



**4th PROGRESS REPORT
to the
INTERNATIONAL JOINT COMMISSION
by the
INTERNATIONAL UPPER GREAT LAKES STUDY BOARD**



Stannard Rock Lighthouse with inset of eddy covariance instrumentation tower
Photos courtesy of Chris Spence and Newell Hedstrom

**Semi-annual Appearance
Ottawa, Ontario
October 29, 2008**

INTERNATIONAL UPPER GREAT LAKES STUDY BOARD

Commissioners:

The International Upper Great Lakes Study Board submits herein its fourth Semi-annual Progress Report, covering activities from March 31 to October 1, 2008.

1. **SUMMARY**

During the reporting period, extensive studies and investigations have been underway to determine the causes for the declining levels of the upper Great Lakes. In addition to these investigations centered around hydraulic modelling of St. Clair River conveyance, defining the bathymetry and sediment character of the river and determining net basin supply components, the issue of uncertainty is being discussed related to the collected data and the results generated by the investigations. Extensive efforts to communicate with the public have been undertaken. Progress has also been made regarding the second phase of the Study on the development of options for improving the management of outflows from Lake Superior.

The following are highlights, with more details provided under Section 2:

- The installation of three international acoustic Doppler current meters has begun; the first of which was on the Detroit River on September 22, following shortly by the St. Clair and St. Marys River gauges through October.
- Full river comparisons have been made of St. Clair River bathymetry for the 1971-2000 and 2000-2007 periods. However, the accuracy of available data especially for the earlier period was not great enough to reliably detect widespread geomorphic change throughout the St. Clair River at the scale required.
- One- and Two- Dimensional hydraulic and sediment model development is proceeding. Preliminary results appear to indicate an increase in conveyance over the 1971-2007 timeframe, but this appears to have stopped or reversed since 2000.
- Extensive mapping of the bed roughness and analysis of the fluvial nature of the St. Clair River in the vicinity of the Bluewater Bridge is proceeding and will be complete this fall.
- The Hydroclimatology Work Group Modelling Strategy Report was reviewed by the Independent Peer Review Group (IRG) which indicated that the approach was acceptable and suggested some modifications.

- The comparative analyses for determining net basin supply, overlake precipitation, lake evaporation and basin runoff are complete and are being evaluated.
- The eddy co-variance evaporation measurement device at Stannard Rock is operable and collecting over-lake data on Lake Superior.
- Twelve public meetings were held around the upper Great Lakes providing an opportunity to describe the Study and its preliminary findings to more than a thousand people. Also as part of the Study's outreach program, two newsletters were distributed.
- Dr. John Boland, a Natural Resources and Environmental Economist from Johns Hopkins University, joined the Study Board as a U.S. Member filling the vacancy created with the departure of Dr. Richard Bishop.
- Kathryn Arnold has been appointed as a new U.S. Member of Public Interest Advisory Group (PIAG), filling the vacancy created by Sam Speck's appointment to the Commission.
- A report outline for the St. Clair report has been agreed upon, writers identified for each section and a coordinator-scientific editor has been contracted.

2. STUDY TEAM AND BOARD ACTIVITIES

2.1 LAKE HURON OUTFLOW/ ST. CLAIR RIVER TASK TEAM

The Team has met extensively during the reporting period, through Team and Technical Work Group (TWG) meetings and teleconferences. Each TWG has been asked to develop a summary report consolidating all research conducted and establishing an overall assessment of findings. These documents will form the basis for the Phase 1 final report. Project matrix sheets showing the status of over fifty projects and their relationship to answering key science questions are shown in Appendix 1.

Specific activities are described in the following sections.

2.1.1 Data Verification and Reconciliation, Surveys and Monitoring TWG

Jacob Bruxer, Environment Canada, submitted draft reports on two efforts related to the impact of Glacial Isostatic Adjustment (GIA) on Great Lakes water levels. The first report submitted on September 19, 2008 provides an update to the rates of apparent vertical movement believed to be primarily due to GIA between all gauges on a given lake and that lake's outlet based on the linear regression of the year-to-year differences between the 4-month (June-September) mean water levels recorded at each station up to and including 2006. In addition, this analysis

identifies a number of issues related to estimating and using long-term average movement rates based on this method. The second report submitted on September 22, 2008 provides an assessment of the volume change of each of the Great Lakes over time due to GIA. Both reports are currently being reviewed internally.

Dave Bennion, United States Geological Survey (USGS), completed his analysis of possible channel changes in the St. Clair River using bathymetric data from surveys made in 1971, 2000, 2002, 2005, 2006, and 2007. His report was provided to the Task Team on June 30, 2008. The reported conclusions were that, while comparisons of the data sets did indicate some geomorphic processes at work, the accuracy of available data was not high enough to reliably detect widespread geomorphic change. While statistical and spatial comparisons of the data sets show that some changes to the channel have taken place during the study period, error associated with various survey methods and interpolation processes limit the utility of the results. Uncertainty associated with the surveys did not allow any significant differences to be discerned. Because of this, volumetric analysis results could only be used anecdotally and not as a firm measure of change.

Dr. Art Schmidt, University of Illinois at Urbana, began work on determining if changes in conveyance have occurred in the St. Clair River since the last major dredging in the early 1960s, using estimates of flow measurements for the period 1962-2006. His work to date has included evaluating the reliability of the historic flow estimates, based on rating equations, equations themselves and the measured flows on which the equations were derived. His preliminary analysis shows that limits and uncertainty in historic flow measurements in the river, made with different procedures and technologies yielding different uncertainty over time, need to be considered in any comparison of historic flows over the period.

