Annual Report to the City of Austin Balcones Canyonlands Preserve
Monitoring WTP4 and the JTM
December 2014

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Summary
Monitoring is being conducted in the Bull Creek watershed to determine effects, if any, of shaft construction and tunneling on water quality and quantity associated with the construction of the Jollyville Transmission Main (JVTM) for Water Treatment Plant #4 (WTP4). Monitoring includes City of Austin, Travis County, and private preserves and generally consists of evaluating water levels and taking water quality samples from stream, springs, and groundwater wells. These data are being used in adaptive management during the construction of the JVTM. Monitoring to date has shown no surface water quality impacts from JVTM construction but has shown some impacts to water levels in the groundwater system at the tunnel horizon (Glen Rose) which have not been shown to transmit to the shallow groundwater system (uppermost Glen Rose, Walnut, and Edwards). Reach 1 of the tunnel from the plant to the Four Points shaft was grouted in June 2013, Reach 2 adjacent to the Four Points shaft and below BCP was grouted from January to March 2014, and Reach 3 from the Spicewood shaft to the Jollyville shaft was grouted in two phases, the first in October 2013 then was completed in March and April 2014. Shaft excavations were completely backfilled by August 2014. Monitoring wells have shown rising water levels in most wells since completion of tunnel grouting and shaft backfilling. These changes can be directly attributed to completion impacts from construction in some wells but are likely due to climatic events (rain) in other wells.

Project Description
The JVTM is comprised of an approximately 6-mile tunnel reaching from WTP4 to the Jollyville Reservoir at 183/McNeil, and four access shafts (WTP4 shaft, Four Points, Spicewood, and Jollyville Reservoir shaft) ranging from 30-40 feet in diameter. All but the Spicewood shaft is excavated through the Edwards formation whereas the tunnel progresses through the Glen Rose formation, and is at least 125' underneath the main stem of Bull Creek at its closest point (usually deeper). The project is further detailed in the attached chart data summary (Appendix 4 Graph Output for July 2014).

Project Status
As of December 2014, the transmission main pipes have been laid, the JVTM shafts and tunnel have been completely grouted and backfilled. Treated water is currently flowing through the pipe to the Jollyville reservoir. The two surface shaft sites closest to BCP

Preserves, Four Points and Spicewood, have been dismantled, top soils spread, stabilizing vegetation planted and temporary irrigation systems have been installed.

Results

Attachment 1 shows results from water levels, flows, and water quality sampling through July 2014. Attachment 2 shows water levels in wells selected for post-construction monitoring though December 2014.

At this point we have not seen impacts to groundwater or surface water quality and with construction of the tunnel complete, we don't expect to see any even though we will be monitoring through February 2015.

Water Levels

No changes in the trend of water levels in the Edwards JT112 well. Impacts from excavation of the shaft were probably previously mitigated by the contact grouting completed in January 2012. The Jumps in water levels in November appear to be due to large rain events.

Water level changes in Glen Rose well JT118 appear to not be related to tunnel activities.

There is a large increase in water level, over 40 ft, in the Glen Rose JT126 well which began in late March 2014. Tunnel grouting of this reach was completed in October 2013and the remaining reach finished in Late March 2014. An upward swing in well water level began about the same time grouting began in October 2013 and may be related to tunnel grouting. However, there were also some significant rain events in that time frame which may have also been a factor in water level recovery.

Water levels in Edwards well JT128 remained constant within a small range between 79.5 and 80 ft below ground level. There was no response in water levels in this well from backfilling the Four Points shaft just a few feet away. This well was plugged an abandoned in September as site restoration began.

Edwards well JT124 had no response to tunnel grouting or shaft backfilling. Water levels remained within a narrow range of 63.5 and 65 ft below ground level.

Water levels in Walnut well JT104 have climbed steadily beginning in the latter part of 2013 which is coincide with tunnel grouting but more likely related to heavy rain events in October 2013.

Water levels in Glen Rose well JT120, which is within 20 feet of the Spicewood shaft, were sharply influenced by backfilling of the Spicewood shaft. Water levels have recovered 20 ft or approximately 1/3 of pre-excavation levels since shaft backfilling was completed in August.

Water levels in Glen Rose well JT125 continue in an upward trend similar to JT126.

Water levels in Glen Rose well JT130 began rising soon after backfilling was completed in the Spicewood shaft which was only 90 ft from the well.

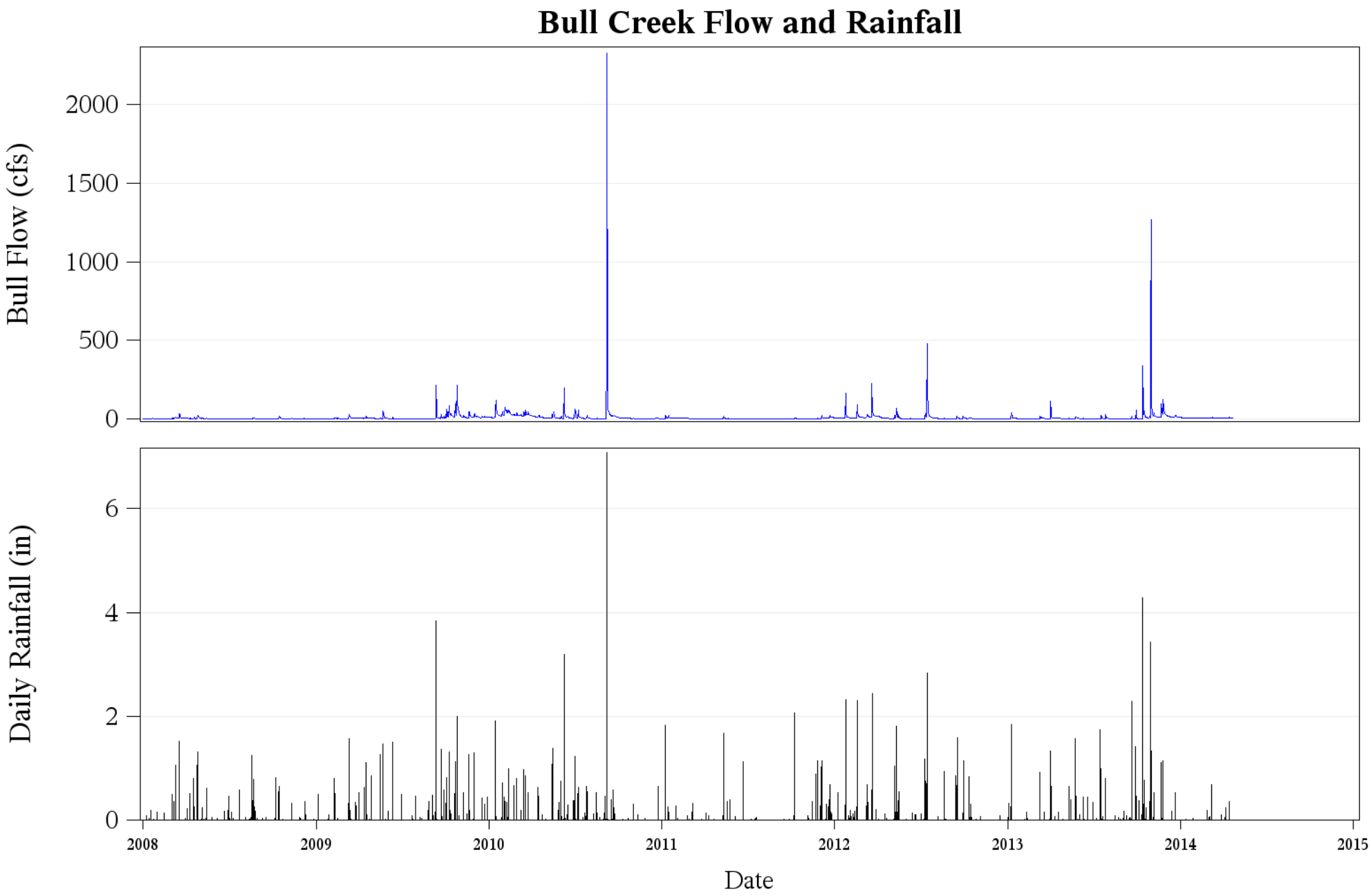
Surface Flows

Groundwater discharge from Lanier and Pit Springs did not show any changes that could be related to tunnel grouting. Lack of rain caused flows to diminish in early September but neither spring stopped flowing. Heavy rain in mid-September increased spring discharge.

Flows in Bull Creek in BCP varied in normal ranges due to climatic events. Flooding in September 2014 peaked at approximately 2,500 cfs at the USGS gauge at Loop 360 and flood debris indicated water rose several feet in the creek thought BCP.

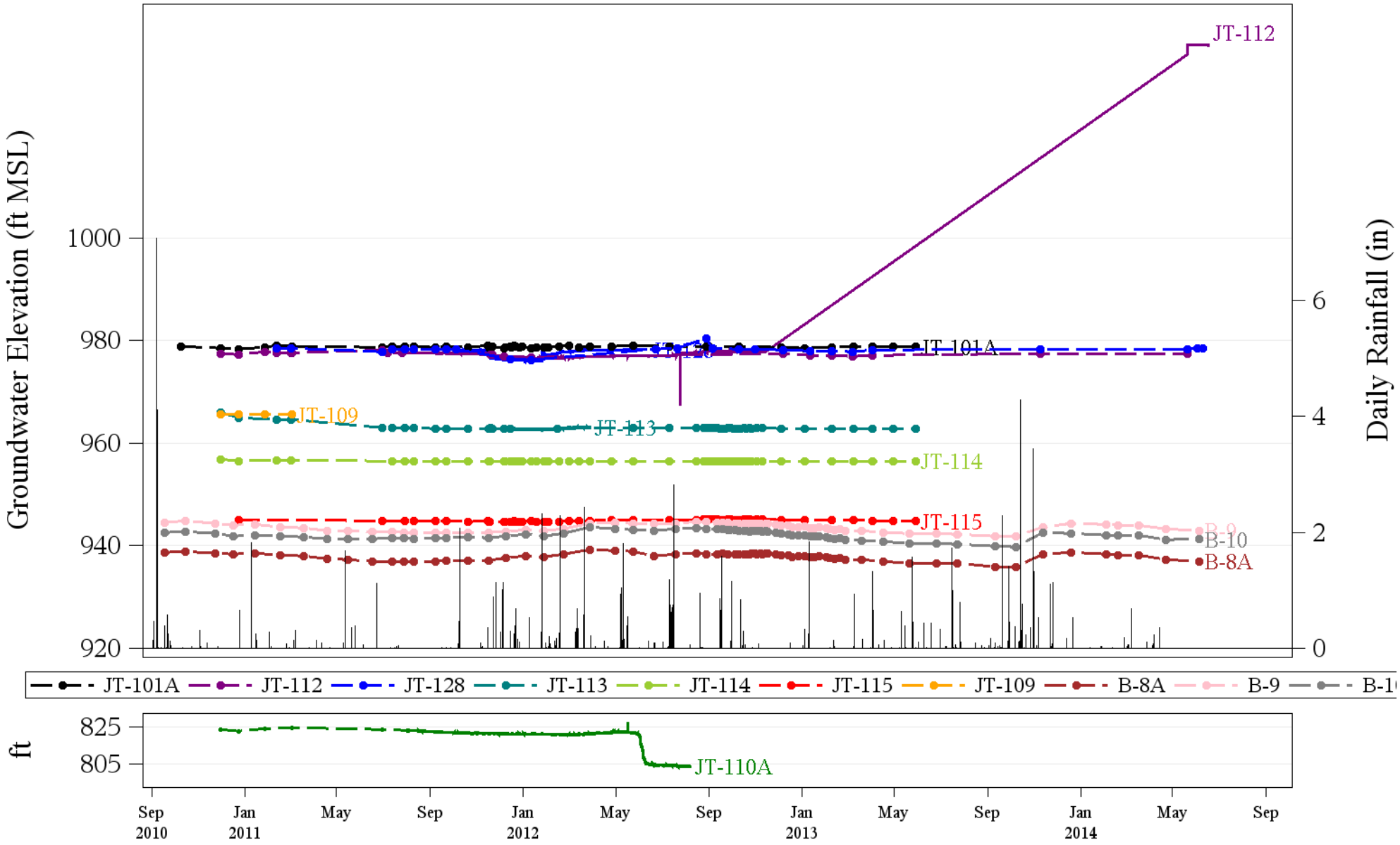
Conclusions

The Jollyville Transmission Main tunnel running below the BCP and along Bull Creek was completely grouted by April 2014 and shaft backfill was completed by August 2014. Water levels in monitoring wells impacted by shaft and tunnel excavation are recovering and rising water levels in other wells appear to be responding to rain events in the fall of 2014. A detailed report on monitoring for the Jollyville Transmission Main will be completed in 2015.



