



**STRAND**  
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# Retrofitting a Pump Station for Future and Intermediate Use

Sanitation District No. 1 of Northern Kentucky (SD1)  
Richwood Pump Station Intermediate Improvements Project

## Ohio Water & Environment Association

2019 Technical Conference

**Wednesday, June 26, 2019**

**Adam W. Athmer, P.E.**



# Presentation Agenda

This presentation consist's of the following;

- Previous system evaluations and identification of issues
- Preliminary engineering evaluation of alternatives
- Detailed design considerations
- Construction

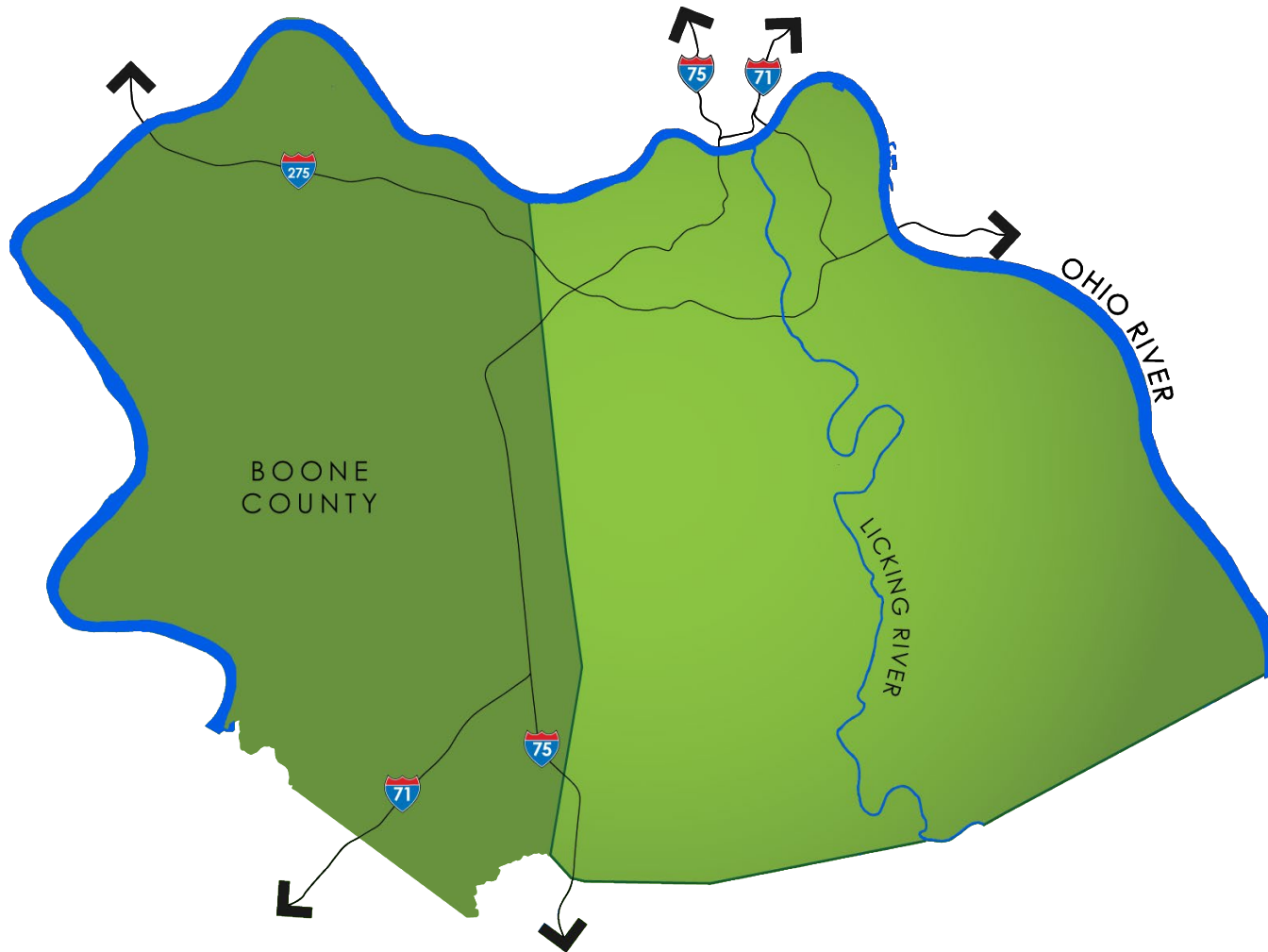
# SD1 Service Area

- **Maintains both Sanitary and Storm Sewers in much of Boone, Kenton, and Campbell County, Kentucky**

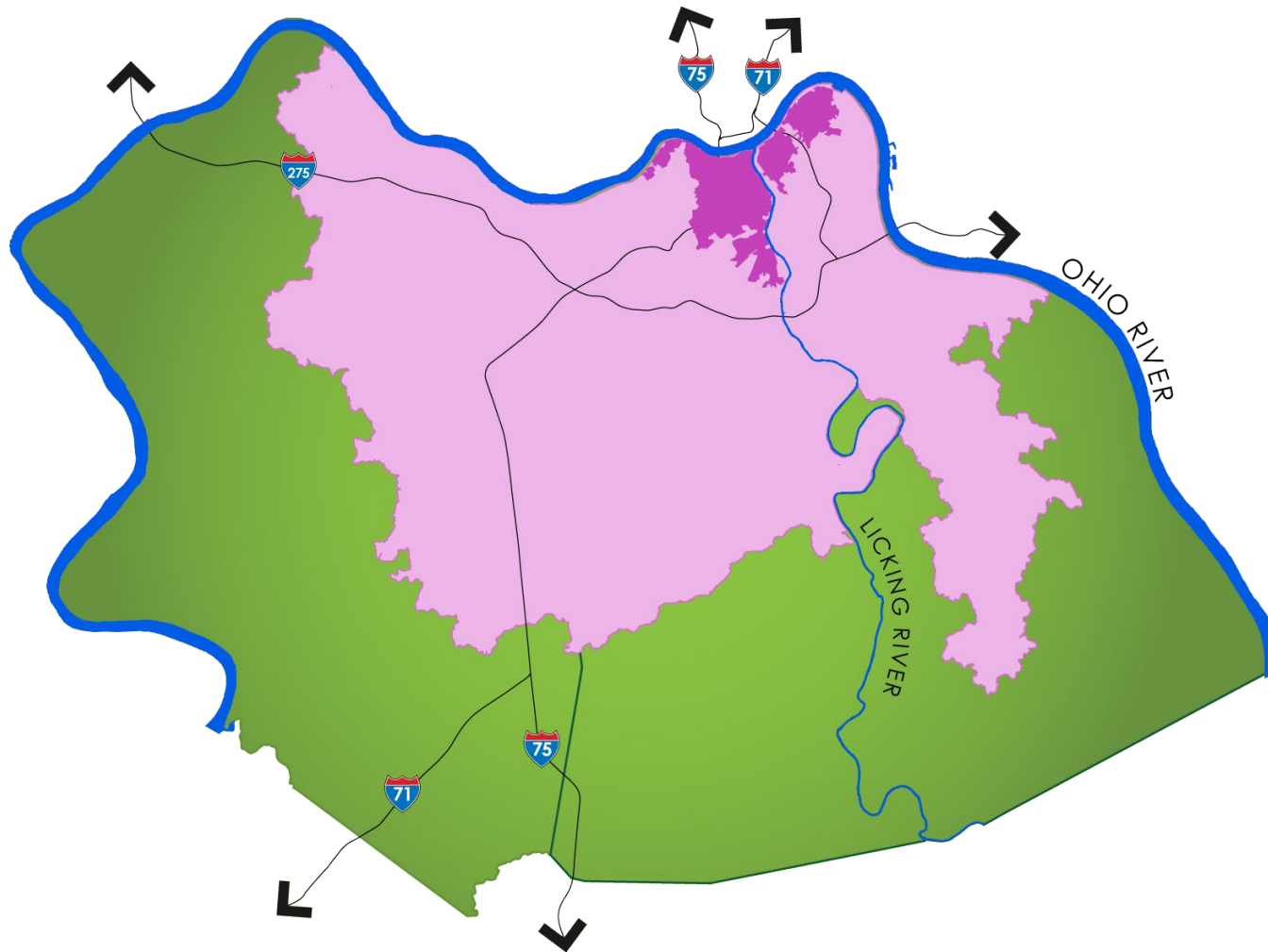
- 115,000 Customers
- ~36 Municipalities
- ~1,640 miles of Sanitary Sewer
- ~416 miles of Storm Sewer
- 121 Sanitary Pumping Stations
- 15 Flood Pumping Stations
- 3 Regional WWTP's
  - Eastern Regional – 4 MGD
  - Western Regional – 20 MGD
  - Dry Creek – 46.5 MGD



