



## MEMORANDUM

**TO:** Utility Advisory Board

**FROM:** Raymond French, Management Analyst

**DATE:** July 20, 2015

**TITLE:** **Hydro Expenditure Authorization for Sediment Study**

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### **RECOMMENDED ACTION**

Adopt the resolution approving an agreement for a sediment analysis with Inter-Fluve to not exceed \$49,689.

### **BACKGROUND**

As part of the federal hydroelectric relicensing process, stakeholders submitted study requests for the project to inform a license application. Among the many suggested areas for study, perceived and real issues related to sediment management at the two impoundments were identified as a need for further study. There is currently \$100,000 budgeted in the 2015-2019 Capital Improvement Plan for hydroelectric relicensing studies in 2015-2016.

In fall 2014, the City retained a hydroelectric licensing consultant to provide an analysis of licensing options available to the City and the costs associated with each. They included continuing with relicensing at one or both facilities, surrendering the license and leaving one or both facilities in place, and removing both dams. The potential cost for sediment management in the case of dam removal was the primary unknown that led to the greatest variation in costs.

On January 13, 2015, the River Falls City Council adopted Resolution 5906 that requires prior approval of the Utility Advisory Board for expenditures for the hydroelectric facilities of \$5,000 or greater. The same resolution also endorsed a Kinnickinnic River Corridor Planning process that called for preliminary studies to inform the community decision of whether to continue generating power at one or both hydroelectric facilities.

As the City continued on the path of seeking a licensing extension and gearing up for the Kinnickinnic River Corridor Plan process, staff continued to meet with stakeholders to gather input on the highest-priority studies. Settling questions related to sediment management was identified as one of the highest priorities.

The primary goal of the sediment analysis is to identify the costs and methods for sediment management if the city were to pursue dam removal in the future at one or both hydroelectric facilities. A request for proposals (RFP) for sediment analysis was drafted to reflect this goal and was published on June 25, 2015.

With suggestions from staff and stakeholders, proposals were solicited from five firms. They included Barr Engineering (Minneapolis, MN); Braun Intertec (St. Paul, MN); Inter-Fluve (Madison, WI); TRC (Madison, WI); and Wenck Associates (Maple Plan, MN). Proposals were received from all five firms by the deadline of July 7, 2015. A brief summary of the proposals is attached to this report.

A small group of staff and stakeholders met to discuss the proposals and come to consensus on a recommendation to the Utility Advisory Board. Included in that group was Brian Hatch (Hydroelectric Operator); Reid Wronski (City Engineer); Ray French (Management Analyst); Dr. Jill Coleman Wasik (UWRF Faculty); Dave Fodroczi (Kinnickinnic River Land Trust); Dan Wilcox (Trout Unlimited); and Michael Page (Friends of the Kinni).

#### **RECOMMENDATION**

The group of City staff and stakeholders agreed that the proposal from Inter-Fluve, Inc (Madison, WI) is the most competitive and recommends the Utility Advisory Board approve an agreement for sediment analysis services. The proposal is also attached to this report.

The primary evaluation criteria for the group was (1) the demonstrated ability of the bidder to perform the work necessary to achieve the goals of the project; (2) the experience of the firm and individuals to perform the work of the project in Wisconsin; and (3) the proposed price and terms of the agreement.

The proposal review group evaluated each of the proposals with the above criteria and discussed the various approaches each proposal took in studying the volume and composition of the sediment as part of this analysis and in preparing the final technical report to the City. There was also an emphasis on experience in projects of similar size and scale.

The proposal from Inter-Fluve was identified to provide the best value for the services rendered and that they are best able to perform the work necessary to achieve the goals of the project. They have proposed a phased approach for studying the volume of sediment and working with the Wisconsin Department of Natural Resources to identify the best number of samples for laboratory analysis. Unique to Inter-Fluve was a proposal to also study sediment mobility, which can help better determine strategies for sediment management for dam removal.

Inter-Fluve's proposal also discussed their experience in Wisconsin, working with the DNR, and demonstrating a range of experience for projects that are either rural or urban and industrialized, which is similar to the character of River Falls. Given their experience on

working with communities to design river corridors, they can effectively guide the City on how the data collected and possible future sediment management strategies may impact the Kinnickinnic River Corridor Plan. They also uniquely offered to advise on providing cost estimates for sediment management in both dam removal and dam in-place scenarios.

Finally, there was discussion on the unknown number of samples needed and the costs associated with that process. The proposal identifies a likelihood of 13 samples to be taken at a maximum cost of \$1,500 each. The final number of samples will be determined in conjunction with the WisDNR, and the costs for each sample analysis will vary based on the requirements for the breadth of the test. \$1,500 for 13 samples is a conservative estimate and is unlikely to be the final cost for sediment sampling. Therefore, staff recommends the agreement provide for the project to not exceed the conservative estimate.

### **FINANCIAL CONSIDERATIONS**

The agreement with Inter-Fluve will be written to not exceed the cost estimate of \$49,689. Staff is optimistic that the final total for the analysis will be less if fewer samples are needed and less breadth in the laboratory analysis.

The funds for this study are budgeted in the Capital Improvement Plan for 2015. If any additional funds are needed or requested for this study, the request will be brought before the Utility Advisory Board and City Council.

### **CONCLUSION**

Staff and stakeholders reviewed proposals for sediment analysis from five well qualified firms. The consensus was to provide a recommendation to the Utility Advisory Board for pursuing an agreement with Inter-Fluve to provide this study. Staff recommends approval of the attached resolution.

**RESOLUTION NO. 2015-05**

**RESOLUTION APPROVING AN AGREEMENT  
WITH INTER-FLUVE FOR SEDIMENT ANALYSIS**

**WHEREAS**, on January 13, 2015, the River Falls City Council adopted Resolution 5906 that requires prior approval of the Utility Advisory Board for expenditures for the hydroelectric facilities of \$5,000 or greater; and

**WHEREAS**, the River Falls City Council also endorsed a Kinnickinnic River Corridor Planning process that called for preliminary studies to inform the process to be completed in 2015; and

**WHEREAS**, there is \$100,000 budgeted in the 2015-2019 Capital Improvement Plan for hydroelectric relicensing studies in 2015-2016; and

**WHEREAS**, staff, in consultation with stakeholders, identified an analysis of the sediment in both reservoirs that identifies potential costs for sediment management as a high-priority study to be completed in 2015; and

**WHEREAS**, staff, in consultation with stakeholders, prepared a Request for Proposals for Sediment Analysis and received proposals from five qualified firms; and

**WHEREAS**, a group of staff and stakeholders met to review the proposals and determined the proposal by Inter-Fluve provided the best value for the services rendered and that they were best able to perform the work necessary to achieve the goals of the project; and

**WHEREAS**, staff and stakeholders recommend that the Utility Advisory Board approve an agreement with Inter-Fluve for sediment analysis not to exceed \$49,689, which was the maximum cost for the project, including for analysis of 13 samples;

**NOW, THEREFORE, BE IT RESOLVED** that the City of River Falls Utility Advisory Board hereby approves an agreement with Inter-Fluve for sediment analysis services not to exceed \$49,689.

Dated this 20th day of July, 2015.

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Grant Hanson, President

ATTEST:

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Lu Ann Hecht, City Clerk

	<b>Barr Engineering</b>	<b>Braun Intertec</b>	<b>Inter-Fluve</b>	<b>TRC Solutions</b>	<b>Wenck Associates</b>
<b>Lake George</b>					
Bathymetric Survey	Yes	Validate 2006 data with depth checks	Update Lake George sediment depth data	Previous studies will be incorporated into data evaluation	Yes
<b>Lake Louise</b>					
Bathymetric Survey	Yes	Yes	Yes	Yes + hydrographic & sub-bottom survey	Yes
<b>Sediment Sampling</b>					
Scope	Based on WiDNR draft sediment sampling and analysis doc dated May 2015.	Based on WiDNR draft sediment sampling and analysis doc dated May 2015.	Internal guidelines developed from WiDNR and EPA guidelines	Developed in consultation with DNR	Based on WiDNR draft sediment sampling and analysis doc dated May 2015.
Number of Cores - Location	6 (3 per lake)	12 (6 per lake)	Unknown	6 (3 per lake)	12 (6 per lake)
Number of Samples - Tests	18 (3 per core)	24 (two per core)	Minimum of 13	2 (1 composite per lake)	Unknown
<b>Cost Structure</b>					
Reported by task	Yes	Yes	Yes	Yes	Yes
Project Total	\$39,030	\$59,340	\$29,803 + \$1,500 per sample	\$49,000	\$35,200
Optional Bid Item	No additional charge	Not addressed	\$650	Included, but add'l method for \$8,200	\$6,900
<b>Representative WI Projects</b>					
Location	Iron River, Bayfield County, WI St. Croix River, WI Kinnickinnic River (Milwaukee), WI Balsam Lake, WI	Balsam Lake, WI Bone Lake Canal, WI	Centerville Creek, WI* Algoma, WI* Big Spring Creek, WI Franklin Dam, WI Mill Creek, WI Nemahbin Dam, WI Newburg Dam, WI Trout Creek, WI	Baraboo River, WI* Rib River, WI Maintowoc River, WI Sturgeon Bay, WI Newton Creek, WI Additional	None listed in Project Examples, but listed in personal resume experience
Project Profiles Included	Yes	No	Yes for *	Yes for *	No
<b>Primary Contacts</b>	Tom MacDonald Kevin Menken John Juntilla Jim Straberg	Becky McCarty Mark A. Ciampone Douglas Bergstrom	Marty Melchior Beth Wentzel Ben Swanson Charlie Phillips	Katherine Vater Kristopher Krause	Joel Toso Jeffrey Strom Brian Beck
<b>Partner Organizations</b>	None stated	<i>Tetra Tech</i> - bathymetric survey of Lake Louise <i>Pace Analytical</i> - sediment sample analysis	<i>Pace Analytical</i> - sediment sample analysis	<i>J.F. Brennan Co</i> - hydrographic survey of Lake Louise	None stated
<b>Evaluation criteria:</b> (1) Demonstrated ability of the bidder to perform the work necessary to achieve the goals of the project; (2) Experience of the firm and individuals to perform the work of the project in Wisconsin; (3) Proposed price and terms of the agreement.					



Applied River and Wetland Restoration  
Founded 1983

July 5, 2015

Ray French  
City of River Falls  
222 Lewis Street  
River Falls, WI

**RE: Response to Request for Proposal – Sediment Analysis**

Dear Ray,

Thank you for allowing us the opportunity to submit a proposal for the sediment analysis in the Lake George and Lake Louise impoundments on the Kinnickinnic River in River Falls. We have been following this project for some time, and are very interested in helping the City proceed forward in the best way possible. Our involvement to date includes extensive review of previous documentation, attendance at select meetings, and continued discussions with the City and watershed partners.

Inter-Fluve is a nationally-recognized leader in river restoration, and this has been our sole focus for more than 30 years over 1,600 river restoration projects. Our dam removal expertise includes over 60 dam removal and fish passage projects nationwide, involving sediment analysis, removal and post removal river restoration assessment and design. We have an in-depth knowledge of dam sediment and how to manage sediment in any kind of dam removal or modification scenario. All of our dam removal designs have included sediment analysis and management of some kind, and we have been involved with developing guidelines for dam removal sediment management on a federal and state level.

Given a notice to proceed, Inter-Fluve can complete the sediment data collection during low flow, likely in July or August, and we anticipate analysis and presentation of findings in the early Fall 2015. Our budget is presented as a total by task for sediment volume estimation and planning for sediment sampling, combined with a unit cost for each proposed contaminant sample.

We think that our qualifications are an excellent fit for this project. We look forward to working with you on this phase of this important project. Thank you for considering our qualifications and please contact me if you have any questions.

Kindest regards,

A handwritten signature in blue ink, appearing to read "Marty Melchior".

Marty Melchior  
Regional Director  
**Inter-Fluve, Inc.**  
301 South Livingston Street  
Madison, WI 53703  
608-354-8260  
[mmelchior@interfluve.com](mailto:mmelchior@interfluve.com)



PROPOSAL AND SCOPE OF WORK

# River Falls Dams Sediment Analysis

*Submitted to*

Ray French  
Management Analyst  
City of River Falls, WI  
54022

Submitted by  
Inter-Fluve, Inc.