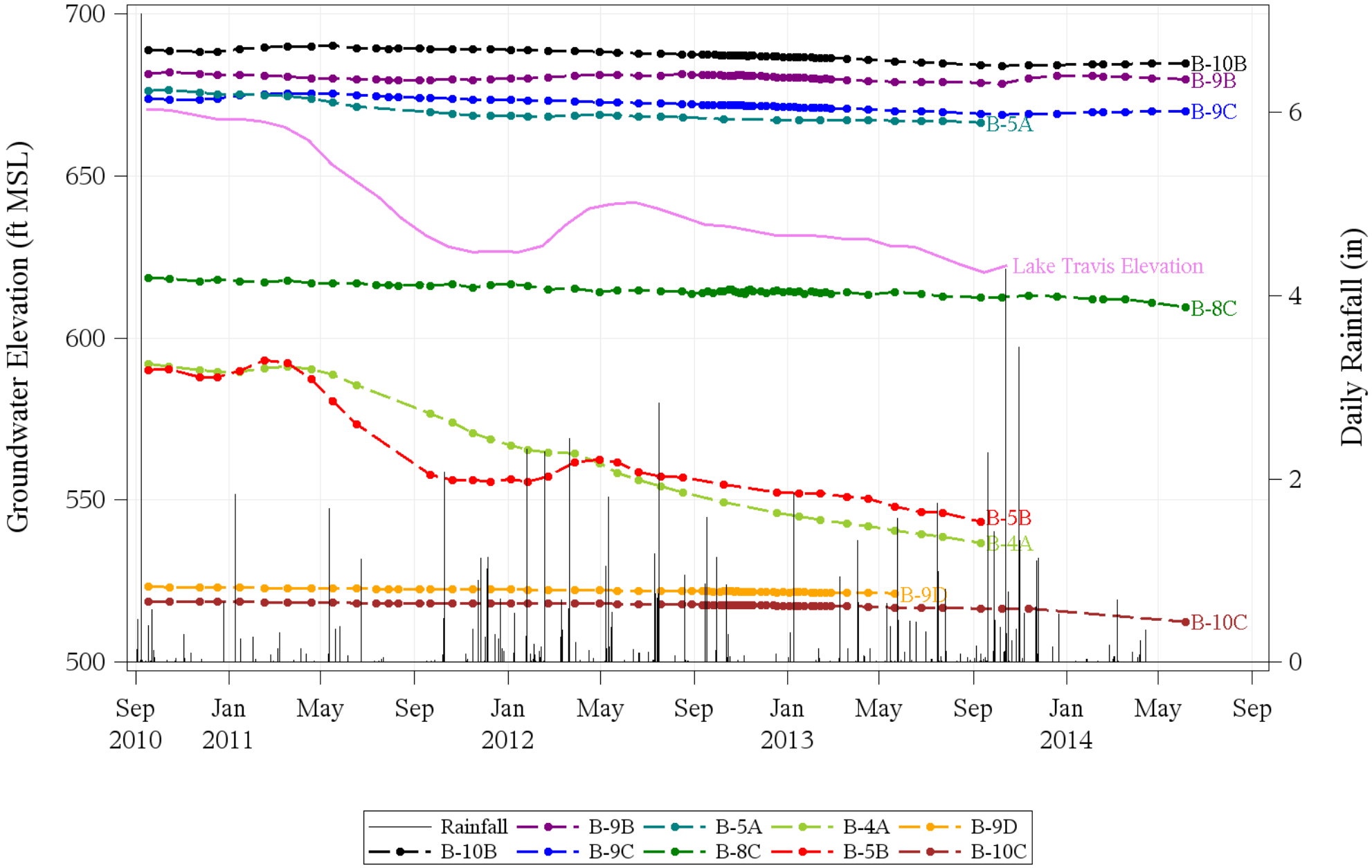
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Hydrographs for Western Area, Shallower



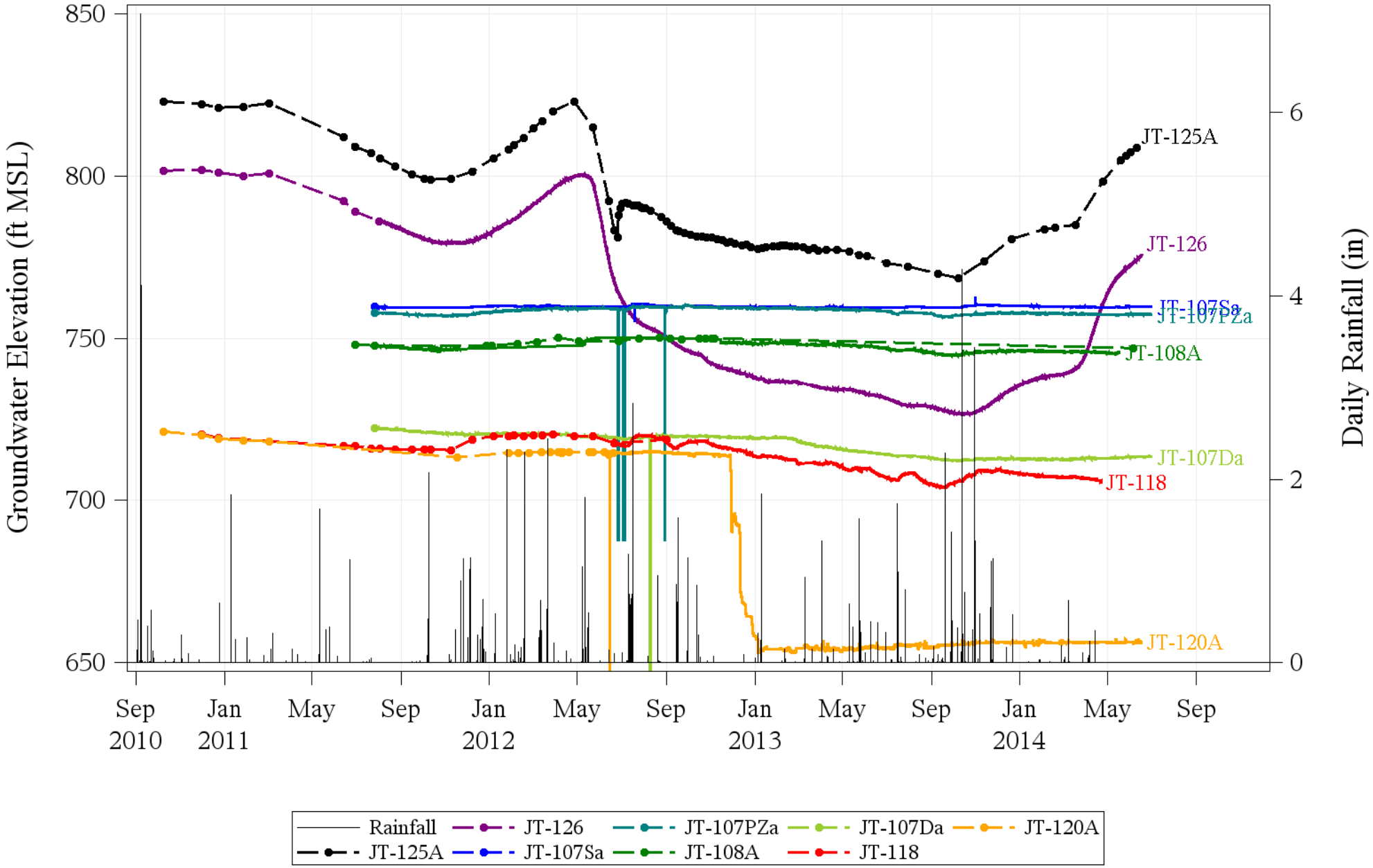
City of Austin DRAFT: QA/QC review pending

Hydrographs for Western Area, Deep



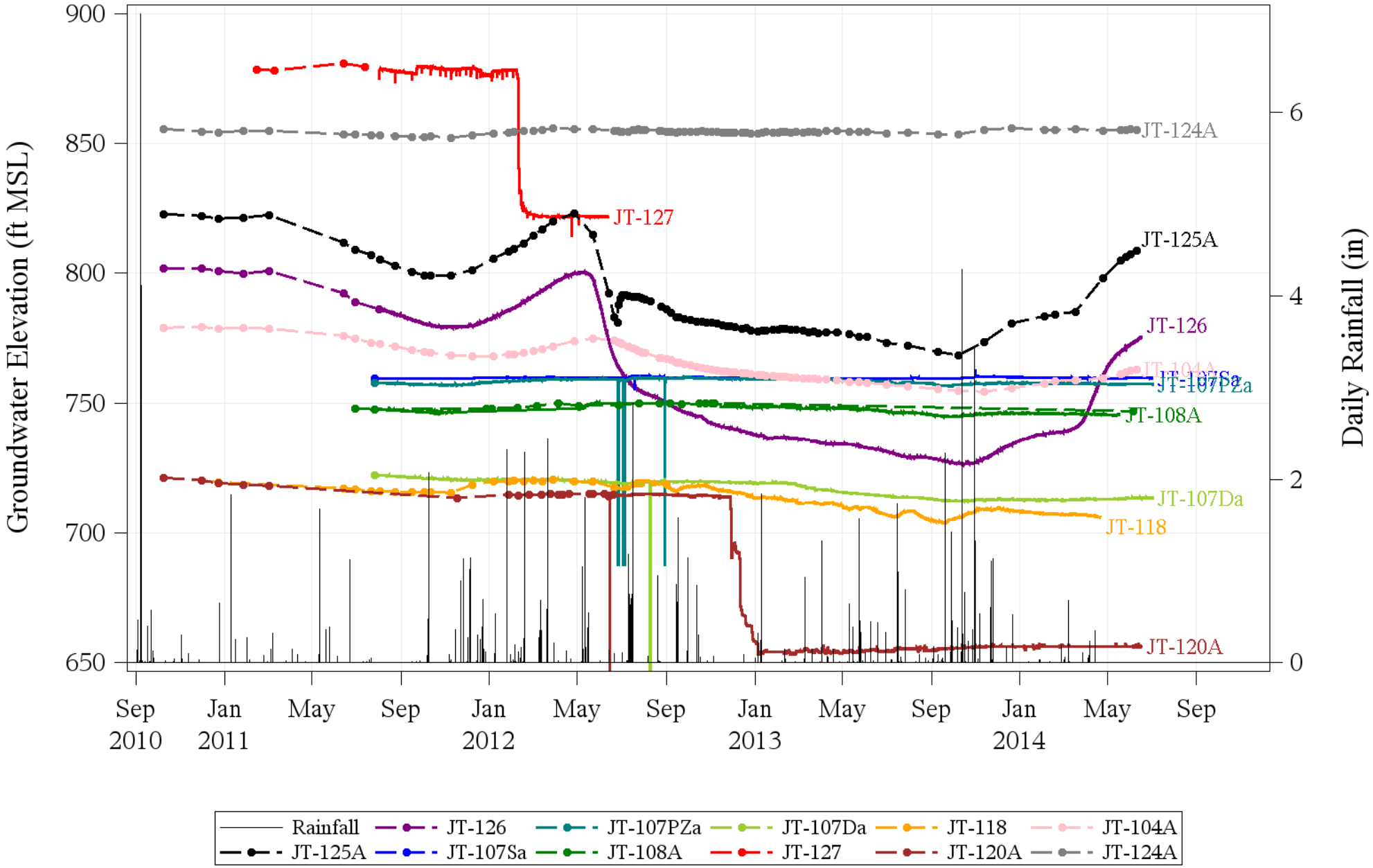
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Monitoring Wells in Glen Rose in Eastern JVTM Region

