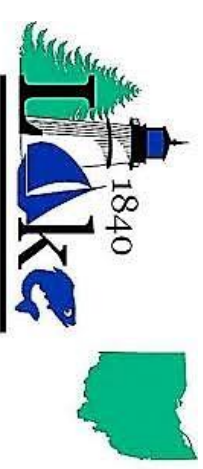


# Lake County, OH Department of Utilities (LCDU) Water Distribution Systems



**OTCO DISTRIBUTION WORKSHOP  
NOVEMBER 14<sup>TH</sup>, 2017  
OTCO-D12994-OM (0.75 HOURS)**

**NICK PIZZI AND JOHN DIEMERT**



*Lake County, Ohio*

# Water Quality Group



- **Responsible for water quality efforts in both systems**
  - Water quality sampling
  - Water main flushing
  - Cross – connection control
  - Tank turnover
  - Meter testing and repair
  - Others special efforts and studies aimed at keeping water age low

# Two LCDU Distribution Systems

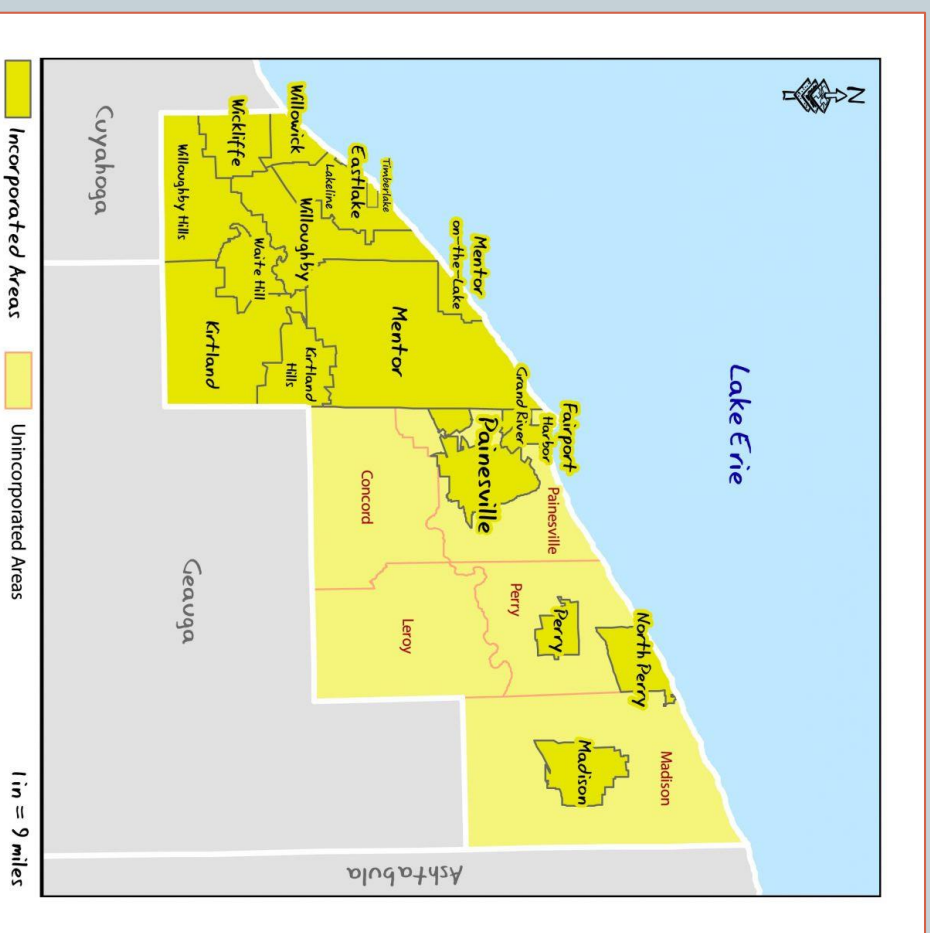


**THE SYSTEMS ARE SEPARATE  
OR “NON-CONTIGUOUS”**

**THEY ARE SEPARATED BY THREE OTHER UTILITIES**

- **AQUA OHIO**
- **CITY OF PAINESVILLE**
- **VILLAGE OF FAIRPORT HARBOR**

# Location / Orientation



There are over 230,000 people living in Lake County. LCDU serves more than 100,000 of them.

# Two Lake County Distribution Service Areas



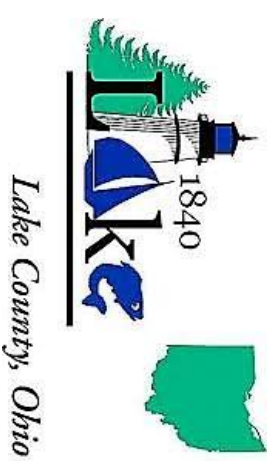
## West End System

- **Serving:**
  - Willoughby, Eastlake, Wickliffe, Willowick, Willoughby Hills, Timberlake, and Lakeline
  - Source: The Aquarius Water Treatment Plant

## East End System

- **Serving:**
  - Painesville, Perry and Madison Townships
  - Villages of North Perry, Perry and Madison
  - Source: The Bacon Road Water Treatment Plant

# West Distribution System





## West Service Area Description

The West WTP serves  
the Western portions of  
Lake County

Areas served are:

Eastlake  
Willoughby  
Willowick  
Wickliffe  
Willoughby Hills  
Timberlake  
Lakeline

**There are three main pressure  
districts:**

- **Low Service**
- **First High Service**
  - Supplies Pelton Road Area
- **Second High Service**
  - Tall Tree Booster area
  - Worrell Road Booster area

# Some Theory of Pressure Districts



## Pressure districts with storage tanks

- Pump size chosen based in part on elevations
- Pumps send water into system
- Tank takes in water not used by customers
  - Altitude valve
- Tank handles demand periods
  - Reduces strain on pumps

