

An aerial photograph of a large water treatment facility. In the foreground, there are several large circular aeration tanks with metal walkways and railings. The middle ground shows various industrial buildings and structures. In the background, the dense Chicago skyline is visible under a clear blue sky with some light clouds. A prominent water tower with the name 'STICKNEY' is visible on the right side of the skyline.

On the Road to 2040:
**AN UPDATE ON THE IMPLEMENTATION
OF THE MWRDGC'S MASTER PLANS**

THOMAS E. KUNETZ, P.E.
Assistant Director of Engineering

**Metropolitan Water Reclamation District
of Greater Chicago**

December 11, 2009

A "Road Map to the Future":

Where Do We
Need to be in
40 Years, and
How Do We
Get There?



HISTORY OF THE MASTER PLANS

- 2000: Recognized Need for a Comprehensive Plan to Address Major Plant Shortcomings at Stickney**
 - 40 Year Planning Horizon (2040)**
 - 20 Year Improvement Projects (2020)**
- 2003: Initiated First Master Plan Work at Stickney**
- 2004: Completed Stickney Master Plan**
- 2005: Completed Calumet Master Plan**
- 2007: Completed North Side Master Plan**
- 2008: Started Hanover Park Master Plan**

Objectives of the Master Plan Process:

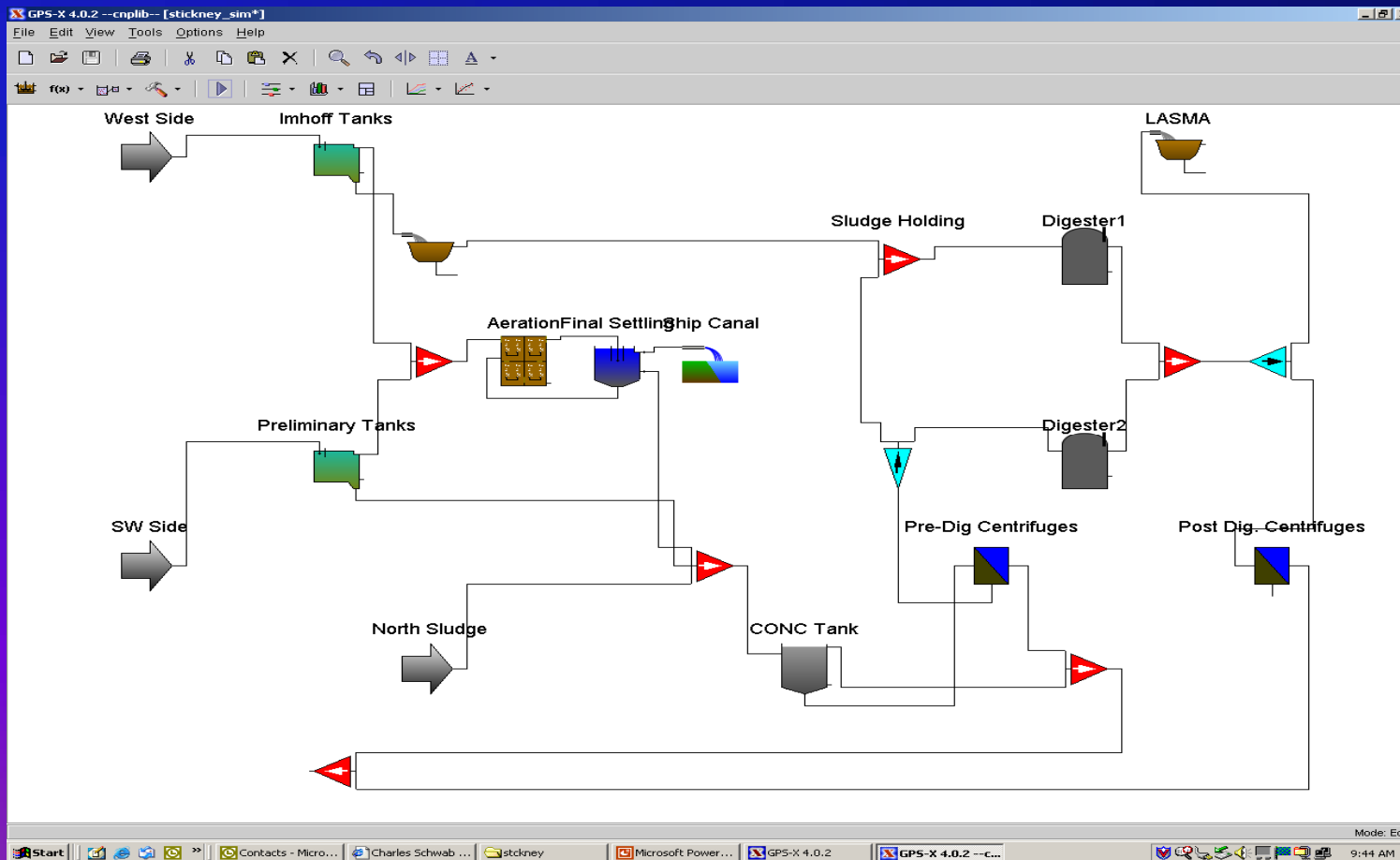
1. **Assess Future Flows and Pollutant Loadings**
2. **Maintain the Treatment Capacity of the Plant through the Year 2040 Projected Flows**
3. **Replace/Upgrade Undersized or Underperforming Unit Processes**
4. **Review Opportunities with Respect to Process Changes**

Objectives of the Master Plan Process:

5. Provide Sustained Treatment Capability for TARP Phase II Reservoir Pumpback (Stickney & Calumet)
6. Prepare to Respond to Changes in Potential Regulations (Nutrient Removal, Disinfection)
7. Standardization of Processes and Equipment Between Plants Where Practical

Products:

1. Master Plan Prioritizing Capital Improvement Projects Over the Next 20 Years
2. Computer Model of the Plant Processes for Future Analysis Using GPS-X Model





MWRDGC

PROCUREMENT

**MAINTENANCE
& OPERATIONS**

FINANCE

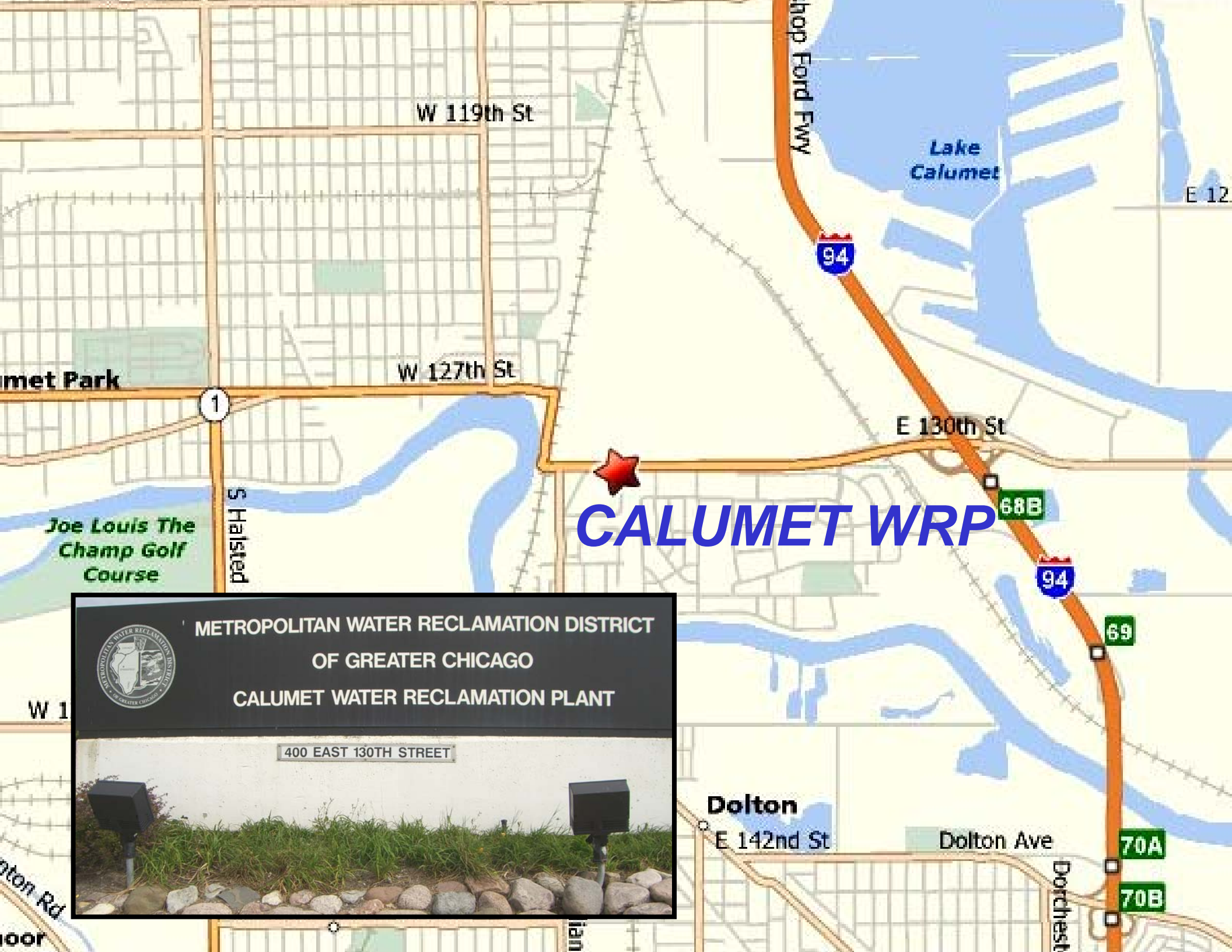
**INFORMATION
TECHNOLOGY**

**HUMAN
RESOURCES**

ENGINEERING

**MONITORING
& RESEARCH**

LAW



W 119th St

Lake Calumet

94

Calumet Park

W 127th St

1

E 130th St

Joe Louis The Champ Golf Course

S Halsted

CALUMET WRP

68B

94

69

METROPOLITAN WATER RECLAMATION DISTRICT
OF GREATER CHICAGO
CALUMET WATER RECLAMATION PLANT

400 EAST 130TH STREET

Dolton

E 142nd St

Dolton Ave

70A

70B

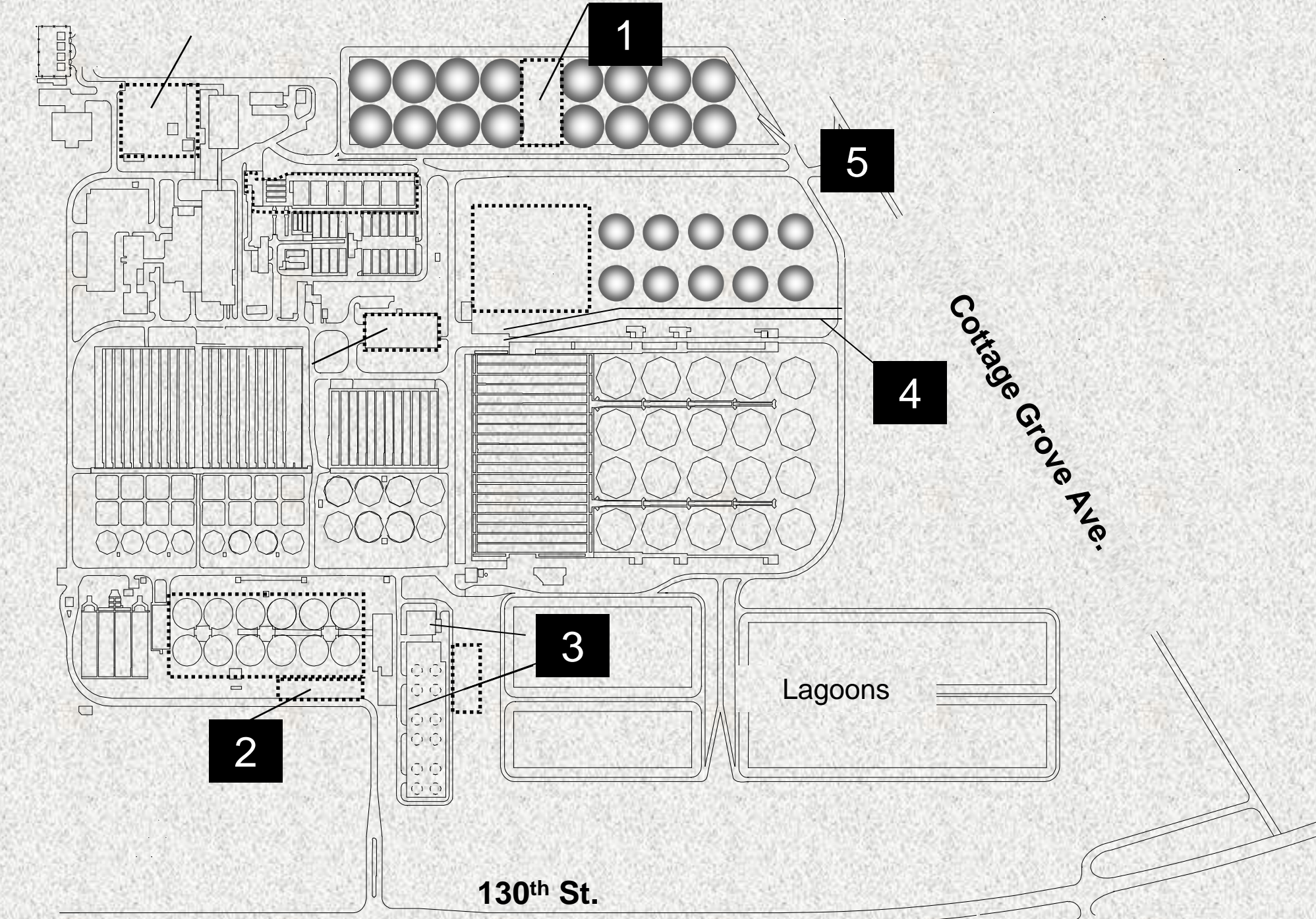
Dorchester

Dorchester Rd
Dorchester

CALUMET WRP



CALUMET WRP MASTER PLAN



NEW HIGH LEVEL INFLUENT PUMPING STATION

- 480 MGD Firm Capacity
- 5 Mechanically Cleaned Bar Screens
- Operating Engineer's Room
- Electrical Operator's Room
- Odor Control
- Construction Completion 2010

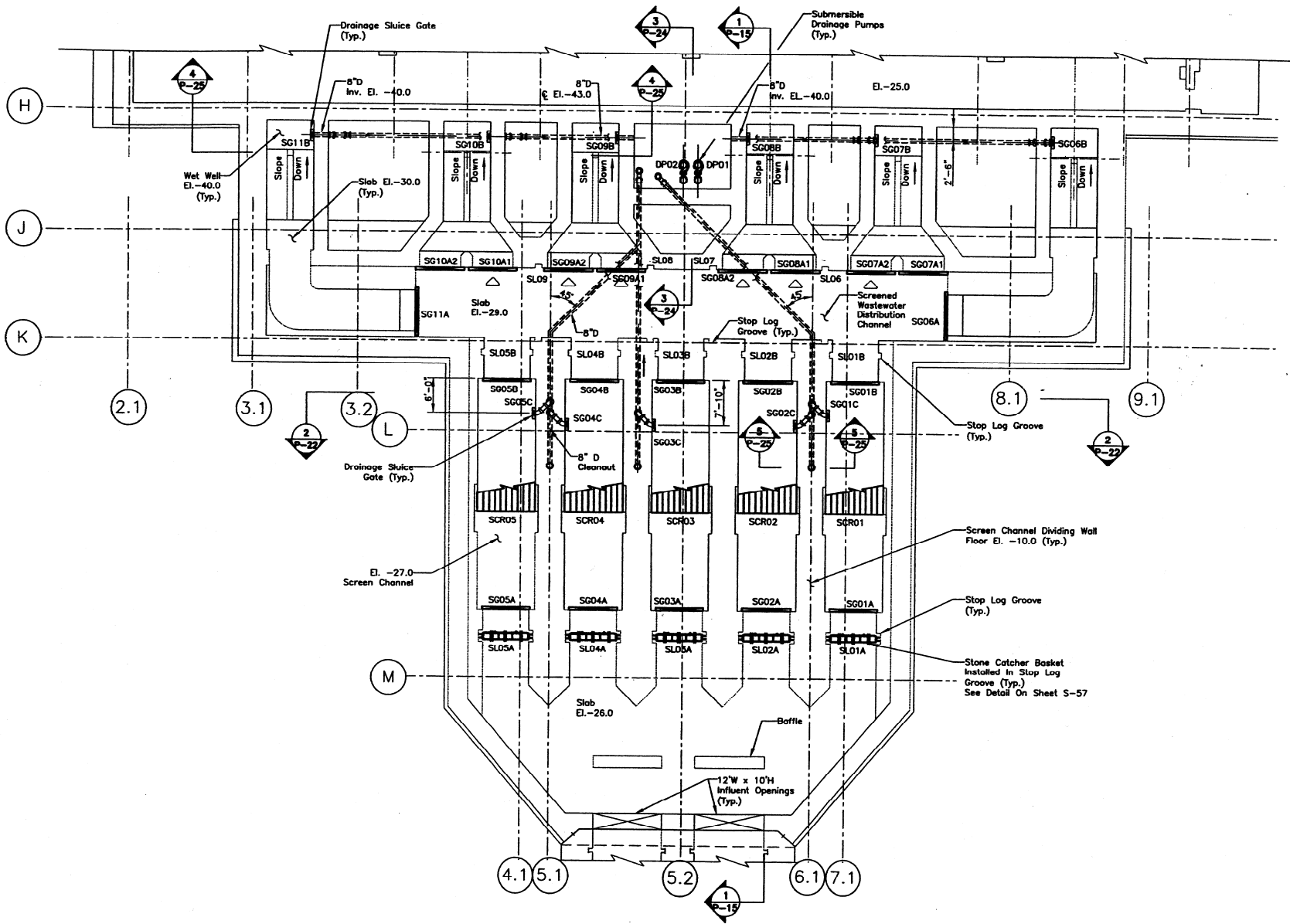


NEW HIGH LEVEL INFLUENT PUMPING STATION



NEW HIGH LEVEL INFLUENT PUMPING STATION





Screen Building And Wet Wells Plan At Elev. -27.0

Scale: 1/8"=1'-0"

