TDH

User Manual

v1.4.0
April 2026

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1.0 INTRODUCTION

Merlin's TDH software is a tool designed by engineers for engineers. It is a slick yet powerful tool in the hands of a skilled user and provides plenty of analysis options for both Torque-Drag and Hydraulics. Results can be easily compared to pre-defined limits or user-defined limits and visualized in a way that allows for easy presentation to fellow engineers or management. TDH provides the ability to plot actual data against models in real-time, or hindcast historical data to determine offset well friction factors. Daily reports from wellbore condition monitoring activities can be built with help of TDH. Projects can be evaluated on a feasibility or detailed engineering basis, making them an all-around tool for torque, drag, and hydraulics calculations.

1.1 AVAILABLE MODULES

TDH core consists of following analysis modules:

1. Torque and drag
2. Hydraulics including PVT

TDH Plus additionally includes:

1. Casing Wear
2. Cementing
3. Casing Design

2.0 ACCESS AND LOGIN

TDH can be accessed from any web browser through tdh.merlinerd.com link, where the user should login with their email address and password. The password will be provided by Merlin upon creation of the account and can be later changed by the user.

Figure 1: Main Log-in Page

Upon first login, the user will be prompted to accept the End User License Agreement (EULA). Once logged in, the user will see the scenario viewer where all the work of the user's company can be accessed. By default, TDH filters the work by active user, or "Author" name.

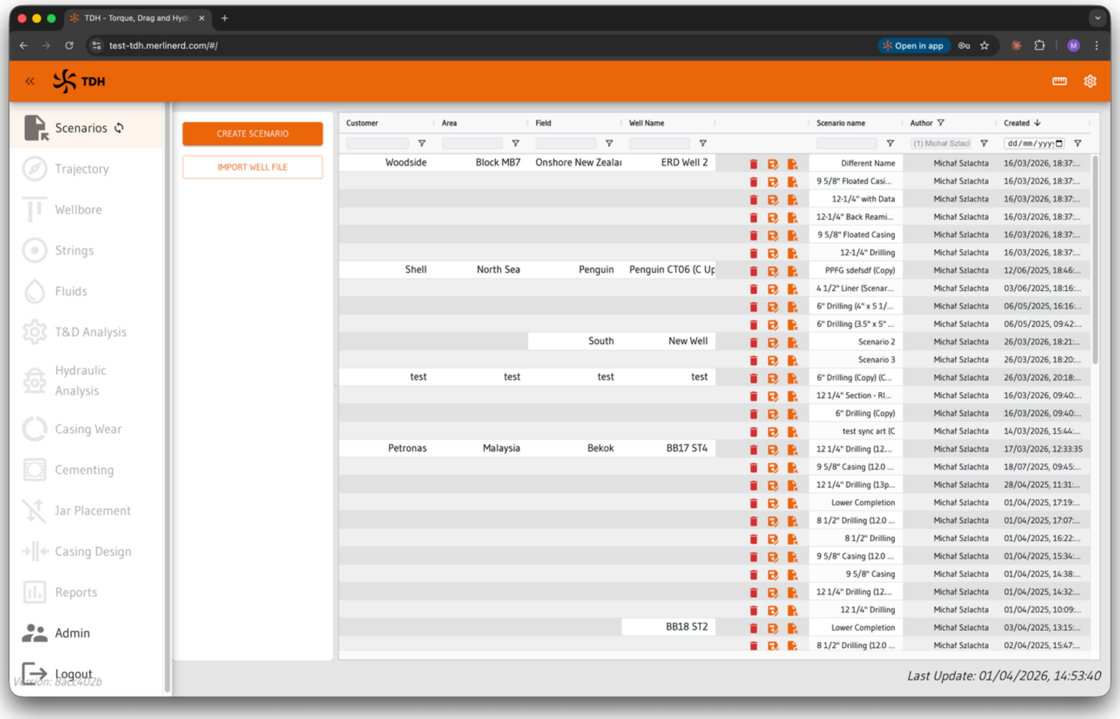

Figure 2: Scenario Selector View

To Create a first scenario, the user must specify Customer, Area, Field, Well and scenario name.

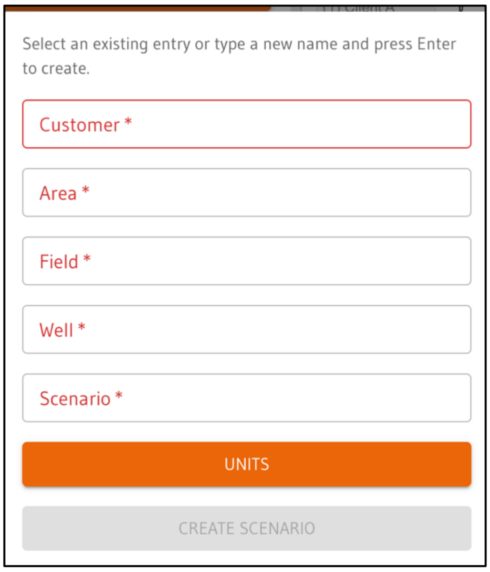

Figure 3: Scenario Creator View

Only then will the "Create Scenario" button become active. The user can click "Enter" after each field (Customer/Area/Field/Well) is specified or simply click on the next field. A green pop-up in the lower left corner will confirm creation of each field. The created fields (Customer/Area/Field/Well) will later be available for selection when creating other scenarios.

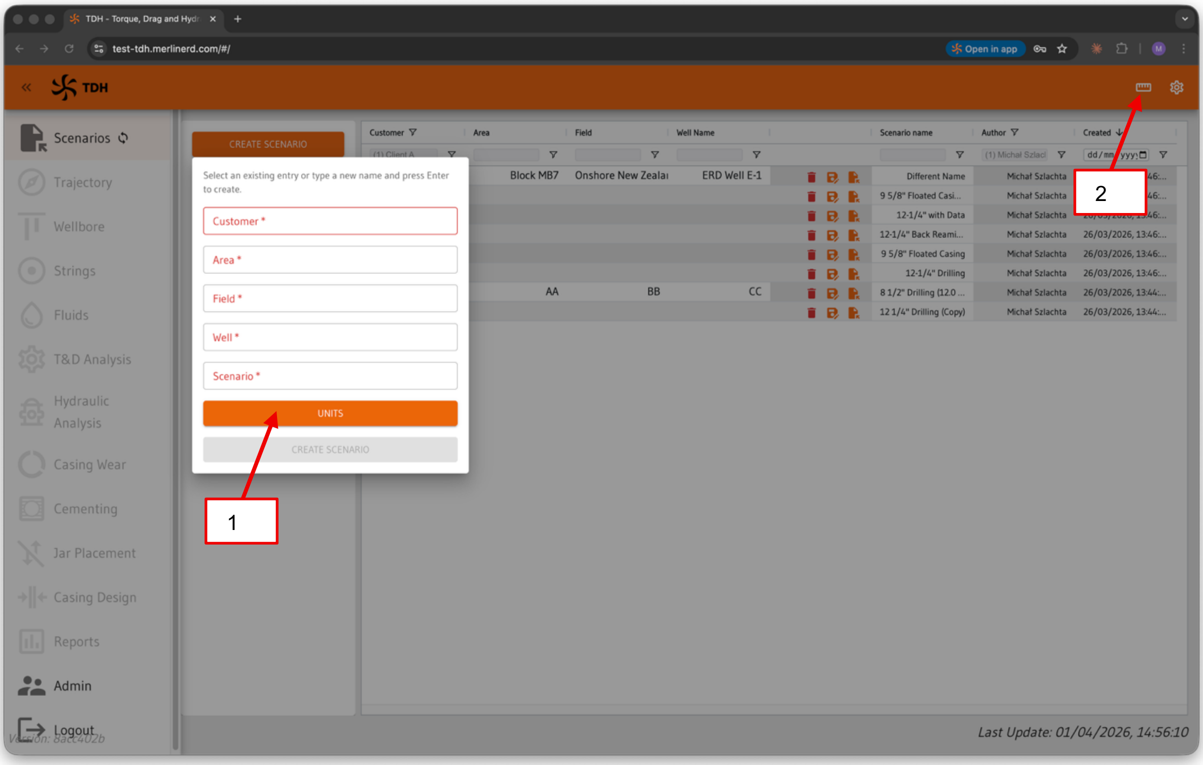

Figure 4: Units Selector View

The user can select units for the scenario that is about to be created via the "Units" button within the scenario selector view (1). The units selection can be made by selecting one of the three pre-defined unit sets. Each of the unit sets can be further modified into a custom set by selecting individual units for any of the listed dimensions. Note that the units selection can be changed at any time, using the units icon (2) at the top-right corner of the main view.

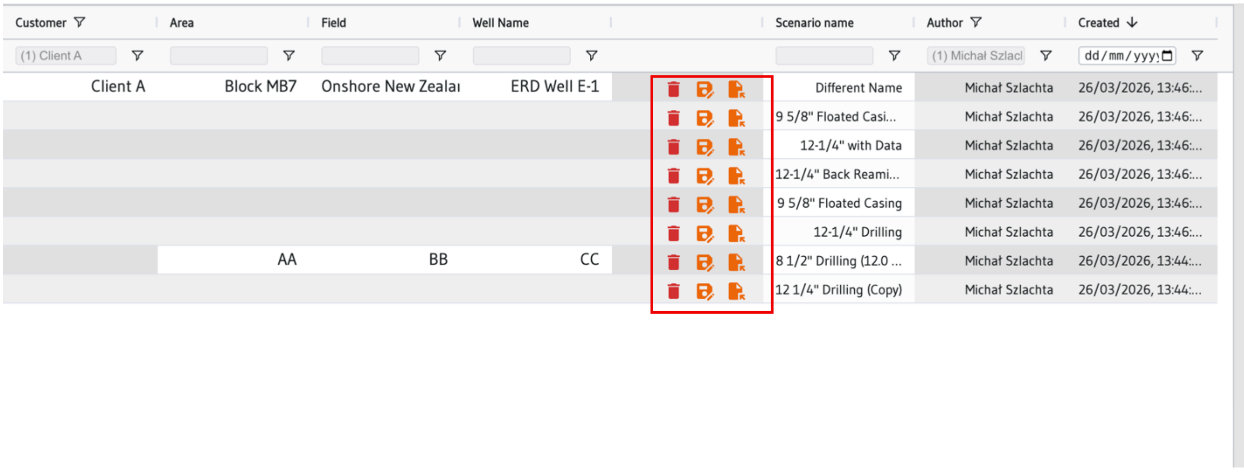

Figure 5: Scenario Selector View – Hierarchical Data

The table within the scenario view shows hierarchical data. That means the rows with no data displayed in a certain field is within the same "folder" as that of the last row with the data specified. In the example above the "MyField 2" field is in the same Area and Customer folders as the row above.

The action column (highlighted red in Figure 4) has action buttons that let the user delete, export or open the scenario. By default, other users are not able to directly edit a scenario created by the original author. However, TDH does allow all users to copy and paste other authors' scenarios: this results in the user being named as the author of the copied scenario, with full edit rights being granted.

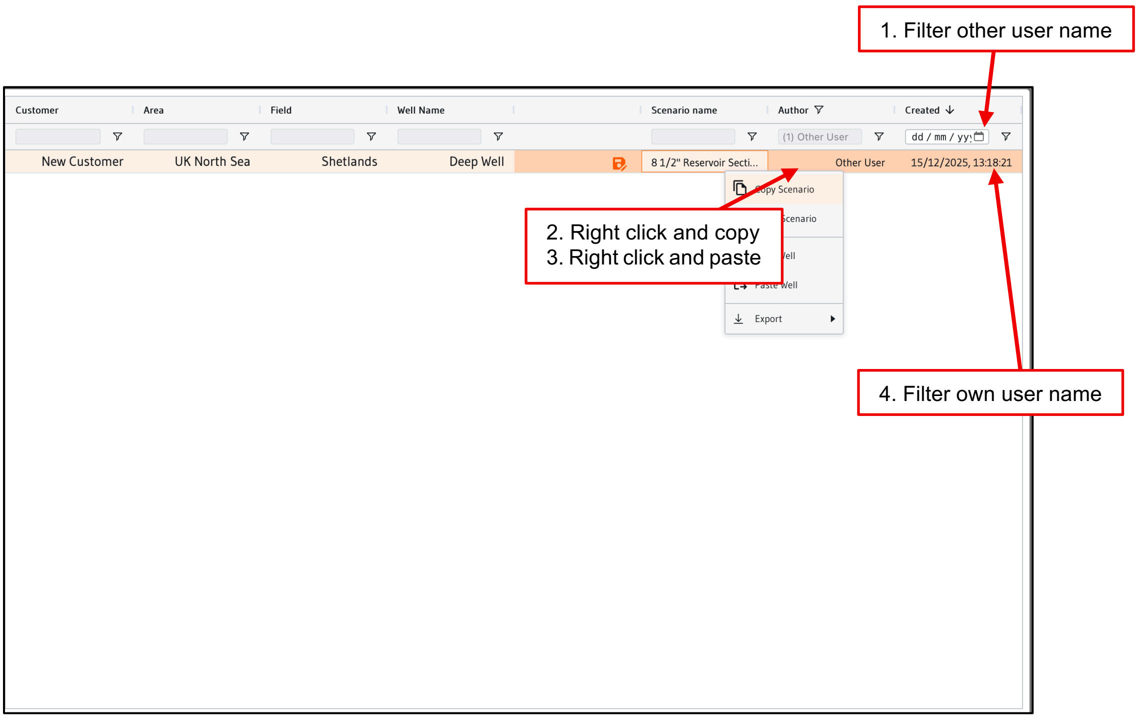

Figure 6: Displaying, Copying and Pasting Another User's Scenario

Users can filter any column in the scenario viewer to find the required scenario easily. Users can also copy their own scenarios and paste them into different Wells/Fields/Areas/Customers.

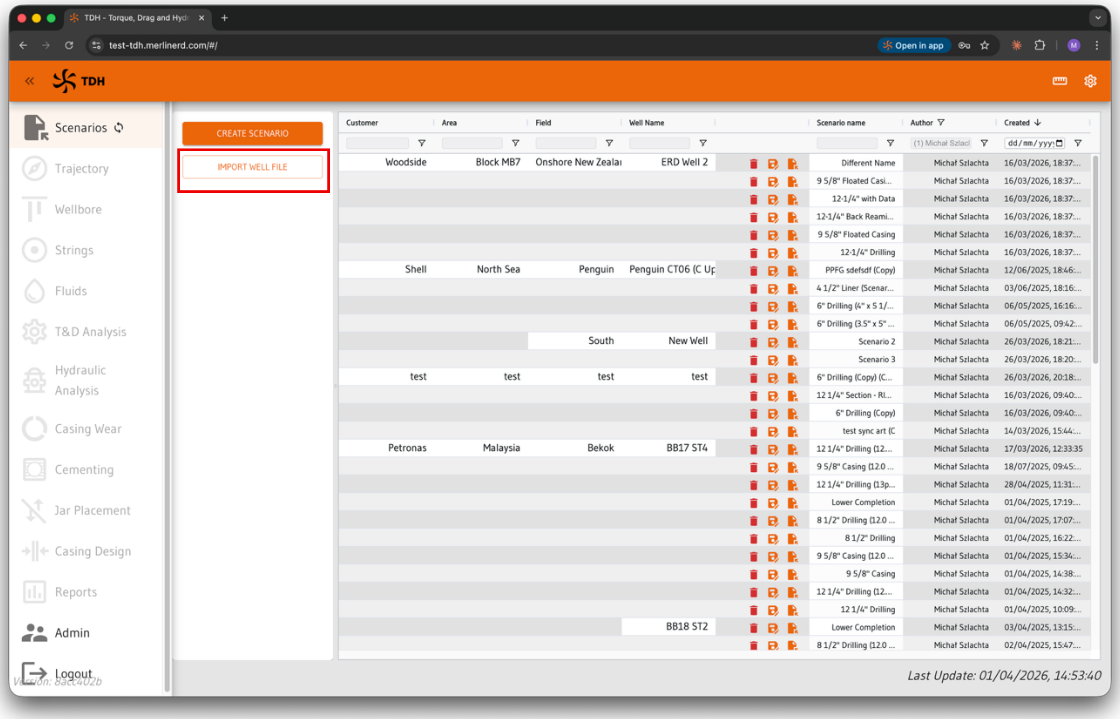

Figure 7: Importing TDH Files

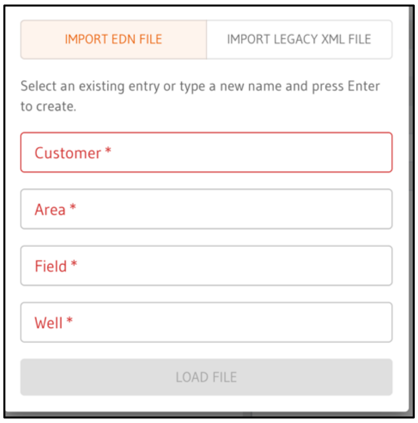

Figure 8: Importing Files - Selector

TDH allows for importing well files, both in the current TDH data format (.EDN) as well as legacy TDH XML files. For legacy / XML files, the user first has to specify the customer via the Customer field in the top-left for XML files (type name or select from the drop-down) and the Area/Field/Well and scenario name will be imported directly from the XML file. For the new format EDN well files, the user will need to specify Customer, Area, Field and Well names, using the method above, while the scenario name will be imported. The user should double check that all the imported data is correct before performing an analysis.

2.1 App Updates

TDH is frequently updated by the development team with new features and fixes. TDH updates automatically upon each login. However, the user might be required – when notified by merlin – to manually update the application by refreshing the web page using ctrl-shift-R (Windows) or cmd-shift-R (Mac) shortcut with TDH app opened.

2.2 OFFLINE MODE & WEB APP

TDH is capable of working fully offline. If working from the web browser, there needs to be connectivity when TDH is started up, then it will continue working if connection is lost. It is also possible to run TDH as a Progressive Web App (PWA). To do this, the user will first need to click on the app installation icon, located in the right-hand side of the address bar in most of the web browsers, and install from there. Once installed and added to the menu bar or desktop as a shortcut, TDH can be opened directly from there with or without internet connectivity.

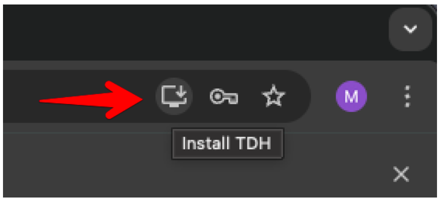

Figure 9: PWA Installation.

It is also possible to force TDH to work in offline mode, which may be useful when there is a slow or unreliable internet connection. There is a switch for this purpose, both at the top of the main panel and in the scenario selector view: it is switched to “on” to force TDH into offline mode.

