

GeoSol™ Performance Modeling Tool User Guide

VERSION 1.0

April 2021

Contents

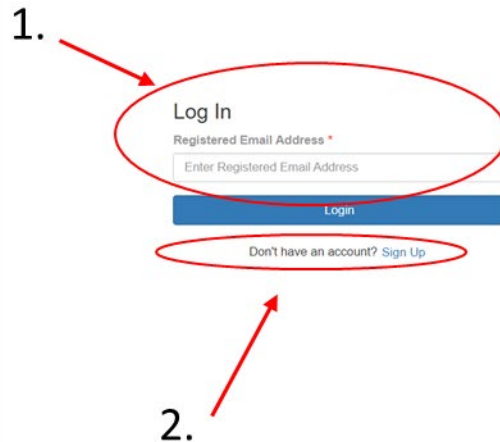
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GeoSol Performance Modeling Tool

The GeoSol Performance Modeling Tool is a web-based application, which allows users to assess the likelihood of mineral scale formation in geothermal production wells and surface separation equipment. Powering the GeoSol Performance Modeling Tool is [WATCH Version 2.4](#) (Iceland GeoSurvey, April 2010) software. The downhole chemical composition, pH and thermodynamic saturation indices are calculated based on user-inputted brine and gas chemical analyses.

Logging In

The GeoSol Performance Modeling Tool is accessible from the Solenis Geothermal Power website: <https://www.solenis.com/en/industries/industrial-markets/geothermal-power>. First-time users are required to create a New User profile (see the “[Creating a New User](#)” instructions below). If you have previously registered, then skip ahead to the “[Log In](#)” directions.



Creating a New User

If you have not registered previously, after clicking “Sign Up” (1), you will be directed to the new user registration form.

1. Please type your First and Last Name, Company Name, and Email Address. Optionally, you can select your country if you would like to be contacted by the Solenis Geothermal Team.
2. Click on “Accept Terms & Conditions”, where a new window will pop up. After ticking the checkbox, click Accept.

GEOSOL MODELING PERFORMANCE TOOL



DISCLAIMER:

This online modeling tool is provided for illustrative purposes only, and the information obtained is not a substitute for working with a qualified Solenis expert. Solenis does not warrant the accuracy of the data provided and the user of the tool assumes all risk and liability for such usage. Please refer to our online [Terms and Conditions](#) and our [Privacy Policy](#) for more information.

Register (New User)

First Name *

Last Name *

Company Name *

Email Address *

I would like to be contacted by the Solenis Geothermal Team, Please select your country


[Accept Terms & Conditions](#)

[Already have an account? Log In](#)

Logging in with a Registered Email Address

1. Type in the email address you used to create your user profile.
2. You will be sent a One-Time Password (OTP) to this email address. Please type it in the text boxes and click “Verify”.
3. If successful, you will be taken to the first page of the GeoSol Performance Modeling Tool input form. If you did not receive your code, click “Resend Code”.

GEOSOL™ PERFORMANCE MODELING TOOL



Validate OTP

Please enter the OTP(one time password) to verify your account.A code has been sent to your registered email address

[Not received your code? Resend code](#)

