



Welcome
to the
PA Rural Water Association
Annual Technical
Training Conference

We're Glad You're
Here!



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

MAINTENANCE MANAGEMENT FOR COLLECTION SYSTEMS

PRESENTERS:

ENTECH ENGINEERING, INC

Bryon Killian, PE

bkillian@entecheng.com

UTILITY SERVICES GROUP (USG), INC

Robb Kalbach, III

rhk3@usginc.net

Special Thanks

- PRWA; Joel Jordan
- Exeter Supply Company; Marc Miller
- Borough of Orwigsburg
- Waymart Area Authority
- Central Wayne Regional Authority

REFERENCES

- Template for Developing Sewer Collection System Preventative Maintenance and Sewer Overflow Response Plans, US EPA, Region 1 working document, November 2009 version
- Wastewater Treatment Plant Operator Certification Training - Modules 23 and 24 on Wastewater Collection Systems
- PADEP - Domestic Wastewater Facilities Manual
- Pumping Station Design 2nd Edition, Sanks, Tchobanoglous, Bosserman, and Jones, 1998.

Presentation – Hour 1

- Overview of Wastewater Collection Systems
- Importance of a Sewer System Maintenance Plan
- Section 1 – Collection System Management
- Section 2 – General System Information

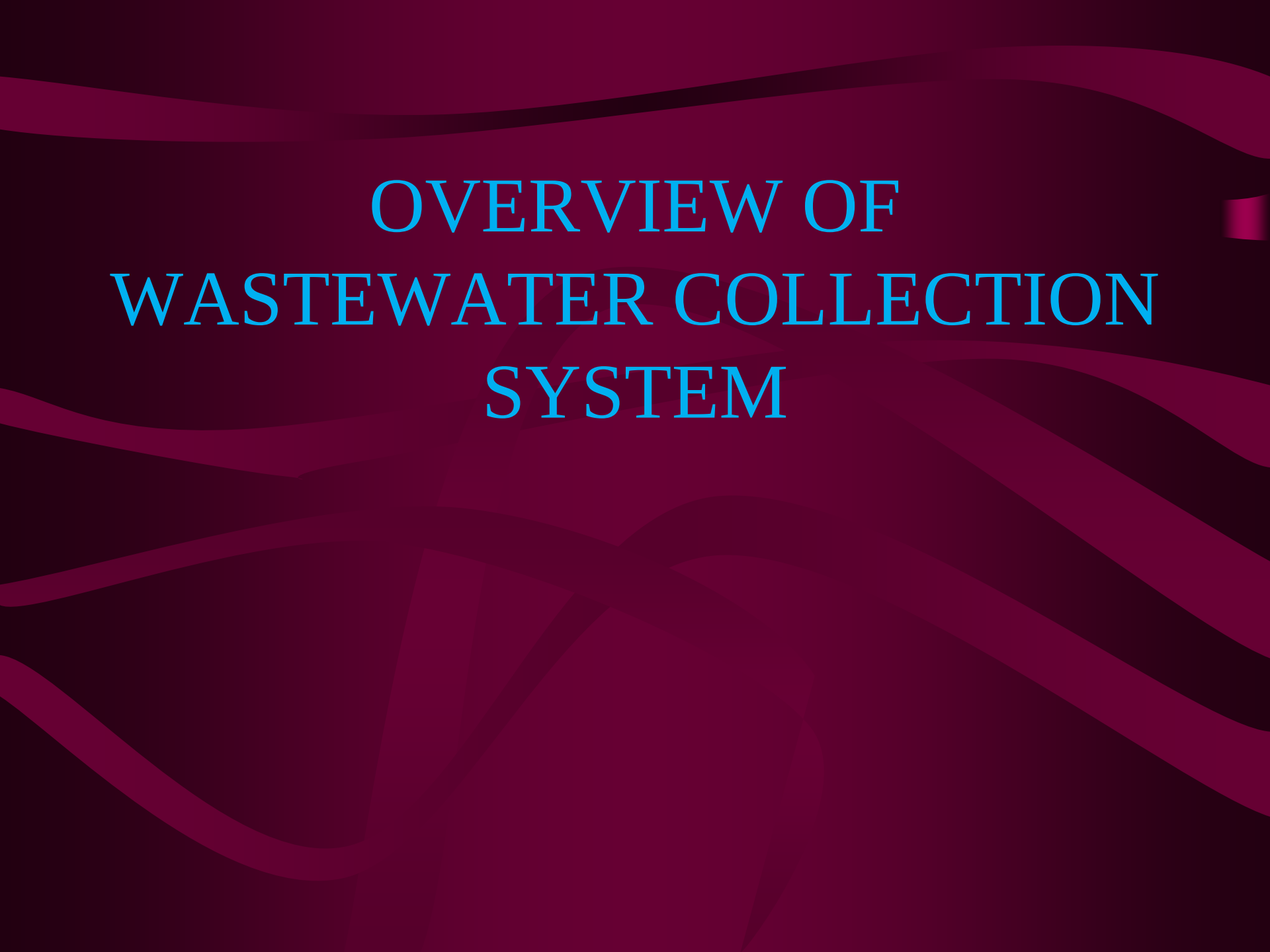
Presentation – Hour 2

- Section 3 – Cleaning, Inspection and Assessment
- Section 4 – Gravity Line Preventive Maintenance
- Section 5 – Easements and Paving: Maintenance and Access

Presentation – Hour 3

- Section 6 – Pump Station / Force Main Maintenance
- Section 7 – Reactive Maintenance
- Section 8 – Equipment and Tool Inventory
- Section 9 – Capacity Management
- Section 10 – Resources and Budget
- Section 11 – Sewer System Maintenance Plan Updates

HOUR 1



OVERVIEW OF WASTEWATER COLLECTION SYSTEM

Sewer System - Components

- Pipe (typically 8-inch minimum for gravity main sewers)
 - Concrete, HDPE, Clay, Ductile Iron, Cast Iron, and PVC
 - PVC SDR 35 with push-on joints is most prevalent today.
 - 25 to 30 feet burial depth
 - Deeper with profile wall
- Manholes
 - Precast concrete
 - Fiberglass
 - PVC
 - Poured-in-place concrete
- Pump Stations and force mains



Laterals

THINK MAINTENANCE IN THE FUTURE

- Cleanouts at the house and at the property line
 - 3 feet from building foundation
 - Property Line
- Locate wyes properly during construction
 - Wyes for empty lots
 - Creation of additional joints and places for infiltration
- Sizing
 - 4-inches to 6-inches

Manhole Components

- Cover / Frame / Riser Rings
- Cone / Barrel
- Base
- Channel
- Pipe Connections



Manholes (cont)

- Spacing:
 - At all changes in grade and pipe size, changes in alignment (less than 24-inches), at all intersections and at distances not greater than 400 feet for sewers 15-inches or less and 500 feet for sewers 18 to 30-inches. Greater spacing may be permitted in larger lines when adequate cleaning equipment for such spacing is provided.

*PADEP Domestic Wastewater Facilities
Manual (10/97), Page 20*

Pump Stations

- Is there really a need for a pump station?
 - Substantial investment
- Location
 - Aesthetic Considerations
 - Force Main Route
- Required Capacity
- Mode of Operation
 - Constant Speed
 - Variable Speed
 - Mixture of the two



LPSS

- Alternative to conventional gravity collection system in situations where the use of gravity sewers is not feasible and/or cost effective.
- Conditions such as the following:
 - Topography
 - Groundwater conditions
 - Excessive Rock Excavation

LPSS Components

- Gravity Lateral
- Grinder Pump in a wet well basin
- Low pressure lateral
- Low pressure sewer main
 - Identify as to not confuse them with water mains
- Cleanouts / Isolation valves / Air and Vacuum Relief Valves
- Conditioning Stations

LPSS Design Considerations

- Grinder Pumps:
 - Mix and match
 - 8 gpm
 - 1 stand-by for 50 units
 - Operation and Maintenance
 - Ownership clearly defined

Collection System Challenges

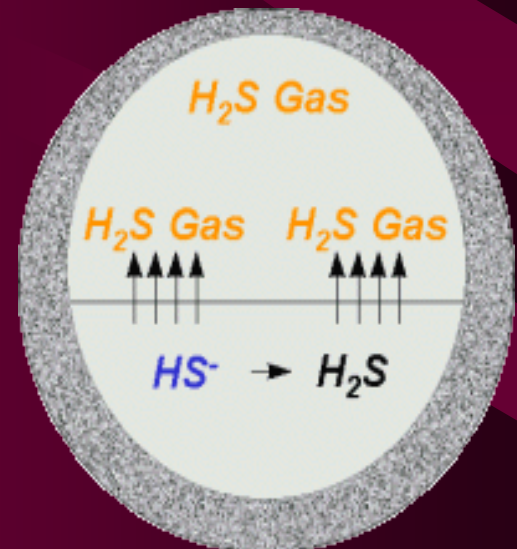
- Biological activity
 - Odors
 - Corrosion
- Varying flows
 - Diurnal Flow Pattern
 - I&I
- Varying terrain
 - It flows downhill unless its uphill



Hydrogen Sulfide - Odor

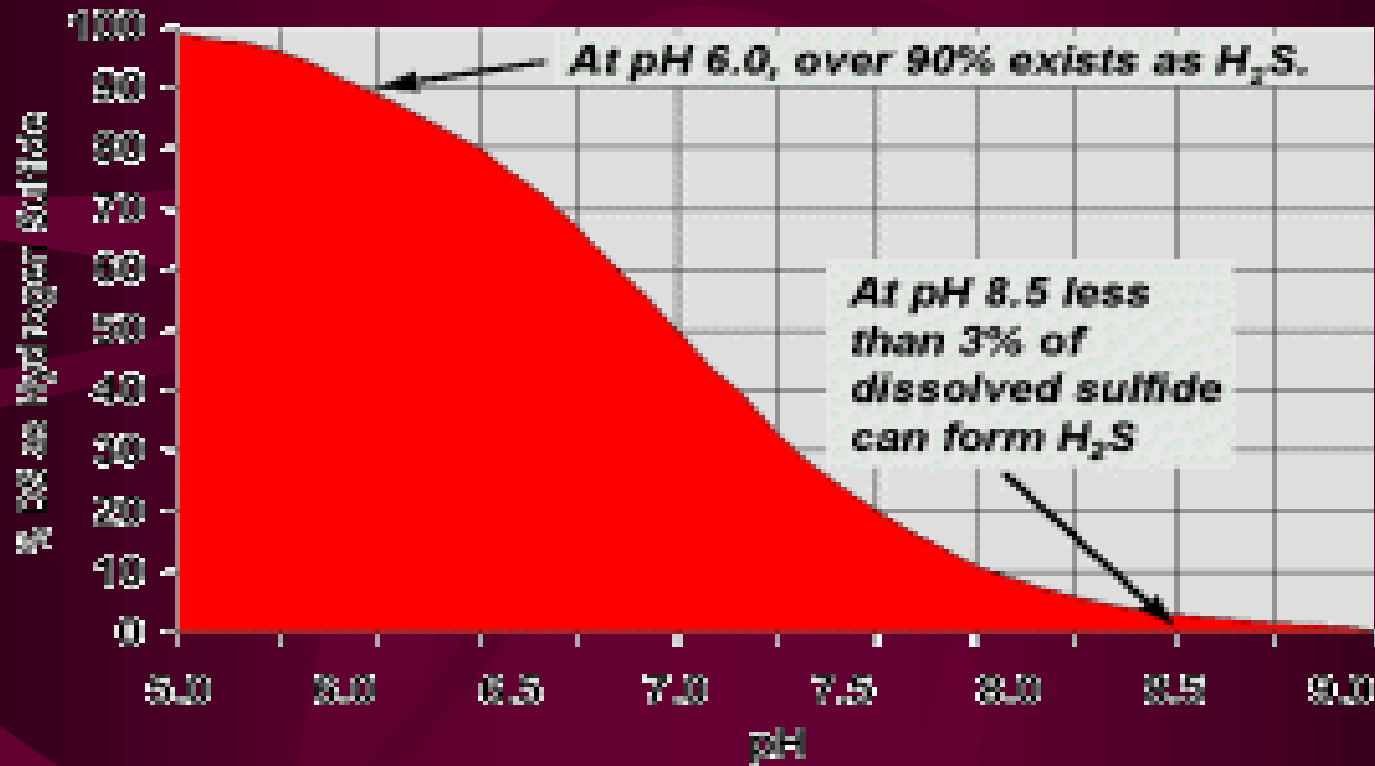
- Hydrogen sulfide (H_2S) is a product of stale sewage and has a rotten egg smell.
- Odors occur when waste water pH allows hydrogen sulfide to evolve from liquid phase hydrosulfide (HS^-).
- Steak, Cheeseburger, and 3-day old nachos.
 - O_2
 - NO_x
 - SO_x

