pa rural water Association

2016

WWW.PRWA.COM/CONFERENCE

PENN STATER HOTEL + CONFERENCE CENTER STATE COLLEGE, PA

MARCH 29 – APRIL 1

Schedule at

http://mobile.prwa.com

Welcome!

We're Glad You're Here!

Please, put your cell phones on vibrate during sessions

Welcome

to the

PA Rural Water Association Annual Technical Training Conference

We're Glad You're Here!

Friday 4/1/16

8AM – 11:30AM

Please, put your cell phones on vibrate during sessions and, take calls to the hallway

NOT ALL IT'S CRACKED UP TO BE – OUR FAILING PIPE INFRASTRUCTURE **(3 W & WW CH)**

ENTECH ENGINEERING, INC

Bryon Killian, PE

bkillian@entecheng.com

UTILITY SERVICES GROUP (USG), INC

Robb Kalbach

rhk3@usginc.net

- A combination of old pipes and earlier than expected failure of newer pipes has led to a “perfect storm” in our pipe infrastructures.

- Estimates of pipeline replacement nationwide exceed $1 billion in the next decade.

This course covers the history of pipes, expected lifespans and considerations for line replacement or rehabilitation.

Discusses ways you can make sure your engineers and contractors are correctly installing new pipes or performing rehabilitation.

PART 1 – Introduction

The Challenge

- Our basic infrastructure that keeps our communities safe, healthy, and prosperous are not only under the strain of continuous growth but have or will soon past their useful lifespan.

2013 ASCE Report Card

- America's GPA = D+
  - Drinking Water = D
  - Wastewater = D
  - Dams = D
  - Hazardous Waste = D
  - Levees = D-
  - Solid Waste = B-
  - Aviation = D
  - Bridges = C+
  - Inland Waterways = D-
  - Etc……..

2013 ASCE Report Card

- Estimated Investment Needed by 2020 = $3.6 Trillion

$3,600,000,000,000

If gold is $41,000 per kilo, this equates to 96,788 tons or….

2,419 eighteen-wheel tractor trailers made of gold

So we all need the…..

This could be a place…..

Out of Sight = Out of Mind

The Challenge

- Water system customers expect an uninterrupted supply of safe water.
- Wastewater system customers expect to be able to flush at any time (even during extreme wet weather events).
- Limited Budgets.
  - Smaller utilities will have a greater per customer impact

AWWA Study

- In 2011 AWWA published, “Buried No Longer: Confronting America’s Water Infrastructure Challenge”

- Identified that the nation must invest $1 trillion over the coming 25 years if we are to maintain our current level of drinking water service.
  - $1,000,000,000,000….. Again that’s a lot of zeros and this is just the water pipes (not plants, storage, or any wastewater)

Preventing Problems

- In order to prevent problems from arising, we must know:
  - What type of problem is likely to occur?
  - Where the problem will be located?
  - How to prevent the problem from happening?

SOUNDS EASY ENOUGH, RIGHT?

EASY

- The easiest way to prevent problems from occurring is to verify that newly installed system components, including replacement / rehabilitation, are properly designed, installed correctly, and tested.

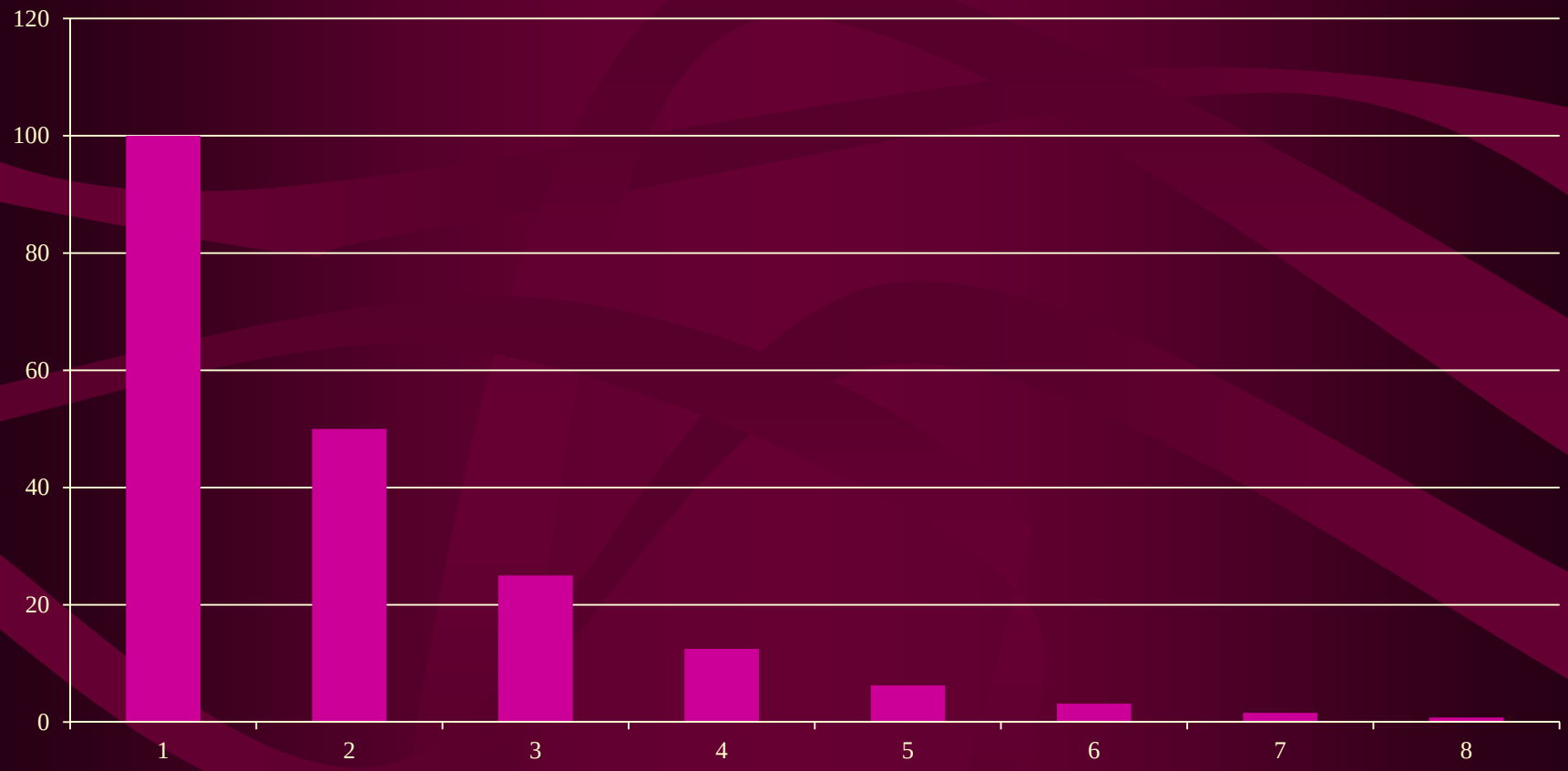
NOT SO EASY

- "The deterioration rate of pipe is not uniform, but is affected by a **number of interdependent factors**, and the relationship among these various factors is too complex to permit useful generalized descriptions."

Dave Butler, Integra Engineering, and Randy Earley, City of Boulder, A Rational Basis for Making Pipeline Replacement Decisions

Law of Diminishing Return

- Sometimes also referred to as the *law of variable proportions*.



The Approach

- Two approaches to maintaining a system:
  - Reactive Maintenance
    - Reacting to known problems
  - Proactive Maintenance
    - Acting to prevent problems from occurring

Reactive Maintenance (unplanned events)

- Corrective Maintenance
- Scheduling
- Tracking and Recording Repairs
- Compliant Response
- Reactive Response Summary

Proactive Maintenance (planned events)

- “In many cases, through more effective planning and management of infrastructure improvements and system operations, organizations can realize annual savings of 20 to 40%”

Journal AWWA, Nov 2001, Vol 93, Stern and Kendall, 2001

PART 2 – Pipe

Pipe – Life Expectancy

- General Rule of Thumb
  - 70 Years

- So using this “General Rule”:

2016 – 70 yrs = 1946

1946

1946

- Average Cost of new house = $5,600
- Average wages per year = $2,500
- Cost of a gallon of Gas = 15 cents
- Average Cost of a new car = $1,120
- The "bikini" debuted in Paris during July of 1946.

Pipe – Life Expectancy

- Life span may be shorter than 70 years for a number of factors:
  - Corrosion
  - Inadequate design
  - Poor installation

Water Pipe – Materials

- Pipe
  - Steel, Ductile Iron, Concrete, and PVC
    - Wood?
  - Still have a lot of cast iron and AC pipe in use.

Water Piping Challenges

- Sized to accommodate normal and peak flows and fire flows without adversely impacting water quality (too big) or resulting in an excessive pressure drop (too small).

  Needs to be just right.

- Constructed of material that is durable and corrosion resistant.

Water Pipe - Corrosion

- Degradation of metal caused by oxidation or chemical action.
- AWWA reported 26% of distribution system pipeline is unlined cast-iron and steel and is in poor condition.
- Reports of early pipe failure caused by corrosion on water and wastewater pipes.

Water Pipe - Water Quality

- Excessive Detention Time
  - Result in a depletion of chlorine residual
    - Possible Microbial Contamination
- Contamination
  - Main Breaks
  - Cross Contamination

Water Pipe - Surge

- Causes:
  - Opening / Closing Valves too quickly
  - Starting or stopping pumps
  - Opening / Closing fire hydrants too quickly
- Problems:
  - Pipe Bursting
  - Pipe Collapsing
  - Other system failures.

Sewer Pipe – Materials

- Pipe (typically 8-inch minimum for gravity main sewers)
  - AC, Concrete, HDPE, Clay, Ductile Iron, Cast Iron, and PVC
    - Orangeburg
  - PVC SDR 35 with push-on joints is most prevalent today.
    - 25 to 30 feet burial depth
    - Deeper with profile wall

Table 1. Gravity Sewer Systems: Percent Distribution by Pipe Material and Diameter Range (WERF, 2004)

Material	Diameter, inches				
	4 to 12	14 to 20	21 to 36	37 to 54	≥ 60
VCP	41	36	23	7.1	3
RCP	18	28	44	64	63
Lined RCP	1.4	3.9	6.2	17	20
PVC	27	15	6	1.6	0
HDPE	1.5	1.4	1	0.9	0
DI/CI	8.6	12	10	4.1	2.5
ACP	3.8	2.6	1.3	5.1	0.1
Brick	0.5	0.9	2.1	3.8	4.2
Other	0.9	1	3	0	6

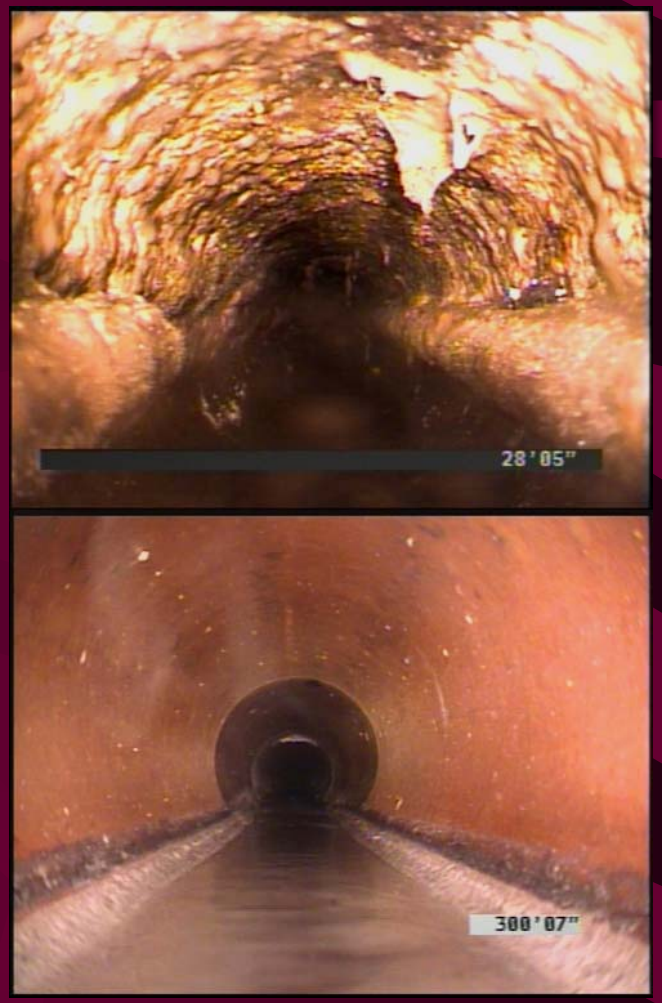
Notes: VCP = vitrified clay pipe; RCP = reinforced concrete pipe; PVC = poly vinyl chloride; HDPE = high density polyethylene; DI = ductile iron (lined and unlined); CI = cast iron (lined and unlined); ACP = asbestos cement pipe.

Sewer Piping Challenges

- Biological activity
  - Odors
  - Corrosion
- Varying flows
  - Diurnal Flow Pattern
  - I&I
- Varying terrain
  - It flows downhill unless its uphill

Sewer Piping Challenges

- Solids deposition
  - Minimum 2 ft/sec
- Grease and Root issues
- System Access
- Other Utility Conflicts



PART 3 – New Construction

Pipe Strengths

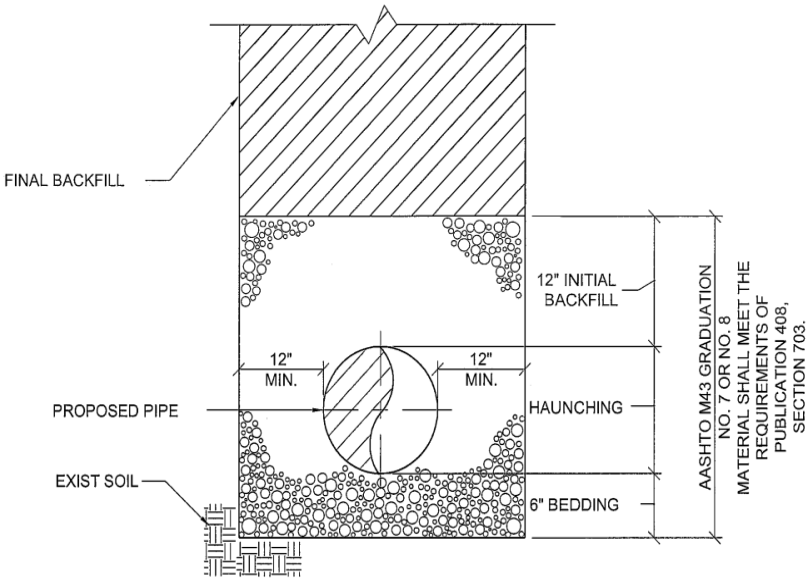
- Rigid Pipe
  - Supports external loads because of the strength of the pipe.
  - Subject to cracking when subject to excessive loads.
  - Examples of Rigid Pipe:
    - Cast-Iron Pipe
    - Reinforced Concrete Pipe (RCP)
    - Vitrified Clay Pipe (VCP)
    - Asbestos Cement (AC)

Pipe Strengths

- Flexible Pipe
  - Supports external loads by distributing the external loads to surrounding soil and /or pipeline bedding, haunching, and backfill material. Therefore, it is extremely important to provide adequate support during installation.
  - Subject to bending but not normally cracking when excessive loads are applied.
  - Examples of Flexible Pipe:
    - Ductile Iron Pipe (DIP)
    - Polyvinyl Chloride (PVC)
    - High Density Polyethylene (HDPE)

Pipe Envelope

- Need to support the pipe.
- VERY IMPORTANT



TYPICAL EXCAVATION, BACKFILL & PIPE EMBEDMENT DETAIL

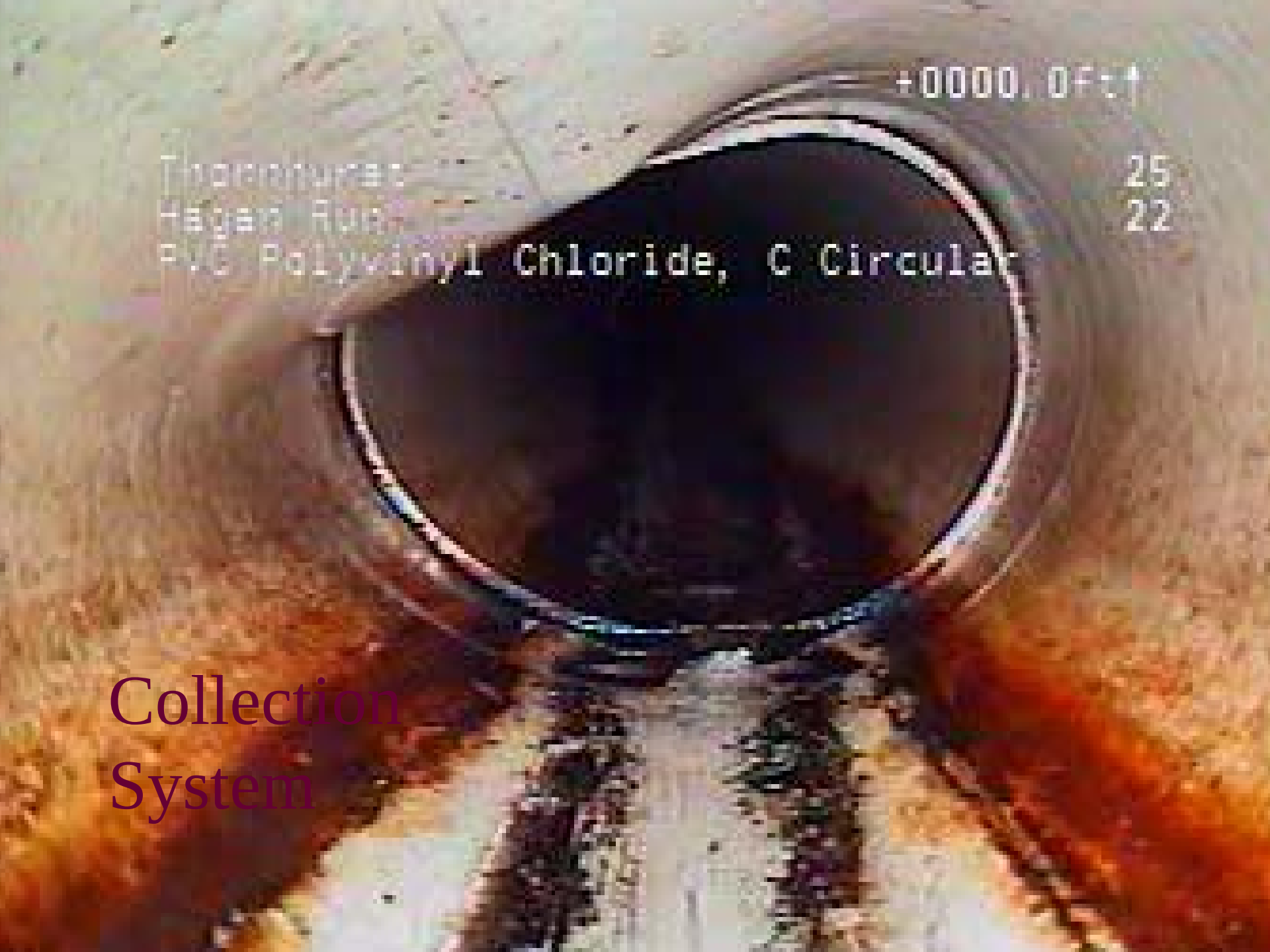
SCALE: NONE

Entech Engineering, Inc.
Engineering Architecture Construction
Corporate Office:
4 S. Fourth Street Reading, PA 19602
ph: 610.373.6667 fx: 610.373.7537

Pottsville, PA ph: 570.628.5655
Mountaintop, PA ph: 570.868.0275
Lititz, PA ph: 717.626.6666
www.entecheng.com 1.800.825.1372

BUTLER TOWNSHIP
TYPICAL EXCAVATION, BACKFILL & PIPE EMBEDMENT DETAIL

PREPARED BY	CHECKED BY	APPROVED BY	PROJECT NO.	DATE:	DRAWING NO.
MBD	BAK	EJP	4190.06	2/24/09	S-4
				SCALE: NONE	



Collection System

What is the easiest and best way to minimize maintenance and manage your collection system?