# SD1 Service Area

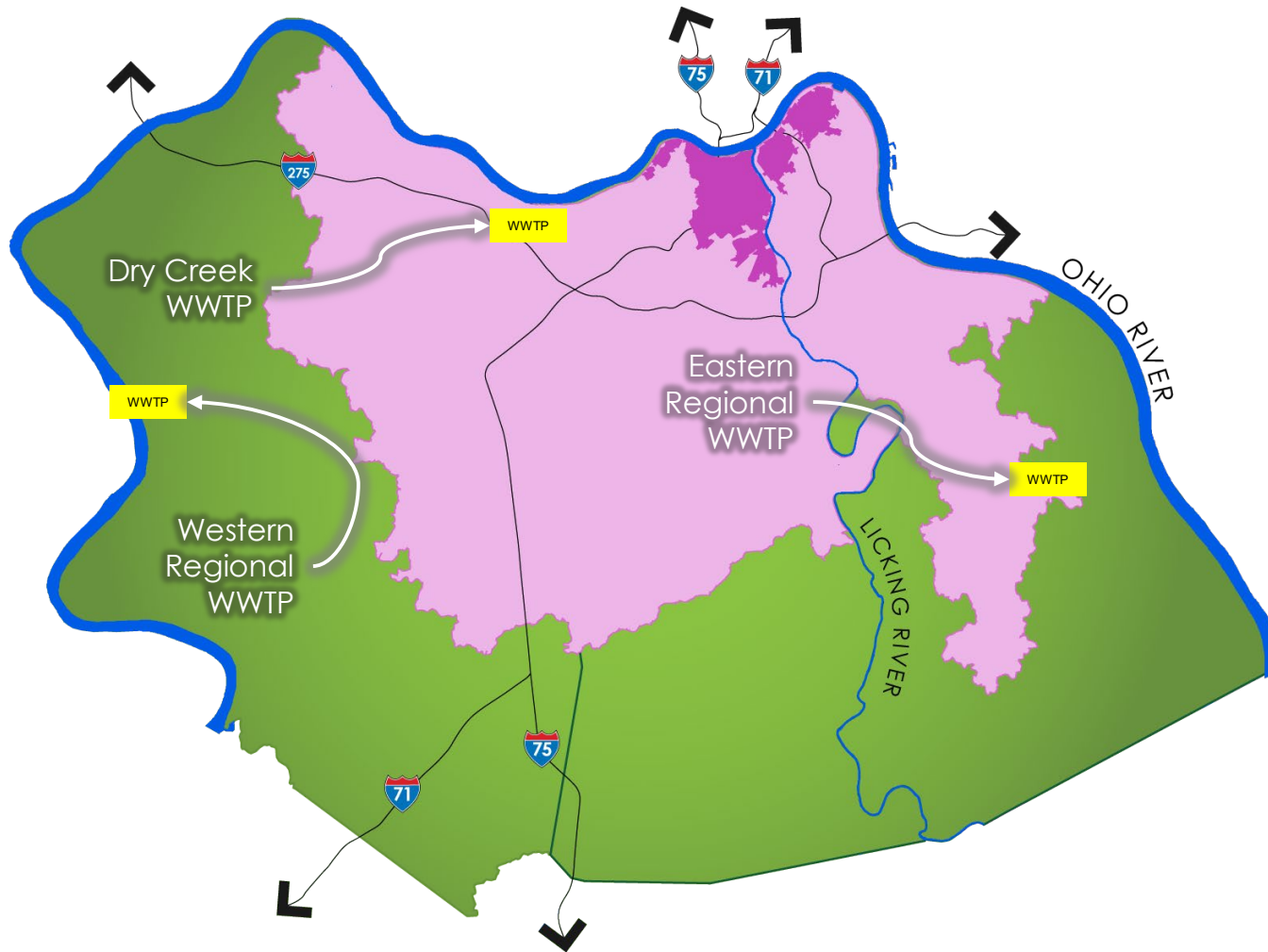


# SD1 Service Area

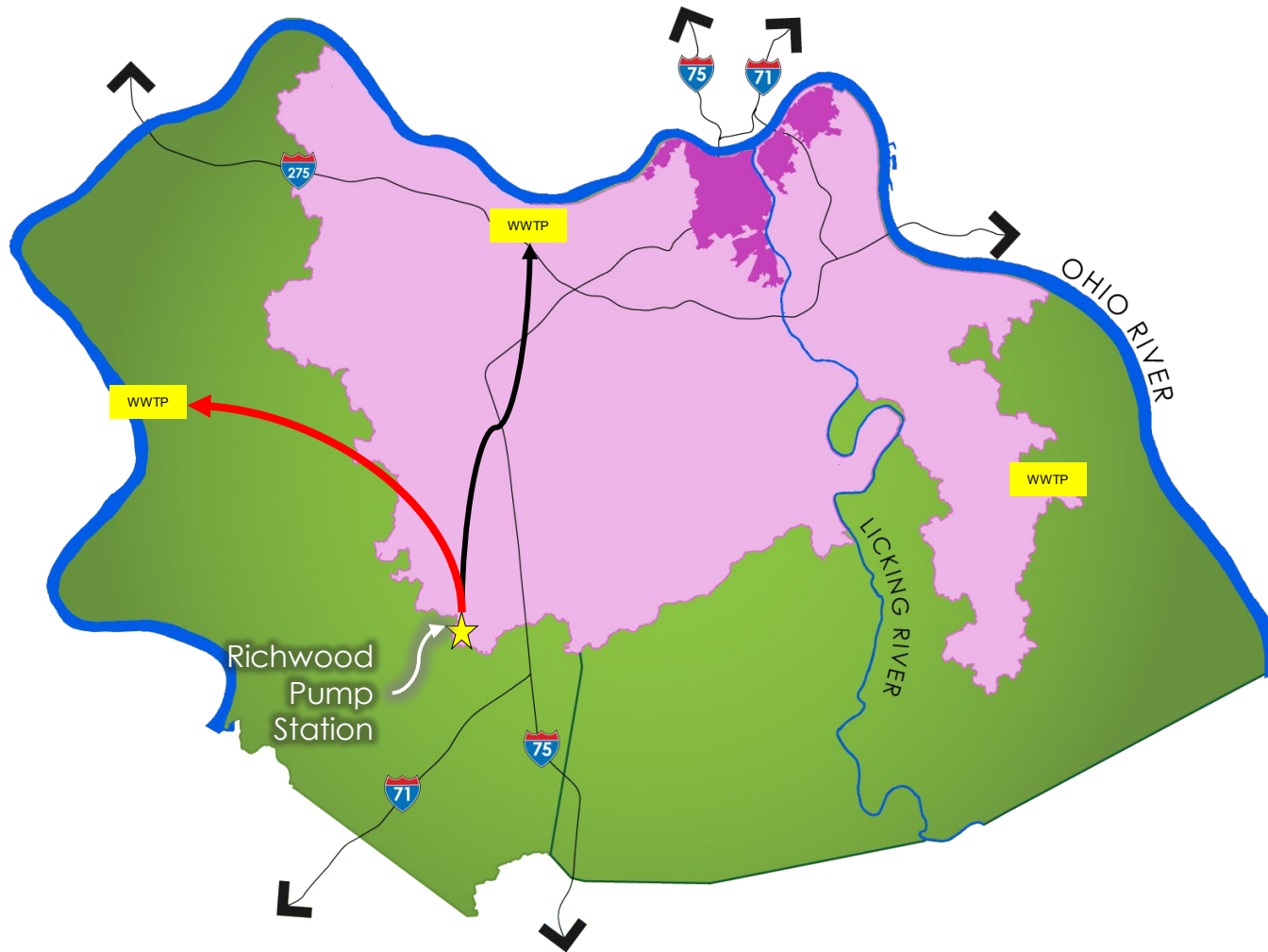


Total Service Area = 146,640 acres  
Combined System Area = 6,036 acres  
Separate Sanitary System Area = 109,890 acres

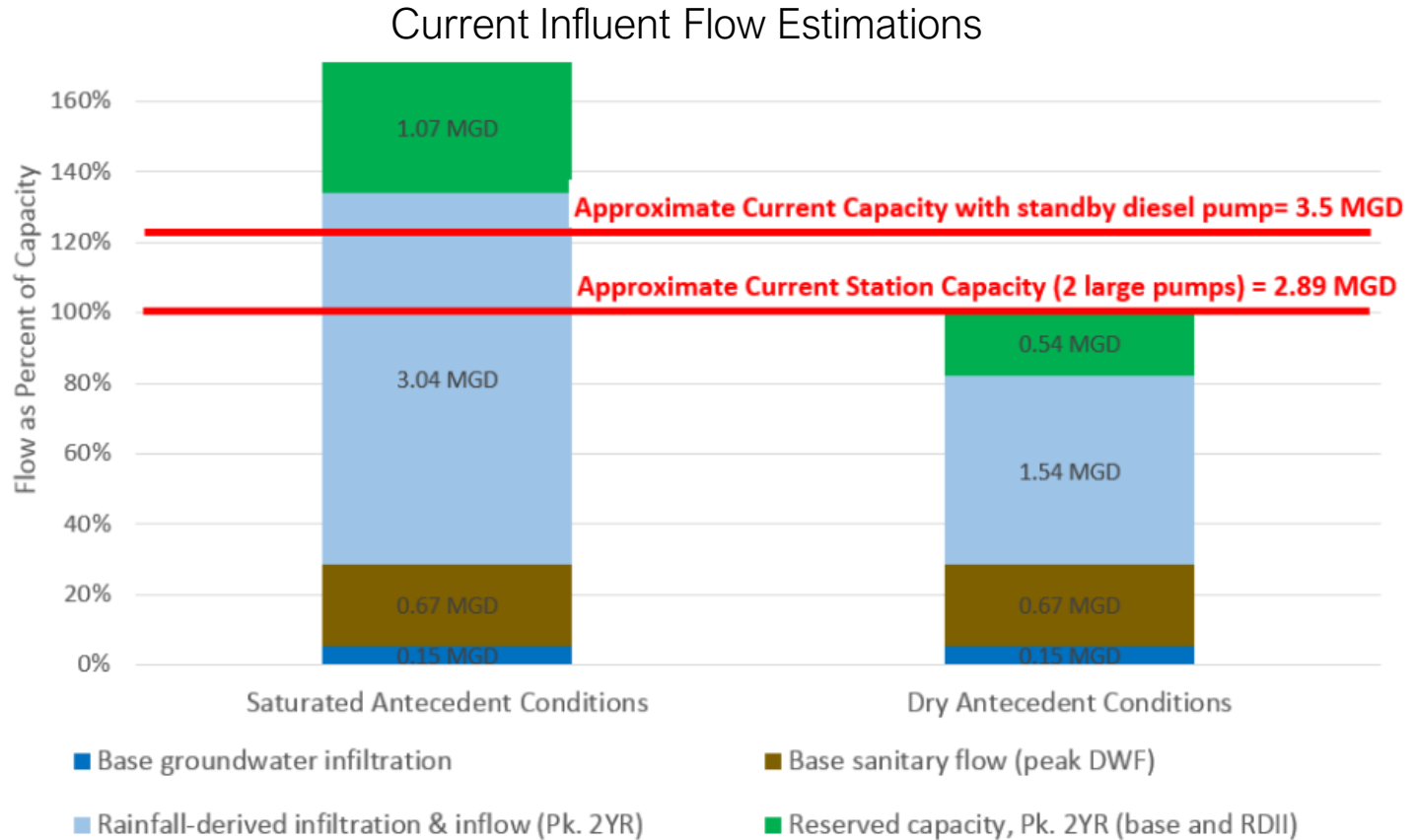
# Capital Improvement Plan (CIP)



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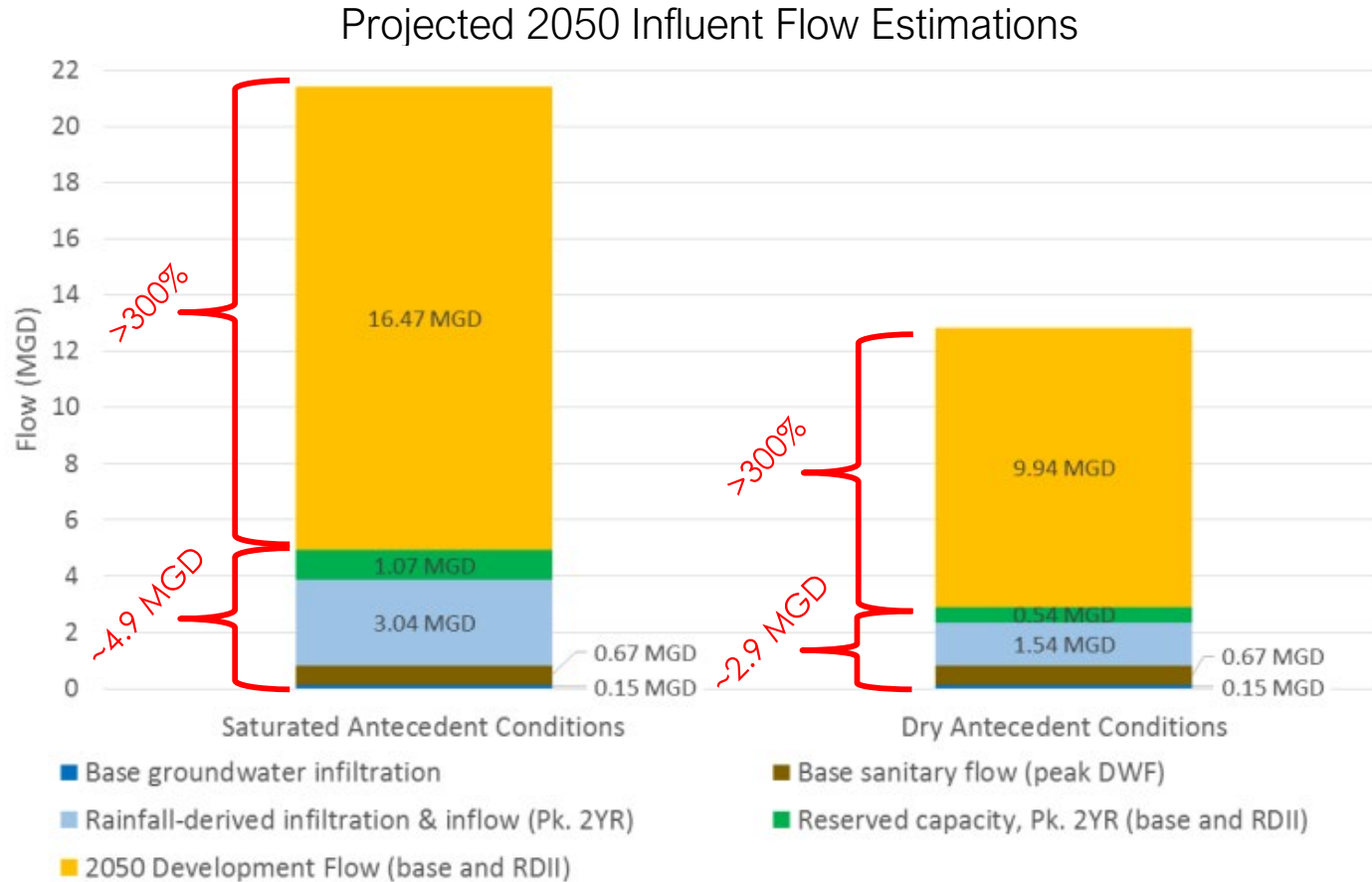


