



Setting the Standard for Automation™

**Where your Drinking Water
Comes from...**

**(and how it all relies on
industrial automation systems)**

Graham Nasby
City of Guelph Water Services
Guelph, Ontario, Canada

ISA Toronto – Annual General Meeting (AGM)
May 30, 2019 – Toronto, Ontario, Canada

About the Speaker



Graham Nasby, P.Eng., PMP, CAP
Water SCADA & Security Specialist
City of Guelph Water Services



- 10 years in the consulting sector
- Joined Guelph Water Services in 2015
- Vice-President of Industries & Sciences in ISA
- Co-chair of ISA112 SCADA Systems standards committee
- Voting member of ISA101 HMI Design and ISA18 Alarm Management standards committees
- Named Canadian Expert on IEC/SCC-TC65 with Standards Council of Canada
- Active member of American Water Works Association and Water Environment Federation
- WebMaster for ISA Hamilton Section
- Has published over 40 papers and articles on automation topics
- Received University of Guelph “Mid Career Achievement Award” in 2014
- Named ISA’s technical division leader of the year award in 2013.
- Contact: graham.nasby@guelph.ca

Presentation Outline



- About Guelph Water Services
- Components of a Municipal Water System
- Operational Framework
- Managing a Drinking Water System
- Water Sources
- Water Treatment
- Water Distribution
- Municipal Water SCADA Systems
- Components of a typical SCADA System



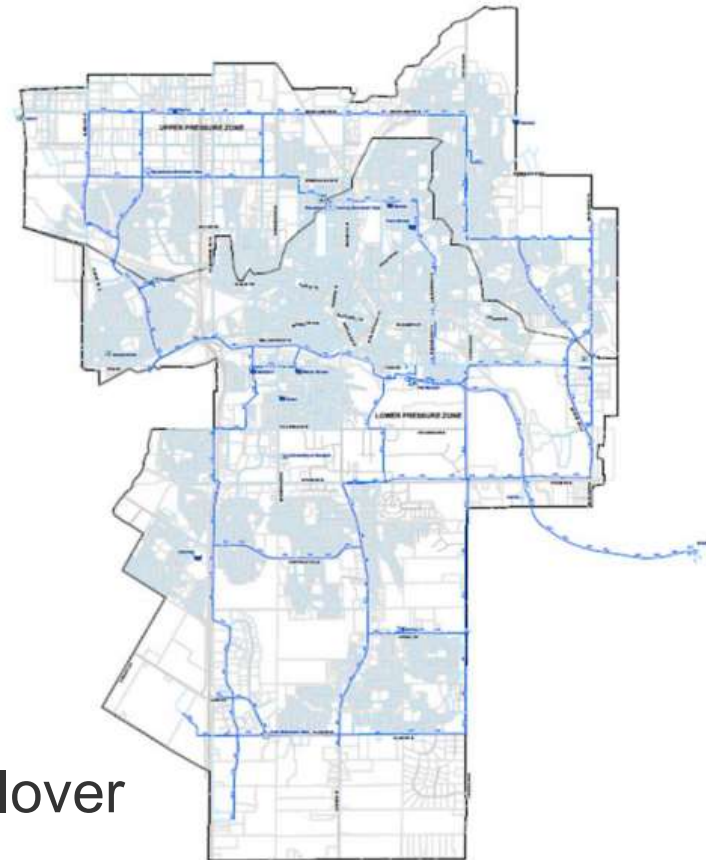
City of Guelph Water Services

- Guelph, Ontario, Canada
- 140,000 residents
- 21 groundwater wells
- 3 water towers
- 549 km of water mains
- 49,000 service connections
- 2,750 fire hydrants
- 46,000 m³/day [12 MGD]



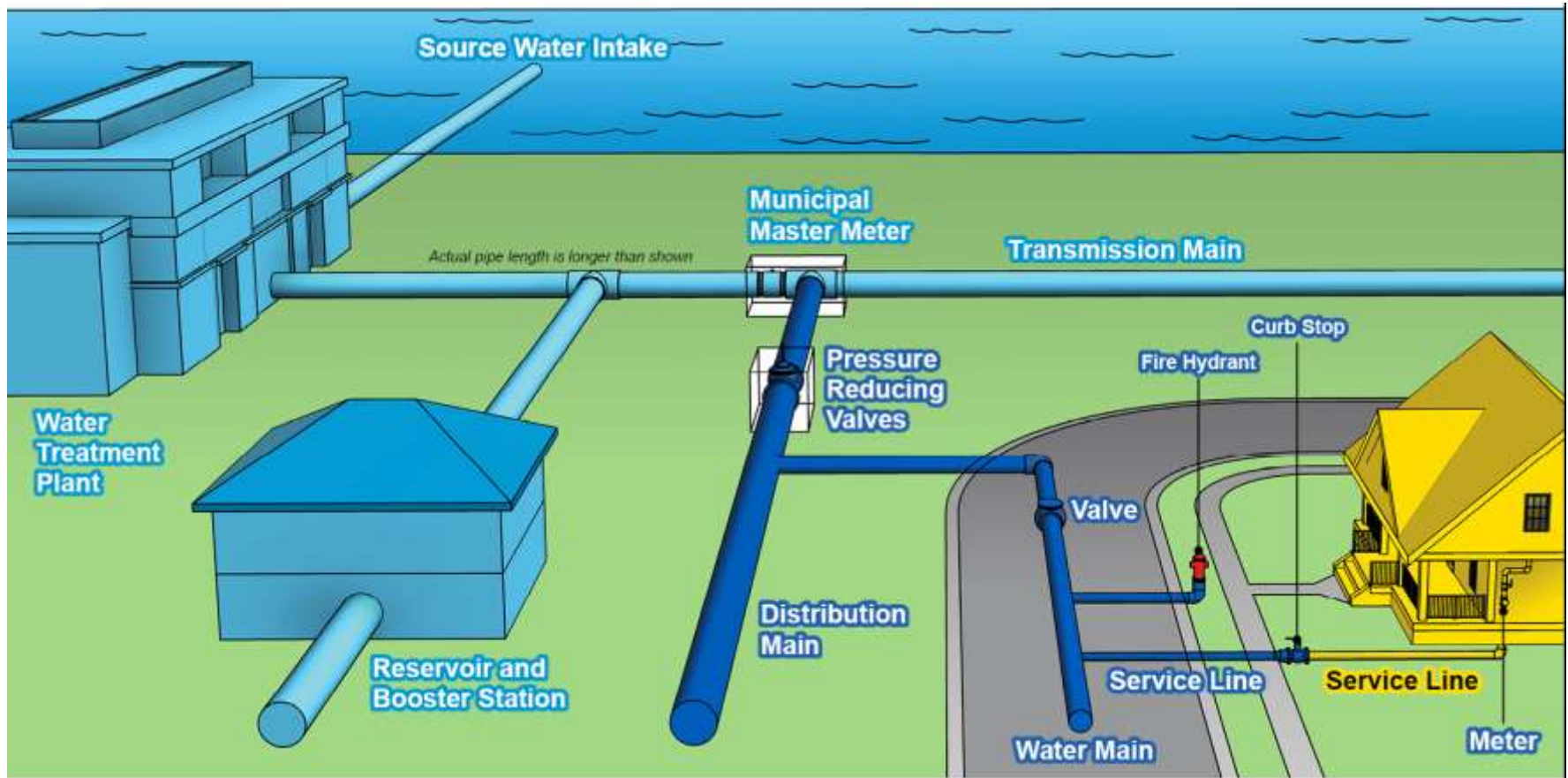
Guelph Water Facilities

- Approx. 15km x 15km (10mi x 10mi)
- 35 Facilities
 - 4 booster stations
 - 21 wells
 - 2 valve chambers
 - 3 water towers
 - 5 monitoring sites
- High availability SCADA network
 - Primary: private fibre optic
 - Secondary: private wireless, auto-failover
- 40 PLCs plus 2 data centers