Screens and Pump Influent Channel



Screen Room

INTERIOR OF THE NEW HIGH LEVEL INFLUENT PUMPING STATION



Six 120 MGD Centrifugal Pumps

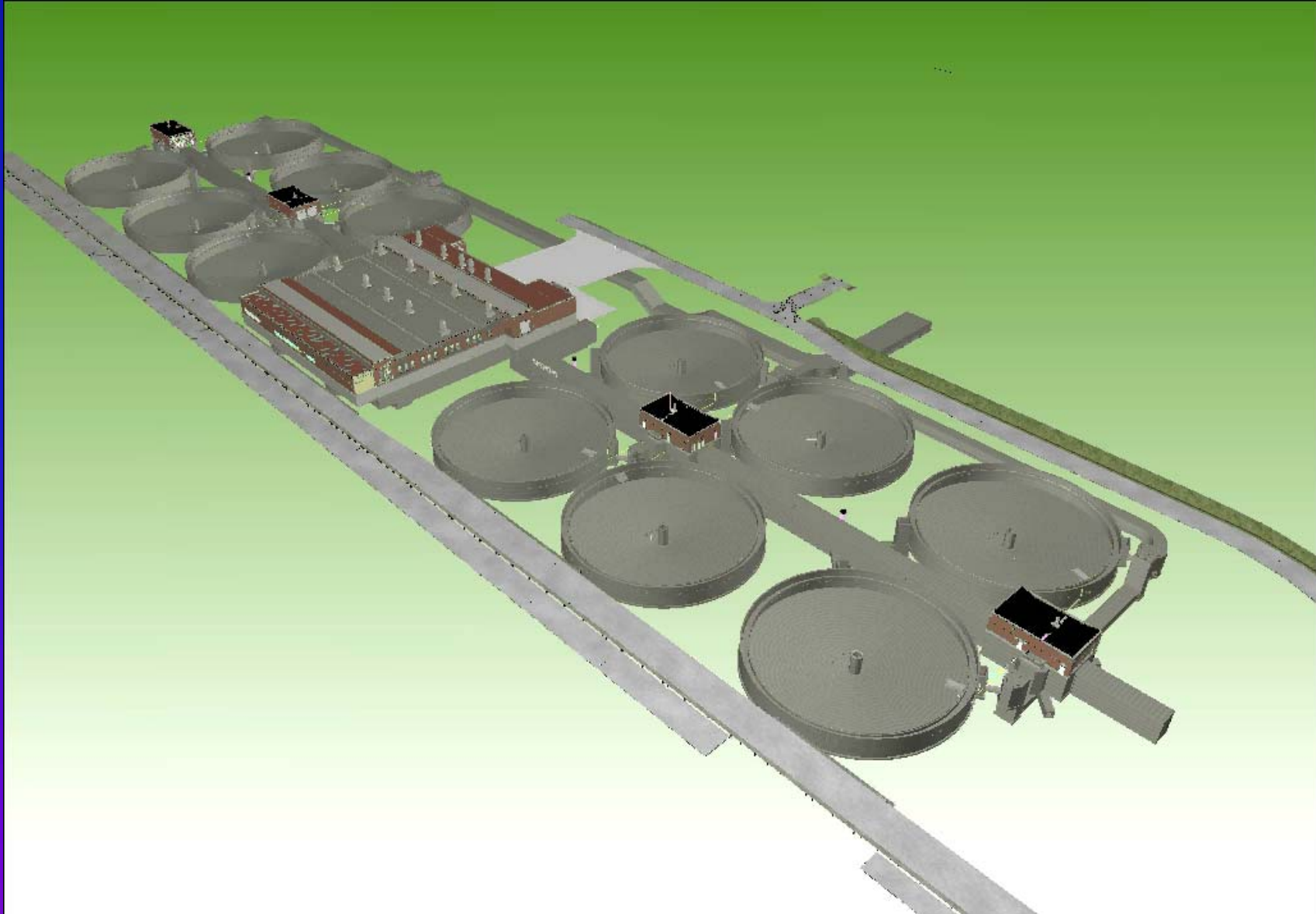


NEW HIGH LEVEL INFLUENT PUMPING STATION



Exterior View

PRIMARY SETTLING TANKS AND GRIT REMOVAL FACILITY



PRIMARY SETTLING TANKS AND GRIT REMOVAL FACILITY



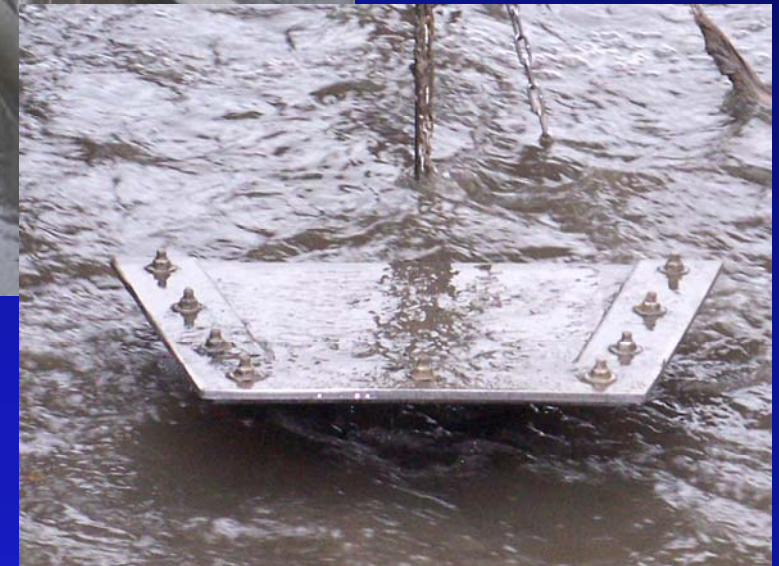
Photo by Brian Fritz

GRIT REMOVAL FACILITY

- 8 25' X 135' Aerated Grit Tanks
- Traveling Bridge Grit Removal System
- Grit Dewatering
- Tanks Covered for Odor Control



TRAVELING BRIDGE GRIT REMOVAL MECHANISM



GRIT REMOVAL FACILITY



South View



West View

GRIT REMOVAL FACILITY



Concrete Base Slab

GRIT REMOVAL FACILITY



96 Inch Influent Pipe North of Grit Building

PRIMARY SETTLING TANKS

- 12 - 155 ft. dia. Circular Primary Settling Tanks
- 4 Primary Sludge and Scum Pumping Stations
- Piping Gallery



Photo by Brian Fritz

PRIMARY SETTLING TANKS (WEST SIDE)



PRIMARY SETTLING TANKS (EAST SIDE)



CALUMET DRIVE BYPASS ROAD



NEW EAST GATE HOUSE



CENTRAL BOILER FACILITY

- 4 Boilers, 70,000 lbs./hr Capacity Each
- 100 psi Output
- Dual Gas (Natural Gas and Digester Gas)
- Overhead Steam and Condensate Return Line



Boiler Features

- Capable of Co-firing Both Digester Gas and Natural Gas Simultaneously
- Ability to Raise Turn-down Ratio From 6:1 to 14:1 to Minimize Boiler Cycling
- Digester Gas Compressors are VFD Driven



Building Features

- Exceeds the ASHRAE building envelope energy requirements by 20%
- Natural convection cooling with operable louvers
- Curtain walls are removable for future expansions
- Insulated metal panels combined with glazing in the windows to limit southern heat gain



Building Features



Removable Cross Bracing



Removable Panels

OVERHEAD STEAM LINE

- 12-inch Steam Line
- 100 psi Pressure
- 6-inch Condensate Return
- 3-inch Pumped Condensate Return
- 44-30" Dia Caissons, 36-ft Deep



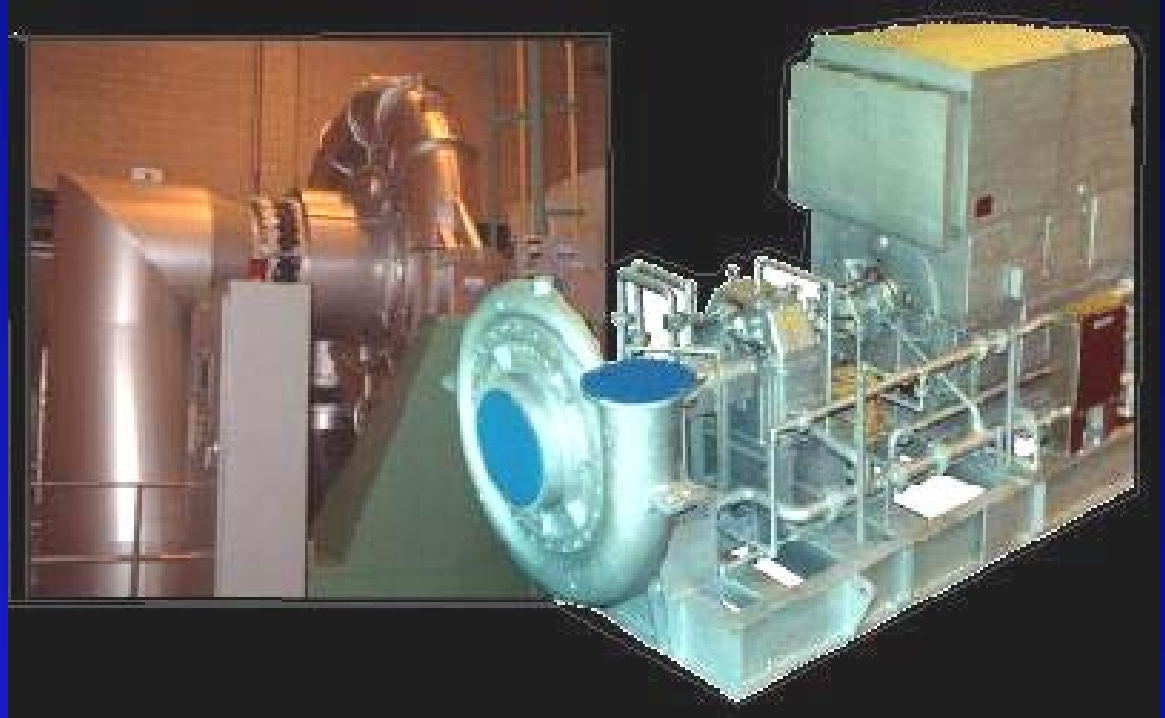
CENTRAL BOILER FACILITY



Design Team

NEW INTERMEDIATE BLOWERS

- Two 75,000 scfm Blowers
- Reduce Energy Consumption at Below Peak Demand
- Looped Air Main to Improve Air Pressure to Battery A
- Construction 2009--2011



Dresser Roots OIB – Overhung Impeller with Bearing Housing - Compressor

SLUDGE THICKENING FACILITIES

- Separation of Primary Sludge from WAS
- WAS to be Thickened by New 3-Meter GBTs
- Primary Sludge Only to Existing 12 Gravity Concentration Tanks



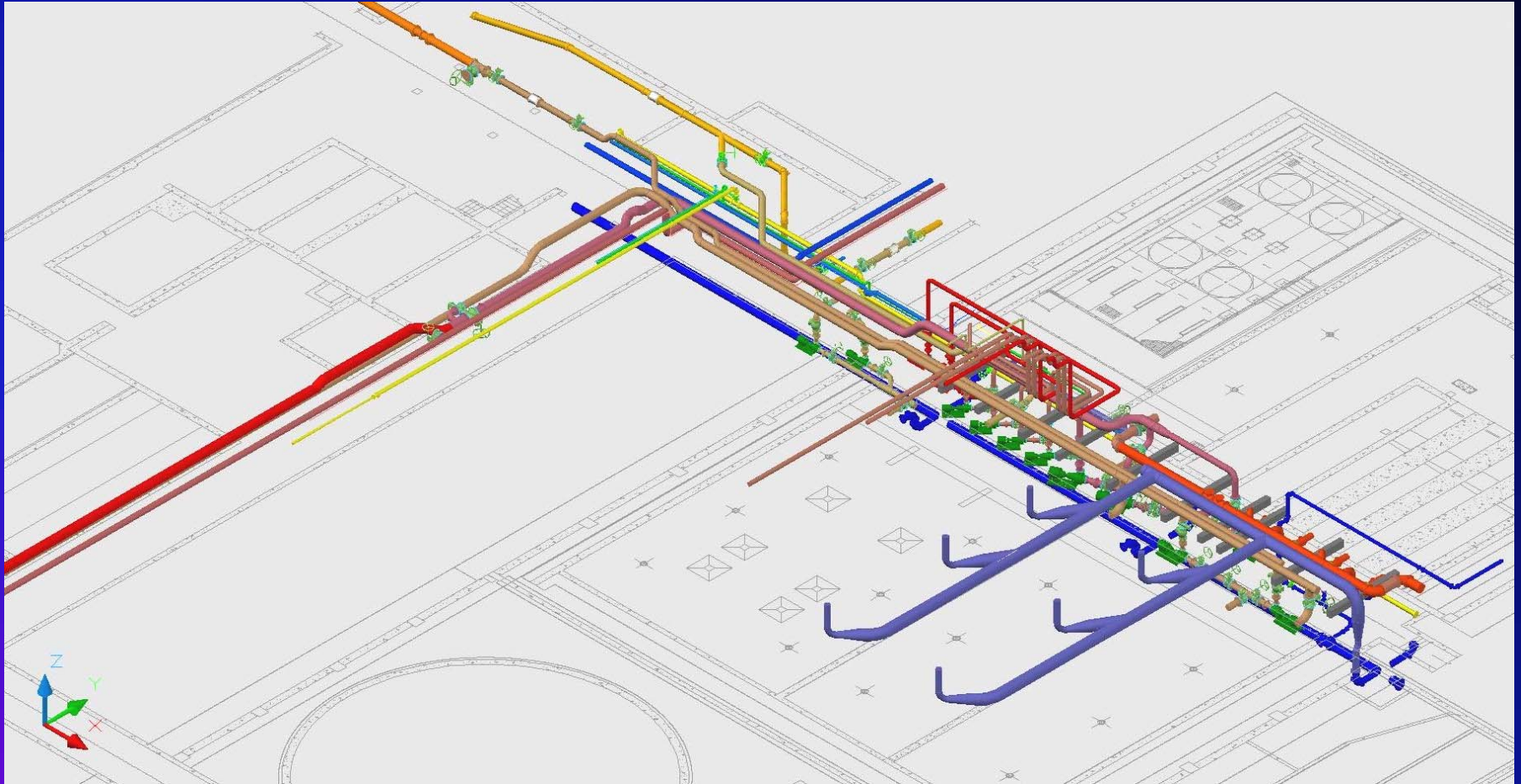
Replace Primary Sludge Screens



Convert Existing Sludge Holding Tanks



OPERATING GALLERY



SOUTHEAST VIEW in AutoCAD MEP

MODIFICATION OF THE POLYMER FEEDSYSTEM

- Addition of 1 Polymer Pump to Create Flexibility for M&O
- Alteration of Polymer Feed Piping to Feed Both GBTs and GCTs
- Construction 2010-2012



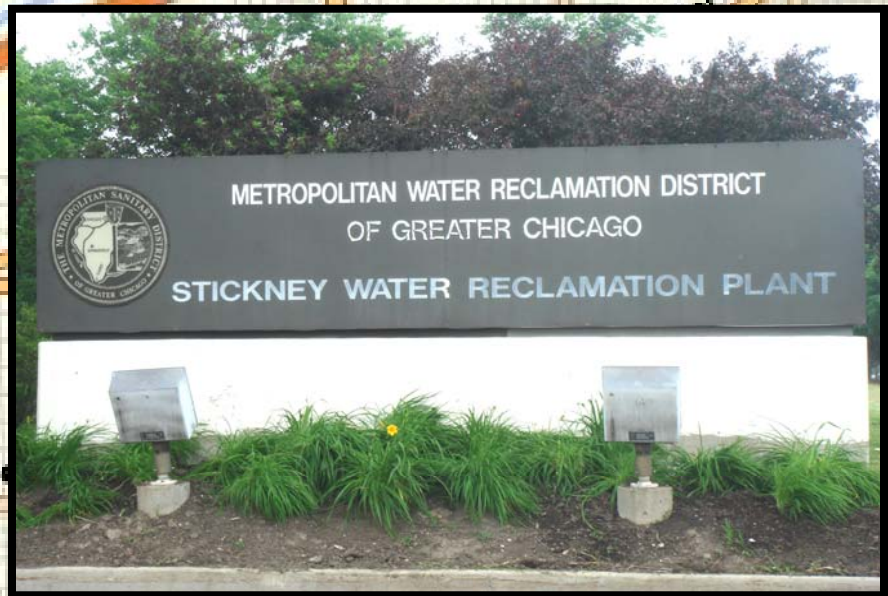
CWRP MASTER PLAN PROJECTS

CWRP MASTER PLAN PROJECTS	Estimated Construction Cost	Estimated Construction Start	Status
Site Improvements and Preparation for Construction Traffic	\$3,000,000	2004	Completed
Central Heating Facility	\$25,844,400	2005	Under Construction
New High Level Influent Pumping Station	\$120,890,000	2006	Under Construction
Primary Settling Tanks and Grit Removal Facilities	\$228,474,000	2008	Under Construction
Blowers Nos. 9 & 10 and Air Main Installation	\$16,025,240	2009	Under Construction
Sludge Thickening Improvements	\$9,500,000	2010	Advertised
Low-Pressure Digester Gas Storage	\$15,000,000	2012	Under Design
Selector Zones	\$9,000,000	2012	
Digester Upgrades for Class A Biosolids	\$30,000,000	2014	
New Aeration Battery D	\$100,000,000	2020	





