New SHRP 2 Tools for Underground Utility Location, Data Collection, and Analysis

U.S. Department of Transportation

Federal Highway Administration

New SHRP 2 Tools for Underground Utility Location, Data Collection, and Analysis

Technical Support

Patrick Zelinski

Communications Associate, SHRP 2

Moderator

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Senior Program Officer, SHRP 2

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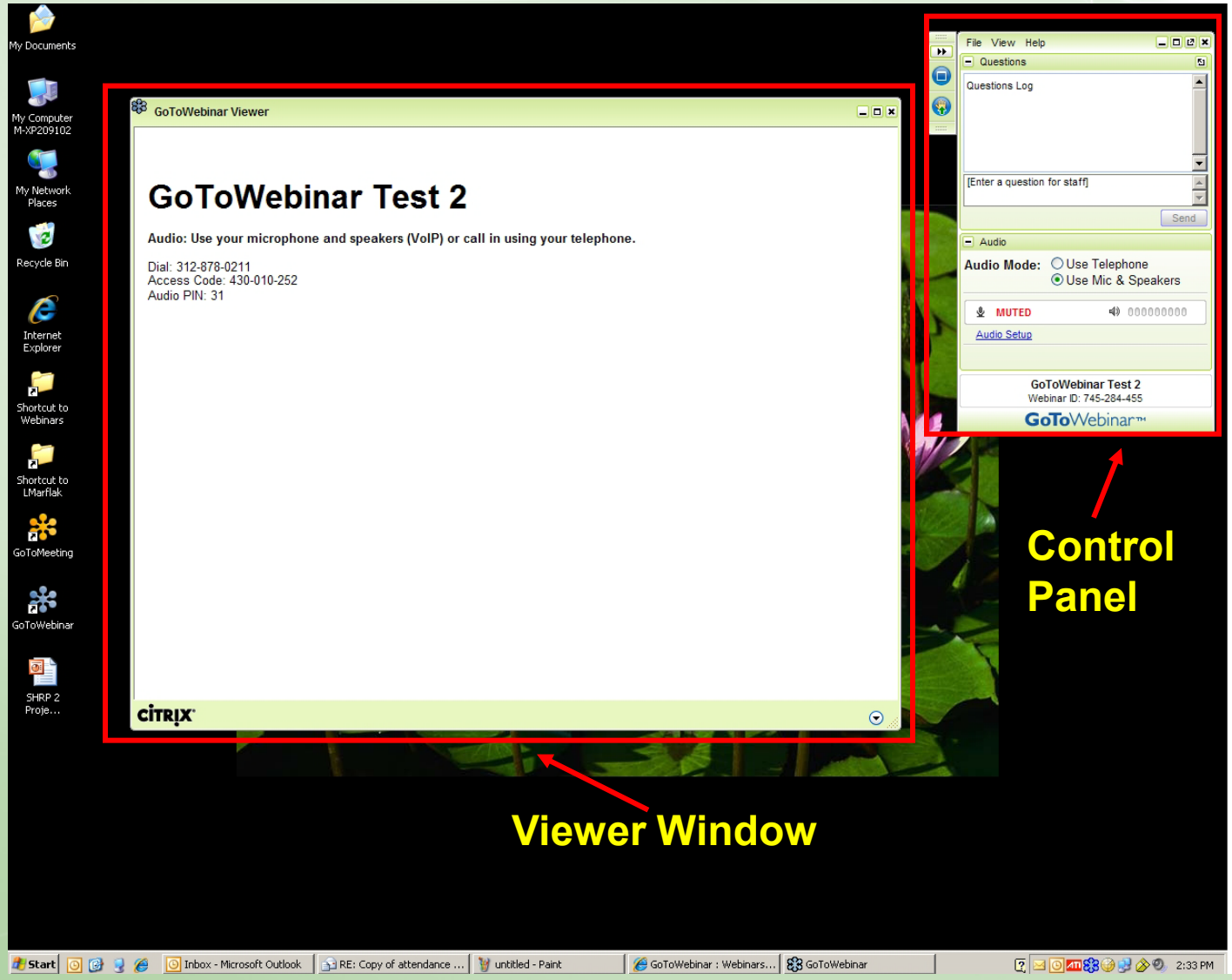

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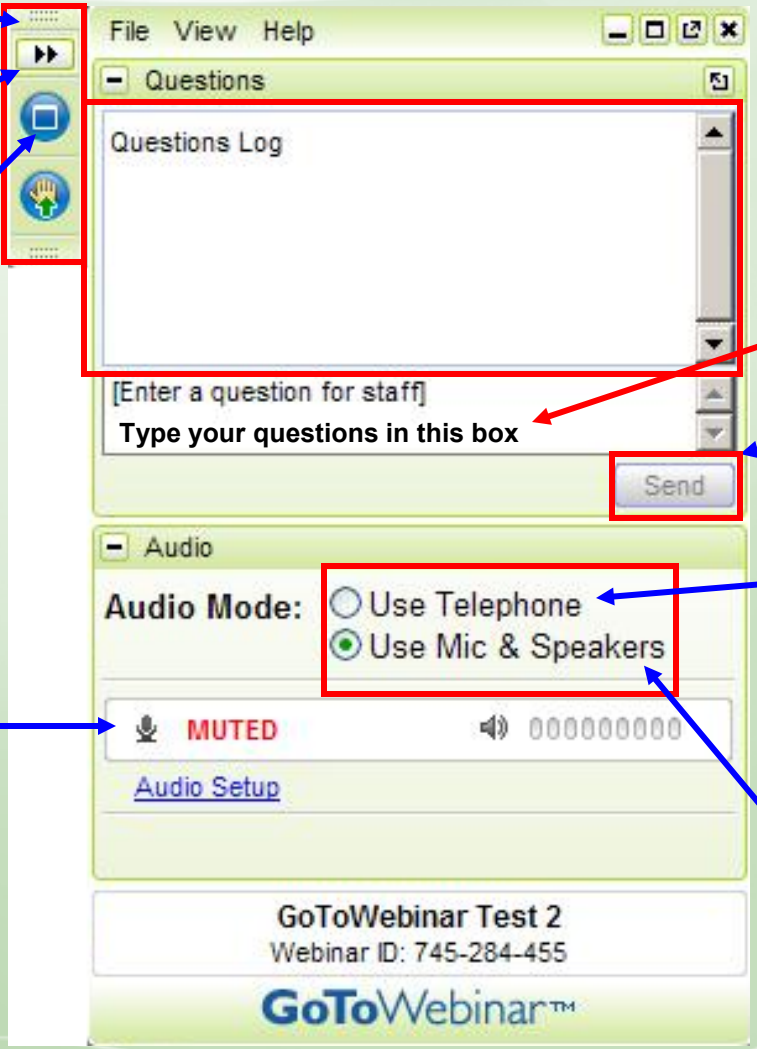

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  - A link to a recording of today's session
  - A link to a copy of the presenters' slides in PDF format

Attendance Poll Question

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Webinar Objectives

What is SHRP 2 doing to reduce the impacts of underground utilities on highway construction projects?

How will I be able to use the products of this SHRP 2 research?

Some Background

- 35 Million Miles of underground utilities (CGA)
- More being installed daily, deeper, with less detectable materials
- Much of the data on location, composition, ownership, and status (active or abandoned) is missing, incorrect, or incomplete
- Current technology/tools can find 80-90%
- Getting the remaining 10- 20% requires new tools

Impacts on Highway Construction

- Redesign costs
- Delay costs
- Change orders
- Claims
- Damages
  - Human casualties
  - Environmental releases
  - Repairs

SHRP 2 Utilities Research

- Develop new tools to locate that remaining 10- 20%:
  - Multi- Sensor Platforms (R01- B)
  - Locating Deep Utilities (R01- C)
- Innovative system to store, retrieve, analyze, visualize 3- D utility location data (R01- A)
- Optimized Utility Conflict Matrix system to organize, track, manage utility conflicts (R15- B)

August 15, 2011 Webinar

- Preliminary info on the functional design and intended use of these new tools
- Most tool prototypes have now been designed, fabricated, and tested
- Today's webinar will include the preliminary results of those tests

Webinar Agenda

- **Multi- Sensor Platforms**
  Gary Young (UIT): slides 16- 38
  Colin Kennedy (UIT)
- **Locating Deep Utilities**
  Chris Ziolkowski (GTI): slides 39- 59
- **Storing & Using 3- D Data**
  Bill Gale (GTI): slides 60- 83
- **Utility Conflicts & Solutions**
  Cesar Quiroga (TTI): slides 84- 102
- **Q&A and Wrap Up**
  Chuck Taylor (SHRP 2)

Questions to be Addressed

- What's different about these new tools?
- What new capabilities will they provide?
- Will they be more difficult to use?
- Will they require special training or operation only by specially- trained people?
- How will the costs to use these tools compare with those of today's tools?
- When will these new tools likely be commercially available?

Presentation Format for the 4 Projects:

- Project Background/Objectives
- Project Products
- Schedule and Status
- Prototype Test Results
- Answers to the Six Questions

What is SHRP 2?
(Strategic Highway Research Program)

- Authorized by Congress in 2005
- Conducted under a memo of understanding among AASHTO, FHWA, National Academies (TRB)
- Funds Provided through FHWA
- Program Recently Extended to March 2015
- Current Budget is $232.5 million

Project Review

RO1-B: Utility Locating Technology Development Utilizing Multi-Sensor Platforms

Prime Contractor: Underground Imaging Technologies, LLC

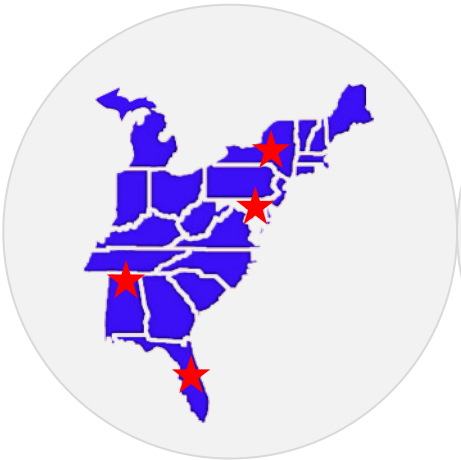
Gary N. Young, Principal Investigator

Colin M. Kennedy, Project Manager

SHRP2 STRATEGIC HIGHWAY RESEARCH PROGRAM

UIT UNDERGROUND IMAGING TECHNOLOGIES A Caterpillar Affiliate

Colin M. Kennedy



Certified Quality Auditor
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- Geophysicist at Underground Imaging Technologies LLC
- SHRP 2 R01-B Project Manager
- 15 years of progressive experience in the execution and management of geophysical investigations across North America for both near-surface environmental related projects and deep subsurface natural resources exploration projects.

SHRP 2 R01-B Outline

1. **Project Objective**
   - Current Systems
   - Limitations
2. **The New SHRP 2 R01-B Tools**
   - Seismic System
   - TDEMI System
   - Software
3. **Geophysical Service Costs**
4. **Availability of SHRP 2 R01-B Tools**
5. **Summary**

Project Objective

"This project will support improvements in the detection and accurate determination of positions of buried utilities beyond Quality Level B as defined by CI/ASCE 38-02…" (from SHRP 2 RFP)

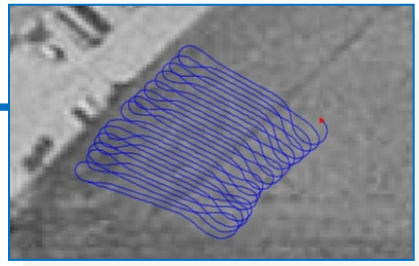
What does this mean?

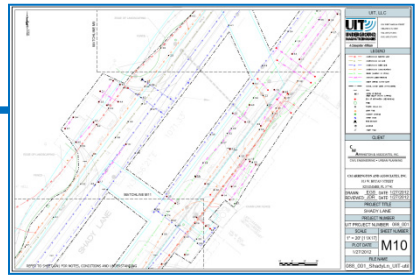
More Complete Quality Level B Investigations

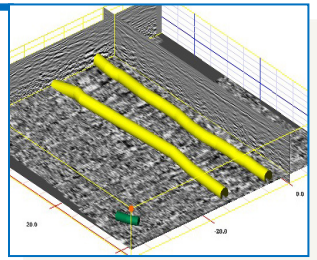
Currently Used Advanced Geophysics

In addition to standard pipe & cable locators, etc.

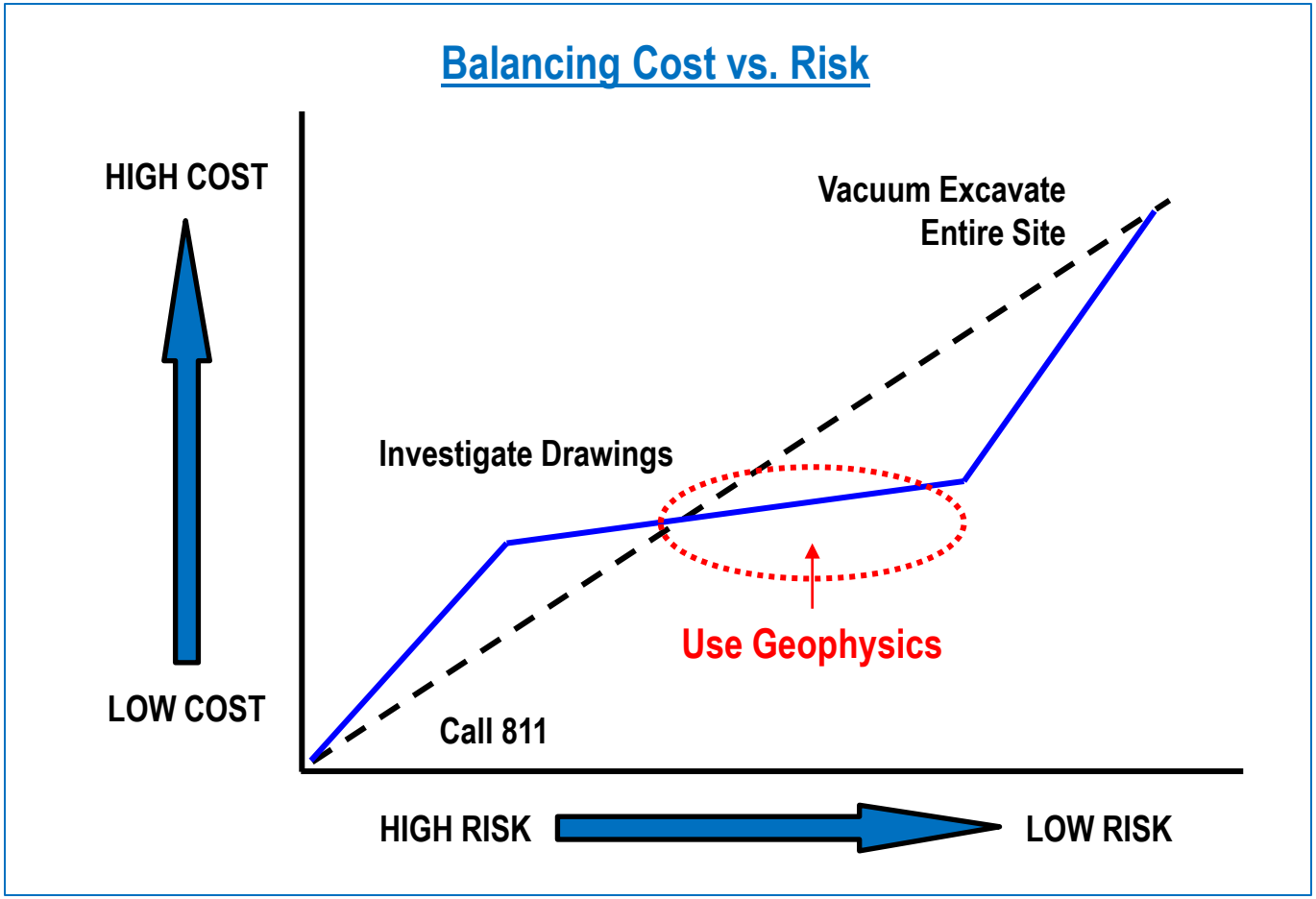
- **Multi-channel GPR**
  Produces 3-D subsurface images
- **Multi-sensors EMI**
  Aids in most soils
  No connection to utility
- **Choice of positioning (GPS or RTS)**
  Depends on needs of the job
- **In-field system integration**
  GPS with GPR and EMI
- **3D processing, visualization and interpretation**
  Critical and difficult
- **Final digital output**
  CAD in client's format
  Dataset for Machine Control and Guidance