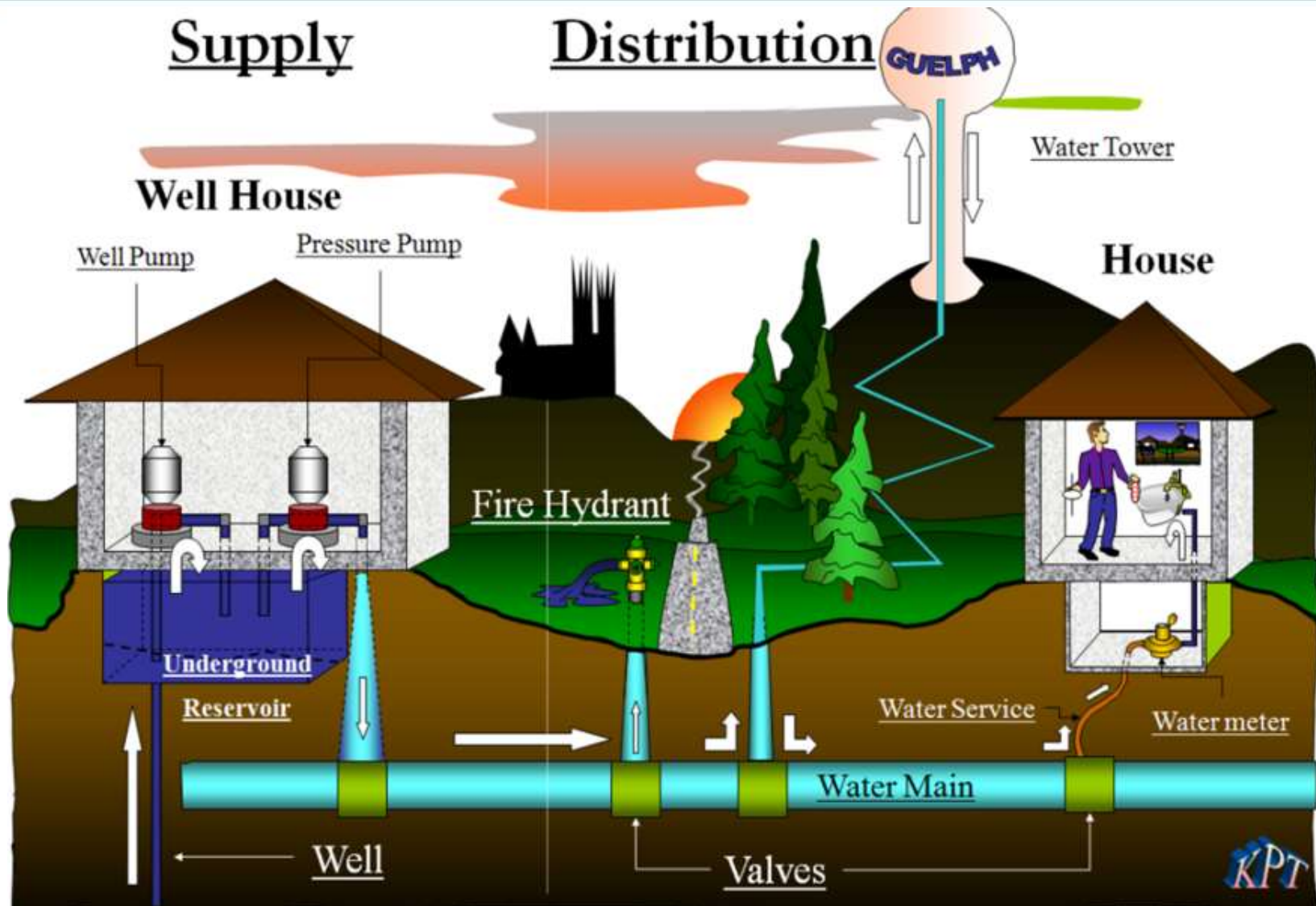


Introduction

Typical Surface Water System



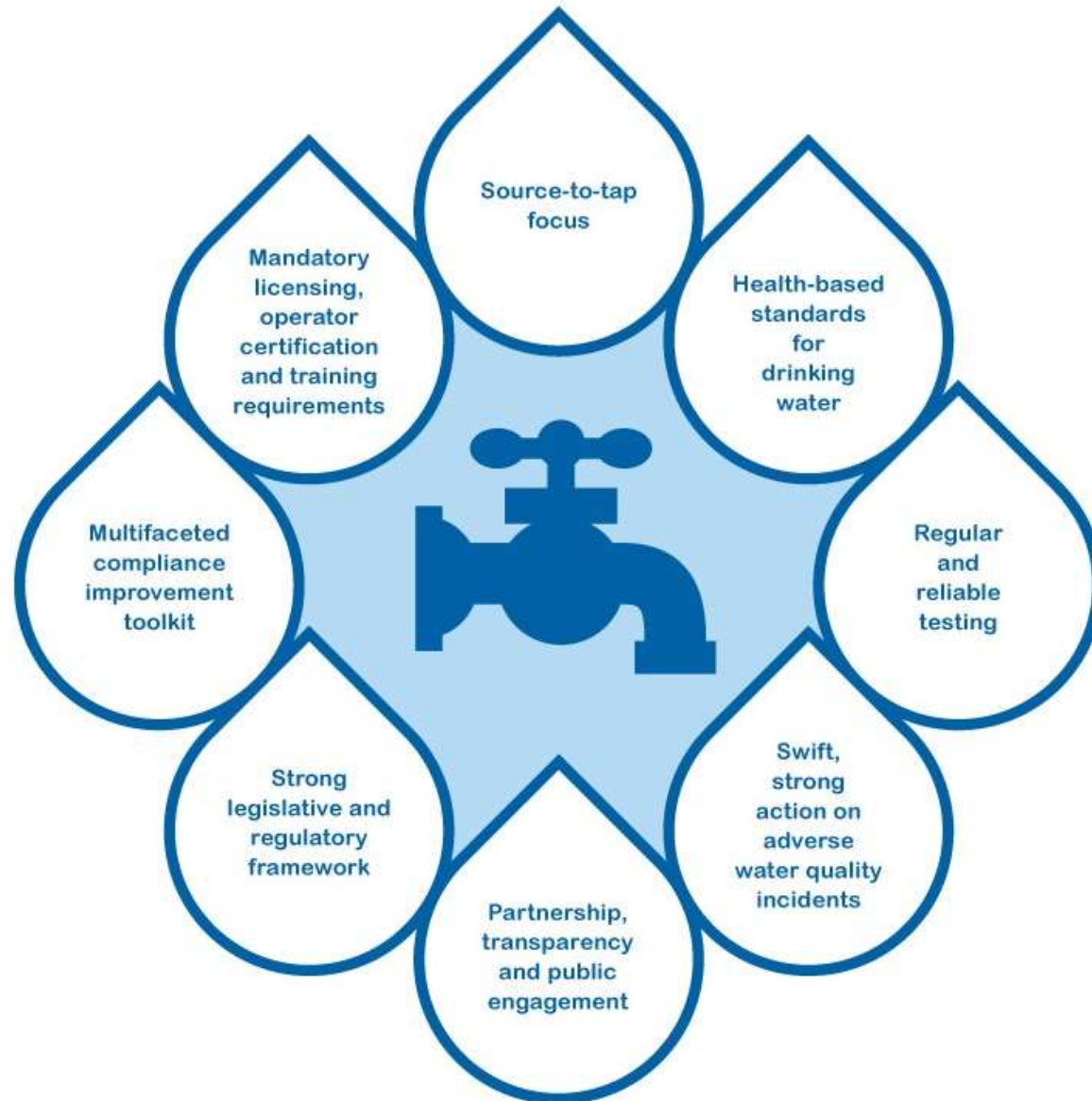
Typical Groundwater System



Components of a Drinking Water System

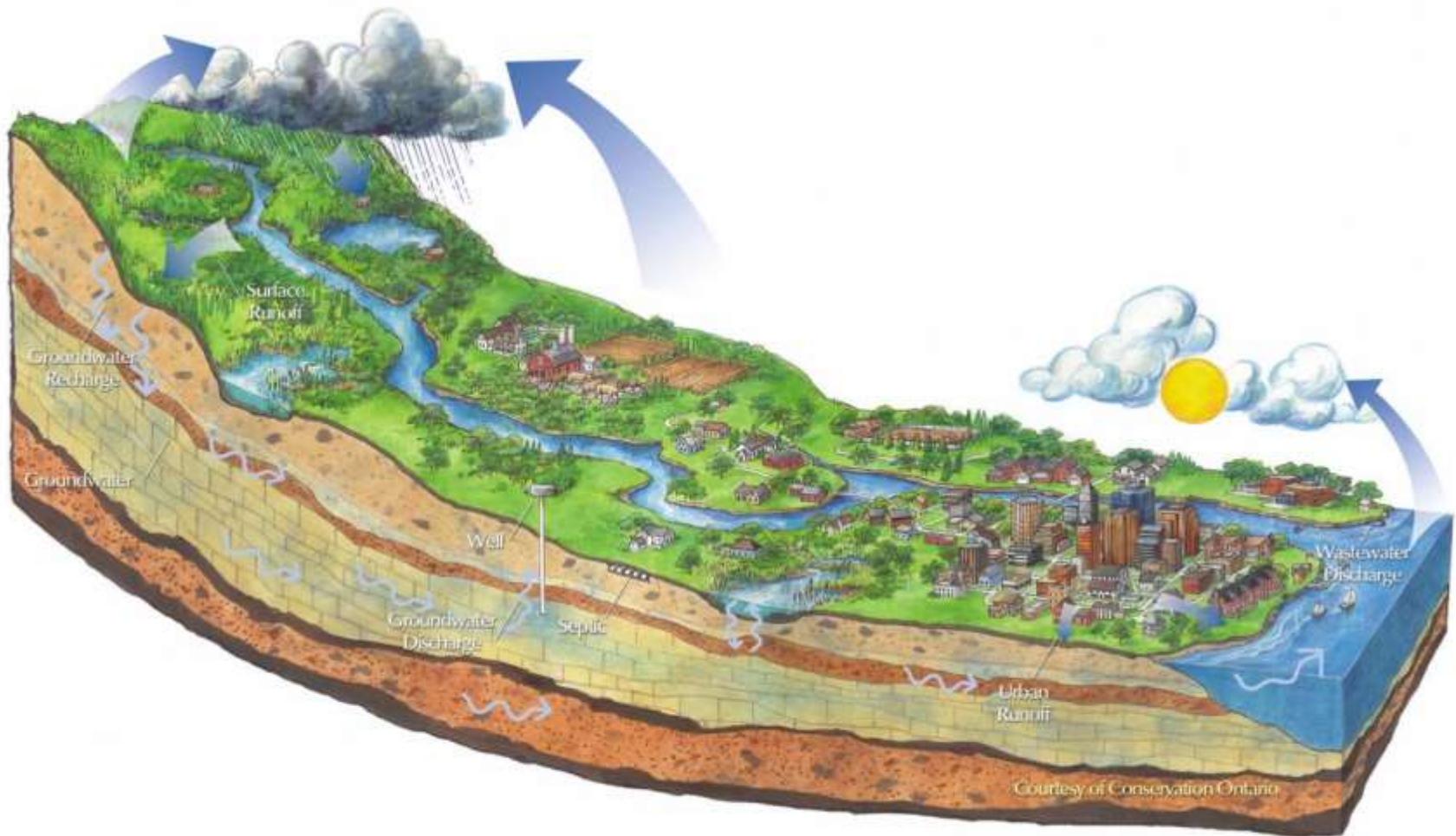


Operational Framework



Source Water

Water Cycle



Source Water

Surface Water – A Typical Watershed



Surface Water River Source



Surface Water River Source



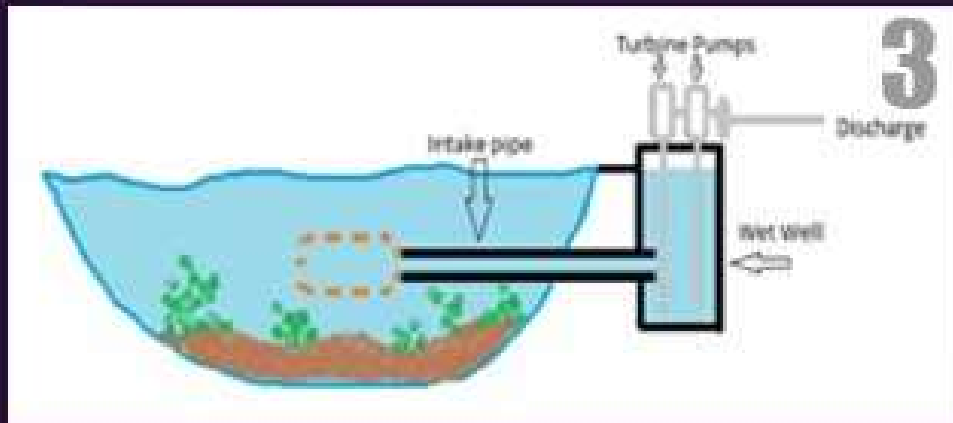
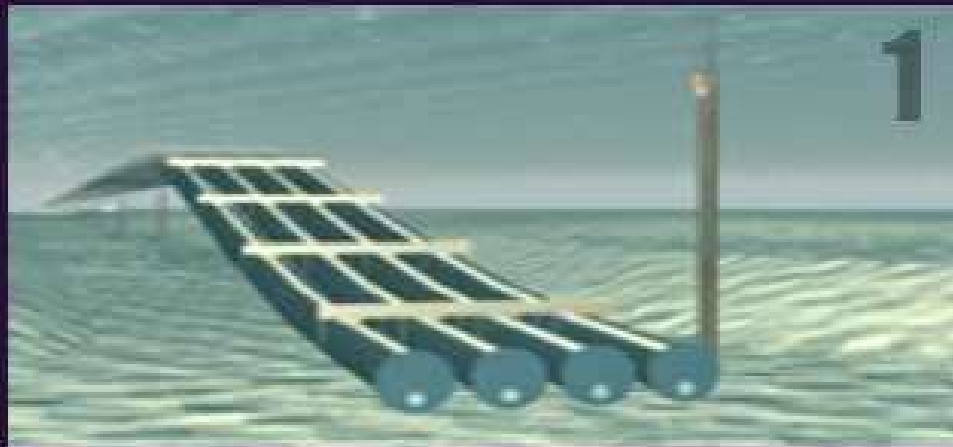
Surface Water Lake Source



