UNIVERSITY LANDS

3D web interface for visualizing complex subsurface well/lease relationships

Draft

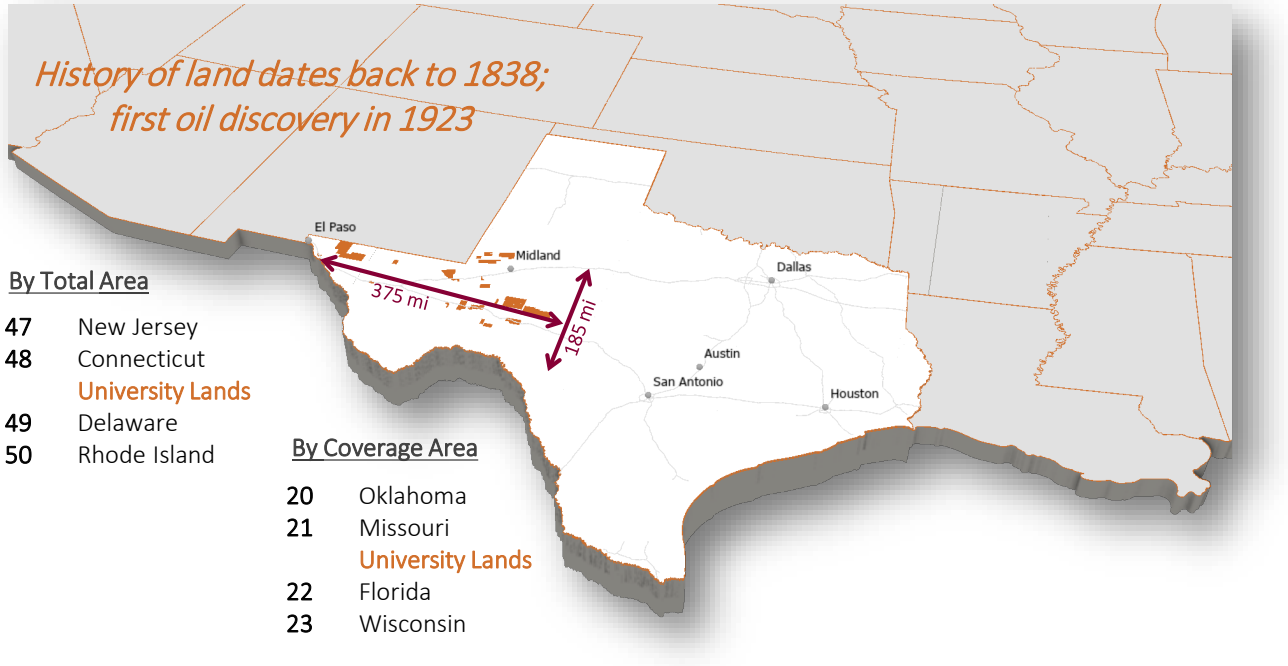
ESRI Energy Resources
GIS Conference

4-5 May 2022

The PUF & University Lands Organization

University Lands (UL) manages the surface and mineral interests of 2.1 million acres of land across nineteen counties in West Texas for the benefit of the Permanent University Fund (PUF).

The PUF is the largest public university endowment in the U.S. and benefits more than 20 educational and health institutions across both The University of Texas System and Texas A&M University System.



24,400
Wells drilled to-date

9,800
Wells currently producing

250+
Operators

79,000
Acres of renewable energy leases

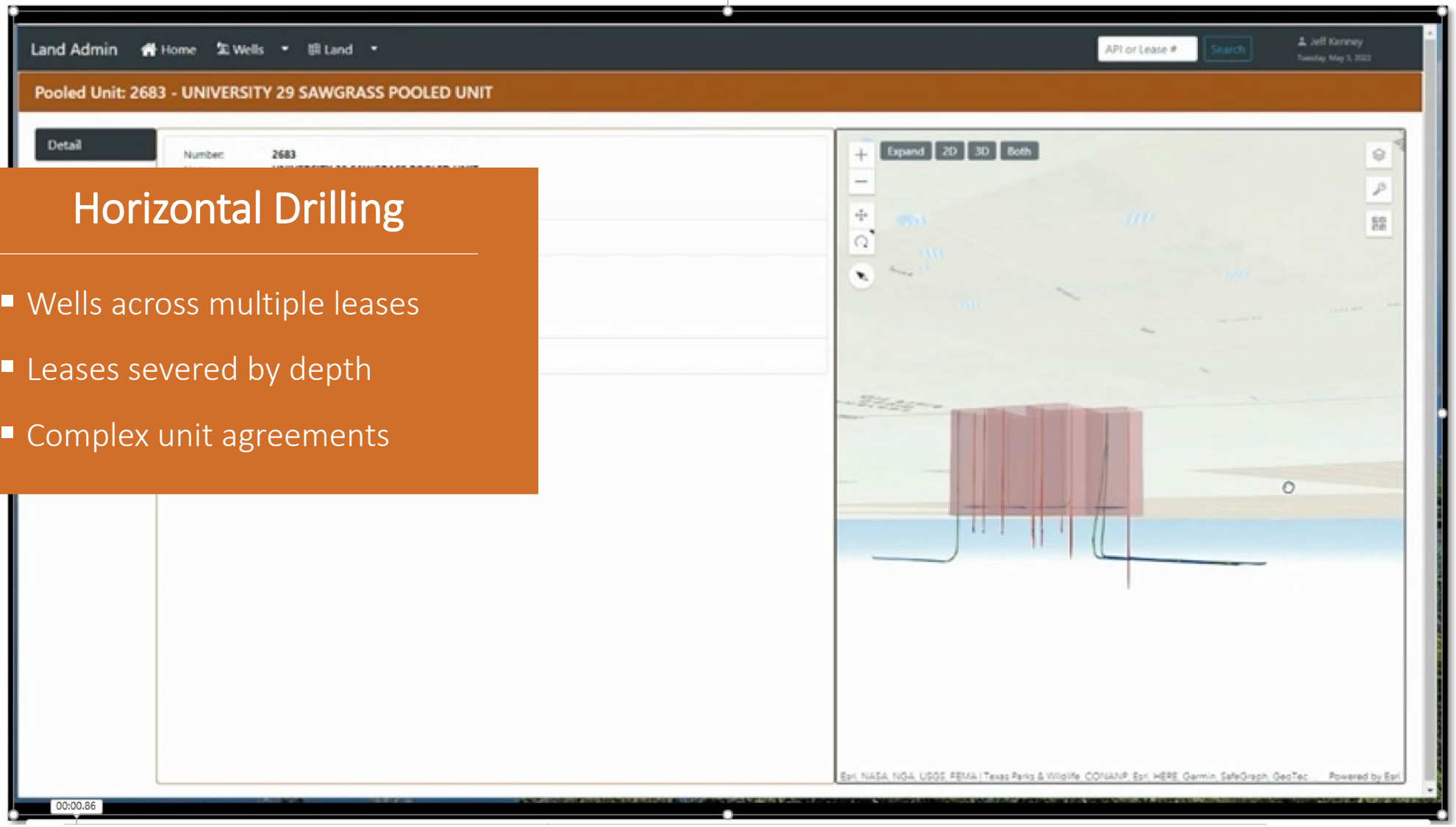
22,000
Miles of pipeline 7 powerline easements

SURFACE LEASES

- Pipelines and power lines
- Grazing and ranching
- Renewables – wind and solar
- Groundwater sales
- Environmental programs

Primary revenue driver is mineral royalty revenue.

