

Restoring the Flow



Improving Selective Small Dam Removal
Understanding and Practice in
the Great Lakes States



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Recommendations from the
Small Dam Removal Workshop & Working Meeting

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North Sails Group



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EXECUTIVE SUMMARY

This report details recommendations that resulted from a unique gathering of more than 40 resource professionals, conservationists, and academics from across the Great Lakes region. Each of the participants brought experience with river and fisheries restoration, dam removal, or both. As a group the participants represented 3 countries, 7 states, and 1 province, had 100 years combined dam removal experience, and removed over 100 dams. The workshop and working meeting was held in Kohler, Wisconsin in April 2001. The purpose of the meeting was to share information about small dam removal in the Great Lakes states where half of the 500 dam removals in the U.S. have taken place, and to develop these recommendations. The recommendations are intended to guide policies and initiatives to improve the understanding and practice of small dam removal as a fisheries and river restoration method in the region. This report specifically addresses recommendations for 1) facilitating adaptive management, 2) project monitoring, 3) research initiatives, and 4) community outreach. The workshop coordinators chose these topics because they were felt to fill areas of greatest need in improving the practice of selective small dam removal.

Rivers and dams have played critical roles throughout U.S. history supplying power, water, and flood control to our country's growing population. By some estimates there are 2.5 million dams in the nation, many of which are now obsolete, aging, and in poor condition. Aging dams often pose a public safety hazard, can be extremely expensive to repair and maintain, and alter river habitat while often no longer serving their original purposes. Small dam removal with the express goal of restoring rivers is a relatively new phenomenon, and it has been found to be an effective and economical river restoration technique in many situations. Although there have been about 500 dam removals documented in the U.S. during the past century, only a small number of published case studies are available.

Practitioners in the region have identified a need to more effectively collect and share information, communicate with each other, and inform the affected communities about the potential benefits and impacts of small dam removal. By gathering experienced people, sharing knowledge and insights, and developing these recommendations the Small Dam Removal Workshop and Working Meeting participants sought to begin filling these needs.

MAJOR RECOMMENDATIONS

Facilitating Adaptive Management

- Develop comprehensive databases of dams and dam removals in the Great Lakes region.
- Revise laws and administrative rules to encourage natural resource agencies and dam owners to fully consider dam removal as an option during dam-related decisions.
- Adopt state and federal permitting frameworks that facilitate rather than hinder river restoration through small dam removal.
- Promote collaboration between research and monitoring entities and regulatory agencies.
- Incorporate stakeholder input, periodic reviews, flexibility to change course if new information indicates it is necessary, and other adaptive management principles into the project process.
- Include on-site consultation with both river scientists and engineers during the small dam removal and restoration process.
- Conduct comprehensive data collection before, during, and after small dam removal projects to provide researchers and managers sound information for modifying future management actions.
- Educate agency managers, elected officials, consultants, conservation and community organizations, dam owners and other stakeholders on the potential benefits and techniques of dam removal.

Project Monitoring

- Set goals to determine the success or failure of a dam removal project.
- Establish uniform minimum standards at the regional level for monitoring at dam removals.
- Create and fund monitoring programs for agencies and in collaboration with other institutions.
- Utilize monitoring information to inform the adaptive management process.

Research Initiatives

- Facilitate and develop research projects to help decision-makers, resource managers, and contractors address the most pressing dam removal issues.
- Focus research on the cumulative effects of multiple dams and dam removals on a single river, and impacts on entire watersheds rather than just isolated reaches.
- Explore collaborative relationships to fill research needs.

Community Outreach

- Provide natural resource agencies and communities the resources necessary to fully consider and implement dam removal during dam-related decisions.
- Develop and widely distribute resources to educate stakeholders about dam removal and river restoration.
- Encourage community involvement in the decision-making, education, and restoration processes.
- Develop and implement effective community outreach initiatives.



Workshop participants pose for a group shot.

Report Audience

The recommendations compiled in this report are intended primarily for natural resource management agencies, universities, elected decision-makers, conservation and community organizations, funding agencies, and others who might be addressing small dam removal issues. This report is being broadly disseminated within the region with the hope that these recommendations will improve the understanding and practice of small dam removal projects in the Great Lakes region.

INTRODUCTION

This report details recommendations that resulted from a unique gathering of more than 40 resource professionals, conservationists, and academics from across the Great Lakes region. Each of the participants brought experience with river and fisheries restoration, dam removal, or both. As a group the participants represented 3 countries, 7 states, and 1 province, had 100 years combined dam removal experience, and removed over 100 dams. The workshop and working meeting was held in Kohler, Wisconsin in April 2001. The purpose of the meeting was to share information about small dam removal in the Great Lakes states where half of the 500 dam removals in the U.S. have taken place, and to develop these recommendations. The recommendations are intended to guide policies and initiatives to improve the understanding and practice of small dam removal as a fisheries and river restoration method in the region. This report specifically addresses recommendations for 1) facilitating adaptive management, 2) project monitoring, 3) research initiatives, and 4) community outreach. The workshop coordinators chose these topics because they were felt to fill areas of greatest need in improving the practice of selective small dam removal.

