# Intelligent Operations and Organizational Culture



February 2, 2017

# Example of Just Water and Sewer DPW Assets in a Community of 70,000 Residents

Water System Assets:

- 3,500 Gate Valves
- 3,400 Fire Hydrants
- 7,000 Water Main Segments
- 11 Water Treatment Plants
- 3 Elevated and Ground Storage Tanks
- 24,000 Customer Water Leads

#### Sewer System Assets:

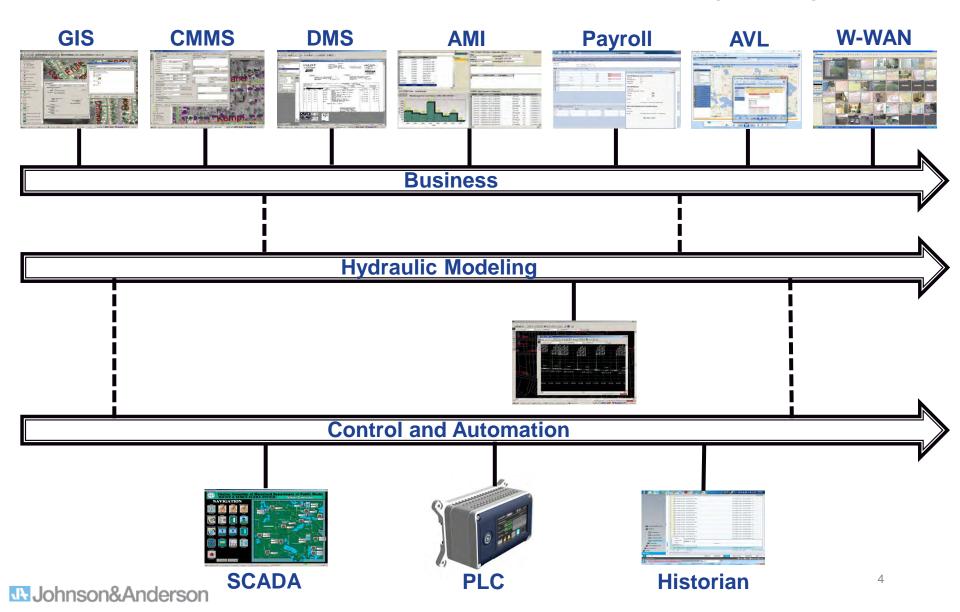
- 8,300 Sewer Manholes
- 8,500 Sewer Main Segments
- 62 Sewer Pumping Stations
- 25,000 Customer Sewer Leads

Total Water and Sewer Assets Alone> 80,000! How Can They be Effectively Managed and Operated? In an effort to move toward greater operational efficiency, consistency and accountability, public works are spending over \$1,000,000,000 every year to incorporate technology solutions and processes through individual business, control, automation, workflow, modeling and analytics platforms.



## **Application Platform Islands**

Stand Alone & Disconnected Business, Automation and Engineering Platforms



The reality is these powerful platforms often fail to deliver their full potential because they lack systemic integration and the necessary cultural evolution for operators to leverage them.



The good news is that it can be solved through systematic integration of business, control, automation, modeling, workflow, analytics and organizational innovation.



# Integrate and Leverage the Application Platform Islands

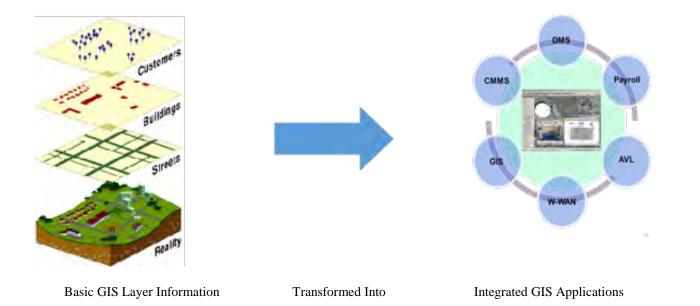
Business, Automation Control, Engineering and Modeling Platform Integration Enhanced with Intelligent Workflows and Analytics

- Adopt Public Entrepreneur approach- Innovate
- Perform needs assessment and use results as a roadmap-Plan
- Recognize need for evolutionary flexibility with culture and technology- Plan
- Utilize cost effective and open architecture based technologies that link business, modeling and automation platforms- Strategy
- Incremental introduction of technology and business processes- Strategy
- Incorporate Workflow and analytic processes to make sense of the data-Innovation
- Ultimate goal of Integrated Enterprise Wide ecosystem with workforce trained and empowered to consume and evolve the applications, processes and culture to continue driving greater efficiency, consistency and accountability- Success



#### GIS and the Geodatabase

The Core Geodatabase for Application Platform Integration



GIS, through the ESRI geodatabase, can provide the backbone business, automation, engineering, and analysis platform through integration with applications that include Computer Maintenance Management Systems (CMMS), Document Management Systems (DMS), Hydraulic Modeling, Supervisory Control and Data Acquisition (SCADA-Historians), Workflow and Analytics. Managers, staff and operators can view and manipulate information through relational database(s) with powerful spatial mapping capability in the same user environment.

#### **Base GIS Layer Examples**

#### **Example Layer** Information within GIS

- Water & Sewer
- Census data
- Roads
- Flood prone areas
- Schools
- Land use
- Zoning
- Parks
- Contours
- Voting precincts
- Wellhead capture zones
- **Building footprints**
- **Drainage basins**
- Cell towers
- Fire rescue boundaries
- Wetlands
- Cemeteries
- Soils
- Subdivisions
- Parcels
- School districts
- Hydrology
- Churches
- Lakes
- **Electrical Power Grid**



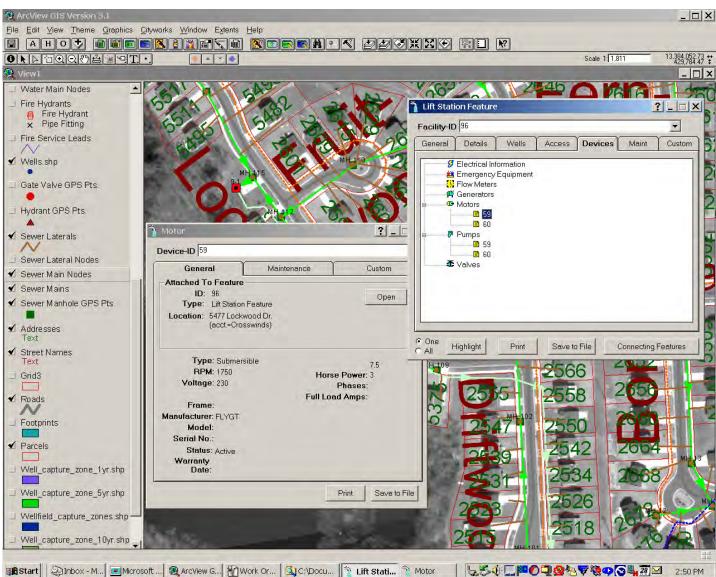
Types of GIS Layer Information that can be Created and Utilized