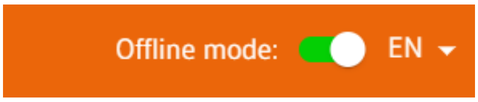

Figure 10: Offline Mode Switch

3.0 TRAJECTORY VIEW

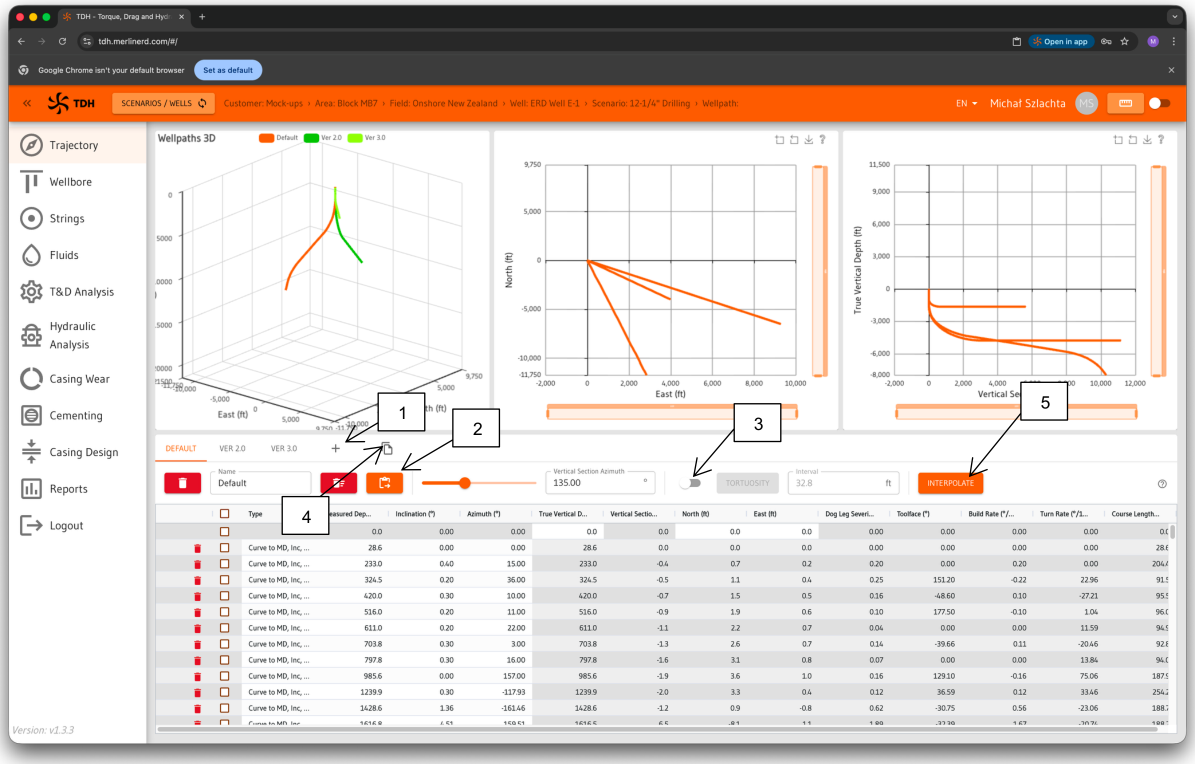

Figure 11: Trajectory View

3.1 Layout

The user creates a new trajectory by clicking the “+” button (arrow 1 on the screenshot above) and can name it in the “Name” input field. The user can create multiple trajectories but only the one selected (underlined with orange line) is being used for the calculations. Therefore, the user must ensure the right trajectory is selected at all times.
Creation of trajectory sections or survey points can be done by pasting the data from an Excel workbook or by creation of sections directly in TDH. To paste in survey points from Excel, copy data in MD, Inc, Azi format (columns) and make sure the surface point at 0 MD is not selected. Then hit the “Paste Wellpath” button (arrow 2 on the screenshot above). The user must ensure that the selected unit for measured depth in TDH is the same as the unit of the data that is being pasted from clipboard.

To create trajectory sections, the user should first select the section type e.g. “Hold” or “Curve to MD, Inc, Azi”, then provide relevant data in the editable fields. Non-editable fields are greyed out.

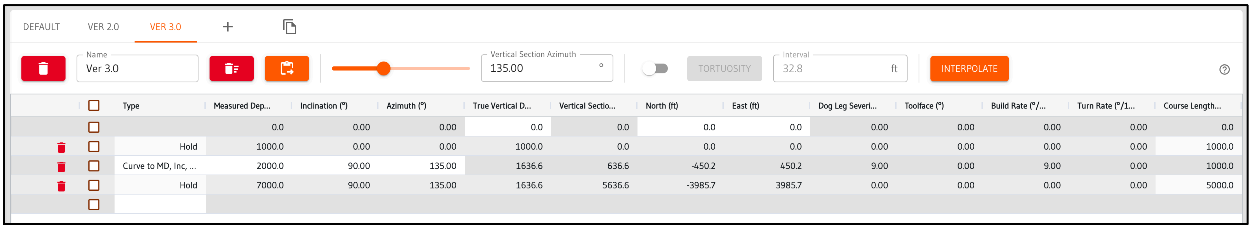

Figure 12: Creating Trajectory Sections

3.2 Tortuosity

To add tortuosity to the entirety or part of the trajectory, enable tortuosity via the switch shown as reference 3 on Figure 11: Trajectory View, set the interpolation to the desired interval then press the “Tortuosity” button. The tortuosity can then be specified for different intervals via a dogleg magnitude value, which is the maximum DLS for that interval using the “random inclination, dependent azimuth” method.

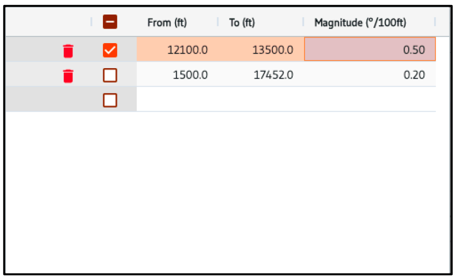

Figure 13: Set Tortuosity Intervals

3.3 Copying Trajectories

To make a copy of the trajectory, the user can press the “copy current wellpath” button (reference 4 on Figure 11: Trajectory View), which will create a duplicate of that wellpath in the current scenario. In order to copy the trajectory to another scenario or well, the user can either copy/paste the entire scenario or export the current trajectory to Excel and then copy and paste it into a new trajectory in another scenario.

3.4 Interpolation

The user can interpolate values at any depth within the wellpath. Use the “Interpolate” button (reference 5 on Figure 11: Trajectory View) to bring up the interpolation window.

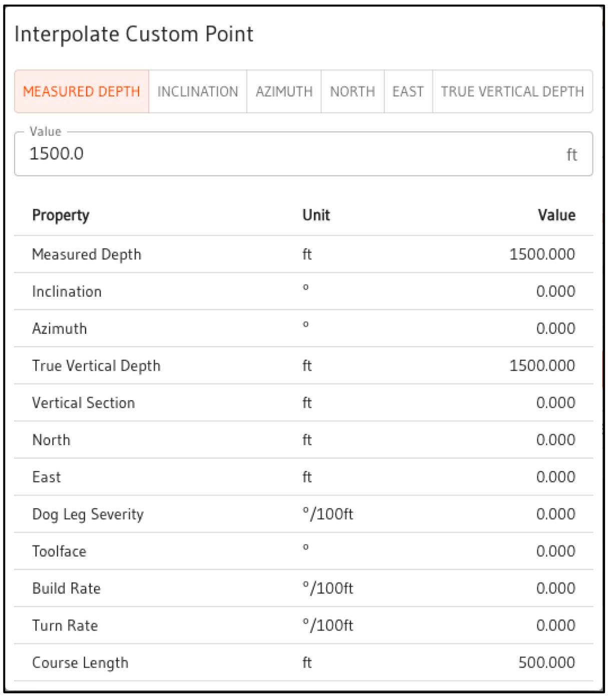

Figure 14: Custom Point Interpolation

In the window, the user can first specify which property the interpolation is to be based on.
Example 1: the user wants to know the interpolated survey values at 1500ft measured depth -> select “Measured Depth” as the property, then TDH will display the other survey values at this depth.
Example 2: the user wants to know at which depth the trajectory reaches 60° -> select “inclination” as the interpolated property. TDH will then find the first point in the trajectory at which the inclination is exactly 60° and will display all other property values at this depth.

4.0 WELLBORE VIEW

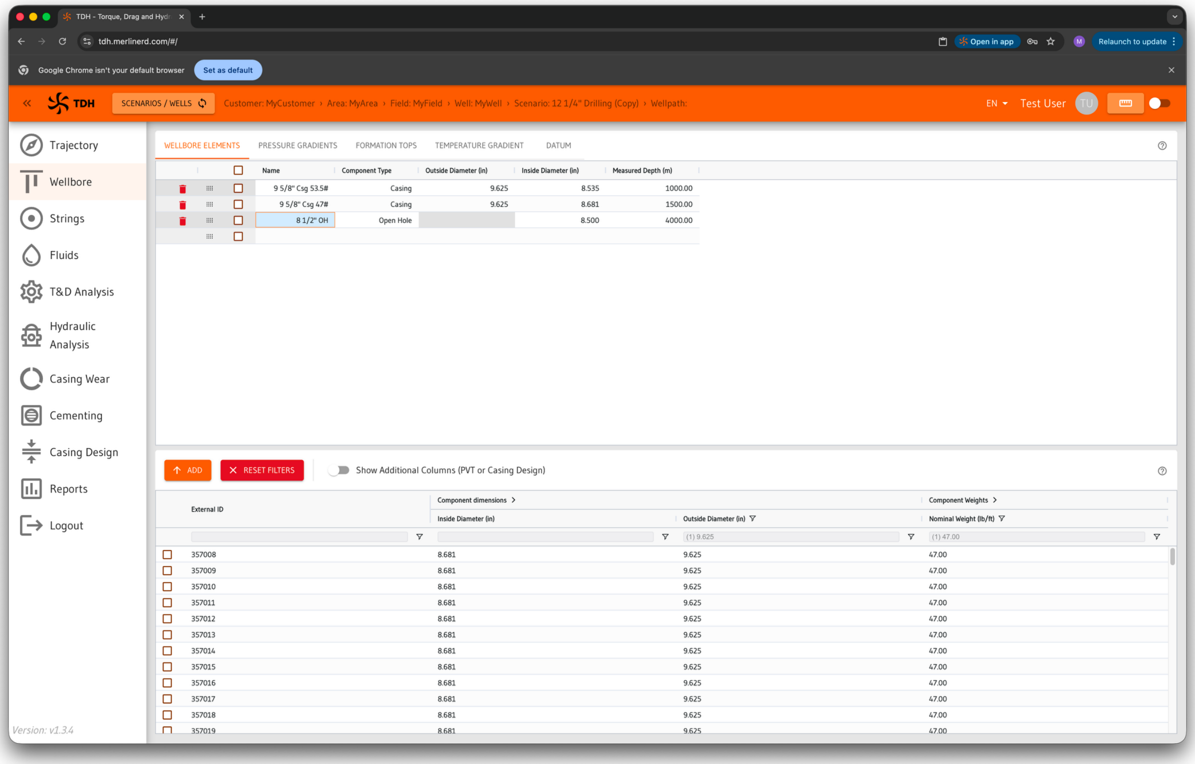

Figure 15: Wellbore View

4.1 Layout

The wellbore module consists of the following tabs (views):

- Wellbore Elements
- Pressure Gradients
- Formation Tops
- Temperature Gradients (for PVT and casing design only)
- Datum tab (for casing design only)

4.2 Wellbore Table

The wellbore table defines the wellbore geometry for the scenario and can be populated directly via a drop-down selection to define component type (cased or open hole), free text to name the component and numerical values to define the hole diameter and measured depth for the wellbore element. These values will be used to calculate the analysis results, and the component description will appear on the reports. Only the inner-most casing or liner string which will be exposed to the drill string should be specified here, along with the open hole section.

Example: when drilling an 8 1/2” section through 9 5/8” casing (casing to surface) there is no need to specify the 13 3/8” casing which is behind 9 5/8” casing, as it will not be in contact with the drill string. The user can delete components from the table by using the delete key.

Note: For hydraulic PVT calculations or in case of casing deign calculations, the user will need to turn on additional columns (reference 1 on Figure 16: Wellbore View for PVT or Casing Design) and provide additional data such as top of cement or mud weight used for drilling the relevant section.

The user can use the casing component library (below the wellbore table) to filter for a specific casing component and add it to the wellbore table. TDH will then add the component with OD and ID into the wellbore table.

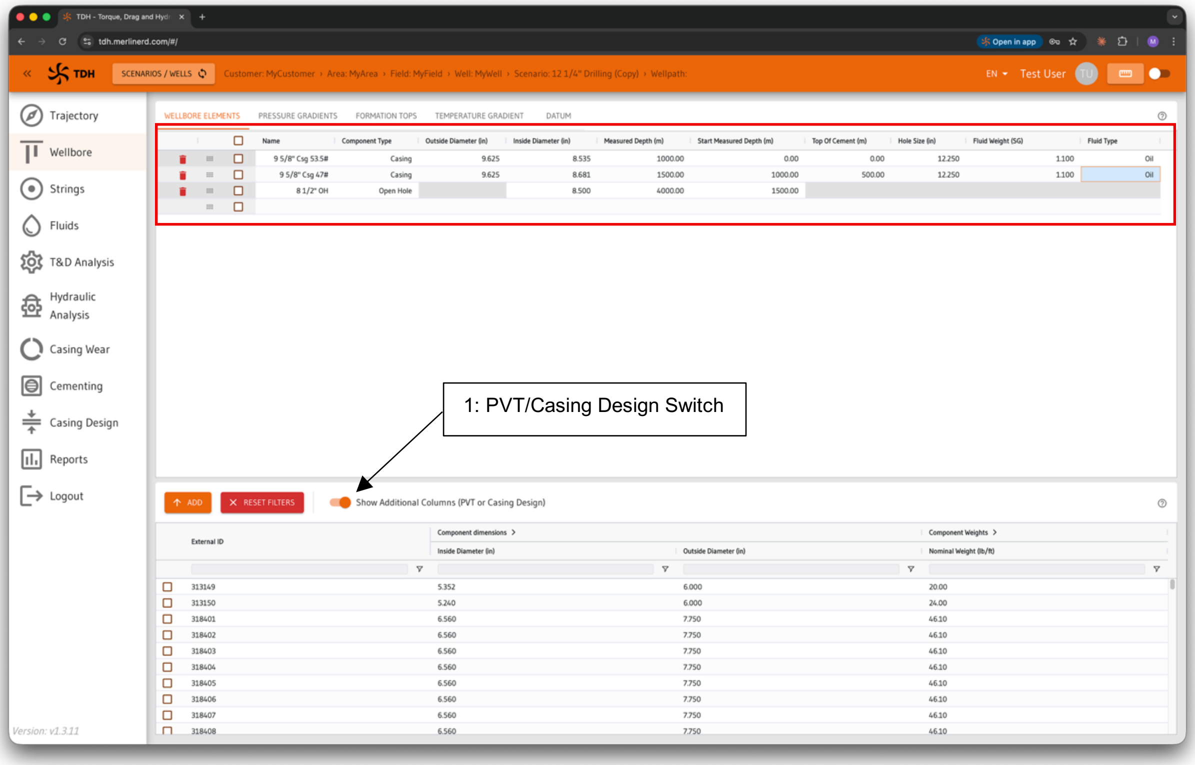

Figure 16: Wellbore View for PVT or Casing Design

4.3 Pressure Gradients

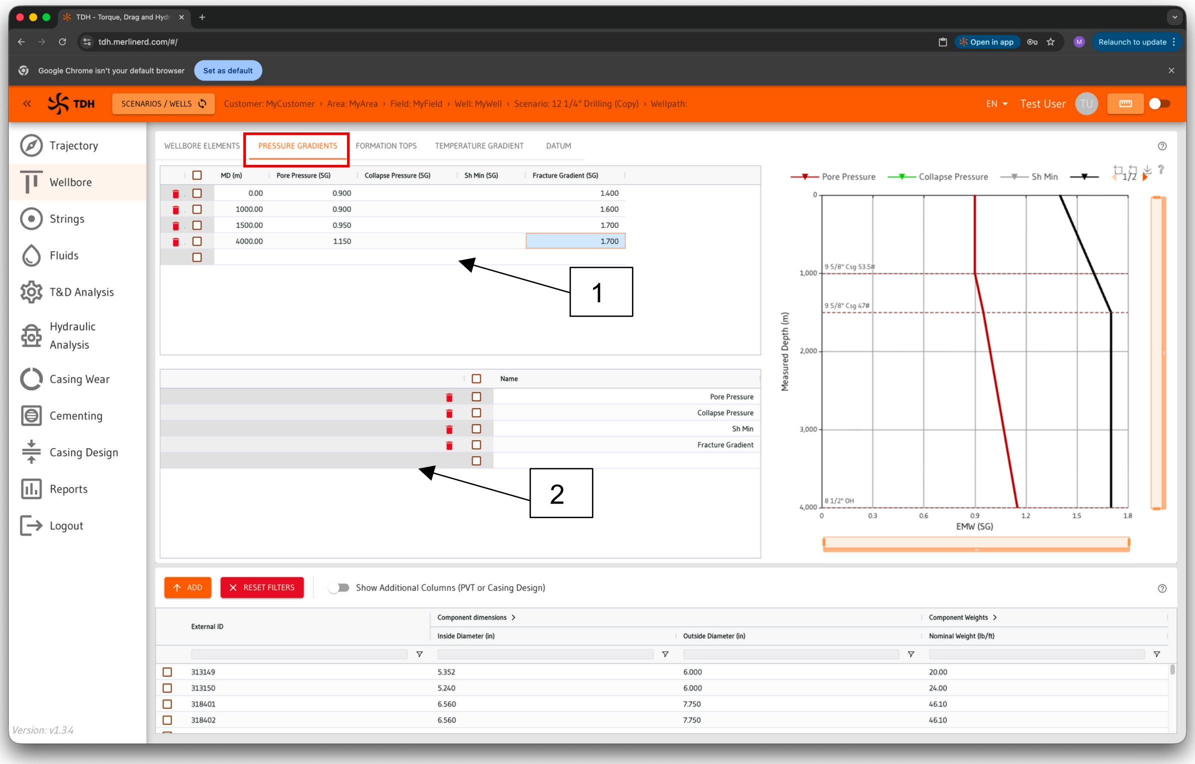

Figure 17: Pressure Gradients View

The user can enter or paste pressure gradient data into the upper table (reference 1 on Figure 17: Pressure Gradients View). Once pressure gradient data has been copied to the clipboard, the user can paste data for all or only a few columns when choosing the “Paste (assign columns)” action from the table’s right click menu. This action will allow also user to paste data in TVD format (by assigning "True Vertical Depth" to the depth column): TDH will then interpolate MD stations for the gradient values.

The lower table (reference 2 on Figure 17: Pressure Gradients View) allows the user to change the definitions of the columns, or add or delete columns in the upper table. Changing column names or deleting rows in the lower table will be reflected in the column definitions in the upper table.
The user can verify the gradient curves via the chart on the right-hand side.

4.4 Formation Tops View

Similarly to the pressure gradients view, the user can specify formation tops in this view simply by entering values into the table or pasting data from the clipboard. The user can choose to specify either the MD or TVD of the formation top: the other value will then be calculated by TDH based on the currently selected trajectory. Formation tops will show on the charts as a horizontal line with label. This visual representation on the charts will help correlate changes in the data trends to changes in the formation and will serve as reference points for the driller.

