




What is the Q⁺ System Projection Application?

The Q⁺ System Projection Application is used to predict reverse osmosis system performance based on NanoH₂O membrane characteristics. It is also capable of simulating polymeric RO membranes if their performance is entered.

Main Screen: The main screen is divided into three major areas; the left **System Input** section where the water, flow rates, energy recovery, and units are selected, the center, the center **System Design** section where the RO system is designed and some vessel specific results are shown, and the right **System Output** section where highlighted results are shown after the **Calculate** button is pressed.

Throughout the program the  icon indicates a new screen which can be opened for more options.

System Input: These parameters are used as inputs for the Q⁺ System Projection Application. The system provides default values for some of the parameters which can be overridden.

FEED WATER: The details of the water which needs to be filtered.

Field	Description
Water Type	Pre-specified water profiles
Temp	The default value is set based on the water type. It can be in the range of 15 to 28 degrees based on water type.
pH	pH value of the feed water.
Year of operation	When a fouling factor or salt passage increase factor is entered in "specify feed water..." the years of operation field will indicate the age of the membranes used for the simulation

System Input

FEED WATER

Water Type: 32000 PPM

Temp: 25 °C

pH: 7.8

Years of Operation: 0

[Specify Feed Water...](#)

FLOW RATE

Permeate 29000 gpd

Feed 82857.14 gpd

Concentrate 53857.14 gpd

Recovery 35 %

ENERGY EFFICIENCY

ERD Type: None

Pump Efficiency: 100.0 %

[Specify Efficiencies...](#)

UNITS

Temp: °C-Celsius

Flow: GPD

Pressure: PSI

Flux: GFD

FLOW RATE: There are four parameters given below for the flow rate. Of these four parameters, two values must be provided for calculation. Once two values are entered the others will automatically be calculated. Checking box will keep that field fixed if another field is to be changed.

Field	Description
Permeate	Value of the permeate flow rate.
Feed	Value of the feed flow rate.
Concentrate	Value of the concentrate flow rate.
Recovery	Percent of feed water converted to Permeate

ENERGY EFFICIENCY: You can specify the Energy Recovery Device Type and pump efficiency to allow system energy consumption to be calculated. Note that actual systems may have other sources of energy loss which will not be accounted for in this application.

Field	Description
ERD Type	Type of Energy Recovery Device.
Pump Efficiency	Efficiency of the pump.

UNITS: The units to be used for flux, pressure, flow and temperature. It shows a separate dropdown with various unit values used for flux, pressure, flow and temperature. Units can be changed at any time and values throughout the application will be converted to the new unit.

Screens: These screens contain additional control over settings, and show more detail regarding results and warnings.

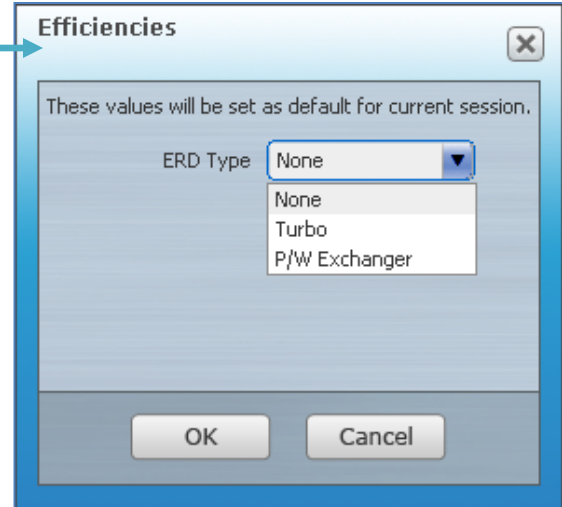
Specify Feed Water: Clicking on

[Specify Feed Water...](#)

shows the Feed Water screen. This screen defines the feed water characteristics. In the main table ionic composition of the feed water can be specified. These values along with temperature and pH can be saved as a new water type that can then be selected in the water type dropdown after balancing the ionic makeup by pressing the **“balance”** button. These water type files can be exchanged and opened by another user by saving the new water type to the water type file.

