DEVELOPMENT PLAN FOR A STATEWIDE WETLAND AND RIPARIAN MAPPING, ASSESSMENT AND MONITORING PROGRAM

2009 - 2015

MONTANA
Natural Heritage
Program

EXECUTIVE SUMMARY

The wetland goal for Montana is no overall net loss of the state's remaining wetland resources as of 1989 and an overall increase in the quality and quantity of wetlands in Montana. To this end, the Montana Wetland Council developed a five-year (2008-2012) strategy, *Priceless Resources: Strategic Framework for Wetland and Riparian Area Conservation and Restoration in Montana (2008-2012).*

Strategic Direction #3 in the Framework covers Mapping, Assessment, and Monitoring and provides that:

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> **The MWC will complete and maintain statewide mapping and condition assessment monitoring programs to conserve and restore wetlands and riparian areas.**
>
> **Ideal Outcome:** Decision-makers, resource managers, and the public have up-to-date statewide National Wetland Inventory and National Riparian Maps in digital format, and rely on a field-based monitoring program that assesses the condition of these resources for making decisions about wetland conservation and restoration.

The recommended action to attain this outcome is:

> "Urge wetland scientists and agencies with monitoring and assessment responsibilities to work with the MTNHP [Montana Natural Heritage Program] to develop a strategy, tools, and schedule to implement a statewide wetland condition monitoring and assessment program. This will be based on EPA's recommended elements."

In furtherance of the Strategic Framework and the no net loss goal, the Montana Natural Heritage Program (MTNHP) has created a Development Plan for a Wetland and Riparian Mapping, Assessment and Monitoring Program, to be carried out by the MTNHP and its partners. The elements of this Development Plan are based on the Environmental Protection Agency's (EPA) document *Application of Elements of a State Water Monitoring and Assessment Program for Wetlands* (2006). By following the EPA's core elements, the Plan will lead to increased knowledge about the ambient condition of wetlands and riparian resources in the state, a more refined ability to identify stressors that directly and indirectly affect wetlands, improved capacity to prioritize areas that need protection or restoration, and greater precision in evaluating the success of management activities.

There are several overarching goals for this Development Plan, including 1) identification, mapping and classification of wetlands and riparian areas; 2) characterization of their ecological integrity and associated functions; 3) establishment of a reference network of sites reflecting the range of conditions for all wetland and riparian ecological systems occurring in the state; 4.) facilitating the incorporation of monitoring and assessment data into the overall statewide water quality monitoring strategy; 5) the creation and refinement of assessment tools that can be adapted or adopted in whole or part by regulatory programs, private sector consultants, researchers, and state, tribal and federal agencies to ensure a consistent regional context for decision making; 6) the development of database and web platforms for data management and dissemination.

This Development Plan is intended to guide the further refinement of a multi-tiered assessment framework to support wetland protection and restoration efforts, as well as future research, integration of assessment data into management plans, and programmatic needs for achieving the objectives of Strategic Direction # 3.

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1.0 INTRODUCTION

1.1 Background

In 2008, the Montana Wetland Council finalized the document *Priceless Resources: Strategic Framework for Wetland and Riparian Area Conservation and Restoration in Montana (2008-2012)*(hereinafter called 'the Framework"). The Framework was created by a working group consisting of state, tribal and federal government agencies, watershed groups, private consultants and other stakeholders involved in wetland and riparian conservation, organized by the Wetlands Program of the Montana Department of Environmental Quality.[1] The Framework was approved by the Governor and Directors of all five state natural resource agencies and serves as a blueprint for protection of Montana's wetlands and riparian areas. It includes eight Strategic Directions aimed at achieving the goal of the MWC, which is "no overall net loss of the state's remaining wetland resources as of 1989 and an overall increase in the quality and quantity of wetlands in Montana." The eight Strategic Directions include:

1. Public education
2. Professional training
3. Mapping, monitoring and assessment
4. Restoration
5. Assistance to local governments
6. Vulnerability evaluations
7. Public policy development
8. Montana Wetland Council effectiveness

Strategic Direction # 3, Mapping, Monitoring, and Assessment, provides that
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> **The MWC will complete and maintain statewide mapping and condition assessment monitoring programs to conserve and restore wetlands and riparian areas.**
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> **Ideal Outcome:** Decision-makers, resource managers, and the public have up-to-date statewide National Wetland Inventory and National Riparian Maps in digital format, and rely on a field-based monitoring program that assesses the condition of these resources for making decisions about wetland conservation and restoration.

[1] This is distinct from The Montana Department of Environmental Quality (MTDEQ)'s statewide Water Quality Monitoring and Assessment Strategy (2009-2019). That strategy is a long term implementation plan for monitoring and assessing water resources in Montana, and lists wetlands as the state's lowest priority for water quality monitoring. However, the Wetlands Protection Section (2.3.2) does reference the Strategic Framework.

The Strategic Direction then outlines six specific needs:

1. wetland mapping;
2. a wetland reference network
3. mitigation site monitoring
4. voluntary restoration monitoring
5. baseline condition assessments and
6. integration with other department monitoring activities.

One of the actions in Strategic Direction # 3 is to:

> "Urge wetland scientists and agencies with monitoring and assessment responsibilities to work with the MTNHP [Montana Natural Heritage Program] to develop a strategy, tools, and schedule to implement a statewide wetland condition monitoring and assessment program. This will be based on EPA's recommended elements."

The Montana Natural Heritage Program, a program of the Montana State Library operated by the University of Montana, is engaged in development of a comprehensive wetland science program focusing on statewide wetland/riparian mapping and assessment, capacity building for tribes and watershed groups, and creation of Montana-specific restoration resources. This work has been supported by EPA Wetland Program Development grants, and by partner funding from multiple local, state, tribal, federal and private partners. The purpose of this Development Plan is to describe the strategy, tools and schedule that we intend to use to carry out the actions described in Strategic Direction # 3.

