ODOR CONTROL OPTIMIZATION – EXTENDING YOUR CARBON LIFE

David Michelsen, P.E.
District Engineer
South Essex Sewerage District
Salem, MA

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SESD
South Essex Sewerage District

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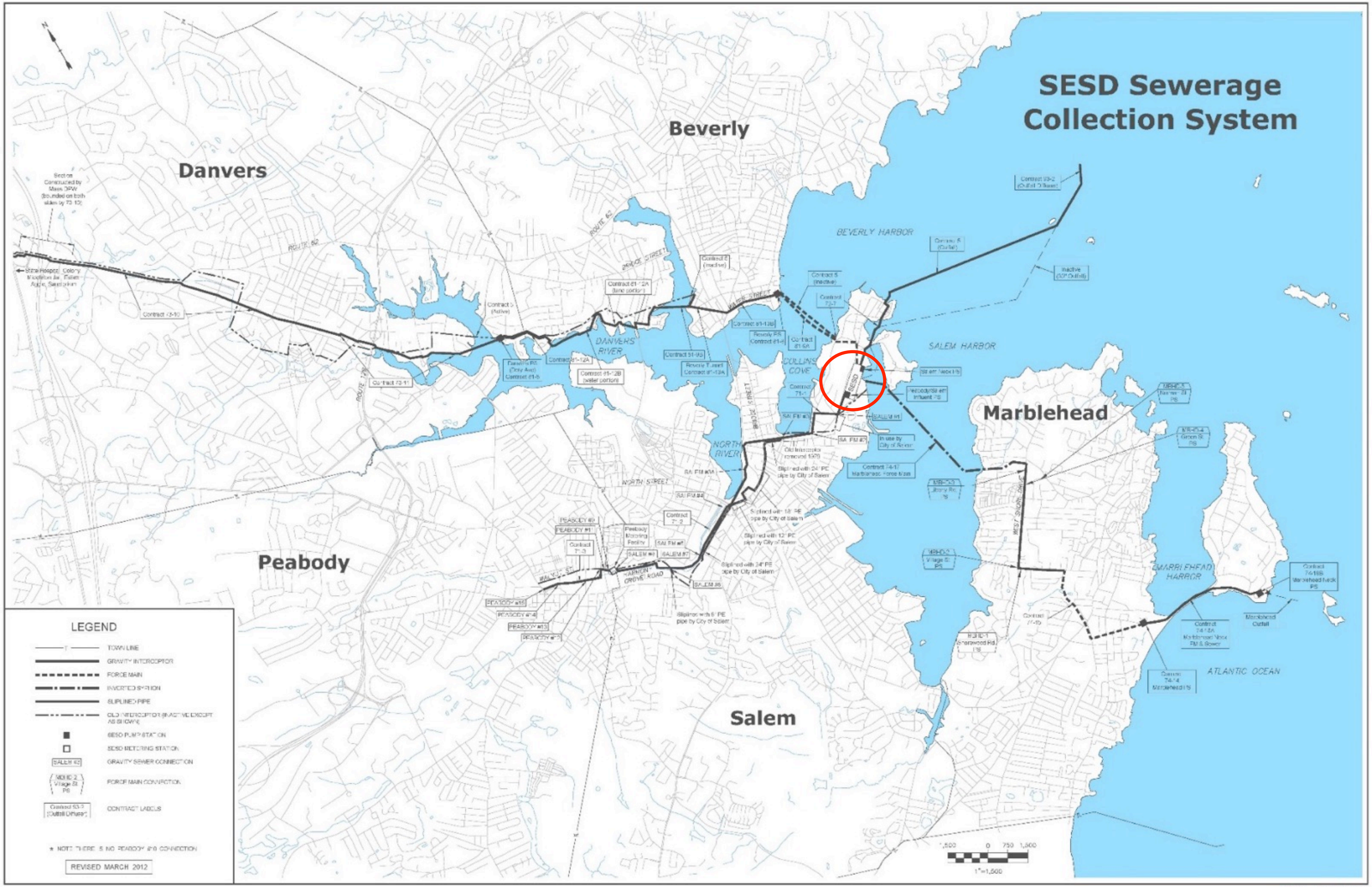
PRESENTATION OVERVIEW

- Background
- Odor Control Facilities
- Optimization Study
- Recommendations
- Conclusions

