Analysis of Environmental Sustainability Needs for the Ohio River Mainstem System Study

By

Carl T. Swor (1)
Larry Canter (2)
David Rieger (3)
Eric Hollins (4)
Lorna Harrell (5)

(1) U.S. Army Corps of Engineers, Nashville District, PO Box 1070 (PM-P), Nashville, TN 37202-1070; phone: 615-736-7853; fax:615-736-2052; e-mail: carl.t.swor@lrn02.usace.army.mil

(2) Environmental Impact Training, PO Box 9143, Horseshoe Bay, TX 78657-9143; phone/fax: 830-596-8804; e-mail: envimptr@aol.com

(3) U.S. Army Corps of Engineers, Huntington District, 502 Eighth Street, Huntington, WV 25701; phone:304-399-5160; e-mail: david.m.rieger@lrh01.usace.army.mil

(4) Woolpert, Inc, 4141 Rosslyn Drive, Cincinnati OH 45209-1183; phone: 513-272-8300; fax: 513-272-8301; e-mail: eric.hollins@woolpert.com

(5) Woolpert, Inc, 4141 Rosslyn Drive, Cincinnati OH 45209-1183; phone: 513-272-8300; fax: 513-272-8301; e-mail: lornaharrell@email.com

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Abstract

A conceptual qualitative model for relating the effects of multiple past, present, and future actions to changes in selected indicators of Environmental Sustainability for the Valued Environmental Components is described. Practical definitions of Environmental Sustainability for water quality, freshwater mussels, and riparian resources will also be presented. Further, the use of Environmental Sustainability findings to delineate collaborative mitigation needs for specific Valued Environmental Components will be discussed, including the use of expert groups, interacting in a non-constrained mode, wherein the focus is on the scientific and policy needs related to the Valued Environmental Component and not tied to agency responsibilities or budgetary limitations.

Keywords: Past, present, and future actions; indicators; ecological resources; sustainability; cumulative effects; mitigation

Introduction

This effort was conducted as part of the Ohio River Mainstem System Study (ORMSS), which is a study being conducted by the US Army Corps of Engineers. The initial purpose of the ORMSS was to identify navigation investment needs through the year 2060. During the course of the study a second purpose was added, that being authorization of an Ecosystem Restoration Program for the Ohio River and Floodplain (USACE, 2000). Late in the study process, a third purpose, identification of ecosystem sustainability needs, was added.

Several important events occurred after the study scope was established in the Project Management Plan in 2001 and influenced the study team's decision to add ecosystem sustainability to the ORMSS. Included among these events were the National Academy of Science (National Research Council, 2001) publication of their review of the Upper Mississippi River/Illinois Waterway (UMR/IWW) draft navigation study and subsequent guidance from Corps of Engineers Headquarters to the study team on UMR/IWW to include environmental sustainability improvements in every alternative. Also, in 2002 the US Army Chief of Engineers issued a set of Environmental Operating Principles (USACE, 2002). These principles stress achieving environmental sustainability, understanding environmental consequences, seeking balance and synergy, and assessing the cumulative effects of Corps of Engineers actions and shall guide planning and execution of the Corps of Engineers' various missions.

Although the concept of sustainability was already included in the ORMSS Cumulative Effects Assessment process, the above events necessitated a change in how sustainability was being considered. Initially, the study only attempted to look at the difference in the future sustainability of resources between the No Action and the Preferred Action plans. Based in part on the new emphasis, the study team expanded their effort by developing and conducting a process to identify the high priority ecosystem sustainability needs for the Ohio River and floodplain.

Distinction Between Ecosystem Restoration and Sustainability Needs

As described by Corps of Engineers Regulations, the objective of ecosystem restoration is to restore degraded ecosystem structure, function, and dynamic processes to a less degraded, more natural condition. Multiple definitions exist to describe sustainability (Bruntland Commission, 1987; President's Council on Sustainable Development, 1996; UNESCO/ASCE, 1998). In the USACE Environmental Operating Principles and Implementation Guidance (USACE, 2002) the following definition of sustainability was given: “a synergistic process whereby environmental and economic considerations are effectively balanced throughout the life cycle of project planning, design, construction, operation and maintenance to improve the quality of life for present and future generations.”