It should be emphasized that this plan specifically addresses actions to be undertaken by the MTNHP, and in no way binds any other agency, tribe, or other entity to adopt or endorse the strategies and methods laid out herein. The Montana Wetland Council's Mapping, Monitoring, and Assessment Work Group includes stakeholders from both regulating and regulated bodies, as well as state, tribal, and federal agencies charged with land and resource management, academic researchers, non-governmental organizations, and private enterprises. Each of these stakeholders will have specific needs that require specific mapping, assessment and monitoring plans. However, we believe that a comprehensive, statewide mapping, assessment and monitoring program can provide critical baseline information, management guidance, and tools that can be used by individual stakeholders to further their particular objectives, while promoting collaboration, data sharing, and protection of wetland and riparian resources.

1.2 Objectives and Outcomes

For any mapping, assessment and monitoring program to be successful, there must be clear program objectives. The overall objectives of this Development Plan are to increase the existing knowledge base about wetland and riparian ecosystems in the state, enhance wetland protection, support regulatory and management decisions, and help prioritize and monitor restoration activities. Specific objectives include:

a. Support management, planning, mitigation and restoration efforts through consistent and accurate statewide digital maps of all wetlands and riparian areas greater than 1/10 of an acre in size.
b. Expand understanding of wetland ecology and functioning by identifying and describing the range of natural variability in wetland ecological systems in Montana;
c. Evaluate and describe the impacts of human activities on wetlands and riparian areas.
d. Enable the collection of data to track and predict the impacts of climate change, drought and changing water supply on the functions and ecological integrity of wetlands and riparian areas.
e. Identify effective performance standards, monitoring tools, and management practices to enhance the effectiveness of compensatory and voluntary mitigation, restoration planning and resource management.
f. Promote data exchange and information sharing across jurisdictions
g. Facilitate identification and protection of high-quality sites, sites of ecological importance and particularly vulnerable wetlands
h. Encourage multi-jurisdictional efforts to address threats to wetlands and riparian areas.

Intended outcomes include:

a. Federal, state, local, tribal and non-governmental resource managers and other stakeholders will know the type, extent and distribution of wetlands and riparian areas within their management units;
b. Federal, state, local, tribal and non-governmental resource managers and other stakeholders will be able to compare the condition of wetlands and riparian areas within their management units to appropriate reference standards and to condition in relevant basins and watersheds;
c. Agency, academic and private researchers will be able to test, validate and calibrate assessment metrics on reference standard wetlands;
d. Regulatory authorities will be able to identify reference water quality condition for wetlands with standing water;
e. Restoration and mitigation practitioners will be able to identify benchmarks to assist in evaluating effectiveness of compensatory and voluntary mitigation and restoration;
f. Land managers will have scientifically-based information to support development and implementation of best management practices;
g. Federal, state, local, tribal and non-governmental resource managers will be able to exchange wetland and riparian assessment and monitoring data as appropriate to their individual needs and objectives.
h. Increased awareness of threats to wetlands and riparian areas will promote widespread adoption of the no net loss goal.

2.0 ELEMENTS OF THE MTNHP'S STATEWIDE MAPPING, ASSESSMENT AND MONITORING PROGRAM

2.1 Mapping

The National Wetland Inventory (NWI), completed in the 1980s and 1990s, was never fully digitized for Montana, so large areas of Montana have no wetland GIS data available. In addition, the old maps captured only wetlands, ignoring the riparian areas that provide vital economic and environmental functions. Therefore, the MTNHP's Wetland and Riparian Mapping Center (WRMC) was initiated in 2006. The WRMC is currently in the process of creating up-to-date statewide National Wetland Inventory (NWI) and National Riparian Maps in a digital format that adhere to strict mapping guidelines set up by the U.S. Fish and Wildlife Service (USFWS) and the Federal Geographic Data Committee (FGDC) to ensure consistency of mapping both statewide and nationally. The goal of the WRMC is to complete statewide mapping by 2015.

The core mapping schedule will generally follow the rotating basin assessment schedule described below. However, to support the cost of mapping, the MTNHP has pursued funding partnerships with state, federal, tribal, local, non-governmental and corporate partners. These partnerships have allowed mapping of over one million acres of wetlands and riparian areas, and funding arrangements are in place to complete approximately 60% of the state. To meet those partners' specific needs, the MTNHP will endeavor to maintain a mapping staff capable of completing specific projects in areas designated by the funding partner while still pursuing systematic statewide mapping. Furthermore, there are large areas of Montana where governmental and tribal land ownership is low, and no funding partnerships exist. With the support of the Montana Wetlands Council and the MTDEQ Wetlands Program Coordinator, Wetland and Riparian Mapping has been identified as one of the 13 statewide GIS layers in the Montana Spatial Data Infrastructure. Each year, the MTNHP will consult with MWC partners to identify areas where wetland and riparian mapping is needed to achieve conservation goals, but for which specific agency funding is unlikely to be available. The MTNHP will seek state funding under the Montana Land Information Act to map these areas.

2.2 Preliminary Assessment Phase

2.2.a. Identification and Description of Reference Standard for Wetlands and Riparian Areas

In 2008, the MTNHP was awarded a USEPA Wetlands Program Development Grant (WPDG) to create a statewide network of reference wetlands reflecting the range of herbaceous wetland

ecological systems[2] found in Montana and the full gradient of human-induced disturbance, from unimpaired to degraded. This project will be complete by June 30, 2010.

In 2008, with funding from the USEPA Office of Water, the MTNHP partnered with the Colorado Natural Heritage Program (CNHP) and the Wyoming Natural Diversity Database (WYNDD) to identify and document the reference standard for four wetland and riparian ecological systems found across the Rocky Mountain West: freshwater marshes; fens; wet meadows; and subalpine/montane riparian shrublands. This project will be completed by 2011.