Customers

Streets

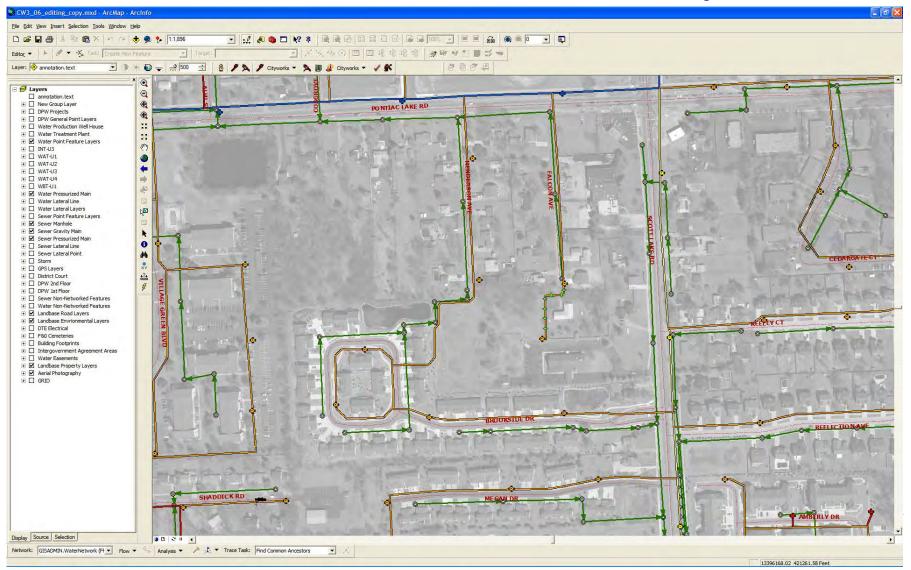
Reality

#### Base Physical Asset GIS Layer



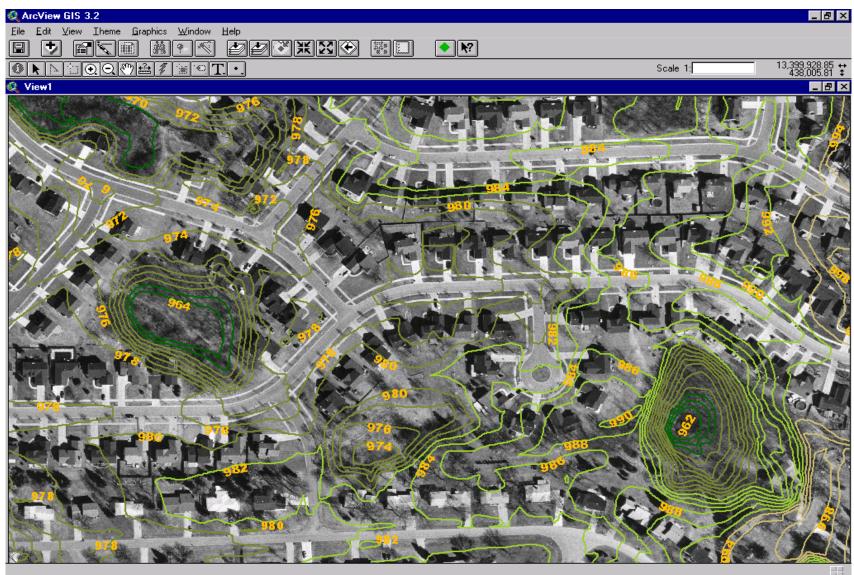
#### Asset Information Contained in Geodatabase

#### **Base Sewer Network GIS Layer**



Sewer Line and Sewer Lead Network GIS Layer

## **Base 2-Foot Elevation Contour GIS Layer**



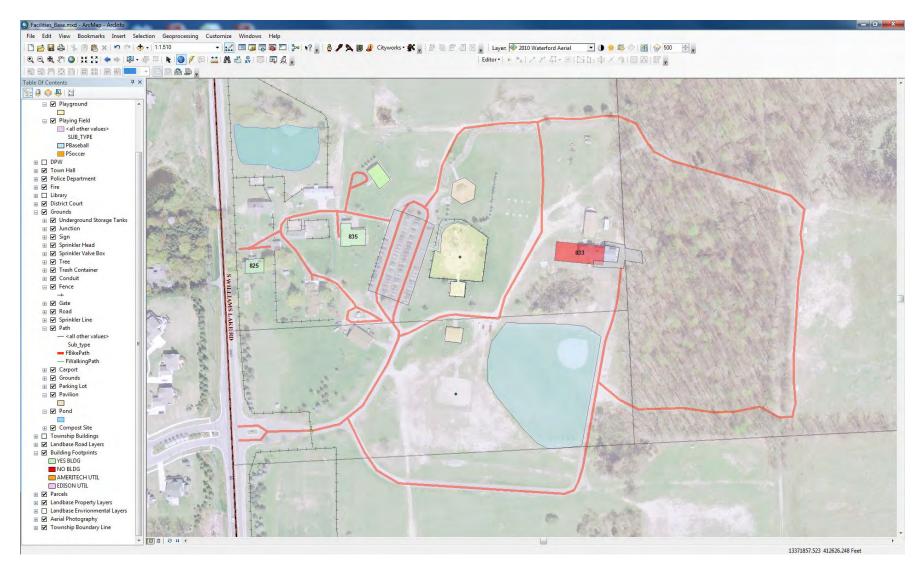
2-Foot Elevation Contour GIS Layer

#### **Base Aerial Photography GIS Layer**



Decades of Historic and Current Aerial Photography Layers in GIS

#### Base Park and Ballfield GIS Layer



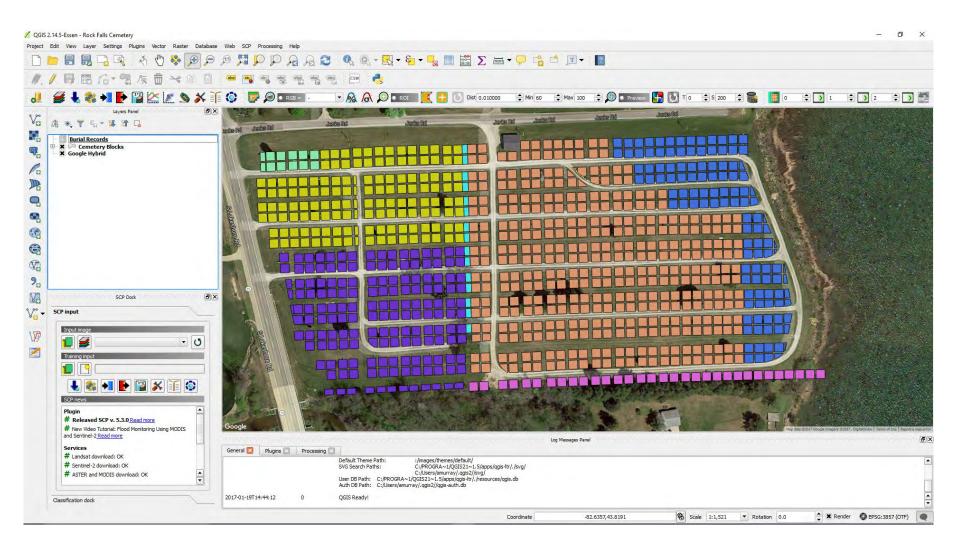
#### Park/Baseball Field Asset Information Layer in GIS

#### **Base Cemetery GIS Layer**



Cemetery Grave and Plot Information Layer in GIS

## **Base Cemetery QGIS Layer**



Cemetery Grave and Plot Information Layer in Open Source QGIS

#### Base Abandoned Well GIS Layer





Abandoned Well Layer in 1,5 and 10 Year Zone of Capture Layer in GIS Johnson&Anderson

#### Base Fats, Oils and Grease GIS Layer



City of Rochester Fats. Oils & Grease (FOG) Problem Areas



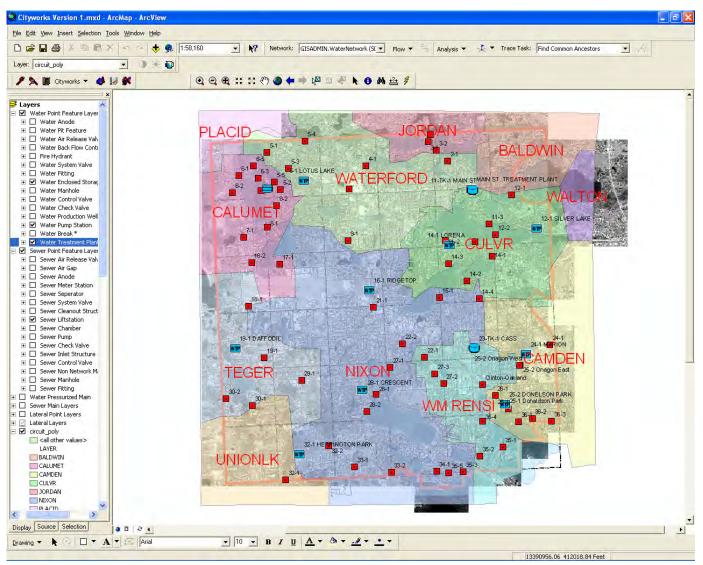
FOG Data Incorporated in GIS for Analysis and Work Order Use

