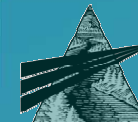
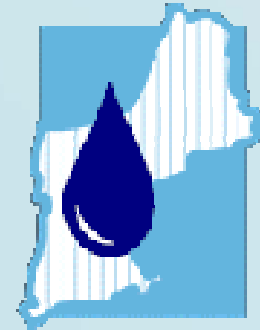


Making the Most of It: Mobile GIS for Utility Infrastructure Management

Presented By:
Peter Witt



ABSTRACT

Underground Assets Mapping & Inspecting Waterbury's Collection System to:



1. Meet regulatory requirements
2. Develop tools for efficiency and planning
3. Train staff

Presentation Outline

1. About Waterbury, Connecticut
2. Regulatory Requirements
3. Data Development
4. Manhole Investigations
 - A. Inspection Strategy
 - B. Training City Staff
 - C. Reporting



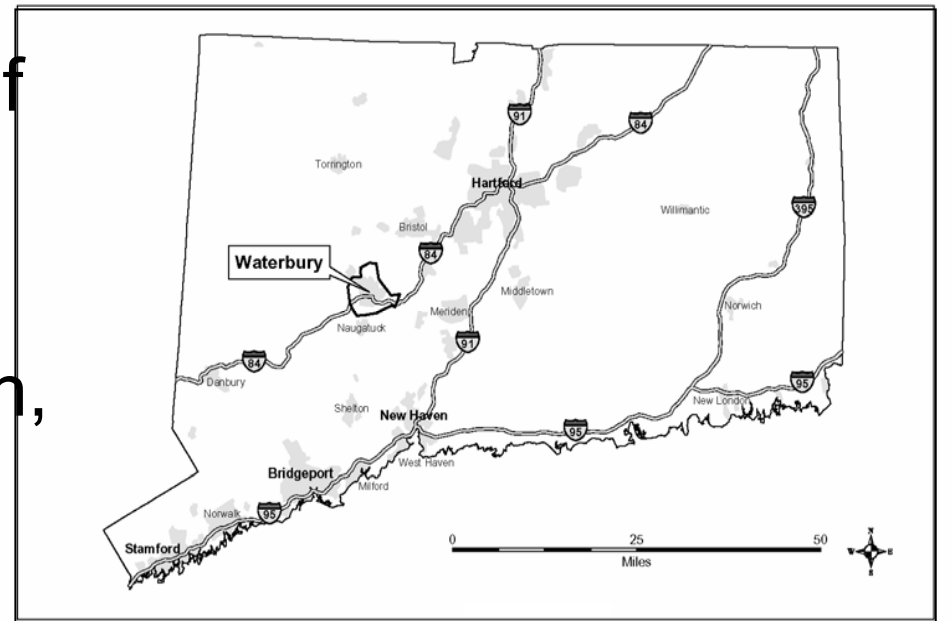
Presentation Outline (continued)

4. Asset Management System
5. Managing Project Cost



About Waterbury

- Located in New Haven County, Connecticut
- 30 miles southwest of Hartford
- 4th largest City in CT
- Growing in population, industry, and commerce
- Approximately 115,000 residents



About Waterbury's Sewers

- Aging infrastructure (early 1900's)
- 320 miles of sanitary sewer
- 93 discrete sewer sub-areas
- 9,500 manholes
- 5 other Towns discharge to Waterbury



More About Waterbury's System

- 21 pump stations
- 4 flow metering stations
- 23 MGD ADF at WPCF
- 80 MGD peak - 50 MGD small event



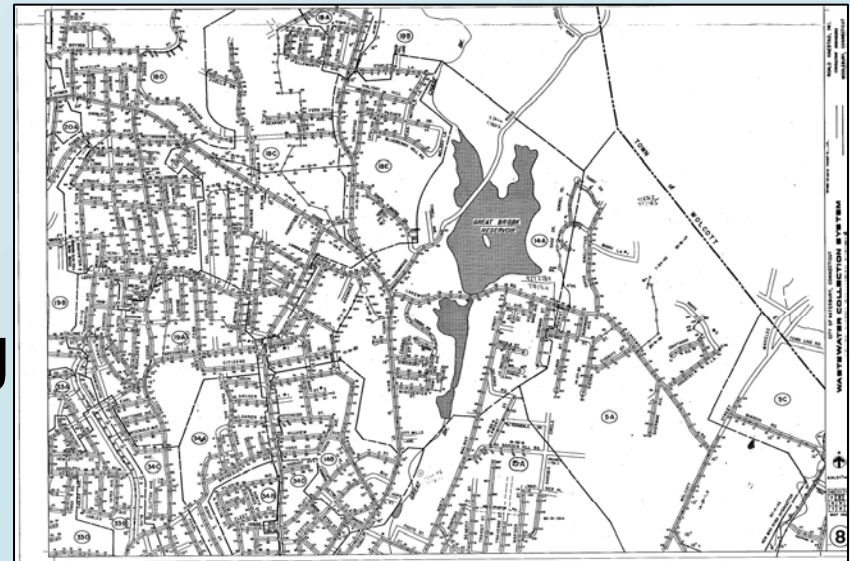
About Waterbury's Challenges

- Water Pollution Control
 - CSO's & SSO's
 - Regulatory concerns
 - Reactive maintenance
- City-wide
 - Administrative turnover
 - Staffing challenges



About Waterbury's Challenges

- Engineering/Technology
 - Limited tools
 - Limited computing resources
 - Limited asset mapping
 - Limited GIS resources



Consent Decree

- USEPA and the CTDEP issued Consent Decree on November 21, 2002:
 - Evaluate the condition of City manholes
 - Inspect 5% of the City manholes
 - Develop Initial and Long-Term Maintenance Plans
 - Infiltration/Inflow Investigations
 - Train City Staff
 - Reporting

= CMOM Program

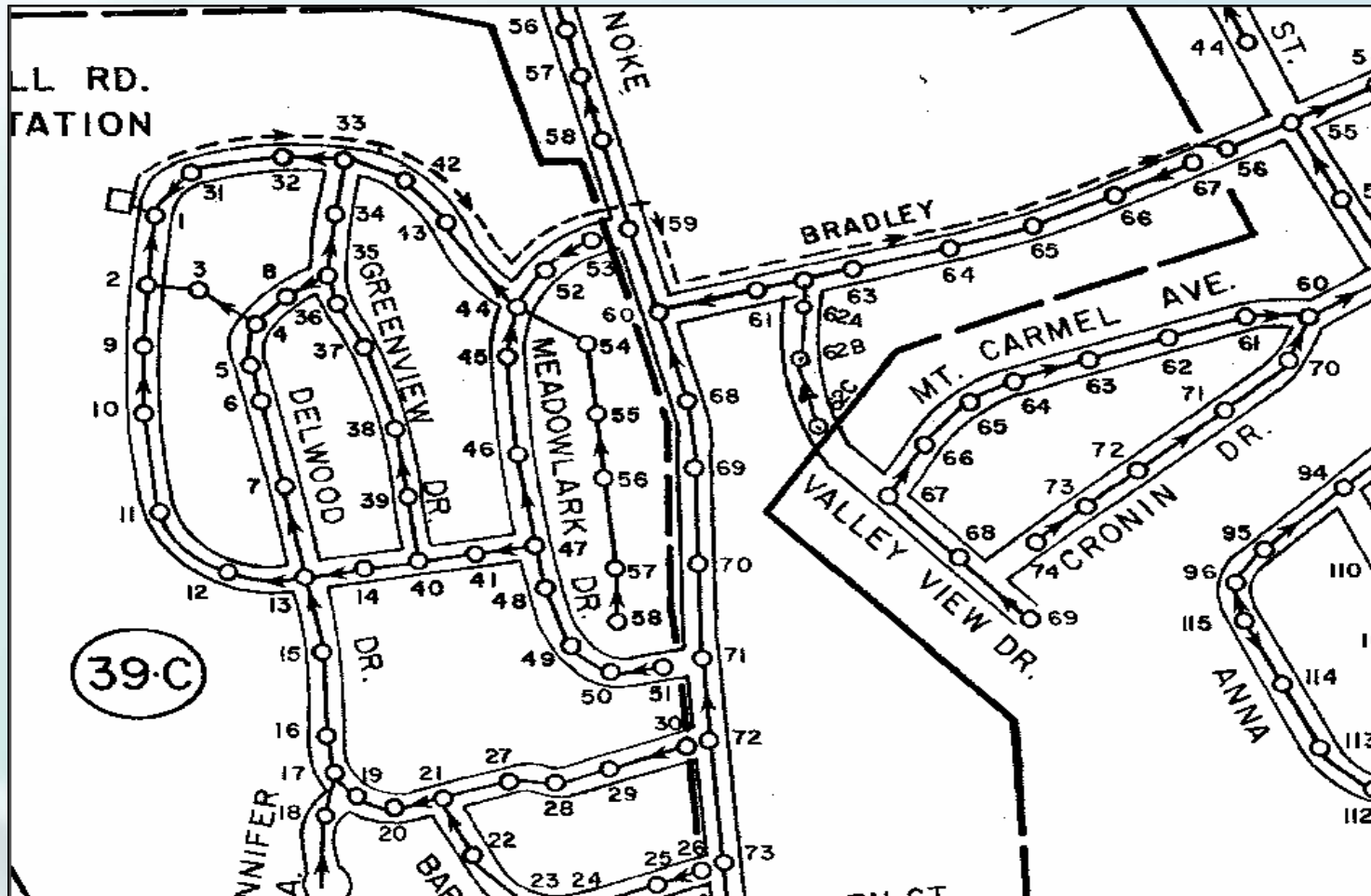
Waterbury Approach to the Consent Decree

