

CRITICAL SEWER & WATER CHRONICLES

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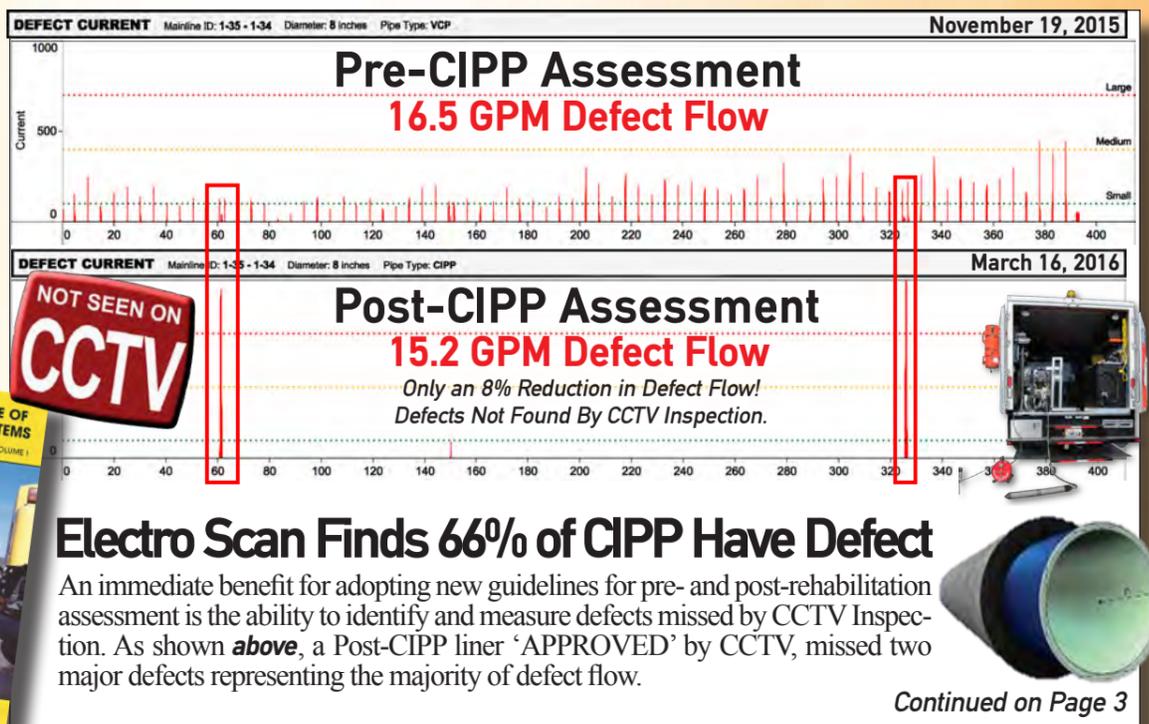
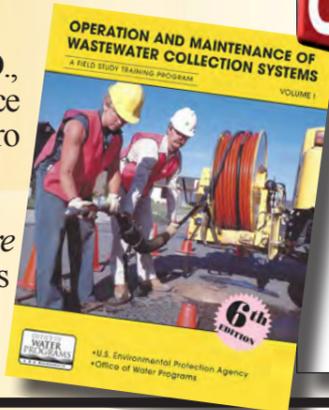
Electro Scan Replaces CCTV Rating To Rank Rehabilitation & Certify Repairs

Defect Flow Rating System Based on GPM Overcomes Problems With 1-5 CCTV Rating

Leading sewer agencies, consulting engineers, and academics, are recommending a new way to rank and prioritize critical sewers using *Electro Scanning Inspection*.

Featured in the 7th Edition, Volume 1, of the industry's leading manual, *Operation and Maintenance of Wastewater Collection Systems* – first introduced in 1976 – Electro Scanning Inspection is now the recommended approach to evaluate sewer mains, particularly for pre- and post-rehabilitation effectiveness.

Written by Ken Kerri, Ph.D., P.E., the new guidelines replace CCTV Inspection with Electro Scanning Inspection recommended to first establish a baseline of defect flows *before* repairs – and then, *after* repairs to ensure a leak-free pipe.



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'Low Voltage Conductivity' Leak Detection To Be Added to AWWA M77 Standard

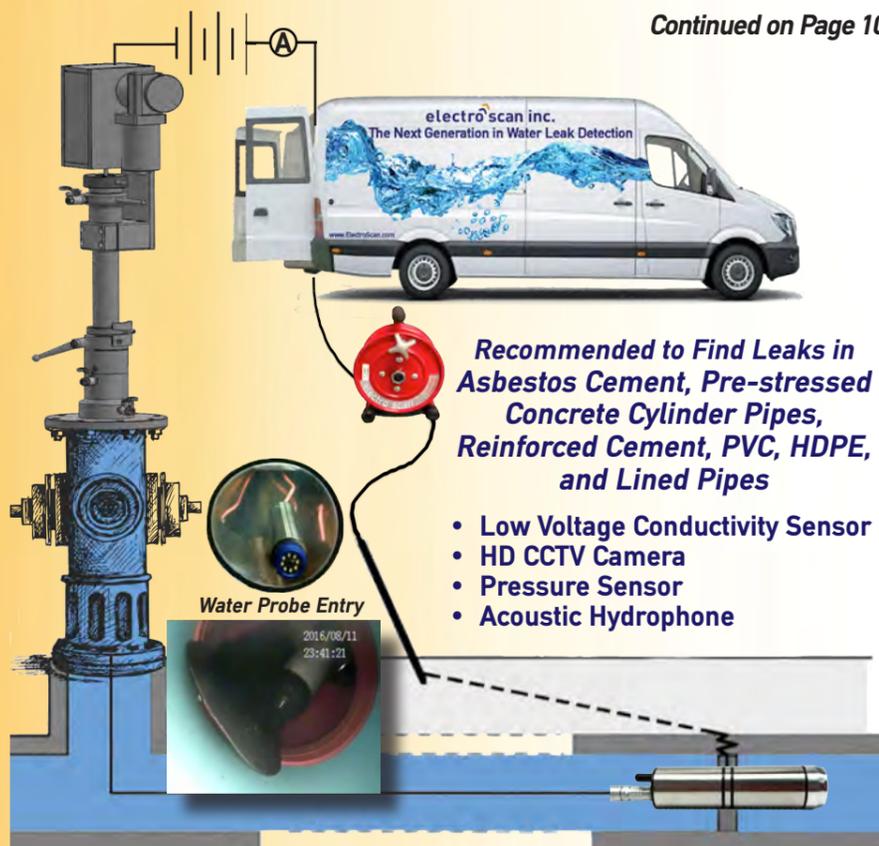
New AWWA M77 Water Main Condition Assessment Manual Features Electro Scan For Pressurized Pipes

Representing a major advancement over legacy acoustic sensors, data loggers, and correlators, Electro Scan's patented low voltage conductivity technology will be added to AWWA's First Edition M77.

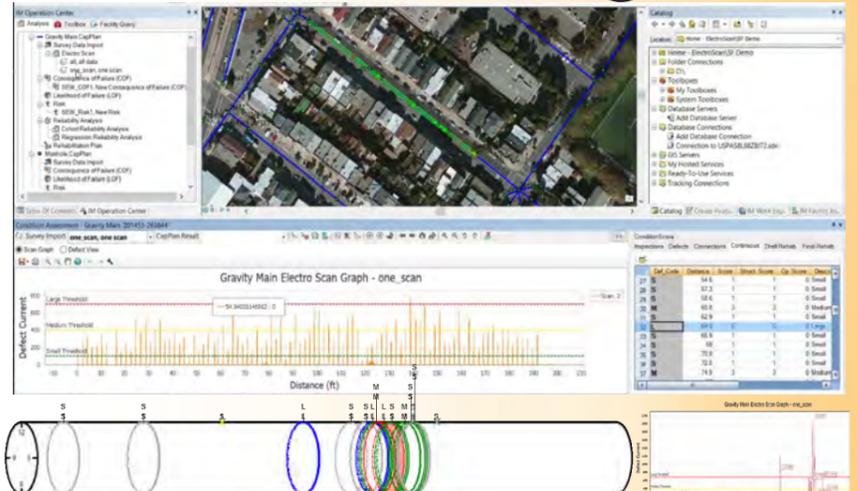
Equipped with a high resolution camera – used as a navigational aid – and an acoustic hydrophone – to show utilities what they are missing – Electro Scan's low voltage probe precisely locates & measures water leaks in gallons per minute or liters per second within 0.4 inches or 1 centimeter.

The new tethered probe enters through a dry or wet barrel hydrant, to assess a pressurized main, while still in service.

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Innovyze InfoMaster and Electro Scan Integration



Electro Scan Inc. and Innovyze® have teamed up to provide a new level of decision support for pre- and post-rehabilitation, integrating Electro Scan's award winning CriticalSewer® cloud application and Innovyze's InfoMaster® for Sewer.

Electro Scan is delighted to be working with Innovyze®, the international leader in business analytics and modeling tools for the water & wastewater markets.

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electro scan inc.
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Short Elliot Hendrickson Inc. (SEH) Engineers Host Electro Scan Roadshow in Minnesota & Wisconsin



CRITICAL SEWERS

Big screen TV allows attendees to immediately view scan results in the field

ELECTRO SCAN TRUCK

Added to an existing CCTV rig, operators can change from Electro Scan to CCTV, and back again, in minutes

DEMONSTRATION PARTICIPANT

ES-620 FOR SEWER MAINS PROBE

Automatically locates & measures all cracks, fractures, pinholes and defective service connections that allow water to pass through the pipe wall. For pipes 6" to 30" in diameter, low voltage conductivity is for non-metallic pipe.

GROUNDING REEL & CABLE

Allows remote connection to the Grounding Stake if a suitable location in the earth cannot be found



SEH INTRODUCES ELECTRO SCANNING INSPECTION TO CLIENTS, RECOMMENDED TO CERTIFY CIPP LINERS, REPAIRS, & NEW INSTALLATIONS

In accordance with new 7th Edition, Volume 1, Operation and Maintenance of Wastewater Collection Systems manual.

Short Elliot Hendrickson Inc. (SEH®) and Electro Scan teamed-up for the second year in a row, bringing a 9-city roadshow to Minnesota and Wisconsin. An additional twenty-three (23) surrounding municipal agencies attended to see how low voltage conductivity finds defects in CIPP, VCP, PVC, RCP, and AC pipes.

Roadshow Highlights – 3 Worst Pipes

- Watertown, WI.** 344 ft. VCP with 81 defects having a combined potential defect flow rate of 107.3 GPM.
- Waseca, MN.** 326 ft. VCP* with 98 defects having a combined defect flow rate of 103.3 GPM.
- Brainerd, MN.** 360 ft. CIPP with seven defects having a combined defect flow rate of 40.3 GPM.

Other Roadshow Highlights

- Waseca, MN.** 70 defects in a 38 ft. service lateral, having a combined defect flow rate of 11.5 GPM.
- Chippewa Falls, WI.** Inspection of a fully surcharged 15" RCP line, never televised due to groundwater

* By comparison CCTV operators previously abandoned their survey at 56ft due to a protruding tap (include side-by-sides at protruding tap – CCTV abandoned & ES 10GPM).

condition and defects. Electro Scan completed its inspection in less than 25 minutes, scanning in both downstream and upstream directions to show its highly accurate repeatability.

Additionally, in April, SEH and Electro Scan completed a 5,600 LF pre- and post-CIPP assessment.

In June, SEH and Electro Scan completed a two-phase pre- and post-CIPP assessment on 66 laterals and 16,250 ft. of sewer main for the City of Golden Valley, MN

Electro Scan would like to thank Paul Pasko, Dan Erickson, Dave Hutton, and Jen Schumann for their efforts in planning this roadshow.

Interested in adopting new condition assessment standards in your area?

For help in MN and WI contact Paul Pasko, P.E. at SEH, direct at 414-949-8978 or ppasko@sehinc.com or Electro Scan at 916-779-0660 or info@electroscan.com.

Leinenkugel's, the pride of Chippewa Falls, WI.



Electro Scan Roadshow

August 1-12, 2016

Wisconsin
Cedarburg
Chippewa Falls
Little Chute
Watertown

Minnesota
Brainerd
Duluth
Grand Rapids
New Ulm
Waseca

Electro Scan Finds 66% of CIPP Have Defects That Leak*



Continued from Page 1

Projects completed between January 1 and July 31, 2016 have shown that sixty-six percent (66%) of Cured-In-Place Pipe (CIPP) lining have defects.

While representing an improvement in the overall inspection of CIPP liners, results show an increase in the percent of liners experiencing more than 10 and 20 Gallons Per Minute (GPM) of defect flow, in many cases leaking more than pre-rehabilitation levels.

A surprise to many that have long relied on trenchless lining to repair, rehabilitate, and renew sewer and water mains and laterals, 2016 results confirm previous findings by Ken Kerri, Ph.D., P.E., that led him to recommend Electro Scanning Inspection for both pre- and post-rehabilitation, published in the 7th Edition, Volume 1, **Operation and Maintenance of Wastewater Collection Systems** manual.

Contact Electro Scan today to receive sample specification to certify liners and other rehabilitation, before Acceptance.

*CIPP Liners surveyed 1/1/2016 to 7/31/2016.

Electro Scanning Inspection For CIPP Certification & Acceptance

	Year to Date 7-31-2016	Life to Date 2011 -2016
CIPP Liners with Defect Flows	66%	84%
CIPP Liners with ZERO Defect Flow (Leak-Free)	34%	16%
Defect Flow By Severity		
More than 1 GPM	55%	62%
More than 2 GPM	49%	54%
More than 3 GPM	46%	51%
More than 4 GPM	45%	47%
More than 5 GPM	42%	43%
More than 10 GPM More Leakage Than Pre-CIPP	37%	34%
More than 20 GPM More Leakage Than Pre-CIPP	25%	21%

Source: Electro Scan Inc., CriticalSewers® cloud application, July 31, 2016.

AS RECOMMENDED in SEVENTH EDITION, VOLUME 1, WASTEWATER O&M MANUAL.

NEW BID STANDARD FOR CIPP & REHABILITATION ACCEPTANCE

Agencies are recommended to require Contractors to deliver a Maximum Leakage Acceptance Rate of 100 Gallons Per Day Per Inch Diameter Mile (GPD/IDM).

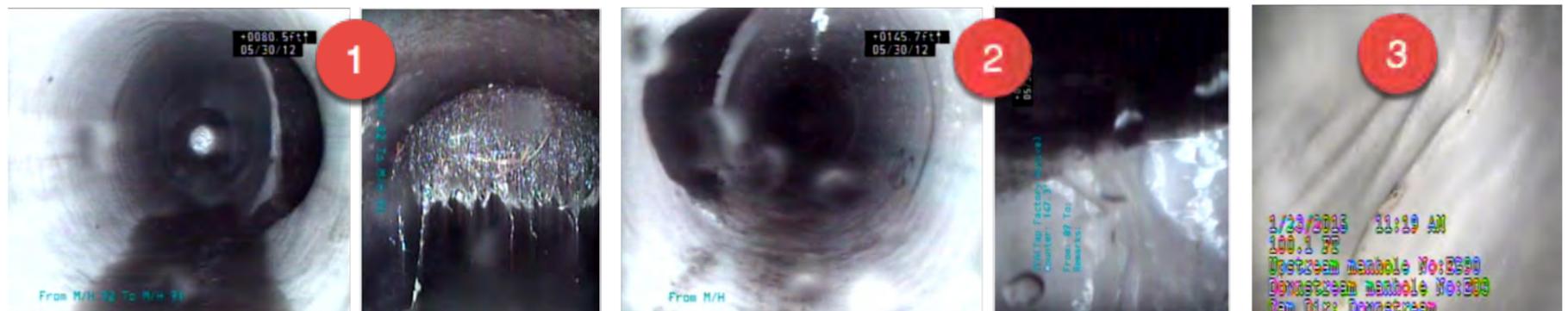
Assuming an 8" Cured-In-Place Pipe (CIPP), the Allowable Leakage Rate for a 100ft, 8in Diameter Pipe Divided by 5,280ft, representing 0.151515 gallons per foot.

Computation,
= 0.151515
Divided By 1440 minutes per day
= 0.00010522 gallons/foot/minute

Computation (Continued)
= 0.00010522 or G/F/M x 300ft Sewer Main
= 0.03156 Gallons Per Minute
= 45.5 Gallons Per Day

How Can CIPP Leak More After Lining Than Before?

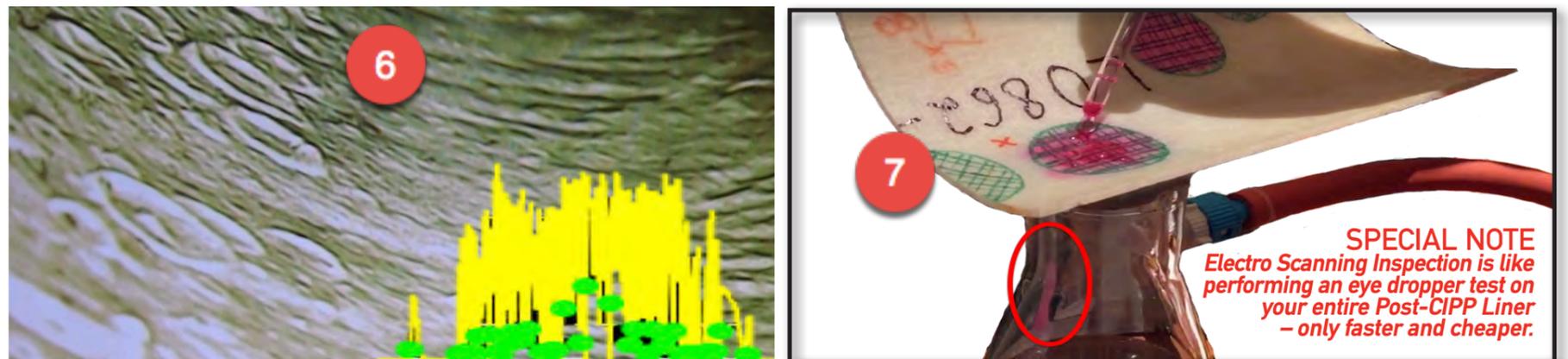
EXAMPLE DEFECTS MISSED OR INCORRECTLY IDENTIFIED BY CCTV INSPECTION



1. Post-CIPP, Bad Service Reconnection. Heavy Roots. 2. Post-CIPP, Bad Service Reconnection. Infiltration. 3. Wrinkles. They May Leak!



4. Accelerator Burns 5. Bad Resin. This pipe was relined in 2014 and certified by CCTV Inspection.

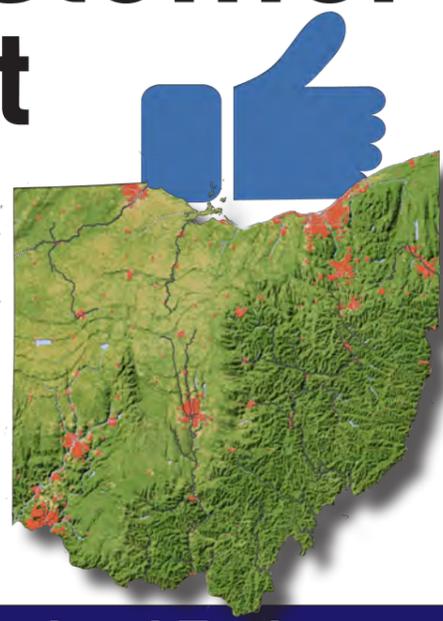


6. Overcooking of CIPP Liner. Electro Scan readings show multiple openings at boil points. 7. Defective Liner. Showing leaks that would be missed by CCTV Inspection.



8. Equipment Damage. Electro Scan found damaged liner six months after agency accepted based on CCTV completed by Contractor. Defect was not called out by Contractor's TV Operator.
9. Defective Epoxy. Electro Scan requested to document liner failure, one month after CIPP warranty expiration.
10. Unidentified or Unrecorded Post-CIPP Defects by CCTV Operator. An Electro Scan Inspection on July 21, 2016, showed a 4.64 gallon per minute leak at a lateral. Comparison to CCTV showed leak's earliest recording, without a callout by the CIPP contractor as early as August 17, 2011. Water Loss Calculation: Total Water Loss = 6,682 GPD (4.64 GPM) x 1,794 Days (4 years, 10 months, 28 days) = 11.1 Million Gallons.

Ohio Electro Scan Customer Surpasses 100,000 Feet



An Ohio-based Electro Scan Customer, managing a 270-mile wastewater collection system has completed its first 100,000 feet (18.9 miles) of Electro Scanning Inspection.

Purchasing the standard equipment and installing it on the agency's existing Closed-Circuit Television (CCTV) truck, crews were trained by

Electro Scan Field Staff and certified to conduct their own independent Electro Scanning Inspection work.

Electro Scan was selected as the Agency's new sewer main condition assessment standard after numerous defects were found causing infiltration that were not detected by CCTV Inspection.

Referred to by EPA benchmarks and consent decrees as the Focused Electrode Leak Location (FELL) technology, Electro Scanning Inspection represents an upgrade from previously used 1-5 visual inspection rating systems.

By ranking pipes based on a Gallons Per Minute Defect Flow, the Agency is able to better allocate capital expenditures and conduct post-rehabilitation acceptance.

As of June 30, 2016	Performance
Total Distance Electro Scanned (Feet)	100,448
Total Number of Pipe Segments	469
Total Defects Found	7,106
Total Gallons Per Minute of Defect Flow (GPM)	7,955
Total Gallons Per Day of Defect Flow (GPD)	11,454,912
Most Feet Scanned in a Single Month (March 2016)	27,550
Most Feet Scanned in a Single Day (March 9, 2016)	3,742
Most Pipes Scanned in a Single Day (March 10, 2016)	18

Source: Electro Scan Inc., Critical Sewers®

FAQ #2

Is a Professional Engineer Needed to Interpret the Data?

No. Electro Scan provides a straight forward, easy to understand explanation of the location and quantity of defect flow, not requiring third party data interpretation or independent experts. Developed for both professional engineers and non-engineers, data is shown in unambiguous, unbiased, repeatable, and reliable amounts, in GALLONS PER MINUTE (or LITERS PER SECOND).

Electro Scan Reduces The Need To Flow Test 'Control Study Basins'

While flow and pump run time monitoring at lift stations, pumping stations, and treatment plants is still recommended, the practice of flow testing adjacent or similar Control Study Basins may soon join the 8-track tape.

Electro Scan's ability to provide a consistently applied, repeatable, and unbiased baseline defect flow

– prior to rehabilitation – on a pipe-by-pipe basis, offers a more reliable approach to determine rehabilitation effectiveness.

