

Mining Enterprise 'Memory' at Lakehaven

Abstract:

Lakehaven Utility District's Geographic Information System (GIS) has been leveraged in support of an asset based Maintenance Management System (MMS). We wanted there to be features to which a work-order could be attached so GIS was asked to map water service line features. During the course of our effort, we became aware of resources that ultimately led to developing a superior data layer. Sharing our experience may help others to more fully employ their resources and increase awareness and understanding of underutilized resources in their periphery.

Background:

This paper describes the process of creating a collection of water service feature classes at Lakehaven Utility District, a special purpose Water & Sewer District. We are located in South King County Washington; South of Seattle adjacent to Tacoma and are responsible for over 450 miles of water main and nearly 30,000 active services.

During the early 1990s we digitized our paper water facility maps using CAD to create an Automated Mapping/Facility Management (AM/FM). In 2005 our CAD AM/FM data was migrated into a GIS geodatabase. In 2010 our Field Operations staff began implementation of a Maintenance Management System (MMS) and the GIS staff was asked to provide water service line features to which work-orders could be attached.

A Water Service is an assembly of features which conveys water from the water main to the customer. Each assembly consists of a connection to a water main (node); a service line from the water main directly to the service setter, or through a service header to multiple services; a meter that measures the amount of water used (which was not specifically mapped); and a structure containing the meter and allowing access. These components are arranged in a number of configurations, each with its own set of considerations and constraints.

Project Research:

We identified and interviewed stakeholders and staff (Field Operations, Engineering, and Management) assessing their needs and expectations either common or unique. Positional accuracy and network connectivity were common themes; they wanted to see every meter location within five feet of their "true" position and manner in which it was connected to the water system. Field Operations was primarily interested in the ability to attach work-orders. Engineering and Management were interested in service number, size and type; service line diameter, material and age; their potential for modeling; as well as being able to analyze and symbolize account data using the GIS features.

We realized early that our services, as an attributed point feature class, had the potential to be associated with a much richer data source held within our accounting databases. Special effort was taken to determine exactly what the service point should represent so we could identify relevant attributes and assess whether they could be fully supported. After much discussion, it was determined the point would represent a conceptual object rather than physical object. That way it could be utilized in a broader array of situations than representing a service setter or water meter. Once our service points were mapped we assigned values identifying them by service type (domestic, irrigation, or fire), service class (single family, multi-family, commercial, or public agency), and status within our permitting and/or billing process.

The service line feature provides network connectivity from the water main to the service point. We realized we didn't have reliable supporting data for size, material, or installation date. Educated generalizations could be made but we wouldn't be sure until these buried features were field verified. We also considered various methods of attributing our level of confidence but haven't yet implemented any.

The service structure polygon feature class represents an in-the-ground container for the setter(s) and/or meter(s); a meter box is appropriate for most single small diameter residential services while a meter vault is used for multiple and large diameter services. This feature was created only after we were satisfied that our service point layer was complete and (as yet) has no formal association to our MMS.

Initial Resources:

We already had a point layer used to indicate that a parcel had a water service account. These features were created at each parcel polygon centroid during conversion from our CAD based AM/FM to GIS. This feature class had an attribute for the service number derived from our Billing database keyed on the parcel Assessor's ID number (PIN). They were previously used in our web based mapping application, Lakehaven Infrastructure Online (LION), as a "pass through" to billing data.

We had digital imagery of our Meter Maps. These were paper water facilities maps (assessor's quarter section maps) with water features and service lines. They had been maintained for decades by Field Operations staff. They had line graphics from the water main which indicated a meter location or parcel being served. They were also used to assign meter reading routes. These maps had numbers we had hoped would indicate a specific service, however, during subsequent conversations with Field Operations staff it was determined the numbers had no correlation to any digital service data and hadn't been maintained in years.

Our Project Team included one fulltime Engineering Technician. Later we added two temporarily assigned individuals, both having meter reading experience. I was responsible for developing methods and workflow; organizing a schedule and tracking plan; implementing QC/QA procedures; project administration and documentation.

Pilot:

We began with a Pilot Project in which we mapped all service features within a group of quarter section grids to help estimate resource requirements and potential for success. This helped quantify the effort, develop a more comprehensive plan of action, and clarified our QC/QA approach.

From the results of our Pilot effort we identified project Phases focused on logical task groupings and established a Tracking spreadsheet listing, by grid, what was done when, and by whom.

We also realized that many manual data development tasks were repetitive and decided to secure outside help developing scripts that automated as many tasks as possible.

Setup and Preparation:

We originally used a nested versioning scheme, but that soon became burdensome to administrate. We found that giving each operator their own version accelerated the process while providing adequate opportunity for QC/QA during each phase. Ensuring they were not working in the same area was the key and allowed us to track our progress without increasing workload.

