WIP for Harris Bayou

1.0 PLAN GUIDANCE

1.1 Vision Statement

Harris Bayou and its watershed are pleasant and safe places to live, work, recreate, and raise a family. Agriculture is productive and profitable, and its practices contribute to adequate water supply and quality to support fishing, swimming, aquatic life, and quality of life.

1.2 Mission Statement

Sustain agricultural profitability; improve water quality/quantity.

1.3 Harris Bayou Watershed Implementation Team

Members of the Harris Bayou Watershed Implementation Team are:

- Mattson Flowers, producer
- Pete Hunter, producer
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The team is supported by P. Bhowal, Mississippi Department of Environmental Quality (MDEQ) and FTN Associates, Ltd (FTN).

2.0 WATERSHED DESCRIPTION

2.1 Geography

Harris Bayou is a tributary of the Sunflower River in east central Mississippi (Figure 2.1). The 71,592 acre Harris Bayou Watershed (HUC # 08030207) is located in Coahoma and Bolivar Counties, Mississippi, in the Delta physiographic region, and Mississippi Alluvial Plain Northern Holocene Meander Belts ecoregion. In the headwaters, the landscape is dominated by ridge and swale topography. Continuing south, the drainage area becomes more diverse as parcels of developed land begin to intertwine with the otherwise ridge and swale landscape. In the southern portion of the watershed, much of the landscape is developed, i.e., fields have been land formed, and drainage infrastructure has been improved.

Only one municipality exists in the watershed, the City of Clarksdale which is located in the northeast portion of the watershed. Several smaller communities are scattered throughout the watershed including Sherard, Stovall, and Farrell. State Highways 61 and 1 pass through the watershed. Cleveland and Tunica are two larger municipalities within 40 miles of the watershed.

2.2 Geology

Harris Bayou is located in the Mississippi River Alluvial Plain physiographic region. Geology in this area consists of mostly unconsolidated deposits of sands, silts, and clays dating back as far as the Pleistocene (Stewart 2003).

2.3 Soils

Soils in the Mississippi River Alluvial Plain physiographic region are primarily young soils (inceptisols) formed on alluvium, and range from mildly acidic to mildly alkaline (Stewart 2003). Soils in the northern part of the watershed (headwaters) are of the Dundee (moderately to somewhat poorly drained fine sandy loam to silty clay loam) and Forestdale (somewhat poorly to poorly drained silty clay loam) series. The southern portion of the watershed is dominated by heavier soils, predominately of the Alligator and Sharkey series. These are poorly drained clay soils. Only the Dundee soils are suitable for crops without drainage management.

2.4 Hydrology

Harris Bayou (HUC # 08030207) begins in west central Coahoma County northwest of Clarksdale, Mississippi. Richies Bayou (headwaters of Harris Bayou) originates around Stovall, MS. Richies Bayou merges with another tributary just west of Clarksdale to form Harris Bayou. Harris Bayou merges with another large tributary in the southern portion of the watershed where it turns east flowing in to the Big Sunflower River. This HUC also includes a portion of the Big Sunflower River (see Figure 2.1). Base flows in Delta streams naturally decrease during the summer months due to low rainfall. However, in the Harris Bayou watershed, irrigation water often supplements summer base flows by providing a constant source of runoff throughout the growing season.

2.5 Land use

Much of the original ridge and swale landscape in Harris Bayou watershed has been developed; fields have been land formed, and drainage infrastructure has been improved. A map of watershed land use is shown in Figure 2.2. Although 79.4% (56,837 acres) of the watershed is in production agriculture, no particular crop is dominant. Corn, cotton, soybeans, and rice are all common. In addition to production agriculture, 1.3% (936 acres) of the watershed is water, 11.04% (7,905 acres) is wetlands, 7.3% (5,201 acres) is urban areas (i.e., Clarksville), and the remaining 1% (711.7 acres) is pasture, barren, and non-wetland forest land.

2.6 Socioeconomics

One interesting characteristic of this watershed is a “forward thinking” mindset of many landowners and farmers. Producers in this watershed have a history of recognizing environmental concerns and voluntarily addressing them through assistance programs such as EQIP and CRP. Stakeholders are informed and receptive of innovative conservation practices, such as those required to successfully reduce nutrient loading in the watershed.

2.6.1 Demographics

Estimated July 2008 population for Bolivar County was 37,195, and for Coahoma County it was 27,272. In both counties the 2008 estimated population was around 3% less than the population reported in the 2000 census.[1]

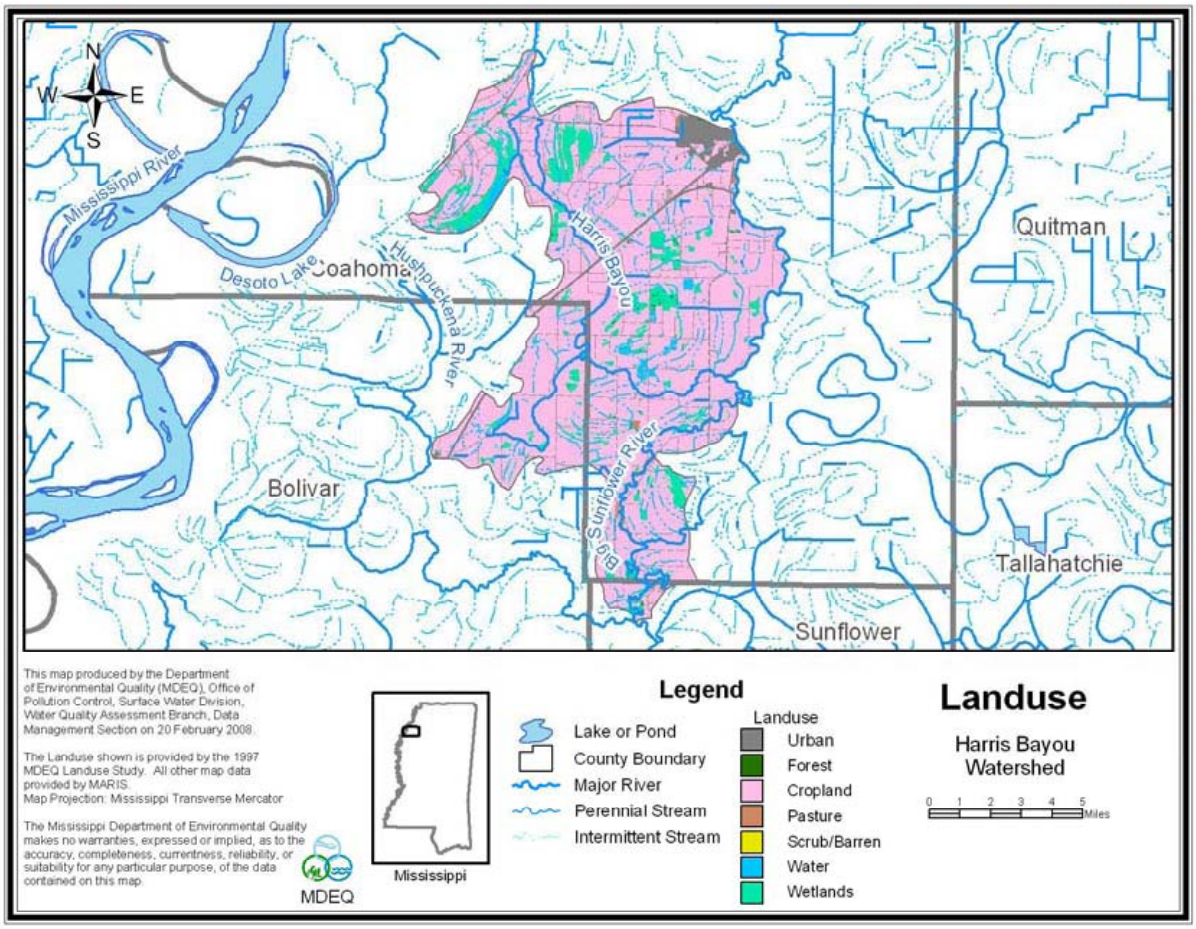

Figure 2.2. Land use in Harris Bayou watershed (HUC # 08030207).