Develop Asset Management Program to Comply and Strengthen WPC

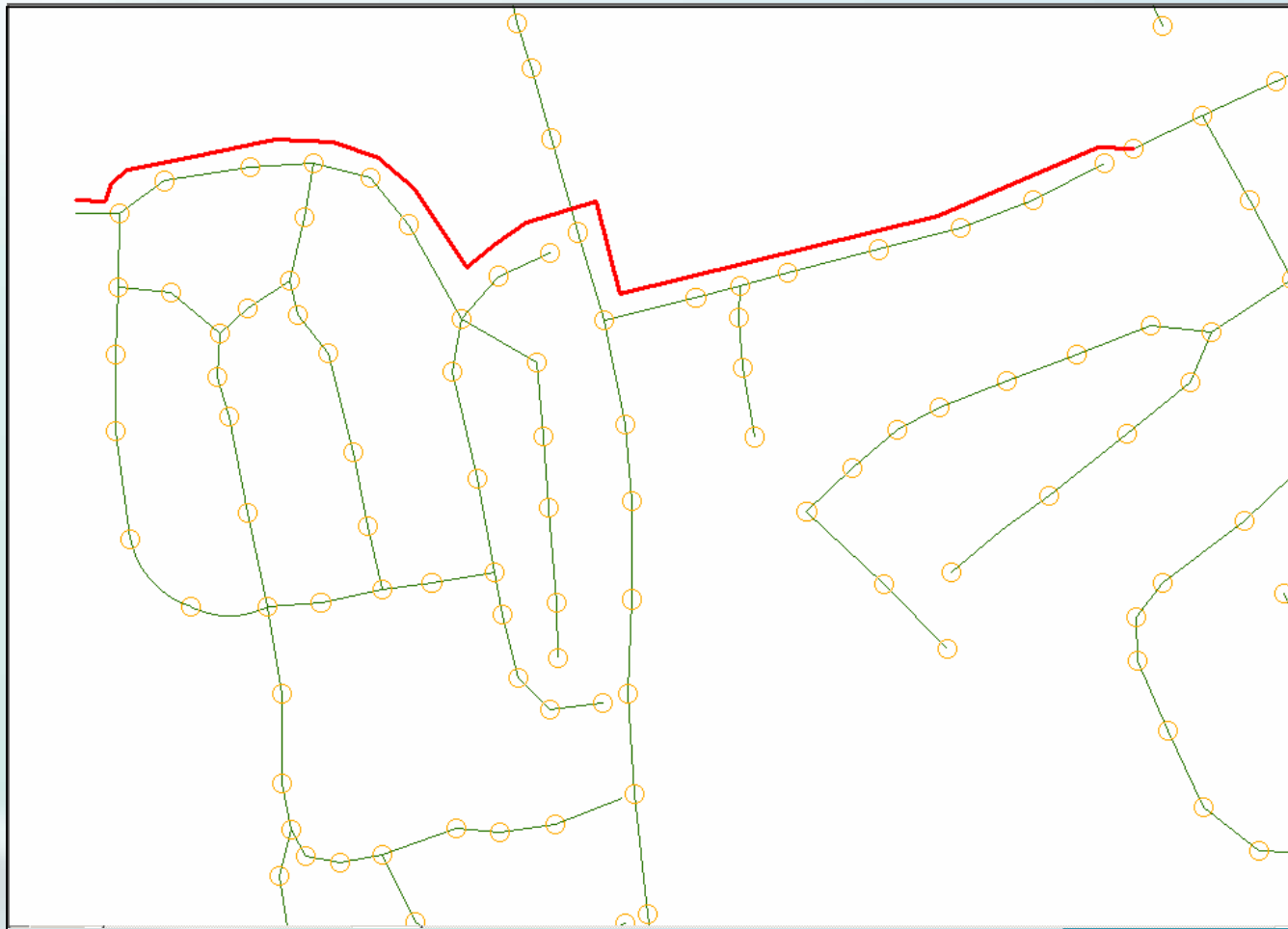
The asset management program must:

1. Maintain compliance
2. Reduce strain on Town forces
3. Create defensible planning tools
4. Grow as funds allow

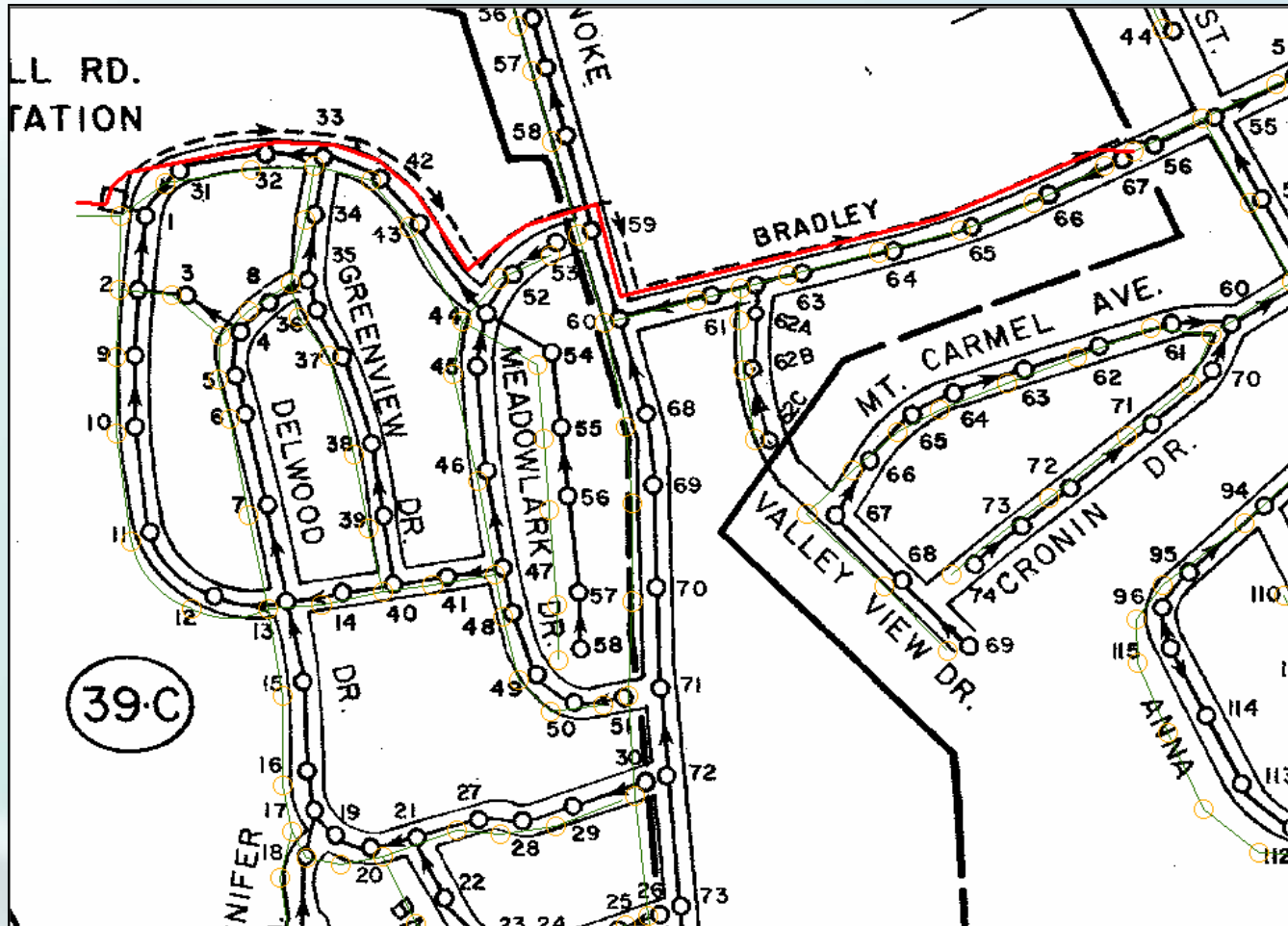
Data Development – Scanned Sewer Maps



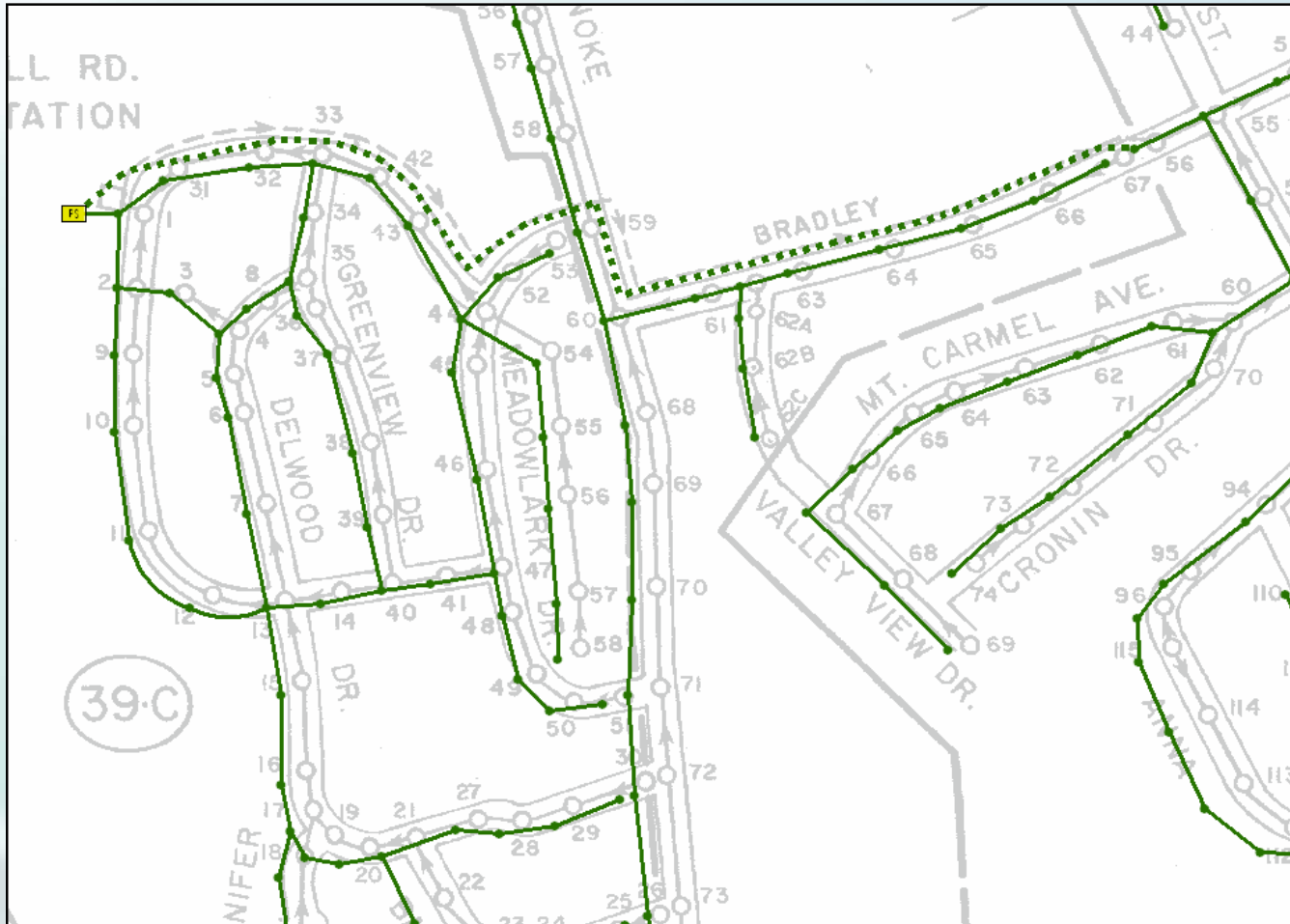
Data Development – CAD Drawing



Data Development – Georeferencing



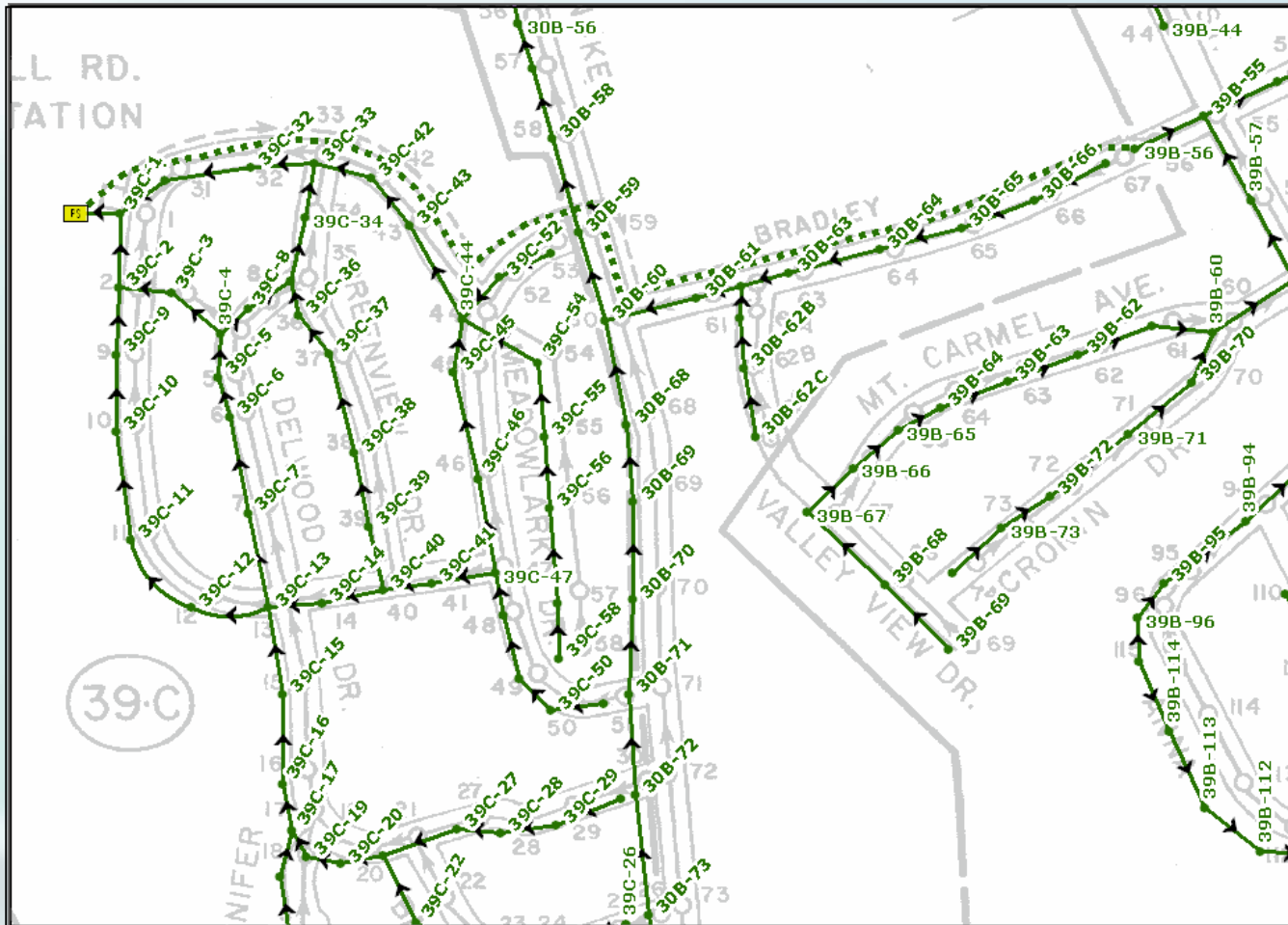
Data Development – GIS Conversion



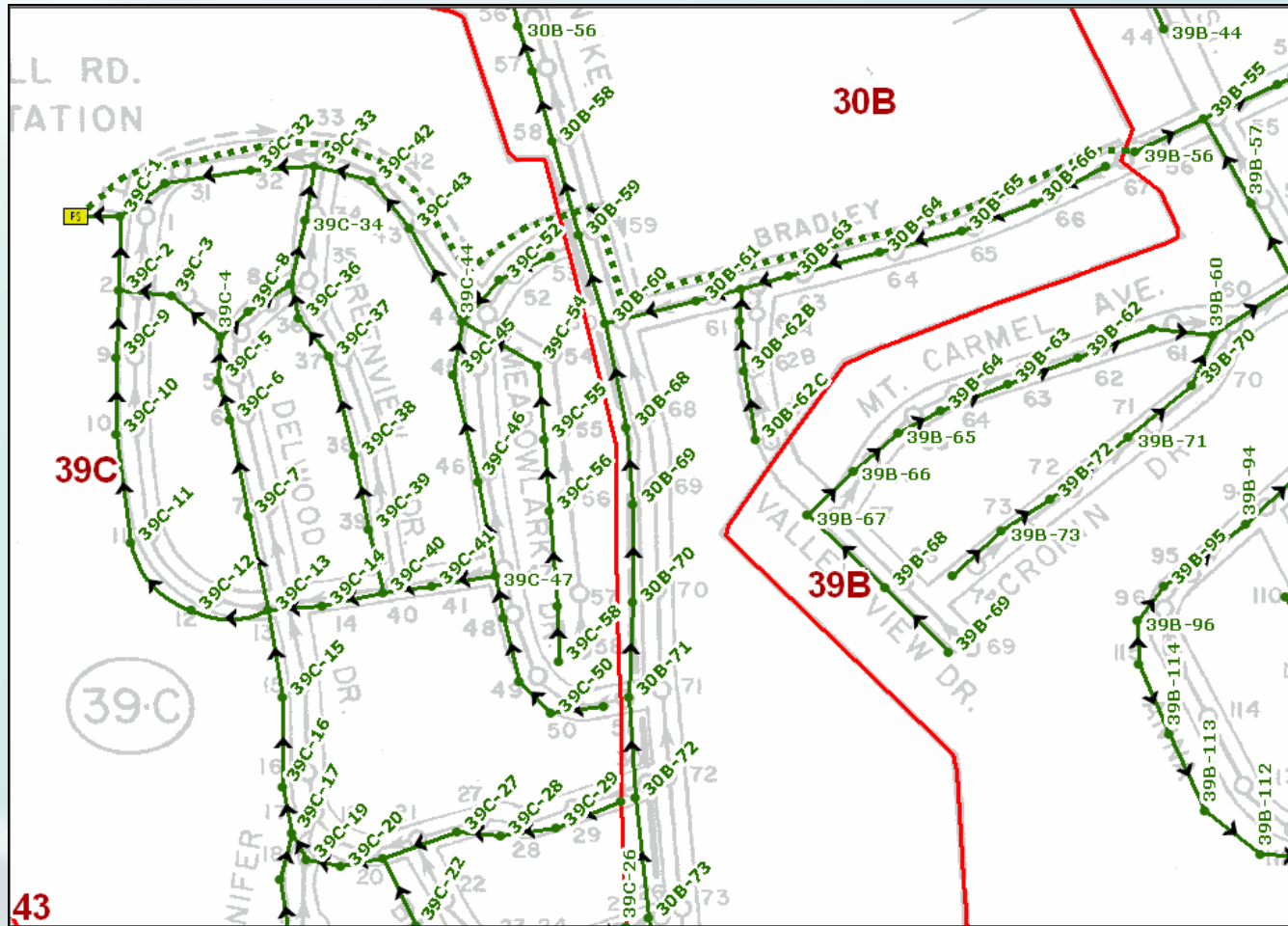
Data Development – Flow Direction



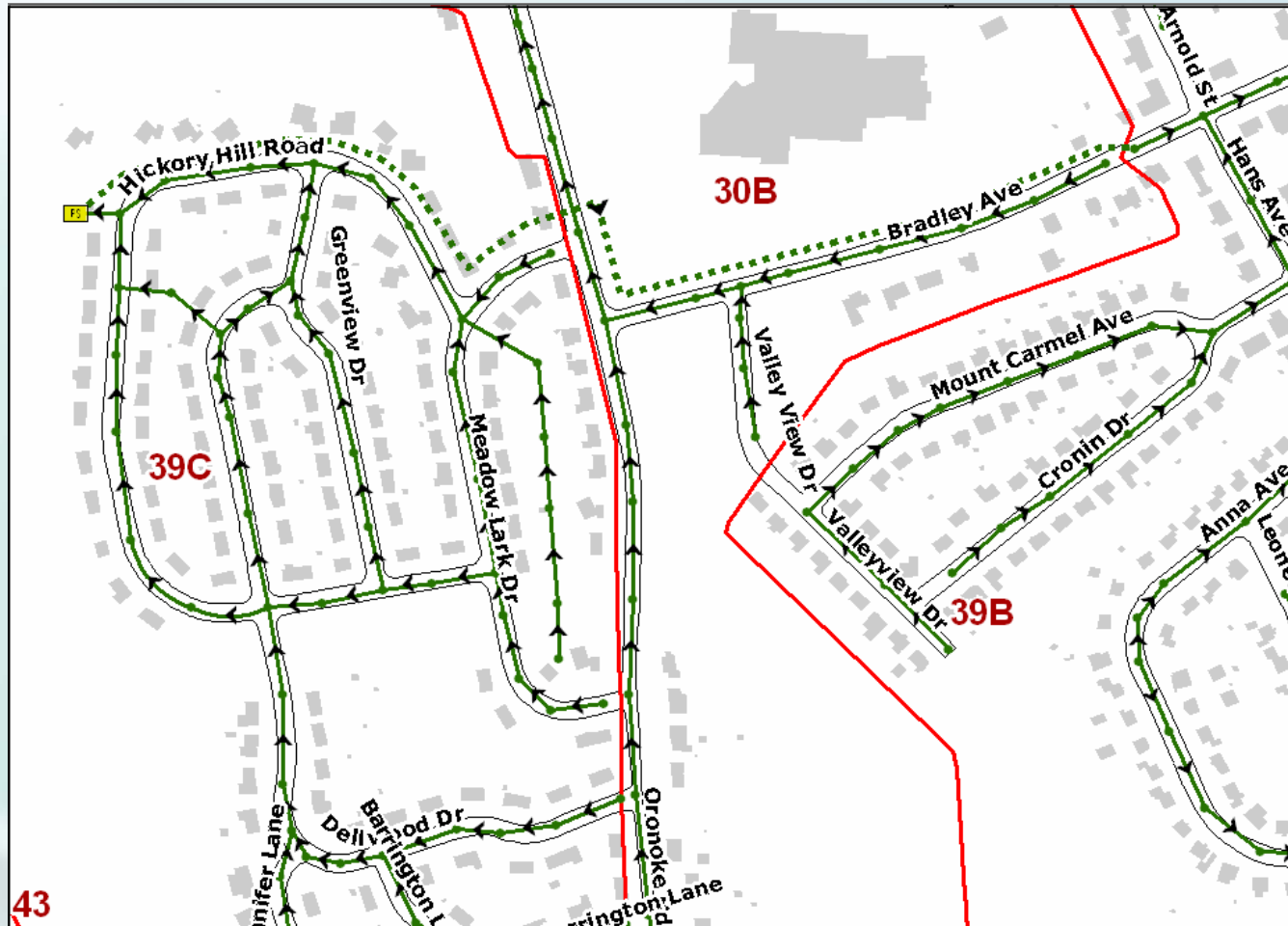
Data Development – Manhole IDs



Data Development – Subareas



Data Development – GIS Basemap



Manhole Inspection Strategy

- Locate manholes while simultaneously assessing condition
- Provide basis for the rehabilitation and management
- Joint partnership between W&C and the City



Manhole Inspection Strategy

- Sustainable method of documenting inspections
- Train City staff to use Geographical Information Systems (GIS)



Routine Maintenance Tracking

- Simple MS Access database
- Low cost
- Electronic data
- Future link to GIS

The screenshot shows a software window titled "Waterbury Pipe Cleaning Log" with a sub-header "Waterbury Sewer Service Log". The interface includes several input fields and checkboxes. The "Employee" field is empty. The "Date" field is set to "1/26/2005". The "Start Time" and "End Time" fields are both set to "11:44 AM". The "Duration (min)" field is set to "0". The "Location" section has "From" and "To" sub-sections, each with "Subarea", "Manhole", and "Street" fields. The "Quadrant" field is empty. The "Length (ft)" field is set to "0". The "Flush Direction" is set to "Upstream". The "Service Activity" section has a list of checkboxes: "Jetter", "Jetter-Vac", "Bucket Machine", "Clam Sewer Cleaner", "Freezing Conditions", "Private Cleaning Contractor", "Bypass", "TV Inspection", "Root-cutting Tool", "Routine Cleaning", and "Emergency Cleaning". The "Line Condition" field is empty. The "Comments" section is a large text area. At the bottom, there are buttons for "Submit", "Report", "Close", and "Help".

