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Beating I/I With Effective 21st Century Sewer Rehabilitation – Good Ideas And Successful Outcomes

Thursday, May 21, 2020
1:00 PM – 3:00 PM ET

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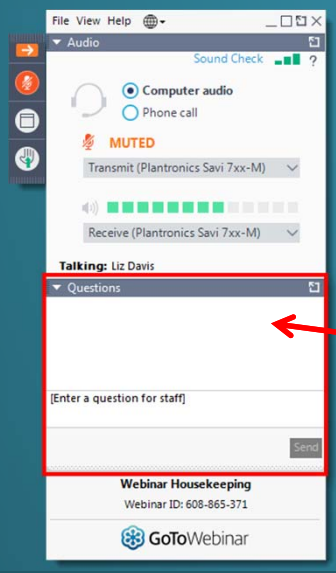
How to Participate Today



- **Audio Modes**
  - Listen using Mic & Speakers
  - Or, select "Use Telephone" and dial the conference (please remember long distance phone charges apply).
- **Submit your questions using the Questions pane.**
- **A recording will be available for replay shortly after this webcast.**

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Today's Moderator

Tim Sumner, PE, CFM, CSM
Project Manager

CMT
Crawford, Murphy & Tilly

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Today's Presenters

- Ted DeBoda
  - Back To Basics: An Overview of Sewer Rehabilitation Technologies
- John Matthews
  - Selecting a Sewer Rehabilitation Technology
- Nick Domenick
  - Constructability Considerations for Private Property I/I Reduction

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Our Next Speaker

Ted DeBoda, P.E.

Chief, Bureau of Utilities,
Department of Public Works

BALTIMORE COUNTY MARYLAND

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BACK TO BASICS
An Overview of Sewer Rehabilitation Technologies

Ted DeBoda, P.E.
CHIEF, Bureau of Utilities
Baltimore County Department of Public Works

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BACK TO BASICS: OUTLINE

- RESOURCES
- REHABILITATION TECHNOLOGIES
- PRIORITIZING PROJECTS

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BACK TO BASICS: RESOURCES

- PRWEF I&I TECHNICAL ACTICES GROUP – FACT SHEETS
  - SANITARY SEWER REHABILITATION-2017
- NASSCO MOP
  - UPDATED IN 2019
  - PEER REVIEWED BY WEF CSC
- PIPELINE INFRASTRUCTURE RENEWAL AND ASSET MANAGEMENT – NAJAFI/NASSCO
  - JOINT EFFORT – 2016
- NASSCO INSPECTOR TRAINING AND CERTIFICATION PROGRAM (ITCP)
  - CIPP – VERSION 4, 2017
  - MANHOLE REHAB – VERSION 1, 2013

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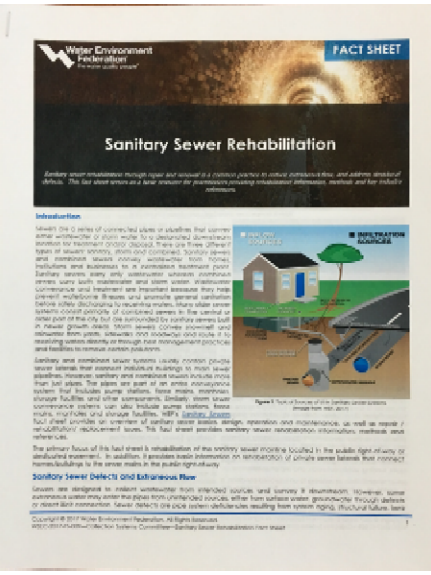
BACK TO BASICS: FACT SHEET

SANITARY SEWER REHAB (PIPE REHAB)

- OVERVIEW AND DISCUSSION OF DEFECTS
- METHODOLOGIES
  - NON-STRUCTURAL REHAB
  - STRUCTURAL REHAB
  - SPRAY OR SPUN CAST SYSTEMS
- SUMMARY MATRIX
  - STRUCTURAL/NON-STRUCTURAL
  - SERVICE LIFE
  - ADVANTAGES/DISADVANTAGES
  - APPLICATIONS
    - SIZE
    - MAIN/LATERAL/MANHOLD



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BACK TO BASICS: FACT SHEET

SANITARY SEWER REHAB (PIPE REHAB)

- OVERVIEW AND DISCUSSION OF DEFECTS
- SUMMARY MATRIX
  - STRUCTURAL/NON-STRUCTURAL
  - SERVICE LIFE
  - ADVANTAGES/DISADVANTAGES
  - APPLICATIONS
    - SIZE
    - MAIN/LATERAL/MANHOLE
- LIMITED TO REHAB (NOT RENEWAL)

Sanitary Sewer Rehabilitation Summary Matrix

Technique	Type	Estimated Service Life (SSEPA, 2014)	Advantages	Disadvantages	Potential Application, Pipe Diameter	Mainline /Lateral/ Manhole
Cementitious Coatings: Shotcrete or Gunite	Structural/ Non-Structural	20 or more years	All shapes and connections accommodated.	Address active infiltration, requires confined space entry	48" and larger	Yes / No / Yes
Spun Cast Concrete	Structural/ Non-Structural	Same as concrete pipe (Army Corps of Engineers)	Robotically applied. Antibacterial additive can be added when microbiologically induced corrosion is present.	Address active infiltrations	30 – 120"	Yes / No / No
Spray Polymer Coatings	Structural/ Non-Structural	50 years	Encapsulates sewer, can be designed for structural load, can improve flow coefficient	Sags and dips in pipe remain, service interrupted, must stop active infiltration	6" and larger as long as the host pipe wall can be properly cleaned and dried.	Yes / No / Yes
Cured-in-place-pipe (CIPP)	Structural	50 years	Prevents further degradation and collapse, improves flow coefficient	Sags and dips in pipe remain, service interrupted, infiltration may follow annular space	3" to 120"	Yes / Yes / Yes
Thermo-formed Pipe (Fold and Form)	Structural	20 or more years	Prevents further degradation and collapse, improves flow coefficient	Sags and dips in pipe remain, service interrupted, infiltration may follow annular space	4" to 30"	Yes / Yes / Yes
Injection / Pressure Grouting	Non-Structural	20-25 years	Seals leaking joints, stabilize supporting soils	Offset joints or longitudinal cracks may not seal	4"and greater	Yes / Yes / Yes
Slipliining	Structural	50 years	Quick insertion, some bends are accommodated	Circular and non -circular, loss of cross sectional area	4" to 144"	Yes / Yes / No
Spiral Wound Pipe	Structural	50 years	Prevents further degradation and collapse, improves flow coefficient	Sags and dips in pipe remain, service interrupted, infiltration may follow annular space	6" to 144", Larger sizes on case by case basis	Yes / No / No

