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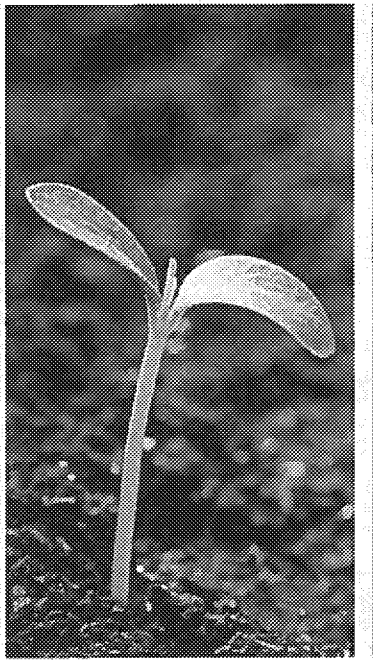
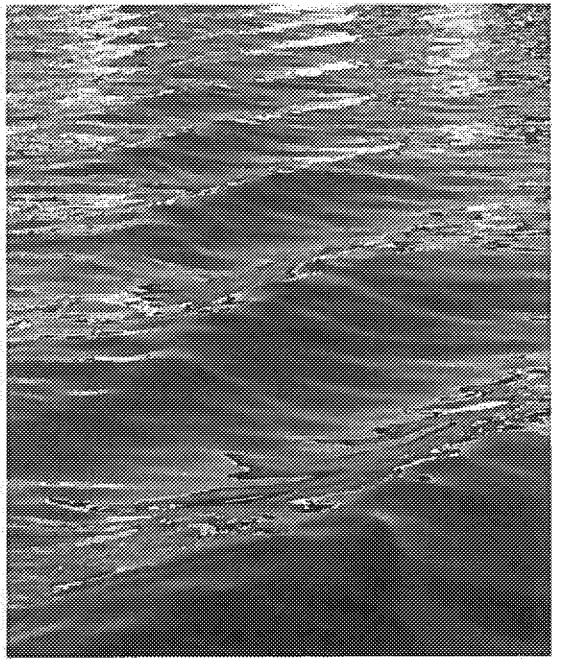
The Milorganite® Heat Drying Process

Milwaukee Metropolitan Sewerage District





MMSD

PARTNERS FOR A CLEANER ENVIRONMENT

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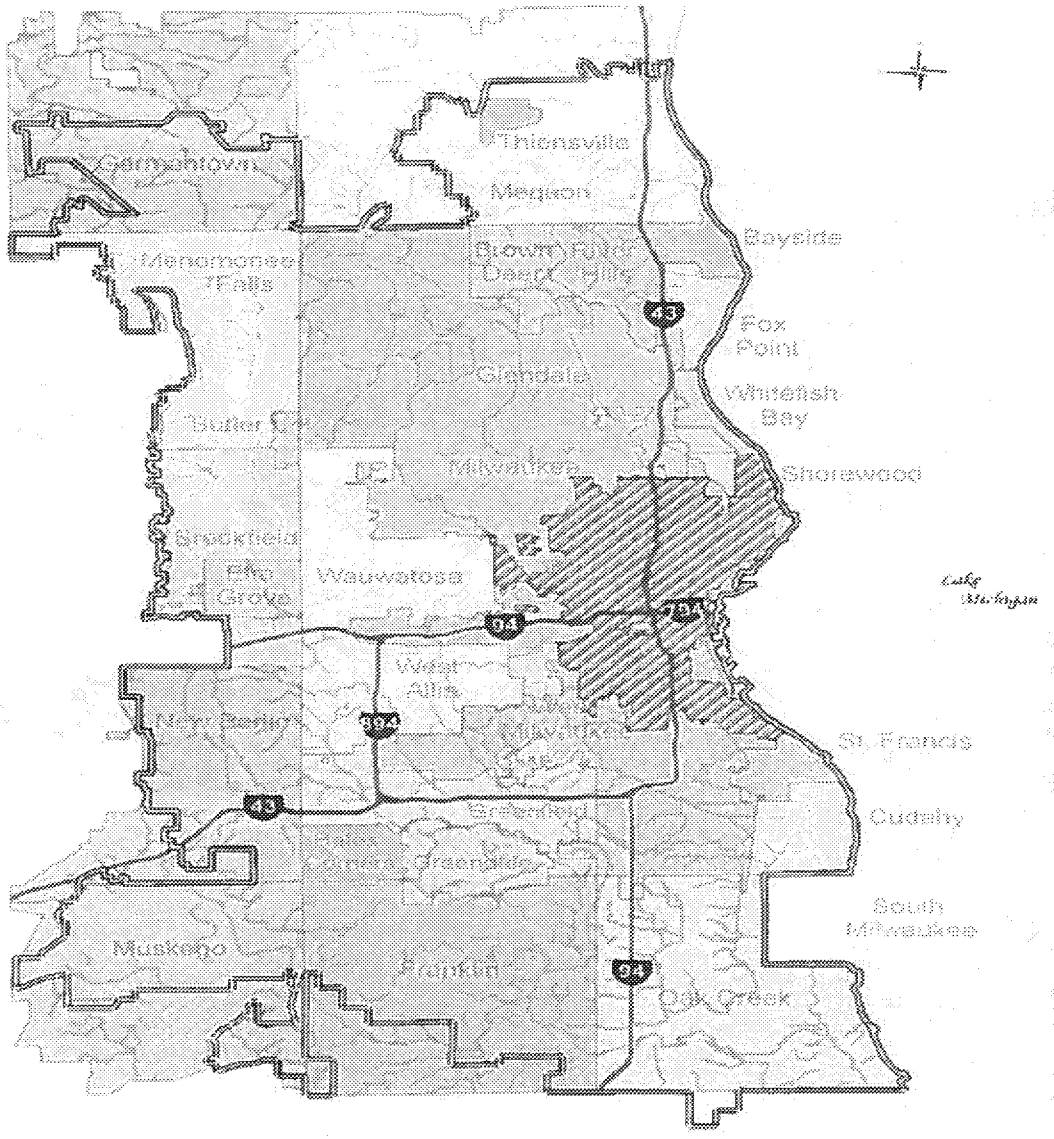

MMSD Serves:

- 1.1 Million Customers
- 28 Municipalities
- 411 Square Miles

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Water Reclamation Facilities

- Jones Island
  - Downtown Milwaukee
  - 330 MGD design capacity
  - 90 MGD typical dry weather flow
  - Where Milorganite® manufacturing occurs
  - Current drying facility in operation since 1994
- South Shore
  - Oak Creek
  - 250 MGD design capacity
  - 90 MGD typical dry weather flow
  - Anaerobic digesters fed primary sludge
- Connected by pipelines for integrated operation

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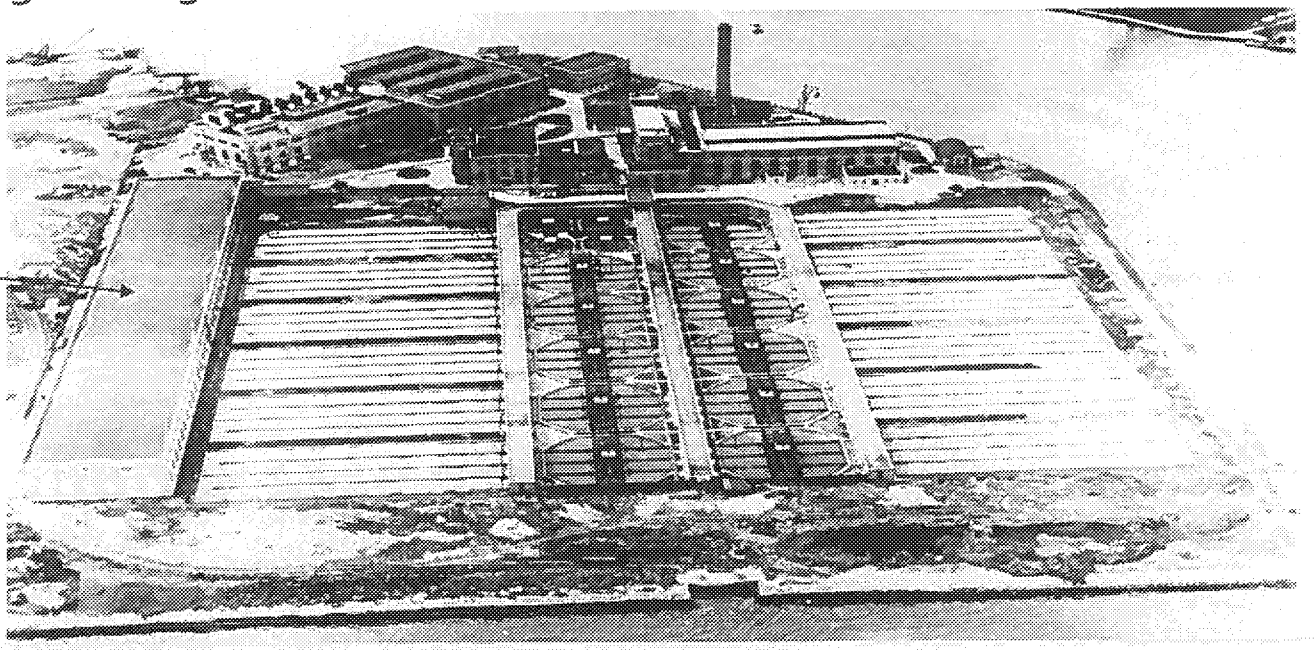
Jones Island

- Completed in 1925
- First municipal activated sludge treatment facility
- National civil engineering landmark

Original
Dryer House



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Milorganite®

- Since 1926
- Marketed as a commercial fertilizer
- Markets developed with turf science and professional turf care

First Rail Car 1926

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United States
Environmental Protection
Agency

Biosolids Technology Fact Sheet

Heat Drying

DESCRIPTION

Heat drying, in which heat from direct or indirect dryers is used to evaporate water from wastewater solids, is one of several methods that can be used to reduce the volume and improve the quality of wastewater biosolids. A major advantage of heat drying versus other biosolids improvement methods, however, is that heat drying is ideal for producing Class A biosolids.

Class A biosolids, as defined in 40 CFR Part 503, are biosolids that have met "the highest quality" pathogen reduction requirements confirmed by analytical testing and/or the use of a Process to Further Reduce Pathogens (PFRP) as defined in 40 CFR Part 257. One advantage of Class A biosolids is that they are approved for unrestricted users for many years. They can be directly applied to agricultural fields, lawns, etc. or mixed with other ingredients prior to application.

APPLICABILITY

Heat drying is an effective biosolids management option for many facilities that desire to reduce biosolids volume while also producing an end-product that can be beneficially reused. For example, the Milwaukee Metropolitan Sewage District (MMSD) has been heat-drying wastewater solids and marketing the end-product as a fertilizer since the 1920s (USEPA 1979). The technology has gained popularity since the mid-1980s, as many large urban wastewater solids generators, especially on the east coast, have shifted from ocean disposal to land-based bene-

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Method 1680: Fecal Coliforms in Sewage Sludge (2010)

7.11 Milorganite® (CAS 8049-99-8) or equivalent

Milorganite® (heat-dried Class A biosolid) is produced by Milwaukee Metropolitan Sewerage District. It is available in many home gardening centers.

Obtain Milorganite® as the reference matrix for initial precision and recovery (IPR) and ongoing precision and recovery (OPR) analyses. Milorganite® is used as the reference matrix because it is easily accessible, inexpensive, generally does not contain the analyte of interest, and is of consistent quality.