Construction Inspection

- Contract Drawings
- Contract Specifications
  - Outline Testing Requirements
- Approved Shop Drawings
- Approved Permits

Construction Inspection

- Confirm approved contract documents are consistent with construction of the system.
  - Material
    - Manufacturer
    - Model
    - New
    - Good working order
  - Construction Techniques
    - Backfill – ground movement/structural failure

New Construction

- Pre-Construction Meeting:
  - Review of Contract Drawings
  - Review of Contract Specifications
  - Review Shop Drawing Requirements
  - Review Testing Requirements
  - Review Permits Requirements

- PA 1 Call Field Mark-ups
  - WALK THE JOB

New Construction Testing

Water Construction Inspection

- Pressure Testing
- Disinfection

Sewer Construction Inspection

- Testing
  - Vacuum MH Testing
    - Top of casting not just to top of cone
  - Air Test Sewer Pipe
  - Lamping / Mandrel
  - Pressure Testing of Force mains
  - CCTV

Sewer - Lamping

- Involves a bright source of light and a mirror.
  - Once person gets into a manhole and reflects a sunlight or shine a bright light down the sewer line.
  - A second person goes into the next manhole to see if the light can be seen. If the light can be seen and looks like a full circle, the line is considered to be straight and open. If the light can not be seen or the reflection is not a full circle (approximately), there is an obstruction or significant deflection.

Sewer - Mandrel Testing

- This deflection test consists of using a mandrel (or rigid ball)
  - Performed by pulling the device through the sewer from manhole to manhole.
  - The device will NOT pass through the sewer if the pipe has been deflected beyond 5% of the pipe diameter or there is an obstruction.
  - Typically if there is a problem, the pipe will need to be excavated and corrected.

The Games we play…..

- Gauge Manipulation
  - Pressure or vacuum
- Grouting quantities
- Excess Quantities
- Unequal Bid Prices
  - Misbalanced Bid

Contracting

- Identify Budget – Select Rehabilitation
- Clarify Scope
  - Access, traffic control, bypass pumping, dump site, light / heavy cleaning, water source, completion timeframe, wet weather, certified operator, deliverables
- Avoid “Sole-Sourcing”
- Economies of Scale


07.14.2010 08:38


07.14.2010 09:05

PART 4 – Mapping

Importance of System Mapping

- Personnel need to know and understand their system
- Perform maintenance and make repairs
- Respond to PA One Calls
- Save time and money

Keeping the information for future generation of operators

http://www.carroll-ohio.com/Water%20off-001.jpg.jpg

Mapping

- 100% Complete Sewer Map
  - Loch Ness Monster, Big Foot, Aliens.
- Continually update and revise.

Mapping

- Existing Mapping versus Observed Conditions

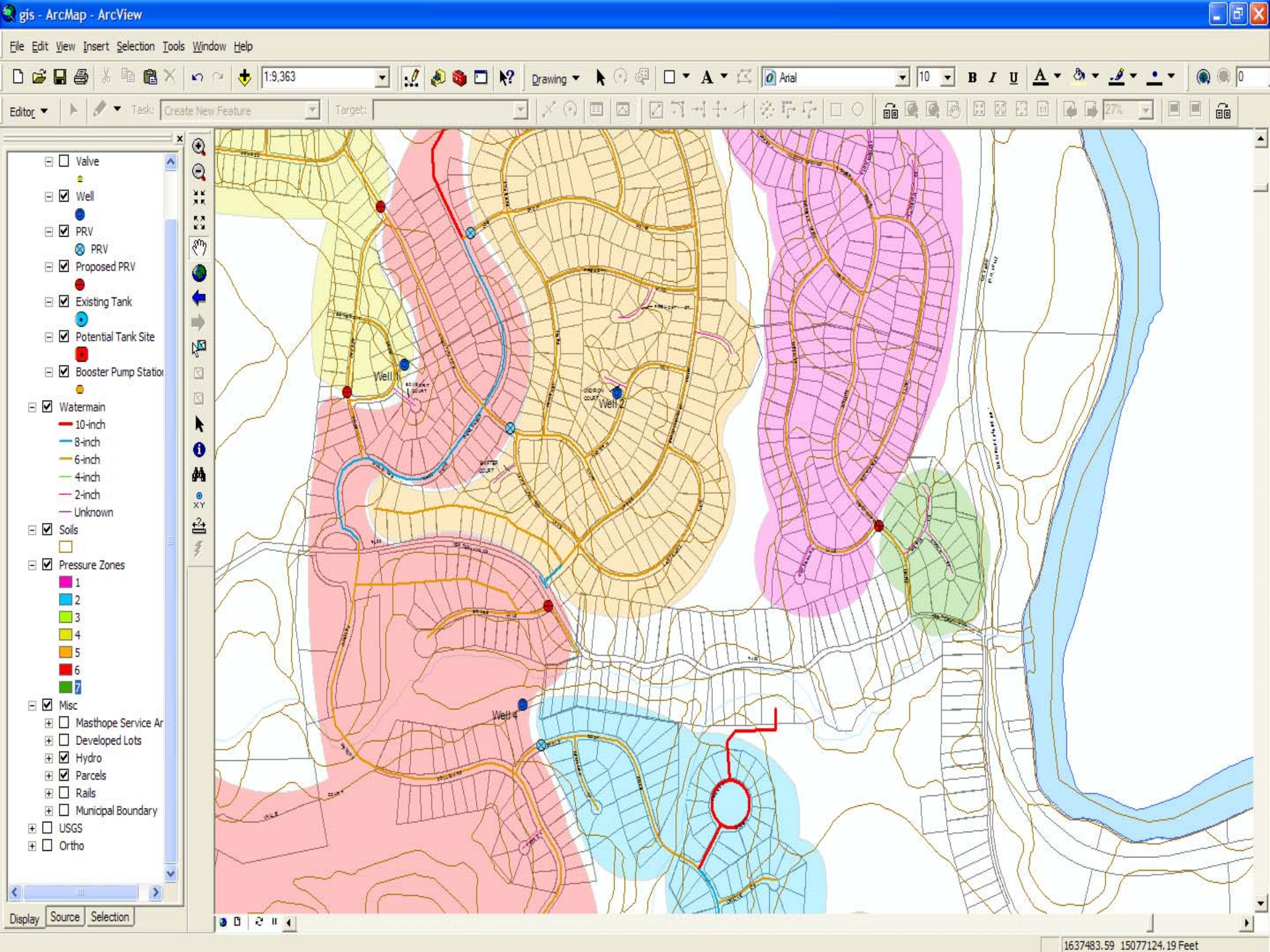
- It’s on my map but I can’t find it!
  - Need reliable data

- Do you think it is there?
  - You know it is not there.
  - It is possible it is there.

Easements and Paving: Maintenance and Access

- Maintenance of ROW and Easements
- Street Paving Coordination
- Utility Coordination

GPS FIELD EQUIPMENT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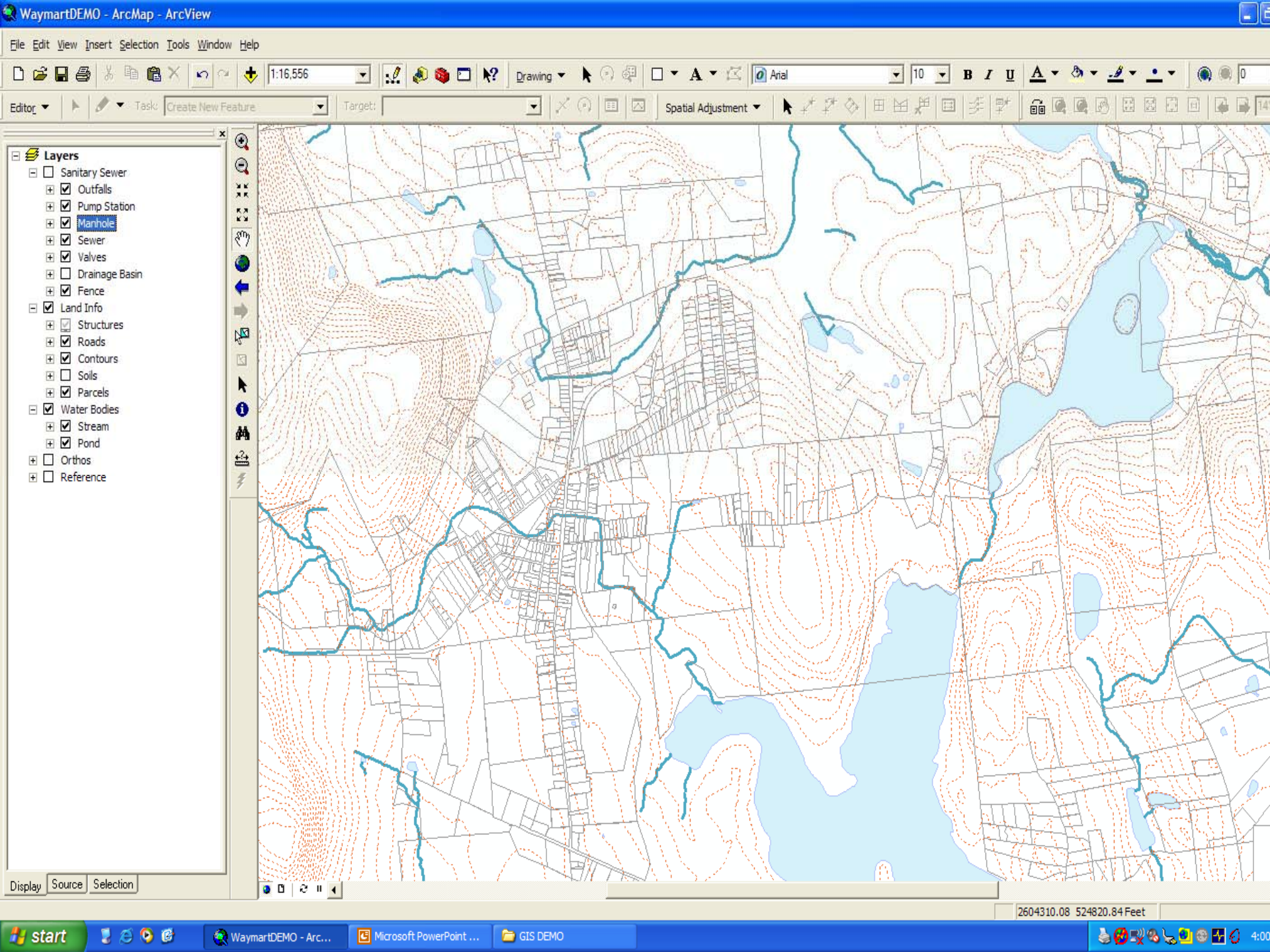
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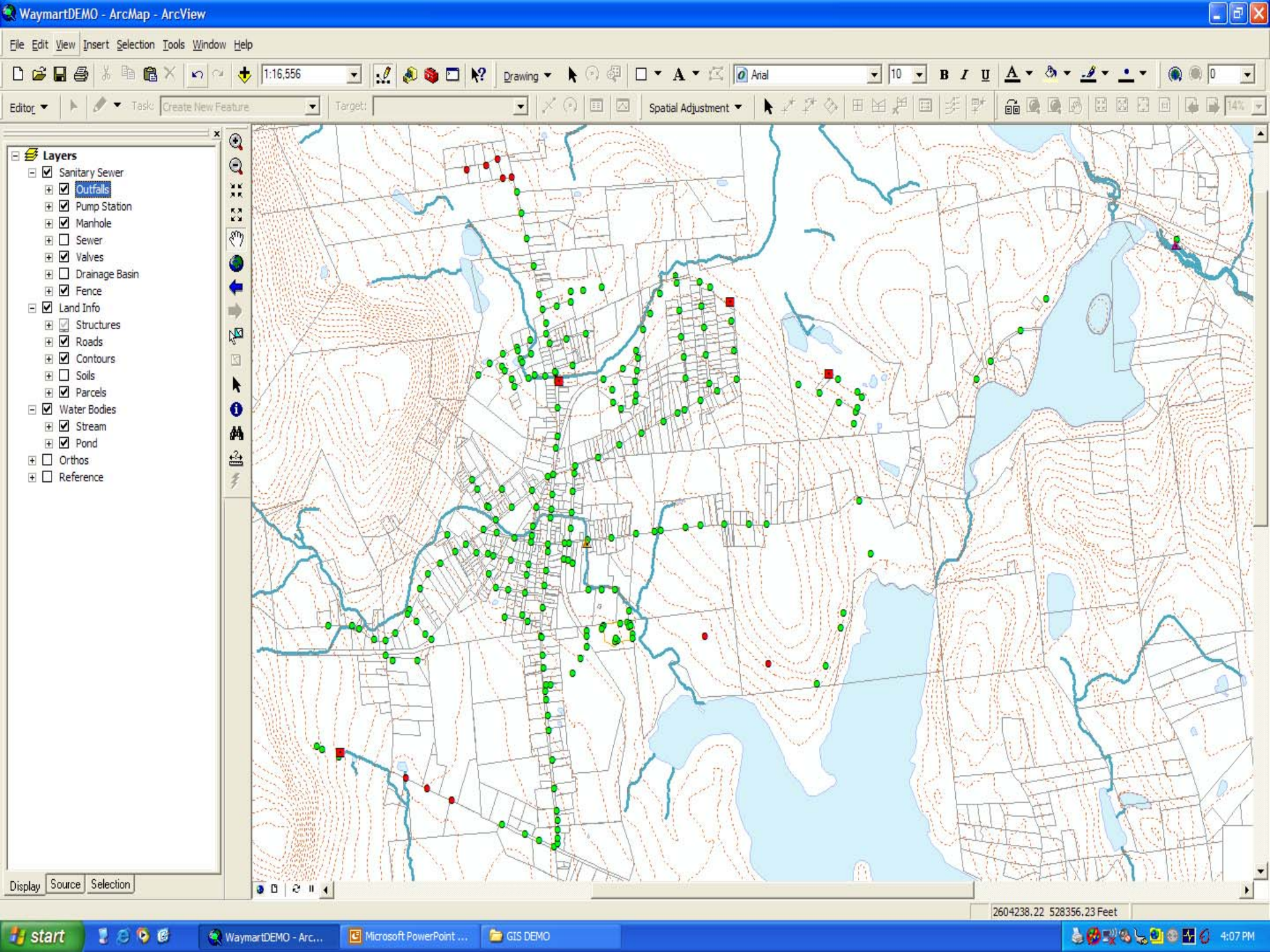
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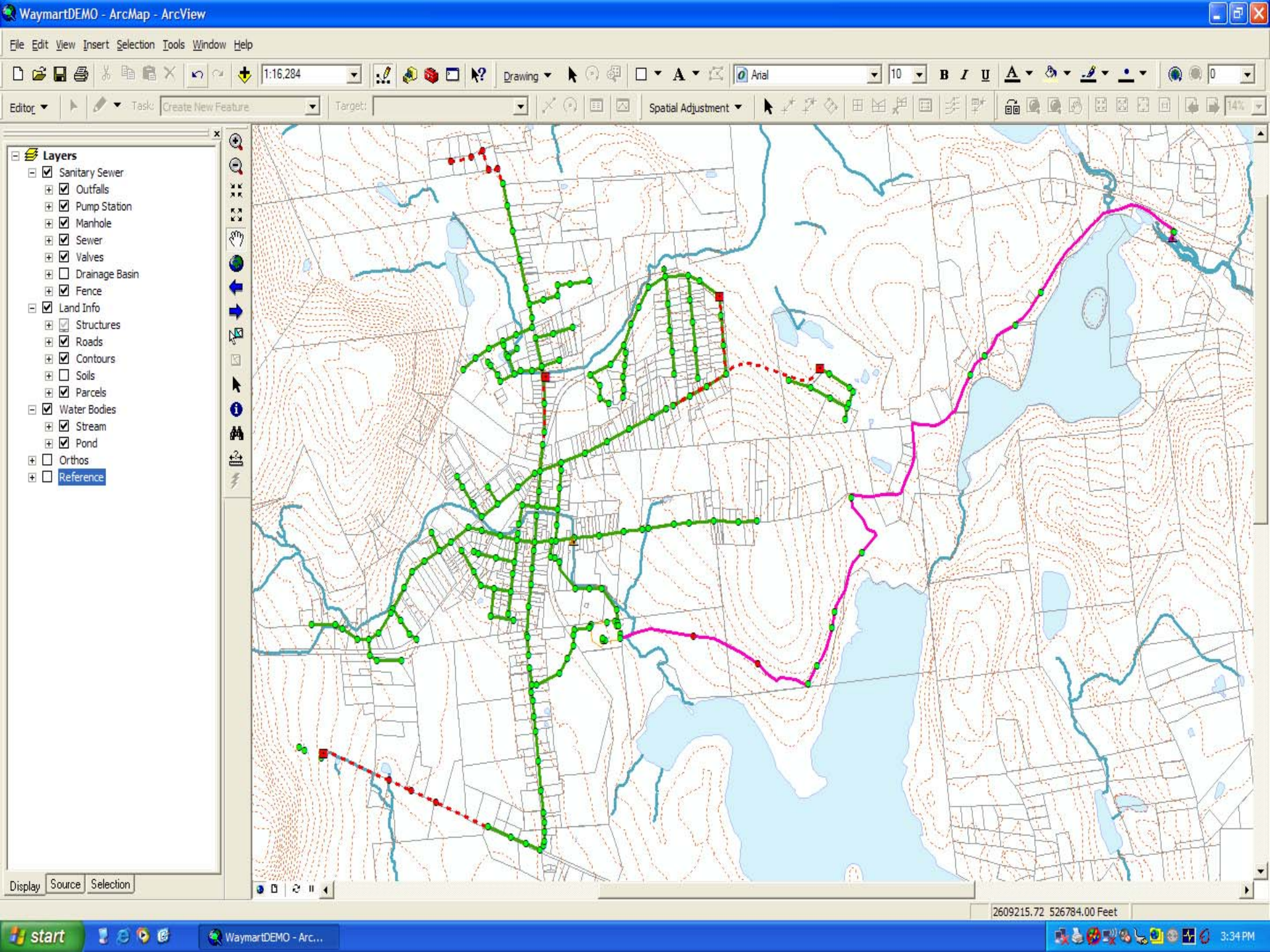
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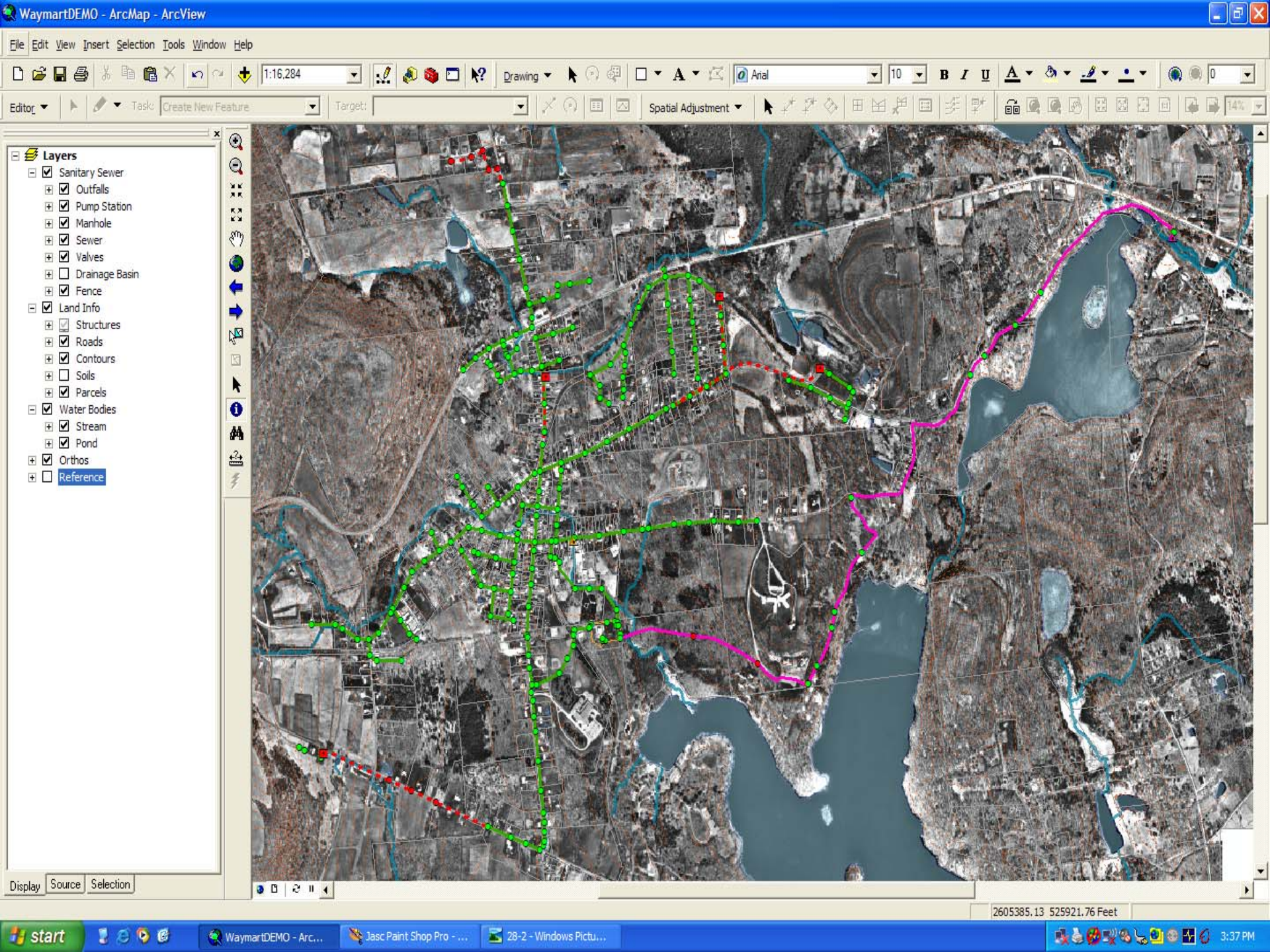
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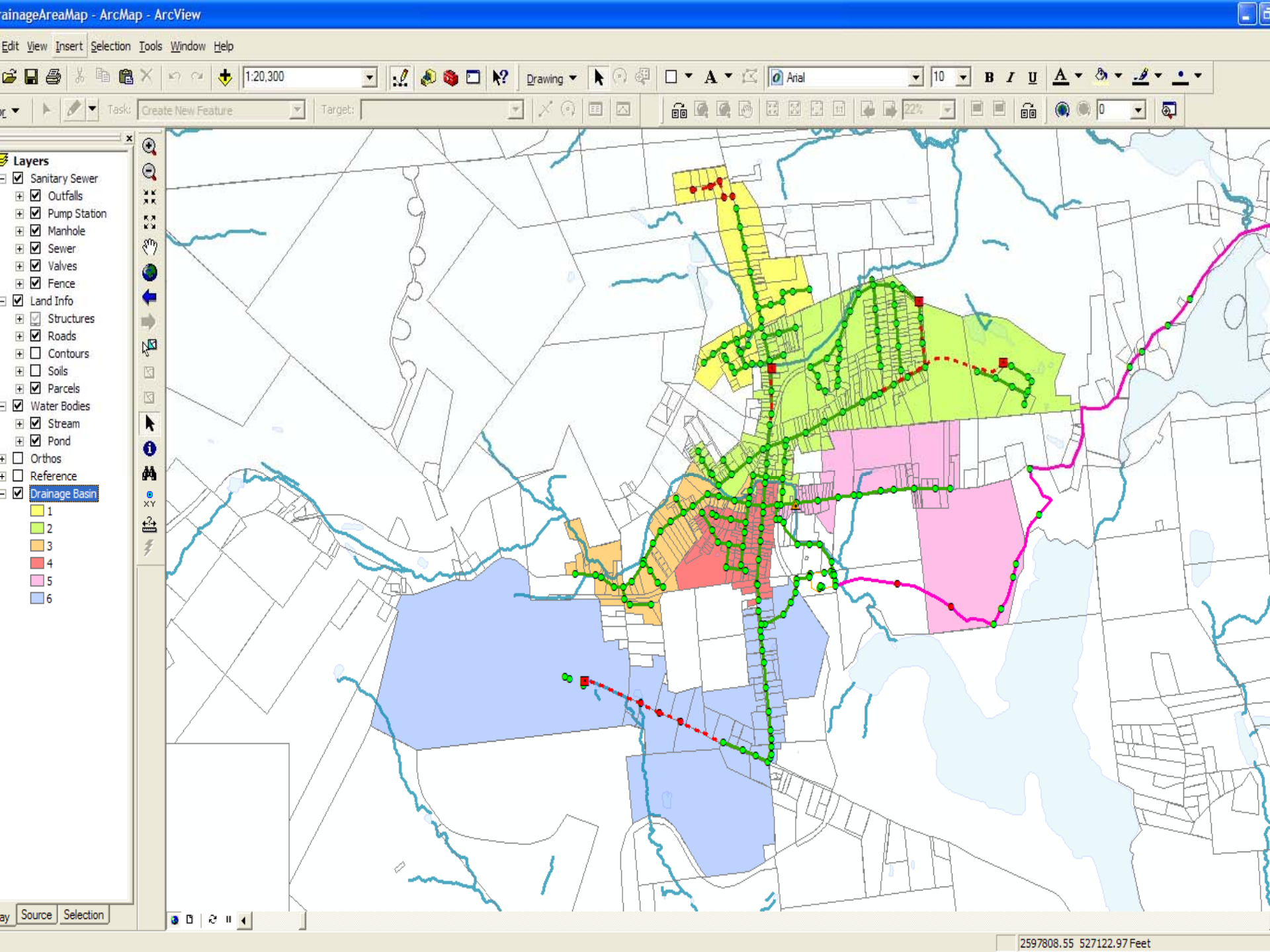
Why not stick with the old way (use the available mapping)?