## Pressure districts without storage tanks

- Pumps send water into “closed” system
- District is typically kept to small area
- May require pressure regulator
- May have stand-by source
  - Water supply, power



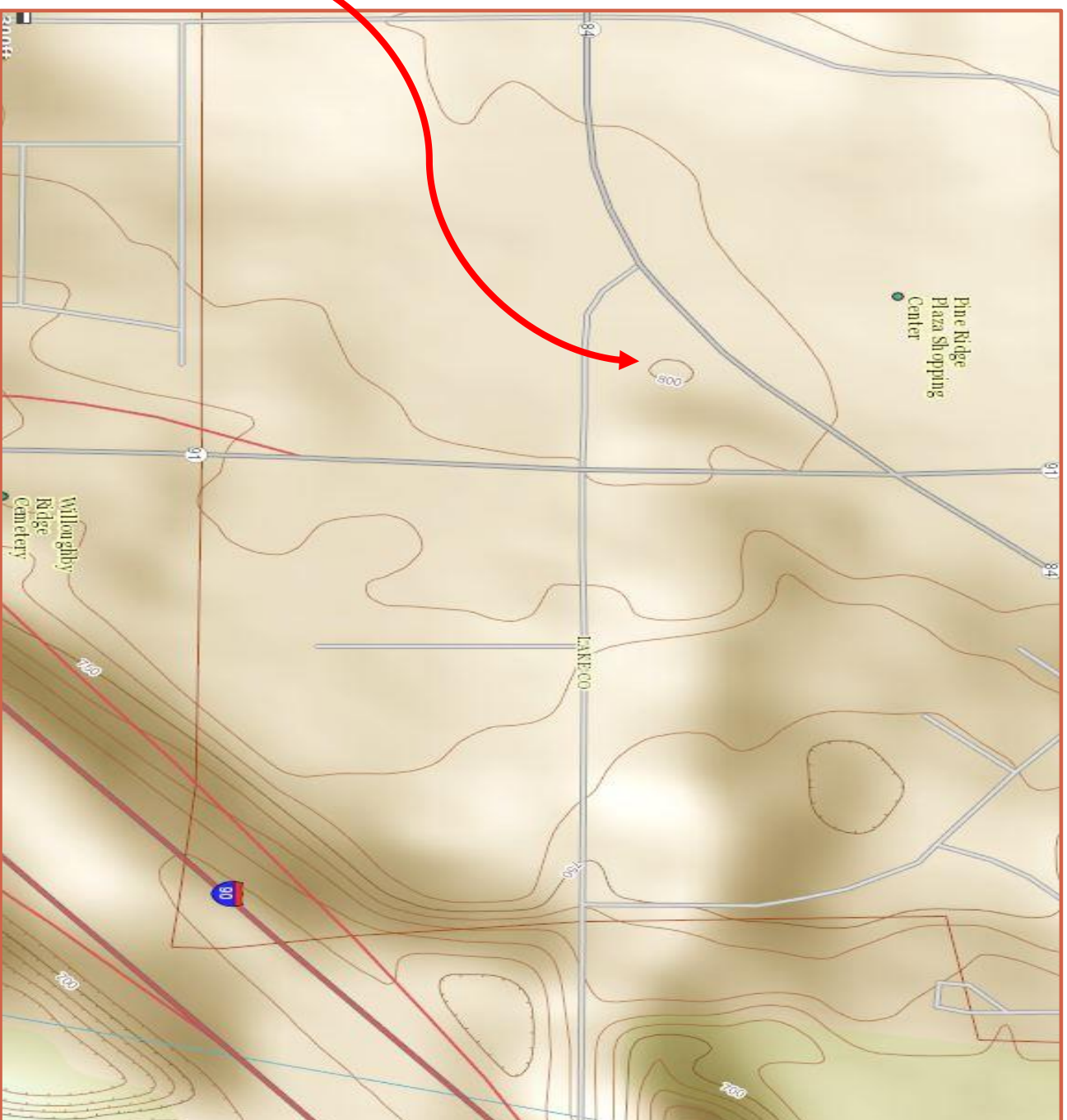


# Topographic Map

General area around the Dome and the ET

These contours range from a low of about 700' to the high point of 800'

The highest point on which they built the Dome and ET



# Storage Tank Operations and Boosters



- Storage tanks and reservoirs in the West Distribution System serve to supply large amounts of water
  - for fire-fighting
  - for helping to equalize supply and demand
- Their ability to “fill and draw” as demand fluctuates helps to diminish the strain on high service pumping from the WTP and from Booster Stations
- Unfortunately, they also provide greater opportunity for chlorine to come into contact with organic carbon in the water

# System Storage and Tank Turnover

- **Water Age** is minimized in the system partly by forcing the storage tanks to “turnover” as frequently as possible
- System storage:
  - The Dome– 5,000,000 gals
  - E.T. – 500,000 gals
  - White Road– 750,000 gals
  - BGR and Standpipe – 3,000,000 gals
- Operators must seek a happy medium between fire protection, system pressure, and water quality