A draft report of the history of dredging and compensation in the St. Clair and Detroit Rivers, being worked on by United States Army Corps of Engineers (USACE) and Environment Canada (EC), was provided to the Task Team in June and updated in August 2008. This report includes maps of locations and estimated quantities of dredging, legislative history of projects, and designs of compensation. A number of compensating structures were constructed on the Detroit River, including structures along the Livingston Channel and Amherstburg Channel. No compensation projects were built on the St. Clair River. Some compensation was addressed through placement of dredge materials. Dredge material was placed in various locations within the Detroit River and St. Clair River for both the 25-foot Project and 27-foot Project, and also for the St. Clair River project at the Black Rock shoal during 1920 to 1922. Previous studies have indicated that this technique of disposal has resulted in some compensation for the increased discharge through the rivers.

Efforts to review and update historical Lake Erie outflow estimates were initiated. To date, activities have focused on the review of historical methodologies and water level and outflow data retrieval. This effort will also consider recently revised

Niagara Board approved rating equation for the flow out of the Maid-of-the-Mist Pool, which is a portion of the Niagara River flow determination. This equation will be used to incorporate better estimates of the flow over the Falls into the historic Niagara River flows.

In order to verify the outflow predicted by the models, three international gauges are being installed by the USGS along the St. Clair, Detroit and St. Marys River. The gauges use in-situ Acoustic Velocity Meters (AVM). The St. Clair AVM replaces the meter installed in 2007, which was close to the outlet of Lake Huron and damaged by ice from the lake. The new gauge is located further downstream, but still in the vicinity of the Blue Water Bridge on the US shoreline. The St. Marys AVM will be located on the US shore downstream of Edison-Sault power plant. The Detroit AVM will be located on the US shore downstream of the Ambassador Bridge. These gauges will be operated throughout the remainder of the Study and after Study completion to monitor conditions and support adaptive management strategies. The TWG is developing a rationale for using the existing water level gauge at Buffalo, NY and its associated rating curve in-lieu of establishing an AVM site as was recommended earlier.

2.1.2 Hydraulic Modelling TWG

The Hydraulic Modelling TWG has made significant progress over the past six months. The studies that were initially undertaken have either been completed or on target to be completed by their scheduled due dates. These projects include 1-D Hydraulic Modelling using HEC-RAS, Computing Flows and Inferring Conveyance Changes using HEC-RAS, 2-D Hydrodynamic modelling using RMA-2, 2-D Hydrodynamic modelling using TELEMAC, and Determining the Effects of Ice on the St. Clair River.

Over the last 6-months other modelling needs were identified and projects initiated. These projects include extending the TELEMAC Hydrodynamic model into Lake Erie, quantifying uncertainty in the model parameters using the RMA-2 hydrodynamic model, and 1-D HEC-RAS modeling with the 1954 cross sections. These study efforts are on schedule and will be completed by their assigned due dates. Of those listed, the effort to quantify uncertainty is the most critical to our group and is scheduled to be complete by this fall.

The Hydraulic Modelling TWG is currently planning a meeting with all primary investigators towards the end of October to discuss the preliminary results. The goal of this meeting is to synthesize and reconcile the results of studies and to begin to formulate conclusions.

2.1.3 Sediment Studies TWG

Work has focused on establishing the characteristics of bed material and sub-bottom material, details of bed forms, and the potential erodibility of the river bed, especially in the first 3-5 km from the outlet of Lake Huron. Data have been collected using several acoustic sensors and with direct video and digital imaging of the bed. Surveys have included:

Video transects and profiles in several locations along the river bed, including high density coverage in specific areas in the upper river and repetition of cross-sections previously surveyed between Sarnia-Port Huron and Port Lambton. Photo analysis is being used to determine grain size of the surface material from the captured video images (EC).

High resolution Multi Beam Echo Sounder (MBES) survey of the upper river and lake outlet to provide detailed bed morphology, bedforms and bed roughness maps by the University of Illinois at Urbana-Champaign.

Acoustic surveys (side scan, multi beam, shallow and deep sub-bottom) of the upper river to interpret bottom and sub-bottom materials by the USGS.

Background report on surficial geology of the region by Morris Geosciences.

Sediment load (bed and suspended) measurement at several cross-sections aided by video observations of bed mobility at sampling sites (EC).

Acoustic Doppler Current Profiler (ADCP) velocity profiles and conventional current meters were used to provide velocity and bed shear stress estimates for assessing bed erodibility.

Completion of these analyses is underway with merging of data sets, final mapping and interpretation to be undertaken in October and November 2008.

Analysis using a 2-D sediment model is underway to investigate river bed dynamics, sediment routing and related scenarios and to assist mapping of bed erodibility and potential sediment movement in the upper river.

Collaboration with the Hydraulic Modelling TWG on flow modelling and with Dave Bennion on historical bathymetric change is progressing.