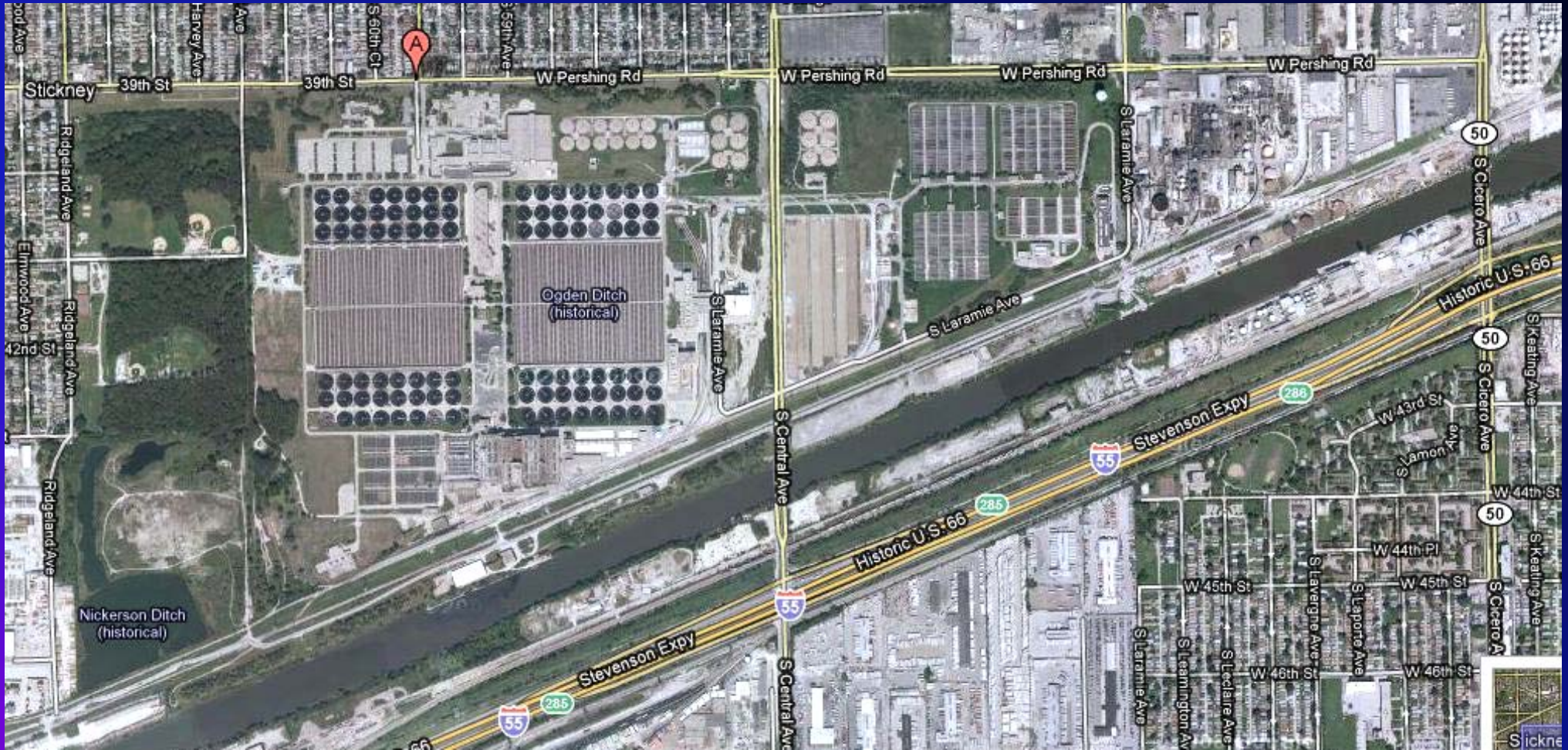
STICKNEY WRP



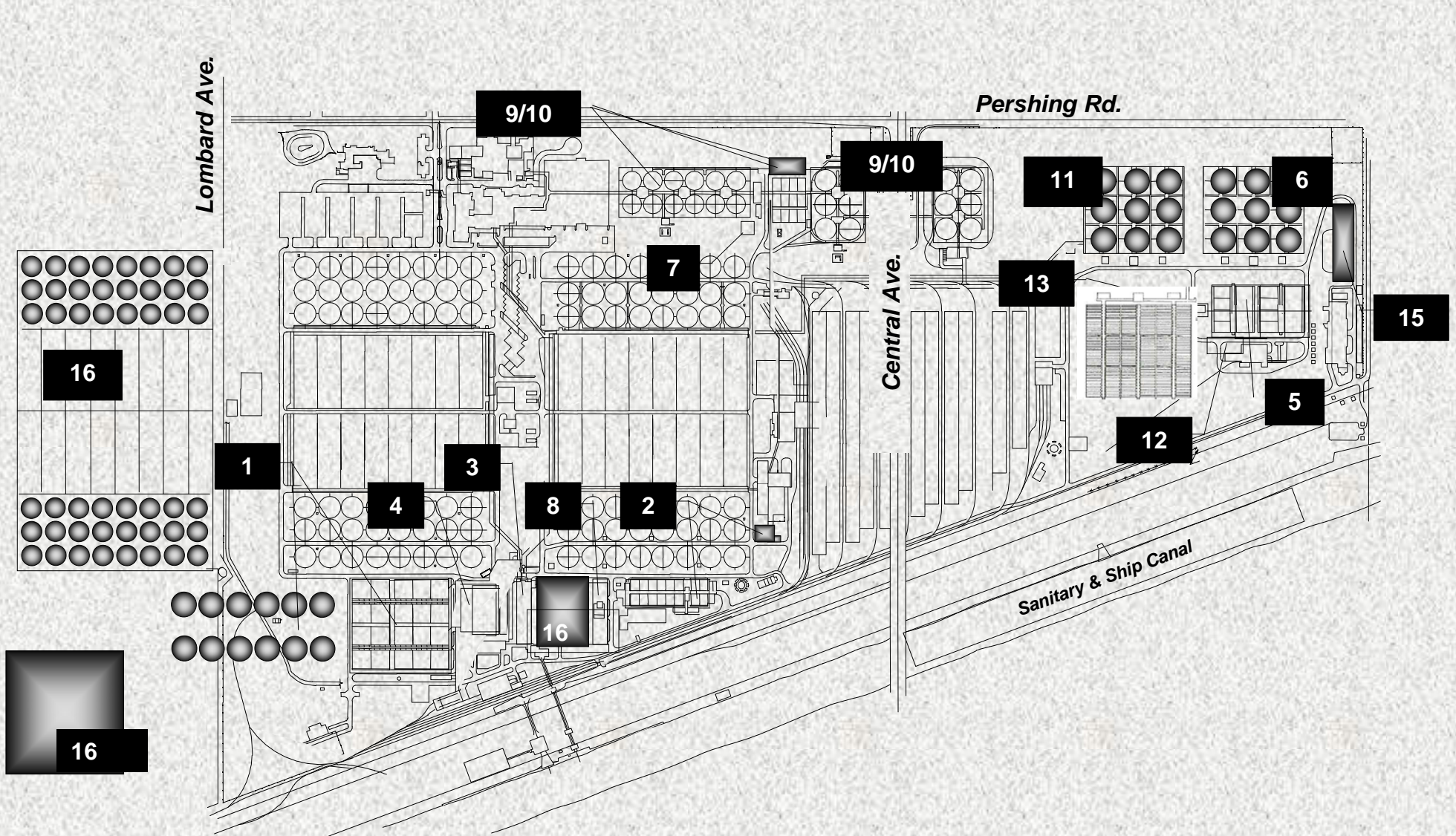
METROPOLITAN WATER RECLAMATION DISTRICT
OF GREATER CHICAGO

STICKNEY WATER RECLAMATION PLANT

STICKNEY WRP



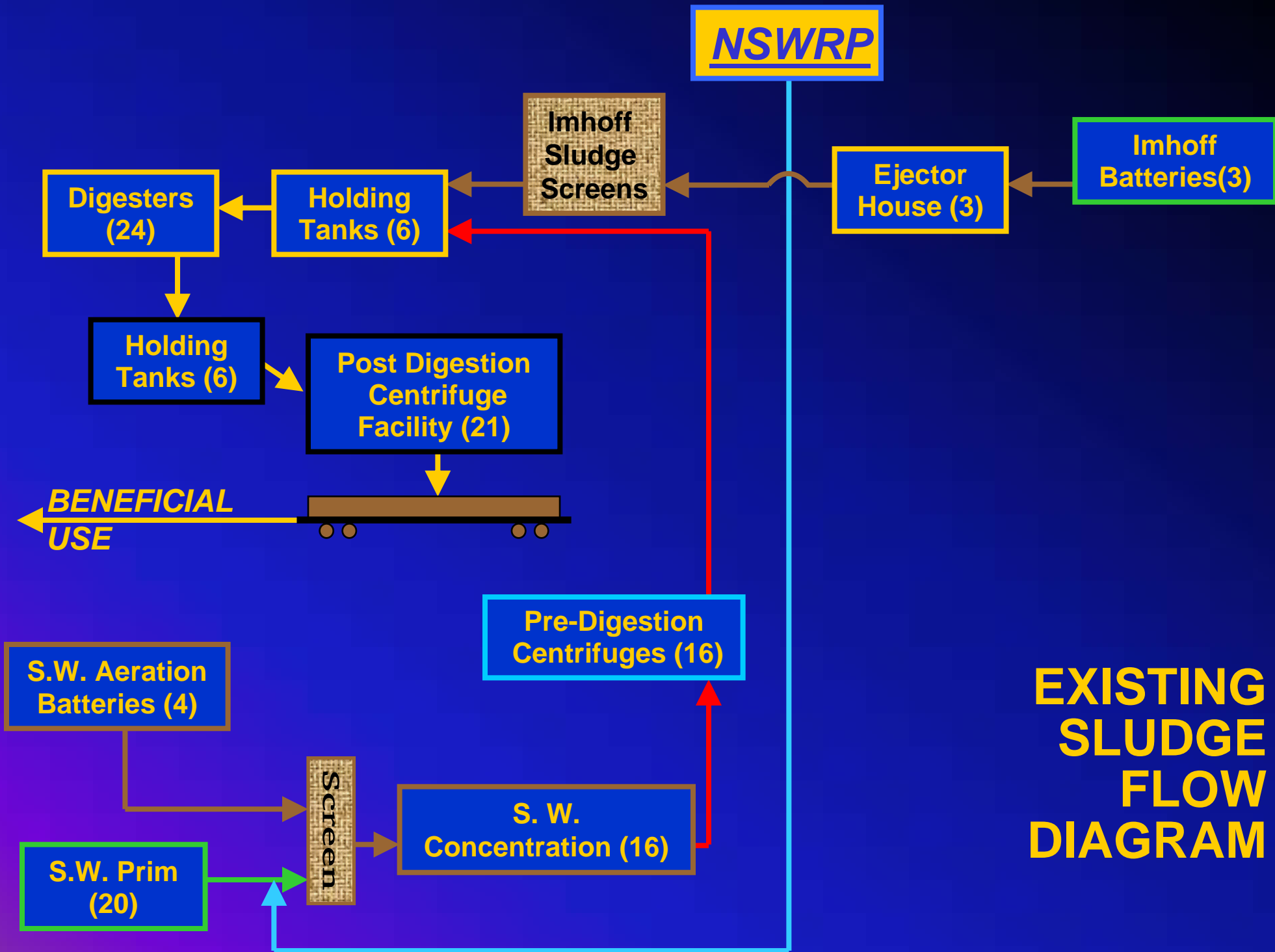
STICKNEY WRP MASTER PLAN



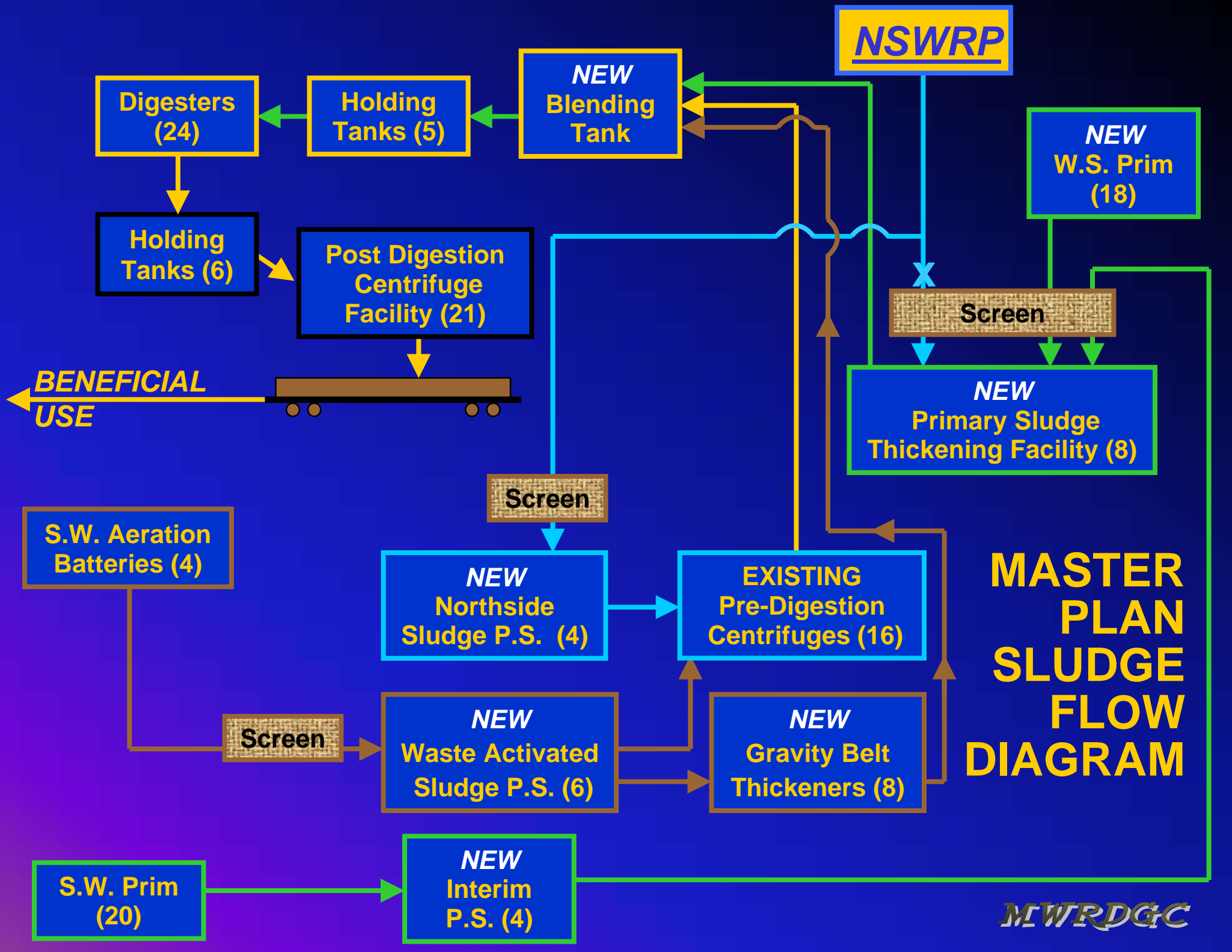
NEW INTERMEDIATE BLOWER

- New Blower No. 2 in SW P&BH
- 155,000 Scfm
- Adjustable Inlet Guide Vanes to Better Tailor Air Production to Air Demand
- Will be Connected to Plant Wide DCS so New DO Probes in Aeration Tanks Can Control Blower Output
- Construction Completion 2010