BACKGROUND

OVERVIEW OF THE SOUTH ESSEX SEWERAGE DISTRICT

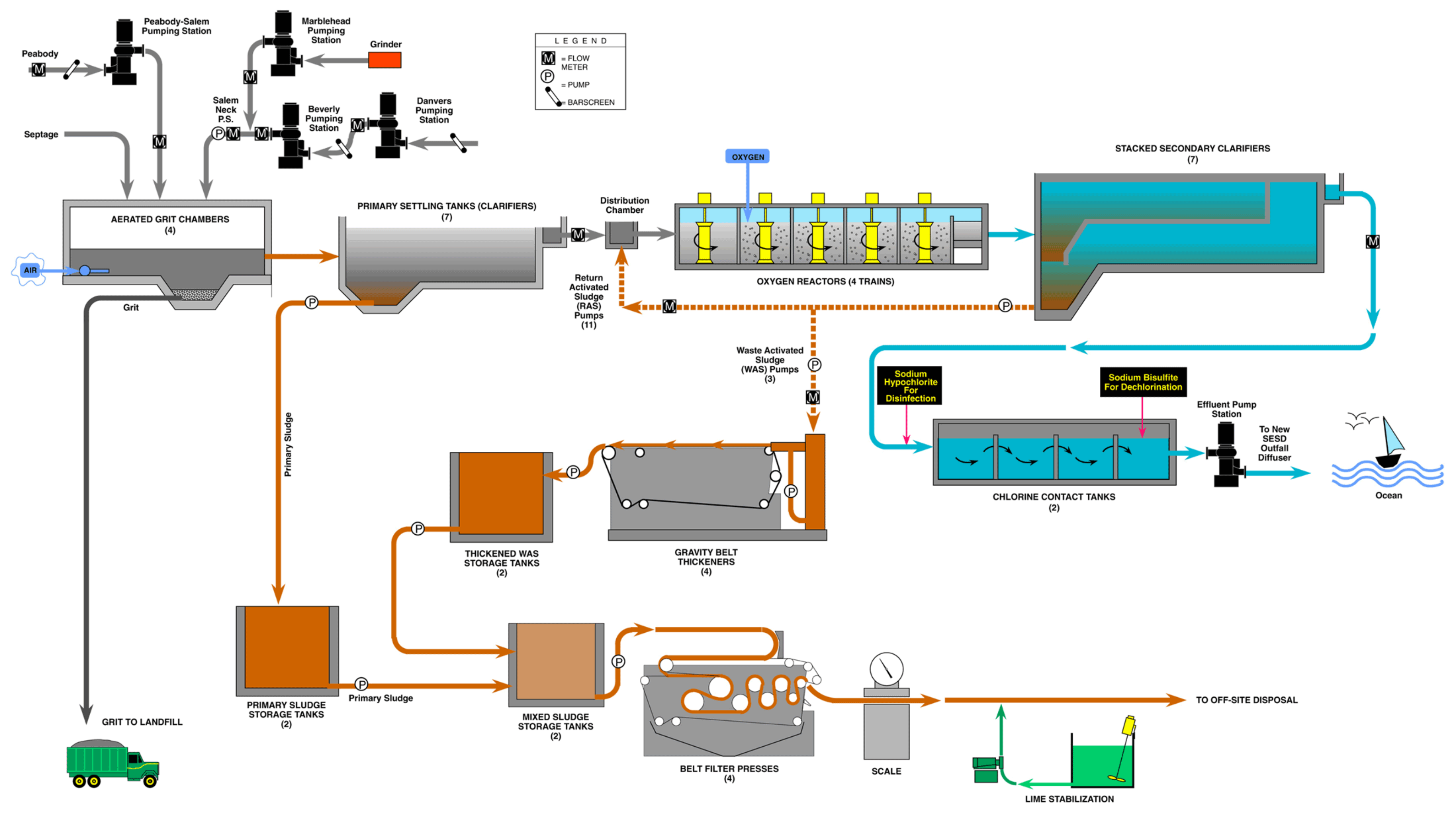
- South Essex Sewerage District (SESD) created in 1925 by Act of Massachusetts Legislature (Chp 339).
- Provides wastewater conveyance and treatment to Beverly, Danvers, Marblehead, Peabody, and Salem.
  - 29 miles of gravity interceptors, force mains, and six pumping/metering stations.
  - 30 MGD secondary treatment facility.
- Serves population of 180,000 people.


SESD Sewerage Collection System
Beverly
Danvers
Marblehead
Peabody
Salem
BEVERLY HARBOR
SALEM HARBOR
DANVERS RIVER
COLLINS COVE
NORTH RIVER
MARBLEHEAD HARBOR
ATLANTIC OCEAN
NORTH STREET
ROUTE 62
ROUTE 128
LEGEND
TOWN LINE
GRAVITY INTERCEPTOR
FORCE MAIN
INVERTED SYPHON
SLIPLINED PIPE
OLD INTERCEPTOR (INACTIVE EXCEPT AS SHOWN)
SESD PUMP STATION
SESD METERING STATION
GRAVITY SEWER CONNECTION
FORCE MAIN CONNECTION
CONTRACT LABELS
REVISED MARCH 2012
1"=1,500

OVERVIEW OF SESD TREATMENT FACILITY

- Secondary treatment facility using high purity oxygen.
- 30 MGD avg. daily treatment capacity; peak flows up to 99 MGD.
- Discharges to Salem Sound with a 660 foot ocean outfall.
- 200,000 scfm of odor control / ventilation capacity.