In 2009, the MTNHP was awarded a USEPA WPDG to evaluate the condition of riparian forests and wetlands along Montana's large rivers. Because of the development that has occurred along the large rivers, it is unlikely that reference standard forests and wetlands will be found. However, the project will attempt to describe a least-disturbed standard for those systems.

In 2010, with funding from Montana Fish, Wildlife and Parks, the Montana Land Information Act Council, and the USEPA, the MTNHP completed a Field Guide to the Ecological Systems of Montana. This field guide contains detailed descriptions of sixteen wetland and riparian ecological systems, crosswalked to the NWI classification system and the National Vegetation Classification Standard. It is available online at: http://fieldguide.mt.gov/displayES_LCLU.aspx.

In 2011, the MTNHP expects to partner with MT DEQ and the Fort Peck Tribe to carry out National Wetland Condition Assessment field work in Montana. These sites will also be included in our reference network Depending on funding, further work under this Development Plan will include:

- Map enhancement and fieldwork to assist in identification and description of reference standard for vulnerable and ecologically significant wetlands, e.g., groundwater-dependent ecosystems, headwater wetlands, woody wetlands (including beaver ponds), and open water systems
- Development of keys and resource materials to assist in field classification of wetland and riparian systems, and crosswalking to other classification schemes.

2.2b Development of a Rotating Basin Assessment Approach

In 2009, with funding from a USEPA WPDG, the MTNHP initiated a long term rotating basin assessment and monitoring program. This program is intended to be a cornerstone of this Development Plan, and to address the core objectives and outcomes laid out in Section 1a.

[2] Ecological systems are groupings of biological communities occurring in similar physical environments, and influenced by similar ecological processes such as flooding, fire, wind, and snowfall. The ecological system concept was developed to provide a mappable unit that could be classified from aerial or satellite imagery, and that would be easily identifiable in the field by land managers, resource specialists, and planners (Comer et al. 2003). Systems typically occur on a landscape at scales of tens to thousands of acres, and generally persist in a recognizable state for 50 or more years.

The rotation is organized so that each year, wetland assessments are conducted within basins where mapping is sufficiently advanced to use a probabilistic survey design that allows us to draw statistically valid conclusions about the condition of wetlands in that basin, using the methods described in section 3.0 below. During that same year, mapping efforts are intensified in a separate basin, so that assessments can be carried out in that separate basin the following year.

The goal is to complete a baseline assessment of wetland condition across Montana by 2014. The initial basins chosen for this project were the Milk, the Marias and the St. Mary's (Figure 1). Wetlands were assessed using the EPA's recommended three-tiered assessment approach. Level 1 (GIS-based) assessments were carried out on 1,000 randomly selected wetlands. Level 2 (Rapid) assessments were conducted on 100 of these. Level 3 (Intensive) assessments were used on 30 wetlands.[3] The Blackfeet Tribe partnered with the MTNHP to complete the three-tiered assessment method on their reservation using the same protocols and sampling design. The BLM also took part in this project by funding Proper Functioning Condition assessments of those wetlands found on BLM lands. The report on this project will be released in June of 2010.

In 2010, the MTNHP was awarded another USEPA WPDG and a small grant from the BLM to continue to develop this program in Southwest Montana (Figure 2) and to complete mapping in Southeast Montana in preparation for the third phase of the rotating basin assessment in 2011. We have partnered with the Custer National Forest, the BLM, and the EPA to ensure that this mapping can be completed.

Partner input has suggested that the 2012 assessment basins be located in Northwest Montana. We are currently pursuing funding from multiple partners to map those basins, and will seek additional support from WPDG to carry out the baseline assessments. This would mean that 2013 assessments would be conducted in Yellowstone and Missouri Basins of Central Montana. This is currently the area of the state with the least mapping; however, by 2013, we anticipate that we will have mapped enough of the area to allow for a probabilistic assessment. Finally, in 2014, we will assess condition in the Northeast corner of the state. This would complete the initial phase of the Plan (Figure 3).

Concurrently with our rotating basin assessments of wetlands, the MTNHP has begun surveying the condition of riparian areas along the large river valleys of Montana. This project, funded by a 2010 WPDG, will complement the wetland surveys by profiling riparian and wetland extent and structure on these floodplains (Figure 4). The project is also intended to develop and pilot a new approach to Level I assessment, using GIS-based metrics. These metrics will evaluate the feasibility of inferring riparian and wetland condition from the size, composition, and patterns of vegetation seen in aerial imagery. Field verification will be conducted using a semi-rapid assessment protocol (Appendix 2).

[3] Rapid assessments were also conducted in riparian areas along the Marias River, using a prototype rapid assessment tool adapted from the Level II wetland assessment protocol.