2.6.2 Economy

The Delta region of Mississippi where Harris Bayou is located is classified as economically depressed. The estimated 2008 median household income for Bolivar County ($28,779) and Coahoma County ($28,320) were both below the state median household income

[1](http://www.olemiss.edu/depts/sdc/estimates/2008/CO-EST2008-01-28.htm, accessed July 2010

($37,818), and were in the lowest 11% of the state (http://www.census.gov/did/www/saipe/data/index.html, accessed July 2010). The economy in the Harris Bayou watershed is dominated by agribusiness.

2.7 Regulations

2.7.1 Federal

2.7.1.1 Clean Water Act

2.7.1.1.1. NPDES Point sources

There are two permitted wastewater discharges in the watershed (enSearch, accessed July 2010). The Publicly Owned Treatment Works (POTW) for the community of Farrell (MS0045187) is a point source "facility of concern". In addition, Mascot Planting Company is also permitted to discharge domestic wastewater (MS0022225).

2.7.1.1.2. NPDES Storm water

The Harris Bayou watershed is not subject to MS4 storm water permitting under the Clean Water Act. Under state law, storm water permits are required for construction in the watershed.

2.7.1.1.3. 303(d) and TMDLs

Water bodies in the Harris Bayou watershed were included on the Mississippi 2006 Section 303(d) List of Impaired Water Bodies (MDEQ 2007a). Harris Bayou, Richies Bayou, and Howden Lake were listed due to evaluated causes of sediment, organic enrichment / low dissolved oxygen, and nutrients. The Clean Water Act requires that total maximum daily load (TMDL) studies be completed for all water bodies included on the 303(d) list. Table 2.1 summarizes the TMDLs addressing Harris Bayou water quality impairments that have been completed as of July 2010. Because these TMDLs have been completed, these water bodies do not appear on the draft 2010 303(d) list (MDEQ 2010).

Table 2.1. TMDLs addressing Harris Bayou watershed water quality impairments.

Parameter	Waterbody	TMDL Approval Date	Source to be Reduced	Recommended % Reduction
Total nitrogen	Harris Bayou	June 2008	NPS	84.32%
	Richies Bayou	June 2008	NPS	85.11%
	Howden Lake	June 2008	NPS	85.68%
Total phosphorus	Harris Bayou	June 2008	NPS	95.24%
	Richies Bayou	June 2008	NPS	95.49%
	Howden Lake	June 2008	NPS	95.65%
Sediment	Harris Bayou, Richies Bayou, Howden Lake	April 2008	NPS	NA (estimate 80%)
Legacy pesticides	Harris Bayou, Richies Bayou, Howden Lake	November 2005	NPS	NA

2.7.1.1.4. Navigable Waters

Several sections of the Clean Water Act deal with controlling impacts to navigable waters. Section 404 of the Clean Water Act controls the placement of dredge or fill materials into wetlands and other waters of the US. Section 401 of the Clean Water Act requires MDEQ to certify that a project requiring a Section 10 (see 2.7.1.2) or Section 404 permit will not violate the state water quality standards. These sections of the Clean Water Act require that impacts to qualifying waterbodies be avoided or minimized. Where impacts are unavoidable, mitigation may be required. Qualifying waterbodies include wetlands and "Other Waters of the US". The basic definition for Other Waters of the US, for the purpose of Section 404, is any waterbody that displays an ordinary high water mark (OHWM). This includes lakes and ponds that have a hydrological connection to a qualifying waterbody, and perennial, intermittent, or ephemeral stream channels which exhibit an OHWM. The US Army Corps of Engineers (USACE) administers the regulations associated with both of these sections.

The USACE commonly issues two types of permits under Section 404; Individual Permits and Nationwide Permits (NWPs). Individual Permits are required when 1) impacts to wetlands exceed 0.5 acre, and/or 2) greater than 300 linear feet of a qualifying waterbody is to be impacted. This Individual Permit includes a period of public review, and processing generally takes between 60 and 120 days. The processing time can be greater if public hearings or environmental statements are required, or if all required information on the permit application

form is not provided. NWPs are general permits typically used when minor impacts are necessary to wetlands (less than 0.5 acre) or a qualifying waterbody (any impacts less than 300 linear feet). Processing time is generally less and no public review period is necessary.

Mitigation for both wetland losses or stream function and value losses may be required by the USACE for a project authorized under either an individual or nationwide permit. The extent of the mitigation is dependent upon the size, quality, and functionality of the wetland or waterbody to be impacted.

2.7.1.2 Rivers and Harbors Act

Section 10 of the Rivers and Harbors Act regulates activities that have the potential to obstruct navigation in waters of the US, including wetlands.

2.7.1.3 Farm Bill

Under the Federal Food Security Act (Farm Bill), initially passed in 1985, all US farm operators are required to meet soil erosion control standards specified in the law. Compliance with these standards is a prerequisite for participation in most federal farm programs. Subsequent amendments to the Farm Bill have added programs that provide incentives to farm operators for enhancing water quality through such actions as taking highly erodible lands out of production, and restoring wetlands. One such program is the Mississippi River Basin Healthy Watersheds Initiative (MRBI). The MRBI is being implemented through NRCS programs funded by the Farm Bill, including the Cooperative Conservation Partnership Initiative, Wetlands Reserve Enhancement Program, and Conservation Innovation Grants. The Harris Bayou watershed is a target sub-watershed of the Sunflower River watershed for the MRBI.

2.7.1.4 National Flood Insurance Program

The National Flood Insurance Program (NFIP) is a non-regulatory federal program, which is administered by the Federal Emergency Management Agency (FEMA). However, this program provides mechanisms that can be used to restrict development in floodplains, which can have beneficial effects on water quality. The NFIP supports development and enforcement of

floodplain management plans and ordinances. All of the unincorporated areas of Bolivar and Coahoma Counties participate in the NFIP, as well as the City of Clarksdale.[2]

2.7.1.5 Safe Drinking Water Act

All drinking water systems serving 25 people or more are considered public drinking water systems and are subject to EPA regulation through the Safe Drinking Water Act. Elements of the Safe Drinking Water Act include the Enhanced Surface Water Treatment Rule, Disinfection Byproducts Rule, and the requirement for Source Water Assessment and Protection. In Mississippi, the Safe Drinking Water Act is administered by the Mississippi State Department of Health. The lists of public water utilities provided on the Mississippi State Department of Health website indicate that there are four public water utilities serving the residents of the Harris Bayou watershed.[3] Information about these utilities and their compliance with Safe Drinking Water standards are summarized in Table 2.2

