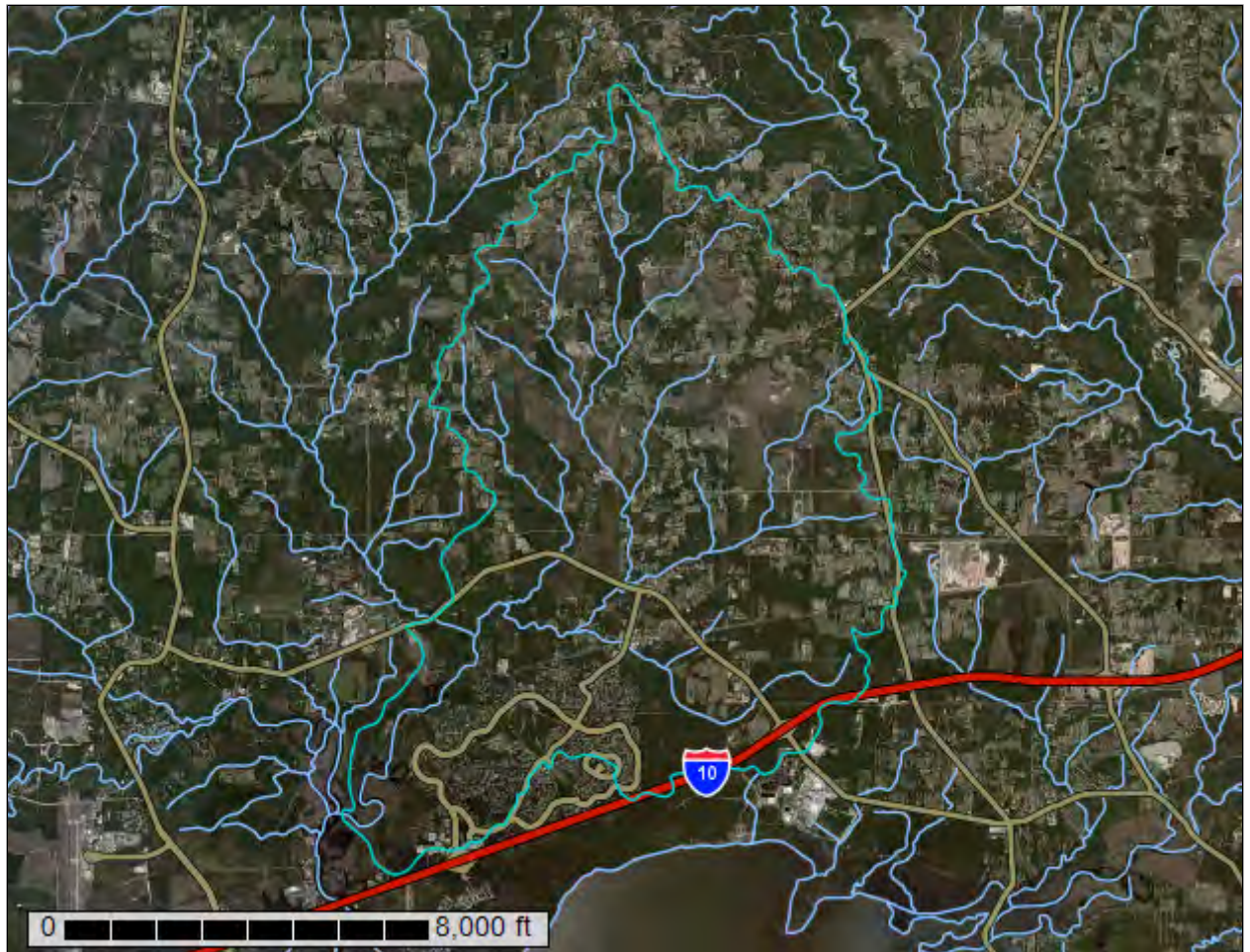




A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

# Custom Soil Resource Report for Hancock County, Mississippi, and Harrison County, Mississippi

## Soil Survey for Rotten Bayou Watershed



## Preface

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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://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/>) 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://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2\\_053951](http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951)).

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 Web Soil Survey, the site for official soil survey information.

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## Appendix A: Soil Survey

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## How Soil Surveys Are Made

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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

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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.

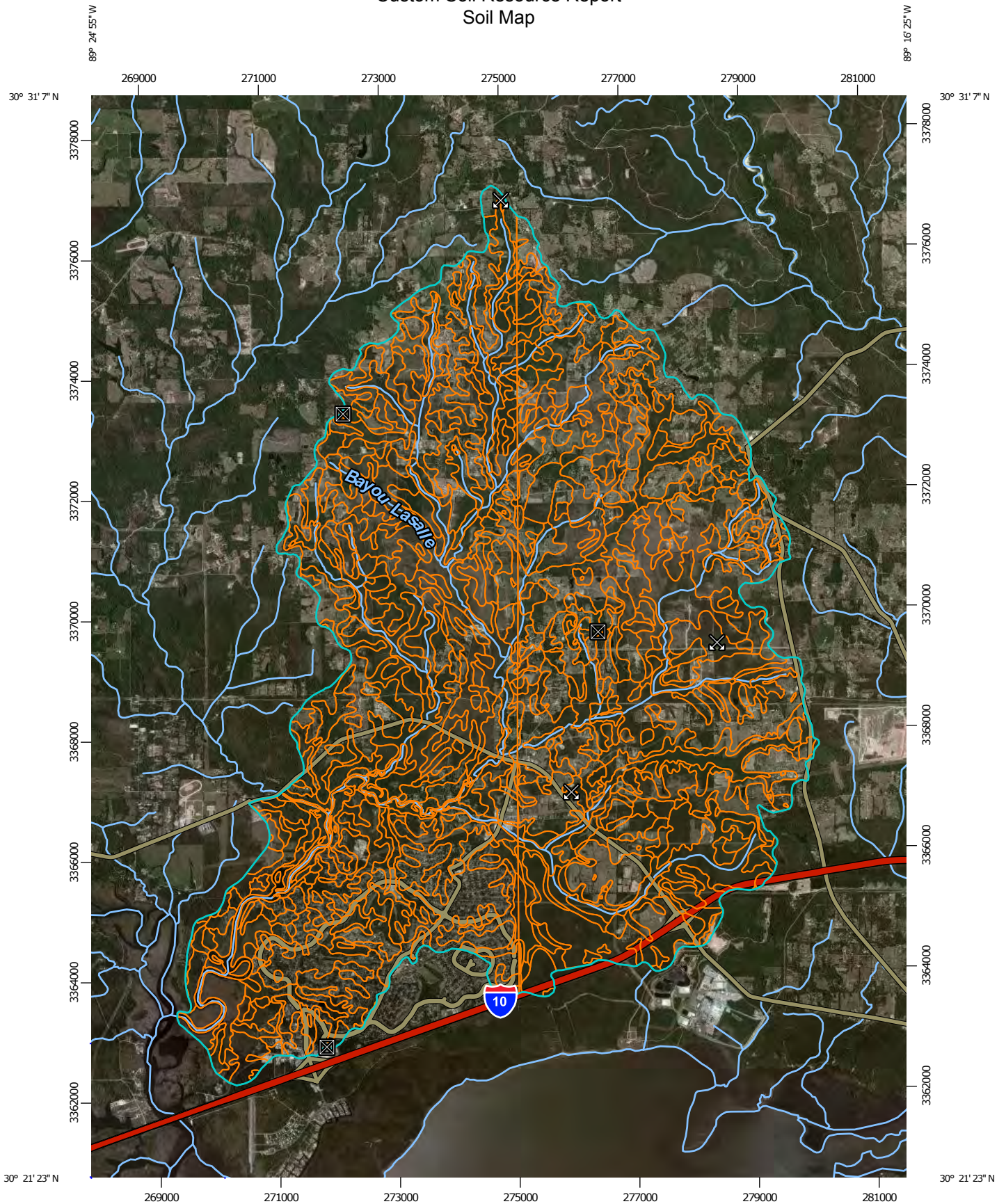
## Soil Map

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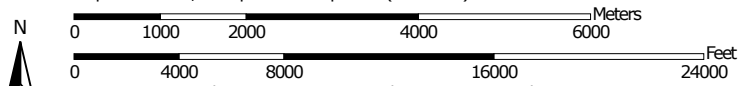
The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.



Custom Soil Resource Report  
Soil Map



Map Scale: 1:87,800 if printed on A portrait (8.5" x 11") sheet.




Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 16N WGS84





**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.

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: Hancock County, Mississippi  
 Survey Area Data: Version 10, Dec 23, 2013

Soil Survey Area: Harrison County, Mississippi  
 Survey Area Data: Version 10, Dec 23, 2013

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

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

Date(s) aerial images were photographed: Jan 22, 2010—Jun 2, 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

Hancock County, Mississippi (MS045)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
At	Atmore silt loam	1,441.1	6.4%
Be	Beauregard silt loam	56.7	0.3%
Bg	Bigbee-Bibb complex, frequently flooded	455.0	2.0%
EsA	Escambia loam, 0 to 2 percent slopes	281.5	1.3%
EsB	Escambia loam, 2 to 5 percent slopes	253.5	1.1%
EuB	Eustis loamy fine sand, 2 to 5 percent slopes	110.7	0.5%
HA	Handsboro association	320.5	1.4%
HIA	Harleston fine sandy loam, 0 to 2 percent slopes	479.7	2.1%
HIB	Harleston fine sandy loam, 2 to 5 percent slopes	225.8	1.0%
MaB	Malbis fine sandy loam, 2 to 5 percent slopes	216.6	1.0%
MaC	Malbis fine sandy loam, 5 to 8 percent slopes	252.0	1.1%
McB	McLaurin fine sandy loam, 2 to 5 percent slopes	36.5	0.2%
McC	McLaurin fine sandy loam, 5 to 8 percent slopes	159.5	0.7%
PoA	Poarch fine sandy loam, 0 to 2 percent slopes	103.4	0.5%
PoB	Poarch fine sandy loam, 2 to 5 percent slopes	3,077.0	13.7%
PoC	Poarch fine sandy loam, 5 to 8 percent slopes	1,312.0	5.8%
PoD	Poarch fine sandy loam, 8 to 12 percent slopes	401.0	1.8%
RuB	Ruston fine sandy loam, 2 to 5 percent slopes	127.3	0.6%
RuC	Ruston fine sandy loam, 5 to 8 percent slopes	116.0	0.5%
SaA	Saucier fine sandy loam, 0 to 2 percent slopes	24.0	0.1%
SaB	Saucier fine sandy loam, 2 to 5 percent slopes	666.4	3.0%
SaC	Saucier fine sandy loam, 5 to 8 percent slopes	453.2	2.0%
SaD	Saucier fine sandy loam, 8 to 12 percent slopes	203.7	0.9%

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Hancock County, Mississippi (MS045)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
ScB	Saucier-Susquehanna complex, 2 to 5 percent slopes	13.9	0.1%
ScD	Saucier-Susquehanna complex, 5 to 12 percent slopes	12.8	0.1%
SmD	Smithdale fine sandy loam, 8 to 12 percent slopes	47.3	0.2%
Su	Smithton fine sandy loam, frequently flooded	489.4	2.2%
W	Water	253.0	1.1%
<b>Subtotals for Soil Survey Area</b>		<b>11,589.4</b>	<b>51.6%</b>
<b>Totals for Area of Interest</b>		<b>22,446.7</b>	<b>100.0%</b>

Harrison County, Mississippi (MS047)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
At	Atmore silt loam	651.5	2.9%
Es	Escambia silt loam	91.4	0.4%
EtB	Eustis loamy sand, 0 to 5 percent slopes	20.2	0.1%
EuE	Eustis and Poarch soils, 8 to 17 percent slopes	22.3	0.1%
HIA	Harleston fine sandy loam, 0 to 2 percent slopes	458.9	2.0%
HIB	Harleston fine sandy loam, 2 to 5 percent slopes	1,710.3	7.6%
Lr	Lakeland fine sand	60.8	0.3%
Nh	Nahunta silt loam	42.2	0.2%
Pm	Plummer loamy sand	106.5	0.5%
PoA	Poarch fine sandy loam, 0 to 2 percent slopes	127.9	0.6%
PoB	Poarch fine sandy loam, 2 to 5 percent slopes	3,712.7	16.5%
PoC	Poarch fine sandy loam, 5 to 12 percent slopes	622.4	2.8%
Ps	Ponzer and Smithton soils	629.2	2.8%
RuB	Ruston fine sandy loam, 2 to 5 percent slopes	954.3	4.3%
RuC	Ruston fine sandy loam, 5 to 8 percent slopes	545.8	2.4%
RuD	Ruston fine sandy loam, 8 to 12 percent slopes (smithdale)	150.5	0.7%
SfB	Saucier fine sandy loam, 2 to 5 percent slopes	488.3	2.2%
SfC	Saucier fine sandy loam, 5 to 8 percent slopes	113.3	0.5%
ShC	Saucier, Smithton, and Susquehanna soils, rolling	22.8	0.1%

## Custom Soil Resource Report

Harrison County, Mississippi (MS047)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
SnB	Saucier-Susquehanna complex, 2 to 5 percent slopes	44.5	0.2%
SsE	Smithdale fine sandy loam, 12 to 17 percent slopes	1.3	0.0%
St	Smithton fine sandy loam	250.1	1.1%
W	Water	30.1	0.1%
<b>Subtotals for Soil Survey Area</b>		<b>10,857.2</b>	<b>48.4%</b>
<b>Totals for Area of Interest</b>		<b>22,446.7</b>	<b>100.0%</b>

## 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.

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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.

## Hancock County, Mississippi

### At—Atmore silt loam

#### Map Unit Setting

*National map unit symbol:* c4w1  
*Elevation:* 20 to 400 feet  
*Mean annual precipitation:* 40 to 75 inches  
*Mean annual air temperature:* 61 to 72 degrees F  
*Frost-free period:* 200 to 335 days  
*Farmland classification:* Not prime farmland

#### Map Unit Composition

*Atmore and similar soils:* 85 percent  
*Minor components:* 12 percent  
*Estimates are based on observations, descriptions, and transects of the mapunit.*

#### Description of Atmore

##### Setting

*Landform:* Depressions  
*Landform position (three-dimensional):* Dip  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear  
*Parent material:* Loamy marine deposits

##### Typical profile

*H1 - 0 to 16 inches:* silt loam  
*H2 - 16 to 39 inches:* loam  
*H3 - 39 to 60 inches:* clay loam

##### Properties and qualities

*Slope:* 0 to 2 percent  
*Depth to restrictive feature:* More than 80 inches  
*Natural drainage class:* Poorly drained  
*Runoff class:* Very high  
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high (0.20 to 0.60 in/hr)  
*Depth to water table:* About 0 to 12 inches  
*Frequency of flooding:* None  
*Frequency of ponding:* None  
*Available water storage in profile:* High (about 12.0 inches)

##### Interpretive groups

*Land capability classification (irrigated):* None specified  
*Land capability classification (nonirrigated):* 4w  
*Hydrologic Soil Group:* B/D

#### Minor Components

##### Escambia

*Percent of map unit:* 3 percent  
*Landform:* Coastal plains  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Crest  
*Down-slope shape:* Linear

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*Across-slope shape:* Linear

**Harleston**

*Percent of map unit:* 3 percent

*Landform:* Stream terraces

*Landform position (two-dimensional):* Shoulder

*Landform position (three-dimensional):* Tread

*Down-slope shape:* Linear

*Across-slope shape:* Linear

**Plummer**

*Percent of map unit:* 3 percent

*Landform:* Flats

*Landform position (three-dimensional):* Dip

*Down-slope shape:* Convex

*Across-slope shape:* Convex

**Smithton**

*Percent of map unit:* 3 percent

*Landform:* Terraces

*Landform position (three-dimensional):* Tread, dip

*Down-slope shape:* Linear

*Across-slope shape:* Linear

**Be—Beauregard silt loam**

**Map Unit Setting**

*National map unit symbol:* c4w3

*Elevation:* 50 to 450 feet

*Mean annual precipitation:* 48 to 75 inches

*Mean annual air temperature:* 63 to 70 degrees F

*Frost-free period:* 200 to 335 days

*Farmland classification:* Not prime farmland

**Map Unit Composition**

*Beauregard and similar soils:* 85 percent

*Minor components:* 12 percent

*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of Beauregard**

**Setting**

*Landform:* Coastal plains

*Landform position (two-dimensional):* Shoulder

*Landform position (three-dimensional):* Crest

*Down-slope shape:* Linear

*Across-slope shape:* Linear

*Parent material:* Loamy alluvium

**Typical profile**

*H1 - 0 to 9 inches:* silt loam



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H2 - 9 to 19 inches: silt loam  
H3 - 19 to 60 inches: silt loam  
H4 - 60 to 64 inches: silty clay loam

**Properties and qualities**

*Slope:* 0 to 1 percent  
*Depth to restrictive feature:* More than 80 inches  
*Natural drainage class:* Moderately well drained  
*Runoff class:* Medium  
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately low to moderately high (0.06 to 0.20 in/hr)  
*Depth to water table:* About 18 to 36 inches  
*Frequency of flooding:* None  
*Frequency of ponding:* None  
*Available water storage in profile:* Very high (about 12.6 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified  
*Land capability classification (nonirrigated):* 2w  
*Hydrologic Soil Group:* C

**Minor Components**

**Atmore**

*Percent of map unit:* 3 percent  
*Landform:* Depressions  
*Landform position (three-dimensional):* Dip  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear

**Escambia**

*Percent of map unit:* 3 percent  
*Landform:* Coastal plains  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Crest  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear

**Harleston**

*Percent of map unit:* 3 percent  
*Landform:* Stream terraces  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Tread  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear

**Smithton**

*Percent of map unit:* 3 percent  
*Landform:* Terraces  
*Landform position (three-dimensional):* Tread, dip  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear

## **Bg—Bigbee-Bibb complex, frequently flooded**

### **Map Unit Setting**

*National map unit symbol:* c4w4  
*Elevation:* 50 to 450 feet  
*Mean annual precipitation:* 60 to 75 inches  
*Mean annual air temperature:* 64 to 70 degrees F  
*Frost-free period:* 270 to 335 days  
*Farmland classification:* Not prime farmland

### **Map Unit Composition**

*Bigbee and similar soils:* 45 percent  
*Bibb and similar soils:* 40 percent  
*Minor components:* 9 percent  
*Estimates are based on observations, descriptions, and transects of the mapunit.*

### **Description of Bigbee**

#### **Setting**

*Landform:* Terraces  
*Landform position (three-dimensional):* Tread  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear  
*Parent material:* Sandy alluvium deposits

#### **Typical profile**

*H1 - 0 to 38 inches:* loamy sand  
*H2 - 38 to 60 inches:* sand

#### **Properties and qualities**

*Slope:* 0 to 2 percent  
*Depth to restrictive feature:* More than 80 inches  
*Natural drainage class:* Excessively drained  
*Runoff class:* Very low  
*Capacity of the most limiting layer to transmit water (Ksat):* High to very high (6.00 to 20.00 in/hr)  
*Depth to water table:* About 42 to 72 inches  
*Frequency of flooding:* Frequent  
*Frequency of ponding:* None  
*Available water storage in profile:* Low (about 4.6 inches)

#### **Interpretive groups**

*Land capability classification (irrigated):* None specified  
*Land capability classification (nonirrigated):* 5w  
*Hydrologic Soil Group:* A

### **Description of Bibb**

#### **Setting**

*Landform:* Flood plains

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*Landform position (three-dimensional):* Tread  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear  
*Parent material:* Sandy and loamy alluvium deposits

**Typical profile**

*H1 - 0 to 60 inches:* silt loam

**Properties and qualities**

*Slope:* 0 to 2 percent  
*Depth to restrictive feature:* More than 80 inches  
*Natural drainage class:* Poorly drained  
*Runoff class:* Very high  
*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 6 to 12 inches  
*Frequency of flooding:* Frequent  
*Frequency of ponding:* None  
*Available water storage in profile:* High (about 10.8 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified  
*Land capability classification (nonirrigated):* 5w  
*Hydrologic Soil Group:* D

**Minor Components**

**Harleston**

*Percent of map unit:* 9 percent  
*Landform:* Stream terraces  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Tread  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear

**EsA—Escambia loam, 0 to 2 percent slopes**

**Map Unit Setting**

*National map unit symbol:* c4w6  
*Elevation:* 20 to 200 feet  
*Mean annual precipitation:* 42 to 75 inches  
*Mean annual air temperature:* 61 to 70 degrees F  
*Frost-free period:* 220 to 350 days  
*Farmland classification:* All areas are prime farmland

**Map Unit Composition**

*Escambia and similar soils:* 85 percent  
*Minor components:* 14 percent  
*Estimates are based on observations, descriptions, and transects of the mapunit.*

## Description of Escambia

### Setting

*Landform:* Coastal plains  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Crest  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear  
*Parent material:* Sandy and loamy marine deposits

### Typical profile

*H1 - 0 to 14 inches:* loam  
*H2 - 14 to 33 inches:* fine sandy loam  
*H3 - 33 to 60 inches:* loam

### Properties and qualities

*Slope:* 0 to 2 percent  
*Depth to restrictive feature:* More than 80 inches  
*Natural drainage class:* Somewhat poorly drained  
*Runoff class:* Low  
*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 18 to 30 inches  
*Frequency of flooding:* None  
*Frequency of ponding:* None  
*Available water storage in profile:* Moderate (about 9.0 inches)

### Interpretive groups

*Land capability classification (irrigated):* None specified  
*Land capability classification (nonirrigated):* 2w  
*Hydrologic Soil Group:* C

## Minor Components

### Atmore

*Percent of map unit:* 3 percent  
*Landform:* Depressions  
*Landform position (three-dimensional):* Dip  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear

### Harleston

*Percent of map unit:* 3 percent  
*Landform:* Stream terraces  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Tread  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear

### Guyton

*Percent of map unit:* 3 percent  
*Landform:* Terraces  
*Landform position (three-dimensional):* Tread  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear

**Saucier**

*Percent of map unit:* 3 percent  
*Landform:* Coastal plains  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Crest  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear

**Poarch**

*Percent of map unit:* 2 percent  
*Landform:* Ridges  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Crest  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear

**EsB—Escambia loam, 2 to 5 percent slopes**

**Map Unit Setting**

*National map unit symbol:* c4w7  
*Elevation:* 20 to 200 feet  
*Mean annual precipitation:* 42 to 75 inches  
*Mean annual air temperature:* 61 to 70 degrees F  
*Frost-free period:* 220 to 350 days  
*Farmland classification:* All areas are prime farmland

**Map Unit Composition**

*Escambia and similar soils:* 85 percent  
*Minor components:* 13 percent  
*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of Escambia**

**Setting**

*Landform:* Coastal plains  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Crest  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear  
*Parent material:* Sandy and loamy marine deposits

**Typical profile**

*H1 - 0 to 14 inches:* loam  
*H2 - 14 to 33 inches:* fine sandy loam  
*H3 - 33 to 60 inches:* loam

**Properties and qualities**

*Slope:* 2 to 5 percent  
*Depth to restrictive feature:* More than 80 inches  
*Natural drainage class:* Somewhat poorly drained

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*Runoff class:* Low

*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 18 to 30 inches

*Frequency of flooding:* None

*Frequency of ponding:* None

*Available water storage in profile:* Moderate (about 9.0 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified

*Land capability classification (nonirrigated):* 2e

*Hydrologic Soil Group:* C

**Minor Components**

**Atmore**

*Percent of map unit:* 3 percent

*Landform:* Depressions

*Landform position (three-dimensional):* Dip

*Down-slope shape:* Linear

*Across-slope shape:* Linear

**Harleston**

*Percent of map unit:* 3 percent

*Landform:* Stream terraces

*Landform position (two-dimensional):* Shoulder

*Landform position (three-dimensional):* Tread

*Down-slope shape:* Linear

*Across-slope shape:* Linear

**Guyton**

*Percent of map unit:* 3 percent

*Landform:* Terraces

*Landform position (three-dimensional):* Tread

*Down-slope shape:* Linear

*Across-slope shape:* Linear

**Poarch**

*Percent of map unit:* 2 percent

*Landform:* Ridges

*Landform position (two-dimensional):* Shoulder

*Landform position (three-dimensional):* Crest

*Down-slope shape:* Linear

*Across-slope shape:* Linear

**Saucier**

*Percent of map unit:* 2 percent

*Landform:* Coastal plains

*Landform position (two-dimensional):* Shoulder

*Landform position (three-dimensional):* Crest

*Down-slope shape:* Linear

*Across-slope shape:* Linear

## **EuB—Eustis loamy fine sand, 2 to 5 percent slopes**

### **Map Unit Setting**

*National map unit symbol:* c4w8

*Mean annual precipitation:* 60 to 75 inches

*Mean annual air temperature:* 64 to 70 degrees F

*Frost-free period:* 270 to 335 days

*Farmland classification:* Farmland of statewide importance

### **Map Unit Composition**

*Eustis and similar soils:* 85 percent

*Minor components:* 12 percent

*Estimates are based on observations, descriptions, and transects of the mapunit.*

### **Description of Eustis**

#### **Setting**

*Landform:* Hillslopes

*Landform position (two-dimensional):* Shoulder

*Landform position (three-dimensional):* Crest

*Down-slope shape:* Linear

*Across-slope shape:* Linear

*Parent material:* Sandy marine deposits

#### **Typical profile**

*H1 - 0 to 6 inches:* loamy fine sand

*H2 - 6 to 24 inches:* sand

*H3 - 24 to 76 inches:* loamy sand

*H4 - 76 to 98 inches:* sand

#### **Properties and qualities**

*Slope:* 2 to 5 percent

*Depth to restrictive feature:* More than 80 inches

*Natural drainage class:* Somewhat excessively drained

*Runoff class:* Very low

*Capacity of the most limiting layer to transmit water (Ksat):* High to very high (6.00 to 20.00 in/hr)

*Depth to water table:* More than 80 inches

*Frequency of flooding:* None

*Frequency of ponding:* None

*Available water storage in profile:* Low (about 5.0 inches)

#### **Interpretive groups**

*Land capability classification (irrigated):* None specified

*Land capability classification (nonirrigated):* 3s

*Hydrologic Soil Group:* A

**Minor Components**

**Escambia**

*Percent of map unit:* 4 percent  
*Landform:* Coastal plains  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Crest  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear

**Harleston**

*Percent of map unit:* 4 percent  
*Landform:* Stream terraces  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Tread  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear

**Poarch**

*Percent of map unit:* 4 percent  
*Landform:* Ridges  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Crest  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear

**HA—Handsboro association**

**Map Unit Setting**

*National map unit symbol:* c4wb  
*Elevation:* 0 feet  
*Mean annual precipitation:* 38 to 75 inches  
*Mean annual air temperature:* 59 to 70 degrees F  
*Frost-free period:* 220 to 335 days  
*Farmland classification:* Not prime farmland

**Map Unit Composition**

*Handsboro and similar soils:* 85 percent  
*Minor components:* 10 percent  
*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of Handsboro**

**Setting**

*Landform:* Tidal flats  
*Landform position (three-dimensional):* Dip  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear  
*Parent material:* Decomposed herbaceous plant remains and alluvium deposits



**Typical profile**

*H1 - 0 to 2 inches:* mucky silt loam  
*Oa - 2 to 46 inches:* muck  
*H3 - 46 to 61 inches:* stratified muck to loam

**Properties and qualities**

*Slope:* 0 to 1 percent  
*Depth to restrictive feature:* More than 80 inches  
*Natural drainage class:* Very poorly drained  
*Runoff class:* Negligible  
*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 inches  
*Frequency of flooding:* Frequent  
*Frequency of ponding:* Frequent  
*Salinity, maximum in profile:* Moderately saline (16.0 mmhos/cm)  
*Sodium adsorption ratio, maximum in profile:* 4.0  
*Available water storage in profile:* Very high (about 14.1 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified  
*Land capability classification (nonirrigated):* 8w  
*Hydrologic Soil Group:* D

**Minor Components**

**Bohicket**

*Percent of map unit:* 10 percent  
*Landform:* Tidal flats  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear

**HIA—Harleston fine sandy loam, 0 to 2 percent slopes**

**Map Unit Setting**

*National map unit symbol:* c4wc  
*Mean annual precipitation:* 60 to 75 inches  
*Mean annual air temperature:* 64 to 70 degrees F  
*Frost-free period:* 270 to 335 days  
*Farmland classification:* All areas are prime farmland

**Map Unit Composition**

*Harleston and similar soils:* 90 percent  
*Minor components:* 2 percent  
*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of Harleston**

**Setting**

*Landform:* Stream terraces

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*Landform position (two-dimensional):* Shoulder

*Landform position (three-dimensional):* Tread

*Down-slope shape:* Linear

*Across-slope shape:* Linear

*Parent material:* Loamy alluvium

**Typical profile**

*H1 - 0 to 9 inches:* fine sandy loam

*H2 - 9 to 60 inches:* sandy loam

*H3 - 60 to 72 inches:* sandy loam

**Properties and qualities**

*Slope:* 0 to 2 percent

*Depth to restrictive feature:* More than 80 inches

*Natural drainage class:* Moderately well drained

*Runoff class:* Low

*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 24 to 36 inches

*Frequency of flooding:* None

*Frequency of ponding:* None

*Available water storage in profile:* Moderate (about 8.7 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified

*Land capability classification (nonirrigated):* 2w

*Hydrologic Soil Group:* C

**Minor Components**

**Unnamed hydric soils (133de)**

*Percent of map unit:* 2 percent

*Landform:* Depressions

*Landform position (three-dimensional):* Dip

*Down-slope shape:* Concave

*Across-slope shape:* Concave

**HIB—Harleston fine sandy loam, 2 to 5 percent slopes**

**Map Unit Setting**

*National map unit symbol:* c4wd

*Elevation:* 100 to 300 feet

*Mean annual precipitation:* 48 to 75 inches

*Mean annual air temperature:* 63 to 70 degrees F

*Frost-free period:* 200 to 335 days

*Farmland classification:* All areas are prime farmland

**Map Unit Composition**

*Harleston and similar soils:* 85 percent

*Minor components:* 12 percent

*Estimates are based on observations, descriptions, and transects of the mapunit.*

## Description of Harleston

### Setting

*Landform:* Stream terraces  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Tread  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear  
*Parent material:* Loamy alluvium

### Typical profile

*H1 - 0 to 8 inches:* fine sandy loam  
*H2 - 8 to 30 inches:* sandy loam  
*H3 - 30 to 60 inches:* sandy loam

### Properties and qualities

*Slope:* 2 to 5 percent  
*Depth to restrictive feature:* More than 80 inches  
*Natural drainage class:* Moderately well drained  
*Runoff class:* Low  
*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 24 to 36 inches  
*Frequency of flooding:* None  
*Frequency of ponding:* None  
*Available water storage in profile:* Moderate (about 8.7 inches)

### Interpretive groups

*Land capability classification (irrigated):* None specified  
*Land capability classification (nonirrigated):* 2e  
*Hydrologic Soil Group:* C

## Minor Components

### Saucier

*Percent of map unit:* 3 percent  
*Landform:* Coastal plains  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Crest  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear

### Smithton

*Percent of map unit:* 3 percent  
*Landform:* Terraces  
*Landform position (three-dimensional):* Tread, dip  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear

### Escambia

*Percent of map unit:* 3 percent  
*Landform:* Coastal plains  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Crest  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear

**Poarch**

*Percent of map unit:* 3 percent  
*Landform:* Ridges  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Crest  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear

**MaB—Malbis fine sandy loam, 2 to 5 percent slopes**

**Map Unit Setting**

*National map unit symbol:* c4wh  
*Mean annual precipitation:* 60 to 75 inches  
*Mean annual air temperature:* 64 to 70 degrees F  
*Frost-free period:* 270 to 335 days  
*Farmland classification:* All areas are prime farmland

**Map Unit Composition**

*Malbis and similar soils:* 90 percent  
*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of Malbis**

**Setting**

*Landform:* Coastal plains  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Crest  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear  
*Parent material:* Loamy marine deposits

**Typical profile**

*H1 - 0 to 7 inches:* fine sandy loam  
*H2 - 7 to 20 inches:* loam  
*H3 - 20 to 32 inches:* sandy clay loam  
*H4 - 32 to 60 inches:* sandy clay loam

**Properties and qualities**

*Slope:* 2 to 5 percent  
*Depth to restrictive feature:* More than 80 inches  
*Natural drainage class:* Moderately well drained  
*Runoff class:* Low  
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high (0.20 to 0.60 in/hr)  
*Depth to water table:* About 30 to 42 inches  
*Frequency of flooding:* None  
*Frequency of ponding:* None  
*Available water storage in profile:* Moderate (about 7.3 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified

*Land capability classification (nonirrigated):* 2e

*Hydrologic Soil Group:* B

**MaC—Malbis fine sandy loam, 5 to 8 percent slopes**

**Map Unit Setting**

*National map unit symbol:* c4wj

*Mean annual precipitation:* 60 to 75 inches

*Mean annual air temperature:* 64 to 70 degrees F

*Frost-free period:* 270 to 335 days

*Farmland classification:* All areas are prime farmland

**Map Unit Composition**

*Malbis and similar soils:* 90 percent

*Minor components:* 2 percent

*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of Malbis**

**Setting**

*Landform:* Coastal plains

*Landform position (two-dimensional):* Shoulder

*Landform position (three-dimensional):* Crest

*Down-slope shape:* Linear

*Across-slope shape:* Linear

*Parent material:* Loamy marine deposits

**Typical profile**

*H1 - 0 to 7 inches:* fine sandy loam

*H2 - 7 to 20 inches:* loam

*H3 - 20 to 32 inches:* sandy clay loam

*H4 - 32 to 60 inches:* sandy clay loam

**Properties and qualities**

*Slope:* 2 to 5 percent

*Depth to restrictive feature:* More than 80 inches

*Natural drainage class:* Moderately well drained

*Runoff class:* Low

*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high (0.20 to 0.60 in/hr)

*Depth to water table:* About 30 to 42 inches

*Frequency of flooding:* None

*Frequency of ponding:* None

*Available water storage in profile:* Moderate (about 7.3 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified

*Land capability classification (nonirrigated):* 3e

*Hydrologic Soil Group:* B

**Minor Components**

**Unnamed hydric soils (133dr)**

*Percent of map unit:* 2 percent  
*Landform:* Drainageways  
*Landform position (three-dimensional):* Dip  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear

**McB—McLaurin fine sandy loam, 2 to 5 percent slopes**

**Map Unit Setting**

*National map unit symbol:* c4wk  
*Mean annual precipitation:* 60 to 75 inches  
*Mean annual air temperature:* 64 to 70 degrees F  
*Frost-free period:* 270 to 335 days  
*Farmland classification:* All areas are prime farmland

**Map Unit Composition**

*McLaurin and similar soils:* 90 percent  
*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of McLaurin**

**Setting**

*Landform:* Coastal plains  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Crest  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear  
*Parent material:* Loamy fluviomarine deposits

**Typical profile**

*H1 - 0 to 10 inches:* fine sandy loam  
*H2 - 10 to 38 inches:* sandy loam  
*H3 - 38 to 49 inches:* loamy sand  
*H4 - 49 to 60 inches:* sandy loam

**Properties and qualities**

*Slope:* 2 to 5 percent  
*Depth to restrictive feature:* More than 80 inches  
*Natural drainage class:* Well drained  
*Runoff class:* Low  
*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 storage in profile:* Moderate (about 7.3 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified

*Land capability classification (nonirrigated):* 2e

*Hydrologic Soil Group:* B

**McC—McLaurin fine sandy loam, 5 to 8 percent slopes**

**Map Unit Setting**

*National map unit symbol:* c4wl

*Mean annual precipitation:* 60 to 75 inches

*Mean annual air temperature:* 64 to 70 degrees F

*Frost-free period:* 270 to 335 days

*Farmland classification:* Farmland of statewide importance

**Map Unit Composition**

*Mclaurin and similar soils:* 90 percent

*Minor components:* 3 percent

*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of McLaurin**

**Setting**

*Landform:* Coastal plains

*Landform position (two-dimensional):* Shoulder

*Landform position (three-dimensional):* Side slope

*Down-slope shape:* Linear

*Across-slope shape:* Linear

*Parent material:* Loamy fluviomarine deposits

**Typical profile**

*H1 - 0 to 10 inches:* fine sandy loam

*H2 - 10 to 38 inches:* sandy loam

*H3 - 38 to 49 inches:* loamy sand

*H4 - 49 to 60 inches:* sandy loam

**Properties and qualities**

*Slope:* 5 to 8 percent

*Depth to restrictive feature:* More than 80 inches

*Natural drainage class:* Well drained

*Runoff class:* Medium

*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 storage in profile:* Moderate (about 7.3 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified

*Land capability classification (nonirrigated):* 3e

*Hydrologic Soil Group:* B

**Minor Components**

**Unnamed hydric soils (133dr)**

*Percent of map unit:* 3 percent  
*Landform:* Drainageways  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Dip  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear

**PoA—Poarch fine sandy loam, 0 to 2 percent slopes**

**Map Unit Setting**

*National map unit symbol:* c4wp  
*Mean annual precipitation:* 60 to 75 inches  
*Mean annual air temperature:* 64 to 70 degrees F  
*Frost-free period:* 270 to 335 days  
*Farmland classification:* All areas are prime farmland

**Map Unit Composition**

*Poarch and similar soils:* 85 percent  
*Minor components:* 14 percent  
*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of Poarch**

**Setting**

*Landform:* Ridges  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Crest  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear  
*Parent material:* Sandy and loamy marine deposits

**Typical profile**

*H1 - 0 to 7 inches:* fine sandy loam  
*H2 - 7 to 35 inches:* loam  
*H3 - 35 to 60 inches:* loam

**Properties and qualities**

*Slope:* 0 to 2 percent  
*Depth to restrictive feature:* More than 80 inches  
*Natural drainage class:* Well drained  
*Runoff class:* Low  
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high (0.20 to 0.60 in/hr)  
*Depth to water table:* About 30 to 60 inches  
*Frequency of flooding:* None  
*Frequency of ponding:* None  
*Available water storage in profile:* Moderate (about 8.8 inches)



**Interpretive groups**

*Land capability classification (irrigated):* None specified

*Land capability classification (nonirrigated):* 1

*Hydrologic Soil Group:* B

**Minor Components**

**Escambia**

*Percent of map unit:* 4 percent

*Landform:* Coastal plains

*Landform position (two-dimensional):* Shoulder

*Landform position (three-dimensional):* Crest

*Down-slope shape:* Linear

*Across-slope shape:* Linear

**Harleston**

*Percent of map unit:* 4 percent

*Landform:* Stream terraces

*Landform position (two-dimensional):* Shoulder

*Landform position (three-dimensional):* Tread

*Down-slope shape:* Linear

*Across-slope shape:* Linear

**Eustis**

*Percent of map unit:* 4 percent

*Landform:* Hillslopes

*Landform position (two-dimensional):* Shoulder

*Landform position (three-dimensional):* Crest

*Down-slope shape:* Linear

*Across-slope shape:* Linear

**Unnamed hydric soils (133de)**

*Percent of map unit:* 2 percent

*Landform:* Depressions

*Landform position (three-dimensional):* Dip

*Down-slope shape:* Concave

*Across-slope shape:* Concave

**PoB—Poarch fine sandy loam, 2 to 5 percent slopes**

**Map Unit Setting**

*National map unit symbol:* c4wq

*Mean annual precipitation:* 60 to 75 inches

*Mean annual air temperature:* 64 to 70 degrees F

*Frost-free period:* 270 to 335 days

*Farmland classification:* All areas are prime farmland

**Map Unit Composition**

*Poarch and similar soils:* 90 percent

*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of Poarch**

**Setting**

*Landform:* Ridges  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Crest  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear  
*Parent material:* Sandy and loamy marine deposits

**Typical profile**

*H1 - 0 to 10 inches:* fine sandy loam  
*H2 - 10 to 73 inches:* loam  
*H3 - 73 to 81 inches:* loam

**Properties and qualities**

*Slope:* 2 to 5 percent  
*Depth to restrictive feature:* More than 80 inches  
*Natural drainage class:* Well drained  
*Runoff class:* Low  
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high (0.20 to 0.60 in/hr)  
*Depth to water table:* About 30 to 60 inches  
*Frequency of flooding:* None  
*Frequency of ponding:* None  
*Available water storage in profile:* Moderate (about 8.8 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified  
*Land capability classification (nonirrigated):* 2e  
*Hydrologic Soil Group:* B

**PoC—Poarch fine sandy loam, 5 to 8 percent slopes**

**Map Unit Setting**

*National map unit symbol:* c4wr  
*Elevation:* 100 to 300 feet  
*Mean annual precipitation:* 48 to 75 inches  
*Mean annual air temperature:* 63 to 70 degrees F  
*Frost-free period:* 200 to 335 days  
*Farmland classification:* Farmland of statewide importance

**Map Unit Composition**

*Poarch and similar soils:* 85 percent  
*Minor components:* 12 percent  
*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of Poarch**

**Setting**

*Landform:* Hillslopes  
*Landform position (two-dimensional):* Shoulder

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*Landform position (three-dimensional):* Side slope  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear  
*Parent material:* Sandy and loamy marine deposits

**Typical profile**

*H1 - 0 to 7 inches:* fine sandy loam  
*H2 - 7 to 35 inches:* loam  
*H3 - 35 to 60 inches:* loam

**Properties and qualities**

*Slope:* 5 to 8 percent  
*Depth to restrictive feature:* More than 80 inches  
*Natural drainage class:* Well drained  
*Runoff class:* Medium  
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high (0.20 to 0.60 in/hr)  
*Depth to water table:* About 30 to 60 inches  
*Frequency of flooding:* None  
*Frequency of ponding:* None  
*Available water storage in profile:* Moderate (about 8.8 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified  
*Land capability classification (nonirrigated):* 3e  
*Hydrologic Soil Group:* B

**Minor Components**

**Escambia**

*Percent of map unit:* 4 percent  
*Landform:* Coastal plains  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Crest  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear

**Harleston**

*Percent of map unit:* 4 percent  
*Landform:* Stream terraces  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Tread  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear

**Smithton**

*Percent of map unit:* 4 percent  
*Landform:* Terraces  
*Landform position (three-dimensional):* Tread, dip  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear

## PoD—Poarch fine sandy loam, 8 to 12 percent slopes

### Map Unit Setting

*National map unit symbol:* c4ws

*Elevation:* 100 to 300 feet

*Mean annual precipitation:* 48 to 75 inches

*Mean annual air temperature:* 63 to 70 degrees F

*Frost-free period:* 200 to 335 days

*Farmland classification:* Farmland of statewide importance

### Map Unit Composition

*Poarch and similar soils:* 85 percent

*Minor components:* 12 percent

*Estimates are based on observations, descriptions, and transects of the mapunit.*

### Description of Poarch

#### Setting

*Landform:* Hillslopes

*Landform position (two-dimensional):* Shoulder

*Landform position (three-dimensional):* Side slope

*Down-slope shape:* Linear

*Across-slope shape:* Linear

*Parent material:* Sandy and loamy marine deposits

#### Typical profile

*H1 - 0 to 7 inches:* fine sandy loam

*H2 - 7 to 35 inches:* loam

*H3 - 35 to 60 inches:* loam

#### Properties and qualities

*Slope:* 8 to 12 percent

*Depth to restrictive feature:* More than 80 inches

*Natural drainage class:* Well drained

*Runoff class:* Medium

*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high (0.20 to 0.60 in/hr)

*Depth to water table:* About 30 to 60 inches

*Frequency of flooding:* None

*Frequency of ponding:* None

*Available water storage in profile:* Moderate (about 8.8 inches)

#### Interpretive groups

*Land capability classification (irrigated):* None specified

*Land capability classification (nonirrigated):* 4e

*Hydrologic Soil Group:* B

**Minor Components**

**Smithton**

*Percent of map unit:* 4 percent  
*Landform:* Terraces  
*Landform position (three-dimensional):* Tread, dip  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear

**Eustis**

*Percent of map unit:* 4 percent  
*Landform:* Hillslopes  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Side slope  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear

**Saucier**

*Percent of map unit:* 4 percent  
*Landform:* Coastal plains  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Side slope  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear

**RuB—Ruston fine sandy loam, 2 to 5 percent slopes**

**Map Unit Setting**

*National map unit symbol:* c4wv  
*Elevation:* 100 to 550 feet  
*Mean annual precipitation:* 60 to 75 inches  
*Mean annual air temperature:* 64 to 70 degrees F  
*Frost-free period:* 270 to 335 days  
*Farmland classification:* All areas are prime farmland

**Map Unit Composition**

*Ruston and similar soils:* 95 percent  
*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of Ruston**

**Setting**

*Landform:* Coastal plains  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Side slope  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear  
*Parent material:* Loamy fluviomarine deposits

**Typical profile**

*H1 - 0 to 7 inches:* fine sandy loam  
*H2 - 7 to 18 inches:* sandy clay loam  
*H3 - 18 to 39 inches:* sandy loam  
*H4 - 39 to 85 inches:* sandy clay loam

**Properties and qualities**

*Slope:* 2 to 5 percent  
*Depth to restrictive feature:* More than 80 inches  
*Natural drainage class:* Well drained  
*Runoff class:* Low  
*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 storage in profile:* Moderate (about 8.6 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified  
*Land capability classification (nonirrigated):* 3e  
*Hydrologic Soil Group:* B

**RuC—Ruston fine sandy loam, 5 to 8 percent slopes**

**Map Unit Setting**

*National map unit symbol:* c4ww  
*Elevation:* 100 to 550 feet  
*Mean annual precipitation:* 60 to 75 inches  
*Mean annual air temperature:* 64 to 70 degrees F  
*Frost-free period:* 270 to 335 days  
*Farmland classification:* All areas are prime farmland

**Map Unit Composition**

*Ruston and similar soils:* 95 percent  
*Minor components:* 2 percent  
*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of Ruston**

**Setting**

*Landform:* Coastal plains  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Side slope  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear  
*Parent material:* Loamy fluviomarine deposits

**Typical profile**

*H1 - 0 to 7 inches:* fine sandy loam  
*H2 - 7 to 18 inches:* sandy clay loam  
*H3 - 18 to 39 inches:* sandy loam

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*H4 - 39 to 85 inches: loam*

**Properties and qualities**

*Slope: 5 to 8 percent*

*Depth to restrictive feature: More than 80 inches*

*Natural drainage class: Well drained*

*Runoff class: Medium*

*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 storage in profile: Moderate (about 8.6 inches)*

**Interpretive groups**

*Land capability classification (irrigated): None specified*

*Land capability classification (nonirrigated): 3e*

*Hydrologic Soil Group: B*

**Minor Components**

**Unnamed hydric soils (133dr)**

*Percent of map unit: 2 percent*

*Landform: Drainageways*

*Landform position (two-dimensional): Shoulder*

*Landform position (three-dimensional): Dip*

*Down-slope shape: Linear*

*Across-slope shape: Linear*

**SaA—Saucier fine sandy loam, 0 to 2 percent slopes**

**Map Unit Setting**

*National map unit symbol: c4wy*

*Mean annual precipitation: 60 to 75 inches*

*Mean annual air temperature: 64 to 70 degrees F*

*Frost-free period: 270 to 335 days*

*Farmland classification: All areas are prime farmland*

**Map Unit Composition**

*Saucier and similar soils: 85 percent*

*Minor components: 14 percent*

*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of Saucier**

**Setting**

*Landform: Coastal plains*

*Landform position (two-dimensional): Shoulder*

*Landform position (three-dimensional): Crest*

*Down-slope shape: Linear*

*Across-slope shape: Linear*

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*Parent material:* Loamy over clayey marine deposits

**Typical profile**

*H1 - 0 to 9 inches:* fine sandy loam

*H2 - 9 to 40 inches:* loam

*H3 - 40 to 47 inches:* silty clay loam

*H4 - 47 to 60 inches:* clay

**Properties and qualities**

*Slope:* 0 to 2 percent

*Depth to restrictive feature:* More than 80 inches

*Natural drainage class:* Moderately well drained

*Runoff class:* Low

*Capacity of the most limiting layer to transmit water (Ksat):* Moderately low to moderately high (0.06 to 0.20 in/hr)

*Depth to water table:* About 30 to 48 inches

*Frequency of flooding:* None

*Frequency of ponding:* None

*Available water storage in profile:* High (about 10.4 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified

*Land capability classification (nonirrigated):* 2w

*Hydrologic Soil Group:* C

**Minor Components**

**Poarch**

*Percent of map unit:* 4 percent

*Landform:* Ridges

*Landform position (two-dimensional):* Shoulder

*Landform position (three-dimensional):* Crest

*Down-slope shape:* Linear

*Across-slope shape:* Linear

**Escambia**

*Percent of map unit:* 4 percent

*Landform:* Coastal plains

*Landform position (two-dimensional):* Shoulder

*Landform position (three-dimensional):* Crest

*Down-slope shape:* Linear

*Across-slope shape:* Linear

**Harleston**

*Percent of map unit:* 4 percent

*Landform:* Stream terraces

*Landform position (two-dimensional):* Shoulder

*Landform position (three-dimensional):* Tread

*Down-slope shape:* Linear

*Across-slope shape:* Linear

**Unnamed hydric soils (133de)**

*Percent of map unit:* 2 percent

*Landform:* Depressions

*Landform position (three-dimensional):* Dip

*Down-slope shape:* Concave

*Across-slope shape:* Concave



## SaB—Saucier fine sandy loam, 2 to 5 percent slopes

### Map Unit Setting

*National map unit symbol:* c4wz

*Mean annual precipitation:* 60 to 75 inches

*Mean annual air temperature:* 64 to 70 degrees F

*Frost-free period:* 270 to 335 days

*Farmland classification:* All areas are prime farmland

### Map Unit Composition

*Saucier and similar soils:* 85 percent

*Minor components:* 12 percent

*Estimates are based on observations, descriptions, and transects of the mapunit.*

### Description of Saucier

#### Setting

*Landform:* Coastal plains

*Landform position (two-dimensional):* Shoulder

*Landform position (three-dimensional):* Crest

*Down-slope shape:* Linear

*Across-slope shape:* Linear

*Parent material:* Loamy over clayey marine deposits

#### Typical profile

*H1 - 0 to 9 inches:* fine sandy loam

*H2 - 9 to 40 inches:* loam

*H3 - 40 to 47 inches:* silty clay loam

*H4 - 47 to 60 inches:* clay

#### Properties and qualities

*Slope:* 2 to 5 percent

*Depth to restrictive feature:* More than 80 inches

*Natural drainage class:* Moderately well drained

*Runoff class:* Low

*Capacity of the most limiting layer to transmit water (Ksat):* Moderately low to moderately high (0.06 to 0.20 in/hr)

*Depth to water table:* About 30 to 48 inches

*Frequency of flooding:* None

*Frequency of ponding:* None

*Available water storage in profile:* High (about 10.4 inches)

#### Interpretive groups

*Land capability classification (irrigated):* None specified

*Land capability classification (nonirrigated):* 2e

*Hydrologic Soil Group:* C

**Minor Components**

**Poarch**

*Percent of map unit:* 4 percent  
*Landform:* Ridges  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Crest  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear

**Escambia**

*Percent of map unit:* 4 percent  
*Landform:* Coastal plains  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Crest  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear

**Harleston**

*Percent of map unit:* 4 percent  
*Landform:* Stream terraces  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Tread  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear

**SaC—Saucier fine sandy loam, 5 to 8 percent slopes**

**Map Unit Setting**

*National map unit symbol:* c4x0  
*Elevation:* 100 to 300 feet  
*Mean annual precipitation:* 48 to 75 inches  
*Mean annual air temperature:* 63 to 70 degrees F  
*Frost-free period:* 200 to 335 days  
*Farmland classification:* Farmland of statewide importance

**Map Unit Composition**

*Saucier and similar soils:* 85 percent  
*Minor components:* 12 percent  
*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of Saucier**

**Setting**

*Landform:* Coastal plains  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Side slope  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear  
*Parent material:* Loamy over clayey marine deposits

**Typical profile**

*H1 - 0 to 9 inches:* fine sandy loam  
*H2 - 9 to 40 inches:* loam  
*H3 - 40 to 47 inches:* silty clay loam  
*H4 - 47 to 60 inches:* clay

**Properties and qualities**

*Slope:* 5 to 8 percent  
*Depth to restrictive feature:* More than 80 inches  
*Natural drainage class:* Moderately well drained  
*Runoff class:* Medium  
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately low to moderately high (0.06 to 0.20 in/hr)  
*Depth to water table:* About 30 to 48 inches  
*Frequency of flooding:* None  
*Frequency of ponding:* None  
*Available water storage in profile:* High (about 10.4 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified  
*Land capability classification (nonirrigated):* 3e  
*Hydrologic Soil Group:* C

**Minor Components**

**Poarch**

*Percent of map unit:* 4 percent  
*Landform:* Hillslopes  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Side slope  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear

**Harleston**

*Percent of map unit:* 4 percent  
*Landform:* Stream terraces  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Tread  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear

**Smithton**

*Percent of map unit:* 4 percent  
*Landform:* Terraces  
*Landform position (three-dimensional):* Tread, dip  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear

## SaD—Saucier fine sandy loam, 8 to 12 percent slopes

### Map Unit Setting

*National map unit symbol:* c4x1

*Elevation:* 100 to 300 feet

*Mean annual precipitation:* 48 to 75 inches

*Mean annual air temperature:* 63 to 70 degrees F

*Frost-free period:* 200 to 335 days

*Farmland classification:* Farmland of statewide importance

### Map Unit Composition

*Saucier and similar soils:* 85 percent

*Minor components:* 12 percent

*Estimates are based on observations, descriptions, and transects of the mapunit.*

### Description of Saucier

#### Setting

*Landform:* Coastal plains

*Landform position (two-dimensional):* Shoulder

*Landform position (three-dimensional):* Side slope

*Down-slope shape:* Linear

*Across-slope shape:* Linear

*Parent material:* Loamy over clayey marine deposits

#### Typical profile

*H1 - 0 to 9 inches:* fine sandy loam

*H2 - 9 to 40 inches:* loam

*H3 - 40 to 47 inches:* silty clay loam

*H4 - 47 to 60 inches:* clay

#### Properties and qualities

*Slope:* 8 to 12 percent

*Depth to restrictive feature:* More than 80 inches

*Natural drainage class:* Moderately well drained

*Runoff class:* Medium

*Capacity of the most limiting layer to transmit water (Ksat):* Moderately low to moderately high (0.06 to 0.20 in/hr)

*Depth to water table:* About 30 to 48 inches

*Frequency of flooding:* None

*Frequency of ponding:* None

*Available water storage in profile:* High (about 10.4 inches)

#### Interpretive groups

*Land capability classification (irrigated):* None specified

*Land capability classification (nonirrigated):* 4e

*Hydrologic Soil Group:* C

**Minor Components**

**Poarch**

*Percent of map unit:* 3 percent  
*Landform:* Hillslopes  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Side slope  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear

**Harleston**

*Percent of map unit:* 3 percent  
*Landform:* Stream terraces  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Riser  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear

**Smithton**

*Percent of map unit:* 3 percent  
*Landform:* Terraces  
*Landform position (three-dimensional):* Tread, dip  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear

**Malbis**

*Percent of map unit:* 3 percent  
*Landform:* Coastal plains  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Side slope  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear

**ScB—Saucier-Susquehanna complex, 2 to 5 percent slopes**

**Map Unit Setting**

*National map unit symbol:* c4x2  
*Elevation:* 100 to 300 feet  
*Mean annual precipitation:* 48 to 75 inches  
*Mean annual air temperature:* 63 to 70 degrees F  
*Frost-free period:* 200 to 335 days  
*Farmland classification:* Not prime farmland

**Map Unit Composition**

*Saucier and similar soils:* 50 percent  
*Susquehanna and similar soils:* 35 percent  
*Minor components:* 12 percent  
*Estimates are based on observations, descriptions, and transects of the mapunit.*

### Description of Saucier

#### Setting

*Landform:* Coastal plains  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Crest  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear  
*Parent material:* Loamy over clayey marine deposits

#### Typical profile

*H1 - 0 to 9 inches:* fine sandy loam  
*H2 - 9 to 40 inches:* loam  
*H3 - 40 to 47 inches:* silty clay loam  
*H4 - 47 to 60 inches:* clay

#### Properties and qualities

*Slope:* 2 to 5 percent  
*Depth to restrictive feature:* More than 80 inches  
*Natural drainage class:* Moderately well drained  
*Runoff class:* Low  
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately low to moderately high (0.06 to 0.20 in/hr)  
*Depth to water table:* About 30 to 48 inches  
*Frequency of flooding:* None  
*Frequency of ponding:* None  
*Available water storage in profile:* High (about 10.4 inches)

#### Interpretive groups

*Land capability classification (irrigated):* None specified  
*Land capability classification (nonirrigated):* 2e  
*Hydrologic Soil Group:* C

### Description of Susquehanna

#### Setting

*Landform:* Coastal plains  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Crest  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear  
*Parent material:* Clayey marine deposits

#### Typical profile

*H1 - 0 to 7 inches:* fine sandy loam  
*H2 - 7 to 60 inches:* clay

#### Properties and qualities

*Slope:* 2 to 5 percent  
*Depth to restrictive feature:* More than 80 inches  
*Natural drainage class:* Somewhat poorly drained  
*Runoff class:* Medium  
*Capacity of the most limiting layer to transmit water (Ksat):* Very low to moderately low (0.00 to 0.06 in/hr)  
*Depth to water table:* More than 80 inches  
*Frequency of flooding:* None  
*Frequency of ponding:* None

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*Available water storage in profile:* High (about 10.4 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified

*Land capability classification (nonirrigated):* 4e

*Hydrologic Soil Group:* D

**Minor Components**

**Harleston**

*Percent of map unit:* 3 percent

*Landform:* Stream terraces

*Landform position (two-dimensional):* Shoulder

*Landform position (three-dimensional):* Tread

*Down-slope shape:* Linear

*Across-slope shape:* Linear

**Poarch**

*Percent of map unit:* 3 percent

*Landform:* Ridges

*Landform position (two-dimensional):* Shoulder

*Landform position (three-dimensional):* Crest

*Down-slope shape:* Linear

*Across-slope shape:* Linear

**Smithton**

*Percent of map unit:* 3 percent

*Landform:* Terraces

*Landform position (three-dimensional):* Tread, dip

*Down-slope shape:* Linear

*Across-slope shape:* Linear

**Malbis**

*Percent of map unit:* 3 percent

*Landform:* Coastal plains

*Landform position (two-dimensional):* Shoulder

*Landform position (three-dimensional):* Crest

*Down-slope shape:* Linear

*Across-slope shape:* Linear

**ScD—Saucier-Susquehanna complex, 5 to 12 percent slopes**

**Map Unit Setting**

*National map unit symbol:* c4x3

*Elevation:* 100 to 550 feet

*Mean annual precipitation:* 45 to 75 inches

*Mean annual air temperature:* 61 to 70 degrees F

*Frost-free period:* 200 to 335 days

*Farmland classification:* Not prime farmland

**Map Unit Composition**

*Saucier and similar soils:* 45 percent

*Susquehanna and similar soils:* 30 percent

*Minor components:* 12 percent

*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of Saucier**

**Setting**

*Landform:* Coastal plains

*Landform position (two-dimensional):* Shoulder

*Landform position (three-dimensional):* Side slope

*Down-slope shape:* Linear

*Across-slope shape:* Linear

*Parent material:* Loamy over clayey marine deposits

**Typical profile**

*H1 - 0 to 9 inches:* fine sandy loam

*H2 - 9 to 40 inches:* loam

*H3 - 40 to 47 inches:* silty clay loam

*H4 - 47 to 60 inches:* clay

**Properties and qualities**

*Slope:* 5 to 12 percent

*Depth to restrictive feature:* More than 80 inches

*Natural drainage class:* Moderately well drained

*Runoff class:* Medium

*Capacity of the most limiting layer to transmit water (Ksat):* Moderately low to moderately high (0.06 to 0.20 in/hr)

*Depth to water table:* About 30 to 48 inches

*Frequency of flooding:* None

*Frequency of ponding:* None

*Available water storage in profile:* High (about 10.4 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified

*Land capability classification (nonirrigated):* 4e

*Hydrologic Soil Group:* C

**Description of Susquehanna**

**Setting**

*Landform:* Coastal plains

*Landform position (two-dimensional):* Shoulder

*Landform position (three-dimensional):* Side slope

*Down-slope shape:* Linear

*Across-slope shape:* Linear

*Parent material:* Clayey marine deposits

**Typical profile**

*H1 - 0 to 7 inches:* fine sandy loam

*H2 - 7 to 60 inches:* clay

**Properties and qualities**

*Slope:* 5 to 12 percent

*Depth to restrictive feature:* More than 80 inches

*Natural drainage class:* Somewhat poorly drained



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*Runoff class:* High

*Capacity of the most limiting layer to transmit water (Ksat):* Very low to moderately low (0.00 to 0.06 in/hr)

*Depth to water table:* More than 80 inches

*Frequency of flooding:* None

*Frequency of ponding:* None

*Available water storage in profile:* High (about 10.4 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified

*Land capability classification (nonirrigated):* 6e

*Hydrologic Soil Group:* D

**Minor Components**

**Poarch**

*Percent of map unit:* 3 percent

*Landform:* Hillslopes

*Landform position (two-dimensional):* Shoulder

*Landform position (three-dimensional):* Side slope

*Down-slope shape:* Linear

*Across-slope shape:* Linear

**Smithton**

*Percent of map unit:* 3 percent

*Landform:* Terraces

*Landform position (three-dimensional):* Tread, dip

*Down-slope shape:* Linear

*Across-slope shape:* Linear

**Escambia**

*Percent of map unit:* 3 percent

*Landform:* Coastal plains

*Landform position (two-dimensional):* Shoulder

*Landform position (three-dimensional):* Crest

*Down-slope shape:* Linear

*Across-slope shape:* Linear

**Ruston**

*Percent of map unit:* 3 percent

*Landform:* Coastal plains

*Landform position (two-dimensional):* Shoulder

*Landform position (three-dimensional):* Side slope

*Down-slope shape:* Linear

*Across-slope shape:* Linear

**SmD—Smithdale fine sandy loam, 8 to 12 percent slopes**

**Map Unit Setting**

*National map unit symbol:* c4x4

Custom Soil Resource Report

*Mean annual precipitation:* 60 to 75 inches  
*Mean annual air temperature:* 64 to 70 degrees F  
*Frost-free period:* 270 to 335 days  
*Farmland classification:* Not prime farmland

**Map Unit Composition**

*Smithdale and similar soils:* 90 percent  
*Minor components:* 2 percent  
*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of Smithdale**

**Setting**

*Landform:* Hillslopes  
*Landform position (two-dimensional):* Backslope  
*Landform position (three-dimensional):* Side slope  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear  
*Parent material:* Loamy fluviomarine deposits

**Typical profile**

*H1 - 0 to 14 inches:* fine sandy loam  
*H2 - 14 to 40 inches:* sandy clay loam  
*H3 - 40 to 80 inches:* sandy loam

**Properties and qualities**

*Slope:* 8 to 12 percent  
*Depth to restrictive feature:* More than 80 inches  
*Natural drainage class:* Well drained  
*Runoff class:* Medium  
*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 storage in profile:* High (about 9.2 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified  
*Land capability classification (nonirrigated):* 4e  
*Hydrologic Soil Group:* B

**Minor Components**

**Unnamed hydric soils (133dr)**

*Percent of map unit:* 2 percent  
*Landform:* Drainageways  
*Landform position (three-dimensional):* Dip  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear

## **Su—Smithton fine sandy loam, frequently flooded**

### **Map Unit Setting**

*National map unit symbol:* c4x7

*Elevation:* 20 to 400 feet

*Mean annual precipitation:* 40 to 75 inches

*Mean annual air temperature:* 61 to 72 degrees F

*Frost-free period:* 220 to 350 days

*Farmland classification:* Not prime farmland

### **Map Unit Composition**

*Smithton and similar soils:* 85 percent

*Minor components:* 12 percent

*Estimates are based on observations, descriptions, and transects of the mapunit.*

### **Description of Smithton**

#### **Setting**

*Landform:* Terraces

*Landform position (three-dimensional):* Tread, dip

*Down-slope shape:* Linear

*Across-slope shape:* Linear

*Parent material:* Loamy alluvium

#### **Typical profile**

*H1 - 0 to 8 inches:* fine sandy loam

*H2 - 8 to 38 inches:* sandy loam

*H3 - 38 to 49 inches:* loam

*H4 - 49 to 60 inches:* loam

#### **Properties and qualities**

*Slope:* 0 to 2 percent

*Depth to restrictive feature:* More than 80 inches

*Natural drainage class:* Poorly drained

*Runoff class:* Very high

*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high (0.20 to 0.60 in/hr)

*Depth to water table:* About 0 to 12 inches

*Frequency of flooding:* Frequent

*Frequency of ponding:* None

*Available water storage in profile:* High (about 9.0 inches)

#### **Interpretive groups**

*Land capability classification (irrigated):* None specified

*Land capability classification (nonirrigated):* 5w

*Hydrologic Soil Group:* D

**Minor Components**

**Atmore**

*Percent of map unit:* 3 percent  
*Landform:* Depressions  
*Landform position (three-dimensional):* Dip  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear

**Guyton**

*Percent of map unit:* 3 percent  
*Landform:* Terraces  
*Landform position (three-dimensional):* Tread  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear

**Harleston**

*Percent of map unit:* 3 percent  
*Landform:* Stream terraces  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Tread  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear

**Plummer**

*Percent of map unit:* 3 percent  
*Landform:* Flats  
*Landform position (three-dimensional):* Dip  
*Down-slope shape:* Convex  
*Across-slope shape:* Convex

**W—Water**

**Map Unit Composition**

*Water:* 100 percent  
*Estimates are based on observations, descriptions, and transects of the mapunit.*

## Harrison County, Mississippi

### At—Atmore silt loam

#### Map Unit Setting

*National map unit symbol:* c4xc  
*Elevation:* 20 to 400 feet  
*Mean annual precipitation:* 40 to 75 inches  
*Mean annual air temperature:* 61 to 72 degrees F  
*Frost-free period:* 200 to 335 days  
*Farmland classification:* Not prime farmland

#### Map Unit Composition

*Atmore and similar soils:* 85 percent  
*Minor components:* 14 percent  
*Estimates are based on observations, descriptions, and transects of the mapunit.*

#### Description of Atmore

##### Setting

*Landform:* Depressions  
*Landform position (three-dimensional):* Dip  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear  
*Parent material:* Loamy marine deposits

##### Typical profile

*H1 - 0 to 13 inches:* silt loam  
*H2 - 13 to 48 inches:* loam  
*H3 - 48 to 70 inches:* clay loam

##### Properties and qualities

*Slope:* 0 to 2 percent  
*Depth to restrictive feature:* More than 80 inches  
*Natural drainage class:* Poorly drained  
*Runoff class:* Very high  
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high (0.20 to 0.60 in/hr)  
*Depth to water table:* About 0 to 12 inches  
*Frequency of flooding:* None  
*Frequency of ponding:* None  
*Available water storage in profile:* High (about 12.0 inches)

##### Interpretive groups

*Land capability classification (irrigated):* None specified  
*Land capability classification (nonirrigated):* 4w  
*Hydrologic Soil Group:* B/D

#### Minor Components

##### Escambia

*Percent of map unit:* 3 percent  
*Landform:* Coastal plains  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Crest  
*Down-slope shape:* Linear

Custom Soil Resource Report

*Across-slope shape:* Linear

**Harleston**

*Percent of map unit:* 3 percent

*Landform:* Stream terraces

*Landform position (two-dimensional):* Shoulder

*Landform position (three-dimensional):* Tread

*Down-slope shape:* Linear

*Across-slope shape:* Linear

**Hyde**

*Percent of map unit:* 2 percent

*Landform:* Terraces

*Landform position (three-dimensional):* Tread

*Down-slope shape:* Linear

*Across-slope shape:* Linear

**Ocilla**

*Percent of map unit:* 2 percent

*Landform:* Stream terraces

*Landform position (two-dimensional):* Shoulder

*Landform position (three-dimensional):* Tread

*Down-slope shape:* Convex

*Across-slope shape:* Convex

**Plummer**

*Percent of map unit:* 2 percent

*Landform:* Flats

*Landform position (three-dimensional):* Dip

*Down-slope shape:* Convex

*Across-slope shape:* Convex

**Smithton**

*Percent of map unit:* 2 percent

*Landform:* Terraces

*Landform position (three-dimensional):* Tread, dip

*Down-slope shape:* Linear

*Across-slope shape:* Linear

**Es—Escambia silt loam**

**Map Unit Setting**

*National map unit symbol:* c4xf

*Elevation:* 100 to 300 feet

*Mean annual precipitation:* 48 to 75 inches

*Mean annual air temperature:* 63 to 70 degrees F

*Frost-free period:* 200 to 335 days

*Farmland classification:* All areas are prime farmland

**Map Unit Composition**

*Escambia and similar soils:* 85 percent

Custom Soil Resource Report

*Minor components: 14 percent*  
*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of Escambia**

**Setting**

*Landform: Coastal plains*  
*Landform position (two-dimensional): Shoulder*  
*Landform position (three-dimensional): Crest*  
*Down-slope shape: Linear*  
*Across-slope shape: Linear*  
*Parent material: Sandy and loamy marine deposits*

**Typical profile**

*H1 - 0 to 13 inches: silt loam*  
*H2 - 13 to 35 inches: fine sandy loam*  
*H3 - 35 to 72 inches: fine sandy loam*

**Properties and qualities**

*Slope: 0 to 2 percent*  
*Depth to restrictive feature: More than 80 inches*  
*Natural drainage class: Somewhat poorly drained*  
*Runoff class: Low*  
*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 18 to 30 inches*  
*Frequency of flooding: None*  
*Frequency of ponding: None*  
*Available water storage in profile: High (about 9.1 inches)*

**Interpretive groups**

*Land capability classification (irrigated): None specified*  
*Land capability classification (nonirrigated): 2w*  
*Hydrologic Soil Group: C*

**Minor Components**

**Atmore**

*Percent of map unit: 3 percent*  
*Landform: Depressions*  
*Landform position (three-dimensional): Dip*  
*Down-slope shape: Linear*  
*Across-slope shape: Linear*

**Smithton**

*Percent of map unit: 3 percent*  
*Landform: Terraces*  
*Landform position (three-dimensional): Tread, dip*  
*Down-slope shape: Linear*  
*Across-slope shape: Linear*

**Harleston**

*Percent of map unit: 3 percent*  
*Landform: Stream terraces*  
*Landform position (two-dimensional): Shoulder*  
*Landform position (three-dimensional): Tread*  
*Down-slope shape: Linear*  
*Across-slope shape: Linear*

**Poarch**

*Percent of map unit:* 3 percent  
*Landform:* Ridges  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Crest  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear

**Saucier**

*Percent of map unit:* 2 percent  
*Landform:* Coastal plains  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Crest  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear

**EtB—Eustis loamy sand, 0 to 5 percent slopes**

**Map Unit Setting**

*National map unit symbol:* c4xg  
*Mean annual precipitation:* 60 to 75 inches  
*Mean annual air temperature:* 64 to 70 degrees F  
*Frost-free period:* 270 to 335 days  
*Farmland classification:* Farmland of statewide importance

**Map Unit Composition**

*Eustis and similar soils:* 85 percent  
*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of Eustis**

**Setting**

*Landform:* Hillslopes  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Crest  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear  
*Parent material:* Sandy marine deposits

**Typical profile**

*H1 - 0 to 6 inches:* loamy sand  
*H2 - 6 to 24 inches:* sand  
*H3 - 24 to 76 inches:* loamy sand  
*H4 - 76 to 98 inches:* sand

**Properties and qualities**

*Slope:* 0 to 5 percent  
*Depth to restrictive feature:* More than 80 inches  
*Natural drainage class:* Somewhat excessively drained  
*Runoff class:* Very low



Custom Soil Resource Report

*Capacity of the most limiting layer to transmit water (Ksat):* High to very high (6.00 to 20.00 in/hr)

*Depth to water table:* More than 80 inches

*Frequency of flooding:* None

*Frequency of ponding:* None

*Available water storage in profile:* Low (about 5.0 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified

*Land capability classification (nonirrigated):* 3s

*Hydrologic Soil Group:* A

**EuE—Eustis and Poarch soils, 8 to 17 percent slopes**

**Map Unit Setting**

*National map unit symbol:* c4xh

*Elevation:* 20 to 400 feet

*Mean annual precipitation:* 40 to 75 inches

*Mean annual air temperature:* 61 to 72 degrees F

*Frost-free period:* 200 to 335 days

*Farmland classification:* Not prime farmland

**Map Unit Composition**

*Eustis and similar soils:* 42 percent

*Poarch and similar soils:* 33 percent

*Minor components:* 23 percent

*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of Eustis**

**Setting**

*Landform:* Hillslopes

*Landform position (two-dimensional):* Shoulder

*Landform position (three-dimensional):* Side slope

*Down-slope shape:* Linear

*Across-slope shape:* Linear

*Parent material:* Sandy marine deposits

**Typical profile**

*H1 - 0 to 6 inches:* loamy fine sand

*H2 - 6 to 24 inches:* sand

*H3 - 24 to 76 inches:* loamy sand

*H4 - 76 to 98 inches:* sand

**Properties and qualities**

*Slope:* 8 to 17 percent

*Depth to restrictive feature:* More than 80 inches

*Natural drainage class:* Somewhat excessively drained

*Runoff class:* Low

*Capacity of the most limiting layer to transmit water (Ksat):* High to very high (6.00 to 20.00 in/hr)

*Depth to water table:* More than 80 inches

Custom Soil Resource Report

*Frequency of flooding:* None  
*Frequency of ponding:* None  
*Available water storage in profile:* Low (about 5.0 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified  
*Land capability classification (nonirrigated):* 7s  
*Hydrologic Soil Group:* A

**Description of Poarch**

**Setting**

*Landform:* Hillslopes  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Side slope  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear  
*Parent material:* Sandy and loamy marine deposits

**Typical profile**

*H1 - 0 to 7 inches:* fine sandy loam  
*H2 - 7 to 32 inches:* loam  
*H3 - 32 to 66 inches:* loam

**Properties and qualities**

*Slope:* 8 to 12 percent  
*Depth to restrictive feature:* More than 80 inches  
*Natural drainage class:* Well drained  
*Runoff class:* Medium  
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high (0.20 to 0.60 in/hr)  
*Depth to water table:* About 30 to 60 inches  
*Frequency of flooding:* None  
*Frequency of ponding:* None  
*Available water storage in profile:* Moderate (about 8.8 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified  
*Land capability classification (nonirrigated):* 4e  
*Hydrologic Soil Group:* B

**Minor Components**

**Plummer**

*Percent of map unit:* 5 percent  
*Landform:* Flats  
*Landform position (three-dimensional):* Dip  
*Down-slope shape:* Convex  
*Across-slope shape:* Convex

**Lakeland**

*Percent of map unit:* 5 percent  
*Landform:* Coastal plains  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Side slope  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear

**Latonia**

*Percent of map unit:* 5 percent  
*Landform:* Terraces  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Tread  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear

**Smithton**

*Percent of map unit:* 4 percent  
*Landform:* Terraces  
*Landform position (three-dimensional):* Tread, dip  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear

**Smithdale**

*Percent of map unit:* 4 percent  
*Landform:* Hillslopes  
*Landform position (two-dimensional):* Backslope  
*Landform position (three-dimensional):* Side slope  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear

**HIA—Harleston fine sandy loam, 0 to 2 percent slopes**

**Map Unit Setting**

*National map unit symbol:* c4xk  
*Mean annual precipitation:* 60 to 75 inches  
*Mean annual air temperature:* 64 to 70 degrees F  
*Frost-free period:* 270 to 335 days  
*Farmland classification:* All areas are prime farmland

**Map Unit Composition**

*Harleston and similar soils:* 90 percent  
*Minor components:* 2 percent  
*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of Harleston**

**Setting**

*Landform:* Stream terraces  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Tread  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear  
*Parent material:* Loamy alluvium

**Typical profile**

*H1 - 0 to 9 inches:* fine sandy loam

Custom Soil Resource Report

*H2 - 9 to 60 inches: sandy loam*

*H3 - 60 to 72 inches: sandy loam*

**Properties and qualities**

*Slope: 0 to 2 percent*

*Depth to restrictive feature: More than 80 inches*

*Natural drainage class: Moderately well drained*

*Runoff class: Low*

*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 24 to 36 inches*

*Frequency of flooding: None*

*Frequency of ponding: None*

*Available water storage in profile: Moderate (about 8.7 inches)*

**Interpretive groups**

*Land capability classification (irrigated): None specified*

*Land capability classification (nonirrigated): 2w*

*Hydrologic Soil Group: C*

**Minor Components**

**Unnamed hydric soils (133de)**

*Percent of map unit: 2 percent*

*Landform: Depressions*

*Landform position (three-dimensional): Dip*

*Down-slope shape: Concave*

*Across-slope shape: Concave*

**HIB—Harleston fine sandy loam, 2 to 5 percent slopes**

**Map Unit Setting**

*National map unit symbol: c4xl*

*Mean annual precipitation: 60 to 75 inches*

*Mean annual air temperature: 64 to 70 degrees F*

*Frost-free period: 270 to 335 days*

*Farmland classification: All areas are prime farmland*

**Map Unit Composition**

*Harleston and similar soils: 85 percent*

*Minor components: 13 percent*

*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of Harleston**

**Setting**

*Landform: Stream terraces*

*Landform position (two-dimensional): Shoulder*

*Landform position (three-dimensional): Tread*

*Down-slope shape: Linear*

*Across-slope shape: Linear*

Custom Soil Resource Report

*Parent material:* Loamy alluvium

**Typical profile**

*H1 - 0 to 9 inches:* fine sandy loam

*H2 - 9 to 60 inches:* sandy loam

*H3 - 60 to 72 inches:* sandy loam

**Properties and qualities**

*Slope:* 2 to 5 percent

*Depth to restrictive feature:* More than 80 inches

*Natural drainage class:* Moderately well drained

*Runoff class:* Low

*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 24 to 36 inches

*Frequency of flooding:* None

*Frequency of ponding:* None

*Available water storage in profile:* Moderate (about 8.7 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified

*Land capability classification (nonirrigated):* 2e

*Hydrologic Soil Group:* C

**Minor Components**

**Escambia**

*Percent of map unit:* 5 percent

*Landform:* Coastal plains

*Landform position (two-dimensional):* Shoulder

*Landform position (three-dimensional):* Crest

*Down-slope shape:* Linear

*Across-slope shape:* Linear

**Latonia**

*Percent of map unit:* 4 percent

*Landform:* Terraces

*Landform position (two-dimensional):* Shoulder

*Landform position (three-dimensional):* Tread

*Down-slope shape:* Linear

*Across-slope shape:* Linear

**Poarch**

*Percent of map unit:* 4 percent

*Landform:* Ridges

*Landform position (two-dimensional):* Shoulder

*Landform position (three-dimensional):* Crest

*Down-slope shape:* Linear

*Across-slope shape:* Linear

## Lr—Lakeland fine sand

### Map Unit Setting

*National map unit symbol:* c4xn

*Elevation:* 40 to 300 feet

*Mean annual precipitation:* 60 to 75 inches

*Mean annual air temperature:* 64 to 70 degrees F

*Frost-free period:* 270 to 335 days

*Farmland classification:* Farmland of statewide importance

### Map Unit Composition

*Lakeland and similar soils:* 85 percent

*Minor components:* 13 percent

*Estimates are based on observations, descriptions, and transects of the mapunit.*

### Description of Lakeland

#### Setting

*Landform:* Coastal plains

*Landform position (two-dimensional):* Shoulder

*Landform position (three-dimensional):* Crest

*Down-slope shape:* Linear

*Across-slope shape:* Linear

*Parent material:* Sandy marine deposits

#### Typical profile

*H1 - 0 to 43 inches:* fine sand

*H2 - 43 to 80 inches:* sand

#### Properties and qualities

*Slope:* 0 to 2 percent

*Depth to restrictive feature:* More than 80 inches

*Natural drainage class:* Excessively drained

*Runoff class:* Very low

*Capacity of the most limiting layer to transmit water (Ksat):* High to very high (6.00 to 20.00 in/hr)

*Depth to water table:* More than 80 inches

*Frequency of flooding:* None

*Frequency of ponding:* None

*Salinity, maximum in profile:* Nonsaline (0.0 to 2.0 mmhos/cm)

*Available water storage in profile:* Low (about 3.9 inches)

#### Interpretive groups

*Land capability classification (irrigated):* None specified

*Land capability classification (nonirrigated):* 4s

*Hydrologic Soil Group:* A

### Minor Components

#### Eustis

*Percent of map unit:* 5 percent  
*Landform:* Hillslopes  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Side slope  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear

#### Poarch

*Percent of map unit:* 4 percent  
*Landform:* Hillslopes  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Side slope  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear

#### Latonia

*Percent of map unit:* 4 percent  
*Landform:* Terraces  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Tread  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear

### Nh—Nahunta silt loam

#### Map Unit Setting

*National map unit symbol:* c4xs  
*Elevation:* 100 to 300 feet  
*Mean annual precipitation:* 48 to 75 inches  
*Mean annual air temperature:* 63 to 70 degrees F  
*Frost-free period:* 200 to 335 days  
*Farmland classification:* Prime farmland if drained

#### Map Unit Composition

*Nahunta and similar soils:* 85 percent  
*Minor components:* 13 percent  
*Estimates are based on observations, descriptions, and transects of the mapunit.*

#### Description of Nahunta

##### Setting

*Landform:* Terraces  
*Landform position (three-dimensional):* Tread  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear  
*Parent material:* Loamy and silty alluvium deposits

**Typical profile**

*H1 - 0 to 8 inches:* silt loam  
*H2 - 8 to 24 inches:* silt loam  
*H3 - 24 to 34 inches:* sandy clay loam  
*H4 - 34 to 58 inches:* silt loam  
*H5 - 58 to 70 inches:* loam

**Properties and qualities**

*Slope:* 0 to 2 percent  
*Depth to restrictive feature:* More than 80 inches  
*Natural drainage class:* Somewhat poorly drained  
*Runoff class:* Very high  
*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 6 to 18 inches  
*Frequency of flooding:* None  
*Frequency of ponding:* None  
*Available water storage in profile:* High (about 11.6 inches)

**Minor Components**

**Nugent**

*Percent of map unit:* 5 percent  
*Landform:* Natural levees  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Rise  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear

**Saucier**

*Percent of map unit:* 5 percent  
*Landform:* Coastal plains  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Crest  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear

**Smithton**

*Percent of map unit:* 3 percent  
*Landform:* Terraces  
*Landform position (three-dimensional):* Tread, dip  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear

**Pm—Plummer loamy sand**

**Map Unit Setting**

*National map unit symbol:* c4xw  
*Elevation:* 20 to 400 feet  
*Mean annual precipitation:* 40 to 75 inches



Custom Soil Resource Report

*Mean annual air temperature:* 63 to 72 degrees F  
*Frost-free period:* 240 to 335 days  
*Farmland classification:* Not prime farmland

**Map Unit Composition**

*Plummer and similar soils:* 85 percent  
*Minor components:* 13 percent  
*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of Plummer**

**Setting**

*Landform:* Flats  
*Landform position (three-dimensional):* Dip  
*Down-slope shape:* Convex  
*Across-slope shape:* Convex  
*Parent material:* Sandy marine deposits

**Typical profile**

*H1 - 0 to 50 inches:* loamy sand  
*H2 - 50 to 72 inches:* sandy clay loam

**Properties and qualities**

*Slope:* 0 to 2 percent  
*Depth to restrictive feature:* More than 80 inches  
*Natural drainage class:* Poorly drained  
*Runoff class:* Very high  
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high to high  
(0.20 to 2.00 in/hr)  
*Depth to water table:* About 0 to 12 inches  
*Frequency of flooding:* Rare  
*Frequency of ponding:* None  
*Available water storage in profile:* Low (about 4.6 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified  
*Land capability classification (nonirrigated):* 4w  
*Hydrologic Soil Group:* B/D

**Minor Components**

**Atmore**

*Percent of map unit:* 5 percent  
*Landform:* Depressions  
*Landform position (three-dimensional):* Dip  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear

**Ocilla**

*Percent of map unit:* 4 percent  
*Landform:* Stream terraces  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Tread  
*Down-slope shape:* Convex  
*Across-slope shape:* Convex

**Nugent**

*Percent of map unit:* 4 percent

Custom Soil Resource Report

*Landform:* Natural levees  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Rise  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear

**PoA—Poarch fine sandy loam, 0 to 2 percent slopes**

**Map Unit Setting**

*National map unit symbol:* c4xx  
*Elevation:* 100 to 550 feet  
*Mean annual precipitation:* 45 to 75 inches  
*Mean annual air temperature:* 61 to 70 degrees F  
*Frost-free period:* 200 to 335 days  
*Farmland classification:* All areas are prime farmland

**Map Unit Composition**

*Poarch and similar soils:* 85 percent  
*Minor components:* 13 percent  
*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of Poarch**

**Setting**

*Landform:* Ridges  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Crest  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear  
*Parent material:* Sandy and loamy marine deposits

**Typical profile**

*H1 - 0 to 7 inches:* fine sandy loam  
*H2 - 7 to 32 inches:* loam  
*H3 - 32 to 66 inches:* loam

**Properties and qualities**

*Slope:* 0 to 2 percent  
*Depth to restrictive feature:* More than 80 inches  
*Natural drainage class:* Well drained  
*Runoff class:* Low  
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high (0.20 to 0.60 in/hr)  
*Depth to water table:* About 30 to 60 inches  
*Frequency of flooding:* None  
*Frequency of ponding:* None  
*Available water storage in profile:* Moderate (about 8.8 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified  
*Land capability classification (nonirrigated):* 1

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*Hydrologic Soil Group: B*

**Minor Components**

**Harleston**

*Percent of map unit: 5 percent*  
*Landform: Stream terraces*  
*Landform position (two-dimensional): Shoulder*  
*Landform position (three-dimensional): Tread*  
*Down-slope shape: Linear*  
*Across-slope shape: Linear*

**Ruston**

*Percent of map unit: 5 percent*  
*Landform: Coastal plains*  
*Landform position (two-dimensional): Shoulder*  
*Landform position (three-dimensional): Side slope*  
*Down-slope shape: Linear*  
*Across-slope shape: Linear*

**Smithton**

*Percent of map unit: 3 percent*  
*Landform: Terraces*  
*Landform position (three-dimensional): Tread, dip*  
*Down-slope shape: Linear*  
*Across-slope shape: Linear*

**PoB—Poarch fine sandy loam, 2 to 5 percent slopes**

**Map Unit Setting**

*National map unit symbol: c4xy*  
*Mean annual precipitation: 60 to 75 inches*  
*Mean annual air temperature: 64 to 70 degrees F*  
*Frost-free period: 270 to 335 days*  
*Farmland classification: All areas are prime farmland*

**Map Unit Composition**

*Poarch and similar soils: 90 percent*  
*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of Poarch**

**Setting**

*Landform: Ridges*  
*Landform position (two-dimensional): Shoulder*  
*Landform position (three-dimensional): Crest*  
*Down-slope shape: Linear*  
*Across-slope shape: Linear*  
*Parent material: Sandy and loamy marine deposits*

**Typical profile**

*H1 - 0 to 10 inches:* fine sandy loam  
*H2 - 10 to 73 inches:* loam  
*H3 - 73 to 81 inches:* loam

**Properties and qualities**

*Slope:* 2 to 5 percent  
*Depth to restrictive feature:* More than 80 inches  
*Natural drainage class:* Well drained  
*Runoff class:* Low  
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high (0.20 to 0.60 in/hr)  
*Depth to water table:* About 30 to 60 inches  
*Frequency of flooding:* None  
*Frequency of ponding:* None  
*Available water storage in profile:* Moderate (about 8.8 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified  
*Land capability classification (nonirrigated):* 2e  
*Hydrologic Soil Group:* B

**PoC—Poarch fine sandy loam, 5 to 12 percent slopes**

**Map Unit Setting**

*National map unit symbol:* c4xz  
*Elevation:* 100 to 300 feet  
*Mean annual precipitation:* 48 to 75 inches  
*Mean annual air temperature:* 63 to 70 degrees F  
*Frost-free period:* 200 to 335 days  
*Farmland classification:* Farmland of statewide importance

**Map Unit Composition**

*Poarch and similar soils:* 85 percent  
*Minor components:* 12 percent  
*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of Poarch**

**Setting**

*Landform:* Hillslopes  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Side slope  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear  
*Parent material:* Sandy and loamy marine deposits

**Typical profile**

*H1 - 0 to 7 inches:* fine sandy loam  
*H2 - 7 to 32 inches:* loam  
*H3 - 32 to 66 inches:* loam

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**Properties and qualities**

*Slope:* 5 to 12 percent

*Depth to restrictive feature:* More than 80 inches

*Natural drainage class:* Well drained

*Runoff class:* Medium

*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high (0.20 to 0.60 in/hr)

*Depth to water table:* About 30 to 60 inches

*Frequency of flooding:* None

*Frequency of ponding:* None

*Available water storage in profile:* Moderate (about 8.8 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified

*Land capability classification (nonirrigated):* 4e

*Hydrologic Soil Group:* B

**Minor Components**

**Smithton**

*Percent of map unit:* 4 percent

*Landform:* Terraces

*Landform position (three-dimensional):* Tread, dip

*Down-slope shape:* Linear

*Across-slope shape:* Linear

**Harleston**

*Percent of map unit:* 4 percent

*Landform:* Stream terraces

*Landform position (two-dimensional):* Shoulder

*Landform position (three-dimensional):* Tread

*Down-slope shape:* Linear

*Across-slope shape:* Linear

**Smithdale**

*Percent of map unit:* 4 percent

*Landform:* Hillslopes

*Landform position (two-dimensional):* Backslope

*Landform position (three-dimensional):* Side slope

*Down-slope shape:* Linear

*Across-slope shape:* Linear

**Ps—Ponzer and Smithton soils**

**Map Unit Setting**

*National map unit symbol:* c4y0

*Elevation:* 100 to 300 feet

*Mean annual precipitation:* 60 to 75 inches

*Mean annual air temperature:* 64 to 70 degrees F

*Frost-free period:* 270 to 335 days

Custom Soil Resource Report

*Farmland classification:* Not prime farmland

**Map Unit Composition**

*Ponzer and similar soils:* 59 percent

*Smithton and similar soils:* 18 percent

*Minor components:* 22 percent

*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of Ponzer**

**Setting**

*Landform:* Drainageways

*Landform position (three-dimensional):* Dip

*Down-slope shape:* Convex

*Across-slope shape:* Convex

*Parent material:* Decomposed organic material over loamy alluvium

**Typical profile**

*Oa - 0 to 24 inches:* muck

*H2 - 24 to 52 inches:* loam

*H3 - 52 to 72 inches:* loam

**Properties and qualities**

*Slope:* 0 to 1 percent

*Depth to restrictive feature:* More than 80 inches

*Natural drainage class:* Very poorly drained

*Runoff class:* Very high

*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high to high  
(0.20 to 2.00 in/hr)

*Depth to water table:* About 0 to 12 inches

*Frequency of flooding:* Frequent

*Frequency of ponding:* None

*Salinity, maximum in profile:* Nonsaline (0.0 to 2.0 mmhos/cm)

*Sodium adsorption ratio, maximum in profile:* 4.0

*Available water storage in profile:* High (about 11.6 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified

*Land capability classification (nonirrigated):* 7w

*Hydrologic Soil Group:* D

**Description of Smithton**

**Setting**

*Landform:* Terraces

*Landform position (three-dimensional):* Tread, dip

*Down-slope shape:* Linear

*Across-slope shape:* Linear

*Parent material:* Loamy alluvium

**Typical profile**

*H1 - 0 to 1 inches:* fine sandy loam

*H2 - 1 to 10 inches:* fine sandy loam

*H3 - 10 to 38 inches:* fine sandy loam

*H4 - 38 to 72 inches:* fine sandy loam

**Properties and qualities**

*Slope:* 0 to 2 percent

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*Depth to restrictive feature:* More than 80 inches  
*Natural drainage class:* Poorly drained  
*Runoff class:* Very high  
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high (0.20 to 0.60 in/hr)  
*Depth to water table:* About 0 to 12 inches  
*Frequency of flooding:* Frequent  
*Frequency of ponding:* None  
*Available water storage in profile:* High (about 9.5 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified  
*Land capability classification (nonirrigated):* 5w  
*Hydrologic Soil Group:* D

**Minor Components**

**Hyde**

*Percent of map unit:* 8 percent  
*Landform:* Terraces  
*Landform position (three-dimensional):* Tread  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear

**Handsboro**

*Percent of map unit:* 7 percent  
*Landform:* Tidal flats  
*Landform position (three-dimensional):* Dip  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear

**St. lucie**

*Percent of map unit:* 7 percent  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Crest  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear

**RuB—Ruston fine sandy loam, 2 to 5 percent slopes**

**Map Unit Setting**

*National map unit symbol:* c4y2  
*Elevation:* 100 to 550 feet  
*Mean annual precipitation:* 60 to 75 inches  
*Mean annual air temperature:* 64 to 70 degrees F  
*Frost-free period:* 270 to 335 days  
*Farmland classification:* All areas are prime farmland

**Map Unit Composition**

*Ruston and similar soils:* 95 percent

Custom Soil Resource Report

*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of Ruston**

**Setting**

*Landform:* Coastal plains  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Side slope  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear  
*Parent material:* Loamy fluviomarine deposits

**Typical profile**

*H1 - 0 to 7 inches:* fine sandy loam  
*H2 - 7 to 18 inches:* sandy clay loam  
*H3 - 18 to 39 inches:* sandy loam  
*H4 - 39 to 85 inches:* sandy clay loam

**Properties and qualities**

*Slope:* 2 to 5 percent  
*Depth to restrictive feature:* More than 80 inches  
*Natural drainage class:* Well drained  
*Runoff class:* Low  
*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 storage in profile:* Moderate (about 8.6 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified  
*Land capability classification (nonirrigated):* 3e  
*Hydrologic Soil Group:* B

**RuC—Ruston fine sandy loam, 5 to 8 percent slopes**

**Map Unit Setting**

*National map unit symbol:* c4y3  
*Elevation:* 100 to 550 feet  
*Mean annual precipitation:* 60 to 75 inches  
*Mean annual air temperature:* 64 to 70 degrees F  
*Frost-free period:* 270 to 335 days  
*Farmland classification:* All areas are prime farmland

**Map Unit Composition**

*Ruston and similar soils:* 95 percent  
*Minor components:* 2 percent  
*Estimates are based on observations, descriptions, and transects of the mapunit.*



**Description of Ruston**

**Setting**

*Landform:* Coastal plains  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Side slope  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear  
*Parent material:* Loamy fluviomarine deposits

**Typical profile**

*H1 - 0 to 7 inches:* fine sandy loam  
*H2 - 7 to 18 inches:* sandy clay loam  
*H3 - 18 to 39 inches:* sandy loam  
*H4 - 39 to 85 inches:* loam

**Properties and qualities**

*Slope:* 5 to 8 percent  
*Depth to restrictive feature:* More than 80 inches  
*Natural drainage class:* Well drained  
*Runoff class:* Medium  
*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 storage in profile:* Moderate (about 8.6 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified  
*Land capability classification (nonirrigated):* 3e  
*Hydrologic Soil Group:* B

**Minor Components**

**Unnamed hydric soils (133dr)**

*Percent of map unit:* 2 percent  
*Landform:* Drainageways  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Dip  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear

**RuD—Ruston fine sandy loam, 8 to 12 percent slopes (smithdale)**

**Map Unit Setting**

*National map unit symbol:* c4y4  
*Elevation:* 100 to 300 feet  
*Mean annual precipitation:* 48 to 75 inches  
*Mean annual air temperature:* 63 to 70 degrees F

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*Frost-free period:* 200 to 335 days

*Farmland classification:* Farmland of statewide importance

**Map Unit Composition**

*Smithdale and similar soils:* 90 percent

*Minor components:* 5 percent

*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of Smithdale**

**Setting**

*Landform:* Hillslopes

*Landform position (two-dimensional):* Backslope

*Landform position (three-dimensional):* Side slope

*Down-slope shape:* Linear

*Across-slope shape:* Linear

*Parent material:* Loamy fluviomarine deposits

**Typical profile**

*H1 - 0 to 11 inches:* fine sandy loam

*H2 - 11 to 38 inches:* loam

*H3 - 38 to 80 inches:* loam

**Properties and qualities**

*Slope:* 8 to 12 percent

*Depth to restrictive feature:* More than 80 inches

*Natural drainage class:* Well drained

*Runoff class:* Medium

*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 storage in profile:* High (about 9.2 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified

*Land capability classification (nonirrigated):* 4e

*Hydrologic Soil Group:* B

**Minor Components**

**Smithton**

*Percent of map unit:* 5 percent

*Landform:* Terraces

*Landform position (three-dimensional):* Tread, dip

*Down-slope shape:* Linear

*Across-slope shape:* Linear

## **SfB—Saucier fine sandy loam, 2 to 5 percent slopes**

### **Map Unit Setting**

*National map unit symbol:* c4y6  
*Elevation:* 100 to 550 feet  
*Mean annual precipitation:* 45 to 75 inches  
*Mean annual air temperature:* 61 to 70 degrees F  
*Frost-free period:* 200 to 335 days  
*Farmland classification:* All areas are prime farmland

### **Map Unit Composition**

*Saucier and similar soils:* 85 percent  
*Minor components:* 14 percent  
*Estimates are based on observations, descriptions, and transects of the mapunit.*

### **Description of Saucier**

#### **Setting**

*Landform:* Coastal plains  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Crest  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear  
*Parent material:* Loamy over clayey marine deposits

#### **Typical profile**

*H1 - 0 to 12 inches:* fine sandy loam  
*H2 - 12 to 48 inches:* loam  
*H3 - 48 to 60 inches:* silty clay loam  
*H4 - 60 to 72 inches:* clay

#### **Properties and qualities**

*Slope:* 2 to 5 percent  
*Depth to restrictive feature:* More than 80 inches  
*Natural drainage class:* Moderately well drained  
*Runoff class:* Low  
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately low to moderately high (0.06 to 0.20 in/hr)  
*Depth to water table:* About 30 to 48 inches  
*Frequency of flooding:* None  
*Frequency of ponding:* None  
*Available water storage in profile:* High (about 10.3 inches)

#### **Interpretive groups**

*Land capability classification (irrigated):* None specified  
*Land capability classification (nonirrigated):* 2e  
*Hydrologic Soil Group:* C

**Minor Components**

**Ruston**

*Percent of map unit:* 4 percent  
*Landform:* Coastal plains  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Crest  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear

**Poarch**

*Percent of map unit:* 4 percent  
*Landform:* Ridges  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Crest  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear

**Harleston**

*Percent of map unit:* 4 percent  
*Landform:* Stream terraces  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Tread  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear

**Smithton**

*Percent of map unit:* 2 percent  
*Landform:* Terraces  
*Landform position (three-dimensional):* Tread, dip  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear

**SfC—Saucier fine sandy loam, 5 to 8 percent slopes**

**Map Unit Setting**

*National map unit symbol:* c4y7  
*Elevation:* 100 to 550 feet  
*Mean annual precipitation:* 45 to 75 inches  
*Mean annual air temperature:* 61 to 70 degrees F  
*Frost-free period:* 200 to 335 days  
*Farmland classification:* Farmland of statewide importance

**Map Unit Composition**

*Saucier and similar soils:* 85 percent  
*Minor components:* 14 percent  
*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of Saucier**

**Setting**

*Landform:* Coastal plains  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Side slope  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear  
*Parent material:* Loamy over clayey marine deposits

**Typical profile**

*H1 - 0 to 12 inches:* fine sandy loam  
*H2 - 12 to 48 inches:* loam  
*H3 - 48 to 60 inches:* silty clay loam  
*H4 - 60 to 72 inches:* clay

**Properties and qualities**

*Slope:* 5 to 8 percent  
*Depth to restrictive feature:* More than 80 inches  
*Natural drainage class:* Moderately well drained  
*Runoff class:* Medium  
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately low to moderately high (0.06 to 0.20 in/hr)  
*Depth to water table:* About 30 to 48 inches  
*Frequency of flooding:* None  
*Frequency of ponding:* None  
*Available water storage in profile:* High (about 10.3 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified  
*Land capability classification (nonirrigated):* 3e  
*Hydrologic Soil Group:* C

**Minor Components**

**Harleston**

*Percent of map unit:* 4 percent  
*Landform:* Stream terraces  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Riser  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear

**Poarch**

*Percent of map unit:* 4 percent  
*Landform:* Hillslopes  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Side slope  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear

**Ruston**

*Percent of map unit:* 4 percent  
*Landform:* Coastal plains  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Side slope  
*Down-slope shape:* Linear

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*Across-slope shape:* Linear

**Smithton**

*Percent of map unit:* 2 percent

*Landform:* Terraces

*Landform position (three-dimensional):* Tread, dip

*Down-slope shape:* Linear

*Across-slope shape:* Linear

**ShC—Saucier, Smithton, and Susquehanna soils, rolling**

**Map Unit Setting**

*National map unit symbol:* c4y8

*Elevation:* 100 to 300 feet

*Mean annual precipitation:* 60 to 75 inches

*Mean annual air temperature:* 64 to 70 degrees F

*Frost-free period:* 270 to 335 days

*Farmland classification:* Not prime farmland

**Map Unit Composition**

*Saucier and similar soils:* 45 percent

*Smithton and similar soils:* 20 percent

*Susquehanna and similar soils:* 10 percent

*Minor components:* 24 percent

*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of Saucier**

**Setting**

*Landform:* Coastal plains

*Landform position (two-dimensional):* Shoulder

*Landform position (three-dimensional):* Side slope

*Down-slope shape:* Linear

*Across-slope shape:* Linear

*Parent material:* Loamy over clayey marine deposits

**Typical profile**

*H1 - 0 to 12 inches:* fine sandy loam

*H2 - 12 to 48 inches:* loam

*H3 - 48 to 60 inches:* silty clay loam

*H4 - 60 to 72 inches:* clay

**Properties and qualities**

*Slope:* 5 to 12 percent

*Depth to restrictive feature:* More than 80 inches

*Natural drainage class:* Moderately well drained

*Runoff class:* Medium

*Capacity of the most limiting layer to transmit water (Ksat):* Moderately low to moderately high (0.06 to 0.20 in/hr)

*Depth to water table:* About 30 to 48 inches

*Frequency of flooding:* None

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*Frequency of ponding:* None  
*Available water storage in profile:* High (about 10.3 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified  
*Land capability classification (nonirrigated):* 4e  
*Hydrologic Soil Group:* C

**Description of Smithton**

**Setting**

*Landform:* Terraces  
*Landform position (three-dimensional):* Tread, dip  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear  
*Parent material:* Loamy alluvium

**Typical profile**

*H1 - 0 to 1 inches:* fine sandy loam  
*H2 - 1 to 10 inches:* fine sandy loam  
*H3 - 10 to 38 inches:* fine sandy loam  
*H4 - 38 to 72 inches:* fine sandy loam

**Properties and qualities**

*Slope:* 0 to 2 percent  
*Depth to restrictive feature:* More than 80 inches  
*Natural drainage class:* Poorly drained  
*Runoff class:* Very high  
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high (0.20 to 0.60 in/hr)  
*Depth to water table:* About 0 to 12 inches  
*Frequency of flooding:* None  
*Frequency of ponding:* None  
*Available water storage in profile:* High (about 9.5 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified  
*Land capability classification (nonirrigated):* 3w  
*Hydrologic Soil Group:* D

**Description of Susquehanna**

**Setting**

*Landform:* Coastal plains  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Side slope  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear  
*Parent material:* Clayey marine deposits

**Typical profile**

*H1 - 0 to 5 inches:* fine sandy loam  
*H2 - 5 to 77 inches:* clay

**Properties and qualities**

*Slope:* 5 to 12 percent  
*Depth to restrictive feature:* More than 80 inches  
*Natural drainage class:* Somewhat poorly drained

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*Runoff class:* High

*Capacity of the most limiting layer to transmit water (Ksat):* Very low to moderately low (0.00 to 0.06 in/hr)

*Depth to water table:* More than 80 inches

*Frequency of flooding:* None

*Frequency of ponding:* None

*Available water storage in profile:* High (about 10.5 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified

*Land capability classification (nonirrigated):* 6e

*Hydrologic Soil Group:* D

**Minor Components**

**Harleston**

*Percent of map unit:* 8 percent

*Landform:* Stream terraces

*Landform position (two-dimensional):* Shoulder

*Landform position (three-dimensional):* Riser

*Down-slope shape:* Linear

*Across-slope shape:* Linear

**Poarch**

*Percent of map unit:* 8 percent

*Landform:* Hillslopes

*Landform position (two-dimensional):* Shoulder

*Landform position (three-dimensional):* Side slope

*Down-slope shape:* Linear

*Across-slope shape:* Linear

**Atmore**

*Percent of map unit:* 8 percent

*Landform:* Depressions

*Landform position (three-dimensional):* Dip

*Down-slope shape:* Linear

*Across-slope shape:* Linear

**SnB—Saucier-Susquehanna complex, 2 to 5 percent slopes**

**Map Unit Setting**

*National map unit symbol:* c4y9

*Elevation:* 100 to 300 feet

*Mean annual precipitation:* 48 to 75 inches

*Mean annual air temperature:* 63 to 70 degrees F

*Frost-free period:* 200 to 335 days

*Farmland classification:* Not prime farmland



### Map Unit Composition

*Saucier and similar soils:* 50 percent

*Susquehanna and similar soils:* 25 percent

*Minor components:* 23 percent

*Estimates are based on observations, descriptions, and transects of the mapunit.*

### Description of Saucier

#### Setting

*Landform:* Coastal plains

*Landform position (two-dimensional):* Shoulder

*Landform position (three-dimensional):* Crest

*Down-slope shape:* Linear

*Across-slope shape:* Linear

*Parent material:* Loamy over clayey marine deposits

#### Typical profile

*H1 - 0 to 12 inches:* fine sandy loam

*H2 - 12 to 48 inches:* loam

*H3 - 48 to 60 inches:* silty clay loam

*H4 - 60 to 72 inches:* clay

#### Properties and qualities

*Slope:* 2 to 5 percent

*Depth to restrictive feature:* More than 80 inches

*Natural drainage class:* Moderately well drained

*Runoff class:* Low

*Capacity of the most limiting layer to transmit water (Ksat):* Moderately low to moderately high (0.06 to 0.20 in/hr)

*Depth to water table:* About 30 to 48 inches

*Frequency of flooding:* None

*Frequency of ponding:* None

*Available water storage in profile:* High (about 10.3 inches)

#### Interpretive groups

*Land capability classification (irrigated):* None specified

*Land capability classification (nonirrigated):* 2e

*Hydrologic Soil Group:* C

### Description of Susquehanna

#### Setting

*Landform:* Coastal plains

*Landform position (two-dimensional):* Shoulder

*Landform position (three-dimensional):* Crest

*Down-slope shape:* Linear

*Across-slope shape:* Linear

*Parent material:* Clayey marine deposits

#### Typical profile

*H1 - 0 to 5 inches:* fine sandy loam

*H2 - 5 to 77 inches:* clay

#### Properties and qualities

*Slope:* 2 to 5 percent

*Depth to restrictive feature:* More than 80 inches

*Natural drainage class:* Somewhat poorly drained

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*Runoff class:* Medium

*Capacity of the most limiting layer to transmit water (Ksat):* Very low to moderately low (0.00 to 0.06 in/hr)

*Depth to water table:* More than 80 inches

*Frequency of flooding:* None

*Frequency of ponding:* None

*Available water storage in profile:* High (about 10.5 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified

*Land capability classification (nonirrigated):* 4e

*Hydrologic Soil Group:* D

**Minor Components**

**Harleston**

*Percent of map unit:* 9 percent

*Landform:* Stream terraces

*Landform position (two-dimensional):* Shoulder

*Landform position (three-dimensional):* Riser

*Down-slope shape:* Linear

*Across-slope shape:* Linear

**Poarch**

*Percent of map unit:* 9 percent

*Landform:* Hillslopes

*Landform position (two-dimensional):* Shoulder

*Landform position (three-dimensional):* Side slope

*Down-slope shape:* Linear

*Across-slope shape:* Linear

**Smithton**

*Percent of map unit:* 5 percent

*Landform:* Terraces

*Landform position (three-dimensional):* Tread, dip

*Down-slope shape:* Linear

*Across-slope shape:* Linear

**SsE—Smithdale fine sandy loam, 12 to 17 percent slopes**

**Map Unit Setting**

*National map unit symbol:* c4yb

*Elevation:* 100 to 550 feet

*Mean annual precipitation:* 45 to 75 inches

*Mean annual air temperature:* 61 to 70 degrees F

*Frost-free period:* 200 to 335 days

*Farmland classification:* Not prime farmland

**Map Unit Composition**

*Smithdale and similar soils:* 85 percent

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*Minor components: 14 percent  
Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of Smithdale**

**Setting**

*Landform: Hillslopes  
Landform position (two-dimensional): Backslope  
Landform position (three-dimensional): Side slope  
Down-slope shape: Linear  
Across-slope shape: Linear  
Parent material: Loamy fluviomarine deposits*

**Typical profile**

*H1 - 0 to 11 inches: fine sandy loam  
H2 - 11 to 38 inches: loam  
H3 - 38 to 80 inches: loam*

**Properties and qualities**

*Slope: 12 to 17 percent  
Depth to restrictive feature: More than 80 inches  
Natural drainage class: Well drained  
Runoff class: Medium  
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 storage in profile: High (about 9.2 inches)*

**Interpretive groups**

*Land capability classification (irrigated): None specified  
Land capability classification (nonirrigated): 6e  
Hydrologic Soil Group: B*

**Minor Components**

**Ruston**

*Percent of map unit: 4 percent  
Landform: Coastal plains  
Landform position (two-dimensional): Shoulder  
Landform position (three-dimensional): Side slope  
Down-slope shape: Linear  
Across-slope shape: Linear*

**Mclaurin**

*Percent of map unit: 4 percent  
Landform: Coastal plains  
Landform position (two-dimensional): Shoulder  
Landform position (three-dimensional): Side slope  
Down-slope shape: Linear  
Across-slope shape: Linear*

**Poarch**

*Percent of map unit: 4 percent  
Landform: Hillslopes  
Landform position (two-dimensional): Shoulder  
Landform position (three-dimensional): Side slope*

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*Down-slope shape:* Linear  
*Across-slope shape:* Linear

**Smithton**

*Percent of map unit:* 2 percent  
*Landform:* Terraces  
*Landform position (three-dimensional):* Tread, dip  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear

**St—Smithton fine sandy loam**

**Map Unit Setting**

*National map unit symbol:* c4yc  
*Elevation:* 100 to 300 feet  
*Mean annual precipitation:* 60 to 75 inches  
*Mean annual air temperature:* 64 to 70 degrees F  
*Frost-free period:* 270 to 335 days  
*Farmland classification:* Prime farmland if drained

**Map Unit Composition**

*Smithton and similar soils:* 85 percent  
*Minor components:* 12 percent  
*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of Smithton**

**Setting**

*Landform:* Terraces  
*Landform position (three-dimensional):* Tread, dip  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear  
*Parent material:* Loamy alluvium

**Typical profile**

*H1 - 0 to 1 inches:* fine sandy loam  
*H2 - 1 to 10 inches:* fine sandy loam  
*H3 - 10 to 38 inches:* fine sandy loam  
*H4 - 38 to 72 inches:* fine sandy loam

**Properties and qualities**

*Slope:* 0 to 2 percent  
*Depth to restrictive feature:* More than 80 inches  
*Natural drainage class:* Poorly drained  
*Runoff class:* Very high  
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high (0.20 to 0.60 in/hr)  
*Depth to water table:* About 0 to 12 inches  
*Frequency of flooding:* Occasional  
*Frequency of ponding:* None  
*Available water storage in profile:* High (about 9.5 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified

*Land capability classification (nonirrigated):* 4w

*Hydrologic Soil Group:* D

**Minor Components**

**Escambia**

*Percent of map unit:* 4 percent

*Landform:* Coastal plains

*Landform position (two-dimensional):* Shoulder

*Landform position (three-dimensional):* Crest

*Down-slope shape:* Linear

*Across-slope shape:* Linear

**Saucier**

*Percent of map unit:* 4 percent

*Landform:* Coastal plains

*Landform position (two-dimensional):* Shoulder

*Landform position (three-dimensional):* Crest

*Down-slope shape:* Linear

*Across-slope shape:* Linear

**Ponzer**

*Percent of map unit:* 4 percent

*Landform:* Drainageways

*Landform position (two-dimensional):* Shoulder

*Landform position (three-dimensional):* Dip

*Down-slope shape:* Linear

*Across-slope shape:* Linear

**W—Water**

**Map Unit Composition**

*Water:* 100 percent

*Estimates are based on observations, descriptions, and transects of the mapunit.*

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# Glossary

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Many of the terms relating to landforms, geology, and geomorphology are defined in more detail in the "[National Soil Survey Handbook](#)."