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BACK TO BASICS: NASSCO MOP

MANUAL OF PRACTICE (MOP)

- SEWER INSPECTION TECHNIQUES
- KEYS TO SUCCESS
  - ASSESSMENT
  - TECHNOLOGY SELECTION
  - SPECIFICATIONS
  - CONSTRUCTION INSPECTION
- REHAB
  - PIPE REHAB
  - MANHOLE REHAB
  - LATERAL REHAB
- CONSTRUCTION
  - SPECIFICATIONS
  - INSPECTION

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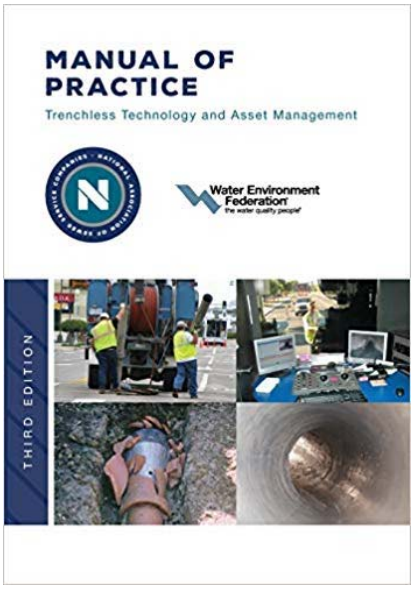

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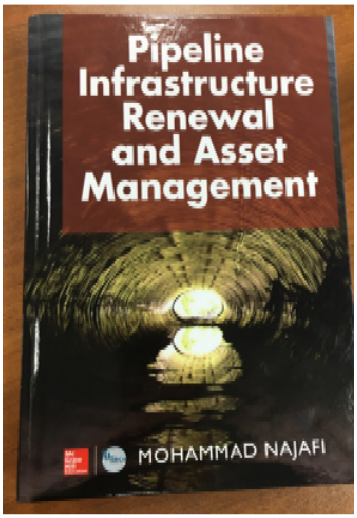
BACK TO BASICS: PIPELINE INFRASTRUCTURE

RENEWAL AND ASSET MANAGEMENT

- DECISION FACTORS
  - WHAT IS THE PROBLEM AND POSSIBLE SOLUTION(S)?
    - INFLOW, INFILTRATION, OR BOTH
    - STRUCTURAL
  - TECHNOLOGY SELECTION



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BACK TO BASICS: INSPECTOR TRAINING AND CERTIFICATION PROGRAM – (ITCP)

- ITCP CIPP
  - CHAPTER 5- PIPELINE RENEWAL TECHNOLOGIES AND THEIR APPLICATION
- ITCP MH REHAB
  - CHAPTER 3- MANHOLE REPLACEMENT AND REHABILITATION TECHNOLOGIES

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BACK TO BASICS: SPECIFICATIONS

NASSCO SPECIFICATION GUIDELINES

- CIPP
- LATERAL REHAB
- GROUTING
- FOLD AND FORM
- MANHOLE REHAB
- ETC.

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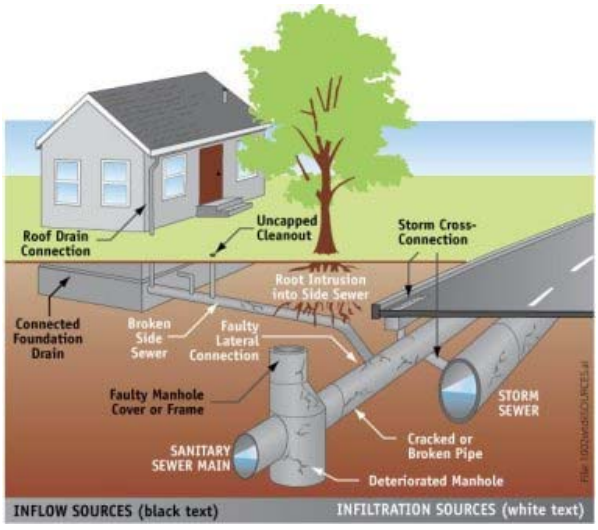
BACK TO BASICS: REHABILITATION TECHNOLOGIES



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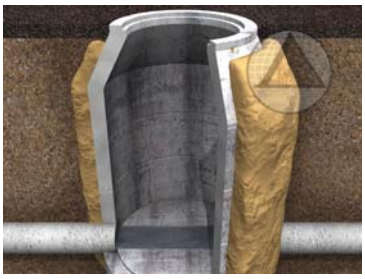
BACK TO BASICS: REHABILITATION

CHEMICAL GROUTING

- PIPELINES WITH FAILED JOINT SEALS
- LEAKING MANHOLES
- LATERAL CONNECTIONS
- NOT STRUCTURAL



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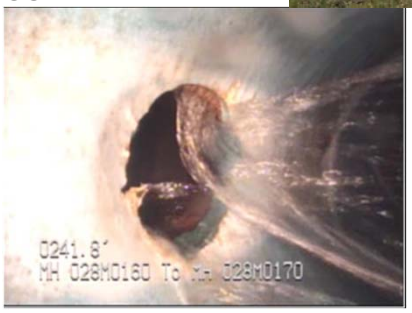
BACK TO BASICS: REHABILITATION