Table 2.2. Public drinking water utilities in Harris Bayou watershed from the EPA Safe Drinking Water Information System[4]

Utility	Water Source	Population Served	Water Quality Violations
Clarksdale Public Utilities	groundwater	2,064	coliform in 2000
Bobo Utilities	groundwater	200	none
Farrell Utilities	groundwater	246	coliform 2007, 2000
Sherard Water Association	groundwater	147	TTHM: Oct 2007 through Mar 2009

2.7.2 State

2.7.2.1 Water quality standards

The water use classifications are established by the State of Mississippi in the document *State of Mississippi Water Quality Criteria for Intrastate, Interstate, and Coastal Waters* (MDEQ, 2007b). The designated beneficial use for the listed segments is Fish and Wildlife (MDEQ 2008a,b,c) The water quality standard applicable to the use of the water body and the pollutant of

[2] http://www.msema.org/insurance/floodplain.html, accessed July 2010
[3] http://msdh.ms.gov/msdhsite/_static/30,0,76,256.html, accessed July 2010
[4] http://oaspub.epa.gov/enviro/sdw_form_v2.create_page?state_abbr=MS, accessed July 2010

concern is defined in the *State of Mississippi Water Quality Criteria for Intrastate, Interstate, and Coastal Waters* (MDEQ, 2007b). Mississippi's current standards contain a narrative criteria that can be applied to nutrients which 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 waters for any designated use* (MDEQ, 2007b)."

The standard for dissolved oxygen states, "DO concentrations shall be maintained at a daily average of not less than 5.0 mg/l with an instantaneous minimum of not less than 4.0 mg/l." In addition, the State water quality standard regulations include a natural condition clause which will be used to determine the appropriate DO for Harris Bayou under critical conditions. Natural conditions are defined as background water quality conditions due only to non-anthropogenic sources. The criteria herein apply specifically with regard to substances attributed to sources (discharges, nonpoint sources, or instream activities) as opposed to natural phenomena. Waters may naturally have characteristics outside the limits established by these criteria. Therefore, naturally occurring conditions that fail to meet criteria should not be interpreted as violations of these criteria.

Since no water quality data have been collected in this watershed, no violations of state water quality criteria have been documented. However, MDEQ has judged that conditions in the watershed are likely to result in violations of these water quality criteria.

2.7.2.2 Highway Construction Runoff

The Mississippi Department of Transportation (MDoT) is responsible for implementation of erosion and sediment control practices on highway construction. MDoT is required to apply to MDEQ for a Certificate of Permit Coverage for construction projects to be permitted through the state construction storm water general permit. As of June 7, 2010, there are no active water permits for highway construction in the Harris Bayou watershed (MDEQ enSearch).

2.7.2.3 On-site wastewater treatment regulations

State regulations addressing on-site wastewater treatment systems are administered through the Mississippi State Department of Health. Regulations are in place to address single-

family residence on-site wastewater treatment systems, as well as on-site systems serving recreational vehicle campgrounds, developments, and multi-family dwellings. These regulations require approval and certification of all new installations of on-site wastewater treatment systems, including replacement of old systems. Certification is not required for systems in use prior to enactment of the regulations, providing they meet criteria specified in the regulations.[5]

2.7.2.4 Fish consumption advisories

Fish tissue sampling is conducted by MDEQ for the purpose of identifying potential human health threats. These data are used by a multi-agency task force to evaluate the need for fish consumption advisories in Mississippi. Harris Bayou is included in the Delta-wide consumption advisory for toxaphene and DDT. This advisory recommends that people limit consumption of carp, buffalo, gar, and catfish larger than 22 inches to no more than one meal every two weeks (MSDH 2001).

2.7.2.5 Water Withdrawals

Under Mississippi law, all wells drilled with a casing diameter of 6 inches or greater are required to have a water use permit. In addition, water use permits are required for surface water withdrawals, and construction of water storage impoundments. Permits are good for 10 years. The Yazoo Mississippi Delta Joint Water Management District (YMD) is responsible for processing water use permits in the Delta, including the Harris Bayou watershed. Water use permits are issued by the MDEQ State Permit Board.

2.7.3 Local zoning

Need info?

[5] http://www.msdh.ms.gov/msdhsite/_static/30,0,78.html, accessed July 2010

2.8 Existing management

Producers in this watershed have a history of recognizing environmental concerns and voluntarily addressing them through assistance programs such as EQIP and CRP. Sediment concerns have been addressed by ongoing efforts. Low flows in water bodies such as the upper Sunflower River have prompted actions such as well fields and weirs.

The primary hydrologic use of Harris Bayou is for agricultural drainage and irrigation.

3.0 RESOURCES AND CONDITION

3.1 Water quality

Water quality data have not been collected in the Harris Bayou watershed prior to 2010. As noted in Section 2.7.1.1, water bodies in this watershed have been identified by MDEQ as not having water quality adequate to support its designated uses (listed in Section 2.7.2.1). However, these determinations were based on evaluated assessments, not on water quality data.

3.2 Water quantity

Water supply is a growing concern in the region. Ground water depletion in the Mississippi Alluvial Plain has resulted in lower flows in many streams, including the Sunflower River (MS Museum of Natural Science 2005). Groundwater is withdrawn for drinking water and to irrigate crops.

3.3 Wildlife and Habitat

The Mississippi Natural Heritage program has identified a number of plants and animals as species of special concern in Bolivar and Coahoma Counties: nine plant species and 15 animal species in Bolivar County, and seven plant species and four animal species in Coahoma County. A list of these species is included as Appendix.

The Mississippi Comprehensive Wildlife Management Plan (MS Museum of Natural Science 2005) identifies species of greatest conservation need and their habitats in Mississippi. Habitats that are identified as important for the animal species of special concern, and that occur in the Harris Bayou watershed include bottomland hardwoods, urban and suburban areas, cottonwood/black willow/river birch woodlands, sandbars, bald cypress/gum swamp forests, oxbow lakes, artificial ponds, ephemeral ponds, reservoirs?, and streams. These habitats are identified as being important for 11 of the animal species of special concern in Bolivar and Coahoma Counties (Appendix). Overall, the plan classifies all streams in the Delta as critically imperiled because of the widespread degradation of stream habitats in this region.

3.4 Recreation

There are very few opportunities for in-stream recreational use on Harris Bayou. Low water levels, flows, and dissolved oxygen during late summer months limit the existence of desirable fish species. Also, public access to Harris Bayou is very limited. Howden Lake is a public lake used for fishing.

4.0 STAKEHOLDER INTERESTS/ISSUES

4.1 Water Management

Water management issues include both flooding and drought. The stakeholders identified flooding as an issue in the Harris Bayou watershed, as well as the need for improved water use efficiency and storage capacity.

4.1.1 Locations Where Water Management is an Issue

Need info

4.1.2 Causes

During storms, water backs up and causes flooding. During the growing season, rainfall and surface water are not adequate to support crops.

4.1.3 Sources

Terrain in the watershed is relatively flat, making it less likely to drain well during storms. In addition, stakeholders have identified sedimentation as contributing to flooding by reducing the conveyance capacity of ditches and streams. Regional climate dictates the natural availability of water during the growing season.

