

USING GIS TOOLS TO IMPLEMENT AN ILLICIT DISCHARGE ELIMINATION PROGRAM IN LIVONIA, MICHIGAN

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ABSTRACT

The City of Livonia, Michigan is using Geographic Information Systems (GIS) technology to enhance the implementation of its illicit discharge elimination program. The illicit discharge elimination program currently underway within the City of Livonia is required by the Michigan Department of Environmental Quality (MDEQ) Voluntary General Stormwater Permit (MIG610000), which was issued in 1997. This permit offers an innovative approach to the National Pollutant Discharge Elimination System (NPDES) permit program by focusing on the concept of watershed management. In August 1999, the City of Livonia received coverage under the MDEQ Voluntary General Stormwater Permit in lieu of requirements of the Environmental Protection Agencies (EPA) Phase I stormwater program.

Within the City of Livonia, GIS has been used in direct support of General Stormwater Permit activities that focus on identifying illicit connections, points of infiltration and likely sources of future contamination to the storm sewer system. Activities currently underway include the mapping of the stormwater conveyance system, the location and mapping of storm sewer outfalls, and the location of on-site sewage disposal systems (OSDS). As a result of the GIS integration, record keeping is improved, problem areas are identified earlier, and joint efforts with surrounding communities and other agencies with storm drainage jurisdictions in Livonia are simplified. These GIS tools are also part of an overall municipal GIS program for improving the delivery of public works services to businesses and residents.

KEYWORDS

GIS, Stormwater Permit, Illicit Discharge, Rouge River National Wet Weather Demonstration Project, On-site sewage disposal systems

INTRODUCTION

The mission of the Rouge River National Wet Weather Demonstration Project (Rouge Project) is to demonstrate effective solutions to water quality problems facing urbanized watersheds that can provide guidance to municipalities across the nation that face similar problems. In addition to providing funding to help construct separated sewers and retention basins for combined sewer overflow (CSO) control, the Rouge Project has funded hundreds of projects by governmental units and non-profit organizations that demonstrate how other sources of pollution can be controlled. The City of Livonia, a municipality located within the Rouge Watershed, has received several of these project grants intended to demonstrate various aspects of stormwater management. Two of these grants focus on the use of GIS in stormwater management. An initial grant was awarded for the enhancement of the City of Livonia's existing stormwater collection system information. A second GIS related grant was provided for the development of additional

GIS data to support an illicit discharge elimination program. These combined grants have helped the City in its pursuit of locating illicit connections, points of infiltration and likely sources of future contamination based upon the age and condition of sewers and the proximity of the sanitary sewers and on-site septic systems to the storm sewer system.

In 1997, the MDEQ issued a Voluntary General Stormwater Permit (MIG610000) for discharges from Municipal Separate Storm Sewer Systems. This permit offers an innovative approach to the National Pollutant Discharge Elimination System (NPDES) permit program by focusing on the concept of watershed management. One of the innovative aspects of this permit is that its pollution control requirements are derived from locally-developed subwatershed management plans rather than "one size fits all" mandates. This program allows local agencies flexibility in meeting the Clean Water Act requirements for stormwater while providing cost-effective environmental benefits. While voluntary at this time for most public agencies, new federal stormwater regulations will require most communities within the Rouge River Watershed to obtain a permit to discharge stormwater within three years. The EPA has indicated that the Michigan watershed-based general permit will meet the new federal requirements.

The City of Livonia received coverage under the MDEQ Voluntary General Stormwater Permit in August of 1999. By receiving coverage under the Voluntary Permit and complying with the conditions of the permit, Livonia will meet Clean Water Act requirements. In addition to providing coverage under recent Phase II regulations, the Voluntary General Stormwater Permit is providing coverage for Livonia in lieu of the Phase I NPDES permit program requirements. The City of Livonia, which has a population of approximately 100,000 residents, recently completed the separation of its combined storm and sanitary sewers, making coverage mandatory within the NPDES program. Because Livonia obtained coverage under the Voluntary General Stormwater Permit, MDEQ has waived implementation of the existing Phase I NPDES program within Livonia.