CURED-IN-PLACE PIPE (CIPP)

- INSERTION OF FLEXIBLE RESIN-IMPREGNATED TUBE
- TUBE IS CURED TO FORM A "PIPE WITHIN A PIPE"
- LATERAL CONNECTIONS ARE CUT OUT
- AMBIENT/HEAT/UV CURED



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BACK TO BASICS: REHABILITATION

TRENCHLESS SPOT REPAIRS

- COMMONLY CIPP OR MECHANICAL
- LEAKING MANHOLES (CHIMNEY SEALS)
- LATERAL CONNECTIONS

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BACK TO BASICS: REHABILITATION

FOLD AND FORM PIPE

- 6-24" HDPE or PVC
- WINCHED INTO PIPE AND UNFOLDED
- GROUT ANNULAR SPACE

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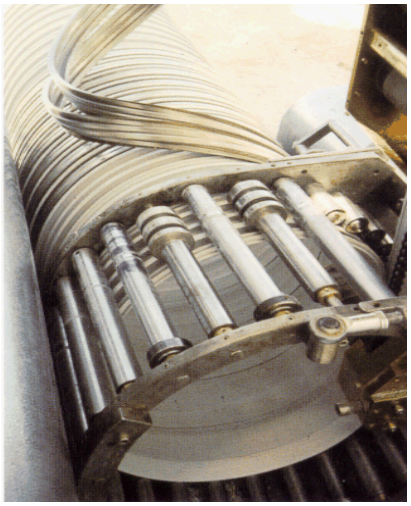
BACK TO BASICS: REHABILITATION

SPIRAL WOUND PIPE

- PVC STRIP WITH INTERLOCKING EDGE



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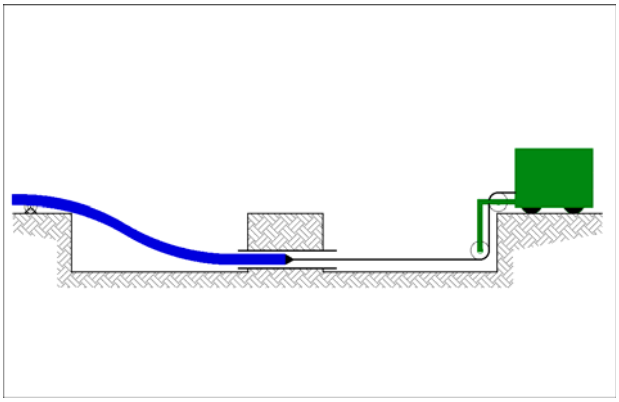
BACK TO BASICS: REHABILITATION

SLIPLINING

- HDPE OR OTHER MATERIAL
- WINCHED INTO PLACE
- SEAL ENDS
- REDUCED DIAMETER



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BACK TO BASICS: REHABILITATION

SPRAY-ON

- GUNITE/SHOTCRETE
- GEOPOLYMERS
- SEAL ENDS
- SMALLER DIAMETER

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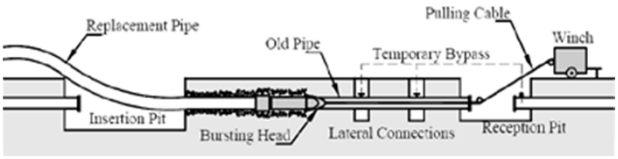
BACK TO BASICS: REHABILITATION

PIPE BURSTING

- 3-36" (AND MORE)
- NOT FULLY TRENCHLESS
- CAN UPSIZE PIPE
  - COMMONLY 0-25%
  - CAN DO 25-50% AND LARGER



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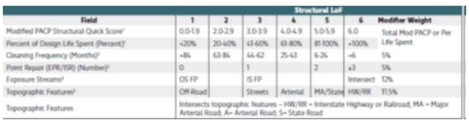
BACK TO BASICS: PRIORITIZING PROJECTS

BACK TO BASICS: PRIORITIZING PROJECTS

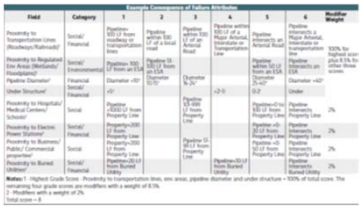
- EMERGENCIES

- PROJECT BACKLOG
  - PRIORITIES AND SEQUENCING
    - LIKELIHOOD OF FAILURE (LOF)
      - PACP/MACP "QUICK RATINGS"
      - NO INSPECTION
      - AGE?
    - CONSEQUENCE OF FAILURE (COF)
      - SIZE, DEPTH, CUSTOMERS
      - TRIPLE BOTTOM LINE
    - RISK = LOF X COF



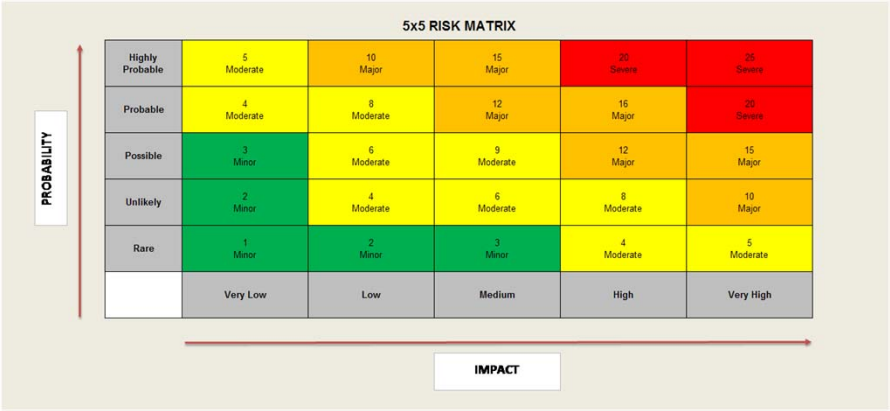
Field	Structural LoF					
	1	2	3	4	5	6
Modified PACP Structural Quick Score[1]	0.0-1.9	2.0-2.9	3.0-3.9	4.0-4.9	5.0-5.9	6.0
Percent of Design Life Spent (Percent)[2]	<20%	20-40%	41-60%	61-80%	81-100%	>100%
Cleaning Frequency (Months)[3]	>84	63-84	44-62	25-43	6-24	<6
Point Repair (EPR/ISR) (Number)[4]	0		1		2	≥3
Exposure Streams[5]	0		1			Intersect
Topographic Features[6]	Off-Road		Streets	Arterial	MA/State	HW/RR
Topographic Features	Intersects topographic features – HW/RR = Interstate Highway or Railroad; MA = Major Arterial Road; A= Arterial Road; S= State Road					