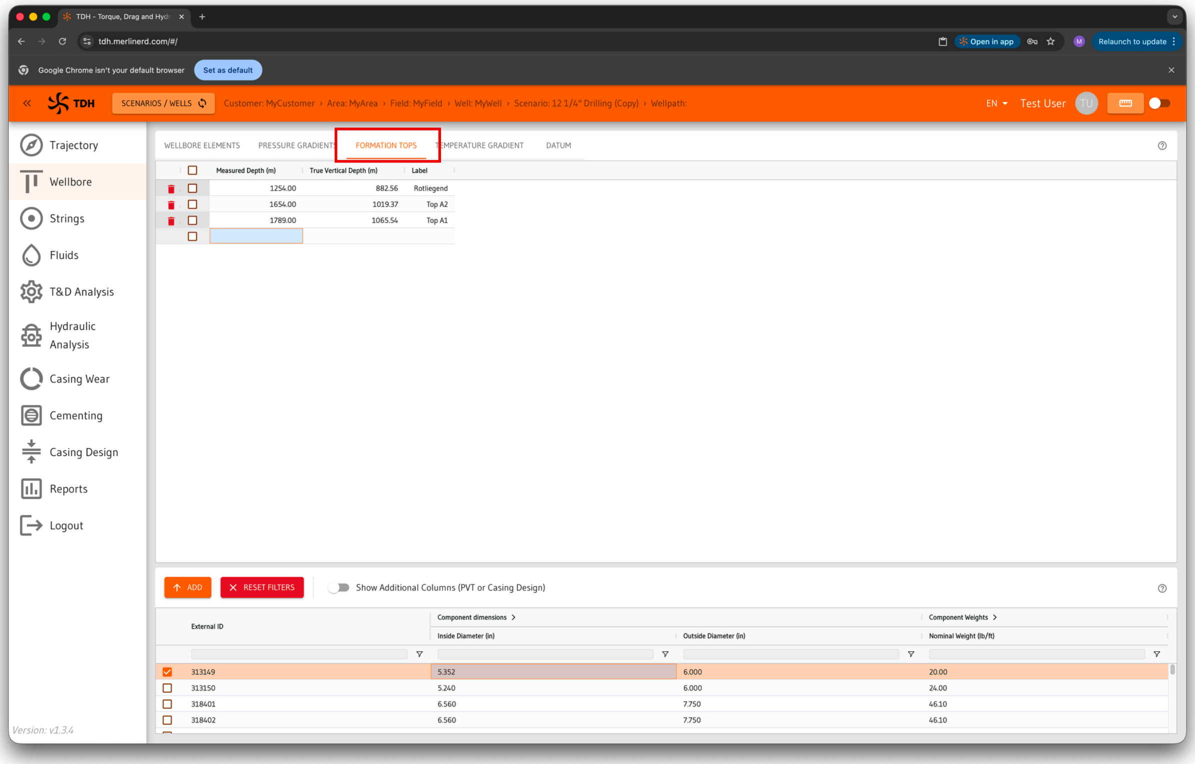

Figure 18: Formation Tops View

4.5 TEMPERATURE GRADIENT

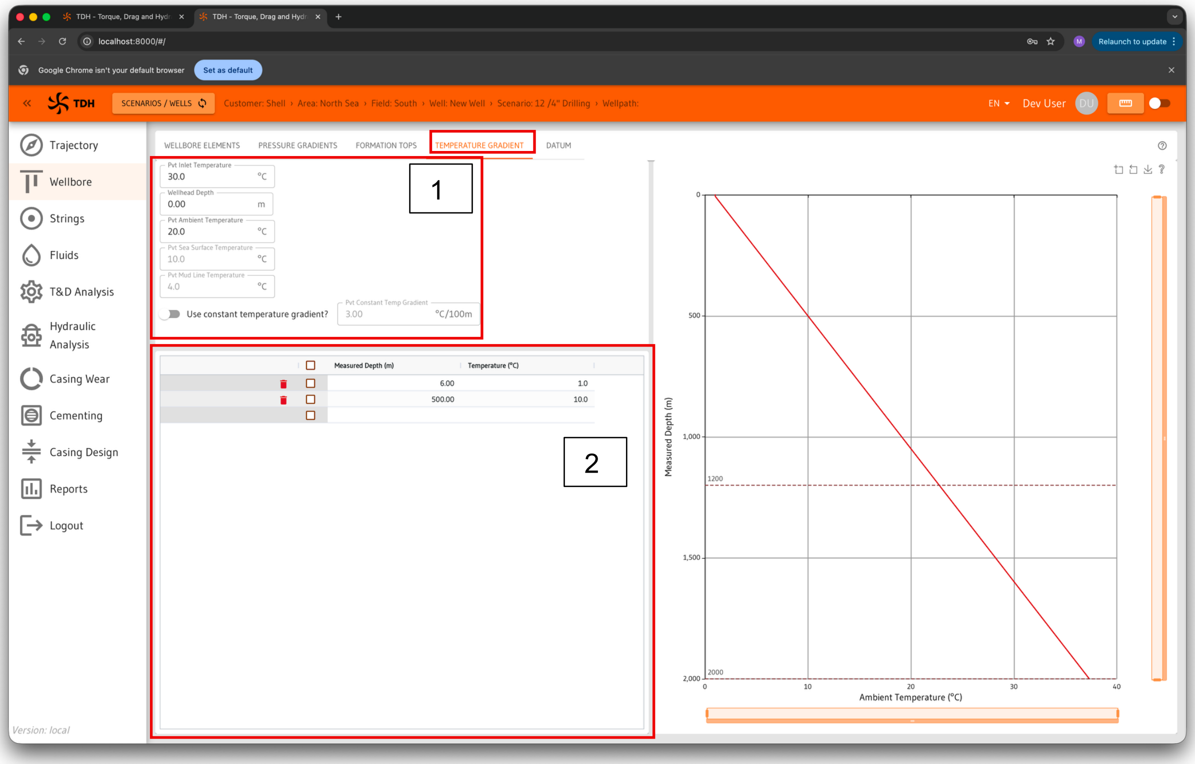

Figure 19: Temperature Gradient View

A temperature gradient definition is required for PVT and Casing Design calculations. The user can choose to specify the temperature profile using either a constant temperature gradient value together with ambient temperature specifications (1), or by pasting the temperature vs depth values into the table (2). The results can be viewed on the temperature vs depth chart.

4.6 DATUM

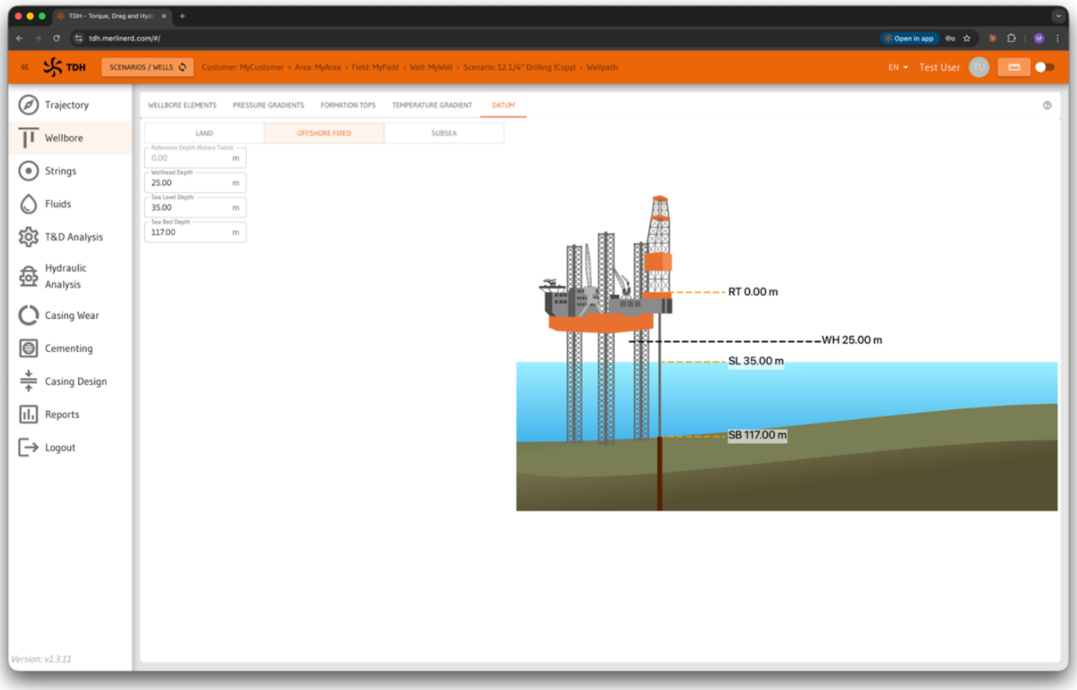

Figure 20: Datum View

This input is used only for PVT and Casing Design calculations. The user specifies well type as “Land”, “Offshore Fixed” (jack-up or platform) or Subsea.

NOTE: the well type will influence how the temperature profile is calculated when using constant temperature gradient. If subsea or offshore fixed is used, temperature calculations will require inputs on sea temperature.

5.0 STRINGS VIEW

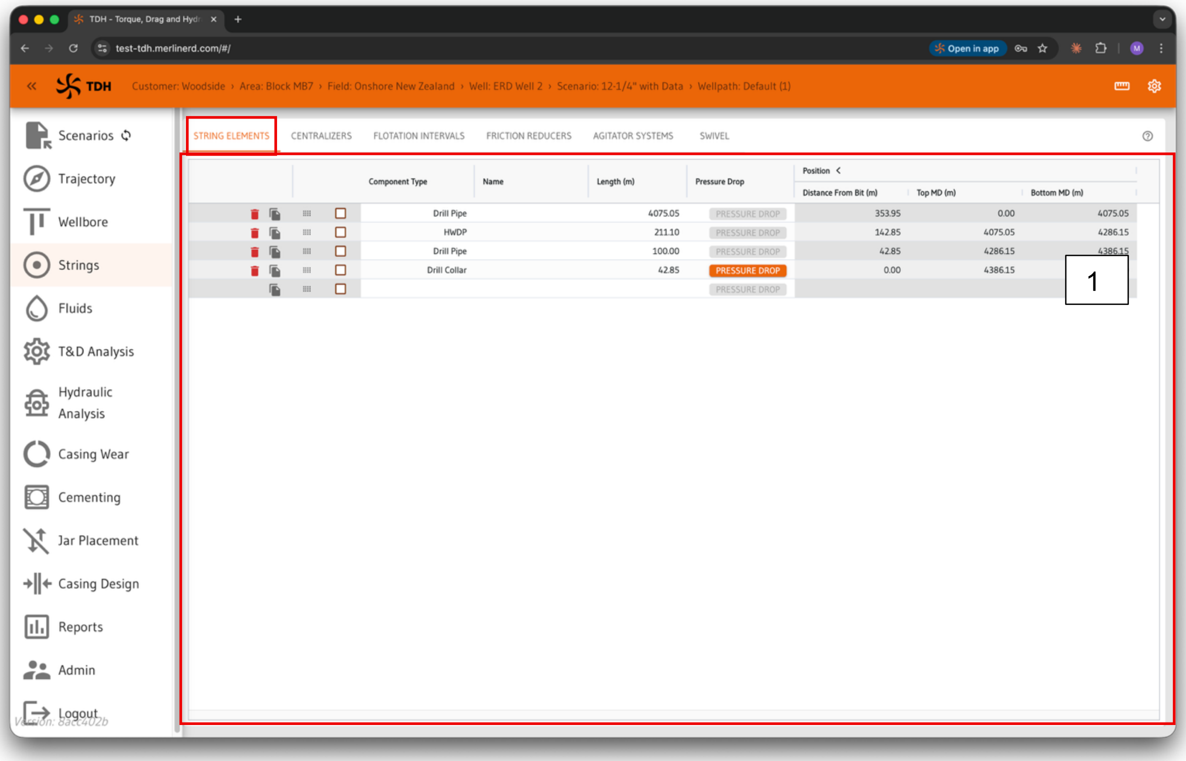

Figure 21: Strings Table View

The string view allows the user to create drill, casing or liner strings and to set up modifiers for the string which will affect torque and drag simulations.

5.1 STRING ELEMENTS

The user can choose string elements from the built-in library and add those to the resulting string table (1). To select a component user shall select component type in an existing or the empty row. This will bring up component selector. The components library contains multiple string component types such as drill collars, drill pipe, HWDP and more.

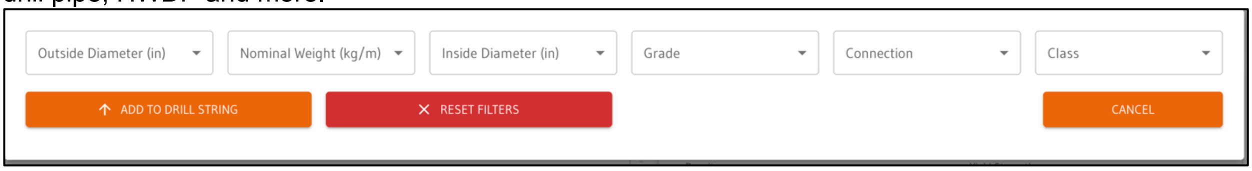

Figure 22: Strings Component Selector

The user can filter by many different categories, including component type, size, connections and mechanical properties. Once added to the string table, the component's properties – including mechanical properties, tensile and torsional limits, make up torque and weights – can then be adjusted as per the specification sheet.

When added to the strings table, the component will be assigned default joint and tool joint lengths. These represent range 2 lengths and can be changed as per the requirements. Tool joint geometry is required for any component of type drill pipe and HWDP – that includes outer diameter, inner diameter, and length. Note that the tool-joint length in the table should be the box or pin length, or an average of the two, as TDH then doubles this length for calculations such as ECD adjustment.

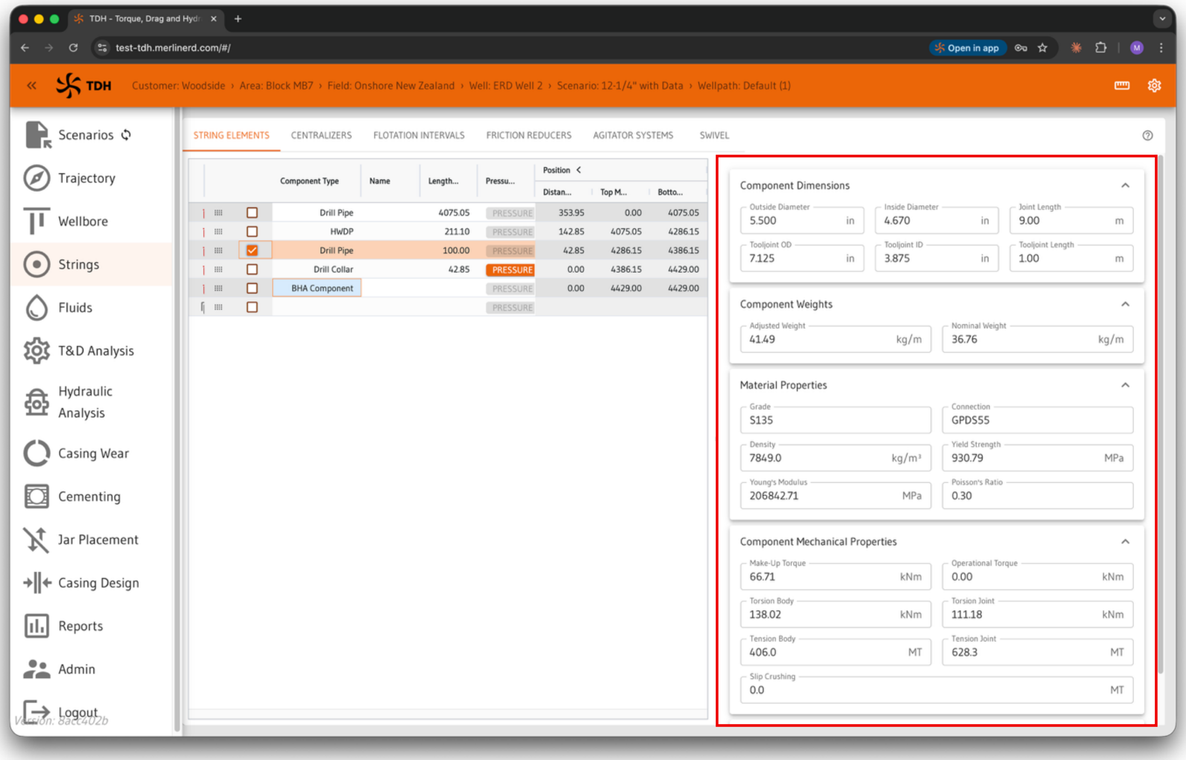

Figure 23: Strings Components Properties

The Mechanical, geometrical and other properties are presented for a selected component row on the right-hand side inside “accordions” that group the properties.

A component of type “drill collar” can have additional pressure drop specified. This additional pressure drop will add pressure drop on top of the normal pressure drop resulting from flowing through the inner diameter. This can be used to simulate any additional pressure drop through a particular downhole tool, such as a motor or MWD tool. While the pressure drop is specified for a particular flow rate, TDH will adjust for any particular hydraulics analysis in proportion with the square of the flow rate.

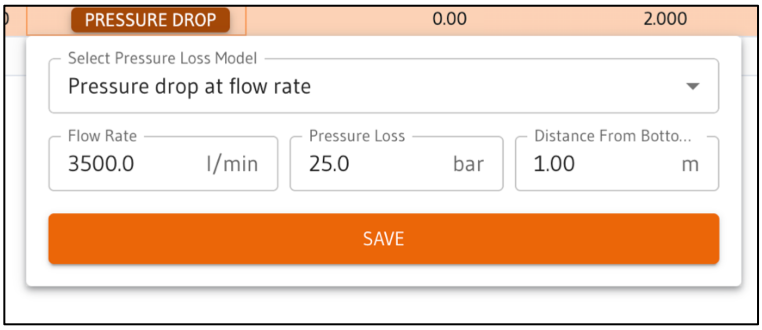

Figure 24: Pressure Drop Pop-up

NOTE: when specifying a component such as the bit or stabiliser. The user should enter outer diameter equal to the collar diameter rather than the gauge OD. Example: 8 ⅜” stabiliser should be specified as a 6 ¾” drill collar.

5.2 Centralizers

STRING ELEMENTS | CENTRALIZERS | FLOTATION INTERVALS | FRICTION REDUCERS

Distance From Bit (m)	Interval Length (m)	Centralizers Per Joint (-)	Joint Length (m)	Running Force (lb)	Outside Diameter (in)
36.00	500.00	1.000	12.00	45.0	8.500

Figure 25: Centralizers Table

In this view, the user can specify centralisers that will affect torque and drag simulations. Note that solid body centralisers do not exert a running force; however, bow-spring type centralisers may do. The user should specify the centralised interval in terms of distance from the bit (to lower-most centraliser) and length of interval. The number of centralisers per joint, joint length and running force is then used to calculate the overall additional drag. The centraliser outer diameter will affect where in the wellbore the running force is effective. In wellbore intervals where the hole ID is larger than the centraliser's OD, the centraliser running force will not be added.

5.3 Floatation Intervals

STRING ELEMENTS | CENTRALIZERS | FLOTATION INTERVALS | FRICTION REDUCERS

Distance From Bit (m)	Interval Length (m)	Inner Fluid Density (kg/m³)
36.00	1200.00	0.0
1200.00	3000.00	1250.0

Figure 26: Flotation Intervals Table

In this table, the user will specify floatation intervals to simulate floated casing or floated liner runs. The user should specify the lower end of the interval as a distance from the bit, followed by the interval length and the fluid density inside the string within that interval.

5.4 Friction Reducers

STRING ELEMENTS | CENTRALIZERS | FLOTATION INTERVALS | FRICTION REDUCERS

Distance From Bit (m)	Interval Length (m)	Drag Reduction (-)	Torque Reduction (-)	NRP effect?
1500.00	3000.00	0.800	0.300	☐

Figure 27: Friction Reducers Table

In this table, the user should specify any interval along the drill string that is affected by tools that locally change friction. In the example above, an interval is specified within the string which causes 20% drag reduction (0.8 multiplier) and 70% torque reduction (0.3 multiplier). The tools in this example rotate together with the string, therefore the NRP effect is turned off. If the tools were non-rotating, the NRP effect would be turned on. This parameter would prevent drag reduction through string rotation but the 0.80 multiplier for axial drag would still apply.

6.0 FLUIDS VIEW

In this view, the user will specify properties of the fluid in the wellbore such as rheology, fluid weight and various pressures affecting hydraulics results. TDH uses the Herschel-Bulkley rheology model to calculate pressure losses for drilling and cementing.

