

**Regional Partnerships to Assess Adaptive Responses for the Grand Traverse Bay Corridor
Water Level Variations**

Final Report

Graham Sustainability Institute Integrated Assessment Planning Grant

August 2015

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EXECUTIVE SUMMARY

This report summarizes the process of engaging stakeholders in the planning stages of an integrated assessment and the results of a preliminary qualitative study of key stakeholder perceptions of fluctuating water levels. Stakeholders representing local and national government agencies, businesses, research and educational institutions, residents and advocacy groups along the Grand Traverse Bay corridor, were selected to engage in interviews, surveys and conversations about changing water levels and their environmental, economic and social impacts. The study focused on the Grand Traverse corridor, a stretch of 150 miles of Lake Michigan shoreline and its surrounding area, which is home to over 100,000 residents and millions of seasonal visitors.

INTRODUCTION

Objectives

The primary objective of this planning grant was to engage key stakeholders in an integrated assessment process to gain deeper understanding of their perceptions of changing water levels and their impacts. Stakeholders were selected along the Grand Traverse corridor, a stretch of 150 miles that extends from the Sleeping Bear Dunes National Park to Elk Rapids.

Methods

Population of Interest

The target population was selected on the basis of several criteria. We identified key stakeholders who are likely to be impacted by changing water levels because of their physical location and the services they provide to communities in the Grand Traverse corridor. We also took into account the stakeholders' willingness to participate in a qualitative study involving interviews, surveys and focus group conversations. Twenty eight key stakeholders were selected to be interviewed, 26 stakeholders were surveyed and a total of 59 stakeholders attended meetings and engaged in focus group conversations. Key stakeholders represent a broad range of services to the community: local, city and tribal governments, business, education, advocacy, and research.

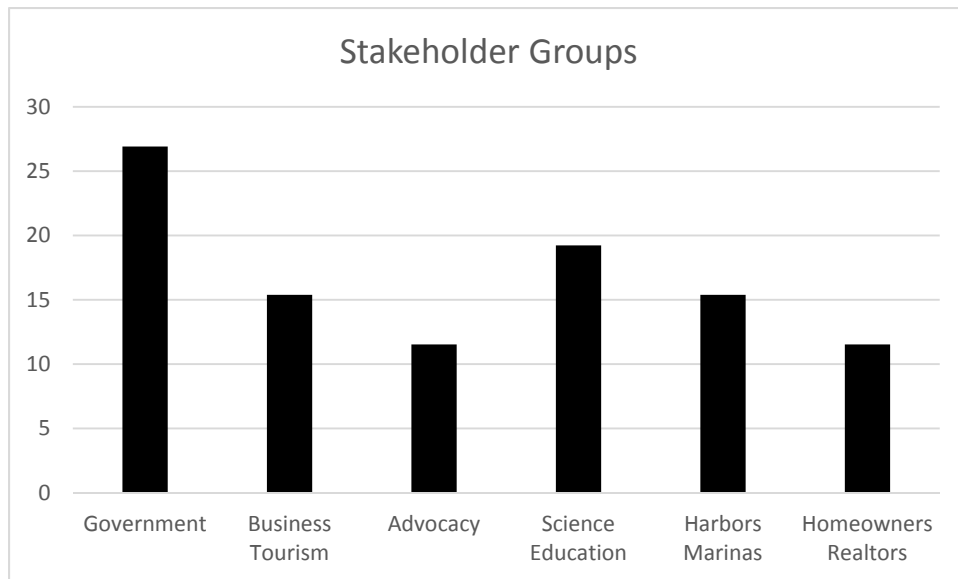


Figure 1: Distribution of Stakeholders

Stakeholders' Selection

The Great Lakes Water Studies Institute (GLWSI) grant team generated the list of 59 individuals representing key stakeholder groups along the Grand Traverse corridor and key potential participants. A total of 25 stakeholders scheduled individual interviews.

Seventy one participants were invited by email to monthly meetings held in May, June and July. Interviewees received a personal invitation during interview sessions and an email. (See Appendix A). Beta versions of surveys were distributed at the second stakeholder meeting and the final version was distributed at the third meeting. (See Appendix B).

Stakeholders' Engagement

A sequence of activities contributed to engagement of stakeholders during the planning stages of this integrated assessment process. Key stakeholders were contacted and scheduled for face-to-face interviews; second we invited those stakeholders to attend a series of lectures on topics related to water level changes (See Appendix C). A third strategy was to engage stakeholders in small focus group conversations and discuss the results of interviews and surveys. See Appendices D, E, and F for stakeholder meeting agendas, attendee lists, and student participation list.

Data Collection

Interviews

All interviewees were contacted by phone and scheduled to be interviewed by the GLWSI student research assistants. Interviews lasted about 45 minutes and followed a general interview protocol based on Jacobson (2014) and modified by the GLWSI team. (See Appendix G). Interview protocols were made available in advance upon request.

Prior to the initiation of each interview session, interviewees were asked to sign a consent form to participate in the study and record the interview session. Twenty five interviews were completed face-to-face and three interviews were conducted on the phone.

Surveys

A modified version of Jacobson (2014) was developed by the GLWSI team and the Office of Research Planning and Effectiveness (ORPE) at Northwestern Michigan College (NMC). The survey consisted of 18 closed-ended questions and 3 open-ended comments. The survey was estimated to take 10-15 minutes to complete. (See Appendix B).

During the initial stages of this project we intended to invite participants to take a phone survey or take an online survey. However, due to time and budget constraints, we did not administer the survey to a large sample. Instead, the survey was administered to 26 stakeholders attending the last of the three stakeholder meetings.

Focus Groups

A total of 25 participants attended the last of the three meetings and engaged in conversations around water level changes and their impacts. Participants were distributed into six focus groups with even distribution of backgrounds and interests including educators, government agencies, business owners, scientists, advocacy groups, residents and tribal members. Conversations were facilitated by GLWSI staff using specific guided questions. (See Appendix H).

