U.S. DEPARTMENT OF ENERGY
Fossil Energy and Carbon Management

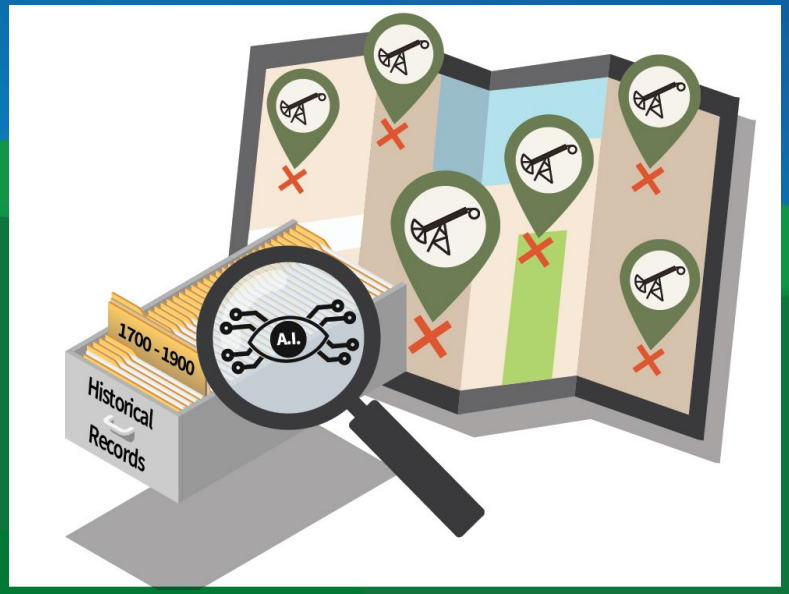
Consortium Advancing Technology for Assessment of Lost Oil & Gas Wells.
CATALOG
Locate Characterize Inform

catalog.energy.gov

Extracting Information from Historic Oil & Gas Regulatory Documents

2024 NETL Resource Sustainability Review Meeting

April 4th, 2024



Project Overview

Consortium Advancing Technology for Assessment of Lost Oil & Gas Wells.

catalog.energy.gov

- FECM Funded: *FWP-1025025*
- Undocumented Orphaned Well Program
- Collaborative effort under CATALOG
  - **WP Leads:** *Greg Lackey (NETL), Dan O'Malley (LANL), David Buttler (LLNL), Dan Gunter (LBNL), Hamilton Link (Sandia)*
- Performance period:
  - Five-year program started at the beginning of fiscal year 2022

BERKELEY LAB

Los Alamos NATIONAL LABORATORY EST. 1943

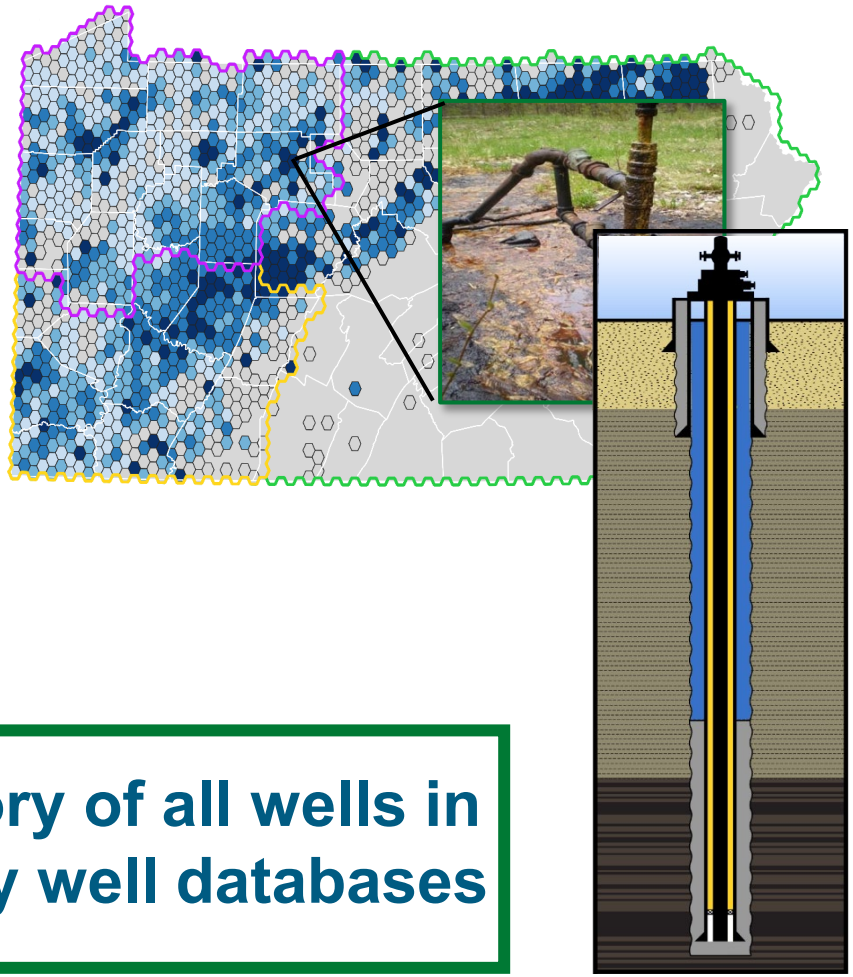
Lawrence Livermore National Laboratory

NATIONAL ENERGY TECHNOLOGY LABORATORY

Sandia National Laboratories

Most Well Information is Not Digital

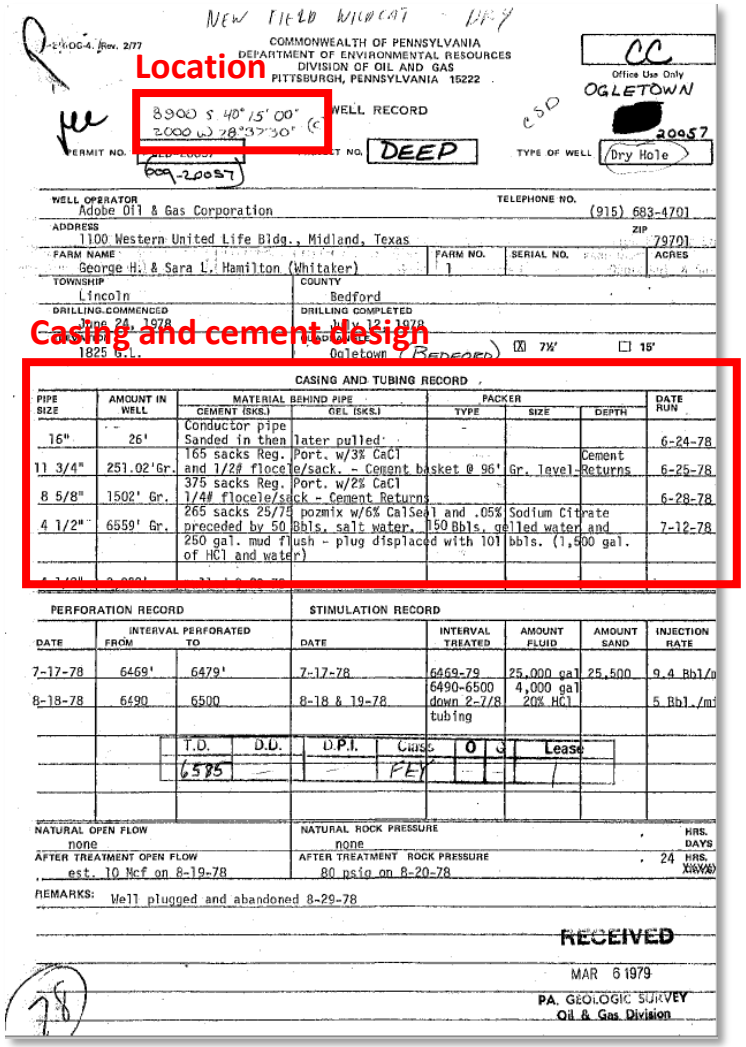
- Obvious lack of information for undocumented orphaned wells (UOWs)
- Limited digital records for documented wells
- Hinders efforts to:
  - Prioritize and plan well plugging operations
  - Identify historic trends and practices
  - Focus characterization efforts



Details describing the construction and use history of all wells in the U.S. missing from most public and proprietary well databases

Well Regulatory Records

- Regulators manage millions of records
- Records document well permitting and construction process
- Many records have been scanned but are not in a machine-readable format



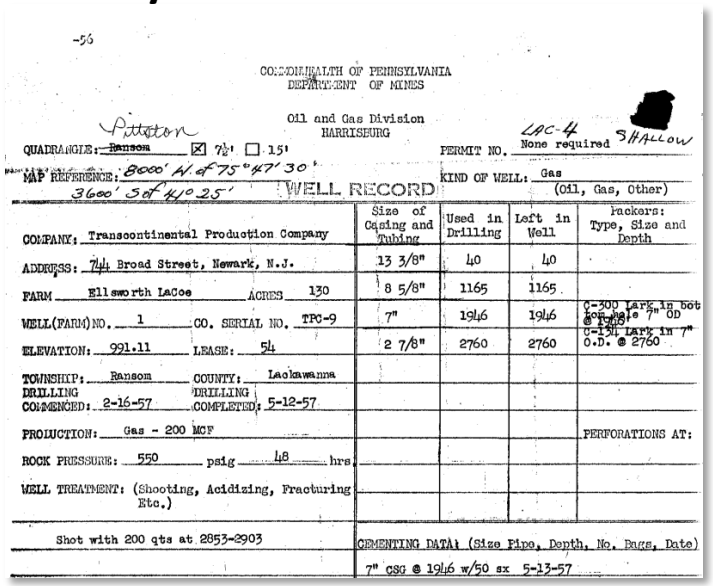
Oil & gas regulatory records contain valuable information about wells that remains "trapped" on scanned forms

Digitizing Well Records

- Quality and format of well regulatory records vary substantially over time and between jurisdictions
- Information contained in each record has generally increased
- Most agencies rely on manual review but would like to digitize all records

There is a critical need to digitize well records for both research and regulatory purposes

Pennsylvania - 1957



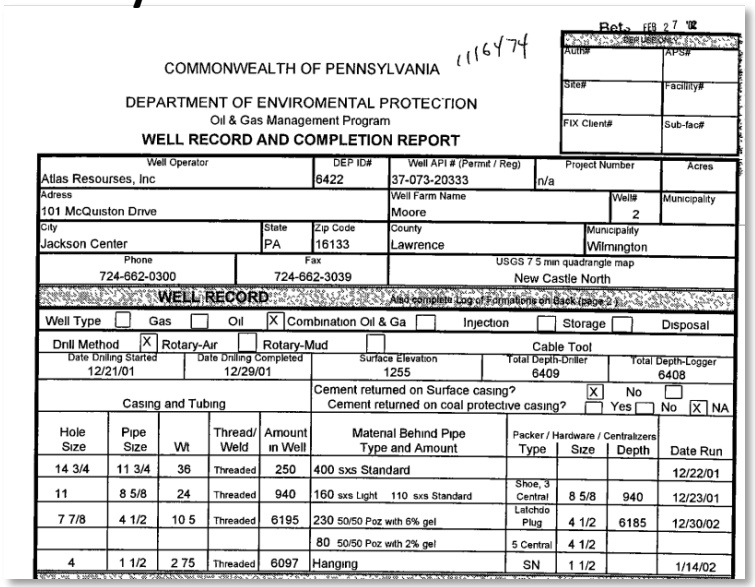
COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF MINES
Oil and Gas Division
HARRISBURG

QUADRANGLE: Ransom ☒ 7½' ☐ 15' — PERMIT NO. LPC-4 None required — SHALLOW
MAP REFERENCE: 8000' N. of 75°47'30" 3600' W. of 41°25' — KIND OF WELL: Gas (Oil, Gas, Other)

WELL RECORD

	Size of Casing and Tubing	Used in Drilling	Left in Well	Packers: Type, Size and Depth
COMPANY: Transcontinental Production Company	13 3/8"	40	40	
ADDRESS: 744 Broad Street, Newark, N.J.	8 5/8"	1165	1165	
FARM Ellsworth LaCoe ACRES 130	7"	1946	1946	C-300 Lark in bot @ 1946
WELL(FARM)NO. 1 CO. SERIAL NO. TPC-9				C-131 Lark in 7" O.D. @ 2760
ELEVATION: 991.11 LEASE: 54	2 7/8"	2760	2760	
TOWNSHIP: Ransom COUNTY: Lackawanna				
DRILLING COMMENCED: 2-16-57 DRILLING COMPLETED: 5-12-57				
PRODUCTION: Gas - 200 MCF				PERFORATIONS AT:
ROCK PRESSURE: 550 psig 48 hrs				
WELL TREATMENT: (Shooting, Acidizing, Fracturing Etc.)				
Shot with 200 qts at 2853-2903	CEMENTING DATA: (Size Pipe, Depth, No. Bags, Date) 7" CSG @ 1946 w/50 sx 5-13-57			

Pennsylvania - 2002



COMMONWEALTH OF PENNSYLVANIA 111674
DEPARTMENT OF ENVIROMENTAL PROTECTION
Oil & Gas Management Program
WELL RECORD AND COMPLETION REPORT

Well Operator	DEP ID#	Well API # (Permit / Reg)	Project Number	Acres
Atlas Resources, Inc	6422	37-073-20333	n/a	

Adress: 101 McQuiston Drive — Well Farm Name: Moore — Well#: 2 — Municipality:
City: Jackson Center — State: PA — Zip Code: 16133 — County: Lawrence — Municipality: Wilmington
Phone: 724-662-0300 — Fax: 724-662-3039 — USGS 7 5 min quadrangle map: New Castle North

WELL RECORD — Also complete Log of Formations on Back (page 2)

Well Type ☐ Gas ☐ Oil ☒ Combination Oil & Ga ☐ Injection ☐ Storage ☐ Disposal
Drill Method ☒ Rotary-Air ☐ Rotary-Mud ☐ Cable Tool

Date Drilling Started	Date Drilling Completed	Surface Elevation	Total Depth-Driller	Total Depth-Logger
12/21/01	12/29/01	1255	6409	6408

Casing and Tubing — Cement returned on Surface casing? ☒ No ☐ — Cement returned on coal protective casing? ☐ Yes ☐ No ☒ NA

Hole Size	Pipe Size	Wt	Thread/ Weld	Amount in Well	Material Behind Pipe Type and Amount	Packer / Hardware / Centralizers Type	Size	Depth	Date Run
14 3/4	11 3/4	36	Threaded	250	400 sxs Standard				12/22/01
11	8 5/8	24	Threaded	940	160 sxs Light 110 sxs Standard	Shoe, 3 Central	8 5/8	940	12/23/01
7 7/8	4 1/2	10 5	Threaded	6195	230 50/50 Poz with 6% gel	Latchdo Plug	4 1/2	6185	12/30/02
					80 50/50 Poz with 2% gel	5 Central	4 1/2		
4	1 1/2	2 75	Threaded	6097	Hanging	SN	1 1/2		1/14/02

Technological Solutions Exist

- **Optical Character Recognition (OCR)**
  - Algorithmic conversion of text into machine readable format
- **Large Language Models (LLMs)**
  - Neural networks trained on large volumes of text that can summarize and answer questions about documents
- Numerous public and proprietary tools available
- Performance relies on specific training

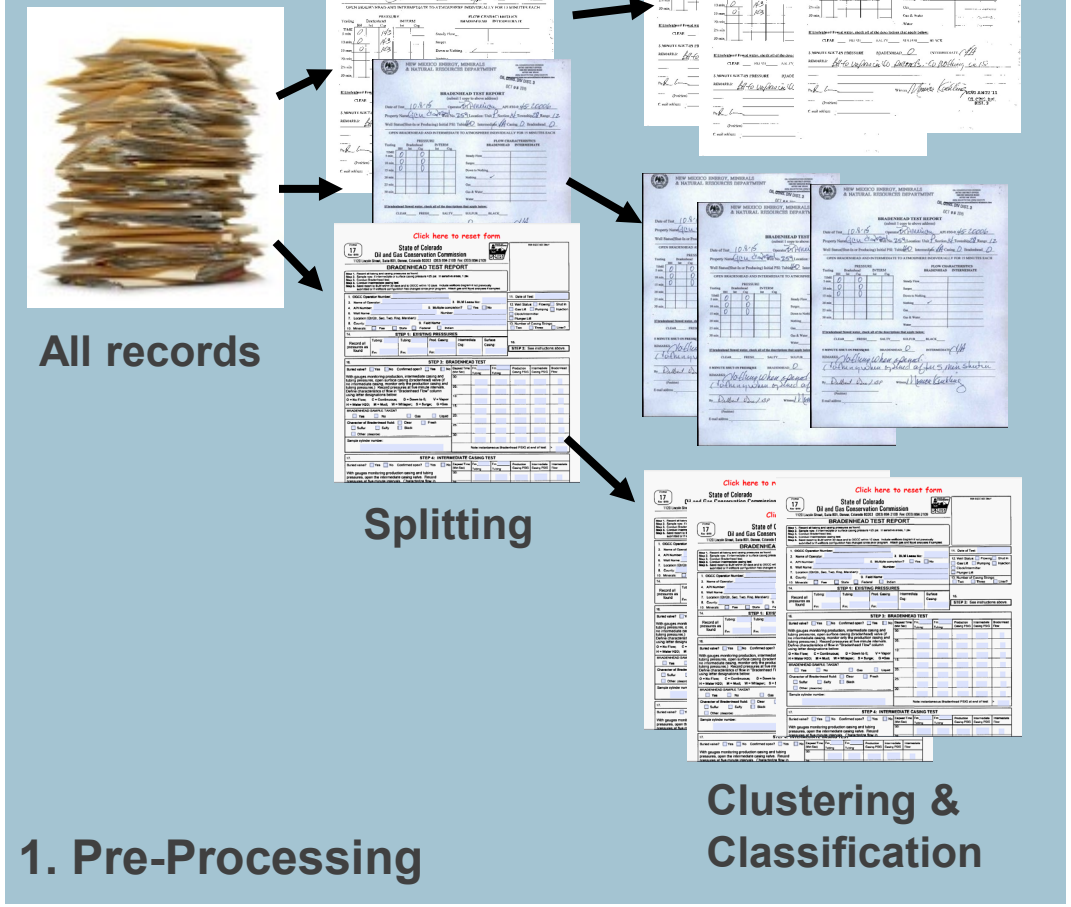
OCR and LLM approaches can reliably digitize information from well records but need to be trained for specific purpose

Project Goals

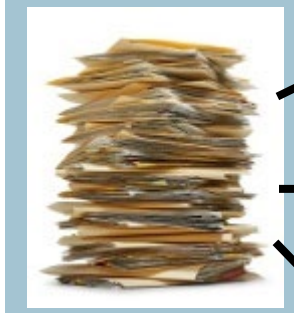
1. Design custom **OCR** and **LLM** approaches for extracting data from oil and gas regulatory records
2. Build a platform that allows users to leverage OCR and LLM models for rapid data extraction from records

