2022

South Branch Pike River Ecosystem Restoration

Appendix C – Monitoring & Adaptive Management Plan

Chicago District
US Army Corps of Engineers
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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 resource 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.

Guidance

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

a. Section 1161 of WRDA 2016

b. Section 1010 of WRDA 2014 Determination of Project Completion

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

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

e. 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 has been broken into Phase I and Phase II to accommodate major road crossings, and allow for easy to read maps of the project. Phase I is bordered to the south by Highway K (60th Street), to the north by Highway 158 (52nd Street), the Canadian Pacific Railroad on the west and the Union Pacific Railroad on the east. The Phase I study area is approximately 53 acres. Phase II is bordered to the south by Highway 158 (52nd Street) and to the north by Highway S (38th Street), Canadian Pacific Railroad on the west and the Union Pacific Railroad on the east and a triangular piece of property to the west of the Canadian Pacific Railroad tracks on County Correctional Institution property. The Phase II study area is approximately 193 acres. Phase I and II total approximately 246 acres. Both Phases are located in Kenosha County, WI.

Habitat Trends Triggering Restoration

The South Branch Pike River (SBPR) has been channelized to obtain faster flow and increased capacity during floods and to accommodate farming practices. Loss of riparian zone and side-stream wetlands have resulted in in-stream habitat degradation, loss in resiliency and morphology of natural banks, reduced natural organic inputs (woody debris/leaves/insects) and poor water quality. Accordingly, riparian, wetland and stream ecosystems have been severely impacted with reduced abundance, diversity and health of aquatic and riparian organisms. Specific problems include but are not limited to:

1. Loss of Fluvial-geomorphic Processes (Riverine Habitat)
    a. Loss of cut & fill alluviation (actively meandering and migrating)
    b. Abnormal sediment inputs, transport and substrate sorting
    c. Instability of banks, streambank armoring and lack of native vegetation
    d. Loss of habitat features (e.g. riffles, pools)
    e. Flow velocities homogenized (hydraulics)
    f. Presence of foreign debris and loss of natural organic debris (e.g., large wood)
2. Degradation of Hydrologic Regime
    a. Natural hydrologic inputs altered
    b. Flashy urban hydrography with extremely high flood flows
    c. Loss of hydro periods
    d. Fragmentation of channel by culverts, abutments and channelization

3. Loss of Riparian Zone
    a. Reduced extent of riparian buffers
    b. Habitat fragmentation and destruction
    c. Loss of riparian inputs (large woody debris, leaf litter, insects/other food)
4. Loss of Species Richness (riverine and riparian native species)
    a. Extirpation through physical removal; development/agriculture
    b. Loss of native seed bank
    c. Fragmentation of river channel and riparian zone

Restoration Design Overview

The preferred plan will greatly increase the ecological integrity and complexity of SBPR. There are several aquatic resource opportunities that could be addressed:

- Opportunity to re-introduce Northern Pike (*Esox lucius*) to the SBPR by creating habitat. According to local legend, the Pike River had so many Northern Pike it was possible to walk across the river on their backs. Today, there are none in the SBPR.
- Opportunity to provide critical habitat for the federally endangered Rusty Patched bumblebee and migrating birds on the Lake Michigan Flyway, part of the larger Mississippi Flyway.
- Opportunity to restore passage for mussel and fish species to access habitat within the SBPR.
    - Mussels depend on fish passage for dispersal, fish being mussel glochidia (larval) hosts.
- Opportunity to provide varied riverine (lotic/flowing) velocities and forces that riverine species require.
- Provide natural sediment (substrate) transport.
    - Restore substrate composition and sorting.
    - Provide natural macro-habitat features.
        - Islands, deep pools, riffles, native aquatic vegetation, bars, undercut banks.
    - Restore ability to naturally filter and clean water and sediments (substrates).
        - Moving water facilitates cleansing as substrates (sediment) move through the river becoming exposed to saprophytes (animals, bacteria, fungi) and oxygen.
- Restore native species richness and composition of riparian zone plant communities.
    - Restore structural diversity.
    - Provide diverse food sources.
    - Reduce noxious chemical sources from non-native plants (i.e. European buckthorn [*Rhamnus cathartica*], garlic mustard [*Alliaria petiolata*]).
    - Restore connectivity along the river (longitudinal) and up the bank (lateral).
- Opportunity to provide adequate flood conveyance, while providing improved habitat.

