

ep.pengtools.com

Achieving potential

All your need to maximize your oil & gas production, quick

Case Study Enhancements Tracking

Mikhail Tuzovskiy, 31.07.2018
mtuzovskiy@pengtools.com



Summary

This Case Study demonstrates the application of the **Enhancement Tracking** workflow to track and evaluate the benefits of executed enhancements using the **E&P Portal**.

The Study is based on the enhancement campaign implemented in an oil field located in Siberia, Russia. The campaign included such enhancements as fracturing, installing and upgrading the ESPs, choke opens and resulted in **4 mln bbl** of incremental oil recovery (**IOR**).

It is shown how to:

- Input the required data to the **E&P Portal**;
- Apply the **Enhancement Tracking** workflow to track and benchmark enhancements;
- Save and export the analysis results.

📎 All the input data is attached to the Case Study for the reference.

Table of Contents

Summary	1
Introduction	3
Enhancement IOR and Scorpion Plot	4
Field and Reservoir Data	5
Enhancement Campaign Data	7
Well 9 Enhancements	8
Enhancement 1. Converting the flowing well to the ESP	9
Enhancement 2. Fracing the damaged well.....	10
Enhancement 3. ESP upgrade	11
Data Input to the E&P Portal	12
Signing up.....	12
Adding the “Huron” field	14
Adding the Huron pad “1”	15
Uploading Huron wells.....	16
Upload the Huron wells daily production data.....	18
Upload the Huron wells enhancement production forecast data.....	20
Upload the Huron wells enhancement campaign data	22
Applying the Enhancement Tracking	24
Well 9 Enhancement.....	25
Enhancement 1. Converting the flowing well to the ESP	25
Enhancement 2. Fracing the damaged well.....	27
Enhancement 3. ESP upgrade	29
Well 9 enhancement summary.....	31
Enhancement campaign analysis.....	33
What is the campaign total IOR vs total cost?.....	34
Which enhancement campaign has better \$/bbl performance?	35
Which well has better \$/bbl performance?	36
Saving and exporting the analysis results.....	37
Conclusions	38
References	39
Attachments.....	39

Introduction

E&P Portal is a service to identify production enhancement opportunities and maximize production and recovery. The average production increase for the last 3 E&P companies applied the **E&P Portal** was 38%.

Enhancement Tracking is a workflow to assess the benefits achieved by executed Enhancements (Martins, MacDonald, Stewart, & Phillips, 1995). The workflow answers those questions:

- What is the campaign total incremental oil recovery (**IOR**) vs total cost?
- Which enhancement campaign has better **\$/bbl** performance?
- Which well has better **\$/bbl** performance?
- What is the **IOR** for each enhancement?

Enhancement is a well intervention to close the performance gap of the well. The typical enhancements are (From most **\$/bbl** effective to least):

- Choke open
- Pump Optimization
- ESP (converting the flowing well to ESP; upgrading the ESP etc)
- Acid Job
- Reperforation
- Frac
- Multistage Frac
- Sidetrack
- Drilling New Well

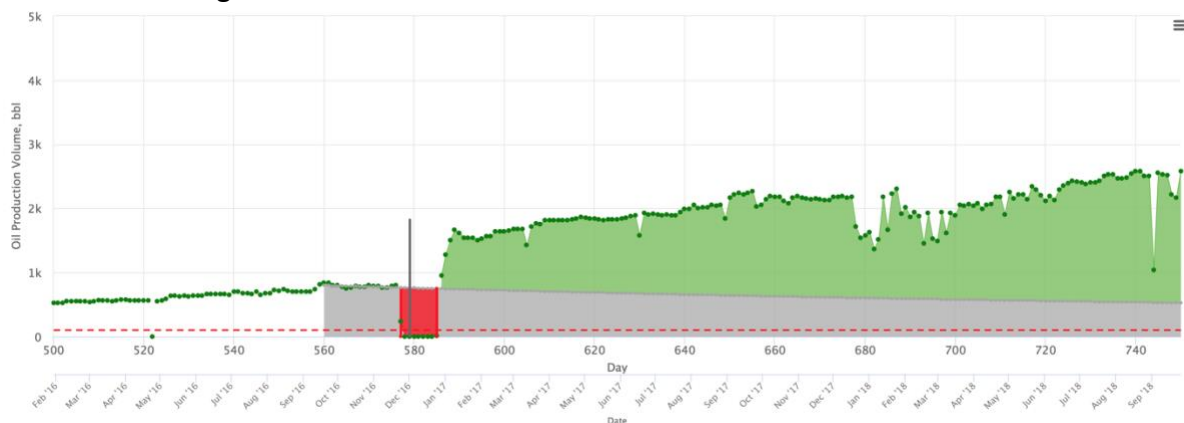


Figure 1 . Enhancement example: Converting the Flowing well to the ESP

Each **Enhancement** is tracked by calculating its enhancement **IOR**.

Scorpion Plot is used for graphical representation of the **Enhancements** performance.

- 😊 **Enhancement Tracking** is available at the **E&P Portal** as one of its engineering workflows. To get the access to the **Enhancement Tracking** tool please sign up at ep.pengtools.com. The access is free for the personal use.

Enhancement IOR and Scorpion Plot

Enhancement IOR is calculated as follows (Figure 2):

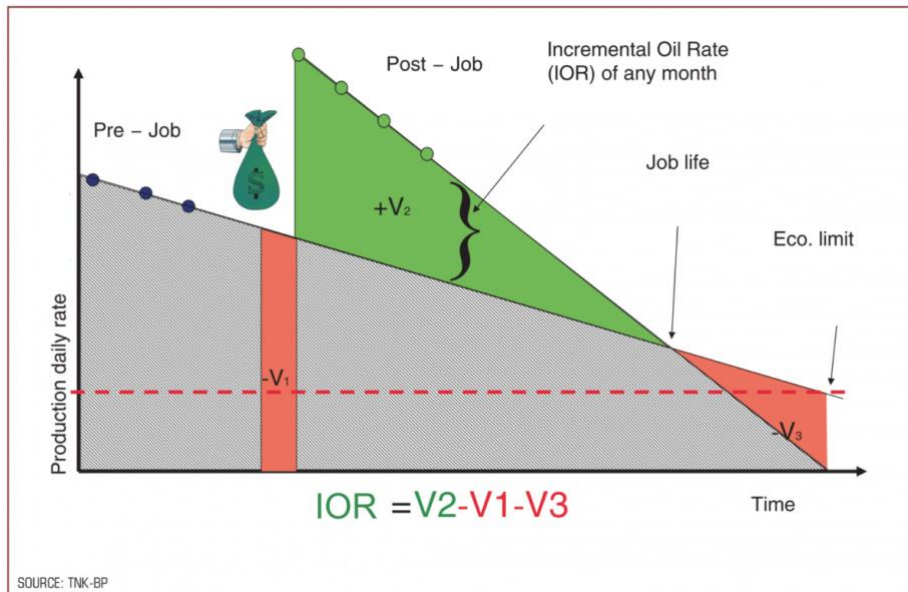


Figure 2 . Calculating enhancement IOR

Decline Curves are used to model base (pre job) and enhanced (post job) well rates.

The **Scorpion plot** (Figure 3) graphically illustrates total program split by individual events and ranked by success. The curve initiates from the origin at a low scope (low \$/bbl) and increasing until running to a vertical asymptote (money spent with no gain in production) and possibly even a negative portion (money spent and production lost as a result of the intervention). This effectively displays program performance (\$/bbl), total volume, total cost, and success rate (Nguyen, 2006).

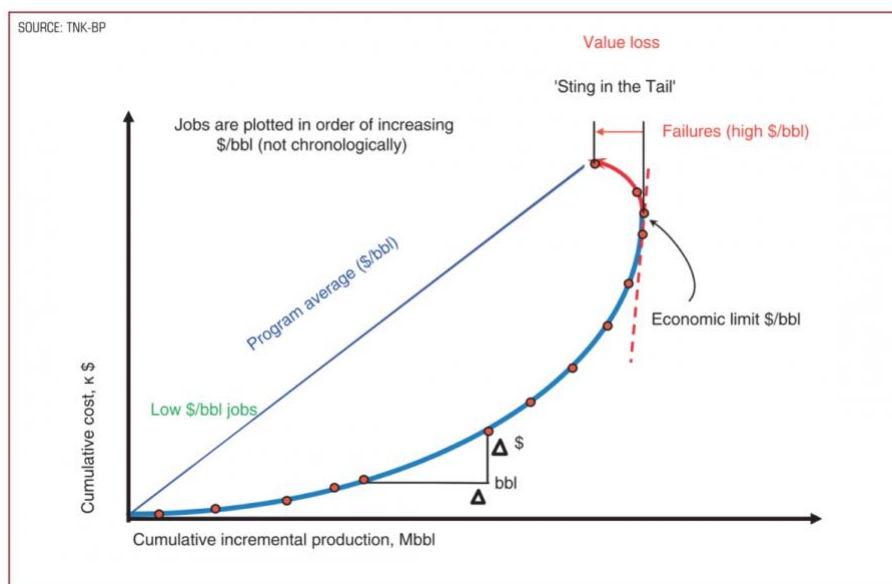


Figure 3 . Scorpion Plot

More details on math and physics of the **Enhancement Tracking** are published on wiki at

https://wiki.pengtools.com/index.php?title=Enhancement_Tracking

Field and Reservoir Data

The “Huron”¹ field has 14 wells drilled from pad “1”, completed and producing from the reservoir “1” (Figure 1).

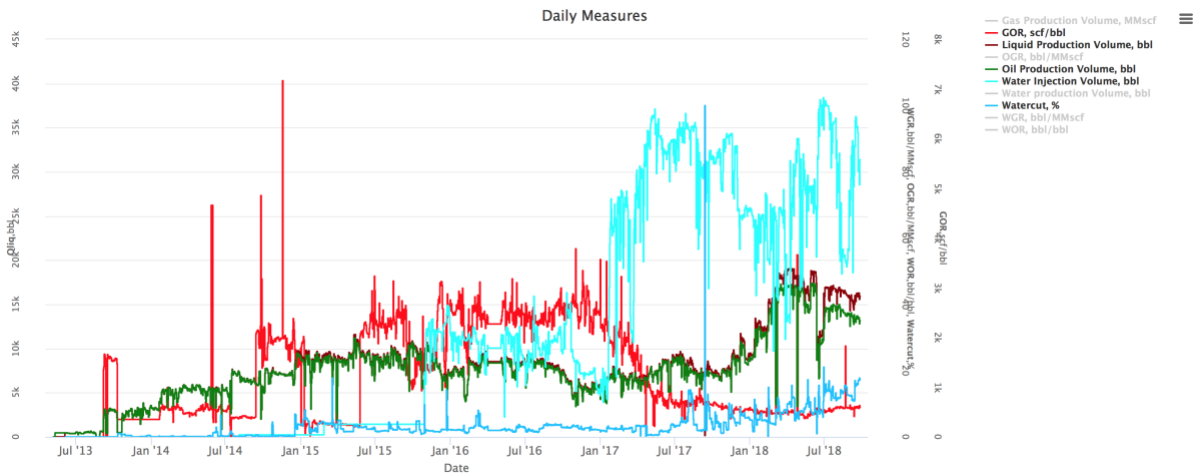


Figure 4 . Huron field production history in the E&P Portal

Well locations are shown on the bubble map showing cumulative production and injection:

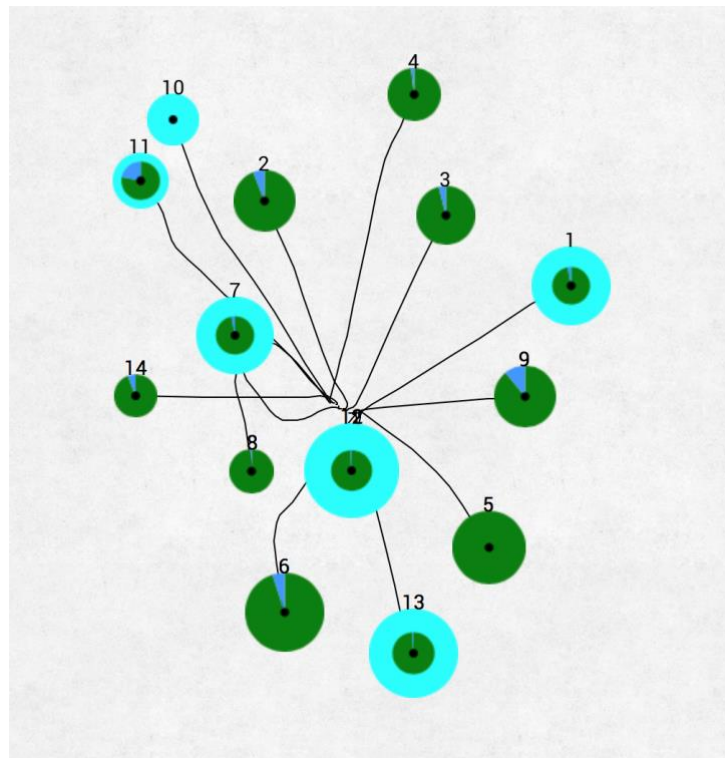


Figure 5 . Huron field bubble map in the E&P Portal

¹ Note that the well, reservoir, field names as well as well production data, dates, costs were changed for the purpose of this study

The reservoir "1" data is given below:

STOIIP		63 MMstb
Connate water saturation	Sw	13 %
Rock compressibility	cr	4.08E-6 psia ⁻¹
Initial reservoir pressure	Pi	3700 psia
Initial reservoir temperature	Ti	100 F
Oil density		40 API
Bubble point pressure	Pb	3700 psia
Solution gas ratio	Rs	2007 scf/bbl
Gas specific gravity	SGgas	0.8
Water specific gravity	SGwater	1.1

Table 1 . Reservoir "1" data.

Enhancement Campaign Data

24 well enhancements were executed in the “Huron” field in 3 campaigns:

1. Choke Open campaign (4);
2. ESP campaign (13);
3. Frac campaign² (7).

Each well enhancement has the following data filed (Figure 6):

- Date
- Type of enhancement (campaign)
- Cost in USD
- Well Stop Date (actual and planned)
- Well Start Date (actual and planned)
- Enhancement design report
- Well Production Forecast