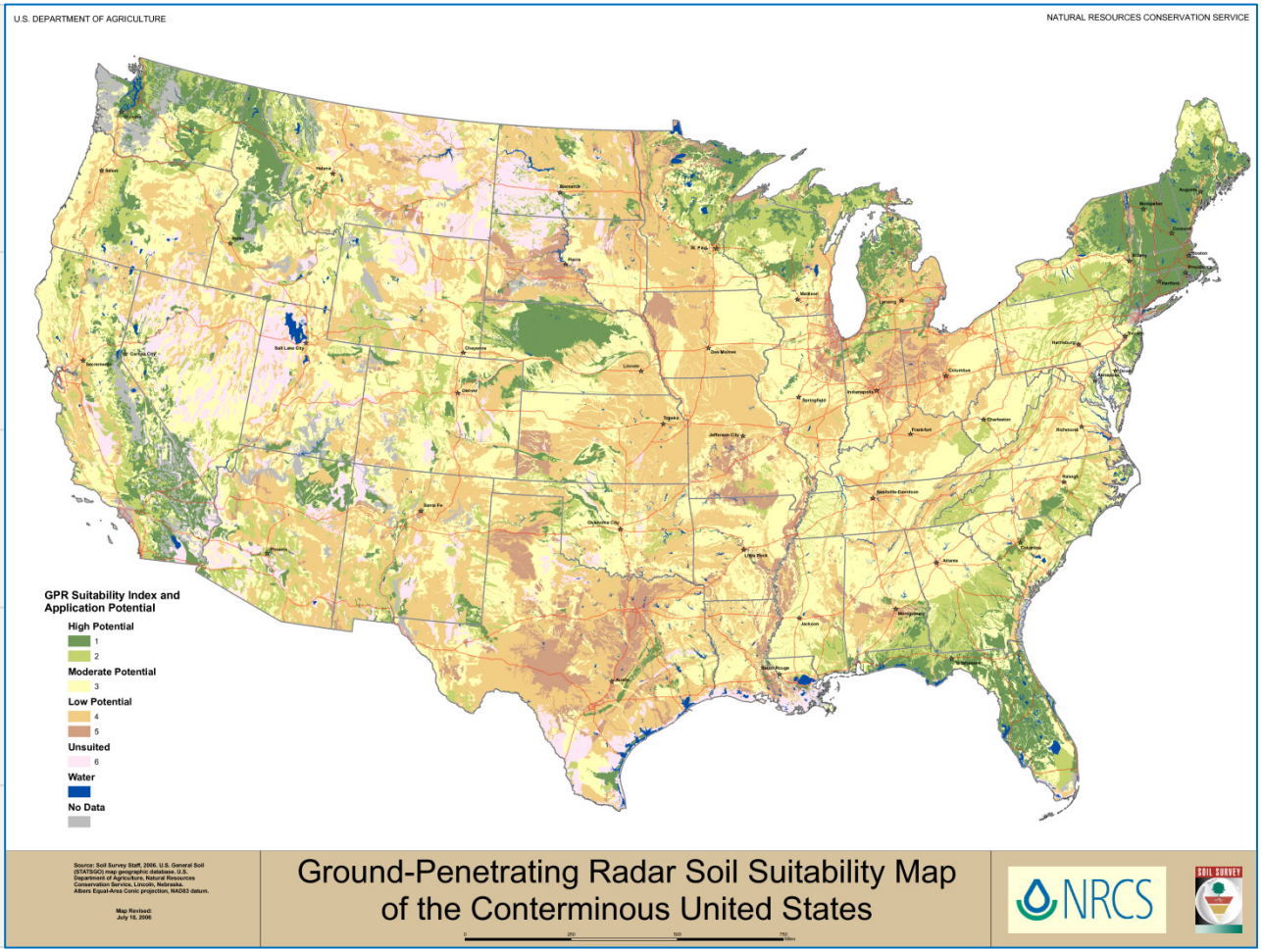


SHRP 2 R01-B Geophysical System(s) Cost Advantage



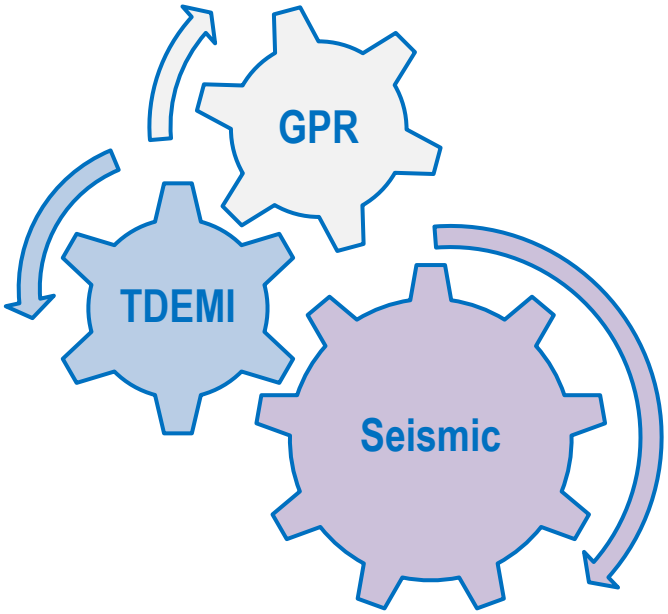
What are the Limitations?

- Varying Soil Conditions
- Utility Size
- Depth
- Density
- Composition



The New SHRP 2 R01-B Tools

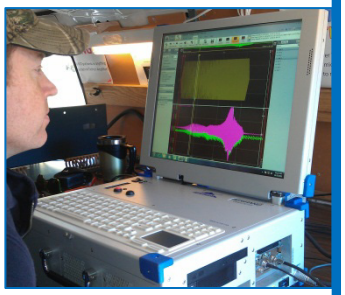
GOAL: Continuous Mapping and 3D Results

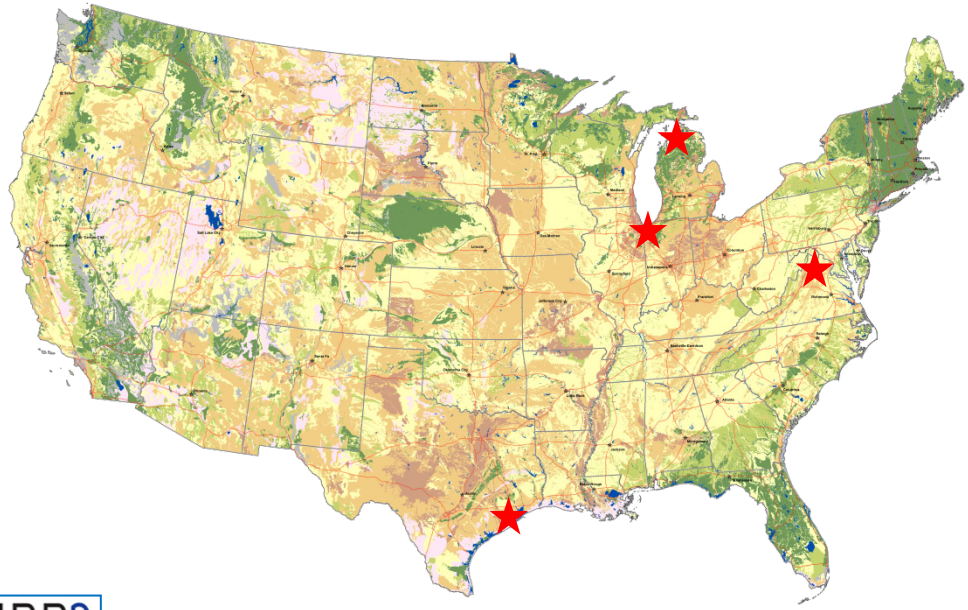


1. High Frequency Seismic (acoustic) Imaging System
2. Improved Time Domain Electromagnetic Induction System
3. Seismic Modeling Software
4. Improvements to Data Analysis Software

* Integration of precise and accurate positioning equipment

Seismic Soil Properties Testing





Seismic Soil Properties Testing Locations

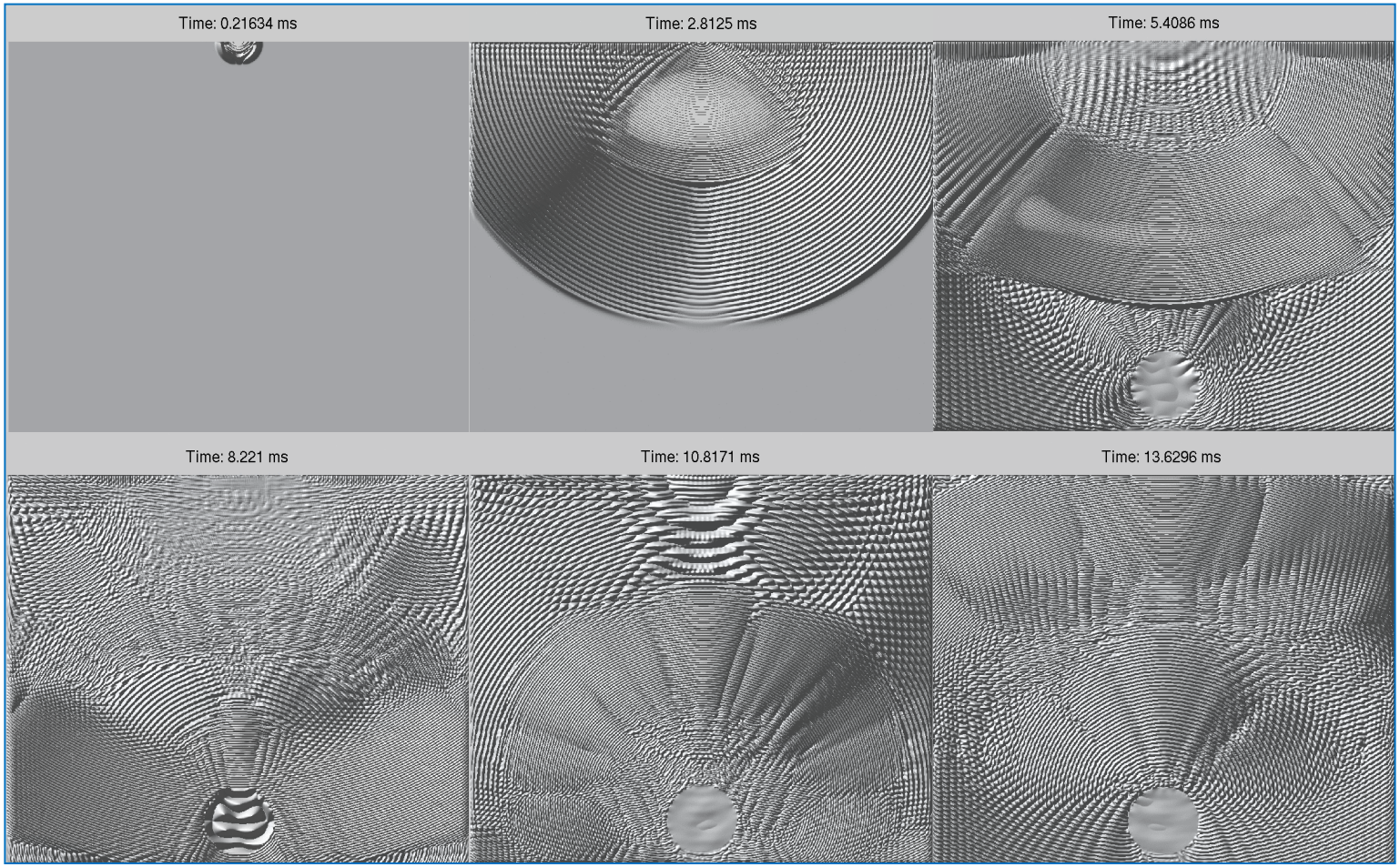
Traverse City, MI

Manteno, IL

Houston, TX

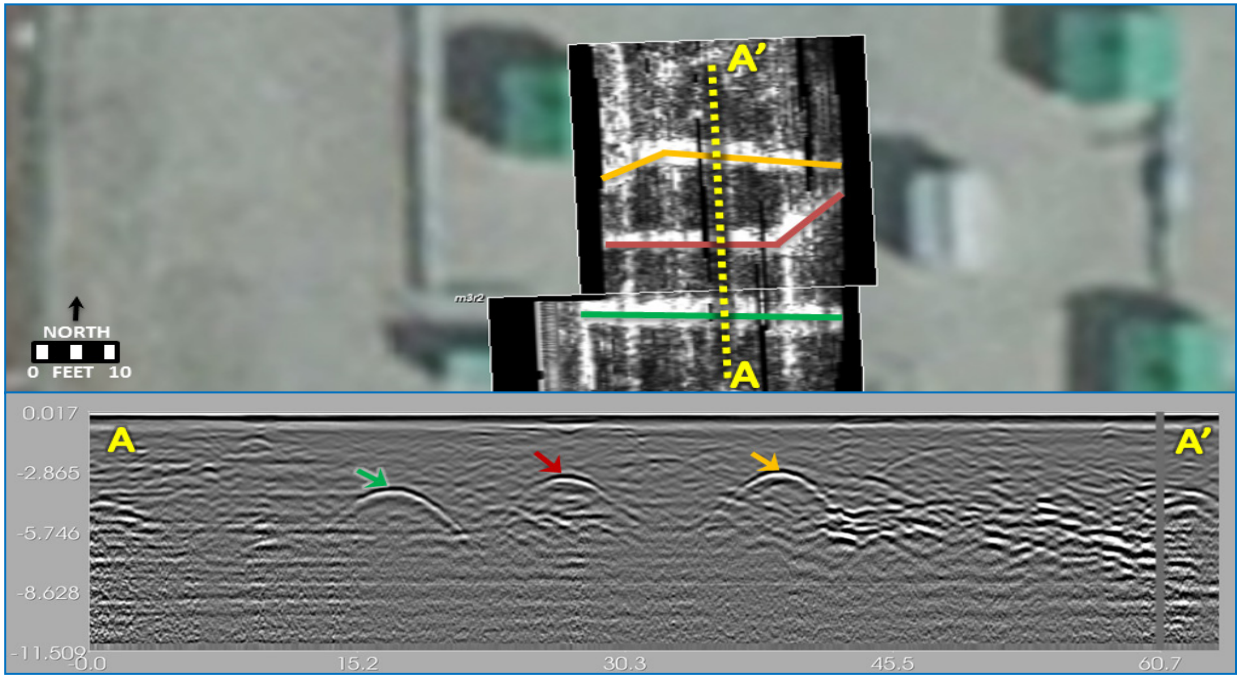
Manassas Park, VA

New Software: Seismic Modeling



Seismic System and Today's Geophysical Tools

- No such system is available today.
- The prototype seismic system will have a detection footprint and data format comparable to that of a multi-channel GPR unit **but will be effective in clay soils.**

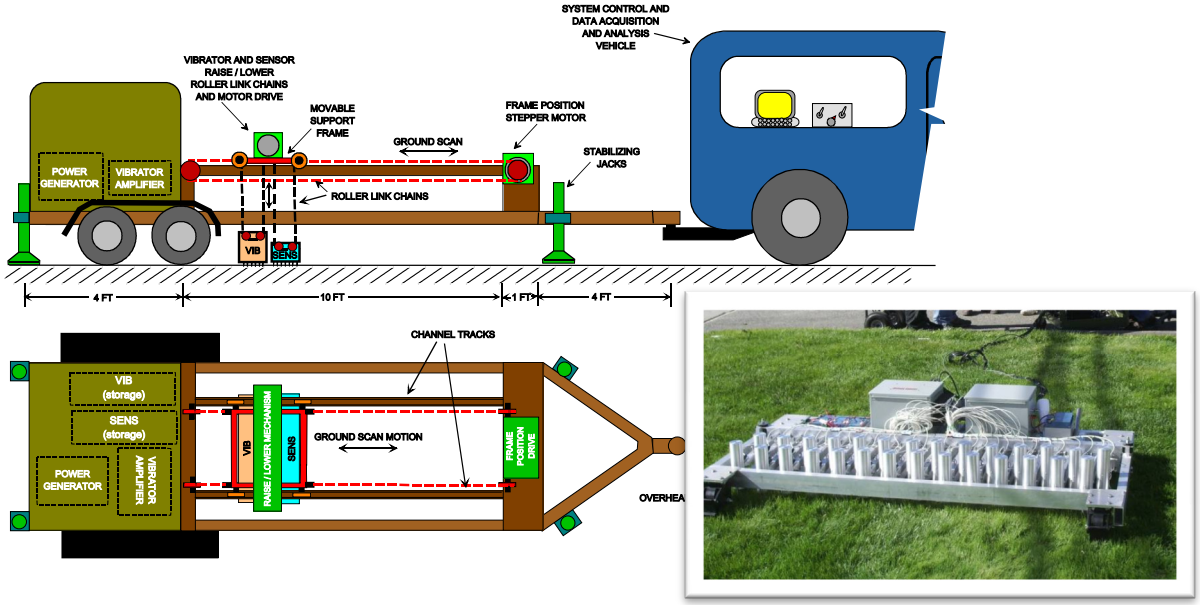


Stylized S-Wave Cross-Section To be Developed in a Similar Way to GPR

New System will use S-Wave Seismic With Reflection Imaging Processing To Make the Data the Same Format as GPR

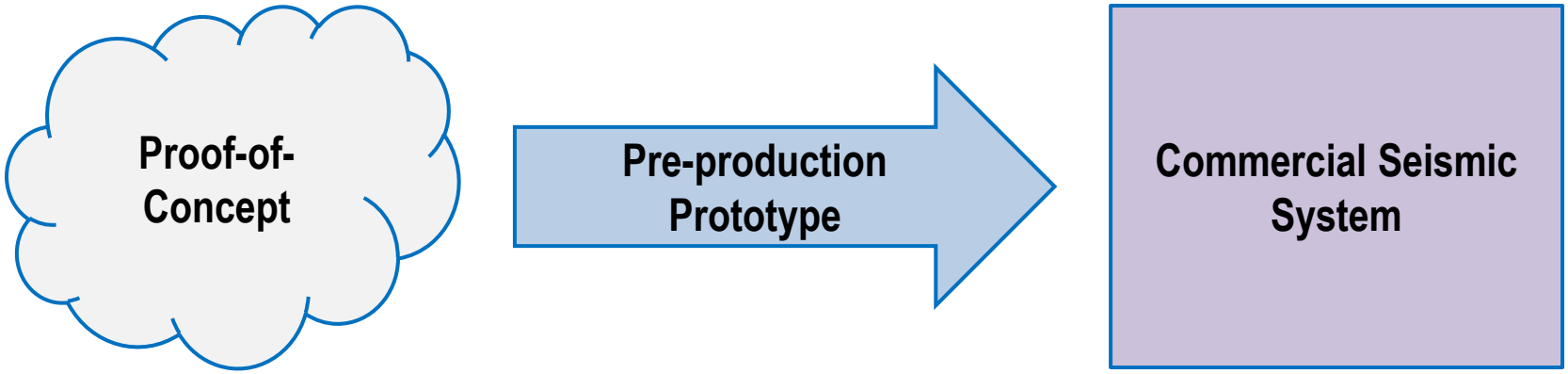
SHRP 2 R01-B Seismic System Prototype(s)

- The seismic prototype system will be complex.
- Data acquisition, data processing and data interpretation will require specially-trained operators and analysts.
- The seismic prototype will be relatively slow in acquiring data, difficult to transport/maneuver, and rely on several codependent components.