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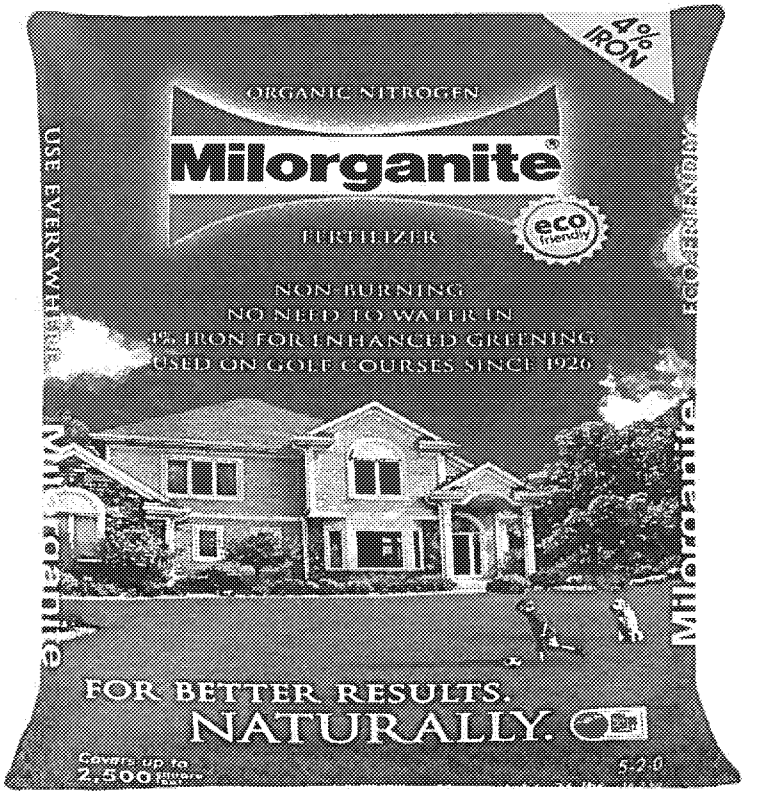
Current Products

- Retail
  - 36 pound bag
  - 5 pound bag
- Professional
  - 50 pound bag
  - 50 pound bag greens grade
  - 1,000 pound bag
- Blending
  - Truck
  - Railcar



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Life in the Fertilizer Marketplace

- Biosolids regulations
- Fertilizer regulations
- Customer satisfaction

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Product Consistency

- Compliance with Regulations
- Performance
  - Nutrients
  - Precise sizing to match fertilizer spreaders
- Over time
- Throughout the country

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How do we achieve consistency with variable inputs?

Massive amounts of recycling!

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Recycling Systems

- Continuous
  - Dryer to dryer
  - Central recycling bins
  - Sizing to recycling bins
- Intermittent
  - Dryer discharge screw failure
  - Single dryer

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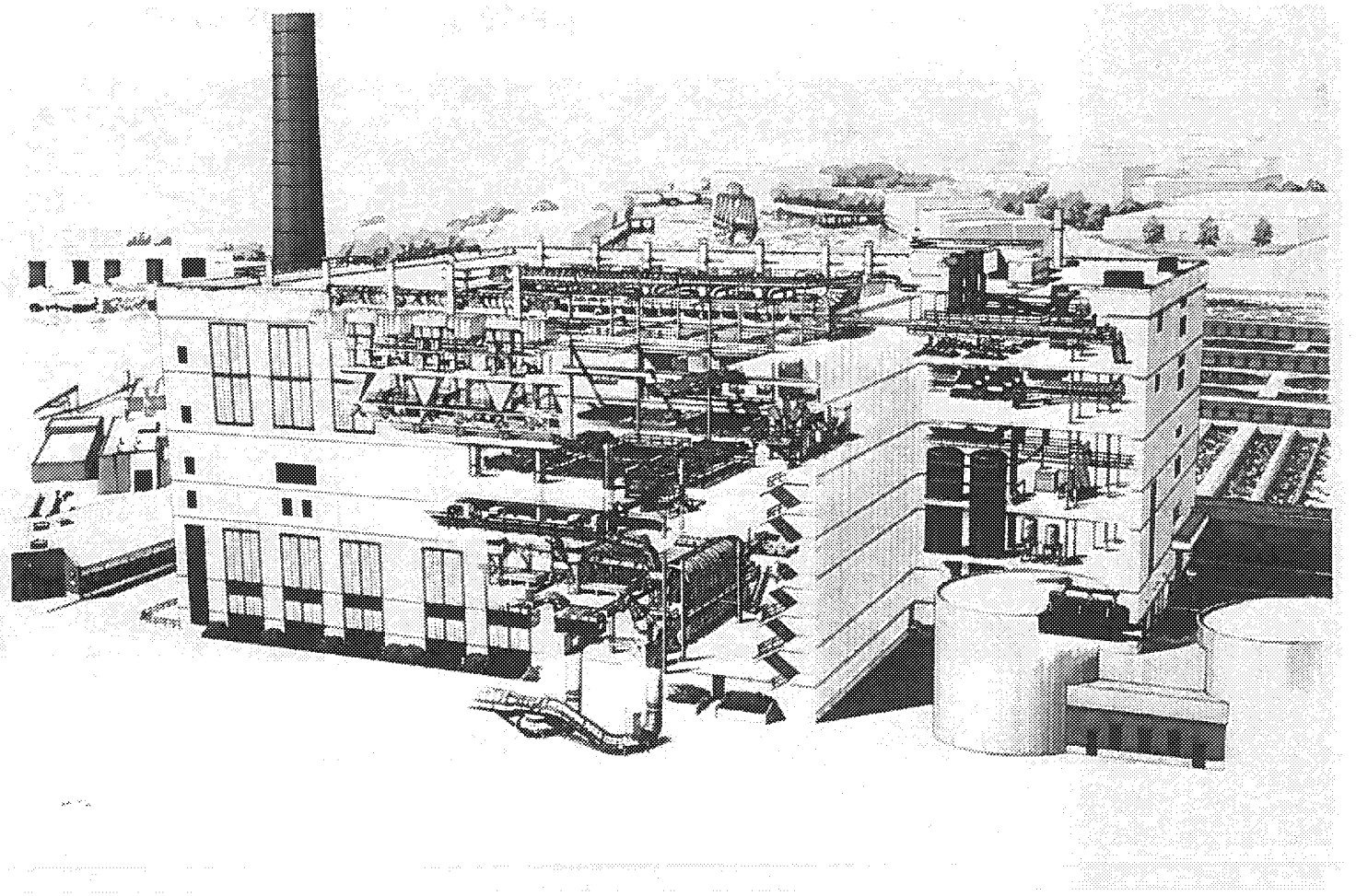
Dewatering and Drying Facility



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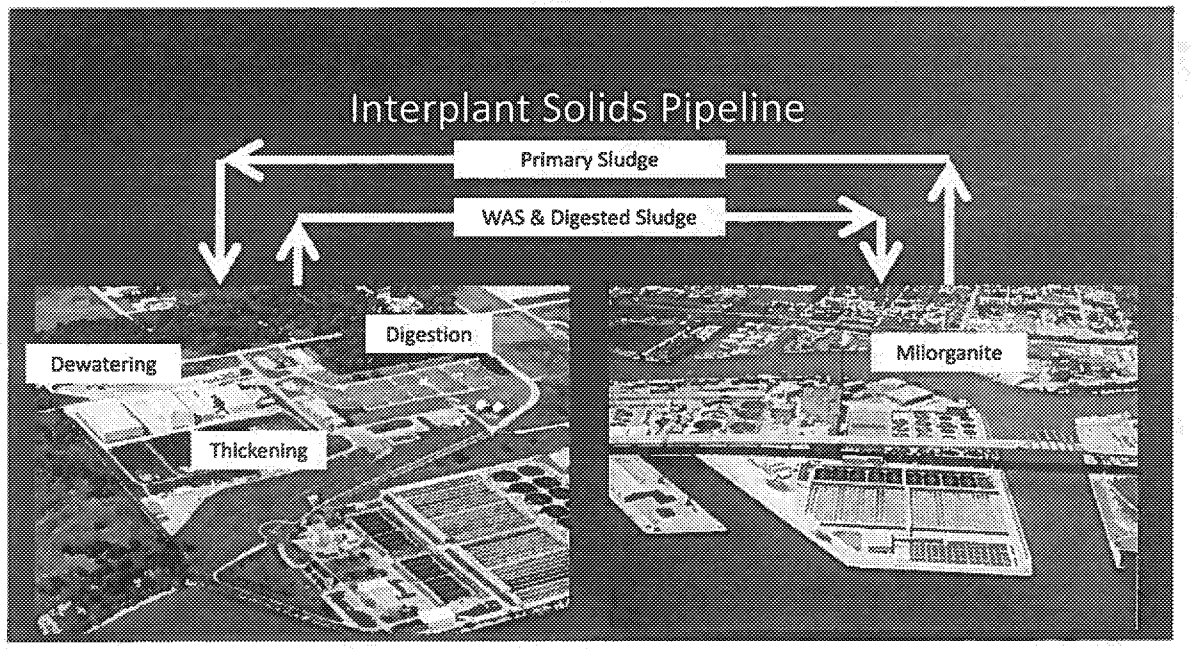
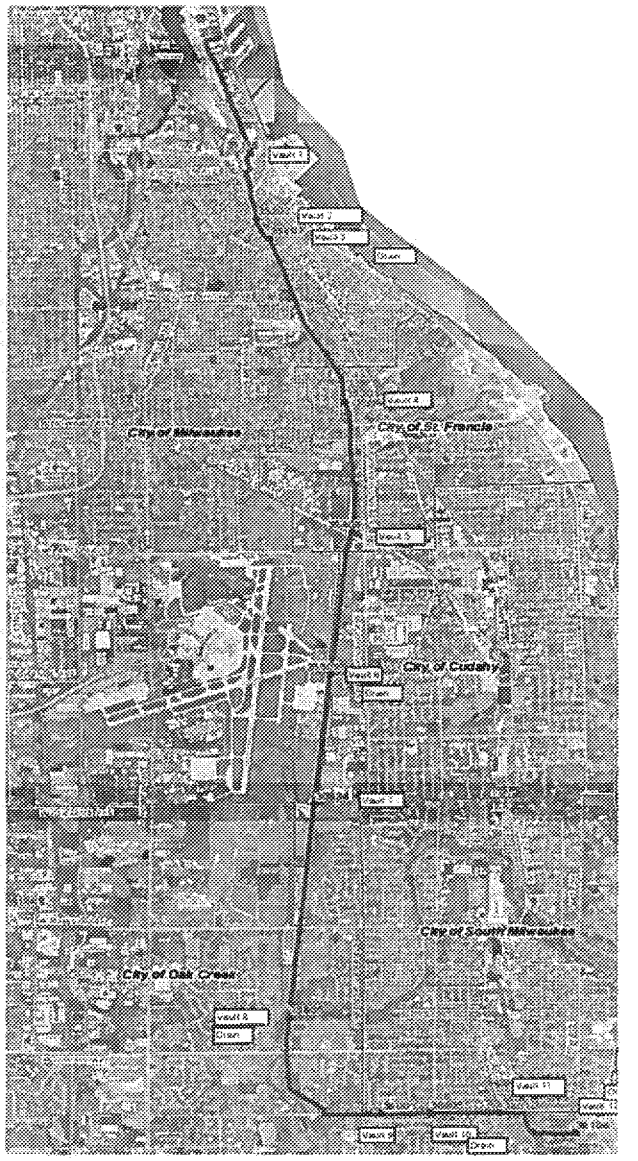
Biosolids From the Two WRFs



- Two Plants are 12 miles apart
- **4 ISP lines: 2-14" and 2-12"**
- **Ductile iron** force mains