Project Background - Drivers



Horizontal Drilling

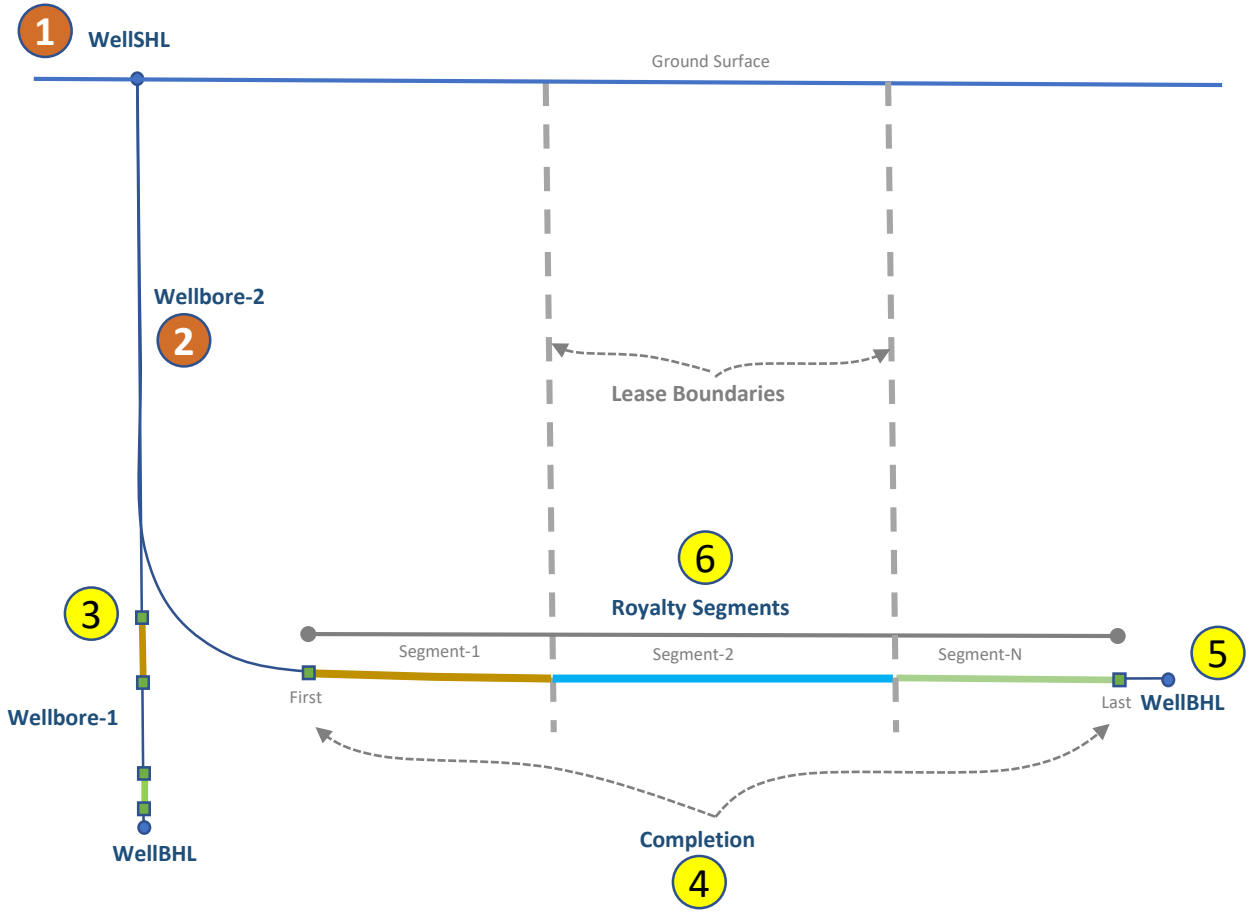
- Wells across multiple leases
- Leases severed by depth
- Complex unit agreements

Well Features

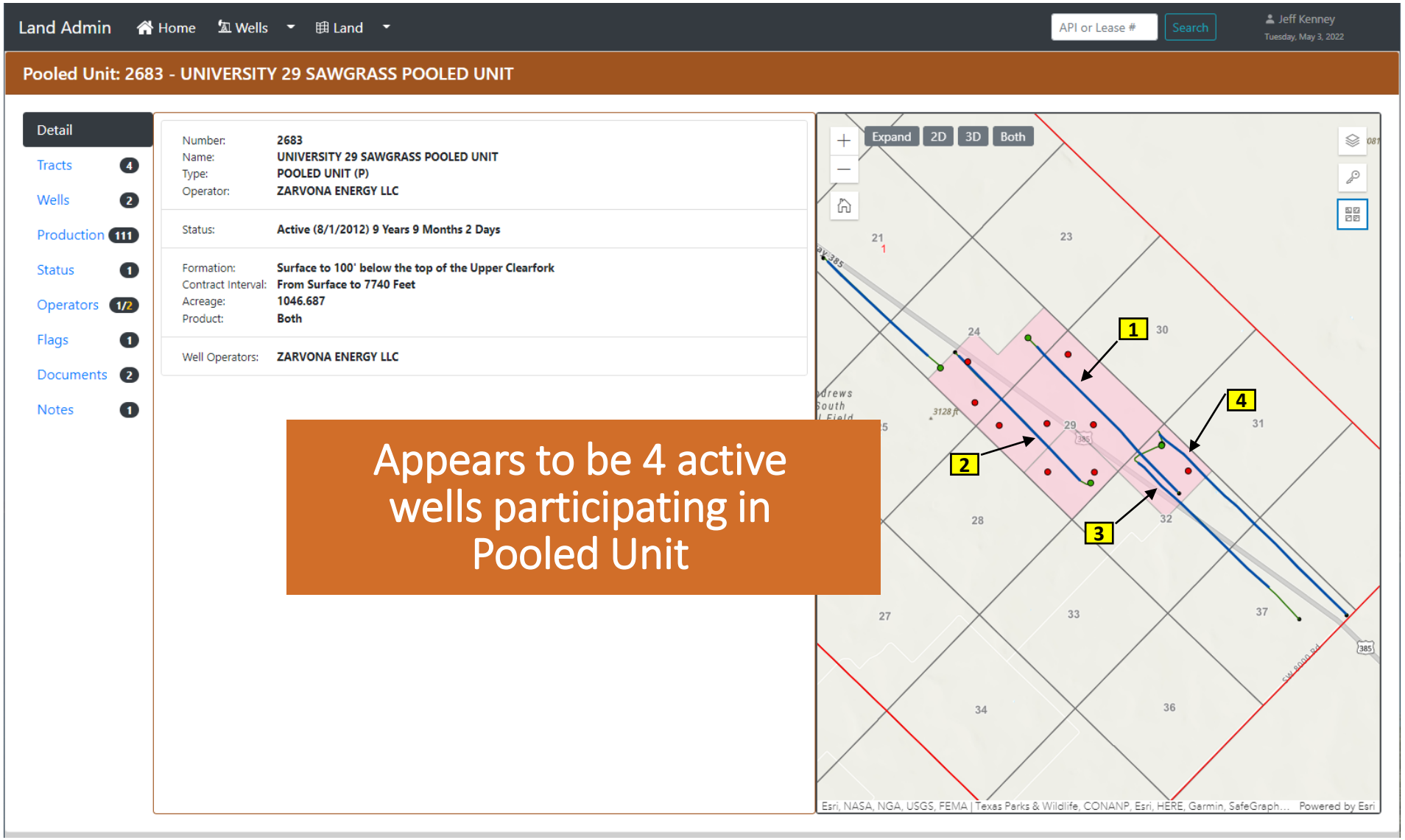
1. **WellSHL (pt)** – Surface Hole Location
2. **Wellbore (line)** – drilled well path