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



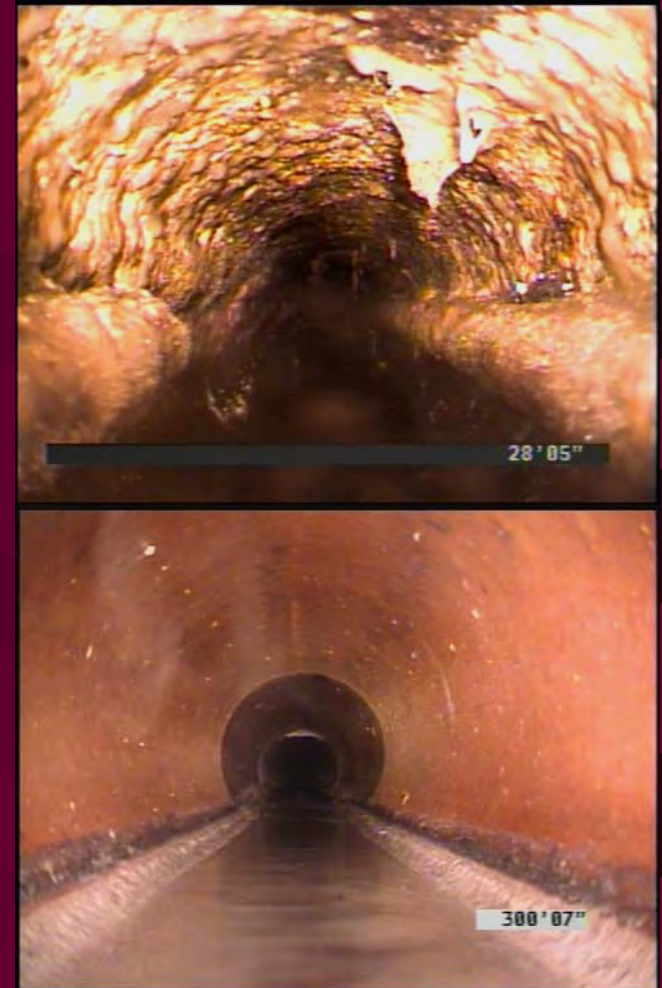
Hydrogen Sulfide - Corrosion

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



Collection System Challenges

- Solids deposition
 - Minimum 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



INFLOW AND INFILTRATION

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

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

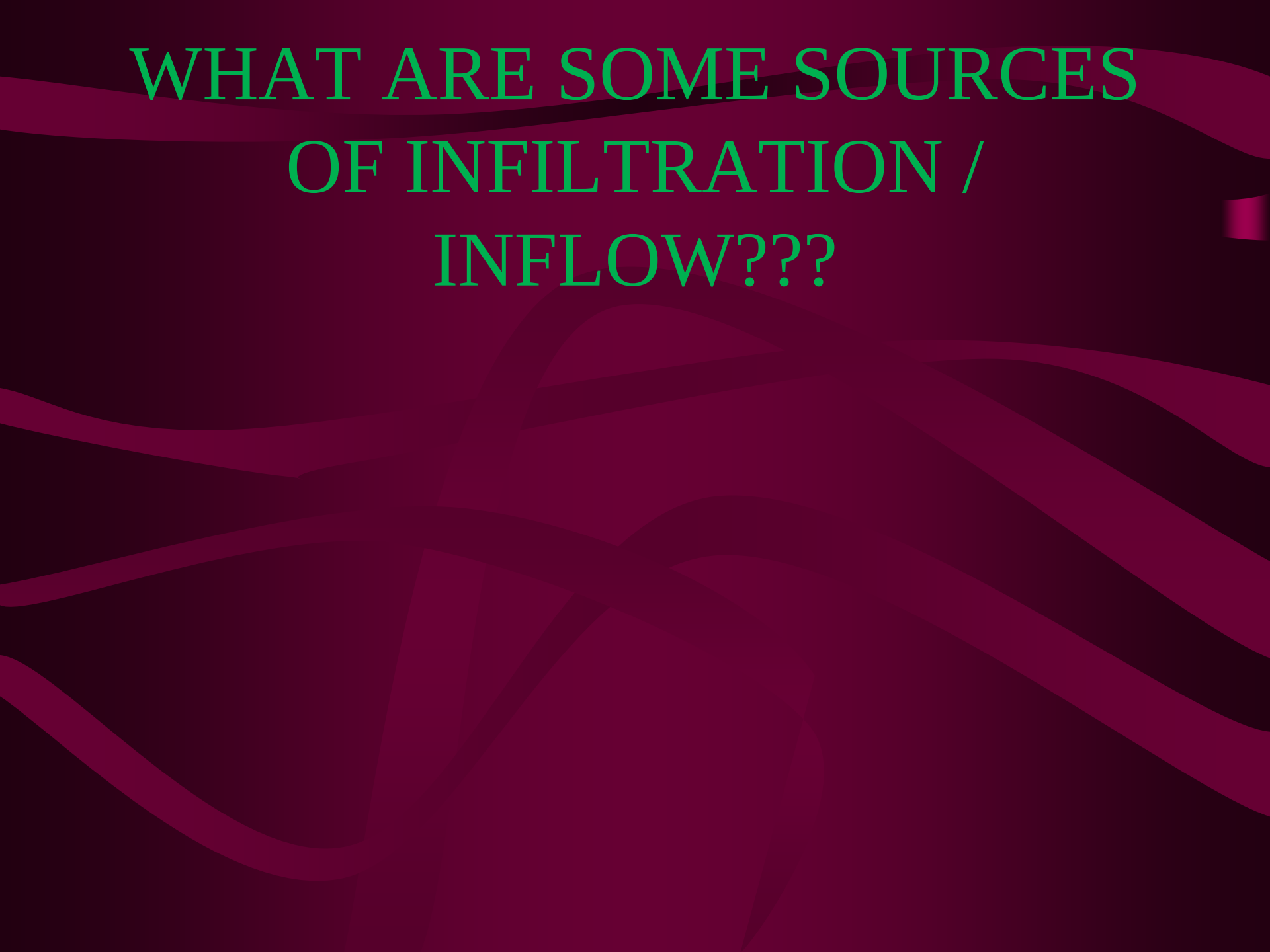
TABLE 2-1
Hydraulic Loading Data

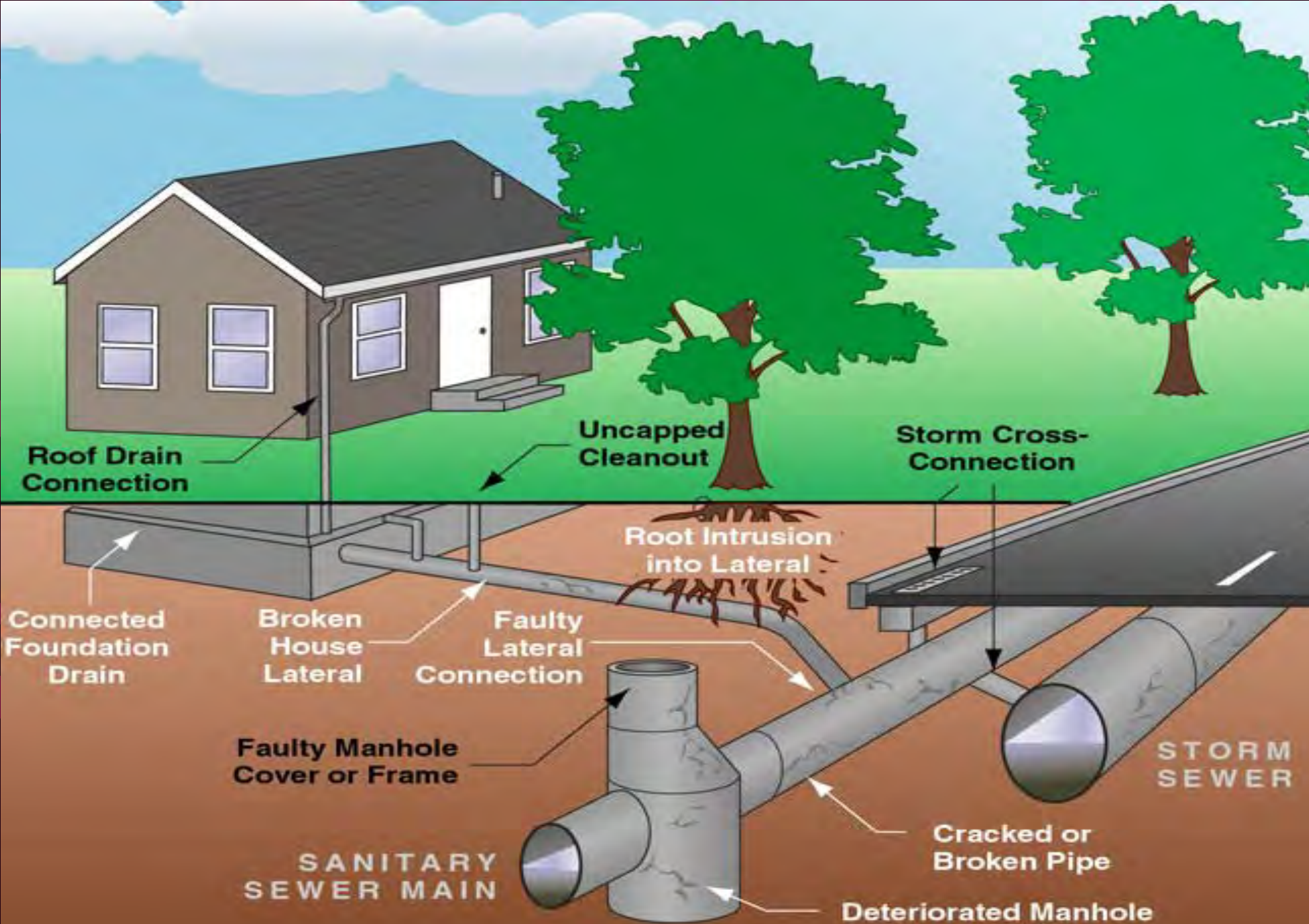
Borough of Orwigsburg
Wastewater Treatment Plant

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

WHAT ARE SOME SOURCES OF INFILTRATION / INFLOW???





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

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

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.

IMPORTANCE OF A SEWER SYSTEM MAINTENANCE PLAN

DOES ANYONE HERE
CURRENTLY HAVE A
SEWER SYSTEM
MAINTENANCE PLAN???

Overview of SSMP

- Preventive maintenance program
 - key to keeping a system in good repair.
- Helps keep capital investment while:
 - Preserving system interruptions
 - Eliminating excessive I&I
 - Minimizing system failures
- Developing a plan also helps you to better understand your system and how it works under various conditions.
- Captures staff knowledge



EPA - Components of a SSMP

- Section 1 – Collection System Management
- Section 2 – General System Information
- Section 3 – Cleaning, Inspection and Assessment
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- Section 6 – Pump Station / Force Main Maintenance

EPA - Components of a SSMP

- Section 7 – Reactive Maintenance
- Section 8 – Equipment and Tool Inventory
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Plan Champion



SECTION 1 – COLLECTION SYSTEM MANAGEMENT

Main Goals

- Prevent public health hazards
- Comply with regulations
- Minimize SSOs
- Minimize complaints
- Quick response
- Efficiently use funds (limited budgets)



Organization

- Identify administrative and maintenance personnel
- Define roles for the personnel
 - *Engineer - Bryon Killian: Prepares wastewater collection system planning and design documents, assists with funding applications, responsible for project oversight with observers to ensure new and rehabilitated projects are properly constructed.*
- Chain of command – reporting of SSOs, etc.

Training / Safety

- Mandatory training requirements
- Non-mandatory (requested) training
- Safety
- Job performance reviews /OJT
- New Employees



Customer Service

- Public relation activities:
 - Talking with schools and universities
 - Presentations to local officials/businesses
 - Presentations to citizens / media
- Compliant Management
 - Phone calls
 - Emails
 - Letters
 - Other



Information Management

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



Legal Authorities and Control

- Ordinances/Resolutions & Agreements

How can paperwork help manage your collection system?

- Design Review
- Sewer Rules and Regulations / Ordinances (Up-to-date)
- Control of improper (illegal) connections
- Connection Permits.
- Lateral and sewer extension inspection

Sewer Rules and Regulations / Ordinances

- Sewer Rules and Regulations / Ordinances should be enacted (**if you don't already have one**) to make it illegal to connect sump pumps, floor drains, rain leaders, etc. to the sanitary sewer system.
- Should include provisions for conducting inspections and penalties to ensure that residents comply.
- New connections sign connection ordinance to allow for inspections and denote that they will comply with ordinances.

Work with your solicitor.....

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

New Construction

- Pre-Construction Meeting:
 - Review of Contract Drawings
 - Review of Contract Specifications
 - Review Shop Drawing Requirements
 - Review Testing Requirements
 - Review Permits Requirements
- Provide Survey Control
- PA 1 Call Field Mark-ups
 - WALK THE JOB



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
 - Lateral piping and connections

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



Construction Inspection

- Record Keeping:
 - Daily Reports
 - Progress of the work
 - Work Conditions
 - Problems Encountered
 - Monthly Reports
 - Payment Quantities
 - As-built Drawings

+0000.0ft+

Thomson

25

Hagan Run

22

PVC Polyvinyl Chloride, C Circular

SECTION 2 – GENERAL SYSTEM INFORMATION

General System Information

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

General System Information

- SSO History
- System Map
 - As-Built



Collect /Analyze Available Data

- Previous I&I / Maintenance Identification
- Previous I&I / Maintenance Elimination Work
- Recent Construction
- As-built Drawings
- Customer Complaints
- Observed Overflows

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 the 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.

