



# National Consortium for Remote Sensing in Transportation Streamlining Environmental and Planning Processes

---

## Streamlining Transportation Corridor Planning Processes and Validating the Application of CRS&SI Technologies for Environmental Impact Assessments

---

Charles O' Hara, MSU  
Roger King, MSU  
Jeremiah Dumas, MSU  
Bethany Stich, MSU  
Suyoung Seo, MSU

Colin Brooks, MTRI  
Richard Wallace, MTRI  
Bob Shuchman, MTRI

Demin Xiong, ORNL CTA  
Patricia Hu, ORNL CTA  
Bill Knee, ORNL CTA





# National Consortium for Remote Sensing in Transportation Streamlining Environmental and Planning Processes

## Partners

### Consortia Partners:

GeoResources Institute, Mississippi State University

MichiganTech Research Institute

Oak Ridge National Laboratory, NTRC and CTA



### DOT Partners:

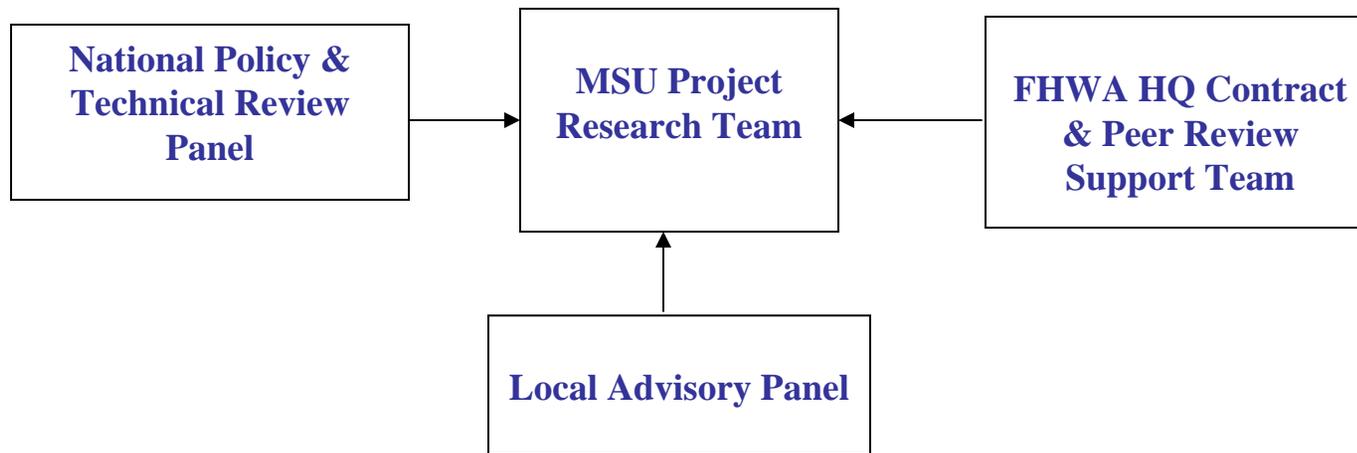
Mississippi DOT

Tennessee DOT

Michigan DOT



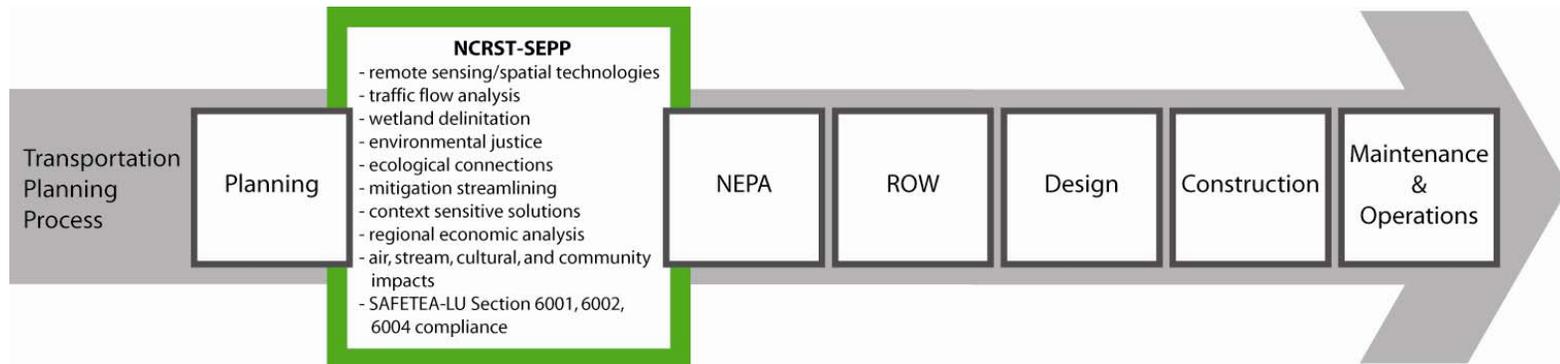
## Advisory Panel Structure



### Initial Challenges and Opportunities Identified by Advisory Panel

- Executive Order 13274: Environmental Stewardship and Transportation Infrastructure Project Reviews and Associated Work Groups
- Ecosystem Approaches and Banking
- Watershed Approaches
- Cooperative Conservation
- Initial Scenario Planning
- GIS for Environmental Streamlining and Stewardship Workshops
- Programmatic Approaches to the Endangered Species Act
- Wildlife Crossings and Habitat Fragmentation
- Context Sensitive Solutions
- Green Highways Initiative

## NEW DOT RITA CRS&SI PROGRAM



- The new US DOT RITA program has selected MSU for addressing corridor planning and environmental assessment in new and innovative ways that can be compared to traditional approaches.
- Our primary focus is on the application and validation of new and innovative approaches that can be compared to results of the EIS recently completed for I-69 segment 9. The results of this will enable adoption of methods and accelerate the acceptance and technology transfer needed to deliver the new technologies.

