUBMITTED AS PART OF
THE CONDITIONAL USE APPLICATION
FOR DENSITY MODIFICATION DEVELOPMENT

BY:

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STORMWATER MANAGEMENT FEASIBILITY NARRATIVE

The Ardrossan Family Trusts own the land known as the Ardrossan Farm in Radnor Township. The total tract, located at Newtown and Darby-Paoli Roads, contains 352.5 acres and is composed of several individual parcels. Parcels 'B' and "E" known as the Wheeler Field and the School House Lot contain a combined area of 27.65 acres and are located on the west side of Darby-Paoli Road extending along Darby-Paoli Road between Saw Mill Road and Godfrey Road. These parcels collectively termed the Wheeler Field at Ardrossan Farm are the subject of this report. The trust proposes to develop the site in accordance with Radnor Township's Density Modification provisions of the zoning ordinance which permits cluster development with the provision of open space areas.

The site currently contains an old dwelling and a few farm buildings. The site borders Darby Creek and a majority of the site is open floodplain meadow. There is an area of higher ground outside the floodplain bordering Darby-Paoli Road containing meadow areas and areas of steep slopes. Under the Density Modification concept, the uplands portion of the site will be developed with approximately 5 new single family dwellings on 6 new individual residential building lots. The existing dwelling will as part of the 6th lot.

In order to protect the existing natural floodplain, the proposed subdivision provides for a cluster of home sites to be served by a common drive off of Darby Paoli Road. The proposed design includes Low Impact Development (LID) techniques to reduce impervious coverage and stormwater management demand providing a clustered development of the site.

Stormwater management for the proposed development will be provided by several structural BMPs sized to control the increase in storm water runoff from the developed sub-basin. It is anticipated that individual on-lot underground pipe systems will be utilized to control the increase in runoff generated by the new single family dwellings and common drive. Ground water recharge seepage beds will be installed to provide recharge throughout the site. Overflow from the proposed detention facilities will be piped to level spreaders so that runoff can be dissipated over land to grade in an un-concentrated manner.

Soil types were obtained via the Web Soil Survey proved by the United States Department of Agriculture and are depicted on the site plan. The soils in the area of development are classified as Glenelg channery silt loam and Glenville silt loam. The Glenelg soils consist of deep, well drained soils of uplands. The soils developed in material weathered mainly from granite, gneiss and mica schist. The Glenelg soils have moderate available moisture capacity and moderate permeability. The Glenville soils consist of deep moderately well drained to somewhat poorly drained soils of uplands. They are usually located in areas of uplands around streams and exhibit mottling in the subsoil layers. The Glenville soils have a moderately slow permeability.

This site is located in the Radnor Darby-Cobbs Watershed District 'B-2'. The township Stormwater management ordinance requires that several storm water management guidelines must be met by the proposed stormwater facilities. The ordinance requires that where feasible, the increase in storm water runoff for the 2-year storm event shall be infiltrated into the ground via percolation. Water quality treatment must be also provided based on the township's

calculation formula and rate control through the 100-year storm must be provided as follows: the 2-year post-development rate to the 1-year pre development rate, the 5-year post to the 2-year pre, the 10-year post to the 5-year pre, the 25-year post to the 5-year pre, the 50-year post to the 10-year pre, and straight rate control for the 100-year storm event. The proposed stormwater management facilities are intended to be designed to meet these Township requirements as well as the DEP NPDES General Permit requirements.

In order to determine the feasibility of providing the required ground water recharge, soil testing was performed during the week of July 15, 2013 by Evans Mill Environmental LLC at several locations where stormwater management systems could be considered for the new lots the site. Results of the testing are included with this report, and show favorable percolation rates in the higher elevations of the site, but evidence of a shallow water table at the lower elevations. Grading associated with the improvements of these lots would most likely raise the elevations of the building site allowing for the possibility of achieving percolation at the higher elevations.

Detailed testing will be performed as part of the design of the individual systems and calculations and associated documentation, including infiltration test results, demonstrating compliance with the Township and DEP codes, will be submitted with the Preliminary Plan application.