# Development Within Richwood Pump Station Service Area



**Graphic Source:** Technical Memorandum –  
Richwood Pump Station Alternatives Evaluation,  
Hazen & Sawyer, August 10, 2015

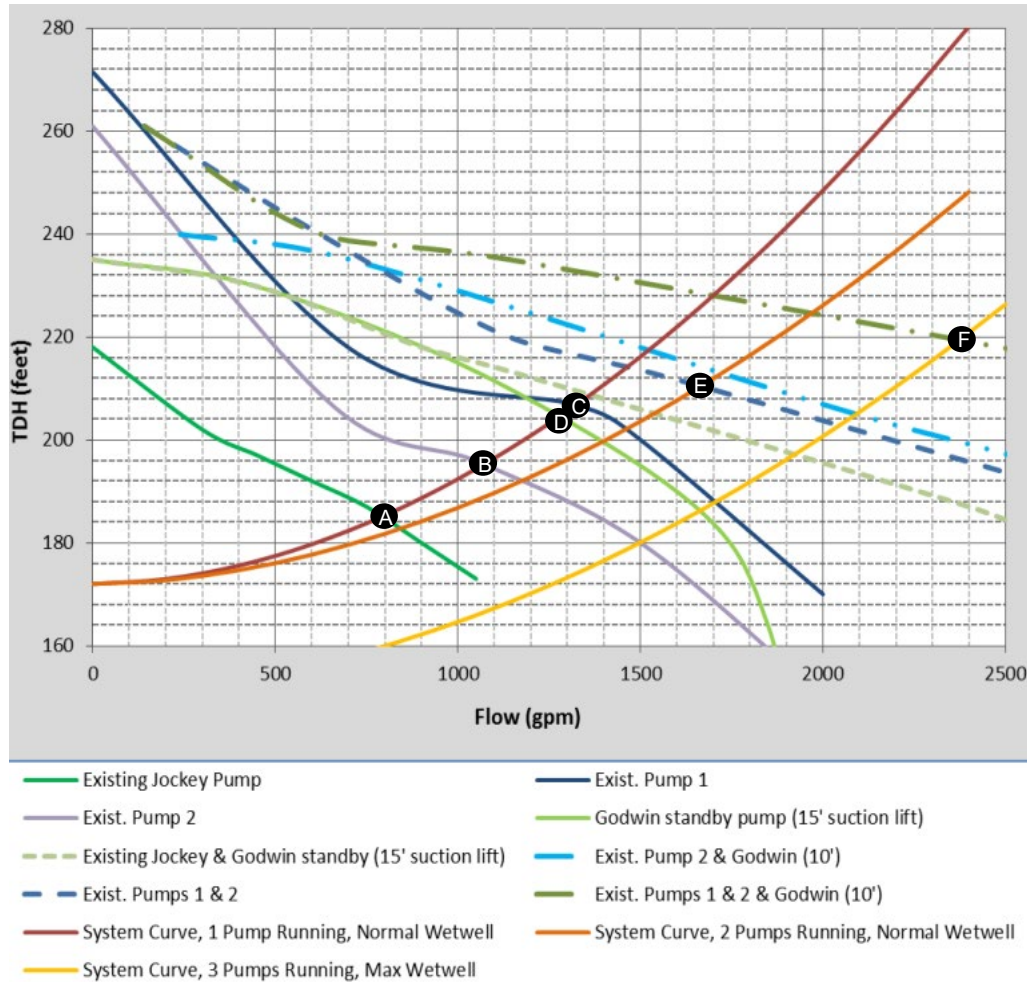
# Development Within Richwood Pump Station Service Area



Graphic Source: Technical Memorandum –  
 Richwood Pump Station Alternatives Evaluation,  
 Hazen & Sawyer, August 10, 2015



# Existing Station Capacities



Graphic Source: Technical Memorandum –  
Richwood Pump Station Alternatives Evaluation,  
Hazen & Sawyer, August 10, 2015

Curve Point	Curve Description	Flow (gpm)	TDH (ft)
A	Jockey Pump	800 (1.2 MGD)	172
B	Primary Pump No. 1	1,075 (1.5 MGD)	195
C	Primary Pump No. 2	1,325 (1.9 MGD)	206
D	Standby Diesel Pump	1,275 (1.8 MGD)	204
E*	Primary Pumps 1 & 2	1,620 (2.4 MGD)	211
E*	Primary Pumps 1 & 2	2,000 (2.9 MGD)	224
F*	Primary Pumps 1 & 2 + Standby Diesel Pump	2,400 (3.5 MGD)	220

\* Max Wet Well Level

# Problems Emerge!

- Capacities
  - No capacity available to manage wet weather events
  - No available capacity for future development
- Pump Deterioration
  - Pump components nearing end of useful life
  - Jockey pump runs continuously
- Debris
  - Large amounts of residential areas are tributary to this station
  - Pumps routinely experience clogging due to fibrous materials (i.e. “flushable wipes”)



# Original Alternatives Developed

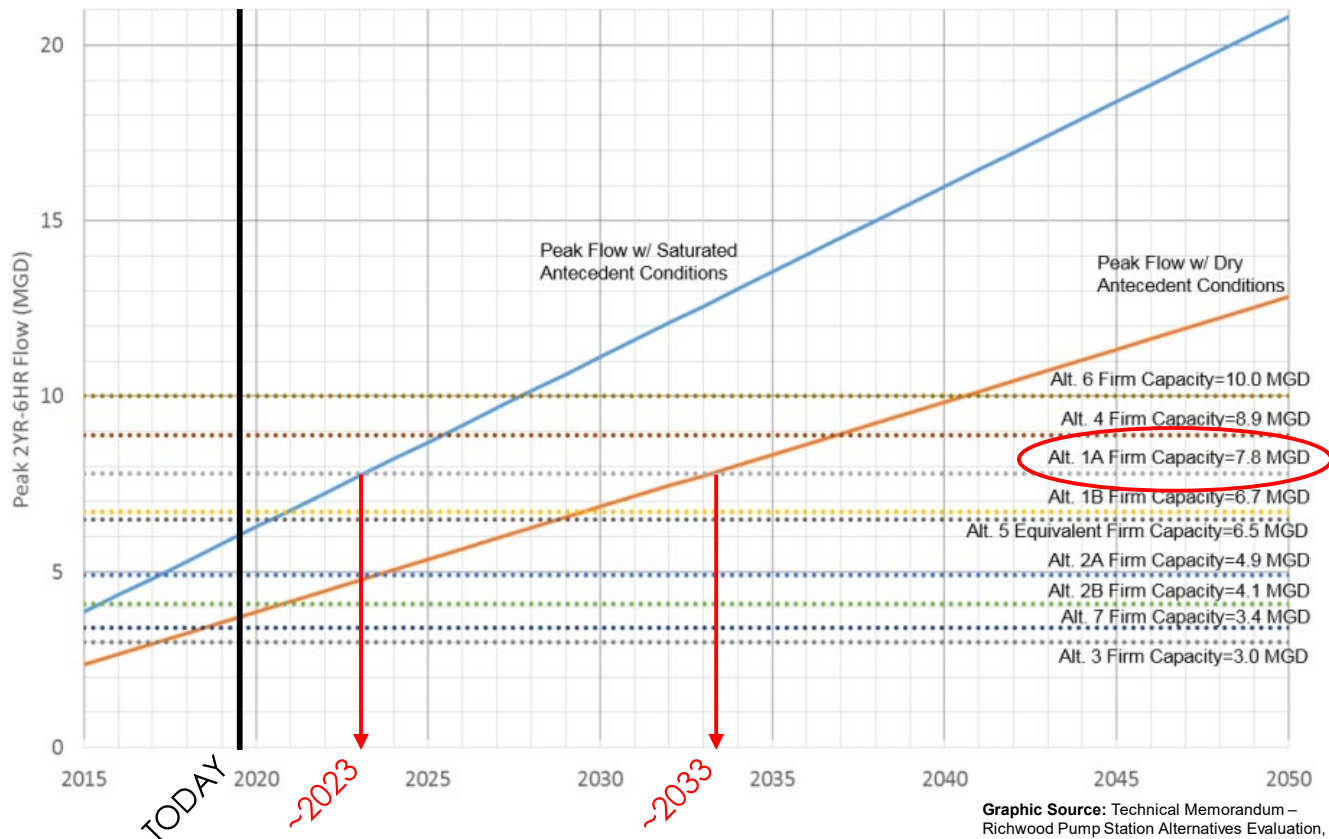
- Alt. 1A - Replace all pumps ← SD1 SELECTED ALTERNATIVE
- Alt. 1B - Replace and upsize both existing primary pumps
- Alt. 2A - Replace both primary pumps in-kind with upsized motor
- Alt. 2B - Replace both primary pumps in-kind
- Alt. 3 - Replace both primary pumps with new pumps in series
- Alt. 4 - Replace all pumps with three equally sized pumps
- Alt. 5 - Keep existing pumps and add equalization storage
- Alt. 6 - Construct a new pumping station
- Alt. 7 - Keep existing pumps (Do Nothing!)

