

Appendix R – Adaptive Management and Monitoring Plan

Appendix R

Monitoring and Adaptive Management

Marsh Lake Ecosystem Restoration Project

Minnesota River

Big Stone, Lac qui Parle, and Swift Counties, Minnesota

April 2011

Introduction

Adaptive management (AM) is a structured process of learning by doing and adapting based on what's learned. AM is a process that promotes flexible decision making and implementation that can be adapted as outcomes from management actions become better understood. Careful monitoring of outcomes advances scientific understanding and helps adjust policies or operations as part of an iterative learning process.

Section 2039 of WRDA 2007 directs the Secretary of the Army to ensure that when conducting a feasibility study for ecosystem restoration that the recommended project includes a plan for monitoring the success of the ecosystem restoration. The monitoring plan shall include a description of the monitoring activities, the criteria for success, and the estimated cost and duration of the monitoring as well as specify that monitoring will continue until such time as the Secretary determines that the success criteria have been met. Within a period of ten years from completion of construction of an ecosystem restoration project, monitoring shall be a cost-shared project cost. Any additional monitoring required beyond ten years will be a non-Federal responsibility.

Monitoring and Evaluation of the Response of Native Mussels to Pomme de Terre River Restoration

The native mussel community in the Pomme de Terre River is described in Section 2.8.7 of the main report. The alternative measure to restore the Pomme de Terre River to its former channel is described in Section 4.1.4.

The lower Pomme de Terre River supports an abundant and diverse mussel community with two state-listed threatened and endangered species. Mussels in the lower reach of the channelized Pomme de Terre River below the lower cut-off embankment would no longer be in a flowing river and would probably die. Mussels in the river channel in the footprint of the cut-off embankment would be buried. Mussels are expected to recolonize the restored historic channel of the Pomme de Terre River after the fine-grained sediment that has been deposited there is washed out. Uncertainty exists about the recolonization of native mussels in the restored Pomme de Terre River channel.

Restoring the native mussel community in the historic channel of the Pomme de Terre River is not one of the project objectives and there have been no performance criteria set to evaluate ecological success. There are no Federally-listed endangered or threatened species in the Pomme de Terre River. A mussel relocation effort prior to construction is not in the Federal interest. The Minnesota Department of Natural Resources (DNR) may choose to relocate mussels from the impact area to other parts of the Pomme de Terre River.

Based on discussions with the DNR, restoring the Pomme de Terre River to its former channel includes pre-project monitoring to quantitatively characterize the mussel community and to estimate impacts of construction. Post construction monitoring would include a series of mussel and habitat surveys in the restored river channel.

Pre-Project Monitoring

A reference reach of the Pomme de Terre River upstream of the impact area was surveyed for mussels in 2010 (Appendix Q). A systematic survey of the impact area of the lower Pomme de Terre River was done in 2010 by collecting 0.25 m² randomly located quadrat samples (Appendix Q). Additional sites not sampled in the 2007 survey were sampled by qualitative timed searches to better assess the species richness of the mussel community. From these data a population estimate, population demographics and community composition descriptors were generated and will be used as perspective when characterizing the recruitment of mussels into the restored channel over time. A map of the river showing the density of mussels, number of mussels <3 years old, and number of species found at each collection site was generated (Appendix Q).

A cursory survey of several sites within the old channel consisting of wading and snorkeling where needed will be done prior to construction to support or refute the assumption that there are no live mussels currently in the former Pomme de Terre River channel to be restored. The former Pomme de Terre River channel to be restored has had six or more inches of silt deposited there since the river was diverted when the Marsh Lake Dam was built. Mussels are unlikely to occur there now.

Post-Construction Monitoring

Following three years of flow through the restored channel areas above and below the Marsh Lake Dam, the DNR will survey the restored river channel using qualitative timed searches at a minimum of 5 sites to assist in finding all species present and systematic quantitative sampling similar to that used within the impact area. This monitoring will be done three times at three year intervals. At least 100 0.25 m² quadrat samples will be collected to allow for a population estimate of mussels that may have been recruited since restoration of flows. Mussels collected during this sampling will be identified to species, measured (TL) and growth arrest lines counted. Qualitative information on the substrate types represented at each sample will be estimated and recorded as a percent among 7 substrate categories: Woody debris, Organic Detritus, Silt, Sand, Gravel, Cobble, or Boulder. A map of the river showing the density of mussels, number of mussels <3years old, and number of species found at each collection site will be generated.

The pre-project monitoring of the existing mussel community and post-construction monitoring to assess reestablishment in restored channel, their habitat, and the ecosystem services they provide is an important part of this project to the DNR. Approaches to accomplish that include: organism identification, enumeration, and valuation using American Fisheries Society (AFS) replacement numbers; habitat mapping and valuation, and ecosystem service identification and valuation. The DNR will conduct the monitoring work, reporting and evaluation. A more complete experimental design will be developed in the detailed design phase of the project.