Traditional concepts of ecosystem restoration focus on ecological structure, functions, and processes. Sustainability, however, requires incorporation of a comprehensive set of considerations to include present and future societal objectives that balance economic development with environmental integrity. A key concept of sustainability is accommodating appropriate development to meet present day needs without compromising the ability of future generations to also meet their needs. In essence, sustainability efforts require that broader and longer term views of actions must be taken to ensure future generations are not deprived of amenities enjoyed by present generations.

Because determination of sustainability needs requires comprehensive consideration of a wide variety of factors, a new perspective must be taken. Unlike the conventional approach taken in the ORMSS ecosystem restoration study, a paradigm shift was required to focus on the major types of activities needed to improve long term resource sustainability. The ecosystem restoration program was developed through a process whereby approximately 280 individual restoration sites were proposed and evaluated. As the study progressed, commonalities among groups of projects were identified leading to several categories of potential projects. Formulation subsequently evolved into a recommendation that a programmatic authority become established that would allow proposing and evaluating each individual project based on it merits and relative contribution to program objectives. The approach used to develop the Ohio River Ecosystem Restoration Program can be characterized as a “bottom up” process, wherein multiple individual components were bundled into groups of projects that were eventually assembled into a program.

The approach taken for identification of sustainability needs was designed to be a “top down” way of looking at the environment. As described in the following section, the concept was to take an overview of the resource condition and identify the highest priority needs. An essential element of this approach was to keep the focus on actions that would provide the most benefit to the resource and not on any constraints to implementation of those actions.

Methods

Planning – To begin determining the most important sustainability needs for ecological resources of the Ohio River a process was designed to elicit expert opinion from those most intimately familiar with the resource and its condition. It was decided that two facilitated brainstorming sessions would be held, one to discuss aquatic sustainability and one to discuss riparian/terrestrial sustainability. A list of desired participants was developed for each session, and another list of possible reviewers was made for aquatic and riparian/terrestrial results, respectively.

Following initial contacts with identified experts to determine interest in participating, a set of instructions was provided to each person. These instructions were:

- Identify major factors only (no more than ten of the most positive and no more than ten of the most detrimental factors) affecting the resource.
- Take the perspective of the resource.
- Be creative.
- Task is forward looking only; consider what can be done from this point forward. Avoid excessive details.

Broad questions to be addressed included:

- What do we want the resource to ultimately look like?
- What factors most influence sustainability (positively and negatively)?
- What are critical needs for improved sustainability?
- What actions should be avoided?
- What must be measured to determine sustainability (i.e., indicators)?
- How do we know when we're there?
- What knowledge gaps should be addressed to help determine sustainability?

Constraints:

Accept that the system is highly modified and will remain so (i.e., it isn't reasonable to return the river and floodplain to predevelopment conditions; however, the system is amenable to further modifications that may affect the resource either positively or negatively).

For now think only about the resource. At this time, don't be concerned with:
Who will do it.
How it would be done.
Who pays.
When it would happen.
Other constraints.

Anticipated products:

- A list of identified factors affecting sustainability.
- Recommendations for measuring and monitoring sustainability.
- A presentation summarizing the results for presentation at an Interagency Environmental Team meeting.
- A written summary report.

<u>Implementation</u> - The expert elicitation session with the aquatic group (23 participants) was conducted on February 11, 2004. The session with the riparian/terrestrial group (15 participants) was held on October 20, 2004. To orient the groups, each session

began with a presentation explaining the ORMSS study objectives, process, and products. The presentation provided detailed information on environmental components, in particular the Integrated System Investment Plan/Programmatic Environmental Impact Statement (SIP/PEIS), the comprehensive Cumulative Effects Assessment (CEA), authorization of the Ecosystem Restoration Program, and the identification of sustainability needs.

Three key points were repeatedly emphasized throughout the discussions:

- The importance of distinguishing between establishment of the Ecosystem Restoration Program and identification of sustainability needs
- The necessity of taking a resource perspective and
- The necessity of taking a landscape or "high altitude" view of the river and floodplain.