SHRP 2 R01-B Seismic Prototype(s) Development

- Proof of concept testing required for utility detection.
- The production system will be the 3rd step of development.



New Sensor: Improved Time Domain EM

Naval Research Lab System

UIT Current EMI Mapping System

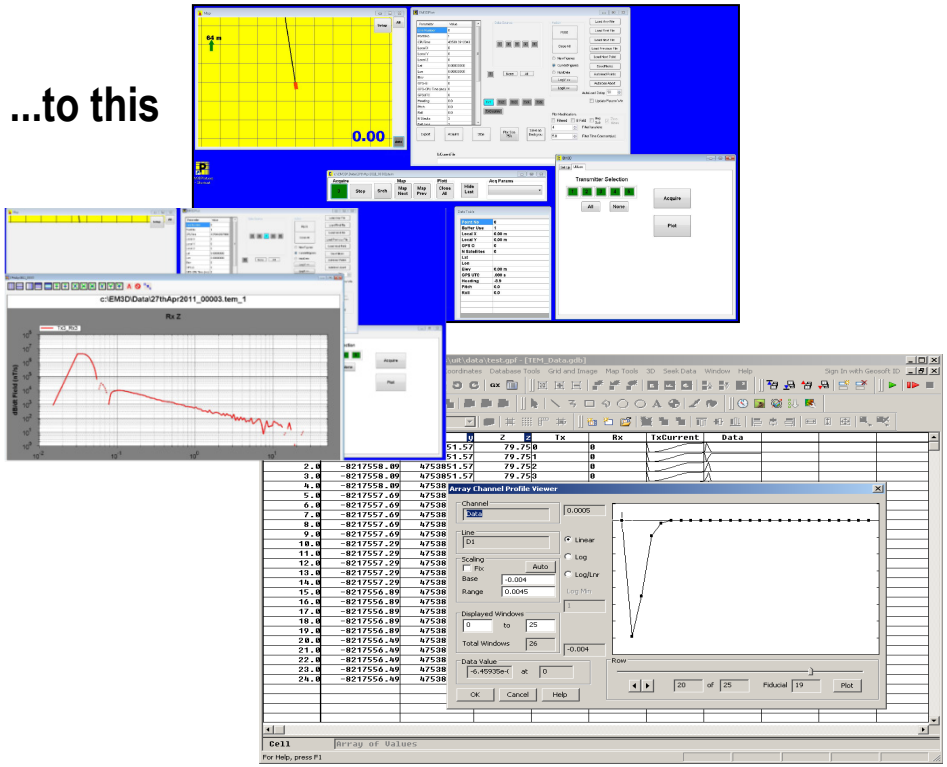
SHRP2 TEM Array

SHRP 2 R01-B Time Domain EMI System Software

Standard Locators Display vs. EM3D Program

From this…

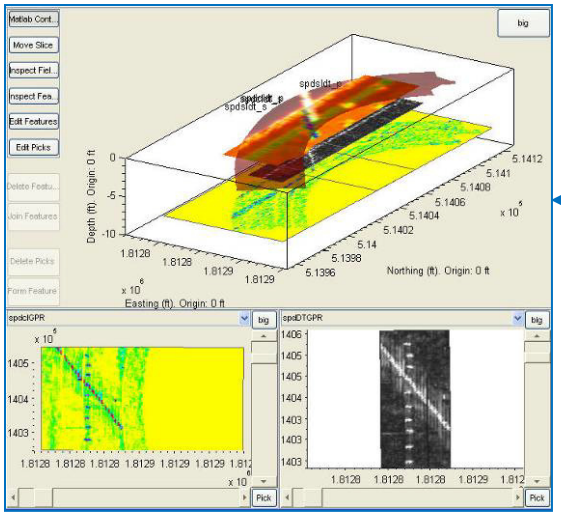
…to this



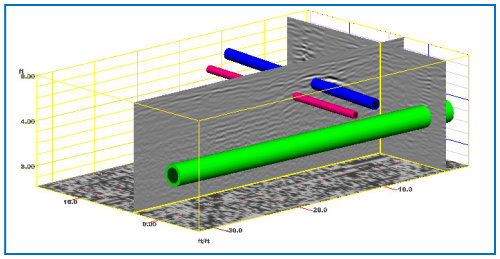
Comparison of SHRP 2 R01-B EMI System vs. Current EMI System

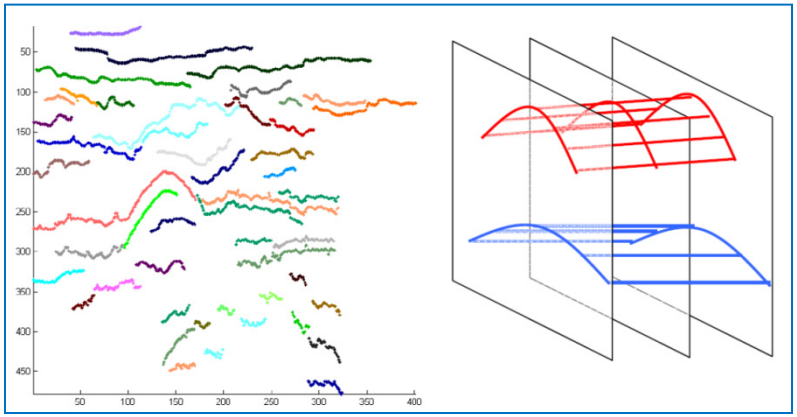
SHRP2 R01-B TDEMI Sensors	Current TDEMI Sensors
	
5 Tx/Rx pairs at 26 time gates = **3900** data points/second	1 Tx/Rx pair at 4 time gates x 3 sensors = **180** data points per second

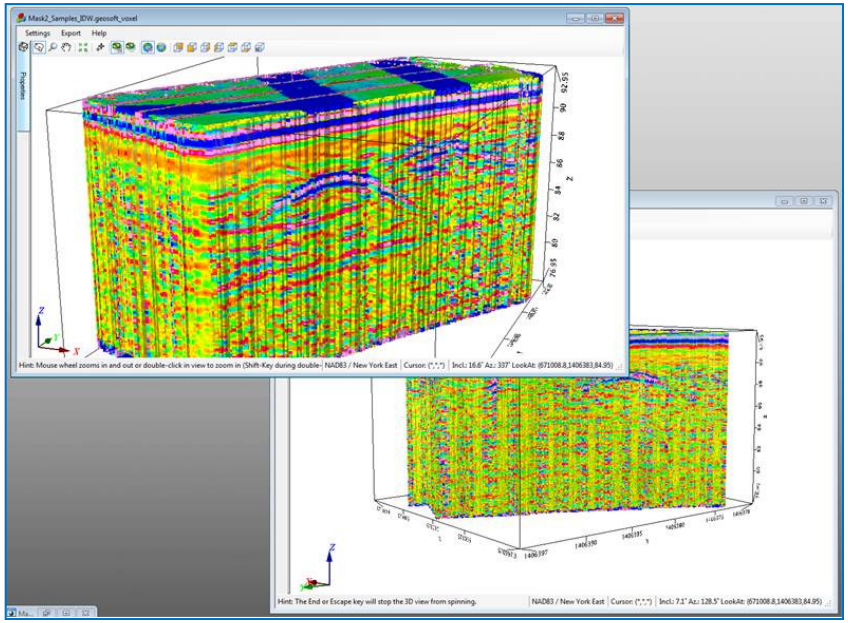
3-D Software Interpretation Environment



Multiple data sets in the same 3D workspace

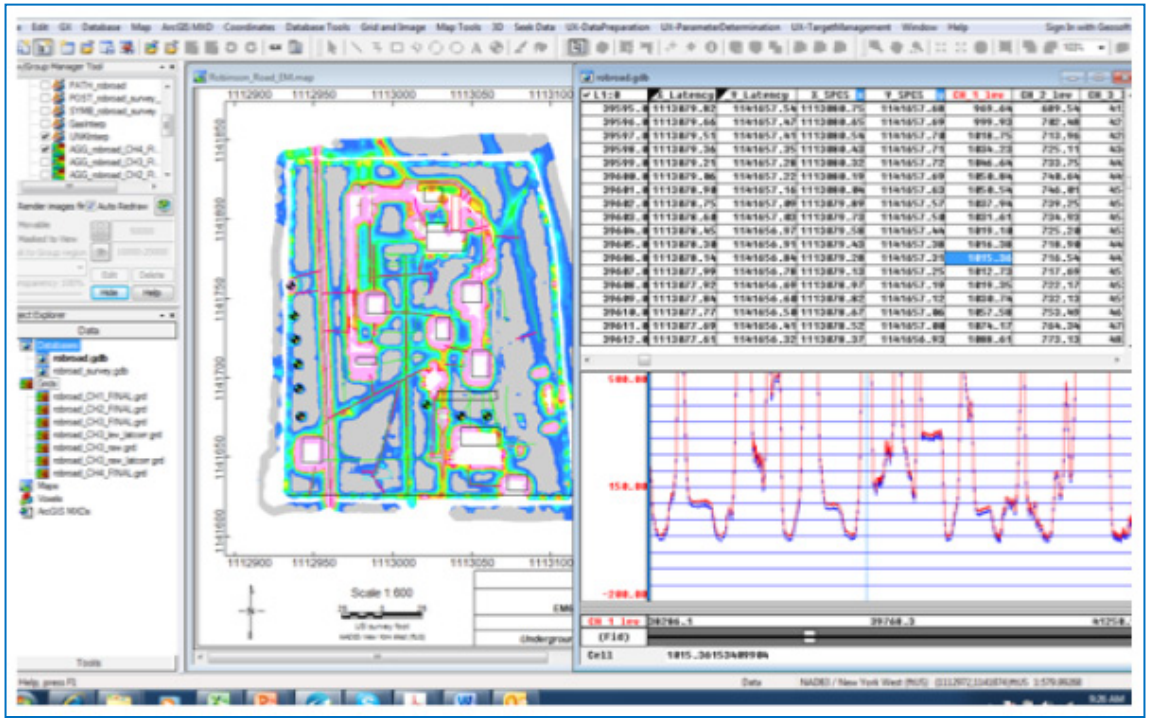






Software Usability and Progression

- These software tools should not be any more difficult to use than those used today
- They should offer a more user friendly graphical interface and automate the most tedious processes.
- Special training will be required to utilize these software tools effectively.

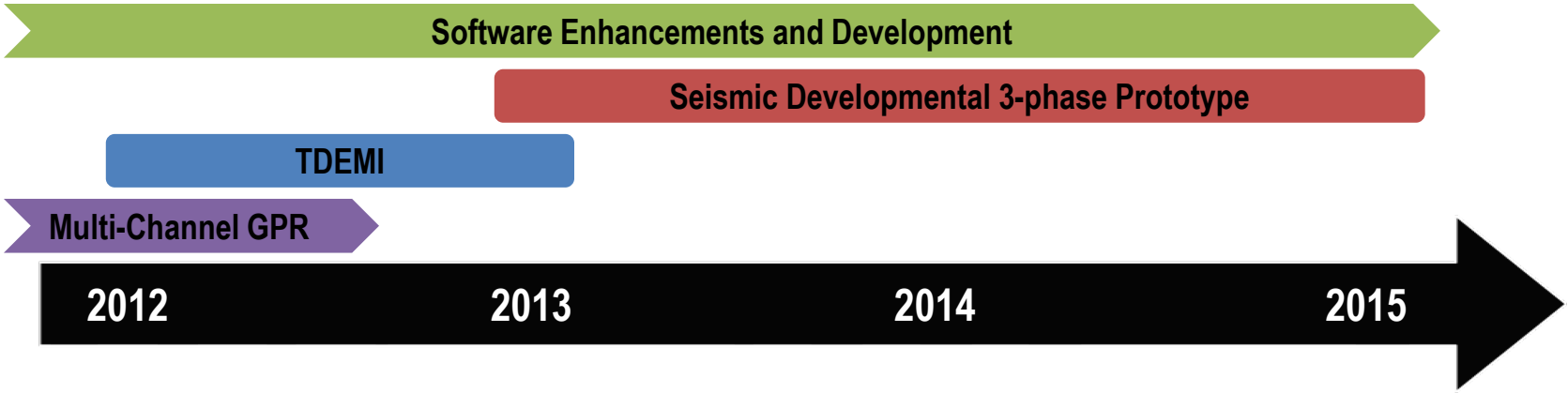


SHRP2 R01-B Products Costs

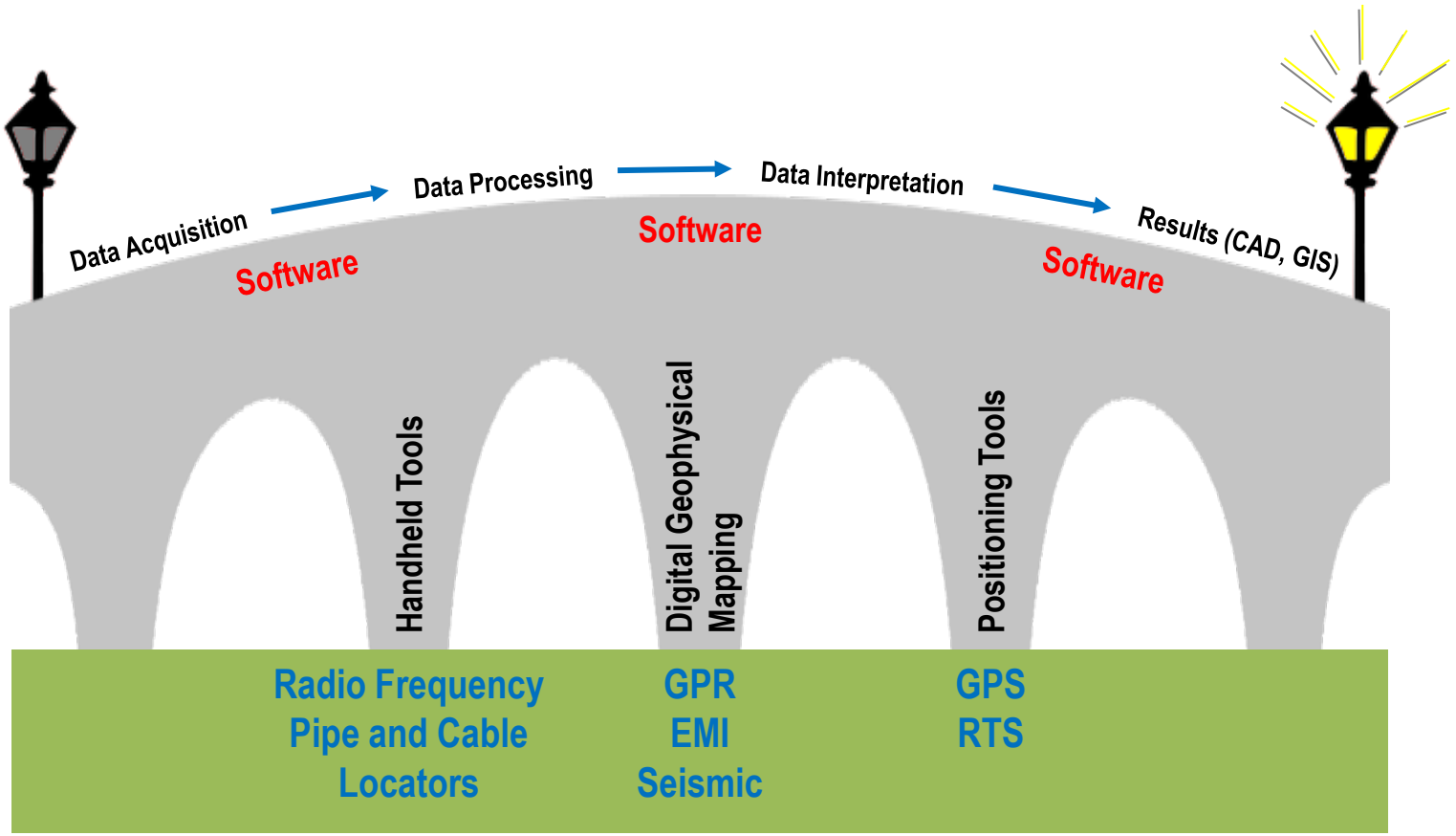
- System field costs will be comparable to other Utility Mapping Systems.
- Geophysical service providers will use these tool in the context of Subsurface Utility Engineering.
- The larger the project and the greater the lead time the better the Return on Investment.

