

# GIS Mapping of Pipelines



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**Maps, Apps and Bridging Gaps**

**2016 Ohio GIS Conference  
September 28 – 30, 2016**



**Hyatt Regency Columbus  
Columbus, Ohio**

# Agenda

- \* Oregon Clean Energy Center Project Overview
- \* Pipeline Terminology
- \* Why? Regulations & Mandates
- \* Why? Then & Now
- \* Software Overview
- \* Data Collection Review
- \* Software Flexibility / Custom Uses
- \* End Results

# Oregon Clean Energy Center Project Overview

23 Miles of Pipeline

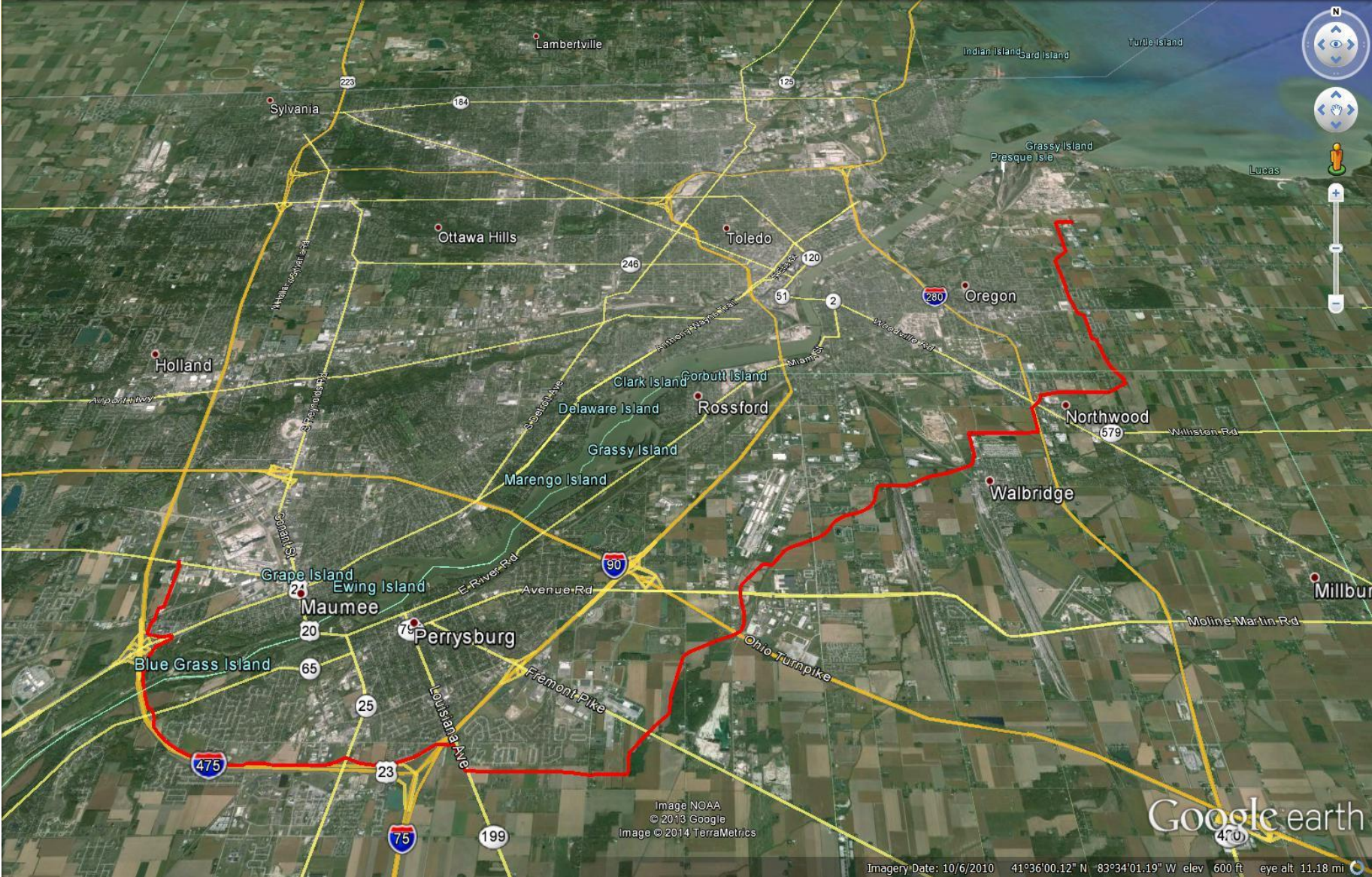
27 Sections

172 Parcels

4,500 Welds

63 Directional Bores

# Oregon Clean Energy Center Pipeline Route



# The Pipeline Project

- \* Boundary Surveys
- \* Route Planning
- \* Pipe Tally
- \* As-built Survey
- \* Topo Surveys
- \* Corridor Layout
- \* Joint Mapping
- \* Field Tile Locations
- \* Storm Water Run Off
- \* Environmental Studies:  
Wetlands, Floodplain,  
Indiana Bat