Rivers and dams have played critical roles throughout U.S. history supplying power, water, and flood control to our country's growing population. By some estimates there are 2.5 million dams in the nation, many of which are now obsolete, aging, and in poor condition. Aging dams often pose a public safety hazard, can be extremely expensive to repair and maintain, and alter river habitat while often no longer serving their original purposes. Small dam removal with the express goal of restoring rivers is a relatively new phenomenon, and it has been found to be an effective and economical river restoration technique in many situations. Although there have been about 500 dam removals documented in the U.S. during the past century, only a small number of published case studies are available.

A significant factor in the removal of a dam can be public perception because the issue often generates controversy within and beyond the affected communities. People sometimes perceive dams with nostalgia, place important historical value on them, or use the impoundments for recreation. Dam removal can change a familiar part of the community so the decision-making process concerning the fate of an obsolete, aging, or dangerous dam must be undertaken carefully.

Practitioners in the Great Lakes region have identified a need to more effectively collect and share information, communicate with each other, and inform the affected communities about the potential benefits and impacts of small dam removal. By gathering experienced people, sharing knowledge and insights, and developing these recommendations the Small Dam Removal Workshop and Working Meeting participants sought to begin filling these needs.

More and more people are recognizing the value of healthy rivers to our communities. They are engaging in discussions of how to balance environmental restoration, public safety, community concerns, and economic considerations in relation to small dams and their removal. Small dam removal can eliminate a public safety hazard, relieve an economic burden for a dam owner, and restore healthy river functions. The Great Lakes region is leading the way in this exciting endeavor. Two Great Lakes states – Pennsylvania and Wisconsin – are recognized nationally as pioneers in the field of small dam removal. The Great Lakes region is poised to continue leading the country on this issue. The contributors to this report hope that the recommendations herein will provide guidance to those who would like to pursue river restoration through an integrated approach to the selective removal of aging and obsolete small dams.

SMALL DAMS IN THE GREAT LAKES REGION

During the 19th century and the early part of the 20th century numerous dams, perhaps as many as 2.5 million, were constructed to power the industrial development of the United States. In the Great Lakes states, it is rare to find a stream or river that does not have a dam somewhere along its course and many river systems have hundreds of dams from headwaters to main stem. While dams were built for a variety of purposes, many or perhaps most of the smaller ones were built to power mills. As society's needs changed and with the advent of new technologies, many small dams were sold or abandoned and no longer served the purpose for which they were built. The majority of small dams – some over 100 years old – remain in the region's rivers and streams. The lack of a complete inventory of dams makes it difficult to pinpoint the full extent of functioning and obsolete dams in the Great Lakes region, but it is clear that thousands of these structures remain, affecting aquatic habitat, posing safety hazards and often causing financial strain for their owners.

There is no universal definition of what constitutes a "small" dam. Some agencies consider dams lower than 15 feet in height as small. Others use 25 feet as a cutoff. The National Inventory of Dams, a federal inventory that catalogs larger dams, uses a combination of structural height and impoundment size as a guideline for inclusion. Generally, small dams do not provide hydropower at an economical scale, and they commonly do not provide flood protection. Although some headwaters flood control dams could be considered small, the majority of small dams designed for milling are considered "run of river" dams, which have small impoundments and do not have any storage capacity for floodwaters. In fact, some of these dams even exacerbate flooding upstream because the dam reduces the flood flow capacity of the stream channel.

Small dams in the Great Lakes region were commonly built from timbers and rock. Most of these structures that are still standing were covered over with concrete at some point in their more recent history. These materials naturally degrade over time, particularly under the pressure of flowing water and the freeze and thaw cycle, which render structures unstable without consistent maintenance. Structural instability can lead to concerns about public safety and protecting downstream property. After assessing repair and maintenance costs for aging dams, communities and private owners are increasingly choosing to remove structures. Decisions to remove, rather than repair a dam, often result in significant cost savings. The cumulative costs to maintain and repair the aging dam infrastructure throughout the Great Lakes region are unknown but are certainly very great and continue to grow. Even well maintained structures can pose safety hazards for boaters and swimmers. While they may be enticing places to swim or boat near, small dams often create dangerous hidden currents that can trap unfortunate victims. These liability issues, along with continual maintenance costs, can lead owners to consider abandoning or removing their dams.