WATER QUALITY, THERMAL IMPACT, AND ANTIDEGRADATION NARRATIVE

By infiltrating the increase in stormwater runoff for the 2-year 24-hr storm event, the runoff generated by the proposed development will be treated structurally to remove the appropriate amount of the Total Suspended Solids, phosphorous, and solutes as required by the BMP Manual. Non-structural BMP's such as landscape restoration, the use of vegetated swales, and use of natural drainage ways will also assist in meeting the water quality objectives.

Also by providing subsurface detention and infiltrating the increase in stormwater runoff for the 2-year 24-hr storm event into subsurface stormwater management facilities, thermal impacts will be mitigated through the following processes:

- Convection. Convective heat transfer within the sub-surface structures, and at the surface on swales, is a significant stormwater cooling mechanism. Site design will include sub-surface conveyance and the implementation of subsurface stormwater management systems. The stormwater contained and/or moving within these structures will exchange thermal content with the cooler earth and fill material around them. Because the ground temperature surrounding these sub-surface structures is always cooler, it will serve as a "thermal sink" and will absorb heat.

- Evapotranspiration. Revegetating disturbed areas at the site, utilizing native species, and utilization of existing vegetative drainage paths will provide significant thermal mitigation benefits through the process of evapotranspiration. The addition of proposed landscaping will help to provide significant cooling effects at the site, even during storm events, and especially during warmer weather.

The requirements of Pennsylvania's anti-degradation regulations to maintain and protect the water quality of Pennsylvania's creeks and streams, which has been interpreted to include thermal impacts, will be satisfied with the proposed stormwater management design. During storm conditions, the proposed BMP "treatment train" of non-structural and structural BMPs will mitigate potential impacts to the receiving streams from the "first flush" thermal loading generated by the site. Specifically, the BMP treatment train will utilize a variety of thermal mitigation mechanisms – including thermal exchange of runoff volume with "thermal sinks" through infiltration, heat losses in underground structures, and thermal exchange during conveyance– to mitigate thermal loading associated with site stormwater.

The water quality impacts of the proposed development, from both a water quality and thermal standpoint, will satisfy the requirements of Pennsylvania's anti-degradation regulations. Non-discharge stormwater alternatives will be utilized whenever environmentally sound and cost effective. Stormwater recharge facilities will mitigate the increase in stormwater runoff volume from the development for a 2 year 24 hour storm event and, through the use of a sophisticated "treatment train" of proposed non-structural and structural BMPs at the site, the water quality of the receiving streams will be protected and maintained.

APPENDIX 1

USDA SOIL RESOURCE REPORT

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Delaware County, Pennsylvania

Wheeler Field at Ardrossan

July 26, 2013

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://soils.usda.gov/sqi/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (http://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://soils.usda.gov/contact/state_offices/).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Soil Data Mart Web site or the NRCS Web Soil Survey. The Soil Data Mart is the data storage site for the official soil survey information.

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the

individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Delaware County, Pennsylvania
Survey Area Data: Version 6, Feb 24, 2009

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jun 17, 2010—Jul 1, 2011

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Delaware County, Pennsylvania (PA045)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
GeB2	Glenelg channery silt loam, 3 to 8 percent slopes, moderately eroded	1.9	7.2%
GeC2	Glenelg channery silt loam, 8 to 15 percent slopes, moderately eroded	2.9	10.8%
GnB2	Glenville silt loam, 3 to 8 percent slopes, moderately eroded	5.9	22.0%
We	Wehadkee silt loam	16.0	59.9%
Totals for Area of Interest		**26.6**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Delaware County, Pennsylvania

GeB2—Glenelg channery silt loam, 3 to 8 percent slopes, moderately eroded

Map Unit Setting

Elevation: 300 to 2,000 feet
Mean annual precipitation: 40 to 55 inches
Mean annual air temperature: 45 to 61 degrees F
Frost-free period: 110 to 235 days

Map Unit Composition

Glenelg and similar soils: 85 percent

Description of Glenelg

Setting

Landform: Hillslopes
Landform position (two-dimensional): Backslope, shoulder
Landform position (three-dimensional): Nose slope, side slope
Down-slope shape: Convex, linear
Across-slope shape: Convex, linear
Parent material: Fine-loamy residuum weathered from mica schist