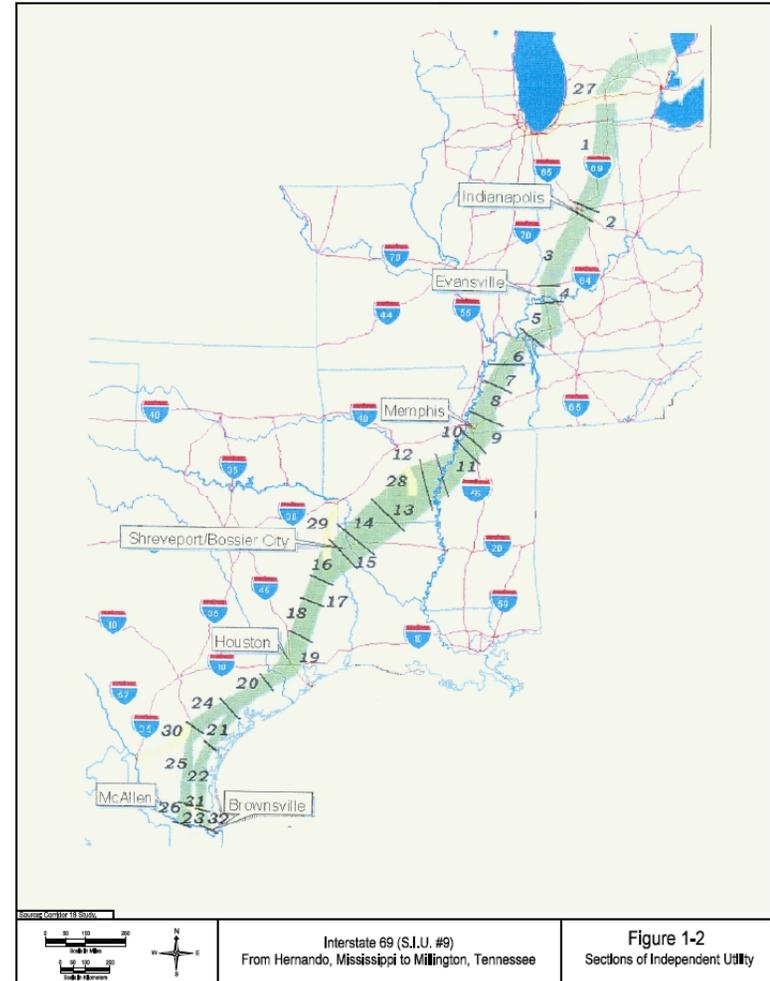
## Existing MSU CRS&SI EIS Streamlining Project Summary

New and innovative approaches to streamlining environmental and planning processes in transportation corridors projects will be demonstrated by the application of commercial remote sensing data and spatial information technologies. A consortium of research institutions led by Mississippi State University shall collaborate with partner DOT agencies to compare and quantify benefits of new and innovative approaches versus traditional methods for completing planning tasks in the EIS process. A completed EIS for a planned segment of I-69 that traverses areas around Memphis, TN, and Northwest Mississippi shall serve as the research test bed to quantify benefits delivered by the technology deployment project.

In addition to streamlining research, the project shall also address Hurricane Katrina lessons learned to derive nationally significant considerations and motivations toward enhanced geospatial preparedness for application to transportation planning practices.

