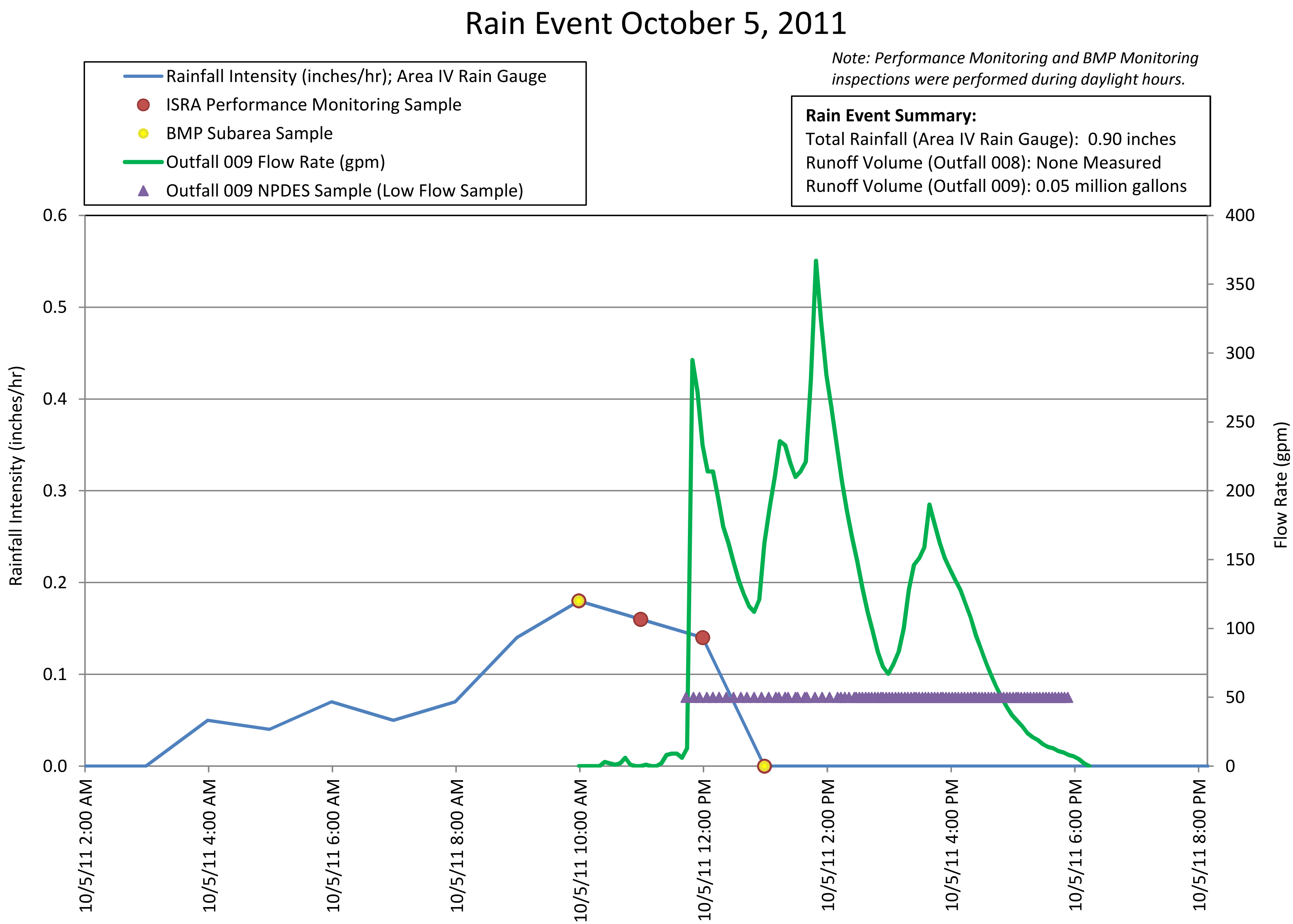
# APPENDIX A

# RAIN EVENT AND SAMPLING CHARTS
# 2011/2012 RAINY SEASON

**2011/2012 Rainy Season Rain Event and Sampling Charts**
**(Page 1 of 11)**

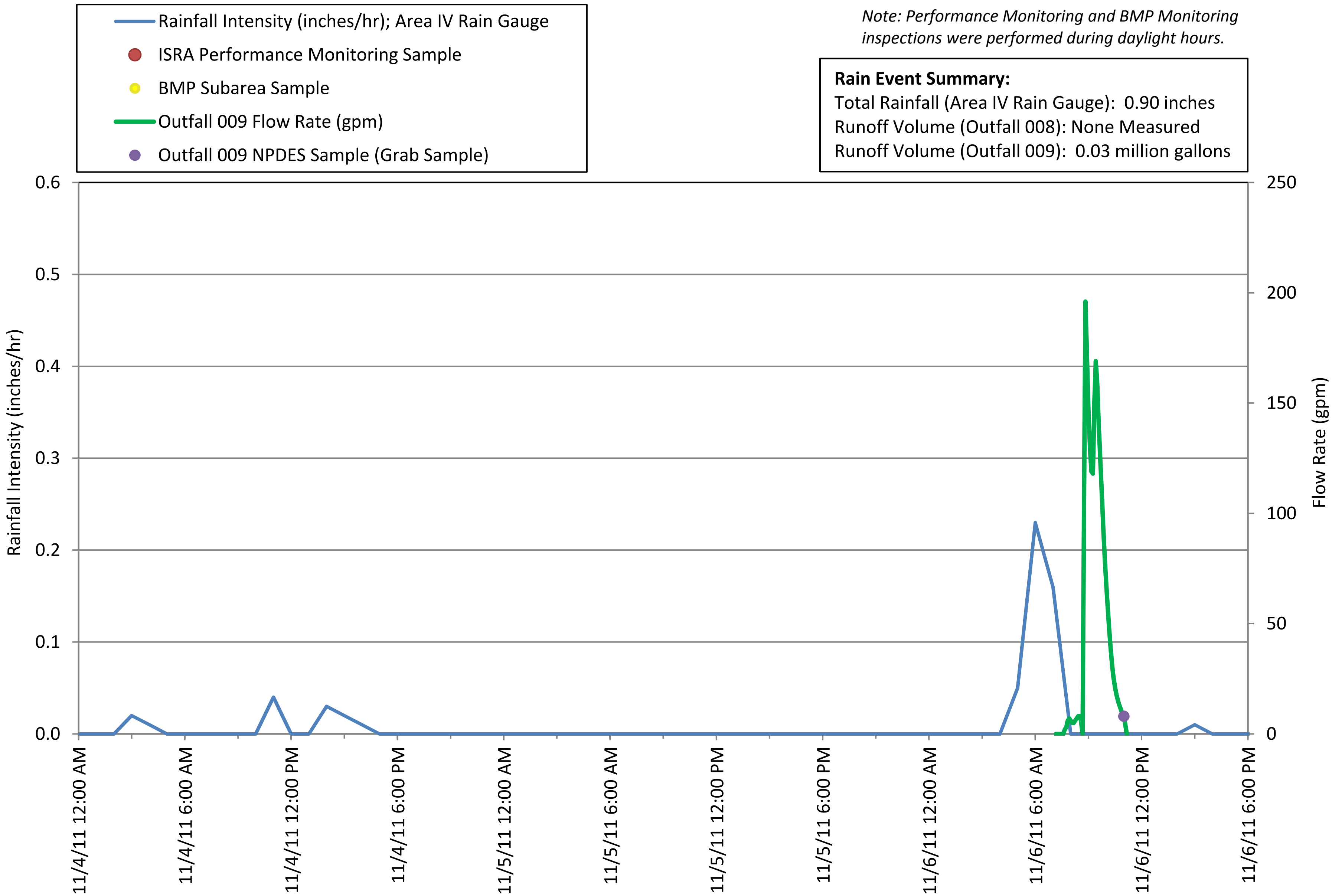


**2011/2012 Rainy Season Rain Event and Sampling Charts**
**(Page 2 of 11)**

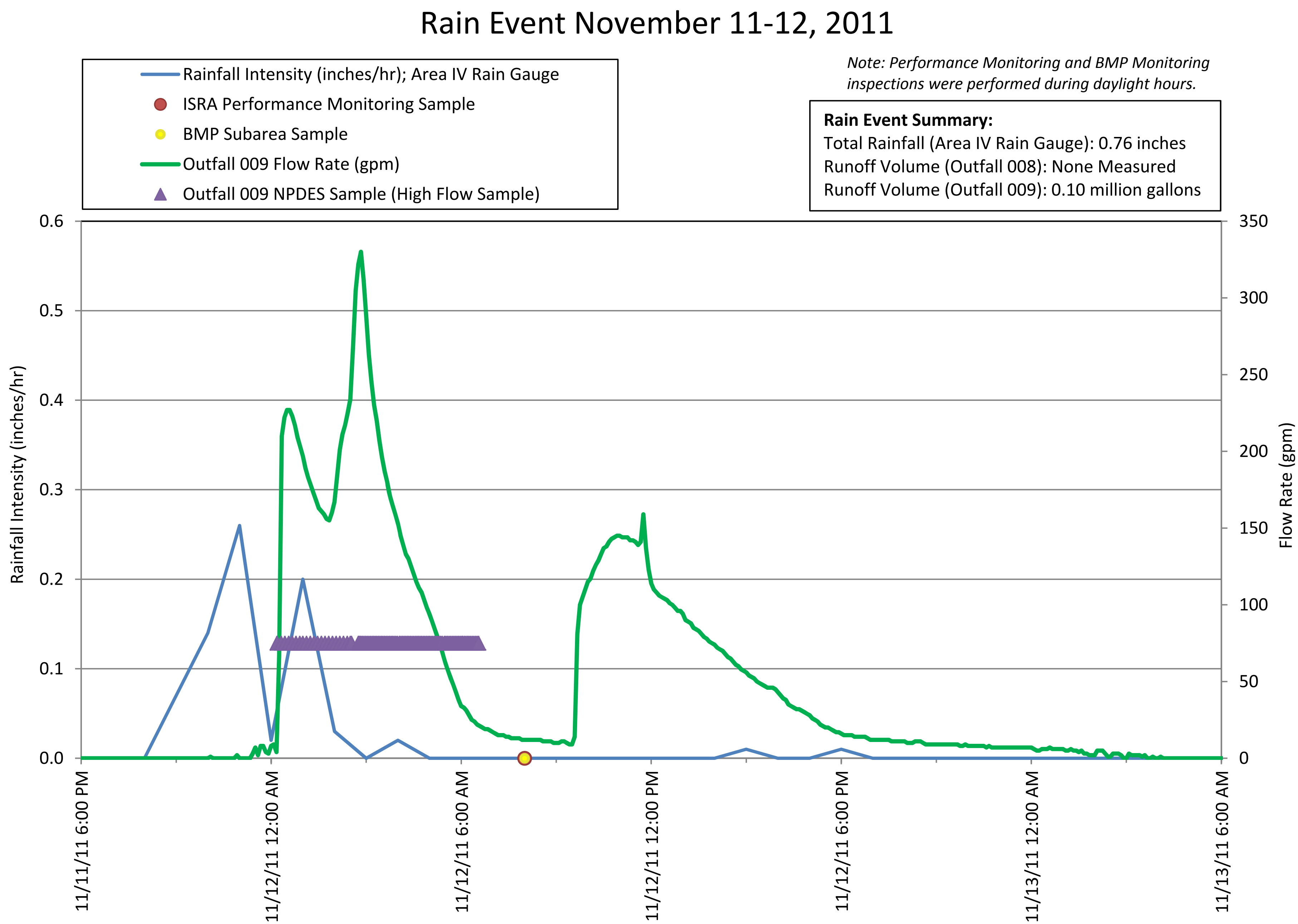
# Rain Event November 4-6, 2011

*Note: Performance Monitoring and BMP Monitoring inspections were performed during daylight hours.*

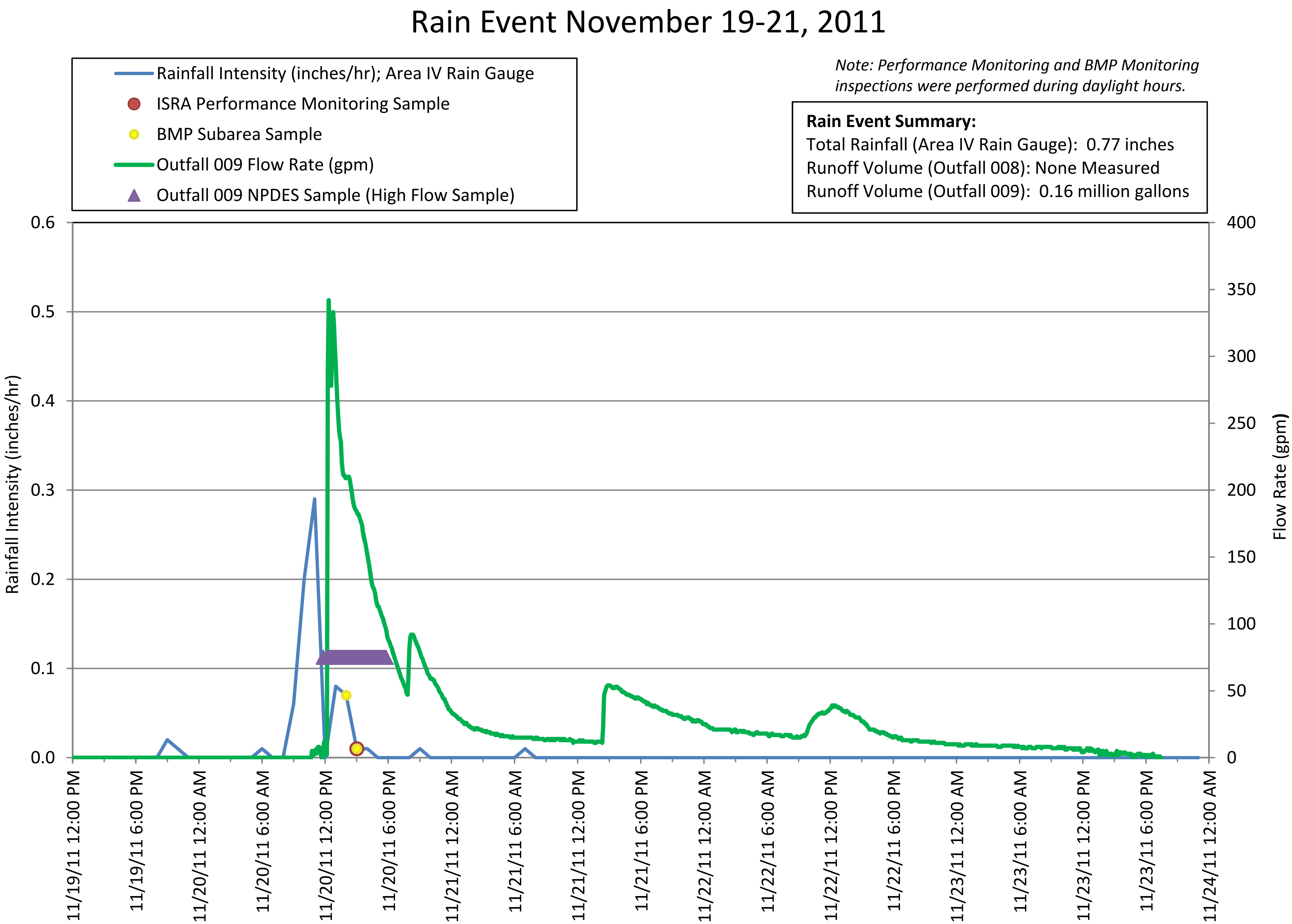
**Rain Event Summary:**
Total Rainfall (Area IV Rain Gauge): 0.90 inches
Runoff Volume (Outfall 008): None Measured
Runoff Volume (Outfall 009): 0.03 million gallons



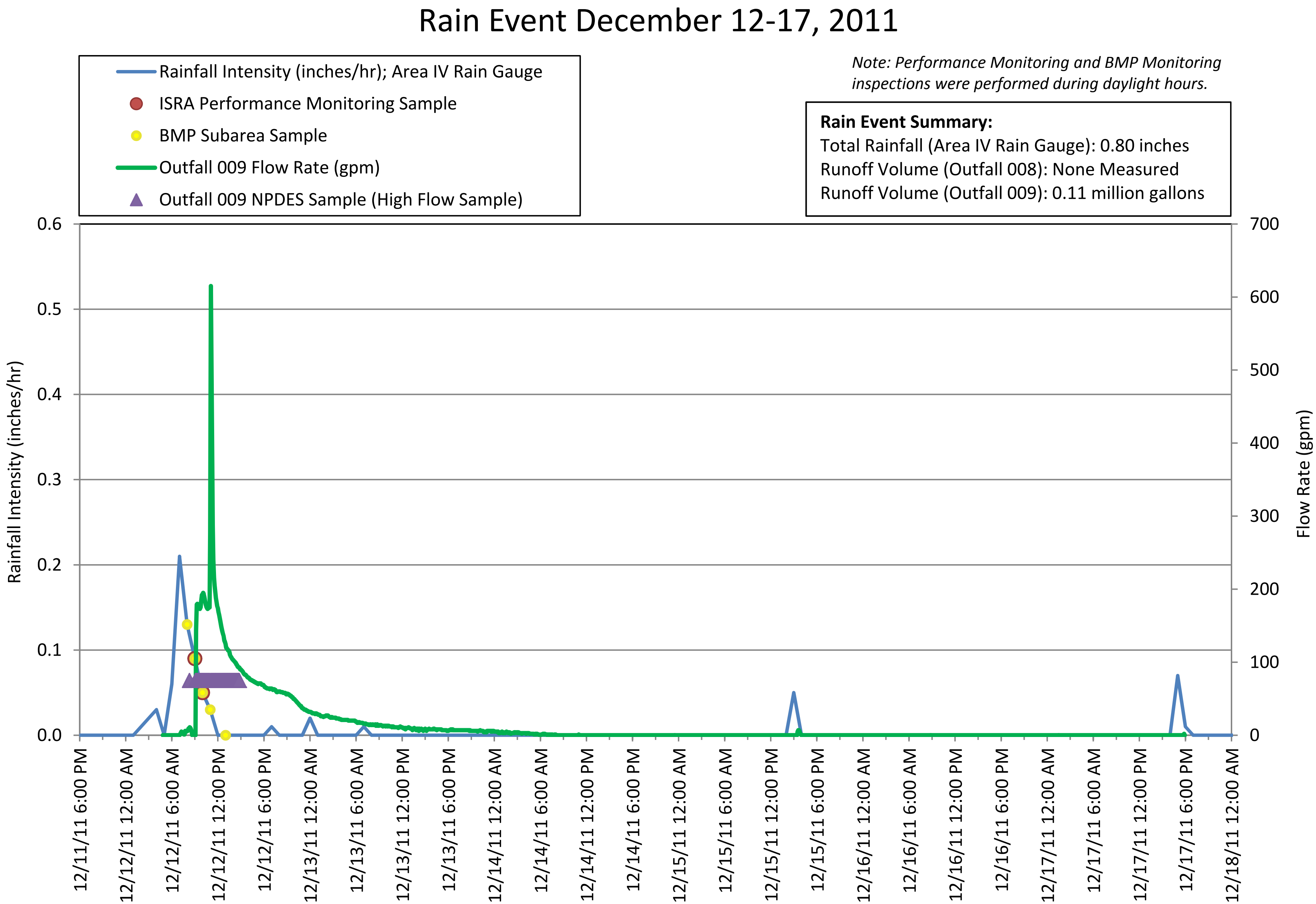
## 2011/2012 Rainy Season Rain Event and Sampling Charts
## (Page 3 of 11)



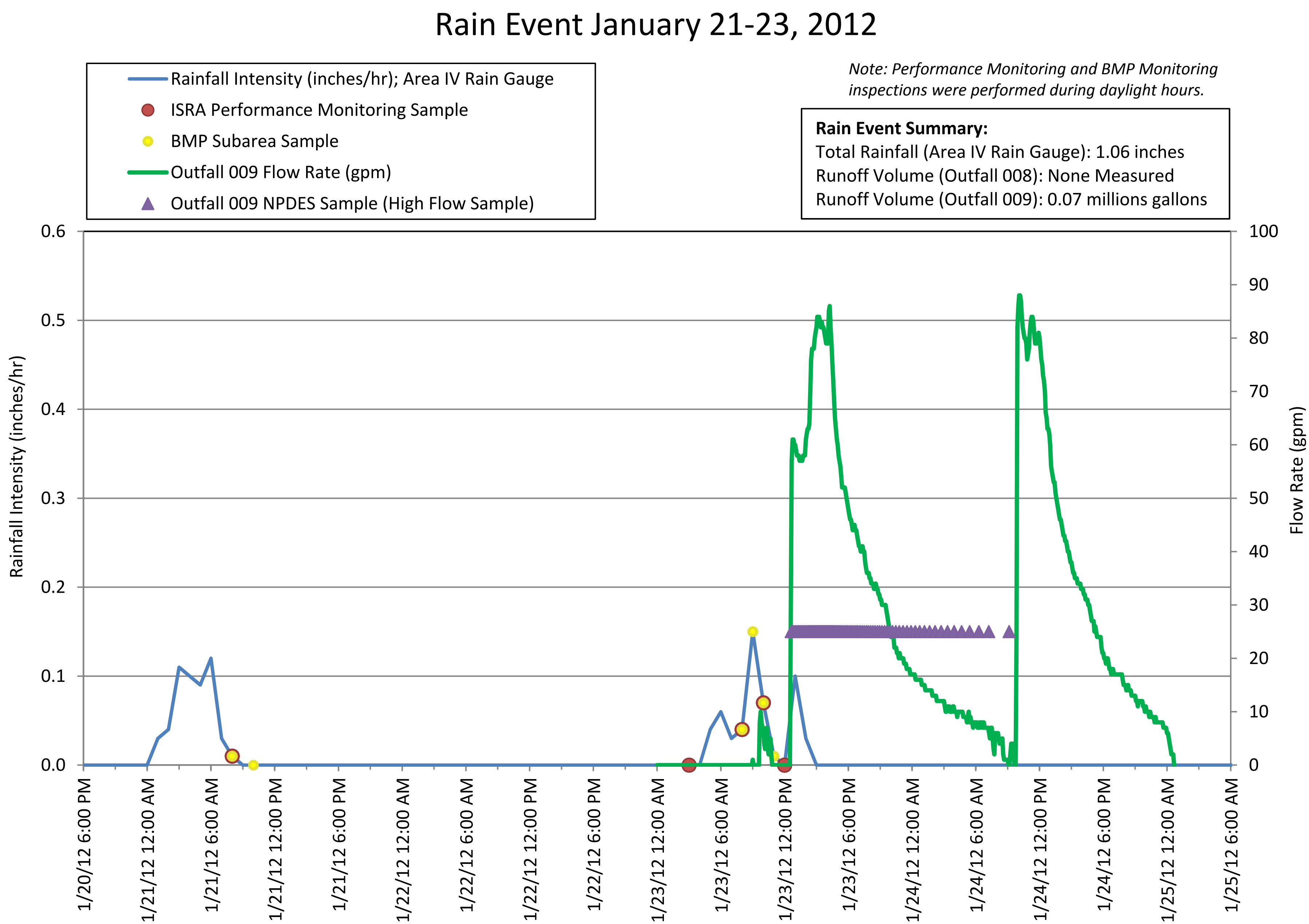
**2011/2012 Rainy Season Rain Event and Sampling Charts**
**(Page 4 of 11)**

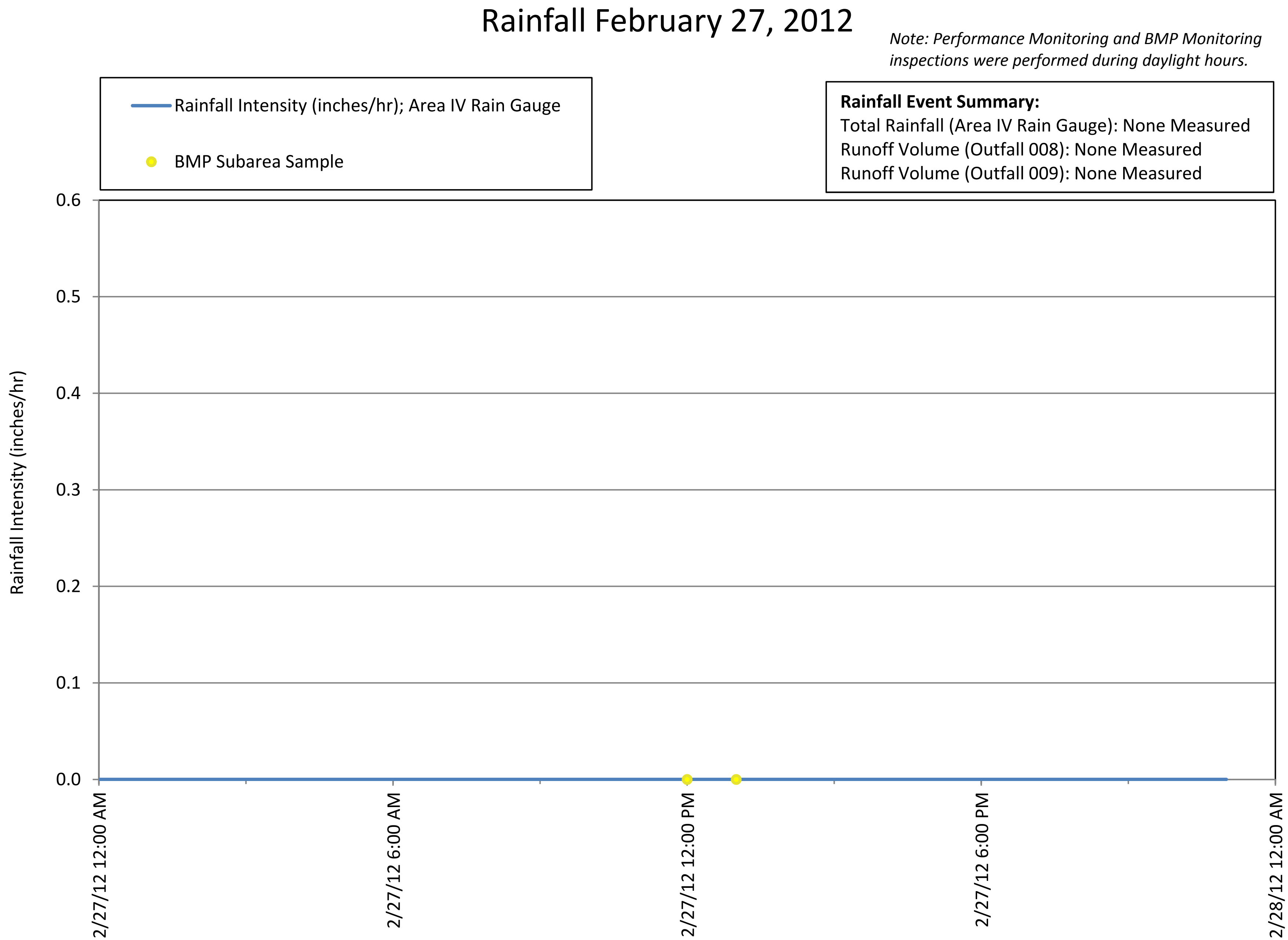


**2011/2012 Rainy Season Rain Event and Sampling Charts**
**(Page 5 of 11)**



**2011/2012 Rainy Season Rain Event and Sampling Charts**
**(Page 6 of 11)**



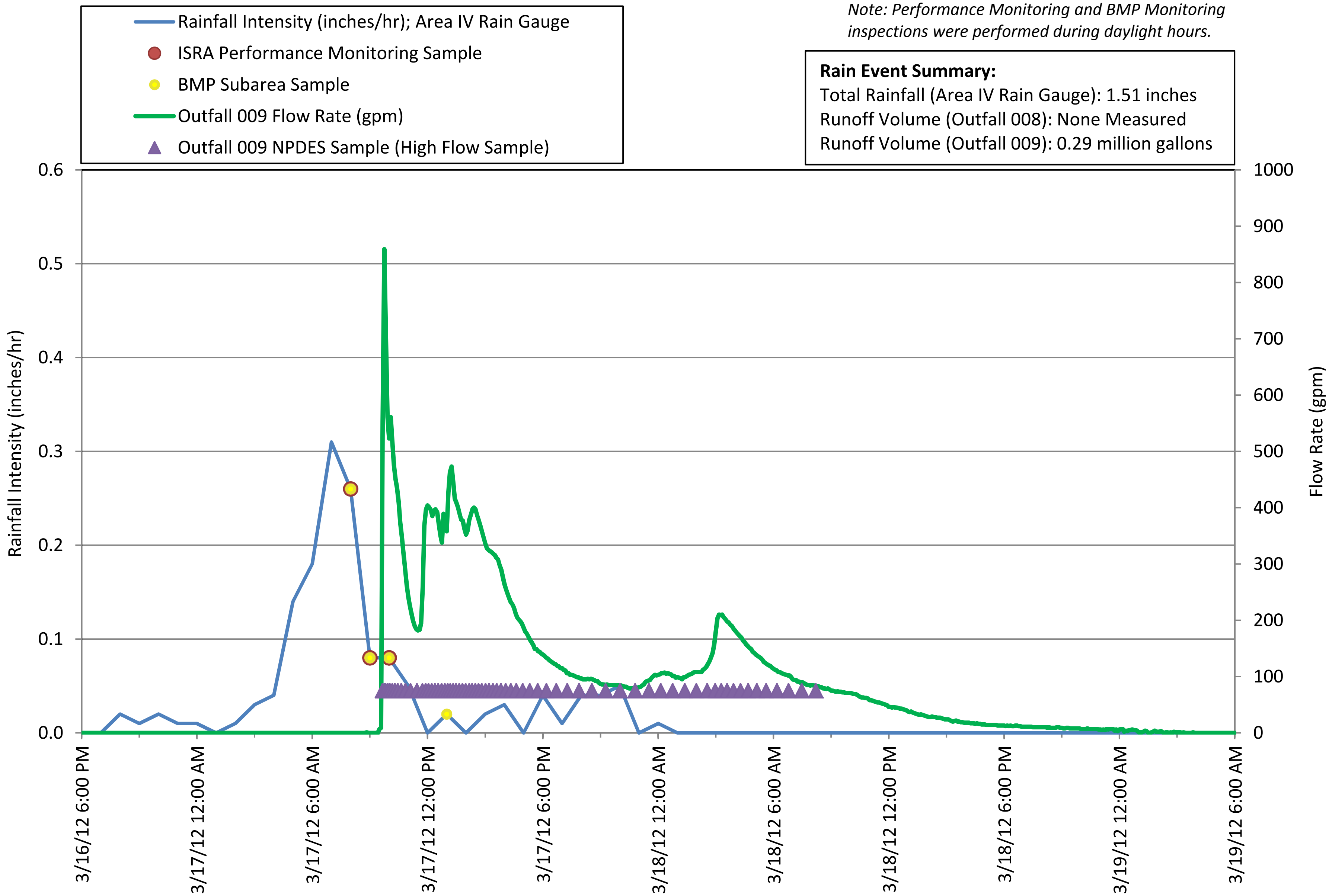

Rainfall February 27, 2012
*Note: Performance Monitoring and BMP Monitoring inspections were performed during daylight hours.*
Rainfall Intensity (inches/hr); Area IV Rain Gauge
BMP Subarea Sample
**Rainfall Event Summary:**
Total Rainfall (Area IV Rain Gauge): None Measured
Runoff Volume (Outfall 008): None Measured
Runoff Volume (Outfall 009): None Measured
Rainfall Intensity (inches/hr)
0.6
0.5
0.4
0.3
0.2
0.1
0.0
2/27/12 12:00 AM
2/27/12 6:00 AM
2/27/12 12:00 PM
2/27/12 6:00 PM
2/28/12 12:00 AM

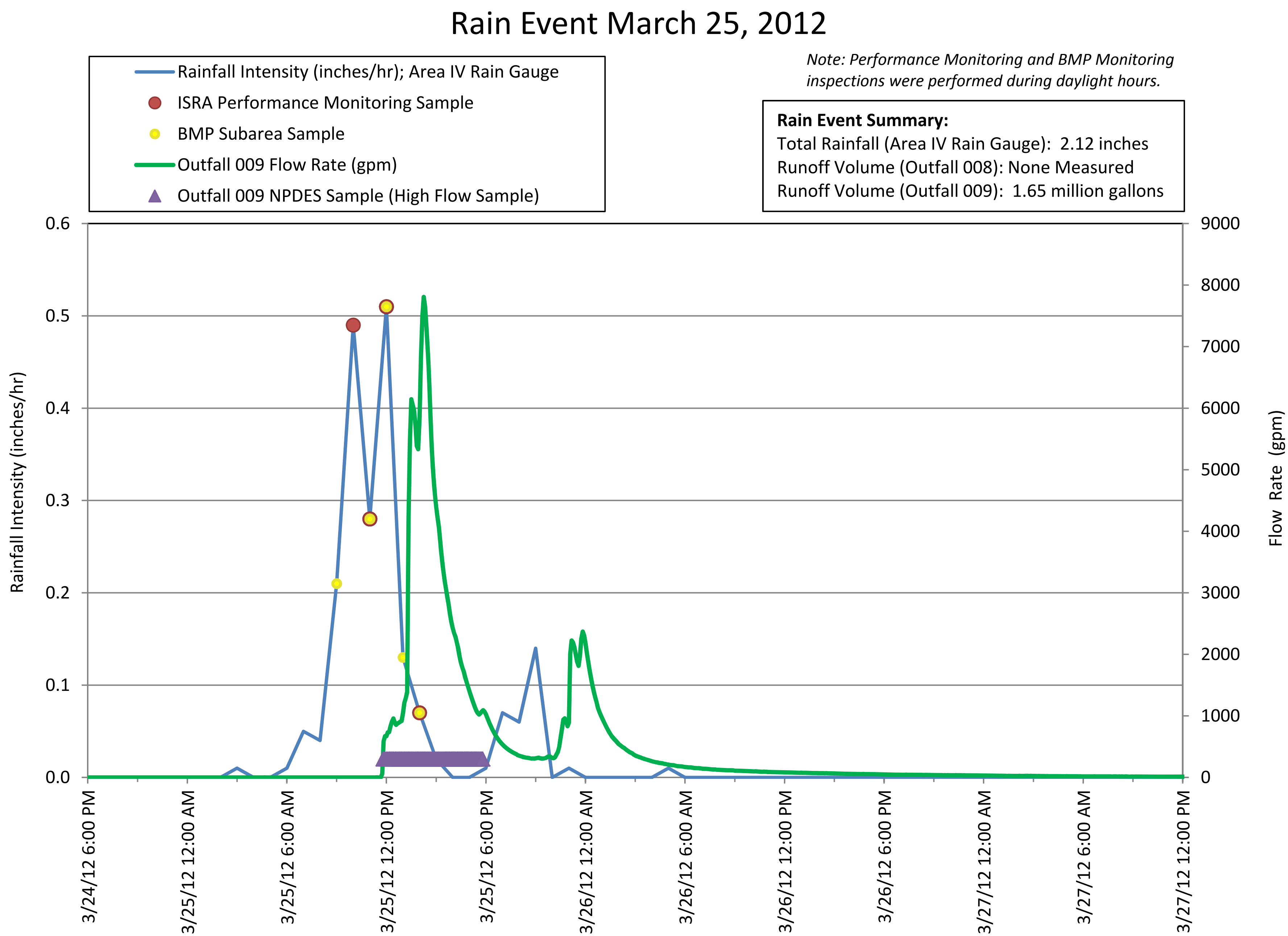
**2011/2012 Rainy Season Rain Event and Sampling Charts**
**(Page 8 of 11)**

# Rain Event March 16-18, 2012

*Note: Performance Monitoring and BMP Monitoring inspections were performed during daylight hours.*

**Rain Event Summary:**
Total Rainfall (Area IV Rain Gauge): 1.51 inches
Runoff Volume (Outfall 008): None Measured
Runoff Volume (Outfall 009): 0.29 million gallons



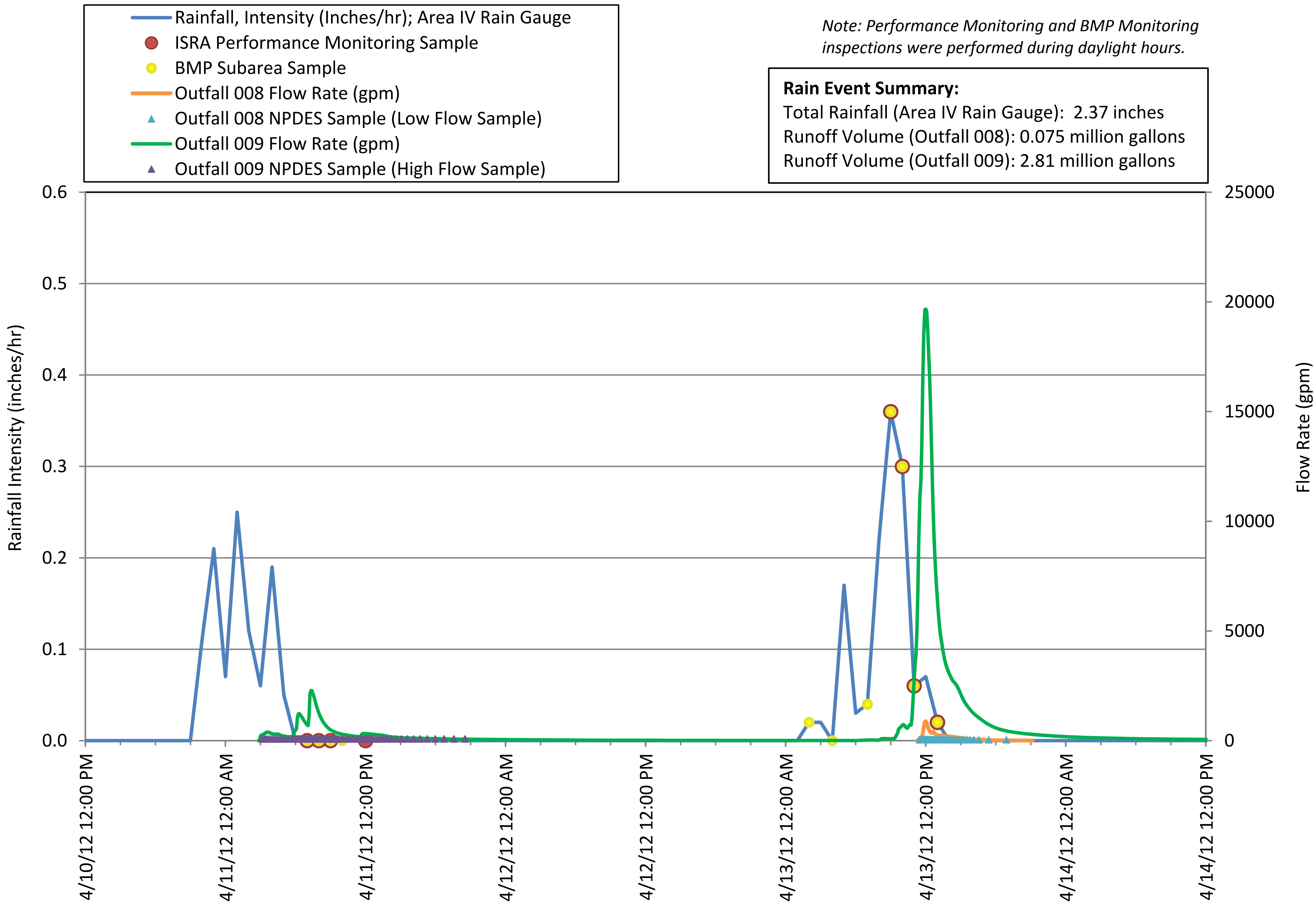

Rain Event March 25, 2012
Rainfall Intensity (inches/hr); Area IV Rain Gauge
ISRA Performance Monitoring Sample
BMP Subarea Sample
Outfall 009 Flow Rate (gpm)
Outfall 009 NPDES Sample (High Flow Sample)
Note: Performance Monitoring and BMP Monitoring inspections were performed during daylight hours.
Rain Event Summary:
Total Rainfall (Area IV Rain Gauge): 2.12 inches
Runoff Volume (Outfall 008): None Measured
Runoff Volume (Outfall 009): 1.65 million gallons
Rainfall Intensity (inches/hr)
Flow Rate (gpm)
0.6
0.5
0.4
0.3
0.2
0.1
0.0
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
3/24/12 6:00 PM
3/25/12 12:00 AM
3/25/12 6:00 AM
3/25/12 12:00 PM
3/25/12 6:00 PM
3/26/12 12:00 AM
3/26/12 6:00 AM
3/26/12 12:00 PM
3/26/12 6:00 PM
3/27/12 12:00 AM
3/27/12 6:00 AM
3/27/12 12:00 PM

## 2011/2012 Rainy Season Rain Event and Sampling Charts
## (Page 10 of 11)

# Rain Event April 10-13, 2012

*Note: Performance Monitoring and BMP Monitoring inspections were performed during daylight hours.*

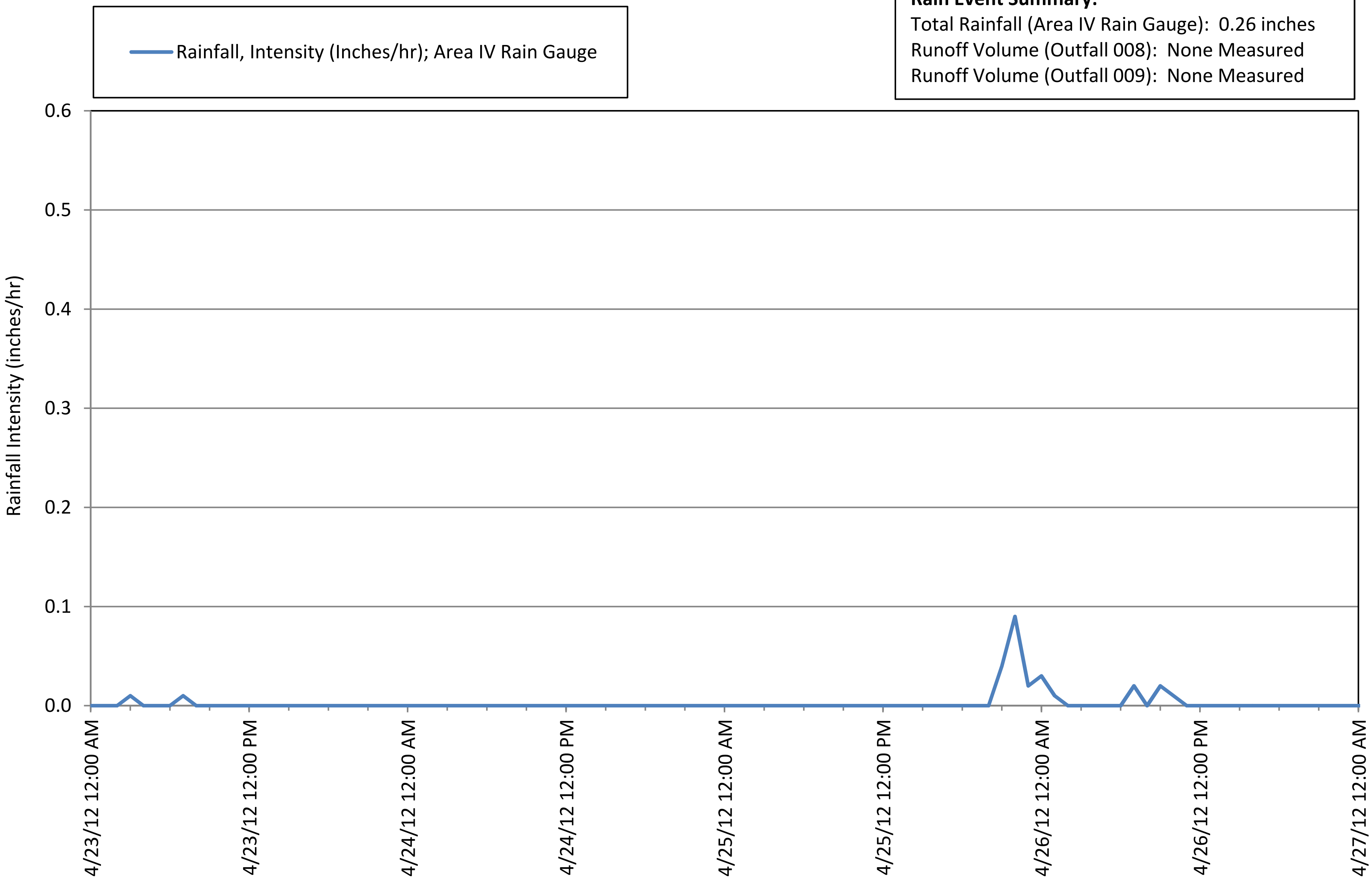
**Rain Event Summary:**
Total Rainfall (Area IV Rain Gauge): 2.37 inches
Runoff Volume (Outfall 008): 0.075 million gallons
Runoff Volume (Outfall 009): 2.81 million gallons



# Rain Event April 23-26, 2012

*Note: Performance Monitoring and BMP Monitoring inspections were performed during daylight hours.*

**Rain Event Summary:**
Total Rainfall (Area IV Rain Gauge): 0.26 inches
Runoff Volume (Outfall 008): None Measured
Runoff Volume (Outfall 009): None Measured



# APPENDIX B

# LABORATORY AND DATA VALIDATION REPORTS
# 2011/2012 RAINY SEASON

# Table B-1
# Laboratory Reports and Data Validation Reports
# 2011-2012 Rainy Season
# Page 1 of 1

| Sample Delivery Group | Sample Collection Date | Sample Type | Laboratory Name | Laboratory Report | Validation Report |
|---|---|---|---|---|---|
| **ISRA Performance Monitoring** | | | | | |
| IUJ0434 | 10/5/2011 | Primary | TA-Irvine | Y | Y |
| IUK1716 | 11/12/2011 | Primary | TA-Irvine | Y | Y |
| IUK2599 | 11/20/2011 | Primary | TA-Irvine | Y | Y |
| IUL1235 | 12/12/2011 | Primary | TA-Irvine | Y | Y |
| 440-735 | 1/21/2012 | Primary | TA-Irvine | Y | Y |
| 440-750 | 1/23/2012 | Primary | TA-Irvine | Y | Y |
| 440-771 | 1/23/2012 | Primary | TA-Irvine | Y | Y |
| 440-5827 | 3/17/2012 | Primary | TA-Irvine | Y | Y |
| 440-6515 | 3/25/2012 | Primary | TA-Irvine | Y | Y |
| 440-6516 | 3/25/2012 | Primary | TA-Irvine | Y | Y |
| 440-8289 | 4/11/2012 | Primary | TA-Irvine | Y | N |
| 440-8306 | 4/11/2012 | Primary | TA-Irvine | Y | N |
| 440-8584 | 4/13/2012 | Primary | TA-Irvine | Y | Y |
| 440-8607 | 4/13/2012 | Primary | TA-Irvine | Y | Y |
| J51279 | 10/5/2011 | RWQCB Split | ASL/CAS/Weck | Y | Y |
| J51773 | 11/20/2011 | RWQCB Split | ASL/Weck | Y | Y |
| J52366 | 1/21/2012 | RWQCB Split | ASL/CAS/Weck | Y | Y |
| J52395 | 1/23/2012 | RWQCB Split | ASL/CAS/Weck | Y | Y |
| J52396 | 1/23/2012 | RWQCB Split | ASL/CAS/Weck | Y | Y |
| J53036 | 3/25/2012 | RWQCB Split | ASL/CAS/Weck | Y | Y |
| J53212 | 4/11/2012 | RWQCB Split | ASL/CAS/Weck | Y | N |
| J53211 | 4/13/2012 | RWQCB Split | ASL/CAS/Weck | Y | N |
| **Treatment BMP Monitoring** | | | | | |
| IUJ0551 | 10/5/2011 | Primary | TA-Irvine/PTS | Y | Y |
| IUK1714 | 11/12/2011 | Primary | TA-Irvine/PTS | Y | Y |
| IUK2660 | 11/20/2011 | Primary | TA-Irvine/PTS | Y | Y |
| IUL1234 | 12/12/2011 | Primary | TA-Irvine/PTS | Y | Y |
| 440-733 | 1/21/2012 | Primary | TA-Irvine/PTS | Y | Y |
| 440-751 | 1/23/2012 | Primary | TA-Irvine/PTS | Y | Y |
| 440-3916 | 2/27/2012 | Primary | TA-Irvine/PTS | Y | Y |
| 440-5828 | 3/17/2012 | Primary | TA-Irvine/PTS | Y | Y |
| 440-6518 | 3/25/2012 | Primary | TA-Irvine/PTS | Y | Y |
| 440-8290 | 4/11/2012 | Primary | TA-Irvine/PTS | Y | Y |
| 440-8609 | 4/13/2012 | Primary | TA-Irvine/PTS | Y | Y |

**Abbreviations**

ASL - American Scientific Laboratories, LLC
CAS - Columbia Analytical Laboratory
PTS - PTS Laboratories, Inc., Santa Fe Springs, California
TA-Irvine - Test America Laboratories, Irvine, California
WECK - Weck laboratories, Inc.