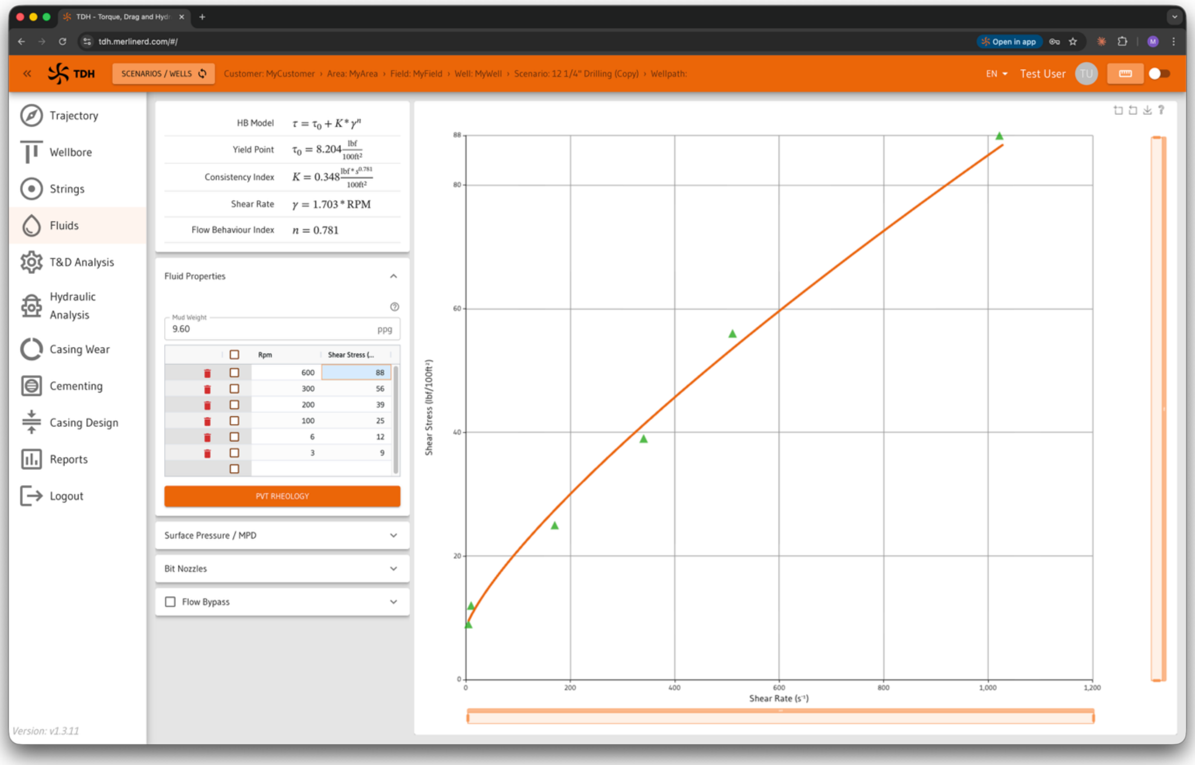

Figure 28: Fluids View

The inputs provided in this view affect torque and drag, hydraulics, cementing, and casing wear calculations. The casing design module is independent from the inputs in this view.

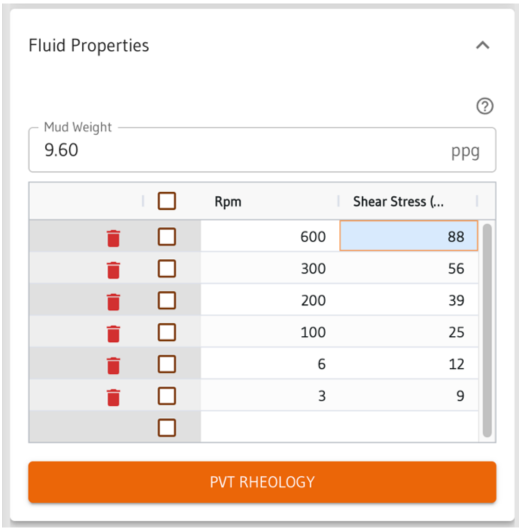

Figure 29: Fluids Properties Group

In the Fluid Properties input group, the user specifies base rheology and mud weight: this information is enough for the torque and drag and hydraulics calculations. In case the PVT correction will be used, the user will need to specify the PVT rheology as well, by pressing the “PVT Rheology Button”.

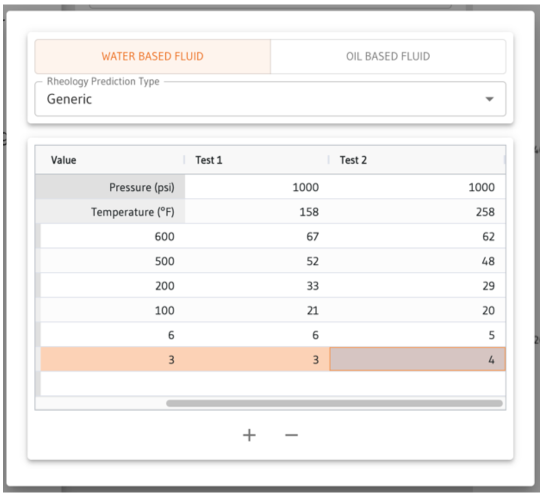

Figure 30: PVT Rheology Pop-up

In the PVT rheology Pop-up, the user will select fluid type, rheology prediction model and provide rheology readings for different pressures and temperatures.

In case the rheology prediction model is set to generic or none, the rheological properties are not required as downhole rheology will either not be calculated (rheological model "none") or Merlin's generic mud properties will be used to generate downhole rheology.

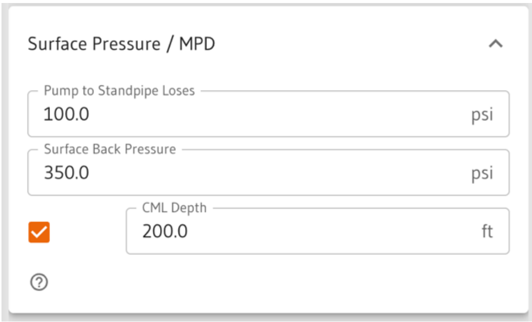

Figure 31: Surface Pressure / MPD Group

In this input group, the user provides information about surface lines pressure losses and will be able to simulate a basic MPD set up via a fixed surface back pressure specification. This is a constant surface back pressure that will affect standpipe pressure, ECD and swab/surge results. The user can also enable a Controlled-Mud-Level option by providing a CML depth that will affect the same results.

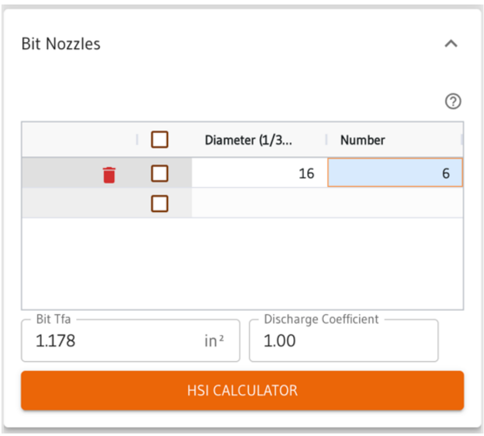

Figure 32: Bit Nozzles Group

In this input group user will specify the TFA of the drill bit or casing shoe. The user can either enter the number and diameter of the nozzles or specify the TFA directly. The HSI calculator button will bring up a pop-up display that allows for optimisation of the TFA.

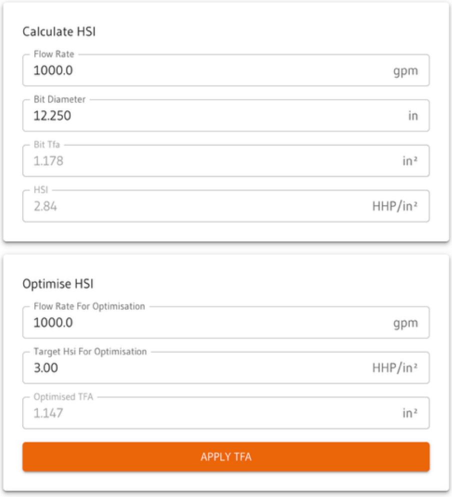

Figure 33: HSI Calculator

In the HSI Calculator, the user can check the current HSI or optimise the TFA for a target HSI and apply that TFA to the bit input group.

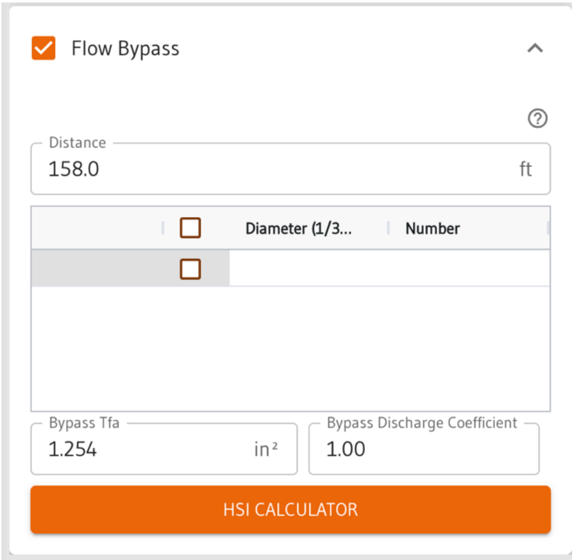

Figure 34: Flow Bypass Input

The flow bypass functionality, when enabled, will allow for split flow calculations in the hydraulics module. The user needs to specify where the flow bypass is within the drill string by entering the distance-from-bit value and specifying the TFA of the flow bypass ports or nozzles. This functionality enables precise ECD and standpipe pressure modelling for tools with a flow-bypass, such as underreamers, circulation subs, and more. The hydraulics module provides a chart that shows the split flow ratio value between the bit and the flow bypass element.

7.0 TORQUE & DRAG ANALYSIS

Required Inputs:

- Trajectory
- Wellbore (simplified)
- Strings
- Fluids (mud weight, rheology if applying hydraulic uplift).

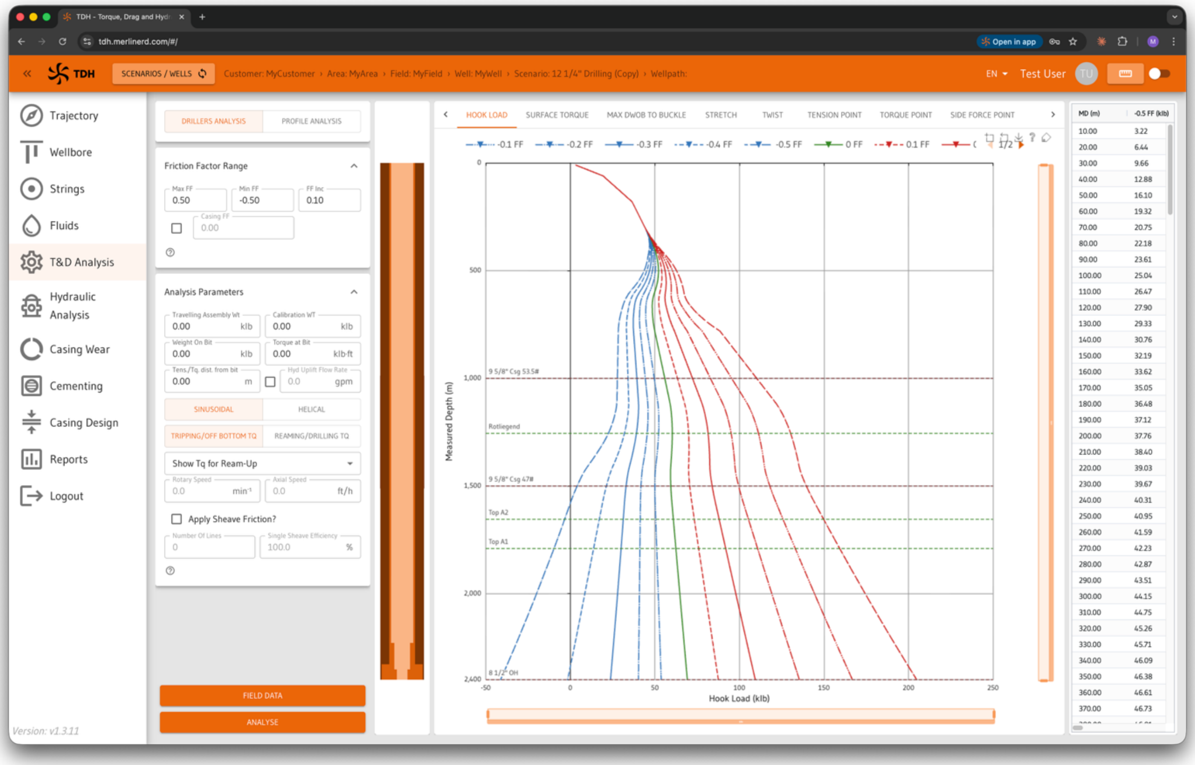

Figure 35: T&D Analysis View

T&D analysis has two main modes of calculation: driller's analysis and profile analysis. The driller's analysis provides hookload and torque results that the driller would see on the surface as a function of bit depth, whereas the profile analysis provides the torque and drag results along the length of the string for one fixed bit depth. Both analyses supplement each other.

All torque and drag calculations are based on the friction factor parameter. Negative friction factors are used to define axial movement in the downward direction (i.e. for slack-off or reaming-in operations), whereas positive friction factors indicate axial movement in the upward direction (i.e. pull out of hole or backreaming operations). The user can specify a range of friction factors to be analysed, along with the increment ("FF Inc") to define the number of lines that will be calculated for a specific case. and friction factor increase that will define how many lines are. Torque and drag calculations can be conducted in one of two operation modes:

- Tripping / Off-bottom: this mode considers only one movement axis a time – i.e. axial or rotational – and is used to simulate tripping loads or weights and off-bottom torque measurements, as usually taken before connections.
- Reaming / Drilling: this mode considers the resultant friction when the string is being rotated and moved axially at the same time (e.g. drilling, back-reaming, down reaming).

The "Point" charts, available on the right when in driller's analysis mode, show T&D results at a specific point within the string (defined via the "Tens./Tq. dist. from bit" input) versus the bit depth. These are helpful when checking loads at specific tools within the drillstring, such as a crossover or drilling jar.

The user can see the results of a simulation on the chart in the centre and can review the numerical values in the results table on the right-hand side. The table can be expanded by pulling the divider between the chart and the table to the left.

Below is the definition of the various “Analysis Parameters” inputs.

Travelling Assembly: This usually represents the combined travelling block & top-drive weight and is added to the tension at the top of the string when in drillers analysis mode to match the weight indicator (or “hookload”) values. Note that in drilling systems where the weight indicator value is measured directly at the top of the string (e.g. load cells or torque and tension subs), this input should be set to zero.

Calibration WT: This is a hookload adjustment value (positive or negative), used to account for unknown variables in the model when calibrating so that the rotating-off-bottom weights match the corresponding modelled curve.

Weight on bit: Use positive values for adding weight on bit, negative to simulate overpull.

Torque at bit: Adds torque to the end of the string. Can be used to simulate bit torque.

Tension/torque point distance from bit: Defines the point in the string for which the tension and torque values will be reported on the Tension Point, Torque Point and Side Force Point charts.

Hydraulic uplift: When enabled and a flow rate is entered, this will simulate the uplift – or hookload-lightening – effect acting on the drill string due to the dynamic pressure drop in the annulus. Mud rheology is required to perform this simulation.

Buckling mode: The buckling mode specified here – sinusoidal or helical – is used to calculate maximum allowable downhole weight to buckle.

Operation mode: In tripping mode, torque results are calculated for an off-bottom string that is not moving axially; similarly, pickup and slack-off loads are calculated with no string rotation. In drilling/reaming mode, axial drag and torque are calculated based on the vector addition of the axial and rotational speeds. Drilling/reaming mode is to be used for on or off-bottom operations that require simultaneous axial movement and rotation of the string (reaming, drilling, back-reaming).

Torque result selector: This selector allows to present torque for reaming up or down, or both. Selection only makes difference if reaming/drilling mode is selected where the string direction produces different torque results.

Rotary speed: This input is enabled when the reaming/drilling mode is selected. The value is disregarded if the tripping mode is selected.

Axial speed: This input is enabled when the reaming/drilling mode is selected. The value is disregarded if the tripping mode is selected again. This value represents the axial speed component of the string i.e. ROP or axial speed while reaming.

Bit Depth (profile analysis mode): Depth parameter defining the string end-depth at which position the profile analysis will run.

Sheave Friction: When enabled, the modelled hookload curves will be adjusted for the sheave friction in a standard block / pulley system. This correction is appropriate for when the hookload measurement is being taken from the dead-line side of the system, when the down weight can read higher than the up weight at lower inclinations. The user needs to provide the average efficiency of each sheave (in %) and number of lines in the pulley system. The sheave efficiency can be calibrated using the hookload measurements when vertical or at low inclinations.

8.0 HYDRAULIC ANALYSIS

Required Inputs (regular analysis):

- Trajectory
- Wellbore (simplified)
- Strings
- Fluids

Required Inputs (PVT analysis):

- Trajectory
- Wellbore (extended)
- Strings
- Fluids incl. PVT rheology data.

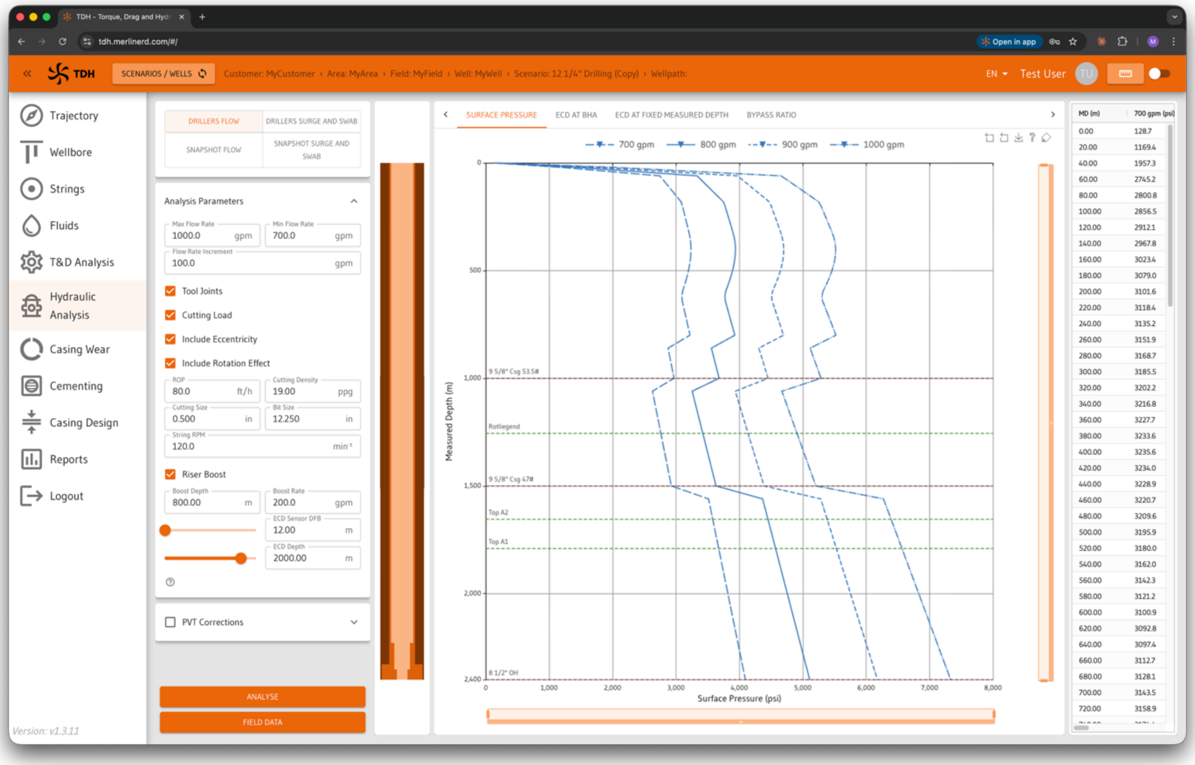

Figure 36: Hydraulic Analysis View

Hydraulics analysis has four different modes: driller’s flow, driller’s surge and swab, snapshot flow and snapshot surge and swab. Similarly to T&D analysis, the driller’s mode shows the result on surface or a specific point in the wellbore vs bit depth, whereas the snapshot modes show the results along the drill string for a fixed bit depth.

The flow analyses have sensitivity to flow rate, while the surge and swab modes have sensitivity for pipe tripping speeds.

The driller’s flow mode calculates:

- Standpipe pressure
- Bypass ratio (split flow ratio)
- ECD at the BHA
- ECD at fixed measured depth

as a function of bit – or casing/liner shoe – depth.

The snapshot/profile analyses calculate:

- Fluid velocity profile (both flow + surge swab)
- Pressure profiles (flow)
- Cutting concentration (flow)
- ECD Profile (flow + surge swab)

- System ∆P breakdown (flow)
- Flow Regime (flow)
- Temperature profile (flow PVT)

In all modes, the user will need to specify the flow or pipe speed range and increment for calculating lines. In surge swab modes, the user will need to specify negative pipe speeds for swab and positive for surge e.g. -90 to 90 ft/min with an increment of 30 ft/min.