- Unfortunately, the wide variety of maps and the diversity of their scales and designs at our disposal make it extremely difficult to access, use, and maximize the value of information they contain.

- GIS is an integrating technology; it integrates all kinds of information and applications with a geographic component into one manageable system.

Easier to Chew

- The system should be broken down into pressure zones and basins (multiple pump stations) and later possibly sub-basins for future investigation.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PART 5 – Distribution and Collection Systems

Important Water System Information

- Main and Service Locations
- Age
- Material
- Size
- Pressure
- Valve Locations
- Hydrant Locations

Gathering Data

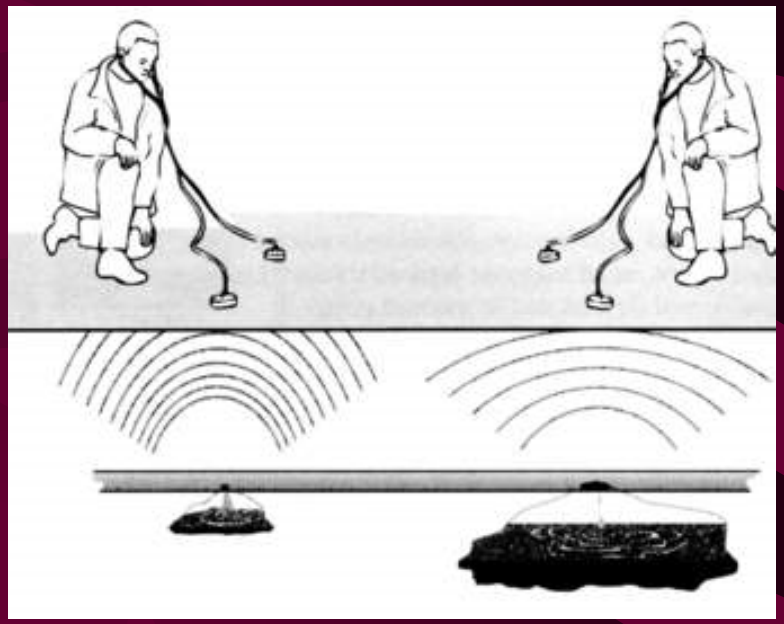
- Typical data already be maintained by the system owner includes:
  - Water Production Records
  - Meter / Billing Records
  - System Maps of various scales and detail
    - As-Built Drawings
  - Maintenance / Failure Records
  - Customer Compliant Reports
  - Previous Water Quality Testing

Distribution System Maintenance

- Pipeline Maintenance
- Valve Maintenance
- Meter Testing and Maintenance
- Fire Hydrant Maintenance

Pipeline Maintenance

- Leak Detection
  - Direct Observation, Acoustic Equipment, and Water Audits
- Main Break Repair and Replacement
  - Asset Management Program
- Cleaning and Lining
  - Flushing Program, Mechanical, and Lining



Valve Exercise

- Inspection Program
  - Is it broke or buried?
- Exercising Program
  - Is it operable?

http://www.cityofbryan.net/PR20130315.asp

Water System Evaluations

- Numerous methods on how to evaluate water systems and how to select pipes for replacement on a rational basis have been presented.
  - Each of these methods have one goal, **data management and analysis**, to identify possible cause-of-problem relationships (trends).
- The correct method is based upon available data and is unique to each system.

The Problems

- Water Loss
- Physical Integrity
  - Breaks
- Carrying Capacity
  - Pressure
- Water Quality

Leak Detection

- Active leak detection and repair programs identify specific problems within the system.

- Maintaining good records on detection and repairs is also an excellent source of information to look for trends.

Important Sewer System Information

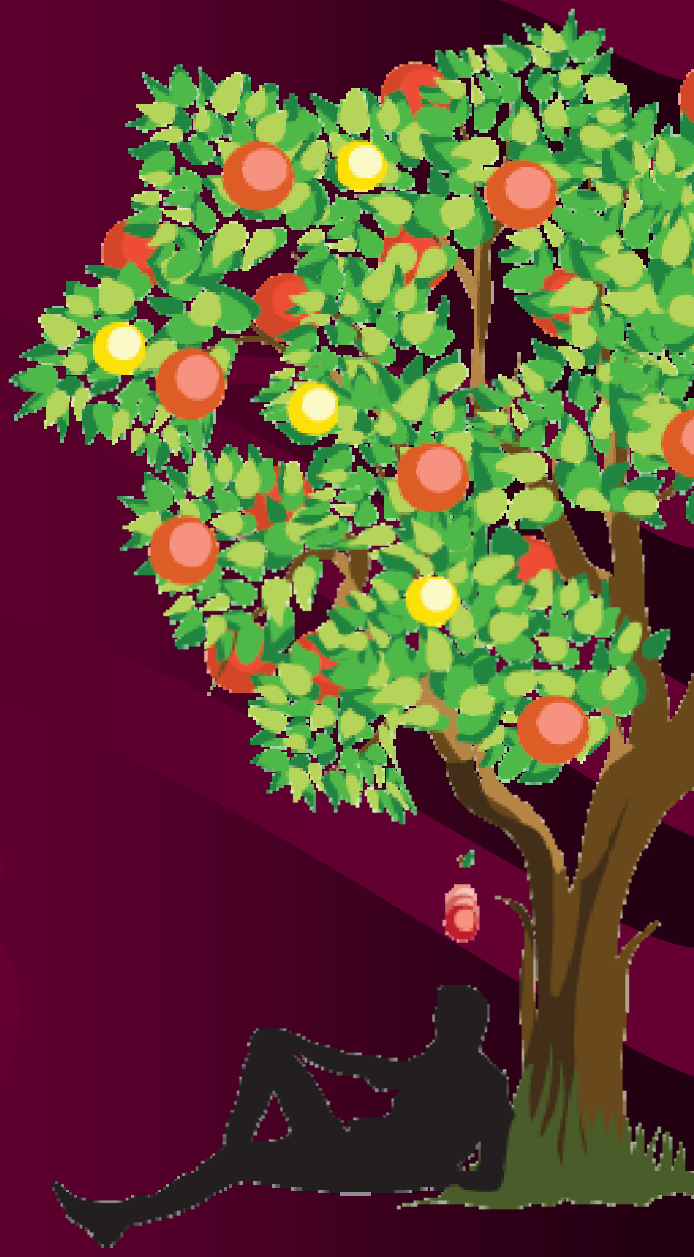
- Main and Lateral Locations
- Depth
- Age
- Material
- Size
- Manhole Locations and Depth

Gathering Data

- Typical data already be maintained includes:
  - Meter Records
  - System Maps of various scales and detail
    - As-Built Drawings or Record Drawings
  - Maintenance / Failure Records
  - Customer Compliant Reports

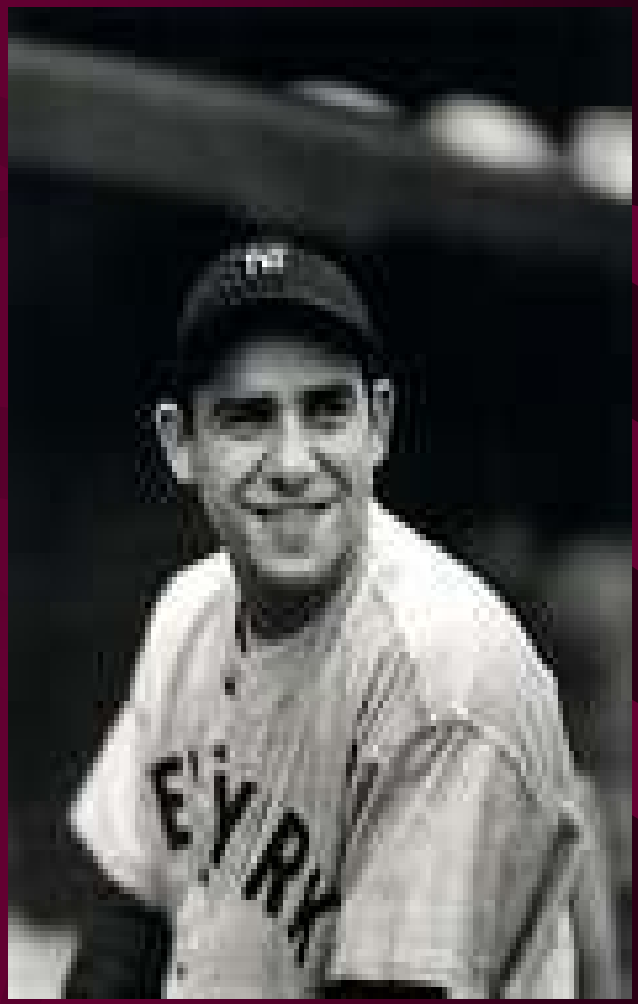
Collection System

- Conventional Gravity System
  - Lateral
  - Main
  - Interceptor
  - Pump Stations
- Alternative Systems
  - LPSS
  - Vacuum
  - STEP



Collection System Challenges

- Biological activity
- Varying flows / terrain
  - It flows downhill unless its uphill
- Solids deposition
  - Min. 2 ft/sec
- Grease and Root issues
- System Access
- Other Utility Conflicts



Typical Maintenance

- Cleaning
  - Pump Stations / Pigging
  - Known Sags
- Root Removal
  - Mechanical
  - Chemicals
- Grease Removal
  - Chemicals
  - Enforce Grease Trap Ordinance
- Hunt and Destroy – I&I

Force Mains

- Piping
  - 4-inches unless grinding is utilized
  - Identify as to not confuse them with water mains
  - Velocity – 2 ft/sec
  - Termination
    - 2 feet rule
  - Reaction blocking
    - Thrust Blocks
    - Mechanical restraints
  - Cleanouts

Force Mains

- Isolation Valves Air and Vacuum Relief Valves
  - Air
    - Design profile to rise all the way to exit (preferred)
    - Install ARVs
    - Velocities that will scour air bubbles (increases friction - increases TDH)

- Odor and Corrosion Issues
  - Chemical Conditioning
  - Turbulence

Hydrogen Sulfide - Odor

- Hydrogen sulfide (H_2S) is a product of stale sewage and has a rotten egg smell.
- Odors occur when waste water pH allows hydrogen sulfide to evolve from liquid phase hydrosulfide (HS-).
- Steak, Cheeseburger, and 3-day old nachos.
  - O_2
  - NO_x
  - SO_x

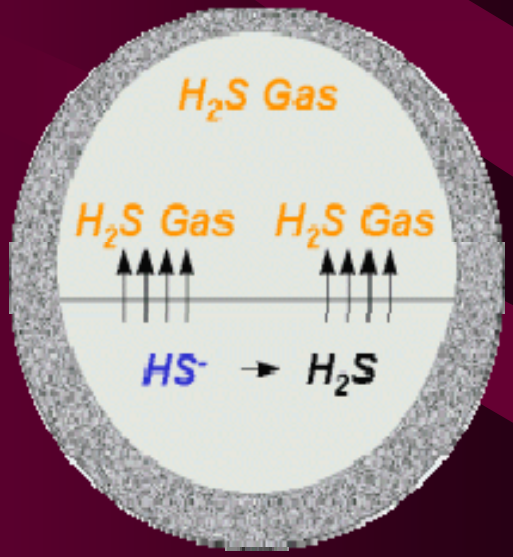


Chart from: http://www.magnesiaspecialties.com/Thioguard/thio_direct.htm

Hydrogen Sulfide - Corrosion

- Certain bacteria convert Hydrogen sulfide (H_2S) to sulfuric acid, which is very corrosive to electrical equipment and to concrete, iron, and steel.