Monitoring Components

Monitoring Plan Goals & Objectives

The goal of the project is to restore stream, riparian, wetland and buffering plant communities to provide habitat for residential and migratory fish and wildlife. The following specific objectives were established for monitoring the effectiveness of this project:

- Reestablish natural fluvialgeomorphic parameters (hydraulics, substrates) and structures to support riverine and riparian habitats (QHEI): QHEI improves annually throughout monitoring period with a target score of $\geq$ 77 (excellent) for headwater streams

- Increase the abundance and richness of native stream fish species for years 1 and 2 of monitoring. Abundance and richness may stay the same or continue to increase for years 3 – 5 of monitoring
- Improve native plant species richness and assemblage structure as measured by coefficient of conservatism of the Chicago Region Floristic Quality Index: Mean C must increase and stay between 3 and 4, greater than 4 is acceptable, less that 3 is unacceptable. A decrease in Mean C over 2 monitoring events is not acceptable
- Eradicate/reduce the presence of non-native and invasive species: Target Invasive Species Eradication Percentage <1% Areal Coverage

Stream hydraulics, stream habitat, fish community, and riparian vegetation will be monitored to determine the effectiveness of the restoration plan. All components will be monitored as specified below, once prior to the project and annually for five years following completion of the project.

Stream Hydraulics

Hydraulic parameters will be monitored at each riffle complex within the stream. In order for the created cobble riffles to provide conditions for lotic macroinvertebrates and fishes, induced flow velocities must be apparent; otherwise they are just a pile of rocks in a stream. These flow patterns will be monitored through observation in the field. Velocity, stream morphology, and substrate count data will be collected within the stream to determine how the channel is developing after restoration.

Stream Habitat and Fish community

Habitat parameters for the restoration reach will be evaluated using the Qualitative Habitat Evaluation Index (QHEI), which is described in section 3.1.2 in the main report. The QHEI consists of six sections with a maximum total of 100 points:

1. Characterization of substrate types and 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

The QHEI is correlated to fish habitat suitability such that as the QHEI score increases so to should native fish species richness and abundance. The QHEI is calculated by visual inspection of the physical characteristics of the stream reach of interest.

Monitoring fish community response to stream re-meandering will be conducted using seine and electro-shock methods. Successful restoration is expected to increase fish species richness and diversity throughout the study reach of South Branch Pike River once restoration has been completed.

Ancillary data will be collected on other assemblages as well. During fish monitoring, effort would be spent observing wildlife utilizing the habitats, including aquatic macroinvertebrates, terrestrial insects, amphibians, reptiles, birds, and mammals

Plant Communities

Evaluation of vegetation will be done using the Floristic Quality Assessment Index (FQA) and native plant richness, as described in the Feasibility Report. In short, the FQA is a measure of overall

environmental quality based on 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 and 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. 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 current site conditions.

Sampling/Survey Frequency

Stream Hydraulics, Habitat, and Fish Community

Monitoring will occur once per year in late spring to summer over the course of 5 years or, per the Implementation Guidance for Section 1161, until such time as the Secretary determines that the success criteria will be met.

Plant Communities

Plant monitoring would occur between June and September of each year of monitoring activities. Sampling would occur once a year. The total monitoring period will be 5 years or, per the Implementation Guidance for Section 1161, until such time as the Secretary determines that the success criteria will be met.

Data Analysis

Stream Hydraulics and Habitat

Stream hydraulics and habitat parameters calculated will be displayed graphically to show trends through time. The repaired hydraulics and habitat structure of the stream should allow for an increase in fish species richness (R) scores. If the trends in the data indicate a decrease in condition, adaptive management actions may be taken.

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, Chicago District will be responsible for monitoring stream hydraulics, habitat, critical infrastructure, erosion points, and plants.

Monitoring & Adaptive Management Costs & Funding Schedule

Table 1 - Monitoring Costs

Tasks	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Hydraulics & Fish	5,000.00	5,000.00	5,000.00	5,000.00	5,000.00	25,000.00
Plant Communities	3,000.00	3,000.00	3,000.00	3,000.00	3,000.00	15,000.00
Adaptive Management	2,000.00	1,500.00	1,500.00	1,000.00	1,000.00	7,000.00
Final Report	$ -	$ -	$ -	$ -	5,000.00	5,000.00
Total						52,000.00

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

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Adaptive Management Planning

Adaptive management needs for this project are minimal and currently no foreseen needs are apparent. However, changes would be planned, approved and implemented if expectations are not being met. Adaptive management may include adjustments to riffle structures and/or supplemental plantings. The following post construction adaptive management may be prescribed for this project.

Hydrogeomorphic Measures

The following is a list of potential adaptive management measures for restoring and creating the hydrogeomorphic setting(s) for native communities.