As scientific research brings a clearer understanding of the ecological impacts of dams on river systems, resource managers and conservationists are considering dam removal as an option to help restore watershed health. Small dams significantly impede fish movement and impair water quality. Algae and other vegetation grows and clogs relatively stagnant water in many dam impoundments. Particularly during the summer, nighttime plant respiration can cause significant declines in water oxygen levels, harming aquatic organisms. The physical changes to river habitat caused by damming often result in changes to fish communities and other aquatic organisms, favoring species that prefer the lake-like habitat of still water. The sheer number of small dams in most river systems results in cumulative ecological impacts on the entire system.

Functions of Dams

- Generate hydropower
- Store water supply
- Provide flood control
- Provide impoundment-based recreation

Most dams do not provide all of these functions. Many dams, particularly small dams, no longer provide the benefits for which they were designed.

Impacts of Dams

- Increase water temperatures
- Decrease water oxygen levels
- Block or slow flushing river flows that can normally serve to dilute some pollutants
- Block or inhibit upstream and downstream movement of fish and other aquatic organisms
- Obstruct the movement of sediment, woody debris, and nutrients
- Inundate wildlife habitat
- Alter timing and variation of river flows

While many of the impacts of dams are harmful to aquatic habitat, some impacts can be beneficial in certain cases.

MEETING OVERVIEW

Workshop participants came together to: 1) share specific information on the technical and social issues related to dam removal; 2) foster interaction among the workshop participants so they gain an integrated understanding of the interdisciplinary nature of small dam removal; 3) develop a set of recommendations for improving the understanding and practice of small dam removal in the Great Lakes region; and 4) share the findings from several dam removal demonstration projects. Workshop participants hailed from six Great Lakes states, Canada, and Washington, D.C. The participants represented a cross-section of individuals that included engineers, agency managers, university researchers, elected officials, community interests, dam owners, and conservation organizations, each with some experience in a dam removal project. The participants were carefully selected and invited to reflect a broad geographic and professional diversity at the meeting.

Presentations covered the fundamentals of small dam removal and included specific case studies and field trips to dam removal sites. The information presented included both the traditional physical, biological, and engineering data, and also the often overlooked, socioeconomic and community aspects of dam removal projects. The format of the workshop emphasized interaction among the participants and an integrated understanding of small dam removal. Small groups had round table discussions focused on broad themes. Facilitators encouraged participants to think about dam removal issues in an integrated fashion by moving beyond the relative comfort of their respective areas of expertise. Finally, we drew from the collective experience of the participants and developed a set of recommendations or "action items" for research, adaptive management initiatives, data and monitoring protocols, and community outreach strategies. These recommendations are outlined in detail below. A summary of the agenda can be found in the Appendix.

Field Trip Stop #1

CLEVELAND

The Centerville Dam was removed from the Lake Michigan tributary stream in Cleveland, Wisconsin in 1996. The dam was removed because it failed a safety inspection. The goal of the dam removal was to solve a safety issue, but at the time of the removal there was little or no consideration for site restoration. Because site restoration was overlooked before the dam removal, some of the potential benefits to the river and the community were unrealized.

The stream channel through the former impoundment is now deeply incised, provides poor habitat, and is a potential safety hazard for local community members. The community had hoped to use the site of the former impoundment as recreational open space. Restoring the channel to provide better stream habitat and to reduce the safety risk to the community members will cost the municipality more than \$250,000. The removal of the structure itself cost only approximately, \$73,500.



Workshop participants examine the site of the former Centerville Dam.



Incised stream channel through the former Centerville Dam impoundment.

RECOMMENDATIONS FOR FACILITATING ADAPTIVE MANAGEMENT

Although many small dams are removed initially for public safety or economic considerations, subsequent restoration of natural river habitat and flows offers important environmental and societal benefits. River restoration through small dam removal is a relatively new opportunity and practitioners can benefit greatly by learning from these early efforts. Adaptive management is a philosophy, increasingly being embraced by natural resource management agencies, which recognizes that ecosystems are naturally complex and unpredictable. It is an approach where all management actions are treated as hypotheses to be tested or as "works in progress." Learning that results from the management outcomes leads to better understanding and improves future management actions. It is an iterative process that relies on thoughtful project design, consistent monitoring protocols, and mechanisms for feedback, collaboration, and information sharing. By employing the principles of adaptive management, lessons learned from each dam removal and river restoration project will help inform the process of subsequent removals. Adaptive management can be more time consuming than other approaches and it does not eliminate the uncertainty involved with managing complex systems, but it can ensure that past learning is incorporated into current decisions, progress is tracked, and necessary adjustments made.

A number of elements must be in place for resources managers to fully utilize adaptive management. Laws and regulations must allow for some flexibility in the management process. An agency culture that supports adaptation will be better able to make necessary changes and incorporate new learning. An adaptive management approach also requires good community outreach mechanisms to effectively communicate changes in the management methods and reduce potential conflicts with the local communities. Monitoring and outreach are addressed briefly in this section as they relate to facilitating adaptive management and are dealt with more comprehensively in their respective sections. To facilitate adaptive management, we recommend essential policies and databases, promoting information sharing among agencies and researchers, easing regulatory barriers, and improved planning and on-site implementation.

