Fine Tuning Your BNR Removal System without the Use of an External Carbon Source

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CDM Smith®

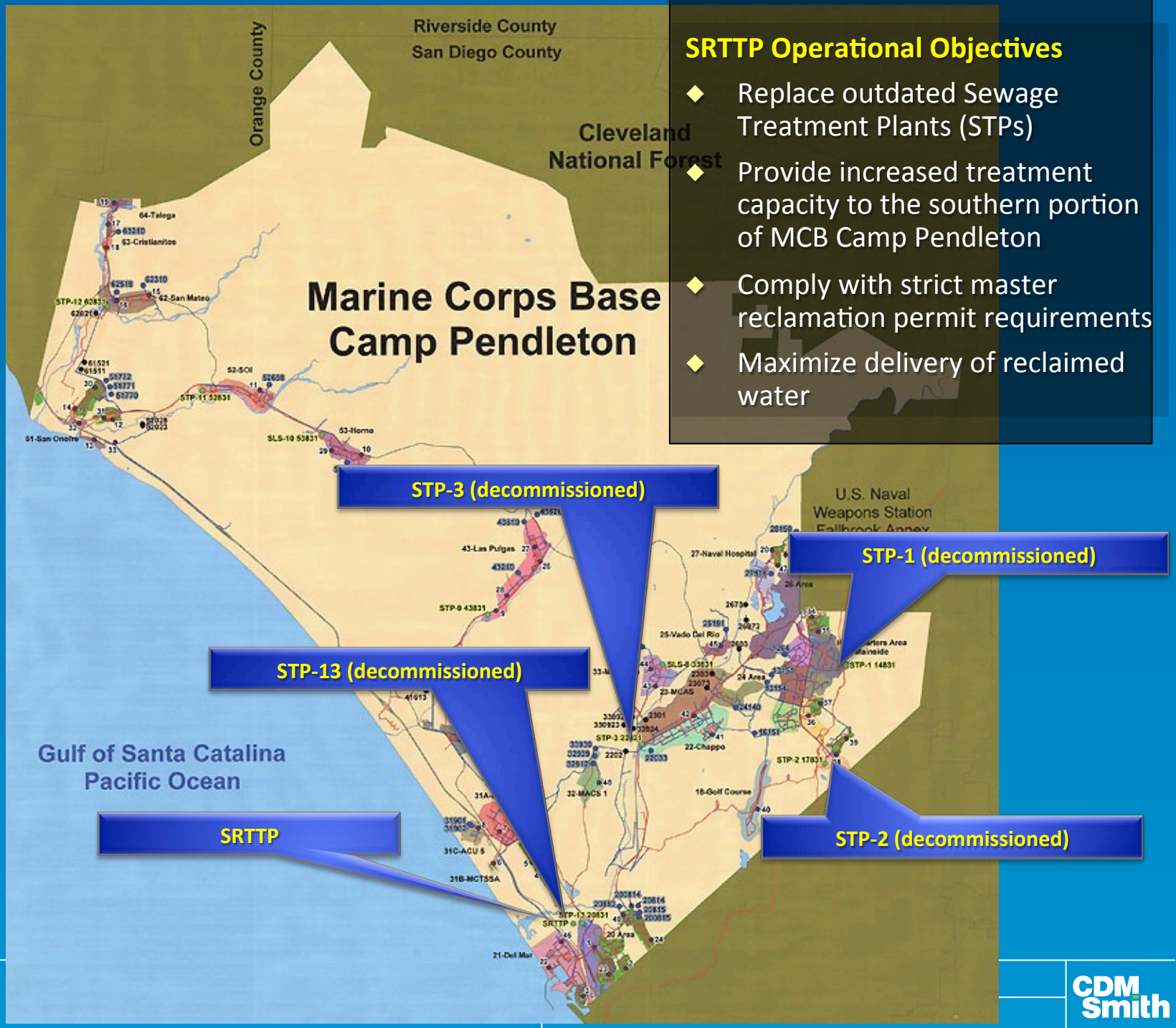
Presentation Overview

- SRTTP Background
- Process Adjustments and Monitoring
- Operational Performance and Results
- Lessons Learned
- Questions

SRTTP BACKGROUND

Southern Regional Tertiary Treatment Plant (SRTTP)

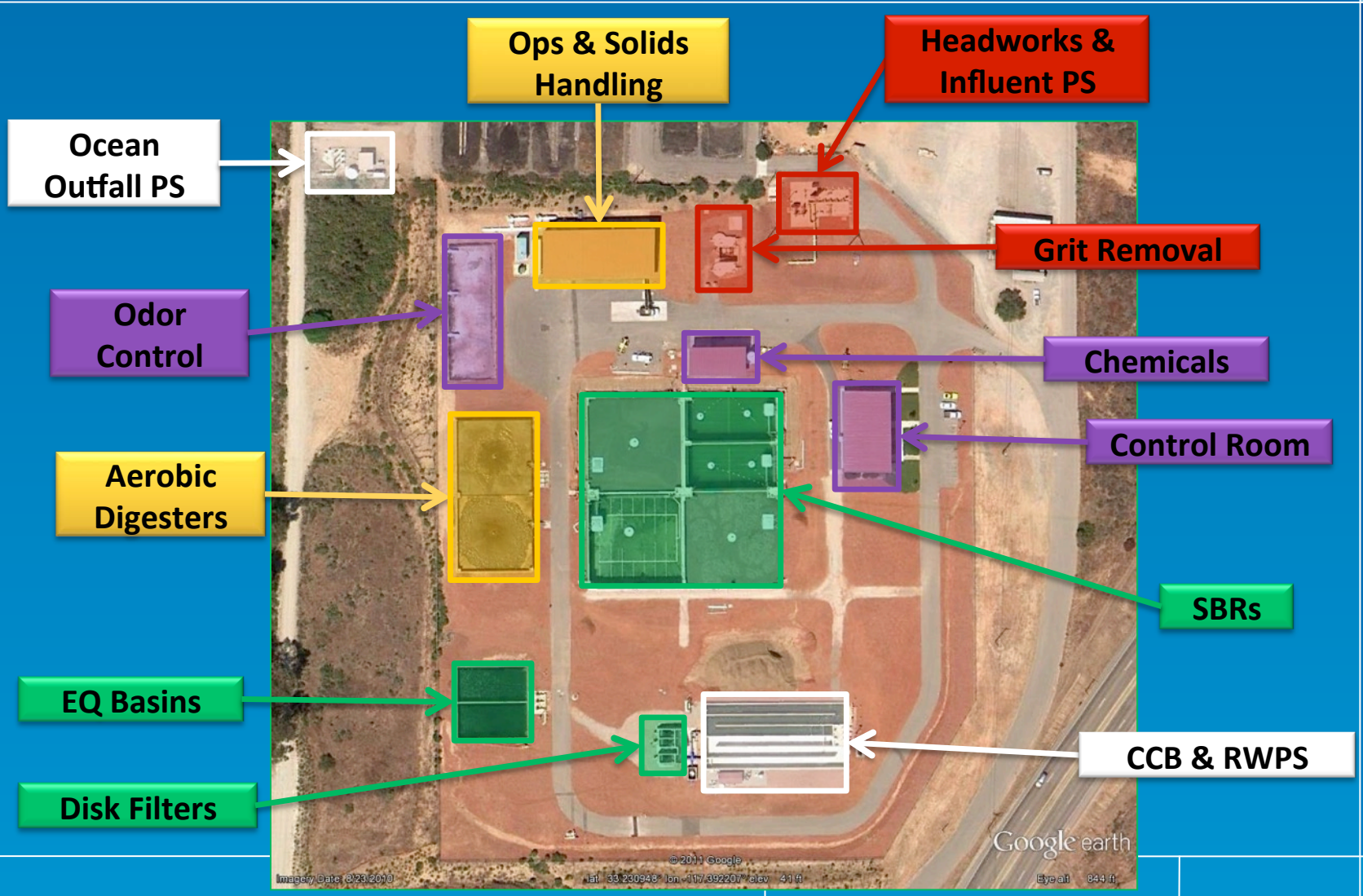
- Sequencing Batch Reactor (SBR) and tertiary filtration treatment facility serving Marine Corps Base Camp Pendleton, CA
- Constructed in 2006
- 5 MGD capacity
- Plant expansion in 2013 increased capacity to 7.5 MGD