#### **Base Road GIS Layer**



Road Information Layer Segmented Along Intersections in GIS

## Base Electric Circuit Area GIS Layer

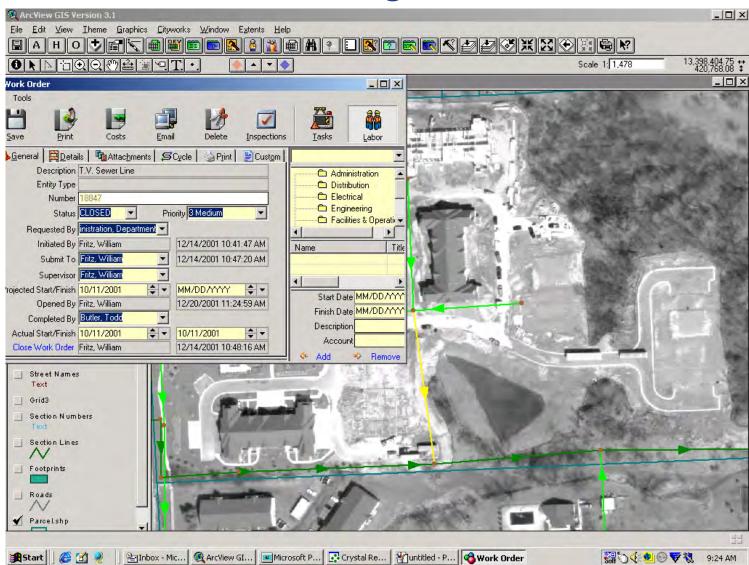


Electric Circuit Area GIS Layer

## **Business- CMMS Integrated with GIS**



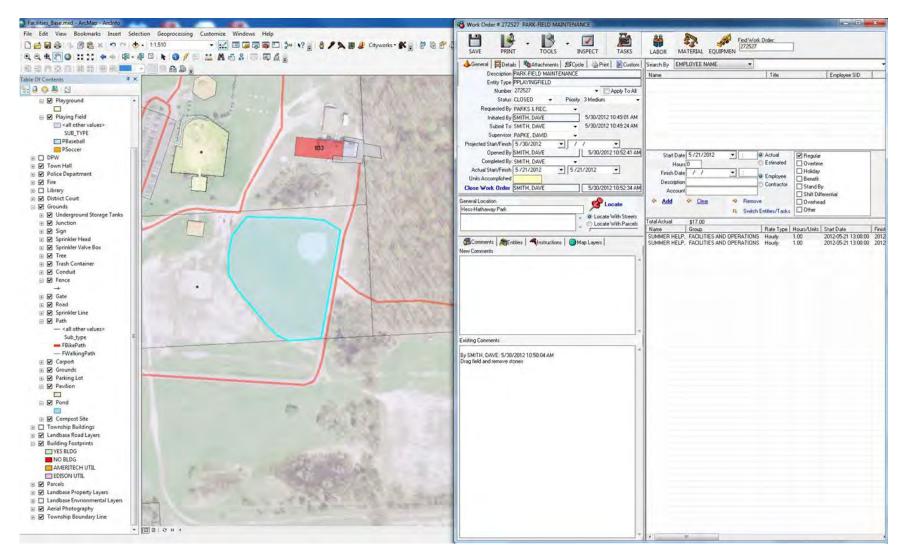
Electronic work order system used to schedule and initiate work to be performed as well as track costs such as labor, material, and equipment. Used as a multi-business process (water, sewer, storm, roads, parks, street lights, cemetery, sign, etc.) application leveraging the GIS spatial investment and the ESRI Geodatabase. Also used to maintain proper inventories of equipment and supplies.



Work Orders Linked to the Feature Itself, Allowing Spatial Work Order Searching

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Work Order Summary on DPW Building



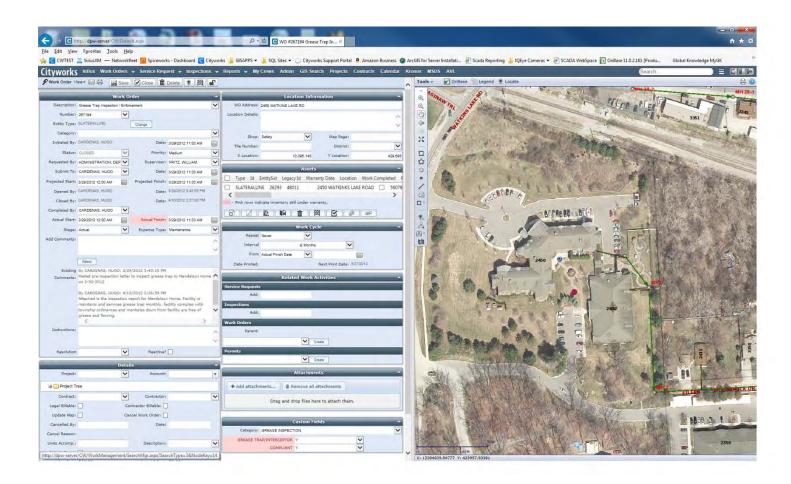
Work Order Summary Park/Playing Field

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Automated Geo-Coded Miss Dig Ticket Information and Work Order

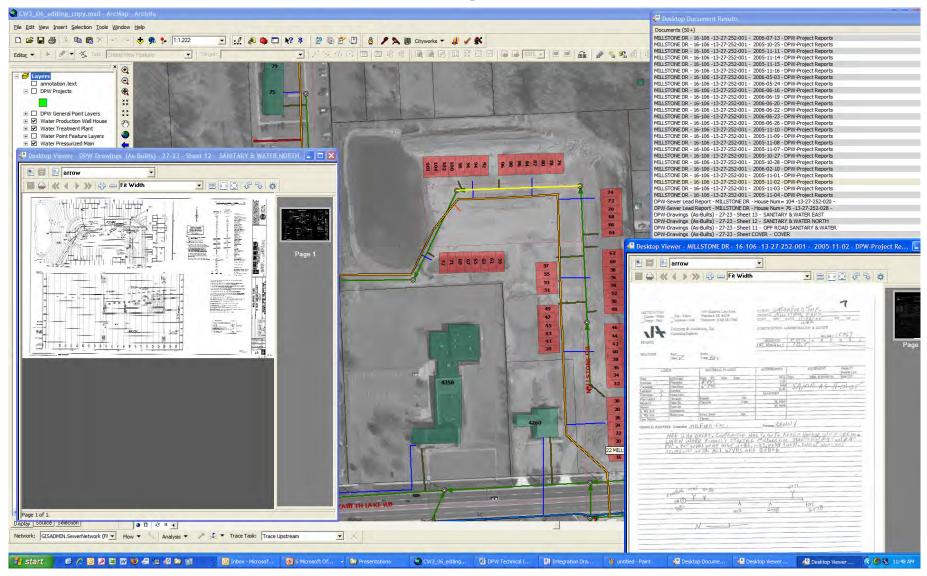


Fat, Oils and Grease Work Order

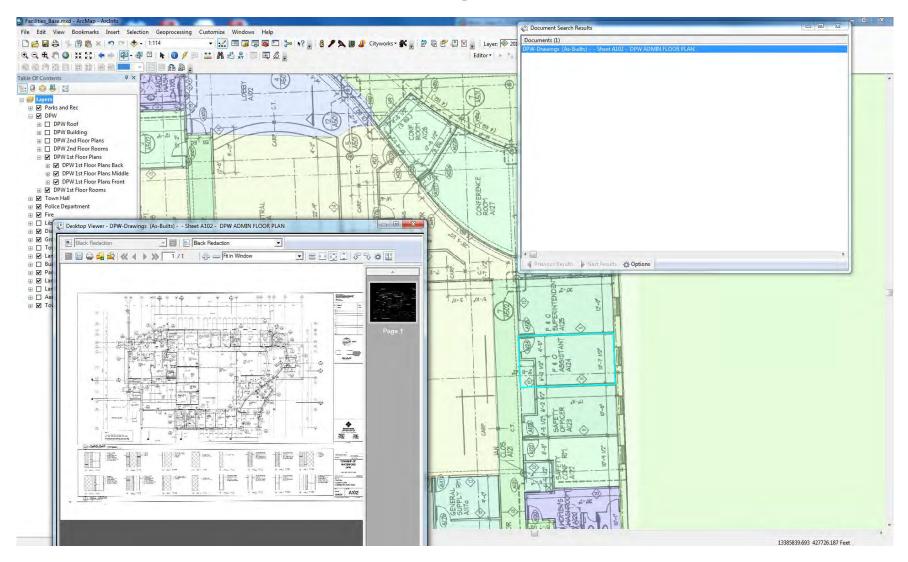
## **Business- DMS Integrated with GIS**



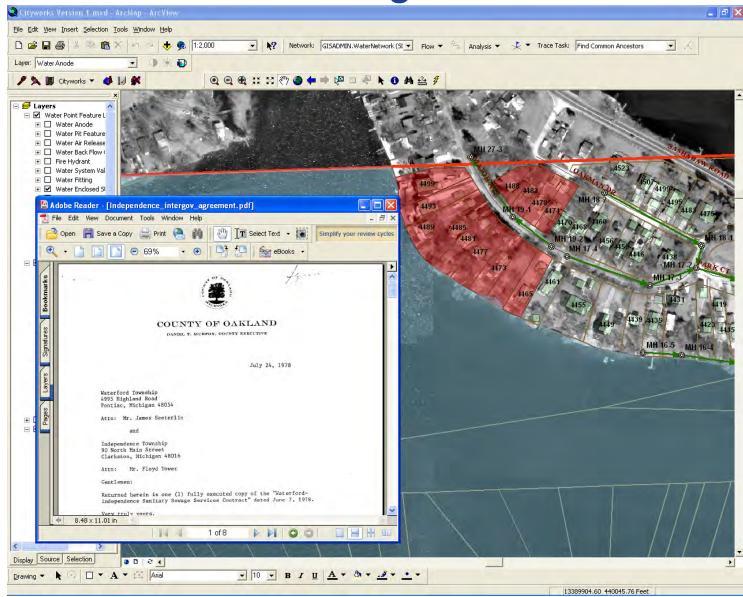
Electronic and database storage of such items as documents, drawings, invoices, contracts and easements so that they can be retrieved and viewed at a computer station or terminal.