# Land Owner Info Deed Research Record Survey Research



Michael Sibbersen  
WOOD COUNTY AUDITOR | WOOD COUNTY, OHIO

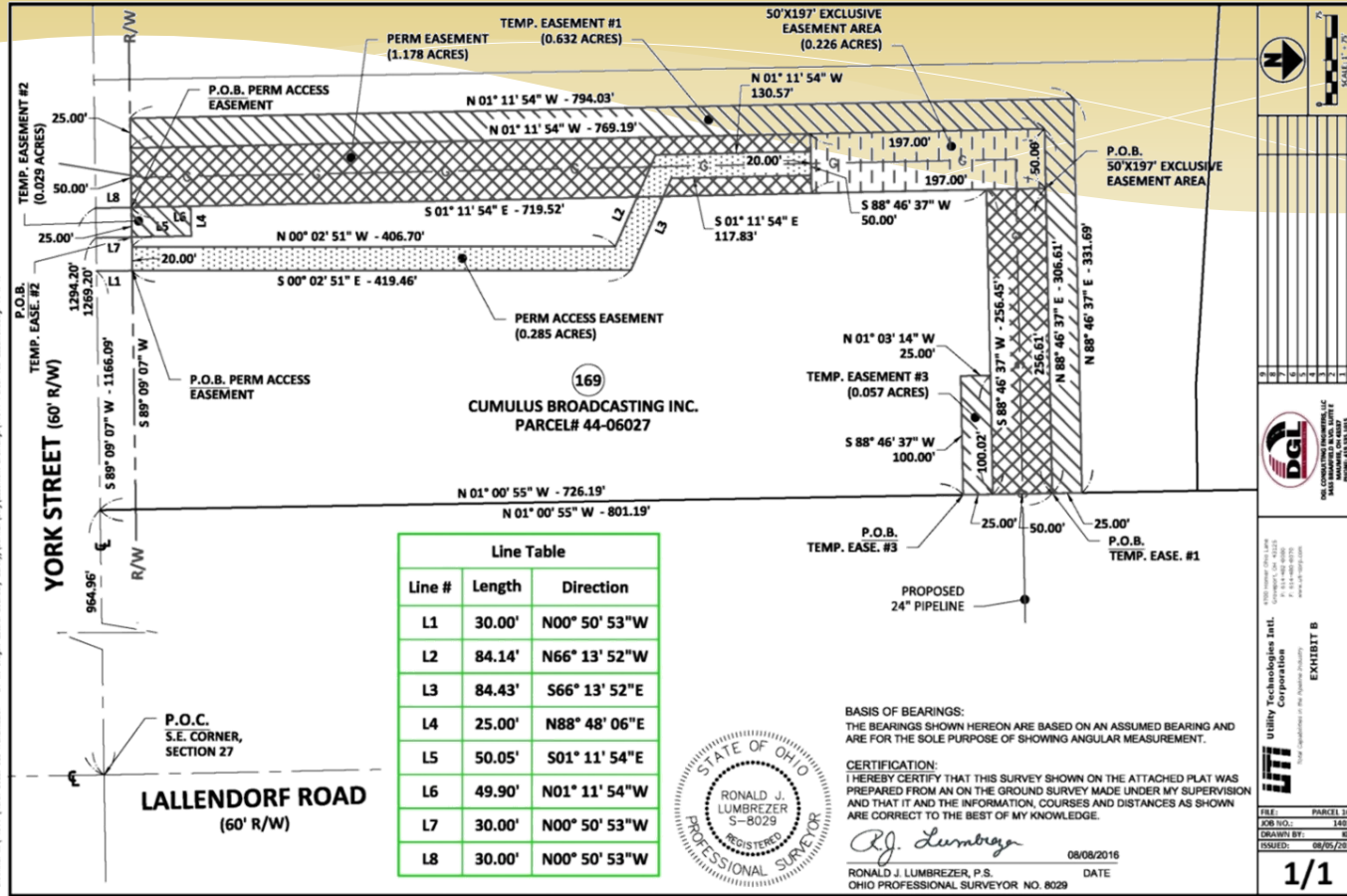


# Pipeline Route Parcel Owner List

## North Coast Gas - OCE Power Plant Project

#	Name	Parcel #	Property Address	Owner/Mailing Address	Acres	Auditor Value	Property Type
1	Panhandle Eastern Pipeline	35-00181	1015 Maumee Western Road Maumee, OH 43537	5444 Westheimer Road Houston, TX 77056	11.043	\$478,700.00	commercial - industrial
2	Panhandle Eastern Pipeline	35-00201	1009 Illinois Avenue Maumee, OH 43537	400 Conant Street Maumee, OH 43537	1.817	\$90,000.00	commercial - industrial
3	Spartan Chemical Company	35-00164	1020 Maumee Western Road Maumee, OH 43537	1110 Spartan Drive Maumee, OH 43537	51.929	\$12,930,200.00	commercial - industrial
4	ANR Pipeline Company	36-80107	1008 Illinois Ave Maumee, OH 43537	PO Box 2168 Houston, TX 77252	13.537	\$582,900.00	commercial - industrial
5	Spartan Chemical Company	35-00021	6002 Monclova Road Maumee, OH 43537	1110 Spartan Drive Maumee, OH 43537	34	\$393,100.00	commercial - industrial
6	Norfolk Southern Combined RailRoad Subsidiaries	35-00037	3 Wabash Road Maumee, OH 43537	110 Franklin Road SE Roanoke, VA 24042	1.6	\$23,800.00	commercial - industrial
7	Norfolk Southern Combined RailRoad Subsidiaries	36-99062	0 Monclova Road Maumee, OH 43537	110 Franklin Road SE Roanoke, VA 24042	n/a	n/a	commercial - industrial
8	Norfolk Southern Combined RailRoad Subsidiaries	35-00045	9 Wabash Road Maumee, OH 43537	110 Franklin Road SE Roanoke, VA 24042	1.452	\$21,600.00	commercial - industrial
9	Thomas P. Ashe	35-00057	6002 Monclova Road Maumee, OH 43537	6002 Monclova Road Maumee, OH 43537	3.92	\$292,300.00	residential/ agriculture
10	St. Lukes Hospital	35-00018	6009 Monclova Road Maumee, OH 43537	5901 Monclova Road Maumee, OH 43537	2.417	\$127,900.00	commercial - industrial
11	St. Lukes Hospital	35-00017	6011 Monclova Road Maumee, OH 43537	5901 Monclova Road Maumee, OH 43537	8.62	\$3,939,800.00	commercial - industrial
12	St. Lukes Hospital	36-80454	6005 Monclova Road Maumee, OH 43537	5901 Monclova Road Maumee, OH 43537	7.365	\$405,300.00	commercial - industrial
13	St. Lukes Hospital	36-80470	5901 Monclova Road Maumee, OH 43537	5901 Monclova Road Maumee, OH 43537	n/a	\$1,654,000.00	commercial - industrial
14	James R. and Beverly L. Patrick	36-80543	1500 Old Trail Road Maumee, OH 43537	1500 Old Trail Road Maumee, OH 43537	7.89	\$438,800.00	residential/ agriculture
15	Toledo Metropolitan Park Board of Commissioners	36-80547	1500 Old Trail Road (Rear) Maumee, OH 43537	5100 W. Central Ave Toledo, OH 43615	5.941	\$7,500.00	commercial - industrial
16	Williams Farms INC	P60-100-601000023001	0 River Road	101 Orchard Grove Drive Clyde, OH 43410	9.3	\$43,300.00	Agriculture
17	Williams Farms INC	P60-100-601000013000	26852 W River Road	101 Orchard Grove Drive Clyde, OH 43410	78.89	\$656,000.00	Agriculture
18	John E. II and Kathleen S. Stump	Q61-100-601002052000	2439 Goldenrod Lane Perrysburg, OH 43551	2439 Goldenrod Lane Perrysburg, OH 43551	N/A	\$247,700.00	residential
19	Reynolds Construction Co.	Q61-100-601002053000	2425 Goldenrod Lane	4808 S Detroit Ave Toledo, OH 43614	N/A	\$50,000.00	residential
20	Reynolds Construction Co.	Q61-100-601002054000	2411 Goldenrod Lane	4808 S Detroit Ave Toledo, OH 43614	0.3471	\$47,300.00	residential
21	Reynolds Construction Co.	Q61-100-601002055000	2397 Goldenrod Lane	4808 S Detroit Ave Toledo, OH 43614	0.3554	\$47,700.00	residential
22	Reynolds Construction Co.	Q61-100-601002056000	2383 Goldenrod Lane	4808 S Detroit Ave Toledo, OH 43614	0.3616	\$48,200.00	residential

# Pipeline Easement Acquisition Exhibit



PLATTED: Aug 08, 2014 - 12:37pm  
 District: 2114014 (North Coast Gas Transmission - 24 in. Oregon Lateral Boundary Survey) (SARNOFF/DARY) (Easement Drawings) (4014 Parcel 188 (Easement) (Page: 11 of 17)



**BASIS OF BEARINGS:**  
 THE BEARINGS SHOWN HEREON ARE BASED ON AN ASSUMED BEARING AND ARE FOR THE SOLE PURPOSE OF SHOWING ANGULAR MEASUREMENT.

**CERTIFICATION:**  
 I HEREBY CERTIFY THAT THIS SURVEY SHOWN ON THE ATTACHED PLAT WAS PREPARED FROM AN ON THE GROUND SURVEY MADE UNDER MY SUPERVISION AND THAT IT AND THE INFORMATION, COURSES AND DISTANCES AS SHOWN ARE CORRECT TO THE BEST OF MY KNOWLEDGE.