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: High (about 9.4 inches)

Interpretive groups

Farmland classification: All areas are prime farmland
Land capability (nonirrigated): 2e
Hydrologic Soil Group: B

Typical profile

0 to 8 inches: Channery silt loam
8 to 26 inches: Channery silt loam
26 to 60 inches: Channery loam

GeC2—Glenelg channery silt loam, 8 to 15 percent slopes, moderately eroded

Map Unit Setting

Elevation: 300 to 2,000 feet
Mean annual precipitation: 40 to 55 inches

Mean annual air temperature: 45 to 61 degrees F
Frost-free period: 110 to 235 days

Map Unit Composition
Glenelg and similar soils: 85 percent

Description of Glenelg

Setting
Landform: Hillslopes
Landform position (two-dimensional): Backslope, shoulder
Landform position (three-dimensional): Nose slope, side slope
Down-slope shape: Linear, convex
Across-slope shape: Linear, convex
Parent material: Fine-loamy residuum weathered from mica schist

Properties and qualities
Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: High (about 9.4 inches)

Interpretive groups
Farmland classification: Farmland of statewide importance
Land capability (nonirrigated): 3e
Hydrologic Soil Group: B

Typical profile
0 to 8 inches: Channery silt loam
8 to 26 inches: Channery silt loam
26 to 60 inches: Channery loam

GnB2—Glenville silt loam, 3 to 8 percent slopes, moderately eroded

Map Unit Setting
Elevation: 200 to 2,000 feet
Mean annual precipitation: 35 to 50 inches
Mean annual air temperature: 45 to 57 degrees F
Frost-free period: 120 to 220 days

Map Unit Composition
Glenville and similar soils: 85 percent
Minor components: 7 percent

Description of Glenville

Setting
Landform: Hillslopes

Landform position (two-dimensional): Footslope, backslope
Landform position (three-dimensional): Head slope, side slope
Down-slope shape: Linear, concave
Across-slope shape: Concave, linear
Parent material: Loamy colluvium and/or residuum weathered from mica schist

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: 60 to 99 inches to
Drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.60 in/hr)
Depth to water table: About 6 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Moderate (about 6.9 inches)

Interpretive groups

Farmland classification: All areas are prime farmland
Land capability (nonirrigated): 2e
Hydrologic Soil Group: C

Typical profile

0 to 10 inches: Silt loam
10 to 16 inches: Silt loam
16 to 50 inches: Silt loam
50 to 70 inches: Channery loam

Minor Components

Worsham

Percent of map unit: 7 percent
Landform: Depressions

We—Wehadkee silt loam

Map Unit Setting

Elevation: 200 to 600 feet
Mean annual precipitation: 36 to 46 inches
Mean annual air temperature: 54 to 57 degrees F
Frost-free period: 140 to 200 days

Map Unit Composition

Wehadkee and similar soils: 90 percent

Description of Wehadkee

Setting

Landform: Flood plains
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope

Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Loamy alluvium derived from igneous and metamorphic rock

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Moderate (about 8.9 inches)

Interpretive groups

Farmland classification: Not prime farmland
Land capability (nonirrigated): 4w
Hydrologic Soil Group: D

Typical profile

0 to 9 inches: Silt loam
9 to 28 inches: Silt loam
28 to 60 inches: Silty clay loam
60 to 64 inches: Stratified clay

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APPENDIX 2

EVANS MILL ENVIRONMENTAL

SOIL TEST PIT
AND
INFILTRATION TESTING LOGS

SOIL SUMMARY REPORT FOR STORMWATER INFILTRATION

PROJECT	ARDROSSAN	PROJECT NUMBER	2143-00-530	SUBDIVISION	ARDROSSAN
SITE LOCATION	NEWTOWN ROAD	MUNICIPALITY	RADNOR	COUNTY	DELAWARE
TEST DATE	7/17/2013	CONDUCTED BY	WJM	SITE	18
WEATHER CONDITIONS	SUNNY	PRECIPITATION			NONE
TEMPERATURE	MID 90'S	SOIL CONDITIONS	WET		X DRY

