

Using GIS to Build the History of a Pipeline

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Problem Definition

- PHMSA's tabular data is organized by Operator ID number
- Operators constantly buy and sell pipelines
- Tabular data can't follow a pipeline as it changes operators
- Solution: tie the data to a GIS pipeline segment and track the "history" of a pipeline as it changes operators
- Complications: operators are not required to identify which lines they have bought and sold, requiring tools which spatially match incoming pipeline data to existing pipeline data





NPMS Background

- US DOT PHMSA regulates gas and hazardous liquid pipelines
- The NPMS (National Pipeline Mapping System) contains GIS data from 1,100 operators of gas transmission and hazardous liquid pipelines, as well as LNG plant and breakout tank data
- Operators are required to submit their GIS data annually
- NPMS data is used for emergency response, inspection planning, risk management, planning smart growth, and allowing the public to view pipelines in their area

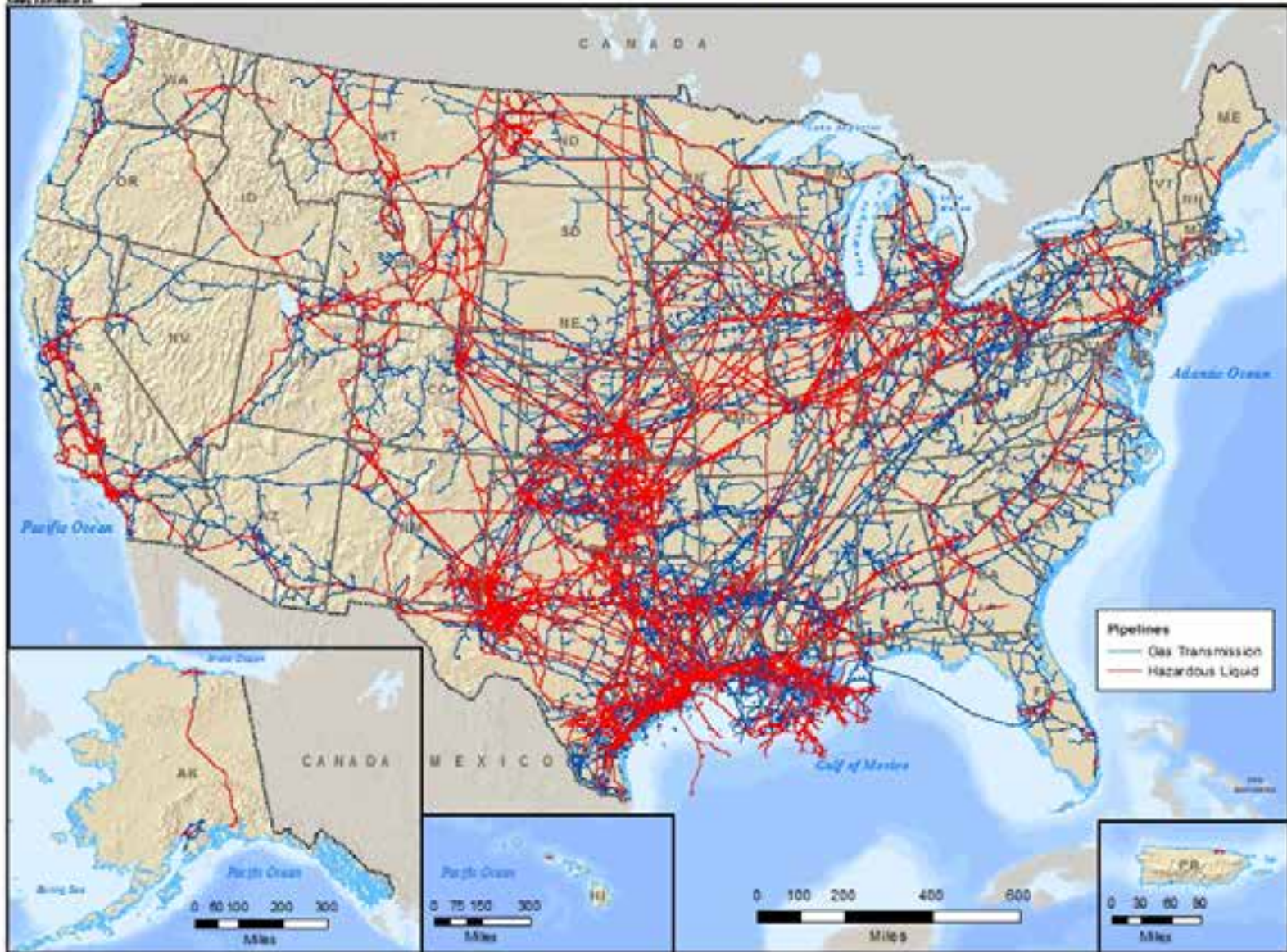




U.S. Department of Transportation
Pipeline and Hazardous Materials Safety Administration
www.dhs.gov

Gas Transmission and Hazardous Liquid Pipelines in the United States

National Pipeline Mapping System



U.S. Department of Transportation, Pipeline and Hazardous Materials Safety Administration
Projection: Albers Equal Area Conic