Mapping

- You must know what you have before you can assess its condition! At least an idea.
 - Existing Mapping / Available Data
 - Field locate MH / Pump Stations / Overflow Points (CSO & SSO) / Critical Monitoring Points / Etc.
 - Name each facility.
 - Operator Updates – they know more than what is on the map.
 - GIS Mapping
 - Database creation
 - Future prioritization.

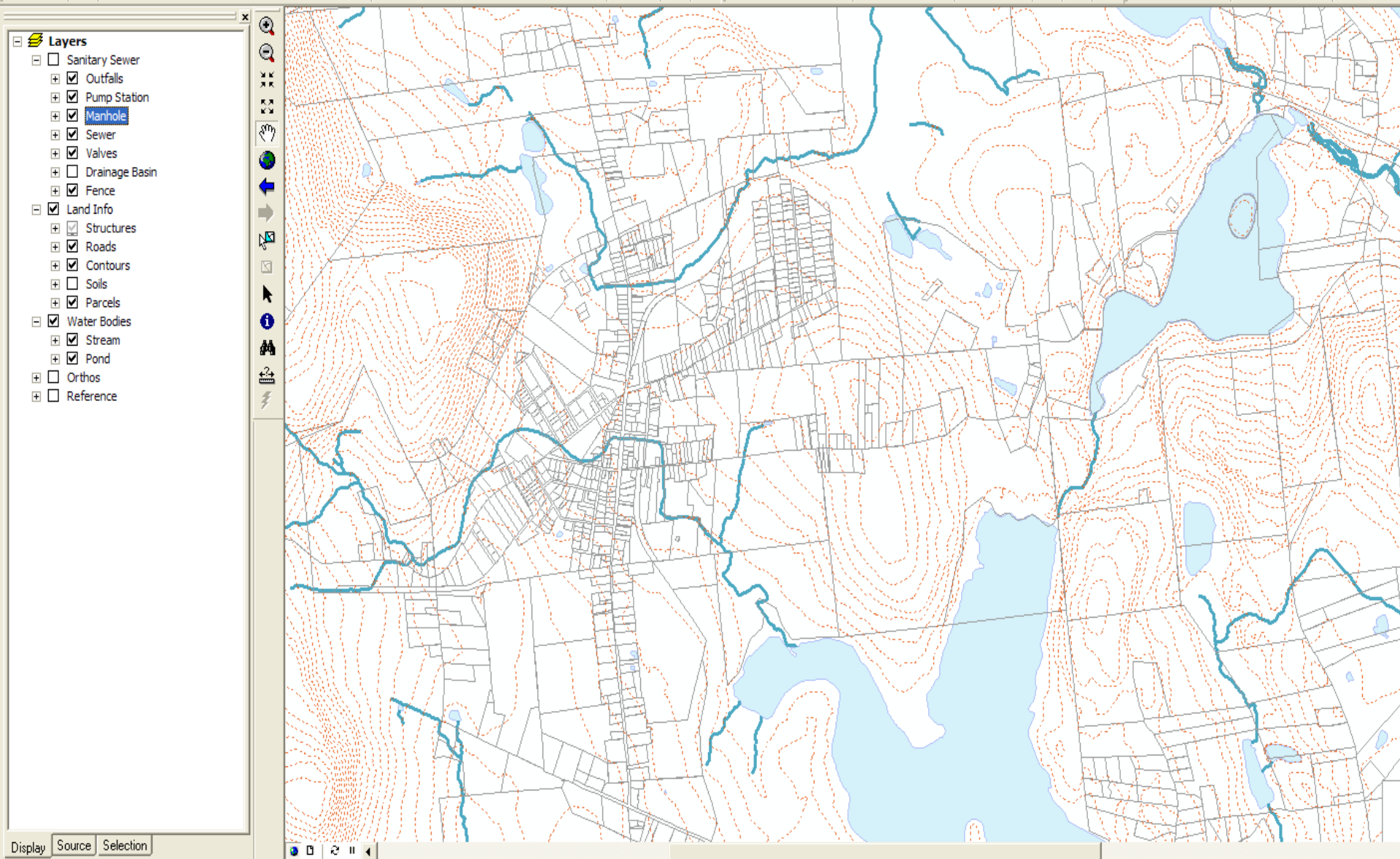
Mapping

- 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.
 - Its possible it is there.