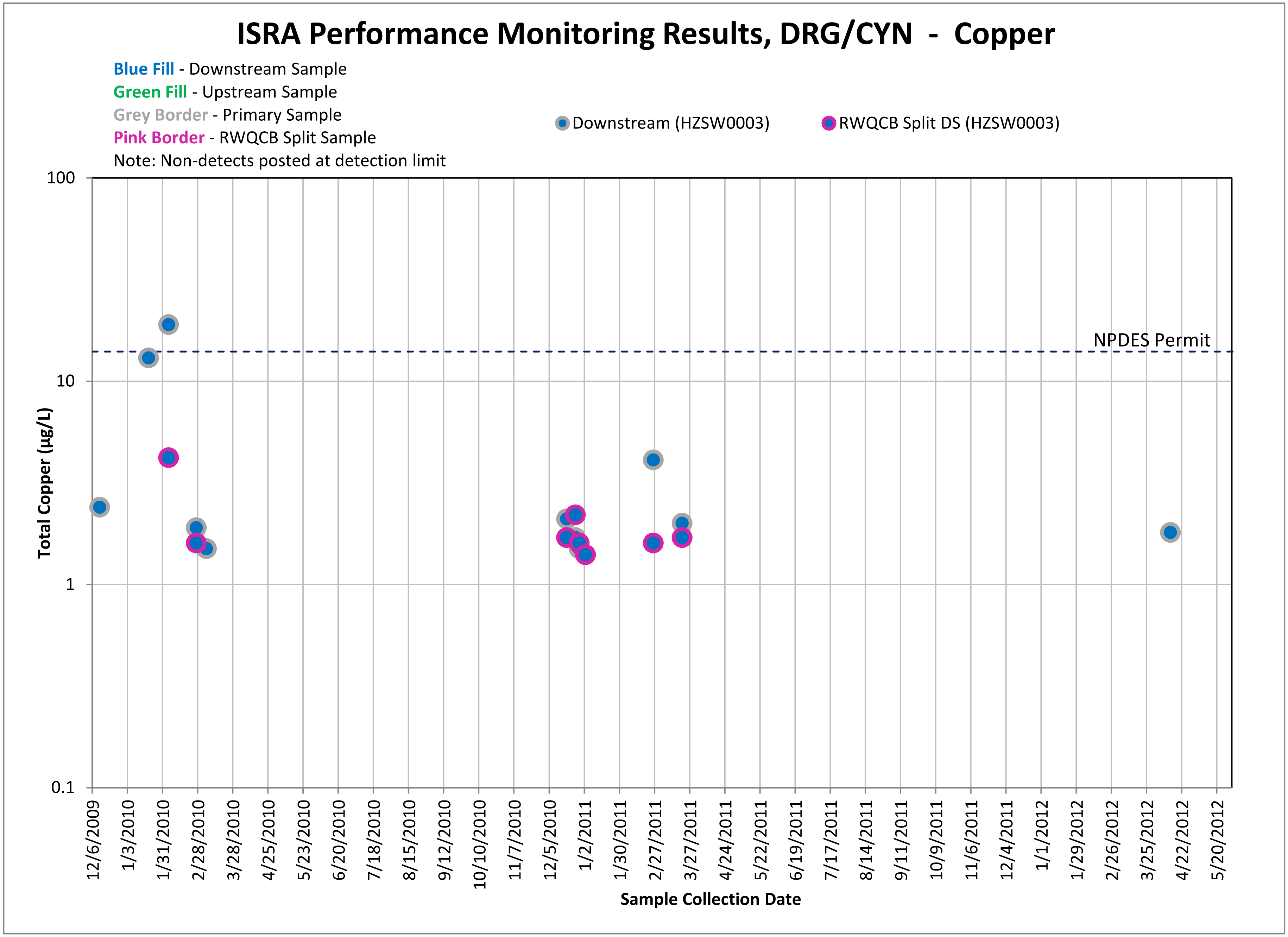
**Please contact Debbie Taege at 818-466-8849 if you would like to receive a CD containing the Laboratory and Data Validation Reports listed in Table B-1. The reports are not posted to the Boeing External Website due to the large file size.**

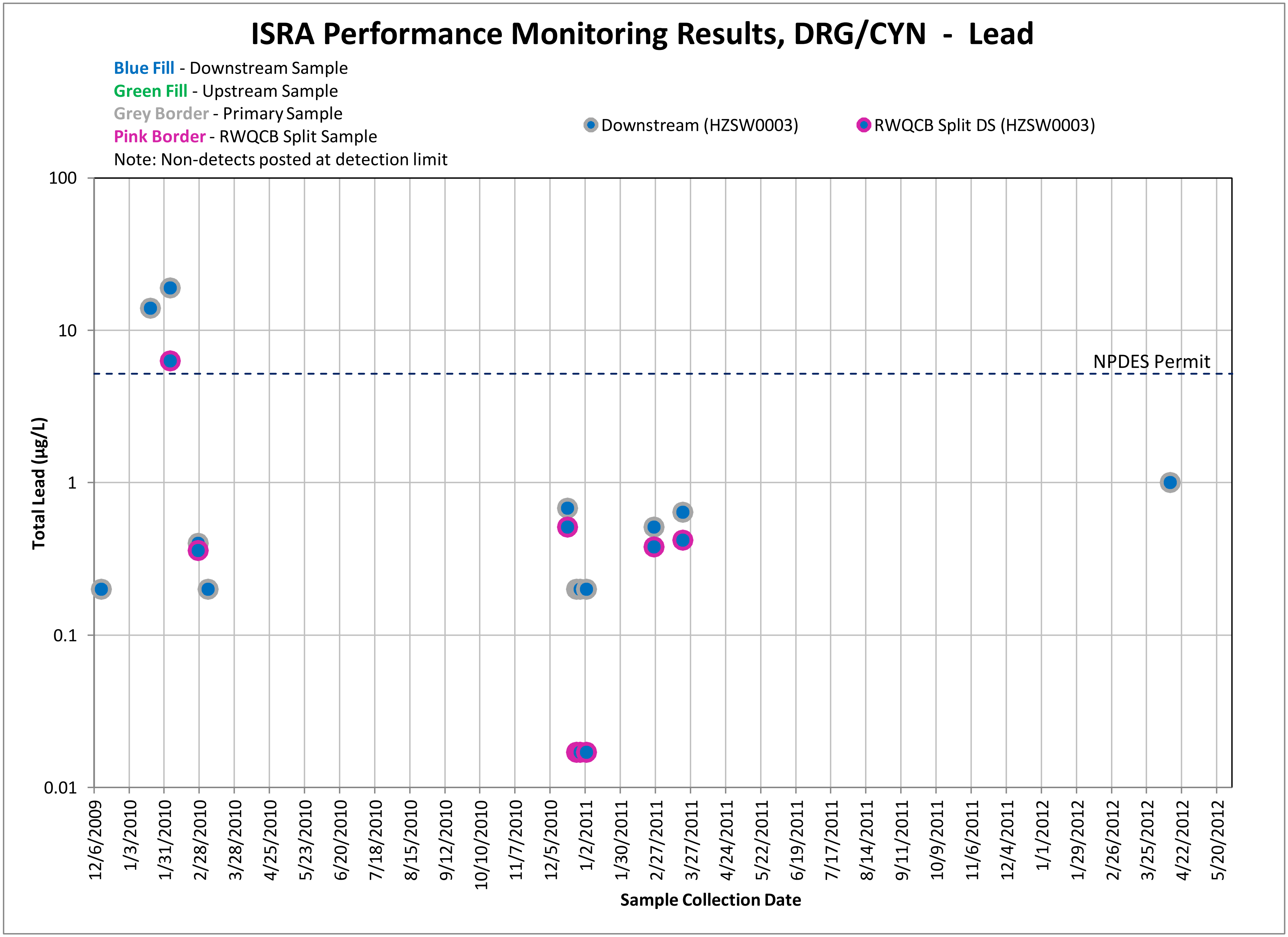
# APPENDIX C

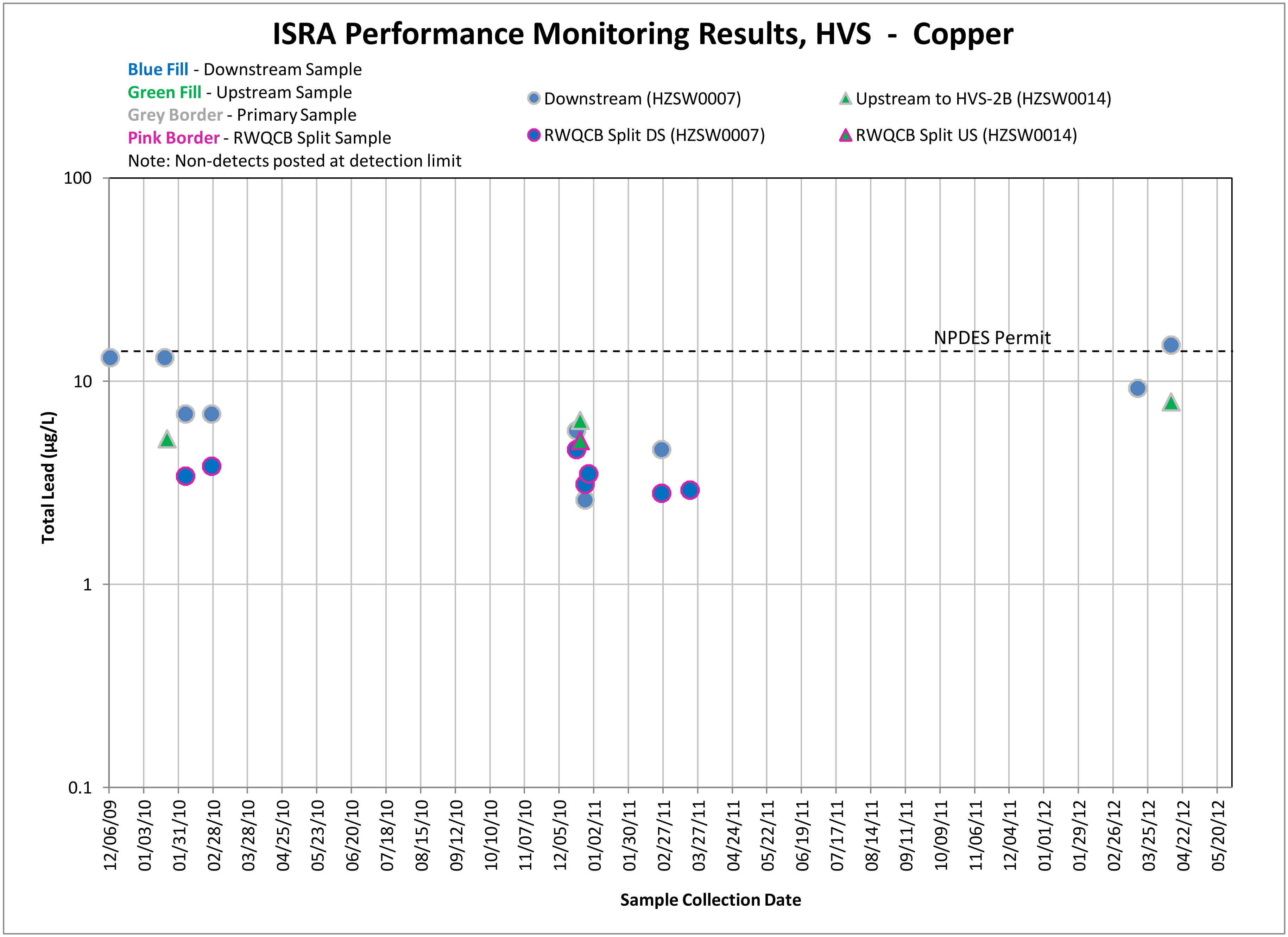
# PERFORMANCE MONITORING CHARTS
# 2011/2012 RAINY SEASON

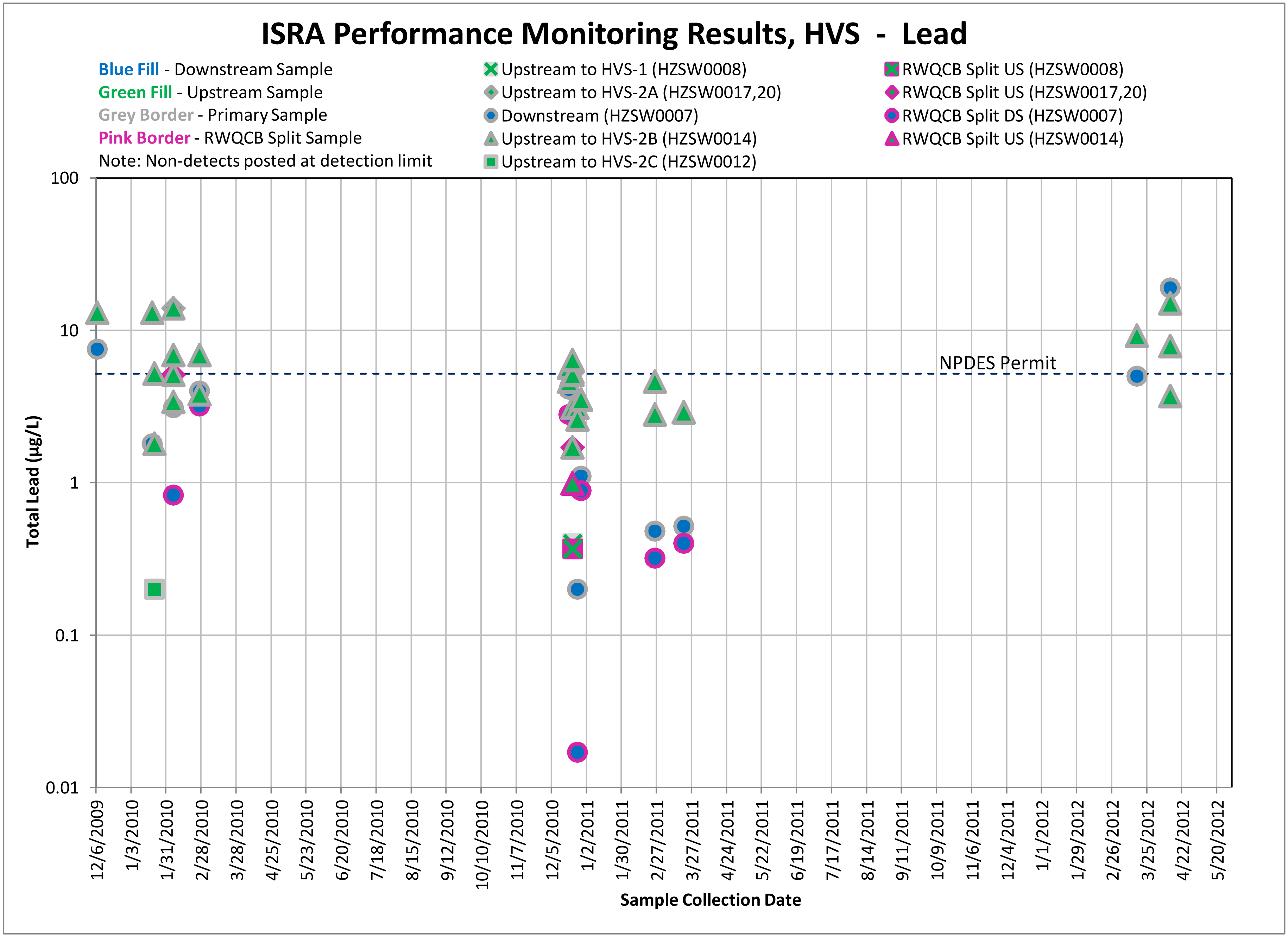
# APPENDIX C-1

# PERFORMANCE MONITORING EVALUATION AREA TIME-SERIES CHARTS
# 2011/2012 RAINY SEASON

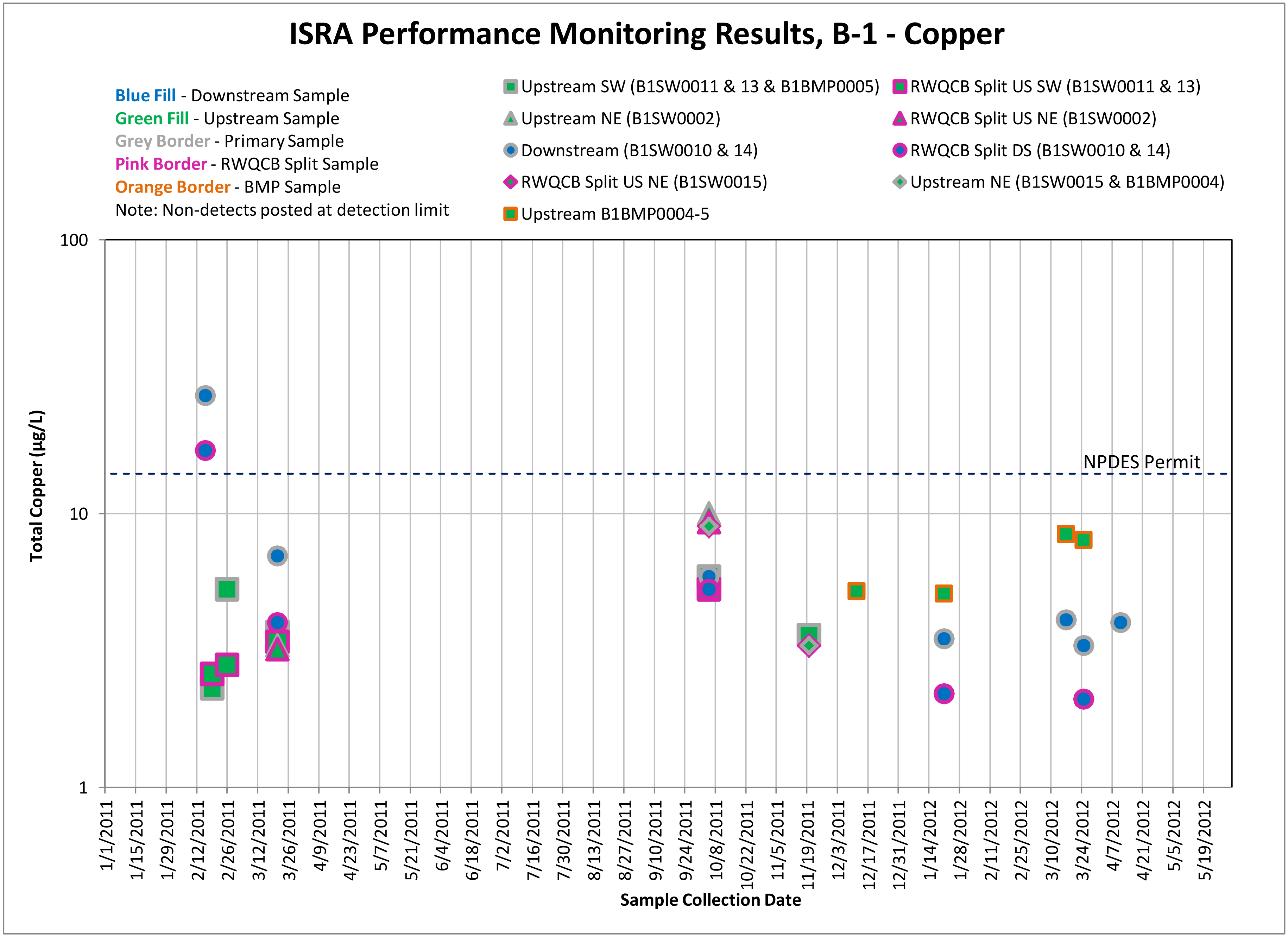

ISRA Performance Monitoring Results, DRG/CYN - Copper
Blue Fill - Downstream Sample
Green Fill - Upstream Sample
Grey Border - Primary Sample
Pink Border - RWQCB Split Sample
Note: Non-detects posted at detection limit
Downstream (HZSW0003)
RWQCB Split DS (HZSW0003)
NPDES Permit
Total Copper (µg/L)
100
10
1
0.1
Sample Collection Date
12/6/2009
1/3/2010
1/31/2010
2/28/2010
3/28/2010
4/25/2010
5/23/2010
6/20/2010
7/18/2010
8/15/2010
9/12/2010
10/10/2010
11/7/2010
12/5/2010
1/2/2011
1/30/2011
2/27/2011
3/27/2011
4/24/2011
5/22/2011
6/19/2011
7/17/2011
8/14/2011
9/11/2011
10/9/2011
11/6/2011
12/4/2011
1/1/2012
1/29/2012
2/26/2012
3/25/2012
4/22/2012
5/20/2012

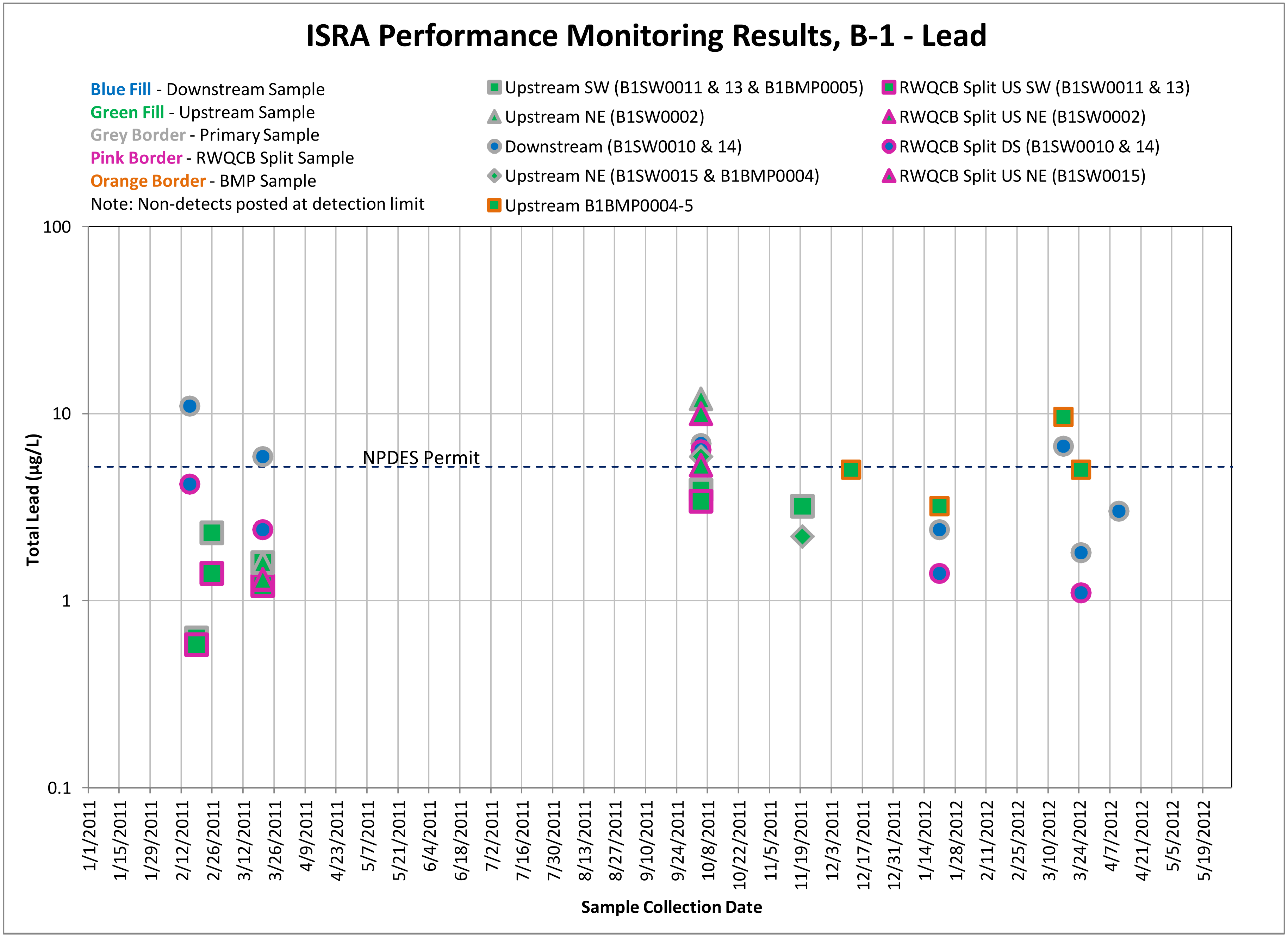

ISRA Performance Monitoring Results, DRG/CYN - Lead
Blue Fill - Downstream Sample
Green Fill - Upstream Sample
Grey Border - Primary Sample
Pink Border - RWQCB Split Sample
Note: Non-detects posted at detection limit
Downstream (HZSW0003)
RWQCB Split DS (HZSW0003)
NPDES Permit
Total Lead (µg/L)
100
10
1
0.1
0.01
12/6/2009
1/3/2010
1/31/2010
2/28/2010
3/28/2010
4/25/2010
5/23/2010
6/20/2010
7/18/2010
8/15/2010
9/12/2010
10/10/2010
11/7/2010
12/5/2010
1/2/2011
1/30/2011
2/27/2011
3/27/2011
4/24/2011
5/22/2011
6/19/2011
7/17/2011
8/14/2011
9/11/2011
10/9/2011
11/6/2011
12/4/2011
1/1/2012
1/29/2012
2/26/2012
3/25/2012
4/22/2012
5/20/2012
Sample Collection Date


ISRA Performance Monitoring Results, HVS - Copper
Blue Fill - Downstream Sample
Green Fill - Upstream Sample
Grey Border - Primary Sample
Pink Border - RWQCB Split Sample
Note: Non-detects posted at detection limit
Downstream (HZSW0007)
Upstream to HVS-2B (HZSW0014)
RWQCB Split DS (HZSW0007)
RWQCB Split US (HZSW0014)
NPDES Permit
100
10
1
0.1
Total Lead (µg/L)
12/06/09
01/03/10
01/31/10
02/28/10
03/28/10
04/25/10
05/23/10
06/20/10
07/18/10
08/15/10
09/12/10
10/10/10
11/07/10
12/05/10
01/02/11
01/30/11
02/27/11
03/27/11
04/24/11
05/22/11
06/19/11
07/17/11
08/14/11
09/11/11
10/09/11
11/06/11
12/04/11
01/01/12
01/29/12
02/26/12
03/25/12
04/22/12
05/20/12
Sample Collection Date

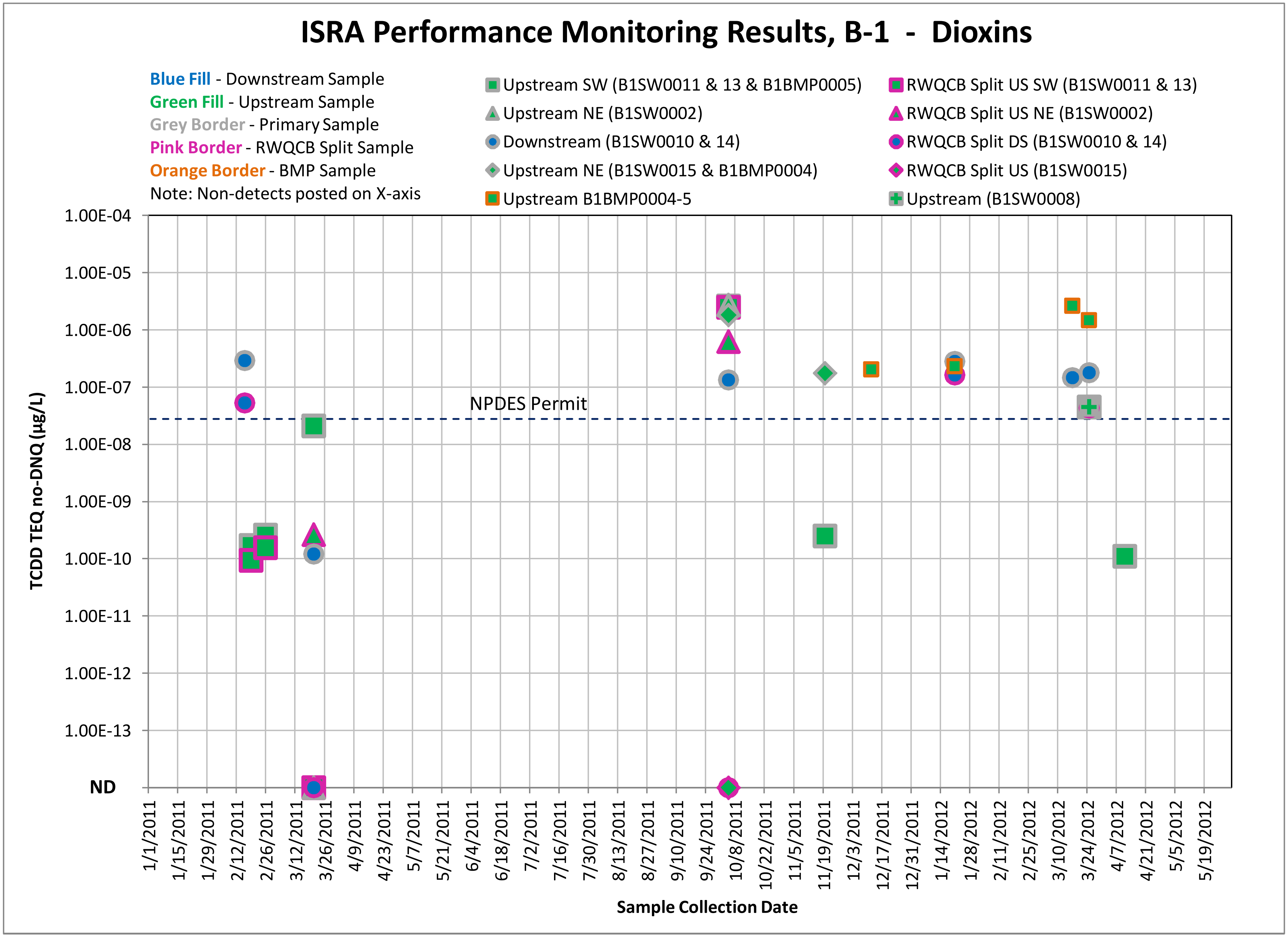


ISRA Performance Monitoring Results, HVS - Lead
Blue Fill - Downstream Sample
Green Fill - Upstream Sample
Grey Border - Primary Sample
Pink Border - RWQCB Split Sample
Note: Non-detects posted at detection limit
Upstream to HVS-1 (HZSW0008)
Upstream to HVS-2A (HZSW0017,20)
Downstream (HZSW0007)
Upstream to HVS-2B (HZSW0014)
Upstream to HVS-2C (HZSW0012)
RWQCB Split US (HZSW0008)
RWQCB Split US (HZSW0017,20)
RWQCB Split DS (HZSW0007)
RWQCB Spilt US (HZSW0014)
NPDES Permit
Total Lead (µg/L)
100
10
1
0.1
0.01
12/6/2009
1/3/2010
1/31/2010
2/28/2010
3/28/2010
4/25/2010
5/23/2010
6/20/2010
7/18/2010
8/15/2010
9/12/2010
10/10/2010
11/7/2010
12/5/2010
1/2/2011
1/30/2011
2/27/2011
3/27/2011
4/24/2011
5/22/2011
6/19/2011
7/17/2011
8/14/2011
9/11/2011
10/9/2011
11/6/2011
12/4/2011
1/1/2012
1/29/2012
2/26/2012
3/25/2012
4/22/2012
5/20/2012
Sample Collection Date

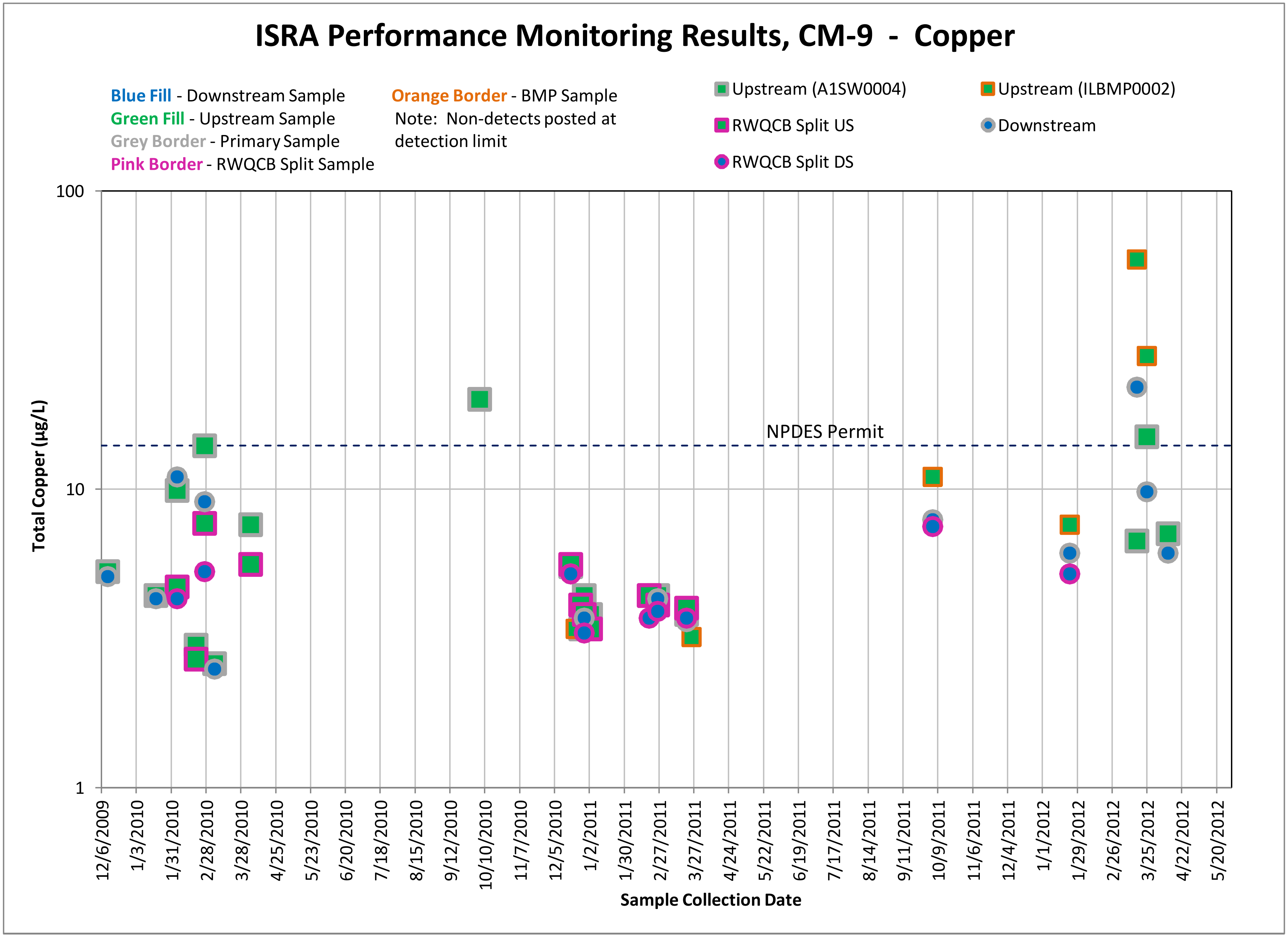

ISRA Performance Monitoring Results, B-1 - Copper
Blue Fill - Downstream Sample
Green Fill - Upstream Sample
Grey Border - Primary Sample
Pink Border - RWQCB Split Sample
Orange Border - BMP Sample
Note: Non-detects posted at detection limit
Upstream SW (B1SW0011 & 13 & B1BMP0005)
Upstream NE (B1SW0002)
Downstream (B1SW0010 & 14)
RWQCB Split US NE (B1SW0015)
Upstream B1BMP0004-5
RWQCB Split US SW (B1SW0011 & 13)
RWQCB Split US NE (B1SW0002)
RWQCB Split DS (B1SW0010 & 14)
Upstream NE (B1SW0015 & B1BMP0004)
NPDES Permit
Total Copper (µg/L)
100
10
1
1/1/2011
1/15/2011
1/29/2011
2/12/2011
2/26/2011
3/12/2011
3/26/2011
4/9/2011
4/23/2011
5/7/2011
5/21/2011
6/4/2011
6/18/2011
7/2/2011
7/16/2011
7/30/2011
8/13/2011
8/27/2011
9/10/2011
9/24/2011
10/8/2011
10/22/2011
11/5/2011
11/19/2011
12/3/2011
12/17/2011
12/31/2011
1/14/2012
1/28/2012
2/11/2012
2/25/2012
3/10/2012
3/24/2012
4/7/2012
4/21/2012
5/5/2012
5/19/2012
Sample Collection Date