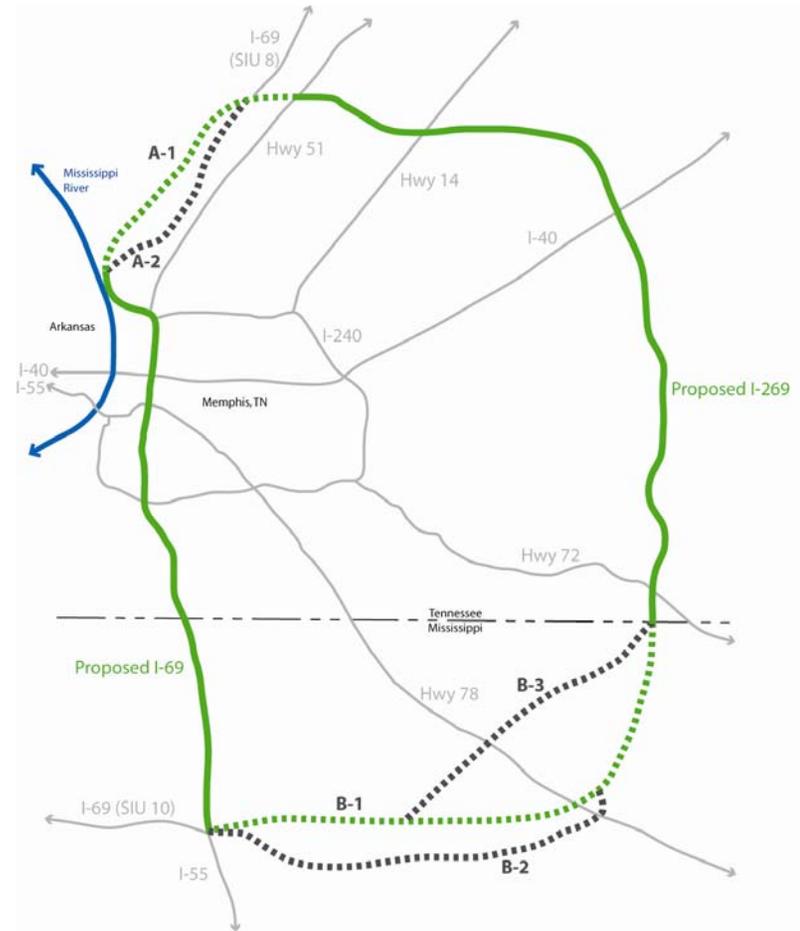
### Traditional EIS: I-69 SIU 9

A Final Environmental Impact Statement (FEIS) is completed for a segment of proposed Interstate 69 (I-69). The selected study will focus on Segment of Independent Utility 9 (SIU 9). The study corridor begins at the Interstate 55 (I-55) and Mississippi 304 (MS 304) Interchange in Hernando, Mississippi and extends north through Memphis, Tennessee to the intersection of US Highway 51 (US 51) and State Route 385 (SR 385) in Millington, Tennessee. The project is located in DeSoto and Marshall Counties in northwest Mississippi and Shelby and Fayette Counties in southwest Tennessee.



## I-69 SIU 9 Study: The I-69/269 Corridor Study

Different planning and environmental challenges were noted in various segments within the project area. These segments provide an ideal set of test beds for analysis and a basis for conducting direct comparative studies.



NCRST-SEPP I-69/269 SIU 9 Project Testbed alternatives A-1,2 and B-1,2,3 shown

## Project Activities and Coordination

- Twelve team tasks and activities are specified in the proposal.
- A kick-off meeting was conducted to initiate activities and refine plans and approaches for activities. An **“Initial Findings”** report has been prepared and submitted that addresses areas where additional resources would enable enhanced capabilities to meet national objectives.
- **“Synthesis Reports”** are being prepared to present the traditional approach to each task and describe how new and innovative methods and technologies may be adapted to the task. Sponsor and advisory panel input will guide refinement of activities to focus on areas of national importance.
- All tasks and activities will involve close coordination and collaboration among team members, the advisory panel, DOTs, and consultants.
- Data exchange and generated data analysis products will be shared with DOTs and project partners.
- Each technical task will involve developing final reports and preparation of materials for technical conference presentation and/or journal publication.

## NCRST-E Background

- Mississippi State University led the former NCRST-E Consortium.
- Work highlighted in NCHRP 25-22(2).
- AASHTO Invited Speaker: August, 2007  
“Remote Sensing Data and Applications for Environmental Analysis in Corridor Planning”
- Innovative applications of multi-source commercial remote sensing data, collected early in project processes to deliver benefits to many aspects of project work.



# NCRST-E

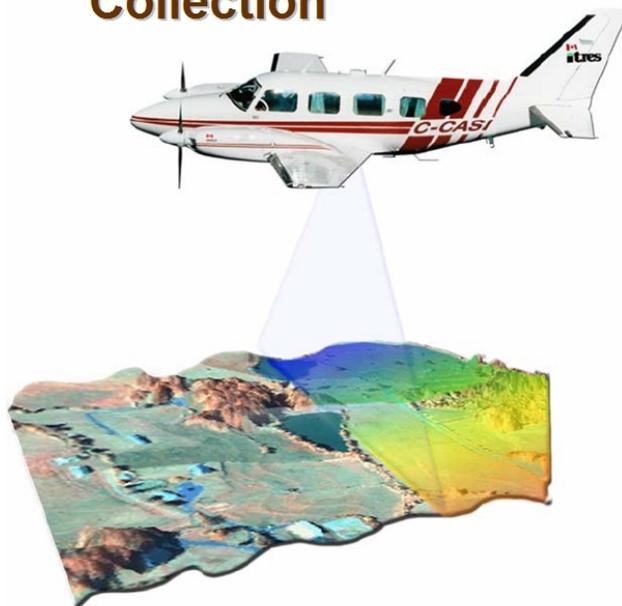
National Consortium on Remote Sensing in  
Transportation - Environmental Assessment