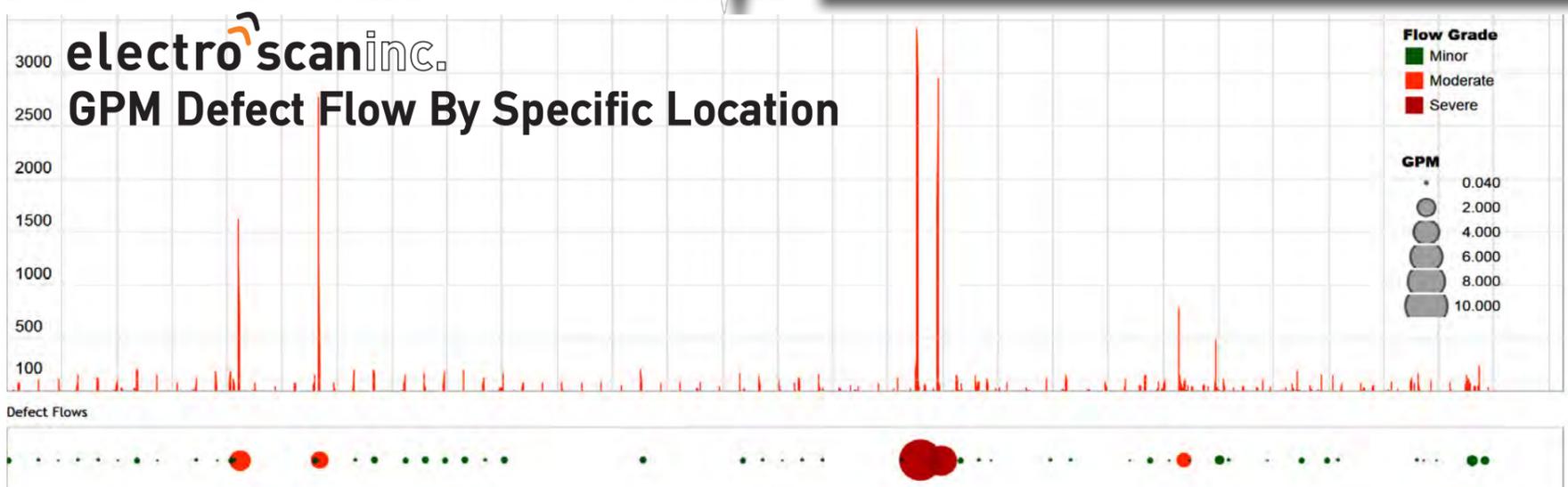
Sewer agencies and consulting engineers can now undertake a variety of repairs, relining, renewals, and rehabilitation projects and produce automatic post-rehabilitation assessment reports to either

provide a leak-free certification of repairs or identify the location and severity of defects required for the Contractor to repair.

Call Electro Scan for further details and case studies. A webinar can also be arranged for you and your Agency's staff.

Electro Scan v. Conventional Flow Monitoring

	electro scan inc.	Flow Monitoring
1. Determines Sewer Main-Specific Defect Flows	Yes	No
2. Identifies Specific Defect Locations Between Manholes	Yes	No
3. Accurate Location of Defect to Within 0.4 inches (1cm)	Yes	No
4. Complete Same-Day Analysis and Reporting	Yes	No
5. Estimates Full Sewer Main Defect Flows in GPM	Yes	No
6. Location & GPM Data, By Defect, In Minutes	Yes	No
7. Defect Flows Able to be Linked to a Joint or Service	Yes	No
8. Creates a Pre- & Post-Rehab GPM Defect Flow, By Pipe	Yes	No
9. Displays Cumulative Downstream Defect Flow, By Pipe	Yes	No
10. Estimates Individual Defect Flows in GPM or L/S	Yes	No
1. May Require Periodic Field Maintenance	No	Yes
2. May Take Several Months or Years for Results	No	Yes
3. Requires Rainfall Event to Show Defect Area	No	Yes
4. Requires 3rd Party Data Interpretation & Analysis	No	Yes



50,000LF Colorado Project Evaluates 315 Sewer Mains, Including 79 CIPP Liners

Electro Scan Finds That CIPP Liners Showed Disproportionate # Defects

Admittedly, the analysis of only five percent (5%) of a 187-mile wastewater collection system may be a small sample.

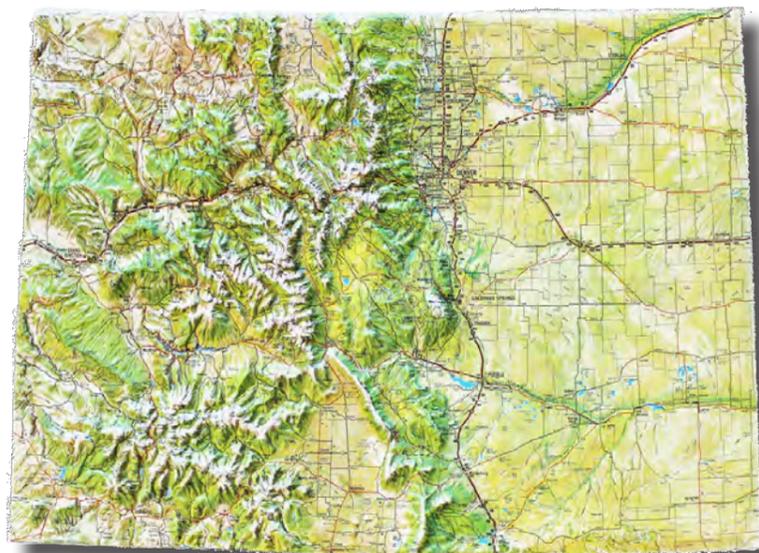
Still, we were surprised to find that Cured-In-Place Pipe (CIPP) showed a disproportionate share of defects, including both total number of defect locations and defect flows as measured in GPM.

- **Total Defect Locations:** 903 or 34% of 2,639 total defect locations.

- **Total Defect Flow:** 1,047 Gallons Per Minute (GPM) or 1.5 Million Gallons Per Day (GPD) defect flow.

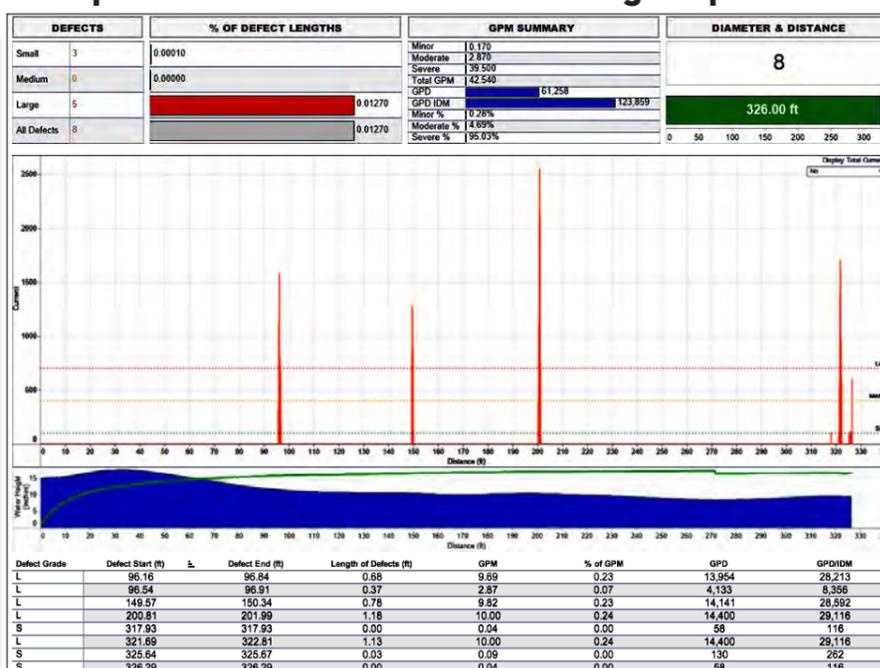
- **Prior Use of CCTV:** According to the Agency, acceptance of its previously lined Cured-In-Place Pipe was limited only to Closed-Circuit Television (CCTV) and visual inspection.

All data was collected in accordance with ASTM F2550 and the 7th Edition, Volume 1, of the *Operation & Maintenance of Wastewater Collection Systems* manual.



Completed in less than thirty days, Electro Scanning Inspection was accomplished with a two-person crew by Electro Scan Services.

Sample Post-CIPP Electro Scanning Inspection



Analysis of Cured-In-Place Pipe Defects Compared to All Pipes

Project Summary	All Pipes Inspected	CIPP Liners	CIPP as a % Total
Number of Sewer Mains Electro Scanned	315	79	25%
Total Footage (In Feet)	50,063	13,354	27%
Number of Total Defects	2,639	903	34%
Estimated Defect Flows			
Gallons Per Minute	3,230	1,047	32%
Gallons Per Day	4,651,229	1,507,608	32%

WRc and Electro Scan Exhibit at No-Dig 2016

WRc's Services Business Group is delighted to showcase their recently launched Electro Scanning Services for sewerage condition assessment at No-Dig Live 2016 in the UK.

First meeting at the 2015 UKSTT Awards Gala in Birmingham after receiving separate awards for achievement, a strategic agreement was negotiated for WRc to become the exclusive provider of Electro Scan Services throughout the United Kingdom and Republic of Ireland. This teaming of WRc and Electro Scan was announced nearly a year ago and several projects have already been successfully completed.

Electro Scan represents a next generation condition assessment technology that automatically locates and measures leaks in gravity mains and stormwater pipes. Providing specific locations for each defect, the innovative technology also provides an estimated defect flow in liters per second for each defect and total sewer main. It provides a baseline defect

flow for prioritising rehabilitation and certifying trenchless repairs as 'leak-free' prior to contractor acceptance.

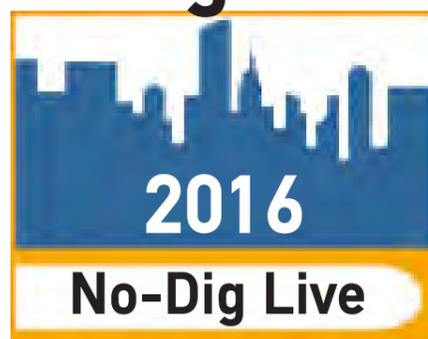
Results are reliable, repeatable, and unambiguous, with results available within minutes after completing each survey. No operator coding or third party interpretation is required, often finding faults not identified by visual inspections. Unlike CCTV, it does not rely upon a subjective visual observation of the pipe – so even pipes that are fully surcharged can be assessed. Data can also be integrated with the InnoVize InfoMaster for Sewer hydraulic modeling program for catchment planning.

UK-based
WRc Electro
Scan Van



Recommended by the U.S. Environmental Protection Agency and widely used by U.S. sewerage agencies for pre- and post-rehabilitation assessment, WRc is spearheading Electro Scan Services to help address requirements in AMP6 amongst the UK's water and sewer companies.

Keith Walker, Head of Commercial Enterprise at WRc comments "Electro Scan's advanced technology combined with the experience and proven consultancy of WRc, make the partnership well positioned to bring the next frontier of innovative solutions to UK water clients."



WRc and Electro Scan can be found on stand 133/51 at No-Dig Live 2016. For further information relating to this release contact Keith Walker at keith.walker@wrcplc.co.uk (tel: 07471 226307).

For general media enquiries, please contact: Jayne Matwiejczyk, Public Relations Department on +44 (0) 1793 865075 or email pr@wrcplc.co.uk.

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Since 2004 NASSCO has based its Pipeline Assessment and Certification Program (PACP) on WRc's Manual of Sewer Condition Classification (MSCC).



20-22 September, Peterborough Arena, East of England, Peterborough PE2 6XE

Innovyze InfoMaster-Electro Scan Integration

Continued from Page 1

Electro Scan Inc. has completed data integration between its flagship sewer condition assessment solution and the Innovyze® InfoMaster for Sewer product.

Electro Scan's breakthrough technology evaluates 360-degrees of a pipe wall to accurately locate and measure defects in gallons per minute (GPM) or liters per second (l/s).

Recent studies indicate that 70-100% of defects are typically not found by legacy inspection techniques, such as Closed-Circuit Television (CCTV) Inspection, Smoke Testing, Dye Flood Testing, Laser Profiling, or Acoustic Sensors.

Recommended to assess and certify pre- and post-rehabilitated pipes, a new chapter was recently added on Electro Scanning Inspection to the industry's leading training manual, **Operation and Maintenance of Wastewater Collection Systems, Seventh Edition, Volume One** (2015), in accordance with ASTM F2550.

"We are delighted to integrate our game changing pipe condition assessment solution with the leading business analytics solution for the wastewater industry," states Chuck Hansen, CEO, Electro Scan Inc.

"The Innovyze® family of smart network modeling and asset management solutions continues to be the standard platform for existing and emerging diagnostic tools," said Paul F. Boulos, Ph.D., BCEEM, Hon.D.WRE, Dist.D.NE, Dist.M.ASCE, NAE, President, COO and Chief Innovation Officer of Innovyze.

"We look forward to offering this new layer of condition assessment data to help our clients in their sewer rehabilitation decisions," continues Boulos.

Electro Scan's Critical Sewers® cloud application allows for up-to-the-minute monitoring of sewer evaluations, lining projects, point repairs, and new construction projects, while crews are still in the field.

Clients can identify pipe-specific problems before rehabilitation project acceptance.

Wirelessly transmitted to the Company's award winning cloud application, defect flows are reported in minutes and incorporated into Innovyze® InfoMaster® for Sewer product for display and analysis.

Since Electro Scan's advanced low voltage conductivity technology does not rely on operator interpretation, third-party data analysis, or independent judgment, a key advantage is its ability to automatically provide specific location, size, and estimated flow for each defect and total pipe.

Customers wishing to utilize Electro Scan's decision support data must be licensed users of Innovyze® InfoMaster® for Sewer and Electro Scan's Critical Sewers® cloud application, including associated integration module.



FAQ #3

How Do Agencies Purchase This Product?

First, make sure you have a current license for both the Innovyze® InfoMaster® for Sewer product and Enterprise License for Critical Sewers®.

You must also purchase an annual license for Electro Scan's InfoMaster Export Module for support and upgrades.

Contact Innovyze to get your license of InfoMaster® for Sewer or let us include results as part of your next Electro Scan project.



Category	Defect Flow	EDF	EDF - Low	EDF - Medium	EDF - High
Category - High	10 gpm, 1.34 mile	17 gpm, 1.07 mile	17 gpm, 0.81 mile	20 gpm, 0.61 mile	20 gpm, 0.41 mile
Category - Medium High	10 gpm, 1.07 mile	17 gpm, 0.79 mile	17 gpm, 0.61 mile	20 gpm, 0.41 mile	20 gpm, 0.21 mile
Category - Medium Low	10 gpm, 0.79 mile	17 gpm, 0.61 mile	17 gpm, 0.41 mile	20 gpm, 0.21 mile	20 gpm, 0.01 mile
Category - Low	10 gpm, 0.51 mile	17 gpm, 0.31 mile	17 gpm, 0.11 mile	20 gpm, 0.01 mile	20 gpm, 0.01 mile

Risk Class	Capital Action
Extreme	High Priority in CIP / Yearly Operational Frequency
High	Standard Priority in CIP / Biannual Operational Frequency
Medium	Low Priority in CIP / 1 in 5 Years Operational Frequency
Low	1 in 10 Years Operational Frequency
Negligible	Wait for a problem to arise

Mainline Segment	PRE-CIPP				POST-CIPP			
	From ID	To ID	Defect Flow	Defect Flow	From ID	To ID	Defect Flow	Defect Flow
AA004	AA001	AA010	133.5	115.1	0	0	0	0
AA012	AA022	REC	133.5	115.1	0	0	0	0
AA025	AA032	REC	133.5	115.1	0	0	0	0
AA019	AA022	CF	133.5	115.1	0	0	0	0
AA023	AA034	REC	133.5	115.1	0	0	0	0

InfoMaster®

Once data is accessible, Electro Scan defect flows may be highlighted by location and severity by Innovyze® InfoMaster for Sewer, including the identification of defective joints, cracks, and leaking service connections, compared to CCTV inspection results.

Electro Scan and Innovyze® users can show pipe defects ranked by highest GPM and

Gallons Per Day Per Inch Diameter Mile (GPD/IDM), utilizing Innovyze's 1D and 2D modeling and mapping features within their InfoMaster® for Sewer product.

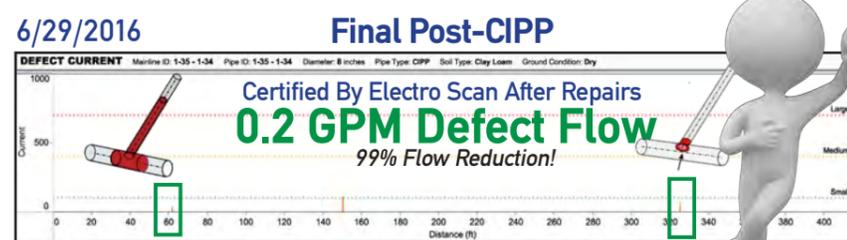
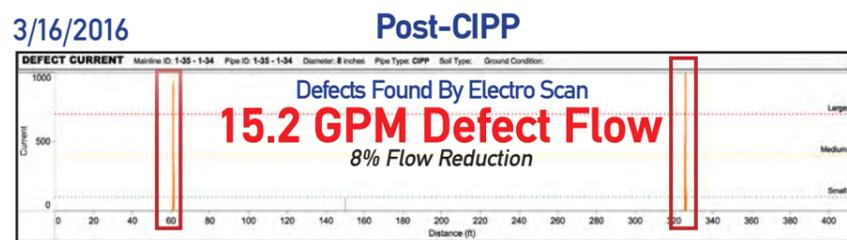
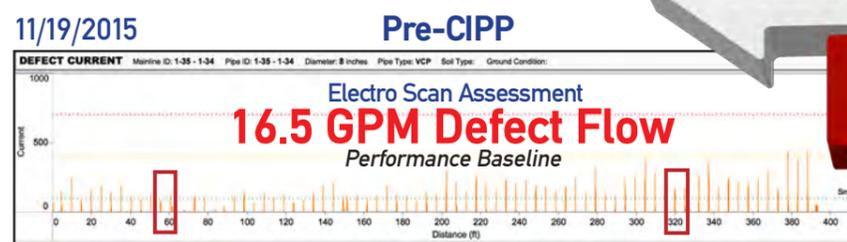
Plans include the integration of Electro Scan's 4-in-1 water leak detection probe with Innovyze® InfoMaster for Water to assess pressurized water mains.

criticalsewers®

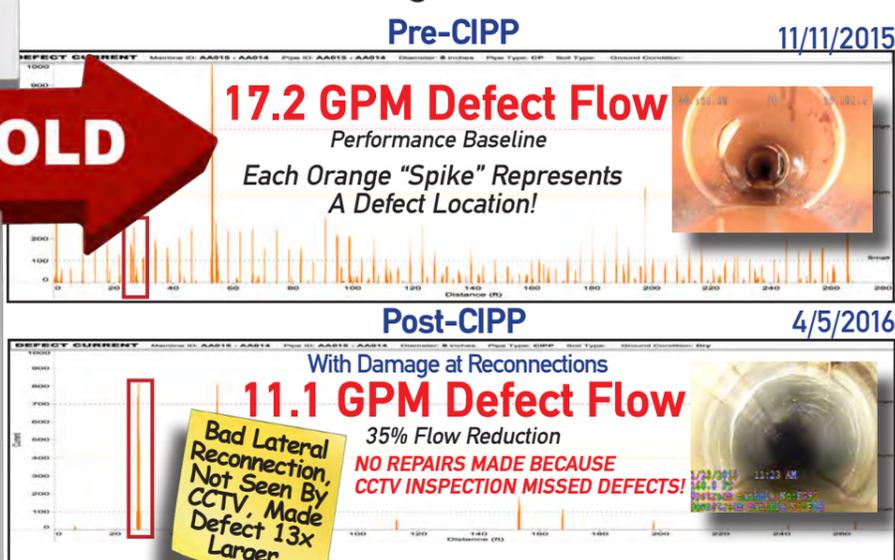
Headquartered in Broomfield, CO, Innovyze® is a leading global provider of wet infrastructure business analytics software designed to meet the needs of water/sewer utilities, government agencies, and engineering firms worldwide. Clients include the majority of the largest UK, Australasian, East Asian and North American cities, foremost utilities on all five continents, and ENR top-rated design firms.

New Standard Ensures Leak-Free CIPP.

Recommended in New 7th Edition, Volume 1, Wastewater Collection O&M manual.



Old Standard Using CCTV Misses CIPP Defects.



Electro Scan provides a complete audit trail of pipe rehabilitation. Tracking flow reductions – in gallons per minute – before and after rehabilitation, allows Owners to maximize flow reductions in their CIPP Projects.

Contact Us Today To Certify Your Repairs.

Electro Scan Project Inspects 66 Sewers; Compares 33 Pipes with CCTV Inspection

FAQ #4

Can I Get A Full Report?

Yes. Call us at 916-779-0660 or email us at info@electroscan.com and tell us what report you want.

Electro Scan can also arrange a webinar to suit your specific needs and review findings from a number of Electro Scan projects.

RESULTS

'Top Ten' Worst Sewer Mains – According to Electro Scan Critical Sewers®

Scans	Footage	Gallons Per Minute	Gallons Per Day
10	3,081	1,043.56	1,502,726

Total Survey

Scans	Footage	Gallons Per Minute	Gallons Per Day
66	11,155	1,793.84	2,583,130

Worst as % of Total

15%

28%

58%

15% of Total Number of Sewer Mains or 28% of Total Footage is Responsible for 58% of the Estimated Defect Flow.

Example Problems with CCTV Inspection

- A Missed CCTV Inspection Observations**
Shows a routine comparison of a sewer main 25% full, missing defects below the waterline and at joints.
- B Abandoned CCTV Survey, Evaluated By Electro Scan**
CCTV abandoned survey from upstream and downstream manholes, with Electro Scan completing all at once with no abandonment.
- C Multiple CCTV With Different Coding & Missed Defects**
CCTV inspections in 2008 and 2012, from two different companies and two different operators, both missing major defects.
- D Missed CCTV Defects**
CCTV operator records a single callout, 'DEBRIS' yet Electro Scan finds several major defects recording location and estimated GPM defect flow.

Electro Scan & CCTV Comparison 33 Sewer Mains With Both Electro Scan & CCTV Inspections

Electro Scanning Identified 1.487 Million Gallons Per Day (MGD) of Potential Infiltration.