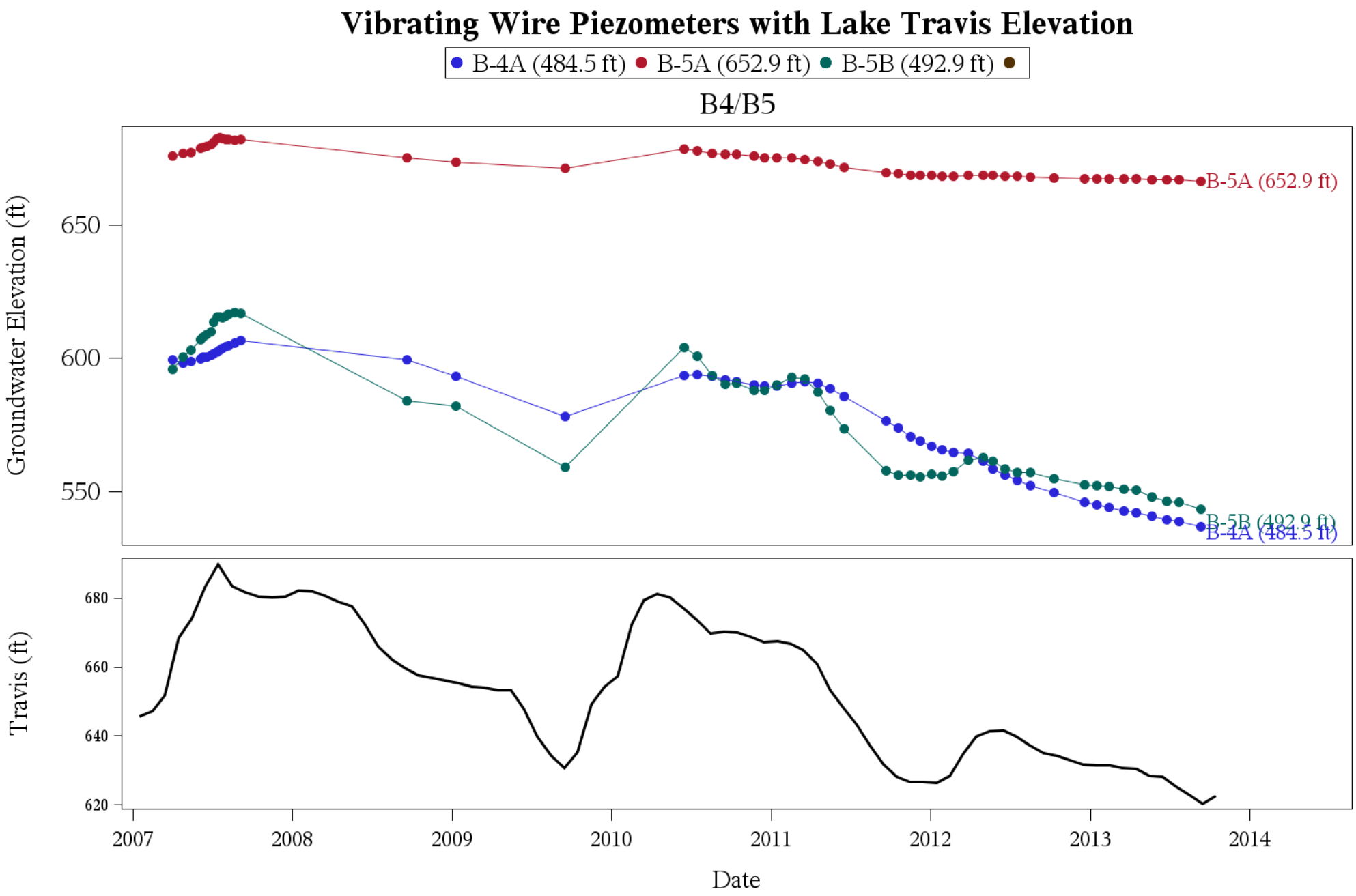


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Hydrographs for Eastern Area

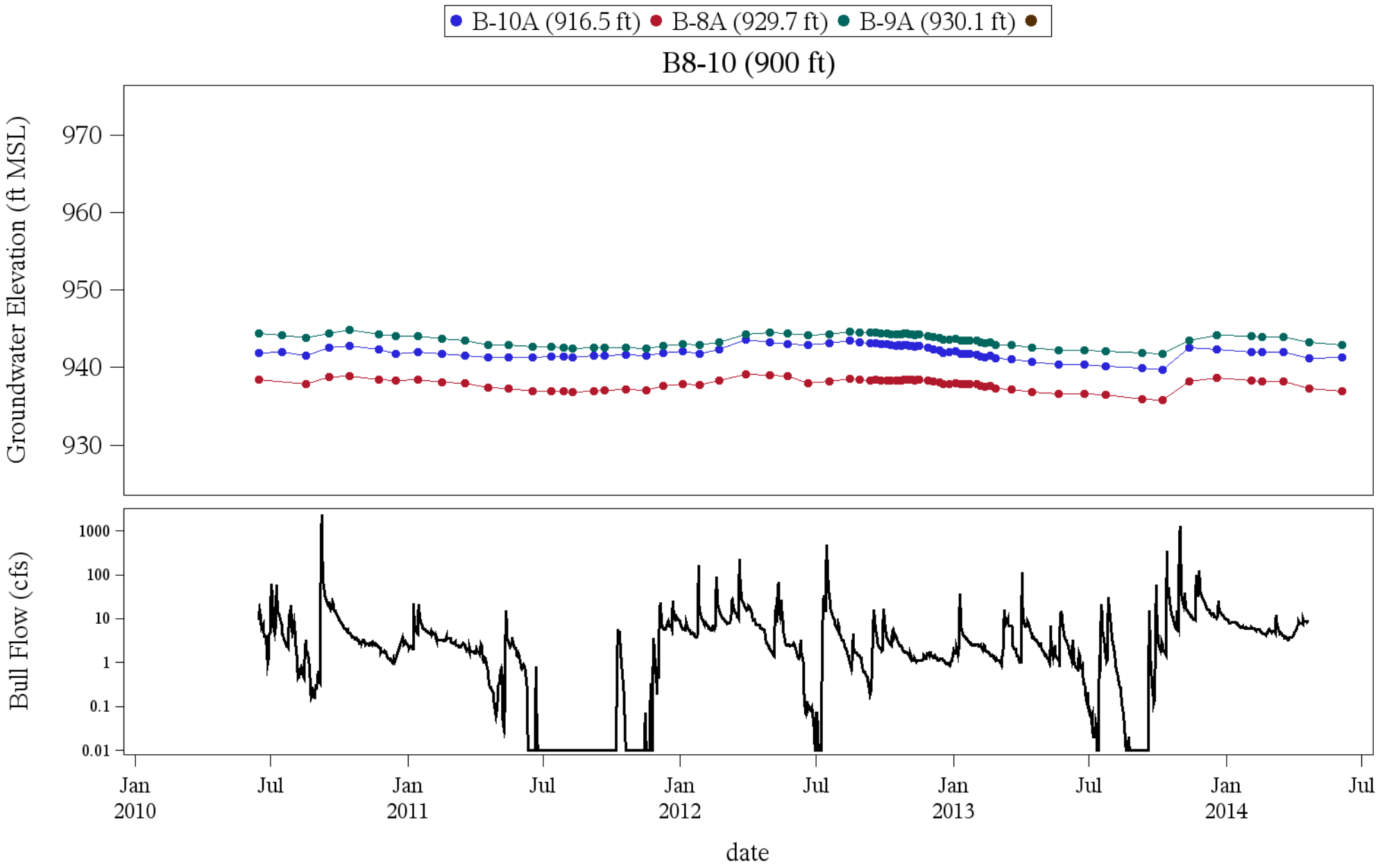


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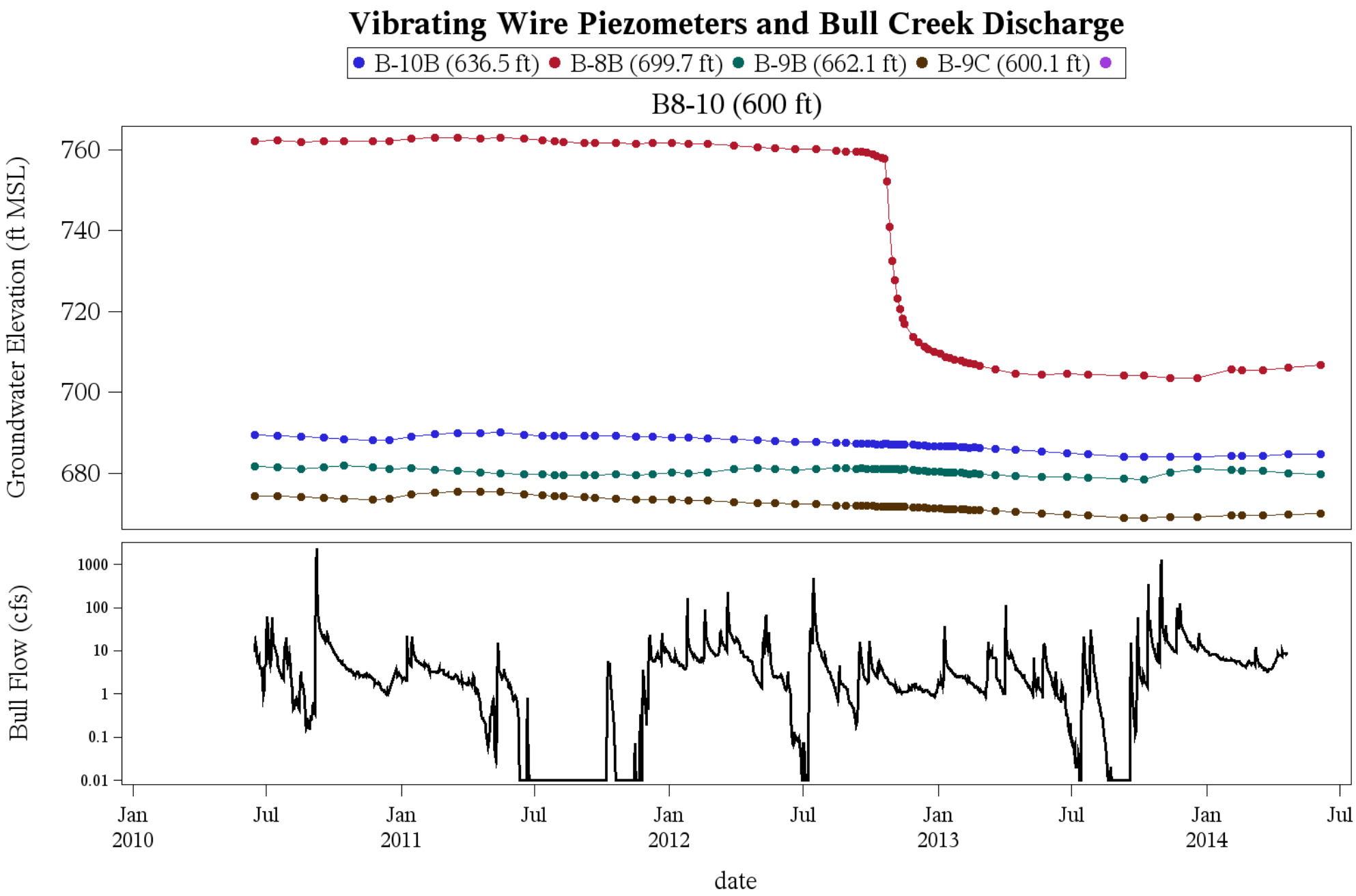