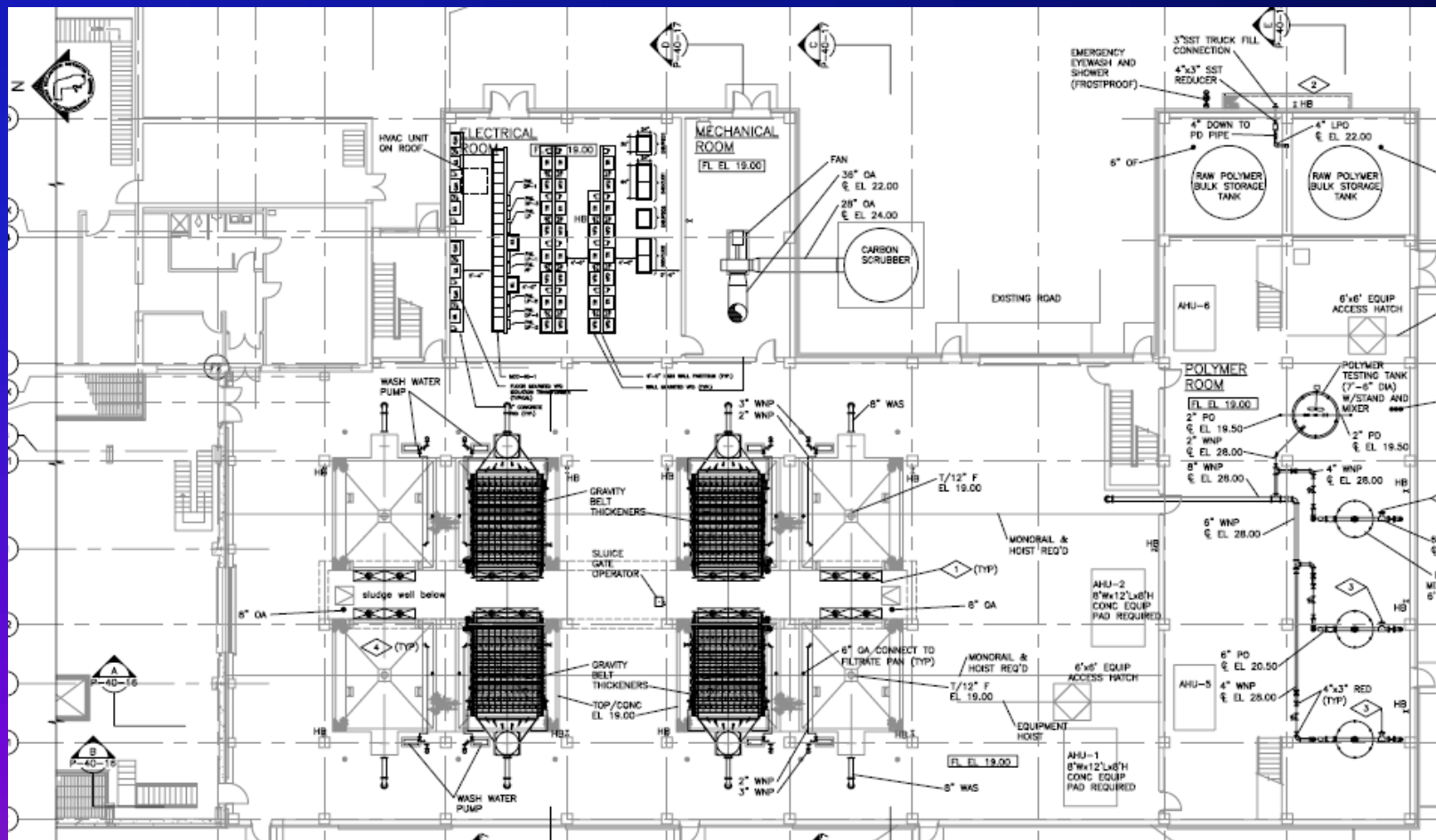


EXISTING SLUDGE FLOW DIAGRAM



MASTER PLAN:

- 8 GBTs for SW WAS
- Maintain 16 Centrifuges for SW WAS and North Side Sludge
- New Building for GBTs, Polymer System





REVISED PLAN:

- New G2 Units have double the throughput of existing centrifuges
- 12 Units for SW WAS
- 4 Units for North Side Solids
- No GBTs, Building, Polymer System

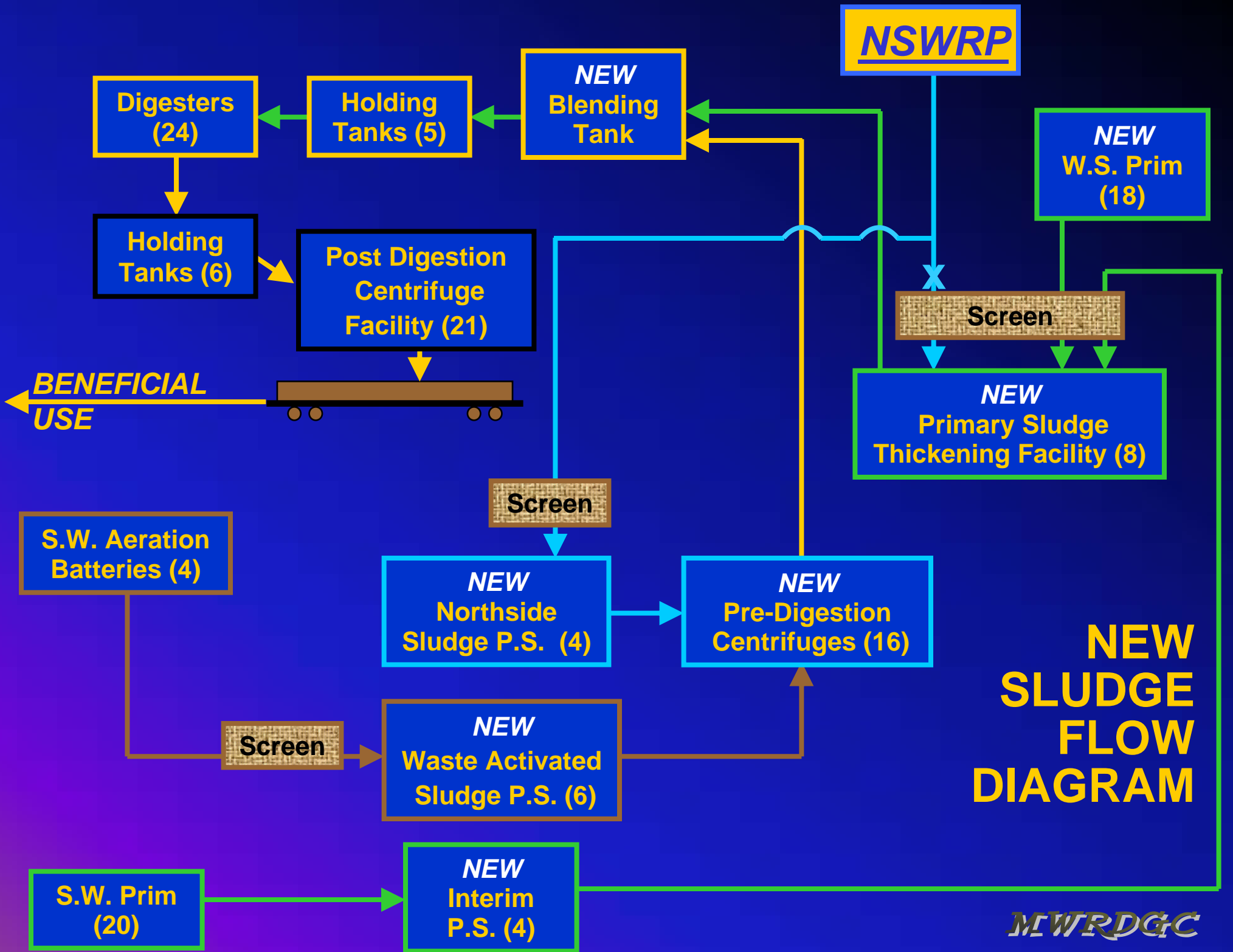


ECONOMIC ANALYSIS OF CENTRIFUGE REPLACEMENT

30-YEAR PRESENT WORTH

COST

- 16 New Centrifuges to Replace Existing: \$184,000,000
- Eight GBTs, Building, and Replacing Existing Centrifuges after 10 Years: \$393,000,000

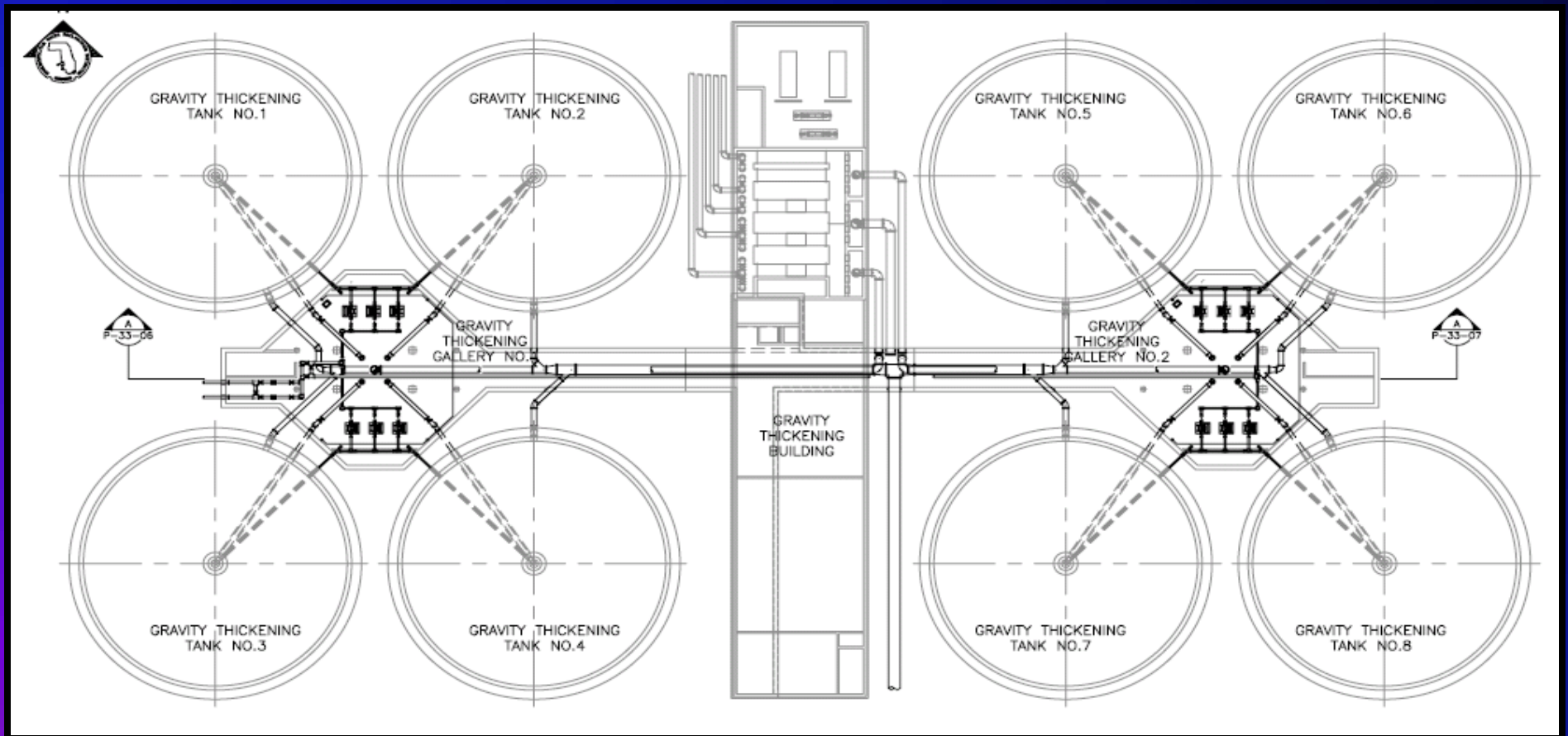


NEW SLUDGE THICKENING PROCESSES

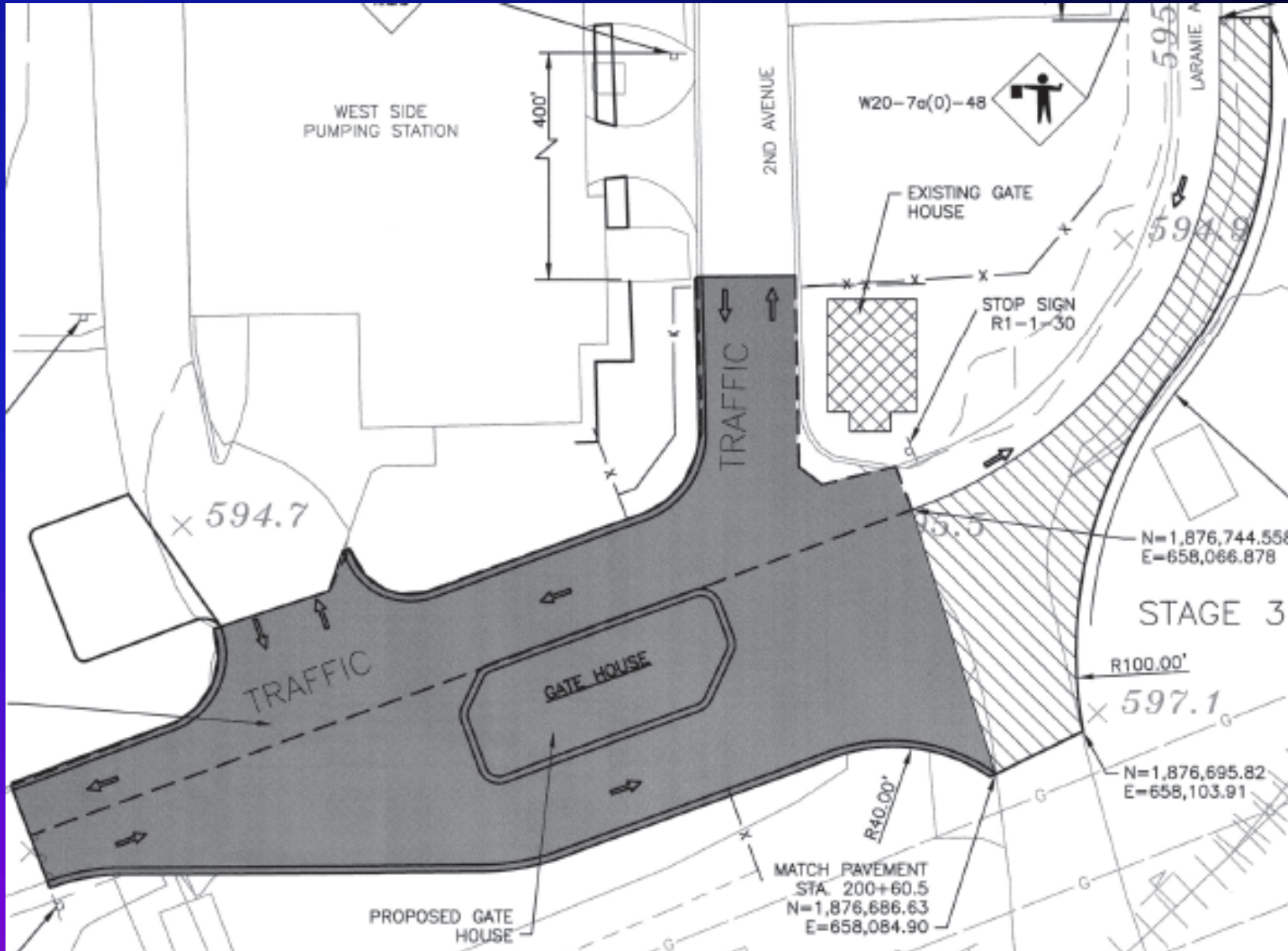
- Separate Primary Sludge Stream from WAS
- Existing Concentration Tanks to be Decommissioned
- Some Tanks to be Converted to Sludge Pumping Stations