SHRP 2 R01-B Products Availability

- The new TDEMI System: ~ 1 year (2013)
- The Seismic System: ~ 3 years (2015)
- The Multi-channel GPR System: Available
  - Improvements to data analysis functions
- Software enhancements are produced continuously with user feedback and the prototype(s) evolution.



Summary of Service - Bridging the Elements



Research Team

Team Lead: Underground Imaging Technologies, LLC, A Corporate Affiliate of Caterpillar

Team Members	Task
Owen Engineering Services (OES)	Seismic development
Psi-G and Bay Geophysical	Seismic development
SAIC	EMI development
Sagentia	Software development
Louisiana Tech Univ.	Seismic model development
University of Birmingham (MTU)	Consulting on all phases
University of Southampton (MTU)	Consulting on seismic
J. H. Anspach Consulting	Coordination with MTU, with in-service testing sponsors, and A, C projects
Geomedia Research & Development	Consulting on seismic
Radar Solutions International	Field support in testing
Dr. Tom Iseley	Consulting on outreach and in-service testing

END OF SLIDES

the Energy to Lead

SHRP 2 Project R01-C
Encouraging Technology Innovation to Improve the Extent of the Locatable Zone

Chris Ziolkowski
Principle Investigator
Gas Technology Institute

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Biography

- R&D Manager, Sensors and Automation Group at Gas Technology Institute
- Group focus on electronics and physics
- Mission of adapting new technologies to utility applications
- Multiple projects in utility and feature location

R01-C Presentation

- What will we cover:
  - Background and motivation for project
  - The schedule and status of project
  - Updates of 4 distinct technology products
  - Anticipated product for each of these
  - Suggested next steps for each technology

R01-C Background

- Modern installation processes go deeper
- Depth can lead to “stacked” infrastructure
- Modern materials are less easily detected
- We need to improve both:
  - Our means to locate deep infrastructure
  - Our means of maintaining location data

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R01-C Objective

- To test prototype technologies for locating buried facilities that are:
  - Of diverse composition
  - At depths of up to 20 feet
  - Obstructed or “stacked”
  - In the challenging, road construction environment

R01-C Schedule

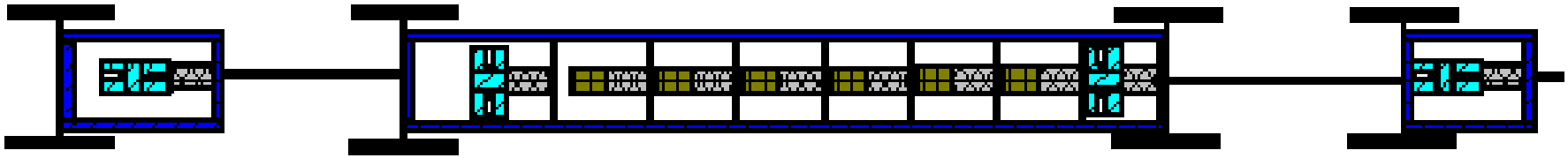
- The R01-C was initiated in Q4 of 2009.
- A state of the art assessment and literature review was prepared.
- Prototype Development was initiated in Q2 of 2010.
- Initial field testing began in Q4 of 2011.
- Testing at an active DOT site is anticipated for April-May of 2012.
- Final Report anticipated end of July.

Anticipated Technology Products

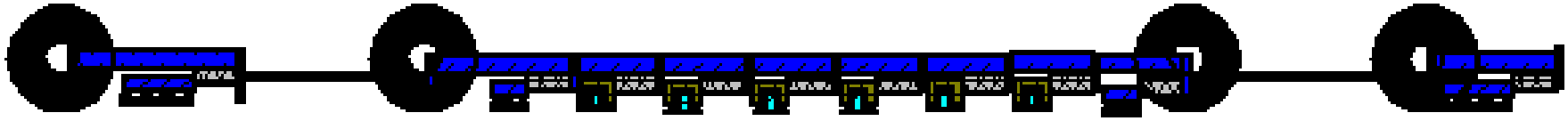
- UIT: Seismic Reflection Locator
- GTI: Active & Passive Acoustic Locator
- VAI: Long-Range RFID Tags
- GTI: Scanning Electromagnetic Locator

UIT 2D Seismic Reflection Technology

- Targets all pipe materials
- Method staged completely above ground
- Shear waves have ability to resolve smaller targets
- Works in clay soils where GPR does not
- Current seismic techniques are suited for large/deep targets.



Trailer Top & Side Views



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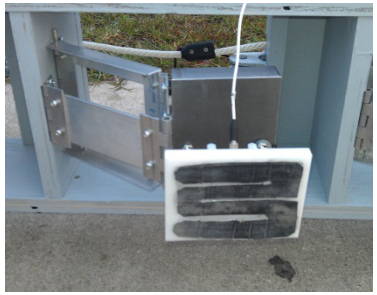
UIT 2D Seismic Reflection Technology

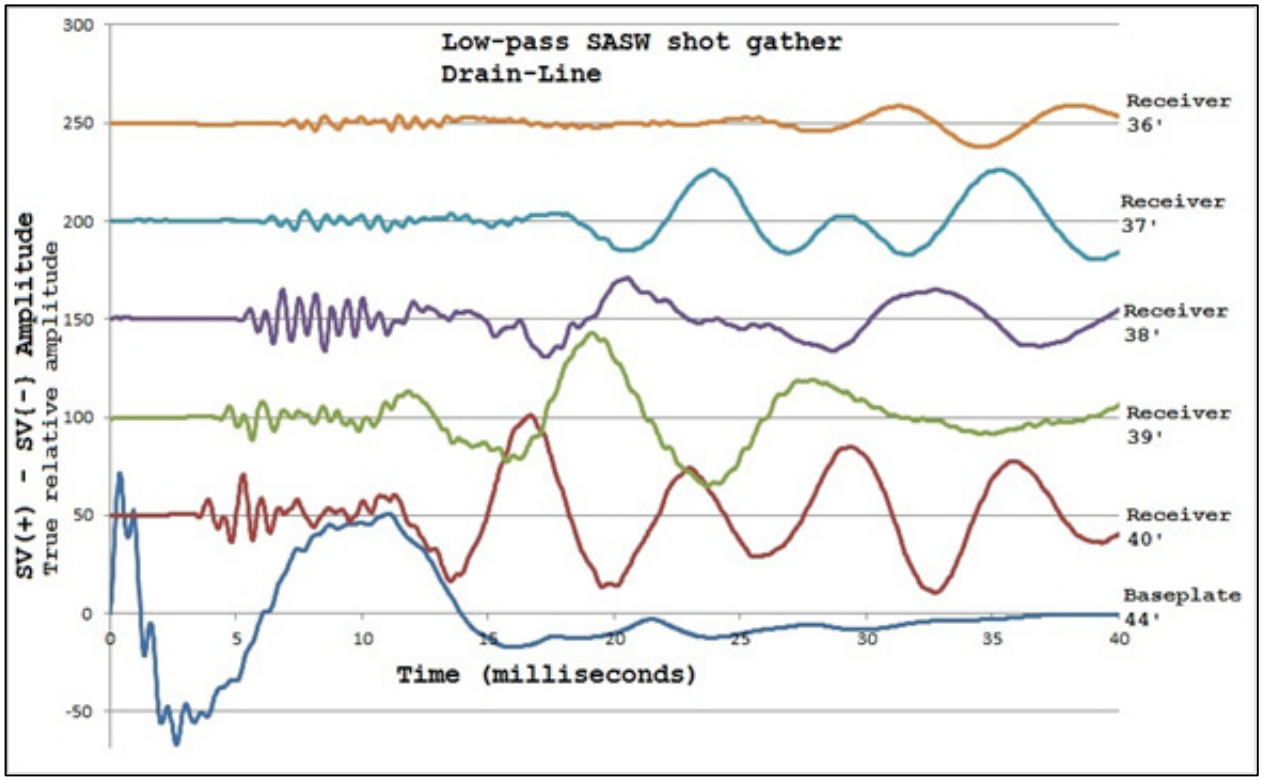
Sources

Receivers



Single Receiver

UIT 2D Seismic Reflection Technology

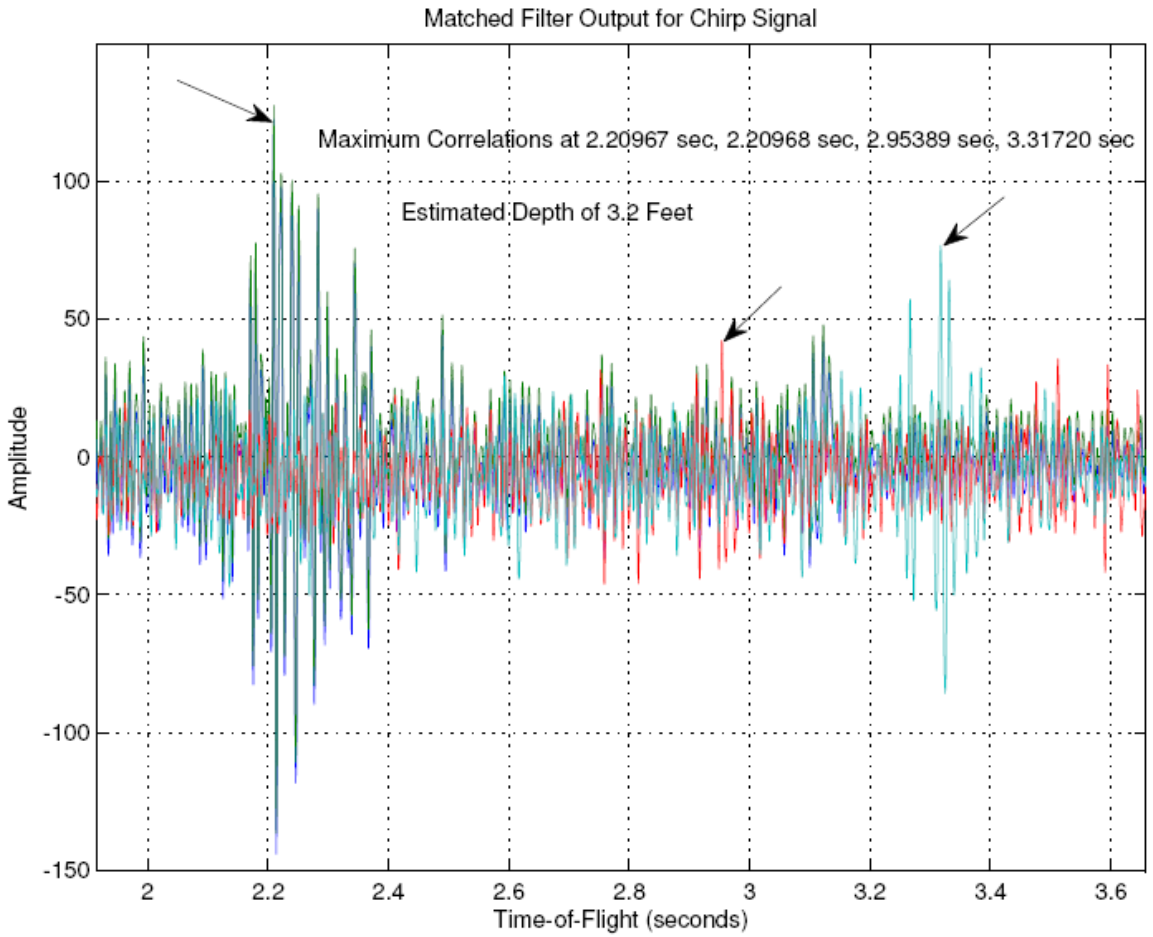


Initial test data shows the surface wave propagates and attenuates more rapidly than the sub-surface wave. This is a positive result for the location of buried structures.

GTI Acoustic Method

- Target can be any pipe material
- A tailored acoustic on the pipe eliminates round trip
- Improves discrimination amongst facilities
- Active requires a connection to the pipe
- Passive uses intrinsic signal; i.e. 60 cycle hum
- Multiple wireless sensors automate depth estimate

GTI Active Acoustic Method



Cross correlation of multiple sensor returns gives an accurate time of flight. The TOF is then further processed to estimate pipe location and depth.

VAI Long Range RFID Tags

- Visible Assets Inc. is producing active RFID tags and hand-held readers for testing
  - Range of up to 40 feet with hand held reader
  - Battery life of 20+ years
  - IEEE 1902.1 public protocol communication
  - VAI in-house testing of first batch of 20 complete
- Current Smart Tags have ranges of about 8 feet and use proprietary protocols.

