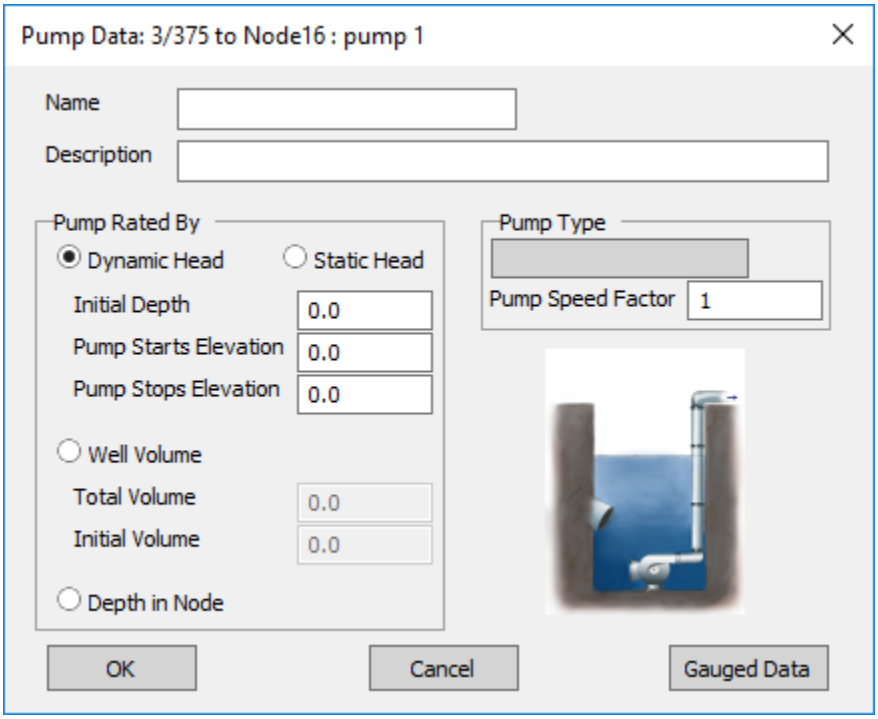
Hydraulics Layer Pump Diversion

A pump station is conceptually represented as either an in-line lift station, or an off-line node representing a wet-well, from which the contents are pumped to another node in the system according to a programmed rule curve. Up to seven pumps may entered for a diversion. The pumps may be selected in any order.

Pumps may be one of five types:

1. Pump Rated by Well Volume: An in-line or off-line pump station with a wet well; the rate of pumping depends upon the volume (level) of water in the wet well.
2. Pump Rated by Depth in Node: An in-line or off-line lift station that pumps according to the level of the water surface at the junction being pumped.
3. Pump Rated By Dynamic Head: An in-line or off-line pump that pumps according to the head difference over the pump using a multi point pump curve and starting and stopping elevations.
4. Pump Rated By Static Head: An in-line or off-line pump that pumps according to the head at the upstream node using a multi point pump curve and starting and stopping elevations.
5. A dynamic head pump that uses a rule curve to modify the behavior of the dynamic head pump based on the depth at either an adjacent or non-adjacent node.



Name

The Hydraulics layer now allows users to specify the pump name explicitly. The analysis engine no longer uses PUMP #1, PUMP #2, PUMP #3 etc. depending on where in the model the pump is located. These names were liable to change when a pump was added to or removed from the network and have therefore been replaced with an explicit name.

Description (Optional)

Enter a pump description applicable to this link and pump.

Pump Type

The pump type is selected from a global database of Pump Rating Curves.

Pump Type (Rating Curve). Select the global database containing the Pump Rating Curve Global Data applicable to this pump.

Pump Speed Factor. Enter the factor by which the Flow Rate of the rating curve will be modified when the model is solved.

The new rating curve is modified such that:

New Flow = Old Flow x Pump Factor, and

New Head = Old Head x Pump Factor^2

Pump Rated By

A pump may be in-line or off-line and rated by Dynamic Head, Static Head, Well Volume or, Depth in Node.

Note: A dynamic head pump will continue to operate even when there is a positive head difference; i.e. the upstream water elevation is above the downstream node (wet well) elevation. In older versions the pump would not operate as this computes a negative head and there are no negative head values on the pump curve to extrapolate a corresponding flow. A configuration parameter has been created and is on by default in the current version to allow the pump to fix to the maximum rate in this unusual situation of negative head. This parameter is PUMP_NEGHD=ON.

Dynamic Head

An in-line or off-line pump that pumps according to the head difference over the pump.

The dynamic head difference between the upstream and downstream nodes determines the pumping rate according to a multi-point head-discharge relationship (rating curve) for the pump. The operating condition (i.e., on/off) for the pump is determined from the wet well elevation from the previous half-step computation.