2.2 LAKE SUPERIOR REGULATION TASK TEAM

The Study Board accepted the Lake Superior Regulation Task Team's suggestion regarding how work should proceed in terms of economic and environmental uncertainty in the long-term. Specifically, the Study Board:

- Accepted the advice of our economic experts that uncertainty in economic (and environmental) factors is as great if not greater than uncertainty about water supply changes due to climate change, so that estimates of the expected value of future impacts would be so uncertain as to be indefensible.
- Agreed that, apart from commercial navigation and hydropower, the Team should gather impact information on some sampling of sites since funds are not available for exhaustive inventories or statistically-defensible representative sampling, and since in many areas the differential impact from a modified regulation plan will be undetectable.
- Accepted that by using a biased set of sampling sites, the Study will not be able to fully extrapolate to produce basin-wide economic impacts for each interest, and therefore will not be able to conduct economic tradeoffs between interests or lakes. The Board also recognized that alternative quantifiable metrics may be more appropriate than trying to translate all impacts to dollars.
- Agreed that it would not recommend a plan that favoured one lake over another to any great degree, even if doing so increased net benefits. However, this does not necessarily mean striving to balancing water levels relative to their mean each month, as Plan 1977A does now, but would prevent, for example, a plan that used Lake Superior as a storage reservoir for Lakes Michigan-Huron, even if that produced greater net economic or environmental benefits.
- Re-stated its desire to help address the potential impacts of climate change on the Great Lakes, but acknowledged that no regulation plan will make much of a difference in unregulated lakes considering how much water supplies may change.

As a result, the Board was able to refine the direction to the TWGs regarding their research on impacts under this and future climate scenarios.

First, the evaluation of the new regulation plan will be based on the current climate (including extremes found in the stochastically generated supplies) and quantifiable impacts from the sample sites (not necessarily economic impacts).

Second, an adaptive management strategy will be developed. The TWGs are thinking about that now. The adaptive management strategy will tentatively consist of two components; 1) triggering mechanisms (when is it time to change management) and 2) responses (what actions might be taken), with the bulk of the response falling outside the authority of the IJC. The idea is that rather than formulate a regulation plan that tries to work best for the current as well as possible future climate conditions, optimize for the current climate now and then suggest when a re-optimization for a changed climate regime might be worthwhile.

2.2.1 Coastal Zone TWG

The Coastal Zone TWG continued to move forward on a variety of tasks. A scope of work has been prepared to consolidate the best available GIS data related to shoreline classification and land use. This will be useful in focusing site study areas and relating site study information to other areas of the basin. Another scope of work has been prepared to review the available models for erosion of cohesive and sandy shorelines to help determine the available options and the associated uncertainty. These two contracts are expected to be awarded in October. A contract has been awarded to do a literature review and assessment of the economic impacts of low water on coastal property owners. Wave data have been identified and collected. Work continues on the contextual narrative as well as further refinement of possible performance indicators.

A Coastal Experts Workshop will be held in October 2008 to help formulate plans for assessment methodologies for selected performance indicators, focusing on flooding, erosion, shore protection and low water. Scoping documents have been prepared to address the associated drivers, vulnerabilities and consequences for each. This will help define data requirements, potential limits of analysis and finalized performance indicators.

2.2.2 Commercial Navigation TWG

The Commercial Navigation TWG held an initial workshop which focused on scoping of the tasks to be undertaken by the TWG and development of potential metrics, performance indicators and system segmentation critical to commercial navigation. The workshop also included a presentation of lessons learned from the Lake Ontario commercial navigation TWG. Follow-on discussions have been held with Buffalo District of the USACE who will be accomplishing the navigation modelling for the Upper Lakes study. Follow-on discussions have also been held with navigation industry representatives to ensure the working group is capturing the correct metrics.

A statement of work has been developed for preparation of a contextual narrative and proposals for this task have been requested. A definitive statement of work is under development for the required modelling, and a meeting with the Buffalo District is scheduled for the first week of October to further refine the scope and ensure the ultimate model will provide the required metrics. The meeting will also include a representative from the Plan Evaluation Group (PEG) to begin discussing model integration requirements. The TWG has a commitment from the Buffalo District for their time/support beginning in October 2008.

2.2.3 Ecosystems TWG

The Ecosystems TWG held its first workshop in Sault Ste Marie, Michigan on June 16-18, 2008 to discuss:

- Regulation plan development and evaluation,
- The Great Lakes Indicators Project conducted by the University of Minnesota,
- Lessons learned from ecosystem modelling of the LOSL Study,
- Literature review,
- Contextual Narrative,
- White Paper on potential impacts due to fluctuating water levels,
- Expert workshop and modelling needs.

A literature review is in progress by the University of Minnesota-Duluth. The work is scheduled for completion by March 2009 with updates given at the next TWG meeting tentatively scheduled for December 9-10 in Windsor.

A scope of work is being finalized for the development of a White Paper on the potential environmental impacts of changing water levels in the Upper Great Lakes, a response to changes in flow regulation, both natural and anthropogenic. The paper will be developed by a team of renown scientists familiar with Great Lakes ecosystems including Dr. Gerald Niemi of the University of Minnesota-Duluth and Dr. Jan Ciborowski of the University of Windsor. The paper will form the centrepiece of discussion by a panel of experts at a workshop tentatively planned for Windsor in conjunction with the Ecosystems TWG meeting in December.

2.2.4 Recreational Boating, Cruise Ship and Tourism TWG

The Recreational Boating, Cruise Ship and Tourism TWG has been engaged in a number of initiatives. The TWG has met twice and has had three conference calls to discuss the task objectives and develop an implementation strategy in order to initiate those tasks.

One of the key undertakings of the TWG was to identify Areas of Survey (AoS) around the Great Lakes to ensure that a good representative sampling of recreational boating facilities was made. It is anticipated that up to 200 recreational boating facilities may be surveyed around the Great Lakes. An additional task related to the survey is to finalize a questionnaire that is pertinent to the requirements of the TWG for usage by the survey team.

