TITLE: Use of Hydro Event Management Tools by a Local Water Delivery Organization to Place Customer Parcel Events on the National Hydrography Database

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ABSTRACT:
Water managers rely on accurate hydrographic data for planning, modeling, display and analysis. Many local managers have diverse information about their organization that needs to be tied to their system in order to facilitate planning and facility and system management. The Hydro Event Management (HEM) tools are specifically designed to create and manage event data that is tied to the National Hydrography Database (NHD). The Burley Irrigation District (BID) agreed to provide data regarding its primary diversion points along its system as well as generalized customer information. BID agreed to use the HEM tools to attempt to place customer parcel events along the system as represented by the NHD. Ease-of-use and difficulties were reported to IDWR and summarized for potential use in further HEM tool refinement.

INTRODUCTION:

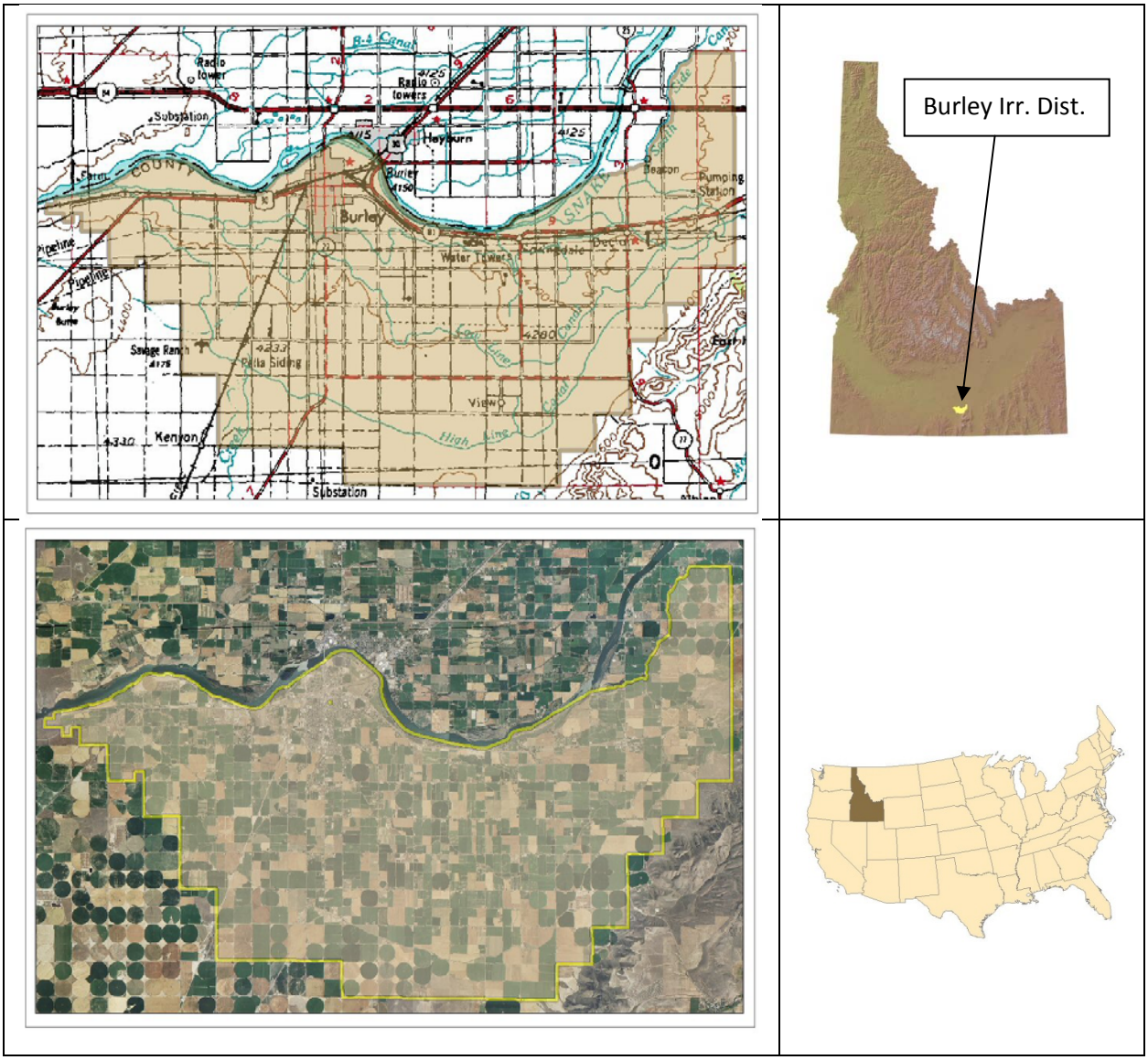
Water managers, be it on a local or regional level, rely on accurate hydrographic data for planning, modeling and other tasks. Currently, much of this data is retained local knowledge or on paper maps maintained by irrigation districts, city planners, and other water managers. The goals of this project are to develop simple and straight forward approaches to collect this data.