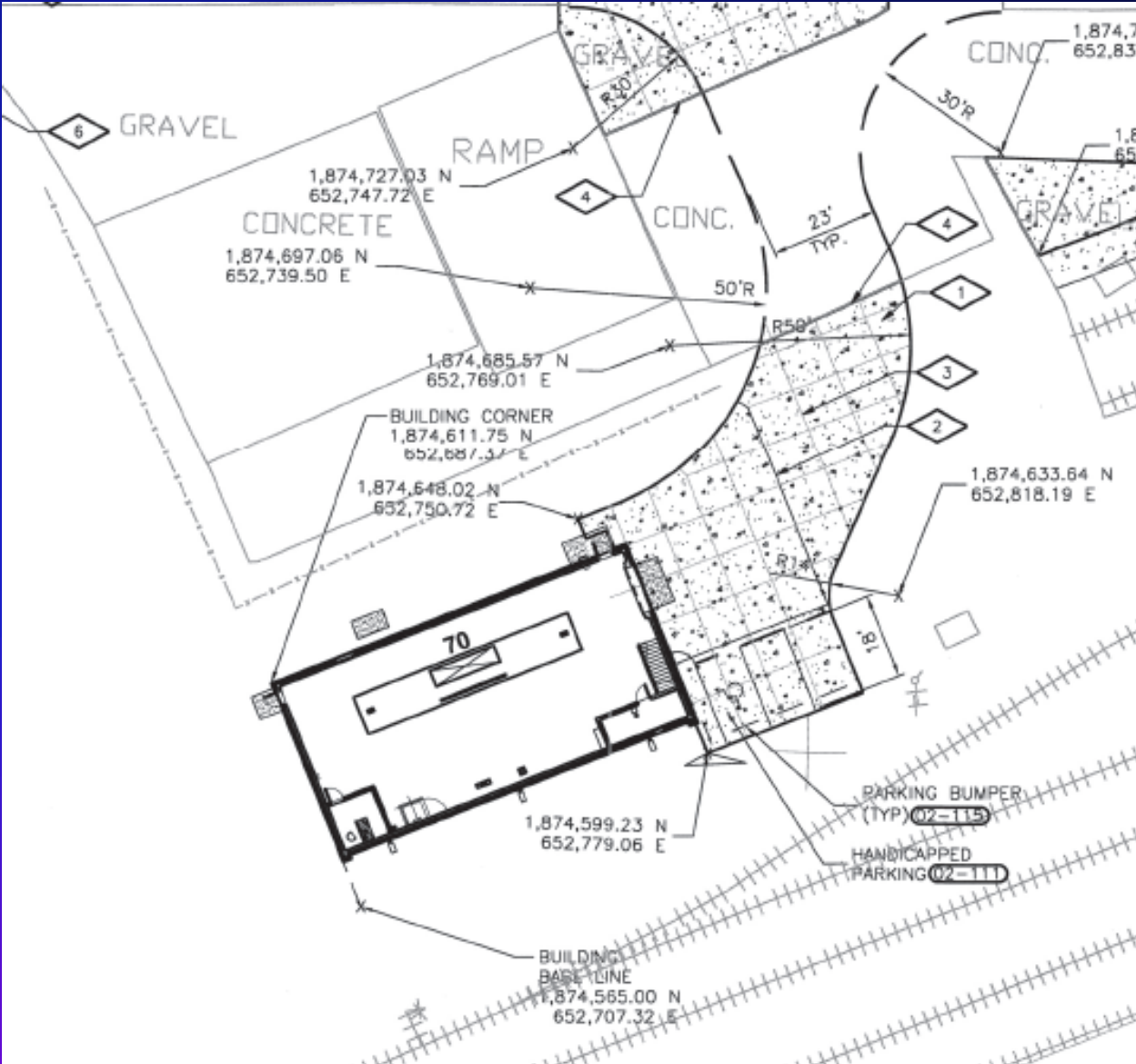
- SW Primary Sludge, and Future WS Sludge to be Thickened in New Round Gravity Concentration Tanks
- Eight 80-ft Diameter Tanks



LARAMIE AVENUE GATE HOUSE



SW PRIMARY CLARIFIER ELECTRICAL SUBSTATION

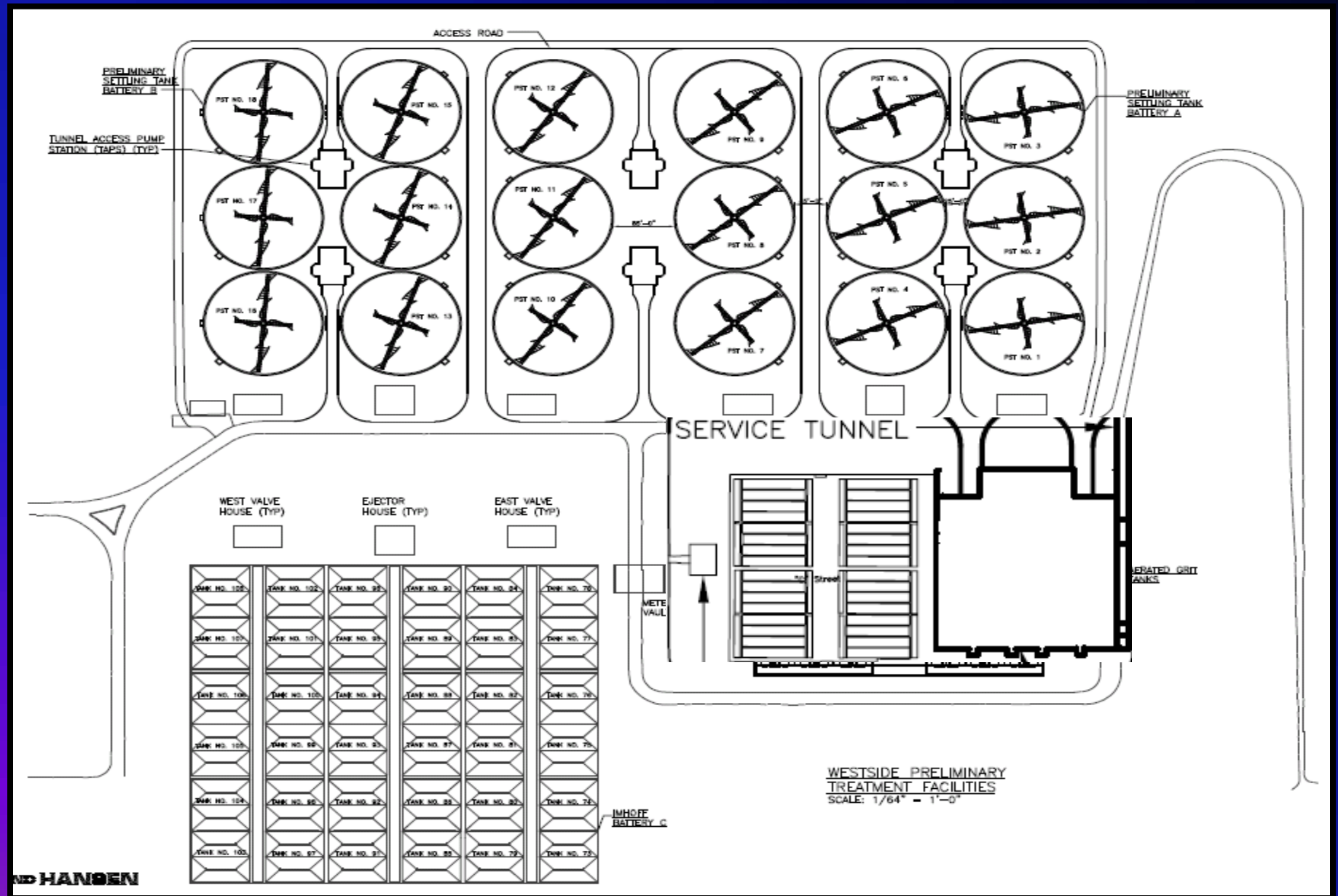


WESTSIDE PRIMARY SETTLING TANKS AND GRIT REMOVAL FACILITIES

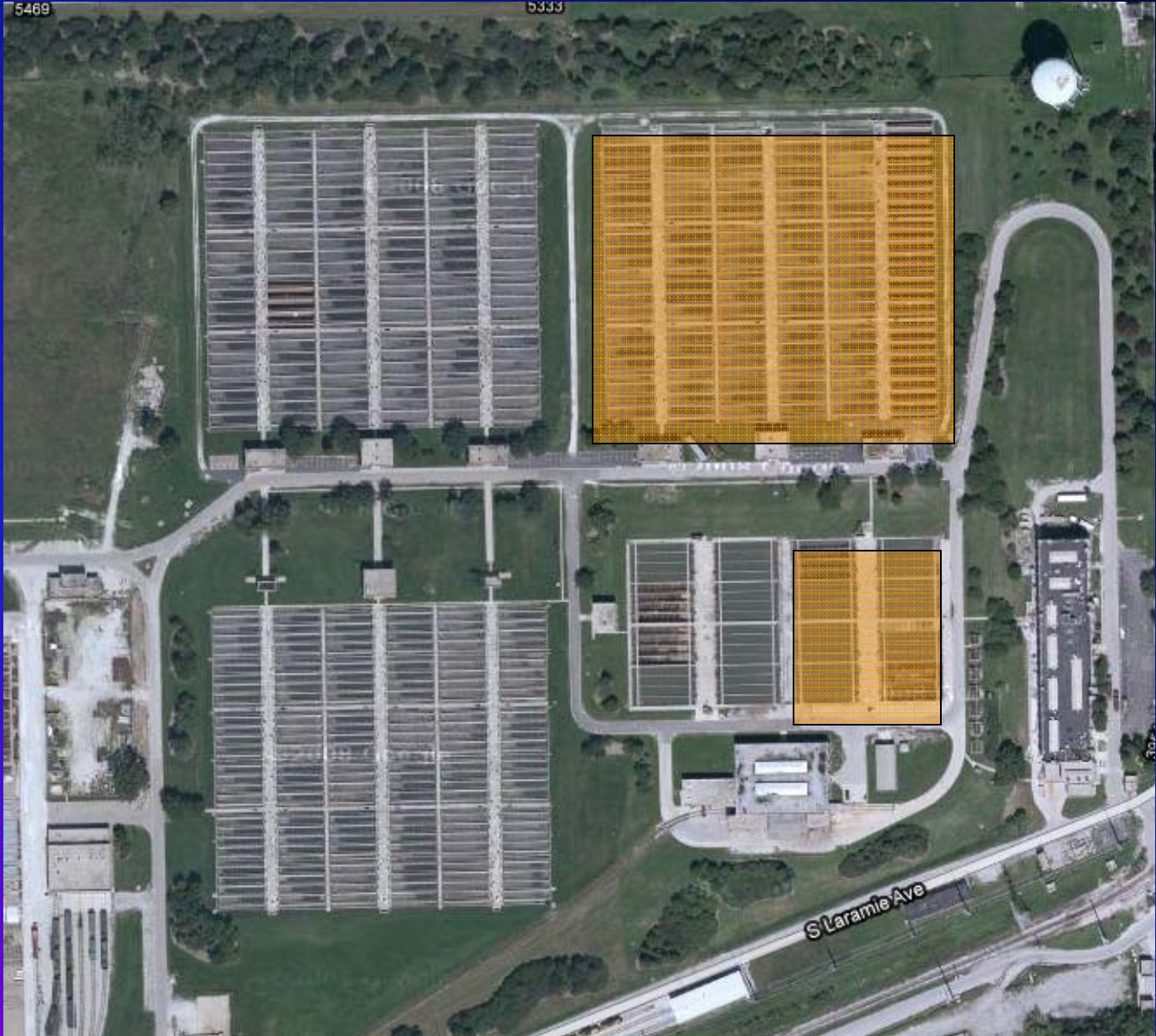
- Replace 3 Batteries of 108 Imhoff Tanks with 2 Batteries of 18 Circular Primary Settling Tanks
- Replace Skimming Tanks with Aerated Grit Tanks
- Imhoff Battery C Abandoned