Waterbury Pipe Cleaning Log

Waterbury Sewer Service Log

Underlined fields are required.

Employee: []
Date: 1/26/2005
Start Time: 11:44 AM
End Time: 11:44 AM
Duration (min): 0

Location

From
Subarea: []
Manhole: []
Street: []

To
Subarea: []
Manhole: []
Street: []

Quadrant: []
Length (ft): 0
Flush Direction: Upstream Downstream

Service Activity

Check all that apply:

<input type="checkbox"/> Jetter	<input type="checkbox"/> Bypass
<input type="checkbox"/> Jetter-Vac	<input type="checkbox"/> TV Inspection
<input type="checkbox"/> Bucket Machine	<input type="checkbox"/> Root-cutting Tool
<input type="checkbox"/> Clam Sewer Cleaner	<input type="checkbox"/> Routine Cleaning
<input type="checkbox"/> Freezing Conditions	<input type="checkbox"/> Emergency Cleaning
<input type="checkbox"/> Private Cleaning Contractor	<input type="checkbox"/> Other: []

Line Condition: []

Comments

[]

Submit Report Close Help

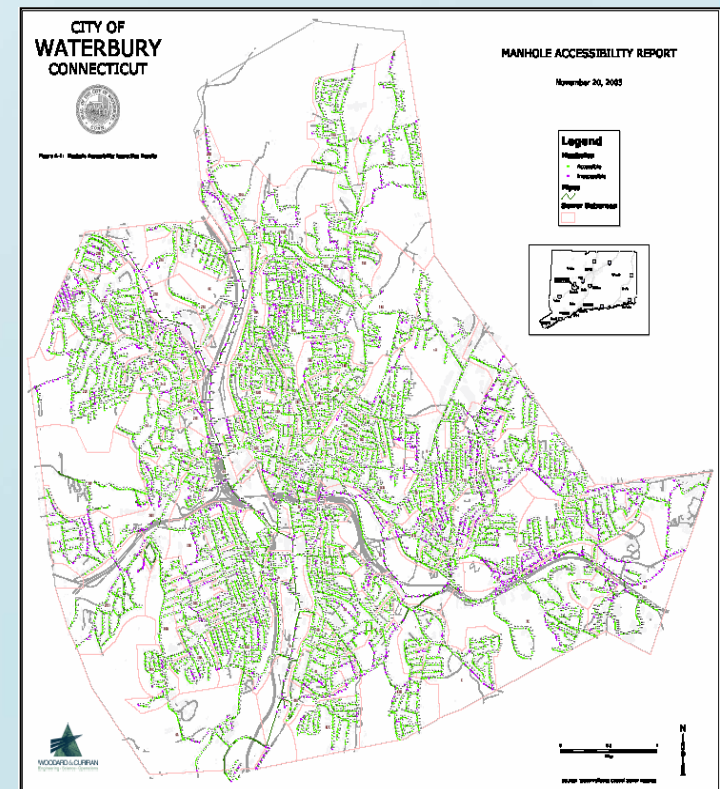
Training City Staff

- Worked with staff in field
- Separate training sessions
- Tools have built in QA/QC
- Simple tools and software



Reporting to Regulatory Agencies

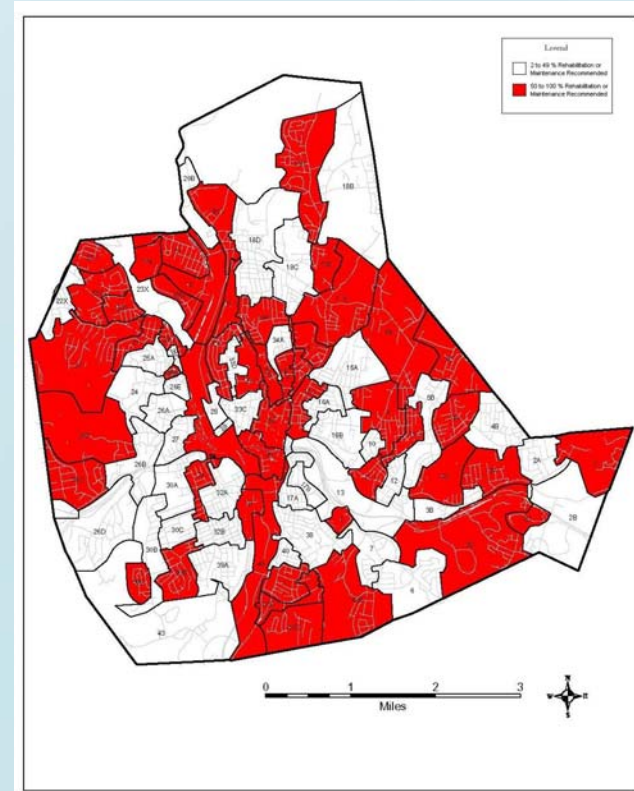
- Graphics and mapping make things clear
- Results easily analyzed
- Complex information now searchable
- Regulators pleased with results



Reporting to Regulatory Agencies

Example:

- Areas with evidence of I/I



Reporting to Regulatory Agencies

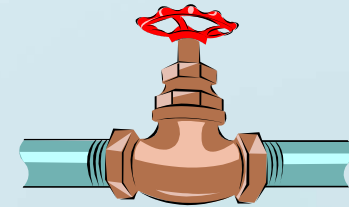
Example:

- Maintenance activity reports

<i>Waterbury Sewer Service Log</i>			
Cleaning Event	Location	Line Condition	Activities Performed
Date: 7/8/2002 Employee: Darren O/ Pe StartTime: 8:00:00 AM EndTime: 9:00:00 AM Duration: 60 min Comments:	From MH: 15A-2 To MH: 15A-70 From St: Robinson Street To St: Robinson Street Quadrant: Section A	Length: 1025 ft Flush Direction: Upstream Debris: Septic	Jetter Routine Cleaning
Date: 7/8/2002 Employee: Peter Y. StartTime: 8:00:00 AM EndTime: 8:33:00 AM Duration: 33 min Comments:	From MH: 15A-71 To MH: 15A-74 From St: E Farm St To St: E Farm St Quadrant: Section A	Length: 400 ft Flush Direction: Upstream Debris: Septic	Jetter Routine Cleaning
Date: 7/8/2002 Employee: Peter Y. StartTime: 8:45:00 AM EndTime: 9:45:00 AM Duration: 60 min Comments:	From MH: 15A-6 To MH: 15A-17 From St: Griggs St To St: Griggs St Quadrant: Section A	Length: 375 ft Flush Direction: Upstream Debris: Septic	Jetter Routine Cleaning
Date: 7/8/2002 Employee: Peter Y. StartTime: 9:50:00 AM EndTime: 10:15:00 AM Duration: 25 min Comments:	From MH: 15A-4 To MH: 15A-6 From St: Robinson St. To St: Robinson St. Quadrant: Section A	Length: 400 ft Flush Direction: Upstream Debris: Septic	Jetter Routine Cleaning

GIS Applications for Water Utilities

- Inventory & Mapping
- Visualization
 - 3D
 - Schematics
- Network Tracing
- Hydraulic Modeling
- **Asset Management**



GIS-based Asset Management

- Mapping
 - Spatially accurate representation of network
- Inspections / Conditions
 - Puts data about features in a spatial context
- Service Requests / Work Orders
 - Provides link between feature data and service, maintenance, and cost histories
- Data Collection / Maintenance
 - Integrates addition & update of data into workflow