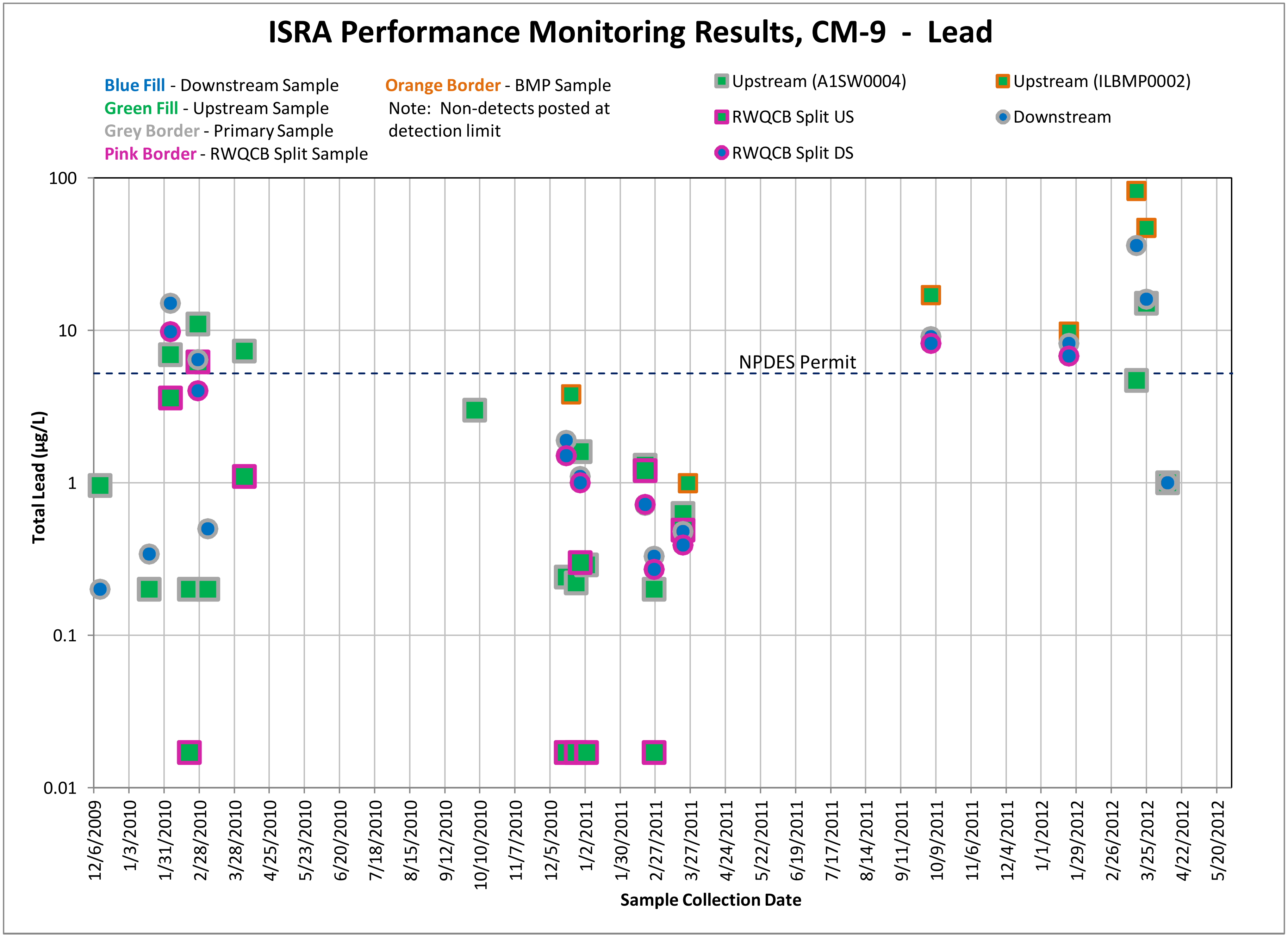


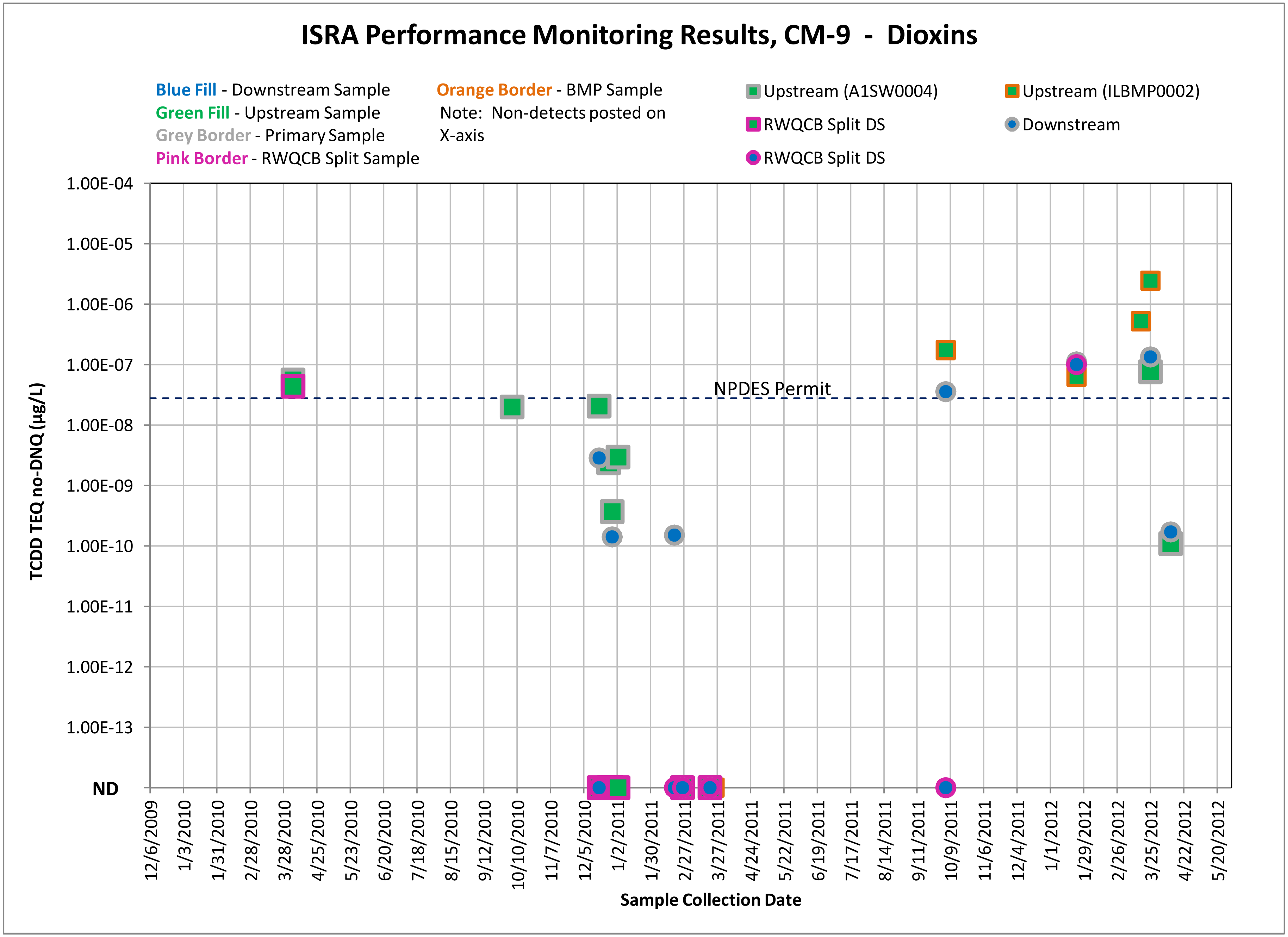
ISRA Performance Monitoring Results, B-1 - Lead
Blue Fill - Downstream Sample
Green Fill - Upstream Sample
Grey Border - Primary Sample
Pink Border - RWQCB Split Sample
Orange Border - BMP Sample
Note: Non-detects posted at detection limit
Upstream SW (B1SW0011 & 13 & B1BMP0005)
Upstream NE (B1SW0002)
Downstream (B1SW0010 & 14)
Upstream NE (B1SW0015 & B1BMP0004)
Upstream B1BMP0004-5
RWQCB Split US SW (B1SW0011 & 13)
RWQCB Split US NE (B1SW0002)
RWQCB Split DS (B1SW0010 & 14)
RWQCB Split US NE (B1SW0015)
NPDES Permit
Total Lead (µg/L)
100
10
1
0.1
1/1/2011
1/15/2011
1/29/2011
2/12/2011
2/26/2011
3/12/2011
3/26/2011
4/9/2011
4/23/2011
5/7/2011
5/21/2011
6/4/2011
6/18/2011
7/2/2011
7/16/2011
7/30/2011
8/13/2011
8/27/2011
9/10/2011
9/24/2011
10/8/2011
10/22/2011
11/5/2011
11/19/2011
12/3/2011
12/17/2011
12/31/2011
1/14/2012
1/28/2012
2/11/2012
2/25/2012
3/10/2012
3/24/2012
4/7/2012
4/21/2012
5/5/2012
5/19/2012
Sample Collection Date

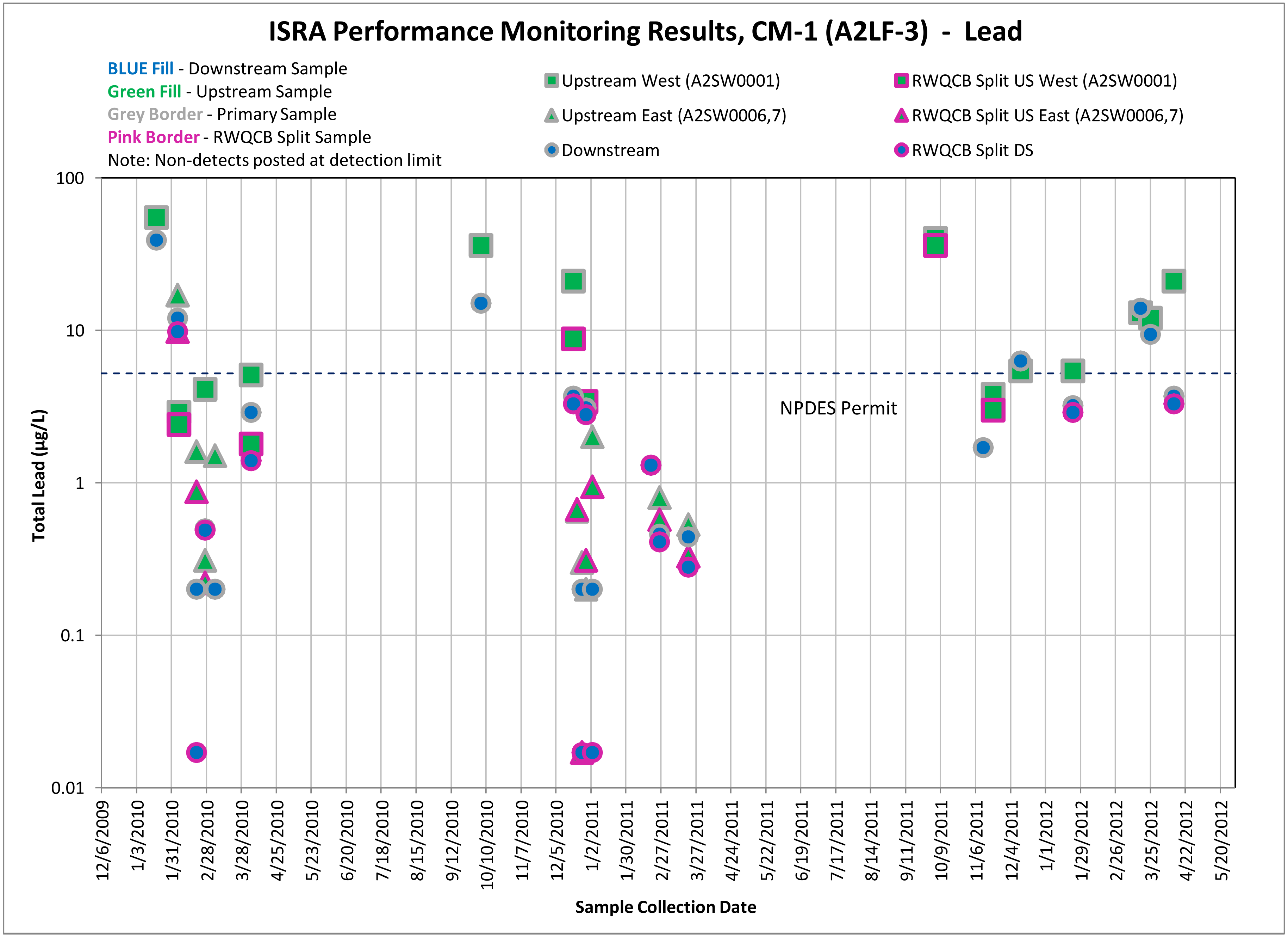


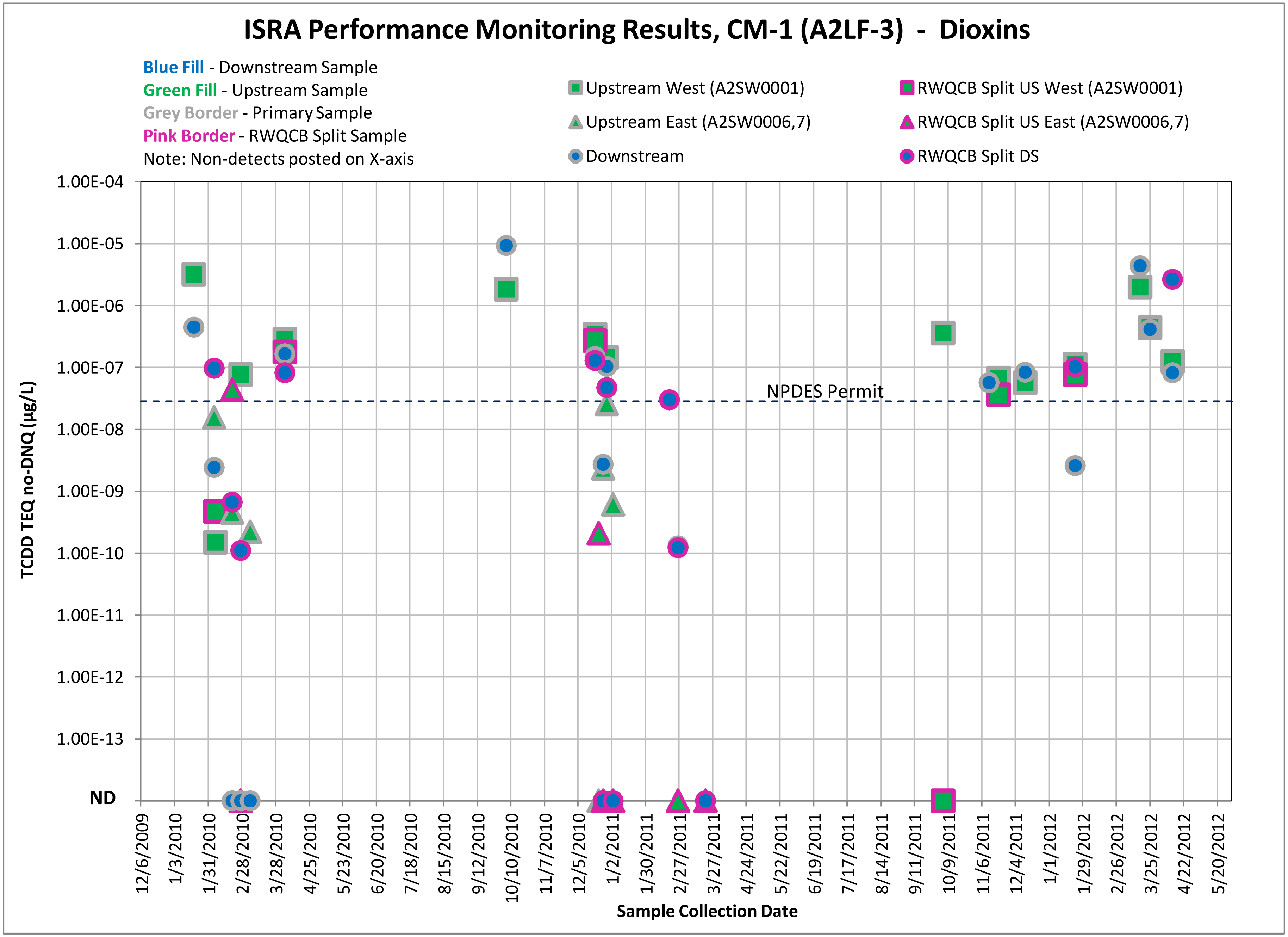
ISRA Performance Monitoring Results, B-1 - Dioxins
Blue Fill - Downstream Sample
Green Fill - Upstream Sample
Grey Border - Primary Sample
Pink Border - RWQCB Split Sample
Orange Border - BMP Sample
Note: Non-detects posted on X-axis
Upstream SW (B1SW0011 & 13 & B1BMP0005)
Upstream NE (B1SW0002)
Downstream (B1SW0010 & 14)
Upstream NE (B1SW0015 & B1BMP0004)
Upstream B1BMP0004-5
RWQCB Split US SW (B1SW0011 & 13)
RWQCB Split US NE (B1SW0002)
RWQCB Split DS (B1SW0010 & 14)
RWQCB Split US (B1SW0015)
Upstream (B1SW0008)
NPDES Permit
TCDD TEQ no-DNQ (µg/L)
1.00E-04
1.00E-05
1.00E-06
1.00E-07
1.00E-08
1.00E-09
1.00E-10
1.00E-11
1.00E-12
1.00E-13
ND
1/1/2011
1/15/2011
1/29/2011
2/12/2011
2/26/2011
3/12/2011
3/26/2011
4/9/2011
4/23/2011
5/7/2011
5/21/2011
6/4/2011
6/18/2011
7/2/2011
7/16/2011
7/30/2011
8/13/2011
8/27/2011
9/10/2011
9/24/2011
10/8/2011
10/22/2011
11/5/2011
11/19/2011
12/3/2011
12/17/2011
12/31/2011
1/14/2012
1/28/2012
2/11/2012
2/25/2012
3/10/2012
3/24/2012
4/7/2012
4/21/2012
5/5/2012
5/19/2012
Sample Collection Date


ISRA Performance Monitoring Results, CM-9 - Copper
Blue Fill - Downstream Sample
Green Fill - Upstream Sample
Grey Border - Primary Sample
Pink Border - RWQCB Split Sample
Orange Border - BMP Sample
Note: Non-detects posted at detection limit
Upstream (A1SW0004)
Upstream (ILBMP0002)
RWQCB Split US
Downstream
RWQCB Split DS
NPDES Permit
Total Copper (µg/L)
100
10
1
12/6/2009
1/3/2010
1/31/2010
2/28/2010
3/28/2010
4/25/2010
5/23/2010
6/20/2010
7/18/2010
8/15/2010
9/12/2010
10/10/2010
11/7/2010
12/5/2010
1/2/2011
1/30/2011
2/27/2011
3/27/2011
4/24/2011
5/22/2011
6/19/2011
7/17/2011
8/14/2011
9/11/2011
10/9/2011
11/6/2011
12/4/2011
1/1/2012
1/29/2012
2/26/2012
3/25/2012
4/22/2012
5/20/2012
Sample Collection Date


ISRA Performance Monitoring Results, CM-9 - Lead
Blue Fill - Downstream Sample
Green Fill - Upstream Sample
Grey Border - Primary Sample
Pink Border - RWQCB Split Sample
Orange Border - BMP Sample
Note: Non-detects posted at detection limit
Upstream (A1SW0004)
RWQCB Split US
RWQCB Split DS
Upstream (ILBMP0002)
Downstream
NPDES Permit
Total Lead (µg/L)
100
10
1
0.1
0.01
12/6/2009
1/3/2010
1/31/2010
2/28/2010
3/28/2010
4/25/2010
5/23/2010
6/20/2010
7/18/2010
8/15/2010
9/12/2010
10/10/2010
11/7/2010
12/5/2010
1/2/2011
1/30/2011
2/27/2011
3/27/2011
4/24/2011
5/22/2011
6/19/2011
7/17/2011
8/14/2011
9/11/2011
10/9/2011
11/6/2011
12/4/2011
1/1/2012
1/29/2012
2/26/2012
3/25/2012
4/22/2012
5/20/2012
Sample Collection Date


ISRA Performance Monitoring Results, CM-9 - Dioxins
Blue Fill - Downstream Sample
Green Fill - Upstream Sample
Grey Border - Primary Sample
Pink Border - RWQCB Split Sample
Orange Border - BMP Sample
Note: Non-detects posted on X-axis
Upstream (A1SW0004)
RWQCB Split DS
RWQCB Split DS
Upstream (ILBMP0002)
Downstream
NPDES Permit
TCDD TEQ no-DNQ (µg/L)
1.00E-04
1.00E-05
1.00E-06
1.00E-07
1.00E-08
1.00E-09
1.00E-10
1.00E-11
1.00E-12
1.00E-13
ND
12/6/2009
1/3/2010
1/31/2010
2/28/2010
3/28/2010
4/25/2010
5/23/2010
6/20/2010
7/18/2010
8/15/2010
9/12/2010
10/10/2010
11/7/2010
12/5/2010
1/2/2011
1/30/2011
2/27/2011
3/27/2011
4/24/2011
5/22/2011
6/19/2011
7/17/2011
8/14/2011
9/11/2011
10/9/2011
11/6/2011
12/4/2011
1/1/2012
1/29/2012
2/26/2012
3/25/2012
4/22/2012
5/20/2012
Sample Collection Date


ISRA Performance Monitoring Results, CM-1 (A2LF-3) - Lead
BLUE Fill - Downstream Sample
Green Fill - Upstream Sample
Grey Border - Primary Sample
Pink Border - RWQCB Split Sample
Note: Non-detects posted at detection limit
Upstream West (A2SW0001)
Upstream East (A2SW0006,7)
Downstream
RWQCB Split US West (A2SW0001)
RWQCB Split US East (A2SW0006,7)
RWQCB Split DS
NPDES Permit
Total Lead (µg/L)
100
10
1
0.1
0.01
12/6/2009
1/3/2010
1/31/2010
2/28/2010
3/28/2010
4/25/2010
5/23/2010
6/20/2010
7/18/2010
8/15/2010
9/12/2010
10/10/2010
11/7/2010
12/5/2010
1/2/2011
1/30/2011
2/27/2011
3/27/2011
4/24/2011
5/22/2011
6/19/2011
7/17/2011
8/14/2011
9/11/2011
10/9/2011
11/6/2011
12/4/2011
1/1/2012
1/29/2012
2/26/2012
3/25/2012
4/22/2012
5/20/2012
Sample Collection Date



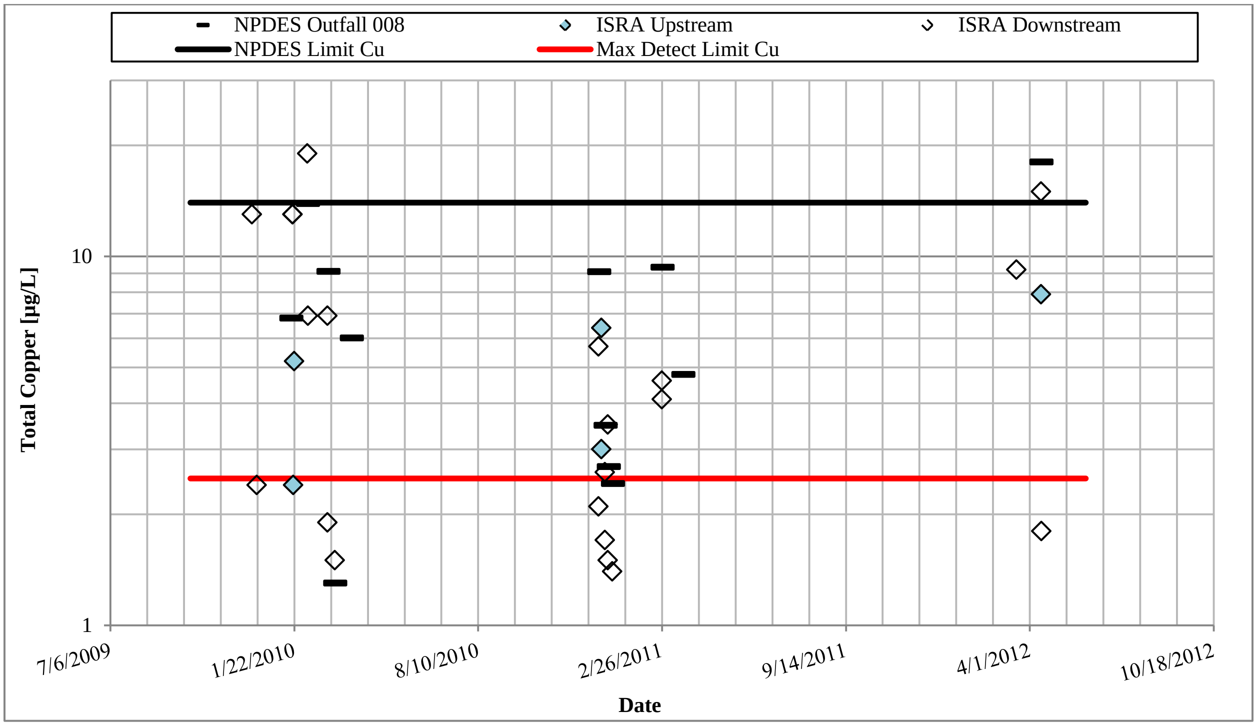
ISRA Performance Monitoring Results, CM-1 (A2LF-3) - Dioxins
Blue Fill - Downstream Sample
Green Fill - Upstream Sample
Grey Border - Primary Sample
Pink Border - RWQCB Split Sample
Note: Non-detects posted on X-axis
Upstream West (A2SW0001)
Upstream East (A2SW0006,7)
Downstream
RWQCB Split US West (A2SW0001)
RWQCB Split US East (A2SW0006,7)
RWQCB Split DS
NPDES Permit
TCDD TEQ no-DNQ (µg/L)
1.00E-04
1.00E-05
1.00E-06
1.00E-07
1.00E-08
1.00E-09
1.00E-10
1.00E-11
1.00E-12
1.00E-13
ND
12/6/2009
1/3/2010
1/31/2010
2/28/2010
3/28/2010
4/25/2010
5/23/2010
6/20/2010
7/18/2010
8/15/2010
9/12/2010
10/10/2010
11/7/2010
12/5/2010
1/2/2011
1/30/2011
2/27/2011
3/27/2011
4/24/2011
5/22/2011
6/19/2011
7/17/2011
8/14/2011
9/11/2011
10/9/2011
11/6/2011
12/4/2011
1/1/2012
1/29/2012
2/26/2012
3/25/2012
4/22/2012
5/20/2012
Sample Collection Date

# APPENDIX C-2

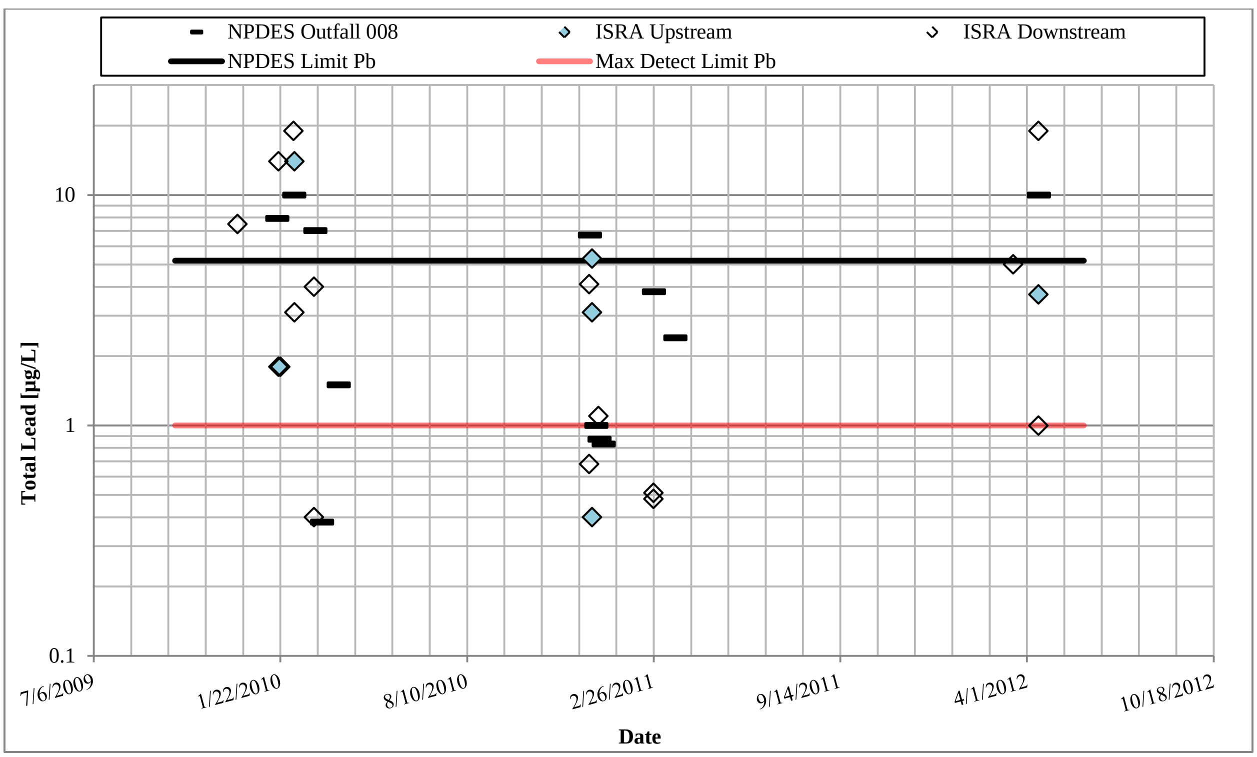
# PERFORMANCE MONITORING COC TIME-SERIES CHARTS
# 2011/2012 RAINY SEASON

# OUTFALL 008 TIMESERIES CHARTS
# ISRA PERFORMANCE MONITORING PROGRAM

## COPPER



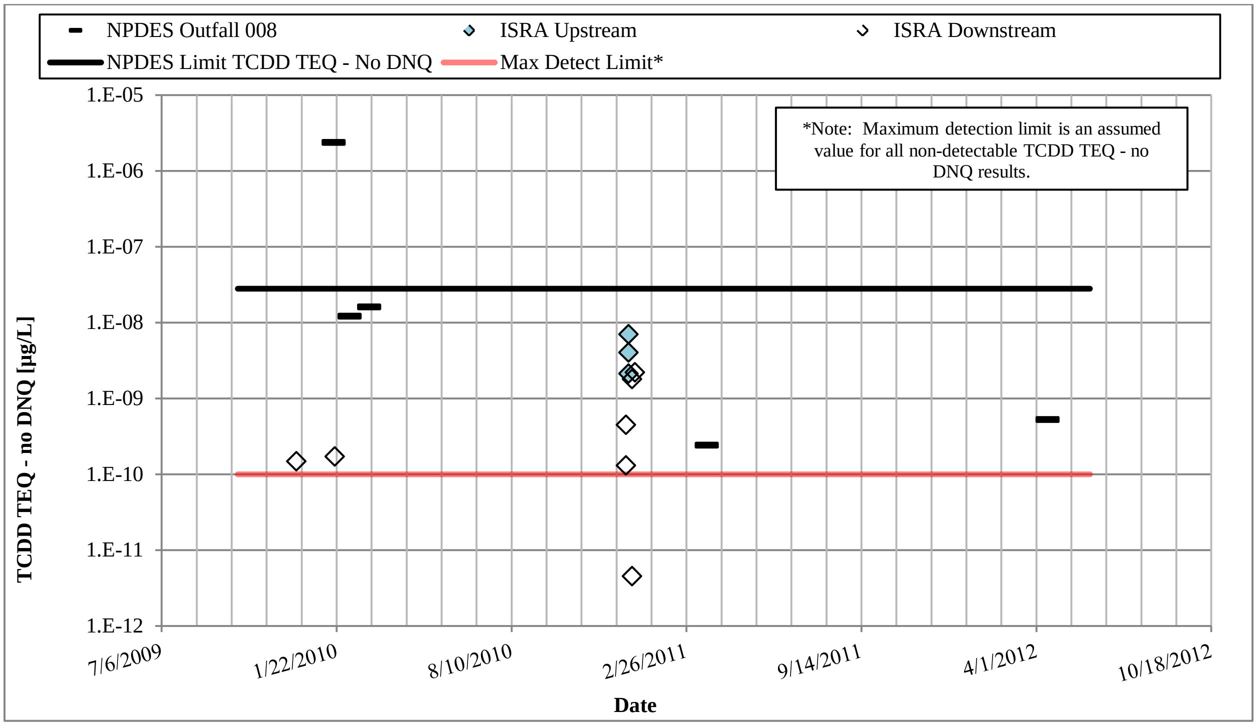

## LEAD



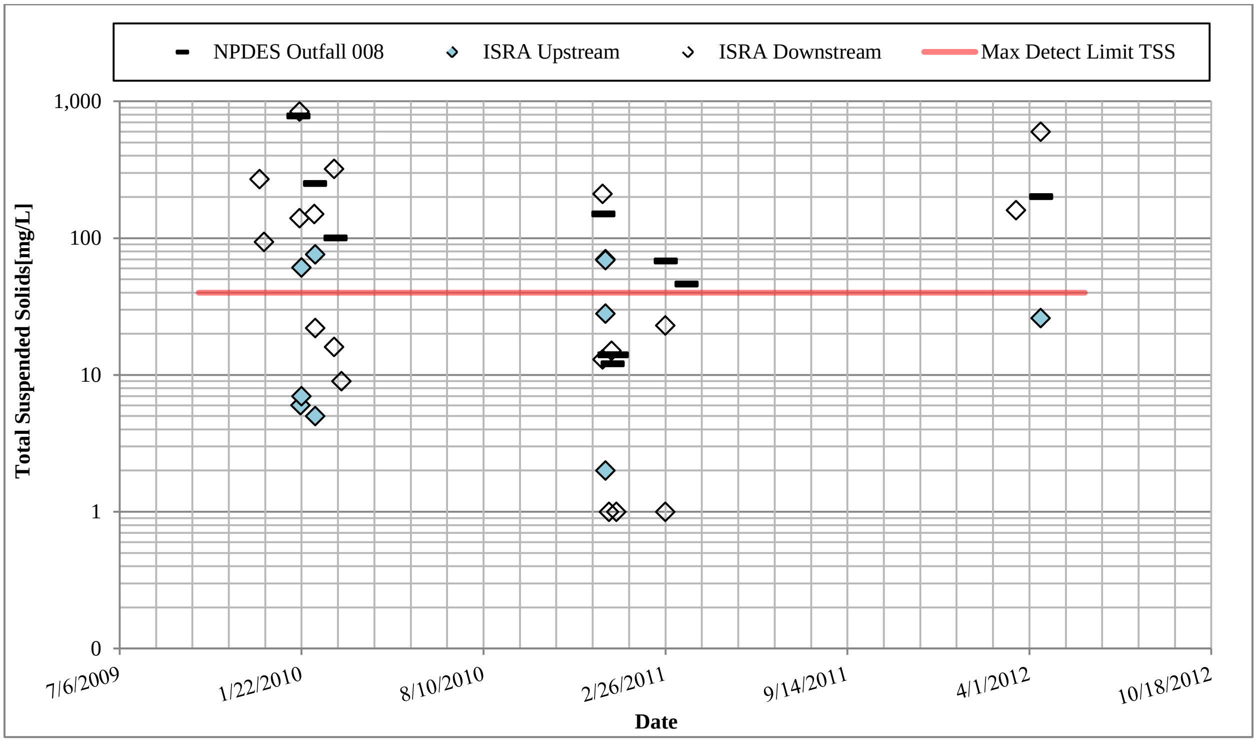

Sample results measured below the detection limit have been excluded. Results shown below the maximum detection limit line correspond to samples with a detection limit less than the maximum detection limit.

# OUTFALL 008 TIMESERIES CHARTS
# ISRA PERFORMANCE MONITORING PROGRAM

## DIOXINS (TCDD-TEQ - no DNQ)



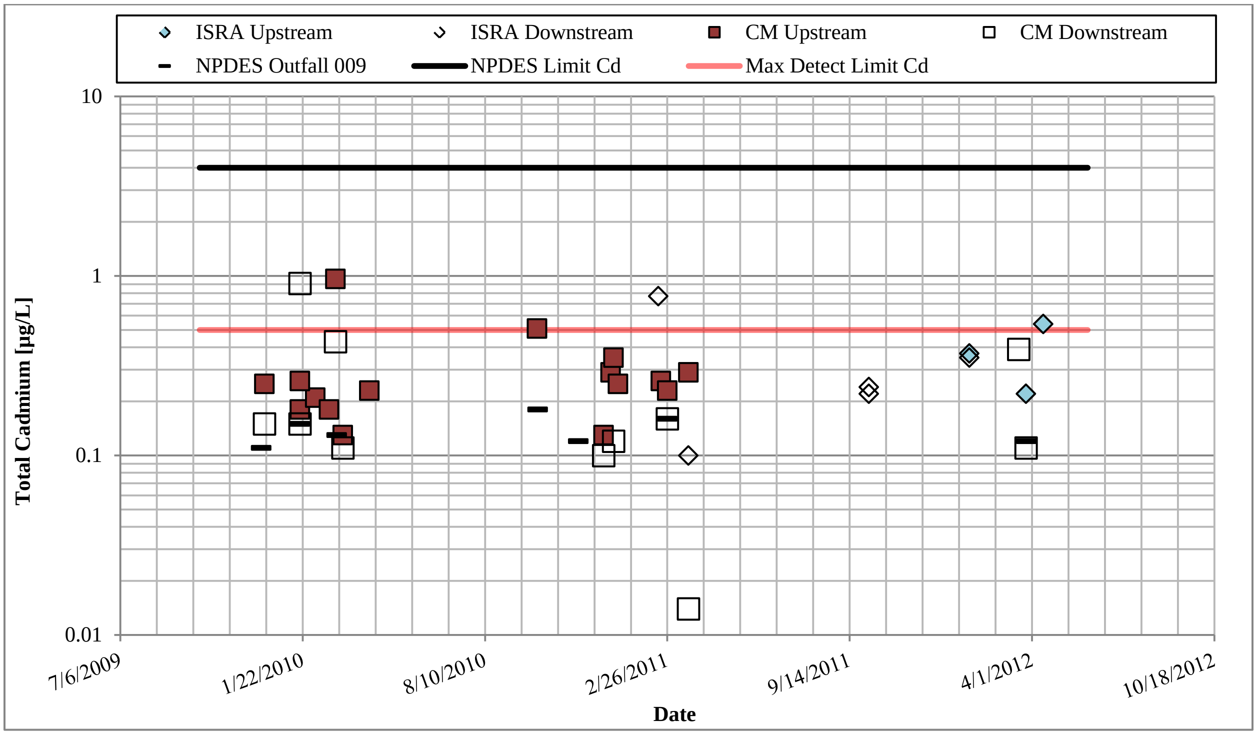

## TSS




Sample results measured below the detection limit have been excluded. Results shown below the maximum detection limit line correspond to samples with a detection limit less than the maximum detection limit.

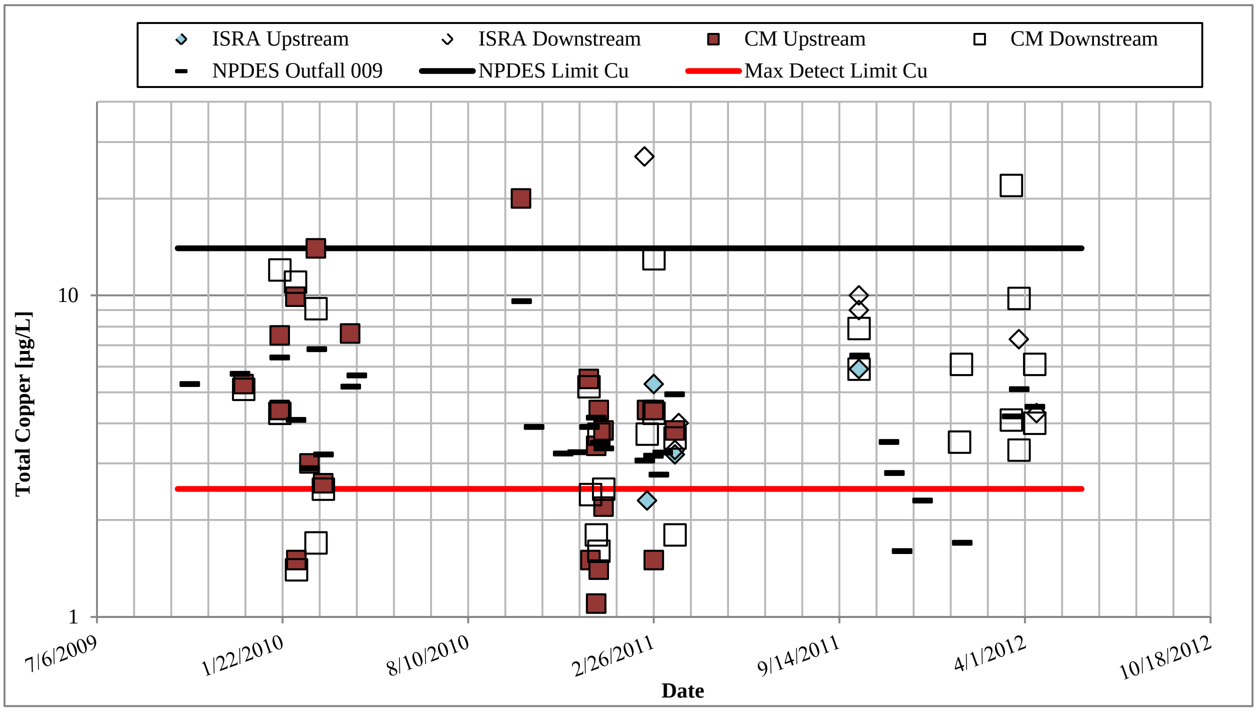
# OUTFALL 009 TIMESERIES CHARTS
# ISRA PERFORMANCE MONITORING PROGRAM

## CADMIUM




Background CM Upstream monitoring locations 8 and 11 were discontinued for the 2011-2012 monitoring season

## COPPER

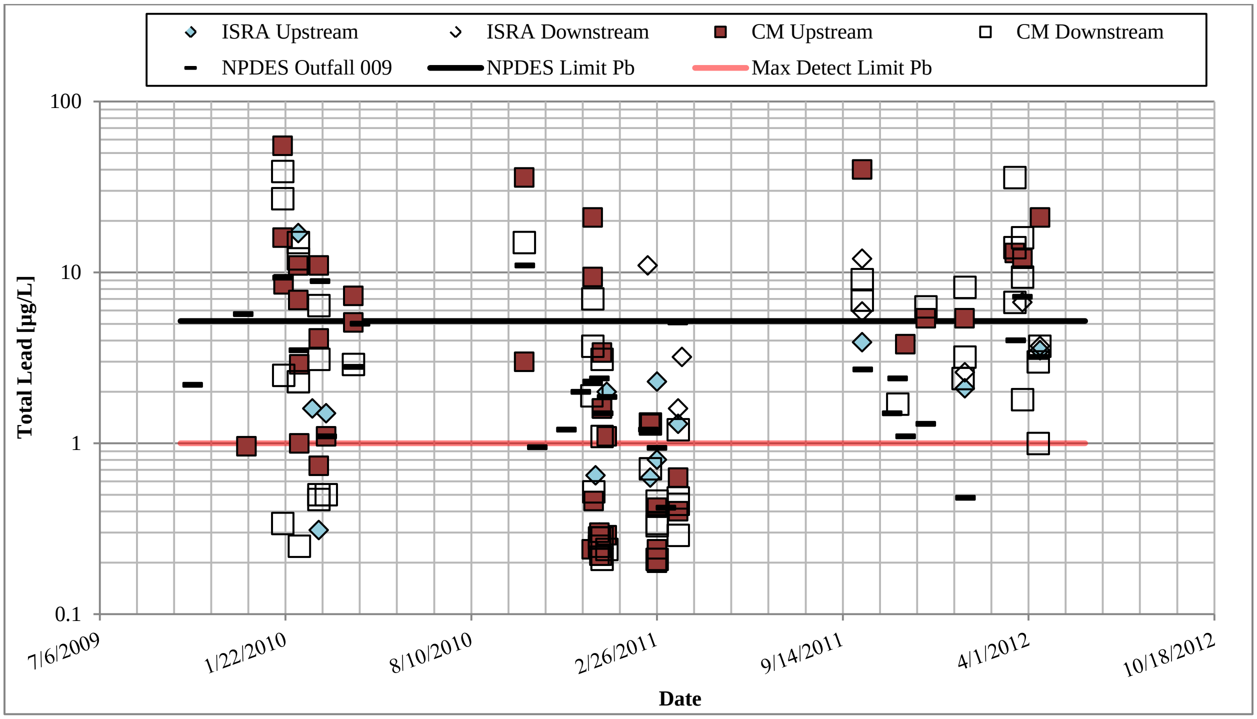



Background CM Upstream monitoring locations 8 and 11 were discontinued for the 2011-2012 monitoring season

Sample results measured below the detection limit have been excluded. Results shown below the maximum detection limit line correspond to samples with a detection limit less than the maximum detection limit.

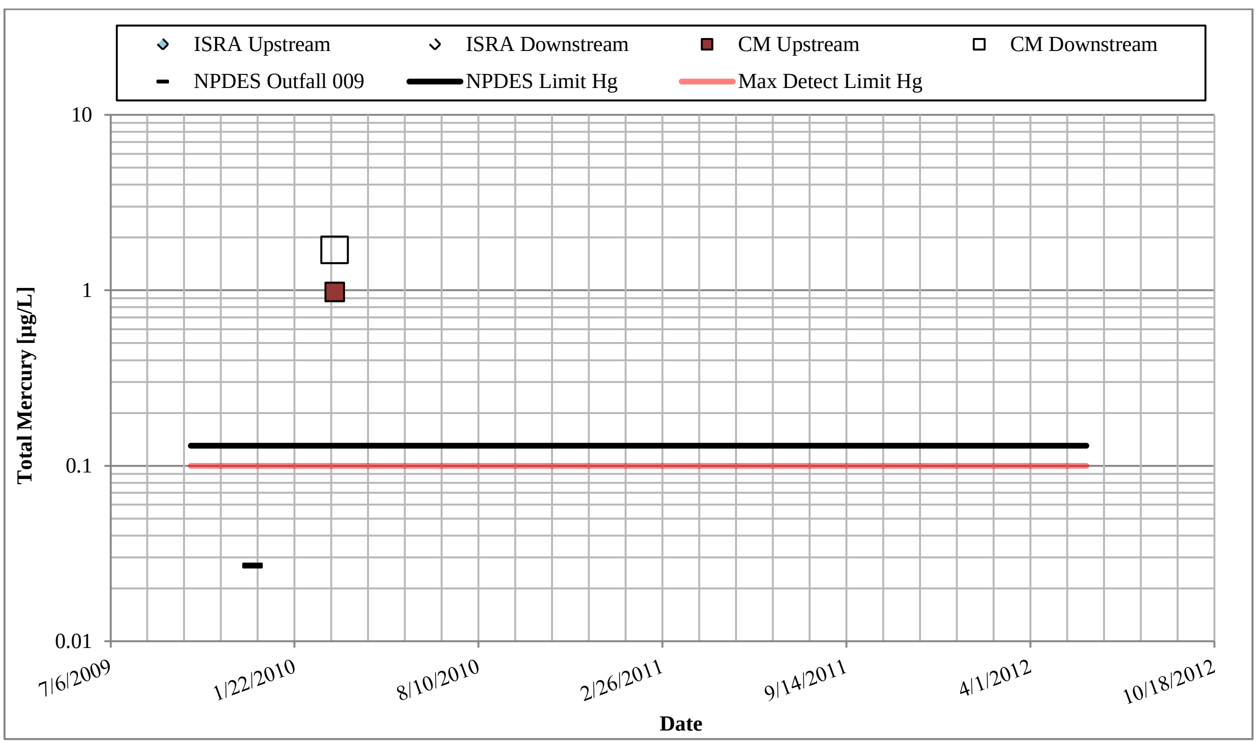
# OUTFALL 009 TIMESERIES CHARTS
# ISRA PERFORMANCE MONITORING PROGRAM

## LEAD




Background CM Upstream monitoring locations 8 and 11 were discontinued for the 2011-2012 monitoring season

## MERCURY

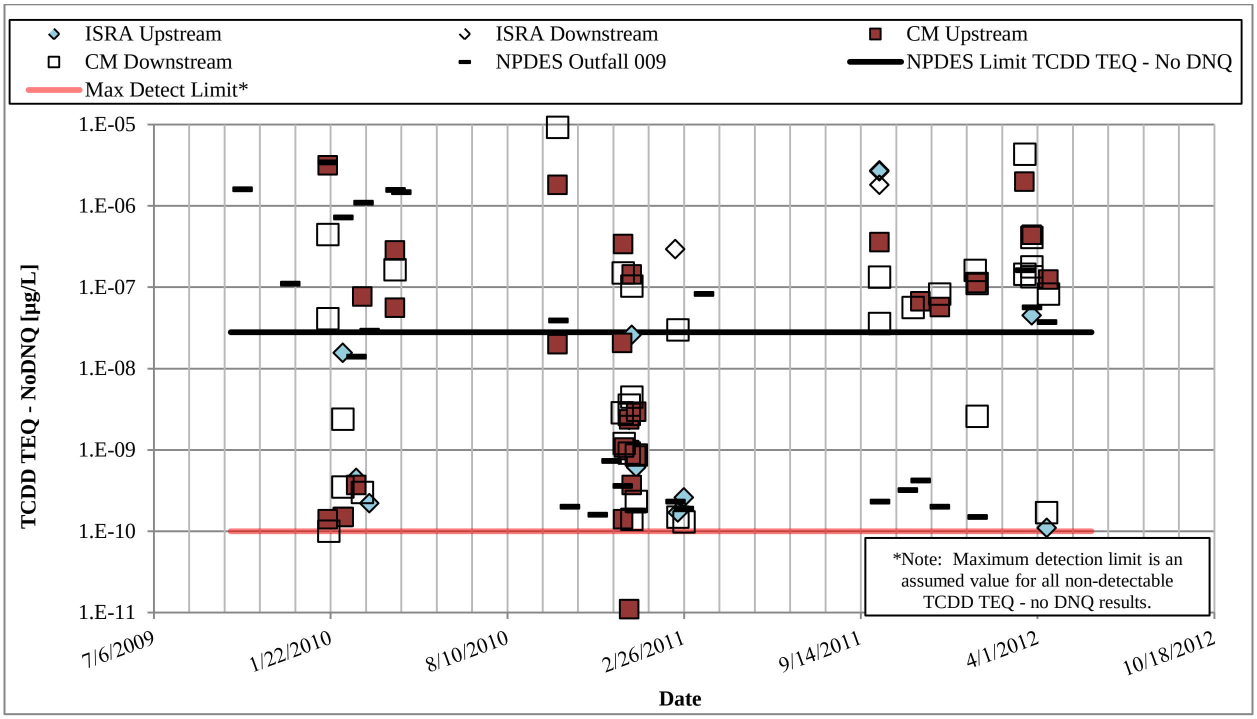



Background CM Upstream monitoring locations 8 and 11 were discontinued for the 2011-2012 monitoring season

Sample results measured below the detection limit have been excluded. Results shown below the maximum detection limit line correspond to samples with a detection limit less than the maximum detection limit.