*RJ Lumbrezer*  
 08/08/2016  
 RONALD J. LUMBREZER, P.S.  
 OHIO PROFESSIONAL SURVEYOR NO. 8029

DATE: \_\_\_\_\_

REVISIONS:

NO.	DATE	REVISION
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

**DGL**  
 DIGITAL GRAPHICS & DESIGN, LLC  
 10000 W. 12th Street, Suite 100  
 Overland Park, KS 66204  
 P: 913-488-8870  
 www.dglgraphics.com

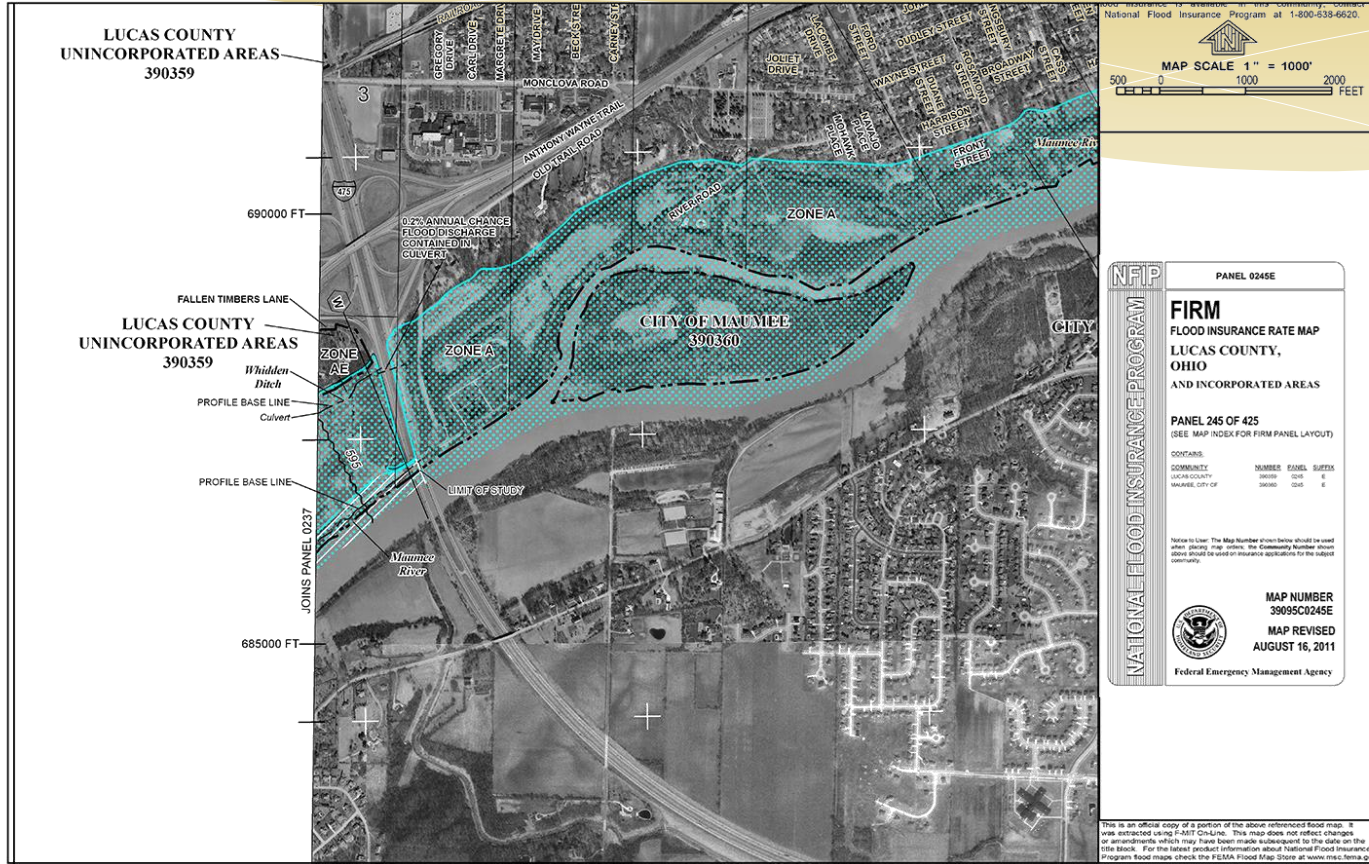
**UTILITY Technologies Intl. Corporation**  
 EXHIBIT B

FILE: PARCEL 188  
 JOB NO.: 14014  
 DRAWN BY: RJT  
 CHECKED: 08/05/2014

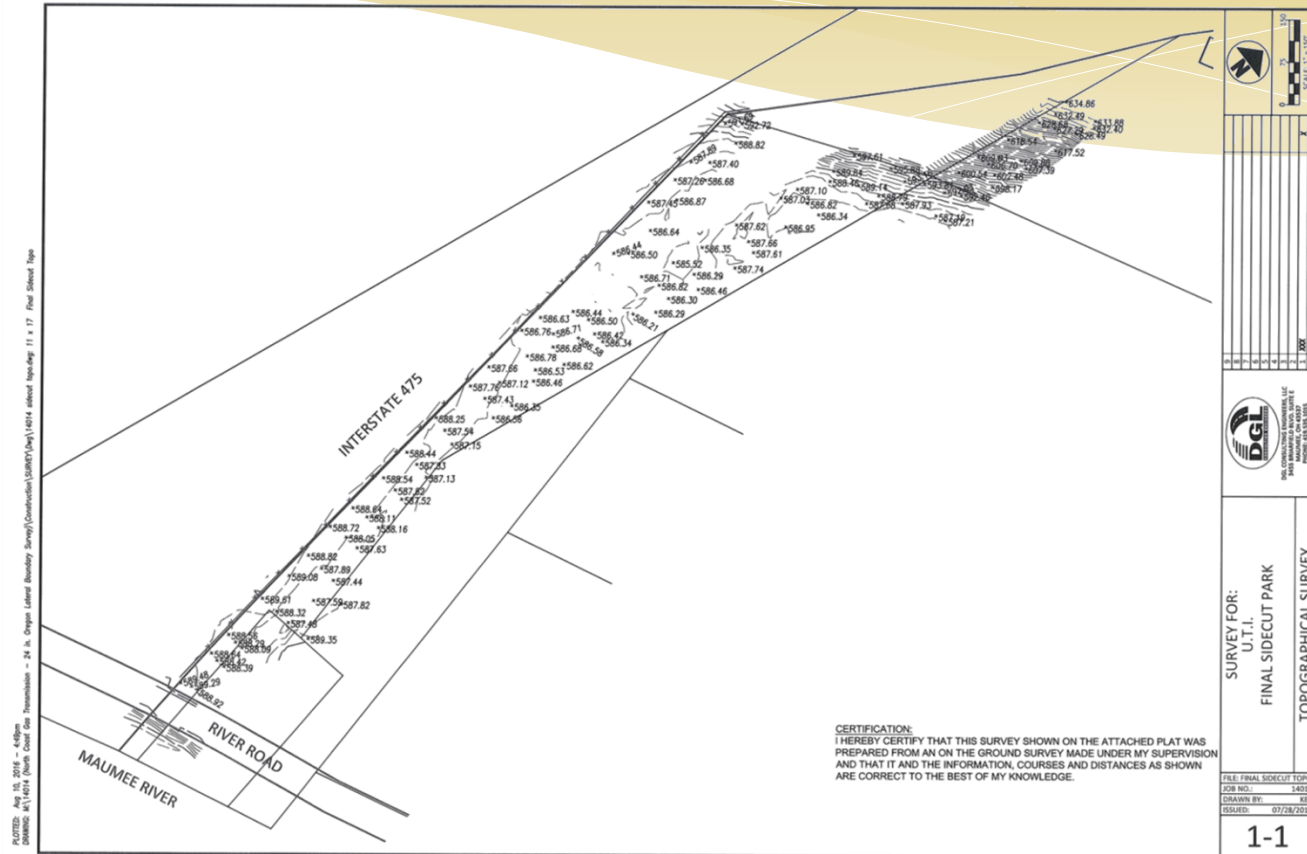
**1/1**



# FEMA Flood Map



# Floodplain Pre-Const. / As-Built Topographic Survey



# Pipeline Terminology

- \* (FERC) Federal Energy Regulatory Commission
- \* TALLY is the process of confirming the manufacturer - MANIFEST or MILL DATA
- \* PIPE is commonly known as a JOINT
- \* Joint Mapping is the process of recording the weld and joint data after the pipeline is welded together.
- \* Joint offcut is called a PUP
- \* ROW strictly speaking is legal ROW for pipeline
- \* CORRIDOR is combination of permanent & temporary easement area (area allowed to work within)