Modifier Weight
Total Mod PACP or Per Life Spent
5%
5%
12%
11.5%



BACK TO BASICS: PRIORITIZING PROJECTS

Risk Matrix



BACK TO BASICS: PRIORITIZING PROJECTS

Risk Matrix

BACK TO BASICS: UNDERSTANDING THE IMPORTANCE OF…

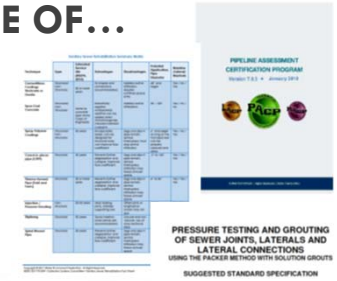
1. CONDITION ASSESSMENT (PACP, MACP, LACP)

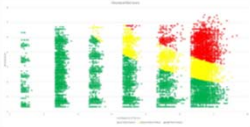
2. SELECT THE RIGHT TECHNOLOGY FOR THE JOB!
   - ADVANTAGES/DISADVANTAGES
   - IS IT PRACTICAL?

3. QUALITY SPECIFICATIONS

4. TRAINED/KNOWLEDGEABLE CONSTRUCTION INSPECTION

PROJECT PRIORITIZATION
FOLLOW-UP ASSESSMENT





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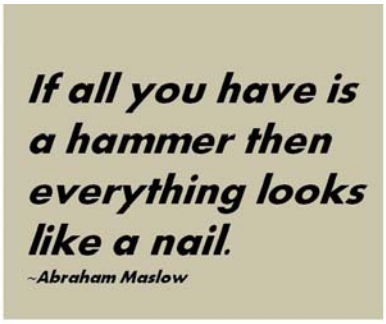
BACK TO BASICS: REHABILITATION



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BACK TO BASICS: REFERENCES

WEF I&I TECHNICAL ACTICES GROUP – FACT SHEETS

- SANITARY SEWER REHABILITATION-C2017

NASSCO MANUAL OF PRACTICE

- UPDATED IN 2019
- PEER REVIEWED BY WEF CSC

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NASSCO SPECIFICATION GUIDELINES

NASSCO PIPELINE ASSESSMENT AND CERTIFICATION PROGRAM (PACP) VERSION 7

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BACK TO BASICS: FOR MORE INFORMATION

WWW.WEF.ORG

WWW.NASSCO.ORG

FACT SHEET, ADDITIONAL RESOURCES

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BACK TO BASICS

AN OVERVIEW OF SEWER REHABILITATION TECHNOLOGIES

Ted DeBoda, P.E.
Chief, Bureau of Utilities
Baltimore County Department of Public Works
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Email: tdeboda@baltimorecountymd.gov

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Our Next Speaker

John Matthews, Ph.D.

Director,
Trenchless Technology Center
Associate Professor,
Louisiana Tech University

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Selecting a Sewer Rehabilitation Technology

John C. Matthews, Ph.D.
Director, Trenchless Technology Center
Associate Professor, Louisiana Tech University

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Agenda

- Critical Selection Factors
  - Structural Integrity
  - Hydraulic Capacity
  - Pipe Characteristics
  - Lateral Connections
  - Longevity of Repair
  - Accessibility
  - Contractor Availability
- Summary of Technology Applicability
- Available Resources

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Critical Factors

- Structural Integrity
- Hydraulic Capacity
- Pipe Characteristics
- Lateral Connections
- Longevity of Repair
- Accessibility
- Contractor Availability

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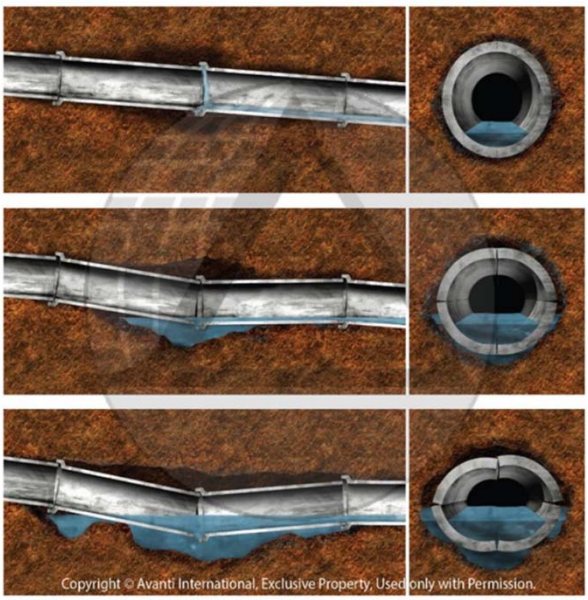
Structural Integrity

- Defect types vary and impact type of repair
- ASTM F1216 used for designing liner thickness
- Partially deteriorated vs fully deteriorated



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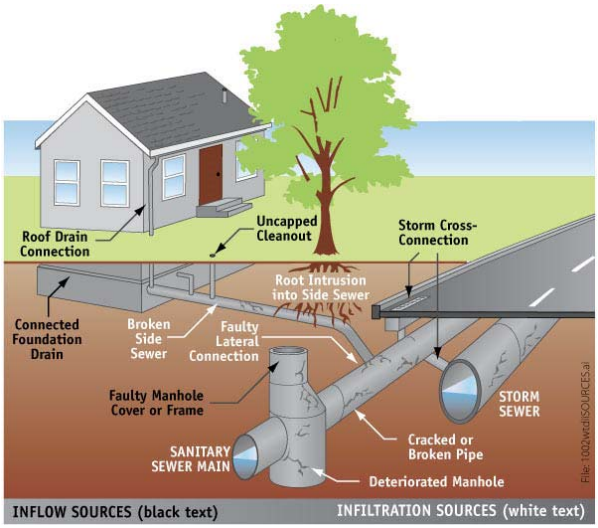
Hydraulic Capacity