# LCDU tank turnover operations

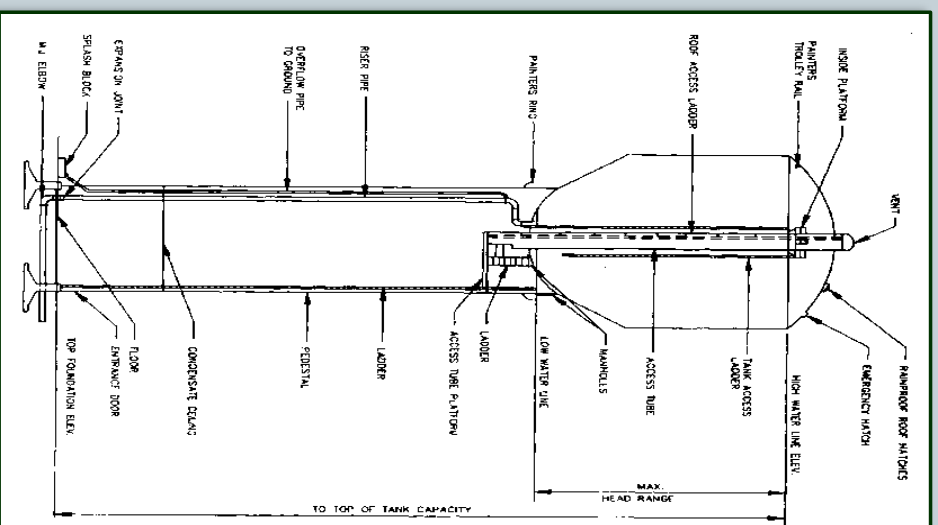


- It makes a difference where the turnover is taking place
  - An easy way to think of it is to divide the tank into three equal sections:
    - ✦ The upper third
    - ✦ The middle third
    - ✦ The lower third
  - Displacing the water through the range of elevations for any of these “third” sections will provide a calculation of 33.3%
  - But the starting and ending point of that one-third turnover dictates the efficiency of the event
  - Because of hydraulics, the displacement of water in the range of the middle third will provide a better mix than it will in the upper third

# Tank Turnover Calculation

## Tank Turnover percent example

- If tank bowl is 0' to 40' **and**
- 10' is the drain/fill event
- $10' / 40' = 25\%$
- Location of drain/fill area is important



Report to Ohio EPA the largest turnover FOOTAGE in month

Day	Drain/Fill	Day	Drain/Fill
1	13	16	13
2	9	17	12
3	12	18	10
4	11	19	11
5	11	20	15
6	12	21	13
7	9	22	12
8	10	23	9
9	8	24	10
10	12	25	11
11	13	26	12
12	12	27	10
13	13	28	9
14	10	29	10
15	10	30	9

# West System Low Service District



- Low service is fed directly from the plant pumps through two 30 inch mains
  - Water going through the Eastern 30 inch main heads into Willoughby
    - ✦ It ends up in the BGR and the Route 174 & 84 standpipe
  - Water going through the Western 30 inch main covers low service areas
    - ✦ It ends up in the 5 MG reservoir known as “the Dome” located at Route 91 & 84
      - ✦ The Dome has a pump house associated with it
    - ✦ The pump house has two sets of pumps that take water from the Dome and puts it into First and Second High service

# West System Storage: The Dome Storage Tank



- The Dome is a 5 MG reservoir that takes in water from low service
  - Therefore, its level is controlled by the action of the High Service Pumps at the Plant
- The Dome works in tandem with the Below Ground Reservoir (BGR) and the Standpipe located at Route 174 and 84
- Together, these storage units help to maintain pressure and volume for the low district

## West System Pumps at Dome



- There are two sets of pumps located in a building located just north of the Dome
- This pump station boosts pressure into 1<sup>st</sup> high and into 2<sup>nd</sup> high and fills the two Tanks associated with them
  - Standby power generation comes on automatically



# West System Pumps at Dome



1<sup>st</sup> High Service



2<sup>nd</sup> High service



# West System Storage: BGR and Standpipe



- The BGR and Standpipe at Routes 174 & 84 are an older part of the system which was obtained in the takeover of the Willoughby Water System

- Like the Dome, these facilities ride on the Low Service District and supply pressure and volume to it
  - The BGR consists of two side-by-side 1 MG tanks operated in parallel
  - The Standpipe has a volume of 1 MG. There are two 650 gpm pumps located at the BGR. Normal operation is for these two pumps to draw water from the BGR and put it into the LS District
  - The pumps can also be used to fill the Standpipe when necessary. Operators can control these pumps from the WTP

# West System Storage - Low Service System



The Dome



BGR and standpipe



# West System BGR and Standpipe



**BGR**



**Standpipe**



# West System Booster Stations



- Booster Stations are used in the West Distribution System to move water into pressure districts other than low service, which is supplied by the WTP.
- These stations need to be operated and maintained in a manner which will keep them in good working order and available when needed.

# West System Boosters



- LCDU Staff uses the Booster Stations as a means to:
  - fill elevated storage tanks
  - help fluctuate the water levels in the tanks to keep water as fresh as possible
- This is accomplished by dialing in the set-points at the pumps
  - These set-points specify a maximum and minimum level of water elevation that is to be maintained in the tanks, and therefore control the on-off events of the pumps
    - ★ The system utilizes winter/summer set-points to minimize depletion of Cl<sub>2</sub>
  - The set-points are also used to determine which pumps will activate, or whether multiple pumps will activate in any given scenario

# West System Booster Stations



- The West System has several booster stations that create specialized pressure districts apart from “low service”
  - First and second high pumps at the Dome
    - ✦ The pumps pull water from the Dome and send it into the two tanks
  - Pumps at BGR and Standpipe now have VFD
    - ✦ The pumps draw water from the BGR and put it into low service
  - **Tall Tree Booster** – created to break away from CWD – and maintain the service that this area was accustomed to experiencing
  - **Worrell Road Booster** – created to serve about 110 homes in a higher elevation
  - **Note – The Old Pelton Road Booster** - which was created to serve area around Kirtland Country Club – in now served from a waterline under the Chagrin River. The Booster does still run during high demand times

