Using Existing Infrastructure at the LeSourdsville WRF to Increase Wet Weather Capacity

June 24, 2015

Same Old, Same Old?

'60 '70 '80 '90 '00 '10 '20

Ohio

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BC water & sewer

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Tony Farina, PE

HAZEN AND SAWYER

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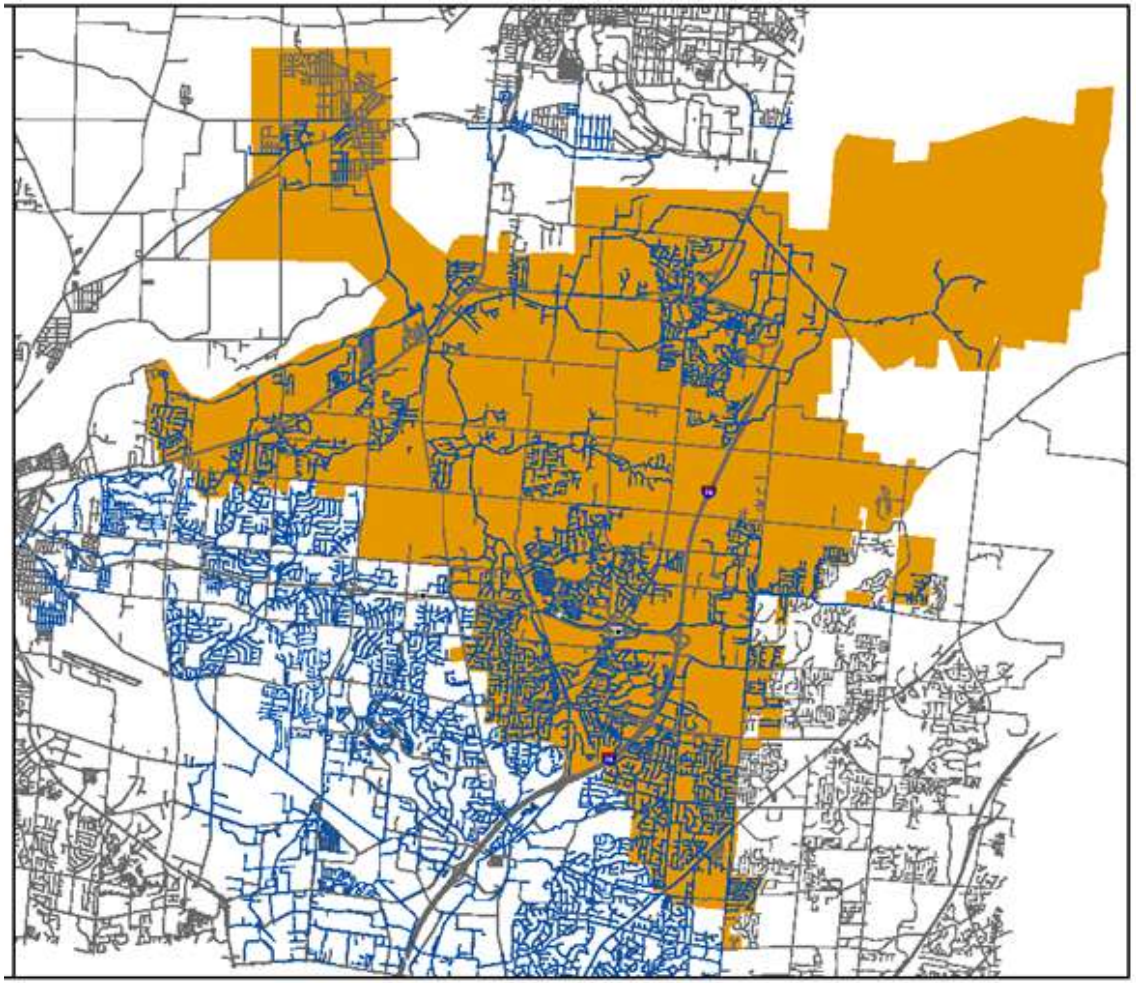
LeSourdsville WRF History