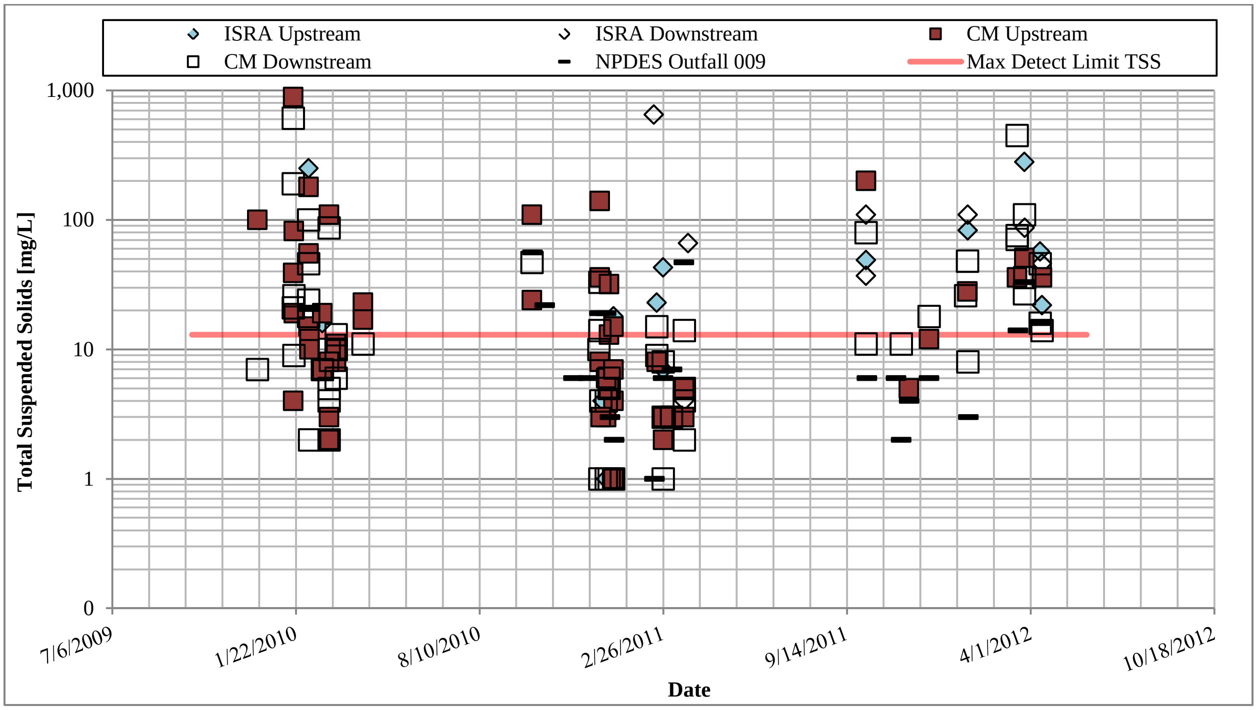
## OUTFALL 009 TIMESERIES CHARTS
## ISRA PERFORMANCE MONITORING PROGRAM

### DIOXINS (TCDD-TEQ – no DNQ)




Background CM Upstream monitoring locations 8 and 11 were discontinued for the 2011-2012 monitoring season

### TSS




Background CM Upstream monitoring locations 8 and 11 were discontinued for the 2011-2012 monitoring season

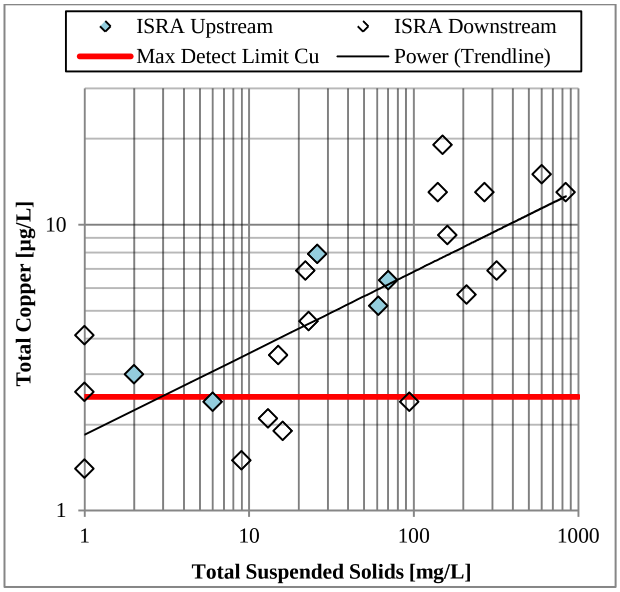
Sample results measured below the detection limit have been excluded. Results shown below the maximum detection limit line correspond to samples with a detection limit less than the maximum detection limit.

# APPENDIX C-3

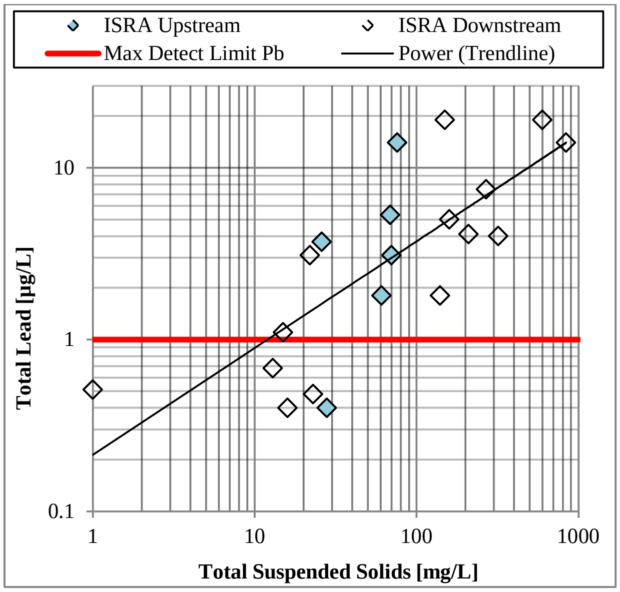
# PERFORMANCE MONITORING COC VS TSS CORRELATION CHARTS
# 2011/2012 RAINY SEASON

## OUTFALL 008 CORRELATION CHARTS
## ISRA PERFORMANCE MONITORING PROGRAM

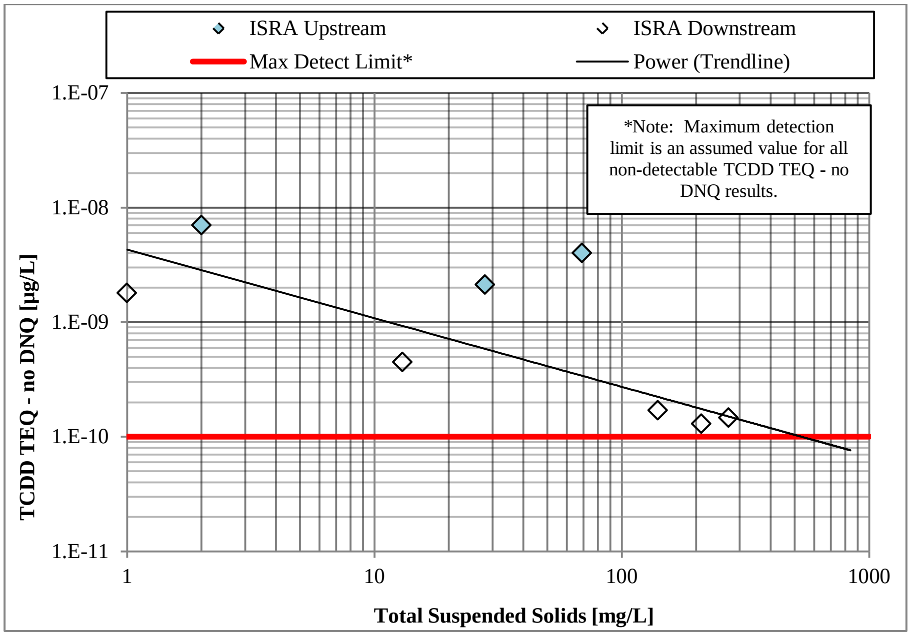
### COPPER VS TSS




### LEAD VS TSS




### DIOXINS (TCDD-TEQ – no DNQ) VS TSS

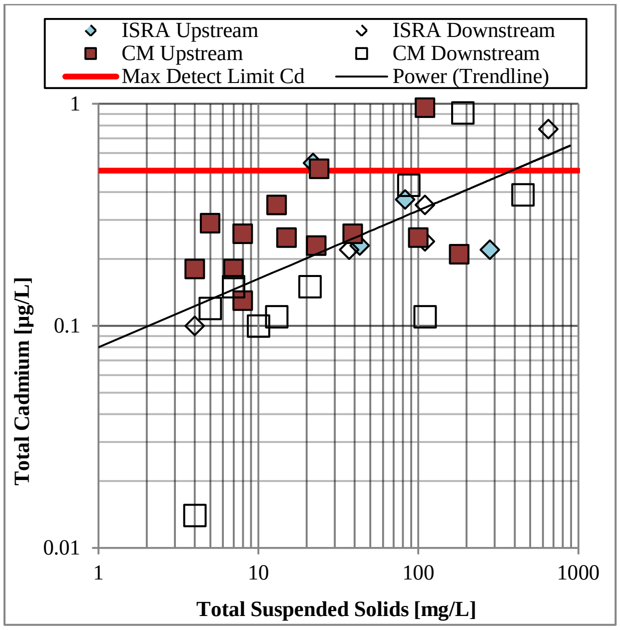



Sample results measured below the detection limit have been excluded. Results shown below the maximum detection limit line correspond to samples with a detection limit less than the maximum detection limit.

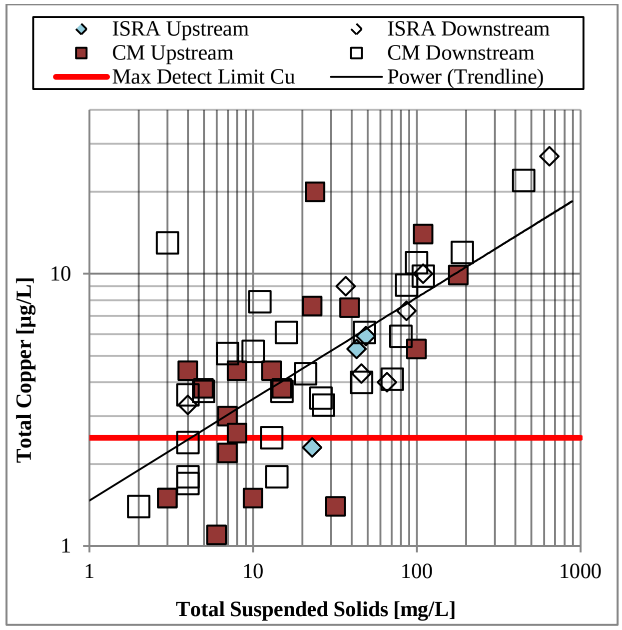
Several CM Upstream locations are also shown as background locations on the BMP Performance Monitoring plots.

# OUTFALL 009 CORRELATION CHARTS
# ISRA PERFORMANCE MONITORING PROGRAM

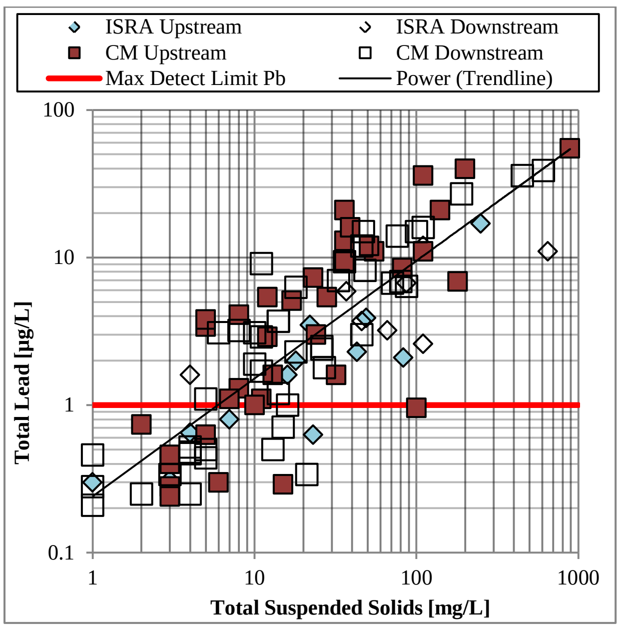
## CADMIUM VS TSS



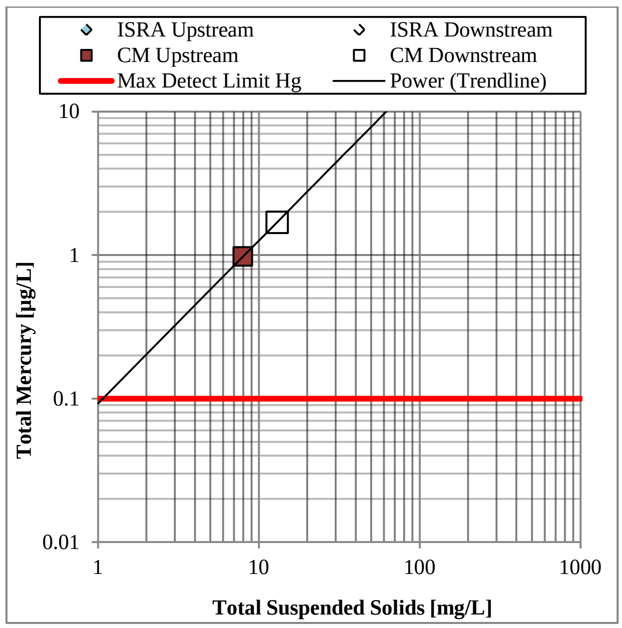

## COPPER VS TSS




## LEAD VS TSS




## MERCURY VS TSS

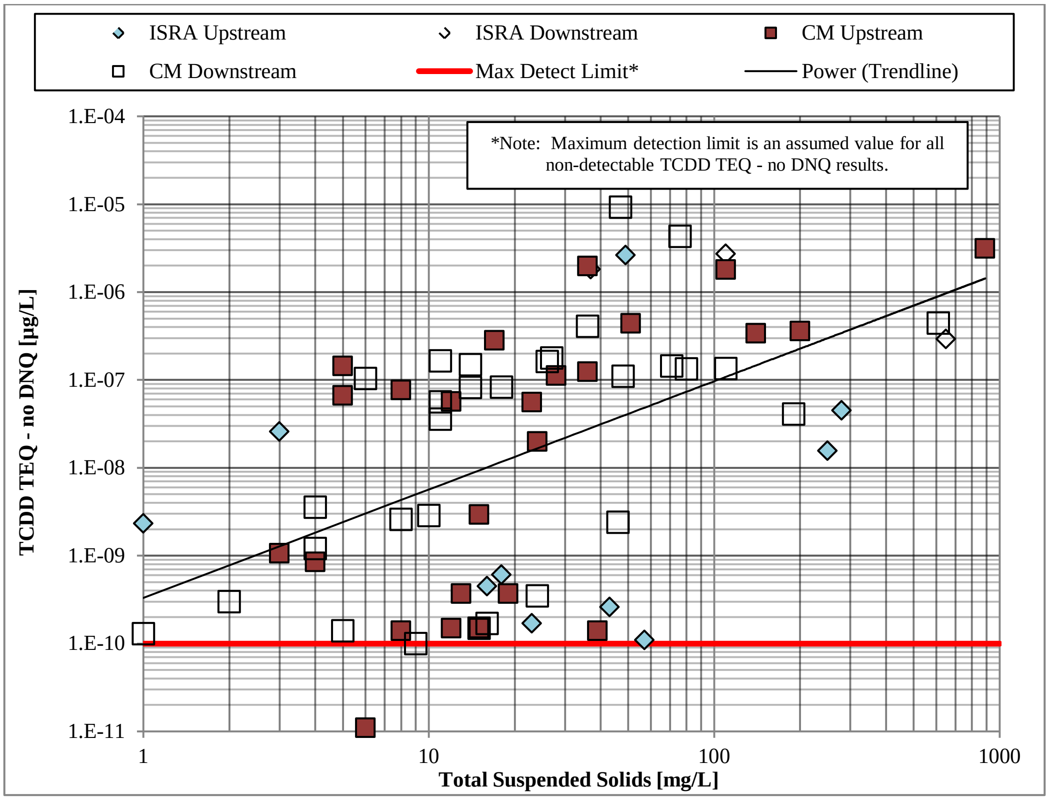



Sample results measured below the detection limit have been excluded. Results shown below the maximum detection limit line correspond to samples with a detection limit less than the maximum detection limit.

Several CM Upstream locations are also shown as background locations on the BMP Performance Monitoring plots.

**OUTFALL 009 CORRELATION CHARTS**
**ISRA PERFORMANCE MONITORING PROGRAM**

## DIOXINS (TCDD-TEQ – no DNQ) VS TSS




Sample results measured below the detection limit have been excluded. Results shown below the maximum detection limit line correspond to samples with a detection limit less than the maximum detection limit.

Several CM Upstream locations are also shown as background locations on the BMP Performance Monitoring plots.

# APPENDIX D

# SAMPLE SPLIT EVALUATION MEMORANDUM
# 2011/2012 RAINY SEASON

# Memorandum

Date: 31 August 2012

To: The Boeing Company (Boeing), Santa Susana Field Laboratory (Santa Susana Site)

From: Geosyntec Consultants and the Santa Susana Site Surface Water Expert Panel

Subject: Sample Split Evaluation
Santa Susana Site
Geosyntec Project: SB0363S

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## Background

The Boeing Company's (Boeing) Santa Susana Site (SSS) is located in the Simi Hills near the Los Angeles/Ventura County line. Part of Boeing's stormwater monitoring program includes sampling at Interim Source Removal Action (ISRA) and culvert modification (CM) (or best management practices [BMPs]) monitoring locations[1]. Stormwater sampling at these locations began in December of 2009. Sample splits were analyzed as part of the stormwater monitoring quality control (QC) program since February of 2010. Splits are typically one sample divided into two subsamples (either in the field or at the laboratory), where one subsample (the "sample") would be analyzed at the project lab and the other subsample (the "split") would be analyzed at an independent lab (in this case, the Regional Water Quality Control Board [RWQCB] laboratory). Early in Boeing's sampling program, a replicate sample was collected by filling a secondary container (the split) after filling the primary container (the sample) at the time of sample collection in the field. Due to inherent difficulties when collecting the two samples containing sediment, or through user error, it is hypothesized that this method may not have resulted in the collection of a true split, or replicate sample. As such, a United States Geological Survey (USGS)-Dekaport (cone) splitter was implemented on February 16, 2011. The USGS developed this new sample splitter for use in the field to split a single collected sample into two or more identical samples. This was done after they found that prior methods resulted in errors, especially for surface water samples that contained significant amounts of solids.

[1] Sample locations with paired data included in this analysis include B1 CM, B1-1A, B1-2, CM-1/A2LF-3, CM-11, CM-3, CM-8, CM-9/A1LF, CM-9/IEL, CTLI, CYN-1/DRG-1, DRG-1, HVS, HVS-1, HVS-2A/-2D, HVS-2B-1/-2, and HVS-3.

The Dekaport splitter is a positive pour device that composites and splits the sample in one step, in a manner that largely compensates for the different settling rates of various sized sediments and is known to provide accurate divisions of samples containing a wide range of particulate solids. Use of the Dekaport cone splitter was expected to improve analytical consistency between split samples containing significant concentrations of suspended sediments to which the SSFL National Pollutant Discharge Elimination System (NPDES) Constituents of Concern (COCs) sorb; at low sediment concentrations, analytical inconsistencies will still have to be attributed to variability in other laboratory or sampling procedures. Proper sampling procedures for this location and the new Dekaport sampling splitter can be found in the document *Environmental Sampling of Dioxins and Other Low Solubility Pollutants at Parts-Per-Billion and Lower Concentrations: Field Protocols for Collecting Santa Susana Field Laboratory (SSFL) ISRA Performance Samples and Obtaining Splits Using a Dekaport Cone Splitter* (WWE and Expert Panel, 2010).

## Purpose

The purpose of this analysis is to evaluate the precision and accuracy of the sample and split results both before and after implementation of the Dekaport splitter. The reliability of the RWQCB laboratory, manual split results, and Dekaport split results are also evaluated through this analysis of split results.

## Methodology

The accuracy and precision of the split sample results, before and after implementation of the Dekaport sampling splitter, have been evaluated for total suspended solids (TSS), TCDD dioxin (TEQ_noDNQ), total copper, and total lead by reporting the mean, coefficient of variation, and average split to sample ratio (A split to sample ratio close to one indicates comparable split to sample results, >1 indicates that split results tended to be greater than sample results, and <1 indicates the opposite. This ratio has more meaning when the difference between split and sample is shown to be significantly different using the one-tailed sign test, as explained below). For the reporting of summary statistics, non-detect results were set at their detection limits[2] and TCDD total toxic equivalence (TEQ) assumed a value of $10^{-10}$ micrograms per liter (ug/L) for non-detect results (roughly equal to the lower TEQ [no DNQ] reported value), and J-flag results were included, again except for TCDD TEQ which did not include congener results not quantified (DNQ) (i.e., these were treated as zero). A nonparametric one-sided sign test ($\alpha$=0. 5) was applied to the paired data to assess if the two datasets were statistically significantly different[3]. To create a more robust statistical analysis, the number of sample results that were greater than or less than their split counterparts (positive and negative signs) was increased by one half the number of instances where the sample result was equal to the split result. A paired

[2] The detection limits varied between laboratories and between samples.
[3] If both the sample and split were non-detect, the sample pair was removed from the nonparametric sign test.

dataset that is different with statistical significance means that insufficient data have been obtained to produce a significant correlation. To allow a visual evaluation of the statistical significance of each paired dataset, the log-transformed data was plotted with 95% confidence limits on the mean response and a linear regression forced through zero[4].

## Results

A summary of the sample and split statistical analysis, prior to and after implementation of the Dekaport splitter in February of 2011, are summarized in Table 1. Over 400 pairs of observations were analyzed, with approximately 35 to 57 pairs of data for each COC using the manual split method and 21 to 44 pairs of data for each COC using the Dekaport splitter (excluding non-detect pairs).

With the exception of copper, which had approximately a 57% difference between split and sample coefficients of variation (COVs), the difference of variation observed for COCs between laboratories was similar during the manual split period, ranging from 3 to 26%. After implementation of the Dekaport splitter, the difference of variation for COCs similarly ranged from 5 to 25%. This suggests that there was some variation in different laboratory procedures introduced after sample collection and splitting, and that, regardless of improved splitting techniques, this variation remained. Variation could have been due to differences in sample handling, transit times, hold times, lab analytical practices, lab analysis/reporting procedures, post-lab data validation practices, or other influencing factors.

The nonparametric sign test resulted in manual split one-tailed p values of 0.02 for TSS, $8.1 \times 10^{-3}$ for copper, and $1.0 \times 10^{-11}$ for lead; three of four COCs in the manual sample set have split and sample results considered statistically significantly different (based on the $p<0.05$ criteria for significance). Dioxin, with a one-tailed p value of 0.08, shows a marginally statistically significant difference. In the Dekaport split sample set, TSS, dioxin, copper and lead all have one-tailed p values less than 0.05, at 0.01, $7.5 \times 10^{-4}$, $2.7 \times 10^{-4}$, and $2.8 \times 10^{-9}$, respectively, which suggests that despite Dekaport implementation, these split and sample results are still considered statistically significantly different, likely indicating a laboratory bias in the results and not a sample splitting issue. Although the same trend was observed last year, as additional data are collected using the Dekaport splitter, it is anticipated that the datasets will be less statistically significantly different for all of the COCs, with the exception of the manually split sample set, which will remain limited to what was collected in the early sample period.

In the sampling period prior to February of 2011, employing manual splits, the average of the split to sample ratios ranged from 0.69 (for lead) to 125 (for dioxin). After Dekaport sampler implementation, the average of split to sample ratios for each unique COC ranged from 0.82 (for copper and lead) to 3.9 (for dioxin), which resulted in all of the ratios improving (becoming

[4] If either the sample or the spit was non-detect, the sample pair was removed so that the plots only display detectable values.

closer to 1) with the exception of copper. Looking at the split to sample ratio of lead, the ratio improves from 0.69 to 0.82. These results suggest that splits obtained using the Dekaport splitter are more reliable (or precise) than those collected by taking two replicate samples manually. However, looking at the split to sample ratios themselves suggests that despite the improved sampling methods, there was still significant variability between laboratories, which is not unusual for trace analyses.

The average split to sample ratio for dioxins was 0.6 for the complete dataset from February 2011 through April 2012 (excluding two outlier ratios of 30 and 39 ug/L, which were measured in spring of 2012). In comparison, looking at February 2011 to March 2011, the split to sample ratio was 0.7, suggesting that there was more inconsistency between labs this year than in past years, and that the RWQCB lab tends to under-predict dioxin results.

**Table 1. Sample Split Statistical Analysis (bolded p values are <0.05)**

| | | **TSS (mg/L)** | **Dioxin (µg/L)** | **Copper (µg/L)** | **Lead (µg/L)** |
|---|---|---|---|---|---|
| Total pairs of observations | | 101 | 63 | 64 | 100 |
| **Split Samples Collected Manually (February 2010 – January 2011)** | | | | | |
| Pairs of observations | | 57 | 42 | 35 | 57 |
| % Detectable Values | | 63 | 60 | 100 | 83 |
| Average (COV) | Sample result | 40 (1.7) | 2.8e-08 (2.7) | 4.6 (0.9) | 3.7 (1.4) |
| | Split result | 93 (2.2) | 3.4e-08 (2.6) | 3.2 (0.50) | 2.1 (1.3) |
| Average split to sample ratio | | 3.9 | 125* | 0.86 | 0.69 |
| p by paired nonparametric one-tailed sign test | | **0.02** | 0.08 | **8.1e-03** | **1.0e-11** |
| **Split Samples Collected using Dekaport Splitter (February 2011 – April 2012)** | | | | | |
| Pairs of observations | | 44 | 21 | 29 | 43 |
| % Detectable Values | | 80 | 69 | 100 | 99 |
| Average (COV) | Sample result | 45 (2.3) | 4.2e-07 (2.0) | 5.7 (0.9) | 3.5 (1.9) |
| | Split result | 54 (2.1) | 3.1e-07 (2.5) | 4.3 (0.7) | 2.9 (2.0) |
| Average split to sample ratio | | 2.4 | 3.9** | 0.82 | 0.82 |
| p by paired nonparametric one-tailed sign test | | **0.01** | **7.5e-04** | **2.7e-04** | **2.8e-09** |

*The average is greatly affected by one paired set with a ratio of 4900. After the removal of this set, the average ratio is 8.7.

**The average is greatly affected by two paired sets with ratios of 39 and 30. After the removal of these two sets, the average ratio is 0.8.

The following scatter plots depict the log-transformed sample results plotted against the log-transformed split results for each of the four COCs for all pre- and post-Dekaport data (Figures 1 to 4). Each plot contains the regression slope (based on all detectable paired data, both sample and split) forced through zero, 95% confidence limits on the coefficient, and a 1:1 line. Where the 1:1 line fits within the confidence limits, the data are considered to have a statistically significant correlation. Additionally, the data are considered to be unbiased if the slope coefficient is close to 1. When creating these plots, if either the sample or split result was reported as non-detect (below the detection limit), then both the sample and split results were removed from the plot (e.g. if the sample result was non-detect, but the split result was a reported value, then both results were excluded from these plots). For copper and lead, most of the data fall to the right of the 1:1 line; therefore the sample results are more often greater than the split results. However this does not necessarily indicate that a statistically significant bias exists (the statistical tests are necessary to base this conclusion).

TSS results are plotted in Figure 1. There is considerable scatter outside of the 95% confidence limits on the slope coefficient, particularly for the manually split results. The fact that scatter for the manually split results remains large at higher concentrations (above about 30 mg/L), while scatter for the Dekaport cone splits is greatly reduced in this range suggests that the splitter is working properly in compensating for difficulties in splitting sediment samples. The 1:1 line does fall within the confidence limits for part of the data and the slope coefficient (1.09) is close to 1, which suggests the data show a statistically significant correlation. In addition, the sign test results for the TSS split data do not indicate any significant difference for these numbers of sample pairs. The dioxin data (Figure 2) show similar trends (1:1 slope falls in the 95% confidence intervals for part of the data and the slope coefficient (0.97) is close to 1), however there is similar scatter in the manual and Dekaport split sample results. In two cases, the sample result was less than the permit limit, but the split result was greater than the permit limit. These occurred at A2SW0002 (CM1 effluent) on February 5, 2010, and at A1SW0006 (CM11 upstream, background) on February 27, 2010. The split:sample ratios for these dates were 41 and 4900, respectively.

Copper (Figure 3) shows a 1:1 line outside of the 95% confidence limits for most of the data and a slope coefficient of 0.80, suggesting that this comparison of sample to split results does not have a statistically significant correlation and displays an approximate 20% bias. Similar scatter is observed for both the manual and Dekaport split samples. Lead (Figure 4) data show a similar trend (the 1:1 line is outside of the 95% confidence intervals for most of the data and a slope coefficient of 0.81 indicating an approximate 20% bias), and shows similar scatter between the manual and Dekaport split samples. Both copper and lead results show significant lab bias with sample results being consistently greater than split results (i.e., majority of data fall to the right of the red dashed 1:1 line).

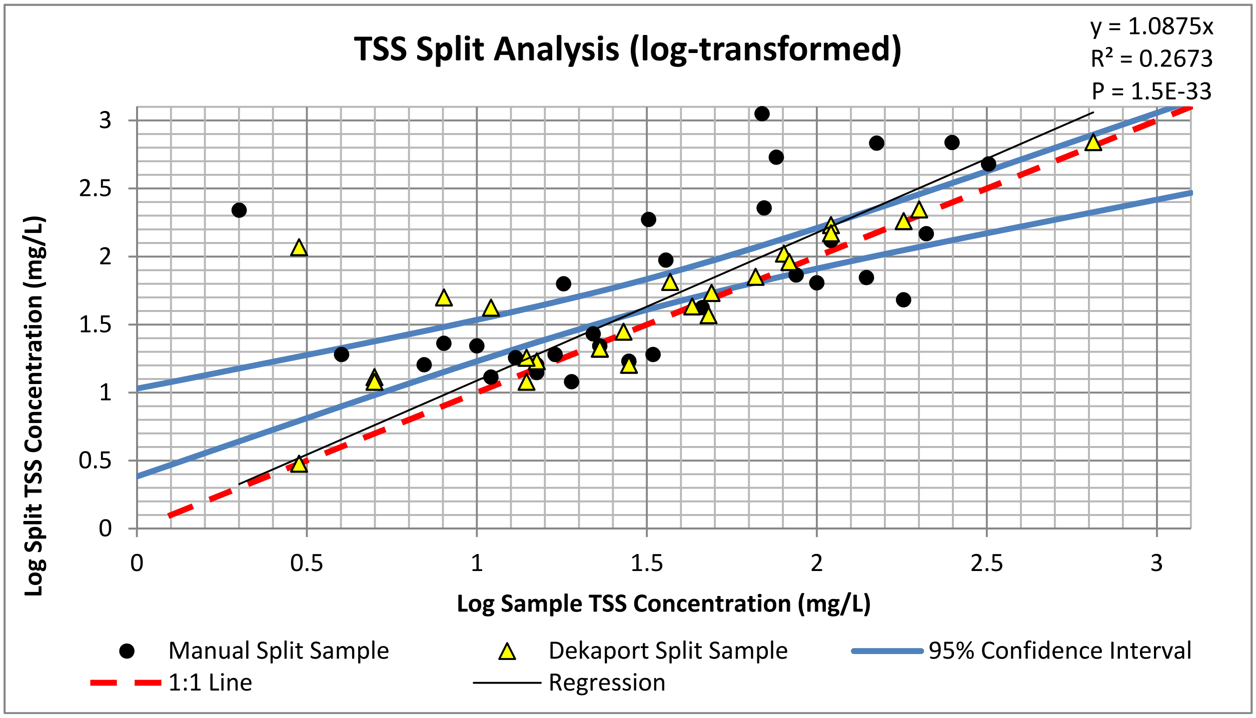


**Figure 1. TSS Sample v. Split Results (Non-detect results excluded in these regression analyses, this data set contains a non-detect result frequency greater than 15% [37% non-detect for Manual Split and 20% for Dekaport Split])**

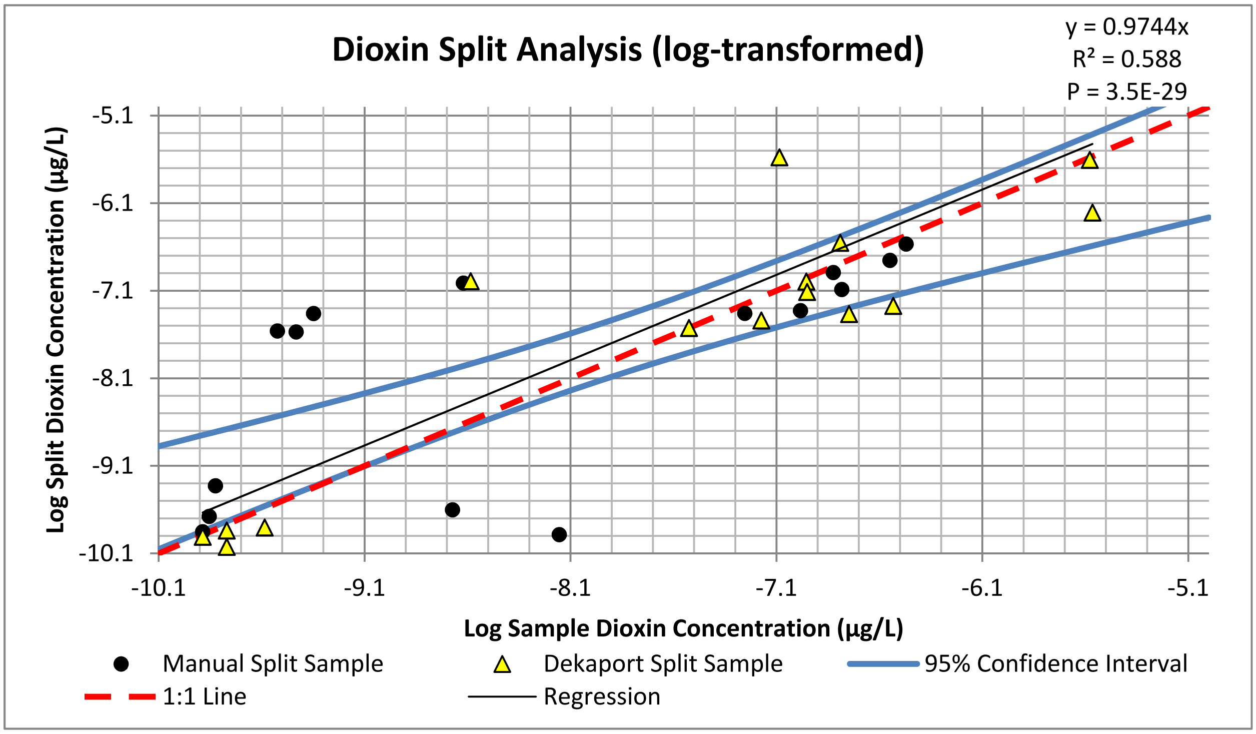


**Figure 2. Dioxin Sample v. Split Results (Non-detect results excluded in these regression analyses, this data set contains a non-detect result frequency greater than 15% [40% non-detect for Manual Split and 31% for Dekaport Split])**

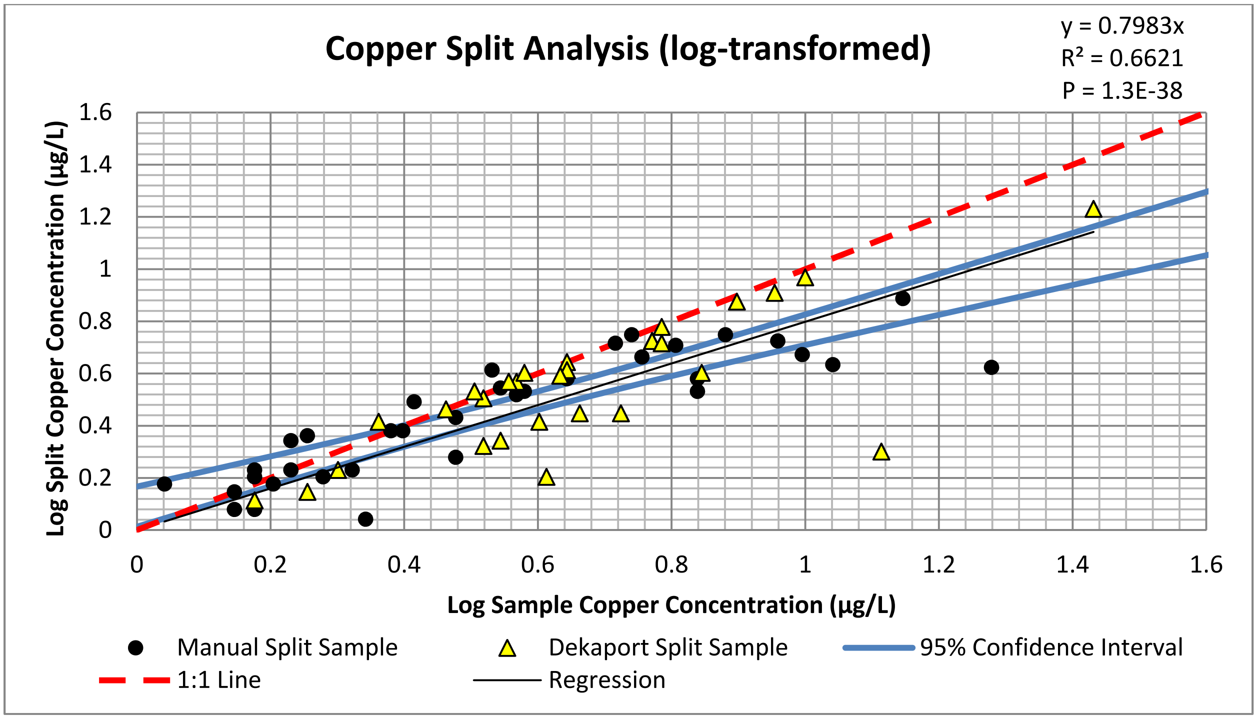


**Figure 3. Copper Sample v. Split Results (Non-detect results excluded in these regression analyses, this data set contains a non-detect frequency much less than 15% [0% non-detect for Manual Split and 0% for Dekaport Split])**

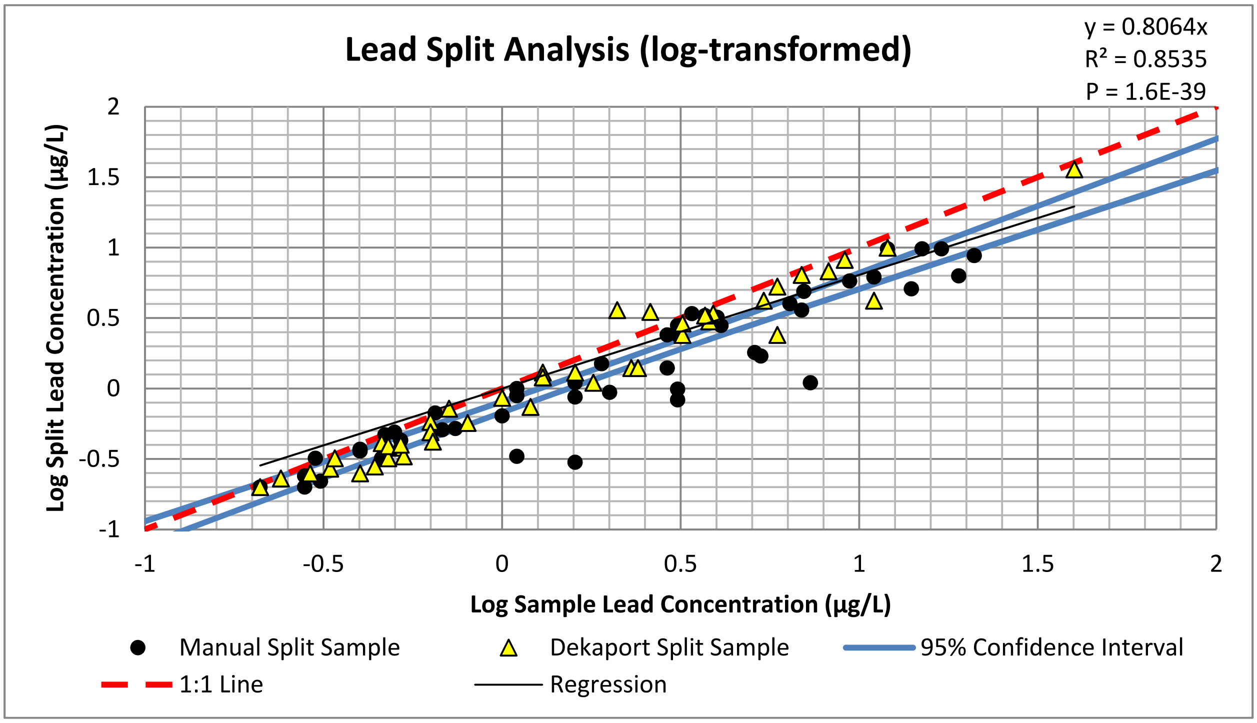


**Figure 4. Lead Sample v. Split Results (Non-detect results excluded from these regression analyses, this data set contains a non-detect result frequency greater than 15% for Manual Split samples [17% non-detect] and a non-detect frequency much less than 15% for the Dekaport Split samples [1% non-detect])**

## Conclusions

- Based on the sample split statistical analysis, implementation of the Dekaport splitter generally appears to improve the correlation of split to sample results for all COCs evaluated, with the exception of copper.
- TSS results do not show a strong correlation for samples collected post-Dekaport cone splitter implementation with the 1:1 line falling outside the 95% confidence intervals for most of the data, although the slope coefficient (1.1) is close to 1. Therefore, split results do not show a statistically significant correlation.
- The dioxin results showed significant scatter between both the manually split and Dekaport split samples, however the 1:1 line falls within the 95% confidence intervals for most of the data and the slope coefficient (0.97) is very close to 1, suggesting that the split results show a correlation with the samples. However, both the manually split and Dekaport split samples had p values indicating that the split results were at least marginally statistically significantly different than the sample results.
- Copper results only showed moderate scatter, but the 1:1 line fell outside of the 95% confidence intervals for most of the data and the slope coefficient of 0.80 indicates an approximate 20% bias, so both pre- and post-Dekaport split datasets do not show a statistically significant correlation with the samples.
- Lead results display the 1:1 line falling outside of the 95% confidence intervals for most of the data and the slope coefficient of 0.81 indicating an approximate 20% bias. Therefore, split results are not considered to show a statistically significant correlation.
- The Panel recommends a review of laboratory QA/QC methods to confirm that their hold times, standards, blanks, and other QA/QC results are all acceptable and comparable. Also, *Standard Methods*, and other literature should be reviewed to understand likely analytical error levels (although those results are usually very optimistic). As the Panel has recommended before, both labs should be sent a set of seven replicates of a standard as a double-blind test, for inclusion with the next SSS sample batch. Additional double blind analyses should be periodically conducted during the monitoring season also, at least for copper and lead. TSS standards could be made from SilCoSil material, or there are commercially available, but quite costly, SSC/TSS standards (Dr. Pitt can provide additional detail upon request). Dioxin standard testing is not considered worth the additional cost at this time. However, since the cone splitter tests showed a significant difference in the sample and split results, a lab review may be warranted.
- Since the TSS data indicate that the Dekaport cone splitter is being used and functioning properly, it is possible that where data for specific COCs do not follow a reduction in scatter similar to that for TSS at sediment concentrations greater than about 30 mg/L, the discrepancies could be an indicator of differences in laboratory procedures. The value of this as an alert for checking laboratory QA/QC practices would have to be tested as additional data are collected.

