Bonnie Brook
Section 506 Great Lakes Fishery & Ecosystem Restoration

Appendix F - Monitoring & Adaptive Management Plan

Chicago District, GL-ECO-CX

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Introduction

Section 2039 of WRDA 2007 directs the Secretary of the Army to ensure, that when conducting a feasibility study for a project (or component of a project) under the Corps ecosystem restoration mission, that the recommended project includes a monitoring plan to measure the success of the ecosystem restoration and to dictate the direction adaptive management should proceed, if needed. This monitoring and adaptive management 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.

Section 2039 of WRDA 2007 also directs the Corps to develop an adaptive management plan for all ecosystem restoration projects. The adaptive management plan must be appropriately scoped to the scale of the project. The information generated by the monitoring plan will be used by the District in consultation with the Federal and State resources agencies and the MSC to guide decisions on operational or structural changes that may be needed to ensure that the ecosystem restoration project meets the success criteria.

An effective monitoring program is necessary to assess the status and trends of ecological health and biota richness and abundance on a per project basis, as well as to report on regional program success within the United States. Assessing status and trends includes both spatial and temporal variations. Gathered information under this monitoring plan will provide insights into the effectiveness of current restoration projects and adaptive management strategies, and indicate where goals have been met, if actions should continue, and/or whether more aggressive management is warranted.

Monitoring the changes at a project site is not always a simple task. Ecosystems, by their very nature, are dynamic systems where populations of macroinvertebrates, fish, birds, and other organisms fluctuate with natural cycles. Water quality also varies, particularly as seasonal and annual weather patterns change. The task of tracking environmental changes can be difficult, and distinguishing the changes caused by human actions from natural variations can be even more difficult. This is why a focused monitoring protocol tied directly to the planning objectives needs to be followed.

This Monitoring and Adaptive Management Plan describes the existing habitats and monitoring methods that could be utilized to assess projects. By reporting on environmental changes, the results from this monitoring effort will be able to evaluate whether measurable results have been achieved and whether the intent of Section 506 Great Lakes & Fisheries Ecosystem Restoration are being met.

Guidance

The following documents provide distinct Corps policy and guidance that are pertinent to developing this monitoring and adaptive management plan:

a. Section 2039 of WRDA 2007 Monitoring Ecosystem Restoration

(a) In General - In conducting a feasibility study for a project (or a component of a project) for ecosystem restoration, the Secretary shall ensure that the recommended project includes, as an integral part of the project, a plan for monitoring the success of the ecosystem restoration.

(b) Monitoring Plan - The monitoring plan shall--

(1) include a description of the monitoring activities to be carried out, the criteria for ecosystem restoration success, and the estimated cost and duration of the monitoring; and

(2) specify that the monitoring shall continue until such time as the Secretary determines that the criteria for ecosystem restoration success will be met.

(c) Cost Share - For a period of 10 years from completion of construction of a project (or a component of a project) for ecosystem restoration, the Secretary shall consider the cost of carrying out the monitoring as a project cost. If the monitoring plan under subsection (b) requires monitoring beyond the 10-year period, the cost of monitoring shall be a non-Federal responsibility.

b. USACE. 2009. Planning Memorandum. Implementation Guidance for Section 2039 of the Water Resources Development Act of 2007 (WRDA 2007) - Monitoring Ecosystem Restoration

c. USACE. 2000. ER 1105-2-100, Guidance for Conducting Civil Works Planning Studies. Washington D.C.

d. USACE. 2003a. ER 1105-2-404. Planning Civil Work Projects under the Environmental Operating Principles. Washington, D.C.

General Monitoring Objectives

As presented in "Guidance on Monitoring Ecosystem Restoration Project" on 12 January 2010, the following are general project monitoring objectives:

- To determine and prioritize needs for ecosystem restoration
- To support adaptive management of implemented projects
- To assess and justify adaptive management expenditures
- To minimize costs and maximize benefits of future restoration projects
- To determine "ecological success", document, and communicate it
- To advance the state of ecosystem restoration practice

Project Area Description

The study area consists of a 1.4 mile reach in the head waters of the Waukegan River. The stream begins in an open field of the Waukegan airport, flows through Bevier Park and Bonnie Brook golf course, and drains into southern Lake Michigan. Urban run-off and river fragmentation from weirs has altered the natural hydrology and hydraulics, providing an ecosystem conducive to invasive plant communities. Similarly, in-stream habitat for important fish, amphibian, and macroinvertebrate species is lacking due to fragmentation and loss of natural hydrology. The potential for complete connectivity to southern Lake Michigan makes

Bonnie Brook an important area of restoration as it will add to habitat heterogeneity within the watershed.