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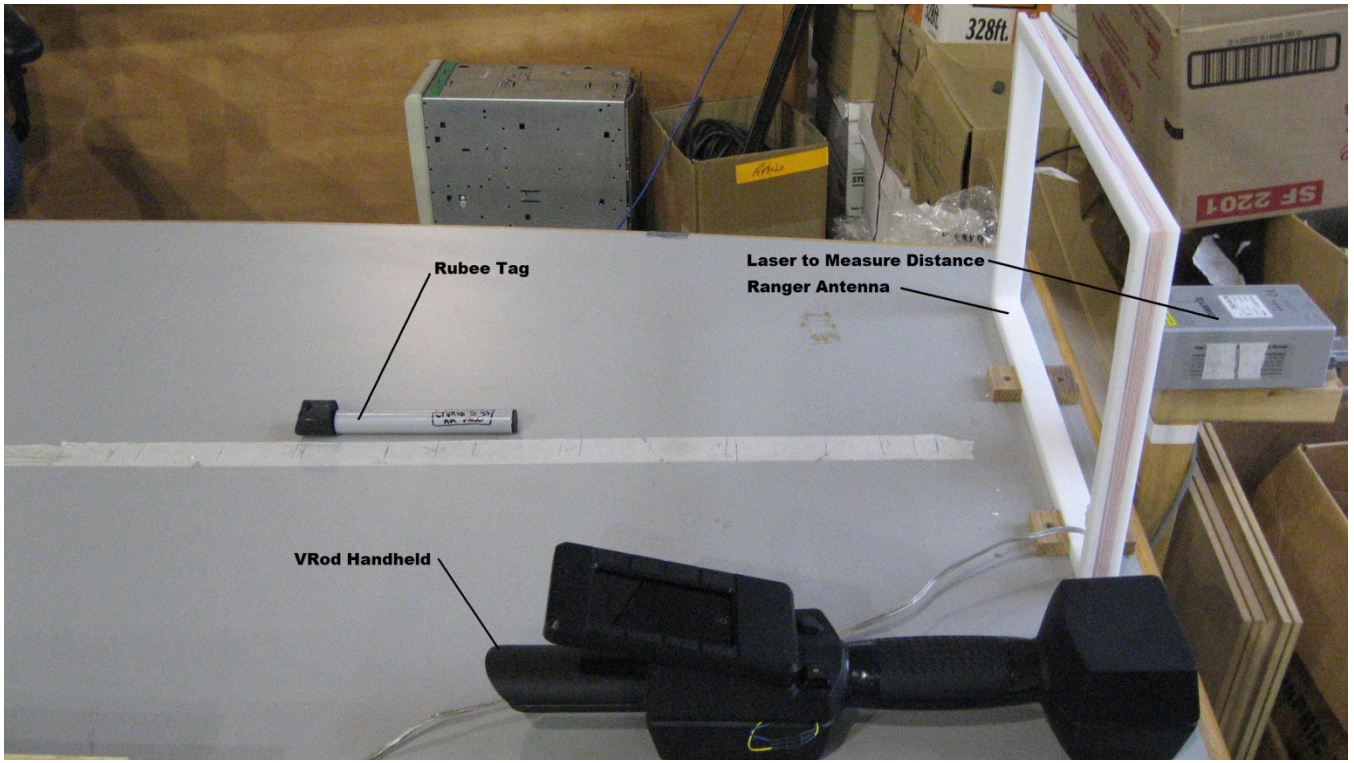
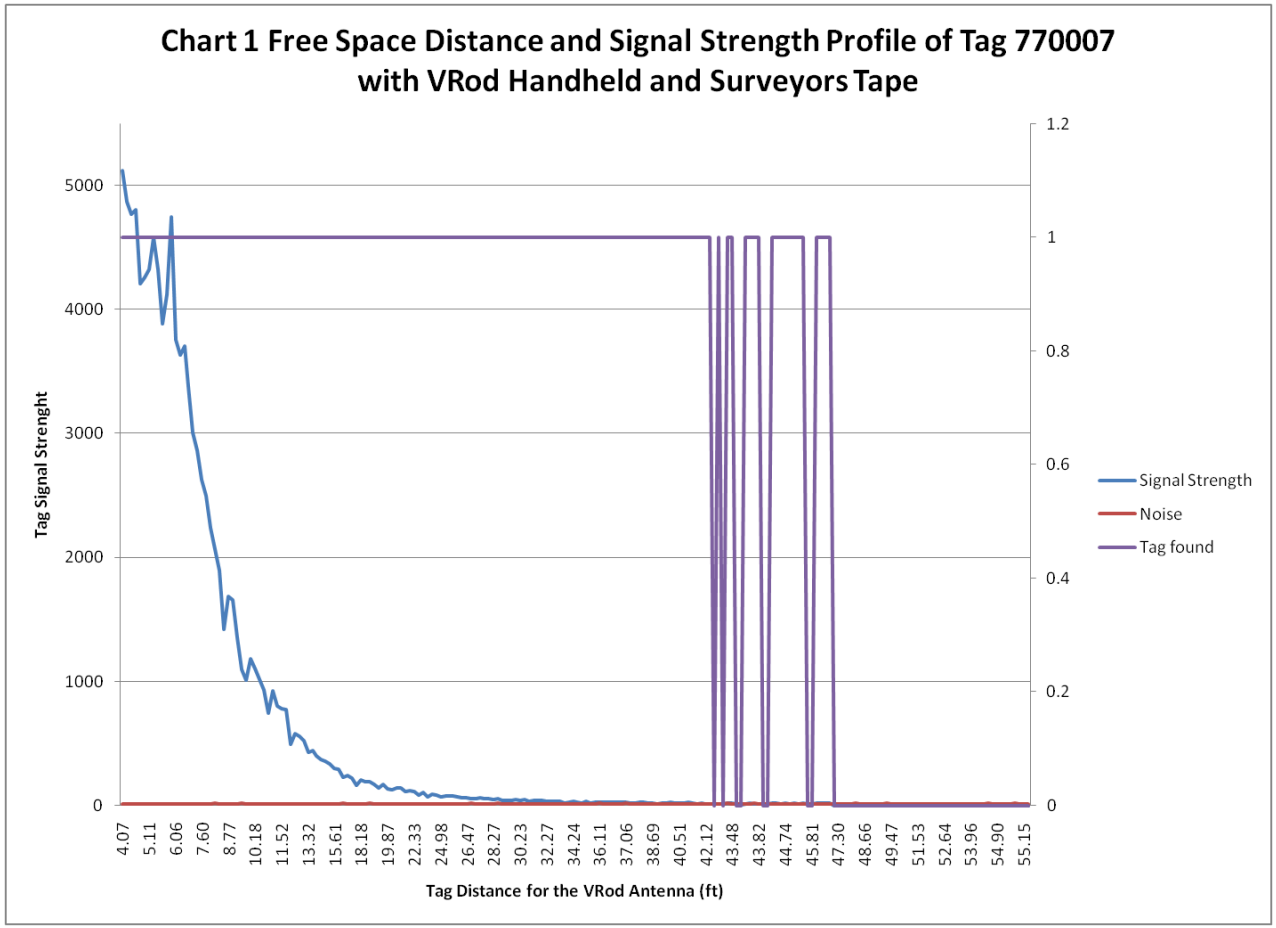
VAI Current State of Prototypes



Tag and hand held reader under test

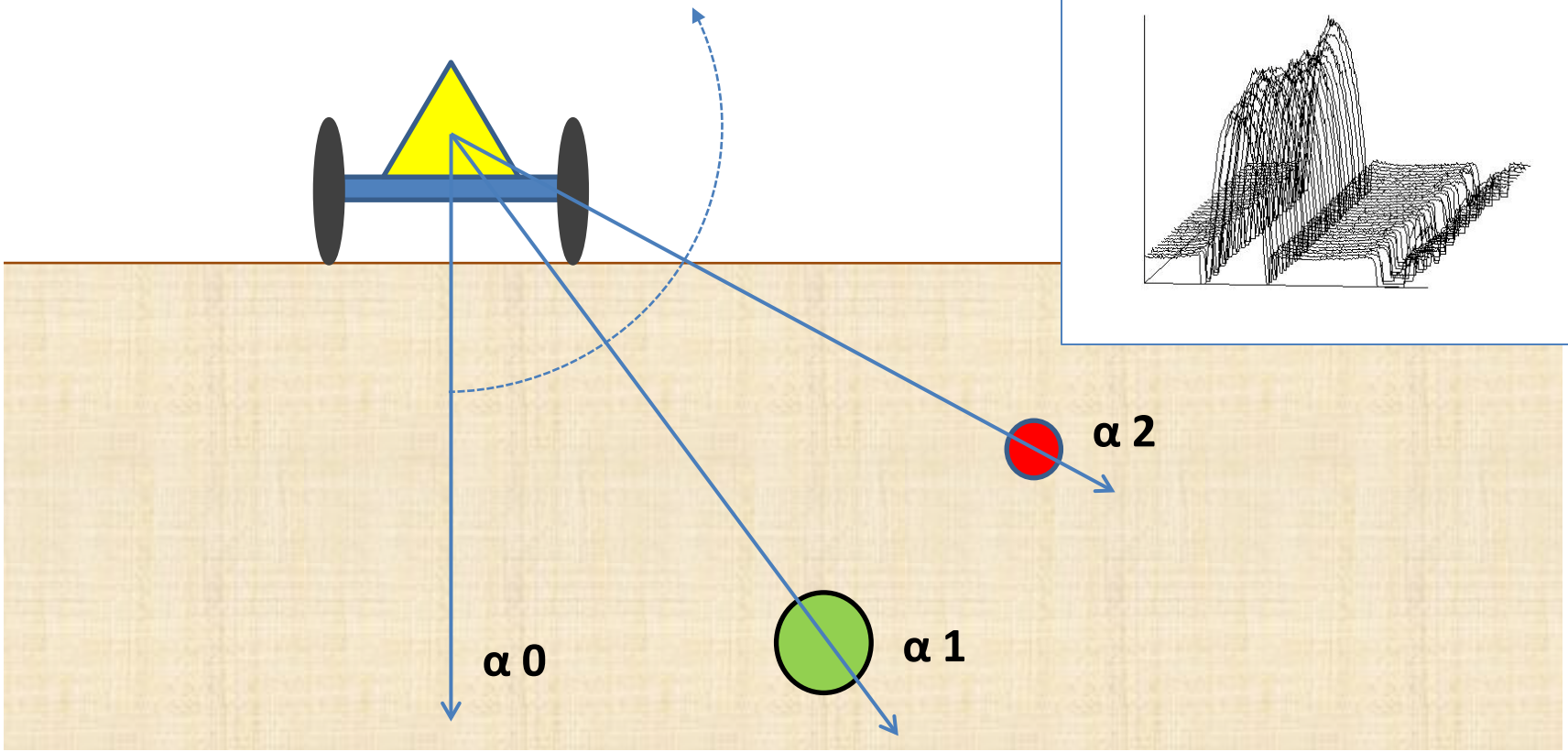
VAI Prototype Test Data



Positive acquisition of Smart Tag to greater than 40 feet

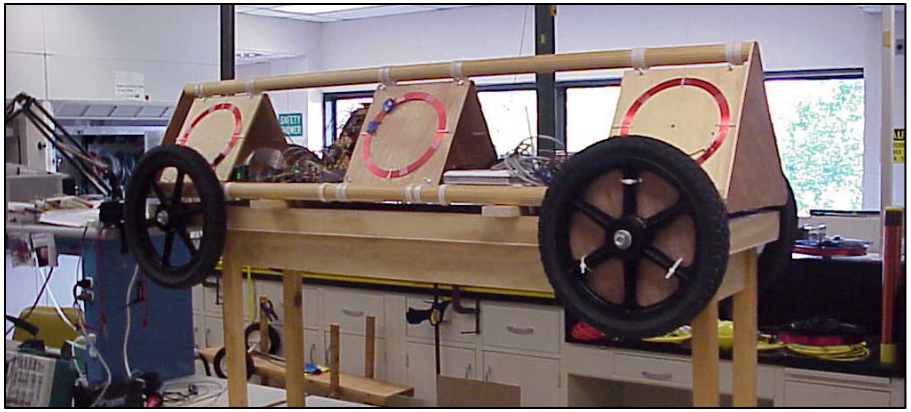
GTI Scanning EM Concept

Cart rolls parallel to pipe path (into page)
EM field scans perpendicular to path



GTI Scanning EM Prototype

- Low frequency EM for depth of penetration
- Inducer and differential pick up moves with the cart
- Unresolved signal strength issues delaying testing
- May be dropped from testing program
- Scan angle provides added location data with fewer passes



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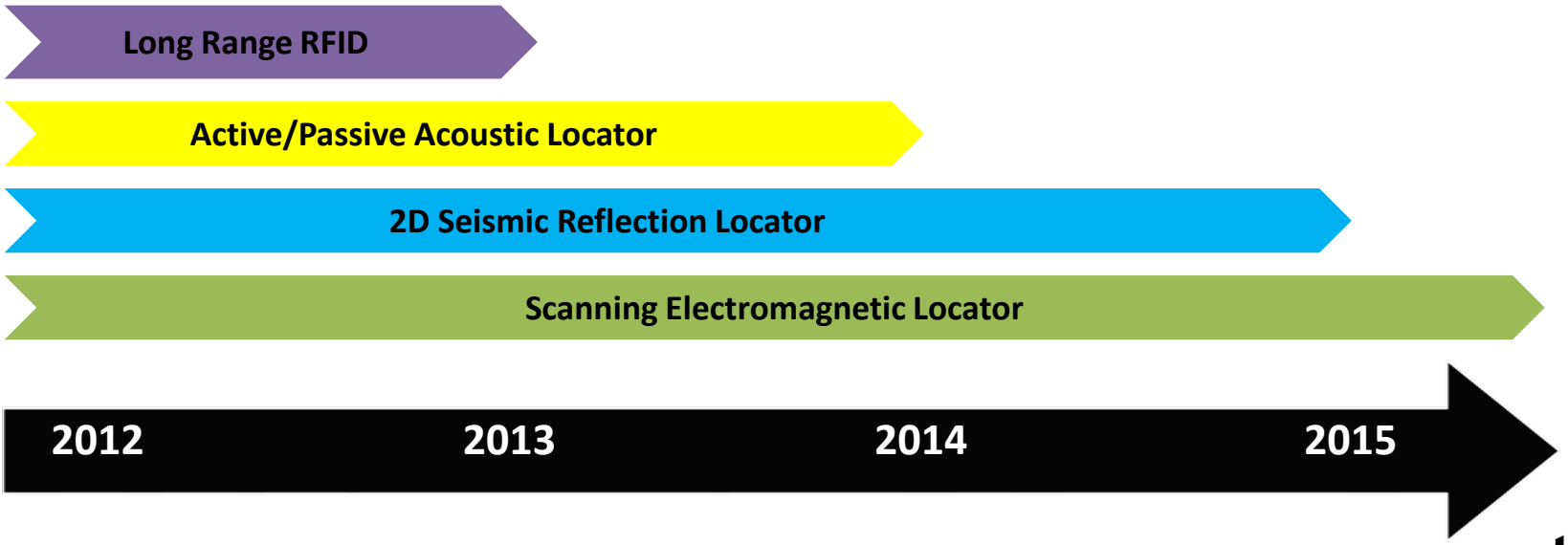
Anticipated Product Characteristics

- What is different about these new tools?
  - Explicitly designed for extended depths
- What new capabilities will they provide?
  - Acoustics and low-frequency EM both work in wet and mineral laden soils that stop GPR
- Will they be more difficult to use?
  - The extended depth tools require more effort than basic locators; they are intended for difficult locates.
- Will they require special training and/or operators?
  - The prototypes; definitely. The productized versions can be made easier to use.

SHRP 2 R01-C Products Availability

- **Long Range RFID Tags:** ~ 1 year (2013)
- **Active/Passive Acoustic Locator:** ~ 2years (2014)
- **2D Seismic System:** ~ 3 years (2015)
- **Scanning Electromagnetic system:** minimum of 3 years



Anticipated Product Availability

- The Smart Tags are closest to commercialization; VAI would like to license. The tags could be sub-$10 in volume.
- Acoustic Methods could be licensed out as hardware is well defined. Additional field testing could be useful in raising awareness in manufacturers and the user community.

Anticipated Product Availability

- The Seismic Reflection will likely require another generation of prototype after the R01-C testing. A hardened prototype and additional testing would raise industry awareness of this technology.
- The signal strength issues for the Scanning EM technology must be resolved before basic testing can be completed. This will require additional funding for hardware modifications.

the Energy to Lead

SHRP2 Project R01-A: Technologies for the Storage, Retrieval, and Utilization of 3-Dimensional Utility Location Data

Bill Gale
Team Technical Lead
Gas Technology Institute

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Presenter – Mr. Bill Gale/GTI

Principal Investigator on multiple GPS/GIS based R&D efforts at GTI. Joined GTI in 2010 after 32 Years with a private Utility (New York State Electric & Gas).

Past experience includes:

- Expertise in the design and development of several large scale enterprise GIS based systems and led the design , development and implementation of the first GIS based Electric Outage Management System .
- Over two decades of experience implementing GIS, document management systems and mobile computing as primary technologies for both the gas and electric utility industry.
- Over 15 years of experience in managing engineering and field construction activities.

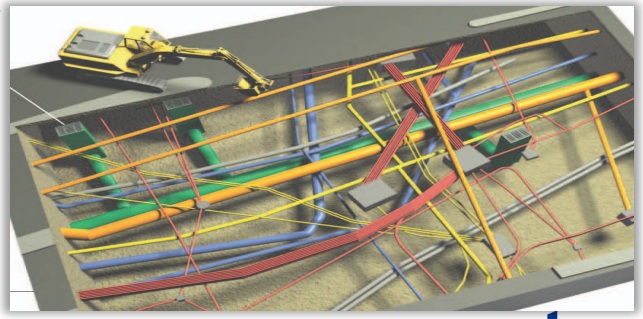
Education : BS Wood Products Engineering SUNY Environmental Science and Forestry at (Syracuse University). Completed 3 years of a 5 year Masters program in theology as part of a Diaconal studies.

Agenda

- Background
- Industry Problem
- Project Objective
- Expected Outcome
- Research Approach
- Research Products
- Schedule and Status
- System and Work Flow Diagrams

Background

- DOTs need accurate and up-to-date utility information during project development in order to consider the impact on utilities.
- Designers are usually provided with this information at the beginning of a project, but do not have a mechanism to ensure it is kept up-to-date.
- There is currently no system in place to track utility changes during a project and notify designers of the changes.
- DOTs need to completely re-map utilities for every new project.



Project Objective

- Create a system that provides a single, up-to-date repository for 3-D utility location data within a project boundary
- Leverage existing permitting and one-call processes to create a change notification system
- Develop supporting administrative procedures
- Utilize existing DOT 2-D and 3-D CAD design software

Expected Outcome

- Reduce re-design work resulting from utility changes unknown to the DOT designers
- Reduce project delays in the design and construction phase
- Reduce excavation damage to utility lines

Research Approach

- Adopt and adapt a 3-D utility data model (Proprietary Model or Industry Standard)
- Utilize a spatial document management system
- Leverage existing 3-D software tools
- Create administrative procedures
- Incorporate supporting best practices

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3-D Utility Data Model

- Sufficient detail to allow designers to model Utility:
  - Location (x, y, z)
  - Attributes (size, material, owner, etc.)
  - Feature Quality and accuracy (ASCE Quality Level)
  - Administrative controls (security, access, etc.)