## References

WWE and Expert Panel, 2010. *Environmental Sampling of Dioxins and Other Low Solubility Pollutants at Parts-per-Billion and Lower Concentrations: Field Protocols for Collecting SSFL ISRA Performance Samples and Obtaining Replicate Splits Using a Dekaport Cone Splitter*. August 31.

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# APPENDIX E

# ISRA AND CM UPSTREAM AND DOWNSTREAM ANALYSIS MEMORANDUM
# 2011/2012 RAINY SEASON

# Memorandum

Date: 31 August 2012

To: The Boeing Company (Boeing), Santa Susana Field Laboratory (Santa Susana Site)

From: Geosyntec Consultants and the Santa Susana Site Surface Water Expert Panel

Subject: ISRA and CM Upstream and Downstream Analysis
Santa Susana Site
Geosyntec Project: SB0363S

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Stormwater monitoring data summarized below were collected at the Boeing Santa Susana Site (SSS) between December 2009 and April 2012 from monitored culvert modification (CM) installations and Interim Source Removal Action (ISRA) locations in National Pollutant Discharge Elimination System (NPDES) outfall 008 and 009 watersheds. The purpose of this stormwater quality evaluation is to confirm whether 1) the excavated and stabilized ISRA areas are maintaining the natural background concentrations of pollutants of concern (POCs) as stormwater runoff sheetflows across each area, and 2) the CM treatment BMPs are decreasing POC concentrations as stormwater ponds and filters through the media mounds. The NPDES POCs addressed in this analysis include total suspended solids (TSS), total lead, dioxin (TCDD TEQ, DNQ excluded, BAFs included), and, for Outfall 008 ISRA locations, total copper.

Paired data with both an upstream and downstream sample collected during the same storm event are presented. Split samples, used for lab comparison purposes, are excluded from this analysis. The number of paired samples varies by constituent but generally ranges from 10-67 pairs for each POC for each location.

With respect to sampling at the culvert modifications (CMs), influent grab samples are collected from flowing surface water upstream of the maximum extent of ponding observed to that date, with the ponded water created by the CM weir boards. All CMs are composed of slipline HDPE pipes with the exception of B-1, which is galvanized corrugated metal. When the extent of ponding increased at the CM-1 and CM-3 culvert basins on December 22, 2010 during a heavy rainfall, the influent sample locations were moved upstream a sufficient distance to remain above the maximum ponded water footprint. CM effluent grab samples are collected at the culvert outlets on the downstream side of the road, where the culvert pipes discharge to the Northern Drainage, with the exception of CM-9 and B-1, where effluent samples were collected from the underdrain beginning in October 2011, rather than the effluent pipe. Flows from the culvert outlets may represent treated runoff (via sedimentation and media filtration) and partially treated runoff (flowing through or over the weir boards). At CM-3, the slipline HDPE pipes were inserted from both the influent and effluent sides and could not be sealed at the point where they meet, and subsurface flows through the road embankment are known to have entered the pipe during rain events from February 2010 through March 2011 because water was observed discharging from the HDPE pipe outlet when no water was flowing into the inlet. Therefore CM-3 performance cannot be reliably assessed based on the effluent sample results included here due to this sample contamination.

It should also be noted that the CM facilities were installed as stormwater controls that could be rapidly installed in areas where existing culverts carried the stormwater below the roads. They were not designed to be of sufficient size to handle the wide range of flows expected during a typical rain year and hence experience relatively short treatment residence times and common overflows. However, the monitored performance indicates the benefits of the sedimentation and media treatment unit processes. The monitoring data have also been used in the site selection evaluations for consideration for enhancements to selected CMs for improved performance in areas where the effluent remains problematic.

Finally, it should also be noted that CM-1 (upstream-east; see additional discussion in Section 1, below), CM-3, CM-8, and CM-11 receive runoff from drainage areas that do not include any known historic industrial activities, although the CM-3 area does include a clean soil borrow area at the top of the watershed. Therefore, influent sample results at these four CM locations (not including CM-1 upstream west) are relatively good quality and considered reflective of “background” stormwater concentrations, making it difficult to achieve additional POC reduction through these CMs.

## 1. LINE PLOTS

The following log-scale line plots illustrate the changes in measured concentrations between upstream and downstream ISRA sampling locations for each set of ISRA and CM upstream/downstream sample pairs. Paired data were obtained from ISRA locations CYN-1/DRG-1, B1-2, HVS, and IEL-2 and from CM locations B1, CM-1, CM-3, CM-8, CM-9, and CM-11. At this time, only downstream samples have been collected at CTLI, so no paired data from this site have been included in these analyses. Paired data are presented by POC in Figures 1 through 34. Pairs are color-coded based on the sampling year during which they were collected, and different symbology is used for different upstream and downstream sample collection locations (symbology is defined in each graph). Additionally, non-detect results are displayed as the detection limit. The statistical analysis of the CM and ISRA datasets is presented in Section 2 below. At certain sites, improvements, such as asphalt removal or filter fabric installation, were made over the course of the sampling period. For these sites, separate graphs are shown for sample results that occurred before and after the improvements were made.

Several locations (CM-1, CM-9, B1 CM, and HVS) have multiple upstream sites:

- CM-1 receives runoff from an eastern tributary that is considered to reflect background concentrations as well as a western tributary comprising paved road and ELV hillside runoff;
- CM-9 receives runoff from the Area I landfill and former Building 1324 parking lot (demolished Summer/Fall 2011), as well as the paved road to the east;
- the B1 CM receives runoff from the north, comprised of pavement and road runoff, and the south, comprised of the upper B1 subarea and sediment basin as well as some road runoff; and
- The HVS ISRA downstream location receives runoff from up to five upstream ISRA areas depending on flow conditions.

The selection of the upstream location used in the pairing evaluation was evaluated on a case by case basis, with similar sample dates taking precedence (between upstream and downstream); in instances when two upstream samples were available for the same downstream-sampling storm event, an impervious area-weighted average (used as an estimate of proportioned flowrate from each influent stream) was used to represent the single upstream result. With regards to the CM line plots, the CM effect on influent concentrations above the Permit limit is the most important since those below the Permit limit are already of acceptable quality and are generally considered to be in the range of irreducible levels.

These charts are included for general visual assessment purposes only; the statistical tests that follow are used to make conclusions regarding ISRA and CM performance. It should be noted that these samples are all grab samples, and therefore highly variable in terms of water quality result, and may represent collection times that vary greatly throughout the hydrograph. Therefore, relatively large numbers of samples are needed to represent the varying conditions with reasonable statistical confidence and power.

Although not recorded for every event, based on field notes the following five effluent samples were collected during overflow/bypass conditions. These conditions are noted on the plots and indicate decreased performance. No other sampling dates were observed for overflow, so whether or not this occurred for other dates cannot be determined. Future sampling notes will more carefully track this information.

CM-9, downstream underdrain samples:

- A2SW0009S001 on 10/5/2011
- A1SW0009S017 on 3/17/2012
- A1SW0009S004 on 3/25/2012

CM-1, downstream culvert outlet samples:

- A1SW0002S020 on 3/17/2012
- A2SW0002S021 on 3/25/2012

Table 1 summarizes total event rainfall data collected for the sampling dates from the 2009-2012 seasons.

**Table 1. Sample collection event rainfall data summary**

| Date(s) | Average Intensity (in/hr) | Max Intensity (in/hr) | Event Total (in) |
|---|---|---|---|
| 12/7/2009 | 0.070 | 0.17 | 1.12 |
| 12/11/2009 – 12/12/2009 | 0.036 | 0.25 | 2.31 |
| 1/19/2010 – 1/22/2010 | 0.052 | 0.52 | 6.89 |
| 2/5/2010 – 2/6/2010 | 0.043 | 0.2 | 1.84 |
| 2/20/2010 | 0.012 | 0.05 | 0.16 |
| 2/27/2010 | 0.089 | 0.34 | 1.52 |
| 3/7/2010 | 0.015 | 0.13 | 0.38 |
| 4/5/2010 | 0.054 | 0.23 | 0.86 |
| 10/6/2010 | 0.049 | 0.18 | 0.93 |
| 12/18/2010 – 12/22/2010 | 0.054 | 0.37 | 7.22 |
| 12/26/2010 | 0.030 | 0.22 | 0.57 |
| 12/29/2010 | 0.043 | 0.1 | 0.43 |
| 1/3/2011 | 0.014 | 0.12 | 0.38 |

| | | | |
|---|---|---|---|
| 2/16/2011 – 2/19/2011 | 0.019 | 0.45 | 2.33 |
| 2/26/2011 | 0.048 | 0.26 | 1.50 |
| 3/7/2011 | 0.006 | 0.02 | 0.12 |
| 3/21/2011 | 0.024 | -- | 4.80 |
| 3/24/2011 | 0.013 | -- | 2.48 |
| 3/25/2011 | 0.018 | -- | 3.44 |
| 10/5/2011 | 0.090 | 0.18 | 0.90 |
| 11/12/2011 | 0.035 | 0.26 | 0.76 |
| 11/20/2011 | 0.031 | 0.29 | 0.77 |
| 12/12/2011 | 0.006 | 0.21 | 0.80 |
| 1/21/2012 – 1/23/2012 | 0.017 | 0.15 | 1.06 |
| 2/27/2012 | 0 | 0 | 0 |
| 3/17/2012 | 0.052 | 0.31 | 1.51 |
| 3/25/2012 | 0.079 | 0.51 | 2.12 |
| 4/11/2012 – 4/13/2012 | 0.037 | 0.36 | 2.37 |

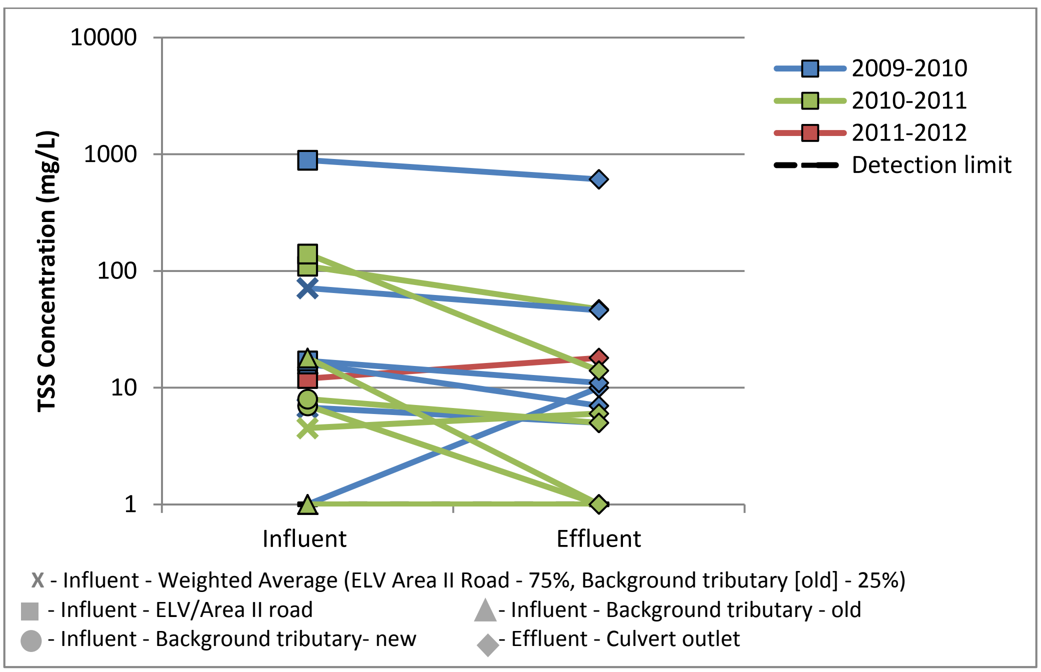



**Figure 1. TSS at CM-1, pre filter fabric installation**

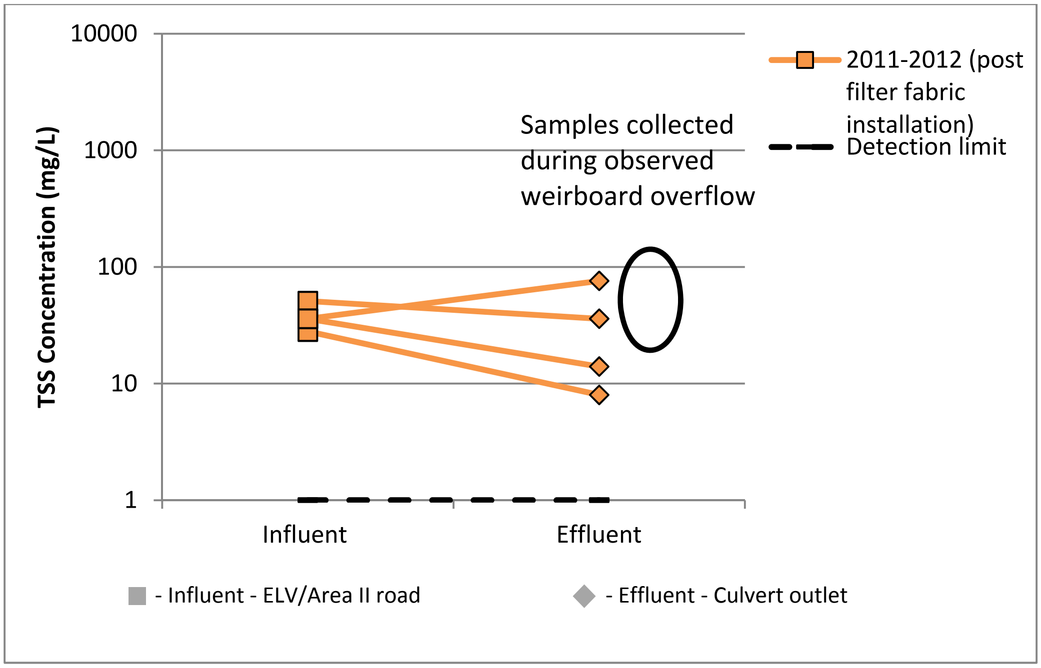



**Figure 2. TSS at CM-1, post filter fabric installation**

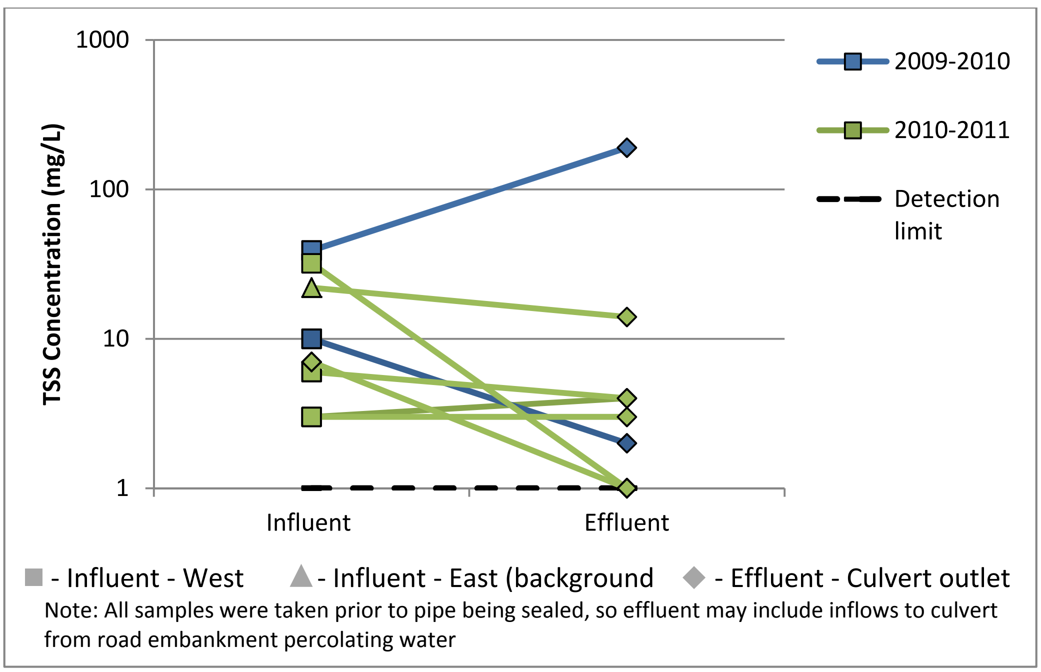



**Figure 3. TSS at CM-3**

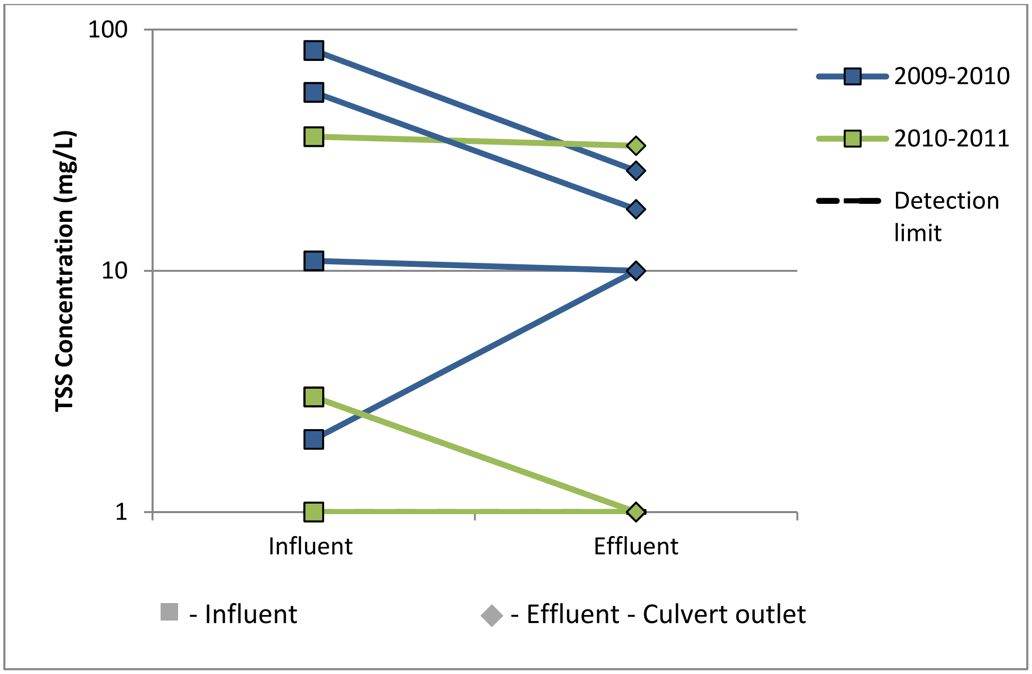



**Figure 4. TSS at CM-8**

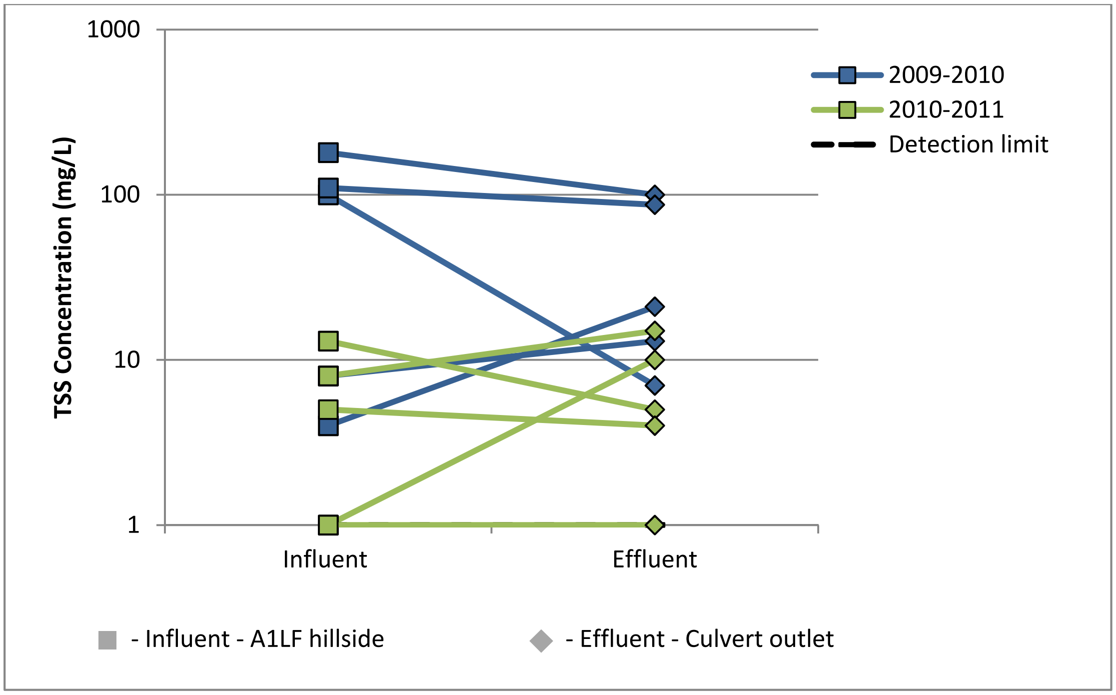



**Figure 5. TSS at CM-9, pre improvements**

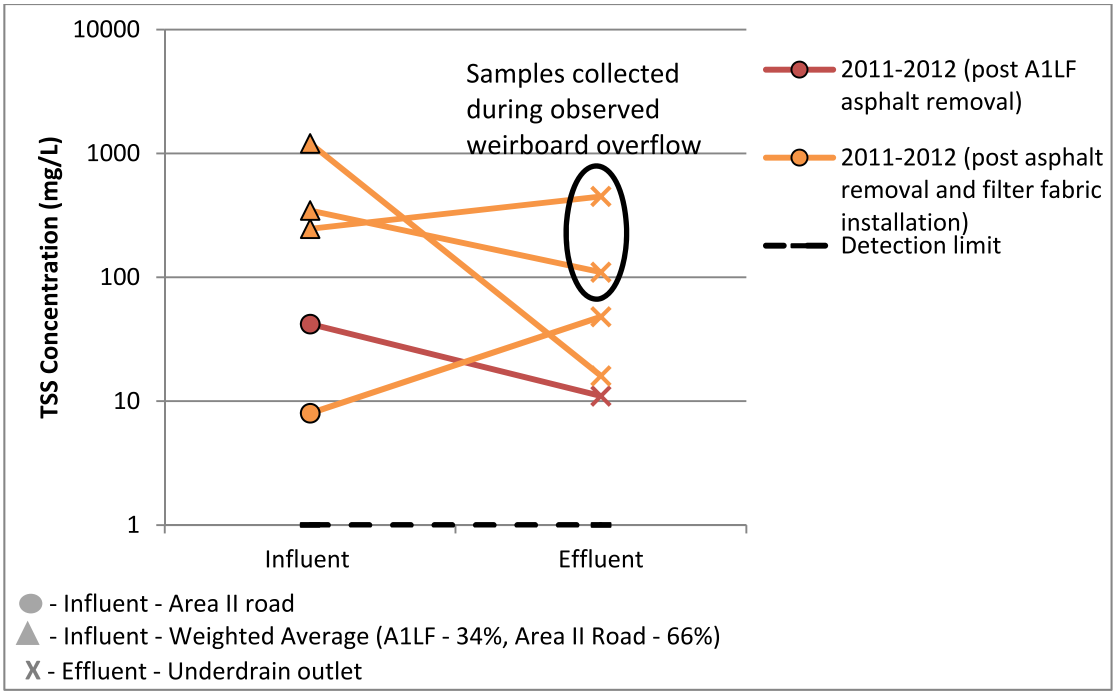



**Figure 6. TSS at CM-9, post improvements**

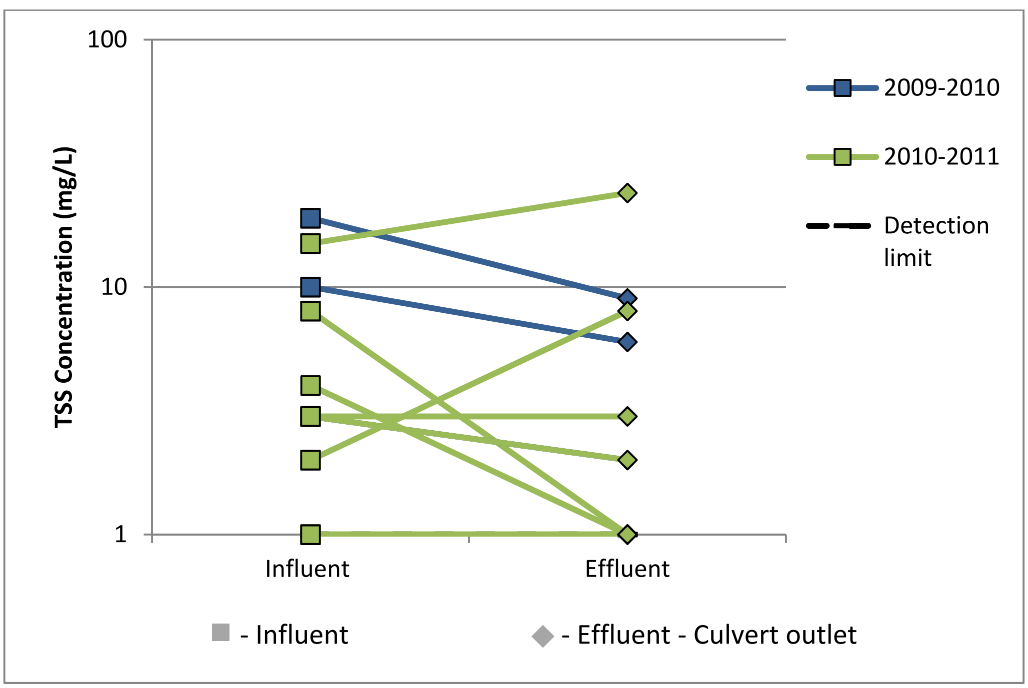



**Figure 7. TSS at CM-11**

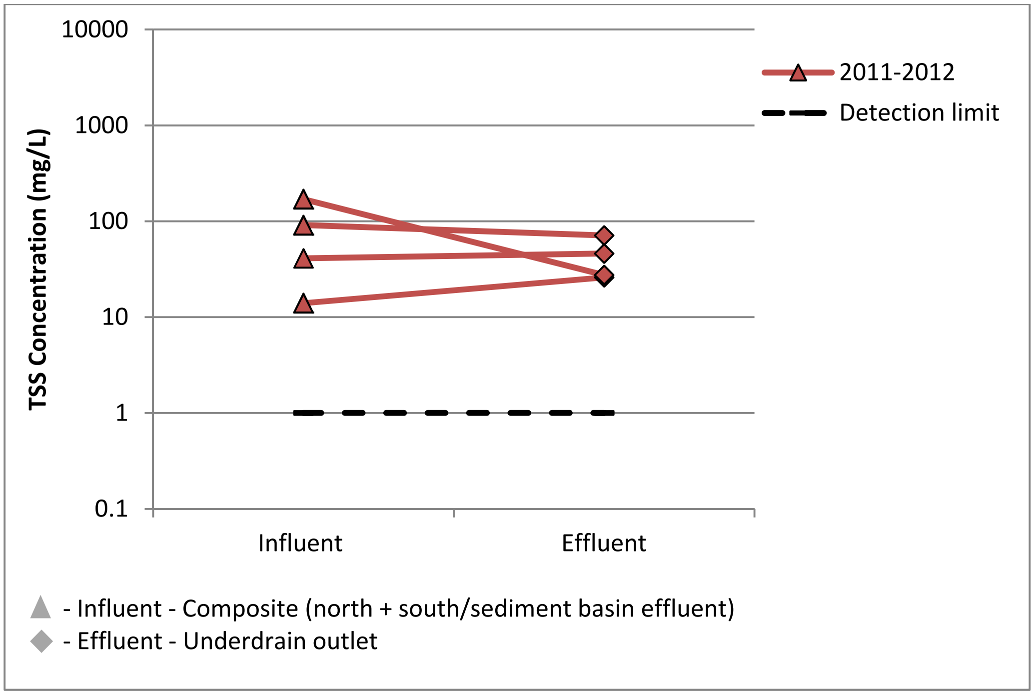



**Figure 8. TSS at B-1 Media Filter (CM)**

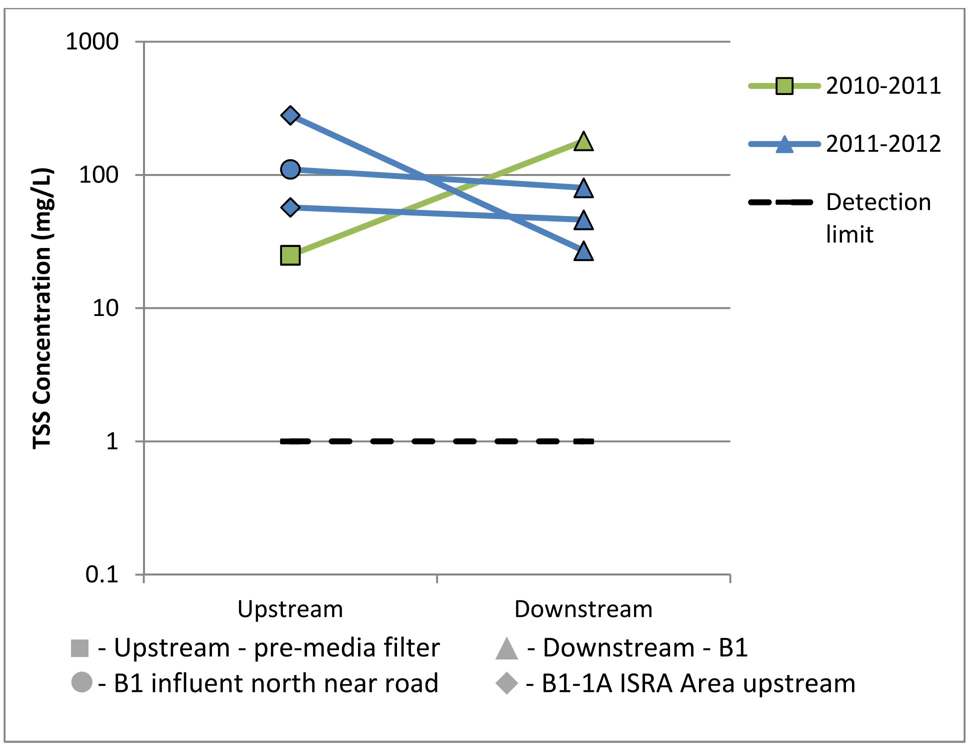



**Figure 9. TSS at ISRA, Watershed 009, B1-2**

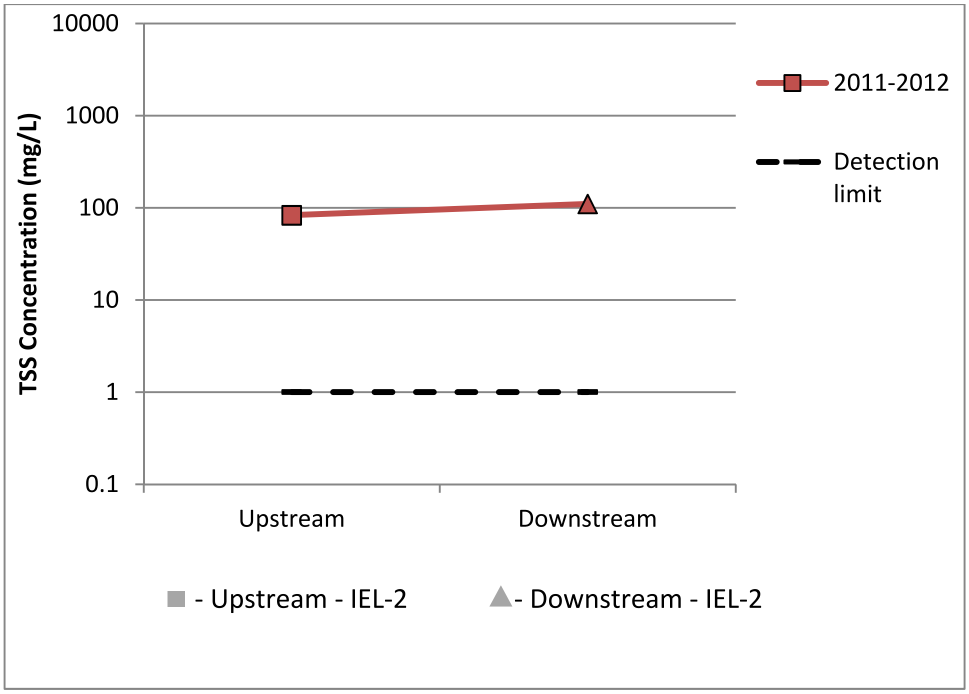



**Figure 10. TSS at ISRA, Watershed 009, IEL-2**

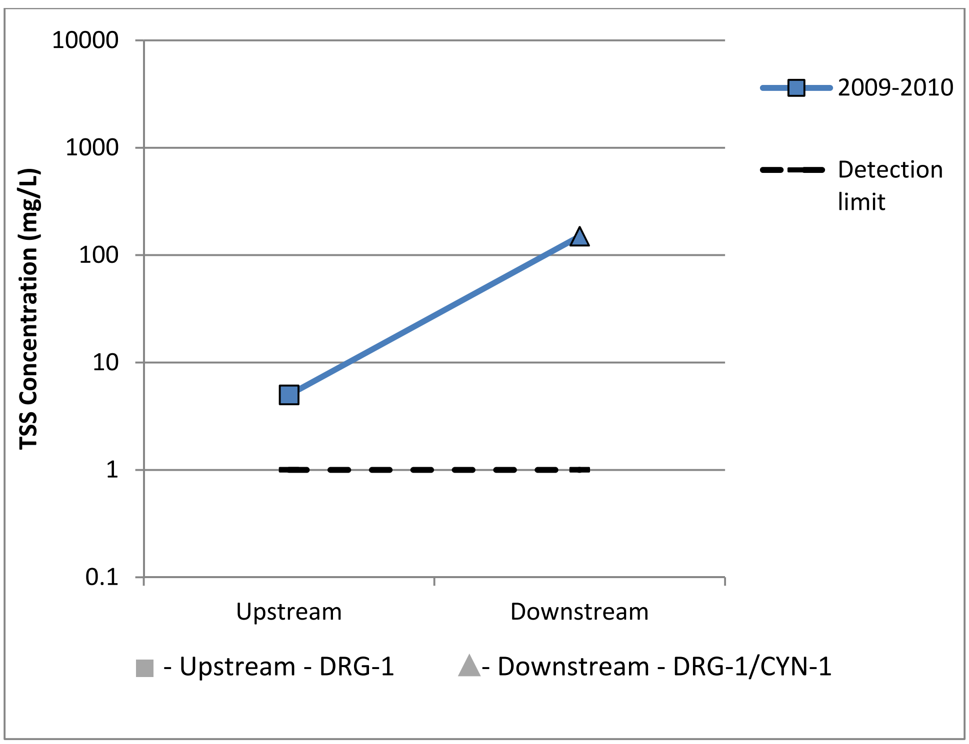



**Figure 11. TSS at ISRA, Watershed 008, Happy Valley West (CYN-1 and DRG-1)**

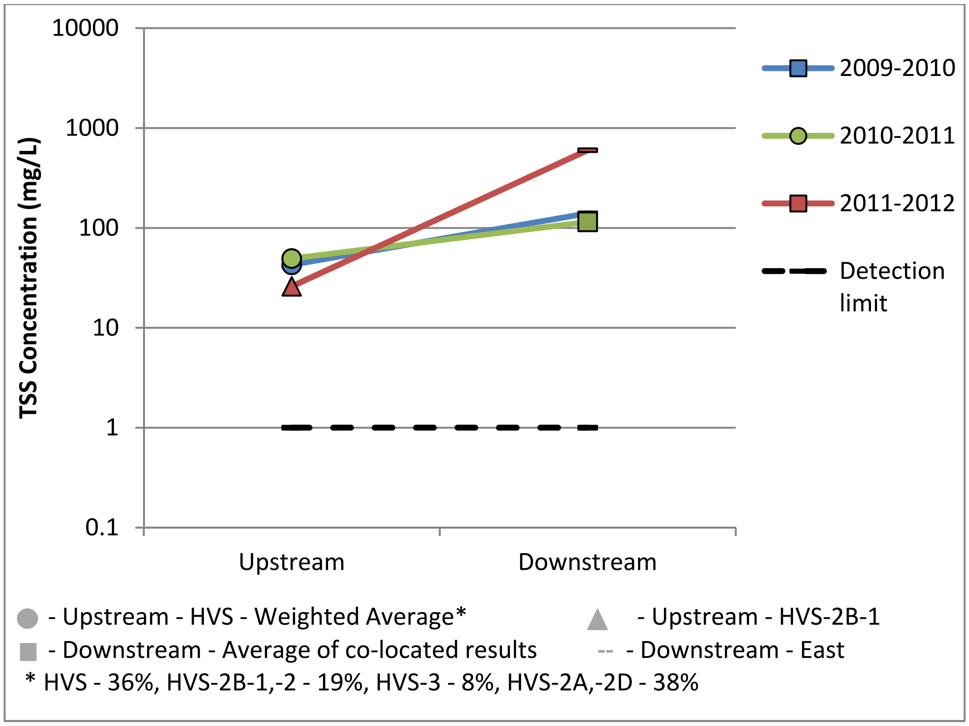



**Figure 12. TSS at ISRA, Watershed 008, Happy Valley East (HVS)**

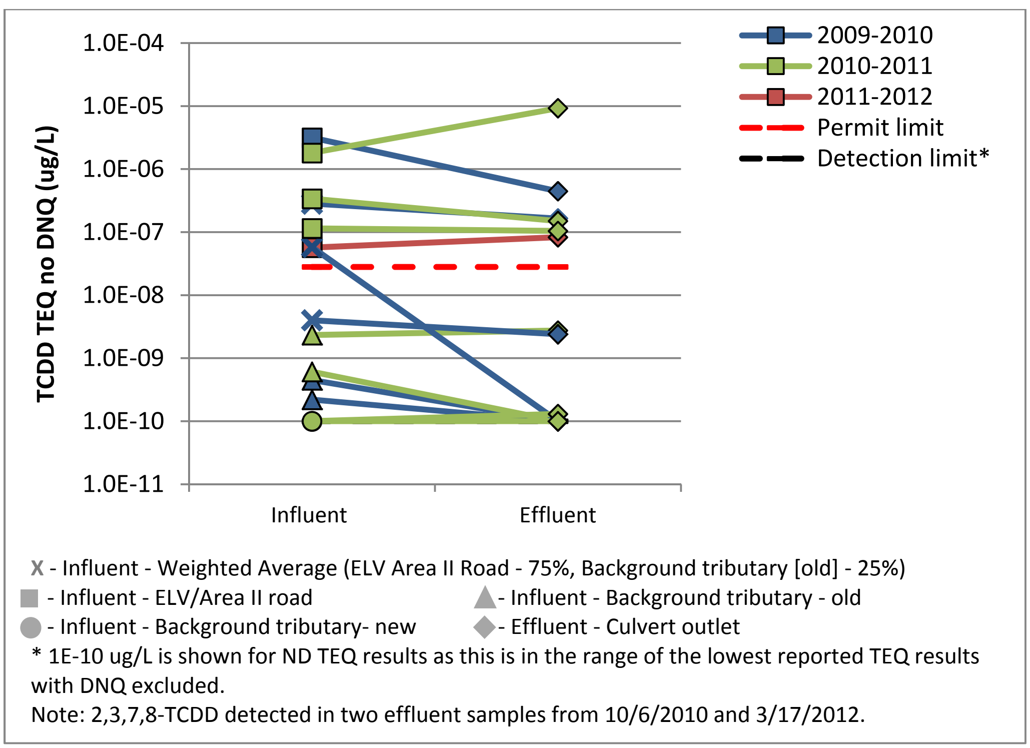
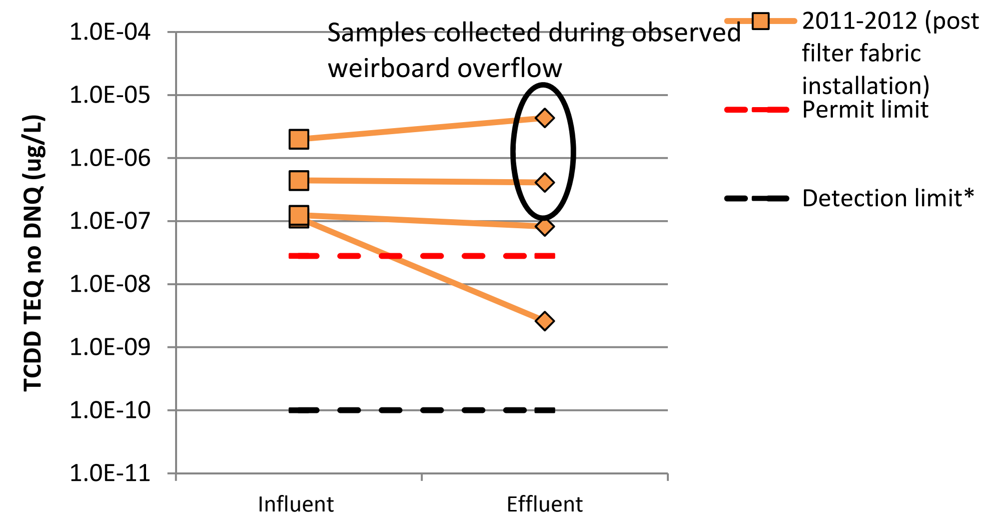



**Figure 13. Dioxin at CM-1, pre filter fabric installation**

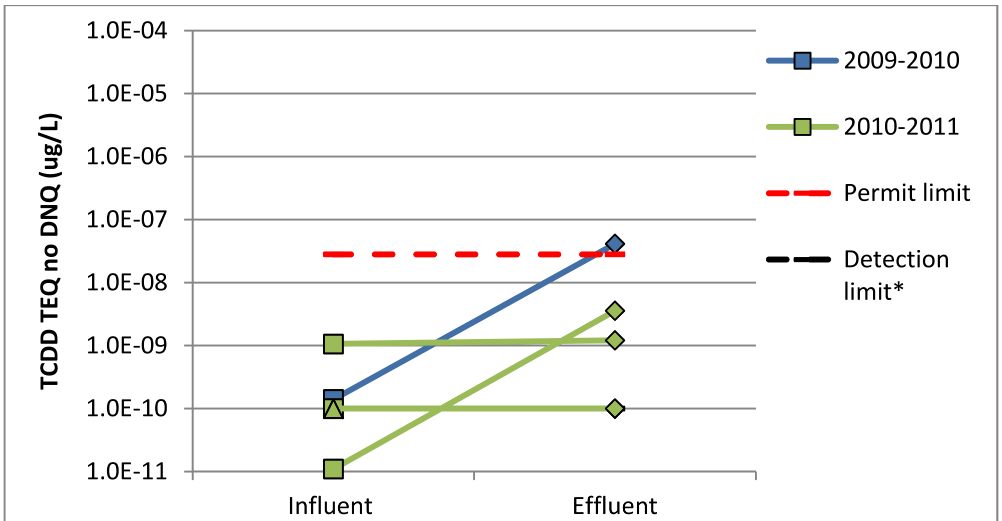



- Influent - ELV/Area II road   - Effluent - Culvert outlet

* 1E-10 ug/L is shown for ND TEQ results as this is in the range of the lowest reported TEQ results with DNQ excluded.

Note: 2,3,7,8-TCDD detected in two effluent samples from 10/6/2010 and 3/17/2012.

**Figure 14. Dioxin at CM-1, post filter fabric installation**




- Influent - West   - Influent - East (background   - Effluent - Culvert outlet

* 1E-10 ug/L is shown for ND TEQ results as this is in the range of the lowest reported TEQ results with DNQ excluded.