Develop comprehensive databases of dams and dam removals in the Great Lakes region.

- Inventory the number, size, age, and location of each dam in the region, including the many smaller dams that do not appear in the National Inventory of Dams.
- Inventory all dam removals in the region including: location, funding, objective of removal, methods of removal, timing and duration of removal, monitoring parameters (social, biotic, abiotic, water quality), cost (estimated and actual), impacts, and lessons learned.

Revise laws and administrative rules to encourage natural resource agencies and dam owners to fully consider dam removal as an option during dam-related decisions.

- Formulate model language for state statutes and/or administrative laws that encourages dam removal as an option, and promotes consideration of habitat restoration opportunities in dam retention/removal decisions.
- Recommend new or revised language that allows federal and state programs to complement river restoration opportunities (e.g. FEMA mitigation, "Greening of the Corps" Initiatives, Farm Bill, EQIP, EPA 319 funding).

Adopt state and federal permitting frameworks that facilitate rather than hinder river restoration through small dam removal.

- Streamline the permitting process to reduce statutory barriers and make it easier to initiate small dam removal projects and to amend management plans during the project process. Pennsylvania has one model that other states could examine. *(See "Information and Resources" for contact information to learn more about the Pennsylvania permitting program.)*
- Authorize a state dam licensing process that incorporates the features of FERC* regulations on the state level. Some of the features include a definite term for license renewal; enforceable articles requiring protection of public safety, water quality, habitat, recreation, and other interests; and licensing fees contributing to an inspection program. **FERC is the Federal Energy Regulatory Commission and they regulate most hydropower dams through a licensing and inspection program that includes public interest criteria beyond safety.*

Promote collaboration between research and monitoring entities and regulatory agencies.

- Create mechanisms for data sharing by merging information distribution systems between agencies and academic institutions.
- Sponsor forums for researchers and agency managers to encourage information sharing and joint problem solving.
- Publish more peer-reviewed papers to expedite technology transfer and increase awareness among practitioners.

See Recommendations for Research Initiatives section for specific research needs.

Incorporate stakeholder input, periodic reviews, flexibility to change course if new information indicates it is necessary, and other adaptive management principles into the project process.

- Develop processes where multiple stakeholders can be included in identifying and testing potential management scenarios.
- Articulate clear and measurable goals and outcomes for small dam removal projects and consistently refer back to them throughout the project timeframe.
- Include provisions in initial project plans for funding and staff to continue post-removal monitoring.
- Foster an institutional culture where researchers and managers are able to admit the "failure" or lack of success of a plan and view it as an important learning tool, rather than burying it in department files.
- Provide institutional support, such as insurance or informed consent procedures that encourages innovation and taking responsible risks. Be explicit about the uncertainty and risk involved with new management endeavors, in particular, and adjust expectations of acceptable outcomes.

Include on-site consultation with both river scientists and engineers during the small dam removal and restoration process.

- Require mandatory contractor training sessions in small dam removal techniques.
- Adopt pre-bid screening policies to ensure that all bidding contractors are adequately qualified to complete the job.

Conduct comprehensive data collection before, during, and after small dam removal projects to provide researchers and managers sound information for modifying future management actions.

- Continue long-term monitoring to collect information that can be used to assess whether short-term impacts of small dam removal are readily overcome.

More detailed monitoring recommendations can be found in the Recommendations for Project Monitoring section.

Educate agency managers, elected officials, consultants, conservation and community organizations, dam owners and other stakeholders on the potential benefits and techniques of dam removal.

More extensive outreach recommendations can be found in the Recommendations for Community Outreach section.

RECOMMENDATIONS FOR PROJECT MONITORING

In practice, there is often a push to complete projects and move on, which effectively eliminates the post-project evaluation and monitoring steps. However, long-term monitoring is a crucial aspect of dam removal and river restoration projects, to evaluate the success of various management techniques and to provide a reference for future projects. Without such data collection and monitoring, there is no mechanism to evaluate a project's success, or to learn from past efforts.

An effective monitoring plan includes activities that allow for stage-by-stage project evaluation in terms of biological, physical, and socioeconomic factors. The following recommendations are provided as guidelines for establishing data collection and monitoring protocols.

Set goals to determine the success or failure of a dam removal project.

- Establish concrete guidelines to evaluate progress and success and provide a framework to improve the effectiveness of future projects.
- Evaluate success based on a range of both socioeconomic and biophysical factors.
- Include goals that focus on ecosystem restoration, rather than on single species management.

Establish uniform minimum standards at the regional level for monitoring at dam removals.