Eight producers living in the Harris Bayou watershed identified watershed issues they would like addressed through a Watershed Implementation Plan. These included sediment, nutrients, pesticides, declining water table and stream flows, water management, loss of coastal marsh, and financing. This plan will also address the water quality impairments identified in the 2006 303(d) list for which TMDLs have been completed. These issues, and their causes and sources are discussed in greater detail below.

4.2 Water Level Declines

Groundwater levels in the Harris Bayou watershed have declined to the point that producers are having to dig deeper wells to access the water. Regional estimates of groundwater level change in the Delta indicate that between 1998 and 2008 the average groundwater level change in the area of the Harris Bayou watershed ranged from zero to 0.9 foot per year (YMD 2008). Stakeholders are also concerned about decreased water levels in the Sunflower River.

4.2.1 Locations Where Water Level Declines are an Issue

Groundwater levels are declining throughout the watershed (YMD 2008). Sunflower River?

4.2.2 Cause

Water is being withdrawn from the aquifer faster than it is being recharged.

4.2.3 Sources

Irrigation accounts for the majority of the ground and surface water withdrawals in the Harris Bayou watershed. As noted in Section 2.15, groundwater is also used to supply drinking water in the watershed.

4.3 Sediment

Stakeholders noted that sedimentation in ditches and streams contributes to flooding. They also expressed concern that the presence of RoundUp-resistant weeds in the watershed may result in increased cultivation (i.e., decreased no-till practice), which could increase erosion and sediment loads. MDEQ has determined that there is a high probability that sediment loads in Howden Lake, Richies Bayou, and Harris Bayou are at levels that interfere with fish and other wildlife. High sediment loads can affect aquatic life by causing reduced visibility (when the sediment is suspended in the water column) or by changing stream habitat when the sediment is deposited (e.g., covering spawning areas). The sediment TMDLs for these water bodies recommend that sediment loads to these water bodies be reduced, although the recommended reduction is not explicitly specified.

4.3.1 Locations Where Sediment is an Issue

Stakeholders identified drainage ditches and streams as places where sedimentation is an issue. MDEQ identified Howden Lake (oxbow lake near Alligator to Harris Bayou), and reaches of Richies Bayou (near Sherard from headwaters to confluence with Harris Bayou) and Harris Bayou (near Beverly from headwaters at Richies Bayou to the Big Sunflower River, including fork to Howden Lake), as areas where sediment was expected to be a water quality issue.

4.3.2 Cause

Sediment is the pollutant causing sedimentation and turbidity issues in these water bodies. Sediment is caused by erosion of soil particles from land surfaces in the watershed and detachment of soil from the banks and beds of water bodies. Soils in the watershed are erosive?

4.3.3 Sources

On the Mississippi 2006 303(d) list, nonpoint sources are listed as the sources of sediment causing the impairments in the listed water bodies in the Harris Bayou watershed. In the sediment TMDL that addresses these impairments, a number of likely sediment sources were identified. These included agriculture, construction sites, roads, urban areas, mass wasting, gullies, channel instability, channel modification, and historical land use activities. The majority of sediment loading to streams occurs during rain storms as a result of runoff and high velocity flows (references). Have locations of any of these conditions been identified in the watershed, or counts made?

4.4 Nutrient Enrichment

Stakeholders identified nutrients in runoff as an issue of concern. Stakeholders also expressed concern about the costs associated with variable-rate fertilizer applications. MDEQ has determined that there is a high probability that nutrient concentrations in Richies Bayou, Harris Bayou, and Howden Lake are at levels that can create conditions harmful to fish and other wildlife. High nutrient concentrations can support unusually high growth of algae or other aquatic plants. When the algae die, their decomposition uses oxygen from the water, which can result in low oxygen levels that are harmful to fish and other aquatic life. The TMDLs for these

water bodies recommend reductions of total phosphorus loads by around 95%, and reductions of total nitrogen loads by about 85% (see Table 2.X).

4.4.1 Locations Where Nutrient Enrichment is an Issue

Stakeholders did not identify specific locations where nutrients are a water quality issue. The following stream reaches were identified in the 2006 303(d) list as having impaired water quality due to nutrient enrichment:

- Richies Bayou from the headwaters near Sherard, MS to the confluence with Harris Bayou;
- Harris Bayou from the headwaters at Richies Bayou near Beverly, MS to the confluence with the Sunflower River; and
- All of Howden Lake.

4.4.2 Cause

Nitrogen and phosphorus are the pollutants that are suspected of causing eutrophic conditions in these water bodies with high productivity and low dissolved oxygen levels. Total nitrogen and total phosphorus are the species of these nutrients that were addressed in the TMDLs.

4.4.3 Sources

4.4.3.1 Point Sources

Two NPDES permitted point sources discharge to Harris Bayou or its tributaries. They are Farrell POTW (MS0045187), and Mascot Planting Company (MS0022225) (enSearch accessed July 2010). Both permits are for the discharge of treated domestic wastewater (i.e., sewage). The NPDES permit for the Farrell POTW includes limits for ammonia. The NPDES permit for the Mascot Planting Company does not include limits for nutrients. Treated domestic wastewater often contains phosphorus and other nitrogen species (e.g., nitrate).

Issues with the Farrell POTW?

4.4.3.2 Nonpoint Sources

Total nitrogen is a combination of the many forms of nitrogen found in the environment. Inorganic nitrogen can be transported in particulate and dissolved phases in surface runoff. Dissolved inorganic nitrogen can enter groundwater through infiltration, and may enter a water body through groundwater seepage or discharge. Finally, atmospheric gaseous nitrogen may enter a water body from atmospheric deposition.

Phosphorus is primarily transported in surface runoff when it has been sorbed to eroding sediment. Phosphorus may also be associated with fine-grained particulate matter in the atmosphere and can enter streams as a result of dry fallout and rainfall (EPA 1999). Phosphorus may also be contained in the surface runoff due to fertilizers and animal excrement or watersheds with naturally occurring soils that are rich in phosphorus (Thomann and Mueller, 1987). Watersheds with a large number of failing septic tanks may also deliver significant loadings of phosphorus to a waterbody. Phosphorus levels are also high in groundwater in the Delta, so phosphorus in surface waters can also come from groundwater seepage or discharge. USGS has an ongoing sampling program to quantify the cause of phosphorus in groundwater.

On the Mississippi 2006 303(d) list, nonpoint sources are listed as the sources of nutrients causing the impairments in Richies Bayou, Harris Bayou, and Howden Lake. In all three nutrient TMDLs, cropland was assumed to contribute the majority of the nutrient load to the water bodies (MDEQ 2008a,b,c). In addition, the majority of nutrient loading to streams comes from storm water runoff (reference). As noted in Section 2.5, there are approximately 56,837 acres of cropland in the Harris Bayou watershed. How many acres fertilized? How much fertilizer used annually? Septic systems? Groundwater nitrate concentrations? Atmospheric deposition?

4.5 Organic Enrichment and Low DO

The presence of high levels of organic material in water bodies can reduce water oxygen levels such that aquatic life cannot be supported. The TMDLs addressing these impairments state that reducing nutrient loads is expected to reduce organic enrichment and low dissolved oxygen conditions. Therefore, no reduction is specified in the TMDLs for organic material (TBODu).

4.5.1 Locations Where Organic Enrichment and Low DO are Issues

The following stream reaches were identified in the 2006 303(d) list as impaired due to organic enrichment and low dissolved oxygen:

- Richies Bayou from the headwaters near Sherard, MS to the confluence with Harris Bayou;
- Harris Bayou from the headwaters at Richies Bayou near Beverly, MS to the confluence with the Sunflower River; and
- All of Howden Lake.