Team will deliver a working tool prototype and summary report in the first year

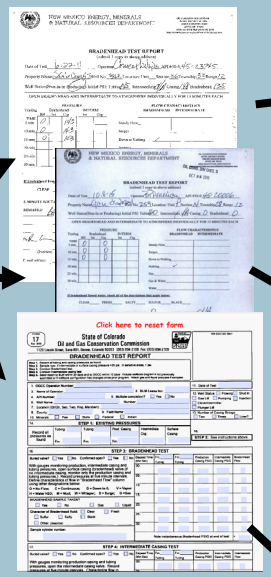
Workflow


All records
Splitting
Clustering &
Classification
1. Pre-Processing

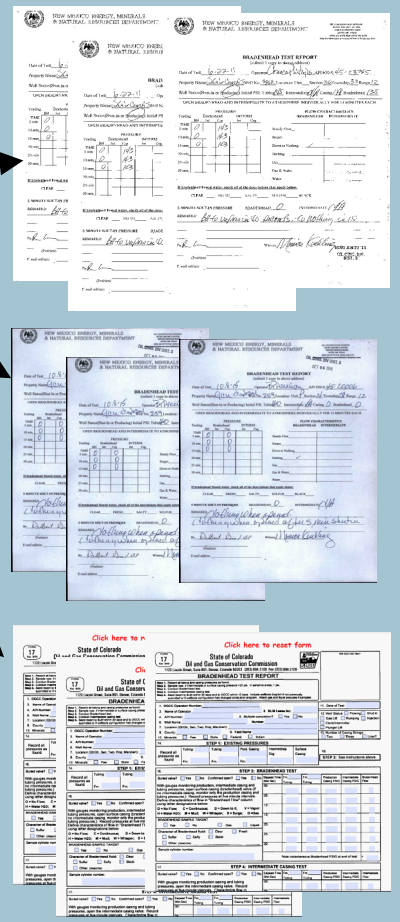
Workflow



All records

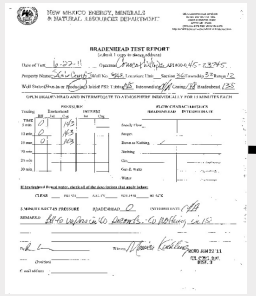


Splitting

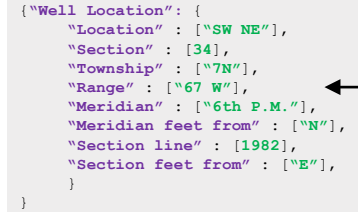


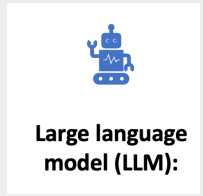
Clustering & Classification

1. Pre-Processing

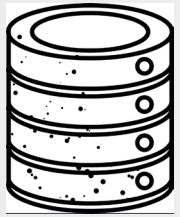


OCR text





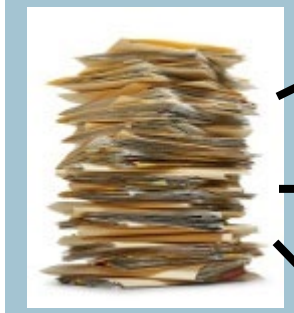
Interpret text & identify fields



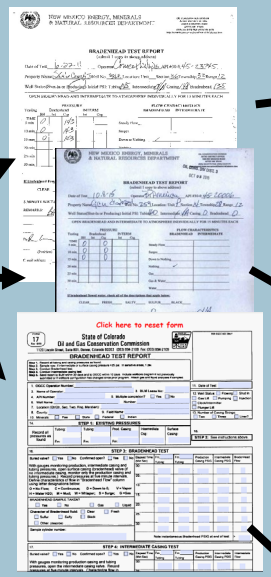
Store in database

2. Data extraction

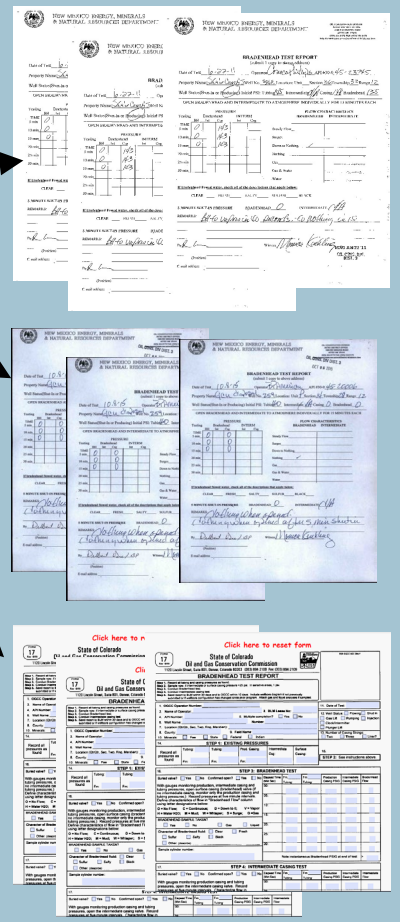
Workflow



All records



Splitting



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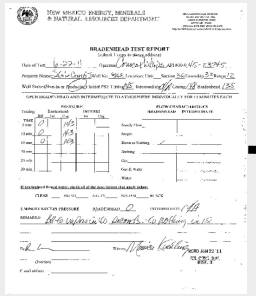
1. Pre-Processing

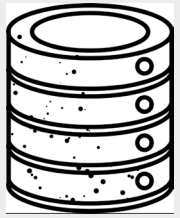


OCR text

```
{"Well Location": {
     "Location" : ["SW NE"],
     "Section" : [34],
     "Township" : ["7N"],
     "Range" : ["67 W"],
     "Meridian" : ["6th P.M."],
     "Meridian feet from" : ["N"],
     "Section line" : [1982],
     "Section feet from" : ["E"],
     }
}
```

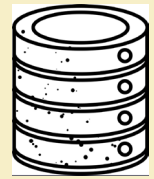
Large language model (LLM):

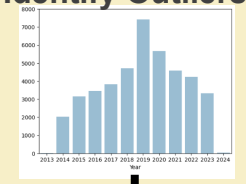
Interpret text & identify fields



Store in database

2. Data extraction

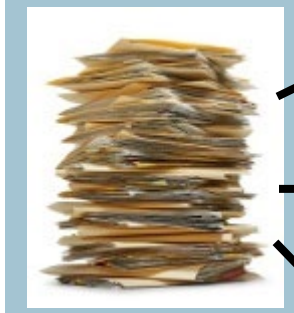




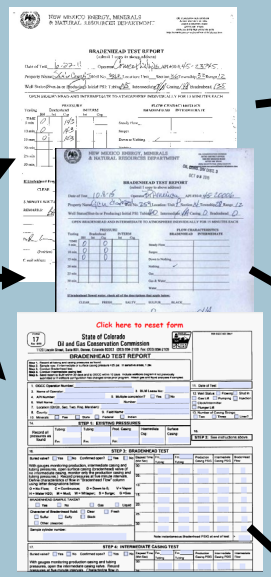
Human Review & edit

3. Validation

Workflow



All records



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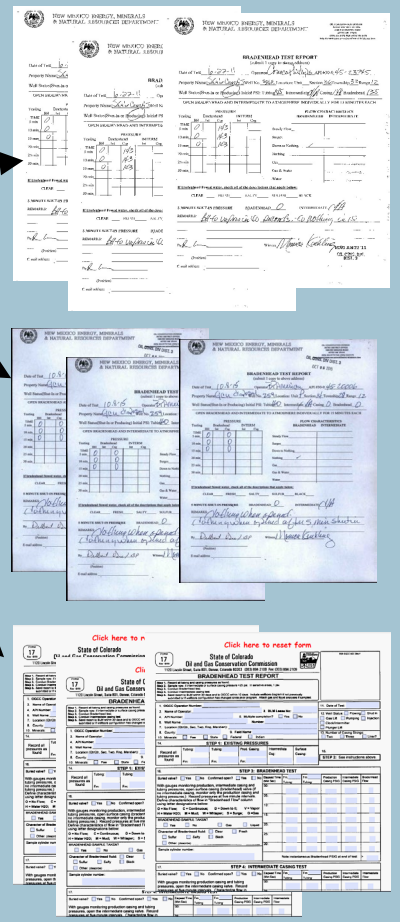

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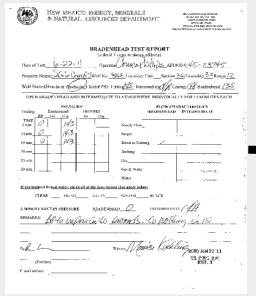

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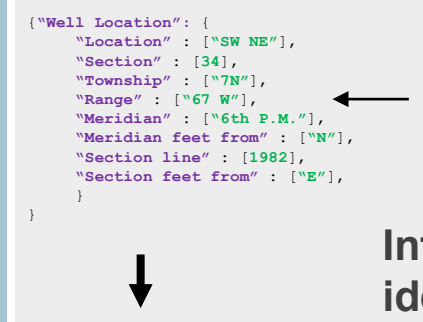

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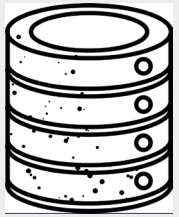
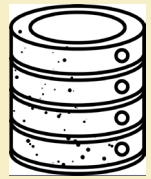
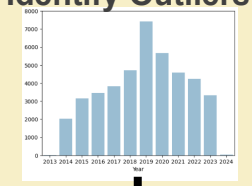


Store in database

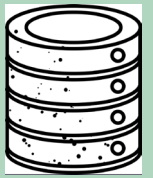
2. Data extraction

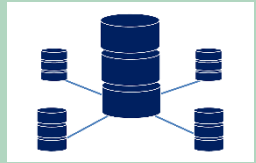




Human Review & edit

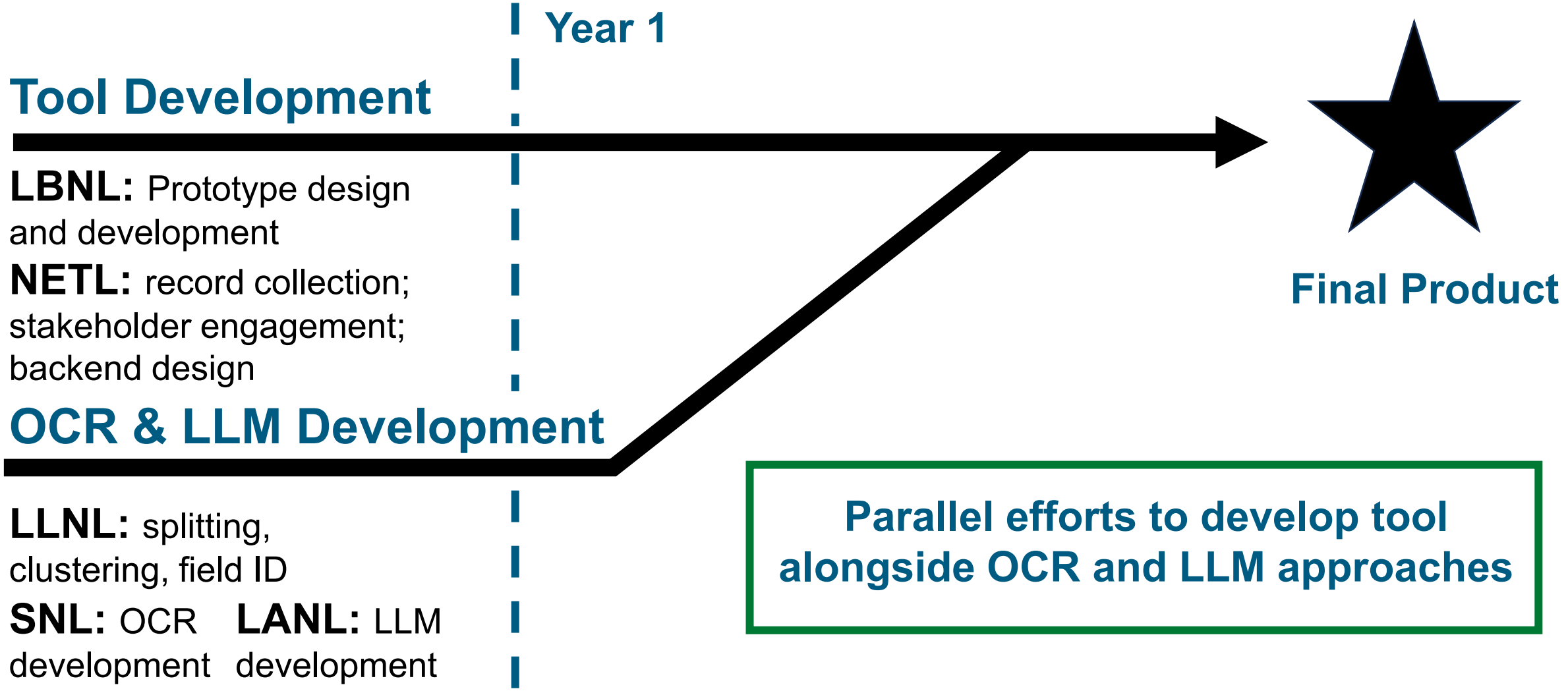
3. Validation





4. Export

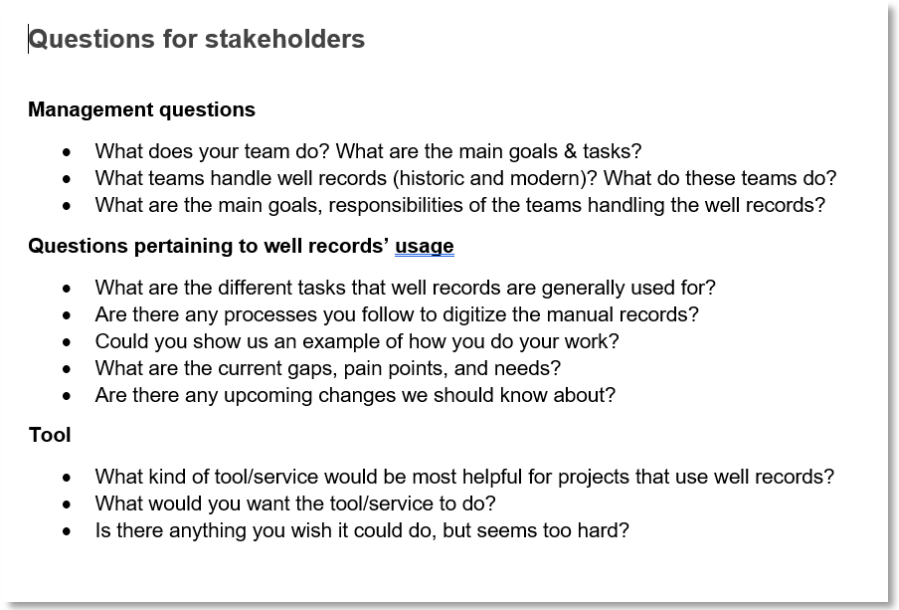
Development Approach



Parallel efforts to develop tool alongside OCR and LLM approaches

Record Collection & Stakeholder Engagement

- Gathered ~440K well records from four states (CA, CO, PA, NM, OK)
- Interviewed prospective users from:
  - Five oil & gas regulatory agencies
  - Three research institutions
  - One oil & gas major
- Documented feedback for tool development



Questions for stakeholders

Management questions

- What does your team do? What are the main goals & tasks?
- What teams handle well records (historic and modern)? What do these teams do?
- What are the main goals, responsibilities of the teams handling the well records?

Questions pertaining to well records' usage

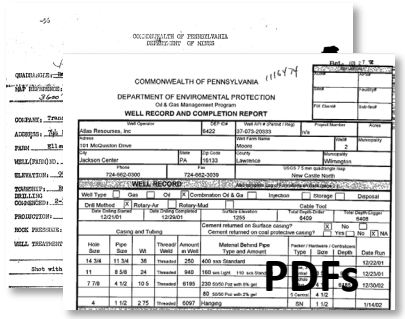
- What are the different tasks that well records are generally used for?
- Are there any processes you follow to digitize the manual records?
- Could you show us an example of how you do your work?
- What are the current gaps, pain points, and needs?
- Are there any upcoming changes we should know about?

Tool

- What kind of tool/service would be most helpful for projects that use well records?
- What would you want the tool/service to do?
- Is there anything you wish it could do, but seems too hard?

Records sufficient for tool development gathered and key partnerships established

Form Splitting and Clustering Approach



PDF2Image

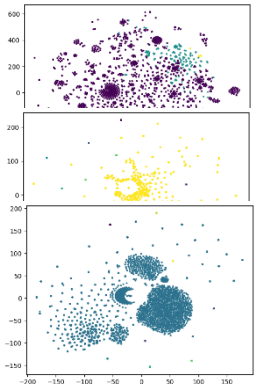
PNG

OCR

Document JSON

LayoutLMv3

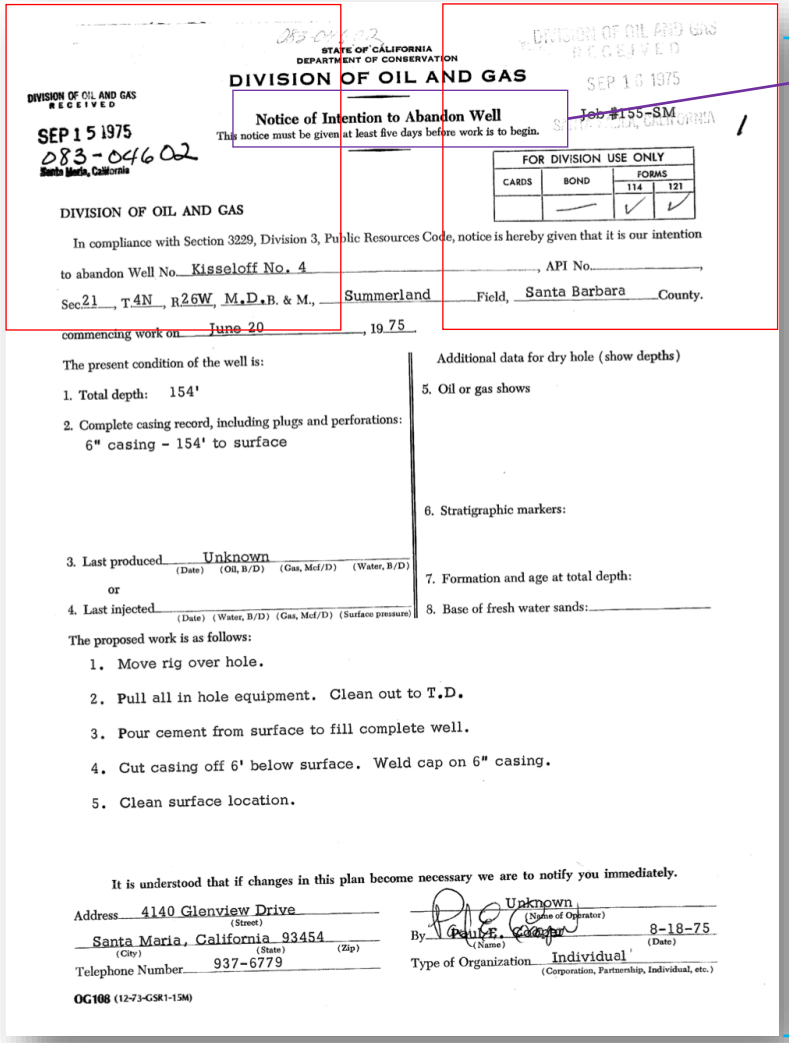
Form Classifier



Grouped JSON forms

- State
- Year
- Type
- ‘Era’

Form Classifier Combines Multiple Embeddings



STATE OF CALIFORNIA
DEPARTMENT OF CONSERVATION
DIVISION OF OIL AND GAS

DIVISION OF OIL AND GAS RECEIVED
SEP 15 1975
083-04602
Santa Maria, California

DIVISION OF OIL AND GAS RECEIVED
SEP 16 1975
SANTA MARIA, CALIFORNIA

Notice of Intention to Abandon Well
This notice must be given at least five days before work is to begin.

Job #155-SM

FOR DIVISION USE ONLY			
CARDS	BOND	FORMS 114	FORMS 121
	—	✓	✓

DIVISION OF OIL AND GAS

In compliance with Section 3229, Division 3, Public Resources Code, notice is hereby given that it is our intention to abandon Well No. Kisseloff No. 4, API No. ____,
Sec. 21, T. 4N, R. 26W, M.D.B. & M., Summerland Field, Santa Barbara County.
commencing work on June 20, 19 75.

The present condition of the well is:

1. Total depth: 154'
2. Complete casing record, including plugs and perforations:
   6" casing - 154' to surface
3. Last produced ____ (Date) ____ (Oil, B/D) ____ (Gas, Mcf/D) ____ (Water, B/D)
   or
4. Last injected ____ (Date) ____ (Water, B/D) ____ (Gas, Mcf/D) ____ (Surface pressure)

Additional data for dry hole (show depths)

5. Oil or gas shows
6. Stratigraphic markers:
7. Formation and age at total depth:
8. Base of fresh water sands:

The proposed work is as follows:

1. Move rig over hole.
2. Pull all in hole equipment. Clean out to T.D.
3. Pour cement from surface to fill complete well.
4. Cut casing off 6' below surface. Weld cap on 6" casing.
5. Clean surface location.