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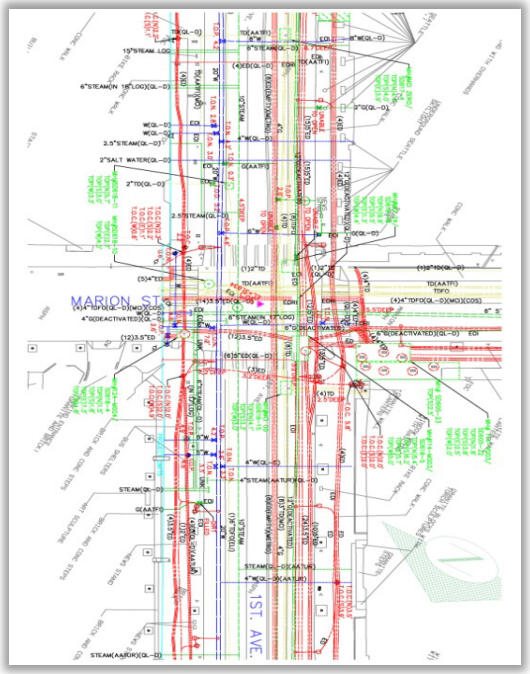
Spatial Document Management System

- Stores all project documents, raster and vector drawings, spreadsheets, survey data, etc.
- Spatial features allow administrative controls
  - Project Boundary Polygon
  - Right of Way (ROW) Permit Boundary Polygon
  - One-call Ticket Boundary Polygon



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Administrative Procedures

- Integration with (ROW) permit and one-call process
- Quality and accuracy management
  - Gatekeeper function
  - Certified Record Drawing
- Balancing security with access

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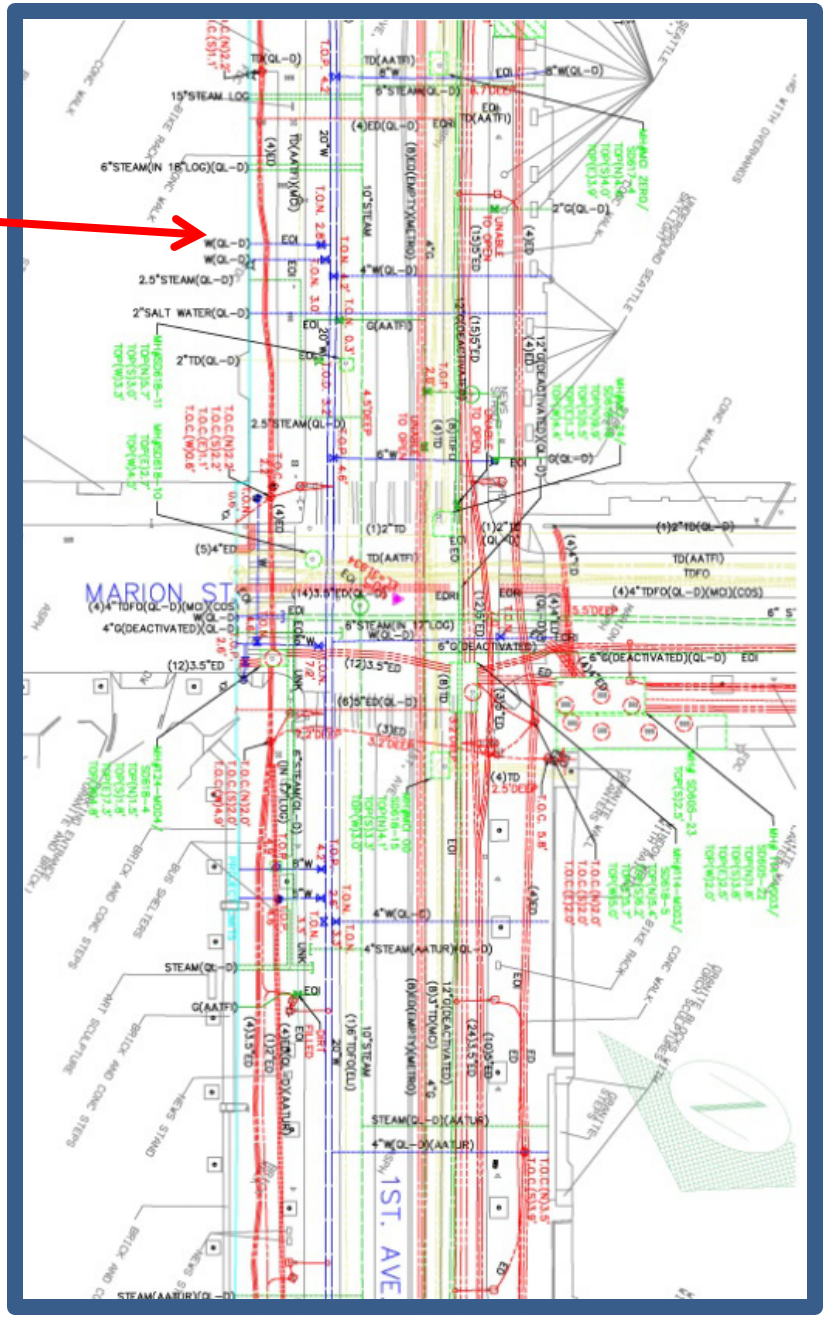
Initial Project Utility Mapping

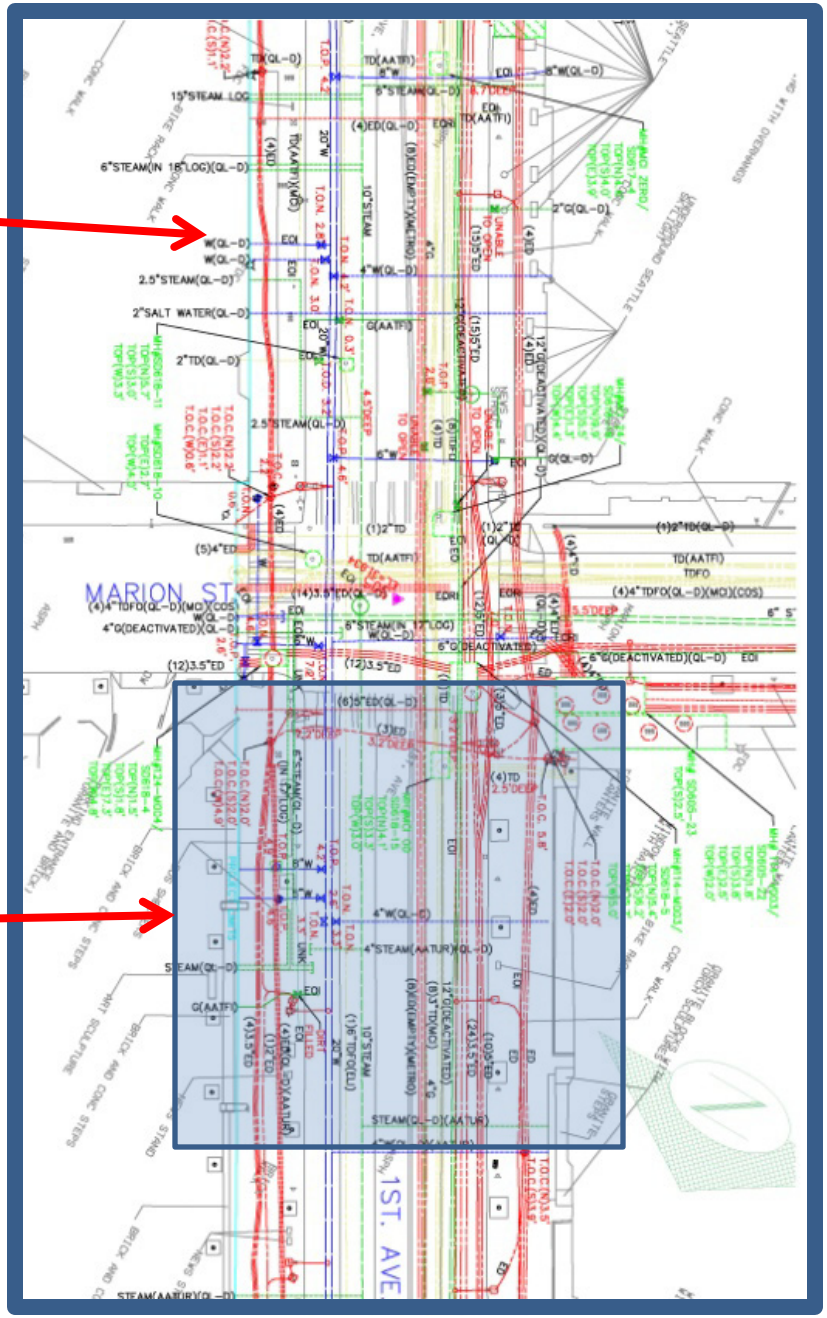
The DOT Project Limits (Project Boundary Polygon)



Initial Project Utility Mapping

The DOT Project Limits
(Project Boundary Polygon)

Boundary of New DOT ROW Permit for Utility Relocation and/or new installation (Permit Boundary Polygon)

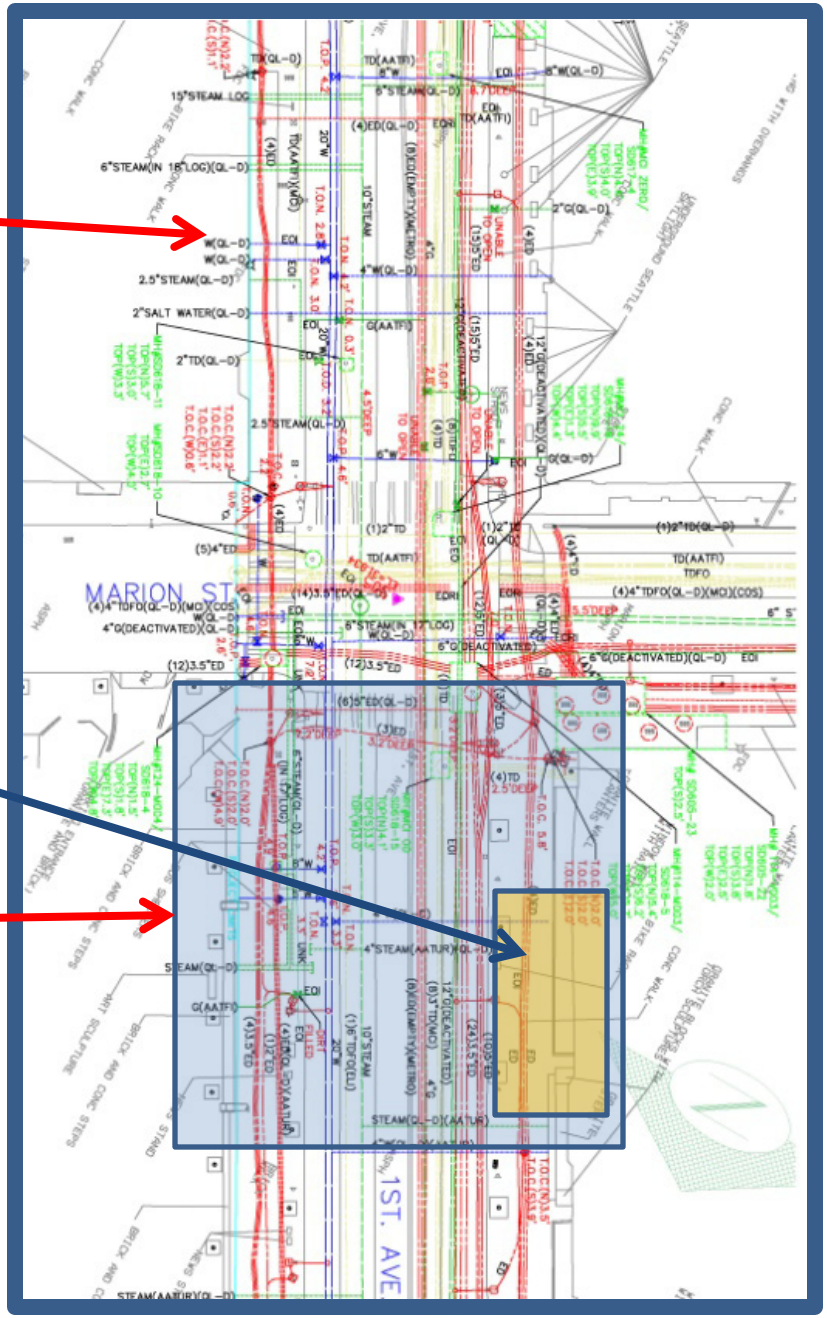


Initial Project Utility Mapping

The DOT Project Limits
(Project Boundary Polygon)

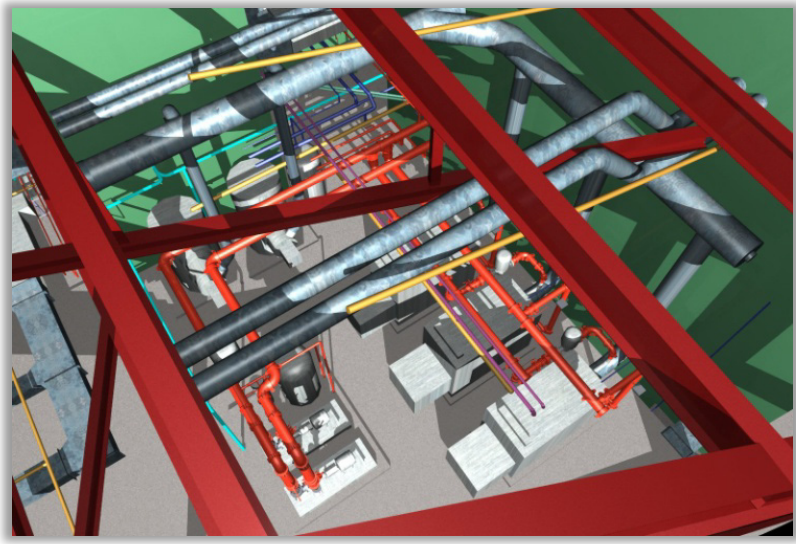
One-Call Ticket (One-Call Ticket Boundary Polygon)

Boundary of New DOT ROW Permit for Utility Relocation and/or new Installations (Permit Boundary Polygon)



Visualization and Notification

- Utilize existing 3-D visualization tools
- Change and **notification** system



EMAIL

Date: September 10, 2012
To: All Project T-31 Task Designers
From: Utility Gatekeeper

There is a change to the existing utilities on the referenced project.

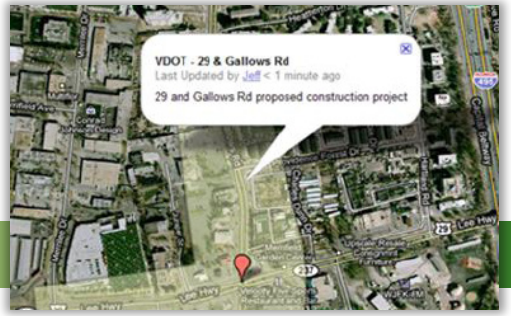
Location: At Project GPS Coordinates 38.54.47.13N ; 77.13.35.98W
What: Washington Gas has relocated their 10" HP gas line

Please view document UM 21.6 for details of the change.

The Master Utility Map has been updated as of 9/10/12, 10:42AM EST.

Supporting Best Practices

- RFID marker ball and smart tag technology
- Certified Record Drawings for new installations
- Electronic DOT ROW permit Feature
- Electronic one-call boundary “white-lining” Feature
- ASCE 38 Utility Quality Levels on GIS attribute and CAD file metadata
- Geo-stamping photos and other data collection activities
- Incorporation of data resulting from advanced tools developed under SHRP B&C technologies
- Incorporation of CSA S250



Research Products

- 3-D Utility Data Model
- Implementation Strategy
- Proof of Concept System
- Pilot Project
  - Virginia DOT, VUPS, participating utility companies
  - Implementation with existing tools
  - Inclusive of RFID marker ball program
  - Evaluation of administrative controls
  - Evaluation of administrative control processes

Research Products/Audience

- Final Report
  - Recommendations for further implementation
  - Technology and administrative best practices

- DOTs, one-call centers, vendors, and service providers can use the process model and best practices to support further implementation

Schedule and Status

- Completed Phase 1 Report January 2012
- Starting Proof of Concept End of 1st Quarter 2012
- Pilot Project Mid 2012
- Project Completion – December 2012

Questions?

