Prepared for Annville Institute

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community design assistance center
College of Architecture and Urban Studies
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In collaboration with the Kentucky Division of Forestry

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Annville Institute is located in Annville, a small town of about 1,100 residents in Jackson County, Kentucky. The Annville Institute property is located in the southern portion of the county near the intersection of highways 3630 and 290. It is located on a campus that has been designated as a historical site on the National Register and is now home to many non-profit organizations. The campus contains about 120 acres of land and occasionally is the scene for community events such as carnivals, weddings, car shows, and competitive trail rides.

Annville Institute requested that the Community Design Assistance Center (CDAC) develop a conceptual master plan for their property that includes an outdoor classroom, amphitheater, wedding venue, primitive camping area, archery range, and walking trail to connect the various parts of the campus. They also requested a proposal for improved signage within the campus and a master planting plan for the property. The site currently houses an equestrian center and several beehives so it was requested that particular consideration be given to plants that are beneficial to bees yet non-toxic to horses. The details of these design considerations are discussed in more detail in the following pages.

Throughout the design process, the Annville Institute Project Team, which consisted of the CDAC design team and representatives from both the Kentucky Division of Forestry and Annville Institute, worked collaboratively to develop a conceptual plan for the campus. This report documents the design process and describes the final concept that was developed.
The Annville Institute property contains roughly 120 acres of land. Its southern portion houses the heart of the campus and the Institute’s seven non-profit organizations. The western half of the property primarily consists of horse pastures and contains a peace garden at the top of a hill. A conference center is located at the edge of a pond in the center of Annville Institute. Finally, a primitive campground and remnants of an old ropes course are located in the northeastern corner of the property. Annville Institute is generally surrounded by rural housing and farmland.
The design process began with an initial site visit to Annville Institute in September 2012. The CDAC design Team walked the property gathering information about the landscape that would later influence the design concepts. By touring the site, the team was able to establish a first-hand understanding of the site conditions, including both opportunities and constraints, which were documented on a series of analysis maps.

The site visit also provided the opportunity to meet with employees and residents of Annville Institute as well as members of its organizations at a community meeting. This meeting allowed members of the Annville Institute community to voice their desires and concerns before the conceptual master plan began to take form. The meeting resulted in a number of objectives (see following page) developed collectively between members of the community and the CDAC team.

With the project objectives in mind and an understanding of the site’s opportunities and constraints, the CDAC team developed a set of preliminary conceptual design alternatives. These alternatives were presented at a second community meeting where they were reviewed and commented on by members of the community. The design alternatives were then revised and combined into a final conceptual master plan based on the comments made at the meeting. The final master plan was presented at a third and final community meeting.
Members of the community and the CDAC team worked together to create a list of objectives at the first Annville Institute community meeting.

- Provide a large variety of trees for identification in Future Farmers of America (FFA) courses
- Provide outdoor picnic and cookout areas
- Include an outdoor classroom
- Include a place for outdoor weddings
- Include an archery range
- Include an area for outdoor craft projects (growing shiitake mushrooms, building bat nesting boxes)
- Beautify and provide parking at the Reflection Center
- Provide erosion control on the eroding slopes in the equestrian area
- Propose a horse trail
- Propose ornamental landscaping around the horse arena
- Treat water runoff from horses before it reaches the creek
- Provide shade for horses utilizing non-toxic trees
- Include plants to help the bee population
- Include trees that will provide wind buffering from the west
- Include a perimeter walking trail
- Include a primitive campground
- Beautify Tank Hill
- Beautify the ponds
- Incorporate trees that will help attract song birds
- Include access roads and parking that are visually hidden in the landscape
- Improve signage within the Annville Institute campus
- Beautify the entrance into the Annville Institute
During the initial site visit to Annville Institute the CDAC team recorded existing site elements and analyzed site conditions. This information was compiled and became a basis for initial conceptual master plan designs. The site inventory was based largely on taking photographs of the property, recording the locations of existing trails and desirable views with GPS units, collecting soil samples, performing percolation tests, and identifying locations of erosion or undesirable conditions for building. GPS units were used to locate an access road to the primitive campground in a way that reduces its visual impact on the landscape. During the site visit a nuisance wind blowing from the west was identified and requested to be slowed or blocked in the design.