It is understood that if changes in this plan become necessary we are to notify you immediately.

Address 4140 Glenview Drive (Street)
Santa Maria, California 93454 (City) (State) (Zip)
Telephone Number 937-6779

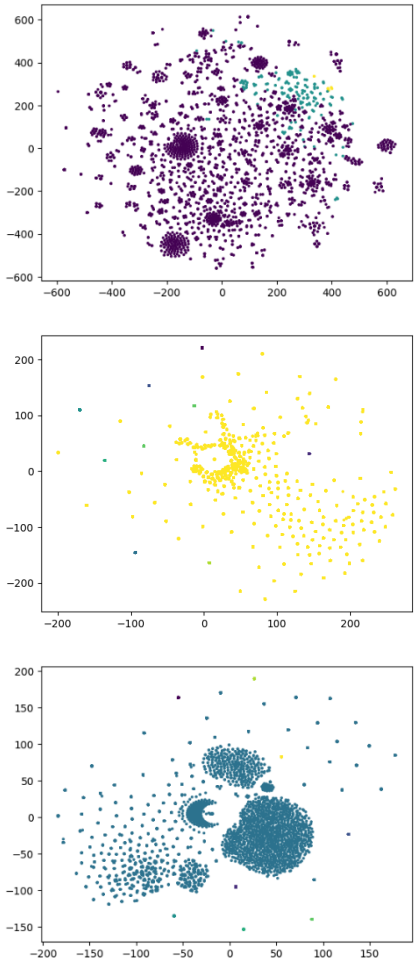
Unknown (Name of Operator)
By Paul B. Cooper (Name) 8-18-75 (Date)
Type of Organization Individual (Corporation, Partnership, Individual, etc.)

OG108 (12-73-GSR1-15M)

Title embedding

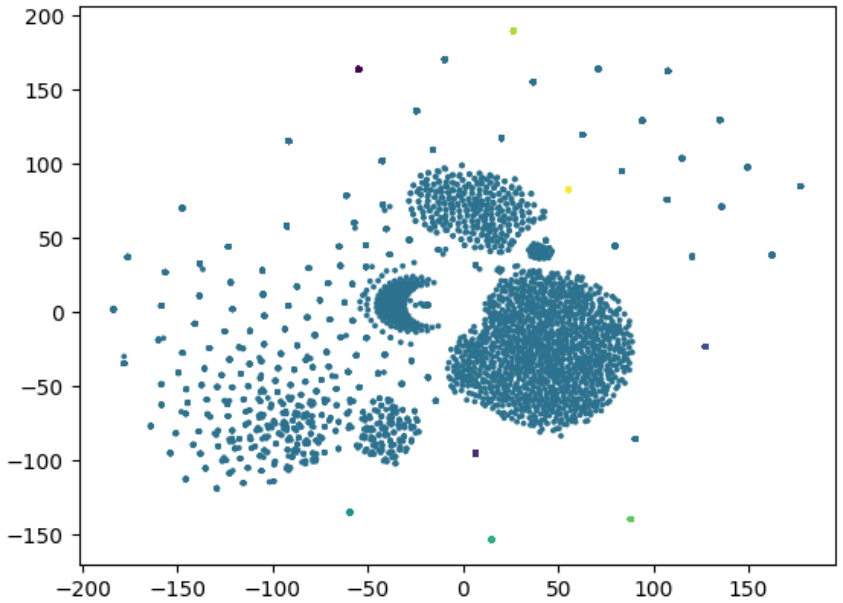
Image patch embedding

OCR embedding

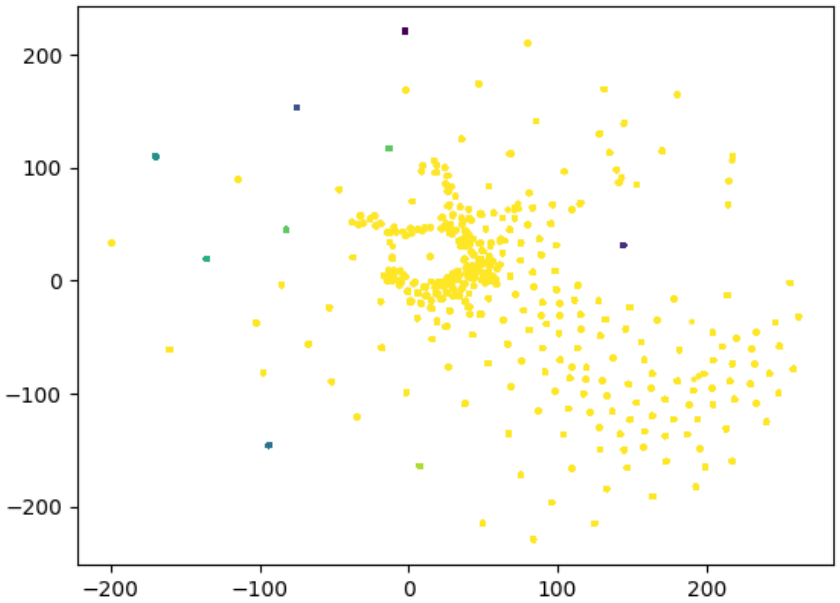


Classify forms by type, and era
Focus data extraction on similar forms

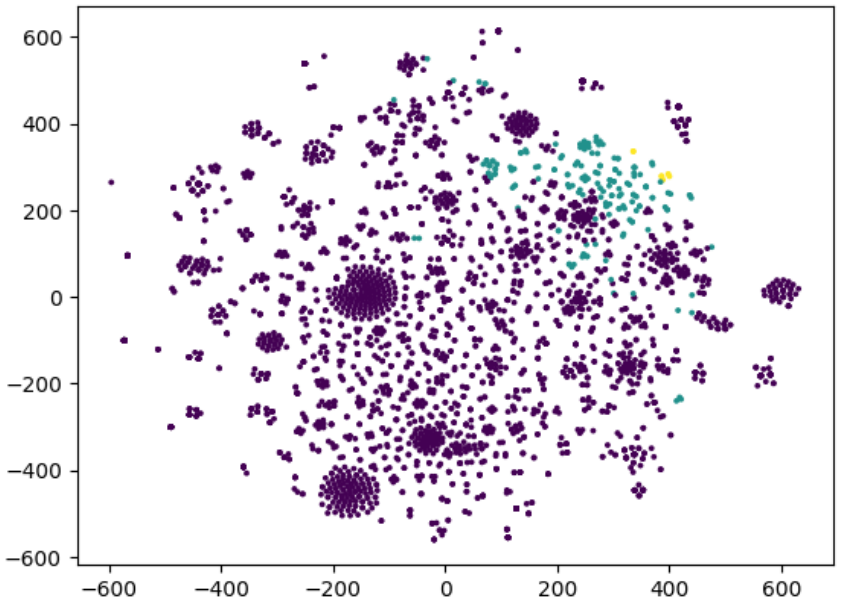
Clustering Embeddings Shows Clear Separation Across States



PA



CO



CA

Clustering embeddings show clear separation across states

Large Language Modeling Approach

Large language model (LLM):

- **DocQuery**[1], developed/fine-tuned by Impira
- Based on Microsoft's LayoutLM model
- Used two dataset, i.e., SQuAD2.0 and DocVQA
- Document Query Engine Powered LLMs
- Able to analyze semi-structured and unstructured documents (PDFs, scanned images, etc.)
- Zero-shot learning (no-training is used for this task at the current stage)

Historical documents

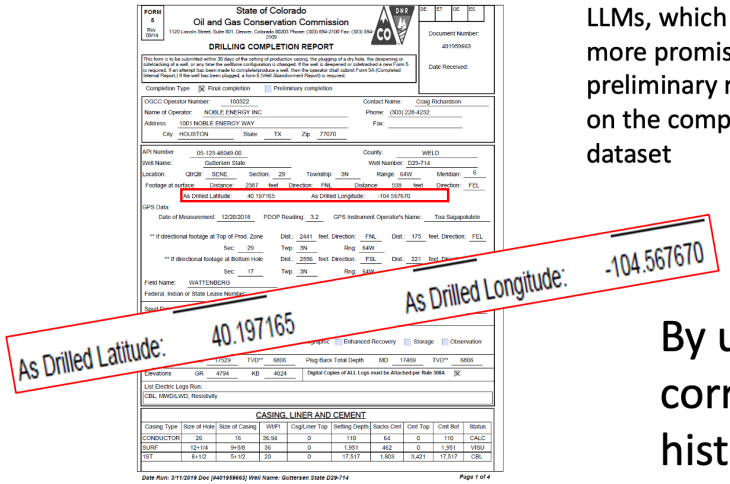
- 150 Drilling Completion Reports from Colorado
- Text-based PDFs
- Information of well location, depth, etc.

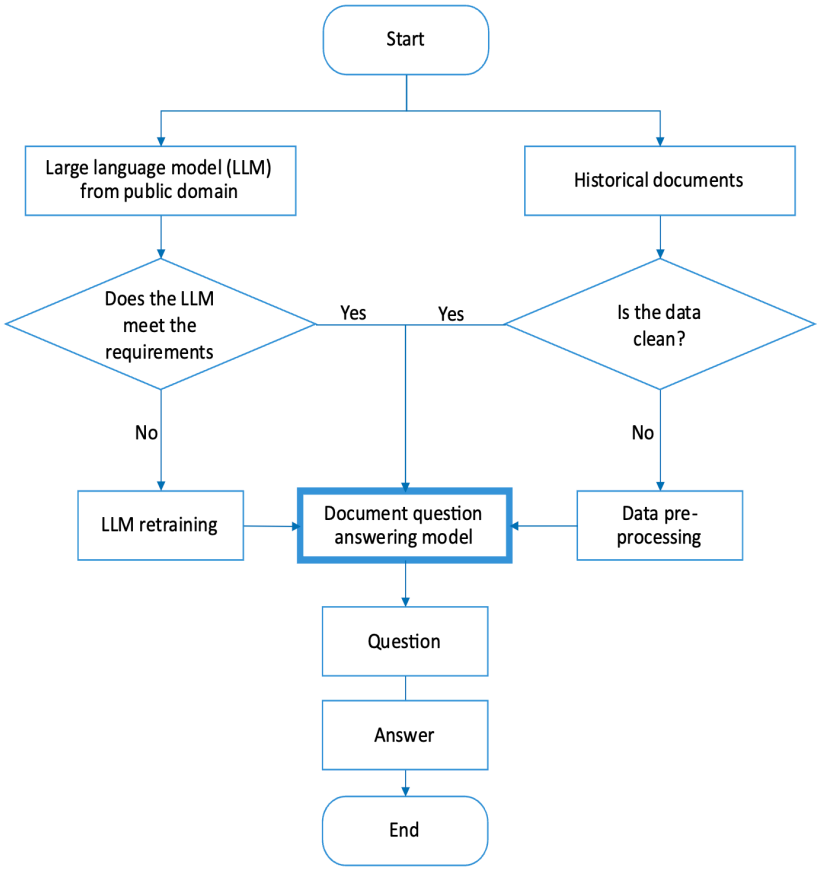
Model performance:

- Extraction time: within two seconds per document
- Accuracy: **100%** on a simple dataset
- Struggles with a more complex dataset

Future direction:

- Generate our own dataset for with questions and answers based on historical documents
- Fine-tuning LLM models
- Use more powerful LLMs, which show more promising preliminary results on the complex dataset

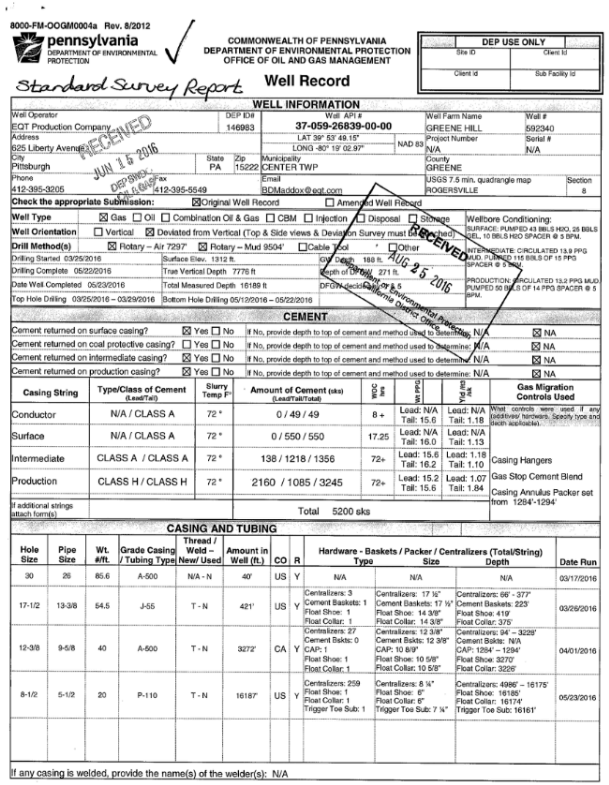




By using Large Language Models, we can obtain correct well location information from historical documents

[1] https://github.com/impira/docquery

Large Language Modeling Results



8000-FM-OOGM0004a Rev. 8/2012

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
OFFICE OF OIL AND GAS MANAGEMENT

DEP USE ONLY

Standard Survey Report

Well Record

WELL INFORMATION

Well Operator	DEP ID#	Well API #	Well Farm Name	Well #
EQT Production Company	146983	37-059-26839-00-00	GREENE HILL	592340

Address: 625 Liberty Avenue
City: Pittsburgh | State: PA | Zip: 15222
Phone: 412-395-3205 | Fax: 412-395-5549
Municipality: CENTER TWP
County: GREENE
Email: BDMaddox@eqt.com
USGS 7.5 min. quadrangle map: ROGERSVILLE | Section: 8
LAT 39° 53' 49.15" LONG -80° 19' 02.97" NAD 83 | Project Number: N/A | Serial #: N/A

Check the appropriate Submission: ☒ Original Well Record ☐ Amended Well Record

Well Type: ☒ Gas ☐ Oil ☐ Combination Oil & Gas ☐ CBM ☐ Injection ☐ Disposal ☐ Storage
Well Orientation: ☐ Vertical ☒ Deviated from Vertical (Top & Side views & Deviation Survey must be attached)
Drill Method(s): ☒ Rotary – Air 7297' ☒ Rotary – Mud 9504' ☐ Cable ☐ Cool ☐ Other
Drilling Started 03/25/2016 | Surface Elev. 1312 ft.
Drilling Complete 05/22/2016 | True Vertical Depth 7776 ft
Date Well Completed 05/23/2016 | Total Measured Depth 16189 ft
Top Hole Drilling 03/25/2016 – 03/29/2016 | Bottom Hole Drilling 05/12/2016 – 05/22/2016
Gyro Depth: 180 ft. | Depth of Conductor: 271 ft.
DFDN check all that apply: ☒ 8.5
Welltore Conditioning: SURFACE: PUMPED 43 BBLS H2O, 25 BBLS GEL, 10 BBLS H2O SPACER @ 5 BPM. INTERMEDIATE: CIRCULATED 13.9 PPG MUD, PUMPED 115 BBLS OF 15 PPG SPACER @ 5 BPM. PRODUCTION: CIRCULATED 13.2 PPG MUD PUMPED 50 BBLS OF 14 PPG SPACER @ 5 BPM.

RECEIVED JUN 15 2016 DEP BWSC REGION 3
RECEIVED AUG 25 2016 Department of Environmental Protection Southcentral Regional Office Oil & Gas

CEMENT

Cement returned on surface casing?	☒ Yes ☐ No	If No, provide depth to top of cement and method used to determine: N/A ☒ NA
Cement returned on coal protective casing?	☐ Yes ☐ No	If No, provide depth to top of cement and method used to determine: N/A ☒ NA
Cement returned on intermediate casing?	☒ Yes ☐ No	If No, provide depth to top of cement and method used to determine: N/A ☒ NA
Cement returned on production casing?	☒ Yes ☐ No	If No, provide depth to top of cement and method used to determine: N/A ☒ NA

Casing String	Type/Class of Cement (Lead/Tail)	Slurry Temp F°	Amount of Cement (sks) (Lead/Tail/Total)	WOC hrs	Slurry Wt. (ppg) Lead	Slurry Wt. (ppg) Tail	Gas Migration Controls Used (What controls were used, if any (additives/ hardware). Specify type and depth applicable)
Conductor	N/A / CLASS A	72 °	0 / 49 / 49	8 +	Lead: N/A Tail: 15.6	Lead: N/A Tail: 1.18	
Surface	N/A / CLASS A	72 °	0 / 550 / 550	17.25	Lead: N/A Tail: 16.0	Lead: N/A Tail: 1.13	
Intermediate	CLASS A / CLASS A	72 °	138 / 1218 / 1356	72+	Lead: 15.6 Tail: 16.2	Lead: 1.18 Tail: 1.10	Casing Hangers
Production	CLASS H / CLASS H	72 °	2160 / 1085 / 3245	72+	Lead: 15.2 Tail: 15.6	Lead: 1.07 Tail: 1.84	Gas Stop Cement Blend Casing Annulus Packer set from 1284'-1294'
If additional strings attach form(s)			Total 5200 sks				

CASING AND TUBING

Hole Size	Pipe Size	Wt. #/ft.	Grade Casing / Tubing Type	Thread / Weld – New/ Used	Amount in Well (ft.)	CO	R	Hardware - Baskets / Packer / Centralizers (Total/String) Type	Size	Depth	Date Run
30	26	85.6	A-500	N/A - N	40'	US	Y	N/A	N/A	N/A	03/17/2016
17-1/2	13-3/8	54.5	J-55	T - N	421'	US	Y	Centralizers: 3 Cement Baskets: 1 Float Shoe: 1 Float Collar: 1	Centralizers: 17 ½" Cement Baskets: 17 ½" Float Shoe: 14 3/8" Float Collar: 14 3/8"	Centralizers: 66' - 377' Cement Baskets: 223' Float Shoe: 419' Float Collar: 375'	03/26/2016
12-3/8	9-5/8	40	A-500	T - N	3272'	CA	Y	Centralizers: 27 Cement Bskts: 0 CAP: 1 Float Shoe: 1 Float Collar: 1	Centralizers: 12 3/8" Cement Bskts: 12 3/8" CAP: 10 8/9" Float Shoe: 10 5/8" Float Collar: 10 5/8"	Centralizers: 94' – 3229' Cement Bskts: N/A CAP: 1284' – 1294' Float Shoe: 3270' Float Collar: 3226'	04/01/2016
8-1/2	5-1/2	20	P-110	T - N	16187'	US	Y	Centralizers: 259 Float Shoe: 1 Float Collar: 1 Trigger Toe Sub: 1	Centralizers: 8 ¾" Float Shoe: 6" Float Collar: 6" Trigger Toe Sub: 7 ¾"	Centralizers: 4986' – 16175' Float Shoe: 16185' Float Collar: 16174' Trigger Toe Sub: 16161'	05/23/2016

If any casing is welded, provide the name(s) of the welder(s): N/A

- 1 -

1. Document image

OCR

2. Semi-structured text

```
8000-FM-OOGM0004a Rev. 8/2012
pennsylvania
DEPARTMENT OF ENVIRONMENTAL PI
COMMONWEALTH OF PENNSYLVANIA I
Standard Survey Report
Well Operator
EQT Production Company
Address
RECEI
625 Liberty Avenue.
City
Pittsburgh
Phone
412-395-3205
JUN 15 2016
DEP ID#
146983
Well Record
WELL INFORMATION
Well API # 37-059-26839-00-00
Site ID
Client Id
DEP USE ONLY
Client Id
Sub Facility Id
Well Farm Name
Well #
LAT 39° 53' 49.15"
LONG -80° 19' 02.97"
GREENE HILL Project Number
```

LLM

3. Structured Well Information

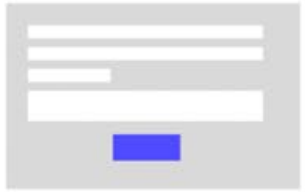
```
{ "latitude": 39.896986
  "longitude": -80.3174
  "depth": 7776}
```