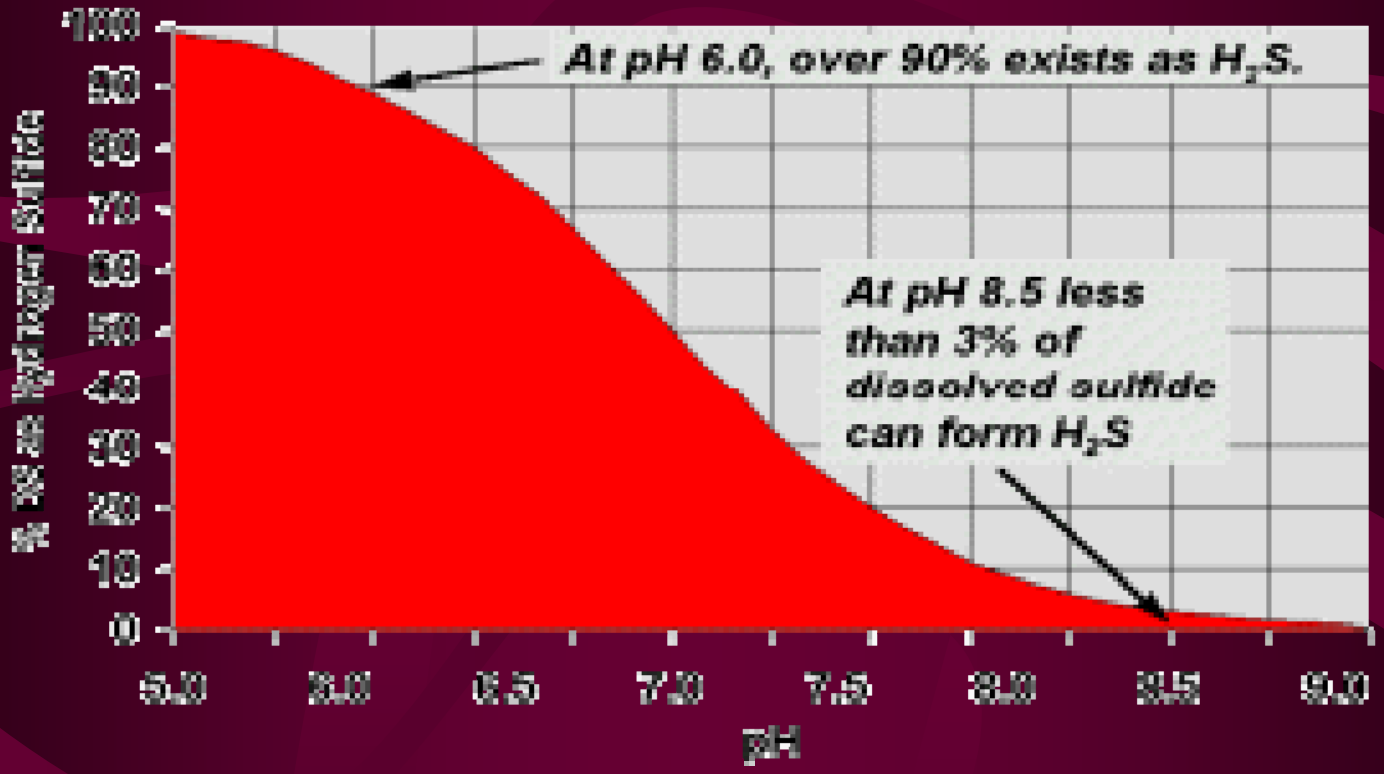


Chart from: http://www.magnesiaspecialties.com/Thioguard/thio_direct.htm

PART 6 – Sewer Inspection and Rehabilitation

Terms & Definitions

- Storm, Sanitary & Combined Sewers
- Inflow & Infiltration (I&I)
- Closed-Circuit TV (CCTV)
- Pipeline Assessment & Certification Program (PACP)
- Trenchless Pipe and Manhole Rehabilitation
- Cured-In-Place-Pipe (CIPP)
- NASSCO
  - Why so important?

Inspection Challenges

- Lack of access / Buried Manholes
- Confined Space / Hazardous Environment
- Lack of accurate system drawings / as-built drawings
- Systematic Error
- Cost

Inflow & Infiltration (I&I)

Quick Review: Infiltration (Ground Water)

- INFILTRATION – “The total extraneous flow entering a sewer system or portions thereof, excluding sanitary sewage, because of poor construction, corrosion of the pipe from the inside or outside, ground movement or structural failure through joints, porous walls or breaks.”

WPCF MOP No. FD-5

Quick Review: Inflow (Surface Water)

- INFLOW – “The extraneous flow which enters a sanitary sewer from sources other than infiltration, such as roof leaders, basement drains, land drains, and manhole covers. Inflow, in short, is usually man made and intentional.”

WPCF MOP No. FD-5

I don’t have I&I!

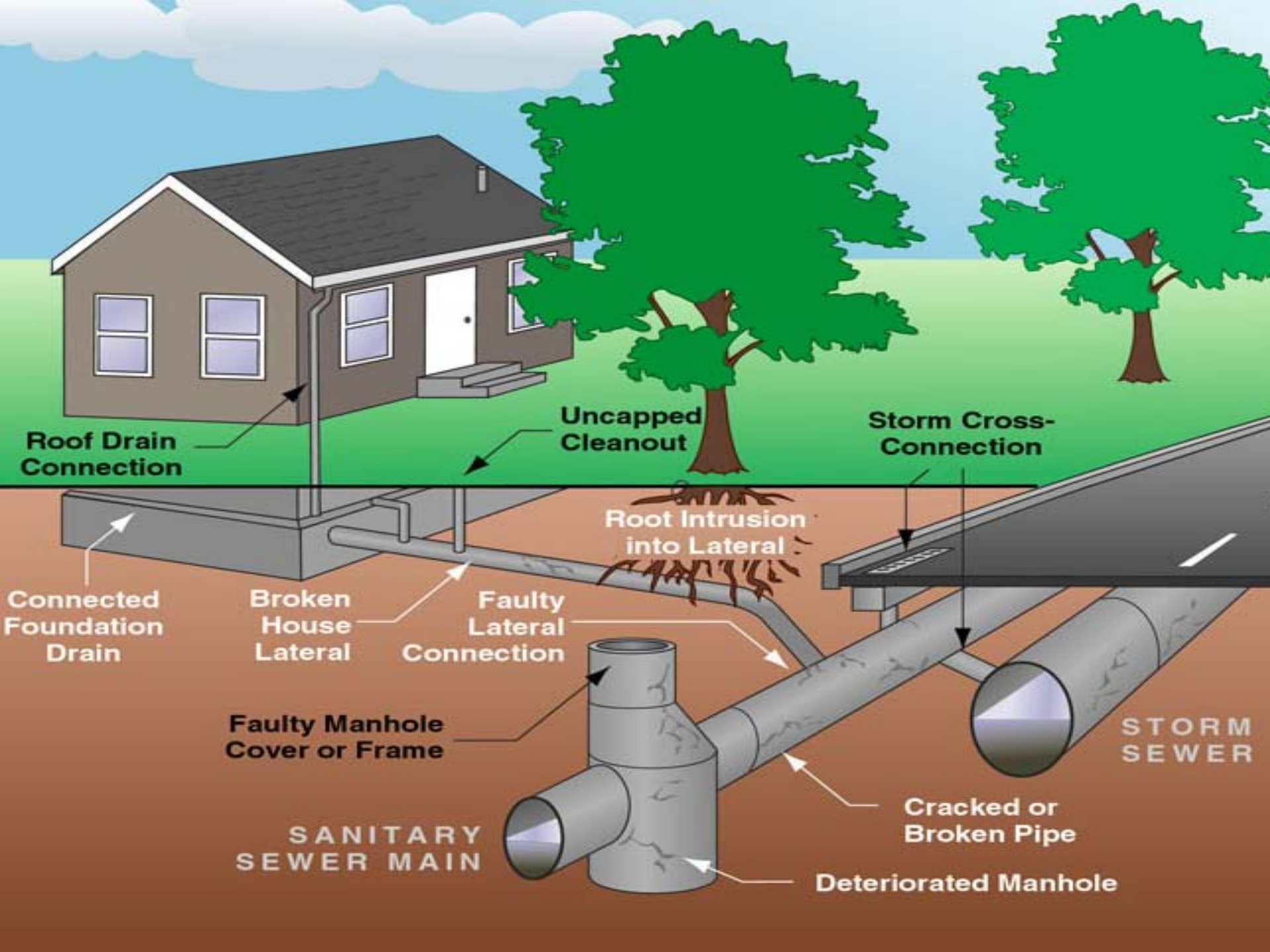
- Every sanitary sewer system has some I&I even newly constructed systems.
- For new construction, the leakage exfiltration or infiltration shall not exceed 100 gallons per inch of pipe diameter per mile per day for any section of the system
  PADEP Domestic Wastewater Facilities Manual (10/97), Page 20
- 3 mile (15,840 ft) of 8-inch sewer pipe would equate to 2,400 gpd of infiltration

A little water never hurt anyone.

- Problems associated with excessive I&I:
  - Basement back-ups
    - $ - Result in litigation & potential liabilities
  - System deterioration
    - $ - System repairs / upgrades (quantity and quality)

CATASTROPHIC FAILURE

- Undermining of piping/structures


Roof Drain Connection
Uncapped Cleanout
Storm Cross-Connection
Root Intrusion into Lateral
Connected Foundation Drain
Broken House Lateral
Faulty Lateral Connection
Faulty Manhole Cover or Frame
STORM SEWER
Cracked or Broken Pipe
SANITARY SEWER MAIN
Deteriorated Manhole

Inflow & MH Covers

- Tests made on manhole covers submerged in only 1-inch of water indicate that the leakage rate per manhole may be from **20 to 75 gpm** depending on the number and size of holes in the cover.
  Rawn, A.M., "What cost leaking manhole?" Waterworks and sewage, Vol, 84, 12, pg. 45, 1937.
- MH Penetrating Pick Holes are common holes in covers.
- Solid Watertight Covers are to be used whenever the manhole tops may be flooded by street runoff or high water.
  PADEP Domestic Wastewater Facilities Manual (10/97), Page 20
- MH Dishes

Do I have a problem with I&I?

- Quick & Dirty.
  - DMRs and Chapter 94 Report
    - Hydraulic Loading Chart
    - 3-month max. versus annual average flow
    - Review Flow per EDU – 400 gpd/edu
  - Pump Stations
    - Hour Meters
    - Drawdown Test
      - Are the pumps properly working?
  - Known Overflows
    - Exceed Hydraulic Capacity / Blockages

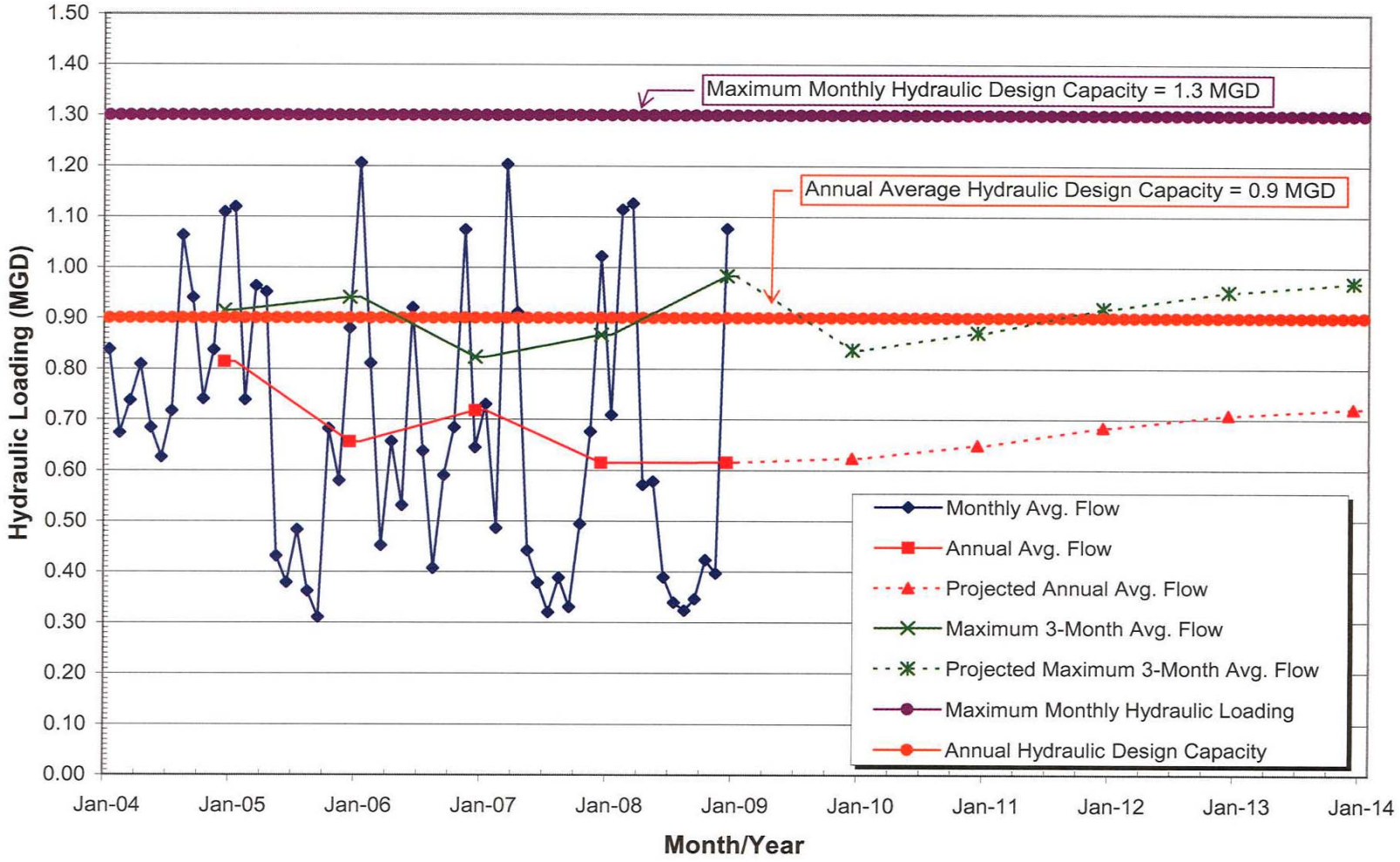
TABLE 2-1
Hydraulic Loading Data

Borough of Orwigsburg
Wastewater Treatment Plant

MONTH	MONTHLY AVERAGE WASTEWATER FLOWS (MGD)					PROJECTED WASTEWATER FLOWS (MGD)				
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
January	0.838	1.119 *	1.206 *	0.730	0.709 *					
February	0.674	0.739 *	0.811 *	0.486 *	1.114 *					
March	0.738	0.963 *	0.452 *	1.203 *	1.126 *					
April	0.809	0.951	0.657	0.911 *	0.571					
May	0.684	0.431	0.531	0.442	0.578					
June	0.626	0.379	0.920	0.378	0.389					
July	0.717	0.483	0.638	0.320	0.339					
August	1.063 *	0.362	0.407	0.388	0.323					
September	0.940 *	0.310	0.590	0.330	0.346					
October	0.741 *	0.682	0.684	0.494	0.423					
November	0.837	0.580	1.074	0.676	0.397					
December	1.109	0.880	0.645	1.022	1.076					
ANNUAL AVERAGE	0.815	0.657	0.718	0.615	0.616	0.624	0.650	0.684	0.709	0.722
NUMBER OF CONNECTIONS	1379	1392	1400	1410	1412	1450	1567	1723	1837	1896
FLOW per CONNECTION (GPD)	591	472	513	436	436	430	415	397	386	381
MAX 3-MONTH AVERAGE	0.915	0.940	0.823	0.867	0.983	0.837	0.871	0.918	0.951	0.968
RATIO (MAX 3-MONTH TO ANNUAL AVERAGE)	1.123	1.432	1.146	1.409	1.596					
AVERAGE OF 5-YEAR RATIOS					1.34					

* Indicates the maximum three consecutive months

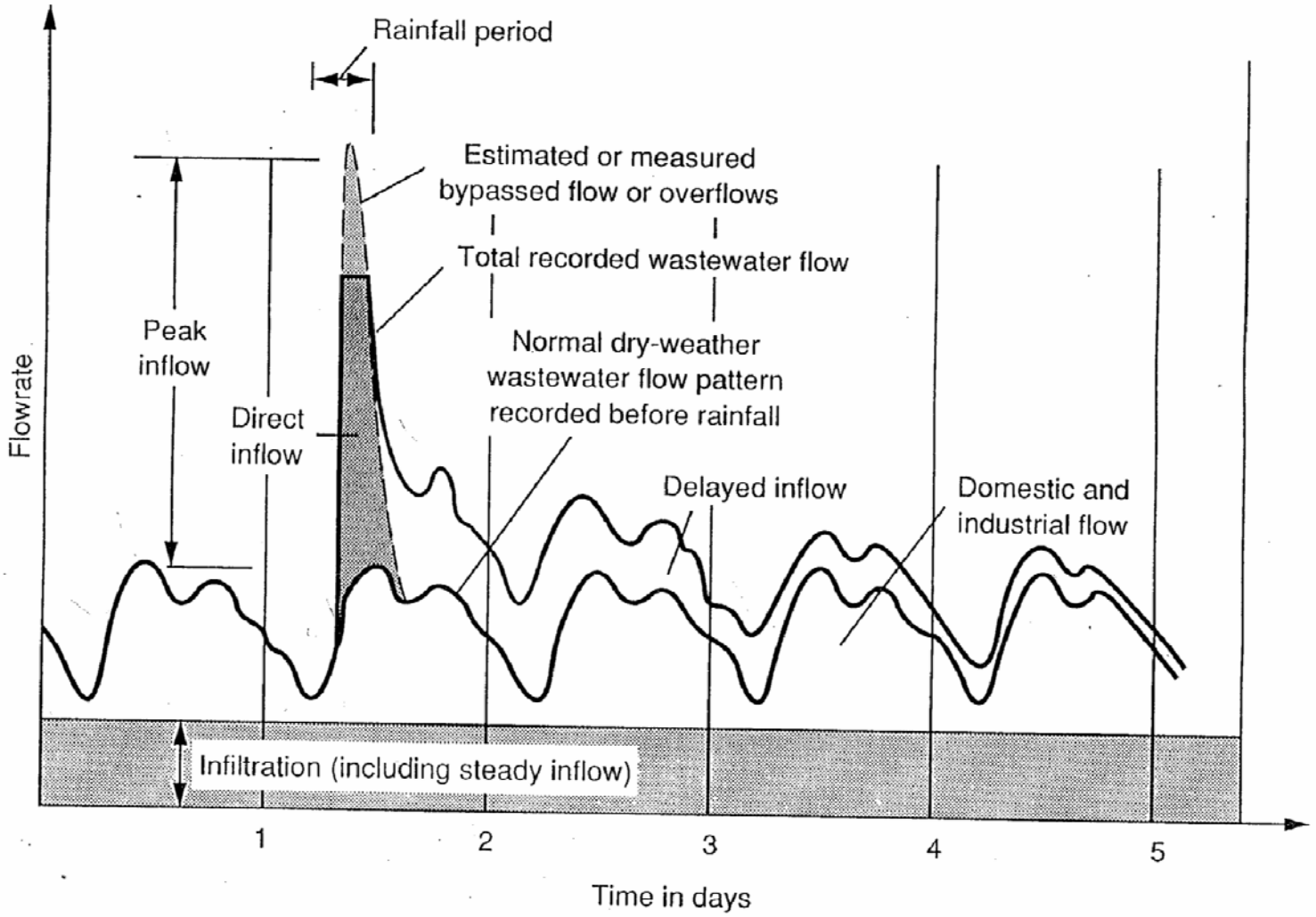
FIGURE 2A
Hydraulic Loading



Flow and Rainfall Monitoring Do I mainly have I or I?