- Collect a basic level of data at all dam removal sites in order to establish a standard set of reference data to use for future projects. Include all stages of a project: baseline data, monitoring of the project in progress, and post-monitoring.
- Use diverse monitoring parameters to gauge impacts of dam removals on the local community, water quality, river health, and the aquatic ecosystem.
- Use photograph reference areas over time as a simple way to enhance the set of reference data.

See 'Project Monitoring Data Collection Recommendations' on next page for a list of monitoring recommendations.

Create and fund monitoring programs for agencies and in collaboration with other institutions.

- Institutionalize and standardize project monitoring procedures to ensure consistent data collection by management teams in different locales.
- Incorporate data collection and monitoring activities early during project planning and include such plans in funding proposals for projects.
- Collaborate with other agencies and organizations to facilitate collecting a range of data, which may require different field expertise.

Utilize monitoring information to inform the adaptive management process.

- Gather and analyze data throughout a project's progress in order to guide potential changes in project management. Channel and riparian habitat restoration can be a long-term process and continual monitoring can help guide future management changes.

Project Monitoring Data Collection Recommendations

While the following list is not exhaustive, it can be used for guidance in developing standardized monitoring protocols for the Great Lakes region. Items that are monitored should be monitored before, during, and after the project.

General Monitoring

- Photographic record before, during, and after of both socioeconomic and biophysical aspects

Socioeconomic Monitoring

- Property values – short and long-term impacts
- Community sentiment regarding structure, impoundment, and river
- Recreational use of impoundment and river and economic impact
- Historical and archeological uses and impacts
- Effectiveness of community outreach and education efforts
- Impacts on existing infrastructure (storm water runoff culverts, water intakes, utility lines, docks, floodwalls, launches, access, bridges)
- Overall economic impact on local community – short and long-term

Biophysical Monitoring

- Sediment quality, quantity, and transport
 - Effectiveness of sediment and erosion control
- Aquatic species – species diversity, abundance, and distribution
 - Fish, Mussels, Insects, Algae, and Water Plants
- Water quality above and below dam
- Riparian species
 - Reptiles, Amphibians, Birds, Mammals
 - Vegetation species and coverages – monitor success of active versus passive revegetation
- Stream path, channel shape, and in-stream habitat
- Substrata changes
- Assess success of any habitat enhancements

Field Trip Stop #2

FRANKLIN DAM — DEMONSTRATION PROJECT

The Wisconsin DNR ordered that the Franklin Dam on the mainstem of the Sheboygan River be removed or repaired because of its deteriorating condition. The dam was partially breached in October 2000 to draw down the impoundment and stabilize the accumulated sediment. Workshop participants heard about the restoration plans and the perspective of the community on the removal process. Some community members opposed the removal but the community was unable to garner the funds to repair the structure and maintain the impoundment.

The rest of the dam was removed during the summer of 2001 and restoration plans included sloping and stabilizing the newly forming channel using bioengineering techniques. The site was planted with native plant species and monitored to determine if more active sediment management would be necessary. Removing the Franklin Dam restored 10 miles of the Sheboygan River to a free-flowing condition. The drained impoundment shows the narrower faster-flowing river channel forming. Colonizing vegetation helps stabilize the accumulated sediment.



Franklin Dam before it failed.



Workshop participants gathered on the remaining sections of the Franklin dam.



Removal of the Franklin Dam using a hydraulic hammer.



Newly drained impoundment at the Franklin Dam site.



Site of the former Franklin Dam Impoundment after the vegetation has grown in.

Field Trip Stop #3

KAMRATH DAM — DEMONSTRATION PROJECT

The streams at the Kamrath site had been dammed and diverted to create ponds and to fill trout rearing raceways. A private conservation buyer purchased the Kamrath and Silver Springs properties because of the unique opportunity to recreate spawning habitat, remove migration barriers, and restore the benefits of the abundant natural spring flow of these headwater sites to the Onion River system. A highlight of the workshop, Wisconsin DNR personnel removed the small Kamrath dam to the cheers of participants and press. Natural channel design and soil bioengineering techniques were used to restore the stream channel that flows through the former pond site. Later in the summer of 2001 the undammed stream was rediverted back into its historic channel path which feeds into this channel.



Aerial view of the Kamrath site before restoration. The dam is in the wooded area near the right angle bend in the road.



Wisconsin DNR personnel remove the small Kamrath dam.



Development of a new channel through the former pond at the Kamrath site.



Restored section of stream in the former pond area at Kamrath.

RECOMMENDATIONS FOR RESEARCH INITIATIVES

As a relatively new endeavor, published research on dam removal and related stream restoration activities is currently minimal. The continual development and dissemination of research on biological, socioeconomic, and geomorphic issues in different regions and on watersheds of various sizes will help decision-makers and resource managers. The following recommendations specify activities that would fill the gaps in the current state of knowledge and practice of removing small dams.

