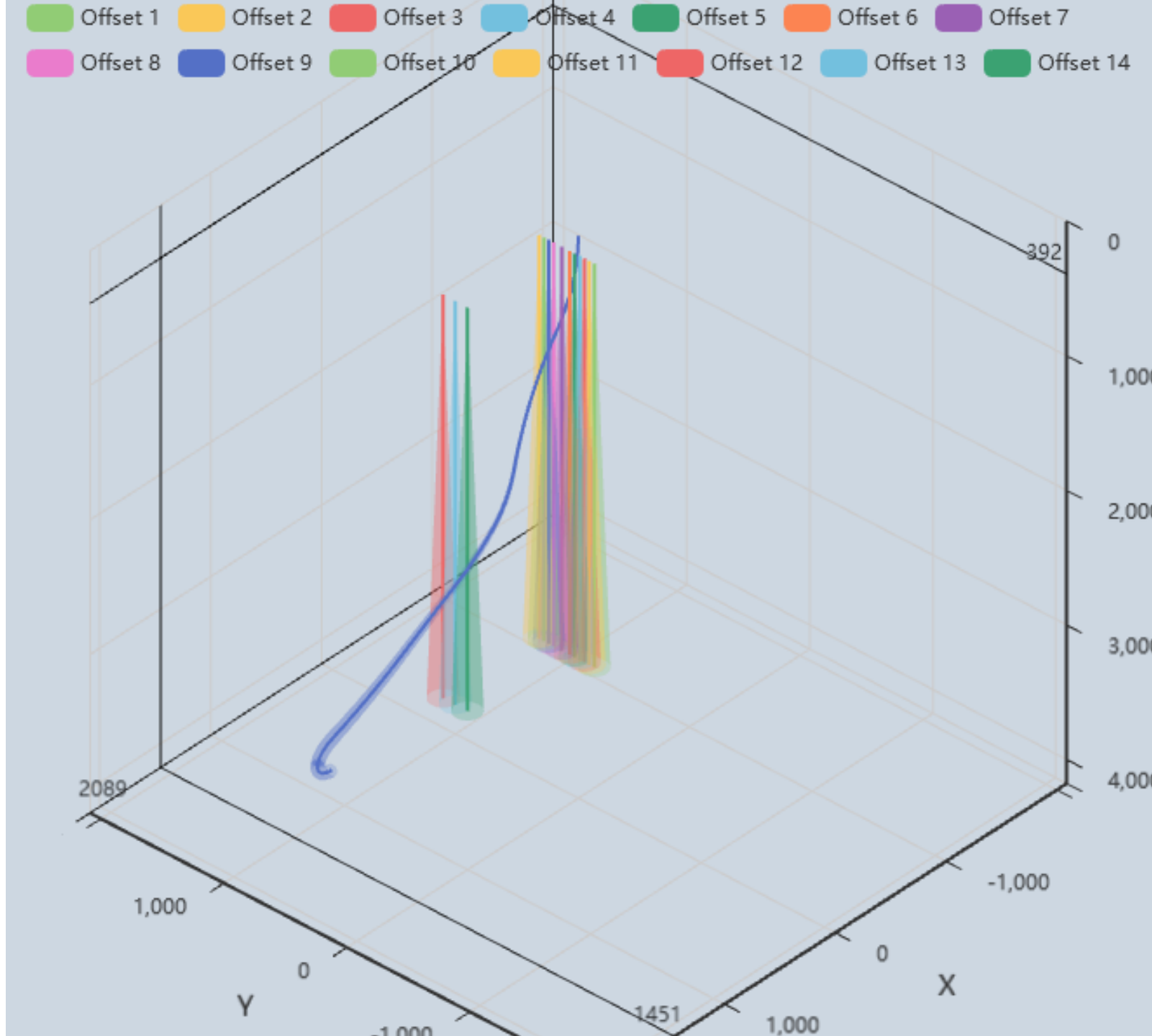


AI Well Planner

User Manual



General Info

- The primary objective of AI Well Planner is to automate the design of trajectories for oil, gas, and geothermal wells
- AI Well Planner automates the tasks of drilling engineers and well planners in developing well paths. It takes into consideration anti-collision with offset wells, sets limits for dog leg severity and inclination for different well sections, and ESP placement; the app automatically finds the optimal well path that meets the requirements in minutes
- To generate solutions, artificial intelligence (AI) methods are employed, which may not always yield consistent results. Consequently, each subsequent solution can vary slightly or, at times, significantly from its predecessor
- Anti-collision calculations are based on SPE-67616, SPE-108279, and ISCWSA toolcodes rev 4

UI Overview

1. New trajectory button

Start your trajectory planning session here

2. Dashboard & history

Observe status of running tasks. Click to see results of complete ones

3. Profile settings

Click to navigate to profile page where you can change your password

4. Log-out button

End session and return to login page

5. Content area

The most work will be done here

6. Switch theme button

Switch between light and dark

AI Well Planner

New trajectory

1 Info 2 Base trajectory 3 AC settings 4 Offset wells 5 Transport section 6 Costs 7 Production section 8 Review

General

Name: Fence Traversal - cost Length unit: m

Location

Latitude (deg): 60 Longitude (deg): 0 Altitude (m): 0

Geomagnetic reference

G (m/s²): 9,80665 B (nT): 50000 Dip (deg): 72 Dec (deg): 0 Grid (deg): 0