The Ecosystem Restoration Program began with the premise that the study would lead to a programmatic authorization by Congress for implementation by the Corps of Engineers. As with most Corps of Engineers authorities, it was assumed that the ecosystem restoration program would require cost sharing with a non federal sponsor. In addition, the program would be constrained by existing Corps of Engineers policies and regulations pertaining to ecosystem restoration. Conversely, the sustainability needs process was not intended to be the responsibility of any one agency or group of agencies. It was to focus on the condition of the resource and identify those actions that would provide the greatest benefit to the resource regardless of how the actions were accomplished or funded.

The need to maintain a focus on the resource itself required a deviation from the normal thought processes for many participants. Typically when an idea is advanced the assessment process begins almost immediately. Assessment usually includes evaluating the practicality of implementing the idea and involves questions such as how much it would cost, who would pay for it, and how feasible is it. These thoughts shift the emphasis from the resource condition to consideration of obstacles to implementation. Although difficult, it was important to keep the participants thinking only about the resource and its needs.

Another necessity was to "step back" from thinking about individual problems and opportunities and take a more holistic view of the resource base. To do this necessitated integration of multiple individual situations into more general patterns. By looking on a broader or landscape scale the larger, more significant factors begin to emerge. As with maintaining a focus on the resource, taking a broader perspective was a different way of considering issues and required managing the discussion process to stay on target.

One important constraint was provided to the discussion. That was to accept that the system is highly modified and will remain so (i.e., it isn't reasonable to return the river and floodplain to predevelopment conditions; however, the system is amenable to further modifications that may affect the resource either positively or negatively). This constraint was established to interject a level of realism in the process. This was necessary to ensure the results would be meaningful to the goal of the study effort and to the definition of sustainability.

As a group, each question was discussed and all responses recorded until no new ideas were forthcoming. The three questions posed to each group were:

- "What do we want the resource to look like?"
- "What needs to happen to attain this vision of the Ohio River?"
- "What are possible indicators of environmental sustainability?"

As discussion of one question began to become repetitive or to pertaining less to broad based resource issues, the discussion on that question was stopped and a new question was posed until all three questions had been thoroughly discussed.

<u>Synthesis</u> – Following each session, the information was examined and the process of synthesizing the responses began. Similar to the process used for the Ecosystem Restoration Program, the synthesis began by determining commonalities among responses and then grouping similar responses. In analyzing and synthesizing the answers to the questions it became obvious that sometimes the ideas generated in the meeting were actually better suited to one of the other questions. In those cases, the answers were shifted to best fit the questions. In other instances, several of the answers had common themes or were re-statements of previous answers, and these were combined to form a single idea. However, care was taken to make sure none of the ideas were omitted from the results. The results were organized and presented in a manner that allowed reviewers to cross-walk between the verbatim ideas generated during the session and the categorized results.

From the aquatic discussion, responses to the question "What do we want the resource to look like?" were initially categorized as pertaining to 1) habitat, 2) biological, or 3) management. Riparian/terrestrial responses to this question were similarly grouped into 1) functions of riparian areas or 2) management opportunities/strategies to protect or improve riparian areas.

Following similar grouping and categorization of answers to each of the three questions, the results were summarized. These are being sent back to the participants for comment and will then be sent to a different group of resource experts for another round of review and revision. Results of this effort will be incorporated into the SIP/PEIS for the ORMSS.

Results

<u>Aquatic</u>

Question 1 - In response to the question "What do we want the resource to look like?" there were 32 thoughts expressed. Initially, all inputs were categorized as belonging to one of the following sets of characteristics:

Habitat
Biological
Management

Habitat characteristics were then grouped as being associated with one of the following factors:

Connectivity
Hydrology
Habitat Quality
Water/sediment Quality

It became apparent that connectivity, hydrology, and habitat quality all had two common themes, that is they all related in some way to provision of a “complex” set of habitat features “interacting” with each other. The water/sediment factors did not seem to fit with the idea of complexity; rather, they appeared to describe a sense of “balance” wherein there is a desirable amount of each constituent in the water but not so much as to overload the system.

From this process of combining ideas to develop an overall answer to the original question, in terms of habitat the following was developed: “A complex and interconnected system of physical habitat features accompanied by balanced nutrient and energy cycling and minimal amounts of chemical and bacteriological contamination.”

With regard to biological characteristics, the ideas appeared to fall into one of the following two dimensions:

Composition
Function

Examining the concepts from the group discussion, the following answer to the first question in terms of biological characteristics was proposed: “A diverse, self-sustaining, and resilient aquatic biological community dominated by native species.”