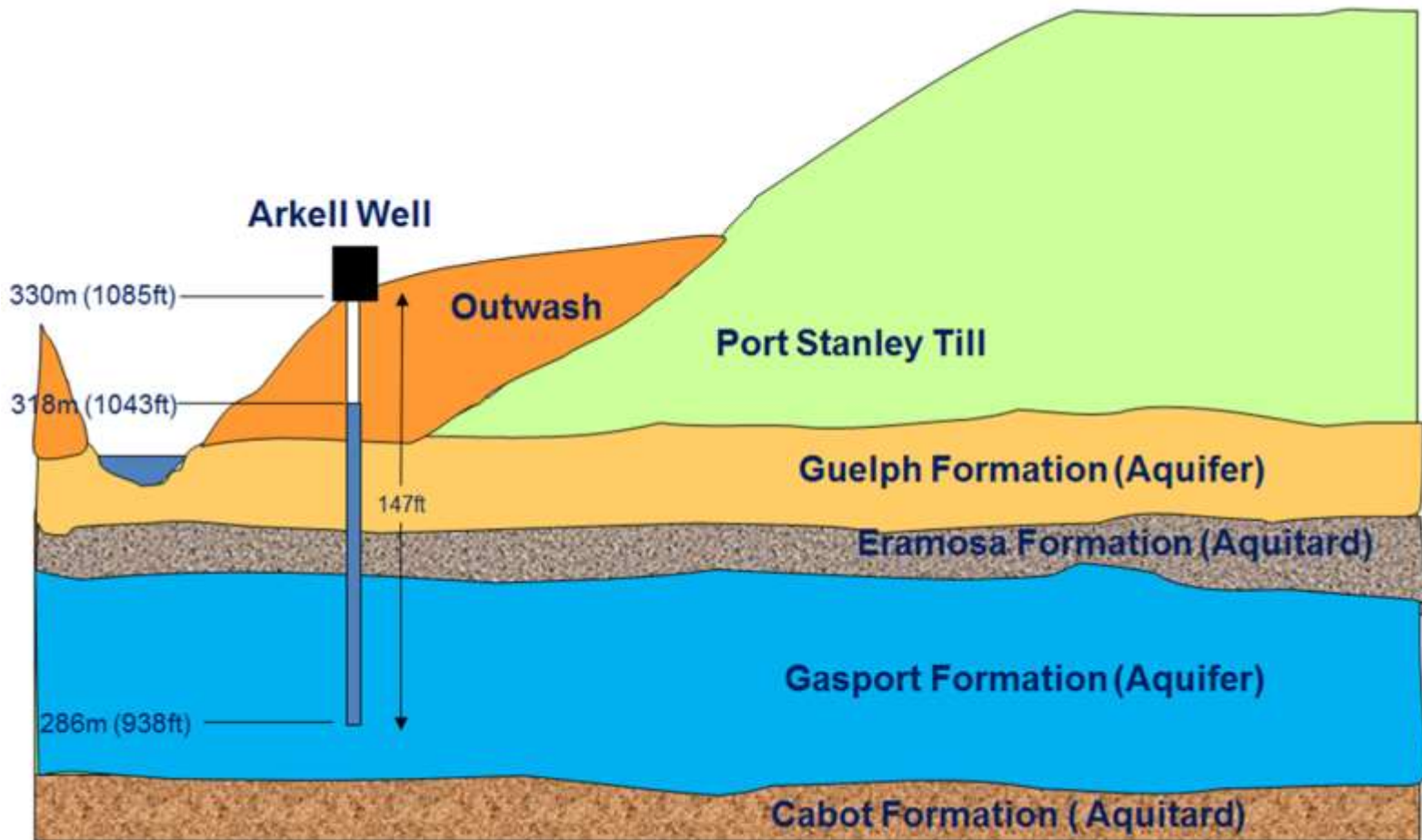
Surface Water Lake Source



Intake Structures for a Surface Water Source



Ground Water Source Example



Groundwater – Typical Well Pumps

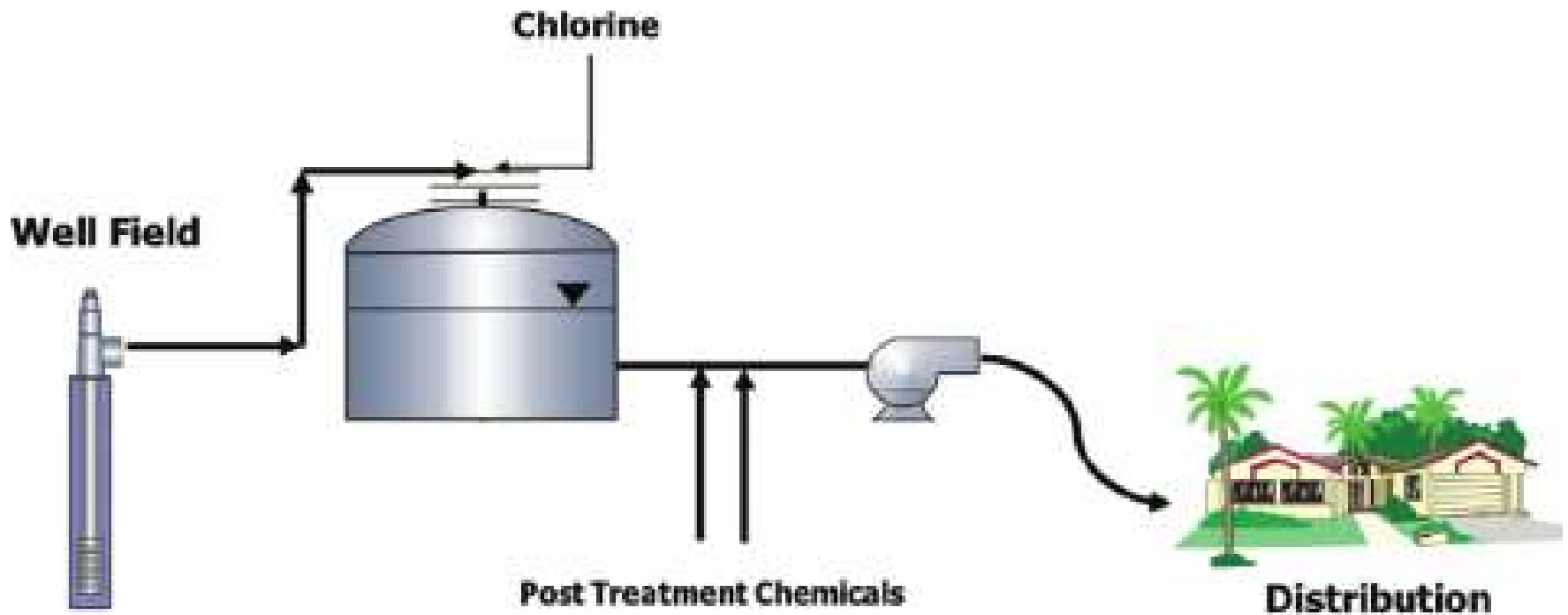


Groundwater Recharge System

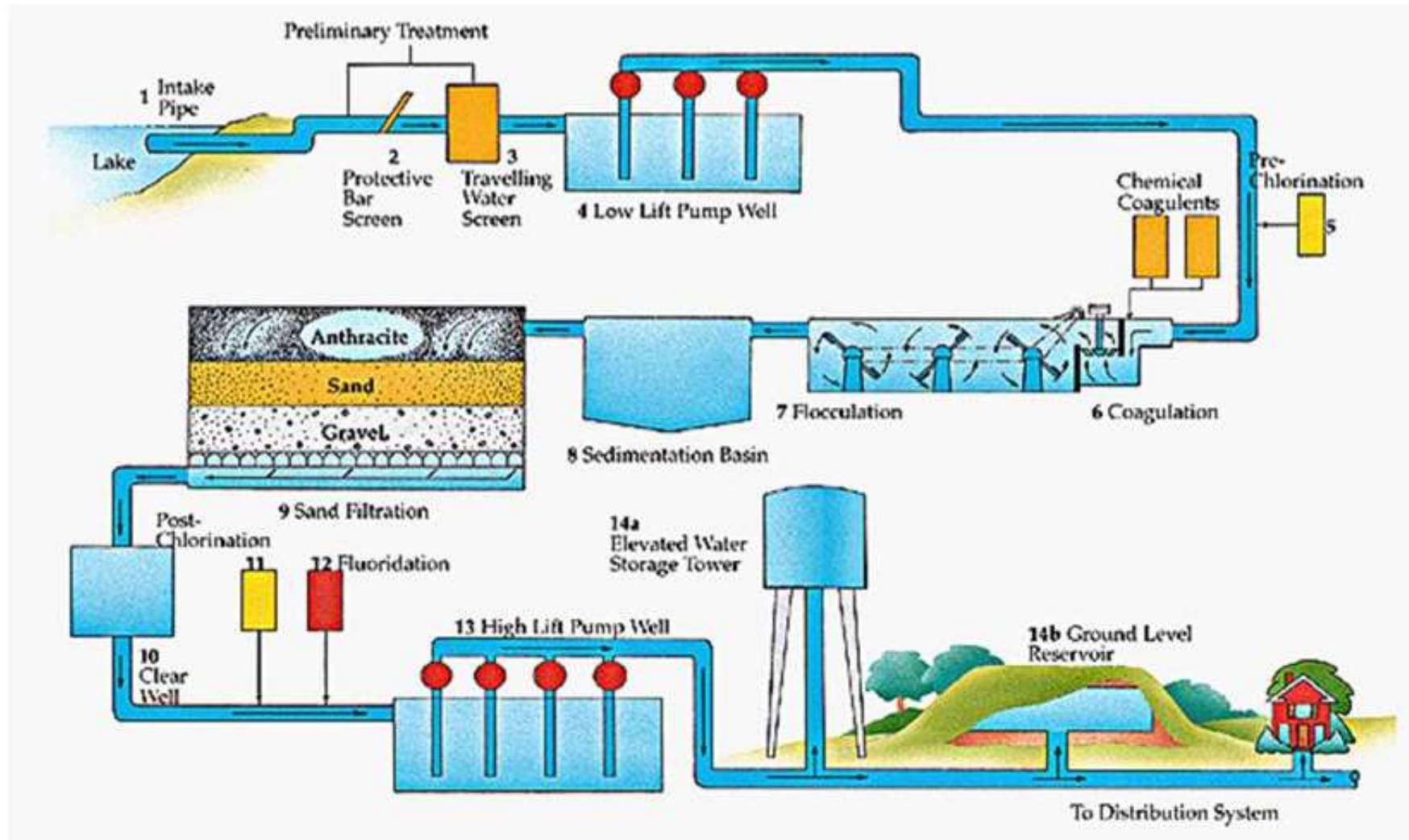


Water Treatment

Ground Water Treatment

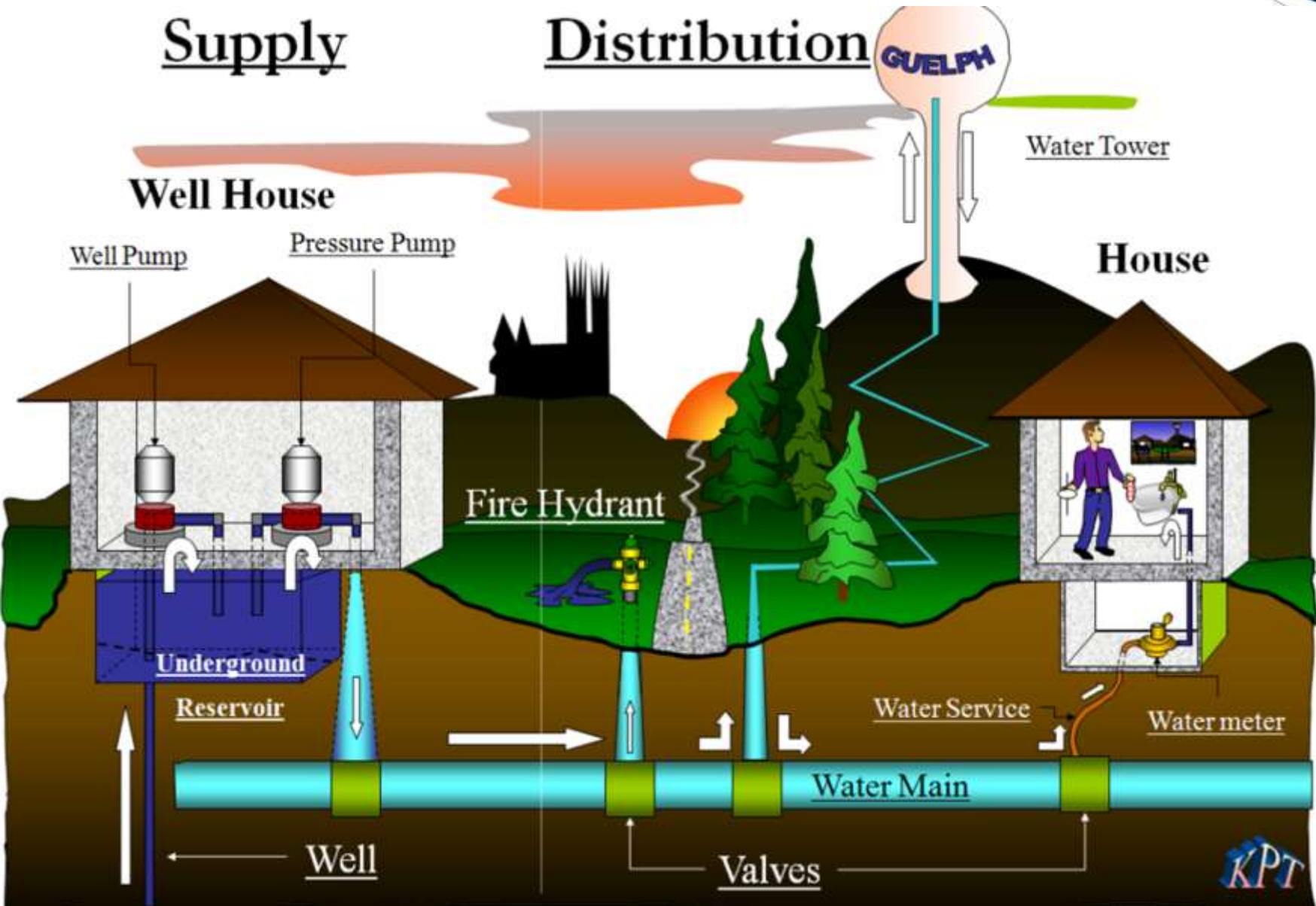


Surface Water Treatment (Conventional Filter Plant)

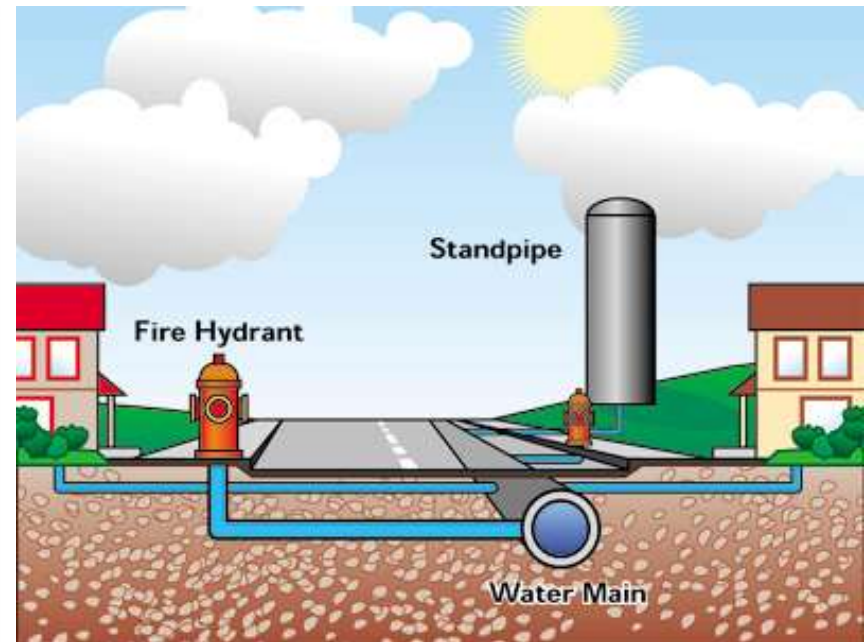
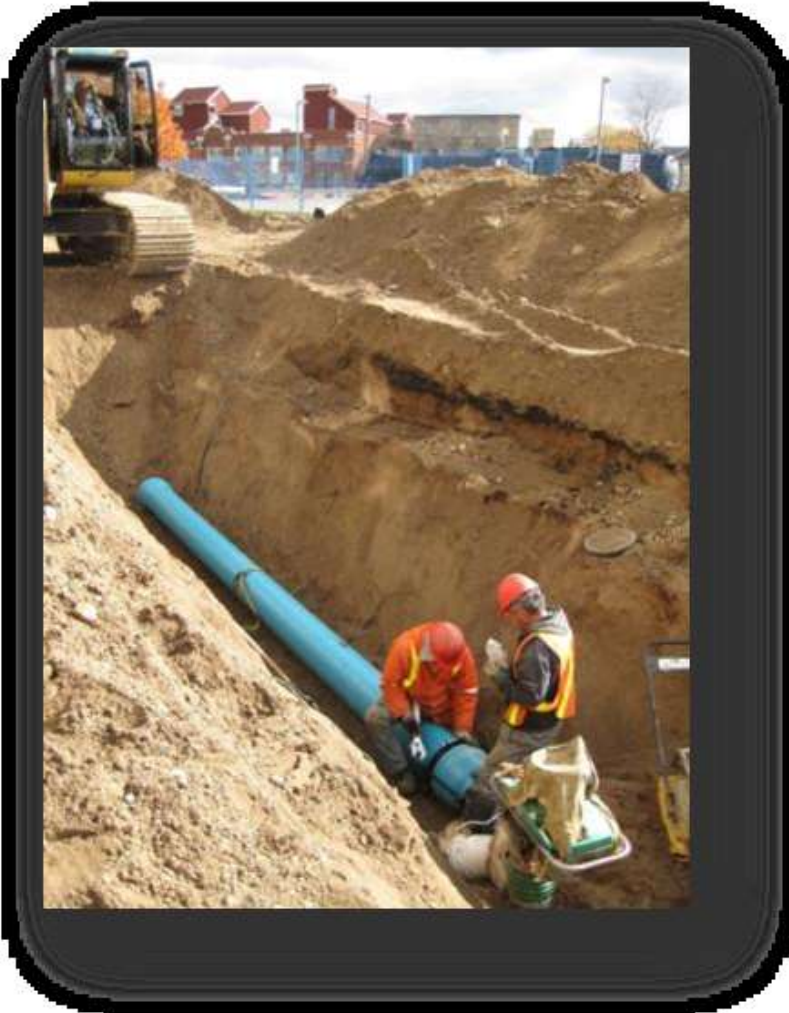