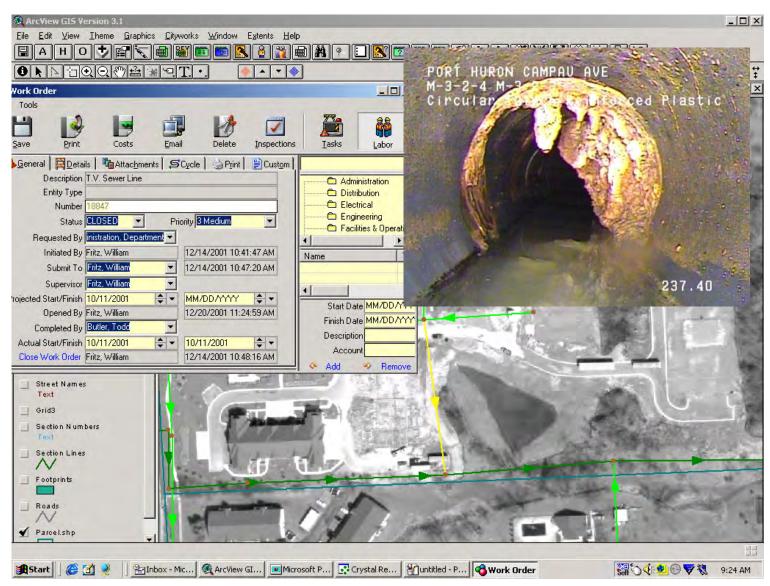
Sewer, Water, and Inspection Drawings from DMS Integrated in GIS



Building Drawings from DMS Integrated in GIS

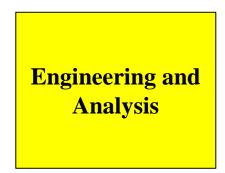


Intergovernmental Agreements from DMS Integrated in GIS



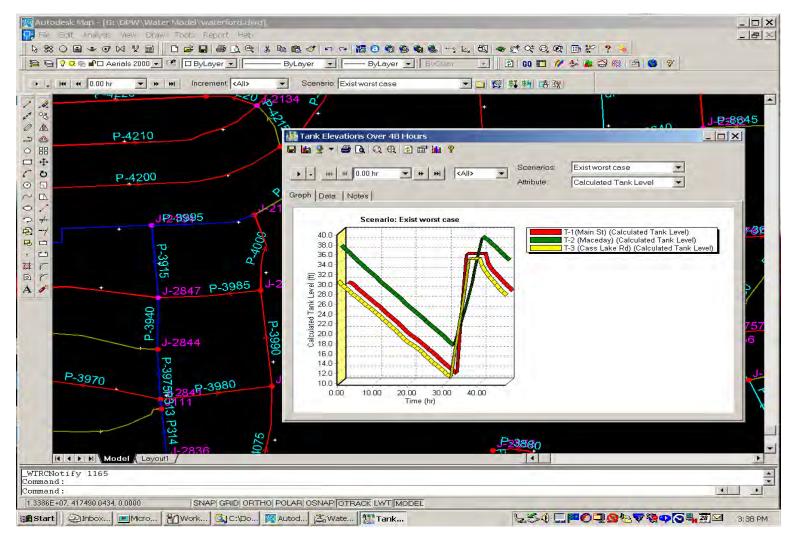
#### DMS Integration of CCTV Sewer Inspection Video

Engineering and Analysis- Hydraulic Modeling and Analysis Tools Integrated with GIS



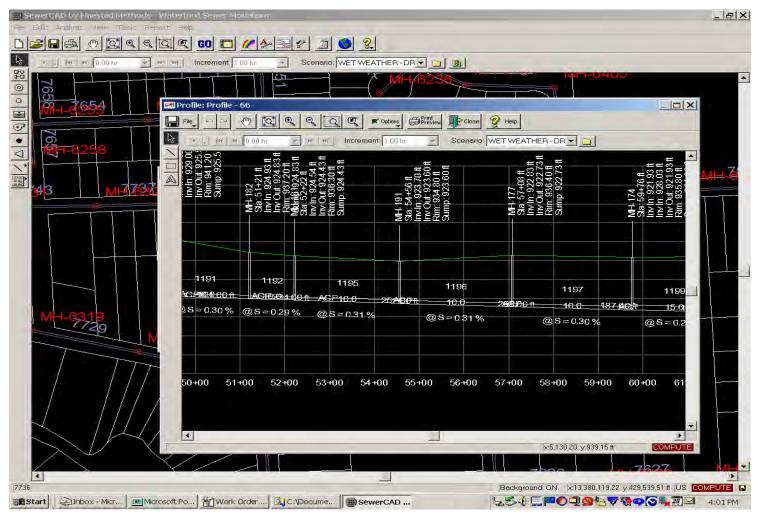
Leveraging GIS data including water and sewer network geometry to create and run hydraulic water and sewer system models to analyze, identify and plan to correct deficiencies or other operational problems. Also includes the incorporation of analysis tools such as upstream and downstream tracing of the sewer system to identify collection basins and customers connected to sewer pumping stations as well as water system valve isolation to aid operations staff with closing the optimum water valves during events including water main breaks.

## Engineering and Analysis- Hydraulic Water Modeling



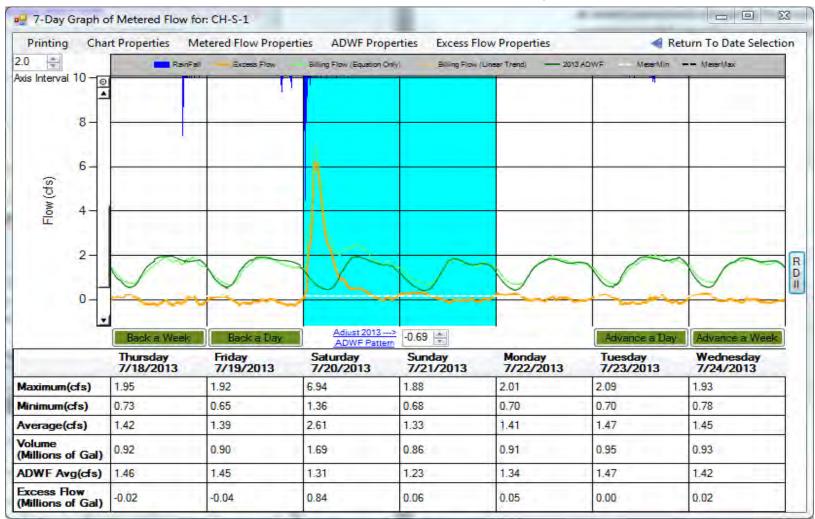
Predicted Tank Elevations Over Time

# Engineering and Analysis- Hydraulic Sewer Modeling



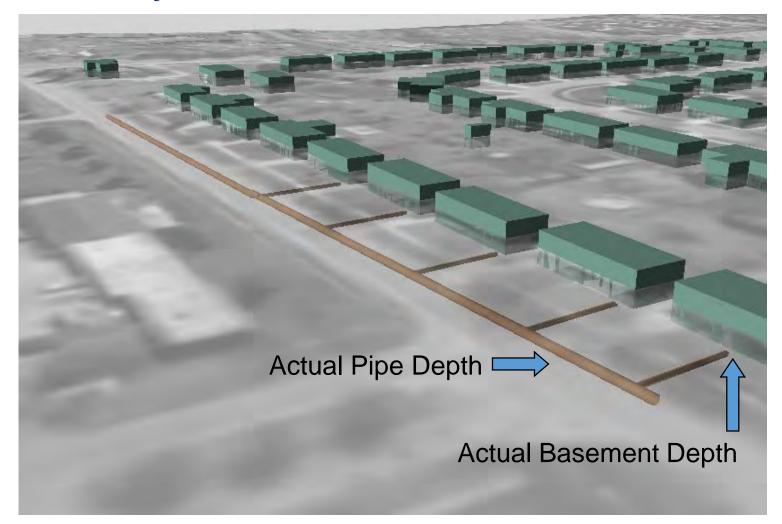
Sewer Segment Hydraulic Grade Line Prediction Under Modeled Wet Weather Event