The National Hydrography Database (NHD) is a nationwide dataset containing hydrologic features such as streams, canals, lakes, and ponds. It is an excellent platform for data exchange of water information. Currently the NHD in Idaho is available at a medium resolution (1:100,000) and high resolution (1:24,000) and is a national data set. The NHD contains a geometric network. By placing events along the NHD geometric network, water managers can share information about their system infrastructure as a referenced location along the NHD. In addition, local managers can take advantage of the functionality of a geometric network including tracing and routing.

The Hydro Event Management (HEM) tools, which are developed by the Pacific Northwest Hydrography Framework (http://hydro.reo.gov/index.html)with support from the USGS and the US EPA, are specifically designed to create and manage event data that is tied to the NHD.

The Burley Irrigation District (BID) is an irrigation company located in south-central Idaho. BID provides water to over 1,500 customers who irrigate over 47,000 acres. The canal system is over 325 miles long and can reach more than 60,000 acres. BID has worked with the NHD Data Steward in Idaho to update its system of canals as represented by the NHDFlowline feature class. BID agreed to provide data to regarding its primary diversion points along its system as well as generalized customer information and agreed to use the HEM tools to attempt to place customer parcel events along the system.

Figure 1: The Burley Irrigation District



The Burley Irrigation District (BID) is representative of many water delivery organizations in Idaho. For BID, as in many local water delivery organizations, a novice GIS Specialist is asked to create the GIS data in addition to their other duties. The organization's ditch riders or water masters are the local experts and review the information for correctness. These local experts often have very limited GIS experience. The organization's hardware is limited to a standard personal computer and the ArcGIS licensing level is the ArcView level.

METHODS:

Development of procedure for use by Local Irrigation Agency

The process of creating events from points using the HEM Tools (ver. 2.2a beta) was summarized by the IDWR NHD Technical Point of Contact (Appendix A). A 78 record point dataset consisting of pumps, head gates, check gates and weirs along the BID system was compiled as a test point of diversion dataset. (See Appendix B for information on the sources of the dataset.) This process and dataset was used initially tested by three IDWR staff. Interestingly, each tester obtained different results in regards as the number of features that were imported at each selection tolerance and the number of candidates presented in the Select Route Location dialog box.

In reviewing the process, there were 2 areas where settings in ArcMap were believed to be affecting the results of the analysis; Selection Tolerance and Snapping Tolerance. Both the Selection Tolerance (Tools|Options) and the Snapping Tolerance (Editor|Options|General Tab) can be set in pixels. The value of a pixel is dependent on map scale and can be highly variable. Because a starting map scale was not specifically set in the initial process, pixel size was suspected as a cause of the varying results.

Because the Snapping Tolerance can be set to pixels but also in map units, setting the Snapping Tolerance was tested first. The same 78 points were imported several times using the HEM Tools with map scale is held constant, hence keeping pixel size constant, and the Selection Tolerance held constant. It was found that changing the Snapping Tolerance has no affect on the number of points that are referenced or the number of candidates selected by the HEM tool. This was found to be true if the Snapping Tolerance was set in either pixels or map units.

The 78 points were again imported several times using the HEM Tools with map scale is held constant, hence keeping pixel size constant, the Snapping Tolerance held constant, but varying the Selection Tolerance. It was found that changing the Selection Tolerance did affect on the number of points that are referenced and the number of candidates selected by the HEM tool.

Because pixel size is affected by map scale and map scale is familiar to most introductory GIS users, the HEM Tool procedure developed for use by a local irrigation agency was developed with incremental increase of map scale until all points were referenced. Adjusting map scale achieved similar results to adjusting Selection Tolerance when tested with the 78 point dataset. A key component to the procedure for creating new events is that if multiple candidates were presented, the first candidate on the list was selected. The merit of the first candidate versus any of the other candidates was not reviewed.