SOIL PROFILE **Test Pit # 7-19-18**

HORIZON	DEPTH UPPER	DEPTH LOWER	BOUNDARY	COLOR	TEXTURE	% CF	REDOX A	REDOX S	REDOX C	STRUCTURE	CONSISTENCE	ROOTS	NOTES % clay, macro pores, etc.
Ap	0	8	A S	10 YR 3/2	SILT LOAM	<5	-			2 GRAN	FRIABLE	MANY	
B1	8	22	A S	7.5 YR 5/6	SILTY CLAY LOAM	<5	-			2 SBK	FRIABLE	-	
B2	22	34	A S	7.5 YR 5/6	SILT LOAM	<5	M	M	D	1 SBK	FRIABLE	-	
B3	34	50	A S	10 YR 5/4	SILT LOAM	<5	M	M	D	1 SBK	FRIABLE	-	
C1	50	58	A S	N 6/;5 YR 5/6	SILT LOAM	<5	M	M	P	O MASS	FRIABLE	-	
C2	58	81	-	5 YR 5/6	SILT LOAM	<5	M	M	P	O MASS	FRIABLE	-	Fe & Mn CONCREATIONS

NOTES: FREE WATER AT 81"

SOIL TYPE:	GLENVILLE	SOIL DEPTH CLASS	SOIL DRAINAGE CLASS
CARBONATE DERIVED	N	X DEEP	WELL DRAINED
LIMITING CONDITION		MODERATELLY DEEP	MODERATELY WELL DRAINED
TYPE:	REDOX	SHALLOW	X SOMEWHAT POORLY DRAINED
DEPTH:	22"		POORLY DRAINED

SLOPE:

COVER: GRASS

REDOX - Redoxymorphic features (Drainage Mottling) A/S/C - Abundance/Size/Contrast
f -few, c -common, m -many; f -fine, m -medium, c -coarse; f -faint, d -distinct, p -prominent

INFILTRATION TEST DATA

HOLE #	DEPTH OF TEST	CASING DIA. (IN)	INITIAL HEIGHT OF WATER COLUMN (IN)	INITIAL FILL TIME	DROP AFTER 1st PRE-SOAK (IN)	DROP AFTER 2st PRE-SOAK (IN)	TIME: 15 MIN OR 30 MIN	READING #1 DROP (IN)	READING #2 DROP (IN)	READING #3 DROP (IN)	READING #4 DROP (IN)	READING #5 DROP (IN)	READING #6 DROP (IN)	READING #7 DROP (IN)	READING #8 DROP (IN)	FIELD RATE OF DROP (in/hr)	INFILTRATION RATE UTILIZING THE HVORSLEV SOLUTION $K_s=[A/(F*D*t)] \times \ln(h_1/h_2)$
1																	
2																	
3							NO	TEST									
4																	
5																	
6																	
															GEOMETRIC MEAN (IN/HR):		

DIAGRAM/COMMENTS:

EVANS MILL ENVIRONMENTAL, LLC
Environmental Engineers & Consultants

SOIL SUMMARY REPORT FOR STORMWATER INFILTRATION

PROJECT	ARDROSSAN	PROJECT NUMBER	2143-00-530	SUBDIVISION	ARDROSSAN
SITE LOCATION	NEWTOWN ROAD	MUNICIPALITY	RADNOR	COUNTY	DELAWARE
TEST DATE	7/17/2013	CONDUCTED BY	WJM	SITE	19
WEATHER CONDITIONS	SUNNY	PRECIPITATION			NONE
TEMPERATURE		SOIL CONDITIONS	WET		X DRY

SOIL PROFILE Test Pit # 7-19-F

HORIZON	DEPTH UPPER	DEPTH LOWER	BOUNDARY	COLOR	TEXTURE	% CF	REDOX A	REDOX S	REDOX C	STRUCTURE	CONSISTENCE	ROOTS	NOTES % clay, macro pores, etc.
Ap	0	9	A S	10 YR 3/2	LOAM	<5	-			2 GRAN	FRIABLE	MANY	
B1	9	21	A S	7.5 R 5/6	SILTY CLAY LOAM	<5	-			1 SBK	FRIABLE	-	
B2	21	32	A S	7.5 YR 5/4	SILT LOAM	<5	F	M	F	2 SBK	FRIABLE	-	
C1	32	52	A S	5YR 5/6; N 6/	SILT LOAM	<5	M	M	D	I SBK	FRIABLE	-	
C2	52	80	A S		LOAM	<5	M	M	D	0 MASS	FRIABLE	-	
W	80+		-										

