SANITATION DISTRICTS OF LOS ANGELES COUNTY

Los Angeles County Sanitation Districts' Odor Control Practices

Robert Morton

Los Angeles County Sanitation Districts

Organization of Presentation

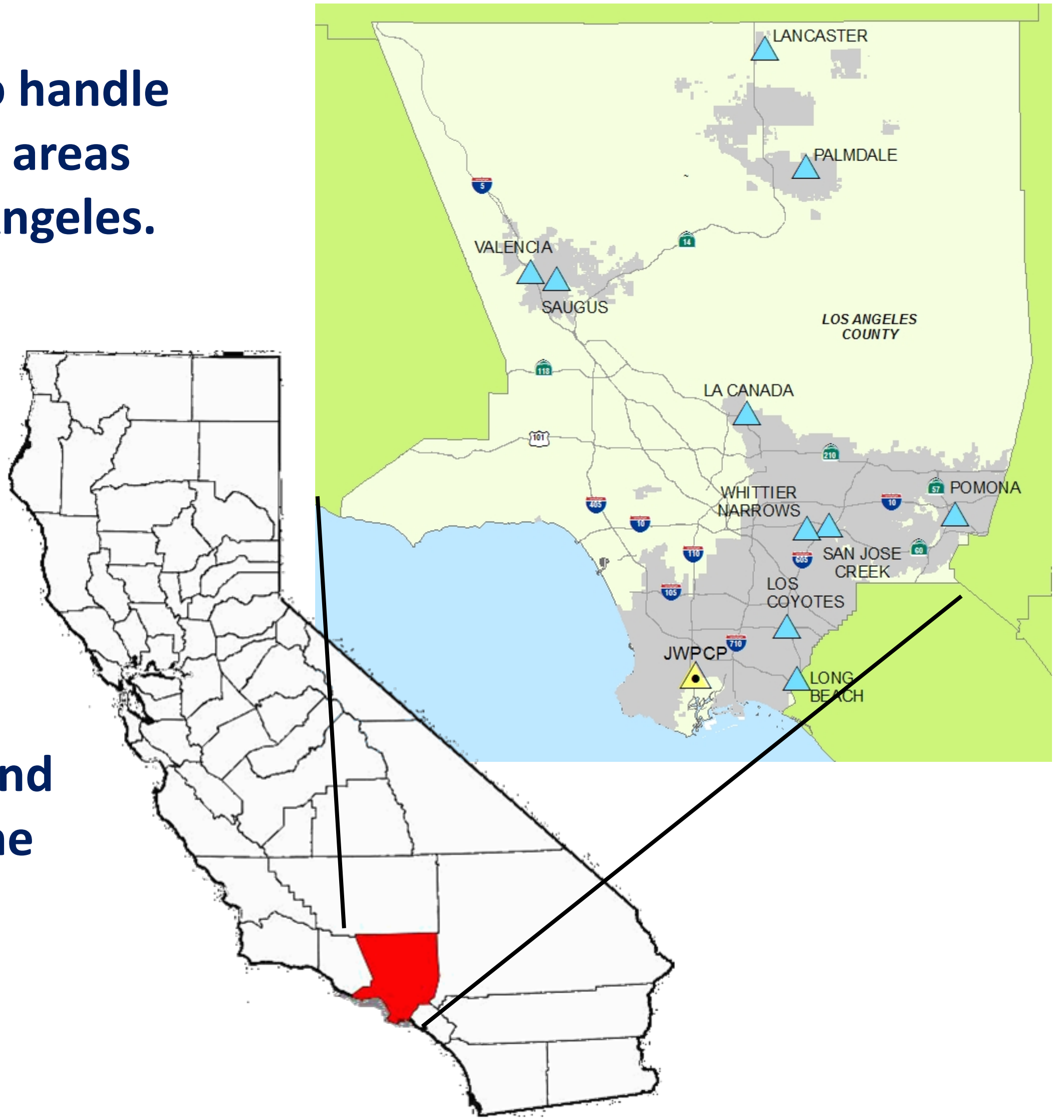
- Background of Los Angeles County Sanitation Districts
- Wastewater treatment information
- Odor control in collection system
- Odor control in wastewater treatment plants

Los Angeles County Sanitation Districts

Districts founded in 1923 to handle cities and unincorporated areas outside of the City of Los Angeles.

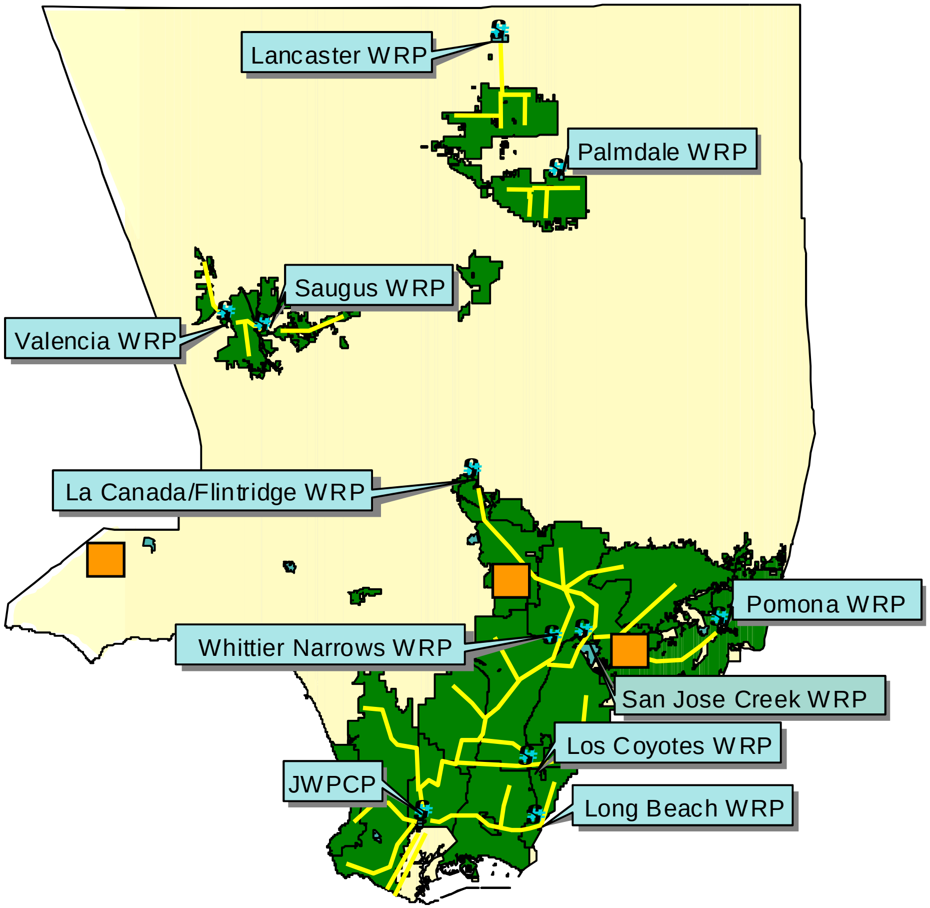
23 separate Districts working cooperatively under joint administration.

Provide water pollution control and solid waste management for 78 cities and unincorporated areas of the County of Los Angeles.



Los Angeles County Sanitation Districts Wastewater Collection & Treatment System

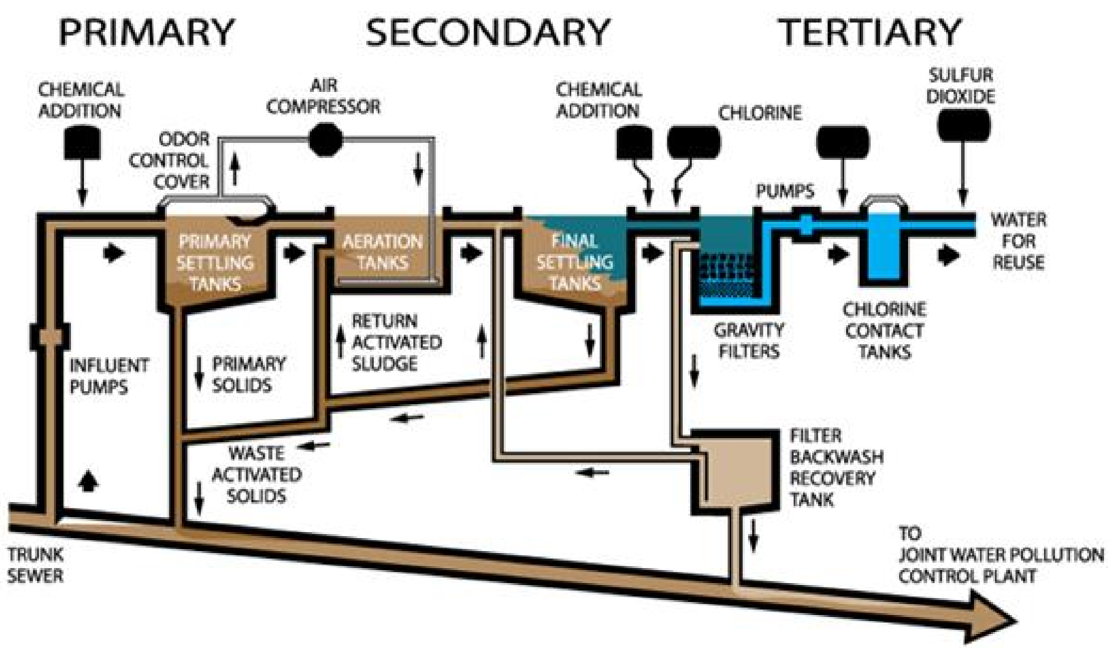
Symbol	Description
(orange square)	3 - Landfills
(light green rectangle)	11 - Treatment Plants
(yellow line)	1,328 miles of regional trunk sewers



Los Angeles County Sanitation Districts Wastewater Collection & Treatment System

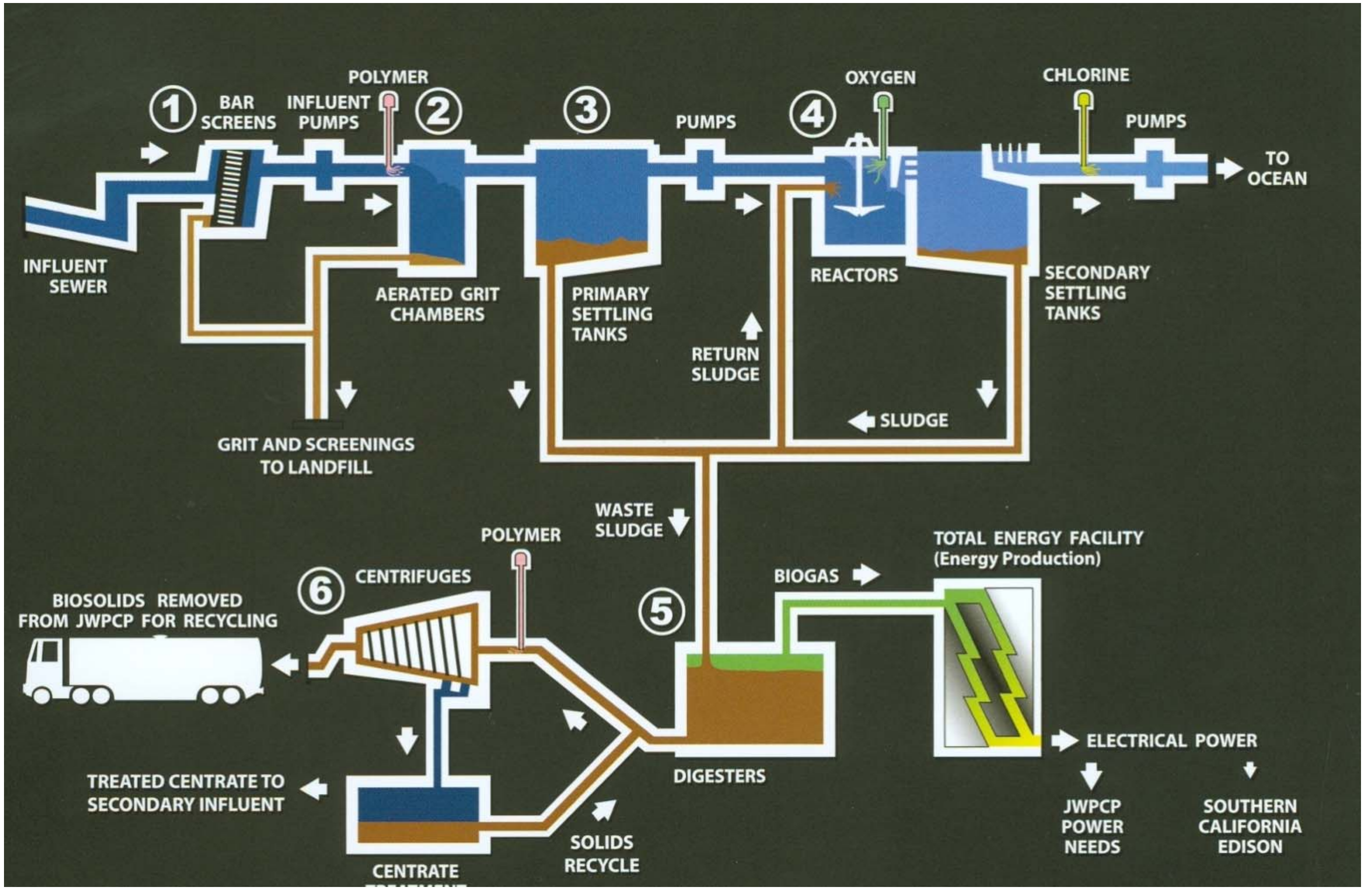
- Treating 500 mgd of wastewater
  - 200 mgd at 10 WRP
  - 300 mgd at JWPCP
- 2012-2013 operation budget ~$565 M