Primary Contact:  
Marty Melchior  
Inter-Fluve, Inc.  
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Madison, WI 53703  
Cell: (608) 354-8260  
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July 5, 2015



# PROJECT UNDERSTANDING AND APPROACH

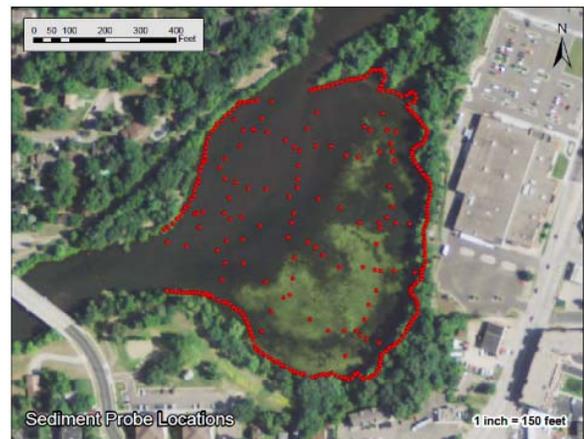
It is our understanding that the City of River Falls currently holds a license from the Federal Energy Regulatory Commission (FERC) to operate the hydroelectric facilities at the Junction Falls (Upper) and Powell Falls (Lower) Dams. The City recently completed an evaluation of the FERC relicensing process and is now pausing relicensing in order to fully evaluate alternatives and gather information to aid in the community decision process. In order to better understand the dam removal alternative and to fully assess risks associated with possible contamination in the existing impoundment sediment, the City of River Falls has requested proposals for assessing the quantity and character of the impounded sediment at both dams. Our approach to this project and scope of work is to help guide the City through the sediment evaluation process, provide accurate information regarding sediment volume and character, answer questions and provide support to the Kinnickinnic River Corridor community planning process.

Inter-Fluve understands the regulatory aspects of the FERC decommissioning process, and can communicate with FERC to ensure that the assessment includes collection of the necessary data for either renewal or surrender of the license. If a dam is decommissioned, FERC requires an assessment and identification of all infrastructure and impoundment features, and also a description of how demolished or removed features will be disposed. Increasingly, as more dams are removed, this has included a solid understanding of impoundment sediment. A

Decommission Plan must include a thorough evaluation of environmental impacts of any sediment and a plan for managing the sediment. If relicensing continues, FERC may impose conditions such as the cleanup of any contaminated sediment. The scope and budget we've provided allows for further discussion and clarification between the City, the WDNR and Inter-Fluve.

**Bathymetric and Sediment Survey** – We understand that the City wishes to utilize previously collected bathymetric and sediment depth data to the extent possible. Because rivers transport sediment continually, and impoundment vegetation decay contributes to sediment accumulation, our scope includes a checking of 2006 bathymetric and depth of refusal data, as well as additional transects along the right and left edge of the impoundment to better characterize possible historic channel locations. We have reviewed the point file data for hard bottom or depth of refusal data collected by J. Downing in 2006 (See Figure above). Northing, easting and elevation data are available for each surveyed point, and can be imported into AutoCAD Civil 3D to create a rough surface. However, there is not enough point data to create an accurate picture of the historic channel alignment, which could be located on either the left or right sides of the impoundment based on the data available. Additional data will need to be collected to both verify the actual elevations and to determine historic channel location. Updated sediment depth also needs to be collected between the main body of the impoundment and the dam structure (no data exists). This area may contain a significant amount of sediment that, given the geomorphology of the gorge, will likely be fully mobilized upon removal.

Our approach will be to update Lake George sediment depth data, collect sediment depth data for Lake Louise, and collect updated bathymetric data for both impoundments. Following typical engineering due diligence for dam removal, the best approach for the City will be to develop sediment volume calculations



**Above: Survey point distribution from the 2006 hard bottom survey (J. Downing 2006)**

with an updated bathymetric surface. It should be noted that if we are surveying for sediment depths, the cost of developing the updated bathymetric surface is minor. We can utilize boat mounted side scan sonar and can collect bathymetry in any waters >2 ft in one day of effort per dam. Shallow waters can be surveyed with GPS-RTK or total station.

Based on previous reports, the impoundment sediments involved are mainly fine sediment and organic deposition that can be manually probed. Inter-Fluve plans to use our depth of refusal probes (either flexible graphite or steel rods) to both find the historic channel bottom *and* historic floodplain surface, and determine the relative size of bed material (sand, gravel, cobble, bedrock). We recommend approximately 10 transects in the Lake Louise impoundment, extending upstream far enough to encompass the upper limit of the topset bed. We also recommend transects spanning possible historic channel alignment areas in the Lake George impoundment. Each transect will include sediment probes at 10-15 locations across each section, with higher density in areas where we suspect historic channel locations. We will collect channel bed and historic bank data. Depth to bedrock may only be encountered at select thalweg locations, and so determining historic bank and floodplain features in softer sediment requires a high level of sensitivity that comes with experience. Some locations will be manually cored to determine historic floodplain soil conditions. Surveying will be conducted at low flow and with the proper precautions to reduce risk to Inter-Fluve staff. Local controls will be set via GPS-RTK and will be based on established controls obtained from the City of River Falls engineering.

**Sediment Volume Estimation** – Sediment volume estimation will be completed in AutoCAD Civil 3-D by comparing bathymetric surfaces with the surface developed through depth of refusal probing. These data will be combined with local LiDAR data to develop a colorized basemap of both bathymetric depths and impoundment sediment depths. The resulting report will include a plan view of the sites with each transect shown as a cross-section showing water surface, top of sediment and historic bed/floodplain surfaces.

**Sediment Mobility** – In order to determine sediment management strategies for removal, it is important to examine how much of the impounded sediment is likely to move under given flood scenarios. Inter-Fluve will run basic sediment transport calculations in a simplified 1-D hydraulic model to determine channel velocities and shear stresses during drawdown, and we will estimate the volume of sediment that could be transported under various flows. Sediment movement in rivers is event based, and so timing is not predictable. However, we can estimate under what flows the sediment will move, and where that sediment will eventually deposit. This requires an in-depth understanding of sediment transport, hydraulics and fluvial geomorphology.

**Sediment Sampling Plan** – Inter-Fluve’s initial discussions between the City of River Falls, the WDNR FERC coordinator and WDNR sediment quality specialists indicate that the WDNR prefers a staged approach to the assessment, whereby sediment volume is assessed and will inform the sediment sampling strategy and the regulatory actions required for management of the sediment (e.g. solid waste disposal regulations). Inter-Fluve has worked with the Wisconsin DNR on sediment sampling and testing for stream restoration and also for several impoundments, including the Algoma, Centerville, Newburg, Grafton,



**Above: Inter-Fluve staff conducts depth of refusal probing in soft sediments of a dam impoundment**

Nemahbin, and Big Spring dam removals. Inter-Fluve will communicate with the Wisconsin DNR regarding the sequencing of sediment sampling and testing. The first phase of the process is sediment volume estimation. Once sediment volume is determined, the next important phase of the sediment management process, and one that we include in this scope of work, is to develop a *Sediment Sampling Plan* (SSP). In addition to sediment core locations, the WDNR may allow pooling of samples, whereby several core samples in an area can be combined into one laboratory sample to give a general presence or absence by area. Stratification is sometimes also recommended in cases where the upper sediment strata are finer and the lower coarse sand or gravel. Fine sediment retains contaminants more readily than coarse material. Stratification involves separating core samples into these upper and lower strata. This increases laboratory fees, as the number of testing samples increases, but can greatly reduce management costs if only the upper strata need to be removed. The SSP will include survey points for sediment volume estimation (map with sections), sediment volume calcs, a relative facies map of sediment types encountered, and sediment sampling details such as sample location, pooling, stratification and laboratory analysis. This relatively short document (5-6 pages) is developed in coordination with the City and the WDNR, so that there are no surprises. The WDNR and the City will ultimately approve the final document, which is then used as the project guidance document for actual sampling and testing.



**Above: Inter-Fluve has surveyed hundreds of rivers and dozens of impoundments. Here, Greg Orum surveys the Simkins Dam in Maryland.**

**Cost Estimates** – Inter-Fluve will develop conceptual cost estimates for actively removing sediment, passively allowing the sediment to move downstream, and a recommended combined approach that best suits the project needs and regulatory constraints. Active removal costs will be determined for both in-place and dam removal scenarios. Inter-Fluve has extensive experience in estimating dam removal and sediment management costs. Climate effects on hydrology, post-recession cost increases from contractors, and local constraints will need to be taken into account, and Inter-Fluve can draw from numerous bid tabs over the past few years.

**Public stakeholder meetings** – For this proposal, we include time for two public meetings. The first public meeting will be to inform the public about the proposed sediment investigations. With any dam removal project, good public relations begin with transparency and detailed information. We will help maintain the City of River Falls’ good faith efforts to be up front and informative. This first meeting will present proposed survey maps, typical contaminant testing methods and detail to the citizens exactly how the work will be performed. The second meeting will be held after the final report is issued to disseminate collected information and results, answer questions and provide technical support to the City. Meetings will include a PowerPoint presentation of plans or findings. We also include hours for conference calls with the City. Inter-Fluve is familiar with the efforts of the Friends of the Kinnickinnic River, Trout Unlimited and the Kinnickinnic River Land Trust, and we understand the issues surrounding sediment, dam removal impacts, fish habitat and community aesthetics. We have *extensive* experience mediating and facilitating in dam removal related public meetings, and can offer suggestions on meeting format and facilitation to get the best results.

**Deliverables** – Inter-Fluve will present the findings of the above outlined tasks as Technical Memoranda, including text, maps and electronic files. Posters or PowerPoint presentations can be added as needed. All Tech Memos will be compiled into a final report that includes recommendations and cost estimates as described above.

**Sediment Sampling Plan, Sampling and Testing** – The question of the existing impoundment sediment toxicity is one that is raised repeatedly and can be answered with adequate data collection and analysis. As mentioned above, Inter-Fluve will first develop a draft Sediment Sampling Plan (SSP), then meet with Wisconsin DNR and the City of River Falls to discuss sediment sampling parameters before finalizing the SSP. Inter-Fluve has developed internal Standard Operating Procedures and Guidelines for impoundment sediment core sampling, sample handling and chain of custody, and we will review these with the City. These guidelines are taken largely from the State of Wisconsin sampling guidelines and are generally in accordance with standard protocols as presented in US- EPA-823-B-01-002, 2001, *Methods for Collection, Storage and Manipulation of Sediments for Chemical and Toxicological Analysis: Technical Manual*. Laboratory analysis will follow the guidelines set forth in the WIDNR document entitled *Consensus-Based Sediment Quality Guidelines; Recommendations for Use & Application Interim Guidance*. This document was developed by the Contaminated Sediment Standing Team in 2003 and provides guidance related to analysis and interpretation of contaminant thresholds.

The City has listed potential parameters to be tested as sediment oxygen demand, total phosphorus, ammonia nitrogen, trace metals (As, Cd, Cr, Cu, Hg, Ni, Pb, Zn), and organic compounds (PAHs, PCBs, and pesticides). Discussions with the WIDNR will include a due diligence review of upstream potential contamination sources, review of WIDNR guidelines, and a review of required ASTM procedures for laboratory analysis. Pooling of subsamples will be discussed, as will the need for stratification of sample cores by depth and sediment type encountered. As previously mentioned, it is sometimes beneficial to stratify and separate coarse and fine layers for testing, as sand and gravel typically do not harbor contaminants and can then be handled differently than fine sediments. This approach can greatly reduce the cost of sediment management.

The 1990 GME report and previous sediment probing suggests that impoundment sediment is predominantly fine organic silty sand, clayey silt, and fine sand that can be sampled via manual coring devices within the impoundment. Sample controls will be taken both upstream of the impoundment and downstream of the dams within the river channel. Given the soft sediment involved, it is assumed that samples can be collected without extraordinary mechanical means such as vibratory coring or other barge mounted equipment. If initial sampling indicates that sediment cannot be collected without special equipment, we will provide an estimate for sampling with the appropriate equipment (e.g. vibrocoring, piston cores, suction or other means). Vibrocoring of sandy sediments typically costs between \$1,200 and \$1,500 per sample, including mobilization, but not including laboratory analysis.