Ions	ppm
Ammonium (NH4)	0.00
Sodium (Na)	9563.04
Potassium (K)	502.38
Magnesium (Mg)	1188.70
Calcium (Ca)	430.39
Strontium (Sr)	7.36
Barium (Ba)	0.01
Fluoride (F)	1.29
Chloride (Cl)	17079.23
Sulfate (SO4)	3062.03
Nitrate (NO3)	0.00
Bromide (Br)	0.00
Carbonate (CO3)	2.40
Bicarbonate (HCO3)	155.34
Boron (B)	4.78

Specify Efficiencies: After clicking on [Specify Efficiencies...](#) on the **System Input** section a dialog box is displayed, where you can specify the properties for different Energy Recovery Devices. Turbo selects a turbo charger, P/W Exchanger selects a pressure or work exchanger. Different values are needed to simulate each.

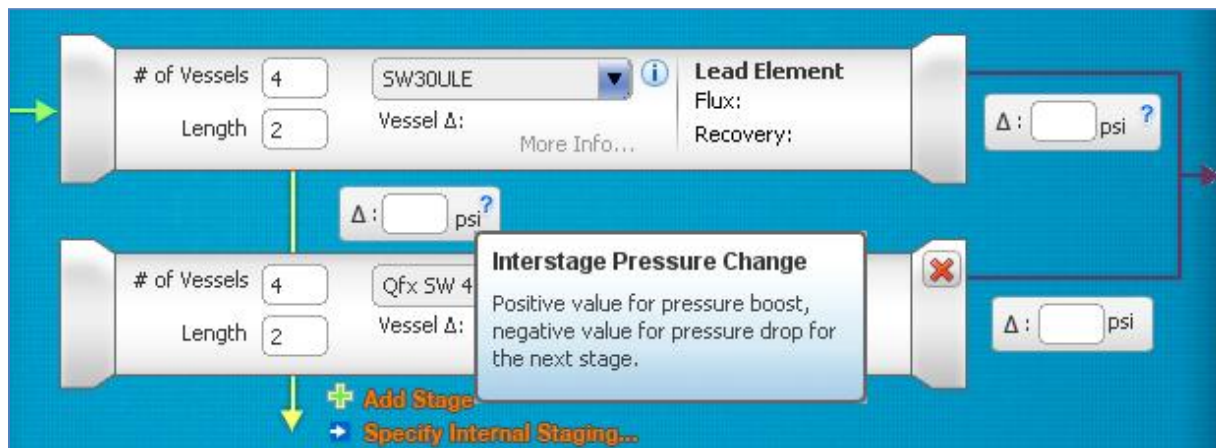


Field	Description
Water Source	Water source affects the set points for various warnings.
Water Type	Water type allows selection of a water type.
Temperature	Temperature of the feed water.
pH	pH of the feed water.
Total Dissolved Solids	The mg/kg of all dissolved components in the water. This is typically an output but can be entered directly for the "NaCl" water type.
Total Osmotic Pressure	This is calculated based on the ionic make up of the feed water.
Charge Balance	This displays the current charge balance of 'cations' and 'anions' in the feed water in meq/L.
Balance	This button is used to balance the water profile by adjusting the content of all 'cations' and 'anions'.
Flow Loss	The percent drop in membrane permeability expected after 1 year of operation
Salt Passage Increase	The percent increase in salt passage after 1 year of operation
Safety Factor	This value will adjust the overall system permeate quality by the amount indicated. It should normally have a value of 1.
Years of Operation	The age of the membrane being simulated
Save Water Profile	After clicking on this link, the water profile name text box is shown. A unique name for this water profile is chosen and then " Save Water Profile " is selected. The ion composition, temperature, and pH values currently loaded in the table are saved as a Water profile. The " Water Type " drop down is updated to show the newly updated entry.

System Design: The center panel contains the graphical representation of the system being modeled. The number of vessels, number of elements in each vessel, number of stages and element type are specified here. When the screen is loaded, or the reset button is pressed this section shows only one stage. More stages [Maximum six] can be added by selecting [+ Add Stage](#).