Note: All samples were taken prior to pipe being sealed, so effluent may include inflows to culvert from road embankment percolating water

**Figure 15. Dioxin at CM-3**

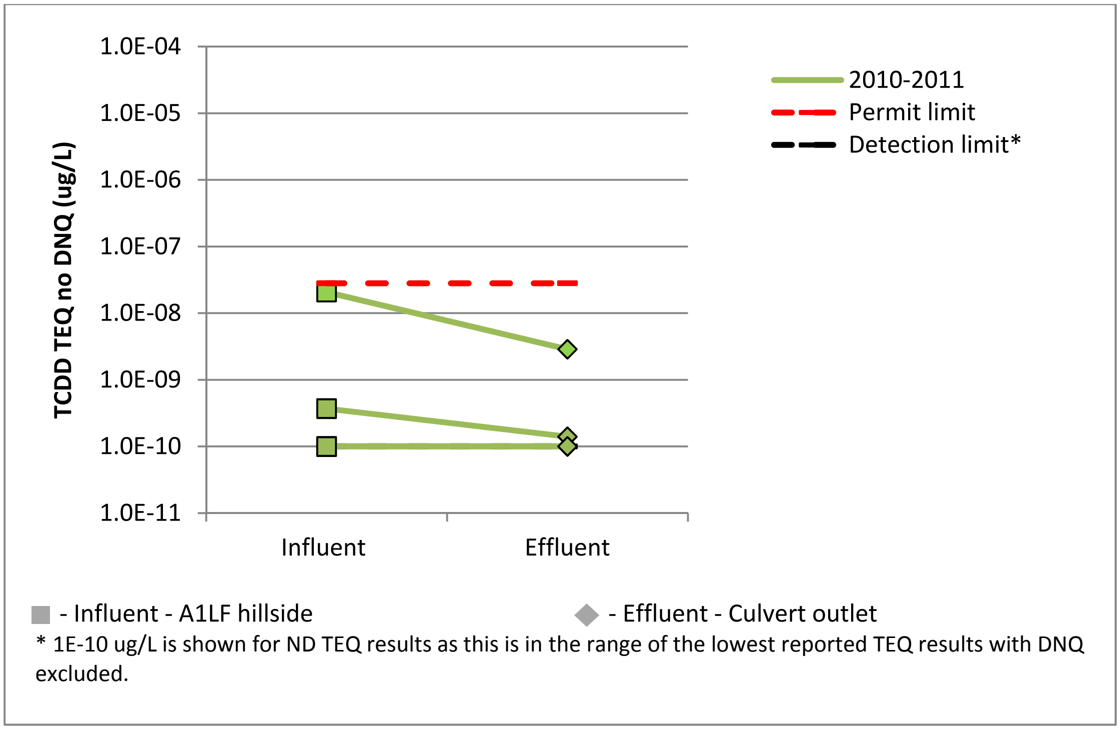



**Figure 16. Dioxin at CM-9, pre improvements**

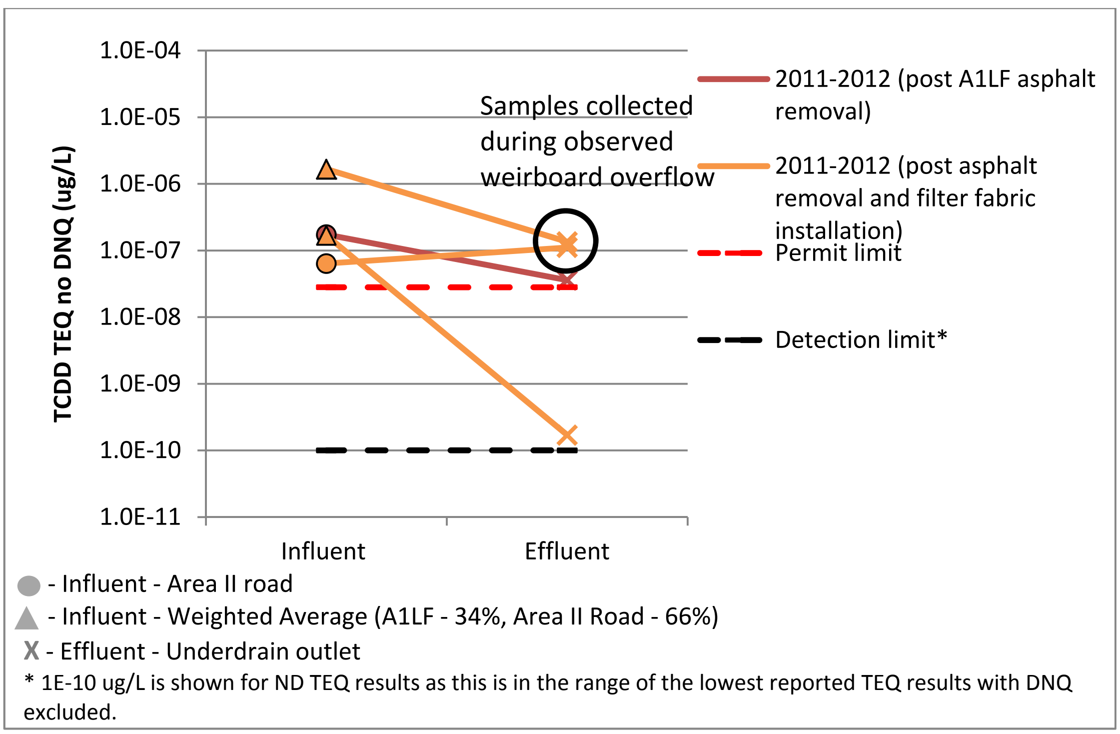



**Figure 17. Dioxin at CM-9, post improvements**

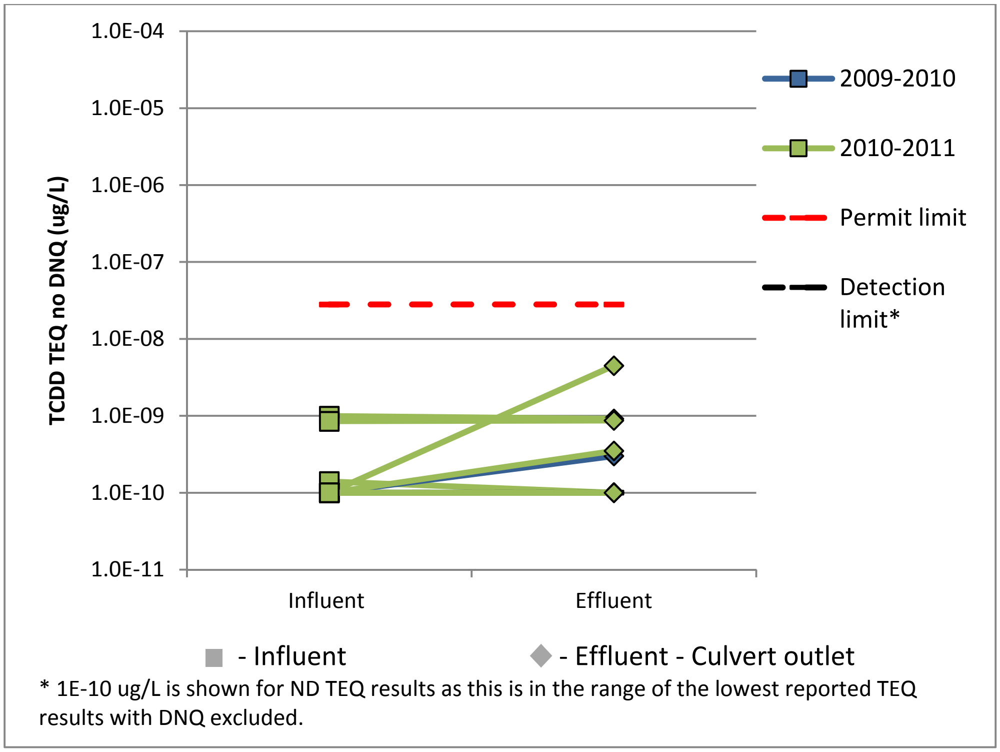



**Figure 18. Dioxin at CM-11**

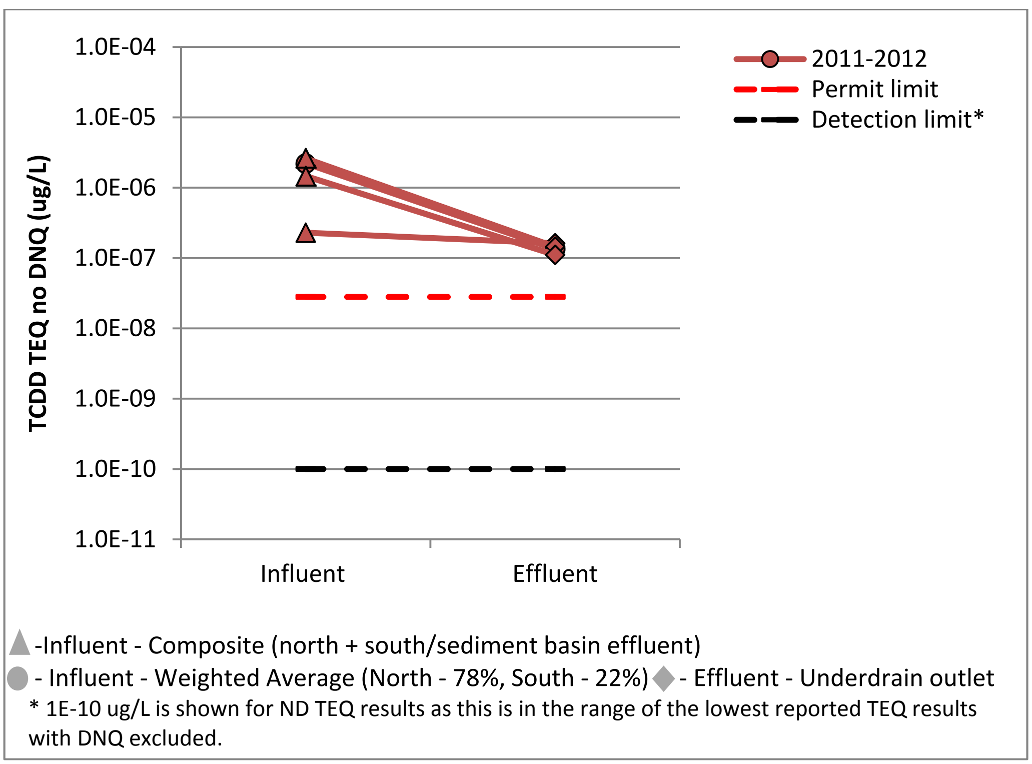



**Figure 19. Dioxin at B1 Media Filter (CM)**

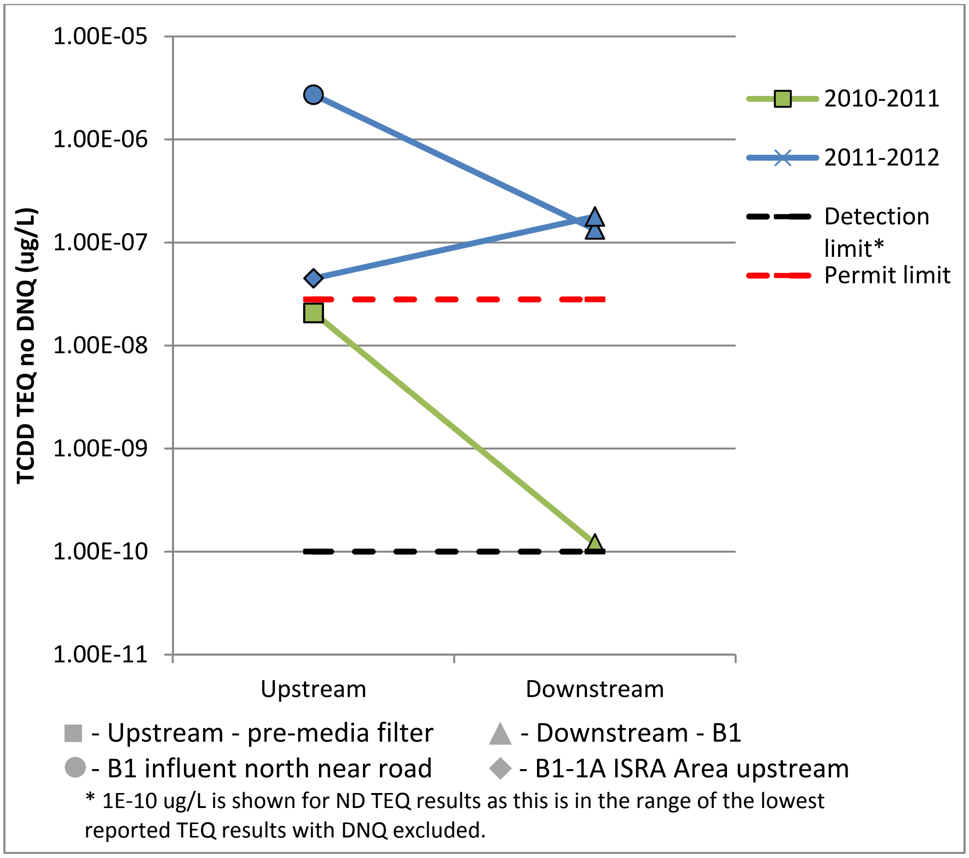



**Figure 20. Dioxin at ISRA, Watershed 009, B1-2**

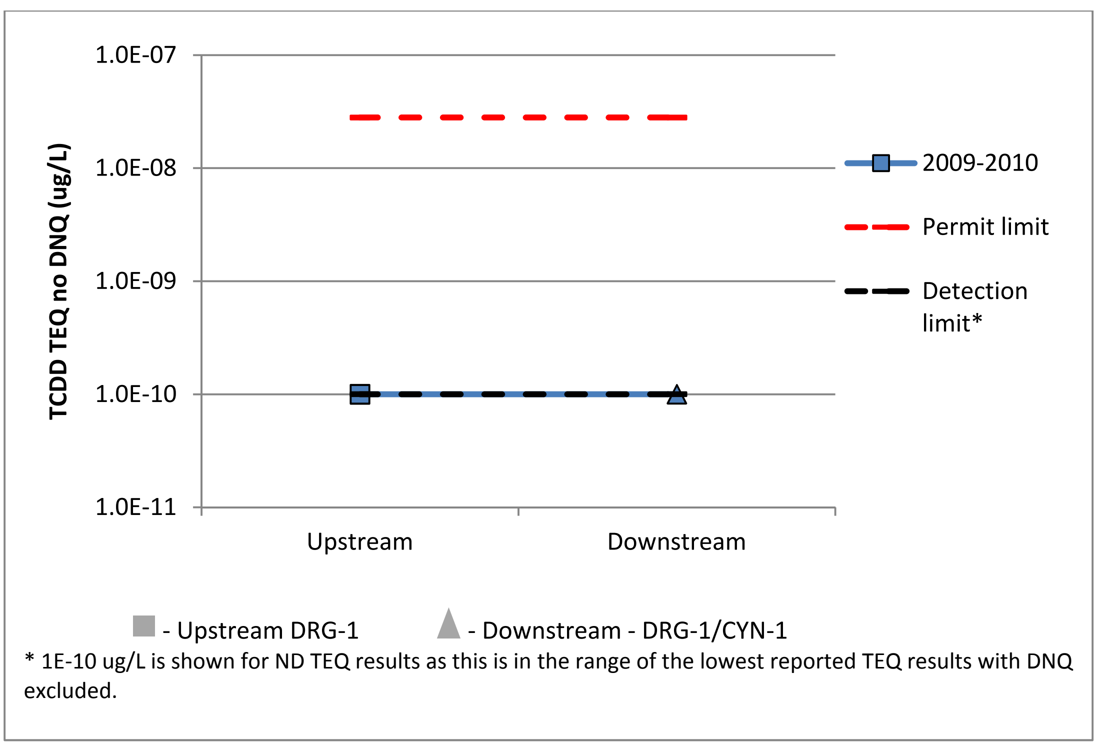



**Figure 21. Dioxin at ISRA, Watershed 008, Happy Valley West (CYN-1 and DRG-1)**

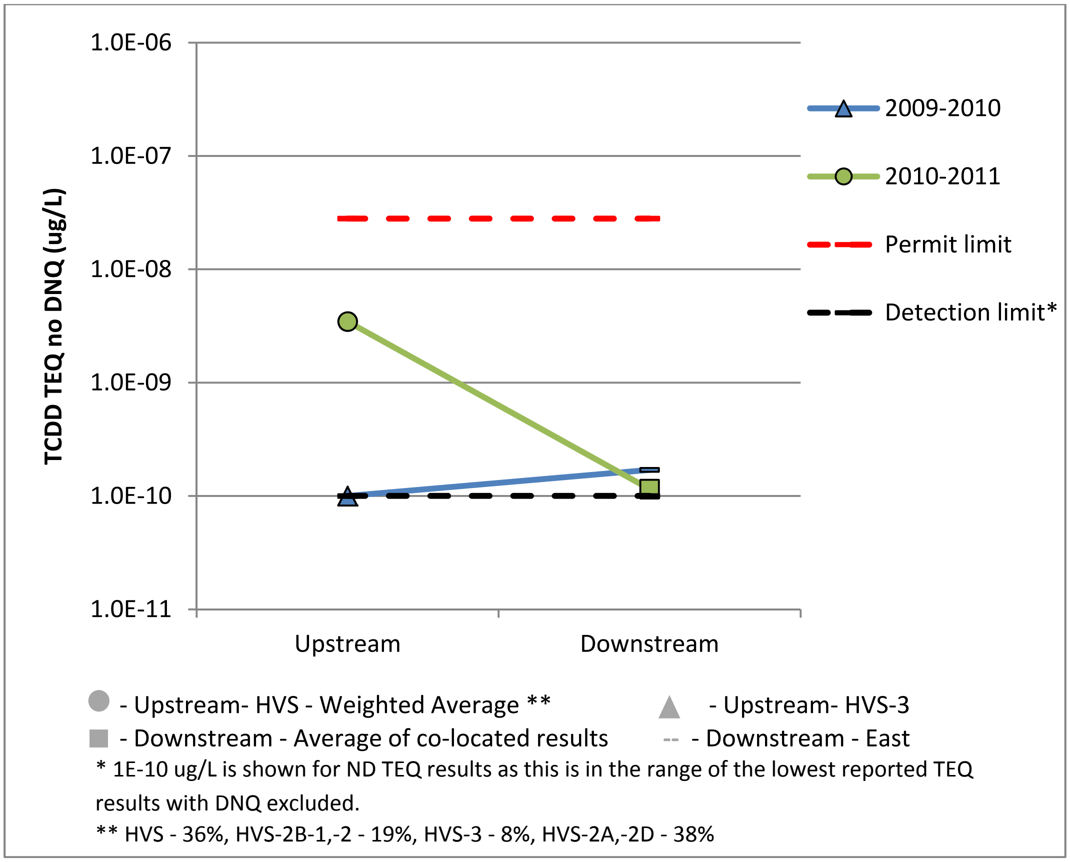



**Figure 22. Dioxin at ISRA, Watershed 008, Happy Valley East (HVS)**

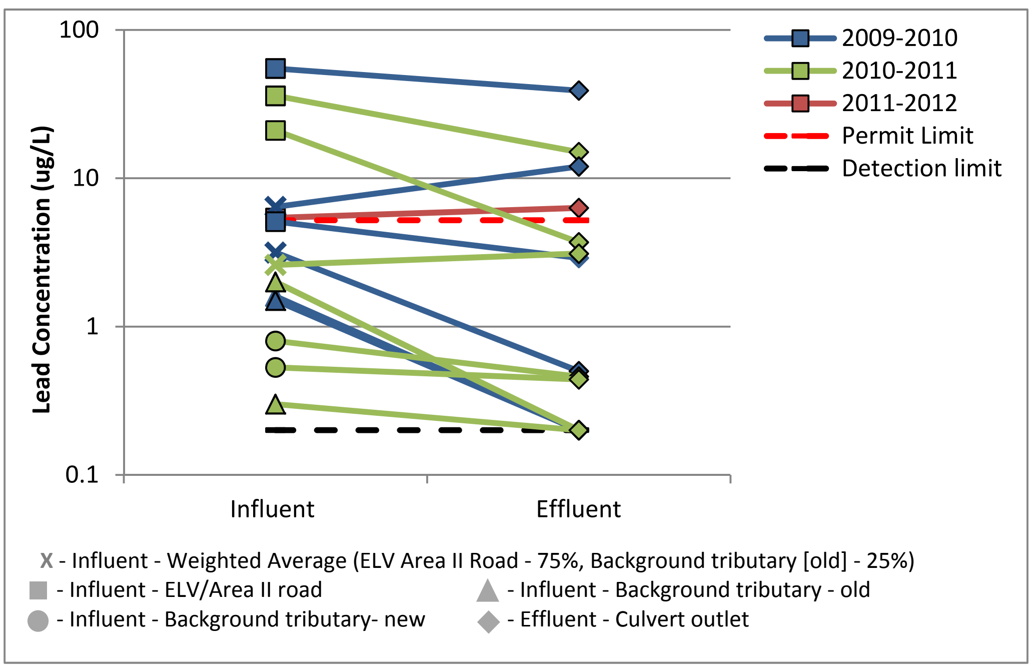



**Figure 23. Lead at CM-1, pre filter fabric installation**

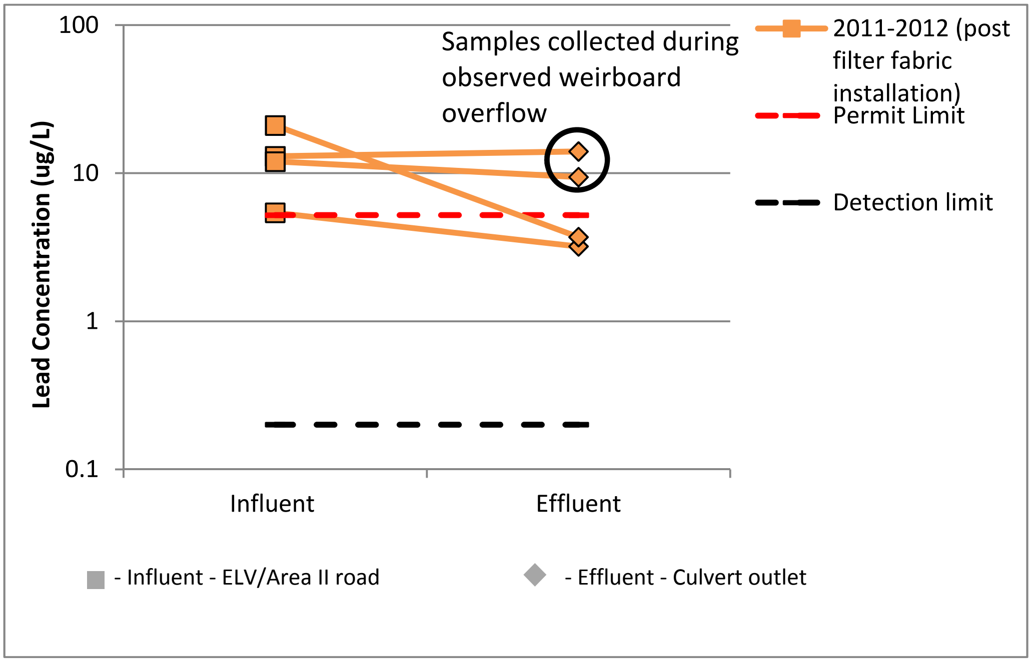



**Figure 24. Lead at CM-1, post filter fabric installation**

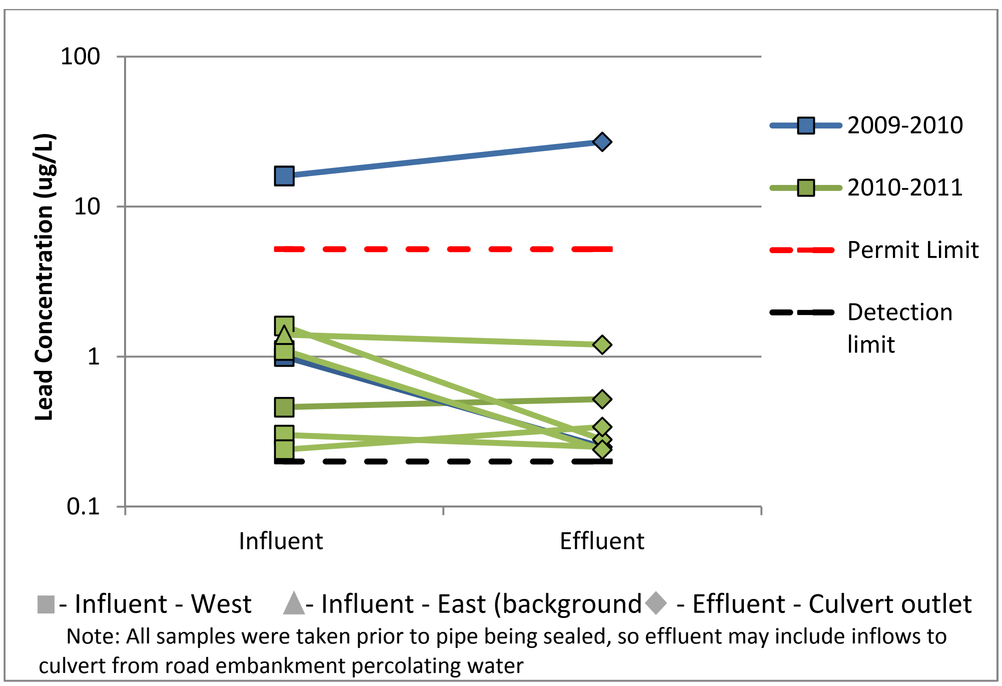



**Figure 25. Lead at CM-3**

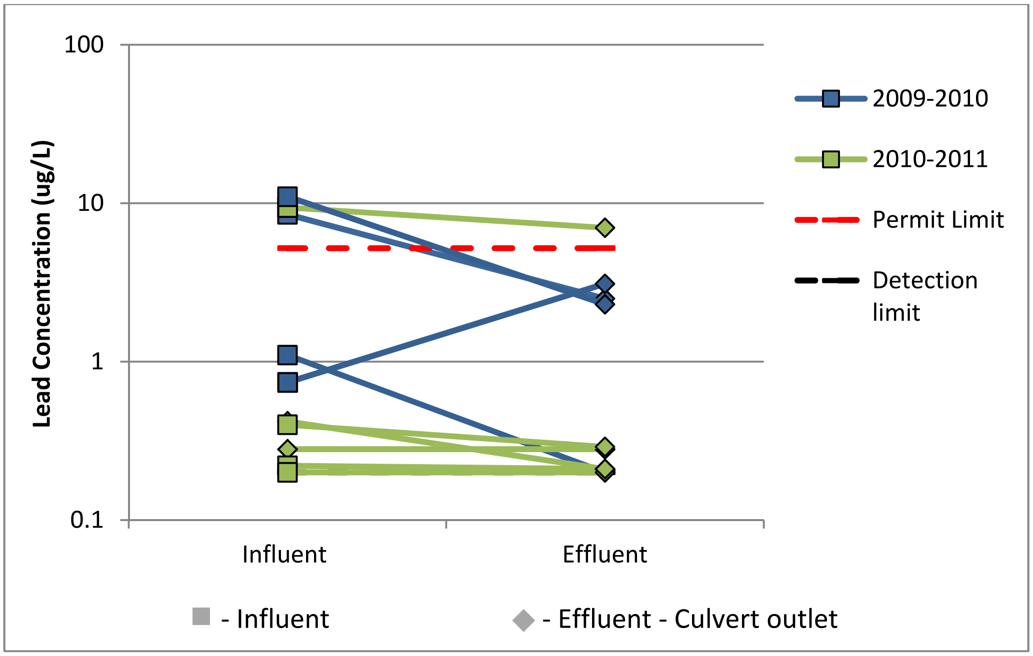



**Figure 26. Lead at CM-8**

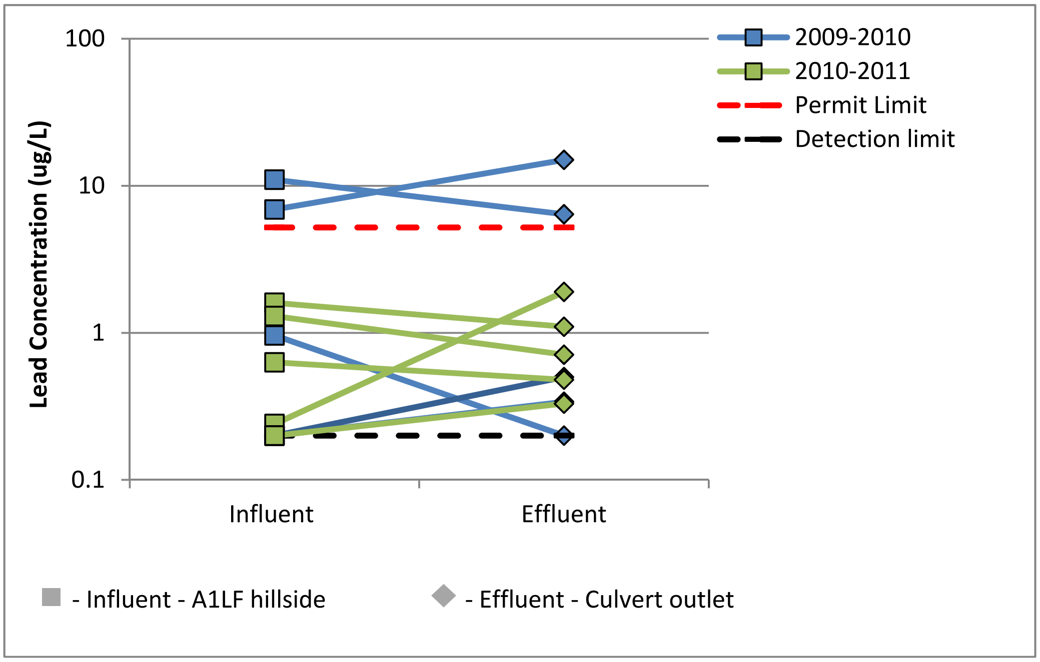



**Figure 27. Lead at CM-9, pre improvements**

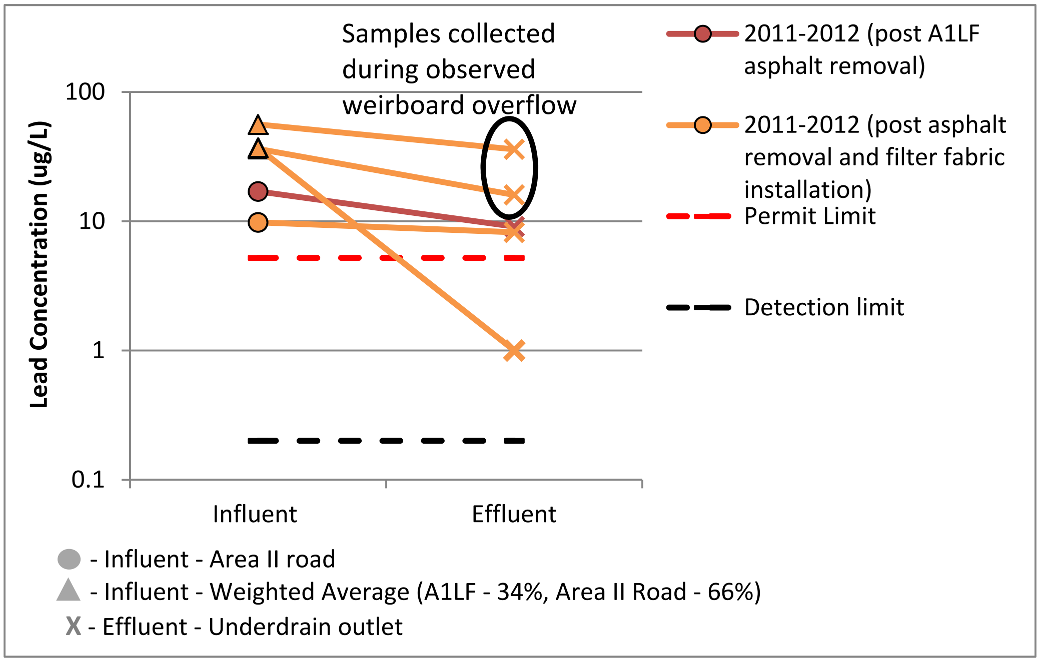



**Figure 28. Lead at CM-9, post improvements**

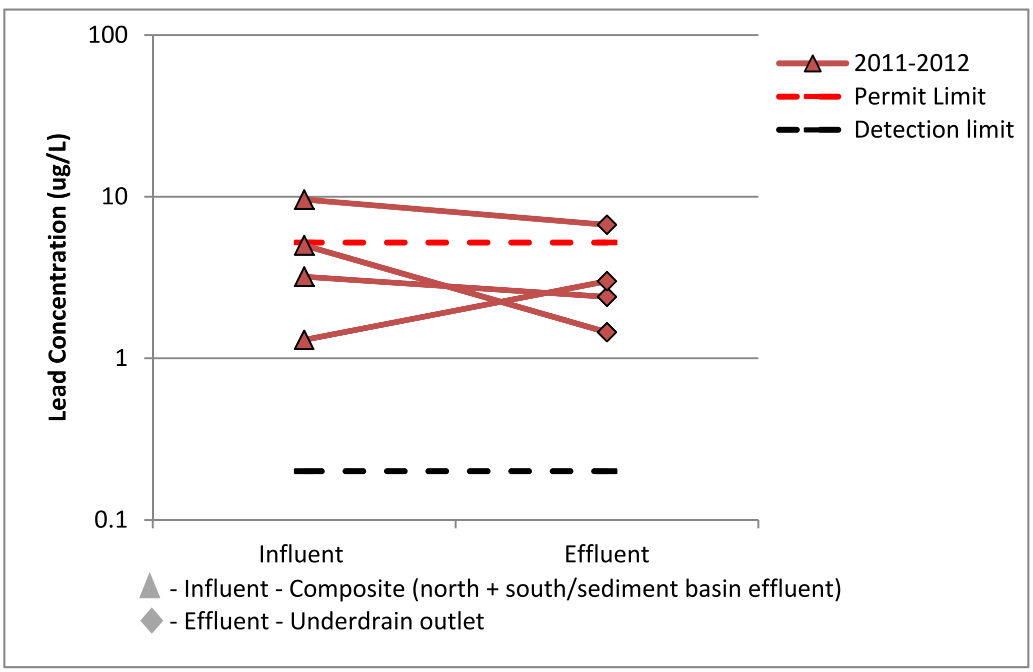



**Figure 29. Lead at B1 Media Filter (CM)**

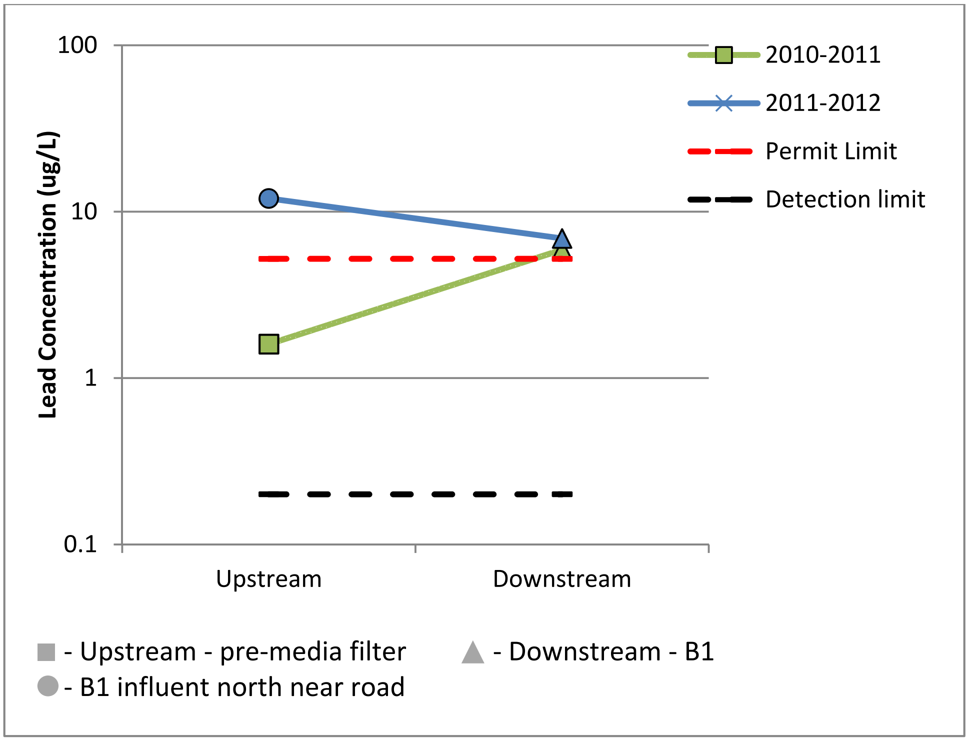



**Figure 30. Lead at ISRA, Watershed 009, B1-2**

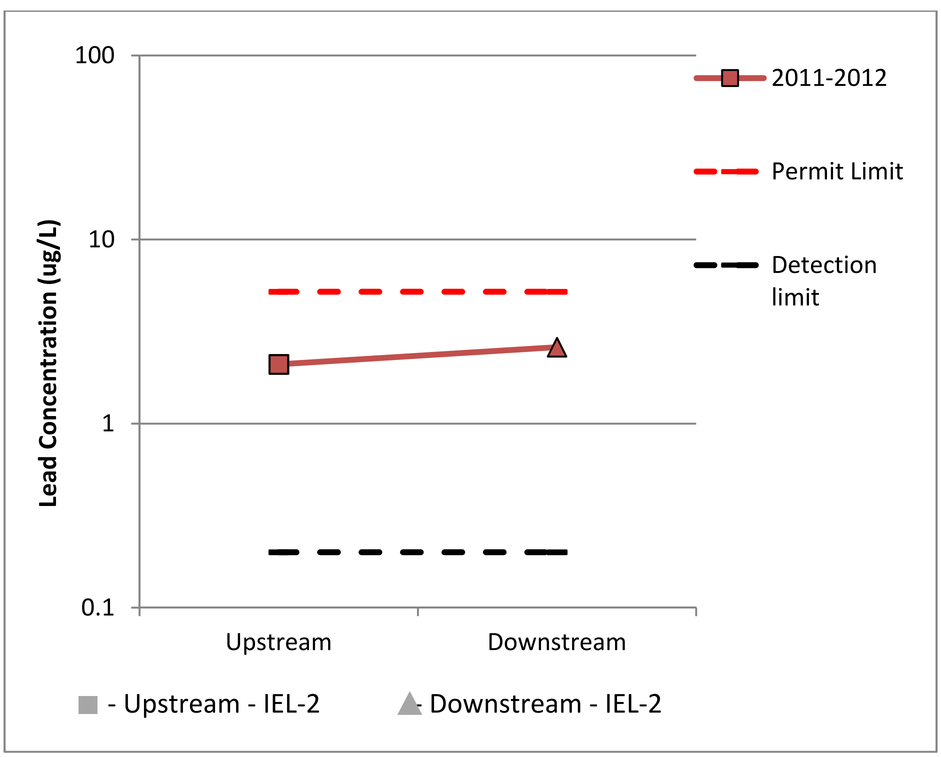



**Figure 31. Lead at ISRA, Watershed 009, IEL-2**

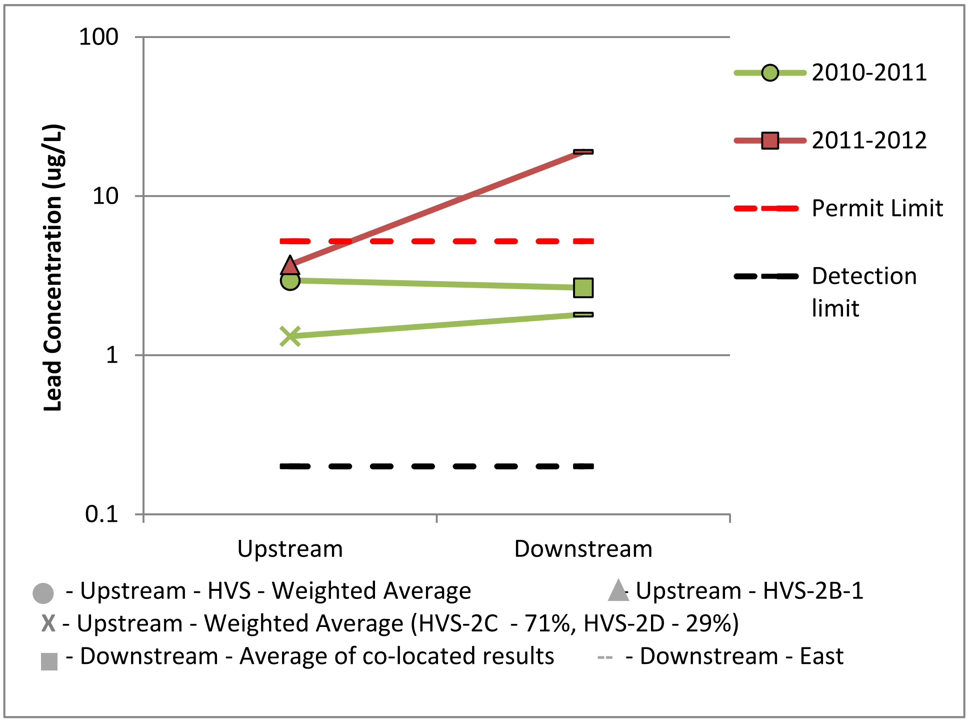



**Figure 32. Lead at ISRA, Watershed 008, Happy Valley East (HVS)**

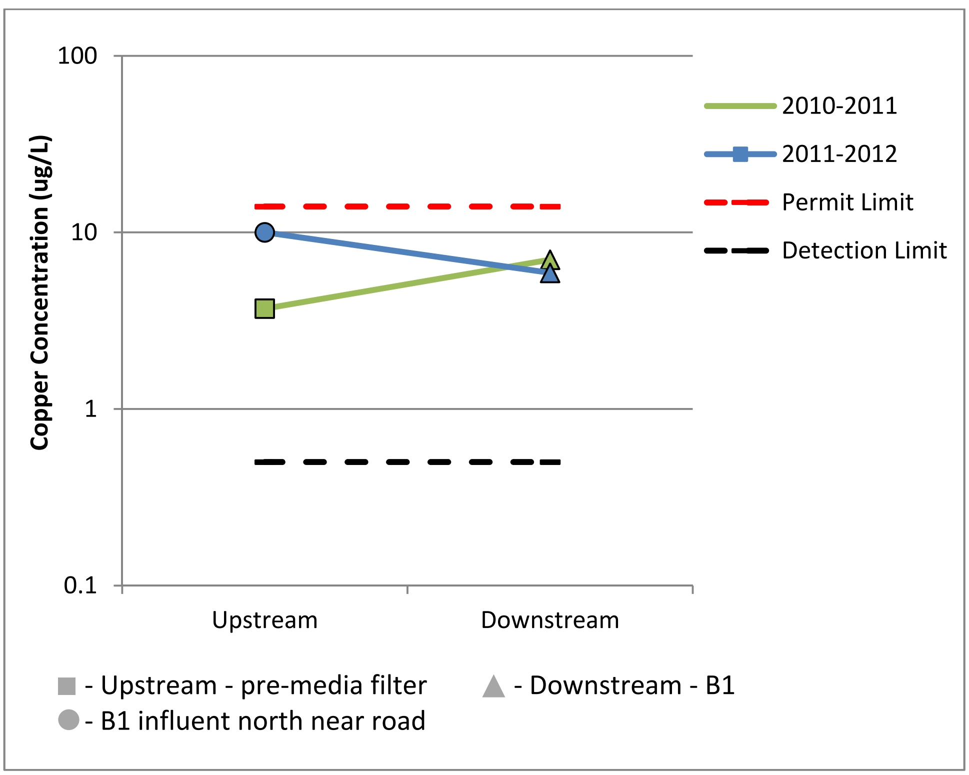



**Figure 33. Copper at ISRA, Watershed 009, B1-2**

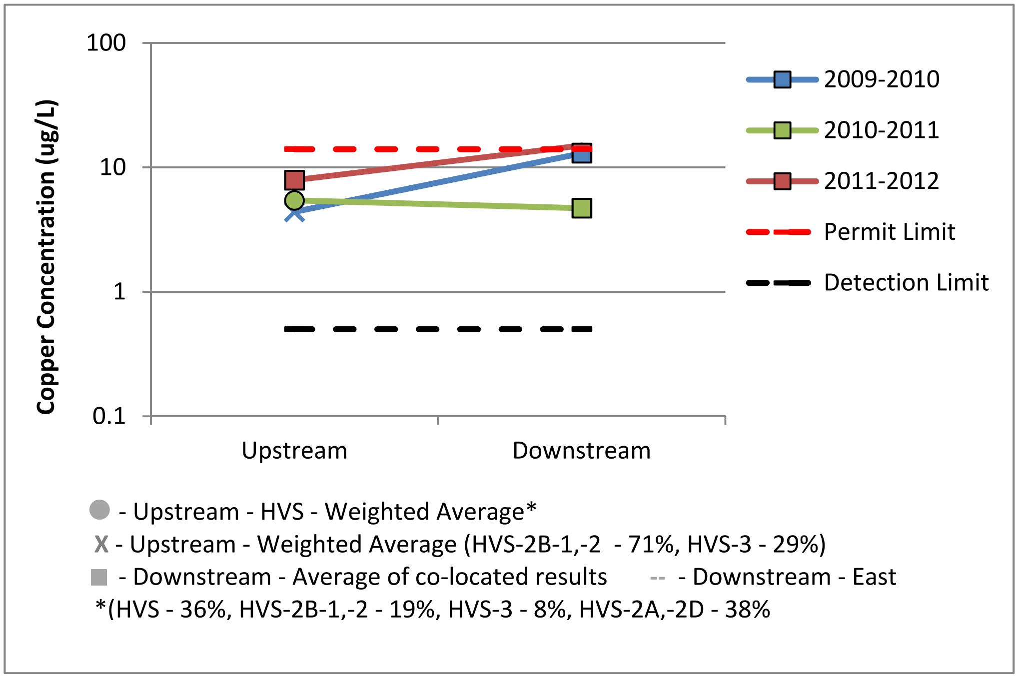



**Figure 34. Copper at ISRA, Watershed 008, Happy Valley East (HVS)**

## 2. STATISTICAL ANALYSIS

Statistical summaries of the SSS paired data using the non-parametric 1-tailed sign test are shown for the ISRA and CM datasets in Tables 2, 3 and 4. This test is used to evaluate statistical differences between paired data points, or in this case, between upstream and downstream (influent and effluent) stormwater samples.