Import AIWP JSON Import COMPASS XML Next

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Plan New Trajectory

Three options:

1. Fill info manually

The most basic option
7-8 step process

2. Import from COMPASS

Skip several steps from manual workflow by [loading base and offset trajectories](#)

3. Import JSON

Load previously saved project (last step)
Skip to [end](#)

In any case you can freely navigate between steps using **stepper** or **Next/Back** buttons and change any values

The screenshot displays the 'AI Well Planner' software interface. At the top, a progress bar titled 'New trajectory' shows eight steps: 1. Info, 2. Base trajectory, 3. AC settings, 4. Offset wells, 5. Transport section, 6. Costs, 7. Production section, and 8. Review. Step 1 is highlighted with a red circle and a blue '1'. Below the progress bar, the 'General' section contains a 'Name' field with 'Fence Traversal - cost' and a 'Length unit' dropdown set to 'm'. The 'Location' section has 'Latitude (deg)' set to 60, 'Longitude (deg)' set to 0, and 'Altitude (m)' set to 0, with a blue '1' next to the altitude field. The 'Geomagnetic reference' section includes 'G (m/s2)' at 9,80665, 'B (nT)' at 50000, 'Dip (deg)' at 72, 'Dec (deg)' at 0, and 'Grid (deg)' at 0. At the bottom, there are two buttons: 'Import AIWP JSON' (highlighted with a purple box) and 'Import COMPASS XML' (highlighted with a green box). A 'Next' button is located at the bottom right. The footer contains the text 'Copyright © AI Well Planner project by MWD STD Inc - 2024.'

Plan New Trajectory – General information

1. Name your project

Names are important
The name will be displayed in dashboard
It also defines export filename