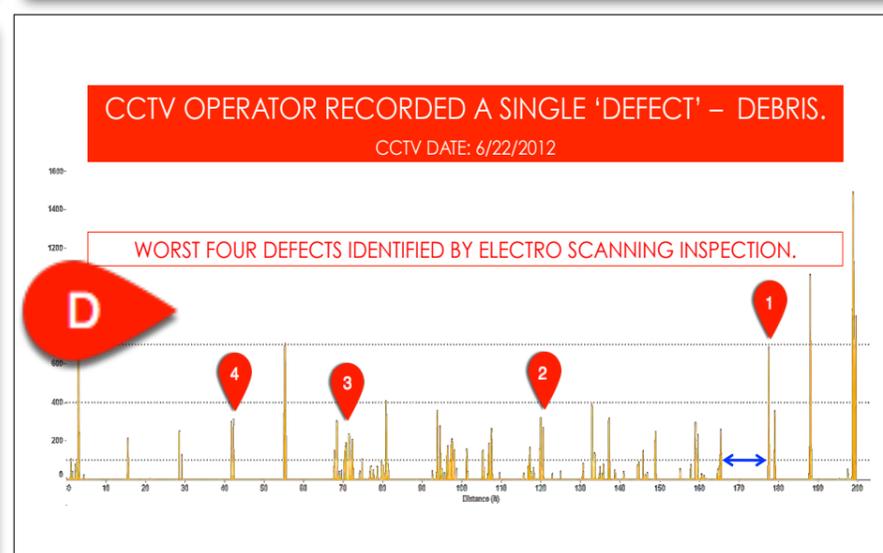
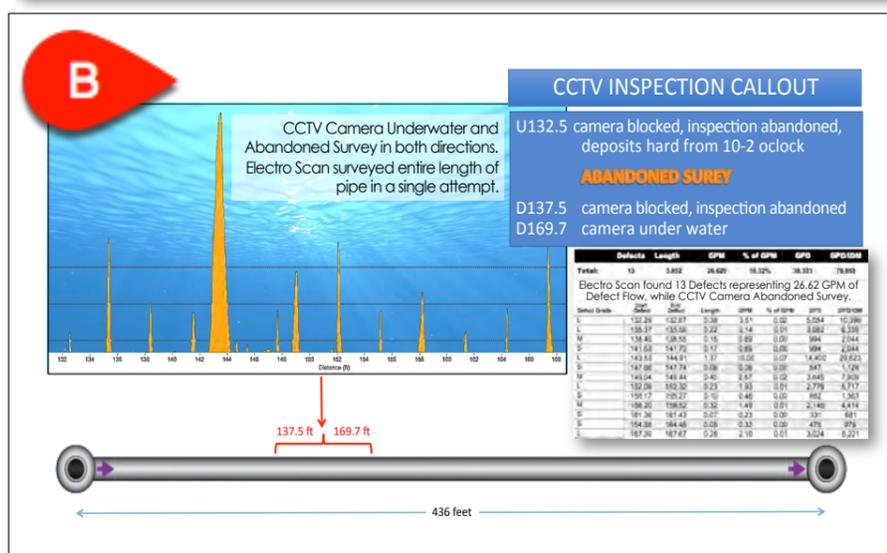
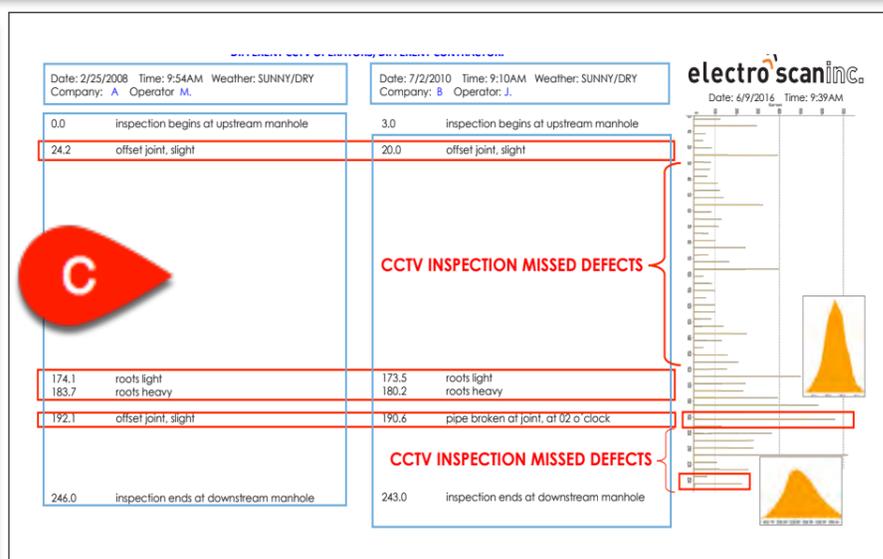
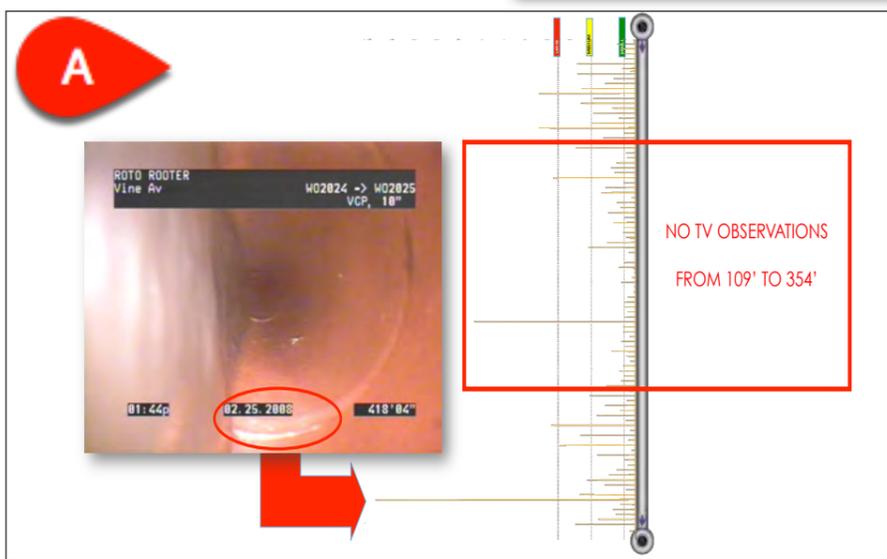
CCTV Inspection Identified Only Two (2) Locations with Infiltration.

ELECTRO SCANNING INSPECTION										
RAW SCAN DATA POINTS	FILTERED DATA POINTS	TOTAL DEFECT FLOW				TOTAL GALLONS PER DAY	NUMBER OF DEFECTS			TOTAL ELECTRO SCAN DEFECTS
		MINOR GPM FLOW	MODERATE GPM FLOW	SEVERE GPM FLOW	TOTAL GPM		SMALL	MEDIUM	LARGE	
385,879	289,701	298	445	290	1,033	1,487,059	1,026	171	171	1,368

CLOSED-CIRCUIT TELEVISION INSPECTION																TOTAL CCTV DEFECTS											
INFILTRATION		SCALE MIN. DEPOSITS	SAGS		OFFSET JOINTS		CRACKS		ABANDONED SURVEY	GREASE			ROOTS		CONNECTIONS												
RUNNING	DRIPPING		DEBRIS	SAG - BEGINNING	SAG - END	SLIGHT	MODERATE	LARGE		CIRCUM @ JOINTS	LONGITUDINAL	MULTIPLE	HOLE	REPAIR	PIPE BROKEN		CAMERA UNDERWATER	LIGHT	MEDIUM	HEAVY	ENCRUSTATION	LIGHT	MEDIUM	HEAVY	DEFECTIVE CONN.	BREAK IN CONN.	INTRUDING CONN.
1	1	7	2	29	25	15	1	0	18	7	5	2	1	3	3	5	0	0	1	1	6	2	2	2	19	4	162

KEY HIGHLIGHTS

Electro Scanning Inspection identified 8.4x more defects than CCTV. In addition to automatically identifying 1,206 more defects, each was provided an estimated GPM and location. Also, 54 or 33% of 162 CCTV callouts were related to BEGINNING and ENDING of SAGS.



Finding Leaking Point Repairs Before Acceptance

Electro Scan: "Many Spot Repairs Should Never Be Done!"

Lately, Electro Scan has been seeing a lot of point repairs that should never have been done. Sewer agencies and consulting engineers expect many of these repairs to bring their pipes up to a 'like new' condition that they can highlight on their Geographic Information System (GIS) and report to their City Council or Board.

However, unless a sewer agency has

completed an emergency point repair resulting from a blockage, many sewer mains are ticking time-bombs that more than likely had a number of defects not seen by their CCTV operator.

One city recently said they had a backlog of point repairs in the hundreds, based on CCTV inspections, but current Electro Scan testing indicates almost 75% of all

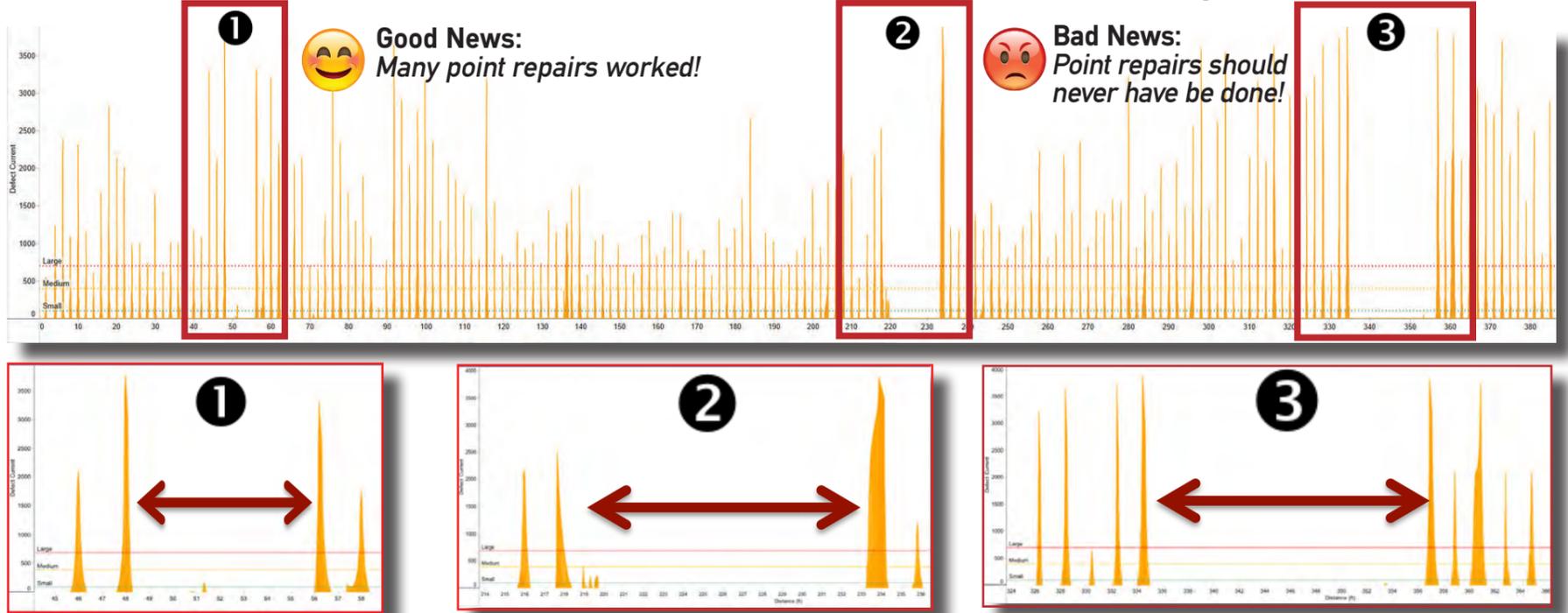
point repairs should never be done in the first place.

Rule of Thumb: If more than 15% of your sewer main has severe defects, another rehab method should be recommended and pursued.

If a point repair is done, make sure you specify low voltage conductivity testing to

make sure that your repair has not created leaks at both ends.

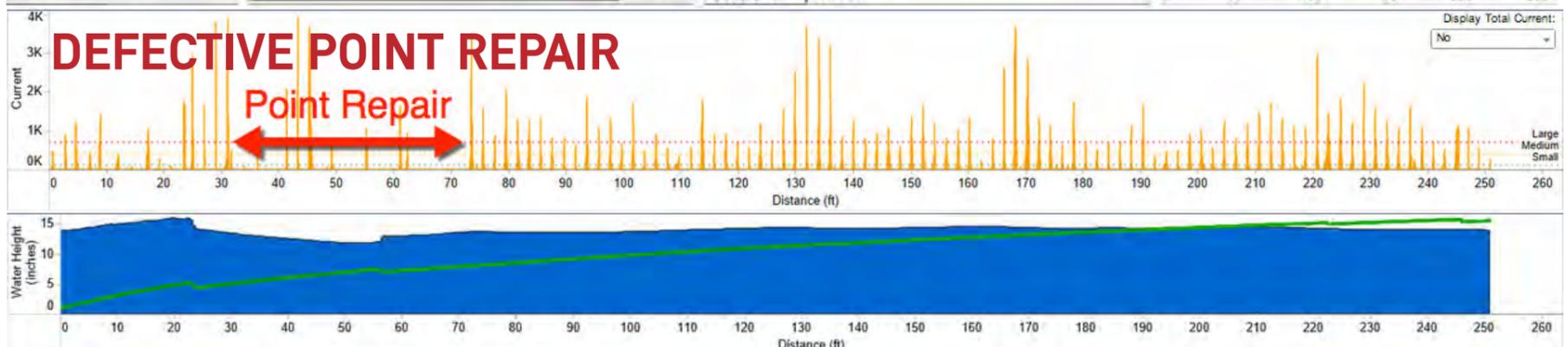
As shown in the example below from a Northern California sewer agency, the point repairs eliminated the majority of leaks for those sections, but left larger defects at the end points, and probably should never have been done in the first place.



Certifying 'Good' Point Repairs Is Key To An Effective Rehabilitation Program



DEFECTS		% OF DEFECT LENGTHS		GPM SUMMARY		DIAMETER & DISTANCE	
Small	11	0.0089		Minor	138.150	6	251.00 ft
Medium	16	0.0198		Moderate	298.900		
Large	87	0.1485		Severe	440.810		
All Defects	116	0.1771		Total GPM	878.860		
				GPD	634,766		
				GPD IDM	2,225,906		
				Minor %	0.81%		
				Moderate %	29.67%		
				Severe %	69.52%		



AWWA M77 Manual of Practice for Water Main Condition Assessment Adds Electro Scanning

FAQ #5

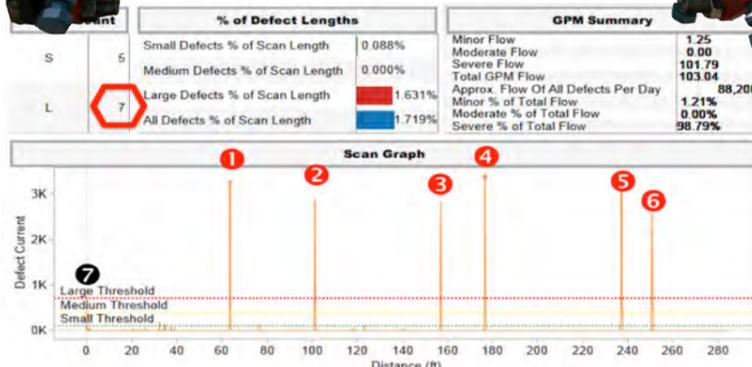
How Does The Probe Enter & Travel Through a Water Main?

Entry is typically done through either a wet or dry barrel hydrant. Working with our strategic partner, ULC, Electro Scan uses a patented device that attaches to the top of a hydrant to allow the water probe to enter the pressurized main, without service disruption.

Once our water probe enters the main, using our high resolution camera to verify entry and direction, an internal parachute provides flow for the probe with data gathered by our probe and communicated to our mobile application via fiber optic cable. Once data is saved, a report is available on the cloud in minutes.

Electro Scan Finds Defects in Pressurized Water Mains Missed by Acoustic Sensors & Correlators

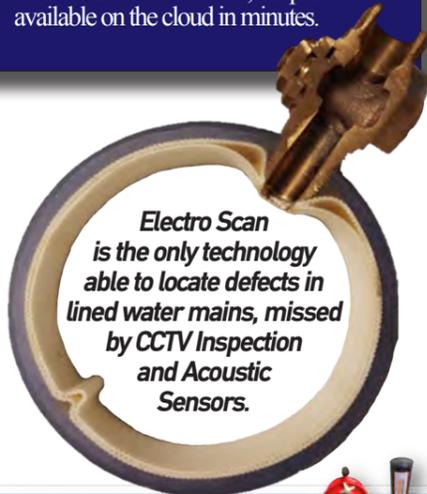
Defects Located Within 0.4 inches (1cm) & Estimated in Gallons Per Minute



Continued from Page 1 and Last Page

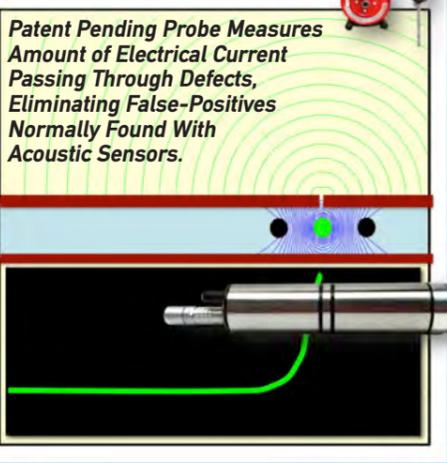
Electro Scan offers the next generation technology that finds & measures leaks not found by acoustic, electromagnetic, ground penetrating radar, or helium tracers.

Already an accepted tool for gravity sanitary sewer mains, Electro Scan for pressurized water mains is only available as a professional service. Call us for project pricing, today!



Acoustic sensors miss water leaks that can't be heard.

Electro Scan locates and measures all leaks in GPM.



FAQ #6

Other Contractors Enter Hydrants. What's Different With Electro Scan?

Other Contractors that televise pressurized water mains and enter hydrants similar to Electro Scan, use Acoustic Sensors to find anomalies that might leak, NOT LOW VOLTAGE CONDUCTIVITY.

Only Electro Scan locates and measures defects that leak in gallons per minute or liters per second, without requiring third-party data interpretation.

Make sure you ask for Electro Scan!

Major drawbacks of CCTV/Acoustic Leak Detection Equipment, includes:

- Interference from ambient noise.
- Difficulties with variable water table heights.
- Inability to test all pipe materials, especially Plastic.
- Problems with certain pipe diameters.
- Unable to determine leak size.
- Inability to quantify defect flows.
- Problems with changes in backfill materials.
- Lengthy data processing & reporting times.
- Lack of repeatability, by crew or equipment.
- Special training required for field crews.
- Need for third-party data interpretation.



Henry Gregory Senior Advisor

Prior to Electro Scan, Gregory was former Assistant Deputy Director, Department of Public Works and Engineering, City of Houston, retiring after thirty years of service. During his career, Gregory oversaw over \$1 billion of rehabilitation for the City of Houston, including managing over 250 people, CCTV, and other condition assessment capabilities.

Mr. Gregory was a Peer Reviewer for the EPA Handbook, Sewer System Infrastructure Analysis and Rehabilitation, EPA/625/6-91/030, still referenced in many EPA Consent Decrees and Administrative Orders. An authority on Cured-In-Place Pipe (CIPP) and Pipeline Condition Assessment, Gregory was a guest lecturer for over ten years at the University of Wisconsin, Madison, on the topic of Sewer Maintenance.



Jamie Johnson Director of Data Services

Johnson is the company's Director of Data Services. NASSCO PACP certified, Johnson is Certified in Critical Sewers® cloud services, including data capture, review, analysis, and presentation. Johnson coordinates the client needs and requirements with project deliverables to ensure that all contractual obligations are met and that new users to Electro Scan's low voltage conductivity technology understand its findings.

Ms. Johnson has prepared over 100 client reports for Electro Scan Inc., including overseeing projects & deliverables with East Bay Municipal Utility District (CA), Eagle River Water and Sanitation District (CO), and Harpeth Valley Water District (TN). Johnson received her B.S., Civil Engineering, at California State University, Sacramento.



Cory Peters Project Engineer

Mr. Peters is responsible for product development, field support, manufacturing control, and quality testing. His extensive engineering background includes experience in CAD drafting, product design, testing, manufacturing, machining, marine diving technologies, and customer service.

Peters is advancing the development of the company's large diameter probe and the multi-sensor water probe. He has undergone course training in COMSOL Multi-Physics, a software used in modeling the company's condition assessment probes. Mr. Peters Received his B.S. in Mechanical Engineering at California State University, Sacramento.



Summer Interns Charlie Johnson

Mr. Johnson is in his third year of pursuing a degree in Mechanical Engineering at California State University, Chico. A graduate of Sacramento County Day School, Johnson is working on a variety of Electro Scan projects. Returning from last year, Johnson worked on numerous projects, including Solidworks modeling of new products and Electro Scan Bay Area inspection projects.



Ben Felix

Mr. Felix, a recent graduate of Sacramento County Day School, worked on a variety of Electro Scan projects, including work in the field & support of Electro Scan's integration with Innovyze InfoMaster product, including various project assignments and system documentation.

Mr. Felix began his engineering degree at Purdue University, West Lafayette, IN in August 2016.



San Francisco Public Utilities Commission Finds Sources of Saltwater Intrusion



Electro Scan Becomes Standard Decision Support Tool

Background

The most densely populated community on the Golden Coast, San Francisco has been suffering from high salinity coastal water entering its sewer system. Wreaking havoc on the treatment plants' biological processes and making it nearly impossible to reuse the treated water, San Francisco Public Utilities Commission (SFPUC) set its sights to 'seek and destroy' elusive salt water intrusion.

The drought has made SFPUC's long-term goal to achieve 100% reuse potable water more important. The need for reusable and sustainable resources has never been greater for any agency in California suffering from a drought that has continued for 5-years, despite the extra rain from El Niño.

Last summer, SFPUC announced the purchase of the first stand-alone Sewer Leak Detection Van to locate and fix unwanted openings in their combined sewer system. Low Voltage Conductivity is the only technology included



SFPUC and Electro Scan in the field.

on the new van, available exclusively from Electro Scan Inc.

Update

In December 2015, Electro Scan delivered the Sewer Leak Detection Van to SFPUC's corporate yard.

That same month, the new **7th Edition, Volume 1, Operation and Maintenance of Wastewater Collection Systems** manual was released from the Office of Wastewater Programs, California State University, Sacramento. The 40-page Electro Scanning Inspection chapter serves as the Electro Scan Certification training guide.

Training began in late January and included a comprehensive online course, onsite classwork, and field training. Twenty (20) SFPUC staff members successfully completed training and received their Electro Scan Certification.

Results

"SFPUC's new Electro Scan program has been successful in identifying defective sewers in critical areas of San Francisco," states Justin Powell, Engineer, SFPUC.