## Key NCRST-E Milestones

- Results were highlighted in NCHRP 25-22(2)
- Conducted multiple demonstration projects
- Partnered closely with DOTs in many projects
- Communicated needs to data vendors for products
- Applied multi-source remote sensing data
- Innovative uses of hyperspectral image data
- Innovative uses of LIDAR data
- Innovative data-fusion for wetlands modeling
- Validation of satellite and aerial image data
- Application of results to corridor planning projects
- Assisted with Hurricane Katrina response
- Compiled Katrina RS data for long-term use
- Regional data acquisition for cooperative research

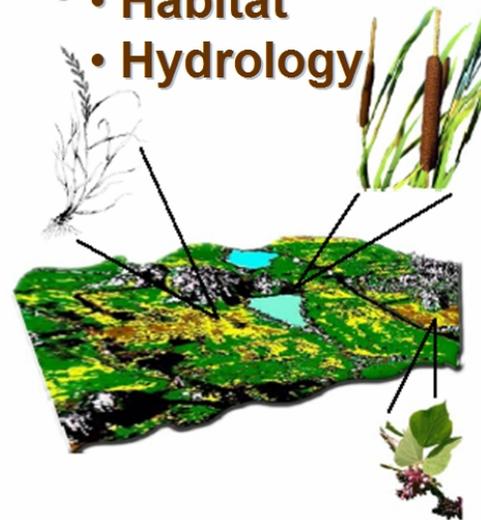
## NCRST-E Activities

**Aerial Remote  
Sensing Data  
Collection**



**Information Products**

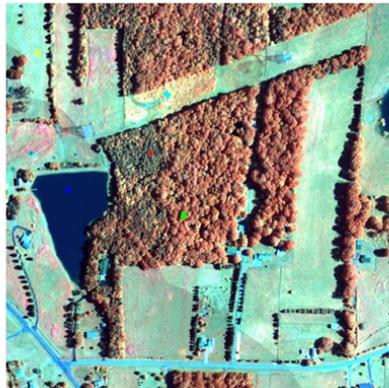
- Land Cover
- Terrain Models
- Wetlands
- Habitat
- Hydrology



# National Consortium for Remote Sensing in Transportation Streamlining Environmental and Planning Processes

## Hyperspectral Image Data

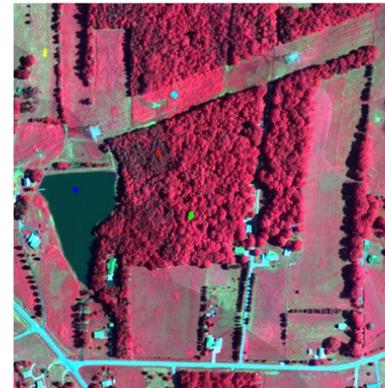
Color Infrared (CIR) View



True Color View



Pseudo CIR View

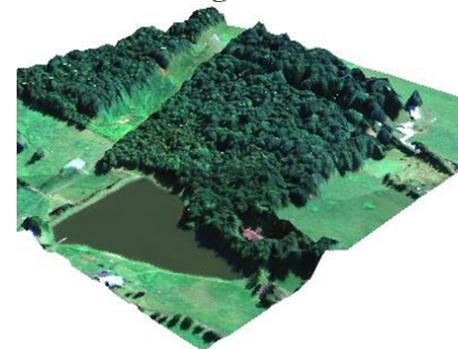


## Hyperspectral Image Data Benefits

- Many narrow spectral bands offers the ability to separate land cover features.
- Hyperspectral image data provide subtle spectral signatures of terrestrial targets.
- Using hyperspectral information enables ‘unmixing’ of pixels, thus improving confidence in classification results.