SRTTP Operational Objectives

- Replace outdated Sewage Treatment Plants (STPs)
- Provide increased treatment capacity to the southern portion of MCB Camp Pendleton
- Comply with strict master reclamation permit requirements
- Maximize delivery of reclaimed water

SRTTP Site Layout (5 MGD)



SRTTP Operational Challenges

- Deal with varying influent wastewater quality
- Maximize reclaimed water delivery
- Meet stringent reclaim water requirements

Constituent	Reclaimed Water (Max Day)	Ocean Outfall (Avg Mth/Max Day)
BOD_5 (mg/L)	10	30/45
TSS (mg/L)	10	30/45
TN (mg/L)	5	----

SRTTP Operation Challenges Cont'd

- Master Reclamation Permit (MRP) changed reclaimed water quality requirements
- 2004 plant design basis for 5 mg/L average monthly TN
- 2009 Master Reclamation Permit issued as 5 mg/L daily maximum TN limit plus many other WQ limitations (e.g., boron, chloride, manganese, TDS, etc.)
  - TN limit will be lowered to 4.1 mg/L daily max in 2014

Excerpt from Master Reclamation Permit (MRP)

5. The recycled water discharged from SRTTP to the Irrigation Areas shall not contain TDS in excess of 1,200 mg/L as a 12-month average[2] or 1,300 mg/L as a daily maximum. From March 12, 2014 on, recycled water discharged from SRTTP to the Front Gate/Recreation Fields shall not contain TDS in excess of 800 mg/L as a daily maximum.

6. The recycled water discharged from SRTTP to the Irrigation Areas shall not contain total nitrogen (as N) in excess of 5.0 mg/L as a daily maximum. From March 12, 2014 on, recycled water discharged from SRTTP to the Front Gate/Recreation Fields shall not contain total nitrogen (as N) in excess of 4.1 mg/L as a daily maximum.

SRTTP Operational Challenges Cont'd

- Impact of 5 mg/L TN instantaneous maximum
  - Reduced reclamation potential
    - Continuous online monitoring shuts down RWPS if ammonia + nitrate > 3 mg-N/L
  - Increased total nitrogen removal
    - Requires longer anoxic cycle for increased denitrification
      - Aerobic cycle time is reduced, oxygen demand increases, blower flow increases
    - Potential for filamentous growth increases
      - Additional basin put in service, operational costs increase (electricity, maintenance, chemicals, lab testing)
    - Reduced operational flexibility

SBR Design Criteria and Current Operations

Parameter	2004 Design Criteria	Current Operations	2011 Design Criteria
Average influent flow (MGD)	5	2.1	7.5
Operating SBR basins	4	3	6
Total Cycle Time (min)	288	288	288
Aerated time per cycle (min)	124 (43%)	70 (24%)	88 (31%)
Anoxic time per cycle (min)	65 (23%)	103 (35%)	104 (36%)
Cycles per day per basin	5	5	5
MLSS @ AWL (mg/L)	4,700	2,400	4,700

PROCESS ADJUSTMENTS & MONITORING

Process Control Adjustment

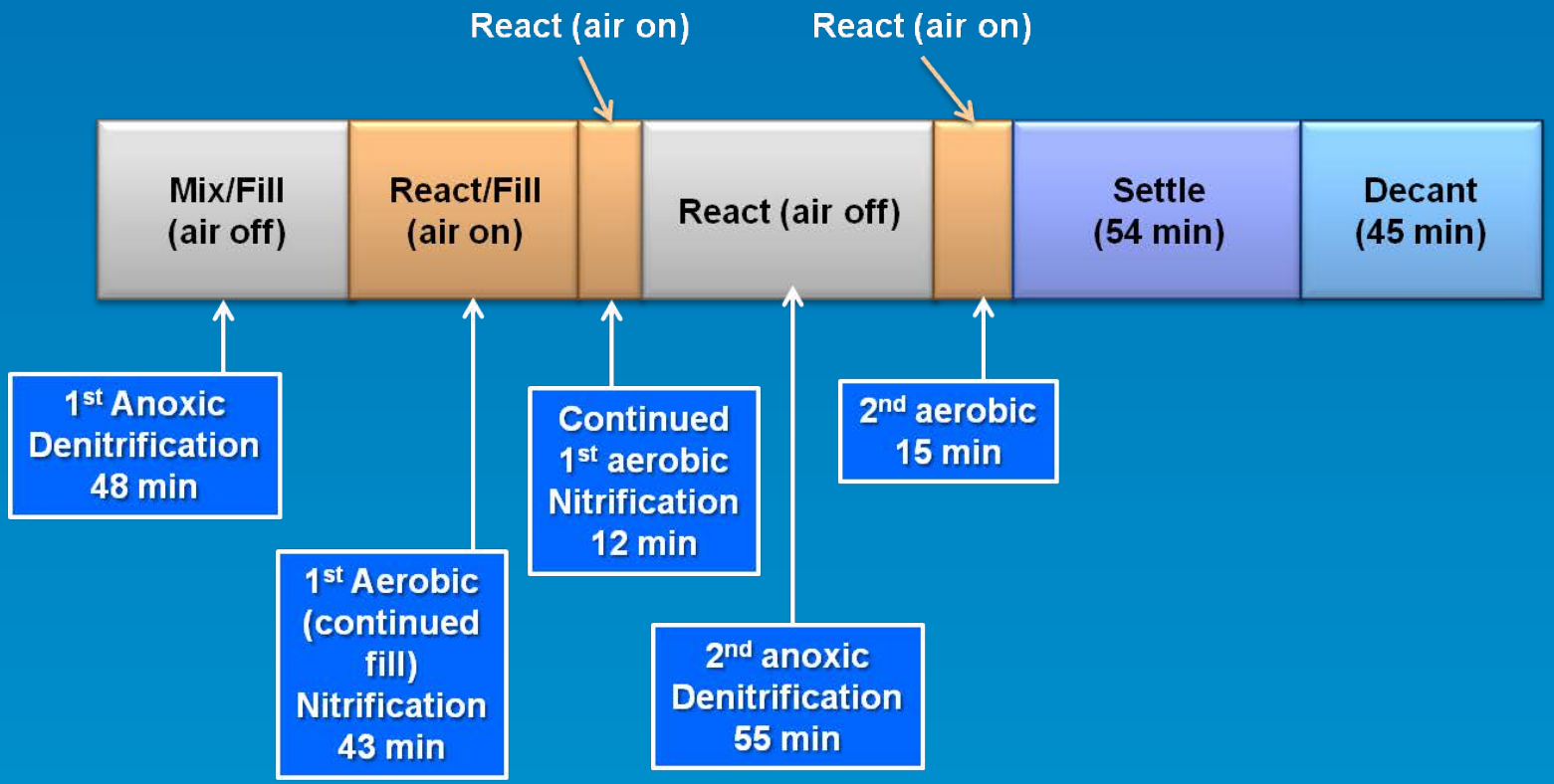
- Analyze operational and laboratory data weekly (sent to process control team prior to weekly phone in meeting)
- Conduct weekly process control meetings with key CDM Smith staff
  - Plant Manager
  - Senior Operator
  - Project Manager
  - Process Control Engineers
  - Key Process Control Operators

Process Monitoring

- Detailed process monitoring and operational adjustments made to meet the new, more stringent, TN limit of 5 mg/L max day
- Online instrumentation and control
  - DO monitoring in SBRs to fine-tune aeration control
  - Ammonia and nitrate monitors in SBRs
  - Ammonia and nitrate monitors on disk filter effluent
    - Set point of 3 mg/L ammonia + nitrate for reclaiming
    - Otherwise, effluent to ocean discharge

SBR Cycle Adjustments

- 272 minutes per cycle (5 cycles per day)
- No supplemental carbon



Nitrification: ammonia → nitrate (needs air)
Denitrification: nitrate → nitrogen gas (no air)