## Engineering and Analysis- Sewer Flow and Rainfall Data Analysis



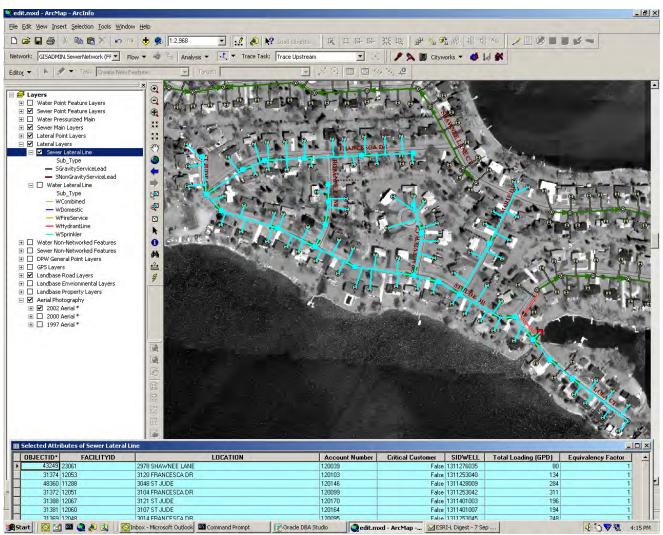
Excess Sewer Flow Volume Due to Rainfall Analysis

### Engineering and Analysis- 3D Rendering of Sewer System and Basement Elevations



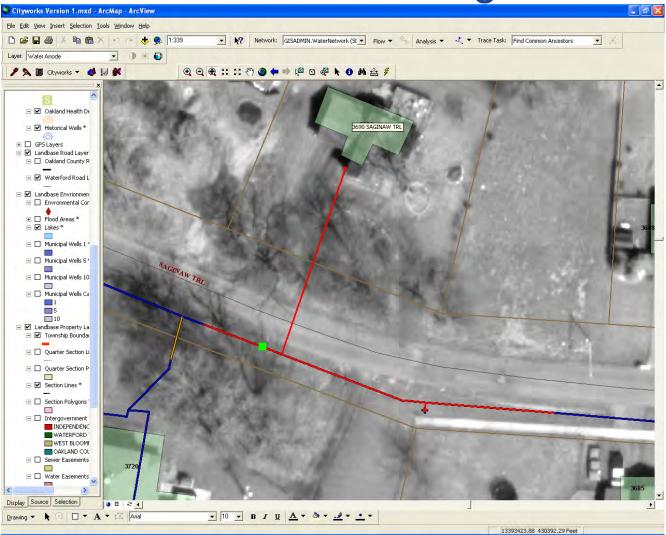
3d Rendering of Sewer System and Building Basements for Sewer Surcharge Analysis

### Engineering and Analysis- Sewer Network Up-Down Stream Tracing



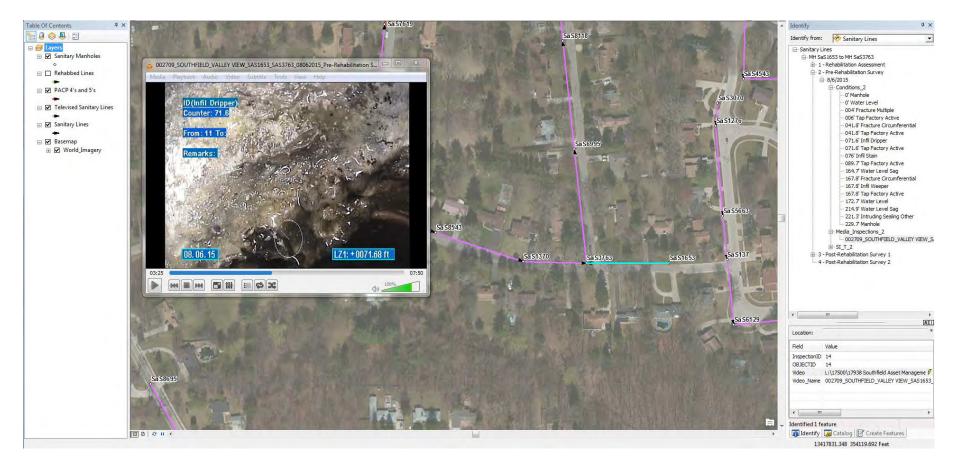
#### Tools Sewer Network Upstream and Downstream Tracing

### Engineering and Analysis- Water Main Isolation Tracing



Tools Water System Isolation Tracing for Water Main Break and Valve Repairs

#### Engineering and Analysis- Sewer CCTV PACP and MACP Data Integration



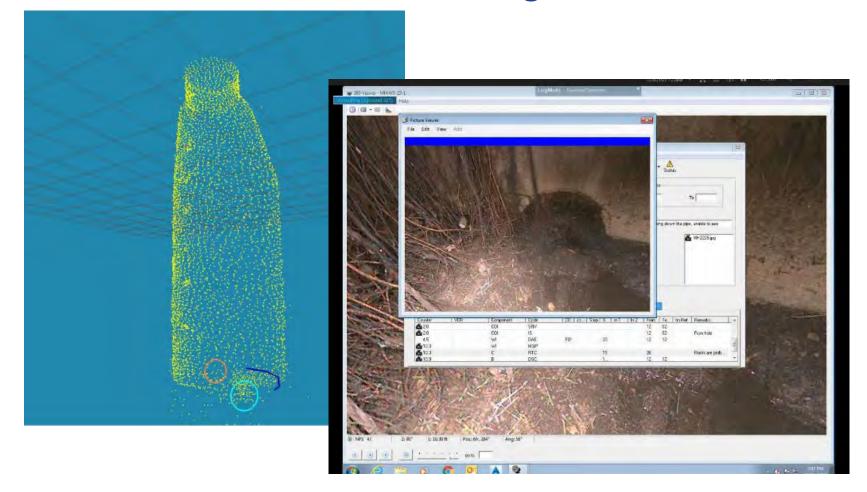
Incorporation of CCTV PACP Data and Defect Video for Analysis

#### Engineering and Analysis- Sewer Main CCTV PACP Data Integration



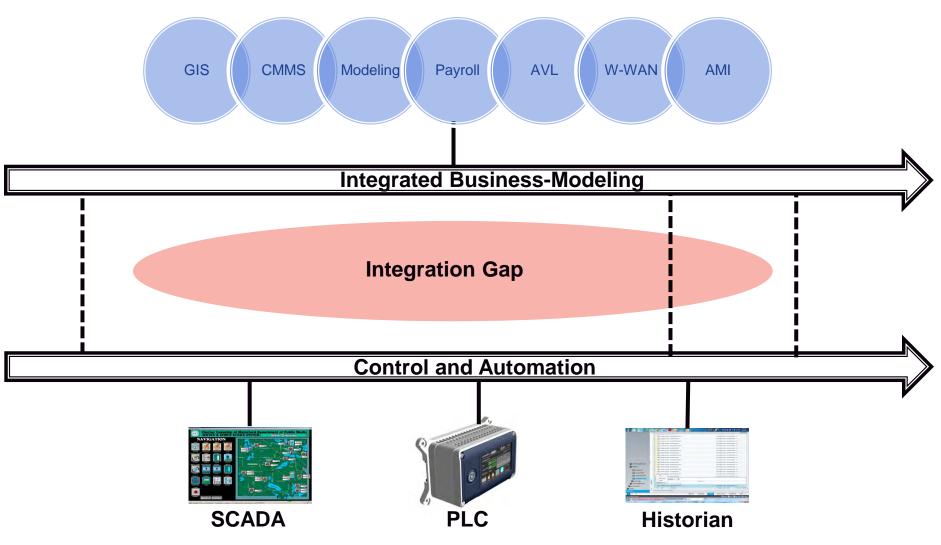
Analysis of PACP Hi Priority Sewer Main Defects as Well as Rehabilitated Ones

#### Engineering and Analysis- Sewer Manhole MACP Data Integration



Analysis of Sewer Manhole MACP Hi Priority Defects as Well as Rehabilitated Ones

### Integrated GIS, Business and Modeling Platform



#### **Control and Automation**



An important component of Intelligent Operations is centered around Control and Automation of DPW assets including water system booster pumping stations, sanitary sewer pumping stations, water and wastewater treatments plants, water storage and HVAC systems. Consideration should be given to open architecture based RTU and PLC controllers and Human Machine Interface (HMI) application platforms as well as mining and analyzing the data they create. Mobile viewing and system access should also be considered to provide operational staff with even capability.

## Control and Automation- Leveraging the Digital Natives



"Digital natives" Deliver new levels of productivity armed with new tools.