OUTCOMES OF PLANNING GRANT

Focus Area

Grand Traverse County--East and West Grand Traverse Bay; Traverse City and surrounding townships; Leelanau County--Leland, Empire, Peshawbestown and Antrim County--Elk Rapids

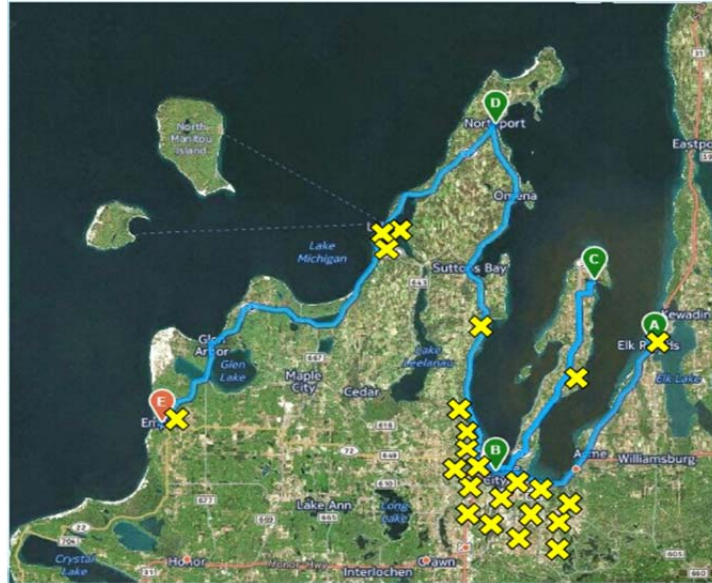


Figure 2: Focus area and stakeholder distribution.

Contributors

Research Team

Principal Investigators--Hans Van Sumeren, Constanza Hazelwood.

Freshwater Studies Students--Taylor West and Adam Smith. Both students are enrolled in Northwestern Michigan College's Freshwater Studies Program at the Great Lakes Water Studies Institute.

Staff--Catherine Jarvi, Scott Swan

Engaged Regional Partners

Government stakeholders—Grand Traverse County Planning and Development, Grand Traverse County Health Department, Grand Traverse Band of Ottawa and Chippewa Indians, Suttons Bay Village, City of Traverse City, Traverse City Water Treatment Plant, and Michigan DNR Parks and Recreation

Business / Tourism / Residents--Traverse City Chamber of Commerce, TraverseCONNECT, Venture North, hotels, tourist shops, and Traverse Area Association of Realtors (TAAR)

Science / Education--Michigan Sea Grant, MSU Extension, Inland Seas Education Association, Great Lakes Environmental Center (GLEC), NOAA, and Sleeping Bear Dunes National Lakeshore

Harbors / Marinas--Harbor West, East Bay Harbor, Elk Rapids, and Leland Harbor

Advocacy--The Watershed Center of Grand Traverse Bay, Fishtown Preservation Society, and Leelanau Conservancy

Active Partner Organizations

The Watershed Center of Grand Traverse Bay, Michigan Sea Grant, Sleeping Bear Dunes National Lakeshore--National Park Service; Grand Traverse Band of Ottawa and Chippewa Indians, Fishtown Preservation Society, City of Traverse City, Grand Traverse County Planning and Development, Elk Rapids- Edward C. Grace Memorial harbor, TAAR, NOAA offices including CO-OPS, GLERL, OCS, NGS, OCM

Activities

Meetings

Planning Meetings with Grantees

Two meetings were held with the Graham Sustainability Institute. At the first meeting, held at the Graham Sustainability Institute, we presented our scope of work and objectives, and we initiated conversations across grantees to envision points of connection. At the second update meeting, facilitated on the phone, we reported on the status of our work.

IA Grant Team Meetings

A total of 30 meetings with the IA Grant team were held between March and August. The team worked on data collection instruments, planning agendas for workshops and focus group meetings and analyzing and reporting data.

Workshops and Lectures

Monday, May 18--Stakeholder Meeting #1

- Water Levels in the Lakes, Upcoming International Great Lakes Datum (IGLD) Update
Laura Rear McLaughlin--Mapping and Charting Program Manager
Colleen Roche, PE--Design and Development Engineering Team Lead, NOAA, Center for Operational Oceanographic Products and Services (CO-OPS)
- Relationship of the North American Vertical Datum of 1988 (NAVD88) and the IGLD, Continuously Operating Reference Stations (CORS), Updates to Datums
Dave Rigney--Michigan geodetic advisor, NOAA, National Geodetic Survey (NGS)
- Updates on Nautical Charts in the Great Lakes
Tom Loeper--Regional Navigation Manager, Great Lakes Region, NOAA, Office of Coast Survey (OCS)
- Communicating Long-term Great Lakes Regional Water Budget and Water Level Data
Dr. Drew Gronewold Ph.D. PE--Physical Scientist, NOAA, Great Lakes Environmental Research Laboratory (GLERL)

Monday, June 22 – Stakeholder Meeting #2

- Lake Level Viewer, a NOAA state-of-the-art mapping tool to visualize fluctuations in water levels
Brandon Krumwiede, Great Lakes Geospatial Coordinator, NOAA Office for Coastal Management
- Integrated Assessment Survey
Research Assistants Taylor West and Adam Smith

Monday, July 27 – Stakeholder Meeting #3

Deep Dive into Key Issues – Roundtable Focus Group Discussions

Water-levels Data Collection

Water levels gauge

In April of 2015, the NOAA CO OPS installed a water level gauge at NMC's Great lakes Campus harbor. By establishing this water level station we were also able to pool in NOAA's expertise as guest speakers at our first stakeholder meeting.

Phone Survey Training

An exploration of phone surveying allowed us to determine that we did not have enough funding to conduct phone surveys. However, the research team participated in two training sessions for phone surveying.

Data Analysis and Reporting

The first set of data from interviews was analyzed by the two interviewers. Based on field notes, a list of recurring themes was generated, and then double-checked with audio recordings. The research team presented its first report to stakeholders after interviews were completed.

Results of stakeholder surveys were quantified and aggregated after the last stakeholder meeting. Data were triangulated with interviews and focus group notes. Open-ended questions were interpreted by three different people, when the question called for clarification. Focus group conversations were first analyzed by generating a list of recurrent themes based on notes from each focus group, and then summarized and reported in this final document.

Key Findings

Engagement

Time constraints and scheduling impacted stakeholder engagement. Most stakeholders are at the peak of activity during summer months and participation in stakeholder meetings was limited. Interestingly, most of the invited stakeholders committed time to be interviewed at their workplace. Stakeholders' connections with our interviewers, who are students in the Freshwater Studies program, prompted a commitment to attend the last meeting when we conducted a focus group session to discuss the results from interviews.

Interdisciplinary topics/drivers

Recurrent topics emerging from surveys were grouped and analyzed by identifying topics under three broad categories: environmental, social, and economic concerns. Examples of recurrent topics under each pillar are given in Table 2.