- Original 4 MGD plant constructed in 1974
  - RBCs, tertiary filtration, chlorine disinfection
- Expansion to 6 MGD in 1989
  - 2 MG oxidation ditch added
- Solids improvements in 1992
- Expansion to 12 MGD in 1994
  - 5 MG oxidation ditch, final clarifiers and UV added
- Centrifuge added in 2003

Collection System Master Plan

- Completed in 2007
- Estimated future growth up to buildout
- Estimated peak flows from 2, 5 and 10-year storms



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WRF Master Plan

- Goals:
  - Address reliability and redundancy
  - Plan for future growth and more stringent effluent limits
  - Increase wet weather capacity
  - Evaluate biosolids options
  - Evaluate non-process facilities
- Completed in 2008
- Recommended phased improvements

Prior Configuration

- RBC train taken out of service
- Limited influent pumping capacity (32 MGD total)
- All flows through screening and grit removal with limited capacity

Prior Configuration

- Large oxidation ditch provided majority of biological treatment
  - Small oxidation ditch used only for wet weather and during maintenance of large ditch aerators
- Limited clarifier capacity
- Limited RAS pumping capacity and redundancy

Influent Flow Criteria

Condition	Annual Average Capacity (MGD)	Peak Secondary Capacity (MGD)	Peak Influent Capacity (MGD)[1]
2008	12	32	32
Near-Term	15	36	70
Future	18	54	100

NOTES:
[1] Desired peak influent capacity based on collection system modeling for 6 hr simulated storm event.

Wet Weather Flow Management

- Evaluated combination of flow EQ and optimizing secondary treatment for wet weather
- Considered two alternatives for flow EQ:
  - New flow EQ tanks (prestressed)
  - Convert oxidation ditches to flow EQ

Wet Weather Flow Management

- Estimated EQ storage volumes based on collection system modeling:

Annual Average Capacity (MGD)	EQ Storage Volume (MG)	
	2-Year Storm	5-Year Storm
12	2.5	9.0
15	3.1	11.7
18	3.5	13.1

NOTES:
[1] Volumes determined based on assumed hydraulic capacity of secondary treatment of three times annual average capacity and 6-hour storm. 18 MGD volumes estimated based on extrapolating values for 15 MGD condition.

Wet Weather Flow Management

- Compared estimated construction costs: new EQ tanks approx. 3X converting existing oxidation ditches
- First convert large ditch (5 MG)
- In future, convert small ditch (2 MG) as needed

Secondary Treatment Evaluation

- Used BioWin model to estimate volumes based on anticipated future effluent limits:

Parameter	Anticipated Future Effluent Limits	
	Near Term	Future
TSS (mg/L)	12	12
$CBOD_5$ (mg/L)	9 summer / 10 winter	9 summer / 10 winter
NH_3 (mg/L)	1 summer / 3 winter	1
TP	1 (above 12 MGD)	1
TN	-	5 summer / 10 winter

Secondary Treatment Alternatives

- Considered two alternatives:
  - Existing + new oxidation ditches + additional reactors
  - New conventional activated sludge (CAS) aeration basins
- Estimated construction costs:
  - 15 MGD, summer nit. – CAS approx. 2X OD
  - 18 MGD, year-round nit., bio P – CAS approx. 1.5X OD
  - 18 MGD, BNR – CAS approx. 1.25X OD