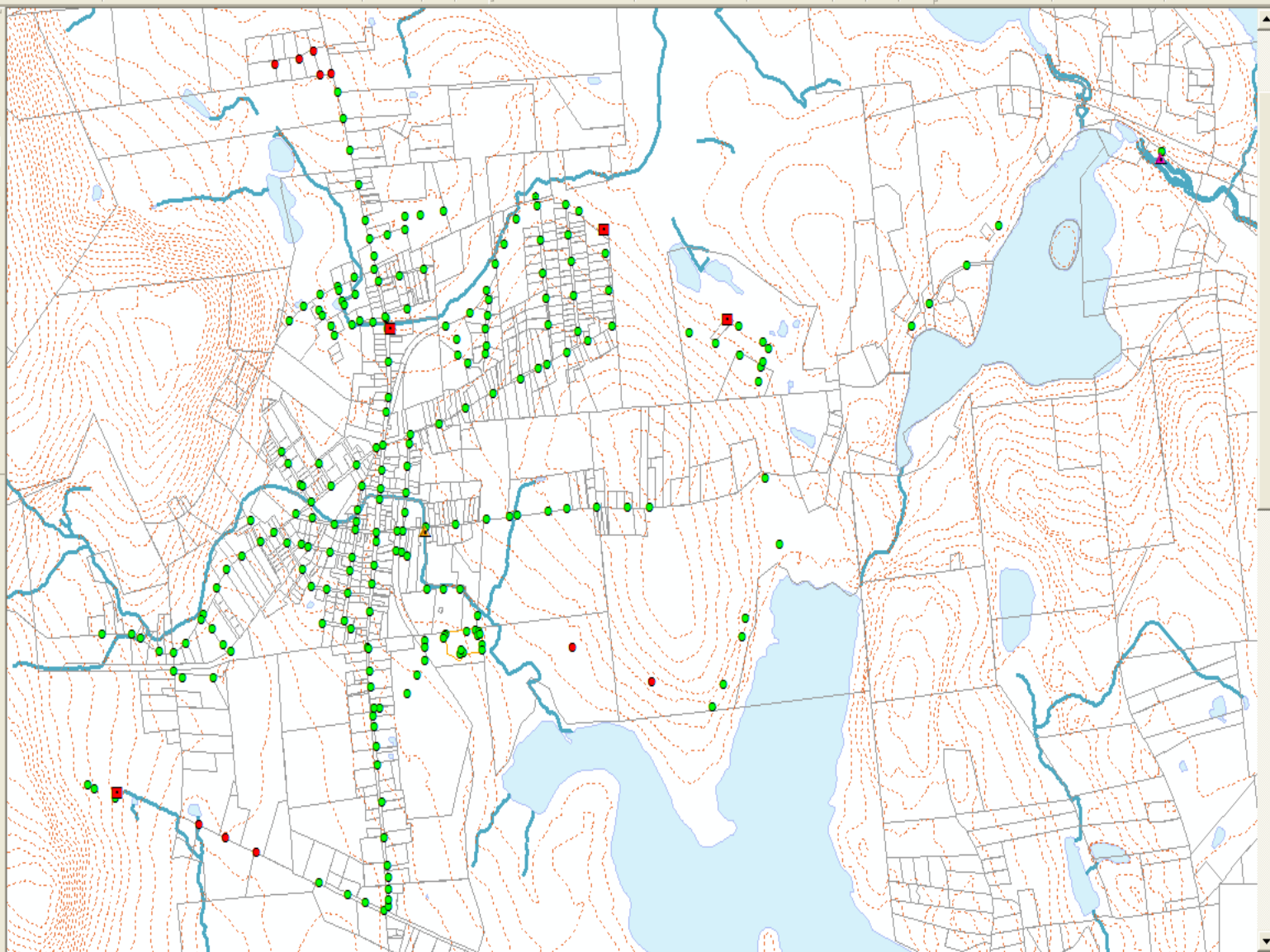
GPS FIELD EQUIPMENT



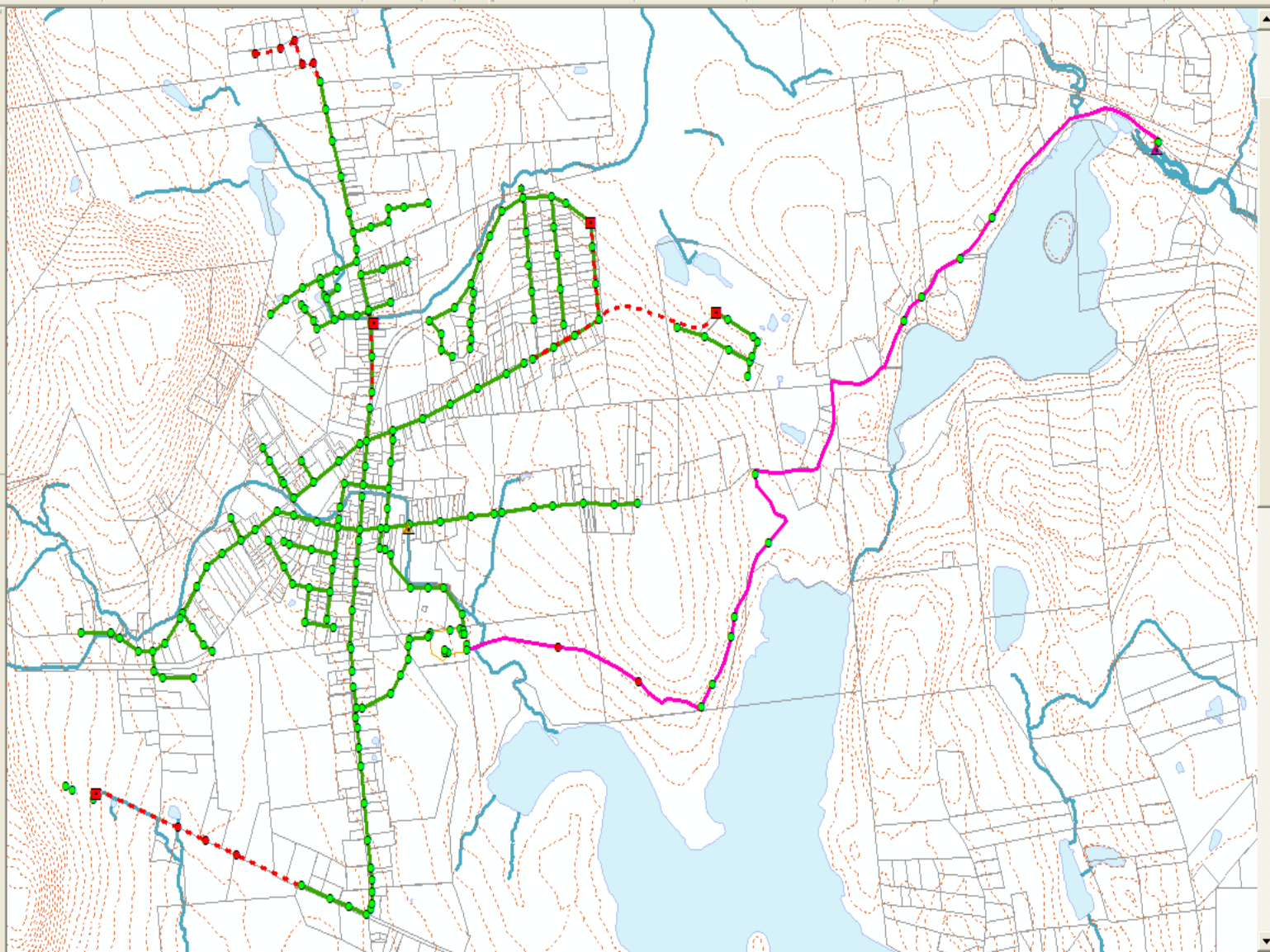


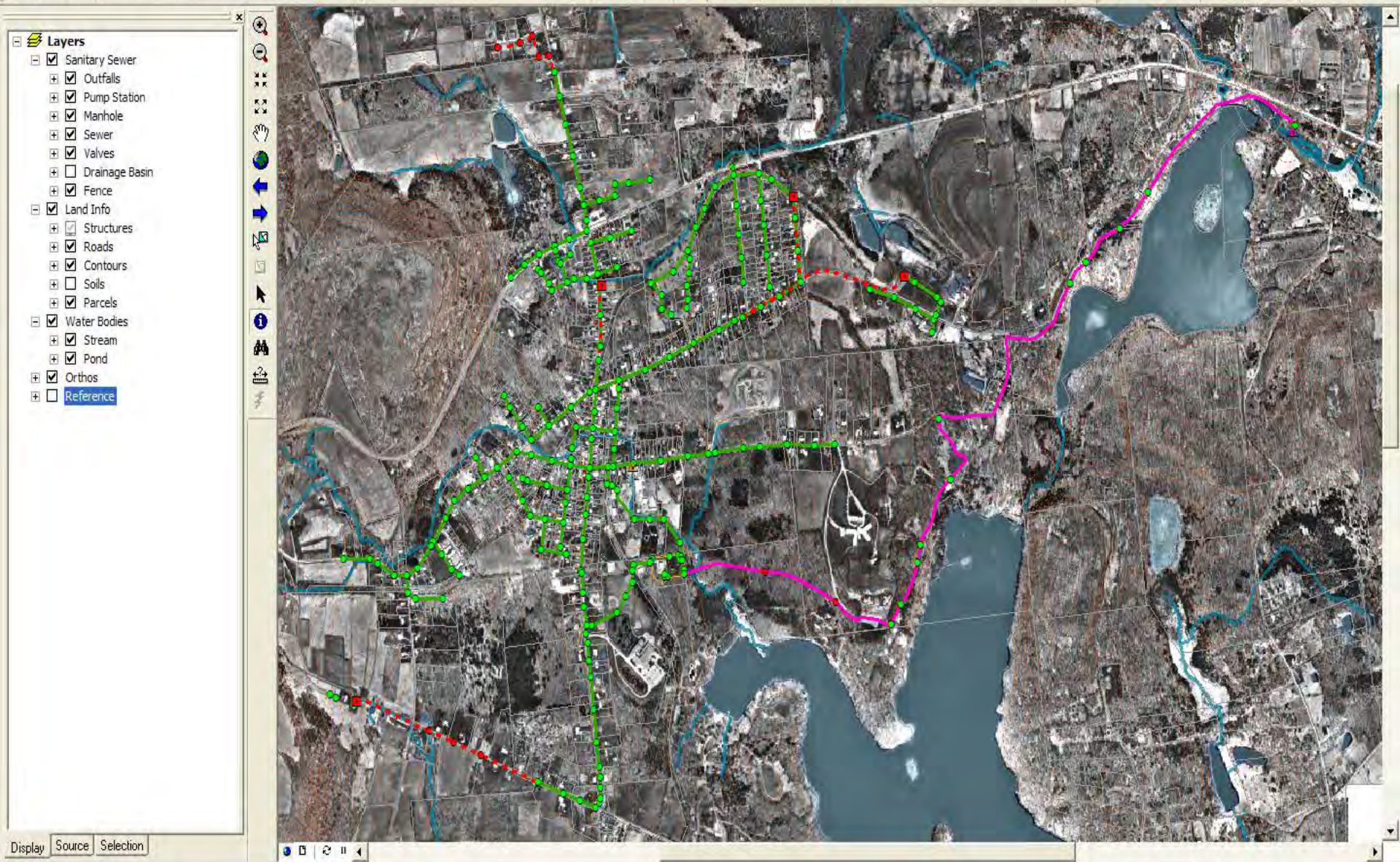


- Layers**
- ☒ Sanitary Sewer
 - ☒ Outfalls
 - ☒ Pump Station
 - ☒ Manhole
 - ☐ Sewer
 - ☒ Valves
 - ☐ Drainage Basin
 - ☒ Fence
 - ☒ Land Info
 - ☒ Structures
 - ☒ Roads
 - ☒ Contours
 - ☐ Soils
 - ☒ Parcels
 - ☒ Water Bodies
 - ☒ Stream
 - ☒ Pond
 - ☐ Orthos
 - ☐ Reference



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- ☒ Sanitary Sewer
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 - ☒ Parcels
 - ☒ Water Bodies
 - ☒ Stream
 - ☒ Pond
 - ☐ Orthos
 - ☐ Reference





GIS Database Development

Left Pipe Section			Right Pipe Section		
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

1:16,284

Editor Task: Create New Feature Target: Spatial Adjustment

Layers

- ☒ Sanitary Sewer
 - ☒ Outfalls
 - ☒ Pump Station
 - ☒ Manhole
 - ☒ Sewer
 - ☒ Valves
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 - ☐ Soils
 - ☒ Parcels
- ☒ Water Bodies
 - ☒ Stream
 - ☒ Pond
- ☐ Orthos
- ☐ Reference

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_RPH	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\VC-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

1:16,284

Editor

Task: Create New Feature

Target:

Spatial Adjustment

Layers

- ☒ Sanitary Sewer
 - ☒ Outfalls
 - ☒ Pump Station
 - ☒ Manhole
 - ☒ Sewer
 - ☒ Valves
 - ☒ Drainage Basin
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- ☐ Reference

28-2 - Windows Picture and Fax Viewer



Identify Results

Layers: <Top-most layer>

Manhole

28

Location: (2609088.503844 524494.126580)

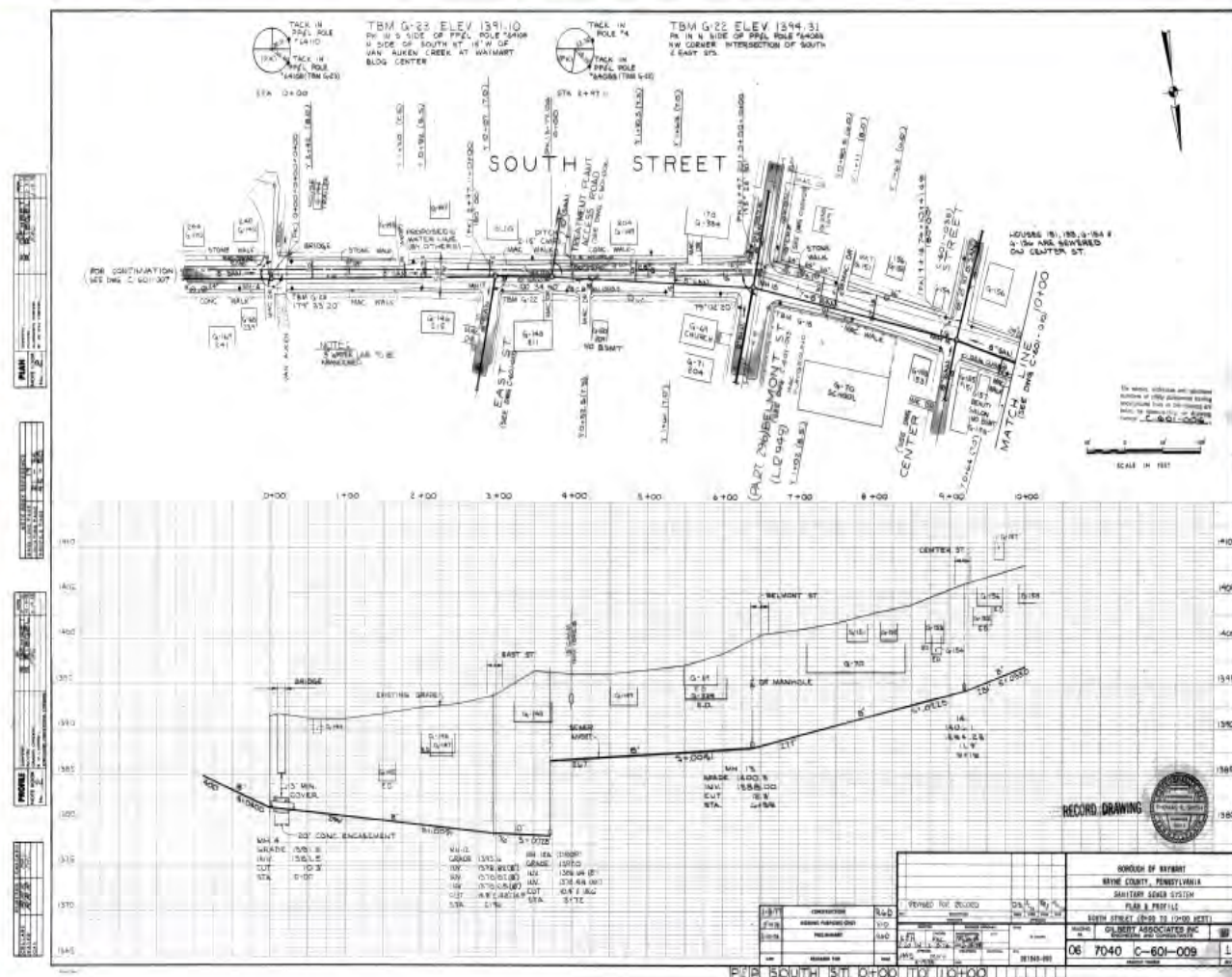
Field	Value
OBJECTID	11
Shape	Point
MH_NO	28
CORR_TYPE	Postprocessed Code
GPS_DATE	9/6/2005
GPS_TIME	09:25:37am
GPS_HEIGHT	1402.61
INSPECTOR	Bryon Killian
INSP_DATE	9/6/2005
SUB_BASIN	2
DEPTH_INV	103
WEATHER	Dry
GRND_SURFC	Asphalt
DRAIN_PATH	Outside
FC_LETTRNG	Sanitary Sewer
FC_ADJUST	11
FC_SIZE	30
FC_CONDTN	Good
FC_COVER	Regular
FC_RPH	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\VC-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.

Display Source Selection

2607717.41 529342.44 Feet

- | Display | Source | Selection |
|---------|--------|-----------|
|---------|--------|-----------|

File Edit View Window Help



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. For example, GIS can integrate multiple utilities, such as water, wastewater, and storm water systems, in a single information system.

Mapping

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



HOUR 2

SECTION 3 – CLEANING, INSPECTION, AND ASSESSMENT

Cleaning, Inspection and Assessment

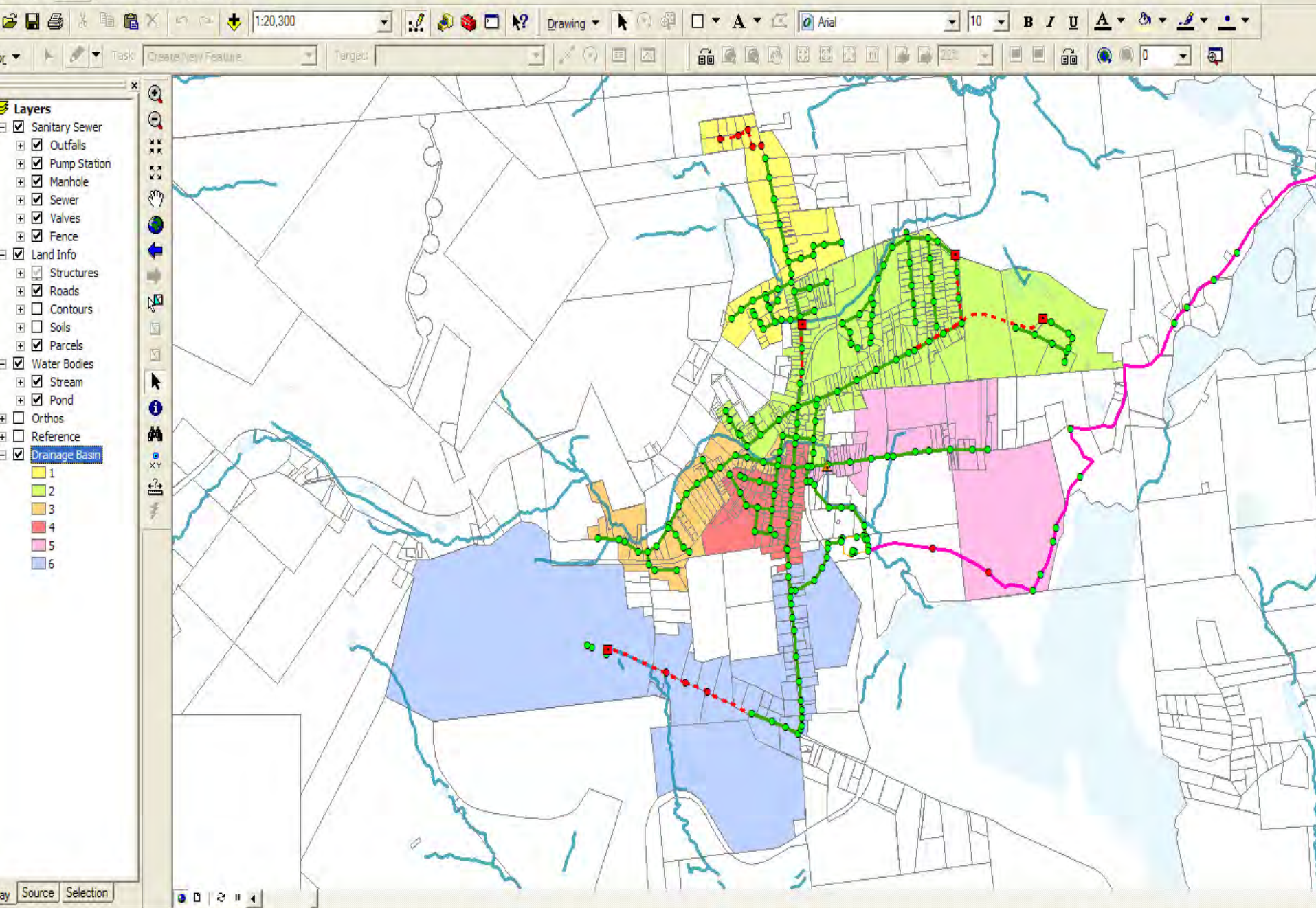
- Cleaning
 - Sags
 - Trouble areas
 - Roots
 - Critical Service Areas
 - Hospitals
 - Schools
 - Prisons
- MH and Pipe Inspection / Assessment
- Staffing and Equipment



Easier to Chew

- The sanitary sewer system should be broken down into basins (multiple pump stations) and later possibly sub-basins for future investigation.