Technology acceleration

enables simpler solutions to complex problems leveraging new levels of computing power



The Industrial Internet connects machines with big data for better, faster answers ... Everything connected, everyone interconnected

#### Eliminate control platform



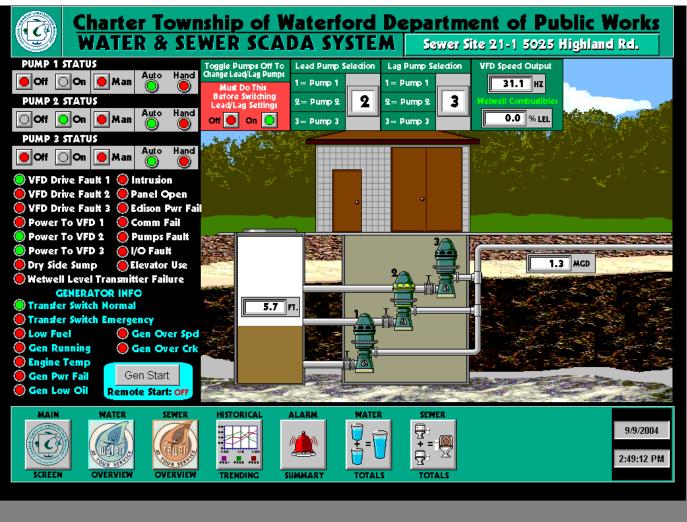
- Well Connected– Support multiple data interfaces with distributed IT to make local control decisions and provide data for analysis and optimization
- Modernization Master Plan Build a stable path to expanding the longevity of the control system investment with minimal production interruptions
- System Reliability Redundant capabilities minimize impact failures and provides command and control options during emergencies

### Control and Automation- Integrated Software Solutions

Implement automation software solutions that seamlessly interface with each other and core high performance automation platform to drive greater productivity, responsiveness and analytical capability through water and wastewater operations.

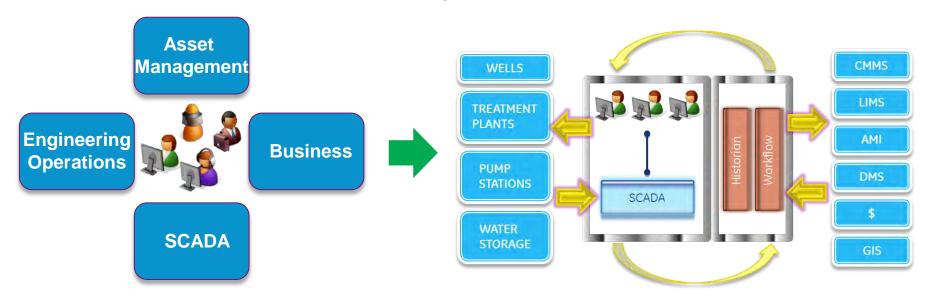


#### Control and Automation- Graphical User Interfaces



Sewer Pumping Station Graphical User Interface

### Control and Automation- Platform Connectivity and eSOP's



#### Leverage technology investment by integrating them through SOA:

- Reduce manual collaboration, duplicate effort, information silos, analysis gaps, operational inefficiency and reactive operations
- Real-time calculation of water efficiencies and energy usage
- Automatically trigger eSOP's on defined alarm events to ensure timely and best practice resolution
- Automatically trigger work orders from alarm events to capture labor and material costs

### **Control and Automation- Advanced Analytics**



#### Leverage real-time historian and other relevant platform data

- Perform powerful process and operational analysis to predict process abnormalities and rank most probable causes to correct them
- Ensure greater regulatory compliance at lower cost
- Analyze and reduce energy and chemical usage through process optimization
- Automatically correct process inefficiencies and/or trigger eSOP's to appropriate staff for corrective guidance

## Control and Automation- Get Mobile and Leverage Analytics

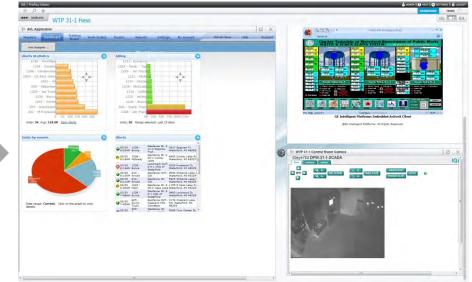


# Real-time Operational Intelligence to predict events and drive action by providing the right in formation to the right people anywhere and anytime

- Optimize staff resources making them proactive vs. reactive while reducing costs
- Ensure greater regulatory compliance due to fast intelligent information dissemination anytime anywhere
- Decrease response times through mobile interface displayed on desk top and/or smart device of your choice
- Instant view of Key Performance Indicators and health index indicators, chart trends and key asset relationships

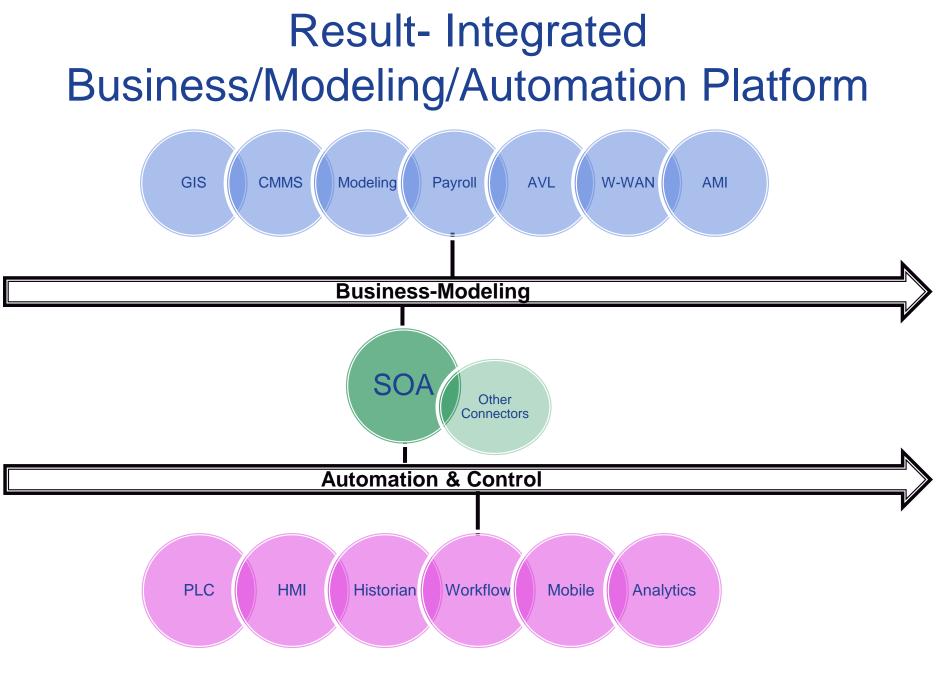
### Control and Automation- Business and Automation Dashboards





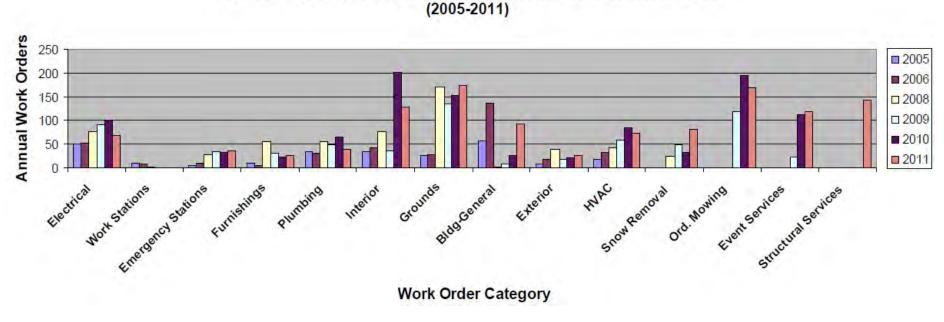
# Business and Automation dashboards secure single container for browser, user roles, tasks and dashboards

- Analyze and react quicker to operational changes
- Make better planning decisions
- Personalize views
- Limit users to view only areas of responsibility