Early success extracting well information using OCR and LLMs; Manuscript drafted

Validation and verification will be critical to this effort

Tool Prototype

New project



Upload records

Digitized records

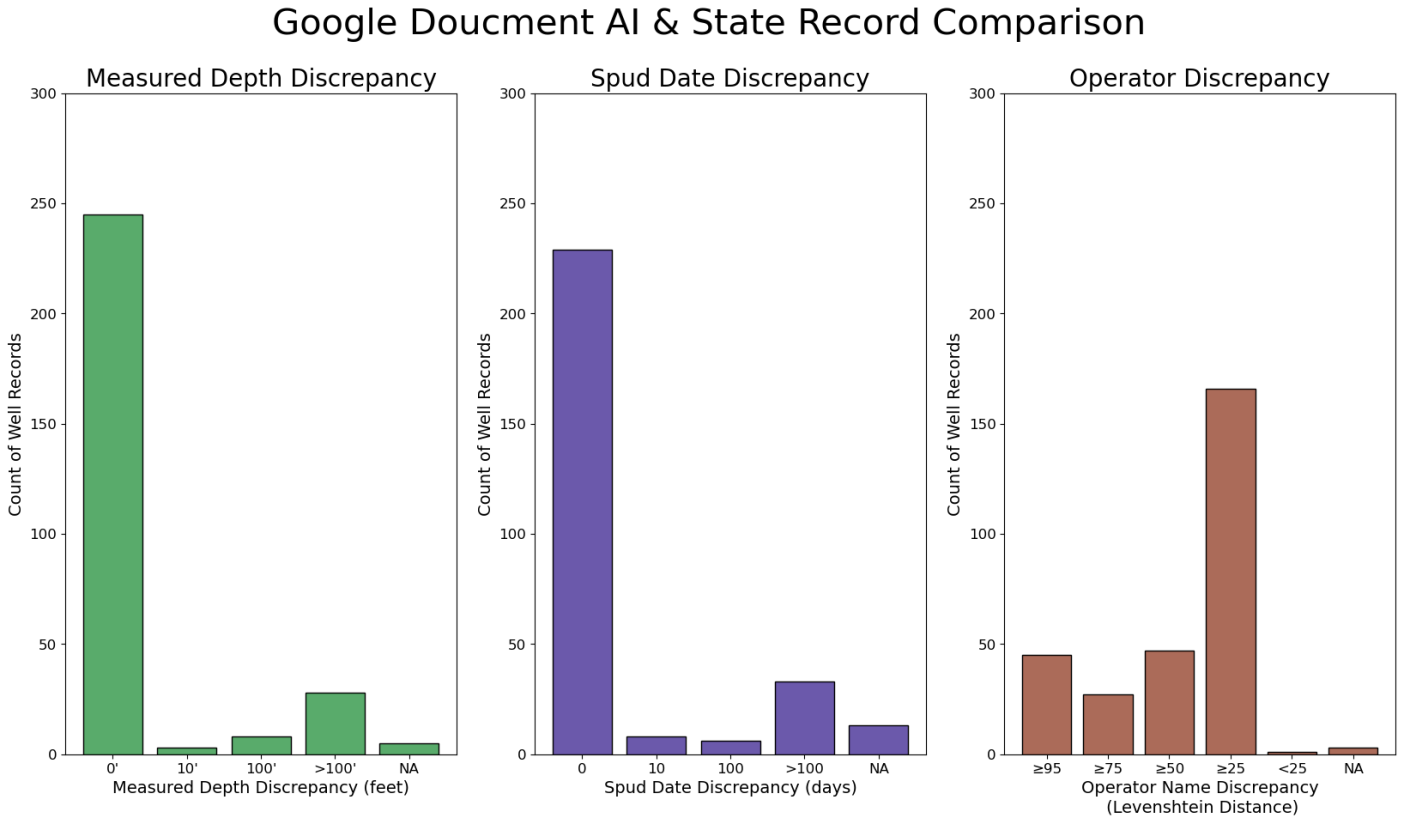
Review & edit

Export records

Google Document AI Case Study

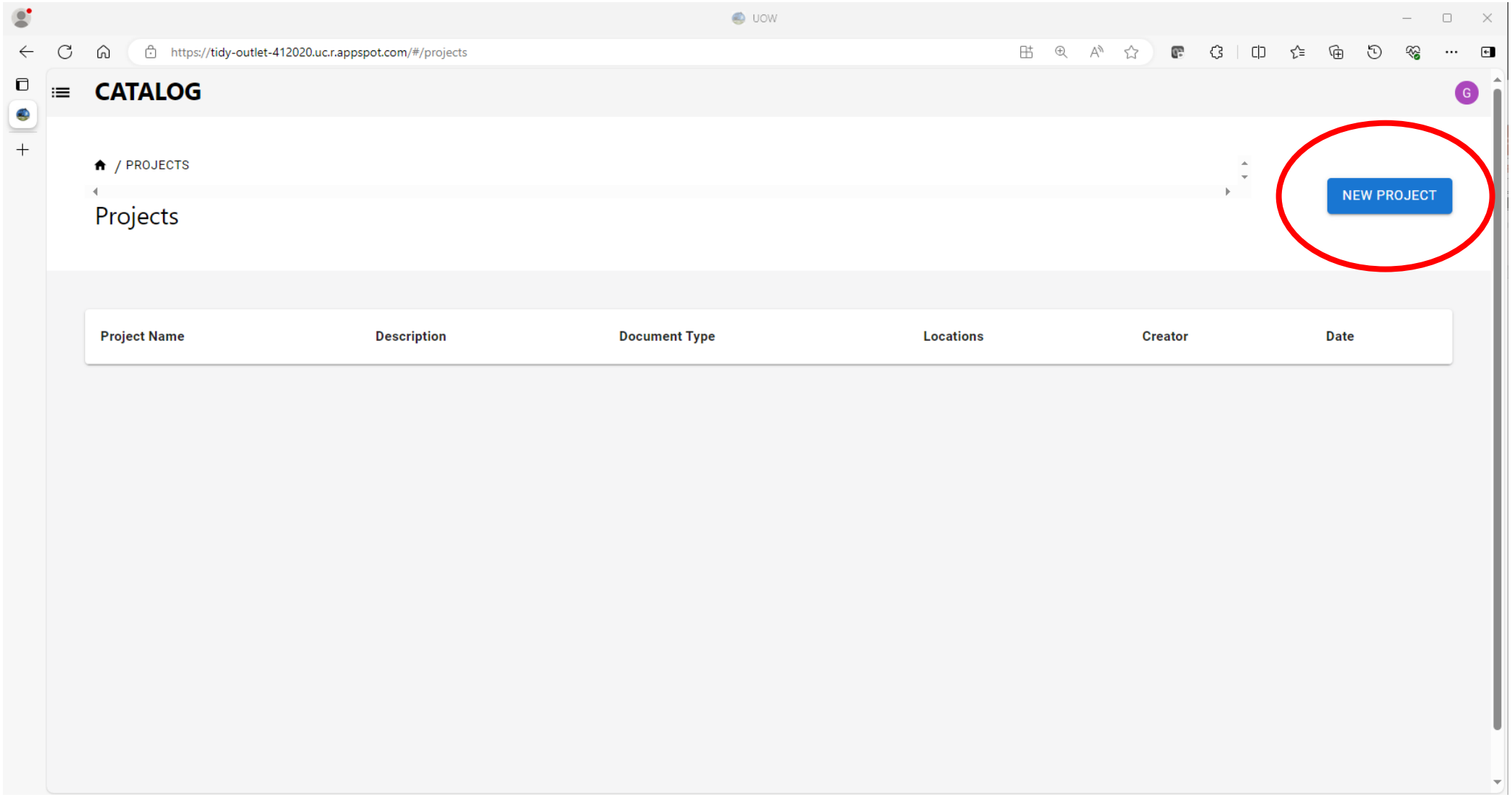
1. Selected 165 CO completion reports (115 training, 50 test)
2. Trained to extract Operator Name, Spud-Date and Measured Depth
3. Google Reported Metrics:
   - **F1:** 0.905 **Precision:** 92.1% **Recall:** 89%
4. Selected Another 289 reports separate from above 165
   - Performed custom analysis post Google Document AI processing
   - Compared Doc AI results vs state database records