Hydraulics analysis parameters allow users to apply certain correction to the results.

- Tool Joints – will account for increased pressure losses across tool joints (both inside and outside pipe).
- Cutting Load – will account for the cuttings load in the annulus increasing the ECD while drilling.
- Eccentricity – pipe eccentricity will be calculated based on the wellbore inclination and annular pressure losses will be adjusted accordingly: a lower pressure loss will be calculated for an eccentric annulus and higher for a more concentric annulus.
- Rotation Effect - used for cases where string rotation is applied (drilling, backreaming, drilling with casing etc). It will increase ECD proportionally to the rotation speed applied.
- Riser Boost – an increase in flow rate will be applied in the annulus from the specified boost depth to surface with the specified boost flow rate.

In surge swab analyses, the user can apply the following corrections:

- Tool Joints – as above.
- Eccentricity – as above.
- Trip with flow – to add flow-related annular pressure losses to the tripping-induced annular pressure losses.
- Dynamic Effects – when this correction is applied, TDH will calculate the worst-case scenario for surge and swab, accounting for transient effects such as breaking gels and pipe acceleration. Without it, TDH will just calculate steady-state surge and swab as per the specified pipe tripping speed. Note that the “Dynamic Effects” correction is set to “on” by default.
- Riser Boost – as above.

In driller’s flow and swab surge flow modes:

- ECD sensor distance from bit – specifies where the ECD will be calculated in the annulus with reference to the bottom of the string (i.e. a moving measurement point). This would normally be set to match the bit-ECD sensor offset, to enable direct comparison with the downhole ECD/EMW measurements, using the “ECD at BHA” or “SURGE/SWAB at BHA” charts.
- ECD depth – this specifies a fixed depth within the annulus will is used to calculate the ECD or Swab/surge at fixed measured depth. On ECD at fixed measured depth, the Y-axis indicates the bit depth, as the string moves in and out of hole, while the X-axis shows the corresponding ECD value at the specified fixed hole depth. The example below shows results for an ECD depth of 2000m. Reading this chart should be done in following manner: Read value for 700 GPM at 1,000m – the value is 15.56 ppg. The result is: “With the bit at 1,000m MD, the formation at 2,000m MD will see 15.56 ppg EMW when flowing at 700 GPM.

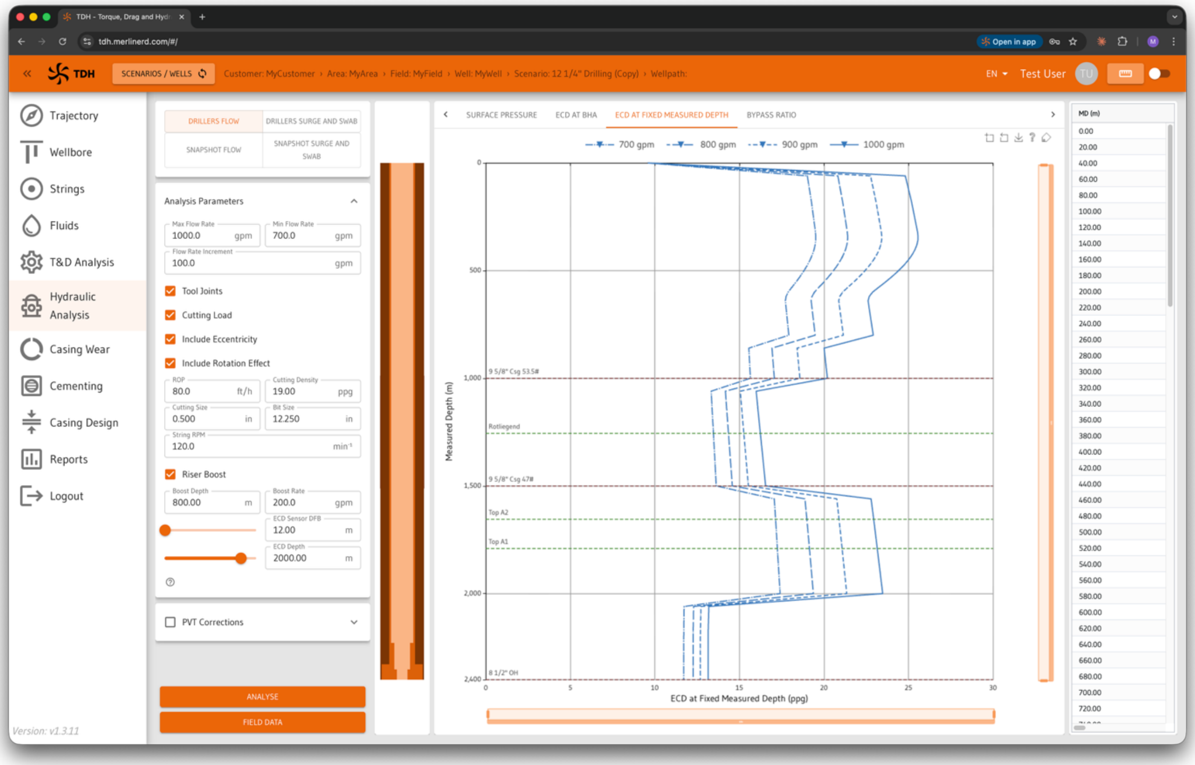

Figure 37: ECD at Fixed Measured Depth Analysis

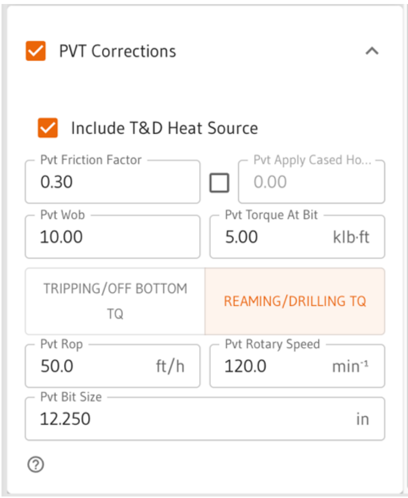

Figure 38: PVT Correction Input Group

The user can enable PVT correction for the hydraulic analysis. That correction calculates downhole pressures and temperatures and adjusts downhole fluid density and rheology based on the calculated pressure and temperature values. It then re-calculates hydraulics iteratively. In each pass, temperature and pressures are computed and downhole corrections are applied until the difference in temperature profile is below a threshold. The final results are then displayed to the user. As a result, PVT is a CPU-heavy calculation that can take up to several minutes to complete, depending on the wellbore length and PC performance.

The user can include T&D heat sources: rotating the pipe in the wellbore will generate heat absorbed by the fluid flow. The bit drilling action will also generate heat that will be added to the fluid at the bottom of the annulus. T&D parameters will need to be specified in this input group when T&D heat source is enabled.

9.0 FIELD DATA

The field data button is available in T&D and hydraulic analysis views. It allows the user to specify actual measured data that is then plotted in the respective T&D and hydraulic charts.

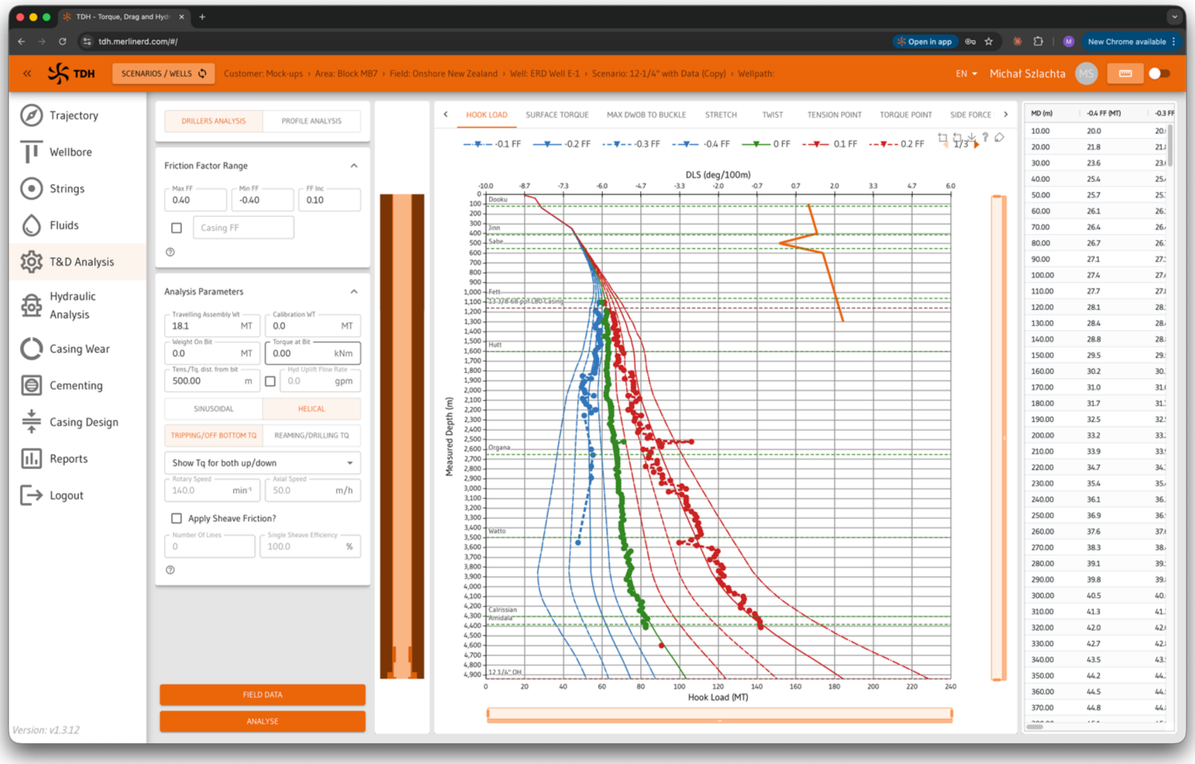

Figure 39: T&D Analysis with Field Data

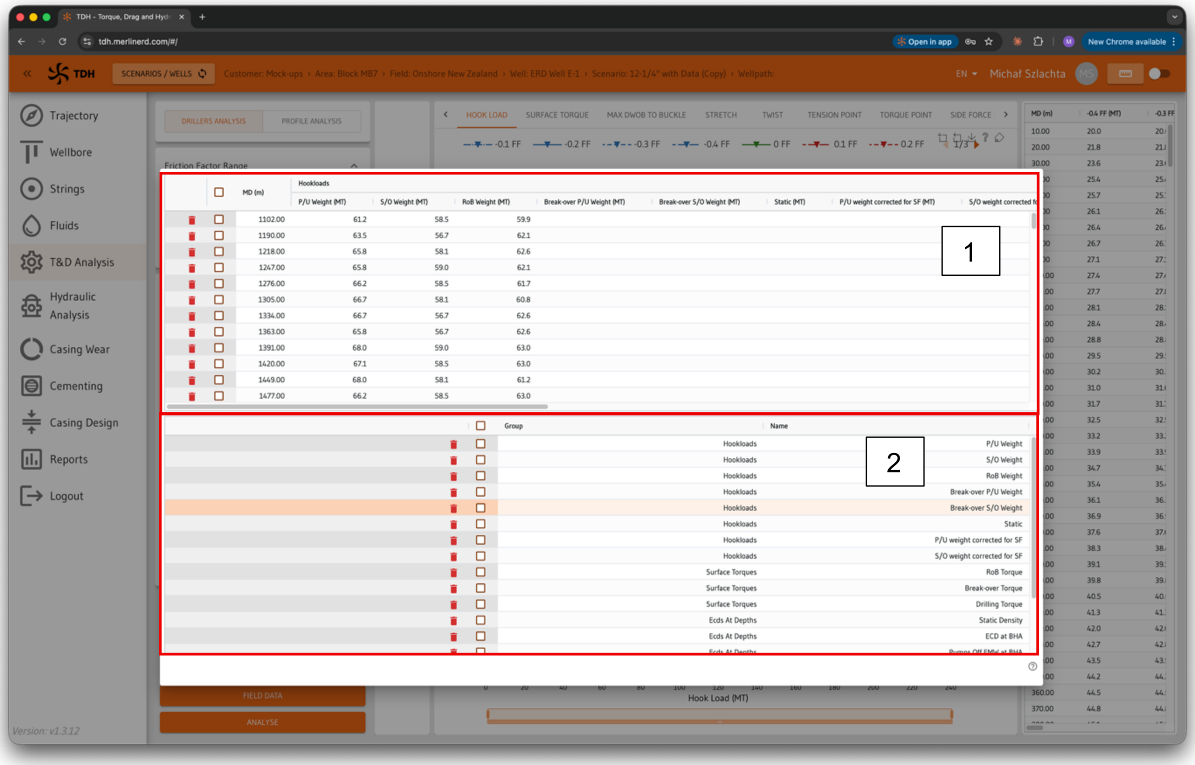

Figure 40: Field Data view

The field data view is divided into the field data table (1), where the user can enter/paste the field data, and the field data definition table (2), where the user can define the column visible in field data table and modify the names of the existing columns. The parameter definitions consist of group and measurement name. The group selection will define on which chart will the field data be plotted. E.g: hookload data will be plotted on the hookload chart, ECDs will be plotted on the ECD and Swab/Surge chart.

Only series that have at least one data point specified (MD and value) will be visible in the legend of a corresponding chart.

The user also has an option to specify custom series on any chart that cannot be defined in the field data table (see Figure 53: Chart Menu – Secondary Axes).

10.0 CASING WEAR ANALYSIS

Required Inputs:

- Trajectory
- Wellbore (simplified)
- Strings
- Fluids (mud weight)

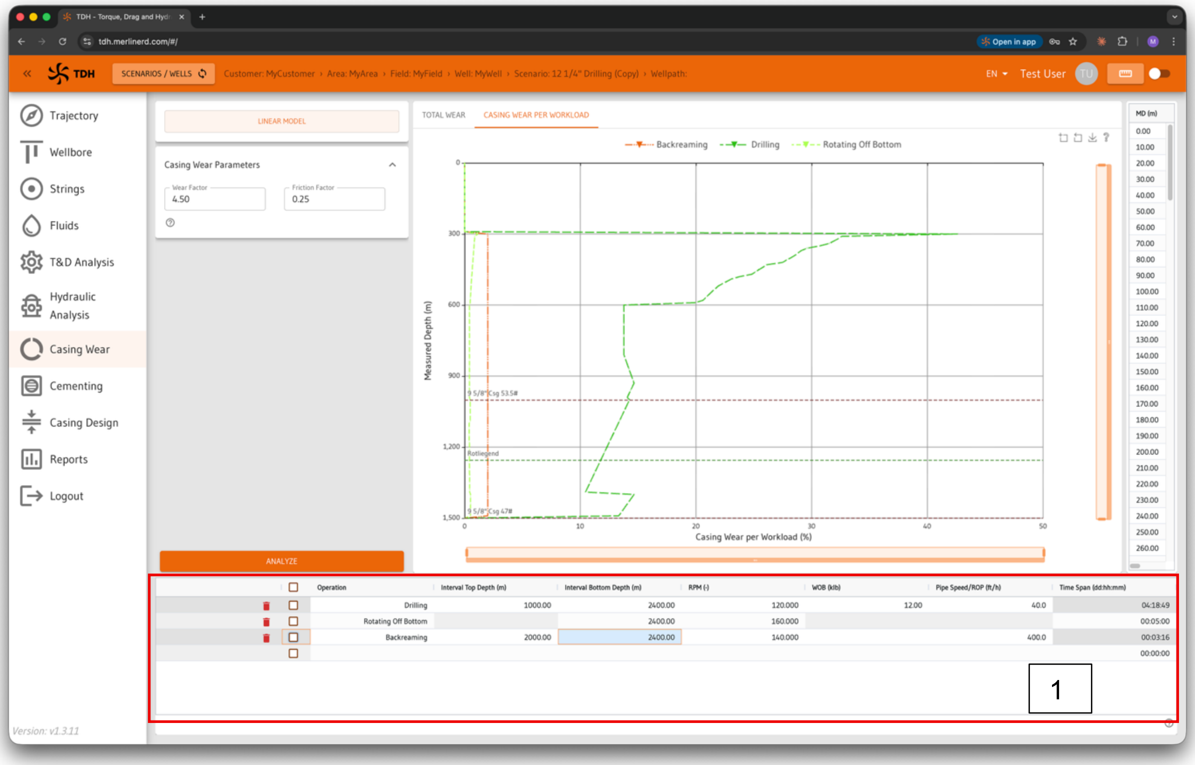

Figure 41: Casing Wear View

In this view, the user can analyse casing wear. Casing wear is calculated with a linear casing wear model, for which the wear rate does not reduce with the increase in width of wear groove. An increase in wear groove width will cause the contact pressure between the string and cased hole to reduce at the same side force. The linear model does not account for that reduction in pressure and so modelled casing wear will progress linearly, proportional to total revolutions of the string and side force; therefore, the results of this modelling should be considered as conservative.

The user is required to specify a wear factor (usually between 2 and 3 for casing-friendly tool joint hard banding) and a friction factor to be used for the operations.

Casing wear is calculated for the operations (workloads) that require string rotation i.e. drilling, reaming-in, rotating off bottom and back reaming. The user will specify these workloads in the table (1). Drilling and reaming operations require specifying the interval for which the operation is conducted as well as the T&D parameters. Rotating off bottom requires the user to enter the depth (Interval Bottom Depth) at which the rotation is conducted and the time span of this operation. For all other operations, the time-span will be automatically calculated.

The resulting casing wear value is displayed as the percentage of the wall thickness worn. I.e. a result of 20% means 20% of the wall thickness will be worn out, with 80% of the wall thickness still remaining.

Available charts show total wear and breakdown of wear per workload (operation).

11.0 CEMENTING ANALYSIS

Required Inputs (regular analysis):

- Trajectory
- Wellbore (simplified)
- Strings
- Fluids

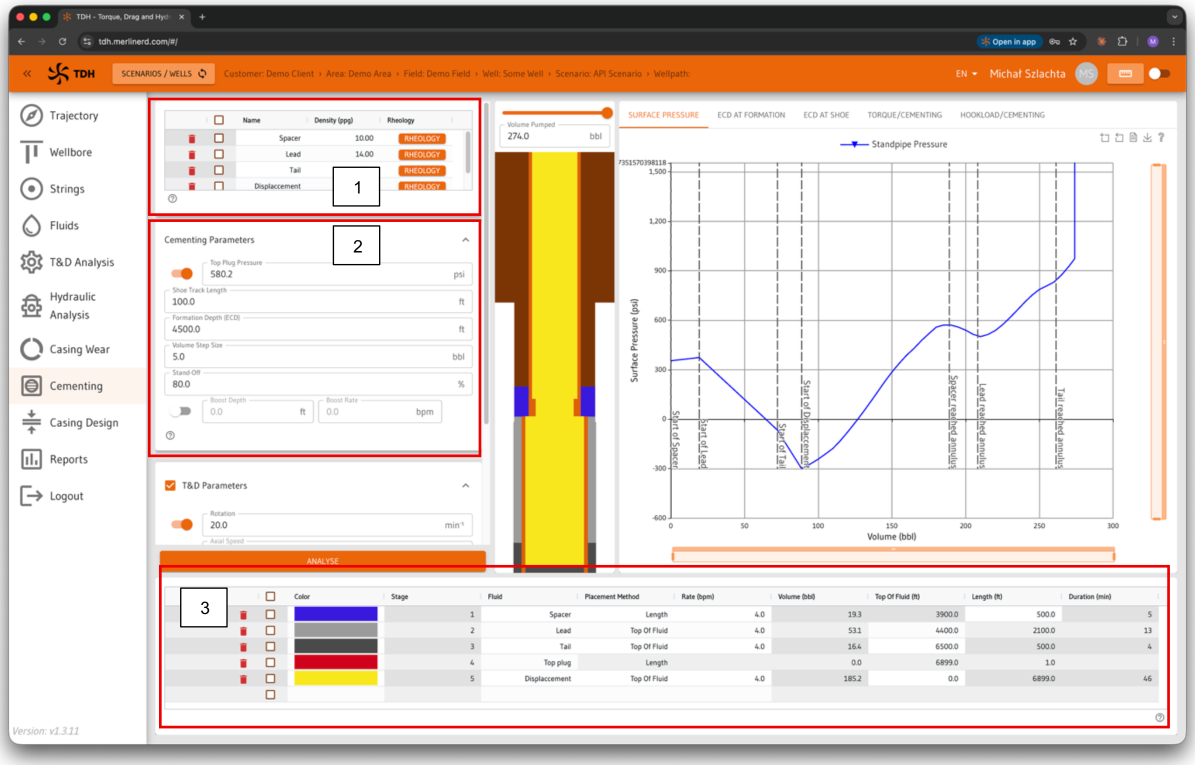

Figure 42: Cementing Analysis View

The cementing analysis is calculated for the wellbore and string specified in the respective input views. The string that is going to be cemented in place needs to be specified in the strings view. While the initial fluid that is in the string and inside the annulus is specified in the main fluids input view, the remaining fluids pumped during the cement job need to be specified in this view (1), shown in Figure 42. The name, density and rheology is required for each cementing fluid.