Typical LACSD WRP Design



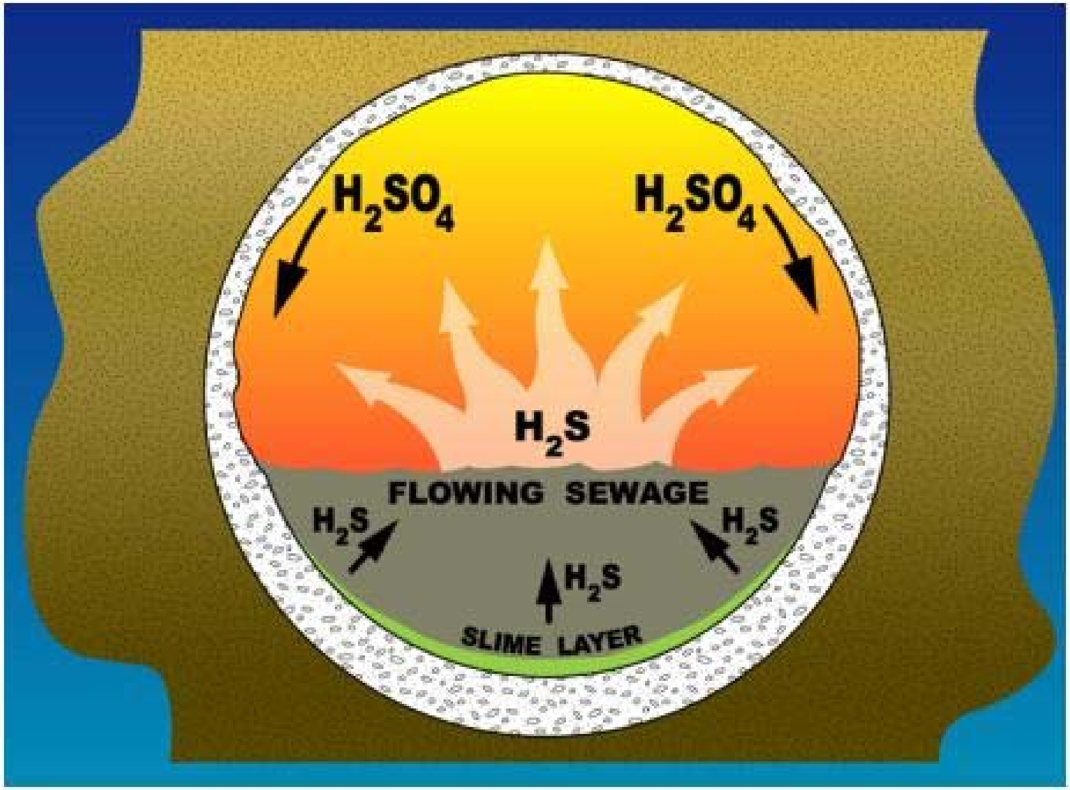
70 MGD of LACSD Secondary and Tertiary Effluents Are Reused

LACSD Joint Water Pollution Control Plant (JWPCP)



Odor Control in Collection Systems

Hydrogen Sulfide is the Typically the Most Odorous Compound Generated in Sewers

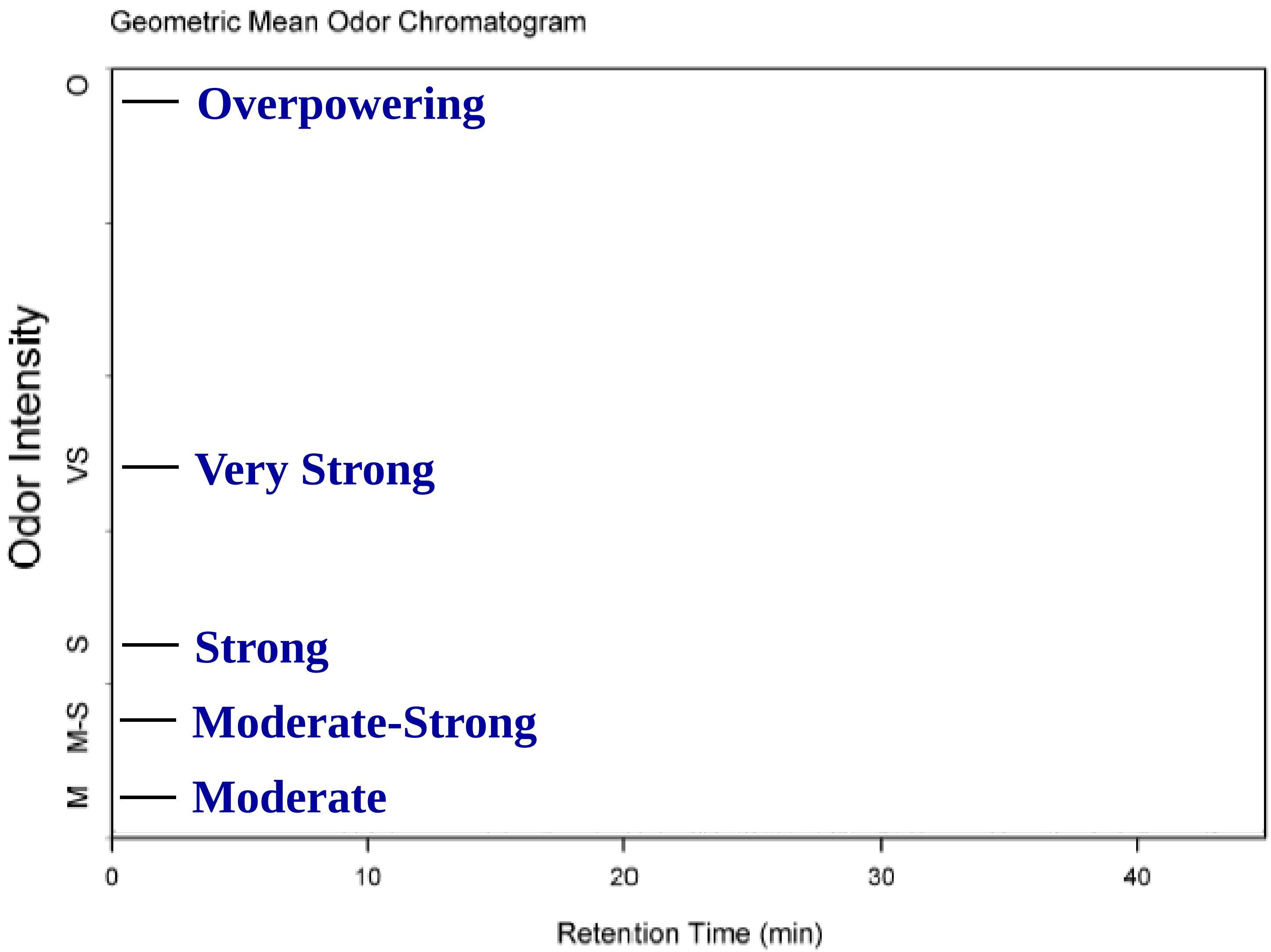


Compounds Other Than Hydrogen Sulfide That Could Contribute Collection System Odors

- **Sulfur compounds**
  - **mercaptans, organic sulfides**
- **Volatile Acids**
  - **fatty and carboxylic acids**
- **Nitrogen Compounds**
  - **ammonia, amines, diamines**

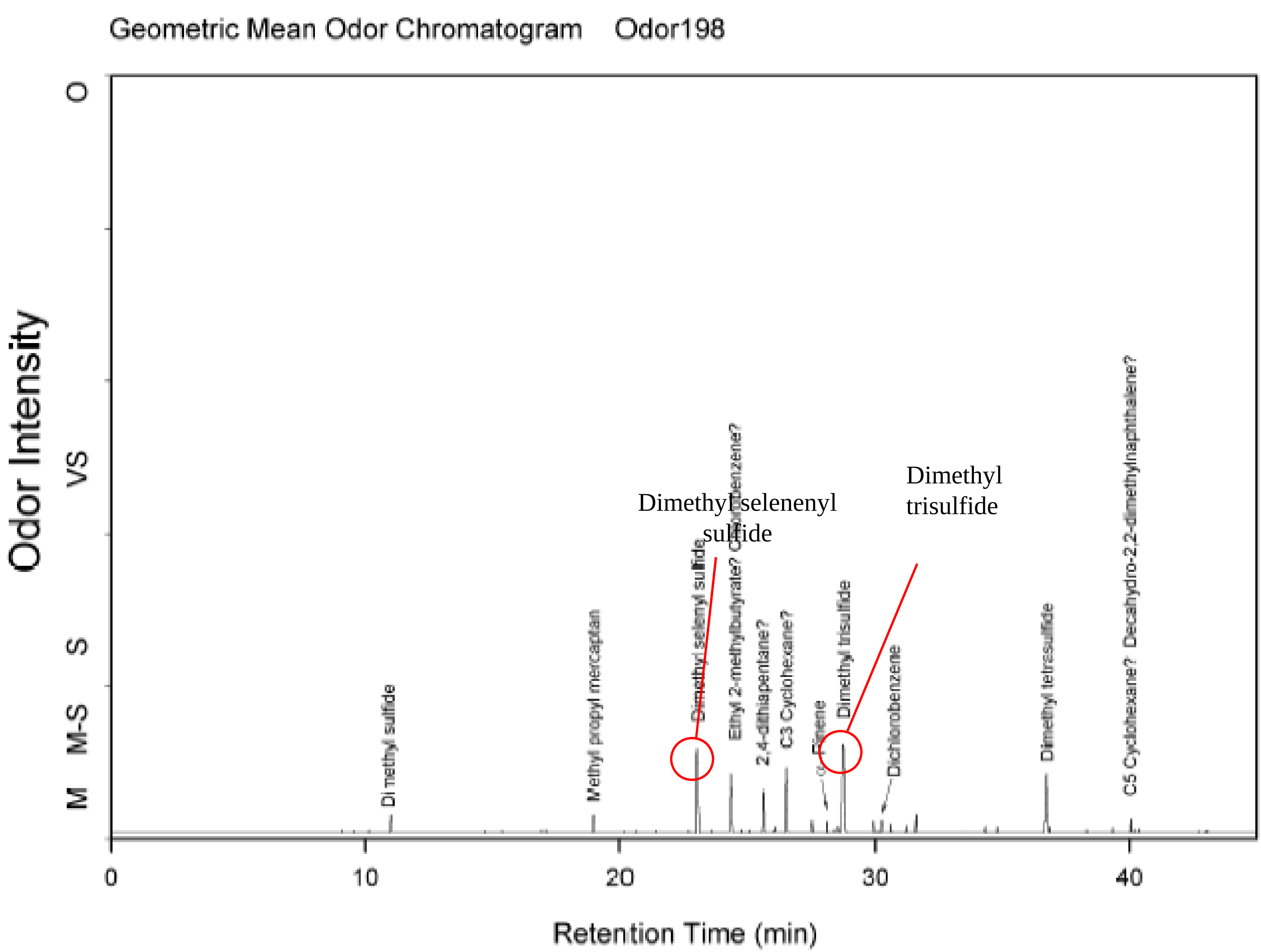
Odor Chromatogram

Example Odor Chromatogram

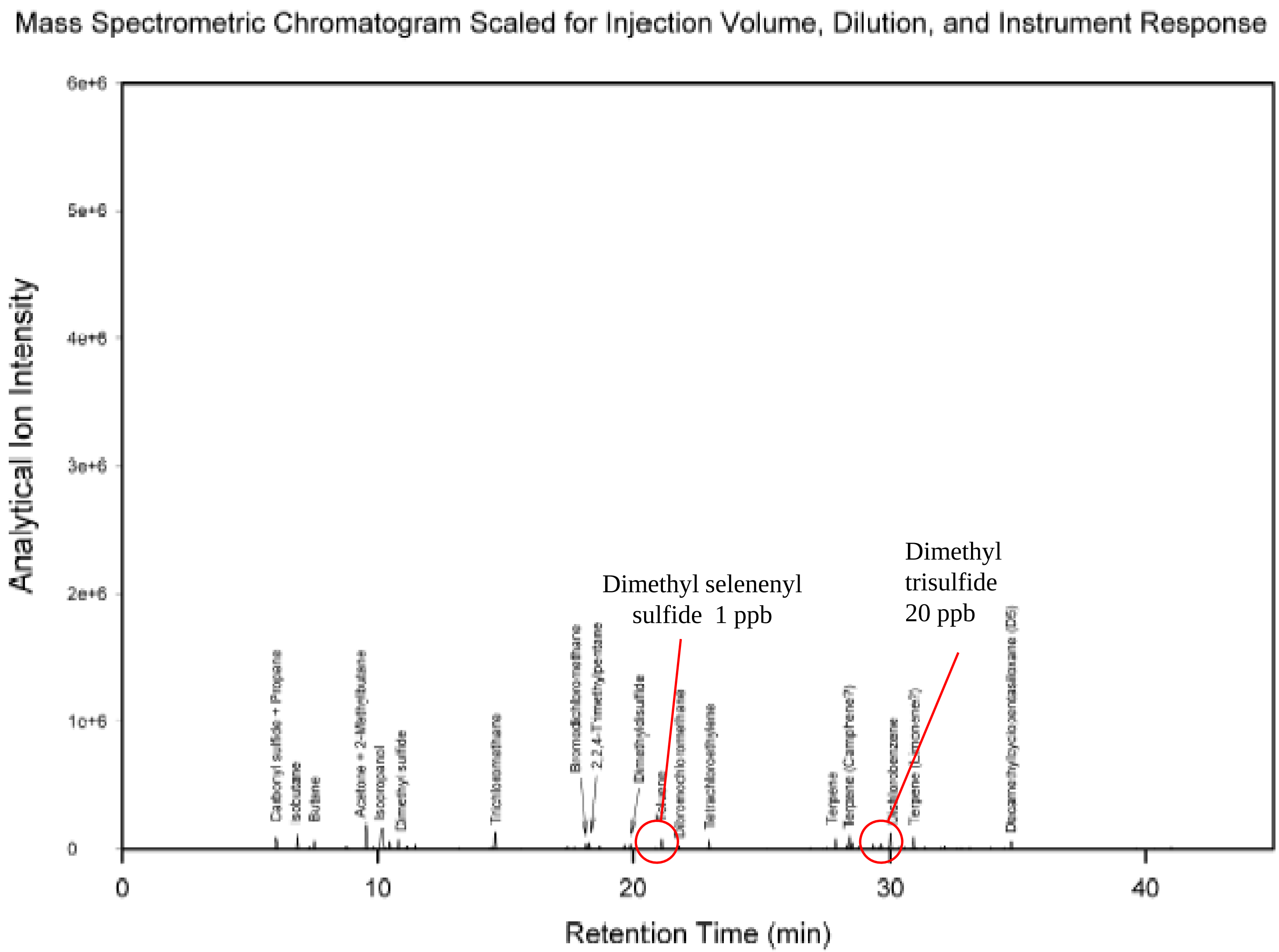


Testing Conducted at Los Angeles County Sanitation Districts

LACSD Manhole MH18



LACSD Manhole MH18



LACSD Manhole MH18

Analysis for Fatty and Carboxylic Acids

Compound	Concentration (ppb v/v)
Acetic Acid	< 5.6
Propionic Acid	< 1.2
Isobutyric	< 0.99
Butyric	< 0.97
Isovalreic	< 0.85
Valeric	< 0.86
Caproic	< 0.76

LACSD Manhole MH18

Analysis Organic Nitrogen Compounds

Compound	Concentration (ppb v/v)
Dimethylamine	< 1.5
Ethylamine	< 1.5
Trimethylamine	1.4
Diethylamine	< 0.89
Butylamine	< 0.92
Triethylamine	< 0.67