	Country	Field	Pad	Well	Date	Flag	Type	PlotDescriptionReport	Cost USD	Production Forecast	PLAN		ACTUAL	
											Well Stop Date	Well Start Date	Well Stop Date	Well Start Date
	--	--	--	--	--	--	--			--				
	United States	Huron	1	9	2018-06-22	Actual	ESP	ESP upgrade to GN10000	75000	Frac campaign(2013-01-01)	2018-06-12	2018-06-30	2018-06-12	2018-06-30
	United States	Huron	1	5	2018-05-24	Actual	ESP	upgrade to GN6200	65000	ESP campaign(2013-01-01)	2018-05-21	2018-05-28	2018-05-21	2018-05-28
	United States	Huron	1	4	2018-05-16	Actual	ESP	ESP upgrade to GN6200	75000	ESP campaign(2013-01-01)	2018-05-12	2018-05-21	2018-05-12	2018-05-21
	United States	Huron	1	14	2018-03-01	Actual	Frac	good 80 ton job	480000	Frac campaign(2013-01-01)	2017-08-20	2018-03-07	2017-08-20	2018-03-07
	United States	Huron	1	9	2018-02-03	Actual	Frac	nice 130 ton job	550000	Frac campaign(2013-01-01)	2018-01-28	2018-02-14	2018-01-28	2018-02-14
	United States	Huron	1	4	2017-11-11	Actual	ESP	DN4300	65000	ESP campaign(2013-01-01)	2017-11-09	2017-11-17	2017-11-09	2017-11-17
	United States	Huron	1	3	2017-09-06	Actual	Frac	56 tons	300000	Frac campaign(2013-01-01)	2017-08-26	2017-09-17	2017-08-26	2017-11-10
	United States	Huron	1	4	2017-06-19	Actual	Choke Open	Choke size changed from 22 mm to 65 mm	100	Choke campaign(2013-01-01)	2017-06-19	2017-06-19	2017-06-19	2017-06-19
	United States	Huron	1	6	2017-06-18	Actual	ESP	ESP upgrade to DN5850	60000	ESP campaign(2013-01-01)	2017-06-18	2017-06-21	2017-06-18	2017-06-21
	United States	Huron	1	6	2017-01-13	Actual	ESP	3000 bbl/d ESP	55000	ESP campaign(2013-01-01)	2017-01-11	2017-01-16	2017-01-11	2017-01-16
	United States	Huron	1	5	2016-10-29	Actual	ESP	upgrade to 3000 bbl/d ESP	40000	ESP campaign(2013-01-01)	2016-10-23	2016-11-07	2016-10-23	2016-11-07
	United States	Huron	1	11	2016-05-24	Actual	Frac	50 ton + 20 m3 acid	350000	Frac campaign(2013-01-01)	2016-05-24	2016-06-16	2016-05-24	2016-06-16
	United States	Huron	1	5	2016-05-11	Actual	ESP	2500 bbl/d ESP	35000	ESP campaign(2013-01-01)	2016-05-08	2016-05-10	2016-05-08	2016-05-14
	United States	Huron	1	10	2016-04-24	Actual	Frac	50 ton frac no oil	350000	Frac campaign(2013-01-01)	2016-04-24	2016-04-24	2016-04-24	2016-04-24
	United States	Huron	1	3	2016-02-07	Actual	ESP	ESP	50000	ESP campaign(2013-01-01)	2016-02-02	2016-02-12	2016-02-02	2016-02-12
	United States	Huron	1	11	2016-01-20	Actual	Frac	20 ton frac	250000	Frac campaign(2013-01-01)	2015-12-12	2016-02-02	2015-12-12	2016-02-02
	United States	Huron	1	4	2016-01-12	Actual	Frac	15 ton	200000	Frac campaign(2013-01-01)	2016-01-10	2016-03-16	2016-01-10	2016-03-16
	United States	Huron	1	8	2015-12-15	Actual	ESP	1000 bbl/d ESP	25000	ESP campaign(2013-01-01)	2015-12-11	2015-12-22	2015-12-11	2015-12-22
	United States	Huron	1	14	2015-08-01	Actual	ESP	1000 bbl/d ESP	30000	ESP campaign(2013-01-01)	2015-07-28	2015-08-10	2015-07-28	2015-08-10
	United States	Huron	1	5	2015-01-29	Actual	Choke Open	choke full open	1	Choke campaign(2013-01-01)	2015-01-29	2015-01-29	2015-01-29	2015-01-29
	United States	Huron	1	6	2014-09-24	Actual	Choke Open	45 to 55 mm	1000	Choke campaign(2013-01-01)	2014-09-24	2014-09-24	2014-09-24	2014-09-24
	United States	Huron	1	13	2014-06-16	Actual	ESP	1000 bbl/d ESP	35000	ESP campaign(2013-01-01)	2014-06-15	2014-06-19	2014-06-15	2014-06-19
	United States	Huron	1	5	2014-04-20	Actual	Choke Open	choke	5000	Choke campaign(2013-01-01)	2014-04-20	2014-04-20	2014-04-20	2014-04-20
	United States	Huron	1	9	2013-10-11	Actual	ESP	3000 bbl/d ESP	45000	ESP campaign(2013-01-01)	2013-10-10	2013-10-16	2013-10-10	2013-10-21
Total:									3141101					

Figure 6. Wells Enhancement data in the E&P Portal

In the next section as an example well “9” enhancements are reviewed in detail.

² The ESP is installed after the frac job by default. The frac cost includes the cost of the frac itself and the cost of installed ESP.

Well 9 Enhancements

There are 3 enhancements done in Well “9”:

1. Flowing well was converted to the ESP (before / after points 1 and 2);
2. Damaged well was fractured (before / after points 3 and 4);
3. Limited capacity ESP was upgraded (before / after points 4 and 5).

The enhancements are shown on the plot below:

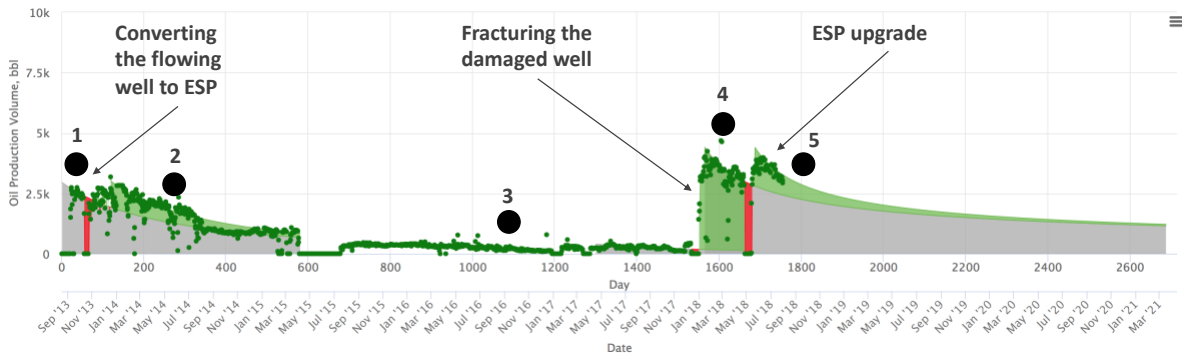


Figure 7 . Well “9” history plot with enhancements in the E&P Portal

The well “9” performance is shown on the PQplot below:

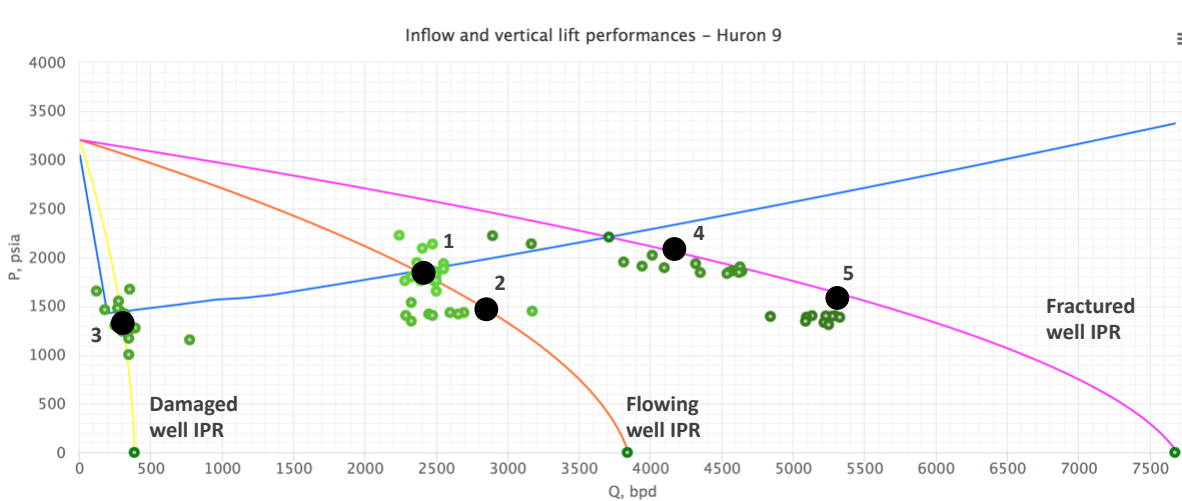


Figure 8 . Well “9” PQplot with before and after enhancement performance points

Below are details on each enhancement done.

Enhancement 1. Converting the flowing well to the ESP

Soon after well startup the well’s flowing data was gathered and well performance was analyzed with [PQplot](#) (Figure 8 point 1). It was quickly realized that well is not working at potential ($Q \sim 2400$ bbl/d) and where potential is (unstimulated well AOF ~ 3800 bbl/d).

To close the performance gap ESP enhancement was designed. The maximum capacity ESP available at that moment was targeting $q_l = 3000$ bbl/d at $P_{wf} \sim 1300$ psi (Figure 9).



Figure 9 . Well “9” ESP design with the [PumpDesign](#) tool

The pump design report is attached as:

📎 Attachment 1 “Huron 9 Pump Design Report.pdf”.

The well was converted to a 5000 bbl/d ESP and started with enhanced performance shown as “point 2” on Figure 8.

The incremental oil recovery reached by this enhancement is **192,623 bbl** at cost of **\$45,000** which is **0.23 USD/bbl** (Figure 40).

Enhancement 2. Fracing the damaged well

After about 2 years of production well “9” was damaged during the workover and left behind for about 2 more years (Figure 8 point 3).

As soon as frac campaign was started the 290000 lbm (130 ton) frac enhancement was designed. Given the maximum permeability proppant 16/20 available at the moment the design target was $J_D=0.32$ which is about 100 folds of productivity increase (Figure 10).

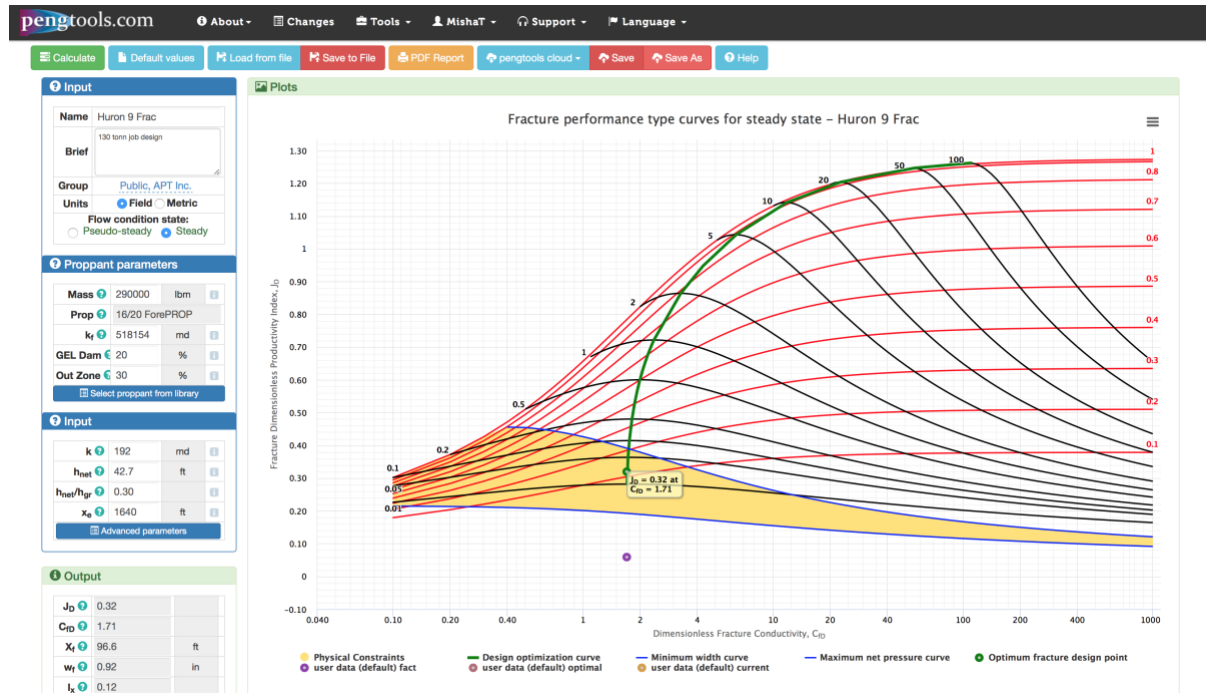


Figure 10 . Well “9” frac design with the [optiFrac](#) tool

The frac design report is attached as:

📎 Attachment 2“Huron 9 Frac Design Report.pdf”.

The well “9” was fraced and started with new performance (Figure 8 point 4).

About 20 folds of productivity increase was achieved in this high permeability (~200md) sand (purple point on the frac design Figure 10 shows the achieved vs planned J_D).

The incremental oil recovery reached by this enhancement is **399,903 bbl** at cost of **\$550,000** which is **1.38 USD/bbl** (Figure 46).

Enhancement 3. ESP upgrade

Soon after the fraced well flowing data was gathered well performance was reevaluated. It was realized that current ESP capacity is not enough to reach the well potential and ESP needs to be upgraded to the bigger one.

To close the performance gap ESP upgrade enhancement was designed The maximum capacity ESP available at that moment was targeting $q_l=5300$ bbl/d at $P_{wf} \sim 1450$ psi (Figure 11).



Figure 11 . Well “9” ESP upgrade design with the [PumpDesign](#) tool

The pump design report is attached as:

📎 Attachment 3“Huron 9 ESP upgrade Report.pdf”.

The well was converted to a 10000 bbl/d ESP and started with new performance (Figure 8 point 5).

The incremental oil recovery reached by this enhancement is **87,814 bbl** at cost of **\$75,000** which is **0.85 USD/bbl** (Figure 52).

Data Input to the E&P Portal

Signing up

First open ep.pengtools.com in your browser and signup or login to the **E&P Portal**.

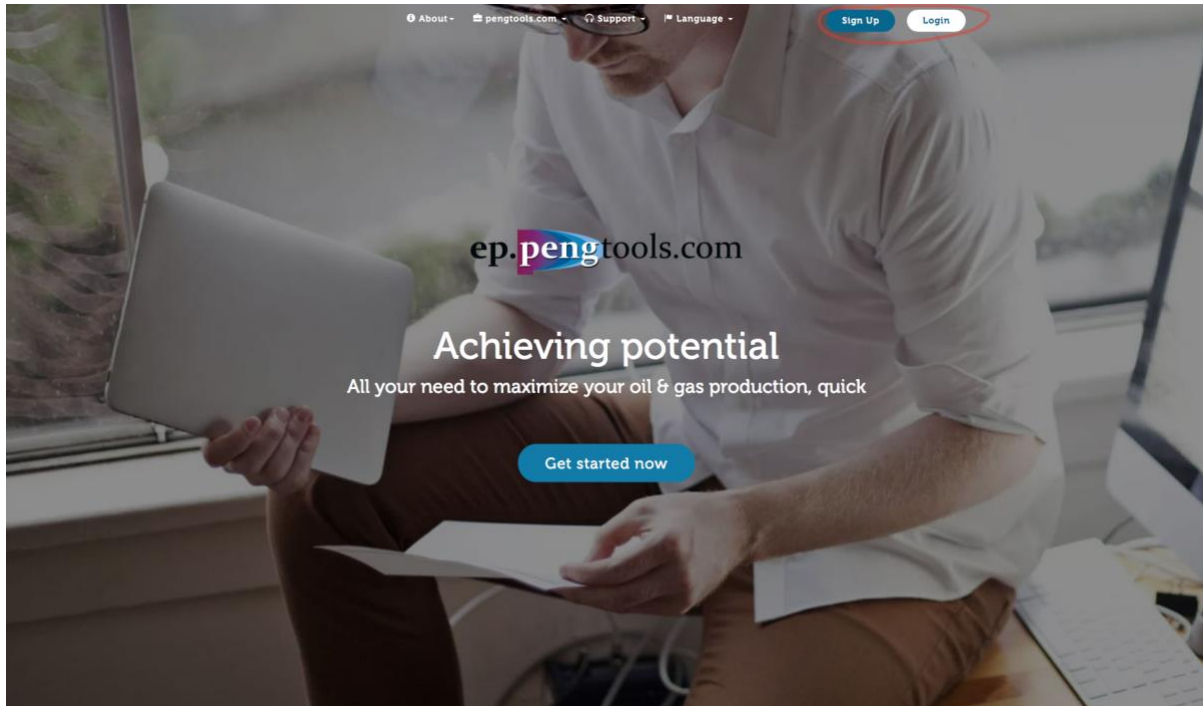


Figure 12 . E&P Portal landing page

After signing up /logging in you'll see the main **E&P Portal** page:

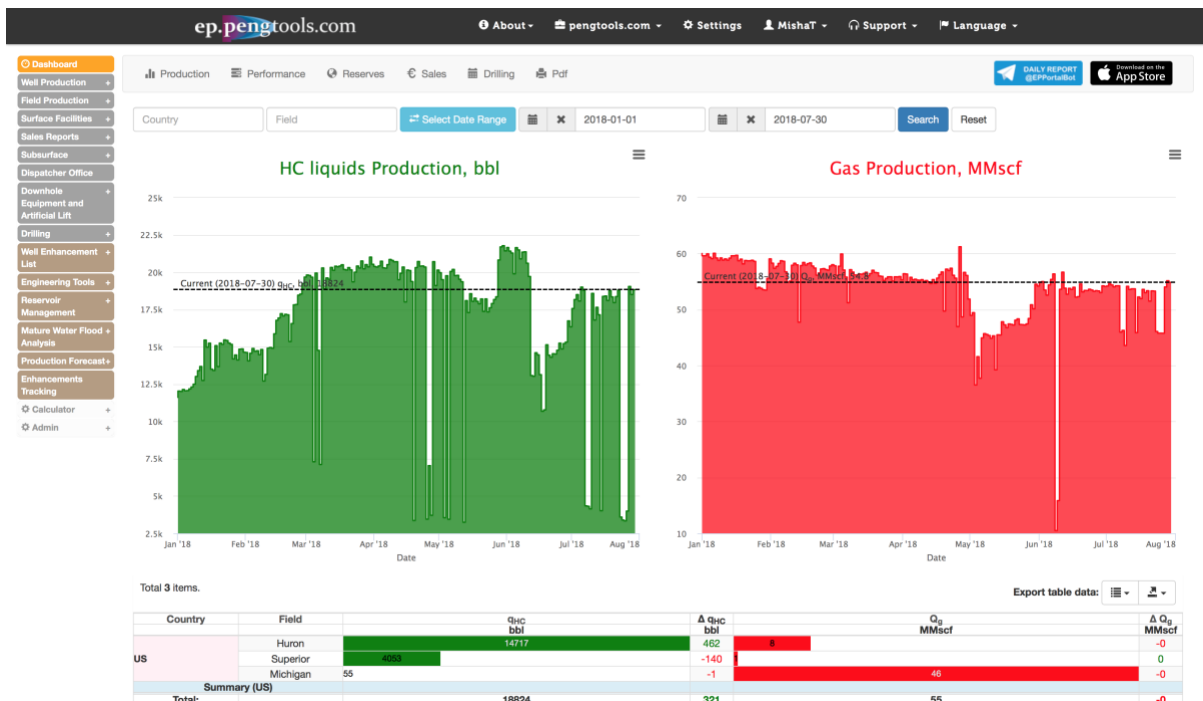


Figure 13 . Main page of the E&P Portal

Check the units in the page footer to be “Field”.