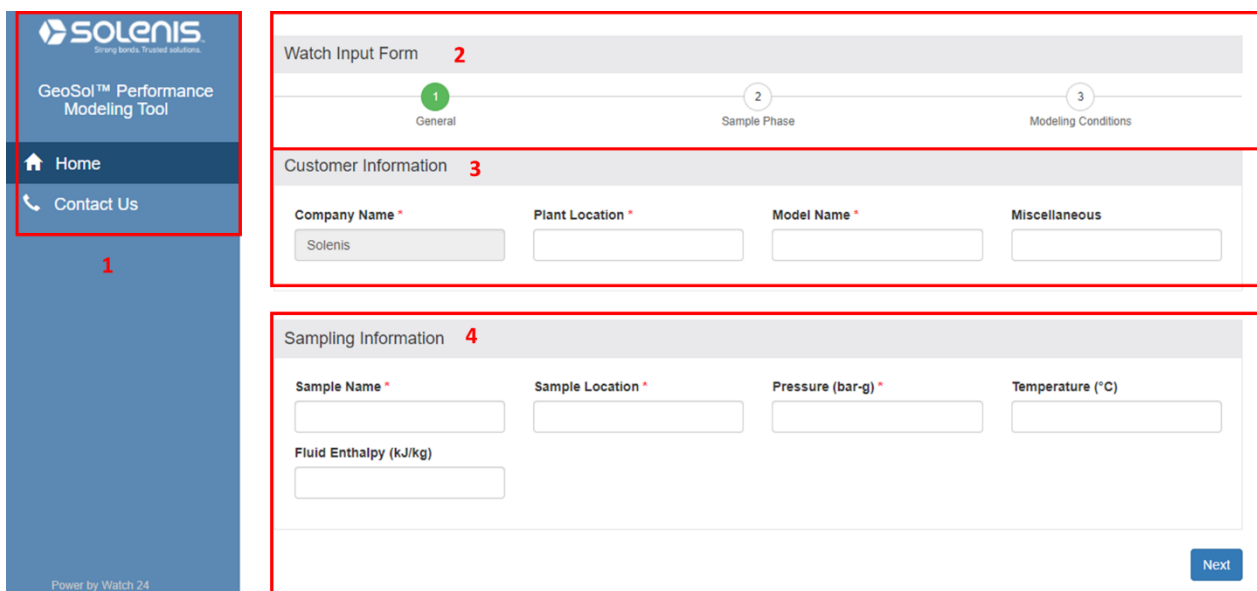
WATCH Input Form

General Information

The WATCH Input Form is the first page you will be brought into once you completed your log in. This window has four separate sections.

1. The static left pane gives you access to the “Home” page and the “Contact Us” page on Solenis.com. Clicking on “Home” will clear any simulation values previously inputted.
2. The top-most section summarizes the three general steps needed to successfully develop a geochemical model using the GeoSol Performance Modeling Tool.
3. The middle section will ask general information (required fields are in **bold**):
 - a. **Plant Location**: Plant or project name.
 - b. **Model Name**: Unique name to identify modeling scenario.
 - c. **Miscellaneous**: Any other information you would like to save in your modeling scenario.
4. The bottom-most section will ask for the modeling conditions:
 - a. **Sample Name**: Unique identifier for the sample, such as date.
 - b. **Sample Location**: Well name, location in the pipeline, etc.
 - c. **Pressure (bar-g)**: Please input the pressure at which brine and vapor samples were taken. Units are in bars gauge (bar-g).
 - d. **Temperature (°C)**: If known, input the sampling temperature.
 - e. **Fluid Enthalpy (kJ/kg)**: If available, input the fluid enthalpy at sampling conditions.

Click “Next” to move to the next step in the simulation.



The screenshot shows the WATCH Input Form interface. On the left is a navigation pane (labeled 1) with the Solenis logo, 'GeoSol™ Performance Modeling Tool', and buttons for 'Home' and 'Contact Us'. The main content area is divided into three sections: 'Watch Input Form' (labeled 2) with a progress indicator showing 'General' (1), 'Sample Phase' (2), and 'Modeling Conditions' (3); 'Customer Information' (labeled 3) with input fields for 'Company Name *' (pre-filled with 'Solenis'), 'Plant Location *', 'Model Name *', and 'Miscellaneous'; and 'Sampling Information' (labeled 4) with input fields for 'Sample Name *', 'Sample Location *', 'Pressure (bar-g) *', 'Temperature (°C)', and 'Fluid Enthalpy (kJ/kg)'. A 'Next' button is located at the bottom right of the Sampling Information section.