"SFPUC is utilizing Electro Scan technology to identify sewers that are undergoing saltwater intrusion. We plan to use the data gathered with Electro Scan to repair and replace sewers in an effort to minimize the amount of saltwater entering our wastewater treatment plant," continued Powell.

A full-time team has been dedicated to operate the Sewer Leak Detection Van five (5) days a week. Electro Scanning Inspections conducted by SFPUC's certified operators and Sewer Leak Detection Van started in February.

"Our system is big, old, combined and in need of rehabilitation in many areas of our city. We come in with Electro Scan equipment and see things in the system that no one has ever been able to 'see'. We scan sewers that were previously inspected by CCTV and find defects that no operator could ever find," said Daniel Pray, Lead Electro Scan Field Operator, SFPUC.

"Electro Scan has given me a new look at how bad aging infrastructure can be, but also how well certain materials and craftsmanship can stand up to the test of time. There have been many times our crew scanned a pipe we thought would be full of defects, but it was almost as good as new construction," continued Pray.

In 6 months, SFPUC's Electro Scan Operators have discovered over 6,200 defects in 262 pipe segments. VCP made up 80% of the pipes assessed, with HDPE making up 18%, and 2% being various materials.

"I'm glad I have the opportunity to help build the Electro Scan program to address problematic areas. We are working to keep San Francisco Bay



Area water ways secure and safe for future generations," stated Pray.

"We are proud that our operators took on the challenge this year and have been very successful," stated Lewis Harrison, Collection System Division Manager, Wastewater Enterprise, SFPUC.

San Francisco Department of Public Works is also adopting new standards to certify their repairs and new installations with Electro Scanning Inspection, as recommended in the new **7th Edition, Volume 1, Operation and Maintenance of Wastewater Collection Systems** manual.

APWA Sacramento Chapter Sponsors Electro Scan Demo in Woodland, Calif.



Total Scans		Footage		Total Defect Locations		Gallons Per Minute			Gallons Per Day		
3		1,420		38		543.56			782,726		
Mainline ID	Pipe ID	Pipe Material	Diameter	Footage	Small	Medium	Large	GPM	GPD	GPD/IDM	
SMH763 - SMH744	SMH763 - SMH744	CIPP	8	447.5	1	0	8	71.15	102,456	151,095	
SMH449 - SMH447	SMH449 - SMH447	VCP	6	326.7	94	39	18	133.59	192,370	514,998	
SMH451 - SMH449	SMH451 - SMH449	VCP	6	643.8	159	95	60	338.82	497,901	666,820	

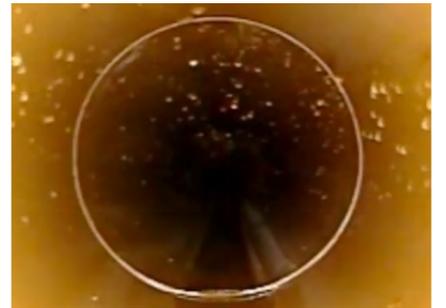
Nearly 40 people attended Electro Scan's field demonstration sponsored by the Sacramento Chapter of APWA, Electro Scan Inc., and the City of Woodland, California. Three (3) sewer mains were surveyed in accordance with ASTM F2550 and the Seventh Edition, Volume 1, Operation & Maintenance of Wastewater Collections Systems manual. Two (2) VCP and an eight-year old CIPP were assessed, with results presented within minutes.

Electro Scan Assesses Full

Selected Pipe Materials.

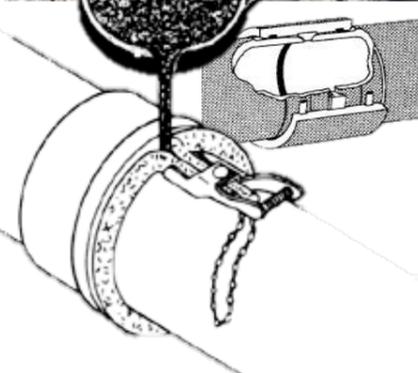
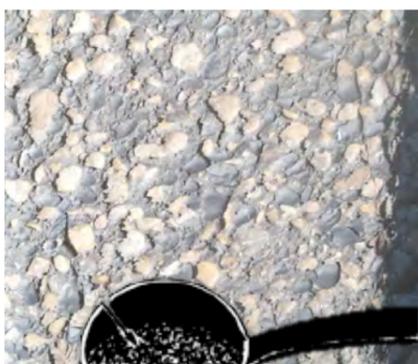
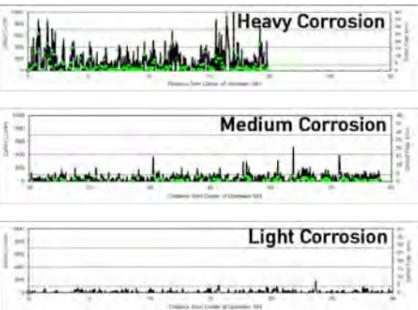
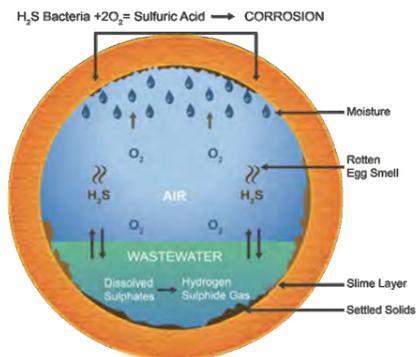


See Page 3 for Example CIPP Defects.



Asbestos Cement Pipe

Corrosion from Hydrogen Sulfide (H₂S) is the arch enemy of asbestos cement and concrete (reinforced & un-reinforced) pipes, but popular to be Electro Scanned. Originally developed for water applications, AC pipe was only used in sewer applications in the late 60s and early 70s. Holding up better than just plain unlined concrete, due to the asbestos content, AC pipes, particularly in sewers, have needed a technology to judge levels of corrosion, best handled by Electro Scan.



Cured-In-Place Pipe Lining

Agencies are changing their specifications to include Electro Scanning because CCTV is not able to find all defects in post-CIPP liners.

Common Defects Missed By CCTV and Not Covered by ASTM F1216

- Accidental Liner Cuts
- Accelerator Burns
- Bad Service Reconnections
- Defective Epoxy
- Defective Resin
- Equipment Damage
- Over or Under-Cooking of Liner
- Poorly Mixed Resin
- Under-Sized (Too Thin) Liner
- Unrecorded Lateral Defects
- Unremoved Debris
- Wrinkles

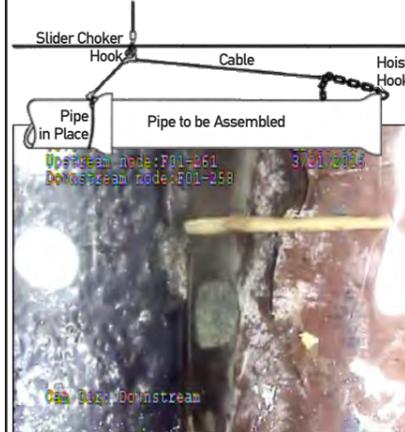


The 7th Edition, Volume 1 of the Wastewater Collection Systems manual and ASTM F2550 recommend the use of Electro Scanning Inspection for all pre- and post-rehabilitation including CIPP lining projects.

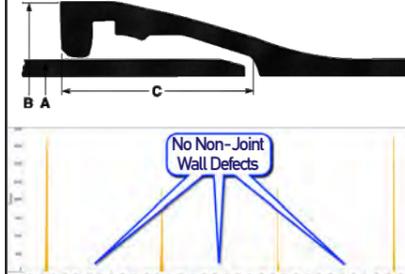
Ductile Iron Pipe

Most Common Defects Found in Ductile Iron Missed by CCTV

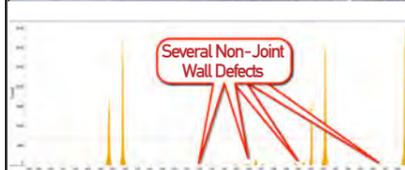
1. Poor Installation (Aggregate in Joint)



2. Poor Service Connection Sealant



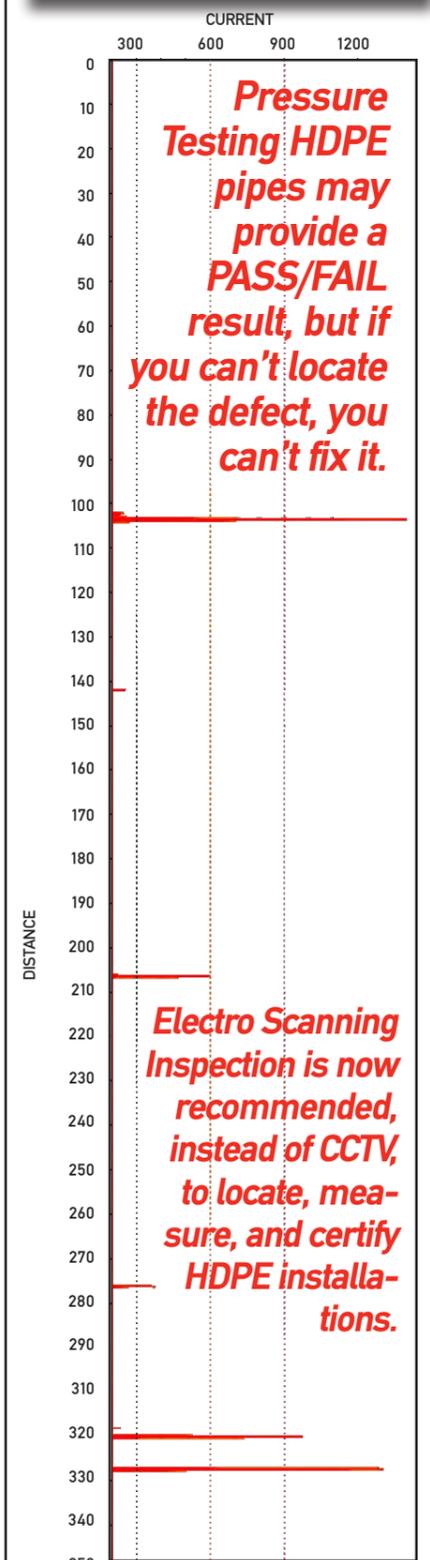
2. Pitting Damage and Corrosion



High-Density Polyethylene Pipe

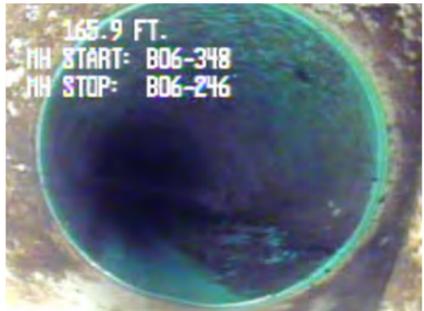
Few defects have been located on the wall of HDPE pipe, with the majority of defects occurring at the joint or at the service connection as shown below.

GPM SUMMARY	
Minor	13,900
Moderate	4,570
Severe	0,000
Total GPM	18,470
GPD	26,597
GPD IDM	61,944
Minor %	75.26%
Moderate %	24.74%
Severe %	0.00%



Extremely difficult for CCTV or visual inspection and cost/time prohibitive to pressure test, Electro Scan is the leading solution to find defects in HDPE, MPE, and PE pipes.

Range of Pipe Materials

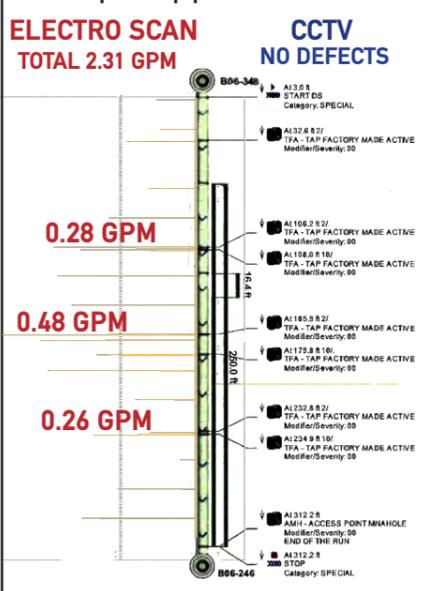


Polyvinyl Chloride Pipe

Representing Electro Scan's first pipe material to be tested and certified, Polyvinyl Chloride (PVC) pipe was an effective pipe material to introduce a variety of defects, including circumferential, transverse, and longitudinal cracks, and to calibrate its leak detection algorithms.



Who knew we would also replace acoustic sensors, data loggers, and correlators as the new standard to assess plastic pipes.

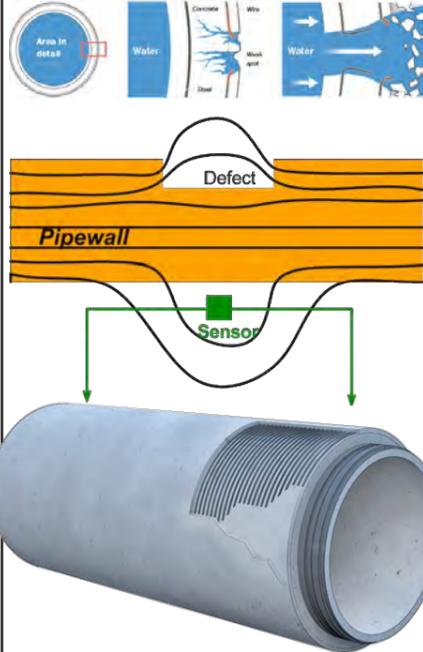


Pre-Stressed Cylinder Pipe

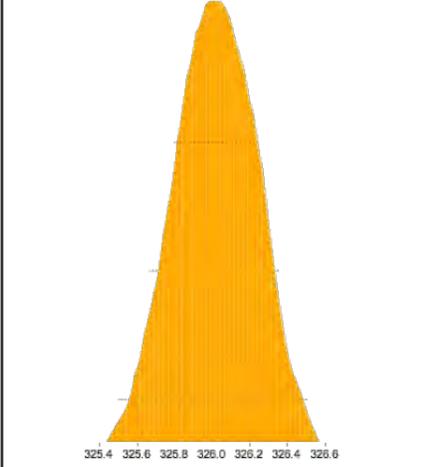
Commonly used for large diameter water transmission mains, water professionals have applied a number of adjacent technologies, such as free-floating or swimming acoustic sensors and electromagnetic sensor arrays to evaluate pipes.

While acoustic sensors have experienced some success in large metallic pipes, vibration transmissions across the surface of PCCP has had limited success.

Alternatively, electromagnetic sensors, while useful in other applications are often challenged to link specifically identified anomalies to actual leak locations or measured quantities.

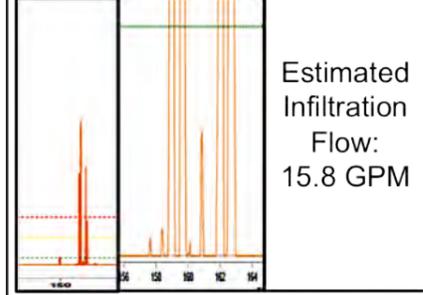
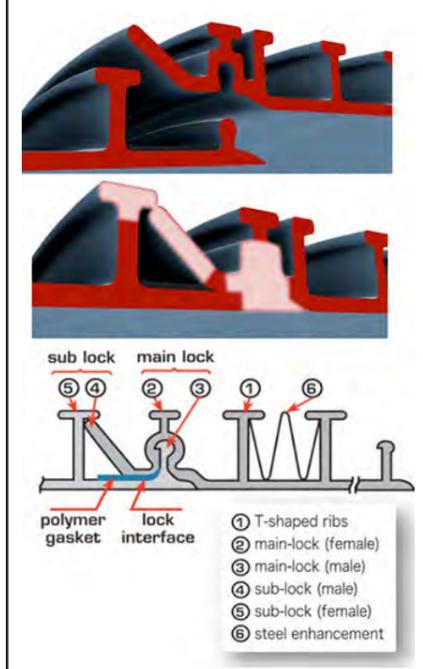


First manufactured in 1942 as lined cylinder pipe, the prestressing wire was wrapped directly around the steel cylinder, with a second type of PCCP developed in 1952 that has concrete encasement of the steel cylinder on both sides. Known as embedded cylinder pipe, it differs from lined cylinder pipe by the encapsulation of its steel cylinder in a concrete core. Therefore, the prestressing wire is wrapped around the concrete core rather than the steel cylinder as in lined cylinder pipe.



Spiral Wound Pipe

Spiral wrap or spiral wound pipe is an innovative solution to reline pipes of varying shapes & sizes. However, given the importance of its interlocking bracing system, if spiral wrapped pipe is not tested using Electro Scanning Inspection, Owners may have a high risk of failure or leakage as part of its post-installed construction.

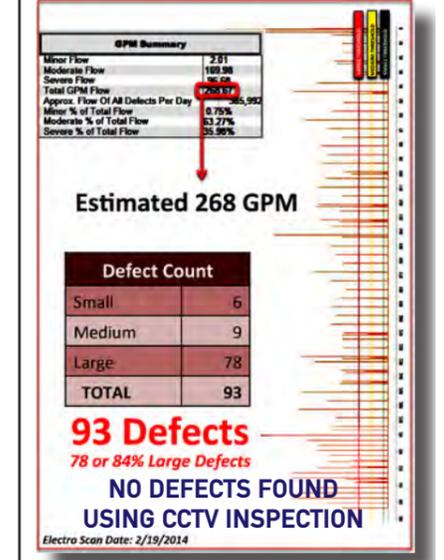
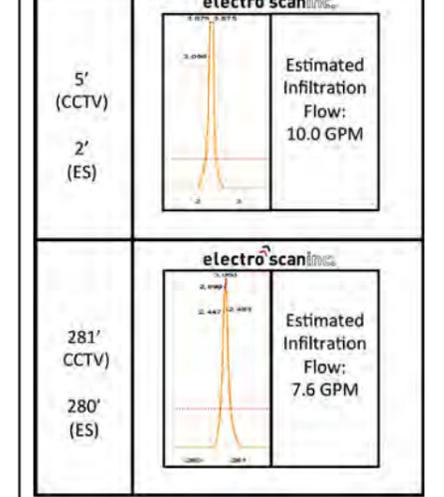
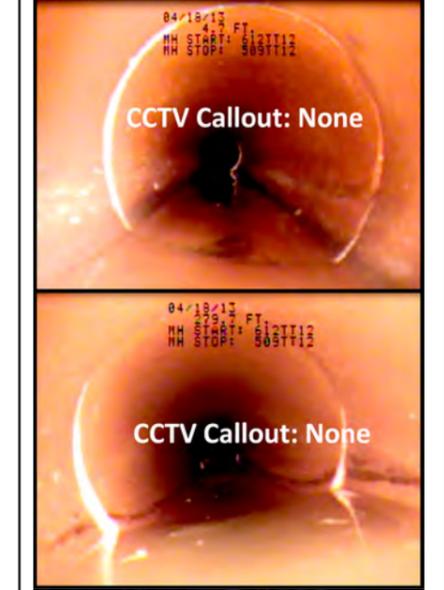


Representing a 66" inch diameter pipe the pipe length was over 1,000 feet running underneath an aquifer.

Metered on both ends of the sewer main and traversing under an interstate highway, peak flows were measuring over 750,000 gallons per day in infiltration.

Vitrified Clay Pipe

CCTV is not recommended for the inspection of VCP due to the inherent risk of miss-identifying joints that are, in fact defective, or using CCTV to prioritize repairs & rehabilitation.



FAQ #7

What Pipe Materials Are Not Recommended for Electro Scan?

Stainless steel, copper, lead, and unlined ductile iron pipe materials are some of the last remaining pipes we do not scan, unless there is a cement mortar lining, epoxy, or other coating.

If lined or coated with a non-conductive material, with at least 1-2mm thickness, Electro Scan will find all the defects in the liner or coating of the pipe.

Add Electro Scan to CCTV Truck

Use This Year's CCTV Budget To Upgrade Your Truck With Electro Scan!

1 CUES



Switch from CCTV to Electro Scan, and Back Again, In Minutes.

RECOMMENDED FOR PRE- AND POST-REHABILITATION ASSESSMENT.

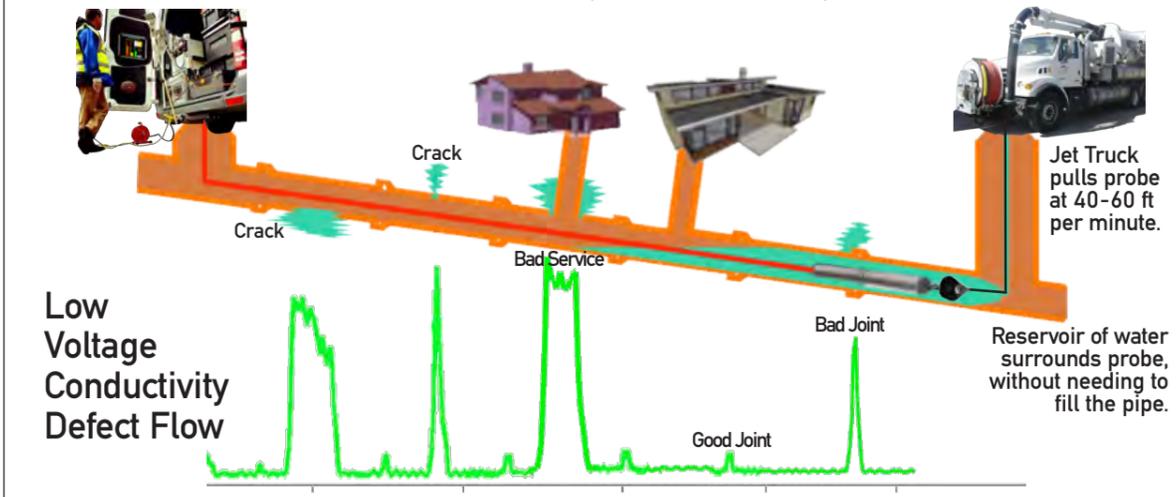
2 ARIES



3 IBAK



ASTM F2550 & 7th Edition, Volume 1, O&M Manual



FAQ #8 Does Pipe Need To Be Filled With Water?

No. Technically water needs to only surround the middle part of the probe, or about a 1 inch circumference. Water acts as the conductor allowing low voltage electric current to travel to the wall of the pipe to see if there are any openings to return back to its grounding source.

Using a funnel cone attached to a jet hose, Electro Scan allows a small reservoir of water to surround the probe allowing its probe to assess 360° of the pipe wall and the entire service connection.