2. Select metric unit

Meter or feet
Keep in mind that all inputs that follow
will be in selected units

3. Location & reference

Self-explanatory. Fill the fields

4. Click Next

The screenshot shows the 'AI Well Planner' interface for creating a new trajectory. The form is titled 'New trajectory' and has a progress bar with 8 steps: 1. Info, 2. Base trajectory, 3. AC settings, 4. Offset wells, 5. Transport section, 6. Costs, 7. Production section, and 8. Review. The 'Info' step is currently active. The form is divided into three sections: 'General', 'Location', and 'Geomagnetic reference'. The 'General' section has a 'Name' field (containing 'Fence Traversal - cost') and a 'Length unit' dropdown (set to 'm'). The 'Location' section has 'Latitude (deg)' (60), 'Longitude (deg)' (0), and 'Altitude (m)' (0) fields. The 'Geomagnetic reference' section has 'G (m/s2)' (9,80665), 'B (nT)' (50000), 'Dip (deg)' (72), 'Dec (deg)' (0), and 'Grid (deg)' (0) fields. A 'Next' button is located at the bottom right. The form is annotated with numbered callouts: 1 points to the 'Name' field, 2 points to the 'Length unit' dropdown, and 3 points to the 'Location' section. A red box highlights the 'Next' button.

AI Well Planner

New trajectory

1 Info 2 Base trajectory 3 AC settings 4 Offset wells 5 Transport section 6 Costs 7 Production section 8 Review

General

Name: Fence Traversal - cost 1 Length unit: m 2

Location

Latitude (deg): 60 Longitude (deg): 0 Altitude (m): 0 3

Geomagnetic reference

G (m/s²): 9,80665 B (nT): 50000 Dip (deg): 72 Dec (deg): 0 Grid (deg): 0

Import AIWP JSON Import COMPASS XML Next

string test@test.a

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Plan New Trajectory – Base trajectory

If your trajectory continues or splits from existing well you should enter it. **If you need set the kick-off point – paste a vertical trajectory here.**

Otherwise just skip this step

1. Enter the wellhead

Keep zeroes if you don't know what are you doing

2. Enter MD/Inc/Az

Just copy MD/Inc/Az values from your Excel spreadsheet, place cursor in highlighted area, and paste

3. Enter survey program

If survey program has more than one survey leg then press the + button to add new ones

4. Click Next

AI Well Planner

New trajectory

Info Base trajectory AC settings Offset wells Transport section Costs Production section Review

Wellhead

NS (m)	EW (m)	TVD (m)
0	0	0

Stations

MD (m)	Inc (deg)	Az (deg)
0,0	0,00	0,00

Paste MD/Inc/Az here

Survey program

Start MD (m)	Stop MD (m)	Toolcode
		MWD

+ 3

Back Next

string test@test.a

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Plan New Trajectory – AC settings

Here you can tune anti-collision defaults. Disabled fields are for information purpose only at the moment

1. Critical OSF

Recommended range is between 1.0 and 1.5

2. Wellhead uncertainty

0,3 m / 1 ft by default

3. OD of subject & offset wells

4. Click Next

AI Well Planner

New trajectory

Info Base trajectory **AC settings** Offset wells Transport section Costs Production section Review

Scan method: Complete search (Min OSF)

Surface rule: 80% clearance + Rsub + Roff

Confidence level (sigma): 2.7995

Critical OSF: 1 (1)

Wellhead uncertainty (m): 0,3 (2)

Reference well OD (m): 0,7

Offset well OD (m): 0,7 (3)

Back Next

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Plan New Trajectory – Offset wells

You can add up to 30 offset wells for AC

1. Add offset well

Just click the button

2. Enter the name

It is useful when you will be reading AC report

3. Enter the trajectory

See [Base trajectory](#). But in this case pay close attention to wellhead coordinates

4. Click Next

AI Well Planner

New trajectory

Info Base trajectory AC settings **Offset wells** Transport section Costs Production section Review

+ Ad 1 well
Offset 1 ✕

Name
Offset 1

Wellhead
NS (m) EW (m) TVD (m)
150 40 0

Stations
MD (m) Inc (deg) Az (deg)
0.0 0.00 0.00
3 000.0 0.00 0.00
Paste MD/Inc/Az here

Survey program
Star... Stop... Toolcode
Start End ION-OPT

Back Next

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Plan New Trajectory – Transport section

Transport section is a well path between the base trajectory end and T1 target.