## **ABC soil**

A soil having an A, a B, and a C horizon.

## **Ablation till**

Loose, relatively permeable earthy material deposited during the downwasting of nearly static glacial ice, either contained within or accumulated on the surface of the glacier.

## **AC soil**

A soil having only an A and a C horizon. Commonly, such soil formed in recent alluvium or on steep, rocky slopes.

## **Aeration, soil**

The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

## **Aggregate, soil**

Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

## **Alkali (sodic) soil**

A soil having so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

## **Alluvial cone**

A semiconical type of alluvial fan having very steep slopes. It is higher, narrower, and steeper than a fan and is composed of coarser and thicker layers of material deposited by a combination of alluvial episodes and (to a much lesser degree) landslides (debris flow). The coarsest materials tend to be concentrated at the apex of the cone.



**Alluvial fan**

A low, outspread mass of loose materials and/or rock material, commonly with gentle slopes. It is shaped like an open fan or a segment of a cone. The material was deposited by a stream at the place where it issues from a narrow mountain valley or upland valley or where a tributary stream is near or at its junction with the main stream. The fan is steepest near its apex, which points upstream, and slopes gently and convexly outward (downstream) with a gradual decrease in gradient.

**Alluvium**

Unconsolidated material, such as gravel, sand, silt, clay, and various mixtures of these, deposited on land by running water.

**Alpha,alpha-dipyridyl**

A compound that when dissolved in ammonium acetate is used to detect the presence of reduced iron (Fe II) in the soil. A positive reaction implies reducing conditions and the likely presence of redoximorphic features.

**Animal unit month (AUM)**

The amount of forage required by one mature cow of approximately 1,000 pounds weight, with or without a calf, for 1 month.

**Aquic conditions**

Current soil wetness characterized by saturation, reduction, and redoximorphic features.

**Argillic horizon**

A subsoil horizon characterized by an accumulation of illuvial clay.

**Arroyo**

The flat-floored channel of an ephemeral stream, commonly with very steep to vertical banks cut in unconsolidated material. It is usually dry but can be transformed into a temporary watercourse or short-lived torrent after heavy rain within the watershed.

**Aspect**

The direction toward which a slope faces. Also called slope aspect.

**Association, soil**

A group of soils or miscellaneous areas geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

**Available water capacity (available moisture capacity)**

The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as:

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*Very low:* 0 to 3

*Low:* 3 to 6

*Moderate:* 6 to 9

*High:* 9 to 12

*Very high:* More than 12

#### **Backslope**

The position that forms the steepest and generally linear, middle portion of a hillslope. In profile, backslopes are commonly bounded by a convex shoulder above and a concave footslope below.

#### **Backswamp**

A flood-plain landform. Extensive, marshy or swampy, depressed areas of flood plains between natural levees and valley sides or terraces.

#### **Badland**

A landscape that is intricately dissected and characterized by a very fine drainage network with high drainage densities and short, steep slopes and narrow interfluvies. Badlands develop on surfaces that have little or no vegetative cover overlying unconsolidated or poorly cemented materials (clays, silts, or sandstones) with, in some cases, soluble minerals, such as gypsum or halite.

#### **Bajada**

A broad, gently inclined alluvial piedmont slope extending from the base of a mountain range out into a basin and formed by the lateral coalescence of a series of alluvial fans. Typically, it has a broadly undulating transverse profile, parallel to the mountain front, resulting from the convexities of component fans. The term is generally restricted to constructional slopes of intermontane basins.

#### **Basal area**

The area of a cross section of a tree, generally referring to the section at breast height and measured outside the bark. It is a measure of stand density, commonly expressed in square feet.

#### **Base saturation**

The degree to which material having cation-exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, and K), expressed as a percentage of the total cation-exchange capacity.

#### **Base slope (geomorphology)**

A geomorphic component of hills consisting of the concave to linear (perpendicular to the contour) slope that, regardless of the lateral shape, forms an apron or wedge at the bottom of a hillside dominated by colluvium and slope-wash sediments (for example, slope alluvium).

#### **Bedding plane**

A planar or nearly planar bedding surface that visibly separates each successive layer of stratified sediment or rock (of the same or different lithology) from the preceding or following layer; a plane of deposition. It commonly marks a change

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in the circumstances of deposition and may show a parting, a color difference, a change in particle size, or various combinations of these. The term is commonly applied to any bedding surface, even one that is conspicuously bent or deformed by folding.

#### **Bedding system**

A drainage system made by plowing, grading, or otherwise shaping the surface of a flat field. It consists of a series of low ridges separated by shallow, parallel dead furrows.

#### **Bedrock**

The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

#### **Bedrock-controlled topography**

A landscape where the configuration and relief of the landforms are determined or strongly influenced by the underlying bedrock.

#### **Bench terrace**

A raised, level or nearly level strip of earth constructed on or nearly on a contour, supported by a barrier of rocks or similar material, and designed to make the soil suitable for tillage and to prevent accelerated erosion.

#### **Bisequum**

Two sequences of soil horizons, each of which consists of an illuvial horizon and the overlying eluvial horizons.

#### **Blowout (map symbol)**

A saucer-, cup-, or trough-shaped depression formed by wind erosion on a preexisting dune or other sand deposit, especially in an area of shifting sand or loose soil or where protective vegetation is disturbed or destroyed. The adjoining accumulation of sand derived from the depression, where recognizable, is commonly included. Blowouts are commonly small.

#### **Borrow pit (map symbol)**

An open excavation from which soil and underlying material have been removed, usually for construction purposes.

#### **Bottom land**

An informal term loosely applied to various portions of a flood plain.

#### **Boulders**

Rock fragments larger than 2 feet (60 centimeters) in diameter.

#### **Breaks**

A landscape or tract of steep, rough or broken land dissected by ravines and gullies and marking a sudden change in topography.

#### **Breast height**

An average height of 4.5 feet above the ground surface; the point on a tree where diameter measurements are ordinarily taken.

#### **Brush management**

Use of mechanical, chemical, or biological methods to make conditions favorable for reseeding or to reduce or eliminate competition from woody vegetation and thus allow understory grasses and forbs to recover. Brush management increases forage production and thus reduces the hazard of erosion. It can improve the habitat for some species of wildlife.

#### **Butte**

An isolated, generally flat-topped hill or mountain with relatively steep slopes and talus or precipitous cliffs and characterized by summit width that is less than the height of bounding escarpments; commonly topped by a caprock of resistant material and representing an erosion remnant carved from flat-lying rocks.

#### **Cable yarding**

A method of moving felled trees to a nearby central area for transport to a processing facility. Most cable yarding systems involve use of a drum, a pole, and wire cables in an arrangement similar to that of a rod and reel used for fishing. To reduce friction and soil disturbance, felled trees generally are reeled in while one end is lifted or the entire log is suspended.

#### **Calcareous soil**

A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

#### **Caliche**

A general term for a prominent zone of secondary carbonate accumulation in surficial materials in warm, subhumid to arid areas. Caliche is formed by both geologic and pedologic processes. Finely crystalline calcium carbonate forms a nearly continuous surface-coating and void-filling medium in geologic (parent) materials. Cementation ranges from weak in nonindurated forms to very strong in indurated forms. Other minerals (e.g., carbonates, silicate, and sulfate) may occur as accessory cements. Most petrocalcic horizons and some calcic horizons are caliche.

#### **California bearing ratio (CBR)**

The load-supporting capacity of a soil as compared to that of standard crushed limestone, expressed as a ratio. First standardized in California. A soil having a CBR of 16 supports 16 percent of the load that would be supported by standard crushed limestone, per unit area, with the same degree of distortion.

#### **Canopy**

The leafy crown of trees or shrubs. (See Crown.)

#### **Canyon**

A long, deep, narrow valley with high, precipitous walls in an area of high local relief.

#### **Capillary water**

Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

#### **Catena**

A sequence, or "chain," of soils on a landscape that formed in similar kinds of parent material and under similar climatic conditions but that have different characteristics as a result of differences in relief and drainage.

#### **Cation**

An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

#### **Cation-exchange capacity**

The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity but is more precise in meaning.

#### **Catsteps**

See Terracettes.

#### **Cement rock**

Shaly limestone used in the manufacture of cement.

#### **Channery soil material**

Soil material that has, by volume, 15 to 35 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches (15 centimeters) along the longest axis. A single piece is called a channer.

#### **Chemical treatment**

Control of unwanted vegetation through the use of chemicals.

#### **Chiseling**

Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard, compacted layers to a depth below normal plow depth.

#### **Cirque**

A steep-walled, semicircular or crescent-shaped, half-bowl-like recess or hollow, commonly situated at the head of a glaciated mountain valley or high on the side of a mountain. It was produced by the erosive activity of a mountain glacier. It commonly contains a small round lake (tarn).

#### **Clay**

As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

#### **Clay depletions**

See Redoximorphic features.

#### **Clay film**

A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

#### **Clay spot (map symbol)**

A spot where the surface texture is silty clay or clay in areas where the surface layer of the soils in the surrounding map unit is sandy loam, loam, silt loam, or coarser.

#### **Claypan**

A dense, compact subsoil layer that contains much more clay than the overlying materials, from which it is separated by a sharply defined boundary. The layer restricts the downward movement of water through the soil. A claypan is commonly hard when dry and plastic and sticky when wet.

#### **Climax plant community**

The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

#### **Coarse textured soil**

Sand or loamy sand.

#### **Cobble (or cobblestone)**

A rounded or partly rounded fragment of rock 3 to 10 inches (7.6 to 25 centimeters) in diameter.

#### **Cobbly soil material**

Material that has 15 to 35 percent, by volume, rounded or partially rounded rock fragments 3 to 10 inches (7.6 to 25 centimeters) in diameter. Very cobbly soil material has 35 to 60 percent of these rock fragments, and extremely cobbly soil material has more than 60 percent.

#### **COLE (coefficient of linear extensibility)**

See Linear extensibility.

#### **Colluvium**

Unconsolidated, unsorted earth material being transported or deposited on side slopes and/or at the base of slopes by mass movement (e.g., direct gravitational action) and by local, unconcentrated runoff.

#### **Complex slope**

Irregular or variable slope. Planning or establishing terraces, diversions, and other water-control structures on a complex slope is difficult.

#### **Complex, soil**

A map unit of two or more kinds of soil or miscellaneous areas in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas.

#### **Concretions**

See Redoximorphic features.

#### **Conglomerate**

A coarse grained, clastic sedimentary rock composed of rounded or subangular rock fragments more than 2 millimeters in diameter. It commonly has a matrix of sand and finer textured material. Conglomerate is the consolidated equivalent of gravel.

#### **Conservation cropping system**

Growing crops in combination with needed cultural and management practices. In a good conservation cropping system, the soil-improving crops and practices more than offset the effects of the soil-depleting crops and practices. Cropping systems are needed on all tilled soils. Soil-improving practices in a conservation cropping system include the use of rotations that contain grasses and legumes and the return of crop residue to the soil. Other practices include the use of green manure crops of grasses and legumes, proper tillage, adequate fertilization, and weed and pest control.

#### **Conservation tillage**

A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

#### **Consistence, soil**

Refers to the degree of cohesion and adhesion of soil material and its resistance to deformation when ruptured. Consistence includes resistance of soil material to rupture and to penetration; plasticity, toughness, and stickiness of puddled soil material; and the manner in which the soil material behaves when subject to compression. Terms describing consistence are defined in the "Soil Survey Manual."

#### **Contour stripcropping**

Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

#### **Control section**

The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

#### **Coprogenous earth (sedimentary peat)**

A type of limnic layer composed predominantly of fecal material derived from aquatic animals.

#### **Corrosion (geomorphology)**

A process of erosion whereby rocks and soil are removed or worn away by natural chemical processes, especially by the solvent action of running water, but also by other reactions, such as hydrolysis, hydration, carbonation, and oxidation.

#### **Corrosion (soil survey interpretations)**

Soil-induced electrochemical or chemical action that dissolves or weakens concrete or uncoated steel.

#### **Cover crop**

A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

#### **Crop residue management**

Returning crop residue to the soil, which helps to maintain soil structure, organic matter content, and fertility and helps to control erosion.

#### **Cropping system**

Growing crops according to a planned system of rotation and management practices.

#### **Cross-slope farming**

Deliberately conducting farming operations on sloping farmland in such a way that tillage is across the general slope.

#### **Crown**

The upper part of a tree or shrub, including the living branches and their foliage.

#### **Cryoturbate**

A mass of soil or other unconsolidated earthy material moved or disturbed by frost action. It is typically coarser than the underlying material.

#### **Cuesta**

An asymmetric ridge capped by resistant rock layers of slight or moderate dip (commonly less than 15 percent slopes); a type of homocline produced by differential erosion of interbedded resistant and weak rocks. A cuesta has a long, gentle slope on one side (dip slope) that roughly parallels the inclined beds; on the other side, it has a relatively short and steep or clifflike slope (scarp) that cuts through the tilted rocks.

#### **Culmination of the mean annual increment (CMAI)**

The average annual increase per acre in the volume of a stand. Computed by dividing the total volume of the stand by its age. As the stand increases in age,



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the mean annual increment continues to increase until mortality begins to reduce the rate of increase. The point where the stand reaches its maximum annual rate of growth is called the culmination of the mean annual increment.

#### **Cutbanks cave**

The walls of excavations tend to cave in or slough.

#### **Decreasers**

The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

#### **Deferred grazing**

Postponing grazing or resting grazing land for a prescribed period.

#### **Delta**

A body of alluvium having a surface that is fan shaped and nearly flat; deposited at or near the mouth of a river or stream where it enters a body of relatively quiet water, generally a sea or lake.

#### **Dense layer**

A very firm, massive layer that has a bulk density of more than 1.8 grams per cubic centimeter. Such a layer affects the ease of digging and can affect filling and compacting.

#### **Depression, closed (map symbol)**

A shallow, saucer-shaped area that is slightly lower on the landscape than the surrounding area and that does not have a natural outlet for surface drainage.

#### **Depth, soil**

Generally, the thickness of the soil over bedrock. Very deep soils are more than 60 inches deep over bedrock; deep soils, 40 to 60 inches; moderately deep, 20 to 40 inches; shallow, 10 to 20 inches; and very shallow, less than 10 inches.

#### **Desert pavement**

A natural, residual concentration or layer of wind-polished, closely packed gravel, boulders, and other rock fragments mantling a desert surface. It forms where wind action and sheetwash have removed all smaller particles or where rock fragments have migrated upward through sediments to the surface. It typically protects the finer grained underlying material from further erosion.

#### **Diatomaceous earth**

A geologic deposit of fine, grayish siliceous material composed chiefly or entirely of the remains of diatoms.

#### **Dip slope**

A slope of the land surface, roughly determined by and approximately conforming to the dip of the underlying bedrock.

#### **Diversion (or diversion terrace)**

A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

#### **Divided-slope farming**

A form of field stripcropping in which crops are grown in a systematic arrangement of two strips, or bands, across the slope to reduce the hazard of water erosion. One strip is in a close-growing crop that provides protection from erosion, and the other strip is in a crop that provides less protection from erosion. This practice is used where slopes are not long enough to permit a full stripcropping pattern to be used.

#### **Drainage class (natural)**

Refers to the frequency and duration of wet periods under conditions similar to those under which the soil formed. Alterations of the water regime by human activities, either through drainage or irrigation, are not a consideration unless they have significantly changed the morphology of the soil. Seven classes of natural soil drainage are recognized—*excessively drained*, *somewhat excessively drained*, *well drained*, *moderately well drained*, *somewhat poorly drained*, *poorly drained*, and *very poorly drained*. These classes are defined in the “Soil Survey Manual.”

#### **Drainage, surface**

Runoff, or surface flow of water, from an area.

#### **Drainageway**

A general term for a course or channel along which water moves in draining an area. A term restricted to relatively small, linear depressions that at some time move concentrated water and either do not have a defined channel or have only a small defined channel.

#### **Draw**

A small stream valley that generally is shallower and more open than a ravine or gulch and that has a broader bottom. The present stream channel may appear inadequate to have cut the drainageway that it occupies.

#### **Drift**

A general term applied to all mineral material (clay, silt, sand, gravel, and boulders) transported by a glacier and deposited directly by or from the ice or transported by running water emanating from a glacier. Drift includes unstratified material (till) that forms moraines and stratified deposits that form outwash plains, eskers, kames, varves, and glaciofluvial sediments. The term is generally applied to Pleistocene glacial deposits in areas that no longer contain glaciers.

#### **Drumlin**

A low, smooth, elongated oval hill, mound, or ridge of compact till that has a core of bedrock or drift. It commonly has a blunt nose facing the direction from which the ice approached and a gentler slope tapering in the other direction. The longer axis is parallel to the general direction of glacier flow. Drumlins are products of

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streamline (laminar) flow of glaciers, which molded the subglacial floor through a combination of erosion and deposition.

#### **Duff**

A generally firm organic layer on the surface of mineral soils. It consists of fallen plant material that is in the process of decomposition and includes everything from the litter on the surface to underlying pure humus.

#### **Dune**

A low mound, ridge, bank, or hill of loose, windblown granular material (generally sand), either barren and capable of movement from place to place or covered and stabilized with vegetation but retaining its characteristic shape.

#### **Earthy fill**

See Mine spoil.

#### **Ecological site**

An area where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. An ecological site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other ecological sites in kind and/or proportion of species or in total production.

#### **Eluviation**

The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

#### **Endosaturation**

A type of saturation of the soil in which all horizons between the upper boundary of saturation and a depth of 2 meters are saturated.

#### **Eolian deposit**

Sand-, silt-, or clay-sized clastic material transported and deposited primarily by wind, commonly in the form of a dune or a sheet of sand or loess.

#### **Ephemeral stream**

A stream, or reach of a stream, that flows only in direct response to precipitation. It receives no long-continued supply from melting snow or other source, and its channel is above the water table at all times.

#### **Episaturation**

A type of saturation indicating a perched water table in a soil in which saturated layers are underlain by one or more unsaturated layers within 2 meters of the surface.

#### **Erosion**

The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

#### **Erosion (accelerated)**

Erosion much more rapid than geologic erosion, mainly as a result of human or animal activities or of a catastrophe in nature, such as a fire, that exposes the surface.

#### **Erosion (geologic)**

Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

#### **Erosion pavement**

A surficial lag concentration or layer of gravel and other rock fragments that remains on the soil surface after sheet or rill erosion or wind has removed the finer soil particles and that tends to protect the underlying soil from further erosion.

#### **Erosion surface**

A land surface shaped by the action of erosion, especially by running water.

#### **Escarpment**

A relatively continuous and steep slope or cliff breaking the general continuity of more gently sloping land surfaces and resulting from erosion or faulting. Most commonly applied to cliffs produced by differential erosion. Synonym: scarp.

#### **Escarpment, bedrock (map symbol)**

A relatively continuous and steep slope or cliff, produced by erosion or faulting, that breaks the general continuity of more gently sloping land surfaces. Exposed material is hard or soft bedrock.

#### **Escarpment, nonbedrock (map symbol)**

A relatively continuous and steep slope or cliff, generally produced by erosion but in some places produced by faulting, that breaks the continuity of more gently sloping land surfaces. Exposed earthy material is nonsoil or very shallow soil.

#### **Esker**

A long, narrow, sinuous, steep-sided ridge of stratified sand and gravel deposited as the bed of a stream flowing in an ice tunnel within or below the ice (subglacial) or between ice walls on top of the ice of a wasting glacier and left behind as high ground when the ice melted. Eskers range in length from less than a kilometer to more than 160 kilometers and in height from 3 to 30 meters.

#### **Extrusive rock**

Igneous rock derived from deep-seated molten matter (magma) deposited and cooled on the earth's surface.

#### **Fallow**

Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grain is grown.

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The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

#### **Fan remnant**

A general term for landforms that are the remaining parts of older fan landforms, such as alluvial fans, that have been either dissected or partially buried.

#### **Fertility, soil**

The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

#### **Fibric soil material (peat)**

The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

#### **Field moisture capacity**

The moisture content of a soil, expressed as a percentage of the oven-dry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity*, *normal moisture capacity*, or *capillary capacity*.

#### **Fill slope**

A sloping surface consisting of excavated soil material from a road cut. It commonly is on the downhill side of the road.

#### **Fine textured soil**

Sandy clay, silty clay, or clay.

#### **Firebreak**

An area cleared of flammable material to stop or help control creeping or running fires. It also serves as a line from which to work and to facilitate the movement of firefighters and equipment. Designated roads also serve as firebreaks.

#### **First bottom**

An obsolete, informal term loosely applied to the lowest flood-plain steps that are subject to regular flooding.

#### **Flaggy soil material**

Material that has, by volume, 15 to 35 percent flagstones. Very flaggy soil material has 35 to 60 percent flagstones, and extremely flaggy soil material has more than 60 percent flagstones.

#### **Flagstone**

A thin fragment of sandstone, limestone, slate, shale, or (rarely) schist 6 to 15 inches (15 to 38 centimeters) long.

#### **Flood plain**

The nearly level plain that borders a stream and is subject to flooding unless protected artificially.

#### **Flood-plain landforms**

A variety of constructional and erosional features produced by stream channel migration and flooding. Examples include backswamps, flood-plain splays, meanders, meander belts, meander scrolls, oxbow lakes, and natural levees.

#### **Flood-plain splay**

A fan-shaped deposit or other outspread deposit formed where an overloaded stream breaks through a levee (natural or artificial) and deposits its material (commonly coarse grained) on the flood plain.

#### **Flood-plain step**

An essentially flat, terrace-like alluvial surface within a valley that is frequently covered by floodwater from the present stream; any approximately horizontal surface still actively modified by fluvial scour and/or deposition. May occur individually or as a series of steps.

#### **Fluvial**

Of or pertaining to rivers or streams; produced by stream or river action.

#### **Foothills**

A region of steeply sloping hills that fringes a mountain range or high-plateau escarpment. The hills have relief of as much as 1,000 feet (300 meters).

#### **Footslope**

The concave surface at the base of a hillslope. A footslope is a transition zone between upslope sites of erosion and transport (shoulders and backslopes) and downslope sites of deposition (toeslopes).

#### **Forb**

Any herbaceous plant not a grass or a sedge.

#### **Forest cover**

All trees and other woody plants (underbrush) covering the ground in a forest.

#### **Forest type**

A stand of trees similar in composition and development because of given physical and biological factors by which it may be differentiated from other stands.

#### **Fragipan**

A loamy, brittle subsurface horizon low in porosity and content of organic matter and low or moderate in clay but high in silt or very fine sand. A fragipan appears cemented and restricts roots. When dry, it is hard or very hard and has a higher bulk density than the horizon or horizons above. When moist, it tends to rupture suddenly under pressure rather than to deform slowly.

#### **Genesis, soil**

The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

#### **Gilgai**

Commonly, a succession of microbasins and microknolls in nearly level areas or of microvalleys and microridges parallel with the slope. Typically, the microrelief of clayey soils that shrink and swell considerably with changes in moisture content.

#### **Glaciofluvial deposits**

Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and occur in the form of outwash plains, valley trains, deltas, kames, eskers, and kame terraces.

#### **Glaciolacustrine deposits**

Material ranging from fine clay to sand derived from glaciers and deposited in glacial lakes mainly by glacial meltwater. Many deposits are bedded or laminated.

#### **Gleyed soil**

Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors.

#### **Graded stripcropping**

Growing crops in strips that grade toward a protected waterway.

#### **Grassed waterway**

A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

#### **Gravel**

Rounded or angular fragments of rock as much as 3 inches (7.6 centimeters) in diameter. An individual piece is a pebble.

#### **Gravel pit (map symbol)**

An open excavation from which soil and underlying material have been removed and used, without crushing, as a source of sand or gravel.

#### **Gravelly soil material**

Material that has 15 to 35 percent, by volume, rounded or angular rock fragments, not prominently flattened, as much as 3 inches (7.6 centimeters) in diameter.

#### **Gravelly spot (map symbol)**

A spot where the surface layer has more than 35 percent, by volume, rock fragments that are mostly less than 3 inches in diameter in an area that has less than 15 percent rock fragments.

#### **Green manure crop (agronomy)**

A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

#### **Ground water**

Water filling all the unblocked pores of the material below the water table.

#### **Gully (map symbol)**

A small, steep-sided channel caused by erosion and cut in unconsolidated materials by concentrated but intermittent flow of water. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage whereas a rill is of lesser depth and can be smoothed over by ordinary tillage.

#### **Hard bedrock**

Bedrock that cannot be excavated except by blasting or by the use of special equipment that is not commonly used in construction.

#### **Hard to reclaim**

Reclamation is difficult after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

#### **Hardpan**

A hardened or cemented soil horizon, or layer. The soil material is sandy, loamy, or clayey and is cemented by iron oxide, silica, calcium carbonate, or other substance.

#### **Head slope (geomorphology)**

A geomorphic component of hills consisting of a laterally concave area of a hillside, especially at the head of a drainageway. The overland waterflow is converging.

#### **Hemic soil material (mucky peat)**

Organic soil material intermediate in degree of decomposition between the less decomposed fibric material and the more decomposed sapric material.

#### **High-residue crops**

Such crops as small grain and corn used for grain. If properly managed, residue from these crops can be used to control erosion until the next crop in the rotation is established. These crops return large amounts of organic matter to the soil.

#### **Hill**

A generic term for an elevated area of the land surface, rising as much as 1,000 feet above surrounding lowlands, commonly of limited summit area and having a well defined outline. Slopes are generally more than 15 percent. The distinction between a hill and a mountain is arbitrary and may depend on local usage.



#### Hillslope

A generic term for the steeper part of a hill between its summit and the drainage line, valley flat, or depression floor at the base of a hill.

#### Horizon, soil

A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the "Soil Survey Manual." The major horizons of mineral soil are as follows:

*O horizon:* An organic layer of fresh and decaying plant residue.

*L horizon:* A layer of organic and mineral limnic materials, including coprogenous earth (sedimentary peat), diatomaceous earth, and marl.

*A horizon:* The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

*E horizon:* The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

*B horizon:* The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

*C horizon:* The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying soil material. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

*Cr horizon:* Soft, consolidated bedrock beneath the soil.

*R layer:* Consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon, but it can be directly below an A or a B horizon.

*M layer:* A root-limiting subsoil layer consisting of nearly continuous, horizontally oriented, human-manufactured materials.

*W layer:* A layer of water within or beneath the soil.

#### Humus

The well decomposed, more or less stable part of the organic matter in mineral soils.

#### Hydrologic soil groups

Refers to soils grouped according to their runoff potential. The soil properties that influence this potential are those that affect the minimum rate of water infiltration on a bare soil during periods after prolonged wetting when the soil is not frozen. These properties include depth to a seasonal high water table, the infiltration rate, and depth to a layer that significantly restricts the downward movement of water. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff.

#### **Igneous rock**

Rock that was formed by cooling and solidification of magma and that has not been changed appreciably by weathering since its formation. Major varieties include plutonic and volcanic rock (e.g., andesite, basalt, and granite).

#### **Illuviation**

The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

#### **Impervious soil**

A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

#### **Increasesers**

Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasesers commonly are the shorter plants and the less palatable to livestock.

#### **Infiltration**

The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

#### **Infiltration capacity**

The maximum rate at which water can infiltrate into a soil under a given set of conditions.

#### **Infiltration rate**

The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

#### **Intake rate**

The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake, in inches per hour, is expressed as follows:

*Very low:* Less than 0.2

*Low:* 0.2 to 0.4

*Moderately low:* 0.4 to 0.75

*Moderate:* 0.75 to 1.25

*Moderately high:* 1.25 to 1.75

*High:* 1.75 to 2.5

*Very high:* More than 2.5

#### **Interfluve**

A landform composed of the relatively undissected upland or ridge between two adjacent valleys containing streams flowing in the same general direction. An elevated area between two drainageways that sheds water to those drainageways.

#### **Interfluve (geomorphology)**

A geomorphic component of hills consisting of the uppermost, comparatively level or gently sloping area of a hill; shoulders of backwearing hillslopes can narrow the upland or can merge, resulting in a strongly convex shape.

#### **Intermittent stream**

A stream, or reach of a stream, that does not flow year-round but that is commonly dry for 3 or more months out of 12 and whose channel is generally below the local water table. It flows only during wet periods or when it receives ground-water discharge or long, continued contributions from melting snow or other surface and shallow subsurface sources.

#### **Invaders**

On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, plants invade following disturbance of the surface.

#### **Iron depletions**

See Redoximorphic features.

#### **Irrigation**

Application of water to soils to assist in production of crops. Methods of irrigation are:

*Basin:* Water is applied rapidly to nearly level plains surrounded by levees or dikes.

*Border:* Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

*Controlled flooding:* Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

*Corrugation:* Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

*Drip (or trickle):* Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

*Furrow:* Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

*Sprinkler:* Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

*Subirrigation:* Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

*Wild flooding:* Water, released at high points, is allowed to flow onto an area without controlled distribution.

**Kame**

A low mound, knob, hummock, or short irregular ridge composed of stratified sand and gravel deposited by a subglacial stream as a fan or delta at the margin of a melting glacier; by a supraglacial stream in a low place or hole on the surface of the glacier; or as a ponded deposit on the surface or at the margin of stagnant ice.

**Karst (topography)**

A kind of topography that formed in limestone, gypsum, or other soluble rocks by dissolution and that is characterized by closed depressions, sinkholes, caves, and underground drainage.

**Knoll**

A small, low, rounded hill rising above adjacent landforms.

**Ksat**

See Saturated hydraulic conductivity.

**Lacustrine deposit**

Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

**Lake plain**

A nearly level surface marking the floor of an extinct lake filled by well sorted, generally fine textured, stratified deposits, commonly containing varves.

**Lake terrace**

A narrow shelf, partly cut and partly built, produced along a lakeshore in front of a scarp line of low cliffs and later exposed when the water level falls.

**Landfill (map symbol)**

An area of accumulated waste products of human habitation, either above or below natural ground level.

**Landslide**

A general, encompassing term for most types of mass movement landforms and processes involving the downslope transport and outward deposition of soil and rock materials caused by gravitational forces; the movement may or may not involve saturated materials. The speed and distance of movement, as well as the amount of soil and rock material, vary greatly.

**Large stones**

Rock fragments 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

**Lava flow (map symbol)**

A solidified, commonly lobate body of rock formed through lateral, surface outpouring of molten lava from a vent or fissure.

#### **Leaching**

The removal of soluble material from soil or other material by percolating water.

#### **Levee (map symbol)**

An embankment that confines or controls water, especially one built along the banks of a river to prevent overflow onto lowlands.

#### **Linear extensibility**

Refers to the change in length of an unconfined clod as moisture content is decreased from a moist to a dry state. Linear extensibility is used to determine the shrink-swell potential of soils. It is an expression of the volume change between the water content of the clod at  $1/3$ - or  $1/10$ -bar tension (33kPa or 10kPa tension) and oven dryness. Volume change is influenced by the amount and type of clay minerals in the soil. The volume change is the percent change for the whole soil. If it is expressed as a fraction, the resulting value is COLE, coefficient of linear extensibility.

#### **Liquid limit**

The moisture content at which the soil passes from a plastic to a liquid state.

#### **Loam**

Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

#### **Loess**

Material transported and deposited by wind and consisting dominantly of silt-sized particles.

#### **Low strength**

The soil is not strong enough to support loads.

#### **Low-residue crops**

Such crops as corn used for silage, peas, beans, and potatoes. Residue from these crops is not adequate to control erosion until the next crop in the rotation is established. These crops return little organic matter to the soil.

#### **Marl**

An earthy, unconsolidated deposit consisting chiefly of calcium carbonate mixed with clay in approximately equal proportions; formed primarily under freshwater lacustrine conditions but also formed in more saline environments.

#### **Marsh or swamp (map symbol)**

A water-saturated, very poorly drained area that is intermittently or permanently covered by water. Sedges, cattails, and rushes are the dominant vegetation in marshes, and trees or shrubs are the dominant vegetation in swamps. Not used in map units where the named soils are poorly drained or very poorly drained.

#### **Mass movement**

A generic term for the dislodgment and downslope transport of soil and rock material as a unit under direct gravitational stress.

#### **Masses**

See Redoximorphic features.

#### **Meander belt**

The zone within which migration of a meandering channel occurs; the flood-plain area included between two imaginary lines drawn tangential to the outer bends of active channel loops.

#### **Meander scar**

A crescent-shaped, concave or linear mark on the face of a bluff or valley wall, produced by the lateral erosion of a meandering stream that impinged upon and undercut the bluff.

#### **Meander scroll**

One of a series of long, parallel, close-fitting, crescent-shaped ridges and troughs formed along the inner bank of a stream meander as the channel migrated laterally down-valley and toward the outer bank.

#### **Mechanical treatment**

Use of mechanical equipment for seeding, brush management, and other management practices.

#### **Medium textured soil**

Very fine sandy loam, loam, silt loam, or silt.

#### **Mesa**

A broad, nearly flat topped and commonly isolated landmass bounded by steep slopes or precipitous cliffs and capped by layers of resistant, nearly horizontal rocky material. The summit width is characteristically greater than the height of the bounding escarpments.

#### **Metamorphic rock**

Rock of any origin altered in mineralogical composition, chemical composition, or structure by heat, pressure, and movement at depth in the earth's crust. Nearly all such rocks are crystalline.

#### **Mine or quarry (map symbol)**

An open excavation from which soil and underlying material have been removed and in which bedrock is exposed. Also denotes surface openings to underground mines.

#### **Mine spoil**

An accumulation of displaced earthy material, rock, or other waste material removed during mining or excavation. Also called earthy fill.

#### **Mineral soil**

Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

#### **Minimum tillage**

Only the tillage essential to crop production and prevention of soil damage.

#### **Miscellaneous area**

A kind of map unit that has little or no natural soil and supports little or no vegetation.

#### **Miscellaneous water (map symbol)**

Small, constructed bodies of water that are used for industrial, sanitary, or mining applications and that contain water most of the year.

#### **Moderately coarse textured soil**

Coarse sandy loam, sandy loam, or fine sandy loam.

#### **Moderately fine textured soil**

Clay loam, sandy clay loam, or silty clay loam.

#### **Mollic epipedon**

A thick, dark, humus-rich surface horizon (or horizons) that has high base saturation and pedogenic soil structure. It may include the upper part of the subsoil.

#### **Moraine**

In terms of glacial geology, a mound, ridge, or other topographically distinct accumulation of unsorted, unstratified drift, predominantly till, deposited primarily by the direct action of glacial ice in a variety of landforms. Also, a general term for a landform composed mainly of till (except for kame moraines, which are composed mainly of stratified outwash) that has been deposited by a glacier. Some types of moraines are disintegration, end, ground, kame, lateral, recessional, and terminal.

#### **Morphology, soil**

The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

#### **Mottling, soil**

Irregular spots of different colors that vary in number and size. Descriptive terms are as follows: abundance—*few*, *common*, and *many*; size—*fine*, *medium*, and *coarse*; and contrast—*faint*, *distinct*, and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

#### **Mountain**

A generic term for an elevated area of the land surface, rising more than 1,000 feet (300 meters) above surrounding lowlands, commonly of restricted summit area (relative to a plateau) and generally having steep sides. A mountain can occur as a single, isolated mass or in a group forming a chain or range. Mountains are formed primarily by tectonic activity and/or volcanic action but can also be formed by differential erosion.

#### **Muck**

Dark, finely divided, well decomposed organic soil material. (See Sapric soil material.)

#### **Mucky peat**

See Hemic soil material.

#### **Mudstone**

A blocky or massive, fine grained sedimentary rock in which the proportions of clay and silt are approximately equal. Also, a general term for such material as clay, silt, claystone, siltstone, shale, and argillite and that should be used only when the amounts of clay and silt are not known or cannot be precisely identified.

#### **Munsell notation**

A designation of color by degrees of three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with hue of 10YR, value of 6, and chroma of 4.

#### **Natric horizon**

A special kind of argillic horizon that contains enough exchangeable sodium to have an adverse effect on the physical condition of the subsoil.

#### **Neutral soil**

A soil having a pH value of 6.6 to 7.3. (See Reaction, soil.)

#### **Nodules**

See Redoximorphic features.

#### **Nose slope (geomorphology)**

A geomorphic component of hills consisting of the projecting end (laterally convex area) of a hillside. The overland waterflow is predominantly divergent. Nose slopes consist dominantly of colluvium and slope-wash sediments (for example, slope alluvium).

#### **Nutrient, plant**

Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.



**Organic matter**

Plant and animal residue in the soil in various stages of decomposition. The content of organic matter in the surface layer is described as follows:

*Very low:* Less than 0.5 percent

*Low:* 0.5 to 1.0 percent

*Moderately low:* 1.0 to 2.0 percent

*Moderate:* 2.0 to 4.0 percent

*High:* 4.0 to 8.0 percent

*Very high:* More than 8.0 percent

**Outwash**

Stratified and sorted sediments (chiefly sand and gravel) removed or “washed out” from a glacier by meltwater streams and deposited in front of or beyond the end moraine or the margin of a glacier. The coarser material is deposited nearer to the ice.

**Outwash plain**

An extensive lowland area of coarse textured glaciofluvial material. An outwash plain is commonly smooth; where pitted, it generally is low in relief.

**Paleoterrace**

An erosional remnant of a terrace that retains the surface form and alluvial deposits of its origin but was not emplaced by, and commonly does not grade to, a present-day stream or drainage network.

**Pan**

A compact, dense layer in a soil that impedes the movement of water and the growth of roots. For example, *hardpan*, *fragipan*, *claypan*, *plowpan*, and *traffic pan*.

**Parent material**

The unconsolidated organic and mineral material in which soil forms.

**Peat**

Unconsolidated material, largely undecomposed organic matter, that has accumulated under excess moisture. (See Fibric soil material.)

**Ped**

An individual natural soil aggregate, such as a granule, a prism, or a block.

**Pedisediment**

A layer of sediment, eroded from the shoulder and backslope of an erosional slope, that lies on and is being (or was) transported across a gently sloping erosional surface at the foot of a receding hill or mountain slope.

#### **Pedon**

The smallest volume that can be called “a soil.” A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

#### **Percolation**

The movement of water through the soil.

#### **Perennial water (map symbol)**

Small, natural or constructed lakes, ponds, or pits that contain water most of the year.

#### **Permafrost**

Ground, soil, or rock that remains at or below 0 degrees C for at least 2 years. It is defined on the basis of temperature and is not necessarily frozen.

#### **pH value**

A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

#### **Phase, soil**

A subdivision of a soil series based on features that affect its use and management, such as slope, stoniness, and flooding.

#### **Piping**

Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

#### **Pitting**

Pits caused by melting around ice. They form on the soil after plant cover is removed.

#### **Plastic limit**

The moisture content at which a soil changes from semisolid to plastic.

#### **Plasticity index**

The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

#### **Plateau (geomorphology)**

A comparatively flat area of great extent and elevation; specifically, an extensive land region that is considerably elevated (more than 100 meters) above the adjacent lower lying terrain, is commonly limited on at least one side by an abrupt descent, and has a flat or nearly level surface. A comparatively large part of a plateau surface is near summit level.

#### **Playa**

The generally dry and nearly level lake plain that occupies the lowest parts of closed depressions, such as those on intermontane basin floors. Temporary flooding occurs primarily in response to precipitation and runoff. Playa deposits are fine grained and may or may not have a high water table and saline conditions.

#### **Plinthite**

The sesquioxide-rich, humus-poor, highly weathered mixture of clay with quartz and other diluents. It commonly appears as red mottles, usually in platy, polygonal, or reticulate patterns. Plinthite changes irreversibly to an ironstone hardpan or to irregular aggregates on repeated wetting and drying, especially if it is exposed also to heat from the sun. In a moist soil, plinthite can be cut with a spade. It is a form of laterite.

#### **Plowpan**

A compacted layer formed in the soil directly below the plowed layer.

#### **Ponding**

Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

#### **Poorly graded**

Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

#### **Pore linings**

See Redoximorphic features.

#### **Potential native plant community**

See Climax plant community.

#### **Potential rooting depth (effective rooting depth)**

Depth to which roots could penetrate if the content of moisture in the soil were adequate. The soil has no properties restricting the penetration of roots to this depth.

#### **Prescribed burning**

Deliberately burning an area for specific management purposes, under the appropriate conditions of weather and soil moisture and at the proper time of day.

#### **Productivity, soil**

The capability of a soil for producing a specified plant or sequence of plants under specific management.

#### **Profile, soil**

A vertical section of the soil extending through all its horizons and into the parent material.

#### **Proper grazing use**

Grazing at an intensity that maintains enough cover to protect the soil and maintain or improve the quantity and quality of the desirable vegetation. This practice increases the vigor and reproduction capacity of the key plants and promotes the accumulation of litter and mulch necessary to conserve soil and water.

#### **Rangeland**

Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

#### **Reaction, soil**

A measure of acidity or alkalinity of a soil, expressed as pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degrees of acidity or alkalinity, expressed as pH values, are:

*Ultra acid:* Less than 3.5

*Extremely acid:* 3.5 to 4.4

*Very strongly acid:* 4.5 to 5.0

*Strongly acid:* 5.1 to 5.5

*Moderately acid:* 5.6 to 6.0

*Slightly acid:* 6.1 to 6.5

*Neutral:* 6.6 to 7.3

*Slightly alkaline:* 7.4 to 7.8

*Moderately alkaline:* 7.9 to 8.4

*Strongly alkaline:* 8.5 to 9.0

*Very strongly alkaline:* 9.1 and higher

#### **Red beds**

Sedimentary strata that are mainly red and are made up largely of sandstone and shale.

#### **Redoximorphic concentrations**

See Redoximorphic features.

#### **Redoximorphic depletions**

See Redoximorphic features.

#### **Redoximorphic features**

Redoximorphic features are associated with wetness and result from alternating periods of reduction and oxidation of iron and manganese compounds in the soil. Reduction occurs during saturation with water, and oxidation occurs when the soil is not saturated. Characteristic color patterns are created by these processes. The reduced iron and manganese ions may be removed from a soil if vertical or lateral fluxes of water occur, in which case there is no iron or manganese precipitation in that soil. Wherever the iron and manganese are oxidized and precipitated, they

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form either soft masses or hard concretions or nodules. Movement of iron and manganese as a result of redoximorphic processes in a soil may result in redoximorphic features that are defined as follows:

1. Redoximorphic concentrations.—These are zones of apparent accumulation of iron-manganese oxides, including:
  - A. Nodules and concretions, which are cemented bodies that can be removed from the soil intact. Concretions are distinguished from nodules on the basis of internal organization. A concretion typically has concentric layers that are visible to the naked eye. Nodules do not have visible organized internal structure; *and*
  - B. Masses, which are noncemented concentrations of substances within the soil matrix; *and*
  - C. Pore linings, i.e., zones of accumulation along pores that may be either coatings on pore surfaces or impregnations from the matrix adjacent to the pores.
2. Redoximorphic depletions.—These are zones of low chroma (chromas less than those in the matrix) where either iron-manganese oxides alone or both iron-manganese oxides and clay have been stripped out, including:
  - A. Iron depletions, i.e., zones that contain low amounts of iron and manganese oxides but have a clay content similar to that of the adjacent matrix; *and*
  - B. Clay depletions, i.e., zones that contain low amounts of iron, manganese, and clay (often referred to as silt coatings or skeletalans).
3. Reduced matrix.—This is a soil matrix that has low chroma *in situ* but undergoes a change in hue or chroma within 30 minutes after the soil material has been exposed to air.

#### **Reduced matrix**

See Redoximorphic features.

#### **Regolith**

All unconsolidated earth materials above the solid bedrock. It includes material weathered in place from all kinds of bedrock and alluvial, glacial, eolian, lacustrine, and pyroclastic deposits.

#### **Relief**

The relative difference in elevation between the upland summits and the lowlands or valleys of a given region.

#### **Residuum (residual soil material)**

Unconsolidated, weathered or partly weathered mineral material that accumulated as bedrock disintegrated in place.

#### **Rill**

A very small, steep-sided channel resulting from erosion and cut in unconsolidated materials by concentrated but intermittent flow of water. A rill generally is not an obstacle to wheeled vehicles and is shallow enough to be smoothed over by ordinary tillage.

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#### **Riser**

The vertical or steep side slope (e.g., escarpment) of terraces, flood-plain steps, or other stepped landforms; commonly a recurring part of a series of natural, steplike landforms, such as successive stream terraces.

#### **Road cut**

A sloping surface produced by mechanical means during road construction. It is commonly on the uphill side of the road.

#### **Rock fragments**

Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

#### **Rock outcrop (map symbol)**

An exposure of bedrock at the surface of the earth. Not used where the named soils of the surrounding map unit are shallow over bedrock or where "Rock outcrop" is a named component of the map unit.

#### **Root zone**

The part of the soil that can be penetrated by plant roots.

#### **Runoff**

The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

#### **Saline soil**

A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

#### **Saline spot (map symbol)**

An area where the surface layer has an electrical conductivity of 8 mmhos/cm more than the surface layer of the named soils in the surrounding map unit. The surface layer of the surrounding soils has an electrical conductivity of 2 mmhos/cm or less.

#### **Sand**

As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

#### **Sandstone**

Sedimentary rock containing dominantly sand-sized particles.

#### **Sandy spot (map symbol)**

A spot where the surface layer is loamy fine sand or coarser in areas where the surface layer of the named soils in the surrounding map unit is very fine sandy loam or finer.

#### **Sapric soil material (muck)**

The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

#### **Saturated hydraulic conductivity (Ksat)**

The ease with which pores of a saturated soil transmit water. Formally, the proportionality coefficient that expresses the relationship of the rate of water movement to hydraulic gradient in Darcy's Law, a law that describes the rate of water movement through porous media. Commonly abbreviated as "Ksat." Terms describing saturated hydraulic conductivity are:

*Very high:* 100 or more micrometers per second (14.17 or more inches per hour)

*High:* 10 to 100 micrometers per second (1.417 to 14.17 inches per hour)

*Moderately high:* 1 to 10 micrometers per second (0.1417 inch to 1.417 inches per hour)

*Moderately low:* 0.1 to 1 micrometer per second (0.01417 to 0.1417 inch per hour)

*Low:* 0.01 to 0.1 micrometer per second (0.001417 to 0.01417 inch per hour)

*Very low:* Less than 0.01 micrometer per second (less than 0.001417 inch per hour).

To convert inches per hour to micrometers per second, multiply inches per hour by 7.0572. To convert micrometers per second to inches per hour, multiply micrometers per second by 0.1417.

#### **Saturation**

Wetness characterized by zero or positive pressure of the soil water. Under conditions of saturation, the water will flow from the soil matrix into an unlined auger hole.

#### **Scarification**

The act of abrading, scratching, loosening, crushing, or modifying the surface to increase water absorption or to provide a more tillable soil.

#### **Sedimentary rock**

A consolidated deposit of clastic particles, chemical precipitates, or organic remains accumulated at or near the surface of the earth under normal low temperature and pressure conditions. Sedimentary rocks include consolidated equivalents of alluvium, colluvium, drift, and eolian, lacustrine, and marine deposits. Examples are sandstone, siltstone, mudstone, claystone, shale, conglomerate, limestone, dolomite, and coal.

#### **Sequum**

A sequence consisting of an illuvial horizon and the overlying eluvial horizon. (See Eluviation.)

#### **Series, soil**

A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

#### **Severely eroded spot (map symbol)**

An area where, on the average, 75 percent or more of the original surface layer has been lost because of accelerated erosion. Not used in map units in which “severely eroded,” “very severely eroded,” or “gullied” is part of the map unit name.

#### **Shale**

Sedimentary rock that formed by the hardening of a deposit of clay, silty clay, or silty clay loam and that has a tendency to split into thin layers.

#### **Sheet erosion**

The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

#### **Short, steep slope (map symbol)**

A narrow area of soil having slopes that are at least two slope classes steeper than the slope class of the surrounding map unit.

#### **Shoulder**

The convex, erosional surface near the top of a hillslope. A shoulder is a transition from summit to backslope.

#### **Shrink-swell**

The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

#### **Shrub-coppice dune**

A small, streamlined dune that forms around brush and clump vegetation.

#### **Side slope (geomorphology)**

A geomorphic component of hills consisting of a laterally planar area of a hillside. The overland waterflow is predominantly parallel. Side slopes are dominantly colluvium and slope-wash sediments.

#### **Silica**

A combination of silicon and oxygen. The mineral form is called quartz.

#### **Silica-sesquioxide ratio**

The ratio of the number of molecules of silica to the number of molecules of alumina and iron oxide. The more highly weathered soils or their clay fractions in warm-temperate, humid regions, and especially those in the tropics, generally have a low ratio.



#### **Silt**

As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

#### **Siltstone**

An indurated silt having the texture and composition of shale but lacking its fine lamination or fissility; a massive mudstone in which silt predominates over clay.

#### **Similar soils**

Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

#### **Sinkhole (map symbol)**

A closed, circular or elliptical depression, commonly funnel shaped, characterized by subsurface drainage and formed either by dissolution of the surface of underlying bedrock (e.g., limestone, gypsum, or salt) or by collapse of underlying caves within bedrock. Complexes of sinkholes in carbonate-rock terrain are the main components of karst topography.

#### **Site index**

A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75.

#### **Slickensides (pedogenic)**

Grooved, striated, and/or glossy (shiny) slip faces on structural peds, such as wedges; produced by shrink-swell processes, most commonly in soils that have a high content of expansive clays.

#### **Slide or slip (map symbol)**

A prominent landform scar or ridge caused by fairly recent mass movement or descent of earthy material resulting from failure of earth or rock under shear stress along one or several surfaces.

#### **Slope**

The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

#### **Slope alluvium**

Sediment gradually transported down the slopes of mountains or hills primarily by nonchannel alluvial processes (i.e., slope-wash processes) and characterized by particle sorting. Lateral particle sorting is evident on long slopes. In a profile sequence, sediments may be distinguished by differences in size and/or specific gravity of rock fragments and may be separated by stone lines. Burnished peds

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and sorting of rounded or subrounded pebbles or cobbles distinguish these materials from unsorted colluvial deposits.

#### **Slow refill**

The slow filling of ponds, resulting from restricted water transmission in the soil.

#### **Slow water movement**

Restricted downward movement of water through the soil. See Saturated hydraulic conductivity.

#### **Sodic (alkali) soil**

A soil having so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

#### **Sodic spot (map symbol)**

An area where the surface layer has a sodium adsorption ratio that is at least 10 more than that of the surface layer of the named soils in the surrounding map unit. The surface layer of the surrounding soils has a sodium adsorption ratio of 5 or less.

#### **Sodicity**

The degree to which a soil is affected by exchangeable sodium. Sodicity is expressed as a sodium adsorption ratio (SAR) of a saturation extract, or the ratio of  $\text{Na}^+$  to  $\text{Ca}^{++} + \text{Mg}^{++}$ . The degrees of sodicity and their respective ratios are:

*Slight:* Less than 13:1

*Moderate:* 13-30:1

*Strong:* More than 30:1

#### **Sodium adsorption ratio (SAR)**

A measure of the amount of sodium (Na) relative to calcium (Ca) and magnesium (Mg) in the water extract from saturated soil paste. It is the ratio of the Na concentration divided by the square root of one-half of the Ca + Mg concentration.

#### **Soft bedrock**

Bedrock that can be excavated with trenching machines, backhoes, small rippers, and other equipment commonly used in construction.

#### **Soil**

A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief and by the passage of time.