TN = NH3 + NO3/NO2+ Organic Nitrogen
TKN = NH3 + Organic Nitrogen

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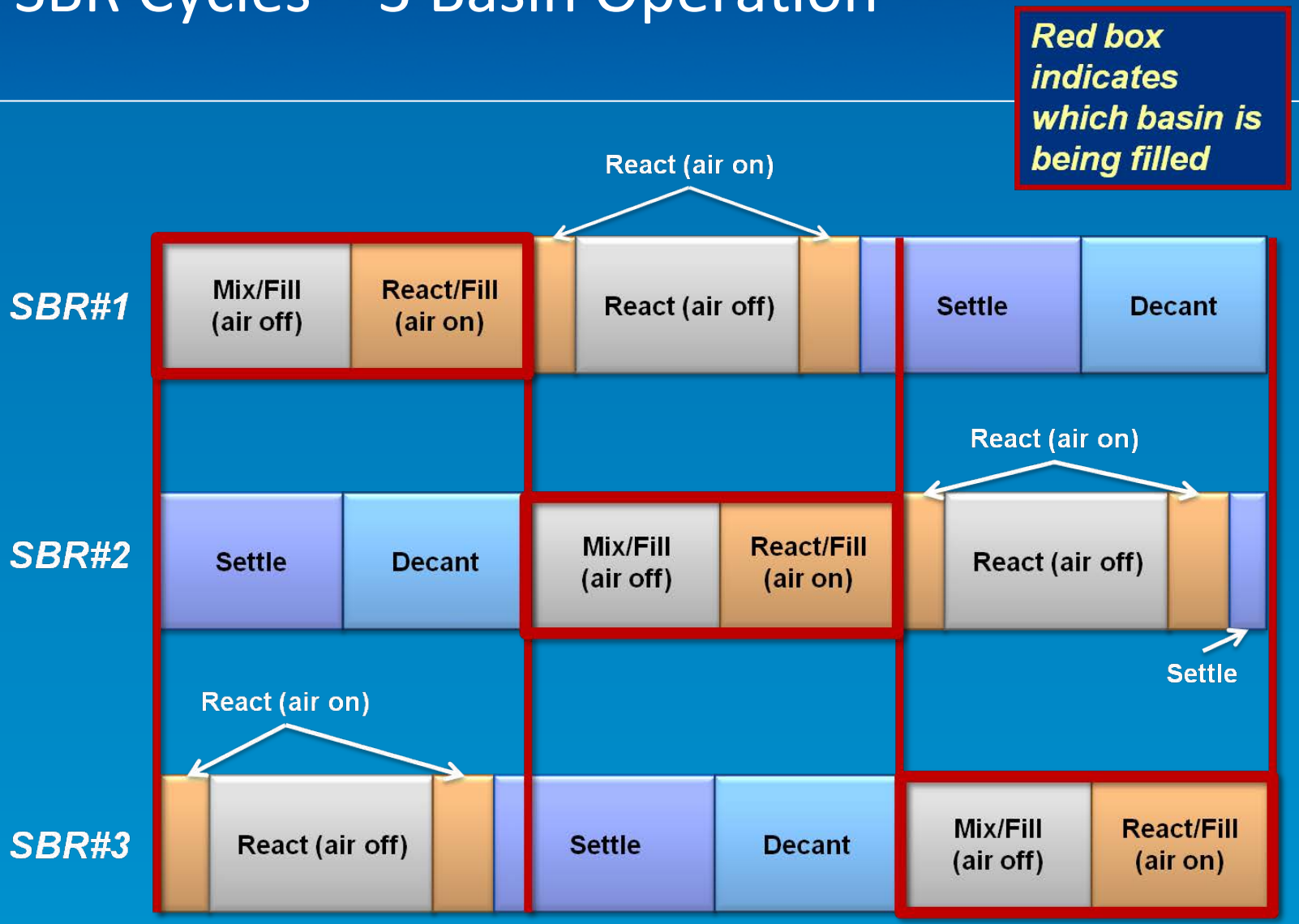
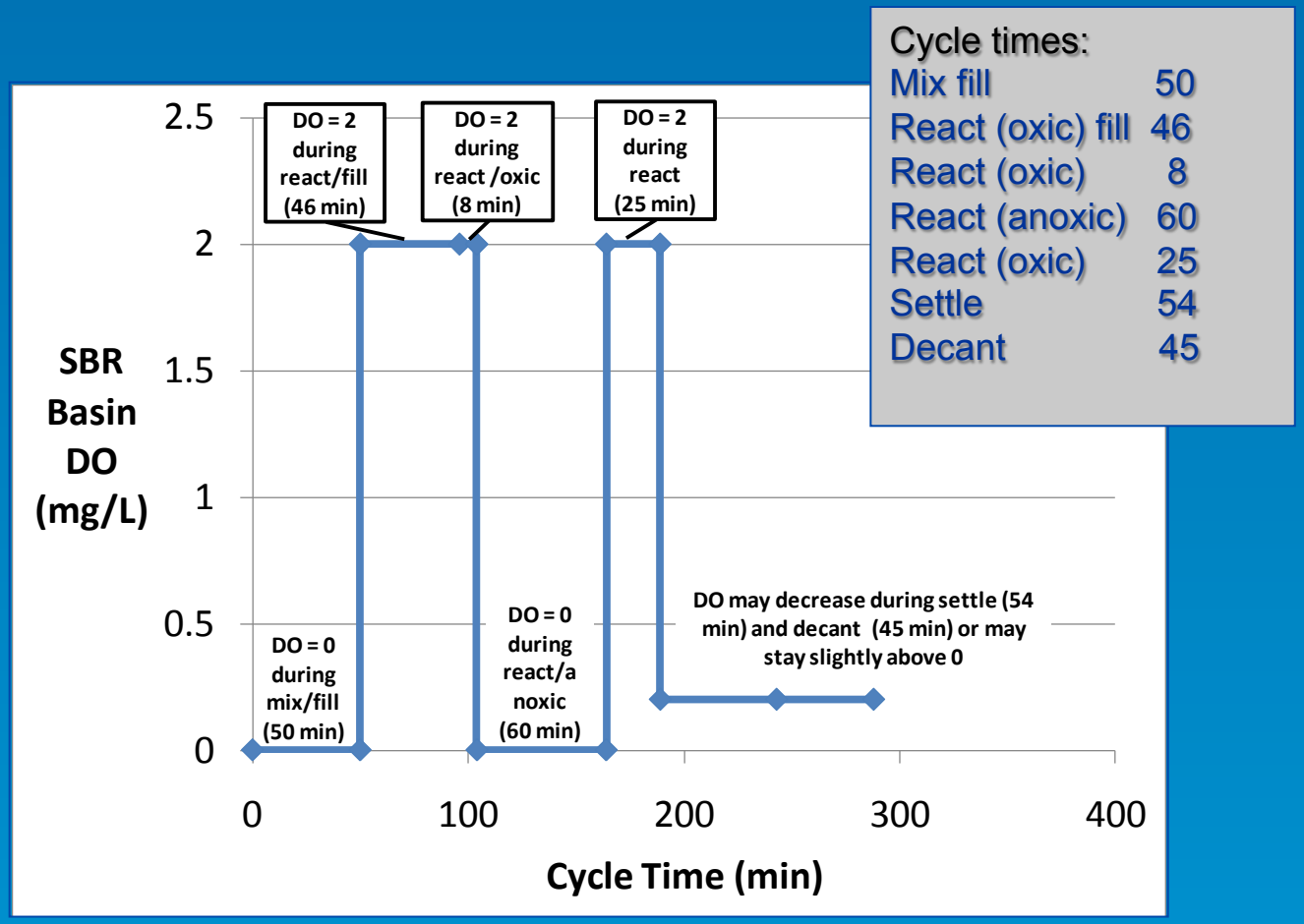
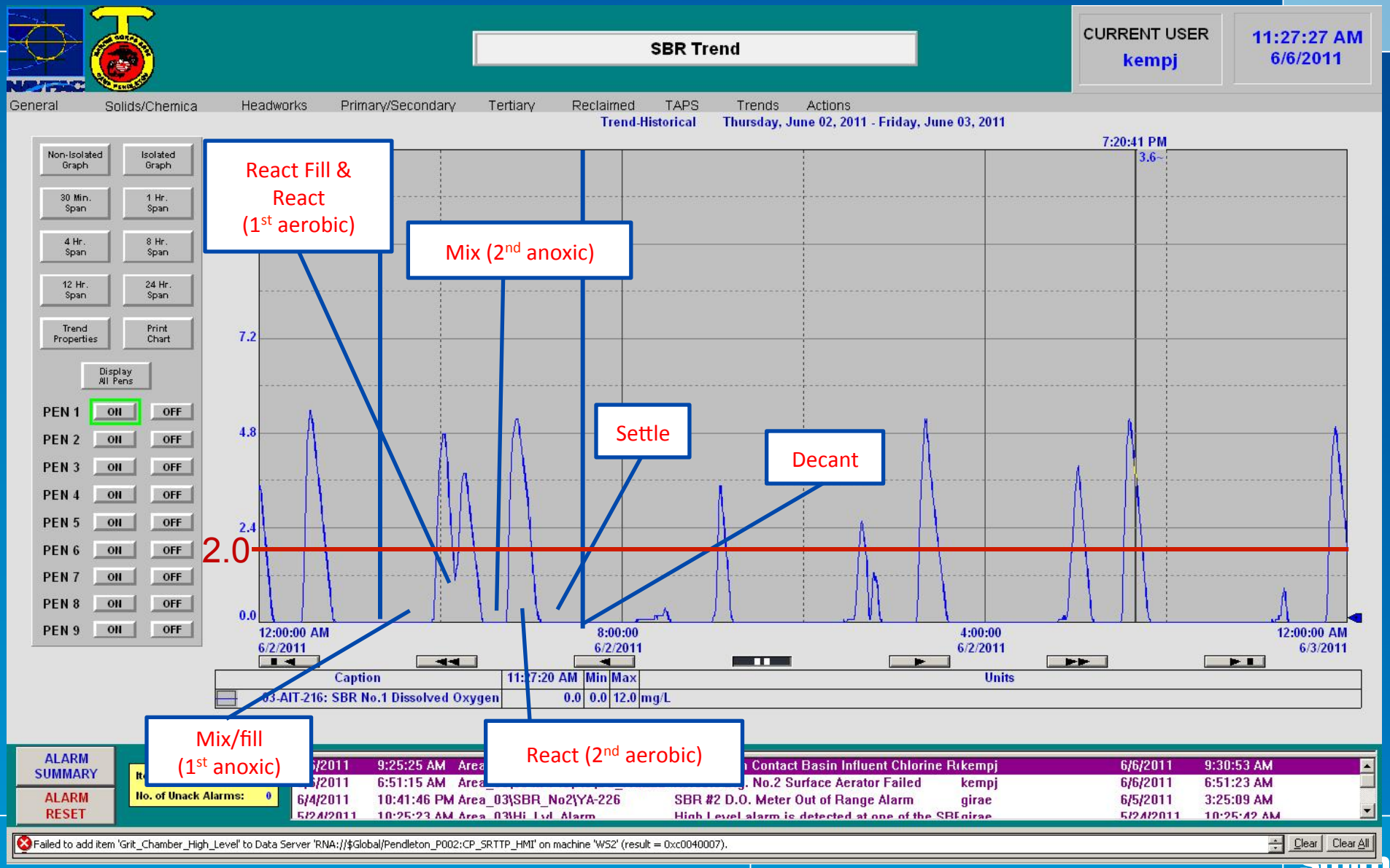
SBR Cycles – 3 Basin Operation