PROBLEM NOT COMPLETELY SOLVED

FUTURE IMPROVEMENTS ARE STILL NEEDED TO MEET  
FUTURE CAPACITY NEEDS

# Selected Alternative

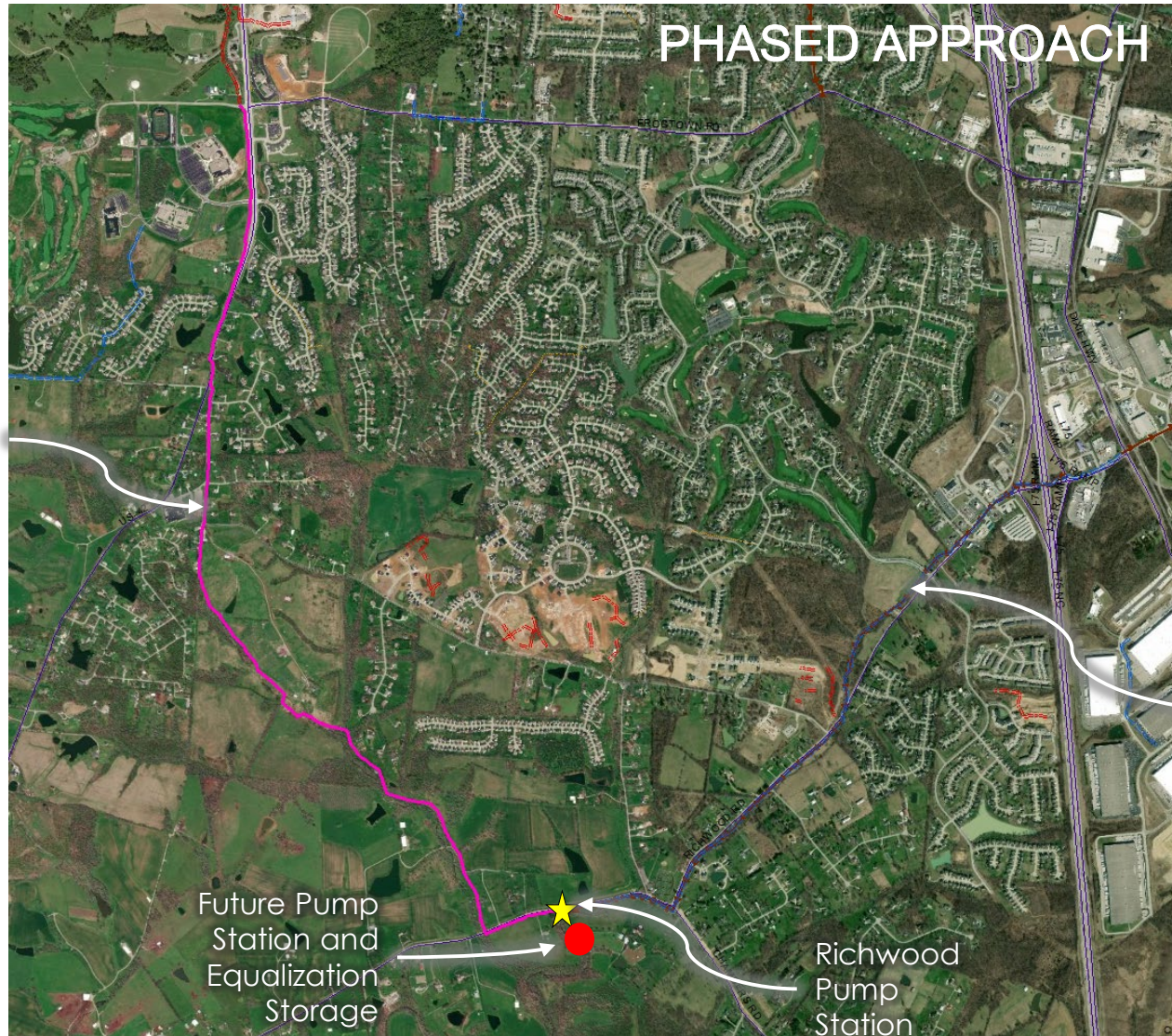
- Replace All Pumps
  - Provides Intermediate Solution to Increase Firm Pump Capacities by >300%, ~7.8 MGD



Graphic Source: Technical Memorandum –  
Richwood Pump Station Alternatives Evaluation,  
Hazen & Sawyer, August 10, 2015



# Additional Future Work



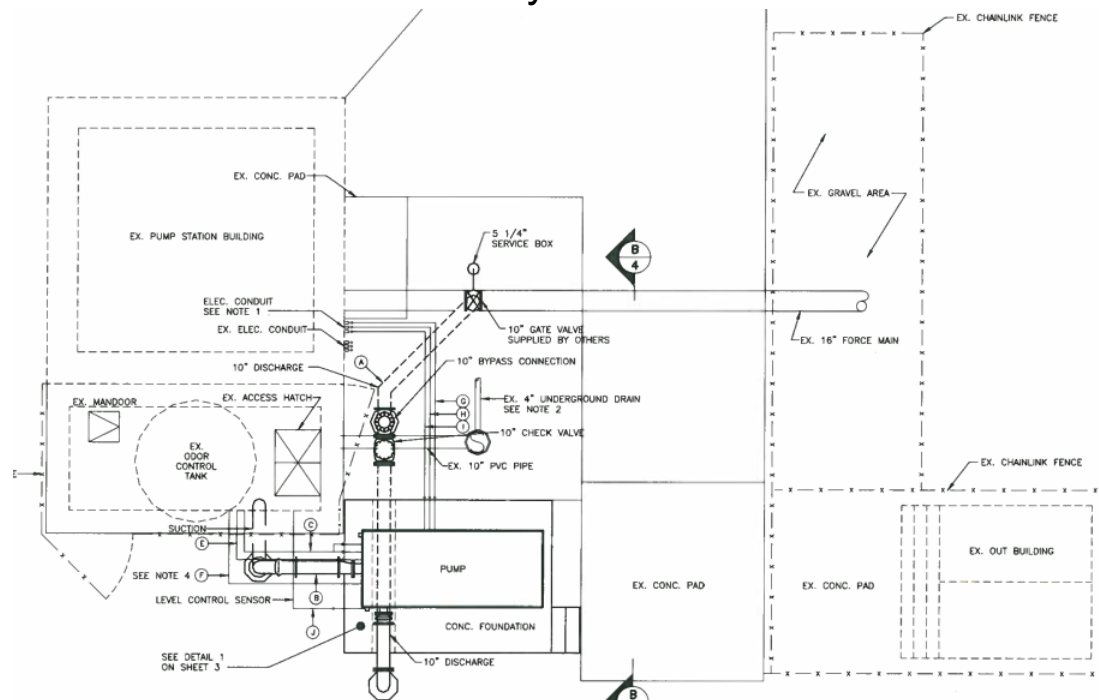
# Detailed Alternative Evaluation

## Main Alternatives

- A - Replace Pumps with Vertical Dry-Pit Submersible Pumps
- B - Convert Station to Submersible Configuration

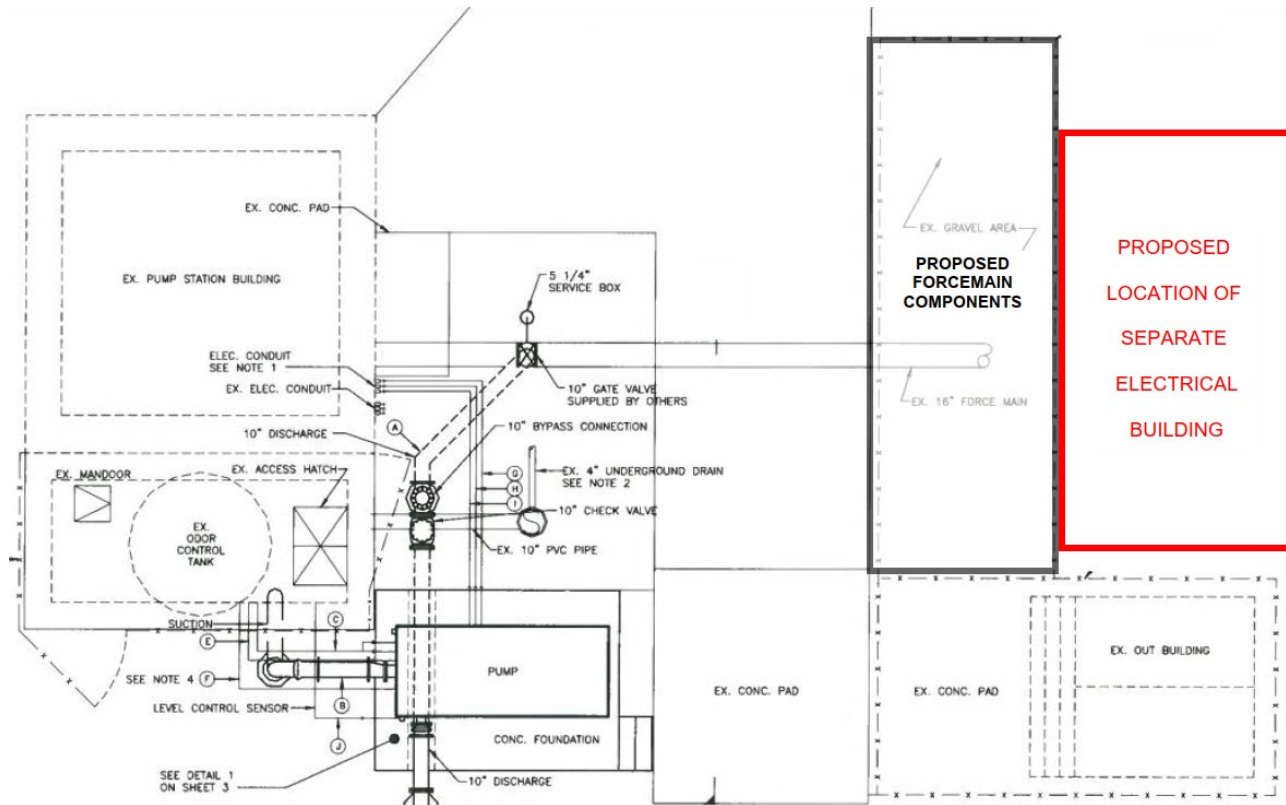
## Sub-Alternatives

- 1 - Construct New Electrical Building Adjacent to Existing Pump Station Building
- 2 - Expand Existing Pump Station Building
- 3 - Install Exterior Electrical Cabinetry



# Detailed Alternative Evaluation

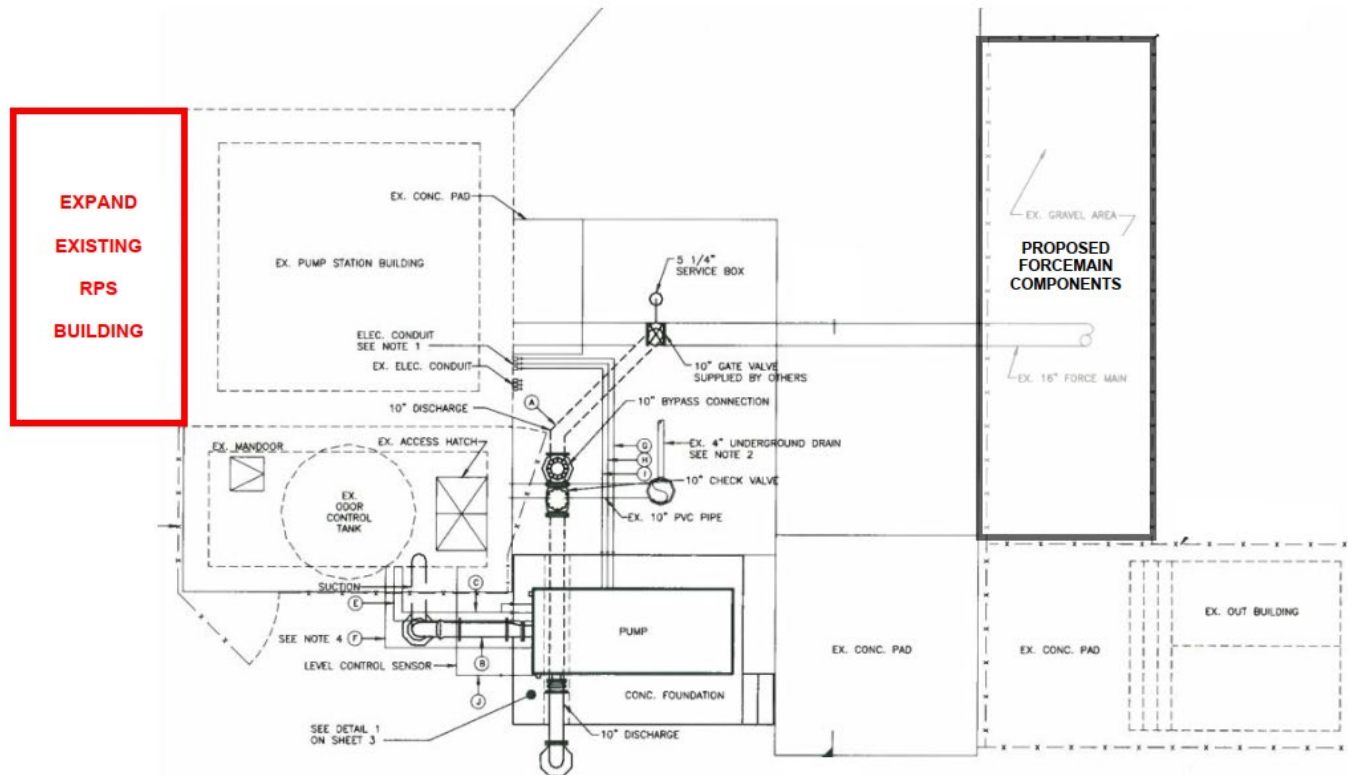
- Alt. A1 – Construct New Electrical Building Adjacent to Existing Pump Station Building