If you need to set the kick-off point – do it in Base trajectory step

1. Enable & Target

T1 target of the transport section

2. Toolcode

Select a survey error model for the transport section

3. Optimization options

Select what you want to optimize – well path length or cost

4. ESP

If you have ESP section please specify the limits

5. Section limits

If needed please specify the limits for particulars TVD ranges

6. Click Next

AI Well Planner

New trajectory

Info Base trajectory AC settings Offset wells **5** Transport section Costs Production section Review

T1

NS (m) EW (m) TVD (m) **1** Inc (deg) Az (deg)

2000 200 3000 90 180

AC settings

Toolcode **2** MWD

Minimize

Traj length **3**

Well cost

Global

Max DLS (deg/30m) 10

ESP

Start TVD (m) End TVD (m) Min inc (deg) **4** Max inc (deg) Max DLS (deg/30m)

Section limits

Name	Start TVD (m)	End TVD (m)	Min inc (deg)	Max inc (deg)	DLS (deg/30m)
Section 1	Start	1000	0	30	2
Section 2	1000	2000	5	180	5
Section 3	2000	End	0	180	10

Back Next

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Plan New Trajectory – Costs

If you chose well cost minimization on previous step then you'll be offered this form

1. Add section(s)

Press button to add one section. You can press it multiple times.

2. Enter stop depths

The first section begins at 0. The last section goes to end. Fill in blanks.

3. Casing type & costs

Need I say more?

4. Delete last section

In case you press + too many times

5. Click Next

AI Well Planner

+ NEW TASK

TASKS

New trajectory

Info Base trajectory AC settings Offset wells Transport section **Costs** Production section Review

Drilling sections

#	Stop TVD (m)	Casing type	Casing price (\$/m)	Drilling price (\$/m)
1	1000	Casing	280	100
2	2000	Casing	143	200
3	End	Casing	96	250

+ 1

Back Next

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Plan New Trajectory – Production section

Production section is a well path through the multiple targets from T1 target or the base trajectory end

1. DLS limits

Please specify DLS limit for the production section

2. AC & Toolcode

If you need to consider AC-calculations for the section please enable and specify the toolcode

3. TVD clearance

If you need to keep the well path inside the corridor please enable and specify TVD deviation

4. Optimization options

You can optimize the well path length or tortuosity. Please select

5. Targets

The targets specify a well path of the production section

Add new pressing +, and remove existing pressing X.

6. Click Next

You already know where button is

Name	NS (m)	EW (m)	TVD (m)	
T2	-1000	0	3000	X
T3	-1000	7000	3050	X

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Plan New Trajectory – R&R (Review and Run)

Finally! The last step!

1. Validation panel

Let AI review your hard work and highlight some issues if there are any.

2. Export

Don't forget to save your project
You can return to it later

3. Task summary

If you wish you can review one more time in case that stupid AI missed something (or you just imported some old task)

4. Create Task

It's time to pass hard work to AI and get some coffee while you [wait for result](#)

The screenshot shows the 'AI Well Planner' interface. At the top, a progress bar indicates the workflow steps: Info, Base trajectory, AC settings, Offset wells, Transport section, Costs, Production section, and Review (8). The 'Production section' is currently selected, showing a 'Production - 2' panel with an 'Export to JSON' button. Below this, a green box displays 'Validation success' with the message 'All seems to be alright' and a large number '1'. A task summary follows, including well head coordinates, section details, and survey parameters. At the bottom right, a 'Create Task' button is highlighted with a red box and a red arrow, indicating the final step. A 'Back' button is also visible.