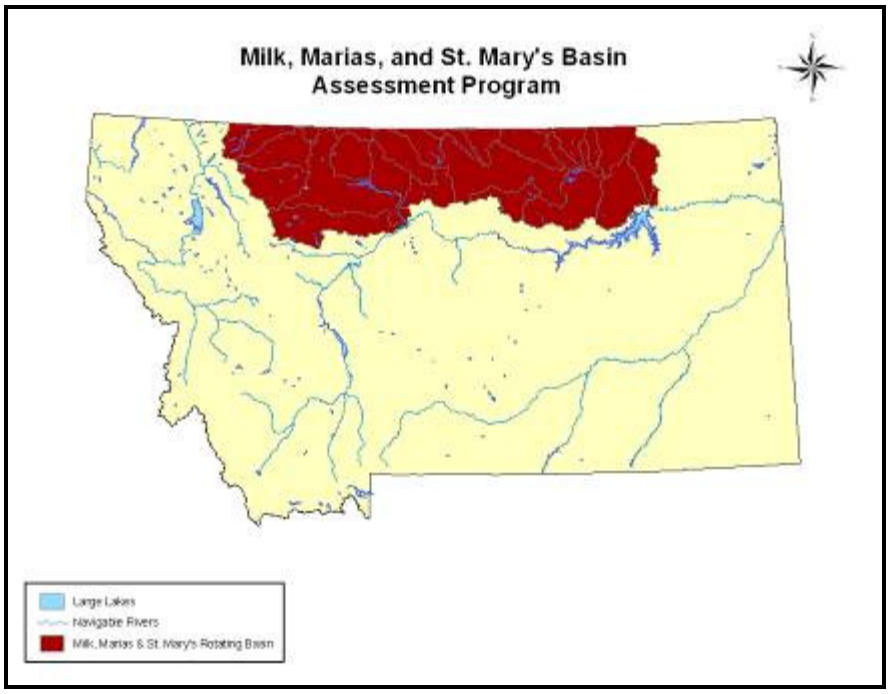

Figure 1. Milk and Marias Assessment Project Area

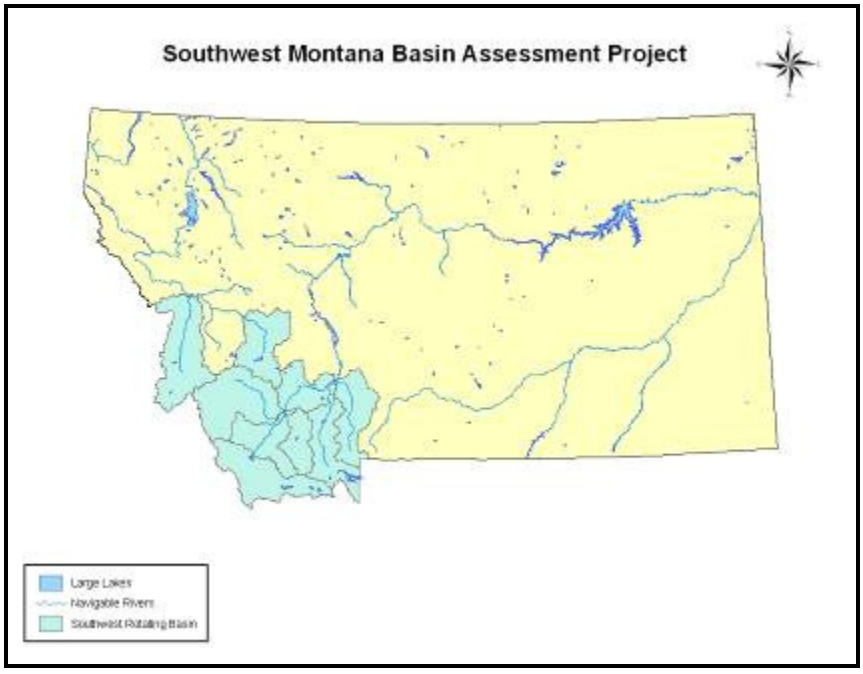

Figure 2. Southwest Montana Assessment Project Area

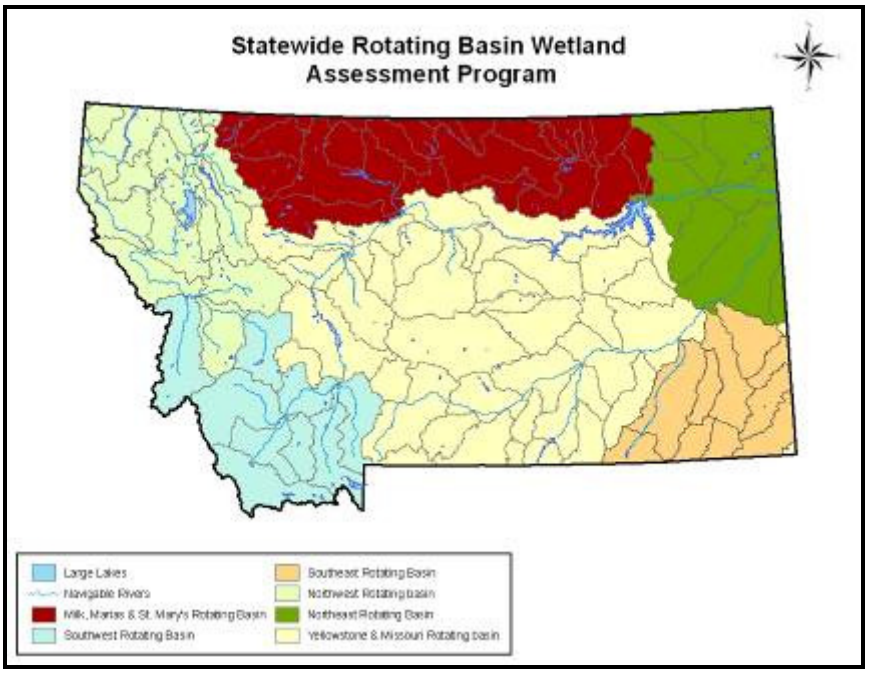

Figure 3. Preliminary Rotating Basins During Assessment Phase

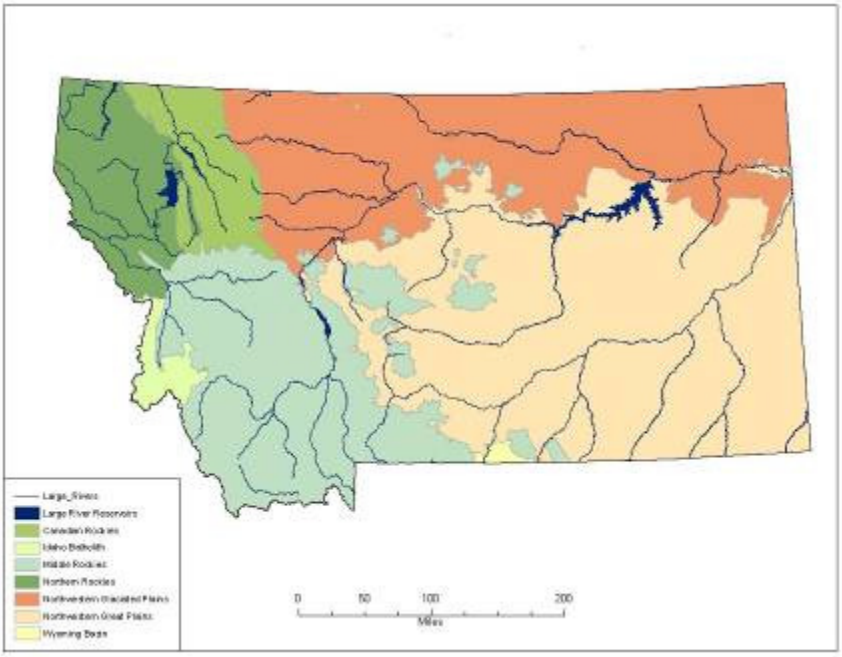

Figure 4. Large rivers assessed in 2010 riparian condition project

2.3 Long Term Rotating Basin Assessment and Monitoring

In 2014, the initial assessment project will segue into a long term rotating basin assessment and monitoring effort, designed to capture changes and or trends in wetland extent, condition, and stressors and to highlight areas in need of management action. In 2014, the watersheds located in the Northeastern part of the state will be assessed in combination with a revisit to the Milk, Marias and St. Mary's watersheds to create Rotating Basin 1. Thereafter, monitoring will rotate to each basin every year so that each basin is being monitored every five years. (Figure 5)

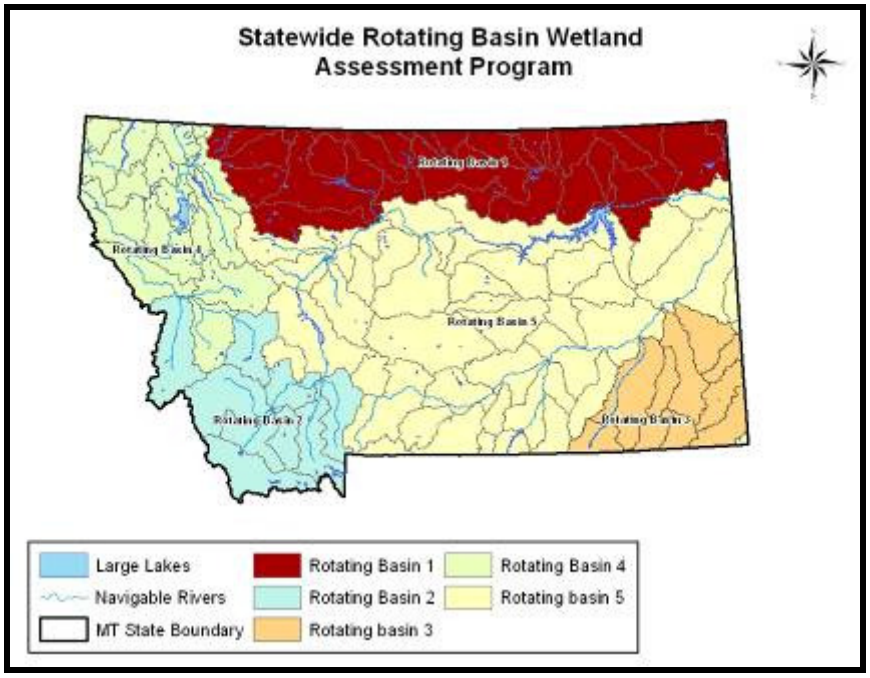

Figure 5. Five Final Rotating Basins in the Monitoring Phase

2.4 Mapping, Assessment and Monitoring Timeline:

May 2010-

Complete the pilot rotating basin assessment project for Milk, Marias, and St. Mary's watersheds.

January 2010 to December 2010-

Complete southwestern and southeastern MT mapping. Carry out second year of development of statewide rotating basin assessment strategy in southwestern Montana. Complete fieldwork for Rocky Mountain ReMAP project. Develop and test metrics for

assessing condition of large rivers. Map wetlands and riparian areas in other parts of state in response to partner needs as funding allows.

January 2011 to March 2012-