NOTES:

SOIL TYPE:	GLENVILLE	SOIL DEPTH CLASS	SOIL DRAINAGE CLASS
CARBONATE DERIVED	N	X DEEP	WELL DRAINED
LIMITING CONDITION		MODERATELLY DEEP	MODERATELY WELL DRAINED
TYPE:	REDOX	SHALLOW	X SOMEWHAT POORLY DRAINED
DEPTH:	22		POORLY DRAINED

SLOPE:

COVER: GRASS

REDOX - Redoxymorphic features (Drainage Mottling) A/S/C - Abundance/Size/Contrast
f -few, c -common, m -many; f -fine, m -medium, c -coarse; f -faint, d -distinct, p -prominent

INFILTRATION TEST DATA

HOLE #	DEPTH OF TEST	CASING DIA. (IN)	INITIAL HEIGHT OF WATER COLUMN (IN)	INITIAL FILL TIME	DROP AFTER 1st PRE-SOAK (IN)	DROP AFTER 2st PRE-SOAK (IN)	TIME: 15 MIN OR 30 MIN	READING #1 DROP (IN)	READING #2 DROP (IN)	READING #3 DROP (IN)	READING #4 DROP (IN)	READING #5 DROP (IN)	READING #6 DROP (IN)	READING #7 DROP (IN)	READING #8 DROP (IN)	FIELD RATE OF DROP (in/hr)	INFILTRATION RATE UTILIZING THE HVORSLEV SOLUTION $K_s=[A/(F'D^*t)] \times \ln(h_1/h_2)$
1																	
2																	
3							NO	TEST									
4																	
5																	
6																	
															GEOMETRIC MEAN (IN/HR):		

DIAGRAM/COMMENTS:

EVANS MILL ENVIRONMENTAL, LLC
Environmental Engineers & Consultants

SOIL SUMMARY REPORT FOR STORMWATER INFILTRATION

PROJECT	ARDROSSAN	PROJECT NUMBER	2143-00-530	SUBDIVISION	ARDROSSAN
SITE LOCATION	NEWTOWN ROAD	MUNICIPALITY	RADNOR	COUNTY	DELAWARE
TEST DATE	7/17/2013	CONDUCTED BY	WJM	SITE	20
WEATHER CONDITIONS	SUNNY	PRECIPITATION			
TEMPERATURE		SOIL CONDITIONS	WET	X DRY	

SOIL PROFILE Test Pit # 7-19-20

HORIZON	DEPTH UPPER	DEPTH LOWER	BOUNDARY	COLOR	TEXTURE	% CF	REDOX A	REDOX S	REDOX C	STRUCTURE	CONSISTENCE	ROOTS	NOTES % clay, macro pores, etc.
Ap	0	8	A S	10 YR 3/2	LOAM	<5	-			2 GRAN	FRIABLE	MANY	
B	8	24	A S	7.5 YR 5/6	LOAM	<5	-			1 SBK	FRIABLE	-	
C	24	84+	-	VARIGATED	SANDY LOAM	30	-			0 MASS	VERHY FRIABLE	-	

NOTES:

SOIL TYPE:	GLENELG	SOIL DEPTH CLASS	SOIL DRAINAGE CLASS	
CARBONATE DERIVED	N	X DEEP	X WELL DRAINED	SLOPE:
LIMITING CONDITION		MODERATELLY DEEP	MODERATELY WELL DRAINED	
TYPE:	BOP	SHALLOW	SOMEWHAT POORLY DRAINED	
DEPTH:	84+		POORLY DRAINED	COVER: GRASS