Derivative Layers

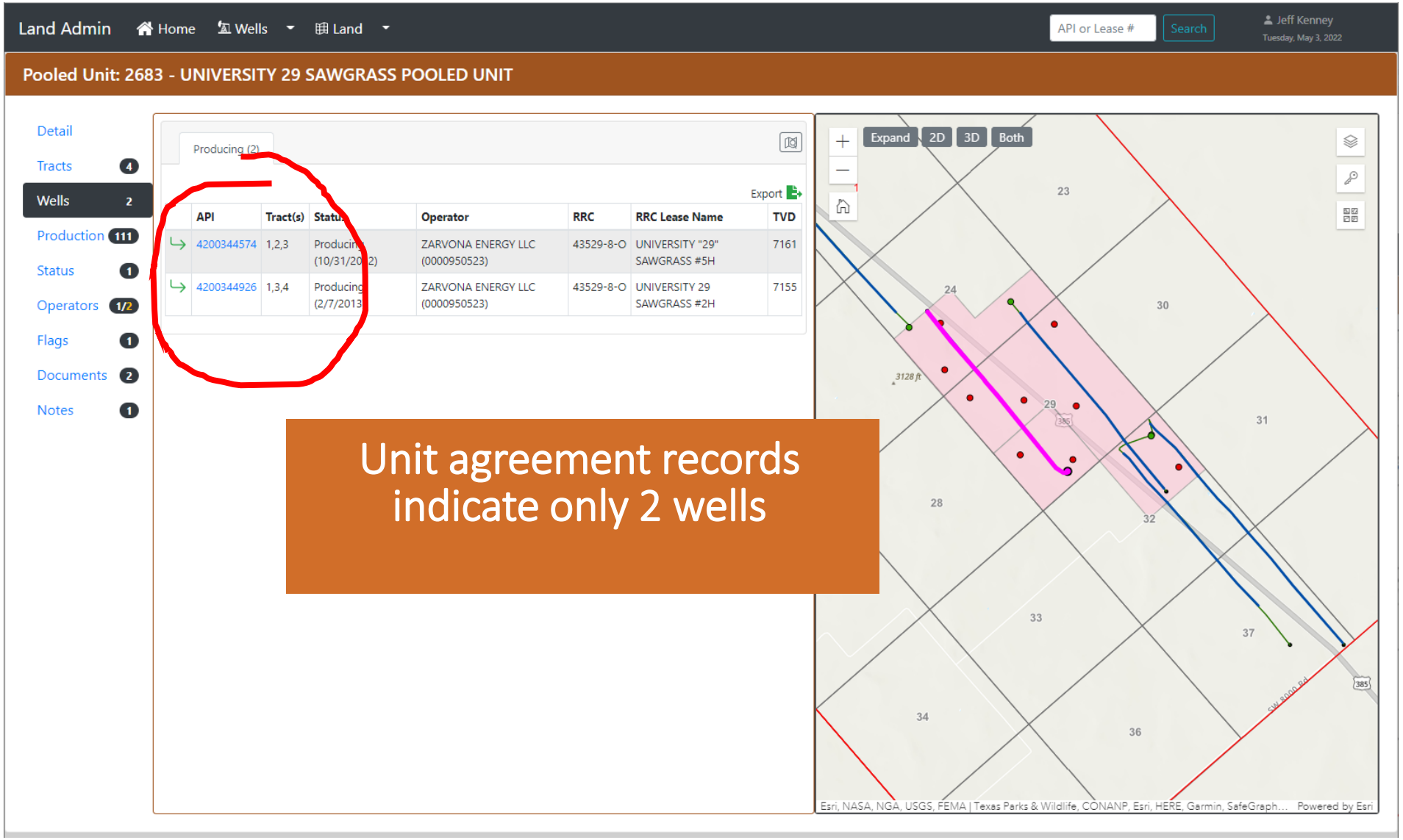
3. **Perfs** (pts) first & last takes
4. **Completion** (line) production interval
5. **WellBHL** (pt) End point of Wellbore
6. **Royalty Segment** (line) Completions split by Oil & Gas Lease boundaries. Used to calculate % wellbore allocation within each lease.