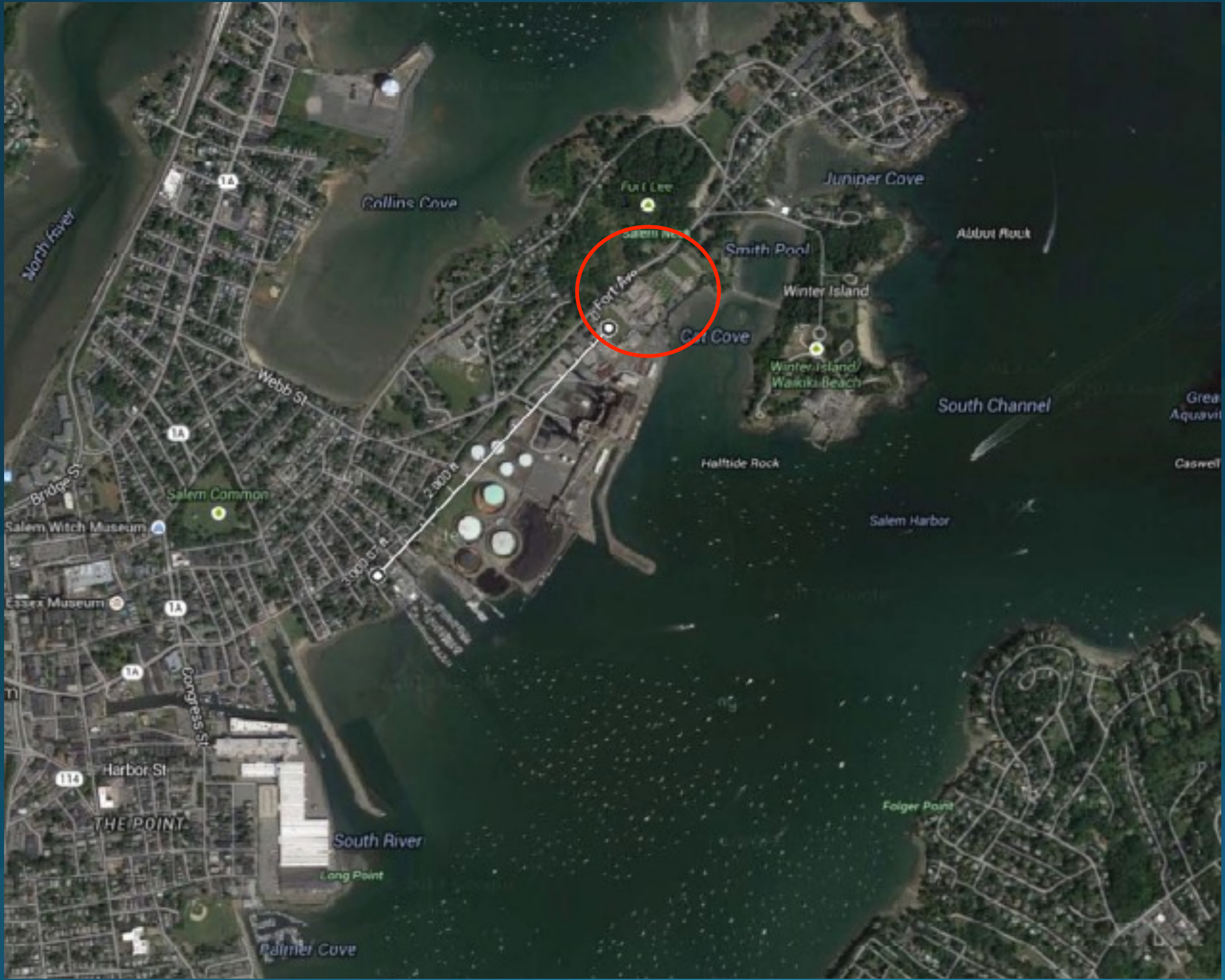
TREATMENT FACILITY SCHEMATIC



CHALLENGES AT SESD

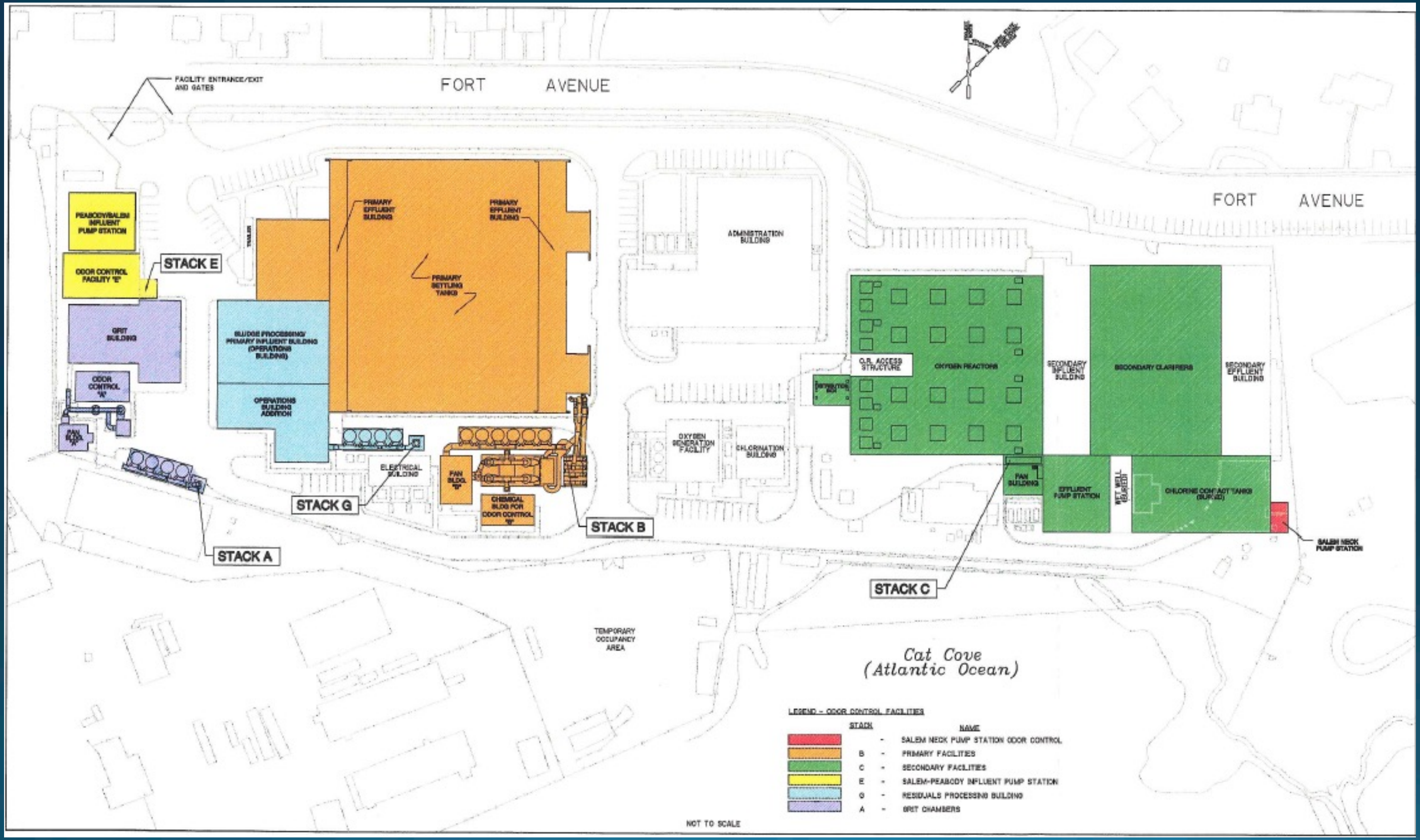
- Very tight site.
- Urban setting with close-by residential neighbors.
- Extensive odor control requirements.
- Significant percentage of operating costs directly attributable to odor control (≈ 20%).
  - Power - $680 K/yr
  - Natural Gas - $535 K/yr
  - Carbon Rplcment - $275 K/yr
  - Chemicals – $155 K/yr
  - Oper. / Maint. Labor
  - City Water - $85 K/yr