Mobile GIS



Mobile GIS

- Data Capture
- Data Editing
- Location / Navigation

Data Capture

- GPS
 - “digitize” locations
- ArcPad
 - Edit forms
 - Simple maps
 - Customizable

Fire Perimeter Form

Collection Method: GPS Digitized

Source: Aerial Hand Drawn

Differential Correction: N/A

Travel Method: N/A

Map scale of source: 1:24,000

OK Cancel

ArcPad Options

Quality Capture Alert

Enable Averaging

Number of positions to average

Points: 50

Vertices: 20

Streaming Vertices Interval: 1

Vertex

X: 117 11 28.641 W

Y: 34 03 20.109 N

Z: 31

M: 0

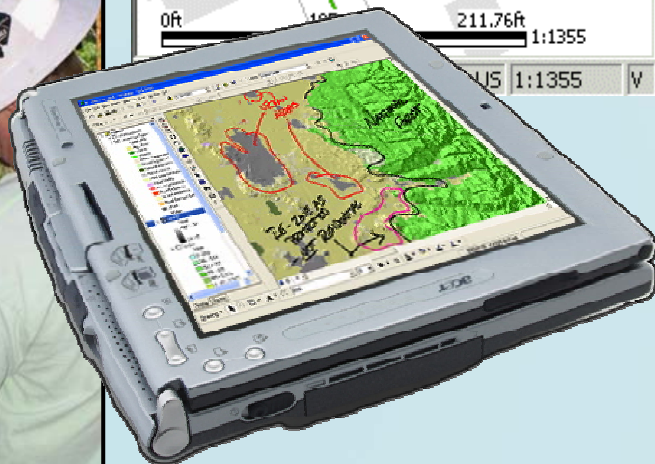
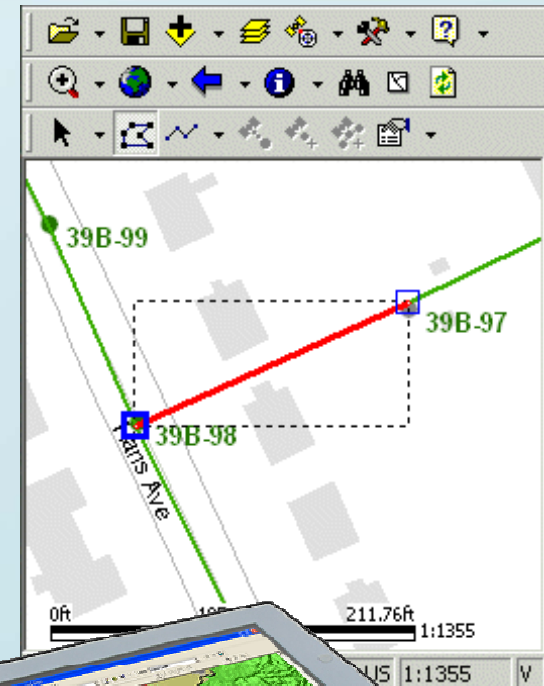
14

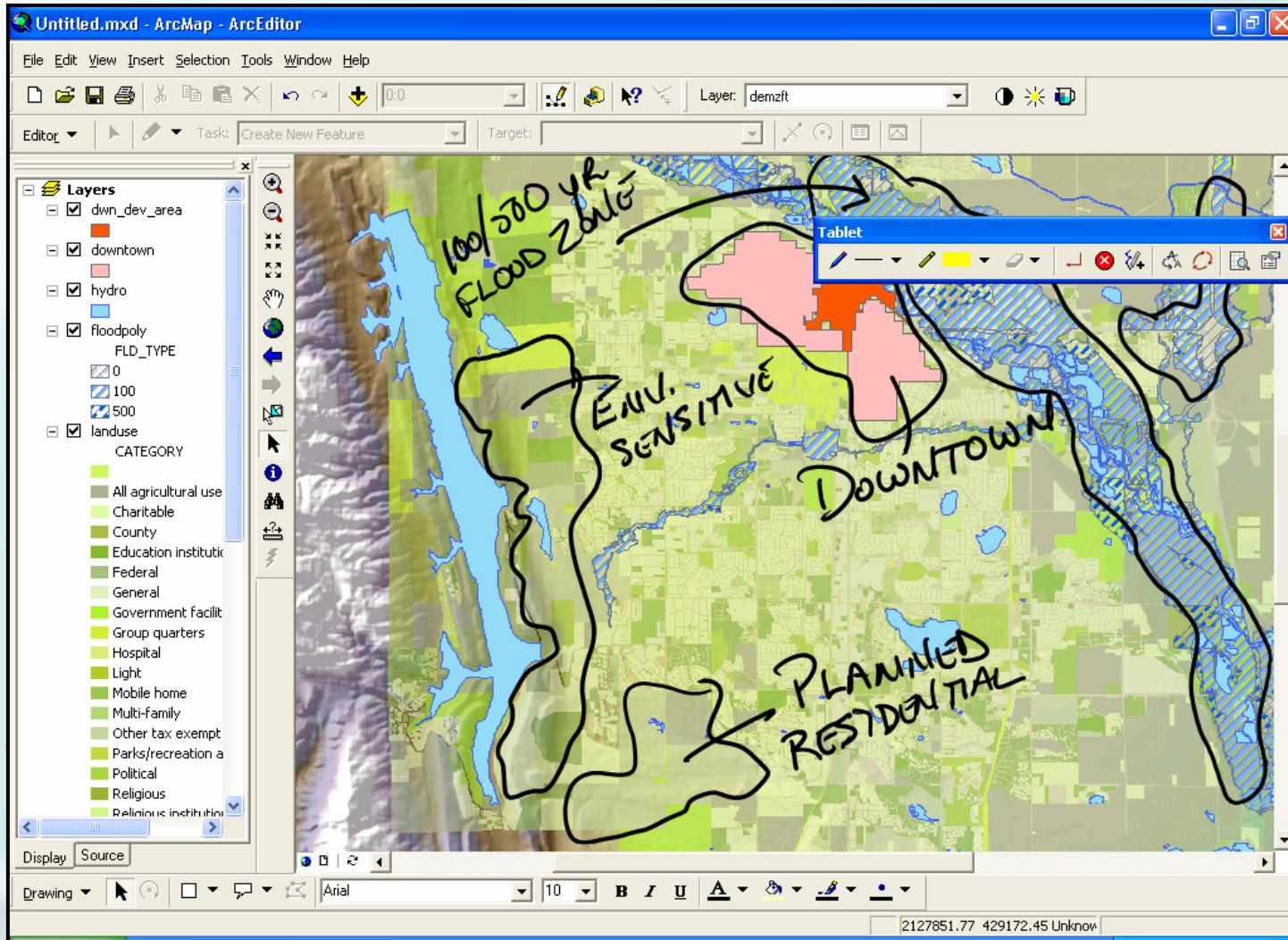
1:24733

11:55a

Data Editing

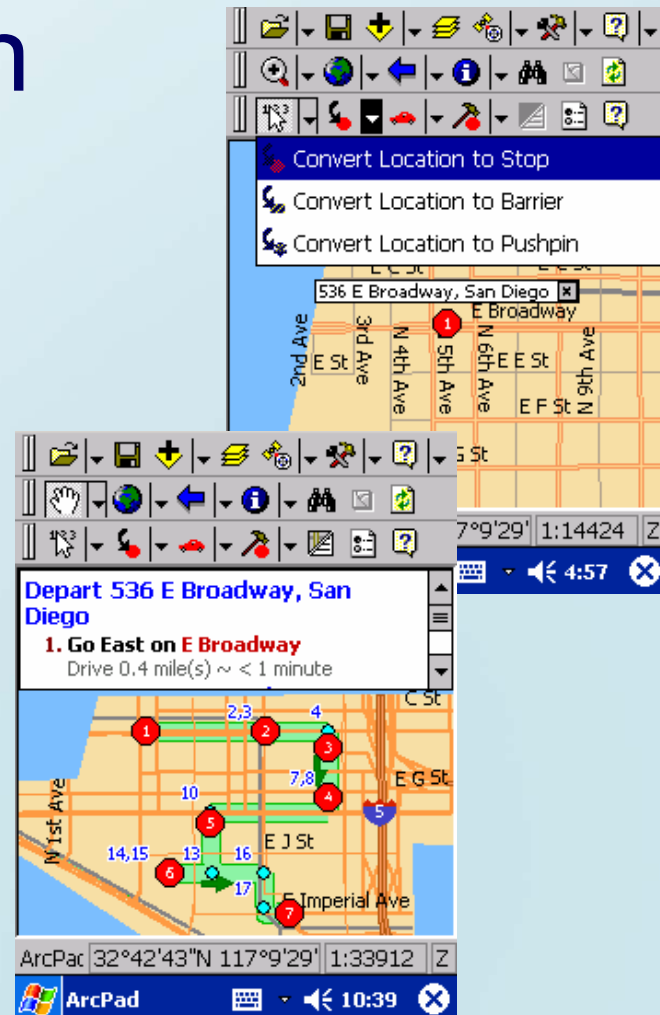
- Handheld device
 - iPAQ
 - Ruggedized PDA
 - Simple edits
- PC
 - Laptop
 - Tablet PC
 - Advanced edits
 - “Geographic sketching”