Map created May 2015

NPMS Public Map Viewer

Log Out | NPMS H

Public Viewer Layer List

- Gas Transmission Pipelines (scale depend)
 - GAS
- Hazardous Liquid Pipelines (scale depend)
 - LIQUID
- LNG Plants (scale dependent)
- Breakout Tanks (scale dependent)
- Other Populated Areas (scale dependent)
- Highly Populated Areas (scale dependent)
- Roads, Railroads & Airports
 - World Transportation
- Boundary Lines & Names
 - World Boundaries and Places
- Shaded Relief
 - World Shaded Relief
- Aerial
 - World Imagery
- Low Resolution 15m Imagery

Please refer to the User Manual which is accessible via the Help link for guidance on this map application. If you need additional assistance, please contact the NPMS National Repository staff at NPMS-NR@mbakercorp.com or 703-317-6294.

Public Viewer on www.npms.phmsa.dot.gov



Not as easy as it sounds...

All of the following situations lead to the failure to make a clean, automated match for an incoming pipeline segment

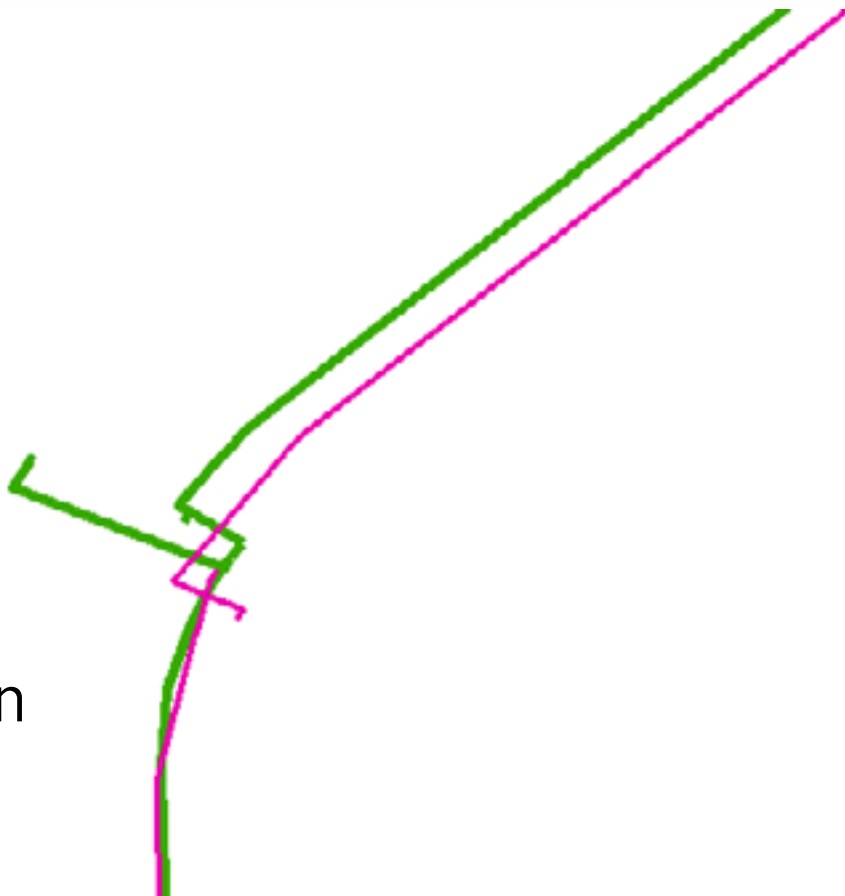
- Operator has resurveyed lines
- Operator has constructed new lines or laterals
- Operator has sold lines in a congested pipe corridor and doesn't know who has bought them
- Operator has bought lines in a congested pipe corridor and doesn't know who sold them
- Pressure on a gas line has been upgraded, bringing it into the requirements to submit to NPMS but not identified as a new line in the operator's records