After conducting the initial on-site inventory and analysis, the CDAC team continued to analyze the property with GIS software. Elevation, slope, slope aspect (the direction a slope is facing), and flow accumulation (where water collects after it rains) were all reviewed and combined into a final synthesis map. The analysis and synthesis maps can be seen on the following pages. Significant elements that arose from the analysis are steep slopes located northwest and northeast of the ponds and a large area of south-facing slopes in the equestrian area. The south facing slopes will require plantings that can survive in harsh sunlight conditions.
This drawing is conceptual and was prepared to show approximate location and arrangement of site features. It is subject to change and not intended to replace the use of construction documents. The client should consult appropriate professionals before any construction or site work is undertaken. The Community Design Assistance Center is not responsible for the inappropriate use of this drawing.
This synthesis map is the result of combining the previous four GIS drawings with the on-site inventory and analysis results conducted during the initial site visit. This map shows the locations of existing vegetation, streams and ditches where water accumulates, nuisance winds, notable and undesirable views, erosion, steep slopes, and potential rest stations. After creating this drawing, the CDAC team used it in combination with the project objectives to design the layout of the preliminary design concepts. For example, areas with notable views and potential rest stations were incorporated in the design while areas of issue, such as steep topography, were either avoided or addressed in specific ways.
After analyzing the property, the CDAC team developed two preliminary design concepts for Annville Institute. Early in the design process the desire for an RV camping area was expressed. During the conceptual design development, it became clear that the space needed for an RV camping area and its visual impact on the landscape outweighed the benefits of providing such an amenity. For this reason, the design team decided to remove this feature. The following pages show the two preliminary design concepts, photo compilations used to convey the desired feel of the spaces, and maps depicting possible trail loop systems.

**Concept A**

Concept A follows a planting strategy influenced by the old hedgerows found in the area. Linear plantings of trees in the western portion of the property act to slow and block winter winds as they blow onto the site. Plantings in other areas of the plan consist of scattered clusters of shade. The outdoor classroom and outdoor chapel are located in such clusters.

Concept A’s wedding venue is located in a formal grid of flowering trees influenced by the aesthetic appeal of an orchard. The bride walks through rows of redbuds and serviceberries to a small white gazebo placed in the framework of the grid. Finally, Concept A provides minimal parking for the wedding venue and campground. This reduces the amount of impermeable surfaces and lowers the visual and environmental impact parking will have on the site.

**Concept B**

Concept B includes many of the same elements as Concept A, however they are located in different places and given different forms. The planting strategy for this plan focuses less on blocking wind and more on providing clusters of shade along a perimeter walking trail. The wedding venue in this design takes a significantly different form than that of Concept A. Instead of sitting in a grid of trees, Concept B’s wedding venue is designed along a strong, formal axis. A tree-lined road leads to a loop planted with ornamental shrubs and flowers where the bride can arrive by horse-drawn carriage. Wedding services are held in a pavilion structure located at the end of the road.

Concept B provides a significant amount of parking for the wedding venue and campground. This makes it convenient for visitors to access these areas, however results in greater visual and environmental impact on the landscape. Finally Concept B includes a horseback riding trail in the northwest corner of the property and a disc golf course along the eastern edge of the site.
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The wedding venue is located in a grove of trees planted in a grid. Formal axes will frame views and create aisles for seating and walking. Temporary seating will be placed within the framework of the grid. A gazebo-like structure is at the edge of the grove where the wedding services will take place.

The outdoor chapel is a place for a congregation to meet and worship outdoors. The form of this element in the landscape can either resemble an amphitheater or a more traditional chapel. The orientation of the chapel is toward a single speaker.

The rest stations are located throughout the Annville Institute site along a proposed perimeter trail. Each station is placed off to the side of the trail in the shade and has a beautiful view. Their forms range from benches and picnic tables to groupings of individual seats.