- Methods for determining Quantity of Inflow
  - Graph wastewater flows and denote precipitation and spikes within the graph.

- Methods for determining Quantity of Infiltration
  - Nighttime flows during dry weather conditions.


Rainfall period
Estimated or measured
bypassed flow or overflows
Total recorded wastewater flow
Peak
inflow
Direct
inflow
Normal dry-weather
wastewater flow pattern
recorded before rainfall
Delayed inflow
Domestic and
industrial flow
Flowrate
Infiltration (including steady inflow)
1
2
3
4
5
Time in days

No more I&I Problem?

"I did I&I work five years ago and I still have a problem!"

The reduction and control of I&I should be considered a part of your disciplined, long-term monitoring and maintenance program.

- NOT A ONE TIME FIX. IT'S A PROGRAM NOT A PROJECT.

Sewer Inspection

Typical Sewer Main Defects

- Protruding Lateral Connections
- Broken Pipe
- Sags
- Misalignment
- Separated Joints

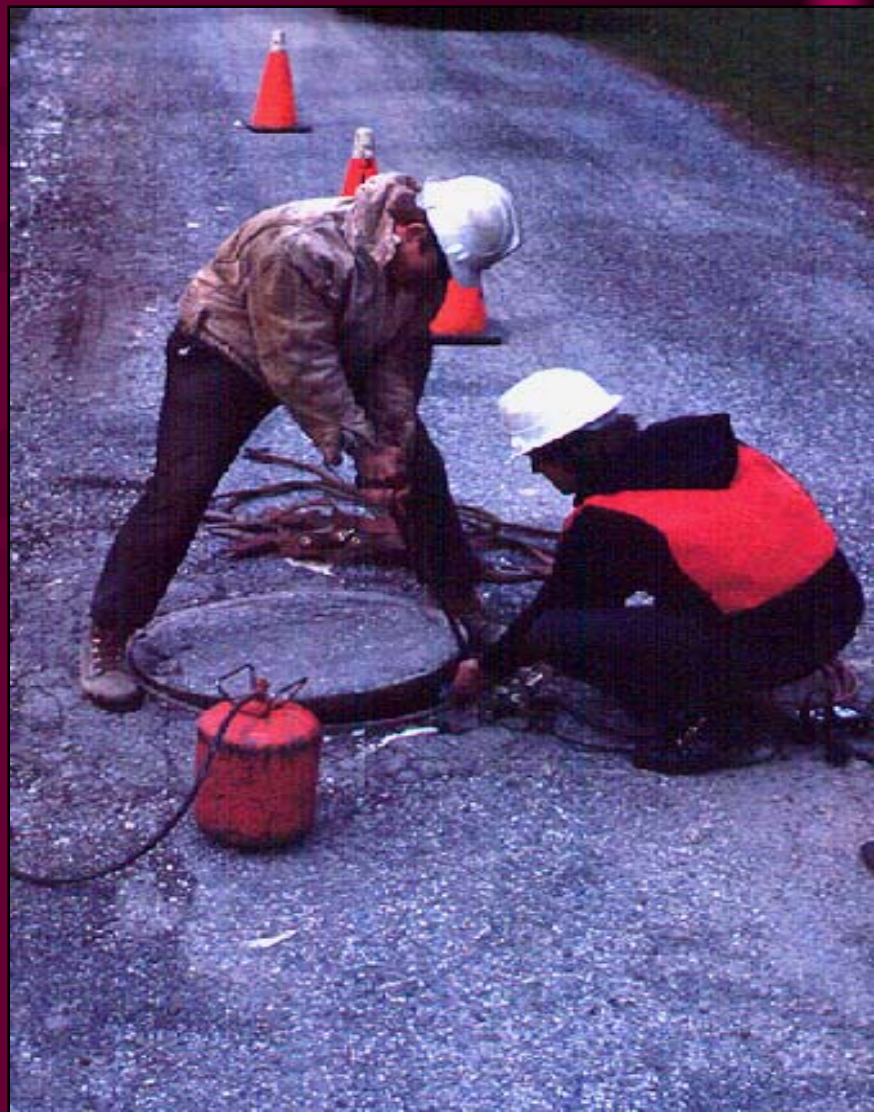
I & I Investigation

- Mainline CCTV
- Lateral CCTV
- Manhole Inspection
- Smoke Testing
- Dye Testing
- Flow-Meters / Rain-Gauge
- Wet-Weather Investigation


MANHOLE: FROM MH245805 TO MH245
00.0
02/22/00 09:14
0063.5 FT.

Wet Weather / Night time Investigations

- Wet Weather
  - Select Manholes
- Night Time
  - Select Manholes



Smoke Testing

- An easy and cost effective method to identify I&I.
- Smoke testing can identify illegal connections, storm water cross connections, abandoned lines not properly plugged, cracked pipes, and bad service connections.
- Proper Trap does not allow smoke to enter.

ENTECH ENGINEERING, INC
MANHOLE INSPECTION REPORT

PROJECT: _____
MANHOLE: _____

I. GENERAL INFORMATION

Inspector: _____
Date: _____
Location: _____
Weather: ( ) Dry ( ) Rain
Ground Surface:
( ) Concrete ( ) Asphalt ( ) Gravel ( ) Grass
Drainage Path:
1. Outside of any visible drainage path ( )
2. Possible ponding over manhole ( )

MH Diameter: ( ) 4-feet ( ) Other _____
Depth to Invert (inches): _____
Insert: Insert Installed: ( )Yes ( ) No
If "No" - Recommend Insert: ( )Yes ( ) No

II. MANHOLE INFORMATION:

FRAME AND COVER
Type of Cover: ( ) Regular ( ) Watertight
Cover Condition:
( ) Poor ( ) Good ( ) Very Good ( ) Cracked
( ) Missing ( ) Needs immediate repair
Dimension: _____ **PPH**: ( ) Yes ( ) No
Holes in Cover: ( ) Number ( ) Size
Lettering: _____ **Adj**: _____
Type of Adj: _____
Frame Condition:
( ) Poor ( ) Good ( ) Very Good ( ) Cracked
( ) Missing ( ) Needs immediate repair

CONE / BARREL / BASE
Material:
( ) Brick ( ) Pre-cast Concrete
( ) Poured-in-place
Condition:
( ) Poor ( ) Good ( ) Very Good
Condition Comment:
( ) Cracked ( ) Major Breaks ( ) Severe
Deterioration ( ) Holes ( ) Leaking Joints
( ) No Channel ( ) No Comment

Debris: ( ) None ( ) Light ( ) Medium
( ) Heavy
Type of Debris:
( ) None ( ) Mud ( ) Stone ( ) Sewage

III. VISIBLE INFILTRATION

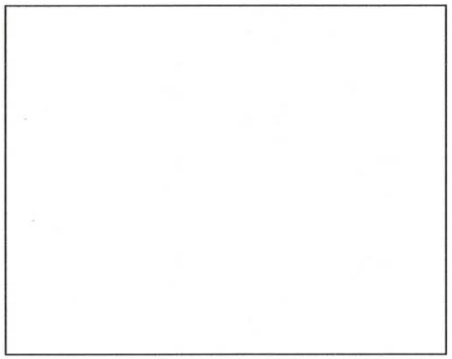
Frame & Cone:	____	GPM
Frame & Risers:	____	GPM
Cone & Risers:	____	GPM
Through Walls:	____	GPM
Through Wall Joints:	____	GPM
Around Pipe:	____	GPM
Through Inverts/Bench:	____	GPM

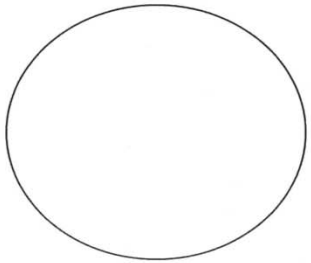
Pictures: _____

Remarks:
_____
_____
_____
_____

- **If None – Write "None"**

LOCATION SKETCH





Cleaning, Inspection and Assessment

- Cleaning
  - Sags
  - Trouble areas
  - Roots
  - Critical Service Areas
    - Hospitals
    - Schools
    - Prisons
- MH and Pipe Inspection / Assessment
- Staffing and Equipment

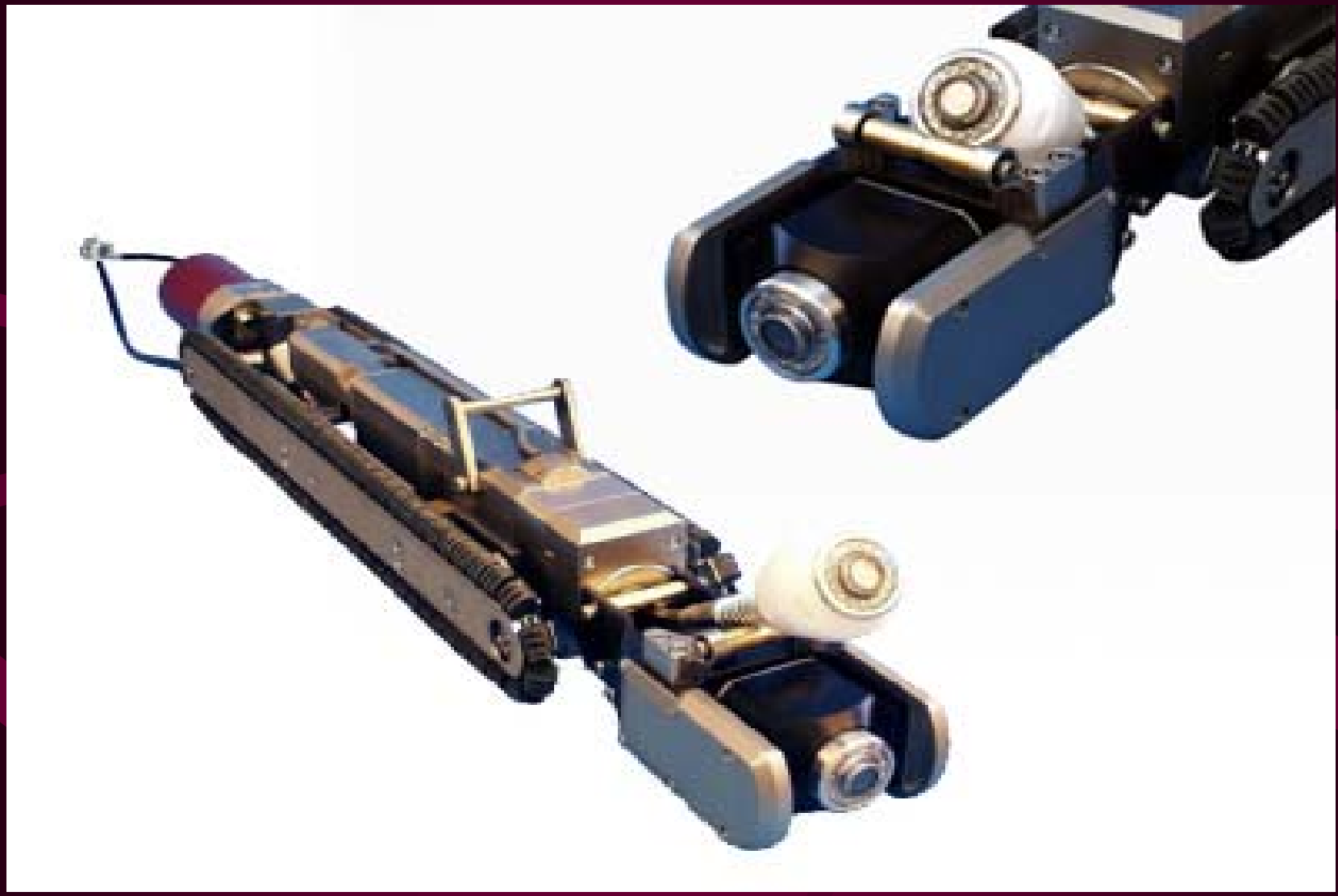
Flushing

- How to flush?
- Screen & Vacuum
- Pump Size & Spec
- “Flying Blind”
  - Value of competency
- Root Cutting
- Protruding-Tap Cutting

CCTV Inspection

- Certified Operator - PACP
- Max Speed = 30 ft / min
- Tracked, Wheeled, Boat and Lateral Launching Systems
- Pan, Tilt & Zoom Camera
- DVD, Viewing Software, Report & Index

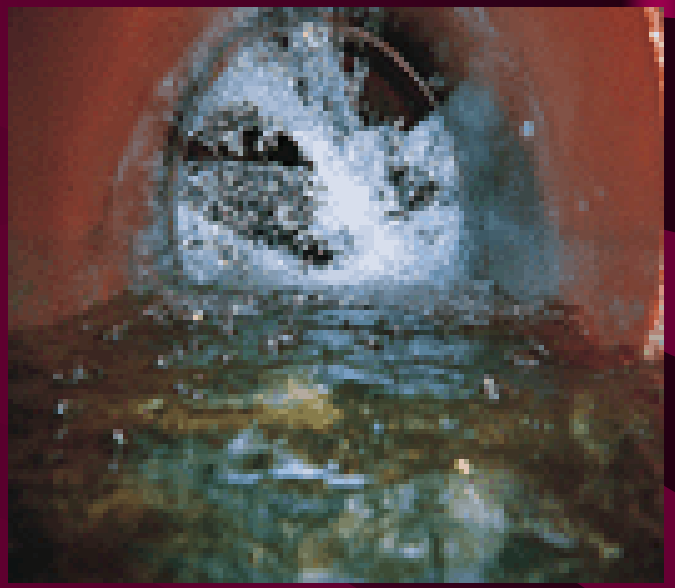
Lateral Launch



Decoding your TV Reports

- Understand the defect coding method used.

- How to Prioritize repairs?
  - Immediate Structural Repairs (ASAP)
  - Structural Repairs (Prioritize / Cost)
  - Major Sources of I&I (Prioritize / Cost)
  - Minor Sources of I&I (Prioritize / Cost)



Sewer Rehabilitation

Now That We've Found The Problem….

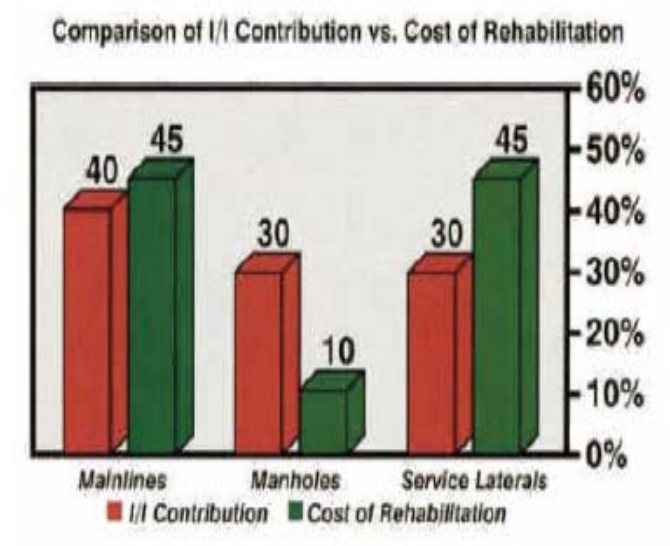
- How do we fix it?
- Dig and Replace
  - Costly, inconvenient, but sometimes necessary
- Trenchless Rehabilitation
  - "No-dig" Option
  - Temporary or Permanent Fix?

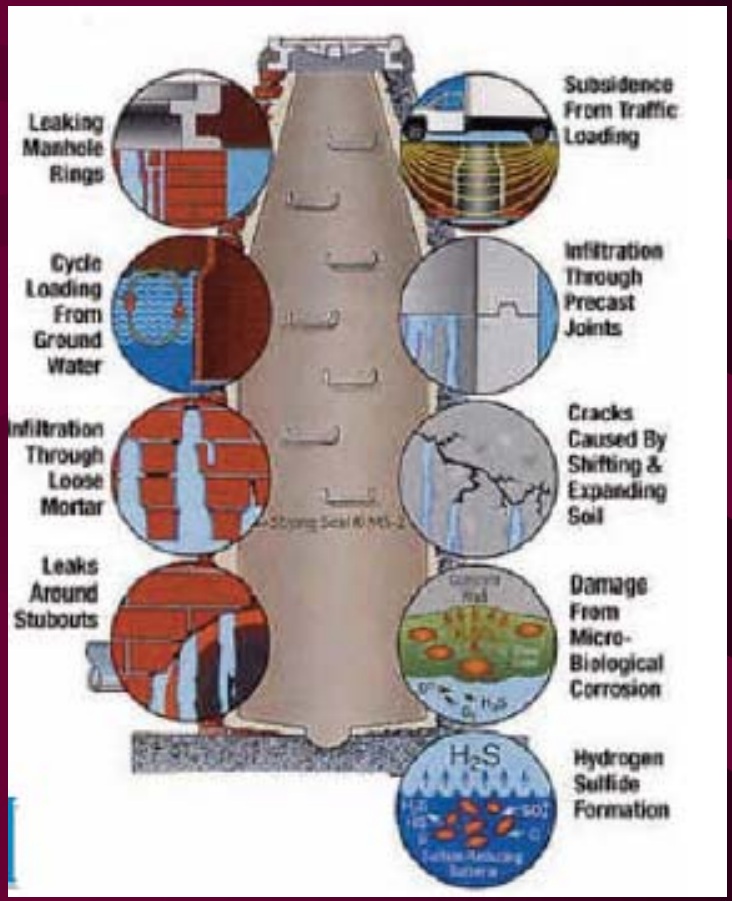
Main Line Replacement versus Rehabilitation

- Condition of existing pipe / manholes / lateral piping
- Constructability of new pipe
- Number of laterals
- Restoration / Permitting Requirements
- Job Size and Number of Contractors

Manhole Rehabilitation

- "Low-Lying Fruit"
- Cost-Effective
- Grouting
- Cementitious vs Epoxy Sprays
  - Selection Criteria
- Chimney Seal





Manhole Rehabilitation Process

H2S Damage

- Usually localized near force main discharge points
- Rehabilitation of H2S prone structures is expensive

Importance of Post-CCTV

- Installation Inspection
- Post-CCTV Verification

Cured-In-Place Sectional Repair

- “Surgical Approach”
- Cost-Effective
- 2’-20’ Repairs

Cured-In-Place Sectional Repair

Lateral Rehabilitation

- Laterals rehabilitation have been given less attention in the past due to:
  - Lack of adequate inspection for small diameter lines
  - Lack of adequate rehabilitation methods for small diameter lines
  - Complex issues of ownership and maintenance
  - Transitions from 4 to 6-inchs
  - Bends
    - Usually up to 45 degree with liners.