Methods for Controlling H_2S in Collection Systems

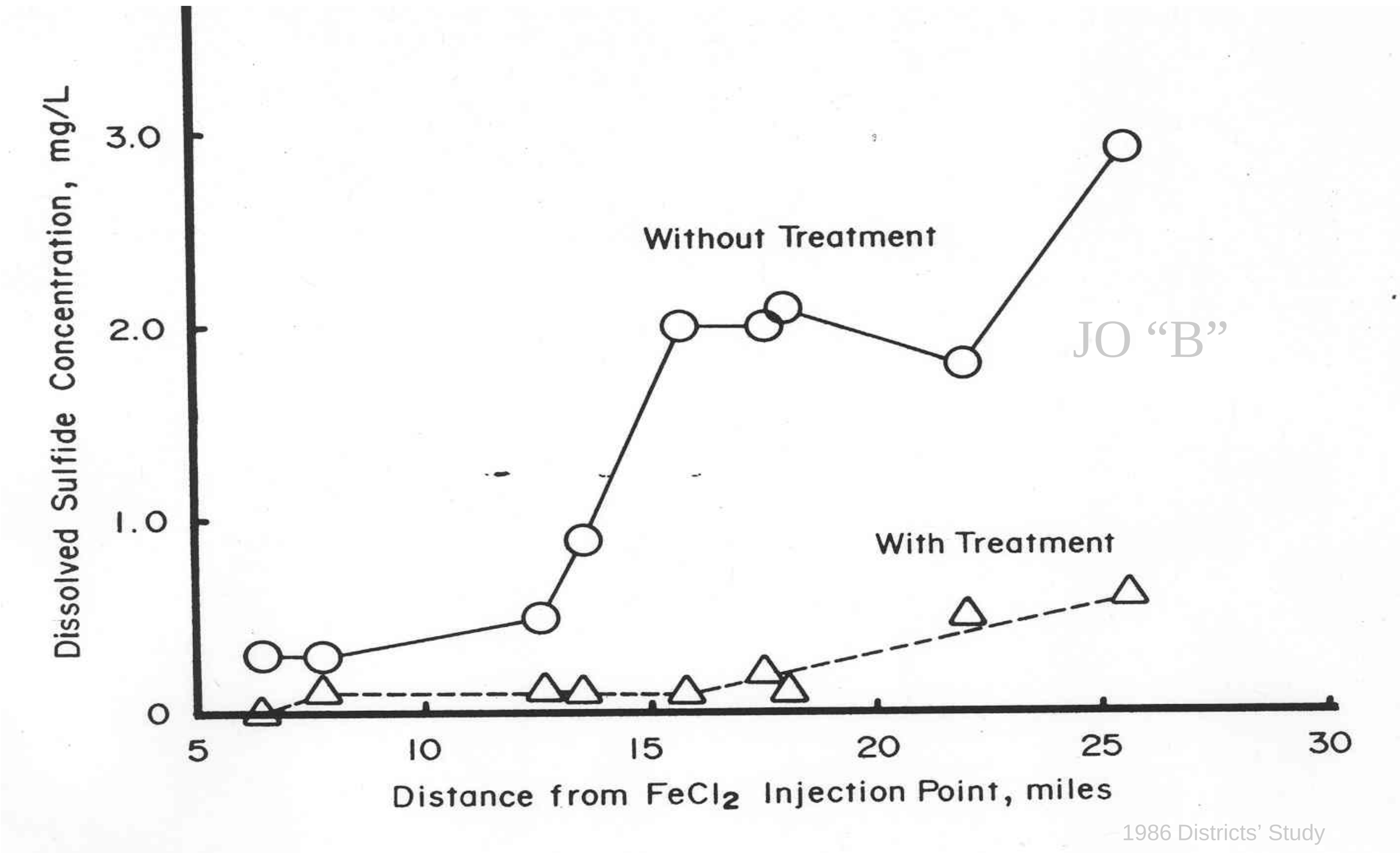
- Chemical addition
  - Preventers
  - Binders
  - Oxidizers
  - pH change
- Vapor phase treatment
  - Wet scrubbers
  - Activated carbon
  - Biological treatment
- Neutralize acid formation

Collection System Odor & Corrosion Control

- Continuous ferrous chloride addition
- Sodium hydroxide (caustic) shock dosing
- Activated carbon scrubbing
- $Mg(OH)_2$ crown spray

Odor Control in Collection Systems

Ferrous Chloride Addition



Sulfide in Wastewater Collection and Treatment Systems, ASCE No. 69

Ferrous Chloride Addition

- **30,000 gpd of $FeCl_2$ added to collection system**
- **Maintain sewer headspace H_2S to less than 20 $ppm_{v/v}$**

Ferrous Chloride Addition

Figure 1 – $FeCl_2$ Addition Points in the Districts Collection System

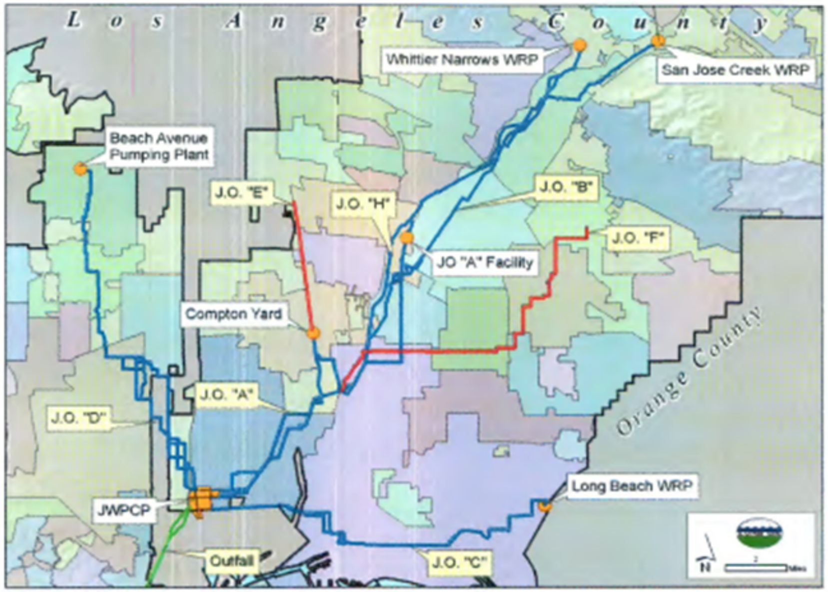


Table 1–Collection System $FeCl_2$ Addition Locations and Amounts

Addition Point	Sewer	Percent Total	Approximately gallons per day*
San Jose Creek WRP	JOB	53%	15,900
Whittier Narrows	JOH	17%	5,100
South Gate	JOA	16%	4,800
Long Beach	JOC	9%	2,700
Beach Avenue Pumping Plant	JOD	5%	1,500

*Assuming 30,000 gpd total

Annual cost of ~$12 million

Caustic Shock Dosing

Activated Carbon Scrubbing

Activated Carbon Use Inside Manholes

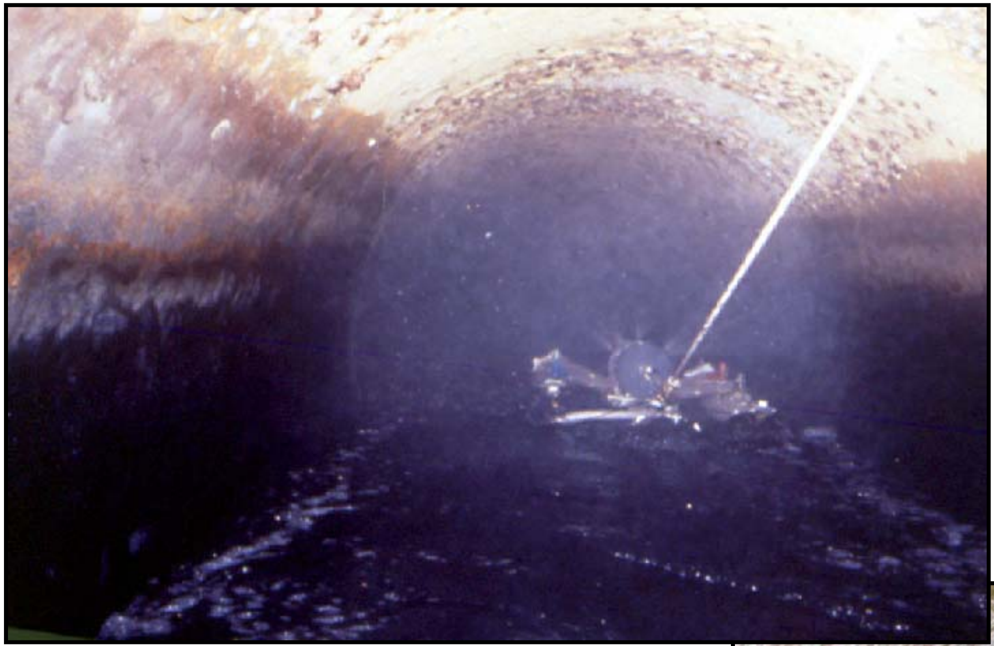
Carbon Canister

Manhole with Activated Carbon

Crown Spray Program

- Crown Spray Process Developed by the Districts
- Magnesium Hydroxide: pH ~10
- Only RCP and NRCP Sewers With Moderate to Severe Corrosion
- 420 Miles Crown Sprayed Annually
- Cost ~$3 million/yr

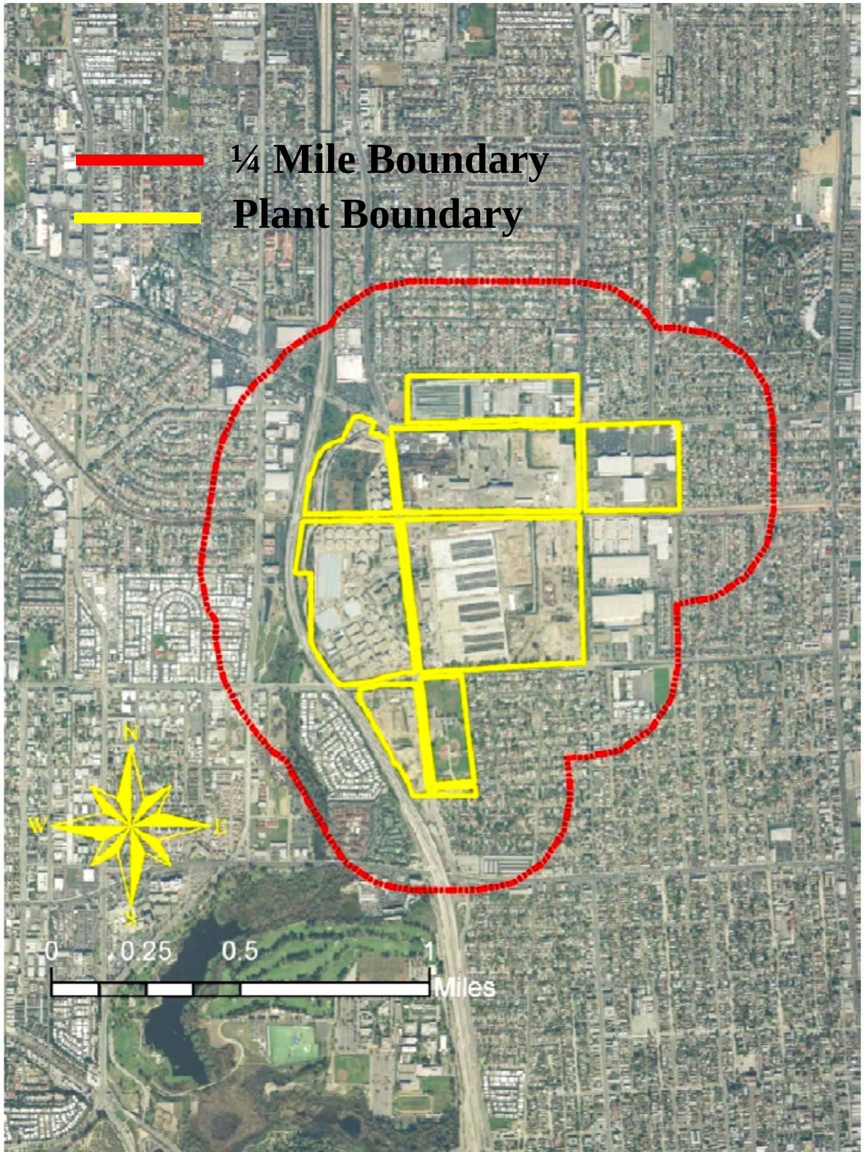
$Mg(OH)_2$ Crown Spraying



Odor Control in Wastewater Treatment Plants

JWPCP Facility

Population Encroachment Near JWPCP



Distance From Plant Boundary Miles	Total Population
0.25	10,100
0.5	26,100
0.75	48,700
1.25	93,500

JWPCP Odor Control Areas

Joint Water Pollution Control Plant (JWPCP)

Methods for Control of Odors from Wastewater Treatment Facilities

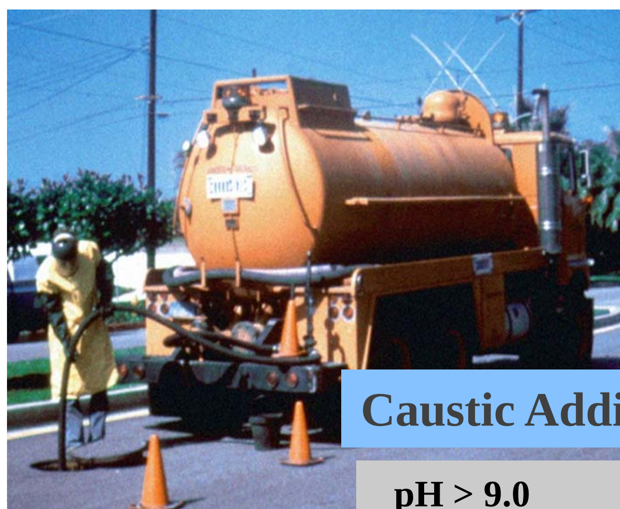
- Chemical Treatment of Wastewater
- Thermal Destruction
- Wet Chemical Scrubbing
- Adsorption
- Biological
  - Biotrickling Filters
  - Biofilters