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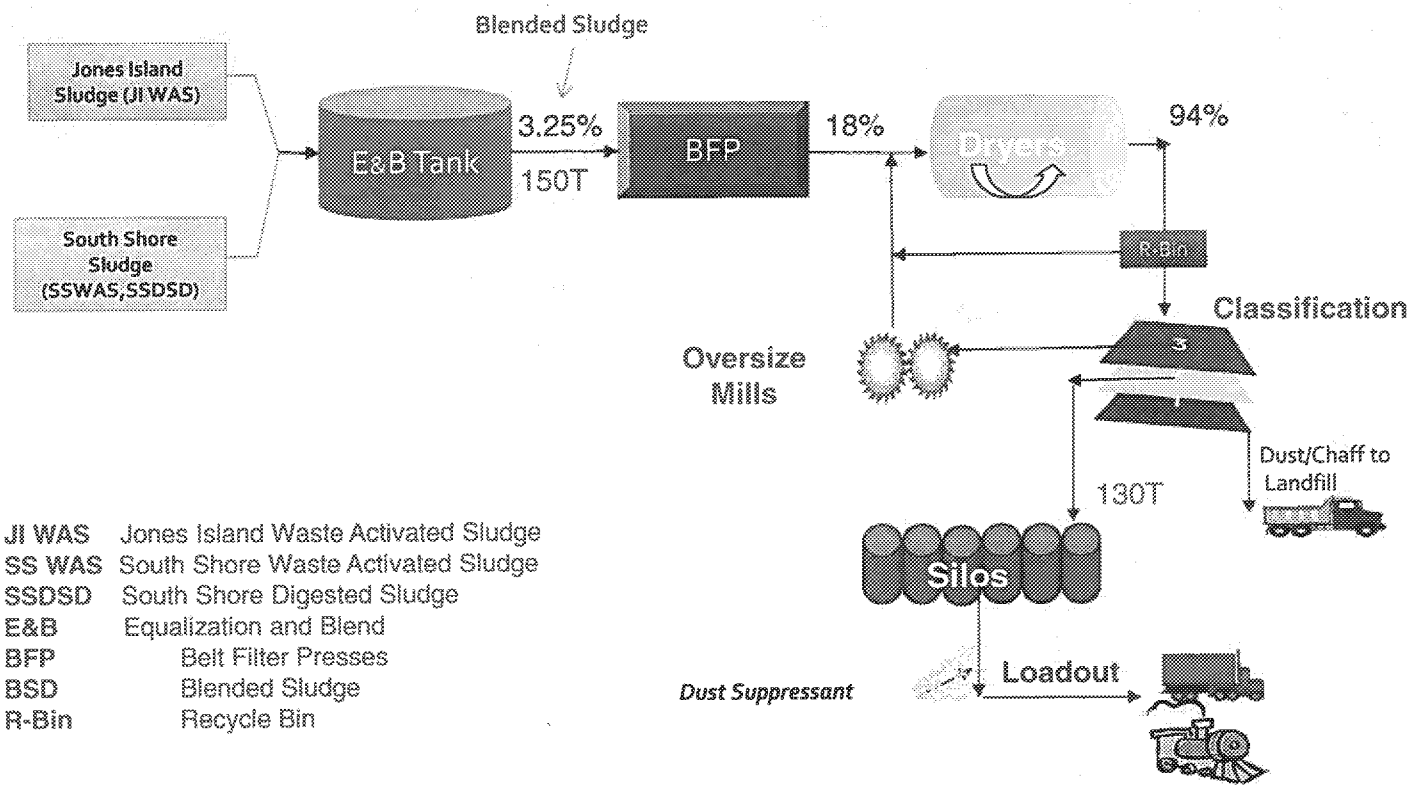
Typical Biosolids Process Day

% TS and Mass (Dry tons per day)



JI WAS	Jones Island Waste Activated Sludge
SS WAS	South Shore Waste Activated Sludge
SSDSD	South Shore Digested Sludge
E&B	Equalization and Blend
BFP	Belt Filter Presses
BSD	Blended Sludge
R-Bin	Recycle Bin

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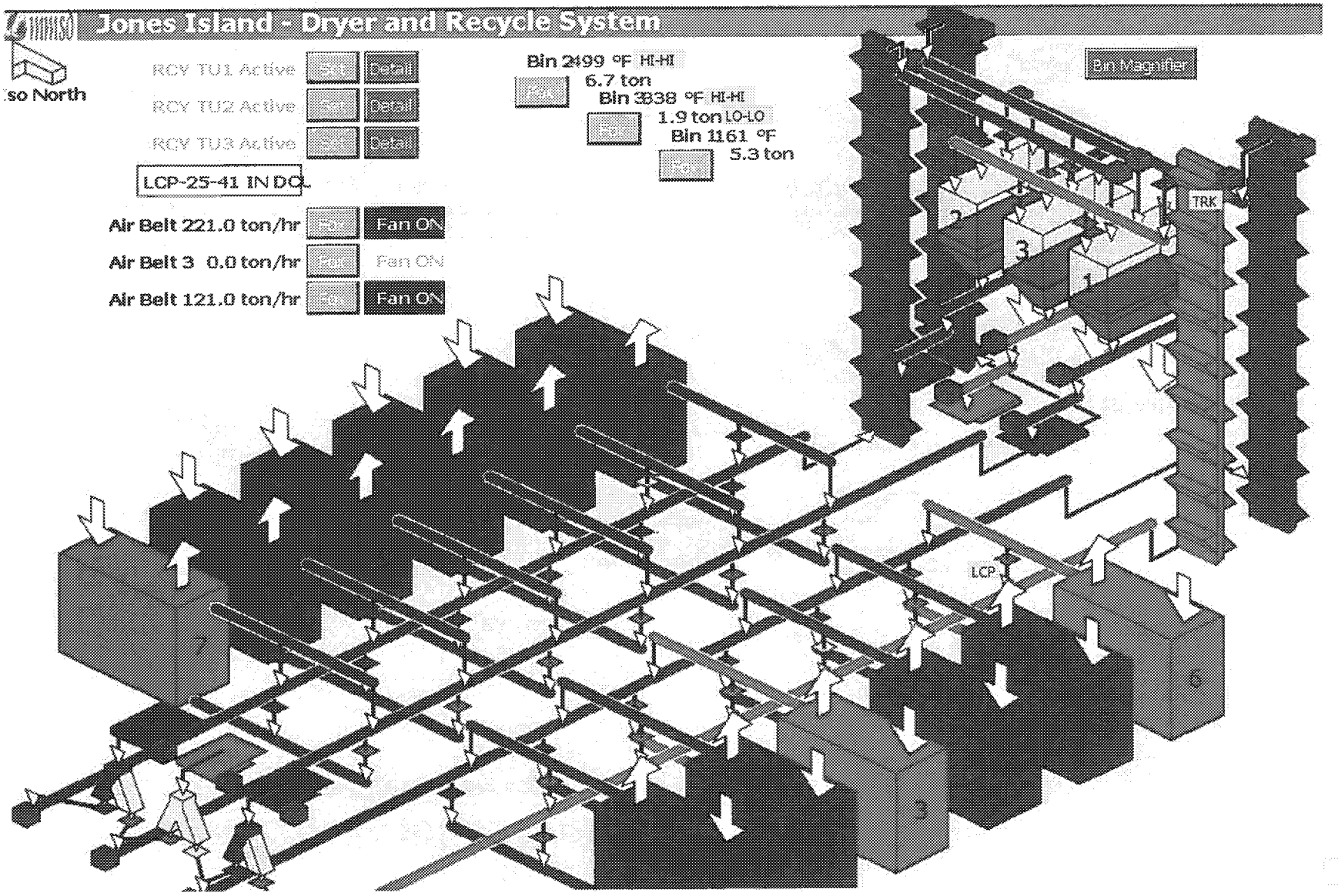

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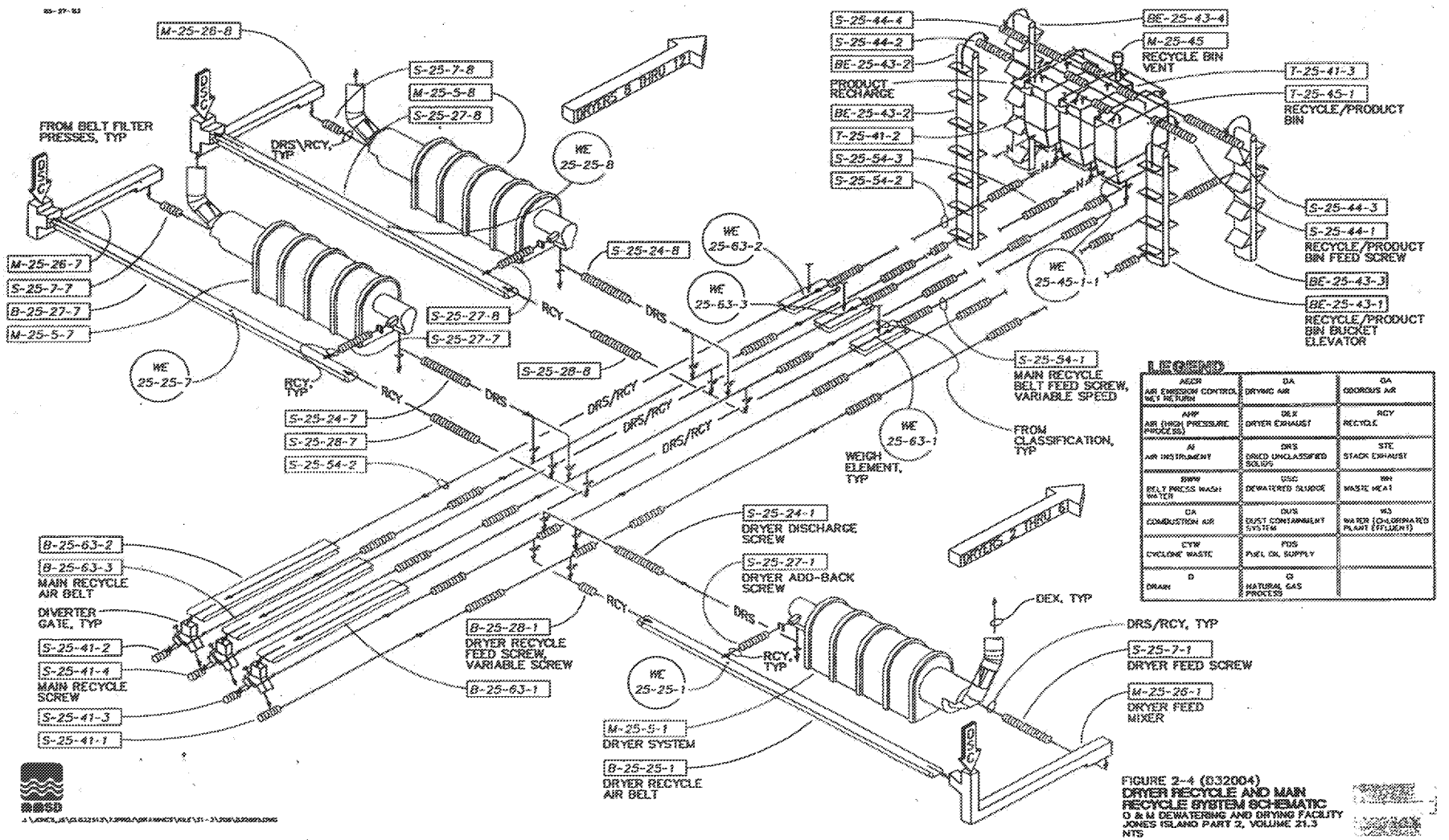

FIGURE 2-4 (032004)
DRYER RECYCLE AND MAIN RECYCLE SYSTEM SCHEMATIC
O & M DEWATERING AND DRYING FACILITY
JONES ISLAND PART 2, VOLUME 21.3
NTS