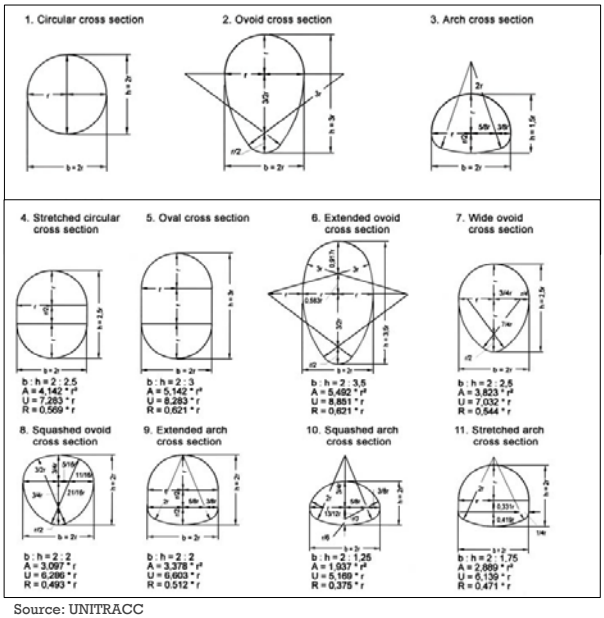
- Inflow from drains, cleanouts, manholes, etc.
- Infiltration through cracks, breaks, faulty connections, etc.
- Under or over designed due to population shifts



Source: King County, WA

Pipe Characteristics

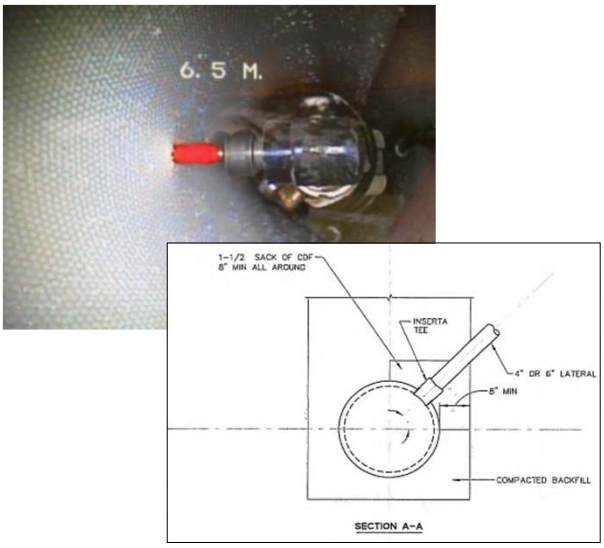
- Diameter, Shape, Length, Depth, Bends, Appurtenances, etc.
- Flow chemistry, soil type, bypass requirements, diameter transitions, etc.



Source: UNITRACC

Lateral Connections

- Internal reinstatements via robotic cutters
- External mechanical or fused saddles
- Not applicable for some methods



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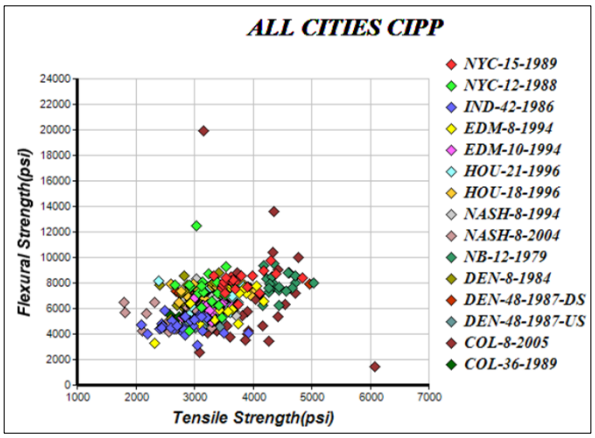
Longevity of Repair

- Repair material (PVC vs HDPE vs RCP vs CIPP vs Grout vs etc.)
- Chemical and abrasion resistance
- More retrospective data needed to confirm for more methods/conditions



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Accessibility

- Some methods can be installed through a standard manhole
- Others required access and receiving pits
- Some methods can be customized to be installed in a MH through not commonly

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Contractor Availability

- Experience level of contractors
- Cost of mobilization
- Availability of competitive quotes
- General contractor costs can also skyrocket

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Summary of Technology Applicability

Methods	Structural Repair	Hydraulic Capacity	Lateral Connections	Repair Longevity	Access	Contractor Availability
CIPP	Yes	May Improve	Internal	50+ Years	Manhole	Nationwide
Chemical Grout	No	No Impact	N/A	<25 Years	Manhole	Nationwide
Fold and Form	Possible	May Decrease	External	>20 Years	Manhole	Regional
Pipe Bursting	Yes	Can Increase	External	50+ Years	Access Pit	Nationwide
Sliplining	Yes	May Decrease	External	50+ Years	Access Pit	Nationwide
Spiral Wound Lining	Yes	May Decrease	External	50+ Years	Manhole	Regional
Spot Repairs	Possible	Variable	Variable	Variable	Both	Nationwide
Spray-on Lining	Yes	May Decrease	Internal	Variable	Manhole	Both