An application to the Ontario government was submitted by the TWG to cover most of the costs of hiring two interns for a one-year period to undertake survey work and analyse existing literature. The application has been approved and a job ad has now been posted in search of suitable candidates. In relation to the survey work, a boat, motor and trailer has been secured at no cost to the TWG from an international boat

manufacturer. Negotiations are now ongoing to make a truck available for the project. On the US side, a graduate student will be hired to assist with survey data collection.

Discussions are ongoing with the Great Lakes Fisheries Assessment Unit to obtain information on commercial fisheries harvest as well as sport fishing activities and harvesting. The task of identifying resource-based tourist operators located along the Great Lakes has begun.

2.2.5 Municipal, Industrial and Domestic Water Uses TWG

The Municipal, Industrial and Domestic Water Uses TWG has held numerous teleconferences. A contract to inventory municipal and industrial water intakes and wastewater outfalls is nearly complete, although the contents of the existing database will remain incomplete due to lack of availability of intake elevation data (490 facilities identified; 58% do not have intake elevation information).

A future water demands contract has just been awarded to Dr. Ben Dziegielewski, completion of which is expected next spring. The TWG's contextual narrative is being developed with support from the Columbus office of USGS.

2.2.6 Hydropower TWG

The Hydropower TWG held its first meeting in Sault Ste Marie, Michigan. It is reviewing and finalizing its scope of work for its contextual narrative. It is reviewing the hydropower component of a "prototype" shared vision model developed by the PEG assessing the derivation of power functions for the Sault Ste Marie units and modelling assumptions.

TWG is developing a contextual narrative to better understand additional study needs.

2.3 SYNTHESIS GROUPS

2.3.1 Plan Evaluation Group

The Plan Evaluation Group (PEG) co-chairs have been sharing the responsibility of attending all Technical Work Group (TWG) meetings and participating on TWG conference calls to help provide guidance on the development of performance indicators for the plan evaluation process.

Doug Cuthbert, former Lake Superior Board member and Canadian co-chair to the Lake Ontario-St. Lawrence River Study, and Frank Lupi, Michigan State University and also involved in the Lake Ontario – St. Lawrence River Study, have been contracted to help guide the contextual narrative process. Their primary objectives will be: to develop an underlying contextual narrative that provides a general

overview on the economic and social state of the Great Lakes Basin; to work with each of the TWGs in developing their interest specific contextual narratives, providing guidance and assistance in ensuring the six contextual narratives are consistent, objective and fact-based; to work with the TWGs to determine if there are areas of overlap, important items that are slipping between TWGs, or are not being addressed at all; and to prepare a white paper.

The PEG is also currently in the contracting process to hire two economic advisers to the study (Canadian and U.S.) to provide advice and guidance to the TWGs and PEG as they develop their performance indicators and later in the plan evaluation process.

The PEG is preparing for its second and third Circles of Influence workshops. PEG is working with PIAG to identify key individuals, who represent and are trusted by their constituency, to go and meet with these representatives in their locations and learn from them. These Circles of Influence workshops are small (no more than 10 people) in which we provide some background on the study and then ask participants to describe problems and opportunities from their point of view. Expectations for the study are discussed, as well as things they think the Study Board should consider in making their recommendations to the IJC. The first circles of influence workshop was held in Muskegon, Michigan on May 3, 2008. This workshop helped identify specific regional issues and identified specific water level targets. Their metrics will be coded into the Board's evaluation model so that they can use their own metrics to compare proposed regulation plans. The next three circles of influence workshops are planned for the fall of 2008 including two First Nations/Native American workshops (one U.S. and one Canadian) and another on the outskirts of Detroit on October 16 in connection with the coastal experts' workshop.

Based on Study Board interviews carried out during the last reporting period, PEG has begun to enumerate the decision criteria Board members say they will use in selecting a preferred new regulation plan. Those criteria will be linked to the performance indicators. A second interview will be carried out later in the year to further refine Study Board decision criteria.

The PEG has continued to work on the development of a prototype evaluation model. In the last six months, PEG has simulated hydropower production and energy value at five plants, has redesigned the main interface to make it easier to use, and added new displays for commercial navigation results. The hydropower calculations are currently under review by the Hydropower TWG. A mistake in the commercial navigation calculations has been corrected which now shows much less impact from climate change, but still needs review by Commercial Navigation TWG. The recreational boating analysis remains unchanged and nothing has yet been added for the Coastal Zone TWG or Ecosystems TWG. These are all preliminary evaluations that will be replaced once the TWGs have completed their more formal analysis.

The PEG co-chairs also participated in two uncertainty workshops focused on the St. Clair issue and have played a key role in assisting with that process. In particular, Bill Werick is assisting with the building of a single deterministic model as the basis for the Ad Hoc Uncertainty Analysis Group (please see 2.3.3).

2.3.2 Hydroclimatology TWG

The Hydroclimatology TWG has made substantial progress since Study Board approved its proposed plan of study on January 29 in Alexandria, VA. Since then, the Hydroclimatology TWG (H-C TWG) has conducted regular monthly conference calls to gauge progress, provide guidance and ensure that the H-C TWG can meet the target deliverables as stated in our plan of study. The H-C TWG has convened and attended a number of important workshops and task team meetings, conducted comparative and statistical water supply analyses, completed initial phases of coupled land-surface/regional atmospheric model simulations, initiated field deployment of Lake Superior evaporation monitoring equipment and successfully presented and defended the Hydrology and Climate Modelling Strategy for peer review.