#### **Soil separates**

Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes, in millimeters, of separates recognized in the United States are as follows:

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*Very coarse sand:* 2.0 to 1.0

*Coarse sand:* 1.0 to 0.5

*Medium sand:* 0.5 to 0.25

*Fine sand:* 0.25 to 0.10

*Very fine sand:* 0.10 to 0.05

*Silt:* 0.05 to 0.002

*Clay:* Less than 0.002

#### **Solum**

The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the material below the solum. The living roots and plant and animal activities are largely confined to the solum.

#### **Spoil area (map symbol)**

A pile of earthy materials, either smoothed or uneven, resulting from human activity.

#### **Stone line**

In a vertical cross section, a line formed by scattered fragments or a discrete layer of angular and subangular rock fragments (commonly a gravel- or cobble-sized lag concentration) that formerly was draped across a topographic surface and was later buried by additional sediments. A stone line generally caps material that was subject to weathering, soil formation, and erosion before burial. Many stone lines seem to be buried erosion pavements, originally formed by sheet and rill erosion across the land surface.

#### **Stones**

Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter if rounded or 15 to 24 inches (38 to 60 centimeters) in length if flat.

#### **Stony**

Refers to a soil containing stones in numbers that interfere with or prevent tillage.

#### **Stony spot (map symbol)**

A spot where 0.01 to 0.1 percent of the soil surface is covered by rock fragments that are more than 10 inches in diameter in areas where the surrounding soil has no surface stones.

#### **Strath terrace**

A type of stream terrace; formed as an erosional surface cut on bedrock and thinly mantled with stream deposits (alluvium).

#### **Stream terrace**

One of a series of platforms in a stream valley, flanking and more or less parallel to the stream channel, originally formed near the level of the stream; represents

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the remnants of an abandoned flood plain, stream bed, or valley floor produced during a former state of fluvial erosion or deposition.

#### **Stripcropping**

Growing crops in a systematic arrangement of strips or bands that provide vegetative barriers to wind erosion and water erosion.

#### **Structure, soil**

The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are:

*Platy*: Flat and laminated

*Prismatic*: Vertically elongated and having flat tops

*Columnar*: Vertically elongated and having rounded tops

*Angular blocky*: Having faces that intersect at sharp angles (planes)

*Subangular blocky*: Having subrounded and planar faces (no sharp angles)

*Granular*: Small structural units with curved or very irregular faces

Structureless soil horizons are defined as follows:

*Single grained*: Entirely noncoherent (each grain by itself), as in loose sand

*Massive*: Occurring as a coherent mass

#### **Stubble mulch**

Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind erosion and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

#### **Subsoil**

Technically, the B horizon; roughly, the part of the solum below plow depth.

#### **Subsoiling**

Tilling a soil below normal plow depth, ordinarily to shatter a hardpan or claypan.

#### **Substratum**

The part of the soil below the solum.

#### **Subsurface layer**

Any surface soil horizon (A, E, AB, or EB) below the surface layer.

#### **Summer fallow**

The tillage of uncropped land during the summer to control weeds and allow storage of moisture in the soil for the growth of a later crop. A practice common in semiarid regions, where annual precipitation is not enough to produce a crop every year. Summer fallow is frequently practiced before planting winter grain.

#### **Summit**

The topographically highest position of a hillslope. It has a nearly level (planar or only slightly convex) surface.

#### **Surface layer**

The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

#### **Surface soil**

The A, E, AB, and EB horizons, considered collectively. It includes all subdivisions of these horizons.

#### **Talus**

Rock fragments of any size or shape (commonly coarse and angular) derived from and lying at the base of a cliff or very steep rock slope. The accumulated mass of such loose broken rock formed chiefly by falling, rolling, or sliding.

#### **Taxadjuncts**

Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior. Soils are recognized as taxadjuncts only when one or more of their characteristics are slightly outside the range defined for the family of the series for which the soils are named.

#### **Terminal moraine**

An end moraine that marks the farthest advance of a glacier. It typically has the form of a massive arcuate or concentric ridge, or complex of ridges, and is underlain by till and other types of drift.

#### **Terrace (conservation)**

An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet. A terrace in a field generally is built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

#### **Terrace (geomorphology)**

A steplike surface, bordering a valley floor or shoreline, that represents the former position of a flood plain, lake, or seashore. The term is usually applied both to the relatively flat summit surface (tread) that was cut or built by stream or wave action and to the steeper descending slope (scarp or riser) that has graded to a lower base level of erosion.

#### **Terracettes**

Small, irregular steplike forms on steep hillslopes, especially in pasture, formed by creep or erosion of surficial materials that may be induced or enhanced by trampling of livestock, such as sheep or cattle.

#### **Texture, soil**

The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand*, *loamy sand*, *sandy loam*, *loam*, *silt loam*, *silt*, *sandy clay loam*, *clay loam*, *silty clay loam*, *sandy clay*, *silty clay*, and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying “coarse,” “fine,” or “very fine.”

#### **Thin layer**

Otherwise suitable soil material that is too thin for the specified use.

#### **Till**

Dominantly unsorted and nonstratified drift, generally unconsolidated and deposited directly by a glacier without subsequent reworking by meltwater, and consisting of a heterogeneous mixture of clay, silt, sand, gravel, stones, and boulders; rock fragments of various lithologies are embedded within a finer matrix that can range from clay to sandy loam.

#### **Till plain**

An extensive area of level to gently undulating soils underlain predominantly by till and bounded at the distal end by subordinate recessional or end moraines.

#### **Tilth, soil**

The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

#### **Toeslope**

The gently inclined surface at the base of a hillslope. Toeslopes in profile are commonly gentle and linear and are constructional surfaces forming the lower part of a hillslope continuum that grades to valley or closed-depression floors.

#### **Topsoil**

The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

#### **Trace elements**

Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, in soils in extremely small amounts. They are essential to plant growth.

#### **Tread**

The flat to gently sloping, topmost, laterally extensive slope of terraces, flood-plain steps, or other stepped landforms; commonly a recurring part of a series of natural steplike landforms, such as successive stream terraces.

#### **Tuff**

A generic term for any consolidated or cemented deposit that is 50 percent or more volcanic ash.

#### **Upland**

An informal, general term for the higher ground of a region, in contrast with a low-lying adjacent area, such as a valley or plain, or for land at a higher elevation than the flood plain or low stream terrace; land above the footslope zone of the hillslope continuum.

#### **Valley fill**

The unconsolidated sediment deposited by any agent (water, wind, ice, or mass wasting) so as to fill or partly fill a valley.

#### **Variiegation**

Refers to patterns of contrasting colors assumed to be inherited from the parent material rather than to be the result of poor drainage.

#### **Varve**

A sedimentary layer or a lamina or sequence of laminae deposited in a body of still water within a year. Specifically, a thin pair of graded glaciolacustrine layers seasonally deposited, usually by meltwater streams, in a glacial lake or other body of still water in front of a glacier.

#### **Very stony spot (map symbol)**

A spot where 0.1 to 3.0 percent of the soil surface is covered by rock fragments that are more than 10 inches in diameter in areas where the surface of the surrounding soil is covered by less than 0.01 percent stones.

#### **Water bars**

Smooth, shallow ditches or depressional areas that are excavated at an angle across a sloping road. They are used to reduce the downward velocity of water and divert it off and away from the road surface. Water bars can easily be driven over if constructed properly.

#### **Weathering**

All physical disintegration, chemical decomposition, and biologically induced changes in rocks or other deposits at or near the earth's surface by atmospheric or biologic agents or by circulating surface waters but involving essentially no transport of the altered material.

#### **Well graded**

Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

#### **Wet spot (map symbol)**

A somewhat poorly drained to very poorly drained area that is at least two drainage classes wetter than the named soils in the surrounding map unit.

**Wilting point (or permanent wilting point)**

The moisture content of soil, on an oven-dry basis, at which a plant (specifically a sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

**Windthrow**

The uprooting and tipping over of trees by the wind.



## Appendix B: Mississippi National Heritage Inventory

Mississippi National Heritage Inventory

www.mdwfp.com

Accessed 8/15/14

*This list is not meant as a comprehensive listing of all plant and animal species. Rather the plants and animals listed below are recognized as species of "special concern".*

GREEN text indicates threatened federal status

### Plants – Hancock County

County	Scientific Name	Common Name	Global Rank	State Rank	Type
Hancock	Agalinis aphylla	Coastal Plain False-foxglove	G3G4	S2S3	Plant
Hancock	Agalinis filicaulis	Thin Stemmed False-foxglove	G3G4	S2?	Plant
Hancock	Amsonia ludoviciana	Creole Phlox	G3	SX	Plant
Hancock	Calopogon barbatus	Bearded Grass-pink	G4?	S2S3	Plant
Hancock	Calopogon multiflorus	Many-flower Grass-pink	G2G3	S1	Plant
Hancock	Carex exilis	Coast Sedge	G5	S2	Plant
Hancock	Chamaecyparis thyoides	Atlantic White Cedar	G4	S2	Plant
Hancock	Cleistes bifaria	Spreading Pogonia	G4?	S3	Plant
Hancock	<i>Dalea carnea var. gracilis</i>	<i>Pine Barrens Prairie Clover</i>	<i>G5T3T4</i>	<i>S2S3</i>	<i>Plant</i>
Hancock	Desmodium tenuifolium	Slim-leaf Tick-trefoil	G4	S2	Plant
Hancock	Dichanthelium wrightianum	Wright's Witchgrass	G4	S1S2	Plant
Hancock	Eleocharis elongata	Slim Spike-rush	G5?	S1	Plant
Hancock	Eriocaulon texense	Texas Pipewort	G4	S2S3	Plant
Hancock	Eryngium aquaticum	Marsh Eryngo	G4	S1	Plant
Hancock	Eupatorium ivifolium	Ivy-leaf Throughwort	G5	S3S4	Plant
Hancock	Hibiscus coccineus	Brilliant Hibiscus	G4?	S2	Plant
Hancock	Ilex amelanchier	Juneberry Holly	G4	S3	Plant
Hancock	Ilex myrtifolia	Myrtle Holly	G5?	S3S4	Plant
Hancock	Isoetes louisianensis	Louisiana Quillwort	G2	S2	Plant
Hancock	<i>Juniperus virginiana var. silicicola</i>	<i>Southern Red Cedar</i>	<i>G5T4T5</i>	<i>S2</i>	<i>Plant</i>
Hancock	Lachnocaulon digynum	Pineland Bogbutton	G3	S2	Plant
Hancock	Lilaeopsis carolinensis	Carolina Lilaeopsis	G3G5	S2S3	Plant
Hancock	Macranthera flammea	Flame Flower	G3	S3?	Plant
Hancock	Panicum nudicaule	Naked-stemmed Panic Grass	G3Q	S2	Plant
Hancock	Pinguicula planifolia	Chapman's Butterwort	G3?	S2	Plant
Hancock	Pinguicula primuliflora	Southern Butterwort	G3G4	S3	Plant
Hancock	Platanthera integra	Yellow Fringeless Orchid	G3G4	S3	Plant

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Hancock	<i>Polygala leptostachys</i>	Georgia Milkwort	G3G4	S1	Plant
Hancock	<i>Quadrula quadrula</i>	Mapleleaf	G5	S5	Plant
Hancock	<i>Rhynchospora curtissii</i>	Curtiss's Beakrush	G4	S1	Plant
Hancock	<i>Rhynchospora macra</i>	Large Beakrush	G3	S3	Plant
Hancock	<i>Rhynchospora stenophylla</i>	Chapman Beakrush	G4	S2S3	Plant
Hancock	<i>Ruellia noctiflora</i>	Night-flowering Ruellia	G2	S2	Plant
Hancock	<i>Ruellia pedunculata</i> ssp. <i>pinetorum</i>	Pine Barren Ruellia	G5T3T4	S3	Plant
Hancock	<i>Sageretia minutiflora</i>	Tiny-leaved Buckthorn	G4	S2	Plant
Hancock	Shell midden shrub/woodland	Southern Redcedar - False Buckthorn	GNR	S1	Plant
Hancock	<i>Syngonanthus flavidulus</i>	Yellow Pipewort	G5	S2?	Plant
Hancock	<i>Utricularia purpurea</i>	Purple Bladderwort	G5	S2S3	Plant
Hancock	<i>Xyris drummondii</i>	Drummond's Yellow-eyed Grass	G3	S2	Plant

### Plants – Harrison County

County	Scientific Name	Common Name	Global Rank	State Rank	Type
Harrison	<i>Agalinis aphylla</i>	Coastal Plain False-foxglove	G3G4	S2S3	Plant
Harrison	<i>Agalinis filicaulis</i>	Thin Stemmed False-foxglove	G3G4	S2?	Plant
Harrison	<i>Agrimonia incisa</i>	Incised Groovebur	G3	S3	Plant
Harrison	<i>Andropogon gyrans</i> var. <i>stenophyllus</i>	Elliott's Bluestem (Var.2)	G5T4	S1S2	Plant
Harrison	<i>Calopogon barbatus</i>	Bearded Grass-pink	G4?	S2S3	Plant
Harrison	<i>Carex exilis</i>	Coast Sedge	G5	S2	Plant
Harrison	<i>Cleistes bifaria</i>	Spreading Pogonia	G4?	S3	Plant
Harrison	<i>Dalea carnea</i> var. <i>gracilis</i>	Pine Barrens Prairie Clover	G5T3T4	S2S3	Plant
Harrison	<i>Desmodium tenuifolium</i>	Slim-leaf Tick-trefoil	G4	S2	Plant
Harrison	<i>Dichantherium erectifolium</i>	Erect-leaf Witchgrass	G4	S3S4	Plant
Harrison	<i>Dichantherium wrightianum</i>	Wright's Witchgrass	G4	S1S2	Plant
Harrison	<i>Elyonurus tripsacoides</i>	Pan American Balsamscale	G5?	SH	Plant
Harrison	<i>Enallagma pollutum</i>	Florida Bluet	G5	S2	Plant
Harrison	<i>Epidendrum conopseum</i>	Green-fly Orchid	G4	S2	Plant
Harrison	<i>Eriocaulon texense</i>	Texas Pipewort	G4	S2S3	Plant
Harrison	<i>Eupatorium ivifolium</i>	Ivy-leaf Throughwort	G5	S3S4	Plant
Harrison	<i>Gaylussacia nana</i>	Dangleberry	G4	S2S3	Plant
Harrison	<i>Gordonia lasianthus</i>	Loblolly Bay	G5	S3	Plant
Harrison	<i>Helianthemum arenicola</i>	Gulf Rockrose	G3	S1S2	Plant
Harrison	<i>Ilex amelanchier</i>	Juneberry Holly	G4	S3	Plant
Harrison	<i>Ilex cassine</i>	Dahoon Holly	G5	S2	Plant

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Harrison	<i>Ilex myrtifolia</i>	Myrtle Holly	G5?	S3S4	Plant
Harrison	<i>Isoetes louisianensis</i>	Louisiana Quillwort	G2	S2	Plant
Harrison	<i>Lachnocaulon digynum</i>	Pineland Bogbutton	G3	S2	Plant
Harrison	<i>Lilaeopsis carolinensis</i>	Carolina Lilaeopsis	G3G5	S2S3	Plant
Harrison	<i>Lindera subcoriacea</i>	Bog Spice Bush	G2G3	S2	Plant
Harrison	<i>Linum macrocarpum</i>	Large Fruited Flax	G2	S2S3	Plant
Harrison	<i>Lycopodiella cernua</i>	Nodding Clubmoss	G5	S2	Plant
Harrison	<i>Macranthera flammea</i>	Flame Flower	G3	S3?	Plant
Harrison	<i>Melanthium virginicum</i>	Virginia Bunchflower	G5	S2S3	Plant
Harrison	<i>Panicum nudicaule</i>	Naked-stemmed Panic Grass	G3Q	S2	Plant
Harrison	<i>Paronychia erecta</i>	Beach Sand-squares	G3G4	S1S2	Plant
Harrison	<i>Paspalum monostachyum</i>	Gulfdune Paspalum	G4?	SU	Plant
Harrison	<i>Peltandra sagittifolia</i>	White Arum	G3G4	S3	Plant
Harrison	<i>Physalis angustifolia</i>	Coast Ground-cherry	G3G4	S3S4	Plant
Harrison	<i>Pinguicula planifolia</i>	Chapman's Butterwort	G3?	S2	Plant
Harrison	<i>Pinguicula primuliflora</i>	Southern Butterwort	G3G4	S3	Plant
Harrison	<i>Platanthera blephariglottis</i>	Large White Fringed Orchid	G4G5	S2	Plant
Harrison	<i>Platanthera cristata</i>	Crested Fringed Orchid	G5	S3	Plant
Harrison	<i>Platanthera integra</i>	Yellow Fringeless Orchid	G3G4	S3	Plant
Harrison	<i>Polygala crenata</i>	Crenate Milkwort	G4?	S1S2	Plant
Harrison	<i>Polygala hookeri</i>	Hooker's Milkwort	G3	S1S2	Plant
Harrison	<i>Polygala leptostachys</i>	Georgia Milkwort	G3G4	S1	Plant
Harrison	<i>Quercus minima</i>	Dwarf Live Oak	G5	S1	Plant
Harrison	<i>Quercus myrtifolia</i>	Myrtle-leaf Oak	G5	S2	Plant
Harrison	<i>Rhynchospora macra</i>	Large Beakrush	G3	S3	Plant
Harrison	<i>Rhynchospora stenophylla</i>	Chapman Beakrush	G4	S2S3	Plant
Harrison	<i>Ruellia noctiflora</i>	Night-flowering Ruellia	G2	S2	Plant
Harrison	<i>Ruellia pedunculata ssp. pinetorum</i>	Pine Barren Ruellia	G5T3T4	S3	Plant
Harrison	<i>Schizachyrium maritimum</i>	Gulf Bluestem	G3G4Q	S3?	Plant
Harrison	<i>Scleria reticularis</i>	Reticulated Nutrush	G4	S1	Plant
Harrison	<i>Setaria corrugata</i>	Coastal Fox-tail	G5?	SU	Plant
Harrison	<i>Sorghastrum apalachicolense</i>	Open Indian Grass	G3G4Q	S3S4	Plant
Harrison	<i>Spiranthes brevilabris var. floridana</i>	Florida Ladies'-tresses	G3G4T1	S1	Plant
Harrison	<i>Spiranthes longilabris</i>	Giant Spiral Ladies'-tresses	G3	S2	Plant
Harrison	<i>Stylisma aquatica</i>	Water Southern Morning-glory	G4	S1	Plant
Harrison	<i>Syngonanthus flavidulus</i>	Yellow Pipewort	G5	S2?	Plant
Harrison	<i>Utricularia purpurea</i>	Purple Bladderwort	G5	S2S3	Plant
Harrison	<i>Xyris drummondii</i>	Drummond's Yellow-eyed Grass	G3	S2	Plant
Harrison	<i>Xyris scabrifolia</i>	Harper's Yellow-eyed Grass	G3	S2S3	Plant

## Appendix B: Mississippi National Heritage Inventory

### Animals – Hancock County

County	Scientific Name	Common Name	Global Rank	State Rank	Type
Hancock	<i>Acipenser oxyrinchus desotoi</i>	Gulf Sturgeon	G3T2	S1	Animal
Hancock	<i>Aimophila aestivalis</i>	Bachman's Sparrow	G3	S3B,S3S4N	Animal
Hancock	<i>Anas fulvigula</i>	Mottled Duck	G4	S2B,S4N	Animal
Hancock	<i>Bufo nebulifer</i>	Gulf Coast Toad	G5	S3	Animal
Hancock	<i>Celithemis amanda</i>	Amanda's Pennant	G5	S2	Animal
Hancock	<i>Charadrius melodus</i>	Piping Plover	G3	S2N	Animal
Hancock	<i>Circus cyaneus</i>	Northern Harrier	G5	S4N	Animal
Hancock	<i>Cirsium lecontei</i>	Leconte's Thistle	G2G3	S1S2	Animal
Hancock	<i>Corynorhinus rafinesquii</i>	Rafinesque's Big-eared Bat	G3G4	S2	Animal
Hancock	<i>Crystallaria asprella</i>	Crystal Darter	G3	S1	Animal
Hancock	<i>Deirochelys reticularia</i>	Chicken Turtle	G5	S4	Animal
Hancock	<i>Drymarchon couperi</i>	Eastern Indigo Snake	G3	S1	Animal
Hancock	<i>Enallagma pallidum</i>	Pale Bluet	G4	S2	Animal
Hancock	<i>Enneacanthus gloriosus</i>	Bluespotted Sunfish	G5	S3	Animal
Hancock	<i>Euphyes bayensis</i>	Bay St. Louis Skipper	G1G3	S1	Animal
Hancock	<i>Falco sparverius</i>	American Kestrel	G5	S3B,S4S5N	Animal
Hancock	<i>Fundulus jenkinsi</i>	Saltmarsh Topminnow	G3	S3	Animal
Hancock	<i>Gomphus hodgesi</i>	Hodges' Clubtail	G3	S2	Animal
Hancock	<i>Gomphus hybridus</i>	Cocoa Clubtail	G4	S3	Animal
Hancock	<i>Gomphus modestus</i>	Gulf Coast Clubtail	G3	S3	Animal
Hancock	<i>Gopherus polyphemus</i>	Gopher Tortoise	G3	S2	Animal
Hancock	<i>Haliaeetus leucocephalus</i>	Bald Eagle	G5	S2B,S2N	Animal
Hancock	<i>Heterandria formosa</i>	Least Killifish	G5	S3	Animal
Hancock	<i>Heterodon simus</i>	Southern Hognose Snake	G2	SX	Animal
Hancock	<i>Ictiobus niger</i>	Black Buffalo	G5	S3	Animal
Hancock	<i>Lampsilis straminea claibornensis</i>	Southern Fatmucket	G5T5	S5	Animal
Hancock	<i>Lampsilis teres</i>	Yellow Sandshell	G5	S5	Animal
Hancock	<i>Macrodiplax balteata</i>	Marl Pennant	G5	S2	Animal
Hancock	<i>Malaclemys terrapin pileata</i>	Mississippi Diamondback Terrapin	G4T3Q	S2	Animal
Hancock	<i>Micrurus fulvius</i>	Eastern Coral Snake	G5	S3S4	Animal
Hancock	<i>Notropis chalybaeus</i>	Ironcolor Shiner	G4	S2	Animal
Hancock	<i>Notropis petersoni</i>	Coastal Shiner	G5	S4	Animal
Hancock	<i>Ophioglossum petiolatum</i>	Stalked Adders-tongue	G5	S4	Animal
Hancock	<i>Polyodon spathula</i>	Paddlefish	G4	S3	Animal

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Hancock	<i>Potamilus purpuratus</i>	Bleufer	G5	S5	Animal
Hancock	<i>Pseudotriton montanus</i>	Mud Salamander	G5	S2S3	Animal
Hancock	<i>Pteronotropis welaka</i>	Bluenose Shiner	G3G4	S3	Animal
Hancock	<i>Puma concolor coryi</i>	Florida Panther	G5T1	SX	Animal
Hancock	<i>Quadrula refulgens</i>	Purple Pimpleback	G3G4	S3S4	Animal
Hancock	<i>Rana heckscheri</i>	River Frog	G5	S1	Animal
Hancock	<i>Regina rigida sinicola</i>	Gulf Crayfish Snake	G5T5	S3?	Animal
Hancock	<i>Rhadinaea flavilata</i>	Pine Woods Snake	G4	S3?	Animal
Hancock	<i>Somatochlora provocans</i>	Treetop Emerald	G4	S2	Animal
Hancock	<i>Tritogonia verrucosa</i>	Pistolgrip	G4G5	S4	Animal
Hancock	<i>Ursus americanus</i>	Black Bear	G5	S1	Animal

### Animals – Harrison County

County	Scientific Name	Common Name	Global Rank	State Rank	Type
Harrison	<i>Acipenser oxyrinchus desotoi</i>	Gulf Sturgeon	G3T2	S1	Animal
Harrison	<i>Aimophila aestivalis</i>	Bachman's Sparrow	G3	S3B,S3S4N	Animal
Harrison	<i>Alligator mississippiensis</i>	American Alligator	G5	S4	Animal
Harrison	<i>Ammodramus nelsoni</i>	Nelson's Sharp-tailed Sparrow	G5	S3N	Animal
Harrison	<i>Anas acuta</i>	Northern Pintail	G5	S4N	Animal
Harrison	<i>Anas fulvigula</i>	Mottled Duck	G4	S2B,S4N	Animal
Harrison	<i>Aythya affinis</i>	Lesser Scaup	G5	S4N	Animal
Harrison	<i>Celithemis amanda</i>	Amanda's Pennant	G5	S2	Animal
Harrison	<i>Cemophora coccinea</i>	Scarlet Snake	G5	S4	Animal
Harrison	<i>Charadrius alexandrinus</i>	Snowy Plover	G4	S2	Animal
Harrison	<i>Charadrius alexandrinus tenuirostris</i>	Southeastern Snowy Plover	G4T3Q	S2	Animal
Harrison	<i>Charadrius melodus</i>	Piping Plover	G3	S2N	Animal
Harrison	<i>Charadrius wilsonia</i>	Wilson's Plover	G5	S1	Animal
Harrison	<i>Circus cyaneus</i>	Northern Harrier	G5	S4N	Animal
Harrison	<i>Cirsium lecontei</i>	Leconte's Thistle	G2G3	S1S2	Animal
Harrison	<i>Colinus virginianus</i>	Northern Bobwhite	G5	S3S4	Animal
Harrison	<i>Crotalus adamanteus</i>	Eastern Diamondback Rattlesnake	G4	S3S4	Animal
Harrison	<i>Deirochelys reticularia</i>	Chicken Turtle	G5	S4	Animal
Harrison	<i>Dromogomphus armatus</i>	Southeastern Spinyleg	G4	S3	Animal
Harrison	<i>Egretta rufescens</i>	Reddish Egret	G4	S2N	Animal
Harrison	<i>Enallagma concisum</i>	Cherry Bluet	G4	S2	Animal
Harrison	<i>Enallagma pallidum</i>	Pale Bluet	G4	S2	Animal
Harrison	<i>Enneacanthus gloriosus</i>	Bluespotted Sunfish	G5	S3	Animal

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Harrison	<i>Eumeces anthracinus</i>	Coal Skink	G5	S3S4	Animal
Harrison	<i>Falco sparverius</i>	American Kestrel	G5	S3B,S4S5N	Animal
Harrison	<i>Falco sparverius paulus</i>	Southeastern American Kestrel	G5T4	S3	Animal
Harrison	<i>Fallicambarus byersi</i>	Lavender Burrowing Crayfish	G4	S3	Animal
Harrison	<i>Fundulus jenkinsi</i>	Saltmarsh Topminnow	G3	S3	Animal
Harrison	<i>Gomphus modestus</i>	Gulf Coast Clubtail	G3	S3	Animal
Harrison	<i>Gopherus polyphemus</i>	Gopher Tortoise	G3	S2	Animal
Harrison	<i>Haematopus palliatus</i>	American Oystercatcher	G5	S1	Animal
Harrison	<i>Haliaeetus leucocephalus</i>	Bald Eagle	G5	S2B,S2N	Animal
Harrison	<i>Heterandria formosa</i>	Least Killifish	G5	S3	Animal
Harrison	<i>Heterodon simus</i>	Southern Hognose Snake	G2	SX	Animal
Harrison	<i>Lampropeltis triangulum elapsoides</i>	Scarlet Kingsnake	G5T5	S4	Animal
Harrison	<i>Lampsilis straminea claibornensis</i>	Southern Fatmucket	G5T5	S5	Animal
Harrison	<i>Laterallus jamaicensis</i>	Black Rail	G4	S2N	Animal
Harrison	<i>Macrochelys temminckii</i>	Alligator Snapping Turtle	G3G4	S3	Animal
Harrison	<i>Malaclemys terrapin pileata</i>	Mississippi Diamondback Terrapin	G4T3Q	S2	Animal
Harrison	<i>Masticophis flagellum</i>	Coachwhip	G5	S3S4	Animal
Harrison	<i>Melanerpes erythrocephalus</i>	Red-headed Woodpecker	G5	S4S5	Animal
Harrison	<i>Morone saxatilis</i>	Striped Bass	G5	SH	Animal
Harrison	<i>Nerodia clarkii clarkii</i>	Gulf Salt Marsh Snake	G4T4	S2?	Animal
Harrison	<i>Notropis chalybaeus</i>	Ironcolor Shiner	G4	S2	Animal
Harrison	<i>Notropis petersoni</i>	Coastal Shiner	G5	S4	Animal
Harrison	<i>Ophioglossum petiolatum</i>	Stalked Adders-tongue	G5	S4	Animal
Harrison	<i>Pandion haliaetus</i>	Osprey	G5	S3B,S1S2N	Animal
Harrison	<i>Pelecanus occidentalis</i>	Brown Pelican	G4	S1N	Animal
Harrison	<i>Pelecanus occidentalis carolinensis</i>	Eastern Brown Pelican	G4TU	S1N	Animal
Harrison	<i>Picoides borealis</i>	Red-cockaded Woodpecker	G3	S1	Animal
Harrison	<i>Pituophis melanoleucus lodingi</i>	Black Pine Snake	G4T2T3	S2	Animal
Harrison	<i>Procambarus fitzpatricki</i>	Spiny-tailed Crayfish	G2	S2	Animal
Harrison	<i>Pseudemys alabamensis</i>	Alabama Redbelly Turtle	G1	S1	Animal
Harrison	<i>Pseudotriton montanus</i>	Mud Salamander	G5	S2S3	Animal
Harrison	<i>Rallus elegans</i>	King Rail	G4	S3B,S3N	Animal
Harrison	<i>Rana heckscheri</i>	River Frog	G5	S1	Animal
Harrison	<i>Rana sevosia</i>	Dark Gopher Frog	G1	S1	Animal
Harrison	<i>Regina rigida sinicola</i>	Gulf Crayfish Snake	G5T5	S3?	Animal
Harrison	<i>Rhadinaea flavilata</i>	Pine Woods Snake	G4	S3?	Animal
Harrison	<i>Rynchops niger</i>	Black Skimmer	G5	S3B,S3N	Animal

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Harrison	<i>Sitta pusilla</i>	Brown-headed Nuthatch	G5	S4B	Animal
Harrison	<i>Sorex longirostris</i>	Southeastern Shrew	G5	S4	Animal
Harrison	<i>Sternula antillarum</i>	Least Tern	G4	S3B	Animal
Harrison	<i>Thalasseus maximus</i>	Royal Tern	G5	S1B,S4N	Animal
Harrison	<i>Thryomanes bewickii</i>	Bewick's Wren	G5	S2B,S3N	Animal
Harrison	<i>Ursus americanus</i>	Black Bear	G5	S1	Animal
Harrison	<i>Villosa lienosa</i>	Little Spectaclecase	G5	S5	Animal
Harrison	<i>Villosa vibex</i>	Southern Rainbow	G5Q	S4?	Animal

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### MISSISSIPPI NATURAL HERITAGE PROGRAM LISTED SPECIES OF MISSISSIPPI 2011

SCIENTIFIC NAME	COMMON NAME	GLOBAL RANK	FEDERAL STATUS	STATE STATUS	STATE RANK
<b>ANIMALS</b>					
<b>BIVALVIA</b>					
<i>Actinonaias ligamentina</i>	Mucket	G5		LE	S1
<i>Cyclonaias tuberculata</i>	Purple Wartback	G5		LE	S1
<i>Elliptio arctata</i>	Delicate Spike	G3Q		LE	S1
<i>Elliptio dilatata</i>	Spike	G5		LE	S1
<i>Epioblasma brevidens</i>	Cumberlandian Combshell	G1	LE, XN	LE	S1
<i>Epioblasma penita</i>	Southern Combshell	G1	LE	LE	S1
<i>Epioblasma triquetra</i>	Snuffbox	G3		LE	S1
<i>Hamiota perovalis</i>	Orangenacre Mucket	G2	LT	LE	S1
<i>Lexingtonia dolabelloides</i>	Slabside Pearlymussel	G2	C	LE	S1
<i>Medionidus acutissimus</i>	Alabama Moccasinshell	G2	LT	LE	S1
<i>Plethobasus cyphus</i>	Sheepnose	G3	C	LE	S1
<i>Pleurobema curtum</i>	Black Clubshell	G1	LE	LE	SH
<i>Pleurobema decisum</i>	Southern Clubshell	G2	LE	LE	S1S2
<i>Pleurobema marshalli</i>	Flat Pigtoe	GH	LE	LE	SX
<i>Pleurobema perovatum</i>	Ovate Clubshell	G1	LE	LE	S1
<i>Pleurobema rubrum</i>	Pyramid Pigtoe	G2		LE	S1
<i>Pleurobema taitianum</i>	Heavy Pigtoe	G1	LE	LE	SX
<i>Potamilus capax</i>	Fat Pocketbook	G1	LE	LE	S1
<i>Potamilus inflatus</i>	Inflated Heelsplitter	G1G2	LT	LE	S1
<i>Ptychobranhus fasciolaris</i>	Kidneyshell	G4G5		LE	S1
<i>Quadrula cylindrica cylindrica</i>	Rabbitsfoot	G3T3		LE	S1
<i>Quadrula metanevra</i>	Monkeyface	G4		LE	SX
<i>Quadrula stapes</i>	Stirrupshell	GH	LE	LE	SX
<b>MALACOSTRACA</b>					
<i>Fallicambarus gordonii</i>	Camp Shelby Burrowing Crayfish	G1		LE	S1
<b>INSECTA</b>					
<i>Neonympha mitchellii mitchellii</i>	Mitchell's Satyr	G2T2	LE		S1
<i>Nicrophorus americanus</i>	American Burying Beetle	G2G3	LE	LE	SX
<b>OSTEICHTHYES</b>					
<i>Acipenser oxyrinchus desotoi</i>	Gulf Sturgeon	G3T2	LT	LE	S1
<i>Crystallaria asprella</i>	Crystal Darter	G3		LE	S1
<i>Etheostoma blennioides</i>	Greenside Darter	G5		LE	S1



## Appendix B: Mississippi National Heritage Inventory

### MISSISSIPPI NATURAL HERITAGE PROGRAM LISTED SPECIES OF MISSISSIPPI 2011

<i>SCIENTIFIC NAME</i>	COMMON NAME	GLOBAL RANK	FEDERAL STATUS	STATE STATUS	STATE RANK
<b>OSTEICHTHYES</b>					
<i>Etheostoma rubrum</i>	Bayou Darter	G1	LT	LE	S1
<i>Notropis boops</i>	Bigeye Shiner	G5		LE	S1
<i>Notropis chalybaeus</i>	Ironcolor Shiner	G4		LE	S2
<i>Noturus exilis</i>	Slender Madtom	G5		LE	S1
<i>Noturus gladiator</i>	Piebald Madtom	G3		LE	S1
<i>Noturus munitus</i>	Frecklebelly Madtom	G3		LE	S2
<i>Percina aurora</i>	Pearl Darter	G1	C	LE	S1
<i>Percina phoxocephala</i>	Slenderhead Darter	G5		LE	S1
<i>Phenacobius mirabilis</i>	Suckermouth Minnow	G5		LE	S1
<i>Phoxinus erythrogaster</i>	Southern Redbelly Dace <sup>2</sup>	G5		LE	S2
<i>Scaphirhynchus albus</i>	Pallid Sturgeon	G1	LE	LE	S1
<i>Scaphirhynchus platyrhynchus</i>	Shovelnose Sturgeon	G4	T/SA		S3?
<i>Scaphirhynchus suttkusi</i>	Alabama Sturgeon	G1	LE	LE	S1
<b>AMPHIBIA</b>					
<i>Amphiuma pholeter</i>	One-toed Amphiuma	G3		LE	S1
<i>Aneides aeneus</i>	Green Salamander	G3G4		LE	S1
<i>Eurycea lucifuga</i>	Cave Salamander	G5		LE	S1
<i>Gyrinophilus porphyriticus</i>	Spring Salamander	G5		LE	S1
<i>Rana sevosia</i>	Dusky Gopher Frog	G1	LE	LE	S1
<b>REPTILIA</b>					
<i>Caretta caretta</i>	Loggerhead	G3	LT	LE	S1B
<i>Chelonia mydas</i>	Green Turtle	G3	LE, LT	LE	SNA
<i>Dermochelys coriacea</i>	Leatherback	G2	LE	LE	SNA
<i>Drymarchon couperi</i>	Eastern Indigo Snake	G3	LT	LE	SH
<i>Eretmochelys imbricata</i>	Hawksbill	G3	LE	LE	SNA
<i>Farancia erythrogramma</i>	Rainbow Snake	G5		LE	S2
<i>Gopherus polyphemus</i>	Gopher Tortoise	G3	PS:LT	LE	S2
<i>Graptemys flavimaculata</i>	Yellow-blotched Map Turtle	G2	LT	LE	S2
<i>Graptemys nigrinoda</i>	Black-knobbed Map Turtle	G3		LE	S2
<i>Graptemys oculifera</i>	Ringed Map Turtle	G2	LT	LE	S2
<i>Heterodon simus</i>	Southern Hognose Snake	G2		LE	SX
<i>Lepidochelys kempii</i>	Kemp's or Atlantic Ridley	G1	LE	LE	S1N
<i>Pituophis melanoleucus lodingi</i>	Black Pine Snake	G4T3	C	LE	S2
<i>Pseudemys alabamensis</i>	Alabama Redbelly Turtle	G1	LE	LE	S1
<b>AVES</b>					
<i>Campephilus principalis</i>	Ivory-billed Woodpecker	G1	LE	LE	SX

## Appendix B: Mississippi National Heritage Inventory

### MISSISSIPPI NATURAL HERITAGE PROGRAM LISTED SPECIES OF MISSISSIPPI 2011

SCIENTIFIC NAME	COMMON NAME	GLOBAL RANK	FEDERAL STATUS	STATE STATUS	STATE RANK
<b>AVES</b>					
<i>Charadrius alexandrinus tenuirostris</i>	Southeastern Snowy Plover	G4T3Q		LE	S1B,S1N
<i>Charadrius melodus</i>	Piping Plover	G3	LE, LT	LE	S1N
<i>Falco peregrinus</i>	Peregrine Falcon	G4		LE	SNA
<i>Grus canadensis pulla</i>	Mississippi Sandhill Crane	G5T1	LE	LE	S1
<i>Haliaeetus leucocephalus</i>	Bald Eagle	G5		LE	S1B,S2N
<i>Mycteria americana</i>	Wood Stork	G4	PS:LE	LE	S1N
<i>Pelecanus occidentalis</i>	Brown Pelican	G4		LE	S1N
<i>Picoides borealis</i>	Red-cockaded Woodpecker	G3	LE	LE	S1
<i>Sterna antillarum athalassos</i>	Interior Least Tern <sup>3</sup>	G4T2Q	PS:LE	LE	S3?B
<i>Thryomanes bewickii</i>	Bewick's Wren	G5		LE	S2S3B
<i>Vermivora bachmanii</i>	Bachman's Warbler	GH	LE	LE	SXB
<b>MAMMALIA</b>					
<i>Myotis grisescens</i>	Gray Myotis	G3	LE	LE	SNA
<i>Myotis sodalis</i>	Indiana Bat	G2	LE	LE	SNA
<i>Puma concolor coryi</i>	Florida Panther	G5T1	LE	LE	SX
<i>Trichechus manatus</i>	West Indian Manatee	G2	LE	LE	SNA
<i>Ursus americanus</i>	American Black Bear	G5	PS	LE	S1
<i>Ursus americanus luteolus</i>	Louisiana Black Bear	G5T2	LT	LE	S1
<b>PLANTS <sup>1</sup></b>					
<b>DICOTYLEDONEAE</b>					
<i>Apios priceana</i>	Price's Potato Bean	G2	LT		S1
<i>Lindera melissifolia</i>	Pondberry	G2	LE		S2
<i>Schwalbea Americana</i>	Chaffseed	G2	LE		SH
<b>ISOETOPSIDA</b>					
<i>Isoetes louisianensis</i>	Louisiana quillwort	G3	LE		S2

<sup>1</sup> Mississippi has no status concerning endangered plants.

<sup>2</sup> West Mississippi disjunct populations

<sup>3</sup> Interior populations nesting along the Mississippi River

Cite the list as:

Mississippi Natural Heritage Program, 2011. Listed Species of Mississippi. Museum of Natural Science, Mississippi Dept. of Wildlife, Fisheries, and Parks, Jackson, MS. 3pp.

# ROTTEN BAYOU WATER QUALITY ASSESSMENT

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## LIST OF ACRONYMS AND ABBREVIATIONS

Abbreviation	Definition
BMP	best management practice
DO	dissolved oxygen
GOMA	Gulf of Mexico Alliance
lbs/day	pounds per day
MDEQ	Mississippi Department of Environmental Quality
mg/l	milligrams per liter
NLCD	National Land Cover Database
TBODu	total biochemical oxygen demand, ultimate
TMDL	total maximum daily load
TN	total nitrogen
TP	total phosphorus
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey

## 1 INTRODUCTION

Rotten Bayou, a tributary to St. Louis Bay, is located on the Mississippi Gulf Coast and is listed on Mississippi's 2004 303(d) List of Water Bodies as impaired for organic enrichment/low dissolved oxygen (DO) and nutrients (MDEQ 2007). Rotten Bayou's beneficial use is designated as "Aquatic Life Support." Applicable water quality standards included DO concentrations maintained at a daily average of not less than 5.0 milligrams per liter (mg/l) with an instantaneous minimum of not less than 4.0 mg/l. For tributaries to St. Louis Bay, the MDEQ 2007 water quality standard for nutrients states:

Waters shall be free from materials attributable to municipal, industrial, agricultural or other discharges producing color, odor, taste, total suspended or dissolved solids, sediment, turbidity, or other conditions in such degree as to create a nuisance, render the waters injurious to public health, recreation or to aquatic life and wildlife or adversely affect the palatability of fish, aesthetic quality, or impair the water for any designated use. (p. 5)

The purpose of this water quality assessment was to investigate watershed nutrient inputs to Rotten Bayou and look for signatures of significant nonpoint source loads by understanding current nutrient levels using existing watershed data and reviewing land use information. Results of the evaluation were used in recommending management steps for controlling nutrients from the watershed to Rotten Bayou. The nutrients considered were total nitrogen (TN) and total phosphorus (TP).

The first step in this water quality assessment was to determine if current monitoring data being collected by the U.S. Geological Survey (USGS) within the Rotten Bayou watershed exceed applicable thresholds: total maximum daily load (TMDL) thresholds, draft thresholds for non-tidal rivers and streams in southeast Mississippi, or threshold recommendations in the tidally influenced St. Louis Bay. The next step involved evaluating if adequate data exist to determine sub-watershed inputs and loads and to discern patterns based on land use and water quality data so that management steps for controlling nutrients from the Rotten Bayou watershed could be recommended.

## 1.1 Applicable Nutrient Thresholds

A TMDL was developed for Rotten Bayou (along with four other tributaries to St. Louis Bay) in 2007 based on monitoring data and modeling of the system (MDEQ 2007). Model calibration and verification were based on water quality studies conducted in 1998, 1999, and 2001. The TMDL for organic enrichment was quantified in terms of total biochemical oxygen demand, ultimate (TBOD<sub>u</sub>); since TBOD<sub>u</sub> did not exceed the assimilative capacity of Rotten Bayou, no reductions in permitted loads of organic material were specified in the TMDL in order to meet water quality limits. The TMDL set a threshold concentration of 1.5 mg/l as the target for TN and 0.1 mg/l for TP for waterbodies located in the St. Louis Bay watershed. Mississippi Department of Environmental Quality (MDEQ) presented these concentrations as preliminary target values for TMDL development but noted that the values are subject to revision after the development of numeric nutrient criteria. Based on these target concentrations and estimated flows, the TMDL established nonpoint source load allocations for Rotten Bayou (inclusive of the nearby Jourdan River) of 5,810 pounds per day (lbs/day) for TN and 387 lbs/day for TP.

The State of Mississippi has not yet adopted numeric water quality standards for allowable nutrient concentrations; however, draft stream nutrient thresholds have been developed for non-tidal streams and rivers to protect aquatic life uses in Mississippi (MDEQ 2011). The draft standards were based on reference approaches, stressor response approaches, and relevant literature values. For TN in southeast Mississippi rivers and streams, the recommended thresholds range from 0.31 to 0.68 mg/l, depending on the approach; for TP, the proposed criteria range from 0.01 to 0.05 mg/l, depending on the approach (MDEQ 2011). Literature values and criteria from other states range from 0.18 to 2.0 mg/l for TN and 0.02 to 0.2 mg/l for TP.

In 2013, the Gulf of Mexico Alliance (GOMA), under the direction of MDEQ, completed a study of sources, fate, transport, and effects of nutrients as a basis for protection in estuarine and near-coastal waters for St. Louis Bay (GOMA 2013). The intent of this study was to provide the technical foundation for pilot nutrient thresholds for St. Louis Bay, a tidally influenced coastal bay. Based on empirical and mechanistic modeling results, the preliminary annual geometric mean threshold recommendations are 0.6 to 0.8 mg/l for TN and 0.06 to 0.08 mg/l for TP.



Table 1 summarizes the TN and TP targets and thresholds from the three reports.

**Table 1**  
**Various Targets and Thresholds for Tributaries to St. Louis Bay and for St. Louis Bay**

Parameter	TMDL Targets and Thresholds for Tributaries to St. Louis Bay (MDEQ 2007)		Draft Revised Stream Nutrient Thresholds for Southeast Mississippi Rivers and Streams (MDEQ 2011)	Threshold Recommendations for St. Louis Bay Based on Modeling Results (GOMA 2013)
	Target* (lbs/day)	Threshold (mg/l)	Threshold (mg/l)	Threshold (mg/l)
Total Nitrogen	5,810	1.5	0.31 – 0.68	0.6 – 0.8
Total Phosphorus	387	0.1	0.01 – 0.05	0.06 – 0.08

Notes:

\*Includes Jourdan River loads

lbs/day = pounds per day

mg/l = milligrams per liter

TMDL = total maximum daily load

## 2 DATA SOURCES

### 2.1 Water Quality

Locations of monitoring gages within the Rotten Bayou watershed from the USGS National Water Information System website were reviewed. Three freshwater (i.e., non-tidal) gages and one tidally-influenced gage were identified due to their proximity to Rotten Bayou (Figure 1):

- 02481661 – Tributary to Bayou LaSalle near Vidalia, Mississippi
- 02481663 – Rotten Bayou near Fenton, Mississippi
- 0248166310 – Mill Creek at Fenton, Mississippi
- 0248166590 – Rotten Bayou Tributary No. 1 at Diamondhead, Mississippi

The gage at Diamondhead, located downstream of the bayou, is tidally-influenced. Because of this, it is impossible to discern the influence of the Rotten Bayou watershed from the influence of St. Louis Bay to nutrient concentrations and loads at this gage due to reversal of

flow. Therefore, while the data from this gage were reviewed and compared to appropriate thresholds, they were not considered in evaluations of sub-watershed contributions of nutrients. In addition, point sources contribute nutrients into the tidally-influenced area (Liu et al. 2008) and, therefore, separating nonpoint source contributions at this gage would be further complicated.

Flow and TN and TP concentration data from the three freshwater gages and one tidally influenced gage were downloaded from the website (USGS); data were collected monthly or every other month from 2012 to 2014, with some days having multiple measurements (Table 2). It should be noted that the USGS data are considered draft and provisional and that the USGS is anticipated to complete their monitoring of these gages in 2014. Analyses of the data by USGS are projected to occur by 2016.

**Table 2**  
**Counts of Available USGS Data**

Gage	Year	Total Nitrogen Concentration	Total Phosphorus Concentration	Flow Measurements	Paired Concentration and Flow Measurements
02481661 – Tributary to Bayou LaSalle near Vidalia	2012	43	43	7	7
	2013	6	6	6	6
	2014*	29	29	5	5
02481663 – Rotten Bayou near Fenton	2012	9	9	9	9
	2013	6	6	6	6
	2014*	5	5	5	5
0248166310 – Mill Creek at Fenton	2012	51	51	9	9
	2013	6	6	6	6
	2014*	17	17	5	5
0248166590 – Rotten Bayou Tributary No. 1 at Diamondhead	2012	37	37	9	8
	2013	22	22	6	6
	2014*	37	37	5	5

Note:

\*Per the project’s schedule, data assessments were performed prior to the availability of all 2014 data. Data from the freshwater gages were downloaded on September 14, 2014, and from the tidal gage at Diamondhead on October 2, 2014.

Data collected within Rotten Bayou during a special water quality study in August 2012 (USEPA 2014) were also reviewed. The monitoring stations located within the bayou were tidally-influenced and therefore not used herein for comparison to nutrient thresholds.

## **2.2 Land Use**

Land use information was downloaded from the internet (Multi-Resolution Land Characteristics Consortium). The coverage was based on the 2006 National Land Cover Database (NLCD), which employs a 16-class land cover classification scheme at a spatial resolution of 30 meters (Fry et al. 2011). As of this assessment, the NLCD 2011 coverage was not available online, only a coverage depicting changes in land use since 2006 was available.

## **3 ASSESSMENT METHODOLOGY**

The water quality assessment methodology consisted of two steps: 1) comparison of TN and TP concentrations to TMDL thresholds (MDEQ 2007), draft stream nutrient thresholds (MDEQ 2011), and St. Louis Bay threshold recommendations (GOMA 2013); and 2) assessment of major land use types upstream of each gage. Thresholds are summarized in Table 1.

Nutrient loads, which are calculated by multiplying stream flow by nutrient concentrations, were not computed due to the paucity of paired concentration and flow data (Table 2). The evaluation of export coefficients (e.g., loads per unit area of watershed) likewise could not be performed due to the limited dataset. As a result, only concentrations and land use variations in sub-watersheds were considered in qualitatively assessing potential sources and management options for reducing nonpoint source nutrients reaching Rotten Bayou.

## **4 FINDINGS**

### **4.1 Comparison of Concentrations to Appropriate Thresholds**

Figures 2 and 3 show temporals of TN and TP concentrations, respectively, at the three freshwater gages. Figures 4 and 5 show TN and TP concentration temporals for the tidally influenced gage at Diamondhead. Measurements were taken on a routine basis as well as a sub-daily basis during storm events (Hicks 2014).

#### **4.1.1 Nutrient TMDL Thresholds**

Few TN and TP measurements from 2012 to 2014 exceeded the nutrient TMDL thresholds at the freshwater gages (Figures 2 and 3). For TN, none of the measurements exceeded the nutrient TMDL threshold with the exception of one measurement on July 18, 2012, at 4:15 pm at 0248166310 Mill Creek at Fenton. For TP, 8% and 4% of samples at 02481661 Tributary to Bayou LaSalle near Vidalia and at 0248166310 Mill Creek at Fenton, respectively, exceeded the TMDL threshold; these exceedances appear to have been during storm events. Only one sample taken at 02481663 Rotten Bayou near Fenton exceeded the TP TMDL threshold; this sample was collected on July 12, 2012.

#### **4.1.2 Draft Revised Stream Nutrient Thresholds**

For the freshwater gages, some TN and TP concentrations from 2012 to 2014 were higher than the draft revised stream nutrient thresholds for southeast Mississippi (Figures 2 and 3). For TN, 13% and 7% of samples exceeded the threshold at 02481661 Tributary to Bayou LaSalle near Vidalia and at 0248166310 Mill Creek at Fenton, respectively; these appear to have been taken during storm events as multiple samples were taken on a single day (Hicks 2014). In addition, detection limits reported for several samples were higher than the threshold (Figure 2). No TN measurement at 02481663 Rotten Bayou near Fenton exceeded the threshold. A similar pattern of exceedances is observed for TP data (Figure 3).

#### **4.1.3 St. Louis Bay Thresholds**

The St. Louis Bay thresholds were developed based on tidally influenced monitoring data in St. Louis Bay. Table 3 summarizes annual geometric means of TN and TP for the tidal gage near Rotten Bayou from 2012 to 2014. At this gage, the annual geometric means exceeded the St. Louis Bay thresholds for both TN and TP in 2013 and 2014.

**Table 3**  
**Annual Geometric Means at the Tidal Gage at Diamondhead**

Nutrient	Annual Geometric Mean (mg/l)		
	2012	2013	2014
Total Nitrogen	0.68	1.15	1.02
Total Phosphorus	0.060	0.106	0.090

## Notes:

- Recommended thresholds for St. Louis Bay based on modeling (GOMA 2013): Total Nitrogen 0.6 to 0.8 mg/l, Total Phosphorus 0.06 to 0.08 mg/l
  - The tidal gage is 0248166590 – Rotten Bayou Tributary No. 1 at Diamondhead.
  - Non-detect values were set to the detection limit prior to calculation.
- mg/l = milligrams per liter

## 4.2 Incorporation of Land Use Information

Figure 6 shows land cover classification within sub-watersheds upstream of each of the three freshwater USGS gages. The sub-watersheds were delineated in ArcMap using topography and the gage locations.

Figure 7 shows the proportions of each land cover classification within each sub-watershed. Land cover is similar among the three sub-watersheds, with shrub/scrub, evergreen forest, and woody wetlands being dominant. From the station furthest upland to downstream, the proportions of developed open space and woody wetlands increase while shrub/scrub and grassland/herbaceous proportions decrease.

## 5 LIMITATIONS OF DATA ASSESSMENT

Limitations of this data assessment are as follows:

- Few paired measurements of TN and TP concentration and flow exist for three freshwater gages near Rotten Bayou (Table 2) and therefore, nutrient loads (i.e., concentration multiplied by flow) cannot be adequately assessed. The calculation of nutrient loads would provide an indication of the amount of nutrients passing each gage during the time of measurement.
- Measurements of TN, TP, and flow during storm events are limited.

- Three years of data are not a long enough record to assess long-term or seasonal trends or fluctuations in TN and TP concentrations due to precipitation (e.g., dry year versus wet year).
- Data downloaded from USGS are draft and provisional. Per the project's schedule, data from 2014 were downloaded in September and October 2014; therefore, an assessment of all 2014 data was not performed. Data are being collected by USGS through 2014.
- The reported detection limits for TN data from USGS are sometimes above the threshold recommendations or are high compared to detected data (see open symbols on Figures 2 and 4). These detection limits should be investigated further.
- Tidally influenced data include both watershed and bay sources of nutrients and therefore, cannot be used to identify sources of nutrients from the watershed.

## 6 RECOMMENDATIONS FOR FURTHER STUDY

Based on the findings, TN and TP concentrations measured at three freshwater gages located in the Rotten Bayou watershed are generally below or near various Mississippi nutrient threshold concentrations with the exception of data collected during a few storm events in 2012 and 2014 (Darby 2014). The TN and TP data collected at a tidal gage just downstream of Rotten Bayou exceeded applicable criteria in 2 of the last 3 years. Based on an evaluation of land cover within the sub-watershed above each gage, streamside management is recommended to control nutrient run-off during timber harvesting and re-vegetation. In addition, landside best management practices (BMPs) to control runoff and stormwater are recommended, particularly upland of the Diamondhead and Mill Creek gages.