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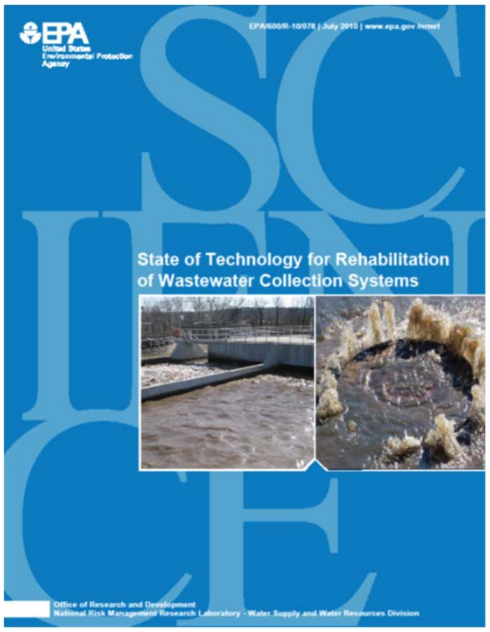
Available Resources

- WEF www.wef.org
- NASSCO www.nassco.org
- NASTT www.nastt.org
- TTC www.ttc.latech.edu
- EPA www.epa.gov



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Thank You

John C. Matthews, Ph.D.

Director, Trenchless Technology Center

Associate Professor, Louisiana Tech University

matthews@latech.edu

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Our Next Speaker

Nick Domenick, P.E.

Project Manager,

Division of Sewage & Drainage

THE CITY OF COLUMBUS
ANDREW J. GINTHER, MAYOR

DEPARTMENT OF PUBLIC UTILITIES

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Constructability Considerations for Private Property I/I Reduction

Nick Domenick, P.E.
City of Columbus, Ohio Division of Sewerage & Drainage
Sewer Systems Engineering Section

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Agenda

- Background
- Private Property Approach
- Current Project Area
- Quality Assurance
- Public Relations
- Bidding Documentation/Process
- Quality Control
- Results
- Lessons Learned

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Background

- 2005 Wet Weather Management Plan (WWMP)
- Gray improvements
  - Plant upgrades
  - Tunnels/relief pipes (CSO)
  - Inflow redirection (CSO)
  - Pipe upsizing (SSO)
  - Pipe rehab (SSO)
- **Lining Mainline/manholes alone had widely varying effect**

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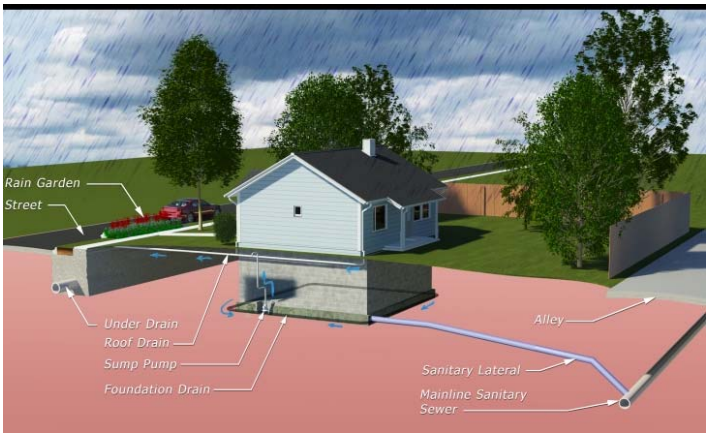
Private Property Approach

- 2015 WWMP update
  - Integrated solutions approach
- Lateral lining (90% of homes)
- Redirect 50% of the roof area
  - (not already to the street)
- Install sump pumps in 25% of homes
- GI to handle additional runoff
- City Ordinance granting authority



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Current Project Areas

- Clintonville 1 project area
  - Previous I/I studies
  - Previous pilot projects
  - 1,000 acres
  - 3,000 homes
  - 2 active, 3 complete lining projects
  - 1 active, 4 complete roof redirection projects
  - 1 active, 2 complete sump pump projects

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Quality Assurance

- CIPP Lining Specs
  - New product committee approval required for materials/suppliers
  - Both one step & two step processes allowed
  - Minimum qualifications for contractors
  - Submittals
    - Liner calcs (street level)
    - Resin volume calcs (using carrier material void ratios)
    - Curing cycle (2-3 hours)

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Quality Assurance

- Downspout redirection
  - Minimize excavation limits/area of disturbance (Mud Mats, Tarps, sod cutter)
  - Restoration allowances
    - For landscaping items only
    - $500/house budgeted
    - Some more/some less

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Public Relations

- Work hours restrictions
- Notification process/protocols
- Homeowner meetings
- Work plan development

Notification	Timeframe	Method	Responsible Party
Notification to schedule inspection	Immediately after NTP	Mailed to all residences and landlords in Project Area	Contractor
2nd Notification to schedule inspection	10 days after 1st Notification	Mailed to all non-responsive residents and landlords in Project Area	Outreach
5-day Notification of inspection	5 days prior to inspection commencing	Mailed to non-responsive residences and landlords AND hand-delivered to residences scheduled for inspection	Contractor
24-hr Notification of inspection	24-hours prior to inspection commencing	Hand-delivered to non-responsive residences scheduled for inspection	Contractor
Summary of work to be completed	After inspection completed	Verbal and/or mailed to resident	Contractor
5-day Notification of private property work	5 days prior to work commencing	Mailed to non-responsive residences and landlords AND hand-delivered to residences scheduled for work	Contractor
24-hr Notification of RR inspection	24-hours prior to work commencing	Hand-delivered to non-responsive residences scheduled for work	Contractor
Notification of completed RR work	Immediately after work completed	Hand-delivered to residence	Contractor

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Bid Docs/Process

- 500 homes per contract
- 1 year Duration
- Scheduling/Sequencing special provisions
- Online bids
- Construction management information system (CMIS)

- Unit price vs performance based lump sum

"The contractor shall sequence the activities to complete all work…within 7 days of mobilizing to the property."

