Water Treatment Plant AI Designer Example

Generate solutions using FrameworX AI Designer

This example demonstrates the solution Highland Municipal Water Treatment Plant created by FrameworX AI Designer.

Solution download: Water Treatment Plant AI Designer Example.dbsln

Technical Specification PDF: Highland_WTP_Equipment_Spec.pdf

L5K PLC Program: Highland_WTP_Main.L5K

Showcases:

- Generate a complete municipal water-treatment SCADA solution from a PDF spec and a Rockwell L5K tag export.
- Map four process areas (Raw Water Intake, Chemical Feed, Filtration, Disinfection) to a Unified Namespace organized by ISA-95 area numbering.
- Reuse three User Defined Types (Pump, ChemPump, Filter) to model dozens of equipment instances consistently.
- Capture water-quality compliance limits (turbidity, chlorine residual, pH) as alarm thresholds aligned to drinking-water regulations.
- Drive the live demo from a built-in value simulator while keeping the ControlLogix channel configured but disabled, ready to swap to a real PLC.
- Show how AI mapping from an L5K file produces a tag database that mirrors the PLC's program structure.
- Surface ML opportunities for filter headloss and turbidity, anticipating raw-water quality changes before they breach limits.

This solution was created as a demonstration of FrameworX AI Designer capabilities. It is not intended for production use. Device connections, alarm limits, and process values are illustrative only and have not been validated against real equipment or regulatory requirements.

Summary

This page contains the technical details for the Act 1 live demo. The AI reads the attached PDF specification and L5K PLC tag database to build the complete SCADA solution.

Demo Prompt

Build a NEW FrameworX solution for the Highland Municipal Water Treatment Plant.

The plant specifications are in the attached PDF, the PLC program is in the attached L5K file.

Create the UNS following ISA-95 standards. Map the PLC points using ControlLogix driver, and add a value simulator protocol for our tests.

Add alarms based on the compliance limits in the spec and set up historian for all process variables.

Create a 3 x 2 dashboard, with Gauges on first rows, and trend, alarm, data grid on second.

Analyze which variables that would benefit from machine learning, for later implementation.

Start everything up and give me a status summary.

Attached documents with the prompt

1. **Highland_WTP_Equipment_Spec.pdf** — Professional spec with equipment lists, compliance limits, process notes
2. **Highland_WTP_Main.L5K** — ControlLogix tag export with 3 UDTs, all controller tags by area, 3 program stubs

Approximately creation = 7 minutes.

Plant Overview

Highland Municipal Water Treatment Plant is a conventional surface water treatment facility serving approximately 18,000 residents. The plant treats raw water from Highland Reservoir with a design capacity of 5 MGD (million gallons per day) and an average daily production of 3.2 MGD.

Area	Name	Description
100	Raw Water Intake	Reservoir intake structure with raw water pumping
200	Chemical Feed	Coagulant, chlorine, and fluoride chemical storage and dosing
500	Filtration	Four dual-media gravity filters with automated backwash
600	Disinfection & Clearwell	Chlorine contact basin and 0.5 MG clearwell

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Control System Architecture

Main Treatment Plant PLC

Parameter	Value
Processor	1756-L83E CompactLogix
IP Address	192.168.1.10
Slot	0
I/O Chassis	1756-A13 (13-slot)
Program File	Highland_WTP_Main.L5K

All treatment plant process variables are available as Controller Tags in the ControlLogix program.

User Defined Types (from L5K)

The L5K file contains 3 UDTs that the AI should recreate as FrameworX User Types:

UDT_Pump

Member	Type	Description
Running	BOOL	Pump running feedback
Fault	BOOL	Pump fault/alarm
Ready	BOOL	Pump ready status
AutoManual	BOOL	0=Manual 1=Auto
SpeedCmd	REAL	Speed command 0-100%
SpeedFeedback	REAL	Speed feedback 0-100%
MotorCurrent	REAL	Motor current in Amps
RunHours	REAL	Accumulated run hours

UDT_ChemPump

Member	Type	Description
Running	BOOL	Pump running feedback
Fault	BOOL	Pump fault/alarm
AutoManual	BOOL	0=Manual 1=Auto
DoseRate	REAL	Current dose rate mL/min
DoseSetpoint	REAL	Dose rate setpoint mL/min
TankLevel	REAL	Chemical tank level %
TotalChemUsed	REAL	Totalizer gallons used
FlowPaced	BOOL	1=Flow-paced 0=Manual rate