The following next steps are recommended for further study:

- Continue review of the USGS data, which are being collected through 2014.
- Evaluate land use types near streams for appropriate watershed BMP selection and implementation.
- Verify if data with TN and TP threshold exceedances were collected during storm events. Design a stormwater sampling program in areas expected to be contributing higher TN and TP loads.

- Determine if chlorophyll-a (algal bloom) is a concern in the tidal portion of the bayou.
- Evaluate bacteria data in Rotten Bayou and its tributaries, as available.

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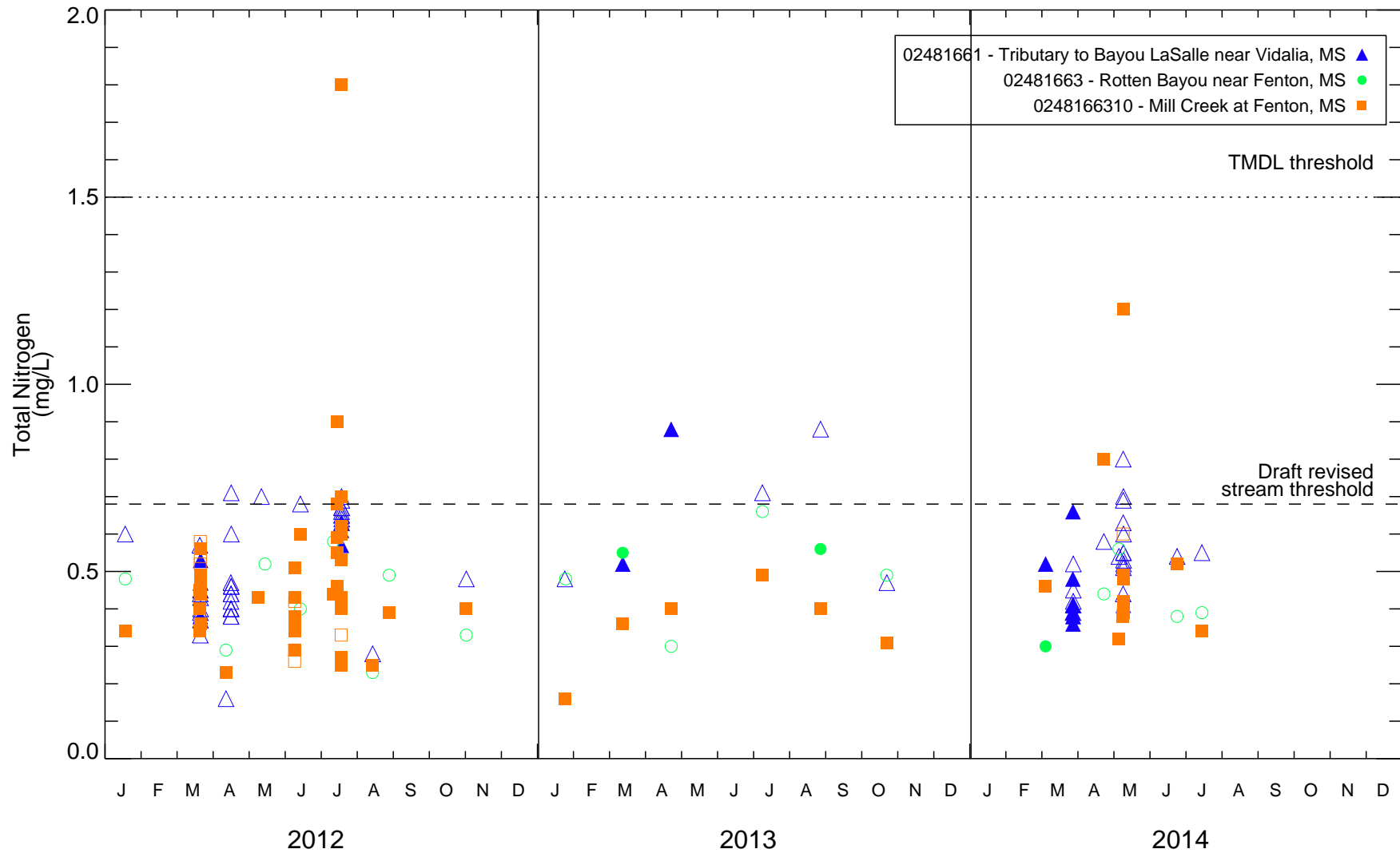


## FIGURES

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**Figure 2**

Temporal of Total Nitrogen Concentration at Three Freshwater USGS Gages near Rotten Bayou



*Non-detects are shown as open symbols at the detection limit.  
 Dotted line is TMDL threshold for tributaries to St. Louis Bay (MDEQ 2007).  
 Dashed line is the top of range of draft revised stream nutrient threshold for southeast MS (MDEQ 2011).*

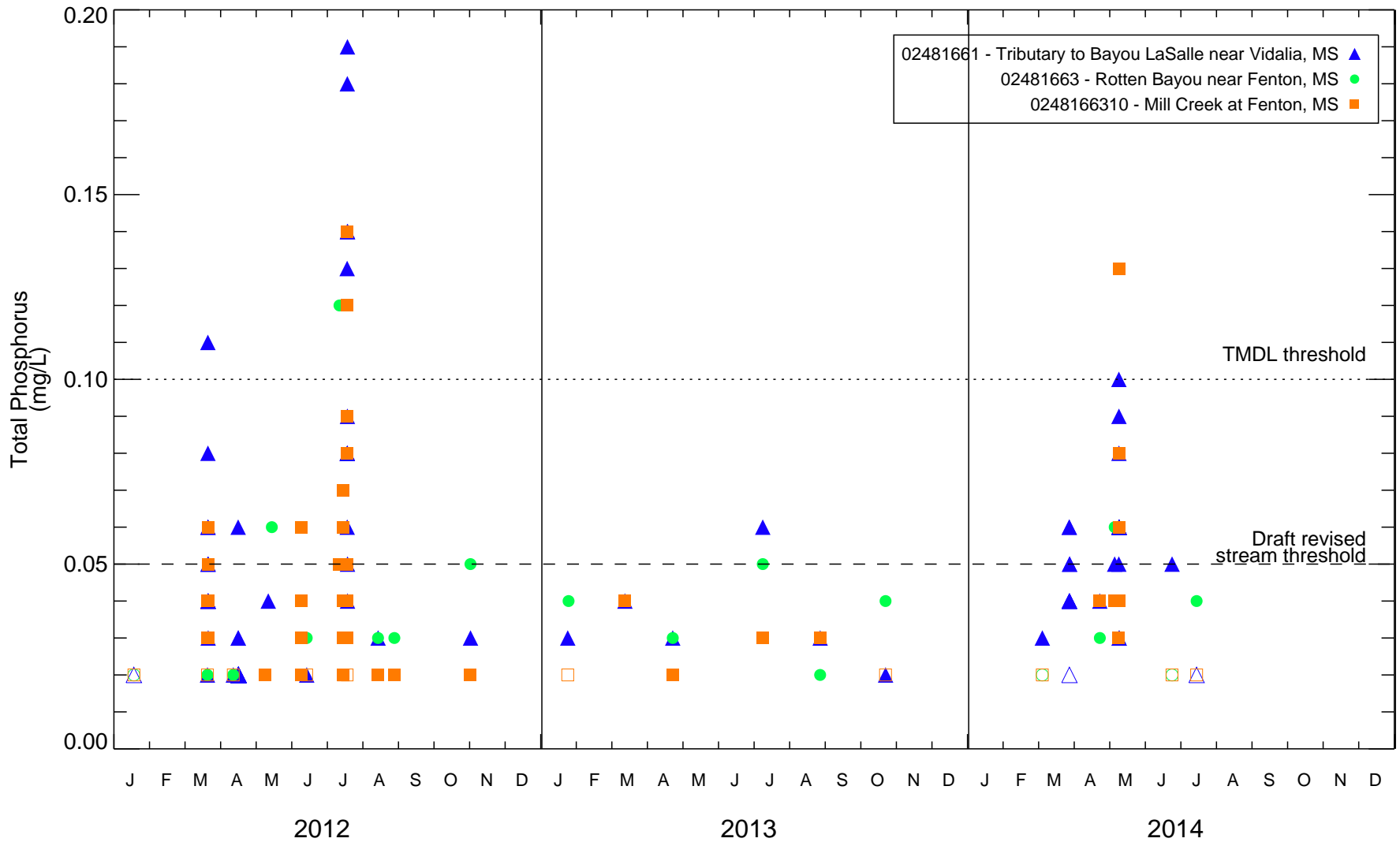
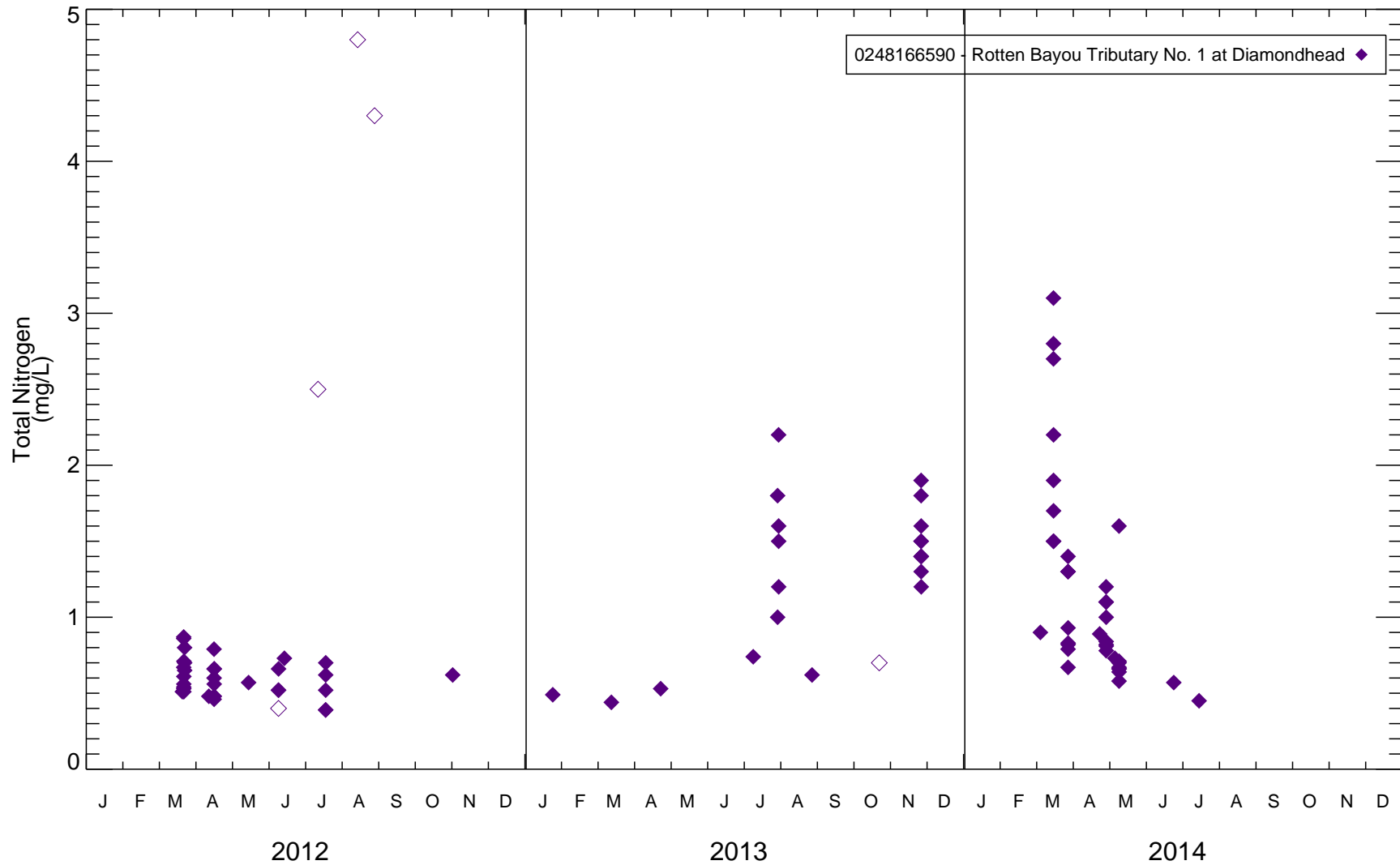


Figure 3

Temporal of Total Phosphorus Concentration at Three Freshwater USGS Gages near Rotten Bayou



Non-detects are shown as open symbols at the detection limit.  
 Dotted line is TMDL threshold for tributaries to St. Louis Bay (MDEQ 2007).  
 Dashed line is the top of range of draft revised stream nutrient threshold for southeast MS (MDEQ 2011).



**Figure 4**

Temporal of Total Nitrogen Concentration at One Tidal USGS Gage near Rotten Bayou

*Non-detects are shown as open symbols at the detection limit.*

Rotten Bayou Water Quality Assessment



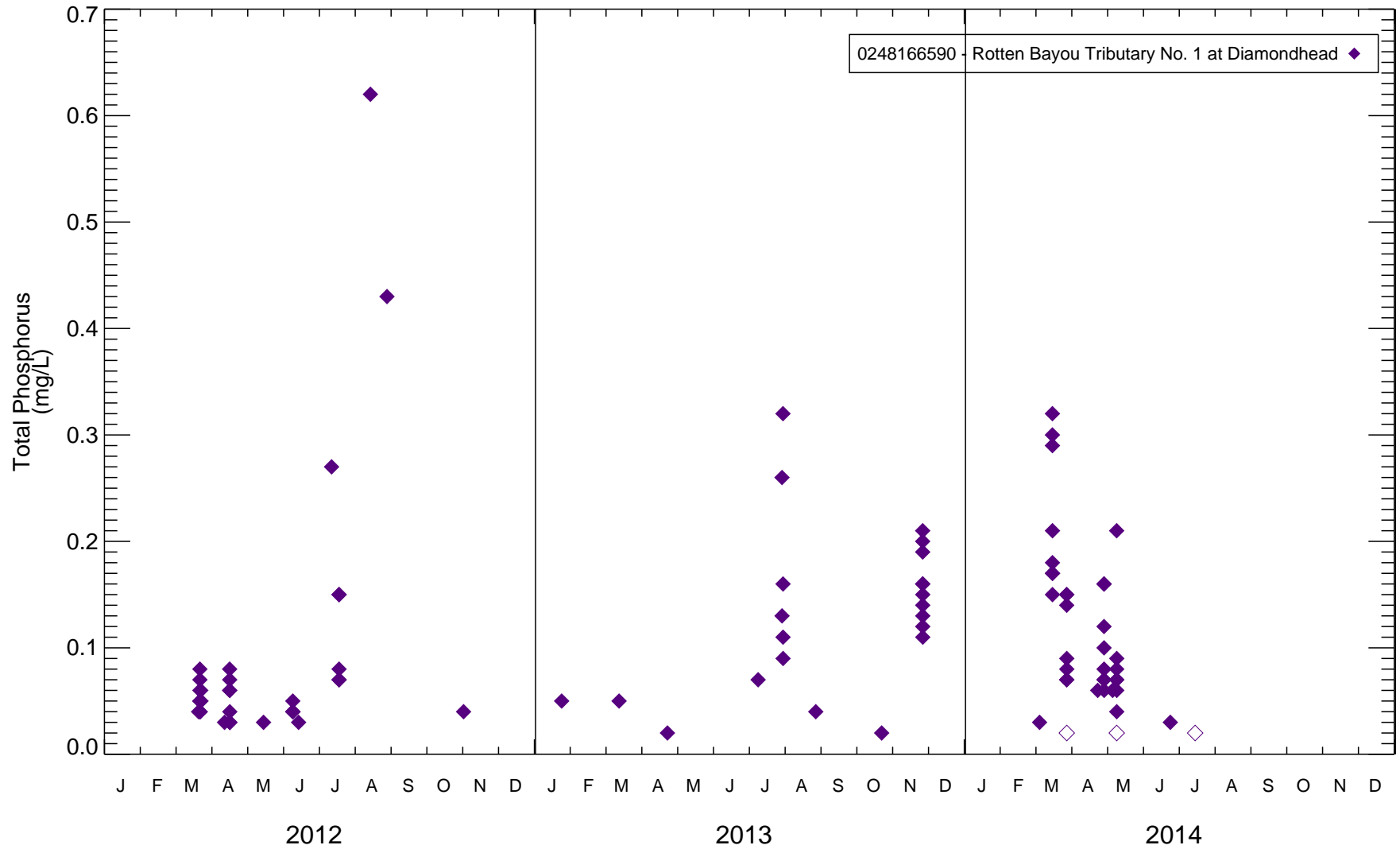


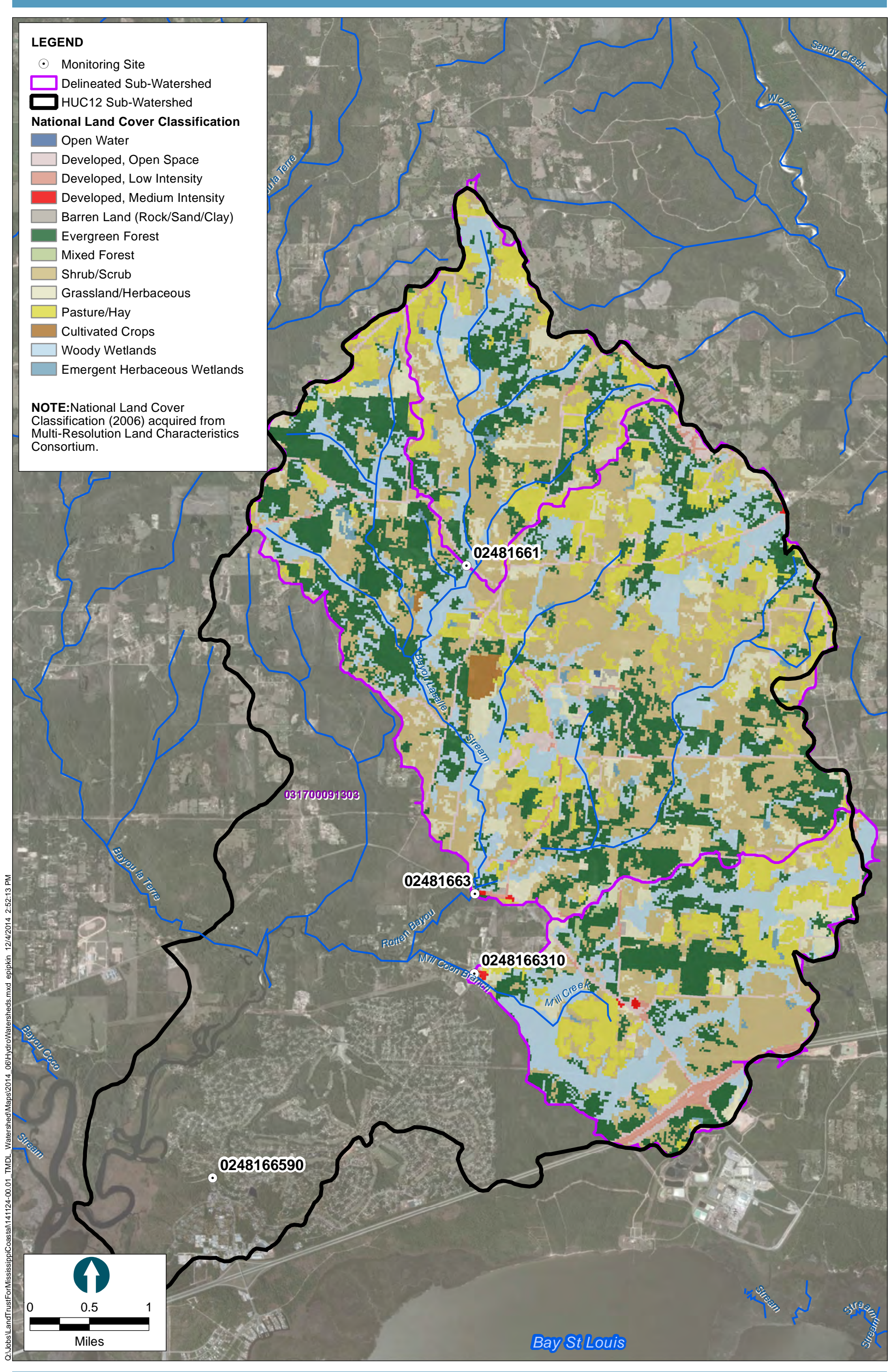
Figure 5

Temporal of Total Phosphorus Concentration at One Tidal USGS Gage near Rotten Bayou

Non-detects are shown as open symbols at the detection limit.

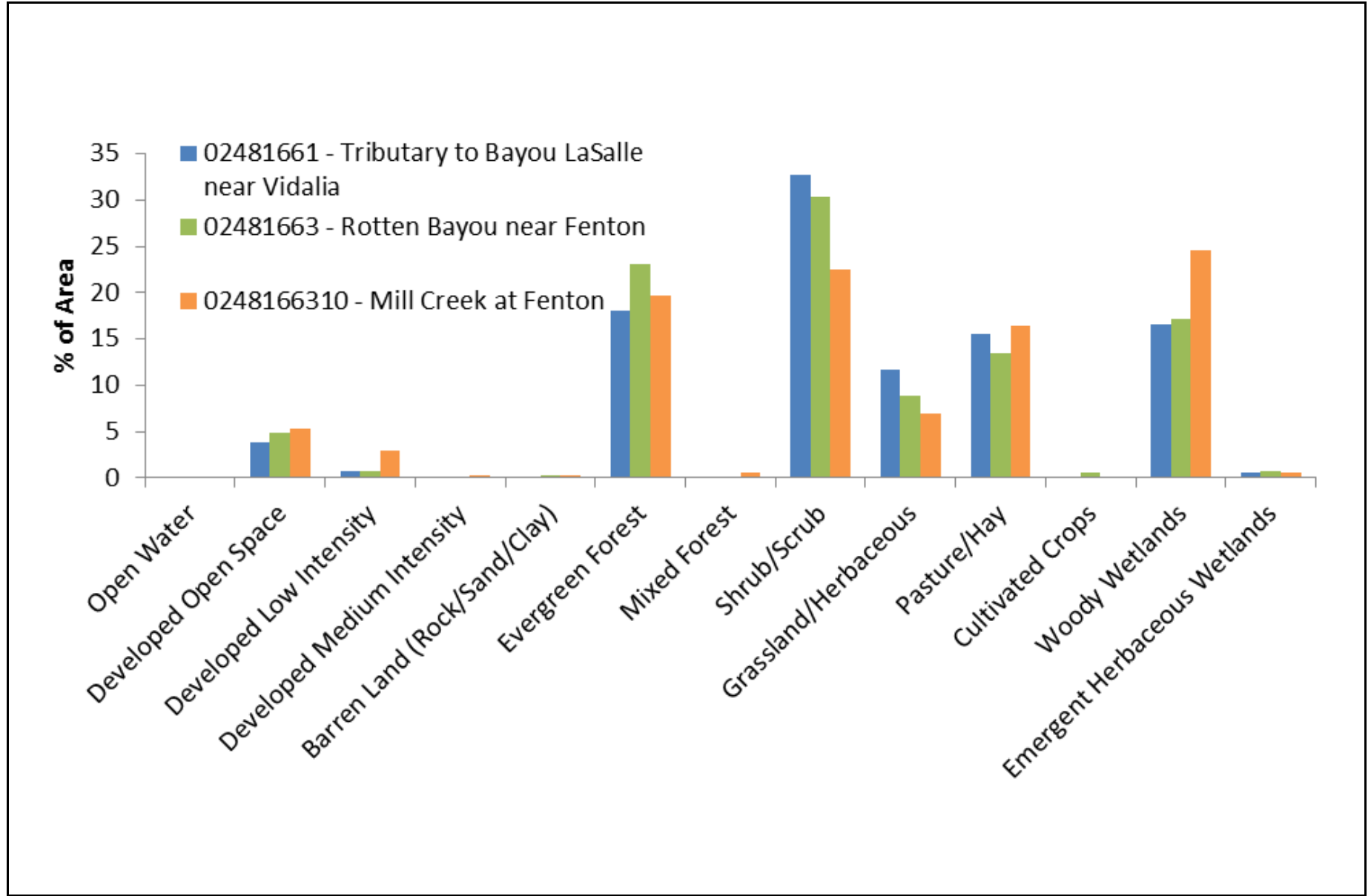
Rotten Bayou Water Quality Assessment





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# **Rotten Bayou Watershed**

## **Final Report**

MDEQ Agreement Number  
12-00011

September 21, 2011-September 30, 2014

Mississippi Soil and Water Conservation  
Commission

ROTTEN BAYOU  
WATERSHED AGRICULTURAL NONPOINT SOURCE  
POLLUTION PROJECT

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## SECTION 319 (H) NONPOINT SOURCE GRANT MILESTONES AND STATUS FORM

QUARTER: September 30, 2014 WORK ORDER NO: 12-00011 STATE: Mississippi

PROJECT NAME: Rotten Bayou Watershed 319 Project

SUBGRANTEE/CONTRACTOR AND OTHER COOPERATORS:

BUDGET PERIOD START DATE: 09/21/11

BUDGET PERIOD END DATE: 09/30/2014

TOTAL PROJECT COST: \$550,001

EXPENDED THIS PERIOD:

TOTAL EXPENDITURES TO DATE:

WATERBODY/WATERSHED IDENTIFICATION: Rotten Bayou

NPS CATEGORY: Agriculture

PURPOSE STATEMENT: The purpose of this project will be to implement Best Management Practices (BMPs) on targeted areas in the Rotten Bayou Watershed that will reduce pollutant loadings from agricultural nonpoint sources.

SPECIFIC MILESTONES/OUTPUTS:	EXPECTED COMPLETION DATE	ACTUAL COMPLETION DATE
1. Coordinate with the Mississippi Department of Environmental Quality (MDEQ), Natural Resources Conservation Service (NRCS), United States Geological Survey (USGS) and the Hancock and Harrison County Soil and Water Conservation Districts (SWCD) to determine priority areas that are contributing significant pollutant loads in the watershed.	Month 1-2	November 2011
2. Develop a Watershed Implementation Plan (WIP) consistent with MDEQ guidance with assistance from the WIT	Month 1-3	
3. Assist in the development and implementation of a watershed monitoring plan for the project	Month 1-36	September 2014
4. Present a draft WIP to MDEQ and Rotten Bayou WIT for review and comments.	Month 1-6	
5. Determine through intensive surveys priority areas that are contributing significant pollutant loads in the watershed.	Month 1-6	February 2012
6. Inform the landowners and operators within the project area about the project and shall work to secure commitments from priority-area landowners and others willing to participate in the project.	Month 1-6	April 2012

## Appendix D: Final Report: Rotten Bayou Watershed Agricultural Nonpoint Source Pollution Project

- |   |             |                |
|---|-------------|----------------|
| 7. Notify MDEQ project officer, in a timely manner, of all project site locations/ inspections/public meetings so that the project officer may have an opportunity to attend.   | Month 1-36  | September 2014 |
| 8. Develop plans for Best Management Practices (BMPs) in accordance with the previously submitted and approved WIP.   | Month 1-10  | September 2014 |
| 9. Assist participants in installing BMPs, in accordance with the guidelines developed in the latest edition of the NRCS Technical Field Manual, or other approved guidelines.  | Month 1-36  | September 2014 |
| 10. Submit blank copies of standard maintenance agreements to MDEQ.   | Month 10-36 | September 2014 |
| 11. Assist the MDEQ project officer in conducting inspections during construction.  | Month 3-36  | September 2014 |
| 12. Collect relevant GPS coordinates of all installed BMPs and incorporate into GIS format. All Geospatial data shall be collected in a manner consistent with the Federal Geographic Data Committee endorsed standards.  | Month 3-36  | September 2014 |
| 13. Submit bi-annual reports not later than September 25 <sup>th</sup> and March 25 <sup>th</sup> of each year showing status of tasks and start/completion dates of each task.   | Month 1-36  | September 2014 |
| 14. Develop and implement an education plan in order to achieve WIP goals with assistance from MDEQ and the WIT.  | Month 1-36  | September 2014 |
| 15. Take adequate photo documentation before, during, and after installation of the approved BMPs.  | Month 1-36  | September 2014 |
| 16. Make project presentations as requested by MDEQ.  | Month 6-36  | September 2014 |
| 17. Submit a final report to MDEQ to include measured, or estimated, non-point-source, pollutant-load reductions or water-quality improvements, measured improvements in fisheries and wildlife habitat, acreage offered, pre- and post-site conditions and GIS data. | Month 36    | September 2014 |

## STATUS OF MILESTONES:

1. Completed. MSWCC coordinated with MDEQ, NRCS, USGS and the Hancock and Harrison County SWCDs to identify priority areas that were contributing significant pollutant loads in the watershed.
2. This milestone is being completed by the Mississippi Land Trust.
3. Completed. MSWCC assisted in the development and implementation of a watershed monitoring plan for the Rotten Bayou project.
4. This milestone is being completed by the Mississippi Land Trust.
5. Completed. Through intensive site surveys, the priority areas that were contributing significant pollutant loads were identified.
6. Completed. A landowner meeting was held on April 9, 2012 to inform the local landowners in the watershed about the project and invite them to participate. There were 37 people in attendance.
7. Completed. The DEQ project officer was notified, in a timely manner, of all project site locations/inspections/public meetings so they would have the opportunity to attend.
8. Completed. Plans were developed for BMPs in accordance to the locations identified by the group. The Land Trust had not completed the WIP at the time these BMPs were installed.
9. Completed. Participants in the project received assistance with the installation of their BMPs to ensure that they met the specifications of the latest edition of the NRCS Technical Field Manual.
10. Completed. Blank copies of the standard maintenance agreement were provided to MDEQ.
11. Completed. The MDEQ officer was assisted on doing inspections during construction.
12. Completed. GPS coordinates were collected on all BMPs that were installed in the project.
13. Completed. Bi-annual reports were submitted to MDEQ on or before the 25<sup>th</sup> of March and September each year during the project.
14. Completed. An educational plan was developed for this project that consisted of field days to showcase installed practices and allow them to see what improvements could be made on their farms. Signs were installed on practices that were visible from the road to raise awareness about the project, and news articles were written to show the highlights of the project and invite others to participate.

15. Completed. Before and after photo documentation was taken on all installed BMPs.
16. Completed. Project presentations were made at the request of MDEQ.
17. Completed. A final report has been submitted to MDEQ and include in this report are as follows: measured or estimated nonpoint source pollution reductions or improvements, improvements to fisheries and wildlife habitat, acres affected, pre and post site conditions, ad GIS data.

# SECTION 319(H) NONPOINT SOURCE GRANT REPORT FOR ROTTEN BAYOU AGRICULTURAL NONPOINT SOURCE POLLUTION PROJECT

MDEQ Agreement No. 12-00011

## FINAL REPORT

### Project Summary

The Rotten Bayou Watershed is approximately 22,446 acres and is located in Eastern Hancock and Western Harrison Counties in South Mississippi. The Rotten Bayou Watershed is comprised of approximately 25% pastureland, 50% timberland, and 25% wetlands, urban, and other. Primarily all the BMP work in this watershed has occurred on the pastureland located within the watershed.

Because of the high level of stakeholder interest and being listed on Mississippi's 303(d) list of impaired waters, the Rotten Bayou Watershed was selected as a priority watershed by the Mississippi Department of Environmental Quality in the Coastal Streams/Pascagoula River Basin for restoration activities. Therefore, a joint effort by the Mississippi Soil and Water Conservation Commission (MSWCC), the Mississippi Department of Environmental Quality (MDEQ), Environmental Protection Agency (EPA), the Natural Resources Conservation Service (NRCS), and the Hancock County Soil and Water Conservation District (SWCD) resulted in a proposal and subsequent implementation of a project to significantly reduce the amount of nutrients and sediment entering Rotten Bayou by implementing selected Best Management Practices (BMPs).

The primary goals of the project have been:

1. To improve water quality and protect high quality waters by demonstrating the economic benefits and effectiveness of selected BMPs in targeted areas,
2. To apply BMPs to agricultural land in the project area as to reach the desired outcome of reduced runoff, cattle access/nutrients to the stream and sedimentation, and
3. To inform and educate the public about BMPs that benefit water quality.

Information/education activities carried out under this project have included the following:

- A. Demonstration farms were established on the following farms: Mark Ladner and Charles DesAngles
- B. The first Educational Field Day was conducted on November 7, 2013. The second Educational Field Day was conducted on August 26, 2014.
- C. News articles were published to make the public aware of the project.
- D. 1,000 fact sheets were distributed to make the public aware of the practices installed and the soil savings from those practices.

Attached below is a summary of the tons of soil saved through the installation of BMPs in the Rotten Bayou Watershed.

### **SUMMARY OF BEST MANAGEMENT PRACTICES INSTALLED**

<b>Practice Name</b>	<b>Number of Practices</b>	<b>Number of Acres Affected</b>	<b>Total Tons of Soil Saved Per Year</b>
342- Critical Area Planting	6	10	51
382- Fencing	19	24,563 feet	
590-Nutrient Management	12	250.5	762.7
512-1-Pasture and Hayland Planting	2	38	144
561- Heavy Use Area Protection	3		
614-Tank/Trough	6		
378- Pond (Alternative Water Source)	14		
638-Water & Sediment Control Basin	4	4	118.2
<b>Totals</b>	<b>66</b>	<b>302.5</b>	<b>1,075.9</b>



## Outputs

The outputs required under this project were:

1. Completed. MSWCC coordinated with MDEQ, NRCS, USGS and the Hancock and Harrison County SWCDs to identify priority areas that were contributing significant pollutant loads in the watershed.
2. This milestone is being completed by the Mississippi Land Trust.
3. Completed. MSWCC assisted in the development and implementation of a watershed monitoring plan for the Rotten Bayou project.
4. This milestone is being completed by the Mississippi Land Trust.
5. Completed. Through intensive site surveys, the priority areas that were contributing significant pollutant loads were identified.
6. Completed. A landowner meeting was held on April 9, 2012 to inform the local landowners in the watershed about the project and invite them to participate. There were 37 people in attendance.
7. Completed. The DEQ project officer was notified, in a timely manner, of all project site locations/inspections/public meetings so they would have the opportunity to attend.
8. Completed. Plans were developed for BMPs in accordance to the locations identified by the group. The Land Trust had not completed the WIP at the time these BMPs were installed.
9. Completed. Participants in the project received assistance with the installation of their BMPs to ensure that they met the specifications of the latest edition of the NRCS Technical Field Manual.
10. Completed. Blank copies of the standard maintenance agreement were provided to MDEQ.
11. Completed. The MDEQ officer was assisted on ding inspections during construction.
12. Completed. GPS coordinates were collected on all BMPs that were installed in the project.
13. Completed. Bi-annual reports were submitted to MDEQ on or before the 25th of March and September each year during the project.
14. Completed. An educational plan was developed for this project that consisted of field days to showcase installed practices and allow them to see what improvements could be made on their farms. Signs were installed on practices that were visible from the road to

raise awareness about the project, and news articles were written to show the highlights of the project and invite others to participate.

15. Completed. Before and after photo documentation was taken on all installed BMPs.
16. Completed. Project presentations were made at the request of MDEQ.
17. Completed. A final report has been submitted to MDEQ and include in this report are as follows: measured or estimated nonpoint source pollution reductions or improvements, improvements to fisheries and wildlife habitat, acres affected, pre and post site conditions, and GIS data.

**All of these outputs that were the responsibility of MSWCC have been completed.**

raise awareness about the project, and news articles were written to show the highlights of the project and invite others to participate.

15. Completed. Before and after photo documentation was taken on all installed BMPs.
16. Completed. Project presentations were made at the request of MDEQ.
17. Completed. A final report has been submitted to MDEQ and include in this report are as follows: measured or estimated nonpoint source pollution reductions or improvements, improvements to fisheries and wildlife habitat, acres affected, pre and post site conditions, and GIS data.

**All of these outputs have been completed.**

## **Equipment**

No equipment has been purchased with 319 funds under this project.

## **Match Documentation**

State and local sources provided the match for this project with the majority of match coming from local sources. The budget table for this project is given on the following page and lists the total expenditures by budget category, the 319 funds used, and the amount of the total expenditures supplied as state and local match.

Local match for this project was received several ways. They are listed as follows:

1. the 40% out of pocket expense to the participants for the installation of BMPS.
2. the expense to participants for installing additional practices to support the water quality benefits of cost-shared BMPs.
3. Soil and Water Conservation District commissioners' time spent on the project.

Examples of local match documentation are included in this report as an attachment.

**Project Budget**

BUDGET EXPENDITURES	319 FUNDS	STATE/LOCAL MATCH	TOTAL
Technical Assistance	\$14,386.45	\$9,591.00	\$23,977.45
Information and Education	\$6,620.20	\$4,414.00	\$11,034.20
Cost Share/ BMP Implementation	\$268,993.35	\$192,809.01	\$461,802.36
<b>Total</b>	<b>\$290,000.00</b>	<b>\$206,814.01</b>	<b>\$496,814.01</b>

Total Federal Funds	\$ 290,000.00
Total Match	\$ 206,814.01
<b>Total Project Cost</b>	<b>\$ 496,814.01</b>

## Index of Attachments

- Attachment 1- Listing of BMPs installed by cooperators
- Attachment 2- Copy of news articles published about the project
- Attachment 3- Example of local match documentation
- Attachment 4- Copy of the fact sheet
- Attachment 5- Photographs of the project

**Appendix E: Diamondhead Cardinal Golf Course BMPs**

<b>Project Name:</b> Cardinal Improvements: Best Management Practices on Diamondhead’s Cardinal Golf Course		<b>Partnership:</b> Land Trust for the Mississippi Coastal Plain MSU’s Gulf Coast Community Design Studio Diamondhead Country Club & Property Owners Assn Mississippi Water Resources Research Institute		
<b>Project Address/Location:</b> 7600 Country Club Drive Diamondhead, MS 39525	<b>City</b> Diamondhead	<b>County</b> Hancock County	<b>State</b> Mississippi	
<b>Watershed Name:</b> Rotten Bayou Watershed	<b>Watershed Number (12-digit HUC):</b> 031700109-002		<b>Name of Improved Waterbody:</b> Rotten Bayou	
<b>Drainage Area (acres):</b> 22,446 Acres	<b>% Impervious Cover in Drainage Area:</b> 30%	<b>Project Square Footage/Footprint:</b> 36,640 sq. ft. for all 3 BMPs		
<b>Run-off volume treated by the BMPs (cubic feet):</b> 19,125 cu. ft. for the 90 <sup>th</sup> percentile rain event				
<b>*Costs of Land:</b> N/A	<b>*Costs of Design/Planning:</b> \$1,800	<b>*Construction Costs:</b> \$5,900	<b>*Legal costs:</b> N/A	<b>*Costs of maintenance (If maintenance has not occurred yet, planned costs should be included):</b> \$550-\$600/month during the growing season (8-9 months of the year). Costs will go down once vegetation is established.
<b>Brief Project Description (2-4 Sentences Maximum):</b> In coordination with the development of a Watershed Implementation Plan to address water quality in Rotten Bayou Watershed, three Best Management Practices (BMPs) were installed on Diamondhead’s Cardinal Golf Course along with educational signage. BMPs included a dry swale on hole one, a restored stream segment on hole two, and a native planting area on hole three. The BMPs installed on Diamondhead’s Cardinal Golf Course are not only reducing stormwater runoff and improving water quality in a critical area in Rotten Bayou Watershed, but are serving as a great outreach tool to education the public.				

## Appendix E: Diamondhead Cardinal Golf Course BMPs

### Project Narrative

Since early 2010 the Land Trust for the Mississippi Coastal Plain (LTMCP) and Mississippi State University's Gulf Coast Community Design Studio (GCCDS) have been facilitating the development of a Watershed Implementation Plan for Rotten Bayou Watershed in Hancock and Harrison Counties, Mississippi. Funding was provided in part by a grant from the US EPA to the Mississippi Department of Environmental Quality, Nonpoint Source Branch under provisions of Section 319(h) of the Clean Water Act along with state and local match.

Developing a watershed plan for Rotten Bayou Watershed is a key step in implementing the Coastal Nutrient Reduction Strategy and improving water quality in the watershed. Rotten Bayou is a tributary of the Bay of St. Louis and is listed on the EPA's Section 303(d) list of impaired waterbodies for organic enrichment, low dissolved oxygen, turbidity, and nutrient levels that do not meet water quality standards. Many community and agency stakeholders have been involved in the planning process and significant outreach, education and training has and is being conducted as part of the project. LTMCP and GCCDS were also tasked with planning and implementing best management practices (BMP) within the watershed.

The US Geological Survey has been monitoring water quality at four different stations within the watershed. Preliminary data showed that more of the nutrients common to fertilizers, etc., were coming from the subwatershed that included the city of Diamondhead. Diamondhead was built as a planned retirement community and is mainly comprised of single family residential and some recreational areas including two, eighteen-hole golf courses. The golf courses are owned and managed by the Diamondhead County Club and Property Owners Association (DPOA) and the golf course superintendent, Brook Sentell, has been an active participant on the steering committee for the Rotten Bayou Watershed Project. Sentell has long been employing best management practices such as soil testing and applying minimal amounts of slow release fertilizer when necessary, but was interested in doing more.

Landscape architects with the Golf Coast Community Design Studio and the Mississippi Water Resources Research Institute worked with Sentell to identify areas on Diamondhead's Cardinal golf course that had existing drainage problems and provided opportunities for slowing and filtering runoff from a larger area. Holes one, two and six were selected. Initially Sentell was planning on piping, filling and sodding these areas to address the drainage challenges as part of ongoing renovation work on the course. When alternative designs were discussed that would not only address the drainage problems, but would reduce maintenance costs and add visual interest to the course, the DPOA agreed to put some of the renovation funding toward installing the suggested BMPs.

Between June 2014 and December 2014 Sentell and the partnership worked to install a dry swale on hole one (See Image 1), a naturalized stream segment on hole two (See Image 2), and a native planting area on hole six (See Image 3). Cory Gallo, Associate Professor of Landscape Architecture at Mississippi State University, working through the Mississippi Water Resources Research Institute, designed the dry swale at hole two and suggested plantings for the native planting area on hole six. Sentell and his team were able to implement both of these BMPs on their own.

The stream naturalization at hole two was a more involved project and GCCDS worked closely with Sentell and his team on this project. In December 2015, GCCDS staff worked alongside Sentell and his



## Appendix E: Diamondhead Cardinal Golf Course BMPs

staff to not only do the stream restoration, but to train the DPOA staff in techniques including terracing the streambank, installing erosion control, and planting and maintaining the native vegetation. The DPOA has received considerable positive feedback on the work on all three holes and, as a result of the training, Sentell and his team are now able to replicate the BMPs at other similar sites on both courses.

While BMP's of this nature are becoming more common on golf courses around the country, they are still relatively new to Mississippi. The partners wanted to be able to educate the public on the work done. To accomplish this, GCCDS designed signage to go at the tee box of each hole where a BMP was installed (See Image 4), sent out a press release that was picked up by several newspapers in Hancock and Harrison Counties (See Supporting Materials); and kept people informed through the Rotten Bayou Watershed Partnership's Facebook page. In addition, GCCDS coordinated a workshop in July 2015 for local leadership, landscaping and lawncare professionals, nursery owners and engineers who do work in Rotten Bayou Watershed. Participants were able to see the work done on holes one and two and learn how they can apply or encourage BMPs in their own professional or leadership roles.

The Coastal Project Coordinator with REACH (Research and Education to Advance Conservation and Habitat) has also been serving on the steering committee for the Rotten Bayou Watershed Partnership. REACH has been working primarily in the central and northern parts of the state with a focus on agriculture. Within the past couple of years REACH has been looking for opportunities to expand their work in South Mississippi. REACH was able to do some water quality monitoring before the BMPs were installed on the golf course and, as the vegetation becomes more established, is continuing to monitor the water quality at the sites. While conclusion data is not yet available from their monitoring efforts, it will be a valuable part of evaluating the effectiveness of the BMPs and may encourage more work to be done in other areas along the coast.

This project has been such a success due to the partnership between the Land Trust for the Mississippi Coastal Plain, the Gulf Coast Community Design Studio and the Diamondhead Country Club and Property Owners Association with assistance from the Water Resources Research Institute and monitoring through REACH. All three BMPs were accomplished with \$1,800 in planning and design work and \$5,900 in construction labor and materials. Educational signage for all three holes cost \$900, bringing the total project budget to \$8,600. Of the total project budget, \$4,200 was grant funded and \$4,400 was funded by the DPOA.

Appendix E: Diamondhead Cardinal Golf Course BMPs





# Laissez les bon temps rouler!

# Diamondhead News

FEBRUARY 2015

www.diamondheadms.org

Vol. 32, No. 2

## Diamondhead golf courses start off the new year green

Golfers will see new signage at the tee boxes of holes one, two and six of Diamondhead's Cardinal Golf Course as they get back to playing in the new year. The signage describes best management practices incorporated on these holes to improve drainage and water quality as stormwater flows over the golf course and eventually into Rotten Bayou. Changes include adding a dry swale, restoring a stream bed, and adding a field of native plantings in place of grass turf. In addition to the signs at the tee boxes, subtle cardinal silhouettes are located at each of the best management practices to direct golfers to the specific changes.

Since becoming Diamondhead Country Club's Golf Superintendent in September 2011, Brook Sentell, has been employing best management practices on Diamondhead's golf courses including applying slow-release fertilizer only when and where necessary and regularly having the soil tested through Mississippi State University's Extension Service. Since joining the Steering Committee of the Rotten Bayou Watershed Partnership, Sentell has also incorporated drainage improvements and native plantings into his renovation plan as recommended by the Partnership. "Not only will the modifications improve drainage and water quality," commented Sentell, "they will add interest to the golf course and reduce our maintenance costs."

Most of the work on the course has been done by Sentell and staff of the Diamondhead Country Club and Property Owners Association (DPOA), but on December 16th landscape architects and planners from Mississippi State University's Gulf Coast Community Design Studio worked with DPOA

staff to restore the stream at hole two and provided training on stream restoration techniques. Work included terracing the stream bank, installing erosion control and rock weirs, and planting native grasses and irises. "I've received a lot of positive feedback on the work done and I hope to be able to make similar improvements to the Pine Course in the next year or so," commented Sentell.

The Land Trust for the Mississippi Coastal Plain and Mississippi State University's Gulf Coast Community Design Studio are facilitating the development of a watershed implementation plan for Rotten Bayou Watershed with the help of community leaders and residents. "The Land Trust for the Mississippi Coastal Plain has enjoyed working with the Rotten Bayou Watershed Implementation Team in helping to bring into reality the vision that the Rotten Bayou watershed residents hold for their community," says Judy Steckler, Executive Director of the Land Trust.

The watershed plan is to address water quality issues in Rotten Bayou and a large part of the work involves outreach and education including demonstration projects and signage such as those implemented on the golf course. The project is partially funded by a grant from the US Environmental Protection Agency to the Mississippi Department of Environmental Quality, Nonpoint Source (NPS) Branch under the provisions of Section 319(h) of the Clean Water Act along with State and local match. Planning, outreach and education activities will continue through the summer of 2015. Follow the progress of the Rotten Bayou Watershed Partnership on facebook at facebook.com/rottenbayou.



### DIAMONDHEAD POA ANNUAL YOUTH FISHING RODEO

**Saturday, March 7**  
 at Twin Lakes Pavilion

Registration begins at 8 a.m.

### DIAMONDHEAD MARDI GRAS PARADE

Krewes of Diamondhead's annual Mardi Gras parade rolls on Saturday, February 14th at 12noon. Parade route begins at the Community Center, goes down Gex Dr., turns left to the shopping area up to the fire station and then on to Golf Club Dr. to its destination at the Country Club.

*NOTE: Items for the next issue of The Diamondhead News must be in the POA office no later than 3 p.m. on February 13*

# Sports



Diamondhead Country Club, Diamondhead Property Owners Assoc. and Rotten Bayou Watershed Partnership have partnered to improve drainage and water quality as stormwater flows over the golf course and eventually into Rotten Bayou.

## Diamondhead golf courses start off the New Year 'green'

**SEA COAST ECHO**  
Golfers will see new signage at the tee boxes of holes one, two and six of Diamondhead's Cardinal Golf Course as they get back to playing in the new year.

The signage describes best management practices incorporated on these holes to improve drainage and water quality as stormwater flows over the golf course and eventually into Rotten Bayou.

Changes include adding a dry swale, restoring a stream bed, and adding a field of native plantings in place of grass turf.

In addition to the signs at the tee boxes, subtle cardinal silhouettes are located at each of the best management practices to direct golfers to the specific changes.

Since becoming Diamondhead Country Club's Golf Superintendent in September 2011, Brook Sentell has been employing best management practices on Diamondhead's golf courses including applying slow-release fertilizer only when and where necessary and regularly having the soil tested through Mississippi State University's Extension Service.

Since joining the Steering Committee of the Rotten Bayou Watershed Partnership, Sentell has also incorporated drainage improvements and native plantings into his renovation plan as recommended by the Partnership.

"Not only will the modifications improve drainage



Signs at the tee boxes and subtle cardinal silhouettes are located at each of the best management practices to direct golfers to the specific changes.

and water quality," commented Sentell, "they will add interest to the golf course and reduce our maintenance costs."

Most of the work on the course has been done by Sentell and staff of the Diamondhead Country Club and Property Owners Association (DPOA), but on Dec. 16, landscape architects and planners from Mississippi State University's Gulf Coast Community Design Studio worked with DPOA staff to restore the stream at hole two and provided training on stream restoration techniques.

Work included terracing the stream bank, installing erosion control and rock weirs, and planting native grasses and irises.

"I've received a lot of positive feedback on the

work done and I hope to be able to make similar improvements to the Pine Course in the next year or so," commented Sentell.

The Land Trust for the Mississippi Coastal Plain and Mississippi State University's Gulf Coast Community Design Studio are facilitating the development of a watershed implementation plan for Rotten Bayou Watershed with the help of community leaders and residents.

"The Land Trust for the Mississippi Coastal Plain has enjoyed working with the Rotten Bayou Watershed Implementation Team in helping to bring into reality the vision that the Rotten Bayou watershed residents hold for their community," says Judy Steckler, executive director of the Land Trust.

The watershed plan is to address water quality issues in Rotten Bayou and a large part of the work involves outreach and education including demonstration projects and signage such as those implemented on the golf course.

The project is partially funded by a grant from the US Environmental Protection Agency to the Mississippi Department of Environmental Quality, Nonpoint Source (NPS) Branch. Work will continue through summer of 2015.

the Keep Diamondhead Beautiful Committee, please contact the Diamondhead City Hall.

### ROTTEN BAYOU WATERSHED PARTNERSHIP

**Local leaders and professionals learn how to improve water quality from example set by Diamondhead Golf Superintendent**

Local leaders, engineers, and landscaping and lawn care professionals from Diamondhead and Hancock and Harrison Counties met Tuesday, July 15th at the Diamondhead Country Club to see projects installed on the Cardinal golf course designed to improve drainage and water quality. The Rotten Bayou Watershed Partnership, led by the Land Trust for the Mississippi Coastal Plain and Mississippi State University's Gulf Coast Community Design Studio, hosted the workshop as part of efforts to improve water quality and awareness in Rotten Bayou Watershed. As part of the workshop, participants learned how to apply techniques such as those used on the golf course, at home and through their work to help improve water quality in Rotten Bayou.

Diamondhead Golf Superintendent, Brook Sentell, has been employing best management practices on Diamondhead's golf courses such as applying slow-release fertilizer only when and

where necessary and regularly having the soil tested through Mississippi State University's Extension Service. Since joining the Steering Committee of the Rotten Bayou Watershed Partnership, Sentell has also incorporated drainage improvements and native plantings into his renovation plan as recommended by the Partnership. "Not only will the modifications improve drainage and water quality," commented Sentell, "they will add interest to the golf course and reduce our maintenance costs." Designs for the projects were done by Cory Gallo of Mississippi State University Department of Landscape Architecture.

The Rotten Bayou Watershed (HUC 031700109-002) is 22,446 acres and lies in Hancock and Harrison Counties. Rotten Bayou itself is a tributary of the Bay of St. Louis and was listed on the EPA's 2006 Section 303(d) list of impaired waterbodies for organic enrichment, low dissolved oxygen, turbidity, and nutrient levels that did not meet water quality standards. The main contributors to these environmental stressors do not come from a single source and so require a holistic approach to developing solutions. Nonpoint source pollution can come from excess fertilizers, herbicides and insecticides from agricultural lands and residential areas; oil, grease and toxic chemicals from urban runoff; sediment

from improperly managed construction sites, crop and forest lands, and eroding streambanks; and bacteria and nutrients from livestock, pet wastes and faulty septic systems.

The Land Trust for the Mississippi Coastal Plain and Mississippi State University's Gulf Coast Community Design Studio are facilitating the development of a watershed implementation plan for Rotten Bayou Watershed with the help of community leaders and residents. This project was partially funded by a grant from the US Environmental Protection Agency to the Mississippi Department of Environmental Quality, Nonpoint Source (NPS) Branch under the provisions of Section 319(h) of the Clean Water Act along with State and local match. Planning, outreach and education activities will continue through the summer of 2015. Follow the progress of the Rotten Bayou Watershed Partnership on facebook at [facebook.com/rottenbayou](http://facebook.com/rottenbayou).