### *ISRA Areas*

At the ISRA monitoring locations CYN-1/DRG-1, B1-2, HVS, and IEL-2, the total number of collected upstream and downstream pairs collected in the rainy seasons between December 2009 and April 2012 range from 5 (copper) to 9 (TSS). Table 2 summarizes the number of paired observations for each constituent, the number of upstream samples that had larger concentrations than the corresponding downstream samples, the calculated p result using the nonparametric paired 1-tailed sign test, and the average concentration and coefficient of variation (COV) for both upstream and downstream pairs.

An average decrease from upstream to downstream samples of 89% was found for dioxins, however these were not found to be statistically significant based on the 1-tailed sign test p-value. This is a positive preliminary indication that stormwater concentrations are not increasing across the ISRA areas (as one might expect for runoff across highly impacted or unstabilized soil areas). It should be noted that ISRA areas, by their nature, are not expected to result in concentration reductions due to control, but rather are intended to result in similar upstream and downstream concentrations, with gradual reductions over time likely in both locations as the disturbed ground (with erosion controls) becomes stabilized and returns to natural cover conditions.

Additional data are needed to determine statistical differences with acceptable confidence, especially for the purposes of evaluating each location separately, which is expected to reduce the variability currently observed. The insignificant increases in some of the constituents shown in Table 2 may indicate a period of increasing stability after the construction period, but with some increased erosion. This is expected to improve with time as ground cover becomes more stabilized and plants mature.

**Table 2. ISRA Statistical Analysis**

| | **TSS (mg/L)** | **Dioxin (µg/L)** | **Copper (µg/L)** | **Lead (µg/L)** |
|---|---|---|---|---|
| Total pairs of observations[1] | 9 | 6 | 5 | 6 |
| Number of upstream samples having larger concentrations than downstream samples | 3 | 3 | 2 | 2 |
| Number of downstream samples having larger concentrations than upstream samples | 6 | 2 | 3 | 4 |
| p by paired nonparametric 1-tailed sign test[2] | 0.25 | 0.50 | 0.50 | 0.34 |
| Average (and COV) upstream concentrations | 75 (1.1) | 4.7E-07 (2.38) | 6.3 (0.42) | 3.9 (1.03) |
| Average (and COV) downstream concentrations | 161 (1.07) | 5.2E-08 (1.57) | 9.1 (0.5) | 6.5 (1) |
| Average percent change (- sign indicating higher downstream results) | -114% | 89% | -45% | -64% |

[1] Some results showed upstream concentration = downstream concentration; this explains why rows 2 and 3 do not necessarily sum to the total pairs of observations.

[2] One-tail sign test used to evaluate data. Results where upstream = downstream were not used in sign test.

### *Culvert Modification Areas*


**Figure 35. Sediment accumulated behind weir boards at CM-3.**

The six monitored CMs (B1, CM-1, CM-3, CM-8, CM-9, and CM-11) are in the 009 watershed. At the CM monitoring locations, the total number of collected influent and effluent pairs ranged from 48 (dioxin) to 67 (TSS). Table 3 and Table 4 summarize the paired data statistics for these locations[1]. CM-8 and CM-11 statistics are presented separately since these are considered background sites. At the B1 site, media filter bleed through was observed during initial sampling dates in the 2011-2012 sampling season. Since this was a malfunction, results from these sample dates were removed from the analysis. For TSS, 23 out of 38 (61%) of influent concentrations were greater than their paired effluent concentrations, with an average decrease of 47%. Figure 35 further demonstrates that significant sediment capture has been observed in the CM ponding areas. For lead, 27 out of 38 (71%) influent concentrations were greater than their paired effluent concentrations, and for dioxins, 20 out of 30 (67%) influent concentrations were greater than effluent concentrations. Results suggest that the comparison of influent and effluent concentrations for dioxin and lead are statistically significant ($p < 0.05$) with influent concentrations greater than effluent concentrations (i.e., POC reduction through the CMs) for lead, but a slight increase from influent to effluent for dioxins. Given the fact that the majority of individual dioxin pairs show decreases from influent to effluent, the results showing an increase in these concentrations on average is unexpected, and in fact, this result appears to be driven by the small number of relatively high concentrations found in samples at CM-1. This highlights the need for additional data in order to enable individual site analyses which will result in being able to better relate the concentration differences to the site characteristics (especially watershed drainage areas above the CMs).

---

[1] As noted earlier in this memorandum, the CM-3 performance cannot be reliably assessed based on the downstream sample results. For this reason, the CM-3 paired data were excluded from the statistical analysis presented in Table 3.

**Table 3. CM Statistical Analysis (results from CM-8 and CM-11 background sites and CM-3 excluded)**

| | TSS (mg/L) | Dioxin (µg/L) | Lead (µg/L) |
|---|---|---|---|
| Total pairs of observations[1] | 38 | 30 | 38 |
| Number of influent samples having larger concentrations than effluent samples | 23 | 20 | 27 |
| Number of effluent samples having larger concentrations than influent samples | 13 | 7 | 11 |
| p by paired nonparametric 1-tailed sign test[2] | 0.066 | 0.010 | 0.007 |
| Average (and COV) influent concentrations | 108 (2.23) | 5.0E-07 (1.76) | 11 (1.38) |
| Average (and COV) effluent concentrations | 57 (2.11) | 5.3E-07 (3.47) | 6.6 (1.44) |
| Average percent change (- sign indicating higher effluent results) | 47% | -6% | 38% |

[1] Some results showed upstream concentration = downstream concentration; this explains why rows 2 and 3 do not necessarily sum to the total pairs of observations.
[2] One-tail sign test used to evaluate data. Results where upstream = downstream were not used in sign test.

**Table 4. CM-8 and CM-11 (background sites) Statistical Analysis**

| | TSS (mg/L) | Dioxin (µg/L) | Lead (µg/L) |
|---|---|---|---|
| Total pairs of observations[1] | 21 | 11 | 10 |
| Number of influent samples having larger concentrations than effluent samples | 13 | 2 | 7 |
| Number of influent samples having larger concentrations than effluent samples | 3 | 4 | 1 |
| p by paired nonparametric 1-tailed sign test[2] | 0.011 | 0.344 | 0.035 |
| Average (and COV) influent concentrations | 12.67 (1.64) | 2.53E-10 (1.31) | 3.23 (1.39) |
| Average (and COV) effluent concentrations | 7.62 (1.26) | 6.83E-10 (1.9) | 1.63 (1.36) |
| Average percent change (- sign indicating higher effluent results) | 40% | -170% | 50% |

[1] Some results showed upstream concentration = downstream concentration; this explains why rows 2 and 3 do not necessarily sum to the total pairs of observations.
[2] One-tail sign test used to evaluate data. Results where upstream = downstream were not used in sign test.

## 3. UPSTREAM v. DOWNSTREAM CORRELATION CHARTS

Figures 36 through 42 compare influent/upstream data to effluent/downstream for the paired data presented above at ISRA and CM sites. A least-squares regression was used to fit a line to log-transformed data (log(y) = mlog(x) + b. The slope of the lines, m, is shown is the lower right corner of the graph. In addition to the slope, the p-value is also shown to indicate the significance of the value of the reported slope. In other words, if the p-value is less than 0.05, the significance of the non-zero value of the slope, m, can be said to be 95%. A 1:1 line was also added to each plot. Data above the 1:1 line indicate a downstream increase in concentrations, while data below the 1:1 line indicate a downstream decrease in concentrations (or positive BMP performance in the case of the CMs). Pairs where one or both results were not detected were excluded from these graphs.

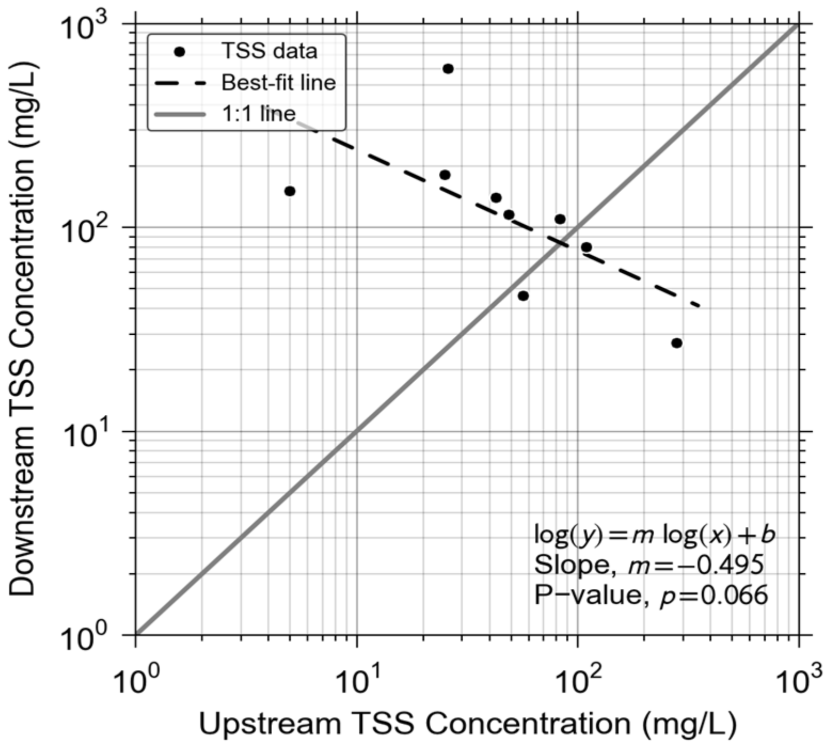



**Figure 36: Paired TSS Concentrations at ISRA Sites**

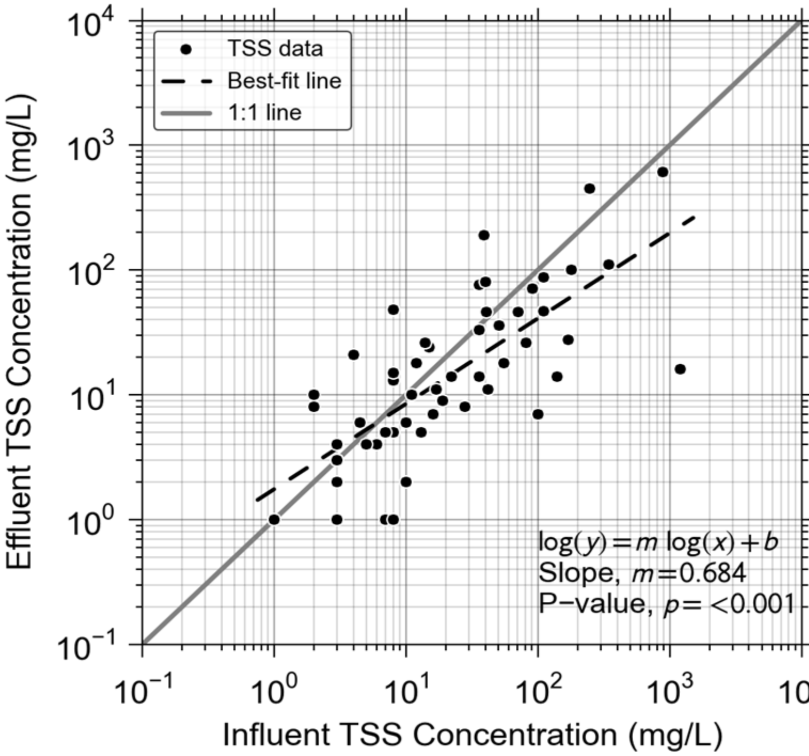



**Figure 37: Paired TSS Concentrations at CM Sites**

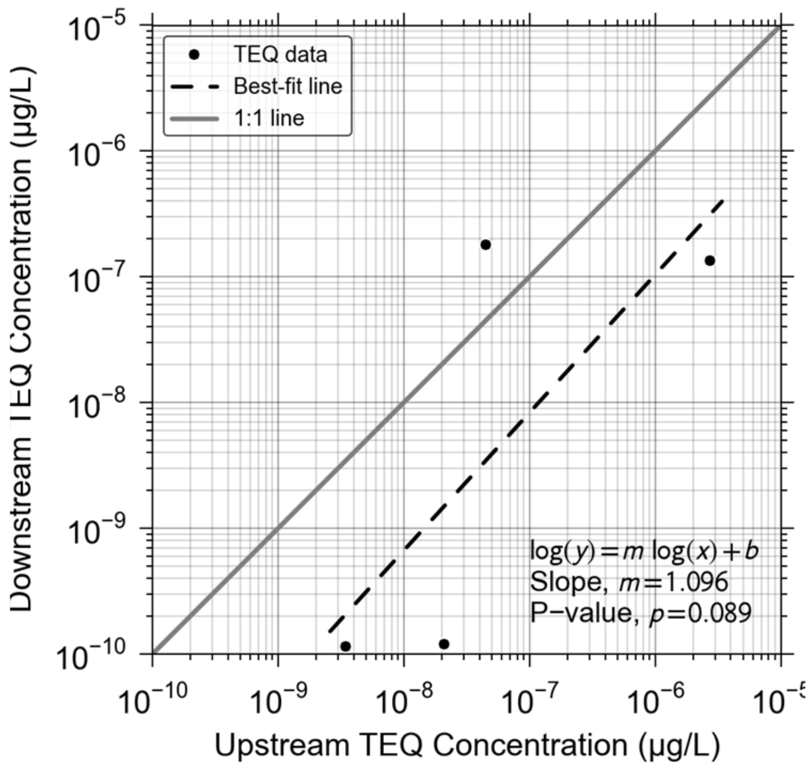



**Figure 38: Paired Dioxin Concentrations at ISRA Sites**

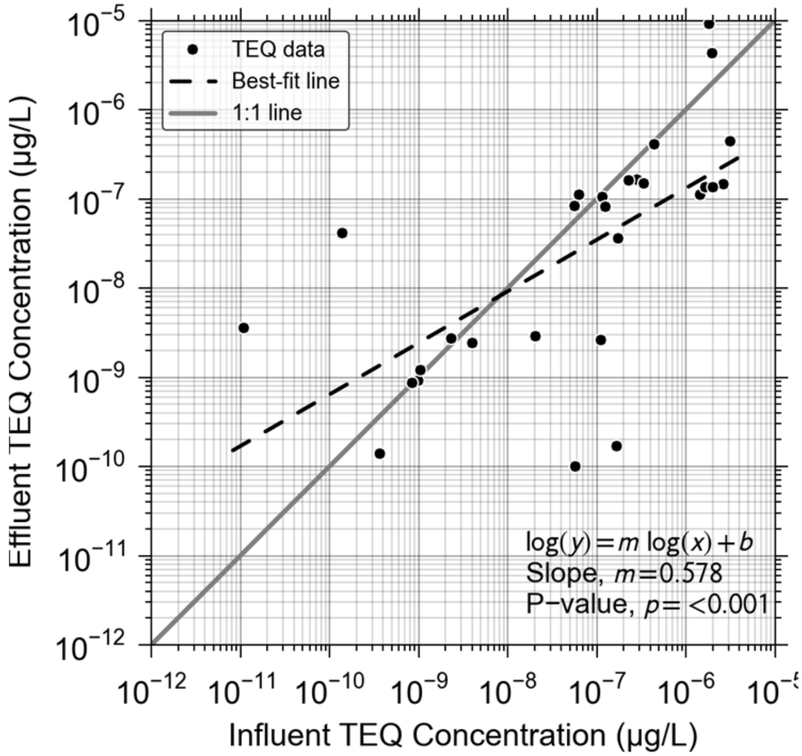



**Figure 39: Paired Dioxin Concentrations at CM Sites**

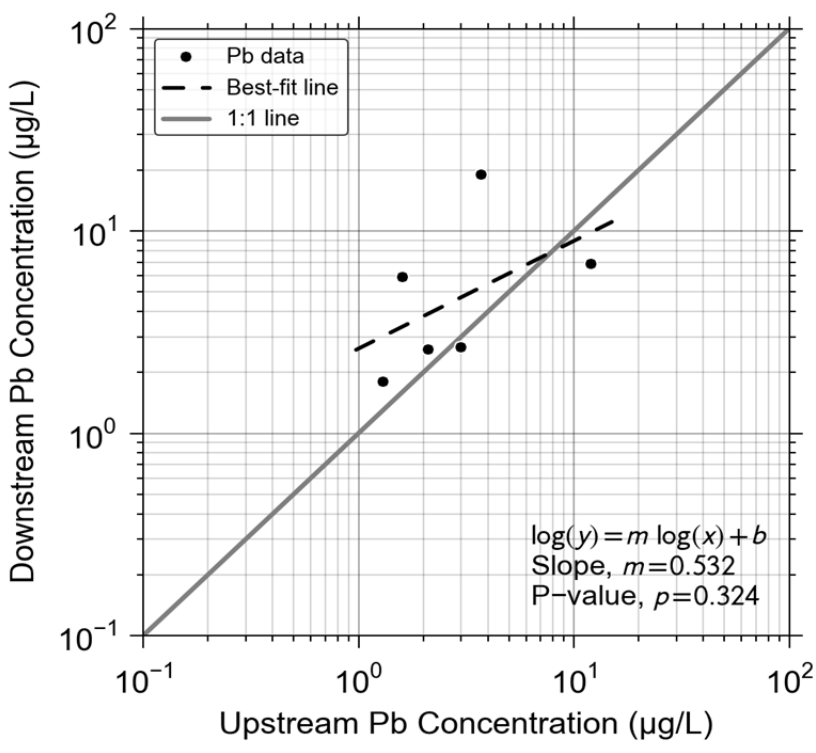



**Figure 40: Paired Lead Concentrations at ISRA Sites**

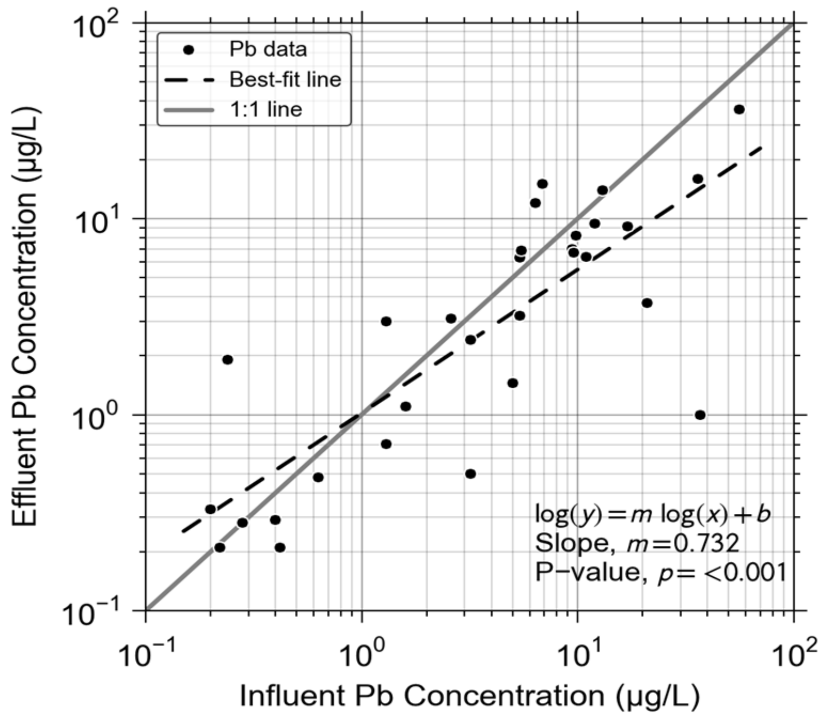



**Figure 41: Paired Lead Concentrations at CM Sites**

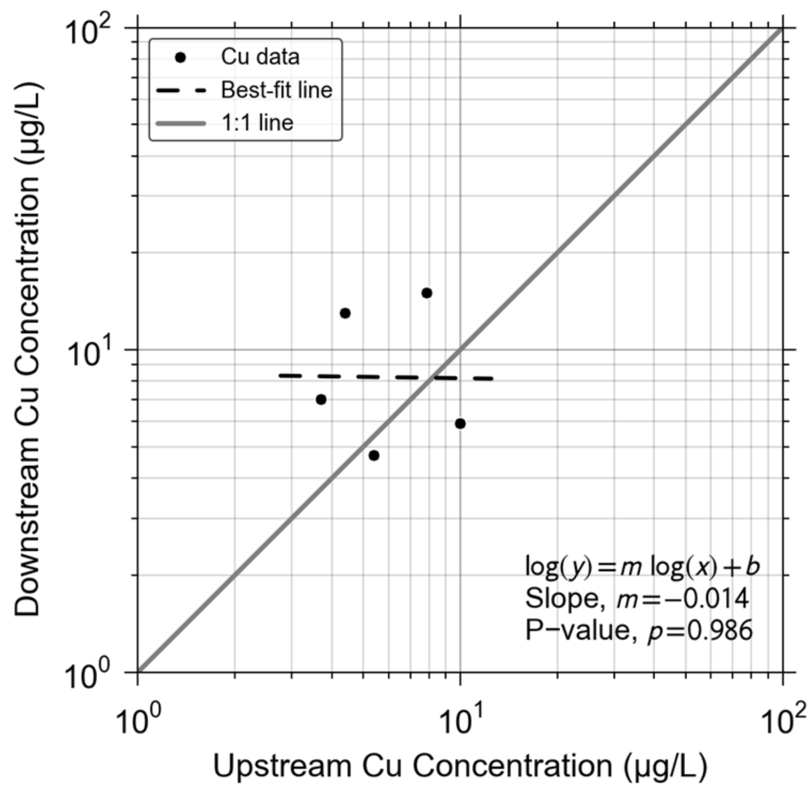



**Figure 42: Paired Copper Concentrations at ISRA Sites**

## 4. PROBABILITY PLOTS

Probability plots, shown in Figures 43 through 49, are prepared by ranking the available data and calculating their probability of occurrence. These probability values (shown on the vertical axis) are plotted against their concurrent concentrations. Where applicable, NPDES permit limits for each POC are also shown on the charts for comparison and are presented as vertical lines. While determining the plotting positions, non-detect (ND) data were sorted independently and assigned to the lowest positions, effectively truncating the probability plots at the fraction of non-detected samples. Therefore, only detected results positions are plotted, which leads to the vertical asymmetry about the median (50th percentile). The figures also contain some basic statistics describing the data shown on the graphs. For each influent/upstream and effluent/downstream dataset, the number of ND results are compared to the total number of results in the dataset and the coefficient of determination ($R^2$), and the significance values resulting from an Anderson-Darling test for normal and lognormal distributions are shown. The coefficient of determination describes how well the (logarithmic) best-fit line fits the data. The Anderson-Darling results represent the confidence level with which one can say how consistent the data are with the examined distributions. For instance, in the case of influent lead at CM locations, one can be 99% confident that the data are consistent with a lognormal probability distribution, but less than 85% (i.e. not confident) that they are consistent with a normal distribution.

Where black influent data consistently fall to the right of the white effluent points, consistent water quality improvement is occurring at these areas. The horizontal distance between the datasets (noting it is a log scale) also indicate the magnitude of the concentration change at these areas.

The relative difference in the amount of scatter observed in these plots indicates that BMP effectiveness may vary in consistency depending on the location and constituent. For instance, the fact that scatter in Figure 43 appears to be greater than that in Figure 44 indicates that CM effectiveness is more consistent than ISRA for TSS. These plots also indicate the influent concentrations above which the CMs are most effective (low concentrations are expected to represent irreducible concentrations). Figure 44 indicated that CMs are more effective for influent TSS concentrations greater than about 20 mg/L and influent concentrations less than 10 mg/L would be very difficult to further reduce.

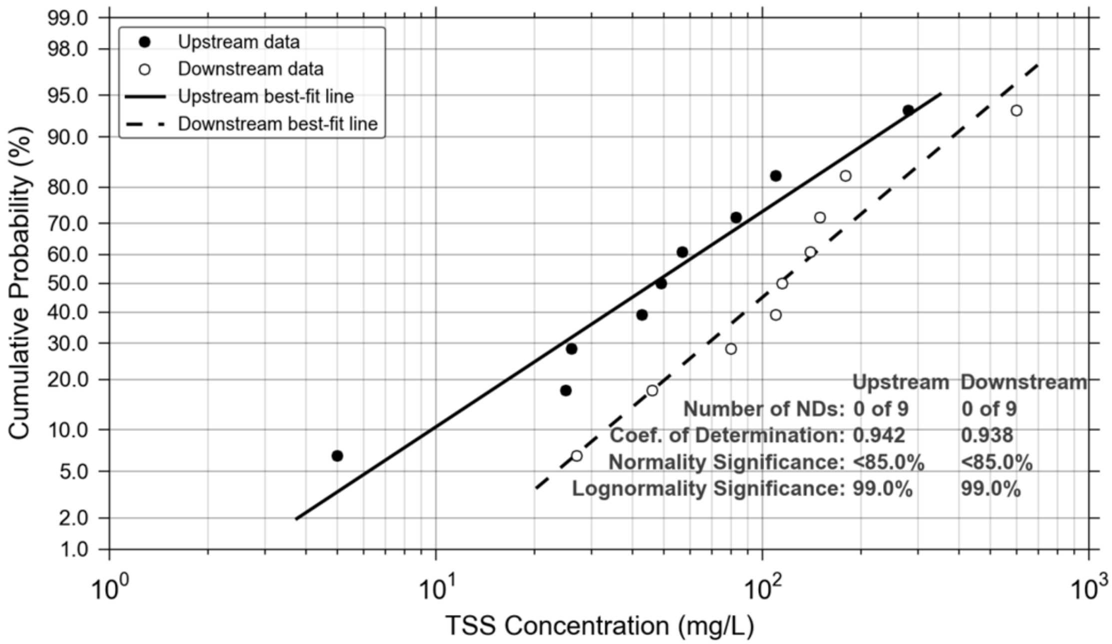



**Figure 43: Probability Plot of TSS at ISRA Locations**

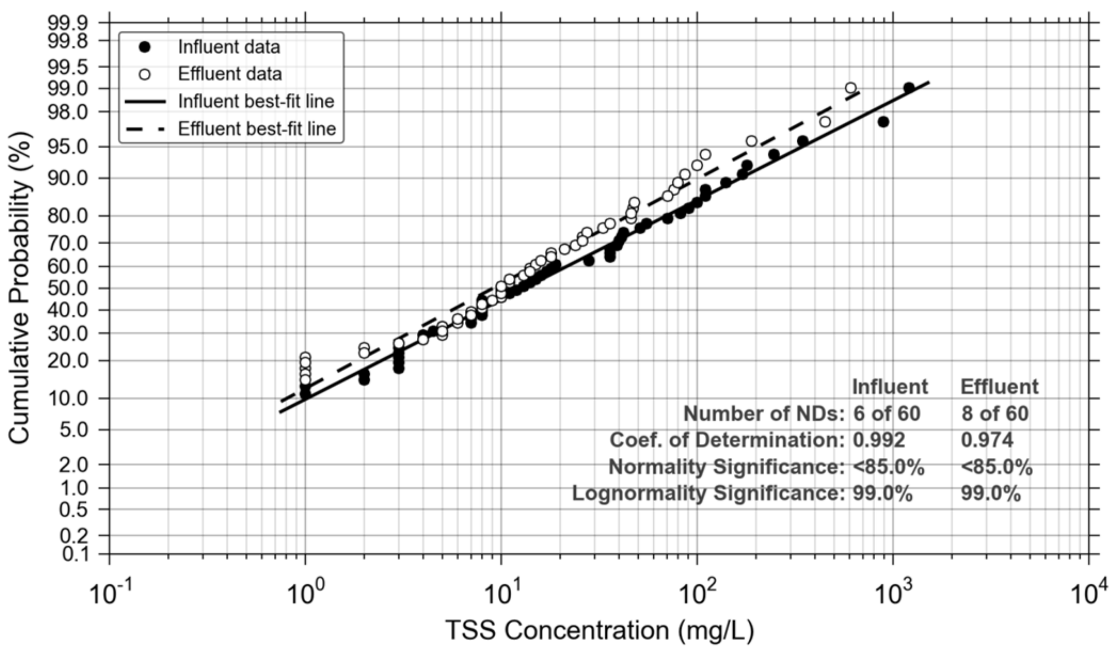



**Figure 44: Probability Plot of TSS at CM Locations**

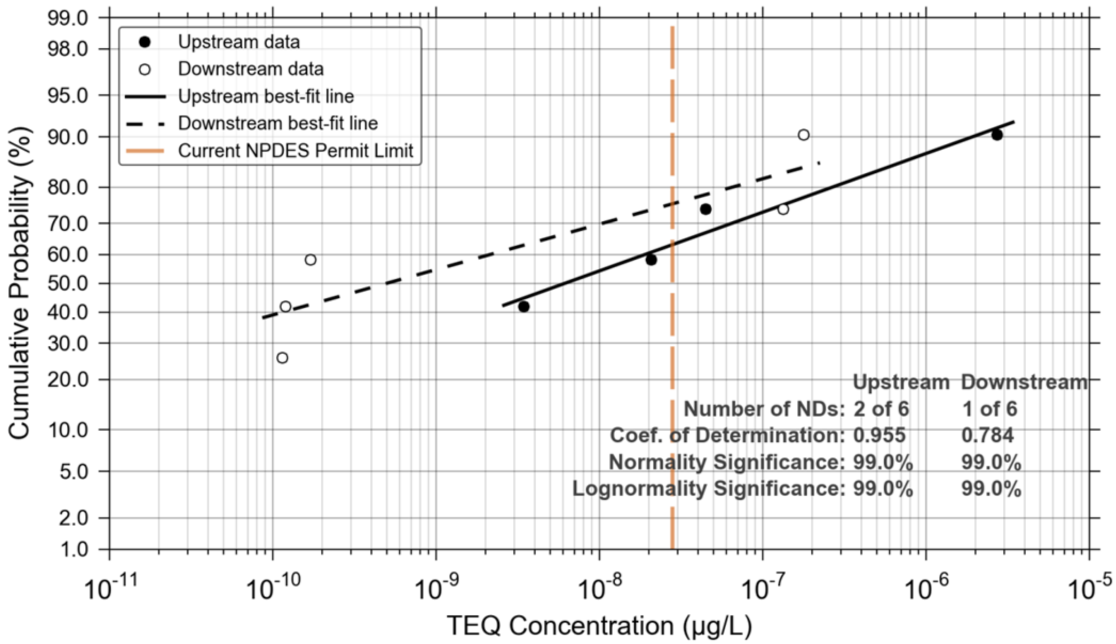



**Figure 45: Probability Plot of Dioxins at ISRA Locations**

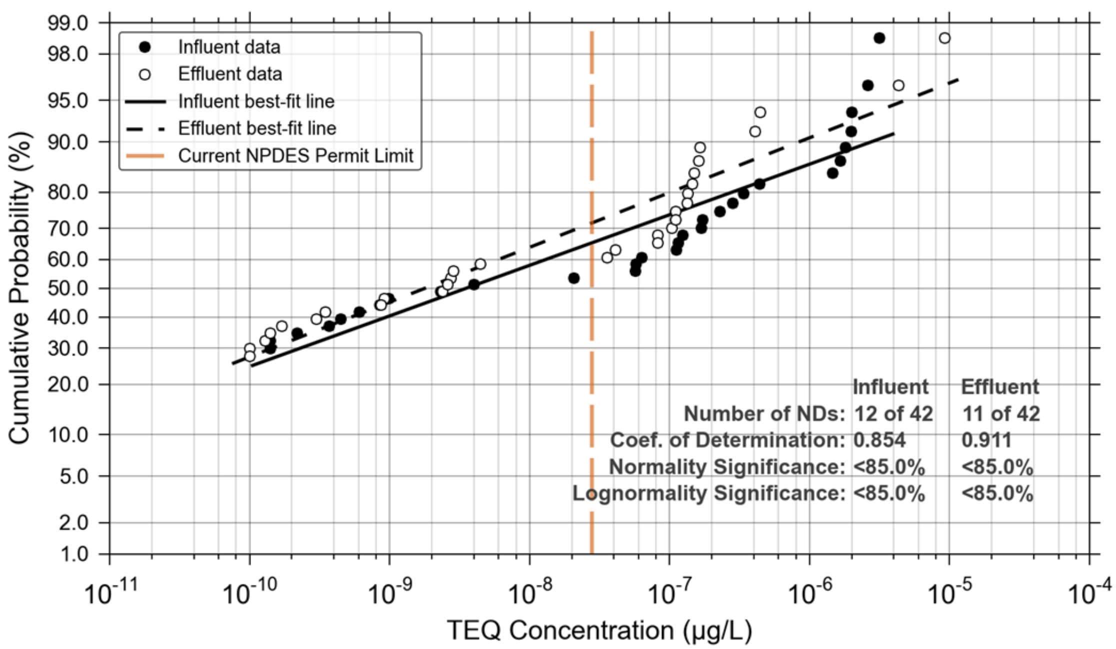



**Figure 46: Probability Plot of Dioxins at CM Locations**

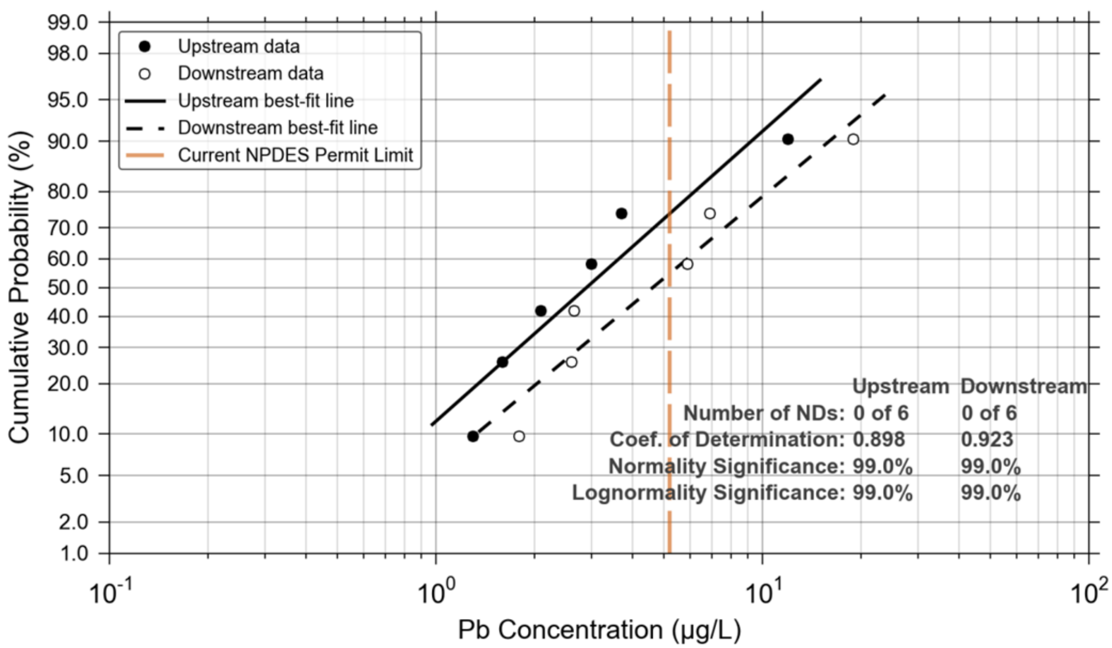



**Figure 47: Probability Plot of Lead at ISRA Locations**

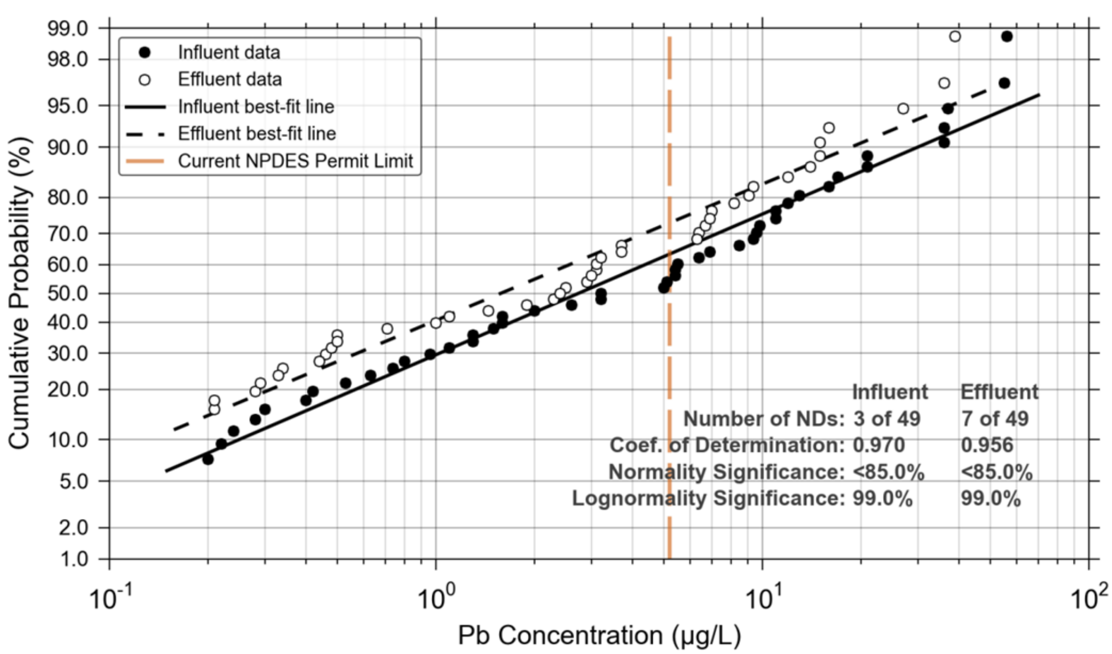



**Figure 48: Probability Plot of Lead at CM Locations**

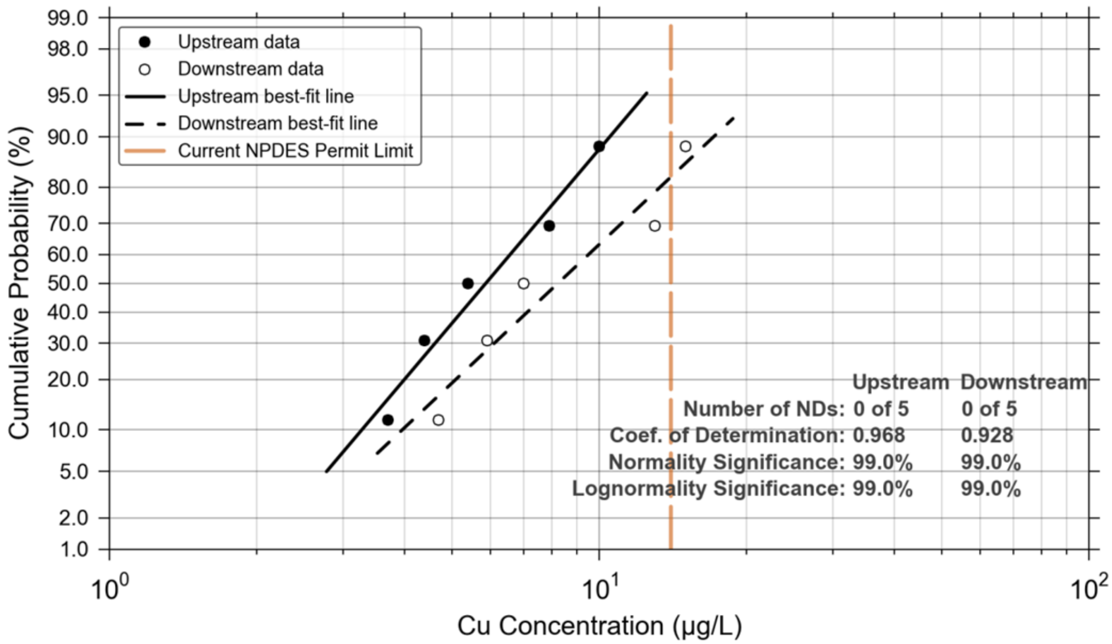



**Figure 49: Probability Plot of Copper at ISRA Locations**

## 6. DISCUSSION

The following general observations were made based on an evaluation of the aforementioned data summary charts and tables.

1. In general, data (as summarized by the statistical analysis tables, correlation charts, and probability plots) indicate that downstream ISRA and CM concentrations were lower than corresponding upstream samples for a number of the constituents, suggesting positive performance of ISRA excavation and stabilization efforts and of the CM treatment systems. Exceptions were TSS, lead and copper in the ISRA sites, and dioxins in the CM sites (both background and non-background), though it should be noted that, in the case of the ISRA and background CM locations, comparisons between the upstream and downstream concentrations for these constituents were not statistically significant. It should also be noted that for the ISRA areas, having comparable upstream and downstream datasets is considered a positive outcome as it suggests that these actions resulted in indistinguishable stormwater quality changes in comparison to unimpacted (upstream) runoff quality.

2. TSS and lead at both the background (Table 4) and non-background (Table 3) CM locations were found to show effluent concentration reductions (i.e., water quality improvements). Non-background sites (Table 3) had a statistically significant decrease for lead (1-tailed sign test p=0.007) and marginally significant decrease for TSS (1-tailed sign test p=0.066). Background sites had a statistically significant decrease for both TSS (1-tailed sign test p=0.011) and lead (1-tailed sign test p=0.035). In non-background sites, 67% of the 30 dioxin sample pairs indicated concentration reductions through the culvert modifications (if samples collected during overflow events are excluded, this would more representatively be 69% of 26 sample pairs with concentration reductions through the culvert modifications). The probability plots further support a small general reduction from influent to effluent. However the influent-effluent correlation plots suggest little to no removal is occurring on average, and this alternative finding was also supported by a slight increase in average concentrations from influent to effluent. Therefore CM performance results for dioxin were mixed. In general, the inconsistent performance of CM controls suggests that CM filter media bypass and weirboard overflow may be occurring regularly due to their small size (due to site constraints), and may be limiting their treatment capacity. However, the monitored performance demonstrates the benefits of the sedimentation and media treatment unit processes. The monitoring data have also been used in the site selection evaluations for consideration for enhancements to selected CMs for improved performance in areas where the effluent remains problematic. Also the Expert Panel's assessment of CM-1 performance, particularly for dioxins, should be viewed as preliminary at this time as several of the Panel's upstream BMP recommendations have yet to be completed, and these modifications are expected to improve runoff capture at this CM.

3. Variations in the design of the different CMs may control effluent quality. Most use media mounds so that general direction of percolation is horizontal from the ponded water to the underdrain, so the driving head is less and contact time is greater. To accommodate the site constraints, the B1 media filter has a vertical flow configuration which increases the head across the media during peak flows. Therefore, the B1 media filter is expected to provide less media contact time than the other CMs despite having roughly the same media thickness, and may not

be able to achieve the same dioxin effluent concentrations. The B1 area also has higher dioxin influent concentrations than all other CMs, with the exception of CM-1.

These results suggest that ISRA area stabilization has been successful, and CM stormwater treatment is occurring, particularly for TSS and total lead.

## 7. RECOMMENDATIONS

1. For the ISRA areas, the Panel recommends continued inspection of erosion controls and revegetation, and maintenance/replacement where/when necessary based on judgment of field staff.

2. Based on evaluation of CM performance, the Panel recommends there be continued inspection and maintenance including: inspection after large storms and at the start of the rainy season, removal of accumulated sediment and debris in ponded footprints (particularly when accumulation depth exceeds 10% of weir board height), inspection of underdrain flows during storms to ensure water is still flowing effectively through media beds, replacement of filter fabric when they are damaged or non-functioning, collection of field notes during sampling to note whether weirboard overflow is occurring, etc. Furthermore, the Panel will provide specific improvement recommendations for CM areas where effluent quality is indicative of additional necessary mitigation.