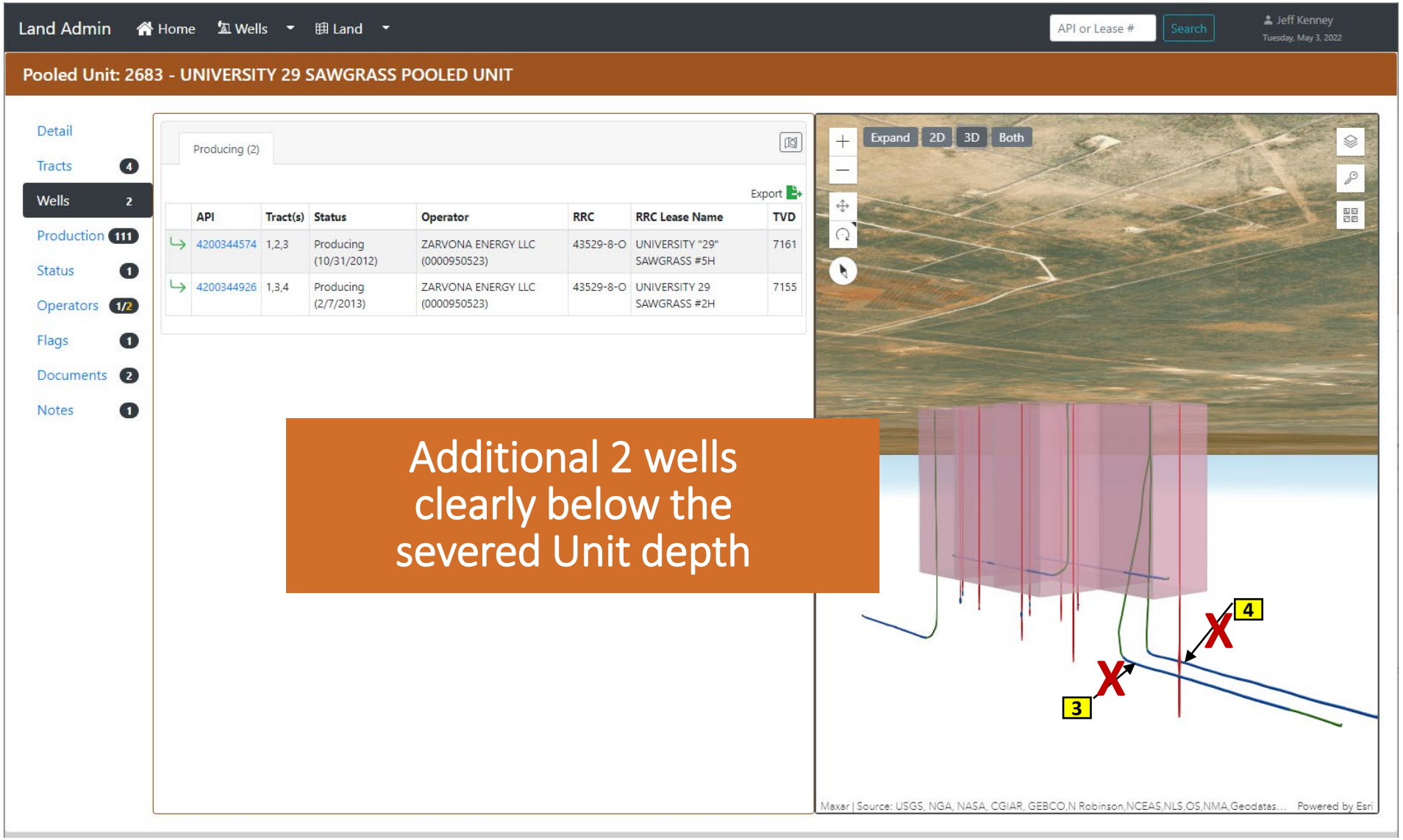
Visualization Value



Visualization Value



Visualization Value

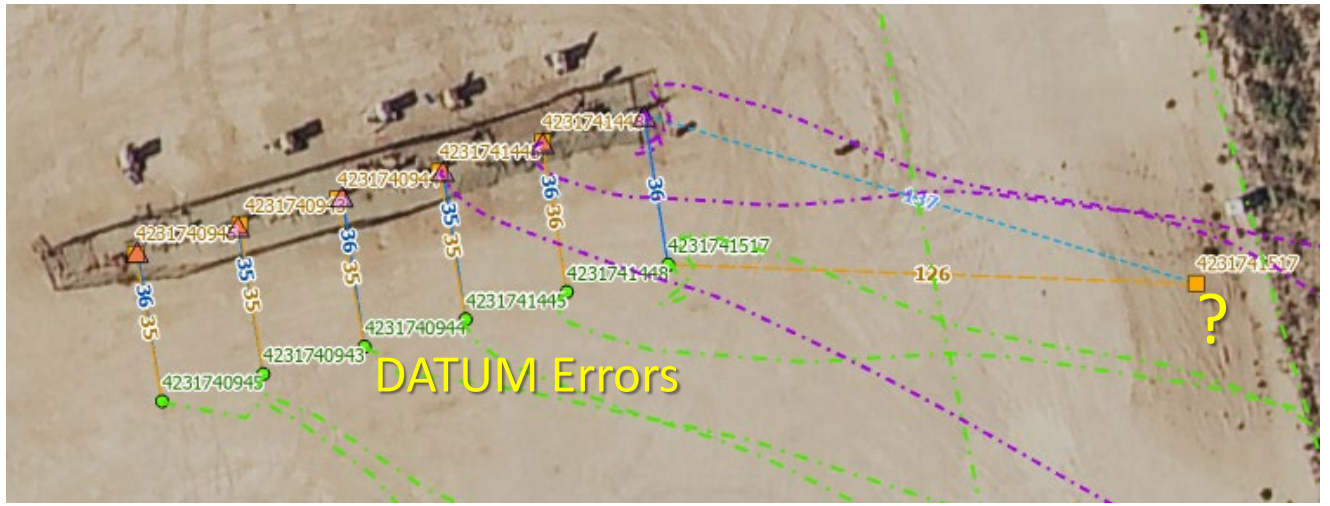


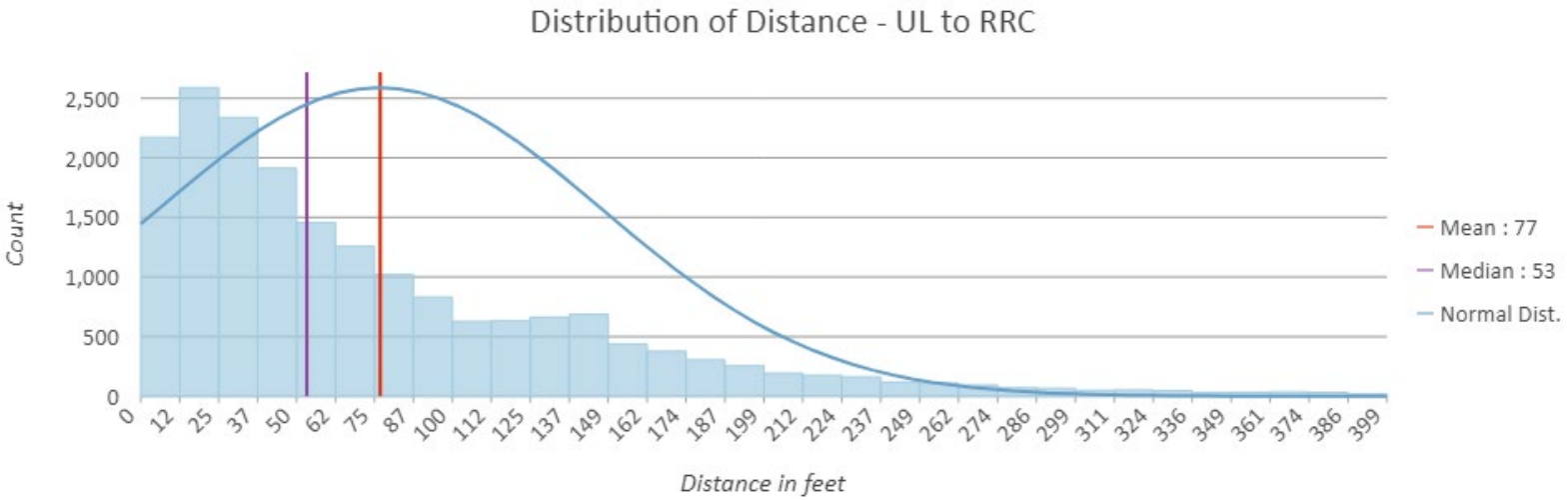
Additional 2 wells clearly below the severed Unit depth

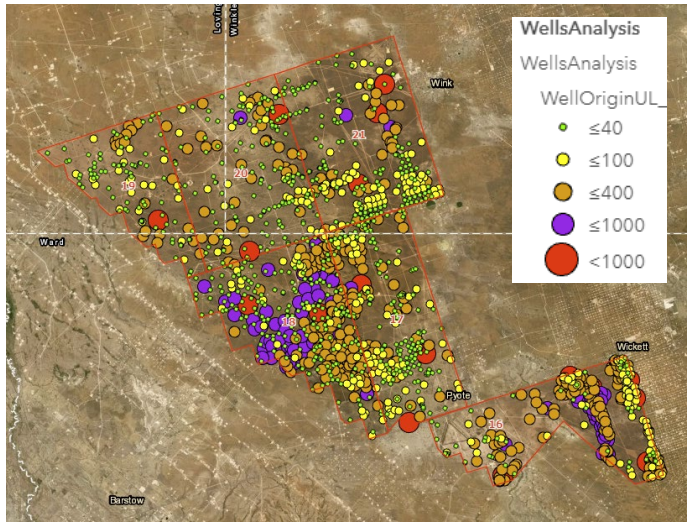
Challenges – Data Quality

Location Accuracy

A variety of Surface Hole Location (SHL) discrepancies between different well data sources.