AI Well Planner

NEW TASK

TASKS

New trajectory

Info Base trajectory AC settings Offset wells Transport section Costs Production section Review

Production - 2

Export to JSON

Validation success
All seems to be alright

1

G: 9,807 m/s² B: 50 000 nT Dip: 72,00 deg Dec: 0,00 deg Grid: 0,00 deg
Well head: N 0,0, E 0,0, MSL 0,0
T1: N 2 000,0, E 200,0, MSL 3 000,0, Inc 90,00 , Az 180,00
T2: N -1 000,0, E 0,0, MSL 3 000,0
T3: N -1 000,0, E -1 000,0, MSL 3 050,0
Vertical clearance: 10,0 m
Max DLS: 10,00 deg/30m
Section 1 Start-1 000,0 m TVD (Max DLS: 2,00 deg/30m)
Section 2 1 000,0-2 000,0 m TVD (Max DLS: 5,00 deg/30m)
Section 3 2 000,0-End m TVD (Max DLS: 10,00 deg/30m)
Survey program
Start-End - MWD
AC method: Complete search (Min OSF)
Surface rule: 80% clearance + R_{sub} + R_{off}

3

Back Create Task

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Plan New Trajectory – Validation

Sometimes things doesn't go smoothly and you get errors like this

! Validation error

Expand to see a list of problems

1



- `limits.esp.tvd` Input should be a valid number
- `limits.esp.tvdTo` Input should be a valid number

Don't give up and just go a few steps back and fix them

If you get a warning like this

⚠ Validation warnings

Expand to see a list of problems

1



- Value error, Distance between targets should be greater than 250 m

you can proceed, but be warned that results may be not very great

(Press [button](#) to expand list of errors)

Plan New Trajectory – Import from COMPASS

The system will ask you to upload COMPASS XML project file and then show you import dialog