Cementing parameters (2) need to be provided and include:

- Top plug pressure – pressure that will be applied once top plug is landed.
- Shoe track length – to calculate cement and displacement fluid volumes.
- ECD Depth – depth for which the ECD will be calculated and reported; for example, this could be the previous casing shoe, or a weak formation.
- Volume step size – the volume step for which the values will be calculated (5 bbl or 1m^3 is generally recommended).
- Stand-off – average standoff for the string to be cemented. The default value is 80% (with 100% representing a string fully concentric within the wellbore).

The user can also enable T&D calculations during cementing. The calculated values are Hookload and Torque while cementing.

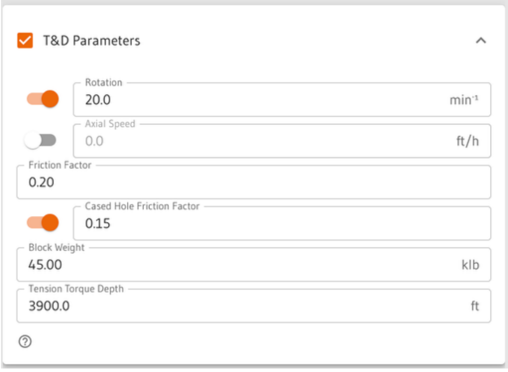

Figure 43: Cementing T&D Parameters

The T&D will depend on the fluid position within the string and the annulus as this will affect the buoyancy. The parameters specified in this input group will affect the T&D results while cementing.
The **tension/torque depth** parameter specifies the point within the string for which the T&D parameters will be reported.

The cementing analysis requires the job grid at the bottom of the view (3) to be populated before hitting the “Analyse” button. The job grid can be populated by first specifying fluids pumping order by selecting from the drop-down menu in the “Fluid” column from spacer, followed by the cement fluids, top plug and then displacement fluids. Top plug input is mandatory and needs to be placed between last cementing fluid and first displacement fluid. There is no need to specify the top plug in the fluids table (1), as it is automatically added to the fluids selector.
For each fluid pumped, the user needs to specify the flow rate, placement method (to calculate volume and position) and relevant placement parameter (top of fluid, volume or length). For displacement fluids it is recommended to use the top of fluid as placement method and set it to 0 so that the string is always fully displaced from surface to top of shoe track.

Note: The module assumes that the casing and annulus contains mud specified in the main Fluids view, before cementing.

12.0 CASING DESIGN ANALYSIS

Required Inputs (from the main input views):

- Trajectory
- Wellbore
  - Wellbore elements with “Show Additional Columns (PVT or Casing Design)” switch set to on.
  - Pressure gradients for pore and fracture gradients.

The casing design analysis allows for 3-axial stress analysis as well as 1D analysis of burst, collapse and axial loads.

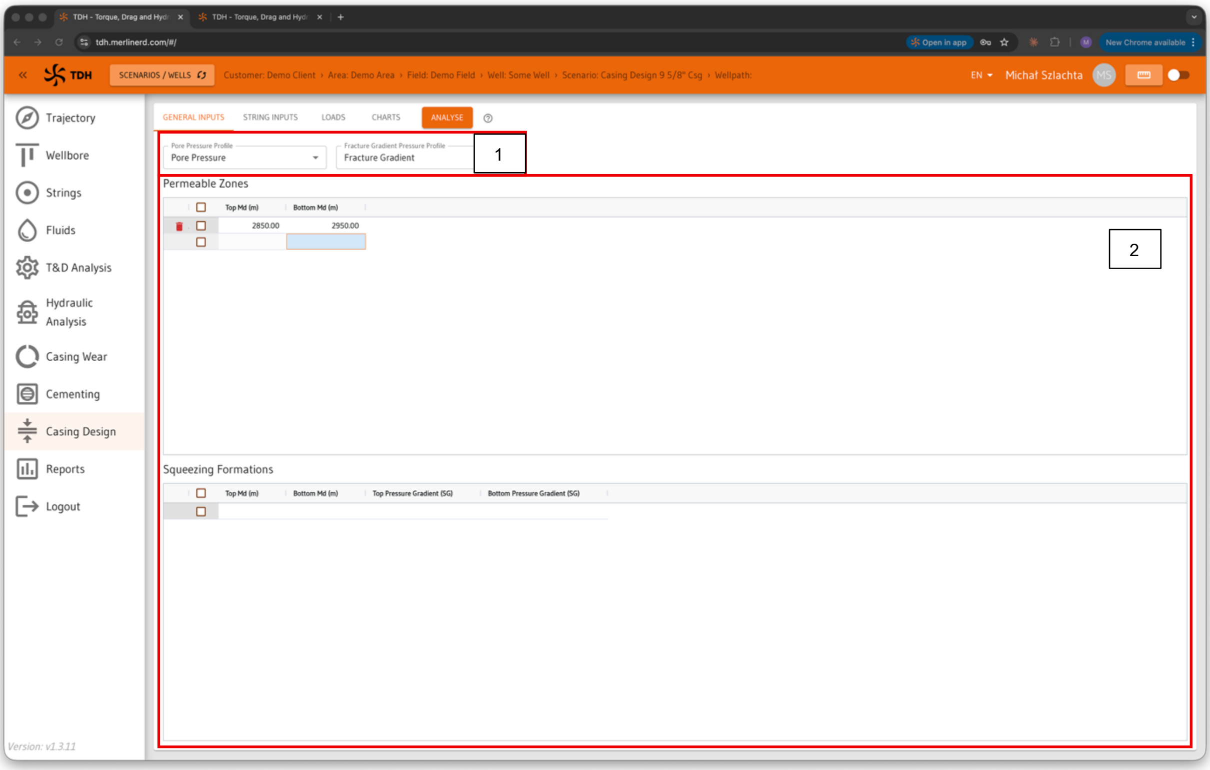

Figure 44: Casing Design View – General Inputs

The general inputs tab requires information that describes the entire length of the wellbore from surface to TD. This information applies to all strings and certain loads. The user needs to specify which gradients, specified in the wellbore view, should be used for the pore and fracture pressure profiles (1). In the tables (2), the user specifies all permeable zones and squeezing formations, if applicable, for the well that is to be analyzed.

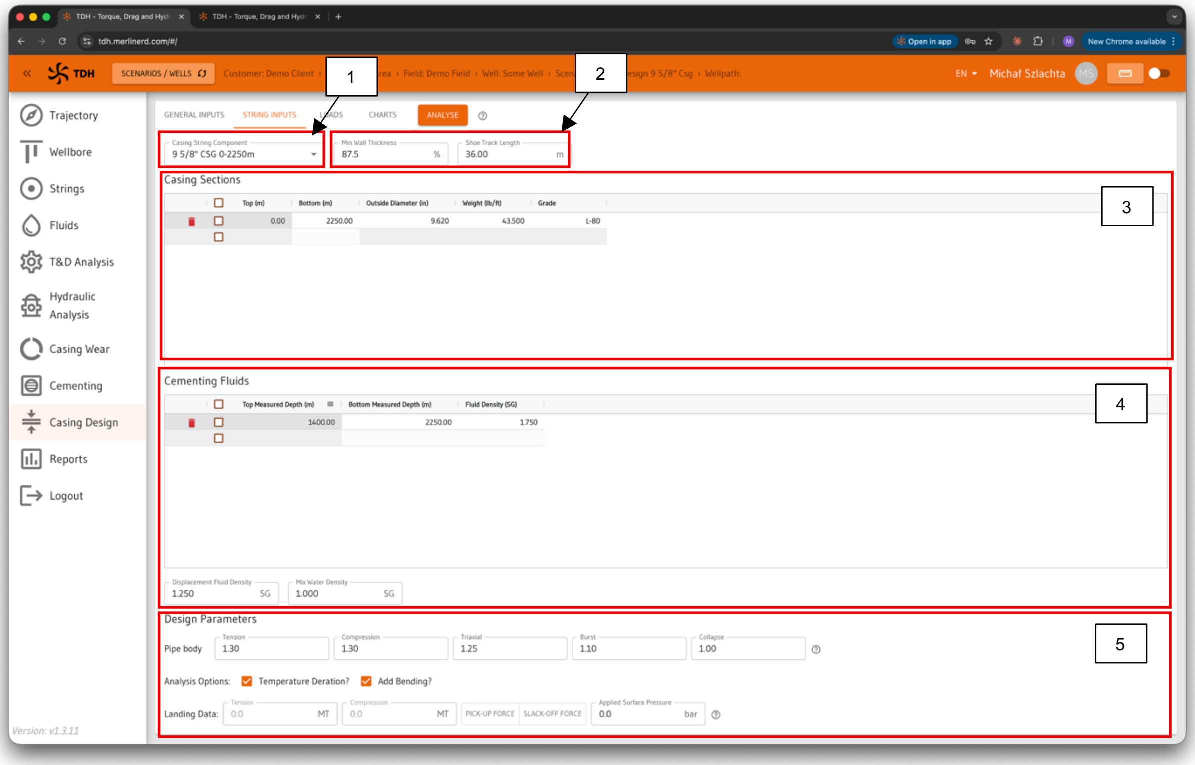

Figure 45: Casing Design View – String Inputs

In the string input view, the user specifies information that applies to the specific string only. The user must first choose the string that is to be analysed. The user can switch between strings and analyse each string defined in the wellbore view one-by-one. Inputs for each string are saved automatically.
The user specifies the minimum wall thickness (the default value is 87.5%) and shoe track length (2).

In the “Casing Sections”, table (3), the user must specify the casing string details for its entire length, using separate lines to specify any changes in OD, Grade etc, as required.

In the “Cementing Fluids” table (4), the user should specify the different cementing-related fluid columns that will be in the annulus at the end of the cement job. This information will be used to calculate the initial stress conditions for all load cases. Note that the first “Top Measured Depth” in this table defaults to the “Top of Cement” already defined in the extended wellbore elements table, within Wellbore view. The definition of the fluid above the top of cement also comes from the wellbore elements table. At the bottom of panel (4), the user is required to enter additional cementing information: displacement fluid density and cement mix water density, in order to calculate the initial and final load conditions.

The user can change the default design parameters (5). The design parameters will be used to multiply the calculated load line and thus bring it closer to the limit line. The design parameters act as safety factors without changing the pipe’s actual limit value.

The user shall provide landing data (5) in case the string is landed in a specific way after cementing (pick-up or slack-off value with reference to the neutral load after cementing). Any surface pressure applied during the cement setting period is entered here also.

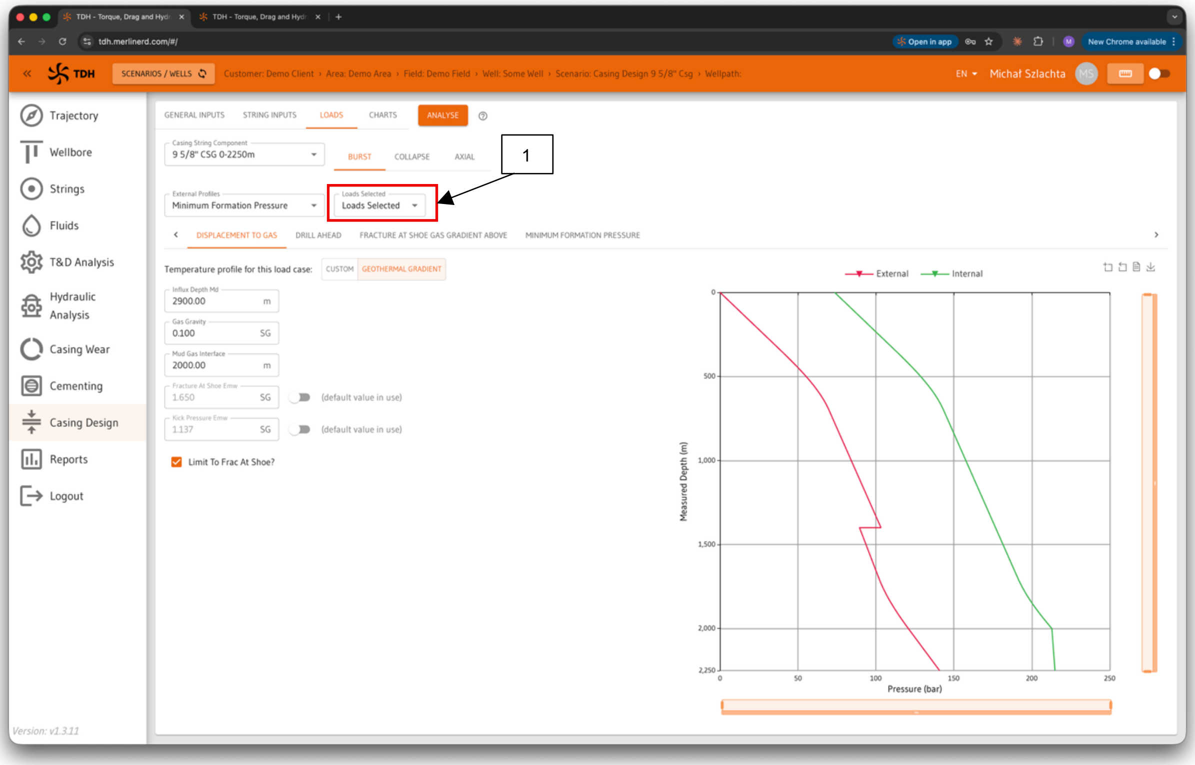

Figure 46: Casing Design View – Loads Inputs

The loads tab allows the user to specify which burst, collapse and axial load cases to calculate, and to provide parameters for each of the load cases. In the case of collapse and burst load cases, the user will need to specify the external pressure profile that will be applied to all burst or collapse load cases. The external pressure profile input is separate for burst and collapse.

Each load case uses the geothermal gradient as the default temperature profile. If the temperature derating is not selected in the string inputs / analysis options, then the choice between geothermal and custom temperature profile is irrelevant. The custom temperature profile allows the user to specify the temperature profile for the load case. This will produce a difference between the geothermal gradient temperature profile used for the initial condition (always) and the profile for the load case (user specified). The temperature difference at each analysis depth will affect the stress analysis results.

Once the loads are selected via the loads selector (1), the relevant input tabs will show below this. These contain controls to input the required parameters for each load case.

NOTE: Some external pressure profiles also require parameter input.

Once the required parameters are provided, the user can analyse the scenario and check the pressure profiles on a chart within each load case tab.

NOTE: Each change in parameters or addition of a load case will require re-analysing the scenario.

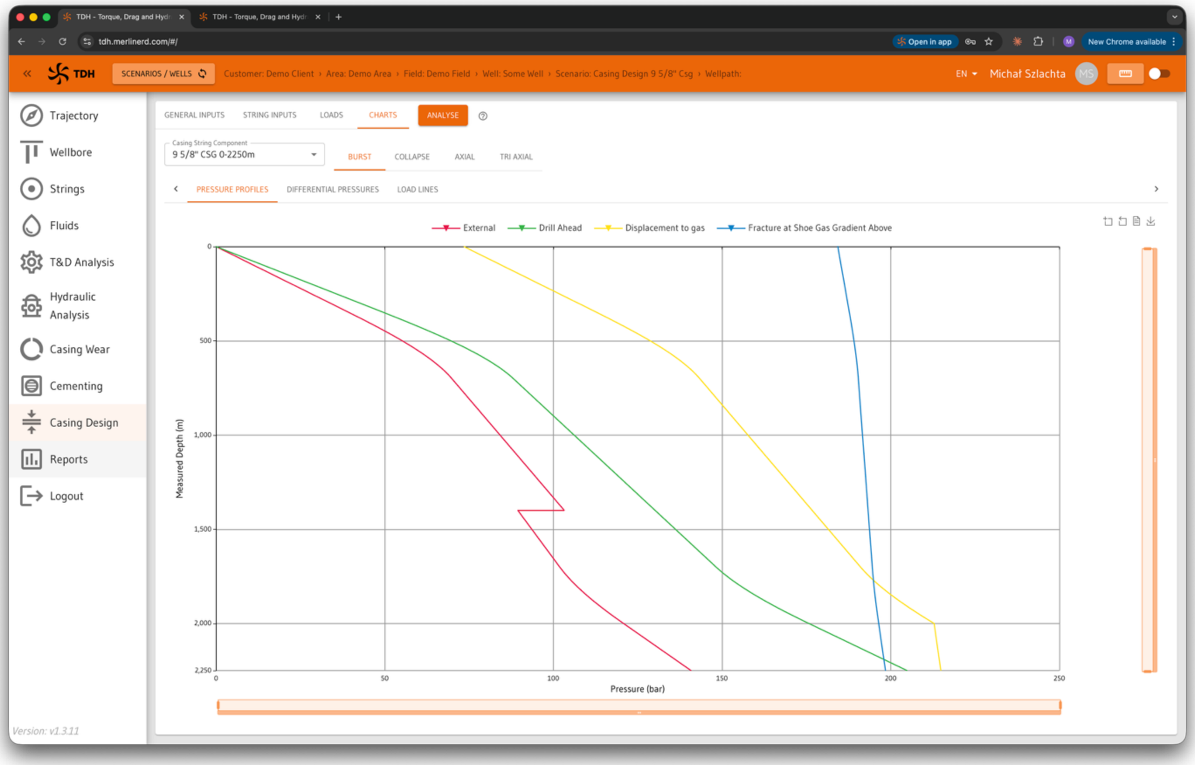

Figure 47: Casing Design View – Charts

The charts view is the results part of the casing design analysis. The results are divided into uni-axial and tri-axial results groups.

In uniaxial groups (burst, collapse, axial groups) following charts are available:

- Pressure profiles: these show each load case internal pressure. Profile and common external pressure profile for the load case type (burst or collapse).
- Differential pressures: show differential pressure between internal and external pressure profile for each load case.
- Load lines: These show the maximum load line which is composed from all differential pressures or axial loads by selecting highest load at each analysis depth vs pipe load limit.

Load lines definitions:

- Apparent load-line – load line resulting from load case before applying temperature derating.
- Derated load-line – load line after applying temperature derating.
- Design load-line – derated load line with design factor applied.

NOTE: Axial loads show axial load profiles rather than pressure profiles. These load profiles show axial loads for each selected axial load case.

Tri-axial results show:

- Load profiles – these are calculated 3-axial stress profiles for each load case (axial, burst and collapse).
- Load lines – composed of the highest 3-axial stress at each analysis depth vs pipe rating (yield stress).
- Design Limits – shows Von Misses ellipse and all load cases presented on axial stress vs differential pressure coordinate system.

13.0 JAR PLACEMENT ANALYSIS

Overview

The Jar Placement Analysis module simulates the mechanical impact of drilling jar operation to help engineers optimize jar placement in the drill string. It calculates the impact force, impulse, and BHA displacement for various jar placement configurations, and provides supporting analyses for weight on bit operating limits and hook load limits during tripping.