# Use of West System Boosters

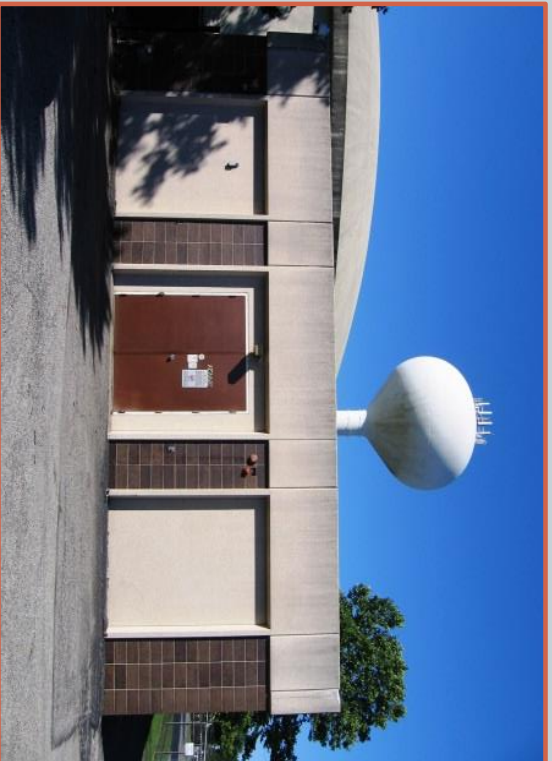


- Generally speaking, the Q/A group uses the Booster Stations as a means to not only fill elevated storage tanks, but also to help fluctuate the water levels in the tanks to keep water as fresh as possible
  - This can be accomplished by dialing in the set-points at the pumps
    - ✦ These set points specify a maximum and minimum level of water elevation that is to be maintained in the tanks, and therefore control the “on-off” events of the pumps
    - ✦ The set points are also used to determine which pumps will activate, or whether multiple pumps will activate in any given scenario