REDOX - Redoxymorphic features (Drainage Mottling) A/S/C - Abundance/Size/Contrast
f -few, c -common, m -many; f -fine, m -medium, c -coarse; f -faint, d -distinct, p -prominent

INFILTRATION TEST DATA

HOLE #	DEPTH OF TEST	CASING DIA. (IN)	INITIAL HEIGHT OF WATER COLUMN (IN)	INITIAL FILL TIME	DROP AFTER 1st PRE-SOAK (IN)	DROP AFTER 2st PRE-SOAK (IN)	TIME: 15 MIN OR 30 MIN	READING #1 DROP (IN)	READING #2 DROP (IN)	READING #3 DROP (IN)	READING #4 DROP (IN)	READING #5 DROP (IN)	READING #6 DROP (IN)	READING #7 DROP (IN)	READING #8 DROP (IN)	FIELD RATE OF DROP (in/hr)	INFILTRATION RATE UTILIZING THE HVORSLEV SOLUTION $K_s=[A/(F*D*t)] \times \ln(h_1/h_2)$
1	60"	3"	6"	9:30	6.00"	6.00"	10 min	3.50"	3.25"	3.00"	3.00"	2.00"	2.00"	2.00"	2.00"	12.00	2.08
2	60"	3"	6"	9:30	6.00"	3.50"	30 min	3.00"	3.25"	3.25"	3.25"					6.50	1.34
3																	
4																	
5																	
6																	
															GEOMETRIC MEAN (IN/HR):	8.83	1.67

DIAGRAM/COMMENTS:

EVANS MILL ENVIRONMENTAL, LLC
Environmental Engineers & Consultants

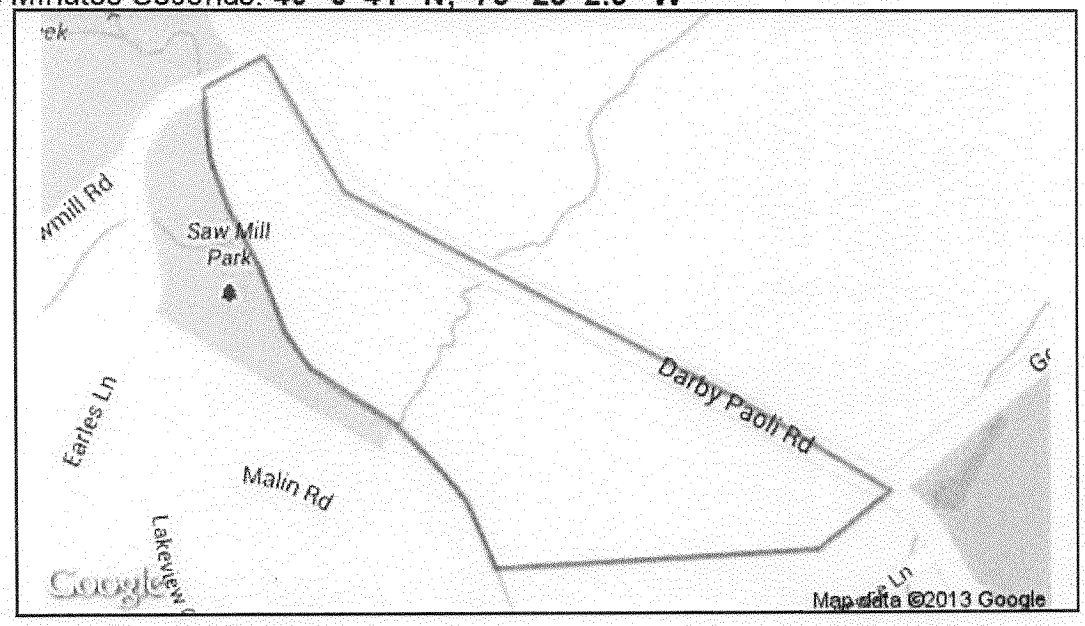
APPENDIX 3

PENNSYLVANIA NATURAL DIVERSITY INVENTORY

PROJECT ENVIRONMENTAL REVIEW RECEIPT

1. PROJECT INFORMATION

Project Name: **Wheeler Field at Ardrossan**
Date of review: **7/30/2013 10:21:29 AM**
Project Category: **Development,Residential,Subdivision containing more than 2 lots and/or 2 single-family units**
Project Area: **26.4** acres
County: **Delaware** Township/Municipality: **Radnor**
Quadrangle Name: **VALLEY FORGE** ~ ZIP Code: **19010,19073,19085**
Decimal Degrees: **40.011378 N, -75.384145 W**
Degrees Minutes Seconds: **40° 0' 41" N, -75° 23' 2.9" W**