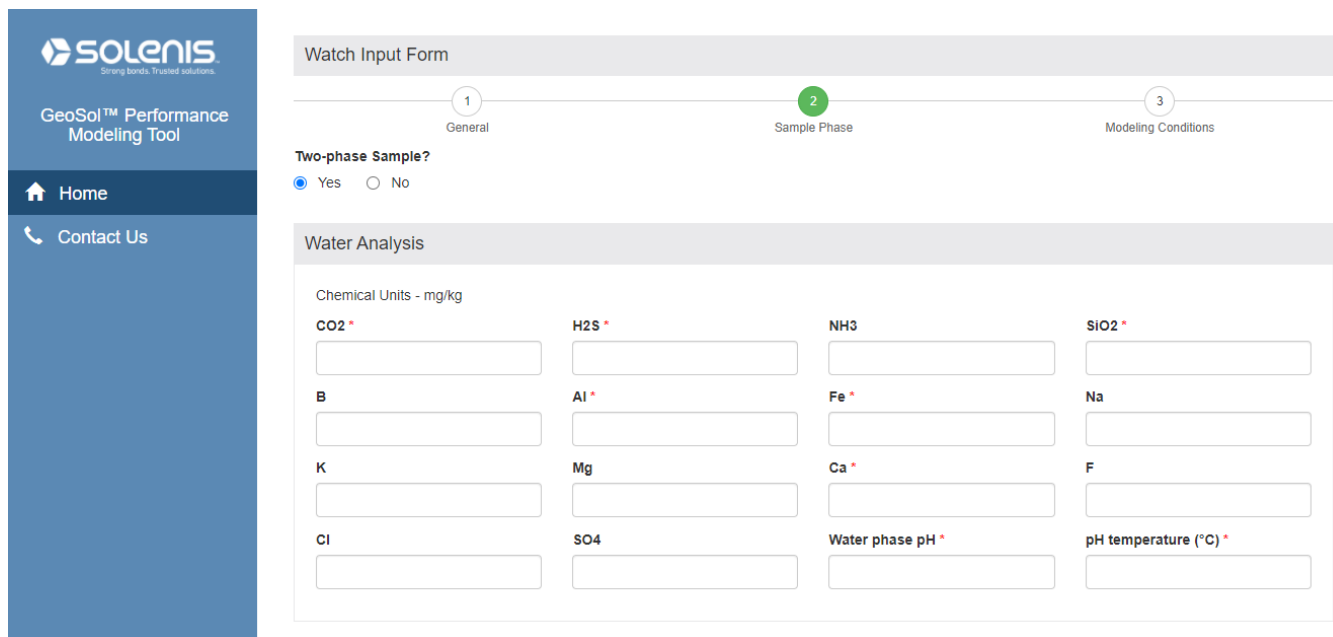
Water and Vapor Analysis

This is the second step in creating the simulation.

Here, you are first asked if you want to model a two-phase sample. If you tick “Yes”, a “Vapor Analysis” section appears at the bottom. If you tick “no”, only the “Water Analysis” input form is shown.

1. **“Water Analysis”**: This form will ask for various species in the brine phase of the sample. Only those with a red asterisk (*) are mandatory for continuing. Please note that carbonate and sulfide species are entered as mg/kg CO₂ and mg/kg H₂S, respectively.
2. **“Vapor Analysis”**: If you have a two-phase sample, the “Vapor Analysis” section will ask for gas concentrations. You can select different units to input your information. Please be aware that after inputting the information in one set of units, if you change the units display, this modelling tool **will not** re-calculate the number to reflect the new units.

Click “Next” to move to the final section of the simulation input form.



The screenshot shows the 'Watch Input Form' section of the software. At the top, there are three numbered steps: 1. General, 2. Sample Phase (which is currently active), and 3. Modeling Conditions. Below the steps, there is a 'Two-phase Sample?' question with radio buttons for 'Yes' (selected) and 'No'. The main section is titled 'Water Analysis' and contains a grid of input fields for various chemical species. The species listed are CO₂*, H₂S*, NH₃, SiO₂*, B, Al*, Fe*, Na, K, Mg, Ca*, F, Cl, SO₄, Water phase pH*, and pH temperature (°C)*. The units are specified as 'Chemical Units - mg/kg'. The asterisk (*) indicates that these species are mandatory for continuing.