# West System 1<sup>st</sup> and 2<sup>nd</sup> High Boosters

1<sup>st</sup> and 2<sup>nd</sup> high service boosters at the Dome



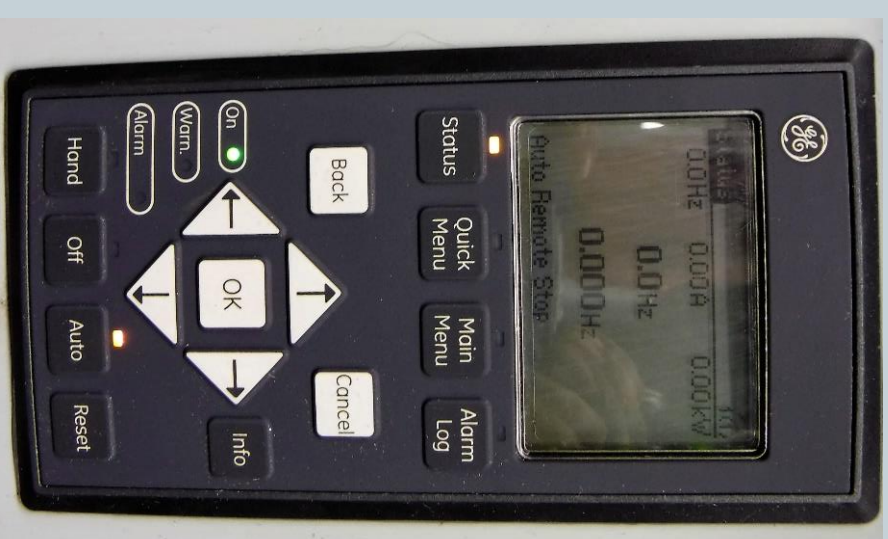
# West System New VFD Equipment



Control Panel



One of the 6 controllers



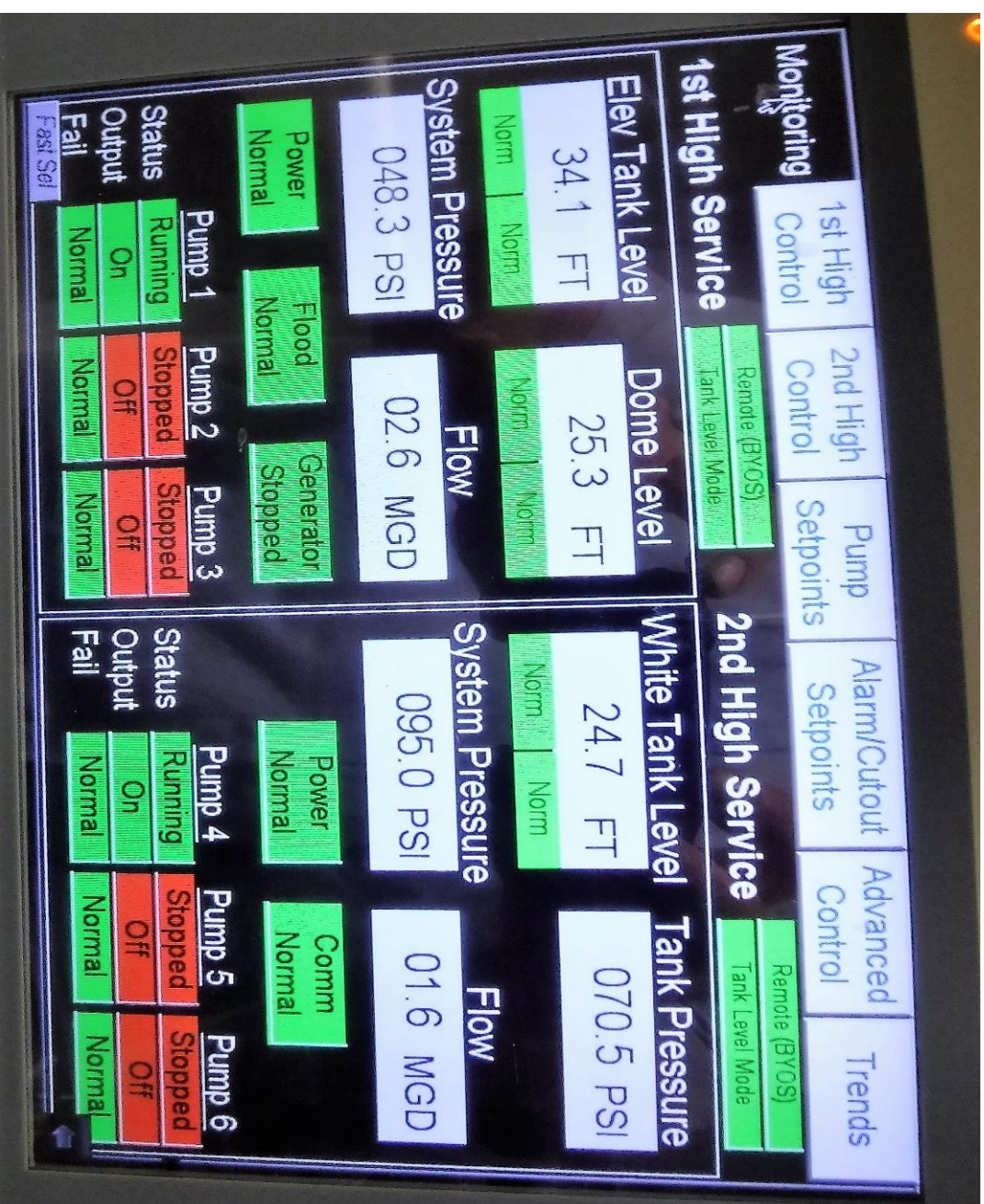


# Control Panel at Dome

The Control Panel provides information as to levels in the tanks, and which pumps are operating.

It also shows flow rates and pressures, and allows control of components at the Dome.

It provides trending capability also.





The Dome has stand-by power generation capable of running the station in the event that power is lost

When normal power is interrupted, the generator automatically activates

This Transfer Switch reacts and allows power from the generator to feed the station demands



## West System Transfer Switch at Dome

# West System First High Service



- First High Service is generally comprised of the portion of the Lake County system which is bordered
  - By route 271 and route 90
- There are three pumps located in the pump station at the Dome which are dedicated to the First High District System.
- Water is moved into the Elevated Tank – or “ET” – where it provides pressure and volume for first high service
  - Volume of ET is 0.5 MG

# West System Elevated Tower: “The (ET)”

- The E.T. is a 0.5 MG elevated storage tank located on the same grounds as the Dome, and it provides pressure and volume for First High Service
- It is filled from a set of pumps located in the pump station at the Dome
  - 3 pumps @ 2,200 gpm



# West System Second High Service



- Second High Service is generally contained in those portions of the system south of Route 90
- There are three pumps located in the pump station at the Dome which are dedicated to the Second High Service district
- Water is moved up to the White Road Tank, which provides pressure and volume for second high service
- Within this district are two booster stations that serve specific parts of it
  - Tall Tree Booster – (uses majority of water in second high)
  - Worrell Road Booster

# West System White Road Tank

- The White Road Tank is a 0.75 MG elevated storage tank located on the West side of Route 271 on White Road, and it provides pressure and volume for 2<sup>nd</sup> High Service
- It is filled from a set of pumps located in the pump station at the Dome
  - 3 @ 1,150 gpm





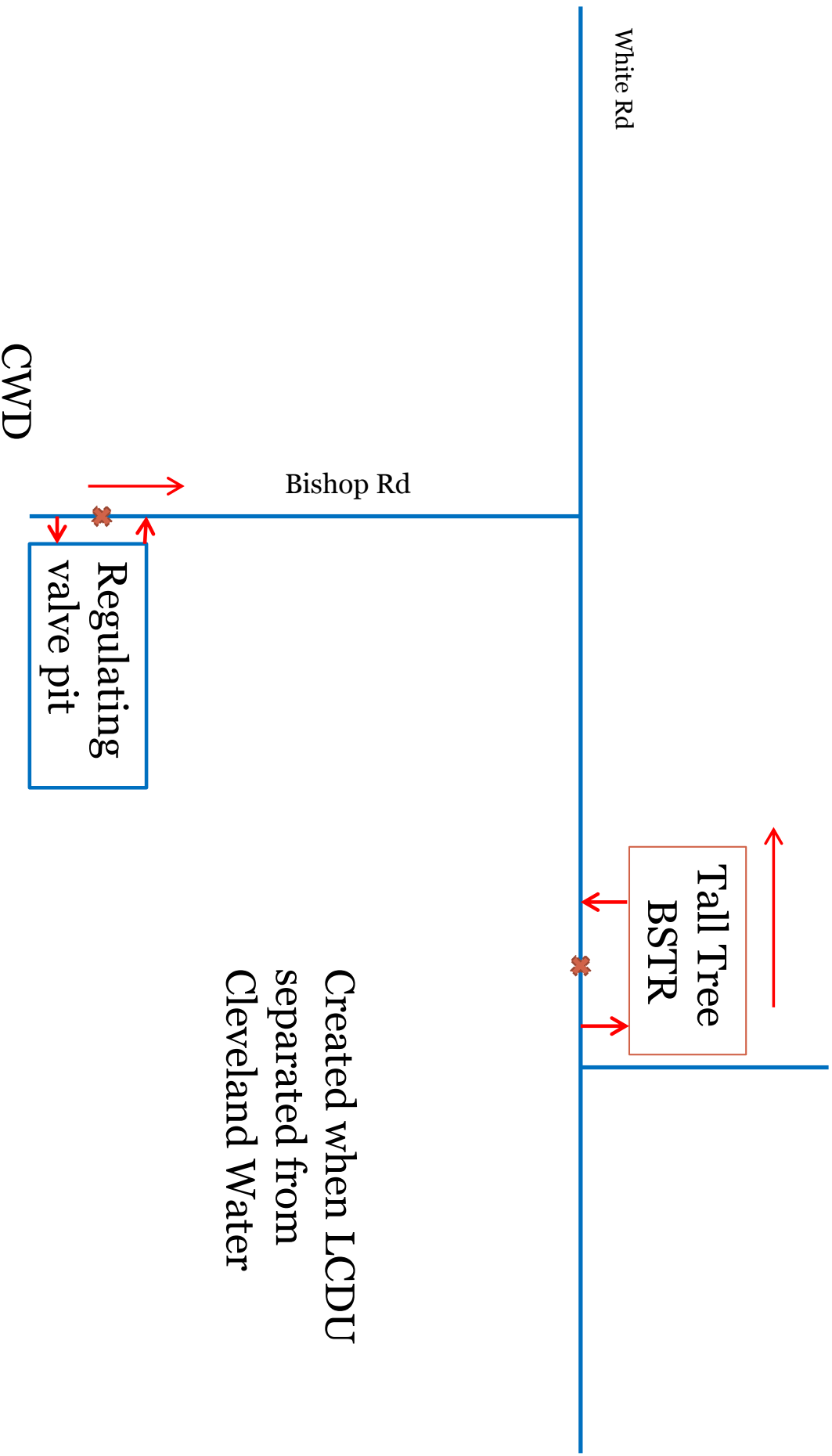
# West System Tall Tree Booster District