# Detailed Alternative Evaluation

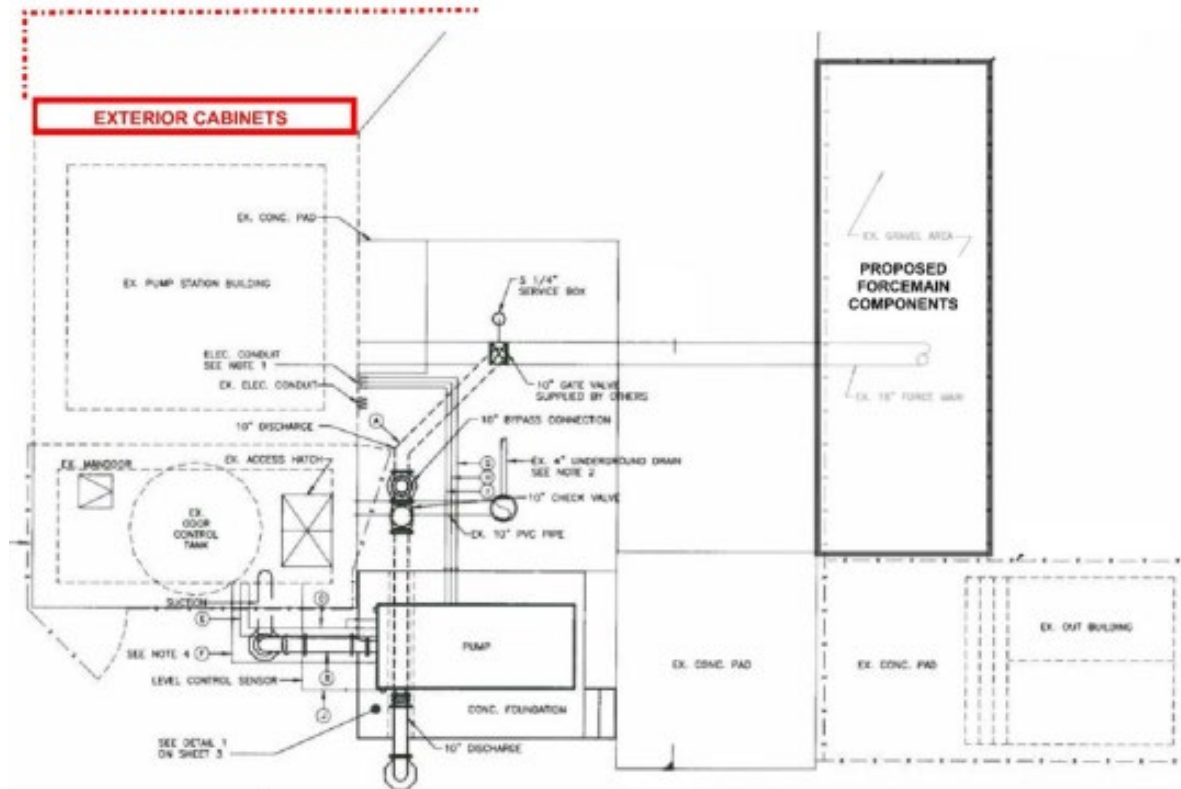
- Alt. A2 – Construct New Electrical Building Adjacent to Existing Pump Station Building





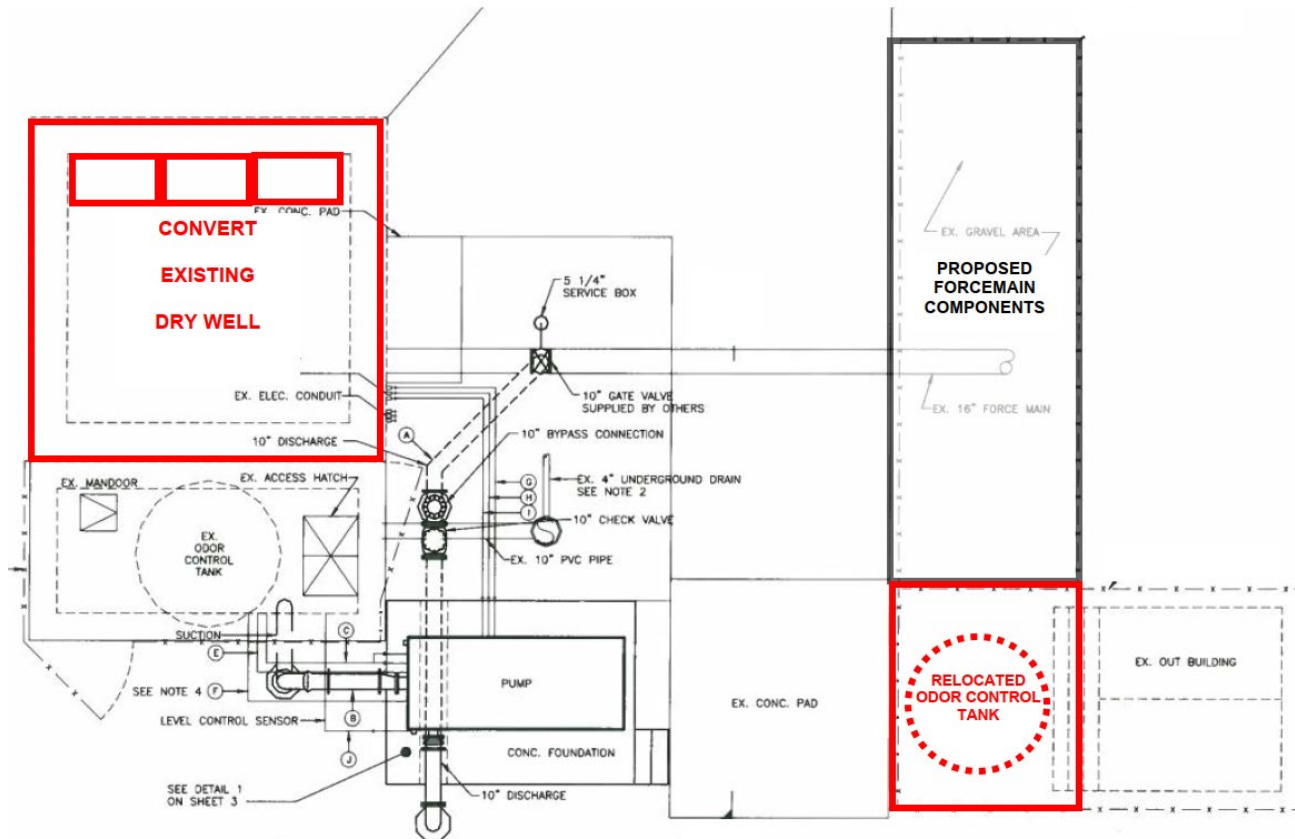
# Detailed Alternative Evaluation

- Alt. A3 – Install Exterior Electrical Cabinetry



# Detailed Alternative Evaluation

- Alt. B – Convert Existing Dry Well to Submersible Wet Well



# Detailed Alternative Comparison

Bid item	Alternative A1 (New Building)	Alternative A2 (Expand Building)	Alternative A3 (Exterior Cabinetry)
Demolition	\$45,000	\$45,000	\$45,000
Structural Improvements	\$130,000	\$115,000	\$50,000
Electrical Improvements	\$490,000	\$480,000	\$530,000
Pumping Equipment	\$680,000	\$680,000	\$680,000
Site Improvements	\$25,000	\$20,000	\$20,000
Land/Easement Acquisition	\$20,000	\$20,000	\$0
Bypass Pumping Needs	\$75,000	\$75,000	\$75,000
Contingency (40%)	\$600,000	\$590,000	\$575,000
<b>Total</b>	<b>\$2,065,000</b>	<b>\$2,025,000</b>	<b>\$1,975,000</b>

**Table 1 Preliminary OPCC–Alternative A/Reuse Existing Dry Well**

Bid item	Alternative B1 (New Building)	Alternative B2 (Expand Building)	Alternative B3 (Exterior Cabinetry)
Demolition	\$45,000	\$45,000	\$45,000
Structural Improvements	\$130,000	\$115,000	\$50,000
Electrical Improvements	\$505,000	\$495,000	\$535,000
Pumping Equipment	\$690,000	\$690,000	\$690,000
Site Improvements	\$25,000	\$20,000	\$20,000
Land/Easement Acquisition	\$20,000	\$20,000	\$0
Bypass Pumping Needs	\$100,000	\$100,000	\$100,000
Contingency (40%)	\$610,000	\$595,000	\$580,000
<b>Total</b>	<b>\$2,125,000</b>	<b>\$2,080,000</b>	<b>\$2,020,000</b>

**Table 2 Preliminary OPCC–Alternative B/Convert to Submersible Station**

# Detailed Alternative Comparison

Bid item	Alternative A1 (New Building)	Alternative A2 (Expand Building)	Alternative A3 (Exterior Cabinetry)
Demolition	\$45,000	\$45,000	\$45,000
Structural Improvements	\$130,000	\$115,000	\$50,000
Electrical Improvements	\$490,000	\$480,000	\$530,000
Pumping Equipment	\$680,000	\$680,000	\$680,000
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Bypass Pumping Needs	\$100,000	\$100,000	\$100,000
Contingency (40%)	\$610,000	\$595,000	\$580,000
<b>Total</b>	<b>\$2,125,000</b>	<b>\$2,080,000</b>	<b>\$2,020,000</b>

**Table 2 Preliminary OPCC–Alternative B/Convert to Submersible Station**

# Detailed Alternative Selection

Bid item	<del>Alternative A1 (New Building)</del>	<del>Alternative A2 (Expand Building)</del>	Alternative A3 (Exterior Cabinetry)
Demolition	<del>\$45,000</del>	<del>\$45,000</del>	\$45,000
Structural Improvements	<del>\$130,000</del>	<del>\$115,000</del>	\$50,000
Electrical Improvements	<del>\$490,000</del>	<del>\$480,000</del>	\$530,000
Pumping Equipment	<del>\$680,000</del>	<del>\$680,000</del>	\$680,000
Site Improvements	<del>\$25,000</del>	<del>\$20,000</del>	\$20,000
Land/Easement Acquisition	<del>\$20,000</del>	<del>\$20,000</del>	\$0
Bypass Pumping Needs	<del>\$75,000</del>	<del>\$75,000</del>	\$75,000
Contingency (40%)	<del>\$600,000</del>	<del>\$590,000</del>	\$575,000
<b>Total</b>	<del><b>\$2,065,000</b></del>	<del><b>\$2,025,000</b></del>	<b>\$1,975,000</b>

**Table 1 Preliminary OPCC–Alternative A/Reuse Existing Dry Well**

Bid item	<del>Alternative B1 (New Building)</del>	<del>Alternative B2 (Expand Building)</del>	<del>Alternative B3 (Exterior Cabinetry)</del>
Demolition	<del>\$45,000</del>	<del>\$45,000</del>	<del>\$45,000</del>
Structural Improvements	<del>\$130,000</del>	<del>\$115,000</del>	<del>\$50,000</del>
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<b>Total</b>	<del><b>\$2,125,000</b></del>	<del><b>\$2,080,000</b></del>	<del><b>\$2,020,000</b></del>