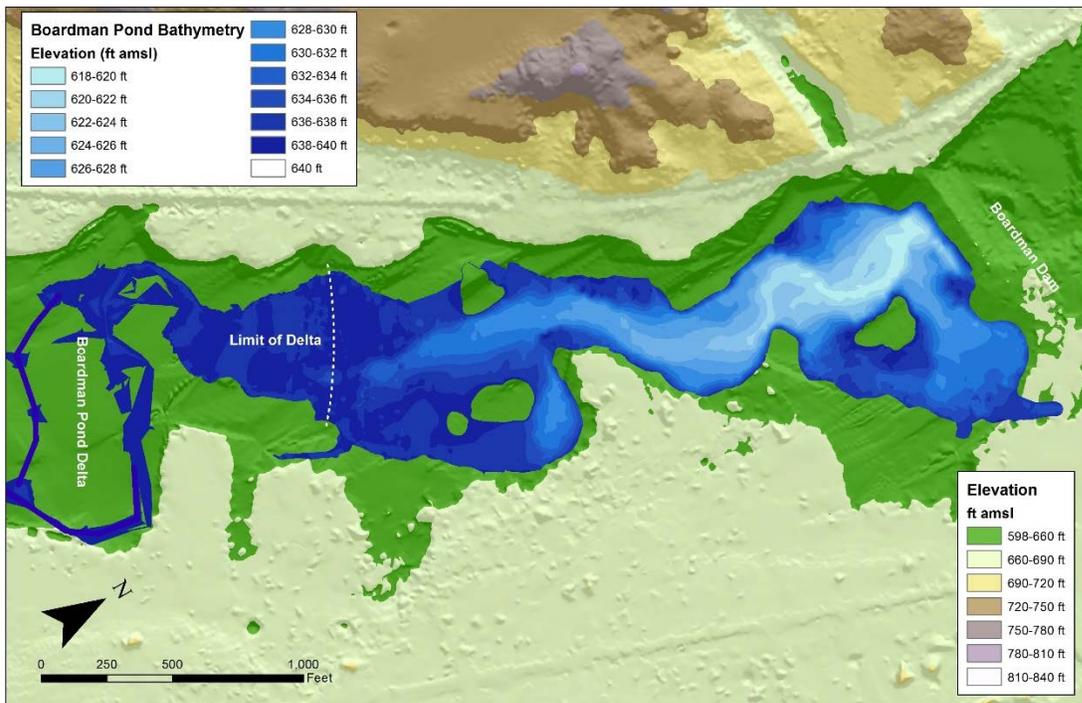
Samples will be processed on site and pickup will be arranged from a pre-approved testing laboratory. Inter-Fluve often uses PACE Analytical for Midwestern sediment analysis. Samples typically take 5-10 days for results. Laboratory analysis and testing thresholds will be tabulated and compared to typical soil background values, USEPA SQRT values, state groundwater and sediment exposure thresholds, and any



**Above: An Inter-Fluve scientist measures a sediment core prior to processing for laboratory analysis**

other relevant toxicity thresholds as required by the WDNR and detailed in the SSP. Inter-Fluve is uniquely familiar with consensus based sediment quality guidelines and thresholds established by both the EPA and the WI DNR as described above. Recommendations will be made for additional testing, if needed, and for any special handling of sediments.

We do not yet know how many samples will be required for each impoundment, and thus cannot provide an accurate estimate of sampling costs. For this proposal, we provide our best estimate based on previous dam projects of similar size, and also provide a unit cost per sample for sampling, laboratory testing and reporting.



**Above: Inter-Fluve’s assessment of sediment inputs on the three Boardman Dam impoundments has formed the basis for both drawdown and restoration plans. The final solution for each dam involves both active removal of sediment and passive release of fine sediment.**

## Optional Task

**Sedimentation Rate Estimate** – There are many ways of estimating sediment load in an impoundment, and these can include watershed based analysis relying on rainfall runoff modeling and assumed sediment loss from various soil and landuse types. LiDAR data comparisons can determine bank erosion and mass wasting inputs. Sediment transport modeling can be used to estimate transport through a reach, and can estimate deposition in impoundments. However, these methods are expensive and far less accurate than a simple temporal comparison within the actual water body. The bathymetric and sediment depth data collected in this study, compared to the 2006 data, will provide us with an accurate estimate of sedimentation in Lake George over the past 10 years. Our survey strategy supports this approach, and we propose to input the 2006 bathymetric and hard bottom data, build a surface in AutoCAD, and compare

those surfaces to the new bathymetry data to get an accurate estimate of sediment loading from 2006 - 2015. This can be averaged to give a sedimentation rate per year, and includes organic material deposition that would not be estimated in a soil-loss equation based estimate of sediment inputs. Based on aerial photo analysis and reporting to date, it appears that the impoundments are reaching an equilibrium sediment volume that has changed little in recent years.

Dam removal projects take 5 - 7 years from inception to completion, on average, with hydro dam removals taking even longer. If dam removal is delayed for several years, the established sedimentation rate, combined with spot elevation checks and analysis of aerial photos, can be used to gauge whether any significant changes have occurred. The effort required to estimate sedimentation rates using the proposed method is minimal, and we believe to be worth the incremental cost.

# SCOPE OF SERVICES

This scope of work covers preliminary surveying and sediment investigation for the Lake George and Lake Louise impoundments within the City of River Falls, WI.

## 1. PROJECT MANAGEMENT/MEETINGS

- 1.1. *Project Kickoff Meeting* – Inter-Fluve staff will participate in a phone conference to clarify scope and schedule, discuss landowner permission, and coordinate survey efforts.
- 1.2. *General project management* – Inter-Fluve will manage staff and tasks to support timely completion of deliverables and will maintain regular correspondence with City staff for the duration of the project. Invoices will be completed on a monthly basis.
- 1.3. *Public Meetings* – Inter-Fluve will attend two public stakeholder meetings, one to present proposed investigation work, and one to present findings and answer questions related to sediment assessment.

## 2. DATA COLLECTION

- 2.1. *Topographic and bathymetric survey* – Inter-Fluve will provide a bathymetric survey of the impoundment. Surveying will be conducted using boat mounted side scan sonar and GPS-RTK, and will include the setting of local control points.
- 2.2. *Sediment depth measurement* – To estimate impoundment sediment volumes and the location of the historic channel alignment, as well as to create a 1-ft contour basemap of the impoundment for calculation of cut and fill volumes and design planning, Inter-Fluve will conduct sediment depth probing of the impoundments using a depth-to-refusal method. Sediment depth locations will be surveyed for inclusion in the basemap, and will be used to develop estimates of impounded sediment volume. A subsampling of previously surveyed data points (circa 2006) will be checked during the survey to verify elevations and locations. Approximately 10 depth-to-refusal transects will be located in the Lake Louise impoundment, and select cross sections of historic channel features will be surveyed in the Lake George impoundment. Results will be incorporated as cross-sections and bathymetric contours in the report plans. Point files will be imported into AutoCAD Civil 3D.
- 2.3. *Sediment volume analysis* – Inter-Fluve will estimate the volume of impounded sediment by calculating the volumetric difference between the existing surface based on the bathymetry data and a pre-dam surface based on the depth-to-refusal measurements. Sediment evacuation estimates via incipient motion analysis will be completed and summarized in a Technical Memo.
- 2.4. *Sediment Sampling Plan* – Inter-Fluve will develop a 2-3 page sediment sampling plan that includes proposed sample locations, testing parameters and protocols. The plan will be submitted to the City for discussion and approval or recommendations. This task includes a phone conference with the WIDNR.
- 2.5. *Sediment Sampling* – Inter-Fluve will collect impoundment sediment samples for contaminant testing. Sampling costs are provided on a unit cost basis. We assume the following sampling program will be required:

- A minimum of two samples will be collected from the area within each impoundment where we believe the new channel will be located. Up to three sub samples may be collected in an area and pooled to create one sample for laboratory analysis.
- A minimum of three samples will be collected from within the remainder of the impoundments in areas that are likely to be exposed floodplain soil and, thus, represent a potential exposure route to human receptors
- One sample will be collected at the upper end of each impoundment, in an area where more recent sediment deposition has occurred.
- One downstream sediment sample will be collected to verify background/localized conditions. Additional sediment samples, if required, can be provided as an addendum.

2.6. *Laboratory analysis* - Sediment samples will be collected in appropriate containers, preserved as necessary and delivered to an analytical laboratory where they will be subjected to the following analyses:

- WDNR organochlorine Pesticides and Herbicides
- EPA Priority Pollutant Metals (arsenic, cadmium, chromium, copper, Pb, mercury, nickel, zinc)
- Extractable Petroleum Hydrocarbons (EPH) with Polycyclic Aromatic Hydrocarbons (PAHs)
- Polychlorinated biphenyls (PCBs)
- Ignitability, reactivity, pH
- Total Organic Carbon (TOC)
- Grain Size Analysis

2.7. *Technical Memorandum* – Methods and results will be summarized for each of the above tasks, including maps and figures supporting the conclusions. Sediment analytical data will be tabulated and presented along with published thresholds for special handling.

#### Deliverables

- Basemap of existing conditions, showing bathymetry, topography and sediment depth in plan and cross-section.
- Sediment sampling plan and Technical Memo Report describing survey methods, results, recommendations and cost estimates. Draft and Final Tech Memorandum will be submitted in PDF format for review and comment.

#### Assumptions

- Sediment sampling numbers are based on discussions with the WDNR and on previous experience with WIDNR sediment policy related to dam removal. The final sample number will be determined and budget amended based on Inter-Fluve's proposed unit cost per sample.
- TCLP analysis is not needed, and is not included, but can be added via addendum
- Upland or dam infrastructure surveying is not included
- Survey does not include diving or extensive probing of bridge piers.
- Boat rental for surveying and coring is included in the cost estimate.

**3. SEDIMENTATION RATE ANALYSIS (OPTIONAL)**

3.1. *Sedimentation Analysis* – Inter-Fluve will compare bathymetric surfaces from 2006 and the present study and generate a volume of sediment accumulated. An average estimate of sediment accumulation per year will be generated.

**COST ESTIMATE**

	<b>Subtask Total</b>	<b>Task Total</b>
<b>Task 1 - Project Management</b>		
Kickoff meeting	\$722	
General Project Management & Comm	\$2,574	
Stakeholder Meeting	\$3,440	
<i>TASK 1.0 ESTIMATE</i>		\$6,736
<b>Task 2 - Data Collection</b>		
Topographic and Bathymetric	\$7,512	
Sediment depth/refusal survey	\$7,366	
Sediment analysis/basemap	\$4,239	
Sediment Sampling Plan	\$1,312	
Tech Memo	\$2,374	
<i>TASK 2.0 ESTIMATE</i>		\$22,803
<b>Base Bid Total</b>		<b>\$29,539</b>
<b>Estimated cost per core sample (includes sampling and lab)</b>		<b>\$1,500</b> per sample
<b>Task 3 - Sedimentation Analysis</b>		
Sedimentation analysis	\$650	
<i>TASK 3.0 ESTIMATE</i>		\$650

# PROJECT TEAM STAFFING & EXPERIENCE

## About Inter-Fluve

Founded in 1983, Inter-Fluve is a river restoration engineering firm headquartered in Hood River, Oregon, with additional offices in Wisconsin, Massachusetts, and Montana. As leaders in aquatic and riparian resource analysis and restoration, our multidisciplinary team integrates biology, hydrology, and engineering to design environmentally-sound solutions for systems ranging from alpine to coastal, rural to urban. With over 30 years of experience building our designs, we have an unparalleled ability to portray complex and innovative solutions into plans and specifications, and to provide efficient construction services. Our 35 engineers and scientists tackle the restoration, enhancement, and revitalization of rivers and wetlands in both urban and rural environments. We've worked on four continents and across all regions of the United States, completing over 2,000 river projects. **We have applied our expertise to over 60 dam assessment, fish passage and removal projects, and have overseen the successful removal of an estimated 20 dams.** The table below demonstrates our experience with sediment surveying, sediment volume estimation and contaminant testing and analysis.

## Project Team

Abbreviated biographies of the key staff who will work on this Project are provided below, along with a table list of recent relevant dam assessment projects.