TREATMENT FACILITY PROXIMITY MAP



ODOR CONTROL FACILITIES

LOCATION OF ODOR CONTROL FACILITIES



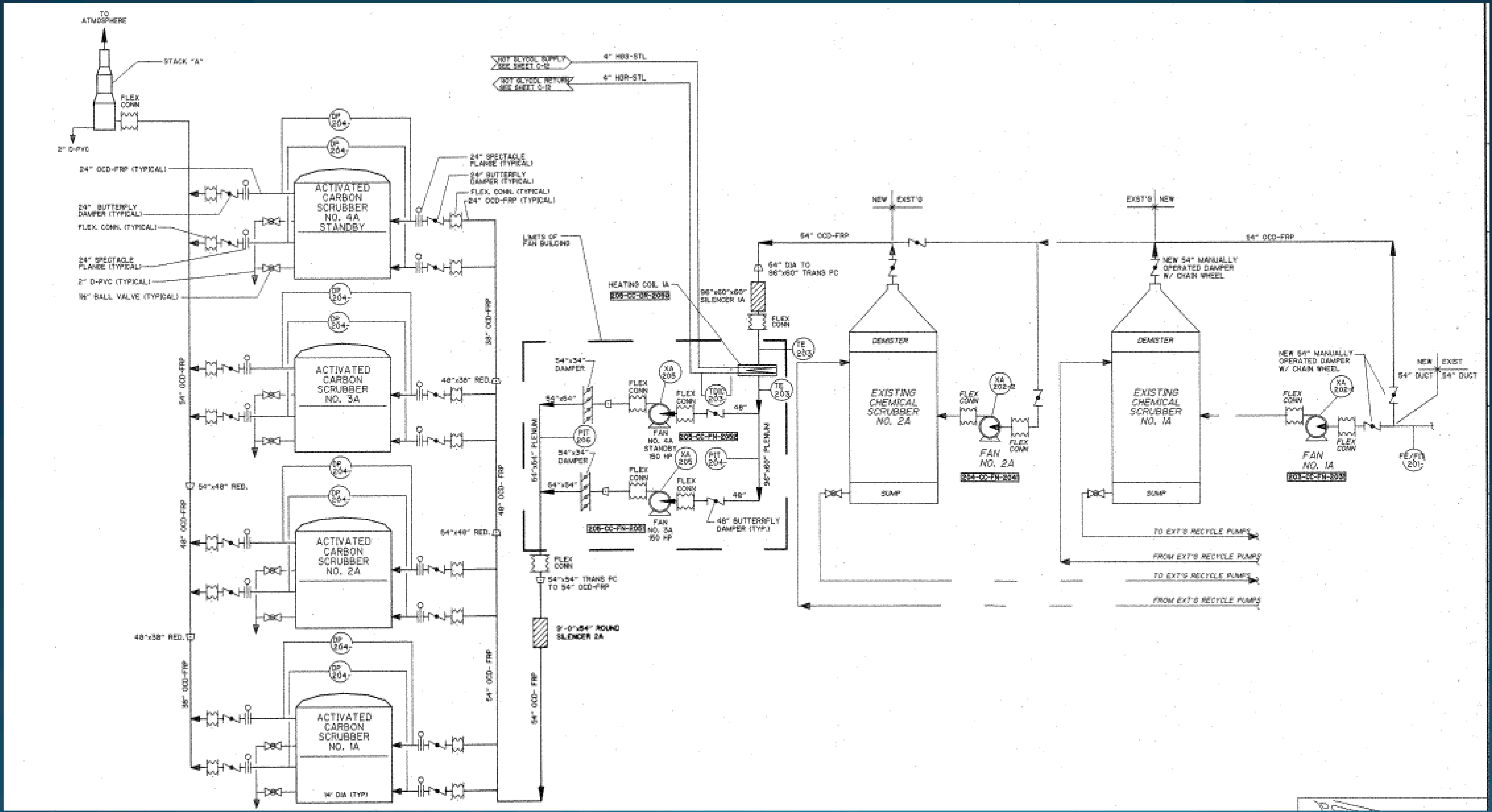
ODOR CONTROL FACILITIES SUMMARY TABLE

SUMMARY OF ODOR CONTROL SYSTEMS AT SOUTH ESSEX SEWERAGE DISTRICT WWTP			
System	Nominal Capacity	Serves	Components
A	40,000 cfm	Grit building	2 wet scrubbers in series 4 dual bed carbon adsorbers 135 ft stack
B	70,000 cfm	Primary clarifiers and solids storage	2 trains of 2-stage wet scrubbers in series followed by 6 dual-bed carbon adsorbers 90 ft stack
C	35,000 cfm	Secondary clarifiers & oxygen reactors	75 ft stack designed for proper dilution
E	15,000 cfm	Peabody/Salem influent pump station	Mist scrubber (not in use) 2 dual bed carbon adsorbers 62 ft stack
G	42,000 cfm	Process building	3 wet scrubbers (2 not in use) 4 dual bed carbon adsorbers 139 ft stack