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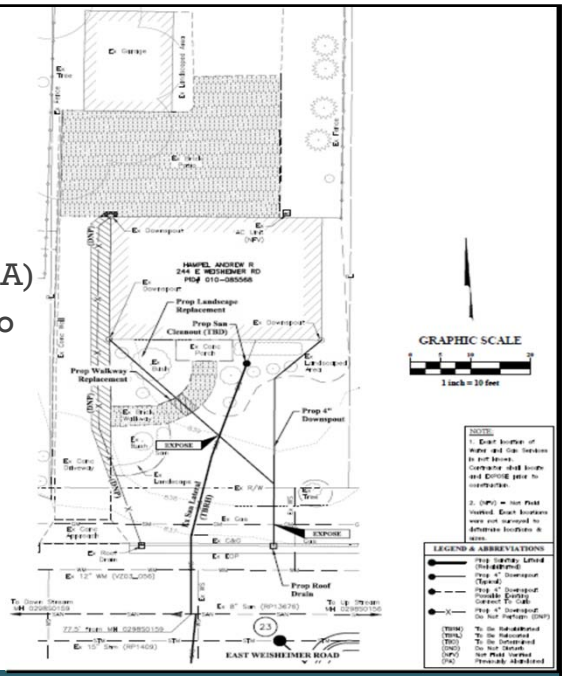
Bid Docs/Process

- Exhibits
  - Investigated every property to determine "directly connected impervious area" (DCIA)
  - Characterized all downspouts (by cost) in to "low", "medium, "high" difficulty
  - Perform all "Lows", and select "mediums"
  - Pay quantities structure
  - Cleanout locations



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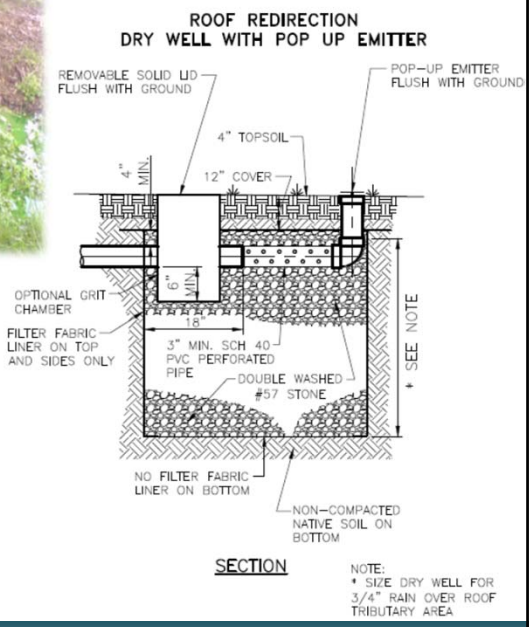
Bid Docs/Process



- Downspout Redirection
  - Bond funded
  - Redirect Beyond 7' buffer area
  - Options for Inadequate grade/curb reveal
  - Roof drain televising/site documentation
  - Verify/revise Work plan

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Bid Docs/Process

- Lateral Lining
  - WPCLF funded
  - Videos
  - Sewer maps (Access/work hours/MOT/Bypass)
  - 4.0 mm min thickness
  - Lump sum for wye and first 35'
  - Leave 4"/6" transition in place
  - **Cleanouts optional**
  - **Hydrophilic end seal materials**
  - **Air tests (adjacency)**

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Bid Docs/Process

	Columbus	Suburb
Connection Seal Price	$4,950/EA	$4,350/EA
Lateral Unit price	$10/LF	$60/LF
Cleanout Price	$0/EA	$1,800/EA
Total:	$5,250	$6,150
Difference:	$900	

** For 65 foot CIPP lateral liner and full wrap seal at wye connection*

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Quality Control

- Pre/post lining videos
- Test Plate sample for all liners
- Air test Cleanouts **after** liner installed
  - Allows obtaining insitu samples
  - Test 10%
  - Escalating penalties for failure
  - Stop liner short to Leave room for installation

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Quality Control

- Lining inspector
  - Training
  - Video review protocols
  - 34-point field Checklist
- CM for continuity
  - Apply go/no-go dollar thresholds consistently
  - Monitor performance goals

SANITARY LATERAL LINING CHECKLIST

Liner Preperation
Verify resin/catalyst and felt liner materials are consistent with the approved submittals
Verify appropriate seasonal resin mix is being used (i.e. summer vs. winter mixes)
Note production date of resin/catalyst to ensure that it is within the recommended shelf life
Verify that the resin/catalyst has been stored in the proper containers and at the appropriate temperatures
Verify liner material cut to length, including 1' for CIPP sample and 1' for test liner used to note resin activation. Note time resin preparation (mixing) is initiated
Verify resin application during wet-out process, i.e. full saturation of liner material with no spotting or dry patches noted. (Note time wet-out process completed.)

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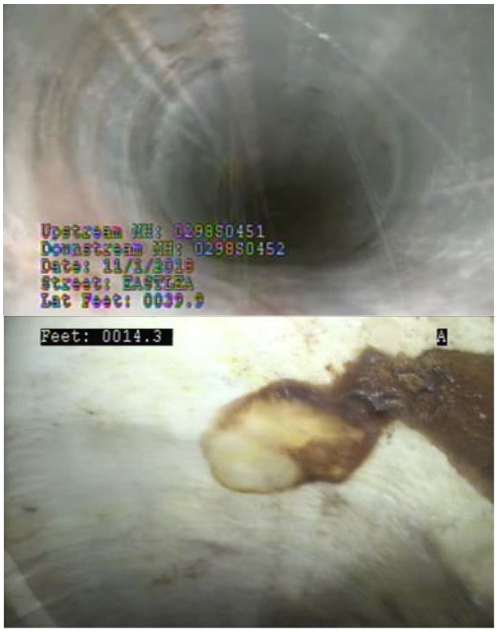
Quality Control

- Wet weather televising
- Emphasizes the need for strict enforcement of specs and well trained personnel
- 4.0 mm bag specified; 5.0 mm bag and resin volume run through a 4.0 mm pinch roller
- **Should 100% leak free be expected?**
- Relined some at contractor's expense
- Reduced payment on others