Facilitate and develop research projects to help decision-makers, resource managers, and contractors address the most pressing dam removal issues.

- Identify topics most critical for improving the dam removal management process.
- Evaluate the effectiveness of both current dam removal methods and viable alternatives. See 'Research Topic Recommendations' below for more ideas on needed areas of research.

Focus research on the cumulative effects of multiple dams and dam removals on a single river, and impacts on entire watersheds rather than just isolated reaches.

- Conduct research to identify the most ecologically effective and cost-effective approaches to restoration. For example, study the impacts of removing headwaters dams versus dams closest to the Great Lakes. Or, study the effectiveness of removing one dam in several watersheds versus several dams in one watershed, based on a range of criteria.

Explore collaborative relationships to fill research needs.

- Collaborate between agencies and universities to help resource managers keep up with the state of the science and help researchers answer questions related to the most meaningful management questions.
- Explore ways to use collaborations to more effectively disseminate research results.

RESEARCH TOPIC RECOMMENDATIONS

This list is not exhaustive and should be considered a sampling of research possibilities.

General Research

- Where are the greatest restoration benefits from dam removal, i.e. dams in the headwaters, first dam in system, remove all dams in one watershed or one dam from many watersheds?
- Effects of impoundment size and dam size on ecosystem recovery following removal.
- Focus research on long-term effects while also assessing changes over the short-term.

Socioeconomic Research

- Comparison of long-term costs and benefits of dam removal versus dam repair and maintenance.
- Analysis of the true costs of retaining a dam and removing a dam, with a special focus on non-market variables, such as impacts to fish and wildlife, water quality, recreation and quality of life.

- Effects on short-term and long-term changes in property values following dam removal.
- Effects on local businesses following dam removal – both recreation-based and other businesses.
- Community sentiments about dams, dam removal, and rivers over time.
- Effects of dam removal on community economic growth and development.
- Impacts of removal on existing infrastructure and flood damages.

Sediment, Engineering, and Geomorphology Research

- Sediment management, transport, and impacts.
 - Effectiveness of models to characterize sediment transport following dam removal.
 - Effectiveness of stabilization techniques.
 - Sediment contamination: acceptable limits of heavy metals and pesticides in fine grain sediments. Sampling techniques to assess contamination, what to look for, duration, distribution, stressor, remediation, mitigation, and removal based on contaminant types.
 - Sediment drying time to decide how to work safely with and on sediment from the former impoundment.
 - Sediment erodability: detailed information on shear stress of dewatered sediment to decide when they will erode and when they can be expected to stay in place.
 - Impact of sediment release on downstream channel (recovery time, biotic impacts, gradual vs. one-time release).
- Cost, engineering, and ecological effectiveness of different removal techniques, including mechanical removal, explosives, and natural aging.
- Impacts of impoundment drawdown on local groundwater levels.
- Impacts of dam removals on flooding and water velocities.
- Effectiveness of active versus passive channel design following removal – when is active design necessary and what are the timescales of change if it is not done?

Biological/Ecosystem Research

- Develop models of plant and animal changes following dam removal.
- Effects of removal timing on plants and animals especially for threatened and endangered species.
- Impacts of removal on restoration of migratory fishes. Assess fishery impacts on a watershed-wide scale, rather than just in the reach of the dam.
- Changes in ecosystem health and diversity following dam removal, particularly colonization of restored stream segments following dam removal.
- Effects of dam removal on movement of exotic species and related competition between native and invasive species.
- Effectiveness of active versus passive revegetation of the former impoundment.
- Define physical habitat needs of native fish and other aquatic organisms that engineers can use to design removal and restoration plans, i.e. required Froude and Reynolds numbers for species health, ground water piezometer requirements, rock substrate, shape and size, etc.

Water Quality

- Water quality, drinking water, ecosystem, and human health impacts of releasing sediment downstream.
- Effects of small dams on local water quality and system-wide effects of many small dams on water quality.
- Develop more information on dissolved oxygen changes following dam removal.

Dam Impacts

- Impacts of dams on fish and mussel distribution on watershed and regional scales.
- Impacts of dams on angling and boating with an emphasis on species availability, creel surveys, access issues, economic effects (impounded vs. free-flowing), fisheries management, and recreational opportunities.
- Effectiveness of fish passage structures on fish movement, distribution, and competition, nutrient influx, restoration of species that had gone locally extinct, and restoring connectivity in Great Lakes region river systems.
- Economic analysis of small hydro dam operation including the value of power produced, value of natural resources losses, value of recreational losses, and effects of small hydro operation strategies on river communities.

RECOMMENDATIONS FOR COMMUNITY OUTREACH INITIATIVES

Social and community issues are a critical component of the dam retention/removal decision-making process. Both options, retention or removal, can affect a community and stakeholders in a wide of range issues. Social values can influence preferences for one option over the other.