# Why? Then & Now

# Then?

<p>WID B = KE HP = NT CID = 5/2 XR# = 1134MS 662</p> <p>L = 40.37 T = 0.375 P = LIN 101516 H = 512433 C = FBE G = X52</p> <p>WID B = KE HP = NT CID = 5/2 XR# = 1134MS 663A</p> <p>L = 40.63 T = 0.375 P = LIN 101518 H = 512534 C = FBE G = X52</p> <p>WID B = KE HP = NT CID = 5/2 XR# = 1134MS 668A</p> <p>L = 40.46 T = 0.375 P = LIN 101519 H = 512259 C = FBE G = X52</p>	<p>WID B = KE HP = NT CID = 5/2 XR# = 1134MS 663D</p> <p>L = 35.99 T = 0.375 P = LIN 101517 H = 512534 C = FBE G = X52</p> <p>WID B = KE HP = NT CID = 5/2 XR# = 1134MS 666A</p> <p>L = 33.80 T = 0.375 P = LIN 101513 H = 494027 C = FBE G = X52</p> <p>WID B = KE HP = NT CID = 5/2 XR# = 1134MS 669A</p> <p>L = 29.81 T = 0.375 P = LIN 101522 H = 512259 C = FBE G = X52</p>	<p>WID B = KE HP = NT CID = 5/2 XR# = 1134MS 664A</p> <p>L = 40.39 T = 0.375 P = LIN 101523 H = 512261 C = FBE G = X52</p> <p>WID B = KE HP = NT CID = 5/2 XR# = 1134MS 667A</p> <p>L = 29.42 T = 0.375 P = LIN 101515 H = 494201 C = FBE G = X52</p> <p>WID B = KE HP = NT CID = 5/2 XR# = 1134MS 670A</p> <p>L = 29.56 T = 0.375 P = LIN 101524 H = 494035 C = FBE G = X52</p>	<p>WID B = KE HP = NT CID = XR# =</p> <p>L = T = P = H = C = G =</p>																		
<p>STATIONS AHEAD →</p>																					
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# Trimble R10 GPS Rover and TSC3 w/ Access Pipelines

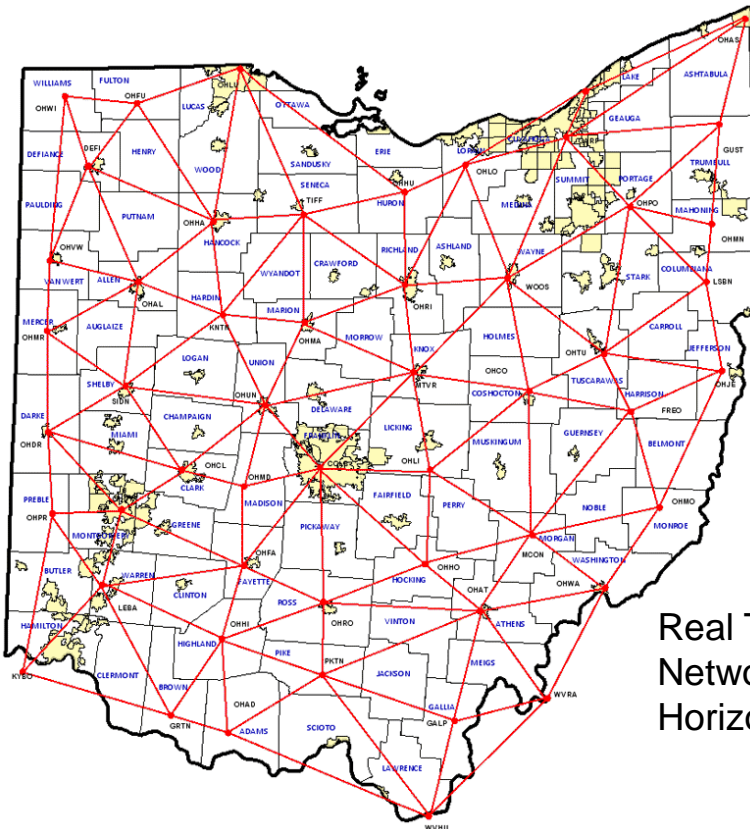


Trimble R10  
GPS Receiver



Trimble  
TSC3

# ODOT VRS (Virtual Reference System)



The Ohio Department of Transportation, Office of CADD and Mapping Services operates and maintains a network of 54 strategically located GPS Continuously Operating Reference Stations (CORS) in the State of Ohio

Real Time Kinematic surveying  
Network RTK

Horizontal . . . . . 8 mm + 0.5 ppm RMS  
~ .03' + 0.5 ppm

Vertical. . . . . 15 mm + 0.5 ppm RMS  
~ .06' + 0.5 ppm

# Trimble Access Pipelines Detailed Overview





# Trimble Access Pipelines

## Main workflows

- \* Record & validate pipe inventory
- \* Record relationship between joints
- \* Survey welds, bends, etc. after installation, automatically linking all pipe attributes



# Trimble Access Pipelines

## Benefits?

- \* Better data in field & from field
- \* Less processing away from job site
- \* Quicker deliverables to contractors

## Who benefits?

- \* Surveyors working on pipelines where asset information is required
- \* Field crews & office technicians
- \* Contractors

# Trimble Access Pipelines Additional Features

- \* Streamline cover computations
- \* Ensure work within corridor
- \* Record entry & exit to exclusion zones
- \* Slope stationing
- \* Ahead & back stationing
- \* Compute deflection angles
- \* Compute crossing angles & separation

# Pipe Alignment

Defining Pipe alignment (.rxl) allows:

- \* Compute & record preliminary station & offset when measuring points
  - \* Station & offset can be recorded with any measurement
  - \* No need to use stakeout to measure points simply to compute station & offset
    - \* Station & offset recorded to job as an attribute
    - \* Recording as attribute requires Feature & Attribute Library with station & offset fields & configuration to specify which to use
    - \* Station & offset values only as accurate as preliminary alignment

# Corridor

- \* Pipe alignment combined with corridor left/right width can be used to define working corridor – or inclusion zone – an area you should work within
- \* Complex corridors are better defined by using Shapefile, DXF or LandXML polygon
- \* Warning is displayed a point is stored outside the corridor

## Warning

The measured position falls outside the selected pipeline corridor polygon.  
Continue storing point?