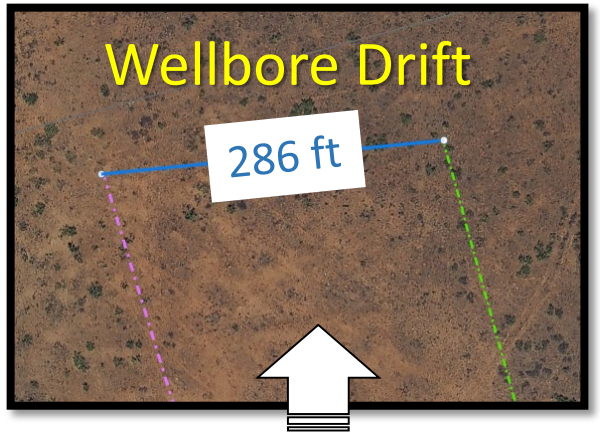


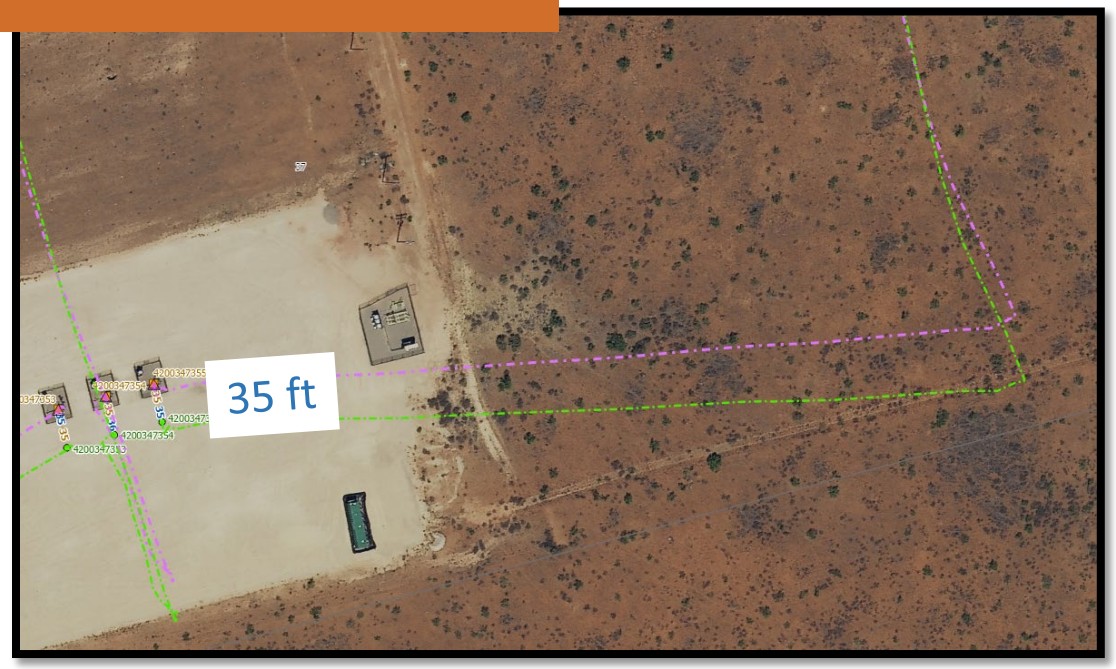


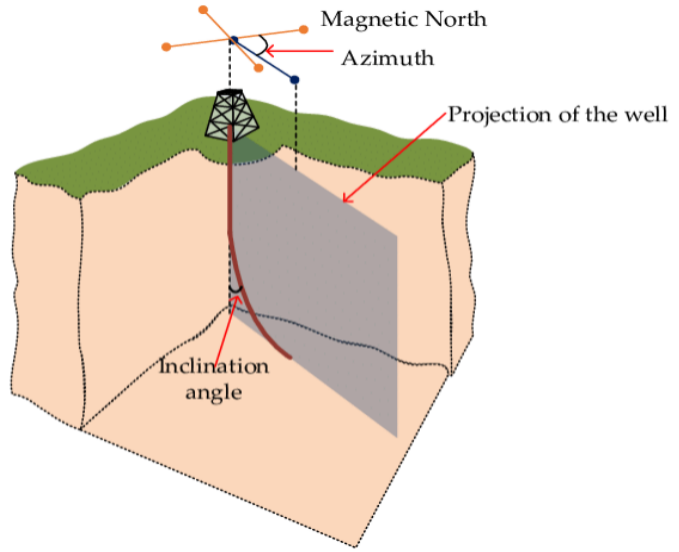
Challenges – Data Quality

Wellbore Build Process

Inconsistent in-house methods being used for building 3D wellbore features.







Orientation (Azimuth & Inclination)

- Magnetic north
- Geographic north (latitude and longitude)
- Grid north [projected coordinate system]

Measurement Methods

- Tangential
- Balanced Tangential
- Average Angle
- Curvature Radius
- Minimum Curvature

Challenges – Data Quality

Attributes

Missing, inaccurate, inconsistent...

Validation Exceptions
Ground elevation missing
Ground Elevation out of tolerance with DEM
SHL Lat/Lon out of tolerance w/wellbore start node
SHL out of tolerance with other sources
Total Measure Depth (TD) missing
Total Vertical Depth (TVD) missing
TVD > TD
Perf(s) missing
Last Take < First Take
Last Take > Total Depth
Hole Direction missing
Hole Direction inconsistent with Wellbore feature
Etc…