Table 1: Recurrent topics emerging from stakeholder focus groups, interviews and surveys

Social:

- Need to understand regulations concerning beach maintenance-permits for grooming and hardening
- Not knowing if dredging is good or bad
- Changing perceptions of safety-- Higher waters, higher risk
- Guiding access to reliable, quality information and giving visibility to untapped resources (i.e. NOAA)
- Need to understand flooding and potential risks

Environmental:

- Understanding changes in the ecosystem due to fluctuations and impacts on the food web
- Understanding distribution of invasive species and spread of avian botulism
- Ideal conditions for fish populations
- Understanding the connection between evaporation, precipitation and water levels

- Understanding what causes water level changes
- Wetlands and their function in the shoreline ecosystem
- Understanding and utilizing available data for the GL – GLOS, NOAA, other

Economic:

- The need for adaptive responses to changing water levels in harbors and marinas: adjustable piers, dredging, larger culverts
- Impact to fisheries when water levels change
- Impacts on tourism due to perceptions of changing water levels

Data from surveys, interviews and focus groups were also grouped under the following specific topics: concern; preference; impacts; contributing factors:

Stakeholders’ Level of Concern

Our surveys indicate that fluctuating water levels are a cause of concern for most stakeholders. Both surveys and interviews confirmed that harbors and marinas were also extremely impacted by water-level fluctuations. One survey respondent indicated that his/her level of concern increases when water levels are low. Two respondents communicated an understanding that these changes are cyclical and one of them expressed a sense of hope that levels will not change so dramatically due to climate change. Respondents who chose neutral as opposed to not at all concerned commented that fluctuations are equally appreciated and not considered a cause of concern.

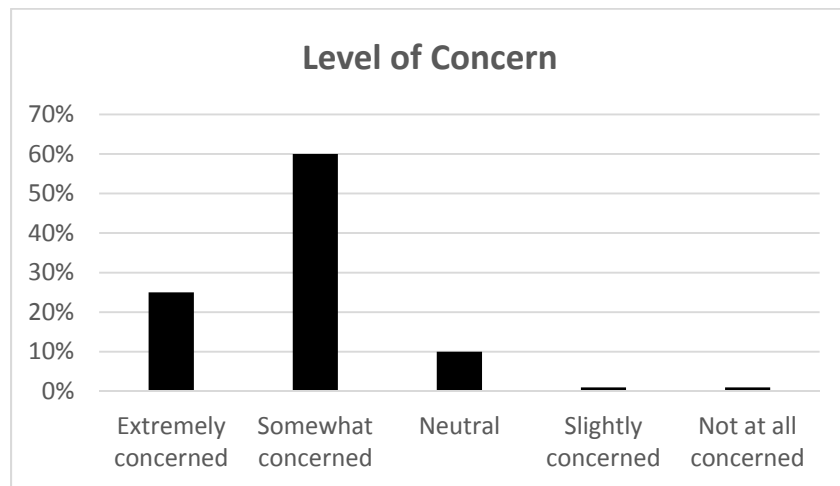


Figure 3: How concerned are you about Lake Michigan water level fluctuations?

In response to the question of how concerned stakeholders are about changing water levels and more specific environmental, economic and social impacts, most participants indicated they were mostly concerned about environmental impacts, followed by economic and social.

Perception of impact: Low vs. High water levels

When stakeholders were asked to identify specific impacts of changing water levels, they often

shared knowledge of current levels and their preference. Most survey respondents perceived current water levels as average. When asked if perceived current levels were ideal, a large percentage of respondents selected “don’t know.” We infer that perceptions are influenced by participants’ recent experience with low levels in 2013 compared to all time high water levels in 1986.

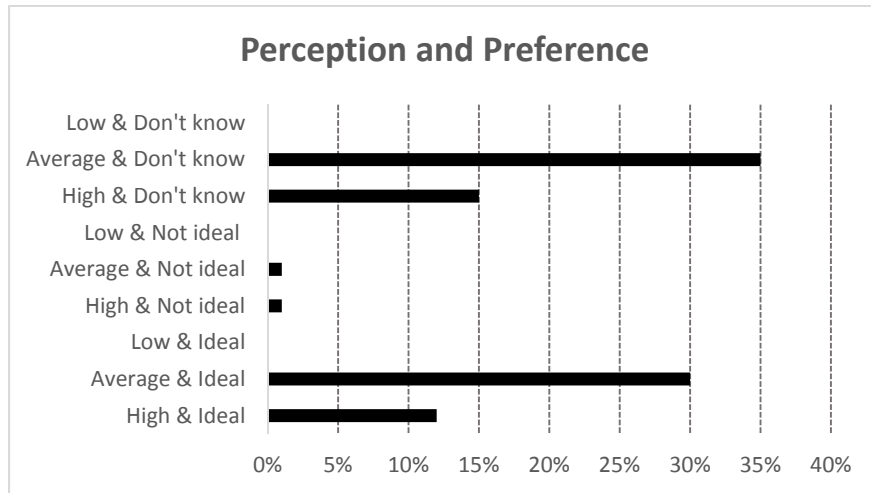


Figure 4: Perception and Preference

Survey data revealed that all stakeholders mentioned a perceived change in current water levels, but not all of them agreed on what level, high or low is their preference. There seems to be a trend of preference for high water levels among realtors, harbors and marinas and fisheries. A few shoreline residents mentioned a preference towards low levels.

Social, Environmental and Economic Impacts

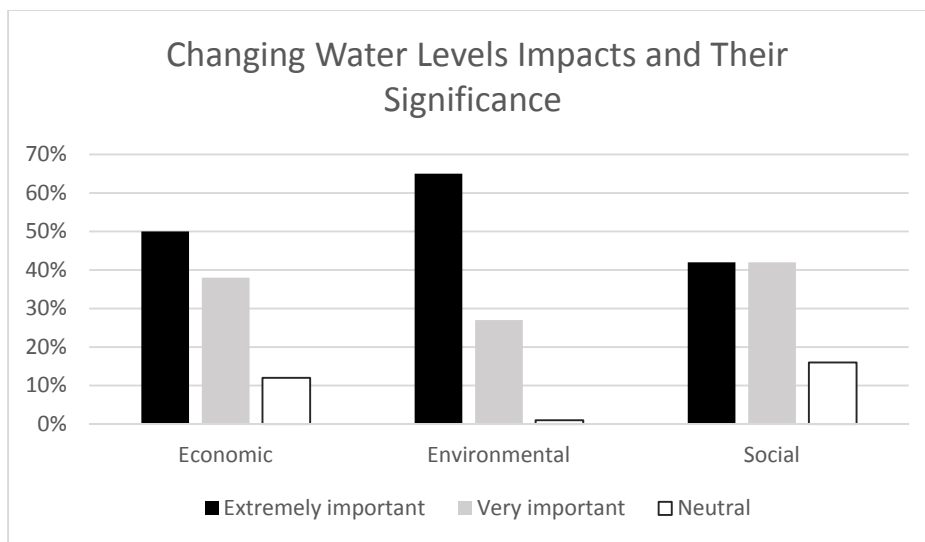


Figure 5: Changing water level impacts and their significance

Environmental impacts of changing water levels were identified by more than 60% of

respondents as extremely important. Wetlands, invasive species and erosion were some of the environmental impacts mentioned. These results were consistent across interviews, focus group conversations and surveys.