Use of HEM tool by Local Irrigation Agency

The Burley Irrigation District (BID) maintains a customer database that contains parcel identification numbers (PIN) along with other relevant irrigation company information. The PIN numbers were compared with local county parcel GIS information and a shapefile containing centroids of parcels with BID customer PINs was created. Water delivery to parcels is tracked by BID through a point of diversion off the BID canal system. Having a virtual address along the BID canal system of a parcel's location is considered more useful to BID staff than creating a polygon event feature of the parcel.

BID agreed to use the HEM Tools version 2.2a with a detailed procedure to create point events from the generated parcel centroids in hopes that these events, when used in conjunction with the NHD geometric network tracing capabilities, can be used for E911 and customer maintenance notifications. Additionally, BID agreed to use the Update Point Event task of the HEM Tools to verify the location of the 78 IDWR generated events of the pumps and diversion structures along the BID system. The full procedure is outlined in Appendix C: Referencing Parcel Centroids to the NHD using HEM Tools.

RESULT:

The Burley Irrigation District successfully used the HEM Tools to create events for 2670 parcel centroid locations along the NHDflowlines. Using the process developed by IDWR (Appendix C), BID estimated that it took 15 to 20 minutes to reference 100 points after the geodatabases and metadata were developed and if the process was uninterrupted.

A summary of the scale at which parcel centroid points resulted in event creation is presented in Table 1.

Table 1:

	Total	Percent			Total	Percent of Points at Scale	Percent of Total
# Pts Referenced	**2670**	**100%**		**# Pts w/ multiple candidates**			
Scale				**Scale**			
1:1000	**31**	**1.2%**		**1:1000**	**0**	**0%**	**0%**
1:5000	**83**	**3.1%**		**1:5000**	**4**	**4.8%**	**0.1%**
1:25000	**809**	**30.3%**		**1:25000**	**210**	**26.0%**	**7.8%**
1:125000	**1420**	**53.2%**		**1:125000**	**1083**	**76.2%**	**40.6%**
1:625000	**327**	**12.2%**		**1:625000**	**325**	**99.4%**	**12.2%**
1:3125000	**0**			**1:3125000**	**0**	**0%**	**0%**
61% of points presented multiple candidates.							

Comments From BID:

- The instructions and training provided were adequate.
- There was a lot of manual intervention involved in keeping track of the subsets and which points in the subset had already been done at what scales. It was fairly easy to lose one's place. If the user did lose their place, they had to go through all the previous points in the subset to find the error.
- There is a need to be able to "pause" the process and return to it. Because it required so much manual input, it was easy to lose one's place in the procedure if a customer required assistance. This was mitigated somewhat by breaking up the input dataset into subsets.
- Import Tool needs a progress bar. After selecting a candidate, the Select Route Candidate Dialog box remains on the screen while the program filters through additional points. Testers were not sure if the tool is waiting for a candidate to be selected, for the OK button to be clicked, or if the tools are running in the back ground.
- Verifying and modifying, if necessary, the 78 pumps and diversion structures events was a simple process and didn't take much time at all.
- During the process, a database corruption occurred. No error messages were received.

Comparison to NEAR methodology of Locate Features Along Routes Tool:

A subset of the parcel events data contained attributes regarding which canal and associated laterals each event should be referenced to. If the event reach code matched the canal system indicated for the original parcel, it was considered correct. A canal system can contain several laterals. The events were not checked to see if they were on the correct lateral.

The original parcel centroids were used as input for the Locate Features Along Routes Tool (Linear Referencing Tools) in ArcGIS. Of 1432 parcel centroids with a canal system indicated,

1178 (82%) of the events referenced using the Locate Features Along Routes tool were placed on the correct canal system. Point events created with the Locate Features Along Routes Tool maintain the attributes from the original point dataset and will maintain one field from the geometric network. This is nearly opposite of the HEM tools which maintain the attributes from the geometric network needed to populate the NHDPointEventFC but only one attribute from the original point dataset.

Of 1432 parcel centroids with a canal system indicated, 1125 of the events referenced using the HEM tools with IDWR procedure were placed on the correct system (78%), approximately 4% less than the Locate Features Along Routes Tool. An advantage of the HEM tool is that it creates a point featureclass. With the Near command, if a point featureclass is needed, it must be generated from the tables using Add Event Theme created by the Locate Features Along Routes Tool.

DISCUSSION:

Following an IDWR outlined procedure, BID staff successfully created point events along NHDflowlines from delivery parcel data using the HEM Tools. Additionally, BID was able to modify existing Diversion Structure point events using the HEM Tools. How accurate those placements are needs to be assessed by BID.