### Marty Melchior, Project Manager

Marty Melchior is one of the most experienced river restoration practitioners in the Midwest, having completed over 200 assessment and restoration projects across the country. He is also one of the Inter-Fluve's most experienced dam removal and natural channel design experts. His project interests include dam removal design, natural channel design, forensic fluvial geomorphology, construction management, and large woody debris dynamics. Marty has managed or provided design input on over two dozen dam removal and fish passage projects in the past decade, and has authored articles on geomorphology and the ecological effects of small dam removal. Marty is an invited member of the *Federal Subcommittee on Sedimentation and Dam Removal*, a group that developed assessment and permit guidelines for nationwide sediment assessment and management practices in dam removal. Marty was a long time technical advisor to the Wisconsin Dam Removal Committee, and was also an invited member of a task force aimed at developing dam removal sediment management guidelines for New Hampshire and Massachusetts. Marty has participated in a Lower MN River state committee on ravine and bluff erosion, and a Federal workgroup on geomorphology database development. Marty has lectured on stream restoration and dam removal at the University of Wisconsin and the Washington Department of Ecology, and is a regular instructor for the UMN / NCED graduate level stream restoration course. Marty's work has been featured in two PBS programs and he was awarded the 2005 Aldo Leopold Award for Excellence in Ecological Restoration. Marty was the lead designer for the Eel River/Sawmill Dam Removal project, a recipient of the Presidential Coastal America Partnership Award. Marty is also a Certified Fisheries Professional with the American Fisheries Society.

*Education:* B.S., Molecular Biology, NDSU, Fargo, ND, 1989; M.S., Fisheries, University of MN, St. Paul, MN, 1998.

## Beth Wentzel, PE, Water Resources Engineer

Beth will serve as technical lead for the sediment management effort. Wentzel has over 16 years of experience in river and wetland restoration research, advocacy, and engineering. She has contributed to development of stream restoration, including dam removal, channel design, fish passage, and channel reconstruction projects throughout the Midwest, and recently led the Newburg, WI and Cacoosing, PA dam removal projects. Beth also has a solid understanding of river protection permitting and regulations which she developed through technical water policy analysis and advocacy for conservation organizations in multiple regions of the US. She has several years of experience in naturalized stormwater management system planning and design. Through these diverse experiences, Beth has become skilled at communicating with individuals and groups with very different backgrounds and interests.

*Education:* MS, Civil and Environmental Engineering, University of Illinois, Urbana-Champaign, 1999 and BS, Civil Engineering, University of Illinois, Urbana-Champaign, 1994.

## Ben Swanson, PhD - Fluvial Geomorphologist

Dr. Swanson has 7 years of academic experience and 4 years of applied experience in fluvial geomorphology and watershed sciences. Ben has been a key member of the Inter-Fluve teams for dam sediment assessment and removal projects, including Boardman Dam (MI), Sabin Dam (MI), Pucker Street Dam (Niles, MI), Mirror Pond Dam (OR) and others. His PhD research focused on disruptions in channel form, habitat, and sediment transport processes across tributary junctions along the Rio Chama, NM, and his masters work documented channel changes along the Clark Fork River, MT, in response to increased sediment inputs associated with historic mining. He's skilled in Geographic Information Systems analyses, collecting geomorphic and sediment field data, and modeling hydraulics and sediment transport. Ben's primary focus has been assessing how stream channels have adjusted their form and function in response to watershed and channel disturbances, and utilizing this information to help re-establish healthy and productive systems.

*Education:* PhD, Earth & Planetary Sciences, University of New Mexico, Albuquerque, NM 2012; MS, Water Resources & Fluvial Geomorphology, University of Montana, Missoula, MT 2002; and BA, Geology, University of Montana, Missoula, MT 1996.

## Charlie Phillips – Survey/CADD Technician

Mr. Phillips is a CADD Technician with particular expertise in stream surveying, dam removal sediment management, natural channel design graphics, 3-D graphic renderings, photo-derived 3-D CAD drafting, and concept plan development. . Charlie leads survey teams for river surveying, dam sediment bathymetry and contaminant sampling, dam removal topography, and hydraulic surveys. He is the lead CAD designer for the Madison office, and has worked on projects in the Midwest, west coast and east coast. Since joining Inter-Fluve he has contributed his knowledge of AutoCAD and Solidworks 3D to projects involving habitat restoration, dam removal and channel migration. Charlie has led numerous surveys of impoundment sediment, sediment depths, depth of refusal and bathymetry.

*Education:* BEng – Mechanical Engineering, Oxford Brookes U, England, 2005 and City & Guilds – Composite Materials, OBU, Brooklands College, Surrey, England, 2004.

Recent Dam Sediment Assessment Projects by Inter-Fluve

Project / River / Dam	River/Stream	State	Year (s)	Dam removal w/ controlled release	Dam removal with rapid drawdown	Floodplain excavation	Bathymetric surveying	Sediment depth/volume assessment	Contaminant testing and analysis	Channel restoration	Canoe/kayak launch/fishing access	Feasibility Study	Final Design	Dam Height (ft)
Balmoral Dam	Shawsheen River	MA	2007-ongoing		•		•	•	•			•	•	10
Barstowe's Pond Dam Removal	Cotley River	MA	2010-Ongoing		•	•	•	•	•			•	•	8
Beaver Pond Dam	Beaver Dam Brook	MA	2011-Ongoing	•			•	•	•	•		•	•	15
Big Spring Dam Removal	Big Spring Creek	WI	2008	•		•	•	•	•			•		8
Bloede Dam Removal	Patapsco River	MD	2011-Ongoing		•	•	•	•	•	•	•	•	•	32
Boyce Pond Dam	Kemp Brook	NH	2013-ongoing		•		•	•	•	•		•		7
Brown Bridge Dam Removal	Boardman River	MI	2011-Ongoing	•		•	•	•	•	•	•	•	•	35
Bruemerville Dam Removal	Silver Creek	WI	2010-2011		•	•	•	•	•	•		•	•	10
Cacoosing Dam Removal	Cacoosing River	PA	2011	•			•	•	•	•		•		8
Centerville Creek Dam Removal	Centerville Creek	WI	1996		•	•	•	•	•	•		•	•	12
Churchill Woods Dam Removal	EB DuPage River	IL	2008	•		•	•	•	•	•	•	•	•	10
Cole's Brook Dam Removal	Westfield River	MA	2005-2006		•	•	•	•		•		•		10
Coonamessett River Restoration	Coonamessett River	MA	2011	•		•	•	•	•	•		•	•	6
Dundaff Dam Removal	Dundaff Creek	PA	2010		•	•	•	•	•			•		8
Forge Road Dam	Peconic River	NY	2013		•	•	•	•				•		8
Franklin Dam Removal	Sheboygan River	WI	2001		•			•	•			•		10
Fyfeshire Dam Removal	Fyfeshire Ponds	MA	2010		•		•	•	•			•		6
Hathaway Pond Dam Removal	Sippican River	MA	2009-2010		•	•	•	•				•		8
Hemlock Dam Removal	Trout Creek	WA	2009		•	•	•	•		•	•	•	•	25
Hobbs Pond Dam Removal	Hobbs Pond	MA	2009-Ongoing		•		•	•	•	•		•		6
Hogan Cedars Dam Removal	Johnson Creek	OR	2001		•		•	•		•		•	•	4
Ione Cedar Creek Dam Removal	Cedar Creek	WA	2005	•		•	•	•	•	•		•		18
Marland Place Dam	Shawsheen River	MA	2007-ongoing	•		•	•	•	•	•	•	•	•	10
Mill Creek Restoration	Mill Creek	WI	2001	•		•	•	•		•	•	•	•	8
Moodna Creek Dam Removal	Moodna Creek	NY	2007-2008		•		•	•		•		•		3
Nemahbin Dam Removal	Bark River	WI	2007-2010	•		•	•	•	•			•	•	8
Newburg Dam Removal	Milwaukee River	WI	2012-Ongoing	•	•	•	•	•	•	•	•	•	•	10
Pucker Street	Niles	MI	2013-ongoing	•		•	•	•	•	•		•	•	15
Red Brook Dam Removal (3 Dams)	Red Brook	MA	2008		•		•	•		•		•	•	6
Sauk River Park Dam Removal	Sauk River	MN	2003		•		•	•				•		10
Sawmill Dam Removal	Eel River	MA	2010	•		•	•	•	•	•		•	•	15
Simkins Dam Removal	Patapsco River	MD	2011		•		•	•	•				•	10
South Middleton Dam	Ipswich River	MA	2009-2010	•			•	•	•	•		•	•	8
State Hospital	Mill River	MA	2013	•		•	•	•	•	•		•	•	10
Trout Creek GC Dam Removal	Trout Creek	WI	2011-2012	•			•	•		•		•	•	3
Upper Mills Dam Removal	Peconic River	NY	2009-2010	•		•	•	•				•		8
Wellingsley Brook Dam Removal	Wellingsley Brook	MA	2010-2012		•		•	•	•	•		•		5
West Britannia Dam	Mill River	MA	2007-ongoing	•			•	•	•	•		•	•	6
Whittenton Dam	Mill River	MA	2007-ongoing		•	•	•	•	•	•		•	•	10

# REFERENCES

Presented below are recent and relevant Performance Evaluations from our clients.

**Matt Payette, Director, Kewaunee County Recreation Department**  
Ph: (920) 388-0444 [payettem@kewauneeeco.org](mailto:payettem@kewauneeeco.org)

*Bruemmerville Dam Removal, Analysis & Design, Silver Creek, WI*

“Kewaunee County selected Inter-Fluve as the prime engineering consultant on the Bruemmerville Dam removal and restoration project near Algoma, Wisconsin. I was extremely satisfied with the results of the project that are directly attributed to Inter-Fluve’s expertise in dam removal and site restoration.

This project was somewhat contentious, and involved difficult public meeting, complex site conditions, construction contractor change requests, and winter construction. Marty and Greg at Inter-Fluve were great at handling questions in the public meetings and developed post-removal design that incorporated fish habitat, park access and trail needs, and riparian zone restoration. Inter-Fluve was very skilled at dealing with flexible site hydrology, changing soil conditions and construction contractor issues.

Despite difficult permit constraints, they were able to come up with a solution that satisfied the USFWS criteria for preventing lamprey passage while still meeting the WDNR definition of dam removal. Kewaunee County made the right choice, and we highly recommend Inter-Fluve for dam removal design and river restoration.”

**Brian Graber, Senior Director, River Restoration Program, American Rivers**  
Ph: (775) 863.2687 [bgraber@amrivers.org](mailto:bgraber@amrivers.org)

American Rivers’ Restoration Program brings life back to rivers by removing dams, replacing culverts, and reconnecting rivers with their floodplains. For more than 10 years, Inter-Fluve has been an important partner in this effort, providing technical guidance and high quality river restoration design services for many of our dam removal and restoration projects. Inter-Fluve demonstrates a very strong understanding of the details of complex geomorphology and hydraulics, and the big picture of river restoration concepts and practice. American Rivers often calls upon Inter-Fluve to accomplish our most challenging and ecologically sensitive projects. One of the greatest compliments of Inter-Fluve’s projects is that they are usually indistinguishable from natural river channels: even for complex projects, soon after Inter-Fluve projects are completed, you could not tell that a large-scale construction project was done there. We highly recommend Inter-Fluve for dam removal and other river restoration projects.

**David Gould, Director, Department of Marine and Environmental Affairs - Town of Plymouth**  
Ph: (508) 747-1620 ext 134  
[DGould@townhall.plymouth.ma.us](mailto:DGould@townhall.plymouth.ma.us)

*Eel River Headwaters Restoration & Sawmill Dam Removal, Plymouth, MA*

The Town of Plymouth has worked with Inter-Fluve on several river restoration projects since 2005. The first involved reclamation of a segment of Town Brook within Brewster Gardens, the centerpiece park near Plymouth Rock. They were asked to assess the site and come up with designs for stabilizing the streambed and banks, and integrate bank stabilization into the park construction that was underway. Inter-Fluve completed the design and construction within a three week timeframe. Inter-Fluve worked closely with the

Town on restoration of the Eel River headwaters, from initial discussion about restoration potential to the final ribbon cutting on a project that has received national attention. Throughout all of the Plymouth projects, Inter-Fluve staff have shown themselves to be advocates of the Town's environmental restoration mission, and have always been willing to provide high level technical advice and expertise. The staff are professional and friendly, and we have enjoyed working with them on every occasion. The Eel River project construction extended over six months of intensive construction, and the upcoming Tidmarsh project will likely last over 12 months. Inter-Fluve is excellent in developing contractors, helping them understand river restoration methods, and getting us the product that we envision. We recommend them for any project involving dam removal or river restoration, and look forward to working with them in 2016 and beyond.