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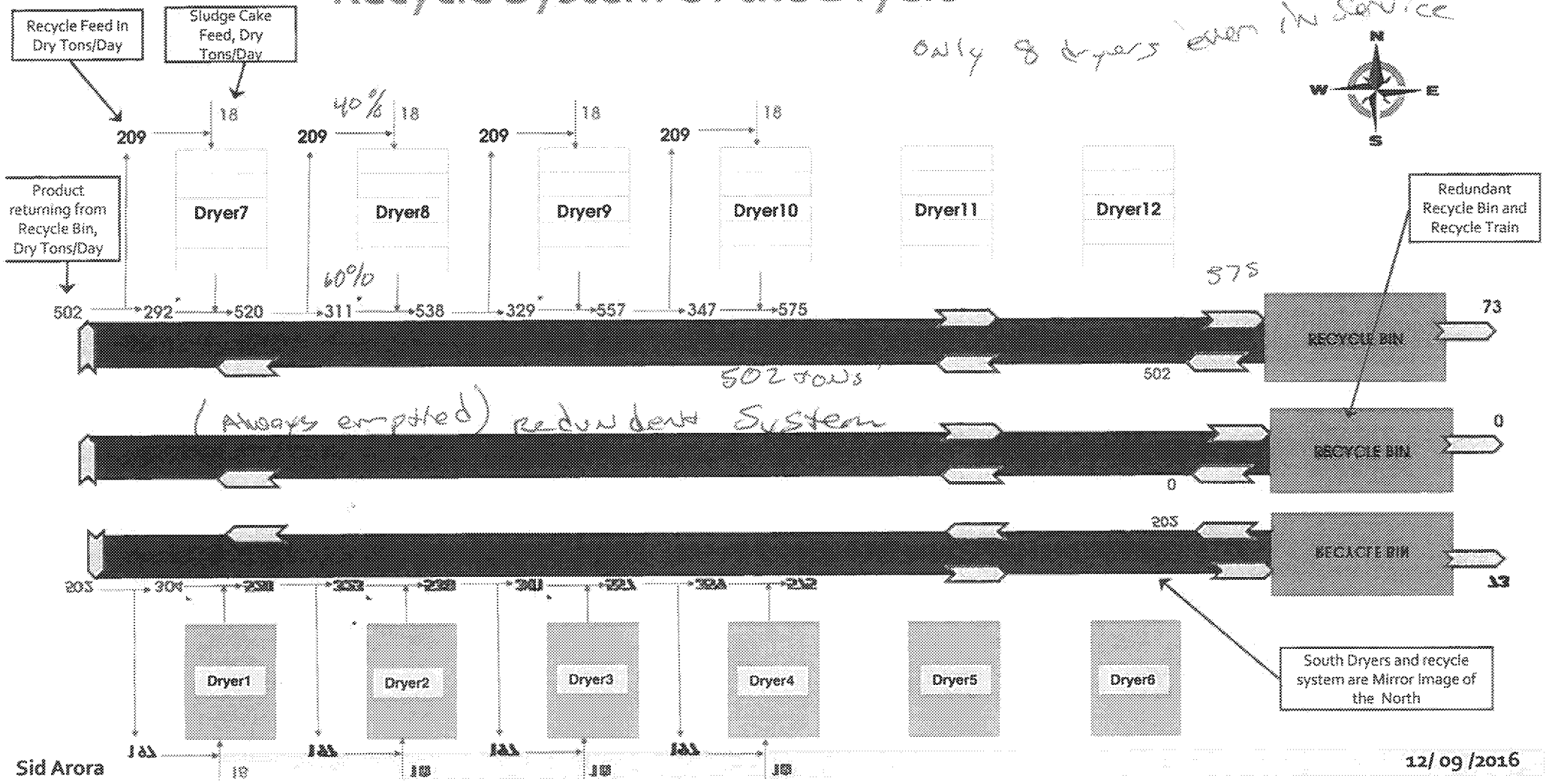
2015 Average

Recycle System Of the Dryers

South side can't go to North

? 7 times Thru System

only 8 dryers even in Service



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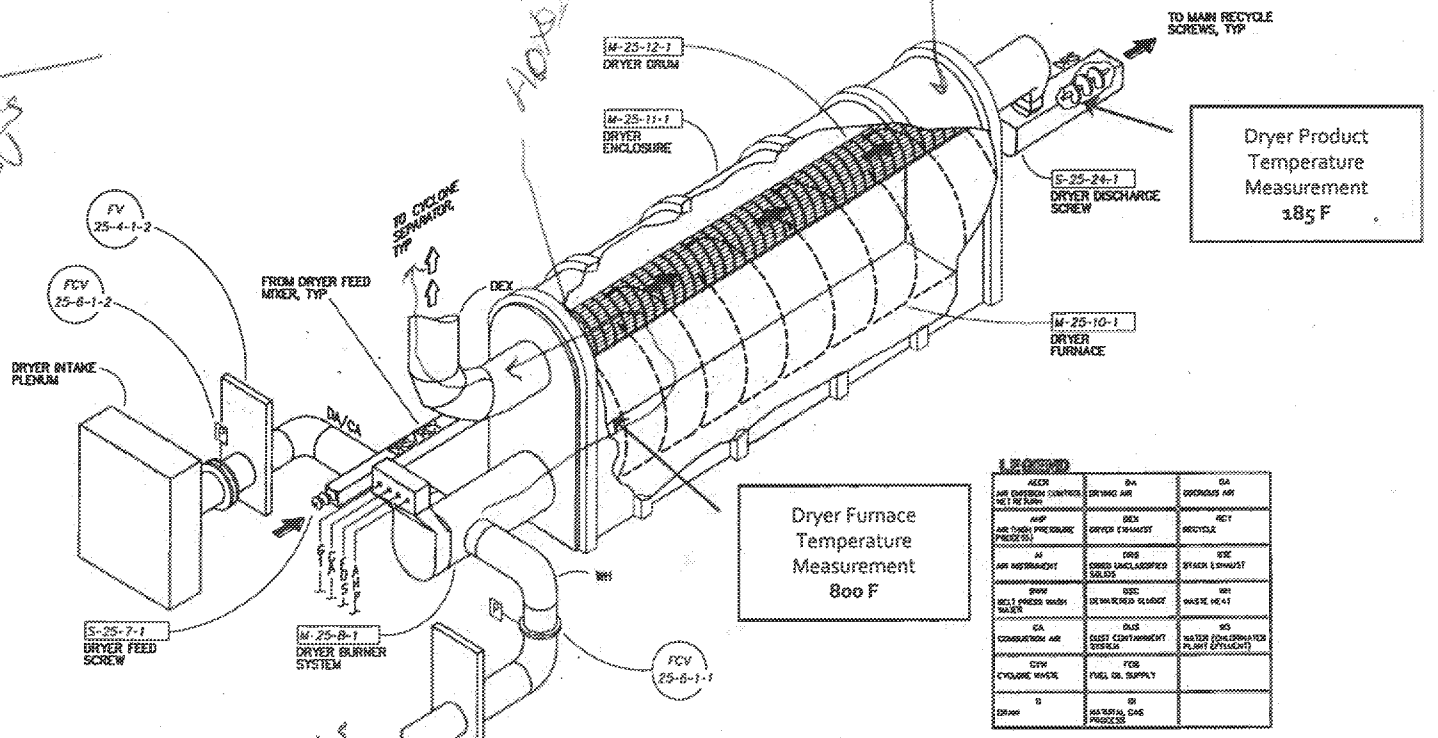
7 Temp Pt

Dryer Furnace and Product Temperatures

HSI
1 - NG Burner
2 - waste heat

Hot Pt

Collect Pt



Turbine

600 °F

waste heat 400 °F from GE Turbine

Generate Their own Power

FIGURE 2-2 (032002)
DRYER SYSTEM SCHEMATIC
O & M DEWATERING AND DRYING FACILITY
JONES ISLAND PART 2, VOLUME 2B.3
NTS

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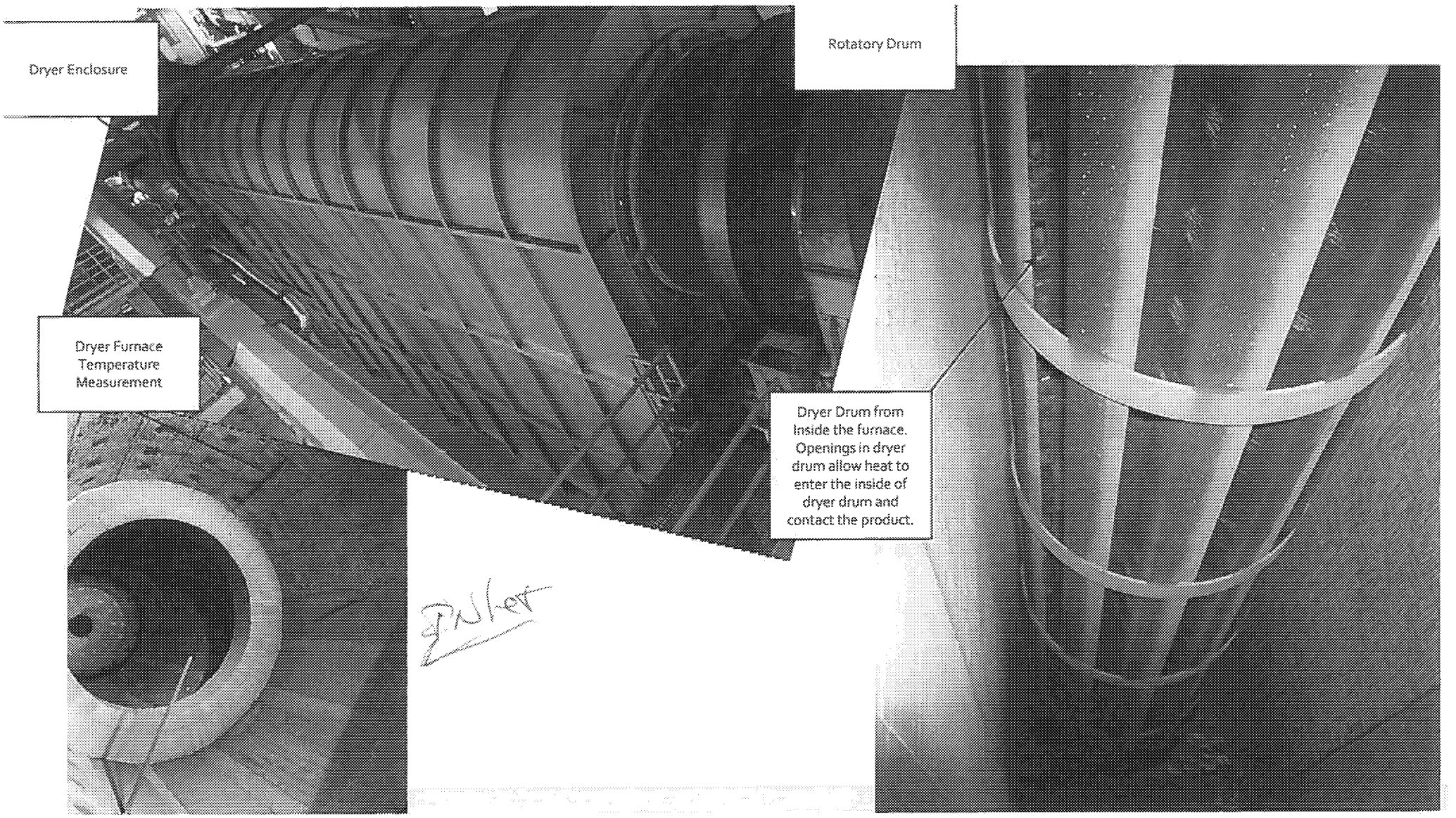