- Demolition
  - Loose fragments and foreign debris
  - Remove drain tiles/pipes
  - Valve drain tiles/pipes
  - Reroute pipes
- Earthwork
  - Excavation and grading to achieve hydrology
    - Sidestream wetland shelves, riparian pocket wetlands
    - Transitional communities
  - Bank grading to achieve hydrology and slopes
    - Terracing for different plant communities
    - Reducing bank slopes on inside bends and straight runs
    - Floodplain connectivity
  - Channel reconfiguration
    - Meandering, braiding, etc.
    - Development for riffle/run/glide/pool
- Channel / Habitat Structures
  - Native Rock Structures
    - Slab-rock, riffle, boulder cluster, cobble bar, etc.
    - J-hook, cross-vane, etc.
  - Large woody debris (LWD)

Demolition – this measure entails those activities associated with the removal of structures within the channel, bank and floodplain zones. Specific structures that could be removed include but are not limited to drain tiles, culverts, pipes, outfalls and other defunct infrastructure. Specific materials to be removed under this measure include but are not limited to large foreign debris, concrete, metal, angular riprap, clay drainage tiles, plastic drain tiles, concrete pipe, etc. All materials removed would be appropriately reused, recycled or disposed of.

Excavation and Grading – this measure includes the removal of earthen materials to achieve required geomorphologies and hydrology for native communities. Large to small earth moving machines would be utilized to excavate earthen materials to specific elevations as required by the targeted native community. All materials would be reused on site to create diverse geomorphologies; stockpiled for reuses by others; and/or disposed of appropriately at other non-federal sponsor owned lands. This measure is typically coupled with grading.

Bank Grading – this measure includes the movement of earthen materials to achieve required geomorphologies and hydrology for native communities. Large to small earth moving machines would be utilized to spread, smooth and undulate surface soils to specific elevation as required by the targeted native plant community. This measure would typically be combined with excavation to provide final elevation, and/or soil amendments (if necessary) to ensure proper incorporation into surficial soils.

Native Rock Structures – this measure includes the placement of rock/stone into the stream channel to provide required geomorphology and substrates for a native stream community. This measure would be more applicable to those channel reaches that exhibit higher stream velocities. Large to small construction machinery would place rock slabs, boulders and/or cobbles that are of the same make up and general shapes as natural reaches with similar gradient. Rock/stone materials would take on various configurations as necessitated by the particular stream parameters present at the restoration site. Different configurations of rock structures would include but not be limited to slab-rock, riffle, boulder cluster, j-hook, cross-vane and cobble bar. All stone structure materials would be appropriately sized based on in-channel parameters. All materials would be sourced from local permitted sources to ensure clean and inert materials. This measure is combinable with a variety of measures as it can add critical habitat and stability components.

Large Woody Debris Structures – this measure includes the placement of large woody debris (LWD) into the stream channel or into wetlands for habitat and stability components. This measure would be more applicable to those channel reaches that exhibit lower stream velocities and wetlands. Large woody debris consists of trees, their major branches, their rootwad and combinations of such. Typically, larger trees (20+ DBH) removed for excavation, grading or native plant community restoration are retained and utilized. These structures may consist of one to many trees placed into the stream channel and bank zones in various configurations to provide habitat and temporary stability. Depending on the forces exhibited in the area targeted, LWD may or may not need to be keyed into and/or tethered to the stream floor or earthen bank.

Native Plant Community Measures

- Invasive Species Clearing & Grubbing
  - Clearing, grubbing, mowing
  - Herbicide
  - Flooding
  - Burning
- Native Species Planting
  - Seeding
  - Dormant rootstock
  - Live plugs
  - Shrubs and trees
- Native Species Establishment
  - Herbivory control
  - Invasive species control

Invasive Species Removal – this measure includes the complete removal of non-native weeds and the selective removal of native weeds in areas that are not treated with other measures that would also provide clearing, such as excavation, grading and some demolition activities. Methods for removing invasive plant species include but are not limited to clearing and grubbing, mowing, burning, flooding, broad-cast herbicide application, spot-treatment herbicide application, etc. This measure is a one-time initial application or an initial series of applications to provide conditions for native plantings; this

measure is not the same as those small spot treatment applications under the Native Plant Establishment measure.

Native Plantings – this measure includes the procurement and planting of native plant species and contract grown plantings. Native planting lists would be specifically developed per plant community type specifying the rates of native seed, live root stock, live plugs and live tree/shrub containers. Current potential for plant community general types include aquatic bed, marsh, meadow, prairie, savanna, woodland and forest.

Native Plant Establishment – this measure includes those elements required to establish and maintain newly created or restored plant communities. Specific elements include but are not limited to invasive species management, herbivory control, protective fencing, limited short-term watering, general plant survival, growth and coverage, etc.