### DIAMONDHEAD VFW WILL HONOR VIET NAM VETERANS

*Jerry L. Peppenger, Senior Vice Commander, VFW Post 2880, [jpeppenger@cablone.net](mailto:jpeppenger@cablone.net) or 228-343-6221*

The city of Diamondhead, MS has a number of veterans that exceeds 25

*Continued on page 12*



# Diamondhead Duck Pond

## Demonstration Project

Diamondhead, MS

Improve Water Quality and decrease sedimentation down stream

Create a welcoming aesthetic for the community

Provide a park atmosphere for community to enjoy



Decrease stormwater velocity and erosion of stream

Provide education about native vegetation to use at home

Provide habitat for butterflies and songbirds



### Components:

Grading

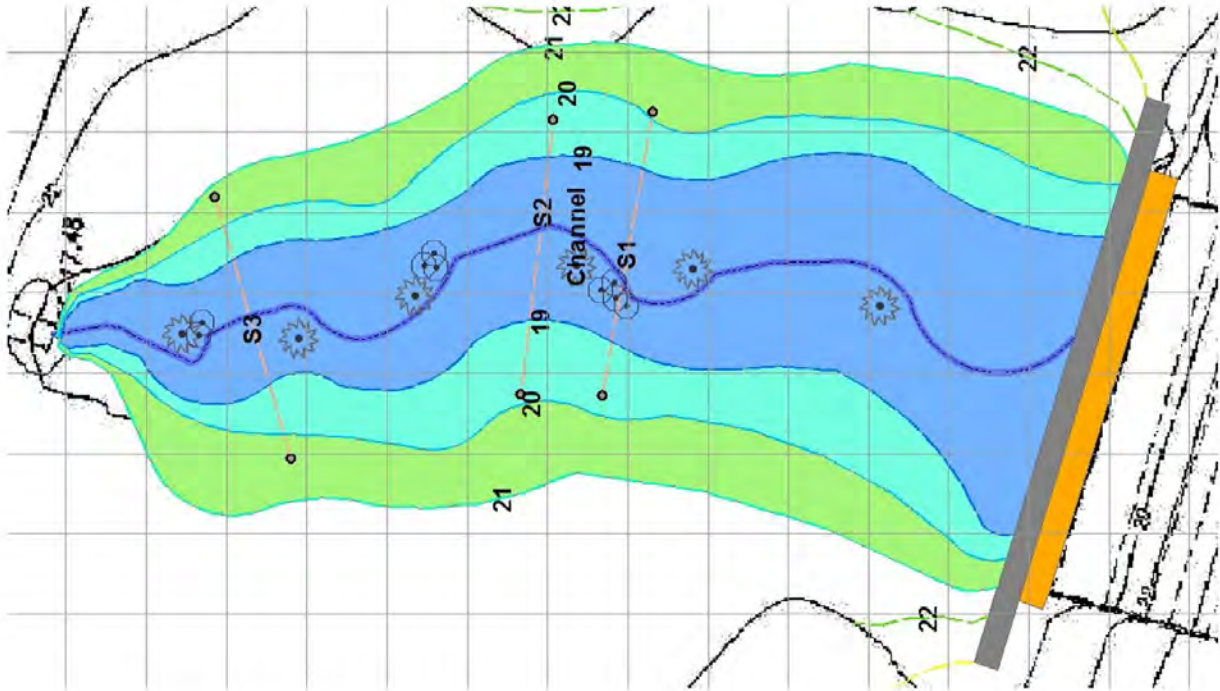
Floating Island

Gabion Structure and Stepping Stones

Mix of Native Vegetation and Trees

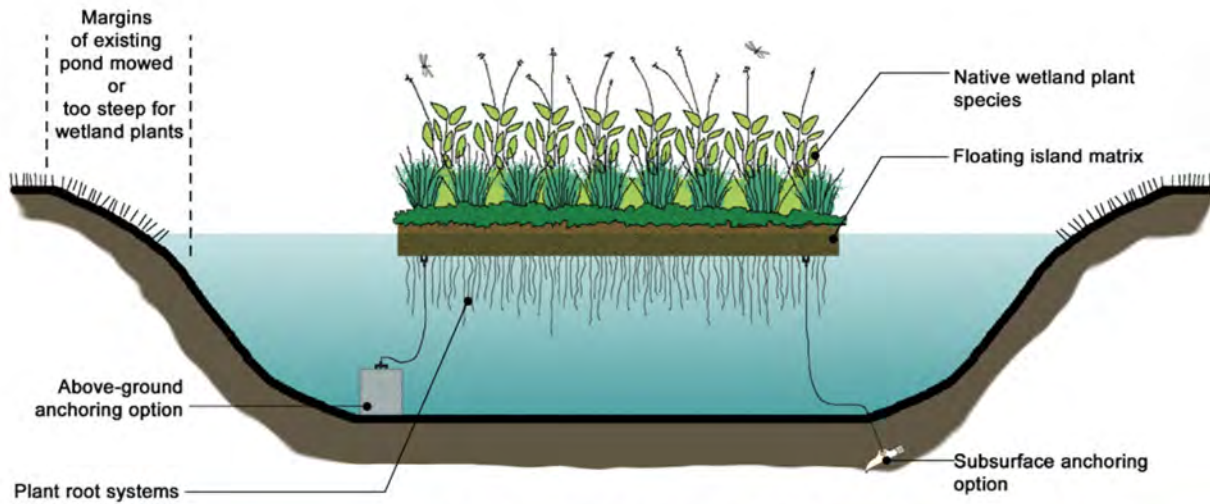
Educational Signage at Deck Overlook

# Appendix F: Diamondhead Duck Pond Demonstration Project



Floodplain image provided by Cypress Engineering

## Grading



Floating Island

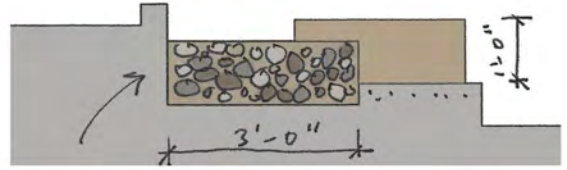




# Appendix F: Diamondhead Duck Pond Demonstration Project



Gabion Structure and Stepping Stones



## Native Vegetation and Trees

Scientific Name	Common Name
<i>Acer barbatum</i>	SOUTHERN SUGAR MAPLE
<i>Cliftonia monophylla</i> (Buddy Lee pink seedling)	BUCKWHEAT TREE
<i>Cephalanthus occidentalis</i>	COMMON BUTTONBUSH
<i>Cyrilla racemiflora</i>	SWAMP TITI
<i>Itea virginica</i>	VIRGINIA-WILLOW
<i>Magnolia virginiana</i> var. <i>australis</i>	SWEETBAY MAGNOLIA
<i>Nyssa aquatica</i>	WATER TUPELO
<i>Oxydendrum aboreum</i>	SOURWOOD
<i>Styrax americanus</i>	AMERICAN SNOWBELL
<i>Taxodium distichum</i>	COMMON BALDCYPRESS
<i>Sagittaria lancifolia</i>	BULLTONGUE
<i>Pontederia cordata</i>	PICKERELWEED
<i>Iris x species</i>	LOUISIANA IRIS
<i>Hibiscus moscheutos</i>	CRIMSON-EYED ROSEMALLOW
<i>Crinum americanum</i>	SWAMP LILY
<i>Crinum americanum</i>	SWAMP LILY
<i>Rhynchospora colorata</i>	STARRUSH SEDGE
<i>Muhlenbergia capillaris</i>	HAIRAWN MUHLY GRASS
<i>Hymenocallis liriosme</i>	SPIDER LILY
<i>Pontederia cordata</i>	PICKERELWEED

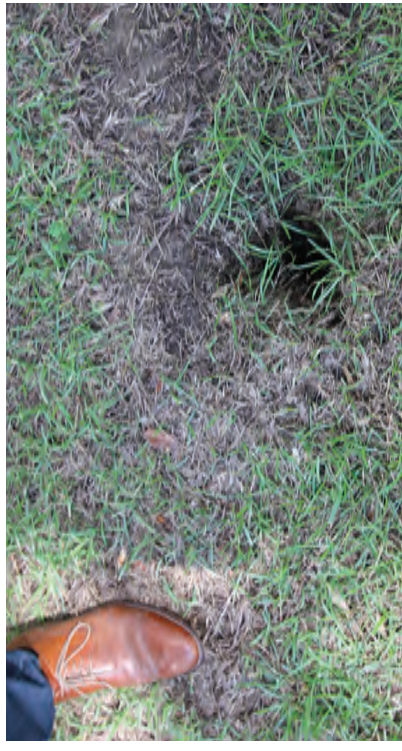


Appendix F: Diamondhead Duck Pond Demonstration Project





Rain Garden Plan view



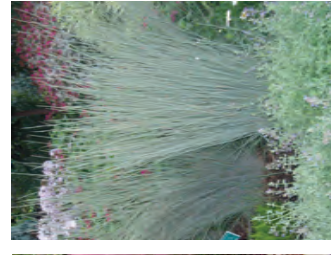
Rain Garden Section View



Example rain gardens for stormwater management



South Mississippi plants for stormwater management



# Opportunity for Restoration & Recreation on Diamondhead Utility Easement



**Problem and Opportunity:** Significant erosion is occurring on the utility easement adjacent to Rotten Bayou primarily caused by lack of vegetation and regular ATV use. Utility easements are more frequently being utilized as habitat and nature/recreation trails to the benefit of communities and wildlife. The Utility easement in Diamondhead between Rotten Bayou and Twin Lakes presents an excellent opportunity for both restoration and recreation.

## PHASE 1



Re-grade steep slopes to prepare soil for planting and stabilization.



Re-plant native plants for stabilize soil, reduce runoff, create habitat and beautify the area.



Place educational signage and work with law enforcement and property owner to eliminate ATV use on easement.

## PHASE 2



Create trails appropriate for pedestrians and bicycles. This walkway and restoration project were designed and implemented by Anchor QEA. Salvaged telephone poles were diverted from a landfill to make this path to the beach. *Photograph by Sea Turtle.*



Introduce signage acknowledging partnerships and educating trail users about the environment.



Existing infrastructure at Twin Lakes provides space for parking and could be a gateway to the nature/recreation trail.

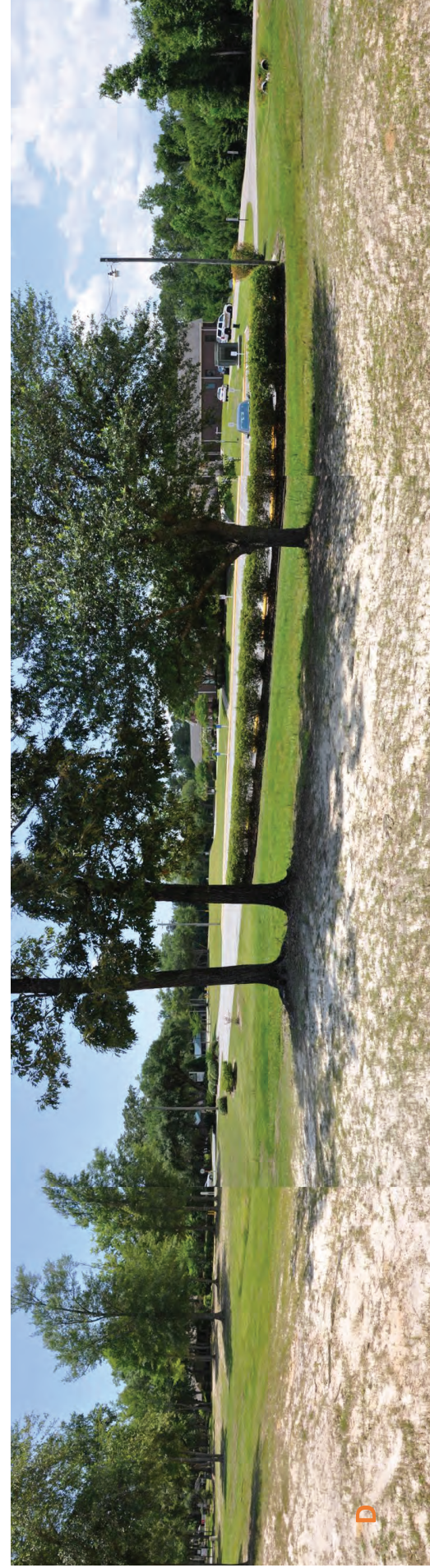
Potential Diamondhead City Hall Restoration and Demonstration Projects



**Background:** The City of Diamondhead currently has plans to address drainage issues on the north end of City Hall property (A). Unfortunately, due to the proximity to existing housing, this drainage area will have to be piped. The drainage area is part of a creek that feeds directly to Rotten Bayou and there are opportunities beyond that area that needs to be piped for creek restoration (B). In addition, there are remnants of an existing trail that could be enhanced for public use. In addition, the City has plans to install an additional parking lot on the north side of the building (C). This would be an excellent opportunity to demonstrate permeable paving. Finally, the area east of the building consistently floods during rain events and lack of vegetation has made the land susceptible to erosion (D). The space is currently not utilized, but has the potential to be a beautiful public area that can accommodate both stormwater and passive recreation.

**Plan Components:**

- Creek Restoration and Nature Trail
- Permeable Parking Lot
- Rain Lawn and Civic Space
- Educational Signage



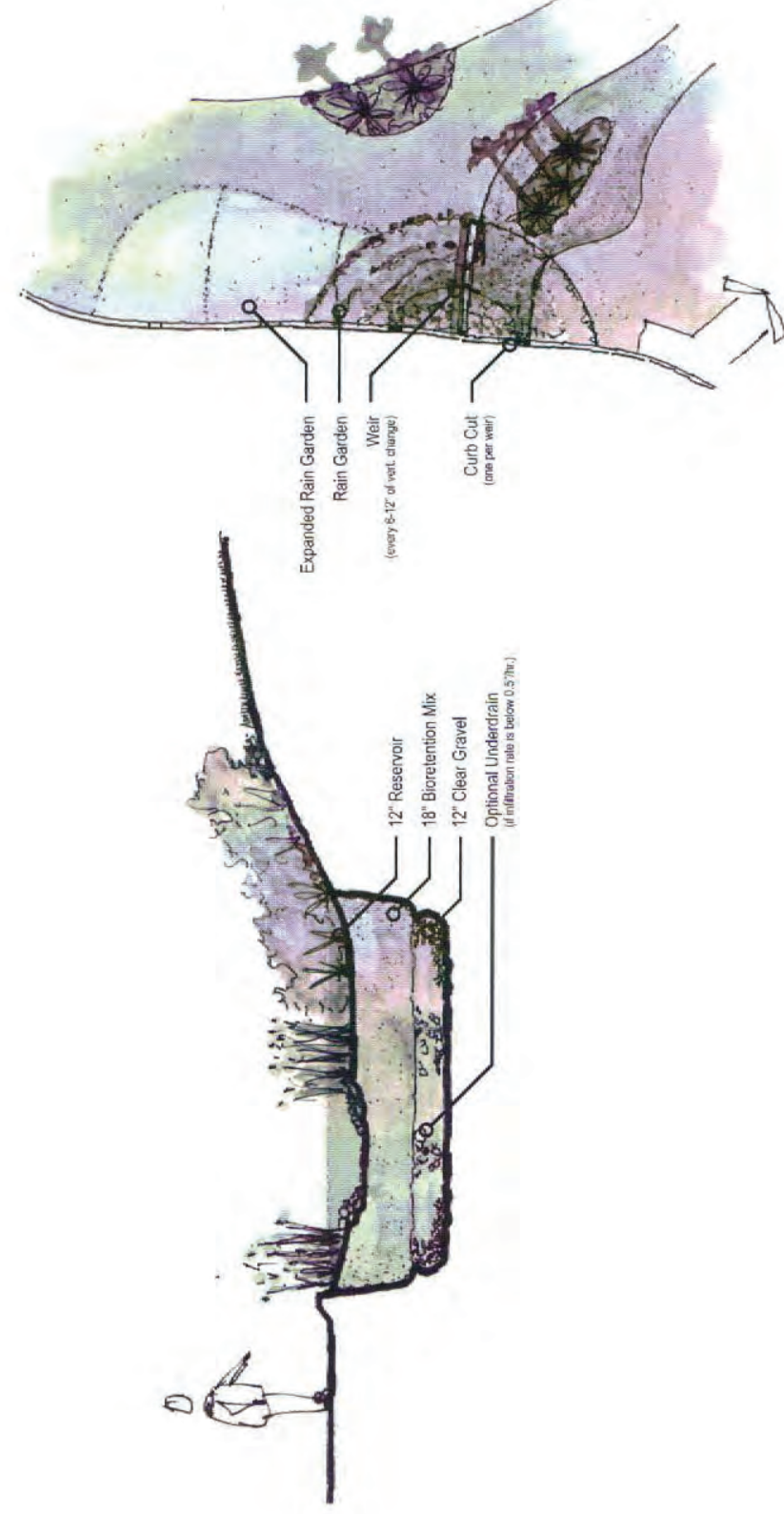
Examples of Rain Gardens and Detention Lawns that serve as civic space:



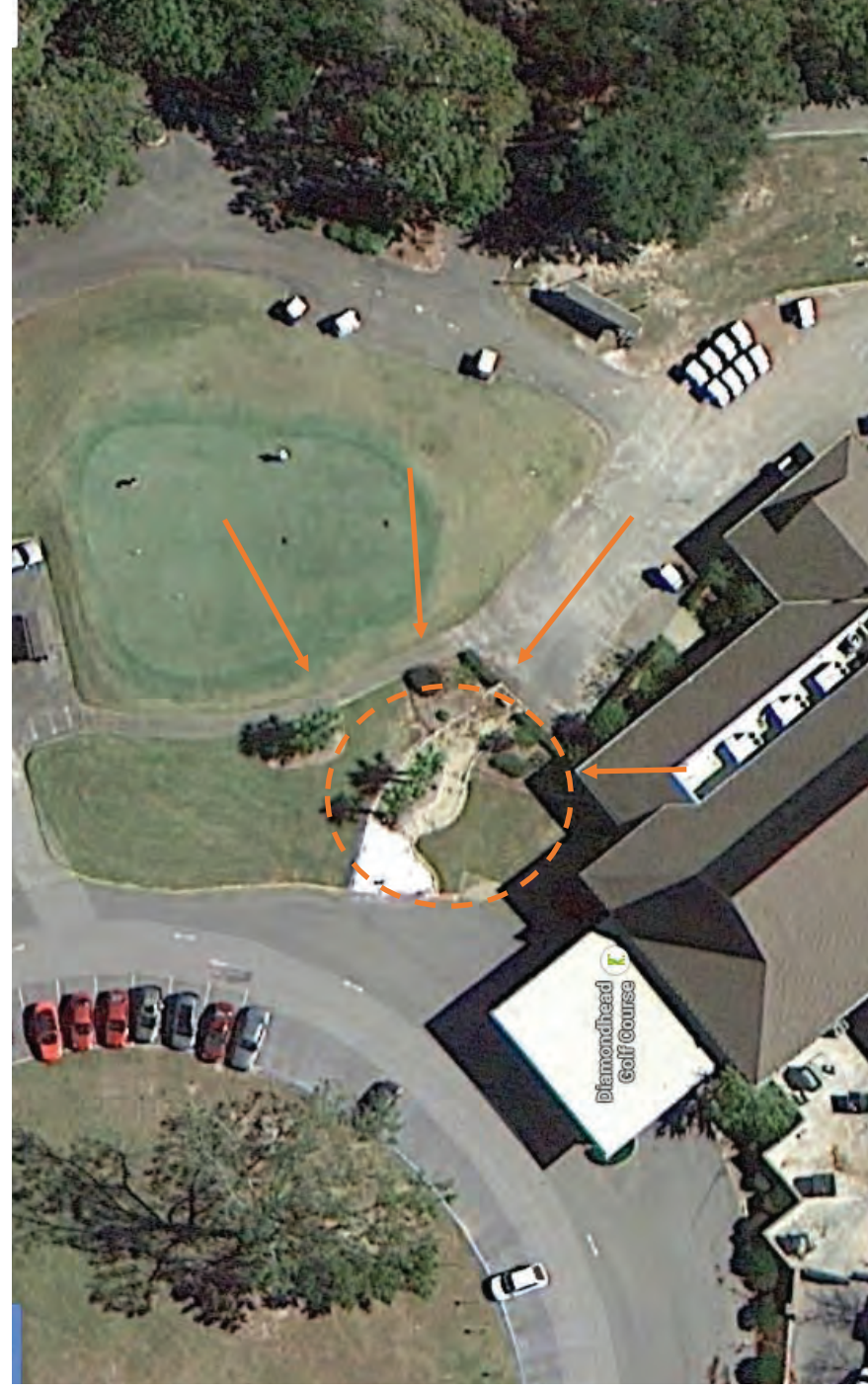
# Potential Rain Garden and Kiosk at Diamondhead Country Club

The proposed rain garden, if expanded, would filter water off the cart parking lot, putting green and section of the club roof. An educational kiosk could complement the design and serve to educate the public on the function of the rain garden and the additional BMPs installed on the golf course.

## CLUBHOUSE RAIN GARDEN DEMONSTRATION



BMP Strategies//Diamondhead, MS



The initial design proposed by the Water Resources Research Institute would be expanded to capture drainage off the club roof and include an educational kiosk.



## Appendix H: Management Actions

No.	Management Action	Watershed Management Category	Goals and Objectives	Cost Estimate*	Implementer and Potential Partners	Potential Funders	Milestones	Proposed Implementation Schedule (S < 5 Years, L > 5 Years)
1	Coordination of Rotten Bayou Watershed Partnership	Rotten Bayou Watershed Partnership	5a	\$15,000 per year (includes salary and minimal cost of supplies)	Potentially GCCDS or LTMCP staff or intern	Grant and/or local business and municipal partners	Designate volunteer coordinator for Rotten Bayou Watershed Partnership	S
							Secure long-term funding source for coordinator of Rotten Bayou Watershed Partnership	L
2	Visual Survey	Data Gaps	1a, 1b	n/a or TBD at time services requested	Boy Scouts or other volunteer group. Gulf Coast Restore Corps or other semi-professional or professional group. Third party may be needed to help synthesis the data.	If funds are needed, most likely will need to be covered by a private sponsor.	Conduct survey before or at time of 5 year watershed assessment and plan revision	S
3	Study: Erosion and Sediment Delivery Rates	Data Gaps	1a	TBD at time services requested	Subcontractor with assistance from MDEQ	MDEQ with potential grant funding	Rotten Bayou Watershed Partnership to determine if this is feasible and a priority	S
4	Study: Primary Source(s) of Pathogens	Data Gaps	2b	TBD at time services requested	Subcontractor with assistance from MDEQ	MDEQ with potential grant funding	Rotten Bayou Watershed Partnership to determine if this is feasible and a priority	S

**Appendix H: Management Actions**

5	Utility Easement Habitat Restoration and Bayou Access	Priority Projects	1b, 1c, 4a, 4b, 5c	3 signs at \$200 per sign	RBWP in partnership with Purcell Corporation, Diamondhead POA and Mississippi Power.	Mississippi Power or other interested party	Signage to stop ATV use on easement	S
				\$10,000-\$20,000/acres for regrading. \$100-\$250/acre for grassland restoration.	Will depend on who retains ownership. Regardless, should be in collaboration with the DPOA, City of Diamondhead and Mississippi Power. Design/environmental engineering services will need to be contracted.	Land donation or funding for land acquisition may be necessary to proceed. Certain grants (i.e. Tidelands Trust Fund Program) will pay for land acquisition and restoration activities. Other grants may pay for recreational trails including Five Star grants through National Fish and Wildlife	Regrading and habitat restoration	L
				\$2,500/quarter mile of trail. \$50,000-\$60,000 for ADA accessible kayak launch including site prep and installation (ex. launch at Bayou Bogue Homa in Hancock County)			Trail development and kayak/canoe launch	L
6	City Hall Rain Lawn and Creek Restoration	Priority Projects	3c	\$15/sq ft	City of Diamondhead in collaboration with Keep Diamondhead Beautiful. Design/environmental engineering	Some grants through Keep America Beautiful may apply along with funding sources listed in Management Action	Rain lawn and civic space	S
				\$50/ft			Creek restoration	L
				\$2,500/quarter mile of trail. \$200 for signage			Trail development and signage	L
7	Country Club Rain Garden	Priority Projects	2a	\$10/sq ft for the rain garden and \$200 for signage	DPOA. Design/environmental engineering services will need to be contracted.	DPOA and/or possible grant funding.	Install rain garden and educational signage	S



## Appendix H: Management Actions

8	Conservation	Conservation and Restoration	3b	Dependent on the property, donation or sales agreement, and extent of restoration needed.	LTMCP in coordination with the City of Diamondhead and DPOA.	Land donations and/or possible grant funding when tied to restoration. RESTORE funds may apply.	At least 1 property along Rotten Bayou put into conservation and providing bayou access	S
9	Living Shorelines	Conservation and Restoration	1b	n/a or TBD at time services requested	Management Action 2	If funds are needed, most likely will need to be covered by a private sponsor.	Determine priority areas through visual survey	S
				\$3/plant/LF to \$200/LF depending on wave energy and amount of hard stabilization needed	Private land owners	Property owner with possible grant funding or cost-share.	One high priority project implemented	L
10	Streamside Buffers	Conservation and Restoration	1b	n/a or TBD at time services requested	Management Action 2	If funds are needed, most likely will need to be covered by a private sponsor.	Determine priority areas through visual survey	S
				Forest Buffer: \$200-700/acre to plant and maintain. Grass Buffer: \$100-400/acres to plant and maintain.	Private land owners	Property owner, cost-share program through USDA or Mississippi Reforestation Tax Credit.	One high priority project implemented	L
11	Dredging and Beneficial Use	Conservation and Restoration	1c	Dependent on project	Will depend on project or property owner	DPOA, City of Diamondhead, Possible grant funding when connected to restoration	n/a	Ongoing

**Appendix H: Management Actions**

12	Bayou Access	Recreation and Ecotourism	4a	Dependent on the property and donation or sales agreement	City of Diamondhead and DPOA with possible support from LTMCP. Design/engineering services will need to be contracted before installing any supporting infrastructure.	Land donations and/or possible grant funding when tied to restoration. RESTORE funds may apply.	Secure property for public access	S
				Overall cost may vary greatly depending on the property.			Grants available through National Fish and Wildlife Foundation, Mississippi Department of Wildlife, Fisheries and Parks, etc.	Install infrastructure and signage needed for access point
13	Blueway	Recreation and Ecotourism	4c	n/a	RBWP with support from LTMCP	Hancock County Chamber of Commerce, City of Diamondhead, DPOA. Five Star grant may apply.	Obtain political and community support	S
				Management Action 12	City of Diamondhead and DPOA with possible support from LTMCP.		Secure additional bayou access point (Management Action 12)	L
				\$95/sign including post and installation. Signs are typically installed at every stream mile and points of interest.	LTMCP in coordination with the City of Diamondhead and Hancock County.		Implement signage along blueway	L
14	Effluent for Irrigation	Waste and Wastewater	2b	Minimal administrative expenses	DWSD, City of Diamondhead and DPOA with support from MDEQ	DWSD, City of Diamondhead, DPOA and possible grant opportunities	Identify infrastructure needed, costs and funding source(s) to use effluent to irrigate golf courses and other potential sites	L
				TBD			If feasible, implement plan to use effluent to irrigate golf courses	L

## Appendix H: Management Actions

15	Curbside Recycling	Litter	2c, 5c	\$3/month/resident	Hancock County, the City of Diamondhead and Hancock County Solid Waste Authority with support from the Mississippi Recycling Coalition	Residents and Jurisdictions	Curbside recycling reinstated in Hancock County	L
16	Trash Catches	Litter	2c, 5c	n/a	Keep Diamondhead Beautiful	City of Diamondhead and/or potential grant funding through Keep America Beautiful	Inventory and prioritize sites to install catches	S
				\$50-\$150 /stormdrain	City of Diamondhead and/or Keep Diamondhead Beautiful		Install 3 trash catches in high priority locations	S
17	Street Sweeping	Litter	2c, 5c	n/a	Keep Diamondhead Beautiful	n/a	Identify high priority roadways in watershed	S
				\$105/curb mile if already own machine	Jurisdictions, MDOT and Keep Diamondhead Beautiful	Jurisdictions, MDOT	Petition jurisdiction to increase frequency and miles swept	S
18	Keep Diamondhead Beautiful Extension	Litter	2c, 5c	n/a	Keep Diamondhead Beautiful	n/a	Amended mission and scope of work	S

## Appendix H: Management Actions

19	Adopt-a-Roadway	Litter	2c, 5c	n/a	Keep Diamondhead Beautiful	n/a	Identify high priority roadways in watershed	S
				One-time costs: \$200/sign and est. \$35/person for reusable supplies including a trash grabber, gloves and safety vest. Annual costs include \$20/adopted roadway segment for trash bags. Jurisdictions will also need to pick up garbage bags on the roadways after clean-up and may incur some minimal additional expenses.	Keep Diamondhead Beautiful and/or Jurisdictions	Jurisdictions and/or grant through Keep America Beautiful	Implement program with a goal of having 5 roadway segments adopted	S
20	Zoning Ordinance Amendment: Permeable Paving	Urban - Nonstructural	2a, 2c	Minimal administrative and/or legal expenses	City of Diamondhead	City of Diamondhead	Ordinance amendment	S
21	Stormwater Ordinance Amendments	Urban - Nonstructural	2a, 2b, 3a, 3c	Minimal administrative and/or legal expenses	City of Diamondhead	City of Diamondhead	Ordinance amendment	S
22	Building Code Amendment	Urban - Nonstructural	2c	Minimal administrative and/or legal expenses	City of Diamondhead	City of Diamondhead	Code amendment	S
23	Fertilizer Ordinance	Urban - Nonstructural	2a	Minimal administrative and/or legal expenses	City of Diamondhead	City of Diamondhead	Ordinance adoption	L

## Appendix H: Management Actions

24	Coastal Technical Manual	Urban - Nonstructural	2a, 3a, 3c	Funding needed dependent on creation of new manual or adoption of existing manual.	MDEQ, MASGC, DMR	MDEQ, MASGC, DMR	Review current technical documents compared to newly revised Georgia Coastal Supplement	S
							Take action to revise existing or adopt Georgia Coastal Supplement	L
25	Urban Wildlife Population Control	Urban - Nonstructural	2b	n/a or TBD at time services requested	City of Diamondhead, MS Department of Wildlife, Fisheries and Parks, MSU Extensions	City of Diamondhead and/or MS Department of Wildlife, Fisheries and Parks	Determine need and cost	S
				\$1,000 -\$10,000 depending on extend of program			If significant need exist, pursue agreed upon course of action	L
26	Enforcement of Stormwater Pollution Prevention Plans	Urban - Structural	1a	Administrative Expenses. Potential need for additional staff or staff hours.	Jurisdictions, MDEQ	Jurisdictions, MDEQ	Increase monitoring and enforcement of SWPPPs	S
27	Drainage Swale Maintenance	Urban - Structural	1a, 2a, 3c	\$1/foot annually	Jurisdictions with guidance from MDEQ/EPA	Jurisdictions	Jurisdictions to stop scouring ditches as part of regular maintenance	S
28	Rain Barrels	Urban - Structural	3c, 5b, 5c	\$50-\$150	Property owners	Property owners	Implemented on private property	Ongoing
29	Rain Gardens	Urban - Structural	3c, 5b, 5c	\$3-\$5/square foot	Property owners	Property owners	Implemented on private property	Ongoing
30	Logging and Forestry Ordinance	Rural - Nonstructural	1a, 3c	Minimal administrative and/or legal expenses	Hancock/Harrison County	Hancock/Harrison County	Adopt ordinance	L
31	Water and Sediment Control Basin	Rural - Structural	2a, 2b	\$2,500-\$7,000/each	Property owners	Property owner or cost-share program through USDA.	Implemented on private property	Ongoing

## Appendix H: Management Actions

32	Heavy Use Area Protection	Rural - Structural	2a, 2b	\$1,000-\$5,000/each	Property owners	Property owner or cost-share program through USDA.	Implemented on private property	Ongoing
33	Fencing	Rural - Structural	2a, 2b	\$1.50-\$5.00/foot	Property owners	Property owner or cost-share program through USDA.	Implemented on private property	Ongoing
34	Pond (Alternative Water Source)	Rural - Structural	2a, 2b	\$2,500-\$7,000/each	Property owners	Property owner or cost-share program through USDA.	Implemented on private property	Ongoing
35	Critical Planting Area	Rural - Structural	2a, 2b	\$250-\$400/acre	Property owners	Property owner or cost-share program through USDA.	Implemented on private property	Ongoing
36	Tank/Trough	Rural - Structural	2a, 2b	\$200-\$700/each	Property owners	Property owner or cost-share program through USDA.	Implemented on private property	Ongoing
37	Facebook Page	Education and Outreach	5b, 5c	n/a	Rotten Bayou Watershed Partnership	n/a	Page maintained and number of likes increased	Ongoing
38	MS Coastal Cleanup	Education and Outreach	2c, 5c	n/a	Hancock County coordinator for MS Coastal Cleanup and Rotten Bayou Watershed Partnership	Funding provided by MDMR and other sponsors	Increased participation and stream miles cleaned	Ongoing
39	Projects for Scout Troops	Education and Outreach	1a, 1b, 5a, 5c	n/a	Boy Scout Troops	n/a	At least 2 local scouts achieving their Soil and Water Conservation Badge through projects that apply to Rotten Bayou Watershed	S

## Appendix H: Management Actions

40	Septic System Maintenance Education	Education and Outreach	2b, 5b, 5c	Only the cost of printing if tied in with a regular mailing through the county or other agency or utility company.	Harrison County, MS Department of Health and Human Services, other agency or utility company who may include information in regular newsletter or mailer.	Harrison County and/or Department of Health and Human Services	Annual mailing	S
41	Pet Waste Education	Education and Outreach	2b, 5b, 5c	\$0 or cost of printing if included in regular mailing or newsletter or distributed at local pet-related businesses such as veterinary clinics	DPOA, Jurisdictions, Keep Diamondhead Beautiful and local pet-related businesses	Possible grant funding available through Keep America Beautiful	1 educational ad, mailer or flier distributed in each jurisdiction	S
42	Pet Waste Signage and Receptacles	Education and Outreach	2b	n/a	RBWP and/or Keep Diamondhead Beautiful	DPOA and Jurisdictions. Possible grant funding available through Keep America Beautiful	Identify high priority locations within the watershed.	S
				\$200-\$600 per receptacle/sign combination	DPOA, Jurisdictions, Keep Diamondhead Beautiful		Install at least 5 receptacles with signage	S

**Appendix H: Management Actions**

43	Education in Schools	Education and Outreach	5b, Indirectly accomplishes other water quality goals 1-3	\$160 per field trip for water quality monitoring at East Hancock Elementary.	East Hancock Elementary School	East Hancock Elementary School	B-Wet program implemented at East Hancock Elementary annually with at least 1 field trip.	S
				\$1,000 per Bayou Town Production Show. MDOT anti-litter education program provided at no cost.	Schools in partnership with Bayou Town Productions, MDOT or other watershed/anti-litter education groups	Schools, MDEQ and/or possible grant through Keep America Beautiful.	2 general watershed education and anti-litter education programs brought to East Hancock Elementary and Delisle Elementary	S
				Approx. \$30K to bring B-Wet program to Delisle Elementary.	GCCDS	DMR education grants may apply	B-Wet program brought to Delisle Elementary	L
44	Promote Use of Native Plants	Education and Outreach	5b, Indirectly accomplishes other water quality goals 1-3	n/a	Diamondhead Garden Club, Pine Hills Nursery, Keep Diamondhead Beautiful and other civic organizations or business with an interest in landscape	n/a	Promote use of native plants through social media, member meetings and community projects	Ongoing



## Appendix H: Management Actions

45	Establish More Connections with County Residents	Education and Outreach	5a, 5b	n/a	RBWP	n/a	Recruit at least 2 new members to the Rotten Bayou Watershed Partnership who represent county community or civic organizations	S
				Cost depends on project chosen. \$50-\$150 per rain barrel. \$10 per sq ft for rain garden.	Potential partners include Sacred Heart Catholic Church and Knights of Columbus	county partner, private sponsor and/or grant funding may be available.	Work with county partner to implement 1 residential-focused demonstration project	L
46	Workshops with Local Leadership	Education and Outreach	5b, Indirectly accomplishes other water quality goals 1-3	\$1,500-\$5,000 depending on cost of venue and number of attendees	MDEQ, MASGC, DMR	MDEQ, MASGC, DMR	1 workshop on swale maintenance and 2 workshops on adopting and enforcing ordinances	S

\*All prices will vary depending upon the site preparation needed, contractor pricing, and the market for the products that will be needed to install the Best Management

## Proposed Zoning Code Amendment Regarding Allowance of Permeable Paving Options

I. **Initiator of Amendment:** Gulf Coast Community Design Studio, as part of the Rotten Bayou Watershed Partnership

II. **Intent of Ordinance Amendment:** To update the standards related to parking and driveway surfacing requirements to better align with the City's goals, objectives and policies.

III. **Appropriate Sections of Zoning Code:**

Article 8.4 DESIGN STANDARDS FOR OFF-STREET PARKING FACILITIES

Article 8.5 OFF STREET LOADING FACILITIES

IV. **Background:**

The Land Trust for the Mississippi Coastal Plain and Mississippi State University's Gulf Coast Community Design Studio are facilitating the development of a watershed implementation plan for Rotten Bayou Watershed with the help of community leaders and residents. Rotten Bayou is a tributary of the Bay of St. Louis and a significant asset to the City of Diamondhead. As a result of concerns regarding organic enrichment, low dissolved oxygen, turbidity, and nutrient levels that did not meet water quality standards, Rotten Bayou was listed on the EPA's 2006 Section 303(d) list of impaired waterways. This designation triggered the need for a watershed implementation plan to outline steps to improve water quality.

A preliminary review of US Geological Survey (USGS) water quality data by environmental and engineering consulting firm, Anchor QEA, suggests that current nutrient levels are not exceedingly high, but do increase during storm events especially coming from the parts of Diamondhead within the watershed (most of the area north of I-10). These findings imply that the area actually has a relatively good standing in terms of water quality, but that any new development has the potential of pushing those nutrient levels higher. The prevalence of impervious surfaces associated with development increases stormwater runoff and the potential for flooding, erosion and pollutants entering the waterways.

Currently, the City's zoning ordinance does not allow for pervious paving options in commercial parking areas, loading facilities or access drives. By allowing and even encouraging the use of pervious paving options the City would be furthering the environmental goals established in the 25 Year Comprehensive Plan and taking necessary steps to protect water quality in Rotten Bayou and the watershed. The following proposed amendment seeks to allow for pervious paving while addressing the City's concerns about ADA compliance and long-term maintenance.

## Appendix I: Recommended Ordinance Changes

Because the proposed change would allow for, but not require, permeable paving, the change would not cost the city or deter future development.

### V. Relationship to Comprehensive Plan:

Goal 2: Guide and direct development in a manner which is sensitive and responsible with respect to the natural environment and natural resources.

Objective 2.1: Provide an incentive for developers and land owners to preserve environmentally sensitive areas and to employ development techniques which result in the conservation of natural resources or otherwise benefit the natural environment.

Goal 18: Develop or encourage building practices, services or procedures within Diamondhead that serve to enhance the natural environment by conserving energy and natural resources.

Policy 18.4.1: Diamondhead will encourage the use of rain barrels, solar panel systems, pervious paving systems, swales and other similar practices as a means to conserve resources.

Objective 18.5: Implement city programs designed to enhance environmental quality.

### VI. Proposed Amendment: *Underlined text represents additions to existing ordinance.*

#### 8.4 DESIGN STANDARDS FOR OFF-STREET PARKING FACILITIES

##### 8.4.1 General Requirements

- A. Surfacing of all parking facilities shall be concrete, asphaltic concrete, or asphalt and all parking facilities shall be properly graded for drainage and maintained in a good condition, free of weeds, dust, trash and debris, potholes or other surface failures. Pervious pavement or pervious pavement systems are allowed subject to the provisions of Article 8.4.9.

...

8.4.9 Pervious pavement or pervious pavement systems. Pervious pavement or pervious pavement systems, capable of carrying a wheel load of four thousand (4,000) pounds, including pervious asphalt, pervious concrete, modular pavers designed to funnel water between blocks, lattice or honeycomb shaped concrete grids with turf grass or gravel filled voids to funnel water, plastic geocells with turf grass or gravel, reinforced turf grass or gravel with overlaid or embedded meshes, or similar structured and durable systems are permitted. Gravel, turf, or other materials that are not part of a structured system designed to manage stormwater shall not be considered pervious pavement or a pervious pavement system. Pervious pavement and pervious pavement systems shall meet the following conditions:

- A. All materials shall be installed per industry standards. Appropriate soils and site conditions shall exist for the pervious pavement or pervious pavement system to function. Documentation that verifies appropriate soils and site conditions shall be

## Appendix I: Recommended Ordinance Changes

provided. For further guidance and technical assistance, please refer to the following source: Georgia Stormwater Management Manual: Volume 2 Technical Handbook.

- B. All materials shall be maintained per industry and city standards. Damaged areas shall be promptly repaired. Gravel that has migrated from the pervious pavement systems onto adjacent areas shall be swept and removed regularly.
- C. Pervious pavement or pervious pavement systems, except for pervious asphalt or pervious concrete, shall not be used for accessible parking spaces or the accessible route from the accessible space to the principal structure or use served.
- D. Pervious pavement or pervious pavement systems shall be prohibited in areas used for the dispensing of gasoline or other engine fuels or where hazardous liquids could be absorbed into the soil through the pervious pavement or pervious pavement system.
- E. Pervious pavement or pervious pavement systems that utilize turf grass shall be limited to overflow parking spaces that are not utilized for required parking and that are not occupied on a daily or regular basis.
- F. Pervious pavement or pervious pavement systems used for parking or associated drive aisles or driveways shall count as impervious surface for the purposes of impervious surface coverage in any zoning district that has a maximum impervious surface limit or percentage, except where a pervious pavement system utilizing turf grass is provided for a fire access lane that is independent of a parking lot.
- G. Pervious pavement or pervious pavement systems shall not allow parking spaces, drives aisles, or driveways to be located anywhere not otherwise permitted by the regulations of this zoning ordinance and the district in which it is located.
- H. Parking areas shall have the parking spaces marked as required by this article except that pervious pavement systems that utilize gravel or turf may use alternative marking to indicate the location of the parking space, including, but not limited to, markings at the end of spaces on the drive aisle or curbing, wheel stops, or concrete or paver strips in lieu of painted lines.

...

### 8.4.2 Parking Space Geometry.

- E. Pedestrian walks shall be located between every other (alternating) parking bay, a parking bay being the vehicular access aisle and parking spaces on one or both side served by it. If parking bays exceed three hundred (300) feet in length without vehicular access to adjacent bays or to another drive or street, a pedestrian walk shall be provided between each parking bay. Required pedestrian walks shall have a four foot (4') clear width and such width shall be protected and maintained by curbs or wheel guards. All pedestrian walks shall be paved and maintained free of standing water. Pervious asphalt or pervious concrete may be used as an alternative to concrete, asphaltic concrete, or asphalt subject to the provisions of Article 8.4.9.

...

### 8.5.2 Construction and Maintenance

- B. They shall be graded for drainage, surfaced with concrete, asphaltic concrete, or asphalt and maintained in good condition free of weeds, dust, trash and debris and be free from

## Appendix I: Recommended Ordinance Changes

potholes or other signs of surface failure. Pervious pavement or pervious pavement systems are allowed subject to the provisions of Article 8.4.9.

### VII. Examples of Pervious Paving

#### Pervious Concrete



*Photo: Bank at the corner of Porter Ave. and Robertson St. in Biloxi*

#### Modular Pavers



*Photo: Behind the Biloxi Civic Center and Library (580 Howard Ave.). Modular pavers are currently being installed by the City of Biloxi at Lighthouse Park at Hwy 90 and Porter Ave.)*

## Appendix I: Recommended Ordinance Changes

### Lattice or Honeycomb Concrete Grids



*Photo: Ohr O'Keefe Museum of Art (386 Beach Blvd., Biloxi). Also installed at the Biloxi Yacht Club (408 Beach Blvd., Biloxi).*

### Reinforced Turf Grass



*Photo: Riverside (12420 Lamey Bridge Rd., Diberville)*

### Plastic Geocells



# **City of Diamondhead**

## **Recommended Changes to the Stormwater Ordinance**

January, 6 2015

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**Prepared by the Mississippi Water Resources Research Institute for the Rotten Bayou  
Watershed Plan**

## Recommendation 1

**Make the following addition to the building code.**

*Reference: Mandeville, LA*

*Reason: Would not allow complete filling of a residential lot, which reduces the area water can be stored within the watershed and may increase flood risk downstream.*

### **Grading Supplement**

No fill shall be placed outside the roof line and or soffit area of the principal building or accessory structure(s) including parking lots except as provided herein. A maximum of two (2) feet of fill material is allowed under the roof line and or soffit area of the principle building without retainer methods of construction. If more than two (2) feet of fill are used, retainer methods of construction shall be required beyond the initial twenty four (24) inches allowed. When fill material is proposed for an attached garage, which is attached to the principle building by common wall and the roof, the finished floor elevation shall be no greater than thirty two (32) inches above existing grade. Fill for all structures (foundations, improvements that require fill material shall taper from the edge of the improvement at a slope of three horizontal feet for every one vertical foot (3:1). In any case, this fill shall not extend out from any improvement or foundation more than six (6) feet. No fill shall be placed within three (3) feet of the property line. No fill shall be allowed around existing trees which are required to remain and no fill shall be allowed around existing trees which are required to remain and no fill shall be allowed in any vegetative protection zone. Driveways, parking lots, and detached accessory structures shall be arranged on the site in a manner that minimizes the alteration or disturbance to existing grades and natural drainage patterns. At completion, a final certificate from a Mississippi Licensed Civil Engineer shall be furnished by the owner stating that the lot was graded accordingly before occupancy is granted.

Beginning at the property line, the lot shall slope upwards not less than 1 inch in 20' away from the receiving drainage facility unless an alternate slope is approved by the Building Inspector. Such drainage to be submitted by a Mississippi Licensed Land Surveyor or Civil Engineer that states the drainage meets all state and local codes not to inundate adjacent property.



## Recommendation 2

**Add the following definition to the stormwater ordinance.**

*Reference: Center for Watershed Protection*

*Reason: The term “redevelopment” is used in proposed Article 7.0 Section B, Part A) of the stormwater ordinance.*

Redevelopment. A change to previously existing, improved property, including but not limited to the demolition or building of structures, filling, grading, paving, or excavating, but excluding ordinary maintenance activities, remodeling of buildings on the existing footprint, resurfacing of paved areas and exterior changes or improvements that do not materially increase or concentrate stormwater runoff or cause additional nonpoint source pollution.

## Recommendation 3

**Make the following changes to Article 6.0 Section A, first and second bullets, of the stormwater ordinance.**

*Reference: Ocean Springs, MS*

*Reason: This change would align with MDEQ permit language and be consistent with other communities in the area.*

Existing:

- 0 < 10,000 square feet of land disturbed: No permit or SWPPP currently required unless the disturbance is part of a Larger Common Plan of Development or Sale. A SWPPP may be requested or required if there are complaints or nuisance conditions.
- 10,000 square feet of land disturbed: Permit required from City of Diamondhead Code Enforcement Office (See Appendix). A Small Construction Notice of Intent (NOI) and SWPPP must be submitted to the Planning Department (See Appendix B and C for examples).

Proposed:

- 0 < 1 ac. of land disturbed: No permit or SWPPP required unless the disturbance is part of a Larger Common Plan of Development or Sale. However, stormwater pollution prevention should be considered during any land disturbance activity, and a SWPPP may be requested or required if there are complaints or nuisance conditions.
- 1 ac. < 5ac. of land disturbed: Permit required from City of Diamondhead Code Enforcement Office (See Appendix). A Small Construction Notice of Intent (NOI) and SWPPP must be submitted to the Planning Department (See Appendix B and C for examples).

## Recommendation 4

**Remove the first sentence of Article 9.0 of the stormwater ordinance.**

*Reason: The sentence states that the agency (city) will adopt BMPs for water quality. By keeping the rest of the section, the ordinance protects the city but doesn't require it to say how it's met thereby putting the responsibility on the developer.*

~~The Board or their authorized enforcement agency will adopt requirements identifying Best Management Practices for any activity, operation, or facility which may cause or contribute to pollution or contamination of stormwater, the storm drainage system, or waters of the U.S.—The owner or operator of a commercial or industrial establishment shall provide, at their own expense, reasonable protection from accidental discharge of prohibited materials or other wastes into the municipal storm drainage system or watercourses through the use of these structural and non-structural BMPs. Further, any person responsible for a property or premise, which is, or may be, the source of an illicit discharge, may be required to implement, at said person's expense, additional structural and non-structural BMP's to prevent the further discharge of pollutants to the municipal separate storm sewer system. Compliance with all terms and conditions of a valid NPDES permit authorizing the discharge of stormwater associated with industrial activity shall be deemed compliant with the provisions of this section. These BMPs shall be part of a Stormwater Pollution Prevention Plan (SWPPP) as necessary for compliance with requirements of the NPDES permit.~~

All post-construction BMPs and landscaping designed for the control or management of stormwater runoff and the control of erosion or sediment shall be maintained and cannot be developed for any other use which would limit or cause to limit the use of the improvements. Responsibility and maintenance of these improvements shall follow the Ownership of the property. Each property owner shall be liable within the contents of his deed for the maintenance of the improvements and must sign a Post-Construction Maintenance Agreement with the City. A special note to this effect shall appear on any final plat of subdivision. Before granting final approval for the project, the Board of Alderman must place the Post-Construction Maintenance Agreement on the agenda of a regular meeting of the Board for approval.

Post-construction BMPs in place and operational prior to the adoption of this ordinance shall be subject to execution of a maintenance agreement between the property owner and the city. In these instances, adoption and approval of the maintenance agreement shall follow the same procedures established herein for new construction or development.

## Recommendation 5

**Make the following changes to Article 7.0 Section B, Part A) of the stormwater ordinance.**

*Reason: The existing language places the responsibility on the city to ensure that a downstream analysis is completed and would require a potentially costly analysis of the downstream watershed. The proposed language creates three levels of compliance and requires specific and reasonable levels of flood protection.*

Existing:

A. It is prohibited to place fill material or construct impervious cover or construct or place any other structure on such person's property or perform any excavation or grading in a manner, which alters the flow of surface water across said property in a manner which damages any adjacent property.

1. No final subdivision plat, subdivision construction plan, site plan or building permit shall be approved by the City unless it can be demonstrated by the owner or developer of such property that the proposed development will not result in damage to any adjacent or downstream property. This will be certified by a professional engineer's submittal of sufficient data and calculations based upon the 2-year, 5-year, 10-year, 25-year and 50-year 24-hour storm events.

Proposed:

A. It is prohibited to place fill material or construct impervious cover or construct or place any other structure on such person's property or perform any excavation or grading in a manner, which alters the flow of surface water across said property in a manner which damages any adjacent property.

1. Sites with 20,000 square feet or more of impervious cover created, added, or replaced for redevelopment must protect downstream overbank flood and property protection by controlling the post-development peak discharge rate to the pre-development rate for the 2-year, 24-hour storm events.
2. Site greater than 1 acre in size with 20,000 square feet or more of impervious cover created, added, or replaced for redevelopment must provide downstream overbank flood and property protection by controlling the post-development peak discharge rate to the pre-development rate for the 2- and 5-year, 24-hour storm events, and demonstrate that the 100-year storm can safely pass through the site without creating damaging conditions downstream.
3. Site greater than 5 acres in size with 40,000 square feet or more of impervious cover created, added, or replaced for redevelopment must provide downstream overbank flood and property protection by controlling the post-development peak discharge rate to the pre-development rate for the 2-, 5-, 10-, 25-year, 24-hour storm events, and demonstrate that the 100-year storm can safely pass through the site without creating damaging conditions downstream.

## Recommendation 6

**Make the following changes to Article 7.0 Section B, Part B) of the stormwater ordinance.**

*Reason: The proposed section gives specific references for standards for the various types of BMPs that could be used and also encourages better site design and green infrastructure solutions, which are better for the environment and the watershed. The list of references should be reviewed and added to as necessary.*

Existing:

B. The above requirement shall be accomplished through one or more of the following options:

1. Design and construction of an on-site stormwater detention facility, or facilities, by the landowner or developer which limits the peak flood flows from the proposed development to the existing peak flood flows from the subject tract.
2. Construction of, or participation in the construction of, off-site drainage improvements, such as storm inlets, storm sewers, culverts, channel modifications, land filling, and/or other drainage facilities such that the peak flood flows for fully-developed watershed conditions from the watershed area in which the proposed development is located will be sufficiently and safely passed without flooding of adjacent and downstream property and roadways. Because this option alone does not assist the City with maintaining pre-development run-off conditions, it must be used in conjunction with the first or third option outlined in this section.
3. Design and construction of the development by certified engineering data and calculations utilizing limited impervious cover, infiltration of runoff from impervious cover via flow through pervious areas, and/or grass-lined swales or channels such that these measures result in a minimal increase in peak flood flows from the development.
4. All on-site stormwater detention facilities shall be designed to adequately and safely pass all stormwater inflows, including flood flows and runoff from upstream and adjacent properties that have natural and/or existing overland flows toward and onto the subject tract. The on-site stormwater detention facilities should not impound stormwater onto or cause backwater to inundate any upstream or adjacent properties in excess of existing conditions.

Proposed:

B. The above requirement shall be accomplished through one or more of the following options:

1. Better Site Planning and Design which involves using site design techniques during the site planning and design process that help to minimize land disturbance and reduce the creation of new impervious and disturbed land cover. Techniques include reducing clearing and grading limits, reducing roadway lengths and widths, and reducing parking lot and building footprints. It also aims to protect valuable aquatic and terrestrial resources from impacts of the land development process. This should protect primary and secondary conservation areas.

## Appendix I: Recommended Ordinance Changes

For further guidance and technical assistance, please refer to the following source:

Georgia Coastal Stormwater Supplement

Section 4.3- Site Planning and Design Criteria

2. Green Infrastructure Practices which used to protect valuable terrestrial and aquatic resources from the direct impacts of the land development process, maintain pre-development site hydrology and reduce post- construction stormwater runoff rates, volumes, and pollutant loads.

For further guidance and technical assistance, please refer to the following source:

Georgia Coastal Stormwater Supplement

Section 7.8- Low Impact Development Practices Profile Sheets

3. Detention which is the temporary storage of storm runoff in a stormwater BMP with the goals of controlling peak discharge rates and providing gravity settling of pollutants.

For further guidance and technical assistance, please refer to the following sources:

Georgia Coastal Stormwater Supplement

Section 8.6.1- Stormwater Pond

Section 8.6.2- Stormwater Wetlands

Section 8.6.3- Bioretention Areas

Georgia Stormwater Management Manual: Volume 2 Technical Handbook

Section 3.4.1- Dry Detention/ Dry Extended Detention Basins

Section 3.4.2- Multi-Purpose Detention Areas

Section 3.4.3- Underground Detention

Mississippi Department of Environmental Quality Handbook for Erosion Control, Stormwater Control, and Stormwater Management on Construction Sites and Urban Areas: Volume 2 Stormwater Management

Chapter 3: Retention/Detention

## Recommendation 7

**Add the following section as Article 7.0 Section B, Part C) of the stormwater ordinance.**

*Reason: If a site discharges directly into a reviving water detention is not necessary and should be waived. This language should be modified for the specific conditions in Diamondhead.*

Proposed:

C. Detention requirements may be waived on any site that discharges directly to a flood plain, Gulf, or major river or waterbody, and the City of Diamondhead determines that waiving the flooding criteria will not harm public health and safety. The applicant shall secure drainage easements from any downstream property owners across whose property the runoff must flow to reach the flood plain, Gulf, major river, or waterbody. The applicant shall also demonstrate that any piped or open-channel system in which the runoff will flow has adequate capacity and stability to receive the project's runoff plus any off-site runoff also passing through the system.