Because dam removal is perceived as a relatively new phenomenon, communities sometimes feel there is insufficient information to consider it as a legitimate alternative to dam retention. This lack of information can also result in an emotionally based reaction against even considering dam removal as an option. Providing information about dam removal projects in other communities can play a critical role in alleviating the fear of change and clearing up fundamental misconceptions about the process and results of dam removal.

Building awareness and facilitating increased understanding about the option of dam removal early in the decision-making process can enable more community involvement, which will lead to a better-informed decision. All of these factors increase the likelihood of a project with long-term success as a result of community support.

Provide natural resource agencies and communities the resources necessary to fully consider and implement dam removal during dam-related decisions.

- Develop a dam removal guidance document for agencies and consultants that deals with difficult technical issues, such as sediment testing, management and stabilization techniques, timing of dam removal, timing of impoundment draw down. This could start as a compilation of technical case studies, and evolve into a detailed technical guidance document.
- Develop stable and significant statewide, regional and/or national funding initiatives that provide financial support to communities that decide to remove a dam (e.g., to pay for engineering design work, physical removal of dam, channel restoration, parkland development, and interpretive signage).

Develop and widely distribute resources to educate stakeholders about dam removal and river restoration.

- Provide financial and technical support to natural resource agencies and conservation groups to create computer generated visual simulations of "before" and "after" dam removal projects.
- Provide information to dam owners about the impacts that dams have on river systems, with site-specific information if possible.
- Locate and distribute, or create where necessary:
 - Educational materials for the general public regarding the functions that dams provide, and how to tell what function a particular dam is providing.
 - General educational materials about the role of rivers in the natural world, what makes a river healthy, what impacts river health, what healthy rivers do for us, etc.
- Locate and distribute, or create where necessary, a series of case studies from communities around the country. Topics of special interest include:
 - Communications strategies at other dam removal sites.
 - Economic impacts of dam removal.
 - Recreational impacts of dam removal.
 - Results of physical, chemical and biological studies associated with dam removal.
 - Historical preservation and dam removal.
 - Educational opportunities associated with dam removal.
 - Community and riverfront revitalization through dam removal.
 - Dam owners who have helped restore a river.
 - Reports of public sentiment and personal stories.
 - Impact of dam removal on flooding and existing infrastructure.

Encourage community involvement in the decision-making, education, and restoration processes.

- Involve community groups from the very beginning of the process, including alternative analysis development and scoping meetings.
- Encourage natural resource agencies to develop and/or sponsor river and watershed-based groups to help support river protection and restoration initiatives.
- Utilize University Extension Specialists in organizing informational forums, facilitating decision-making processes and providing information on rivers, river health and the impacts of dams.
- Involve community groups and schools in the actual restoration work.
- Promote integration of river sciences in academic curricula (elementary, secondary and college), with the goal that rivers and lakes receive equal representation in the classroom.
- Develop relationships with community outreach specialists to help prioritize and strategize the dam retention/removal decision-making process.

Develop and implement effective community outreach initiatives.

- Develop a community outreach strategy with a focus on educating citizens, dam owners, public officials and government agency representatives about the option of dam removal.
- Establish a funding source dedicated to developing and implementing outreach efforts and educational resources (e.g., educational materials, informational meetings, training sessions).

Field Trip Stop #4

SILVER SPRINGS — DEMONSTRATION PROJECT

The Silver Springs site was profoundly altered early last century to create a fish farm. The extensive network of ponds, dikes, and pipes slows and warms the abundant spring flow, blocks fish passage, and significantly lowers water quality. Most of the ponds have been drained but the dikes, pipes, and dam structures remain in place. Restoration plans include removing all the "plumbing," constructing new stream channels using natural channel design and soil bioengineering techniques, and creating a forested wetland on much of the site. Workshop participants heard a discussion of the planning process and toured this extremely disturbed site.



Silver Springs site before restoration work was initiated.



Silver Springs site during the restoration process in the Summer of 2002.



New "natural" stream channel flowing through the wetland area at Silver Springs.

INFORMATION AND RESOURCES



Small group sessions facilitated the development of recommendations.

Case Studies and Field Trip Site Information

For copies of the presentations and write-ups on the case studies and the field trip sites contact:

Trout Unlimited-Midwest Office
(608) 250-3534 Phone
restorerivers@tu.org

Or check out Trout Unlimited's website at www.tu.org or River Alliance of Wisconsin's website at www.wisconsinrivers.org.

Pennsylvania Dam Removal Permitting Program Information

For additional information on Pennsylvania's dam removal program contact:

Scott Carney
Pennsylvania Fish and Boat Commission
1225 Shiloh Rd.
State College, PA 16801
(814) 353-2225
Scarney@lazerlink.com

For information on permitting contact:

Don Martino
Pennsylvania Department of Environmental Protection
Division of Dam Safety
(717) 787-8568

Additional Resources for Small Dam Removal Information

For additional information and resources on small dam removal contact one of the following organizations. They will also be able to put you in contact with the relevant agency or organizations in your area.