Case Study Results



Google Doc AI results matched database ~90% of time for depth and spud date

Tool Prototype Demo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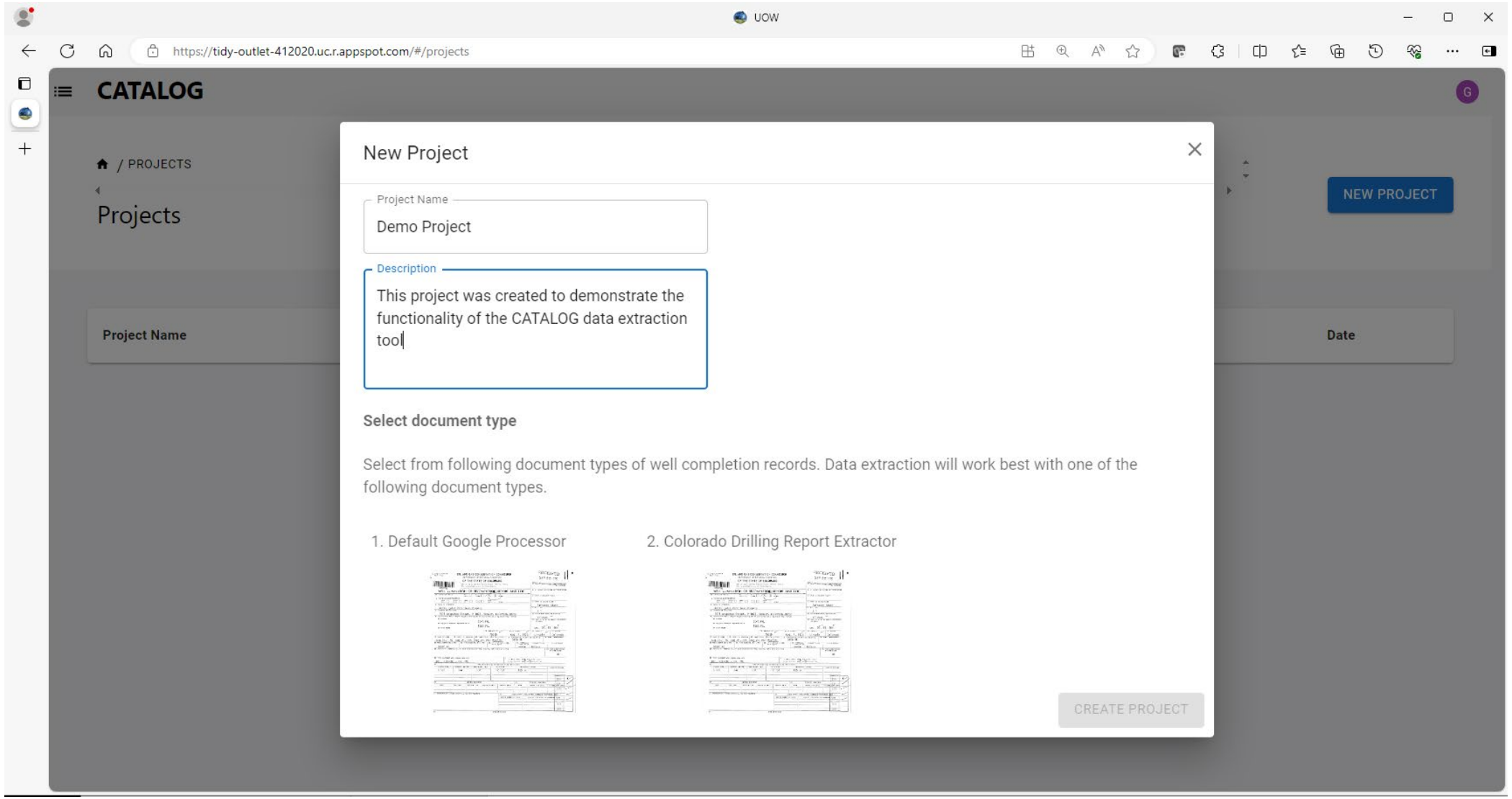
/ PROJECTS
Projects
NEW PROJECT
Project Name
Description
Document Type
Locations
Creator
Date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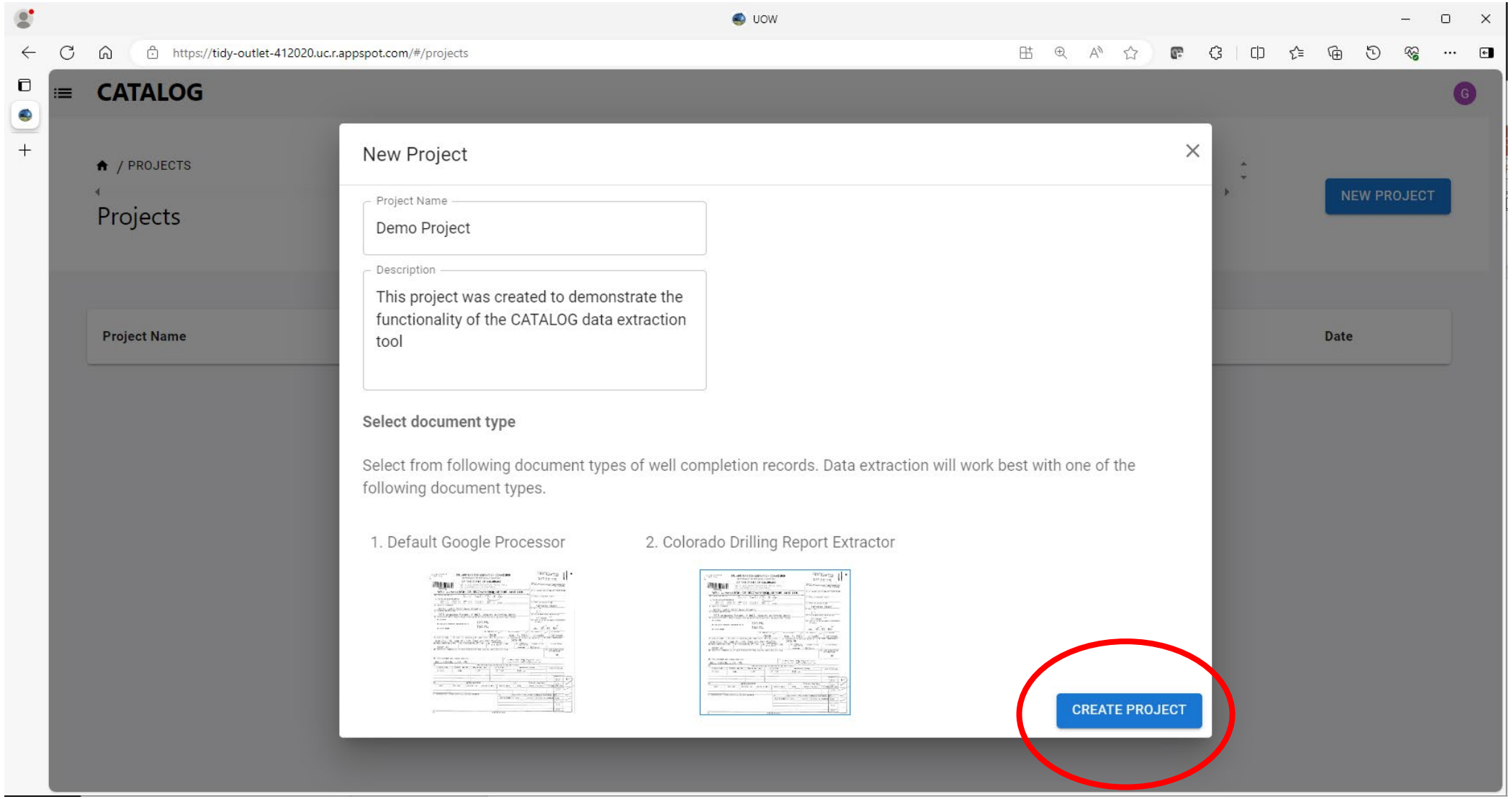
CATALOG
/ PROJECTS
Projects
NEW PROJECT
Project Name
Date
New Project
Project Name
Demo Project
Description
This project was created to demonstrate the functionality of the CATALOG data extraction tool
Select document type
Select from following document types of well completion records. Data extraction will work best with one of the following document types.
1. Default Google Processor
2. Colorado Drilling Report Extractor
CREATE PROJECT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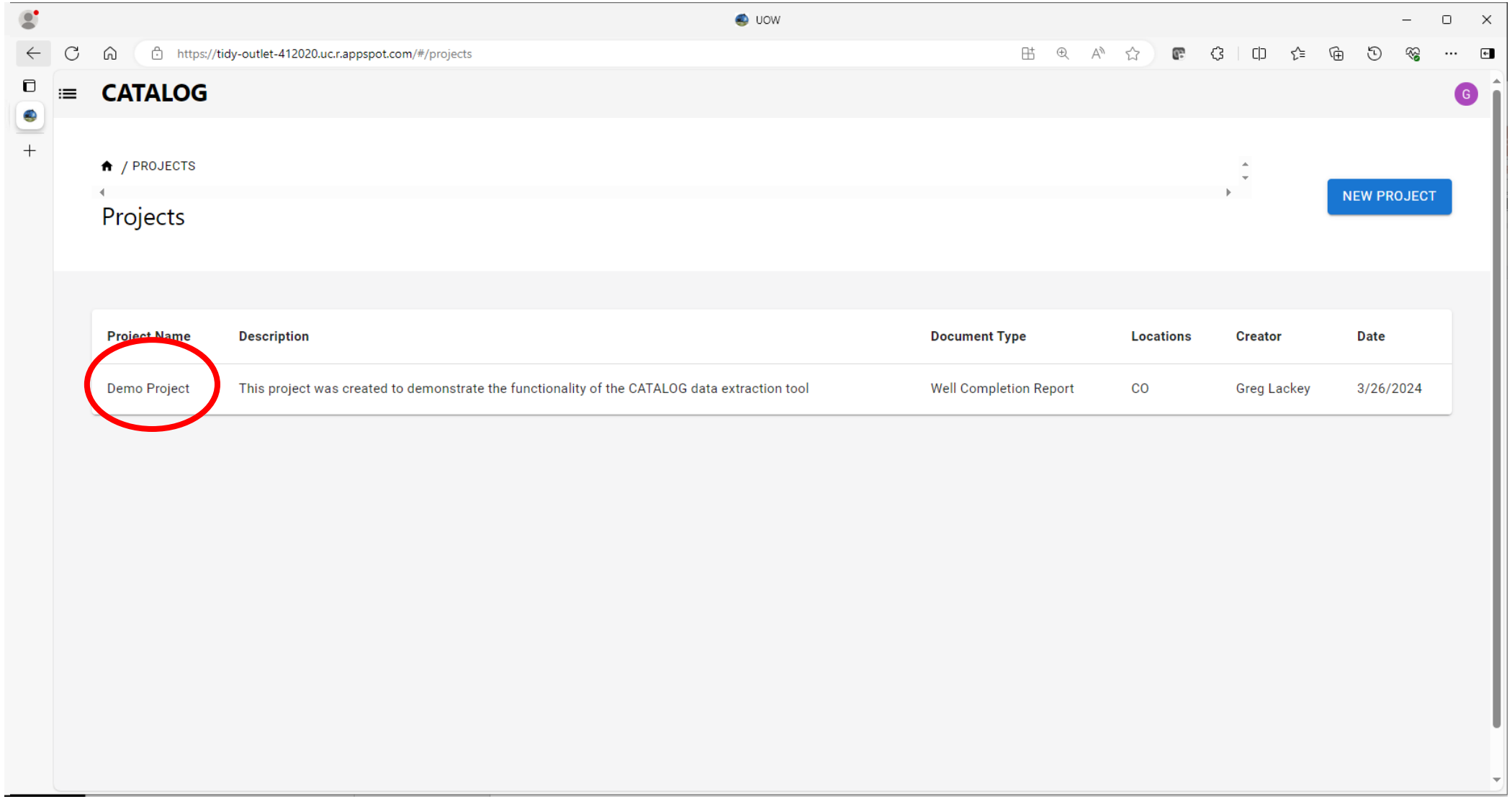
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CATALOG
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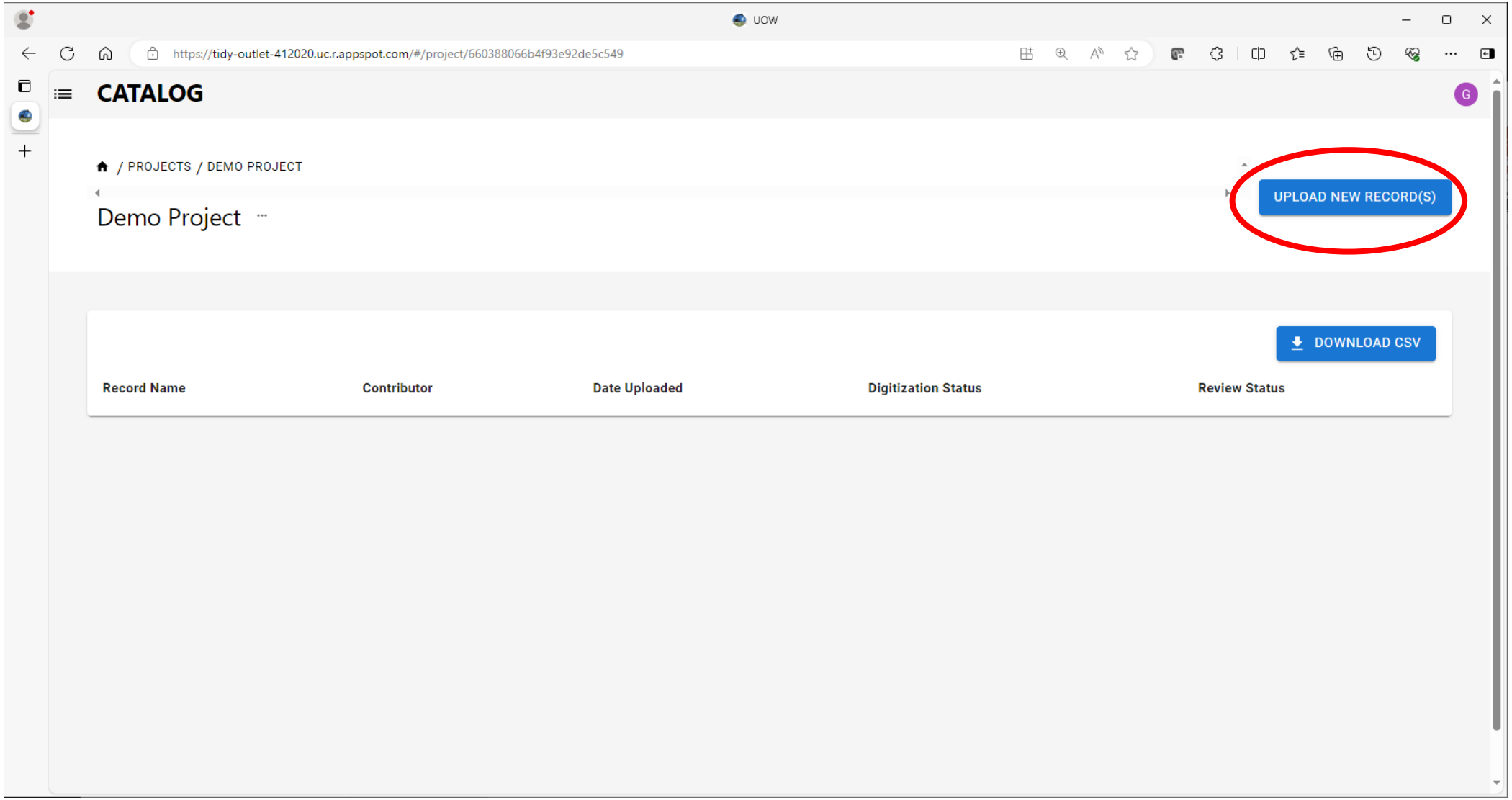
/ PROJECTS
Projects
NEW PROJECT
Project Name
Description
Document Type
Locations
Creator
Date
Demo Project
This project was created to demonstrate the functionality of the CATALOG data extraction tool
Well Completion Report
CO
Greg Lackey
3/26/2024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Demo Project
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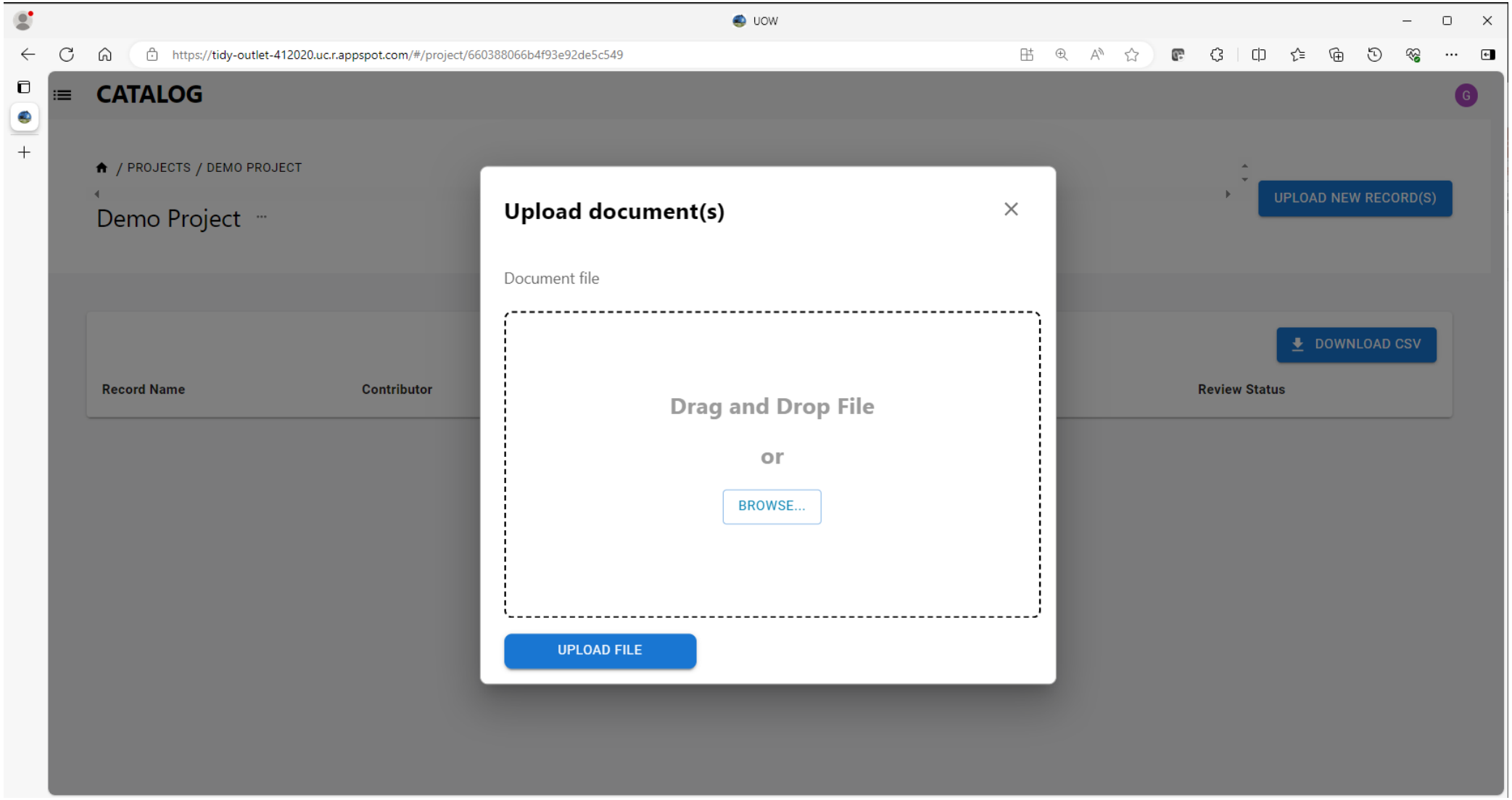
DOWNLOAD CSV
Record Name
Contributor
Date Uploaded
Digitization Status
Review Status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DOWNLOAD CSV
Record Name
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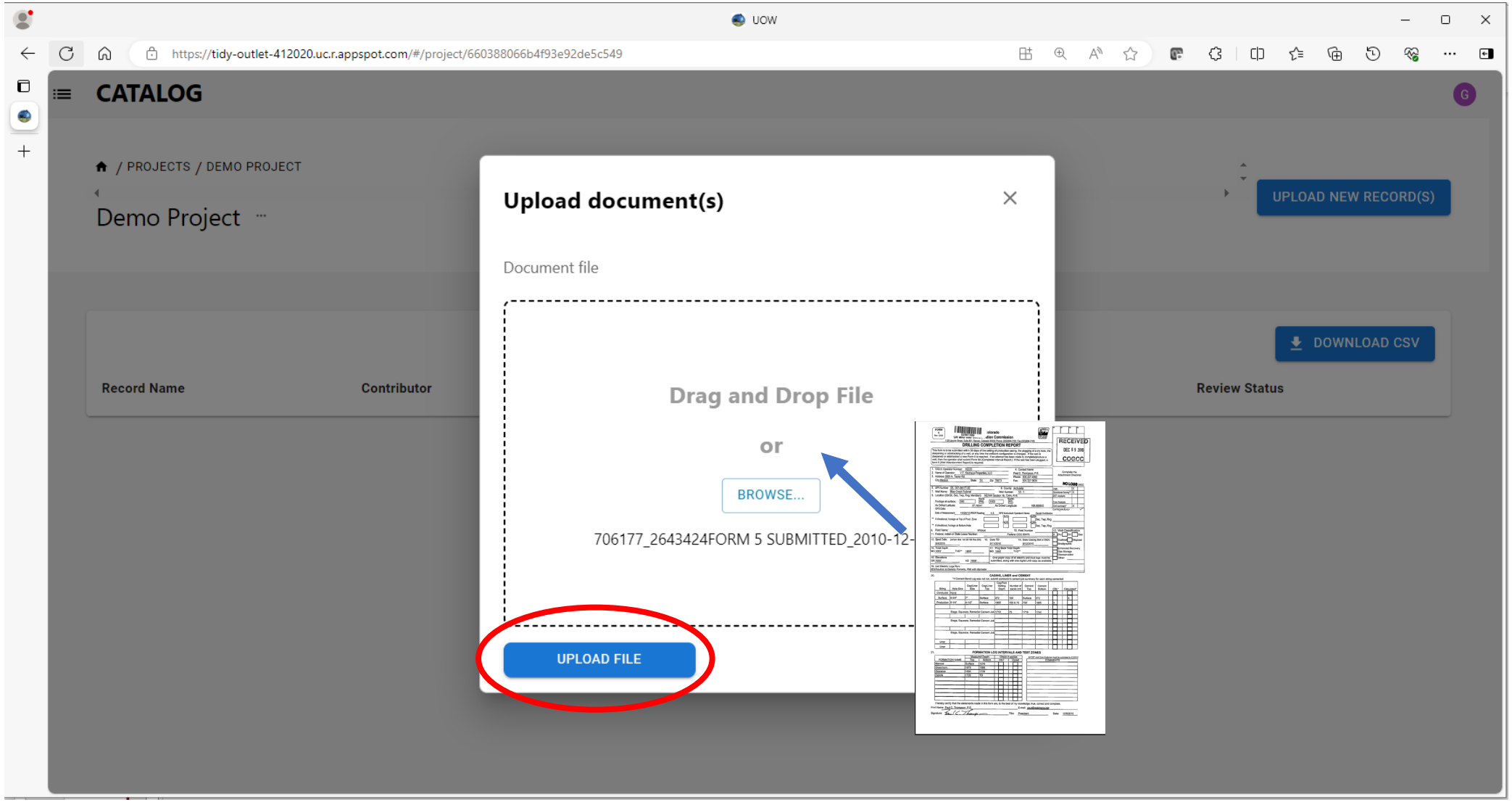
Review Status
Upload document(s)
Document file
Drag and Drop File
or
BROWSE...
UPLOAD FILE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DOWNLOAD CSV
Record Name
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Upload document(s)
Document file
Drag and Drop File
or
BROWSE...
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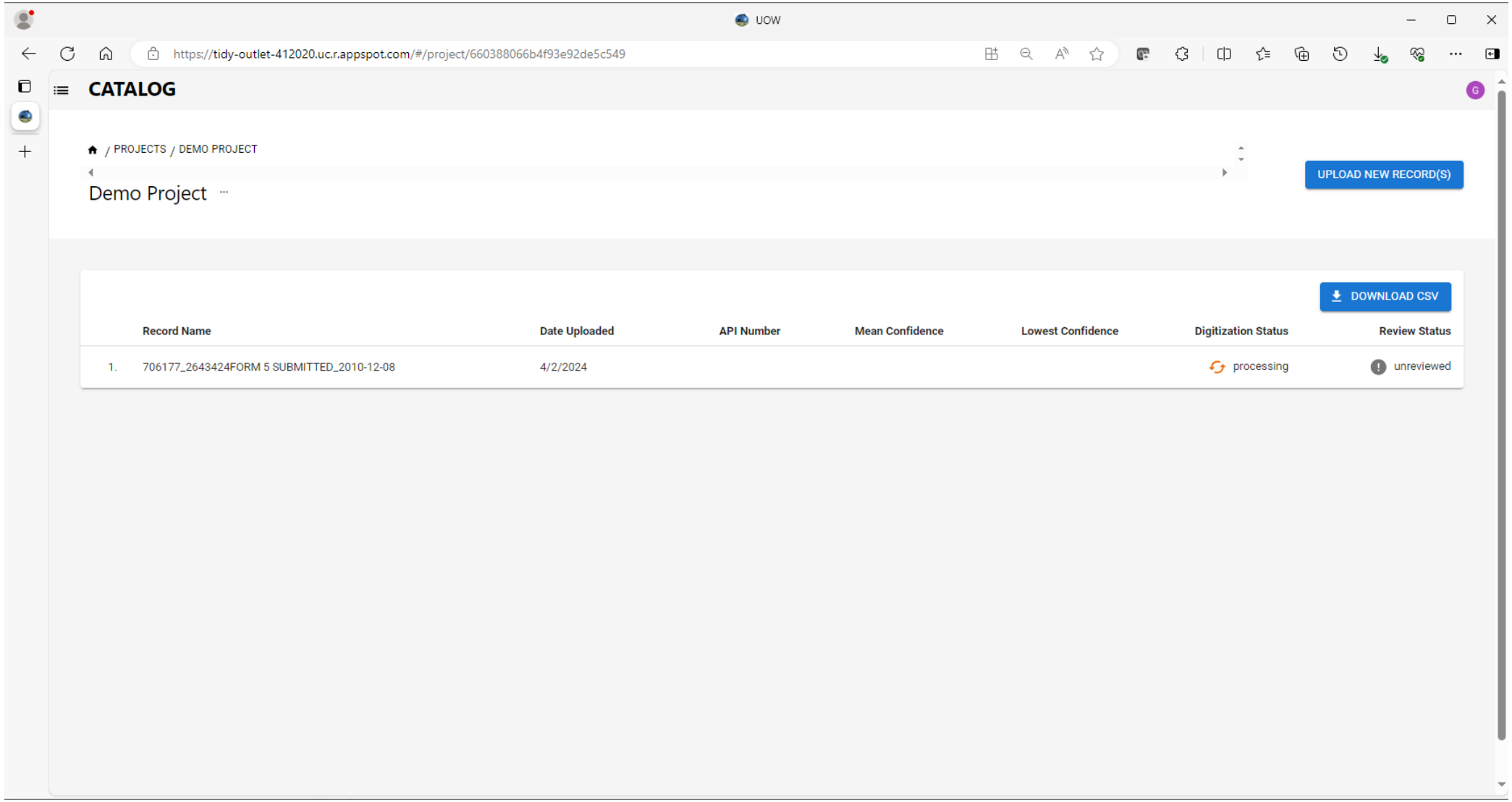
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Date Uploaded
API Number
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Lowest Confidence
Digitization Status
Review Status
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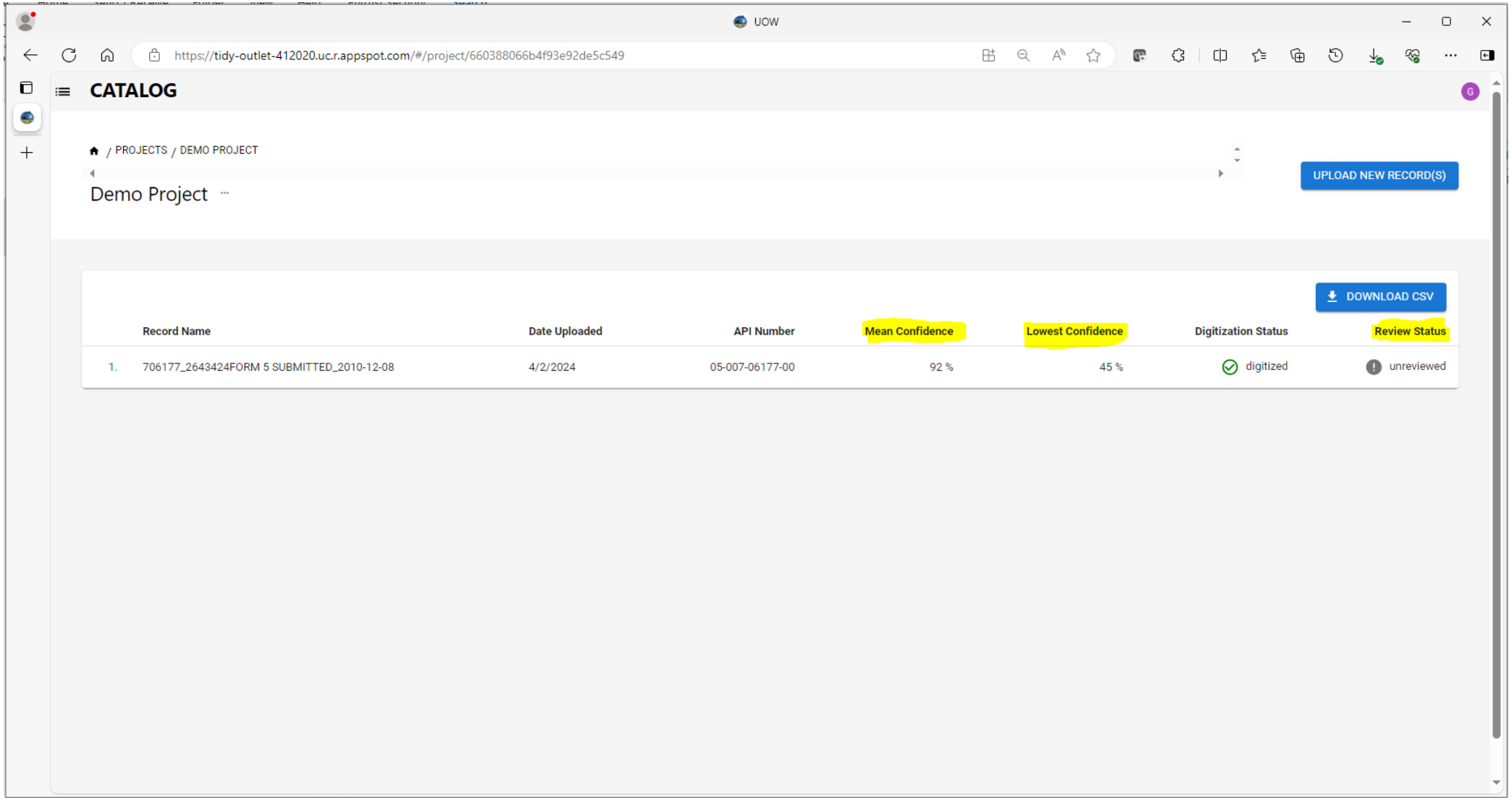
4/2/2024
processing
unreviewed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Demo Project
UPLOAD NEW RECORD(S)
DOWNLOAD CSV
Record Name
Date Uploaded
API Number
Mean Confidence
Lowest Confidence
Digitization Status
Review Status
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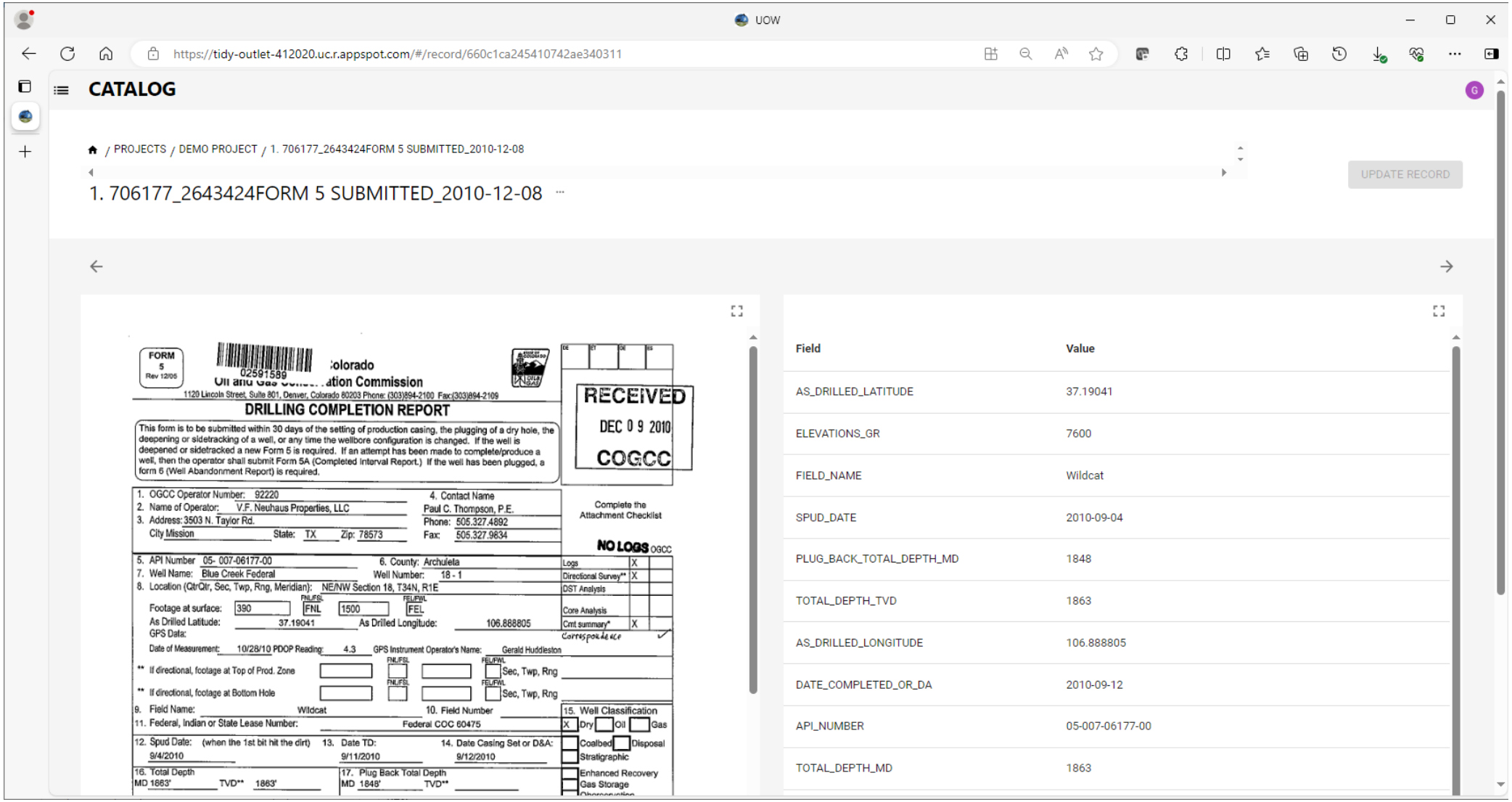
4/2/2024
05-007-06177-00
92 %
45 %
digitized
unreviewed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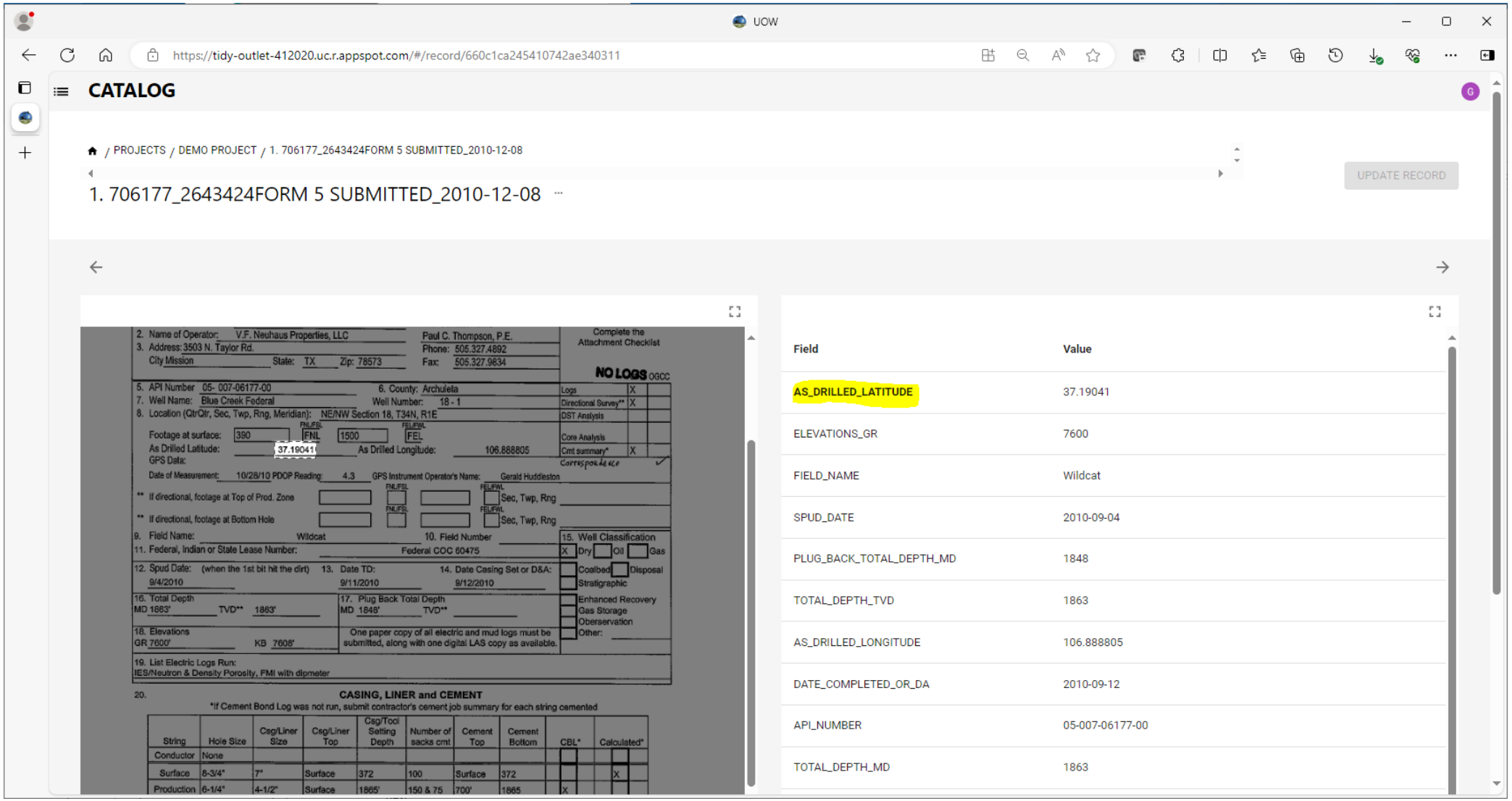
/ PROJECTS / DEMO PROJECT / 1. 706177_2643424FORM 5 SUBMITTED_2010-12-08
1. 706177_2643424FORM 5 SUBMITTED_2010-12-08
UPDATE RECORD
FORM 5 Rev 12/05
02591589
Colorado
Oil and Gas Conservation Commission
1120 Lincoln Street, Suite 801, Denver, Colorado 80203 Phone: (303)894-2100 Fax:(303)894-2109
DRILLING COMPLETION REPORT
This form is to be submitted within 30 days of the setting of production casing, the plugging of a dry hole, the deepening or sidetracking of a well, or any time the wellbore configuration is changed. If the well is deepened or sidetracked a new Form 5 is required. If an attempt has been made to complete/produce a well, then the operator shall submit Form 5A (Completed Interval Report.) If the well has been plugged, a form 6 (Well Abandonment Report) is required.
RECEIVED
DEC 0 9 2010
COGCC
1. OGCC Operator Number: 92220
2. Name of Operator: V.F. Neuhaus Properties, LLC
3. Address: 3503 N. Taylor Rd.
City Mission State: TX Zip: 78573
4. Contact Name
Paul C. Thompson, P.E.
Phone: 505.327.4892
Fax: 505.327.9834
Complete the Attachment Checklist
NO LOGS OGCC
5. API Number 05- 007-06177-00
6. County: Archuleta
7. Well Name: Blue Creek Federal
Well Number: 18 - 1
8. Location (QtrQtr, Sec, Twp, Rng, Meridian): NE/NW Section 18, T34N, R1E
Footage at surface: 390 FNL/FSL FNL 1500 FEL/FWL FEL
As Drilled Latitude: 37.19041
As Drilled Longitude: 106.888805
GPS Data:
Date of Measurement: 10/28/10 PDOP Reading: 4.3 GPS Instrument Operator's Name: Gerald Huddleston
** If directional, footage at Top of Prod. Zone
** If directional, footage at Bottom Hole
Sec, Twp, Rng
9. Field Name: Wildcat
10. Field Number
11. Federal, Indian or State Lease Number: Federal COC 60475
12. Spud Date: (when the 1st bit hit the dirt) 9/4/2010
13. Date TD: 9/11/2010
14. Date Casing Set or D&A: 9/12/2010
16. Total Depth MD 1863' TVD** 1863'
17. Plug Back Total Depth MD 1848' TVD**
Logs X
Directional Survey** X
DST Analysis
Core Analysis
Cmt summary* X
Correspondence
15. Well Classification
X Dry Oil Gas
Coalbed Disposal
Stratigraphic
Enhanced Recovery
Gas Storage
Field
Value
AS_DRILLED_LATITUDE 37.19041
ELEVATIONS_GR 7600
FIELD_NAME Wildcat
SPUD_DATE 2010-09-04
PLUG_BACK_TOTAL_DEPTH_MD 1848
TOTAL_DEPTH_TVD 1863
AS_DRILLED_LONGITUDE 106.888805
DATE_COMPLETED_OR_DA 2010-09-12
API_NUMBER 05-007-06177-00
TOTAL_DEPTH_MD 1863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CATALOG
/ PROJECTS / DEMO PROJECT / 1. 706177_2643424FORM 5 SUBMITTED_2010-12-08
1. 706177_2643424FORM 5 SUBMITTED_2010-12-08
UPDATE RECORD
2. Name of Operator: V.F. Neuhaus Properties, LLC
Paul C. Thompson, P.E.
3. Address: 3503 N. Taylor Rd.
Phone: 505.327.4892
City Mission State: TX Zip: 78573
Fax: 505.327.9834
Complete the Attachment Checklist
NO LOGS OGCC
5. API Number 05- 007-06177-00
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Logs X
Directional Survey** X
DST Analysis
Core Analysis
Cmt summary* X
Correspondence
** If directional, footage at Top of Prod. Zone FNL/FSL FEL/FWL Sec, Twp, Rng
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15. Well Classification
X Dry Oil Gas
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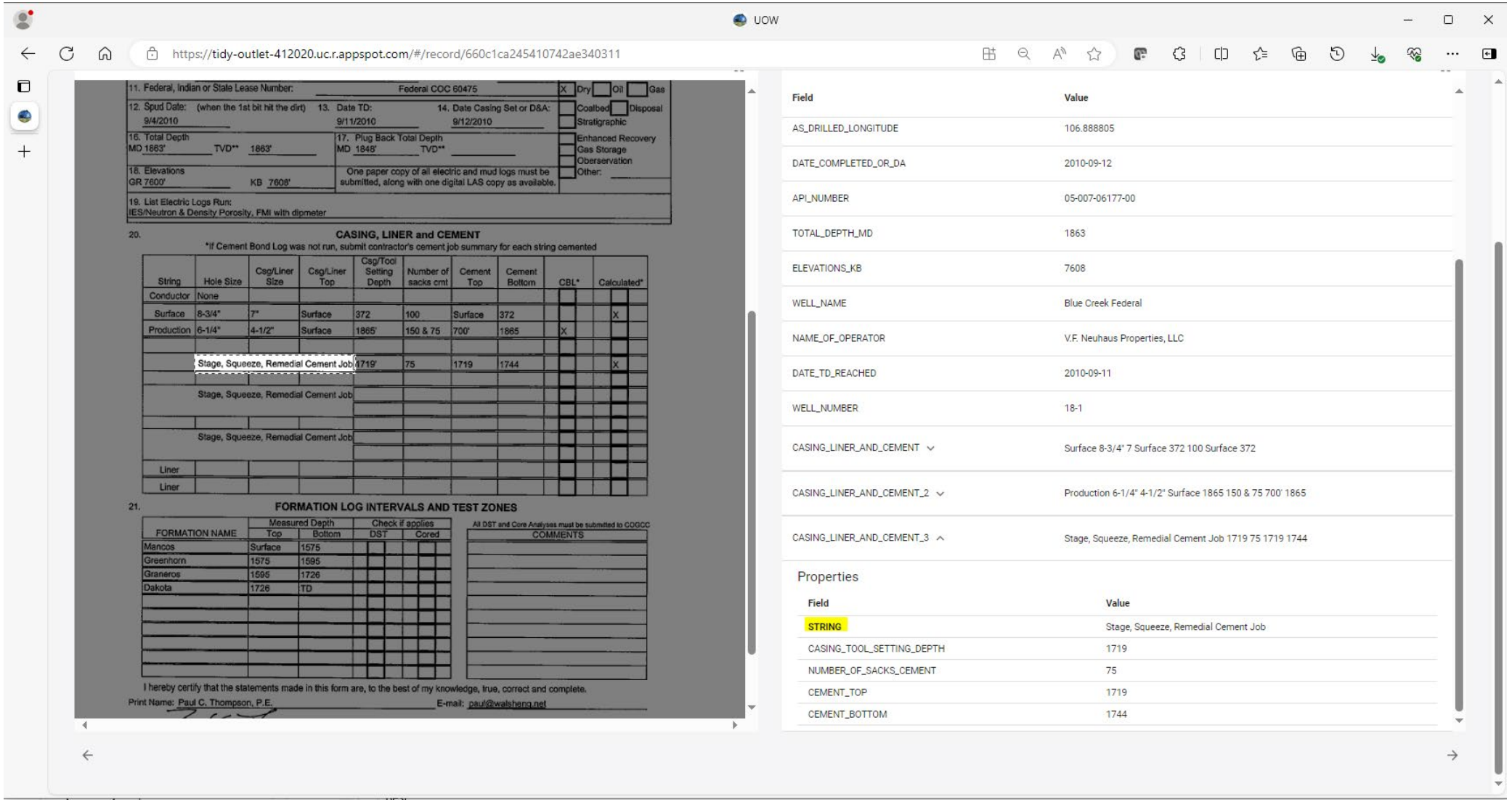
13. Date TD: 9/11/2010
14. Date Casing Set or D&A: 9/12/2010
Coalbed Disposal
Stratigraphic
16. Total Depth MD 1863' TVD** 1863'
17. Plug Back Total Depth MD 1848' TVD**
Enhanced Recovery
Gas Storage
Observation
Other:
18. Elevations GR 7600' KB 7608'
One paper copy of all electric and mud logs must be submitted, along with one digital LAS copy as available.
19. List Electric Logs Run:
IES/Neutron & Density Porosity, FMI with dipmeter
20. CASING, LINER and CEMENT
*If Cement Bond Log was not run, submit contractor's cement job summary for each string cemented
String | Hole Size | Csg/Liner Size | Csg/Liner Top | Csg/Tool Setting Depth | Number of sacks cmt | Cement Top | Cement Bottom | CBL* | Calculated*
Conductor | None
Surface | 8-3/4" | 7" | Surface | 372 | 100 | Surface | 372 | | X
Production | 6-1/4" | 4-1/2" | Surface | 1865' | 150 & 75 | 700' | 1865 | X
Field
Value
AS_DRILLED_LATITUDE
37.19041
ELEVATIONS_GR
7600
FIELD_NAME
Wildcat
SPUD_DATE
2010-09-04
PLUG_BACK_TOTAL_DEPTH_MD
1848
TOTAL_DEPTH_TVD
1863
AS_DRILLED_LONGITUDE
106.888805
DATE_COMPLETED_OR_DA
2010-09-12
API_NUMBER
05-007-06177-00
TOTAL_DEPTH_MD
1863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11. Federal, Indian or State Lease Number: Federal COC 60475
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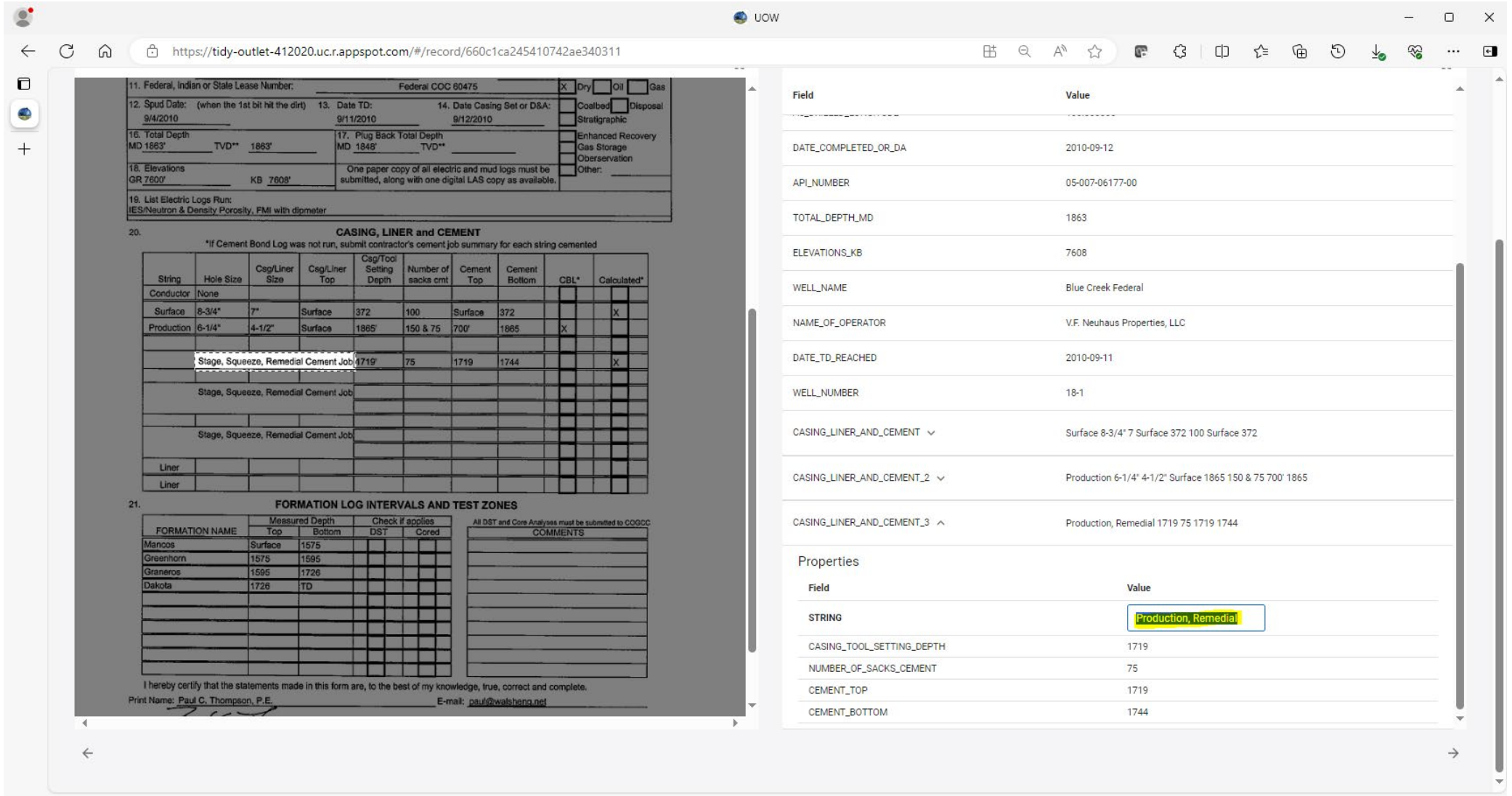
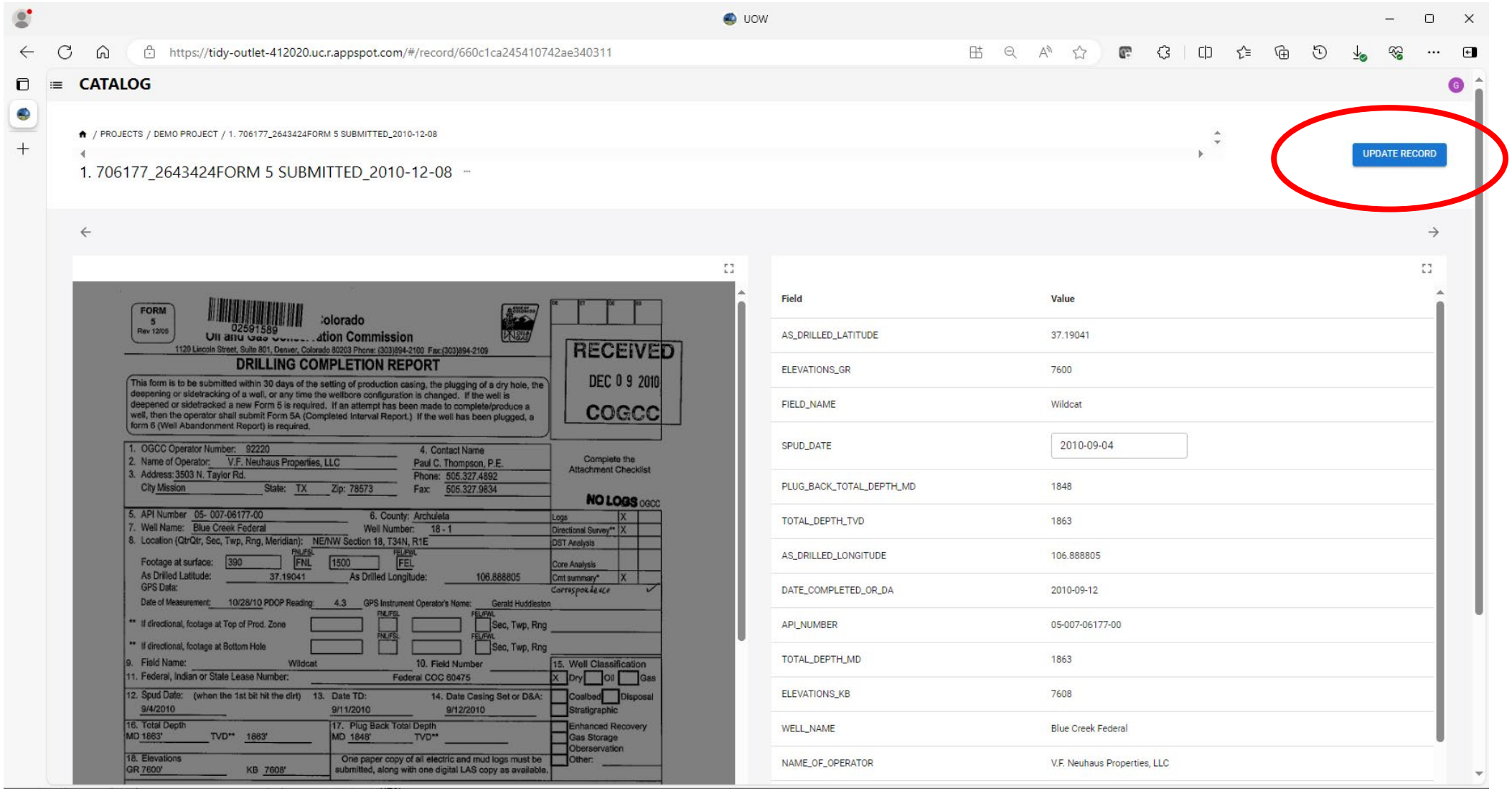
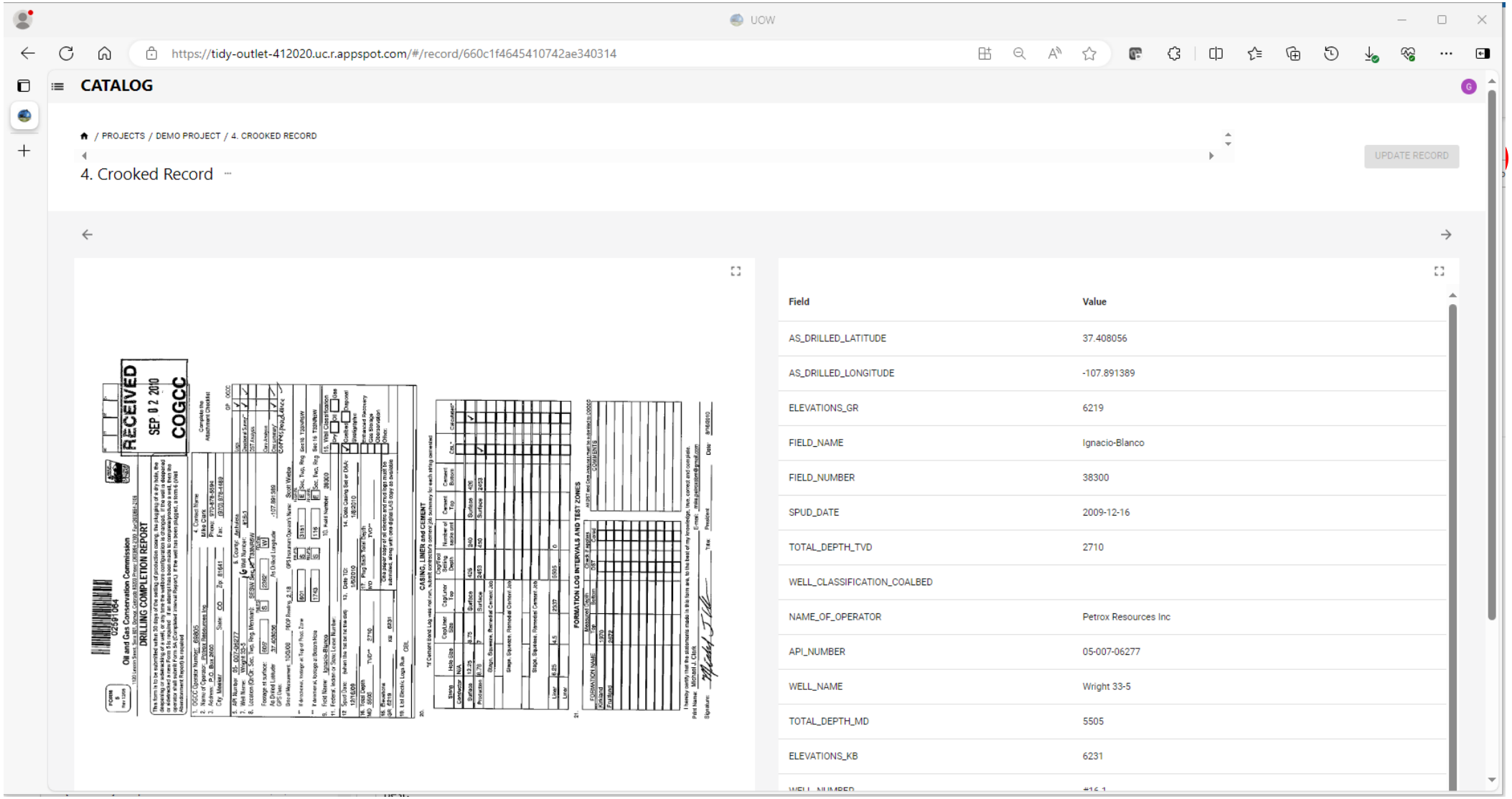
Conductor | None
Surface | 8-3/4" | 7" | Surface | 372 | 100 | Surface | 372 | | X
Production | 6-1/4" | 4-1/2" | Surface | 1865' | 150 & 75 | 700' | 1865 | X
Stage, Squeeze, Remedial Cement Job | 1719' | 75 | 1719 | 1744 | X
Stage, Squeeze, Remedial Cement Job
Stage, Squeeze, Remedial Cement Job
Liner
Liner
21. FORMATION LOG INTERVALS AND TEST ZONES
FORMATION NAME | Measured Depth Top | Bottom | Check if applies DST | Cored | COMMENTS
Mancos | Surface | 1575
Greenhorn | 1575 | 1595
Graneros | 1595 | 1726
Dakota | 1726 | TD
I hereby certify that the statements made in this form are, to the best of my knowledge, true, correct and complete.
Print Name: Paul C. Thompson, P.E. E-mail: paul@walsheng.net
Field | Value
AS_DRILLED_LONGITUDE | 106.888805
DATE_COMPLETED_OR_DA | 2010-09-12
API_NUMBER | 05-007-06177-00
TOTAL_DEPTH_MD | 1863
ELEVATIONS_KB | 7608
WELL_NAME | Blue Creek Federal
NAME_OF_OPERATOR | V.F. Neuhaus Properties, LLC
DATE_TD_REACHED | 2010-09-11
WELL_NUMBER | 18-1
CASING_LINER_AND_CEMENT | Surface 8-3/4" 7 Surface 372 100 Surface 372
CASING_LINER_AND_CEMENT_2 | Production 6-1/4" 4-1/2" Surface 1865 150 & 75 700' 1865
CASING_LINER_AND_CEMENT_3 | Stage, Squeeze, Remedial Cement Job 1719 75 1719 1744
Properties
Field | Value
STRING | Stage, Squeeze, Remedial Cement Job
CASING_TOOL_SETTING_DEPTH | 1719
NUMBER_OF_SACKS_CEMENT | 75
CEMENT_TOP | 1719
CEMENT_BOTTOM | 1744


