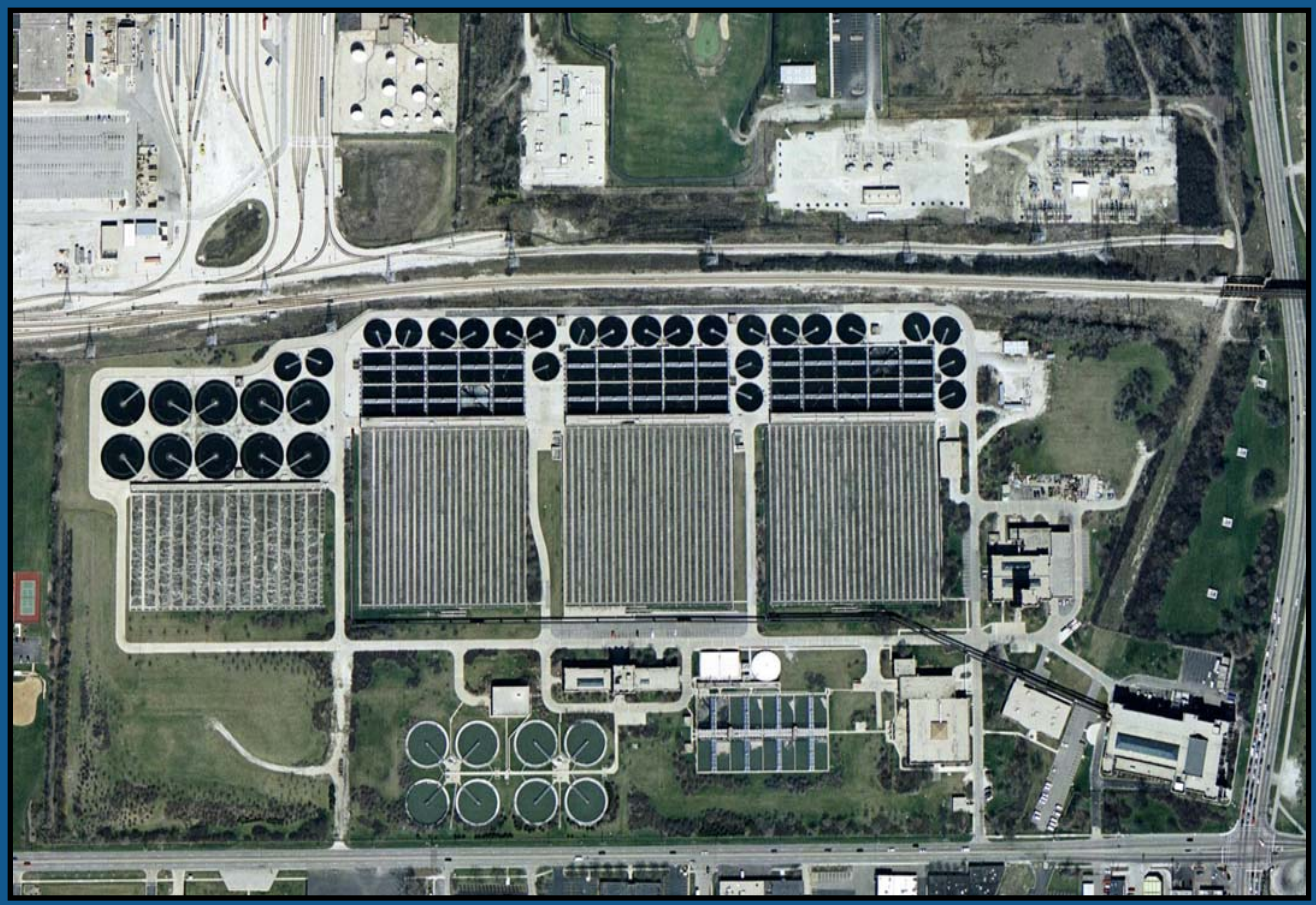


North Side WRP Master Plan
Research and Development Department
2006 Seminar Series – October 27, 2006

Metropolitan Water Reclamation District of Greater Chicago

Today's Goals

- Discuss project background
- Provide an overview of evaluation results
- Outline recommended plan

Content of Presentation

- Objectives and Guiding Principles
- Current and Future Conditions
- Liquid Handling
- Solids Handling
- Site Planning
- Recommended Plan

Objectives and Guiding Principles

Objectives and Guiding Principles

- Assess future flow and loads
- Study major needs to year 2040
- Consider escalating energy costs and stricter effluent limits

Objectives and Guiding Principles (cont.)

- Establish prioritized capital projects for next 20 years (year 2026)
- Comment on needs beyond year 2026
- Standardize equipment among all WRP's where practical