Yes

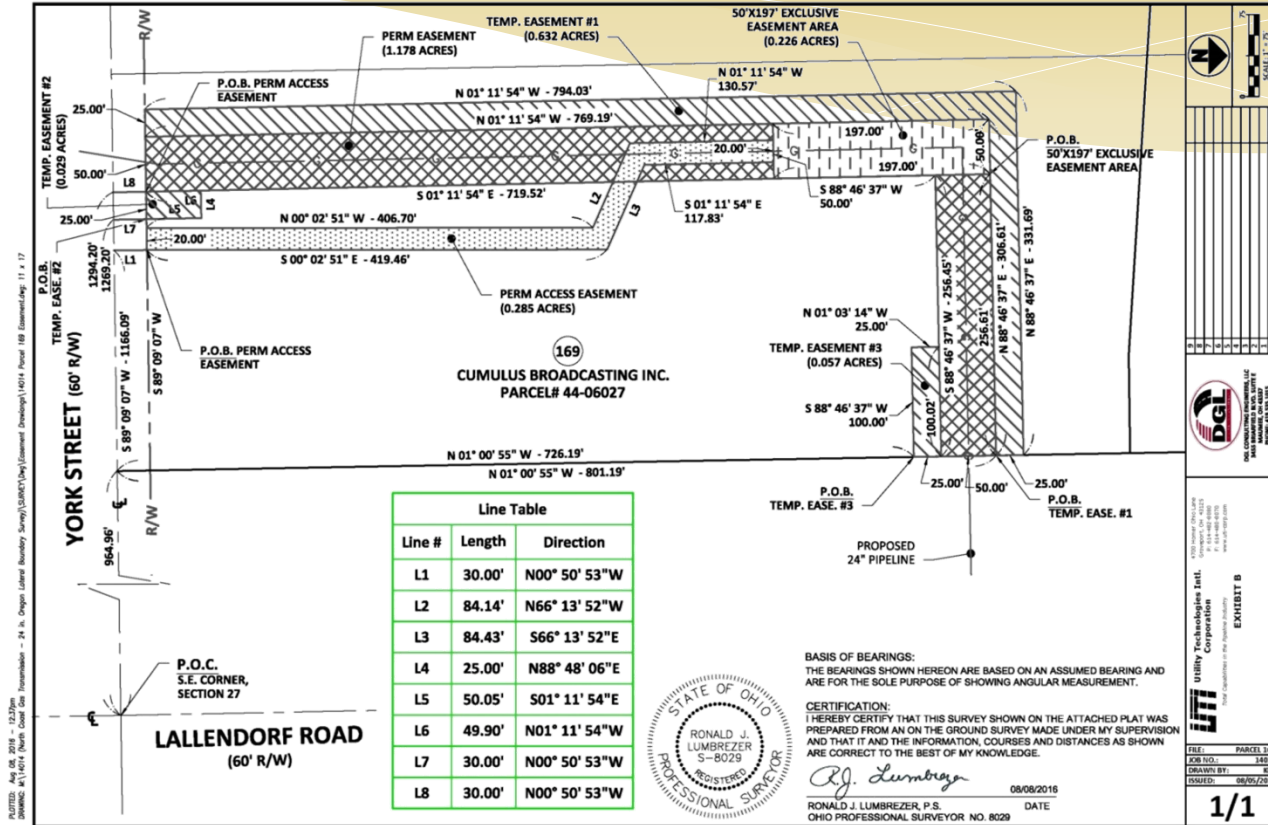
No

# Exclusion Zones

Supported exclusion zone file types:

- \* Shape files – Polygons
- \* DXF files – Closed polylines
- \* LandXML files – Parcel elements
- \* Warning appears when exclusion zone is entered
- \* Position is recorded when exclusion zone is entered or exited
- \* If point is stored in exclusion zone, a warning will appear asking if it's appropriate to store in exclusion zone

# Exclusion Zones Exhibit



# Data Collection

- \* Completely customizable
- \* Redundancy (both digital & hand written data)



# Tally – Getting started

- \* Get manifest from pipe manufacturer
- \* Modify the manifest as necessary to ensure unique ID & remove details not important (if you can't get a manifest, create a CSV with just a header containing attributes to be collected)
- \* Create or modify Feature code library (FXL) to match manifest/tally headings
- \* Copy Tally CSV & FXL to Controller
- \* Configure Job to link files

# Yellow Fields Indicate Held Attribute

**Create tally** [Navigation icons]

Unique ID:	PIPE #:
<input style="background-color: #ffff00;" type="text" value="?"/>	<input type="text" value="2944"/>
HEAT #:	LENGTH:
<input style="background-color: #ffff00;" type="text" value="?"/>	<input style="background-color: #ffff00;" type="text" value="?"/>
DIAMETER:	WALL THICKNESS:
<input style="background-color: #ffff00;" type="text" value="16"/>	<input style="background-color: #ffff00;" type="text" value="0.317"/>
MANUFACTURER:	
<input style="background-color: #ffff00;" type="text" value="ARAMCO"/>	
COATING:	GRADE:
<input style="background-color: #ffff00;" type="text" value="FBE"/>	<input style="background-color: #ffff00;" type="text" value="?"/>

1/2

No survey PDOP:1.0

Esc Find Clear Print Defaults ↑ Enter



JOINT ID NUMBER:

COATING TYPE:

CUT OFF:

FINAL JOINT LENGTH:

GRADE:

HEAT NUMBER:

ORIGINAL JOINT LENGTH:

PUP ID:

WALL THICKNESS:

OUTSIDE DIAMETER:

PHOTO:

BEND TYPE:

BEND DIRECTION:

BEND DIRECTION 2:

COMMENT:

DISTANCE TO BEND:

BEND ANGLE:

BEND ANGLE 2:

1/3

✓ Checked

Record position

2/3

Esc

Next

Esc

Next

Prev


Camera

Rename

File

Next

TALLY



DGL JOB NO: 14014  
 NCGT 24" OREGON LATERAL

Crew: \_\_\_\_\_

Date: \_\_\_\_\_

JOINT ID NUMBER

HEAT NUMBER	COATING TYPE			
	FBE	NONE	ARO	
ORIG. JOINT LENGTH	CUT OFF			PUP ID NUMBER
FINAL JOINT LENGTH	WALL THICKNESS			GRADE
	0.500	0.375	0.406	60000 65000 70000
OUTSIDE DIAMETER	BEND TYPE			BEND DIRECTION
24"	FACTORY	FIELD		LEFT RIGHT OVER SAG
BEND ANGLE	BEND DIRECTION 2			BEND ANGLE 2
	LEFT	RIGHT	OVER SAG	
DISTANCE TO BEND	PHOTO			
COMMENTS:				

# Tally Joint & Heat #'s



# Check Tally

Check tally

JOINT ID NUMBER: 1603 HEAT NUMBER: T21089

COATING TYPE: FBE ORIGINAL JOINT LENGTH: ?

CUT OFF: ?

FINAL JOINT LENGTH: 40.0

GRADE: 60000

24.000

1/3

Esc Prev Camera Rename File Next

Information

The joint length for joint 1603 is shorter than the original length. If the pipe has been cut then you should record the offcut joint details in the tally. Do you want to add a PUP to the tally now?

Yes No

# Ready for Joint Mapping



# Joint Mapping

- \* Primary role of joint mapping is to record details of weld, bend or loose end & joint ahead & joint behind

Joint mapping

Weld ID: 8

Joint behind ID: ?

WELDER ID: ?

WELD COATING: None

Note: ?