The archery range is located in the shade with 3 to 4 shooting corridors. The range can either be designed with a wooden structure separating the shooters or it can be marked on the ground.

The outdoor classroom is an environment that encourages group interaction. Unlike the outdoor chapel, this feature in the landscape is oriented in a circle where all participants are included. This is a space for discussion and outdoor crafts.
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Annville Institute Idea Photos

Concept B

These photos show conceptual ideas of a wedding venue, amphitheater/outdoor pavilion, outdoor classroom, recreational opportunities, and wedding themes that are applicable to the Annville Campus.

Wedding Themes - The passive qualities of the campus are ideal for many wedding themes and picture-taking opportunities.

Wedding Venue - This is an example of an outdoor venue that maintains the natural material palette of the site and provides ample seating and views to the campus.

Amphitheater/Pavilion - These are examples of an outdoor amphitheater and covered stage. This is an opportunity to build an outdoor pavilion to cater to social gatherings and provide ample seating for large events.

Recreational Opportunities - These examples include the opportunity for both a high and low ropes course, archery range, camping, a multi-purpose field for team sports such as soccer and softball.

Outdoor Classroom - This is an example of what could be one of many outdoor classroom areas that provide space for education and crafts.

Wedding Themes as Related to Site Conditions

Wedding Venue

Recreational Opportunities
Loop 1 travels around a horse pasture. The path sticks to the edge of the woods, creating a pleasant shaded walk with good views to the south.
Loop 2 travels around the barn. It runs between pastures and connects the equestrian area to the southern portion of Annville Institute.
Loop 3 travels through the center of Annville Institute. Its path changes experiences ranging from a walk along the pond's edge to a climb up a hill covered in wildflowers.
Loop 4 connects the amphitheater, outdoor classroom, wedding venue and campground to each other and to the rest of Annville Institute. This loop could possibly accommodate a horse-drawn carriage for weddings.

Loop 1 travels around the lower pasture and allows easy access from campus. Level 2 difficulty
Loop 2 travels around a horse pasture and sticks to the edge of the woods, creating a pleasant shaded walk with good views to the south. Level 4 difficulty
Loop 3 allows access to the forest for a more seclusive experience. Convenient for FFA education such as plant ID and timber cruising. Level 4 difficulty
Loop 4 travels around the barn. It runs between pastures and connects the equestrian area to the southern portion of the Annville Institute. Level 6 difficulty
Loop 5 travels along the pond's edge and through the lower wildflower field. The minimal elevation change makes this loop an easy walk. Level 1 difficulty
Loop 6 travels along the pond's edge and through the lower wildflower field. The minimal elevation change makes this loop an easy walk. Level 1 difficulty
Loop 7 connects the amphitheater, outdoor classroom, wedding venue and campground to each other and to the rest of the Annville Institute. This loop could possibly accommodate a horse-drawn carriage for weddings. Level 5 difficulty
Community Meeting

A second community meeting was held in October 2012 at the Annville Institute. The purpose of this meeting was to present the preliminary design concepts and to collaboratively move closer toward a single, final conceptual master plan. The site analysis information of the project site and the two preliminary design concepts were presented to a group of representatives from the organizations within the Annville Institute. Pros and cons of each design were discussed and the CDAC team worked with the community representatives to select which elements from each design were desirable so they could later be combined into a final plan.
After receiving feedback from the preliminary design concepts, the CDAC team created the final conceptual master plan. The positive elements of each preliminary design that were identified during the community meeting were refined and combined into a single plan.

A number of elements from Concept A were identified as desirable and further developed for the final design. The hedgerow planting strategy on the western portion of the site was kept with some changes to the area around the future arena. The location of the archery range was kept. The form and location of the outdoor classroom were kept and the form of the outdoor chapel was found desirable however it was moved further north to prevent blocking views from the wedding venue. Finally, the smaller parking lot of Concept A was preferred over the larger alternative.