**Dave Rowe, WI DNR Fisheries Manager**

**Ph: (608) 635-8122**

**[David.Rowe@wisconsin.gov](mailto:David.Rowe@wisconsin.gov)**

*Clark Creek Bluff Stabilization, Baraboo, WI*

Wisconsin DNR fisheries collaborated with Inter-Fluve and Sauk County Conservation Planning and Zoning Department on the recently completed Clark Creek restoration project, which focused on watershed land-use change and long term bluff stabilization to reduce fine sediment inputs into Clark Creek, a trout stream in the Baraboo Hills area. The staff at Inter-Fluve recently taught a fluvial geomorphology and river restoration short course to key WDNR staff, and their expertise in this arena has proven to be exceptional. The project involved fairly complex geomorphology following large floods that caused channel incision and major soil loss. Inter-Fluve used an innovative strategy incorporating engineered log jams to set the outside floodplain boundary away from the bluff toes, thereby letting the bluffs heal passively. The WDNR provided construction equipment and labor, and Inter-Fluve worked very well with our crew, providing them with excellent technical construction oversight from start to finish. The end product included engineered log jams, a step pool channel, floodplain roughness and revegetation. We value Inter-Fluve's expertise in river restoration, and look forward to working with Inter-Fluve on future projects.

**Desmond Berry, Dept. Manager, Grand Traverse Band of Ottawa & Chippewa Indians Natural Resources Division**

*Boardman River, Brown Bridge Dam Removal, City of Traverse City, MI*

The Grand Traverse Band of Ottawa & Chippewa Indians has been working closely with Inter-Fluve for the past 5 years on the Boardman River Dam Removal project. In that time, Inter-Fluve has demonstrated an unmatched level of fluvial geomorphic and river engineering expertise, which has translated directly into efficient and innovative design strategies that have helped to make the Brown Bridge Dam removal project a success. Inter-Fluve has shown an in-depth understanding of post-dam removal river restoration from start to finish.

Just as GTB staff have attained and can appreciate its "inherent value", Inter-Fluve staff have expertise in the Rosgen Natural Channel Design (approach) format; but also bring to the table a high level of expertise in fluvial geomorphic process as it relates to dam removal and restoration.

Inter-Fluve has shown excellent attitude and spirited cooperation throughout the project. Both field and non-field related site visits were gratefully punctuated by countless professional knowledge and skill transfer sessions that transcend the "typical" client-consultant relationship with an honest willingness to

teach what they know, as well as being open to learning themselves. We look forward to working with them on the remaining dam removals as part of the Boardman River Restoration Project, and other projects in the future.

Inter-Fluve staff are also great guys to work with, both as individuals and as a team. They reflect the best of what a team can be and are definitely “outstanding in their field”.



*Photo of restored Trout Cr. (Wind R. basin) courtesy of USFS*

**The photo above shows a restored section of Trout Creek, WA at the former Hemlock Dam site. Inter-Fluve designed the removal, including riffle and pool construction and floodplain restoration.**

## Inter-Fluve Staff Resources

### Sample of Models Used

- HEC-1/HEC-HMS
- GEO-RAS
- HEC-2/UNET /HEC-RAS
- FEQ
- SWMM/XPSWMM
- FESWMS
- RMA2/RMA4
- USGS MDSWMS/IRIC

### GIS Capabilities

- Inter-Fluve makes extensive use of GIS for natural resources assessment and restoration. Inter-Fluve currently has 8 scientists and engineers using ArcMap 9.3 or 10. Our staff consists of individuals experienced with data compilation, data analysis, database development, projections/coordinate systems, and mapping. Our staff utilizes the 3-D and spatial analyst extensions for necessary analyses, and use ArcPad to transfer data between GIS and the GeoXT Trimble GPS units. We regularly use GIS in the investigation and design phases of projects, and we use GIS-based maps to convey concepts to clients and other stakeholders.

### Survey Equipment

- Total station and ground based LiDAR (numerous units and data collectors, rods, prisms)
- Depending on the needs and horizontal/vertical precision necessary for a particular project, Inter-Fluve maintains 2 Trimble GeoXT (sub-meter horizontal accuracy with post-processing), 5 Garmin e-Trex (~5-m horizontal accuracy), a Garmin 76 and a 76s GPS unit (3-5 m horizontal accuracy), 2 Top-Con RTK units (sub-centimeter horizontal and vertical accuracy) and base stations.
- Our GIS staff have experience integrating GIS analysis software with design focused applications such as AutoCAD, MicroStation, and hydraulic modeling software. We frequently utilize HEC-GeoRAS to analyze and display flood inundation patterns to support project design. Our GIS products can be packaged in multiple media formats including DVD, CD-ROM, or in web-based applications. We are also accustomed to performing data documentation and ensuring adherence to established metadata standards.
- Dam and impoundment surveying includes 17 ft outboard, 14 ft johnboat (rental) and canoes, kayaks. Boat mounted side scan sonar, water level loggers, pressure transducer loggers, wetland corers, manual sand corer, muck corer and gravel corer, silt piston corer, vibratory probes and rental of geoprobe and geotech drilling rigs. Also includes custom depth of refusal probe rods.

## Project Descriptions

Below are a series of descriptions of completed projects by Inter-Fluve and AECOM. All are relevant examples exemplifying our expertise to lead the removal of the Monterey Dam. References are included.

### Mill River Dams Removal Analysis, Design, Construction – (IFI)

#### TAUNTON, MA

Client: Southeast Regional Planning and Economic Development District (SRPEDD), MA DER  
Reference: Beth Lambert, Aquatic Habitat Restoration Program Manager, MA DER (617) 626-1526

Southeast Regional Planning and Economic Development District (SRPEDD), Massachusetts Division of Ecological Restoration, NOAA, American Rivers and other project partners contracted with Inter-Fluve to investigate the feasibility of dam removal and fish passage options on the Mill River in Taunton, Massachusetts. Inter-Fluve and its teaming partner Woodlot studied the three lowermost dams, the State Hospital Dam, West Britannia Dam and the Whittenton Pond Dam, all of which have been present in some form since the 1600s. We examined the effect of potential restoration on a fourth dam upstream. The project involved extensive topographic surveying, wetland assessment, bathymetry, sediment volume estimation (depth of refusal), HEC-RAS modeling and concept and final designs.

State Hospital Dam was removed during the summer of 2012 and channel restoration completed in early 2013. During the first anadromous fish migration, hundreds of herring were observed upstream of the dam for the first time in hundreds of years.

While trout were not deemed viable in this river due to water temperature and water quality, brook trout were also observed upstream of the former dam. The Whittenton Pond Dam was removed in late July 2013 and final channel restoration is ongoing. We have completed the preliminary designs for the removal of West Britannia Dam and are currently in the permitting process. Construction will likely begin in late 2015 or 2016.



*The Mill River has seen intensive flooding and associated safety concerns related to three dams, all present since the 1600s. Inter-Fluve designed and performed construction oversight on the removal of two and preparing for the third.*

## Simkins Dam Removal – (IFI)

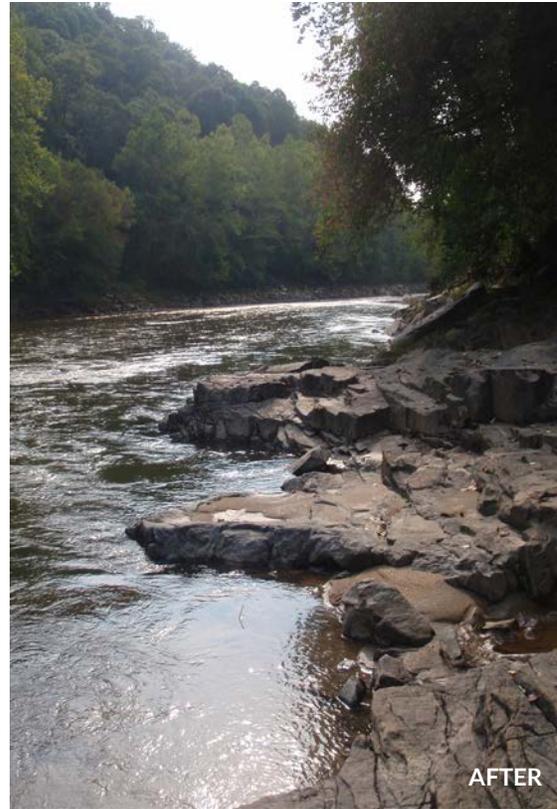
### ELLICOTT CITY, MD

Client: Elliot City, MD

Reference: Serena McClain, American Rivers,  
Washington, DC (202 )347-7550

The removal of the 10-foot-high and 200-foot-wide Simkins Dam in Maryland is part of a larger project to remove all four dams along 175 miles of the Patapsco River and restore habitat to herring, shad, and eel. The dam – built to produce power – had not been used in decades. With help from the American Reinvestment and Recovery Act of 2009, we worked with American Rivers, NOAA, Maryland DNR fisheries, Baltimore/Howard counties, Patapsco Valley State Park staff, and the Friends of the Patapsco Valley State Park to develop designs for the removal of Simkins Dam.

Simkins, as well as Union Dam, were removed in 2010. Our work included topographic and bathymetric surveying, sediment screening, geomorphic assessment, bank stabilization, and vibration monitoring to prevent damage to a 42-inch sanitary sewer pipe. We partnered with Stillwater Sciences to model sediment transport using the DREAM-1 model. Today, Inter-Fluve and partners are designing plans for the removal of Bloede Dam. Removal of Bloede will leave Daniels Dam as the fourth, and last remaining dam on the river.



*Project partners discuss the removal of 200-foot-wide Simkins Dam before it was removed in 2010 (above). Top photo shows the site after Simkins dam was removed.*

# San Clemente Dam Removal - (IFI)

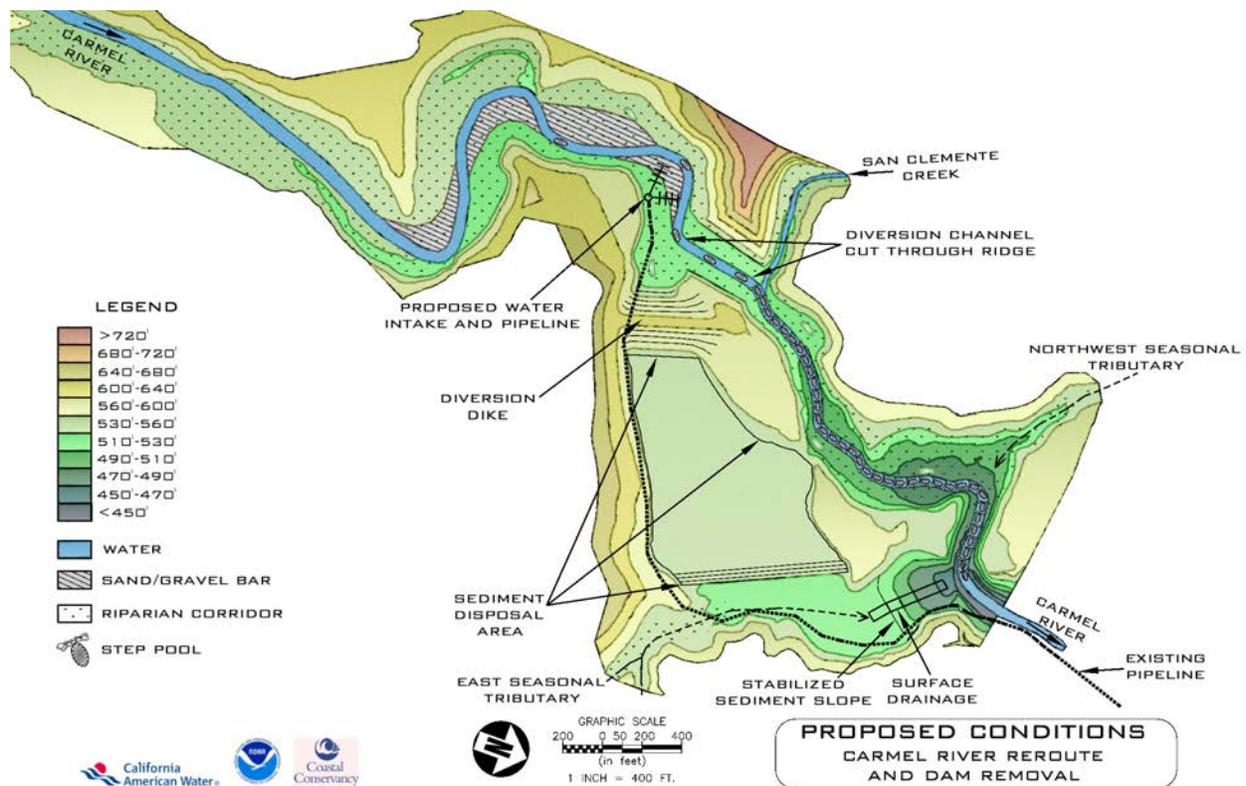
## CARMEL, CA

Client: California Coastal Conservancy  
 Reference: Trish Chapman (510) 286-0749

This project alleviates critical dam safety concerns and restores passage for ESA-listed steelhead by removing the 106-foot tall dam constructed in 1921. Inter-Fluve currently (since 2008) leads the channel design task, and provides overall dam removal and ecological restoration advisory services. This role has required extensive collaboration with project stakeholders, resource agencies, and technical review team to arrive at a channel design which is naturally-functioning but can be demonstrated to provide an acceptable level of service for fish passage by steelhead. This has required developing approaches to provide confidence in the project design while the subsurface conditions to be encountered following sediment removal are largely unknown. Project coordination tasks have included assisting with formalization of project goals, objectives and design criteria, risk assessment, and development of contingency long-term management plans. Technical tasks included geomorphic reconnaissance, channel survey, alternatives analysis, hydraulic modeling, fish passage design, and channel design.