An early success occurred in June with the deployment of eddy covariance sensing equipment at Stannard Rock Lighthouse. The equipment has successfully functioned and reported 100% data return. The principal investigators submitted a preliminary report analyzing the data from June-August with very interesting and exciting results. It is important to note that this is the first time direct measurements of Lake Superior evaporation have been made. The principal investigators are now finalizing site selection for Lakes Michigan-Huron and plan to establish the second equipment installation next spring/early summer.

In addition to attending the regular St. Clair and Lake Superior Task Team meetings, the H-C TWG leads convened a workshop June 9-10 in Cleveland, Ohio focusing on climate. The purpose of the workshop was twofold, and two main tracks were proposed and convened. Track 1 focused on "Trends and Uncertainties in Hydrological Data" and reviewed preliminary findings of the TWG associates conducting the comparative and statistical water supply analyses, including the coupled model simulations. Track 2 focused on Climate Scenario Application in support of work to be conducted later for the Lake Superior Task Team and regulation plan formulation. The keynote presentation for Track 1 was given by Dr. Harry Lins, USGS on trends in streamflow. Similarly, Dr. Casey Brown, Columbia University presented the keynote address for Track 2 where he described recent approaches to applying IPCC AR4 climate projections and GCM downscaling to hydrological scenarios. Both Tracks 1 and 2 participants spent the afternoon in detailed discussions to refine plans of study, identify gaps, and finalize modelling strategies. Dr. Frank Quinn has conducted some preliminary evaluations and he hypothesizes that there may be a linkage between possible St. Clair River conveyance change and high water levels during the mid-1980s.

As an outcome of the Cleveland workshop, the TWG leads finalized and presented a final draft of the Hydrology and Climate Modelling Strategy to the IRG on June 26 at ASCE Headquarters in Reston, VA. The IRG reported they were pleased with the modelling strategy and provided helpful comments. The IRG assessed the scientific methodology of the strategy and also considered needs related to public understanding of model results. The consensus of the review team was that the proposed methodology was “generally appropriate for accomplishing the outlined tasks, has clearly stated objectives, and uses generally appropriate and widely accepted databases and modeling approaches.” The IRG also commended the Hydroclimatology TWG for their impressive efforts in assembling such a cohesive and comprehensive strategy.

One issue that was raised through the peer-review process was on the feasibility of this strategy to deal with predictive uncertainty. In order to address this, the H-C TWG US Co-Chair attended the two recent workshops (August 6-7 and September 9 in Burlington, ON) on uncertainty analysis and aspects learned from these workshops will be applied in this TWG. The TWG co-leads also presented preliminary results of our work at the St. Clair Task Team meeting held in Burlington, Ontario on September 8 and 9. Results from the project teams were presented and are available through a PowerPoint presentation on the Study’s internal SharePoint website.

The TWG is continuing with regular teleconference meetings on the first Thursday of every month, and it will be having a meeting in Burlington, Ontario on October 15-16. The objectives of this meeting are to share analyses and results and begin integrating them to address the contribution of climate to the change in lake level relationship between Lakes Michigan-Huron for the completion of the first phase of this study. Presentations from this meeting, along with minutes from TWG conference calls and draft reports are being made available on the Study’s internal SharePoint website.

2.3.3 Ad Hoc Uncertainty Analysis Group

An ad hoc Uncertainty Analysis Group met twice during the reporting period. The meetings were initiated by the Hydraulic Modelling TWG, which encountered uncertainty related to data collection and the results of its modelling efforts. The purpose of the first meeting was to receive input from participants on how to incorporate uncertainty in the decision process, and how it will be used with the various tasks and interests. Invited experts from Integra, Inc. of Austin, Texas and from the Universities of Iowa and Waterloo, and McMaster University gave their views on how uncertainty can be determined and represented. The discussion ended with an agreement that a Group should be established and a “bucket” model should be developed. This analysis will be used to attribute causes of loss of head between Michigan-Huron and Erie with statements as to the uncertainty of such attribution. The second meeting discussed the specifics of the model that will consist of net basin supply components, Glacial Isostatic Adjustments, St. Clair

River conveyance, diversions and other stochastic input, such as Monte Carlo generated hydrological data. A scope of work is being developed for its creation with completion planned for late 2008.

2.3.4 Consideration of Potential Remediation and Mitigation Options

Since a possible outcome of Phase 1 may be the outcome that conveyance in the St. Clair River has changed, remedial actions may be suggested. Mitigation may be suggested to address climate change. As a prelude to this possible outcome, a scope of work is being developed through which structural and non-structural measures will be identified to return conditions to a yet to be determined base case. It is anticipated that the outcome of this work will be incorporated in the Phase 1 report, the first draft of which will be completed in February 2009.

2.4 PUBLIC INTEREST ADVISORY GROUP (PIAG)

PIAG activities intensified during the reporting period with the group hosting 12 public meetings that were attended by more than 1250 residents throughout the Study Area. In addition, PIAG members delivered many presentations about the study, including meetings of the International Association for Great Lakes Research, the Lake Huron Centre for Coastal Conservation Conference and the Great Lakes and the Ontario mayors of the Great Lakes and St. Lawrence Cities Initiative (GLSLCI), among others. A Circles of Influence Workshop facilitated by Study modellers was held in Muskegon and generated useful information from a group of riparians and ecosystem experts that will help develop evaluation criteria for alternative regulation plans.

Individual PIAG members have been assigned to liaise with the various TWGs and Task Teams. A number of members have been very active in fulfilling their liaison roles, especially with those of the St. Clair River Task Team. Since the Lake Superior Regulation Task Team has just begun its substantive work, PIAG are expected to become more heavily involved in those activities.