UOW
https://tidy-outlet-412020.uc.r.appspot.com/#/record/660c1ca245410742ae340311
11. Federal, Indian or State Lease Number: Federal COC 60475
X Dry Oil Gas
12. Spud Date: (when the 1st bit hit the dirt) 9/4/2010
13. Date TD: 9/11/2010
14. Date Casing Set or D&A: 9/12/2010
Coalbed Disposal
Stratigraphic
16. Total Depth MD 1863' TVD** 1863'
17. Plug Back Total Depth MD 1848' TVD**
Enhanced Recovery
Gas Storage
Observation
Other:
18. Elevations GR 7600' KB 7608'
One paper copy of all electric and mud logs must be submitted, along with one digital LAS copy as available.
19. List Electric Logs Run:
IES/Neutron & Density Porosity, FMI with dipmeter
20. CASING, LINER and CEMENT
*If Cement Bond Log was not run, submit contractor's cement job summary for each string cemented
String | Hole Size | Csg/Liner Size | Csg/Liner Top | Csg/Tool Setting Depth | Number of sacks cmt | Cement Top | Cement Bottom | CBL* | Calculated*
Conductor | None
Surface | 8-3/4" | 7" | Surface | 372 | 100 | Surface | 372 | | X
Production | 6-1/4" | 4-1/2" | Surface | 1865' | 150 & 75 | 700' | 1865 | X
Stage, Squeeze, Remedial Cement Job | 1719' | 75 | 1719 | 1744 | X
Stage, Squeeze, Remedial Cement Job
Stage, Squeeze, Remedial Cement Job
Liner
Liner
21. FORMATION LOG INTERVALS AND TEST ZONES
FORMATION NAME | Measured Depth Top | Bottom | Check if applies DST | Cored | All DST and Core Analyses must be submitted to COGCC COMMENTS
Mancos | Surface | 1575
Greenhorn | 1575 | 1595
Graneros | 1595 | 1726
Dakota | 1726 | TD
I hereby certify that the statements made in this form are, to the best of my knowledge, true, correct and complete.
Print Name: Paul C. Thompson, P.E.
E-mail: paul@walsheng.net
Field
Value
DATE_COMPLETED_OR_DA
2010-09-12
API_NUMBER
05-007-06177-00
TOTAL_DEPTH_MD
1863
ELEVATIONS_KB
7608
WELL_NAME
Blue Creek Federal
NAME_OF_OPERATOR
V.F. Neuhaus Properties, LLC
DATE_TD_REACHED
2010-09-11
WELL_NUMBER
18-1
CASING_LINER_AND_CEMENT
Surface 8-3/4" 7 Surface 372 100 Surface 372
CASING_LINER_AND_CEMENT_2
Production 6-1/4" 4-1/2" Surface 1865 150 & 75 700' 1865
CASING_LINER_AND_CEMENT_3
Production, Remedial 1719 75 1719 1744
Properties
Field
Value
STRING
Production, Remedial
CASING_TOOL_SETTING_DEPTH
1719
NUMBER_OF_SACKS_CEMENT
75
CEMENT_TOP
1719
CEMENT_BOTTOM
1744