Responses - Data Quality

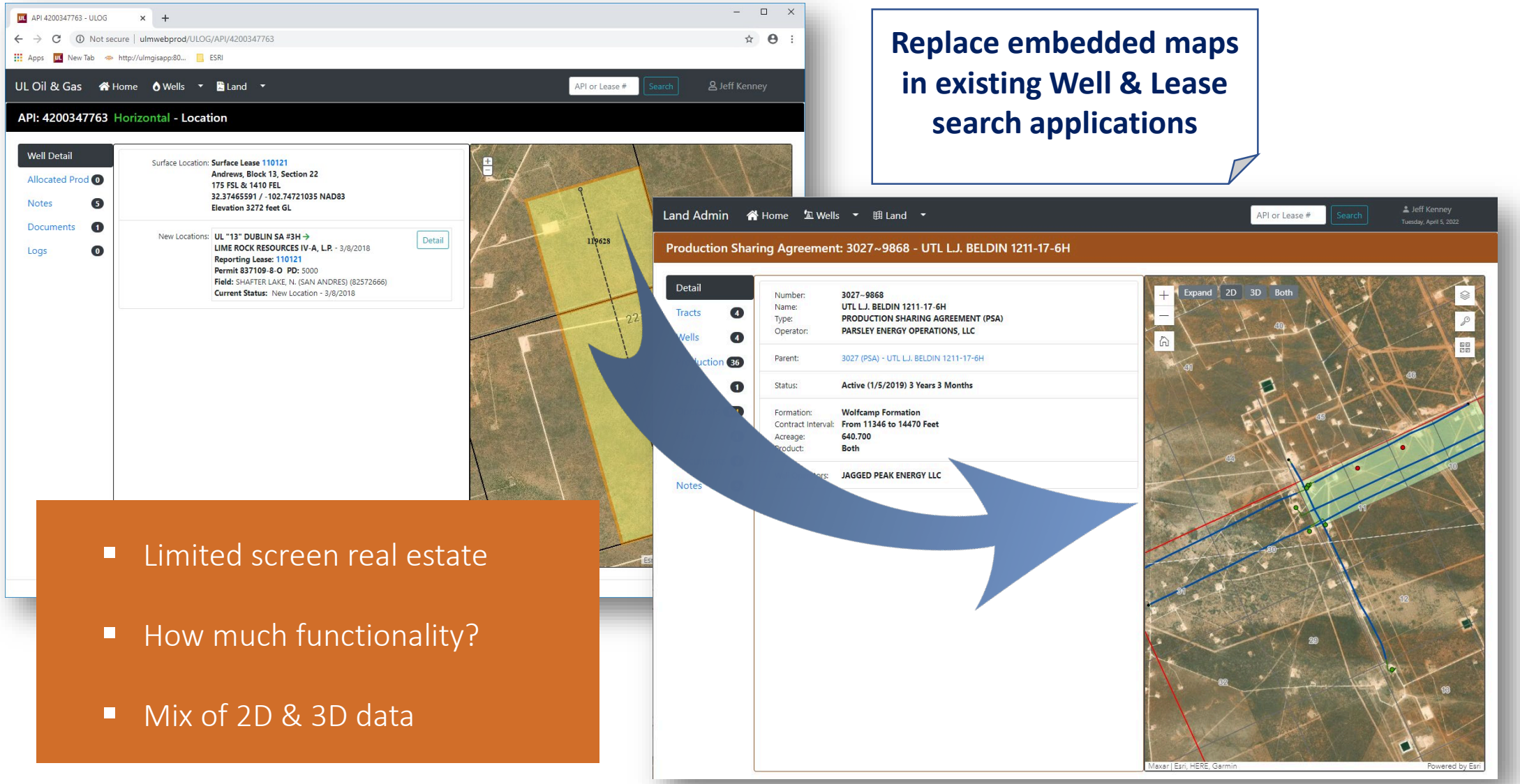
Master Data Management

Blends & masters wellbore attributes from multiple sources

+ Spatial validations using FME

- **Supplements in-house data**
- **Framework for data cleanup**

Challenges - Development



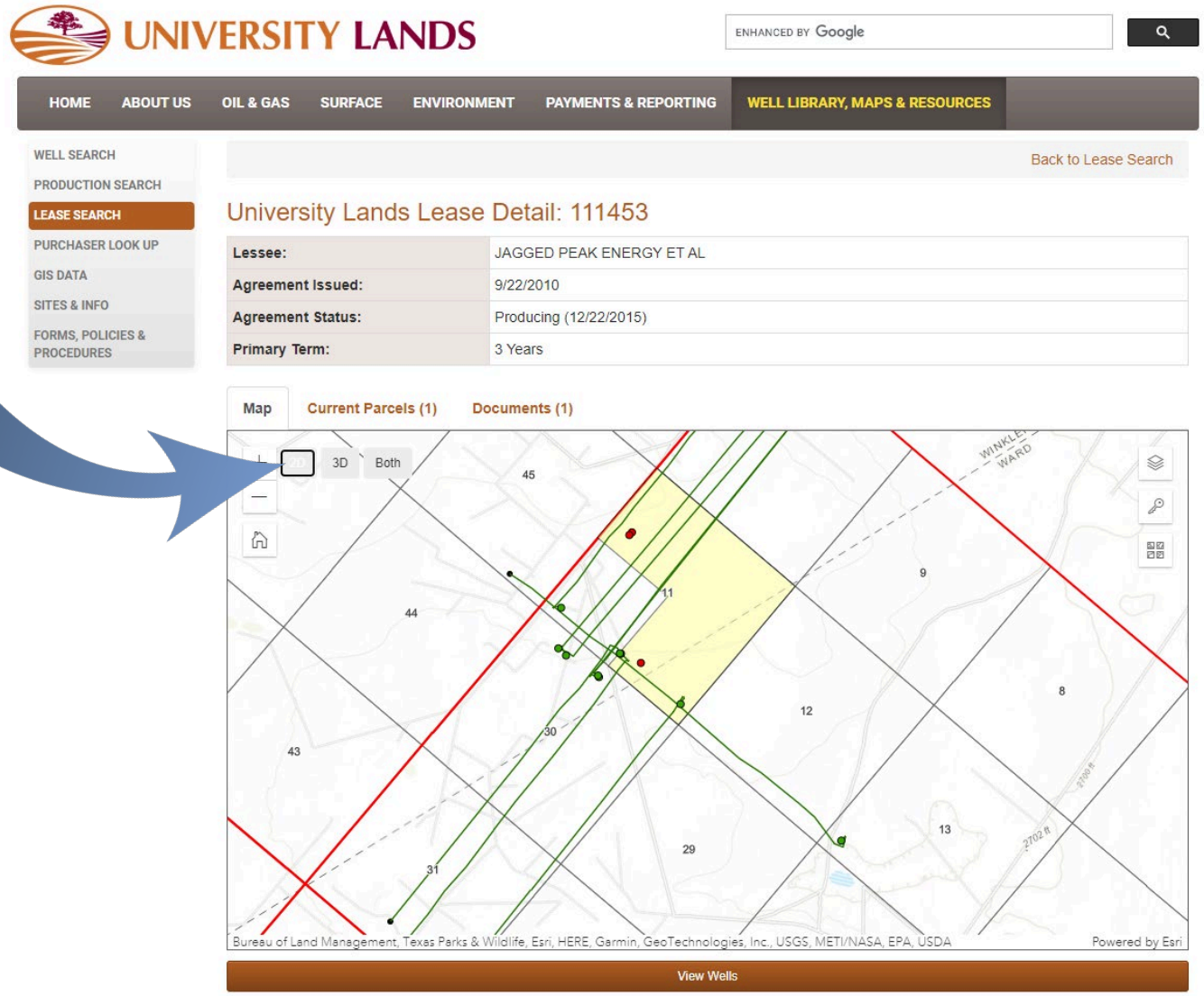
Replace embedded maps in existing Well & Lease search applications

- Limited screen real estate
- How much functionality?
- Mix of 2D & 3D data

Responses – Development

Screen Real Estate

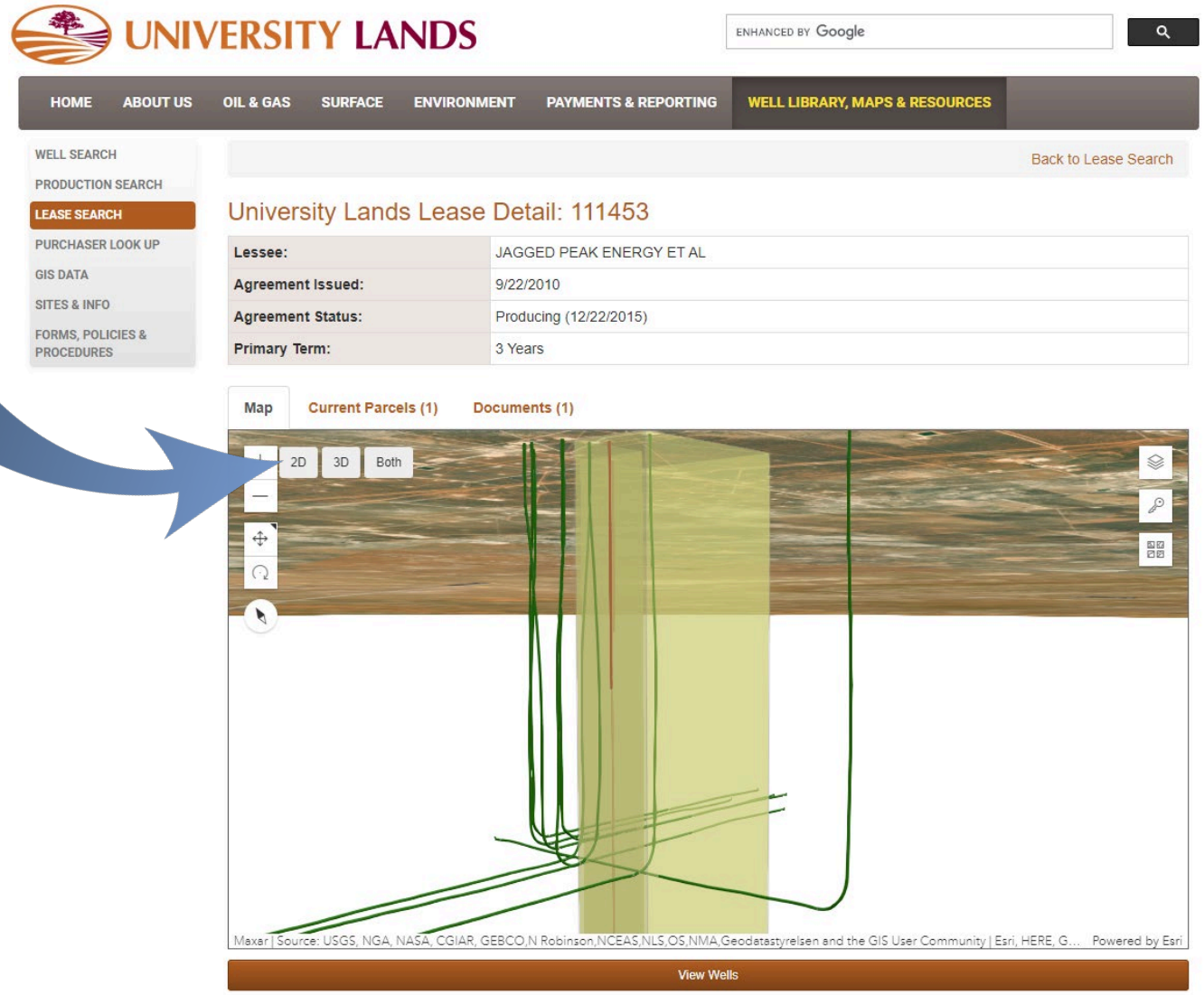
Added toggles for different display types