Other Solutions

- Pipe Bursting
  - Need to re-connect laterals
- Slip-Lining
  - Grout the annular space
- Lateral Lining

Main Line Rehabilitation

- Protruding Lateral Cutting
- Grouting
  - Air Testing
- Cured-in-place Pipe (CIPP)
- Fold and Form
- Sliplining
- Pipe Bursting / Splitting
- Point Repairs

Protruding Lateral Cutting

- Laterals that protrude into main line
- Robotic Cutter

Grouting

- Injection of a multi-component chemical grout into voids within the pipe for the purpose of sealing leaks and stabilizing the ground.
- Air Testing
- Minimum Price per Gallon

Grouting (cont)

- Design Considerations:
  - Negative
    - Does not stop the void from returning
    - No structural support is being added

Grouting (cont)

- Design Considerations:
  - Positive
    - Per foot cost inexpensive when compared to other common pipeline rehabilitation techniques
    - Good for reducing infiltration
    - Good for void stabilization
    - Lateral connections can be grouted

Cured-in-Place Pipe (CIPP)

- Use of resin impregnated fabric that is either pulled or inverted into the existing pipe, expanded or inflated to the diameter of the existing pipe and then cured, typically with an external heat source.

Cured-in-Place Pipe (cont)

- Design Considerations:
  - Positive
    - Capable of handling minor irregularities in existing pipe
    - Improves flow characteristics by reducing friction factor
    - Eliminates Main Line Joints
    - Capable of providing structural integrity

Cured-in-Place Pipe (cont)

- Design Considerations:
  - Negative
    - Bypass Pumping Required
    - Curing can be difficult for large pipe segments
    - Defective installation may be difficult to rectify
    - Does not increase pipe size
    - Additional work to re-establish laterals is needed through use of robotic cutter.

http://www.ariesindustries.com/products/lateral-reinstatement-cutters/raptor.html

Fold and Form

- Use of malleable plastic pipe or deformed HDPE, pulled from MH to MH (or more appropriately access point to access point), which is cured using heat and pressure.

Fold and Form (cont)

- Design Considerations:
  - Positive
    - Capable of handling minor irregularities in existing pipe
    - Improves flow characteristics by reducing friction factor
    - Eliminates Main Line Joints
    - Capable of providing structural integrity

Fold and Form (cont)

- Design Considerations:
  - Negative
    - Bypass Pumping Required
    - Curing can be difficult for large pipe segments
      - Shrink or unfold after expansion
    - Defective installation may be difficult to rectify
    - Does not increase pipe size
    - Additional work to re-establish laterals is needed through use of robotic cutter.

Sliplining

- Process of pulling (sliplining) a new pipe, typically HDPE, inside the old pipe (aka. host pipe).

Sliplining (cont)

- Design Considerations:
  - Positive
    - Capable of handling minor irregularities in existing pipe
    - Improves flow characteristics by reducing friction factor
    - Eliminates Main Line Joints
    - Capable of providing structural integrity

Sliplining (cont)

- Design Considerations:
  - Negative
    - Decreased pipe diameter
    - Excavation required at laterals
    - Not suitable for small diameter pipes

Sliplining (cont)

Manning's Equation:

$Q = (1.49/n) \times A \times R^{2/3} \times S^{1/2}$

Where:

Q = Flow Rate, (ft^3/s)

v = Velocity, (ft/s)

A = Flow Area, (ft^2)

n = Manning's Roughness Coefficient

R = Hydraulic Radius, (ft)

S = Channel Slope, (ft/ft)

Sliplining (cont)

- **Typical Manning's Roughness Coefficients "n":**
  - **Concrete**
    - **Unfinished = 0.014**
    - **Finished = 0.012**
  - **HDPE**
    - **Smooth Wall = 0.009 to 0.015**
    - **Corrugated Wall = 0.018 to 0.025**
  - **PVC**
    - **Smooth Wall = 0.009 to 0.011**
  - **PADEP DWFM = 0.013 (default)**

Sliplining (cont)

- **For an 8-inch pipe with minimal slope (0.40 feet per 100 feet) with a Manning's Roughness Coefficient "n" of 0.013 equates to a full pipe design capacity of approximately :**

0.5 MGD

Sliplining (cont)

- **For an 8-inch pipe with minimal slope (0.40 feet per 100 feet) with a Manning's Roughness Coefficient "n" of 0.009 equates to a full pipe design capacity of approximately :**

0.72 MGD

- **An increase of 44%.**

Pipe Bursting / Splitting

- A bursting tool breaks apart or splits the host pipe and forces the existing pipe into the existing pipe envelope and simultaneously pulls the new pipe, again typically HDPE, into place.

Picture from:
www.mcgillivrayandsons.com

Pipe Bursting / Splitting (cont)

- Design Considerations:
  - Make SURE you televise the line
  - Positive
    - Can increases pipe diameter (more capacity)
    - Capable of handling minor irregularities in existing pipe
    - Improves flow characteristics by reducing friction factor
    - Eliminates Main Line Joints
    - Capable of providing structural integrity

Picture from: www.oxfordplasticsinc.com

Pipe Bursting / Splitting (cont)

- Design Considerations:
  - Negative
    - Bypass Pumping Required
    - Excavation required at laterals
    - Limited Contractors
    - Per foot cost expensive when compared to other common pipeline rehabilitation techniques

Point Repairs

- When you have 4 or less repairs in a pipe run, this method could be your most economical repair. However, numerous factors should be considered.
- Cured-in-place Liner
  - Robotic cutter for lateral reinstatement.
- Mechanical Spot repair
  - Link Pipe

Point Repairs (cont)

- Design Considerations:
  - Positive
    - Cost Effective
    - Good for repairing structural defects

Point Repairs (cont)

- Design Considerations:
  - Negative
    - Does not increase pipe size
    - Additional work to re-establish laterals is needed through use of robotic cutter with a CIP liner.
    - A sectional dig and replace is required at laterals if using only mechanical point repairs

Lateral Rehabilitation

- Laterals rehabilitation have been given less attention in the past due to:
  - Lack of adequate inspection for small diameter lines
  - Lack of adequate rehabilitation methods for small diameter lines
  - Complex issues of ownership and maintenance
  - Transitions from 4 to 6-inchs
  - Bends
    - Usually up to 45 degree with liners.

Lateral Grouting

- Typically, acrylamide grout.
- Usually performed from the main line and seals the lateral connection and typically the 1st 6 feet towards the house. However, some bladders are now cable of grouting the 1st 20 feet.
- Lateral Packer
- Flood Grouting
  - Manholes, mainlines, and laterals simultaneously.

Lateral Lining

- Generally, four types of lateral lining systems are available:
  - Standard Liner
    - Typically installed through cleanouts (or other access points) towards main line.
    - My extend to main line but does not repair the connection.
  - Short Connection Liner
    - Installed from main line towards house.
    - Commonly known as “Top Hats”, which is a brand name
    - Covers the lateral to mainline connection
      - 3-inch brim around the connection
      - 6 to 12-inches into lateral piping from main line

Lateral Lining (cont)

- Long Connection Liner
  - Installed from main line towards house.
  - Covers the lateral to mainline connection
    - 3-inch brim around the connection
    - 25 to 30 feet into lateral piping from main line
- T-Liner
  - Installed from main line towards house.
  - Covers the lateral to mainline connection
    - Full circle main line seal (Approx. 16-inches) around the connection, which is stitched and fused to the standard CIP liner
    - Up to 160 feet into lateral piping from main line

Lateral Pipe Bursting

- Similar to Main Line Pipe Bursting
- Excavation of two small pits
- Possible damage during bursting at shall depths (i.e., driveways)

Lateral Backflow Preventers

- Accidental backflow from main sewer into buildings.
  - Agreement that property owner is responsible for maintenance.
    - Cleaned every couple of months
      - Grease
      - Rags
      - Etc..

PART 7 – Asset Management

Cost- Effective Projects

- The overall goal to maintaining this data and developing possible relationships between problems and their causes is to **effectively utilize limited budgets** in the maintenance and repair of your system.

Information Management

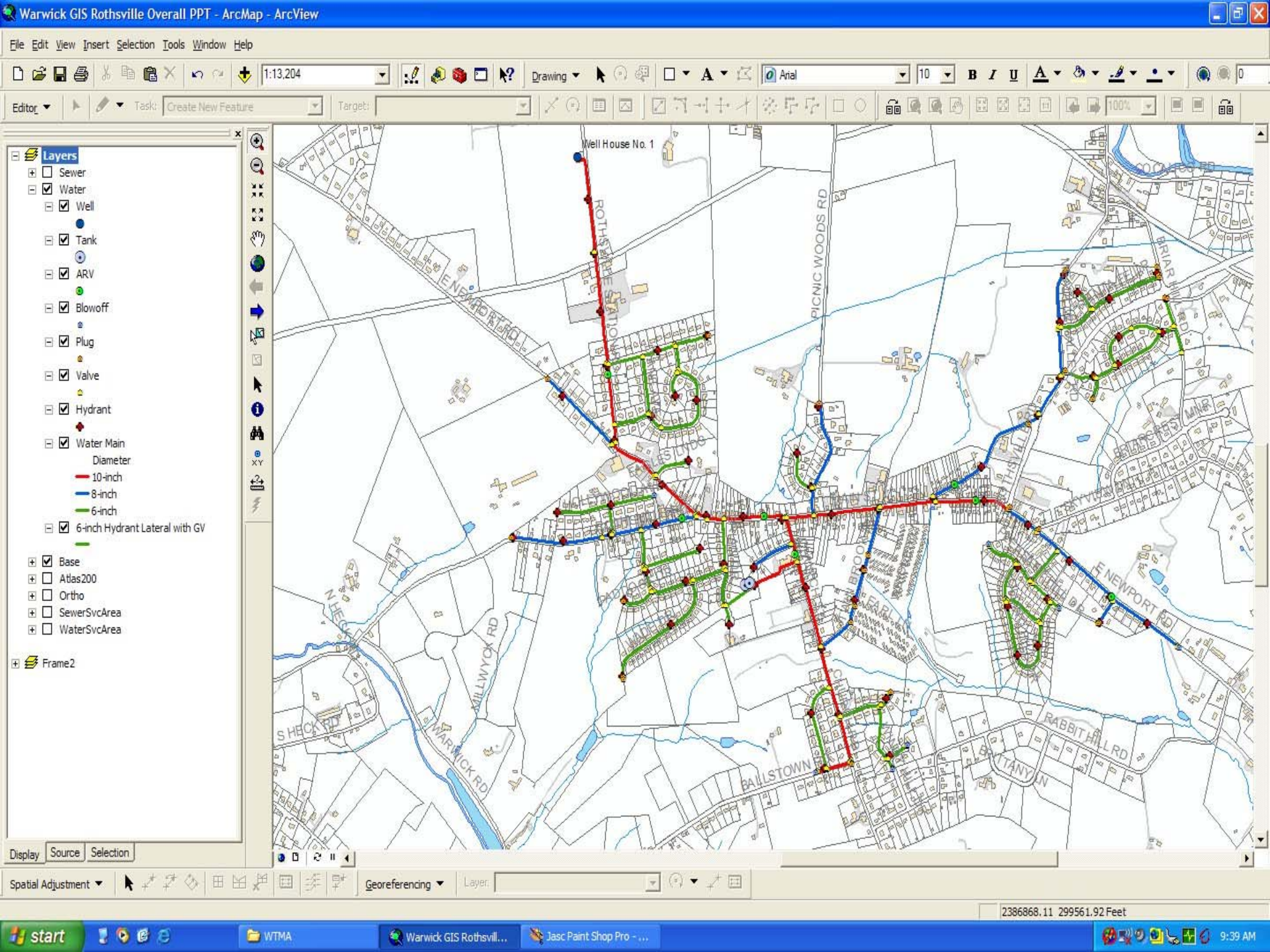
- Geographical Information System (GIS)
- Organized Master Folder
- Electronic Scanning
- As-Builts

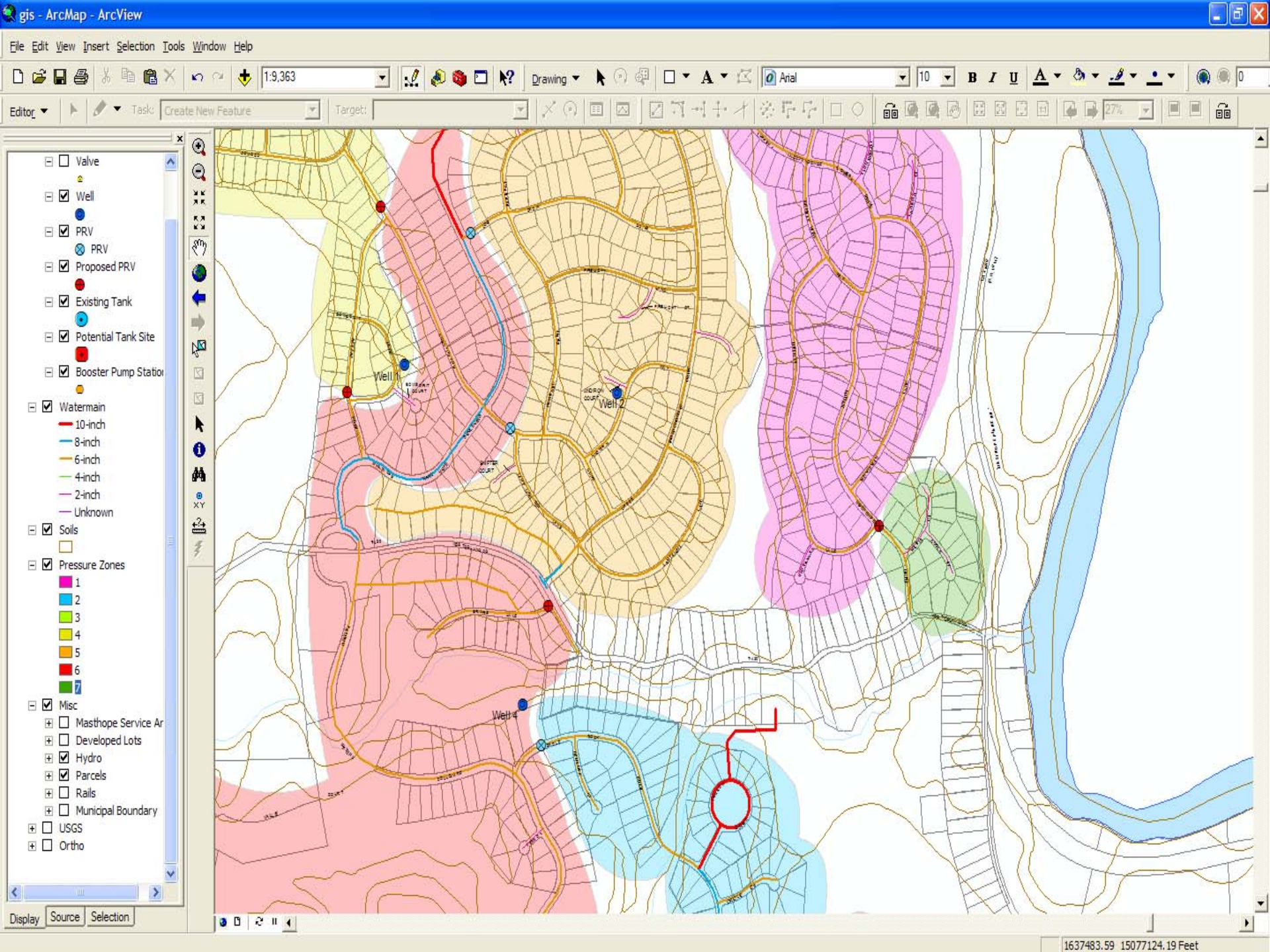
General System Information

- System Description
  - System narrative
  - Names of municipalities served
  - Population
- System Details
- Age Distribution of Systems
- Length of Pipe by Diameter

Collect /Analyze Available Data

- Previous Maintenance Identification
- Previous Maintenance Elimination Work
- Recent Construction
- As-built Drawings
- Customer Complaints