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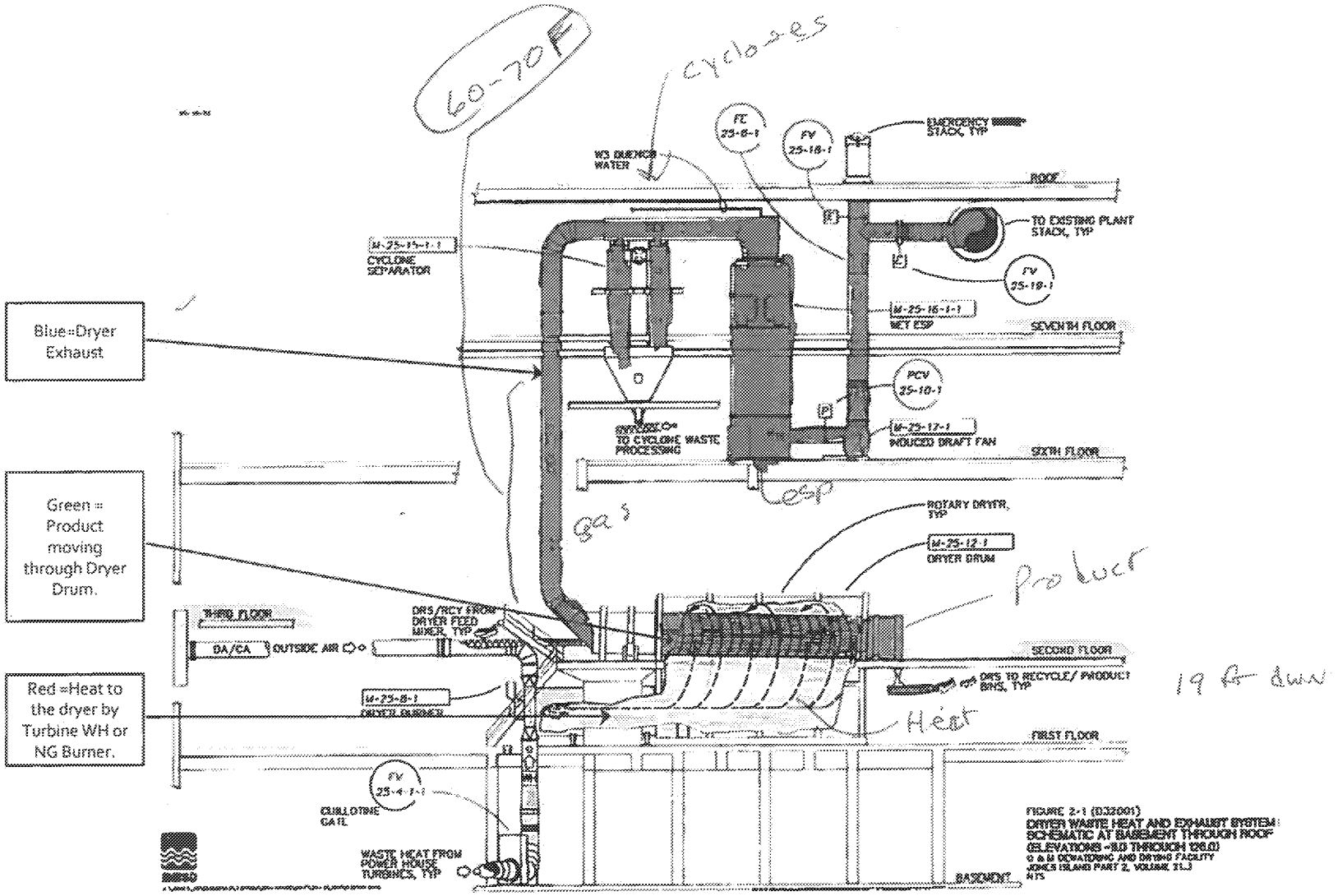

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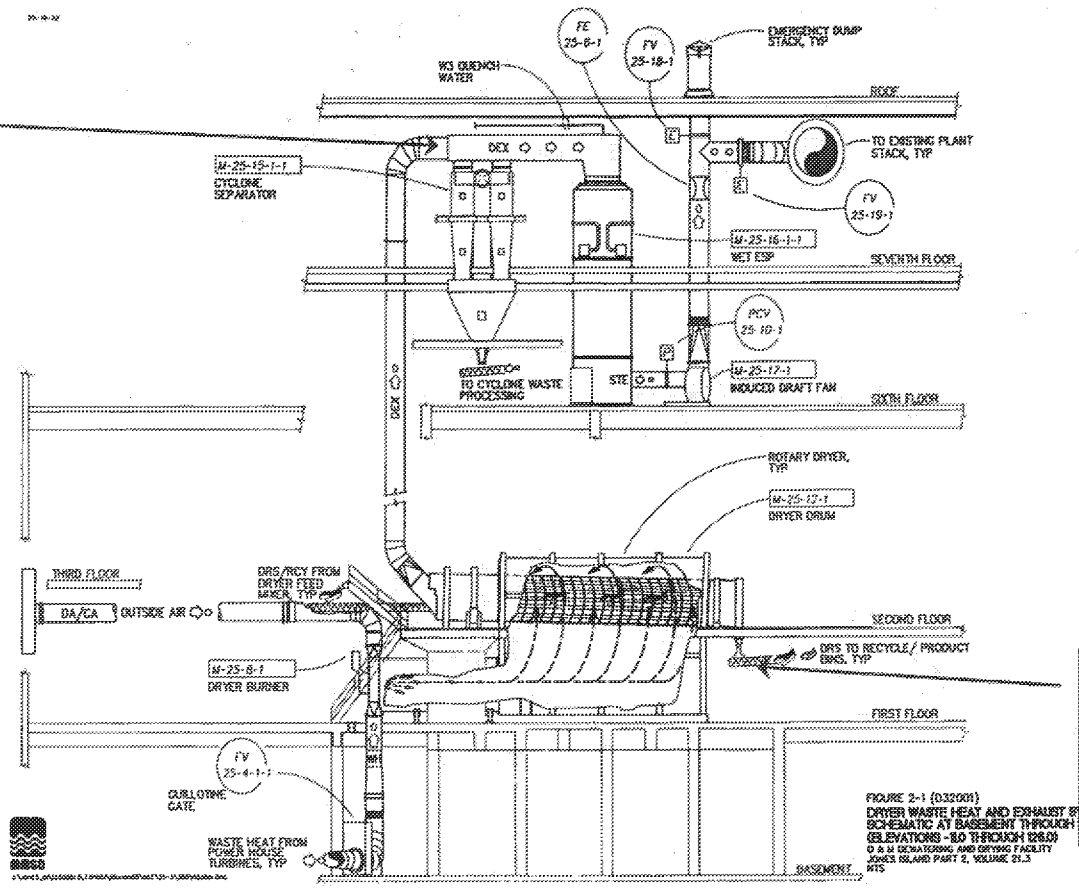
Dryers Exhaust Temperature Measurement

Dryer Exhaust Gas Temperature Measurement on 7th floor.
180 F (typical)



Dryer Product Temperature Measurement. 19 ft from the actual discharge of the product.
185 F (typical SP)

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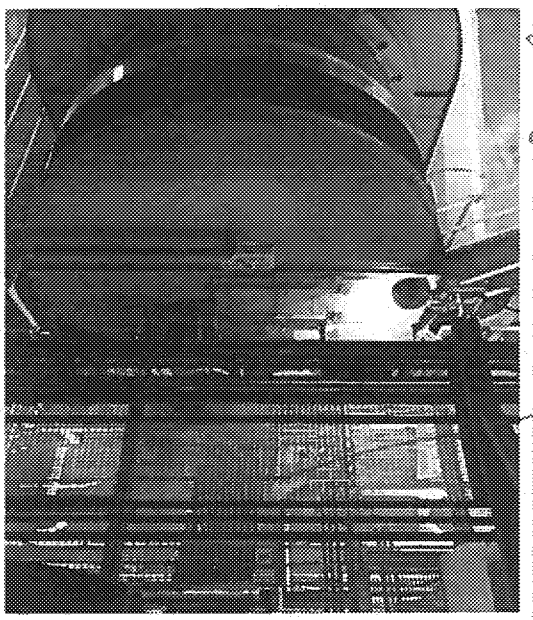
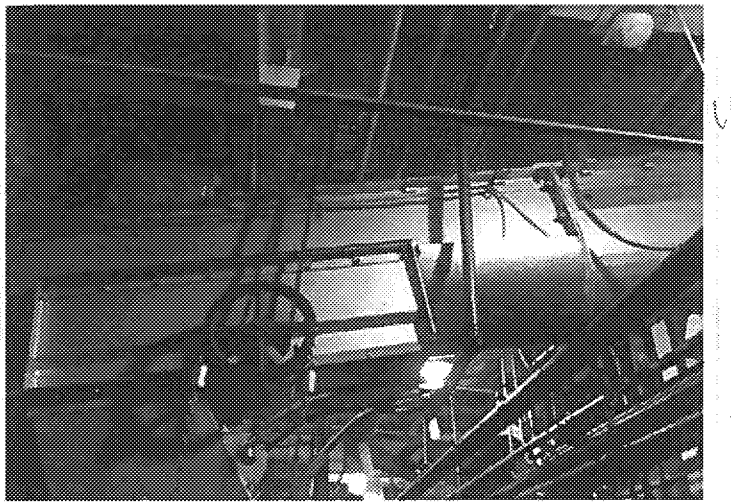
Dryer Product Temperature Measurement



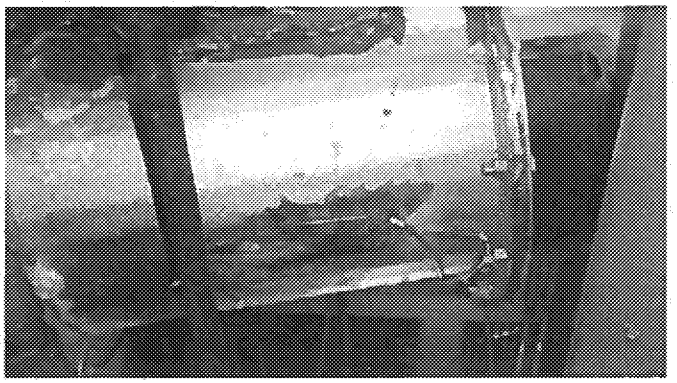
Fan and

Pipe



"measures the Temp of the Trough 19."