The tested HEM Tool create point events methodology is dependent on the user manually selecting a route candidate. This methodology may not be useful to a local water delivery organization where a GIS users is asked to create events but has limited or no knowledge of the best placement location. This issue appears to be addressed in the next release of the HEM tool with the Suppress Route Candidate option.

The IDWR procedure followed by BID indicated that map scale should be increased by a factor of 5. The majority of the points were referenced at a scale of 1:125,000. Additional research is needed to see if additional scales between 1:25000 and 1:125000 would be useful in referencing points with fewer candidates. Control of a buffer distance where the event feature snaps to the network rather than a dependence on pixel size may be more useful to local water managers.

Additionally, while using the HEM Tools to create point events, several issues arose. Below is a summary of those issues:

1) Due to the HEM tools' dependence on pixel size, scale matters. Starting scale when Import Points is initially selected appears to affect the number of route candidates.

When Zooming to Feature from the Select Route Location to review a location candidate, the number of candidates for next feature appear to be adjusted. Zooming to selected feature alters the size of the pixel. This methodology brings repeatability into question. Additionally, the Select Route Location dialog box has other limitations, see comments below.

2) Because original datasets can be large and with the process having no "pause", the amount of time dedicated to placing each event through the Select Route Location dialog box could be done effectively by the Locate Features Along Routes Tool with a large search radius. Additionally, the Select Route Location dialog box has other limitations, see comments below.
3) The Select Route Location dialog box
    a. Dialog box does not provide enough information to be effective.
        i. Reachcode and ComID, although unique, are not informative to many users. Adding a user determined attribute or GNIS_Name could be very useful.
        ii. No identification regarding the point that is the source of the event is provided to the user. It is very difficult to make a choice of the best route location when one is unsure of which event is being created.
    b. The Flash Feature is only useful after zooming to a feature or if it happens to be in the view when the tool is started. A Pan To Feature option would be useful.
    c. The Dialog box freezes the pan and zoom capabilities. The ability to review the candidates is limited to Zoom To and Flash Feature.
4) The Snapping Tolerance (Editor|Options, General Tab) appears to have no affect on tool performance. Snapping Tolerance would appear to be a logical place to control route candidate selection as values could be specified in either pixels or map units.
5) If projection of Data Frame does not EXACTLY (name and parameters) match the projection of the network, an error will be displayed every time more than one route candidate exists (HRESULT:0x80040215). This can result in a lot of time wasted pressing the OK button before application is released. A programmatic comparison of the data layer projection and the network projection before creating the first event could be useful.
6) The tool will import points from event feature class into itself. This creates a multitude of errors. A programmatic error trap is needed if the Target of the HEM Tools equals the feature layer being imported.

Using the ArcGIS Locate Features Along Routes tool appears to be effective in placing a point on the correct canal and lateral system as the current HEM tool methodology of no candidates are reviewed. Additionally, the ArcGIS tool works on a selection set of the NHDflowline data.

Much of the point of diversion data contains some type of source information that could be used to filter the potential NHDflowlines the points should be linked as events on. It would be useful if the HEM tool would do the same hence narrowing the possible candidates. An advantage of the HEM tool is that it maintains the attributes from the geometric network needed to populate the NHDPointEventFC making it directly compatible with the NHD.

CONCLUSION:

BID successfully used the HEM Tools version 2.2a with a detailed procedure to create point events from the generated parcel centroids bringing them one step closer to being able to use the NHD dataset for E911 and customer maintenance notifications. BID now has the task of quality checking each event for correct lateral placement and relationship with nearby events. Once the quality check is complete, these events, in conjunction with the diversion structure events and the updated NHDflowlines will make this system one of the best documented in Idaho. Hopefully, the advantages having a current canal system representation fully networked in the NHD will prompted other local water managers in Idaho to improve their system as well.

Appendix:

A. **Proof of Concept: Referencing POD's to the NHD using HEM Tools**
   http://www.idwr.idaho.gov/GeographicInfo/NHD/Projects/PDF/Proof_of_Concept_POD_HEM.pdf

B. **BID Diversion Structure Data Sources**
   http://www.idwr.idaho.gov/GeographicInfo/NHD/Projects/PDF/BID_POD_Data_Sources.pdf

C. **Referencing Parcel Centroids to the NHD using HEM Tools**
   http://www.idwr.idaho.gov/GeographicInfo/NHD/Projects/PDF/Parcel_Ref_Using_HEM.pdf

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