Wet Weather Management / Secondary Treatment Evaluation

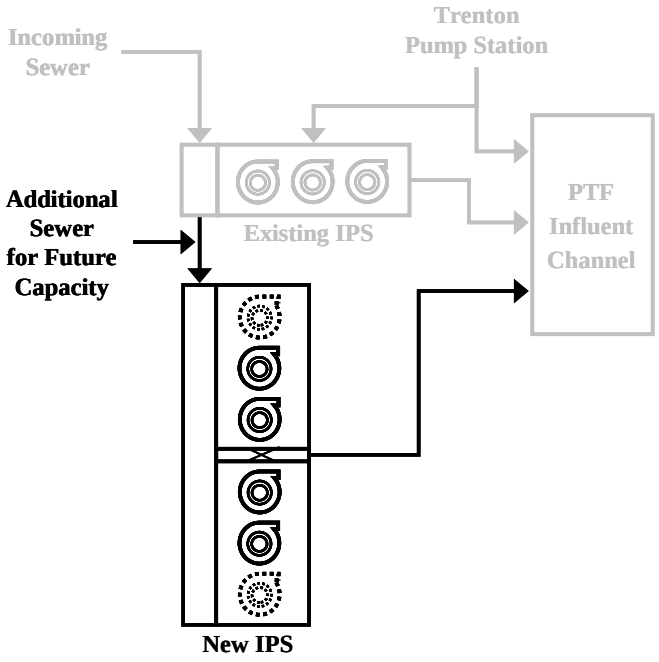
- EQ / secondary treatment combined costs:
  - 15 MGD, summer nit. – approx. same
  - 18 MGD, BNR – CAS < OD
- Selected CAS with conversion of OD to flow EQ
  - Accommodate wet weather flow management (step feed)
  - Additional redundancy (multiple basins)
  - More easily expandable in future for nutrient limits

Influent Pumping

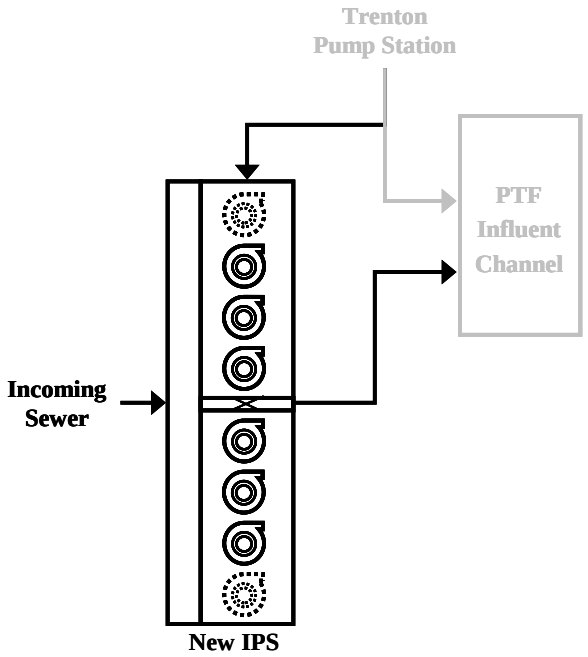
- Limited capacity (32 MGD total), pump maintenance concerns
- Options to increase influent pumping capacity:
  - Rehab existing pump station + construct small new pump station
  - Demo existing pump station + construct large new pump station
- Size influent pumping firm capacity to match projected peak influent flows (70 MGD, expandable to 100 MGD)

Influent Pumping

Rehab Existing + Construct New



Demo Existing + Construct New



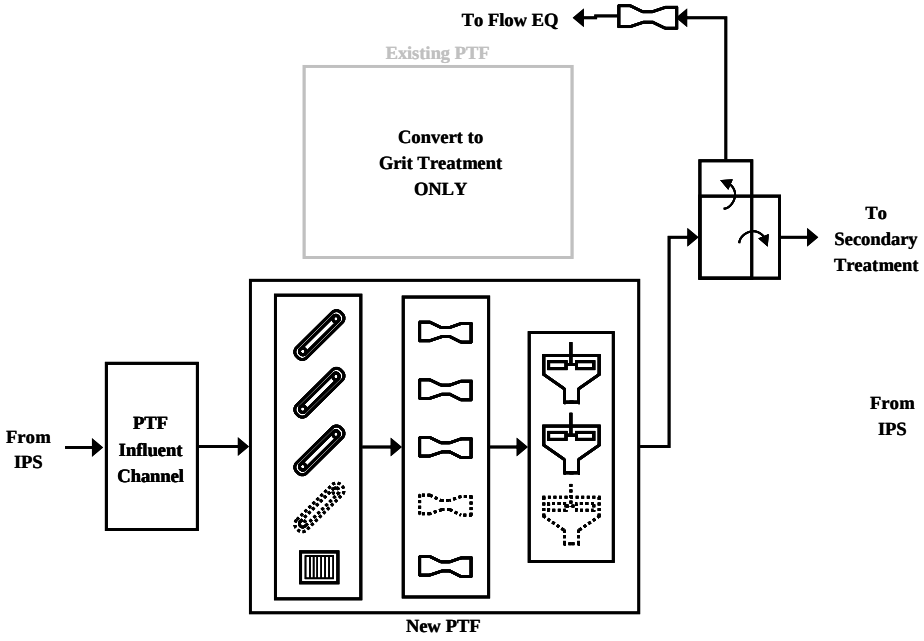
- Similar estimated construction costs – demo existing / construct new selected based on site constraints