4.5.2 Cause

The nutrient TMDLs assumed that nutrient enrichment was the cause of the organic enrichment and low dissolved oxygen conditions. As described in Section 4.2, high nutrient concentrations in a water body can encourage the growth of aquatic plants, which becomes organic material when it dies, and removes oxygen from the water as it decomposes. High levels of organic material decomposing in a water body deplete oxygen from the water suffocate aquatic life.

4.5.3 Sources

While nutrient enrichment is believed to be the primary cause of organic enrichment and low dissolved oxygen conditions cited for the listed water bodies, there are potential sources of organic matter in the watershed that may also contribute to these conditions. They are discussed below. See Section 4.2.3 for a discussion of nutrient sources in the Harris Bayou watershed.

4.5.3.1 Point Sources

Two NPDES permitted point sources discharge to Harris Bayou or its tributaries. They are Farrell POTW (MS0045187), and Mascot Planting Company (MS0022225) (enSearch accessed July 2010). Both permits are for the discharge of treated domestic wastewater (i.e., sewage). The NPDES permit for the Farrell POTW includes limits for oxygen demand and dissolved oxygen. The NPDES permit for the Mascot Planting Company also includes limits for oxygen demand (Table 4.1). While these types of discharges can deplete oxygen downstream of the discharge point, the effect is usually fairly localized.

4.5.3.2 Nonpoint Sources

Organic material, such as crop residue, leaves, and chaff, can be washed into the water body from the surrounding land. Sources can also include plants along the stream banks.

4.6 Pesticides

Stakeholders identified the potential for runoff to carry pesticides to ditches and streams as a concern. They also expressed concern that the presence of RoundUp-resistant weeds in the watershed may lead to increased herbicide application. A fish consumption advisory is in effect for long-lived pesticides in selected fish that covers all Delta streams and lakes, including those in the Harris Bayou watershed (see Section 2.7.2.4). Pesticide concentrations in soils, surface water and groundwater have not been identified as a health concern. Which fish are commonly caught in Harris Bayou, Howden Lake, and other water bodies in the watershed.

4.6.1 Locations Where Pesticides are an Issue

Legacy pesticides in fish are an issue for all Delta water bodies, including Harris Bayou, its tributaries, and all other water bodies in the watershed.

4.6.2 Causes

DDT and Toxaphene are the pesticides named in the Delta-wide fish consumption advisory. These pesticides degrade very slowly in the environment and are bioaccumulative, meaning they accumulate in living tissue and can be passed on to other organisms, including humans, through the food chain. Eventually, these pesticides can accumulate in certain fish species to the point that eating those fish can cause health problems in people. DDT and Toxaphene have been measured in fish tissue throughout the Delta at levels that may harm human health.

4.6.3 Sources

Stakeholders expressed concern about the potential for field applications of herbicides to contribute pesticides to surface waters. As weeds become resistant to commonly-used herbicides

such as RoundUp, application rates and frequency of herbicide applications can increase, which increases the potential for herbicides to enter surface waters.

DDT and Toxaphene are no longer used in the US. The use of DDT was banned in the US in 1973, and use of Toxaphene was banned in 1982. However, years ago, DDT and Toxaphene were commonly used on croplands in the Delta, including the 56,837 acres of cropland in the Harris Bayou watershed. Because it takes decades for these chemicals to degrade, they are still found in soils, sediments, and living organisms in the Delta. Recent measurements of concentrations of DDT and Toxaphene in fish tissue collected from the Delta indicate that concentrations of these pesticides are decreasing (reference). This suggests that the residual DDT and Toxaphene is finally breaking down into less harmful chemical components.

Table 4.1. NPDES permit limits for point sources of organic enrichment.

Discharge	Phase	BODs Limits		DO Limits
		Avg	Max	Min
Farrell POTW	I	45 mg/L	65 mg/L	report
	II	6 mg/L	9 mg/L	6 mg/L
Mascot Planting Company	NA	30 mg/L	40 mg/L	NA

5.0 RESTORATION AND PROTECTION GOALS

Use the 3 questions in a statement form the Delta Nutrient Reduction Strategy:

1. Determine the percent reduction of sediment N. Phosporus possible and increased water use effusing- can 80% N and 94% phosphorus reductions be attained? Can groundwater recharge be attained?
2. Determine what it costs.
3. Determine benefits to stakeholders.

6.0 TARGETING AND PRIORITIZATION

BMPs are being implemented in the Harris Bayou watershed through an EPA 319 grant, and through the MRBI. The prioritization and targeting processes used for these projects are described below.

6.1 Delta Nutrient Reduction Strategy

Nutrient loading in agricultural runoff varies by region, watershed, and individual field. The nutrient cycle in an agricultural watershed is an extremely complex system with many inputs and variables. To fully address the issue, a comprehensive approach must be used to ensure that all factors are considered. As part of the Delta Nutrient Reduction Strategy, the Site Characterization Work Group was tasked with developing a strategy to prioritize agricultural systems for nutrient reduction. Systems within the Harris Bayou watershed were classified based on soil type, cropping practices, and existing drainage infrastructure. Soils were classified as ***heavy*** (clays), ***medium*** (loams) ***light*** (sandy loams), and ***mixed*** (clay, loam, and sandy loams found in close proximity due to ridge and swale topography). Cropping practices were initially classified as ***irrigated*** or ***dry land***, and then by crop type - ***soybeans***, ***rice/soybean rotation***, ***cotton,*** or ***corn***. Drainage infrastructure was classified as ***developed*** or ***undeveloped***. Developed land typically consists of leveled or precision graded fields with pipes, pads, and tailwater ditches, or ridge and swale land that has been shaped to facilitate furrow irrigation. Undeveloped land includes areas with significant ridge and swale and/or that are subject to frequent flooding. These areas are not developed because the development cost exceeds the benefits that would be gained.

Two catchments were selected as "work areas" within the Harris Bayou watershed. These catchments are each characterized by a set of similar agricultural systems that are representative of the agricultural landscape throughout the watershed.

The "north site" (Attachment B) catchment is approximately 2,200 acres classified as *mixed, undeveloped* and *developed, irrigated* and *dry land,* in *corn, cotton, and soybeans*. This catchment is a representative sample of many catchments throughout the region. Drainage infrastructure is mostly un-improved, consisting of three large drainage ditches. Cropping

practices in the catchment primarily consist of conventionally farmed corn, cotton, and soybeans. The land is also mostly undeveloped, and the watershed is characterized by ridge and swale topography. This catchment also contains one point source facility of concern.

The "south site" (Attachment C) catchment is roughly 1,300 acres in size and was classified as *heavy, developed* and *undeveloped, irrigated land* ,in *rice/soybean* production. The catchment is drained by two tributaries that empty directly into Harris Bayou.