Chemical Addition for H2S Control

Ferrous Chloride

$2FeCl_2 + 2\ H_2S \rightarrow 2FeS + 4HCl$

Dissolved Sulfides < 0.2 mg/L



Caustic Addition

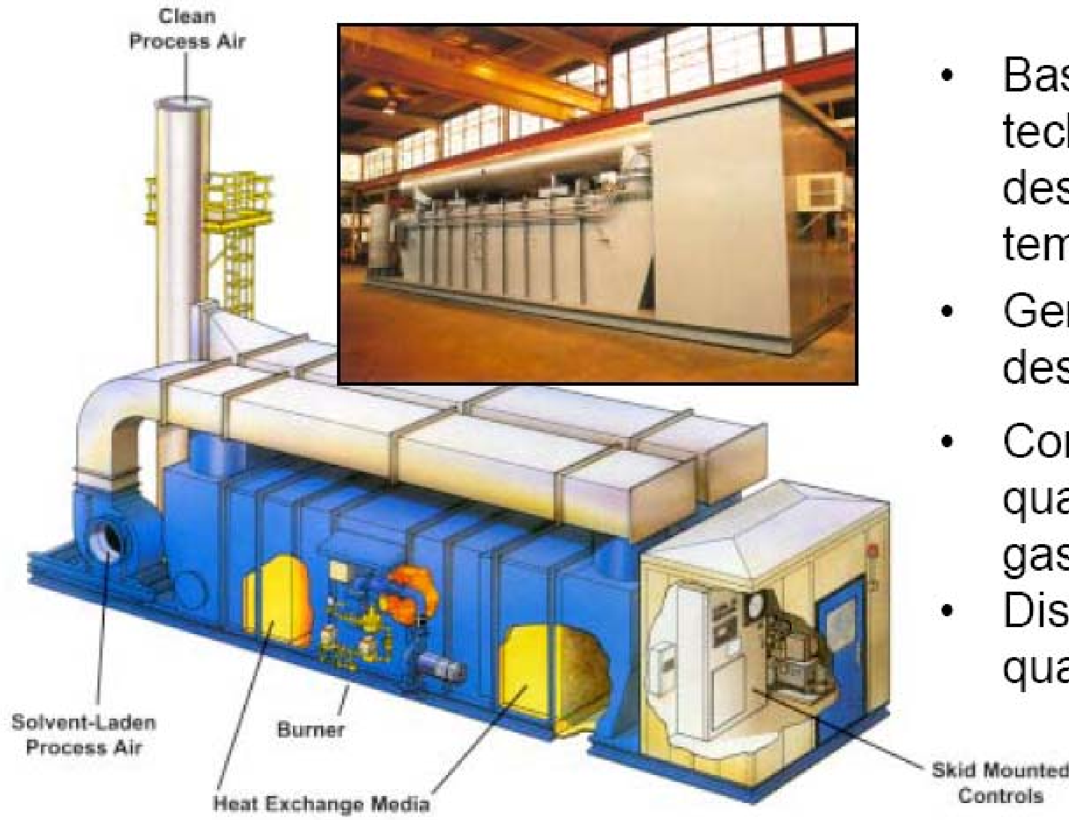
pH > 9.0

Air Process Stream Treatment

Odor Control Alternative	Ability to Remove						
	H_2S	Organic Sulfur Compounds	Ammonia	Track Record	Flexibility	Mechanical Equipment Intensive	Residual By-Products
Thermal Destruction	✓	✓	✓	✓		✓	✓
Wet-Scrubbing	✓		✓	✓	✓	✓	✓
Carbon	✓	✓		✓			✓
Biofilter	✓	✓	✓		✓		
Biotrickling Filter	✓			✓			

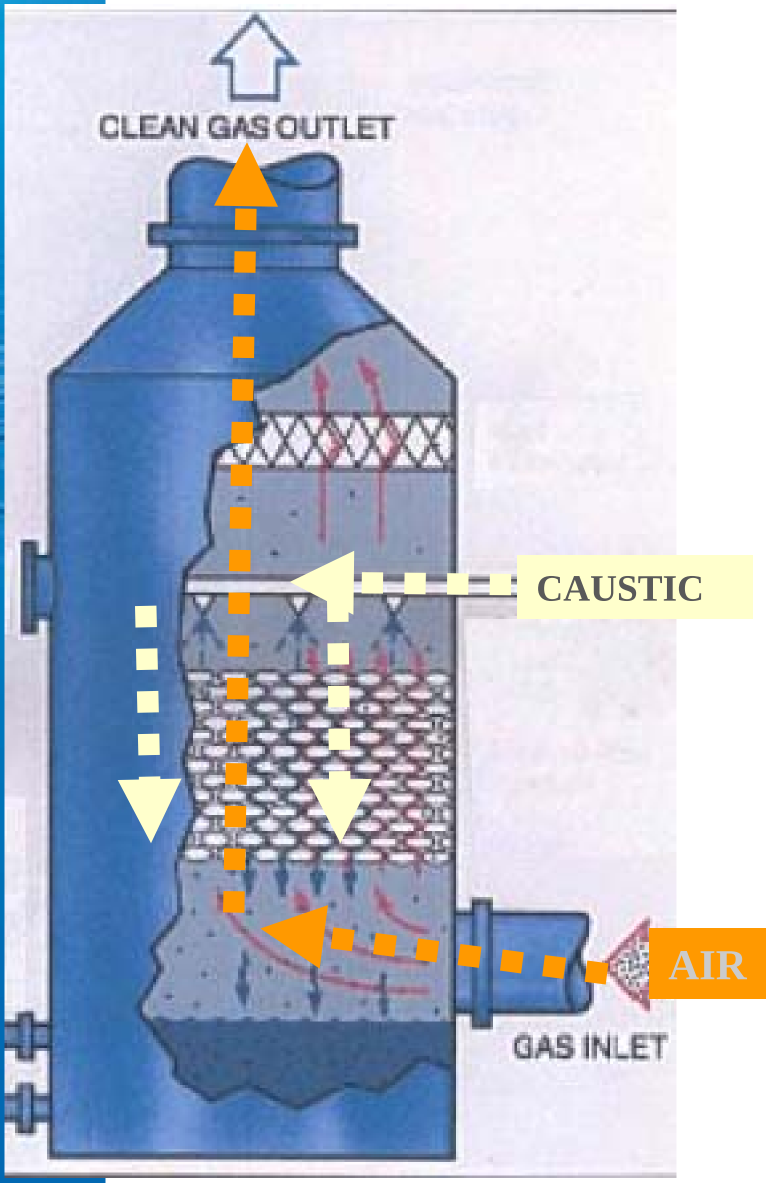
Thermal Destruction

Thermal/Catalytic Oxidization



- Basic Incineration technology, VOC's destroyed at high temperatures (>1400° F)
- Generally achieves >95% destruction efficiency.
- Consumes significant quantities of fuel (natural gas).
- Discharges NOx and large quantities of CO_2.

Caustic Packed Tower



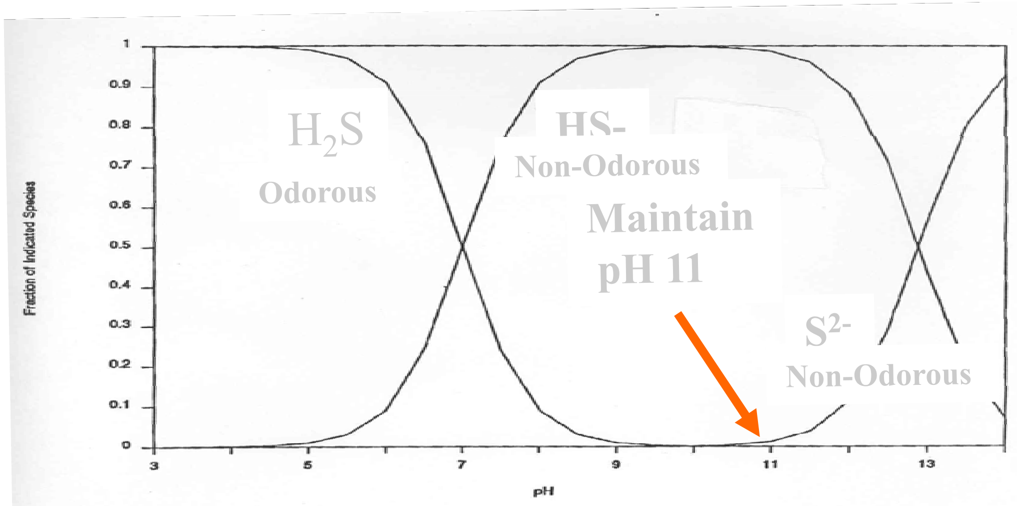
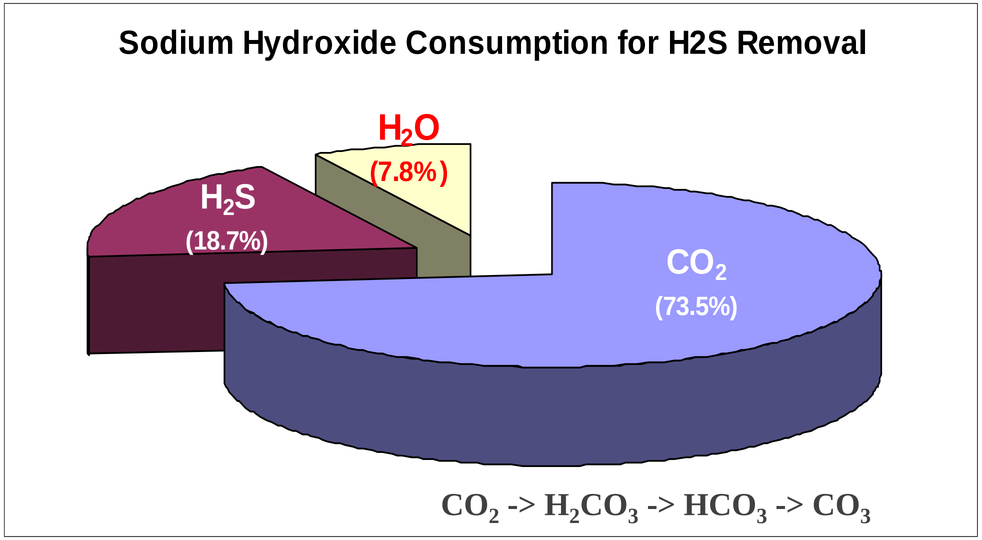
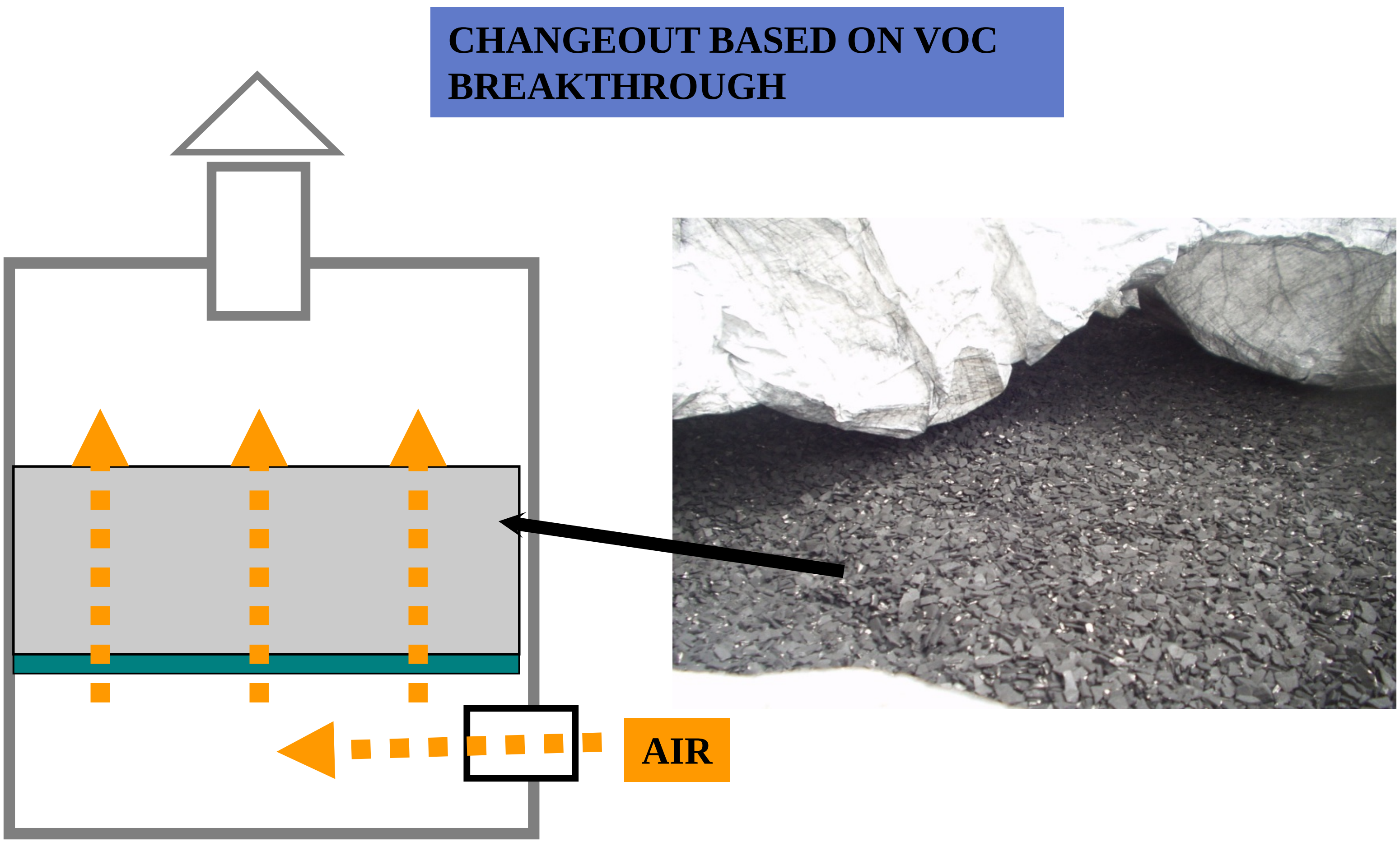