2. SEARCH RESULTS

Agency	Results	Response
PA Game Commission	No Known Impact	No Further Review Required
PA Department of Conservation and Natural Resources	**Potential Impact**	**FURTHER REVIEW IS REQUIRED, See Agency Response**
PA Fish and Boat Commission	No Known Impact	No Further Review Required
U.S. Fish and Wildlife Service	No Known Impact	No Further Review Required

As summarized above, Pennsylvania Natural Diversity Inventory (PNDI) records indicate there may be potential impacts to threatened and endangered and/or special concern species and resources within the project area. If the response above indicates "No Further Review Required" no additional communication with the respective agency is required. If the response is "Further Review Required" or "See Agency Response," refer to the appropriate agency comments below. Please see the DEP Information Section of this receipt if a PA Department of Environmental Protection Permit is required.

Note that regardless of PNDI search results, projects requiring a Chapter 105 DEP individual permit or GP 5, 6, 7, 8, 9 or 11 in certain counties (Adams, Berks, Bucks, Carbon, Chester, Cumberland, Delaware, Lancaster, Lebanon, Lehigh, Monroe, Montgomery, Northampton, Schuylkill and York) must comply with the bog turtle habitat screening requirements of the PASPGP.

3. AGENCY COMMENTS

Regardless of whether a DEP permit is necessary for this proposed project, any potential impacts to threatened and endangered species and/or special concern species and resources must be resolved with the appropriate jurisdictional agency. In some cases, a permit or authorization from the jurisdictional agency may be needed if adverse impacts to these species and habitats cannot be avoided.

These agency determinations and responses are **valid for two years** (from the date of the review), and are based on the project information that was provided, including the exact project location; the project type, description, and features; and any responses to questions that were generated during this search. If any of the following change: 1) project location, 2) project size or configuration, 3) project type, or 4) responses to the questions that were asked during the online review, the results of this review are not valid, and the review must be searched again via the PNDI Environmental Review Tool and resubmitted to the jurisdictional agencies. The PNDI tool is a primary screening tool, and a desktop review may reveal more or fewer impacts than what is listed on this PNDI receipt. The jursidictional agencies **strongly advise against** conducting surveys for the species listed on the receipt prior to consultation with the agencies.

PA Game Commission

RESPONSE: No Impact is anticipated to threatened and endangered species and/or special concern species and resources.

PA Department of Conservation and Natural Resources

RESPONSE: Further review of this project is necessary to resolve the potential impacts(s). Please send project information to this agency for review (see WHAT TO SEND).

DCNR Species: (Note: The PNDI tool is a primary screening tool, and a desktop review may reveal more or fewer species than what is listed below. After desktop review, if a botanical survey is required by DCNR, we recommend the DCNR Botanical Survey Protocols, available here: http://www.gis.dcnr.state.pa.us/hgis-er/PNDI_DCNR.aspx.)
Scientific Name: Aplectrum hyemale
Common Name: Puttyroot
Current Status: Special Concern Species*
Proposed Status: Special Concern Species*

PA Fish and Boat Commission

RESPONSE: No Impact is anticipated to threatened and endangered species and/or special concern species and resources.

U.S. Fish and Wildlife Service

RESPONSE: No impacts to **federally** listed or proposed species are anticipated. Therefore, no further consultation/coordination under the Endangered Species Act (87 Stat. 884, as amended; 16 U.S.C. 1531 *et seq.* is required. Because no take of federally listed species is anticipated, none is authorized. This response does not reflect potential Fish and Wildlife Service concerns under the Fish and Wildlife Coordination Act or other authorities.