Water Distribution

Water Distribution Systems



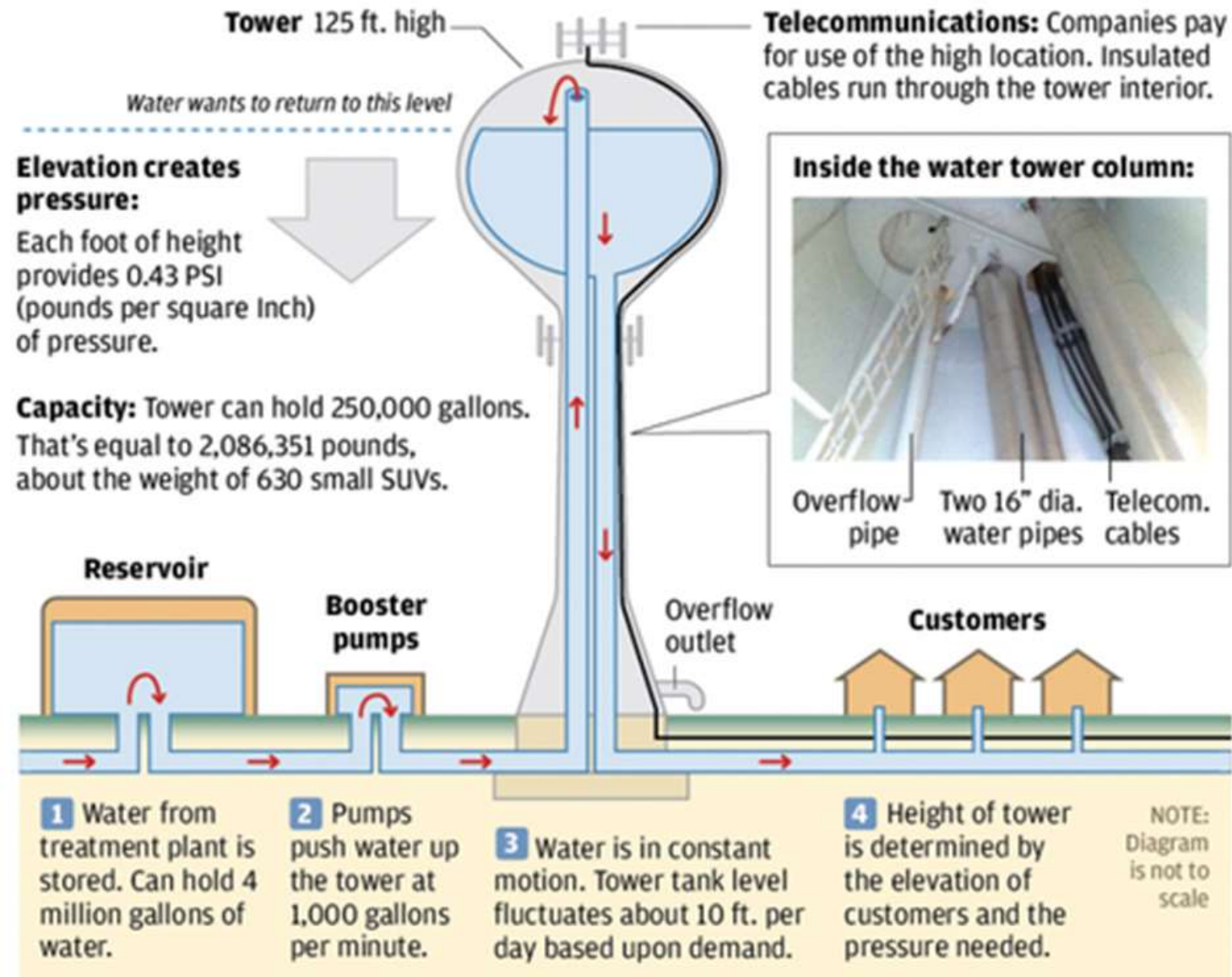
Water Distribution



Water Towers



HOW A WATER TOWER WORKS



Watermain Repairs



Automated Control Systems at Water Facilities

**Called “SCADA” in the Water sector
(SCADA = Supervisory Control and Data Acquisition)**

What is SCADA?

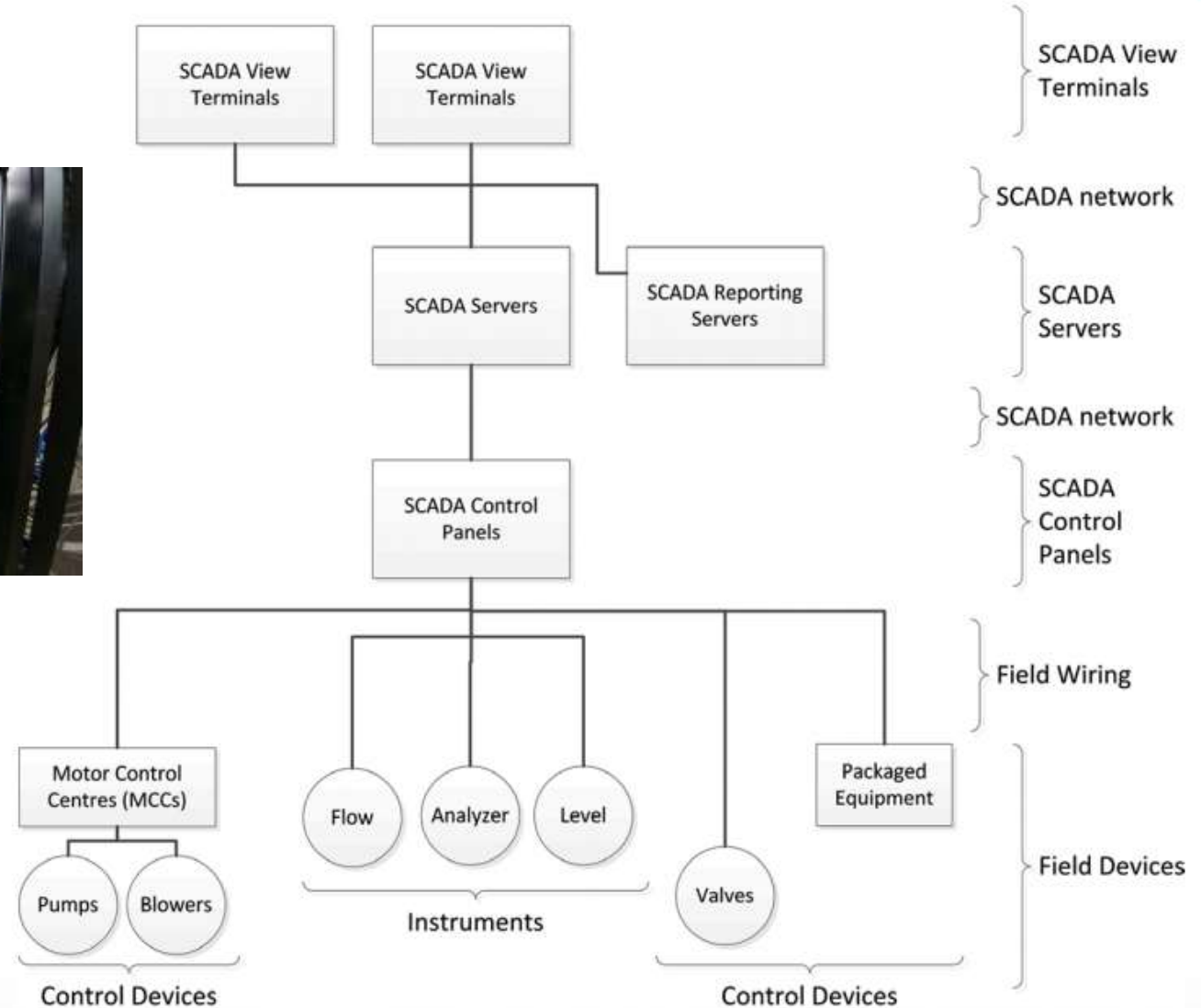


SCADA = Supervisory Control and Data Acquisition

Not SCADA



Typical SCADA Architecture



Why we have SCADA systems

- Unattended automatic control of water facilities
- Logging of critical control parameters
 - Chlorine Residuals (e.g., every 5 minutes)
 - Turbidity
 - Well Flow Rates & Daily Flow Totals
 - POE Flow Rates & Daily flow Totals
 - Tower Levels & Pressure
- Provides “visualization” of water facilities to Operators
- Enables remote monitoring and control by Operators
- Triggering and Annunciation of Alarms
- Automated responses (increase chlorine dose, shutdown, etc.)
- Reporting based on logged process data



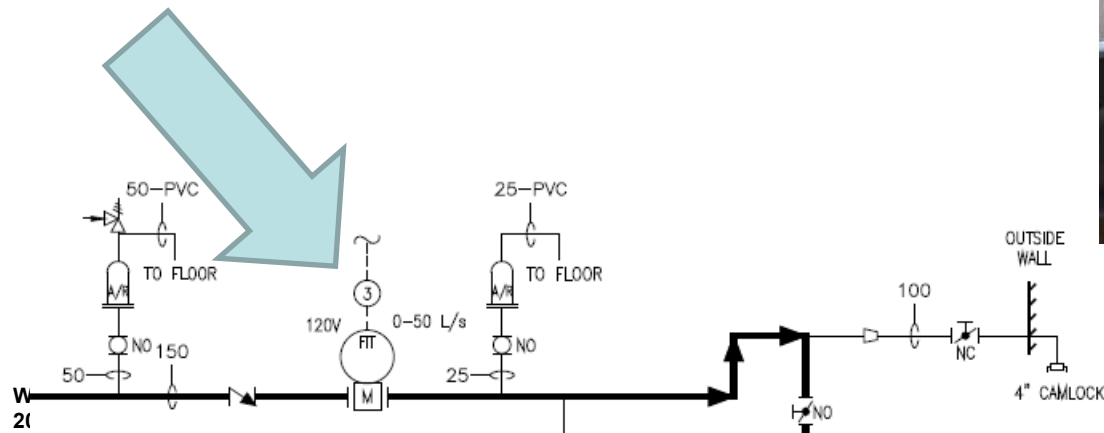
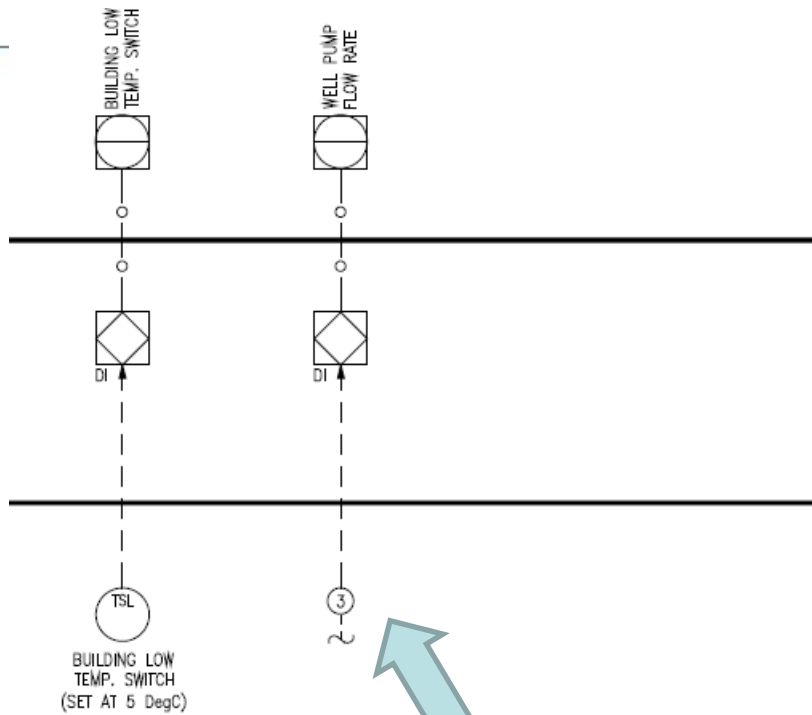
SCADA View Terminal