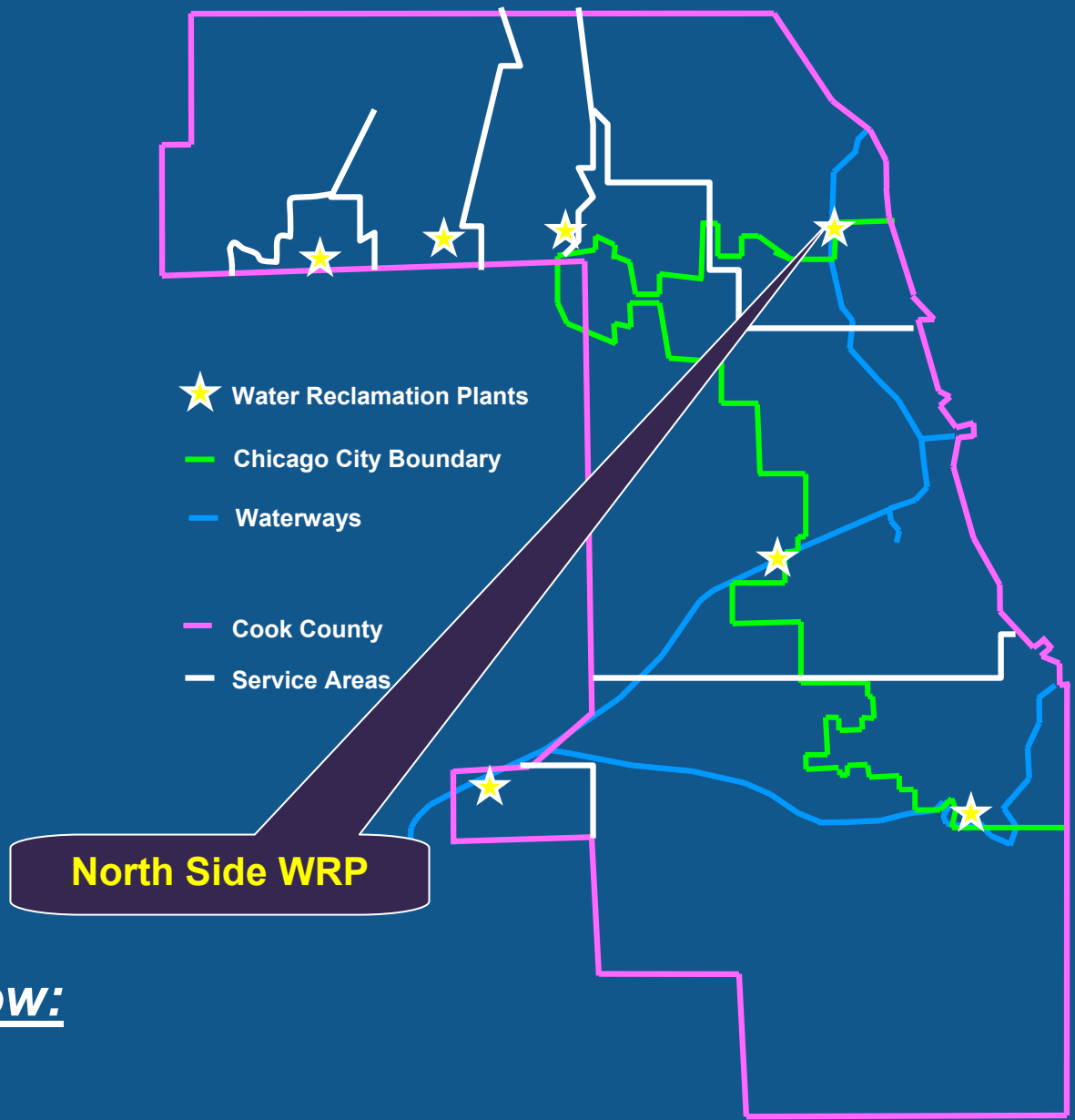
Current and Future Conditions

NORTH SIDE
Service Area

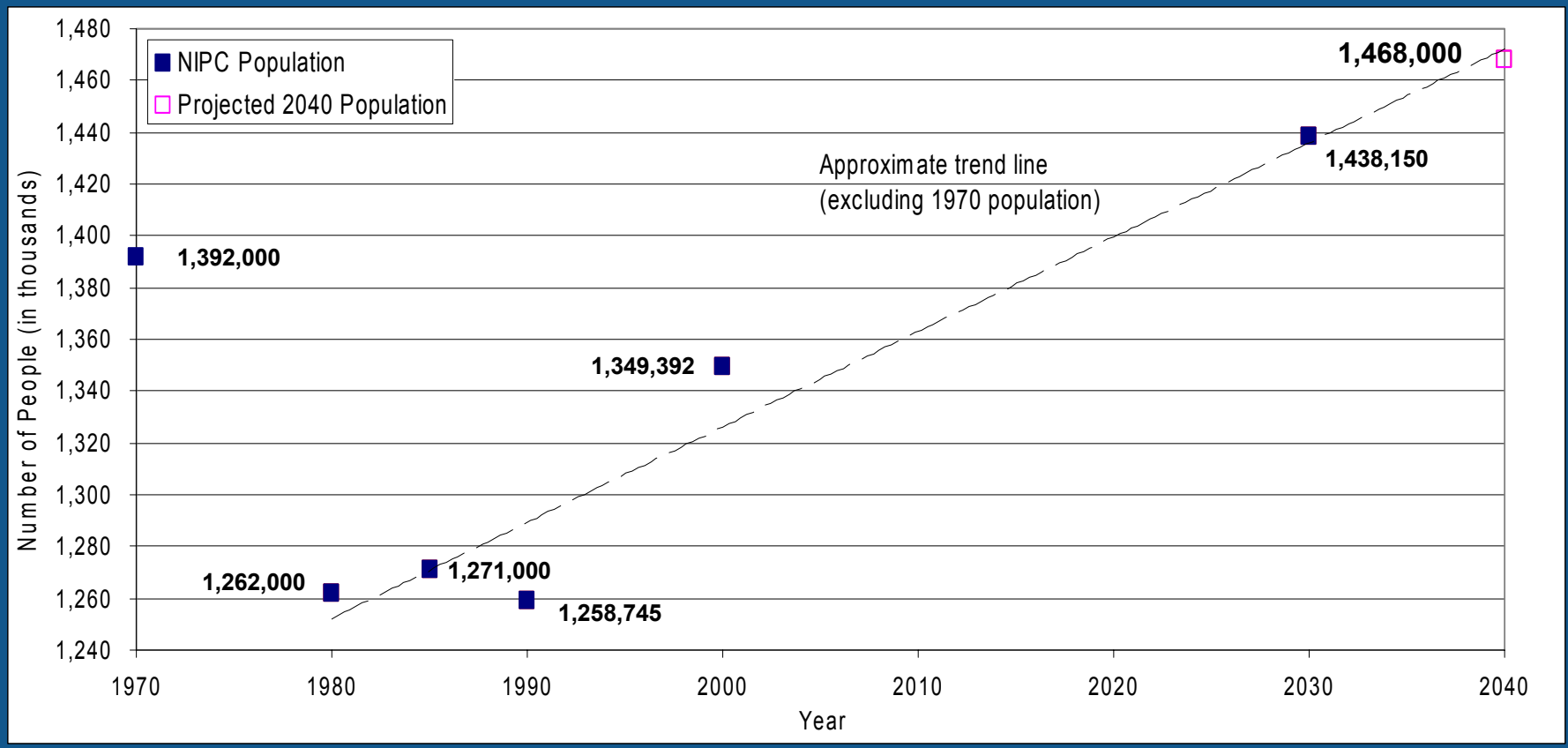
Service Area:
142.4 Sq. mi.

Population Served:
1,349,392 (2000)

Design Average Flow:
333 MGD



Population Trend Line



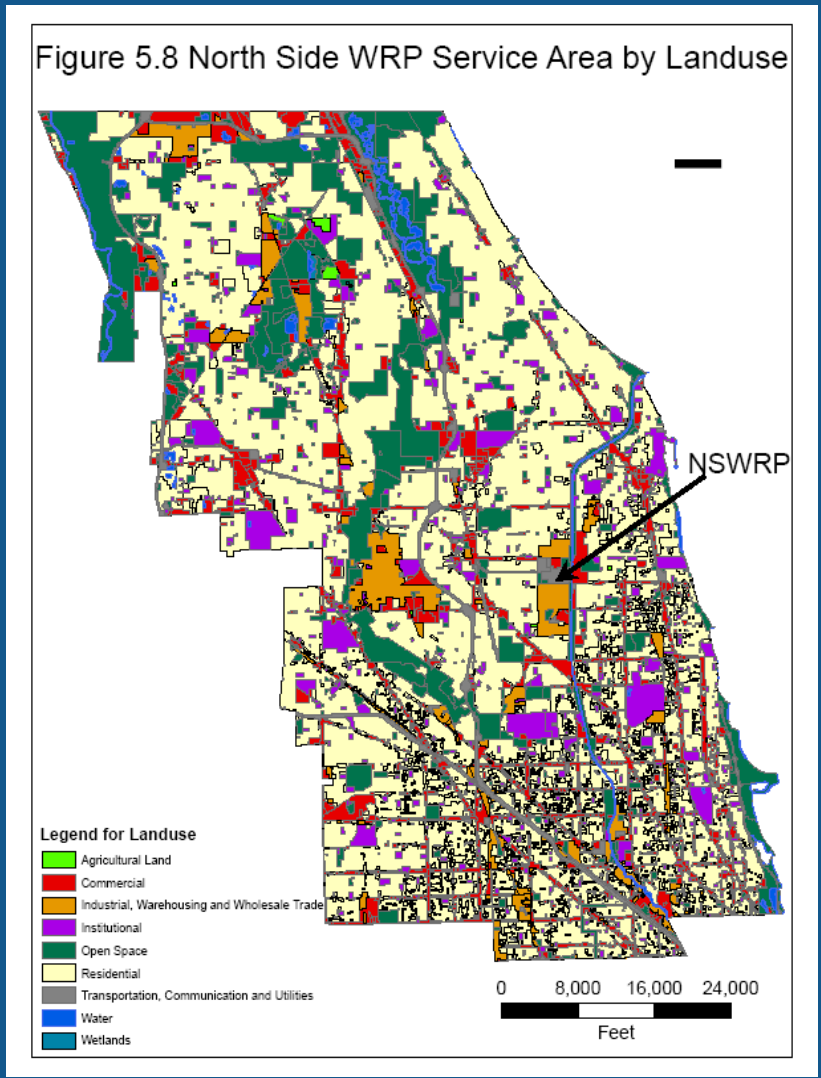
Population and Flow Projection

Year	Population	Annual Average Flow, MGD	Gallons Per Capita
2000	1,349,392	259	192
2040	1,468,000	282	192

Land Use Evaluation

- Obtained land use map from NIPC
- Extracted acreage for year 2000
- Estimated flow based on gallons / acre
- Estimated land use for year 2040 assuming build-out of developable land

Land Use Projections



- Green area are open space or agricultural
- Limited undeveloped property

Year 2040 Flow Projections

- Population method: 282 MGD
- Land Use method: 287 MGD
- Current permitted rating: 333 MGD
- Conclusion: Use 333 MGD annual average for master planning evaluations
- Assume no net change in I/I over planning period
- Assume no change in raw sewage characteristics over planning period

Summary of 1996 – 2003 Data (10% outliers excluded)

Parameter	Unit	Min Day	Annual Avg	Max Month	Max-week	Max Day
Flow	mgd	157	259	349	404	460
BOD_5	tpd	47	113	144	175	207
	mg/L	72	104	99	104	108
$CBOD_5$	tpd	29	82	102	123	151
	mg/L	44	76	70	73	79
TSS	tpd	23	119	158	202	223
	mg/L	35	110	108	120	116
NH_3-N	tpd	2	10	13	15	19
	mg/L	2.8	9.4	9.1	8.8	10.1
TKN	tpd	8	21	26	28	39
	mg/L	12.2	19.1	17.8	16.6	20.2
TP	tpd	0.5	3.3	4.0	5.3	6.0
	mg/L	0.7	3.0	2.8	3.2	3.1

Year 2040 Projected Influent Flow and Loads

Parameter	Unit	Min Day	Annual Avg	Max Month	Max-week	Max Day
Flow	mgd	202	333	449	450	450
BOD_5	tpd	61	144	185	195	203
	mg/L	72	104	99	104	108
$CBOD_5$	tpd	37	106	131	137	148
	mg/L	44	76	70	73	79
TSS	tpd	29	153	202	225	218
	mg/L	35	110	108	120	116
NH_3-N	tpd	2.4	13	17	16.5	19
	mg/L	2.8	9.4	9.1	8.8	10.1
T K N	tpd	10.3	27	33	31.1	37.9
	mg/L	12.2	19.1	17.8	16.6	20.2
T P	tpd	0.6	4.2	5.2	6.0	5.8
	mg/L	0.7	3.0	2.8	3.2	3.1

Current and Projected Monthly Average Permit Limits

Parameter	Current	Possible 2010 - 2020	Future Year 2040
Total Phosphorus (mg/l)	No standard	1.0	0.5
Total Nitrogen (mg/l)	No standard	6.0 to 8.0	5.0
Carbonaceous BOD_5 (mg/l)	10.0	10.0	10.0
Total Suspended Solids (mg/l)[2]	12.0	12.0	12.0
Ammonia-Nitrogen (mg/l)	2.5 (summer); 4.0 (winter)	2.5 (summer); 4.0 (winter)	1.5 (summer); 3.0 (winter)
***E. coli* (cfu/100 ml)**	No standard	400 cfu/100 ml[5]	400 cfu/100 ml[5]

Potential permit limits were considered for space planning only and are not to be interpreted as acceptance by the District.