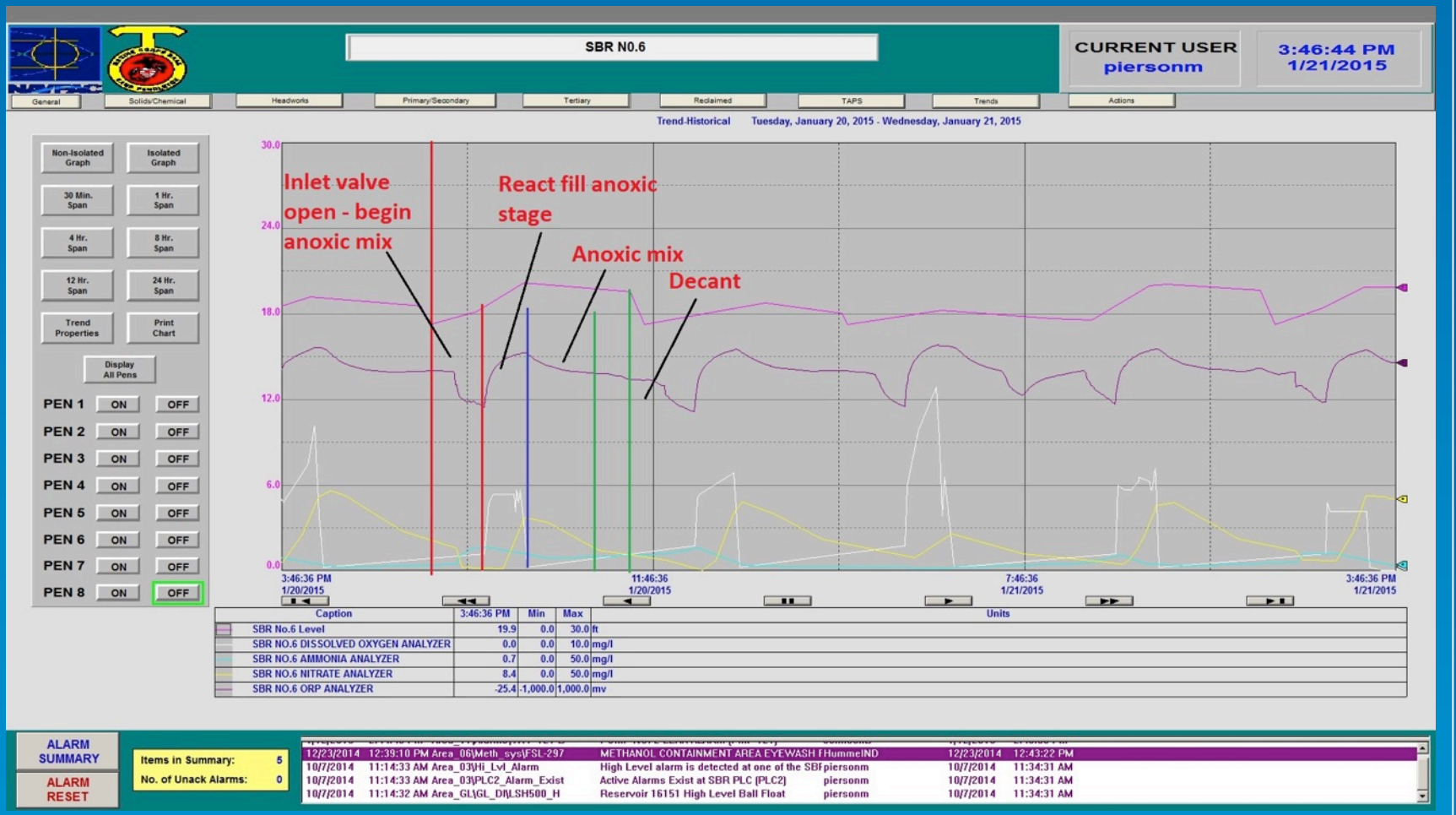
Optimal DO Profile



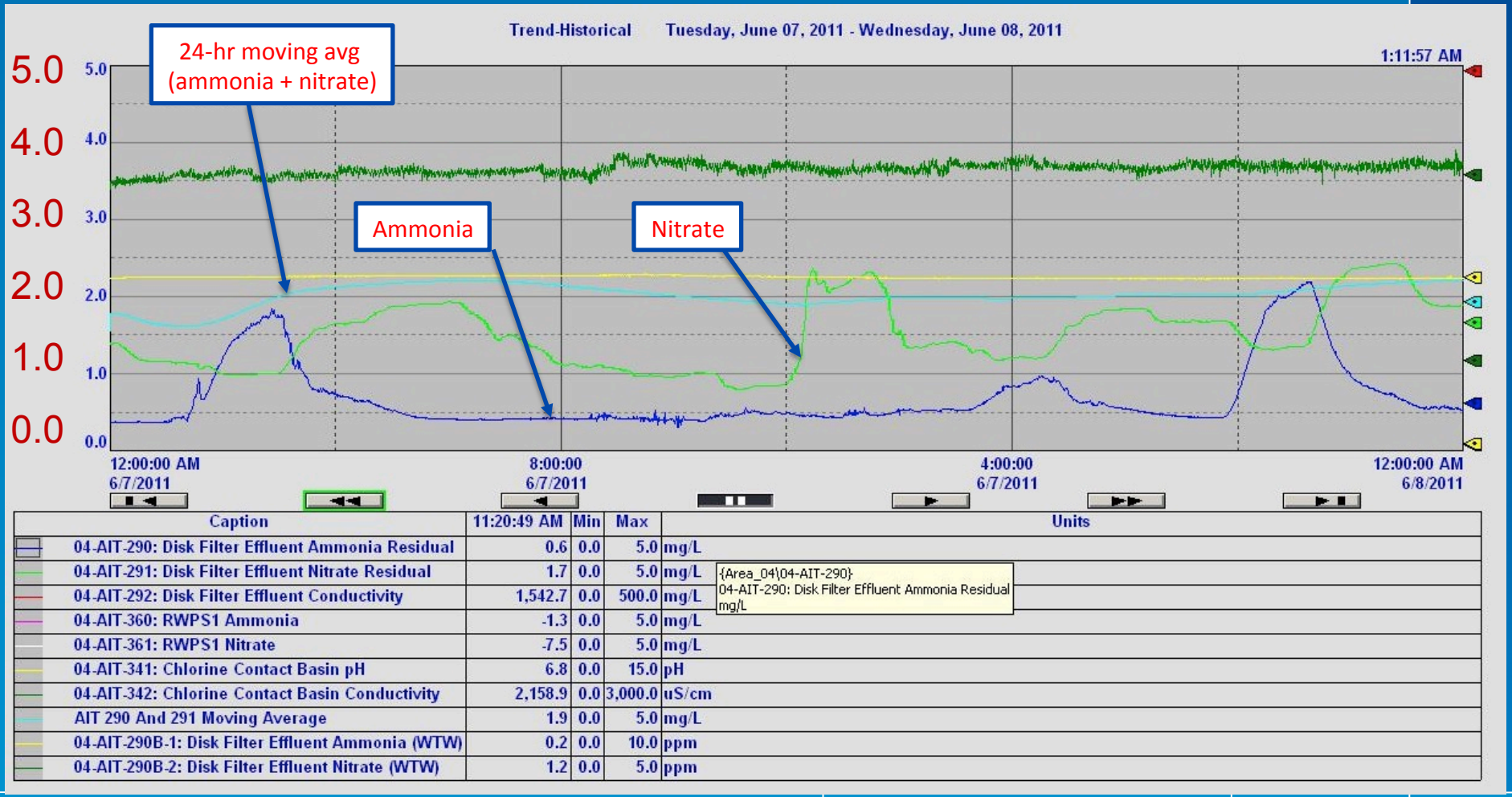
Actual SBR DO Profile – May 2, 2011



SBR Trend 1/21/15



Filter Effluent Ammonia & Nitrate – June 7, 2011

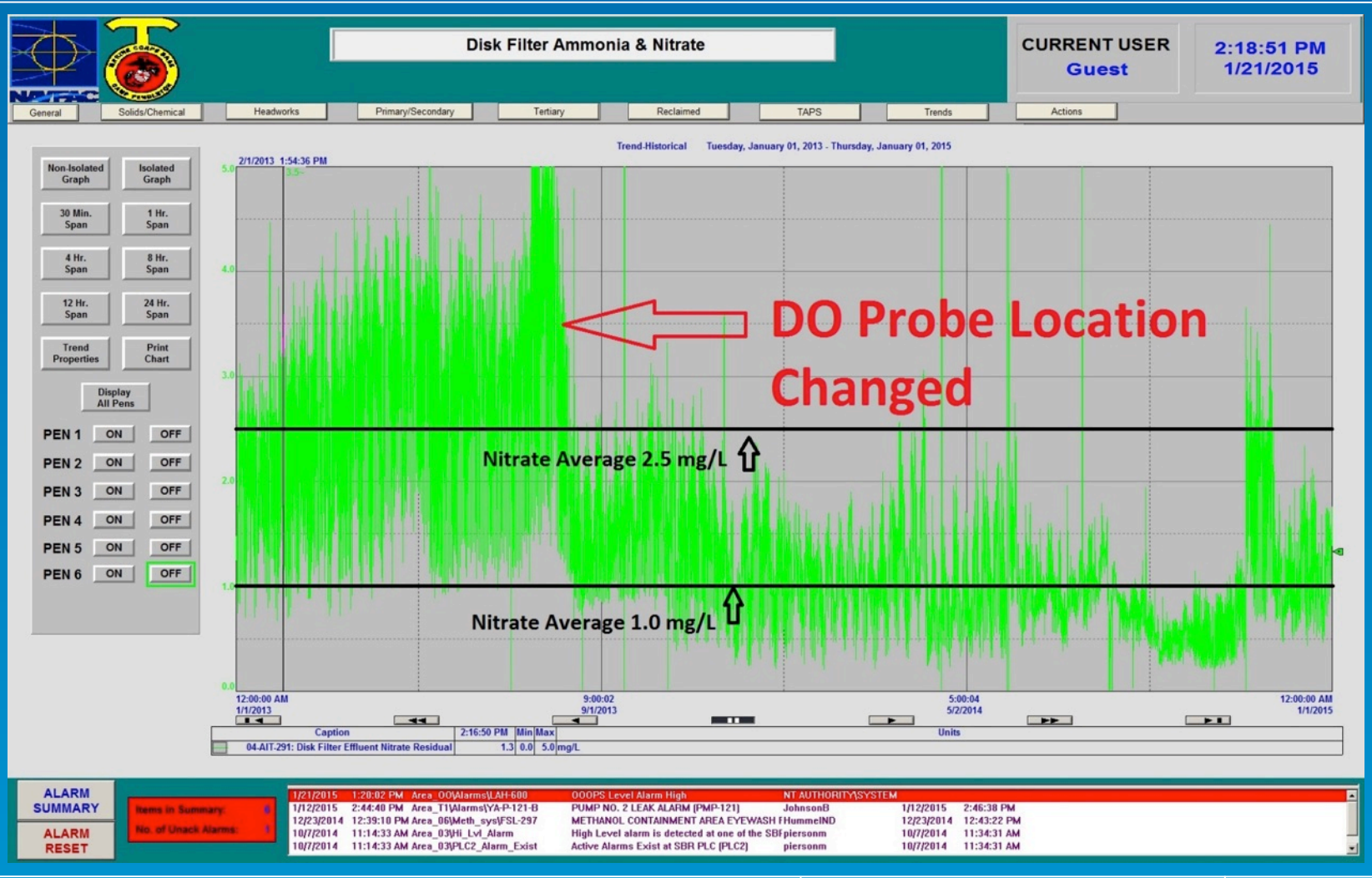


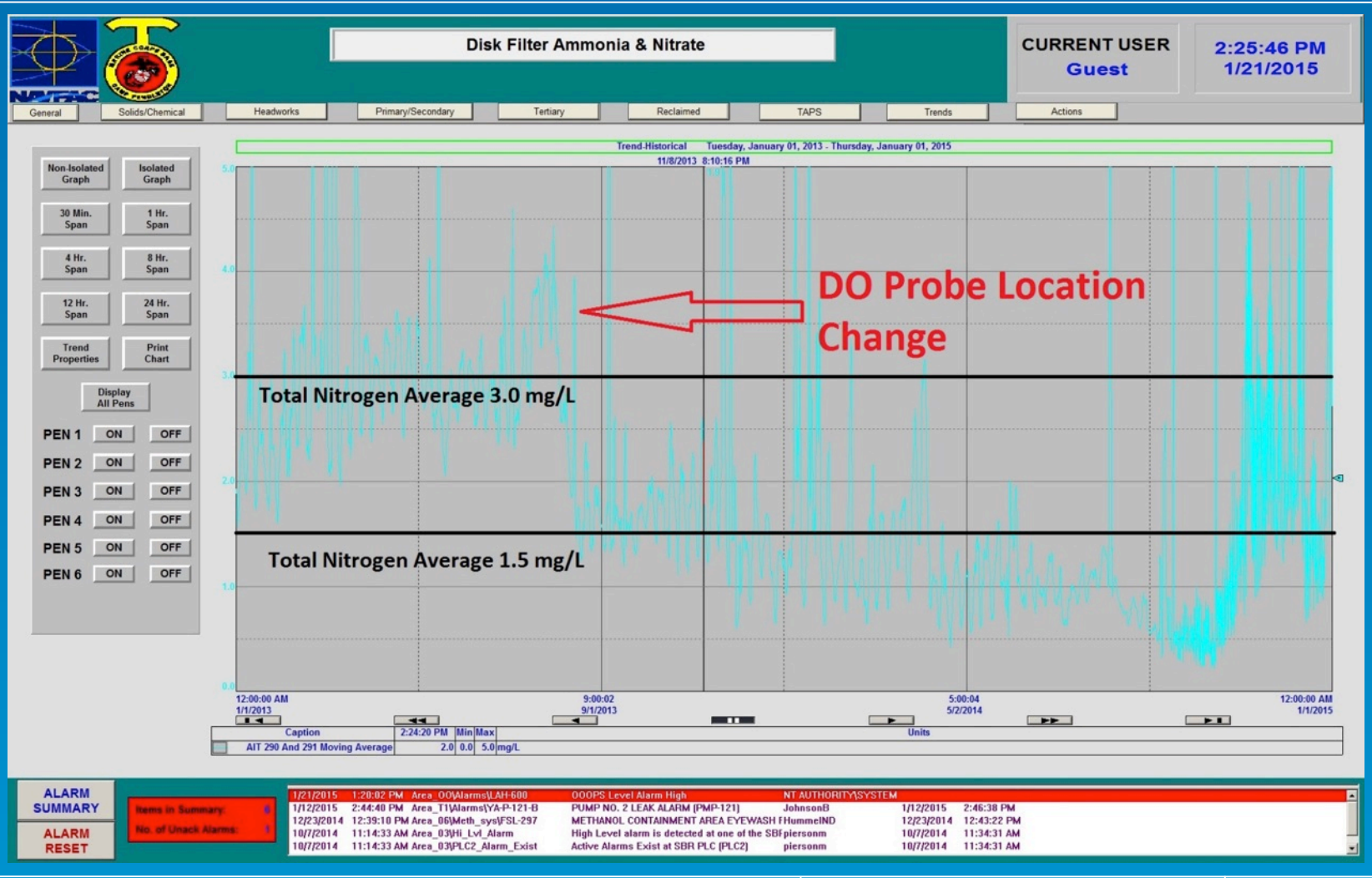
Caption	11:20:49 AM	Min	Max	Units
04-AIT-290: Disk Filter Effluent Ammonia Residual	0.6	0.0	5.0	mg/L
04-AIT-291: Disk Filter Effluent Nitrate Residual	1.7	0.0	5.0	mg/L
04-AIT-292: Disk Filter Effluent Conductivity	1,542.7	0.0	500.0	mg/L
04-AIT-360: RWPS1 Ammonia	-1.3	0.0	5.0	mg/L
04-AIT-361: RWPS1 Nitrate	-7.5	0.0	5.0	mg/L
04-AIT-341: Chlorine Contact Basin pH	6.8	0.0	15.0	pH
04-AIT-342: Chlorine Contact Basin Conductivity	2,158.9	0.0	3,000.0	uS/cm
AIT 290 And 291 Moving Average	1.9	0.0	5.0	mg/L
04-AIT-290B-1: Disk Filter Effluent Ammonia (WTW)	0.2	0.0	10.0	ppm
04-AIT-290B-2: Disk Filter Effluent Nitrate (WTW)	1.2	0.0	5.0	ppm

{Area_04\04-AIT-290}
04-AIT-290: Disk Filter Effluent Ammonia Residual
mg/L

Process optimization

- Operators noted “dead” zones in SBR during aeration stage.
  - Possible poor DO readings
- DO profile of the basin
  - DO probe relocated to a more optimum location
- This lead to the reduction of air and carry over of DO during denitrification stage
  - Overall reduction of nitrates by 1.5 mg/L