Concept B was found to have other desirable elements. The trail system from this design was selected and developed further. The plantings of scattered clusters of shade in the central and eastern portions of the site and the large areas of wildflowers west and south of the ponds were found desirable. Finally the disc golf course was kept and moved south of the pond and the wedding venue proposal from this concept was selected over the grid of trees in Concept A.

A number of new elements were introduced into the conceptual master plan after the second community meeting. Shrub plantings were proposed in areas suffering from erosion in the horse pastures and wildflowers were expanded to a new area northeast of the ponds. New plantings of trees and shrubs were introduced to visually block the Reflection Center buildings from the wedding venue. New parking is located on the side of the road by the Reflection Center and the location for a possible new lodge in the southeastern corner of the site was identified. Finally, a design to beautify the area around the barn and future equestrian arena was developed.
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A series of digitally-created perspective drawings was produced to convey the feel of the proposed spaces. Perspectives include the entrance to Annville Institute, the barn and future arena, the outdoor classroom, outdoor chapel, a rest station, and the wedding venue. The map above shows the locations and orientations of the perspective drawings on the following pages.
Entry into the Annville Institute is currently marked by two old stone walls that frame the entrance road. Within the campus are a number of separate signs for each of the organizations. The current entry lacks unity and way-finding between the various organizations and would benefit from both aesthetic improvements and better locations of signage.

The proposed entrance utilizes the existing walls to create a hierarchical entry sign with Annville Institute as the primary heading. Sub-headings mark the other organizations within the campus in a formal, organized fashion. 
A proposed riding arena will be located adjacent to the existing barn. Planted with ornamental shrubs and lined with flowering trees, the plan for the barn and arena will beautify the landscape while providing a level surface for new and experienced riders.
Outdoor Classroom

One of the primary desired elements expressed during the first community meeting was an outdoor classroom. The proposed classroom lies in a cluster of trees that provides shade for a comfortable teaching environment.

The classroom itself consists of seating arranged in a circle to promote an atmosphere of equality and encourage discussion. This space can be used for organized group discussion, craft lessons, or simply as a social gathering space.
Another element that was desired during the first community meeting was an outdoor amphitheater. This eventually turned into an outdoor chapel with the formal layout of an amphitheater. Like the classroom, the chapel lies in a cluster of trees. The seating is oriented toward a single point where a speaker can stand.

This space is more formal than the outdoor classroom and it can be used for lectures or outdoor services.
Rest Station

Rest stations are located along the trails throughout Annville Institute. They are located in places with a beautiful view or in specific areas where a hiker may need to catch their breath.

This specific rest station is located at the top of a steep slope. Benches and a picnic table are located underneath a giant white oak with a view of Annville Institute and the mountains beyond.
The wedding venue is located on a hill behind the Reflection Center. Services are held in a pavilion structure that lies at the terminus of a formal road lined with flowering trees.

This space was designed to create a moment of anticipation. Guests watch the bride arrive by horse-drawn carriage through the landscape and down the tree-lined road toward the altar.
Wedding Venue

When not used for weddings, the pavilion structure provides a shaded place to enjoy the scenic quality of the surrounding landscape.

Existing view from potential wedding venue

Proposed wedding venue structure provides shaded area for visitors when not in use
The planting design for the barn and arena was developed as an open space that is easy to guide a horse through. Evergreen shrubs are located along edges as perimeter plantings while two rows of flowering trees strengthen the axis of the arena. This leaves the walking space between the barn and arena open for riders to easily navigate through.
The planting strategy is a significant part of the Annville Institute conceptual master plan. All plants selected for the site were chosen to survive in the appropriate USDA hardiness zone and soil type. Plants were also selected for diversity. Diversity is important because it creates a landscape filled with different textures and colors but it also acts as a defense against pests and diseases that target specific species of trees.

Several other important factors influenced the plants selected for the site and where they were placed. The first factors that influenced planting were the slope aspect and moisture of the soil. South facing slopes were planted with trees that can take direct sunlight while areas that flood or remain wet were planted with trees that need or can tolerate a lot of moisture. Wind was another factor that influenced plantings. Large evergreen trees were selected to act as windbreaks along the western edge of the site.