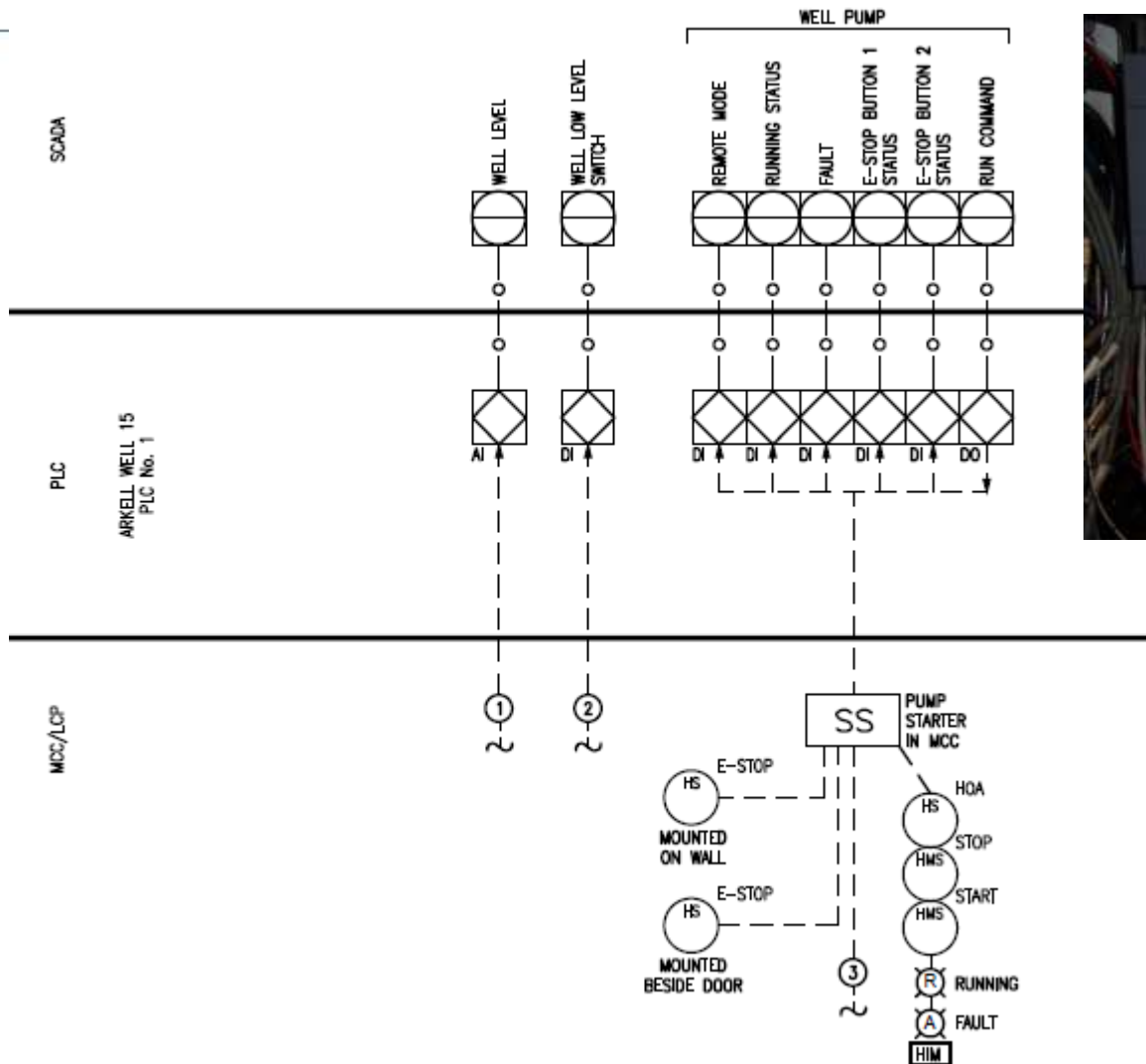
More Heavily Used SCADA View Terminals



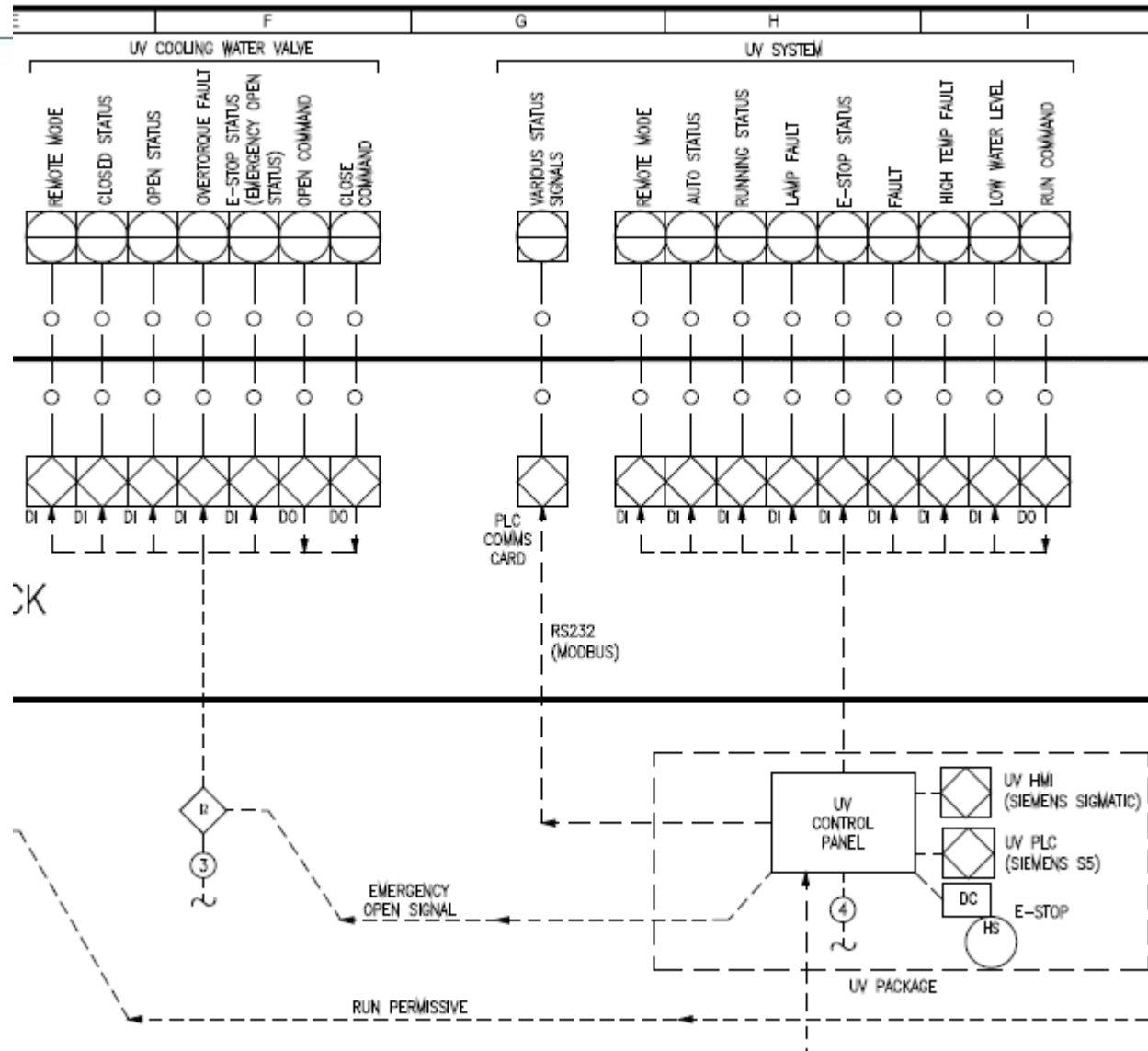
I/O Level - Instrumentation



I/O Level - Pumps



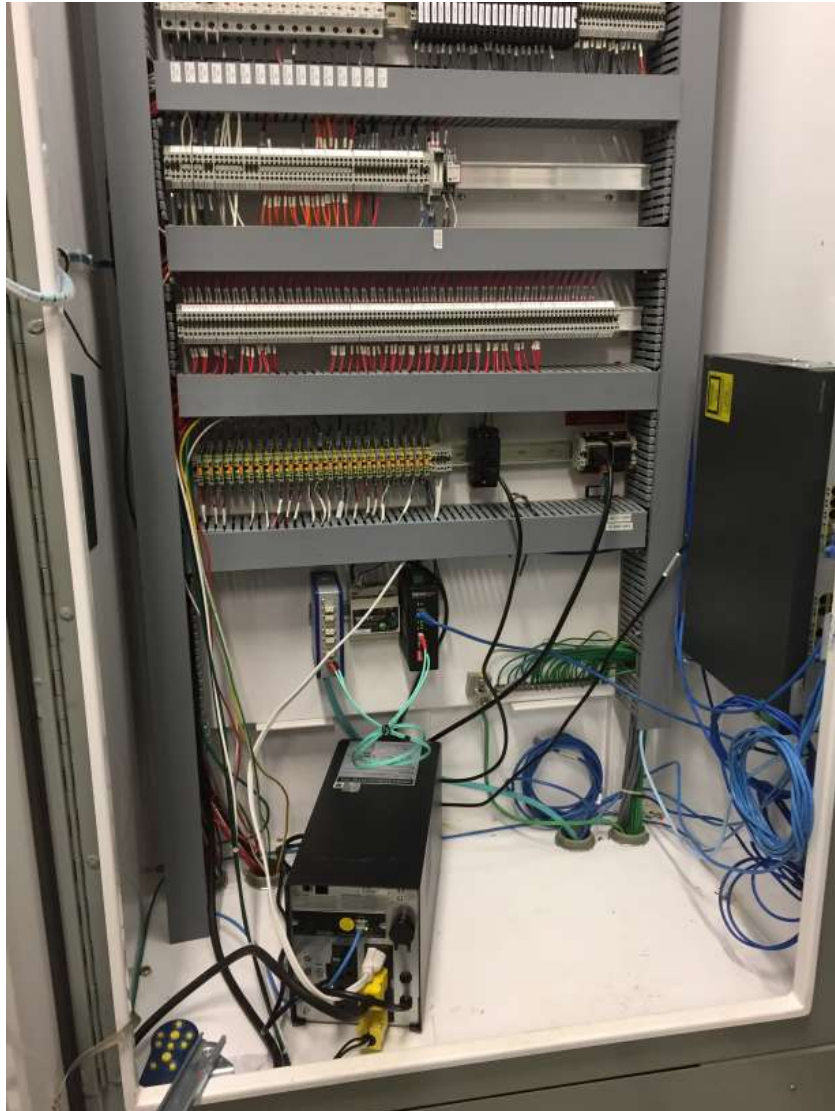
I/O Level – a more complicated example



UV Reactor



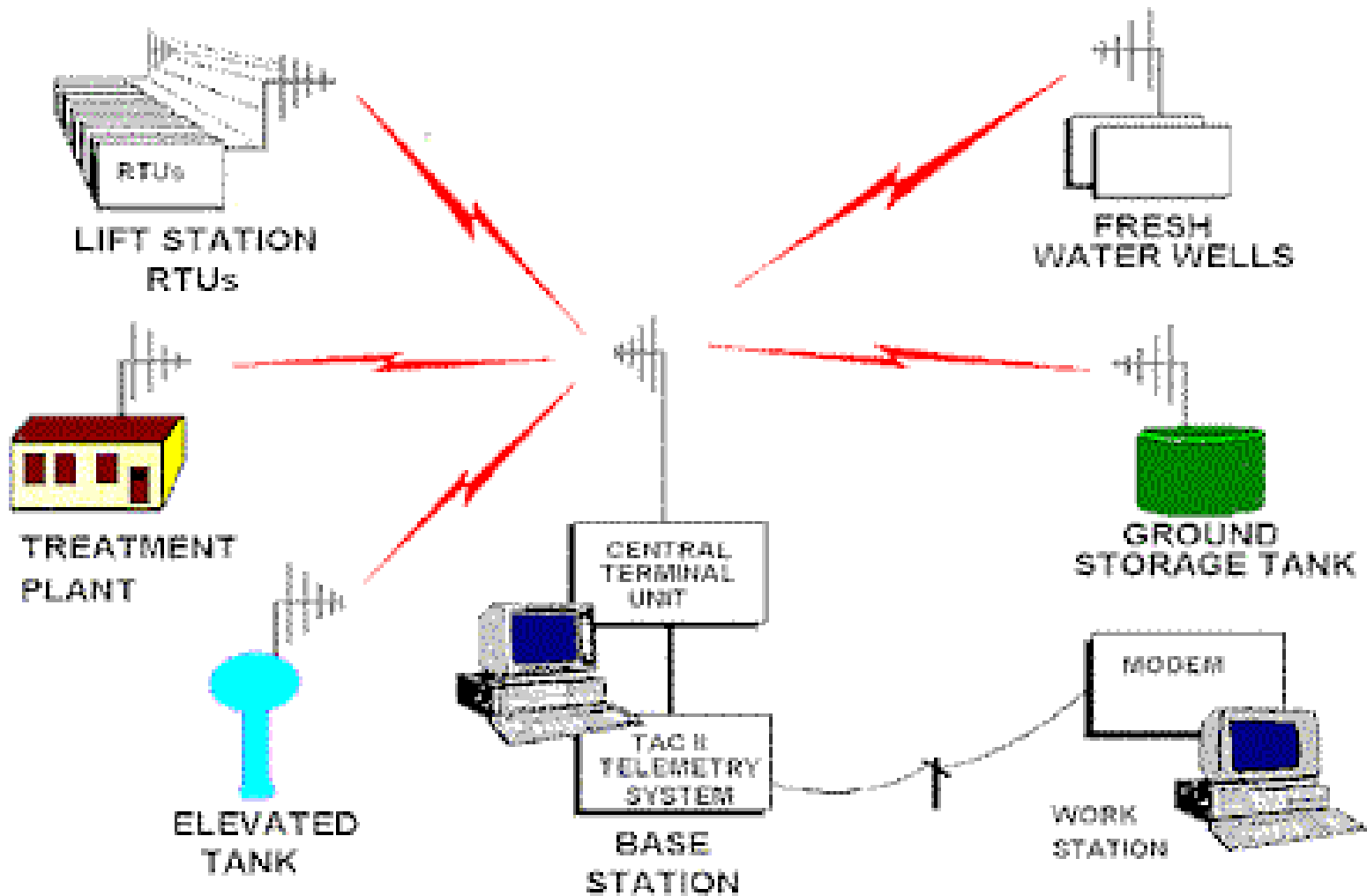
PLC Control Panels