1. Select metric unit

Check and select appropriate unit: feet or meter

Keep in mind that all inputs in the project will be using the same unit

2. Choose base trajectory

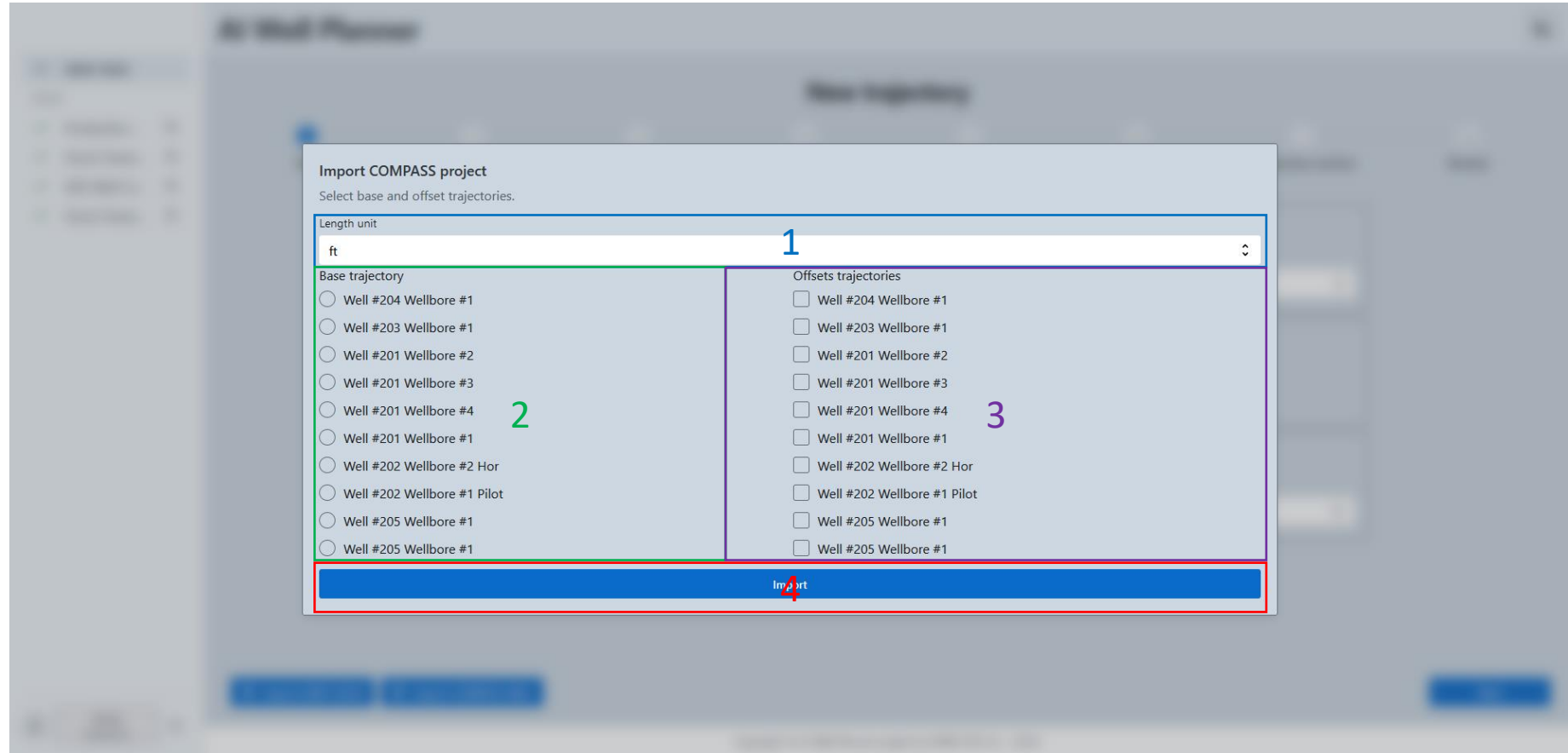
Pick one from wellbores in project

3. Pick offset wells

Check wells that will be used in AC

4. Click Import

You'll be redirected to [Transport section](#) step



Import COMPASS project

Select base and offset trajectories.

Length unit
ft

Base trajectory

- Well #204 Wellbore #1
- Well #203 Wellbore #1
- Well #201 Wellbore #2
- Well #201 Wellbore #3
- Well #201 Wellbore #4
- Well #201 Wellbore #1
- Well #202 Wellbore #2 Hor
- Well #202 Wellbore #1 Pilot
- Well #205 Wellbore #1
- Well #205 Wellbore #1

Offsets trajectories

- Well #204 Wellbore #1
- Well #203 Wellbore #1
- Well #201 Wellbore #2
- Well #201 Wellbore #3
- Well #201 Wellbore #4
- Well #201 Wellbore #1
- Well #202 Wellbore #2 Hor
- Well #202 Wellbore #1 Pilot
- Well #205 Wellbore #1
- Well #205 Wellbore #1

Import

Dashboard – Wait for result

Starting task redirects to dashboard where you can

1. Wait for result

It can take 5-10 minutes. Then a green checkmark appears. It means that task is finished

2. Browse previous tasks

Click on row (not the X) to see previous results in [content area](#)

3. Delete old results

The screenshot shows the 'AI Well Planner' dashboard. On the left, there is a 'TASKS' sidebar with a 'NEW TASK' button and a list of tasks. The first task, 'Production - 3', is highlighted with a blue box and a red '1'. The second task, 'Production ...', has a green checkmark and is highlighted with a green box and a red '2'. The third task, 'Fence Traver...', has a green checkmark and is highlighted with a red box and a red '3'. The main content area is a large grey rectangle with a purple border, containing a circular progress indicator and the text 'In Progress' and 'Your request is being processed. Upon its completion, you will be redirected to the results.' At the bottom left, there is a user profile section with a person icon, the text 'string test@test.a', and a plus icon. At the bottom right, there is a copyright notice: 'Copyright © AI Well Planner project by MWD STD Inc – 2024.'