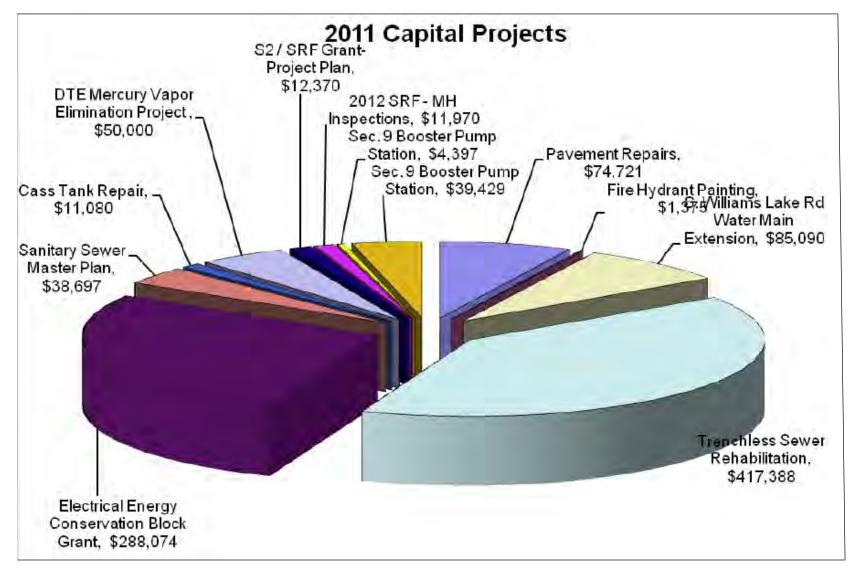


Better information results in better operations. A major consideration when developing an Intelligent Operations culture includes focusing on the longterm objective of effectively mining the vast quantities of data the integrated platform applications will create. Done effectively, Reporting will provide the organization with a single version of the truth whether analyzing a problem, justifying rate increases, capital improvement planning and effective resource utilization. Reports can be created specifically for the user and/or the audience.

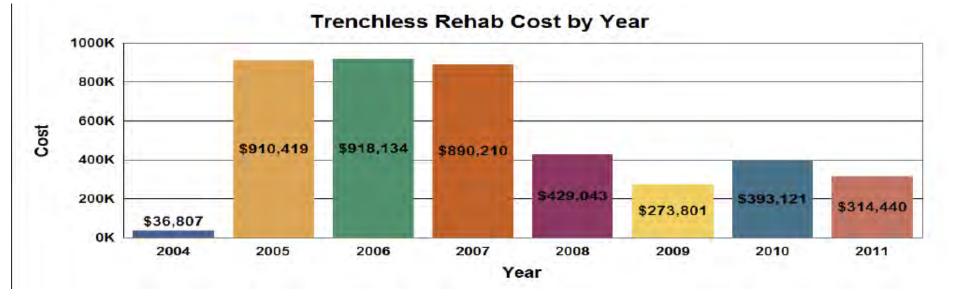


Facilities and Operations Annual Buildings and Grounds Work Orders

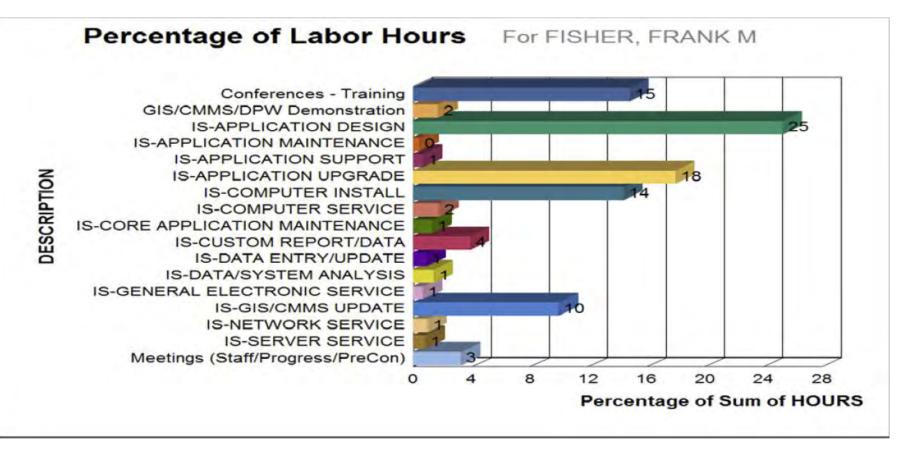
Annual Buildings and Grounds Work Order Summary