6.2 MRBI CCPI Priority Areas

Need info

6.3 MRBI/WREP Priority Areas

GIS analysis will determine the extent and location of existing land cover for wildlife and waterfowl corridors, including forest cover, riparian habitat, CRP and WRP contracts. These analyses will identify high priority gaps or fragmented areas in existing land cover for wildlife and waterfowl habitat and eligible landowners within these gaps or fragmented areas. Ranking criteria for high priority restoration and enhancement projects, developed by DW and MDWFP, include factors such as location, riparian buffers, water availability, proximity to other waterfowl habitat, and connectivity with surrounding habitat (see Appendix). The Forest Breeding-Bird Decision Support Model results will also be considered as part of the prioritization process. In consultation with local NRCS staff, these ranking criteria will be used to help prioritize sites, as well as existing WRP easements that would benefit from additional management.

7.0 MANAGEMENT

There are two underlying management principles of this WIP: ecosystem-based management and adaptive management. The goals and objectives of this plan reflect these principles. Each of these management principles is briefly described below, followed by watershed management actions that are planned for the near future to work toward the vision for Lake Washington. Goals related to other existing or potential concerns in this watershed will be addressed in future implementation plans.

7.1 Ecosystem-Based Management

Harris Bayou and its watershed represent the ecosystem management unit. Although bayous and lakes are typically considered the ecosystem, water bodies and their watershed cannot be divorced. Land use and land cover activities in the watershed directly or indirectly affect the water body. Sediment and nutrient loadings from the watershed drive many aquatic ecosystem processes, including both desirable and undesirable changes in the water body. The ecosystem, however, is characterized not only by its environmental attributes, but also by its socioeconomic attributes. Humans are part of, not apart from, aquatic ecosystems. Watershed management is fundamentally a social activity (Thornton and Creager 2001).

The benefits that accrue from reduced sediment and nutrient loadings to water bodies in the Harris Bayou watershed are not just in terms of increased water clarity, reduced sedimentation, reduced algal blooms, a more productive sport fishery, and greater recreational and aesthetic values. The agricultural community also benefits from reduced sediment and nutrient loadings. For example, Pimentel et al. (1995) estimated that each ton of sediment lost was worth about $6.75 per year to the farmer ($5.00 per ton for lost nutrients, and $1.75 per ton for lost soil and water capacity). The Delta sediment TMDL estimates that at least 0.007 tons per acre per day of sediment is lost. Based on this loss rate, just over approximately 183,000 tons of soil are lost from the Harris Bayou watershed each year (71,592 acres x 0.007), and the minimum estimate of dollars lost from the watershed is about $1.2 million per year. This is equivalent to just over $90,000 in lost nutrients from the watershed and just over $300,000 in lost sediment and water capacity. These estimates are very conservative because they are based on

yield from the watershed, not loss from the fields (field losses are higher than delivery to the waterbody). An ecosystem-based approach is being used for watershed management in the Harris Bayou watershed.

7.2 Adaptive Management Process

In addition to ecosystem-based management, an adaptive management process is being used for watershed management in the Harris Bayou watershed. Adaptive management is "learning by doing" and has become the recommended approach for ecosystem and natural resources management, including watershed management (Christensen et al. 1996; Holling 1978; Jackson et al. 2001). Adaptive management has helped shift management from the concept that there is a "balance of nature" to a more realistic concept that ecosystems are dynamic, non-equilibrium systems. The environment is continually changing – climate, development, agricultural practices, demographics, and societal values. Adaptive management is the only feasible approach for moving toward sustainable water resources (Coleman 1998).

Adaptive management, or learning by doing, means that periodic assessments must be made to determine if results-based criteria are being attained and if the water bodies and watershed are moving toward the desired vision for Harris Bayou and its watershed. The schedule for these periodic assessments and revision of the watershed management plan is discussed in Chapter 8. The rotating basin approach used by MDEQ is part of this periodic assessment process.

7.3 Planned activities

There are two key factors in this watershed that dictate which BMPs will be successful, *irrigation* and *development*. With development comes an increased financial investment by the landowner. As land cost increases, landowner willingness to implement edge of field BMPs decreases. This scenario calls for larger BMPs to be implemented in undeveloped areas that will treat runoff from upstream, developed areas. The less developed areas of the watershed are characterized by ridge and swale topography and there are more opportunities for BMP implementation. Low-lying swales are suitable for treatment wetlands, while unimproved

drainage ditches are prime candidates for low grade weirs, tail water recovery systems, and other BMPs.

Irrigation, particularly of rice, introduces an additional factor into the nutrient equation. Base flows in most Delta streams naturally decrease during the summer months due to less rainfall. Irrigation water supplements these base flows and often provides a constant source of runoff throughout the growing season. Although increased base flows benefit many aspects of stream health and water quality, it also reduces the ability of some BMPs to trap nutrients. For example, multiple low grade weirs are designed to trap and pool runoff allowing biological transformations to occur. With a steady base flow the utility of these in-stream BMPs can be diminished. To effectively treat this type of runoff, BMPs should be capable of treating or reusing large volumes of water. Therefore, for areas of the watershed characterized by both development and irrigation, treatment wetlands and/or tail water recovery systems will be the primary BMPs.

Given these considerations, the management practices currently targeted for the Harris Bayou watershed include:

- Nutrient and sediment BMPs,
- Enroll lands in WRP,
- Water management projects, and
- Sewage management.

7.3.1 Nutrient and Sediment BMPs

Two catchments of Overcup Bayou, a tributary of Richies Bayou, have been targeted for monitoring and installation of BMPs to reduce nutrient and sediment loads in cropland runoff. Specific BMPs that will be installed in these catchments include low-grade weirs, pipes and pads, treatment wetlands, and tailwater recovery systems. Low-grade weirs, pipes and pads, and tailwater recovery systems will be discussed in this section of the plan. Wetlands will be discussed in Section 7.3.2.

7.3.1.1 Low-grade Weirs

Installation of low-grade weirs in agricultural drainage ditches can improve water quality through removal of sediment and nutrients. The weirs slow flow during storm events and allow sediment to be deposited. In addition, holding water in the ditches behind the weirs creates environments that encourage biogeochemical transformation of nutrients, as well as contribute to groundwater recharge (Kroger et al 2008a). One study in the Delta determined that low-grade weirs reduced annual phosphorus loads from cropland runoff by over 40% (Kroger et al. 2008).

Low-grade weirs will be installed in several ditches in the Overcup Bayou catchment (a tributary to Richies Bayou). These ditches are associated with approximately ?? acres of cropland. Estimated pre-installation nutrient loads from these lands, along with the estimated potential load reductions, are shown in Table 7.?. Sediment loads estimates?

The cost of installing and maintaining these weirs is estimated to be ??. The weirs will be designed by MSU and installed by landowners with assistance from MSU, NRCS, and Delta Wildlife. Financial assistance for installation and maintenance of the weirs will be provided by NRCS through the EPA Section 319 grant program.

7.3.1.2 Tailwater Recovery

A tailwater recovery system will be installed in the northern Overcup catchment in the summer of 2010. This system will recover drainage from approximately ?? acres of cropland in this catchment. In addition to water quality improvement, tailwater recovery ponds can benefit several of the species of concern identified in Section 3.3.

Other installs under CCPI?

7.3.1.3 Pipes and Pads

Need info

7.3.2 Enroll Lands in WRP

Natural and constructed wetlands have been shown to improve water quality through removal of sediment and nutrients (references). Slower flow through the wetlands allows sediments to be deposited. Nutrients are used by wetland plants, and sorbed by wetland soils. The wet environment encourages biogeochemical transformation of nutrients. In addition, wetlands contribute to groundwater recharge.