Dashboard – Review result

1. Result trajectory

List of stations which leads from surface to target(s)

2. Export to CSV

Save as CSV to import in other software

3. Sub-report switch

One screen is not enough to show all results. Select:

- 3D plot
- AC report
- QC flags
- Costs report

4. Display area

Shows interactive 3D plot by default

The screenshot displays the 'AI Well Planner' interface. On the left, there is a 'TASKS' sidebar with a 'NEW TASK' button and a list of tasks, each with a checkmark and a close button. The main area is divided into two sections. The top section is a table with columns: MD (m), Inc (deg), Az (deg), NS (m), EW (m), TVD (m), and DLS (deg/30...). The bottom section is a 3D plot showing well trajectories. The plot has a legend for 'Targets' (blue dot) and 'Offset' (various colored dots). The plot axes are labeled 'EW' (East-West) and 'TVD' (True Vertical Depth). A red box highlights the 3D plot area, and a blue box highlights the table area. A red '4' is placed on the plot, and a blue '1' is placed on the table.

MD (m)	Inc (deg)	Az (deg)	NS (m)	EW (m)	TVD (m)	DLS (deg/30...
0.0	0.00	0.00	0.0	0.0	0.0	0.00
456.3	30.08	280.34	21.0	-115.1	435.6	1.98
1 309.6	34.89	350.85	310.1	-373.0	1 179.9	1.28
1 936.8	56.71	7.84	753.8	-365.6	1 616.2	1.19
2 444.0	51.18	21.82	1 148.8	-262.9	1 915.5	0.74
3 321.2	51.68	18.80	1 791.9	-24.9	2 462.6	0.08
3 745.8	53.37	18.29	2 111.3	82.3	2 721.0	0.12
4 164.8	90.00	180.00	2 000.0	200.0	3 000.0	10.00

Dashboard – Review result – Sub-reports

Anti-collision report

3D	AC scan	QC	Costs		
Name	OSF	C-to-C (m)	Subject MD (m)	Offset MD (m)	
Offset 1	1,00	40,0	914,2	800,0	
Offset 2	1,86	69,5	812,6	800,0	
Offset 3	2,83	98,6	812,6	700,0	
Offset 4	3,83	122,5	711,1	700,0	
Offset 5	4,94	154,5	711,1	700,0	
Offset 6	6,15	188,4	711,1	700,0	
Offset 7	8,04	303,6	914,2	900,0	
Offset 8	9,39	451,9	1 219,0	1 200,0	
Offset 9	10,04	519,1	1 320,5	1 300,0	
Offset 10	10,64	587,5	1 422,1	1 400,0	
Offset 11	11,20	658,5	1 523,7	1 500,0	
Offset 12	5,44	487,2	2 437,9	2 000,0	
Offset 13	4,53	398,1	2 437,9	2 000,0	
Offset 14	3,51	298,7	2 336,3	1 900,0	
Offset 15	7,40	501,5	1 726,8	1 600,0	
Offset 16	8,06	549,6	1 726,8	1 600,0	
Offset 17	8,72	598,0	1 726,8	1 600,0	

QC flags

3D	AC scan	QC	Costs
<input checked="" type="checkbox"/>		Transport target	
<input checked="" type="checkbox"/>		Global DLS	
<input checked="" type="checkbox"/>		Section 1	
<input checked="" type="checkbox"/>		Section 2	
<input checked="" type="checkbox"/>		Section 3	

Costs report (only for transport section)

3D	AC scan	QC	Costs			
#	Drilling			Casing		
	Length (m)	Price (\$/m)	Cost (\$)	Length (m)	Price (\$/m)	Cost (\$)
1	1 050,9	100,00	105 090,29	1 050,9	280,00	294 252,81
2	1 309,7	200,00	261 945,67	2 360,6	143,00	337 570,27
3	1 638,6	250,00	409 639,04	3 999,2	96,00	383 921,99
Subtotal			776 675,00			1 015 745,07
Total						1 792 420,06

Abnormal Result

- If you entered conflicting limits (too low DLS, too narrow inclination range, etc.), AI/DE will not be able to find a solution and will produce an abnormal result as in the picture
- If you get something similar to the picture, try restarting the task with relaxed limits