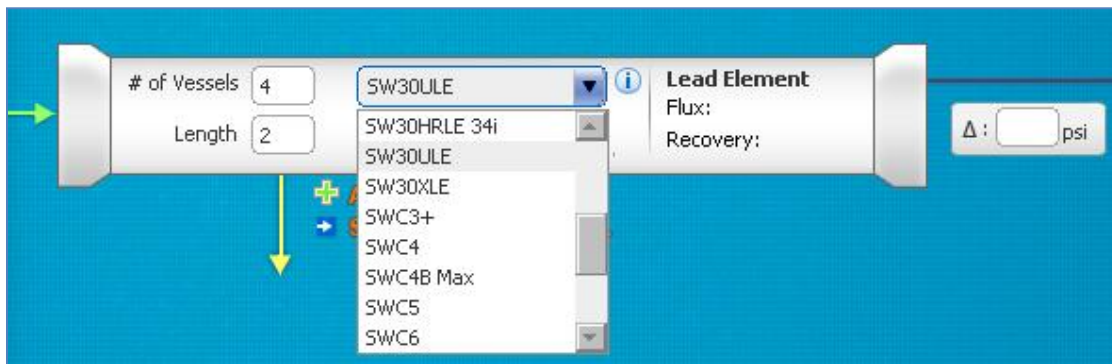
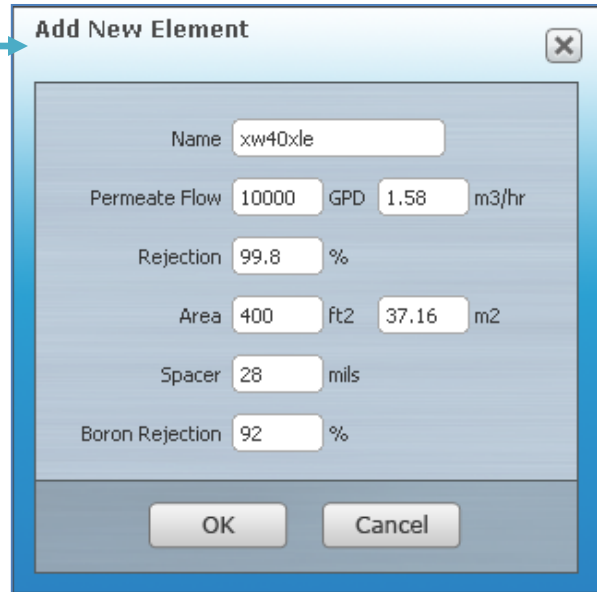


Field	Description
# of Vessels	The number of vessels present in the given stage.
Length	The vessel length in number of modules.
Select Element Type	Selection of the specific module to be simulated. Selecting “add new element” allows creation of a new element type. This can be used to simulate, for example, an older partially fouled element that may be used with new elements.
Permeate Back Pressure	This value simulates backpressure on the permeate side allowing required feed pressure to be calculated.
Vessel DP	The calculated pressure drop value for the vessel is shown here.
Lead Element Flux	The calculated Lead Element Flux value for the stage is shown here.
Lead Element Recovery	The calculated Lead Element Recovery value for the stage is shown here.
Add Stage	Clicking on this button adds an additional stage to the system design portion shown below.



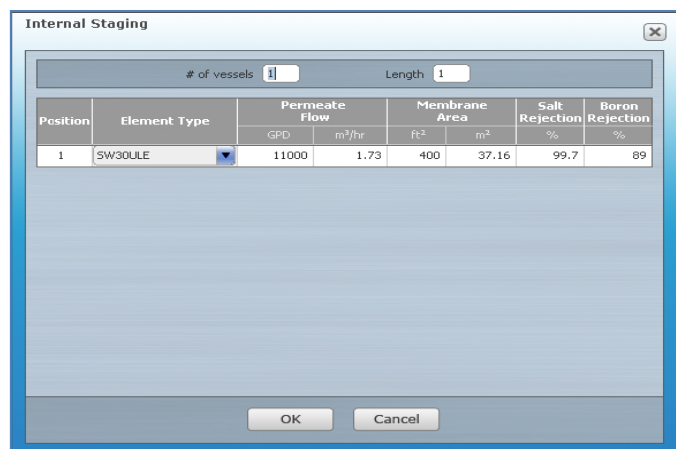
Interstage Pressure Change: The box between stages allows a pressure change to be simulated. Positive values simulate a pressure boost, negative value simulate a pressure loss.