Manhole Visual Inspections

- MH inspections should denote such items as:
 - MH Location / Drainage path
 - MH to MH connections
 - Pipe Sizes
 - Structural Condition
 - Active / Evidence of Infiltration (staining/debris)
 - Evidence of Inflow (staining/debris)
 - Cycled flow
 - Clear flow
 - Increase or decrease in quantity of flow
 - Etc....

The background features a dark blue field with several wavy, horizontal lines in a lighter blue shade. A large, semi-transparent number '4' is positioned in the lower-left quadrant. Centered on the slide is the following text:

REVIEW OF SAMPLE MH
INSPECTION FORM & STEP
BY STEP ON HOW TO
COMPLETE FORM



ENTECH ENGINEERING, INC
MANHOLE INSPECTION REPORT

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

PROJECT: _____
MANHOLE: _____

III. VISIBLE INFILTRATION

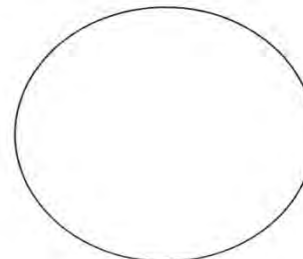
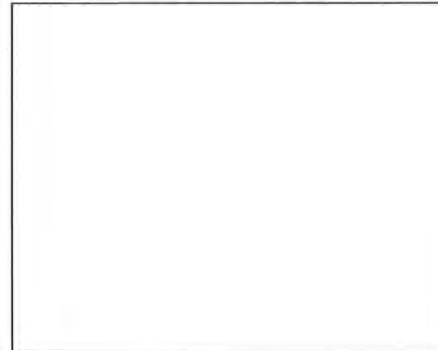
Frame & Cone: _____ GPM
Frame & Risers: _____ GPM
Cone & Risers: _____ GPM
Through Walls: _____ GPM
Through Wall Joints: _____ GPM
Around Pipe: _____ GPM
Through Inverts/Bench: _____ GPM

Pictures: _____

Remarks: _____

- If None – Write "None"

LOCATION SKETCH



Manhole Visual Inspections



Manhole Rehabilitation

- Manhole Grouting
- Cementitious Restoration
- Polymers
- Manhole Cured-in-place liners
- Panel Liners
- Chimney Seals
- Barrel Joint Seals
- Pre-cast inserts

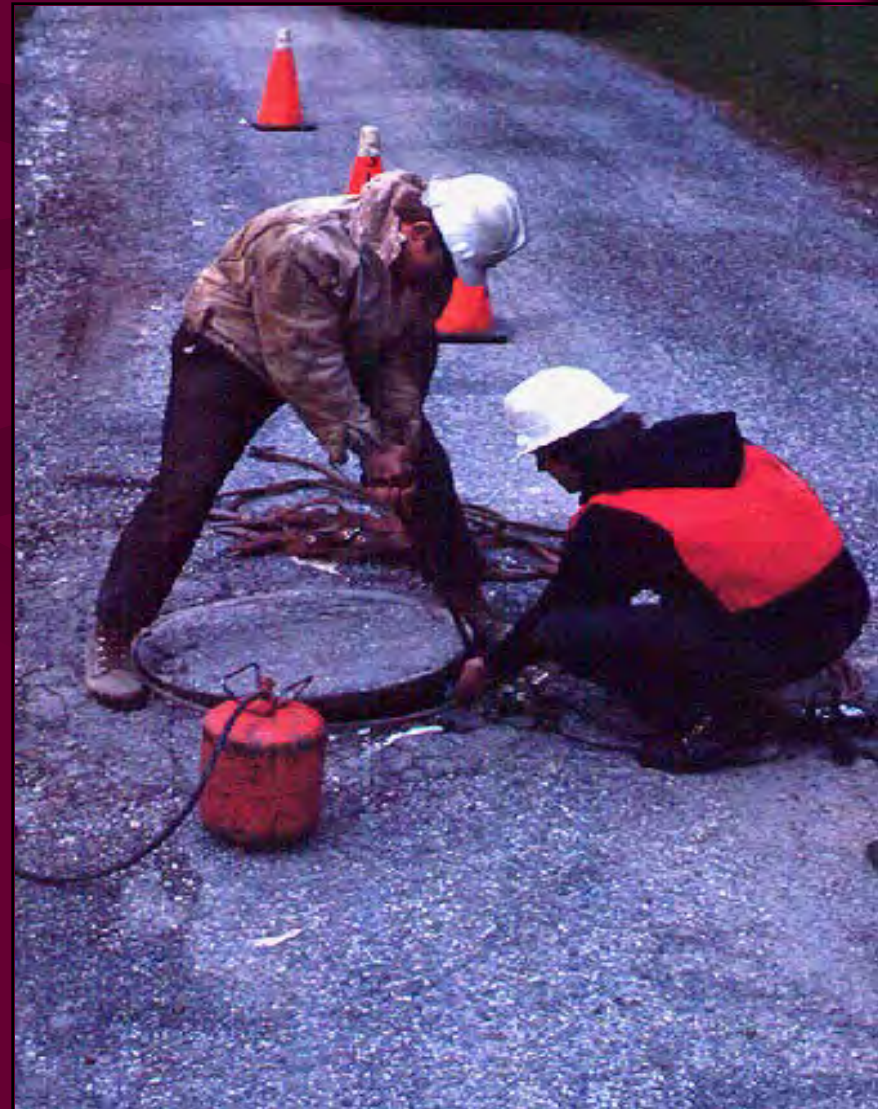


Pump Station Visual Inspections



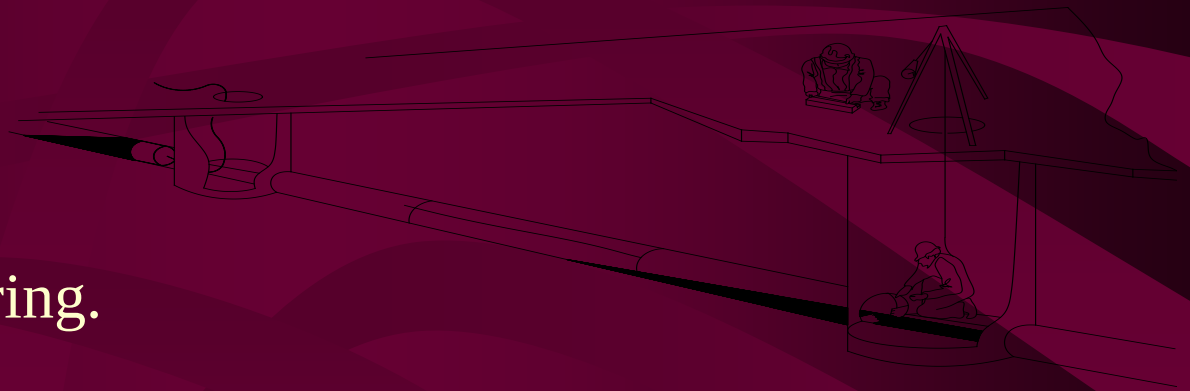
Wet Weather / Night time Investigations

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



Flow and Rainfall Monitoring

- Flow Monitoring.
 - Instantaneous
 - Short-term
 - Long Term
 - Permanent
- Rainfall Monitoring.
- “6/8” guideline.
 - 6 to 8 weeks with 6 to 8 rainfall events
 - Like to see at least 2 events with 1-inch or better.



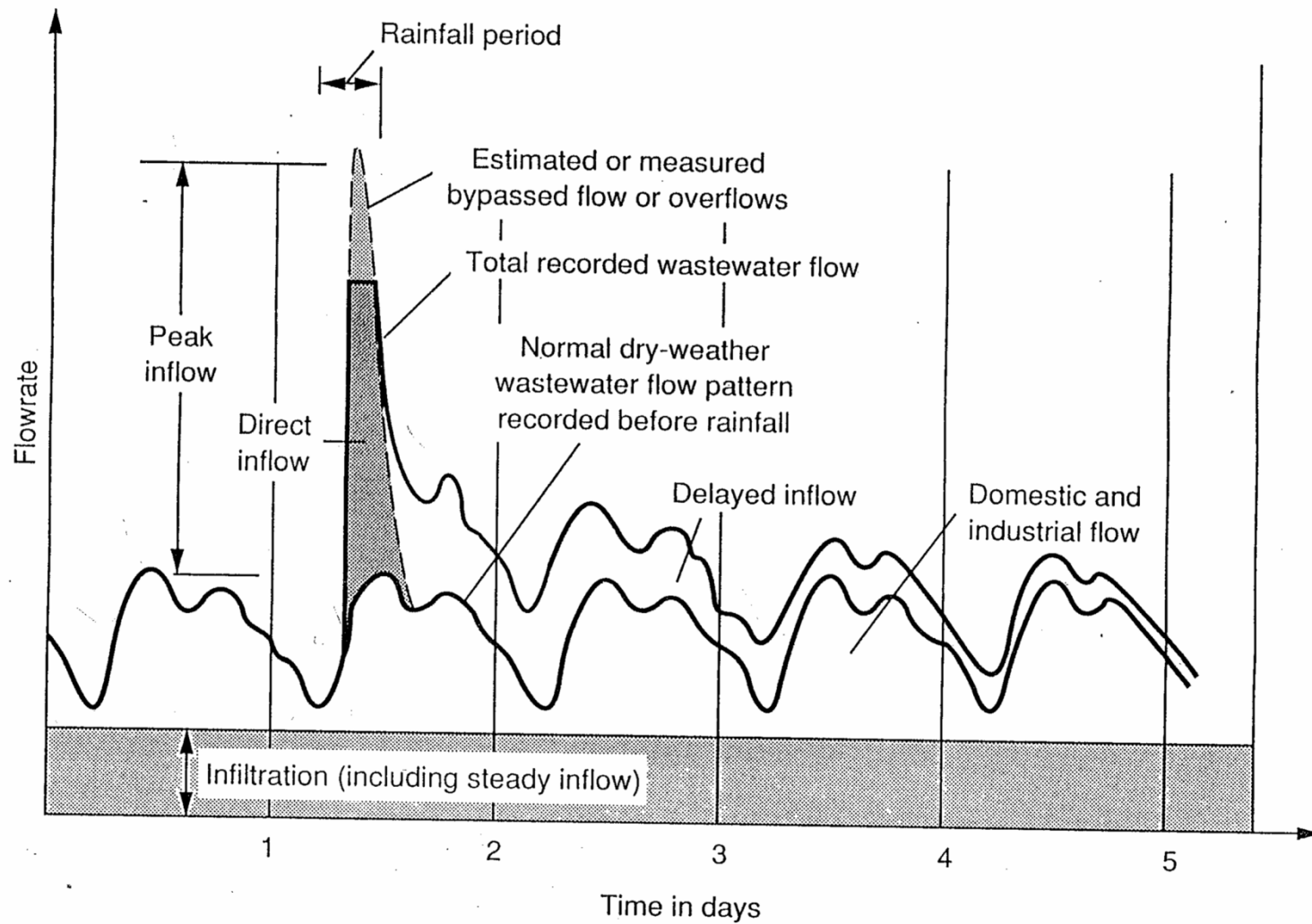
Flow and Rainfall Monitoring

- To measure wastewater flows through the sanitary sewer system it is important to select the appropriate flow meter and location.
- The measured flow correlated to the time of day and precipitation will determine whether the system is susceptible to infiltration, inflow, or both.

Flow and Rainfall Monitoring

Do I mainly have I or I?

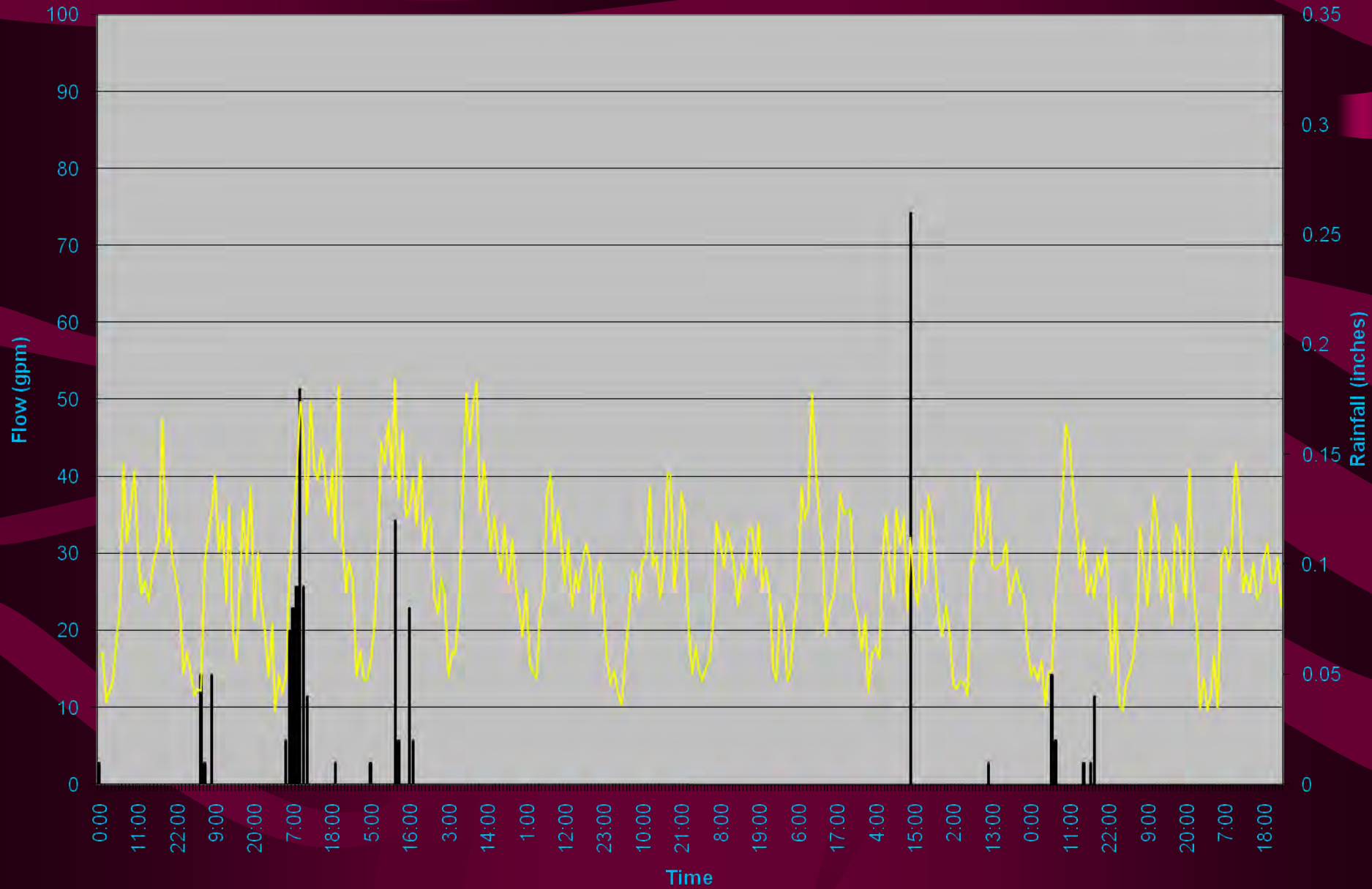
- Methods for determining Quantity of Inflow
 - Graph wastewater flows and denote precipitation and spikes within the graph.
- Methods for determining Quantity of Infiltration
 - Nighttime flows during dry weather conditions.