Combining the two descriptions, the full answer to the question is “A complex and interconnected system of physical habitat features accompanied by balanced nutrient and energy cycling and minimal amounts of chemical and bacteriological contamination. These habitats would support a diverse, self-sustaining, and resilient aquatic biological community dominated by native species.”

Regarding management characteristics, it was determined that these were actually a series of “actions” rather than descriptors of a desirable state. Therefore, these actions were combined with answers to the second question: “What needs to happen to attain this vision of the Ohio River?”

Question 2 - There were 34 responses to the question “What needs to happen to attain this vision of the Ohio River?” These were grouped into four broad categories of actions: 1) habitats, 2) biological, 3) policy/procedural, and 4) communications.

Habitats - Habitat actions were subsequently divided into four groups: 1) connectivity actions, 2) complexity actions, 3) nutrient balance actions, and 4) contaminant actions. Listed below are the categories of actions associated with connectivity and complexity along with an example of each.

Connectivity actions included:

- Actions at dams (e.g., providing fish passage)
- Riparian/floodplain actions (e.g., reconnect river with floodplain)
- In-stream actions (e.g., maintenance of connection between river and embayments).

Complexity actions were:

- In-stream actions (e.g., restoration of stable shoals)
- Water management actions (e.g., mimic natural regimes including seasonal and extreme floods and droughts)
- Riparian/floodplain actions (e.g., build/restore islands)

Nutrient balance actions primarily involved management of point sources (e.g., elimination of combined sewer overflows) and nonpoint sources (e.g., fertilizer runoff). Contaminant actions focused on minimizing spill and cleanup of existing contaminated areas.

Biological – Biological actions fell into one of two categories: 1) composition and 2) function. Composition actions were associated with either control of exotic species or re-establishment of native species (including expansion into historical habitats). Function actions were associated with managing populations to achieve resiliency and adaptability.

Policy/Procedural – These actions were either regulatory or policy actions. An example of a regulatory action was review of state and federal regulatory processes. Policy actions included increasing the public land base and changes in floodplain land use.

Communications – Communications actions included improved communications with regulatory agencies and increased public awareness and appreciation of the river and the resources it supports. Also comments were made regarding need to better communicate Standard Operating Procedures, the Corps of Engineers Environmental Operating Principles, and examples of Best Management Practices.

Question 3 – This question sought to identify the possible indicators of environmental sustainability. Thirty ideas were expressed on this topic. These were grouped into the following: 1) scientific measures, 2) actions to improve the environment or communications, 3) composite indicators of sustainability, and 4) monitoring needs. During the review, it was determined that some of these were not related to indicators. The group "actions to improve the environment or communications" included two types of actions: 1) those that directly affect the environment and 2) those that concern communication needs. As these topics were both addressed within question 2, they were added there. Also, the “monitoring needs” answers were separated from the indicator responses as these were deemed activities rather than indicators.

Scientific Measures included the following:

- Baseline water and sediment quality
- Drinking water intake quality
- Algal communities
- Macroinvertebrates

Composite Indicators of Sustainability were identified as:

- Habitat data – quantity/quality and change over time
- Designated use attainment
- Floodplain wetlands (acres)
- Shoreline development
- Demographic shifts
- Recreational use patterns
- Regulatory permit issuance
- Fish Community Health Indices

As stated above, several data collection or monitoring needs were identified during the discussion of indicators. Because these were activities rather than indicators monitoring needs were separated from the indicators group. However, these were not added to the list of actions needed to improve the resources as they would not directly result in improved sustainability. Therefore, monitoring needs were listed as though they were a separate (fourth) question. The ideas expressed regarding monitoring needs were:

- Mussel monitoring
- Watershed/tributary data
- Consistency with methodology and monitoring
- Monitoring of larval fish/fish communities
- Ohio River Fish Index
- Monitor shallow near shore wetlands/embayments (acres)
- Riparian vegetation monitoring
- Genetic monitoring
- Assimilation of data
- Analyses of information and wide dissemination of data

Riparian/Terrestrial

Questions asked of the riparian/terrestrial group varied slightly from those posed to the aquatic group. The questions asked were:

- What do we want the resource to look like?