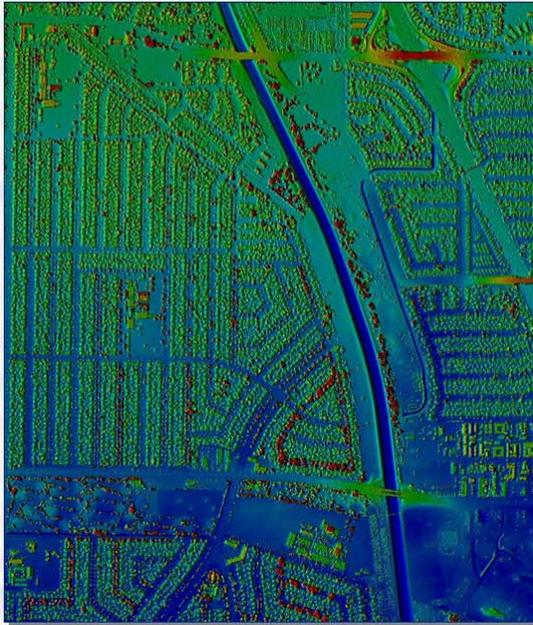
## Highly Useful Visualization

Hyperspectral Image Data Draped  
Over LIDAR Derived Digital Surface Model

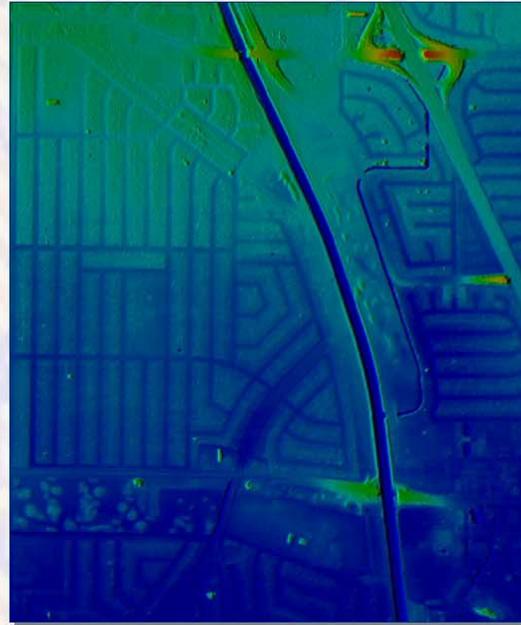


## NCRST-E LIDAR Applications

LIDAR Digital Surface Model



LIDAR Bare-Earth Terrain Model



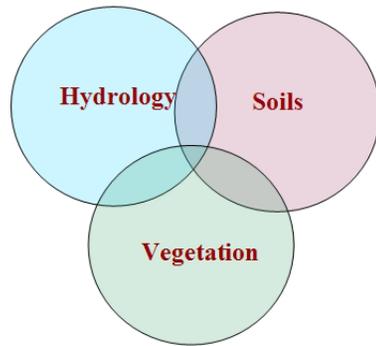
LIDAR Derived Extracted Features



### LIDAR Data Applications

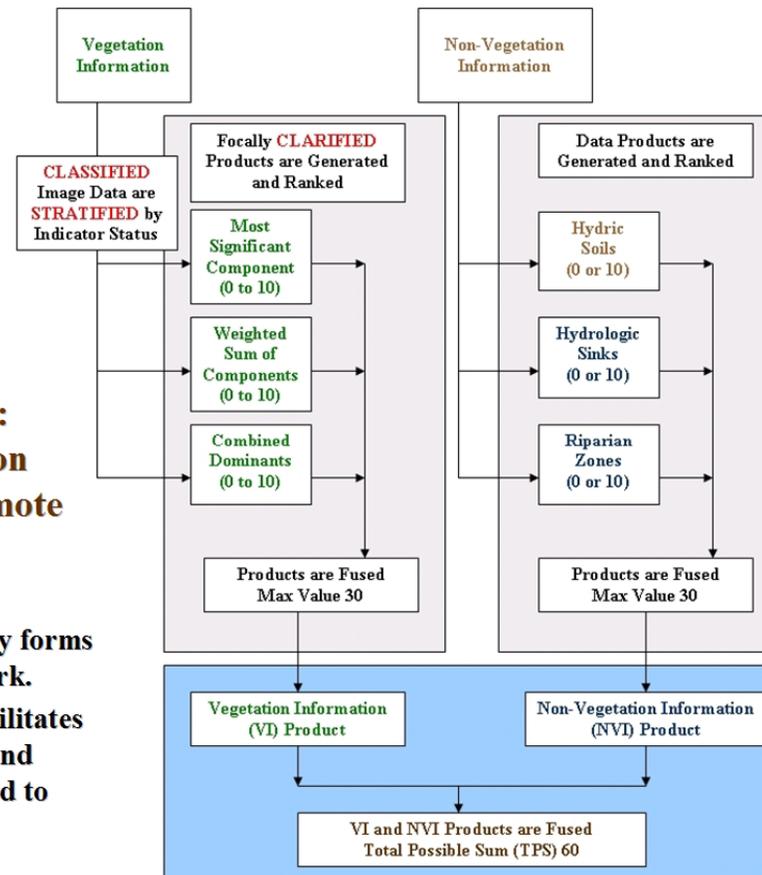
- Hydrologic analysis
- Riparian zone analysis
- Wetlands analysis
- Flood plain mapping
- Cut and fill estimates
- Vertically optimizing final alignments
- Estimation of stream impacts
- Slope and terrain analysis

### NCRST-E Wetlands Analysis



#### New Data and Enhanced Analysis: Wetland Mapping Analysis Based on Surrogate Representations From Remote Sensing Data Processing

- The assessment of vegetation, soils, and hydrology forms the basis of standard wetlands field assessment work.
- Determining how those assessments are made facilitates the development of surrogate processes using RS and geospatial technologies within algorithms developed to produce similar analytical map-based results.



### ORNL Research Background

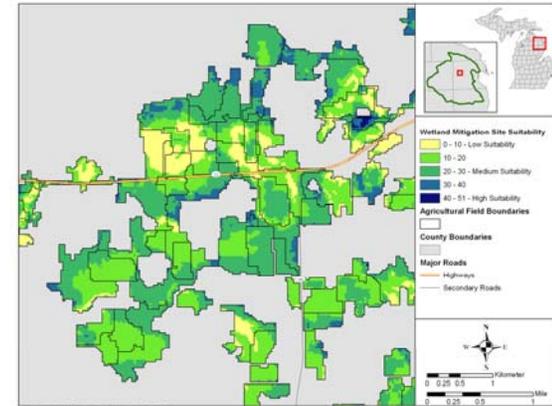
- Characterization and Attribution of Interconnected Multimodal Transportation Networks for the Selected Transportation Corridor
- Deliverable: An Analytical Multimodal Network for the Project Corridor
- Decision Support for Transportation Planning Options and Environment Assessments
- Deliverable: An Application Demonstration and the Overall Technical Report for the Project