Nearly 50% of stakeholder interviewees mentioned that infrastructure damage was one of the main impacts as a result of fluctuating water levels. Harbors and marinas, residents and businesses are among the stakeholders for whom infrastructure is a concern. Approximately 40% of stakeholders identified erosion of shoreline and property as a result of fluctuating water levels. National Park Service and shoreline residents are particularly aware of this impact.

Contributing factors to water level fluctuations

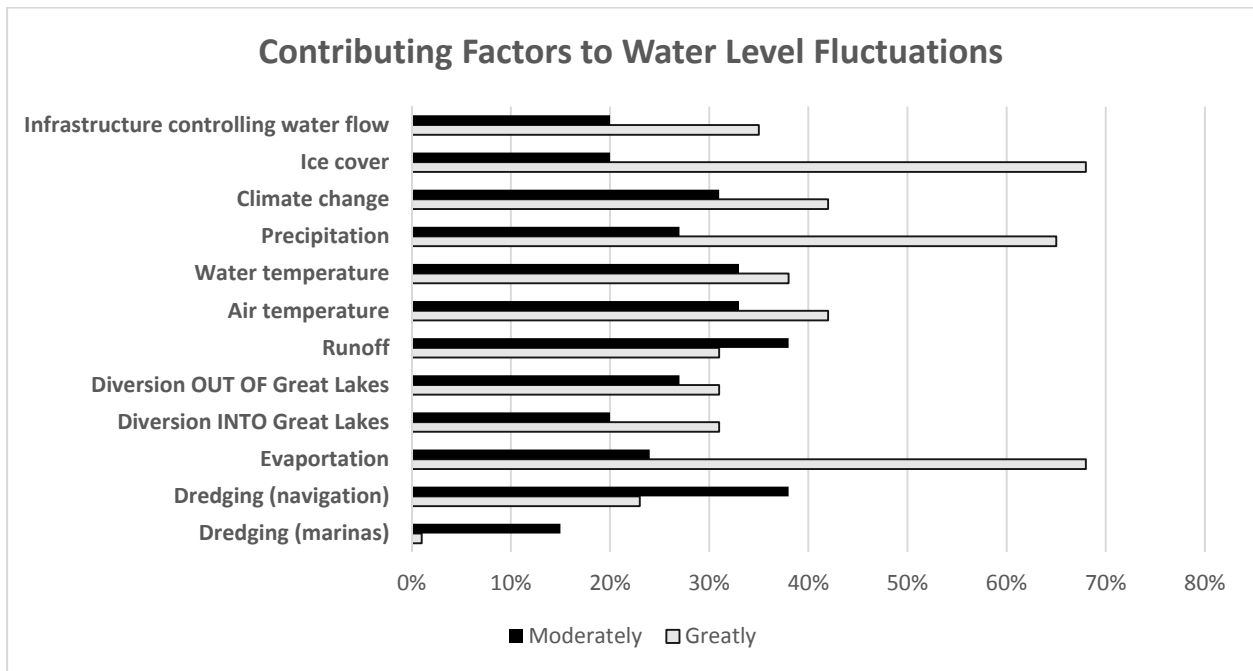


Figure 6: Using a scale from “greatly” to “not at all”, to what extent do you believe each of the factors contributes to changes in Lake Michigan water level

Knowledge Gaps

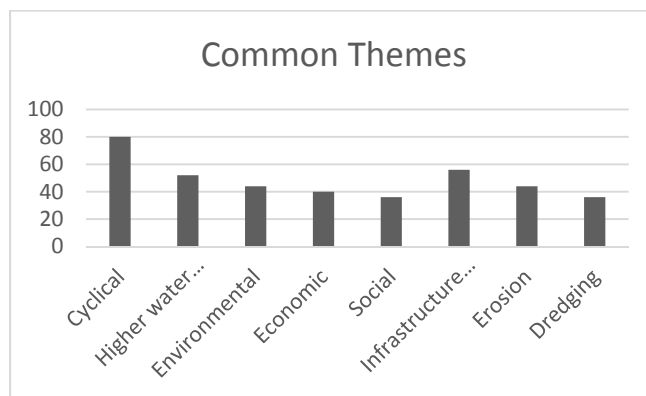


Figure 7: Summary of responses to interview questions.

Stakeholders’ perceptions and knowledge about fluctuating water levels became evident during interview sessions. Some recurrent themes are captured in Figure 7. The term cyclical was mentioned frequently. Nearly 70% of stakeholders stated that water level fluctuations are cyclical ranging from 20 to 50 years. During interviews, it was also apparent that stakeholders had a bias towards either high or low water levels. Dredging and infrastructure damage were a more frequent topic and of bigger concern for harbors and marinas. Thirty percent of stakeholders mentioned dredging as an impact of water level fluctuations. Three out of four harbors and marinas mentioned dredging as a maintenance and budgetary concern. Harbor dredging was also mentioned in the context of explaining changing water levels, suggesting that people might not understand the complexities of dredging and infrastructure as a potential cause for changing water levels.

A major theme emerging from this planning phase is the knowledge gap that exists among stakeholders with finding and interpreting reliable Great Lakes information. The following potential learning topics were identified as gaps deserving attention to offer future educational opportunities:

- What causes changing water levels?
- What scientific models are available to predict and inform planning decisions?
- How can the Grand Traverse corridor better assess risk and enhance adaptability?

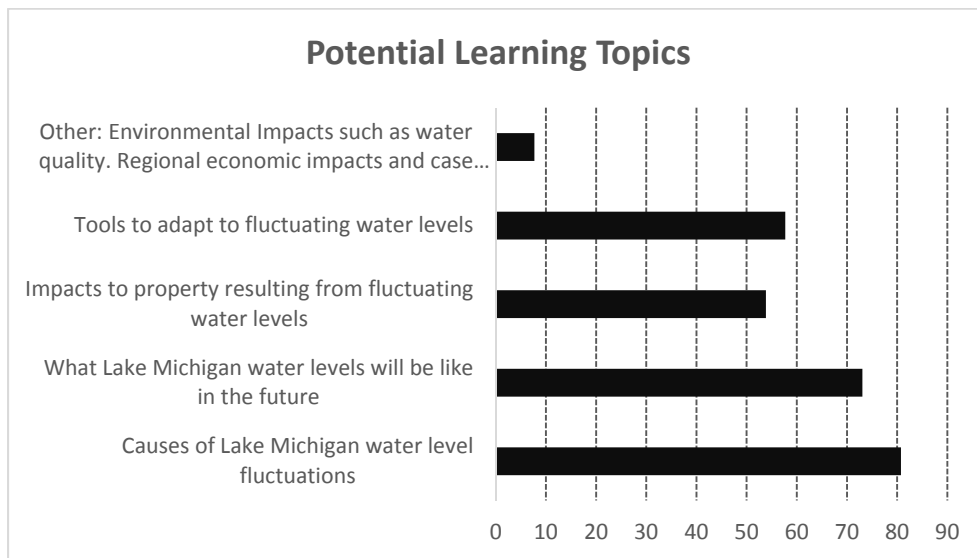


Figure 8: Survey Question: “Of the following topics, which would you like to learn more about?”