Another significant factor that influenced planting was the need for trees that are safe for horses. Some trees are toxic to horses, leading to sickness and in some cases may be fatal. Other trees may not be toxic but have large nuts or hard fruit that can damage a horse’s teeth or cause leg or hoof injuries. Trees that were identified as horse-friendly by the ASPCA were selected for the equestrian area of the property.

In addition, there are two beehives on the property that could benefit from specific types of plants. Flowering shrubs and trees provide bees the opportunity to pollinate while larger trees provide good nesting locations. Plants ideal for bees were chosen for the central portion of the property near the ponds.

The final major factor that influenced the planting strategy was Future Farmers of America (FFA). FFA hosts tree identification competitions that require a landscape filled with a diverse population of trees. The planting plan reflects this need and includes a number of native and specimen plants.

These factors led to the creation of a preliminary planting strategy that was developed before the final planting plan. This strategy divides the Annville Institute into three separate planting zones (see following page). Zone 1 consists of plants safe for horses. Zone 2 consists of plants safe for horses and ideal for bees. Zone 3 includes the largest diversity of trees (that may not be ideal for horses) which are suited for tree identification.

The planting plan (page 33) has been broken up into 4 phases for implementation (page 34). Phase 1 should be implemented first. This is made up of the trees that will block the wind as it enters the site, making the rest of the property more comfortable during the winter. The remaining 3 phases should be implemented in an order that follows construction on the site. Trees shouldn't be planted until after trail and building construction is finished in any given area.
Planting Zones

Zone 1
- Balsam Fir
- Abies balsamea
- Speckled Alder
- Alnus incana
- River Birch
- Betula nigra
- Hackberry
- Celtis occidentalis
- Eastern Redbud
- Cercis Canadensis
- Fringetree
- Chionanthus virginicus
- Flowering Dogwood
- Cornus florida
- Hawthorn
- Crataegus spp.
- Beech
- Fagus sp.
- Honey Locust
- Gleditsia triacanthos
- Tulip Poplar
- Liriodendron tulipfera
- Red Mulberry
- Morus rubra
- Black Gum
- Nyssa sylvatica
- Norway Spruce
- Picea abies
- White Spruce
- Picea glauca
- Black Spruce
- Picea mariana
- Colorado Spruce
- Picea pungens
- Sycamore
- Platanus occidentalis
- Poplar
- Populus spp.
- Staghorn Sumac
- Rhus typhina
- Willows
- Salix spp.
- Eastern White Cedar
- Thuja occidentalis
- Elms
- Ulmus spp.

Zone 2
- Aster
- Aster
- Butterfly Bush
- Buddleja davidii
- Coneflower
- Echinacea sp.
- Coreopsis
- Coreopsis spp.
- Red Hawthorne
- Crataegus mollis
- Purple Coneflower
- Echinacea sp.
- Sunflower
- Helianthus annuus
- Crapemyrtle
- Lagerstroemia spp.
- Bee Balm
- Monarda didyma
- Summer Phlox
- Phlox paniculata
- Potentilla
- Potentilla spp.
- Staghorn Sumac
- Rhus typhina
- Roses
- Rosa spp.
- Willows
- Salix spp.