REVIEW OF SAMPLE FLOW
MONITORING CHART &
AUDIENCE PARTICIPATION
ON WHAT IF ANYTHING
CAN WE TELL BE THE
CHART

Weeks 7 & 8 - DRAINAGE AREA NO. 2
6 JULY 12 to 19 JULY 12

Rainfall
Drainage Area 2



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.



Dye Testing

- Verification of suspect sources
 - Roof leaders
 - Storm Inlets
 - Unknown pipes



Building Inspections

- Roof Leaders
 - Smoke Testing
 - Dye Testing
- Sump Pumps
 - Dye Testing
- Basement/Driveway/Yard Drains
 - Smoke Testing
 - Dye Testing
- Others



Building Inspections

- Most residents are unaware whether they have these types of connections and that they are illegal.
- Notify and Educate the Public.
 - Notify and educate the public about I&I problems and the steps that you are taking to reduce I&I.
 - Mailings with utility bill, newspaper announcements, and on web sites.
 - Informed residents will understand the nature and impact of I&I problems and will be more likely to voluntarily correct illegal connections and consent to inspections.
- Allow grace periods for compliance.

Building Inspections

- An 8-inch diameter sewer can adequately move the domestic wastewater flow from up to 200 homes, which is roughly equivalent to:
 - 8 Sump Pumps operating at full capacity.
 - A single sump pump can contribute over 7,000 gpd, which is equal to the average daily flow from 26 homes.
 - 6 homes with downspouts connected

REVIEW OF SAMPLE HOME INSPECTION FORM & STEP BY STEP ON HOW TO COMPLETE FORM

BUILDING SEWER INSPECTION PROGRAM - rev. 10.5.09

(7)

Roof Drains/Leader

Roof drains and leaders direct storm water from roof gutters to the ground through pipes and downspouts. Roof drains should not be connected to the sanitary sewer but should discharge to the ground outside of a building. If your roof drains are connected to the sanitary sewer, disconnect them, plug any open connections to the sanitary sewer using a non-shrink permanent material, and redirect the roof drains onto the ground outside the building.

N/A

Foundation Drains

Foundation drains are underground pipes that collect storm water from around the base of a building and into a sump basket, where it is then pumped outside of the building. Foundation drains should not be connected to the sanitary sewer. The process could involve excavation to disconnect the foundation drain from the sanitary sewer and installation of a sump pump system. The new sump system must pump directly to the ground outside of the building or be connected to the storm sewer system.

N/A

Floor Drains

Floor drains are designed to capture surface or ground water that enters basements or crawl spaces. Floor drains should not be connected to the sanitary sewer. The process could involve excavation to disconnect the floor drain from the sanitary sewer and redirect to the storm system or installation of a sump pump system. The new sump system must pump directly to the ground outside of the building or be connected to the storm sewer system.

(1)

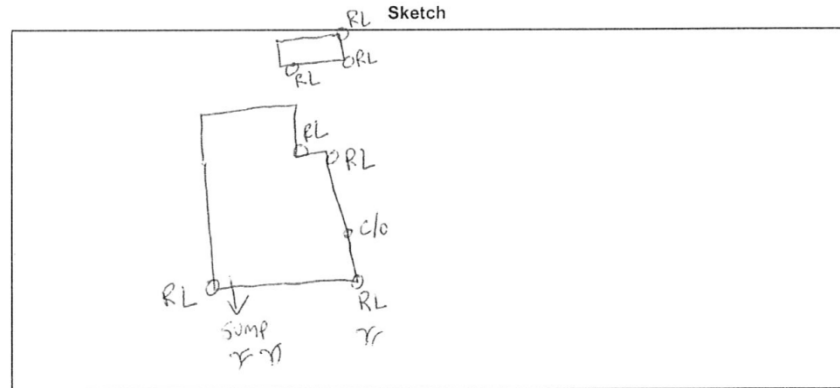
Sump Pump Systems

Sump pumps are designed to capture surface or ground water that enters basements or crawl spaces and pump it away from the house. The basic sump system includes drain tile, a sump pit, a sump pump, a float or switch, and a drain line. The sump pit extends below the slab and collects surface water that enters the basement/crawl space or groundwater that rises to the slab. Sump pumps should not be connected to the sanitary sewer. Sump pumps should drain into the storm sewer system through one of two methods: a direct connection (a pipe from the house to the main storm sewer line), if available, or directly onto the ground (preferably 20 feet from the house and not into a neighbor's yard).

NOT
LOCATED

Vents and Cleanouts

Vents and cleanouts are designed to vent sewer gases and provide lateral access for maintenance. Low lying and/or broken vents and cleanouts can be responsible for extraneous flow entering the sanitary sewer system. Inspections to be made on existence, location, and structural condition of vents/cleanouts.



INITIAL INSPECTION

Inspector Name:

BRYON KILLIAN

Inspector Signature:

[Signature]

Home Owner Name:

N/A - FOR SALE

Home Owner Signature:

N/A

House Address:

13 BIRCH STREET

Date:

11/27/09

Problems Identified:

NONE

Solutions Identified:

N/A

FOLLOW-UP INSPECTION (IF NECESSARY) - WITHIN 30 DAYS FROM INITIAL INSPECTION

Follow-up Inspection Date:

N/A

Have all issues been corrected:

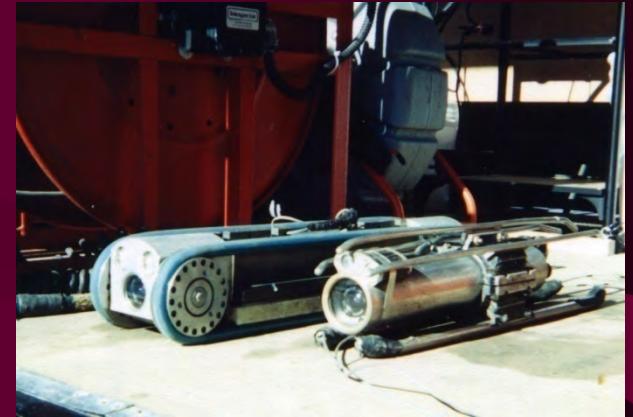
N/A

BOROUGH OF ORWIGSBURG

- Created GIS Mapping and completed MH Inspections
- Organized a lot of data from many years of I&I investigation
- Developed priority list
- Conducted 2 MH Rehabilitation Projects
- Started Home Inspections
 - 44 Downspouts
 - 77 Floor Drains
 - 21 Sump Pumps
 - 43 Low Lying Cleanouts
 - 9 Others
- Wet Weather Inspection

Cleaning / CCTV Pipe Inspection

- Cleaning
 - Debris Removal
 - Root removal
- CCTV Pipe Inspection
 - Maintenance
 - Structural
 - I&I



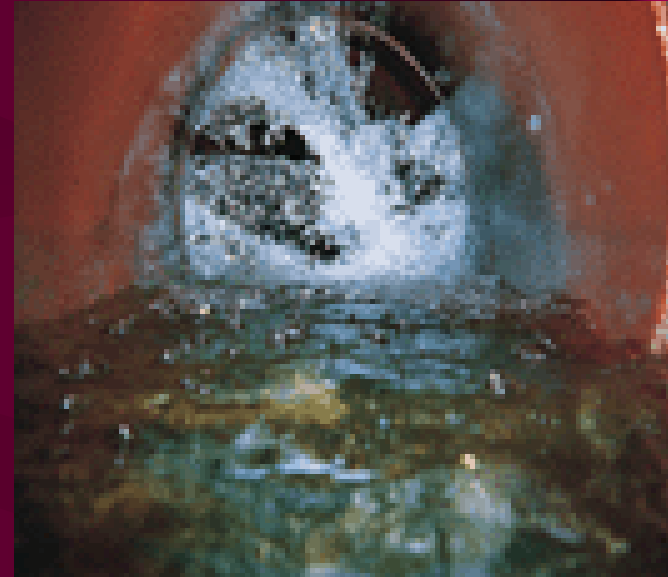
Lateral Inspection

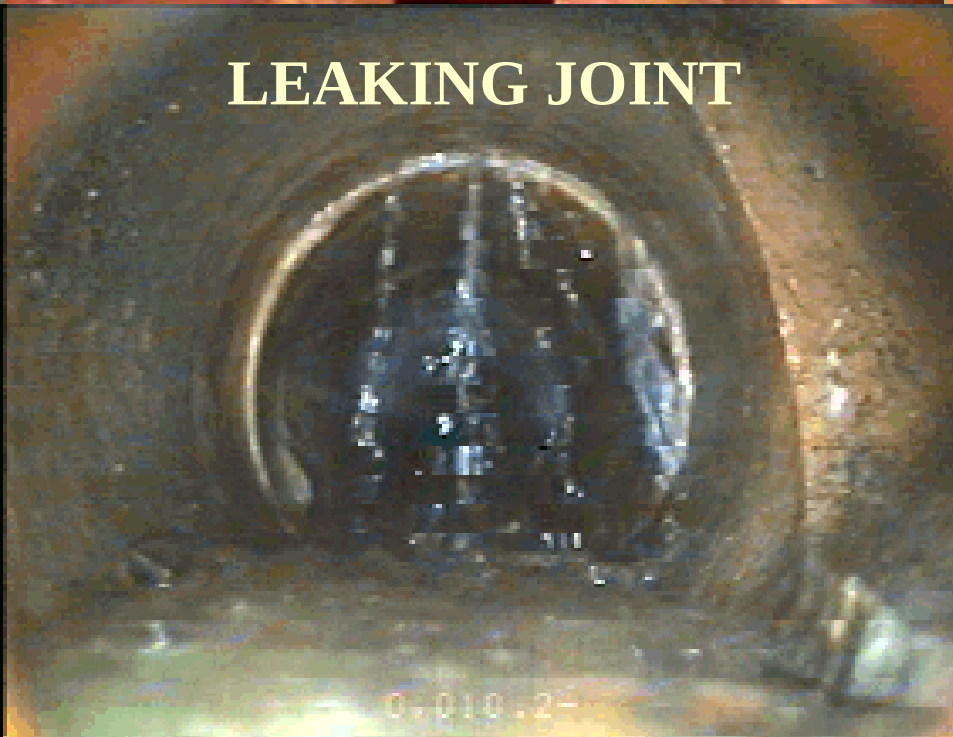
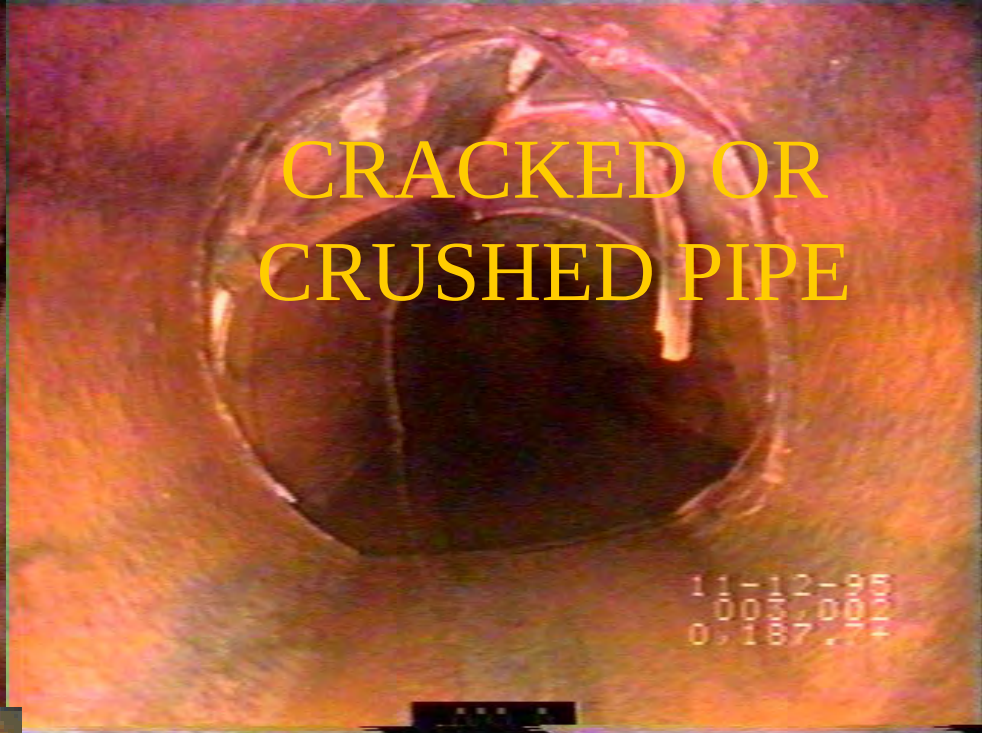
- Lateral CCTV
 - Push Camera
 - From cleanout towards main line
 - Self-propelled
 - From main line up the lateral
- Pressure Testing
 - Air
 - Water