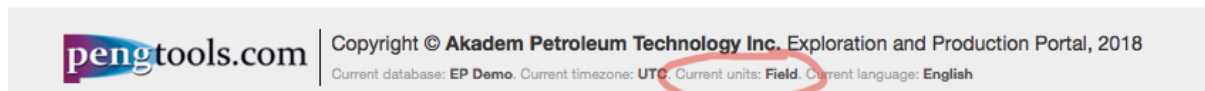


Figure 14. Field units in the main page footer

Check the current database in the page footer to be “EP Demo”.

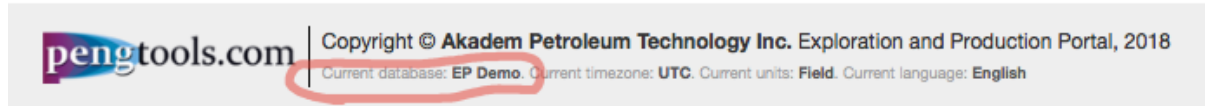


Figure 15. Current database in the main page footer

😊 Now you are ready to start entering the data into the **E&P Portal**

Adding the “Huron” field

In the left menu open the “Fields” page of the “Subsurface” module:

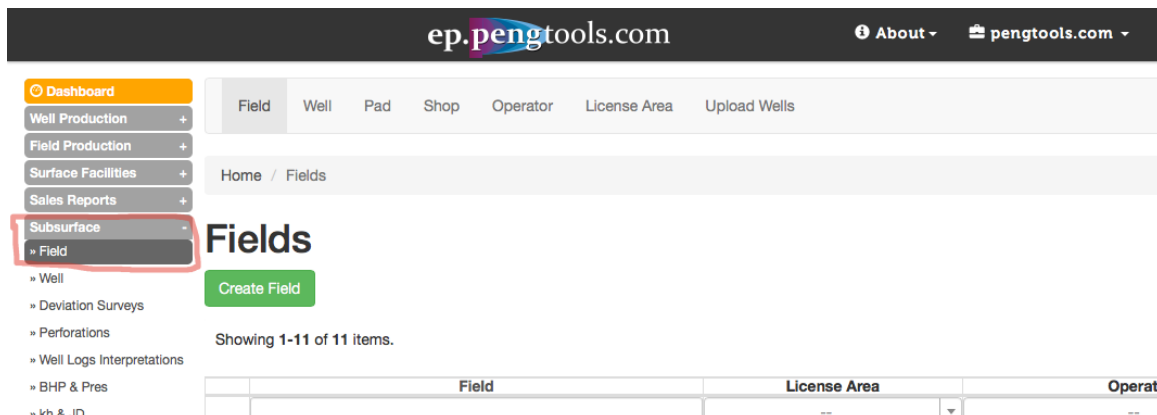


Figure 16. Fields page of subsurface module of the E&P Portal

Click “Create Field”, fill the form as follows and click “Create”:

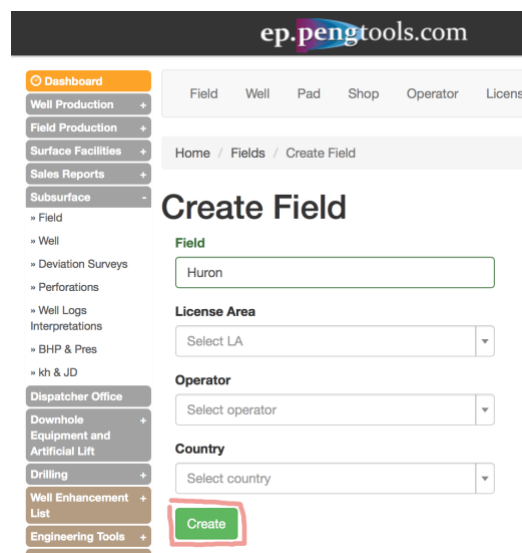


Figure 17. Creating the “Huron” field in the E&P Portal

😊 Now you have successfully added the “Huron” field to the **E&P Portal**:

Adding the Huron pad “1”

In the left menu open the “Fields” page of the “Subsurface” module and click “Pad”:

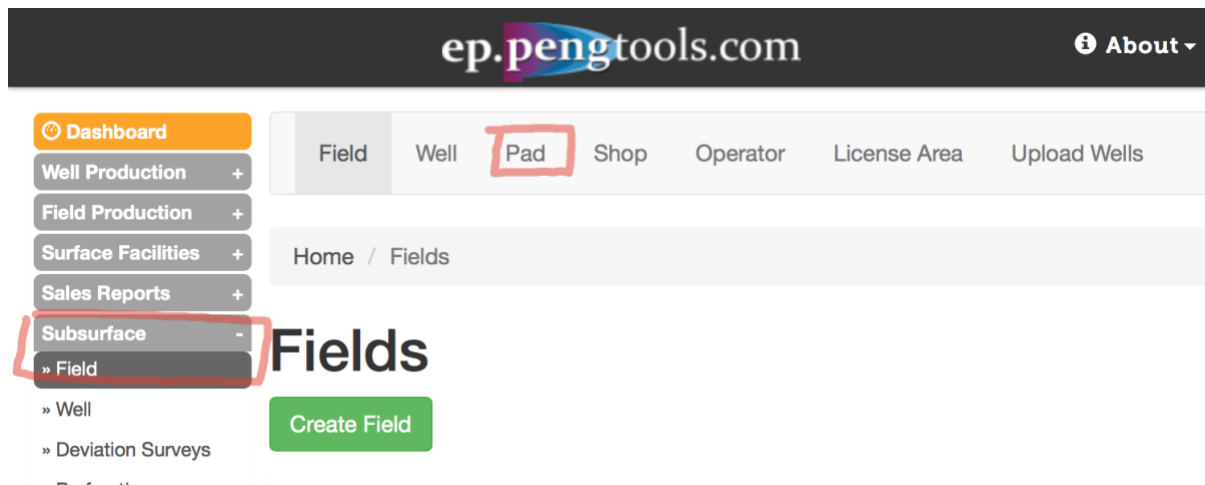


Figure 18. Pad page of subsurface module of the E&P Portal

Click “Create Pad”, fill the form as follows and click “Create”:

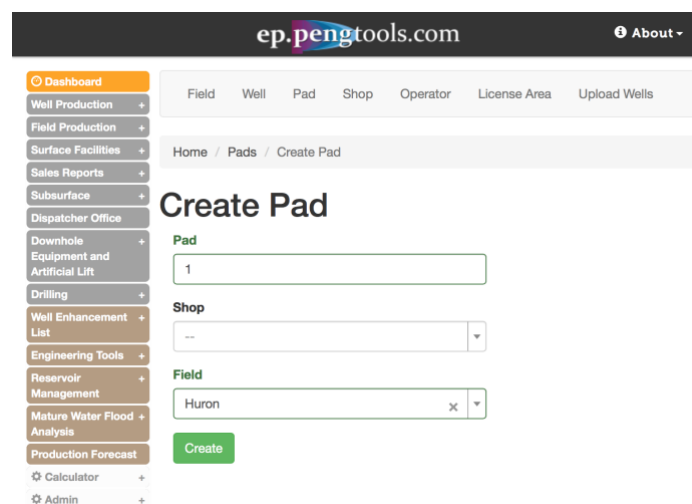


Figure 19. Creating the pad “1” in the E&P Portal

😊 Now you have successfully added the pad “1” field to the **E&P Portal**:

Uploading Huron wells

In the left menu open the “Well” page of the “Subsurface” module and click “Upload Wells”:



Figure 20. Well page of Subsurface module of the E&P Portal

Fill the form as follows and click “Upload”. The well list as attached as:

Attachment 4 “Huron wells.csv”.

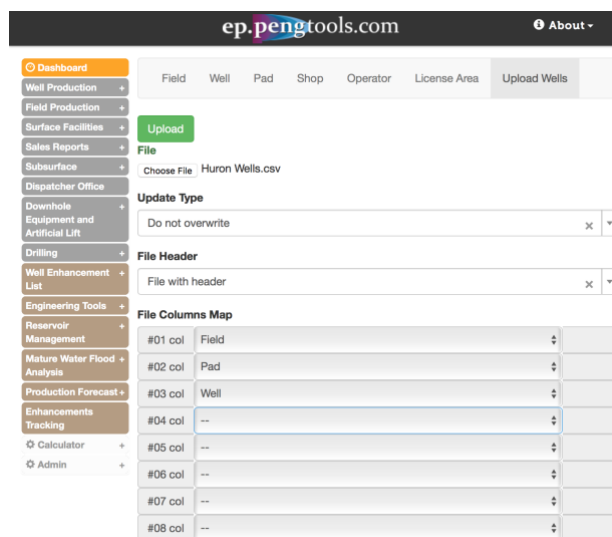


Figure 21. Creating the well “8” in the E&P Portal

Wait for the message showing the data upload status:

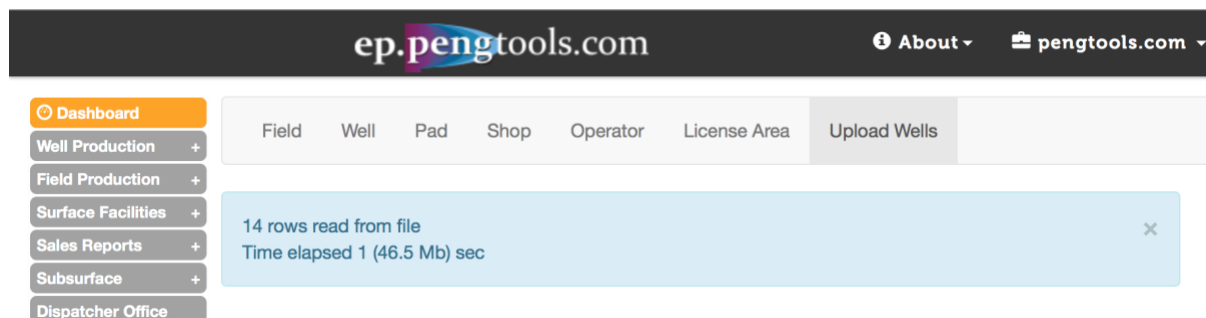


Figure 22. Successful wells upload message

😊 Now you have successfully added Huron wells to the **E&P Portal**:

ep.pengtools.com About - pengtools.com - Settings MishaT - Support - Language -

Dashboard
Well Production
Field Production
Surface Facilities
Sales Reports
Subsurface
Field
Well
Deviations Surveys
Perforations
Well Logs Interpretations
BHP & Pres
kh & JD
Dispatcher Office
Downhole Equipment and Artificial Lift
Drilling
Well Enhancement List
Engineering Tools
Reservoir Management
Mature Water Flood Analysis
Production Forecast
Enhancements Tracking
Calculator
Admin

Field Well Pad Shop Operator License Area Upload Wells

Home / Wells

Wells

Create Well Wiki it

Showing 1-14 of 14 items.

Export table data: [icon] [icon]

Well ID	Pad	Shop	Field	Operator	License Area	Country	Well Type	Status	Status Type	Deviation Type	Operation Type	Username	Created At	Updated At
1	1		Huron			United States	Change	Change	Change		Change	Mikhail Tuzovskiy	2018-07-26 10:16:28+00	2018-07-26 10:16:28+00
10	1		Huron			United States	Change	Change	Change		Change	Mikhail Tuzovskiy	2018-07-26 10:16:28+00	2018-07-26 10:16:28+00
11	1		Huron			United States	Change	Change	Change		Change	Mikhail Tuzovskiy	2018-07-26 10:16:28+00	2018-07-26 10:16:28+00
12	1		Huron			United States	Change	Change	Change		Change	Mikhail Tuzovskiy	2018-07-26 10:16:28+00	2018-07-26 10:16:28+00
13	1		Huron			United States	Change	Change	Change		Change	Mikhail Tuzovskiy	2018-07-26 10:16:28+00	2018-07-26 10:16:28+00
14	1		Huron			United States	Change	Change	Change		Change	Mikhail Tuzovskiy	2018-07-26 10:16:28+00	2018-07-26 10:16:28+00
2	1		Huron			United States	Change	Change	Change		Change	Mikhail Tuzovskiy	2018-07-26 10:16:28+00	2018-07-26 10:16:28+00
3	1		Huron			United States	Change	Change	Change		Change	Mikhail Tuzovskiy	2018-07-26 10:16:28+00	2018-07-26 10:16:28+00
4	1		Huron			United States	Change	Change	Change		Change	Mikhail Tuzovskiy	2018-07-26 10:16:28+00	2018-07-26 10:16:28+00
5	1		Huron			United States	Change	Change	Change		Change	Mikhail Tuzovskiy	2018-07-26 10:16:28+00	2018-07-26 10:16:28+00
6	1		Huron			United States	Change	Change	Change		Change	Mikhail Tuzovskiy	2018-07-26 10:16:28+00	2018-07-26 10:16:28+00
7	1		Huron			United States	Change	Change	Change		Change	Mikhail Tuzovskiy	2018-07-26 10:16:28+00	2018-07-26 10:16:28+00
8	1		Huron			United States	Change	Change	Change		Change	Mikhail Tuzovskiy	2018-07-26 10:16:28+00	2018-07-26 10:16:28+00
9	1		Huron			United States	Change	Change	Change		Change	Mikhail Tuzovskiy	2018-07-26 10:16:28+00	2018-07-26 10:16:28+00

Figure 23. Huron wells in the E&P Portal

Upload the Huron wells daily production data

In the left menu open the “Daily Data” page of the “Well Production” module and click “Upload”:

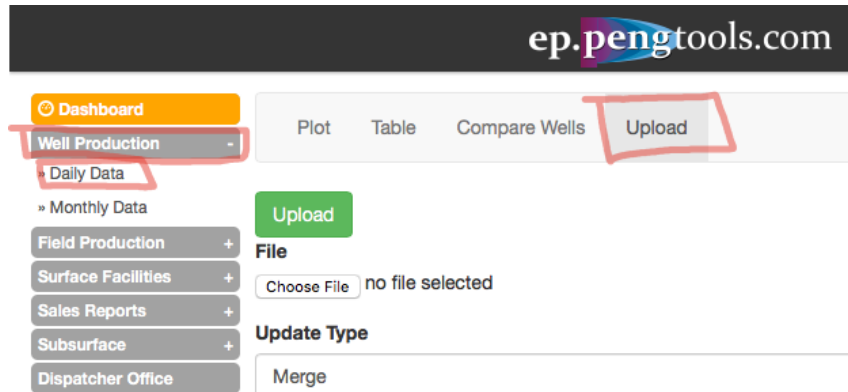


Figure 24. Wells daily data upload page of the E&P Portal

Fill the form as follows and click “Upload”. Huron wells daily production data is attached as:

Attachment 5 “Huron wells daily measures.csv”.