Existing Treatment Capacity Evaluation Results – Based on Design Criteria

Item	Design Guideline	Plant Influent Flows at which design guidelines exceeded, MGD
Primary Settling	Ten-States	
SOR (annual avg.)	1,000 gpd/sf	102
SOR (peak hourly)	2,000 gpd/sf	205
Aeration Tank	IEPA	
HRT (annual avg.)	8 hours	186
Organic Loading, BOD_5/1,000 ft^3/day	15 annual average	187
Final Settling	IEPA	
SOR (peak hourly)	1,000 gpd/sf	335
SLR (peak hourly)	50 ppd/sf	488

Existing Treatment Capacity Evaluation Results - Based on NSWRP Baseline Model (10% Capacity Out of Service)

Item	Current Permit Limit, mg/l	Plant Influent Flows at which model predicted permit violations, mgd
Monthly Average		
$CBOD_5$	10	375
TSS	12	300
NH_3-N, winter	4	370
Weekly Average		
$CBOD_5$	12	360
TSS	18	300
Daily Maximum		
NH_3-N, winter	8	360

Liquid Handling

Unit Processes Considered

- Raw Sewage Pumping
- Screening
- Grit Removal
- Primary Tanks
- Aeration Tanks / Nutrient Removal
- Aeration Blowers
- Final Tanks
- Tertiary Treatment (for space planning only)
- Disinfection (for space planning only)

Raw Sewage Pumps

Existing Raw Sewage Pumps - Existing

6 Constant Speed

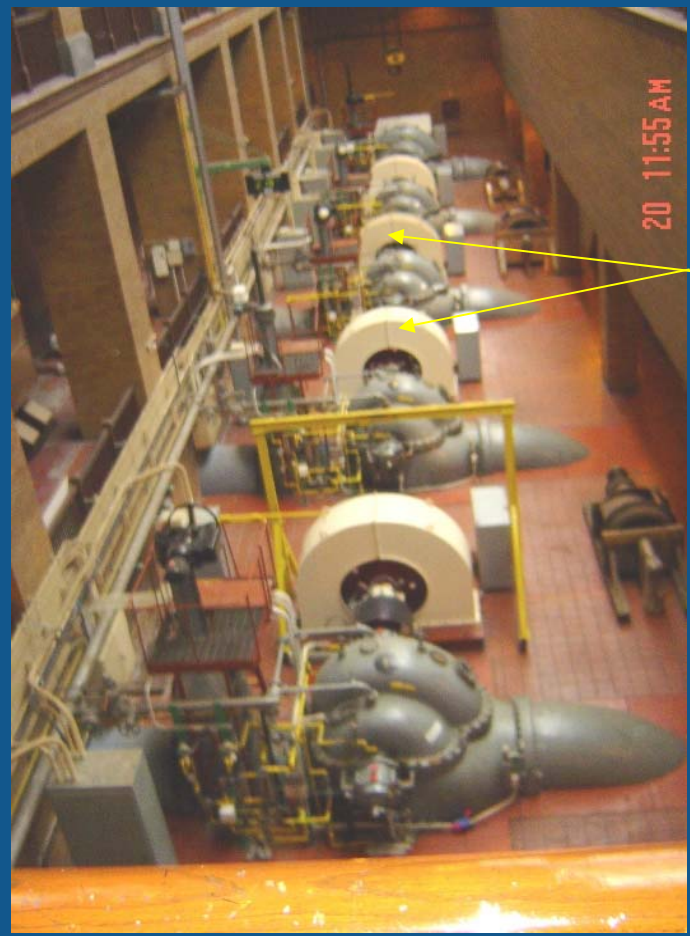
- Capacity:
  n+1 583 MGD
  n+1+1 400 MGD

- Objective:
  n+1+1 @ 450 MGD
  w/ flexibility

Raw Sewage Pumps Recommendation – Replace Impellers in Small Pumps w/ New Motors and VFD's

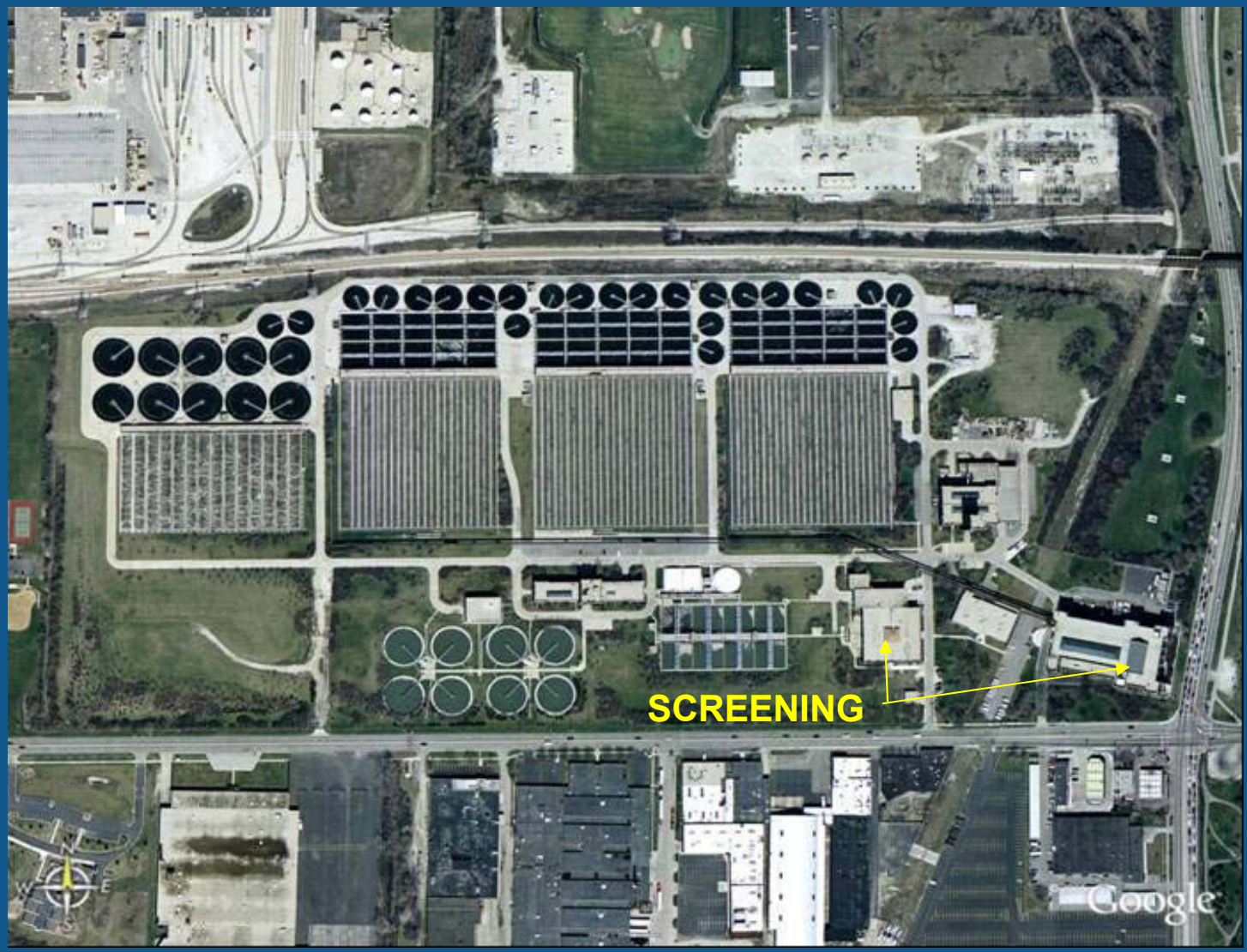
Benefits:

- Improves Reliability
- Wide Range of Flow
- VFD enables automatic control
- Meets 450 mgd w/ one VFD pump and P-5 or P-6 out of service



Replace Impellers in Pumps No. 3 & 4 w/ new Motors and VFD's

Screening



Existing Screens – Climber Type

Coarse Screens
3.5” Clear Spacing

Fine Screens
0.5” Clear Spacing

Screening Recommendation – Replace Coarse Screens w/ 1.5” clear spacing; continue to maintain existing fine screens

Benefits:

- Improves reliability
- Minimizes solids build-up in grit tanks

Replace existing coarse climber screens

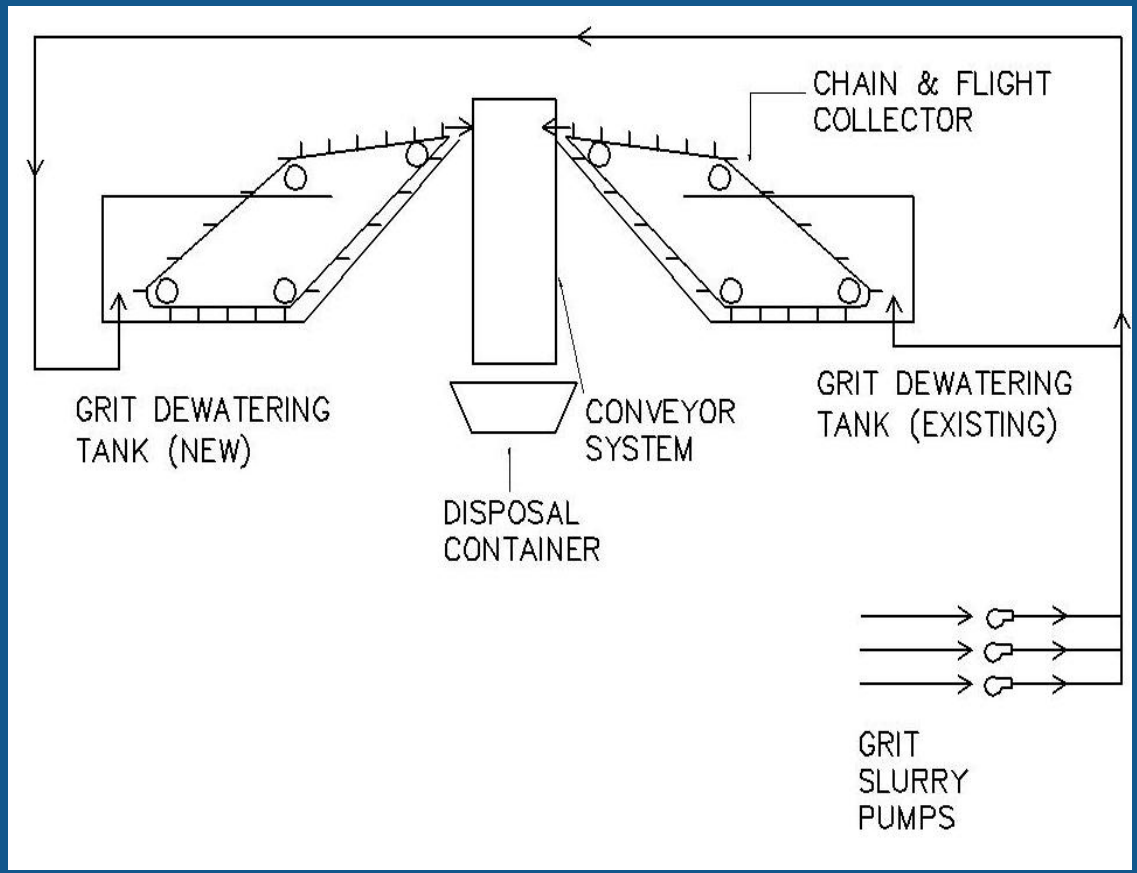
Grit Removal

Grit System - Existing

Aerated Grit Tank

Dewatering w/concrete wash tank or cyclones & classifiers

Grit System Recommendation – Continue to maintain aerated grit system; provide redundant wash tank