Zone 3
- Red Maple
- Acer rubrum
- Sugar Maple
- Acer saccharum
- Buckeye
- Aesculus spp.
- Serviceberry
- Amelanchier arborea
- Pawpaw
- Asimina triloba
- American Hornbeam
- Carpinus caroliniana
- Bitternut Hickory
- Carya cordiformis
- Pignut Hickory
- Carya glabra
- Pecan
- Carya illinoensis
- Shagbark Hickory
- Carya laciniosa
- Mockernut Hickory
- Carya tomentosa
- American Chestnut
- Castanea dentata
- Sweet Chestnut
- Castanea sativa
- Buttonbush
- Cephalanthus occidentalis
- Kentucky Coffee Bean
- Gymnocladus dioicus
- Persimmon
- Diospyros virginiana
- Kentucky Coffeetree
- Gymnocladus dioicus
- Witch Hazel
- Hamamelis virginiana
- American Holly
- Ilex opaca
- White Walnut
- Juglans cinerea
- Black Walnut
- Juglans nigra
- Eastern Redcedar
- Juniperus virginiana
- Sweetgum
- Liquidambar styraciflua
- Magnolia
- Magnolia spp.
- Eastern Hophornbeam
- Ostrya virginiana
- Sourwood
- Oxydendron arboretum
- Eastern White Pine
- Pinus strobus
- Loblolly Pine
- Pinus taeda
- Virginia Pine
- Pinus virginiana
- Eastern Cottonwood
- Populus deltoids
- White Oak
- Quercus alba
- Southern Red Oak
- Quercus falcata
- Shingle Oak
- Quercus imbricaria
- Bur Oak
- Quercus macrocarpa
- Chestnut Oak
- Quercus muehlenbergii
- Cherrybark Oak
- Quercus pagodaefolia
- Pin Oak
- Quercus palustris
- Willow Oak
- Quercus phellos
- Chestnut Oak
- Quercus prinus
- Northern Red Oak
- Quercus rubra
- Post Oak
- Quercus stellata
- Black Oak
- Quercus velutina
- Black Locust
- Robinia pseudoacacia
- Sassafras
- Sassafras albidum
- Baldcypress
- Taxodium distichum
- American Basswood
- Tilia Americana

Planting Strategy

1. Planting Safe for Horses
2. Planting Safe for Horses and Ideal for Bees
3. Planting not Safe for Horses
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The need for improved signage at Annville Institute became apparent after the initial site visit. Currently the entrance into the property is marked with separate signs for each organization without any sense of visual unity. Buildings are marked with short metal signs facing parallel to the road that are difficult to read from a vehicle. There is currently no directional signage to help visitors find their way around the campus.

The design team proposed improvements to signage for the Institute. Design was influenced by three sets of criteria. First, the signs must be legible from the road. This means that lettering must be large enough to read from a distance and the signs should be angled perpendicular to the street. This angle will allow drivers to read the signs through their front windshields rather than turning to the side. Second, the signs should share a sense of unity throughout the campus. They should all match as if part of a set. Third, the signs should be designed to reduce maintenance. They should be on a single post and tall enough for a riding lawn mower to pass underneath.

The signage proposal was presented during the final community meeting at Annville Institute. The plan included improvements to the entrance sign, building signs, and a proposal for directional signage. The entrance sign will be placed on the surface of the existing stone walls that frame the entry drive. Its hierarchical form will display Annville Institute as the primary heading with the names of the individual organizations as secondary headings. Building signage was improved to increase legibility from the street. It is recommended that directional signs be seven feet tall and oriented perpendicular to the road and that this signage visually match the building signs. The directional signage will display the names of destinations within Annville Institute with arrows pointing in their directions. Directional signs will be located where roads and paths split or intersect. Signage design concepts and a map of sign locations can be found on the following page.
**Existing Signage**

**Gateway Signage**
- Hierarchical entry sign displaying Annville Institute as primary heading and all other organizations as sub-headings.

**Directional Signage**
- Simple signage displaying directions of destination points.

**Building Signage**
- Signage displaying names of each building or destination point. Located along road edge and sidewalks for ease of wayfinding.

**Proposed Signage**

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Annville Institute captures the most beautiful qualities of eastern Kentucky. Its rolling hills, old hedgerows and giant oaks create a pastoral beauty that lets one’s mind become lost in the landscape. It is a place of healing for both one’s self and for communities. There is a great opportunity to share this landscape with visitors, whether it is through camping under the stars or enjoying a church retreat. The landscape of Annville Institute can be improved to support new functions such as outdoor services, lectures or classes. However caution must be taken to avoid lessening the beauty of the place.