Budget to Add To Your New or Existing TV Truck

Municipal Sewer Agencies Only, Not Available to Commercial Contractors

Description	Budget
ES-620 Sewer Probe	\$ 95,000
ES-620 Spares Program	12,500
CCTV Integration Package	12,500
System Installation Services	10,000
Funnel Cones - Two Sets	10,000
Jet Hose/Cone/ES Attachment	2,500
ES Mainline Application - Truck	10,000
Critical Sewers® One-Time Set-Up	12,500
ES Online Learning Course	4,500
ES Office & Onsite Field Training	7,500
Travel Budget	2,500
F.O.B. Sacramento - Shipping	3,500
Annual Support - Field Equipment	7,500
Annual Support - Office Reporting	7,500
TOTAL BUDGET COST	\$ 198,000
Add All Applicable Taxes	

Call 916-779-0660
or Email Us
sales@electroscan.com
For Detailed Budget Costs
For Your Specific CCTV
Configuration

4 IPEK



5 Rausch



Purchase An Electro Scan Van

Field Production of 2,000-to-4,000 Ft/Day and Better Accuracy Than CCTV Favors Standalone Van



FEATURED CUSTOMER



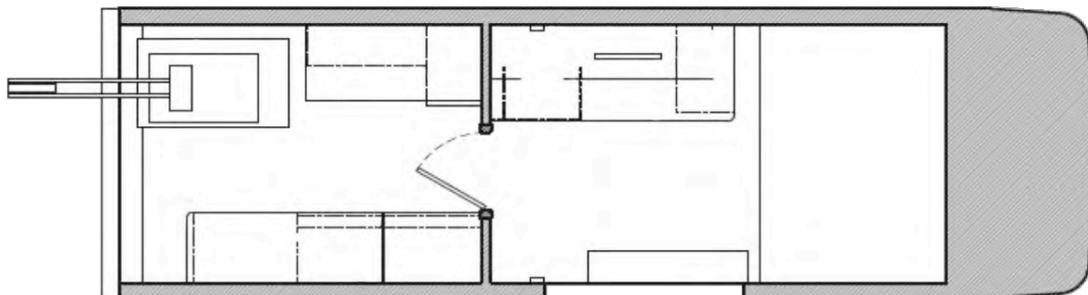
San Francisco Water Power Sewer
Services of the San Francisco Public Utilities Commission

Miles of Sewer Main: 1,000

Application
Identifying locations and estimating defect flows for sources of salt water infiltration.



Probes are customized to Agency's preferred manufacturer's controller, winch, and reel.



"We put a lot of tender loving care in all the Electro Scan Vans we build in the U.S. and Europe - whether delivered with or without a kegerator."

Mark Grabowski, VP and General Manager, Electro Scan, Inc.

Electro Scan Mobile Configurations *Call for Pricing!*



Budget To Purchase Electro Scan Van

Municipal Sewer Agencies Only, Not Available to Commercial Contractors

Description	Budget
ES-620 Sewer Probe	\$ 95,000
Cargo Van - Current Model Year	130,000
Mobile Office Build-Out	80,000
Cable, Reel & Controller System	75,000
Premium Cable, 1,000 LF	8,500
ES-620 Spares Program	12,500
CCTV Integration Package	12,500
System Installation Services	10,000
Funnel Cones - Two Sets	10,000
Jet Hose/Cone/ES Attachment	2,500
ES Mainline Application - Truck	10,000
Critical Sewers® One-Time Set-Up	12,500
ES Online Learning Course	4,500
ES Office & Onsite Field Training	7,500
Travel Budget	2,500
F.O.B. Sacramento - Shipping	3,500
Annual Support - Field Equipment	7,500
Annual Support - Office Reporting	7,500
TOTAL BUDGET COST	\$ 491,500
Add All Applicable Taxes	

Call 916-779-0660 For Electro Scan To Provide a Budget Quote & Sole Source Justification

Electro Scan Provides An Early Warning System To Audit & Accept CIPP Installation

Tennessee Agency Substitutes CCTV With Electro Scan to Certify Lining



Cured-In-Place Pipe (CIPP) has been an industry accepted rehabilitation technique for nearly 40 years. But agencies are starting to wonder why flow levels of recently lined pipes are returning to pre-rehabilitation levels, and why defects can't be found before acceptance?

Recently, a Tennessee sewer agency decided to see if Electro Scanning Inspection could find defects that its CCTV could not – adding the extra step of having its lining contractor immediately repair defects found by Electro Scan in order to achieve the lowest possible defect flow results.

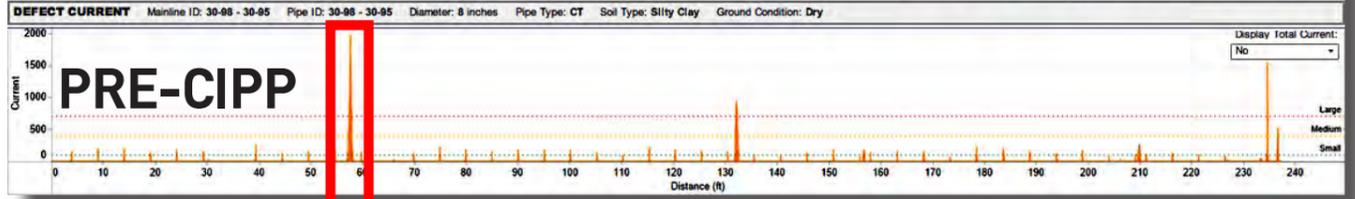
As shown to the **Right**, Electro Scanning Inspection had completed numerous pre- and post-CIPP inspection projects, that showed GPM Defect Ratings, but use of outdated specifications that limited Contractor Acceptance to CCTV, prevented the agencies from requiring that pipes be fixed.

In this case, the Tennessee sewer agency would now require a third and final Electro Scan survey to ensure that any defect found by Electro Scan after Post-CIPP, would be fixed.

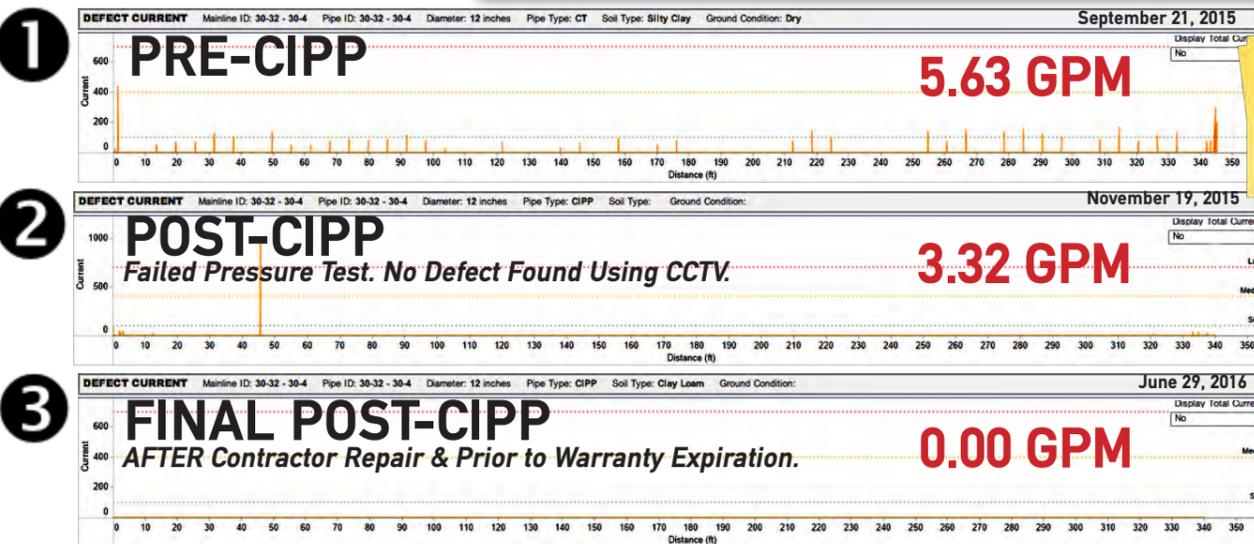
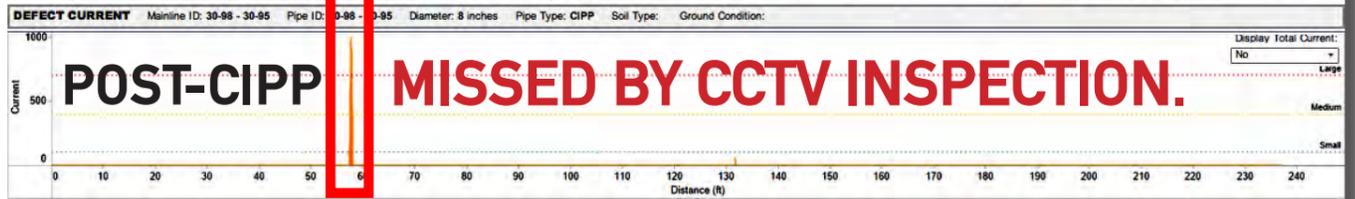
As shown **Below**, by scanning a sewer main BEFORE rehabilitation ①, sewer agencies can establish a baseline defect flow rating for each of its sewer mains. AFTER a Contractor relines a sewer, the new Wastewater O&M manual recommends Electro Scanning (not CCTV) to find defects that may require repair ②. Given the Electro Scan roadmap, CCTV is then recommended to visually record the area to be repaired. Finally, AFTER Repair, a Final Electro Scan ③ should be made to record a Final Post-CIPP Defect Flow Rating Report.

Date	Mainline	Pipe Material	Diameter	Footage	Small	Medium	Large	GPM	GPD	GPD/IDM
9/21/2015	30-98 - 30-95	CT	8	237.5919	41	1	3	34.87	50.213	139.487
2/16/2016	30-98 - 30-95	CIPP	8	237.2935	0	0	1	6.63	9.547	26.555

DEFECTS		% OF DEFECT LENGTHS	GPM SUMMARY		DIAMETER & DISTANCE		OPERATOR INFO	
Small	41	0.01130	Minor	11.510	8	237.59 ft	Tech Electroscan Project Phase 1 (Pre Scans) Job Phase 1 (Mainline Pre Scans)	Atmospheric Test Scan Start 9/21/2015 6:21:41 AM 9/21/2015 7:53:06 AM
Medium	1	0.00000	Moderate	6.530				
Large	3	0.00850	Severe	18.830				
All Defects	45	0.01970	Total GPM	34.870				
			GPD	50.213				
			GPD IDM	139.487				
			Minor %	31.92%				
			Moderate %	17.54%				
			Severe %	51.53%				



DEFECTS		% OF DEFECT LENGTHS	GPM SUMMARY		DIAMETER & DISTANCE		OPERATOR INFO	
Small	0	0.000000	Minor	0.000	8	237.29 ft	Tech Electroscan Project Phase 1 (Post Scans) Job Phase 1 (Mainline Post Scans)	Atmospheric Test Scan Start 2/16/2016 8:14:06 AM 2/16/2016 9:19:33 AM
Medium	0	0.000000	Moderate	0.000				
Large	1	0.002800	Severe	15.830				
All Defects	1	0.002800	Total GPM	6.630				
			GPD	9.547				
			GPD IDM	26.555				
			Minor %	0.00%				
			Moderate %	0.00%				
			Severe %	100.00%				



FAQ #9 Does Electro Scan Eliminate CCTV Inspection?

Yes, for Certifying Pre- and Post-Rehabilitation.

But, CCTV cameras still remain a useful tool for certain aspects of operation & maintenance, especially identifying roots, grease, construction debris, and sags. It just cant assess joints, service connection and rehabilitation effectiveness.

Since Electro Scan is able to identify defects to the closest 0.4 inches (1cm), CCTV trucks can be easily retrofit to upgrade to Electro Scan, using your existing winch, cable, and reel.

Don't Tie Up Your Best Combo Truck To Support Your Electro Scanning Inspection

Want to maintain good production for your Electro Scanning Inspection without sacrificing your best combination jet truck? Don't forget, Electro Scan doesn't require a sewer to be filled with water or cleaned before Electro Scanning Inspection.

After all, only the center portion of the Electro Scan probe – about an inch in length – needs to be surrounded by water to properly evaluate the 360° circumference of a pipe wall.

Using the jet hose to pull the Electro Scan probe – typically from upstream to downstream manhole – while delivering light pressure through the hose connected to a funnel cone, a small jet truck or portable jetter can easily be used.

With data delivered to the Electro Scan truck via standard coax cable while pulled by the jetter, a 300 ft. sewer main can be inspected in less than 10 minutes, with a final report, not requiring third-party data interpretation, ready a few minutes later.



Several jet trucks and portable jettors offer the minimum psi and length of hose to support Electro Scanning Inspection.

SHN Consulting Engineers & Electro Scan Save Bay City, Oregon \$1.1 Million in Rehabilitation Costs

Oregon DEQ Visits Electro Scan in the Field

Located eighty miles west of Portland within Tillamook County, Bay City, Oregon is a quiet coastal community that rests on the eastern shore of Tillamook Bay.

With a population of 1,265 people and an average elevation of 17 feet above sea level, Bay City's average annual rainfall is 88.65" resulting in a number of unwanted & unplanned wet weather events.

By pinpointing specific defect locations, for each sewer main, Bay City officials reduced their total rehabilitation by foregoing \$1.1 million or 73% on pipes not requiring rehabilitation, based on Electro Scanning Inspection's more targeted and accurate condition assessment results.

Bay City has now created a baseline defect flow rating for 21 sewer mains, totaling 4,548 feet or 8% of its 55,000 ft. sewer system.



Infrastructure Profile	
Miles of Sewer Main	10.4
Manholes	204
Service Connections	446

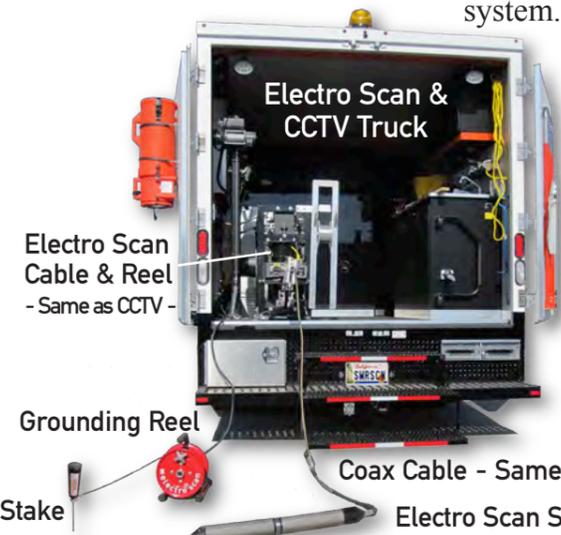
Pipe Material	Pipe Length (Feet)	Total	GALLONS PER MINUTE (GPM)				Total GPD	
			Minor Defect Flow	Moderate Defect Flow	Severe Defect Flow	Total Defect Flow		
	4,548	845	223.62	136.76	26.92	387.30	100%	557,712
CP	3,148	538	133.68	79.74	21.19	234.61	61%	337,838.4
RCP	1,400	307	89.94	57.02	5.73	152.69	39%	219,873.6

Highest Priority Sewer Mains (Defect Flow of 20 GPM and Higher)

Mainline ID	Pipe	Dia	Footage	Def	Minor Flow	Mod Flow	Severe Flow	Total Flow	% Total	GPM	GPD	Cum. Flow
1	43	42	CP	8	260	69	15.98	50.52	16.45	82.95	21%	119,448
2	153	145	RCP	8	498	144	50.99	10.71	0.00	61.70	16%	88,848
3	155	154	RCP	8	309	89	19.97	19.04	0.00	39.01	10%	56,174
4	33	32A	RCP	12	96	25	5.11	23.87	0.00	28.98	7%	41,731
5	41	40	CP	8	226	49	13.63	7.95	4.74	26.36	7%	37,958
6	154	153	RCP	8	497	49	13.87	3.40	5.73	23.00	6%	33,120
7	40A	39	CP	8	211	76	21.50	0.00	0.00	21.50	6%	30,960

Other Sewer Mains (Defect Flow of Less Than 20 GPM)

8	53	52	CP	8	277	39	14.73	2.32	0.00	17.05	4%	24,552
9	56	55	CP	8	217	42	12.54	3.59	0.00	16.13	4%	23,227
10	55	68	CP	8	282	51	10.05	5.61	0.00	15.66	4%	22,550
11	40	40A	CP	8	194	39	8.26	2.85	0.00	11.11	3%	15,998
12	56	55	CP	8	81	18	5.37	3.29	0.00	8.66	2%	12,470
13	54	53	CP	8	178	24	6.20	0.00	0.00	6.20	2%	8,928
14	58	57	CP	8	265	36	5.58	0.00	0.00	5.58	1%	8,035
15	59	58	CP	8	153	20	4.41	1.03	0.00	5.44	1%	7,834
16	66	65	CP	8	206	20	4.50	0.00	0.00	4.50	1%	6,480
17	42	41	CP	8	179	20	3.97	0.00	0.00	3.97	1%	5,717
18	56	55	CP	8	97	10	2.20	1.16	0.00	3.36	1%	4,838
19	57	56	CP	8	68	14	2.82	0.00	0.00	2.82	1%	4,061
20	41A	41	CP	8	41	5	0.45	1.38	0.00	1.83	0%	2,635
21	64	56	CP	8	212	6	1.49	0.00	0.00	1.49	0%	2,146



Electro Scan Truck: An Add-on Option to Standard CCTV Truck

Change from CCTV to Electro Scan, and back again, in minutes.

The Oregon Department of Environmental Quality (DEQ) is a regulatory agency whose job is to protect the quality of Oregon's environment. Oregon's history of environmental regulation dates back to 1938 when the Oregon State Sanitary Authority was formed. In 1969, the Authority changed its name to the Department of Environmental Quality and established itself as an independent state agency.



Steve Donovan, P.E.
SHN Consulting Engineers & Geologists

experience in trenchless technologies for new installations and rehabilitated facilities. He specializes in evaluating sewer and water pipeline systems, horizontal directional drilling, sewer rehabilitation techniques, water and wastewater pumping systems, and small community wastewater treatment facilities. Steve's public sector projects have ranged in size from 0.05 MGD to 100 MGD. He is a recognized authority in horizontal directional drilling (HDD) and teaches introductory classes on trenchless technologies to public works officials.

Muscatine, Iowa Selects Electro Scan for Post-CIPP Assessment Mandated by U.S. Army Corp of Engineers



Total Scans	Footage	Total Defect Locations	Gallons Per Minute	Gallons Per Day
12	2,939	38	82.69	119,074

Mainline ID	Pipe Material	Diameter	Footage	Small	Medium	Large	GPM	GPD	GPD/DM
1414 - 3876	Cured-In-Place Pipe	27	275.1	1	2	4	23.58	33,955	24,137
1415 TD 1414	Cured-In-Place Pipe	27	495.1	4	2	4	29.55	42,552	16,817
1415 - 1416	Cured-In-Place Pipe	24	388.0	3	0	1	4.12	5,933	3,364
1416 - 3859	Cured-In-Place Pipe	24	223.0	1	1	0	1.23	1,771	1,747
3859 - 3875	Cured-In-Place Pipe	24	250.0	5	0	0	0.96	1,382	1,217
3875 - 3804	Cured-In-Place Pipe	24	54.0	0	0	0	0.00	0	0
3803 - 3804	Cured-In-Place Pipe	24	12.2	2	1	3	17.45	25,128	376,280
3810 - 3809	(Left Blank)	24	263.7	1	1	0	4.96	7,142	5,960
3803	Cured-In-Place Pipe	24	390.3	1	0	0	0.25	360	203
2 - 3810	Cured-In-Place Pipe	24	46.3	0	0	0	0.00	0	0
5055 - 5053	(Left Blank)	24	283.2	1	0	0	0.59	850	660
5053 - 3812	Cured-In-Place Pipe	24	258.6	0	0	0	0.00	0	0

Results: Only 3 out of 12 Post-CIPP liners achieved a ZERO-LEAKAGE rating as defined by the EPA's standard definition of Gallons Per Minute By Inch Diameter Mile. Agencies are recommended by the new Wastewater O&M manual to use ASTM F2550 as its new standard for CIPP acceptance.

Case Study Update – City of Wauwatosa, WI Corrected WERF Results on Sewer Laterals Published in 7th Edition, Vol. 1, O&M Manual

Electro Scanning Inspection Finds & Measures Defect Flows in Laterals

Data Analysis In Original WERF/EPA Report Corrected In the 7th Edition, Volume 1, New Wastewater Collection Systems O&M Manual

Mistakes happen. Especially when dealing with a new technology that is changing how sewers are assessed and prioritized for repairs, rehabilitation, and renewal.

Despite recommendations to comply with ASTM F2550, a recently published Water Environment Research Foundation (WERF) report entitled Sewer Lateral Electro Scan Field Verification Pilot, incorrectly limited its analysis to assessing sewer mains by Small, Medium, and Large currents (i.e. height of defect current), without consideration of size (i.e. width) of the defect, automatically determined by the Electro Scan process and recommended by ASTM F2550.

Subsequent discussions and review of the published WERF Report by Ken Kerri, Ph.D., P.E., found many inaccuracies which led to inclusion of the revised data as part of the 7th Edition, Volume 1, **OPERATION AND MAINTENANCE OF WASTEWATER COLLECTION SYSTEMS** manual, published December 2015.

ASTM F2550 states that “the focused electrode current data may be processed to grade the variations of the focused electrode current values into those that represent small, medium, and large pipe defects according to the maximum amplitude of focused electrode current.” But, the standard goes on to state that “the processed focused electrode current data may be presented as a distance versus current plot showing the location, grading, and classification of the focused electrode current variations.” A recommended table and chart displaying Electro Scan data was provided as part of the ASTM F2550-06, and also in ASTM F2550-13.

The Standard also states that “the apparatus manufacturer should be consulted regarding the relationship between focused electrode current and pipe defect size.”

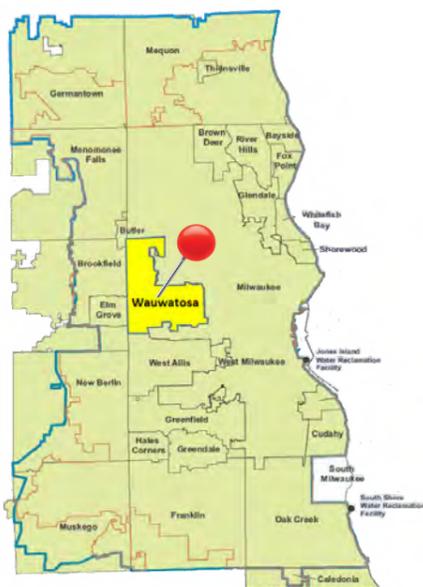
Ken Kerri, Ph.D., P.E., adds corrected WERF Report data to the new 7th Edition, Volume 1, Wastewater O&M manual.

Unfortunately, the published WERF Report based its findings on the number of Small (S), Medium (M), and Large (L) electric current readings. While Small, Medium, and Large indicators may indicate Maximum Defect Currents, the WERF Report failed to consider the percent of pipe affected by the defect, i.e. distance or size of an electric current is sustained over the area of the pipe for each defect.