Example

- Lines resurveyed? Was the lateral on the left sold?



Pink = New (incoming) Submission

Green = Previous submission





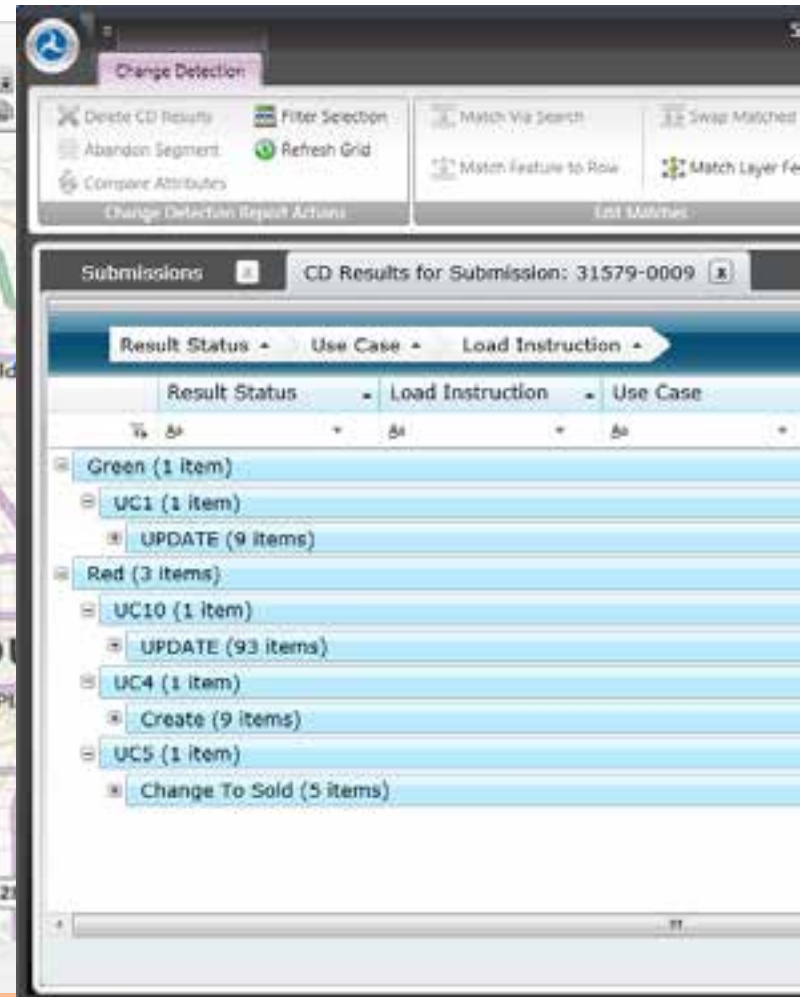
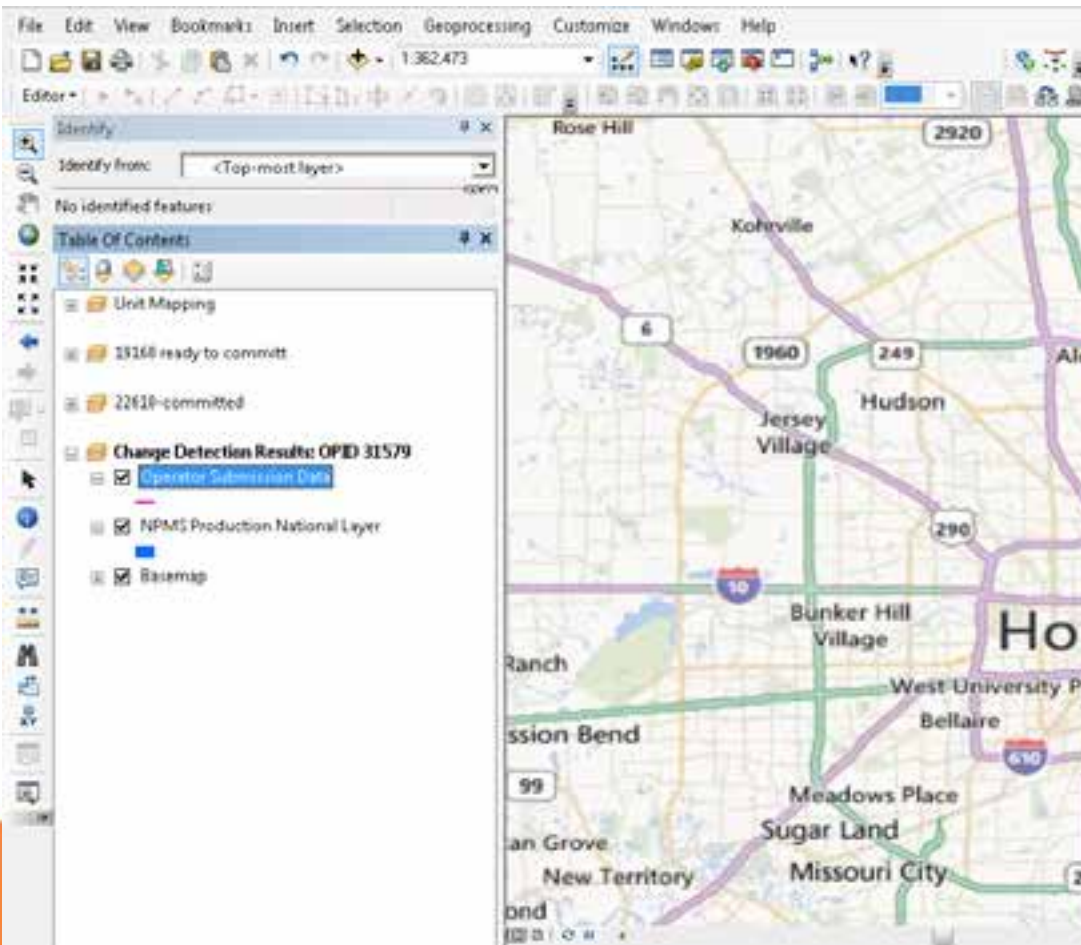
Example