Complete mapping of northwestern MT. Carry out third year of development of statewide rotating basin assessment strategy in southeastern Montana. Conduct field work and data analysis for National Wetland Condition Assessment. Complete large rivers assessment project. Map wetlands and riparian areas in other parts of state in response to partner needs as funding allows. Initiate identification and description of vulnerable and significant wetlands through map enhancement and field work.

January 2012 to March 2013-

Complete mapping for at least one half of central MT as funding allows. Carry out fourth year of development of statewide rotating basin assessment strategy in northwestern Montana. Map wetlands and riparian areas in other parts of state in response to partner needs as funding allows. Continue identification and description of vulnerable and significant wetlands through map enhancement and field work.

January 2013 to March 2014-

Complete mapping for northeastern portion of the MT. Carry out fourth year of development of statewide rotating basin assessment strategy in the Yellowstone and Missouri watersheds in central Montana. Map wetlands and riparian areas in other parts of state in response to partner needs as funding allows. Continue identification and description of vulnerable and significant wetlands through map enhancement and field work.

January 2014 to March 2015-

Complete statewide mapping. Carry out final phase in the development of a statewide rotating basin assessment strategy by assessing wetland condition in the northeastern portion of the state; segue into a monitoring mode by revisiting the original watersheds included in the pilot project. Determine next steps in identification and description of vulnerable and significant wetlands.