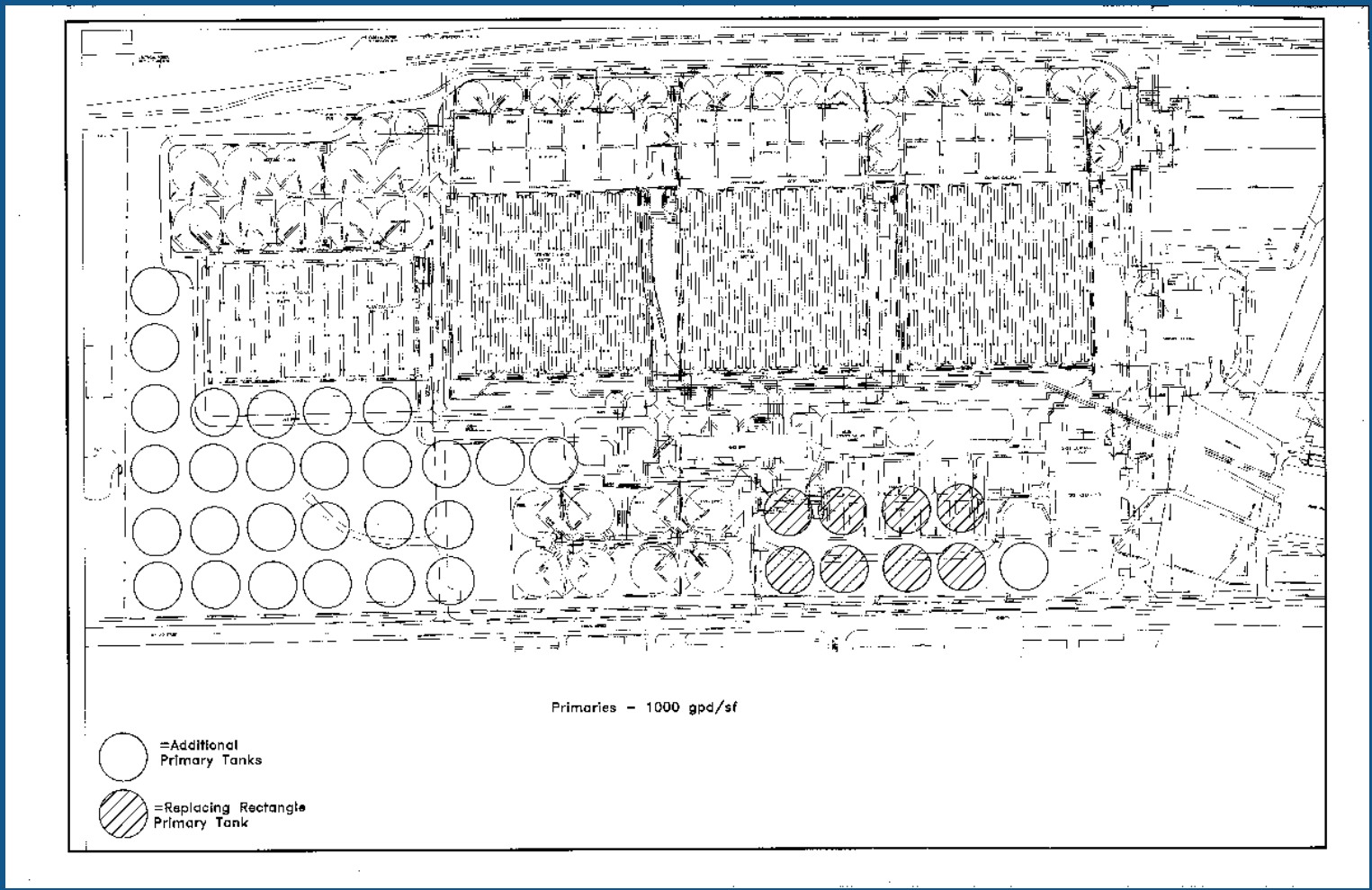


Benefits:

- Improves reliability
- Minimizes need for cyclones and classifiers
- Provides redundancy

Primary Tanks

Primary Tanks at 1,000 gpd/sf – Conceptual Sketch



Considered a range of loading rates from 1,000 to 2,000 gpd/sf

Primary Tanks - Existing

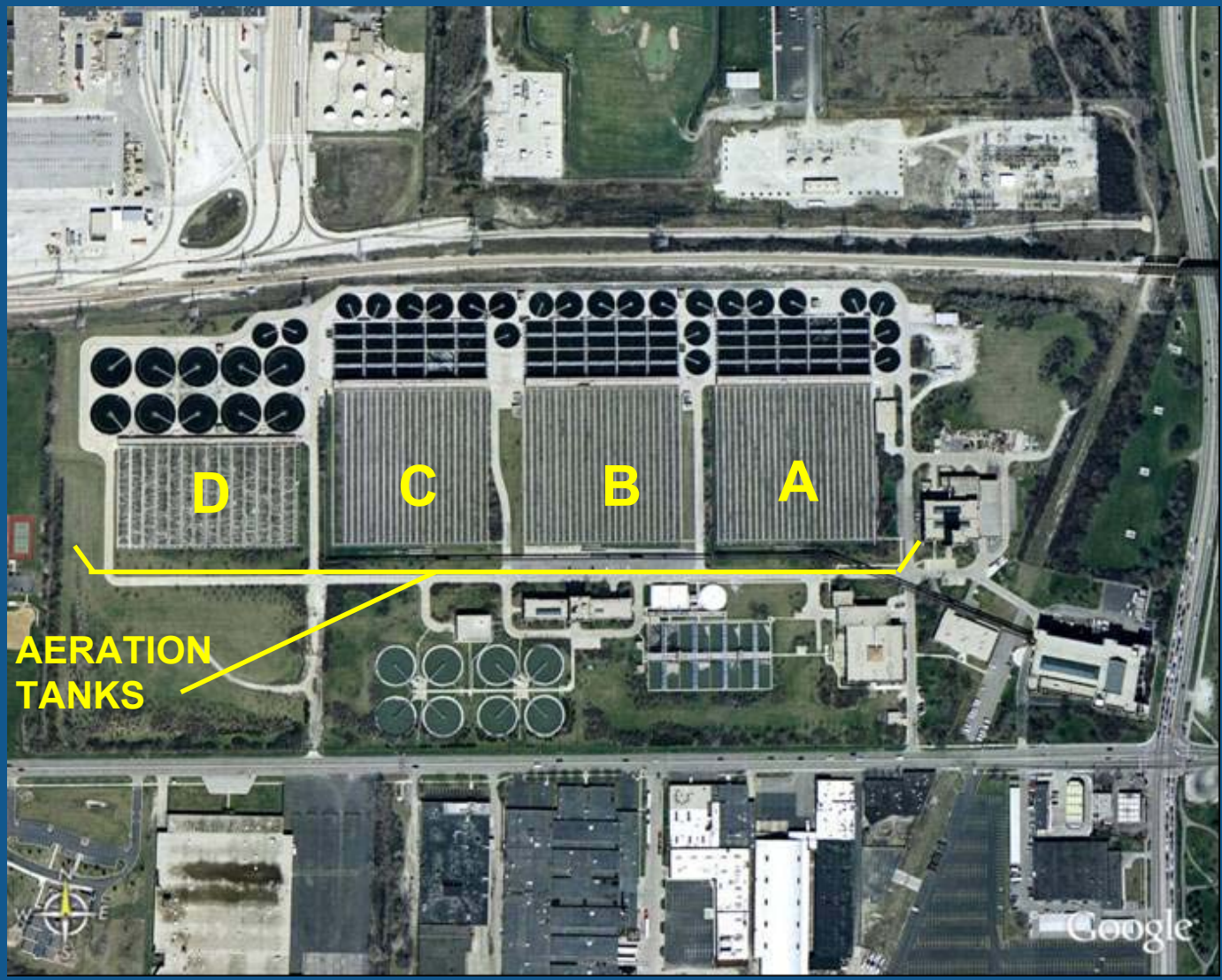
- 8 Square Tanks @ 80’ x 80’ x 14’ center water depth
- 8 Circular @ 100’ dia w/ 17’-10” center water depth
- Total Surface Overflow Rate (SOR) 2,270 gpm/sf @ current average flow @ 259 MGD

Primary Tanks Recommendation – Provide 8 new Primary Tanks @ 100’ diameter; maintain existing circular tanks