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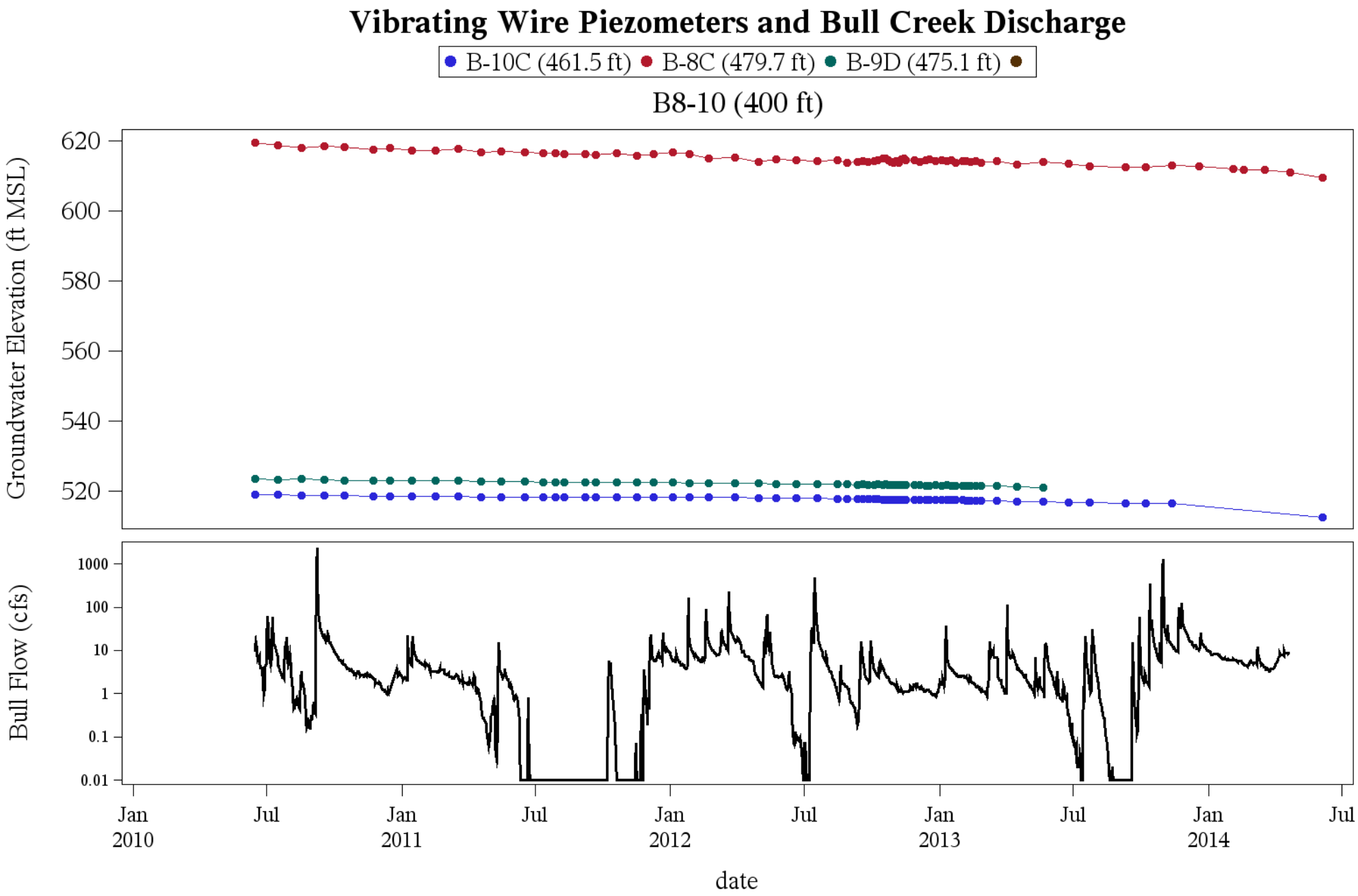
Vibrating Wire Piezometers and Bull Creek Discharge



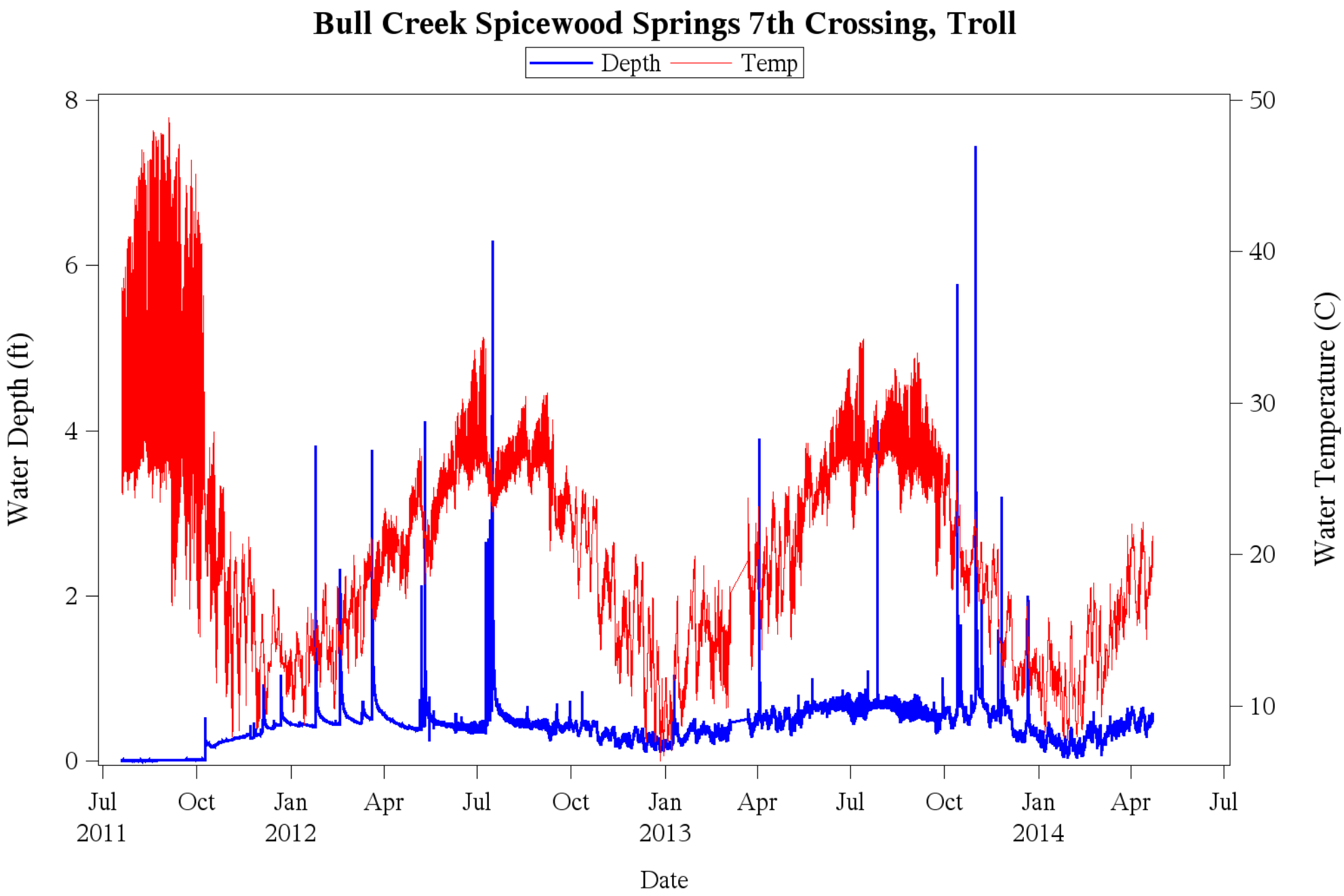
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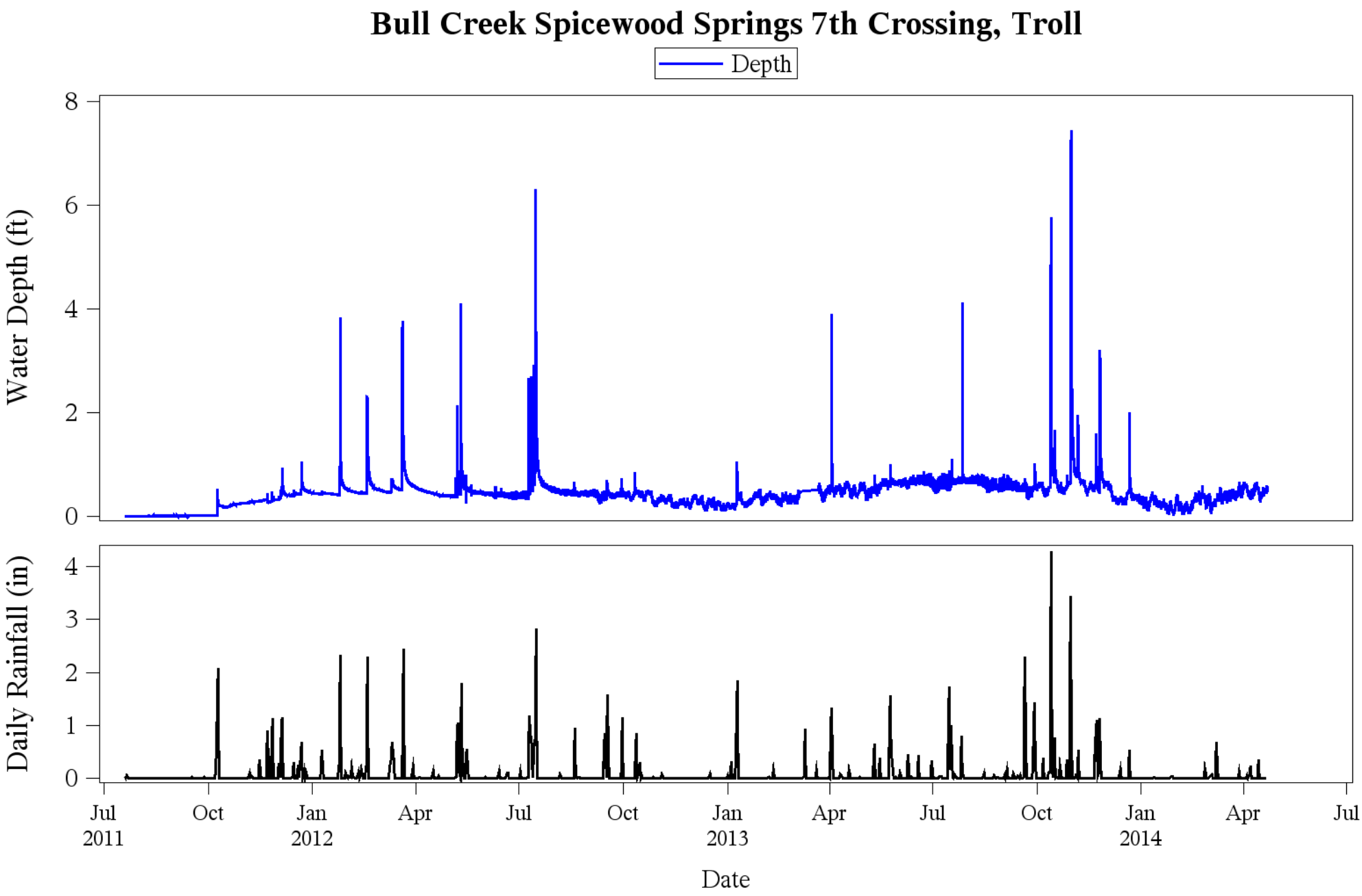
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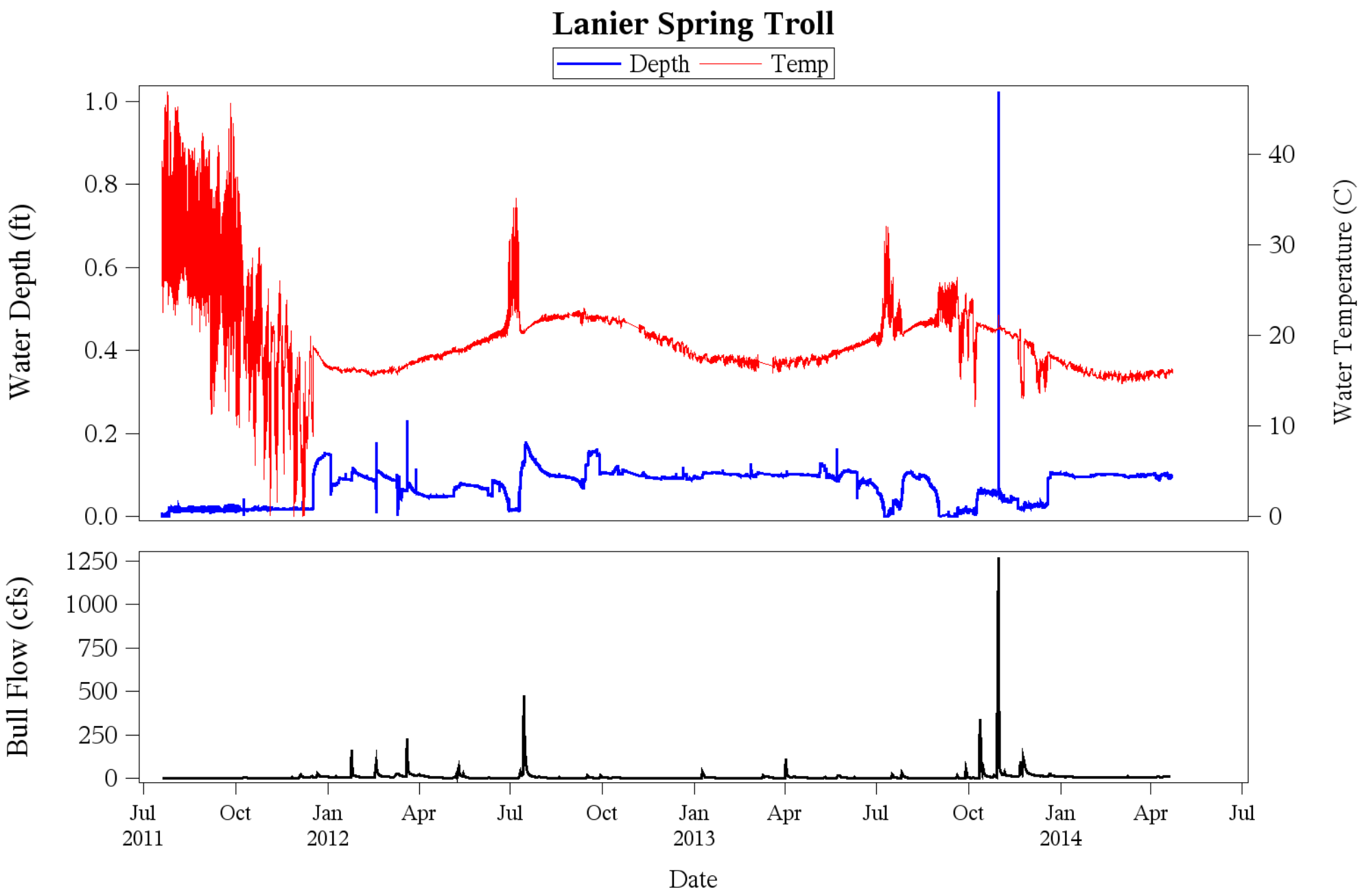