Location / Navigation

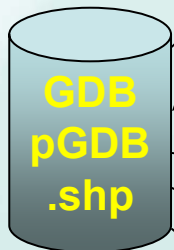
- Address lookups
- Routing
- Waypoint navigation
- Distance & bearing



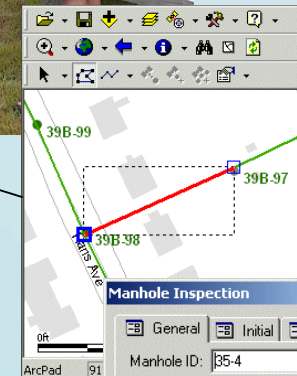
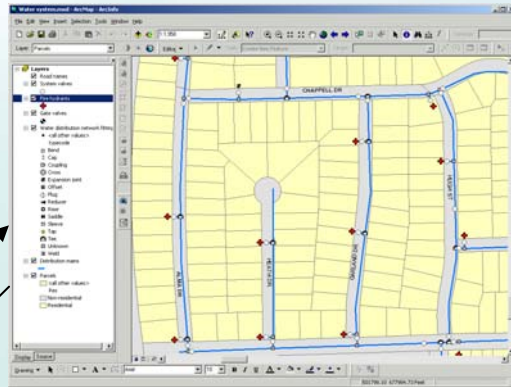
Mobile GIS Workflow

Desktop GIS

Field GIS



GIS Data



Manhole Inspection

General	Initial
Manhole ID:	35-4
Interceptor:	
Sewer Subarea:	
Depth (in):	0
Inspection Date:	05/31/2003
Time:	3:01:59 PM
Inspector:	
Weather:	

OK Cancel

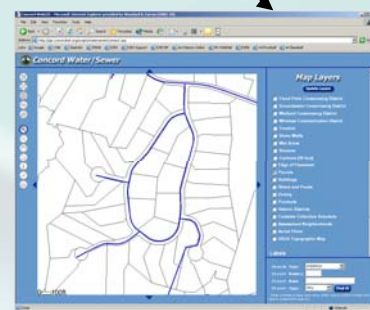
**CITY OF SAPO
DEPARTMENT OF PUBLIC WORKS
CITY ENGINEER'S OFFICE**

PROJECT NO.:	
CONTRACT NO.:	
REPORT NO.:	
PROJECT NAME:	
Requested by:	
Checked by:	
Approved by:	
Date:	

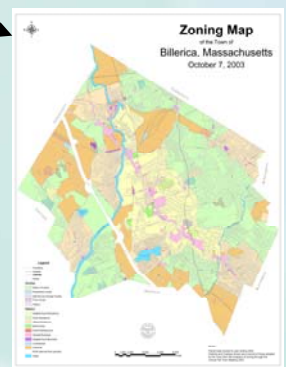
City Engineer's Office

Inspector:	
Inspector:	
Inspector:	
Inspector:	

Reports



WebGIS



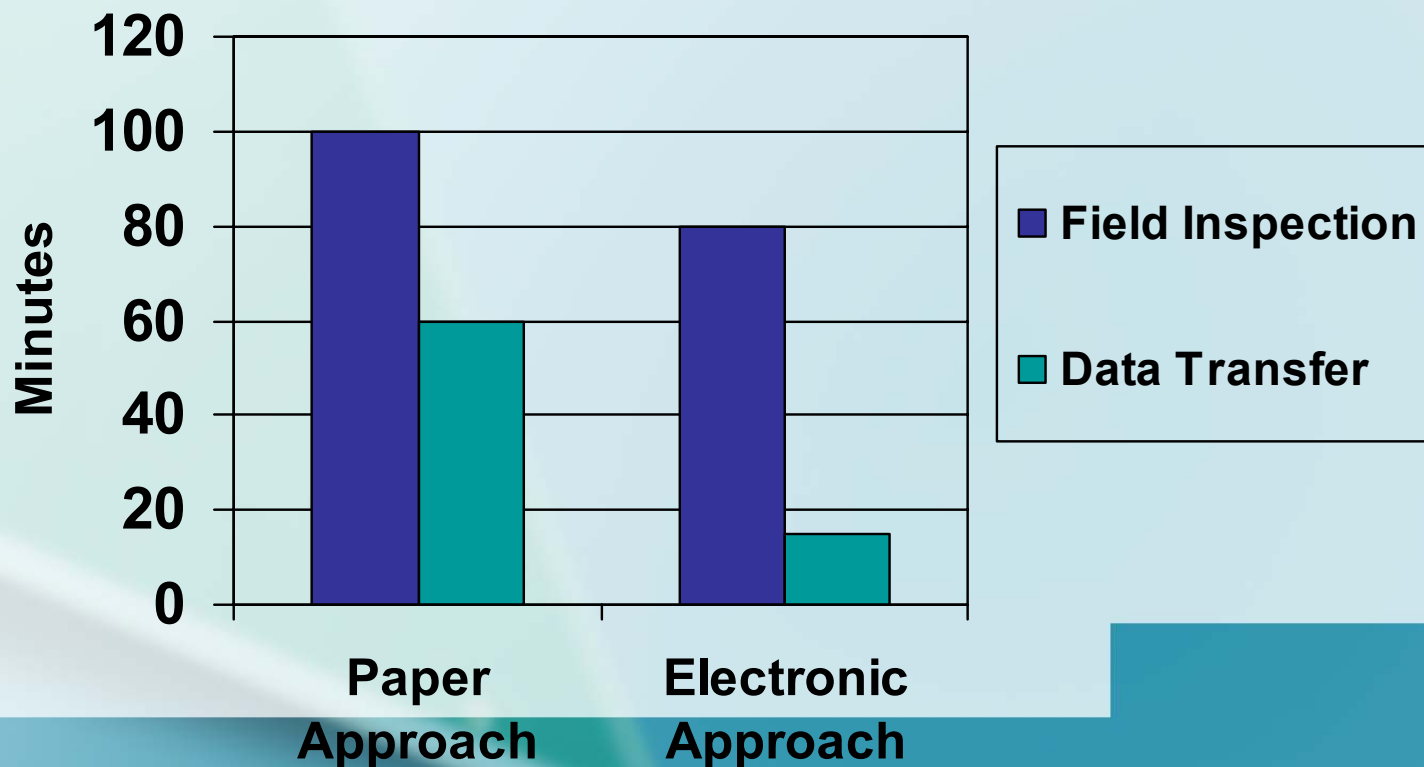
Maps

Benefits of Mobile GIS

- Improved Efficiency
 - Decreased hardcopy map production
 - Faster field data integration
- Better accuracy
 - Reduces data entry errors
 - Field workers have more and better data
- Leverages other enterprise GIS components
- Lower data collection and maintenance costs

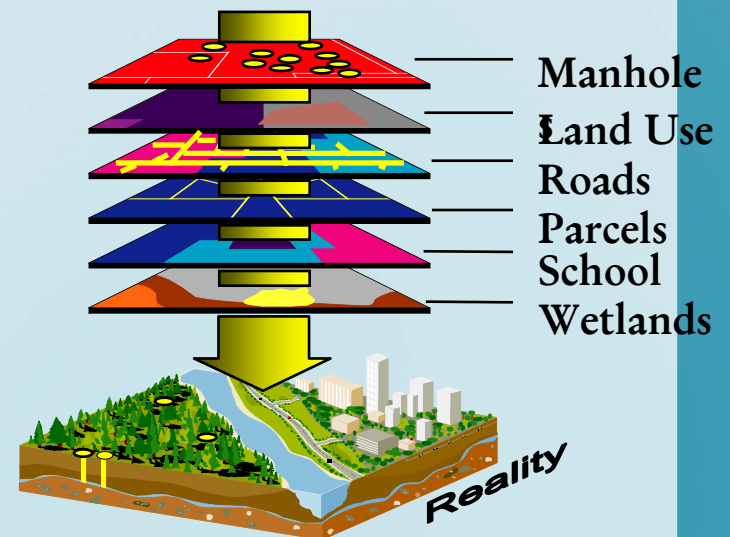
Asset Management Tools Reduce Strain on City Forces