3.0 ASSESSMENT AND MONITORING DESIGN AND APPROACH

3.1 Background

One of the primary goals of the Clean Water Act (CWA) is to maintain and restore the physical, chemical, and biological integrity of the waters of the United States. Integrity is defined as the ability of a system to support "a balanced integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to the natural habitat of the region" (Karr and Dudley 1981, U.S. EPA 2002a, Fennessy et al.

2007). Evaluation of integrity is a two-stage process. First, the ecological condition of the wetland or riparian area has to be assessed, without reference to stressors. Ecological condition is defined as "the ability of a wetland to support and maintain its complexity and capacity for self-organization with respect to species composition, physicochemical characteristics, and functional processes as compared to wetlands of a similar type without human alterations (Karr and Dudley 1981, Fennessy 2007). Second, the stressors that may be affecting the wetland or riparian area need to be documented. By assessing the extent to which the condition of individual sites departs from the reference standard condition for that system, and examining the stressors most commonly associated with sites exhibiting significant departure, it is possible to tease out the stressors that are degrading a system. In turn, this allows resource managers to identify the management actions that are best suited to restoring or protecting wetland condition.

Even degraded wetlands can perform certain wetland functions to a high degree. For example, excavated pits can hold storm water, and thus perform flood mitigation functions. However, this kind of wetland will not perform the same suite of functions as an undisturbed pond. Therefore, the premise of ecological integrity assessments is that a wetland that is closer to full ecological integrity will have all its functions intact, while impacted wetlands will continue to lose functions as they become more degraded. Consequently, we have chosen to assess wetland integrity as a means of evaluating both function and overall ecological condition. .

3.2 Sampling Design

In wetland assessments, we follow a spatially balanced sampling approach. This approach allows us to account for the spatial patterning inherent in most ecological systems (e.g., sites in close proximity tend to be more similar than widely separated sites). Spatially balanced sampling is also more efficient than simple random sampling by minimizing the redundancy inherent in a simple random sample that might select multiple proximate sites (Stevens and Jensen 2007). The survey design follows a Generalized Random Tessellation Stratified (GRTS) procedure for discrete objects with reverse hierarchical randomization, where polygons within the sample frame are the discrete objects and their location is identified by their centroid. The GRTS design creates a spatially balanced sample among randomly selected sites (Stevens 1997, Stevens and Olsen 1999, Stevens and Olsen 2004). In each of our rotating basin assessments, we select approximately 1,000 wetlands, stratifying by Level IV ecoregion (Omernik 1987). GRTS sampling is performed using package spsurvey (Kincaid et al. 2009) in R (R Development Core Team 2009). We examine each selected wetland in order to ensure it still exists and is accessible until we have approximately 100 wetlands selected for Level 2 field assessments. We then conduct intensive Level 3 assessments at approximately 30% of these 100 wetlands.

The GIS-based assessment of large rivers attempts to characterize the condition of every reach of the river. Here, the valley bottom for each river is hand-delineated from aerial photos, and is then segmented into assessment units based on geomorphic factors. Every segment is assessed using GIS-based metrics that measure the departure from the least-disturbed standard observed in rivers of similar size and location. Field sampling is opportunistic. Because most land in

large river corridors is privately owned, and because there are too many river miles to conduct a full field assessment during two brief field seasons, we will conduct field sampling along reaches accessible by boat, using assessment results to test, validate, and calibrate the GIS-based metrics.

3.3 EIA Protocol Development

To manage and conserve wetlands and riparian areas within a watershed context, information must be incorporated at multiple spatial scales (Brooks et al. 2004). The ecological integrity assessment (EIA) framework meets this need, as it evaluates the integrity of wetlands and riparian areas via multi-metric indices evaluated at multiple spatial scales, from landscape level land uses based on remotely sensed data to site-level condition assessments. Over the past four years, the MTNHP has been involved in developing ecological integrity assessments in collaboration with ecologists from other state Natural Heritage programs and the NatureServe network (Faber-Langendoen et al. 2006, 2008; Rocchio 2006a, 2006b). The EIA framework is based on Karr and Dudley's (1981) concept of ecological integrity as the ability of an ecosystem to support and maintain its full suite of organisms with species composition, diversity, and function comparable to those of systems in an undisturbed state. Ecological integrity occurs along a continuum of anthropogenic influence or disturbance (Karr and Chu 1999). At one end of this continuum are pristine or minimally impacted systems that support the full complement of ecological processes. With increasing human disturbance, the condition of these systems changes along this continuum.

Our multi-scale EIA approach follows the EPA's recommended three-tiered framework:

Level 1 Landscape assessment:

The ability of wetlands to effectively perform certain functions depends not only upon vegetation, but also upon landscape position. Hydrogeomorphic modifiers (HGM) emphasize these features that are believed to control the functional aspects of wetlands (Brinson 1993). Therefore, in addition to being classified with the Cowardin classification system, wetlands polygons are also attributed with an HGM code so that wetland mapping can be used to conduct a wetland profile across a watershed that provides information on the distribution and function of wetlands. These modifiers, in combination with the wetland classifications, provide a means of linking wetland type with wetland function. Five metrics are calculated to produce the wetland profile: overall wetland acres; acres of isolated wetlands (defined as wetlands not located within a stream or on its floodplain and not connected to another wetland); acres of altered wetlands; percent of wetlands in private or public ownership; and percent of wetlands with high functional value for each of ten wetland ecological functions. For each function, the acres of wetland assigned a value of "3" for high function are summed and divided by the total number of acres within each basin, watershed, or subwatershed.