Trout Unlimited
1500 Wilson Blvd., Ste. 310
Arlington, VA 22209
(703) 522-0200
www.tu.org

River Alliance of Wisconsin
306 E. Wilson St., Ste. 2W
Madison, WI 53703
(608) 257-2424
www.wisconsinrivers.org

American Rivers
1025 Vermont Ave. NW, Ste. 720
Washington, DC 20005
(202) 347-7550
www.amrivers.org

APPENDIX

Summary Agenda

DAY 1

WELCOME & OPENING PLENARY

David Hart, The Patrick Center for Environmental Research, Speaker

***Dam Removal and River Restoration:
Scientific Principles, Best Management Practices, and Community
Partnerships***

After brief welcoming comments from representatives of Trout Unlimited, River Alliance of Wisconsin, and the Great Lakes Protection Fund the plenary address made a strong case for taking an integrated approach to river restoration through small dam removal.

FUNDAMENTALS OF DAM REMOVAL

This moderated session explored a number of case studies that demonstrate a range of commonly encountered technical and community issues highlighting the fundamental aspects of small dam removal.

Scudder Mackey, Great Lakes Protection Fund, Moderator

R. Scott Carney, Pennsylvania Fish & Boat Commission, Presenter

Small Dam Removal in Pennsylvania

Bob Martini, Wisconsin Department of Natural Resources, Presenter

Prairie River Watershed Restoration

Sara Johnson, Trout Unlimited, Presenter

Baraboo River Case Study: Citizen Roles in Restoring Rivers

(More detailed information is available on these case studies. See "Information and Resources" for contact information to obtain write-ups.)

CONCURRENT SESSIONS

The purpose of the concurrent session was to expose participants to the aspects of small dam removal with which they were less familiar. Participants were placed in one of the two groups based on pre-conference interviews.

Bob Martini, Wisconsin Department of Natural Resources, Presenter

Technical Issues

This session provided a broad overview of the biological, physical, and engineering issues associated with small dam removal. Topics covered included sediment management, channel restoration, aquatic species issues, structural removal methods and timing, and impacts to existing infrastructure.

Stephanie Lindloff, River Alliance of Wisconsin, Presenter

Community Issues

This session provided a broad overview of the community and economic issues that are commonly encountered with small dam removal. Topics covered included community identity and sentiment, decision-making processes, citizen roles, economic realities, property values, historical concerns, public safety, and post-removal opportunities.

FIELD TRIP

A field trip to four very different local small dam removal sites gave participants an opportunity to explore first-hand the various aspects of dam removal issues. The Cleveland Dam site provided a vivid example of the technical and community issues that arise when channel restoration is neglected as part of the removal process. The Franklin Dam site provided an example of issues encountered when a "community dam" is removed. The Silver Springs and Kamrath Dam sites focused more on the technical and biophysical aspects of small dam removal and stream restoration



John Nelson, WDNR Fisheries Biologist, talks to workshop participants on the field trip.

John Nelson, Wisconsin Department of Natural Resources, Presenter
Marty Melchior, Inter-fluve, Inc., Presenter
Stephanie Lindloff, River Alliance of Wisconsin, Presenter
Steve Simons, City of Cleveland, Presenter

(More detailed information is available on these field trip sites. See "Information and Resources" for contact information to obtain write-ups.)

DAY 2

"OOPS" PRESENTATIONS

This session provided time for people to share "oops" experiences where some aspect of a restoration dam removal did not go as expected. The intention was to discuss and learn from other's mistakes. The loudest applause went to the biggest "oops."

ROUNDTABLE DISCUSSIONS

The purpose of this session was to encourage participants to think integratively before they were asked to develop recommendations. In facilitated discussions groups addressed one of four broad themes. The discussions were framed as if the group were a committee advising a community involved in a small dam removal project. Participants were randomly assigned to ensure that diverse perspectives and areas of expertise were represented in each group. The four topical areas for the roundtable discussions were Fish & Wildlife Issues, Land & Property Issues, Sediment Management Issues, and Public Impact Concerns.

"STUMP THE EXPERTS" SESSION

The participants represented many years of collective experience with small dam removal. Yet, as a relatively young field there are new issues encountered with each dam removal case. In this loosely facilitated session participants had a chance to share experiences that have challenged them, and see how their colleagues at the workshop dealt with a similar situations.

RECOMMENDATIONS DEVELOPMENT SESSIONS

Participants were divided into four thematic groups; Research Initiatives, Facilitating Adaptive Management, Community Outreach, and Monitoring and Data Collection Protocols. Each group was asked to develop a set of recommendations in their area to improve the understanding and practice of small dam removal in the Great Lakes region.