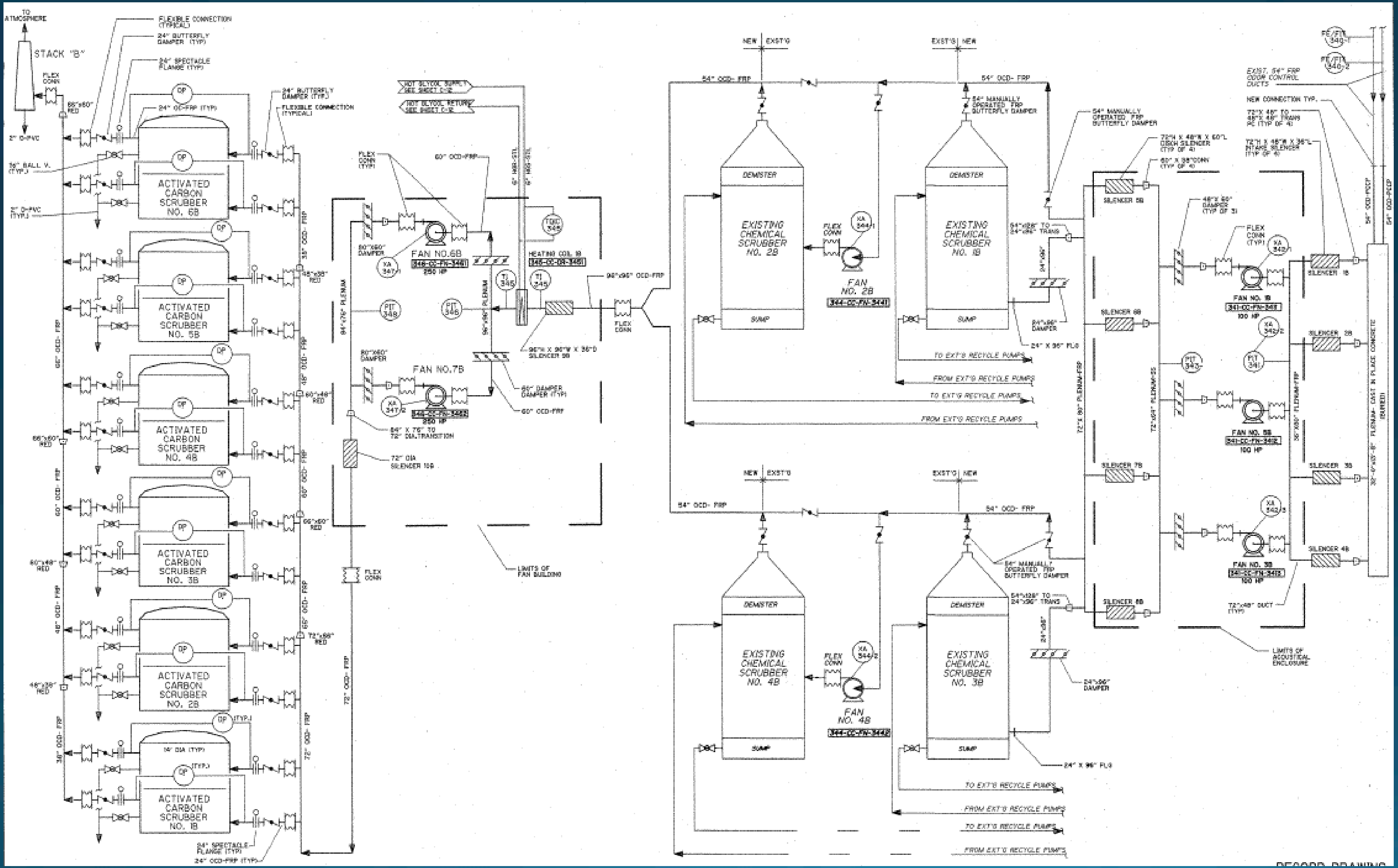
STACK EMISSIONS

SUMMARY OF SCRUBBER LOADING OF HYDROGEN SULFIDE GAS SOUTH ESSEX SEWERAGE DISTRICT WWTP		
System	Average H_2S Gas Concentration	Range of H_2S Gas Concentration
Odor A - Stack	0.054 mg/L	0.000 to 0.51 mg/L
Odor B - Stack	0.027 mg/L	0.000 to 0.27 mg/L
Odor C - Stack	0.035 mg/L	0.000 to 0.124 mg/L
Odor E - Stack	0.001 mg/L	0.000 to 0.017 mg/L
Odor G - Stack	0.001 mg/L	0.000 to 0.003 mg/L