Water Pollution Control Effort to Inspect 10 Manholes



Managing Project Cost

- Start with “low hanging fruit”
 - What data exists?
 - What data can be easily developed?
- Develop phased plan
 - Build momentum by solving immediate problems



Phasing Implementation Makes Asset Management Affordable

- Start with basics
- Get more sophisticated over time

10/21/1999 THU 07:38 FAX 978 2510509 HOWE SURVEYING 0014

**TOWN OF DEDHAM - SEWER AND DRAIN INVENTORY
FIELD DATA SHEET**

PLAN_NUM Map Number: D-12 Street Name / Location: PROVIDENCE HIGHWAY

System Type: SANITARY SEWER / STORMWATER DRAIN

(POINT_ID) Identification Number: CB/2

(TYPE) Type: MANHOLE / CATCHBASIN / OUTFALL / WETWELL / PUMP STATION / OTHER

(DEPTH) Rim to Invert Depth (in feet): 6.08

Shape: SQUARE / ROUND

(SIZE) Diameter of Structure (in inches): 48"

(MATERIALS) Material of Construction: BRICK / CONCRETE / BLOCK / OTHER

(COV_LTYPE) Type of Manhole Cover: DRAIN / SEWER / MDC / UNMARKED / OTHER

(COV_SIZE) Size of Cover (in inches): 24" x 30"

(GRATE_TYPE) Type of Catchbasin Grate: CHECKER / RIB / D-SHAPE / CIRCULAR / OTHER

(CURB_IN_TYPE) Type of Catchbasin Curb Inlet: NONE / STONE / CAST IRON / OTHER

(SUBMERGED) Is the Outfall Submerged? Y N (circle one)

(WATERSHED) Name of Watershed in Which Structure is Located: _____

(NEIGHBORHOOD) Name of Neighborhood in Which Structure is Located: _____

(INSPECTOR) Inspector (initials): BDP

(COV_COND) Condition of Cover: NORMAL / DETERIORATION / corrosion / CRACKS / OTHER

(FRAME_COND) Condition of Frame: NORMAL / DETERIORATION / corrosion / CRACKS / OTHER

(WALL_COND) Condition of Walls: NORMAL / DETERIORATION / corrosion / CRACKS / OTHER

(WEATHER) Weather (at time of inspection): WET DRY (circle one)

(DRY_FLOW) Is Dry Weather Flow Present? Y N / N/A (circle one)

(SHEEN) Is There a Sheen on the Water? Y N / N/A (circle one)

(DEBRIS) Is Debris Present? Y N / N/A (circle one)

(FLOW) Total Depth of Flow (in inches): 28" WATER

(SEDIMENT) Observed Sediment Depth (in inches): 0

(ODOR) Observed Odors: NONE / MUSTY / sewage / EGGS / SOUR / OTHER

(COLOR) Observed Color: Clear / CLOUDY / opaque / SOLIDS / OTHER

(FLOATABLES) Observed Floatables: NONE / GARBAGE / SEWAGE / OTHER

(STAIN) Observed Stains: NONE / SEDIMENT / oil / OTHER

(ANIMALS) Evidence of Animals Residing? Y N / N/A (circle one)

(SAMPLED) Sampled Status: Y N (circle one)

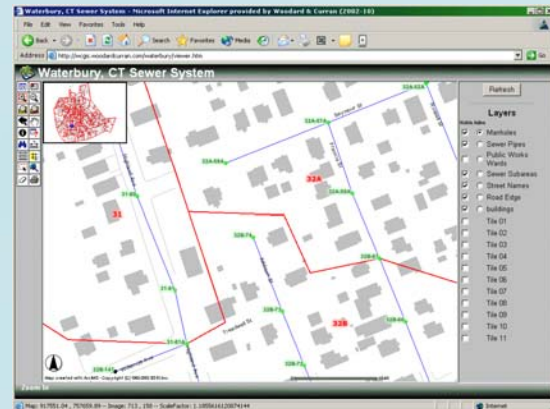
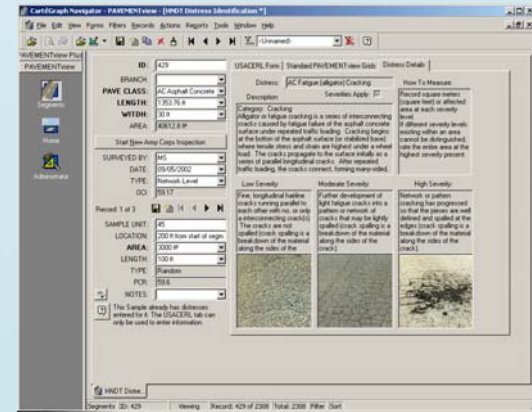
Sample Identification Number: _____

(INSPECTION_DATE) Date of Inspection: 9/1/99



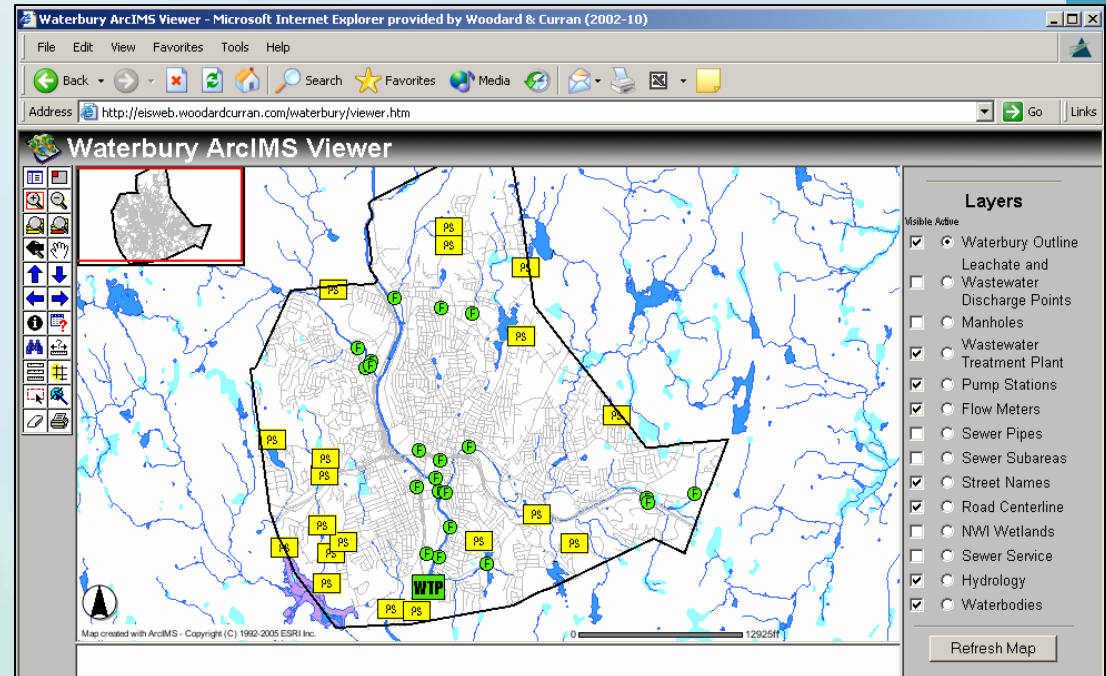
Programs Grow as Funds Allow Implement What You Can Afford

- Higher cost example a “Pavement Management Program”
- Lower cost example Waterbury’s Manhole Inspection Program



Future System Enhancements

- Expand WebGIS
- TV Inspection tracking
- Link maintenance program
- Add other utilities
- Add other layers



Initiating an Asset Management Program Strengthened Waterbury

Waterbury's Collection System Asset Management Program:

1. Maintains Compliance
2. Reduces strain on Town forces
3. Creates defensible planning tools
4. Grows as funds allow

Our Program Brought Waterbury Many Benefits

- Explanation of tools and visuals received praise from City
- Many City departments want to implement something similar
- Asset management and GIS are well under way, enthusiastically supported

Thank You

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Ted Chapin
[*tchapin@woodardcurran.com*](mailto:tchapin@woodardcurran.com)