Public Meeting Location	Date
Bay City, MI	April 28
Port Huron, MI	April 29
Muskegon, MI	May 3
Duluth, MN	June 16
Thunder Bay, ON	June 17
Sturgeon Bay, WI	June 19
Mequon, WI	June 20
Little Current, ON	August 9
Parry Sound, ON	August 9
Midland, ON	August 10
Collingwood, ON	August 12
Owen Sound, ON	August 12

The public meetings were extensively covered by local and regional media and participants commented extensively on the impact of fluctuating water levels on their respective interests. For example, there were many similar comments from riparians regarding the problems created by low levels in both Sturgeon Bay (Lake Michigan) and throughout the Georgian Bay region of Lake Huron. In contrast, other participants reminded Study managers of the extreme damage caused by record high levels in the mid-1980s as

well as the ecological importance of more naturally fluctuating water levels. Many concerns were also expressed regarding downstream effects of any possible remediation measures in the St. Clair River.

During the period, PIAG met face-to-face twice – on April 30 in Port Huron and August 11 in Midland. PIAG members have also become engaged in the work of the TWGs, with a PIAG liaison providing input to each TWG and reporting back on TWG activities to the full group. In addition, the first two editions of the Study newsletter, “*On the Level*” were published, with 1500 copies of each distributed to public meeting participants, provided to libraries, posted online and distributed at other events (such as the GLSLCI annual meeting). The Study website has been very active, with more than 6300 unique visitors (from 56 countries) during the period and nearly 500,000 total website hits.

Further Circles of Influence Workshops are planned for this fall, including sessions with First Nations and Native Americans. Additional public meetings are being planned for Northern Michigan and Ohio. With respect to membership, Samuel Speck resigned from PIAG when he joined the International Joint Commission and was replaced by Kathryn Arnold of Ohio.

2.5 STUDY MANAGEMENT

2.5.1 Meetings

The various groups associated with the Study have met throughout the last reporting period. Appendix 2 shows the groups, activities, dates and locations of the meetings. Meetings planned for October through December of this year are also shown.

Most of the studies are on schedule, however, more time may be required to reconcile apparent differences in findings and synthesize the multiple project results into a scientifically credible set of conclusions. This may impact the tight deadline originally agreed to for completion of the Phase 1 Report. Other factors, including the additional time requested by PIAG for review and the possible requirement for French translation, may result in further delays in the production and release of the final report.

2.5.2 Budget/ Expenditures

Tables 1 & 2 below show approved, committed and spent amounts in the US and Canada. For the US, the amounts are shown through Fiscal Year 2008 (year 2). For Canada, the amounts are shown for Fiscal Year 2008 from April through September 30, 2008.

Table 1 - US Funding (in \$1000US)

Activity	Budget ¹	Committed ²	Spent ³	Difference ⁴
Study Board and Management	400	19	213	168
Lake Huron Outflow/ St. Clair Task Team	572	181	377	14
Lake Superior Task Team	408	0	146	262
Public Interest Advisory Group	136	0	8	128
Information Technology Group	0	0	0	0
Plan Evaluation Group	241	15	161	65
Peer Review Group ⁵	6	0	5	1
Grand Total Budget	1763	214	912	637

Notes:

1. Study Board budget
2. Funds allocated to for Principal Investigator or Agency, to be spent in year 3
3. Funds spent to date
4. Difference between the budget and committed plus spent which will be carried into year 3
5. Funds for independent peer review retained by the IJC

Table 2 - Canadian Funding (in \$1000Can)

Activity	Budget ¹	Committed ²	Spent ³	Difference ⁴
Study Board and Management	349	8	154	187
Lake Huron Outflow/ St. Clair Task Team	1225	512	163	550
Lake Superior Task Team	512	236	54	222
Public Interest Advisory Group	50	0	17	33
Information Technology Group	75	0	15	60
Plan Evaluation Group	110	88	2	20
Peer Review Group ⁵	30	12	21	-3
Grand Total Budget	2351	856	426	1069

Notes:

1. Study Board budget
2. Funds allocated to for Principal Investigator or Agency.
3. Funds spent to date.
4. Difference between the budget and committed plus spent.

2.5.3 Independent Peer Review Process

The Study Team met with the IJC staff and representatives of the American Society of Civil Engineers – Environment & Water Resources Institute (ASCE-EWRI) and Canadian Water Resources Association (CWRA) twice during the reporting period. The purpose of the meeting to review and the overall peer review process during the life of the Study. Subsequently, IJC has put in place two long-term contracts, one for each group to undertake independent peer review of the Study.

3. IJC ADVICE, CONSULTATION AND INFORMATION

The Study Board would like direction from the Commission on the following topics and issues:

- Request from members of PIAG for 60- to 90-day review periods in-lieu of planned 30 day review period for the draft Phase 1 Report. The draft report is scheduled to be completed on February 28, 2009. Sixty- and ninety-day reviews will delay release of the final Phase 1 report from June 30 to July 31 and August 31, 2009, respectively.
- The Study Board may request an extension of a month or two for the completion of the draft report. By December it will be known if this is needed and will be raised at the December 2008 Executive Meeting through the IJC liaison.
- The Study Board requests direction on French translation. Does the full report and appendices need to be translated or can it be only for the extended Executive Summary? This may result in further delays in report production if all material has to be translated and simultaneously released.
- The Study Board has determined that 3-D modelling is not required even though there continues to be intensive lobbying from one group. Even though this issue has been addressed in the public forums and newsletter, the Study Board is open to suggestions by the IJC as to whether any further dialogue or additional specific activities is required about this matter?
- Does the IJC have any concern regarding the Study's direction to forego forecasting economic and environmental conditions to 2040, based on advice from the economic advisory group, as part of the development of further growth and development scenarios that would be compatible with climate change scenarios? Rather, the Study Board would consider evaluation of the new regulation plans based on the historic climate record and quantifiable contemporary economic and social impacts from the sample sites.