ODOR A SCHEMATIC



ODOR B SCHEMATIIC



OPTIMIZATION STUDY

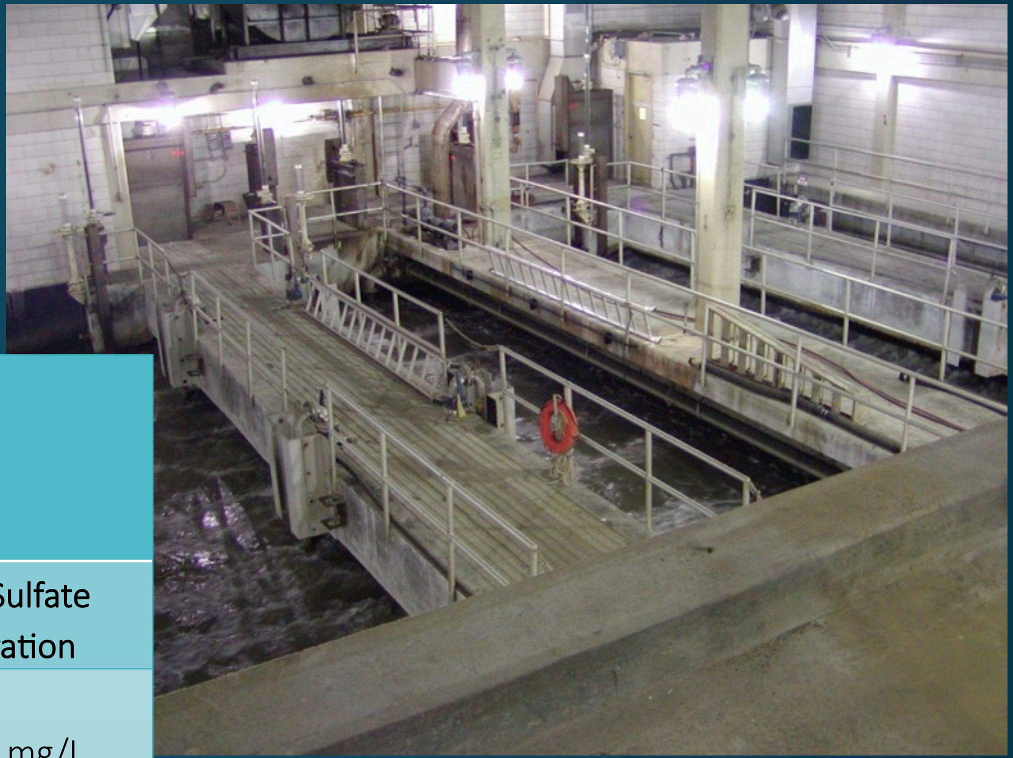
GOALS OF OPTIMIZATION STUDY

- Understand formation of H_2S in collection system.
- Optimize scrubber performance to minimize loading to GAC adsorbers.
  - Assess use of plant water for scrubber makeup water.
- Develop systematic approach to testing and replacing GAC.
- Modify operations to extend carbon life and reduce operating costs.

COLLECTION SYSTEMS TESTING

- Collected monthly data of dissolved sulfides and oxidation state in collection system and WWTP.
- Documented H_2S generation in force mains and large interceptors.
- Sulfide generation increased:
  - Low flows
  - Elevated wastewater temperatures.

SYSTEM SULFIDES



SUMMARY OF DISSOLVED SULFIDES IN SESD WASTEWATER SOUTH ESSEX SEWERAGE DISTRICT WWTP			
Location	Average H_2S Concentration	Range of H_2S Concentration	Range of Sulfate Concentration
Influent Force Main	1.9 mg/L	0.19 to 4.1 mg/L	28 to 138 mg/L
Influent Pump Station	2.0 mg/L	0.15 to 6.2 mg/L	88 to 224 mg/L
Grit Chamber	1.7 mg/L	0.1 to 5.2 mg/L	62 to 316 mg/L
Primary Effluent	1.0 mg/L	0.15 to 1.7 mg/L	56 to 264 mg/L

SCRUBBER ASSESSMENT

- Wet Chemical Scrubbers – Two in Series
  - Both operate at elevated pH with an oxidant.
  - Elevated pH drives sulfide into soluble form (HS^- and S^{-2})
  - Oxidant converts soluble sulfide to sulfate
  - Chemical Addition: NaOH and NaOCl
- Operational Issues
  - Scrubber water carryover.
  - Potable water usage.
  - Maintenance of proper chemical setpoints.

SCRUBBER AND GAC LOADING

SUMMARY OF SCRUBBER LOADING OF HYDROGEN SULFIDE GAS SOUTH ESSEX SEWERAGE DISTRICT WWTP		
Location	Average H_2S Gas Concentration	Range of H_2S Gas Concentration
Odor A - Loading to Scrubbers	5.80 mg/L	0.03 to 21 mg/L
Odor A - Loading to GAC	0.65 mg/L	0.001 to 7.8 mg/L
Odor B - Loading to Scrubbers	6.8 mg/L	1.0 to 13 mg/L
Odor B - Loading to GAC	0.39 mg/L	0.001 to 3.2 mg/L

Current H_2S removal performance of scrubbers meets design.

GAC CARBON TESTING

- Historically have replaced carbon based on a time schedule; no testing to confirm carbon was spent.
- Goal to develop quantitative protocol for replacing carbon in contactors.
- Focused on apparent density and percent sulfur on carbon as measurement tools.