- Fed from Second High Service and White Road Tank
- The area it serves has an emergency connection with Cleveland Water in case of power outage
  - On Bishop Road – an 8 inch pressure regulating valve set to open at 110 psi



Designed to put out high pressure

# West System Tall Tree Booster District



Created when LCDU separated from Cleveland Water

# West System Worrell Road Booster District

- Located at a far end of Second High Service



# West System Pelton Road Booster



# West System Pressure Regulation



- The Lake County West Distribution system has 4 working pressure regulators in its system:
  - Eagle Road, Willoughby Hills
  - Dodd Road, Willoughby Hills
  - Rodgers Road, Willoughby Hills
  - River Road (SR 174), Willoughby Hills
    - ✦ The units are on a regularly scheduled maintenance list, and must be kept in good working order or they will fail. For this reason, spare parts are kept on-hand, and staff is trained so that more than one person knows how to work on these units in an emergency.
- There is a regulator at route 84 and 90 that is under consideration for use

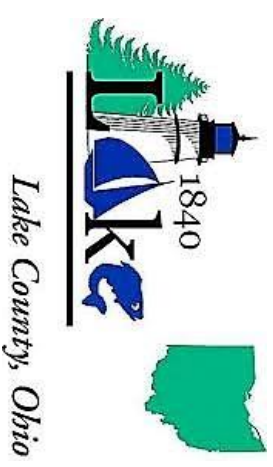
## West System - Several Boundary Valves and Interconnects



- **Boundary valves** help to keep separate the *pressure districts* within the system
- **Interconnects** are valves and/or meters that allow the West System to provide water to, or receive water from, another water system, and serves to keep the systems separate

Boundary valves and interconnects are normally kept closed

# East Distribution System





## East System Service Area Description

The East WTP serves  
the Eastern portions  
of Lake County

Areas served are:

Painesville, Perry  
and Madison  
Townships

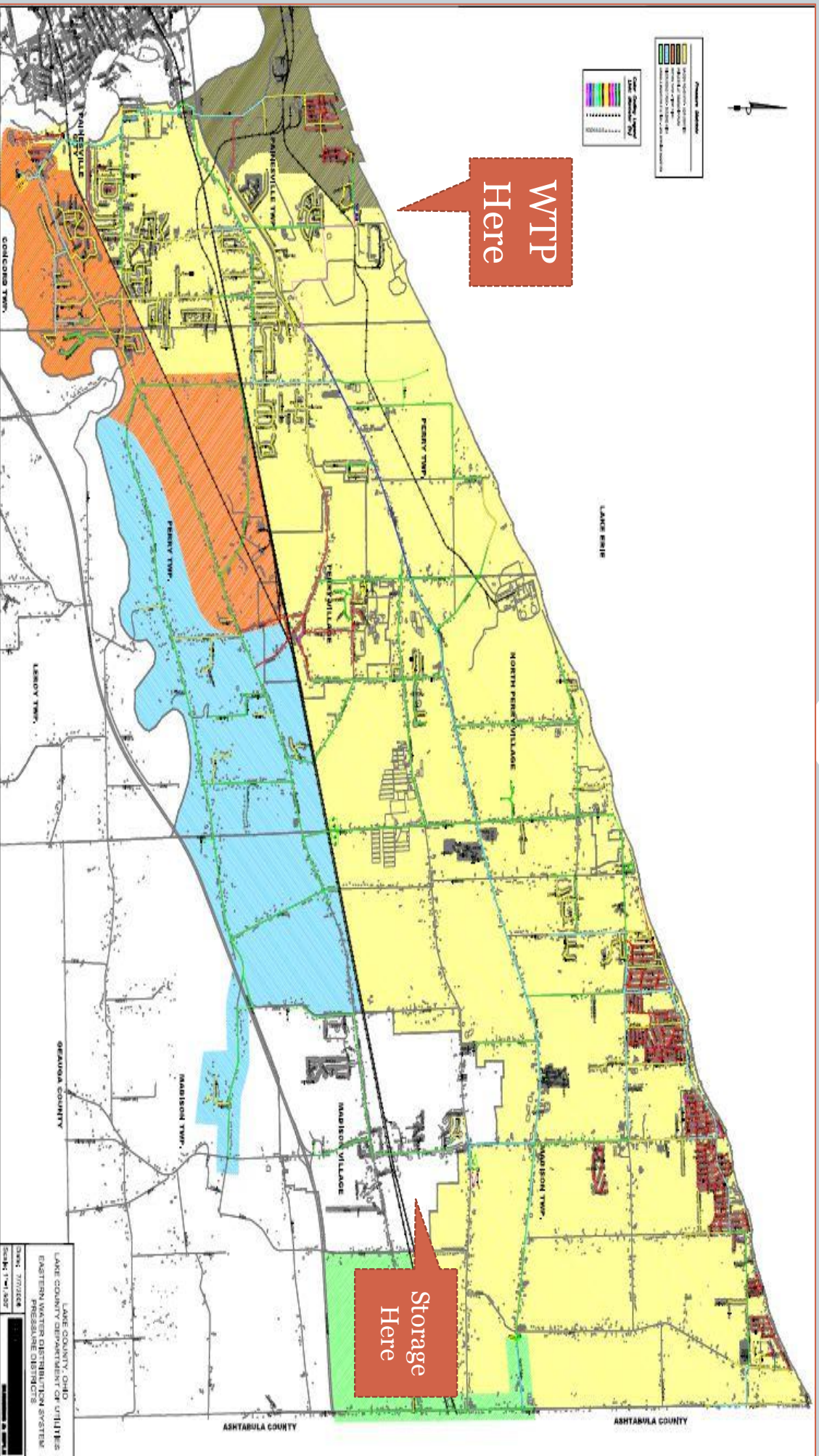
Villages of North  
Perry, Perry and  
Madison