- Congested pipeline corridor
- Symbology = Operator ID number
- Multiple pipelines in the same buffer zone used to identify matches, and many lines running together have the same OPID
- How can you program a tool to find matches in this situation?





Custom tools compare newly submitted segments to the universe of OPIDs in the national layer





Analyst is presented with use cases and has the ability to create a new history record or identify the incoming pipe segment as identical to an existing segment

Submission Manager

Change Detection

Change Detection Report Actions: Delete CD Results, Abandon Segment, Compare Attributes, Filter Selection, Refresh Grid

Edit Matches: Match Via Search, Match Feature to Row, Match Layer Features, Swap Matched Rows

Submission ArcFocus: Zoom, Select, Flash, Show Selected, Delete Selected for CD Refun

Production ArcFocus: Zoom, Select, Flash, Show Selected

Submissions | CD Results for Submission: 31579-0009

Result Status | Use Case | Load Instruction

Result Status	Load Instruction	Use Case	Sub Miles	Oper Sub ID	Sub OPID	Prod Event ID	Prod OPID
UC10 (1 item)							
UPDATE (93 items)							
UC4 (1 item)							
Create (9 items)							
Red	Create	UC4	0.030560	2814562	31579		
Red	Create	UC4	0.000340	2814563	31579		
Yellow	Create	UC4	0.131180	2814564	31579		
Green	Create	UC4	0.000410	2814565	31579		
Red	Create	UC4	7.638750	2814566	31579		
Red	Create	UC4	0.988490	2814567	31579		
Red	Create	UC4	0.544980	2814595	31579		
Red	Create	UC4	1.143670	2814599	31579		