Approximately 7,905 acres of wetlands currently exist in the Harris Bayou watershed. It is estimated that approximately ?? acres of wetlands will be restored and/or created in the Harris Bayou watershed. Acres of cropland associated with (i.e., runoff load input)? WQ improvement? Water storage, recharge? In addition to water quality improvement and groundwater recharge, restored and constructed wetlands can benefit several of the species of concern identified in Section 3.3. For example, wetlands can provide wintering habitat, migratory stop-over sites, late summer/fall foraging sites, and breeding/nesting habitat for a number of waterfowl, forest, and migratory bird species.

Delta Wildlife (DW) and Mississippi NRCS will assist with design of constructed wetlands. Mississippi Department of Wildlife Fisheries and Parks (MDWFP) will assist with development of management plans for both restored and constructed wetlands. Financial assistance for design, installation, and maintenance of restored and constructed wetlands will be available from the NRCS Mississippi River Basin Initiative through the Wetland Reserve Enhancement Program.

7.3.3 Water Management Projects

Water management activities anticipated for Harris Bayou include installation of water control structures on Harris Bayou, tailwater recovery systems, off-channel storage, and the PHAUCET irrigation computer protram. Tailwater recovery systems are described in Section 7.3.1.2. The remaining activities are described below.

7.3.3.1 Harris Bayou Water Control Structures

In 2008, the YMD funded preliminary design of water control structures proposed for Harris Bayou downstream of Highway 61 (YMD 2008). The purpose of this project is to provide

in-stream storage for surface water withdrawals, and to augment Sunflower River flows in the fall. Three rock riprap weirs were proposed to be installed in Harris Bayou at approximately river miles 37, 184, and 432. The weir farthest upstream would increase water levels in Harris Bayou by two feet. The other two weirs would raise Harris Bayou water levels five feet (YMD 2008).

7.3.3.2 Off-channel storage

Off-channel water storage will be added in the Harris Bayou watershed through installation of tailwater recovery impoundments (see Section 7.3.1.2), and restoration and construction of wetlands (see Section 7.3.2).

7.3.3.3 PHAUCET

YMD is working with producers in the Delta to implement the NRCS PHAUCET Irrigation Computer Program. This program helps producers design flat poly pipe furrow irrigation systems by identifying the appropriate hole sizes to punch in the pipe based on variables such as the well pump rate, field slope, row lengths, and size of poly pipe (YMD 2009). This design assistance is expected to reduce water usage. Feedback from producers who have used PHAUCET has all been positive (YMD 2009).

7.3.4 Sewage Management

Farrell WWTP?

7.4 Schedule

Table 7.? Below summarizes the implementation schedule for the management actions discussed above.

Table 6.? Schedule summary.

Management Action	Milestones	Start Date	End Date
BMP evaluation project	Install low-grade wiers and tailwater recovery system in north catchment		
	install low-grade weirs in south catchment		
	post installation monitoring		
WREP enrollment project	targeting of catchments in Sunflower River watershed		
	Contact targeted landowners		
	Targeted lands enrolled in WREP		October 2013
	Design of constructed wetlands		
	Develop wetland management plans		
	Wetlands constructed		
	Biennial inspections		October 2016
	paid wetland maintenance		October 2016
Water Management			
Sewage Management			

7.5 Budget

Table 6.?, below, summarizes the budget information for the management actions discussed above.

Management Action	Activities	Budget	Funding Sources
BMP evaluation project	Install low-grade wiers and tailwater recovery system in north catchment		319 grant with Delta FARM, producer
	install low-grade weirs in south catchment		319 grant with Delta FARM, producer
WREP enrollment project	targeting of catchments in Sunflower River watershed		MRBI WREP grant with Delta Wildlife and MDWFP
	Contact targeted landowners		
	Targeted lands enrolled in WREP		
	Design of constructed wetlands		
	Develop wetland management plans		
	Wetlands constructed		
	Biennial inspections		
	paid wetland maintenance		
Water Management	Harris Bayou water control weirs		YMD
	Tailwater recovery		MRBI CCPI grant with Delta Wildlife and MDWFP, 319 grant with Delta FARM, producer
	re-lift systems		MRBI CCPI grant with Delta Wildlife and MDWFP
	off-channel storage		MRBI CCPI grant with Delta Wildlife and MDWFP, MRBI WREP grant with Delta Wildlife and MDWFP, 319 grant with Delta FARM, producer
	PHAUCET		NRCS, YMD, producer
Sewage Management			

8.0 AWARENESS EDUCATION AND OUTREACH

8.1 Goals

Need

8.2 Management Team

Need info

8.3 Survey

Need info

8.4 Nutrient and Sediment BMPs

The landowners in the targeted catchments were contacted to provide input on issues they perceived and would like addressed in the management plan. The data gathered from the monitoring will be used to inform producers in the area, and the BMP sites will be included on informative tours for Delta farmers.

8.5 WRP Enrollment

As part of its MRBI project, DW will prepare a brochure that describes the WREP objectives, available funds for both enhancement and protection/restoration, WRP process of enrollment, and general management requirements. The brochure will be distributed to all potential WRP land owners, including landowners currently under WRP contracts (are there any in Harris Bayou watershed?). The most effective outreach efforts are those that work one on one with individual landowners, which is the process that will be used by both DW and MDWFP. DW will work with individual landowners first, to enroll in WRP and contract for wetland easements in perpetuity, or at least for 30 yr. Once the contracts are signed, DW will work with NRCS engineers, and the individual landowners to design and construct the WRP project, ensuring compatibility with farming practices, and providing insight and information on how wetland functions benefit the landowner. In addition, ancillary benefits the landowner receives

by having the WRP project on their property will be described and documented. MDWFP will work with NRCS engineers and the individual landowners in developing and implementing the WRP management plan. This will include annual consultation and inspections for 3 years to make any needed mid-course changes in management practices, or reinforce the need for specific management actions.

Personal contact with individual landowners and producers through annual inspections will be used to increase their awareness of the benefits of the wetlands to them. The success stories and value of wetland ecosystem services will be published in producer magazines, DW, MDWFP magazine articles and brochures, included on their web sites, documented through NRCS Fact Sheets, presented at agricultural conferences/meetings, included in MSU Cooperative Extension Farm Day Demonstrations, and disseminated through any other information sources that will increase stakeholder awareness and outreach. Sustaining both the wetland functions and management activities over time will be significantly enhanced with three years of individual landowner outreach on wetland management. After three years, the wetlands will be established and close to being self-sustaining. Further, after 3 years of individual consultation and encouragement, landowner management activities are expected to become part of their routine farming practices. Through the MDEQ 319 program, ecosystem services and associated benefits will be quantified and provided to DW and MDWFP for distribution and discussion with the individual land owners. Finally, exceptional WRP projects will be nominated for Ducks Unlimited, Partners in Flight, and similar national and international program awards that acknowledge landowner stewardship and leadership.

8.6 CCPI Projects

Need info

8.7 Schedule

The schedule for education and outreach activities is summarized in Table 8.1.

Education, Outreach Activity	Milestones	Start Date	End Date
Management Team			
Survey			
319 Project			
WRP Enrollment			
CCPI Projects			

8.8 Budget

Budget information for education and outreach activities is summarized in Table 8.2.