Disk Filter Ammonia & Nitrate
CURRENT USER
Guest
2:18:51 PM
1/21/2015
General
Solids/Chemical
Headworks
Primary/Secondary
Tertiary
Reclaimed
TAPS
Trends
Actions
Trend-Historical
Tuesday, January 01, 2013 - Thursday, January 01, 2015
2/1/2013 1:54:36 PM
Non-Isolated Graph
Isolated Graph
30 Min. Span
1 Hr. Span
4 Hr. Span
8 Hr. Span
12 Hr. Span
24 Hr. Span
Trend Properties
Print Chart
Display All Pens
PEN 1 ON OFF
PEN 2 ON OFF
PEN 3 ON OFF
PEN 4 ON OFF
PEN 5 ON OFF
PEN 6 ON OFF
DO Probe Location Changed
Nitrate Average 2.5 mg/L
Nitrate Average 1.0 mg/L
12:00:00 AM 1/1/2013
9:00:02 9/1/2013
5:00:04 5/2/2014
12:00:00 AM 1/1/2015
Caption
2:16:50 PM
Min
Max
Units
04-AIT-291: Disk Filter Effluent Nitrate Residual
1.3
0.0
5.0
mg/L
ALARM SUMMARY
ALARM RESET
Items in Summary: 8
No. of Unack Alarms: 1
1/21/2015 1:20:02 PM Area_OO\Alarms\LAH-600 OOOPS Level Alarm High NT AUTHORITY\SYSTEM
1/12/2015 2:44:48 PM Area_T1\Alarms\YA-P-121-B PUMP NO. 2 LEAK ALARM (PMP-121) JohnsonB 1/12/2015 2:46:38 PM
12/23/2014 12:39:10 PM Area_06\Meth_sys\FSL-297 METHANOL CONTAINMENT AREA EYEWASH H HummelND 12/23/2014 12:43:22 PM
10/7/2014 11:14:33 AM Area_03\Hi_Lvl_Alarm High Level alarm is detected at one of the SBI piersonm 10/7/2014 11:34:31 AM
10/7/2014 11:14:33 AM Area_03\PLC2_Alarm_Exist Active Alarms Exist at SBR PLC (PLC2) piersonm 10/7/2014 11:34:31 AM