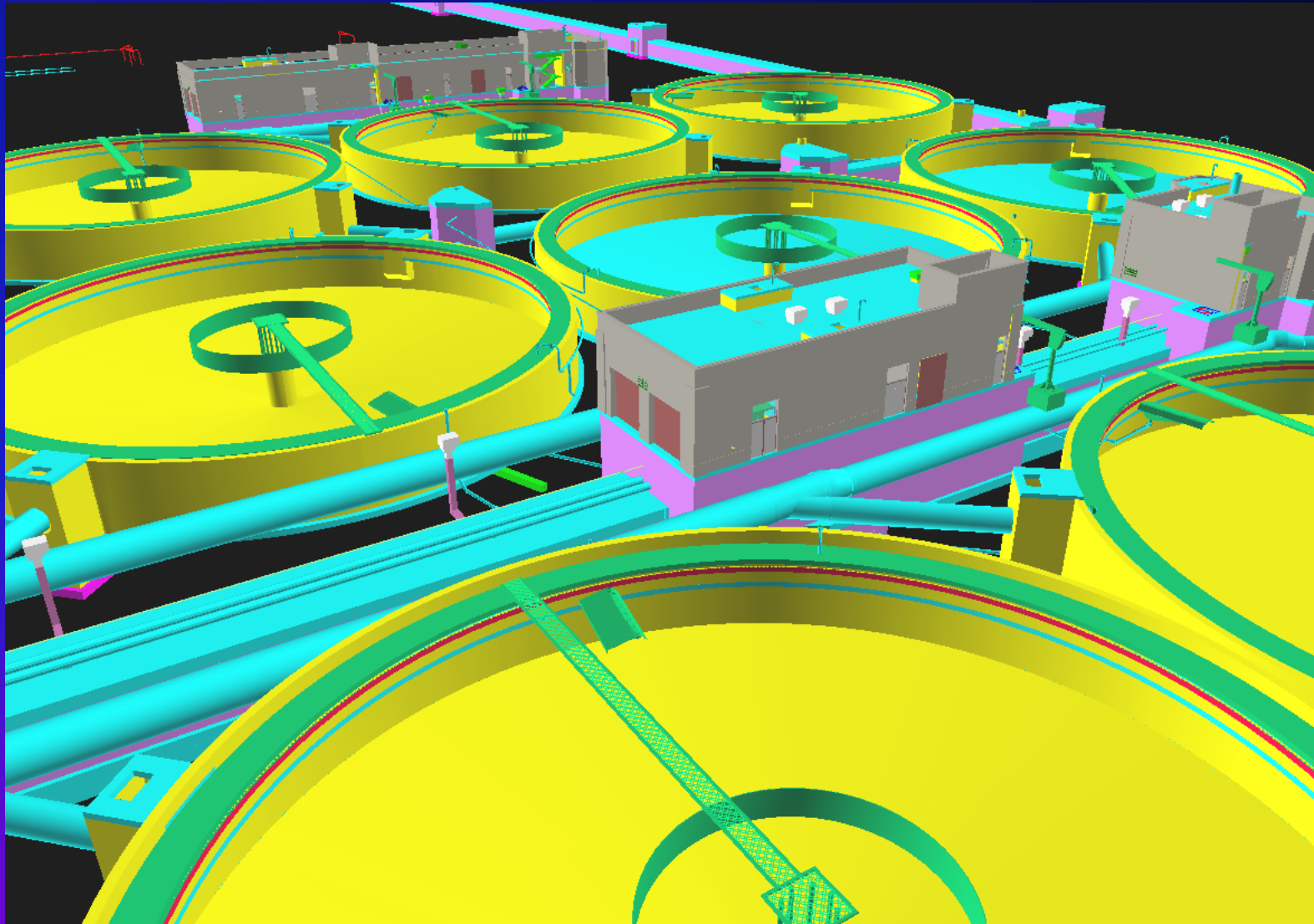
NEW WESTSIDE PSTs AND GRIT



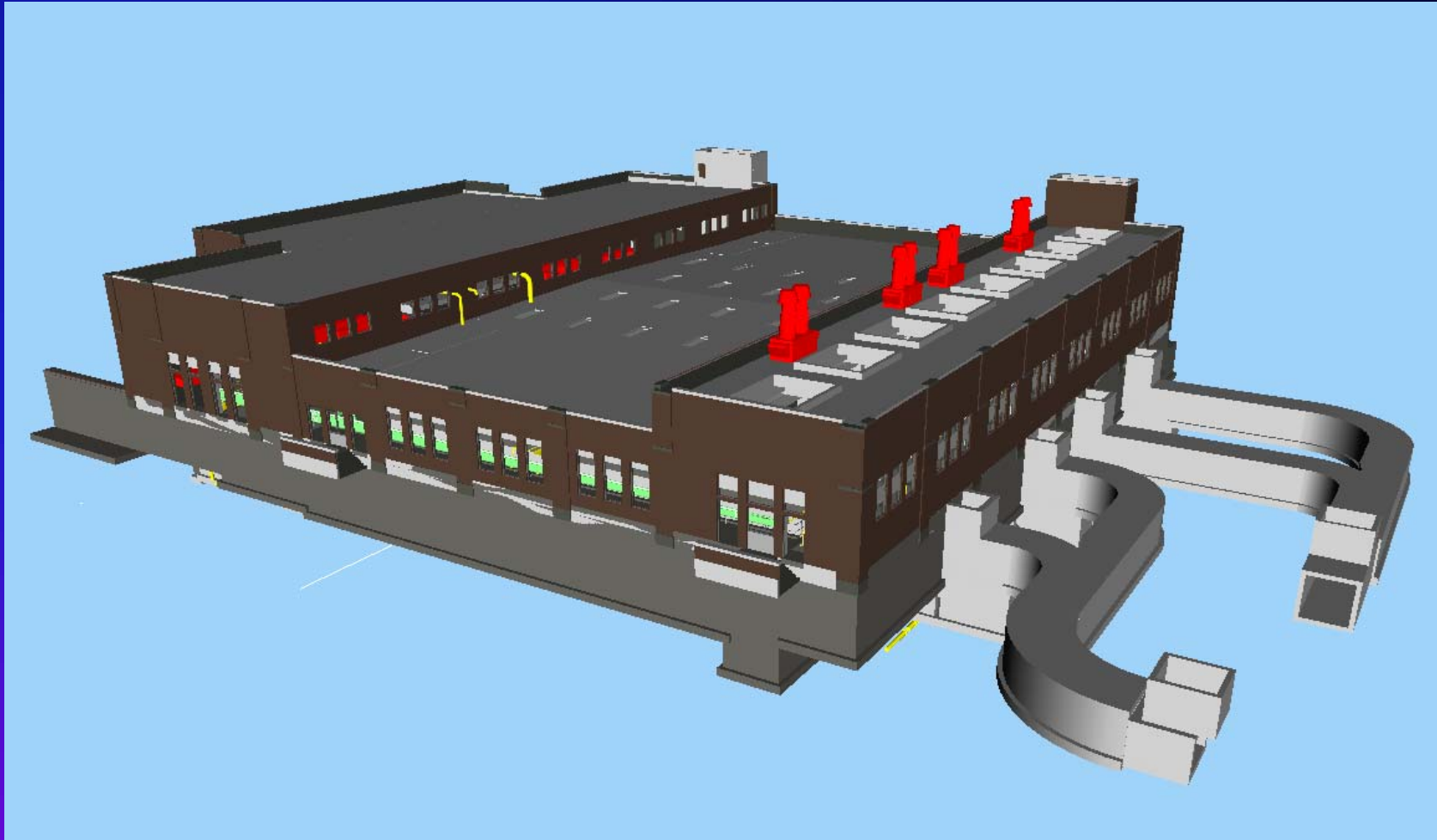
IMHOFF TANK BATTERY A DEMOLITION



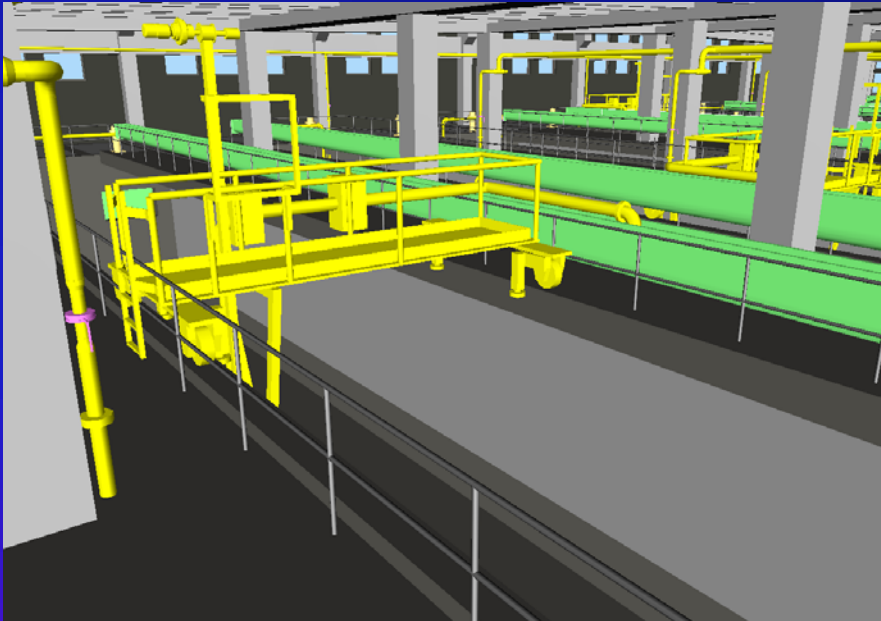
NEW 160' DIA PRIMARY SETTLING TANKS



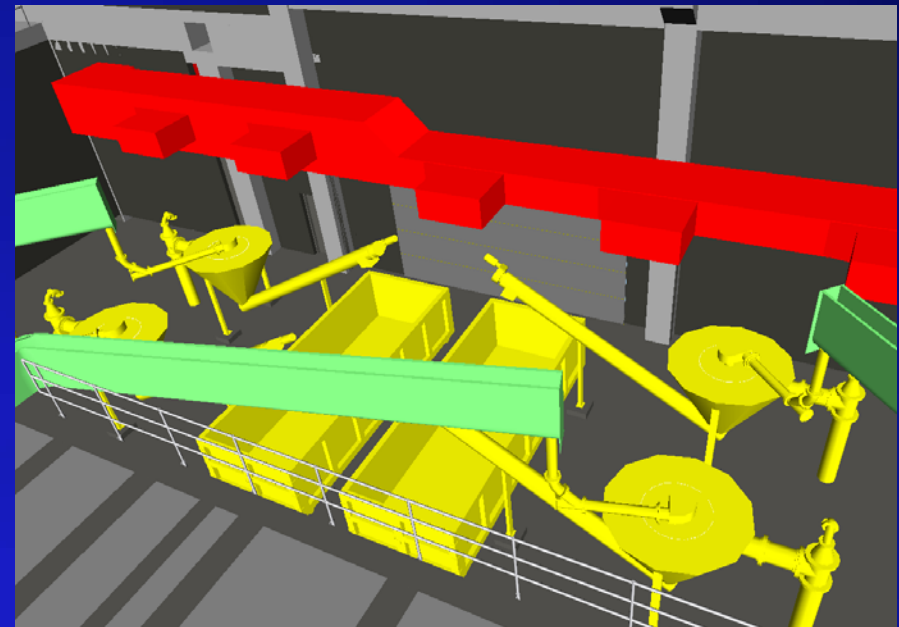
NEW GRIT HANDLING FACILITY



NEW GRIT HANDLING FACILITY



Traveling Bridge



Dumpster

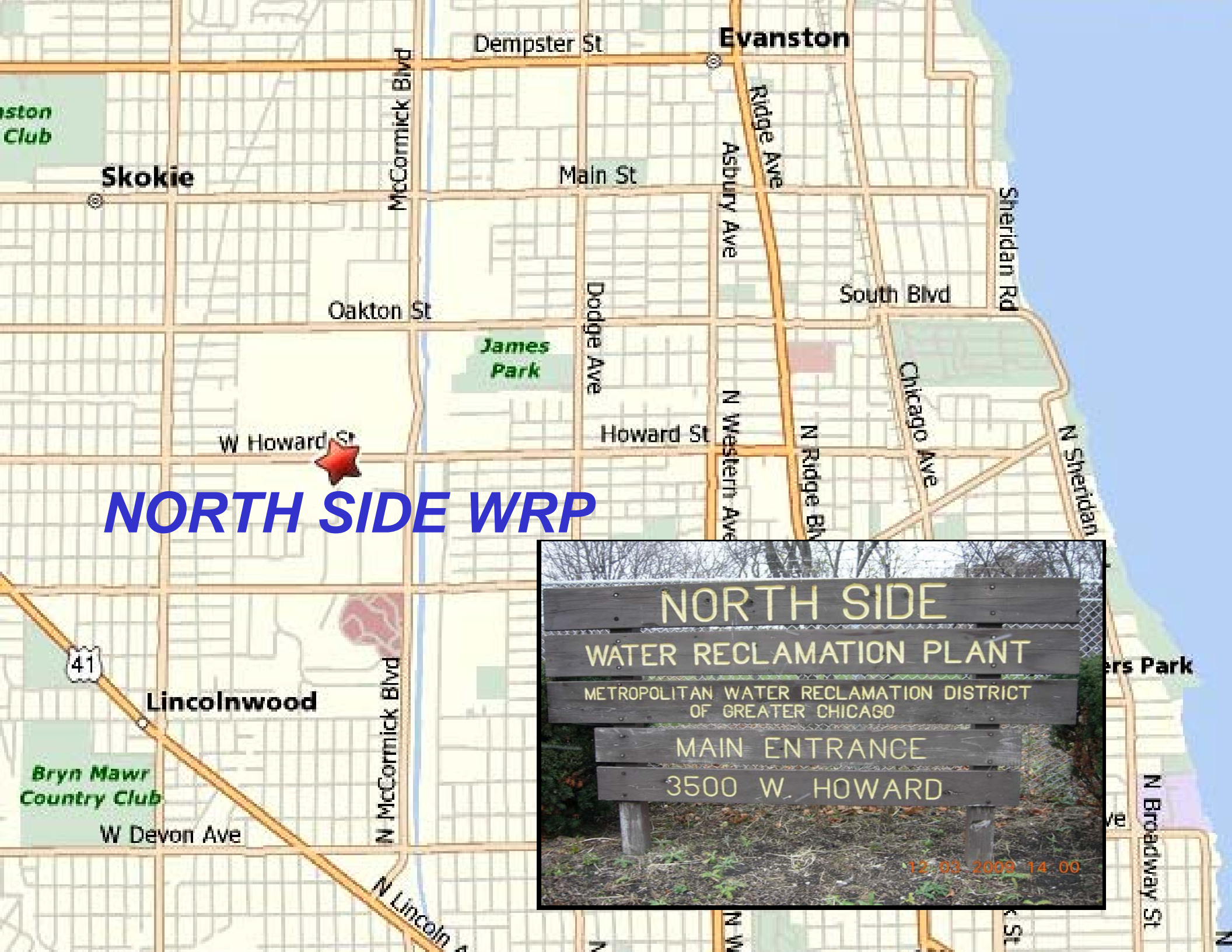
LOW PRESSURE DIGESTER GAS STORAGE



SWRP MASTER PLAN PROJECTS

SWRP MASTER PLAN PROJECTS	Estimated Construction Cost	Estimated Construction Start	Status
Process Air and Central Blower Project	\$3,282,000	2006	Under Construction
New Sludge Thickening Facilities	\$201,600,000	2010	Advertised
Westside Imhoff Battery A and Skimming Tank Demolition	\$61,500,000	2010	Advertised
Westside Primary Settling Tanks - Battery A Imhoff Replacement	\$150,000,000	2011	Under Design
Westside Grit Handling Improvements	\$130,000,000	2011	Under Design
Low-Pressure Digester Gas Storage	\$25,000,000	2012	Under Design
Westside Primary Settling Tanks - Battery B Imhoff Replacement	\$150,000,000	2014	Under Design
Waste Heat Utilization from Pelletizer	\$15,000,000	2014	
Southwest Screens Handling Equipment	\$5,000,000	2014	
Westside Fine Screen Replacement	\$15,000,000	2014	
Westside Meter Upgrades	\$2,000,000	2015	
Digester Upgrades for Class A Biosolids	\$25,000,000	2018	
New Southwest Primary Tanks	\$130,000,000	2019	
Westside Pump Station Replacement	\$100,000,000	2023	





NORTH SIDE WRP

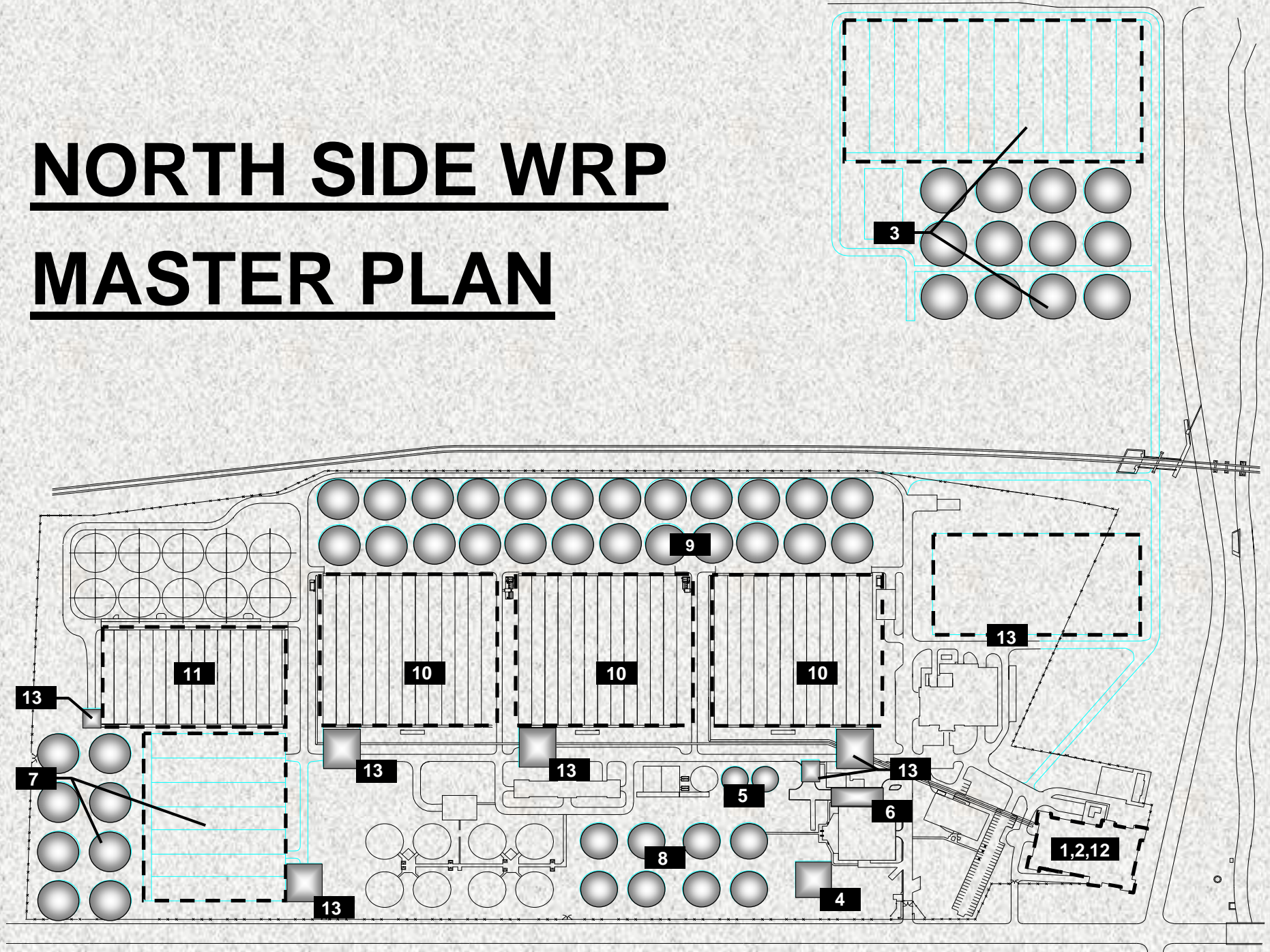


NORTH SIDE WRP



NORTH SIDE WRP

MASTER PLAN

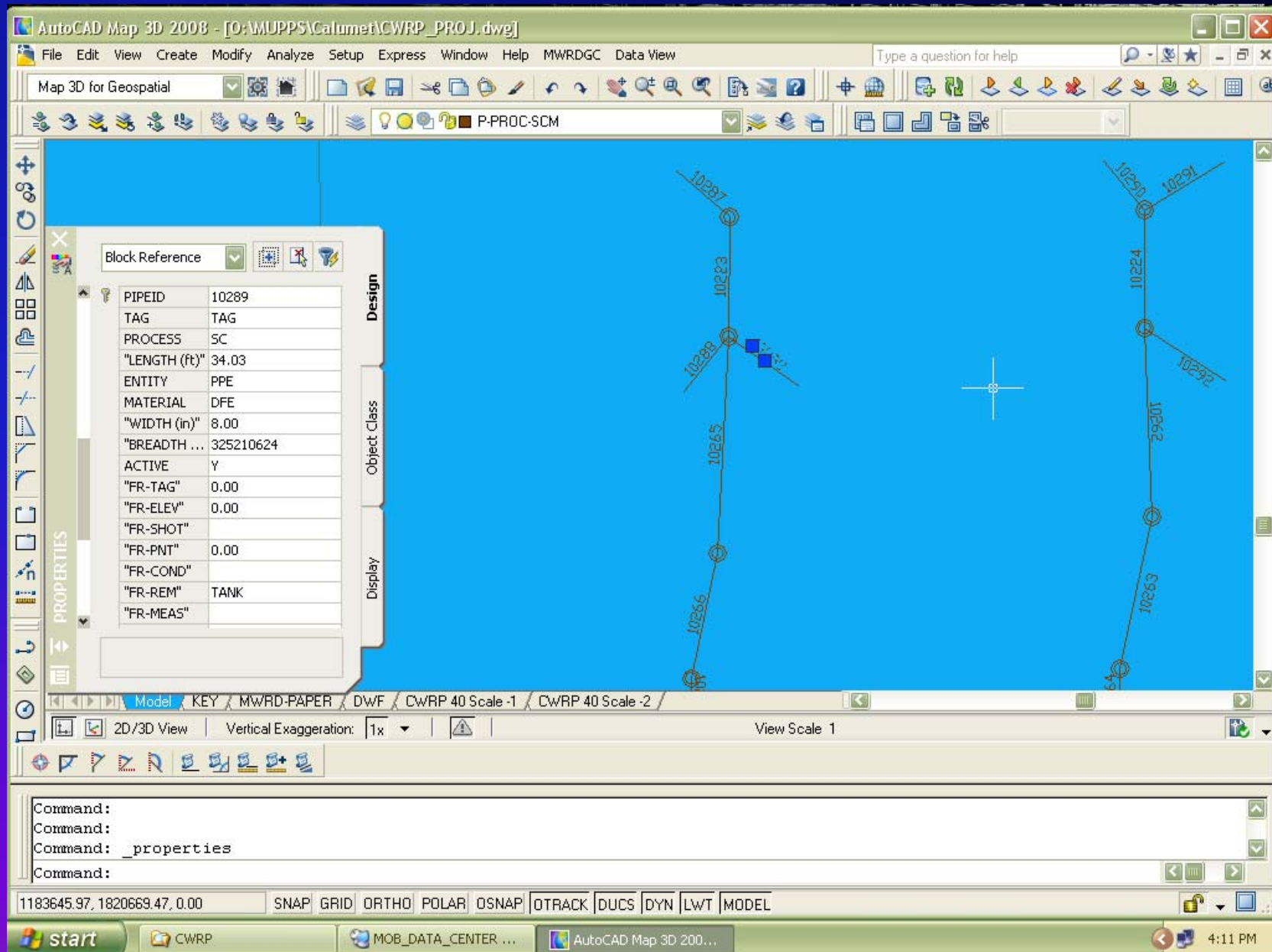


NEW BLOWERS No. 1 and 7

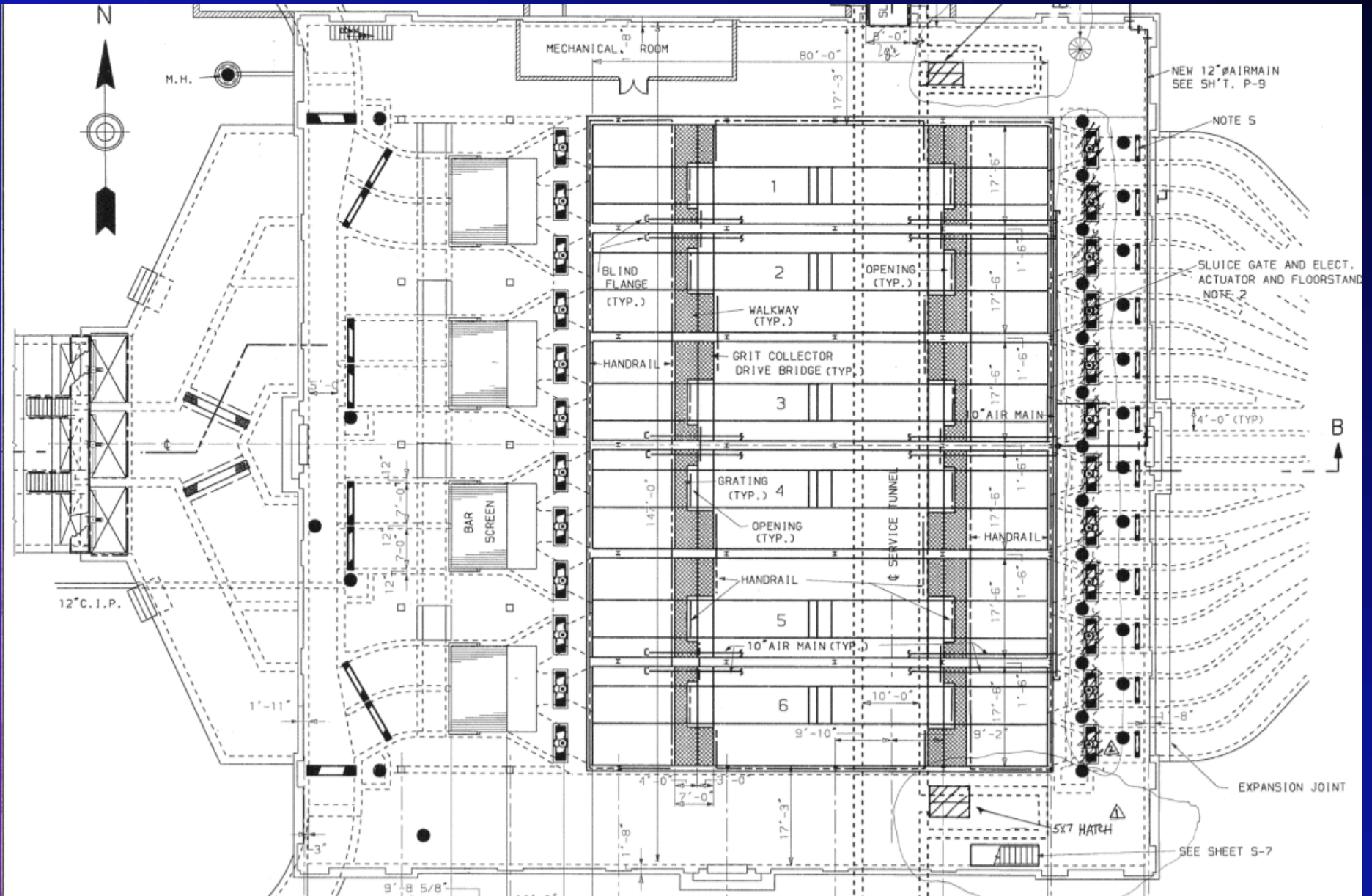
- 55,000 SCFM
- Blowers 2-6 to be replaced in future



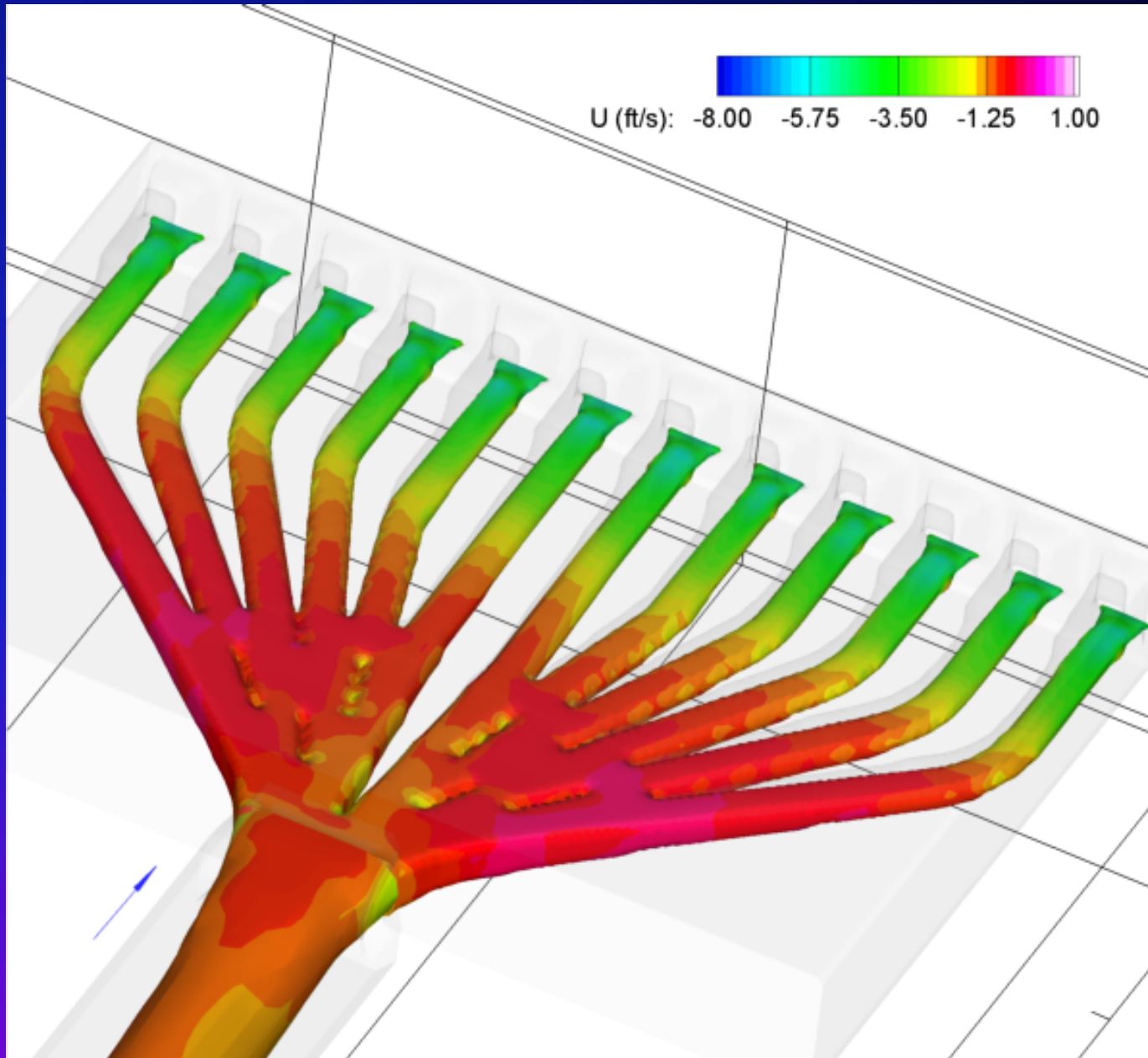
North Side Master Underground Piping Plan



CORRECT UNBALANCED FLOW TO AERATED GRIT CHAMBERS



CFD MODELING OF AERATED GRIT CHAMBERS





DIXTON STREET

VACANT

METRA FACILITY

DEMOLITION / DECOMMISSION

New Road

New Battery E

New Internal Recycle Pump Station (Typ.)

New Final Settling Tanks @ 130' Dia. each (Typ.)

New Primary Settling Tanks @ 130' Dia. each (Typ.)

Existing Primary Settling Tanks to Remain

New Final Settling Tanks @ 110' Dia. each

Pump Station and Wet Well

O₂ Generation Bldg. (If needed)

Disinfection

New Tertiary Filters

Sludge Concentration Tanks

New Ferric Chloride Bldg.

Grit Dewatering Tank

Existing Pump and Blower House; Coarse Screen Replacement

New Degritted Primary Effluent Pump Station

New Sludge Pipeline

Additional Final Settling Tanks @ 110' Dia. each

Battery F

BATTERY D

BATTERY C

BATTERY B

BATTERY A

New Primary Settling Tanks @ 100' Dia. each

HOWARD STREET

HAMILTON AVENUE

EXISTING FENCE

LEASED PARK AREA

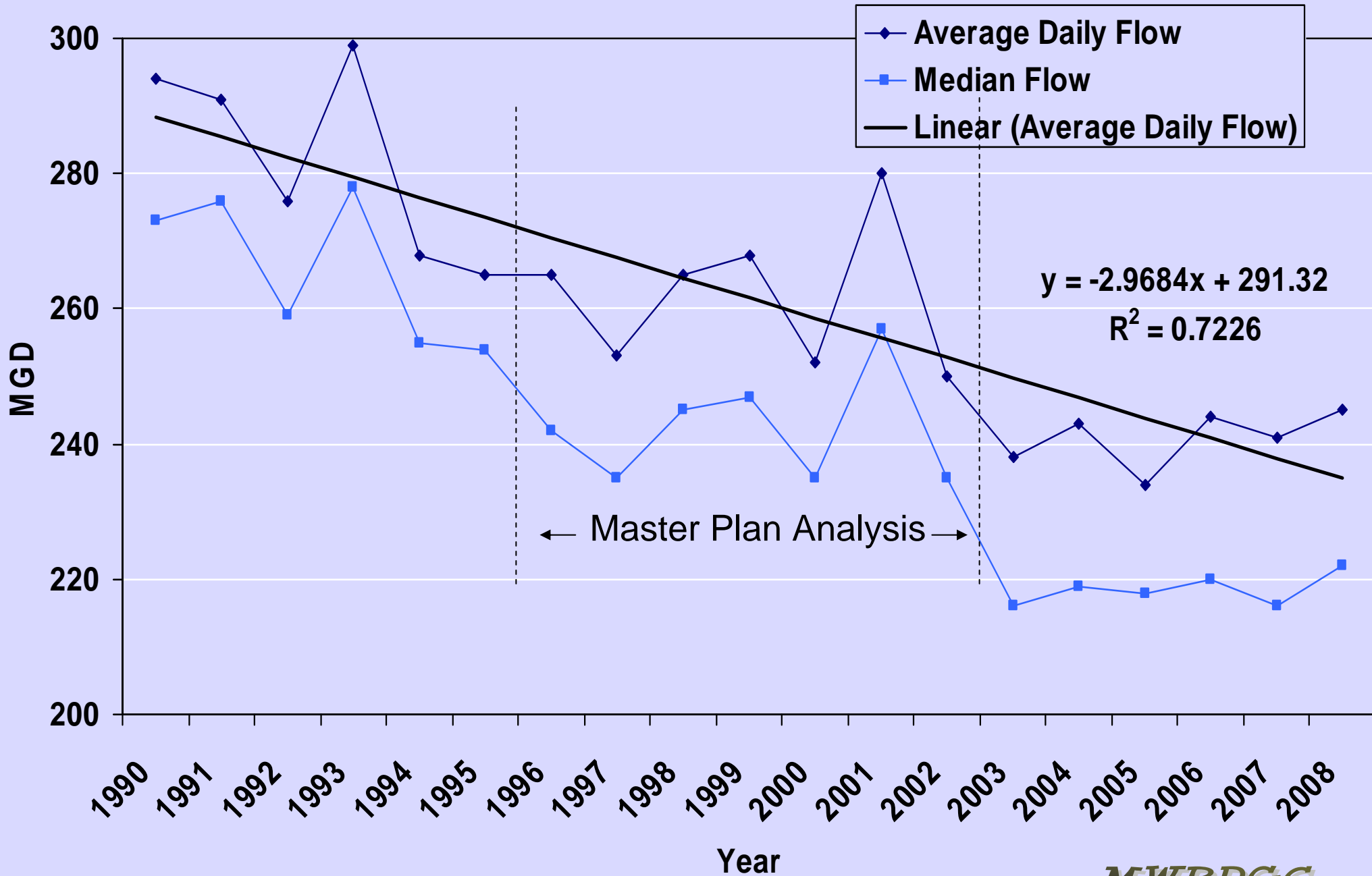
CCM-ED

ACCUMULATOR HOUSE

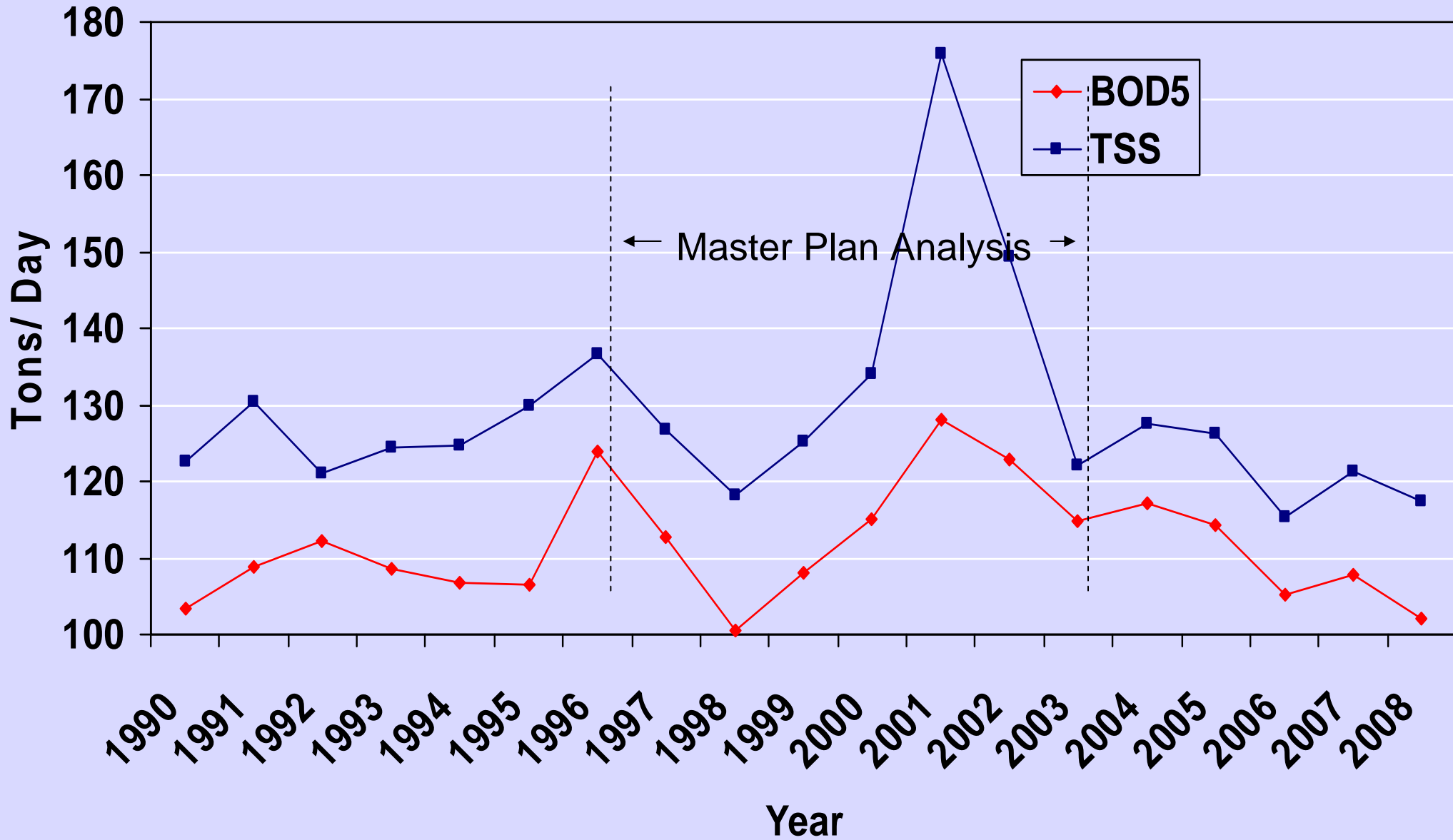
CTE | AECOM

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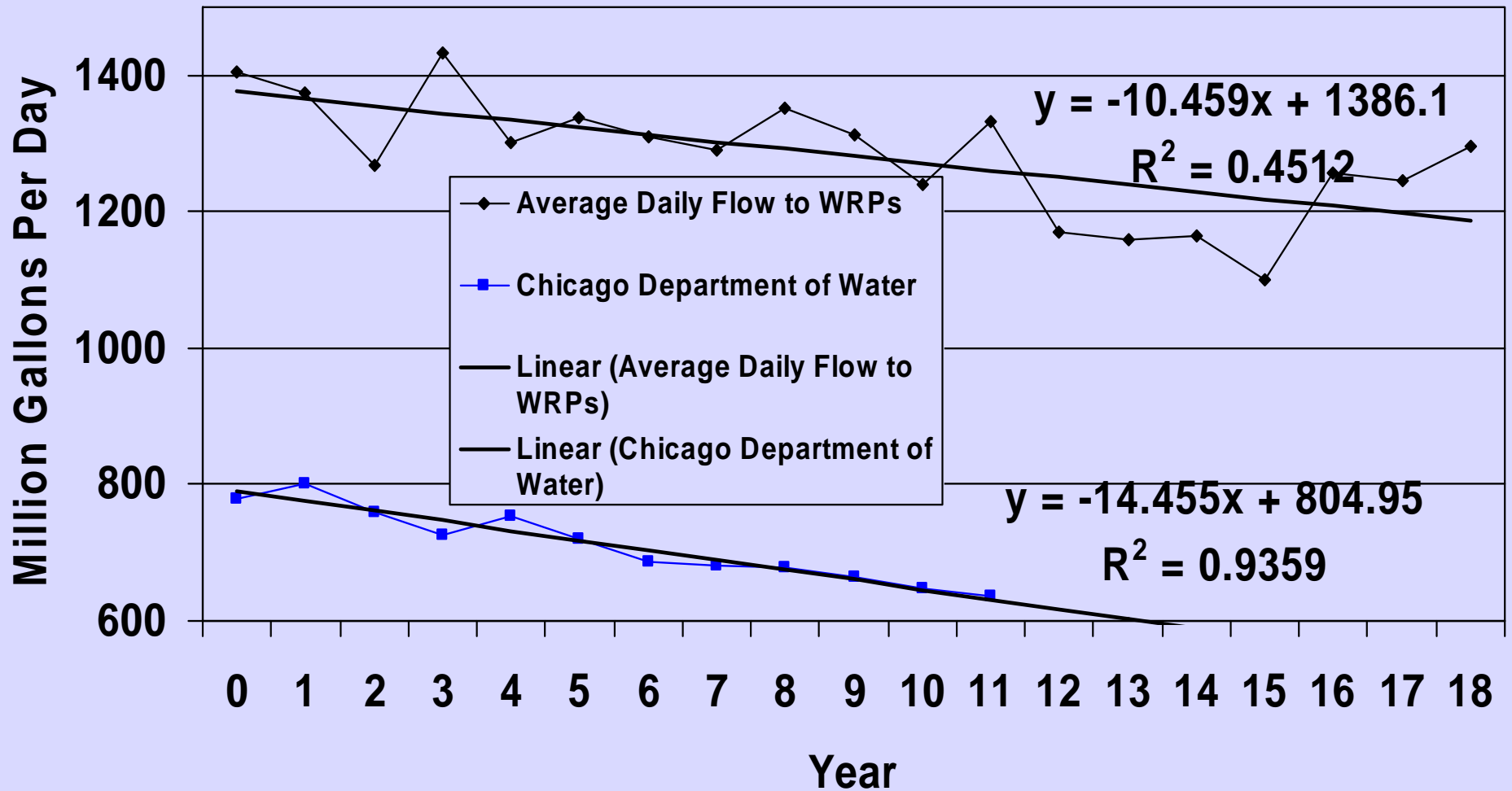
Annual Average and Median Flow to North Side WRP



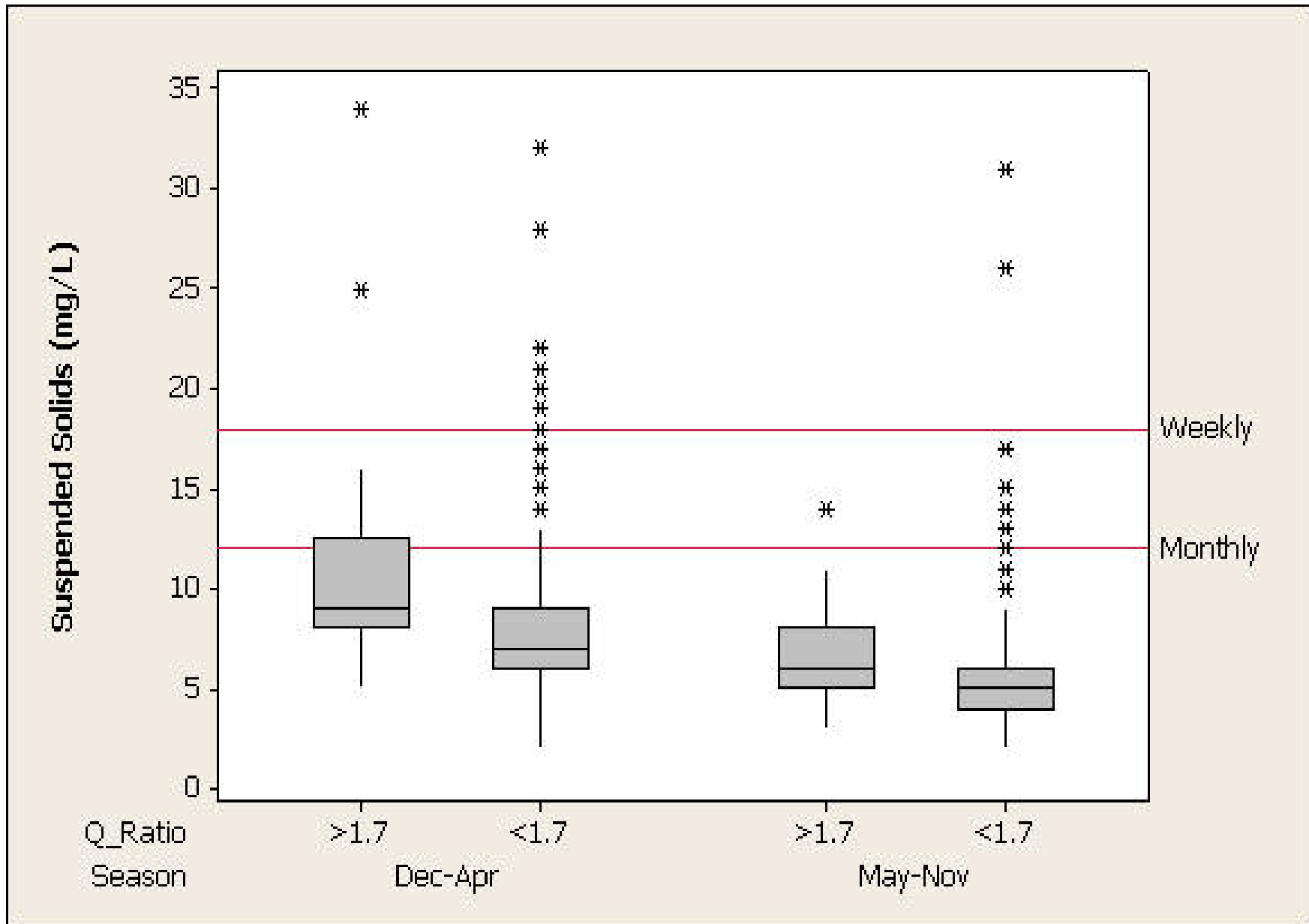
Annual Average Loading to the North Side WRP



Average Combined Flow to North Side, Calumet, and Stickney WRP and Flow Reported by Chicago Department of Water (Year 0: 1990)



Distribution of Effluent SS as a Function of Change in Plant Flow: $Q \text{ ratio} = Q_{\text{Day2}}/Q_{\text{Day1}}$





NSWRP

Howard St

St Louis Ave

© 2009 Europa Technologies
© 2009 Google

922 ft

1, 2007

42°01'12.15" N 87°43'02.50" W elev. 605 ft

Eye alt 3

Go

NSWRP MASTER PLAN PROJECTS

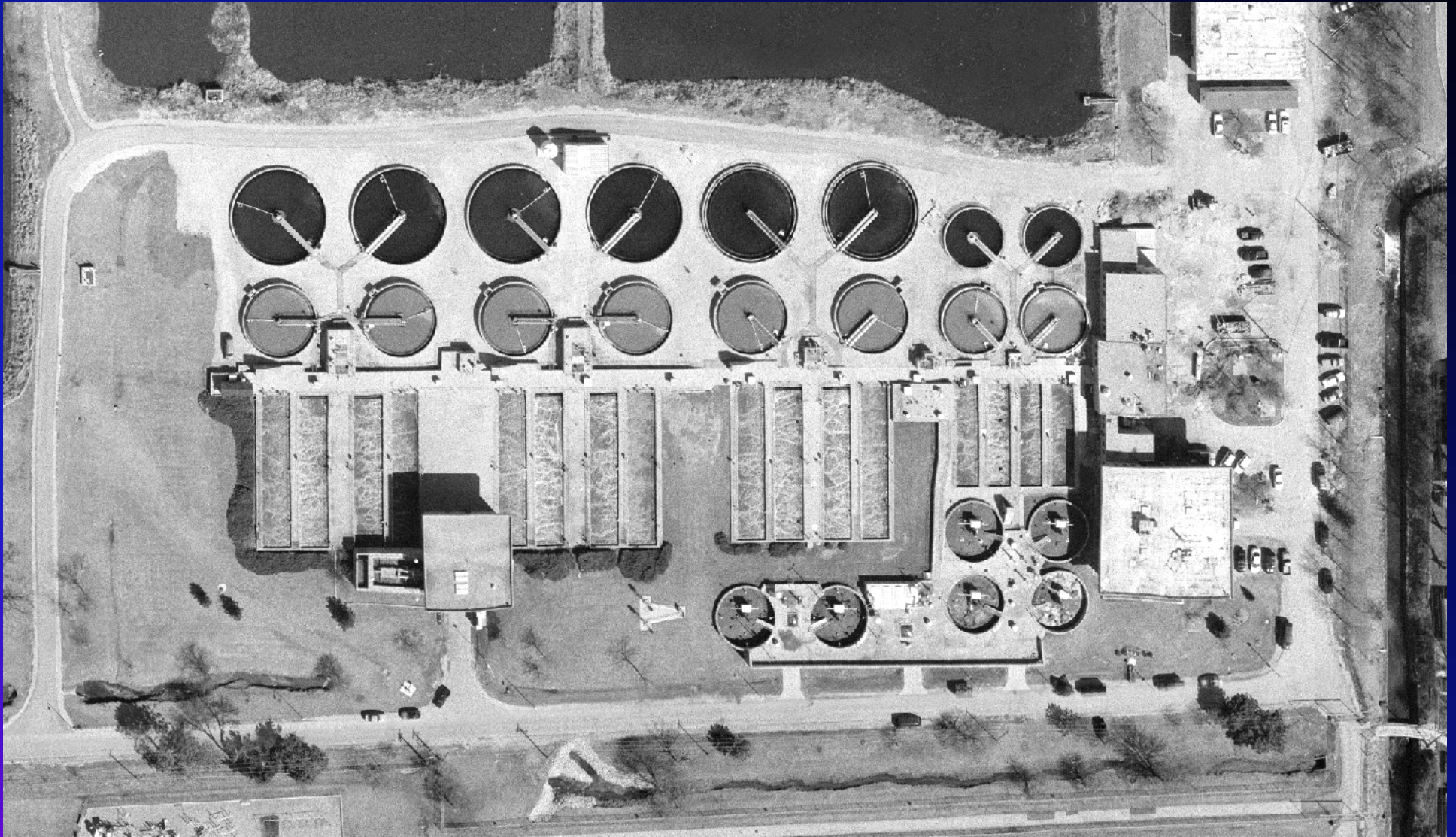
NSWRP MASTER PLAN PROJECTS	Estimated Construction Cost	Estimated Construction Start	Status
MUPPs	\$980,000	2007	Completed
Aeration Blower Upgrades	\$42,000,000	2011	Under Design
Battery E	\$282,000,000	2011	Under Design
Raw Sewage Pump Upgrades	\$5,000,000	2013	
North Side Sludge Force Main	\$18,000,000	2013	
Sludge Concentration Tank Improvements	\$20,000,000	2014	
Grit Dewatering Modification and Sodium Hypochlorite Feed System/Feed Point Modifications	\$6,000,000	2014	
Battery A Improvements: FSTs; Air and Flow Distribution Improvements; Aeration Tank Maintenance and Repairs	\$30,000,000	2016	
Battery B Improvements: FSTs; Air and Flow Distribution Improvements; Aeration Tank Maintenance and Repairs	\$30,000,000	2018	
Battery C Improvements: FSTs; Air and Flow Distribution Improvements; Aeration Tank Maintenance and Repairs	\$30,000,000	2020	
Battery D Improvements: FSTs; Air and Flow Distribution Improvements; Aeration Tank Maintenance and Repairs	\$10,000,000	2020	
Coarse Screen Replacement	\$9,000,000	2024	
Submetering; Employee Facilities; and Miscellaneous Needs Assessment	\$2,000,000	2024	

NSWRP MASTER PLAN PROJECTS

NSWRP MASTER PLAN PROJECTS	Estimated Construction Cost	Estimated Construction Start	Status
MUPPs	\$980,000	2007	Completed
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Battery B Improvements: FSTs; Air and Flow Distribution Improvements; Aeration Tank Maintenance and Repairs	\$30,000,000	2018	
Battery C Improvements: FSTs; Air and Flow Distribution Improvements; Aeration Tank Maintenance and Repairs	\$30,000,000	2020	
Battery D Improvements: FSTs; Air and Flow Distribution Improvements; Aeration Tank Maintenance and Repairs	\$10,000,000	2020	
Coarse Screen Replacement	\$9,000,000	2024	
Submetering; Employee Facilities; and Miscellaneous Needs Assessment	\$2,000,000	2024	



MWRDGC



**HANOVER PARK WASTEWATER RECLAMATION PLANT
INFRASTRUCTURE AND PROCESS NEEDS
FEASIBILITY STUDY
(MASTER PLAN) RESULTS – 2010**

MWRD&C

SUSTAINABILITY FEATURES

- Premium Efficiency Motors
- VFD Control on Most Pumps
- Roof and Road Drains Running to Rain Gardens or Local Landscaping, Not Into Sewer
- Buildings Meet District's Sustainable Facilities Guideline
- Biofilter for Odor Control, Requiring No Chemical Addition
- Skylights and Windows for Natural Light
- High Efficiency Thickening Centrifuges, with More Than Twice the Sludge Throughput and Less Polymer Usage

SUSTAINABILITY FEATURES

- **High-efficiency Lighting**
- **White Colored Roofing Systems in Lieu of Black Built-up Coal Tar Roofs**
- **Thermal Insulation on All New Buildings**
- **Primary Sludge Thickening Building and Aerated Grit Facility Designed to Support Solar Panels in Future**
- **Recycled Construction and Demolition Debris**
- **High Speed, High Efficiency Turbo Blowers for Airlift Pumps and Aerated Grit Process Air**
- **Biosolids Augmented Topsoil**
- **Triple Bottom Line Analysis Used for Alternatives Evaluation**

A LOOK AHEAD

- **New Blowers and Upgrade of Raw Sewage Pumps, NSWRP**
- **New Aeration Tank in Battery D, NSWRP**
- **Expansion of Gravity Concentration Tanks, NSWRP**
- **Grit Dewatering and Sodium Hypochlorite Feed Modifications, NSWRP**
- **Low Pressure Digester Gas Storage, SWRP, CWRP, HPWRP**
- **Battery B Primary Settling Tanks, SWRP**

What's all this going to cost?

Stickney Master Plan Work:	\$1,013,382,000
Calumet Master Plan Work:	\$557,733,640
<u>North Side Master Plan Work:</u>	<u>\$484,980,000</u>
Total=	\$2,056,095,640

2009 dollars, does not include disinfection, nutrient removal, or Hanover Park

**Preservation and Capital Improvements
Projects
(Non-Master Plan Projects)
at All Seven MWRD Water Reclamation Plants
Commence in 2009—2012:**

- **44 Construction Projects**
- **\$468,578,000**

PROCESS FACILITIES DIVISION STAFF

26 Civil Engineers

16 Electrical Engineers

14 Mechanical Engineers

12 Structural Engineers

6 Architects

15 Draftsmen and Engineering Technicians

ACKNOWLEDGEMENTS

★ Shu Ming Qiu

★ Jan Kolar

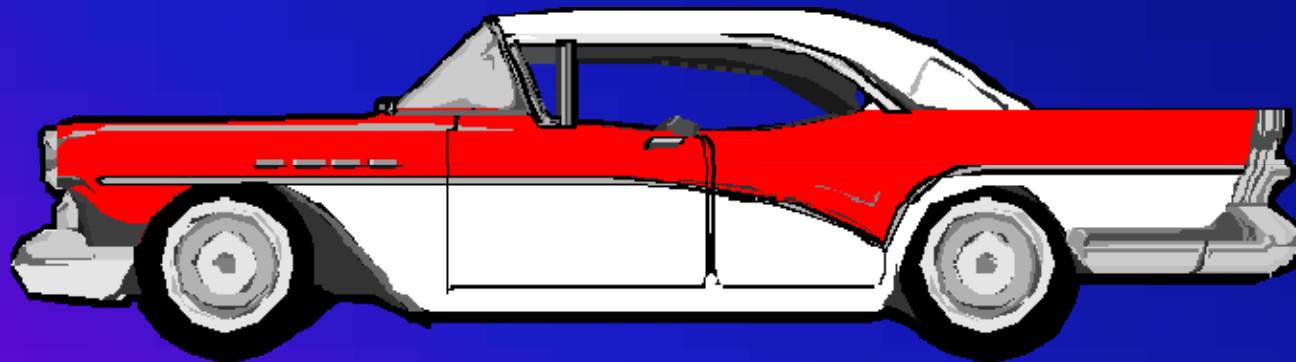
★ Christopher Haite

★ AECOM

★ Greeley and Hansen

★ Black & Veatch

★ Brian Fritz Photography





Thank You