Method: Welds

Loose ends

Bends

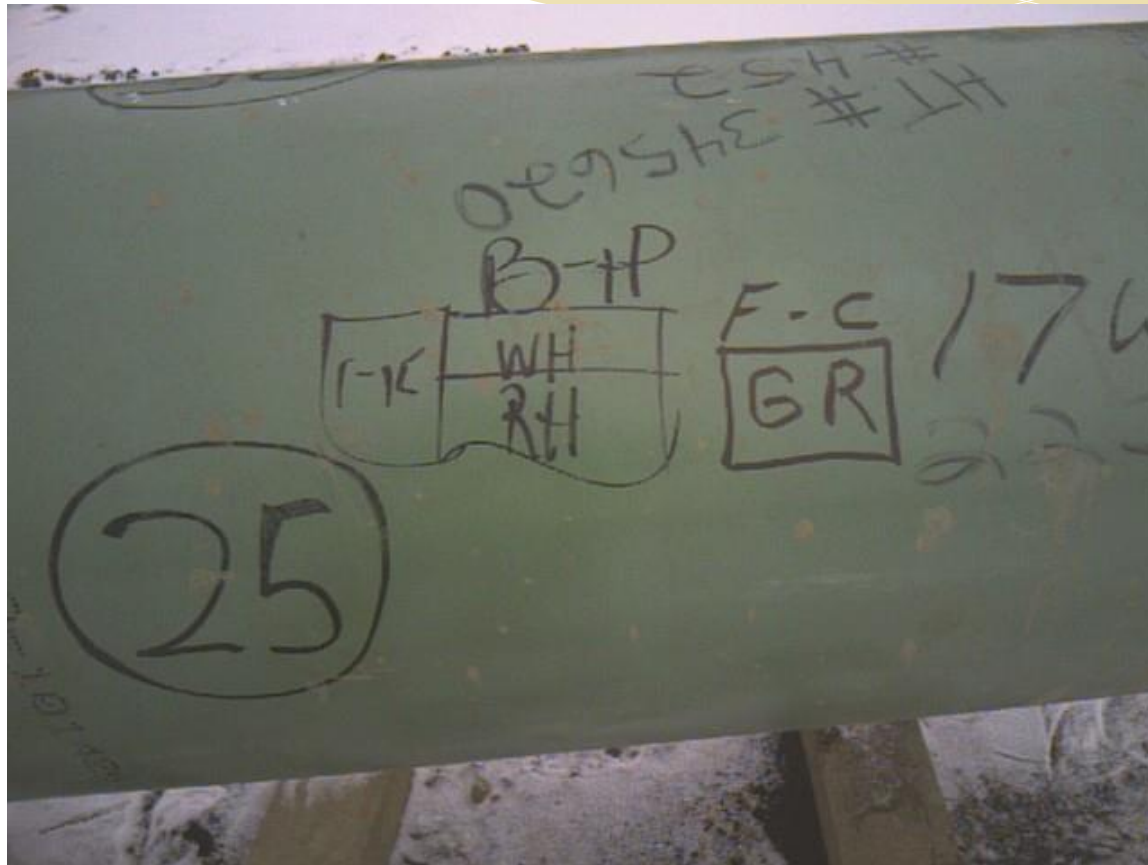
Record position

1/2

No survey PDOP:1.0

Esc Options Prev Next

# Joint Mapping Data Welder's Stencil





# Joint Mapping Office Setup

...INE-DGL -phase II - BD.fxl

Name	Description
BEND	BEND
TALLY	TALLY
VALVE	VALVE
WELD	WELD
X	GROUND

Esc  Edit

Add Delete

Enter feature code

Feature code:  Description:

Feature type:  
Point

Attributes

X-RAY NO. / WELD NO.:	JOINT AHEAD:
Text	Text
JOINT BEHIND:	WELD DATE:
Text	Text

1/3

Esc  Accep

# Joint Mapping Office Setup

Enter feature code

BEAD (LEFT): Text	BEAD (RIGHT): Text
HOT PASS (LEFT): Text	HOT PASS (RIGHT): Text
FILL (LEFT): Text	FILL (RIGHT): Text
CAP (LEFT): Text	CAP (RIGHT): Text
X-RAY GOOD?: Menu	DEFECT: Text

2/3

Esc  Accep

Enter feature code

LOCATION: Text	REP. WLDR: Text
REP. DATE: Text	REP. OK/REJ.: Menu
DEPTH OF COVER: Text	PHOTO: Photo
COMMENTS: Text	VT: Text
RVT: Text	

2/3

Esc  Accep

# Joint Mapping Field

**Joint mapping** [Navigation icons]

Weld ID: **DXR773** [▶]

Joint behind ID: **1603** [◀]

WELD DATE: **7-23-16**

BEAD (RIGHT): **JT**

Method: **Welds**

Joint ahead ID: **602**


BEAD (LEFT): **AB**

HOT PASS (LEFT): **AB**

1/9 [▼]

Esc [Options] [Details] [Prev] [Next] [↑] Update

JOINT MAPPING/AS-BUILT

 DGL JOB NO: 14014  
NCGT 24" OREGON LATERAL

Crew: \_\_\_\_\_  
Date: \_\_\_\_\_

X-RAY NO. / WELD NO. \_\_\_\_\_

JOINT BEHIND	JOINT AHEAD	WELD DATE
BEAD (LEFT)	BEAD (RIGHT)	
HOT PASS (LEFT)	HOT PASS (RIGHT)	
FILL (LEFT)	FILL (RIGHT)	
CAP (LEFT)	CAP (RIGHT)	
VT	RVT	
		PHOTO

COMMENTS:

# Joint Mapping – Bends

- \* Like welds, additional bend information can also be configured for storage
  - \* Bend type; field or factory
  - \* Direction 1; left, right, sag, overbend
  - \* Angle 1
  - \* Direction 2
  - \* Angle 2
- \* You configure the additional information to be stored

# Field or Factory Bends



# Collecting Additional Bend Information

**Joint mapping** [Navigation icons]

Bend ID: **b1** [Dropdown arrow]

Method: **Bends**

Joint ID: **ABC2946** [Text box]

BEND TYPE: **Field** [Dropdown arrow]

DIRECTION 1: **Right** [Dropdown arrow]

ANGLE 1: **90** [Text box]

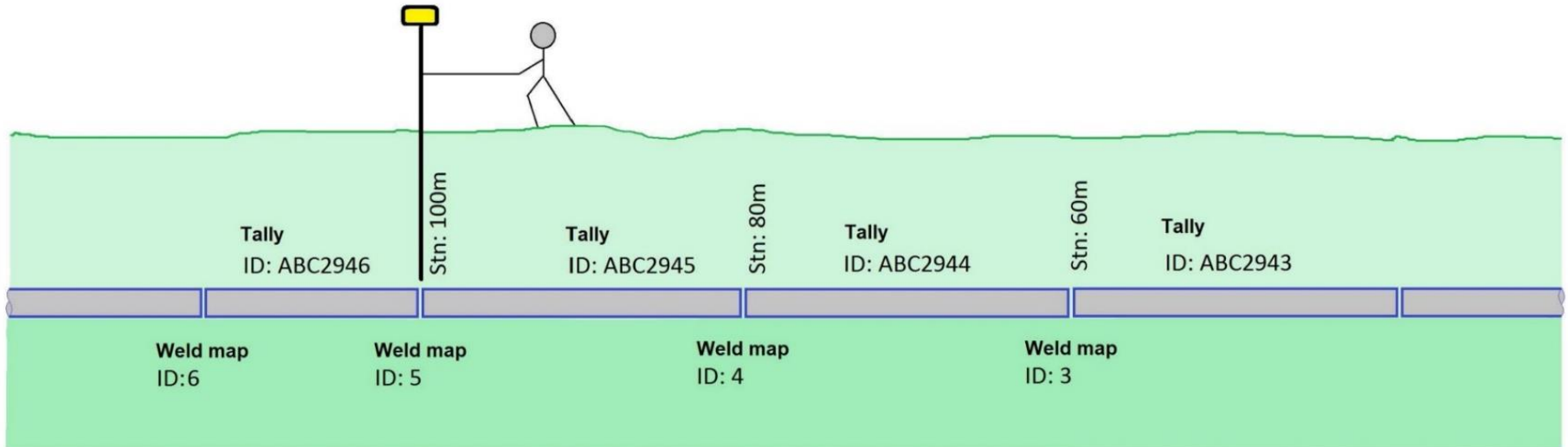
DIRECTION 2: **Sag** [Dropdown arrow]

1/2 [Dropdown arrow]

Esc [Text box] **No survey PDOP:1.6** [Text box] [Up arrow]

Options Details Prev Next [Up arrow]

# As-Built Pipeline Diagram



# Cut Out Welds

Joint mapping

Weld ID: 1

Method: Welds

Joint behind ID: ABC2941

Joint ahead ID: ABC2942

WELDER ID: ME

HEAT #: 12345

WELD COATING: ARO

TEMPERATURE: 17

Note: ?