As part of the requirements of its Voluntary General Stormwater Permit coverage, it was necessary for Livonia to prepare and implement an illicit discharge elimination program. Livonia's program includes elements to find, prioritize and eliminate illicit discharges and illicit connections identified during dry weather screening activities. In addition, the program includes activities to minimize infiltration of seepage from sanitary sewers and septic systems into Livonia's separate stormwater drainage system. As an integral part of their illicit discharge elimination program, Livonia has chosen to develop their existing GIS to help implement and track progress of its permit activities.

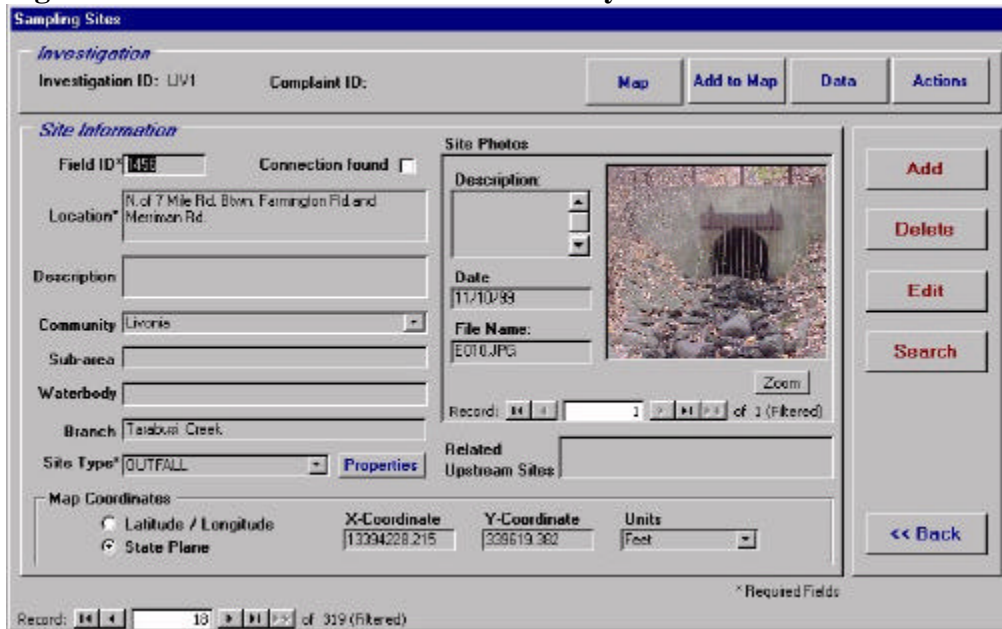
METHODOLOGY

An initial step towards general permit compliance involved the visual screening of stormwater outfalls to the river during dry weather conditions. The main objectives of this survey were to locate, inventory and document all the outfalls along the streams surveyed, as well as identify the type of outfall located and the quality of the discharge water. For pilot purposes, three areas within the City of Livonia were surveyed, covering a river distance of approximately 12 miles. The stream characteristics of the three pilot areas were varied in nature – one area consisted primarily of a large impoundment of the river, the second took place in a tributary headwater area and the third in more downstream tributary area.

The visual screening of the outfalls was a multi-step process. Before the start of the fieldwork, existing maps of the storm sewer system were generated to assist the field crew in locating anticipated outfalls. While in the field, standard procedures were followed at each outfall. A survey form was used to document the characteristics of non-stormwater flow from the outfalls including observations related to the amount of flow, color and odor. In addition, structural conditions of the outfall such as size, material, and condition of the pipe or headwall were recorded. Spatial locations were recorded using a Global Positioning System (GPS) and photographs of each outfall were taken. The GPS location of the outfalls allows for easy location of outfalls for follow up and other future screening activities.