- Legal question for lawyers: What is the period of record that should be used in IUGLS for analyses of regulation changes and other plans? In the Lake Ontario Study, the question of using the pre-project rather than the historic period of record (1900-2001) was raised since the Orders of Approval were based on the pre-project record. The “legally appropriate” record should be determined prior to detailed plan development and evaluation.

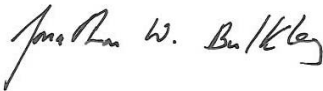
Respectfully submitted,



GENE STAKHIV
U.S. Co-Chair



KAY FELT



JONATHAN BULKLEY



JAMES BREDIN



JOHN BOLAND



TONY EBERHARDT
U.S. Study Manager



TED YUZYK
Canadian Co-Chair



JIM BRUCE



DON BURN



JON GEE



ALLAN CHOW



SYED MOIN
Canadian Study Manager

Result Integration - St. Clair River Tasks

		Science Questions Framework					
		Has the " <u>Conveyance</u> " of the St. Clair River Changed since the 1962 dredging?			Has the " <u>Morphology</u> " of the St. Clair River altered since the 1962 dredging?		
		SQ1	SQ2	SQ3	SQ4	SQ5	SQ6
No.	Project	What is causing the declining head difference between Lakes Michigan/Huron - Erie?	Has the St. Clair River flow regime (i.e. water level-discharge relationship) changed with time and if so, why?	Has the velocity patterns in the St Clair River been modified and if so, what are the implications?	Is the St. Clair River bed stable or eroding?	If the bed of the St Clair river is eroding, what initiated it, and when?	Has the sediment budget for the St. Clair River changed and if so, what are the implications?
P21	Net Basin Supplies Comparison and Water Balance Closure	□	❖				
P22	Glacial Isostatic Adjustment	□	❖				
P2	Review of St. Clair & Detroit River Rating Curves and Develop Hydraulic Performance Graphs	□	□		❖	❖	
P7	Discharge Computation of the River Using the Standardized HEC-RAS Model	□	□		❖	❖	
P3	Development of a Basic 1-D Modelling of St. Clair River Using HEC RAS	❖	□	❖	❖		
P4	1-D Conveyance Analysis of the St. Clair River Using the Standardized HEC- RAS Model	❖	□	❖	❖		
P8	Ice Effects of Flows and Levels Using Standardized Geometry Model of HEC-RAS	❖	□	❖	❖		
P10	1-D Conveyance Analysis of the St. Clair River using the Mobile Bed MOBED Model	❖	□	❖	□	❖	❖
P23	2-D Conveyance / Morphological Analysis of the St. Clair River using SED2D or equivalent	❖	□	❖	□	❖	❖
P5	Application of 2-D Modelling Using Existing RMA2 Model of the St. Clair River with Different Bathymetric Data Sets	❖	□	□	□	□	
P6	Application of 2-D Model of the St. Clair River Using Telemac Modules with Different Bathymetric Data Sets	❖	□	□	□	□	
P24	Quantification of Uncertainties in 1-D and 2-D Modeling	❖	□	□	□	□	❖
P1	Bathymetry of St. Clair River 1971 - 2007		□		□	□	❖
P13	Analysis of Bathymetric and Planform Changes in the Past 130 years and Registration into Common GIS		□		□	□	❖
P15	Obtain and Analyze the Bottom Velocity Data from ADCP		❖	□	□	❖	
P16	New Coincident ADCP and Multi-beam Data for Hydraulic/sediment Model Verification		❖	□	□	❖	
P18	Extract Bed Movement Velocity from Existing or New ADCP Data		❖	□	□	❖	
P11	Side-scan Sonar and Video of Substrate in Upper St Clair River		❖		□	❖	
P12	Sediment Coring and Physical Testing of Substrate in the ST. Clair River		❖		□	❖	
P9	Video Transects of River Bed, Monthly Sediment Load Measurements, Cross-section Surveys, Grab samples of Bed Material - Sarnia-Pt Lambton		❖		□	□	□
P17	Analysis of Ship Effects, Both Movement and Sinking on Sediment and Erosion Regimes				❖	□	❖
P19	Reports and Data on Surficial Geology, Littoral Transport, St Clair River and Delta				❖	❖	□
P20	Conduct Sedimentation Studies of the St Clair River Delta		❖		❖		□
P14	History of St. Clair River and Detroit River Dredging and Compensation Works				❖	❖	❖

Legend:

Primary focus
 Secondary focus

Result Integration - Hydrology and Climate Technical Group

		Science Questions Framework					
		What are the historic estimates of the net basin supply in the upper lakes and how have any potential changes to the NBS and its components affected the level of the lakes?			What potential impact could variations in the climate system have on future regulations of the Upper Great Lakes?		
		St. Clair Task Team			Superior Task Team		
No.	Project	SQ1	SQ2	SQ3	SQ4	SQ5	SQ6
		Does the project define/reduce the uncertainties of the NBS and its components through new observations or modelled data?	Does the project focus on new methodologies and approaches for improved estimates of water supplies?	Does the project identify causative factors and trends affecting lake levels?	Does the project help establish the suite of suitable climate change scenarios?	Does the project identify and apply downscaling methodologies for regional assessments?	Does the project consider future climate variability and change and its application to lake plan formulation and evaluation?
T1	Improvements to the Coordinated Regulation and Routing Model						
T1.1	Miscellaneous programming improvements to support lake level evaluation, plan formulation, and climate change assessment	□	◇			□	◇
T1.2	Develop visual interface and linkages to socio-economic and environmental models for plan evaluation			□			□
T2	Comparative Analysis of Net Basin Supply						
T2.1	Analysis of GLERL NBS Component Uncertainty and Its Impact on NBS	□	□	◇		◇	◇
T2.2	Comparative Analysis of current Net Basin Supply Computations	□	◇	◇			
T3	Experimental focus on components with greatest uncertainty						
T3.1	Overlake Precipitation						
T3.1.1	Computation of ECNWDS overlake/land precipitation 2004 -2009	□	□	◇		◇	
T3.1.2	Comparison of GLERL overlake/land precipitation with ECNWDS reanalysis/NCEP reanalysis/NOAA MPE gridded radar rainfall	□	□	◇		◇	
T3.2	Lake Evaporation						
T3.2.1	Computation of ECNWDS lake evaporation 2004 -2006	□	□	◇		◇	
T3.2.2	Comparison of GLERL LLTM lake evaporation estimates with ECNWDS reanalysis/NCEP reanalysis	□	□	◇		◇	
T3.2.3	Measurements of Lake Evaporation Using Eddy Covariance System	□	□	◇		◇	
T3.2.4	Changes in ice regime and surface water temperatures on evaporative flux	□	□	□		◇	◇
T3.3	Basin Runoff						
T3.3.1	Computation of ECNWDS basin runoff 2004 -2009	□	□	◇		◇	
T3.3.2	Improve proration of gauged area streamflow to ungauged areas through correlation of spatial land surface characteristics	□	□	◇		◇	
T3.3.3	Comparison of GLERL runoff estimates with INRS-Eau/USGS geo-statistical approach/ ECNWDS reanalysis	□	□	◇		◇	
T3.4	Connecting Channel Flow and Retardation Factors						
P2	Review of St. Clair & Detroit River Rating Curves and Develop Hydraulic Performance Graphs	□	□	□			
T3.4.1	Development of Connecting Channel apparent ice and weed retardation values, assessment of trends and significance to lake levels	◇	◇	□		◇	
T3.5	Lake Levels and Change in Storage						
P22	Glacial Isostatic Adjustment	□	◇	□			◇
T3.5.1	Assessment of uncertainty in change in storage			□			
D1	Correct/Adjust 1900-2006 water balance data based on findings from Tasks 2 and 3		□	□	◇		
T4	Statistical Analyses, Teleconnections and Stochastic Analysis						
T4.1	Trend Analysis		□	□	□		□
T4.2	Teleconnections	◇	□	□	□	□	□
T4.3	Stochastic Analysis	□			□		□
T5	Integration of Tasks 1-4: Affect of net basin supply on the change in Lakes Michigan-Huron and Lake Erie lake level relationship						
T5.1	Rank and describe the uncertainty of the water balance components relative to one another and assess the impact of uncertainty on the attribution of water supply changes to lake levels	□		□			
T5.2	Determine the affect of net basin supply on the change in lake level relationship			□			
T6	Climate Change Sequences						
T6.1	Prepare base simulation for comparison with scenarios				□	□	
T6.2	Regional downscaling using Canadian RCM				□	□	□
T6.3	Conventional downscaling using GLERL's AHPS				□	□	□
T6.4	Regional downscaling using GLERL's CHARM				□	□	□
T6.5	Interaction between H&C TWG and PEG for joint development of climate scenarios				□	□	□
S	Integration of Tasks 4-6: Climate change assessment to year 2040						
S1	Climate change assessment to year 2040				□	□	□

Legend:

Primary focus	□
Secondary focus	◇
Contributing Task to Superior Task Team	□
Dependent Task from Data TWG	□
Dependent Task from St. Clair Task Team	□

Appendix 2 – Meetings Related to the Study

	Held						Planned		
	Apr 08	May 08	Jun 08	Jul 08	Aug 08	Sept 08	Oct 08	Nov 08	Dec 08
Study Board		Windsor (1-2)				Niagara Falls, ON (17-18)			Windsor (10-11)
Task Teams					LSTT – Burlington (26-27)	SCTT – Burlington (10-11)		SCTT Windsor (24-25)	LSTT – Burlington (2-3)
TWGs			Climatic Workshop Cleveland (9-10) Ecosystem TWG – Sault Ste Marie, MI (17-18) Rec. Boating TWG – Collingwood (25-26)		Uncertainty Workshop Burlington (6-7)	Uncertainty Workshop Burlington (9)	Plan Eval. Group – Cornwall (6-8) Coastal Expert Wksp.- Port Huron (14-16) Hydro-climatic Group – Burlington (15-16) Hydraulic Modelling TWG – Detroit, MI (21-22)	Sediment Studies TWG – Urbana, IL (10-11)	Ecosystem Experts Workshop Windsor (9-10)
PIAG	Port Huron (29-30)				Midland (11)				Windsor (12)
Public Mtgs.	Port Huron/Sarnia (29-30)	Muskegon, MI (2)	Thunder Bay, Duluth, Sturgeon Bay, Mequon (17-20)		Little Current, Parry Sound, Midland, Collingwood, Owen Sound (9-12)				
Other			IPR Group Reston, VA (26)				IJC Appearance - Ottawa (29)		