Education, Outreach Activity	Budget	Funding Sources
Management Team		319 grant with Delta FARM, MRBI CCPI grant with Delta Wildlife
Survey		319 grant with Delta FARM
319 project		319 grant with Delta FARM
WRP Enrollment		MRBI WREP grant with Delta Wildlife and MDWFP
CCPI Projects		MRBI CCPI grant with Delta Wildlife and MDWFP

9.0 EVALUATION

9.1 Monitoring

9.1.1 Water Quality

A water quality monitoring plan has been implemented for evaluating the impacts of BMPs to be installed in the Overcup Bayou catchment (see Appendix). This monitoring is being conducted by USGS and MSU and funded by NRCS and Delta Wildlife through the EPA 319 grant program. This monitoring will also contribute to the MRBI tiered monitoring program to document reductions in sediment, N, and P in the Big Sunflower River watershed. The edge of field monitoring will be considered Tier 1, and the ditch monitoring will be Tier 2. USACE is monitoring Tier 3 sites on Harris Bayou and the Big Sunflower River. MDEQ, COE, USGS, MSU, and DW are monitoring flow, sediment, N, and P, and other constituents during both base flow and storm flow, prior to, and after, construction and implementation of conservation management practices to determine the resulting percent reduction in sediment, N, and P.

Sewage management

CCPI projects

9.1.2 Habitat

WREP projects in the Harris Bayou watershed will be monitored for habitat enhancement. MDWFP and DW will conduct bi-annual management inspections and consultations (spring and fall) with the landowner for 3 years as the wetland becomes established or enhanced. GIS coverage will track improvements in green infrastructure and corridors for waterfowl and wildlife throughout the 4 year period in which wetland ecosystems are restored and enhanced. DW/MDWFP cash will be used to document increased waterfowl, wildlife, and migratory songbird use of restored/enhanced wetland acreage and reconnected corridors. Restored/enhanced wetlands will be categorized by type and location throughout the Delta. Spring and fall waterfowl, wildlife, and bird counts will be conducted for each of the restored/enhanced wetlands. One quarter of the wetlands will be monitored each year. Monitoring initiation will begin in the second year of management following completion of construction. All wetlands will be monitored by the conclusion of the project in 2016.

Waterfowl, wildlife and migratory songbird use will be related to factors such as wetland type, location, and management practices and documented in a management report.

9.1.3 Water Levels

Ground water levels in Harris Bayou watershed are routinely monitored at selected wells by YMD. YMD surveys water levels in 550 wells throughout the Delta every year in the spring and fall (YMD 2008). There are no USGS continuous ground water monitoring wells located in the Harris Bayou watershed, although there are two wells located near Clarksdale.[6]

Surface water levels do not appear to be routinely monitored at any water body in the Harris Bayou watershed. Water levels in the Sunflower River are monitored by a USGS gage downstream of Harris Bayou at Sunflower.[7]

9.1.4 Water Use Survey

YMD conducts an annual water use survey for the five major crop types in the Delta – corn, cotton, soybeans, rice, and catfish. Between 100 and 150 sites are surveyed each year. Irrigation water volumes are estimated based on pump flow rate and monthly electricity usage.

[6] http://waterdata.usgs.gov/ms/nwis/gw
[7] http://waterdata.usgs.gov/ms/nwis/dv/?site_no=07288500&referred_module=sw

9.1.5 Schedule

The schedule for monitoring activities is summarized in Table 9.1.

Monitoring Activity	Milestones	Start Date	End Date	Frequency
Water quality	pre-implementation monitoring north catchment	March 2010	July 2010	monthly and during storms
	post-installation monitoring north catchment	August 2010	August 2013	
	pre-implementation monitoring south catchment	March 2010	March 2011	
	post installation monitoring	April 2011	April 2014	
Wetland habitat	monitor wildlife use of constructed and restored wetlands			
Water level	Ground water levels	1990s	TBD	bi-annual
Water use	water use survey	2002	TBD	monthly data collection Apr - Sep

9.1.6 Budget

Budget information for monitoring activities is summarized in Table 9.2.

Monitoring Activity	Budget	Funding Source
Water quality		319 grant with Delta FARM, MRBI CCPI grant with Delta Wildlife and MDWFP
Wetland habitat		Delta Wildlife and MDWFP
Ground water levels		YMD
Water use		YMD

9.2 Criteria

9.2.1 Nutrient targets

The nutrient TMDLs completed for Harris Bayou water bodies used preliminary annual average concentration targets of 1.05 mg/L for TN, and 0.16 mg/L for TP (MDEQ 2008a,b,c).

9.2.2 Sediment

The targeted sediment yield range developed for Delta streams is 0.0014 to 0.0045 tons per acre per day at the effective discharge (MDEQ 2008d).

9.2.3 Water Levels

Need info

9.3 Assessment

Implementation milestones and schedules have been developed for the management actions and education and outreach activities described in this plan. This information is summarized in Table 7.? for use in tracking and evaluating implementation of this plan. For implementation to be considered successful, all activity milestones must be met on time. The Team will meet quarterly to review progress on achieving the milestones and make needed adjustments to the schedule. Each Team member serves as the chair for one of the major management categories, such as sewerage, sediment and nutrient loading, etc. There is a subcommittee associated with each of these categories to ensure that the management actions are implemented.

9.3.1 Plan

Specific management action schedules toward achieving the vision for the Harris Bayou watershed are described in Chapters 7.0 and 8.0 and summarized in Table ?. If the schedules are not being met, the causes behind the failure to meet the goals will be determined, and actions will be taken. Specific management action goals and/or expectations are described in Chapter 7.0.

9.3.2 Education and outreach

Specific goals and/or expectations for education and outreach activities are described in Chapter 8.0. If the activity goals were not met, the causes behind the failure to meet the goals will be determined. In addition, the plan activities will be evaluated with regard to information and knowledge about the watershed and its waterbodies that has been gained since the existing plan was developed, as well as any relevant physical changes in the watershed or changes in policy affecting the watershed. Implementation of the activities will be reevaluated in light of all of this information on a quarterly basis, as discussed above.

9.3.3 Budget and Funding

10.0 PLAN REVISION

After evaluation, the Team will prepare a revised WIP, incorporating the changes requested by the reviewers and reconciling any conflicting comments or requests for change.

If the evaluation criteria are all being met for Harris Bayou watershed, the WIP will be revised to address different restoration issues, and to continue activities that protect the water quality of the lake. If the evaluation criteria are not being met, the approach for restoring Harris Bayou watershed quality will be revised based on knowledge that has been gained since 2007. The draft of the revised WIP will be completed one month after the evaluation has been completed.

The draft WIP will be submitted to the Team and all others who submitted comments. Within two weeks of receiving the draft WIP, the Team will notify their stakeholders of the availability of the revised WIP for stakeholder review. One month will be allowed for review of the draft. Comments will be due at the end of this review period. Within a month after the comments on the draft WIP are received, the Team will prepare a final updated WIP. The updated WIP will be submitted to the Team for review and approval. After the updated WIP has been approved, the Team will notify their stakeholders of the completion and availability of the updated WIP for use as a guide to watershed restoration and protection activities.

The plan will be reviewed and revised following the MDEQ Rotating Basin schedule for the Yazoo River Basin. This will permit the Team to incorporate monitoring information and assessment reports prepared by MDEQ. This approach also is consistent with adaptive management and the process used by the Team for managing Harris Bayou watershed.

Budget and funding

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