As illustrated below, ‘Large Current Readings’ over ‘Large Areas’ often result in the largest GPM or Defect Flow; however ‘Large Current Readings’ (i.e. used in the WERF Report) over a ‘Small Area’ often result in Minor or Moderate GPMs, therefore missing ‘Small Current Readings’ over ‘Large Areas’ that may indicate Severe GPM flows.



Fortunately, Dr. Kerri noticed the report’s shortcoming and included corrected results, as originally intended, as part of the Seventh Edition, Volume 1, **OPERATION AND MAINTENANCE OF WASTEWATER COLLECTION SYSTEMS** manual, in accordance with ASTM F2550.



Seventh Edition, Volume One Operation and Maintenance of Wastewater Collection Systems manual, Page 255, Figure 4.48

Rank	SCAN ID	Number of Defects				ASTM F2550 % Anomaly Length of Pipe Tested						Electro Scan's Recommended GPM			
		Small	Medium	Large *	Total *	Small	Medium	Large	Joint	Other	Total **	Minor GPM Flow	Moderate GPM Flow	Severe GPM Flow	Total GPM **
1	dafu_0025	9	2	14	25	0.22	0.40	11.07	4.67	7.02	11.69	2.49	24.47	15.4	42.3
2	dafu_0031	30	7	4	41	5.90	1.93	1.22	3.80	5.25	9.05	10.48	14.52	0.0	25.0
3	dafu_0009	5	9	6	20	1.77	2.75	1.48	1.83	4.17	6.00	6.2	16.46	0.0	22.7
4	dafu_0023	17	4	5	26	2.15	1.66	1.91	3.37	2.35	5.72	5.51	13.31	0.0	18.8
5	dafu_0022	14	6	3	23	1.16	1.56	2.02	1.08	3.66	4.74	4.92	9.96	0.0	14.9
6	dafu_0028	23	0	1	24	3.55	0.00	1.61	1.65	3.51	5.16	5.81	2.02	6.2	14.1
7	dafu_0015	22	4	0	26	5.42	1.07	0.00	2.84	3.65	6.49	8.53	5.27	0.0	13.8
8	dafu_0008	12	6	1	19	0.20	2.81	2.94	1.41	4.54	5.95	6.58	6.49	0.0	13.1
9	dafu_0018	26	5	0	31	0.77	0.13	0.00	0.90	0.00	0.90	8.4	2.12	0.0	10.5
10	dafu_0029	14	9	0	23	1.26	1.62	0.00	2.88	0.00	2.88	10.52	0	0.0	10.5
11	dafu_0006	22	4	2	28	0.47	1.55	1.91	2.79	1.14	3.93	6.67	3.66	0.0	10.3
12	dafu_0012	19	5	1	25	0.36	0.85	1.43	2.45	0.19	2.64	6.29	2.61	0.0	8.9
13	dafu_0011	16	2	1	19	0.49	0.59	0.56	0.74	0.90	1.64	4.12	2.85	0.0	7.0
14	dafu_0020	18	5	0	23	1.48	0.89	0.00	2.11	0.26	2.37	6.85	0	0.0	6.9
15	dafu_0027	21	2	0	23	1.78	0.38	0.00	1.56	0.60	2.16	5.52	1.13	0.0	6.7
16	dafu_0016	13	1	0	14	0.83	0.19	0.00	0.90	0.12	1.02	4.13	0	0.0	4.1
17	dafu_0017	19	2	0	21	0.72	0.24	0.00	0.87	0.09	0.96	3.99	0	0.0	4.0
18	dafu_0030	14	0	1	15	1.37	0.00	0.21	0.30	1.28	1.58	3.97	0	0.0	4.0
19	dafu_0026	9	0	1	10	1.61	0.00	0.00	1.27	0.34	1.61	2.27	1.02	0.0	3.3
TOTAL		323	73	40	436										240.7

* WERF reporting metric, used to correlate with Exfiltration Tests.
** Not included in WERF Report

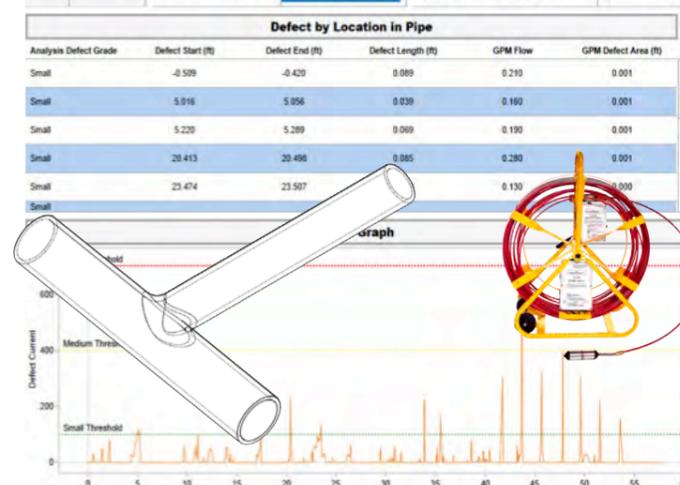
Understanding The Power of Electro Scanning Inspection

Sewer Agencies are now able to individually assess sewer mains and rank their largest defects, based on their estimated Defect Flow measured in GPM.



Defect Count	Defect Lengths	GPM Summary
Small: 13	Small Defects Total Length (ft): 5.916	Total Minor GPM Flow: 4.13
Medium: 1	Medium Defects Total Length (ft): 5.220	Total Moderate GPM Flow: 0.00
	Large Defects Total Length (ft): 20.413	Total Severe GPM Flow: 0.00
	All Defects Total Length (ft): 23.474	Total Approximated Flow Per Minute: 4.13
		Total Approximated Flow Per Day: 5947

For example, a small longitudinal crack may not leak much, but may represent a higher % of the pipe length. At the City of Wauwatosa, a majority of infiltration occurred at offset joints, most registering a defect length of less than 1/4 of an inch, but leaking the largest amounts, resulting in a low % of defective pipe, but high defect flow ratings.



Source: Electro Scan Inc. Critical Sewers® September 2012

SCAN	ELECTRO SCAN ID	ELECTRO SCAN & EXFILTRATION DATE	DISTANCE -- BLDG TO SEWER MAIN	PIPE DIAMETER	PIPE DEPTH	PIPE LENGTH	PIPE MATERIAL	GROUND CONDITION	Detail Exfiltration Test Results	Exfiltration & Infiltration Testing				Electro Scan Inc. critical sewers®																		
										Drop (Feet)	4 inches, 1ft, 1.5ft, 2ft, 3ft Drop in 1 second (ft)	Time (Seconds)	Gallons Per Minute (Equiv. Drop Divided By Time)	Gallons Per Day (GPM x 1,440 min/day)	Exfiltration				Infiltration				Number of Defects			% Anomaly Length of Pipe Length Tested				Estimated Flow		
1	dafu_0006	6/26/08	59	6	108	58.8	VCP	D - Dry	Exfiltration - 3ft drop in 8.9 sec	0.333	29,346.6	7.05	4.2	5,994	22	4	2	28	0.47	1.55	1.91	2.79	1.14	3.93	6.67	3.66	0.0	10.3				
2	dafu_0008	6/28/08	60	6	108	52.37	VCP	D - Dry	Exfiltration - 4 inch in 7.05 sec.	0.333	29,346.6	3.59	8.2	11,771	12	6	1	19	0.20	2.81	2.94	1.41	4.54	5.95	6.58	6.49	0.0	13.1				
3	dafu_0009	6/28/08	58	6	108	52.35	VCP	D - Dry	Exfiltration - 4 inch drop in 3.59 sec	0.333	29,346.6	3.59	8.2	11,771	5	9	6	20	1.77	2.75	1.48	1.83	4.17	6.00	6.2	16.46	0.0	22.7				
4	dafu_0011	7/4/08	59	6	114	55	VCP	D - Dry	Exfiltration - 2ft drop in 9.56 sec.	2	176,256	9.56	18.4	26,549	16	2	1	19	0.49	0.59	0.56	0.74	0.90	1.64	4.12	2.85	0.0	7.0				
5	dafu_0012	7/12/08	60	6	127	47.67	VCP	D - Dry	Exfiltration - 1ft drop 2.01 sec.	1	88,128	2.01	43.8	63,136	19	5	1	25	0.36	0.85	1.43	2.45	0.19	2.64	6.29	2.61	0.0	8.9				
6	dafu_0015	7/12/08	62	6	108	0	VCP	D - Dry	Exfiltration - 1ft drop in 2.61 sec.	1	88,128	2.61	33.8	48,622	22	4	0	26	5.42	1.07	0.00	2.84	3.65	6.49	8.53	5.27	0.0	13.8				
7	dafu_0016	7/12/08	55	6	107	47.96	VCP	D - Dry	Exfiltration - 2ft drop in 2.6 sec.	2	176,256	2.6	67.8	97,619	13	1	0	14	0.83	0.19	0.00	0.90	0.12	1.02	4.13	0	0.0	4.1				
8	dafu_0017	7/12/08	64	6	100	48.71	VCP	D - Dry	Exfiltration - 1ft at 1.68 sec.	1	88,128	1.68	52.5	75,538	19	2	0	21	0.72	0.24	0.00	0.87	0.09	0.96	3.99	0	0.0	4.0				
9	dafu_0018	7/12/08	59	6	109	48.91	VCP	D - Dry	Exfiltration - 1ft drop in 1.7 sec.	1	88,128	1.7	51.8	74,650	26	5	0	31	0.77	0.13	0.00	0.90	0.00	0.90	4.32	0	0.0	4.3				
10	dafu_0020	7/15/08	55	6	90	44.48	VCP	D - Dry	Exfiltration - 1ft drop in 4.1 sec.	1	88,128	4.1	18.0	25,899	18	5	0	23	1.48	0.89	0.00	2.11	0.26	2.37	6.85	0	0.0	6.9				
11	dafu_0022	7/15/08	56	6	100	46.5	VCP	D - Dry	Exfiltration - 1ft drop in 7.7 sec.	1	88,128	7.7	11.4	16,481	14	6	3	23	1.16	1.56	2.02	1.08	3.66	4.74	4.92	9.96	0.0	14.9				
12	dafu_0023	7/15/08	56	6	112	51.3	VCP	D - Dry	Exfiltration - 1ft drop in 4.4 sec.	1	88,128	4.4	20.0	28,842	17	4	5	26	2.15	1.66	1.91	3.37	2.35	5.72	5.51	13.31	0.0	18.8				
13	dafu_0025	7/15/08	60	6	107	50.6	VCP	D - Dry	Exfiltration - 1ft drop in 74.2 sec.	1	88,128	74.2	1.2	1,710	9	2	14	25	0.22	0.40	11.07	4.67	7.02	11.69	2.49	24.47	15.4	42.3				
14	dafu_0026	7/18/08	63	6	121	39	VCP	W - Wet	Exfiltration - 1.5ft drop in 17.2 sec.	1.5	132,192	17.2	7.7	11,067	9	0	1	10	1.61	0.00	0.00	1.27	0.34	1.61	2.27	1.02	0.0	3.3				
15	dafu_0027	7/18/08	57	6	110	53	VCP	W - Wet	Exfiltration - 2ft drop in 4.1 sec.	2	176,256	4.1	43.0	61,905	21	2	0	23	1.78	0.38	0.00	1.56	0.60	2.16	5.52	1.13	0.0	6.7				
16	dafu_0028	7/18/08	56	6	107	47.7	VCP	W - Wet	Exfiltration - 1ft drop in 12.3 sec.	1	88,128	12.3	7.2	10,317	23	0	1	24	3.55	0.00	1.61	1.65	3.51	5.16	5.81	2.02	6.24	14.1				
17	dafu_0029	7/18/08	64	6	109	51.2	VCP	W - Wet	Exfiltration - 1ft drop in 5.6 sec.	1	88,128	5.6	15.7	22,661	14	9	0	23	1.26	1.62	0.00	2.88	0.00	2.88	10.52	0	0.0	10.5				
18	dafu_0030	7/18/08	61	6	103	52.2	VCP	W - Wet	Exfiltration - 1ft drop in 22.3 sec.	1	88,128	22.3	4.0	5,691	14	0	1	15	1.37	0.00	0.21	0.30	1.28	1.58	3.97	0	0.0	4.0				
19	dafu_0031	7/24/08	57	6	108	51	VCP	D - Dry	Exfiltration - 2ft drop in 4.5 sec.	2	176,256	4.5	39.2	56,402	5	30	7	41	5.90	1.93	1.22	3.80	5.25	9.05	10.48	14.52	0.0	25.0				
TOTAL										477.5					323	73	40	436														234.5

Only 19 of 45 laterals on Eagle Street had CCTV, Electro Scan, and Exfiltration Test Results (i.e. 7 Exfiltration Test were deemed unusable as plugs got loose during field testing and 3 were never taken). Only 6 laterals with previous Infiltration (i.e. soaker) Tests, were included in the 19 tests.

In computing GPM, Electro Scan's proprietary model assumes 1ft of head and 1% pipe gradient. As a result, Electro Scan's computations tend to underestimate GPM in higher groundwater conditions.

WERF Data Shows Electro Scan Consistently & Reliably Finds Lateral Defects Not Seen By CCTV

Electro Scanning Recommended To Replace CCTV to Correctly Assess Sewer Laterals

A key objective of the originally proposed WERF Sewer Lateral Electro Scan Field Verification Pilot was to perform a comprehensive comparison of CCTV and Electro Scan for sewer laterals. Yet, the research team did not feel it was a 'constructive use of research resources' to accomplish this task.

As communicated by the WERF Team:

"Since the research project was not in direct ownership or control of the CCTV, accounting for defect number, type, and severity data would have required manual gleaning from the CCTV reports which was not considered to be a constructive use of research resources."

Principal Investigator
March 25, 2013

While CCTV has been an effective tool to 'see' and catalogue pipe sags, protruding service connections, grease, roots, crossbores, and alignment problems, the Eagle Street results clearly show that CCTV inspections proved ineffective in identifying sources of infiltration.



Based on side-by-side comparisons for all twenty-seven (27) Eagle Street sewer laterals (i.e. both televised and Electro Scanned) Electro Scanning Inspection found 562 total defects, compared to 156 total defects identified by CCTV. In fact, 10 of 27 or 37% of all CCTV surveys, identified three or fewer defects, missing all major defects identified by Electro Scanning Inspection.

Based on side-by-side comparisons of LACP-certified CCTV results and Electro Scan results for Eagle Street, it appears that CCTV consistently, (1) missed major sources of infiltration, (2) repeatedly used the same LACP standard for different sized defects or leaks, (3) repeatedly used different LACP standard designations for the same-sized defects or leaks, and (4) in-

10 out of 27 CCTV Reports Had 3 or Fewer Defects, Missing The Majority of Potential Sources of Infiltration

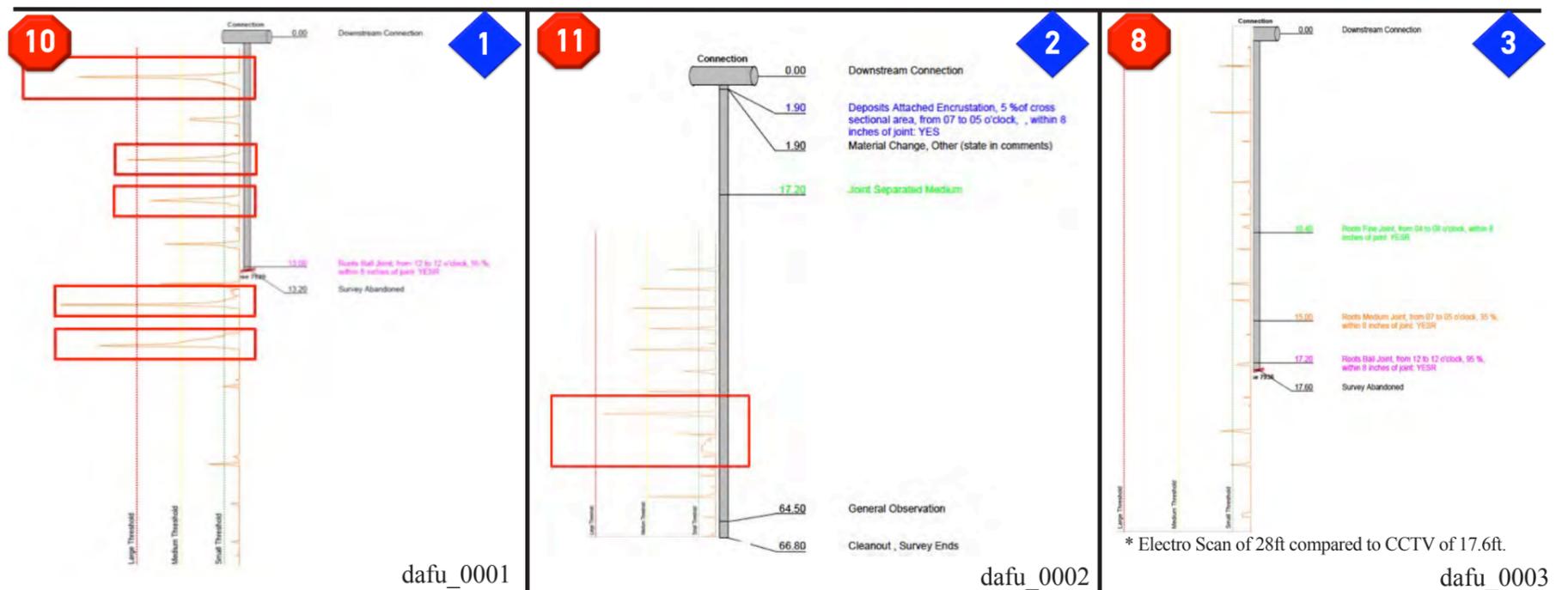
dicated defects where no Electro Scan defect was shown, i.e. no pathway to ground was indicated by low voltage conductivity testing.

Finally, a major deficiency of the original report was the lack of re-review of CCTV footage that corresponded to defects identified by Electro Scan. This would have determined whether CCTV operators either (a) failed to record visual defects, or (b) were simply unable to 'see' defects by visual inspection techniques, warranting further study.

Electro Scan Inc. critical sewers®													CCTV INSPECTION															
SCAN	ELECTRO SCAN ID	ELECTRO SCAN DATE	CCTV DATE	DISTANCE -- BLDG TO SEWER MAIN	PIPE DIAMETER	PIPE DEPTH	PIPE LENGTH (MM to FT)	PIPE MATERIAL	GROUND CONDITION	RAW SCAN DATA POINTS	FILTERED DATA POINTS	PIPE LENGTH (MM)	Number of Defects				Estimated Flow				Structural Codes	Service Defects	Constructional Features	Misc. Features	Collapsed or Collapse Imminent	Total Defects	OPRI	# of Laterals With 3 or Less Defects
													Small	Medium	Large	Total	Minor GPM Flow	Moderate GPM Flow	Severe GPM Flow	Total GPM								
1	dafu_0001	6/26/12	6/12/12	19	6	108	19	VCP	D - Dry	1952	710	5791	3	3	4	10	2.2	12.1	0.0	14.3	0	0	0	0	0	1	4.00	1
2	dafu_0002	6/26/12	6/12/12	61	6	108	61	VCP	D - Dry	1777	817	18593	6	5	0	11	4.9	2.1	0.0	7.0	1	1	0	0	0	2	1.50	1
3	dafu_0003	6/26/12	6/12/12	58	6	108	58	VCP	D - Dry	2117	758	17678	8	0	0	8	0.6	0.0	0.0	0.6	1	0	1	1	0	3	2.67	1
4	dafu_0006	6/27/12	6/12/12	59	6	108	59	VCP	D - Dry	3240	1445	17983	22	4	2	28	6.7	3.7	0.0	10.3	4	3	0	0	0	8	1.63	1
5	dafu_0007	6/27/12	6/12/12	55	6	108	55	VCP	D - Dry	1467	625	16764	8	5	0	13	2.3	4.7	0.0	7.0	1	0	0	1	0	2	2.50	1
6	dafu_0008	6/29/12	6/12/12	60	6	108	60	VCP	D - Dry	2592	1257	18288	12	6	1	19	6.6	6.5	0.0	13.1	1	5	3	0	0	9	2.22	1
7	dafu_0009	6/29/12	6/11/12	58	6	108	58	VCP	D - Dry	2466	1273	17678	5	9	6	20	6.2	16.5	0.0	22.7	2	1	1	0	0	4	1.33	1
8	dafu_0010	7/5/12	6/12/12	60	6	113	60	VCP	D - Dry	3021	1344	18288	13	4	5	22	7.4	3.6	7.0	18.0	3	5	1	1	0	10	2.00	1
9	dafu_0011	7/5/12	6/12/12	59	6	114	59	VCP	D - Dry	2613	1403	17983	16	2	1	19	4.1	2.9	0.0	7.0	6	0	1	0	0	7	1.29	1
10	dafu_0012	7/13/12	6/12/12	60	6	127	60	VCP	D - Dry	3140	1264	18288	19	5	1	25	6.3	2.6	0.0	8.9	0	3	0	0	0	3	2.00	1
11	dafu_0013	7/13/12	6/11/12	62	6	108	62	VCP	D - Dry	3742	1648	18898	22	4	0	26	8.5	5.3	0.0	13.8	1	1	1	0	0	3	2.00	1
12	dafu_0016	7/13/12	6/11/12	55	6	107	55	VCP	D - Dry	2787	1451	16764	13	1	0	14	4.1	0.0	0.0	4.1	0	1	0	1	0	2	3.00	1
13	dafu_0017	7/13/12	6/11/12	64	6	100	64	VCP	D - Dry	2856	1259	19507	19	2	0	21	4.0	0.0	0.0	4.0	0	0	0	0	0	0	0.00	1
14	dafu_0018	7/13/12	6/11/12	59	6	109	59	VCP	D - Dry	3367	1419	17983	21	2	0	23	4.3	0.0	0.0	-4.3	5	0	1	0	0	6	1.33	1
15	dafu_0019	7/16/12	6/11/12	55	6	92	55	VCP	D - Dry	2673	1139	16764	26	5	0	31	8.4	2.1	0.0	10.5	7	1	0	0	0	8	1.13	1
16	dafu_0020	7/16/12	6/11/12	55	6	90	55	VCP	D - Dry	3016	1158	16764	18	5	0	23	6.9	0.0	0.0	6.9	3	3	0	0	0	6	1.50	1
17	dafu_0021	7/16/12	6/12/12	56	6	116	56	VCP	D - Dry	2550	1164	17069	18	0	0	18	4.0	0.0	0.0	-4.0	3	1	3	0	0	7	2.00	1
18	dafu_0022	7/16/12	6/11/12	56	6	100	56	VCP	D - Dry	2936	1317	17069	14	6	3	23	4.9	10.0	0.0	14.9	1	1	1	0	0	3	2.00	1
19	dafu_0023	7/16/12	6/11/12	56	6	112	56	VCP	D - Dry	3342	1379	17069	17	4	5	26	5.5	13.3	0.0	18.8	0	0	6	0	0	6	3.00	1
20	dafu_0024	7/16/12	6/11/12	55	6	104	55	VCP	D - Dry	2698	1223	16764	11	5	5	21	4.8	9.8	0.0	14.6	0	5	3	1	0	9	2.56	1
21	dafu_0025	7/16/12	6/12/12	60	6	107	60	VCP	D - Dry	2986	1248	18288	9	2	14	25	2.5	24.5	15.4	42.3	0	8	3	1	0	12	2.42	1
22	dafu_0026	7/19/12	6/12/12	63	6	121	63	VCP	W - Wet	2354	990	19202	9	0	1	10	2.3	1.0	0.0	3.3	2	8	3	0	0	13	2.08	1
23	dafu_0027	7/19/12	6/12/12	57	6	110	57	VCP	W - Wet	3253	1320	17374	21	2	0	23	5.5	1.1	0.0	6.7	0	3	0	1	1	5	3.00	1
24	dafu_0028	7/19/12	6/12/12	56	6	107	56	VCP	W - Wet	2286	1143	17069	23	0	1	24	5.8	2.0	6.2	14.1	2	0	1	0	0	3	1.67	1
25	dafu_0029	7/19/12	6/12/12	64	6	109	64	VCP	W - Wet	2699	1239	19507	14	9	0	23	10.5	0.0	0.0	10.5	3	1	0	0	0	4	1.25	1
26	dafu_0030	7/19/12	6/12/12	61	6	103	61	VCP	W - Wet	2625	1275	18593	14	0	1	15	4.0	0.0	0.0	4.0	0	10	3	1	1	15	2.53	1
27	dafu_0031	7/25/12	6/11/12	57	6	108	57	VCP	D - Dry	2780	1336	17374	30	7	4	41	10.5	14.5	0.0	25.0	2	0	4	1	0	7	2.57	1
													1,540	Electro Scan Total # Leaks 562				310.5				CCTV Total # Callouts 156					1.90	10