The module evaluates multiple jar placement variations by iterating over different combinations of upper and lower (above and below jar) drill string element joint counts, producing 3D surface charts that help identify the optimal jar position for maximum jarring effectiveness.

Required Inputs:

- Trajectory
- Wellbore (simplified)
- Strings – defined drill string with jar element
- Fluids (mud weight).

User Interface Layout

The Jar Placement analysis screen is divided into four panels:

Control Panel (1) - Input parameters organized in collapsible sections, plus the Analyse button.
Wellbore Graphics (2) - Visual representation of the wellbore and drill string.
Charts Panel (3) - Tabbed chart area displaying analysis results.
Results Table (4) - Numerical results corresponding to the active chart.

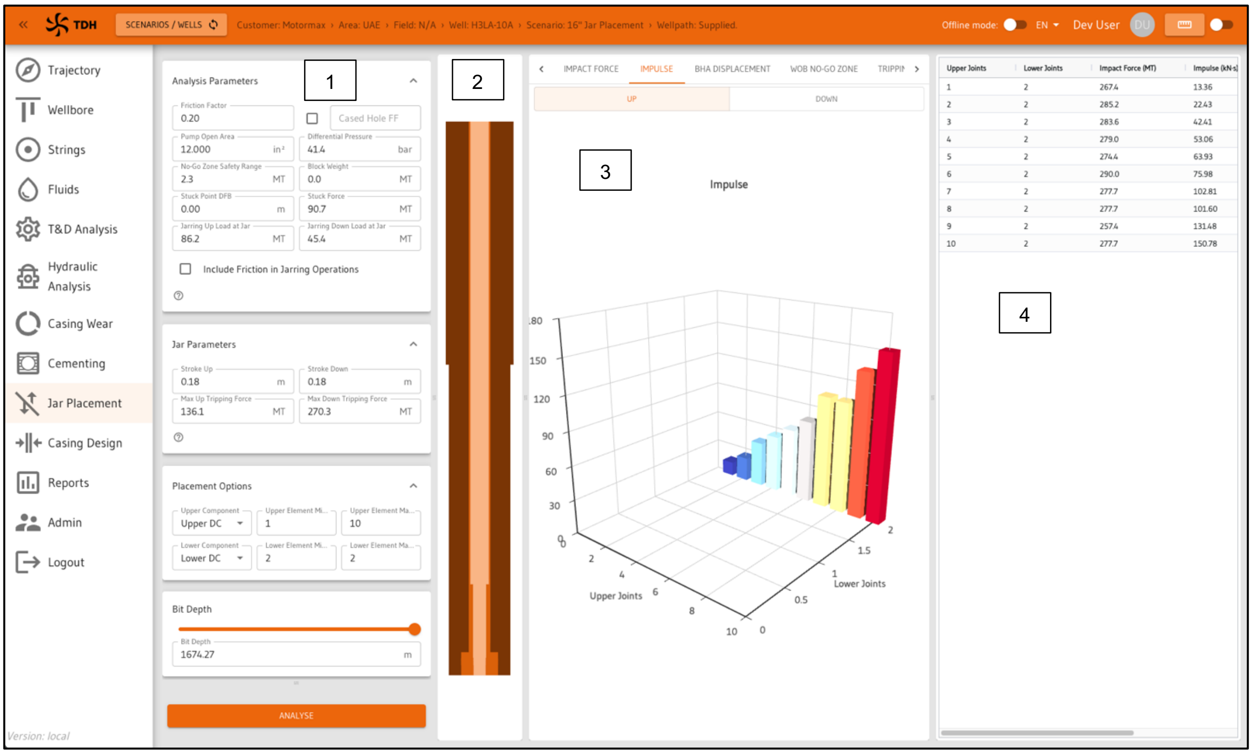

Figure 48: Jarring Analysis View

Analysis Parameters

- **Bit Depth:** The measured depth of the drill bit. Adjustable via a numeric input or a slider. Defines the depth at which the drill string is positioned for the analysis. The maximum value is determined by the wellpath total depth.

- **Friction Factor:** The friction factor applied to open-hole sections for torque & drag calculations used in the jarring analysis. Enter as a decimal (e.g., 0.30)
- **Cased Hole FF:** A separate friction factor for cased-hole sections. Only active when the Cased Hole FF checkbox is enabled. If disabled, the primary friction factor is used for all sections.
- **Pump Open Area:** The area inside the jar affected by differential pressure at jar, used to calculate hydraulic force acting inside the jar.
- **Differential Pressure:** The difference between internal and external pressure at the jar. Combined with the pump open area, this creates an additional hydraulic force acting on the jar.
- **No-Go Zone Safety Range:** A safety margin applied to the WOB chart to define a buffer zone to ensure the neutral point is kept away from the jar. Operating within this zone risks damage to the jar.
- **Block Weight:** The weight of the traveling block and top drive assembly. Added to the surface tension to calculate the total hook load displayed in the tripping limits chart.
- **Stuck Point DFB:** Distance From Bit to the stuck point. Defines where the pipe is assumed to be stuck. The analysis calculates the impact force delivered to this point.
- **Stuck Force:** The force required to free the stuck pipe. Impact forces below this threshold produce zero useful impulse and zero BHA displacement.
- **Jarring-Up Load at Jar:** The overpull force applied at the jar location when jarring upward. This is the pre-tension or "cocking force" that stores elastic energy in the drill string before the jar fires.
- **Jarring-Down Load at Jar:** The compression force applied at the jar location when jarring downward. This is the pre-compression force that stores elastic energy before the jar fires.
- **Include Friction in Jarring Operations:** When checked, the analysis includes wellbore friction effects (from TnD calculations) in the jarring wave propagation model. This decelerates the hammer and anvil sections during pre-impact wave travel, resulting in lower impact velocities. When unchecked, friction is ignored.

Jar Parameters

- **Stroke Up:** The stroke length of the jar in the upward (tensile) direction. This is the distance the jar's internal mechanism travels before impact when jarring up.
- **Stroke Down:** The stroke length of the jar in the downward (compressive) direction. This is the distance the jar's internal mechanism travels before impact when jarring down.
- **Max Up Tripping Force:** The maximum allowable tripping force in the upward direction. Used in the tripping limits analysis to define the safe operational envelope for latching the jar.
- **Max Down Tripping Force:** The maximum allowable tripping force in the downward direction. Used in the tripping limits analysis to define the safe operational envelope for latching the jar.

Placement Options

This section defines which drill string components form the drill string assembly and how many joint variations to evaluate.

- **Upper Component:** Select the drill string component that sits above the jar. The dropdown lists all available drill string components, excluding the one selected as the lower component.
- **Upper Element Min/Max Joints:** The minimum/maximum number of joints of the upper component to include in the analysis variations. Must be a positive integer. If the user wants to keep the hammer or anvil at fix length and only optimize the other component, the max and min joints values should be the same. Example: optimize hammer length between 1 and 10 joints and keep fixed anvil length at 120ft: Upper component min joints 1, upper component max joints 10, lower components min joints 4 (120ft), lower components max joints 4 (120ft).
- **Lower Component:** Select the drill string component that sits below the jar. The dropdown lists all available drill string components, excluding the one selected as the upper component.
- **Lower Element Min/Max Joints:** The minimum/maximum number of joints of the lower component to include in the analysis variations. Must be a positive integer.

Analysis Outputs & Charts

The chart panel has five tabs:

- **Impact Force** (Up/Down): Impact force at the stuck point for each jar placement variation.
- **Impulse** (Up/Down): Useful impulse (above stuck force) for each placement variation.
- **BHA Displacement** (Up/Down): Theoretical pipe movement at the stuck point for each variation.
- **WOB No-go Zone:** Weight on Bit operating limits vs. measured depth.
- **Tripping Limits**: Hook load limits that results in downhole tension limits for the jar. The downhole limits for tripping out of the hole will be equal to Max up-tripping force (input) and for running in the hole to Max down-tripping force (use negative value for compression) vs. measured depth.

3D Bar Charts (Impact Force, Impulse, BHA Displacement)

These charts display a 3D surface where:

- X-axis - Number of upper joints
- Y-axis - Number of lower joints
- Z-axis - The output value (impact force, impulse, or BHA displacement)

Each bar represents one jar placement variation (a specific combination of upper and lower joint counts). The chart helps identify which placement maximizes impact effectiveness.

A direction toggle (Up / Down) switches between jarring-up and jarring-down results.

Understanding the Outputs

Impact Force is the peak force generated at the stuck point when the jar fires. Higher values indicate a more forceful impact. The impact force depends on:

- The elastic energy stored in the upper and lower sections
- The masses and cross-sectional areas of the collar sections
- Wave transmission efficiency through component boundaries
- Friction losses during wave propagation (if friction is included)

Impulse is the time-integrated force above the stuck force threshold. Only the portion of the impact force that exceeds the stuck force contributes to freeing the pipe. A higher impulse indicates more energy available to overcome the sticking mechanism. If the impact force never exceeds the stuck force, the impulse is zero.

BHA Displacement is the distance the pipe at the stuck point would move if the impact successfully overcame the stuck force. This indicates whether the jar impact can physically free the stuck pipe. Zero displacement means the impact force is insufficient.

WOB No-go Zone Chart

A 2D line chart showing Weight on Bit vs. Measured Depth with three series:

- WOB for Neutral Point at Jar: The WOB value that places the neutral point (zero axial load) exactly at the jar location. Operating in this condition can lead to fatigue-related damage at the jar and so should be avoided.
- Min. WOB for Jar in Compression: If the jar is to be run in compression, this is the minimum WOB which needs to be applied to ensure that the neutral point is above the jar by the margin specified via the “No-Go Zone Safety Range” input.
- Max. WOB for Jar in Tension. If the jar is to be run in tension, this is the maximum WOB which needs to be applied to ensure that the neutral point is below the jar by the margin specified via the “No-Go Zone Safety Range” input.

The area between the dashed lines represents the **no-go zone** i.e. an operating region where the jar transitions between tension and compression, which should be avoided. The width of this zone is controlled by the No-Go Zone Safety Range input parameter.

Tripping Limits Chart

A 2D line chart showing Hook Load vs. Measured Depth with two series:

- Max. Hookload for Up-Latch: The maximum hook load allowed when tripping to avoid firing the jar in the upward direction. Exceeding this load could damage equipment.
- Min. Hookload for Down-Latch: The minimum hook load required when tripping to avoid firing the jar in the downward direction. Going below this load could cause unintended jar activation.

These limits help the driller maintain hook loads within the safe operating window while tripping the string.

Tips & Best Practices

Start with friction disabled: Run an initial analysis without friction ("Include Friction in Jarring Operations" unchecked) to establish baseline impact forces. Then enable friction to see the realistic reduction.

Vary the stuck force: If the actual stuck force is unknown, run multiple analyses with different stuck force values to understand sensitivity.

Check both directions: Even if you plan to jar in one direction, check both up and down results. The direction with higher impact force may be preferred.

Watch the WOB chart: Ensure your planned drilling WOB keeps the jar safely in either tension or compression, avoiding the no-go zone.

Verify tripping limits: Before running pipe, check the tripping limits chart to know the safe hook load window at each depth for latching the jar.

Placement optimization: The 3D bar charts reveal the optimal joint count combination. Look for the peak of the surface - this is where jar effectiveness is maximized.

Larger variations = longer analysis: The analysis evaluates every combination of upper and lower joint counts. A range of 1–10 for both produces 100 variations. Keep ranges reasonable for faster results.

14.0 CHARTS

The chart menu can be accessed via a right-click on any chart surface from within any of the analysis views or the Reports view. The pop-up consists of several tabs that enable the user to modify and customize the appearance of both the chart and its series.

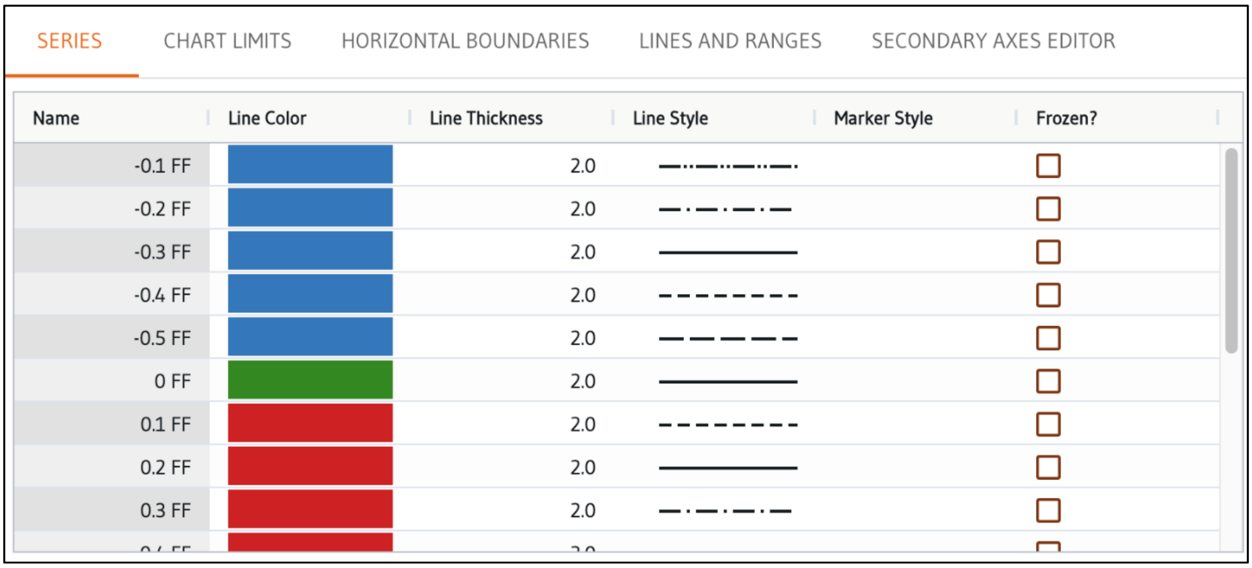

Figure 49: Chart Menu – Series

The series menu enables the style of the series names and markers to be customised. The series freeze functionality is used for sensitivity analysis: Once one or more series are frozen, the analysis can be re-run with changed inputs, allowing for visual comparison of the results.

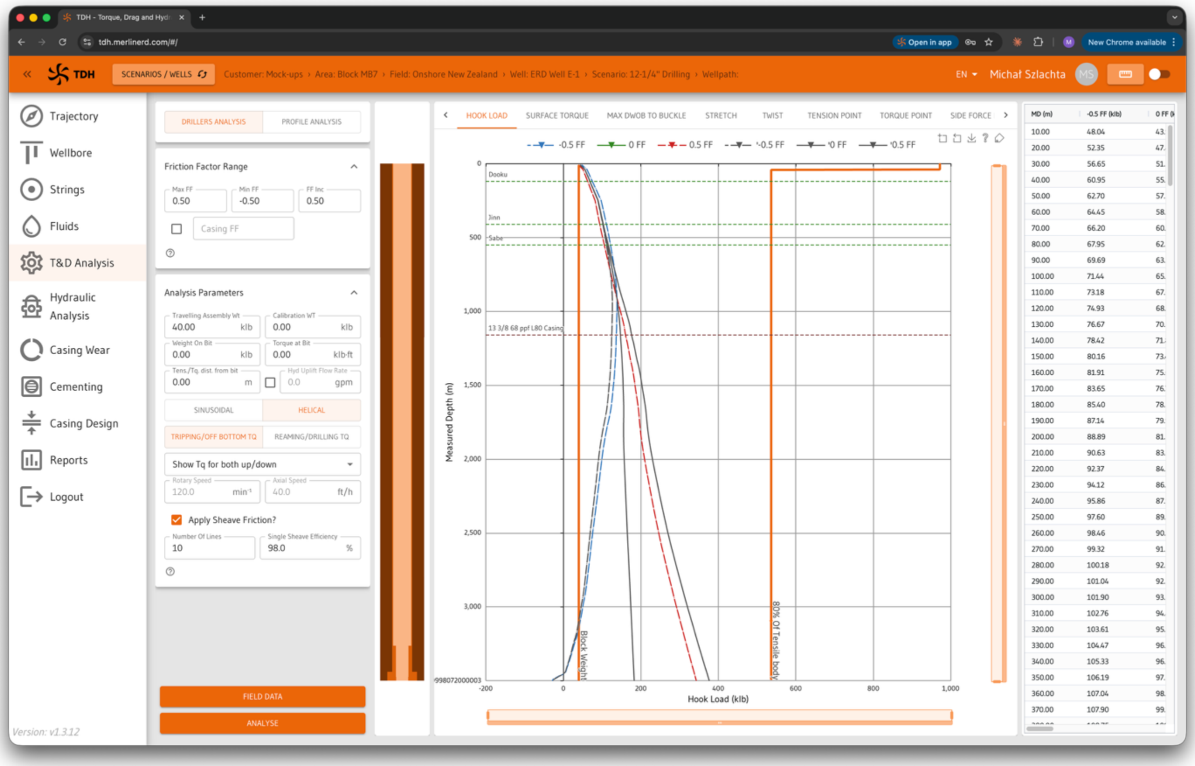

Figure 50: Comparing Frozen Series

In the example shown in Figure 50, the hookload series have been frozen and the model re-analysed with the addition of a sheave friction correction. Seeing both sets of series on one chart lets the user assess the amount of change and depths at which the changes occur.

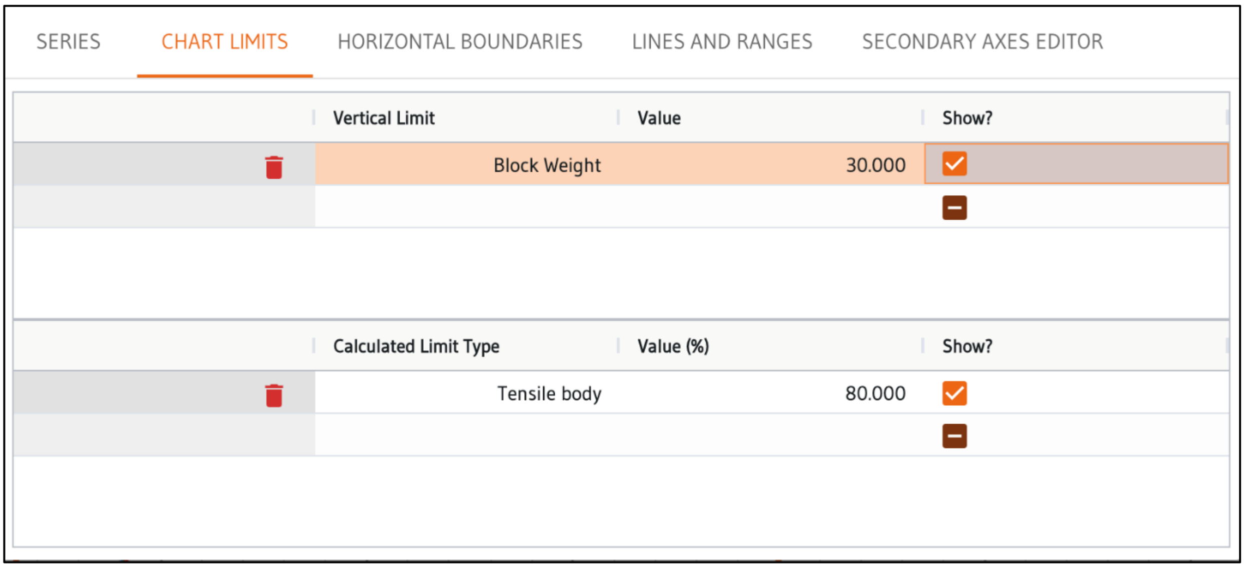

Figure 51: Chart Menu - Limits

The chart limits menu allows the user to add or remove series that show the relevant limits for the current analysis.

The vertical limit is a series plotted at a single X-axis value specified for the entire chart. This can be used to plot a constant limit for all depths (e.g. block weight on a hookload plot or max. discharge pressure for a specific pump liner size on a standpipe pressure plot).