"Temp of conveyor" 1/2" of product



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~~30~~ 24x7
15 day shut down

4 Belts / pair of Dryers

Probability Analysis of Dryer Product Temp Greater than 176F

Draft

Annual Average for Calander Year 2015	Wet Tons/Day	% TS	Dry Tons/day
BFP Sludge Cake Processed in Dryers in 2015 (annual Ave)	826	17.7%	146.5
Base Recycle Dry Product in 2015(annual Ave)	538	93.2%	502

always stays w/ system

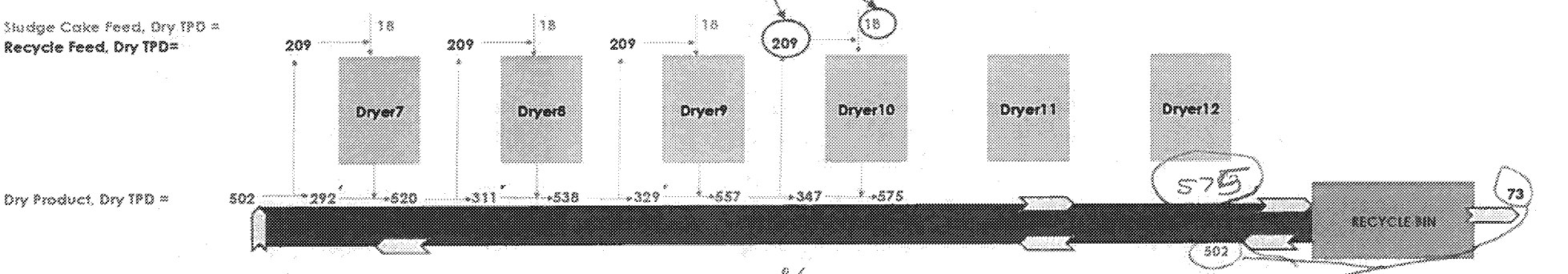
Dryer Feed (Wet Vs Dry) based on Recycle Ratio	Wet Tons/Day	% TS	Dry Tons/day
Sludge Cake Feed per Dryer /Day	103	17.7%	18
Recycle Feed per Dryer /Day	224	93.2%	209

% Dryed Recycle in Dryer Feed (2015 Annual Ave) 68.5%

Wet Tons of Recycle Product / (Wet tons of Sludge Cake +Wet Tons of Recycle Product)

Average Number of Dryers in Service 8 (4 Dryers on each Side)

North Side Dryers Mass Balance (Based on a Annual Average Dry Tons/Day)



Dry Product going through Single pass from:

Dryer 1	18	11	7	4	0.6
Dryer 2		18	11	7	1.0
Dryer 3			18	11	1.7
Dryer 4				18	2.7
Dryer 5	Out of Service				0.0
Dryer 6	Out of Service				
	18	29	35	41	6
					1.0%

40% 40% 40% 4

Dry Product going through Single pass, Dry Tons/day

6%

73/575

Total Product in circulation, TPD	575
Product going through single pass from a Dryer, TPD	6
% Particles Temperature Measured in 2015 that are <176 F	8%
Probalilty of Dryer Product <176 F	0.08%

Probability of Dryer product leaving the system with Temp >176F = 99.9%

99.92

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w/ Loss % for 2 pass
3 pass
↓
7 pass

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Actual Data for the year 2015 used

Annual Average for Calander Year 2015	Wet Tons/Day	%TS	Dry Tons/day
BFP Sludge Cake Processed in Dryers in 2015 (annual Ave)	826	17.7%	146.5
Base Recycle Dry Product in 2015(annual Ave)	538	93.2%	502

Dryer Feed (Wet Vs Dry) based on Recycle Ratio	Wet Tons/Day	%TS	Dry Tons/day
Sludge Cake Feed per Dryer /Day	103	17.7%	18
Recycle Feed per Dryer /Day	224	93.2%	209

% Dryed **Recycle** in Dryer Feed (2015 Annual Ave) 68.5%

Wet Tons of Recycle Product / (Wet tons of Sludge Cake +Wet Tons of Recycle Product)

Average Number of Dryers in Service 8 (4 Dryers on

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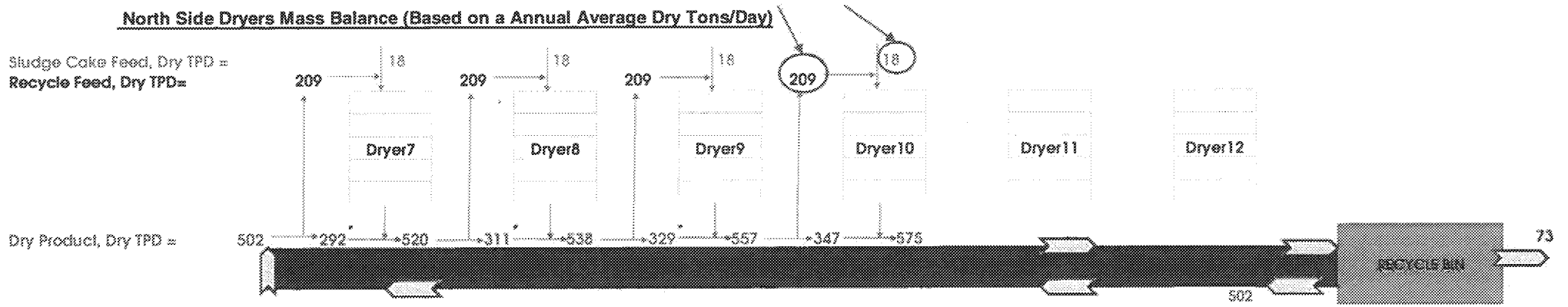
North Side Dryers Mass Balance (Based on a Annual Average Dry Tons/Day)



Dry Product going through Single pass from:					Dry Product going through Single pass, Dry Tons/day
Dryer 1	18	11	7	4	0.6
Dryer 2		18	11	7	1.0
Dryer 3			18	11	1.7
Dryer 4				18	2.7
Dryer 5	Out of Service				0.0
Dryer 6	Out of Service				
	18	29	36	41	6
					1.0%

Total Product in circulation, TPD	575
Product going through single pass from a Dryer, TPD	6
% Particles Temperature Measured in 2015 that are <176 F	0%
Probalility of Dryer Product <176 F	**0.00%**

Probability of Dryer product leaving the system with Temp >176F = 99.9%

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40 CFR Part 503 Biosolids Rule

- Heat Drying - Sewage sludge is dried by direct or indirect contact with hot gases to reduce the moisture content of the sewage sludge to 10 percent or lower. Either the temperature of the sewage sludge particles exceeds 80 degrees Celsius or the wet bulb temperature of the **gas in contact with the sewage sludge as the sewage sludge leaves the dryer** exceeds 80 degrees Celsius.

Feb → measure Air Temp as product leaves

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Air Temperature Monitoring

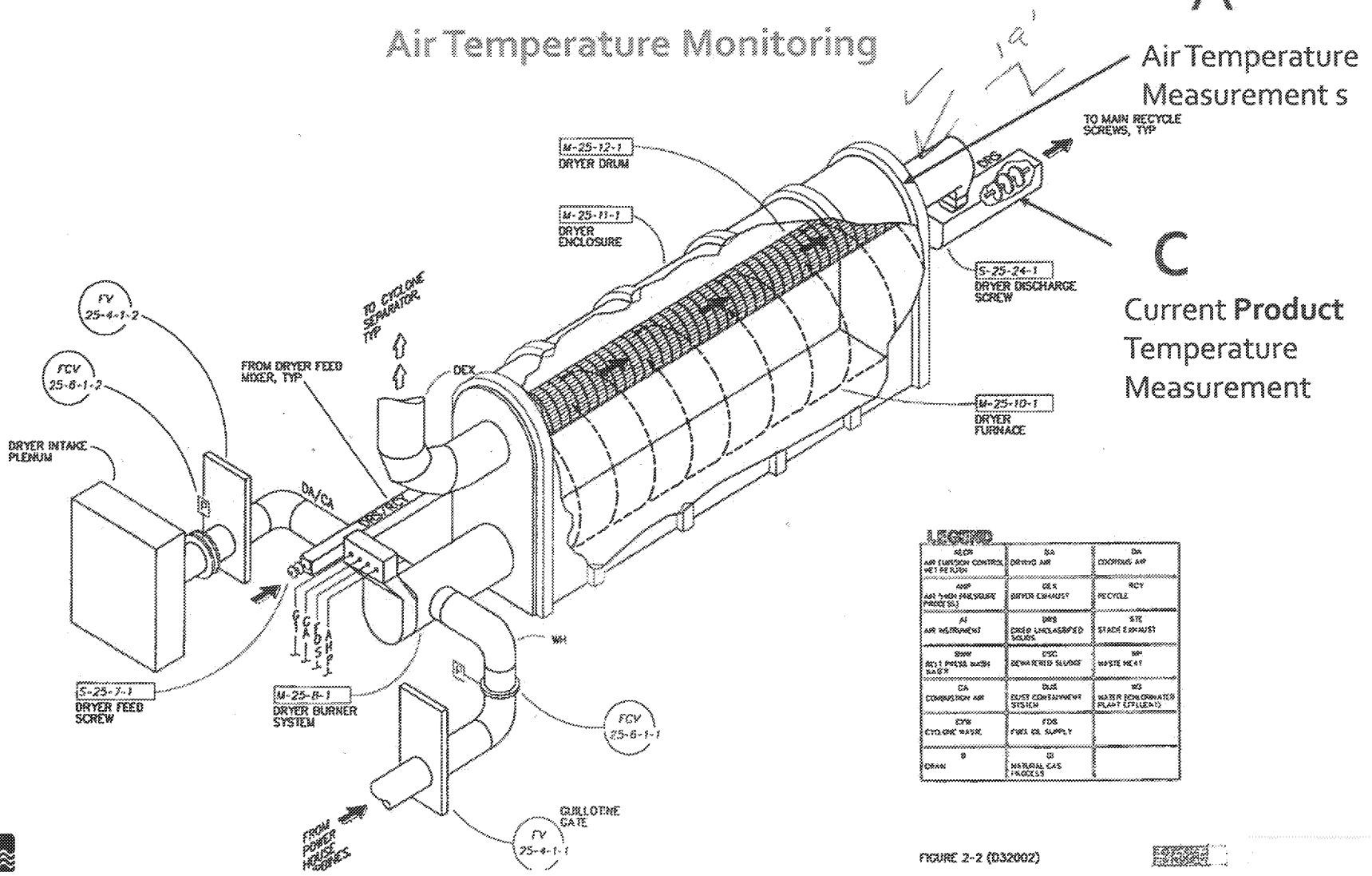

FIGURE 2-2 (D32002)

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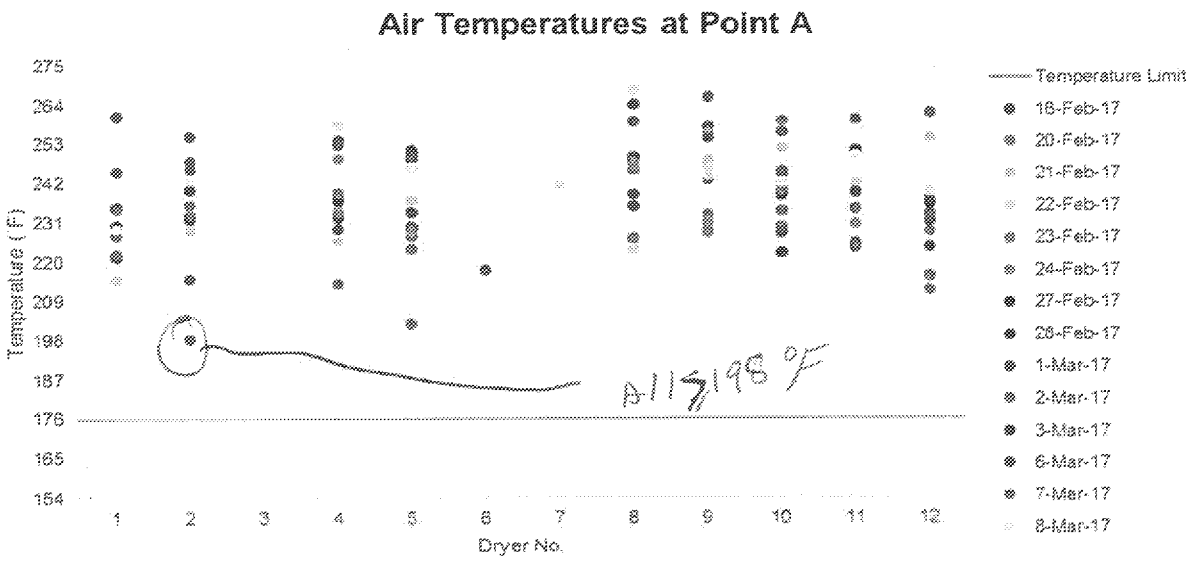
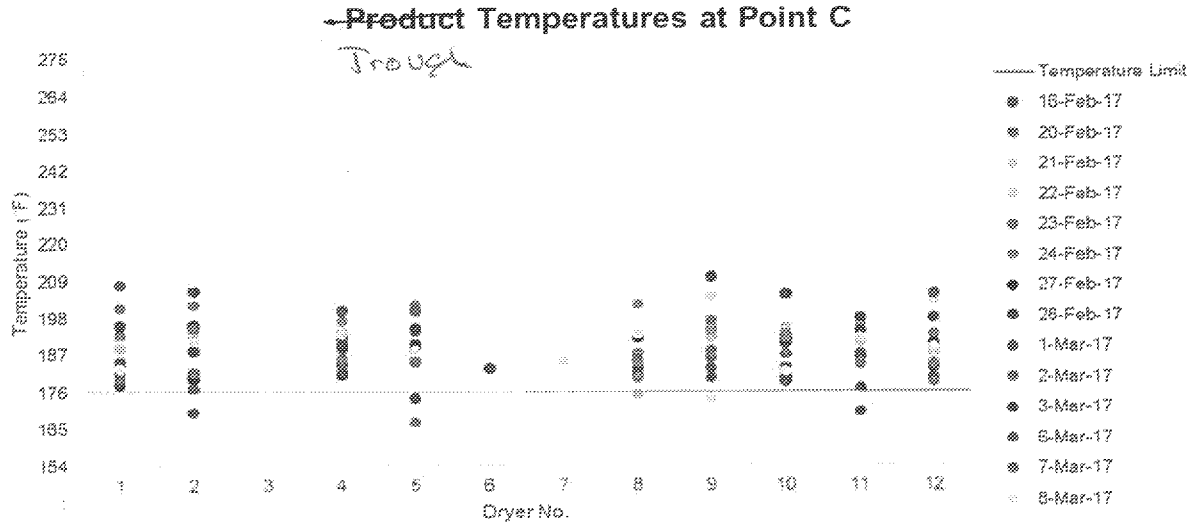
Rel Hum close to 100 %