Responses – Development

Screen Real Estate

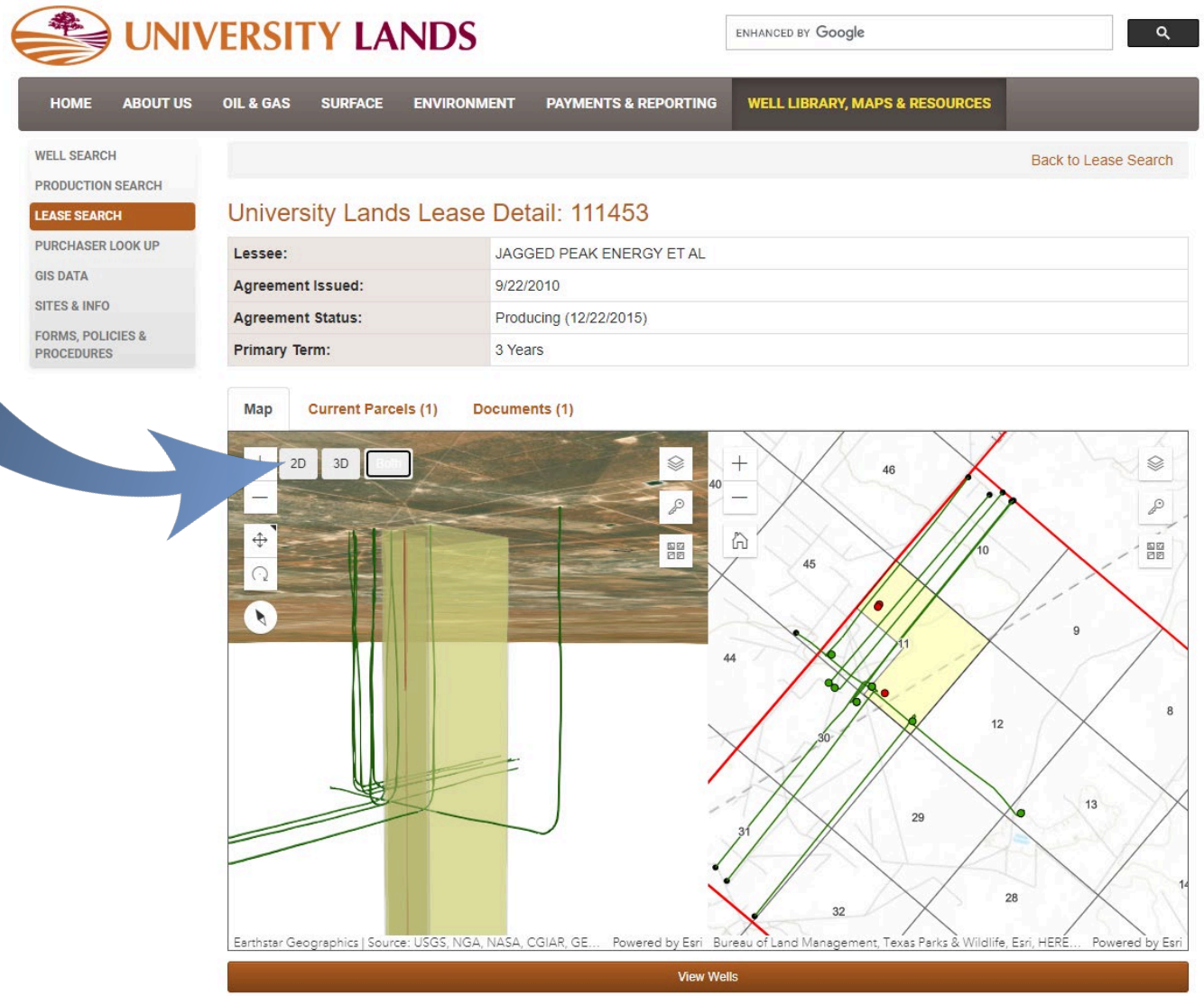
Added toggles for different display types



Responses – Development

Screen Real Estate

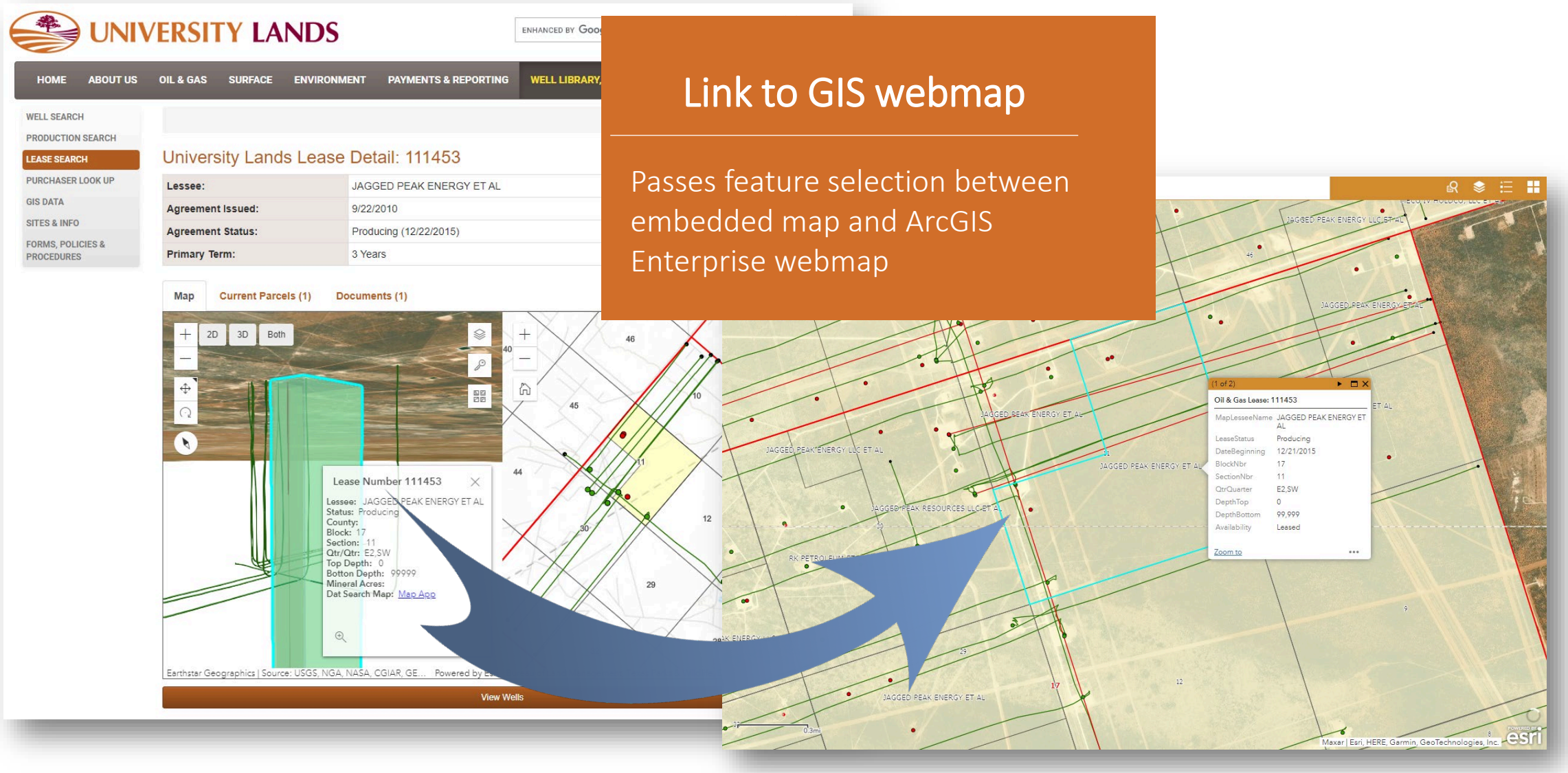
Added toggles for different display types