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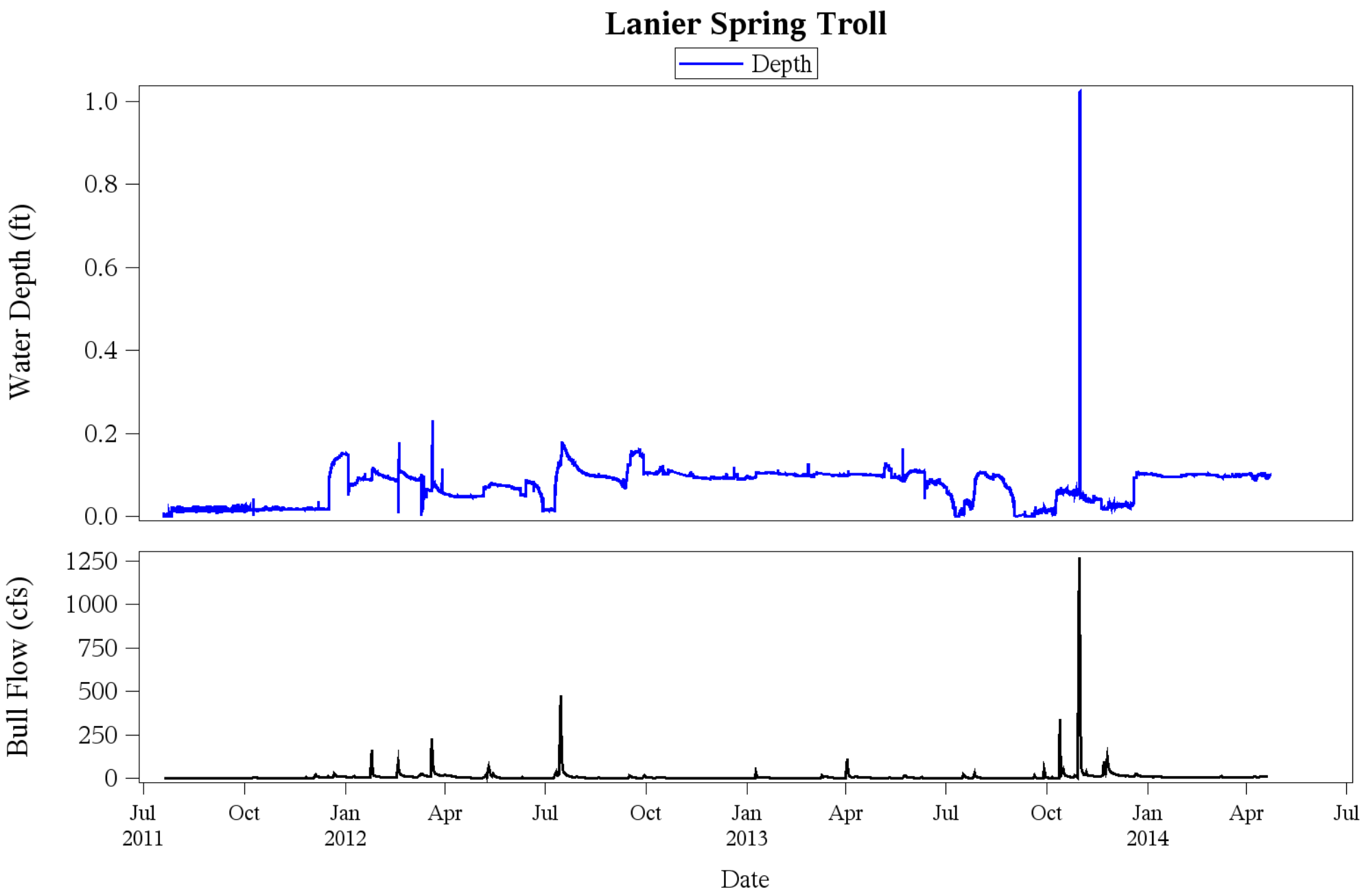


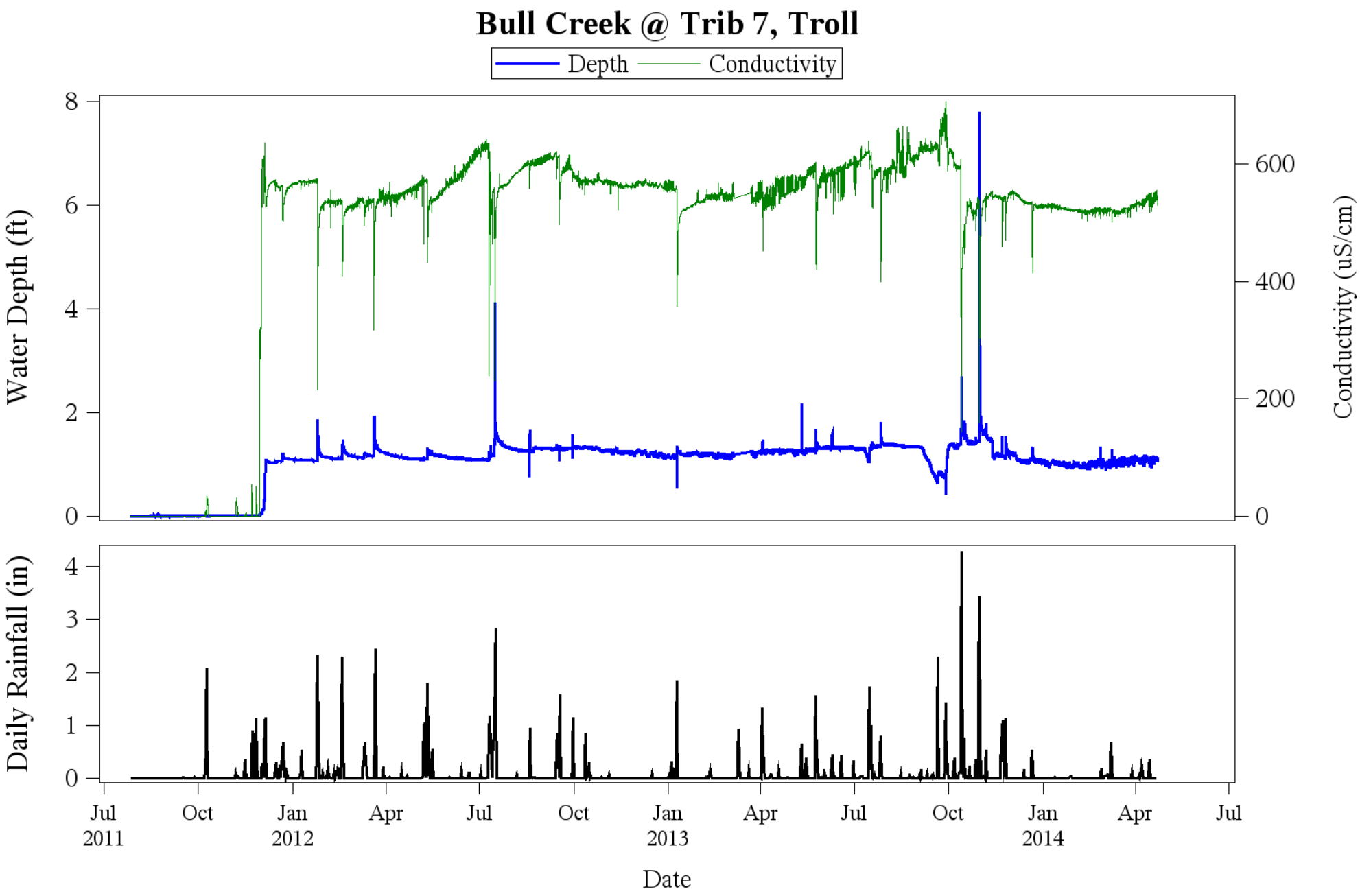
City of Austin DRAFT: QA/QC review pending