## There are three main pressure districts:

- **Low Service**
  - Low Service Reduced
- **Three Boosted districts:**
  - Arcola
  - Townline
  - Golf Drive
- **Village of Madison**
  - Satellite, but soon to be annexed



# East Distribution System Issues Created by Long Thin Route to Storage



# East System: Low Service

## Description

- **Low service** is fed directly from the plant High Service pumps
- Has the 0.75 MG Middle Ridge Tank floating on it
- When LCDU acquired Painesville Township, Middle Ridge Tank would not turn over
- LCDU installed a small pump in the tank for turnover.
  - pump runs for about 12 hours during the day and helps to recirculate the water in the tank and keeps it fresh

## High Service Pumps - Middle Ridge Tank





# East System Booster Stations



- The East System has three booster stations that create specialized pressure districts apart from “low service”
  - Arcola Booster
    - ✦ The Arcola Booster Station provides water into Ashtabula, and also can be configured to receive water from Ashtabula
  - Townline Booster
    - ✦ The Townline Booster sits on the South portion of the low service district and boosts water into the first high service River Road Tank portion of the system
  - Golf Drive Pumps
    - ✦ The pumps system at the Golf Drive Reservoir fill the Orton Road Tank

# East System Storage Tanks

- **Water Age** is minimized in the system partly by forcing the storage tanks to “turnover” as frequently as possible
- Three tanks: Middle Ridge, Orton, and River Road
  - Middle Ridge – 750,000 gals
  - Orton – 500,000 gals
  - River Road – 250,000 gals
- Operators must seek a happy medium between fire protection, system pressure, and water quality