* Special Concern Species or Resource - Plant or animal species classified as rare, tentatively undetermined or candidate as well as other taxa of conservation concern, significant natural communities, special concern populations (plants or animals) and unique geologic features.
** Sensitive Species - Species identified by the jurisdictinal agency as collectible, having economic value, or being susceptible to decline as a result of visitation.

WHAT TO SEND TO JURISDICTIONAL AGENCIES

If project information was requested by one or more of the agencies above, send the following information to the agency(s) seeking this information (see AGENCY CONTACT INFORMATION).

Check-list of *Minimum* Materials to be submitted:

____**SIGNED** copy of this Project Environmental Review Receipt
____Project narrative with a description of the overall project, the work to be performed, current physical characteristics of the site and acreage to be impacted.
____Project location information (name of USGS Quadrangle, Township/Mu?icipality, and County)
____USGS 7.5-minute Quadrangle with project boundary clearly indicated, and quad name on the map

The inclusion of the following information may expedite the review process.
____A basic site plan(particularly showing the relationship of the project to the physical features such as wetlands, streams, ponds, rock outcrops, etc.)
____Color photos keyed to the basic site plan (i.e. showing on the site plan where and in what direction each photo was taken and the date of the photos)
____Information about the presence and location of wetlands in the project area, and how this was determined (e.g., by a qualified wetlands biologist), if wetlands are present in the project area, provide project plans showing the location of all project features, as well as wetlands and streams

4. DEP INFORMATION

The Pa Department of Environmental Protection (DEP) requires that a signed copy of this receipt, along with any required documentation from jurisdictional agencies concerning resolution of potential impacts, be submitted with applications for permits requiring PNDI review. For cases where a "Potential Impact" to threatened and endangered species has been identified before the application has been submitted to DEP, the application should not be submitted until the impact has been resolved. For cases where "Potential Impact" to special concern species and resources has been identified before the application has been submitted, the application should be submitted to DEP along with the PNDI receipt. The PNDI Receipt should also be submitted to the appropriate agency according to directions on the PNDI Receipt. DEP and the jurisdictional agency will work together to resolve the potential impact(s). See the DEP PNDI policy at http://www.naturalheritage.state.pa.us.

5. ADDITIONAL INFORMATION

The PNDI environmental review website is a **preliminary** screening tool. There are often delays in updating species status classifications. Because the proposed status represents the best available information regarding the conservation status of the species, state jurisdictional agency staff give the proposed statuses at least the same consideration as the current legal status. If surveys or further information reveal that a threatened and endangered and/or special concern species and resources exist in your project area, contact the appropriate jurisdictional agency/agencies immediately to identify and resolve any impacts.

For a list of species known to occur in the county where your project is located, please see the species lists by county found on the PA Natural Heritage Program (PNHP) home page (www.naturalheritage.state.pa.us). Also note that the PNDI Environmental Review Tool only contains information about species occurrences that have actually been reported to the PNHP.

6. AGENCY CONTACT INFORMATION

PA Department of Conservation and Natural Resources
Bureau of Forestry, Ecological Services Section
400 Market Street, PO Box 8552, Harrisburg, PA. 17105-8552
Fax:(717) 772-0271

U.S. Fish and Wildlife Service
Endangered Species Section
315 South Allen Street, Suite 322, State College, PA. 16801-4851
NO Faxes Please.

PA Fish and Boat Commission
Division of Environmental Services
450 Robinson Lane, Bellefonte, PA. 16823-7437
NO Faxes Please

PA Game Commission
Bureau of Wildlife Habitat Management
Division of Environmental Planning and Habitat Protection
2001 Elmerton Avenue, Harrisburg, PA. 17110-9797
Fax:(717) 787-6957

7. PROJECT CONTACT INFORMATION

Name:_____
Company/Business Name:_____
Address:_____
City, State, Zip:_____
Phone:(_____)_____Fax:(_____)_____
Email:_____

8. CERTIFICATION

I certify that ALL of the project information contained in this receipt (including project location, project size/configuration, project type, answers to questions) is true, accurate and complete. In addition, if the project type, location, size or configuration changes, or if the answers to any questions that were asked during this online review change, I agree to re-do the online environmental review.

_____ _____
applicant/project proponent signature date