Bull Creek Spicewood Springs 7th Crossing, Troll
Depth
Water Depth (ft)
8
6
4
2
0
Daily Rainfall (in)
4
3
2
1
0
Jul 2011
Oct
Jan 2012
Apr
Jul
Oct
Jan 2013
Apr
Jul
Oct
Jan 2014
Apr
Jul
Date

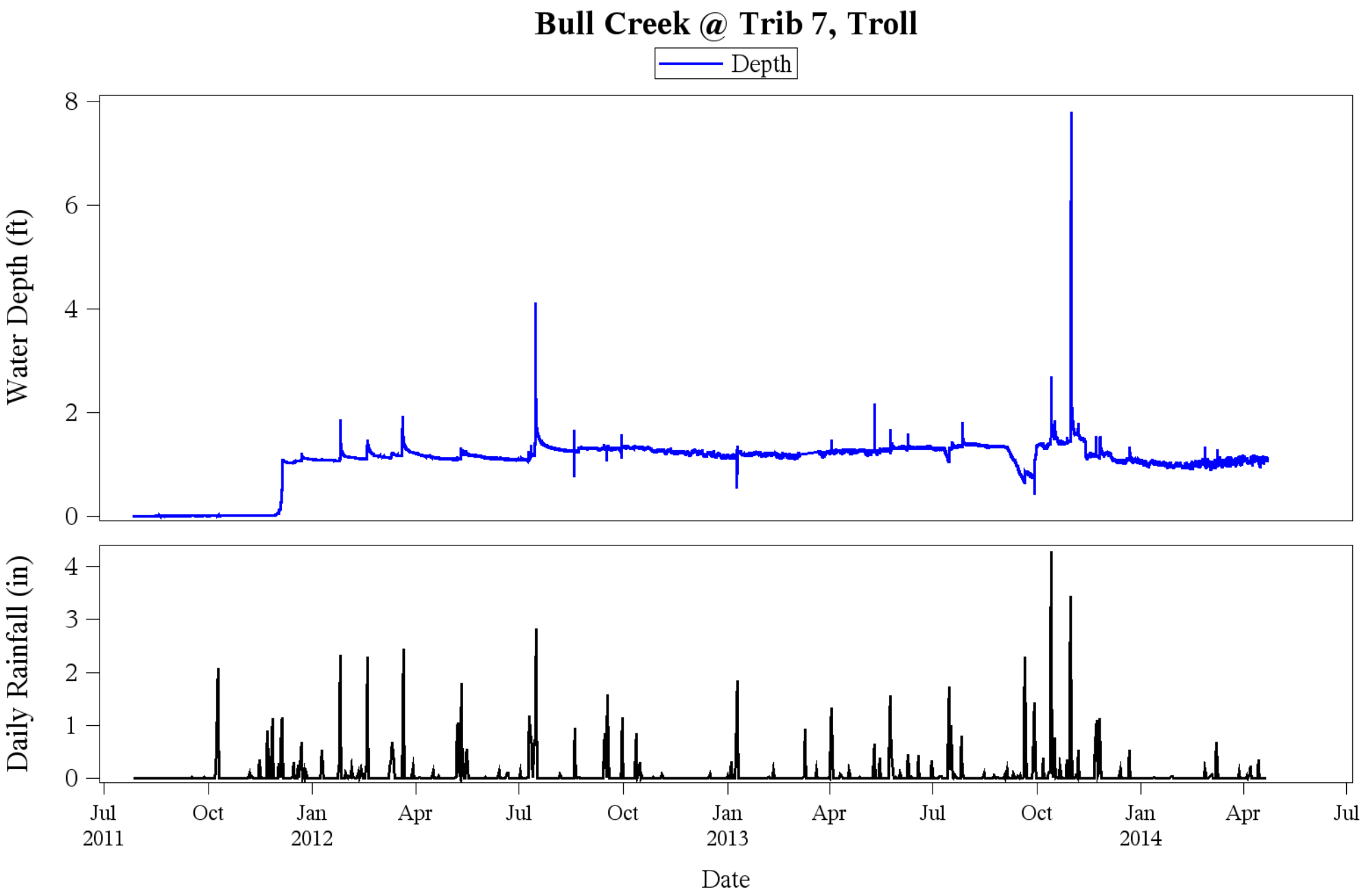


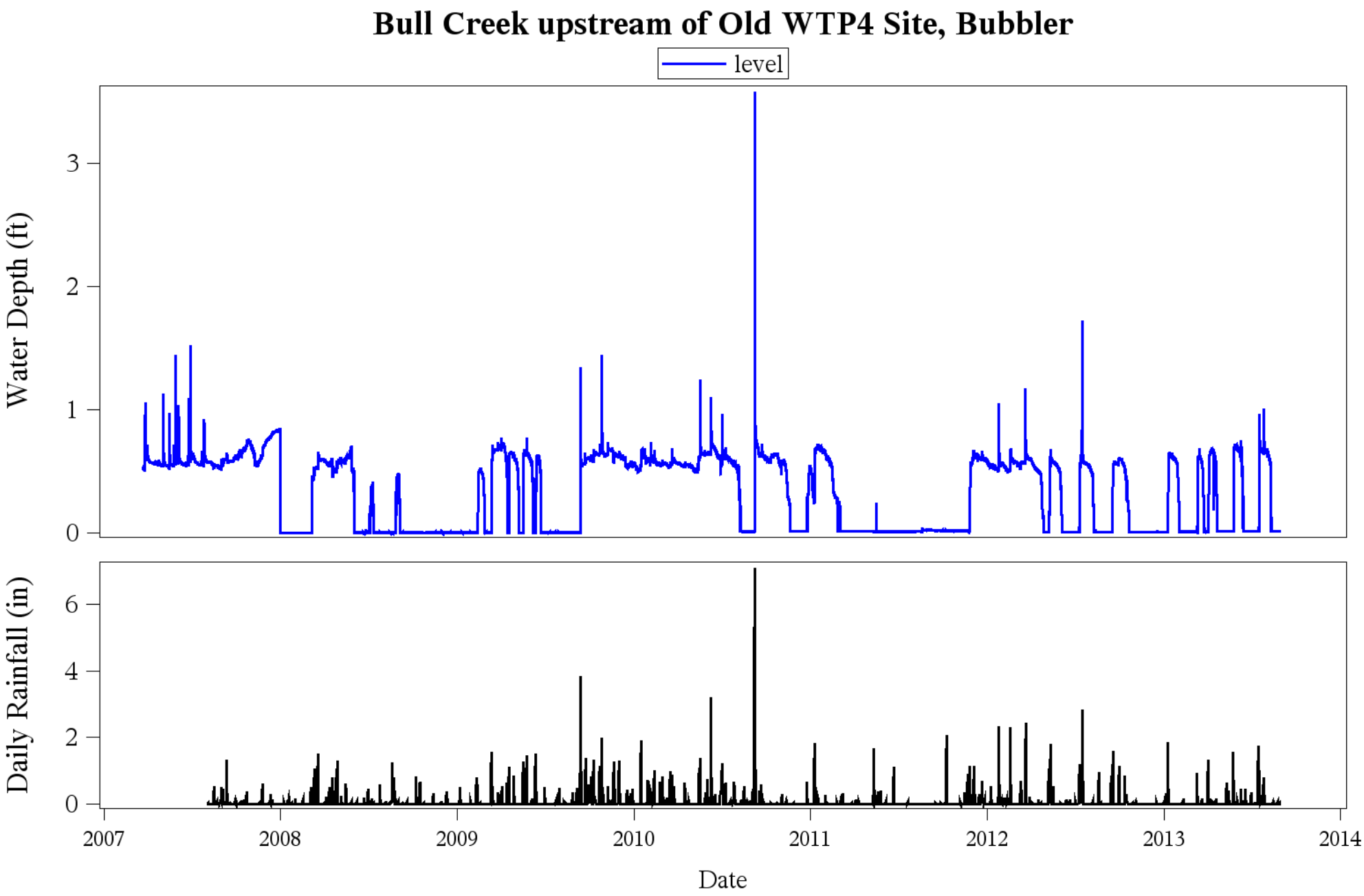
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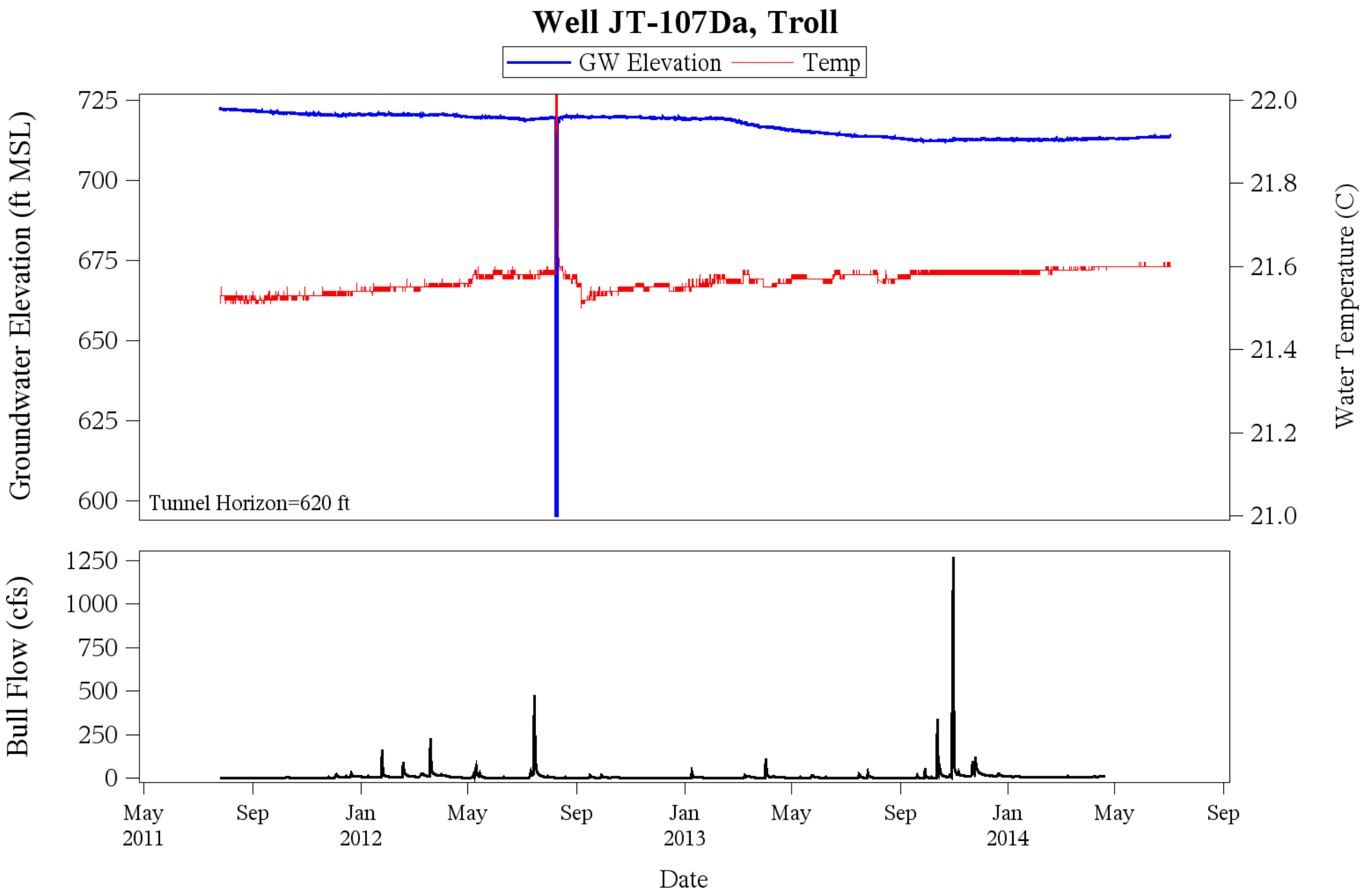