Air Temperature Monitoring Data

- Manual Air Temperature Monitoring started on February 16, 2017
- Purpose was to support the demonstration of compliance with heat drying standard.
- Location A = air temperature where product leaves the dryer furnace
- Location C= product temperature readings from the discharge screw approx. 19 ft from furnace discharge

☆ Everything based on Trough Temperature

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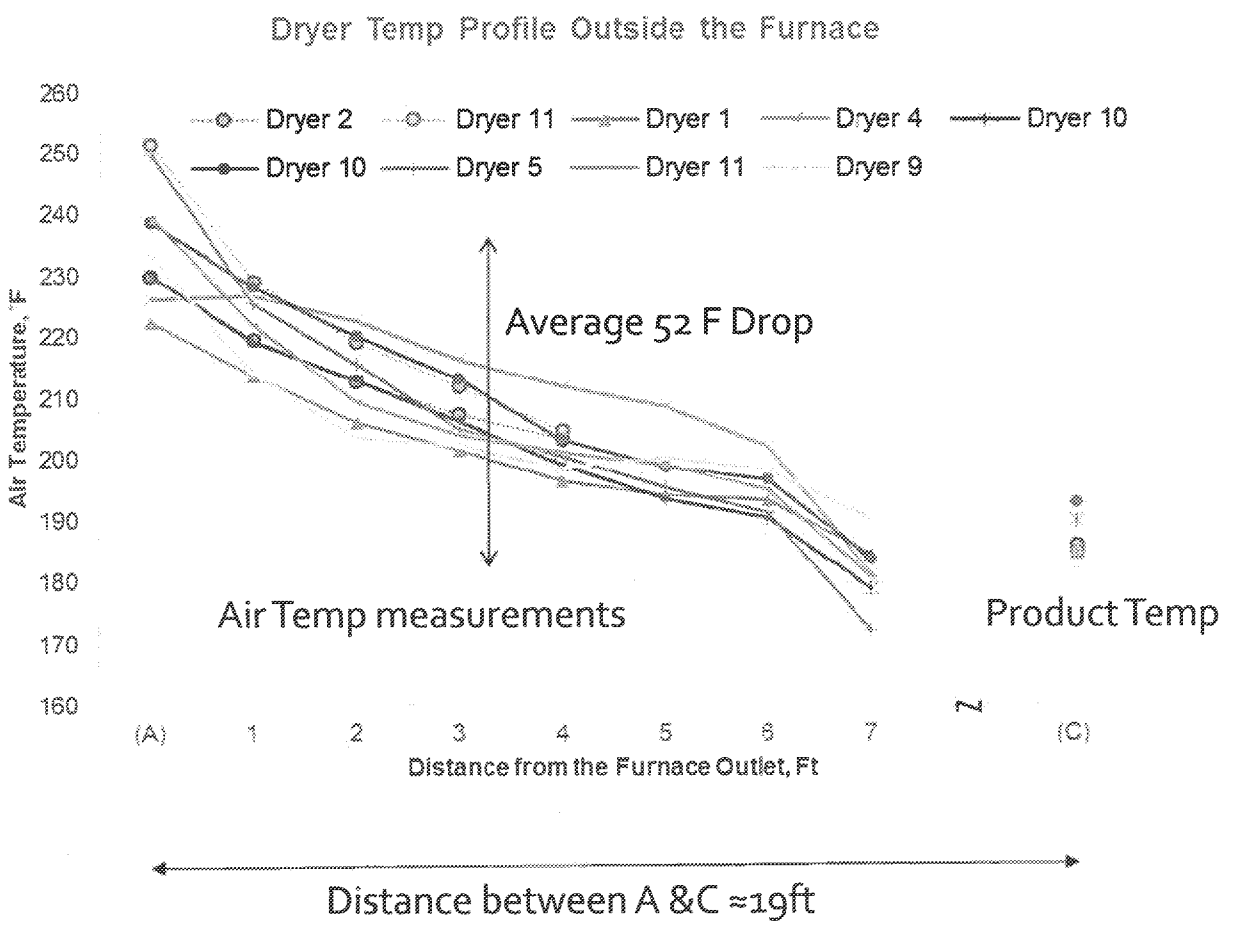

Cooling starts immediately Downstream of the Dryer Furnace

Distance between A &C ≈19ft

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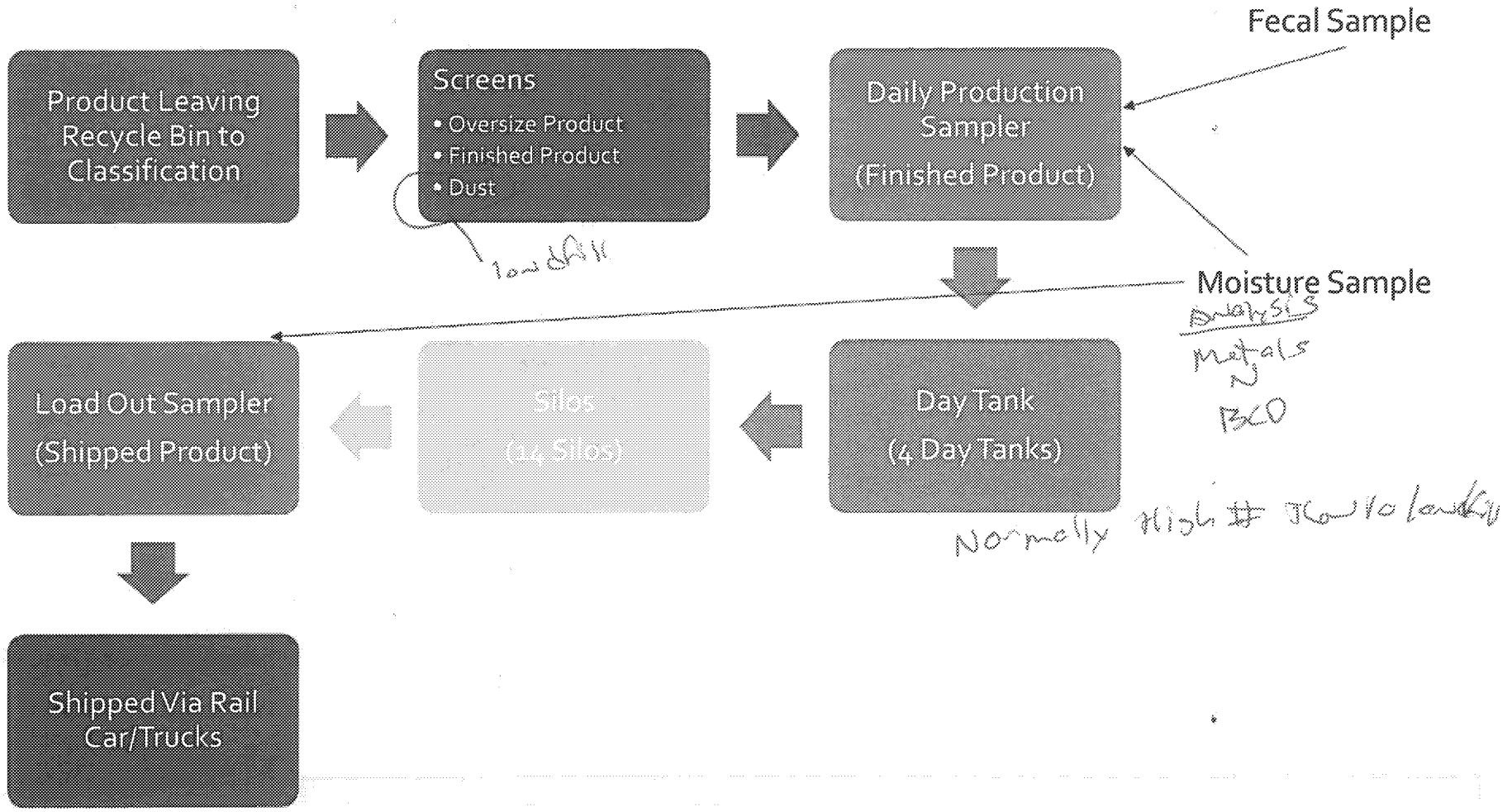
Milorganite Process Control Sampling Locations



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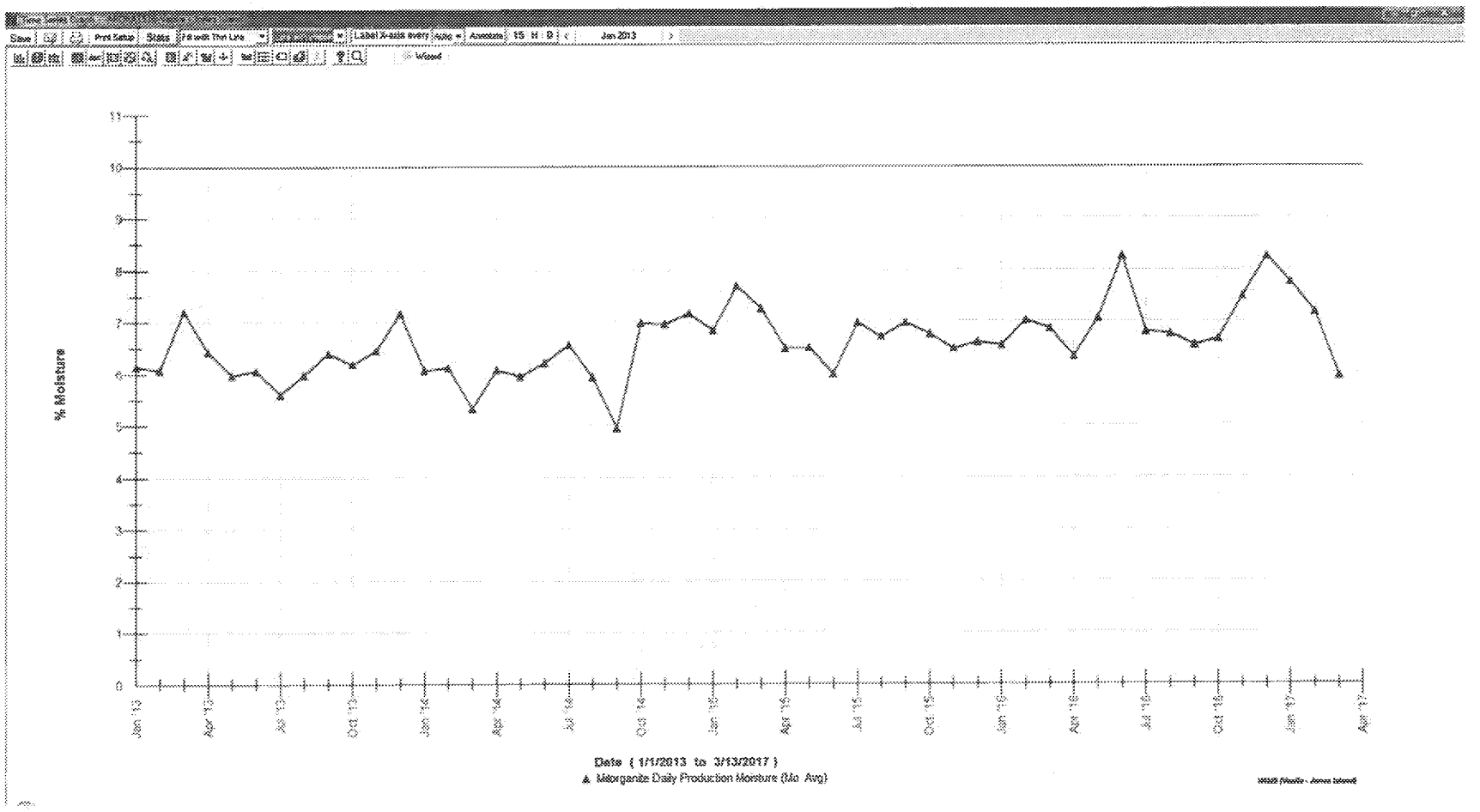
Milorganite Moisture Data (Daily Production) 2013-present