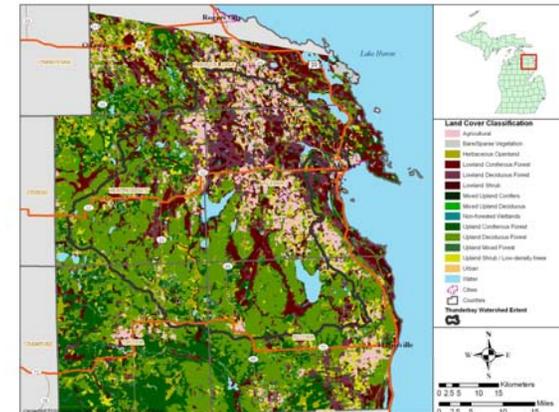
### MTRI Research Background

- Utilize wetlands mitigation site suitability index
- Map transportation-focused updated land cover including wetlands
- Characterize hydrology hydrologic high-resolution elevation data
- Map potential rare species habitat
- Demonstrate methods for estimating Annual Average Daily Traffic (AADT) using remotely sensed imagery

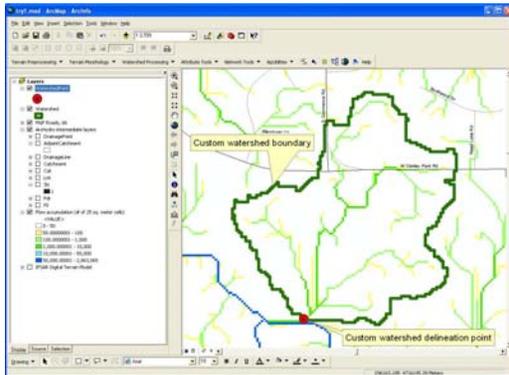
### Wetland Suitability Index



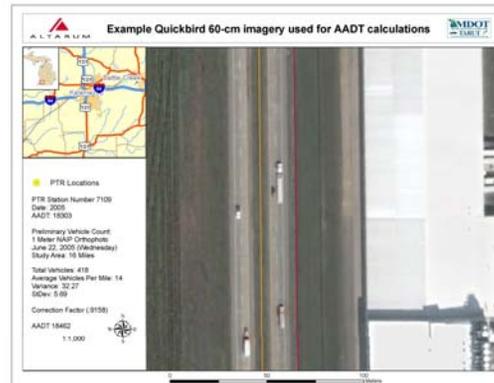
### Thunder Bay Land Cover



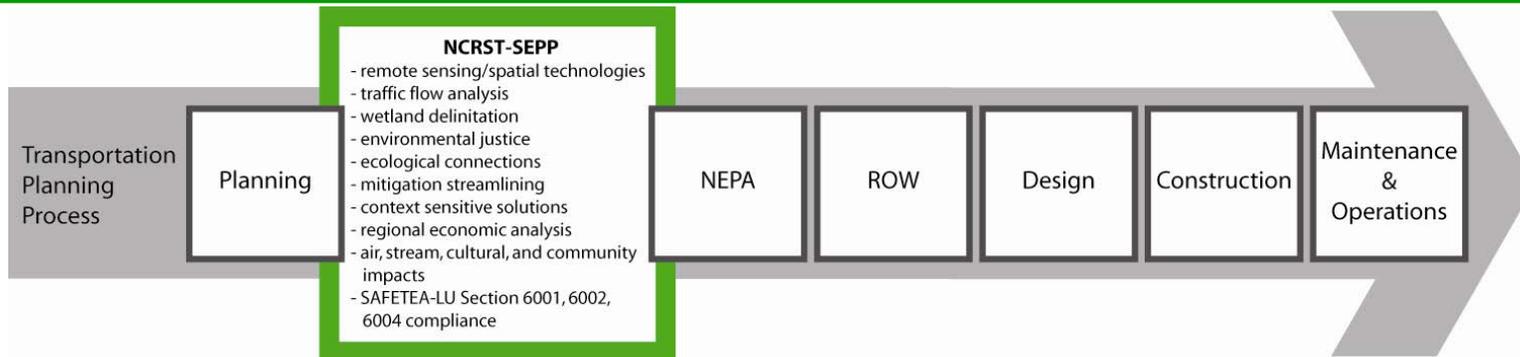
### Hydrologic Analysis



### AADT Estimations



# National Consortium for Remote Sensing in Transportation Streamlining Environmental and Planning Processes



## Initial Findings: Sponsor/Advisory Panel Input, Questions, and Suggestions

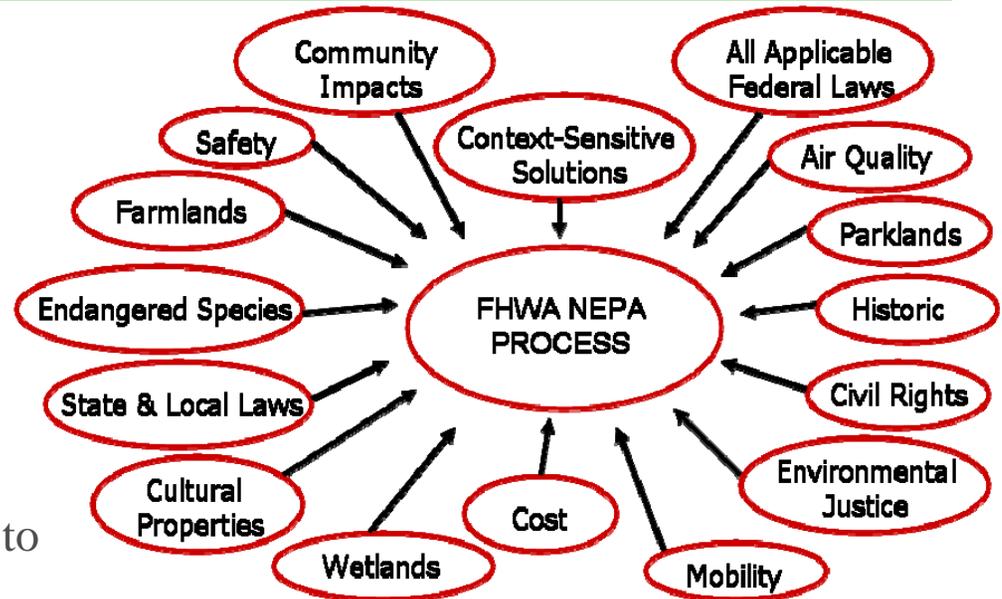
- Refine task descriptions to define specific phases of the corridor planning process? Are we looking at planning, NEPA, location, design, etc.
- Can we provide tools and data to early planning process that can feed into the NEPA process and be supplemented by additional tools and data?
- Enhanced data utilized in the NEPA process feeds back to planning and can enable improved long-term / future planning activities.
- Pre-NEPA consultation is a ripe area for RS data and tools that can be linked into pre-NEPA activities. This is a critical gap that can be addressed / filled. This is specific focus of SAFETEA-LU.

### Action Items

- Rework the task list and refine task descriptions to more aptly indicate process phase.
- Action Item: Provide improved NEPA diagram to comply w/ 6002.

### Observed NEPA Linkages & Program Opportunities

- Improve travel demand – inject technologies into simulation models for enhanced predictive capabilities
- Enhance visualization techniques for planning and EIS audiences
- Consider linkage and integrated applicability of tools and technologies to varying project processes and organizational entities of practitioners
- Include qualitative measures in results
- Identify benefits for saving costs
- Reducing processing time and costs
- Improve quality of product
- Readily accessible data in usable format



- Develop generic/transferable tools such as archaeological site identifications
- Delays increase overall project costs mainly in row costs and lost mitigation opportunities
- NEPA is a risk management process that may be enhanced by products of RS

### Synthesis Reports: Describe Traditional Approaches in EIS Studies & Present Opportunities for CRS&SI Technology Application