Warwick GIS Rothsville Overall PPT - ArcMap - ArcView
File Edit View Insert Selection Tools Window Help
Editor
Layers
Sewer
Water
Well
Tank
ARV
Blowoff
Plug
Valve
Hydrant
Water Main
Diameter
10-inch
8-inch
6-inch
6-inch Hydrant Lateral with GV
Base
Atlas200
Ortho
SewerSvcArea
WaterSvcArea
Frame2
Display
Source
Selection
Well House No. 1
ROTHSVILLE STATION
ENGLEHART RD
PICNIC WOODS RD
E NEWPORT RD
S HECK RD
WARWICK RD
BALLSTOWN
RABBIT HILL RD
Spatial Adjustment
Georeferencing
2386868.11 299561.92 Feet
start
WTMA
Warwick GIS Rothsvill...
Jasc Paint Shop Pro - ...
9:39 AM


gis - ArcMap - ArcView
File Edit View Insert Selection Tools Window Help
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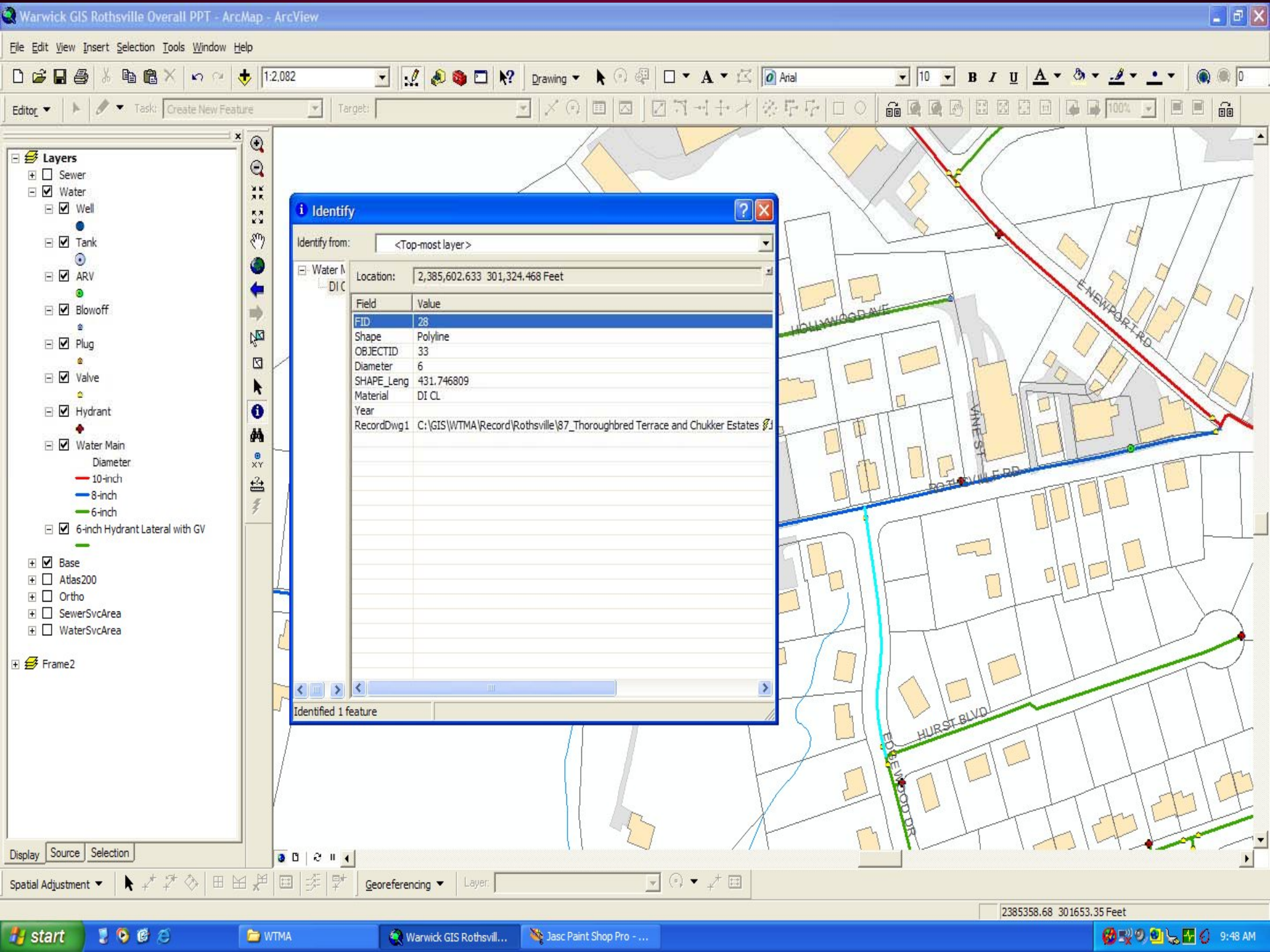
Drawing
Arial
10
Editor
Task:
Create New Feature
Target:
Valve
Well
PRV
PRV
Proposed PRV
Existing Tank
Potential Tank Site
Booster Pump Statio
Watermain
10-inch
8-inch
6-inch
4-inch
2-inch
Unknown
Soils
Pressure Zones
1
2
3
4
5
6
7
Misc
Masthope Service Ar
Developed Lots
Hydro
Parcels
Rails
Municipal Boundary
USGS
Ortho
Well 1
Well 2
Well 4
Display
Source
Selection
1637483.59 15077124.19 Feet


Warwick GIS Rothsville Overall PPT - ArcMap - ArcView
File Edit View Insert Selection Tools Window Help
Identify
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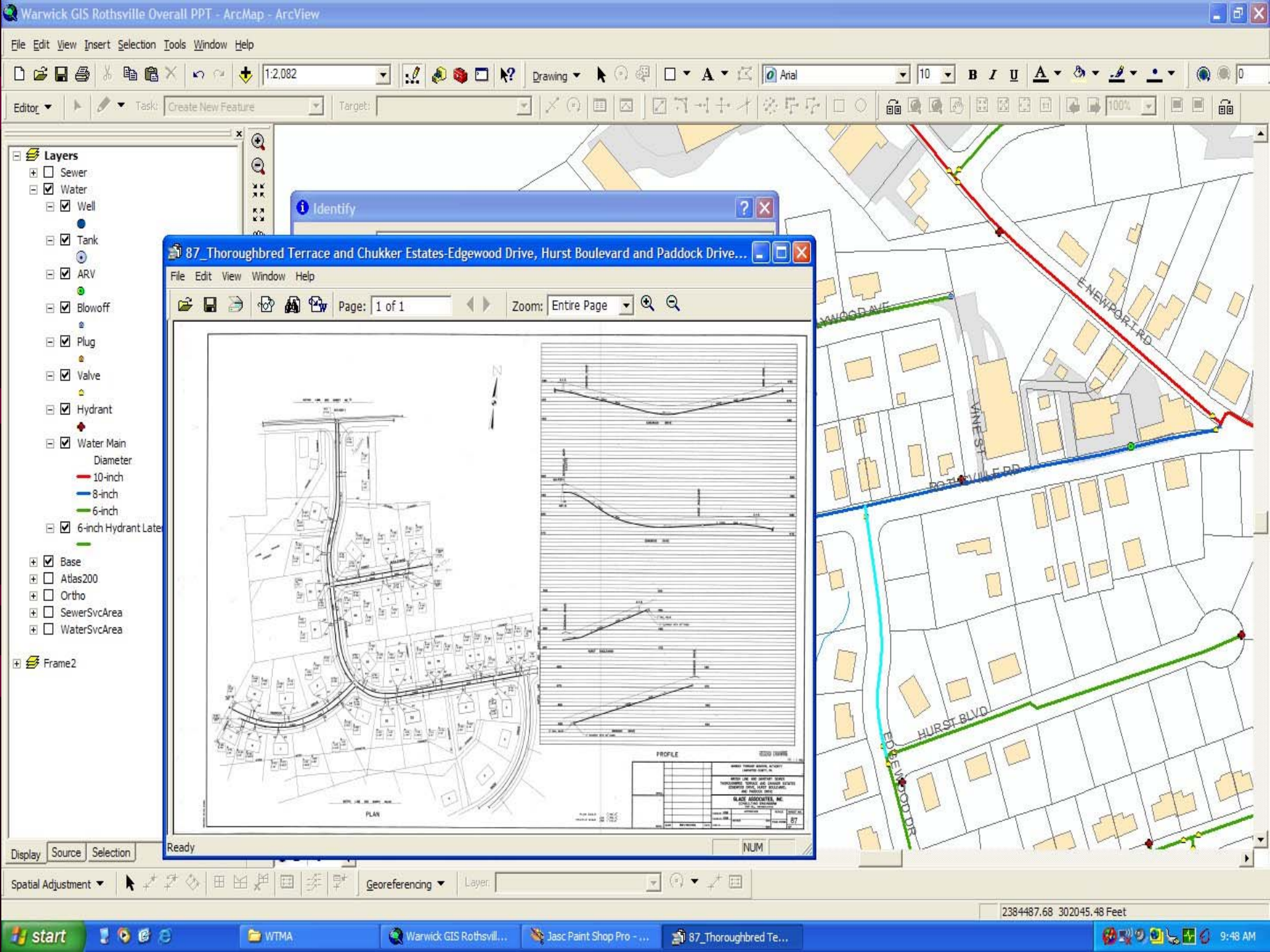
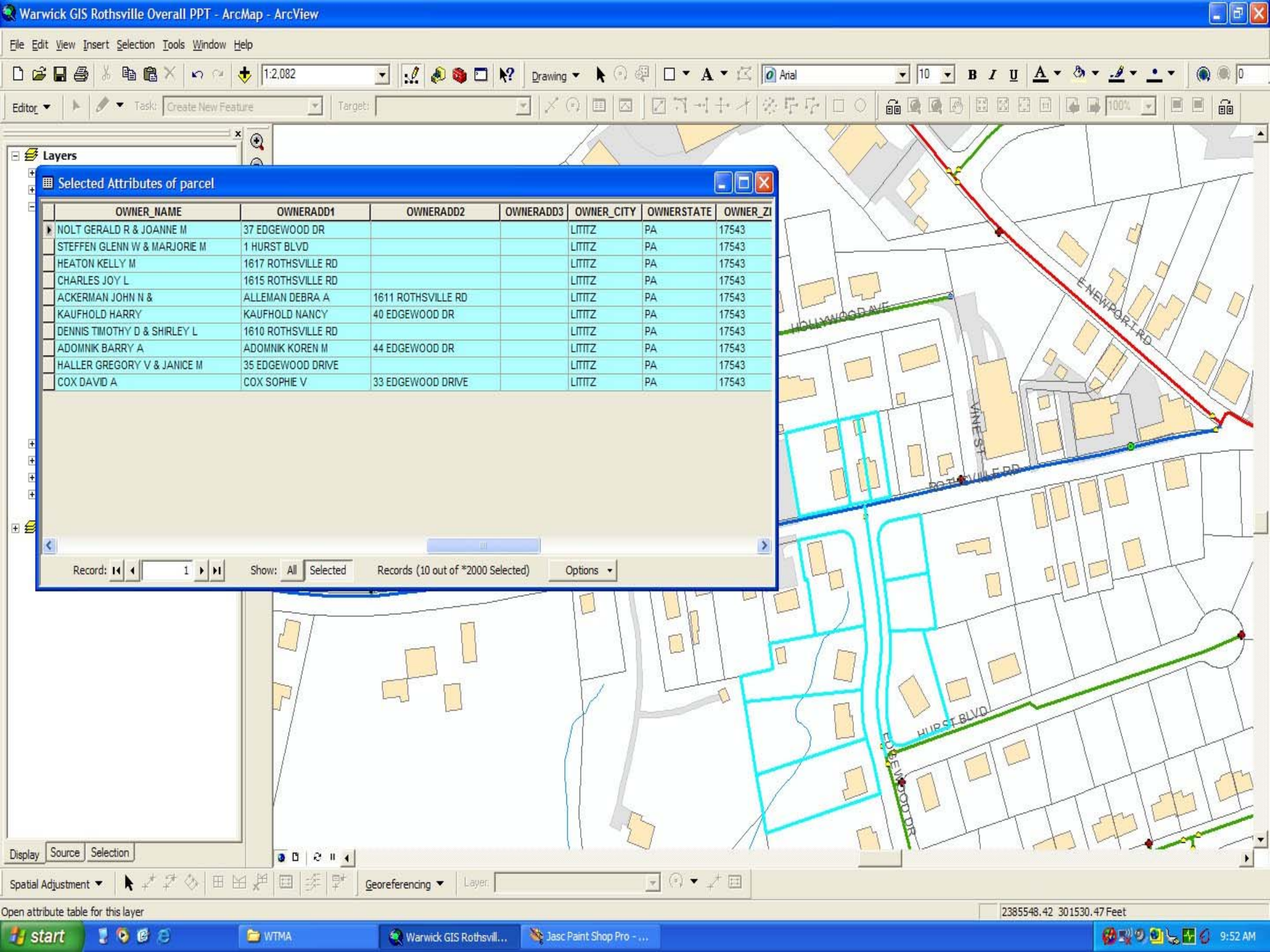
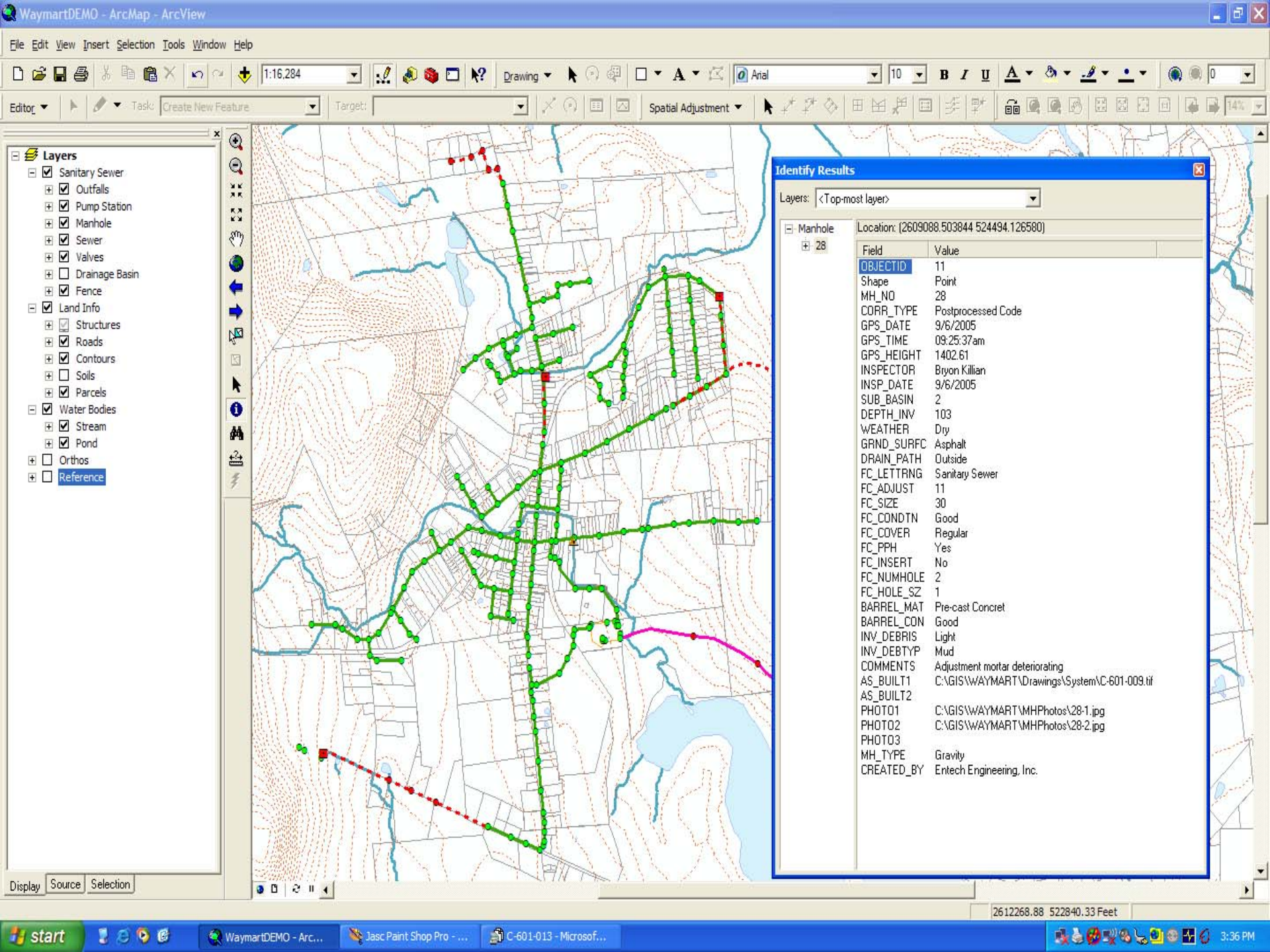
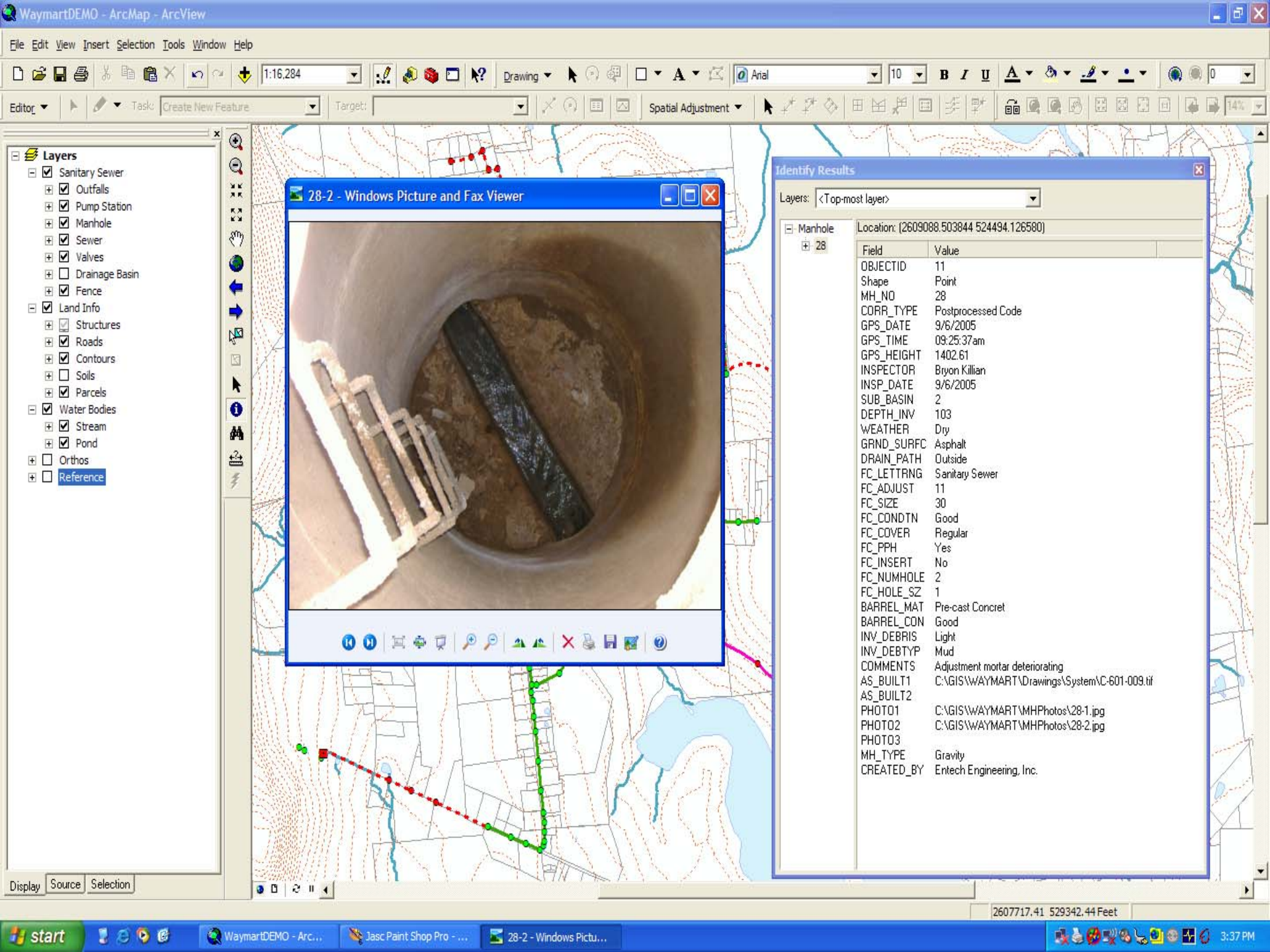
<Top-most layer>
Location:
2,385,602.633 301,324.468 Feet
Field
Value
FID
28
Shape
Polyline
OBJECTID
33
Diameter
6
SHAPE_Leng
431.746809
Material
DI CL
Year
RecordDwg1
C:\GIS\WTMA\Record\Rothsville\87_Thoroughbred Terrace and Chukker Estates
Identified 1 feature
Layers
Sewer
Water
Well
Tank
ARV
Blowoff
Plug
Valve
Hydrant
Water Main
Diameter
10-inch
8-inch
6-inch
6-inch Hydrant Lateral with GV
Base
Atlas200
Ortho
SewerSvcArea
WaterSvcArea
Frame2
Display
Source
Selection
Spatial Adjustment
Georeferencing
E NEWPORT RD
HOLLYWOOD AVE
VANEST
HURST BLVD
EDGEWOOD DR
2385358.68 301653.35 Feet
start
WTMA
Warwick GIS Rothsvill...
Jasc Paint Shop Pro - ...
9:48 AM