Calculated limits are available for hookload and torque charts and show the limit varying with depth depending on the string component properties, the type selected and the chosen analysis view. For example, the pipe body tensile limit, “Tensile body”, will typically be selected for a hookload or tension profile chart, with a particular percentage specified to allow for a safety factor. In the case of a hookload chart, the tensile limit will be automatically adjusted to include the block weight. NOTE: The driller’s view shows the limit of the element at surface with varying bit depth. The profile analysis view shows the limits along the string.

The horizontal boundaries tab allows for specifying any horizontal series for a specific Y-axis Value. This feature could be used to plot different bit run depths, etc. Note that any formation tops specified within the Wellbore view will be plotted already.

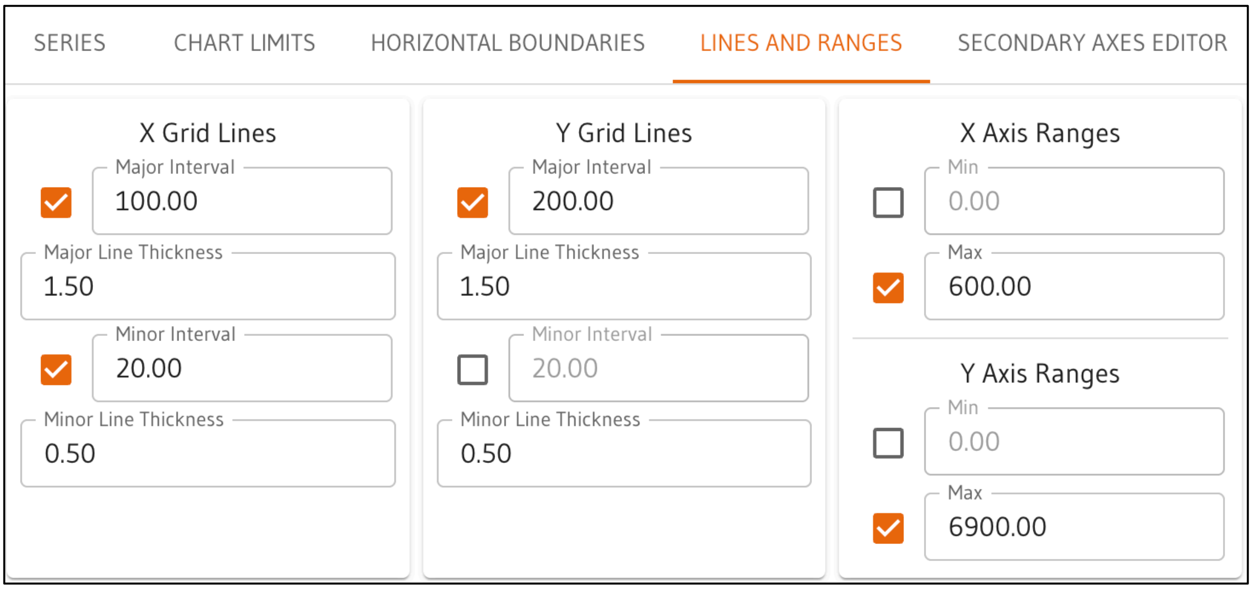

Figure 52: Chart Menu – Lines and Ranges

The lines and ranges menu allows the user to override the automatically calculated ranges and grid line intervals for a specific chart. It also allows adding major and minor grid lines for the X and Y axes.

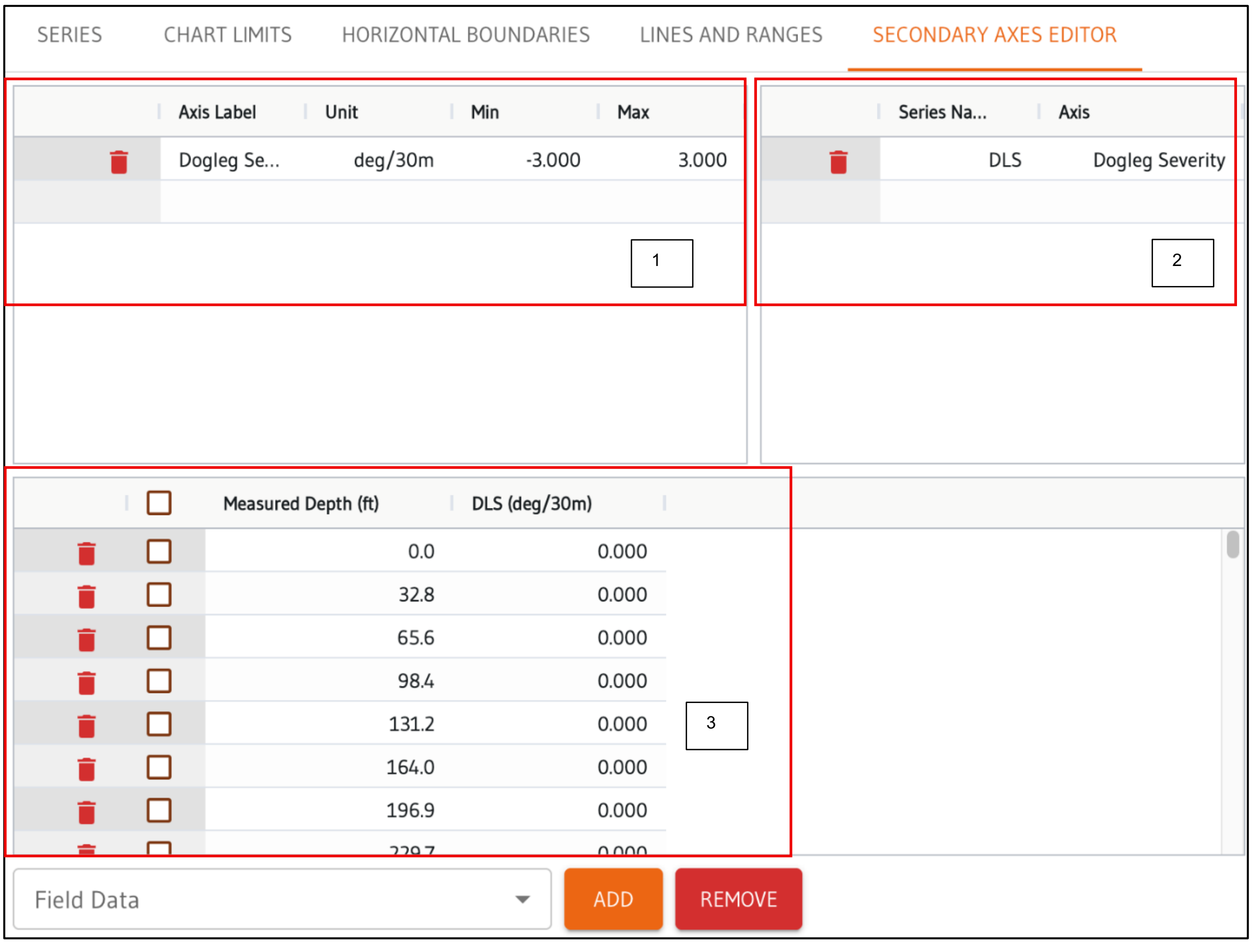

Figure 53: Chart Menu – Secondary Axes

The secondary axes editor is a powerful tool that allows the user to overlay additional data on an existing chart. In the example above, an additional series was created to plot the dogleg severity series on a hookload chart to correlate the DLS values with overpull values during the trip out of hole. To create a custom series on any chart:

1. Right click the chart and select the “secondary axes editor” tab.
2. Create the secondary X-axis by specifying the axis label, units and value range (1).
3. Create series by specifying its name and assign it to the newly created secondary axis name via the drop-down menu (2).
4. With the series column now created, the user should type or paste the series data to be plotted on the custom X-axis (3).

15.0 REPORTING VIEW

The reporting view allows users to create single or multi page reports with one click of a button and export those easily to PDF or as an image to clipboard.

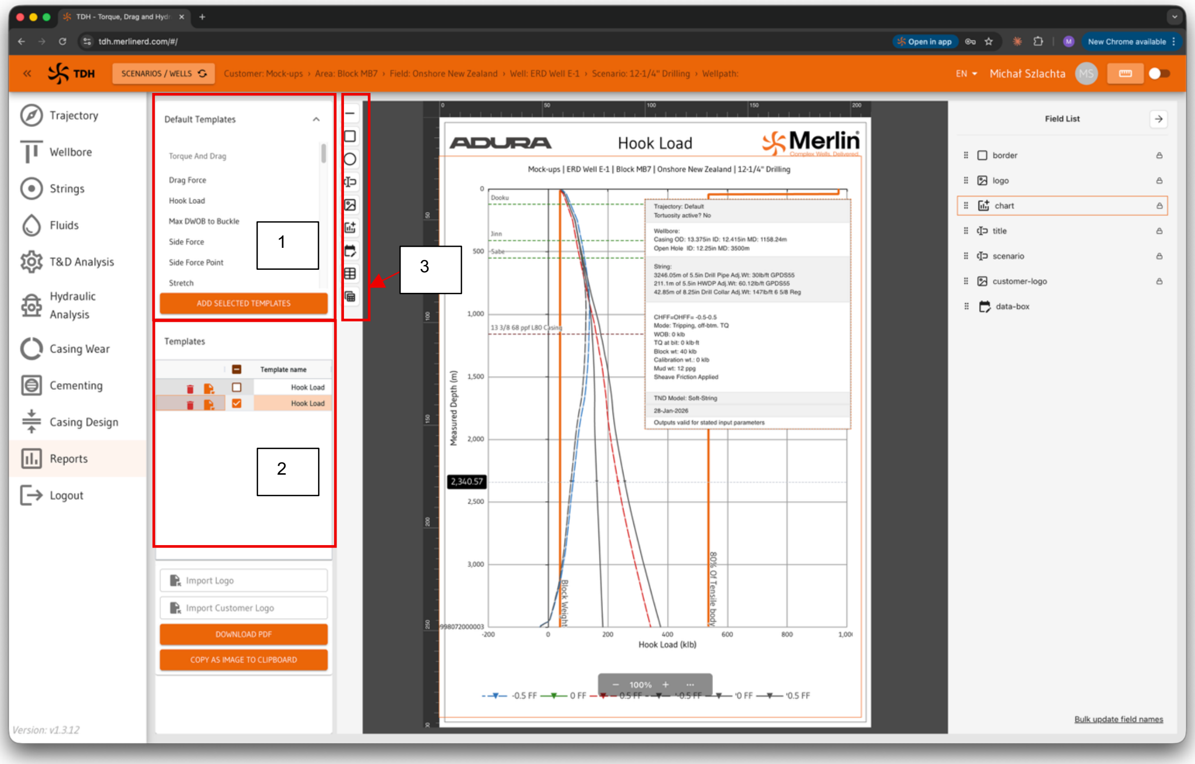

Figure 54: Reporting View

The reporting view consists of the default templates selector (1), active report templates which the user can open, modify and rename (2), drag-drop controls (3) and the report viewer in the centre.

The recommended workflow is to select required templates from the default templates list, where there is one template for each chart available in TDH, and add it to the active templates list. The user can then open the report template one at the time. Adding a logo for the user company and the client company will apply logos to every active template and every template that will be added to the active list thereafter. Once the active template is opened, the chart can be modified in the same way as it is in the analysis view (right click). The user can drag-drop additional items onto the report and position them as required. These are: shapes (line, rectangle circle), text, pictures, additional charts, tables and parameters.

Each default template comes with a parameters box specific to the chart e.g. T&D parameters are shown on the hookload and torque charts while hydraulics parameters are shown on the hydraulics-related charts. The parameters box can be customized with a right click and data to show in the box can be selected. As the parameters box is always populated directly from the inputs used on the current analysis, it can be reliably used for QA/QC purposes.

16.0 LICENSING

16.1 OVERVIEW

The License Manager controls your access to TDH application modules. To open it, click the settings icon in the top-right corner of the application toolbar, then select "License Manager".

TDH uses two types of licenses:

- Standalone License: assigned to you personally.
- Concurrent User License: shared across your company on a first-come, first-served basis.

You need at least one active (non-expired) license to access TDH modules.

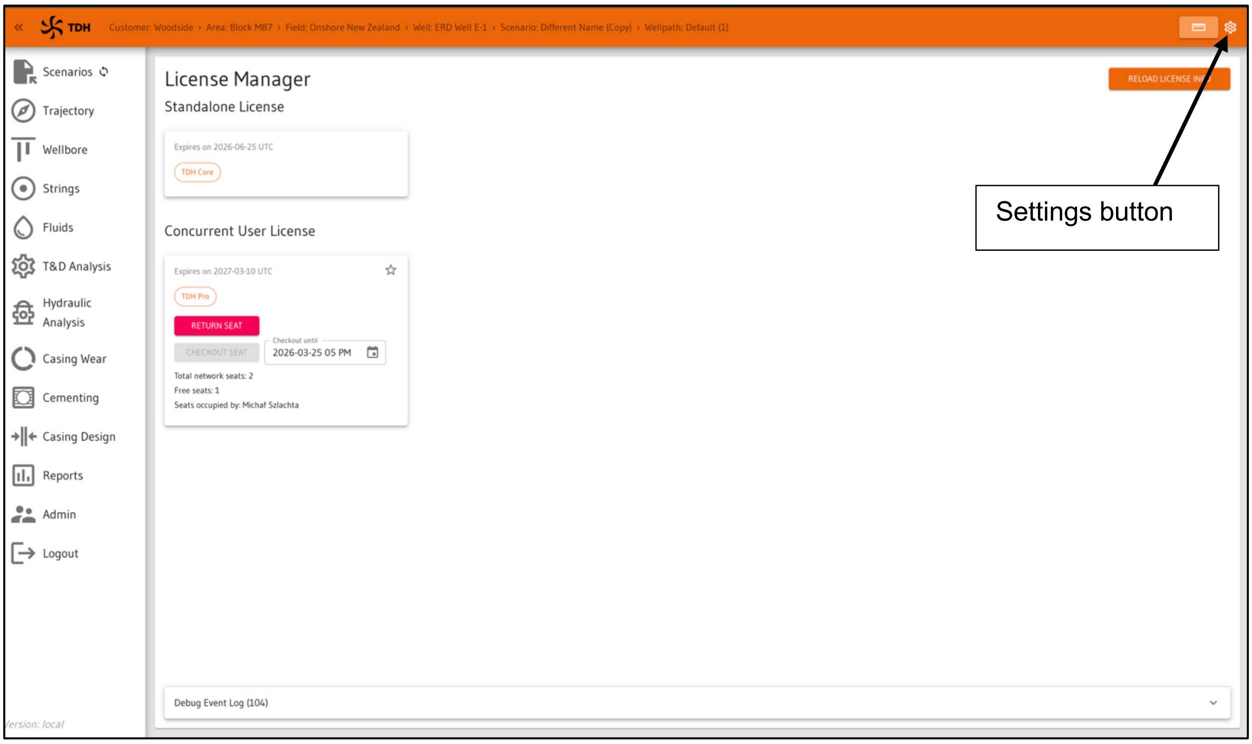

Figure 55: License Manager View

When you open the License Manager, you will see:

- Title bar: "License Manager" on the left, "Reload License Info" button on the right.
- Standalone License section (if you have one assigned).
- Concurrent User License section (if your company has any).
- Debug Event Log at the bottom (collapsible, for troubleshooting).

16.2 Standalone License

A standalone license is tied directly to your user account. If you have one, it appears under the "Standalone License" heading.

The license card shows:
- Expiry status: "Expires on YYYY-MM-DD UTC" or "Expired".
- TDH product bundle: the TDH modules this license grants access to (e.g., "TDH Core", "TDH Pro").

No action is required from you - a standalone license is always active as long as it has not expired.

16.3 Concurrent User License

Concurrent licenses can be shared among all users in a company. Each license has a limited number of concurrent uses, or “seats”. To use a concurrent license, you must "check out" a seat. When you are finished, you should "return" the seat so others can use it.

Each concurrent license card shows:

Expiry date
Displayed at the top: "Expires on YYYY-MM-DD UTC" or "Expired".
An expired license cannot be checked out.

TDH product bundle
The TDH modules this license grants access to.

Seat information
Total network seats: the maximum number of users who can use this license at the same time.
Free seats: how many seats are currently available.
Seats occupied by: names of users who currently hold a seat.

Favourite star (top-right corner of the card)
Click the star icon to mark a license as your favourite. A filled star means it is selected as favourite.
PURPOSE: When you mark a license as favourite, the application will automatically check out a seat for you each time you log in. This saves you from having to manually check out every session. The auto-checkout reserves a seat for 1 hour and automatically renews it as long as you remain logged in.

Checkout Seat button
Click this to reserve a seat on the license. Before clicking, use the date/time picker next to the button to set how long you want to hold the seat ("Checkout until"). The minimum is 1 hour from now; the maximum is the license expiry date. Once you check out, the button becomes active and you can update your checkout duration by changing the date/time and clicking "Checkout Seat" again.

Return Seat button
Appears after you have checked out a seat. Click this to release your seat immediately, making it available for other users. This is the recommended action when you are finished working.

Date/time picker
Sets the expiry time for your seat reservation. After this time, your seat is automatically released. Use the calendar and hour selector to choose a date and time.

IMPORTANT NOTES:
If all seats are occupied and you do not have a checkout, you will only see the seat information (who is using them). You cannot check out until a seat becomes free. When you close the browser or log out, all your checked-out seats are automatically returned.

16.4 Offline Mode

Every time the application successfully loads or updates your license data (on login, checkout, check-in, or periodic refresh), it is saved locally.

If you lose your internet connection or switch to offline mode (using the toggle in the settings menu), the application will validate your access against this locally cached license data. This means:

- You can continue working offline as long as your locally cached license has not expired.
- Concurrent license checkouts that were made while online remain valid offline until their checkout expiry time. No new checkouts or seat returns can be made while offline, since these require server communication.

When your connection is restored (or you switch back to online mode), the application will automatically refresh your license data from the server.

TIP: Before going to a location without internet, make sure you have an active checkout with a long enough duration to cover your offline working time. Marking a license as favourite also helps, as it will automatically check out a seat as soon as you are back online.

16.5 Reload License

The "Reload License Info" button in the top-right corner of the License Manager forces a refresh of all license data from the server. Use this if:

- You believe the displayed information is out of date.
- Your administrator has made changes to your licenses.
- You see unexpected behaviour.

A green notification will appear when the reload succeeds. A red notification will appear if there is a problem connecting to the server.

16.6 TDH Product Bundles

The modules you can access depend on your active license type:

TDH Core:
Scenario Opener, Wellpath, Wellbore, Drill String, Hydraulic System, T&D Analysis, Hydraulic Analysis, Reports.

TDH Pro:
Everything in TDH Core, plus Casing Wear, Cementing, Casing Design, and Jar Placement.

Jar Placement:
Scenario Opener, Wellpath, Wellbore, Drill String, Hydraulic System, Jar Placement, Reports.

16.7 Event Log

At the bottom of the License Manager is a collapsible "Debug Event Log" panel. This is primarily for troubleshooting. It records:

- License fetch operations (when the app loads license data).
- Checkout and check-in actions.
- Automatic renewal events.
- Any errors that occur.

Each entry shows a timestamp, event name, and details. The "Clear Log" button empties the log. The log keeps a maximum of 200 entries. If you experience licensing issues, expand this panel and share its contents with your administrator or support team.

17.0 REFERENCES

Guo, B. a. (2011). Applied Drilling Circulation Systems: Hydraulics, Calculations, and Models. *Gulf Professional Publishing*.

Wu, J. i Juvkam-Wold, H. (1995). The Effect of wellbore Curvature on Tubular Buckling and Lockup. *ETCE Drilling Technology Symposium*, (strony 214-218). New Orleans, LA.

Lesso Jr., W., Mullens, E. i Daudey, J. (1989). Developing a Platform Strategy and Predictiong Torque Losses for Modeled Directional Wells in the Amauligak Field of the Beaufort Sea, Canada. *SPE 19550*.

Luke, G. R. i Juvkam-Wold, H. C. (1993). Determination of True Hook Load and Line Tension Under Dynamic Conditions. *SPE Drilling and Completion SPE-23859-PA*.