The Annville Institute Conceptual Master Plan complements and enhances the scenic quality of the landscape. It frames views and preserves the qualities that already make the site beautiful. It addresses issues and suggests new uses for the landscape. There is a potential to bring new people and new life onto the property as it becomes a desirable destination. The master plan may also help Annville Institute in applying for grants and fundraising to make the design a reality.
Appendix A: Soil Test Results

Organic Matter

- Very High OM
- High OM
- Medium OM

This image shows the levels of organic matter and pH of each specific sample location.
<table>
<thead>
<tr>
<th>Sample</th>
<th>Sub Sample</th>
<th>Soil Description</th>
<th>Compaction?</th>
<th>Perc Rate</th>
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<tbody>
<tr>
<td>1</td>
<td>a</td>
<td>Loamy Clay</td>
<td>No</td>
<td>1.25&quot; in 10 min.</td>
</tr>
<tr>
<td></td>
<td>b</td>
<td>Clay</td>
<td>No</td>
<td>1.5&quot; in 10 min.</td>
</tr>
<tr>
<td></td>
<td>c</td>
<td>More Loam than a and b</td>
<td>No</td>
<td>1.5&quot; in 10 min.</td>
</tr>
<tr>
<td></td>
<td>d</td>
<td>Mostly Clay</td>
<td>No</td>
<td>1.25&quot; in 10 min.</td>
</tr>
<tr>
<td></td>
<td>e</td>
<td>Mostly Clay</td>
<td>No</td>
<td>1.25&quot; in 10 min.</td>
</tr>
<tr>
<td>2</td>
<td>a</td>
<td>Clay</td>
<td>No</td>
<td>1.5&quot; in 10 min.</td>
</tr>
<tr>
<td></td>
<td>b</td>
<td>Clay</td>
<td>No</td>
<td>1.25&quot; in 10 min.</td>
</tr>
<tr>
<td></td>
<td>c</td>
<td>Clay, Medium</td>
<td>No</td>
<td>1.25&quot; in 10 min.</td>
</tr>
<tr>
<td></td>
<td>d</td>
<td>Clay w/ some loam</td>
<td>No</td>
<td>1.25&quot; in 10 min.</td>
</tr>
<tr>
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<td>e</td>
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<td>No</td>
<td>1.25&quot; in 10 min.</td>
</tr>
<tr>
<td>3</td>
<td>a</td>
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<td>No</td>
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</tr>
<tr>
<td></td>
<td>b</td>
<td>Clay</td>
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<td>3&quot; in 10 min.</td>
</tr>
<tr>
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<td>c</td>
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</tr>
<tr>
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<td>d</td>
<td>Clay</td>
<td>No</td>
<td>1.25&quot; in 10 min.</td>
</tr>
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</tr>
<tr>
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<td>c</td>
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<tr>
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<td>c</td>
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</table>
Notes:
- Soil cation exchange capacity (CEC) is the ratio of the amount of acid-generating cations (as measured by the Mehlich 1 buffer) that occupy soil cation exchange sites to the total CEC sites.
- Higher CEC values indicate a higher ability to resist changes in pH.

Buffer Index Scale:
A high buffer index means that the soil has a high pH, and can be lessened by adding iron sulfate, which is a slow process. Check about wood ashes and lime in high alkaline areas.