UDT_Filter

Member	Type	Description
InService	BOOL	Filter in service
Backwashing	BOOL	Backwash in progress
HeadLoss	REAL	Differential pressure PSI
EffluentTurbidity	REAL	Effluent turbidity NTU
ValvePosition	REAL	Effluent valve 0-100%
TimeSinceBackwash	REAL	Hours since last backwash
BackwashCount	DINT	Cumulative backwash count

Equipment List by Process Area

Area 100 - Raw Water Intake

Tag	Equipment	Description
P-101	Raw Water Pump 1	100 HP VFD centrifugal, 2500 GPM
P-102	Raw Water Pump 2	100 HP VFD centrifugal, 2500 GPM (standby)
FT-101	Flow Transmitter	Magnetic flow meter, raw water header
AIT-101	Turbidity Analyzer	Raw water turbidity, Hach 1720E
AIT-102	pH Analyzer	Raw water pH, Hach pHD sc
LT-101	Level Transmitter	Intake wet well level

Area 200 - Chemical Feed

Tag	Equipment	Description
P-201	Coagulant Pump	Metering pump, aluminum sulfate (alum)

P-202	Pre-Chlorine Pump	Metering pump, sodium hypochlorite
P-203	Fluoride Pump	Metering pump, hydrofluosilicic acid
LT-201	Coagulant Tank Level	2,500 gallon poly tank
LT-202	Hypochlorite Tank Level	5,000 gallon poly tank
LT-203	Fluoride Tank Level	1,500 gallon poly tank

Area 500 - Filtration

Four identical dual-media (anthracite/sand) gravity filters. Tag pattern: FILT{n} where n = 1–4.

Tag Pattern	Description	Type
FILT{n}_HeadLoss	Filter differential pressure	Analog, 0-10 PSI
FILT{n}_Turbidity	Filtered effluent turbidity	Analog, 0-5 NTU
FILT{n}_InService	Filter in-service status	Digital
FILT{n}_Backwashing	Backwash in progress	Digital
FILT{n}_Valve	Effluent valve position	Analog, 0-100%

Backwash trigger: HeadLoss > 8.0 PSI or operator-initiated. Cycle: ~15 min. Only one filter may backwash at a time.

Area 600 - Disinfection and Clearwell

Tag	Equipment	Description
AIT-601	Free Chlorine Analyzer	Post-chlorination residual, Hach CL17sc
AIT-602	pH Analyzer	Finished water pH, Hach pHD sc
AIT-603	Turbidity Analyzer	Finished water turbidity, Hach TU5400sc
LT-601	Clearwell Level	0.5 MG clearwell, ultrasonic level

Water Quality Compliance Limits

Per TCEQ and EPA Surface Water Treatment Rule:

Parameter	Tag	Warn Lo	Warn Hi	Crit Lo	Crit Hi	Unit
Finished Water Turbidity	AIT-603		0.3		1.0	NTU
Filter Turbidity (each)	FILT{n}		0.15		0.5	NTU
Free Chlorine Residual	AIT-601	0.2	3.5	0.1	4.0	mg/L
Finished Water pH	AIT-602	6.5	8.5	6.0	9.0	
Clearwell Level	LT-601	25%	95%	15%	98%	%
Chemical Tank Levels	LT-201,2,3	15%		10%		%

Process Notes for SCADA Configuration

1. **Chemical Dosing:** Coagulant (alum) dose rate is flow-paced from FT-101. Pre-chlorination is operator-adjusted. Fluoride is flow-paced with manual trim.
2. **Filter Backwash:** Only one filter may backwash at a time. Sequence takes ~15 minutes. Remaining three filters handle full plant flow.
3. **ML Opportunity:** Filter headloss rate and post-sedimentation turbidity are early indicators of raw water quality changes. Predictive monitoring could enable proactive chemical dose adjustment.

4. **Historian Requirements:** All analog process variables historized with appropriate deadband. Digital status on-change. Minimum 1-year retention for regulatory compliance.

Data Source Strategy for the Demo

Source	Status	Purpose
Value Simulator	ENABLED	Drives all live data during demo — makes dashboard come alive
Allen-Bradley ControlLogix	Configured, channel DISABLED	Shows AI correctly mapped tags from L5K file (no physical PLC)

In this section...