Figure 2
Ionization of Hydrogen Sulfide



Activated Carbon Scrubber



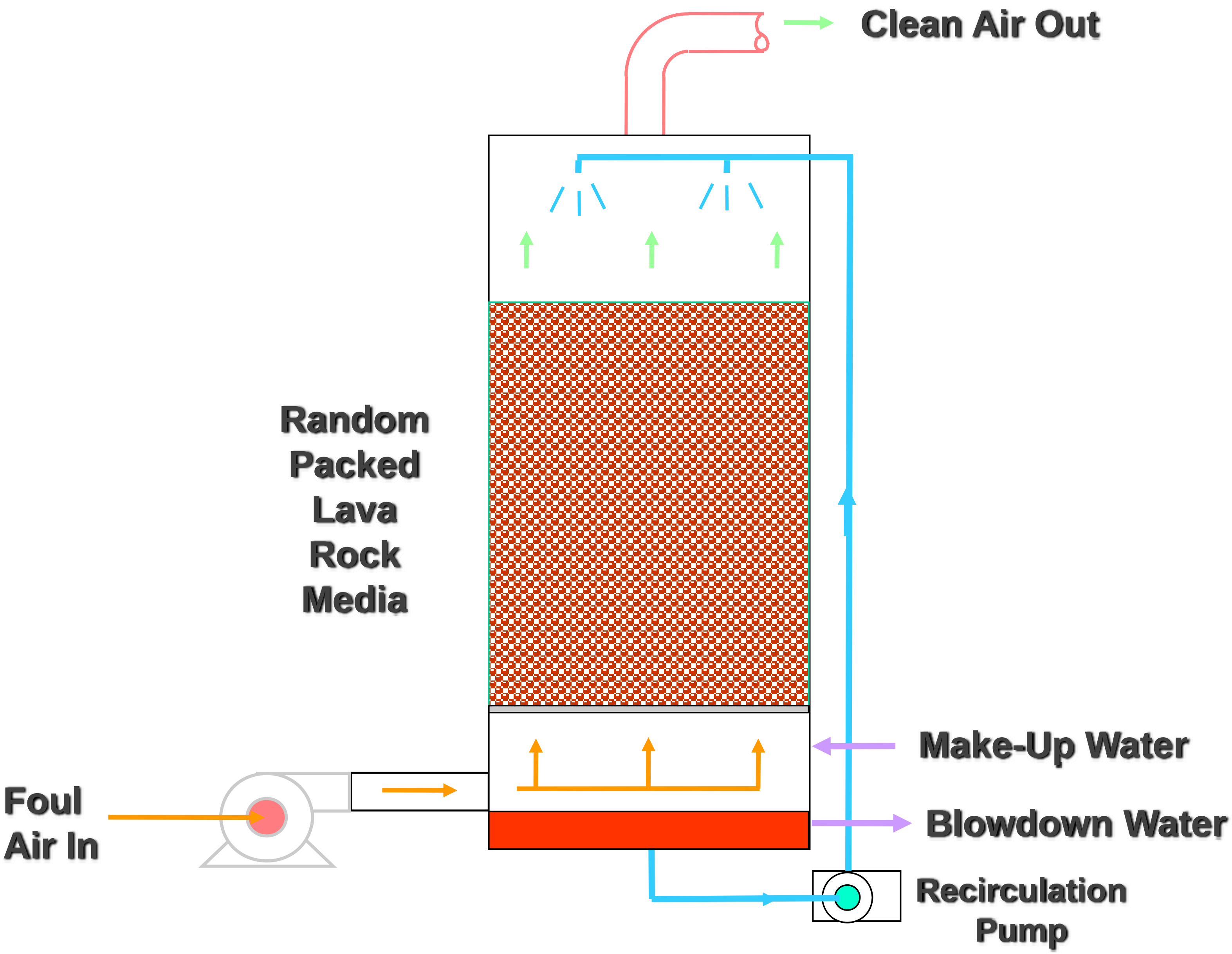
Two-Stage Treatment
Chemical Scrubbing and Activated Carbon

Biotrickling Filters or Bioscrubbers

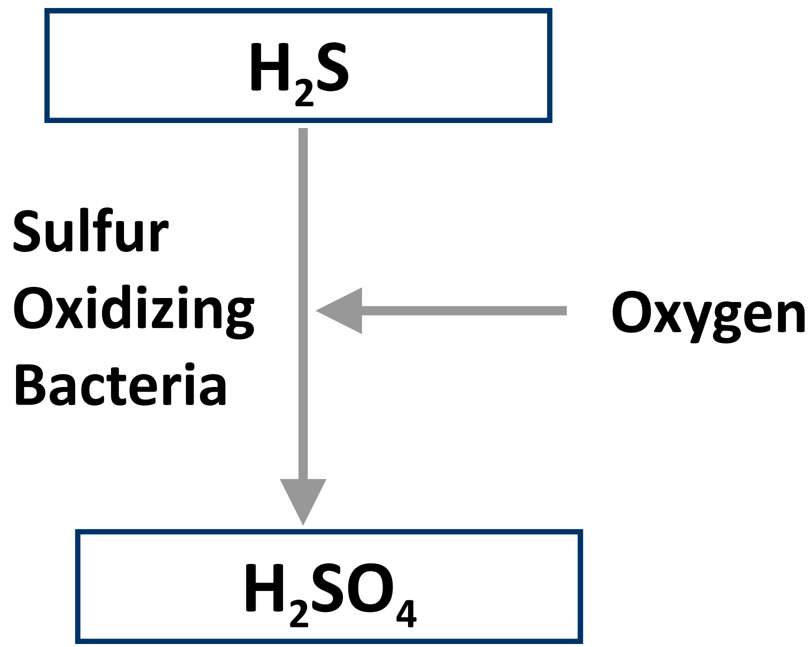
Old and New Covers

JWPCP Odor Control – Primary Treatment

Los Angeles County Sanitation Districts' Lava Rock Biotrickling Filte Schematic

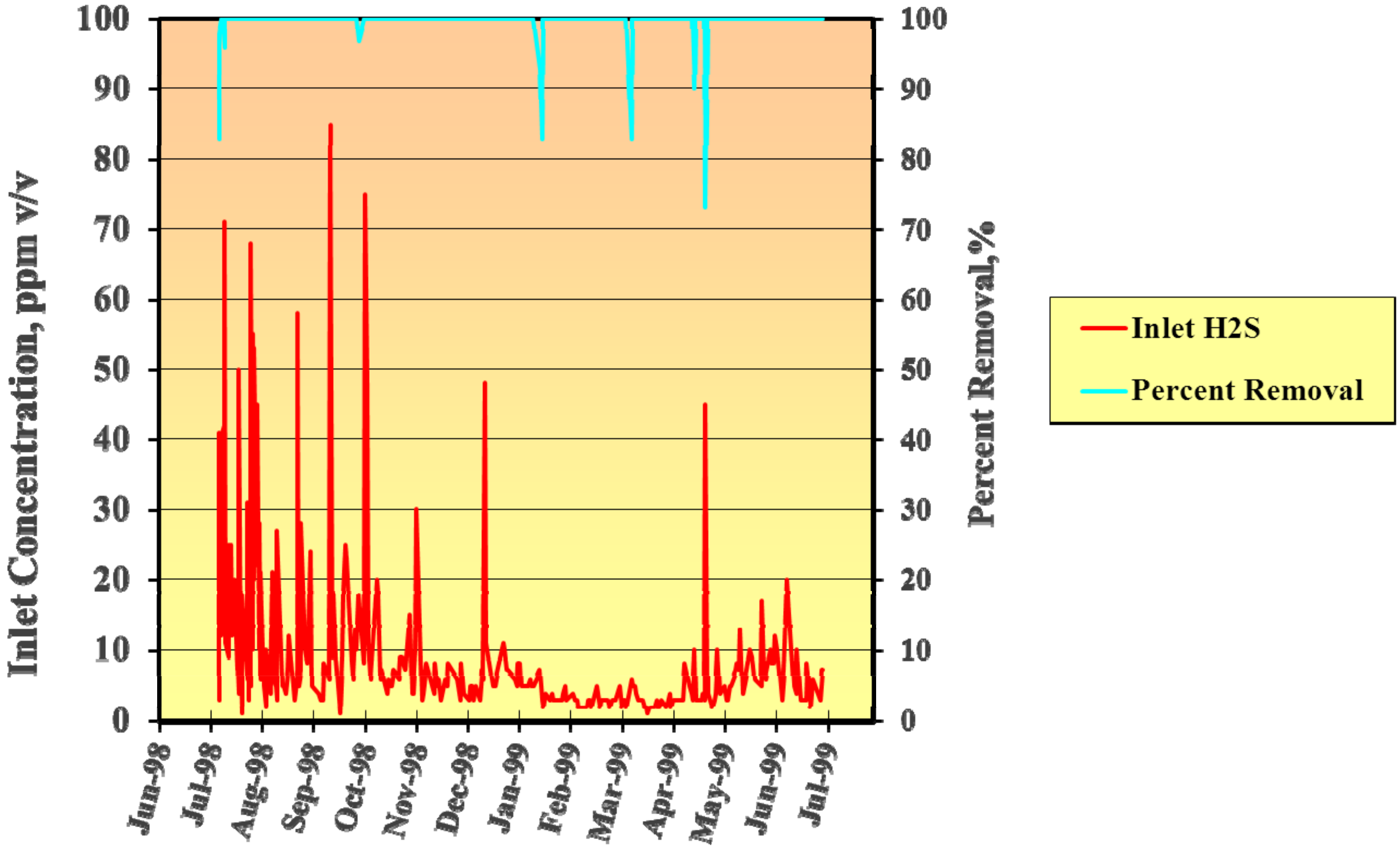


Sulfur Oxidizing Bacteria



Los Angeles County Sanitation Districts' 1500 cfm Biotrickling Filter

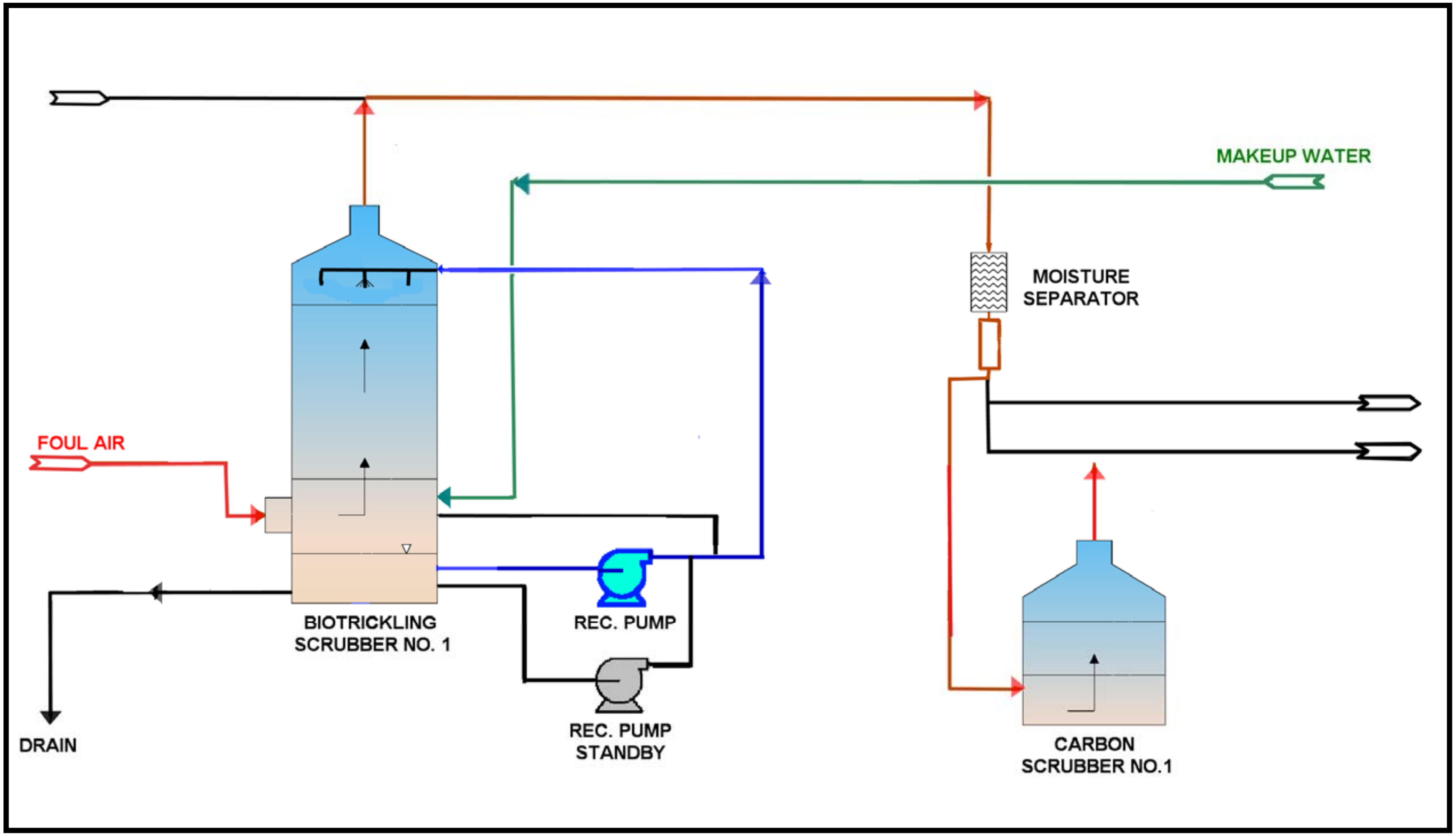
Removal of Hydrogen Sulfide by LACSD Lava Rock Biotrickling Filter During the First Year of Operation



Some Basic Concepts Used in the Design of the JWPCP Central Odor Station

- Use a two-stage system to achieve maximum removal of odors
- Employ high ventilation rates to keep primary treatment areas under negative pressure
- Use of secondary treated effluent as a source of nutrients for biotrickling filters
- Design of redundant units to allow maintenance and repairs

JWPCP Central Odor Biotrickling Filters Process Flow Diagram



Biotrickling Filters After Completion of Concrete Form Work

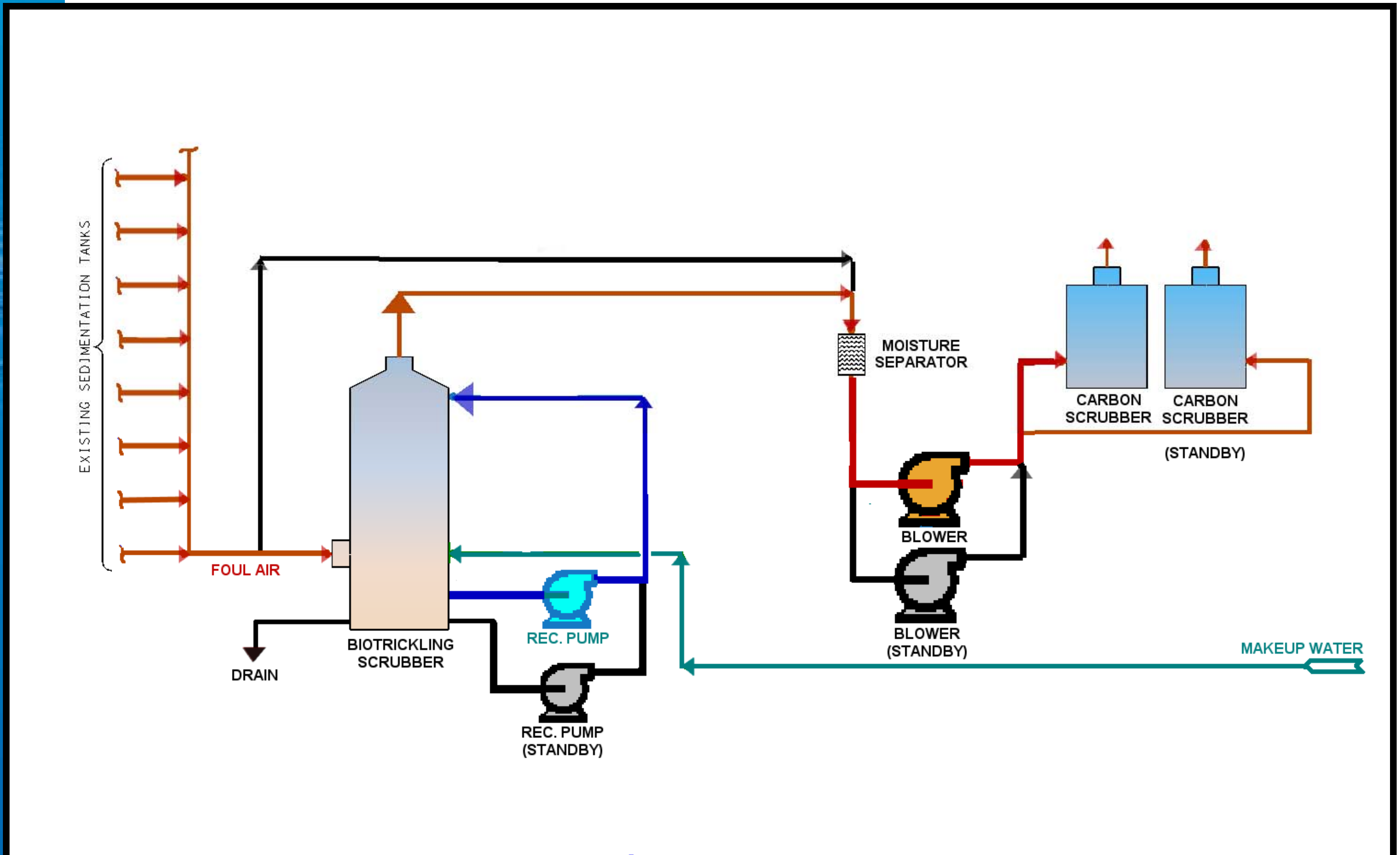
Two Stage Treatment of Air from Plant Headworks, Channels and Grit Chambers