## Recommendation 8

**Remove Article 7.0 Section C, Part (c) 6 of the stormwater ordinance.**

*Reference: Ocean Springs, MS*

*Reason: The section relies on MS4 language which Diamondhead is not a part of.*

Proposed:

~~This permit authorizes the following non-storm water discharges provided: (1) they do no cause or contribute to a violation of water quality standards, (2) the Executive Director of the Mississippi Department of Environmental Quality (MDEQ) has determined these sources entering the MS4 are not a substantial cause or contributor of pollutants entering the Municipal Separate Storm Sewer System (MS4) that may violate applicable state or federal laws, regulations, or criteria, (3) the regulated entity has determined these sources entering the MS4 are not a substantial contributor of pollutants entering the MS4 that may violate applicable state or federal laws, regulations, or criteria, and (4) the regulated entity is implementing the Storm Water Management Program as set forth in ACT5 as set forth in the MS4 General Permit.~~



## Florida Department of Environmental Protection

### MODEL ORDINANCE FOR FLORIDA-FRIENDLY FERTILIZER USE ON URBAN LANDSCAPES

[alternate title: **MODEL ORDINANCE FOR  
FLORIDA-FRIENDLY USE OF FERTILIZER ON URBAN LANDSCAPES**]  
2015

[Note: Title revision for clarity. There is no defined Florida-Friendly fertilizer product, as timing, chemistry, grade, amount, site-specific conditions and application practices all affect “Florida-friendliness”.]

### INTRODUCTION

This attached Model Fertilizer Use Ordinance is another tool to reduce sources of nutrients coming from urban landscapes to reduce the impact of nutrients on Florida’s surface and ground waters. Limiting the amount of fertilizer applied to the landscape will reduce the risk of nutrient enrichment of surface and ground waters, but effective nutrient management requires more comprehensive control measures. Such a comprehensive approach is needed that may include, but is not limited to, land planning and low-impact development, site plan design, landscape design, irrigation system design and maintenance, fertilizer application, landscape maintenance, and waste disposal. To assist local governments in improving their existing land development regulations, several “model” ordinances have been developed. These include:

- “Low Impact Design” ordinances which seek to reduce the impact of urbanization on our natural resources by stressing “source controls” that either minimize the generation of stormwater or minimize the pollutants that can get into stormwater. For example, promoting development designs that minimizes clearing of natural vegetation and the compaction of urban soils. A Model Springs Protection Code was developed by DCA, DEP, and other stakeholders that includes specific Land Development Regulation recommendations that promote Low Impact Design. This Model Code is available as Chapter 5 in *Protecting Florida's Springs: An Implementation Guidebook*. It is available at <http://www.dca.state.fl.us/fdcp/DCP/springs/index.cfm>.
- “Landscape Ordinances” because design, construction, and maintenance are major determinants in the amount of fertilizer and irrigation that is needed to maintain healthy urban landscapes and minimize adverse impacts on water resources. A model Landscape Ordinance entitled “Guidelines for Model Ordinance Language for Protection of Water Quality and Quantity Using Florida-Friendly Lawns and Landscapes” was developed by a group of agencies, industries, and interest groups over a two year period and published in 2003. It was fundamentally an adaptation of earlier water conservation ordinances revised to include water quality protections for compliance with Total Maximum Daily Load (TMDL) or stormwater NPDES permit requirements. The language focused on continuing education of lawn care and landscape professionals, proper planning and supervision during development and construction, and the use of best management practices, including the Florida-

Friendly Landscape Program. This model ordinance has been renamed “Florida-Friendly Landscaping™ Model Guidelines for Ordinance Language for Protection of Water Quality and Quantity,” updated in 2008 and 2010 and may be downloaded from: <http://www.dep.state.fl.us/water/nonpoint/pubs.htm>.

- Finally, the 2004 Florida Legislature directed Florida’s water management districts to work with interested parties to develop landscape irrigation and Florida-Friendly design standards for new construction (section 373.228, F.S.). Local governments are to use the standards and guidelines when developing landscape irrigation and Florida-Friendly ordinances. The Committee on Landscape Irrigation and Florida-Friendly Design Standards convened and developed the standards. They are published in a booklet called **Landscape Irrigation and Florida-Friendly Design Standards (December 2006)**. The 2009 Legislature has directed that it be revised in 2011. The current version of this document can be downloaded from: [http://www.dep.state.fl.us/water/waterpolicy/land\\_irr.htm](http://www.dep.state.fl.us/water/waterpolicy/land_irr.htm)

**MODEL ORDINANCE FOR  
FLORIDA-FRIENDLY USE OF FERTILIZER ON URBAN LANDSCAPES  
(FEBRUARY 2015)**

**1. FINDINGS**

As a result of impairment to (MUNICIPALITY / COUNTY)'S surface waters caused by excessive nutrients, or, as a result of increasing levels of nitrogen in the surface and/or ground water within the aquifers or springs within the boundaries of (municipality/county), the governing body of (municipality / county) has determined that the use of fertilizers on lands within (municipality / county) creates a risk to contributing to adverse effects on surface and/or ground water. Accordingly, the governing board of (municipality/county) finds that management measures [Guidance: optional "additional management measures than are otherwise"] contained in the most recent edition of the "*Florida-Friendly Best Management Practices for Protection of Water Resources by the Green Industries, 2008,*" may be required by this ordinance.

**2. PURPOSE AND INTENT**

This Ordinance regulates the proper use of fertilizers by any applicator; requires proper training of Commercial and Institutional Fertilizer Applicators; establishes training and licensing requirements; establishes a Prohibited Application Period; specifies allowable fertilizer application rates and methods, fertilizer-free zones, low maintenance zones, and exemptions. The Ordinance requires the use of Best Management Practices which provide specific management guidelines to minimize negative secondary and cumulative environmental effects associated with the misuse of fertilizers. These secondary and cumulative effects have been observed in and on (MUNICIPALITY / COUNTY)'s natural and constructed stormwater conveyances, rivers, creeks, canals, springs, lakes, estuaries and other water bodies. [Guidance: as appropriate] Collectively, these water bodies are an asset critical to the environmental, recreational, cultural and economic well-being of (MUNICIPALITY / COUNTY) residents and the health of the public. Overgrowth of algae and vegetation hinder the effectiveness of flood attenuation provided by natural and constructed stormwater conveyances. Regulation of nutrients, including both phosphorus and nitrogen contained in fertilizer, will help improve and maintain water and habitat quality.

**3. DEFINITIONS**

For this Article, the following terms shall have the meanings set forth in this section unless the context clearly indicates otherwise.

"Administrator" means the (MUNICIPALITY / COUNTY) Administrator, or an administrative official of (MUNICIPALITY / COUNTY) government designated by the City/County Administrator to administer and enforce the provisions of this Article.

"Application" or "Apply" means the actual physical deposit of fertilizer to turf or landscape plants.

## Appendix J: Model Ordinance for Florida-Friendly Fertilizer Use on Urban Landscapes

“Applicator” means any Person who applies fertilizer on turf and/or landscape plants in (MUNICIPALITY / COUNTY).

“Board or Governing Board” means the Board of City/County Commissioners of (MUNICIPALITY / COUNTY), Florida.

“Best Management Practices” means turf and landscape practices or combination of practices based on research, field-testing, and expert review, determined to be the most effective and practicable on-location means, including economic and technological considerations, for improving water quality, conserving water supplies and protecting natural resources.

“Code Enforcement Officer, Official, or Inspector” means any designated employee or agent of (MUNICIPALITY / COUNTY) whose duty it is to enforce codes and ordinances enacted by (MUNICIPALITY / COUNTY).

“Commercial Fertilizer Applicator”, except as provided in 482.1562(9) F.S., means any person who applies fertilizer for payment or other consideration to property not owned by the person or firm applying the fertilizer or the employer of the applicator.

“Fertilize,” “Fertilizing,” or “Fertilization” means the act of applying fertilizer to turf, specialized turf, or landscape plants.

“Fertilizer” means any substance or mixture of substances that contains one or more recognized plant nutrients and promotes plant growth, or controls soil acidity or alkalinity, or provides other soil enrichment, or provides other corrective measures to the soil.

“Guaranteed Analysis” means the percentage of plant nutrients or measures of neutralizing capability claimed to be present in a fertilizer.

“Institutional Applicator” means any person, other than a private, non-commercial or a Commercial Applicator (unless such definitions also apply under the circumstances), that applies fertilizer for the purpose of maintaining turf and/or landscape plants. Institutional Applicators shall include, but shall not be limited to, owners, managers or employees of public lands, schools, parks, religious institutions, utilities, industrial or business sites and any residential properties maintained in condominium and/or common ownership.

“Landscape Plant” means any native or exotic tree, shrub, or groundcover (excluding turf).

“Low Maintenance Zone” means an area a minimum of ten (10) feet wide adjacent to water courses which is planted and managed in order to minimize the need for fertilization, watering, mowing, etc.

“Person” means any natural person, business, corporation, limited liability company, partnership, limited partnership, association, club, organization, and/or any group of people acting as an organized entity.

“Prohibited Application Period” means the time period during which a Flood Watch or Warning, or a Tropical Storm Watch or Warning, or a Hurricane Watch or Warning is in effect for any portion of (CITY/COUNTY), issued by the National Weather Service, or if heavy rain<sup>1</sup> is likely.

“(MUNICIPALITY / COUNTY) Approved Best Management Practices Training Program” means a training program approved per 403.9338 F.S., or any more stringent requirements set forth in this Article that includes the most current version of the Florida Department of Environmental Protection’s “*Florida-Friendly Best Management Practices for Protection of Water Resources by the Green Industries*, 2008,” as revised, and approved by the (MUNICIPALITY / COUNTY) Administrator.

"Saturated soil" means a soil in which the voids are filled with water. Saturation does not require flow. For the purposes of this ordinance, soils shall be considered saturated if standing water is present or the pressure of a person standing on the soil causes the release of free water. [Guidance: Some have questioned the enforceability of practical field definitions which should be considered before adoption.]

“Slow Release,” “Controlled Release,” “Timed Release,” “Slowly Available,” or “Water Insoluble Nitrogen” means nitrogen in a form which delays its availability for plant uptake and use after application, or which extends its availability to the plant longer than a reference rapid or quick release product.

“Turf,” “Sod,” or “Lawn” means a piece of grass-covered soil held together by the roots of the grass.

"Urban landscape" means pervious areas on residential, commercial, industrial, institutional, highway rights-of-way, or other nonagricultural lands that are planted with turf or horticultural plants. For the purposes of this section, agriculture has the same meaning as in s. 570.02.

#### **4. APPLICABILITY**

This Ordinance shall be applicable to and shall regulate any and all applicators of fertilizer and areas of application of fertilizer within the area of (MUNICIPALITY / COUNTY), unless such applicator is specifically exempted by the terms of this Ordinance from the regulatory provisions of this Ordinance. This Ordinance shall be prospective only, and shall not impair any existing contracts.

[Guidance: In 403.9336, the Legislature further finds that local conditions, including variations in the types and quality of water bodies, site-specific soils and geology, and urban or rural densities and characteristics, may necessitate the implementation of additional or more stringent fertilizer

<sup>1</sup> World Meteorological Organization definition of heavy rain: Rainfall greater than or equal to 50 mm (2 inches) in a 24 hour period. <http://severe.worldweather.org/rain/>, and forecast keyword “likely”, [http://www.wrh.noaa.gov/sew/MediaGuide/TermsOutlooks\\_Watches\\_Warnings.pdf](http://www.wrh.noaa.gov/sew/MediaGuide/TermsOutlooks_Watches_Warnings.pdf).

management practices at the local government level. Local government may adopt additional or more stringent provisions to the model ordinance as provided in 403.9337(2). However, the local government should consider the disadvantages of confusing jurisdictional differences and should clearly demonstrate they meet the required criteria:

(2) Each county and municipal government located within the watershed of a water body or water segment that is listed as impaired by nutrients pursuant to s. 403.067, shall, at a minimum, adopt the department's Model Ordinance for Florida-Friendly Fertilizer Use on Urban Landscapes. A local government may adopt additional or more stringent standards than the model ordinance if the following criteria are met:

- o (a) The local government has demonstrated, as part of a comprehensive program to address nonpoint sources of nutrient pollution which is science based, and economically and technically feasible, that additional or more stringent standards than the model ordinance are necessary in order to adequately address urban fertilizer contributions to nonpoint source nutrient loading to a water body.
- o (b) The local government documents that it has considered all relevant scientific information, including input from the department, the institute, the Department of Agriculture and Consumer Services, and the University of Florida Institute of Food and Agricultural Sciences, if provided, on the need for additional or more stringent provisions to address fertilizer use as a contributor to water quality degradation. All documentation must become part of the public record before adoption of the additional or more stringent criteria.]

[Guidance: Florida Statutes 125.568(3), 166.048(3), 373.185(3), 720.3075(4), and others provide that a local ordinance, deed restriction or covenant may not prohibit or be enforced so as to prohibit any property owner from implementing Florida-friendly landscaping on his or her land or create any requirement or limitation in conflict with any provision of part II of this chapter {373} or a water shortage order, other order, consumptive use permit, or rule adopted or issued pursuant to Chapter 373 part II.]

[Guidance: Florida Statutes 482.156 and 482.1562. Neither the Limited Commercial Landscape Maintenance Certification Program nor the Limited Certification for Urban Landscape Commercial Fertilizer Application allows landscape maintenance workers to make any kind of pesticide applications (including weed control and/or weed and feed products) to any turf areas.]

[Guidance: Florida Statutes 482.242, and 487.051 (2), F.S. Regulation of pest control businesses and applicators, and of pesticide use, is preempted to the Florida Department of Agriculture and Consumer Services (FDACS and suspected pesticide misuse should be reported to FDACS.

## **5. TIMING OF FERTILIZER APPLICATION**

No applicator shall apply fertilizers containing nitrogen and/or phosphorus to turf and/or landscape plants during the Prohibited Application Period, or to saturated soils.

[Guidance: One of the most controversial issues associated with recent fertilizer ordinances enacted by local governments is the definition of the Prohibited Application Period. Some ordinances have prohibited the application of fertilizer, even slow release formulations, during the summer rainy season, typically June 1 to September 30. The reasoning is that rain occurs frequently, saturating the soil, leading to more runoff. Saturated soils are prone to runoff or leaching with little or no additional water, and pose a higher than normal risk until soil moisture capacity is restored. Fertilizer management is largely about keeping the nitrogen and/or phosphorus in the root zone where it can be used by plants. Periods of heavy rainfall contribute to leaching, which is washing nutrients out of the root zone, and to runoff, especially in areas with compacted or bare soils and significant slope. Vegetative ground cover is important to minimizing

erosion, filtering particulates, and incorporating or promoting the biological transformation of potential pollutants. Many variables influence the relationship between fertilizer rates, vegetation health and nutrient enrichment of surface and ground waters. Accordingly, sound science and carefully reasoned judgment are recommended in determining how to define the Prohibited Application Period.]

## **6. FERTILIZER FREE ZONES**

Fertilizer shall not be applied within ten (10) feet of any pond, stream, watercourse, lake, canal, or wetland as defined by the Florida Department of Environmental Protection (Chapter 62-340, Florida Administrative Code) or from the top of a seawall, unless a deflector shield, drop spreader, or liquid applicator with a visible and sharply defined edge, is used, in which case a minimum of 3 feet shall be maintained. If more stringent (MUNICIPALITY / COUNTY) Code regulations apply, this provision does not relieve the requirement to adhere to the more stringent regulations. Newly planted turf and/or landscape plants may be fertilized in this Zone only for a sixty (60) day period beginning 30 days after planting if need to allow the plants to become well established. Caution shall be used to prevent direct deposition of nutrients into the water. [Guidance: This zone is a setback to prevent the applicator from inadvertently depositing fertilizer in the water while performing the application. It is not designed as a treatment buffer, and is to be adhered to as a fundamental environmental safety aspect of the applicator's job, regardless of the owner's desires. Some communities have existing residential setbacks of as little as 10 feet from water or seawall. Low maintenance zones, vegetated filter strips, and riparian buffers are strongly encouraged, but such activities are rightly a part of land use planning. Local governments are encouraged to implement these low-impact development practices where feasible.]

## **7. LOW MAINTENANCE ZONES**

A voluntary ten (10) foot low maintenance zone is strongly recommended, but not mandated, from any pond, stream, water course, lake, wetland or from the top of a seawall. A swale/berm system is recommended for installation at the landward edge of this low maintenance zone to capture and filter runoff. If more stringent (MUNICIPALITY / COUNTY) Code regulations apply, this provision does not relieve the requirement to adhere to the more stringent regulations. No mowed or cut vegetative material may be deposited or left remaining in this zone or deposited in the water. Care should be taken to prevent the over-spray of aquatic weed products in this zone. [Guidance: Care must be taken to ensure erosion of the surface soil does not occur. Excessive erosion may be a greater pollution hazard than occasional proper applications of fertilizer.]

## **8. FERTILIZER CONTENT AND APPLICATION RATES**

[Guidance: RULE 5E-1.003, F.A.C contains the following provisions for golf courses, parks and athletic fields. As such, no additional specific requirements are included for these types of urban turf. The appropriate Best Management Practices listed below must be followed on such sites for nutrient management activities:

These include not to exceed rates recommended in the document titled SL191 "*Recommendations for N, P, K and Mg for Golf Course and Athletic Field Fertilization Based on Mehlich I Extractant*", and to comply with the recommendations in "*BMP's for the Enhancement of Environmental Quality on Florida Golf Courses*", published by the Florida Department of Environmental Protection, dated 2012.

Note that this does not exempt applicators at these sites from the required basic Green Industry BMP training.

- (a) Fertilizers applied to turf within (MUNICIPALITY / COUNTY) shall be applied in accordance with requirements and directions provided by Rule 5E-1.003, Florida Administrative Code.
- (b) Fertilizer containing nitrogen shall not be applied before seeding or sodding a site, and shall not be applied for the first 30 days after seeding or sodding, except when hydro-seeding for temporary or permanent erosion control in an emergency situation (wildfire, etc.), or in accordance with the Stormwater Pollution Prevention Plan for that site.
- (c) Nitrogen or phosphorus fertilizer shall not be applied to turf or landscape plants except as provided in (a) above for turf, or in UF/IFAS recommendations for landscape plants, vegetable gardens, and fruit trees and shrubs, unless a soil or tissue deficiency has been verified by an approved test. [Guidance: Soil and tissue tests for phosphorus are normally done by UF/IFAS or another accredited laboratory. IFAS recommendations are available from the County Extension service or [http://solutionsforyourlife.ufl.edu/lawn\\_and\\_garden/](http://solutionsforyourlife.ufl.edu/lawn_and_garden/)]

**9. APPLICATION PRACTICES**

- a. Spreader deflector shields are required when fertilizing via rotary (broadcast) spreaders. Deflectors must be positioned such that fertilizer granules are deflected away from all impervious surfaces, fertilizer-free zones and water bodies, including wetlands.
- b. Fertilizer shall not be applied, spilled, or otherwise deposited on any impervious surfaces.
- c. Any fertilizer applied, spilled, or deposited, either intentionally or accidentally, on any impervious surface shall be immediately and completely removed to the greatest extent practicable.
- d. Fertilizer released on an impervious surface must be immediately contained and either legally applied to turf or any other legal site, or returned to the original or other appropriate container.
- e. In no case shall fertilizer be washed, swept, or blown off impervious surfaces into stormwater drains, ditches, conveyances, or water bodies.

**10. MANAGEMENT OF GRASS CLIPPINGS AND VEGETATIVE MATTER**

In no case shall grass clippings, vegetative material, and/or vegetative debris be washed, swept, or blown off into stormwater drains, ditches, conveyances, water bodies, wetlands, or sidewalks or roadways. Any material that is accidentally so deposited shall be immediately removed to the maximum extent practicable.

**11. EXEMPTIONS**

The provisions set forth above in this Ordinance shall not apply to:

- (a) bona fide farm operations as defined in the Florida Right to Farm Act, Section 823.14 Florida Statutes;



(b) other properties not subject to or covered under the Florida Right to Farm Act that have pastures used for grazing livestock;

(c) any lands used for bona fide scientific research, including, but not limited to, research on the effects of fertilizer use on urban stormwater, water quality, agronomics, or horticulture.

[Guidance: Limited waivers for special cases such as botanical gardens, etc. should not be considered as less stringent for the purposes of the model as a minimum requirement.]

## **12. TRAINING**

(a) All commercial and institutional applicators of fertilizer within the (un)incorporated area of (MUNICIPALITY / COUNTY), shall abide by and successfully complete the six-hour training program in the “*Florida Friendly Best Management Practices for Protection of Water Resources by the Green Industries*” offered by the Florida Department of Environmental Protection through the University of Florida Extension “*Florida-Friendly Landscaping™*” program, or an approved equivalent.

(b) Private, non-commercial applicators are encouraged to follow the recommendations of the University of Florida IFAS *Florida Yards and Neighborhoods* program when applying fertilizers.

[Guidance: A local government may establish a certification/education program for the institutional or private application of fertilizers indicating the completion of an education program for special local requirements not covered in the above programs. It is up to the local government to set a continuing education or renewal provision for these applicators. Persons with statewide FDACS commercial fertilizer certification cannot be required to submit to additional local testing after obtaining the FDACS certificate. ]

## **13. LICENSING OF COMMERCIAL APPLICATORS**

All commercial applicators of fertilizer within the (un)incorporated area of (MUNICIPALITY / COUNTY), shall have and carry in their possession at all times when applying fertilizer, evidence of certification by the Florida Department of Agriculture and Consumer Services as a Commercial Fertilizer Applicator per 5E-14.117(18) F.A.C.

All businesses applying fertilizer to turf and/or landscape plants (including but not limited to residential lawns, golf courses, commercial properties, and multi-family and condominium properties) must ensure that at least one employee has a “*Florida-Friendly Best Management Practices for Protection of Water Resources by the Green Industries*” training certificate prior to the business owner obtaining a Local Business Tax Certificate. Owners for any category of occupation which may apply any fertilizer to Turf and/or Landscape Plants shall provide proof of completion of the program to the (Municipality/ County) Tax Collector’s Office. [Guidance: This is an example of an administrative enforcement mechanism. It may be modified to use other local mechanisms as appropriate].

## **14. ENFORCEMENT**

## Appendix J: Model Ordinance for Florida-Friendly Fertilizer Use on Urban Landscapes

[Guidance: Local governments should consider making penalties consistent with their other fines and penalties.]

Funds generated by penalties imposed under this section shall be used by (Municipality/ County) for the administration and enforcement of section 403.9337, Florida Statutes, and the corresponding sections of this ordinance, and to further water conservation and nonpoint pollution prevention activities.

## Appendix K: Sample Boy Scout Projects for Rotten Bayou Watershed

### Appendix L: Sample Boy Scout Projects for Rotten Bayou Watershed

Highlighted below are activities that can be used to satisfy the **Soil and Water Conservation Merit Badge** that are particularly relevant to and would benefit Rotten Bayou Watershed.

- Plant 100 trees, bushes and/or vines for a good purpose.
- Seed an area of at least one-fifth acre for some worthwhile conservation purpose, using suitable grasses or legumes alone or in a mixture.
- Make a list of places in your neighborhood, camps, school ground, or park having erosion, sedimentation, or pollution problems. Describe how these could be corrected through individual or group action.

More information can be found at <http://www.boyscouttrail.com/boy-scouts/meritbadges/soil-and-water-conservation-merit-badge.asp>



# Soil and Water Conservation

## Merit Badge Workbook



This workbook can help you but you still need to read the merit badge pamphlet.

The work space provided for each requirement should be used by the Scout to make notes for discussing the item with his counselor, not for providing the full and complete answers. Each Scout must do each requirement.

No one may add or subtract from the official requirements found in **Boy Scout Requirements** (Pub. 33216 – SKU 34765).

The requirements were last issued or revised in 2005 • This workbook was updated in January 2014.

Scout's Name: \_\_\_\_\_ Unit: \_\_\_\_\_

Counselor's Name: \_\_\_\_\_ Counselor's Phone No.: \_\_\_\_\_

<http://www.USScouts.Org> • <http://www.MeritBadge.Org>

Please submit errors, omissions, comments or suggestions about this **workbook** to: [Workbooks@USScouts.Org](mailto:Workbooks@USScouts.Org)  
Comments or suggestions for changes to the **requirements** for the **merit badge** should be sent to: [Merit.Badge@Scouting.Org](mailto:Merit.Badge@Scouting.Org)

1. Do the following:

a. Tell what soil is.


Tell how it is formed.


b. Describe three kinds of soil. Tell how they are different.

1.	

# Appendix K: Sample Boy Scout Projects for Rotten Bayou Watershed

Soil and Water Conservation

Scout's Name: \_\_\_\_\_

2.	
3.	

c. Describe the three main plant nutrients in fertile soil.

1.	
2.	
3.	

Tell how they can be put back when used up.


2. Do the following:

a. Define soil erosion.


# Appendix K: Sample Boy Scout Projects for Rotten Bayou Watershed

Soil and Water Conservation

Scout's Name: \_\_\_\_\_

b. Tell why it is important.


Tell how it affects you.


c. Name three kinds of soil erosion. Describe each.

1.	
2.	
3.	

# Appendix K: Sample Boy Scout Projects for Rotten Bayou Watershed

Soil and Water Conservation

Scout's Name: \_\_\_\_\_

- d. Take pictures or draw two kinds of soil erosion.

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3. Do the following:

- a. Tell what is meant by conservation practices.


- b. Describe the effect of three kinds of erosion-control practices.

1.	
2.	
3.	

# Appendix K: Sample Boy Scout Projects for Rotten Bayou Watershed

Soil and Water Conservation

Scout's Name: \_\_\_\_\_

- c. Take pictures or draw three kinds of erosion-control practices.


- 4. Do the following:

- a. Explain what a watershed is.






# Appendix K: Sample Boy Scout Projects for Rotten Bayou Watershed

Soil and Water Conservation

Scout's Name: \_\_\_\_\_

- c. Explain how removal of vegetation will affect the way water runs off a watershed.


- d. Tell how uses of forest, range, and farm land affect usable water supply.


- e. Explain how industrial use affects water supply.


- 6. Do the following:

- a. Tell what is meant by water pollution.


# Appendix K: Sample Boy Scout Projects for Rotten Bayou Watershed

Soil and Water Conservation

Scout's Name: \_\_\_\_\_

- b. Describe common sources of water pollution and explain the effects.

Water Pollution Source	Effects

- c. Tell what is meant by "primary water treatment," "secondary waste treatment," and "biochemical oxygen demand."

Primary  
water  
treatment


# Appendix K: Sample Boy Scout Projects for Rotten Bayou Watershed

Soil and Water Conservation

Scout's Name: \_\_\_\_\_

secondary  
waste  
treatment


biochemical  
oxygen  
demand


d. Make a drawing showing the principles of complete waste treatment.



# Appendix K: Sample Boy Scout Projects for Rotten Bayou Watershed

## Soil and Water Conservation

Scout's Name: \_\_\_\_\_

7. Do TWO of the following:

- a. Make a trip to two of the following places. Write a report of more than 500 words about the soil and water and energy conservation practices you saw.
  - 1. An agricultural experiment.
  - 2. A managed forest or woodlot, range, or pasture.
  - 3. A wildlife refuge or a fish or game management area.
  - 4. A conservation-managed farm or ranch.
  - 5. A managed watershed.
  - 6. A waste-treatment plant.
  - 7. A public drinking water treatment plant.
  - 8. Industry water use installation.
  - 9. Desalinization plant
- b. Plant 100 trees, bushes and/or vines for a good purpose.
- c. Seed an area of at least 1/5 acre for some worthwhile conservation purpose, using suitable grasses or legumes alone or in a mixture.
- d. Study a soil survey report. Describe the things in it. On tracing paper over any of the soil maps, outline an area with three or more different kinds of soil. List each kind of soil by full name and map symbol.


- e. Make a list of places in your neighborhood, camps, school ground, or park that have erosion, sedimentation, or pollution problems. Describe how these could be corrected through individual or group action.


- f. Carry out any other soil and water conservation project approved by your merit badge counselor.

**Requirement resources can be found here:**  
[http://www.meritbadge.org/wiki/index.php/Soil and Water Conservation#Requirement resources](http://www.meritbadge.org/wiki/index.php/Soil_and_Water_Consevation#Requirement_resources)

### Important excerpts from the [Guide To Advancement - 2013](#), No. 33088 (SKU-618673)

#### [1.0.0.0] — Introduction

The current edition of the *Guide to Advancement* is the official source for administering advancement in all Boy Scouts of America programs: Cub Scouting, Boy Scouting, Varsity Scouting, Venturing, and Sea Scouts. It replaces any previous BSA advancement manuals, including *Advancement Committee Policies and Procedures*, *Advancement and Recognition Policies and Procedures*, and previous editions of the *Guide to Advancement*.

#### [Page 2, and 5.0.1.4] — Policy on Unauthorized Changes to Advancement Program

**No council, committee, district, unit, or individual has the authority to add to, or subtract from, advancement requirements.** There are limited exceptions relating only to youth members with special needs. For details see section 10, "Advancement for Members With Special Needs".

#### [Page 2] — The "Guide to Safe Scouting" Applies

Policies and procedures outlined in the *Guide to Safe Scouting*, No. 34416, apply to all BSA activities, including those related to advancement and Eagle Scout service projects.

#### [7.0.3.1] — The Buddy System and Certifying Completion

A youth member must not meet one-on-one with an adult. Sessions with counselors must take place where others can view the interaction, or the Scout must have a buddy: a friend, parent, guardian, brother, sister, or other relative—or better yet, another Scout working on the same badge—along with him attending the session.

When the Scout meets with the counselor, he should bring any required projects. If these cannot be transported, he should present evidence, such as photographs or adult verification. His unit leader, for example, might state that a satisfactory bridge or tower has been built for the Pioneering merit badge, or that meals were prepared for Cooking. If there are questions that requirements were met, a counselor may confirm with adults involved. Once satisfied, the counselor signs the blue card using the date upon which the Scout completed the requirements, or in the case of partials, initials the individual requirements passed.

Note that from time to time, it may be appropriate for a requirement that has been met for one badge to also count for another. See "Fulfilling More Than One Requirement With a Single Activity," 4.2.3.6.

#### [7.0.3.2] — Group Instruction

It is acceptable—and sometimes desirable—for merit badges to be taught in group settings. This often occurs at camp and merit badge midways or similar events. Interactive group discussions can support learning. The method can also be attractive to "guest experts" assisting registered and approved counselors. Slide shows, skits, demonstrations, panels, and various other techniques can also be employed, but as any teacher can attest, not everyone will learn all the material.

There must be attention to each individual's projects and his fulfillment of *all* requirements. We must know that every Scout—actually and *personally*—completed them. If, for example, a requirement uses words like "show," "demonstrate," or "discuss," then every Scout must do that. It is unacceptable to award badges on the basis of sitting in classrooms *watching* demonstrations, or remaining silent during discussions.

It is sometimes reported that Scouts who have received merit badges through group instructional settings have not fulfilled all the requirements. To offer a quality merit badge program, council and district advancement committees should ensure the following are in place for all group instructional events.

- Merit badge counselors are known to be registered and approved.
- Any guest experts or guest speakers, or others assisting who are not registered and approved as merit badge counselors, do not accept the responsibilities of, or behave as, merit badge counselors, either at a group instructional event or at any other time. Their service is temporary, not ongoing.
- Counselors agree not to assume prerequisites have been completed without some level of evidence that the work has been done. Pictures and letters from other merit badge counselors or unit leaders are the best form of prerequisite documentation when the actual work done cannot be brought to the camp or site of the merit badge event.
- There is a mechanism for unit leaders or others to report concerns to a council advancement committee on summer camp merit badge programs, group instructional events, and any other merit badge counseling issues—especially in instances where it is believed BSA procedures are not followed. See "Reporting Merit Badge Counseling Concerns," 11.1.0.0.
- There must be attention to each individual's projects and his fulfillment of all requirements. We must know that every Scout—actually and personally—completed them.

#### [7.0.3.3] — Partial Completions

A Scout need not pass all the requirements of one merit badge with the same counselor. It may be that due to timing or location issues, etc., he must meet with a different counselor to finish the badge. The Application for Merit Badge has a place to record what has been finished—a "partial." In the center section on the reverse of the blue card, the counselor initials for each requirement passed. In the case of a partial completion, the counselor does not retain his or her portion of the card. A subsequent counselor may choose not to accept partial work, but this should be rare. A Scout, if he believes he is being treated unfairly, may work with his unit leader to find another counselor. An example for the use of a signed partial would be to take it to camp as proof of prerequisites. Partials have no expiration except the Scout's 18th birthday. Units, districts, or councils shall not establish other expiration dates for partial merit badges.

#### [7.0.4.8] — Unofficial Worksheets and Learning Aids

Worksheets and other materials that may be of assistance in earning merit badges are available from a variety of places including unofficial sources on the Internet and even troop libraries. Use of these aids is permissible as long as the materials can be correlated with the current requirements that Scouts must fulfill. Completing "worksheets" may suffice where a requirement calls for something in writing, but this would not work for a requirement where the Scout must discuss, tell, show, or demonstrate, etc. Note that Scouts shall not be required to use these learning aids in order to complete a merit badge.

## Appendix L: Elementary Education for Rotten Bayou Watershed

### Project Summary

**Project Title:** Elementary Education for Rotten Bayou Watershed

**Organization Title:** Gulf Coast Community Design Studio, Mississippi State University

**Principle Investigator:** David Perkes, AIA, Director  
Gulf Coast Community Design Studio  
769 Howard Avenue  
Biloxi, MS 39530  
Office Phone: 228.436.4661  
Email: dperkes@gccds.msstate.edu

**Scope of Work:** Mississippi State University's Gulf Coast Community Design Studio, in partnership with East Hancock Elementary School, Mississippi Wildlife Federation's (MWF) Adopt-a-Stream Program, NOAA's National Coastal Data Development Center (NCCDC), and Land Trust for the Mississippi Coastal Plain (LTMCP) proposes to work with the fifth grade students at East Hancock Elementary during the 2014-2015 academic year. There will be approximately 150 fifth grade students enrolled during the 2014-2015 academic year under the guidance of five teachers, the majority of whom live in the Rotten Bayou Watershed (Hydrologic Unit Code 031700109-002). Programming will include a four-day, in-class workshop with the students based on curriculum developed by the Gulf Coast Community Design Studio in 2012 for sixth graders at Biloxi Junior High School (See Appendix D: NEA Environmental Education with Biloxi Junior High School) and will focus on how the built environment, human activity and stormwater runoff affect the health of their waterways and watershed. Students will also go on two field trips – one to collect water quality data with assistance from the MWF Adopt-a-Stream Program and another to collect geospatial data with assistance from NCCDC. Students will work with GCCDS and partnering organization to analyze, present and share their data both within the school and larger community (See Data Share Plan). This project will enhance the current science curriculum at East Hancock Elementary; assist with the transition to Common Core standards by encouraging critical thinking, subject integration and information sharing; and support the efforts of the Rotten Bayou Watershed Implementation Planning Effort funded by the Mississippi Department of Environmental Quality (MDEQ).

**Priorities Addressed:** This project will address the following priorities defined by the Gulf B-WET Program.

- I. Meaningful Watershed Educational Experiences for Students: Students will be engaged both in and out of the classroom through an interactive workshop and data collection and observation in the field. Students will learn to use new equipment and technology including World Water Monitoring Challenge chemical kits, aquatic nets, forceps, jeweler's loupes and digital cameras with GPS. Through the proposed program students will receive base knowledge, interact with the natural environmental and reflect on their findings by making connections to other watershed-wide initiatives.
- II. GOMA Priorities addressed: Water quality for healthy beaches and shellfish beds; environmental education; and reducing nutrient inputs to coastal ecosystems. To a lesser extent wetland and coastal conservation and restoration; identification and characterization of gulf habitats; and coastal community resiliency will be addressed.

**Total Federal Funding Requested:** \$44,236.88.

Cost per student: \$294.91

## Appendix L: Elementary Education for Rotten Bayou Watershed

### Project Description

#### **Organization and Partners:**

The Gulf Coast Community Design Studio (GCCDS), an outreach program of Mississippi State University's College of Architecture, Art + Design, provides professional design and planning services to local communities and organizations to assistance in increasing their capacity to address issues of housing, public space, neighborhood development and the environment. The GCCDS staff that will manage and implement the project include David Perkes, Architect, Associate Professor and founding Director of the studio, Britton Jones, Landscape Architect, and Kelsey Johnson, Community Planner (*See Appendix B: Resumes*)

Partners include East Hancock Elementary School, Land Trust for the Mississippi Coastal Plain (LTMCP), Mississippi Wildlife Federation's (MWF) Adopt-a-Stream Program, and NOAA's National Coastal Data Development Center (NCDDC) (*See Appendix C: Letters of Support*).

#### **Objectives:**

The educational program for fifth graders at East Hancock Elementary strives to:

- Enhance the current fifth grade science curriculum around issues of stormwater runoff, water quality, and the effects of land use, development and human activity on the health of the watershed.
- Utilize creative, innovative and multidisciplinary educational methodologies to inspire learning and assist with the transition to Common Core.
- Introduce students to water quality and geospatial data collection techniques and technology.
- Connect students to professionals in the science and design fields to encourage interest in science, technology, engineering, and math (STEM) and higher education.
- Connect students and their families with Rotten Bayou watershed to foster increased stewardship and efforts of the Rotten Bayou Watershed Implementation Plan.

#### **Summary and Project Justification:**

The Rotten Bayou Watershed (HUC 031700109-002) is 22,446 acres and lies in Harrison and Hancock Counties in Mississippi. Rotten Bayou is a tributary of St. Louis Bay and has a TMDL for organic enrichment, low dissolved oxygen, and nutrients. The Mississippi Natural Resource Conservation Service (NRCS ) has partnered with the Mississippi Department of Environmental Quality (MDEQ) to implement a Coastal Nutrient Reduction Strategy in Rotten Bayou Watershed. As part of the initiative, MDEQ is funding the Land Trust for Mississippi Coastal Plain and the Gulf Coast Community Design Studio to complete a Watershed Implementation Plan (WIP) for Rotten Bayou. A key part of a WIP is education and outreach. While the WIP partnership is specifically tasked with doing outreach to local officials and professionals, GCCDS is proposing to expand this outreach to local teachers, children and their families by leveraging funding through the Gulf B-WET Program.

GCCDS is proposing to engage fifth grade students and teachers in an innovative and interactive educational program focused on water quality, stormwater runoff and watershed dynamics that would lead to an overall



## Appendix L: Elementary Education for Rotten Bayou Watershed

meaningful watershed educational experience as defined by the Gulf B-WET Program. The fifth grade at East Hancock Elementary located at 4221 Kiln Delisle Road in Kiln, Mississippi was chosen for this outreach effort because the vast majority if not all of the students live in Rotten Bayou Watershed and key water quality and watershed concepts are introduced to students in the fifth grade based on Mississippi's science curriculum. While the program curriculum is relevant to many coastal watersheds and in line with the Mississippi science curriculum, materials will be modified to highlight the specific characteristics of Rotten Bayou Watershed. Students will be further connected to their watershed through participation in two field trips throughout the year.

The proposed educational program is innovative on several fronts. First, the program is uniquely tailored to the local community and watershed. The four-day workshop held at the beginning of the program, though science-based, has a strong tie to the planning and design fields further enhancing the multidisciplinary nature of the program. After the students receive some base knowledge from the workshop and are prepared to go into the field, they will be guided by science and technical professionals who will help put the students work into context. Finally, with assistance from GCCDS and the other partners, students will be guided through a process of analyzing, displaying and sharing their findings with each other, the school and larger community.

In addition to forwarding the Gulf B-WET Programs goal of providing meaningful watershed educational experiences for students, this project directly supports several of the GOMA priorities including water quality for healthy beaches and shellfish beds; environmental education; and reducing nutrient inputs to coastal ecosystems. To a lesser extent the program also supports and coastal conservation and restoration; identification and characterization of gulf habitats; and coastal community resiliency will be addressed. Many of these goals are directly in line with those of the Coastal Nutrient Reduction Strategy for Rotten Bayou Watershed and the Rotten Bayou Watershed Implementation Plan that GCCDS is concurrently developing with funding from MDEQ through the Land Trust for the Mississippi Coastal Plain.

### **Methodology and Deliverables:**

Preparation Phase and Classroom Work:

*Four In-Class lesson plans, lectures, experiment models, and digital presentations:* GCCDS developed a four day science and arts based curriculum on the role people and materials play in the quality and quantity of stormwater runoff (See Appendix D: NEA Environmental Education with Biloxi Junior High School).

Day 1 *Then & Now* discusses the important role water plays in our everyday lives, what our waterways (bays, rivers, bayous & gulf) were like before people inhabited the land around them versus, and what the condition they are in now.

Day 2 *Materials* discusses how the materials of our build environment (houses/roofs, roads, lawns & etc.) affect the quantity of stormwater runoff.

Day 3 *Behaviors* discussed how our actions and pollution (littering, disposing of paint/oil/chemicals, composting, water harvesting & etc.) can affect the quality of stormwater runoff.

Day 4 *Improving Stormwater* discusses ways that we can make design decisions that positively affect stormwater runoff and ways architects and landscape architects design buildings and spaces to improve stormwater runoff.

## Appendix L: Elementary Education for Rotten Bayou Watershed

GCCDS designed an experiment to go along with the lesson plans to demonstrate the issues affecting stormwater runoff quality and quantity. Each teacher will receive a model that consists of four gutters to represent different materials. Water with materials added to represent pollutants will be poured into the four gutters so the students can compare the quantity and quality of water going in versus that coming out. Each lesson includes an interactive presentation created in PREZI. This digital tool takes students and teachers through the entire lesson plan and experiments in a fun and thorough manner. These are designed to teach students about local issues affecting the world around them and the tools created during the project can be used by teachers in future years.

*One take-home brochure about stormwater lesson:* GCCDS produced a brochure for students and science teachers to take home and share with their family and friends. The brochure titled *What You Can Do to Be a Stormwater Super Hero* discusses what stormwater runoff is, how it can be a problem, why we should care and what we can do about it. The brochure provides information for local resources that can help improve stormwater runoff at your own home. This brochure is designed to help reach a broader audience and to bring the lessons taught in class back to the student's home.

*Artworks created:* During the last three in-class lessons students will be asked to create a piece of art that is representative of their own home (materials, site, behaviors and stormwater conditions). Based on what they learned through the four days of lessons, the students will use paper collage and drawing to design improvements for their home that will have a positive impact on stormwater runoff. By applying what they were taught to their design the knowledge gained from the classes will become integrated into their everyday lives.

*Field work and data collection:* GCCDS will work in partnership with MWF's Adopt-a-Stream Program and NCDDC to guide the students in field work and data collection around water quality and land use/habitat change. The Adopt-a-Stream program staff will facilitate the use of World Water Monitoring Challenge chemical kits to test various parameters in streams to help determine water quality. In addition, students will learn about the importance of macroinvertebrates in the water system and how to identify common aquatic organisms. Testing kits and other equipment will be purchased through the grant and given to the teachers to use with future classes.

Students will choose two sites currently being monitored by USGS for the Rotten Bayou Watershed Project. One to Two classes will go out at various times during the academic year (Fall, Winter and Spring) to collect data at the chosen locations. Students will be able to compare their data to data collected by USGS and will also be tasked with reporting their findings to the other fifth grade classes not present on that given field trip. Dividing up the classes and spreading out the trips over the year will give students the opportunity to see variations in water conditions and challenge them to communicate those findings to their peers. Water quality data will be used in the Rotten Bayou Watershed Implementation Plan and made publically available on the MWF Adopt-a-Stream program website and the Rotten Bayou Watershed webpage hosted on the website of the Land Trust for the Mississippi Coastal Plain (See Appendix E: Data Share Plan).

NOAA's National Coastal Data Development Center staff will assist the students with collecting digital photographs, GPS coordinates and descriptions about surrounding land uses around the streams that are being sampled for water quality. NCDDC will also provide USGS LANDSAT satellite imagery characterizing land usage and habitat change over a period of time for Rotten Bayou Watershed. NCCDC will use the students' data for ground truthing and validation of the NOAA imagery analyses and will work with the students and teachers to make all data accessible online through ESRI's ArcGIS Online (See Appendix E: Data Share Plan).

## Appendix L: Elementary Education for Rotten Bayou Watershed

*One school-wide and one community exhibit:* GCCDS will work with students at the end of the academic year to design and install an exhibit of their work. Displaying in the school will the program to reach more of the student and teacher population along with the issues they were addressing to extend the knowledge and conversation beyond the fifth grade. Following the school-wide exhibit, the installation will be moved to a location in the community that is publically accessible so that the larger community and Rotten Bayou Watershed Implementation Planning Effort can also benefit from the students knowledge and work.

## Appendix L: Elementary Education for Rotten Bayou Watershed

### Timeline:

Task	Description/Deliverable	Responsible Party	Jul-14	Aug-14	Sep-14	Oct-14	Nov-14	Dec-14	Jan-15	Feb-15	Mar-15	Apr-15	May-15	Jun-15
Workshop Preparation	Modified lesson plans specific to Rotten Bayou Watershed based on GCCDS work with Biloxi Junior High School in 2012 and assembly of stormwater runoff models (1 per class) to be left with the teachers.	GCCDS												
Pre-Program Survey	Survey will gage students base knowledge and awareness of issues in their watershed.	GCCDS												
Field Trip Preparation	Field trips will be planned in collaboration with technical partners. Materials and equipment for field trips will be purchased and organized.	GCCDS, MWF Adopt-a-Stream, NCDDC, East Hancock Elementary												
4-Day, In-Class Workshop	Detailed lesson plans, in-class and take-home materials and models to be left with the teachers for future use. Student work will be utilized in a post-workshop exhibition.	GCCDS												
Water Quality Field Trips (1-2 classes/day)	1-2 Classes will go out at a time and collect water quality data at 2 site in the watershed currently being monitored by USGS.	GCCDS, MWF Adopt-a-Stream, East Hancock Elementary												
Post-Field Trip Evaluations	Evaluations will gage suscess of field trip to improve subsequent trips.	GCCDS												
Geospatial Field Trip	All 5 classes will go to a site to be determined by NOAA's NCDDC and collect digital imagery, GPS coordinates and other land use data.	GCCDS, NCDDC, East Hancock Elementary												
Data Compilation & Sharing	As data is collected students will analyze their data, present water quality data to the other fifth grade classes and post data on LTMCP and MWF's websites and ArcGIS online.	GCCDS, LTMCP, MWF Adopt-a-Stream, NCCDS, East Hancock Elementary												
Exhibition Installation & Exhibition	GCCDS will work with students to compile their work in a school-wide exhibition. The installation will then be moved to a publically accessible site in Diamondhead to use as outreach and education for the Rotten Bayou Watershed Implementation Planning Effort.	GCCDS, LTMCP, East Hancock Elementary												
Post-Program Evaluation	Students and teachers will be surveyed at the culmination of the program and program partners will work together to summarize the findings from all surveys and evaluations conducted during the grant period.	GCCDS												

GCCDS understands that there may be a need to change the start date of the project. All partners involved in this proposal are anticipating the need to be flexible with the start date of the work and detailed schedules of the proposed activities.

## Appendix L: Elementary Education for Rotten Bayou Watershed

### Expected Outcomes:

- 150 fifth grade students and 5 teachers will be directly involved with the program during the 2014-2015 academic year. The materials, equipment and lesson plans, however, will remain with the teachers and benefit countless future students.
- Student work and outreach materials will be made available to the rest of the school and the students' families further extending the impact of their work.
- Students will develop a stronger connection to their waterways and watershed developing and increased sense of stewardship.
- Interaction with science and design professionals will increase student interest in STEM, thus contributing to NOAA's obligations under the America Competes Act (33 USC 893a(a)) and encouraging the importance of higher education.
- Student work and data collected will be utilized by partnering organizations and made available to the larger community which will have the twofold effect of helping the students realize the importance of their work and increasing the communities' awareness of issues and opportunities in their watershed.

### Project Evaluation:

GCCDS is committed to collecting information before, during and after the completion of the proposed education program in order to improve the program's effectiveness. At the start of the grant, GCCDS will conduct a survey of the participating students to determine their prior knowledge and attitudes about the topics they will study. Questions will attempt to gain information about the following:

- Student knowledge around issues of stormwater runoff, water quality, and the effects of land use, development and human activity on the health of the watershed;
- Student understanding about their connection to Rotten Bayou Watershed;
- Student interest in higher education and science, technology, engineering, and math (STEM)
- Students' inclinations towards environmental stewardship.

Results from this survey will be compared to the results of a survey to be conducted at the end of the academic year to determine how the students understanding and interests have changed as a result of the program.

GCCDS will also conduct a survey of students and teachers following each field trip. This information will be used by GCCDS and partners to improve subsequent field trips. At the end of the academic year, GCCDS will survey the students and teachers. Students will be asked to complete the same survey they completed at the beginning of the year so that changes in their knowledge and interests can be evaluated. Teachers will be consulted to determine their level of satisfaction with the program in terms of student development, teacher capacity building, enhancement of Mississippi science curriculum, and promotion of Common Core

## Appendix L: Elementary Education for Rotten Bayou Watershed

standards. At the end of the grant, partners will evaluate and summarize the findings of surveys and provide recommendations for potential program and funding modification.

GCCDS is also aware that grantees may be asked to participate in data collection for the national B-WET evaluation and is willing to assist in any way possible.

**Appendix L: Elementary Education for Rotten Bayou Watershed**

**Appendix A: Letter of Support**



# East Hancock Elementary School



4221 Kiln-Delisle Road Kiln Mississippi 39556 Phone (228)255-6637

November 6, 2013

Amy Clark  
Gulf of Mexico B-WET Program Manager  
NOAA Fisheries Southeast Regional Office  
Building 1100  
Room 202D  
Stennis Space Center, MS 39529

Dear Grant Review Committee,

On behalf of East Hancock Elementary school, we are pleased to support the Gulf Coast Community Design Studio's proposal to work with our 5th graders. Through the acquisition of this grant, our Mississippi science curriculum will be greatly enhanced. Not only will this project correlate with our science standards, but it will be a great tool for subject integration as we transition into Common Core. In addition, as the students interact with professionals from Adopt-a-Stream, NOAA, and USGS to collect, analyze and share data, their interest in various areas of STEM and post high school education will likely increase.

The 5th grade teachers and administration at East Hancock are in full support of devoting class time to the proposed workshops on stormwater runoff, waters quality and their relationship to the health of the larger watershed. We are also excited for our students to have the opportunity to collect, analyze and share waters quality, macroinvertebrate and geospatial data from their own watershed. The equipment and materials provided through this grant will be a great addition to our classroom resources and will benefit many students that will come through our program in the future. In addition, as most of our kids live in Rotten Bayou Watershed, it is exciting to know that the work they do and information they take home will benefit the larger efforts to improve the ecological health of Rotten Bayou Watershed lead by the Land Trust for the Mississippi Coastal Plain. Thank you again for your consideration.

Sincerely,

A handwritten signature in purple ink that reads "Tammy Estapa".

Tammy Estapa

District and School Science Liaison





**UNITED STATES DEPARTMENT OF COMMERCE**  
**National Oceanic and Atmospheric Administration**  
NATIONAL ENVIRONMENTAL SATELLITE, DATA,  
AND INFORMATION SERVICE

Russell H. Beard  
Director, NOAA's National Coastal Data Development Center (NCDDC)  
NOAA Gulf of Mexico Regional Collaboration Team Lead

6 November 2013

David Perkes, Director (AIA)  
769 Howard Avenue, Biloxi, MS 39530

Dear David:

The NCDDC strongly endorses your proposal submitted by the Gulf Coast Community Design Studio for educational training of students to enhance their understanding of the impacts of development and human activity on storm water runoff and water quality as it relates to the Rotten Bayou watershed (Figure 1.) The in-kind technical support we will offer is an excellent companion piece to the Adopt-A-Stream program that will provide training and assistance to the students in water quality testing on streams in Rotten Bayou watershed.

The NCDDC will provide USGS LANDSAT satellite imagery characterizing land usage and habitat change over a period of time (e.g., 1970-2012), for the Rotten Bayou watershed. For those streams sampled by the students, we would task the students to undergo field observations for the collection of digital photographs, GPS coordinates, develop a brief narrative on the stream characteristics (e.g., estimated width/depth, free flowing, stagnant, and/or intermittent flow, presence of algae) and describe the surrounding land usage, e.g., housing, rural, forest, wetland, agricultural, recreational, industrial etc. The students will submit their in situ observations to NCDDC be used for ground truthing and validation of the NOAA imagery analyses. The NCDDC staff working with the teachers and students will make all data accessible immediately upon validation via the Internet (Figure 2. ESRI's ArcGIS Online). The data management plan will incorporate NOAA regulations (Appendix A) and NCDDC will assist the PI in preparation.

This proposal addresses 5 of the 6 established regional priorities of the Gulf of Mexico Alliance including: water quality; environmental education; identification and characterization of Gulf habitats; reducing nutrients to coastal ecosystems; and, coastal community resilience. The project will greatly enhance the student's knowledge on the need to monitor environmental conditions, and the impact of development/change on the watershed's health. We encourage the NOAA B-WET to fund this worthwhile proposal.

Respectfully

A handwritten signature in blue ink that reads "Russ Beard".

Russell H Beard



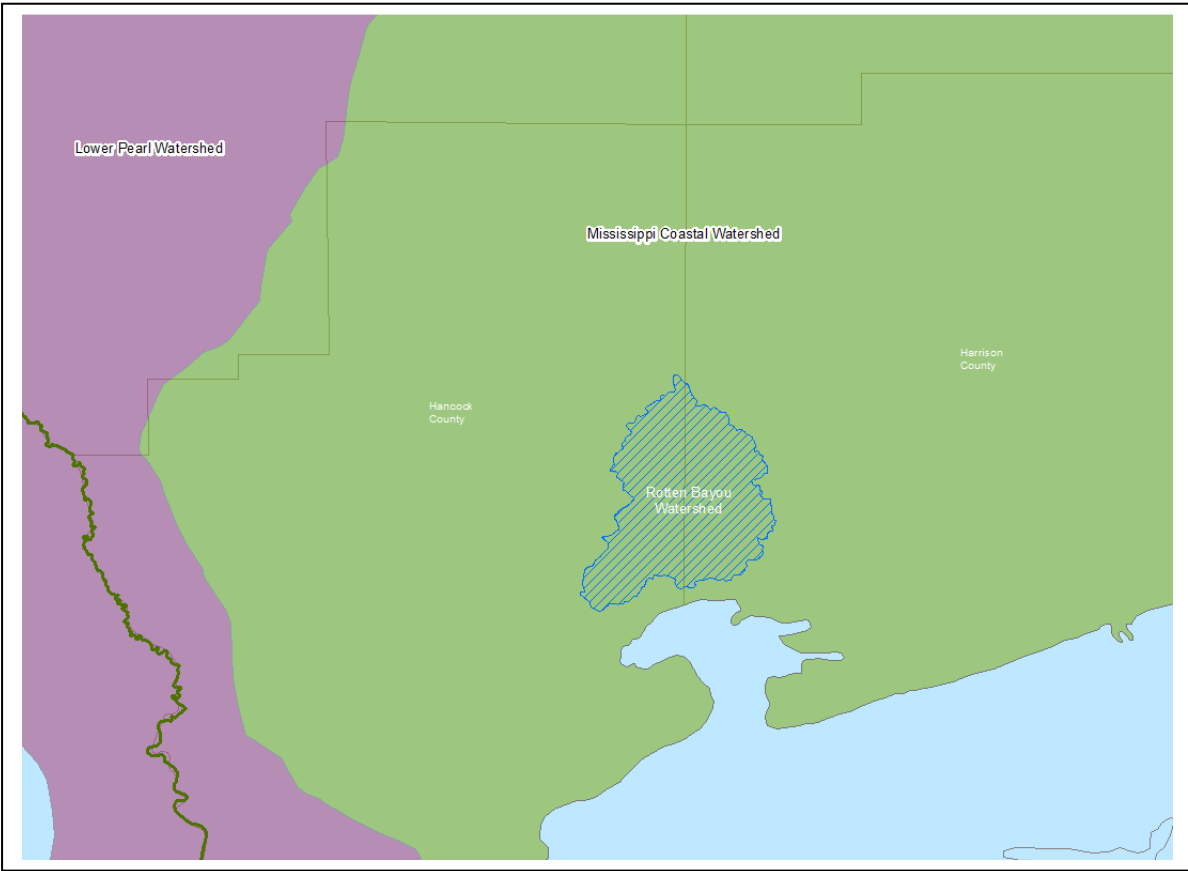


Figure 1. Rotten Bayou Watershed

## Appendix L: Elementary Education for Rotten Bayou Watershed

A story map is built on intelligent maps (also called web maps) hosted on ESRI's ArcGIS Online or on your own web server. In addition, a story map provides a way to combine other elements such as descriptive text, clickable icons, and multi-media content (photos, videos, etc.) into a seamless picture that students can interact with. There are various story map templates available for use. Below is a version called "Map Tour" that combines photos with locations on an interactive map.