Record position

1/2

Esc Rename Delete Swap ↑ Update

Tap the cut-out icon then tap **Update** to remove from the joint map sequence

If you cut-out a joint map weld you need to enter a new ID for replacement weld.

If you **Delete** a joint map, you can reuse the ID.



# PUPs

- \* The tally typically includes the joint length
- \* As shown in the previous slides, the tally is accessible for review & edit during joint mapping
- \* The tally is easily accessible during the survey of the welds
- \* **Any time** the joint length is shortened by more than a user-configured distance, you are prompted to create a PUP

# PUP Creation

The screenshot shows a software window titled "Check tally" with a standard Windows-style title bar. The main area contains several input fields: "UNIQUE ID:" with the value "ABC2941", "PIPE #:" with "34782941", "HEAT #:" with "D413", "DIAMET:" with "16", "MANUF:" with "SALZ", and "COATIN:" with "FBE". A dialog box titled "Information" is overlaid on the screen, containing the text: "The joint length for joint ABC2941 is shorter than the original length. If the pipe has been cut then you should record the offcut joint details in the tally. Do you want to add a PUP to the tally now?". Below the text are two buttons: "Yes" and "No". At the bottom of the window, there is a status bar showing "RTK H:0.008m V:0.012m" with a green checkmark, and a navigation bar with buttons for "Esc", "File", "Prev", "Rename", and "Next".

The original length was 20m

It was changed to 17m

A dialog appears giving you the option to create a PUP

# Automated Cover Computations

- \* Numerous ways to compute cover, simply because different projects/clients/surveyors have different needs
- \* Use solution that works best for you:
  - \* From *closest* natural ground point
  - \* From *last* measured point
  - \* From vertical alignment
  - \* From surface model

# Cover Computations Data

Review job

<b>Cover details</b>	
Ground point name	60700
Ground elevation	618.181sft
Depth of cover	5.243sft
Required cover	3.999sft
Cover OK	Yes
<b>Position</b>	
Alignment name	14014 construction skaking
Station	745+36.990sft
Station (slope)	?
Offset	-3.842sft

Joint data (JOINT AHEAD)

Esc  Details

Page ↑ Page ↓ Search Note

# Pipeline / Utility Crossings

- \* Surveying pipeline crossings is another important process most companies perform
- \* The Compute intersection angle function allows to calculate crossing details:
  - \* Record angle of intersection
  - \* Record separation
  - \* Store intersection point
  - \* Produce report on crossings

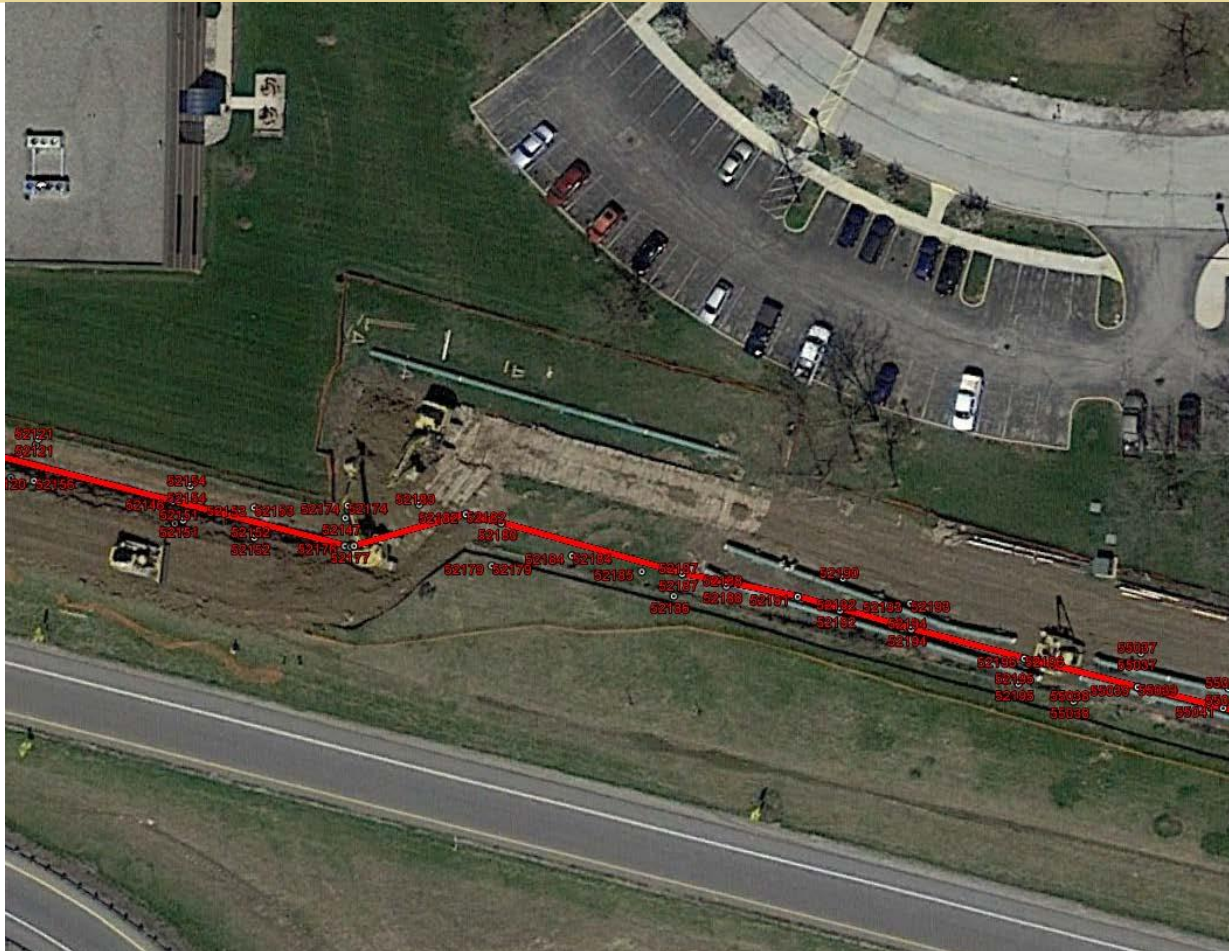
# Export & Reporting

- \* All data, including weld & joint ID, joint attributes, cover, crossings calculations etc. are all stored in Trimble Access job
  - \* Data flows through to TBC
- \* Reporting in Trimble Access can be used for daily reports
  - \* Tally progress
  - \* Joint mapping progress
  - \* Crossing reports
  - \* As-built progress