Questions and Answers

- 1. The new tools will provide a automated means of understanding change within a project area.
- 2. New 3-D and 2-D views of utility change and data quality available without laborious research time.
- 3. The tools will require additional training and understanding of the system nomenclature and work flow. DOT organizations should restructure their work practices.
- 4. New software products may need to be purchased or extensions added to existing systems.
- 5. The Prototype has not been developed for pricing. Additional information will be available mid Summer 2012.

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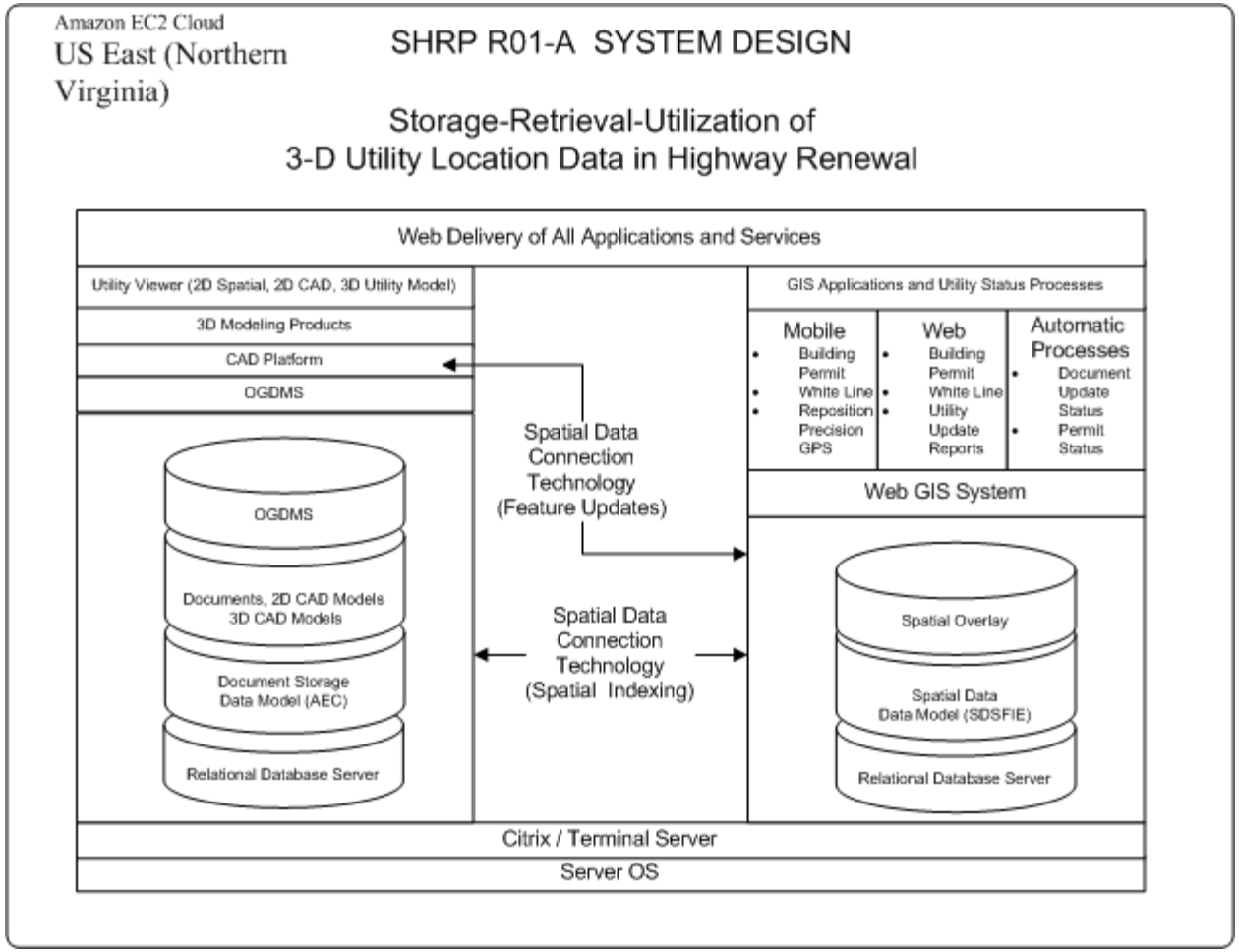
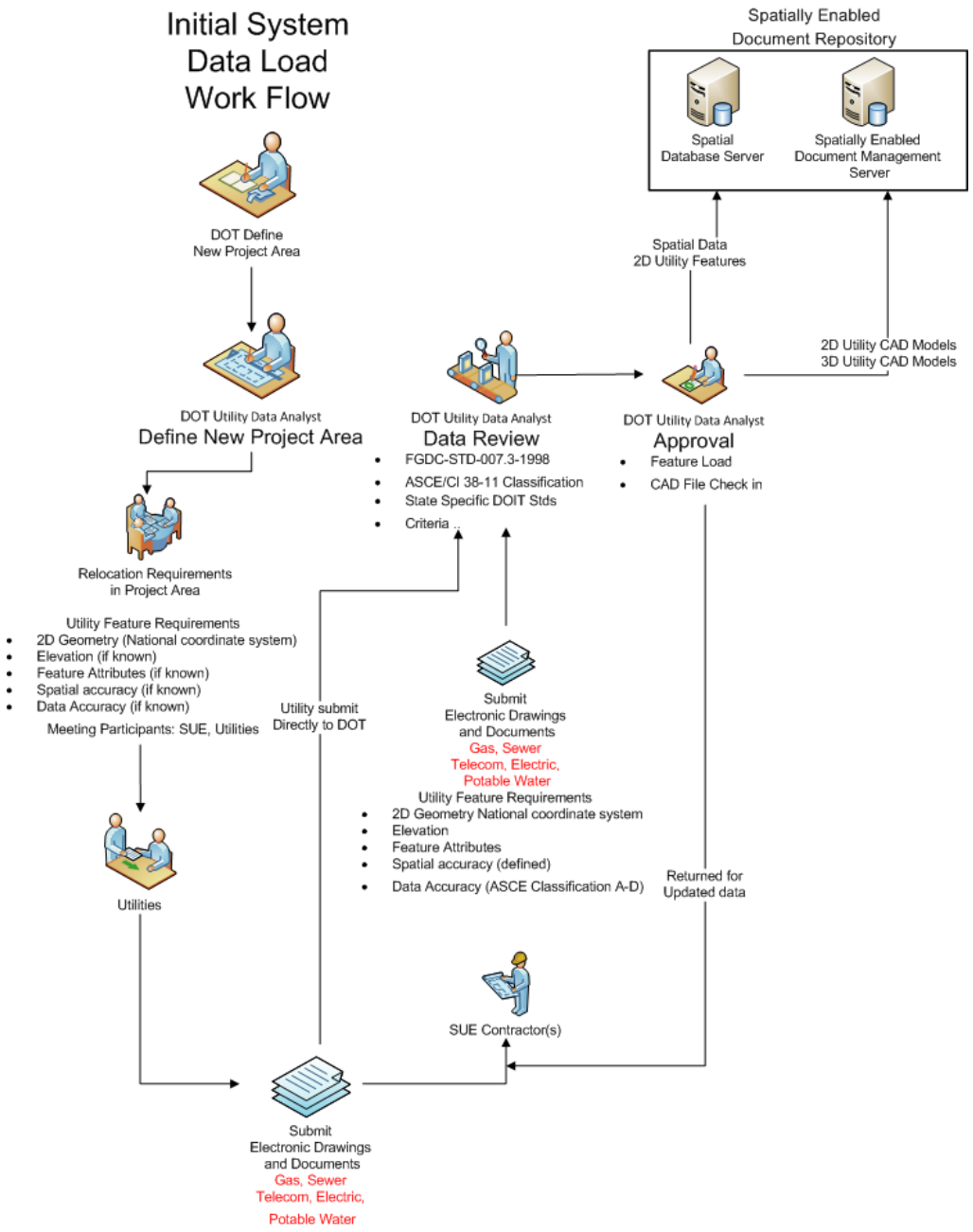
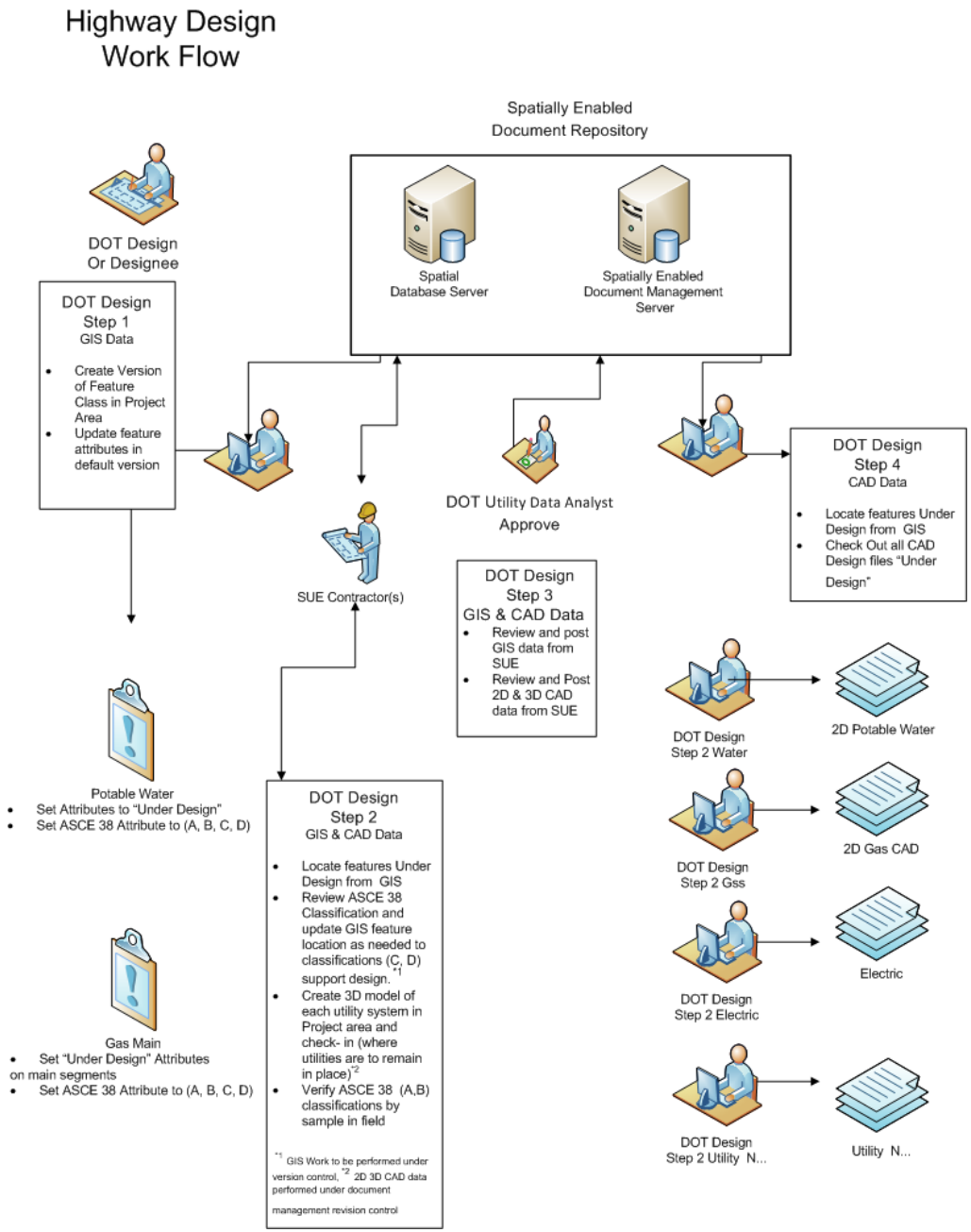
Proof of Concept & Pilot System





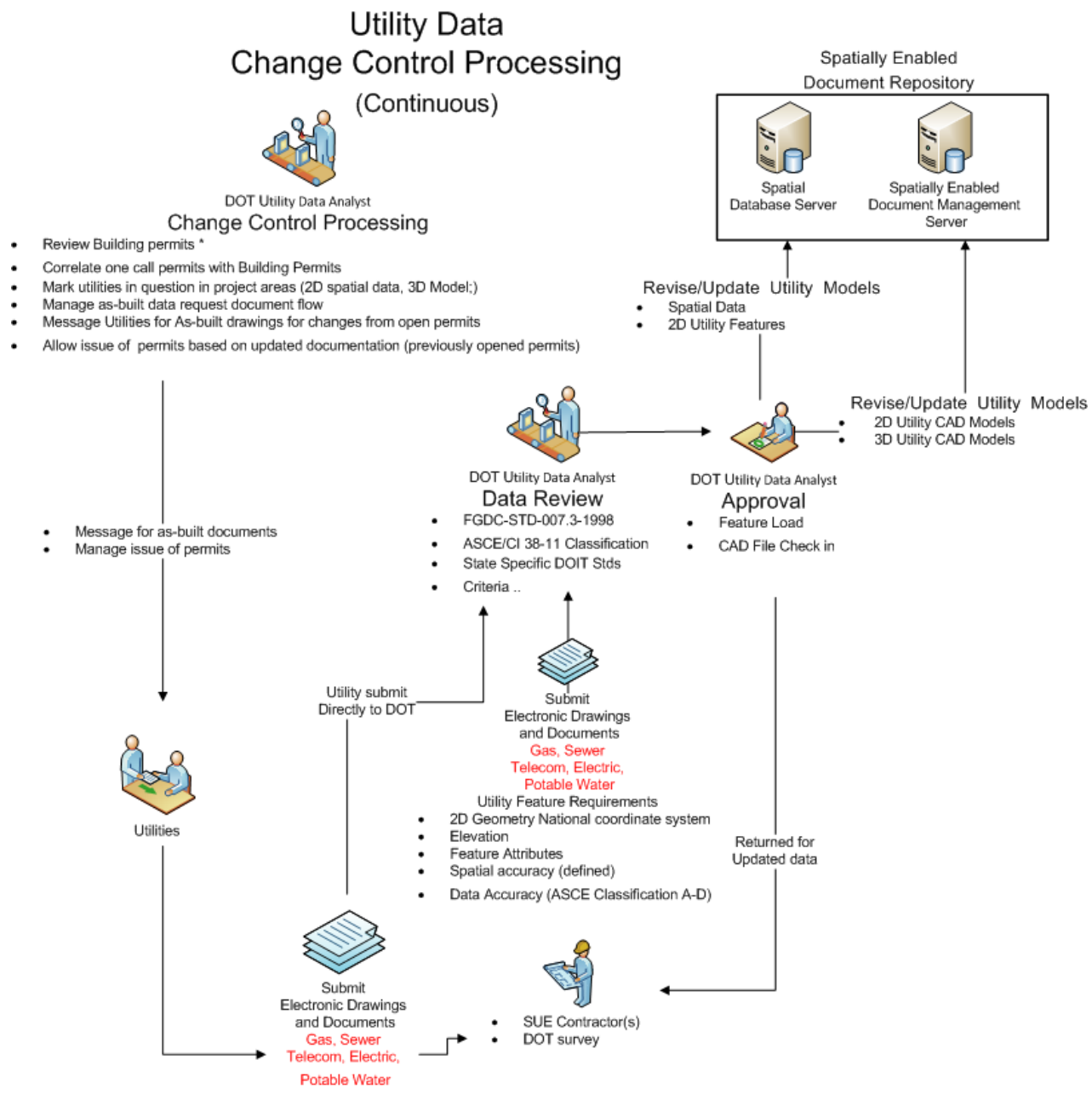
System Work Flow

Data Load



System Work Flow

Design



System Work Flow Change Management

SHRP 2 Project R15-B: Identification of Utility Conflicts and Solutions

Cesar Quiroga

Texas Transportation Institute

New SHRP 2 Tools for Underground Utility Location, Data Collection, and Analysis

SHRP 2/FHWA Webinar, February 15, 2012

Cesar Quiroga's Profile

- Senior Research Engineer and Manager, San Antonio Office at TTI
- Current research work:
  - Project development process optimization
  - Utility coordination and ROW acquisition
  - Spatial data technologies
  - Impacts of energy developments on the transportation infrastructure and ROW
- MSCE and Ph.D. from Louisiana State University
- Member ASCE, ITE, IRWA
- Co-Chair, TRB Spatial Data Committee
- Secretary, TRB Utilities Committee

Presentation Outline

- Background and research objectives
- Research products
- Anticipated value and implementation cost
- Answers to today's questions
- Pilot implementation

Utility Conflict Solution Strategies

- Remove, abandon, or relocate utilities in conflict
  - Relocating utilities NOT ALWAYS the best or most cost-effective solution
- Modify transportation facility
- Protect-in-place utility installation
- Accept an exception to policy