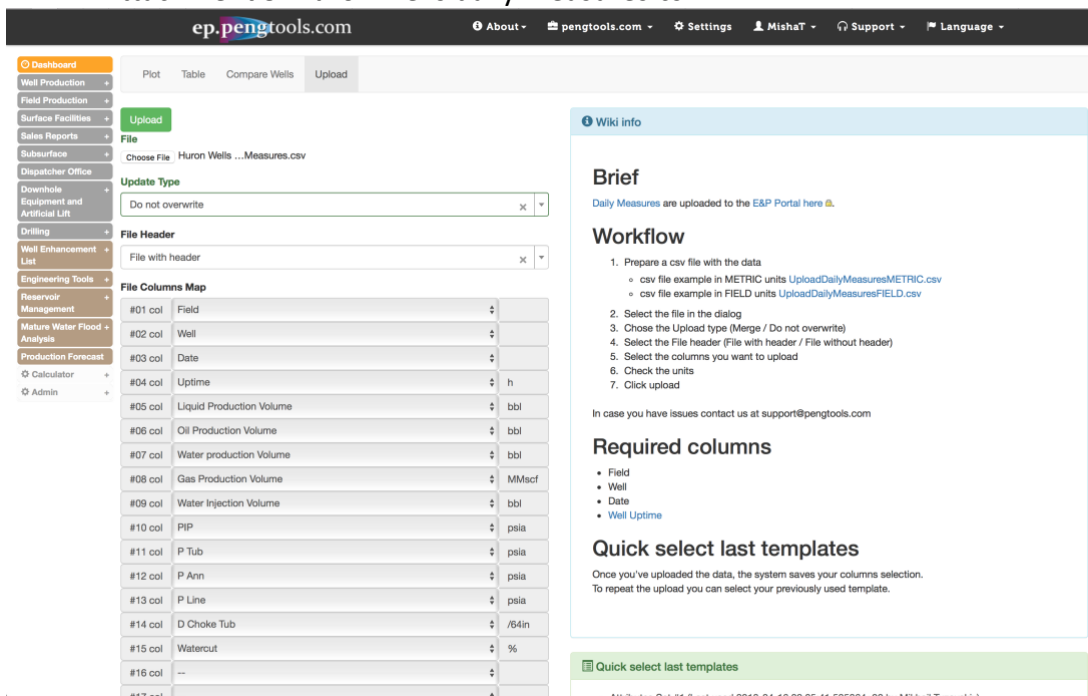


Figure 25. Huron wells daily data upload to the E&P Portal

Wait for the message showing the data upload status:

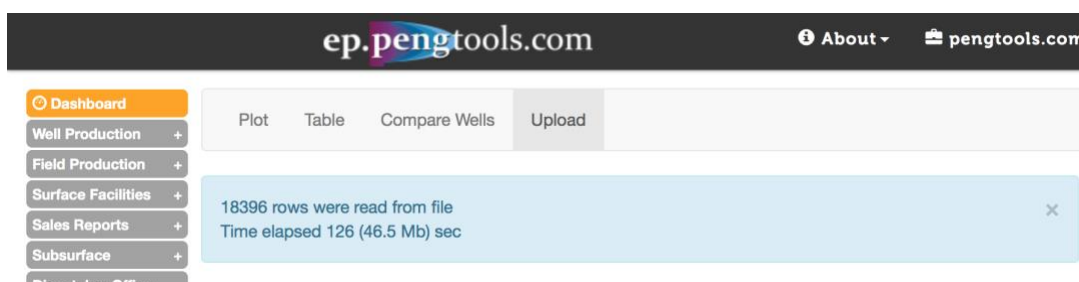


Figure 26. Huron wells daily data upload status message

😊 Now you have successfully uploaded Huron wells daily data to the **E&P Portal**.

Let's visually inspect the data uploaded for one of the wells. In the top menu click the "Plot". Fill the filter as follows and click "Search":

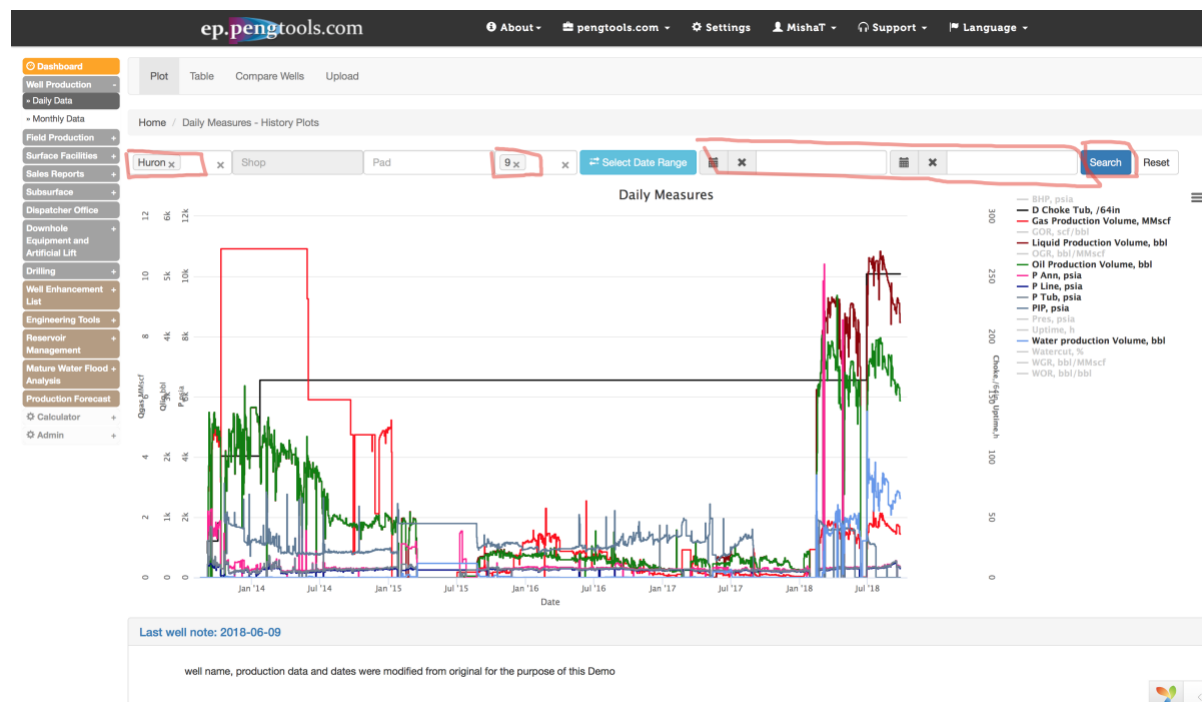


Figure 27. Huron well "9" daily data visualization in the E&P Portal

Upload the Huron wells enhancement production forecast data

In the left menu open the “Well” page of the “Production Forecast” module and click “Well Upload”:

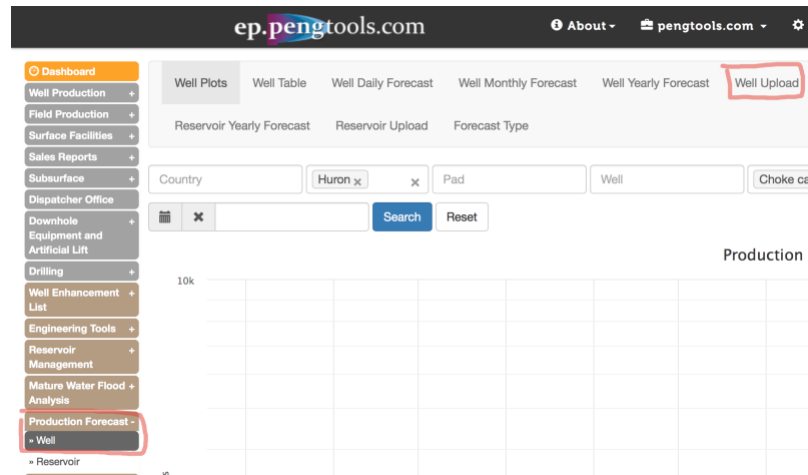


Figure 28. Production Forecast upload page of the E&P portal

Fill the form as follows and click “Upload”. The wells production forecast data is attached as:

📎 Attachment 6 “Huron wells production forecast data.csv”.

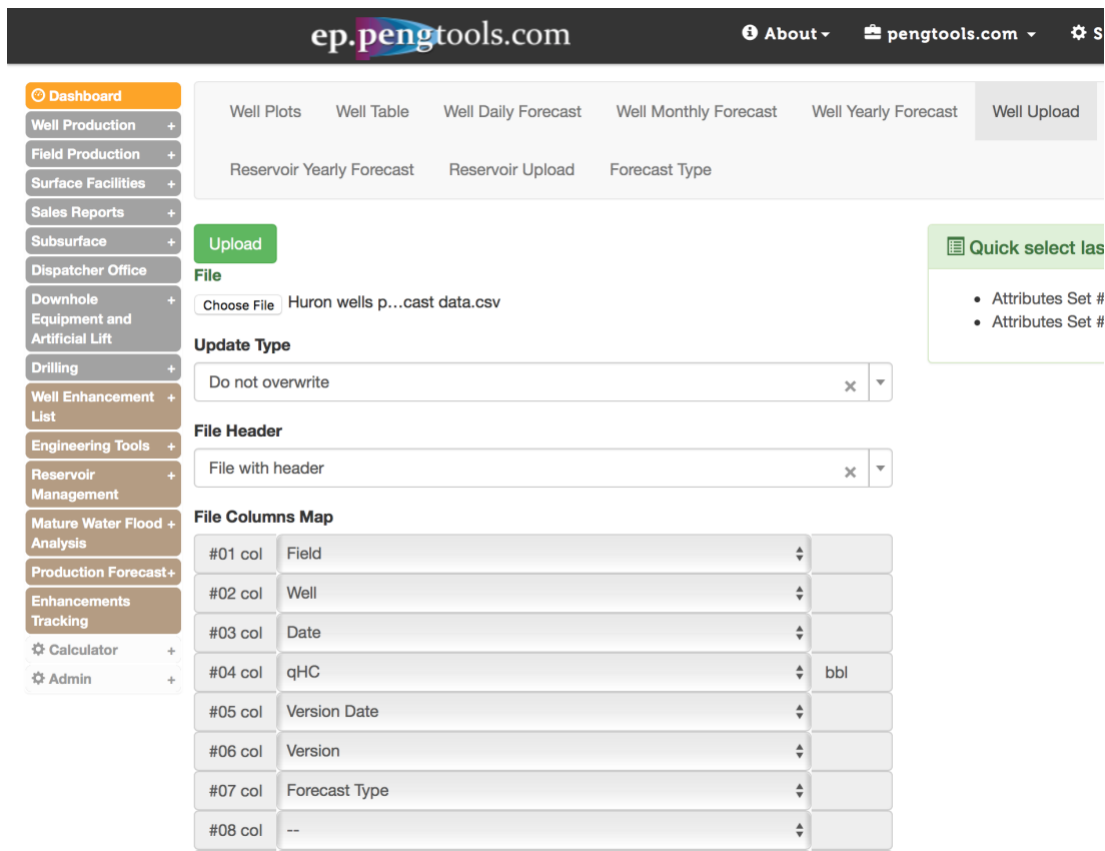


Figure 29. Huron wells enhancement campaign production forecast upload to the E&P Portal

Wait for the message showing the data upload status:

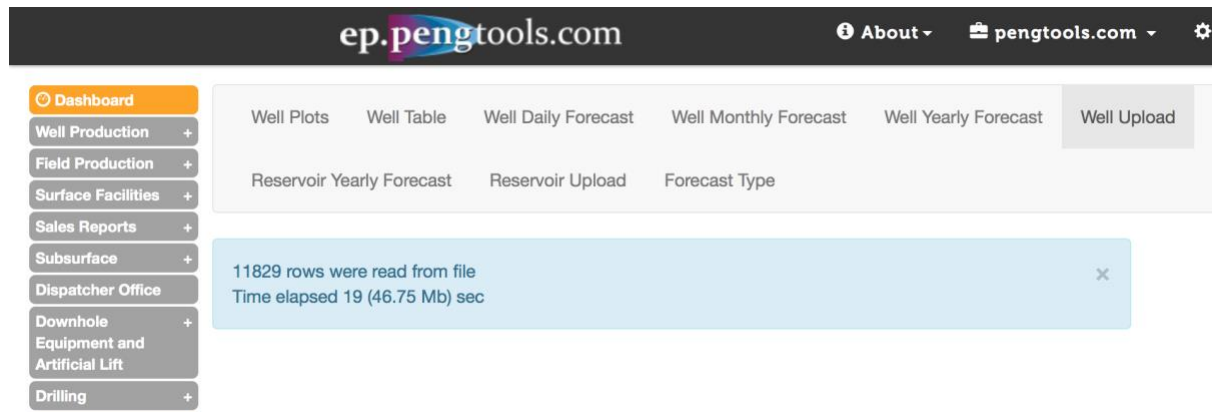


Figure 30. Huron wells enhancement campaign production forecast upload status message

😊 Now you have successfully uploaded Huron wells enhancement production forecast data to the **E&P Portal**

The screenshot shows the 'Well Production Forecast' page. It includes a sidebar with navigation options and a main table. The table has columns for Country, Field, Pad, Well, Version, Date, Type, Start Date, End Date, Days Flag, GP, PGP, OP, POIP, Username, Created At, and Updated At. The data rows list various wells from the Huron field, including ESP and Frac campaigns, with their respective production metrics and dates.

Country	Field	Pad	Well	Version	Date	Type	Start Date	End Date	Days Flag	GP	PGP	OP	POIP	Username	Created At	Updated At
United States	Huron	1	14	2013-01-01	ESP campaign	Decline	2015-08-04	2017-07-14	711	Use k	9.18	0	10,791	18,355	2018-07-26 10:53:14	2018-07-26 10:53:14
United States	Huron	1	14	2013-01-01	Frac campaign	Decline	2018-03-13	2019-09-14	551	Use k	24.3	0	9,255	20,849	2018-07-26 10:53:14	2018-07-26 10:53:14
United States	Huron	1	13	2013-01-01	ESP campaign	Decline	2014-06-19	2015-07-24	401	Use k	6.01	0	7,172	57,090	2018-07-26 10:53:10	2018-07-26 10:53:10
United States	Huron	1	11	2013-01-01	Frac campaign	Decline	2016-02-02	2016-11-15	257	Use k	0	0	40,450		2018-07-26 10:53:18	2018-07-26 10:53:18
United States	Huron	1	10	2013-01-01	Frac campaign	Decline	2016-04-24	2016-08-01	100	Use k	0	0	38,274		2018-07-26 10:53:21	2018-07-26 10:53:21
United States	Huron	1	9	2013-01-01	ESP campaign	Decline	2013-10-16	2016-07-11	1,000	Use k	36.7	0	1,799	1,261	2018-07-26 10:53:04	2018-07-26 10:53:04
United States	Huron	1	9	2013-01-01	Frac campaign	Decline	2018-02-14	2020-11-09	1,000	Use k	7.04	0	1,042.25	2,729,270	2018-07-26 10:53:04	2018-07-26 10:53:04
United States	Huron	1	8	2013-01-01	ESP campaign	Decline	2015-12-22	2016-09-20	274	Use k	76.0	0	30,043	12,458	2018-07-26 10:53:16	2018-07-26 10:53:16
United States	Huron	1	6	2013-01-01	Choke campaign	Decline	2014-09-24	2015-01-22	121	Use k	28.4	0	70,239	30,182	2018-07-26 10:53:12	2018-07-26 10:53:12
United States	Huron	1	6	2013-01-01	ESP campaign	Decline	2017-01-16	2020-01-31	1,105	Use k	2,062	0	1,568,557	3,207,490	2018-07-26 10:53:12	2018-07-26 10:53:12
United States	Huron	1	5	2013-01-01	Choke campaign	Decline	2014-04-20	2016-04-06	714	Use k	41.5	0	32,967	3,789	2018-07-26 10:53:05	2018-07-26 10:53:05
United States	Huron	1	5	2013-01-01	ESP campaign	Decline	2016-05-10	2020-12-29	1,681	Use k	2,140	0	1,317,854	3,565,916	2018-07-26 10:53:16	2018-07-26 10:53:16
United States	Huron	1	4	2013-01-01	Frac campaign	Decline	2016-03-16	2017-05-14	425	Use k	1.91	0	0	46,171	2018-07-26 10:53:17	2018-07-26 10:53:17
United States	Huron	1	4	2013-01-01	Choke campaign	Decline	2017-06-19	2017-11-10	145	Use k	2.25	0	3,144	87,442	2018-07-26 10:53:17	2018-07-26 10:53:17
United States	Huron	1	4	2013-01-01	ESP campaign	Decline	2017-11-17	2021-06-09	1,289	Use k	1,580	0	3,852	1,858,077	2018-07-26 10:53:17	2018-07-26 10:53:17
United States	Huron	1	3	2013-01-01	ESP campaign	Decline	2016-02-12	2016-09-09	211	Use k	7.6	0	891.57	89,242	2018-07-26 10:53:18	2018-07-26 10:53:18
United States	Huron	1	3	2013-01-01	Frac campaign	Decline	2017-09-17	2022-01-24	1,591	Use k	1,970	0	888,772	18,911	2018-07-26 10:53:20	2018-07-26 10:53:20
Total:										11,536	0	7,206,318	15,901,247			

Figure 31. Huron wells enhancement campaign production forecast in the E&P Portal

Upload the Huron wells enhancement campaign data

In the left menu open the “Upload” page of the “Enhancement Tracking” module and click “Upload”:

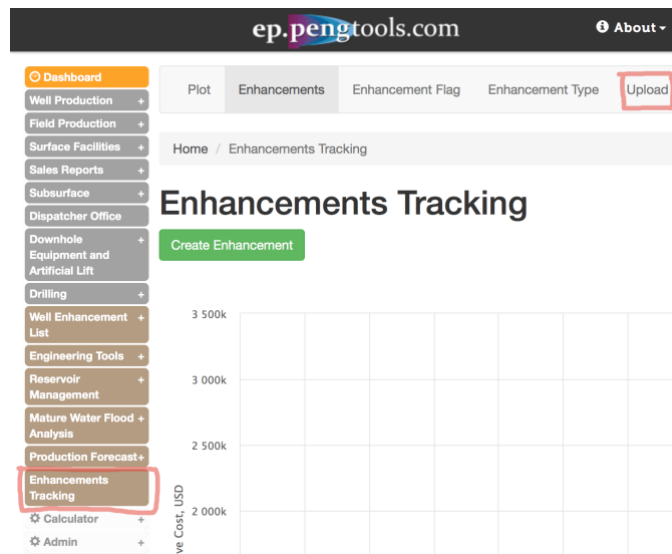


Figure 32. Enhancement Tracking upload page of the E&P portal

Fill the form as follows and click “Upload”. The wells enhancement data is attached as:

① Attachment 7 “Huron wells enhancement data.csv”:

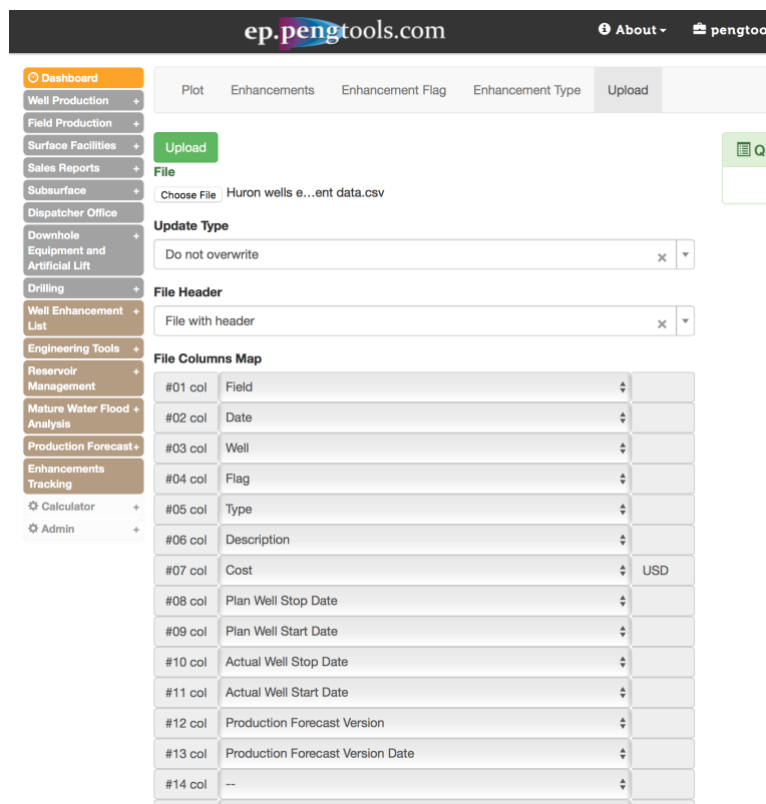


Figure 33. Huron wells enhancement campaign data upload to the E&P Portal

Wait for the message showing the data upload status:

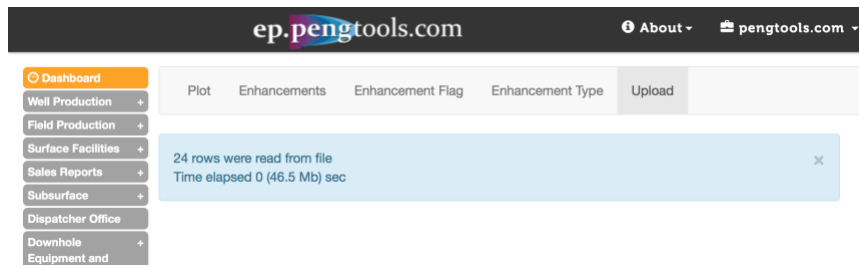


Figure 34. Huron wells enhancement campaign data upload status message

😊 Now you have successfully uploaded Huron wells enhancement campaign data to the E&P Portal

	Country	Field	Pad	Well	Date	Flag	Type	PlotDescriptionReport	Cost USD	Production Forecast	PLAN		ACTUAL	
											Well Stop Date	Well Start Date	Well Stop Date	Well Start Date
	--	--	--	--		--	--			--				
	United States	Huron	1	9	2018-06-22	Actual	ESP	ESP upgrade to GN10000	75000	Frac campaign(2013-01-01)	2018-06-12	2018-06-30	2018-06-12	2018-06-30
	United States	Huron	1	5	2018-05-24	Actual	ESP	upgrade to GN6200	65000	ESP campaign(2013-01-01)	2018-05-21	2018-05-28	2018-05-21	2018-05-28
	United States	Huron	1	4	2018-05-16	Actual	ESP	ESP upgrade to GN6200	75000	ESP campaign(2013-01-01)	2018-05-12	2018-05-21	2018-05-12	2018-05-21
	United States	Huron	1	14	2018-03-01	Actual	Frac	good 80 ton job	480000	Frac campaign(2013-01-01)	2017-08-20	2018-03-07	2017-08-20	2018-03-07
	United States	Huron	1	9	2018-02-03	Actual	Frac	nice 130 ton job	550000	Frac campaign(2013-01-01)	2018-01-28	2018-02-14	2018-01-28	2018-02-14
	United States	Huron	1	4	2017-11-11	Actual	ESP	DN4300	65000	ESP campaign(2013-01-01)	2017-11-09	2017-11-17	2017-11-09	2017-11-17
	United States	Huron	1	3	2017-09-06	Actual	Frac	56 tons	300000	Frac campaign(2013-01-01)	2017-08-26	2017-09-17	2017-08-26	2017-11-10
	United States	Huron	1	4	2017-06-19	Actual	Choke Open	Choke size changed from 22 mm to 65 mm	100	Choke campaign(2013-01-01)	2017-06-19	2017-06-19	2017-06-19	2017-06-19
	United States	Huron	1	6	2017-06-18	Actual	ESP	ESP upgrade to DN5650	60000	ESP campaign(2013-01-01)	2017-06-18	2017-06-21	2017-06-18	2017-06-21
	United States	Huron	1	6	2017-01-13	Actual	ESP	3000 bbl/d ESP	55000	ESP campaign(2013-01-01)	2017-01-11	2017-01-16	2017-01-11	2017-01-16
	United States	Huron	1	5	2016-10-29	Actual	ESP	upgrade to 3000 bbl/d ESP	40000	ESP campaign(2013-01-01)	2016-10-23	2016-11-07	2016-10-23	2016-11-07
	United States	Huron	1	11	2016-05-24	Actual	Frac	50 ton + 20 m3 acid	350000	Frac campaign(2013-01-01)	2016-05-24	2016-06-16	2016-05-24	2016-06-16
	United States	Huron	1	5	2016-05-11	Actual	ESP	2500 bbl/d ESP	35000	ESP campaign(2013-01-01)	2016-05-08	2016-05-10	2016-05-08	2016-05-14
	United States	Huron	1	10	2016-04-24	Actual	Frac	50 ton frac no oil	350000	Frac campaign(2013-01-01)	2016-04-24	2016-04-24	2016-04-24	2016-04-24
	United States	Huron	1	3	2016-02-07	Actual	ESP	ESP	50000	ESP campaign(2013-01-01)	2016-02-02	2016-02-12	2016-02-02	2016-02-12
	United States	Huron	1	11	2016-01-20	Actual	Frac	20 ton frac	250000	Frac campaign(2013-01-01)	2015-12-12	2016-02-02	2015-12-12	2016-02-02
	United States	Huron	1	4	2016-01-12	Actual	Frac	15 ton	200000	Frac campaign(2013-01-01)	2016-01-10	2016-03-16	2016-01-10	2016-03-16
	United States	Huron	1	8	2015-12-15	Actual	ESP	1000 bbl/d ESP	25000	ESP campaign(2013-01-01)	2015-12-11	2015-12-22	2015-12-11	2015-12-22
	United States	Huron	1	14	2015-08-01	Actual	ESP	1000 bbl/d ESP	30000	ESP campaign(2013-01-01)	2015-07-28	2015-08-10	2015-07-28	2015-08-10
	United States	Huron	1	5	2015-01-29	Actual	Choke Open	choke full open	1	Choke campaign(2013-01-01)	2015-01-29	2015-01-29	2015-01-29	2015-01-29
	United States	Huron	1	6	2014-09-24	Actual	Choke Open	45 to 55 mm	1000	Choke campaign(2013-01-01)	2014-09-24	2014-09-24	2014-09-24	2014-09-24
	United States	Huron	1	13	2014-06-16	Actual	ESP	1000 bbl/d ESP	35000	ESP campaign(2013-01-01)	2014-06-15	2014-06-19	2014-06-15	2014-06-19
	United States	Huron	1	5	2014-04-20	Actual	Choke Open	ESP	5000	Choke campaign(2013-01-01)	2014-04-20	2014-04-20	2014-04-20	2014-04-20
	United States	Huron	1	9	2013-10-11	Actual	ESP	3000 bbl/d ESP	45000	ESP campaign(2013-01-01)	2013-10-10	2013-10-16	2013-10-10	2013-10-21
Total:									3141101					

Figure 35. Huron wells enhancement campaign data in the E&P Portal

Applying the Enhancement Tracking

The well enhancement tracking workflow is:

1. Open the well enhancement page
2. Create the decline model before the enhancement – Base Type Curve
3. Create the decline model after the enhancement – Enhanced Type Curve
4. Inspect the actual IOR vs plan
5. Save the model data
6. Move to the next well enhancement

First well “9” enhancements will be processed as an example.

Then the total enhancement campaign will be analyzed.

Well 9 Enhancement

Enhancement 1. Converting the flowing well to the ESP

STEP 1: In the left menu open the “Enhancement Tracking” page, scroll down to the table and click “Show Plot” to open the ESP enhancement:

ep.pengtools.com About pengtools.com Settings MishaT Support

Showing 1-24 of 24 items.

Country	Field	Pad	Well	Date	Flag	Type	PlotDescriptionReport	Cost	Production Forecast	PLAN Well Stop Date	PLAN Well Start Date	ACTUAL Well Stop Date	ACTUAL Well Start Date
United States	Huron	1	9	2018-06-22	Actual	ESP	ESP upgrade to GN10000	75000	Frac campaign(2013-01-01)	2018-06-12	2018-06-30	2018-06-12	2018-06-30
United States	Huron	1	5	2018-05-24	Actual	ESP	upgrade to GN8200	65000	ESP campaign(2013-01-01)	2018-05-21	2018-05-28	2018-05-21	2018-05-28
United States	Huron	1	4	2018-05-16	Actual	ESP	ESP upgrade to GN8200	75000	ESP campaign(2013-01-01)	2018-05-12	2018-05-21	2018-05-12	2018-05-21
United States	Huron	1	14	2018-03-01	Actual	Frac	good 80 ton job	480000	Frac campaign(2013-01-01)	2017-08-20	2018-03-07	2017-08-20	2018-03-07
United States	Huron	1	9	2018-02-03	Actual	Frac	nice 130 ton job	550000	Frac campaign(2013-01-01)	2018-01-28	2018-02-14	2018-01-28	2018-02-14
United States	Huron	1	4	2017-11-11	Actual	ESP	DN4300	65000	ESP campaign(2013-01-01)	2017-11-09	2017-11-17	2017-11-09	2017-11-17
United States	Huron	1	3	2017-09-06	Actual	Frac	56 tons	300000	Frac campaign(2013-01-01)	2017-08-26	2017-09-17	2017-08-26	2017-11-10
United States	Huron	1	4	2017-06-19	Actual	Choke Open	Choke size changed from 22 mm to 65 mm	100	Choke campaign(2013-01-01)	2017-06-19	2017-06-19	2017-06-19	2017-06-19
United States	Huron	1	6	2017-06-18	Actual	ESP	ESP upgrade to DN5850	60000	ESP campaign(2013-01-01)	2017-06-18	2017-06-21	2017-06-18	2017-06-21
United States	Huron	1	6	2017-01-13	Actual	ESP	3000 bbl/d ESP	55000	ESP campaign(2013-01-01)	2017-01-11	2017-01-16	2017-01-11	2017-01-16
United States	Huron	1	5	2016-10-29	Actual	ESP	upgrade to 3000 bbl/d ESP	40000	ESP campaign(2013-01-01)	2016-10-23	2016-11-07	2016-10-23	2016-11-07
United States	Huron	1	11	2016-05-24	Actual	Frac	50 ton + 20 m3 acid	350000	Frac campaign(2013-01-01)	2016-05-24	2016-06-16	2016-05-24	2016-06-16
United States	Huron	1	5	2016-05-11	Actual	ESP	2500 bbl/d ESP	35000	ESP campaign(2013-01-01)	2016-05-08	2016-05-10	2016-05-08	2016-05-14
United States	Huron	1	10	2016-04-24	Actual	Frac	50 ton frac no oil	350000	Frac campaign(2013-01-01)	2016-04-24	2016-04-24	2016-04-24	2016-04-24
United States	Huron	1	3	2016-02-07	Actual	ESP	ESP	50000	ESP campaign(2013-01-01)	2016-02-02	2016-02-12	2016-02-02	2016-02-12
United States	Huron	1	11	2016-01-13	Actual	Frac	20 ton frac	250000	Frac campaign(2013-01-01)	2015-12-12	2016-02-02	2015-12-12	2016-02-02
United States	Huron	1	4	2016-01-12	Actual	Frac	15 ton	200000	Frac campaign(2013-01-01)	2016-01-10	2016-03-16	2016-01-10	2016-03-16
United States	Huron	1	8	2015-12-15	Actual	ESP	1000 bbl/d ESP	25000	ESP campaign(2013-01-01)	2015-12-11	2015-12-22	2015-12-11	2015-12-22
United States	Huron	1	14	2015-08-01	Actual	ESP	1000 bbl/d ESP	30000	ESP campaign(2013-01-01)	2015-07-28	2015-08-10	2015-07-28	2015-08-10
United States	Huron	1	5	2015-01-29	Actual	Choke Open	choke full open	1	Choke campaign(2013-01-01)	2015-01-29	2015-01-29	2015-01-29	2015-01-29
United States	Huron	1	6	2014-09-24	Actual	Choke Open	45 to 55 mm	1000	Choke campaign(2013-01-01)	2014-09-24	2014-09-24	2014-09-24	2014-09-24
United States	Huron	1	13	2014-06-16	Actual	ESP	1000 bbl/d ESP	35000	ESP campaign(2013-01-01)	2014-06-15	2014-06-19	2014-06-15	2014-06-19
United States	Huron	1	5	2014-04-20	Actual	Choke Open	ESP	5000	Choke campaign(2013-01-01)	2014-04-20	2014-04-20	2014-04-20	2014-04-20
United States	Huron	1	9	2013-10-11	Actual	ESP	3000 bbl/d ESP	45000	ESP campaign(2013-01-01)	2013-10-10	2013-10-16	2013-10-10	2013-10-21
Total:								3141101					

Figure 36. Opening the well “9” ESP enhancement in the E&P Portal

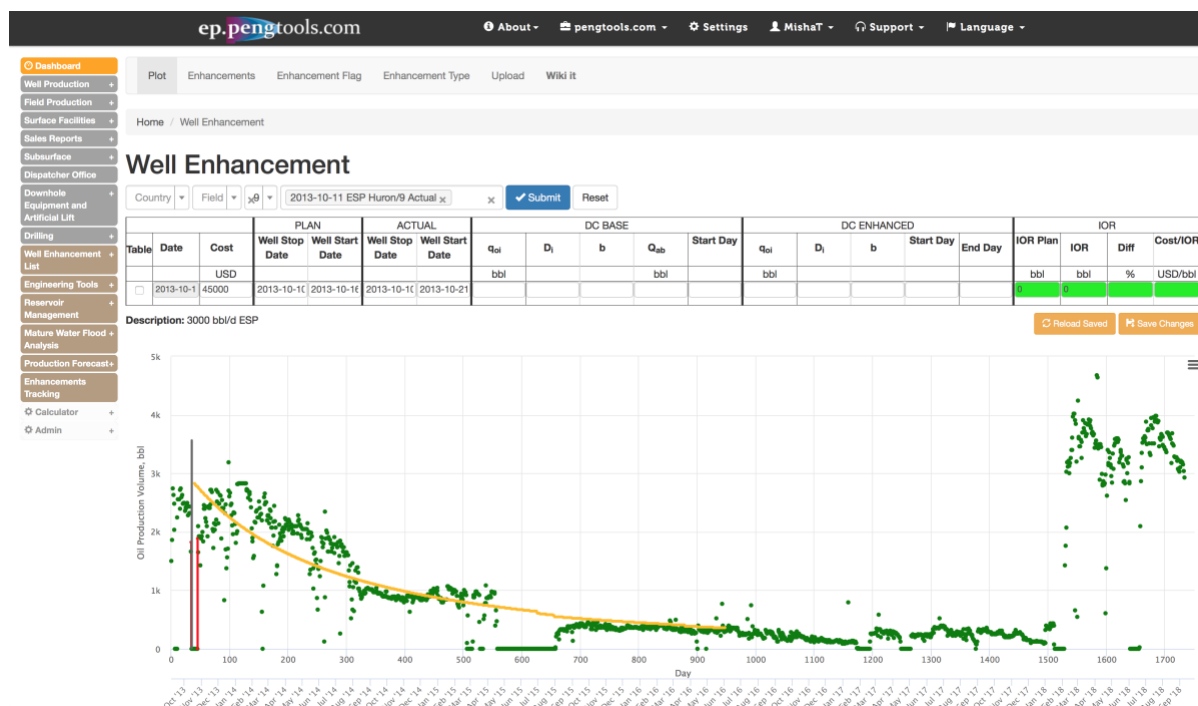


Figure 37 Well “9” ESP enhancement page in the E&P Portal

STEP 2&3: Fill the decline model parameters for Base and Enhanced type curves as follows and click Enter.