# Deliverables / End Results

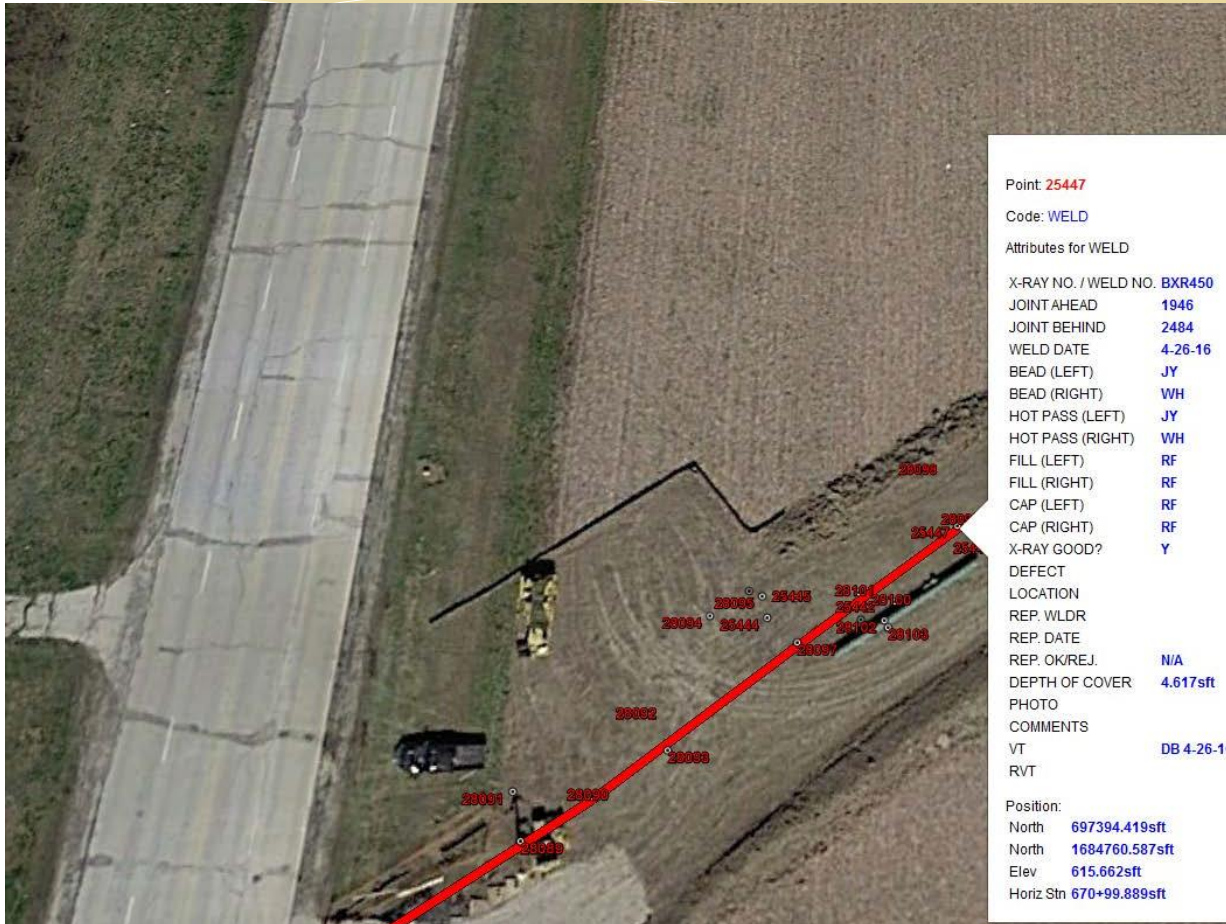
- \* Insert .kml file into Google Earth image with data link
- \* Export into Excel spread sheet
- \* Export into a Geodatabase

# Google Earth Image with .kml File





# Google Earth Image with .kml File



# Deliverables / End Results

STATION	Slope Station	POINT NO.	NORTHING	EASTING	ELEVATION	CODE
3.389	?	62612	696101.746	1644289.304	625.317	WELD
37.146	?	62616				WELD
59.905	?	62617				WELD
94.573	?	62614	696010.561	1644289.925	625.161	WELD
146.525	?	62619				WELD
148.031	?	62620				WELD
148.956	?	62621				WELD
241.253	?	55581	695861.757	1644290.254	625.588	WELD
246.584	?	55583	695856.795	1644292.834	625.805	WELD
285.646	?	55589	695833.018	1644324.299	628.563	WELD
325.82	?	55594	695805.943	1644354.036	630.347	WELD
354.051	?	55596	695785.741	1644373.761	630.844	WELD
421.180	?	50978	695757.56	1644401.671	630.50	WELD

# Deliverables / End Results

X-RAY #	WELD DATE	BEAD (LEFT)	BEAD (RIGHT)	HOT PASS (LEFT)	HOT PASS (RIGHT)	FILL (LEFT)	FILL (RIGHT)	CAP (LEFT)	CAP (RIGHT)
BXR1040	7/11/2016	JP	JS	JP	JS	JP	JS	JP	JS
BXR1041	7/12/2016	JP	JS	JP	JS	JP	JS	JP	JS
BXR1042	7/12/2016	JP	JS	JP	JS	JP	JS	JP	JS
BXR1058	7/13/2016	JP	JS	JP	JS	JP	JS	JP	JS
BXR1059	7/13/2016	JP	JS	JP	JS	JP	JS	JP	JS
BXR1060	7/13/2016	JP	JS	JP	JS	JP	JS	JP	JS
BXR1074	7/13/2016	JP	JS	JP	JS	JP	JS	JP	JS
BXR1084	7/15/2016	JP	JS	JP	JS	JP	JS	JP	JS
BXR1093	7/15/2016	JP	JS	JP	JS	JP	JS	JP	JS
BXR1103	7/16/2016	JP	JS	JP	JS	JP	JS	JP	JS
BXR1083	7/13/2016	JP	JS	JP	JS	JP	JS	JP	JS
BXR1102	7/16/2016	JP	JS	JP	JS	JP	JS	JP	JS
BXR348	2/20/2016	DF	BT	DF	BT	DF	BT	DF	BT

# Deliverables / End Results

JOINT AHEAD	JOINT ID NUMBER	JOINT AHEAD HEAT NUMBER	JOINT AHEAD COATING TYPE	JOINT AHEAD ORIGINAL LENGTH	JOINT AHEAD CUT OFF	JOINT AHEAD PUP ID
777	777	447321	ARO	32.0		
791	791	447689	ARO	32.0		
603	603	437302	ARO	27.0		
604	604	447136	ARO	29.4		
660	660	GB6711	ARO	39.9		
653	653	531516	ARO	39.8		
664	664	M05859	ARO	39.7		
B-140	B-140	M15BDK	FBE	6.0		
257	257	345527	FBE	39.9		
794	794	345242	FBE	39.9		
796	796	345528	FBE	39.5	10.6	796-pup
263	263	345620	FBE	40.0		
269	269	345528	FBE	39.9		

# Deliverables / End Results

JOINT AHEAD FINAL LENGTH	JOINT AHEAD WALL THICKNESS	JOINT AHEAD GRADE	JOINT AHEAD DIAMETER	JOINT AHEAD PHOTO	JOINT AHEAD COMMENTS
32.0	0.406	65000	24.000		
32.0	0.406	65000	24.000		
27.0	0.406	65000	24.000		
29.4	0.406	65000	24.000		
39.9	0.500	60000	24.000		
39.8	0.500	60000	24.000		
39.7	0.500	60000	24.000		
6.0	0.500	65000	24.000		
39.9	0.406	65000	24.000		
39.9	0.406	65000	24.000		
28.9	0.406	65000	24.000		
40.0	0.406	65000	24.000		
39.9	0.406	65000	24.000		

# Deliverables / End Results

JOINT AHEAD BEND TYPE	JOINT AHEAD DISTANCE TO BEND	JOINT AHEAD BEND DIRECTION 1	JOINT AHEAD BEND ANGLE 1	JOINT AHEAD BEND DIRECTION 2	JOINT AHEAD BEND ANGLE 2	JOINT BEHIND	JOINT BEHIND ID NUMBER
None		None		None		614A	614A
None		None		None		777	777
None		None		None		791	791
None		None		None		603	603
None		None		None		604	604
None		None		None		660	660
None		None		None		653	653
Factory		Left	51.5	None		664	664
None		None		None		B-140	B-140
Field	19.2	Left	7.25	Overbend	3.25	257	257
None		None		None		794	794
Field	20.0	Overbend	2.5	None		796	796
Field	22.8	Sag	2.25	None		263	263