Potential for Transferability

Our conclusions indicate that stakeholders need further education and training on topics concerning causes and consequences of water level fluctuations. An IA must address knowledge gaps of the community as a condition to move into formulation of appropriate adaptive responses and corresponding policies.

Feasibility of conducting a place-based analysis of a particular set of options that will contribute to the IA

Stakeholder engagement

The methods used to engage stakeholders in the beginning stages of an integrated assessment are transferable to other settings. We strongly support participation of college students in the process of data collection, analysis, reporting and engaging participants.

After the first round of interviewing, surveying and conducting stakeholder conversations, we believe this study may be continued to expand the scope of work and engage a larger audience in enhancing their understanding of Great Lakes. This would include development of training modules that would engage stakeholders in identifying the tools available to:

- Better predict changes
- Better prepare for the anticipated change
- Develop longer term strategies that are inclusive of multiple stakeholder groups

Analysis of options

Partnering with other grantees may offer opportunities to assess how education and outreach programs impact policy and decision-making processes.

IV. ADDITIONAL CONSIDERATIONS

- Budget and scope of potential phase I projects could be a limiting factor
- Engagement of stakeholder groups while addressing potential conflict and political bias (climate change, government control, ordinances)

V. LITERATURE CITED

Jacobson, R. (2014). Experiences and Perceptions of Great lakes Water Level Change: A survey of shoreline property owners. Practicum project submitted in partial fulfillment of the requirements for the degree of Master of Science (Natural Resources and Environment) at the University of Michigan. Ann Arbor, MI.

VI. Appendices

APPENDIX A: Interviewee Invitation

Hello my name is Adam/Taylor and I am a research assistant at the Great Lakes Water Studies Institute at Northwestern Michigan College. We recently received a grant from the Graham Sustainability Institute at University of Michigan. The purpose of the grant is to gather information to better prepare our region for frequent changes in water levels.

As the _____ you have been identified as a key stakeholder. Your input will provide a better understanding of the impact of changing water levels in our region. We are very interested in meeting with you for a brief interview, about 30 to 45 minutes, in the next couple of weeks.

Would you be available to schedule an interview at your convenience next week?

Thank you for your time. In the event you need to contact me, please call and/or email me at _____.

Additional Info:

--If you would like to receive the interview protocol, please give us your email address.

--If you want to learn more about the grant, please go to.....

---We will follow-up with interview questions, website with additional information. Please give us your email address.

APPENDIX B: Survey



**Northwestern
Michigan
College**

**Great Lakes Water Studies Institute
Lake Michigan Integrated Assessment Survey
Spring/Summer 2015**

The Great Lakes Water Studies Institute at Northwestern Michigan College has received grant funding to understand challenges and opportunities posed by Lake Michigan water level variability. The results of this survey will be used to help decision makers as they seek to address the impact of water levels.

This survey is expected to take approximately 10 minutes to complete. Your responses to this survey will be confidential. A final report will be submitted and published by the Graham Sustainability Institute at the University of Michigan. No one's individual results will be shared in the final report.

Thank you for your participation.

Q1. I am responding to this survey as a/an: (select only one)

- Community resident
- Business owner
- Government agency
- Advocacy group
- Educational/Institutional organization

Q2. Does your primary residence include Lake Michigan frontage:

- Yes
- No

Q3. In which season do you spend a majority of your time in this area? (Select all that apply)

- Spring (March-May)
- Summer (June-August)
- Fall (September-November)
- Winter (December-February)
- I am a year round resident

Q4. Generally how concerned are you about Lake Michigan water level fluctuations:

- Extremely concerned
- Somewhat concerned

- Neutral
- Slightly concerned
- Not at all concerned

Comments:

Q5. What is your perception of Lake Michigan's current water level?

- High
- Average
- Low
- Don't know

Comments:

Q6. Is Lake Michigan's current water ideal?

- Yes
- No
- Don't know

Comments:

Q7. Using a scale of “Extremely Important” to “Not at all Important,” how important are the following impacts of changing water levels?

	Extremely Important	Very Important	Neutral	Very Unimportant	Not at all Important	Don't Know
Economic Impacts (e.g. property damage, decreased business revenue, operating expenses)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Environmental Impacts (E.g. invasive species, wetland loss, water quality)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Social Impacts (E.g. effects on other properties, changes to culture of a community, shoreline management)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Comments:

Q8. Using a scale of “Greatly” to “Not at all,” to what extent to you believe each of the following factors contributes to changes in Lake Michigan water levels?

	Greatly	Moderately	Neutral	Slightly	Not at All	Don't Know
Dredging marinas and harbors	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Dredging navigation river channels (I.e. St Claire River)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Evaporation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Diversion of water into the Great Lakes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Diversion of water out of the Great Lakes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Runoff	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Air Temperature	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Water Temperature	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Precipitation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Climate Change	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ice Cover	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Infrastructure controlling water flow	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other (please specify)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Comments:

Q9. Using a scale of “Greatly” to “Not at all,” to what extent have you been affected by the following impacts from Lake Michigan water level fluctuations?

	Greatly	Moderately	Neutral	Slightly	Not at All	Don't Know
Property damage due to flooding	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Property damage due to erosion	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Decrease in recreational opportunities due to low water levels	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Decrease in recreational opportunities due to high water levels	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Decrease in water quality due to fluctuating water levels	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Increase in operating expenses due to low water levels	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Increase in operating expenses due to high water levels	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Comments:

Q10. Using a scale of “Completely Reliable” to “Not at all reliable,” how reliable do find the following sources of information about Lake Michigan water levels?