A comparison of the density, species composition and age structure of the native mussels in the restored channel to the pre-project mussel community in the Pomme de Terre River will allow assessment of the ecological success of mussels in recolonizing the restored channel. There are no performance criteria for mussels that would indicate a need to modify the project. This AM activity will provide increased understanding of the ecological effects of river restoration on native mussels.

Estimated cost for the lower Pomme de Terre pre-project survey and three years of post-project monitoring was provided by the DNR (main report Table 4-2). The estimated total cost of \$128,000 includes data analysis and reporting.

Table 4-2 (from main report). Estimated cost of Pomme de Terre River survey and monitoring mussel recolonization in the restored Pomme de Terre River channel.

Tasks	Days	# Crews	Per Day/one crew	Report	Total
Est. Current Channel Pop & Reference site	6	2	\$ 2,000.00	\$ 2,000.00	\$ 26,000.00
Evaluate New Channel	1	2	\$ 2,000.00	\$ 2,000.00	\$ 6,000.00
Cutoff Channel Mussel Salvage	2	2	\$ 2,000.00	\$ 1,000.00	\$ 9,000.00
Yr3 Monit; New Channel/Reference site	6	2	\$ 2,000.00	\$ 5,000.00	\$ 29,000.00
Yr6 Monit; New Channel/Reference site	6	2	\$ 2,000.00	\$ 5,000.00	\$ 29,000.00
Yr10 Monit; New Channel/Reference site	6	2	\$ 2,000.00	\$ 5,000.00	\$ 29,000.00
				Total	\$ 128,000.00

Project Objectives and Performance Criteria to Evaluate Success in Ecosystem

Restoration

Performance criteria for each of the project objectives have been identified (Table 1). Performance criteria are SMART; Specific, Measurable, Achievable, Relevant, and Time-bound. The performance criteria set by the PDT include target values and ranges where appropriate, considering inter-annual variation, future management actions and natural disturbance regimes.

Table 1. Ecosystem objectives and performance criteria for the Marsh Lake Project.

Marsh Lake Project Ecosystem Objectives	Performance Criteria
1. Reduced sediment loading into Marsh Lake	Pomme de Terre River re-routed into Lac qui Parle.
2. Restored natural fluctuations to hydrologic regime in Marsh Lake	Maintain water levels in Marsh Lake at 938.3 feet or higher 70% of the time in August, and 937.6 feet or higher 70% of the time in September and October, excluding years in which a draw down is completed. Low growing season water levels as needed to restore aquatic vegetation. Low winter water levels (following growing season drawdowns) to reduce carp abundance in Marsh Lake.
3. Restored natural geomorphic and floodplain processes in Pomme de Terre River	Delta area of the lower Pomme de Terre River with more natural hydrologic regime, distributary complexity, rates of change and vegetation communities by 2015.
4. Reduced sediment resuspension in Marsh Lake	Growing season average Secchi disc water transparency equal or greater than 0.5 m by 2020.
5. Increased extent, diversity and abundance of emergent and submersed aquatic plants in Marsh Lake	Increase the area of EAV in Marsh Lake to 1500 acres by 2015 with 200 acres of EAV other than cattail (e.g., bulrush, arrowhead)
6. Increased availability of waterfowl habitat within Marsh Lake	Increase the area of SAV in Marsh Lake to 2000 acres in 6 out of 10 years by 2020 with 400 acres of submersed plants other than Sago pondweed (e.g., coontail, milfoil). Detect SAV at 2/3 of sampled sites in Marsh Lake where water depth is less than 3 ft. Increase fall waterfowl use on Marsh Lake from 6,000 to 25,000 birds by 2015. As a subset, increase diving duck use from 400 to 5,000 birds by 2015 (measured by summarizing the peak count recorded for each species from weekly aerial surveys, mid-September through freeze-up, Marsh Lake. Survey area is from the Marsh Lake Dam to Louisburg Grade Road). Increase shorebird use on Marsh Lake from a current peak count now estimated in the hundreds to a peak count measured in the thousands by 2015. Criteria will only apply to those years of a natural or targeted growing season drawdown providing extensive mudflats.
	Maintain colonial waterbird numbers on Marsh Lake at approximately 19,000 American pelican and 1,000 double-crested cormorant nests, respectively (2006 & 2007 average). Maintain species diversity associated with nesting islands: ring-billed gulls, great egrets, great blue herons, black-crowned night herons, and Forster's terns. Breeding pairs of western grebes return to Marsh Lake by 2020.
7. Restored habitat connectivity for fish to migrate between Marsh Lake, the Pomme de Terre River and Lac Qui Parle	Increased natural reproduction of walleyes in the Pomme de Terre River by 2015 with naturally reproduced year classes 7 out of 10 years. Increase natural reproduction of northern pike by 2015 in Marsh Lake with naturally reproduced year classes in 3 out of 5 years.
8. Reduced abundance of carp in Marsh Lake	Modify fish community composition in Marsh Lake to less than 40 percent carp by weight by 2015.
9. Increased diversity and abundance of native fish in Marsh Lake and the Pomme de Terre River	Increased species richness and relative abundance (catch per unit effort by electrofishing) of native fish in the Pomme de Terre River by 2015.