Riparian areas are profiled in a similar way, but with more emphasis on access to floodwaters, spatial pattern, sinuosity, and so on. Ultimately, all these data improve the ability of agencies, watershed groups, consultants and stakeholders to focus restoration and protection efforts on

critical wetlands and riparian areas that will help improve water quality throughout the watershed. This information will also lead to better informed restoration decisions because it will provide focus, guide development, act as a standard for measuring success, and provide a method to compare alternatives. In addition, the MTNHP has developed a Landscape Integrity Model (LIM) to assess wetland condition remotely using landscape-level indicators (Vance, 2009). These indicators are used to predict the condition of a wetland or riparian area based on the integrity of the landscape surrounding it. The LIM incorporates anthropogenic factors such as roads, resource extraction, hydrologic alterations, and land ownership and allows a rapid calculation of condition within a landscape context. The Level 1 analysis is performed at three spatial scales for wetlands: 100 meters, 300 meters, and 1,000 meters from the wetland perimeter. For riparian areas along large rivers, it is carried out across the entire valley bottom of that river segment.

Level 2 Rapid Assessments:

Level 2 rapid assessments use EIA protocols adapted to Montana. EIA development relies on the identification of key ecological indicators or metrics and stressors that can be readily measured or monitored. Metrics are comprised of narrative ratings and are scaled along a gradient reflecting wetland condition relative to a natural or undisturbed state (i.e., reference standard). Ideally, metrics should be unambiguous, mutually exclusive, and equally distributed along a disturbance gradient, allowing the observer to best describe the observed state (Sutula et al. 2006). EIA metric ratings are integrated to produce overall scores for four attributes: 1) Landscape Context; 2) Vegetation; 3) Physicochemical; and 4) Hydrology. For each of the four attributes there is a section where the scope and severity of a stressor is reported so that there is a clear relationship between a metric that scores poorly and a specific stressor. The ratings for these four attributes can be combined to produce an overall EIA score. The Level 2 assessment takes approximately two hours to complete.

The Level 2 rapid assessments (Appendix 1) have been designed so that they can be used on all wetland ecological systems that occur in Montana. A separate but similar rapid assessment form has been developed for riparian systems and large river systems (Appendix 2).

Level 3 Intensive Assessments:

Currently, the Level 3 intensive assessment includes only a vegetation assessment. During the course of carrying out the assessment phase of the Development Plan, we will test the efficacy of additional intensive measurements, including the collection of water and soil for chemical analysis, algae and phytoplankton, and invertebrate and amphibian surveys. These additional Level 3 metrics are designed to help meet water quality and ecological objectives as well as help to further refine the Level 2 rapid assessments.

Level 3 intensive vegetation data are collected at approximately 30% of wetland sites using a 20 m x 50 m relevé plot (Peet et al. 1998). This method takes up to 6 hours per site. The method has been in use by the North Carolina Vegetation Survey for over 10 years (Peet et al. 1998), has been used to successfully develop a vegetation index of biotic integrity (VIBI) in

Ohio (Mack 2004a; Mack 2004b) and the Colorado VIBI (Rocchio 2006b; Rocchio 2007a; Lemly and Rocchio 2009). The structure and placement of the plot is described in Appendix 4.

4.0 QUALITY ASSURANCE

The MTNHP collects and manages all data collected with EPA funding under an EPA-approved Quality Assurance Project Plan (QAPP). These plans are approved by the EPA prior to any data collection for each rotating basin. A QAPP includes information on project and task organization, data generation and acquisition, sampling design, sampling methods, quality control, equipment testing, data management, assessment and oversight, and data review and analysis. A sample QAPP can be found in Appendix 5.

5.0 DATA MANAGEMENT

All wetland and riparian condition assessment data is stored in a Microsoft Access database designed by MTNHP. The data quality objective for data management is to have an error-free database. After the data are entered into the database, reports will be printed to compare species and coverage data to original data records on the field form.

All data created and compiled for wetland and riparian mapping will be housed on servers at the MTNHP office. These servers are backed up nightly. FGDC-compliant metadata will be created for each data set.

6.0 DATA ANALYSIS

Level 1 Assessments: Descriptive statistics are calculated and the range and distribution of each metric is assessed by examining histograms. A correlation matrix using Spearman's correlation coefficients is created to investigate relationships and evaluate redundancy among metrics. Similarly, Spearman's correlation coefficients of Level 2 attribute scores and final ecological integrity scores will be calculated to determine correlations among Level 2 attribute and overall scores and Level 1 metrics.

Level 2 Assessments: Descriptive statistics are calculated and the range and distribution of each metric will be assessed by examining histograms. A correlation matrix using Spearman's correlation coefficients is created to investigate relationships and to evaluate any redundancy among metrics. Similarly, Spearman's correlation coefficients of attribute scores and final ecological integrity scores are calculated to determine the amount of variability explained by each attribute and each metric.

Level 3 Assessments: For the Level 3 intensive vegetation data, coefficients of conservatism (C-values) are assigned to all plant species (Jones et al. 2005, Rocchio 2007b). C-values represent the relative tolerance of a species to disturbance, ranging from 0 to 10. Native

species that exhibit high degrees of ecological specificity have C-values of 9-10. Native species that are typical of well established communities that have undergone minimal disturbance have C-values of 7-8. Native species that are typically found in particular ecological communities but can tolerate moderate disturbance have C-values of 4-6. Widespread native species that occur in a variety of communities and are common in disturbed sites have values of 1-3. Finally, exotic species are assigned C-values of 0.

The average C-value of native plant species will be calculated for each site and used to calculate an adjusted floristic quality assessment index (FQAI) for each site. Studies have demonstrated that the FQAI is a good predictor of wetland condition (Lopez and Fennessy 2002, DeKeyser et al. 2003, Jones 2004, Hargiss et al. 2008). The FQAI incorporates both C-values and native species richness. However, several studies have noted that the emphasis on native species richness can provide misleading results (Francis et al. 2000, Rooney and Rogers 2002, Miller and Wardrop 2006). For example, Miller and Wardrop (2006) observed the tendency for sites with greater species richness but lower average C-values to receive higher FQAI scores. Given that some wetland ecological systems are naturally species poor, we use an adjusted FQAI score described in Miller and Wardrop (2006). This adjusted score uses the mean C-values of native plant species for a site and incorporates both native and non-native species into the final index. The adjusted FQAI score for each site will be calculated as:

$$\text{Adjusted FQAI} = \left(\overline{C}/10 \times \sqrt{N}/\sqrt{N+A}\right) \text{ x } 100$$

where $\overline{C}$ is the mean C-value of native plant species, N is the number of native species, and A is the number of non-native species. Spearman's correlation analyses between FQAI values and Level 2 attribute and overall scores will be conducted to determine the ability of the method to discern among wetlands of different condition.