	Completely Reliable	Somewhat Reliable	Neutral	Somewhat Unreliable	Not at all Reliable	Don't Know
Federal Government	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
State Government	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Local Government	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
News Media	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Property Owners' Associations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Environmental Organizations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Academic Institutions	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Industry Organizations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
NMC's Great Lakes Water Studies Institute	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Experts in the field	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Social media (Facebook, Twitter, Instagram, etc)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Advocacy Groups	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Comments:

Q11 Of the following topics, which would you like to learn more about? (select all that apply)

- Causes of Lake Michigan water level fluctuations
- What Lake Michigan water levels will be like in the future
- Impacts to property resulting from fluctuating water levels
- Tools to adapt to fluctuating water levels
- Other (please specify) _____
- None

Q12 What is your age?

- 18-24
- 25-34
- 35-44
- 45-54
- 55-64
- 65+
- Prefer not to respond

Q13 What is your ethnicity?

- White/Caucasian
- Hispanic or Latino
- African American
- Native American
- Asian/Pacific Islander
- Other
- Prefer not to respond

Q14 What best describes your primary employment status?

- Employed full time (≥ 35 hrs/week)
- Employed part time (<35 hrs/week)
- Self employed
- Retired
- Unemployed
- Student
- Other (please specify) _____
- Prefer not to respond

Q15 What is the highest level of education you have completed?

- Some high school (grades 9-12, no degree)
- High school graduate or equivalent
- Some college (1-4 years, no degree)
- Trade-technical/vocational training
- Associate's degree
- Bachelor's degree (BA, BS, AB, etc.)
- Master's degree (MA, MS, MENG, MSW, etc.)
- Professional school degree (JD—law degree, MD—medical degree, etc.)
- Doctorate (PhD, EdD, etc.)
- Don't Know/Refused

Prefer not to respond

Q16 Are you male or female?

Male

Female

APPENDIX C: Sample E-mail Invitation to Stakeholder Meetings

You're Invited

Great Lakes Water Level Fluctuations - What does the future hold?

May 18, 2015 2-5 pm

Hagerty Center located at NMC's Great Lakes Campus

Please join the Great Lakes Water Studies Institute for the first of a three part seminar series focused on improved understanding of Great Lakes water levels and how future trends may influence our region. Learn about the latest developments of a new International Great Lakes Datum (IGLD-2000), the benchmark of how lake levels are measured. These free community discussions are sponsored by Northwestern Michigan College's Great Lakes Water Studies Institute through direct funding from the Graham Sustainability Institute at the University of Michigan.

The attached document provides more details and a list of speakers and topics for this seminar.

The event is free and open to the public although registration is required as space is limited.

Please RSVP to water@nmc.edu

Subject line - Water Levels IA Stakeholder Meeting - Session #1

Provide names of attendees and a contact number.

APPENDIX D: Agendas for Three Stakeholder Meetings



Great Lakes Water Level Fluctuations – What Does the Future Hold?

Monday, May 18, 2-5 p.m.
Hagerty Center

AGENDA

Welcome

- Hans Van Sumeren, Director, Great Lakes Water Studies Institute
- Adam Smith, Research Assistant

Speakers & Topics

- **Water Levels in the Lakes, Upcoming International Great Lakes Datum (IGLD) Update**
 - Laura Rear McLaughlin - Mapping and Charting Program Manager
 - Colleen Roche, PE - Design and Development Engineering Team Lead, NOAA, Center for Operational Oceanographic Products and Services (CO-OPS)
- **Relationship of the North American Vertical Datum of 1988 (NAVD88) and the IGLD, Continuously Operating Reference Stations (CORS), Updates to Datums**
 - Dave Rigney - Michigan geodetic advisor, NOAA, National Geodetic Survey (NGS)
- **Updates on Nautical Charts in the Great Lakes**
 - Tom Loeper - Regional Navigation Manager - Great Lakes Region, NOAA, Office of Coast Survey (OCS)
- **Communicating Long-term Great Lakes Regional Water Budget and Water Level Data**
 - Dr. Drew Gronewold Ph.D. PE - Physical Scientist, NOAA, Great Lakes Environmental Research Laboratory (GLERL)

Question & Answer



Sponsored by Northwestern Michigan College's Great Lakes Water Studies Institute through direct funding from the Graham Sustainability Institute at the University of Michigan.

Integrated Assessment Team:

Project Investigators: Hans Van Sumeren and Dr. Constanza Hazelwood

Research Assistants: Adam Smith and Taylor West

Project Assistant: Catherine Jarvi



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Great Lakes Water Level Fluctuations – What Does the Future Hold?

Monday, June 22, 12-2 p.m.

Hagerty Center

AGENDA

Welcome

- Hans Van Sumeren, Director, Great Lakes Water Studies Institute
- Dr. Constanza Hazelwood, Education and Outreach Coordinator, Great Lakes Water Studies Institute

Speakers and Topics

12 Noon	Introduction of Team and Roundtable Introductions Summary of Stakeholder Meeting 1
12:15- 1:00	Lake Level Viewer, a NOAA state-of-the-art mapping tool to visualize fluctuations in water levels Brandon Krumwiede, Great Lakes Geospatial Coordinator, NOAA Office for Coastal Management
1:00-1:15	Question & Answer
1:15-1:45	Research Assistants Taylor West and Adam Smith: Integrated Assessment Survey
1:45-2:00	Wrap Up Seminar 3 – Date and Time



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Integrated Assessment Team:

Project Investigators: Hans Van Sumeren and Dr. Constanza Hazelwood

Research Assistants: Adam Smith and Taylor West

Project Assistant: Catherine Jarvi



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Great Lakes Water Level Fluctuations –

What Does the Future Hold?

Monday, July 27, 12-3 p.m.

Hagerty Center

AGENDA

Welcome

- Hans Van Sumeren, Director, Great Lakes Water Studies Institute
- Dr. Constanza Hazelwood, Education and Outreach Coordinator, Great Lakes Water Studies Institute

Presentations & Topics

12:00-12:15 Welcome & Introductions

12:15-12:45 Lunch

12:45-1:30 Planning Grant Update

1:30-2:30 Deep Dive into Key Issues

2:30-3:00 Wrap Up



Sponsored by Northwestern Michigan College's Great Lakes Water Studies Institute through direct funding from the Graham Sustainability Institute at the University of Michigan.