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)





431A	19.77	Roots Fine Joint, from 06 to 09 o'clock, within 8 inches of joint: YES	00:02:01	
	19.97	Crack Longitudinal, at 12 o'clock, within 8 inches of joint: YES	00:02:36	2_3A
	22.97	Tap Factory Made Capped, at 03 o'clock, 6", within 8 inches of joint: YES	00:03:23	
	36.05	Fracture Circumferential, from 12 to 12 o'clock, within 8 inches of joint: NO	00:04:31	2_5A
	37.85	Tap Factory Made, at 03 o'clock, 6", within 8 inches of joint: YES	00:05:10	
	53.35	Joint OR Seal Missing	00:05:58	2_7A
	54.83	Fracture Circumferential, from 12 to 12 o'clock, within 8 inches of joint: YES	00:06:24	2_8A
	55.75	Infiltration Dropper, at 03 o'clock, within 8 inches of joint: YES, REMARK: Evidence of Infiltration	00:06:46	2_9A
	64.02	Tap Factory Made Capped, at 03 o'clock, 6", within 8 inches of joint: YES	00:07:31	
	74.40	Crack Longitudinal, at 12 o'clock, within 8 inches of joint: YES	00:08:26	2_11A
	131.43	Hole, from 12 to 06 o'clock, within 8 inches of joint: YES	00:13:33	2_12A
	132.03	Tap Factory Made Capped, at 09 o'clock, 6", within 8 inches of joint: YES	00:13:56	
	142.91	Tap Factory Made Capped, at 03 o'clock, 6", within 8 inches of joint: YES	00:14:39	
	149.10	Tap Break-In Active, at 11 o'clock, 6", within 8 inches of joint: YES	00:15:20	
	149.10	Survey Abandoned, REMARK:	00:15:20	2_16A

Typical Sewer Main Defects

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

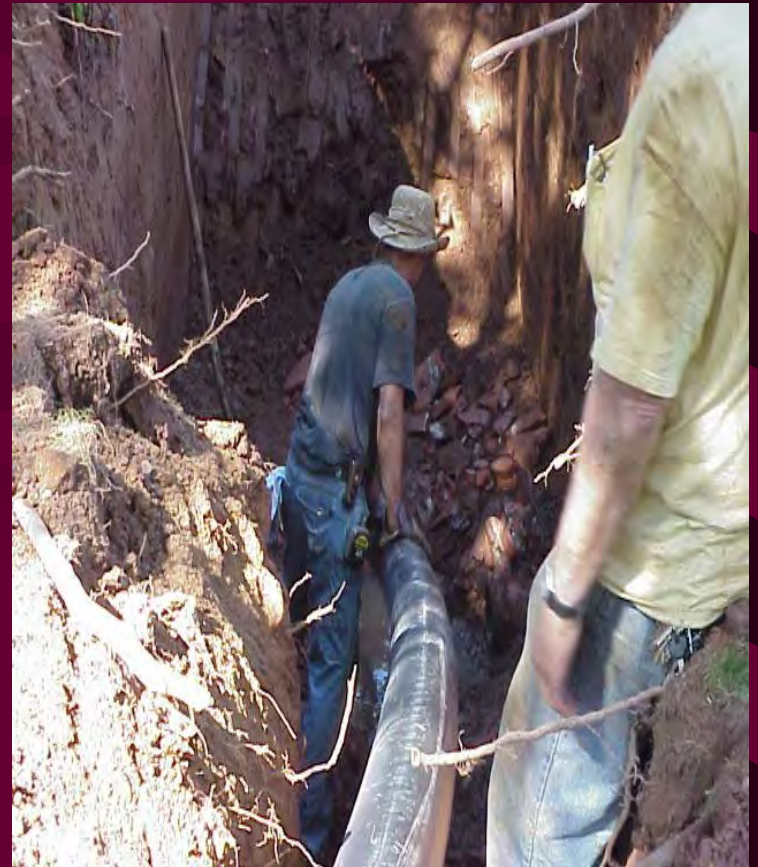


Main Line Replacement versus Rehabilitation

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

Main Line Rehabilitation

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



SECTION 4 – GRAVITY LINE PREVENTATIVE MAINTENANCE

Gravity Line Preventative Maintenance

- FOG Control
 - Significant cause of sewer blockages
- Root Control
 - Significant cause of sewer blockages
- Service Laterals
 - Home change over

SECTION 5 – EASEMENTS
AND PAVING:
MAINTENANCE AND
ACCESS

Easements and Paving: Maintenance and Access

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



HOUR 3

SECTION 6 – PUMP STATION & FORCE MAIN MAINTENANCE

Pump Stations

- Two main types of pumping stations
 - Wet well / Dry Well
 - Pumps, motors, electrical controls and auxiliary equipment are located in the dry well.
 - Submersible
 - Submersible pumps placed in wet well
 - Quick Disconnect.
- Alarm Systems
- Emergency Operation
- Operator Training and Maintenance
 - Good operation is just as important as a good design.

Wet Wells

- Size and control setting shall be appropriate to void heat buildup in the pump motor due to frequent starting and to avoid septic conditions due to excessive detention time.
- Detention Time
 - Not to exceed 10 minutes for the maximum monthly flow.
- Sloping Floor
- Ventilation

Types of Pumps

- Two main types of pumps used:
 - Centrifugal
 - Positive Displacement
- Cars on a highway - Joe Evans, PhD

Pump Controllers

- Four main types of pump controllers used:
 - Floats
 - Sometimes used just as a high-level alarm
 - Ultrasonic Measurement
 - Pressure transducers
 - Air Bubblers
- NEC Requirements for Class 1, Division 1, Group D
- Location
 - Away from high turbulence

Valve Vaults

- Three main types of valves used:
 - Gate Valves
 - Plug Valves
 - Check Valves
 - Between the shut-off valve and the pump
 - Horizontal versus vertical position
 - Ball check valves
- Odor and Corrosion Issues
- Space inside vault
 - Pig Launching Facilities
 - Bypass Pump Connections

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

Pump Station / Force Main Maintenance

- Mechanical and Electrical Maintenance
- Force Main Maintenance
- Private Pump Stations
- Corrosion Control

PUMP STATION DRAWDOWN

EXAMPLE CALCULATIONS



SECTION 7 – REACTIVE MAINTENANCE

Reactive Maintenance (unplanned events)

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



SECTION 8 – EQUIPMENT AND TOOL INVENTORY

Equipment and Tool Inventory

- Essential day-to-day items
- Spare equipment and tools





EQUIPMENT AND TOOL LIST

AUDIENCE PARTICIPATION

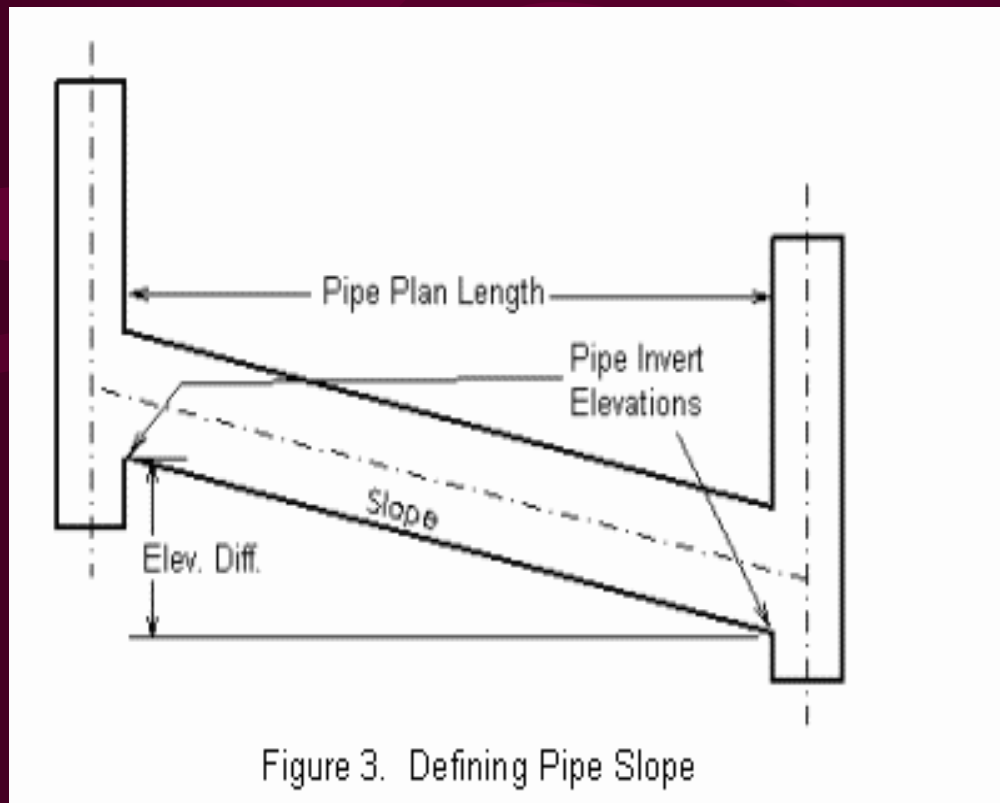
SECTION 9 – CAPACITY MANAGEMENT

Capacity Management

- Sewer Capacity Certification / Connection Policy
 - Any new developments
 - Work on existing
- Lateral Replacement Program

PIPE SLOPE / CAPACITY

EXAMPLE CALCULATIONS



Pipe Slope and Size

- Ratio of change in vertical distance to the change in horizontal distance.

MH Run of 8-inch pipe = 400 feet

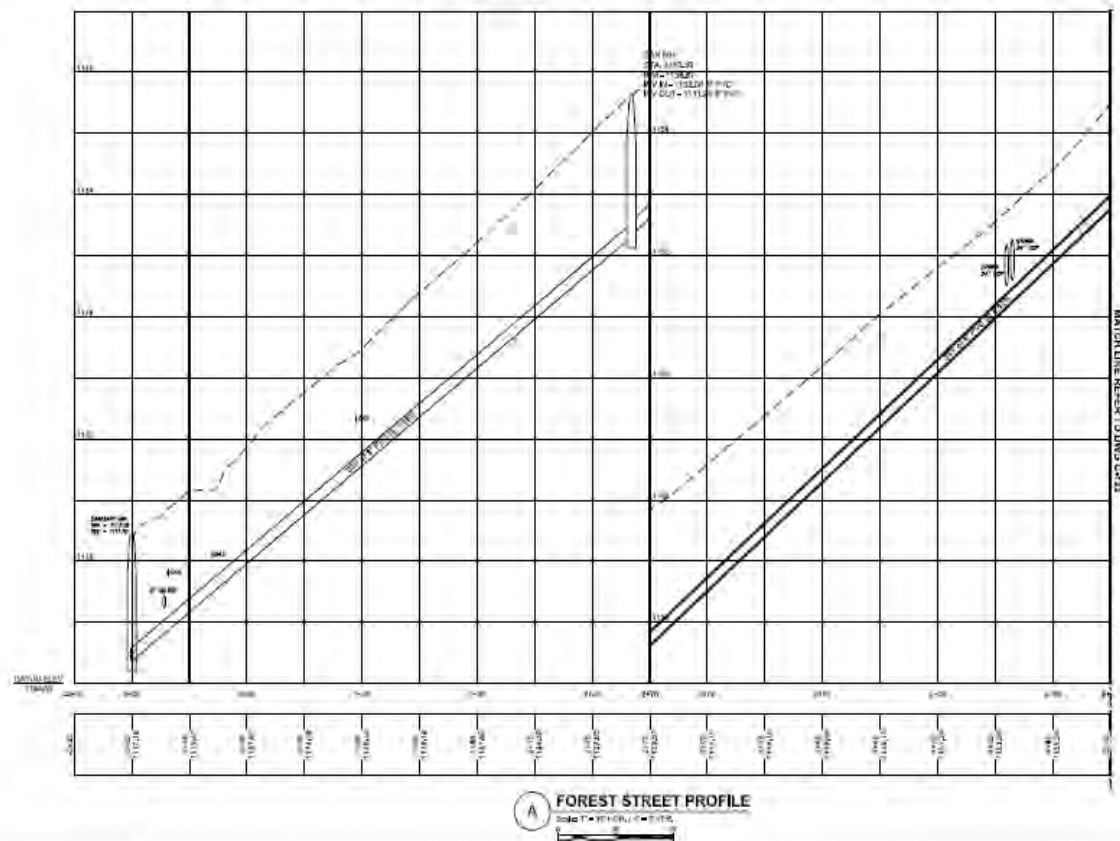
Higher MH Invert (out) = 1002.15

Lower MH Invert (in) = 1001.00

$\text{Slope} = \text{Change Y} / \text{Change X} = 1.15 / 400 = 0.0029$

* Usually expressed as 0.29%

- Size – ½ full when conveying peak dry weather flow.