We engaged our GIS Consultant to create tools that automatically created service line from a group of service points as single services or from a pair of services as a double service. We also automated meter box/vault creation, and a routine for global QC/QA. There was a longer period of testing and revisions than originally anticipated before the scripts performed to our satisfaction but the effort and expense was justified by the time saved from having to do these tasks manually.

We created a set of Production Tracking Maps (PTM) for use in identifying potential problem areas and confirming tasks were done. To do so, we had to geo-reference and rubber-sheet each Meter Map image to register with its corresponding GIS quarter section grid. As each grid was processed we plotted a 1:1200 scale color hard copy. As production advanced we published, and posted

graphic reports which helped clearly visualize our progress and keep Management apprised of project status.

Prior to full project launch we reviewed the PTMs to identify areas that we knew could not be easily automated or would interrupt smooth workflow; service lines that were not a perpendicular alignment from main to service point; those that had inadequate information; those presenting conflicting data; those with multiple services (multi-family complexes or commercial properties); situations where the service was not located on, or adjacent to, the parcel polygon being served (spaghetti-line services or lot-line adjustments); and those we knew to be unique configurations (large meter banks). We highlighted these areas of concern with the intention of addressing them after we had “picked the low hanging fruit”.

Phases:

The project was divided into Phases: Points, Lines, and Polygons. Each Phase was further subdivided into specific task(s) to be performed sequentially on all grids. We decided that we would perform on-going QC/QA during each Phase with global QC/QA performed toward the end of the project

Phase 1A	Move residential points
Phase 1B	Move non-residential points
Phase 1C	Create missing and specialized service points
Phase 1D	Assign service and meter type values from Acct. data
Phase 2A	Create residential service lines using scripting tools
Phase 2B	Create service lines that require manual input
Phase 3A	Create polygons to represent meter boxes
Phase 3B	Create polygons to represent vaults

Service Points:

We started adjusting our existing service points from their positions near the parcel centroid to a location adjacent to right of way as suggested by the Meter Map. Starting at opposite ends of the District when possible we endeavored to ensure that we weren’t working in the same area simultaneously. QC/QA was critical during this Phase of the project since all the subsequent Phases relied on the service point locations being valid. We checked them off the Production Tracking Maps as they were processed.

While we moved quickly through single family residential areas, a more focused involvement was required in areas that had non-residential facilities or multi-family dwelling units. We primarily relied on the Meter Readers to validate each service position for which they used a variety of tools; memory; interpreted locations from route descriptions, used Aerial Ortho imagery and/or Google Maps Street view ®; or made field visits to ground truth the areas in question. Having practical field experience, they were skilled in understanding the arcane language of the route descriptions and taught the rest of us to decipher them supporting validation of more points in less time.

Service Lines

Creating service lines presented different challenges. A service could be connected directly to the water main with a single service line (single service) or two services shared a single service line through a manifold or “header” (double service). Subsequently, we established the service line as a separate feature class from the header. The service line has association with the MMS while the header does not. This allowed us to maintain geometric network connectivity while minimizing confusion about what feature can be assigned a work-order.

We used tools created by our GIS Consultant to do the “heavy lifting” but still had to manually sketch service lines within cul-de-sacs where alignment from the service point to the water main

was not perpendicular. These had been previously identified in the Production Tracking Maps and were checked off they were created.

Service Structure Polygons

Once all the other features were in place, we created the meter boxes and vaults containing the service points. We went through the district grid by grid using the Production Tools developed by our Consultant. During this Phase the temporary staff had been released. While our Engineering Tech was creating meter boxes, my focus was the service vaults. We used the accounting databases to identify the oversized services and validated these through communications with Field Operations staff responsible for their maintenance.

Global QC/QA

Our initial effort was simply to compare our GIS data with that in the accounting databases. The results identified missing service points to be added while any errors in the accounting databases were also identified and resolved.

One of the tools developed by our GIS Consultant was used to draw a line between the new service points and the legacy service points within the parcels. This revealed several situations where a service point and legacy service point showed up on opposite ends of the District. This tool also helped us identify locations of our “spaghetti” service lines.

Conclusion:

Our project lasted approximately 6 months and took >2200 hrs to complete. All stakeholders have approved and are actively using the new features. Our goal is that service features are available for work-order tracking within 2 days from the time their permit is processed.

We have developed a dynamic maintenance program whereby the service features are created in GIS when we map new developments from Construction Record Drawings (CRD). Occasionally these new services are inadvertently misrepresented so it is incumbent on our Field Operations staff to continue to act as our eyes in the field to ensure the service features are eventually mapped correctly in GIS and on the CRD.

Lessons Learned:

- Approach your Pilot Project knowing things are going to change.
- Use graphics, whenever possible, to support communication with your sources, end users, and consultants.
- Listen to the folks who work with the features being mapped, whether in the field or in the office. They are the experts, but the GIS Professional translates the expert’s knowledge into GIS.
- Keep an open mind when resources are presented, they might be more valuable than originally anticipated. This is likely the first time this particular feature has been mapped by your organization.