Habitat Trends Triggering Restoration

This project aims to remedy adverse trends of:

- Altered instream hydraulics stemming from urban runoff, dams (low head weirs) and non-native riparian vegetation
- Riverine fragmentation from a series of small dams
- Water quality impairment stemming from urban runoff, non-native riparian vegetation and a series of small weirs
- Lack of natural instream physical habitat, such as root wads and boulders
- Lack of wetland pockets with the riparian corridor and stream fringes

Restoration Design Overview

The preferred plan will greatly increase the ecological integrity and complexity of Bonnie Brook. The specific elements of the proposed plan are:

- Naturalize floodplain hydrology to extent possible
- Reestablish riverine hydraulics and instream complexity
- Reestablish a functioning riparian corridor
- Reduce invasive species and prevent further infestation or spread
- Maximize floral and faunal species richness and abundance

Monitoring Components

Monitoring Plan Goals & Objectives

The goal of the project is to increase habitat complexity and biodiversity in and around the project area. The following specific objectives were established for monitoring the effectiveness of this project:

- Critical Flow: **~ 1.0**
- Helical Flow: **observation yes or no**
- Improve native fish species richness, abundance and assemblage structure as measured by the Illinois Region 4 Index of Biotic Integrity: Target IBI Score = **≥30**
- Improve macroinvertebrate species richness, abundance, and assemblage: Target MBI **≤5**
- Improve native plant species richness and assemblage structure as measured by coefficient of conservatism of the Chicago Region Floristic Quality Index: Target Overall Mean C Score = **≥5.2**
- Eradicate / reduce the presence of non-native and invasive species: Target Invasive Species Eradication Percentage = <**1% Areal Coverage**

Fish communities, macroinvertebrate communities, stream habitat, stream hydraulics, and riparian vegetation will be monitored to determine the effectiveness of the restoration plan. All components with be monitored as specified below, once prior to the project and over the course of five years following completion of the project.

Stream Hydraulics

Hydraulic parameters will be monitored at each riffle/pool complex. In order for riffles to provide conditions for lotic macroinvertebrates and fishes, critical flow must be induced over the riffle; otherwise it is just a pile of rocks in a ditch. Critical flow will be monitored through observation and calculation. Helical flow is also important as water flows over the riffle and into the pool at meander bends. Helical flow is a cork-screw effect water under goes as changes course in a meander bend. This effect can be observed through placing semi-buoyant material in the water which becomes entrained in the flow pattern. The phenomenon is important to stream fishes that depend on flowing water to bring food to them. Other data would be taken at certain cross-sections as well to record how the channel is developing, which includes velocity, stream morphology, and substrate counts.

Stream Habitat

Habitat parameters for the restoration reach will be evaluated using the Qualitative Habitat Evaluation Index, or QHEI (Rankin 1989). The QHEI consists of eight sections with a maximum total of 100 points:

1. Characterization of substrate types and the effects of siltation
2. Characterization of in-stream cover
3. Characterization of channel morphology
4. Characterization of the riparian zone and bank erosion
5. Assessment of the pool / glide & riffle / run
6. Gradient
7. Shade
8. Channel incision

One raw data sheet consisting of one to five transects will be completed for each site. The sites will be assessed from a river right descending perspective. The transects were dependent and based on the area sampled for fishes and began some distance up or downstream from evident bridge disturbance to the stream; however, the impacts from these structures should be taken into consideration when implementing restoration measures since this study recommends remedies to anthropogenic disturbance to stream morphology and function.

Macroinvertebrate Community

Macroinvertebrates will be collected concurrently with fish samples, according to Illinois River Watch Protocols (IDNR 2000). Samples will be taken from all habitat types within the restoration reach. The Macroinvertebrate Biotic Index (MBI, Bertrand et al. 1996), a water quality index based on tolerance of taxa to pollution, would be calculated for each location sampled. MBI values range from 0-12, with lower scores indicating better water quality.