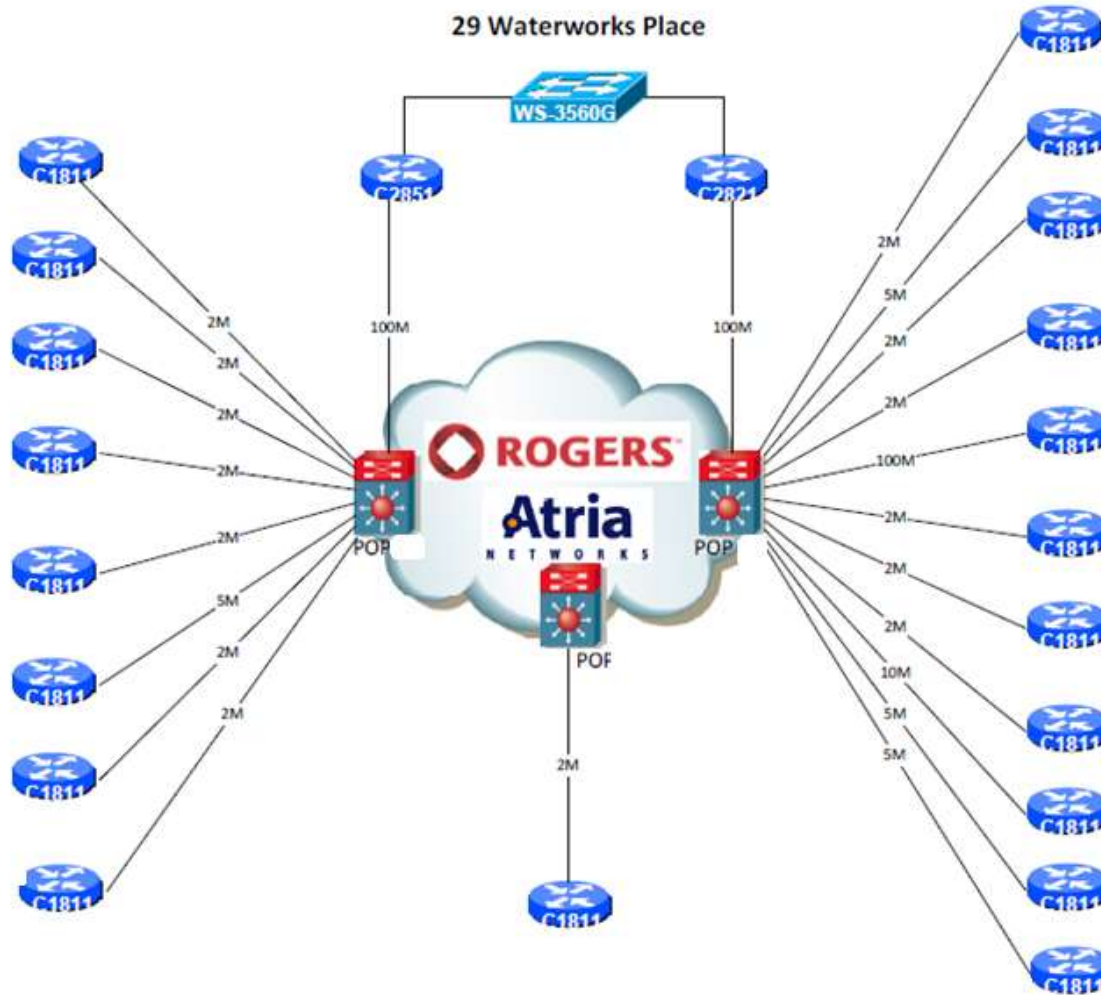
PLCs – Old and New Technology



SCADA Network

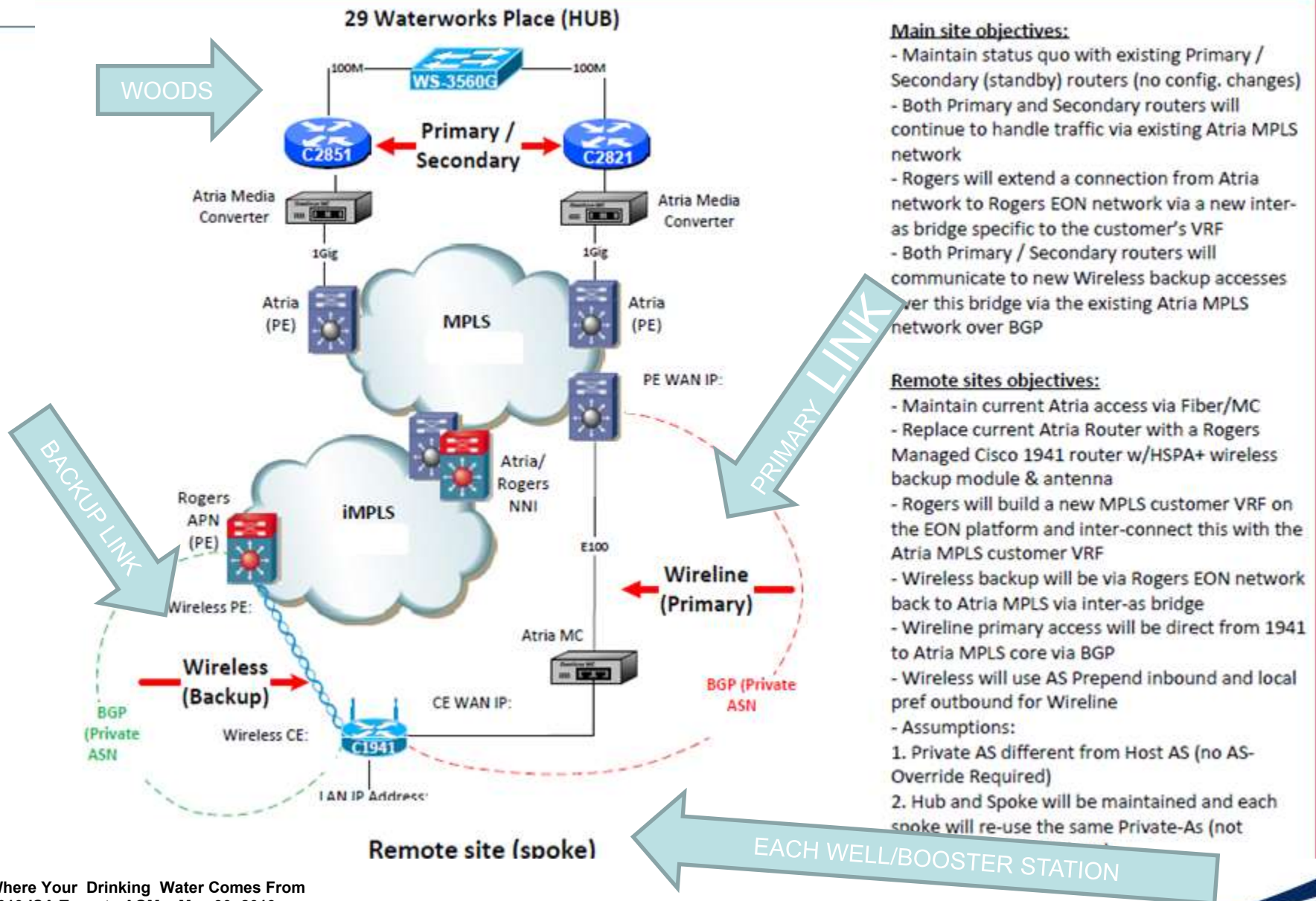


SCADA Network (Fibre optic example)



Example: Guelph Water SCADA Network

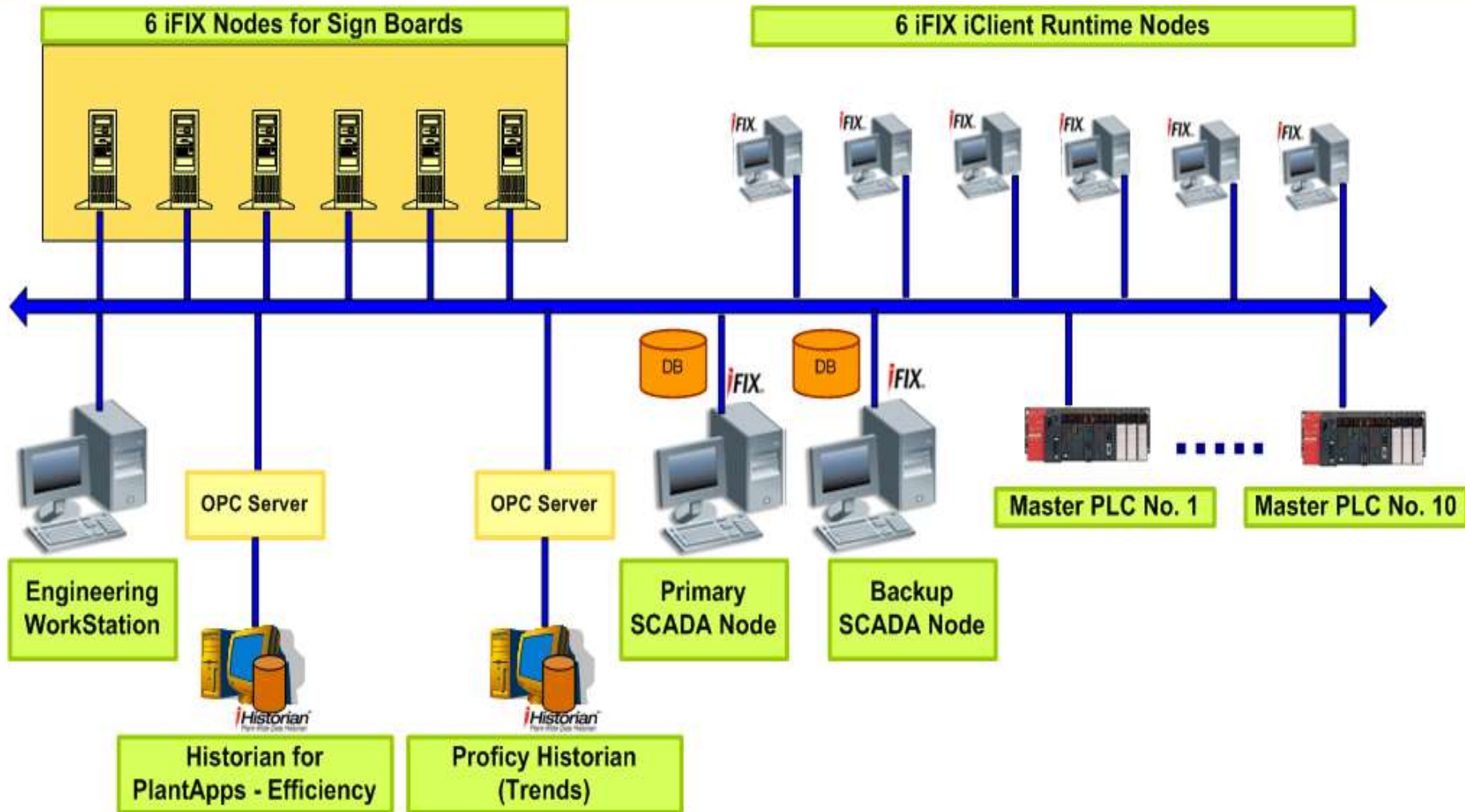
Fibre-topic network with automatic fail-over to Wireless backup