DC BASE					DC ENHANCED				
q _{oi}	D _i	b	Q _{ab}	Start Day	q _{oi}	D _i	b	Start Day	End Day
bbl			bbl		bbl				
2700	1.5	0.6	10	0	2800	1.5	0.6	120	557

Figure 38 Well “9” ESP enhancement Base and Enhanced type curves parameters



Figure 39 Well “9” ESP enhancement page with Base and Enhanced decline models

STEP 4: Inspect the IOR results. The incremental oil recovery reached by this enhancement is **192,623 bbl** at cost of **\$45,000** which is **0.23 USD/bbl**. The achieved IOR is about 30% less than planned.

IOR			
IOR Plan	IOR	Diff	Cost/IOI
bbl	bbl	%	USD/bbl
288237	192623	-33.2	0.23

Figure 40 Well “9” ESP enhancement IOR results in the E&P Portal

STEP 5: Click “Save Changes” to save the model:

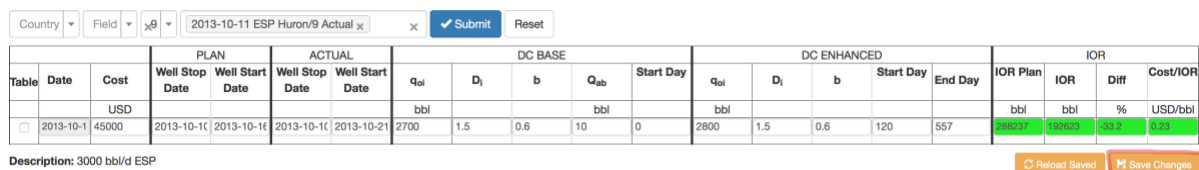


Figure 41 Well “9” Saving the ESP enhancement model in the E&P Portal

😊 Now well “9” ESP Enhancement analysis is complete.

Enhancement 2. Fracing the damaged well

STEP 1: In the left menu open the “Enhancement Tracking” page, scroll down to the table and click “Show Plot” to open the Frac enhancement:

Country	Field	Pad	Well	Date	Flag	Type	PlotDescriptionReport	Cost	Production Forecast	Well Stop Date	Well Start Date	Well Stop Date	Well Start Date
United States	Huron	1	9	2018-06-22	Actual	ESP	ESP upgrade to GN10000	75000	Frac campaign(2013-01-01)	2018-06-12	2018-06-30	2018-06-12	2018-06-30
United States	Huron	1	5	2018-05-24	Actual	ESP	upgrade to GN6200	65000	ESP campaign(2013-01-01)	2018-05-21	2018-05-28	2018-05-21	2018-05-28
United States	Huron	1	4	2018-05-16	Actual	ESP	ESP upgrade to GN6200	75000	ESP campaign(2013-01-01)	2018-05-12	2018-05-21	2018-05-12	2018-05-21
United States	Huron	1	14	2018-03-01	Actual	Frac	good 80 ton job	480000	Frac campaign(2013-01-01)	2017-08-20	2018-03-07	2017-08-20	2018-03-07
United States	Huron	1	9	2018-02-03	Actual	Frac	nice 130 ton job	55000	Frac campaign(2013-01-01)	2018-01-28	2018-02-14	2018-01-28	2018-02-14
United States	Huron	1	4	2017-11-11	Actual	ESP	DN4300	65000	ESP campaign(2013-01-01)	2017-11-09	2017-11-17	2017-11-09	2017-11-17
United States	Huron	1	3	2017-09-06	Actual	Frac	56 tons	300000	Frac campaign(2013-01-01)	2017-08-26	2017-09-17	2017-08-26	2017-11-10
United States	Huron	1	4	2017-06-19	Actual	Choke Open	Choke size changed from 22 mm to 65 mm	100	Choke campaign(2013-01-01)	2017-06-19	2017-06-19	2017-06-19	2017-06-19
United States	Huron	1	6	2017-06-18	Actual	ESP	ESP upgrade to DN5850	60000	ESP campaign(2013-01-01)	2017-06-18	2017-06-21	2017-06-18	2017-06-21
United States	Huron	1	6	2017-01-13	Actual	ESP	3000 bbl/d ESP	55000	ESP campaign(2013-01-01)	2017-01-11	2017-01-16	2017-01-11	2017-01-16
United States	Huron	1	5	2016-10-29	Actual	ESP	upgrade to 3000 bbl/d ESP	40000	ESP campaign(2013-01-01)	2016-10-23	2016-11-07	2016-10-23	2016-11-07
United States	Huron	1	11	2016-05-24	Actual	Frac	50 ton + 20 m3 acid	350000	Frac campaign(2013-01-01)	2016-05-24	2016-06-16	2016-05-24	2016-06-16
United States	Huron	1	5	2016-05-11	Actual	ESP	2500 bbl/d ESP	35000	ESP campaign(2013-01-01)	2016-05-08	2016-05-10	2016-05-08	2016-05-14
United States	Huron	1	10	2016-04-24	Actual	Frac	50 ton frac no oil	350000	Frac campaign(2013-01-01)	2016-04-24	2016-04-24	2016-04-24	2016-04-24
United States	Huron	1	3	2016-02-07	Actual	ESP	ESP	50000	ESP campaign(2013-01-01)	2016-02-02	2016-02-12	2016-02-02	2016-02-12
United States	Huron	1	11	2016-01-13	Actual	Frac	20 ton frac	250000	Frac campaign(2013-01-01)	2015-12-12	2016-02-02	2015-12-12	2016-02-02
United States	Huron	1	4	2016-01-12	Actual	Frac	15 ton	200000	Frac campaign(2013-01-01)	2016-01-10	2016-03-16	2016-01-10	2016-03-16
United States	Huron	1	8	2015-12-15	Actual	ESP	1000 bbl/d ESP	25000	ESP campaign(2013-01-01)	2015-12-11	2015-12-22	2015-12-11	2015-12-22
United States	Huron	1	14	2015-08-01	Actual	ESP	1000 bbl/d ESP	30000	ESP campaign(2013-01-01)	2015-07-28	2015-08-10	2015-07-28	2015-08-10
United States	Huron	1	5	2015-01-29	Actual	Choke Open	choke full open	1	Choke campaign(2013-01-01)	2015-01-29	2015-01-29	2015-01-29	2015-01-29
United States	Huron	1	6	2014-09-24	Actual	Choke Open	45 to 55 mm	1000	Choke campaign(2013-01-01)	2014-09-24	2014-09-24	2014-09-24	2014-09-24
United States	Huron	1	13	2014-06-16	Actual	ESP	1000 bbl/d ESP	35000	ESP campaign(2013-01-01)	2014-06-15	2014-06-19	2014-06-15	2014-06-19
United States	Huron	1	5	2014-04-20	Actual	Choke Open	ESP	5000	Choke campaign(2013-01-01)	2014-04-20	2014-04-20	2014-04-20	2014-04-20
United States	Huron	1	9	2013-10-11	Actual	ESP	3000 bbl/d ESP	45000	ESP campaign(2013-01-01)	2013-10-10	2013-10-16	2013-10-10	2013-10-21
Total:								3141101					

Figure 42. Opening the well “9” Frac enhancement in the E&P Portal



Figure 43 Well “9” Frac enhancement page in the E&P Portal

STEP 2&3: Fill the decline model parameters for Base and Enhanced type curves as follows and click Enter.

DC BASE					DC ENHANCED				
q _{oi}	D _i	b	Q _{ab}	Start Day	q _{oi}	D _i	b	Start Day	End Day
bbl			bbl		bbl				
400	1.5	0.6	10	1300	4000	2	2	1565	1657

Figure 44 Well "9" Frac enhancement Base and Enhanced type curves parameters

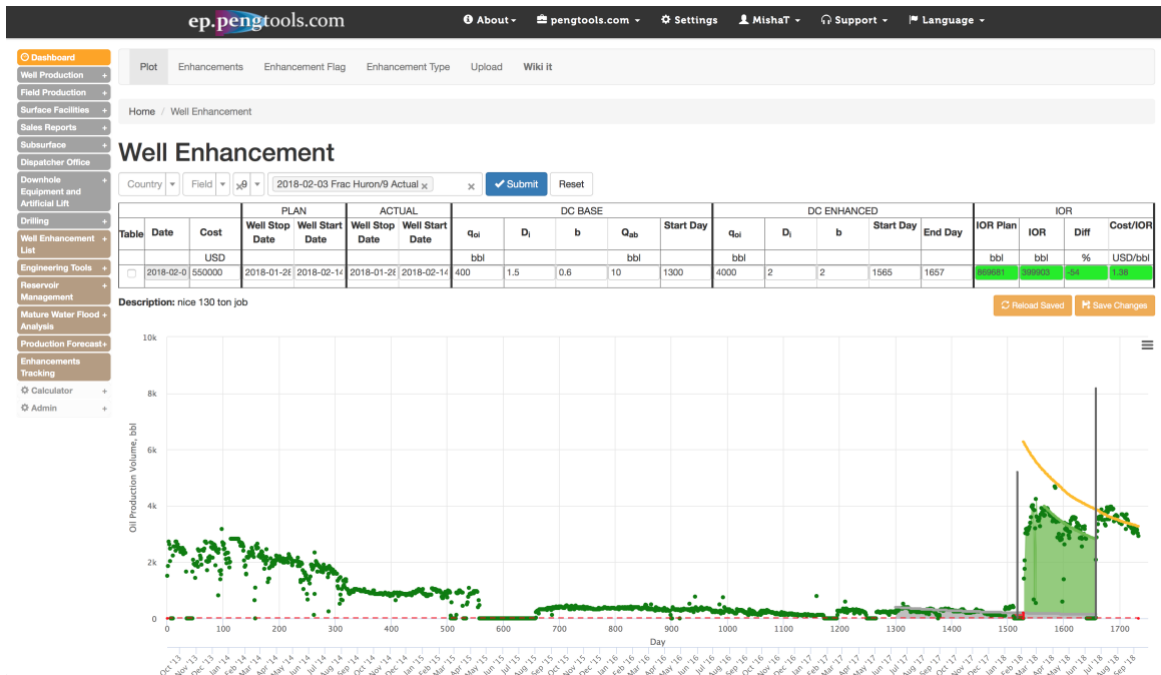


Figure 45 Well "9" Frac enhancement page with Base and Enhanced decline models

STEP 4: Inspect the IOR results. The incremental oil recovery reached by this enhancement is **399,903 bbl** at cost of **\$550,000** which is **1.38 USD/bbl**. The achieved IOR is about 50% less than planned.

IOR			
IOR Plan	IOR	Diff	Cost/IOR
bbl	bbl	%	USD/bbl
869681	399903	-54	1.38

Figure 46 Well "9" Frac enhancement IOR results in the E&P Portal

STEP 5: Click "Save Changes" to save the model:

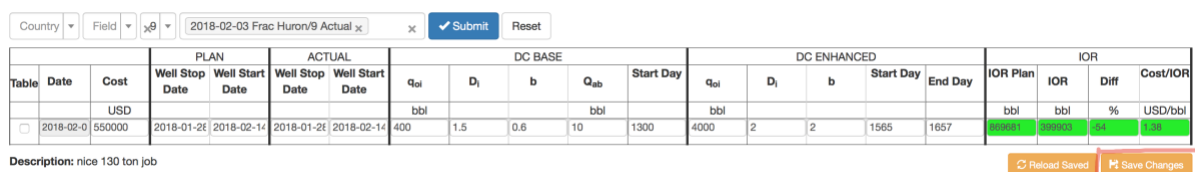


Figure 47 Well "9" Saving the Frac enhancement model in the E&P Portal

😊 Now well "9" Frac Enhancement analysis is complete.

Enhancement 3. ESP upgrade

STEP 1: In the left menu open the “Enhancement Tracking” page, scroll down to the table and click “Show Plot” to open the ESP upgrade enhancement:

Country	Field	Pad	Well	Date	Flag	Type	PlotDescriptionReport	Cost USD	Production Forecast	PLAN Well Stop Date	PLAN Well Start Date	ACTUAL Well Stop Date	ACTUAL Well Start Date
United States	Huron	1	9	2018-06-22	Actual	ESP	ESP upgrade to GN10000	75000	Frac campaign(2013-01-01)	2018-06-12	2018-06-30	2018-06-12	2018-06-30
United States	Huron	1	5	2018-05-24	Actual	ESP	upgrade to GN6200	65000	ESP campaign(2013-01-01)	2018-05-21	2018-05-28	2018-05-21	2018-05-28
United States	Huron	1	4	2018-05-16	Actual	ESP	ESP upgrade to GN6200	75000	ESP campaign(2013-01-01)	2018-05-12	2018-05-21	2018-05-12	2018-05-21
United States	Huron	1	14	2018-03-01	Actual	Frac	good 80 ton job	480000	Frac campaign(2013-01-01)	2017-08-20	2018-03-07	2017-08-20	2018-03-07
United States	Huron	1	9	2018-02-03	Actual	Frac	nice 130 ton job	550000	Frac campaign(2013-01-01)	2018-01-28	2018-02-14	2018-01-28	2018-02-14
United States	Huron	1	4	2017-11-11	Actual	ESP	DN4300	65000	ESP campaign(2013-01-01)	2017-11-09	2017-11-17	2017-11-09	2017-11-17
United States	Huron	1	3	2017-09-06	Actual	Frac	56 tons	300000	Frac campaign(2013-01-01)	2017-08-26	2017-09-17	2017-08-26	2017-11-10
United States	Huron	1	4	2017-06-19	Actual	Choke Open	Choke size changed from 22 mm to 65 mm	100	Choke campaign(2013-01-01)	2017-06-19	2017-06-19	2017-06-19	2017-06-19
United States	Huron	1	6	2017-06-18	Actual	ESP	ESP upgrade to DN5850	60000	ESP campaign(2013-01-01)	2017-06-18	2017-06-21	2017-06-18	2017-06-21
United States	Huron	1	6	2017-01-13	Actual	ESP	3000 bbl/d ESP	55000	ESP campaign(2013-01-01)	2017-01-11	2017-01-16	2017-01-11	2017-01-16
United States	Huron	1	5	2016-10-29	Actual	ESP	upgrade to 3000 bbl/d ESP	40000	ESP campaign(2013-01-01)	2016-10-23	2016-11-07	2016-10-23	2016-11-07
United States	Huron	1	11	2016-05-24	Actual	Frac	50 ton + 20 m3 acid	350000	Frac campaign(2013-01-01)	2016-05-24	2016-06-16	2016-05-24	2016-06-16
United States	Huron	1	5	2016-05-11	Actual	ESP	2500 bbl/d ESP	35000	ESP campaign(2013-01-01)	2016-05-08	2016-05-10	2016-05-08	2016-05-14
United States	Huron	1	10	2016-04-24	Actual	Frac	50 ton frac no oil	350000	Frac campaign(2013-01-01)	2016-04-24	2016-04-24	2016-04-24	2016-04-24
United States	Huron	1	3	2016-02-07	Actual	ESP	ESP	50000	ESP campaign(2013-01-01)	2016-02-02	2016-02-12	2016-02-02	2016-02-12
United States	Huron	1	11	2016-01-13	Actual	Frac	20 ton frac	250000	Frac campaign(2013-01-01)	2015-12-12	2016-02-02	2015-12-12	2016-02-02
United States	Huron	1	4	2016-01-12	Actual	Frac	15 ton	200000	Frac campaign(2013-01-01)	2016-01-10	2016-03-16	2016-01-10	2016-03-16
United States	Huron	1	8	2015-12-15	Actual	ESP	1000 bbl/d ESP	25000	ESP campaign(2013-01-01)	2015-12-11	2015-12-22	2015-12-11	2015-12-22
United States	Huron	1	14	2015-08-01	Actual	ESP	1000 bbl/d ESP	30000	ESP campaign(2013-01-01)	2015-07-28	2015-08-10	2015-07-28	2015-08-10
United States	Huron	1	5	2015-01-29	Actual	Choke Open	choke full open	1	Choke campaign(2013-01-01)	2015-01-29	2015-01-29	2015-01-29	2015-01-29
United States	Huron	1	6	2014-09-24	Actual	Choke Open	45 to 55 mm	1000	Choke campaign(2013-01-01)	2014-09-24	2014-09-24	2014-09-24	2014-09-24
United States	Huron	1	13	2014-06-16	Actual	ESP	1000 bbl/d ESP	35000	ESP campaign(2013-01-01)	2014-06-15	2014-06-19	2014-06-15	2014-06-19
United States	Huron	1	5	2014-04-20	Actual	Choke Open	ESP	5000	Choke campaign(2013-01-01)	2014-04-20	2014-04-20	2014-04-20	2014-04-20
United States	Huron	1	9	2013-10-11	Actual	ESP	3000 bbl/d ESP	45000	ESP campaign(2013-01-01)	2013-10-10	2013-10-16	2013-10-10	2013-10-21
Total:								3141101					