## East System - Golf Drive Booster



There are two pumps here  
that fill Orton Road tank

Suction pressure is  
approximately 23 psi and  
must not go lower



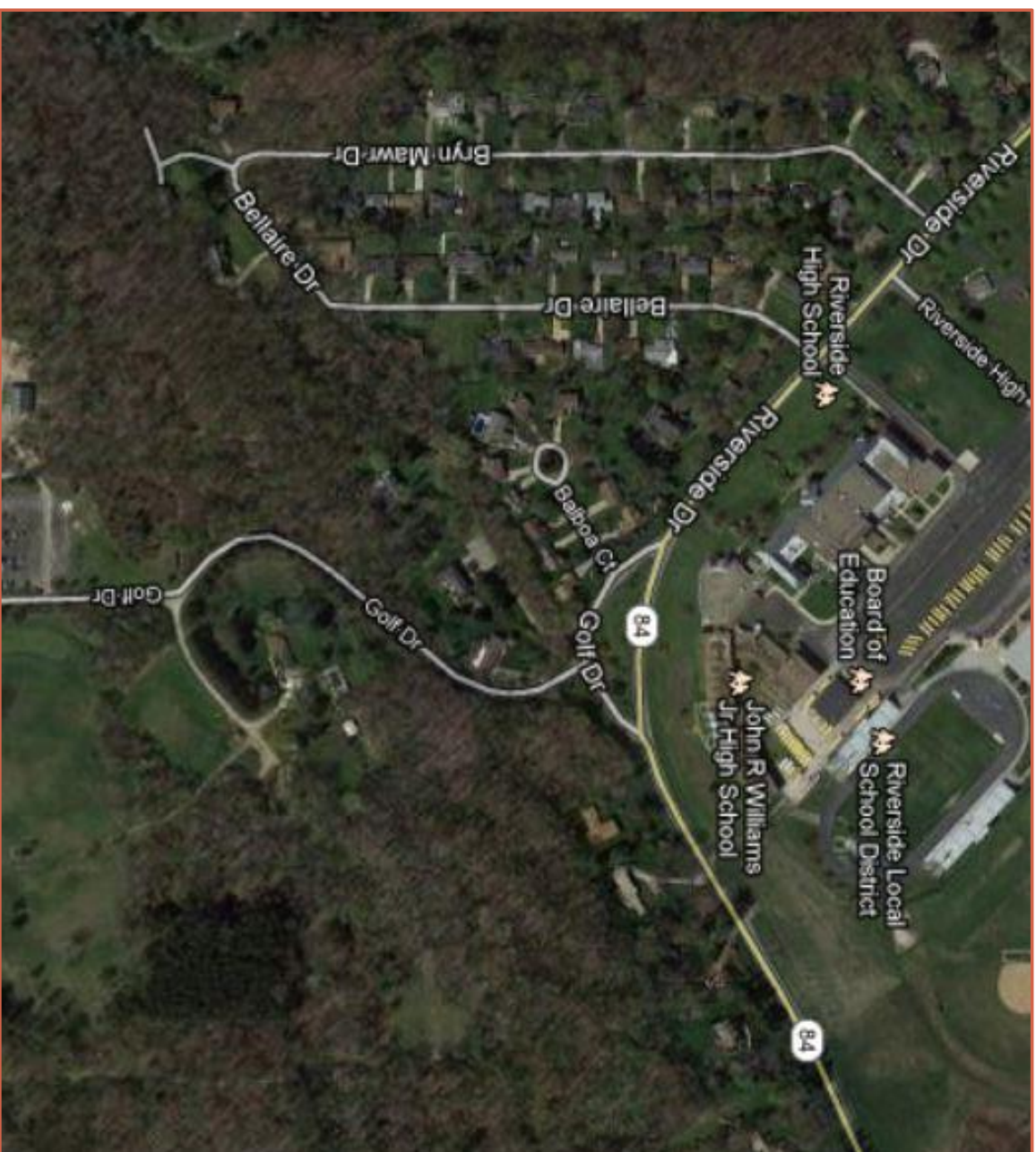


# Golf Drive

Huge elevation change as you approach the tank

Originally put there because the below ground reservoirs were used by Painesville to feed the City

BGR no longer used



# East System: Orton Road District

## Description

- **The Orton Road District** is at the south end of Painesville Twp.
- The tank itself is fed from 2 pumps that are located on Golf Drive
- The pumps are controlled by the operators at the plant, who are supposed to maintain a minimum plant pressure of 95 psi so that the Golf Drive pumps will have enough suction to operate.
- The Orton Road Tank holds 500,000 gallons.

Orton Road Tank and Altitude Valve/ Golf Drive Pumps





## East System – Townline Booster Station

- 3 pumps that fill River Road Tank.
- Pumps controlled by SCADA.
- Suction pressure is approximately 46 psi.
- Can fill Orton Road in an emergency
- Can be Controlled MANUALLY BY PLANT OPERATORS.



# East System - Arcola Booster

- Services a small section of Route 20 and south Countyline Road
- Used to fill Harpersfield Tank in Geneva area (Aqua Ohio)
- Suction pressure is approximately 70 psi and is discharged @ 120 psi



# East System: Townline Boosted District



## Description

- **Townline Boosted District** is fed by the Townline Booster and generally feeds those areas sitting at the elevation of South Ridge Road (Route 84). The Booster Station has two pumps (#2 and #3) which operate under normal conditions. The water from the booster makes its way into the River Road Tank. It normally leaves the station with a pressure of 124 psi. There is a HS pump in the Booster (pump #4) which will come on automatically when the demand calls for more water, and it will run until the River Road Tank is full, then shut down. The River Road Tank holds 250,000 gallons of water.

## River Road Tank Townline Booster



# Three East System Altitude Valves



- The purpose of this type of valve is to control the height to which the water level will rise in the tank, without allowing the tank to overflow and waste water

- Valve at Orton Road Tank
- Valve at Middle Ridge Tank
- No valve at River Road Tank
- Valves need periodic maintenance



# East System Boundary Valves and Interconnects



- **Boundary valves** help to keep separate the pressure districts within the system
- **Interconnects** are valves and/or meters that allow the East System to provide water to, or receive water from, another water system, or that separate systems
  - There are two interconnects with the City of Painesville
  - There are three interconnects with Ashtabula County (two metered)
  - There is a master meter interconnect with the Village of Madison

Boundary valves and interconnects are normally kept closed



# East System: Painesville Interconnects

One on Casement Avenue

The second on Madison  
Avenue

The Q/A group  
meets once per  
year with  
Painesville to  
operate valves,  
flush the system,  
and check water  
quality





# Village of Madison Interconnect

Located on Route 528  
in the old Madison  
Village WTP

They take water  
through a master meter,  
then pump it into their  
system

They sell bulk water  
from the station also

The Q/A group makes  
sure meter is tested and  
backflow device  
maintained



Middle Ridge Tank



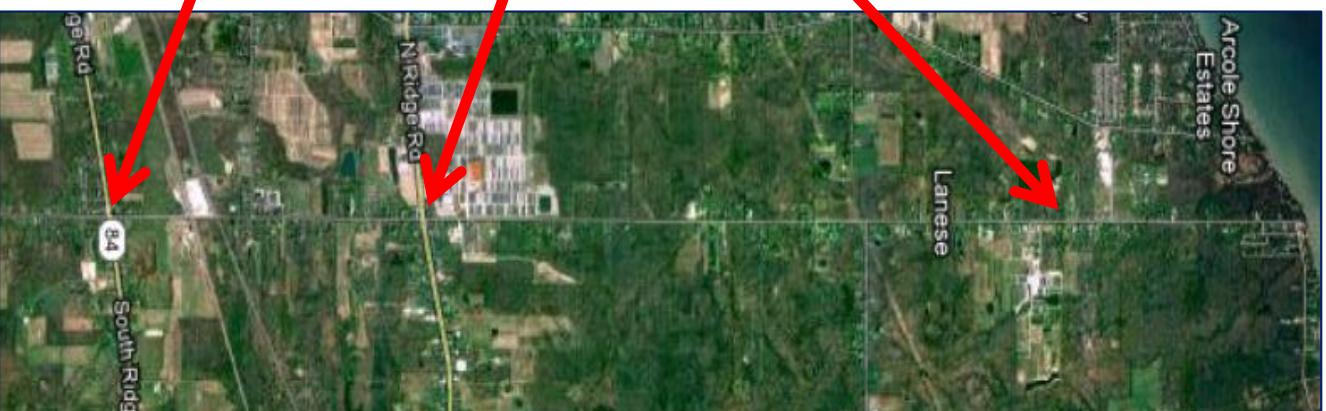
# Lake County / Ashtabula County

## Interconnects

North on County Line  
Road

Route 20 (unmetered)

Route 84



This patchwork of interconnects resulted when the LCDU was created in the early 1980's, and the predecessor to Aqua Ohio was operating a WTP in the middle of this system.

These are manually controlled valves