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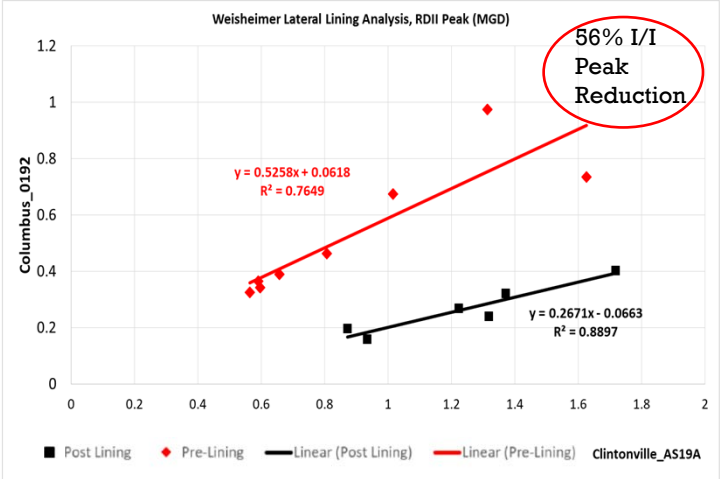
"Results"

- Flow monitoring still being collected

- Lining = $5,500/lateral
- Downspouts = $4,200/house
- Sump Pumps = $6,500/house



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"Results"

- Few failing CIPP Tests (structural/thickness)
- Few failed air tests
- Under budget
- Productivity rates
  - Laterals: 2-3/day/crew
  - Downspouts: 6 houses/day
- Latter contracts way behind schedule
- Lack of bidders/competitiveness

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Lessons Learned

- Programmatic
  - Reduce lateral televising
    - $250/lateral
  - Reduce property exhibit effort
    - 4-6 hours/exhibit = $1.1M
    - Aerial photography
    - Statistical projections
  - Monitor post downspout redirection for effectiveness

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Lessons Learned

- Roof redirection
  - Verify roof drain capacity calcs
  - Clarify expectations for deliverables
  - Clearly defined roles/responsibilities for decisions
  - 99% positive public feedback

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Lessons Learned

- Lateral lining
  - Lining during wet weather
  - Point repairs (arborist evaluations/Tree removal indemnification letter)
  - Resin saturation at liner seams
  - Monitor inhibitor volumes
  - Calibration tubes lengths
  - 90' Max
  - No more than two 45 degree bends

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Lessons Learned

- Lateral lining
  - Issues discovered/revealed beyond limits of work
  - Lateral Cleaning (root saw vs. jetter)
  - Contractor training (Soft skills)
  - Inspector training
  - Equipment clearance in previously rehabbed 8" main
  - Get more producers/products approved (Full wrap vs "tophat")
  - Both upstream & downstream manhole required
  - Goofy stuff will happen

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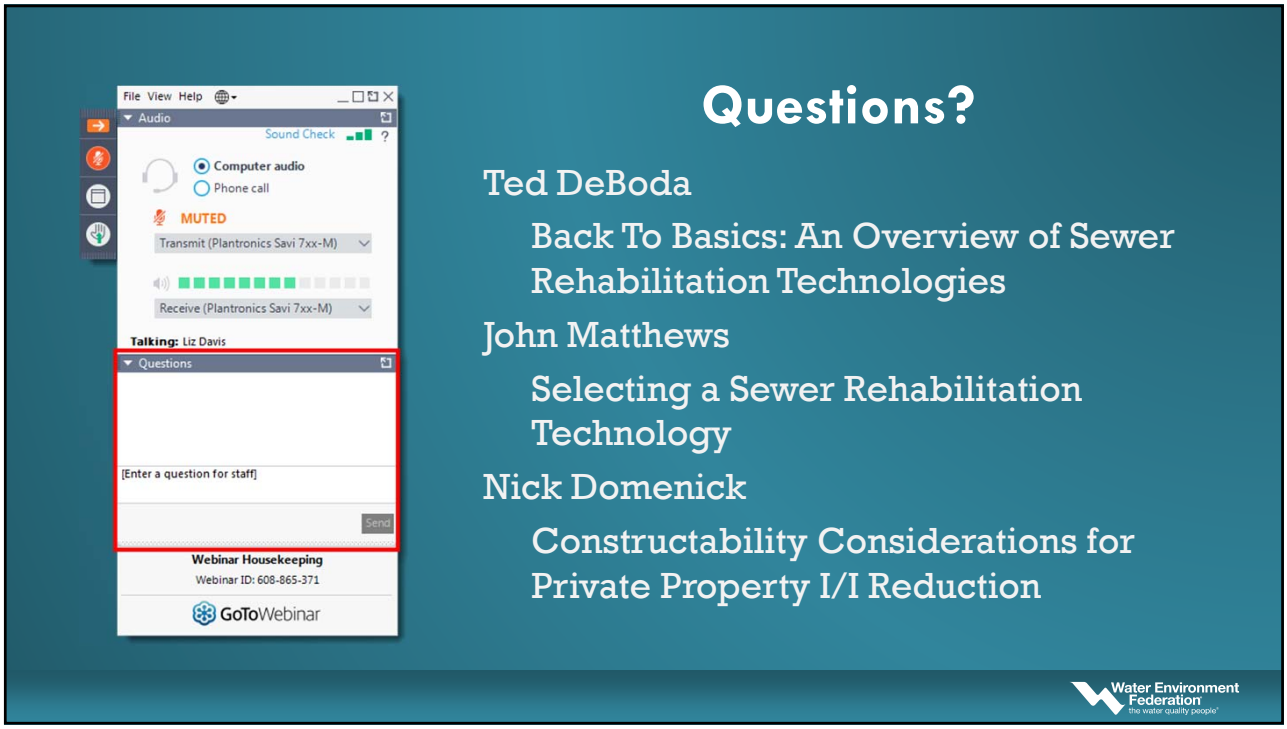
Questions?
Ted DeBoda
Back To Basics: An Overview of Sewer Rehabilitation Technologies
John Matthews
Selecting a Sewer Rehabilitation Technology
Nick Domenick
Constructability Considerations for Private Property I/I Reduction
File View Help
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