7.0 REPORTING

All spatial data collected during under this Development Plan will be made available for download from the MTNHP website, and linked to MTDEQ's Wetland Information Clearinghouse. Our goal is to integrate the data into one of MTNHP's interactive online map exploration tools. All digital wetland mapping will be available from the National Wetland Inventory of the U.S. Fish and Wildlife Service. Provisional mapping data is available on request from the MTNHP. The distribution of digital riparian mapping is not currently supported by the National Wetland Inventory; therefore, we will make it available through the Natural Resource Information Service by registering it with the Montana GIS Portal.

A final report documenting the condition of wetlands within each rotating basin will be produced. This report will include wetland profiles for 4th code hydrological units that are within the rotating basin. Other information will be distributed as needed including priority areas for restoration and conservation. The river assessment project will result in a series of maps showing condition scores for each reach along each river. These maps will be made

available in paper and digital formats. Reports on vulnerable and ecologically significant wetlands will be made available on our website as projects are completed.

8.0 INTEGRATION WITH PARTNER DATA COLLECTION EFFORTS

Recognizing that partners collect wetland data using other assessment tools and approaches, we will work with members of the Mapping, Monitoring and Assessment Workgroup to identify the best ways to integrate their data into our online data exploration tools. We will also create a Monitoring and Assessment webpage, similar to the Wetland and Riparian Mapping Webpage, that provides rapid access to information and tools. Partners will have the option of linking their assessment data to this page.

To support integrated reporting of wetland condition data with water quality data, we will transmit digital data to the MTDEQ Water Quality Planning Bureau for inclusion in biennial reports. When wetland assessment sites occur on lands managed by partners, we will attempt to coordinate efforts by including partner staff, or by entering into cooperative funding arrangements to incorporate a secondary data collection effort using partner protocols.

9.0 PROGRAMMATIC EVALUATION

We will send reports and requests for feedback and evaluation to members of the Montana Wetland Council's Mapping, Monitoring, and Assessment Work Group. We will also meet at the end of each 5-year rotating basin cycle to evaluate the monitoring and assessment strategy. Members of this workgroup includes representatives from the Department of Environmental Quality, the MTNHP, the Montana Department of Transportation, the Montana Department of Fish, Wildlife and Parks, the U.S. Forest Service, the Bureau of Land management, and the Blackfeet Tribe, as well as faculty from the Montana State University and the University of Montana. We invite periodic field audits from the EPA, and attempt to coordinate field visits with partners and with interested landowners and local citizens.

10.0 RESEARCH NEEDS

Monitoring and assessment programs are always evolving as our understanding of these dynamic systems increases. While the overall monitoring and assessment goals are to protect and restore wetlands and riparian areas in Montana, many of the ecological and water quality objectives include gathering new scientific information to help guide management decisions. The following are research needs that will help to improve wetland and riparian protection and restoration:

1. What are the affects of forest loss and drought on the ecological condition of wetlands and riparian areas?

2. Are groundwater dependent wetland ecosystems at risk from within-basin water development, and to what degree is that influenced by landscape position?
3. What is the historic range of variability in these systems?
4. Can space for time substitutions be used to predict the potential impacts of climate change?
5. Are wetlands that are in better ecological condition more resilient to climate change, drought, or other anthropogenic causes of disturbance?
6. Are wetter wetlands and riparian areas more likely to be in better ecological condition than drier wetlands when all other things are equal?
7. What are the specific hydrological differences between different ecological systems?
8. To what degree do riparian areas along impounded rivers retain the dynamic processes necessary for sustainability?
9. What Level 3 assessments need to be developed so that wetland water quality standards can be established?
10. What Level 3 assessments need to be developed to further validate Level 2 assessments?
11. What vertebrate species are most at risk from wetland and riparian loss?

11.0 PROGRAMMATIC NEEDS AND SUPPORT

The success of this development plan will require us to address a number of technical and programmatic needs as funding permits:

1. The Level 2 rapid assessment has not been tested for use on wetland mitigation sites or restoration sites. Determine if the metrics are useful pre and post construction.
2. Test rapid assessment form to see what kind of user variability exists.
3. Create specific guidelines for using the Level 2 rapid assessment for assessing voluntary wetland mitigation sites pre and post construction and in developing performance standards for restoration areas.
4. Develop additional Level 3 intensive assessments to validate, calibrate and refine our Level 2 metrics and meet partner data needs (e.g., soils, macroinvertebrates, birds).
5. Refine more information management tools so that stakeholders can use data from wetland mapping and Level 2 and 3 assessments to report on status and trends of wetland and riparian areas on public land.
6. Establish technical training opportunities for agencies, Tribes, consultants and other stakeholders wishing to adopt or adapt our methodologies.
7. Incorporate wetlands monitoring into Montana's Statewide Water Quality Monitoring and Assessment Strategy.
8. Provide training and support to non-technical users of wetland and riparian mapping and assessment information.
9. Coordinate with other agencies such as the Department of Natural Resources, Montana Department of Transportation, the Bureau of Land Management , the Army Corps of Engineers and the Forest Service, and with tribal partners, to strengthen support for this statewide monitoring and assessment strategy.

10. Secure a consistent source of funding for the continuing development of assessment protocols, data management, wetland and riparian mapping, and education and outreach.

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APPENDICES 1-5 This version is without appendices.