[illegible]

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-inches
 - Bends
 - Usually up to 45 degree with liners.

SECTION 10 – RESOURCES AND BUDGET



Resources and Budget

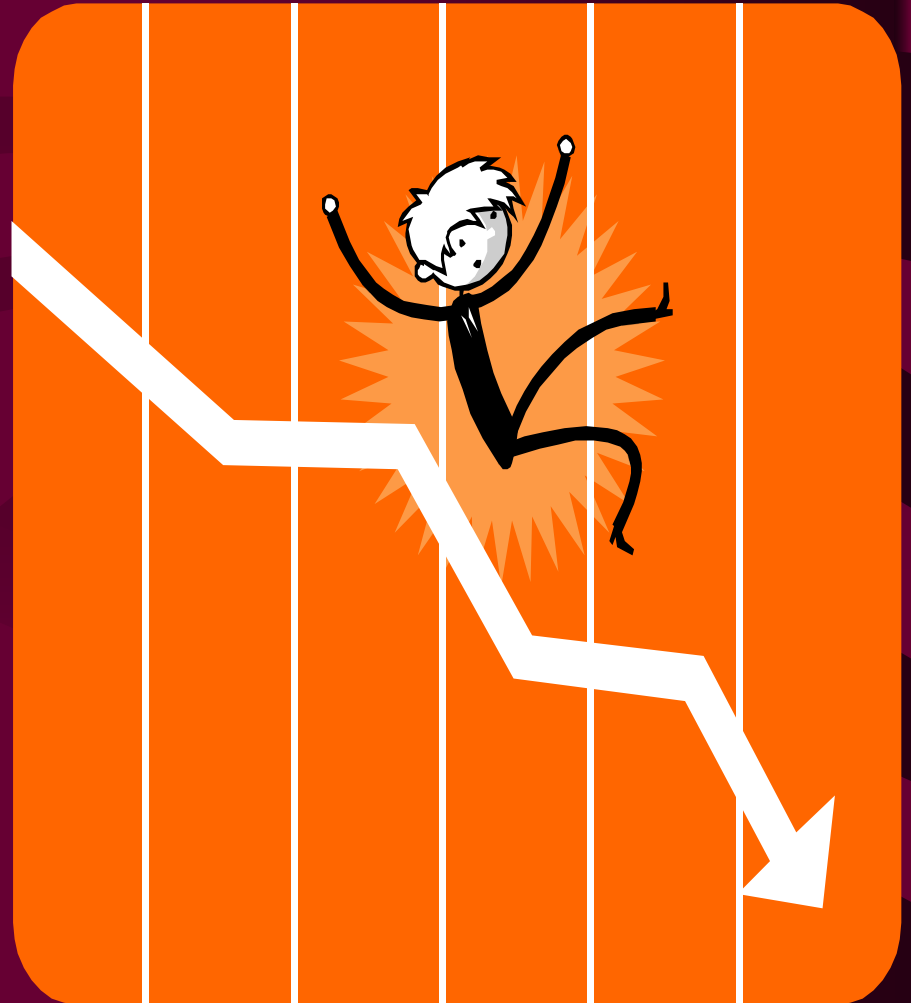
- Budget Process
- Rate Setting, Budgetary Policies and Financial History
- Historical Rate Review
- Operating and Maintenance Expense
- Capital Improvement Program Overview
- Capital Improvement Plan

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?

Post-Rehab Flow Data

- Did it work?
 - Pre- and post rehab evaluation
 - Are the flows down?
 - Monitor peaks
 - Monitor duration



SECTION 11 – PLAN UPDATES

Plan Updates

- Plan Update Process
- Monitoring, Measurement, and Program Modifications

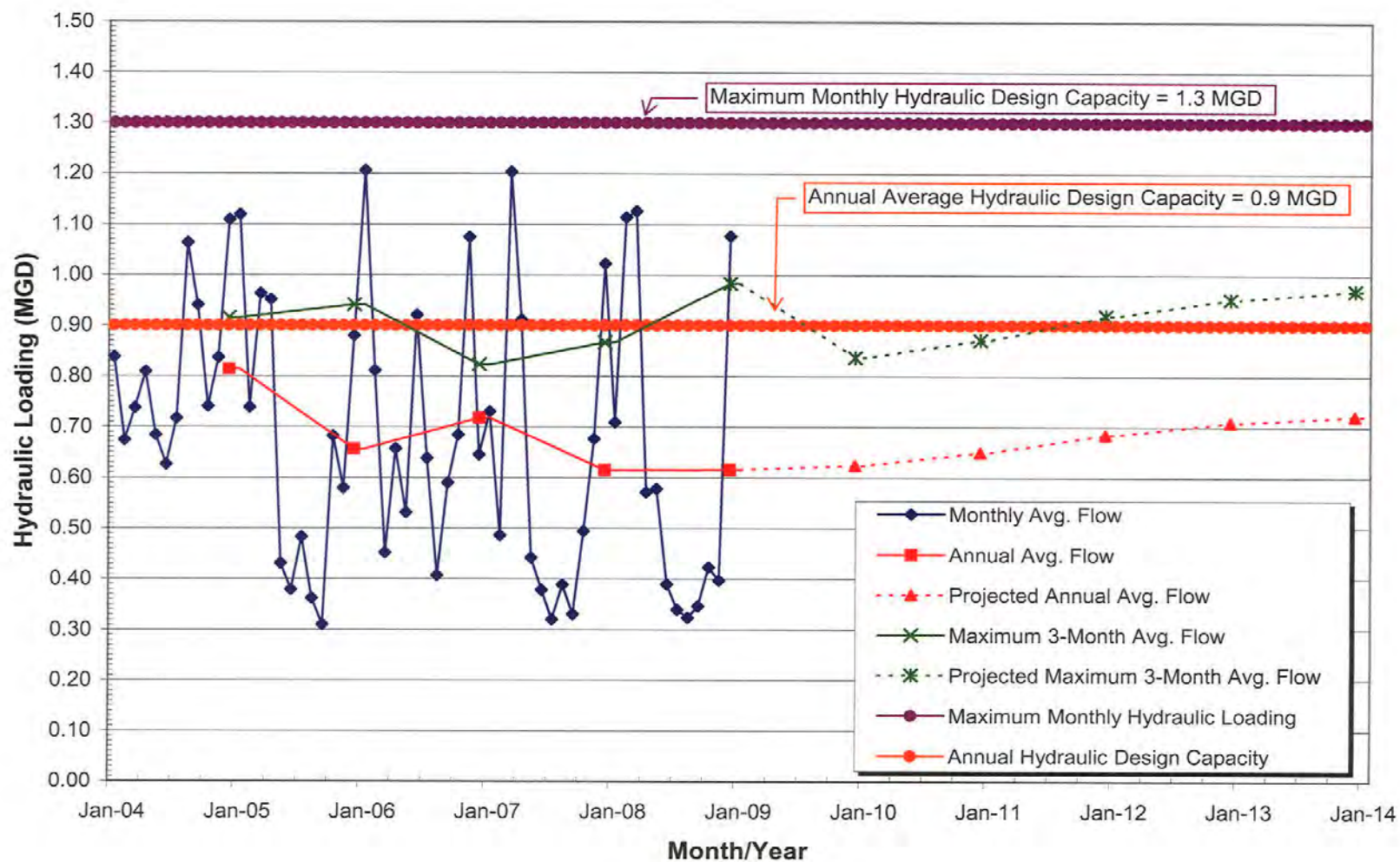
Questions?

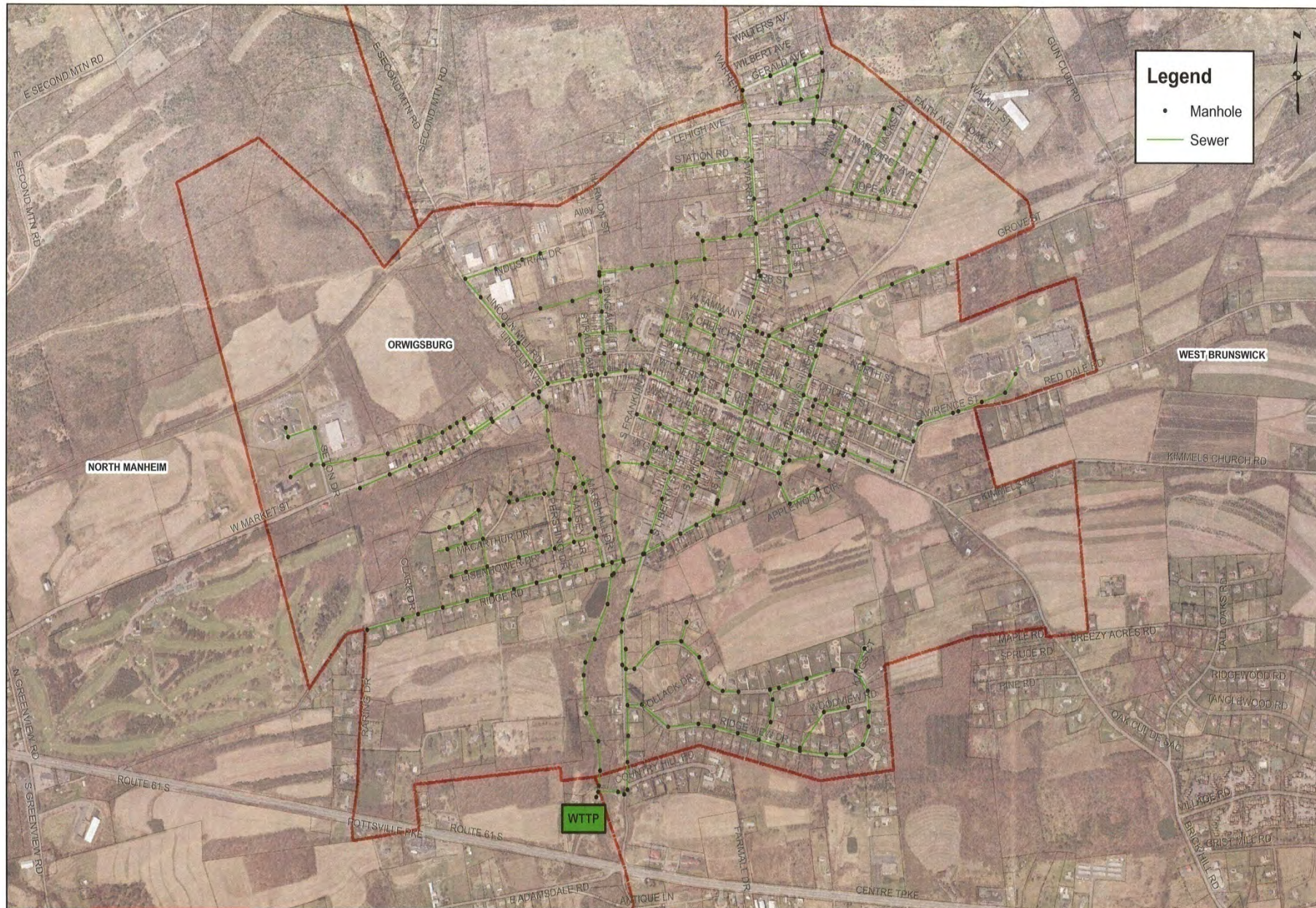
EXAMPLE
(IF TIME ALLOWS)

BOROUGH OF ORWIGSBURG

- Vertical Loop Oxidation Plant
- NPDES = 0.9 MGD
- WQM Part II = 1.3 MGD
- 1,412 EDUs
 - 436 GPD/EDU
- Average Flow = 0.616 MGD
- 3-Month Maximum Flow = 0.983 MGD
 - 1.60 Peaking Factor

FIGURE 2A
Hydraulic Loading





ENTECH

Entech Engineering Inc.
 4 S. Fourth Street
 Reading, PA 19603
 Pottsville, PA
 Mountain Top, PA
 Limerick, PA
 www.entechny.com
 1.800.826.1372

BOROUGH OF ORWIGSBURG SANITARY SEWER SYSTEM MAP

PREPARED BY	CHECKED BY	PROJECT ENGINEER
MBB	KAM	KAM
DATE	PROJECT NO.	SCALE
MAR 2009	4169.52	1" = 1,000'
		DRAWING NO.
		EXH-1



07.14.2010 08:38



07.14.2010 09:05