Add New Element: This dialog box is shown when you select the option “Add New Element” from any of the “Element Type” dropdowns shown below on the System Designer Page. You can specify a new membrane element to be used during system projection calculation. Once you have provided all the necessary parameters for the element, it will be added to the “Element Type” dropdown for the future use.



Specify Internal Staging: Some systems can be optimized through the use of different membrane types in vessel. The “Internal Staging” feature allows each element in a vessel to be individually specified.

There are two sections of the “Internal Staging” dialog. The left side allows different elements for different positions in the vessel to be selected. The right side shows information about the chosen element.



Field	Description
# of Vessels	The number of Vessels present in the given stage.
Length	The vessel length in number of modules for the given stage.

System Output Section: After clicking “Calculate”, the projection details are shown on the system output section.

PERMEATE: This section shows the Total Dissolved Solids, Chloride and Boron content of the permeate.

POWER: This section shows the Feed Pressure and Specific Energy Consumption.

SYSTEM: This section shows the values for various parameters that may be of concern for the specific system design.

WARNINGS: Details about warnings. If there are warnings available then the “More...” link is enabled. It displays warnings in two sections Design warnings and Stability warnings.

The screenshot shows the 'System Output' window with the following data:

- PERMEATE:** TDS: 388.36 ppm, Chloride: 228.48, Boron: 1.67
- POWER:** Pressure: 651.89 psi, Energy Consumption: 9.46 KWh
- SYSTEM:** Average Flux: 6.46 gfd, Max Element Flux: 13.34 gfd, Max Element Recovery: 11.28 %, Max Element Polarization: 1.130, Max Element Pressure Drop: 3.76 psi, Max Vessel Pressure Drop: 6.92 psi, Final Net Driving Pressure: 20.53 psi
- WARNINGS (1):** Design provides insufficient net driving pressure for the final element.

Detailed Results: The “Detailed Results” link is enabled when a valid projection calculation result is available. The “Detailed Results” screen is divided into six major sections.

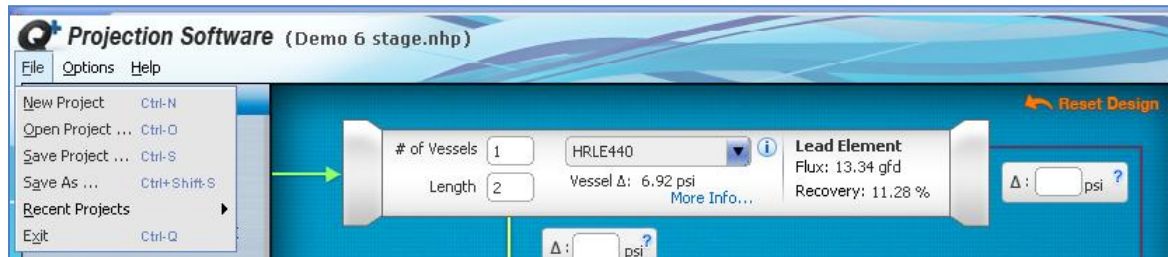
Section	Description
Project and Input Parameters	This displays the project information, feed water details and the design factors.
System Parameters	This shows the combination of some input parameters and some important calculated output parameters.
Water Analysis	This shows the ionic composition of the feed water, concentrate, and permeate at both the system and stage level.
Within Vessels	This section summarizes the system performance at the element level.
Solubility	This shows the calculated solubility values for feed and concentrate.
Warnings	This lists out the various warnings encountered during system projection calculation and also the system stability warnings.

