Proceedings of Crude Move Symposium: Oil Transportation Infrastructure, Economics, Risk, Hazards and Lessons Learned

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We thank the symposium presenters and participants for their many contributions to this effort. The symposium was a success because of their active engagement, constructive comments, and thoughtful discussion.

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OVERVIEW

United States and Canadian government, industry, academic, and non-governmental organization (NGO) stakeholders assembled for the first-of-its-kind crude oil movement symposium for the Great Lakes-St. Lawrence River Basin and other critical northern watersheds, including Lake Champlain and the Hudson River.

Crude oil travels through the Great Lakes Basin in unprecedented quantities and domestic crude production has been increasing over the last decade. Crude oil production from North Dakota's Bakken oil fields and the Alberta tar sands has begun to outpace pipeline capacity, putting pressure on other forms of transportation: rail, truck and vessel. Increased safety concerns related to these alternative transportation modes, together with aging and inadequate infrastructure, pose a risk to the Great Lakes and other watersheds in the U.S. and Canada.

Hosted by the Great Lakes Sea Grant Network, Gulf of Mexico Sea Grant Oil Spill Science Outreach Program, Great Lakes Commission, and International Joint Commission, the symposium provided an opportunity to increase understanding of the complexity of crude oil movement in these important northern basins. Topics included regional transportation, economics, hazards and risk, emergency response, and lessons learned from the Gulf of Mexico.

Presentations from the symposium are available online: https://gulfseagrant.org/crude-move-oil-symposium/
and https://www.youtube.com/playlist?list=PLqFLXVUy3C1568d3a6UI7qKVYHAUfEYQ2

Great Lakes Ballroom
Drury Plaza Downtown Cleveland

Day 1 – June 8

1:00 p.m. **Welcome and Charge**
Tim Eder, Great Lakes Commission
Trish Morris, Great Lakes Regional Office, International Joint Commission
William Bowden, New York Sea Grant, Great Lakes Sea Grant Network
Katherine Bunting-Howarth, New York Sea Grant
Michèle Leduc-Lapierre, Great Lakes Commission

1:20 p.m. **Keynote Speaker**, Jerome Popiel, U.S. Coast Guard

1:50 p.m. **Science and Its Role in Response and Risk Assessment**, Mike Doig, NOAA Office of Response & Restoration

2:10 p.m. **Setting the Stage - How Crude Moves**, Bradley Hull, John Carroll University

2:30 p.m. **Financial Analysis of the Oil Industry in the Region**, Marcello Graziano, Central Michigan University

3:00 p.m. **Break**

3:15 p.m. **Panel: Different perspectives of risk**
One Step Prior to Risk Analysis: Evaluating Sensitivity to Oil Exposure from Shipping, Rail and Pipelines in the Great Lakes, Jerome Marty, Council of Canadian Academies
Transportation risks – The Hazards and Risks of Crude Move, James Winebrake, Rochester Institute of Technology

Human Health and Societal Risks, Larissa Graham, Mississippi-Alabama Sea Grant Consortium
Risk from the Industry Perspective, Brad Shamla, Enbridge
Risk from the Insurance Perspective, Jason Ralph, Zurich North America
Panel discussion

5:30 p.m. **Adjourn**

Day 2 – June 9

8:30 a.m. **Day one recap and introduction to day 2**

8:35 a.m. **Implementing the recommendations of Michigan's Pipeline Task Force**, Matthew Goddard, Michigan Department of Environmental Quality

9:00 a.m. **Panel: Relevant lessons Learned from the Deepwater Horizon Oil Spill**
Responding to the Spill, Doug Helton, NOAA Office of Response and Restoration
Science's Role in Response and Risk Communication, Larissa Graham, Mississippi- Alabama Sea Grant Consortium
Policy Changes and Restoration Efforts, Kelly Samek, NOAA (via web)

10:00 a.m. **Break**

10:15 a.m. Panel: Lessons Learned from the Great Lakes-St. Lawrence River Region
Federal Government, Laureen Kinney, Transport Canada
Tribal Government, Homer Mandoka, Nottawaseppi Huron Band of Potawatomi
Non-Governmental Organizations, Michael Murray, National Wildlife Federation

11:30 a.m. **Lunch**

12:30 p.m. **Legal Framework**, Michael Polich, Great Lakes Commission

1:00 p.m. **Translating Risk for Decision- Making,** Margaret Schneemann, Illinois-Indiana Sea Grant

1:30 p.m. **Identify Next Steps**

2:00 p.m. **Wrap-up and departure**

Presentations are available online at: https://gulfseagrant.org/crude-move-oil-symposium/ and https://www.youtube.com/playlist?list=PLqFLXVUy3C1568d3a6UI7qKVYHAUfEYQ2*)*

PRESENTATION SUMMARIES

DAY 1

Welcome and Charge

Tim Eder, Executive Director, Great Lakes Commission (GLC)
Eder welcomed everyone to the symposium and thanked the planning team. He emphasized the importance of the collaboration with Gulf of Mexico colleagues and of learning from one another. Eder reviewed the history of the GLC and its Canadian partnership: as a bi-national organization, the GLC represents the interests of the Great Lakes states and provinces. He noted that oil is essential to the economies of both the United States and Canada; the Great Lakes region's oil refineries, automotive, and manufacturing industries depend on it. Eder also noted the risks that oil transport poses to the region, both human and ecological. He recalled Quebec's tragic Lac-Mégantic incident and highlighted the potential impact of oil transport on the region's valuable freshwater resources. He emphasized the need for stakeholders to come together to minimize the risks of oil transport while also recognizing its benefits.

Trish Morris, Director, Great Lakes Regional Office, International Joint Commission (IJC)
Morris welcomed everyone on behalf of the IJC. She described her previous work with the oil and gas industry in the Gulf of Mexico and the RESTORE Act (Resources and Ecosystem Sustainability, Tourist Opportunities, and Revived Economies of the Gulf Coast States Act) pursuant to the Deepwater Horizon oil spill. She also noted her current work providing advice to governments on oil, gas, and other water quality issues in the Great Lakes.

Morris emphasized the IJC's interest in crude oil transport throughout the region. In particular, IJC is addressing concerns expressed at public meetings about Enbridge's Line 5 and other oil and gas matters. She highlighted a 2006 IJC report that focused on the St. Clair-Detroit River corridor and found a need for enhanced coordination among government agencies and improved communication with the public. She further noted work that the IJC Science Advisory Board is doing to characterize the potential impacts of unrefined liquid hydrocarbons on Great Lakes water quality. Morris thanked everyone for participating and for taking the time to be a part of these important discussions about mitigating risk to our shared water resources.

William Bowden, Chair, Great Lakes Sea Grant Network; Director, Lake Champlain Sea Grant
Bowden gave an overview of the Sea Grant program mission: bringing the best science to bear on the environmental, economic, and social issues facing our coastal resources; providing education, outreach, and training for stakeholders and decision makers; and connecting government, NGOs, communities, and researchers. He echoed earlier comments addressing both economic and environmental concerns relating to petroleum products and noted the importance of learning from the experiences of Gulf of Mexico colleagues.

Katherine Bunting-Howarth, New York Sea Grant and Michèle Leduc-Lapierre, Great Lakes Commission

Before introducing the keynote speaker, Bunting-Howarth and Leduc-Lapierre provided a framework for the symposium and thanked the sponsors: the Great Lakes Sea Grant Network; the Gulf of Mexico Sea Grant Oil Spill Science Outreach Program; the Gulf of Mexico Research Initiative (GoMRI); IJC; GLC; The Joyce Foundation; and the Charles Stewart Mott Foundation. Leduc-Lapierre mentioned the upcoming panel on risk and noted the importance of understanding the complexity of using and understanding risk. Bunting-Howarth articulated the symposium goals: for attendees to work together to synthesize the information and research presented, identify information gaps, reflect on lessons learned, and compile a list of tools, programs, and projects needed to make well-informed decisions about the movement of crude oil throughout the Great Lakes basin and other critical northern watersheds.

Keynote Speaker

Jerome Popiel, U.S. Coast Guard (USCG)

Popiel welcomed everyone to Cleveland, home of the Ninth Coast Guard District. He began by noting the increase in public interest around pipeline issues and he thanked the symposium sponsors for taking a leadership role and understanding the importance of prevention, preparedness, and response. He outlined the missions of the Coast Guard: safety, security, and stewardship. He also mentioned federal partners in the Great Lakes region: the Environmental Protection Agency (EPA), Regions 2, 3, and 5, and the National Oceanic and Atmospheric Administration (NOAA) Great Lakes Environmental Research Lab (GLERL). He noted that the Great Lakes region is complex, shared among eight U.S. states, two Canadian provinces, and numerous tribal nations. It is a both a seasonal and sensitive system.

Popiel discussed the ways in which the Coast Guard addresses the three key areas of oil spills: prevention, preparedness, and response. USCG is committed to renewing Area Contingency Plans (ACPs) across the Great Lakes region. These ACPs optimize the processes and systems by which planners and responders protect the environment. Looking at cumulative data across the U.S., the Great Lakes region's spills are extremely small relative to the national scale. Popiel emphasized that although events are infrequent and small in size, no spill is minor and could affect the drinking water of millions of residents.

In 2015, the sunken barge, ARGO, a legacy wreck in Lake Erie that occurred in 1937, provided an opportunity for the USCG to exercise components of its contingency plans. An extensive bi-national, multi-jurisdictional operation removed over 33,000 gallons of cargo-water mixture. The USCG's Oil Spill Liability Trust Fund (OSLTF) and EPA's Superfund provided funding for the removal operation. Popiel said the recovery was a huge operational success and prevented a potential tragedy for the Great Lakes region. The response illustrated the importance of preparedness and how disparate parties can come together to work toward the common cause of protecting the environment.

Popiel went on to say an energy renaissance is happening in North America. This is due to expanding production in Canadian oil sands, as well as Bakken crude and other oil and natural gas products. Benefits include additional energy supply and options for export, but these hazardous materials must be moved safely throughout the region. Freshwater provides unique challenges; with a lower density than saltwater, non-floating oils behave differently. Fast response time is necessary, and the USCG is in the process of improving its equipment and technology to respond to heavy oil spills.

Popiel highlighted recent USCG pipeline spill response exercises. USCG has increased their cooperation and coordination with PHMSA (Pipeline and Hazardous Materials Safety Administration) and Canada's National Energy Board. Later this year, the USCG will report the findings of the Great Lakes Oil Spill Response and Cleanup Activities Assessment to Congress. He noted that the 2013 update to the Canadian Coast Guard and United States Coast Guard (CANUS) Joint Marine Pollution Contingency Plan (JCP) has been a model for highly cooperative international spill preparedness and response. USCG also co-chairs Regional Response Teams (RRTs) with EPA, acting as a regional planning and coordination body for preparedness and response actions. Popiel discussed the research and development work accomplished in the Straits of Mackinac to address oil response in ice and winter conditions. A Federal On-scene Coordinator (FOSC) Guide for responding to oil spills in ice was released in March 2017 and is available online. USCG is also adapting NOAA's Environmental Response Management Application (ERMA) tool for the Great Lakes. This will allow electronic mapping of key data in both U.S. and Canadian areas for local contingency plans.

In closing, Popiel highlighted the need for additional freshwater research and development, particularly investment into non-floating oil recovery. Response exercises that ensure readiness to respond to risks posed by heavy oils should be continued, as should industry compliance with all applicable regulations and policy. He also noted the importance of further dialogue and collaboration throughout the region.

Science and Its Role in Response and Risk Assessment
Mike Doig, NOAA Office of Response & Restoration

Doig opened his discussion of the role of science in response and risk assessment by describing the role of the NOAA Scientific Support Coordinator (SSC). SSCs provide the Federal On-Scene Coordinator (FOSC), typically the USCG captain of the port (COPT) and/or the EPA On-Scene Coordinator (OSC), with scientific advice. SSCs are consultants to USCG for water spills and to EPA for land spills, providing good science and technical information on oil and hazardous material.

Doig gave a history of the events that led to existing federal structures and legislation:

- In 1968, the first National Contingency Plan (NCP) developed in response to the 1967 Torrey Canyon spill, which released over 100,000 tons of crude oil into the English Channel.

- The 1976 Argo Merchant spill released 7.7 million gallons of heavy fuel onto Nantucket Shoals and resulted in the creation of the NOAA Hazardous Materials (HAZMAT) team, now called the Emergency Response Division (ERD), and the SSC.
- The 1989 Exxon Valdez spill in Prince William Sound, Alaska released 250-750,000 barrels of crude oil and resulted in the creation of the Oil Pollution Act of 1990 (OPA) and the OSLTF.

Doig then described NOAA's structure and function for oil spill response. As a part of the Department of Commerce, through the ERD in the Office of Response and Restoration, they provide a 24/7 national network of scientific support. As an incident unfolds, NOAA's team of oceanographers, modelers, biologists, chemists, and weather forecasters help answer five major questions: What happened? Where will the spill will go? Who and what will be hit? What might happen? What can be done? NOAA scientists have an extensive array of software and mapping products, job aides, and tools for information synthesis to assist with spill response and restoration.

Doig went on to highlight NOAA's role as a partner in planning and preparedness. NOAA participates in NCPs and ACPs, provides support for drills, coordinates with USCG Great Lakes Sectors, and provides training workshops such as *Science of Spills* and *Shoreline Cleanup and Assessment Technique*.

Setting the Stage - How Crude Moves
Bradley Hull, John Carroll University

Hull began by outlining modes of crude oil movement in the Great Lakes region: refineries, pipelines, rail, and water. Approximately 20 percent of North American refineries are located in the Great Lakes-St. Lawrence Region (GLSLR). Over 90 percent of crude oil enters the GLSLR through pipelines, both to the region's refineries and passing through to refineries outside the region. Pipelines access all world oil sources for GLSLR refineries. They are relatively high volume and low cost, but with a large capital investment. The pipelines range in age, with a large number built in the 1950s and 1960s and between 2000 and the present.

Hull noted that less than 5 percent of U.S. and Canadian oil is moved by rail. Railways provide access to all oil fields and refineries, including those with no pipeline access, and can respond quickly to add service if needed. Chicago is the North American rail hub, with 1300 trains/day, and both the Bakken and Canadian loads have a large amount of spare capacity. Many rail routes follow water, where terrain is flat, and pass through major cities in the region: Toledo and Cleveland, Ohio; Detroit, Michigan; Buffalo, Syracuse, and Albany, New York; Toronto, Ontario; and Montreal, Quebec.

Like rail transport, less than 5 percent of North American oil moves on GLSLR waterways. Water is more limited than rail due to poor market access, a lack of direct access to oil fields, and access only to waterborne refineries. Ice also poses seasonal challenges, as do locks and

other barriers along the waterways. Although petroleum products produced at Great Lakes refineries are transported by vessels throughout the region, crude oil is not moved on GLSLR waterways.

Hull closed by highlighting three new projects with an impact on the GLSLR:

- Dakota Access Pipeline: North Dakota, Bakken crude; potential to divert crude to Gulf of Mexico markets, reducing rail transport through the GLSLR to the east coast.
- Proposed Energy East Pipeline: entirely within Canadian borders; would serve as an export terminal for Canada.
- Trans Mountain Pipeline: potential to shift Canadian oil export west, away from the GLSLR.

Economic Analysis of the Oil Industry in the Region
Marcello Graziano, Central Michigan University

Graziano began by reiterating the importance of the Great Lakes region in the transport of crude oil and petroleum products. Oil sands and Bakken shale production is increasing and much of this moves through the Great Lakes. He then reviewed selected works on the economic impact of crude oil transportation and raised issues with the work: lack of independence; proprietary, often “black box” models; mainly regional; focused only on benefits; high-growth assumptions; and put one mode in competition with another.

Graziano outlined his objectives:

- Present relevant data sources and data shortages/discrepancies
- Quantify the size of the sector within the Great Lakes region (defined by watershed, plus the Chicago metro area) of the U.S. and Canada.
- Provide an initial understanding of the strengths/weaknesses within the relevant Great Lakes industries.

Graziano described the various sources he used for data acquisition, including: several U.S. and Canadian federal agencies; census data; InfoUSA; and Economic Modeling Specialists International (EMSI), using 6- and 4-digit North American Industry Classification System (NAICS) codes. He encountered difficulty with U.S./Canadian mismatches: different types of data collected, differing NAICS codes, and varying data availability.

He went on to discuss the state of the industry, providing numbers for total count and capacity for crude-oil-relevant infrastructures in the Great Lakes region. Graziano’s findings show an average of $30M/firm and 0.36 percent of all sales in the region, mainly in low-tech companies. He found that 0.1 percent of all jobs in the Great Lakes region are in primary firms, with the bulk of the impact coming from the refining sector. In Ontario and Quebec, a concentration of planning and design firms gives pipelines a higher impact. The jobs are primarily in larger urban areas.

Graziano then took a broader view, noting that the oil industry generates, impacts, and supports other jobs. However, the materials purchased for the operation of refineries are primarily (i.e. by value) imported from outside the Great Lakes region in the form of crude oil. He also noted the costs borne by the region: pipeline and rail spills, CO2 emissions ($146M/year), socio-ecological and human health impacts. Future projected cost/year of spills are $72M for pipeline and $25M for rail – health costs are not included in these projections

He concluded with next steps:

- Use Regional Economic Modeling Inc. (REMI), including health, socio-ecological, and amenity costs of spills.
- Map the supply chain and use simulations to examine how much crude oil matters to the Great Lakes region as an industrial input.
- Look at different transport scenarios: rail vs. pipeline vs. multimodal; include fatalities.
- Harmonize data in the region, particularly between the U.S. and Canada.
- Compare risks and final payers within the Blue Accounting efforts of the region.

Questions and Discussion

During questions and discussion, the following points were made and/or clarified:

- Refined petroleum products move in separate pipelines from crude oil. The map of movement of refined products would be similar to crude oil, but the pipelines are smaller.
- The 200 mbd Montreal/Quebec pipe/ship figure is an extrapolation based on data and will change from month to month.
- There are differences in oil spill response management between the U.S. and Canada. In the U.S., a party can be held responsible.
- Chicago is a highly congested rail hub. Access to Alberta, for both pipeline and rail, comes through Chicago.
- USCG has specialists working on ice/winter spill response in the Straits of Mackinac using oil surrogates in tests.
- Prior to a spill, the NOAA SSC engages with RRD on protocols, tactics and research.
- In the financial analysis, refined products were not included.
- There are many barriers to moving crude oil on the St. Lawrence Seaway: seasonality, ice, locks, minimal job creation, and environmental concerns. No crude oil is currently moving on Great Lakes waterways.

Panel: Different perspectives of risk

One Step Prior to Risk Analysis: Evaluating Sensitivity to Oil Exposure from Shipping, Rail and Pipelines in the Great Lakes

Jerome Marty, Council of Canadian Academies

Marty outlined the objectives for his work: 1) assess where oil is transported in the Great Lakes basin by rail, pipelines, and marine shipping; 2) collect environmental data on physical,

biological and socio-economic features; and 3) evaluate the overlap between transportation and environmental data. He said the purpose for the work is threefold: 1) the first national risk assessment on oil spills in Canada used only data from Canadian waters, and it is important to include U.S. data in the context of the Great Lakes as well; 2) there has been increased attention to hydrocarbons issues in freshwater systems; and 3) there is no existing sensitivity analysis on combining multiple oil transportation modes. The work does not consider spill probabilities or oil fate and behavior and therefore, it is not a risk assessment. In addition, it does not consider prevention and response measures, and it is limited to public data.

Marty described his methodology, which combined exposure (from rail, pipelines and shipping) of crude, refined products, and liquefied natural gas (LNG) with consequences, as measured by Environmental Sensitivity Index (ESI). He used these data to create heat maps illustrating transport locations and volume as well as environmental sensitivities by transport mode. His results showed highest sensitivities in the lower Great Lakes and nearshore areas.

Marty emphasized the need for coordinated data management. He would like to consider adding probabilities to identify areas for potential trajectory modeling and recommended that tools be framed to allow for the addition of future projects.

Transportation risks – The Hazards and Risks of Crude Move
James Winebrake, Rochester Institute of Technology

Winebrake began by emphasizing the importance of risk analysis in crude oil transport. He said that models need to be transparent, validated, and based on good data. He defined risk as having both qualitative and quantitative components; both the probability of an event and the severity of its impact must be considered. He noted that impacts are usually viewed in terms of spills or leakages, but other impacts include: air quality, noise, safety, employment and socio-economic impacts, infrastructure and land use, and cultural resources.

Winebrake reviewed the multiple modes of crude transport and noted the risk inherent in all modes. The probability of accidents is non-zero; they will happen. He presented accident data showing an overall downward trend for tanker truck and shipping spills and an increase in rail incidents (due to an increase in carloads of crude shipped by rail). He then discussed the many issues affecting impact assessment: types of oil, mode of transport, landscape, vulnerability sensitivity, and climate/seasonal weather. Software exists to assist with assessments, and he highlighted a website (http://arcg.is/2ag39nq) that helps visualize potential risks with layered maps.

Moving from data visualization to modeling, Winebrake articulated his modeling goal: create a multi-modal, optimization model that can be used to identify ways to minimize risk. The Geospatial Intermodal Freight Transport Model (GIFT) ties rail, highway, and waterway transport (not pipeline) and populates the network with different attributes (environmental, engine types, etc.) to postulate different solutions to crude oil transport. An important next step

is to characterize risk and integrate that characterization into multi-modal, multi-criteria optimization transportation models.

Human Health and Societal Risks
Larissa Graham, Mississippi- Alabama Sea Grant Consortium

Graham opened by describing the difference between technological (human-created) and natural disasters, and noting the different impacts that can occur. Natural disasters tend to create therapeutic communities, where people come together and re-build in the aftermath of the disaster. Technological disasters tend to create corrosive communities where cynicism about government agencies and the compensation process can undermine social patterns. Corrosive communities emerge and persist when mental and physical health are at risk, there is a poor perception of those in charge, and the litigation process is drawn out.

Mental health impacts occur when industries are affected and income is lost, causing high levels of stress and anxiety. Contaminated seafood, water, and beaches can add to stress and anxiety levels, whether real or perceived. After a disaster, blame and distrust can lead to poor agency perception, which can shift depending on the views of local people and places and the types of resources that are affected by the spill. Lastly, drawn-out litigation can cause stress and secondary trauma, as well as competition and social comparisons.

Graham then discussed lessons learned for creating therapeutic communities. Resilient communities are characterized by community attachment, a strong social network, and a sense of purpose. Those who have lived through previous disasters often show higher resilience.

Graham noted that in current oil spill response efforts, mental and behavioral health impacts are infrequently addressed. Protection of human health and safety typically focuses on the health of emergency responders and keeping oil off shorelines. Laws dictate spill assessment and response, leading to a focus on the health of the environment and the economy and not on impacts to mental and behavioral health. The complexity of the compensation process and poor perceptions of those in charge can also lead to mental and behavioral health challenges. Sea Grant programs offer resources for coastal audiences, such as agencies and residents. After the Deepwater Horizon oil spill, Sea Grant programs in the Gulf of Mexico trained community members as peer listeners, held public forums, and provided explanations of complicated legal documents.

Risk from the Industry Perspective
Brad Shamla, Enbridge

Shamla opened his discussion of the industry's perspective on the risks of oil transport by showing a map of the Enbridge system. It includes crude oil, refined petroleum products, natural gas, and renewable energy development. He said that renewable energy is a growth area and includes waste heat recovery, geothermal power, wind, solar, and hydroelectric power assets.

Shamla noted that the Great Lakes region is a vital link in North America's energy supply, and Enbridge transports over 70 percent of crude oil supplies to Midwestern refineries. The U.S. consumes over three billion barrels of gasoline per year, and the Great Lakes states are high level consumers.

Shamla then described how Enbridge works to reduce risk. Safety and operational reliability are their top priorities, and they have invested over $5 billion into the integrity of their systems over the last five years. In the area of pipeline safety, multiple safeguards create layered protection against incidents. They have computational pipeline monitoring, aerial pipeline patrols, and a 24/7 control center with a toll-free emergency number.

Shamla addressed, more specifically, the safety and reliability of Line 5 in the Straits of Mackinac. Line 5, built in the early 1950s, transports light crude oil and natural gas liquids (NGLs) and has recently received a large amount of public and media attention. Shamla said it is well-designed and Enbridge employs additional emergency response measures to ensure safety and reliability. These measures include: a response crew added at Mackinaw City/St. Ignace; a 2016 full-scale exercise; $7M in additional equipment to enhance emergency response capabilities; high-speed oil containment and recovery systems; additional skimmers/ice-response skimming systems; and additional containment, protection and absorbent boom.

Risk from the Insurance Perspective
Jason Ralph, Zurich North America

Ralph began by outlining two guiding principles of insurance: the premiums of the many pay the losses of the few, and the premium must be commensurate with the risk. Each risk is unique, so it's important to define risk. Speculative risk has the potential for profit or loss, while pure risk has the potential for loss but not profit. Pure risk is insurable, but speculative risk is not.

Ralph went on to discuss risk in more detail, saying that risk has three distinct factors: uncertainty, varying levels of risk, and causation of loss. Risk necessarily implies uncertainty about the outcome of a given situation, and also that the outcome would be worse than the current situation. Risks vary, both in their frequency (probability of an outcome) and severity (seriousness of outcome), and this variation affects the cost and availability of coverage. When analyzing causation of loss, perils and hazards are two key aspects to consider. Peril is an event that will give rise to a loss, while hazards are conditions that may cause a peril to occur. Hazards can be physical or moral, and while they are not the cause of the event, they increase the probability or severity of an outcome when a peril operates. Physical hazards are physical features of the risk, such as pipeline age, and moral hazards are attributable to the human element. Physical hazards are easily mitigated or removed, but moral hazards are extremely difficult or impossible to mitigate.

Ralph then described an insurer's view of risk in the transportation of crude oil: high severity and high visibility. Environmental damage from crude is expensive and punitive, and identifying water sources and other significant environmental pathways is important for effective analysis. He said most insurers require that companies have a rigorous and clearly defined emergency response protocol. He noted that risk management efforts vary in effectiveness, and there has been a perceived lack of oversight at the corporate and regulatory level. Comparing among different modes of oil transport, Ralph noted that most claims result from physical hazards, which are easily controlled.

Ralph closed with comments on risk management and emphasized that insurance is not a replacement for safe operation. Insurers seek a proactive risk management approach, and safety must be prioritized over profits and costs. He noted that the cost of risk management is lower than the economic cost of reputational damage and that risk management efforts involve continual improvement.

Panel discussion

During the panel discussion, the following points were made and/or clarified:

- Natural gas liquids contain the full spectrum of natural gas, including propane and heavier components, and move in liquid form. Enbridge Line 5 has propane, extracted for market and shipped as liquid under pressure, it moves only light crude oil and NGL.
- Social indicator metrics can be used in modeling when based on quantitative measures. It is technically feasible with good data sets, but using modeling tools with multiple stakeholder interests is more challenging.
- It is common to run multiple liquids in the same pipeline. Products can be batched, and the pressure is the same.
- When considering moral hazards, insurers are restricted to looking at risk management programs, policies and procedures. Interpersonal interactions can give good impressions about the effort companies are putting into risk management. When mergers and acquisitions occur, migrating new divisions into existing culture can be challenging.
- Enbridge manages moral hazards by ensuring that corporate culture is aligned to safety. Any employee can shut down a pipeline system at any time, and systems are built in to pick up human errors.
- Companies can self-insure within the scope of regular insurance policies.
- Insurers and industry are looking at risk broadly, including not just economic and environmental risk, but risk to the community as well. Insurers map the entirety of the damage, whether covered or not. Enbridge is spending increased time on risk management; they will shut down voluntarily to mitigate risk. Public involvement, transparency, and good data are key components of this effort.
- Insurers anticipate worst-case scenarios on multiple levels: looking at previous incidents, amount of product moved, protections, and projecting outcomes if all safeguards fail.
- At Enbridge, lessons learned from spills in rivers and ice areas have been integrated into safety and response planning. Trainings are constantly updated and new information is factored into emergency response plans.

- When harmonizing U.S. and Canadian data, socio-economic features are very challenging. Geographic Information Systems (GIS) maps also don't connect and are labor-intensive to fix. Real-time data would improve models.
- Mapping of social dimensions can identify areas of high risk. The economic structure of a community prior to an event can help predict social sensitivity.

DAY 2

Implementing the recommendations of Michigan's Pipeline Task Force
Matthew Goddard, Michigan Department of Environmental Quality

Goddard opened with a summary of the Michigan Petroleum Pipeline Task Force, comprised of eight state officials from government agencies. It is tasked with identifying and recommending actions within state government to protect the public health, safety, and welfare of Michigan citizens and the environment related to the transportation of liquid petroleum products through major pipelines within the state. The task force met seven times between August 2014 and April 2015. They gathered information from a wide range of external sources, including federal agencies, NGOs, industry, tribal governments, academia and members of the public. Their report, released in July 2015, made four specific recommendations regarding the Straits pipelines and nine statewide recommendations.

The recommendations for the Straits pipelines are:

- **Prevent the transportation of heavy crude oil through the Straits Pipelines.** Completed September 3, 2015. The agreement prevents Enbridge from transporting heavy crude through the Straits Pipelines unless the pipelines are re-engineered.
- **Require an independent risk analysis and adequate financial assurance for the Straits Pipelines.** Ongoing. Began August 29, 2016, draft report is expected June 2017.
- **Require an independent analysis of alternatives to the existing Straits Pipelines.** Ongoing. Analysis began August 28, 2016 and a draft report is expected June 2017.
- **Obtain additional information from Enbridge relating to the Straits Pipelines.** Ongoing. Information is publicly available on the Michigan Attorney General's and the Michigan Petroleum Pipelines' websites.

The statewide recommendations are:

- **Coordinate mapping of existing pipelines among state agencies.** Ongoing. It is a multi-agency collective effort.
- **Ensure that state agencies collaborate on emergency planning and spill response.** Ongoing.
- **Ensure coordinated emergency response training exercises and drills.** Ongoing. Full-scale Response Exercises (were conducted in the Straits of Mackinac on September 24, 2015 and in the St. Clair River on May 25, 2016.

- **Ensure regular state consultation with PHMSA on hazardous liquid (including petroleum) pipelines.** Ongoing. Staff of the Michigan Public Service Commission (MPSC) continue to consult with PHMSA on liquid pipelines in Michigan.
- **Consider legislation requiring state review and approval of oil spill response plans, improved spill reporting, and more robust civil fines.** On hold. As of Dec. 31, 2016, HB 5198 was still in House of Representatives Natural Resource Committee.
- **Evaluate whether to establish a Hazardous Liquids Pipeline Safety Program in Michigan.** Ongoing. Michigan already has a safety program for natural gas pipelines. There are issues with attracting personnel, the PHMSA timeline, budget implications, and stakeholder support.
- **Consider legislation or rulemaking to improve siting process for new petroleum pipelines.** On hold. Updating Act 16 (liquid pipelines) or Act 9 (natural gas) of 1929 has not moved forward.
- **Consider issuing an Executive Order creating an Advisory Committee on Pipeline Safety.** Completed September 13, 2015. Governor Snyder issued Executive Order 2015-14 creating the Pipeline Safety Advisory Board.
- **Create a continuing Petroleum Pipeline Information website.** Completed: http://mipetroleumpipelines.com

Goddard continued with a summary of the Alternatives Analysis for the Straits Pipeline (Enbridge's Line 5), done by Dynamic Risk Assessment Systems, Inc. The analysis is in the final writing stages and a draft report is projected for June 2017. The alternatives are:

- Alternative 1: The construction of one or more new pipelines that do not cross open waters of the Great Lakes, and then decommissioning the existing Straits Pipelines.
- Alternative 2: The utilization of existing pipeline infrastructure located in Canada, other states, and elsewhere in Michigan that do not cross the open waters of the Great Lakes, and then decommissioning the existing Straits Pipelines.
- Alternative 3: The utilization of alternative transportation methods (rail, tanker truck, oil tankers and barges), and then decommissioning the existing Straits Pipelines.
- Alternative 4: Replacement of the existing Straits Pipelines using the best available design and technology.
- Alternative 5: Maintaining the existing Straits Pipelines, including an analysis of the effective life of the existing pipelines.
- Alternative 6: Eliminating all transportation of petroleum products and natural gas liquids through, and then decommissioning, the Straits of Mackinac segment of Line 5.

Goddard mentioned that a risk analysis review is being done by Det Norske Veritas (USA) Inc - DNVGL to define worst case spill and response impacts and costs. A draft report is projected for June 2017.

Looking ahead, Goddard said they will be implementing a public outreach strategy, including a public comment period, information meeting, and feedback sessions during July-August 2017.

Panel: Relevant lessons Learned from the Deepwater Horizon Oil Spill

Responding to the Spill

Doug Helton, NOAA Office of Response and Restoration

Helton's office provided scientific support to the USCG during the Deepwater Horizon oil spill and he said many lessons were learned during the response and restoration efforts. Because oil spills are low-probability, high-impact events, and because personnel change during the years between incidents, he noted that lessons must be continually re-learned.

Helton emphasized that prevention is always best. Once oil is spilled, there is no good outcome. He said that NOAA responds to many spills in the Great Lakes region, but they are not large-scale incidents like Deepwater Horizon. Helton described the critical role that science support plays in spill response. Crisis science, data science, and Natural Resource Damage Assessment (NRDA) are all critical components of response. Spills can have subtle impacts and science is a key element of understanding them.

Helton went on to describe the role of emergency operational science in determining what happened, where the oil could go, what it could affect, what harm it could cause, and what can be done to help. During Deepwater Horizon oil spill response, they learned that early information is usually wrong and oil can spread quickly in multiple directions. Natural, economic, and social dimensions can all be affected, and harm can be widespread and subtle. Helton noted that it is common for initial estimates of released oil to be less than actual amount released. When in doubt, assume the worst case scenario of what has been released. Responders also learned that residual oil is extremely difficult to recover. Only 3 percent of the oil spilled was mechanically recovered (skimmed). Helton said modeling was a useful tool for keeping the public informed on spill trajectories and forecasts of where the oil will go over the long-term. Determining what resources are at risk is a challenge and ESI maps are often outdated. He noted that outreach efforts are important for educating the public about the spill response.

Helton closed by emphasizing that recovery is a long-term prospect. Thirty years after the Exxon Valdez spill, there are still some species that have not recovered.

Science's Role in Response and Risk Communication

Larissa Graham, Mississippi-Alabama Sea Grant Consortium

Graham introduced GoMRI, a program that began after the Deepwater Horizon oil spill. Its purpose is to study how oil and dispersants interact with one another, move around the environment, and how they impact the Gulf's people, habitat, water quality, fish, and wildlife. In 2014, GoMRI partnered with Sea Grant to create the Oil Spill Science Outreach Team to share science-based, peer-reviewed information with coastal audiences. GoMRI funding reaches far

outside the Gulf; several researchers throughout the Great Lakes region have received funding from GoMRI.

Graham highlighted GoMRI technology used in research, including drifters, dyes, robots, and remote sensors. GoMRI researchers are studying where the oil went after the Deepwater Horizon oil spill and how it affected habitats. Graham said that wetland research and restoration are also key focus areas.

In science communication, Graham noted that “facts are facts but perception is reality.” The public’s perception of an issue can be at odds with the science, and taking time to build trust with communities is important for effective science outreach.

Policy Changes and Restoration Efforts
Kelly Samek, NOAA (via web)

Samek began by noting a historical pattern showing that big disasters can motivate policy makers. Deepwater Horizon was an unprecedented event, and the public called for changes in laws, policies, and procedures. This led to the creation of the National Commission on the BP Deepwater Horizon Oil Spill and the Gulf Coast Ecosystem Restoration Task Force, but there weren’t significant legal or policy shifts in the wake of the spill. This is likely due to the considerable flexibility afforded under current law, which allows for creativity and discretion in spill response and restoration.

She went on to give examples of ways in which current law affords flexibility. Trustees must invite responsible parties to participate in assessment, but the nature and extent of that participation is subject to considerations such as willingness to fund, cooperation in response, and actions in prior assessments. Settlement is available at any time as long as it is adequate to satisfy the goal of OPA and is fair, reasonable, and in the public interest.

Samek then discussed pre-settlement restoration, noting that emergency restoration is prescribed by federal NRDA regulations and is allowable if it will not interfere with response efforts. After the Deepwater Horizon spill, early restoration was pursued on an unprecedented scale. Early restoration is different from emergency restoration in that it is voluntary and not prescribed by regulation. Early restoration can operate as a partial interim settlement.

In her discussion of post-settlement restoration, Samek noted that federal regulations are sparse on post-settlement guidance but public interest in monitoring and restoration success is high. In the Deepwater Horizon settlement, monitoring and adaptive management allotted $520M and up to an additional $700M was available for adaptive management for unknown conditions. Trustees can expedite restoration through pre-incident planning by identifying support services, natural resources at risk, regional response resources, baseline information, data management systems, and funding options.

Panel discussion
During the panel discussion, the following points were made and/or clarified:

- Restoration planning on the federal level could be streamlined through legislative or policy changes.
- After a spill occurs, the responsible party must notify the national response center, managed by USCG and EPA, as soon as possible (within minutes/hours). Legally, if responsible parties do not notify, they will not receive protections that are available. EPA has inland jurisdiction, and USCG handles waterways.
- Local government is an important audience for GoMRI, both for awareness and for accessing tools in the event of another spill. GoMRI also recognizes the importance of getting research to the oil industry. GoMRI is coming into its last years of funding and is investing in graduate students and a publication database to continue its work after funding disappears.
- Formal sharing of information with other countries occurs through the International Maritime Organization and through international conferences. Information from a Mexican spill was used in the Deepwater Horizon response.
- ESI maps are supposed to be updated on a seven to ten year cycle, but there isn't stable funding and maps can go 20 years without an update.
- A worst-case scenario spill in the Great Lakes is likely to be much smaller than a large Gulf spill, but it would still be considered catastrophic in its effects for the region. PHMSA uses current throughput for lines, and theoretical worst-case scenarios take that into account, but the Kalamazoo River spill was an example of errors leading to spill amounts that exceeded the worst-case scenario.

Panel: Lessons Learned from the Great Lakes- St. Lawrence River Region

Federal Government
Laureen Kinney, Transport Canada

The 2013 train derailment and tragic oil spill in Lac Mégantic, Quebec prompted the Canadian government to respond with legislative and regulatory changes. Kinney said they immediately talked about how to: a) strengthen the rules, b) provide outreach and support to affected communities, c) support the front-line first responders, and d) strengthen research and testing to improve preparedness. She noted that not only has the volume of oil transported by rail increased, but the composition of the crude has changed.

Kinney went on to describe the changes in rules and regulations, as well as additions to safety provisions and community outreach, that occurred after the spill. Within their legal framework, government officials are empowered, through protective directions and emergency directives, to make changes that have the force of regulation. Within a month of the Lac Mégantic incident, an Emergency Directive was issued requiring the securing of unattended locomotives and number of crew for trains carrying dangerous goods. Within six months, protective directions were

issued to improve classification of products being transported, industry and community members were engaged, and updates to Canadian Rail Operating Rules were approved. Within a year, additional Protective Directions and Emergency Directives were issued and a comprehensive review of the liability and compensation regime for rail was completed.

Kinney emphasized that they took a tailored outreach approach for multiple audiences, including the public, first responders, and industry. She highlighted the convening of the Emergency Response Task Force (ERTF), which led to recommendations for expansions and improvements in Emergency Response Assistance Plans (ERAPs). She also emphasized harmonization, citing the importance of working closely with the U.S. and other members of the international community to learn from their experiences.

Kinney described the future outlook, where they will focus on Transportation of Dangerous Goods Regulations (TDGR), a review of the Railway Safety Act, and the Oceans Protections Plan, a new initiative that will enable Transport Canada to lead the way in marine safety, shipping impacts, habitat restoration, and cooperation with indigenous communities.

Tribal Government
Homer Mandoka, Nottawaseppi Huron Band of Potawatomi (NHBP)

Mandoka began by reviewing the federally recognized tribes in Michigan: the Chippewa, Ottawa and Potawatomi. There are nine Potawatomi nations; seven are in the Midwest region of the U.S. and two are in Ontario, Canada. He described the NHBP environmental staff, with expertise in geography, water quality, wildlife habitat, air quality, and wild rice restoration. In addition, the Council appoints seven tribal members to advise environmental staff and provide cultural ties to the community.

On July 25, 2010, there was a rupture in Enbridge Line 6B, near the Pine Creek Reservation in Marshall, MI. The spill went unaddressed for 17 hours, contaminating 30 miles of Kalamazoo River. Enbridge initially mistook the spill for an anomaly and twice re-started the pipeline, leading to an estimated total release of over 800,000 gallons and a cost over $700M. The NTSB established that there was a lack of well-trained responders from Enbridge and limited PHMSA guidance and oversight. It affected culturally significant tribal sites as well as sensitive habitat.

Mandoka noted that tribal nations were not included in the NRDA process and he emphasized the importance of ensuring that tribes are able to participate and submit claims. He described cultural resource threats, particularly to wild rice which is important for tribal agriculture, wildlife, and waterfowl.

Mandoka closed by reviewing NHBP's lessons learned after the Line 6B spill:

- Networking with universities and local, state, and federal agencies is important.
- Tribes need to have a role in the NRDA process.
- Baseline studies prior to damage are useful for identifying other hazards in the area.

- Cascading event modeling is preferable to site-specific modeling.
- Influence changes in policy and culture, with both Enbridge and PHMSA. Lack of consultation with tribes is a detriment to the response and restoration process.

Non-Governmental Organizations
Michael Murray, National Wildlife Federation (NWF)

Murray summarized what NWF has historically considered key stresses in the Great Lakes region: toxic chemicals, land use changes, invasive species, nutrient loading, hydrologic alterations, overfishing, and climate change. Energy and oil transport were not considered until after the 2010 Kalamazoo River oil spill, when NWF turned its attention to the issue. They have since published a number of reports and educational materials on the environmental risks of oil production and transportation. In a partnership with the University of Michigan Water Center, modeling and analysis of contaminant release scenarios were done for Line 5. NWF also holds a seat on Michigan's Pipeline Safety Advisory Board.

Murray listed NWF's recommendations:
- Strategic decommissioning of Line 5 – minimize ancillary, economic disruptions
- Stronger pipeline safety measures at federal levels, including considering comprehensive/cumulative impacts, oil composition, siting
- Ensure adequate, coordinated spill response plans are in place
- Adequate funding for all federal activities involving oil transportation management
- Broader efforts (energy efficiency, appropriate clean energy standards) to reduce reliance on petroleum in general

Panel discussion
During the panel discussion, the following points were made and/or clarified:
- Looking at the ecological implications of the different components of crude in a spill event and having good informationz on current crude composition is important. Enbridge is continually testing sediments to look at long-term consequences of a spill, such as leaching to the water table.
- Tribal sovereignty: if treaty rights are infringed upon, tribes can file claims to be reviewed by federal courts. This strategy could be possibly be used to remove pipelines from tribal land. The outcome would depend on the approach of the individual tribe, and there are many different sovereign tribes with differing interests and approaches.
- If local/state governments and stakeholders want to track crude oil production and composition, following research coordinated by PHMSA and Transport Canada is important.
- NWF has not articulated a specific alternative if Line 5 is decommissioned. They are looking to Michigan's Alternatives Analysis for the Straits Pipeline report for guidance.
- Canada's Oceans Protection Plan is a national plan with a marine focus, but there are initiatives in all areas. Timing of implementation is aligned with a number of issues but the GLSLR is being well-addressed.

Legal Framework
Michael Polich, Great Lakes Commission

Polich opened his discussion of the regulatory framework for oil transportation with an overview of the applicable laws and controlling agencies for pipeline, rail, and vessel transport in both the U.S. and Canada. In the U.S., the lead agencies are the Department of Transportation, EPA and USCG. The regulatory scheme is "command and control," with the agencies in control of the regulated entities. Applicable regulations vary slightly among different modes of transport.

Polich went on to discuss each mode of transport in greater detail. For pipeline transport in the U.S., the Pipeline Safety Act is the controlling legislation, operated by PHMSA. Comprehensive response plans, consistent with federal contingency plans, are required by PHMSA and necessitate inspections and reporting. Interstate pipeline siting, however, is left to the states. PHMSA and the Federal Railroad Administration (FRA) control rail transport, with PHMSA handling the hazardous materials regulations and FRA managing the railways. PHMSA requires basic response plans, but most inspections are done by the railway. Recent regulatory action for rail includes: trains transporting 1,000,000 gallons of Bakken crude must notify State Emergency Response Centers (SERCs); Fixing America's Surface Transportation Act of 2015 ("FAST Act") requires the generation of real-time train information; and new safety design regulations for high-hazard flammable trains (HHFTs). For vessels, OPA is the controlling statute under the Department of Transportation. It was enacted as a result of the Exxon Valdez spill and created the OSLTF, in which responsible parties are strictly and jointly and severally liable for the removal of oil and damages resulting from an oil spill. Vessels must show financial ability to cover liability. Annual inspections and Vessel Response Plans (VRPs) are required; however VRPs are omitted for spills on large lake systems so it's not clear how that would apply to a Great Lakes spill.

Polich then described the Canadian regulatory scheme, with Transport Canada and the National Energy Board as lead agencies and Environment Canada and the Canadian Coast Guard leading response. In contrast to the "command and control" style in U.S., the Canadian regulatory environment is goal-oriented and relies on flexibility and cooperation with regulated entities. For pipelines, the National Energy Board Act is the controlling legislation, regulating onshore pipelines through emergency management programs, environmental protection programs, damage prevention programs, and emergency response plans. Industry, through the Canadian Standards Association, self-regulates pipeline design, construction, operation, inspection, and maintenance. Operators must have sufficient financial capability to cover costs and damages of a spill. Through the Railway Safety Act (RSA) and TDGR, Transport Canada regulates rail transport. The Safety Management System (SMS) creates a framework that ensures a culture of safety, with inspections performed by the railroad. For vessels, the Canada Shipping Act, under Transport Canada, is the controlling legislation and requires inspections and response plans. The Marine Liability Act follows the "polluter pays" principle, where responsible parties are liable for damages. Vessels are required to maintain insurance linked to tonnage of vessel.

Polich addressed the issue of transport through both the U.S. and Canada; in that case companies will follow the strictest regulation. He noted the existence of international agreements, particularly the Great Lakes Water Quality Agreement which provides the framework for the joint contingency plans (CANUSLAK and CANUSCENT) that facilitate information sharing between the two countries.

Question and Answer

During question and answer, the following points were made and/or clarified:

- Punitive penalties are not explicitly stated in OPA, and common law applies if it is not in the statute, so no punitive damages are carried over from previous/existing laws. There is a cap for damages, and there is always the possibility of prosecution for non-compliance.
- There are maritime organizations that also set standards for oil transport shipping, and if oil was ever shipped on the Great Lakes, vessels would have to comply with them.

Translating Risk for Decision-Making

Margaret Schneemann, Illinois-Indiana Sea Grant

Schneeman began her discussion of the role of economics in decision-making by noting the many regional economic benefits of crude oil transport. Chicago is the busiest freight hub in the U.S., with 25% of all freight and over half of intermodal freight passing through metropolitan Chicago. It is also at the heart of Midwest crude oil movement by rail, is the only maritime connection between the Great Lakes and Mississippi River basin, and has the largest crude oil refining capacity in the Midwest. All of this activity has a large economic impact on the Great Lakes region-- over $1.3 trillion worth of goods move into and out of the region each year.

When comparing transportation options, she noted the importance of looking at benefits and costs. Benefits include transport efficiency, jobs, and greater response capacity; costs include transport risks, environmental and social damages, and a large impacted population in urban areas. She emphasized the need for a standard economic approach when comparing risk. Monetizing otherwise incomparable risks eases comparison, regulatory design, and modeling.

During a discussion of guidelines for economic analysis, Schneeman gave several examples of economic methods: cost effectiveness, benefit-cost analysis, life-cycle cost analysis, market and non-market valuation, and ecosystem services valuation. She noted that these methods are affected by federal guidelines governing transportation and oil accident response planning.

Question and Answer

During question and answer, the following points were made and/or clarified:

- Avoided cost studies are used by economists, but cost and value are distinct. More data exists on cost than on value, but value is often greater than cost. In the case of an oil spill, using the cost of cleanup as a rough estimate in economic valuation analyses would not be as useful as using the value associated with the damages.

IDENTIFICATION OF NEXT STEPS

The following are the questions posed and answers generated during three different breakout groups at the end of the symposium.

What is the most pressing question(s) you have after sitting through the symposium?

- How will a return to “normal” crude prices impact amount of oil moving in the Great Lakes-St. Lawrence region?
- How will ratios of modal volumes/tonnages change with advent of more pipelines?
- How can we push the science regarding alternative transportation routes and modes (i.e. what if Line 5 is shut down and the mode changes, what are the impacts to low-income neighbors)?
- What are the differences in impacts of the different types of crude oil in the event of a spill?
- What is the condition of the rail, pipeline infrastructure? Is it adequate to handle increases in transportation? (We need to better understand the state of infrastructure and have access to an inventory.)
- How can agencies, industries, researchers, and users better work together?
- How can we harmonize data and better share it between the U.S. and Canada? (This could apply to flooding and spill reporting among other topics.)
- How active are the Great Lakes states in exercising authority in the siting of oil transportation infrastructure? Which states have authority in addition to federal authority on siting specific transportation modes?
- How can we communicate information and discussion from last 1.5 days to the public in an engaging manner?
- Are people aware of existing non-equipment resources (i.e. contingency plans, how to access plans – now complicated by homeland security concerns)?
- How do we emphasize and share the concepts behind the picture of “bridge of trust, weight of truth?” Some people don’t trust industry, some don’t trust government. How do we share neutral information? Where/how to frame the discussion?

Are there topics that you heard about that you believe require further investigation or action?

<u>Social</u>

- We need to better understand social justice implications, concerns, and education needs related to oil transportation, oil spill prevention and oil spill recovery.

<u>Economic</u>

- A robust economic analysis and more economic information is needed. United States Army Corps of Engineers (USACE) considers sabotage in economic analyses to determine consequence management so maybe industry and government should as well. However, how open/transparent can the conversation be given security issues?
- We need to do much better job of calculating value using multi-criteria decision analysis tools and systems thinking as we explore cost versus value.

Research

- Baseline research identified as a need.
- We need more science of oil spills in freshwater systems, including research and development funding. Great Lakes research needs are not as expansive as the Gulf since we have no exploration/production. The region has different characteristics than the Gulf so smaller spill quantities could have relatively greater impacts on health and the environment.
- Since there are many finished oil products and chemicals being carried on the Great Lakes, we need to learn more about the impacts of spills of the full spectrum of hazardous goods.
- There is a need to integrate known science.
- Use technology and citizen science to better inform the discussion and decision-making. Existing response practices and clean-up technology will never be enough. In the event of a spill, most of the oil will be lost in the system.
- We need to focus on the differences in addressing spills and their impacts in different seasons—ice, heavy winds, different severe weather—when discussing response and recovery.
- We are in an infrastructure crisis (water, and others) and are in need of asset management. Everyone wants new infrastructure instead of maintaining current infrastructure.
- Hydrological modeling taking into account the tributaries and their relationships with ground water is needed. We need to engage these scientists. We also need baseline data so we can see what happens during an oil spill. This should also include surface water/groundwater interactions as they relate to the lakes, as well as how spills behave in tributary/river environments. (Faith Fitzpatrick from USGS has advanced understandings related to the latter.)

Coordination

- We need to better understand the needs of industry and governments. We need more work on coordinating activities between the two federal governments (U.S. and Canada).
- We need better policy after lessons learned – need to move across entire industry. Industry best practices need to be shared.
- Mapping of most restrictive regulations/practices in space/time is needed in order to understand which country's regulations apply.
- Better coordination between US and Canada for spill response; public communication is needed.
- Data harmonization efforts have been led independently by each of the countries and not done together; this should be improved.
- GIS maps could be developed to note choke points and complex interactions between modes in order to better understand what drives intermodal decisions.
- States need to be more intentional about prevention and response training for personnel outside of emergency management. Other agencies have a role to play, but they are not all connected to an emergency management agency. States needs to improve coordination as well.

- A collaborative approach to know who is doing what and who is responsible for what is needed to document groups/agencies that have models, data, other info or products.

Extension, Education and Outreach

- Public right-to-know – one can find public infrastructure info online, but not privately owned infrastructure like pipelines or rails. Concept of clearinghouse for crude oil movement information. The public should have more access to this information. It would help us if we understood this.
- Create a better public understanding of why crude is moving through particular communities.
- Explore whether there is adequate training for first responders for all seasons and weather conditions.
- Better understand the state of infrastructure, or an inventory. In what condition is the rail, pipeline infrastructure? Is it adequate to handle increases in transportation? What are implications of changes in patterns or route?
- Public information officers are needed at each incident command post so communities can get information instantly.

Do you see your organization working on any of these topics? If so which ones and how?

- Presenters on oil exposure sensitivity are willing to share data and tools and find location for consolidated results in appropriate journal.
- Approach an academic journal regarding hosting a special issue on the Crude Move topic. This will open the discussion to a wider group of academics because faculty would receive credit for publishing in the special issue.
- Sea Grant will be invested in hydrocarbon issues in terms of communicating science.
- GLC is interested in doing more work on economics.
- GLC has some limited efforts to link public and environmental health data.
- The US Coast Guard also has information on other dangerous chemicals.
- There is counter pressure due to security concerns to make data less available.

Other Next Steps

- Host a Crude Move Session at the upcoming Transportation Research Board (TRB) this January. Volpe National Transportation Systems Center strongly supports the TRB (they gave many presentations last year) and this would be a way of getting their attention, participation and/or support.
- Create a website to act as an information clearinghouse

LIST OF ACRONYMS

ACP:	Area Contingency Plan
ADM:	Assistant Deputy Minister
CANUS:	Canadian Coast Guard and United States Coast Guard
CCA:	Council of Canadian Academies
CCEA:	Connecticut Center for Economic Analysis
CMAP:	Chicago Metropolitan Agency for Planning
COPT:	Captain of the Port
DFO:	Department of Fisheries and Oceans (Canada)
EMSI:	Economic Modeling Specialists Intl.
EPA:	Environmental Protection Agency
ERD:	Emergency Response Division
ERAP:	Emergency Response Assistance Plan (Canada)
ERMA:	Environmental Response Management Application
ERTF:	Emergency Response Task Force (Canada)
ESI:	Environmental Sensitivity Index
FAST Act:	Fixing America's Surface Transportation Act of 2015
FEMA:	Federal Emergency Management Agency
FOSC:	Federal On-Scene Coordinator
FRA:	Federal Railroad Association
FSE:	Full-scale Response Exercise
GIFT:	Geospatial Intermodal Freight Transport Model
GIS:	Geographic Information Systems
GLC:	Great Lakes Commission
GLERL:	Great Lakes Environmental Research Lab
GLSLR:	Great Lakes St. Lawrence Region
GoMRI:	Gulf of Mexico Research Initiative
HAZMAT:	Hazardous Materials
HHFT:	High-Hazard Flammable Train
IAGLR:	International Association for Great Lakes Research
IJC:	International Joint Commission
JCP:	Joint Marine Pollution Contingency Plan
LNG:	Liquefied natural gas
MPSC:	Michigan Public Service Commission
NAICS:	North American Industry Classification System
NCP:	National Contingency Plan
NGL:	Natural Gas Liquid
NGOs:	Non-governmental Organizations
NHBP:	Nottawaseppi Huron Band of Potawatomi
NOAA:	National Oceanic and Atmospheric Administration
NRDA:	Natural Resource Damage Assessment
NTSB:	National Transportation Safety Board
NWF:	National Wildlife Federation

OPA:	Oil Pollution Act of 1990
OSLTF:	Oil Spill Liability Trust Fund
OSC:	On-Scene Coordinator
PHMSA:	Pipeline and Hazardous Materials Safety Administration
REMI:	Regional Economic Modeling Inc.
RESTORE Act:	Resources and Ecosystem Sustainability, Tourist Opportunities and Revived Economies of the Gulf Coast States Act
RRT:	Regional Response Team
RSA:	Railway Safety Act (Canada)
SAMS:	Scottish Association for Marine Science
SCL:	Society of Canadian Limnologists
SERC:	State Emergency Response Center
SLRI:	St. Lawrence River Institute
SMS:	Safety Management System (Canada)
SSC:	Scientific Support Coordinator
TDGR:	Transportation of Dangerous Goods Regulations (Canada)
USACE:	United States Army Corps of Engineers
USCG:	United States Coast Guard
VRP:	Vessel Response Plan

PRESENTER BIOGRAPHIES

(presented in alphabetical order)

Mike Doig, National Oceanic and Atmospheric Administration

Lieutenant Michael E. Doig is the Scientific Support Coordinator for the Great Lakes in Cleveland, OH. Previous assignments include serving as the Operations Officer aboard the NOAA Ship Gordon Gunter in Pascagoula, MS; Research Support Coordinator at the Atlantic Oceanographic and Meteorological Laboratory in Miami, FL; and Navigation Officer aboard the NOAA Ship Pisces in Pascagoula, MS. He has sailed extensively throughout the Gulf of Mexico, Caribbean, and along the Eastern seaboard. He has a Master of Science in Science Education from Pace University in New York City and a Bachelor of Science in Zoology from the University of Hawai'i, Mānoa.

Larissa Graham, Mississippi-Alabama Sea Grant Consortium

Larissa Graham is the Oil Spill Science Outreach Specialist with Mississippi-Alabama Sea Grant Consortium. She is one of four specialists that are sharing oil spill science with audiences along the Gulf of Mexico. Her focus is on the impacts of oil spills on human health. Larissa has been sharing science with coastal audiences since finishing her Master of Science degree in Fisheries and Wildlife Science from Virginia Tech in 2007. Prior to her current position, Larissa worked as the Coastal Training Program Coordinator for the Grand Bay National Estuarine Research Reserve in Moss Point, Mississippi. She assessed stakeholder needs and developed workshops that focused on water quality, habitat restoration, and climate change to ensure that decision makers had the most up-to-date science to manage coastal resources. Before moving to the Gulf Coast, Larissa worked for NY Sea Grant as the Outreach Coordinator for the National Estuary Program for Long Island Sound where she taught coastal residents, community leaders, teachers, and students about the importance and health of the estuary and watershed.

Marcello Graziano, Central Michigan University

Marcello Graziano is Assistant Professor in the Department of Geography at Central Michigan University. Marcello is an economic geographer, with a specialization in regional economics and energy geography. Prior to his current position, Marcello was a Postdoctoral Research Associate at The Scottish Association for Marine Science (SAMS) – University of the Highlands and the Islands. In addition, he is currently a Research Fellow for the Connecticut Center for Economic Analysis (CCEA) at the University of Connecticut, and an Associate of the SAM Learned Society. He holds a B.Sc. in Foreign Trade, and a M.Sc. in International Economics (both from the University of Turin), and a Ph.D. in Geography from the University of Connecticut.

Doug Helton, National Oceanic and Atmospheric Administration

Doug Helton is the Regional Operations Supervisor for the U.S. National Oceanic and Atmospheric Administration's Emergency Response Division in the Office of Response and Restoration. The Division provides scientific and technical support to the Coast Guard during oil and chemical spill responses. Doug is based in Seattle, WA, but works on NOAA response

efforts nationally. Doug has worked on oil spills, shipwrecks, abandoned vessels, marine debris, and other emergency response efforts in almost all coastal states, ranging from Maine to American Samoa. Doug received a BA from Reed College in 1985 and an MS from the University of Washington School of Fisheries in 1991.

Bradley Hull, John Carroll University
Bradley Hull III is Associate Professor of Supply Chain Management at John Carroll University in Cleveland, Ohio. At John Carroll, he researches Great Lakes logistics issues and, with the late Arnie de la Porte, developed a justification for the Cleveland Europe Express. Previously he was a supply chain manager at BP Oil and BP Chemicals Company for three decades. During that time, he developed many mathematical models for crude oil logistics. He was responsible for moving crude oil into the Great Lakes Basin from Canada, Alaska, the US West Coast, and the US Gulf Coast. Thus, he is familiar with North American crude oil and refined products pipelines, tankers, rail, and barge movements. Education: B.S. in Mathematics (University of Pennsylvania), M.S. in Operations Research (Stanford University), PhD. in Operations Research (Case Western Reserve University)

Laureen Kinney, Transport Canada
Laureen Kinney is the Assistant Deputy Minister (ADM) for Safety and Security at Transport Canada. Laureen is responsible for Transport Canada's safety and security programs in transportation across the country, including aviation, marine, rail, vehicles and transportation of dangerous goods. Notable projects include leadership of multiple Beyond the Border security initiatives and transportation elements under the Regulatory Cooperation Council. In general, Laureen directs the development of Canadian regulations and standards in these areas, as well as the development of national standards on oversight programs. This includes risk assessment systems, quality assurance programs and design of safety management systems, as well as the provision of direction on inspections, enforcement and training programs.

Jérôme Marty, Council of Canadian Academies
Jérôme Marty is a Project Director at the Council of Canadian Academies (CCA). Prior to joining the CCA in 2016, Jérôme held positions as a research scientist at the St. Lawrence River Institute, as director of environment in a large consulting firm (WSP), and most recently as a science advisor at Fisheries and Oceans Canada (DFO). He led the first national risk assessment for oil and chemical spills in Canada and contributed as an expert to the CCA Commercial Marine Shipping Accidents assessment. Jérôme holds a M.Sc. and PhD in Biology from Université de Montréal and Université du Québec à Montréal respectively. He is a part-time professor at the University of Ottawa and adjunct professor in Biology at the University of Waterloo. Over the last 10 years, Jérôme has served on several scientific boards, as President of the Society of Canadian Limnologists (SCL) and the International Association for Great Lakes Research (IAGLR) and as a member of the Science Advisory Committee of the River Institute (SLRI).

Homer Mandoka, Nottawaseppi Huron Band of the Potawatomi
Homer Mandoka serves currently as the Sergeant at Arms for the Nottawaseppi Huron Band of the Potawatomi, where he has also served on the Tribal Council. Previously, he served on the Bronson, MI Police Force for 15 years. Mandoka is certified in emergency management by the Federal Emergency Management Agency (FEMA) and is passionate about safe petroleum transportation. The NHBPs ancestral homelands include the Kalamazoo river basin where the tribe was an integral part of the Kalamazoo river cleanup following the 2010 British Petroleum (BP) oil spill. Mandoka earned his associate degree in law enforcement from Kellogg Community College. He was also recognized in 2013, as the Tribal Leader of the Year by the Native American Finance Officers Association.

Michael Murray, National Wildlife Federation
Michael Murray is Staff Scientist with the National Wildlife Federation's Great Lakes office, and has over two decades' experience working increasingly as a generalist on a broad range of Great Lakes science, science-policy, and policy issues. Trained as an environmental chemist, Michael worked for a number of years on toxic chemical issues, including involving sources, cycling, human health and ecological exposures and effects, and control and pollution prevention options for mercury and other toxic chemicals. He has over the past decade worked in a number of other areas, including involving aquatic invasive species, fisheries and food web issues, Great Lakes indicators and restoration prioritization, harmful algal blooms, and climate change impacts, adaptation, and mitigation. He has worked on several energy-related projects, including involving oil spills, spill risks, and potential emissions reduction benefits of demand-side management in power generation. He has a B.S. degree in geological engineering from Colorado School of Mines, and M.S. and Ph.D. degrees in environmental chemistry from University of Wisconsin-Madison, has taught environmental science and policy courses at the University of Michigan, and currently teaches part-time in the MPH Program and Biology Department at Augusta University. He has served on three dozen technical and other advisory committees, including currently on the Science Priority Committee of the International Joint Commission's Science Advisory Board, where he is co-chairing the Energy Transport and Water Quality Work Group.

Michael Polich, Great Lakes Commission
Michael Polich is the 2016 GLC – Sea Grant Fellow. Michael assists the Commission in a range of projects, including Great Lakes oil transportation, Blue Accounting, green infrastructure, and nonpoint source pollution and nutrient reduction efforts. Michael has spent time working at the United States Geological Survey, United States Environmental Protection Agency, Wisconsin Department of Military Affairs, and the Environmental Law & Policy Center. He received his Juris Doctorate from the University of Wisconsin, where he also received his Master of Science Degree in biological systems engineering and a Bachelor of Science Degree in civil and environmental engineering.

Jerome Popiel, U.S. Coast Guard
Jerome Popiel assumed duties as Incident Management and Preparedness Advisor, Ninth Coast Guard District, in 2011. He also serves as Co-Chair of Regional Response Team (Region

5) and Co-Chair of the Joint Response Team for the Canada/U. S. Great Lakes region. Prior to this assignment, he served as Search and Rescue Program Manager and Chief, Command Center, Ninth Coast Guard District, where he was responsible for the command center's coordination and oversight of Ninth District responses to multi-mission incidents in the eight-state Great Lakes region.

Jason Ralph, Zurich North America
Jason Ralph is a Casualty Underwriting Specialist with Zurich Commercial Insurance North America, based in the Toronto office. Jason has spent his 10 year career with Zurich's Canadian Energy team writing both Domestic and International risks, focusing on the Mining, Power Generation, Petrochemical, and Oil & Gas (Upstream, Midstream, Downstream, and Service Contractors) industry segments. As a Specialist, he takes a lead role in analyzing individual risks, assessing loss probabilities, developing pricing and program structure, and negotiating
terms and conditions with Broker partners. Additionally, he contributes coverage expertise on Claims issues and aides in the development of Underwriting practices and guidelines locally for Energy risks. Through his interaction with Customers representing various industry segments, Jason has developed an enhanced knowledge of Risk Management and Enterprise Risk Management, affording a comprehensive understanding of best practices and providing a solid base for creating unique solution for high severity risks.

Kelly Samek, National Oceanic and Atmospheric Administration
Kelly Samek is the Gulf Regional Lead and Program Officer for the Mississippi-Alabama, Louisiana, and Texas Sea Grant Programs as well as the National Sea Grant Law Center. She was formerly the Gulf Restoration Coordinator for the Florida Fish and Wildlife Conservation Commission (FWC) and prior to that was the Coastal Program Administrator at the Florida Department of Environmental Protection (FDEP). Before entering program administration, she practiced law at FDEP for 6 years and at FWC for 4 years. Kelly has a J.D. from the University of Florida, an LL.M. in Environmental Law and Policy from Florida State University, and a B.A. in Environmental Studies from New College of Florida. She expects to complete a graduate certificate in Ecological Restoration from the University of Florida in December 2016.

Margaret Schneemann, Illinois-Indiana Sea Grant
Margaret Schneemann is the Illinois-Indiana Sea Grant (IISG) water resource economist. Her position is part of a partnership between IISG, the Chicago Metropolitan Agency for Planning (CMAP), and the University of Illinois Extension. Ms. Schneemann is located in the CMAP offices in Chicago. She is leading an economic analysis to support the development and implementation of a sustainable water and supply plan for the Chicago region. Before joining Sea Grant, Schneemann taught economics, finance and statistics at Robert Morris College while pursuing her doctorate in economics at the University of Illinois at Chicago. She has also been a consultant for a variety of businesses and educational and government institutions. Schneemann holds a master's degree in resource economics and policy from the University of Maine.

Brad Shamla, Enbridge
Brad Shamla has been with Enbridge for more than two decades, working in Operations, Engineering, Business Development and Administration across Canada and the U.S. He is currently Vice President, U.S. Operations where he is responsible for U.S. Liquids Pipelines operations and gathering systems. Since he started with Enbridge in 1991, Brad has taken on roles of increasing responsibility within the organization, including leadership positions in Business Development, Canadian Operations, the Control Center, Gathering Systems, U.S. Engineering and the U.S. Operations Group. In his most recent role, as Vice President, Market Development, Brad was responsible for leading the business development activities related to the Enbridge Mainline, New Market Access, Contract Terminals, and Strategic Acquisitions and Divestitures for Liquids Pipelines (LP). Prior to joining the Business Development group in 2008, Brad served as General Manager in the LP Operations Group, overseeing mainline operations in Saskatchewan and Manitoba as well as the Company's first wind farm near Gull Lake, Saskatchewan. Brad is a Registered Professional Engineer in six states and holds degrees in Civil Engineering (BCE) and Business Administration (MBA) from the University of Minnesota.

James Winebrake, Rochester Institute of Technology
Dr. James (Jamie) Winebrake currently serves as the dean of the College of Liberal Arts at the Rochester Institute of Technology, where he works to advance interdisciplinary education and scholarship that integrates the social sciences, humanities, engineering, computing, and the arts. Dr. Winebrake has earned international recognition for his research on issues related to the environmental impacts of transportation, including health risk assessments of ocean-going vessels, total fuel-cycle analysis of alternative fuels, and cost-effectiveness of emissions reduction technologies and policies for trains, trucks and ships. He serves or has served on several National Academies of Science research committees, the New York State Energy Planning Board, and other professional boards related to energy and environmental policy and planning. Dr. Winebrake received his PhD in Energy Management and Policy from the University of Pennsylvania. He also holds a B.S. in Physics from Lafayette College and a M.S. in Technology and Policy from the Massachusetts Institute of Technology

LIST OF ATTENDEES

Jon Allan	Michigan Office of the Great Lakes
Ted Auch	The FracTracker Alliance
Michael Beaulac	Michigan Office of the Great Lakes
Dale Bergeron	Minnesota Sea Grant, University of Minnesota
William Bowden	Lake Champlain Sea Grant
John Bratton	LimnoTech
Mark Breederland	Michigan Sea Grant Extension
Kathryn Buckner	Council of Great Lakes Industries
Katherine Bunting-Howarth	New York Sea Grant
Mark Burrows	International Joint Commission - Great Lakes Regional Office
Thomas Cermak	Pennsylvania Sea Grant
Matthew Child	International Joint Commission
Tom Crane	Great Lakes Commission
Jennifer Daley	LimnoTech
Lisa Denys	Great Lakes Commission
Michael Doig	NOAA
John Downing	Minnesota Sea Grant
Nate Drag	Alliance for the Great Lakes
Tim Eder	Great Lakes Commission
Faith Fitzpatrick	U.S. Geological Survey
Laura Florence	Independent Contractor
Paul Focazio	New York Sea Grant
Karl Gebhardt	Ohio Lake Erie Commission / Ohio EPA
Matthew Goddard	Michigan Department of Environmental Quality
Larissa Graham	Mississippi-Alabama Sea Grant Consortium
Marcello Graziano	Central Michigan University
James Halloran	PNC Wealth Management
Scott Hardy	Ohio Sea Grant
Doug Helton	NOAA, National Ocean Service, Office of Restoration & Response
Jeffrey Herzog	Nexus Engineering Group, LLC
Joshua Hobson	U.S. Coast Guard
Bradley Hull	John Carroll University
Kerith Iverson	Quebec Government Office in Chicago
Laura Kammin	Illinois-Indiana Sea Grant
Rick Kane	FLOW: For Love of Water
Shelley Kath	Solo practice
Laureen E. Kinney	Transport Canada
Michele Leduc-Lapierre	Great Lakes Commission
Suzanne Lemieux	American Petroleum Institute
Lorraine Little	Enbridge, Inc.
Mark Malchoff	Lake Champlain Sea Grant
Homer A. Mandoka	Nottawaseppi Huron Band of the Potawatomi

Jerome Marty	Council of Canadian Academies
Pat McCaffrey	Marathon Petroleum Co.
Jennifer McKay	Michigan Pipeline Safety Advisory Board and Tip of the Mitt Watershed Council
David Mergenthaler	U.S. Coast Guard, Sector Buffalo
Alex Morese	Michigan Agency for Energy
Trish Morris	International Joint Commission
Michael Murray	National Wildlife Federation
Julia Noordyk	University of Wisconsin Sea Grant Institute
Michael Polich	Great Lakes Commission
Jerome Popiel	U.S. Coast Guard
James Quinn	New York State Department of Environmental Conservation
Jason Ralph	Zurich Insurance Company Ltd
Elizabeth Rohring	NOAA Sea Grant - National Office
Margaret Schneemann	Illinois-Indiana Sea Grant
Brad Shamla	Enbridge Energy
Brian Sheldon	Michigan Agency for Energy
Jamie Singer	Envirosceince, Inc.
Tara Skelton	Mississippi-Alabama Sea Grant Consortium
Rochelle Sturtevant	Sea Grant Extension
Mark Sweatman	Michigan Department of Natural Resources - Office of Minerals Management
Lorne Thomas	U.S. Coast Guard, Ninth District
Beth Wallace	National Wildlife Federation
Travis Warner	Michigan Agency for Energy
James Winebrake	Rochester Institute of Technology
William Wise	New York Sea Grant

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