60,000 cfm of foul air treatment

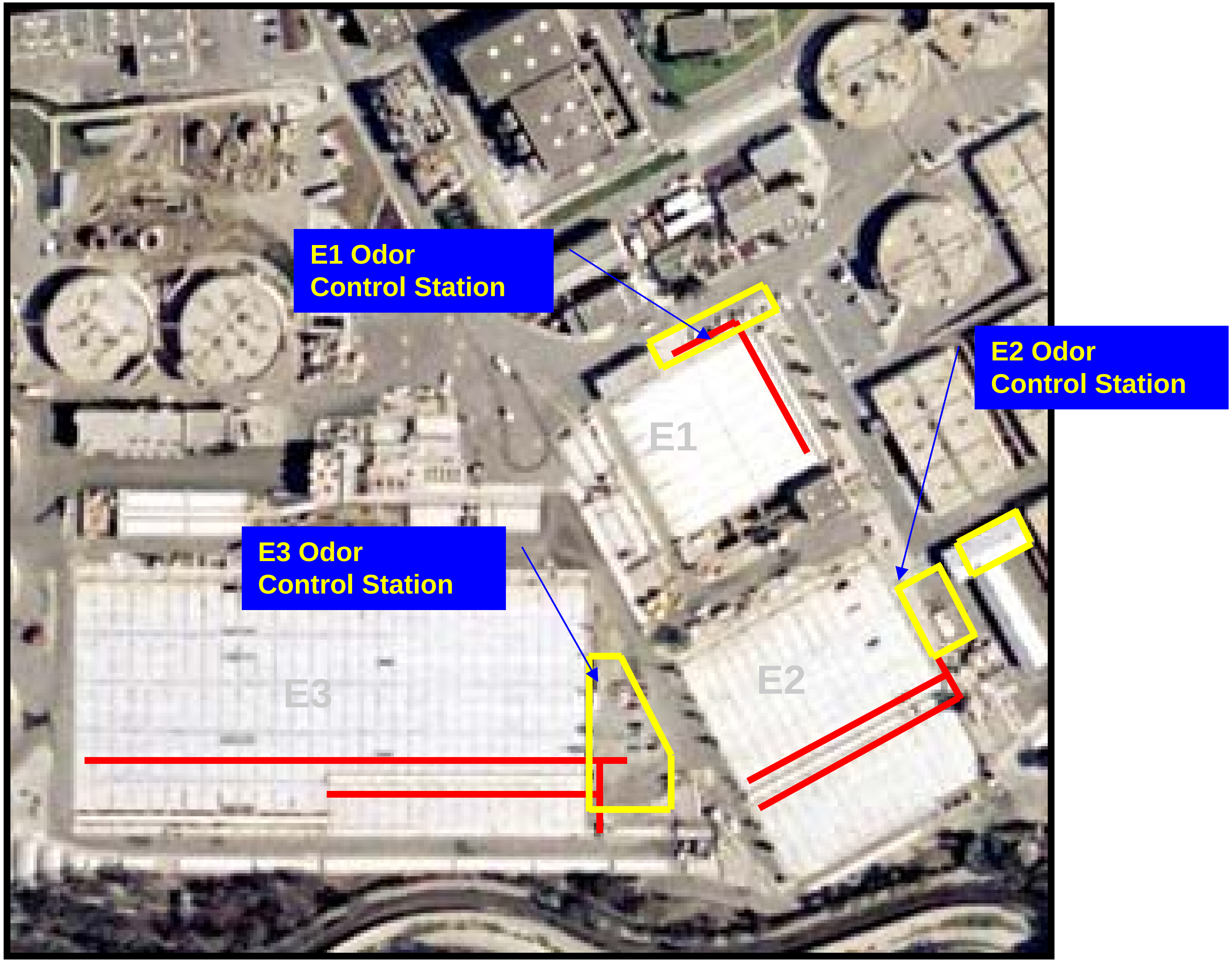
Sedimentation Tank Odor Control Project

- Primary sedimentation tanks and the primary effluent channels
- Three (3) odor control stations
- Biotrickling and activated carbon scrubbers
- 160,000 cfm total ventilation rate

Sedimentation Odor Control Station Process Flow Diagram



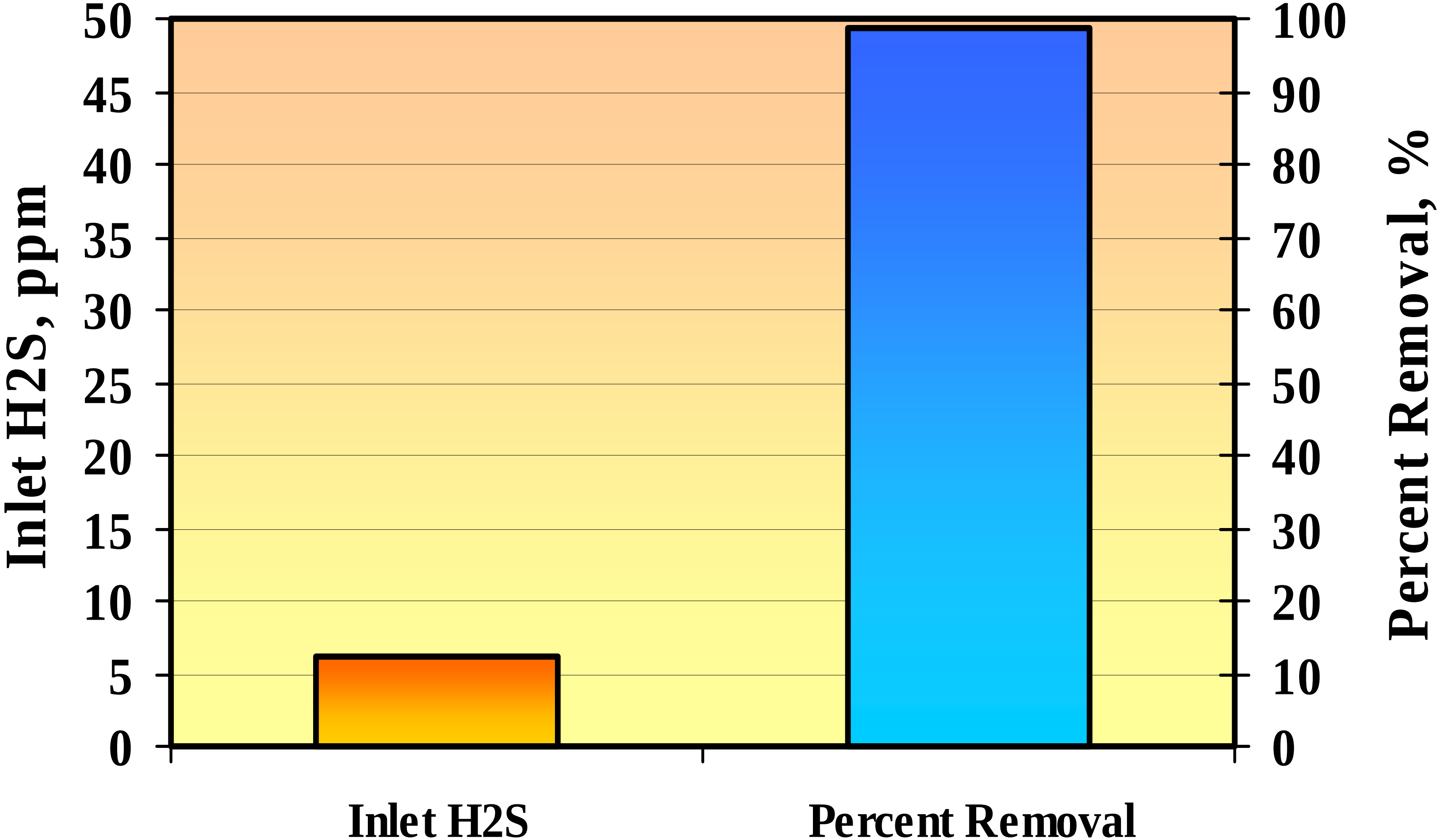
Sedimentation Tank Odor Control Project



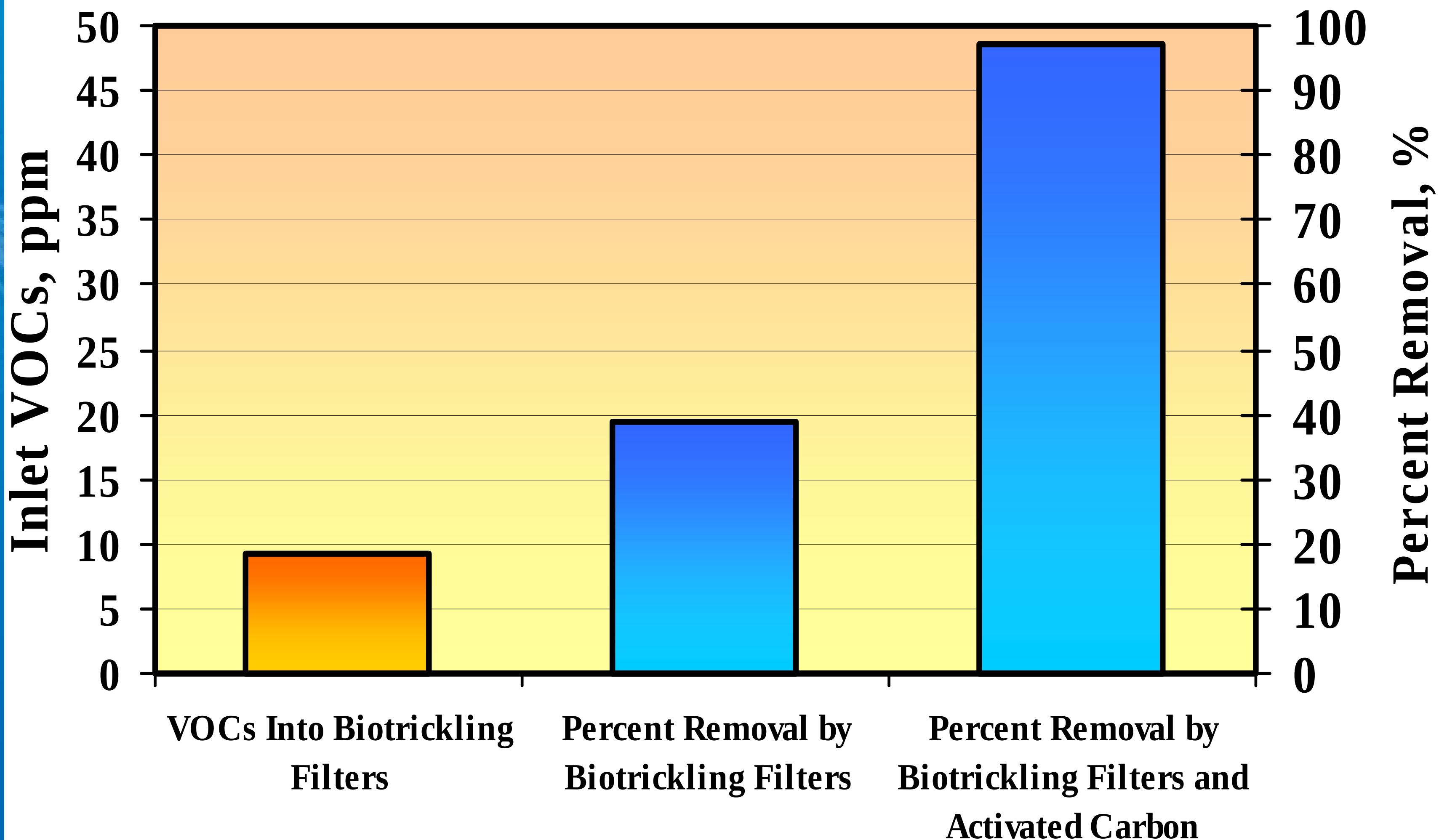
Full-Scale Biotrickling Filter and Activated Carbon Design Criteria

Odor Control Stations		E-1	E-2	E-3	Central Odor
Biotrickling Filters' Information	Shape	Rectangular	Rectangular	Rectangular	Cylindrical
	Media Depth (ft)	12.5	12.5	12.5	12.5
	Media Volume (ft3) / Vessel	5,317	4,513	6,050	4,752
	Design EBRT (sec)	14	14	14	14
	No. BTFs	1	2	4	3
Carbon Scrubbers' Information	Shape	Rectangular	Rectangular	Rectangular	Cylindrical
	Media Depth (ft)	3	3	3	3
	Media Volume (ft3) / Vessel	1,323	1,134	2,523	1,473
	Vessel Height (ft)	15	15	15	15
	No. of Units	2	3	3	3
	No. of Operational Units	1	2	2	2
	EBRT (sec)	3.00	3.00	3.00	3.00
Total Permitted Flow (cfm)		**23,000**	**37,000**	**100,000**	**60,000**