Figure 48. Opening the well “9” ESP upgrade enhancement in the E&P Portal

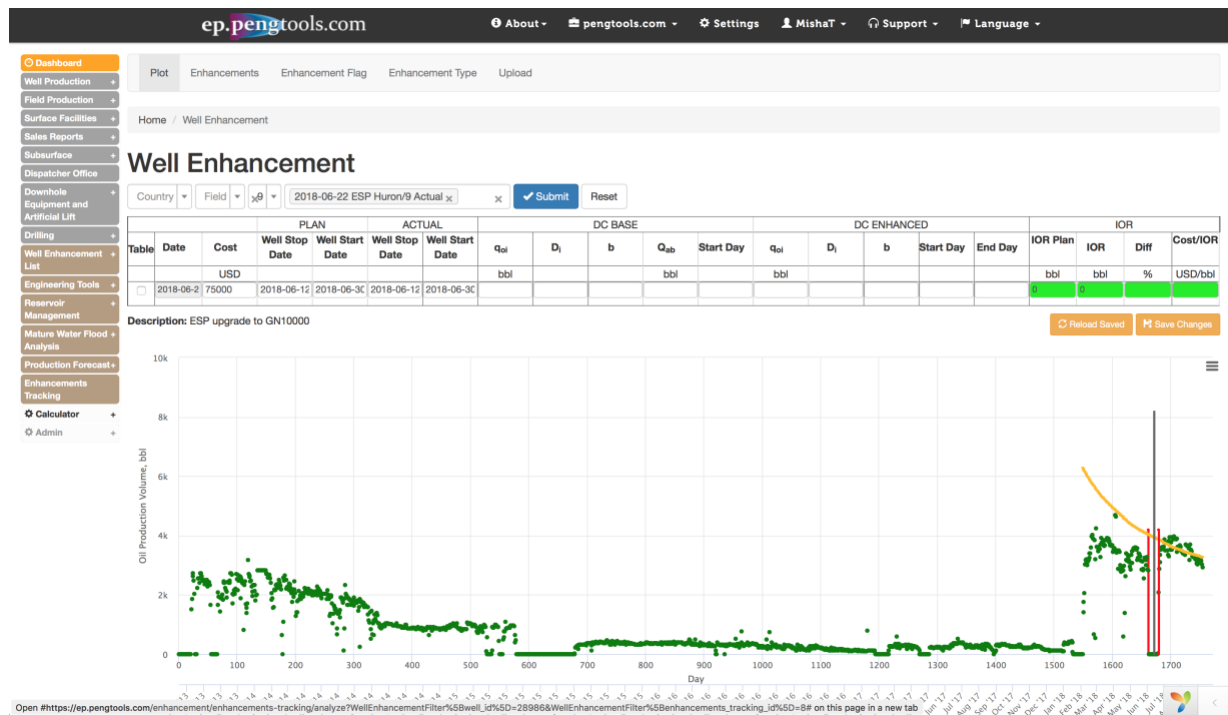


Figure 49 Well “9” ESP upgrade enhancement page in the E&P Portal

STEP 2&3: Fill the decline model parameters for Base and Enhanced type curves as follows and click Enter.

DC BASE					DC ENHANCED				
q _{oi}	D _i	b	Q _{ab}	Start Day	q _{oi}	D _i	b	Start Day	End Day
bbl			bbl		bbl				
4000	2	2	10	1565	3600	2	2	1700	2500

Figure 50 Well "9" ESP upgrade enhancement Base and Enhanced type curves parameters

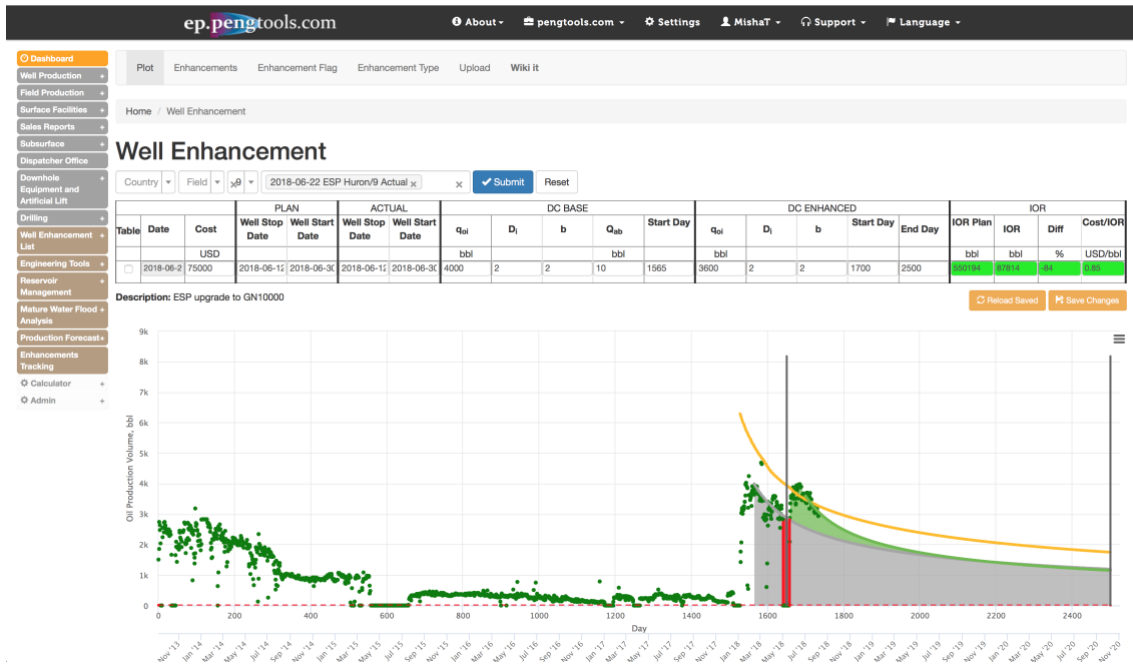


Figure 51 Well "9" ESP upgrade enhancement page with Base and Enhanced decline models

STEP 4: Inspect the IOR results. The incremental oil recovery reached by this enhancement is **87,814 bbl** at cost of **\$75,000** which is **0.85 USD/bbl**. The achieved IOR is about 80% less than planned.

IOR			
IOR Plan	IOR	Diff	Cost/IOR
bbl	bbl	%	USD/bbl
550194	87814	-84	0.85

Figure 52 Well "9" ESP upgrade enhancement IOR results in the E&P Portal

STEP 5: Click "Save Changes" to save the model:

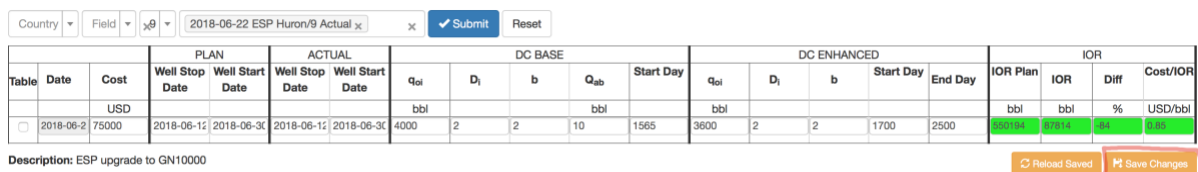


Figure 53 Well "9" Saving the ESP upgrade enhancement model in the E&P Portal

😊 Now well "9" ESP Upgrade Enhancement analysis is complete.

Well 9 enhancement summary

Displaying all well enhancements on one plot

In the left menu open the “Enhancement Tracking” page, scroll down to the table and click “Show Plot” to open the ESP upgrade enhancement:

Country	Field	Pad	Well	Date	Flag	Type	PlotDescriptionReport	Cost USD	Production Forecast	PLAN Well Stop Date	PLAN Well Start Date	ACTUAL Well Stop Date	ACTUAL Well Start Date
United States	Huron	1	9	2018-06-22	Actual	ESP	ESP upgrade to GN10000	75000	frac_campaign(2013-01-01)	2018-06-12	2018-06-30	2018-06-12	2018-06-30
United States	Huron	1	5	2018-05-24	Actual	ESP	Upgrade to GN6200	65000	ESP_campaign(2013-01-01)	2018-05-21	2018-05-28	2018-05-21	2018-05-28
United States	Huron	1	4	2018-05-16	Actual	ESP	ESP upgrade to GN6200	75000	ESP_campaign(2013-01-01)	2018-05-12	2018-05-21	2018-05-12	2018-05-21
United States	Huron	1	14	2018-03-01	Actual	Frac	good 80 ton job nice 130 ton	480000	frac_campaign(2013-01-01)	2017-08-20	2018-03-07	2017-08-20	2018-03-07
United States	Huron	1	9	2018-02-03	Actual	Frac		550000	frac_campaign(2013-01-01)	2018-01-28	2018-02-14	2018-01-28	2018-02-14

Figure 54. Opening the well “9” ESP upgrade enhancement in the E&P Portal

In the filter check “Select all” box and click “Submit”

Country: [v] Field: [v] x9 [v] 2018-06-22 ESP Huron/9 Actual x [x] [Submit] [Reset]

Table	Date	Cost	Well	Date	DC BASE
		USD			D _i b
<input type="checkbox"/>	2018-06-2	75000	2018-		2.2 2 1

Select all

Description: ESP upgrade to GN10000

Figure 55. Selecting all well “9” enhancements in the filter in the E&P Portal

Inspect all the well enhancements:

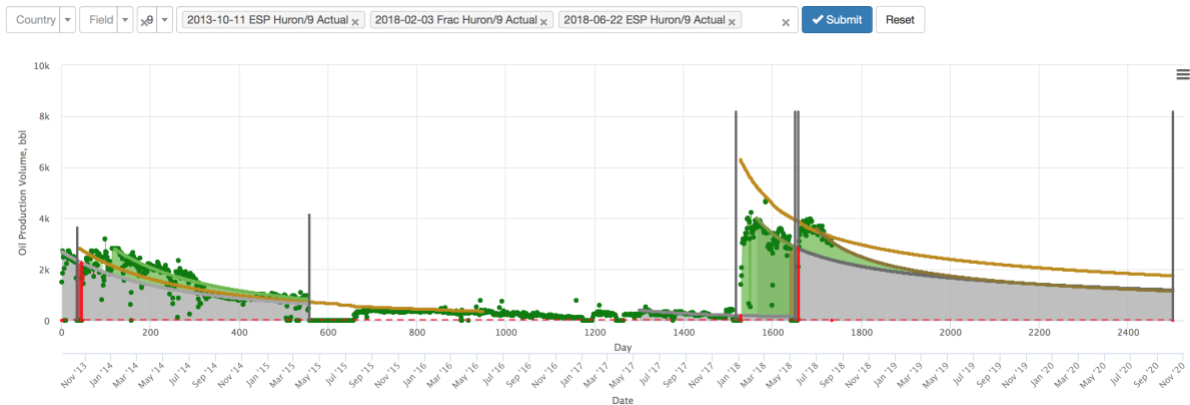


Figure 56. All well “9” enhancements on a single plot in the E&P Portal

Displaying all well enhancements results

In the left menu open the “Enhancement Tracking” page, scroll down to the table and select “Huron” filed in the field column filter and well “9” in the well column filter:

	Country	Field	Pad	Well	D
	--	Huron	--	x9	
	United States	Huron	1	9	20
	United States	Huron	1	9	20
	United States	Huron	1	9	20
Total:					

Figure 57. Selecting well “9” enhancements in the filter

The enhancement analysis results are displayed in the left part of the table:

DC BASE					DC ENHANCED					IOR Plan	IOR	DiffCost/IORI	
q _{oi}	D _i	b	Q _{ab}	Start Day	q _{oi}	D _i	b	Start Day	End Day	bbl	bbl	% USD/bbl	
bbl			bbl		bbl								
4000	2	2	10.00	1,565	3600	2	2	1,700	2,500	55019	87814	-	0.85
400.01	1.500	0.60	10.00	1,300	4000	2	2	1,565	1,657	869681	399903	-5	1.38
2700	1.500	0.60	10.00	0	2800	1.500	0.60	120	557	288237	192823	-33	0.23
										1708113680	340-60		0.98

Figure 58. Well “9” enhancement analysis results in the E&P Portal

The total well incremental oil recovery reached by all well enhancements is **680,340 bbl** at total cost of **\$670,000** which is **0.98 USD/bbl**. The achieved IOR is about 60% less than planned.

Scroll up to inspect the well “9” Scorpion Plot:

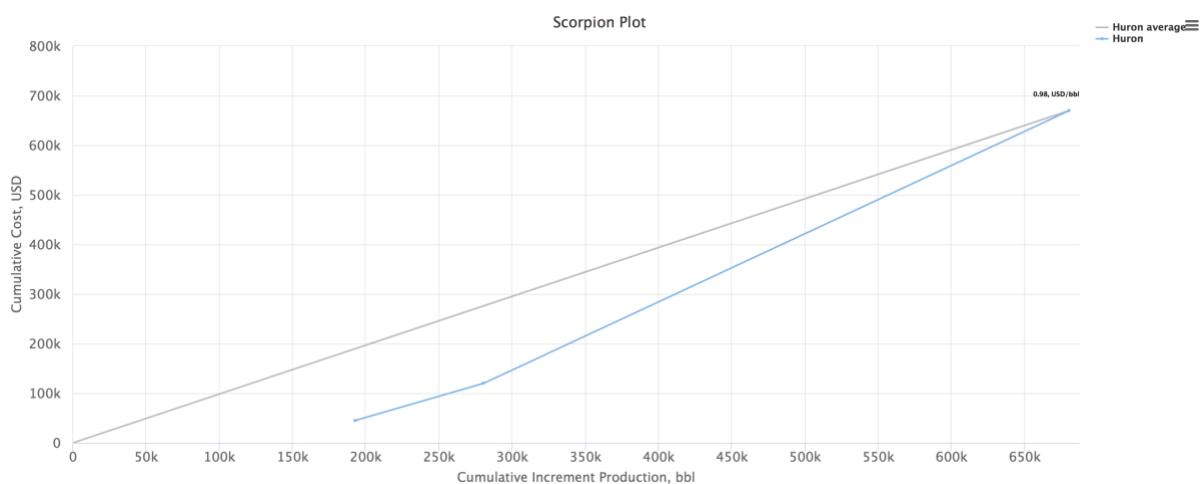


Figure 59. Well “9” Scorpion Plot in the E&P Portal

What is the campaign total IOR vs total cost?

In the left menu open the “Enhancements” page of the “Enhancement Tracking” module. Scorpion Plot and enhancement table will be displayed on the page.

Set the “Group By” setting to “Field” at the bottom of the plot.