Lanier Spring Troll
Depth
Water Depth (ft)
1.0
0.8
0.6
0.4
0.2
0.0
Bull Flow (cfs)
1250
1000
750
500
250
0
Jul 2011
Oct
Jan 2012
Apr
Jul
Oct
Jan 2013
Apr
Jul
Oct
Jan 2014
Apr
Jul
Date

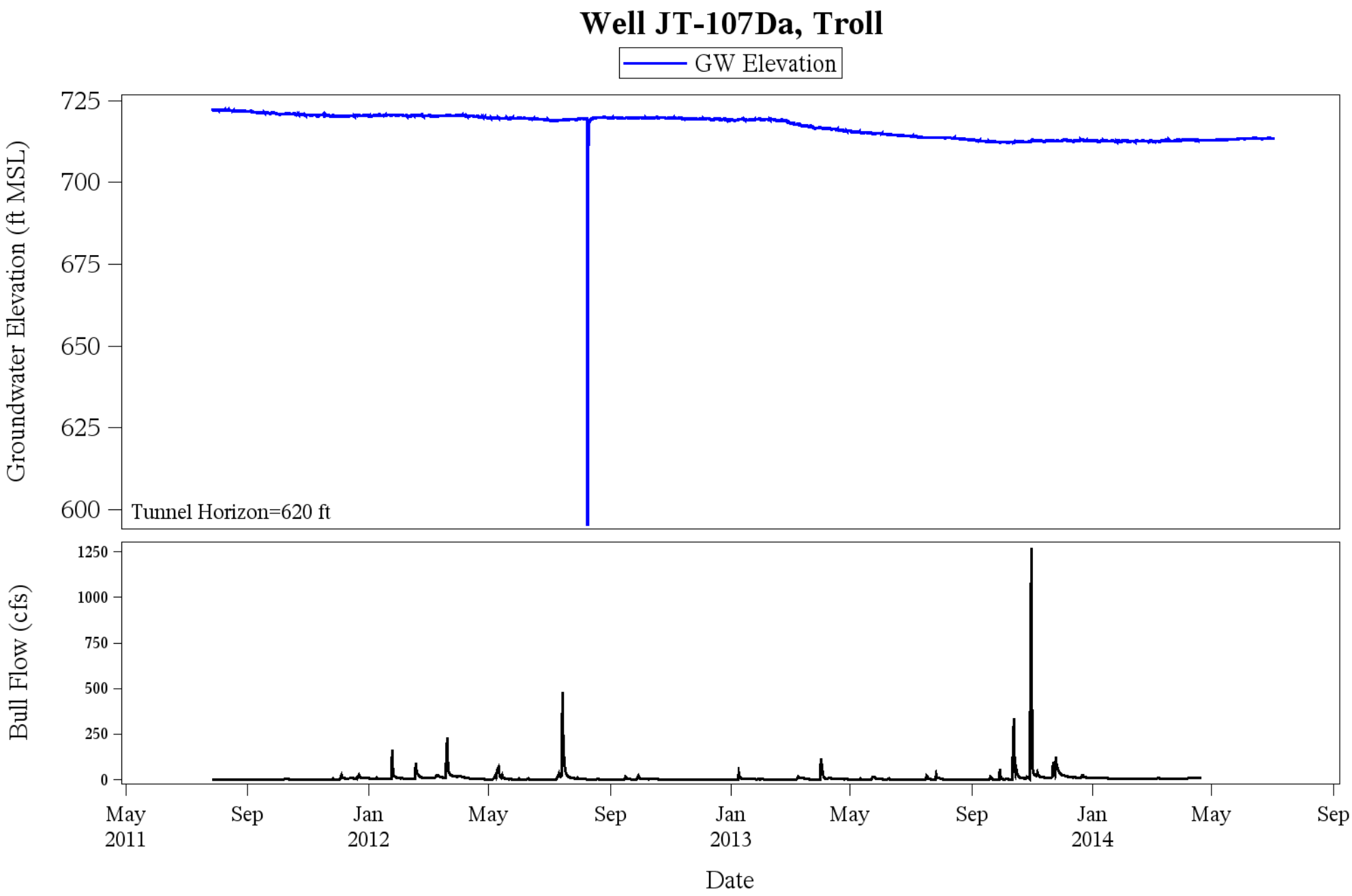


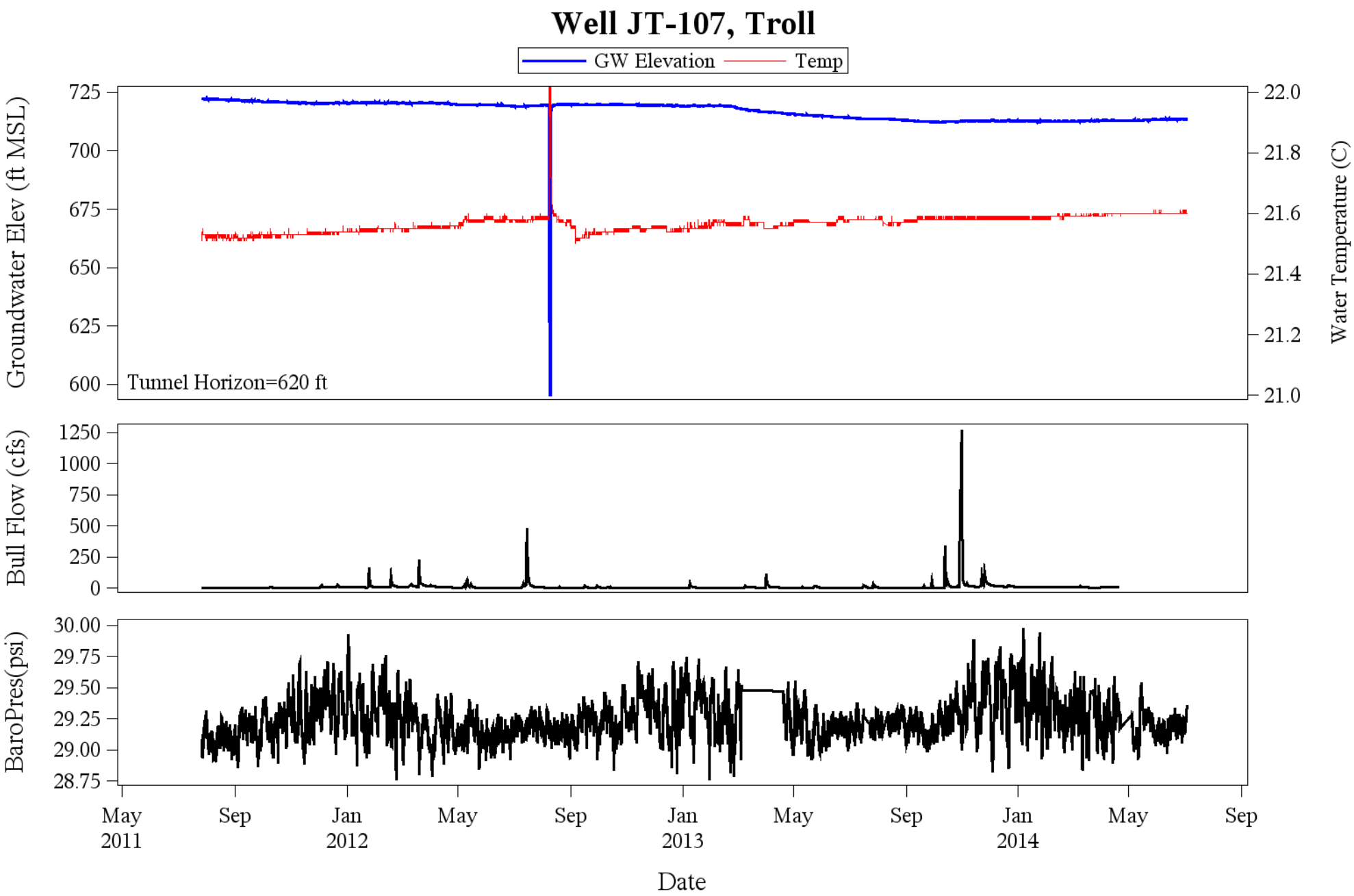
City of Austin DRAFT: QA/QC review pending


Bull Creek @ Trib 7, Troll
Depth
Water Depth (ft)
0
2
4
6
8
Daily Rainfall (in)
0
1
2
3
4
Jul 2011
Oct
Jan 2012
Apr
Jul
Oct
Jan 2013
Apr
Jul
Oct
Jan 2014
Apr
Jul
Date