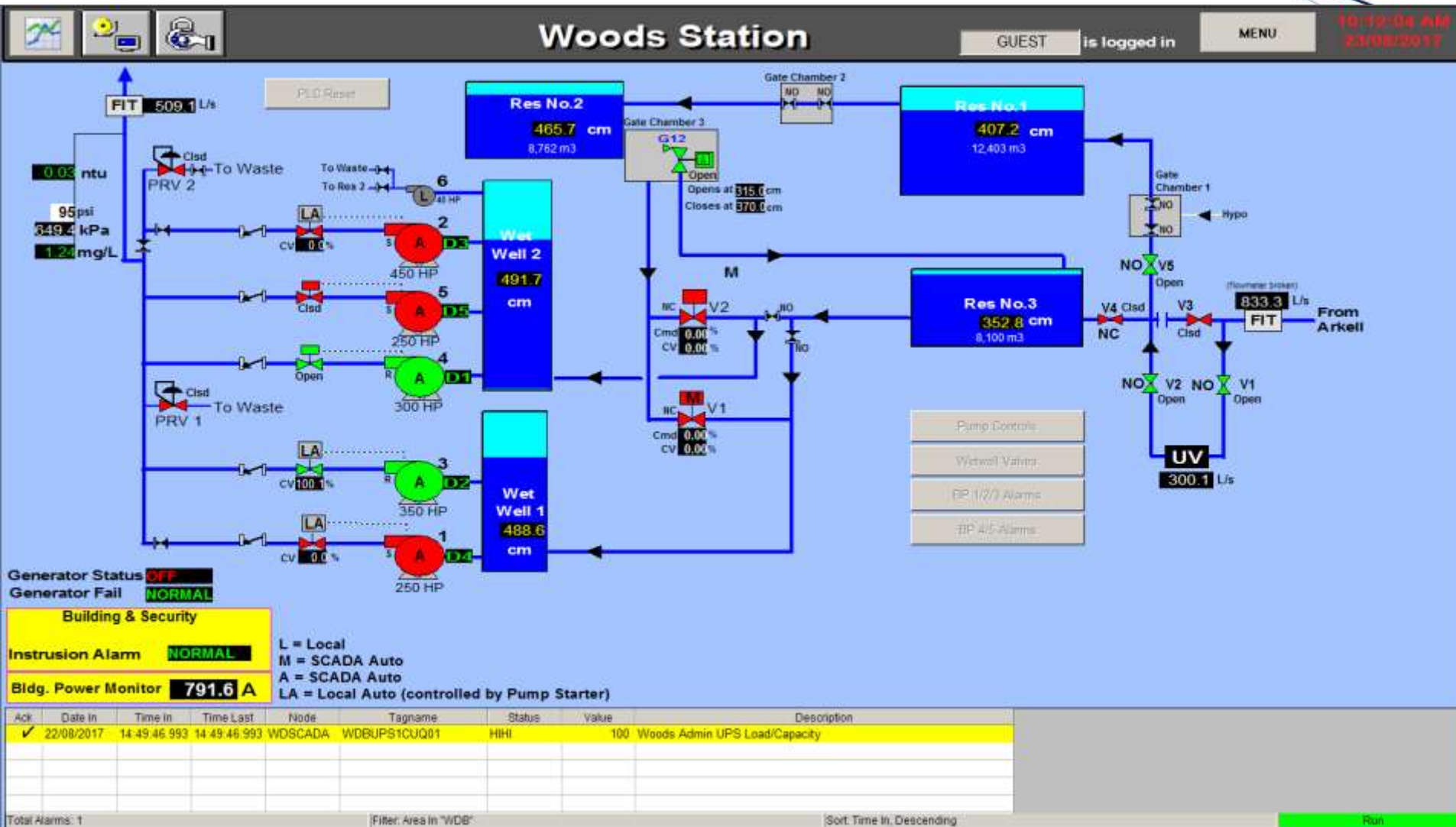
SCADA Servers



SCADA Servers - Example



SCADA Screens



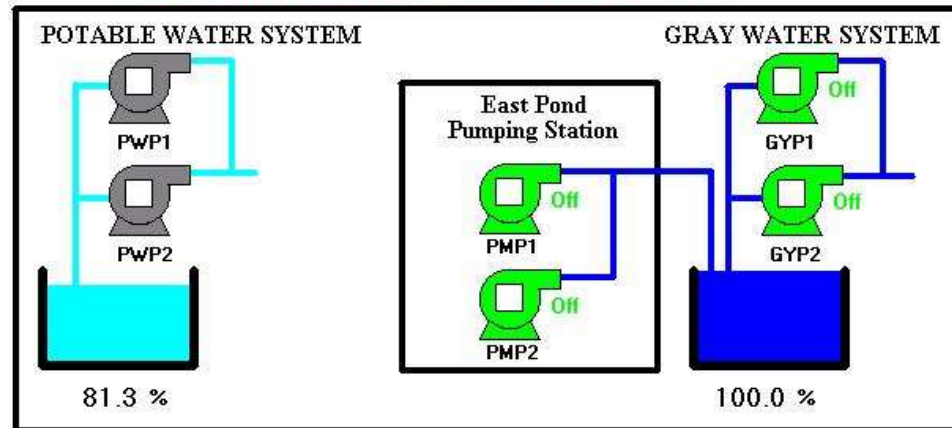
HMI = Human Machine Interface



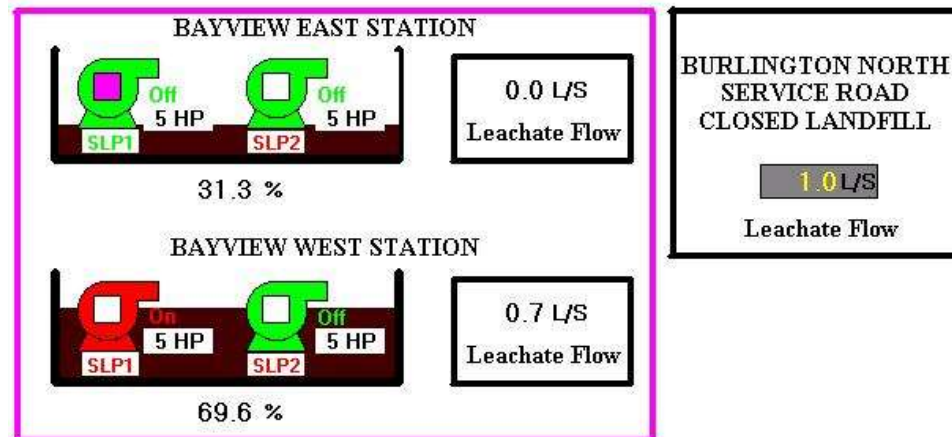
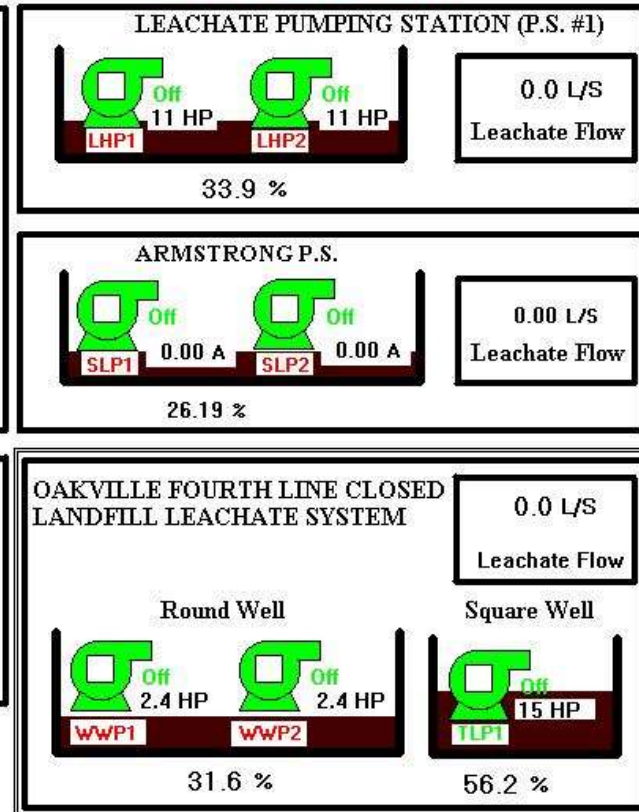
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Screens – another example

HALTON WASTE MANAGEMENT SITE DIAGRAMS



REMOTE SITE DIAGRAMS



Jul 30	13:13:02	EVENT	DDE	604	BWWSLP1DMDI_SS	Bayview West SLP1 Running Status	ON
Jul 30	13:08:21	EVENT	DDE	99	M11LHP2DM#SP	Leachate Pump #2 Float Stop Command	Off
Jul 30	13:06:00	EVENT	DDE	604	BWWSLP2DMDI_SS	Bayview West SLP2 Running Status	OFF
Jul 30	13:06:00	EVENT	DDE	600	BWWDY1DPAI_CV	Bayview West SLP Duty 1 Current	1

Alarm System & Call Out Alarms

WIN-911 Log Viewer (Active)

Live Historical

Drag a column header and drop it here to group by that column

State	Most Recent Event	Alarm Point	Condition	Source Type
	10/30/2013 9:19:30 AM	Tank Pump	Pump is on	OPCDA
	10/30/2013 9:15:39 AM	Gate Valve	Closed	OPCDA
	10/29/2013 3:15:59 PM	Hopper 1	LO	ifix

View alarm details

Digital Definition to Edit (1 of 69)