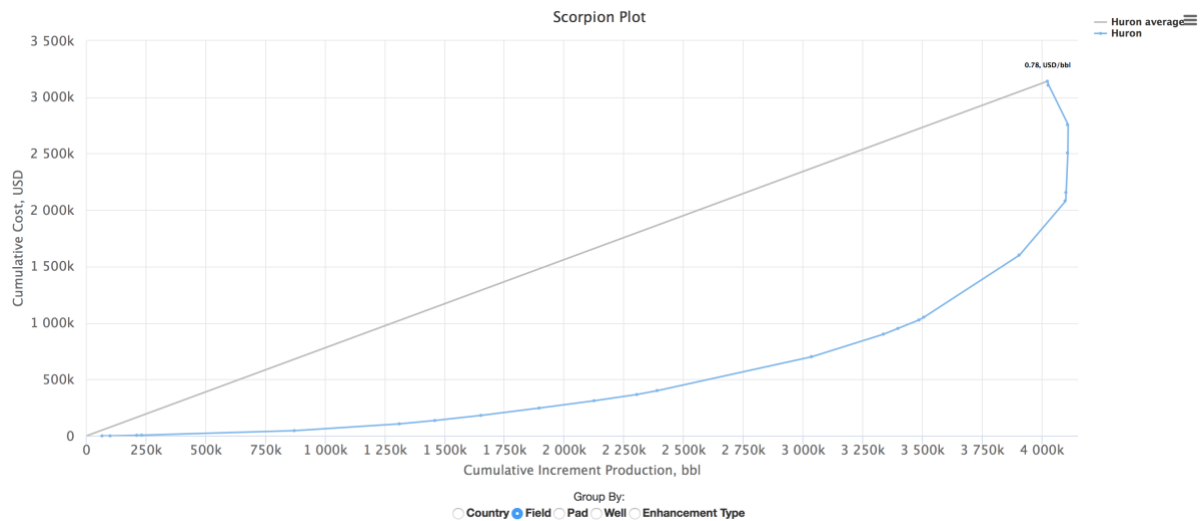


Figure 62. Huron field Scorpion Plot in the E&P Portal

The total campaign IOR is **4,022,246 bbl** at total cost of **\$ 3,141,101** which is **0.78 USD/bbl**. The achieved IOR is about 45% less than planned.

Which enhancement campaign has better \$/bbl performance?

In the left menu open the “Enhancements” page of the “Enhancement Tracking” module. Scorpion Plot and enhancement table will be displayed on the page.

Set the “Group By” setting to “Enhancement Type” at the bottom of the plot.

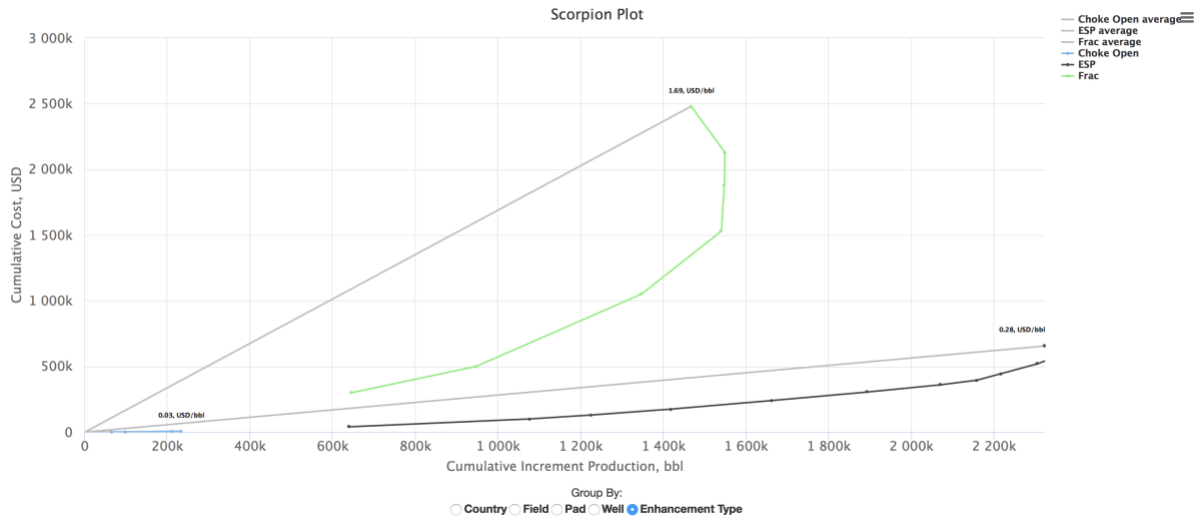


Figure 63. Huron field Scorpion Plot grouped by Enhancement Type in the E&P Portal

The enhancement campaign performance is:

Campaign	IOR, bbl	Cost, USD	Performance USD/bbl
Choke Open	232,985	6,101	0.03
ESP	2,322,443	655,000	0.28
Frac	1,466,819	2,480,000	1.69
Total	4,022,247	3,141,101	0.78

Table 2 . Enhancement campaign performance

The Choke Open campaign has the lowest cost per added bbl, however it produced only 5% of the total **IOR**.

The ESP campaign produced about 60% of the total **IOR**.

Which well has better \$/bbl performance?

In the left menu open the “Enhancements” page of the “Enhancement Tracking” module. Scorpion Plot and enhancement table will be displayed on the page.

Set the “Group By” setting to “Well” at the bottom of the plot.

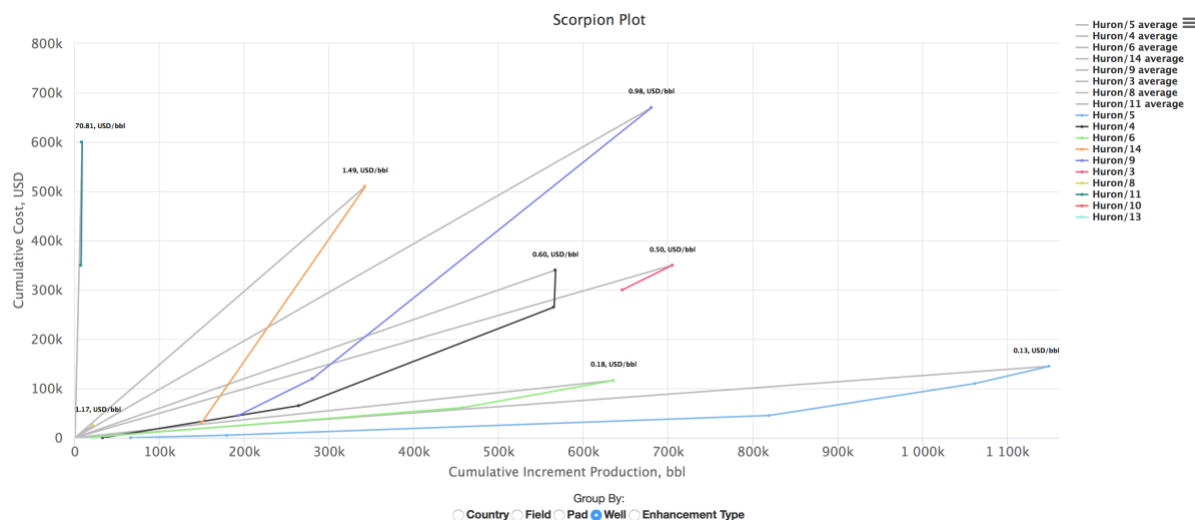


Figure 64. Huron field Scorpion Plot grouped by well in the E&P Portal

The wells performance is:

Well	IOR, bbl	Cost, USD	Performance USD/bbl
5	1,149,671	145,001	0.13
6	634,870	116,000	0.18
3	704,618	350,000	0.50
4	566,912	340,100	0.60
9	680,340	670,000	0.98
8	21,328	25,000	1.17
14	342,615	510,000	1.49
11	8,474	600,000	70.80
13	(5,232)	35,000	-6.69
10	(81,349)	350,000	-4.30
Total	4,022,247	3,141,101	0.78

Table 3. Wells enhancement performance

Saving and exporting the analysis results

In the left menu open the “Enhancements” page of the “Enhancement Tracking” module. Scroll down to the enhancement table.

Click to the export button on the top right corner of the table and select the output format you want the data in:

Showing 1-24 of 24 items.

Export table data:

Country	Field	Pad	Well	Date	Flag	Type	PlotDescriptionReport	Cost USD	Production Forecast	PLAN			ACTUAL			DC BASE			DC ENHANCED			HTML			
										Well Stop Date	Well Start Date	Well Start Date	Well Stop Date	Well Start Date	Well Stop Date	Q _{oil}	D _i	Q _{gas}	Start Day	Q _{oil}	D _i		Q _{gas}	Start Day	
United States	Huron	1	9	2018-06-22	Actual	ESP	ESP upgrade to GN10000	75000	Frac campaign(2013-01-01)	2018-06-12	2018-06-30	2018-06-12	2018-06-30	4000	2.2	10.001	566	3600	2.2	10.001	565				
United States	Huron	1	5	2018-05-24	Actual	ESP	upgrade to GN6200	65000	ESP campaign(2013-01-01)	2018-05-21	2018-05-28	2018-05-21	2018-05-28	3360	0.80	1.0001	477	3360	1.1	1.0001	477				
United States	Huron	1	4	2018-05-16	Actual	ESP	ESP upgrade to GN6200	75000	ESP campaign(2013-01-01)	2018-05-12	2018-05-21	2018-05-12	2018-05-21	2600	1.1	1.000	756	3516	2.50	1.88	1.000				
United States	Huron	1	14	2018-03-01	Actual	Frac	good 80 ton job	480000	Frac campaign(2013-01-01)	2017-08-20	2018-03-07	2017-08-20	2018-03-07	0	0	0	750	750	0.2	1.950	1,500				
United States	Huron	1	9	2018-02-03	Actual	Frac	nice 130 ton job	550000	ESP campaign(2013-01-01)	2018-01-28	2018-02-14	2018-01-28	2018-02-14	400	1.500	60	10,001	300	400	2.2	1,565	1,657			
United States	Huron	1	4	2017-11-11	Actual	ESP	DN4300	65000	ESP campaign(2013-01-01)	2017-11-09	2017-11-17	2017-11-09	2017-11-17	800	0.1	1.000	560	600	0.2	2	756	757			
United States	Huron	1	3	2017-09-06	Actual	Frac	56 tons	300000	Frac campaign(2013-01-01)	2017-08-26	2017-09-17	2017-08-26	2017-09-17	157.2	0.100	26	10,000	900	3500	3	0	1,312	0,000		
United States	Huron	1	4	2017-06-19	Actual	Choke Open	Choke size changed from 22 mm to 65 mm	100	Choke campaign(2013-01-01)	2017-06-19	2017-06-19	2017-06-19	2017-06-19	1258	2	1.000	0	817.7	2	1	580	580	87		
United States	Huron	1	6	2017-06-18	Actual	ESP	ESP upgrade to DN6200	60000	ESP campaign(2013-01-01)	2017-06-18	2017-06-21	2017-06-18	2017-06-21	3200	0.50	1.0001	039	4580	2.50	1	1,387	2,000			
United States	Huron	1	6	2017-01-13	Actual	ESP	3000 bbl/d ESP	55000	ESP campaign(2013-01-01)	2017-01-11	2017-01-16	2017-01-11	2017-01-16	2070	0.50	1.000	800	3100	1.1	1	1,039	1,039			
United States	Huron	1	5	2016-10-29	Actual	ESP	upgrade to 3000 bbl/d ESP	40000	ESP campaign(2013-01-01)	2016-10-23	2016-11-07	2016-10-23	2016-11-07	1800	0.80	1.000	820	3360	0.80	1	1,477	1,547			
United States	Huron	1	11	2016-05-24	Actual	Frac	50 ton + 20 m3 acid	350000	Frac campaign(2013-01-01)	2016-05-24	2016-06-16	2016-05-24	2016-06-16	0	0	0	115	0	0	0	290	290			
United States	Huron	1	5	2016-05-11	Actual	Frac	2500 bbl/d ESP	35000	ESP campaign(2013-01-01)	2016-05-08	2016-05-14	2016-05-08	2016-05-14	2053	0.80	1.000	380	1800	0.80	1	820	980			
United States	Huron	1	10	2016-04-24	Actual	Frac	50 ton frac no oil	350000	Frac campaign(2013-01-01)	2016-04-24	2016-04-24	2016-04-24	2016-04-24	1000	0.1	1.000	0	0	1	1	9	100			
United States	Huron	1	3	2016-02-07	Actual	ESP	ESP	50000	ESP campaign(2013-01-01)	2016-02-02	2016-02-12	2016-02-02	2016-02-12	1887	0.440	26	10,000	0	1384	0.460	25	540	720		
United States	Huron	1	11	2016-01-20	Actual	Frac	20 ton frac	250000	Frac campaign(2013-01-01)	2015-12-12	2016-02-02	2015-12-12	2016-02-02	0	0	0	0	100	1.1	1	137	137			
United States	Huron	1	4	2016-01-12	Actual	Frac	15 ton	200000	Frac campaign(2013-01-01)	2016-01-10	2016-03-16	2016-01-10	2016-03-16	0	0	0	0	1350	2	1	11	436			
United States	Huron	1	8	2015-12-15	Actual	ESP	1000 bbl/d ESP	25000	ESP campaign(2013-01-01)	2015-12-11	2015-12-22	2015-12-11	2015-12-22	960	2.2	1.000	140	900	1.1	1	800	800			
United States	Huron	1	14	2015-08-01	Actual	ESP	1000 bbl/d ESP	30000	ESP campaign(2013-01-01)	2015-07-28	2015-08-10	2015-07-28	2015-08-10	450	2	0.50	10,000	0	1300	2.800	0.50	4	750	0	
United States	Huron	1	5	2015-01-29	Actual	Choke Open	choke full open	1	Choke campaign(2013-01-01)	2015-01-29	2015-01-29	2015-01-29	2015-01-29	2650	0.80	1.000	100	2053	0.80	1	380	813			
United States	Huron	1	6	2014-09-24	Actual	Choke Open	45 to 55 mm	1000	Choke campaign(2013-01-01)	2014-09-24	2014-09-24	2014-09-24	2014-09-24	2750	1.50	1.000	0	2300	1.1	1	80	200	14		
United States	Huron	1	13	2014-06-16	Actual	ESP	1000 bbl/d ESP	35000	ESP campaign(2013-01-01)	2014-06-15	2014-06-19	2014-06-15	2014-06-19	850	0.800	10,010	0	790	0.80	1	100	500			
United States	Huron	1	5	2014-04-20	Actual	Choke Open	ESP	5000	Choke campaign(2013-01-01)	2014-04-20	2014-04-20	2014-04-20	2014-04-20	2516	0.80	1.000	0	2650	0.80	1	100	380			
United States	Huron	1	9	2013-10-11	Actual	ESP	3000 bbl/d ESP	45000	ESP campaign(2013-01-01)	2013-10-10	2013-10-16	2013-10-10	2013-10-16	2700	1.500	60	10,000	0	2800	1.500	60	120	557		
Total:								3141101															174		

Figure 65. Exporting the enhancements table from the E&P Portal

Open the downloaded file “epDataExport.xlsx”:

Figure 66. Exported enhancements table in Excel spreadsheet

The exported file is attached as:

Attachment 8 “epDataExport.xlsx”.

Now enhancement data is successfully exported.

Conclusions

This Case Study demonstrated application of the **Enhancement Tracking** workflow to track and evaluate the benefits of executed enhancements using the **E&P Portal**.

A step by step guide was presented to assist users along the way of using the **E&P Portal** and **Enhancement Tracking** workflow.

The following steps were covered:

- Input the required data to the **E&P Portal**;
- Apply the **Enhancement Tracking** workflow to track and benchmark enhancements;
- Save and export the analysis results.

As usual, data preparation and upload step took the most time an effort, while the analysis part once data is processed was relatively easy and quick.

Imagine the power of the **E&P Portal** then data continually flows to the system for the hundreds and thousands of wells and ready for the analysis like the **Enhancement Tracking** in the live mode!

With the help of the **E&P Portal** you can quickly analyze the big number of wells saving the engineering time while increasing the well's and field's production and company's revenues.

References

- Martins, J. P., MacDonald, J. M., Stewart, C. G., & Phillips, C. J. (1995). The Management and Optimization of a Major Wellwork Program at Prudhoe Bay. *Society of Petroleum Engineers*, SPE-30649-MS.
- Nguyen, D. (2006). Improving Performance Management in TNK-BP. *Innovator, TNK-BP Technology Magazine*(12), 22-24.

Attachments

- Attachment 1 "Huron 9 Pump Design Report.pdf"9
- Attachment 2 "Huron 9 Frac Design Report.pdf"10
- Attachment 3 "Huron 9 ESP upgrade Report.pdf"11
- Attachment 4 "Huron wells.csv"16
- Attachment 5 "Huron wells daily measures.csv"18
- Attachment 6 "Huron wells production forecast data.csv"20
- Attachment 7 "Huron wells enhancement data.csv":22
- Attachment 8 "epDataExport.xlsx"37