From 2007-08, Inter-Fluve served as the primary technical advisor to the Coastal Conservancy in their evaluation of options for removing San Clemente Dam. Primary tasks included interpretation and analysis of technical reports, development of work scopes for supplemental studies, documentation of project goals and objectives, and development of illustrative figures to communicate the dam removal project concept to a larger, non-technical audience.

In both the design and advisory roles, Inter-Fluve has been key in transforming the project design into one that results in full-scale valley bottom restoration achieving a high degree of ecological integrity. Through this effort, Inter-Fluve has successfully interfaced with a broad group of stakeholders and agency representatives representing a range of mandates related to the project.



*Inter-Fluve is leading the channel design task, providing overall dam removal and ecological restoration advisory services for the San Clemente Dam removal and Carmel River reroute..*



*Boardman River, Brownbridge Dam Removal before (left) and after (right). The restoration enhanced and restored habitat for native cold water fish, impacted the local economy by stimulating recreation tourism, encouraged collaboration between numerous agencies and has also become an educational laboratory for school children and research scientists alike.*

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## Boardman River, Brown Bridge Dam Removal & Channel Restoration – (IFI) TRAVERSE CITY, MI

Client: Boardman River Implementation Team  
Reference: Amy Beyer, Executive Director, Ph: (231) 946-6817

Inter-Fluve completed conceptual and final design documents for the Brown Bridge dam removal and provided full construction oversight for the sediment management and channel restoration. The Brown Bridge dam (1500' long and 40' tall), was the first and largest of three dams to be removed on the river, and one of the largest removed in the state of Michigan. Project elements included: fish habitat assessment, hydraulic and Level 3 geomorphic analysis, sediment sampling, analysis and management plan development, conceptual through final design and preparation of construction documents, construction cost estimate, and construction oversight. The Boardman River (291 sq. mi.) is one of the premier cold water systems in the state of Michigan. Because the river was in relatively pristine condition, the removal focused on restoring the 3 miles of channel through the impoundment, and the careful management of accumulated sediment, including a mile-long delta deposit at the head of the impoundment that had buried the old river channel with as much as 12 feet of sand. Final design involved the excavation of over 200,000 cubic yards of impounded sediment.

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## Centerville Creek Restoration Following Dam Removal – (IFI) CLEVELAND, WI

Client: Village of Cleveland, WI  
Reference: Steve Simons, Village of Cleveland Ph: (920) 693-8181

Centerville Creek was once a healthy trout stream draining off of high bluffs on the western shore of the Lake Michigan. The Cleveland Dam, near the mouth of the Centerville Creek, was installed in the late 1800's creating a 6-acre impoundment. The dam was removed in 1995 after nearly 120 years of sediment accumulation, draining the reservoir and leaving behind tens of thousands of yards of highly erodable silt deposits. The main goal of this project was to develop plans for the restoration of Centerville Creek to a stable, natural and functioning stream ecosystem. Inter-Fluve evaluated options for the restoration of Centerville Creek, conducted Level 3 assessments on nearby rivers and developed regional curve data sets for clay streams draining directly into Lake Michigan to determine the habitat potential and geomorphic stability of a restored channel. Design recommendations included habitat restoration, analysis of construction planning, dewatering, bioengineering options, utilities, sediment disposal and permitting.



*Bruemmerville Dam Removal & Restoration before (left) and after (right). Inter-Fluve designed a lamprey barrier that is high enough to keep lampreys from migrating upstream and low enough to allow migrating pike and walleye to swim through. The design also allowed for the creation of a floodplain park.*

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## Bruemmerville Dam Removal & Restoration- (IFI)

### ALGOMA, WI

Client: Kewaunee County Promotions and Recreation Department  
Reference: Matt Payette, Ph: (920) 388-0444

The Algoma or Bruemmerville Dam was a 10-ft high low head dam on a moderate gradient cobble and gravel riffle pool segment of Silver Creek in Northeast Wisconsin. Kewaunee County has been interested in removing the dam for some time. The U.S. Fish and Wildlife Service (USFWS) was concerned that the dam removal would allow for introduction of invasive lamprey into Silver Creek. Inter-Fluve met with representatives from multiple agencies to hammer out design criteria for the project. Our engineers designed a combination velocity and removable leaping barrier to prevent lamprey invasion yet allow migrating pike and walleye to pass the removal site. The project was constructed in summer of 2012 and included restoration of 2,000 feet of B-channel stream with toe wood, riffles, pools and floodplain grading. Inter-Fluve was also involved in the public outreach process and attended several meetings with the project partners and the public. Staff scientists provided meeting facilitation services, graphic and visual aids, and mediated discussions.



## REGIONAL DIRECTOR

# Marty Melchior CFP

Marty has 18 years of experience in fish habitat restoration, natural channel design, dam removal, fluvial geomorphologic assessment, engineered wood design, bioengineering, and biotic assessment. Marty has participated in state and federal workshops on geomorphology and dam removal committees within the Federal Subcommittee on Sedimentation. He also occasionally lectures for various university restoration programs. Marty was the lead designer for the Eel River project, a recipient of the 2011 Coastal America Partnership Award presented by the Secretary of the Interior. In 2013, Marty and Inter-Fluve were selected as one of the River Alliance of Wisconsin's 20th Anniversary River Heroes.

### EXPERTISE

- Natural Channel Design
- Dam Removal
- Fluvial Geomorphologic Assessment
- Urban River Restoration
- Cranberry Bog Restoration
- Project Management
- Bioengineered River Bank Stabilization
- Fish Population Analysis
- Stream Ecology

### EDUCATION

MS, Fisheries, University of Minnesota, St. Paul, MN, 1998

BS, Molecular Biology, North Dakota State University, Fargo, ND, 1989

### PROFESSIONAL AFFILIATIONS & REGISTRATIONS

Certified Fisheries Professional American Fisheries Society

Wisconsin Small Dam Committee

### SELECTED PROJECT EXPERIENCE

#### State Hospital Dam & Channel Restoration

Taunton, MA (2012)

Marty was the lead designer for the removal of the State Hospital Dam, one of three removals designed or in process on the Mill River. Marty was involved with collection of topographic data, bathymetric data and sediment coring and grain size analysis. Other work included analysis of potential sediment mobility, hydraulic modeling of proposed restoration conditions, development of alternatives for contaminated sediment removal and development of both sediment sampling and sediment management plans. Marty met with Mass DEP and other regulators to develop a program of contaminated sediment removal and treatment that allowed for full restoration of the impoundment and floodplain. Marty provided design input and construction oversight for the project, which was completed in January of 2012 and involved dewatering, drawdown, dam breaching, floodplain excavation, channel restoration, large wood habitat and riffle and pool construction.

#### Centerville Creek Restoration following Dam Removal Cleveland, WI

This project involves the restoration of Centerville Creek and its floodplain following the 1998 removal of the Cleveland Dam. Removal of the dam and subsequent incision of the channel into the former impoundment sediments has resulted in a deeply incised and highly eroding stream with little habitat or aesthetic value. Preliminary design integrated these data into floodplain and forest restoration, fish habitat design and wetland construction. Final construction was completed in 2012.

#### Newburg Dam Removal

Milwaukee, WI (2012)

The project included addressing utility conflicts, addressing contaminated sediments, and designing a multi-use trail to connect public parks upstream and downstream of a road crossing and also serve as a flood conveyance channel.

#### Eel River Headwaters Restoration & Dam Removal

Plymouth, MA (2010)

Marty served as project manager, lead designer and senior construction manager for this project in historic Plymouth. Inter-Fluve provided design and oversight for the restoration of a 40-acre cranberry bog site. This \$2 Million project involved the grading of large quantities of sand from the bog surface, construction of groundwater level controls (riffles), and construction of over 8,000 feet of stream channel. Habitat restoration for brook trout, eel and herring included the installation of over 1,000 pieces of large woody debris, raptor perches, wildlife passage culvert design, riffle and pool construction, and boulder step pool channel construction. The 15-ft high Sawmill Dam was removed and Marty coordinated efforts to preserve part of the structure for historic purposes, replacing half of the dam with a 45-ft long concrete and steel footbridge. With 17,000 white cedars and over a mile of deer protection fencing, the project is the largest Atlantic White Cedar bog restoration in the northeast, and was featured in both the Boston Globe and Civil Engineering magazine. The project won the 2010 Coastal America Partnership Award for outstanding efforts to restore and protect the coastal environment. Construction was completed in June 2010.

## Marty Melchior, CFP

### ADDITIONAL PROJECT EXPERIENCE

#### Boardman River Dam Removal

Traverse City, MI (2012)

Inter-Fluve was part of a design team developing final design plans for the removal of Brown Bridge Dam and the Sabin Dam on the Boardman River in northern Michigan. Marty assisted in developing concept designs, sediment management guidelines for the Brown Bridge removal, and conducted site reconnaissance and sediment depth surveying for the project. Marty also participated in multi-agency coordination and planning meetings. Drawdown and construction of the restored channel and floodplain was completed in 2012.

#### Bruemerville Dam Removal

Algoma, WI (2012)

The Algoma Dam, or Bruemerville Dam, was a 10-ft high low head dam on a moderate gradient cobble and gravel riffle pool segment of Silver Creek in northeast Wisconsin. The USFWS was concerned that the dam removal would allow for introduction of invasive lamprey into Silver Creek. Inter-Fluve designed a combination velocity and removable leaping barrier to prevent lamprey invasion yet allow migrating pike and walleye to pass the removal site. The project was built in winter of 2012. Marty supervised the design and assisted in construction oversight, client communication and permitting guidance.

#### Nemahbin Roller Mill Dam Removal

Delafield, WI (2013)

Marty was the project manager for this project, begun in 2001, to remove a 12-foot high dam outside of Milwaukee. The project involved sediment volume estimation, sediment transport analysis, public meetings, contested case hearings and preliminary engineering design plans. The dam was drawn down in 2012 and removed in Fall 2013.

#### Simkins Dam Removal

Baltimore, MD (2010)

Marty was the project manager for the Simkins Dam removal, a project funded through Economic Recovery Act Funding. This project involves American Rivers, NOAA, Maryland DNR Fisheries, and the Friends of the Patapsco River Valley State Park. Inter-Fluve conducted topographic and bathymetric surveying, sediment coring, and contaminant testing, and developed draw-down plans and a sediment management plan. The project involved working with the SS in integrating their DREAM sediment transport model to determine the fate of sediment released during removal. Final design plans included demolition of the spillway, and passive transport of 60,000 cubic yards of sediment downstream. Construction was substantially completed in January 2010. Dam rubble was used to build artificial oyster reefs in Chesapeake Bay.