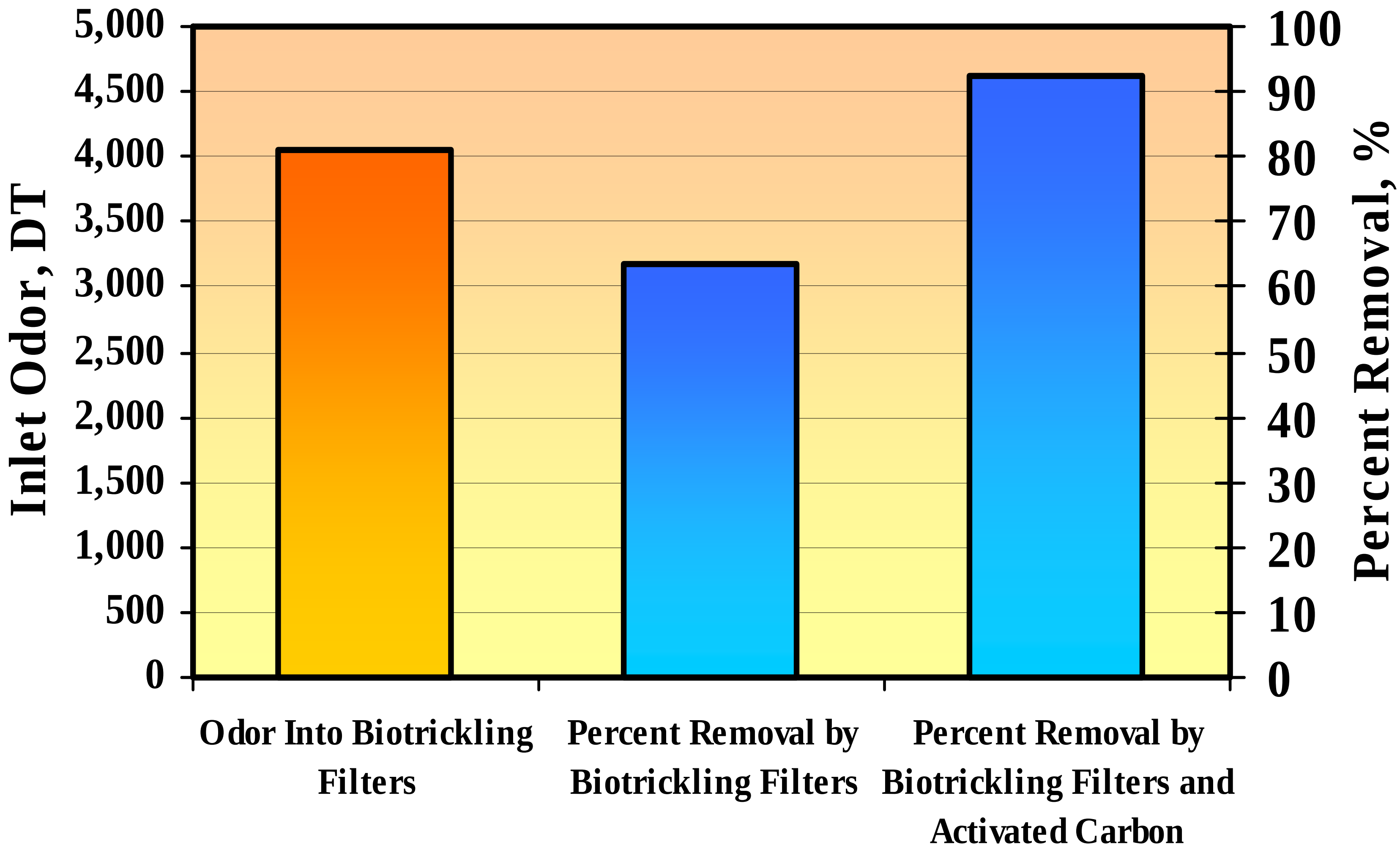
Average Removal of H_2S by Biotrickling Filters



Average Removal of VOCs by Biotrickling Filters and Activated Carbon



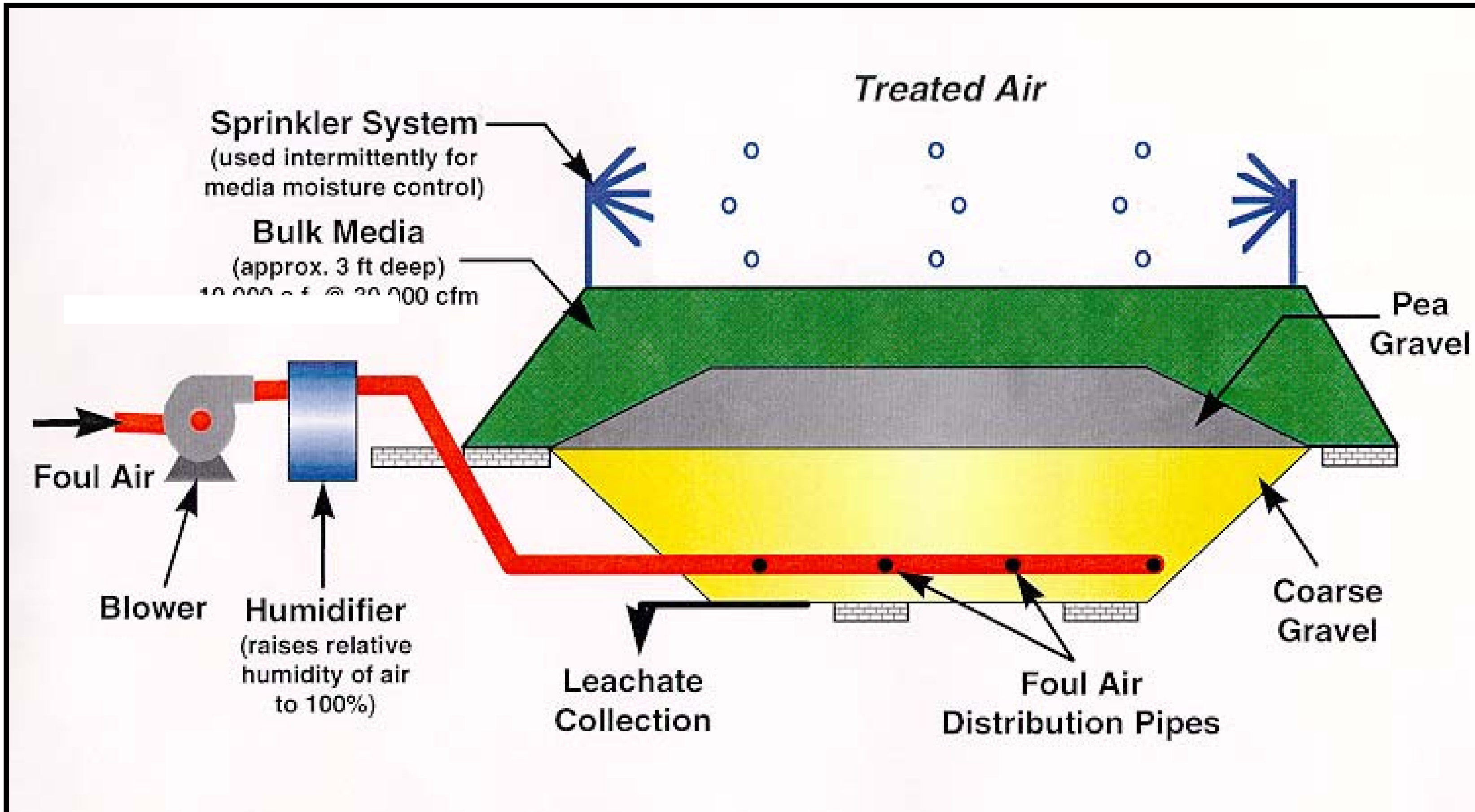
Average Removal of Odor by Biotrickling Filters and Activated Carbon



JWPCP Odor Control Areas

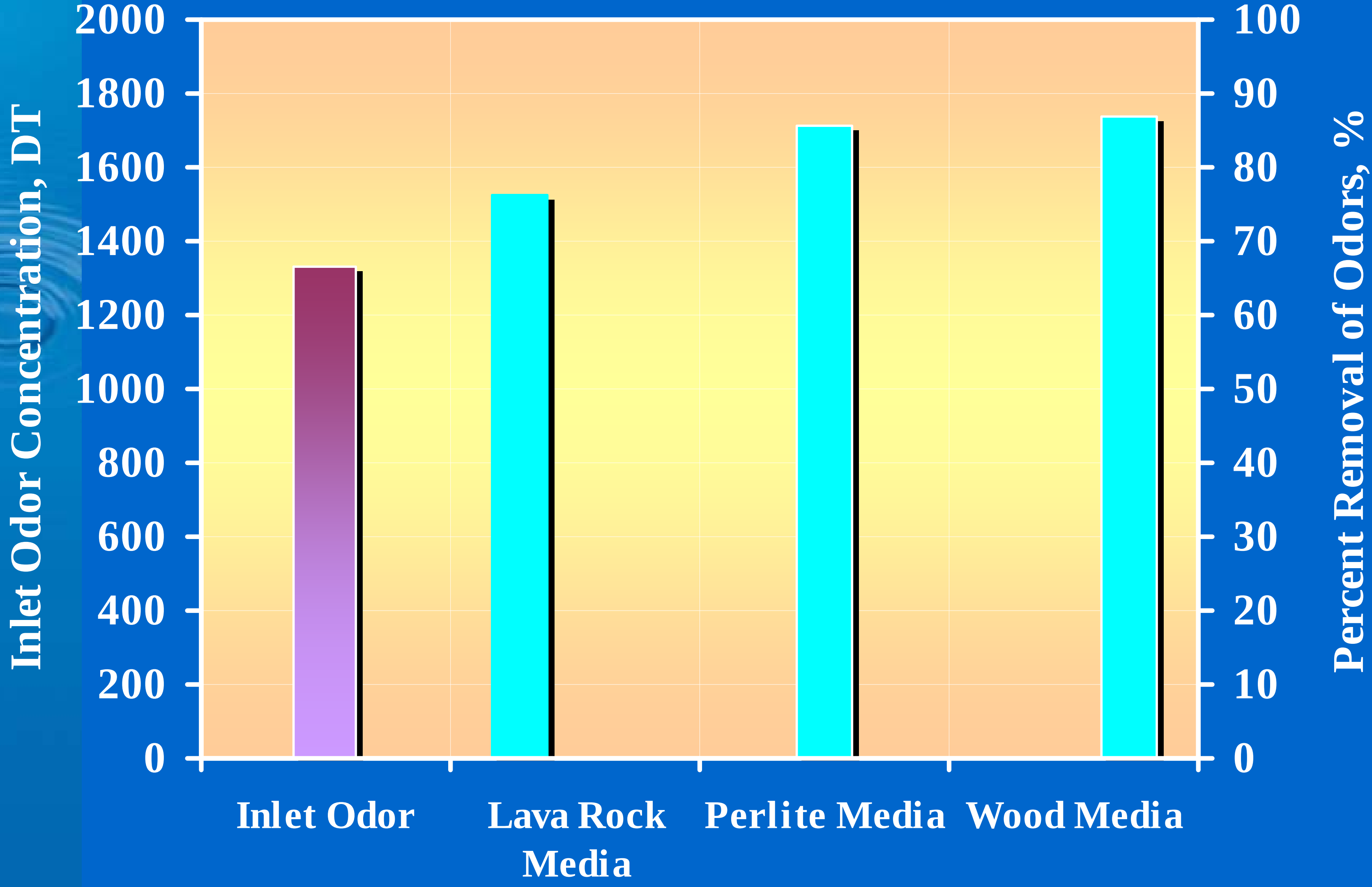
Biofilters

Typical Biofilter Schematic

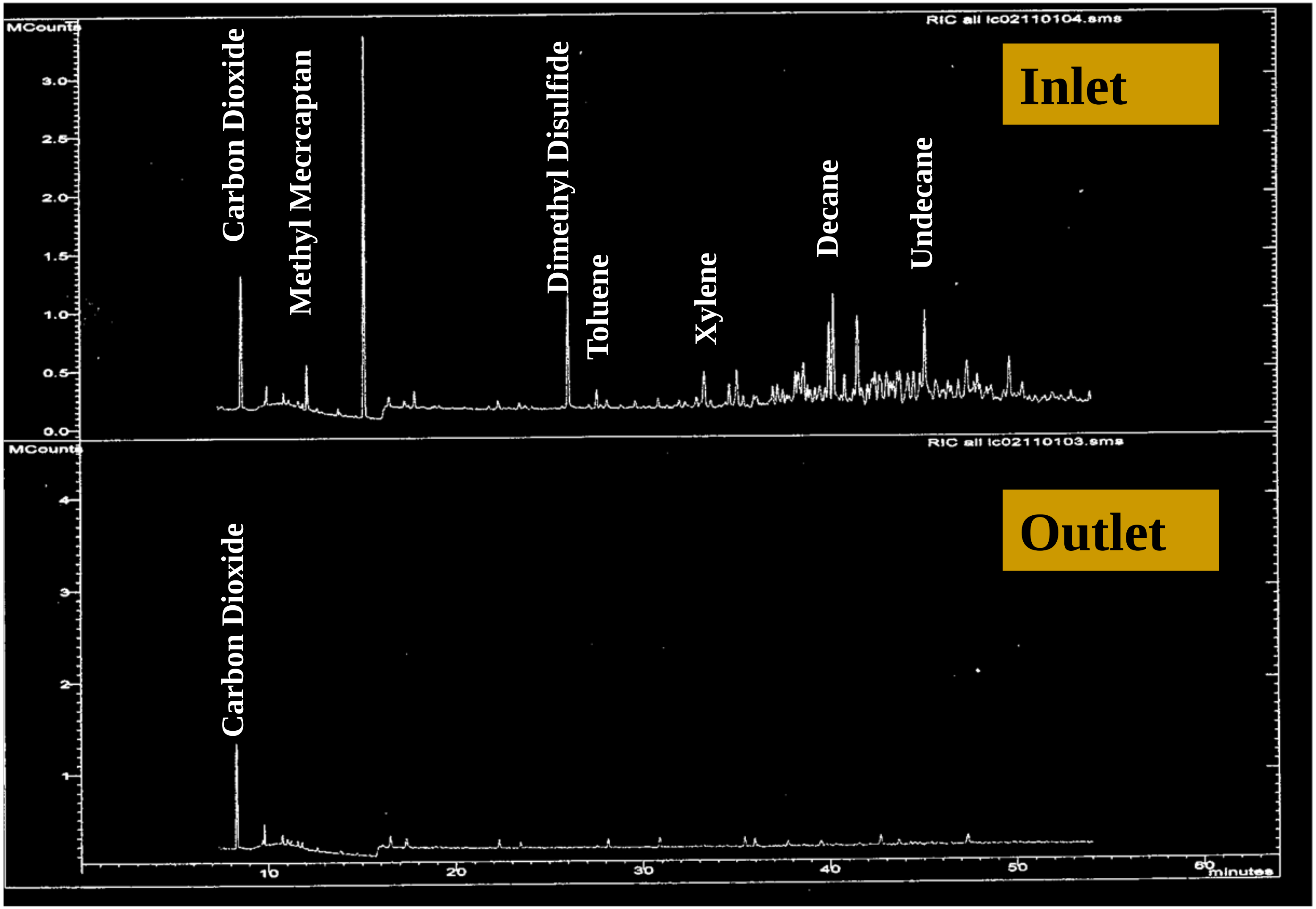


Finished Cargo Container Modular Biofilters

Average Inlet Odor Concentration and Percent Removal of Odors



Inlet and Outlet GC-MS Chromatogram Plots from Modular Biofilter With Wood Media



JWPCP Biosolids Handling Odor Control Project

- Reduce odors associated with conveying and storage of dewatered biosolids
- Enclose and contain areas that generate odorous emissions
- Approx. 170,000 cfm of ultimate flow