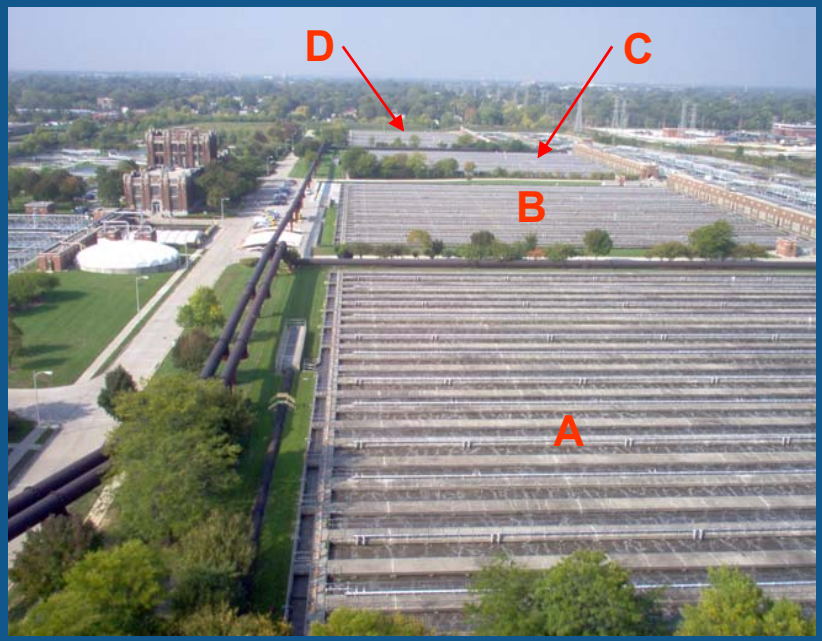
Benefits:

- Eliminates inefficient square tanks
- Improves hydraulic flow splitting
- Provides SOR @ 2,000 gpd/sf

Aeration Tanks / Nutrient Removal

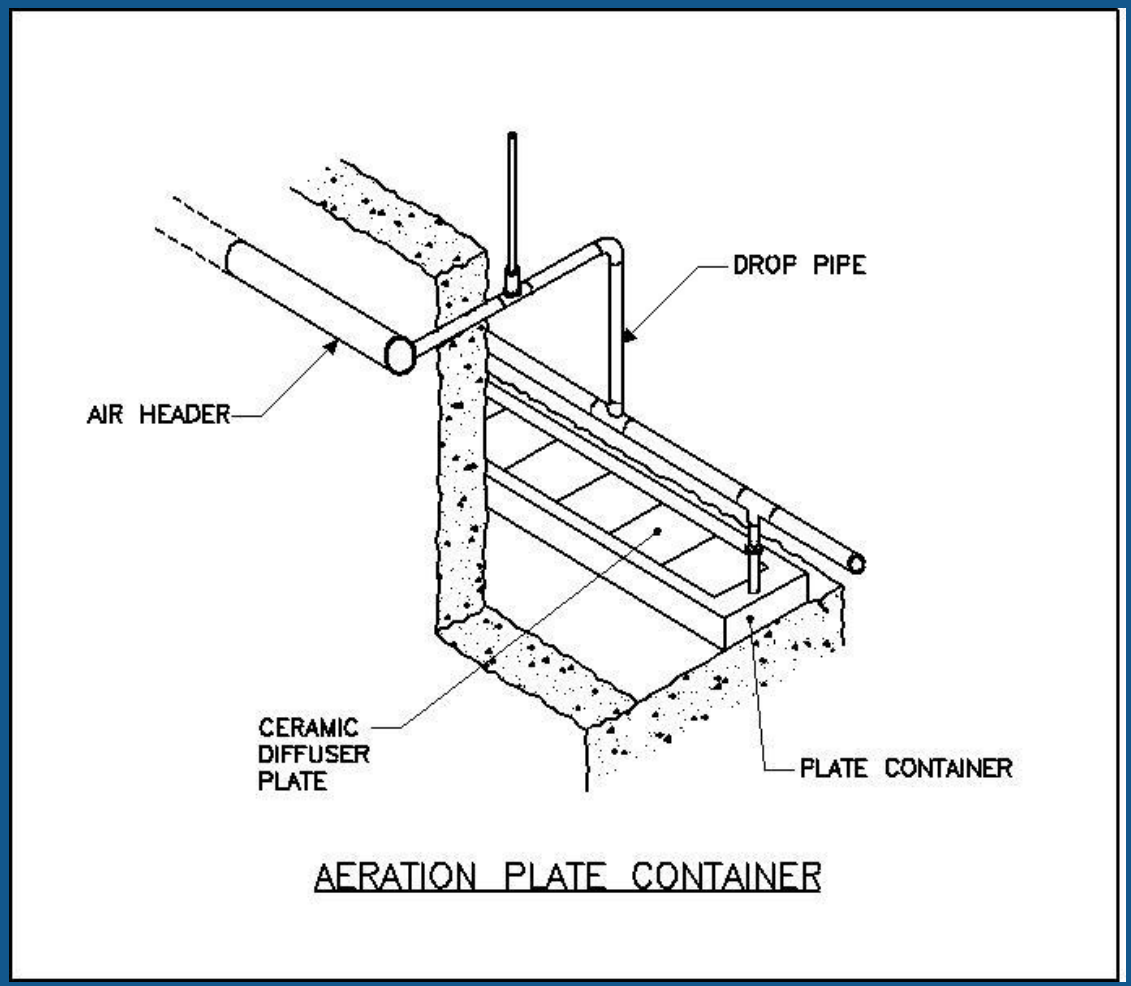


Aeration Tanks - Existing



- 4 Batteries w/ Total Volume @ 68 million gallons
- Hydraulic Retention Time, HRT @ 259 MGD current annual average flow, 6.3 hours
- Single stage nitrification, plug flow
- Silica / Alumina plate type diffusers

Aeration Tanks Recommendation – Increase HRT for minimum 7.2 hours; continue with alumina / silica plate diffusers; improve D.O. control



Benefits:

- Improves reliability
- Greater flexibility to meet maximum flow and loads

Aeration Blowers - Existing

Replace existing with new centrifugal units

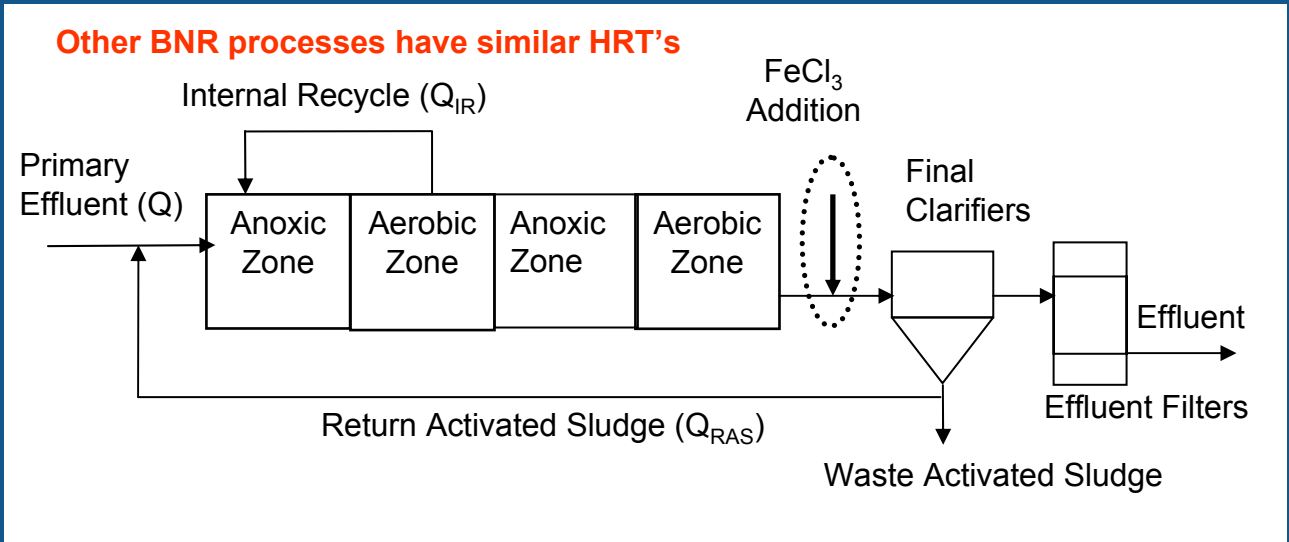
Future Nutrient Removal

- Considered for planning future space requirements only
- Plan for lower TP and TN limits
- Evaluate impacts on existing system

Nutrient Removal Recommendations

- For effluent TP = 1.0 mg/l, use ferric chloride addition
- For effluent TP = 0.5 mg/l and TN in the range of 6 to 8 mg/l, use ferric chloride addition with 4-stage Bardenpho BNR process with tertiary filters