Research Objectives

- Utility conflict matrix (UCM): Important tool for managing utility conflicts
- Objectives:
  - Review trends and identify best UCM practices
  - Develop a recommended UCM approach and document related processes
  - Develop training materials
  - Develop implementation guidelines

SHRP 2 R15-B Research Products

- Prototype 1: Compact, standalone UCM
- Prototype 2: Utility conflict data model and database
- One-day UCM training course
- Implementation guidelines

Prototype 1: Utility Conflict Matrix

- MS Excel format, includes drop-down lists

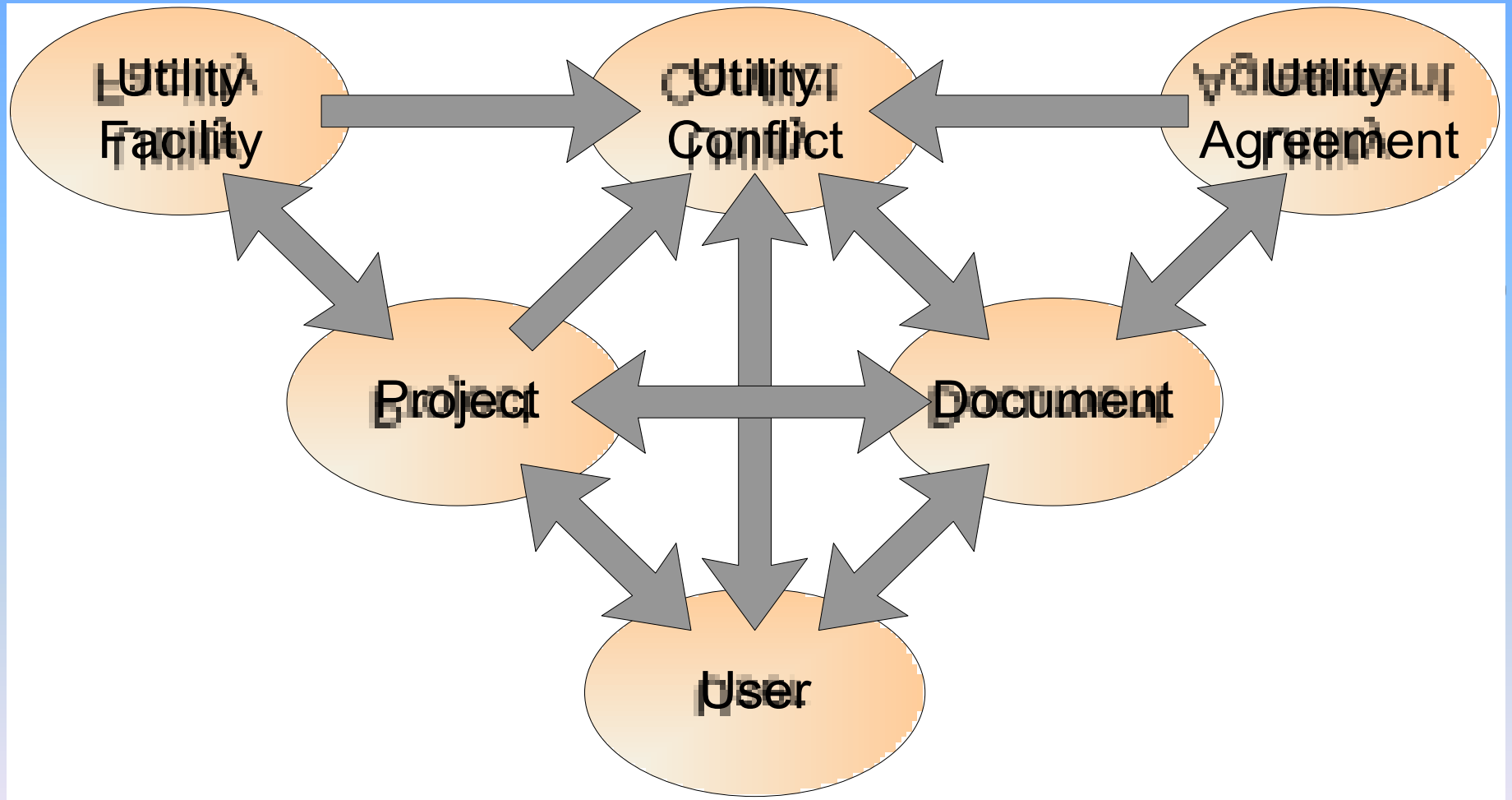
Utility Owner and/or Contact Name	Conflict ID	Drawing or Sheet No.	Utility Type	Size and/or Material	Utility Conflict Description	Start Station
AT&T	1	U-1	Telephone	Fiber Optic	Conflict with construction of frontage road widening.	21+00

End Station	Start Offset	End Offset	Utility Investigation Level Needed	Test Hole	Recommended Action or Resolution	Estimated Resolution Date	Resolution Status
22+00	45' Lt	45' LT	QLC		Relocation before construction.	3/8/2010	Utility conflict identified.

Prototype 1: Cost Estimate Analysis

Alternative Number	Engineering Cost (Utility)	Direct Cost (Utility)	Engineering Cost (DOT)	Direct Cost (DOT)	Total Cost	Feasibility	Decision
0	$ 10,375.00	$ 63,875.00	$ -	$ -	$ 74,250.00	Yes	Selected
1	$ 7,875.00	$ 32,375.00	$ -	$ -	$ 40,250.00	No	Rejected
2	$ -	$ -	$ 95,375.00	$ -	$ 95,375.00	No	Rejected
3	$ -	$ -	$ -	$ -	$ -	No	Rejected
4	$ 10,375.00	$ 63,875.00	$ -	$ -	$ 74,250.00	No	Rejected

Prototype 2: Data Model and Database



Prototype 2: Example (Prototype 1)

Utility Conflict Matrix Developed/Revised By: _____ **Date:** _____

Reviewed By: _____ **Date:** _____

End Offset	Utility Investigation Level Needed	Test Hole No.	Recommended Action or Resolution	Responsible Party	Estimated Resolution Date	Resolution Status	Cost Analysis
45' Lt	QLC		Relocation before construction.	U	3/8/2010	Utility conflict identified	Detail
37' Rt	QLC		Relocation before construction.	U	3/8/2010	Utility conflict identified	Detail
48' Rt	QLC		Relocation before construction.	U	3/8/2010	Utility conflict identified	Detail
48' Rt	QLC		Relocation before construction.	U	3/8/2010	Utility conflict identified	Detail
49' Lt	QLB		Design change.	D	3/8/2010	Utility owner informed of utility conflict	Detail

Prototype 2: Example (Prototype 1)

lution Alternatives

e Analysis

Texas Transportation Institute

Date: 11/24/2010

Project Owner: Texas Department of
Project No.: 1234-56-789
Project Description: Road construction pr
Highway or Route: I-10 Katy Freeway

Conflict ID:	1
Utility Owner:	AT&T
Utility Type:	Telephone
Size and/or Material:	Fiber Optic
Project Phase:	60% Design

Alternative Number	Alternative Description	Party	Engineering Cost (Utility)	Direct Cost (Utility)	Engineering Cost (DOT)	Direct Cost (DOT)	Total Cost	Feasibility	Decision
0	Relocation before construction.	No c no a	$10,375.00	$63,875.00	$0.00	$0.00	$74,250.00	Yes	Selected
1	Protect in-place.		$7,875.00	$32,375.00	$0.00	$0.00	$40,250.00	No	Rejected
2	Design change.		$0.00	$0.00	$95,375.00	$0.00	$95,375.00	No	Rejected
3	Exception to policy.		$0.00	$0.00	$0.00	$0.00	$0.00	No	Rejected

Prototype 2: Other Potential Reports

- All utility conflicts associated with company X (project, corridor, or timeframe)
- Average conflict resolution time for electric utilities
- All utility conflicts with resolution time >100 days
- Customized UCMs for individual utility companies
- Utility certification for inclusion in PS&E package
- …

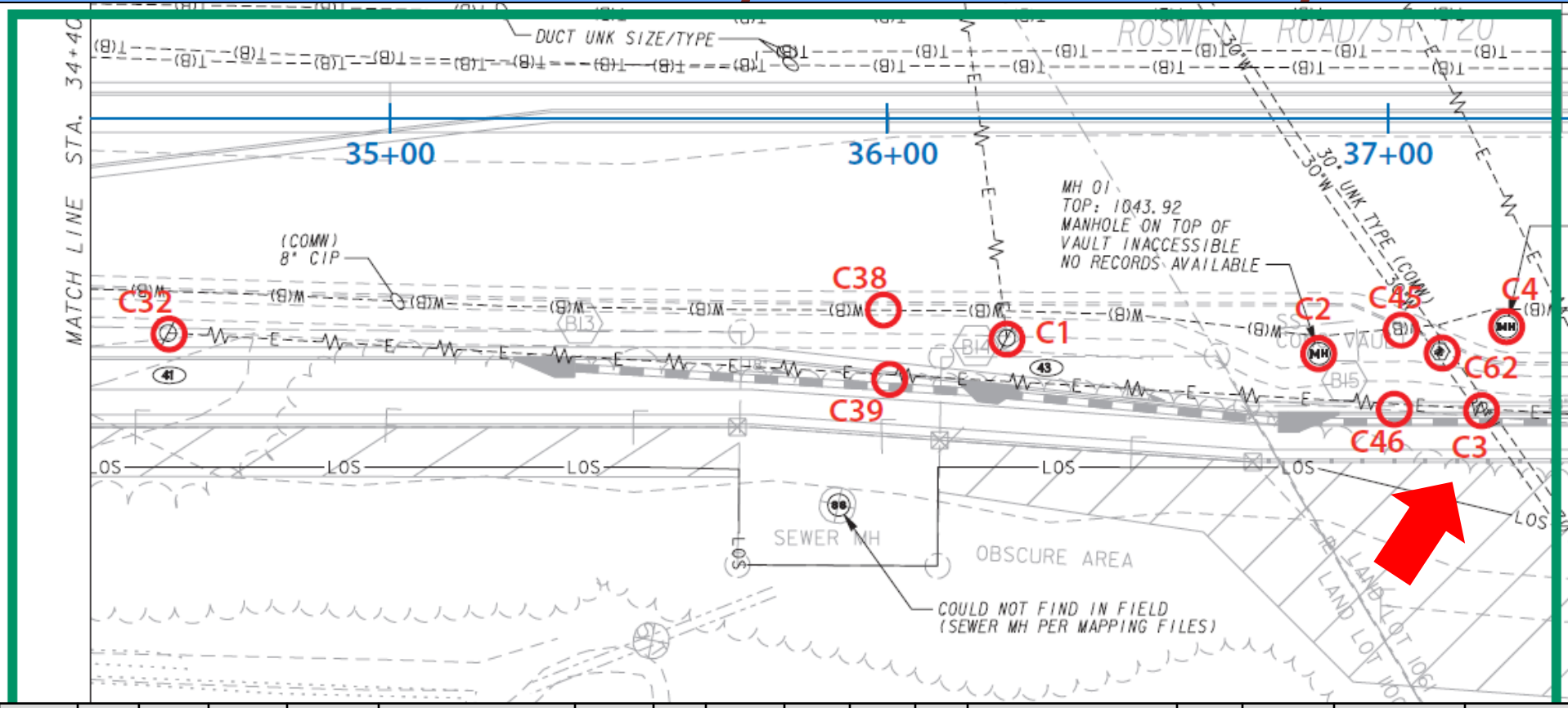
Utility Conflict Event Tracking

0	Utility conflict identified	15	Required adjustment completion
1	Comment created	16	Estimated adjustment completion
2	Utility owner informed of utility conflict	17	Scheduled adjustment completion
3	Utility conflict resolved	18	Notice to proceed to utility owner
4	Utility owner acknowledges receipt of document	19	Adjustment construction start
		20	Adjustment construction end
5	Document requested	21	Permit application
6	Document sent	22	Permit approved
7	Document received	23	Exception requested
8	Document reviewed	24	Exception approved
9	Document certified	25	Plans sufficient sent to utility owner
10	Document approved	26	30-day notice submitted
11	Document uploaded	27	90-day notice submitted
12	Document review, comment, and appro	28	Utility conflict resolution strategy selected
13	Utility coordination meeting	29	Utility relocation under construction
14	ROW cleared for adjustment	30	Utility conflict archived

One-Day UCM Training Course

- Lesson plan (6 lessons)
- Presentation materials (PowerPoint)
- Presenter notes
- Participant handouts
  - Handouts, sample project plans, UCM templates
- Companion CD
  - All training materials, including UCM
  - Prototype utility conflict database

Hands-on Utility Conflict Analysis



Utility Owner	ID	Sheet No.	Utility Type	Size/ Material	Utility Conflict Description	Start Sta.	End Sta.	Start Offset	End Offset	Inv. Need	Test Hole	Recommended Action	Rsp. Party	Est. Res. Date	Res. Status	Cost Analysis
	C3	1	WM	30"	Proposed 18" drainage pipe would cross WM.	37+20		60' Rt		QLA	3	Review possibility of adjusting drainage pipes up to avoid conflict, lowest structure (B13) is at 5.6'.	D	n/a	Utility conflict identified.	

Anticipated Value and Implementation Cost

Implementation Product	Value	Cost
Prototype 1 (standalone UCM in Excel format)	20	$
UCM training course	40	$$
Prototype 2 (standalone database implementation in Access format)	50	$$$
Prototype 2 (enterprise-level implementation)	80	$$$$

Today's Questions

- What's different about these new tools?
- What new capabilities will they provide?
- Will they be more difficult to use?
- Will they require special training or operation only by specially-trained people?
- How will the costs to use these tools compare with those of today's tools?
- When will these new tools likely be commercially available?

Answers to Today's Questions

- Systematic treatment of utility conflicts
- More effective project development process integration
- Easy to use given a correct implementation
- Training for all stakeholders is highly recommended to realize benefits of UCM implementation
- Slightly higher front-end costs but potentially much lower costs at the end
- Research products available as soon as SHRP 2 publishes them

Pilot Implementation

- Four tasks over a 14-month period
  - Schedule meeting with key stakeholders
  - Select state DOT and assemble agency-wide task force
  - Conduct UCM training course for selected users
  - Assist users with full implementation of Prototype 1 and limited implementation of Prototype 2

Webinar Objectives

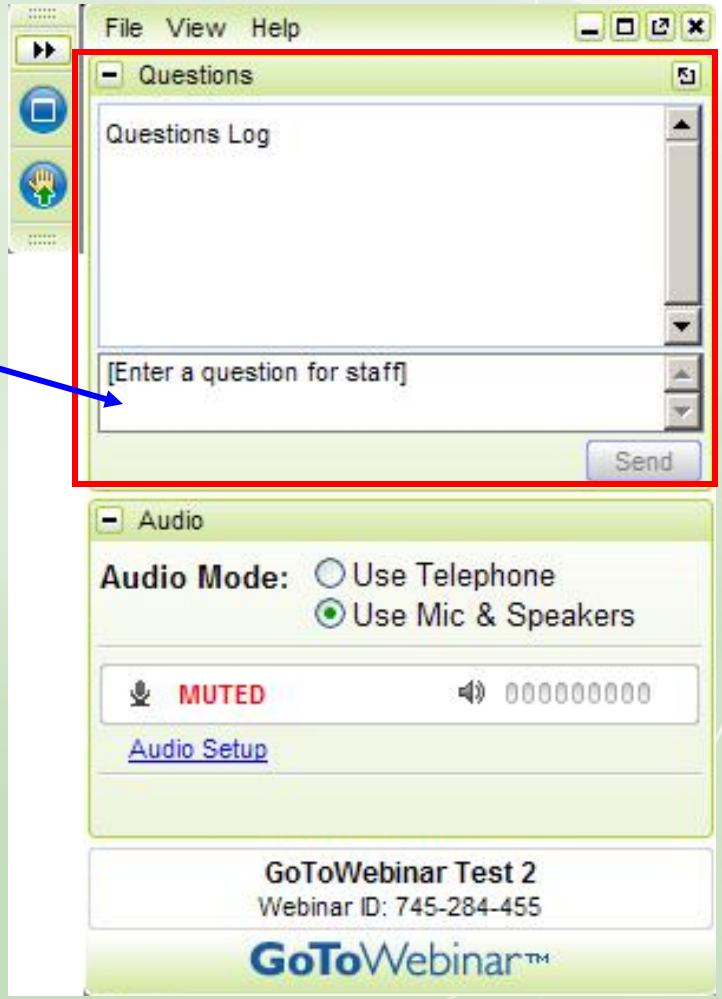
What is SHRP 2 doing to reduce the impacts of underground utilities on highway construction projects?

How will I be able to use the products of this SHRP 2 research?

Question and Answer Session

Please type your questions into this box

We will answer as many of your questions as time allows



Thank you for attending the webinar!

Chuck Taylor
ctaylor@nas.edu

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