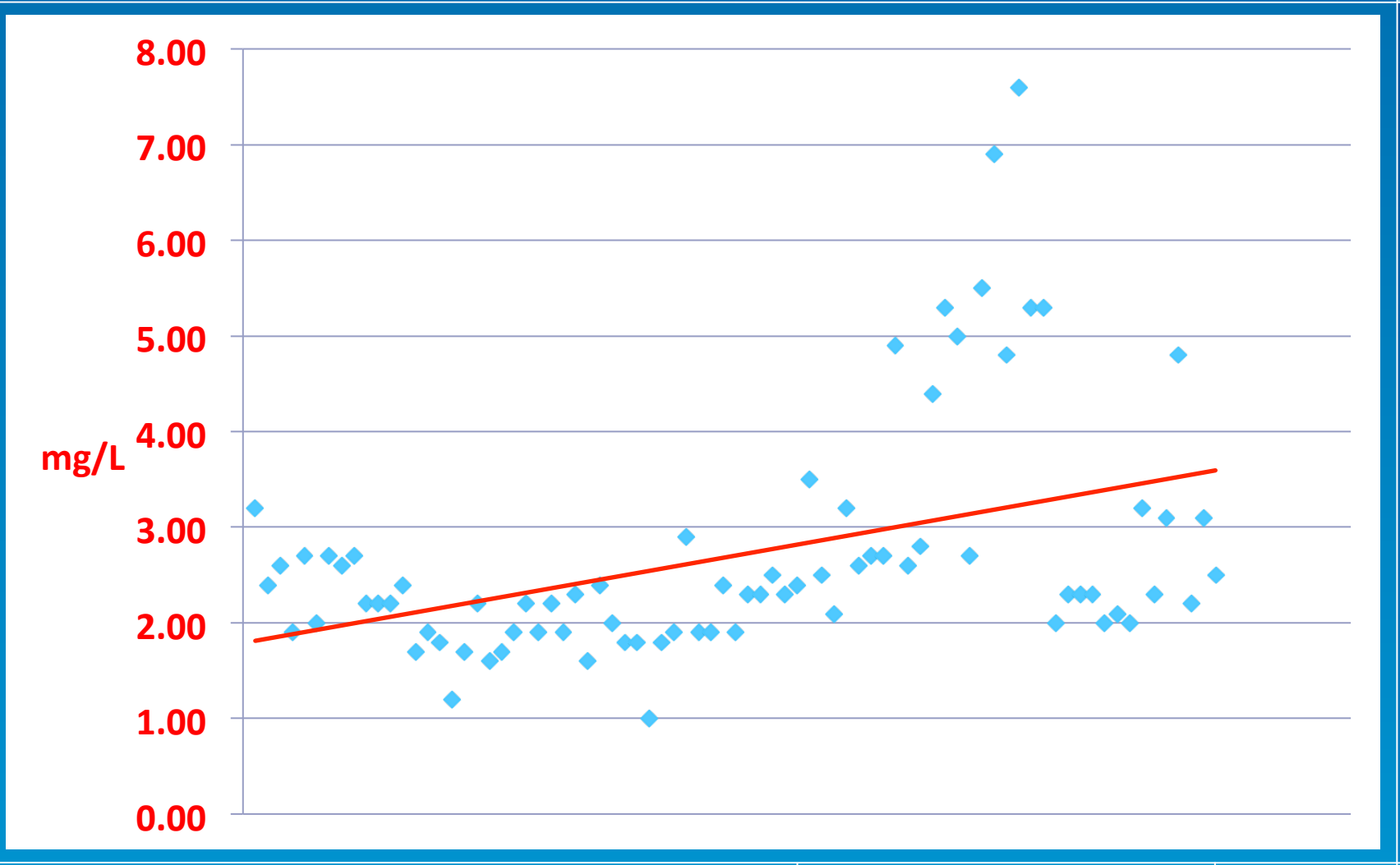

Disk Filter Ammonia & Nitrate
CURRENT USER
Guest
2:25:46 PM
1/21/2015
General
Solids/Chemical
Headworks
Primary/Secondary
Tertiary
Reclaimed
TAPS
Trends
Actions
Non-Isolated Graph
Isolated Graph
30 Min. Span
1 Hr. Span
4 Hr. Span
8 Hr. Span
12 Hr. Span
24 Hr. Span
Trend Properties
Print Chart
Display All Pens
PEN 1 ON OFF
PEN 2 ON OFF
PEN 3 ON OFF
PEN 4 ON OFF
PEN 5 ON OFF
PEN 6 ON OFF
Trend-Historical Tuesday, January 01, 2013 - Thursday, January 01, 2015
11/8/2013 8:10:16 PM
DO Probe Location Change
Total Nitrogen Average 3.0 mg/L
Total Nitrogen Average 1.5 mg/L
12:00:00 AM 1/1/2013
9:00:02 9/1/2013
5:00:04 5/2/2014
12:00:00 AM 1/1/2015
Caption
2:24:20 PM
Min
Max
Units
AIT 290 And 291 Moving Average
2.0
0.0
5.0
mg/L
ALARM SUMMARY
ALARM RESET
Items in Summary: 6
No. of Unack Alarms: 1
1/21/2015 1:20:02 PM Area_OO\Alarms\LAH-600 OOOPS Level Alarm High NT AUTHORITY\SYSTEM
1/12/2015 2:44:48 PM Area_T1\Alarms\YA-P-121-B PUMP NO. 2 LEAK ALARM (PMP-121) JohnsonB 1/12/2015 2:46:38 PM
12/23/2014 12:39:10 PM Area_06\Meth_sys\FSL-297 METHANOL CONTAINMENT AREA EYEWASH H HummelND 12/23/2014 12:43:22 PM
10/7/2014 11:14:33 AM Area_03\Hi_Lvl_Alarm High Level alarm is detected at one of the SBI piersonm 10/7/2014 11:34:31 AM
10/7/2014 11:14:33 AM Area_03\PLC2_Alarm_Exist Active Alarms Exist at SBR PLC (PLC2) piersonm 10/7/2014 11:34:31 AM

OPERATIONAL PERFORMANCE & RESULTS

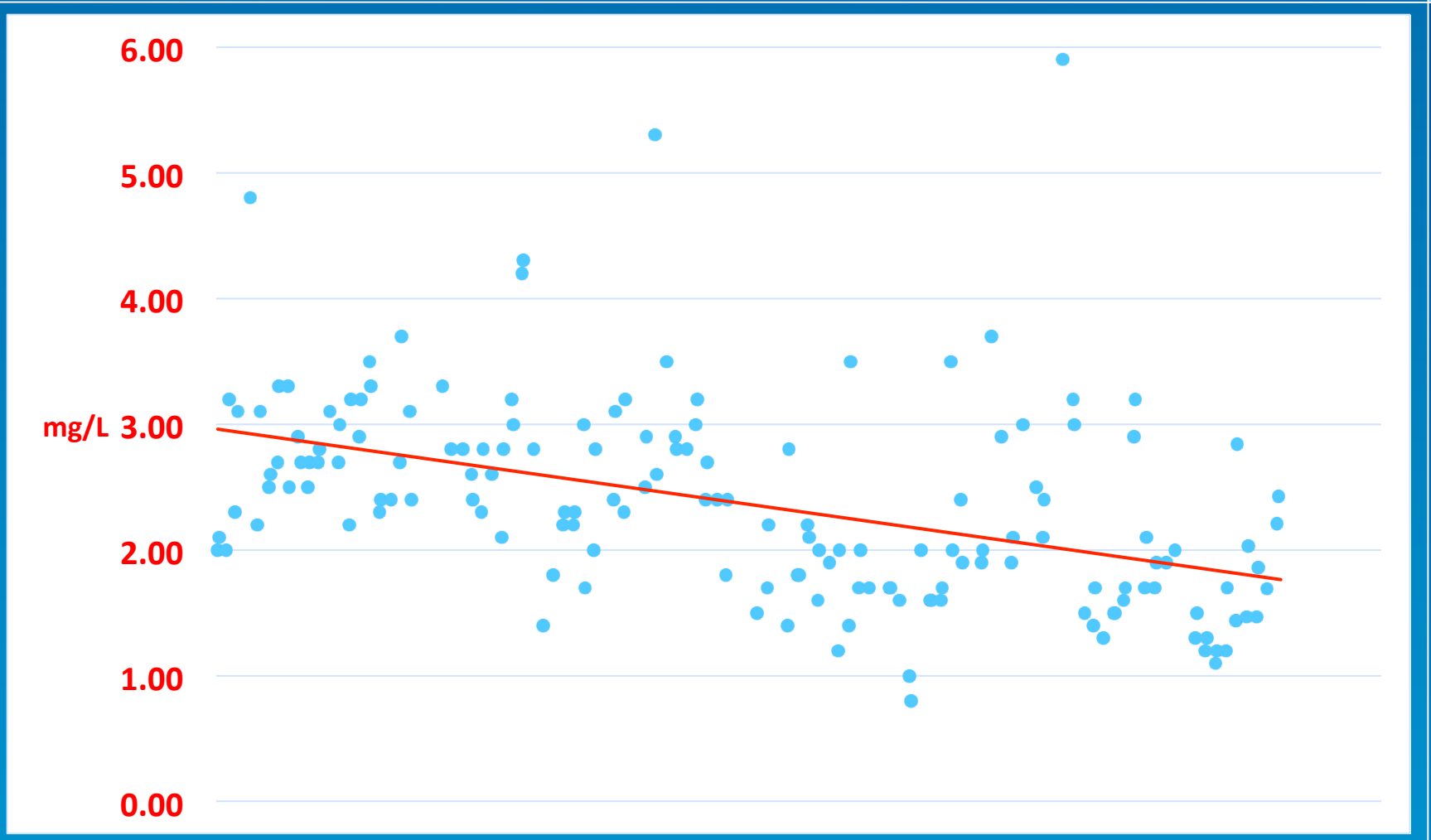
2014 Average SBR Operating Conditions

- Influent flow
  - Design flow = 5 MGD (average), 15 MGD (peak)
  - Current flow = 2.1 MGD
- Influent Concentrations
  - BOD = 202 mg/L, TSS = 189 mg/L
  - TKN = 53 mg/L, NH_3 = 37 mg/L, NO_3 = 0.1 mg/L
- Reclaimed Concentrations
  - BOD = 3 mg/L, TSS = 3 mg/L
  - TN = 1.5 mg/L, TKN = 0.5 mg/L, NH_3 = 0.05 mg/L, NO_3 = 1.0 mg/L
- Aerobic SRT = 10 days (all SBR's)
- MLSS = 2000 mg/L (all SBR's)
- SVI = 156 (all SBR's)