Vapor Analysis

Units

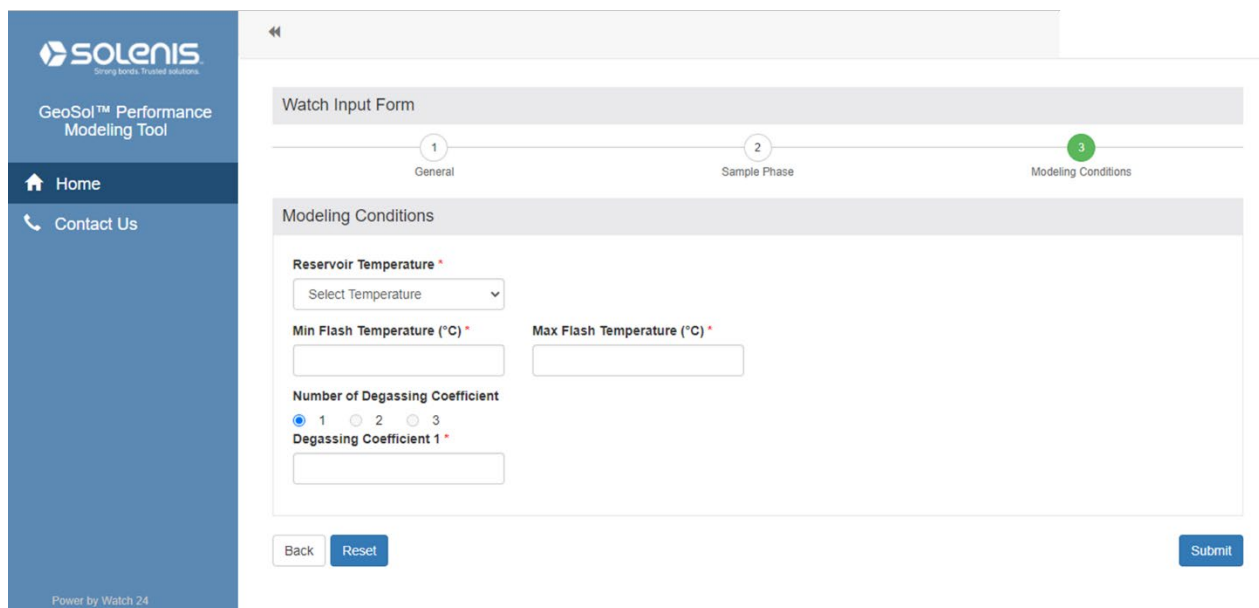
mmole gas/100mole H2O
 mmole gas/mole H2O
 ppm
 Total gas (wt. %) and wt. % gas

Gas CO2*	Gas H2S*	Gas NH3	Gas H2
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
Gas O2	Gas CH4	Gas N2	
<input type="text"/>	<input type="text"/>	<input type="text"/>	

Modeling Conditions

Here, you are asked to input the modeling conditions for the previously entered sample.

- Reservoir Temperature:** Two options are provided: “Measured” and “Quartz Calculated”. If the reservoir temperature is not known, then the quartz geothermometer temperature can be estimated from the inputted silica concentration.
- Minimum and Maximum Flash Temperatures (°C):** These are the minimum and maximum temperatures over which modeling will occur. The maximum flash temperature is limited to 320 °C.
- Degassing Coefficient:** This parameter is a measure of incomplete degassing during flashing. Acceptable values are 0.01 – 1 with unity signifying equilibrium boiling.



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Watch Input Form
 1 General 2 Sample Phase 3 Modeling Conditions

Modeling Conditions
Reservoir Temperature *
 Select Temperature ▼
Min Flash Temperature (°C) * **Max Flash Temperature (°C) ***

Number of Degassing Coefficient
 1 2 3
Degassing Coefficient 1 *

Simulation Results

The results of the simulation are shown on the final page.

1. General summary information (1) that was previously inputted: Company Name, Plant Location, Sample Name and the Timestamp of the simulation.
2. Chemical Species for modeling and Reservoir Temperature (2). In this limited version of the GeoSol Performance Modeling Tool, calcite is the only species that can be modeled. Please contact Solenis if interested in modeling other chemical species.
3. The calculated Calcite Saturation Index (3) over the temperature range specified as the minimum and maximum flash temperatures.
4. Lastly, “Print” and “Back to Input Form” buttons (4) are shown. The “Print” button opens a new window where to print or create a PDF summary of the simulation. The “Back to Input Form” redirects you to the General Information screen. Any values previously inputted are saved.

Logging Out

To end the modeling session, close your browser window. User-inputted data and information is not saved. To begin a new simulation, follow the instructions in the “Logging In” section of this user guide.

The screenshot displays the 'Current Simulation' page. At the top right, there are two buttons: 'Print' and 'Back to Input Form', both circled in red and labeled with a '4'. The main content area is divided into several sections:

- Section 1:** General summary information including Company Name (Solenis), Plant Location (Sample), Sample Name (Sample), and Timestamp (Apr 16th 2021, 4:13:53 PM(UTC)).
- Section 2:** Chemical Species selection (Calcite is selected) and Reservoir Temperature (218.8).
- Section 3:** Calcite Saturation Index table with a degassing coefficient of 1.000.
- Section 4:** Calcite After Flashing graph showing the Calcite Saturation Index versus Flash Temperature (°C).

Temp (°C)	Degassing Coeff = 1.000
140	0.587
153	0.74
166	0.896
179	1.046
193	1.173
206	1.224
219	0.758
233	1.066
246	1.364
260	1.649