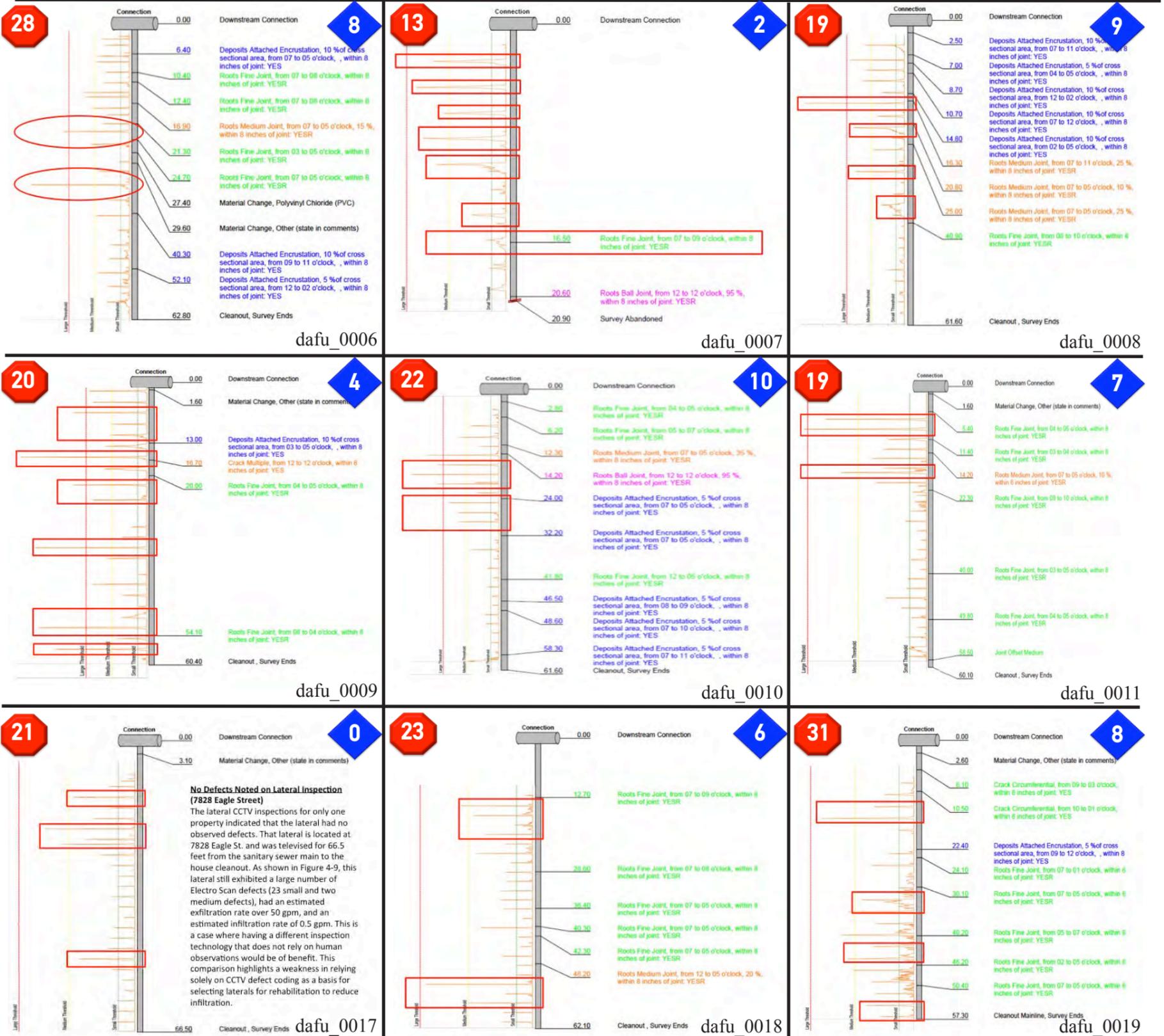
Seventh Edition, Volume One
Operation and Maintenance of Wastewater Collection
Systems manual, Page 256, Figure 4.49

Side-By-Side Comparisons of Electro Scan & CCTV Inspections



20 Selected Additional Side-By-Side Comparisons of Electro Scan & CCTV Inspection

Contact Electro Scan for a Free Report Updated by Ken Kerri, Ph.D., PE, and included as part of the Seventh Edition, Volume 1, Operation & Maintenance of Wastewater Collection Systems manual.



FAQ #10

Can Electro Scan Evaluate Large Diameter Pipes?

Yes!

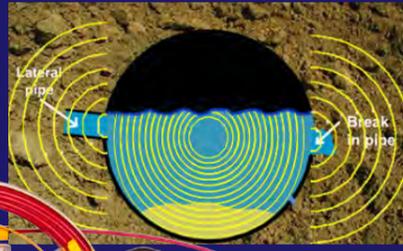
Accurate condition assessment of large diameter, high flowing sewers and water pipes remain one of the most significant challenges facing utilities. Yet, the cost of bypass pumping an interceptor or dewatering a transmission line makes closed circuit television inspection ineffective and cost-prohibitive.

Due to the constant high velocity flows commonly encountered, CCTV cameras tend to be too unstable, preventing cameras from operating effectively and efficiently. In addition to the high flows, CCTV cameras often get bogged down or stuck due to debris.

Given the lackluster detection capabilities of acoustic sensors, electromagnetic, sonar, and

other technologies, Electro Scan is well positioned to help utilities detect leaks below the waterline.

Due to the set-up, mobilization, and reporting, Electro Scan Services offers this as an exclusive service to agencies and consulting engineers. Call or email us for more details on scanning your 48" to 84" diameter pipe.



Chuck Hansen with his ES-38 & ES-250 systems for 3" to 8" (150mm to 255mm) diameter pipes.

WEF Names Electro Scan 'Best Innovative Technology'

"We are delighted to be recognized by our colleagues and peers," stated Mark Grabowski, Vice President of Electro Scan. "Not since the introduction of TV cameras to televise sewers, has a technology so quickly and radically changed the way we locate defects and certify repairs as leak-free. Electro Scan changes everything from deciding which pipes to fix, to determining final acceptance of point repairs and lining projects."

"Electro Scan adds a new dimension to sewer condition assessments," stated Charles Wilmut, P.E., former Senior Vice President, Burgess & Niple, one of the technology's earliest adopters, and now a Senior Advisor to Electro Scan, Inc. "While CCTV provides an operator with an overall visual account of a pipe, it is unable to locate and measure defects that cannot be seen. It's not just the fact that Electro Scan finds more defects than CCTV, but that Electro Scan can locate and measure the estimated magnitude of each defect -- something never before available."

"Congratulations on being selected for this significant honor," stated Jeff Eger, WEF's Executive Director. The award recognized Electro Scan's contribution to improving water quality and was honored at WEFTEC, October 2013.

Electro Scan uses its patented technology to generate an intense, focused array, of low-voltage/high-frequency electric current to systematically assess 360° of pipe walls.

If a pipe is in good condition, no current will be able to "leak" or escape out of the pipe and into the ground, unless there is a crack. All bad joints, defective service connections, and breaks in a pipe, are found by Electro Scan, not typically seen or recorded by visual inspection, acoustic, laser profiling, sonar, or ground penetrating radar.

Advantages of the Electro Scan technology include its ability to rapidly scan pipes that are either full or partially full of water and provide automated leak detection information, including location to the nearest 0.4 inches (1 cm) and estimated GPM. While CCTV cameras are rarely, if ever, used during periods of wet weather, Electro Scan, combined with CCTV, provides a year-round solution.

In 2013, Electro Scan won the Joseph L. Abbott, Jr. Product Innovation Award presented by the North American Society of Trenchless Technologies (NASTT) and the Sierra Nevada Innovation Challenge for Best CleanTech Company in California.

Founded in 1928, the Water Environment Federation (WEF) is a not-for-profit association with more than 36,000 members worldwide providing technical education and training for water quality professionals who clean water and return it safely to the environment.



Jeff Eger, Former WEF Executive Director

CIPP Specification Updated to Adopt *Electro Scanning Inspection* to Certify & Accept Contractor's Performance

Acceptance testing and certification of all repairs, relining, and renewal, shall be performed using electro scanning inspection and shall be performed by an independent third-party contractor experienced in the use of the electro scanning system, in accordance with the **MAINTENANCE AND OPERATION OF WASTEWATER COLLECTION SYSTEMS, Volume 1, Seventh Edition, 2015, ISBN 978-1-59371-066-8** and **ASTM F2550, Standard Practice for Locating Leaks in Sewer Pipes By Measuring the Variation of Electric Current Flow Through the Pipe Wall**. The City shall select (and pay for the services of) the independent 3rd party contractor to conduct this pre and post testing.

The electro scanning inspection test shall be conducted on one hundred percent (100%) of the total linear footage of mainline pipe, including a Pre-CIPP and Post-CIPP survey, with all results available to the City immediately following the test completion. Testing shall be performed on all non-conductive lined and host pipes, including but not limited to, **Asbestos Cement Pipe, Brick, Cement Mortar Lined Ductile Iron or Steel Pipe, Ceramic Epoxy, Clay, Concrete, Fiberglass Pipe, High-Density Polyethylene Pipe, Polyvinyl Chloride Pipe, Reinforced Concrete Pipe, and Vitrified Clay Pipe**, among others.

The following limits shall be used to determine the significance of detected defects.

- Defects below the "Small Threshold" (<100 mA) are considered acceptable, but may be eligible for investigation at no cost to City. This excludes anomalies detected at the beginning and end of pipe at manholes.
- Defects above the "Small Threshold" >100 mA, will be initially considered "unacceptable." Defects need to be further investigated and reviewed. If deemed unacceptable, the pipe will be failed.
- Defects that occur at the beginning and end of a lined pipe, where the probe is exiting or entering a manhole, will not be the responsibility of the Contractor and will be accepted by City.
- If no lateral connection rehabilitation will take place, contractor will not be held liable for any anomalies detected at lateral reinstatements. However, lateral reinstatements must be performed to City specification.
- City will have full access to all automatically recorded testing conditions via a cloud-based portal and will be verifying all tests are being performed within the manufacturer's recommended parameters. All scans must be performed within the following testing parameters:
 1. Pipe must be fully surcharged with water at the location of the probe to ensure a full 360-degree inspection of the pipe. This can be achieved in whatever means the Contractor chooses, but City and manufacturer recommend using a Sliding Funnel Plug or Cone, in conjunction with a hydraulic jet truck or portable jetter. If chosen, probe must remain a minimum of three (3) feet from funnel plug.
 2. Total Current readings must be a MINIMUM of 2800mA when probe is in a concrete manhole when starting the scan, and must not drop below 1000 mA after entering the lined pipe.
 3. Probe speed must range from 30-60 feet per minute.
 4. All pipes with Defects above the "Small Threshold" shall be retested after Contractor has addressed the defect at no additional cost to City.
 5. The Electro Scan Contractor shall provide same day fully analyzed results to both the Contractor and City representative within 1 hour of testing each section of pipe via uploading each scan to the City's licensed viewing platform. NOTE: Contractor will not have any access to the City's viewing platform to maintain independent testing and certification of all tests.



Contact Electro Scan for Sample Specifications in Microsoft Word format.

- CIPP-Related ASTM Standards**
- ASTM D543 Test Method for Resistance of Plastics to Chemical Reagents
 - ASTM D638 Test Method for Tensile Properties of Plastics
 - ASTM D790 Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
 - ASTM D883 Definitions and Terms Relating to Plastics
 - ASTM D1600 Abbreviations, Acronyms, and Codes for Terms Relating to Plastics
 - ASTM F412 Definitions of Terms Relating to Plastic Piping Systems
 - ASTM F1216 Rehabilitation of Existing Pipelines and Conduits by Inversion and Curing of a Resin Impregnated Tube
 - ASTM F2550-13 Standard Practice for Locating Leaks in Sewer Pipes By Measuring the Variation of Electric Current Flow Through the Pipe Wall**

Electro Scan R&D Helps Automatically Assess 360° of Pipe Wall To Locate & Measure Critical Defects

Electro Scan's U.S. and International patents and patents pending technology has forever changed how pipeline managers conduct pre- and post-rehabilitation assessment of their critical assets.

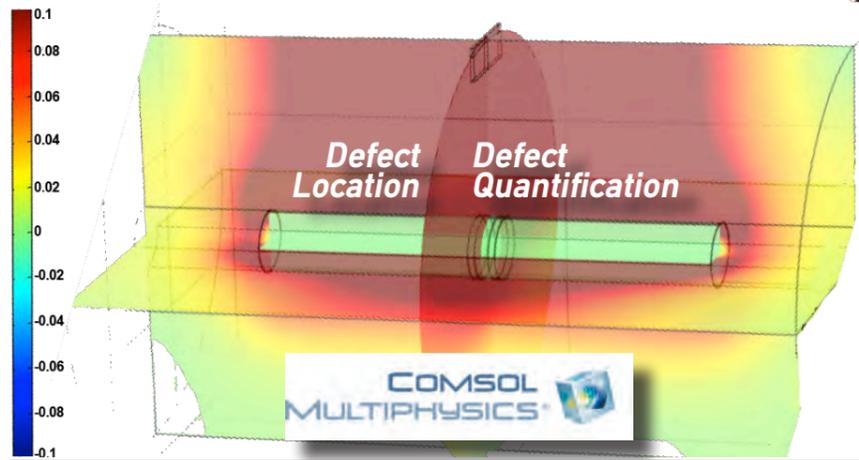
But how does it find defect locations within 0.4 inches (1cm) and provide an estimated GPM (l/s) for each defect, and each pipe, while legacy techniques cannot?

A key factor of Electro Scan's success has been its ongoing research & development, focusing on technologies that can automatically capture, process, store, and display thousands of data points to accurately determine defects.

A recent EPA-consent decree project evaluating 44,000LF, collected over 2.2 million data points, with reports – showing location and severity of each defect – available in a matter of minutes.

Partnership With ULC Helps Entry Into Pressurized Water Mains

Electro Scan's R&D team doesn't work alone and we are delighted to work with ULC Pipeline Robotics, Hauppauge, NY, for their help in developing our hydrant / water main entry devise, allowing Electro Scan's 4-in-1 probe to enter pressurized water mains, without service disruption.



Electro Scan Inc. Sponsors 2016 Jammin' 4 Water

Jammin' 4 Water

MUSIC • WATER • HUMANITY

GENERATIONS HALL
310 Andrew Higgins Drive, New Orleans

September 24, 2016
6:00pm – 1:00am

\$50 | \$60
ONLINE | DOOR

www.jammin4water.org

www.jammin4water.org

Jammin' 4 Water

Generations Hall 6PM - 1AM Saturday, Sept 24

WEFTEC CONVENTION CENTER

Chuck Hansen to play J4W

Tower of Power Horns, including (L to R) Doc Kupka, Chuck Hansen, Tom Polizer & Emilio Castillo, July 2016

Jammin' 4Water, celebrates its 4th year in New Orleans, the weekend prior to WEFTEC, with Electro Scan Inc. as a new sponsor. Past charities benefiting from this event have included WEF Service Project, Water For People, GlobalH2O, Engineers Without Borders, Charity: Water, World Water Relief, Ecoloodi, and Kids Connection Haiti. This year's event is expected to host more than 1,000 pre-WEFTEC conference attendees with two musical stages operating simultaneously during portions of the evening to allow all musicians of different genres to participate. With a 2016 fundraising goal of \$75,000, let Jammin' 4Water help kick-off WEFTEC in legendary New Orleans style. Chuck Hansen, Electro Scan's CEO and a former owner of Hansen Information Technologies will be joining the Jammin' 4Water horn section, too.

Missed Defects and Poor Repeatability Reduces Usefulness of CCTV Inspection

Electro Scanning Inspection Brings More Accuracy, Reliability, and Timely Reporting of Pipe Condition Assessment, Overcoming Drawbacks of CCTV

Sewer utilities, contractors, and consulting engineers have traditionally inspected wastewater pipes using Closed-Circuit Television (CCTV) cameras. However, limitations to accurately locate & measure defects and inability to find sources of infiltration has reduced or significantly curtailed the use of CCTV as a pipe condition assessment tool.

“CCTV will not go away,” states Chuck Hansen, a pioneer in CCTV assessment. “Especially to evaluate Debris, Fats, Oil and Grease (FOG), Sags, Roots, and Protruding Taps. It’s just not appropriate to evaluate joints, service connections, or pre- and post-rehabilitation effectiveness.”

Sewer utilities, contractors, and engineers have long acknowledged problems with TV camera inspection and utilities need to only go as far as their own data to see *why*. Utilities should ask how many times conditions like Fats, Oil and Grease, Roots, Silt, and Encrustation have been recorded as a % of total observations. Or look at the frequency of pipes that were ¼, ½, or ¾ full of water -- all covering up defects below the waterline.

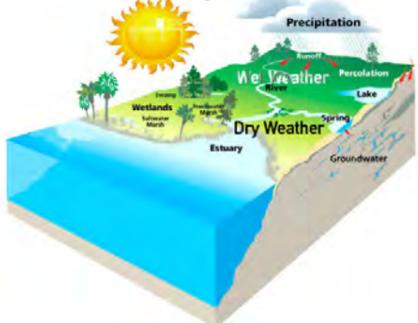
Still have doubts? Have your best two TV operators independently review and rate the same CCTV videotape.

Why The Industry is Shifting to Better Solutions?

Major Limitations From Using CCTV Inspections

1 Reliance on Dry Weather Pipes

A key reason for curtailing CCTV inspection is that it is primarily used during dry weather conditions – when pipes are less likely to leak. In fact, if rain is just starting, most crews will call it a day as cameras are not able to effectively televise mains when sewers are surcharged.



2 Pipe Half Full or Half Empty?

TV cameras are not effective in full or half-full pipes, missing any defects below the waterline. The Result: 30% to 50% of operators misidentify defects. More dramatic in larger diameter pipes, major cracks and leaks tend to be located below the waterline.



3 Fats, Oil, and Grease

While grease is a frequent call out for certified TV operators, it often disguises structural problems that may only be assessed if the pipe is thoroughly cleaned.

In contrast, Electro Scan does not require a clean pipe, and can assess with Light, Medium or Heavy Grease. Since grease represents a non-conductive material, Electro Scan’s low voltage current is able to assess the pipe wall, with or without the presence of grease.



4 Roots

Representing a clear pathway between the inside of a pipe and surrounding ground, roots are an obvious potential source of infiltration, yet national coding standards recommend that operators rate the level of roots, and not identify or measure the potential defect flow resulting from roots.

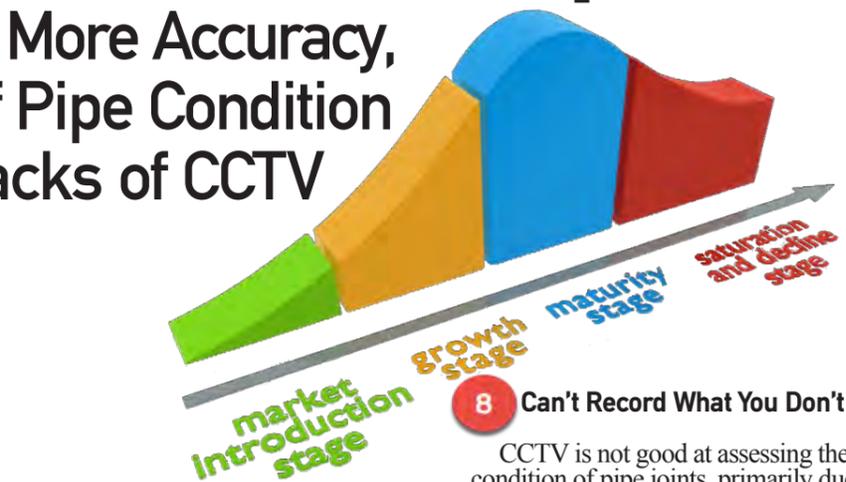
As a non-conductive material, Electro Scan measures the size of the opening allowing roots to flourish and is able to measure an estimated gallon per minute of defect flow, too.



5 Encrustations

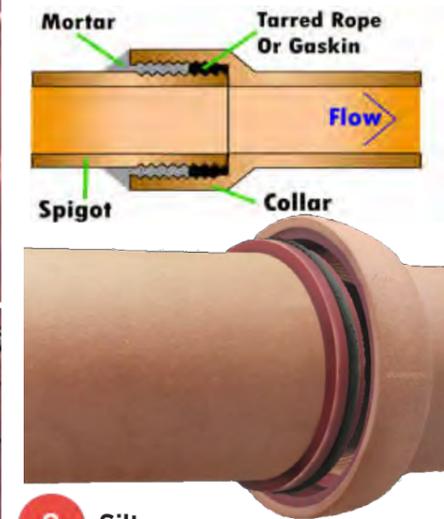
Another potential misdirection in terms of false-positive sewer condition assessment surveys can happen when TV operators catalogue *encrustations*.