Preliminary Treatment

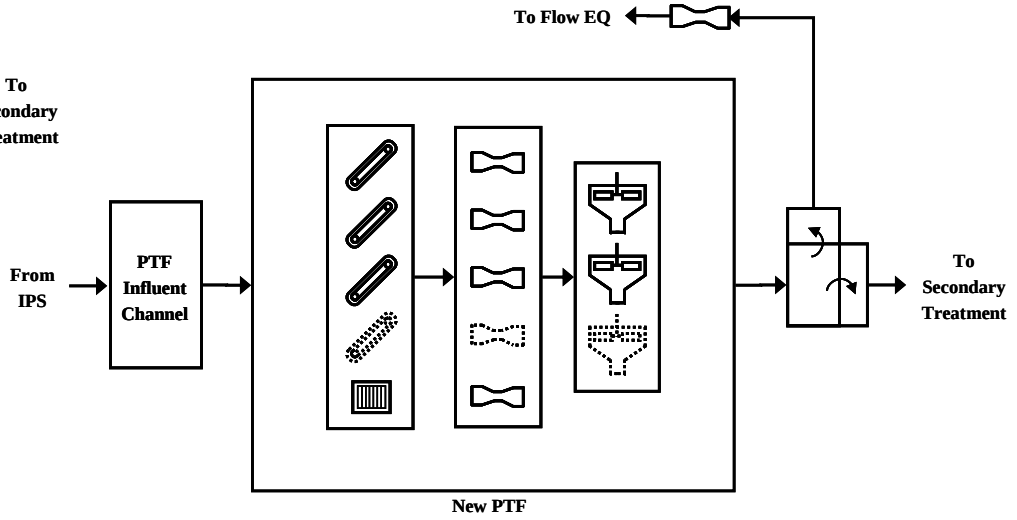
- Options to increase screening and grit removal capacity:
  - Construct new screening and grit removal facility + use existing facility for grit dewatering
  - Demo existing structure and construct new screening and grit removal facility
- Size screening/grit removal capacity to match projected peak influent flows (70 MGD, expandable to 100 MGD)

Preliminary Treatment

Existing Grit Dewat. + Construct New



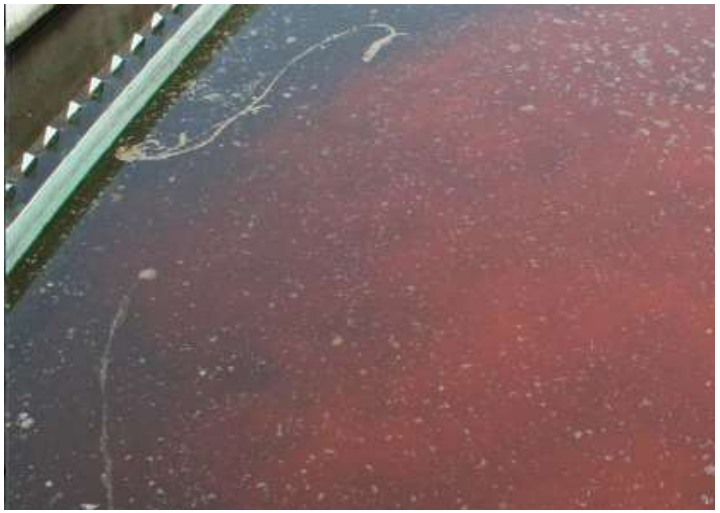
Demo Existing + Construct New



- Similar estimated construction costs – demo existing / construct new selected based on site constraints

Final Clarifiers and RAS Pumping

- Clarifier stress testing
  - Addition of EDI and density baffles recommended to improve performance
- Other improvements needed:
  - Improved scum removal
  - Additional clarifiers for increased secondary capacity
  - Increased RAS pumping capacity and redundancy



Phased Improvements

- Phase 1 – more immediate needs (smaller project)
- Phase 2
  - Increase capacity from 12 MGD to 15 MGD
  - Increase wet weather capacity from 32 MGD to 70 MGD
    - 5 MG flow EQ
  - Accommodate future expansion
- Future
  - 18 MGD capacity
  - 100 MGD wet weather capacity
    - 2 MG additional flow EQ if needed
  - Biological nutrient removal if needed

Phase 1 Improvements

- Completed in 2009
- Addition of second centrifuge
- New vactor unloading and septage receiving stations
- RBC train removed
  - More space for vehicles and material storage

Phase 2 Improvements

- In operation in 2014
- New Influent Pump Station (submersible)
- New Preliminary Treatment Facility
- Convert Oxidation Ditches to Flow EQ
- New Aeration Basins and Blower Building
- New Final Clarifier, Replace Existing Mechanisms
- Expand RAS Pump Station

Screenings Removal Alternatives

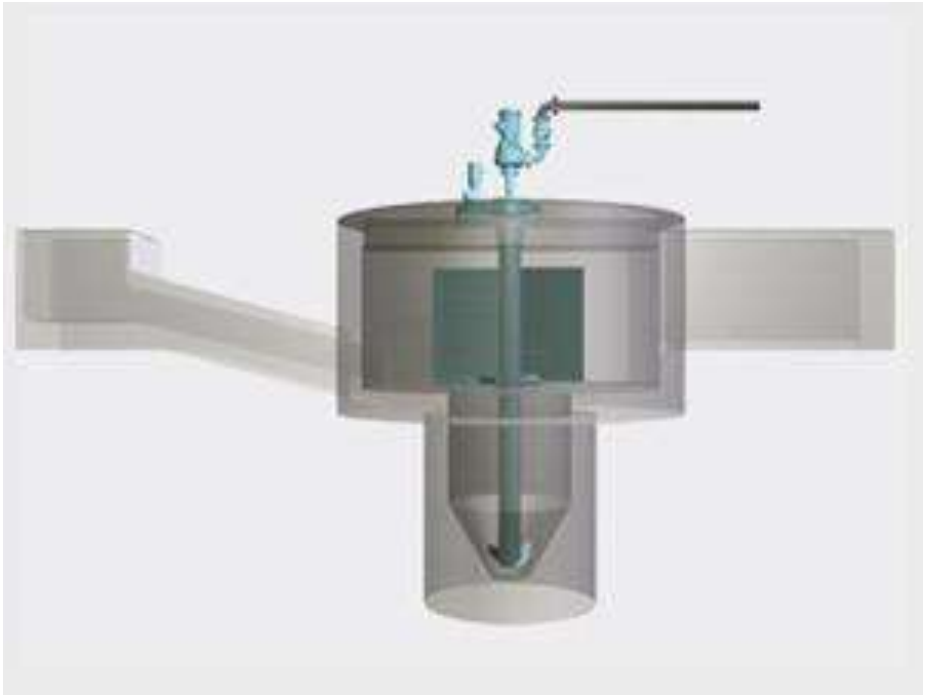
- Traveling Rake
  - Similar to previous mechanical bar screen (Parkson Aquaguard)
  - Less removal than perforated plate
  - Less headloss
- Perforated Plate
  - New type of screen to plant staff
  - Greater removal than traveling rake
  - Greater headloss
- Selected perforated plate screens due to increased screenings removal

Grit Removal Alternatives

- Grit sampling performed to assess particle sizes and quantities
  - Approx 30% < 300 micron
  - Approx 10% < 150 micron
- Considered two types of grit removal basins: stirred vortex and stacked tray
  - Similar footprint, similar estimated construction cost
  - Selected stacked tray for increased grit removal

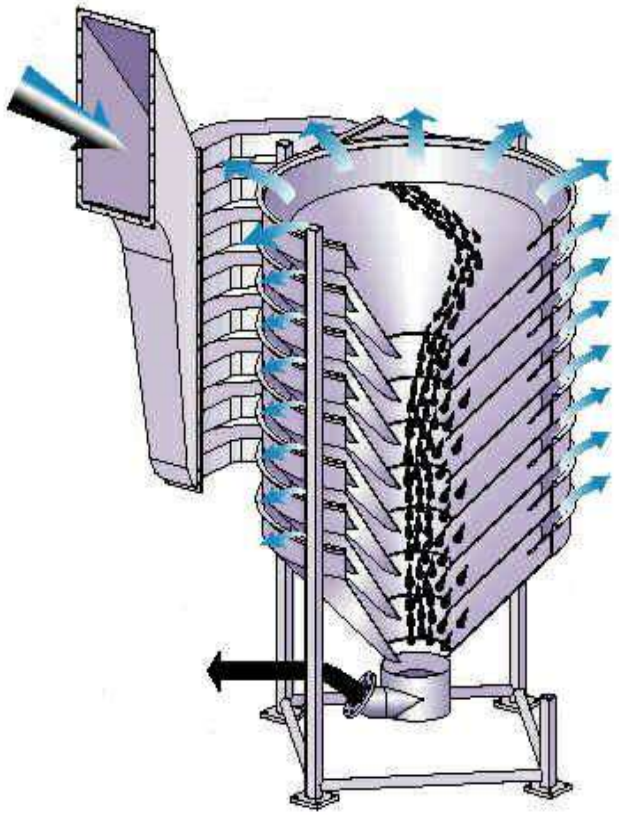
Grit Removal Alternatives

Stirred Vortex



Courtesy: Smith & Loveless

Stacked Tray

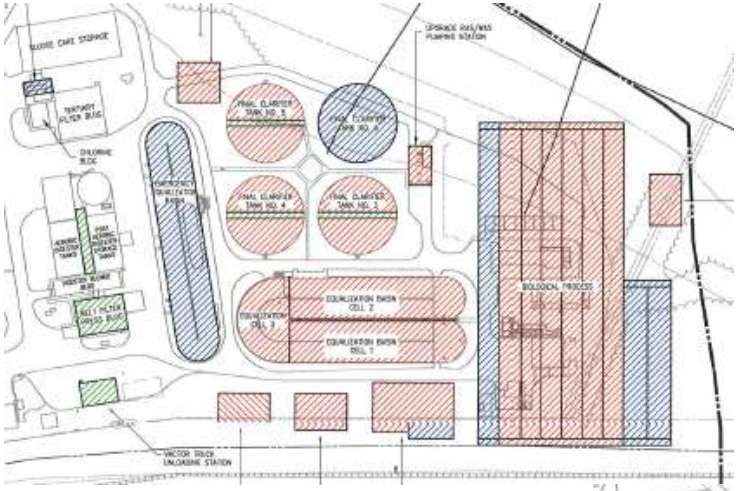


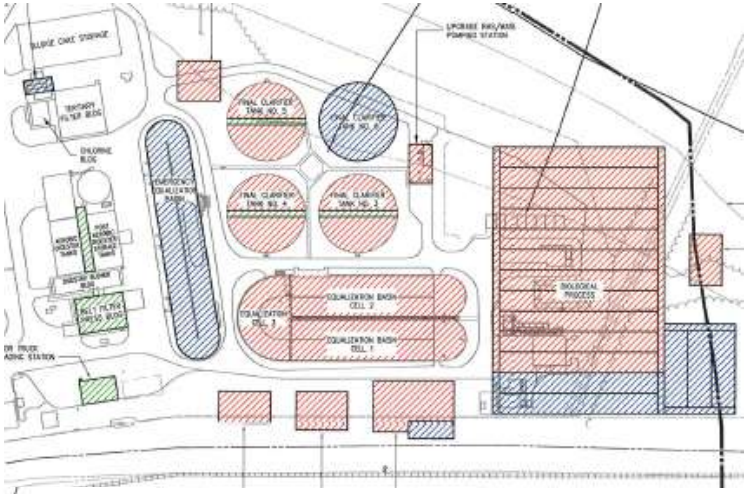
Courtesy: Hydro International

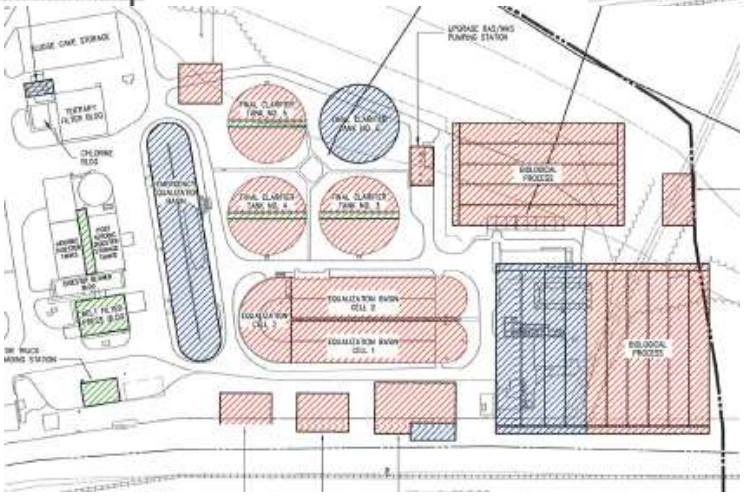
EQ Basin Aeration / Washdown Alternatives

- Aeration alternatives considered:
  - Floating aerators
  - Blowers / coarse bubble diffusers
  - Jet aeration
  - Floating aerators selected (lower cost)
- Washdown alternatives considered:
  - Water cannons
  - Tipping buckets
  - Flushing gates
  - Water cannons selected (lower cost, greater flexibility)

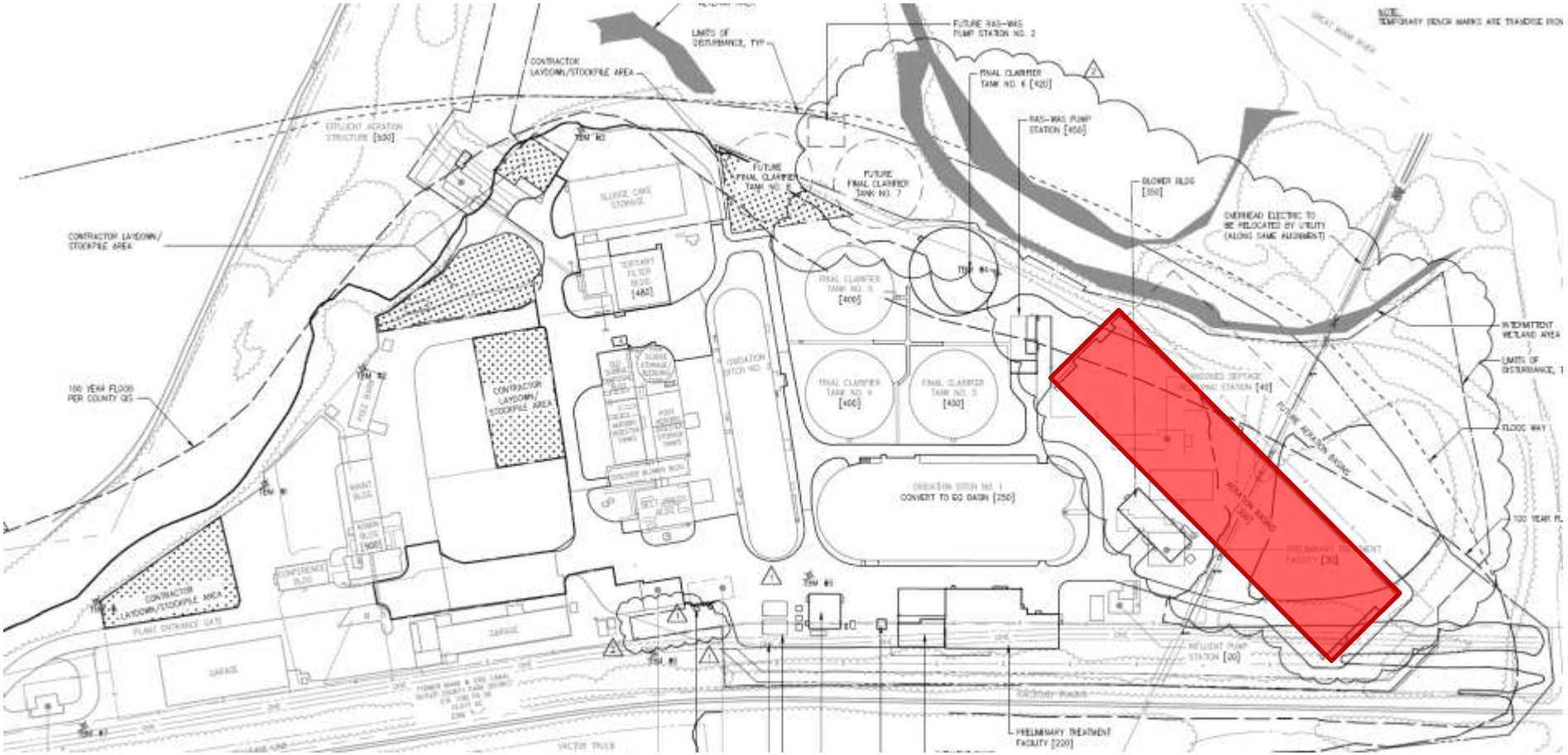
Aeration Basin Layout Alternatives







Aeration Basin Selected Layout



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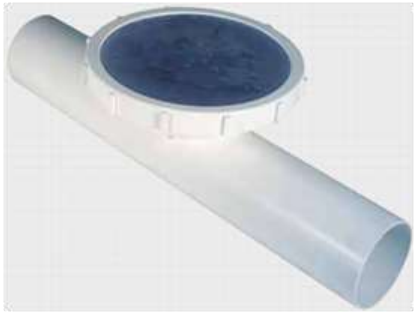
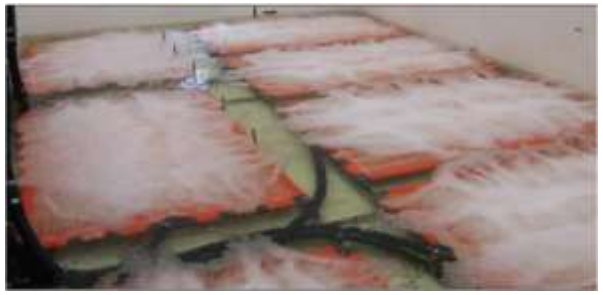
Aeration Basin Diffuser Alternatives

- Evaluated multiple types of fine bubble membrane diffusers:



Discs

Tubes



Panels

- Selected discs (lowest overall net present worth)

Aeration Basin Blower Alternatives

- Evaluated multiple types of blowers:
  - Multi-stage centrifugal
  - Integrally geared single-stage centrifugal
  - High speed direct drive centrifugal
- Selected high speed direct drive blowers (air foil bearing) based on reduced maintenance and operating range

Final Clarifiers and RAS Pumping

- Clarifiers:
  - New clarifier, rehab existing
  - Sludge scraper mechanisms to match existing config.
  - Full radius scum removal
  - Energy dissipating inlet and density baffles to improve flocculation and settling
- RAS pumps:
  - New pumps – one per clarifier plus standby
  - Expand existing pump station structure to reduce construction cost

Overall Objectives

- Increased dry weather and wet weather capacity
  - Influent pumping
  - Screening and grit removal
  - Flow EQ
  - Biological treatment
  - Clarifiers and RAS pumping
- Increased redundancy and reliability
- Accommodate future expansion, effluent limits
- Reuse existing facilities / infrastructure where possible to reduce cost

Photos of New / Retrofitted Facilities

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Acknowledgements

- Butler County Water and Sewer Department
  - Steve Seitz, PE – Chief Engineer
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  - LeSourdsville WRF Operations and Maintenance Staff
- Hazen and Sawyer Team

Questions?

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