UOW
https://tidy-outlet-412020.uc.r.appspot.com/#/record/660c1ca245410742ae340311
CATALOG
/ PROJECTS / DEMO PROJECT / 1. 706177_2643424FORM 5 SUBMITTED_2010-12-08
1. 706177_2643424FORM 5 SUBMITTED_2010-12-08
UPDATE RECORD
FORM 5 Rev 12/05
02591589
Colorado Oil and Gas Conservation Commission
1120 Lincoln Street, Suite 801, Denver, Colorado 80203 Phone: (303)894-2100 Fax:(303)894-2109
DRILLING COMPLETION REPORT
This form is to be submitted within 30 days of the setting of production casing, the plugging of a dry hole, the deepening or sidetracking of a well, or any time the wellbore configuration is changed. If the well is deepened or sidetracked a new Form 5 is required. If an attempt has been made to complete/produce a well, then the operator shall submit Form 5A (Completed Interval Report.) If the well has been plugged, a form 6 (Well Abandonment Report) is required.
RECEIVED
DEC 0 9 2010
COGCC
1. OGCC Operator Number: 92220
2. Name of Operator: V.F. Neuhaus Properties, LLC
3. Address: 3503 N. Taylor Rd.
City Mission State: TX Zip: 78573
4. Contact Name Paul C. Thompson, P.E.
Phone: 505.327.4892
Fax: 505.327.9634
Complete the Attachment Checklist
NO LOGS OGCC
5. API Number 05- 007-06177-00
6. County: Archuleta
7. Well Name: Blue Creek Federal
Well Number: 18 - 1
8. Location (QtrQtr, Sec, Twp, Rng, Meridian): NE/NW Section 18, T34N, R1E
Footage at surface: 390 FNL/FSL FNL 1500 FEL/FWL FEL
As Drilled Latitude: 37.19041 As Drilled Longitude: 106.888805
GPS Data:
Date of Measurement: 10/28/10 PDOP Reading: 4.3 GPS Instrument Operator's Name: Gerald Huddleston
** If directional, footage at Top of Prod. Zone FNL/FSL FEL/FWL Sec, Twp, Rng
** If directional, footage at Bottom Hole FNL/FSL FEL/FWL Sec, Twp, Rng
9. Field Name: Wildcat
10. Field Number
11. Federal, Indian or State Lease Number: Federal COC 60475
12. Spud Date: (when the 1st bit hit the dirt) 9/4/2010
13. Date TD: 9/11/2010
14. Date Casing Set or D&A: 9/12/2010
16. Total Depth MD 1863' TVD** 1863'
17. Plug Back Total Depth MD 1848' TVD**
18. Elevations GR 7600' KB 7608'
One paper copy of all electric and mud logs must be submitted, along with one digital LAS copy as available.
Logs X
Directional Survey** X
DST Analysis
Core Analysis
Cmt summary* X
Correspondence
15. Well Classification
X Dry Oil Gas
Coalbed Disposal
Stratigraphic
Enhanced Recovery
Gas Storage
Oberservation
Other:
Field
Value
AS_DRILLED_LATITUDE 37.19041
ELEVATIONS_GR 7600
FIELD_NAME Wildcat
SPUD_DATE 2010-09-04
PLUG_BACK_TOTAL_DEPTH_MD 1848
TOTAL_DEPTH_TVD 1863
AS_DRILLED_LONGITUDE 106.888805
DATE_COMPLETED_OR_DA 2010-09-12
API_NUMBER 05-007-06177-00
TOTAL_DEPTH_MD 1863
ELEVATIONS_KB 7608
WELL_NAME Blue Creek Federal
NAME_OF_OPERATOR V.F. Neuhaus Properties, LLC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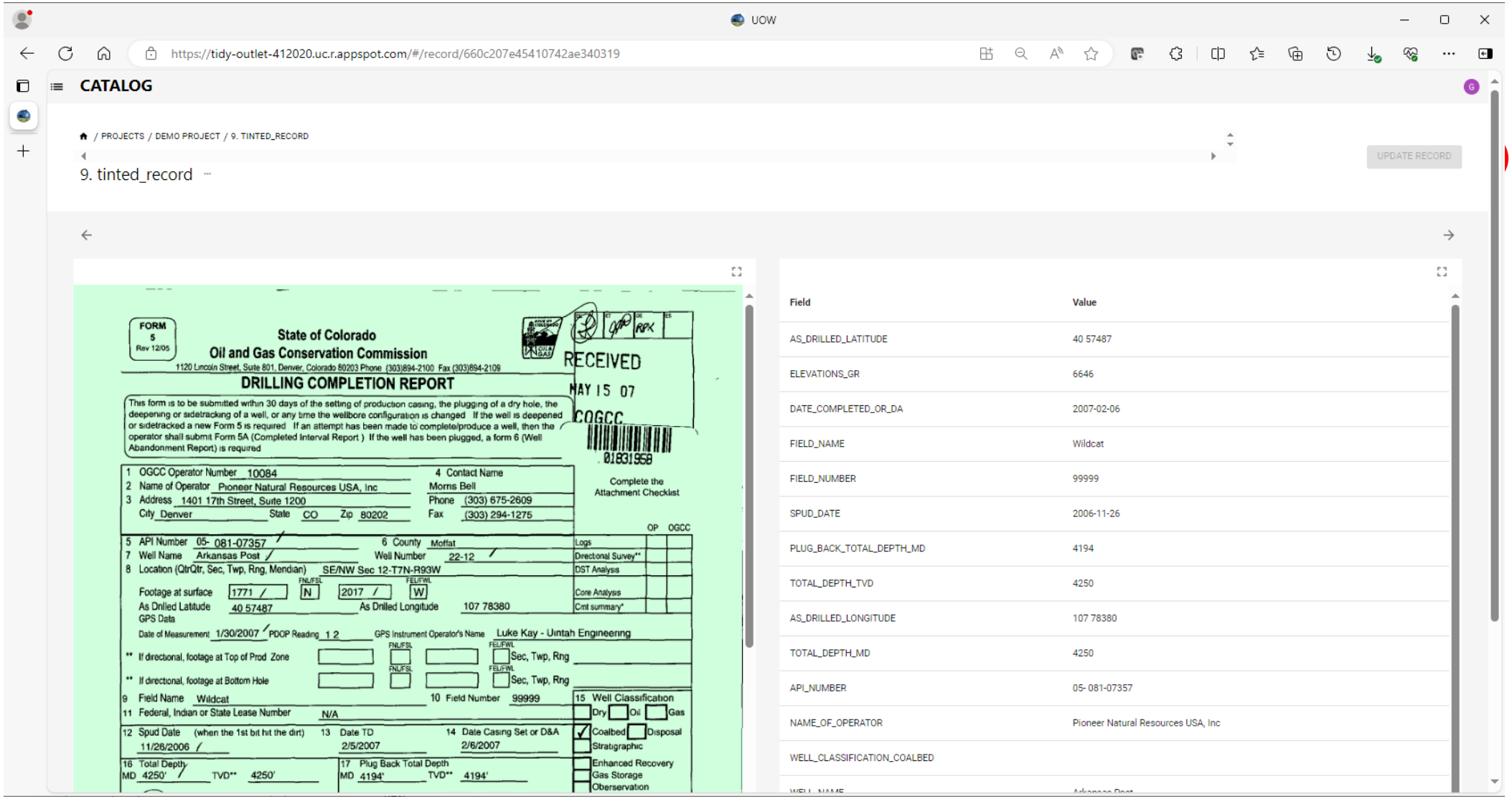
https://tidy-outlet-412020.uc.r.appspot.com/#/record/660c1f4645410742ae340314
CATALOG
/ PROJECTS / DEMO PROJECT / 4. CROOKED RECORD
4. Crooked Record
UPDATE RECORD
RECEIVED
SEP 02 2010
COGCC
Oil and Gas Conservation Commission
DRILLING COMPLETION REPORT
Field
Value
AS_DRILLED_LATITUDE
37.408056
AS_DRILLED_LONGITUDE
-107.891389
ELEVATIONS_GR
6219
FIELD_NAME
Ignacio-Blanco
FIELD_NUMBER
38300
SPUD_DATE
2009-12-16
TOTAL_DEPTH_TVD
2710
WELL_CLASSIFICATION_COALBED
NAME_OF_OPERATOR
Petrox Resources Inc
API_NUMBER
05-007-06277
WELL_NAME
Wright 33-5
TOTAL_DEPTH_MD
5505
ELEVATIONS_KB
6231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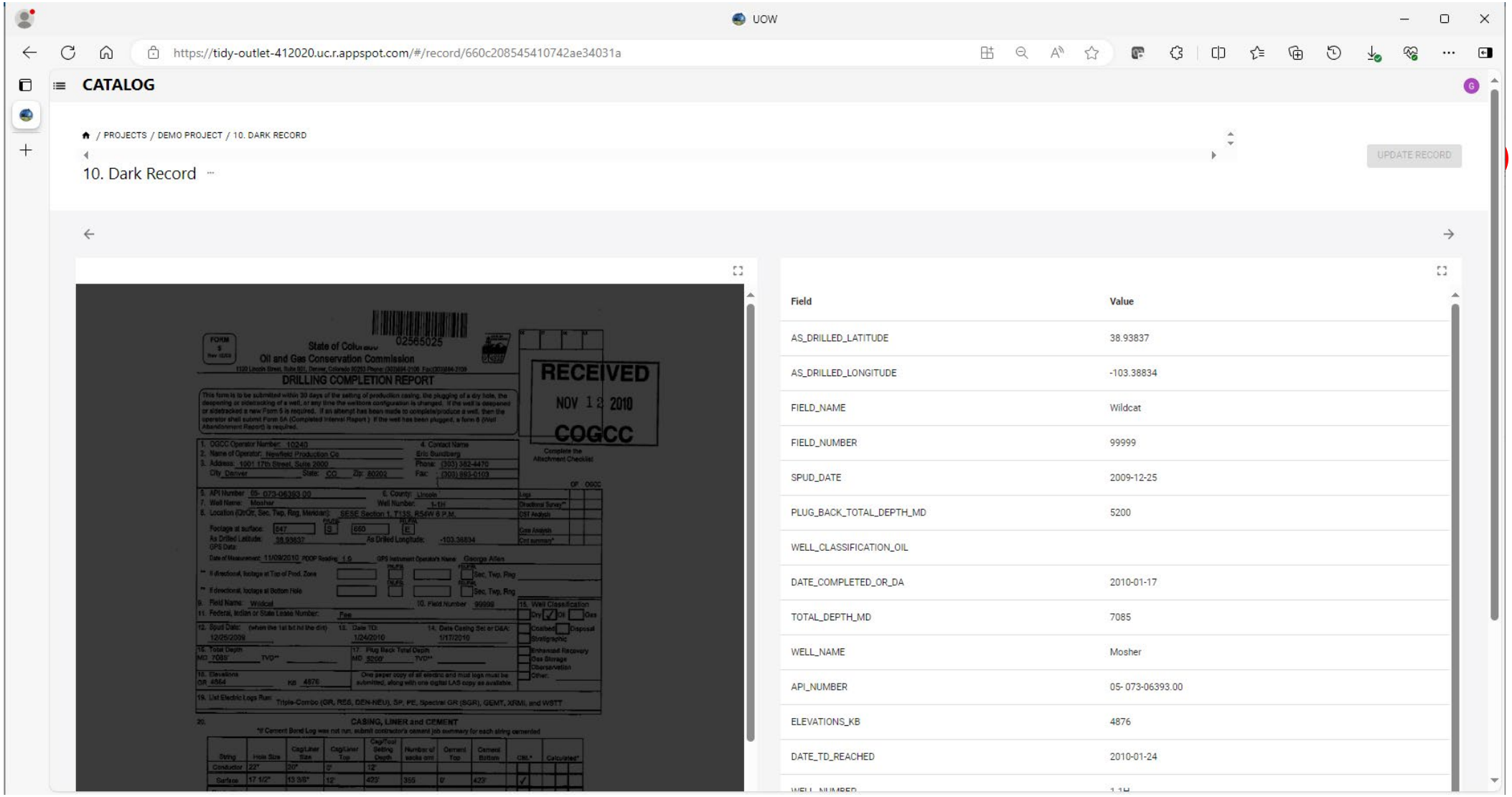
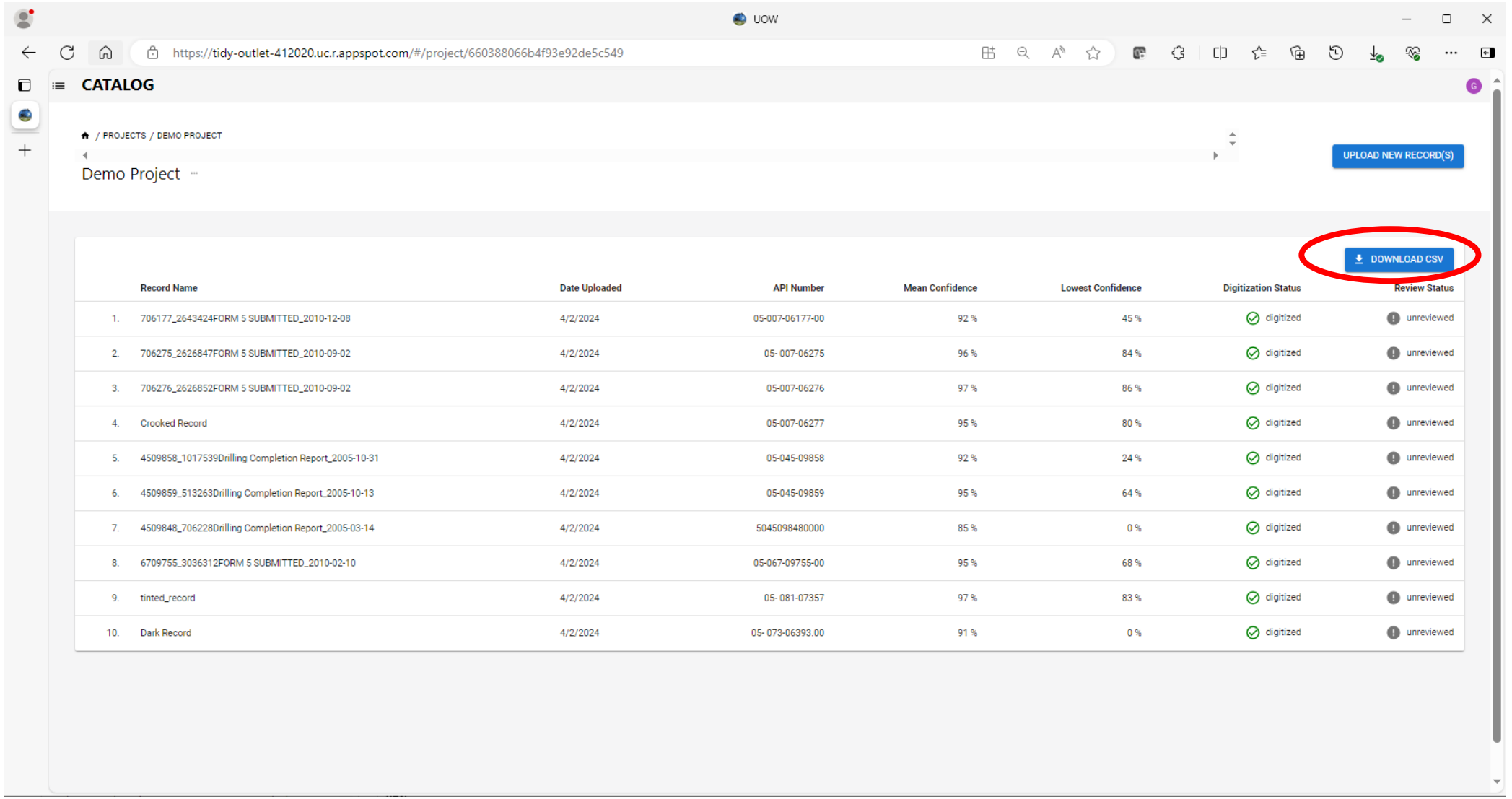
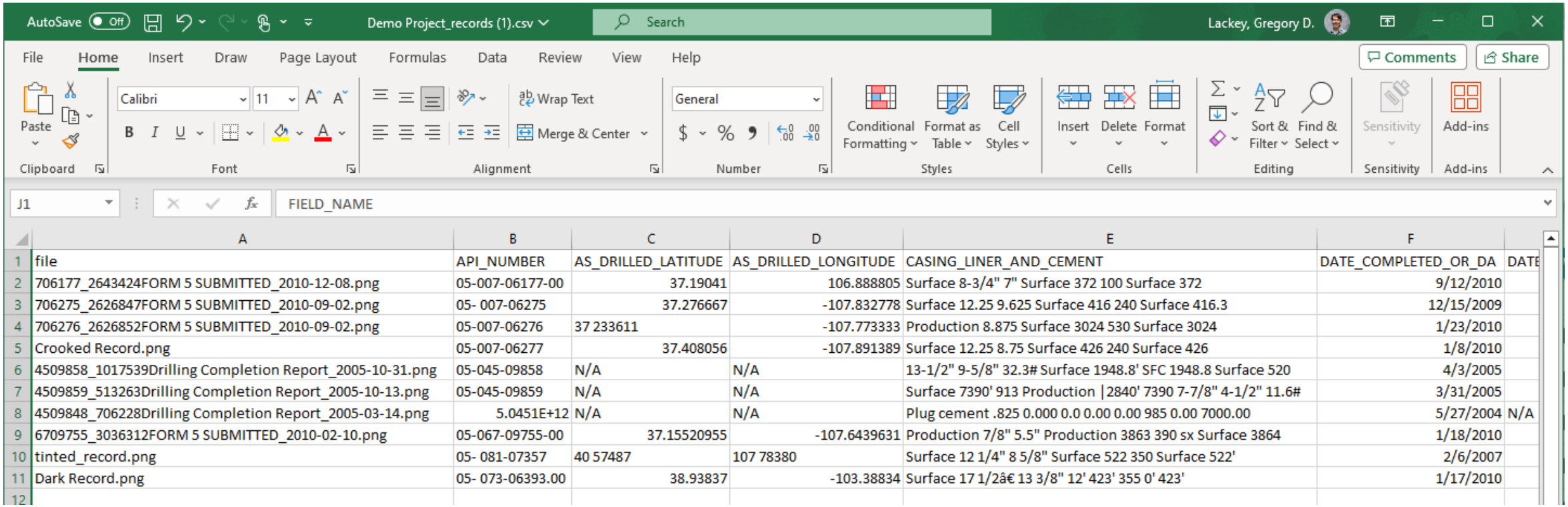
https://tidy-outlet-412020.uc.r.appspot.com/#/record/660c207e45410742ae340319
CATALOG
/ PROJECTS / DEMO PROJECT / 9. TINTED_RECORD
9. tinted_record
UPDATE RECORD
FORM 5 Rev 12/05
State of Colorado
Oil and Gas Conservation Commission
1120 Lincoln Street, Suite 801, Denver, Colorado 80203 Phone (303)894-2100 Fax (303)894-2109
DRILLING COMPLETION REPORT
RECEIVED
MAY 15 07
COGCC
01831958
This form is to be submitted within 30 days of the setting of production casing, the plugging of a dry hole, the deepening or sidetracking of a well, or any time the wellbore configuration is changed. If the well is deepened or sidetracked a new Form 5 is required. If an attempt has been made to complete/produce a well, then the operator shall submit Form 5A (Completed Interval Report). If the well has been plugged, a form 6 (Well Abandonment Report) is required
1 OGCC Operator Number 10084
2 Name of Operator Pioneer Natural Resources USA, Inc
3 Address 1401 17th Street, Suite 1200
City Denver State CO Zip 80202
4 Contact Name Morris Bell
Phone (303) 675-2609
Fax (303) 294-1275
Complete the Attachment Checklist
5 API Number 05- 081-07357
6 County Moffat
7 Well Name Arkansas Post
Well Number 22-12
8 Location (QtrQtr, Sec, Twp, Rng, Meridian) SE/NW Sec 12-T7N-R93W
Footage at surface 1771 / N 2017 / W
As Drilled Latitude 40 57487
As Drilled Longitude 107 78380
GPS Data
Date of Measurement 1/30/2007 PDOP Reading 1 2
GPS Instrument Operator's Name Luke Kay - Uintah Engineering
** If directional, footage at Top of Prod Zone
** If directional, footage at Bottom Hole
9 Field Name Wildcat
10 Field Number 99999
11 Federal, Indian or State Lease Number N/A
12 Spud Date (when the 1st bit hit the dirt) 11/26/2006
13 Date TD 2/5/2007
14 Date Casing Set or D&A 2/6/2007
16 Total Depth MD 4250' TVD** 4250'
17 Plug Back Total Depth MD 4194' TVD** 4194'
15 Well Classification
Dry Oil Gas
Coalbed Disposal
Stratigraphic
Enhanced Recovery
Gas Storage
Oberservation
Logs
Directional Survey**
DST Analysis
Core Analysis
Cmt summary*
OP OGCC
Field
Value
AS_DRILLED_LATITUDE 40 57487
ELEVATIONS_GR 6646
DATE_COMPLETED_OR_DA 2007-02-06
FIELD_NAME Wildcat
FIELD_NUMBER 99999
SPUD_DATE 2006-11-26
PLUG_BACK_TOTAL_DEPTH_MD 4194
TOTAL_DEPTH_TVD 4250
AS_DRILLED_LONGITUDE 107 78380
TOTAL_DEPTH_MD 4250
API_NUMBER 05- 081-07357
NAME_OF_OPERATOR Pioneer Natural Resources USA, Inc
WELL_CLASSIFICATION_COALBED