If the model detects that a pump is on then its flow is computed from the dynamic head difference based on a linearized pump operating curve as shown below.

The pump's operating range is limited to the range between the low-rate head and the high-rate head regardless of the detected dynamic head. Pump rates will remain fixed at either the low-rate head or the high-rate head until the system returns to the normal operating range of the pump.

A dynamic head pump is defined in terms of:

- **Initial Depth.** Enter the initial depth in the pump inflow node (ft or m). This depth is measured from the node invert and is not an elevation value. Used by Dynamic and Static Head Pumps. The initial depth must be entered in the upstream node in addition to this field since the initial depth in the wet well is derived from the node initial depth.
- **Pump Starts (Elevation).** Elevation (RL) in pump inflow node at which pump turns on (feet or metres). Used by Dynamic and Static Head Pumps.
- **Pump Stops (Elevation).** Elevation (RL) in pump inflow node at which pump turns off (ft or m). Used by Dynamic and Static Head Pumps.

> ⚠ Pumps are set initially to "OFF" and do not start pumping until the water level is greater than the designated starting level.

Static Head

An in-line or off-line pump that pumps according to the head at the wet well.

The depth in the upstream node determines the pumping rate according to a multi-point head-discharge relationship (rating curve) for the pump. The operating condition (i.e., on/off) for the pump is determined from the wet well elevation from the previous half-step computation.

If the model detects that a pump is on then its flow is computed from the head at the upstream node based on a linearized pump operating curve as shown below.

The pump's operating range is limited to the range between the low-rate head and the high-rate head regardless of the detected dynamic head. Pump rate will remain fixed at either the low-rate head or the high-rate head until the system returns to the normal operating range of the pump.

A static head pump is defined in terms of:

- **Initial Depth.** Enter the initial depth in the pump inflow node (ft or m). This depth is measured from the node invert and is not an elevation value. Used by Dynamic and Static Head Pumps. The initial depth must be entered in the upstream node in addition to this field since the initial depth in the wet well is derived from the node initial depth.
- **Pump Starts (Elevation).** Elevation (RL) in pump inflow node at which pump turns on (feet or metres). Used by Dynamic and Static Head Pumps.
- **Pump Stops (Elevation).** Elevation (RL) in pump inflow node at which pump turns off (ft or m). Used by Dynamic and Static Head Pumps.

Well Volume

An off-line (usually) pump station with a wet well. The pump must be supplied from their own wet well, i.e., only one conduit must be connected to the node at which the pump is located. The rate of pumping depends on the volume of water in the well.

The program sets the node invert elevation (level) to -100.

Note that only one conduit may be connected to the node from which this type of pump operates.

Inflows to the off-line pump must be derived from the main sewer system through an orifice, a weir, or a pipe. The influent to the wet-well node must be a free discharge regardless of the diversion structure. The pump rating curve is based on the volume of water in the storage node.

A multi-point volume/flow rate rating curve is prespecified for each pump station: V1 < V2 < Vn, where Vn is the maximum capacity of the wet well. The pump rate is selected automatically by the Hydraulics layer depending on the volume in the wet-well.

A mass balance of pumped outflow and inflow is performed in the wet-well during the model simulation period.

If the wet-well goes dry, the pump rate is reduced below rate R1 until it just equals the inflow rate. When the inflow rate again equals or exceeds R1, the pumping rate goes back to operating on the rule curve. If Vn is exceeded in the wet-well, the inflow to the storage node is reduced until it does not exceed the maximum pumped flow.

A wet well pump station is defined in terms of its:

- **Total Well Volume.** Enter the total well capacity (ft^3 or m^3).
- **Initial Well Volume.** Enter the initial well capacity (ft^3 or m^3).

Depth in Node

An in-line (usually) lift pump. The rate of pumping depends on the level of water, i.e., depth, in the node being pumped.

For an in-line station, the pump rate is based on the water depth at the pump junction. The Pump Rate rule is as follows:

R1 for	0	< Y <	Y1
R2 for	Y1	< Y <	Y2
Rn for	Yn-1	< Y <	Yn

For Y = 0, the pump rate is the inflow rate to the pump junction.

Gauged Data

Measured time series data can be entered directly in the Pump Data dialog for comparison with model results. This time series is displayed on graphs created with the Review Results tools. Note that the scales of the x (time) and y (values) axes on the review results graphs are based on the ranges of the model results. Gauged data outside the ranges of the model results will not appear on the plots. Read more on this parameter in the Gauged Data page in the Nodes section.

1. Depth in the Hydraulics mode is relative to inverts
2. elevation or stage in hydraulics is relative to zero