3. The Panel recommends that culverts that continue to be sampled be inspected for sediment which may act as an ongoing source for POCs. Similarly, the Panel recommends that when sediment is removed from upstream of the weir boards, the filter fabric is inspected to see if it has accumulated sediment to the point that it has become a source.

4. If media clogging or media failure is a concern, video inspections would be useful in order to inspect underdrains for signs of clogging, material movement into the pipe, or a cracked pipe. The Panel recommends doing video inspections while the system is dry, and then again after water is introduced upstream of the weir boards in a controlled manner, such as from a water truck. In the “water” inspection, it would be helpful to time how long it takes water to move through the treatment media.

# APPENDIX F

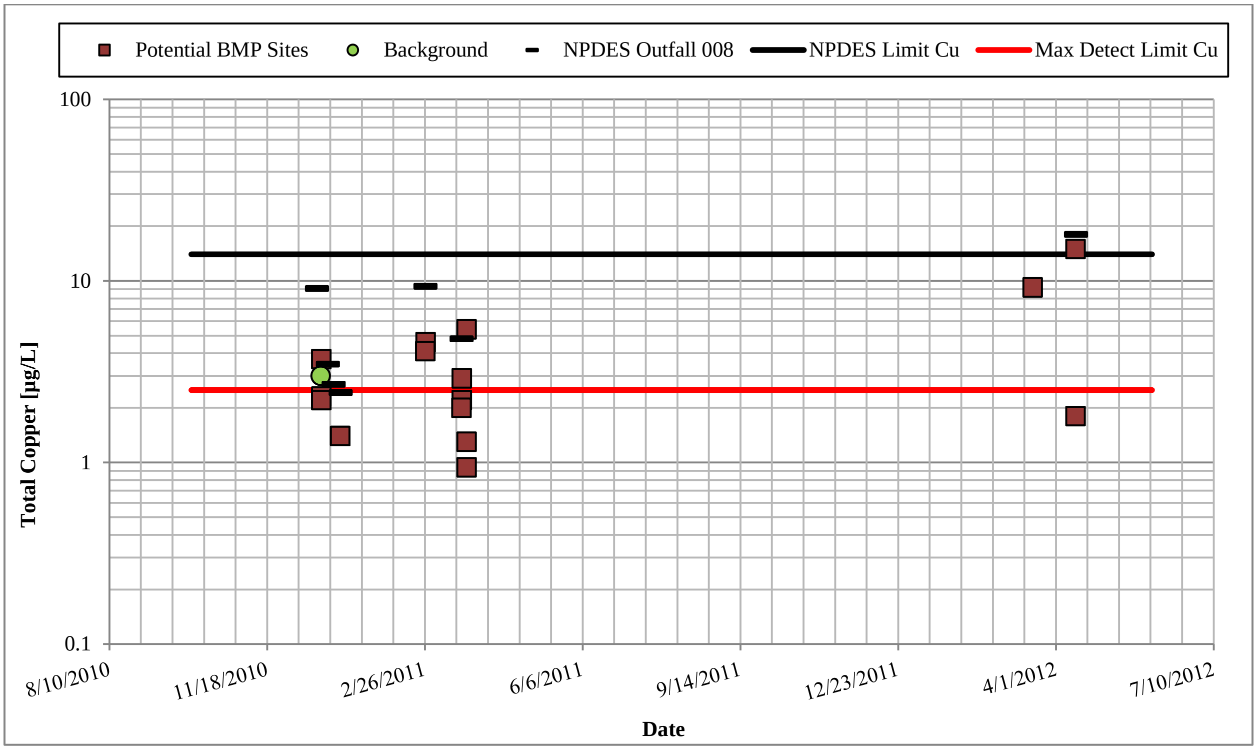
# BMP MONITORING CHARTS
# 2011/2012 RAINY SEASON

# APPENDIX F-1

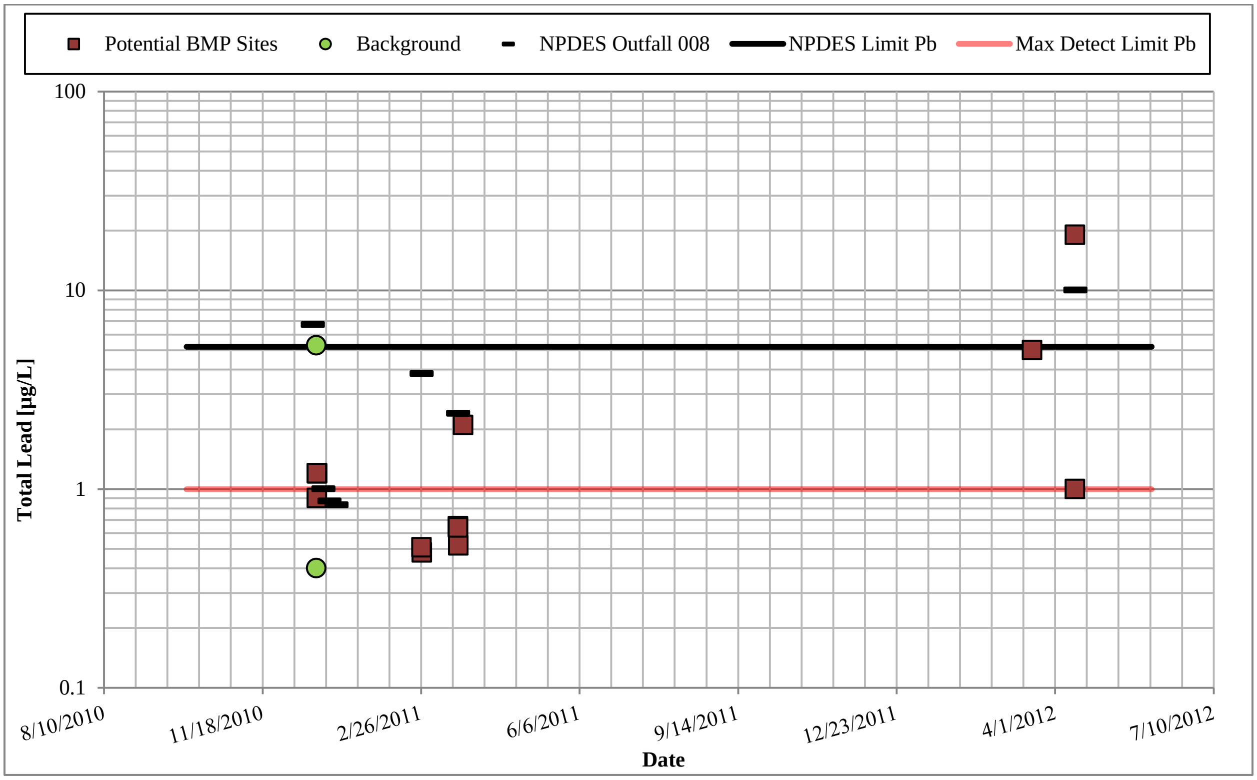
# BMP MONITORING COC TIME-SERIES CHARTS
# 2011/2012 RAINY SEASON

# OUTFALL 008 TIMESERIES CHARTS
# POTENTIAL BMP SUBAREA MONITORING PROGRAM

## COPPER



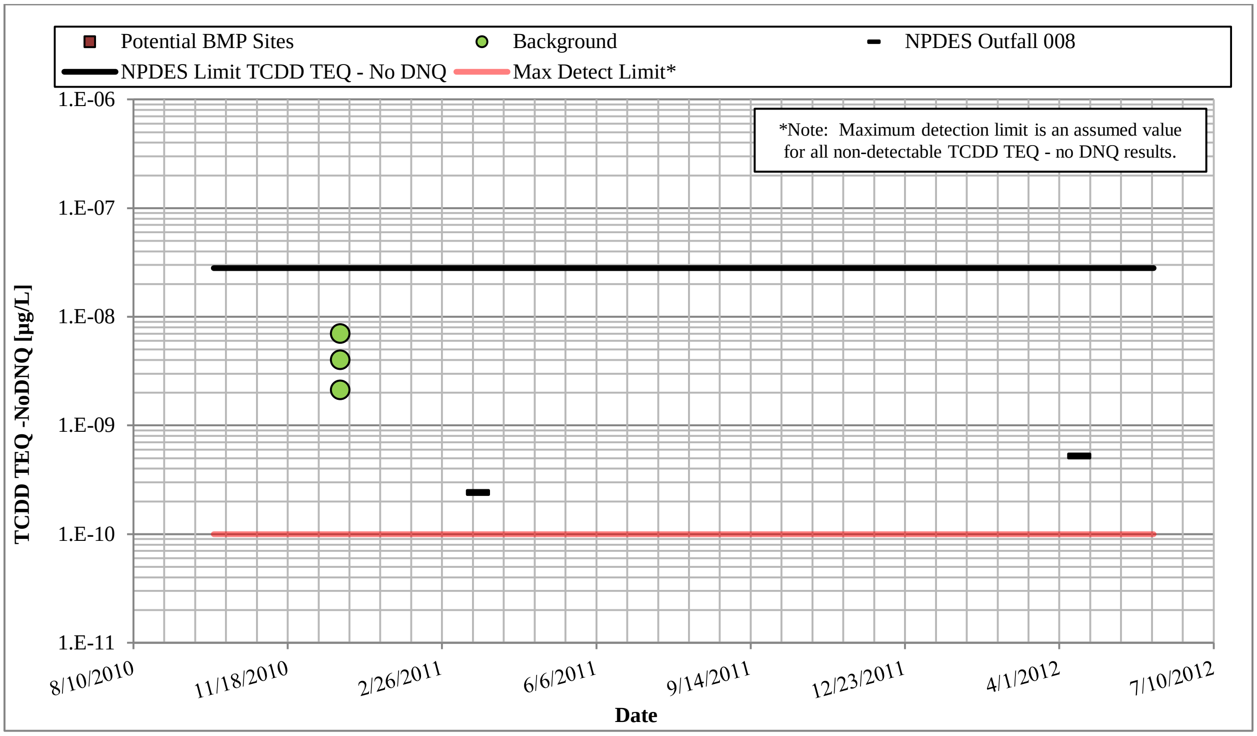

## LEAD



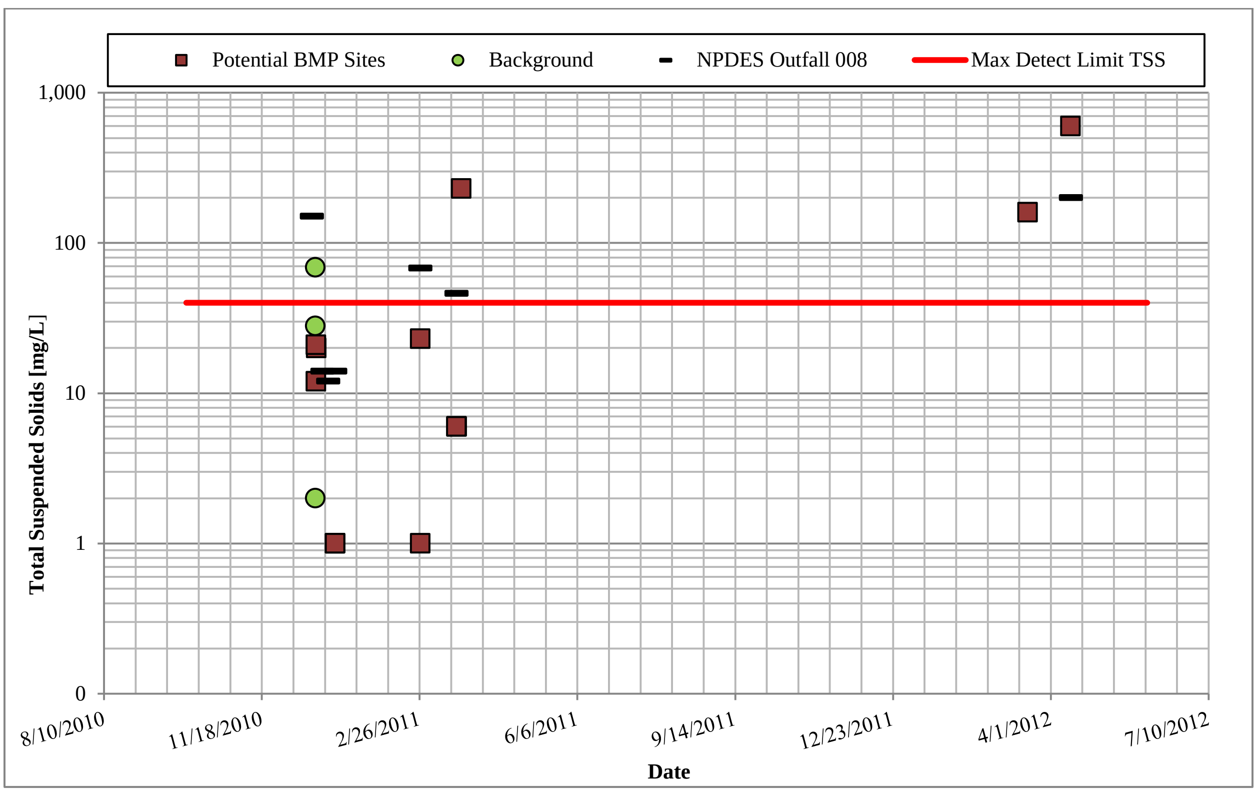

Sample results measured below the detection limit have been excluded. Results shown below the maximum detection limit line correspond to samples with a detection limit less than the maximum detection limit.

## OUTFALL 008 TIMESERIES CHARTS
## POTENTIAL BMP SUBAREA MONITORING PROGRAM

### DIOXINS (TCDD-TEQ – no DNQ)

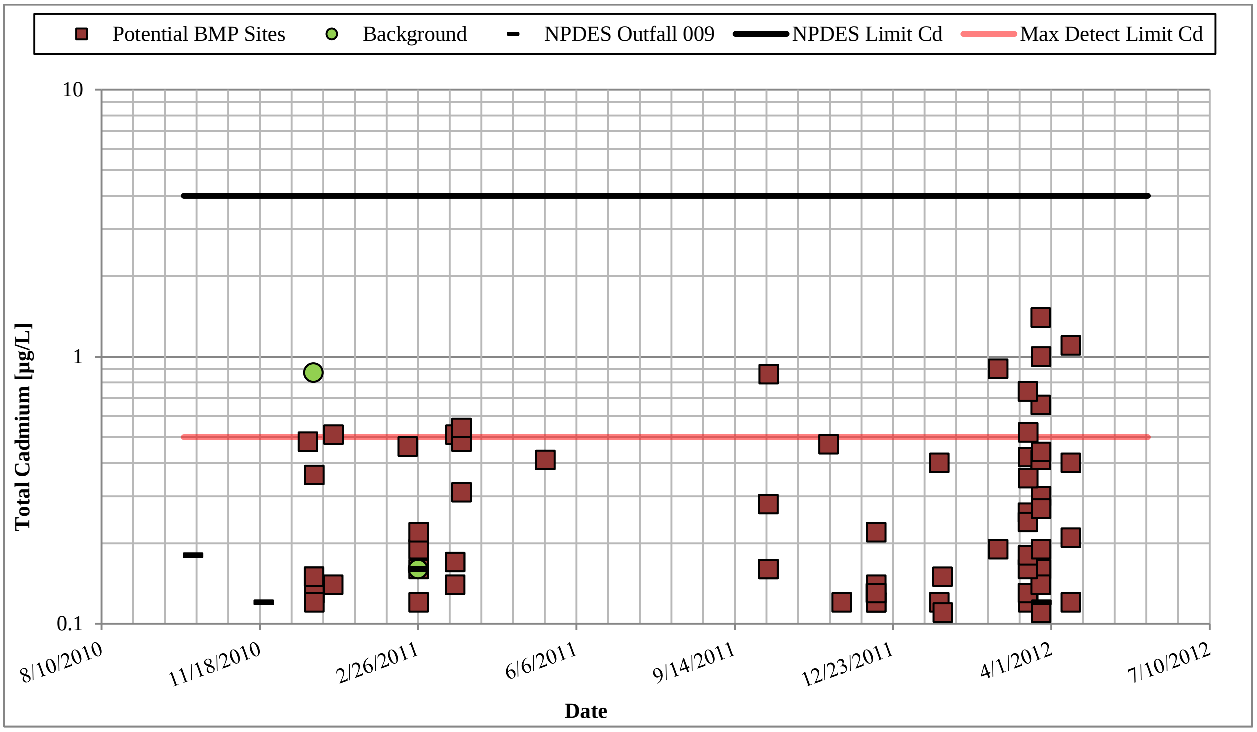



### TSS

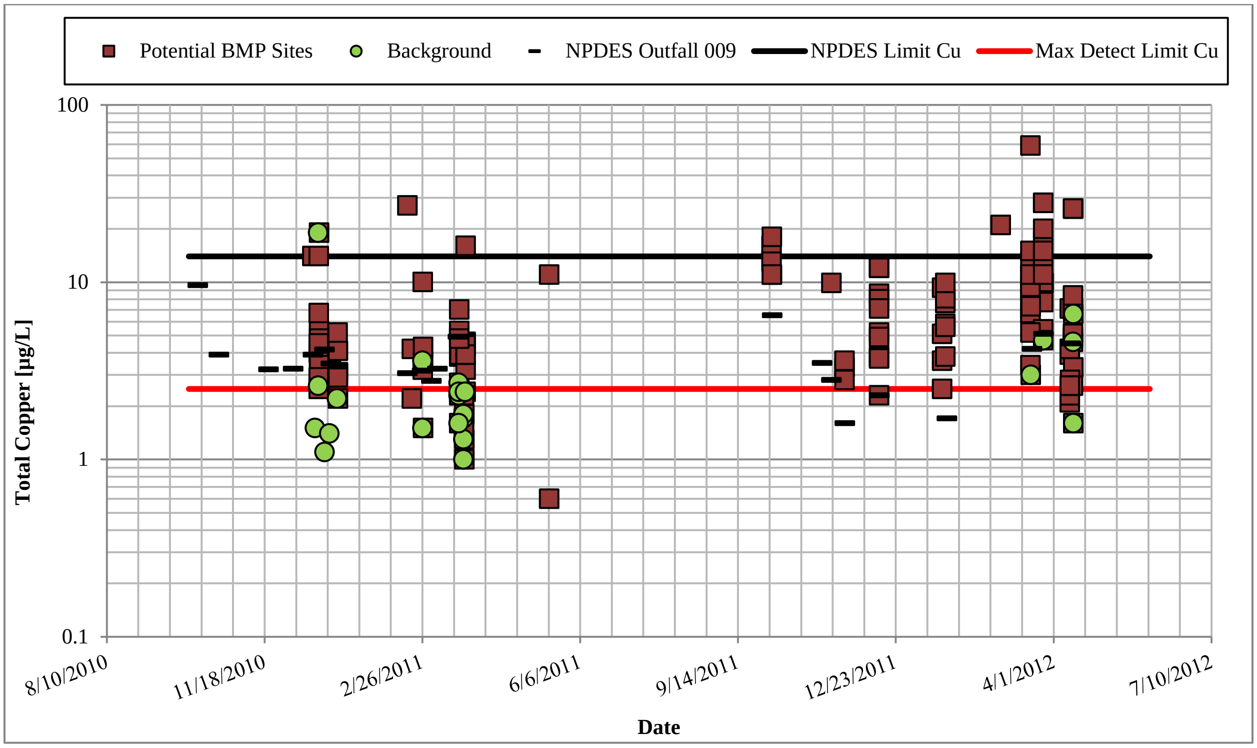



Sample results measured below the detection limit have been excluded. Results shown below the maximum detection limit line correspond to samples with a detection limit less than the maximum detection limit.

## CADMIUM



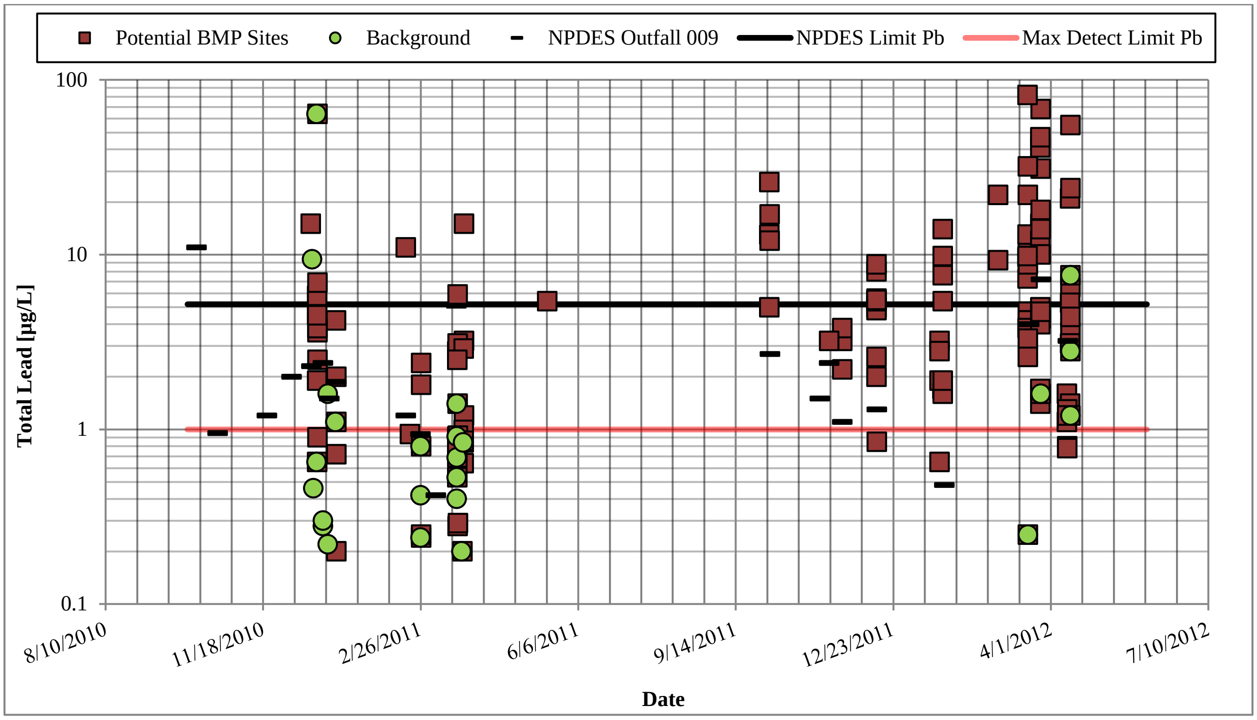

## COPPER



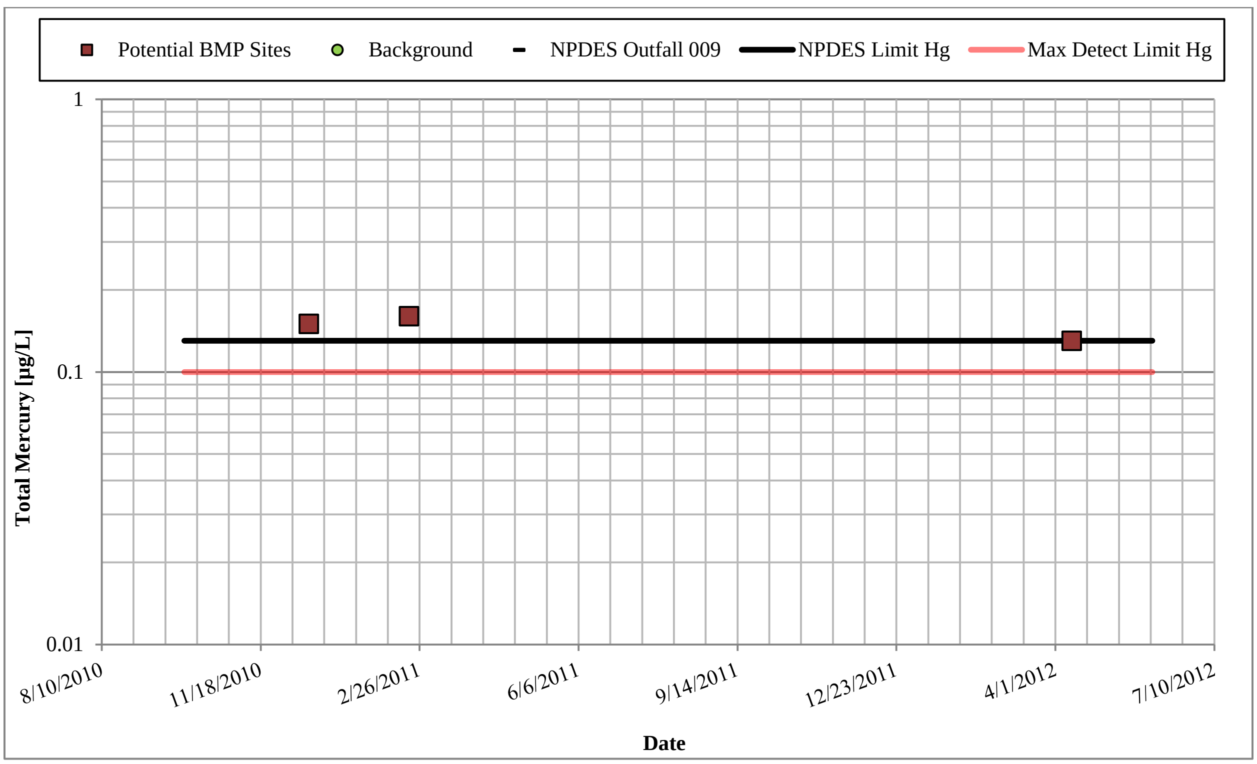

Sample results measured below the detection limit have been excluded. Results shown below the maximum detection limit line correspond to samples with a detection limit less than the maximum detection limit.

OUTFALL 009 TIMESERIES CHARTS
POTENTIAL BMP SUBAREA MONITORING PROGRAM

## LEAD



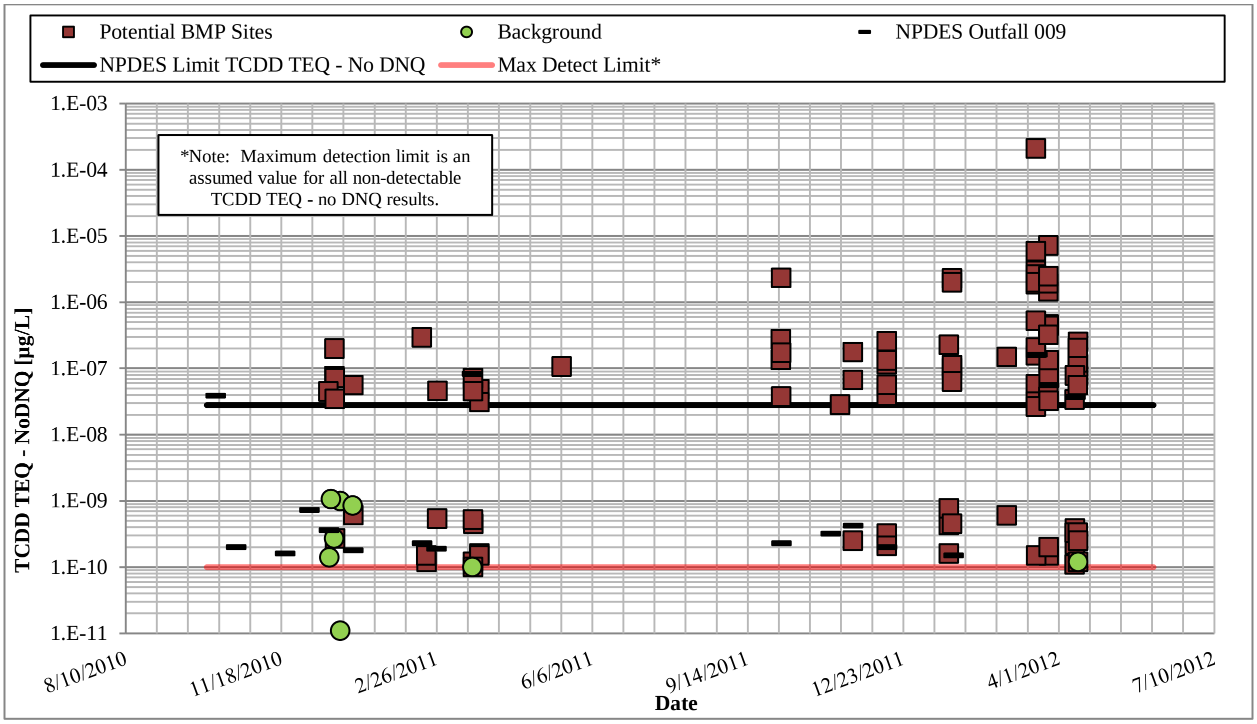

## MERCURY



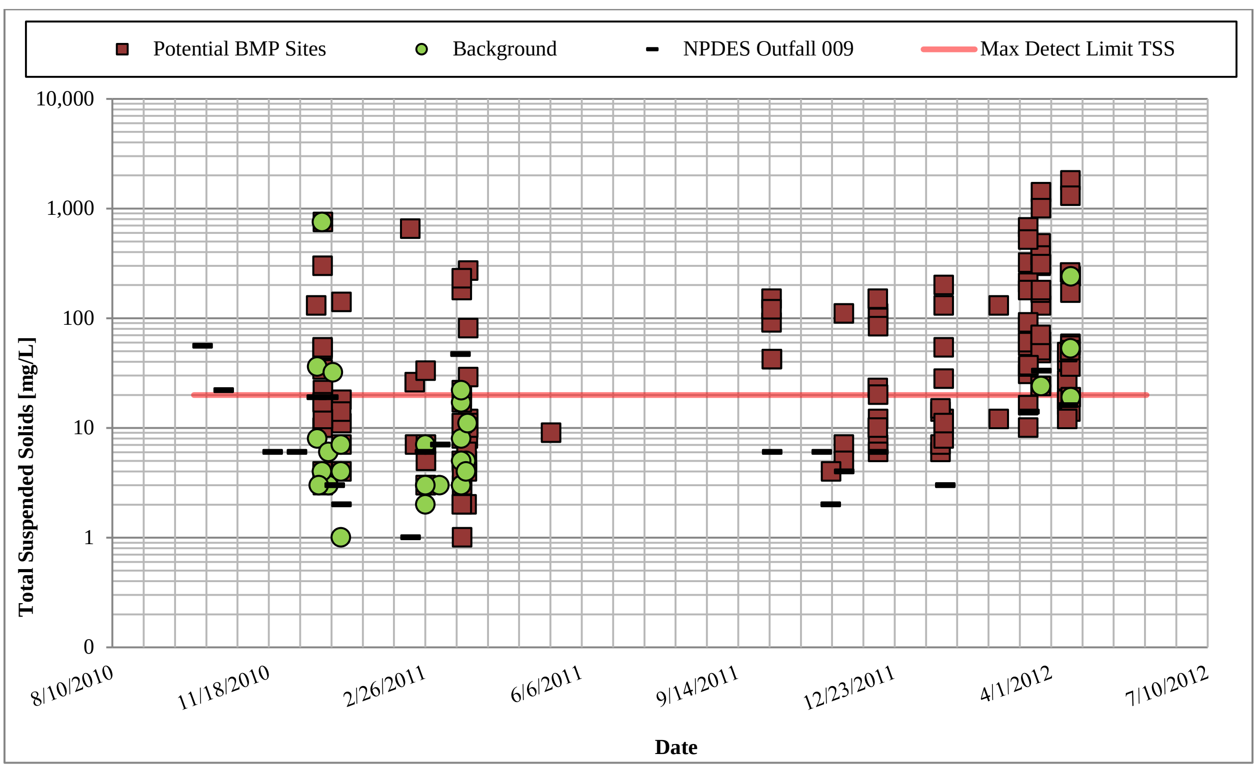

Sample results measured below the detection limit have been excluded. Results shown below the maximum detection limit line correspond to samples with a detection limit less than the maximum detection limit.

## OUTFALL 009 TIMESERIES CHARTS
## POTENTIAL BMP SUBAREA MONITORING PROGRAM

### DIOXINS (TCDD-TEQ – no DNQ)




### TSS



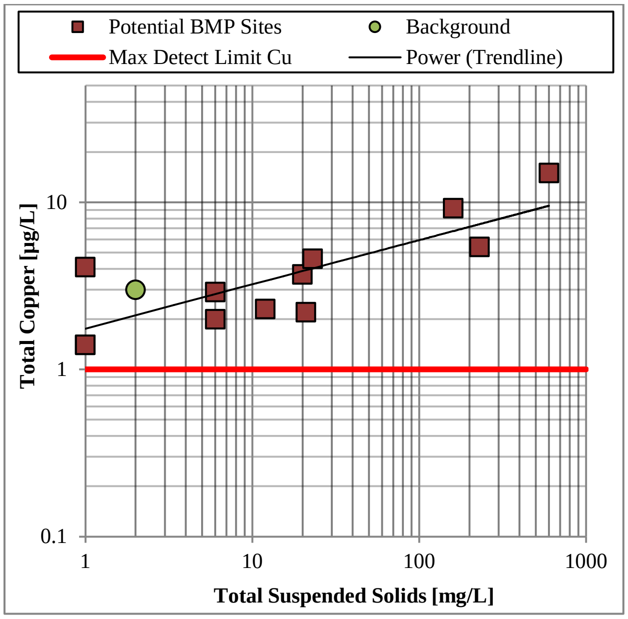

Sample results measured below the detection limit have been excluded. Results shown below the maximum detection limit line correspond to samples with a detection limit less than the maximum detection limit.

# APPENDIX F-2

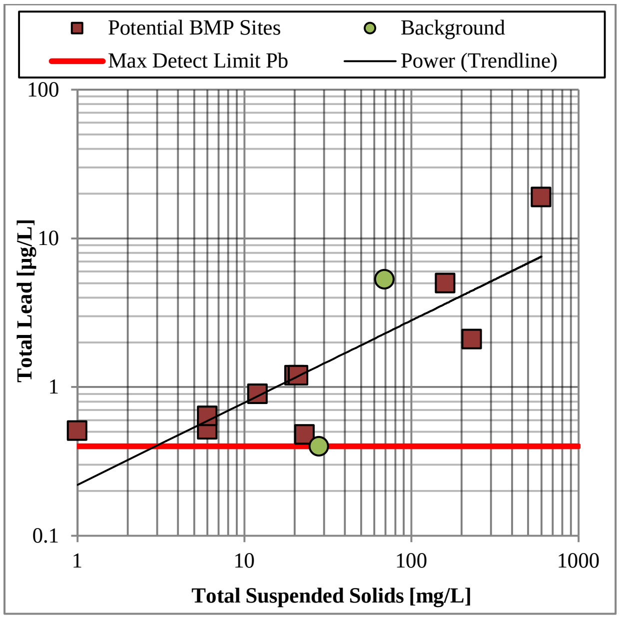
# BMP MONITORING COC VS TSS CORRELATION CHARTS
# 2011/2012 RAINY SEASON

# OUTFALL 008 CORRELATION CHARTS
# POTENTIAL BMP SUBAREA MONITORING PROGRAM

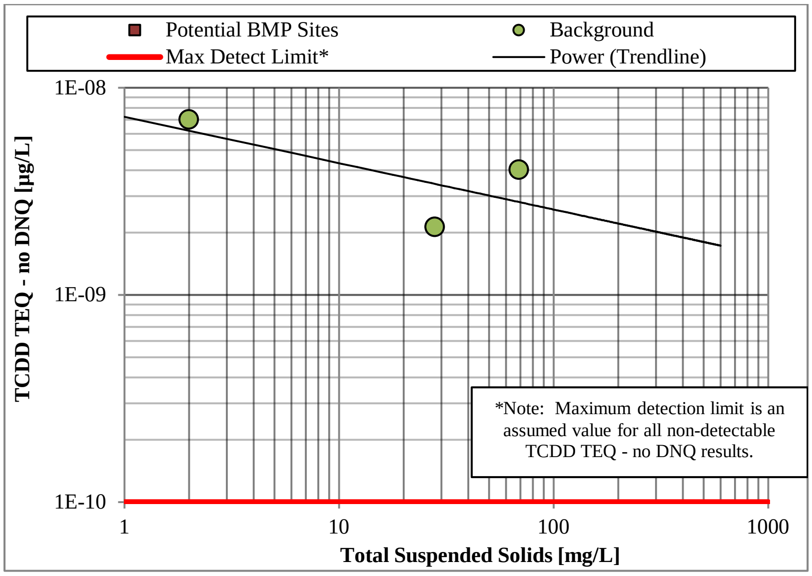
## COPPER VS TSS




## LEAD VS TSS




## DIOXINS (TCDD-TEQ – no DNQ) VS TSS

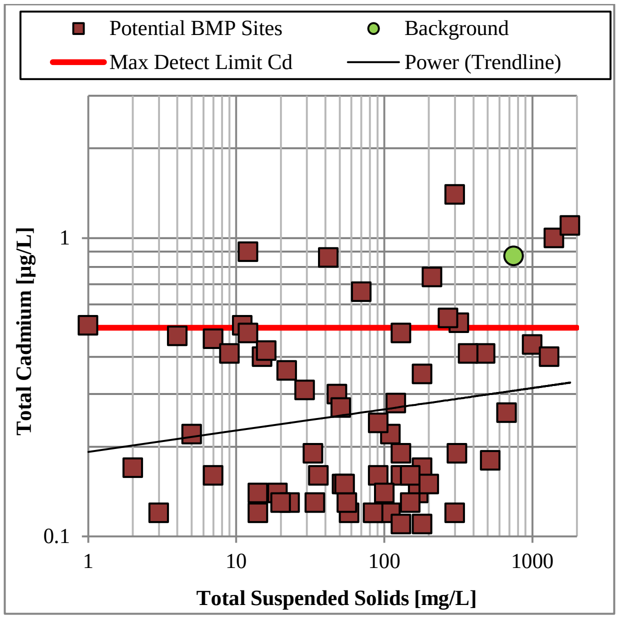



Sample results measured below the detection limit have been excluded. Results shown below the maximum detection limit line correspond to samples with a detection limit less than the maximum detection limit.

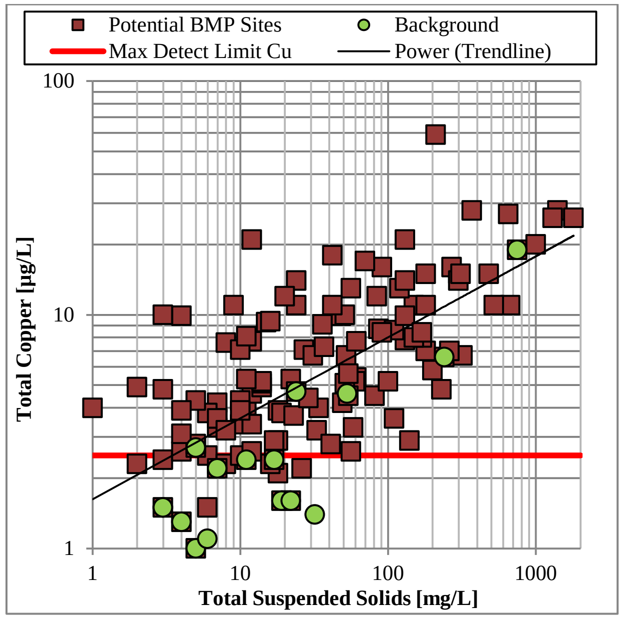
Several Background locations are also shown as CM Upstream locations on the ISRA Performance Monitoring plots.

## OUTFALL 009 CORRELATION CHARTS
## POTENTIAL BMP SUBAREA MONITORING PROGRAM

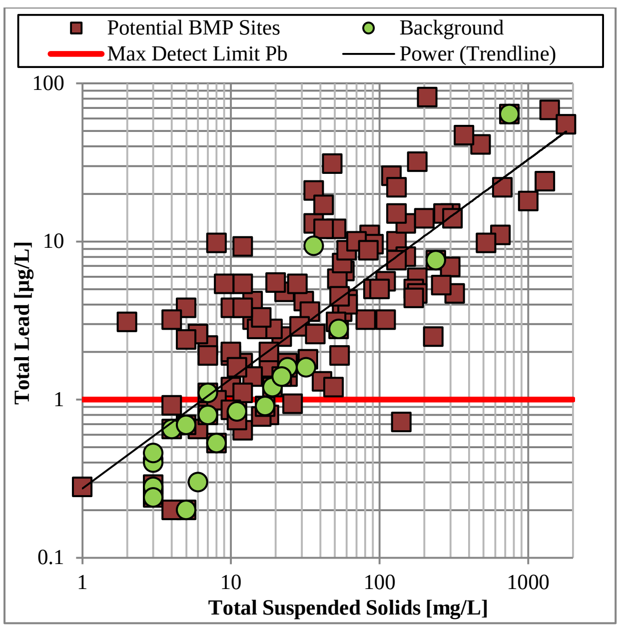
### CADMIUM VS TSS



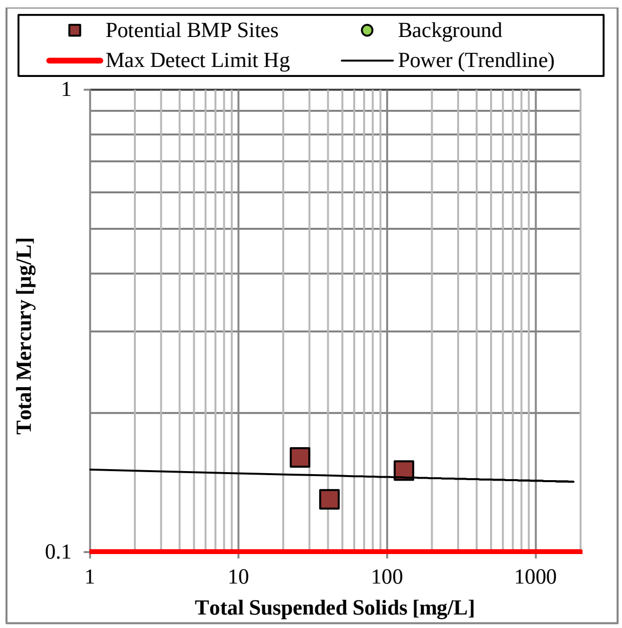

### COPPER VS TSS




### LEAD VS TSS




### MERCURY VS TSS

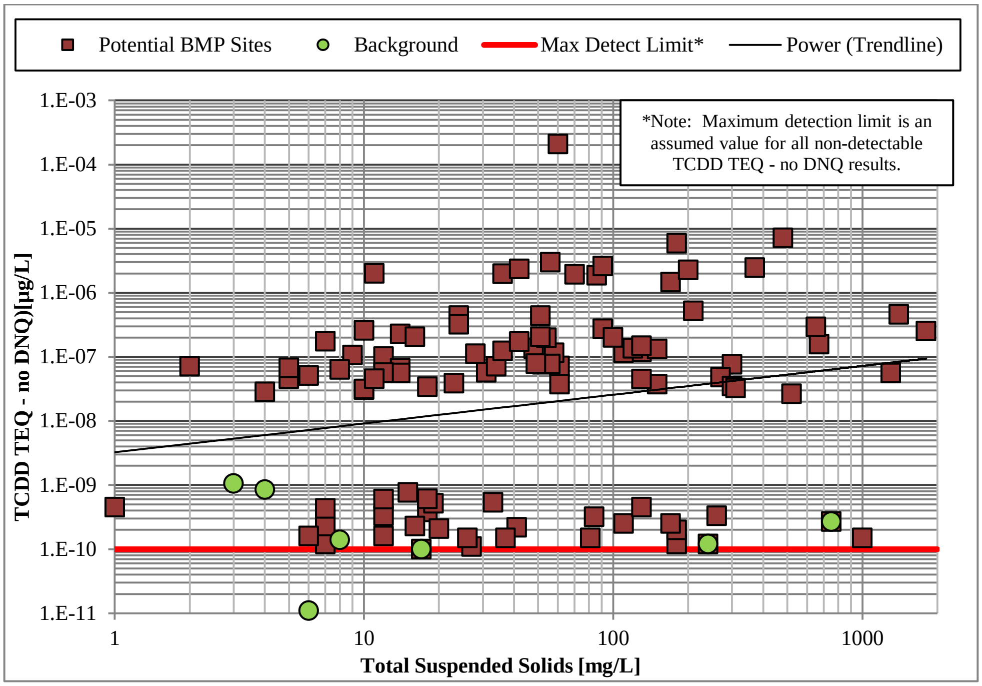



Sample results measured below the detection limit have been excluded. Results shown below the maximum detection limit line correspond to samples with a detection limit less than the maximum detection limit.

Several Background locations are also shown as CM Upstream locations on the ISRA Performance Monitoring plots.

# OUTFALL 009 CORRELATION CHARTS
# POTENTIAL BMP SUBAREA MONITORING PROGRAM

## DIOXINS (TCDD-TEQ – no DNQ) VS TSS




Sample results measured below the detection limit have been excluded. Results shown below the maximum detection limit line correspond to samples with a detection limit less than the maximum detection limit.

Several Background locations are also shown as CM Upstream locations on the ISRA Performance Monitoring plots.