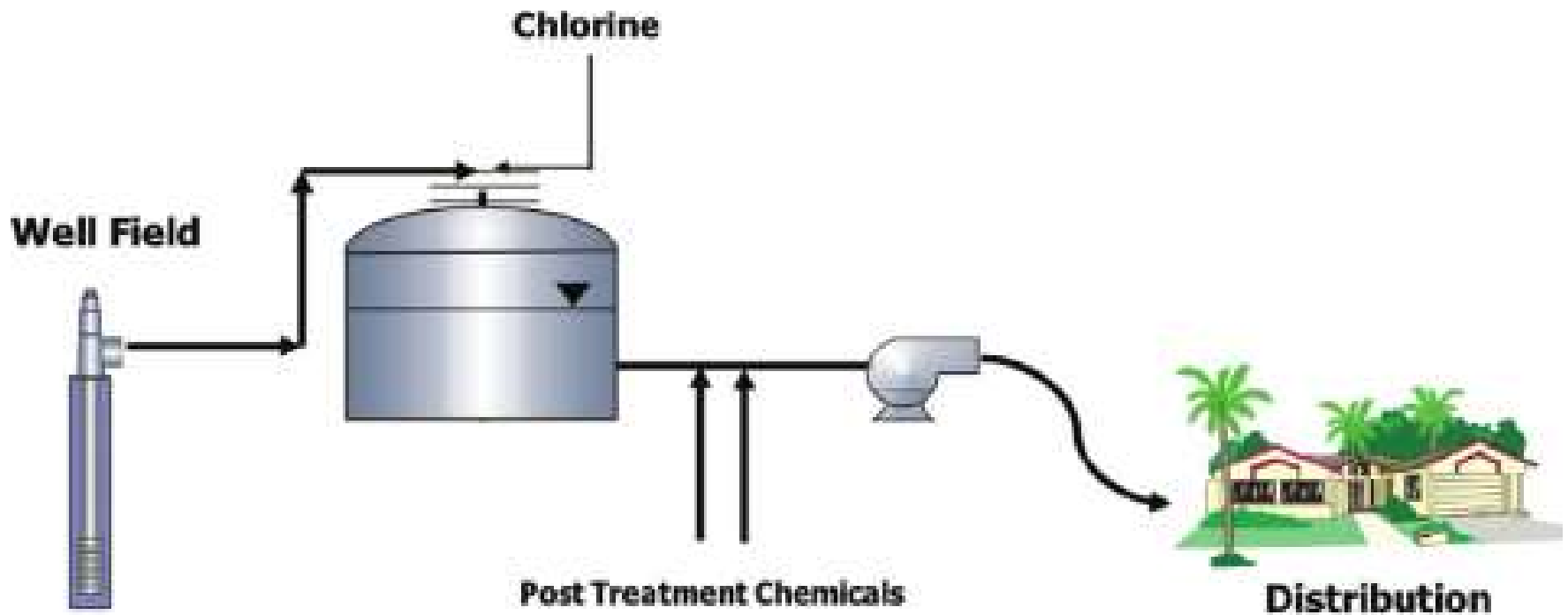
Group: All Groups

Tagname	Description	Group name	Tag Sound	Use Tagname	Use Is/Was	Auto Ack	Access Name
GC1_TIT_AH	Glycol Regenerator Temp - A	Call Out	Glycol Regenerator Temp - Alarm High	X	X	Never	InTouch Direct Connect
GC1_TIT_AL	Glycol Regenerator Temp - A	Call Out	Glycol Regenerator Temp - Alarm Low	X	X	Never	InTouch Direct Connect
Chrom_SD_FF2	Gas Chromatograph - Shutdo...	Call Out	Gas Chromatograph - Shutdown - FF2	X	X	Never	InTouch Direct Connect
CSG_PSH	Casing Gas Pressure - Safety	Call Out	Casing Gas Pressure - Safety High	X	X	Never	InTouch Direct Connect
CSG_Valves_PSL	Casing Gas Valves - Well Cel...	Call Out	Casing Gas Valves - Well Celler - Pilot Pressure	X	X	Never	InTouch Direct Connect
E14_Aux	GC2 Discharge Fin Fan - Ru...	Call Out	GC2 Discharge Fin Fan - Run Status	X	X	Never	InTouch Direct Connect
E1A_E1B_Aux	West Fin Fan - Run Status	Call Out	West Fin Fan - Run Status	X	X	Never	InTouch Direct Connect
E1C_E1D_Aux	East Fin Fan - Run Status	Call Out	East Fin Fan - Run Status	X	X	Never	InTouch Direct Connect
E6_PIT_AH	Rething Fin Fan Press - Alarm	Call Out	Rething Fin Fan Press - Alarm High	X	X	Never	InTouch Direct Connect
E6_PIT_AL	Rething Fin Fan Press - Alarm	Call Out	Rething Fin Fan Press - Alarm Low	X	X	Never	InTouch Direct Connect
Fire_System_Aln	Fire System	Call Out	Fire System Alarm	X	X	Never	InTouch Direct Connect
GateBuzzer	Gate Buzzer	Call Out	Gate Buzzer	X	X	Never	InTouch Direct Connect
GC1_Aux	Gas Comp #1 - Run Status	Call Out	Gas Comp #1 - Run Status	X	X	Never	InTouch Direct Connect
GC1_TIT_AH	GC1 Discharge Temp - Alarm	Call Out	GC1 Discharge Temp - Alarm High	X	X	Never	InTouch Direct Connect
GC1_TIT_AH_H	GC1 Discharge Temp - Alarm	Call Out	GC1 Discharge Temp - Alarm High High	X	X	Never	InTouch Direct Connect
GC1_TIT_TSH_SD	GC1 Discharge Temp - Safet...	Call Out	GC1 Discharge Temp - Safety High - Shutdown	X	X	Never	InTouch Direct Connect
GC2_Aux	Gas Comp #2 - Run Status	Call Out	Gas Comp #2 - Run Status	X	X	Never	InTouch Direct Connect
GC2_TIT_AH	GC2 Discharge Temp - Alarm	Call Out	GC2 Discharge Temp - Alarm High	X	X	Never	InTouch Direct Connect
GC2_TIT_TSH_SD	GC2 Discharge Temp - Safet...	Call Out	GC2 Discharge Temp - Safety High - Shutdown	X	X	Never	InTouch Direct Connect
GC3_Aux	Gas Comp #3 - Run Status	Call Out	Gas Comp #3 - Run Status	X	X	Never	InTouch Direct Connect
GC3_TIT_AH	GC3 Discharge Temp - Alarm	Call Out	GC3 Discharge Temp - Alarm High	X	X	Never	InTouch Direct Connect
GC3_TIT_TSH_SD	GC3 Discharge Temp - Safet...	Call Out	GC3 Discharge Temp - Safety High - Shutdown	X	X	Never	InTouch Direct Connect
G0_PSH	Gross O4 Header Pressure - ...	Call Out	Gross O4 Header Pressure - Alarm High/Low	X	X	Never	InTouch Direct Connect
H2S_System_Aln	H2S System	Call Out	H2S System Alarm	X	X	Never	InTouch Direct Connect
I3_IS_PSH_SD	Water Inj Pump - Hi Discha...	Call Out	Water Inj Pump - Hi Discharge Press - Shutdown	X	X	Never	InTouch Direct Connect
I3_IS_PSL1_SD	Water Inj Pump - Suct. - Pres...	Call Out	Water Inj Pump - Suct. - Press Safety Low - Shutdown	X	X	Never	InTouch Direct Connect
I3_IS_PSL2_SD	Water Inj Pump - Disch. - Pre...	Call Out	Water Inj Pump - Disch. - Press Safety Low - Shutdo	X	X	Never	InTouch Direct Connect
I3_IS_VSD_Status	Water Inj Pump - VSD Status	Call Out	Water Inj Pump - VSD Status	X	X	Never	InTouch Direct Connect
IAS_PAL1	Instrument Air Supply - Press...	Call Out	Instrument Air Supply - Press Alarm Low	X	X	Never	InTouch Direct Connect
IAS_PSL2_SD	ESD Pneumatic System - Ele...	Call Out	ESD Pneumatic System - Elect Equip - Shutdown	X	X	Never	InTouch Direct Connect
IAS_PSL3_SD	Deluge Pneumatic System - ...	Call Out	Deluge Pneumatic System - Elect Equip - Shutdown	X	X	Never	InTouch Direct Connect
K1A_Aux	Rething Comp - Run Status	Call Out	Rething Comp - Run Status	X	X	Never	InTouch Direct Connect
LEL_System_Aln	LEL System	Call Out	LEL System Alarm	X	X	Never	InTouch Direct Connect
P10BA_P10BB_Not_Running	Amine Reflux Pumps - Not R...	Call Out	Amine Reflux Pumps - Not Running	X	X	Never	InTouch Direct Connect
P113A_P113B_Not_Running	Amine Solution Pumps - Not ...	Call Out	Amine Solution Pumps - Not Running	X	X	Never	InTouch Direct Connect
P15A_P15B_Not_Running	Water Injection Charge Puns...	Call Out	Water Injection Charge Pumps are Shutdown	X	X	Never	InTouch Direct Connect
P1A_P1B_Not_Running	Glycol Injection Pumps - Not ...	Call Out	Glycol Injection Pumps - Not Running	X	X	Never	InTouch Direct Connect
P2_Aux	Hot Glycol Charge Pump - R...	Call Out	Hot Glycol Charge Pump - Run Status	X	X	Never	InTouch Direct Connect
P4A_P4B_P4C_Not_Running	All Water Circulation Pumps	Call Out	All Water Circulation Pumps Stopped	X	X	Never	InTouch Direct Connect
Purge_Amine	Amine PLC Panel - Lo Purge	Call Out	Amine PLC Panel - Lo Purge Press Alarm	X	X	Never	InTouch Direct Connect
Rupture_Disk_Amine	Rupture Disk - Amine Plant	Call Out	Rupture Disk - Amine Plant Vent Line	X	X	Never	InTouch Direct Connect
Rupture_Disk_Sales	Rupture Disk - Sales Gas Ve...	Call Out	Rupture Disk - Sales Gas Vent Line	X	X	Never	InTouch Direct Connect
SCE_Status	SCE Power Off	Call Out	SCE Power Off	X	X	Never	InTouch Direct Connect
T0_PSH_SD	Test Oil Header Pressure - S...	Call Out	Test Oil Header Pressure - Safety High/Low new	X	X	Never	InTouch Direct Connect

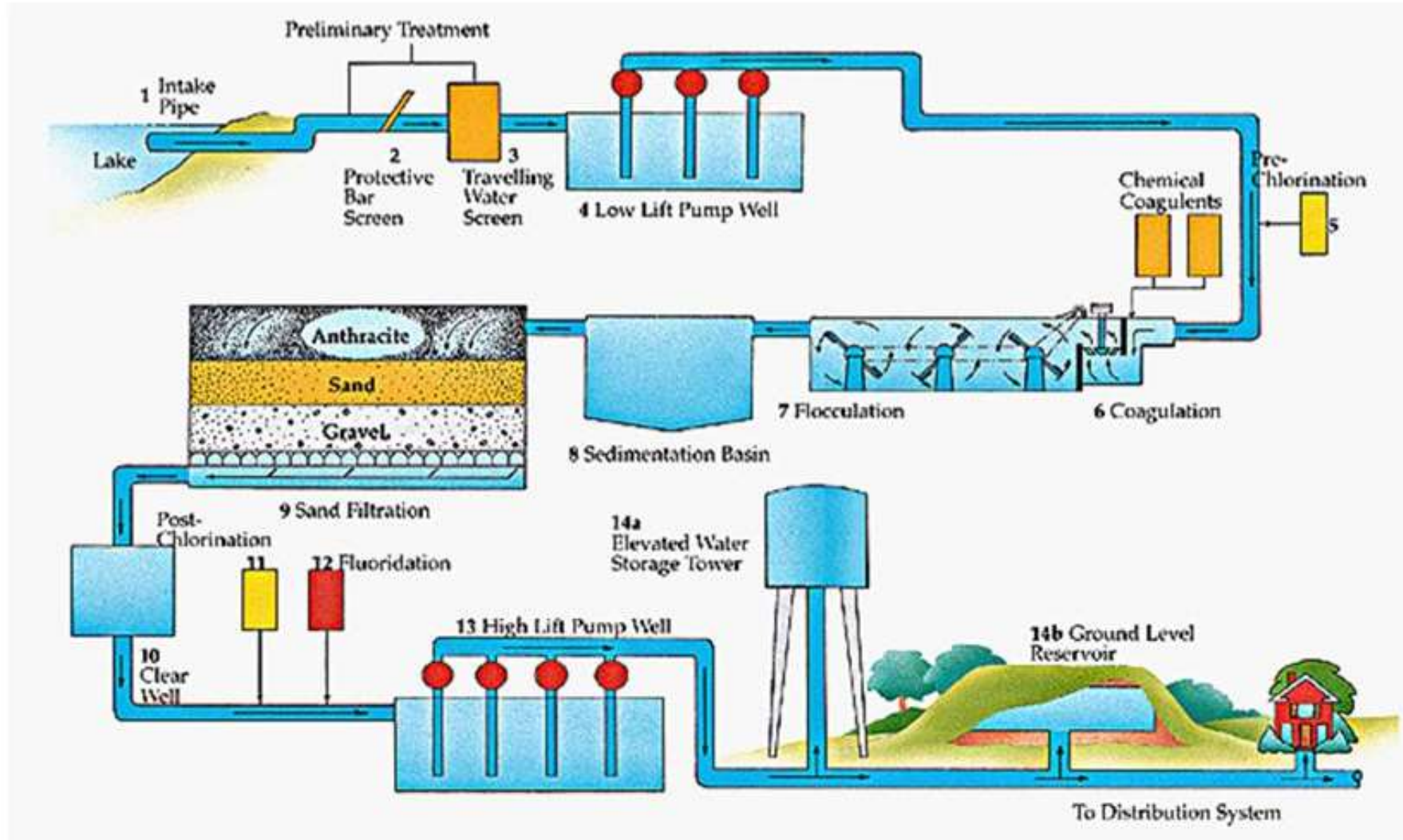
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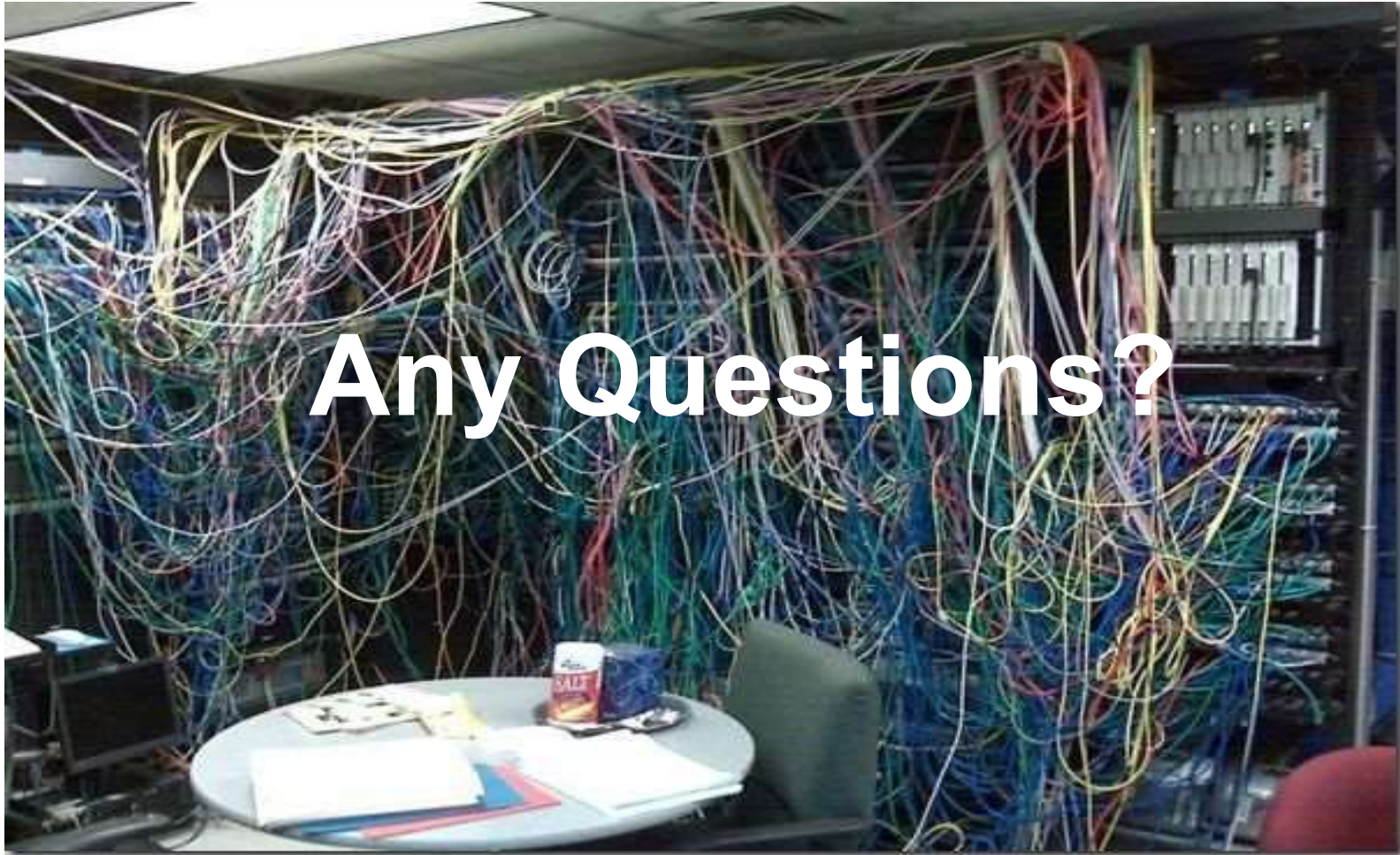
Typical SCADA Control Techniques

Ground Water Treatment



Surface Water Treatment (Conventional Filter Plant)





* Not a high performance SCADA System