Warwick GIS Rothsville Overall PPT - ArcMap - ArcView
File Edit View Insert Selection Tools Window Help
Layers
Sewer
Water
Well
Tank
ARV
Blowoff
Plug
Valve
Hydrant
Water Main
Diameter
10-inch
8-inch
6-inch
Base
Atlas200
Ortho
SewerSvcArea
WaterSvcArea
Frame2
Identify
87_Thoroughbred Terrace and Chukker Estates-Edgewood Drive, Hurst Boulevard and Paddock Drive...
File Edit View Window Help
Page: 1 of 1
Zoom: Entire Page
PLAN
PROFILE
Ready
NUM
E NEWPORT RD
VINE ST
HURST BLVD
EDGEWOOD DR
Display Source Selection
Spatial Adjustment
Georeferencing
Layer:
2384487.68 302045.48 Feet
start
WTMA
Warwick GIS Rothsvill...
Jasc Paint Shop Pro - ...
87_Thoroughbred Te...
9:48 AM


Warwick GIS Rothsville Overall PPT - ArcMap - ArcView
File Edit View Insert Selection Tools Window Help
1:2,082
Drawing
Arial
Editor
Task: Create New Feature
Target:
Layers
Selected Attributes of parcel
OWNER_NAME | OWNERADD1 | OWNERADD2 | OWNERADD3 | OWNER_CITY | OWNERSTATE | OWNER_ZI
NOLT GERALD R & JOANNE M | 37 EDGEWOOD DR | | | LITITZ | PA | 17543
STEFFEN GLENN W & MARJORIE M | 1 HURST BLVD | | | LITITZ | PA | 17543
HEATON KELLY M | 1617 ROTHSVILLE RD | | | LITITZ | PA | 17543
CHARLES JOY L | 1615 ROTHSVILLE RD | | | LITITZ | PA | 17543
ACKERMAN JOHN N & | ALLEMAN DEBRA A | 1611 ROTHSVILLE RD | | LITITZ | PA | 17543
KAUFHOLD HARRY | KAUFHOLD NANCY | 40 EDGEWOOD DR | | LITITZ | PA | 17543
DENNIS TIMOTHY D & SHIRLEY L | 1610 ROTHSVILLE RD | | | LITITZ | PA | 17543
ADOMNIK BARRY A | ADOMNIK KOREN M | 44 EDGEWOOD DR | | LITITZ | PA | 17543
HALLER GREGORY V & JANICE M | 35 EDGEWOOD DRIVE | | | LITITZ | PA | 17543
COX DAVID A | COX SOPHIE V | 33 EDGEWOOD DRIVE | | LITITZ | PA | 17543
Record: 1
Show: All Selected
Records (10 out of *2000 Selected)
Options
HOLLYWOOD AVE
E NEWPORT RD
VINE ST
ROTHSVILLE RD
HURST BLVD
EDGEWOOD DR
Display Source Selection
Spatial Adjustment
Georeferencing
Layer:
Open attribute table for this layer
2385548.42 301530.47 Feet
start
WTMA
Warwick GIS Rothsvill...
Jasc Paint Shop Pro - ...
9:52 AM


WaymartDEMO - ArcMap - ArcView
File Edit View Insert Selection Tools Window Help
Layers
Sanitary Sewer
Outfalls
Pump Station
Manhole
Sewer
Valves
Drainage Basin
Fence
Land Info
Structures
Roads
Contours
Soils
Parcels
Water Bodies
Stream
Pond
Orthos
Reference
Display Source Selection
Identify Results
Layers: <Top-most layer>
Manhole
28
Location: (2609088.503844 524494.126580)
Field Value
OBJECTID 11
Shape Point
MH_NO 28
CORR_TYPE Postprocessed Code
GPS_DATE 9/6/2005
GPS_TIME 09:25:37am
GPS_HEIGHT 1402.61
INSPECTOR Bryon Killian
INSP_DATE 9/6/2005
SUB_BASIN 2
DEPTH_INV 103
WEATHER Dry
GRND_SURFC Asphalt
DRAIN_PATH Outside
FC_LETTRNG Sanitary Sewer
FC_ADJUST 11
FC_SIZE 30
FC_CONDTN Good
FC_COVER Regular
FC_PPH Yes
FC_INSERT No
FC_NUMHOLE 2
FC_HOLE_SZ 1
BARREL_MAT Pre-cast Concret
BARREL_CON Good
INV_DEBRIS Light
INV_DEBTYP Mud
COMMENTS Adjustment mortar deteriorating
AS_BUILT1 C:\GIS\WAYMART\Drawings\System\C-601-009.tif
AS_BUILT2
PHOTO1 C:\GIS\WAYMART\MHPhotos\28-1.jpg
PHOTO2 C:\GIS\WAYMART\MHPhotos\28-2.jpg
PHOTO3
MH_TYPE Gravity
CREATED_BY Entech Engineering, Inc.
2612268.88 522840.33 Feet
start
WaymartDEMO - Arc...
Jasc Paint Shop Pro - ...
C-601-013 - Microsof...
3:36 PM


WaymartDEMO - ArcMap - ArcView
File Edit View Insert Selection Tools Window Help
Layers
Sanitary Sewer
Outfalls
Pump Station
Manhole
Sewer
Valves
Drainage Basin
Fence
Land Info
Structures
Roads
Contours
Soils
Parcels
Water Bodies
Stream
Pond
Orthos
Reference
Display Source Selection
28-2 - Windows Picture and Fax Viewer
Identify Results
Layers: <Top-most layer>
Manhole
28
Location: (2609088.503844 524494.126580)
Field Value
OBJECTID 11
Shape Point
MH_NO 28
CORR_TYPE Postprocessed Code
GPS_DATE 9/6/2005
GPS_TIME 09:25:37am
GPS_HEIGHT 1402.61
INSPECTOR Bryon Killian
INSP_DATE 9/6/2005
SUB_BASIN 2
DEPTH_INV 103
WEATHER Dry
GRND_SURFC Asphalt
DRAIN_PATH Outside
FC_LETTRNG Sanitary Sewer
FC_ADJUST 11
FC_SIZE 30
FC_CONDTN Good
FC_COVER Regular
FC_PPH Yes
FC_INSERT No
FC_NUMHOLE 2
FC_HOLE_SZ 1
BARREL_MAT Pre-cast Concret
BARREL_CON Good
INV_DEBRIS Light
INV_DEBTYP Mud
COMMENTS Adjustment mortar deteriorating
AS_BUILT1 C:\GIS\WAYMART\Drawings\System\C-601-009.tif
AS_BUILT2
PHOTO1 C:\GIS\WAYMART\MHPhotos\28-1.jpg
PHOTO2 C:\GIS\WAYMART\MHPhotos\28-2.jpg
PHOTO3
MH_TYPE Gravity
CREATED_BY Entech Engineering, Inc.
2607717.41 529342.44 Feet
start
WaymartDEMO - Arc...
Jasc Paint Shop Pro - ...
28-2 - Windows Pictu...
3:37 PM

WaymartDEMO - ArcMap - ArcView

File Edit View Insert Selection Tools Window Help

1:16,284 | Drawing | Arial | 10

Editor | Task: Create New Feature

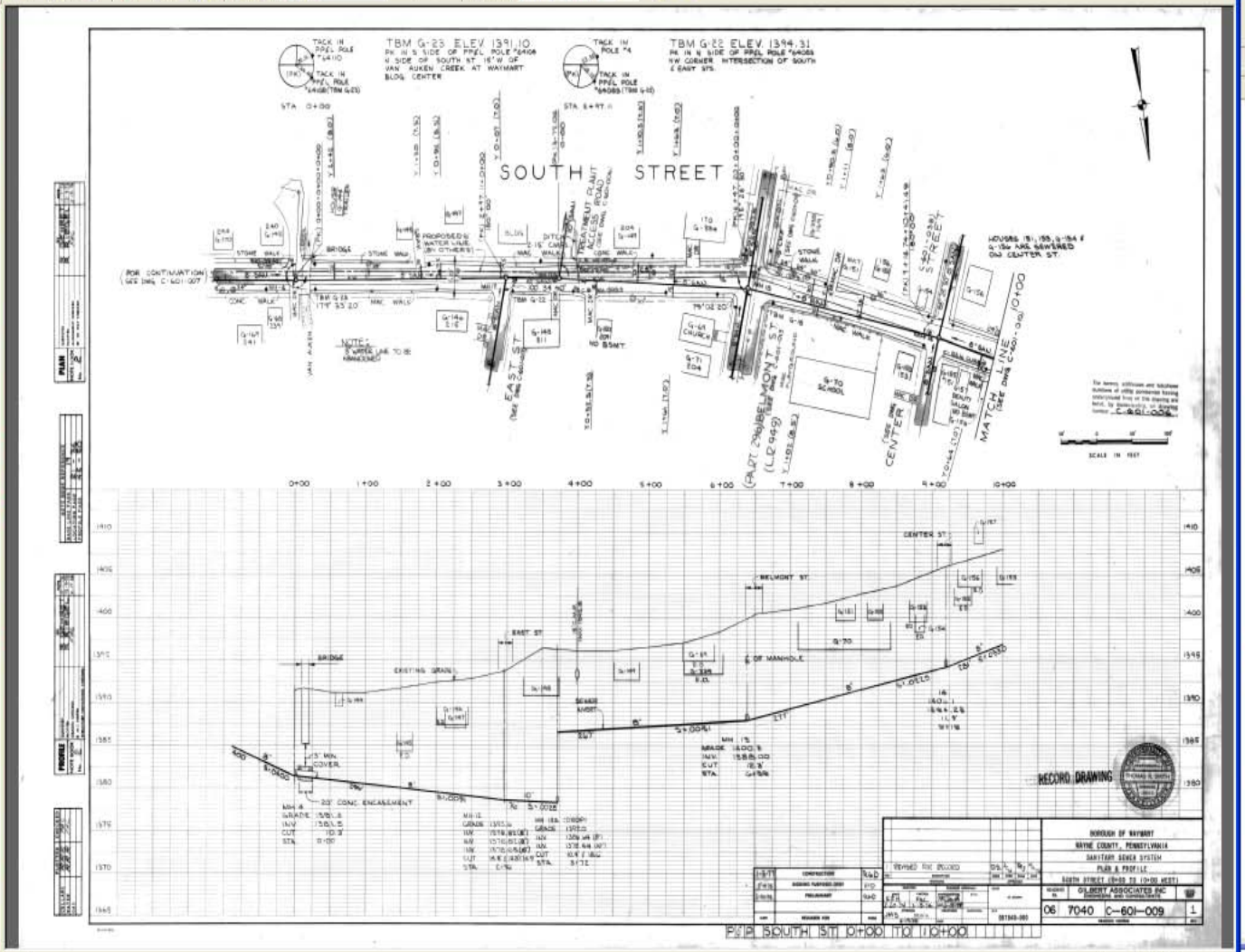
Layers
- Sanitary Sewer
  - Outfalls
  - Pump Station
  - Manhole
  - Sewer
  - Valves
  - Drainage Basin
  - Fence
- Land Info
  - Structures
  - Roads
  - Contours
  - Soils
  - Parcels
- Water Bodies
  - Stream
  - Pond
- Orthos
- Reference

Display | Source | Selection

C-601-009 - Microsoft Office Document Imaging

File Edit View Window Help

Page: 1 of 1 | Zoom: Entire Page



Ready | NUM

2612777.74 520352.56 Feet

start | WaymartDEMO - Arc... | Jasc Paint Shop Pro - ... | C-601-009 - Microsof... | 3:37 PM

Basin	Miles of Gravity Sewer	Miles of Force Main	Number of Manholes	Number of Pump Stations	Age	Comment
1	2.4	3.0	525	6	1960-1970	Basin has severe inflow issues and PS 3 has overflowed numerous times.
2	6.0	5.5	1000	3	Pre 1930	All manholes are constructed Brick in this older section of t collection system.
3	2.0	1.0	500	1	2000-2010	Latest development. System is tight.
4	1.5	0	400	2	1980-1990	Creek overflows the bank and we need to ensure watertight MH lids are functioning.

Basin	Gravity Main Length (lf)	Material	Force Main Length (lf)	Material	Comment
1	10,000	VCP	15,840	PVC	VCP pipe is in generally good condition with the exception of several longitudinal cracks in the downtown area.
	2,672	PVC	5,840	DI	DI force main has some corrosion issues at PS 2
2	2.0	TC	1.0	PVC	Old TC pipe is structurally deficient and most joints show signs of infiltration.
	1.5	Concrete	0	N/A	Concrete pipe used under parking lot at the mill and for the River Interceptor.

Basin	SSO Date	Location	Est. Volume Released (gal)	Cause of Release
1	4/1/13	MH 34	15,840	2-inches of rain in 7 hours
1	4/2/13	MH 1	9,000	Blockage at MH 3
1	4/2/13	MH 2	10,000	Blockage at MH 3
3	5/8/12	PS 6	20,000	Pumps failed to automatically operate. Turned pumps on hand and reset system.

GIS Database Development

LENGTH	DIAMETER	MATERIAL	LENGTH	DIAMETER	MATERIAL
300.91484559007	8.00	Terra Cotta	316.00723316314	8.00	PVC
349.53268615516	8.00	Terra Cotta	192.46507606507	8.00	PVC
397.84812818151	8.00	Terra Cotta	130.95226037021	8.00	PVC
399.93100990895	8.00	Terra Cotta	234.69156065816	8.00	PVC
211.22174587562	8.00	Terra Cotta	234.61219123264	8.00	PVC
189.44882444467	8.00	Terra Cotta	135.07897573245	8.00	PVC
137.64338389120	8.00	Terra Cotta	399.69713854780	8.00	PVC
274.24397077654	8.00	Terra Cotta	161.13741942872	8.00	PVC
231.53643256467	8.00	Terra Cotta	77.44421231525	8.00	PVC
248.73181089043	8.00	Terra Cotta	29.09992361825	8.00	PVC
252.68847715601	8.00	Terra Cotta	244.46300544946	8.00	PVC

PART 8 – Resources and Budgets

Selecting the right method

- What are the problems to be addressed?
- What methods can remedy the problems identified?
- Does the method provide a short or long term solution?
- Does the method go beyond just solving the problem identified and is there an added benefit?

Revenue

- User Fees
- Tapping Fees
- Federal or State Reimbursements
- Developer Contributions / Special

Costs

- Debt Service
- Manpower, Salaries, Benefits
- Utilities / Power
- Solids Disposal
- Chemicals
- Legal / Engineering

Planning

- Worth of your assets
- Expecting Life Span
- Replacement Costs
- Capital Improvements Plan
  - 5-Year Horizon
  - 10-Year Horizon

Communication Plan

- What do you want to communicate?
- Why is it applicable to the reader?
  - Reader centered approach.
- What actions (if any) are you REQUIRING or REQUESTING?
- What was the response?

Resources and Budget

- Budget Process
- Rate Setting, Budgetary Policies and Financial History
- Historical Rate Review
- Operating and Maintenance Expense
- Capital Improvement Program Overview
- Capital Improvement Plan

Meaningful Conversation with your Board

What is needed now versus what can be budgeted in the future?

Selecting the right method

- What are the problems to be addressed?
- What methods can remedy the problems identified?
- Does the method provide a short or long term solution?
- Does the method go beyond just solving the problem identified and is there an added benefit?

Operator Certification Act

Importance of advocating for what is right / needed

Finding ways to help your board see and understand

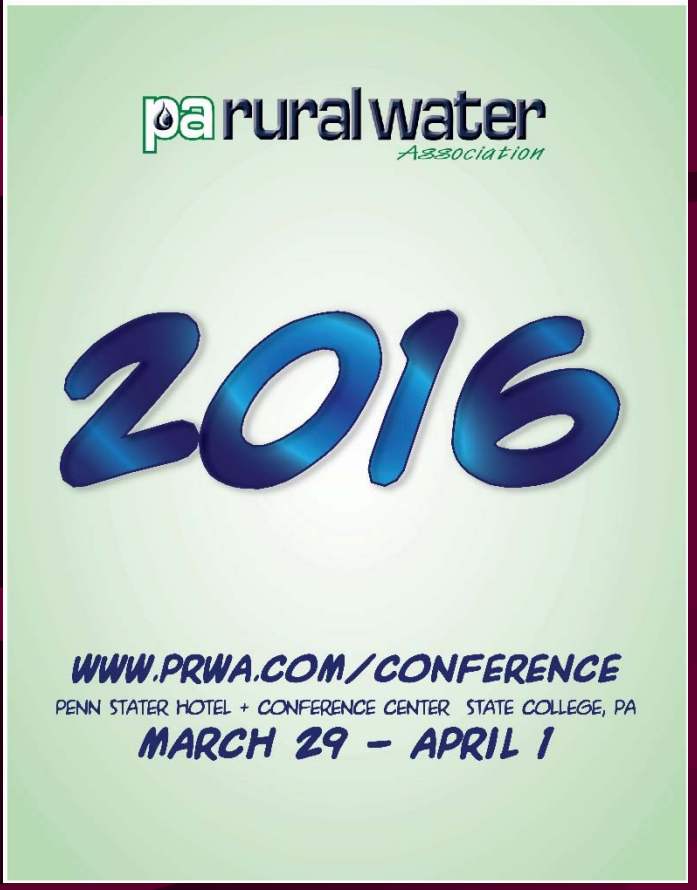
Justifying why you need them to fund collection system maintenance

Questions

- Bryon Killian, PE
  bkillian@entecheng.com

- Robb Kalbach
  rhk3@usginc.net

REVIEW / QUIZ



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