**Table 2 Preliminary OPCC–Alternative B/Convert to Submersible Station**



# Design Constraints

- Available Property (~0.25 ac)
  - 1990 Easement - ~113' x 75'
  - 2002 Easement - ~107' x 20'



# Design Constraints

- Variable Flow Regimes
  - New Jockey Pump rated for 2,500 gpm (3.6 MGD)
    - Selected Pump Operating Range 2,600-840 gpm (3.7-1.2 MGD)
  - New Primary (Wet Weather) Pumps rated for a firm 5,400 gpm (7.8 MGD) and a total 6,944 gpm (10 MGD)
    - Selected Pump Operating Range 5,450-1,500 gpm (7.8-2.2 MGD)

Criteria	New 20-Inch Force Main	Old 16-Inch Force Main
No. of Pumps	1	1
Target Capacity	2,500 gpm (3.6 mgd)	2,500 gpm (3.6 mgd)
Static Head	170 ft	175 ft
Dynamic Head	22 ft	47 ft
TDH	192 ft	222 ft

Dry Weather Conditions – Target Pump Selection Criteria

Criteria	New 20-Inch Force Main	Old 16-Inch Force Main
No. of Pumps	2	2
Target Capacity	6,944 gpm (10 mgd)	6,944 (10 mgd)
Static Head	170 ft	175 ft
Dynamic Head	168 ft	298 ft
TDH	338 ft	473 ft

Wet Weather Conditions – Target Pump Selection Criteria

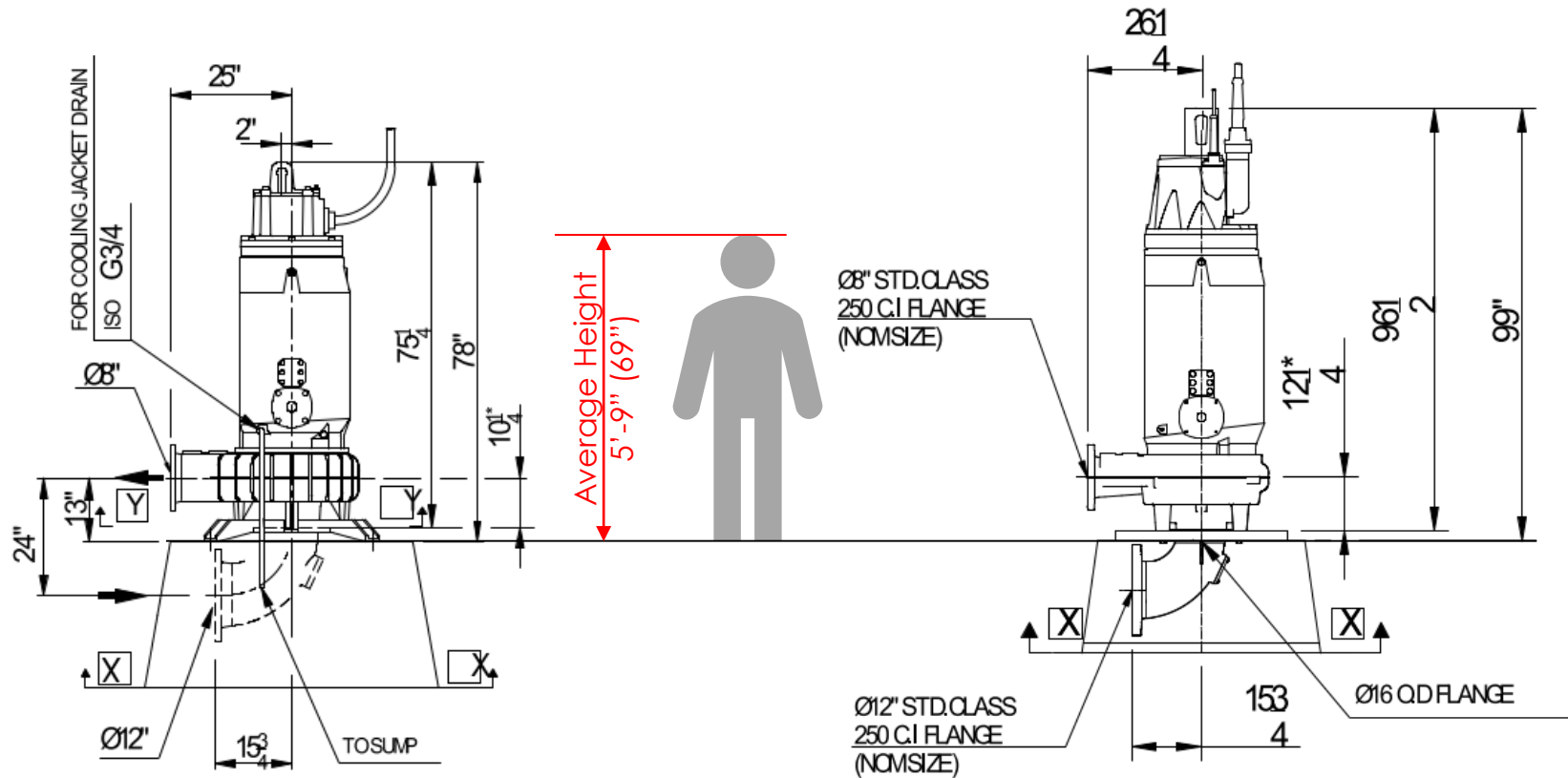
# Pump Selections

- Jockey Pump

- 250 HP, NT 3231/745 3~ 480

- Wet Weather Pumps

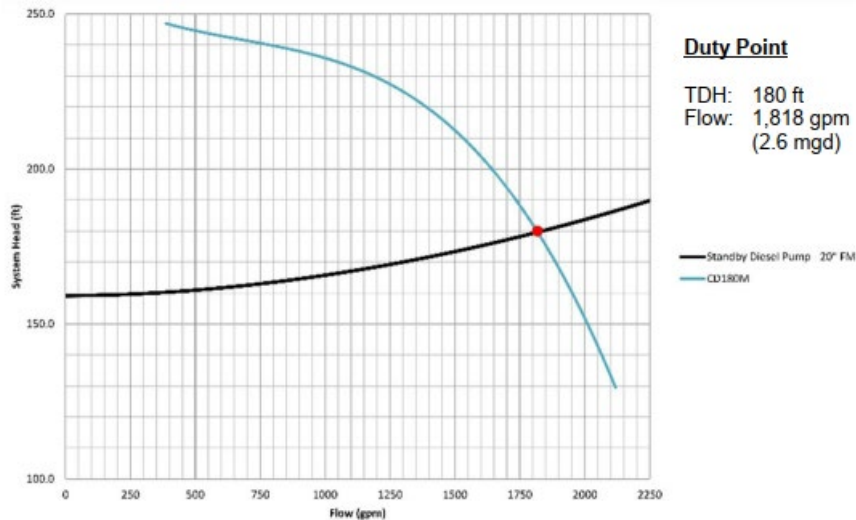
- 455 HP, CT 3240/845 3~ 450





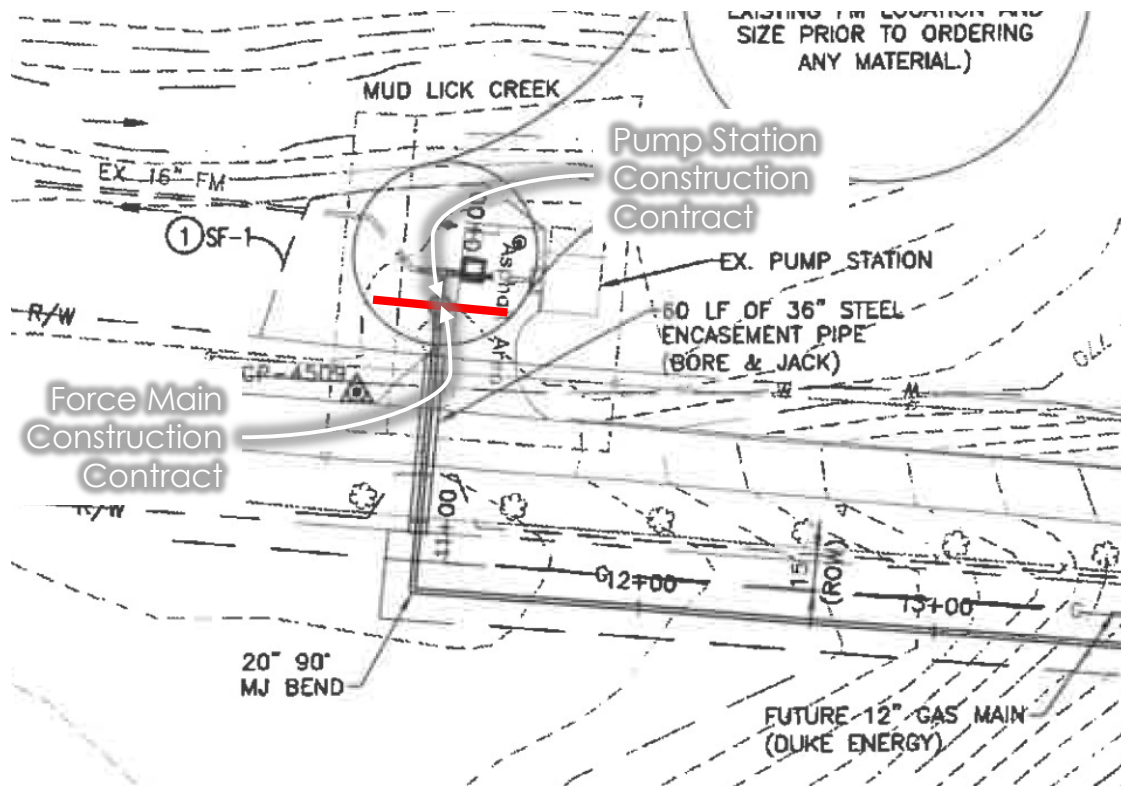
# Design Constraints

- Emergency Pumping Operations
  - Existing Standby Diesel Pump to remain
  - Supplemented by portable standby pump if necessary based on SD1 standard operation procedures