UOW
https://tidy-outlet-412020.uc.r.appspot.com/#/record/660c208545410742ae34031a
CATALOG
/ PROJECTS / DEMO PROJECT / 10. DARK RECORD
10. Dark Record
UPDATE RECORD
State of Colorado
Oil and Gas Conservation Commission
DRILLING COMPLETION REPORT
RECEIVED
NOV 12 2010
COGCC
Field
Value
AS_DRILLED_LATITUDE
38.93837
AS_DRILLED_LONGITUDE
-103.38834
FIELD_NAME
Wildcat
FIELD_NUMBER
99999
SPUD_DATE
2009-12-25
PLUG_BACK_TOTAL_DEPTH_MD
5200
WELL_CLASSIFICATION_OIL
DATE_COMPLETED_OR_DA
2010-01-17
TOTAL_DEPTH_MD
7085
WELL_NAME
Mosher
API_NUMBER
05- 073-06393.00
ELEVATIONS_KB
4876
DATE_TD_REACHED
2010-01-24



	Record Name	Date Uploaded	API Number	Mean Confidence	Lowest Confidence	Digitization Status	Review Status
1.	706177_2643424FORM 5 SUBMITTED_2010-12-08	4/2/2024	05-007-06177-00	92 %	45 %	digitized	unreviewed
2.	706275_2626847FORM 5 SUBMITTED_2010-09-02	4/2/2024	05- 007-06275	96 %	84 %	digitized	unreviewed
3.	706276_2626852FORM 5 SUBMITTED_2010-09-02	4/2/2024	05-007-06276	97 %	86 %	digitized	unreviewed
4.	Crooked Record	4/2/2024	05-007-06277	95 %	80 %	digitized	unreviewed
5.	4509858_1017539Drilling Completion Report_2005-10-31	4/2/2024	05-045-09858	92 %	24 %	digitized	unreviewed
6.	4509859_513263Drilling Completion Report_2005-10-13	4/2/2024	05-045-09859	95 %	64 %	digitized	unreviewed
7.	4509848_706228Drilling Completion Report_2005-03-14	4/2/2024	5045098480000	85 %	0 %	digitized	unreviewed
8.	6709755_3036312FORM 5 SUBMITTED_2010-02-10	4/2/2024	05-067-09755-00	95 %	68 %	digitized	unreviewed
9.	tinted_record	4/2/2024	05- 081-07357	97 %	83 %	digitized	unreviewed
10.	Dark Record	4/2/2024	05- 073-06393.00	91 %	0 %	digitized	unreviewed



	A	B	C	D	E	F	
1	file	API_NUMBER	AS_DRILLED_LATITUDE	AS_DRILLED_LONGITUDE	CASING_LINER_AND_CEMENT	DATE_COMPLETED_OR_DA	DATE
2	706177_2643424FORM 5 SUBMITTED_2010-12-08.png	05-007-06177-00	37.19041	106.888805	Surface 8-3/4" 7" Surface 372 100 Surface 372	9/12/2010	
3	706275_2626847FORM 5 SUBMITTED_2010-09-02.png	05- 007-06275	37.276667	-107.832778	Surface 12.25 9.625 Surface 416 240 Surface 416.3	12/15/2009	
4	706276_2626852FORM 5 SUBMITTED_2010-09-02.png	05-007-06276	37 233611	-107.773333	Production 8.875 Surface 3024 530 Surface 3024	1/23/2010	
5	Crooked Record.png	05-007-06277	37.408056	-107.891389	Surface 12.25 8.75 Surface 426 240 Surface 426	1/8/2010	
6	4509858_1017539Drilling Completion Report_2005-10-31.png	05-045-09858	N/A	N/A	13-1/2" 9-5/8" 32.3# Surface 1948.8' SFC 1948.8 Surface 520	4/3/2005	
7	4509859_513263Drilling Completion Report_2005-10-13.png	05-045-09859	N/A	N/A	Surface 7390' 913 Production |2840' 7390 7-7/8" 4-1/2" 11.6#	3/31/2005	
8	4509848_706228Drilling Completion Report_2005-03-14.png	5.0451E+12	N/A	N/A	Plug cement .825 0.000 0.0 0.00 0.00 985 0.00 7000.00	5/27/2004	N/A
9	6709755_3036312FORM 5 SUBMITTED_2010-02-10.png	05-067-09755-00	37.15520955	-107.6439631	Production 7/8" 5.5" Production 3863 390 sx Surface 3864	1/18/2010	
10	tinted_record.png	05- 081-07357	40 57487	107 78380	Surface 12 1/4" 8 5/8" Surface 522 350 Surface 522'	2/6/2007	
11	Dark Record.png	05- 073-06393.00	38.93837	-103.38834	Surface 17 1/2â€ 13 3/8" 12' 423' 355 0' 423'	1/17/2010	
12							

Next Steps

1. Iterate tool prototype design and functionality internally
2. Partner with a small number of stakeholders (researchers, state agencies) that will use tool to digitize well records
3. Collect feedback and continue to improve tool design
4. Incorporate document splitting and clustering workflow
5. Progress open-source OCR and LLM approaches and replace Google Document AI backend
6. Expand collaborations and release general version of tool

Contacts

Greg Lackey
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National Energy Technology Laboratory
Gregory.Lackey@netl.doe.gov
412-386-7590 (office)

Dan O'Malley
Subsurface Flow & Transport Team Lead
Los Alamos National Laboratory
omalled@lanl.gov