Fish Community

Monitoring of fish communities is a well-established approach for evaluating overall aquatic ecosystem health and will be quantified through the use of the Index of Biotic Integrity (IBI). The IBI employs fish assemblage as the indicator of ecological form and function. Fish are not only a highly visible part of the aquatic resource, but they are quite sensitive to the surrounding water and habitat quality. This does not suggest that the use of other organisms is insufficient or inappropriate (Simon 1991). The pre and post dam removal condition of the project reach was and will be evaluated using the IBI (Karr 1981; Karr et. al. 1986; Simon 1991; Smogor 2002). This method makes use of a systematic process to set quantitative criteria that enables the measurement of riverine stream quality. This index employs ten parameters or "metrics" based on structural and functional components of the fish assemblage. Structural components include diversity, taxonomic guilds, and abundance. Functional components include feeding or trophic guilds, reproductive behavior, tolerance to adverse environmental stressors, and individual stresses (Simon 1991; Smogor 2002). These metrics are calibrated to for differences in stream size and geographic region. The following ten metrics may each receive a score 0 to 6, based on comparison to unaltered reference sites, with a total IBI score ranging from 0 to 60 (Smogor 2002):

1. Number of native fish species
2. Number of native Catostomid species
3. Number of native Centrarchid species
4. Number of native intolerant species
5. Number of native Cyprinid species
6. Number of native benthic insectivore species
7. Proportion of individuals as specialist benthic insectivores
8. Proportion of individuals as generalist feeders
9. Proportion of individuals as obligate course-mineral substrate spawners and intolerant
10. Proportion of tolerant species

Riparian Plant Communities

Evaluation of riparian vegetation will be done using the Floristic Quality Assessment Index (FQA) and native plant richness, as described in the PDA. In short, the FQA is a measure of overall environmental quality based the presence or absence of certain plant species. Plant species that are assigned a coefficient of conservatism of 5 to 10 are considered to be indicative of less human mediated disturbance and a higher level of functionality. As the area stabilizes after restoration measures are complete, the number of higher conservative plant species that become established will increase. Communities that have an average mean coefficient of conservatism of between 3 to 5 are considered to be fair quality. This is a good estimate of the future quality of the area based on the current plant community and 'good' quality natural sites in the surrounding areas. The overall number of native plant species is expected to increase dramatically as well, helping to increase the overall biodiversity of the area.

Sampling Stations

Transects will be established within the pond and littoral zones for fish and macroinvertebrates. Riparian vegetation will be surveyed and analyzed by both a roaming and stratified random transect survey. Each habitat type will be analyzed separately.

Reference Site Discussion

No reference site is deemed necessary; improvements will be judged from site current conditions.

Sampling/Survey Frequency

Fish and Macroinvertebrate Communities

Monitoring will occur once per year in late spring over the course of 5 years.

Riparian Plant Communities

Plant monitoring would occur between June and August of each year of monitoring activities. Sampling would occur once a year. The total monitoring period will be 5 years.

Stream Hydraulics and Habitat

Observations will be conducted concurrently with fish and macroinvertebrate sampling periods.

Data Analysis

Data Analysis

Stream Hydraulics, Habitat, Fish and Macro Invert Communities

Fish and macroinvertebrate parameters calculated will be displayed graphically to show trends through time. The repaired hydraulics and habitat structure of the riverine system should allow for a) increased QHEI scores within a year and b) increase in IBI/MBI scores. If the trends in the data indicate a decrease in condition, adaptive management actions may be taken.

Riparian Plant Communities

The information generated through sampling the plant community would be used to indicate the trend in overall condition of the area. If the FQA analysis indicates a decrease in condition, adaptive management actions may be taken to increase the score for the following sampling year.

Monitoring Responsibilities

The US Army Corps of Engineers will be responsible for monitoring of fish, macroinvertebrates, riparian plants, reptiles, and amphibians.

Monitoring Costs & Funding Schedule

Tasks	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Fish and Inverts	$7,000	$7,000	$7,000	$7,000	$7,000	$35,000
Riparian Plants	$2,600	$2,600	$2,600	$2,600	$2,600	$13,000
Stream Hydaulics	$3,000	$3,000	$3,000	$3,000	$3,000	$15,000
Final Report	n/a	n/a	n/a	n/a	5,000.00	$5,000
Total	$12,600	$12,600	$12,600	$12,600	$17,600	$68,000

Reporting Results

A yearly monitoring summary report would be drafted by the USACE that briefly summarizes the data collected and determines if adaptive management is needed. A final monitoring report would be drafted that details the outcomes of the restoration project.

Contact Information

Fish, Inverts & Habitat

Francis M. Veraldi
Fish Biologist / Restoration Ecologist
US Army Corps of Engineers, Chicago District
111 N. Canal St., Suite 600
Chicago, IL 60606
312-846-5589
Frank.M.Veraldi@usace.army.mil

Riparian Plants

Robbie Sliwinski
Botanist / Restoration Ecologist
US Army Corps of Engineers, Chicago District
111 N. Canal St., Suite 600
Chicago, IL 60606
312-846-5486
Robbie.Sliwinski@usace.army.mil

Adaptive Management

Adaptive management needs for this project are minimal and currently not foreseen needs are apparent. However, changes would be planned, approved and implemented if expectations are not being met.