Annual Capital Project and Cost Summary Report

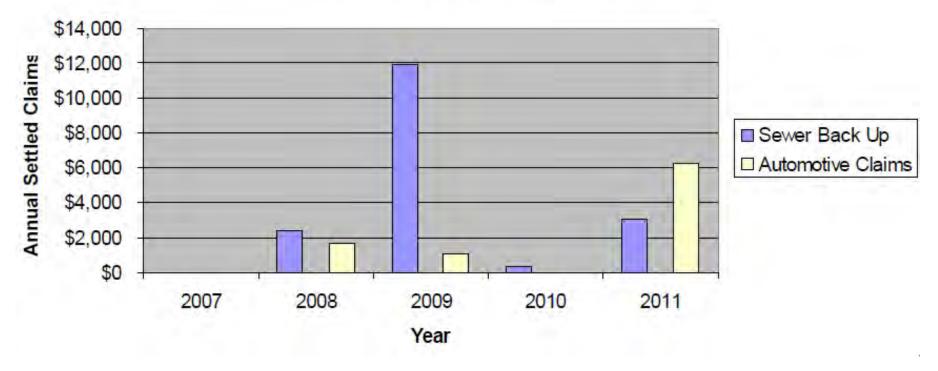


Multi-Year Trenchless Pipeline Rehab Cost Summary

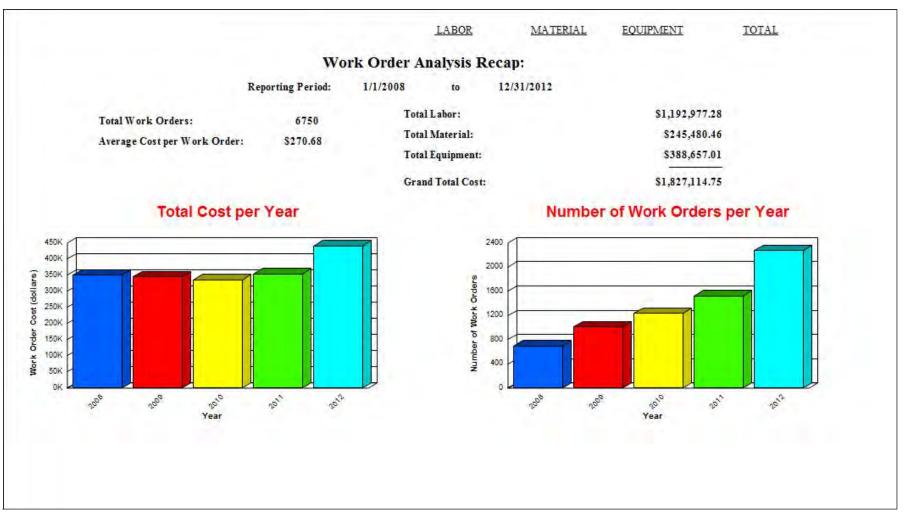


**Employee Labor Hour Report Summary** 

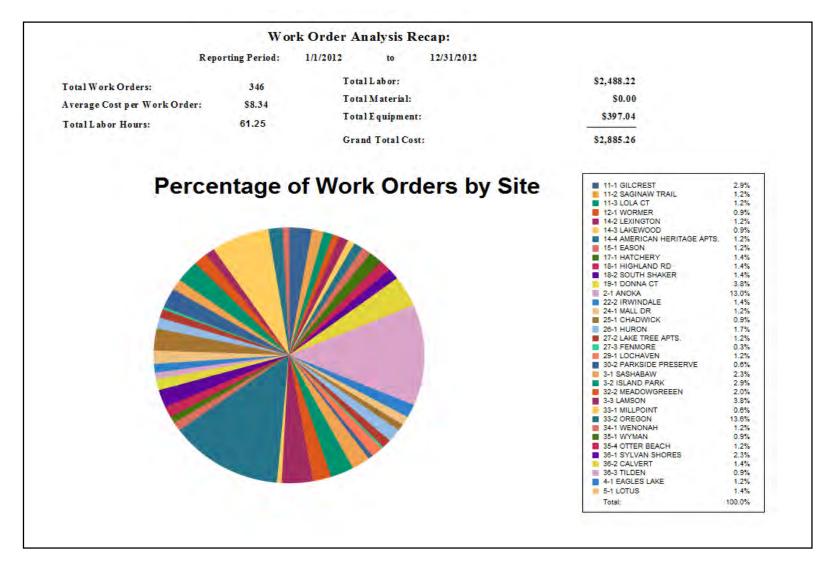
Waterford DPW Insurance Claims



Multi-Year Insurance Claim Cost Summary



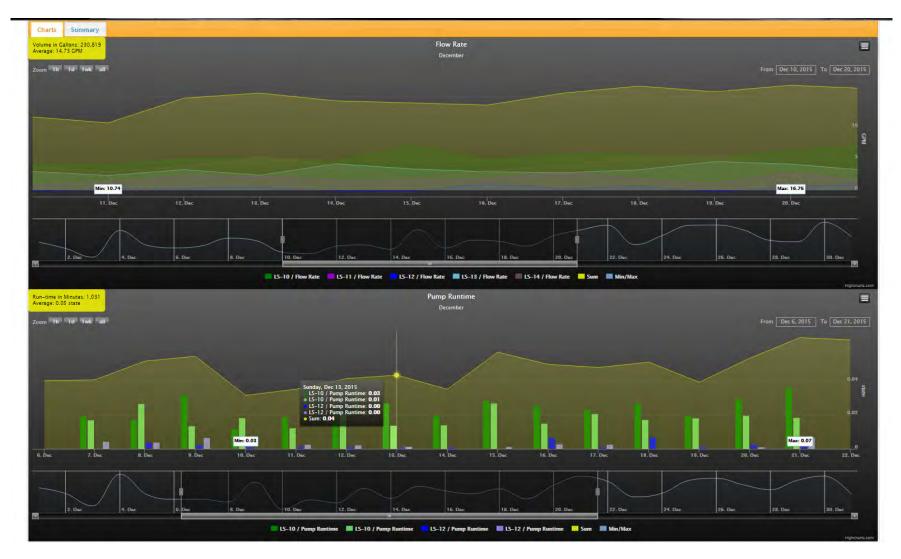
Staking Request Work Order Summary



All Pumping Station Work Order Cost Summary

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Daily Water System Demand from SCADA Historian Data and as Exported to Excel for Further Analysis



Multi-Site Sewer Pumping Station Flowrate and Runtime Report with Flow Totalization from SCADA Historian Data

#### **Organizational Initiatives**



Without updating and changing the culture of the organization, most technology initiatives will fail. At best they will remain a stand-alone application used by specific groups without the benefit of integration resulting in the lost opportunity of leveraging the technology investments.

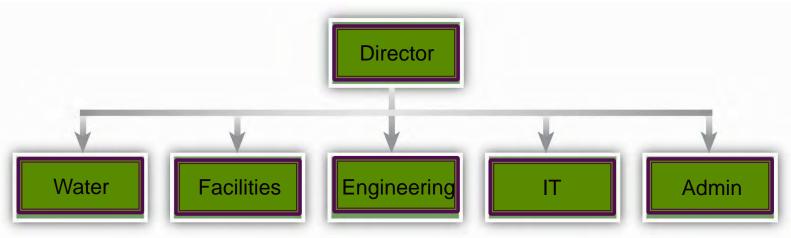
## Intelligent Operations Organizational Initiatives

- Define organizational needs and goals aligning positions and classifications with mission needs and objectives
- Establish Enterprise IT oversight committee
- Standardize core computer hardware and software platforms
- Justify need for needed full-time technical staff to implement and support technology initiatives
- Create culture of personal and professional growth
- Work to build organizational trust through fair and consistent staff accountability doctrine
- Create culture that recognizes the importance of safety
- Disseminate programs and organizational information to governing bodies and public regularly
- Do not computerize bad business processes
- Implement incrementally building on progress made from previous work



### Flatten Organizational Structure

- Flatter organizational structures enable greater levels of communication between staff and management empowering them to take charge, aid in decision making, work toward common goals and accountability for the utilities success
- Decisions and responses can be made faster by not having to move up the chain of command for permission and direction
- Eliminate "Not in my sandbox mentality" through crosstraining training initiatives



### Provide Staff Advancement through Career Ladder Program

- Implementation of a career ladder program that provides an accomplishment based path for advancement
- Particularly effective in Union environments where advancement is based almost exclusively on seniority
- Under this type of program, staff has the opportunity to automatically progress through designated promotions and higher pay as they obtain higher level treatment, distribution, collection, mechanic and other licenses
- As a result, the utility will have better cross trained and more licensed personnel to execute the utilities mission



### Create Culture of Information, Safety and Productivity

- Creation of Risk Manager and/or Safety Coordinator position to plan, train, monitor and implement environmental safety and health related programs and to manage operator licensing, and cross training programs.
- Implement on-line licensing and safety training program to reduce costs and lost staff time due to traveling for classes and testing.
- Host hands-on on-site classroom safety and licensing training to reduce costs and reinforce learning.
- Implement on-line MSDS program to ensure up to date anytime/anywhere information access for chemical and other material.



#### **Public Outreach and Service**

- Leverage the technology investment to provide more efficient, consistent and accountable information and services to the public.
- Accomplished through public education, online services and detailed operational reports mined from the CMMS, financial, engineering and analysis, and automation application platform investment.



**Operational Improvements** 

- Optimized operations reducing energy, chemical, equipment and labor costs
- Improved hydraulic transients and water main breaks
- Reduced pump station failure and SSO's
- Continual real-time system and process feedback & analysis
- Enhanced terrorist and/or other system contaminant event detection and prevention
- Consistent best of practice control and response to problems
- Daily water efficiencies and real-time leak detection
- Optimized water quality and water quality analysis
- Exception based monitoring and alarming with data for forensic analysis
- Efficient, consistent and accountable customer responses
- Optimized analysis and response



**Operational-Capital Planning** 

- Increased project justification and ROI capability
- Asset readiness and service life optimization
- Integrated data for better operational and capital infrastructure planning
- Maximized use of application expenditures through integration
- Integrated hydraulic water and sewer modeling for system deficiency analysis
- Greater value engineering and project optimization



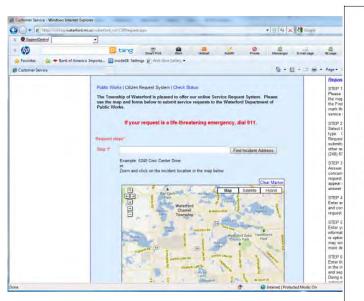
#### Labor

- Reduced lost work days and Worker Comp claims
- Proactive thriving flexible organizational culture
- Highly trained, licensed and cross trained staff
- Empowered and proactive staff
- Timely and accurate project review, information dissemination, and customer service
- Timely and accurate response to operational and process problems

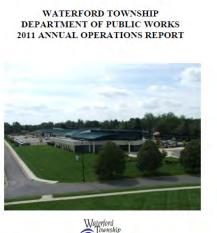


#### Public Awareness

- Proactive customer service, response and accountability
- Public empowerment and awareness through Online Customer Service Portal, Billing and other operational and informational programs
- Improved water system ISO rating lowering customer insurance
- Enhanced public-utility relationship



Johnson&Anderson



Respectfully Submitted February 27, 2012 to the Honorable Charter Township of Waterford Board of Trustees

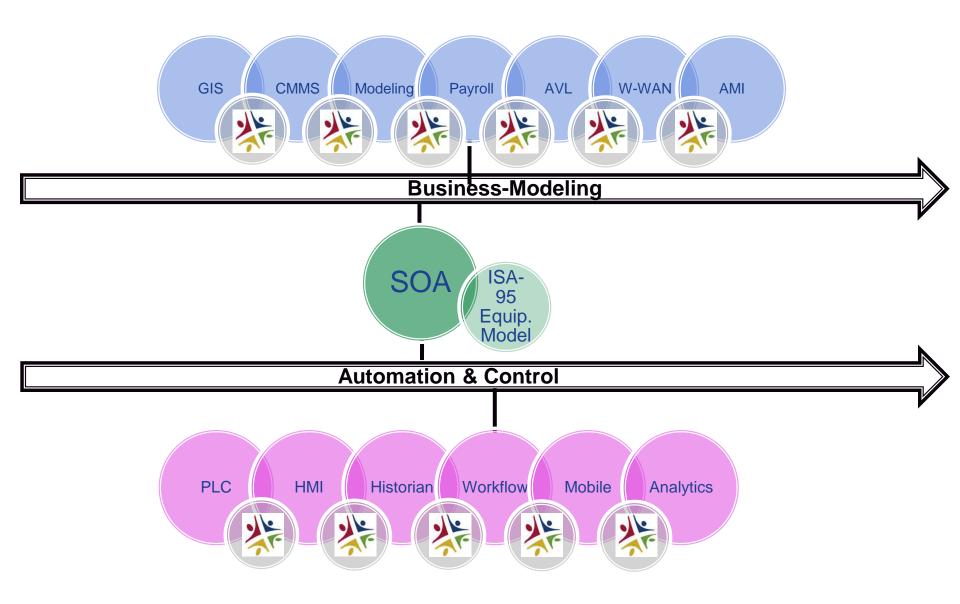


#### Community Education and Outreach





#### **Intelligent Operations- Achieved**



# **Questions?**

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