The visual screening exercise was used to identify outfall locations and to provide the data necessary to initiate follow up of locations of suspected illicit discharge activity. All data collected during this dry weather screening process was stored in a GIS database system. The database system was designed to record investigation data and to provide ease in reporting investigation activities. Figure 1 shows a data input screen from the GIS database system. In addition to their use for potential illicit connection investigations, the spatial outfall inventory locations recorded during the visual screening process were used in the storm sewer coverage updates.

Figure 1 - GIS Database of Outfall Inventory Data



Another step in implementing Livonia’s illicit discharge elimination program involved an update of the existing stormwater collection system GIS coverages. Updates were made to further refine the accuracy and completeness of existing stormwater related coverages. The City of Livonia’s existing stormwater collection system GIS data consisted of digital versions of paper maps at a 1"=500' scale. The paper maps that were used as a source in the original data development process had a disclaimer on the accuracy and completeness, because some areas had not been updated for 15-18 years. For their use with the General Stormwater Permit requirements, updates

were necessary to build consistency within the stormwater coverages. The updates completed included data for storm sewers, open drains, inlets, catch basins, and manholes.

During the update process, the storm sewer network was carefully reviewed to verify system connectivity, direction of flow within the system and the completeness of the sewer network. When practical, aerial photography was used to realign locations of catch basins, manholes, inlets, outfalls and the location of the river reaches. Outfall inventory data collected during the dry weather screening process were also used to modify the storm sewer coverage. Additional source materials such as county maps, as-builts and personal knowledge of City personnel as to the location, size and condition of storm mains, catch basins, outfalls and open drains also provided valuable data. In areas where existing documentation was inadequate, a GPS was used during field verification.

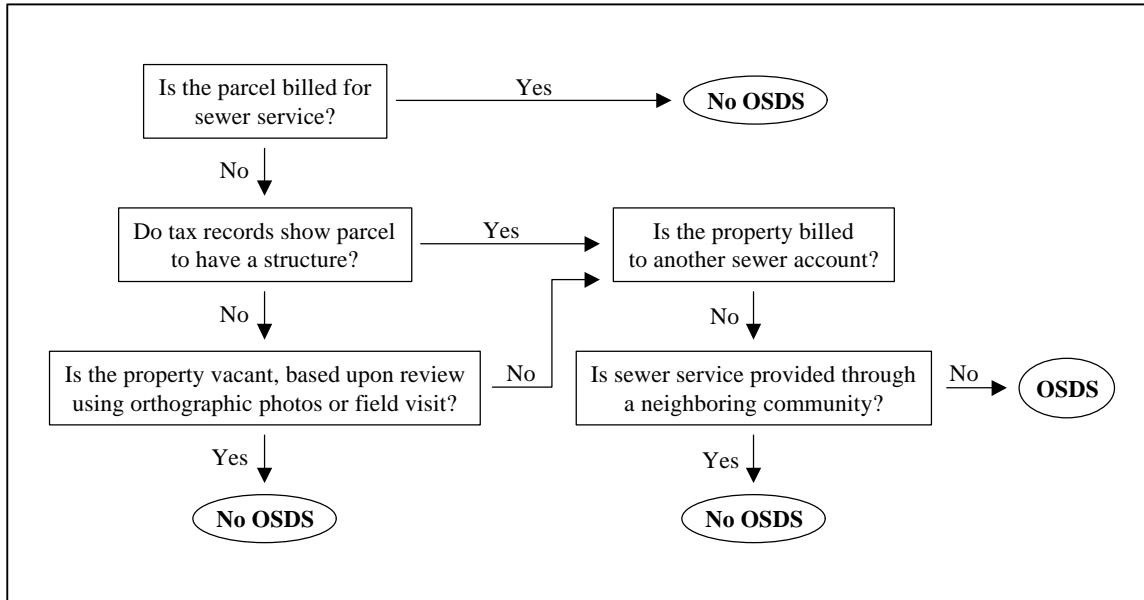
An ArcView database was designed to incorporate modifications needed as new or more accurate stormwater related data were received during the project. Additional fields were also included to accommodate stormwater coverage information anticipated during future updates. Updates to the coverages were made in ArcView and included the addition of tie-ins with neighboring communities, missing structure such as catch basins manholes, open or enclosed drains that were missing or not aligned properly, and the addition of retention/detention basins that were not on the original source maps. In addition, new coverages were developed to display outfalls and detention ponds.