Integrated Assessment Team:

Project Investigators: Hans Van Sumeren and Dr. Constanza Hazelwood

Research Assistants: Adam Smith and Taylor West

Project Assistant: Catherine Jarvi

APPENDIX E: Lists of Registrations for Three Stakeholder Meetings

**IA Stakeholder Meeting #1
Reservation List
May 18, 2015**

	Name	Organization	Title	Phone
1	Arnold, Bill	GLEC	Manager	(231) 941-2230
2	Barr, Rebecca	Private citizen		bobausable@gmail.com bobausable@gmail.com
3	Barr, Robert	Private citizen		
4	Bosch, Robert	Lake Leelanau Lake Association	Member	(231) 649-2087
5	Breederland, Mark	MI Sea Grant	MSU Extension	(231) 922-4628
6	Brown, Frank	Private citizen		(231) 838-4218
7	Cacciaglia, Ernie*	Grand Traverse County	GIS Coordinator	(231) 922-4771
8	Case, Charlotte	Private citizen		cecace@cfaith.com
9	Casselmann, David*	IPR	Reporter	(231) 276-7200
10	Cotto, Marguerite	NMC	VP for LPL	mcotto@nmc.edu
11	Crissman, Christine	Watershed Center	Exec. Director	(231) 935-1514, x. 1
12	Crissman, Eric	Edward C Grace Memorial Harbor	Harbor Master	(231) 357-9419
13	Cunningham, Don	University Center	Director	dcunningham@nmc.edu
14	Frick, Dean*			frixddb@aol.com
15	Gardner, Karen*	FWS	Student	(760) 520-3870
16	Geoghegan, Anna	Fishtown Preservation Society	Intern	(231) 256-8878
17	Gronewold, Drew	Speaker / NOAA	Physical Scientist	drew.gronewold@noaa.gov
18	Haas, Joseph	DEQ, Gaylord	District Supervisor	(989) 330-9252
19	Henry, McCord	FWS Student		(231) 409-1537
20	Hobson, Hampton	DNR Parks & Rec	Supervisor	(231) 357-0443
21	Holmes, Amanda	Fishtown Preservation Society	Executive Director	(231) 256-8878
22	Houston, Robb	NMC Faculty	Science	(231) 995-2126

23	Jacobson, Mike	NMC Faculty	Science	(231) 995-1229
	Jarvi, Cathy	NMC Staff	GLWSI	(231) 995-3333
24	Kelly, Colleen*	Kelly & Paquette	Environmental Atty.	(231) 421-5428
25	Kelly, Tom	ISEA	Board of Directors	(231) 510-1207
26	Kobberstad, Barbara*	Lake Leelanau Lake Association	Member	(231) 649-2087
27	Kobberstad, Jim	Lake Leelanau Lake Association	Member	(231) 649-2087
28	Koehler, Nancy	Private citizen		(231) 838-4218
29	Lewandowski, Tonya	Env, Consulting & Technology	Sr. Associate Engineer	(231) 946-8200
30	Loeper, Tom	Speaker / NOAA	Reg. Navigation Manager	tom.loeper@noaa.gov
31	Lounsbery, Keith	DNR, Grawn		(231) 357-0443
32	McCauley, Dennis	GLEC	President	(231) 941-2230
33	McKinney, John	MI Sea Grant	Retired	mckinne8@msu.edu
34	Laura Rear McLaughlin	Speaker / NOAA	Mapping/Charting Program Manager	laura.rear.mclaughlin@noaa.gov
35	Mortier, Justin*	Grand Beach & Sugar Beach Resorts	Managing Partner	(931) 938-0100
36	Nicolaou, Elitza	Fishtown Preservation Society	Operations Manager	(231) 256-8878
37	Nowak, David	Private citizen		sidnowak@gmail.com
38	Nowak, Suzanne	Private citizen		sidnowak@gmail.com
39	Otto, Chris	NPS	Water Quality Tech	chris_i_otto@nps.gov
40	Paquette, Darryl	Kelly & Paquette	Environmental Atty.	(231) 421-5428
41	Reichert, Rainer E.	Grand Traverse Cty.	GIS Analyst	(231) 922-4775
42	Rhodes, Jessica	NMC	FWS Student	rhodes@mail.nmc.edu
43	Rigney, Dave	Speaker / NOAA	MI Geodetic Advisor	dave.rigney@noaa.gov
44	Roche, Colleen, PE	Speaker / NOAA	Design & Dev. Engineering Team Lead	colleen.roche@noaa.gov
45	Schmidt, Robyn	DEQ, Cadillac	Water Resources Division	(231) 383-5952
46	Shea, Neal	Fishtown	Intern	(231) 256-8878

		Preservation Society		
47	Smith, Adam	NMC Staff	GLWSI	(231) 995-3333
48	Spencer, Gabrielle*	Private citizen		(231) 342-1960
49	Sych, John	GT Planning & Dev	Director	(231) 922-4677
50	Taylor, Rachel Franks	NOAA		rachel.f.taylor@noaa.gov
51	Wylie, Rob	Private citizen		
52	Zehner, Richard*	Private Citizen		ricz@charter.net
*Registered but did not attend				

**IA Stakeholder Meeting #2
Reservation List
June 22, 2015**

	Name	Organization	Title	Contact Info
1.	Breederland, Mark	MI Sea Grant	Extension Educator	(231) 922-4628
2.	Crissman, Christine	Watershed Center	Executive Director	935-1514, x. 1
3.	Green, Dave	City of Traverse City	DPS Director	922-4900, x. 116
4.	Hazelwood, Constanza	NMC GLWSI	Education/Outreach Coordinator	995-1722
5.	Jarvi, Cathy	NMC GLWSI	Staff	995-3333
6.	Kohler, Steve*	WMU	Program Director	
7.	Krueger, Art	City of Traverse City	Superintendent. Water Treatment	922-4920
8.	Krumwiede, Brandon	Speaker / NOAA	G.L. Geospatial Coordinator	
9.	Lutchko, John	NMC GLWSI	Staff	jlutcko@nmc.edu
10.	LaCross, Larry	City of Traverse City	Asset Management	922-4900, x. 130
11.	McKinney, John	MI Sea Grant	Retired	mckinne8@msu.edu
12.	Olson, Jim*	FLOW	President	jolson@nmc.edu
13.	Purvis, Bill*	East Bay Harbor	Harbor Master	(231) 938-2131
14.	Smith, Adam	NMC GLWSI	Staff	995-3333
15.	Van Sumeren, Hans	NMC GLWSI	Director	995-1793
16.	West, Taylor	NMC GLWSI	Staff	995-3333
17.	Wheeler, Whitney*	LIAA	Executive Director	
*Registered but did not attend				