Often referred to as self-healing defects – at least check encrustations are still not an approved rehab method – encrustations can harden and cover-up cracks and fissures to the point of passing some pressure tests; but its non-conductive feature still can be positively passed through to determine the location and size of a potential defect flow.



8 Can't Record What You Don't See

CCTV is not good at assessing the condition of pipe joints, primarily due to the basic design of joints. No matter how close an operator zooms into the surface of a joint, there is no possible way to assess the integrity or remaining useful life of the mortar. That is, unless pressure testing the joint or using Electro Scan.



9 Silt

Silt is a dangerous thing to find in a sewer as it oftentimes represents the liquefaction of bedding surrounding a pipe that may indicate the early start of a void -- a warning to all sewer utilities that have an over-reliance on vac trucks to routinely remove silt.

But while TV cameras cannot see through silt on the bottom of a pipe, Electro Scan can. When wet, silt is a conductive material, allowing Electro Scan’s low voltage current to go right through silt to find defects where leaks can occur.



10 Clean v. Dirty Pipe Assessments

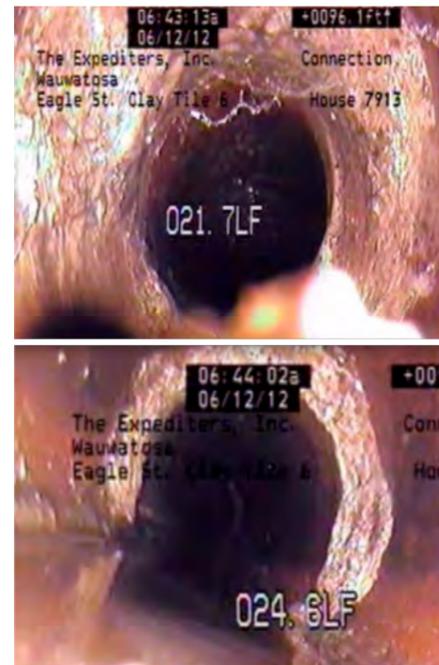
In 2010, the EPA arranged a benchmark in Kansas City, MO to compare Electro Scan and CCTV. While Electro Scan found 40% more defects and selected critical pipes that were rated in *good condition* by a nationally certified CCTV operator, comparisons were also evaluated on whether the pipe had been cleaned or not, prior to evaluation.

While cleaning may eliminate fats, oils, and grease, roots, debris, and silt, it also eliminates key evidence of water leaks. As a result, TV inspections in the study did find fewer defects, after cleaning, as clues to locating leaks were removed, and therefore more difficult to see with a camera.

Continued on Next Page



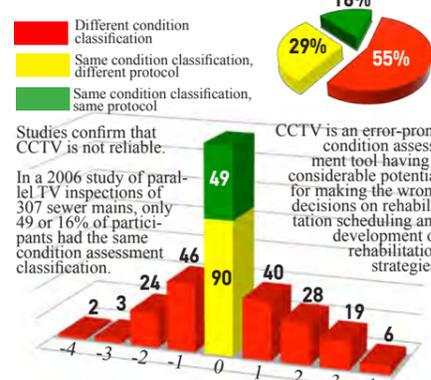
Below -- A sample series of encrustation call outs that passed a pressure test and found in good condition.



6 Different Codes, Same Defect

It is unfortunate, but true: train and certify two TV operators on the *same* day, using the *same* course instructor, utilizing the *same* materials (i.e. videos, photographs, etc.), test both using the *same* video, and you may get completely different interpretations of defects, not to mention a different number of defects.

It’s human nature and has been studied extensively, as shown below.



Differences in CCTV condition classification of 307 sewer reaches after parallel inspections (Müller, 2006).

The introduction of Electro Scan has not only shed light on defects not found by television inspection, but also highlights why CCTV inspection is not recommended to certify post-CIPP rehabilitation.

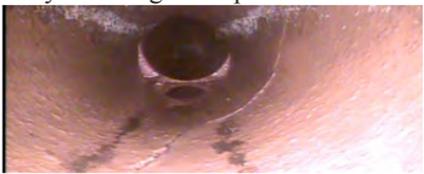
7 Same Code, Different Defects

A corollary for using different codes indicating the same defect, is finding that TV operators frequently use the *same* codes to describe *different* defects.

As confirmed in the EPA/WERF sponsored study in Milwaukee, Wisconsin, it was found that certified TV operators frequently used the same code for widely different defects, creating highly questionable Overall Pipe Rating Index (OPRI) metrics frequently used to determine rehabilitation priorities.

11 Cracks

Unfortunately, CCTV cameras are not able to tell the difference between a superficial surface crack and a crack that goes completely through the pipe wall. Too often, cracks are blamed for the infiltration, when in reality, the unsealed joint, a few inches away has a larger leak potential.



12 'Favorite' Code, Different Defects

Some operators often use 'favorite' codes that may or may not relate to the same or different defects.

C CRACK 54	F FRACTURE 57	B BRICKS 54	D DIRT 54	D DEFORMED 58	C COLLAPSE 52	J JOINT 52
CL Longitudinal	FL Longitudinal	BS Bad Work	DD Dirty	DD Deformed	CC Crushed	JJ Joints
CS Circumferential	FC Circumferential	BSV Bad Work	DDV Dirty	DDV Deformed	CCV Crushed	JJV Joints
CSW Cracks	FCW Cracks	BSV Bad Work	DDV Dirty	DDV Deformed	CCV Crushed	JJV Joints
CSW Cracks	FCW Cracks	BSV Bad Work	DDV Dirty	DDV Deformed	CCV Crushed	JJV Joints
CSW Cracks	FCW Cracks	BSV Bad Work	DDV Dirty	DDV Deformed	CCV Crushed	JJV Joints
CSW Cracks	FCW Cracks	BSV Bad Work	DDV Dirty	DDV Deformed	CCV Crushed	JJV Joints
CSW Cracks	FCW Cracks	BSV Bad Work	DDV Dirty	DDV Deformed	CCV Crushed	JJV Joints
CSW Cracks	FCW Cracks	BSV Bad Work	DDV Dirty	DDV Deformed	CCV Crushed	JJV Joints
CSW Cracks	FCW Cracks	BSV Bad Work	DDV Dirty	DDV Deformed	CCV Crushed	JJV Joints

15 Fittings & Ferncos

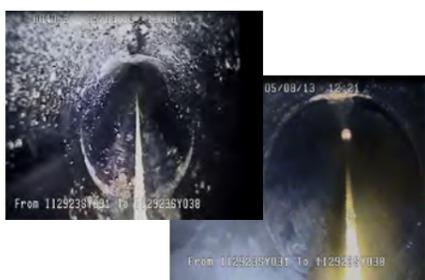
CCTV cameras do not have the ability to test or validate the water tightness of fittings or Ferncos often used in VCP pipes, and located outside the pipe. The subject of an open trench smoke testing benchmark, Electro Scan accurately found defective ferncos (shown below), missed after repeated CCTV inspections.



16 Dark-Colored Pipe

Darkened pipe walls not only mask visual signs of defects, but dark colors typically absorb a camera's lighting, further reducing the chance of a proper inspection.

Ductile iron pipe, polyethylene, and high density polyethylene pipes are just some of the materials that may have darkened surfaces that are difficult to observe and assess.



17 Point Repairs

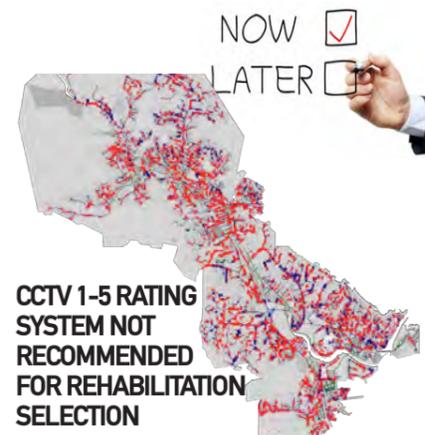
CCTV is not a reliable tool to certify point or spot repairs. Whether completed with a trenchless or open-cut method, CCTV is not able to see if newly-created seams are watertight.



18 Pre-Rehabilitation Selection

Too often, a rehabilitation program is deemed "unsuccessful" when flows are not reduced. Unfortunately, since CCTV cameras cannot properly assess pipes for leakage potential, TV programs should not be used to rank or prioritize needed repairs, rehabilitation, or renewals.

OPRI Grading	Structural Performance Grade (SPG)	Pipe Failure
5	Immediate Attention	Collapse or collapse imminent. Pipe has failed or will likely fail within the next 5 years
4	Poor	Collapse likely in foreseeable future. Pipe will probably fail in 5 to 10 years
3	Fair	Collapse unlikely in near future. Pipe may fail in 10 to 20 years
2	Good	Minimal collapse risk. Pipe unlikely to fail for at least 20 years
1	Excellent	Acceptable structural condition. Failure unlikely in the foreseeable future



19 Missed Defects

Relying on a visual technology results in missed defects more often than not. Smudges on the lens, build up of debris and effluent on pipe walls, high flows, and operator inattentiveness, all contrib-

ute to missed defects. Not to mention the most common missed source for leaks – unsealed joints – which cameras cannot assess.



20 Infiltration

The requirement to have an empty pipe during CCTV inspection and inability to readily quantify openings in a pipe make identification of "infiltration" difficult, if not impossible. Further complicating the accurate identification of infiltration, is the lack of any correlation between 'Root' intrusions to possible defect flows – solved by Electro Scan.

I INFILTRATION	IW Weeper	6-13
	ID Dripper	6-13
	IR Runner	6-13
	IG Gusher	6-13

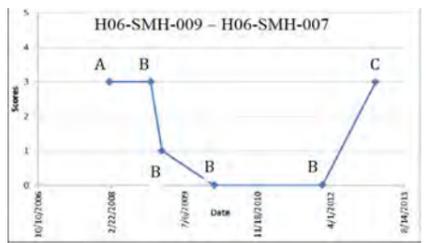
13 Different Codes, Same Operator

Not including data entry, CCTV operators may enter different observations on the same sewer main.



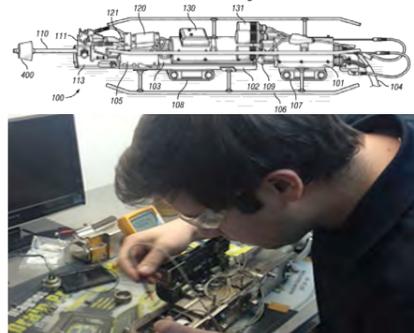
14 Repeatability

Recent studies suggest that certified TV operators are often unable to repeat the same CCTV observations, when evaluating the same pipe at different times – undermining development of an accurate visual assessment of sewer mains.



21 Camera Breakdown

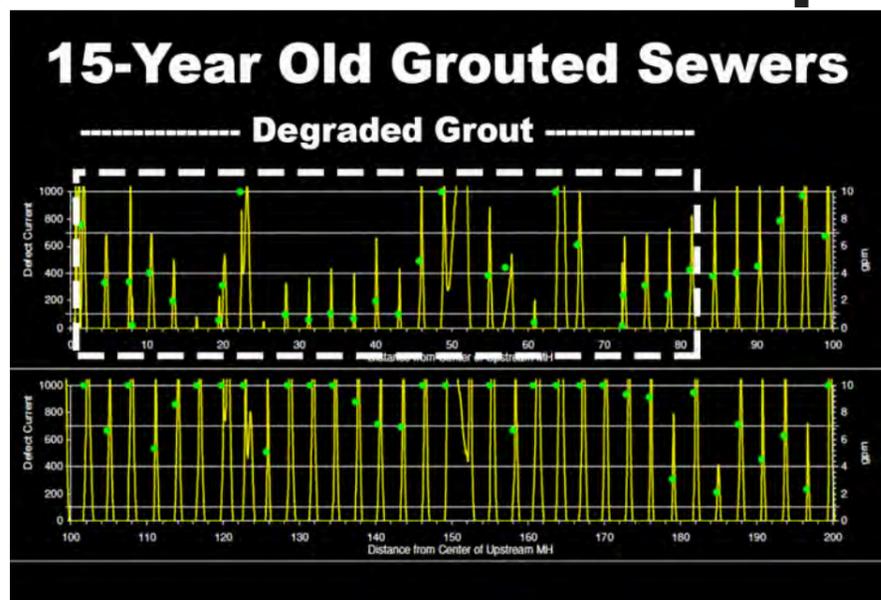
A multitude of moving parts coupled with considerable heat build up while inside a pipe, results in a treacherous environment for cameras and their crawlers. As a result, breakdowns may occur for a variety of reasons including entanglements from roots & debris, getting stuck in thick silt, or caught in a broken joint, all contributing to compromised video quality or an abandonment survey.



Non-Destructive & Non-Invasive Electro Scan Replaces Packer Testing of Joints to Protect Pipe



Some say that if a joint doesn't leak before an air test delivered by a packer, it will afterwards! That's just one of the reasons that Electro Scan is recommended to quickly & easily locate and estimate defects in joints, instead of using a packer. Electro Scan is a big fan of grouting, but the time, expense, and possibility of damage to the joint, makes Electro Scanning Inspection the preferred "Pre-Grout and Degraded-Grout Assessment Tool."



CALL TODAY FOR ELECTRO SCAN SERVICES

Electro Scan Expands Leak Detection Services To Pressurized Water Mains

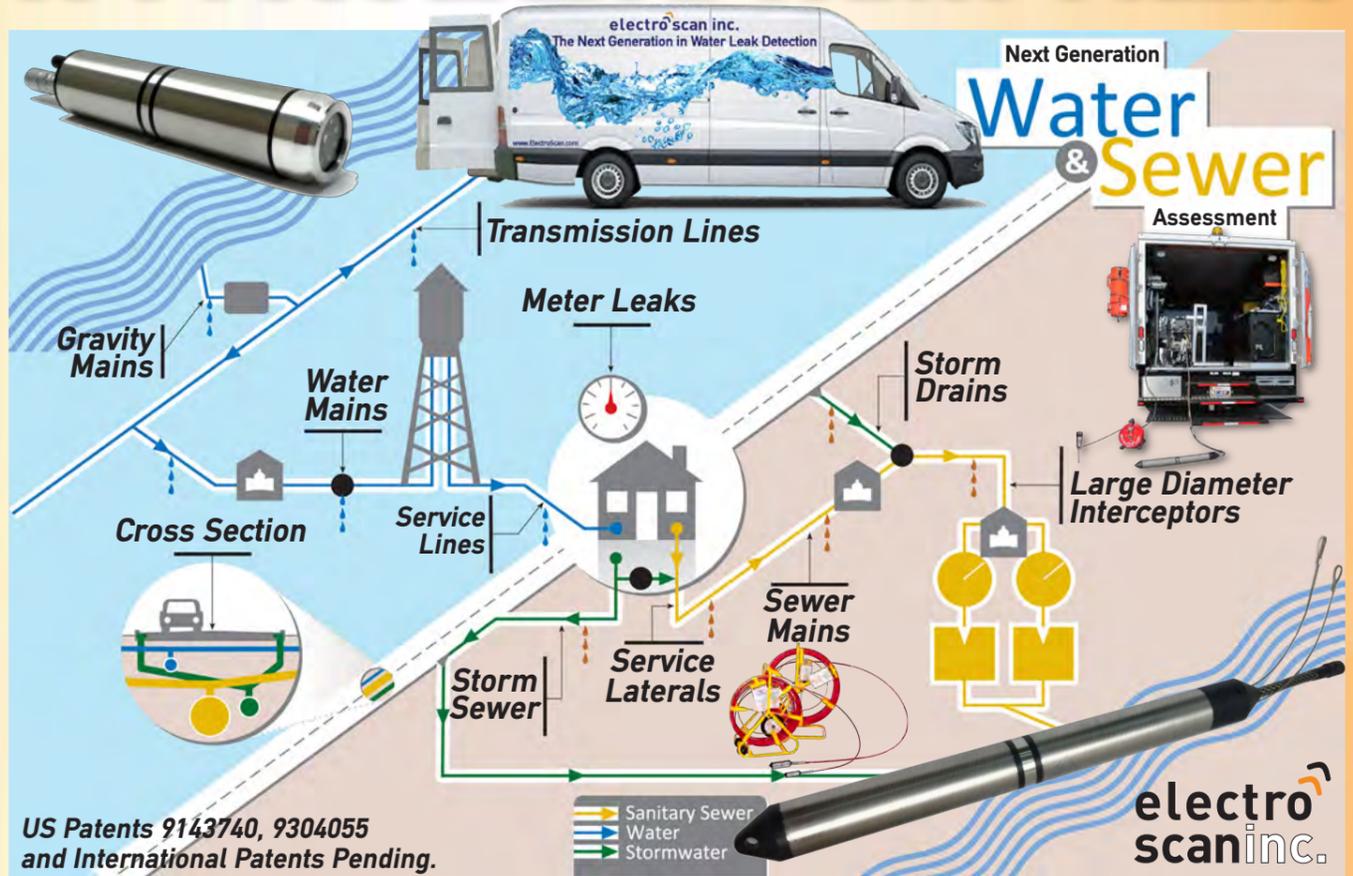
Already established as the leading technology to assess sewer mains, finding and measuring defects commonly missed by Closed-Circuit Television (CCTV) cameras, Electro Scan is expanding its services using its patented and patent-pending next generation solution to assess pressurized water mains & transmission mains, replacing acoustic sensors, data loggers, and correlators.

“We are delighted to see our technology added to the AWWA M77 Condition Assessment of Water Mains Manual of Water Supply Practices,” states Mark Grabowski, Vice President and GM of Electro Scan.

“The water industry has been looking for alternatives to accurately locate and measure leaks in GPM or Liters Per Second,” states Chuck Hansen, Electro Scan’s Chairman.

“We hear stories every week about water utilities that just finished an acoustic inspection, rarely finding a leak,” continues Hansen. “It reminds me of using CCTV cameras to find leaks in sewers – it’s just not likely or probable.”

“We are delighted to bring our technology to find & measure defects



US Patents 9143740, 9304055 and International Patents Pending.

missed by legacy inspection techniques,” states Carissa Boudwin, Electro Scan’s Director of Marketing. “Offered as a professional service,

Electro Scan is giving preference to cities that are existing Electro Scan sewer customers and water utilities looking to comply with regulations

enacted as part of Senate Bill 555, recently signed into law by California’s Governor, Jerry Brown.”

CONTINUED ON PAGE 10

CIPP Lining, SSES, and New Construction Specifications Add ASTM F2550 To Bids

Inability to Locate or Measure Defects Using CCTV, Smoke Testing, Dye Flood Testing, & Laser Profiling Lead Utilities to Switch to Easy-To-Understand Electro Scan

Chuck Hansen learned a lot from when his former company, Hansen Information Technologies, helping the City of Houston conduct CCTV, Smoke Testing, Dye Flood Testing, and Manhole Inspections on its entire 6,000 miles of sewer main as mandated by EPA Region 6.

But, difficulties quantifying & prioritizing sewer main defects, repeatability of test results, and the lack of an available technology to test Post-CIPP liners, were just some of the project’s challenges.

Even more difficult was managing CCTV inspection results from nearly 250 TV trucks; the first time that all were required to use the HANSEN CCTV coding standard.

Showcased in the EPA’s 1991 Handbook by Henry Gregory – Senior Advisor to

Electro Scan Inc. and former Assistant Deputy Director, Department of Public Works and Engineering, City of Houston – the use of Smoke Testing, Dye Flood Testing, and CCTV were limited in the information it provided, but was the best the industry offered at the time.

But recently, Sacramento, Calif-based Electro Scan has introduced a new set of tools to assess sewer & water mains.

66% of CIPP Liners Found With Defects Missed by CCTV

Representing a next generation in condition assessment, *Electro Scanning Inspection*

is now recommended to accurately and reliably inspect sewer mains and to certify rehabilitation, finding defects missed by TV.

Tracing its roots to 2004, the first major EPA benchmark comparing CCTV & Electro Scanning Inspection for sewer mains

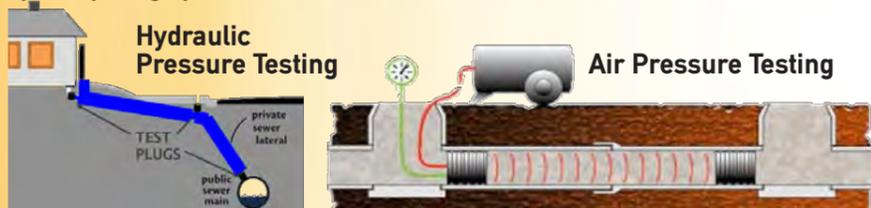
was published in July 2011, with similar findings in sewer laterals published in 2013 in an EPA/WERF study (See Page 18 &19)

With over ten years of data, Electro Scanning Inspection is now recommended for all pre- and post-rehabilitation where it



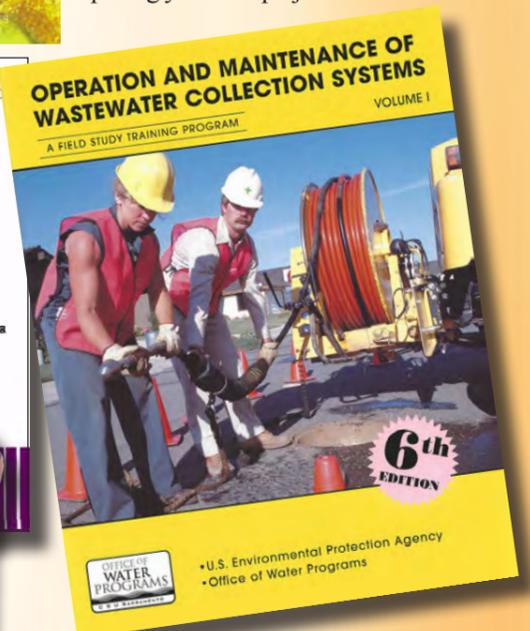
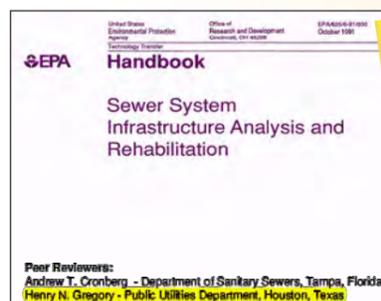
31% of CIPP Found to Have 10 GPM or More in Defect Flow

has found 66% of all Cured-In-Place Pipe (CIPP) had one or more defects, and 31% of all CIPP had 10 gallons per minute or more in defect flow. Contact us today for pricing your next project.



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Henry Gregory Joins Electro Scan Inc. as Senior Advisor
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