Responses – Development

Link to GIS webmap

Passes feature selection between embedded map and ArcGIS Enterprise webmap



Responses – Development

Mix of 2D & 3D data

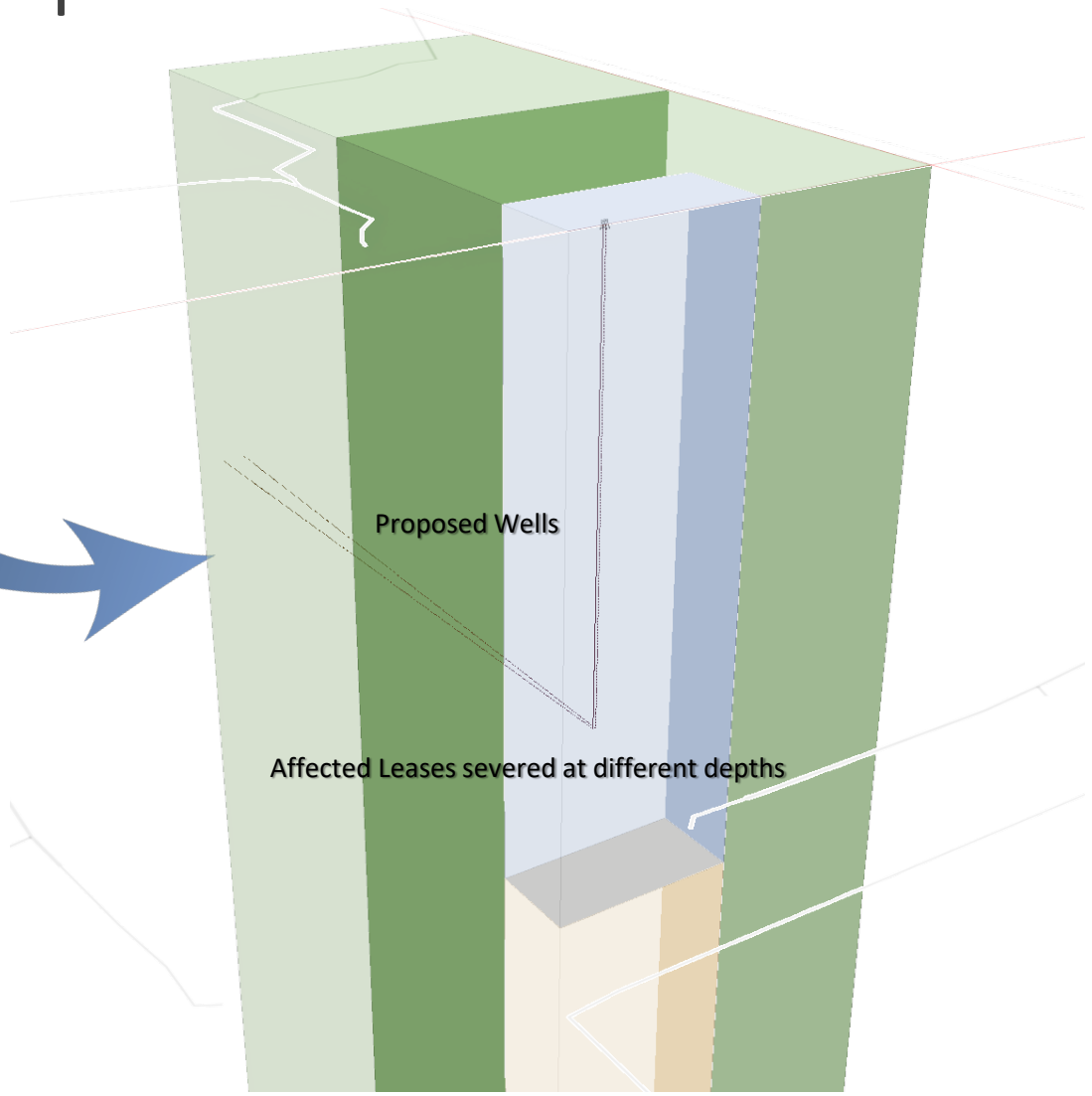
Needed to migrate all Well & Lease related features to accommodate 3D analysis

Available Leases

Not stored in our Land Admin

Permitted Wells

3D lines vs 2D draped on surface



Key Take-Aways

1. Under estimated the data engineering effort
   - FME critical component
2. Pleasantly surprised with ArcGIS Enterprise
   - 3D web visualization performance out of the box
3. 3D visualization provides business value
   - if for no other reason than improved data quality

Going Forward

Validation

Automate spatial validation of data quality

Visualization

Incorporate data quality factors into display

Cleanup

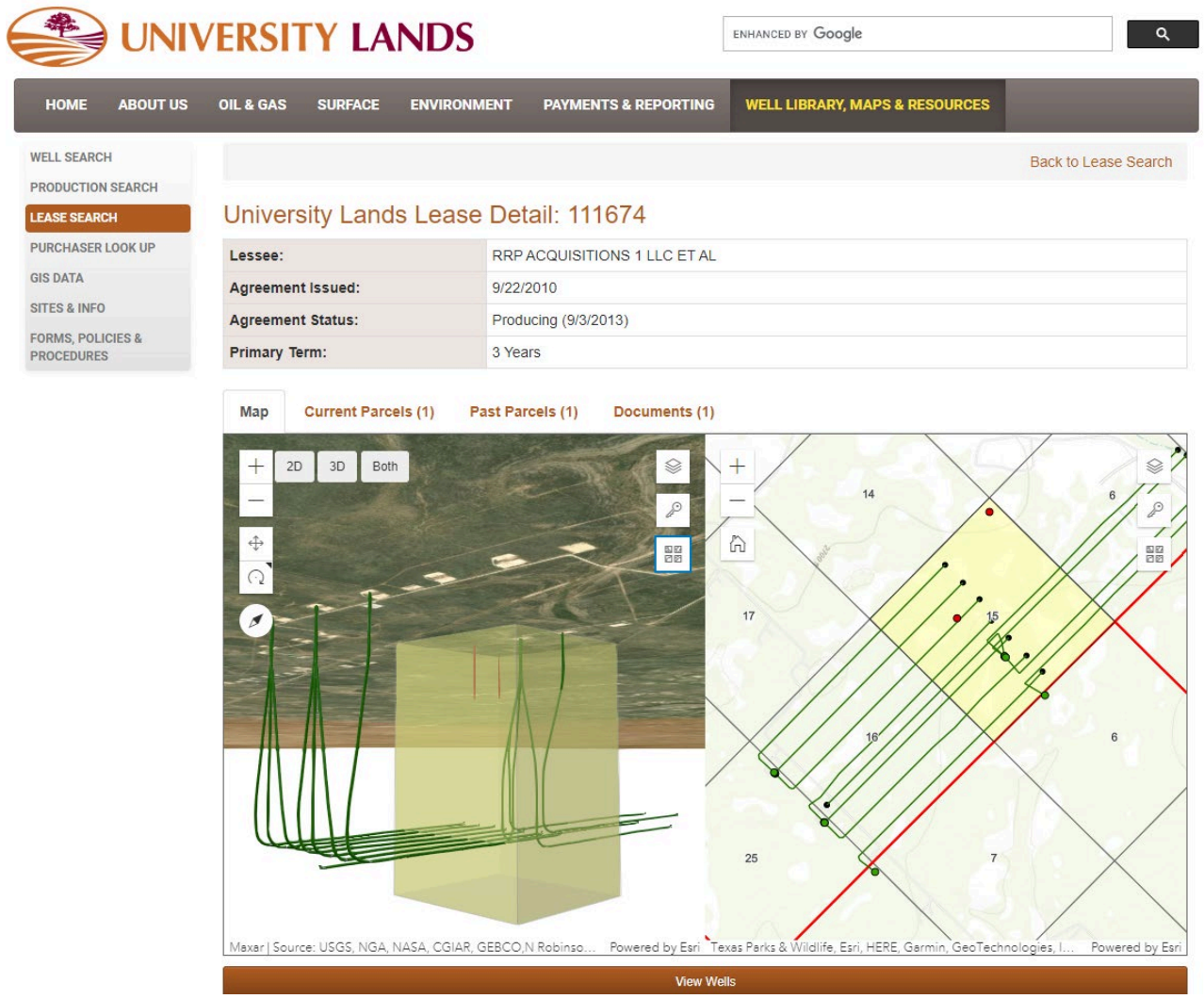
Embedded tools for corrections

Parcel Fabric

Move all lease types into Parcel Fabric model

Land Admin

Embed OG lease editing into web interface



End