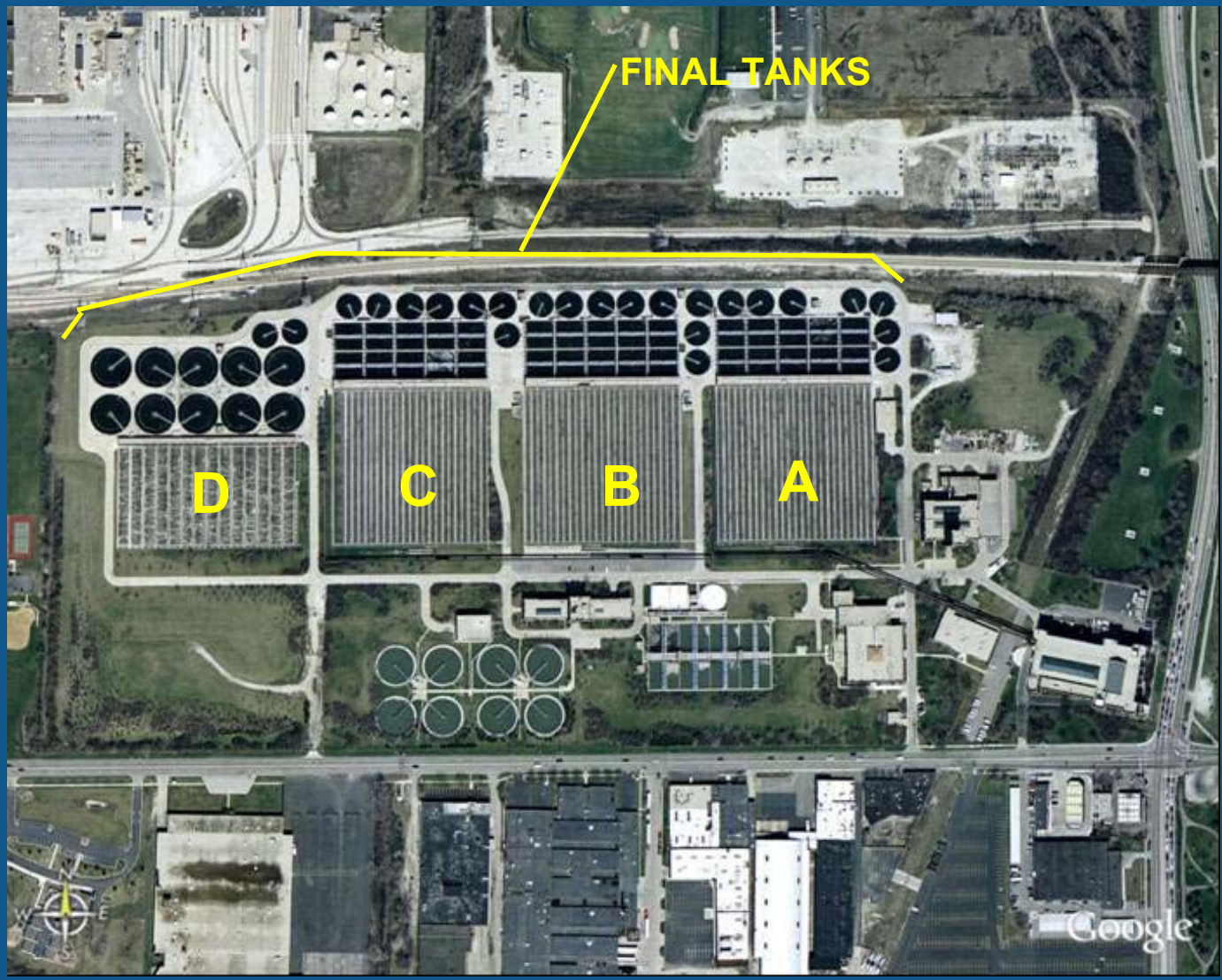
Nutrient Removal Potential BNR Processes



Four-stage Bardenpho w/ chemical addition and filtration

Nutrient removal was considered for planning purposes only and are not to be interpreted as acceptance by the District

Final Tanks



Final Tanks - Existing

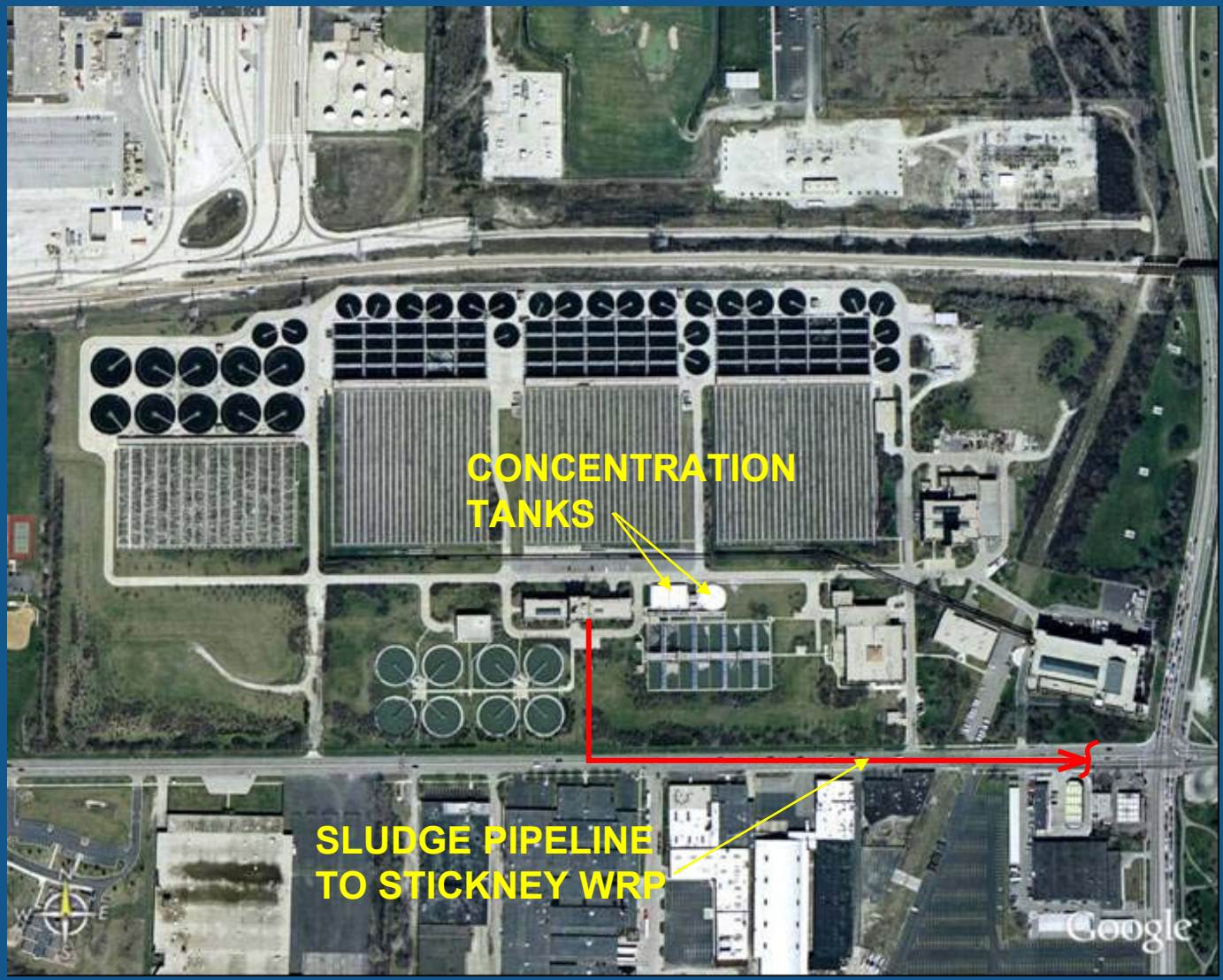
- 4 Batteries – difficult to control flow split proportionally
- Surface Overflow Rate, SOR @ 450 MGD peak flow
  ± 1,240 gpd/sf depending on flow split
- 40 square tanks @ 77’ x 77’ x 14.5’ side water depth (SWD)
- 12 circular @ 75’ diameter, 15’ SWD; 12 circular @ 70’ diameter, 15’SWD; 10 circular @ 110’ diameter, 14.5’ SWD (Battery D)
- Battery A, B, & C experience biological bulking on occasion
- Battery D functions more efficiently than Battery A, B, & C

Final Tanks - Recommendations

- Improve flow splitting to proportion flow equally
- Upgrade for SOR of 1,000 gpd/sf @ 450 MGD peak
- Use circular tanks @ 110’ diameter minimum

Solids Handling

Solids Handling Facilities



Concentration Tanks - Existing

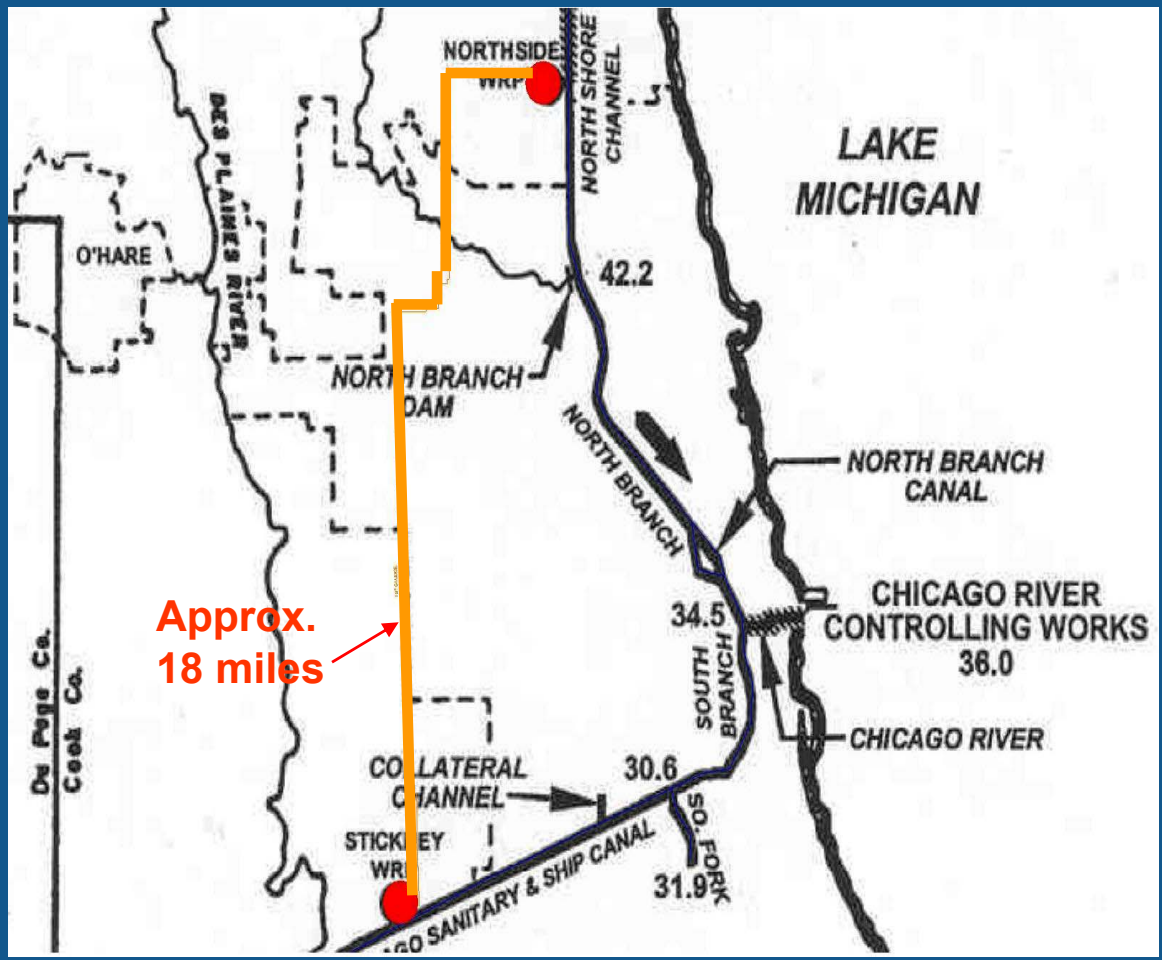
- 2 Rectangular tanks @ 46.75’ x 70’ x 14’ SWD
- 1 Circular Tank @ 70’ diameter w/ 15.92’ SWD
- Solids concentration varies between 1.1 to 1.4 %
- Tanks function as holding tanks w/ minimal thickening