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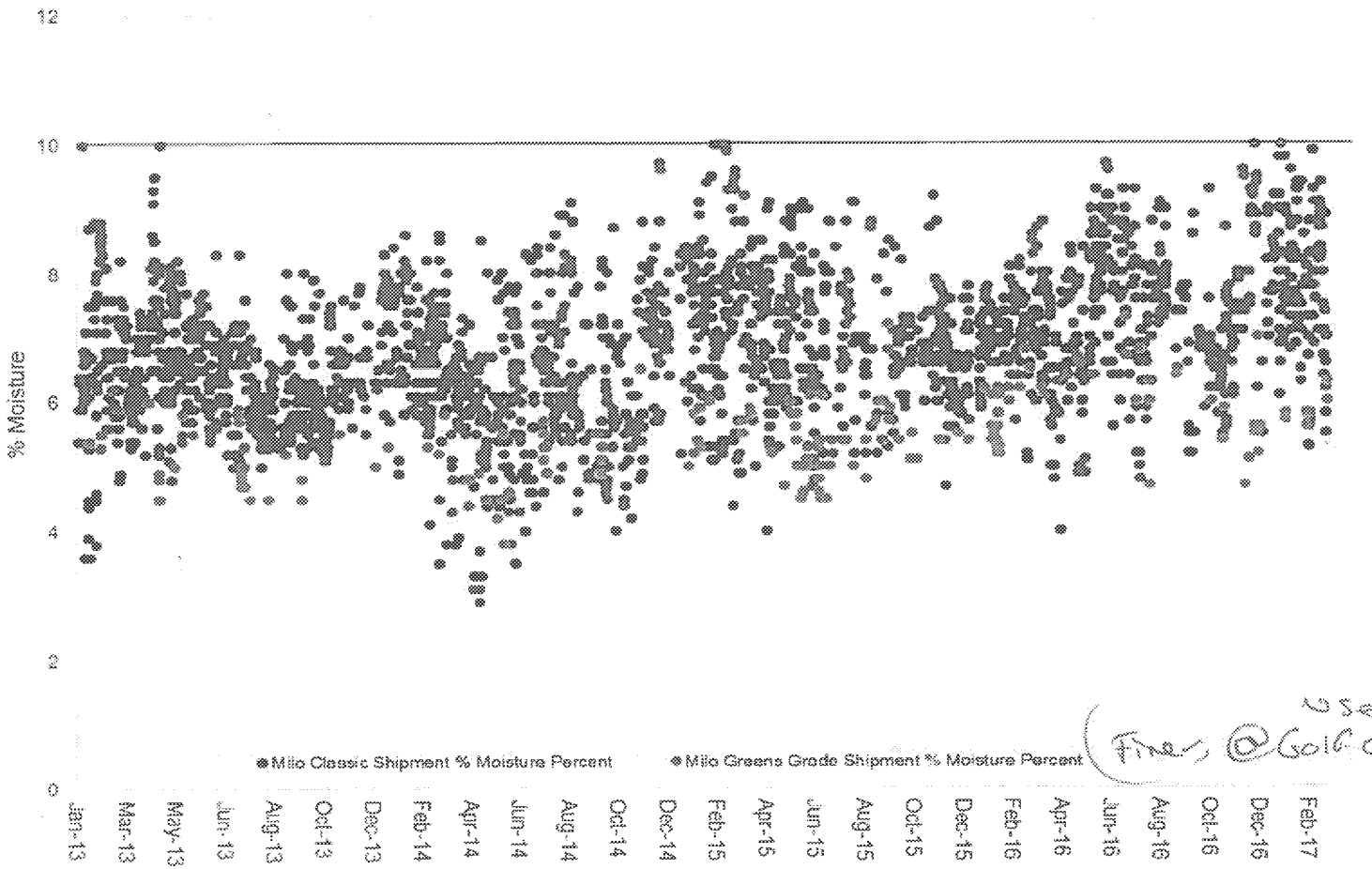
Milorganite Moisture Data (Load Out) 2013-Present



(Fines @ Golf course used) vs

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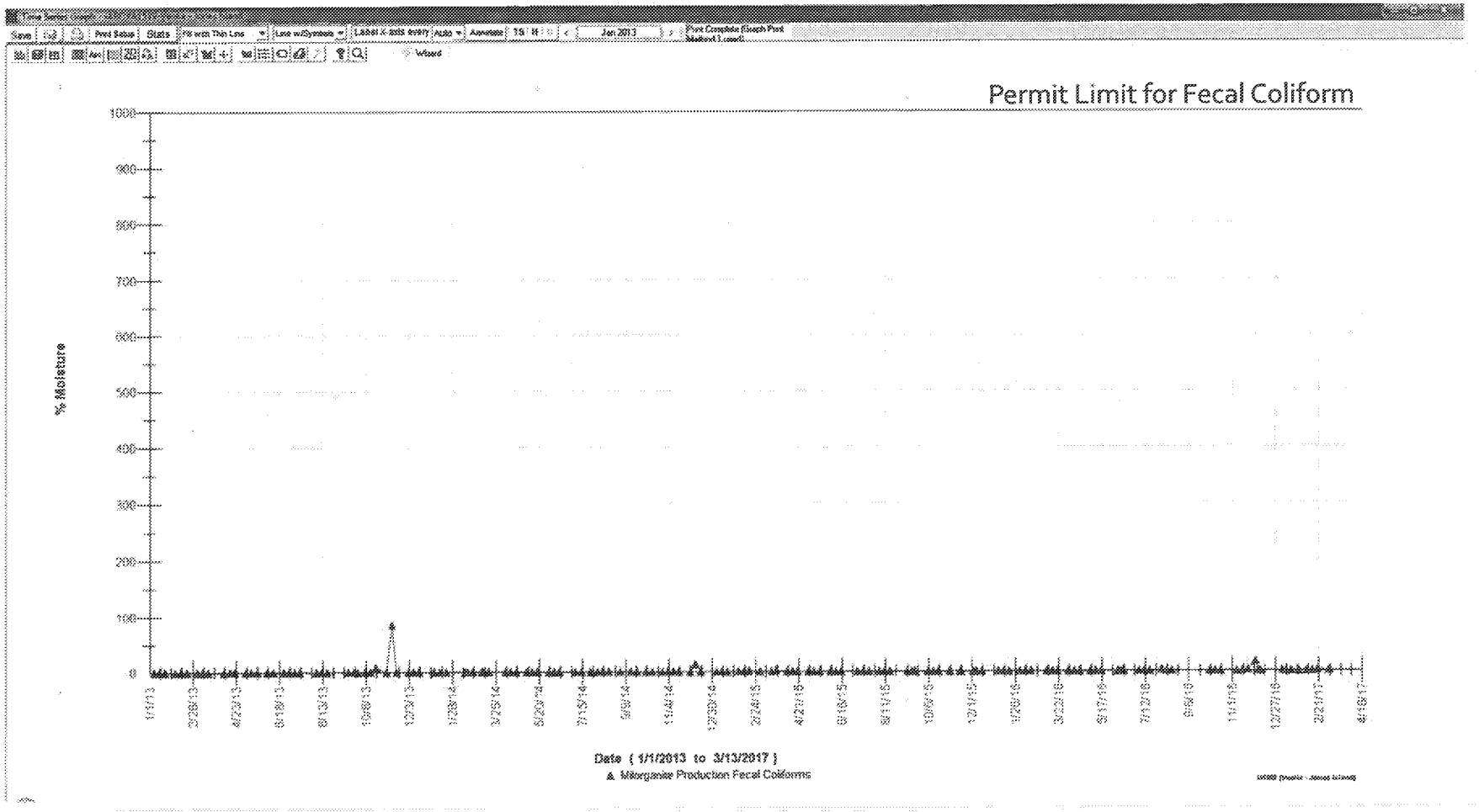
Milorganite Fecal Coliform Data (Daily Production) 2013-present



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Milorganite Fecal Coliform Data (Load Out) Feb 2017

Sample Date	LIMS Number	Fecal Coliforms	Limit of Detection
2/22/2017	17004124	8.67	0.2
2/24/2017	17004234	< 0.20	0.2
3/2/2017	17004632	<0.19	0.19
3/2/2017	17004633	1.38	0.19

Results are expressed as most probable number per gram of total solids, MPN/gTS.

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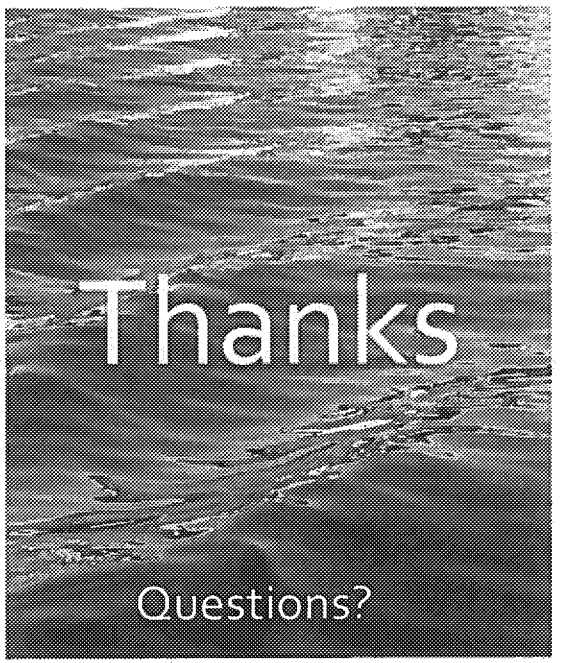
Q&As

- Why does data show some product temps less than 176 F?
  - We are measuring ≈**19 ft**. away from Dryer Furnace outlet, product starts cooling down as soon as product leaves the Dryer Furnace area.
  - Dryer could be operating in Add Back Mode
  - Dryer Discharge Screw has layer of product sticking on the bottom, thereby shielding the real temperatures
  - Dryer Temperature Probe not reading correctly

- Why have we not used existing dryer exhaust temps to show compliance?
  - Air Temps are currently measured 60-80 ft away from the dryer on 7th Floor.

- What do we do if Dryer Product Temperature Measurements show less than 176 F
  - Operator would measure Temperatures manually using a infrared gun and make changes to the dryer operation based on infrared gun temperature measurements.

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