#### Matrix of Impacts Quantity of Displacements

#### Evaluation of Impacts Context of Displacements Quantity/Context/Intensity/Value

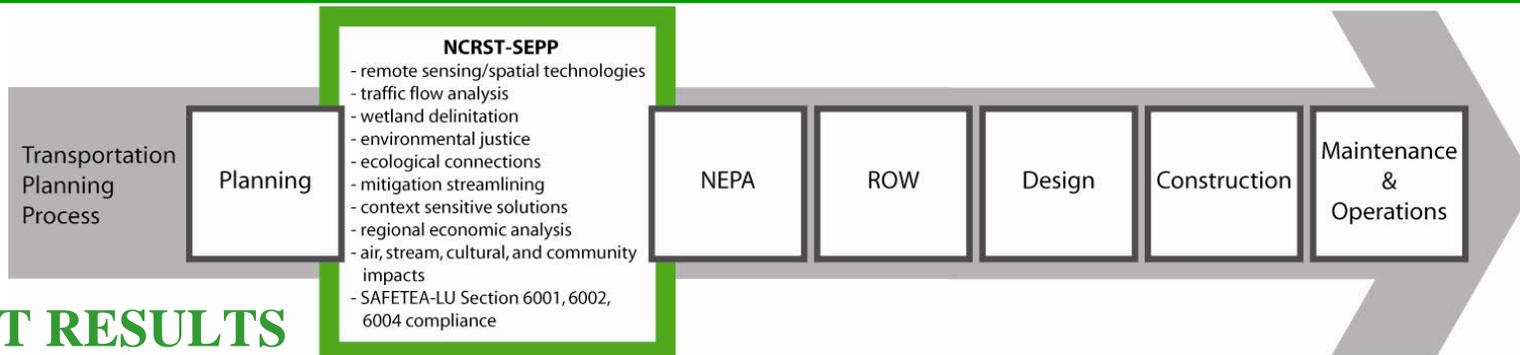
TABLE I  
SUMMARY OF ALTERNATIVES

Alternatives	A-1	A-3	B-1	B-2	B-3	A-1/ B-1	A-1/ B-2	A-1/ B-3	A-3/ B-1	A-3/ B-2	A-3/ B-3
Project Length (miles)	15.2	15.3	28.6	30.6	26.6	43.8	45.8	41.8	43.9	45.9	41.9
New Right-of-Way (acres)	739	798	1479	1552	1406	2218	2291	2145	2277	2350	2204
Family Displacements	21	60	64	53	52*	85	74	73*	117	113	112*
Business Displacements	2	5	6	6	1	8	8	3	11	11	6
Non-Profit Displacements	0	0	0	0	0	0	0	0	0	0	0
Farmland (acres)	128	95	435	497	253	563	625	381	530	592	348
Stream Crossings	21	20	39	46	37	60	67	58	59	66	57
Potential Linear Feet of Stream Impacts (feet)	9,590	8,620	15,780	20,980	13,850	25,370	30,570	23,440	24,400	29,600	22,470
Wetlands (acres)	48	53	69	51	6	117	99	54	122	104	59
Historic Properties Impacted	0	0	0	0	0	0	0	0	0	0	0
Recorded Archaeological Sites	11	9	20	22	15	31	33	26	29	31	24
Hazardous Waste Sites	0	1	0	0	0	0	0	0	1	1	1
Landfill Sites	3	4	0	0	0	3	3	3	4	4	4
Impacted Noise Receptors	3	29	70	68	43†	73	71	46†	99	97	72†
Construction Cost (\$ million)	233.4	264.9	416.5	462.0	368.8	649.9	695.4	602.2	681.4	726.9	633.7
Right-of-Way Cost (\$ million)	38.4	43.6	68.6	76.1	60.7	107.0	114.5	99.2	112.2	119.7	104.4
Utility Cost (\$ million)	2.8	3.1	4.9	5.4	4.3	7.7	8.2	7.1	8.0	8.6	7.5
Total Cost (\$ million)	274.6	311.6	490.0	543.5	433.8	764.6	818.1	708.5	801.6	855.2	745.6

Impacts are based on a 300-foot wide corridor.  
Cost data has been updated since the Draft EIS to reflect the most recent cost estimates.  
\* Because of the recent residential development along this alignment, B-3 has the potential to displace several hundred new homes in the Forest Hill Community subdivision.  
† Does not include future noise impacted residences in the Forest Hill Community subdivision that is currently under construction.



# National Consortium for Remote Sensing in Transportation Streamlining Environmental and Planning Processes



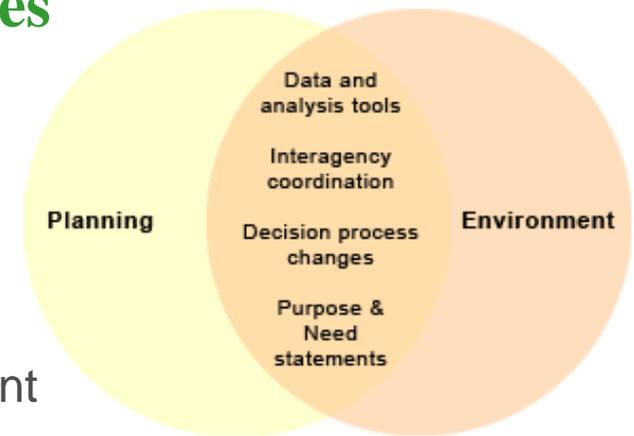
## SWOT RESULTS

### Brainstorming, Feedback, & Key Opportunities Identified

- Identify low-hanging fruit for injecting data/tools/technologies into pre-NEPA processes that will enable enhanced screening/constraints analysis as well as identification of avoidance areas that are mutually understood by DOT and resource agencies.
- Develop strategies/methods for communicating, visualizing, exchanging specific resource agency issues of concern for a given project and collection of resource agencies so that key resource agency concerns can be rapidly quantified and mitigation options presented.
- Look at things like the 20 year plan to identify opportunities to “get ahead” of environmental issues that can not be easily minimized and develop basis for common agreement with resource agencies that these are viable directions.
- Provide data to enable an informed conversation. Other issues will be raised and documented as they arise, but these “data enabled” decision processes may benefit significantly from appropriate injection of data/tools/and applicable products.
- Injecting qualitative attribution to the matrix of impacts as well as contextual basis for evaluating relative impacts for alternative assessment – “context and intensity.”

## Key New Activities: Linking Planning and Environmental Processes

- A system approach is proposed to integrate transportation, economic, environmental, and policy analysis approaches with RSSI technologies and transportation project development activities to deliver enhanced consideration of the built environment and enhanced overall streamlining benefits.
- Integrated use of new technologies within a RSSI technology framework will demonstrate the benefits of integrating the use of advanced tools and spatial data, and will provide key providing connections between system-level planning and project-level decisions. A key aspect of this demonstration will be to show that it provides DOTs the ability to integrate statewide and metropolitan transportation planning with the NEPA process to streamline project delivery.





## Conclusions

- The project team looks forward to directions, guidance, and feedback from the advisory panel and to communications, exchange, and collaborations with practitioner communities.
- A web site for the project will soon be available with enhanced capabilities for capturing input and enabling exchange among researchers and practitioners.
- Please feel free to send your questions, comments, and/or suggestions.

Thank You!  
Chuck O'Hara  
cgohara@gri.msstate.edu