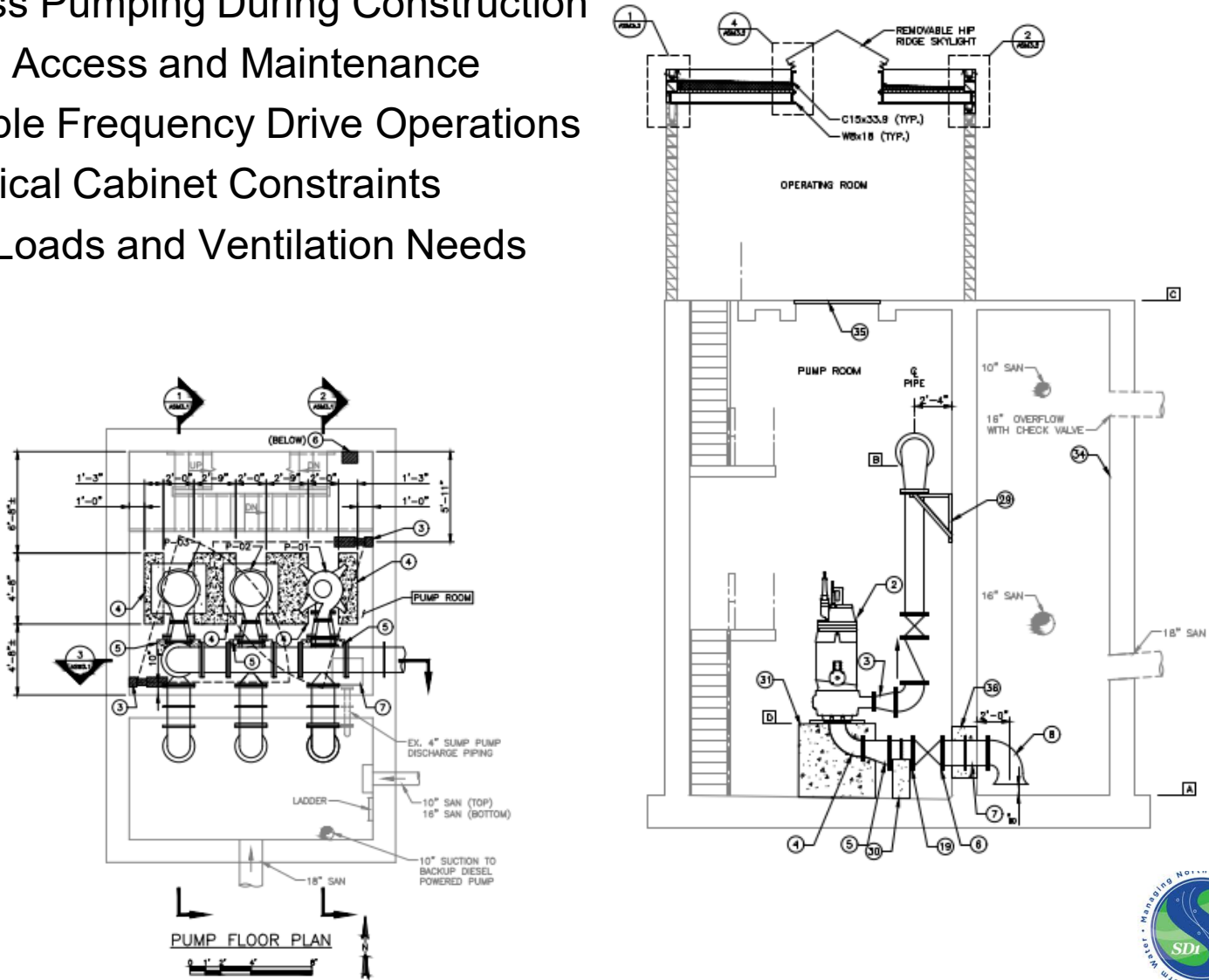
# Design Constraints

- Adjacent Construction Activities



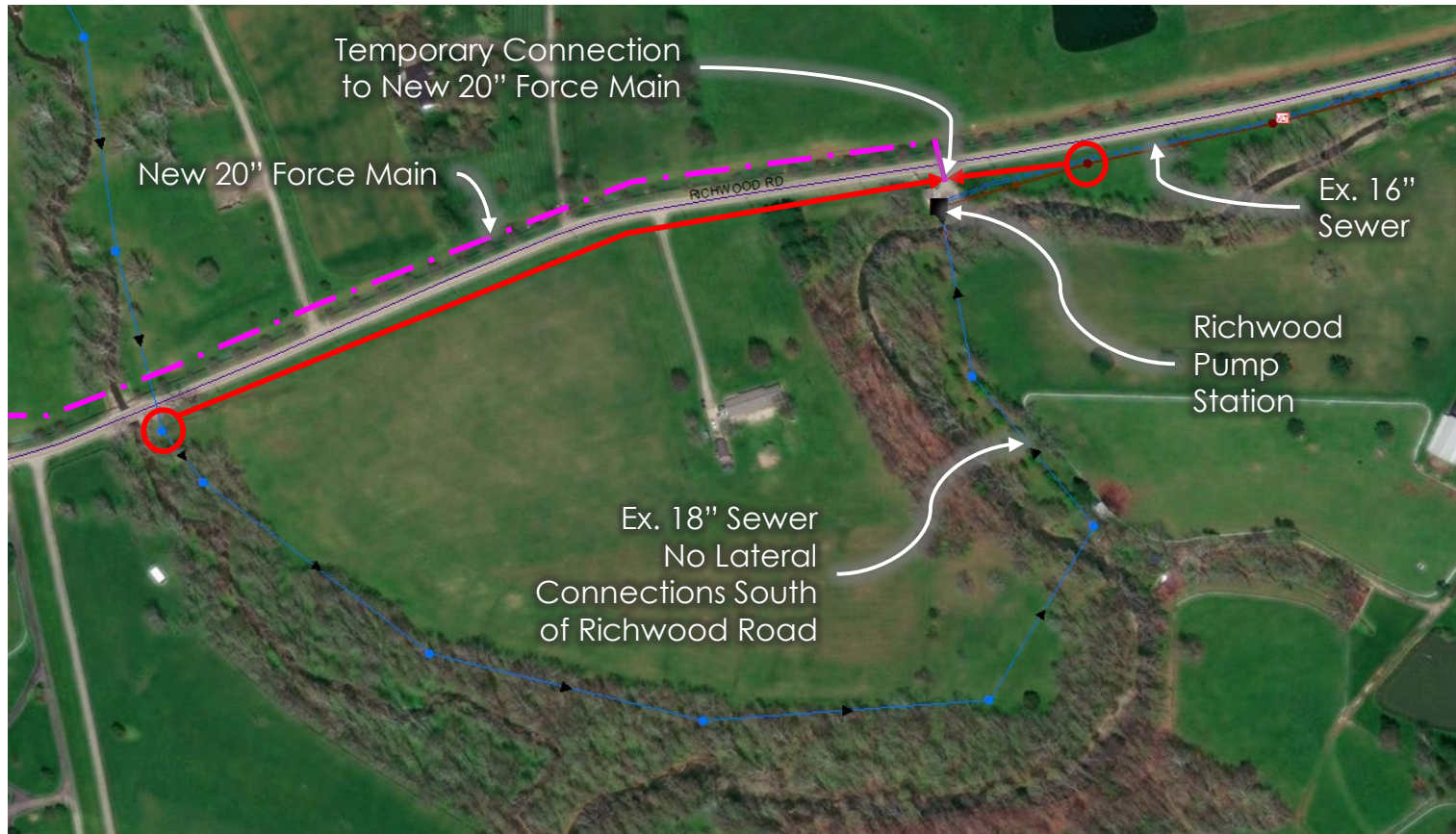
# Design Considerations to Reuse Existing Building

- Bypass Pumping During Construction
- Pump Access and Maintenance
- Variable Frequency Drive Operations
- Electrical Cabinet Constraints
- Heat Loads and Ventilation Needs



# Bypass Pumping During Construction

## Phase 1 – Wet Well Renovations





# Bypass Pumping During Construction

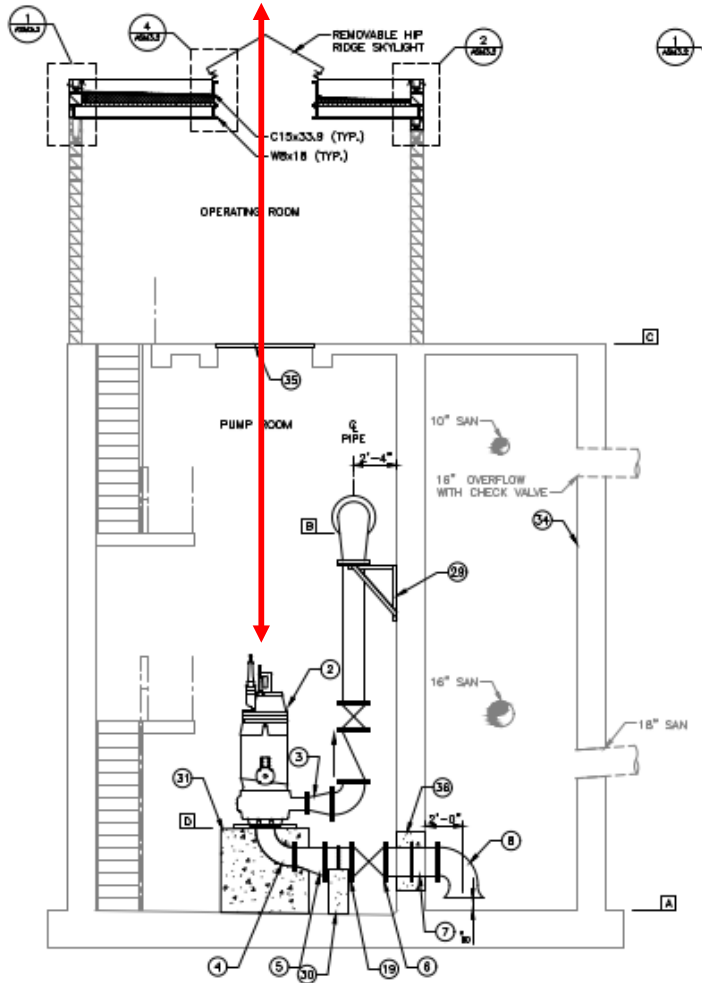
- Phase 1 – Wet Well Renovations



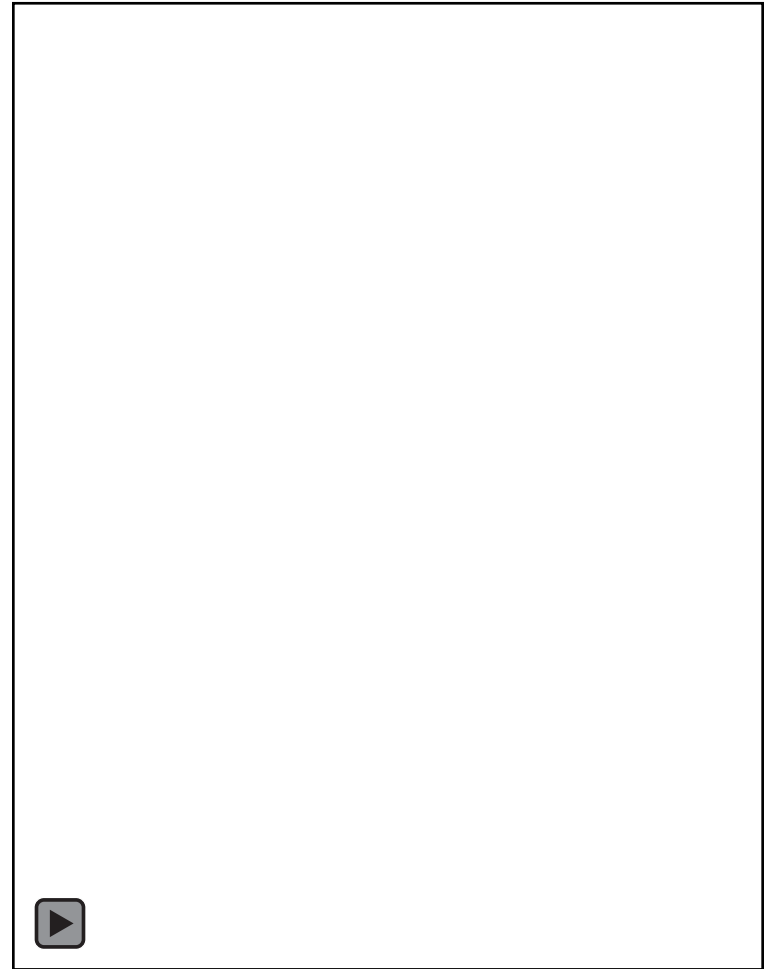
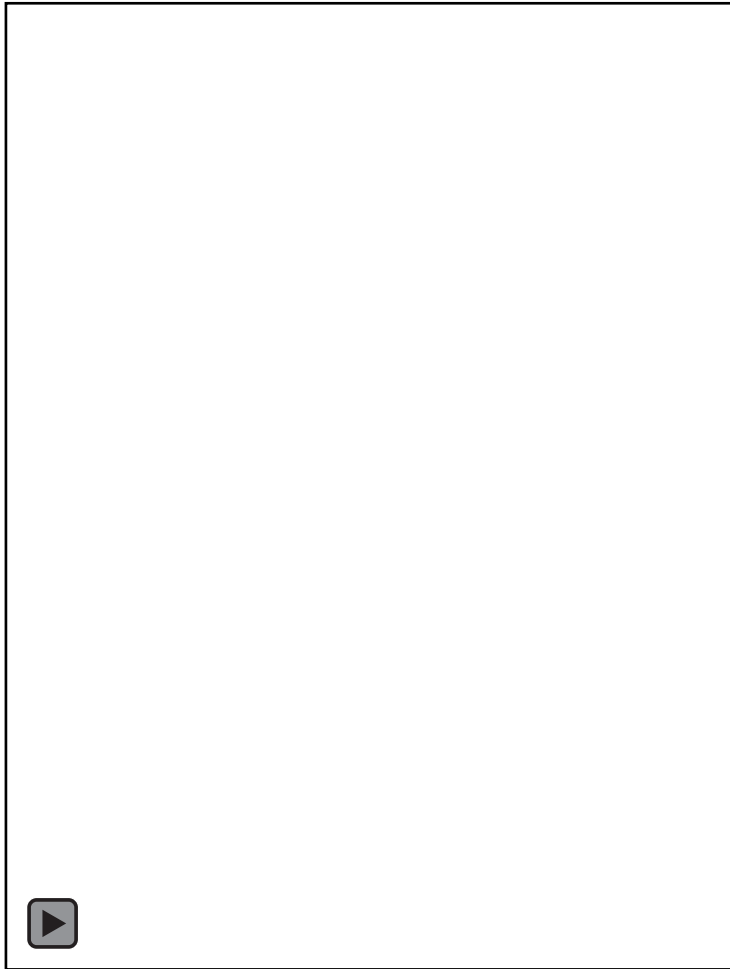
- Phase 2 – Dry Well Renovations