Soil PH:
Natural Soils: 1-12 meq/100g

Soil Test Results Continued

| sample_id | ph  | bph  | p  | k  | ca  | mg  | zn  | cu  | fe  | b  | om  | ss  | cec | pctacidity | pctbasesat | pctcasat | pctmgsat | pctksat | p_rating | k_rating | ca_rating | mg_rating |
|-----------|-----|------|----|----|-----|-----|-----|-----|-----|----|-----|-----|-----|------------|------------|----------|----------|----------|----------|----------|----------|-----------|-----------|
| 01        | 5.75 | 6.26 | 37 | 17 | 742 | 44  | 0.5 | 6.1 | 0.4 | 14 | 0.2 | 2.7 | 4.9 | 16.8       | 832        | 75        | 7.3       | 0.9       | H        | L        | H-        | M-        |
| 02        | 6.29 | 6.36 | 18 | 18 | 954 | 40  | 0.4 | 7.4 | 0.3 | 8  | 0.3 | 4  | 5.4 | 4.4        | 95.6       | 88.6      | 6.1       | 0.8       | M        | L        | H         | M-        |
| 03        | 6.11 | 6.33 | 16 | 13 | 701 | 26  | 0.4 | 3.7 | 0.3 | 17 | 0.2 | 3.7 | 4.6 | 9.0        | 91         | 85.7      | 4.6       | 0.7       | M+       | L        | H-        | L+        |
| 04        | 6.27 | 6.34 | 16 | 8  | 23 | 844 | 35  | 0.4 | 5.1 | 0.2 | 9.4 | 0.3 | 3.4 | 4.9         | 73         | 92.7      | 86.2      | 5.8       | 0.7       | M+       | L        | H         | L+        |
| 05        | 5.7  | 6.19 | 5  | 16 | 623 | 51  | 0.5 | 3.5 | 0.4 | 21 | 0.2 | 3.5 | 4.8 | 25.9       | 74.1       | 64.6      | 8.7       | 0.9       | L+       | L        | M+        | M         |
| 06        | 6.5  | 6.35 | 7  | 13 | 833 | 23  | 0.3 | 4.3 | 0.3 | 10.9 | 0.2 | 3.4 | 4.7 | 6.3        | 93.7       | 89        | 4         | 0.7       | M-       | L        | H-        | L         |
| 07        | 7.22 | N/ A | 2 | 26 | 5038 | 95 | 0.3 | 5.2 | 0.1 | 0.7 | 0.3 | 3.2 | 26 | N/A        | 100        | 96.7      | 3         | 0.3       | L        | L        | VH        | H         |
| 08        | 6.58 | 6.40 | 11 | 17 | 1312 | 36 | 0.7 | 6.4 | 0.3 | 15.6 | 0.3 | 3.9 | 6.9 | 9.9        | 99.1       | 94.3      | 4.3       | 0.6       | M        | L        | VH        | L+        |
| 09        | 6.73 | 6.29 | 0 | 13 | 940 | 41 | 0.5 | 6.5 | 0.3 | 19.9 | 0.4 | 4.9 | 5.7 | 11.4       | 88.6       | 81.7      | 5.9       | 4         | 1        | M        | L        | H         | M-        |
| 10        | 6.09 | 6.27 | 7 | 20 | 21 | 754 | 29 | 0.4 | 7.4 | 0.3 | 6.6 | 0.3 | 4.1 | 4.8         | 16.0       | 84        | 78        | 4.9       | 1.1       | M-       | L        | H-        | L+        |
Appendix B: Designing for Horses

1) ASPCA Toxic and Non-Toxic Plant List - Horse
http://www.aspca.org/Pet-care/poison-control/plant-list-horses

2) Horses For Clean Water
http://www.horsesforcleanwater.com
## Appendix C: Plant List for Proposed Planting Plan

<table>
<thead>
<tr>
<th>NAME</th>
<th>Quantity</th>
<th>NAME</th>
<th>Quantity</th>
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<tbody>
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<td>American Basswood</td>
<td>2</td>
<td>Large Fothergilla</td>
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<tr>
<td>American Beech</td>
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<td>Loblolly Pine</td>
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</tr>
<tr>
<td>American Elm 'Valley Forge'</td>
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<td>Mockernut Hickory</td>
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<td>American Holly</td>
<td>9</td>
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<td>American Hornbeam</td>
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<td>Balsam Fir</td>
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<td>Bitternut Hickory</td>
<td>1</td>
<td>Pin Oak</td>
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<tr>
<td>Black Gum</td>
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<td>Post Oak</td>
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<td>Red Maple</td>
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<td>Bottlebrush Buckeye</td>
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<td>Riverbirch</td>
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<td>Shellbark Hickory</td>
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Appendix D: Planting for Bees

NRCS Delaware Native Plants for Native Bees