JWPCP Biosolids Handling Large Scale Biofilters

Total Area 1.5 Acres

South Biofilter: 0.65 Acres **East Biofilter: 0.85 Acres**

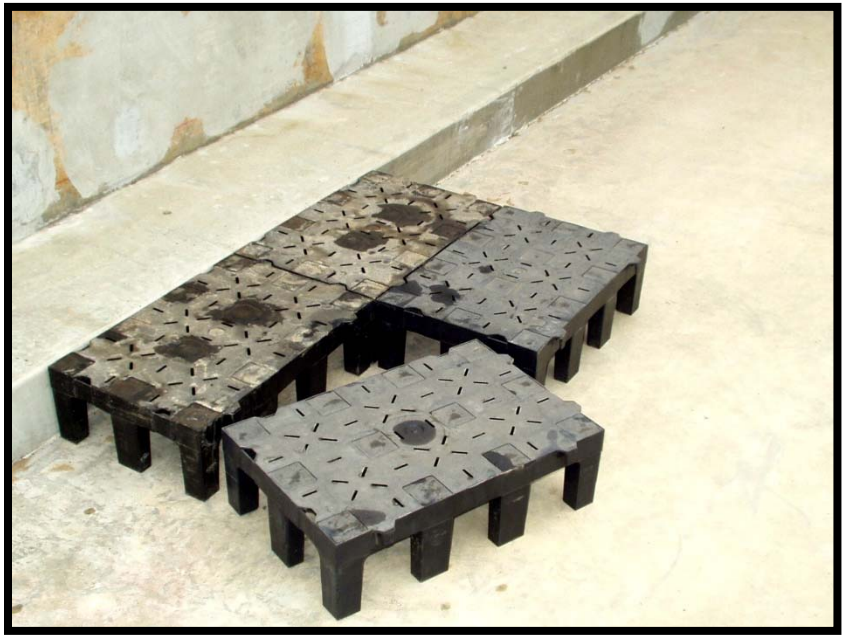
JWPCP Biosolids Handling Large Scale Biofilters

JWPCP Large Scale Biofilter Design Criteria

Description	South Biofilter	East Biofilter
System flow	68,000 cfm	88,000 cfm
Number of cells	4	5
Air flow capacity, each cell	17,000 cfm	17,400 cfm
Dimensions of each cell	60 ft x 100 ft	60 ft x 100 ft
Media depth, ft	6 ft	
Contact time with all cells on-line	85 sec	83 sec
Contact time with one cell off-line	64 sec	66 sec
Media	wood chips	
Pressure drop across cells	0.5 inches per ft of media	

JWPCP Biosolids Handling Large Scale Biofilters

Air Plenum Plates

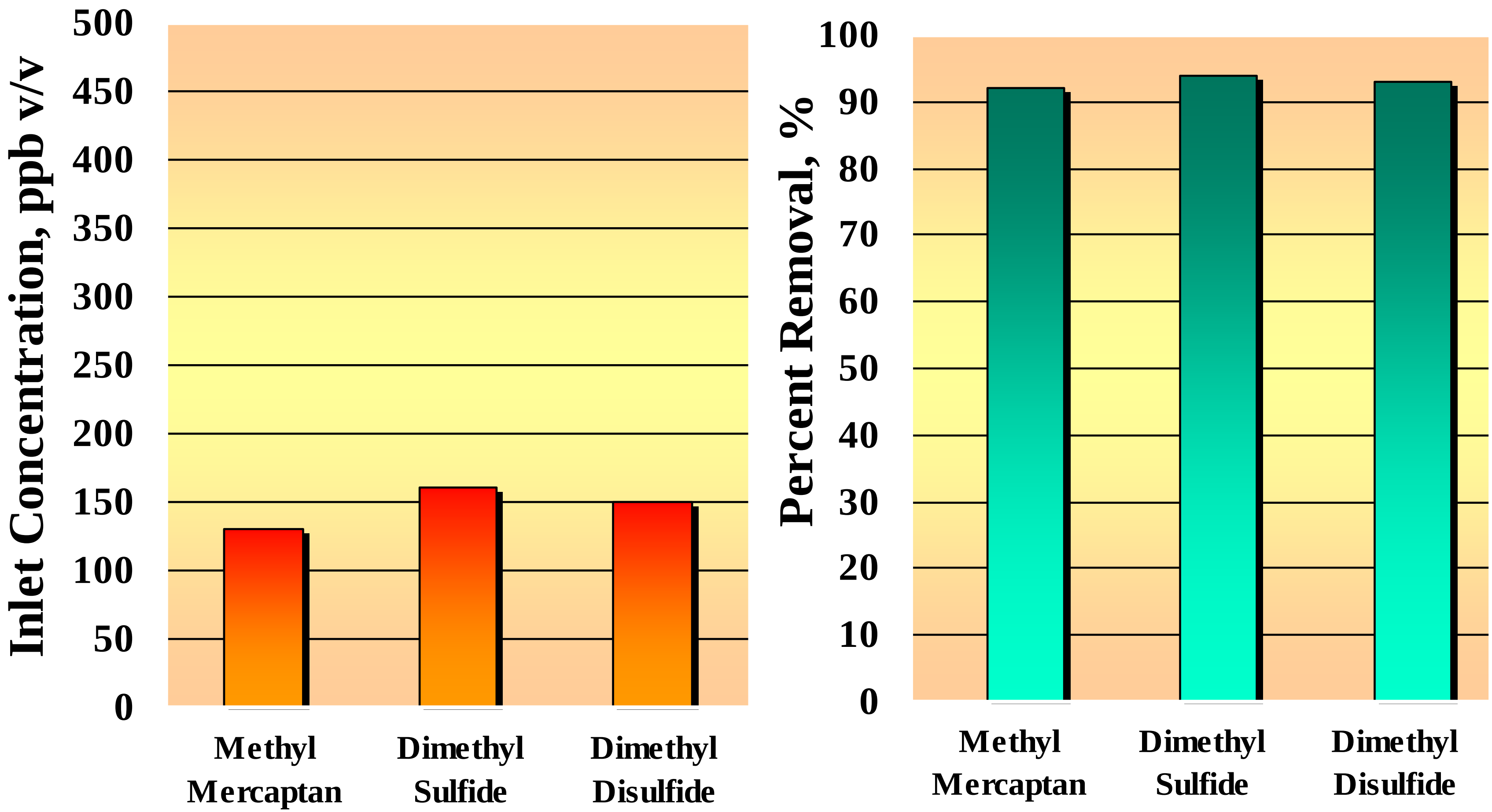


JWPCP Biosolids Handling Large Scale Biofilters

Loading the Media

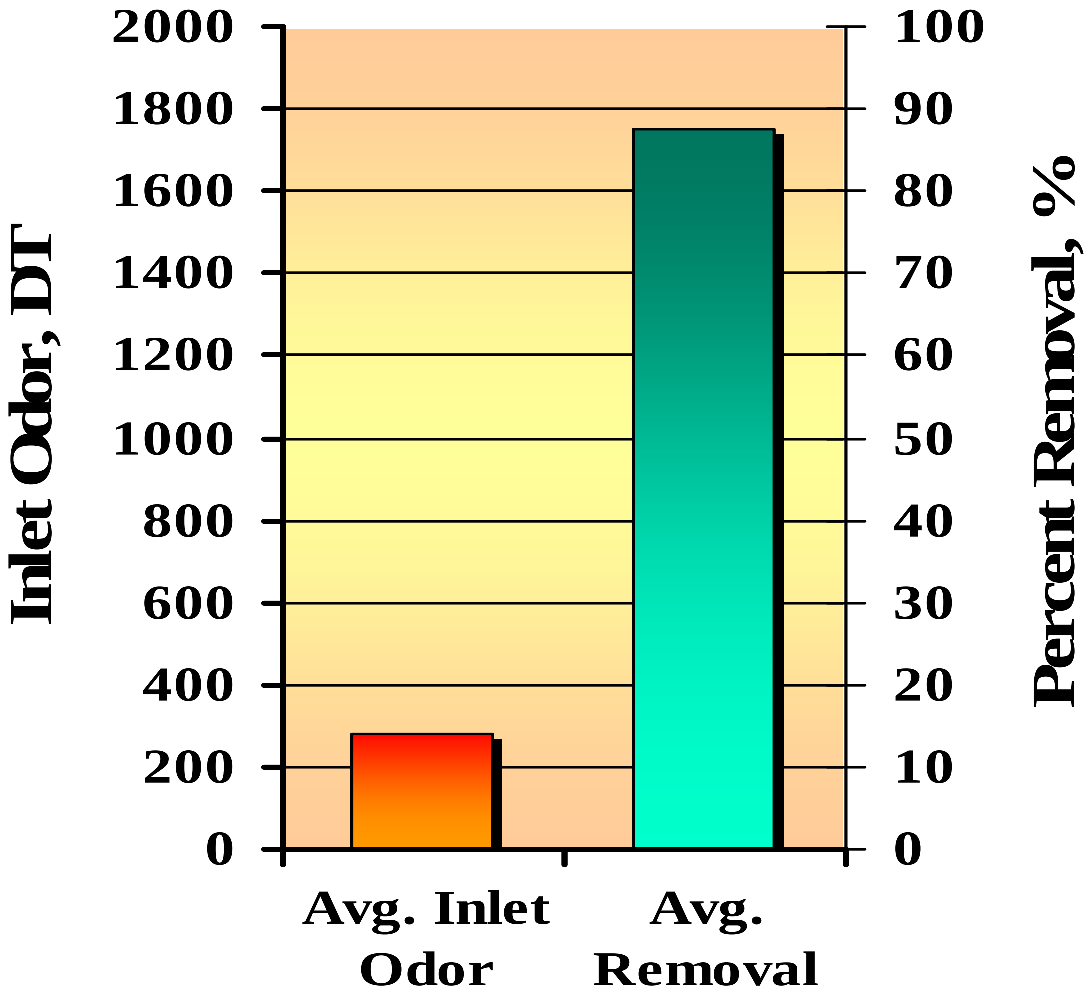
JWPCP Biosolids Handling Large Scale Biofilters

Organic Sulfur Removal

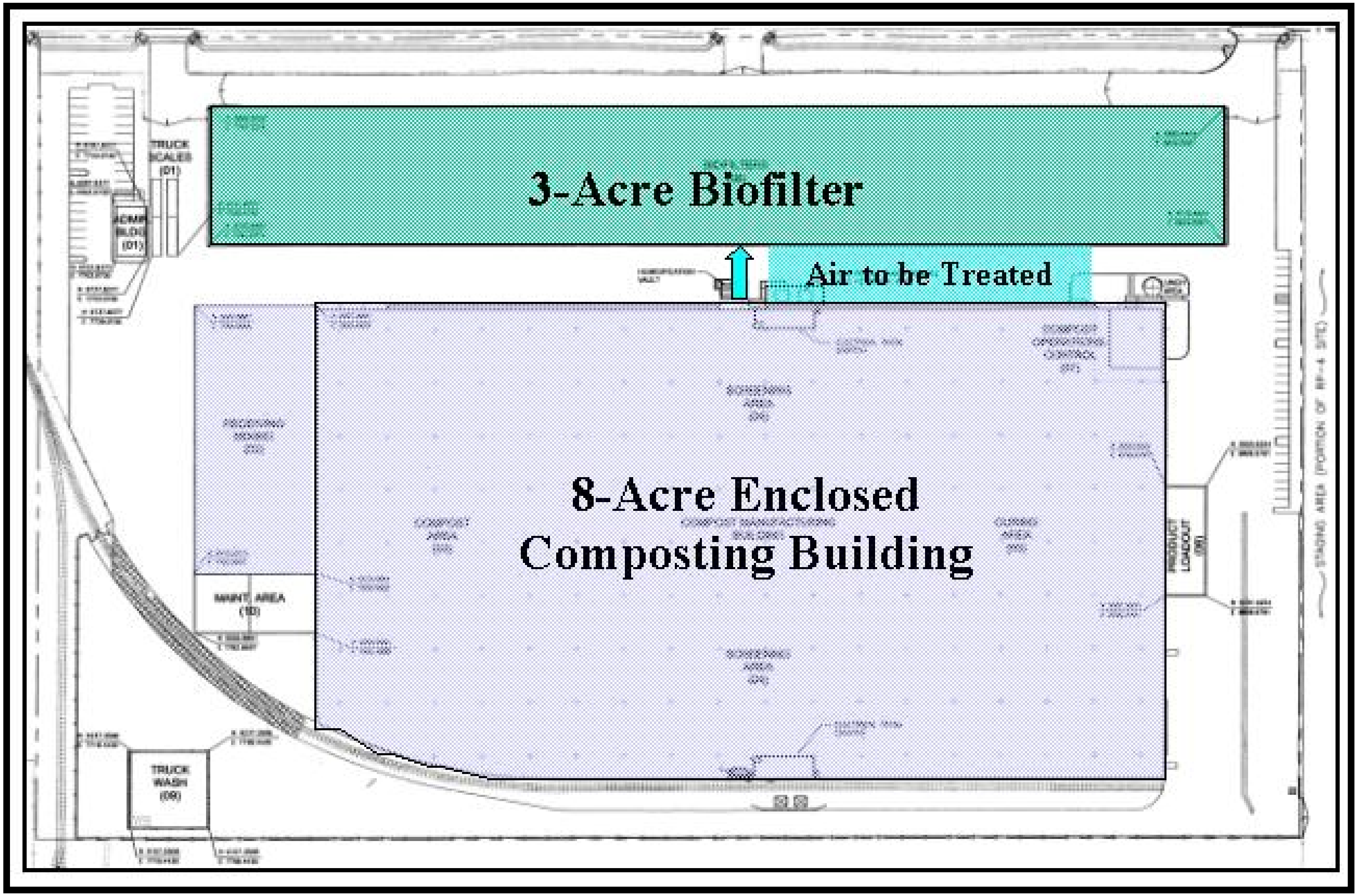


JWPCP Biosolids Handling Large Scale Biofilters

Odor Removal



Inland Empire Regional Composting (IERCF) Facility Biofilter



IERCF Biofilter Construction

Inland Empire Composting Facility

IERCF Very Large Scale Biofilter Design Criteria

Description	Data
System flow	800,000 cfm
Number of cells	12
Air flow capacity, each cell	66,700 cfm
Dimensions per cell	85 ft x 135 ft
Media depth, ft	6 ft
Contact time with all cells on-line	62 sec
Contact time with one cell off-line	57 sec
Media	wood chips
Pressure drop across cells	0.5 inches per ft of media


Questions?