- What are the critical needs that must be met to improve riparian sustainability?
- What specifically needs to be done in riparian habitats in urban areas?
- What must be measured or monitored to determine sustainability?
- What actions should be taken or tools used to increase riparian sustainability?

Responses to each of the questions are provided below.

Question 1 - What do we want the resource to look like?

Nearly 40 responses were made to this question, although several responses were similar or overlapping. Initially, all inputs were categorized as relating either to functions of riparian areas or to management opportunities/strategies to protect or improve riparian areas. The three riparian functions and examples of group responses related to these functions were:

- Providing diverse habitats (e.g., maintain and create islands, no exotics, revegetate floodplains with native species, diverse wildlife habitat)
- Promoting biogeochemical processes and nutrient cycling (e.g., functioning wetlands, 100+ meter buffer strips to intercept pollution)
- Providing hydrological connections and sediment cycling (e.g., take out or move back levees, mimic natural flows, keep existing islands stable).

Several of the group's responses potentially pertained to all three riparian functions and emphasize the complex, interrelated nature of riparian components. Such responses included restoration of identified sites proposed for the Ohio River Ecosystem Restoration Program, floodplain function over the whole system and presence of floodplains within each pool.

Responses categorized as "management" provided general guidelines for moving Ohio River riparian/floodplain resources in a more sustainable direction. Examples of such responses included allowing minimal floodplain development, acquiring more public lands and refuges, promoting conservation programs on agricultural lands, and creating partnerships and other institutional relationships to improve sustainability.

Combining the group's responses, the following was developed in answer to the question of what the group wanted the riparian resource to optimally look like: "Riparian resources along the Ohio River will resemble an integrated natural system that exhibits key functions related to habitat diversity, biogeochemical processes and nutrient cycling, and hydrological connectivity and sediment dynamics."

Such an integrated riparian system would be characterized by functional buffer strips, healthy wetlands, vegetation dominated by diverse native species, and the enhancement and stabilization of islands. Attainment of this goal could involve limits on floodplain development, more land in public ownership and conservation easements, linkages among fragmented habitats and more natural flood/drought hydrologic regimes.

Question 2 - What are the critical needs that must be met to improve riparian sustainability?

The eight responses to this question included ideas to enhance riparian functions (e.g., increase forest cover) and management strategies (e.g., limit human encroachment through zoning, decrease agricultural activity). However, the group acknowledged the necessities of sufficient funding and cohesive institutional management and oversight. These would be essential elements of an adaptive management program.

Question 3 – What specifically needs to be done in riparian habitats in urban areas?

The fourteen responses to this question included physical removal of manmade structures, increased public awareness, and more public ownership and management of urban riparian resources. A strong interest in riverfront projects (parks, multi-purpose facilities, entertainment complexes, Brownfields restoration, etc.) was expressed. Most urban areas either have such projects already or they are in progress. Lack of public understanding and limited education on the benefits of riparian areas hamper improvements to urban riparian areas, but recent public facilities along the riverfront afford opportunities for education and heightened public awareness.
There was a consensus that increased sustainability of urban riparian resources will require a careful balancing between land use and recreation use, on the one hand, and maintenance of riparian functions, on the other.

Question 4 – What must be measured or monitored to determine sustainability?

The 26 responses to this question included increasing acreages of public lands, wetlands, etc., vegetation assessments (e.g., canopy cover, diameter breast height for trees), numbers of certain species. (e.g., nesting birds or amphibians) and various indices of biological integrity (IBI). A potential tool to evaluate riparian conditions might be developed that is analogous to the Qualitative Habitat Evaluation Index (QHEI) developed for streams. Analyses of trends, riparian stability and functions, soil erosion were also mentioned as measures of sustainability. Such trend analyses should continue into the future with historic data for key indicators, when available. Several responses (e.g., water quality and hydrology) acknowledged the interaction between land and water.

Question 5 – What actions should be taken or tools used to increase riparian sustainability?

The 21 responses to this question ranged from implementing specific actions (e.g., developing pool-by-pool master plans, designation/prioritization of critical areas, and restoring islands) to actions aimed at establishing working relationships toward common goals (e.g., identification of stakeholders, public commitment) and procuring adequate funding.