Concentration Tanks Recommendation – Provide 2 new 70’ diameter concentration tanks

Benefits:

- Improves flexibilty
- Arrange to thicken primary sludge & blend w/ WAS

Recommendation – Inspect / test existing pipeline prior to new pipeline

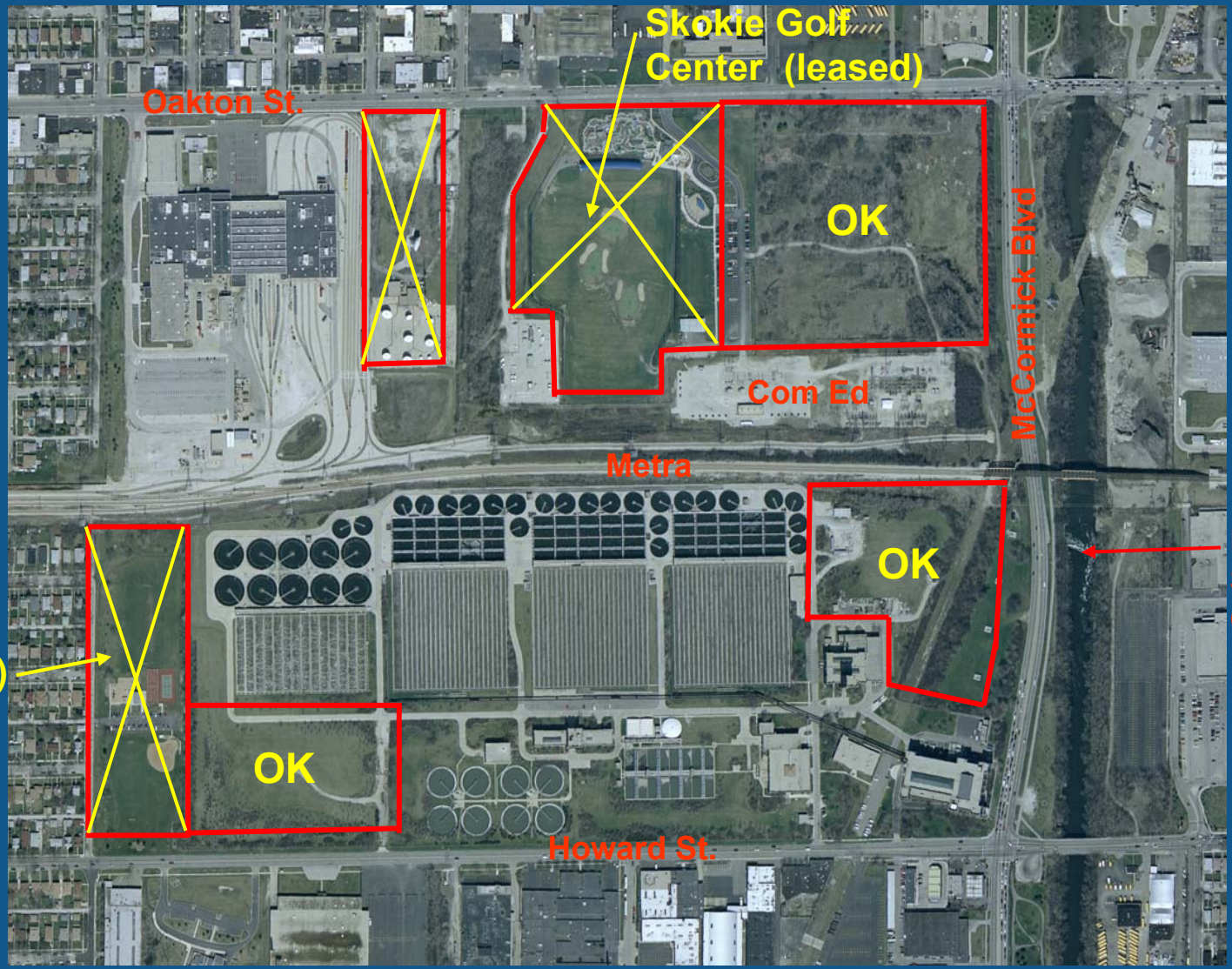


Benefits:

- Enable pressure up 100 psig
- Reduce pipeline maintenance
- Provides improved solids handling flexibility