Topologic building was performed on an iterative basis to attach dangling or unconnected storm drains and structures. A tracing application that operates in ArcView was initially used to verify the connectivity of the system, and was subsequently used for verification as updates were made. Final topologic building took place in ArcInfo to ensure a comprehensive, integrated network of the stormwater collection system.

A third GIS related component of Livonia's illicit discharge elimination program was the location of on-site sewage disposal systems (OSDS), commonly known as septic systems. To provide an updated list of OSDS, GIS and database tools were used to compile a list of parcels within the city not served by sewers. This was achieved by comparing water and sewer service billing records to the Livonia GIS parcel coverage. Figure 2 shows a flowchart documenting the process that was used evaluate the status of sewer service for each parcel within the City of Livonia.

In addition to identifying parcels serviced by OSDS, GIS was used to identify sites that would potentially be required to connect to the sanitary sewer system. Within the City of Livonia, one criteria in identifying sewer availability is the distance of the sanitary sewer from the property to be serviced. If a sanitary sewer is within 10 feet of the property boundary, the owner may be required to connect to the sanitary sewer. Sanitary sewer availability analysis was completed in ArcView by buffering the sanitary sewer by ten feet and then performing a spatial join between the buffered sanitary sewer coverage and the parcel coverage. All parcels located within ten feet of the sanitary sewer were identified using this process.

Figure 2 – Procedure to Locate Parcels with OSDS



RESULTS

The outfall inventory completed during the dry weather screening process was beneficial as both a first step towards illicit discharge elimination and providing spatial data for updates to the storm sewer GIS coverages. During the dry weather screening process, 114 outfalls were identified within the pilot areas. The outfalls ranged in size from 6 to 114 inches in diameter or width, many of which were easily matched with the appropriate storm sewer that they served. Forty percent of the outfalls found during visual screening were identified as outfalls serving the City of Livonia storm sewer system. Some of the remaining outfalls identified were less than 12 inches in diameter and were attributed to underdrains from residential homes. Others discharge drainage directly from private storm sewer systems or systems owned by the local county road agency, Wayne County. Preliminary follow-up on outfalls not easily identified as city, county or private ownership revealed segments of the storm sewer system not included in the original GIS coverage.

Modifications to the storm sewer system from based upon GPS survey data and other sources provided a topologically built storm sewer GIS coverage. Results were provided in storm sewer, open drain, catch basin, inlet, manhole, catch basin, outfall and detention pond coverages. Additionally, drainage subareas were delineated for each outfall within the City of Livonia, based upon the storm sewer drainage system and the topography of the City. With the updated network and subareas, Livonia staff can now use GIS to trace upstream within the system if a pollutant is found discharging from the storm sewer outfall.