Sustainability group members agreed that communication is a key element in attaining goals for Ohio River riparian areas. Not only must public awareness of the importance of riparian areas be heightened, but communications with regulatory agencies and institutions must be strengthened in regard to principles of sustainability, conservation, Best Management Practices, and the Corps of Engineers' Environmental Operating Principles. An annual or biannual symposium on Ohio River sustainability and adaptive management has been suggested as a catalyst/tool to meet communication needs.

Summary

Although the aquatic and the riparian/terrestrial group discussions were held separately, the results yielded many common points. Both groups' answer to the question "What do we want the resource to look like?" were similar incorporating concepts of interconnectedness, balanced nutrient cycling, and supporting biological diversity.

Regarding actions needed to improve sustainability, the two groups again produced many similarities including the following:

- Provide overall diverse/complex habitats
- Protect and restore special habitat types (e.g., wetlands, islands, bottomland hardwoods, shoals, islands)
- Restore lateral and longtitudinal connectivity (river, floodplain, tributaries, pools, embayments, fragmented habitats)
- Balance nutrient input and cycling
- Restore native species and reduce exotic species
- Provide more public lands
- Improve regulatory review processes
- Increased monitoring
- Improved communications

Unlike responses to the above two questions, discussions of indicators diverged between the two groups. The aquatic group focused on aspects relating directly to aquatic parameters, while the riparian/terrestrial group identified metrics considered important in characterizing land based resources.

Determination of aquatic and riparian/terrestrial sustainability needs for the Ohio River and floodplain has yet to be completed. Through the remaining review process, the needs should become more clearly defined, and agreement should emerge regarding relative importance of actions needed. In many respects the results of this process were very different from those of the previous ecosystem restoration program. An example of this divergence of results is the range of needs identified. The ecosystem restoration program concentrated on site specific habitat modifications to be implemented through a cost shared program administered by the Corps of Engineers. The sustainability needs process identified a much more comprehensive list of actions. These included site specific habitat improvements, but also introduced concepts of connectivity, nutrient management and cycling, species manipulations, land ownerships and use/management changes, regulatory process improvements, monitoring, communications, and perhaps most importantly, the necessity for all stakeholders working together to use their capabilities and authorities to contribute to the identified resource needs.

The question should be asked as to how the outcome of the sustainability needs process could be used. While all the possible uses have certainly not been identified to date, some are readily apparent. Those directly applicable to the Corps of Engineers include evaluating proposed projects for the ecosystem restoration program (i.e., do they contribute to the highest priority needs?), to development of mitigation plans (rather than mitigating in kind as a first priority, mitigate by contributing to the high priority sustainability needs), and to permit processing. Knowledge of sustainability needs will also be useful in moving into an adaptive management mode for the Corps of Engineers as well as for other stakeholders. Possible examples could include programs by other federal agencies (e.g., refuge management, endangered species recovery efforts, non point source grants, conservation reserve), state agencies (e.g., fish management, monitoring, land management), and non governmental organizations (e.g., land purchases, public awareness/education). Although not required, many stakeholders could use the sustainability needs assessment as a management and evaluation tool for their programs and projects.

The focus of the IAIA ’05 conference is on “ethics and quality.” Adding identification of ecosystem sustainability needs to a study originally examining only commercial navigation improvement needs contributes to both ethics and quality. Ethically it is a proper thing to undertake and it will bring balance to the study outcome. From a quality perspective, the concept of identifying sustainability needs is entirely focused on improving the quality of the environment as well as the quality of life. Ethics and quality was embedded throughout the ORMSS process from the very beginning. Studies dealing with transportation issues have become highly controversial in recent years. To keep the ORMSS an open and collaborative process, one of the first priorities was establishment of an Interagency Environmental Team. This team consisted of representatives from each of the six states along the Ohio River, six offices of the US Fish and Wildlife Service, three regions of the US Environmental Protection Agency, four Corps of Engineers district offices, and several non governmental organizations. This team met three to four times per year to discuss study progress, suggest areas of improvement, and review study results. A goal of that process was that there would be no surprises to the participants when the draft SIP/PEIS was circulated for public review and comment. Conducting the study with this type of mindset results in incorporation of the highest quality thoughts and ideas throughout the process, and the openness also contributes to an ethical outcome.

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