Export to Excel



Results

Each incoming pipe segment is classified by:

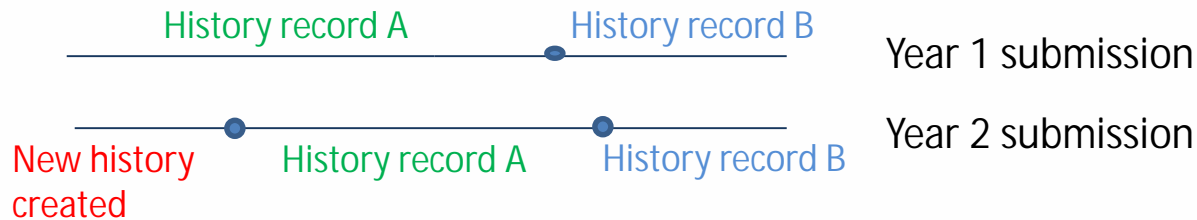
- **Match confidence:**
 - High Confidence match (Green)
 - Medium Confidence match (Yellow)
 - Low Confidence match (Red)
 - No Match (Red)
- **Use Case (UC):**
 - Match between same Operator – UC1
 - Match between different Operators – UC10
 - No match for Submission feature – UC4
 - No match for Submission feature but feature attribute states addition – UC3





Pipe segmentation

- Changes in segmentation create issues with inheriting history
- Operators create a new pipe segment when an attribute changes
- Operators can also create segments arbitrarily
- Which history should a new segment inherit?



- Multiple segments cannot inherit one history record





History Creation

Once matches are verified or created, incoming data is sent through a load process:

- Unique ID from the existing feature is transferred to the incoming feature
- Existing feature is removed from the existing layer
- Incoming feature is added to the existing layer
- Incoming feature is added to the History layer





PIMMA Plus

A new web application built to allow the user to query pipeline history as well as integrated tabular data

The screenshot displays the PIMMA Plus web application interface. At the top, there is a navigation bar with the 'n-pms' logo and the text 'PIMMA plus'. Below the navigation bar is a toolbar with various icons for map layers, query tools, and social media. A search bar is located on the right side of the toolbar. The main area of the application is a map showing the United States, with a 'Query Pipeline History' dialog box overlaid in the center. The dialog box has a blue header and contains several sections for selecting query criteria:

- Select the elements on which to query:**
- OPID:** All OPIDs, Specific OPIDs (with a 'Click Here to Select Values' button)
- Pipeline Status:** All Statuses (in service, idle, retired, abandoned), Specific Statuses (with a 'Click Here to Select Values' button)
- Interstate/Intrastate:** Interstate and Intrastate, Interstate, Intrastate
- Low Stress:** Low Stress and Not Low Stress, Low Stress, Not Low Stress
- Location:** All Locations, PHMSA Region(s) (with a 'Click Here to Select Values' button), State(s) (with a 'Click Here to Select Values' button), County(ies) (with a 'Click Here to Select Values' button)
- Commodity:** All Commodities, Gas or Liquid (with a dropdown menu), Specific Commodities (with a 'Click Here to Select Values' button)
- Calendar Year:** All Years, Year Range (with 'From' and 'To' input fields)

At the bottom right of the dialog box are 'OK' and 'Cancel' buttons. The background map shows the United States with state names visible. The Google logo is in the bottom left corner, and the text 'Map data ©2013 Google, WGS84 Imagery ©2013 TerraMetrics' is at the bottom.



Using history to meet mission goals

- Display liquid lines whose commodity has recently been converted to ethanol
- Display pipe segments with accidents over the past five years
- Display pipe segments that have been inspected in the past 24 months





Questions?

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www.npms.phmsa.dot.gov



Careers in Pipeline Safety

- PHMSA's FY15 budget appropriated ~109 new positions.
- OPS is hiring inspectors, investigators, and transportation specialists in our five regions.
- Visit our website at: <http://www.phmsa.dot.gov/careers>
 - Learn more about OPS
 - Find out how to apply
 - View current job openings
 - Sign up for job alerts