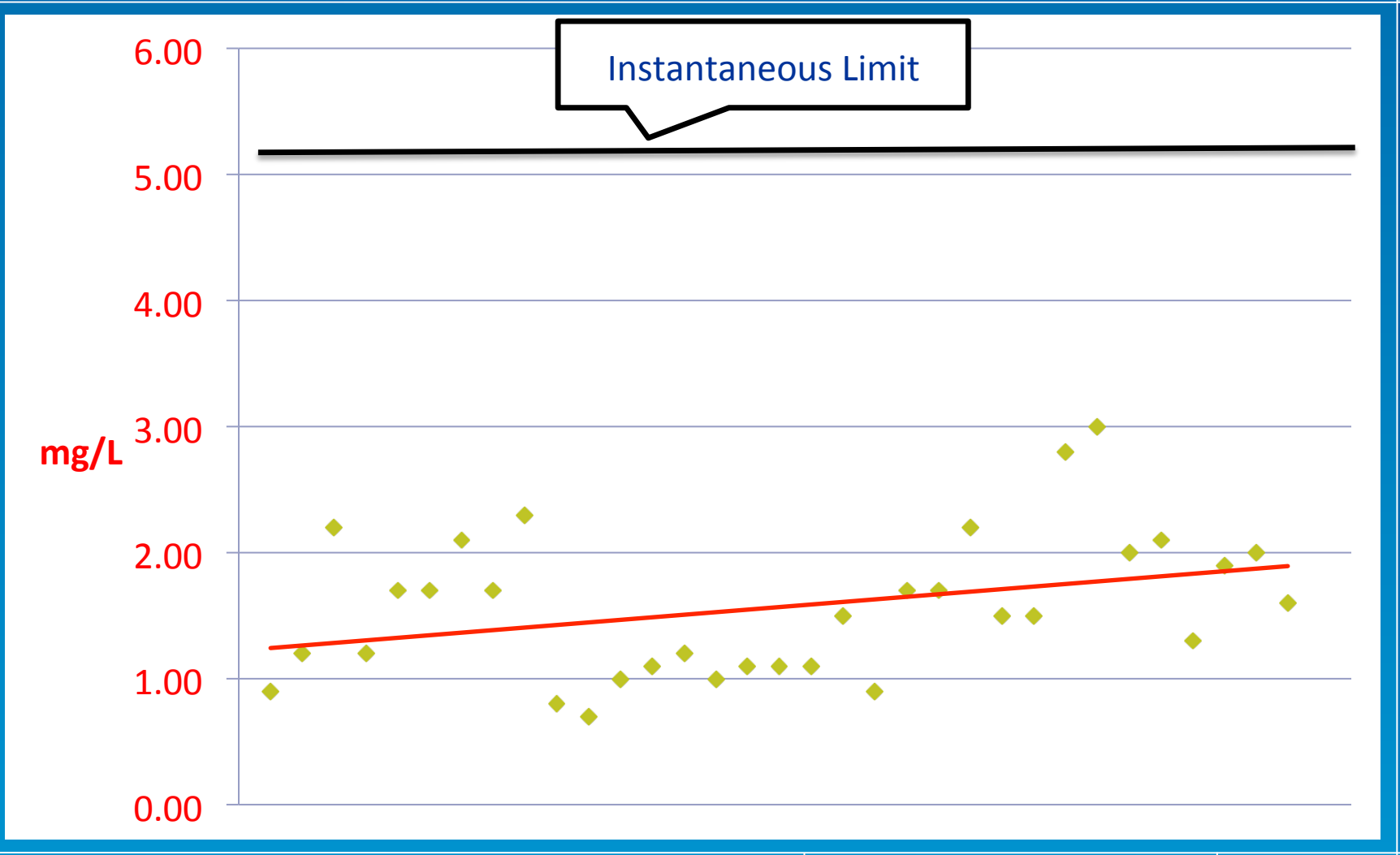
Oceanside Outfall TN 3/12 thru 2/13



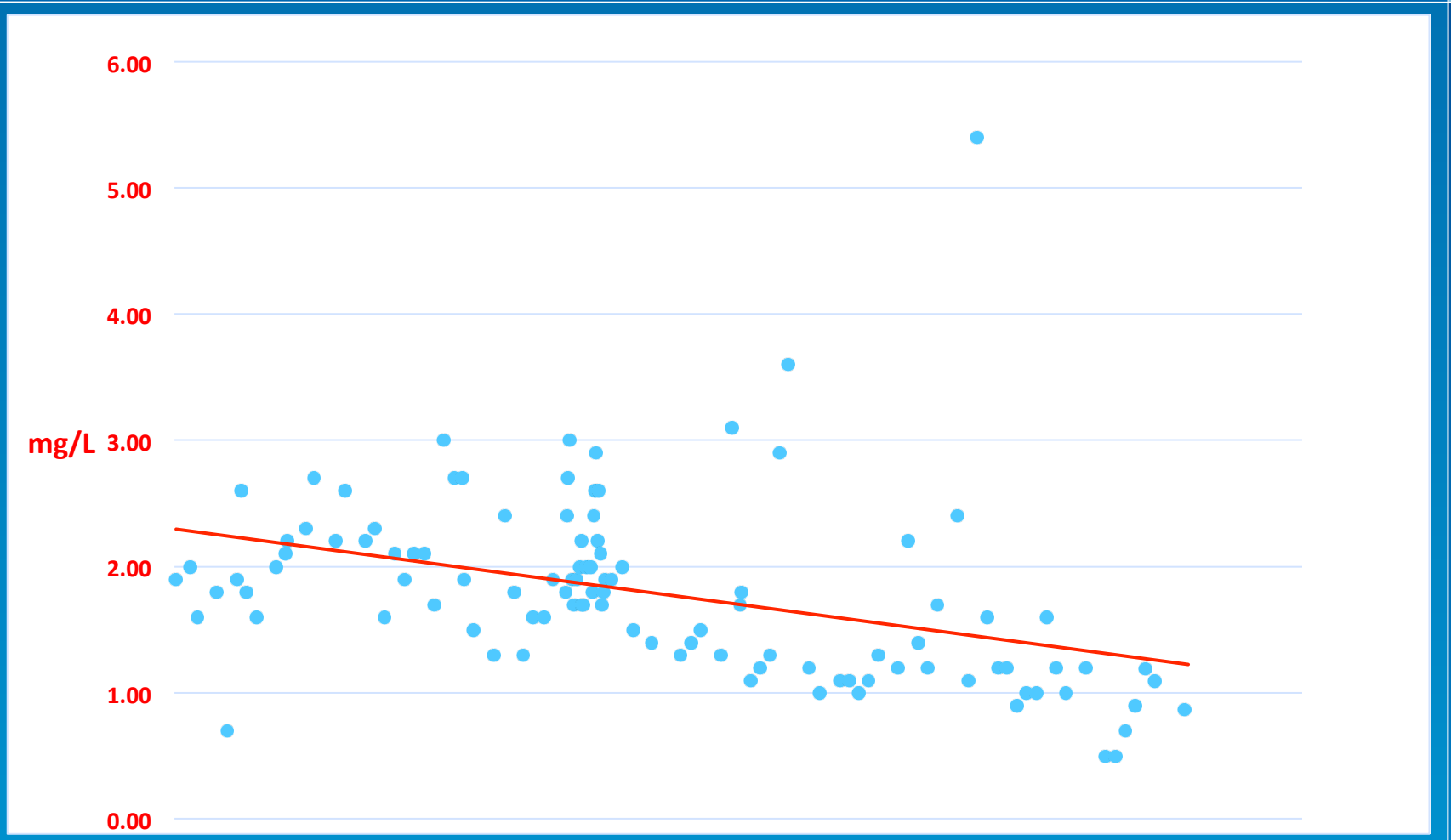
Oceanside Outfall TN 1/13 thru 12/15



Reclaimed Water TN 2/12 thru 1/13



Reclaimed Water TN 1/13 Thru 1/15



LESSONS LEARNED

Process Control Lessons Learned

- Factors contributing to meeting 5 mg/L instantaneous total nitrogen limit
  - Detailed review of existing plant data
  - Review placement of in process analyzers
  - Operational adjustments
    - One adjustment at a time
    - Typical 'rule of thumb' that each adjustment is less than 10% of previous number
    - Wait after each adjustment to observe effect
  - Close monitoring of plant processes for continued performance
  - Perform weekly process control meetings with staff, communications!

Operational Lessons Learned

- Conduct and assess staffing needs
- Audit laboratory equipment
- Audit and purchase process equipment
- Develop in depth round sheets (these are teaching aids, what should the operator expect?)
- Assign coverage areas (if not assigned, no one is responsible!)
- Daily check off sheet (If all else fails make sure this is accomplished…)
- Develop SOP's and MOPO's
- Implement laboratory analysis schedule

QUESTIONS