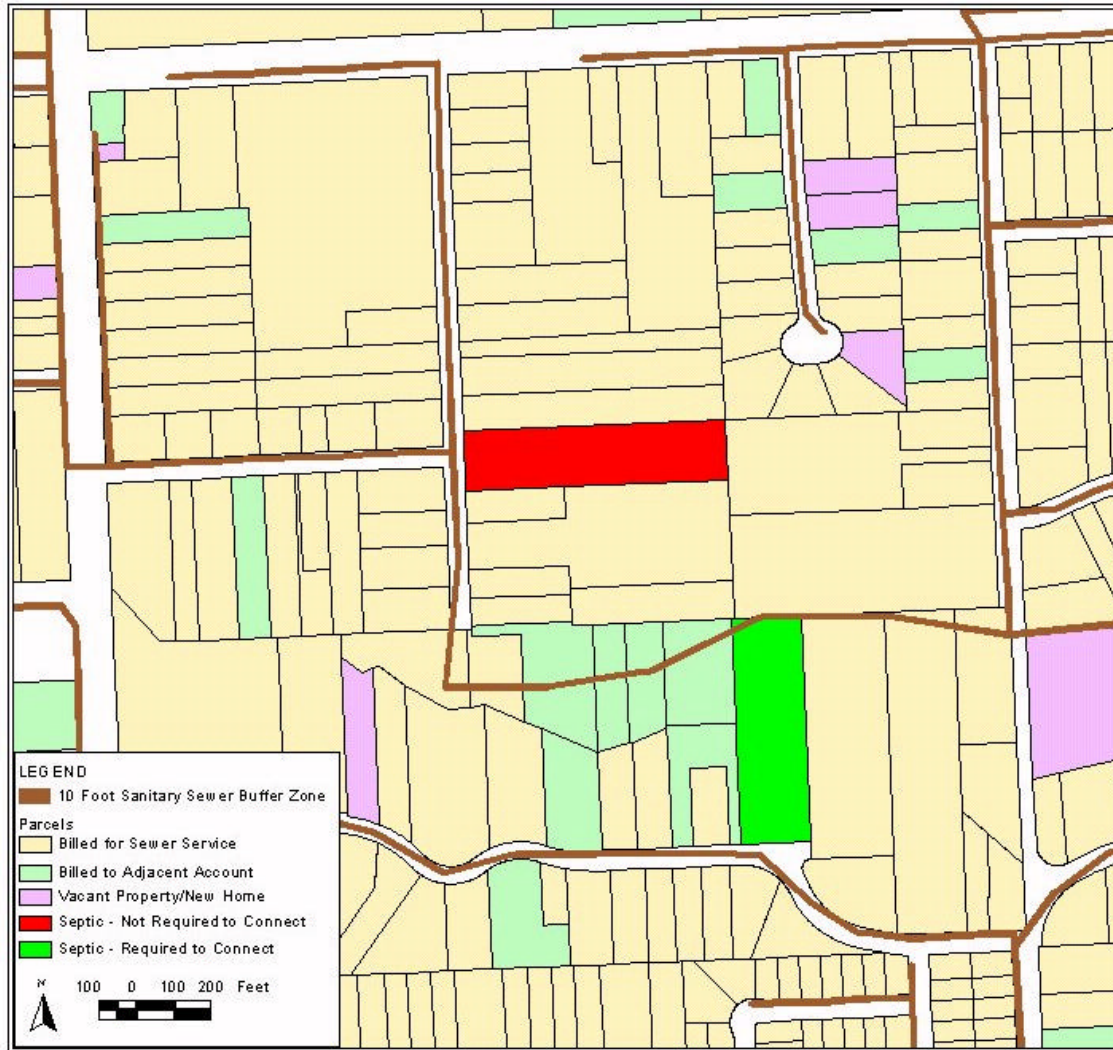
Using the methodology displayed in Figure 2, GIS analysis allowed Livonia to locate and map over 200 OSDS locations throughout the City. In this process, all parcels were identified to be either:

- Paying sewer charges;
- Billed through water & sewer charges through an account for an adjacent parcel;

- Provided sewer service through a neighboring community; or
- Not in need of sewer service (e.g., vacant property).

The analysis also identified parcels within the City that were receiving sewer service, but not paying it. Figure 3 shows the sewer service status of each parcel in Livonia subdivision. The proximity of the existing sanitary sewers are also indicated by a ten foot buffer shown on the map.

Figure 3 – Sewer Service Status with Sanitary Sewer Buffer



CONCLUSIONS

The data developed for the stormwater collection system network, outfall locations and locations of OSDS all work jointly as the foundation for Livonia’s illicit discharge elimination program. Water quality problems identified through dry weather screening and complaints submitted by local citizens can be traced upstream within the drainage network to identify potential pollutant sources. The data established through this process will help the City determine the location of

existing illicit connections, points of infiltration and likely sources of future pollution as required under the Michigan General Stormwater Permit.

ACKNOWLEDGEMENT

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