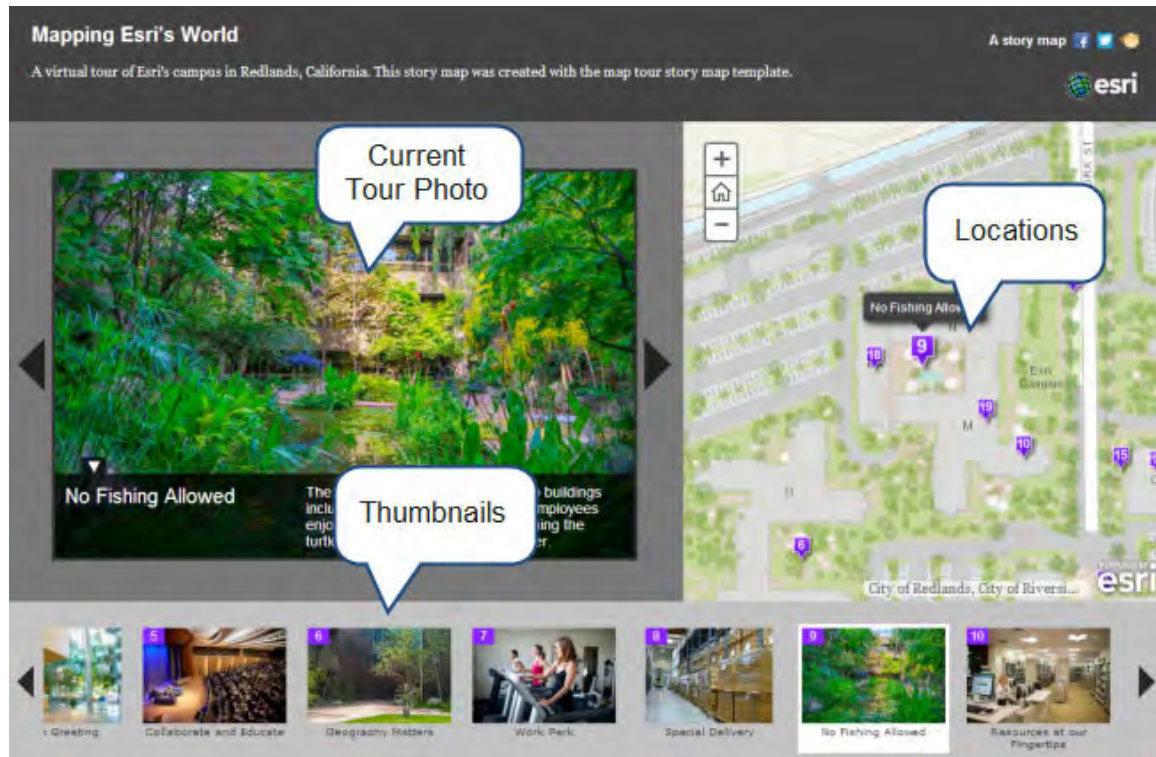


Figure 2. Example of Story Map

### Data Management Plan (Data and Information Sharing)

A typical plan should include descriptions of the types of environmental data and information that will be collected/created during the course of the project; the tentative date by which data will be shared and documentation of any proposed exceptions (e.g. data anticipated to have homeland/national security, cultural heritage, or protected resources value); the standards to be used for data/metadata format and content; policies addressing data stewardship and preservation; procedures for providing access, sharing, and security; and prior experience in publishing such data.

Spatial data are considered a national capital asset, and to that end, the National Spatial Data Infrastructure described in Office of Management and Budget (OMB) Circular No. A-16 facilitates efficient collection, integration, sharing, and dissemination of spatial data among all levels of government institutions, academia, and the private sector. The White House Office of Science and Technology Policy (OSTP) consistently reaffirm requirements for open government and transparent access to digital data through a series of Memorandums and Policy Directives. The OSTP Memorandum Open Data Policy – Managing Data as an Asset issued May 9, 2013 directs that data and information collected or created with public funds should be managed “... in a way that supports downstream information processing and dissemination activities.”

On behalf of the NOAA Observing System Council (NOSC) and the NOAA CIO Council, the Environmental Data Management Committee (EDMC) coordinates the development of NOAA’s environmental data management strategy and policy in compliance with National Policy. NOAA Administrative Order (NAO) 212-15 Management of Environmental Data and Information provides high-level direction to guide consistent implementation of procedures, decisions and actions regarding environmental data and information management. Approved Procedural Directives provide detailed guidance on environmental data management lifecycle components.

The NAO applies to all NOAA environmental data and to the personnel and organizations that manage these data, unless exempted by statutory or regulatory authority. The NOAA Procedural Directive for Data Sharing Policy for Grants and Cooperative Agreements states in part

All NOAA Grantees must share data produced under NOAA grants and cooperative agreements in a timely fashion, except where limited by law, regulation, and policy or security requirements. Grantees must address this requirement formally by preparing a Data Sharing Plan as part of their grant project narrative.



Debra Veeder  
Mississippi Wildlife Federation  
Adopt-A-Stream Coordinator  
517 Cobblestone Court, Suite 2  
Madison, MS 39110

November 4, 2013

To Whom It May Concern:

On behalf of the MS Wildlife Federation Adopt-A-Stream Program we support the funding of a grant proposal submitted by the Gulf Coast Community Design Studio for educational training of students to enhance their understanding of the impacts of development and human activity on stormwater runoff and water quality as it relates to their watershed. The Adopt-A-Stream program would be very interested in working with the Gulf Coast Community Design Studio on this proposed project. The Adopt-A-Stream program will assist the program by providing training and assistance to the students so that they can do water quality testing on streams in their watershed area. Adopt-A-Stream can also provide a venue to store and track data that they obtain through their water quality testing. Adopt-A-Stream is a program that is administered through the Mississippi Wildlife Federation from a grant with the Mississippi Department of Environmental Quality.

Projects like these that can educate and involve the community help the water resources that we all depend on both economically and aesthetically. We are pleased to promote this project and collaborate with the Gulf Coast Community Design Studio to make this project a success.

Please do not hesitate to contact me if you need additional information.

Sincerely,



Debra Veeder  
Adopt-A-Stream Coordinator  
(601)605-1790  
[dveeder@mswf.org](mailto:dveeder@mswf.org)



Appendix L: Elementary Education for Rotten Bayou Watershed



OFFICERS

November 5, 2013

Jon Bond  
President

Amy Clark  
Gulf of Mexico B-WET Program Manager  
NOAA Fisheries Southeast Regional Office  
Building 1100  
Room 202D  
Stennis Space Center, MS 39529

Melanie Allen  
Vice President

Flowers White  
Treasurer

Alice Duckett  
Secretary

Dear Grant Review Committee,

BOARD OF DIRECTORS

Melanie Allen

Beth Ashley

Jennifer Tyler Baker

Jon Bond

Russell Evans

Lisa Eveleigh

Peggy Hoover

Steve Lawler

Johnny Marquez

Allen Reed

Flowers White

The Land Trust for the Mississippi Coastal Plain (LTMCP) is enthusiastic about the Gulf Coast Community Design Studio's proposal to work with the 5th graders at East Hancock Elementary to supplement their science curriculum around the impacts of the built environment and human activity on watersheds and Rotten Bayou Watershed, in particular. LTMCP recently received funding from the Mississippi Department of Environmental Quality to develop a Watershed Implementation Plan for Rotten Bayou Watershed. In addition to developing a Watershed Implementation Plan, LTMCP is tasked with conducting field assessments, planning and implementing restoration actions and best management practices, and conducting meetings to education landowners and stakeholders. The Land Trust has contracted with the Gulf Coast Community Design Studio to facilitate these planning efforts in the Rotten Bayou Watershed and is fully supportive of the Design Studio's initiative to apply for additional funding to bring watershed-related education to the students at East Hancock and to assist the students with water quality and geospatial data collection that will benefit the larger watershed planning work.

Wherever possible the Land Trust will assist with these educational and data collection efforts as they so directly tie in with the goals of the Rotten Bayou Watershed Implementation Plan and Coastal Nutrient Reduction Strategy. As an accredited land trust, LTMCP has valuable knowledge and experience in restoring and maintaining coastal lands and will be a valuable asset to this partnership. Our broad base of experienced volunteers will also prove valuable in assisting the partnership in outreach, education and data collection activities. Thank you for your consideration of this proposal.

Respectfully,

Judy Steckler  
Executive Director

/det

**Appendix L: Elementary Education for Rotten Bayou Watershed**

**Appendix B: Budget and Budget Justification**

<b>Total Project Costs &amp; Justification</b>	<b>REQUEST YEAR 1</b>	<b>MATCH YEAR 1</b>	<b>TOTAL YEAR 1</b>	<b>REQUEST YEAR 2</b>	<b>MATCH YEAR 2</b>	<b>TOTAL YEAR 2</b>	<b>TOTAL REQUEST</b>	<b>TOTAL MATCH</b>	<b>TOTAL PROJECT COSTS</b>
<p><b>A. Personnel/Salaries:</b>  <b>Key Staff: David Perkes, Britton Jones, Kelsey Johnson</b>                      David Perkes is an architect, director of GCCDS, and the Principle Investigator for the grant. Britton Jones is a landscape architect and Kelsey Johnson is a planner at GCCDS. Both have significant experience with environmental education.  <b>Support Staff: Public Design Intern</b>                      Salary for a Public Design Intern has been included in the project budget. The intern will dedicate about 200 total hours to the project and assist with all aspects of the work. Public Design Interns with GCCDS hold a minimum of a bachelors degree and work at GCCDS while receiving credit to complete independent study through MSU.</p>	\$14,548.71								\$14,549
	\$3,600.00								\$3,600
	<b>\$18,148.71</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$18,149</b>
<p><b>B. Fringe Benefits:</b>                      Fringe benefits at MSU are currently set at 36.04%</p>	\$6,540.80								
	<b>\$6,540.80</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$6,541</b>
<p><b>C. Travel:</b>  <b>Travel Directly Related to Program Implementation</b>                      Includes 13 round trips from Biloxi to the Diamondhead area for two staff cars. Trips are for classroom time, field trips and preparatory meetings. Distance is approximately 80 miles round trip and the reimbursement rate is \$0.565/mile.  <b>Travel Indirectly Related to Program Implementation</b>                      Includes flight, hotel and rental car for a two-day Regional B-WET conference to be held in one of the Gulf States or a National B-WET conference during the award period for one of the key staff.</p>	\$1,400.00								
	\$1,500.00								
	<b>\$2,900.00</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$2,900</b>
<p><b>D. Equipment:</b></p>									
	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$0</b>
<p><b>E. Supplies</b>                      Expenses are for 50 World Water Monitoring Challenge chemical kits, 25 larval trays, 25 heavy duty D-frame aquatic nets, 25 forceps, 36 jeweler's loupes, 5 digital cameras with GPS, materials to build 5 stormwater demonstration models, and paper, markers, etc. for the 4-day classroom workshop. All equipment and models will be left with the teachers at East Hancock Elementary for use with future classes.</p>	\$7,800.00								
	<b>\$7,800.00</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$7,800</b>
<p><b>F. Contractual</b></p>									
	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$0</b>
<p><b>G. Construction:</b>                      Construction is not allowed through the B-WET Program</p>	XXXXXX	XXXXXX	XXXXXX	XXXXXX	XXXXXX	XXXXXX	XXXXXX	XXXXXX	XXXXXX
<p><b>H. Other:</b></p>									
	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$0</b>
<p><b>I. Total Direct Charges:</b></p>	<b>\$35,389.51</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$35,390</b>
<p><b>J. Indirect Charges:</b></p>	\$8,847.38								\$8,847
<p><b>K: Totals:</b></p>	<b>\$44,236.89</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$44,237</b>

## **Appendix L: Elementary Education for Rotten Bayou Watershed**

### **Appendix C: Resumes**



# GCCDS

Gulf Coast Community Design Studio

Mississippi State University College of Architecture Art + Design  
425 Division Street, Biloxi, MS 39530 phone: 228-436-4661

## DAVID PERKES, AIA

### BIO

David Perkes is a licensed architect and Professor for Mississippi State University. He is the founding director of the Gulf Coast Community Design Studio, a professional outreach program of the College of Architecture, Art + Design. The design studio was established in Biloxi following Hurricane Katrina and has evolved into a multi-disciplinary, non-profit design firm with planners, landscape architects, architects and interns working on projects that range from regional planning to individual houses.

David has a national role in leading the effort for design organizations to better serve the needs of communities. He has lectured and written on community design for many years and is an active participant in several national social-impact design organizations such as the Association for Community Design, Structures for Inclusion, Better World by Design, and SEED Network. David is part of a four person national team to receive the 2011 Latrobe Prize from the American Institute of Architects. The prize is supporting research in Public Interest Practices in Architecture. In 2011 David was selected by the White House as a "Champion of Change" for his work on the Gulf Coast.

David works to build and strengthen partnerships in the work of the Gulf Coast Community Design Studio. Under his leadership the design studio has assisted in the renovation of hundreds of damaged homes and over two hundred new house projects in Biloxi and other communities. The Biloxi house projects were awarded an Honor Citation from the Gulf States Region AIA in 2007, a Turner Award for Innovative Housing, and a Mississippi AIA Honor Citation in 2009. Before creating the Gulf Coast Community Design Studio, David was the director of the Jackson Community Design Center and taught in the School of Architecture's fifth year program in Jackson, Mississippi.

### EDUCATION AND REGISTRATION

Loeb Fellow, Harvard Graduate School of Design, 2004  
Master of Environmental Design, Yale School of Architecture, 1993  
Master of Architecture, University of Utah, 1985  
Ecole d' Art Americaines, Fountainbleau, France, Summer 1984.  
Bachelor of Science in Civil and Environmental Engineering, Utah State University, 1982.  
AIA, Mississippi & Pennsylvania

### PROFESSIONAL AFFILIATIONS

American Institute of Architects, Latrobe Prize Research Team 2011  
Association for Community Design, Board Member, 2008 to present  
SEED Network, Member 2010 to present  
Public Interest Design Institute, Instructor 2011 to present

### COMMUNITY INVOLVEMENT

Moore Community House, Board Member  
Gulf Coast Renaissance Corporation, Advisory Board Member

### PROJECTS

#### Community Education

- East Lawn Elementary School Playground
- Moss Point Community Exhibits

#### Non-profit organizations

- Camp John I Hay Pavilion, Boys and Girls Club
- Farish Street Baptist Church Site Improvements
- Mississippi 4-H Museum

#### Historic, Adaptive Reuse, or Renovation

- Shaw Homestead
- Bratton Street House Projects

#### Research

- Temporary Disaster Housing Research, Department of Homeland Security
- Flood-proof Commercial Construction, Department of Homeland Security
- Energy Efficient Design Tools, Department of Energy
- Housing Systems Educational Program, Small Business Administration
- Renaissance Development Standards Housing
- Long Term Work Force Housing Design Services
- Bethel Estates
- Sustainable Habitat for Humanity House

#### Urban Planning

- Gulf Coast Sustainable Communities Regional Plan
- Downtown Biloxi Planning
- East Biloxi Redevelopment Planning
- Soria City Neighborhood Planning
- Mississippi Renewal Forum
- Jackson Metro Parkway Open Space Program ming and Pre-planning

#### Environmental

- Bayou Auguste Restoration
- Eco Village Bridge
- Earth Lab Demonstration House



Gulf Coast Community Design Studio

Mississippi State University College of Architecture Art + Design  
425 Division Street, Biloxi, MS 39530 phone: 228-436-4661

## BRITTON JONES, RLA

### BIO

Britton Jones is a Landscape Architect at the Gulf Coast Community Design Studio (GCCDS), a non-profit professional office that offers sustainable design services in architecture, planning and landscape to the communities of the Mississippi Gulf Coast. Britton's work and interest are in the challenges of creating places that successfully merge ecological and social systems. He is involved in projects that range from large scale planning to small scale design. His work has also been to help organize and lead design charrettes, public exhibits and workshops, and lead educational activities in the public schools.

Britton has over eight years of experience in landscape architectural practice. Prior to his work at the GCCDS Britton was a landscape designer at OLIN Landscape Studio in Philadelphia, PA where he worked on and managed projects of varying scales and scopes in many areas of the United States. His work in the field has allowed him to work on award winning projects that pride themselves on socially and ecologically sustainable designs.

### EDUCATION AND REGISTRATION

Master of Landscape Architecture, Auburn University, 2004 cum laude  
Bachelor of Science in Environmental Design, Auburn University, 2002  
RLA, Mississippi

### TEACHING/VISITING CRITIC

Spring 2013 Biloxi Jr. High School 6th grade science - Developed and taught lessons on stormwater and our built environment

Spring 2012 Louisiana State University MLA Studio – Rethinking Biloxi Waterfronts

Spring 2010 GCCDS & University of Minnesota MArch Studio – Gulfport/Soria City Community Planning Project

Summer 2004 Auburn University (prospective MLA students) – Drawing by Hand

### PROFESSIONAL ACTIVITIES

November 2012 Bays & Bayous Symposium – Presenter of 'Community Based Restoration'

March 2012 Structures for Inclusion 12 – Presenter of 'The Bayou by You'

May 2011 Gulf Coast Sustainable Economies Leadership Academy – Presenter of 'Bayou Auguste Urban Restoration Project'

May 2011 Coastal Development Strategies Conference – Presenter of 'The Bayou by You: A Community Partnership for Urban Wetland Restoration in East Biloxi'

### SELECTED PROJECTS

#### Community Education

- Biloxi Public Schools Bayou Ecology Lessons
- Moss Point Community Exhibits

#### Non-profit organizations

- Blossman Family YMCA
- Community Design Collaborative\*

#### Historic, Adaptive Reuse, or Renovation

- Shaw Homestead
- Old Brick House
- Moss Point Parks

#### Research

- Sustainable Office Practices\*
- Renaissance Development Standards

#### Campus

- ABC/Disney Studios at Golden Oak Ranch \*
- Harbor Plaza\*

#### Parks & Gardens

- Getty Stark Sculpture Garden\*
- Philadelphia Museum of Art Sculpture Garden\*
- Director's Park\*

#### Urban Planning

- Baltimore Pratt Street Master Plan\*
- Downtown Biloxi Planning
- Soria City Neighborhood Planning
- I-110 Loop & Underpass

#### Environmental

- Bayou Auguste Restoration
- Mill River Restoration\*

#### Residential

- Cottages at Oak Park
- Cottages at 2nd Street
- Lamey Bridge Senior Center

\*OLIN project



Mississippi State University College of Architecture Art + Design  
425 Division Street, Biloxi, MS 39530 phone: 228-436-4661

## KELSEY JOHNSON, COMMUNITY PLANNER

### BIO

Kelsey Johnson is a Community Planner with the Gulf Coast Community Design Studio in (GCCDS), a non-profit professional office that offers sustainable design services in architecture, planning and landscape to the communities of the Mississippi Gulf Coast. Her work has focused on assessing housing priorities on the Mississippi Gulf Coast and developing recommendations as part of a three-year regional sustainability plan. She also works with various communities and organizations along the coast on planning and public engagement.

Prior to joining the studio she worked as an Environmental Planner II at the Metropolitan Washington Council of Governments. There she worked with various governmental partners as part of the Anacostia Watershed Restoration Partnership, as well as with schools and community groups to educate students and residents about restoration efforts and stewardship. Kelsey holds a Masters of Urban and Regional Planning from the University of Michigan, focusing on environmental and land use policy and planning. The majority of her studies concentrated on planning issues and policy in coastal towns. While earning her masters she served as an AmeriCorps member in the Community and Economic Development Department at Focus: HOPE in Detroit, Michigan. There she worked closely with community groups on neighborhood revitalization and capacity building.

### EDUCATION AND REGISTRATION

Master of Urban & Regional Planning, University of Michigan, 2007  
Bachelor of Science in Environmental Studies, Bucknell University, 2005

### PROFESSIONAL ACTIVITIES

Gulf Coast Sustainable Economies Leadership Academy 2011 – Team Leader

MS APA Annual Conference 2012 – Conference Committee

Leadership Hancock County - Class of 2013

### COMMUNITY INVOLVEMENT

Community of Choice Workgroup for Hancock County's Economic Development Strategy - 2011 to Present

### SELECTED PROJECTS

#### Regional Planning

- Sustainable Communities Regional Plan for the Mississippi Gulf Coast

#### Environmental Planning

- Rotten Bayou Watershed Implementation Plan

#### Mapping

- Gulf Coast Renaissance Corporation - New Market Tax Credit Eligibility
- Gulf Coast Renaissance Corporation - CDFI Fund Eligibility
- Moss Point City Ordinances

#### Community Education

- Biloxi Junior High School Stormwater Lessons

#### Research

- East Biloxi Vacant Land Study
- Planning for a Mixed-Use Community in Kiln, Mississippi
- Southside Economic & Mixed-Use Development A Planning and Design Exercise for Diamondhead, MS

# Appendix L: Elementary Education for Rotten Bayou Watershed

## Appendix D: Data Share Plan

Environmental Data Created:

Through the course of the proposed project the following data sets will be collected:

- Water quality data including pH, dissolved oxygen, temperature, and turbidity
- Presence of macroinvertebrates
- Stream Characteristics (e.g., estimated width/depth; free flowing, stagnant and/or intermittent flow; presence of algae)
- Land Usage Characteristics (e.g., residential, rural, forest, wetland, agricultural, recreational, commercial)
- GPS Coordinates
- Digital Photographs

Temporal and Spatial Data Coverage:

Data will be collected during the 2014-2015 academic year between September and April. All data will be collected within the Rotten Bayou Watershed (Hydrologic Unit Code 031700109-002).

Timeline for Data Sharing:

Data collected will be shared immediately upon validation and during the course of the 2014-2015 academic year.

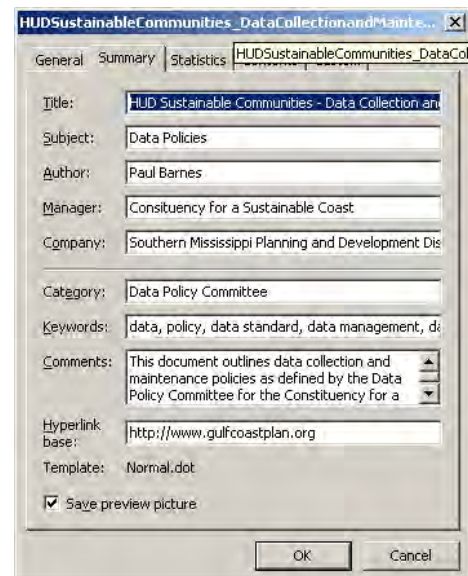
Standards for Data/MetaData Format and Content:

Metadata will be entered for all shared files including Word docs, PDFs, Powerpoint, etc. (File>Properties). Information will include Title, Subject, Author, Manager, Company, Category, Keywords, Comments and Hyperlink as shown in Figure 1.

GCCDS will adhere to the following website data formats and website accessibility standards Under Title II of the ADA (<http://www.ada.gov/pcatoolkit/chap5toolkit.htm>) when posting all data.

- Images should have alternate text when uploaded.
- All graphics such as charts and graphs should have an excel table copy linked to in the alternate text for the image.
- All headings should be marked as <h2> elements.
- Standard HTML elements of <b>, <i>, and <u> should be used where needed.

Figure 1



## Appendix L: Elementary Education for Rotten Bayou Watershed

- All featured news posts should have an image associated.

### Data Stewardship and Preservation:

able and reliable infrastructure to support long-term access and preservation, preserving data access and archive integrity during media migration and software evolution, providing effective data support services and tools for users, and enhancing data and metadata by adding information that is established throughout the data life cycle.

Since environmental data is not static, stewardship is ongoing that relies on the stability of the servers, storage systems, software, etc. Inclusion of consistent and complete metadata is another important component of data stewardship and preservation. GCCDS and partnering organizations are committed to maintaining and preserving all data collected during the project period.

### Access, Sharing and Security:

All data collected during the project period will be publically available upon validation with no access limitation.

## Appendix L: Elementary Education for Rotten Bayou Watershed

### Appendix E: NEA Environmental Education with Biloxi Junior High School:

The Gulf Coast Community Design Studio developed and implemented an educational outreach program with the Biloxi Public School District's sixth grade class of Biloxi Junior High School. The program, which was developed and taught in cooperation with the sixth grade science teachers, focused on the role people, the built environment, and stormwater play in protecting local waters, one of our most valued resources. During four in-class sessions students learned the importance of healthy water and how stormwater runoff from their neighborhoods affects the waters quality and quantity. In-class exhibits, interactive presentations, and experiments explained how the materials chosen to build our neighborhoods and the activities done around them can reduce or increase runoff and can contribute or mitigate pollution. With this new knowledge, students created site plans of their homes including the materials that make them and the activities that take place around the home. They were then asked to identify problems and opportunities for dealing with stormwater runoff and develop creative solutions to make improvements to the stormwater runoff leaving their homes. At the end of the program selected artworks were displayed in a school-wide exhibit for the entire student body and teachers to observe. Students were also given brochures and handouts to take home and share with their families on the stormwater issues they learned in class. With this program GCCDS was able to reach students and their families on an important local issue to the community and offer information, resources, and creative and practical solutions to help keep their waters clean.

**Four In-Class lesson plans, lectures, experiment models, and digital presentations.** The Gulf Coast Community Design Studio (GCCDS) developed a four day science and arts based curriculum on the role people and materials play in the quality and quantity of stormwater runoff. Day 1 *Then & Now* discussed the important role water plays in our everyday lives, what our waterways (bays, rivers, bayous & gulf) were like before people inhabited the land around them versus, and what the condition they are in now. Day 2 *Materials* discussed how the materials of our build environment (houses/roofs, roads, lawns & etc.) affect the quantity of stormwater runoff. Day 3 *Behaviors* discussed how our actions and pollution (littering, disposing of paint/oil/chemicals, composting, water harvesting & etc.) can affect the quality of stormwater runoff. Day 4 *Improving Stormwater* discussed ways that we can make design decisions that positively affect stormwater runoff and ways architects and landscape architects design buildings and spaces to improve stormwater runoff.

GCCDS designed and built an experiment to go along with the lesson plans to demonstrate the issues affecting stormwater runoff quality and quantity. Each teacher received a model that consisted of four gutters to represent different materials. Water with materials added to represent pollutants were poured into the four gutters so the students could compare the quantity and quality of water going in versus that coming out.

Each lesson included an interactive presentation created in PREZI. This digital tool takes students and teachers through the entire lesson plan and experiments in a fun and thorough manner. These lessons were successful in teaching students about local issues affecting the world around them and the tools created during the project can be used by teachers in future years.

**One take home brochure about stormwater lessons.** GCCDS produced a brochure for all 6<sup>th</sup> grade students and science teachers to take home and share with their family and friends. The brochure titled *What You Can Do to Be a Stormwater Super Hero* discusses what stormwater runoff is, how it can be a problem, why we should care and what we can do about it. The brochure provided information for local resources that can help improve stormwater runoff at your own home. This brochure was used to help reach a broader audience and to bring the lessons taught in class back to the students home.

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**736 artworks created.** During the last three in-class lessons students were asked to create a piece of art that was representative of their own home (materials, site, behaviors and stormwater conditions). Based on what they learned through the four days of lessons, the students used paper collage and drawing to design improvements for their home that would have a positive impact on stormwater runoff. By applying what they were taught to their design the knowledge gained from the classes became integrated into their everyday lives.

**Four in-class exhibits and one school wide exhibit.** GCCDS created four in-class exhibits, one for each classroom. This included work created during the lessons and aerial map of Biloxi. Each student wrote or drew their favorite water related activity (fishing, swimming or etc.) on a sticky note and placed it on the map at the location of where they like to do that activity. Each student also placed a sticker indicating approximately where they live. This process illustrated the physical relationship between where people live, where they recreate and why they should care about their local waterways. At the end of the program GCCDS installed an exhibit of the students' work located in one of the most visible spaces in the school for 1,200 students and teachers to observe. The exhibit introduced the program and its purpose and displayed 80 representative works of art created by the students. Displaying in the school allowed the program to reach more of the student and teacher population along with the issues they were addressing to extend the knowledge and conversation beyond the sixth grade.

All project activities were carried out with the exception of a change in the number of organizational partners working together on the project as well as the total number of individuals who benefited. When the scope and location of our project changed from Moss Point schools to Biloxi Junior High we neglected to update the number of partnering organizations with whom we would be working which affected the number of people exposed to the project. Instead of working with seven organizational partners, which included several schools in Moss Point, three organizations worked together on this project including GCCDS, Biloxi Junior High, and the City of Biloxi. With the reduction in schools involved the number of students, teachers, and family members who benefited was also reduced from 17,000 to 4200.

The Gulf Coast Community Design Studio, the grant recipient, initiated and developed project activities along with five teachers from Biloxi Junior High School. The former Biloxi School's science curriculum coordinator and current teacher at Biloxi Junior High helped us define our program and determine the most appropriate teachers, class, and age group for conducting the program. This teacher connected GCCDS with four enthusiastic sixth grade science teachers who worked to fit the program into their existing strand of earth science curriculum. As GCCDS develop the program content and activities the teachers reviewed and suggested ways to make the materials age appropriate and relevant to their curriculum. Once the program content was complete GCCDS staff taught twenty-five sixth grade classes per day with the teachers' assistance. Project materials have been passed onto the teachers and they will be prepared to continue the curriculum in future years due to their help in the development and assistance through the entire program.

The City of Biloxi was a key partner in providing support and information on the specific local conditions of stormwater infrastructure throughout the city. The information provided included the function and types of infrastructure present in the city, as well as mapping information to find the location of different systems. This information was used to create accurate and relevant content to develop a program specific to Biloxi.

The Arts Endowment outcome of learning was addressed very specifically in this project through the direct contact with 368 Junior High students inside their classroom. GCCDS along with the support and assistance of the sixth grade science teachers taught twenty-five classes per day over a four day period. The program was rooted in existing curriculum and used several methods for teaching the program including interactive presentations and experiments. It also brought an alternative approach to learning in the sciences by

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introducing a design approach method to their inquiries. The level of understanding and learning by the students was evaluated by the quality and content of the artwork created by the students during the project lessons. The content of the artworks reflected what information each student learned during class as well as how they could develop solutions that creatively addressed relevant issues raised during the course. Based on these measures the outcome of learning was achieved by the students.

This project benefitted GCCDS by built capacity for developing curriculum and teaching school age students about design related issues and methodology. It also expanded the quality and quantity of outreach materials available and created new teaching tools for future community engagement.

These materials will be of special interest and benefit to other community design educators as a successful model and program for those teaching similar issues around the country. We predict the program will become known through the various national conversations we engage in with others in our field as well as from our website.

The principal and educators of Biloxi Junior High were very grateful and supportive of the contribution made by this program and our organization during our work together. The impact of this NEA program has led to further conversations with the school principal on ways to continue working with the school and students through a variety of new programs.

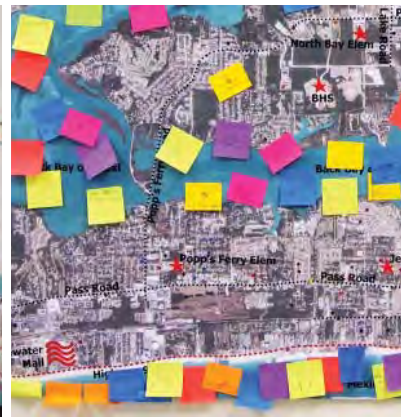


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## EXPERIMENTS WITH STORMWATER



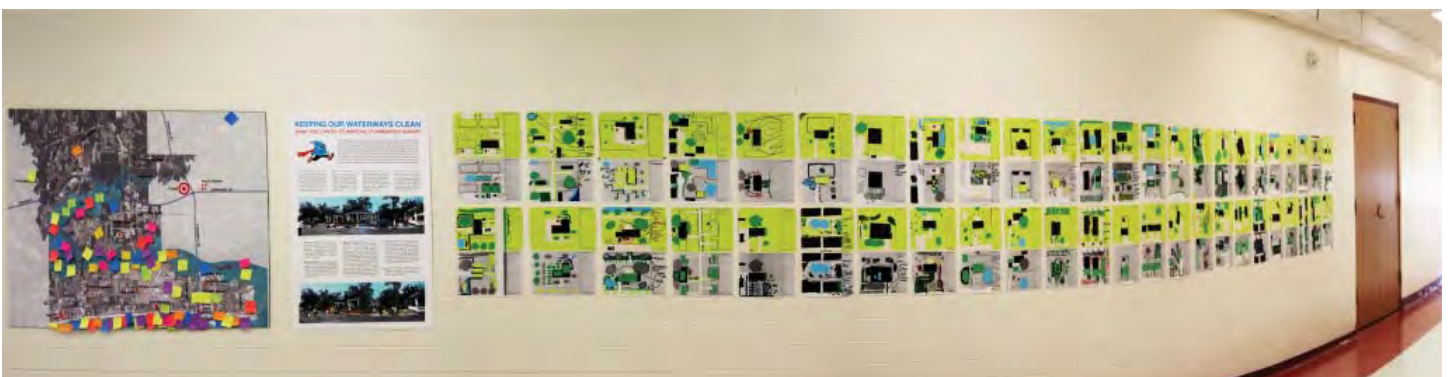
## IN CLASS EXHIBITS - WATER ACTIVITIES AND RELATING IT TO WHERE WE LIVE



## MAKING ARTFUL COLLAGES OF OUR HOMES



## EXHIBIT AT BILOXI JUNIOR HIGH SCHOOL



## Appendix L: Elementary Education for Rotten Bayou Watershed

### DAY 1 CONNECTING TO AND CARING FOR OUR LOCAL WATERWAYS

#### Introductions (3 min)

1. Introduction (Self and studio, where we are located, what we do)  
GCCDS – Architects, Landscape Architects and Planners (ask what are these things?)  
Stormwater runoff, or what happens to rainwater when it hits the ground, is a really important part of our work because it affects everything from someone’s roof to their yard to the parks in their neighborhood to streets all around the city and the beach.
2. Run through the four days (Introduction, Materials, Behaviors, Designs)
  - a. Today
    - i. Map activity
    - ii. Presentation about how stormwater moves through the city.
  - b. Wednesday - Materials
    - i. Hands on experiment.
    - ii. Learn how to make a site plan, which we use in our design studio.
  - c. Friday – Behaviors
    - i. Another hands on experiment.
    - ii. Class game
    - iii. Continue to work on site plan.
  - d. Monday – Creative designs
    - i. Presentation on creative designs
    - ii. Finish up site plan with your own designs.

#### Map Activity (15 min)

3. Introduce Map
  - a. Point out major waterways (Gulf, Back Bay, Biloxi river, bayous)
  - b. Point out major landmarks (Roads, schools, air force base, shopping)
4. Demo Activity (Explain handout)
  - a. Find our office and put up favorite water activity.
5. Pass out handouts for each student, post-it note and marker.
6. Students should line up when they are ready. Might not get through everybody.
7. Sum up activity – It is really important for us to understand how what we do at home affects the waterways all around us. These four classes we’ll be learning about how to keep our water from getting polluted, how to prevent harm to habitat for animals and plants, and how to keep being able to enjoy our favorite water activities.
8. If there is extra time, go through the different waterways and ask kids about their activities there.

#### PREZI BILOXI THEN & NOW (25 min – 5 minutes per section)

##### A. What is Stormwater Runoff

1. Definition: Stormwater runoff occurs when rain or other precipitation flows over the ground. Whenever it rains, water flows into different systems that might include ditches, drains and pipes, but eventually the water in Biloxi that doesn’t soak into the ground comes out at the Gulf of Mexico. Paved surfaces like driveways, sidewalks and streets prevent stormwater from naturally soaking into the ground. Stormwater runoff is important because it affects how much water we have and how clean that water is. Stormwater runoff affects all the water activities we love!
2. Video: Introduction to Runoff (stop after approx. 2 min)
3. Introduce the four areas on the map: Beach, Bayou, River and Inland. Have the students raise their hand if they live in one of these areas. We will be looking at what these areas are like now, and what they were like before Biloxi was a city.

##### B. Beach

1. Now

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- a. Today, Biloxi has a nice long sandy beach along the water.  
*What are some of your favorite beach activities on the map?*
    - i. The sand is raked and fluffed and groomed for beach activities.
    - ii. Highway 90 runs beside the beach and is separated from it by a sidewalk and a concrete sea wall. The concrete wall is used to keep sand off the highway and protect the beach.
    - iii. Some buildings are right along the water, like the Beau Rivage.
  - b. Stormwater diagram
2. Then
    - a. There used to be a very narrow beach by the water but most of the sand in today's beach has been brought in from other places.  
Oak and cypress trees and grasses grew close to the water. It probably looked a lot more like Deer Island.  
Rain and wind transformed the water's edge, it was constantly changing.
    - b. Stormwater diagram
  3. Problems
    - a. While the beach allows for lots of fun activities, there are some problems with how stormwater flows to the beach.
      - i. Pollution comes through pipes and dumps onto the beach or directly into the water. The water is sometimes so polluted that the beach has to close for a couple days.
      - ii. Litter from people's houses can wash onto the beach, affecting animals like this Spork Crab.
      - iii. *Have you found any garbage down at the beach?*
      - iv. *How might litter affect some of your favorite activities?*
  4. Solutions
    - a. The stormwater runoff used to get cleaned by plants and grasses that flowed into small streams and then into the Gulf. Planting new vegetation near the water helps to filter and clean water that runs off.
    - b. We can participate in beach clean up days to pick up litter.
    - c. Throw garbage and recycling into containers instead of onto the street or anywhere else where it can wash down to the beach.
- C. Bayou**
1. Now
    - a. *What are some of your favorite beach activities on the map?*
    - b. Even if you live right near a bayou, you might not know it. A lot of the waterways in Biloxi have been piped underground.
    - c. *Why put the bayou in a pipe and pave over it?* (i.e. to build houses, roads, sidewalks, shops)
    - d. There may be a storm drain near your house that runs under the street and comes out of a pipe (also called a culvert) into a waterway.
    - e. Stormwater diagram
  2. Then
    - a. Before Biloxi was a city, the bayous were lined with marsh grasses and many other plants. Many more animals lived both in the water and along the banks. There were no pipes, houses or pavement, and there was a lot more water.
    - b. Stormwater diagram
  3. Problems
    - a. In order to build houses and roads, the banks of the bayou were all filled in. Lots of vegetation and animal habitat was lost when this happened.

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- b. When water comes out of pipes (or culverts) it can be polluted. It is also difficult for animals like fish to survive in the pipes, or moving from the pipe to the stream. This makes for very unhappy fish.
- c. *How might water from drainage pipes affect some of your favorite activities?*

### 4. Solutions

- a. There is a project our studio did in Bayou Auguste. The Bayou used to be in a pipe, but it was opened up and the banks were rebuilt and planted with vegetation. The wall you see is made of oyster shells and helps prevent the banks from caving in (called erosion). Before it was just a pipe, but now it is like a community park, where you can go and enjoy the open stream. It is also very good for animal habitat both in the bayou and along the banks.

## D. Biloxi River

### 1. Now

- a. *What are some of your favorite river activities on the map?*
- b. This Home Depot is very close to the Biloxi River near Popps Ferry Road. While some parts of the river are still natural, there are many roads, stores and houses that have been built up very close to it.
- c. Stormwater diagram

### 2. Then

- a. The river had soft planted edges. Many grasses and plants grew right up to the banks. The river meandered and changed course over time (wind, storms, soil moving around) The river was much wider and was surrounded by larger forests.
- b. Stormwater diagram

### 3. Problems

- a. There are many more paved surfaces like parking lots, roofs and roads. Large amounts of stormwater collect and flow into the river above the land or in pipes. There is so much water and it comes so fast that it causes erosion when it hits the river. Erosion is when part of the soil bank is washed away into the water.
- b. *How might erosion affect some of your favorite activities?*

### 4. Solutions

- a. Stormwater moves more slowly when there are more plants and soil because part of the water can soak into the ground.
- b. Parking lots are large paved surfaces, and we can design them in creative ways to help with stormwater issues. Planted areas help soak up some of the stormwater.
- c. Some hard materials like these parking pavers also allow some water to soak through the ground instead of running off into the river.

## E. Inland

### 1. Now

- a. There are many areas of Biloxi that aren't close to a waterway. In this part of Biloxi, there are many neighborhoods that have houses with yards and streets.
- b. Stormwater diagram

### 2. Then

- a. This is an example of a pine forest, which would have been growing in some parts of Biloxi, away from the water. There were many species of plants and animals that lived in this type of forest.
- b. Stormwater diagram

### 3. Problems

- a. Even if we don't live anywhere near the water, many of the things we do at our house or apartment affect the quality of the water, and how many pollutants it carries with it on its journey to a waterway, like the Back Bay or the Gulf of Mexico.

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- b. There are a lot of chemicals we use at home, like fertilizer for the grass, paint, motor oil, and all these things can end up in a waterway somewhere if we're not careful.
- c. One example would be working on a car in the driveway. If some motor oil or gas leaks out, it can go down a drain and dump out into a waterway.
- d. When pets go to the bathroom outside and their waste isn't picked up, there might be bacteria and other harmful chemicals that can end up in the water.
- e. *How might what you do at home affect some of your favorite water activities?*

#### 4. Solutions

- a. We can dispose of harmful chemicals properly.
- b. Some creative designs can help filter some chemicals out of the water and slow down water as it runs off yards. This example is a rain garden, where a ditch is planted with grasses that don't mind sitting in water some of the time.
- c. Another way to prevent all the water from the roof flowing over chemicals you might have in the yard or on the driveway is to collect and recycle the rainwater with a barrel. This recycled water can be used to water plants in the yard.

#### F. Conclusion

The end! Today we talked about four areas of Biloxi: the beach, the bayou, the river and the inland areas. Even if rain falls far away from a waterway, it still has a great affect on the water and on all our favorite activities. Tomorrow, we'll learn about how stormwater runoff moves around at your home through an experiment and activity. We'll learn all about different materials.

#### Questionnaire (3-5 min)

We have a scavenger hunt for you to complete about your own house or apartment. What I want you to do is investigate your home and the land around it for these different things. Some are about where certain things are, like your driveway, and others are about what materials you have at home. We will use this on Wednesday to work on a site plan. A site plan is a drawing from above, like a close up of an aerial map. We will teach you all about the site plan on Wednesday, but the scavenger hunt is to get you ready.

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### DAY 2 PAYING ATTENTION TO WHAT HAPPENS TO STORMWATER RUNOFF WHERE YOU LIVE- MATERIALS

#### GREETING/RECAP OF LAST LESSON: (5 min.)

- A. When it rains, the water that falls around your home either absorbs into the ground or flows across the land and ends up in the Gulf of Mexico. This flowing water is called runoff.
- B. The other day we talked about some of the effects runoff can have on the water we use for different activities. Lots of runoff can: (put in main points from Day 1)
  - 1. Cause flooding
  - 2. Erosion
  - 3. Pollution
  - 4. Litter

#### INTRODUCE TODAY'S LESSON AND GOALS: (2 min.)

- A. Today we will learn how different materials around your home and neighborhood affect the amount of runoff that leaves your home and makes its way to the Gulf.
- B. Then we will use our memory, questionnaire, and imagination to make a picture/plan of all the materials that are around our homes

#### PREZI & EXPERIMENT: HOW MATERIALS AFFECT STORMWATER RUNOFF (15 min.)

- A. Objects and materials that make up the place you live absorb different amounts of water or none at all. Materials that are able to absorb fluids are called porous. Materials that can't absorb fluids are called non porous.
  - 1. Ask for three volunteers to do a demonstration on what it means to be porous.
  - 2. Two students stand with arms and legs out with their fingers and feet touching representing small pieces of dirt that are porous.
  - 3. A third student representing water tries to get through the rocks. It's pretty easy.  
Name some porous materials: dirt, sand, gravel, grass, oyster shells, fabric
  - 4. Now the two students stand right next to each other shoulder to shoulder representing a non porous material like concrete.
  - 5. The third student representing water can't get through.  
Name non porous materials: concrete, plastic, asphalt, bricks,
- B. These 4 gutters represent different materials you can find around your home and neighborhood. (Show pictures of the materials and places in presentation while talking about them)
  - 1. Concrete- Driveways, sidewalks, roads, asphalt, tile roof, pipes, storm vault
    - a. See what happens when rain falls on these surfaces
    - b. Same amount of water runoff in same amount out
    - c. This is a non porous material
  - 2. Soil- open ditches, bare ground, beach
    - a. See what happens when rain falls on a surface like this
    - b. Amount of water runoff is less
    - c. This is a porous material
    - d. There is some dirt in the water-Erosion  
The amount depends on how hard and fast it rains.
    - e. Dirt, sand particle are so small and are easily carried away by water
      - i. Dirt in water can make it hard for wildlife and plant to live in it.
      - ii. Makes land less stable
  - 3. Rock over dirt- gravel driveways, oysters, pavers, rip-wrap, rock ditches
    - a. See what happens when rain falls on rock that is covering bare ground
    - b. Amount of water runoff is a little less
    - c. This is a porous material
    - d. There is some dirt in the water-Erosion rocks stop it a little

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4. Plants- Trees, Gardens, rain gardens, wetlands, plant beds
  - a. See what happens when rain falls on a planted surface like this
  - b. Amount of water runoff is much less
  - c. This is a porous material
    - i. Plant roots grow far down into the soil and let water infiltrate it easier.
    - ii. Plants also absorb water so there is less runoff
    - iii. Plants stabilize soil and prevent erosion

### **EXERCISE- MAKING A SITE PLAN OF YOUR HOME. WHAT OBJECTS AND MATERIALS MAKE UP THE PLACE WHERE YOU LIVE? (15+ min.)**

Now with all of this new knowledge about materials around our homes you are going to use your memory, questionnaire, and imagination to make a picture/plan of all the objects and materials that are around your home.

- A. Let me walk you through an example sight plan of a friend's house and another friend's apartment
  1. This is a picture of my friend Rachel's house.
    - The house is close to the street
    - It has a driveway on the right and a sidewalk to the front door
    - There are planter boxes and trees in the front yard
    - There is a shed and a little apartment in the back yard
    - There isn't much grass in the back yard but there is another tree
  2. Here is the example site plan we put together or this house
  3. There are a lot of hard surfaces around Sarah's house so there is a lot of runoff here.
  4. This is a picture of my friend Matt's apartment.
    - Matt lives in this building here on the bottom floor.
    - He parks his car here in the long parking lot.
    - There is a sidewalk that leads from the parking lot to his building and the other building across from his apartment.
    - The yard is shared with neighbors. There are a couple of plants and trees.
  5. Here is the example site plan we put together or this apartment
  6. There is a lot of paving around the apartment so there is a lot of runoff.
  7. Estimate whether the site plan creates little or a lot of stormwater runoff.
- B. Each student will make a generic model of home property using colored paper.
  1. GCCDS will prepare standard size elements (sidewalks, driveway, house, garage, trees, garden, gutters, etc.)
  2. Students will take note of the different materials in their site plan, which ones are porous, or non porous, and estimate if their home creates a lot or a little stormwater runoff.

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### DAY 3 POLLUTION AND YOU- ACTIVITIES AND BEHAVIORS THAT AFFECT STORMWATER RUNOFF

#### Intro (5 Minutes)

- A. Recap from Day 2
  1. Reintroduce the ideas of how different materials around your home and neighborhood affect the amount of runoff that leaves your home and makes its way to the Gulf.
  2. Go over what each type of gutter represents-ask students if they can remember the different types of drainage and ask students to define porosity or other key words.

#### Pollution and the world around you (15 minutes)

- A. When rain runs off our yards, streets, and roofs it absorbs pollutants and brings them into stormwater system, which results in high concentrations of pollutants in our Bayous and in the Gulf.
- B. In this experiment we will show how pollutants mix with water and how they impact the environment. There are four categories of pollutants and each impacts the environment differently. Begin to mix the pollutions into the water for drainage test-as mixing tell students what each thing represents and ask them for examples of things around them and discuss how they impact the water.
  1. The first type of pollutants are contaminates that dissolve into the water
    - a. We will use Sprinkles to represent these
    - b. Can you think of any contaminants that dissolve in water? (Fertilizer, dog poop, detergents, etc.)
    - c. This type of contaminant reduces the water quality which limits the amount of species that can survive. In particular, the overuse of fertilizers is a widespread problem, and can drastically affect ecosystems by overloading them with nutrients. Have you heard of The Dead Zone in the Gulf?
  2. The second type of pollutants are large amounts of organic matter
    - a. We will use Parsley Flakes to represent this
    - b. Can you think of an example of this? (Yard trash, leaves, bush or tree trimmings).
    - c. While organic material in small amounts is fine for a water system, large amounts clog up water movement and change the nutrient balance of the water.
  3. The third type of pollutants is manmade trash
    - a. We will use Red Pepper Flakes to represent this
    - b. Examples of this include? (Plastic bottles and bags, newspapers, cans, tires etc. )
    - c. Ingested trash can kill wildlife and large amounts of trash can smother a habitat. Also, as trash breaks down it can release harmful chemicals.
  4. The fourth type is the chemicals that don't mix with water (hydrophobic)
    - a. We will use Sesame Oil to represent this
    - b. Examples of this include? (car oil, gasoline, a lot of industrial waste)
    - c. These types of pollutants poison wildlife and persist in the environment for a very long time.

#### Eye-Spy/ Behavioral Analysis (10 Minutes)

- A. In each of the following images there are examples of good and bad behavior that affect runoff. Can you pick out some of these? How do you think they affect the environment? If the behavior is negative, how would you improve it? What kind of pollutant/sprinkle is each of these?
- B. Eye-Spy 1: The House (from left to right)
  - o Littering
  - o Leaving out large piles of organic matter
  - o Leaving trash in loose bags on the street, not sorting out recyclables.
  - o Animal Waste
  - o Rainwater Barrel



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- Car Washing
- Permeable Paving
- Use/overuse of fertilizers
- C. Eye-Spy 2: The Bayou
  - Animal Waste
  - People Fishing
  - Bulkhead
  - Lawn up to water edge
  - Rain Garden
  - Riparian Edge/Native Plants
  - Green Roof
- D. Eye-Spy 3: The Apartment
  - Littering
  - Mardi Gras Litter
  - Washing paint down drain
  - Recycling
  - Water sprinklers on pavement
  - Gutter connected to planter
  - Not disposing of oil properly
  - Native Plants
  - Planters

### Site Plan, Part Two: (15 Minutes)

- A. We are now going to think about our own homes and what kinds of behaviors we see that affect the rainwater runoff.
- B. Using your site plan, mark places around your home where you notice a behavior that will affect the runoff. Think about where your trash is located, is it stored tightly or can it get into the stormwater system? Do you have a planter or garden at your home that absorbs rainwater? Do you have a rain barrel?
- C. Using our example home, we might note the planters in the front yard, the semi permeable driveway, the water sprinklers that spray the road, the uncollected animal waste...
- D. For this next part, think about:
  - 1. How does water move from your home into the bay? Using a marker/pencil draw how the water moves off of your roof and into the ground or drain. Where does runoff from your driveway go? And how about your sidewalk?
  - 2. Continue to note objects/behaviors that affect runoff. Here are some ideas to keep you going:
    - a. What kinds of materials are around your house? Thinking back to our experiment on porosity, what materials absorb water and which ones shed it?
    - b. What about the gutter or if you don't have gutters, where does the runoff from the roof collect?
    - c. Where is the nearest drain?
    - d. Is there a pile of organic waste?
    - e. Do you live near a stream or bayou? Does the water from your house flow into it?

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### DAY 4: What You Can Do to Improve Stormwater

#### Introduction/Recap (3 mins)

Last week we learned what stormwater runoff is, how materials (or our built world) affect runoff, and we learned how our behaviors affect runoff.

A. Questions to engage the class:

- Who can tell me what runoff is?
- Who can give me an example of a porous surface and how that surface affects runoff?
- Who can give me an example of a non-porous surface and how that surface affects runoff?
- What is an example of a behavior that negatively affects runoff/water quality?
- What is an example of a behavior that positively affects runoff/water quality?

#### PREZI: IMPROVING STORMWATER AT YOUR HOME (12 MINS)

Today we are going to learn about ways we can positively affect (or improve) runoff and water quality!

In today's PREZI you will see how people change their actions to improve water quality and how people / designers create fun and interesting ways to use runoff and improve water quality. After the PREZI you will use these ideas and some of your own ideas to illustrate on your site plan how you can have a positive effect on stormwater runoff from your own home.

Slide:

1. Intro – How will you improve stormwater runoff?
2. Compare bad and good behaviors
3. Example of a bad place for stormwater runoff (all non-porous)
4. Example of buildings that absorb, filter or reuse stormwater
5. Example of a house that does not improve or help stormwater runoff
6. Example of houses that improve and/or use stormwater
7. Examples of yards that use, filter and decrease stormwater runoff
8. Example of a detention pond that is bad due to grass mown to edge, perhaps fertilizer = algae
9. Example of a detention pond that has clean water with lots of plants at the edge acting as a filter
10. Example of a seawall/bulkhead failing and not helping to filter stormwater or provide habitat
11. Example of a living shoreline that stabilizes the shore, filters water and provides habitat
12. Example of a culvert emptying into the Gulf, where stormwater carries all the pollutant with it
13. Ways to filter water before it goes into culverts, at the end of the culvert and beach plantings
14. Explain and compare the example site plans and their improvements

#### EXERCISE- MAKING IMPROVEMENTS ON YOUR SITE PLAN (20 mins)

Give students the Xerox copy of their plans and hand out colored construction paper, markers, glue and scissors. Have them illustrate through collage, drawings and words ways they can improve stormwater runoff on their site.

- A. **(10 mins)** Allow for time at the end of class for some of the students to present their ideas to the class.