Objectives and Monitoring Activities

Table 2 outlines the monitoring and evaluation activities and provides an estimated cost. For those activities that are routine and will be conducted regardless of the restoration project

(e.g., Corps monitoring of water levels in Marsh Lake, DNR monitoring fall waterfowl use), no additional costs would be incurred. The water quality monitoring work would be done by the Corps. The biological response (vegetation cover, fish, mussel monitoring) would be done by the DNR. The monitoring activities would be conducted in the first 10 years following project construction.

Table 2. Monitoring Activities and Estimated Cost.

Marsh Lake Project Ecosystem Objectives	Monitoring Activities	Estimated Cost
1. Reduced sediment loading into Marsh Lake	None	
2. Restored natural fluctuations to hydrologic regime in Marsh Lake	Water levels at Marsh Lake Dam	None - Monitored daily at dam
3. Restored natural geomorphic and floodplain processes in Pomme de Terre River	Vegetation cover in Pomme de Terre River delta, interpreted from aerial photography at years 1, 5 and 10	\$10,000
4. Reduced sediment resuspension in Marsh Lake	Secchi transparency measurements measured weekly May through September	\$5,000
5. Increased extent, diversity and abundance of emergent and submersed aquatic plants in Marsh Lake	Vegetation cover in Marsh Lake, interpreted from aerial photography in years 1, 5 and 10	(included in above)
6. Increased availability of waterfowl habitat within Marsh Lake	SAV rake survey in years 5, 10	\$10,000
	Fall waterfowl surveys	None - Monitored annually by DNR
	Late summer shorebird surveys during drawdown years	\$5,000
	Colonial waterbird colony surveys conducted annually	None - Monitored annually by DNR
7. Restored habitat connectivity for fish to migrate between Marsh Lake, the Pomme de Terre River and Lac Qui Parle	Fall fish surveys in Lac qui Parle conducted every other year	\$10,000
8. Reduced abundance of carp in Marsh Lake	Fall fish surveys in Marsh Lake in years following drawdown	(included in above)
9. Increased diversity and abundance of native fish in Marsh Lake and the Pomme de Terre River	Stream electrofishing surveys in years 1, 5 and 10	\$15,000
	Estimated Monitoring Cost over 10 years:	\$55,000
	Evaluation and Reporting:	\$15,000
	Total Monitoring and Evaluation:	\$70,000

The total estimated cost for monitoring and evaluation of the Marsh Lake project to evaluate success in meeting the project objectives is \$70,000 over 10 years following project construction. Monitoring to evaluate the response of native mussels to Pomme de Terre River restoration is estimated to cost \$87,000 over 10 years following project construction. Pre-project monitoring work conducted in 2010 cost \$26,000. Pre-project surveys and mussel relocation is estimated to cost \$15,000.

7.2.3 Evaluation and Adaptive Management

Reports on condition of the Marsh Lake ecosystem with results of the monitoring activities will be prepared annually. Results of the monitoring activities will be used to evaluate ecosystem response to the project. Should the restoration and management actions not meet the performance criteria, the Corps and the DNR will evaluate adaptive management actions (management or project modifications) to best attain the ecosystem objectives for the project.

The tentatively recommended plan (Alternative Plan 4) includes measures to restore submersed aquatic vegetation (SAV) by reducing sediment loading, restoring the water level regime, and by reducing the abundance of carp (restore the Pomme de Terre River to its former channel, modify Marsh Lake Dam with a fishway to attain target water levels, construct a water control structure in Marsh Lake Dam to enable drawdowns of the lake). Uncertainty exists about the response of SAV to these measures.

One alternative measure, constructing islands in Marsh Lake (included in Alternative Plan 5 in the feasibility report), is considered for implementation in the future if needed to attain the objectives submersed aquatic vegetation. Islands would reduce wind fetch and sediment resuspension, improving conditions for SAV growth. SAV aquatic vegetation and Secchi disc water transparency will be monitored to determine the success of the project in restoring SAV and to determine the need to construct islands.