**IA Stakeholder Meeting #3
Reservation List
July 27, 2015**

	Name	Organization	Title	Contact Info
1	Brainerd, Andrea	Private Citizen	Private Citizen	drabrainerd@gmail.com
2	Brainerd, Rick	Private Citizen	Private Citizen	drabrainerd@gmail.com
3	Breederland, Mark	MI Sea Grant	Extension Educator	(231) 922-4628
4	Burfield, Jennifer	GT Band of Ottawa & Chippewa Indians	Intern	jburfield@gmail.com
5	Burfield, Leona	GT Band of Ottawa & Chippewa Indians	Water Quality Tech	leona.burfield@gtbindians.com
6	Crissman, Christine	Watershed Center	Executive Director	935-1514, x. 1
7	Crissman, Eric	Elk Rapids Harbor	Harbor Master	231-357-9419
8	Fordyce, Steve	Private Citizen	Private Citizen	
9	Harris, Kendra*	Private Citizen	Private Citizen	231-632-7610
10	Harris, Shelby*	FWS Program	Student	231-632-7610
11	Hazelwood, Constanza	NMC GLWSI	Education Outreach Coordinator	995-3333
12	Heiman, Matt	Leelanau Conservancy	Director of Land Programs	
13	Hight, Bethany*	FWS Program	Student	231-313-9721
14	Jarvi, Cathy	NMC GLWSI	Staff	995-3333
15	Largent, Steve*	GT Conservation District	Director	slargent@gtcd.org
16	Luciani, Doug	TraverseCONNECT	CEO	doug@traverseconnect.org
17	McCauley, Dennis*	GLEC	President	231-941-2230
18	McKinney, John	MI Sea Grant	Retired	mckinne8@msu.edu
19	Otto, Chris	NPS Sleeping Bear	Water Quality Tech	chris_i_otto@nps.
20	Pearlman, Trisha*	Private Citizen		tap.windhorse@gmail.com
21	Porter, Traci	Private Citizen	Private Citizen	
22	Simoni, Joseph	FWS Program	Student	simoni2@mail.nmc.edu
23	Smith, Adam	NMC GLWSI	Staff	995-3333
24	Smith, David	Private Citizen	Private Citizen	
25	Smith, Lynda	Private Citizen	Private Citizen	

26	Smith, Tasha	Private Citizen	Private Citizen	
27	Sonderegger, Carolan	GT Band of Ottawa & Chippewa Indians	Biologist	carolan-sonderegger@gtbindians.com
28	Swan, Scott	NMC Faculty	GIS Instructor	995-2343
29	Taylor, Rachel	NOAA	Staff	rachel.f.taylor@noaa.gov
30	Van Sumeren, Hans	NMC GLWSI	Director	995-1793
31	VanZale, Ben*	FWS Program	Student	vanzal1@mail.nmc.edu
32	Waara, Whitney	LIAA	Director	wwaara@liaa.org
33	Webster, Randy	FWS Program	Student	webste78@mail.nmc.edu
34	West, Luann	Private Citizen		solutions4youonM22@yahoo.com
35	West, Taylor	NMC GLWSI	Staff	995-3333
36	West, Tony	Private Citizen		dabroncs32@yahoo.com

*Registered but did not attend

APPENDIX F: Student Participation List

**Great Lakes Water Levels Integrated Assessment Plant Grant
Freshwater Studies Student Participation List
August, 2015**

1. Adam Smith, Research Assistant
2. Taylor West, Research Assistant
3. McCord Henry, Participant, Stakeholder Meeting #1
4. Jessica Rhodes, Participant, Stakeholder Meeting #1
5. Joseph Simoni, Participant, Stakeholder Meeting #3
6. Randy Webster, Participant, Stakeholder Meeting #3

APPENDIX G: Interview Protocol

Questions for Integrated Assessment
(Interview Protocol)

Interviewee(s):

Organization:

Current Position:

Group:

Interviewer(s):

Date:

1. Historically, how has _____ addressed lake levels?
2. What areas are typically affected by changing water levels?
 - a. What resources are invested in responding to lake levels?
 - b. How do you adjust the budget for unusual events? How quickly do you adjust?
 - c. How do your expenses fluctuate annually?
3. How effective have your responses been?
 - a. How would you improve?
4. How are various departments assigned tasks to respond to water levels?
5. Where does _____ look for expertise, ideas or potential solutions on water levels?
 - a. Water level predictions: where do you go for information?
 - b. Is there a process for decision-making?
 - c. Government regulations?
 - d. What liabilities do you consider in response to changing water-levels?
 - e. What is the highest priority in your responses to economic, environmental or social impact?
6. What are the top challenges that water levels pose on _____ ?
 - a. All-time high in 1986
 - b. All-time low in 2013
 - c. More than 40 in change in the last 18 months
7. Do you have any records, images, or historical indications of water level fluctuations?
8. Are there any other comments, concerns, or opinions you have on water level fluctuations?
9. Suggestions for survey respondents and other potential interviewees.

APPENDIX H: Focus Group Questions



Great Lakes Water Studies Institute Lake Michigan Integrated Assessment Survey Final Conference Discussion July 27, 2015

The Great Lakes Water Studies Institute at Northwestern Michigan College has received grant funding to understand challenges and opportunities posed by Lake Michigan water level variability. The results of this survey will be used to help decision makers as they seek to address the impact of water levels.

Our goal is to gain a more detailed perspective from our stakeholders on key questions taken from the original survey. We will use these results in our final report, which will be submitted and published by the Graham Sustainability Institute at University of Michigan. Your responses to this discussion will be confidential. No one's individual results will be shared in the final report, and no names or organizations will be mentioned. Thank you for your participation.

Of the following categories, which are very important to you in regards to fluctuating water levels? (Select all that apply)

- Economic Impacts (E.g. property damage, decreased business revenue, operating expenses)
- Environmental Impacts (E.g. invasive species, wetland loss, water quality)
- Social Impacts (E.g. effects on other properties, changes to culture of a community, shoreline management)

Comments

How has Lake Michigan water levels impacted you.

Impacts could include the following...

- Property damage due to flooding
- Property damage due to erosion
- Decrease in recreational opportunities to LOW water levels
- Decrease in recreational opportunities to HIGH water levels
- Decrease in water quality due to fluctuating water levels
- Increase in operating expenses due to LOW water levels
- Increase in operating expenses due to HIGH water levels

Comments:

For each of the following sources, explain your reasoning for **trust** / **distrust** to information regarding Lake Michigan water level fluctuations:

- Federal Government
- State Government
- Local Government
- News Media
- Property Owners Associations
- Environmental Organizations
- Academic Institutions
- Advocacy Groups
- Industry Associations
- Northwestern Michigan College's Great Lakes Water Studies Institute
- Experts in the field
- Social Media (Facebook, Twitter, Instagram, etc.)

Of the following, which do you believe contribute to changes in Lake Michigan water levels?

(Circle the ones that you believe affect Lake Michigan water levels the most)

- Dredging
- Evaporation
- Diversions of water INTO Lake Michigan
- Diversions of water OUT OF Lake Michigan
- Runoff
- Air Temperature
- Water Temperature
- Precipitation
- Climate Change
- Ice Cover
- Human Built Structures Controlling Water Flow
- Other: