GRAHAM SUSTAINABILITY INSTITUTE
UNIVERSITY OF MICHIGAN

November 24, 2014

Hydraulic Fracturing in Michigan Integrated Assessment

1. Background

The Hydraulic Fracturing in Michigan Integrated Assessment is a holistic evaluation of the impacts of hydraulic fracturing in Michigan through a research-based partnership of University of Michigan (U-M) institutes, centers, and faculty.

Hydraulic fracturing intersects many issues that are important to Michigan residents - drinking water, air quality, water supply, local land use, energy security, economic growth, tourism, and natural resource protection, including the Great Lakes. This project's technical analyses, stakeholder engagement, and analysis of policy options to minimize negative impacts are likely to be important outcomes that will guide future decision making on the issue and help decision makers avoid some of the missteps that have occurred in other states. The project does not seek to predict the future, but it theorizes that natural gas extraction pressures will likely increase in Michigan if the following trends persist: desire for job creation, economic strength, energy independence, and decreased usage of coal.

The idea for conducting an Integrated Assessment on hydraulic fracturing was developed by the Graham Sustainability Institute over a one year time frame (June 2011-June 2012) and involved conversations with several other U-M institutes, the Graham Institute's External Advisory Board, U-M faculty, researchers at other institutions, regulatory entities, industry contacts, and a wide range of non-governmental organizations.

Integrated Assessment (IA) is one of the ways the Graham Institute addresses real-world sustainability problems. This methodology begins with a structured dialog among scientists and decision makers to establish a key question around which the assessment will be developed. Researchers then gather and assess natural and social science information to better prepare decision makers in addressing the question. For more about the IA research framework, please visit: http://graham.umich.edu/knowledge/ia.

2. Project Update

The project's first phase involved preparation of technical reports on key topics related to hydraulic fracturing.

A diverse team of U-M researchers developed seven technical reports focused on key topics related to hydraulic fracturing in the State of Michigan, which were peer-reviewed and made public in September 2013 (available at: http://graham.umich.edu/knowledge/ia/hydraulic-fracturing). The peer reviewers consisted of independent subject area experts identified by U-M's Graham Sustainability Institute, Erb Institute for Global Sustainable Enterprise, Energy Institute, and Risk Science Center. Upon completion of the peer review process, final decisions regarding report content were made by the technical report authors in consultation with the Graham Institute. These reports provide decision makers and stakeholders with a solid foundation of information on the topic based primarily on analysis of existing data. The reports also identified additional information needed to fill knowledge gaps. The technical reports were informed by (but do not necessarily reflect the views of) an Advisory Committee, expert peer reviewers, and numerous public comments.

During the technical report phase of the Integrated Assessment process, the Graham Institute convened a meeting in Lansing, Michigan on March 5, 2013, where Technical Report team members presented their research plans to a larger group of decision makers and stakeholders. In addition, a public webinar

was held on September 6, 2013 following the release of the technical reports. Summaries and recordings of these two public events can be found at: http://graham.umich.edu/knowledge/ia/hydraulic-fracturing.

3. Integrated Assessment Process

The next project phase focuses on producing the Integrated Assessment.

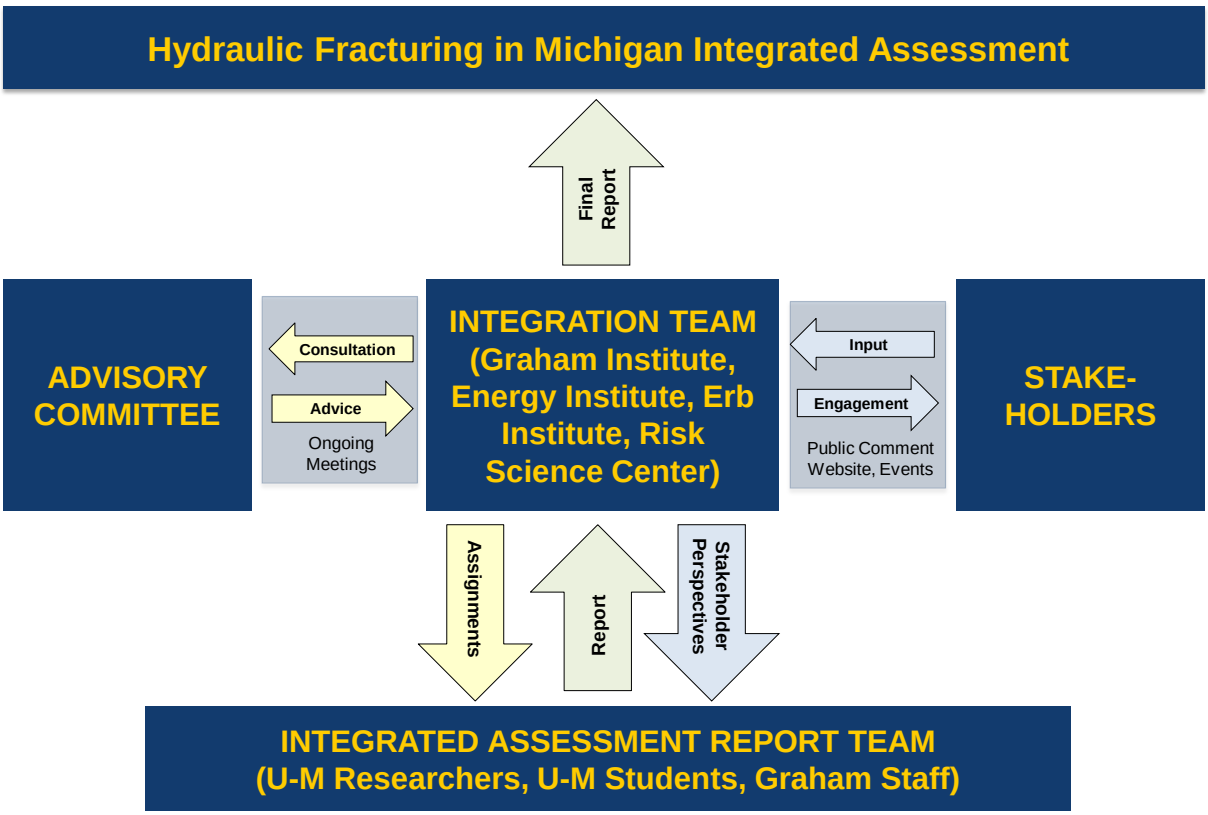
Drawing upon the information provided by the technical reports, additional peer-reviewed materials, and stakeholder input received following the release of the technical reports, the Integrated Assessment (IA) will focus on an analysis of strategic policy options to address the guiding question:

What are the best environmental, economic, social, and technological approaches for managing hydraulic fracturing in the State of Michigan?

The final IA will be a single, comprehensive, cross-cutting report that:

- Synthesizes and integrates work from the technical reports,
- Identifies key strategies and policy options in response to the IA guiding question,
- Assesses the strengths and weaknesses of these policy options,
- Articulates key uncertainties, and
- Includes a catalog of knowledge needs.

Preparation of the final IA will be an iterative process among various groups and individuals as framed below.



Integration Team
The Integration Team will be led by U-M's Graham Institute and include U-M's Energy Institute, Risk Science Center, and Erb Institute. This team is charged with:

- Identifying U-M researchers to serve on the Report Team,
- Identifying experts to serve as peer review panelists,
- Coordinating Advisory Committee input and broader stakeholder engagement,
- Working with the Report Team to ensure the final IA products meet established guidelines and address significant comments received from the review panel, and
- Making final editorial decisions regarding IA content.

The Integration Team members are:

- Maggie Allan, Integrated Assessment Program Specialist, U-M Graham Sustainability Institute
- Mark Barteau, Director, U-M Energy Institute
- John Callewaert, Integrated Assessment Center Director, U-M Graham Sustainability Institute
- Andy Hoffman, Director, U-M Erb Institute for Global Sustainable Enterprise
- Drew Horning, Deputy Director, U-M Graham Sustainability Institute
- Andrew Maynard, Director, U-M Risk Science Center
- Don Scavia, Director, U-M Graham Sustainability Institute
- Tracy Swinburn, Managing Director, U-M Risk Science Center

Report Team
The Report Team consists of the following U-M researchers:

Researcher	Expertise	U-M Unit
Diana Bowman	Risk science & health policy	School of Public Health; Risk Science Center and Department of Health Management and Policy
Brian Ellis	Geology	College of Engineering; Department of Civil and Environmental Engineering
Sara Gosman	Law	Law School
Ryan Kellogg	Economics	College of Literature, Science, and the Arts; Department of Economics
Eric Kort	Atmospheric science	College of Engineering; Department of Atmospheric, Oceanic and Space Sciences
Shaw Lacy	Environment/water	Graham Sustainability Institute
John Meeker Ryan Lewis	Environmental health	School of Public Health; Department of Environmental Health Sciences
Johannes Schwank	Chemical engineering	College of Engineering: Department of Chemical Engineering
Kim Wolske	Risk communication & engagement	School of Natural Resources and Environment and the Ross School of Business; Erb Institute

This team will:

- Receive funding from the Graham Institute commensurate with their level of engagement to carry out the analysis.
- Collaborate with other report team members to identify common themes, strategies, and policies.
- Prepare and review report content,

- Seek consensus on the report. If consensus cannot be reached on any issue, it will be brought to the Integration Team who may seek additional outside expertise. If the Integration Team cannot reach consensus, then the Graham Institute will make final editorial decisions.

Advisory Committee
The following committee has been assembled to advise current project efforts:

- Valerie Brader, Senior Strategy Officer, Office of Strategic Policy, State of Michigan
- James Clift, Policy Director, Michigan Environmental Council
- John DeVries, Attorney, Mika Meyers Beckett & Jones; Michigan Oil and Gas Association
- Hal Fitch, Director of Oil, Gas, and Minerals, Michigan Department of Environmental Quality
- Gregory Fogle, Owner, Old Mission Energy; Michigan Oil and Gas Association
- James Goodheart, Senior Policy Advisor, Michigan Department of Environmental Quality
- Tammy Newcomb**,** Senior Water Policy Advisor, Michigan Department of Natural Resources
- Grenetta Thomassey, Program Director, Tip of the Mitt Watershed Council
- John Wilson, President, TMGEnergy

The committee's role is to provide input and advice reflecting the views of key stakeholder groups and to ensure the IA scope is relevant to decision makers. Committee members may also provide data and input to the Report and Integration Teams throughout the process, including feedback on the policy topics, analytic approach, and format of the IA and review of draft reports. As with preparation of the technical reports, all decisions regarding content of project analyses and reports will be determined by the IA Report and Integration Teams.

Stakeholders
The project will continue to include broad stakeholder engagement to ensure public viewpoints are included as input to the process. An online comments/ideas submission webpage (http://graham.umich.edu/knowledge/ia/hydraulic-fracturing/comment) was established at the start of the project to direct public input to research teams, and it will remain open until the IA has concluded.

Upon release of the technical reports in September 2013, the public was invited to provide input to inform the IA for a 30-day period. The more than 200 comments received were all carefully reviewed, organized, and shared with the technical report authors, Integration Team, Report Team, and Advisory Committee to aid in developing the IA plan. Key comment themes include:

- Environment
- Water quality and quantity
- Health and safety
- Air quality
- Community and social impacts
- Net economic benefits
- Alternative and renewable energy
- Climate change
- Waste fluid management
- Construction and engineering practices
- Chemical disclosure
- Liability and remediation
- Monitoring
- Compliance/enforcement
- Public participation
- Transparency

Similar to what was done upon releasing the technical reports, another public webinar will be scheduled to coincide with the release of the draft IA report. Comments on the draft IA report will be sought through a publicly available web-based form and through direct solicitation of experts who represent a balanced mix of sectors with significant expertise and interest on the topic (e.g., industry affiliates, environmental organizations, academics, policymakers).

Review Panel
To ensure a rigorous, scientific analysis of the topic, the Integration Team will identify subject area experts representing multiple disciplines to serve on a peer review panel. As technical experts on the subject, reviewers will evaluate the scientific credibility, rigor, and integrity of the assessment.

Panelists will receive the draft IA report and a summary of the public and directly-solicited comments. After preparing individual reviews, panelists will meet in person to discuss their reviews and the draft IA report. The panel will then provide a single, final written review of the draft IA. Reviewers will be reimbursed for travel expenses by the Graham Institute and receive a modest honorarium for their time.

Based on the review panel and public comments, the Report Team will prepare the final IA report. Responses will be prepared to address the issues raised by the review panel and public comments, and to explain how comments were incorporated into the final IA.

4. The Integrated Assessment Report

The report outline and approach proposed below is intended to guide the Integrated Assessment; however the final version of the report will be determined through the analysis, comment, and review processes.

Purpose and Approach

The purpose of the IA is to present information that expands and clarifies the scope of policy options in a way that allows a wide range of decision-makers to make choices based on their preferences and values. As a result, the IA will not advocate for a single, recommended course of action. Rather, it will present information about the likely strengths, weakness, and outcomes of various courses of action so that decision-makers in Michigan can then make informed choices.

Integrated Assessment Scope

The guiding question—*What are the best environmental, economic, social, and technological approaches for managing hydraulic fracturing in the State of Michigan?*—bounds the scope of the IA. While the IA will focus on Michigan it will also take advantage of learnings from other locations that are relevant to Michigan's geology, regulations, and practices, and keep an eye toward how its findings may be useful elsewhere. Additionally, the IA will primarily concentrate on high volume hydraulic fracturing (defined by the Michigan Department of Environmental Quality guidelines as well completions that intend to use a total of more than 100,000 gallons of hydraulic fracturing fluid), but the Report Team's analysis of options may also consider implications for other practices or include options for different subsets of wells.

The IA will also acknowledge and summarize important issues that relate to but are beyond the scope of the IA, including issues raised in the public comments.

Policy Analysis

The IA will focus on key issues emerging from the technical reports, input from the Advisory Committee, and public comments. Rather than making recommendations, the IA will identify a range of possible policy options and approaches. Using both qualitative and quantitative methods, the IA will evaluate the likely effects (environmental, economic, social, and community-related) of the various approaches and identify key uncertainties. The IA will also consider how the policy options may play out under different potential futures.

Additional Considerations

The IA will identify limitations and additional knowledge needs and discuss additional data and support tools.

Resources

Because the scientific, legal, and business landscape related to hydraulic fracturing is continuously evolving, the final IA report will incorporate and cite additional resources as needed to account for new information not contained in the technical reports.

5. Timeline

The final Integrated Assessment report will be available in 2015.

Timeframe	Action/Deliverable
Fall 2014	Draft IA Report
January 2015	Advisory Committee Review of Draft IA Report
February 2015	30 Day Public Comment Period
March 2015	Peer Review of Draft IA and Public Comments
Spring 2015	Revise, Finalize, and Release IA Report

6. Funding

The project is entirely funded by the University of Michigan.

The project is expected to cost at least $600,000 with support coming from U-M's Graham Institute, Energy Institute and Risk Science Center. Current funding sources are limited to the U-M General Fund and gift funds, all of which are governed solely by the University of Michigan

7. Ensuring a Rigorous, Scientific Analysis

It is imperative that no aspect of the Integrated Assessment process be compromised by real or apparent conflicts of interest.

For this initiative, the term "conflict of interest" means any financial or other interest that conflicts with the service of the individual because it (1) could significantly impair the individual's objectivity or (2) could create an unfair competitive advantage for any person or organization. Therefore, all Technical Report authors, IA Report and IntegrationTeam members, and peer reviewers have completed or will complete conflict of interest forms (adapted from National Academy of Sciences materials) indicating they have no conflicts (financial or otherwise) related to their contributions to this initiative.

More information at: http://graham.umich.edu/knowledge/ia/hydraulic-fracturing or contact John Callewaert, Graham Institute Integrated Assessment Center Director, (734) 615-3752, jcallew@umich.edu.

This is a planning document and, thus, constitutes a work in progress. Because it is a work in progress, it is incomplete and subject to revision. The content does not reflect a consensus position and is not intended to limit on-going discussions of project pathways or preclude new options from being considered. This is not an official document and as such, this document is not to be quoted, cited in any reference, or used by anyone for any purpose other than as a planning document.