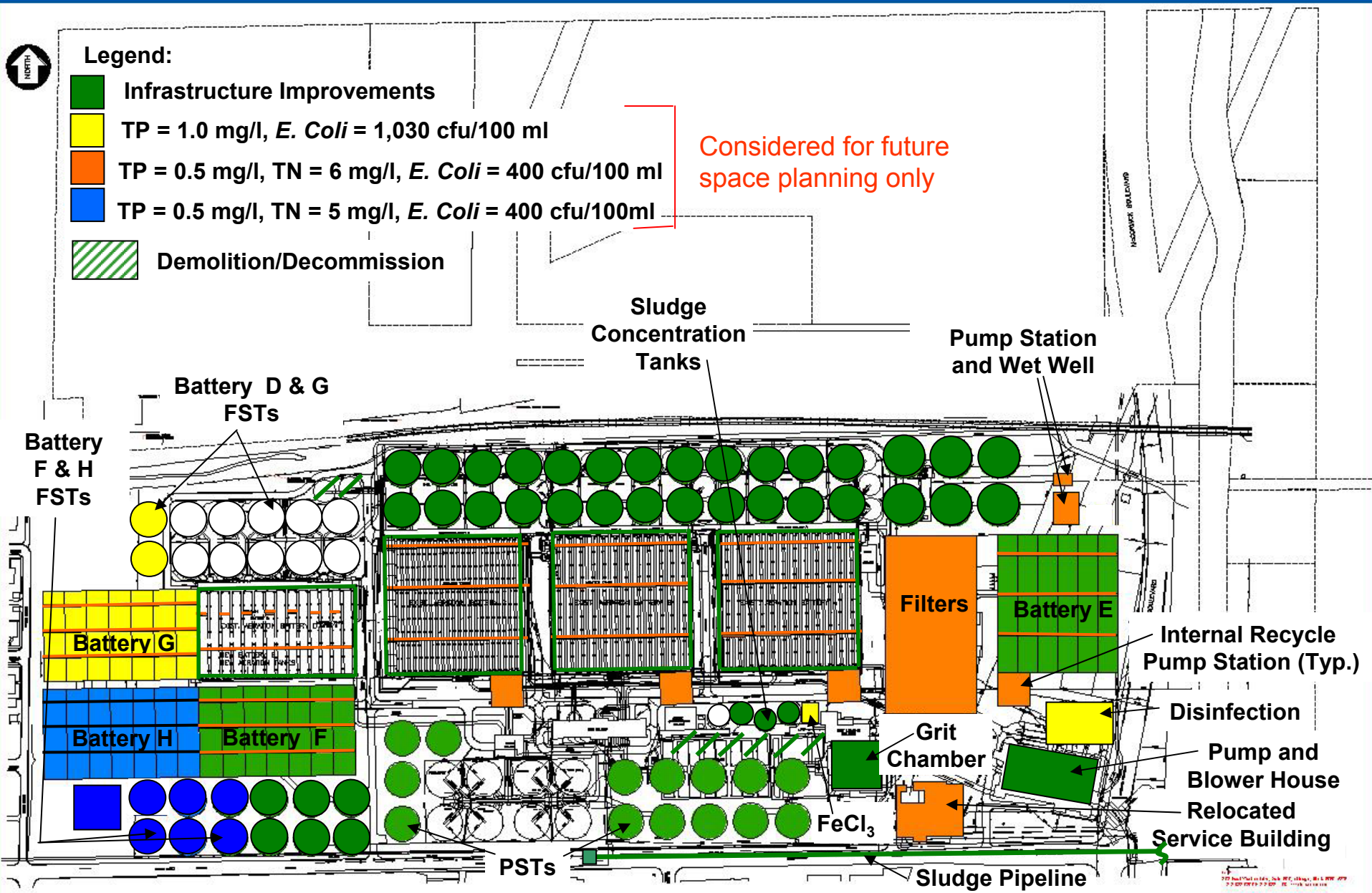
Site Planning

Available MWRDGC Property



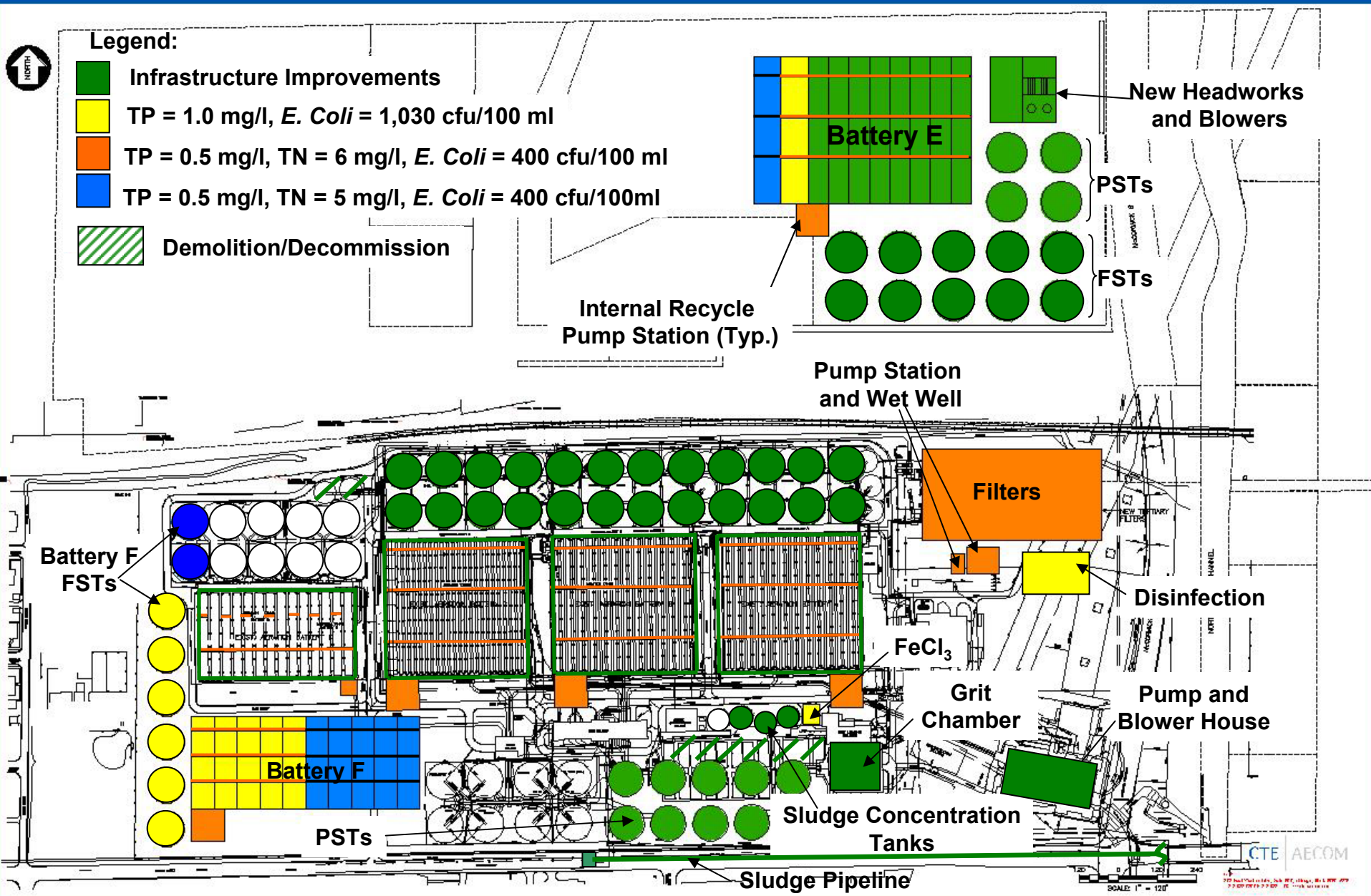
Potential Conceptual Site Plan – utilize existing south site (including west ball park)

CTE | AECOM

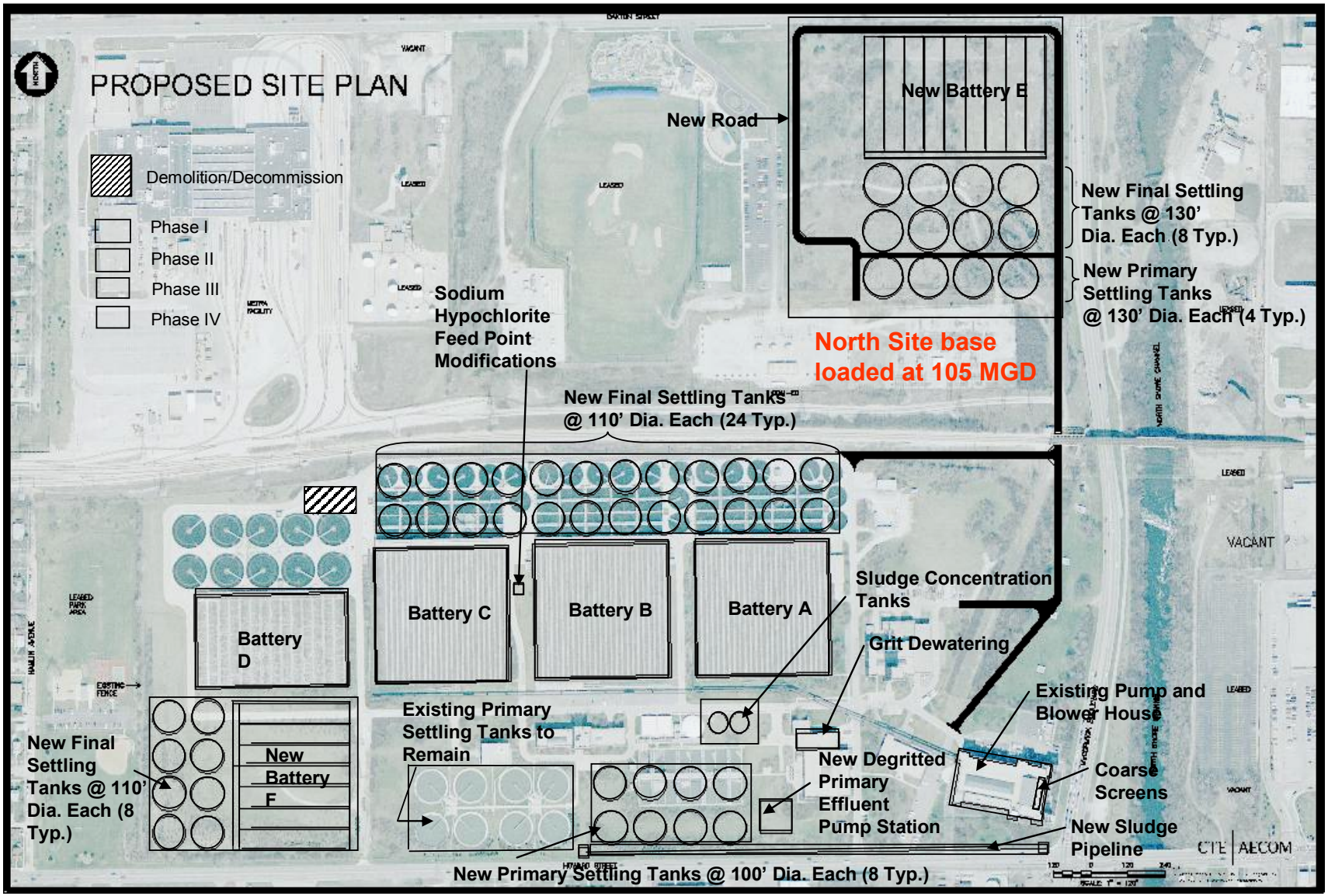


Potential Conceptual Site Plan – Two-plant operation (south and north)

CTE | AECOM



Proposed Site Plan – to Year 2026



North Side Water Reclamation Plant Master Plan (Tentative)

Near-Term Projects: 2007 – 2011	Construction Budget Costs	Construction Start
Raw Sewage Pump Upgrades	$3,000,000	2008
Piping to Battery E and Degritted Primary Influent Pump Station	$64,000,000	2008
Existing Sludge Pipeline Testing and Repair; and New Sludge Pipeline	$90,000,000	2008
Aeration Blower Upgrades	$19,000,000	2009
New North Battery E and North Site Primaries	$315,000,000	2009
Sludge Concentration Tank Improvements	$18,000,000	2010
Grit Dewatering Modification and Sodium Hypochlorite Feed System/Feed Point Modifications	$3,000,000	2011

North Side Water Reclamation Plant Master Plan (Tentative)

Mid-Term Projects: 2011 – 2015	Construction Budget Costs	Construction Start
Addition of New South PSTs; Primary Influent Distribution and Plant Drain Improvements	$44,000,000	2012
New Battery F	$179,000,000	2013

North Side Water Reclamation Plant Master Plan (Tentative)

Long-Term Projects: 2015 – 2026	Construction Costs	Construction Start
Demolition of Square PSTs; Addition of New North PSTs; and Plant Drain Improvements	$31,000,000	2016
Battery C Improvements: FST Replacement; Diffuser Replacement; Air and Flow Distribution Improvements; Aeration Tank Repairs; Air Lift Pump Replacement; and Plant Drain Improvements	$87,000,000	2017
Battery B Improvements: FST Replacement; Diffuser Replacement; Air and Flow Distribution Improvements; Aeration Tank Repairs; Air Lift Pump Replacement; and Plant Drain Improvements	$87,000,000	2020

North Side Water Reclamation Plant Master Plan (Tentative)

Long-Term Projects: 2015 – 2026 (cont.)	Construction Budget Costs	Construction Start
Battery A Improvements: FST Replacement; Diffuser Replacement; Air and Flow Distribution Improvements; Aeration Tank Repairs; Air Lift Pump Replacement; and Plant Drain Improvements	$87,000,000	2023
Battery D Improvements: Diffuser Replacement; Air Distribution Improvements; and Air Lift Pump Replacement	$15,000,000	2024
Coarse Screen Replacement	$8,000,000	2025
Submetering and Miscellaneous Electrical Upgrades	$2,000,000	2025

Questions ??