GAC CARBON TEST RESULTS

SUMMARY OF GAC CARBON SAMPLING SOUTH ESSEX SEWERAGE DISTRICT WWTP		
Location	Lower Port Percent Sulfur	Upper Port Percent Sulfur
Odor A – Vessel 1	5.36%	0.21%
Odor A – Vessel 4	6.17%	N/A
Odor B – Vessel 2	4.65%	0.20%
Odor B – Vessel 3	5.34%	N/A
Odor E - Vessel 2	0.12%	0.07%
Odor G - Vessel 1	0.10%	0.12%

RECOMENDATIONS

COLLECTION SYSTEM RECOMMENDATIONS

- Recommendations to reduce H_2S production in collection system:
  - Operate only one of two dual force mains during low flow conditions.
  - Reduce operating depth of interceptors where practical.
- Changes will:
  - Increase velocity
  - Decrease solids deposition
  - Decrease residence time

SCRUBBER SYSTEM RECOMMENDATIONS

- New Chemical Setpoints and Controls Optimization:
  - pH setpoint = 9.0.
  - ORP (oxidation) setpoint = 600 mV.
  - Increased instrument calibration and control loop tuning.
  - Increased scrubber monitoring/performance tracking.
- Replace mesh mist eliminators with chevron-style.
- Increase city water make-up flow rate.
  - Evaluate cost-effectiveness of a water softener to allow use of plant water.

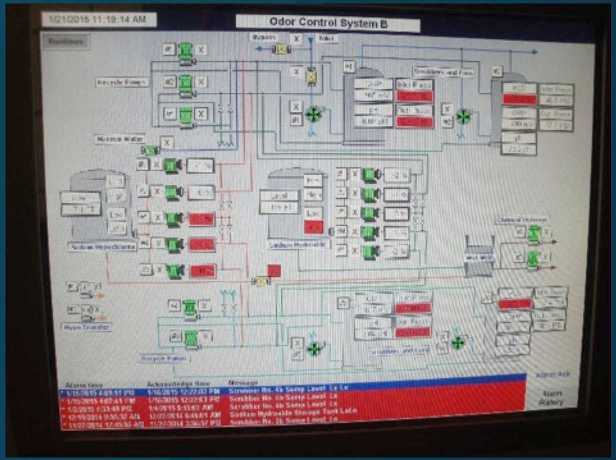
RECOMMENDED ODOR SAMPLING PROTOCOL

- Measure scrubber recirculation water to verify ORP, pH, and solids concentration.
- Measure H_2S concentration at following locations twice weekly:
  - Inlet and outlet to each scrubber
  - Each stack after GAC adsorbers

RECOMMENDED GAC TESTING AND REPLACEMENT PROTOCOL

- Routine "sniff" test to monitor for odor breakthrough:
  - Conduct quarterly testing on two vessels per odor facility.
    - Sniff odor from all sample ports – qualitative assessment.
    - Test H_2S concentration.
- Analytical testing of carbon for remaining life:
  - Test carbon from top sample port for sulfur on carbon (percent dry weight) at least twice per year.
  - Replace carbon when percent sulfur exceeds 5%.

IMPLEMENTATION



- Implementation Efforts:
  - Replacing existing mist eliminators with chevron style.
  - Updating testing program.
  - Planning carbon replacement in spring for Odor A and B.
    - New carbon will be tested to establish benchmark.
- Ongoing process to maximize odor control removal efficiencies and decrease operating costs.

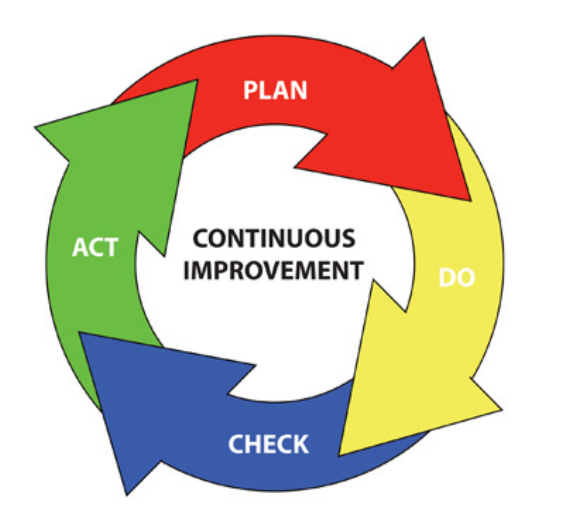
SUMMARY

SUMMARY

- Odor Control is critical at SESD and has a large impact on SESD's operating costs.
- Developed Optimization Plan to improve system performance, reliability, and efficiency:
  - Reduce formation in collection system.
  - Minimize release of odors from facility.
  - Optimize scrubber performance.
  - Reduce scrubber chemicals and city makeup water.
  - Extend carbon replacement frequency.
  - Reduce operating costs.

SUMMARY

- Implementation is started but will take time.
- Ongoing process to maintain and optimize system performance and decrease operating costs.



Questions?