#### San Clemente Dam Fish Passage

Carmel, CA (2007-Ongoing)

This project alleviates critical dam safety concerns and restores passage for ESA-listed steelhead by removing the 106-foot tall dam constructed in 1921. Inter-Fluve currently (since 2008) leads the channel design task, and provides overall dam removal and ecological restoration advisory services. This role has required extensive collaboration with project stakeholders, resource agencies, and technical review team. Technical tasks included geomorphic reconnaissance, channel survey, alternatives analysis, hydraulic modeling, fish passage design and channel design. From 2007-08, served as the primary technical advisor to the Coastal Conservancy in their evaluation of options for

removing San Clemente Dam. In both the design and advisory roles, Inter-Fluve has been key in transforming the project design into one that results in full-scale valley bottom restoration achieving a high degree of ecological integrity. Marty assisted in concept development and evaluation of steelhead migration windows.

#### Minnehaha Creek Restoration

St. Louis Park, MN

Inter-Fluve restored a 1500 foot reach of Minnehaha Creek running through the Methodist Hospital wetland property. The project involved in-depth flood analysis to ensure a no-rise design. Low profile large wood was used to provide 20-30 years of toe protection while still allowing for canoe and kayak passage. Construction was completed in February 2010. A boardwalk connects the site to the Hospital and is used frequently by hospital staff to promote healing in patients.

#### Shawsheen River Dam Removals/Fish Passage Restoration

Andover, MA (Ongoing)

Marty is the lead designer and project manager for the removal of the Balmoral, Marland Place, and Ballardvale dams on the Shawsheen River. This project involves public outreach, surveying, concept plans, final design and construction oversight. The design involves stabilization of historic dam abutments and adjacent apartment buildings. The design of this project included GEO-RAS modeling of flooding conditions following removal. Marty manages all aspects of this project including contaminated sediment removal and management. Final design was completed in 2012 with construction of the lower two removals completed in 2014.

#### Big Spring Dam Removal

Adams, WI (2011)

Marty lead the Inter-Fluve team in assessing current conditions and designing the dam removal and stream restoration for Big Spring Creek, a brown trout stream in central Wisconsin. This project features sediment transport analysis, hydraulic and hydraulic studies and natural channel design. The initial drawdown was completed in 2009, with full removal and impoundment sediment excavation in 2011. This involved channel training and grade control manipulation to guide the headcut into the final channel location.

#### Franklin Dam Removal

Franklin, WI

The Franklin Dam was a 100 ft. abandoned mill dam on the Sheboygan River. Marty worked with Wisconsin DNR engineers and biologists to develop a set of design plans for the removal of the dam, restoration of the drained impoundment and stabilization of the floodplain and streambanks. Marty also provided construction oversight for the project.

#### Dundaff Creek Dam Removal

Wilkes-Barre, PA (2010)

American Rivers hired Inter-Fluve to remove a small dam on Dundaff Creek, a brook trout stream in northeast Pennsylvania. With a limited budget, Marty and the design team were able to complete the removal design in a short time window. The design featured on-site disposal of excavated impoundment sediment. Large woody debris placement was used to train the stream to create



## WATER RESOURCES ENGINEER

# Beth Wentzel, PE

Beth has over 16 years of experience in river and wetland restoration research, advocacy, and engineering. She has contributed to development of defensible stream enhancement designs, including dam removal, fish passage, and channel reconstruction projects. Beth also has a solid understanding of river protection laws and regulations which she developed through technical water policy analysis and advocacy for conservation organizations in multiple regions of the US. She has several years of experience in naturalized stormwater management system planning and design. Through these diverse experiences, Beth has become skilled at communicating with individuals and groups with very different backgrounds and interests.

### EXPERTISE

Hydrologic and Hydraulic Analysis  
 Natural Channel Design  
 Stormwater Management System Design and Monitoring  
 Wetland Restoration Design  
 Project Management

### EDUCATION

MS, Civil and Environmental Engineering, University of Illinois, Urbana-Champaign, 1999  
 BS, Civil Engineering, University of Illinois, Urbana-Champaign, 1994

### PROFESSIONAL AFFILIATIONS & REGISTRATIONS

Registered Professional Engineer:  
 PA, IL, MN, WI  
 NJ - in process

### CONTINUING EDUCATION

XPSWMM Stormwater Model Training, 2006  
 Fluvial Geomorphology for Engineers – Rosgen Level I, 2008  
 Geomorphology and Sediment Transport Principles Applied to Channel Design, 2010  
 Principles of Engineering Project Management, 2012

### SELECTED PROJECT EXPERIENCE

#### Shawsheen River Dam Removal Andover, MA (2010)

Beth conducted sediment sampling to inform the design for the removal of the Balmoral, Marland Place and Ballardvale dams on the Shawsheen River. Beth also developed the sediment management plan to ensure compliance with state regulations.

#### Pucker Street Dam Niles, MI (2014-Ongoing)

Beth is assisting with the survey of the existing and pre-dam ground surfaces and development of stream restoration concepts and preliminary cost estimates associated with removal of the 20 ft high, 200 ft long Pucker Street Dam on the Dowagiac River. The dam removal and stream restoration design include assessing impounded sediment quantities, collecting and analyzing impoundment sediment samples to depths of over 10 ft below existing ground surface, ensuring stability of a bridge immediately upstream of the dam, designing stable banks in a small corridor, addressing adjacent landowner concerns, coordinating with regulatory agencies, and securing funding.

#### Papermill Dam Removal & Cacoosing Creek Restoration Spring Ridge, PA (2010-13)

Beth was the project manager in developing the design and securing regulatory approval for the removal of the Papermill Dam on Cacoosing Creek. The project required topographic survey, sediment sampling and management planning, hydrologic and hydraulic analysis, and CDs preparation.

#### Whittenton Dam Removal Taunton, MA (2010-12)

Beth managed the preliminary dam removal design project to achieve the project goals of improving habitat and ensuring fish passability through the currently impounded reach of the Mill River. She coordinated the collection of survey and sediment quality data, developed the sediment management plan, and oversaw the development of the design plans and specifications.

#### Ulao Creek Habitat Enhancement Grafton, WI (2013-2014)

Beth is the lead engineer and project manager for the enhancement of aquatic and wetland habitat in a large wetland in southeastern Wisconsin that had been ditched and modified, limiting the diversity of the system. Design included remeandering more than a mile of new stream channel and incorporating topographic diversity into the floodplain to allow for additional plant species to thrive.

#### Nemahbin Roller Mill Dam Removal Delafield, WI (2010)

Beth assisted with the field survey, led the development of the sediment management plan, and assisted in the development of the restoration design associated with the removal of this dam on the Bark River. Addressing concerns raised by downstream stakeholders required a very robust plan for managing the sediment that had accumulated in the impoundment.

# Beth Wentzel, PE

## ADDITIONAL PROJECT EXPERIENCE

### Newburg Dam Removal

Milwaukee, WI (2012)

Beth managed and led the engineering design of the removal of the Newburg Dam and restoration of a reach of the Milwaukee River. The project included addressing utility conflicts, addressing contaminated sediments, and designing a multi-use trail to connect public parks upstream and downstream of a road crossing and also serve as a flood conveyance channel. Beth completed hydrologic, hydraulic and sediment analyses of the Milwaukee River in this reach, coordinated permitting activities, developed the construction documents, and provided construction management services.

### Spring Creek Daylighting

Sussex, WI (2010-15)

Beth completed the hydrologic and hydraulic analysis, and developed concepts for a project that includes removing approximately 500 ft of stormsewer pipe and restoring a natural stream channel with a shorter fish friendly culvert at a road crossing. Beth is currently working with a multidisciplinary team to incorporate the design into a larger road re-construction project.

### Oak Meadows Golf Course Stream Enhancement

Wood Dale and Addison, IL (2013-2015)

Beth is leading the engineering design for the enhancement of Salt Creek through the Oak Meadows Golf Course in DuPage County, IL. The project entails reconfiguring the channel cross section to accommodate flashy urban hydrology while providing hydraulic conditions and instream structure necessary to diversify habitat.

### Trout Brook Stream Daylighting

St. Paul, MN (2011-2014)

Beth was the project manager and assisted in designing a 3,000-ft section of stream that now flows through an urban city park after decades of flowing through a storm sewer. To accommodate for future needs, the stream and floodplain was designed to function under the short-term hydrologic regime, and the proposed long term hydrologic projections. Our work included assessment of the quality and quantity of potential water sources; determination of stream and pipe alignments across and through the underground infrastructure of an urban environment; addressing the existence of contaminated soils on the site; and assessing the ecological potential of the project. Inter-Fluve developed construction drawings and specifications, an estimate of construction costs, and provided construction oversight.

### Fawell Dam Modifications

DuPage County, IL (2014-15)

Beth assisted with hydraulic survey and sediment sampling, provided review of hydrologic and geomorphic evaluations, and coordinated the fish passage criteria assessment and project reporting associated with preliminary feasibility investigations for modifications to Fawell Dam in DuPage County, Illinois. Objectives for the modification include maintaining the dam's flood storage function, while allowing fish passage and habitat enhancement. The design and construction of modifications at this structure are anticipated to proceed in 2015-2017.

### Minnehaha Creek, Reach 20, Channel Restoration & Floodplain Enhancement

Minneapolis, MN (2012-13)

The Minnehaha Creek Watershed District and its project partners hired Inter-Fluve and HR Green to develop restoration concept designs for a segment along Reach 20 of Minnehaha Creek. Inter-Fluve and HR Green examined the hydrology, hydraulics, geomorphology, and existing infrastructure of the reach. We then developed conceptual designs for restoring a sinuous stream channel, improving wetland and floodplain function, improving site recreation and trail connectivity, and integrating stormwater management best management practices. Inter-Fluve developed final designs for the project, and provided permitting assistance and construction oversight. Beth was involved in the latter, providing construction observation which included providing guidance to the contractor regarding the installation of large wood, monitoring fabric encapsulated lift construction, and documenting daily construction activities.

### Hidden Falls Restoration

St Paul, MN (2013-14)

Beth managed and led the engineering analysis for the development of concept designs for the restoration of the waterfalls and stream at Hidden Falls Regional Park. The stream through the park varies dramatically in form, including very steep reaches and lower gradient reaches as it drops from the top of a limestone bluff and across the Mississippi River floodplain. The design required step pool channel design in conjunction with protection and restoration of historic walls along the falls. It also required determination of a stable, attractive stream geometry for the lower gradient floodplain reach.

### Croxton Ditch Improvement

Angola, IN, (2010-11)

Beth managed this project to reconnect a channelized headwater stream to its floodplain and incorporate meanders and pools into the stream. The goals of the project included retention of water and pollutants in the new floodplain to minimize impacts to downstream waters.

### Minnesota River Meander Limit Study & Bank Stabilization

Kesota, MN (2012-14)

Beth managed a meander limit study on a stretch of the Minnesota River. Based on study findings that river migration poses a threat to existing infrastructure, Inter-Fluve designed bank stabilization measures for the river. Beth was the project manager for this design project, which includes site survey, hydrologic and hydraulic analysis, permitting, and construction document preparation.

### RiverFirst Mississippi River Redevelopment

Minneapolis, MN (2012)

Beth managed Inter-Fluve's role as part of a multidisciplinary team charged with developing concepts for the redevelopment of portions of the Mississippi River waterfront through Minneapolis. The proposed improvements will include development of new park spaces and natural areas along the river. Inter-Fluve led the assessment of the regulatory feasibility and requirements associated with several of the design elements and conducted hydraulic analysis of the proposed alternatives.



## CADD TECHNICIAN

# Charlie Phillips

Charlie is a CADD Technician with particular interests in habitat conservation and oceanography. Prior to working for Inter-Fluve he was working as a Divemaster in New Zealand where he was part of a marine conservation team, monitoring the effects farming seaweed had on local ecosystems. Since joining Inter-Fluve he has contributed his knowledge of AutoCAD and Solidworks 3D to projects involving habitat restoration, dam removal and channel migration.

### EXPERTISE

Computer Aided Drafting & Design

- AutoCAD Civil 3D
- Solidworks 3D
- Revit

### EDUCATION

BEng – Mechanical Engineering, Oxford Brookes University, Oxford England, 2005

City & Guilds – Composite Materials, Oxford Brookes University, Brooklands College, Surrey, England, 2004

PADI Divemaster, 2010

PADI Rescue Diver, 2009

Emergency First Responder, 2009

### PROFESSIONAL AFFILIATIONS & REGISTRATIONS

New Zealand Underwater Association

### SELECTED PROJECT EXPERIENCE

#### **Bloede Dam Removal Alternatives, Analysis & Design, Final Design Patapsco River, Ilchester, MD (2011-present)**

Bloede Dam is located on the Patapsco River within the most visited state park in Maryland. The dam is the last major fish passage barrier in the lower Patapsco watershed. In 2011, Inter-Fluve was contracted by American Rivers to complete alternatives analysis through final design plans for the Bloede Dam Removal. The goals are restoration of fish and aquatic organism passage and restoration of the Patapsco River. The project includes relocation of over 1,500 lf of 48-inch pressurized sanitary sewer interceptor. The project also requires close coordination with Maryland Department of Natural Resources, NOAA, and numerous stakeholders.

#### **Boardman River Dam Removal Traverse City, MI (2013)**

Inter-Fluve was part of a design team developing final design plans for the \$4-million removal of Brown Bridge Dam and the Sabin Dam on the Boardman River in northern Michigan. We completed conceptual and final design documents, and provided full construction oversight for the sediment management and channel restoration at the Brown Bridge dam (1500' long and 40' tall), which was the first and largest of three dams to be removed on the river, and one of the largest removed in the state of Michigan. Drawdown of Brown Bridge was completed in fall 2012 and restoration of the channel and floodplain completed in January 2013. Charlie provided CAD.

#### **Newburg Dam Removal Milwaukee, WI (2012)**

The demolition of the Newburg dam on the Milwaukee River enables fish and other aquatic life to move freely between Grafton and West Bend for the

first time since the 1840s. The removal of the dam will give downstream fish access to the main river channel as well as miles of tributary streams that will provide spawning habitat for the fish. Charlie provided CAD.

#### **Cotley River Dam Removal Taunton, MA (2013)**

The Cotley River Dam is a small dam impounding a former headwater stream just east of Taunton, MA. Removal plans call for partial spillway removal, preservation of historic structures, and stabilization of an upstream railroad crossing potentially affected by changing hydraulic conditions upstream.

#### **Minnehaha Creek Reach 20 MN (2013)**

Reach 20 of Minnehaha Creek was ditched in the 1950's. The purpose of this project was to reconnect the creek with it's historical flood plain and sections of it's old alignment. The project includes improving stormwater filtration, restoring former channel sinuosity, updating canoe access, and developing recreational trails while creating wetland and riparian habitats. Charlie provided CAD.

#### **Sheboygan River Habitat Sheboygan, WI (2013)**

This reach of the Sheboygan River has been classed as an AOC (Area of Concern) by the EPA; it serves as a sink for pollutants carried from three watersheds, the Sheboygan River, Mullet River and Onion River. The priorities of the overall project include remediation, source pollution control, brownfield and waterfront restoration, and habitat restoration and protection. Inter-Fluve is focusing on the habitat restoration and



## FLUVIAL GEOMORPHOLOGIST

# Ben Swanson, PhD

Mr. Swanson has 7 years of academic experience and 4 years of professional experience in fluvial geomorphology and watershed sciences. His PhD research focused on disruptions in channel form, habitat, and sediment transport processes across tributary junctions along the Rio Chama, NM, and his masters work documented channel changes along the Clark Fork River, MT, in response to increased sediment inputs associated with historic mining. He's skilled in Geographic Information Systems analyses, collecting geomorphic and sediment field data, and modeling hydraulics and sediment transport. Ben's primary focus is assessing how stream channels have adjusted their form and function in response to watershed and channel disturbances, and utilizing this information to help re-establish healthy and productive systems.

### EXPERTISE

#### Fluvial Geomorphology

- Channel and Floodplain Assessment
- Geographic Information Systems
- Hydraulic Modeling
- Sediment Transport Analyses
- Aquatic Ecology

#### Field Experience

- Topographic Survey (GPS, Total Station, Level)
- Geomorphic Survey (Cross-sections, Profiles)
- Bed Material Size Distributions
- Bed Material Transport Sampling
- Scour/Erosion Analyses
- Soils Analyses
- Mapping

### EDUCATION

PhD, Earth & Planetary Sciences,  
University of New Mexico  
Albuquerque, NM 2012

MS, Water Resources & Fluvial  
Geomorphology  
University of Montana  
Missoula, MT 2002

BA, Geology  
University of Montana  
Missoula, MT 1996

### CONTINUING EDUCATION

40 - Hour Hazwopper Training. 2005. Acute Engineering.

### SELECTED PROJECT EXPERIENCE

#### Mirror Pond Sediment Management Feasibility Study Bend, OR (2013)

Mirror Pond is an urban reservoir located on the the Deschutes River in the city of Bend, Oregon. Dredged in 1985, it has since filled with sediment again. To address the sedimentation issues in both the short- and long-term, Inter-Fluve developed a preliminary sediment management plan. The document included background information covering the existing watershed and reservoir conditions, as well as a discussion of potential solutions and their impacts to the system. Potential actions range from leaving the reservoir alone, to partial or full dredging, to dam removal and stream restoration. Ben worked closely with the City, Greenworks Landscape Architecture, and Inter-Fluve staff to establish the physical, ecological, and social ramifications of each solution and produced the document being used to further narrow the City's preferred options.

#### Ulao Creek Habitat Enhancement Grafton, WI (2013)

Ben is working with the Ozaukee County and Inter-Fluve team to develop and implement a habitat enhancement project along the upper reach of Ulao Creek, near Grafton, WI. Habitat work is addressing limiting factors for northern pike and other fish species that use this straightened wetland stream for spawning. The project aims to restore meanders to the stream, provide greater access to the wetland floodplain for both flooding and fish, and improve wetland vegetation diversity. Ben has been involved in assessing and surveying the site and analyzing hydrology data. He also provided geomorphic analyses on nearby creeks which were used as references for his design of the Ulao Creek planform and cross-sections.

#### Dowagiac Stream Restoration Project (2013) Dowagiac, Michigan

Inter-Fluve is currently developing design criteria to guide the restoration of a reach of Michigan's Dowagiac River managed by the Pokagon Band of the Potawatomi Tribe. The river was straightened in the early 1900s. The Pokagon Tribe and supportive watershed groups are trying to re-establish the meandering planform to invigorate trout habitat and wetland function, and increase recreational use for fishing and canoeing. Ben has collected and presented historical maps and documents describing the pre-dredged river; helped produce a geomorphic survey; collected sediment information from relict channels; and produced GIS maps providing visual access to most of this data.

#### Little Manistee Habitat Enhancement Manistee, MI (2013)

Inter-Fluve is working with Conservation Resource Alliance to improve habitat for salmonids and other aquatic species by installing woody debris along a reach of the Little Manistee River. The woody debris is intended to create more complexity to the channel and help expose gravel that lies beneath the generally sandy stream bed. Ben helped collect channel cross-section survey data and assess the existing morphology and habitat within the project reach. He also constructed a hydraulic model based on the survey data and a hydrologic assessment. He is currently helping to assess woody debris buoyancy and produce designs.

## Ben Swanson, PhD

### ADDITIONAL EXPERIENCE PRIOR TO INTER-FLUVE

#### Misty Acres Creek Weir Removal & Restoration Manistee, MI (2013)

An inactive weir and a road crossing impact a small tributary to the Betsie River in the Northeastern Lower Peninsula of Michigan, which is protected by the Grand Traverse Regional Land Conservancy. Inter-Fluve is working with Conservation Resource Alliance and the Conservancy to remove the weir and improve geomorphic conditions along the channel. As part of that effort, Ben examined the hydrology and hydraulics of the project reach, including constructing a hydraulic model. He is assisting with sediment management and design of the channel for when the weir is eventually removed.

#### Spring Creek Daylighting & Realignment Sussex, WI (2013)

Ben is working with the Village of Sussex and project partners to develop and implement a daylighting plan for a spring creek that currently flows through a 300-foot-long culvert. The channel will be realigned in an open easement and will incorporate meanders and habitat elements that are currently non-existing. The channel and floodplain will also include a section of rock wall to help protect adjacent infrastructure. Ben has been involved in producing a hydraulic model and in the design of the proposed channel and floodway.

#### Boyce Pond Dam Removal & McQueston Brook Dam Removals

Fitzwilliam & Manchester, NH (2013)

Inter-Fluve is working with watershed groups and dam owners to remove numerous small, outdated dams in the Northeastern United States, including New Hampshire's Boyce Pond Dam and McQueston Brook Dams. As part of the planning and design for these dam removal projects, Ben has produced Quality Assurance Project Plans and Site Specific Project Plans documents for government agency approvals. These documents outline the steps Inter-Fluve will use to collect and manage topographic and sediment data, and provides due diligence analyses concerning potential sediment and sediment contaminant issues, wildlife impacts, and other factors. His work at these sites also includes hydrologic and hydraulic analyses, including model development.

#### Mill River Channel Realignment Whately, MA (2013)

Ben performed a historical analysis of the channel, which utilized historic air photos to document rates and directions of channel change. The assessment provided guidance for protecting the nearby interstate highway and other infrastructure, as well as the adjacent wells.

#### Shell Creek Watershed Assessment Schuyler, NE (2013)

The Shell Creek Watershed Improvement Group and the Lower Platte North NRD has contracted with the Inter-Fluve team to develop concepts to help lessen sedimentation and erosion along 80 miles of Shell Creek. The Creek has been impacted by intense row-crop agriculture for decades, and has also experienced channel straightening, removal of stream side vegetation, levee construction, and other impacts. Ben is working on documenting historic changes to channel form and adjacent landuse using GIS and historic air photos. He is also identifying general stream enhancement projects and prioritize reaches for future work in the watershed using LiDAR elevation data to model stream conditions and a field assessment.

#### Red Cedar River Bank Erosion Assessment & Stabilization

Colfax, WI (2013)

Tainter Lake, a reservoir along the Red Cedar River, has experienced an increase in sedimentation and nutrient pollution over the last few decades, leading to loss of lake access for many lakeside properties and large algae blooms. Inter-Fluve has teamed with the Tainter Menominee Lake Improvement Association and numerous government agencies to assess upstream bank and bluff erosion and stream adjacent landuse, and provide conceptual plans for reducing sediment within the system. Ben documented historical channel erosion and avulsion along the reach downstream of Colfax, WI, and has also helped prioritize reaches for future work. As the project continues, he will be involved in modeling hydraulics through the prioritize reach, and will formulate plans and an implementation strategy for slowing erosion along the channel.

### EXPERIENCE PRIOR TO JOINING INTER-FLUVE

#### Northern Rivers Dam Licensing Project (Parish Geomorphic Ltd)

Ontario, Canada

Ben was the technical lead on a series of geomorphic assessments of multiple bedrock rivers in northern Ontario. The assessments were performed for Xeneca Power, Inc., who were developing run-of-the-river dams for hydroelectric power. The assessments included field measurements of bed material size and channel form, and analyses of sediment transport and bank erosion. He utilized hydraulic and sediment transport modeling to evaluate flooding and sediment bed material connectivity under both existing and dammed conditions. He also used LiDAR data and simple geomorphic models to map areas of potential bluff erosion in a GIS.

#### Robinson Creek Restoration Design (Parish Geomorphic Ltd)

Markham, Ontario, Canada (2012)

Robinson Creek is an urban stream impacted by relatively dense residential development and multiple road crossings. The Toronto and Region Conservation Authority worked with Ben's team to re-meander the low-gradient stream channel, establish a wet meadow floodplain, and enhance in-stream habitat for the endangered red-side dace. Ben provided the hydraulic modeling and channel design for the project, which featured a series of wetland pools connected by sinuous channels.

#### Coupling of Hydrologic/Hydraulic Models and Aerial Photos (University of New Mexico)

Rio Grande and Rio Chama, Albuquerque, NM (2006-2009)

As part of a background study for potential river management projects in New Mexico, Ben provided historical channel analyses for the Rio Grande and Rio Chama for the Army Corps of Engineers' Arid Region Demonstration Project. He documented major channel and floodplain changes over time as observed from sets of closely spaced sequential aerial photographs. He then compared the style and processes associated with these changes to shifts in hydrology and hydraulics in the channel, as well as to changes in landuse and river management, such as dam operations and levees. The work is now being used to evaluate the potential effectiveness of ESA-listed Rio Grande silvery minnow habitat restoration projects and impending changes to the timing and magnitude of flow releases upstream of the project areas.