Data from the Detailed Results section can be exported to excel or printed through the options on the top right side of the window.

Option	Description
Print	Prints the detailed results.
Export	Exports the detailed results to an excel file.

Menus

File Menu: This section holds the menu items required for project file management.

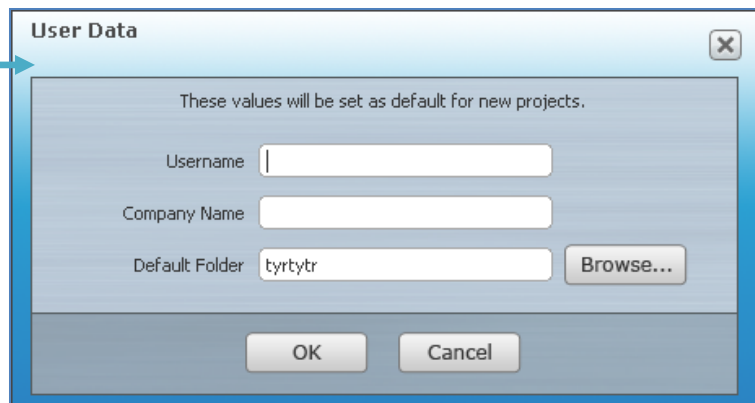


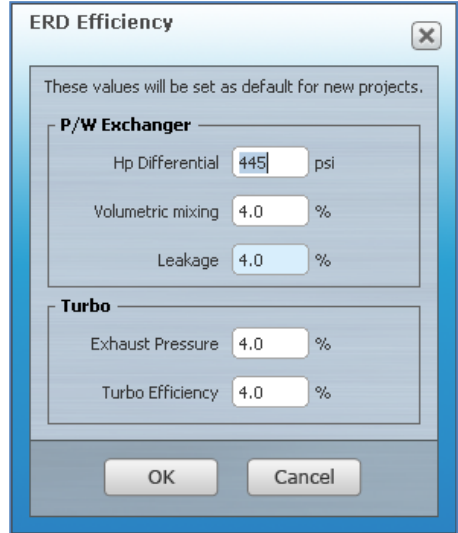
Menu Item	Description
New Project	Clicking on this option will create a new project and it will reset the designer view.
Open Project	Opens an existing project.
Save Project	Saves the project in the current file name.
Save As	Saves the currently loaded project by another name.
Recent Projects	Displays the latest 10 projects and allows them to be opened.
Exit	Closes the application.

Options Menu: This section has menu items related to default values used by the program such as user data, default values for energy efficiency and the sections that will be displayed in the detailed result sections.

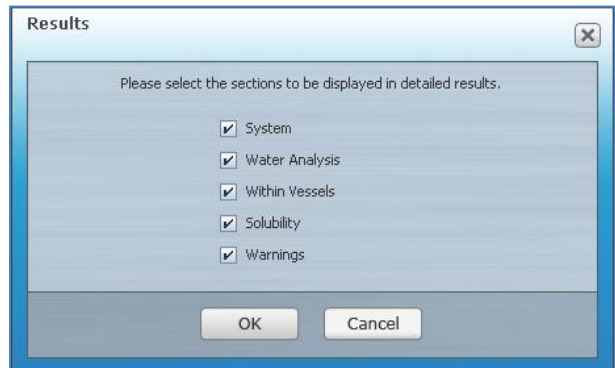


- 1. Set Default User Data:** Sets the Default User Name and Company Name displayed in the Project information section for all new projects.
- 2. Set Default ERD Efficiency:** Sets the default set of values for ERD efficiency.





3. Set Default Results: Sets the sections that will be displayed on the “Detailed Results” screen and excel report.



Help Menu: This section has contact information about NanoH₂O, and allows this help dialogue to be displayed.



Menu Item	Description
Help	This opens the PDF file you are currently reading.
Properties	It contains details about the Q ⁺ System Projection Application, version number, release date and support information etc.
Contact Us	It displays the contact us ids for more information about NanoH ₂ O and for sales inquiries. Also displays NanoH ₂ O website link and facebook link.