# Pump Access and Maintenance

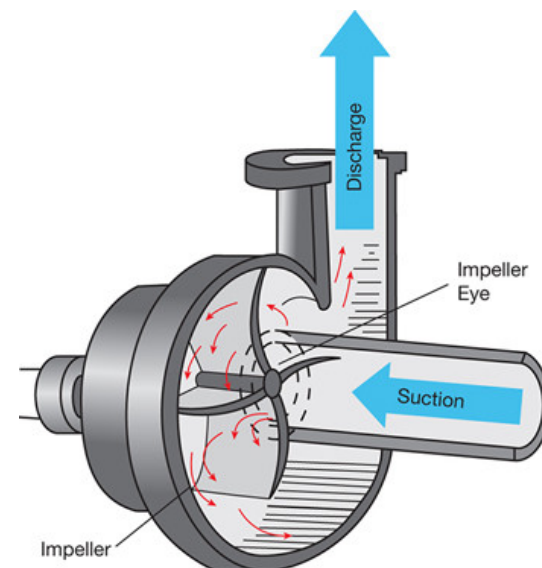


# Pump Access and Maintenance



# Variable Frequency Drive (VFD) Operations

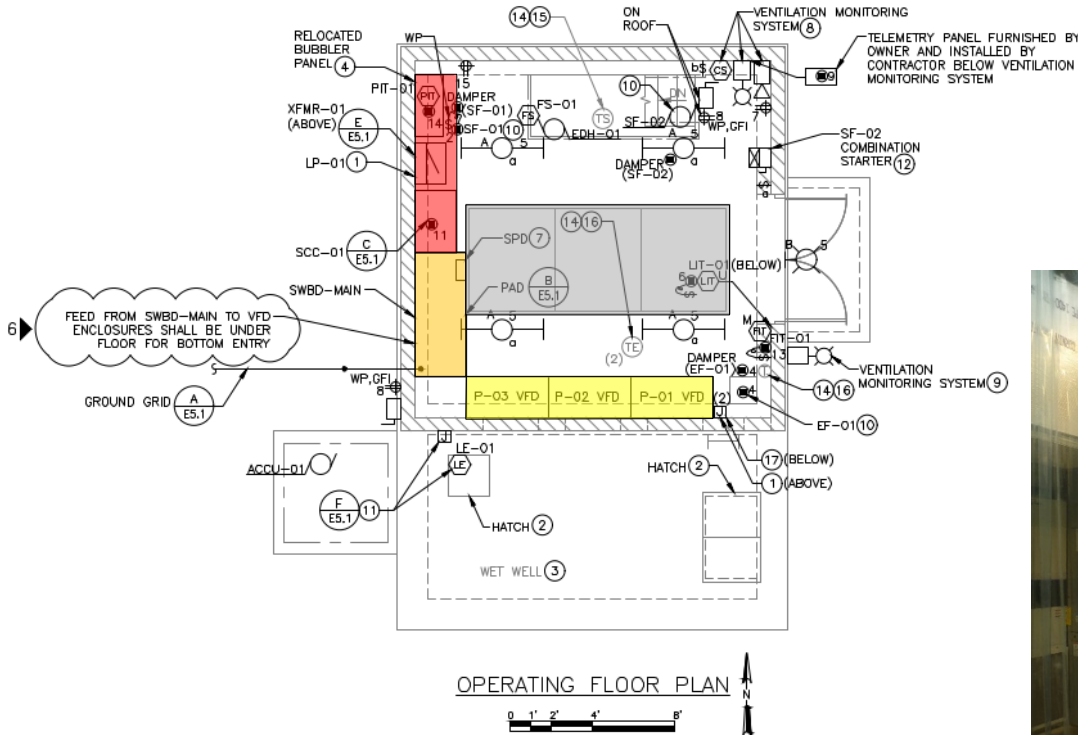
- Allow wet weather pumps to operate in wide array of flow regimes
- Force Main Scouring
  - Primary Wet Weather Pumps will not run during dry weather until development is established
  - Each day at ~1:00 am the well will be permitted to fill and activate one of the wet weather pumps and ramp up to full speed. Pumps alternate each night
- Fibrous Materials (“Flushable Wipes”)
  - Not able to screen influent from both lines
  - VFD will operate pump in reverse at a low frequency at each start up and if excess amp draw is detected.



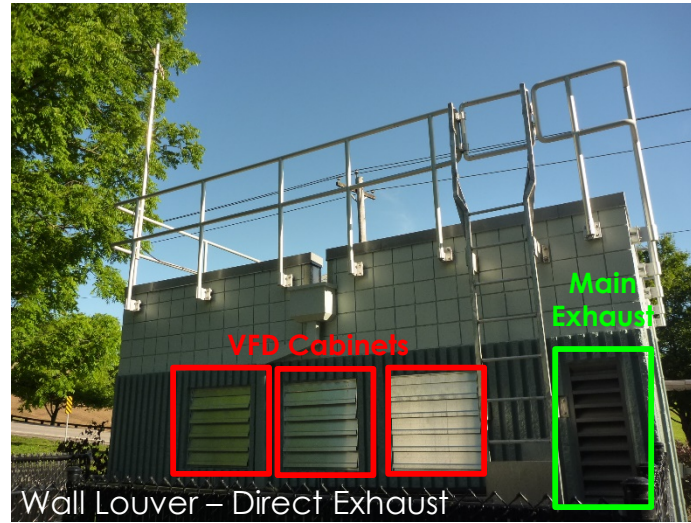


# Electrical Cabinet Constraints

- No need to utilize expensive exterior cabinetry.
- Congested interior layout!



# Heat Loads and Ventilation





# Construction



**BEFORE**

**AFTER**



# Suction Line Installation





# Quick Disconnect - Variance



Safety Procedures – Control of Hazardous Energy Lockout/Tagout Program

## Control of Hazardous Energy Lockout/Tagout (LOTO) Program

29 CFR 1910.147  
29 CFR 1910.333  
803 KAR 2:309

# Congested Construction... From Top





.... To Bottom!





# Requires Unique O&M Considerations

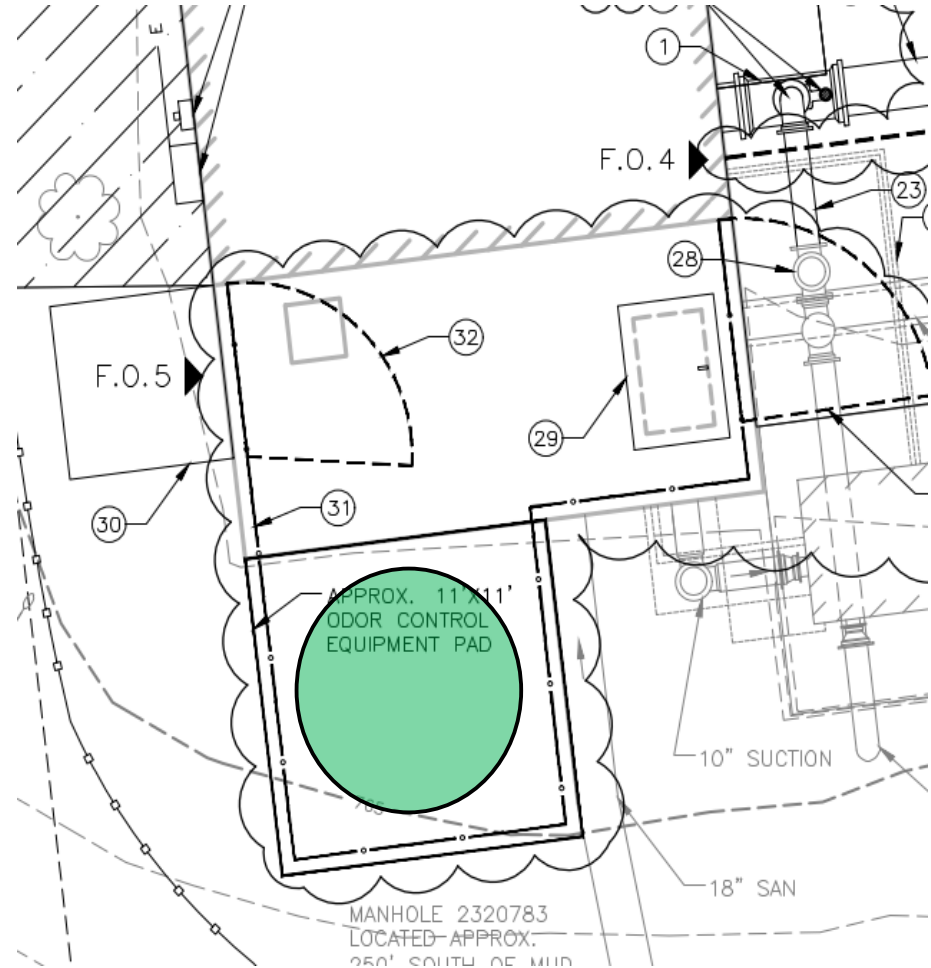




# Construction Modifications Due to Adjacent Construction



# Construction Modifications Due to Adjacent Construction





# Construction Modifications Due to Adjacent Construction





# Finished Product!





# Considerations For Your Next Retrofit Project

- Look into the system to best understand the forecasted changes
- Understand your limitations at the existing site
- Cheapest cost doesn't always mean best alternative. Compare both cost and risk factors to select most appropriate approach forward
- Don't use a square peg in a round hole! Close coordination with O&M staff to determine what techniques can be implemented with available staff capabilities
- Construction **WILL HAVE** issues... design and construction oversight must be flexible

QUESTIONS?

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