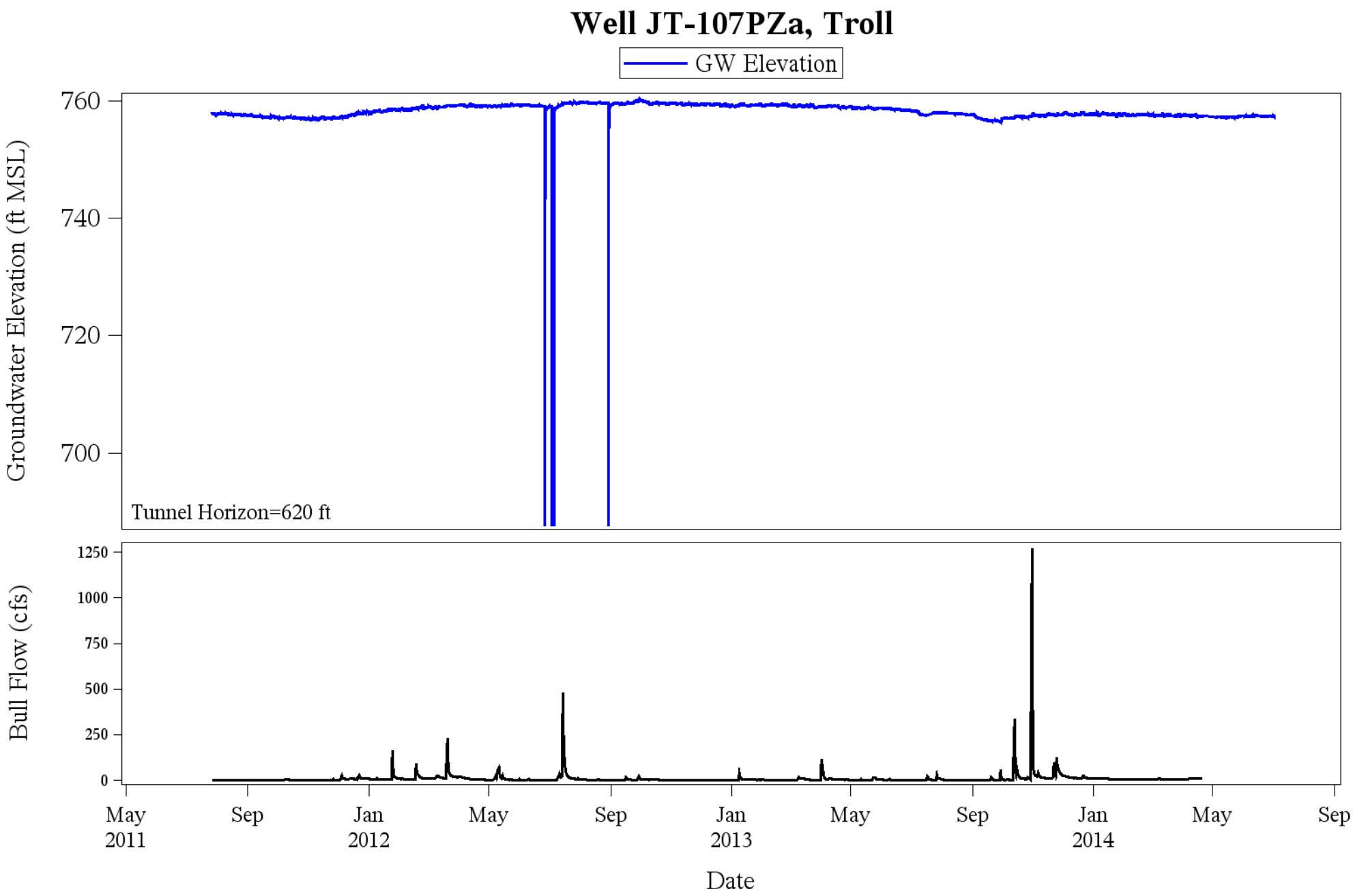

Bull Creek upstream of Old WTP4 Site, Bubbler
level
Water Depth (ft)
0
1
2
3
Daily Rainfall (in)
0
2
4
6
2007
2008
2009
2010
2011
2012
2013
2014
Date

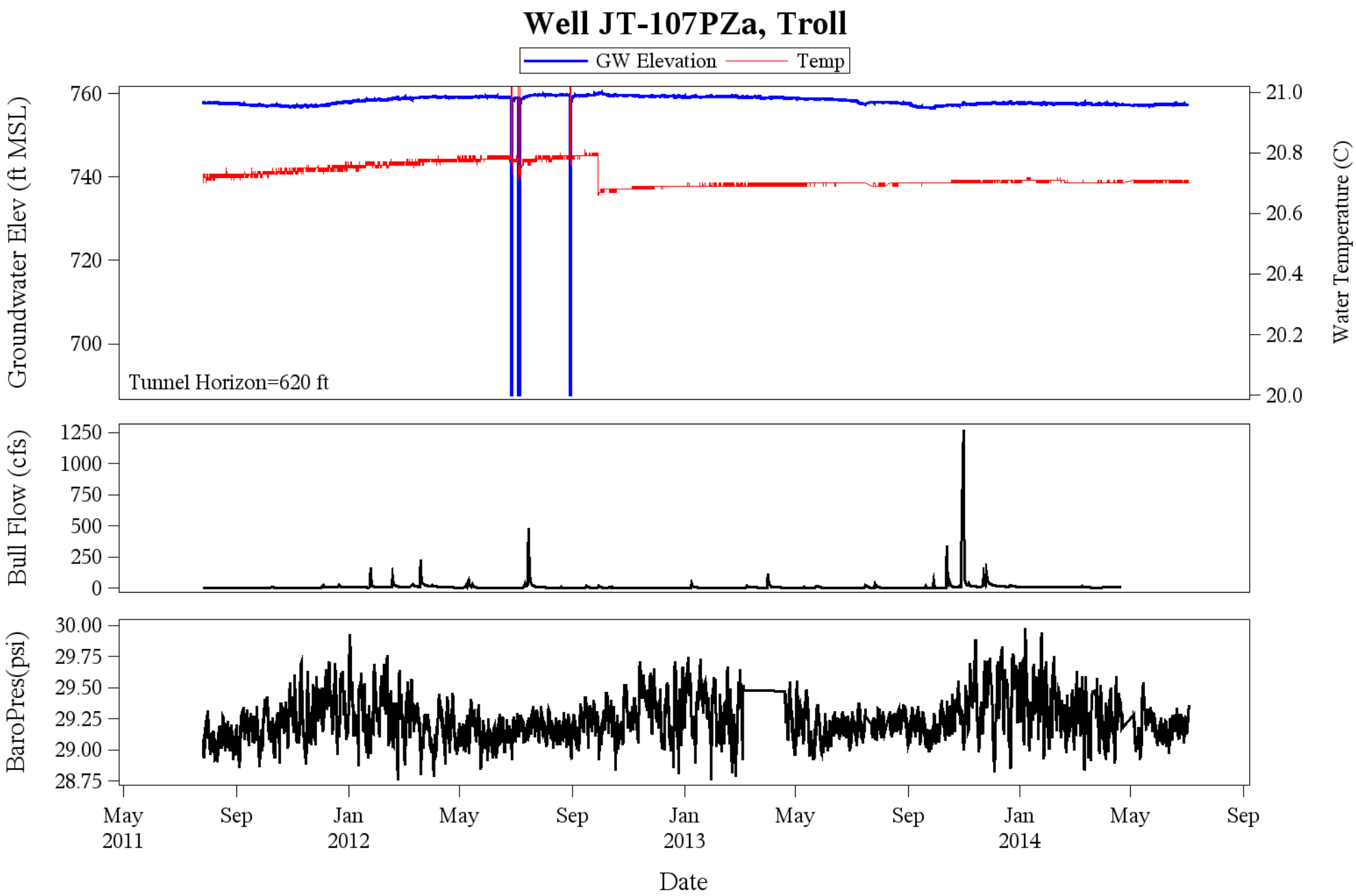

Well JT-107Da, Troll
GW Elevation
Temp
Groundwater Elevation (ft MSL)
725
700
675
650
625
600
Tunnel Horizon=620 ft
Water Temperature (C)
22.0
21.8
21.6
21.4
21.2
21.0
Bull Flow (cfs)
1250
1000
750
500
250
0
May 2011
Sep
Jan 2012
May
Sep
Jan 2013
May
Sep
Jan 2014
May
Sep
Date

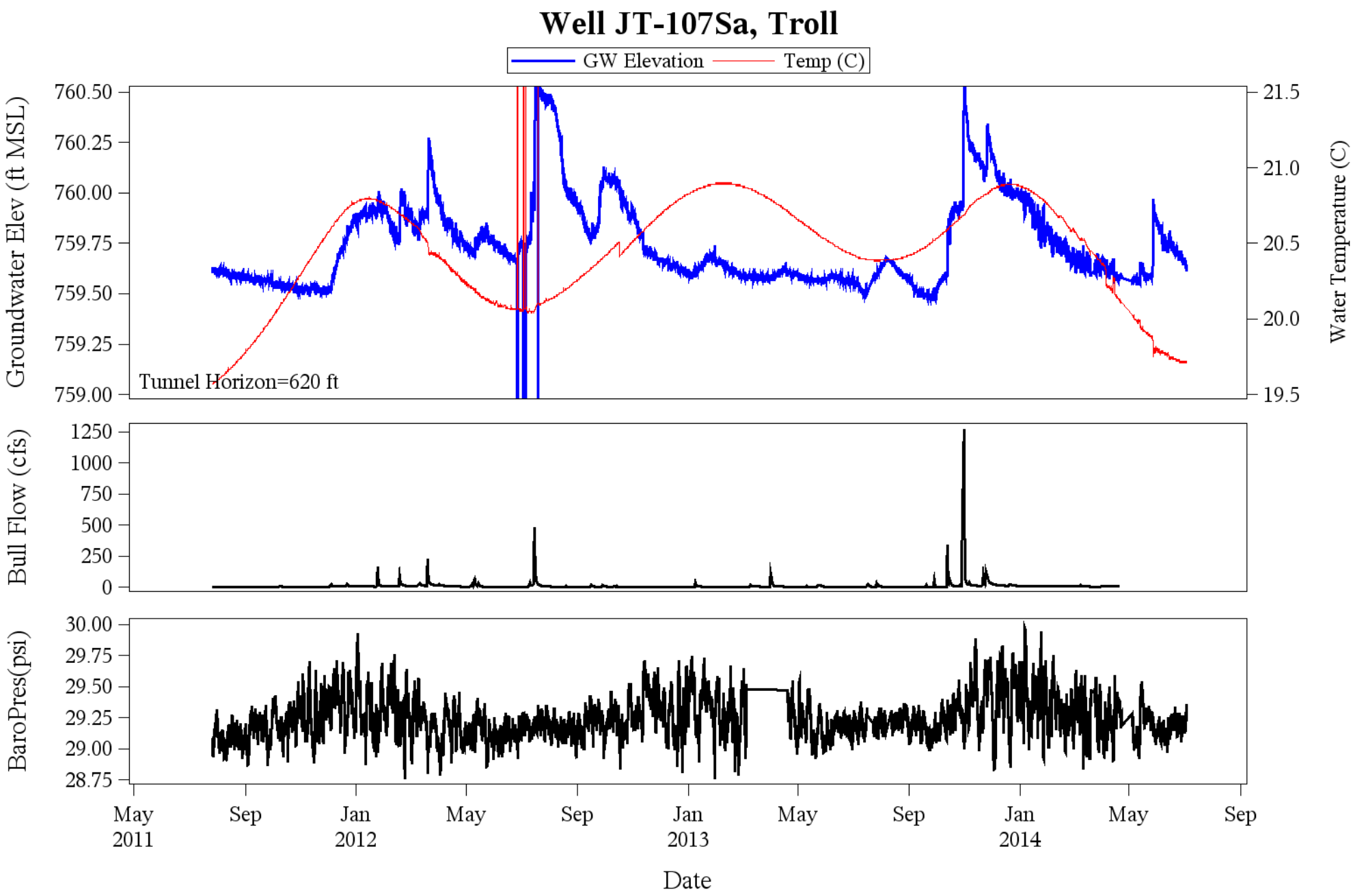

Well JT-107Da, Troll
GW Elevation
Groundwater Elevation (ft MSL)
725
700
675
650
625
600
Tunnel Horizon=620 ft
Bull Flow (cfs)
1250
1000
750
500
250
0
May 2011
Sep
Jan 2012
May
Sep
Jan 2013
May
Sep
Jan 2014
May
Sep
Date



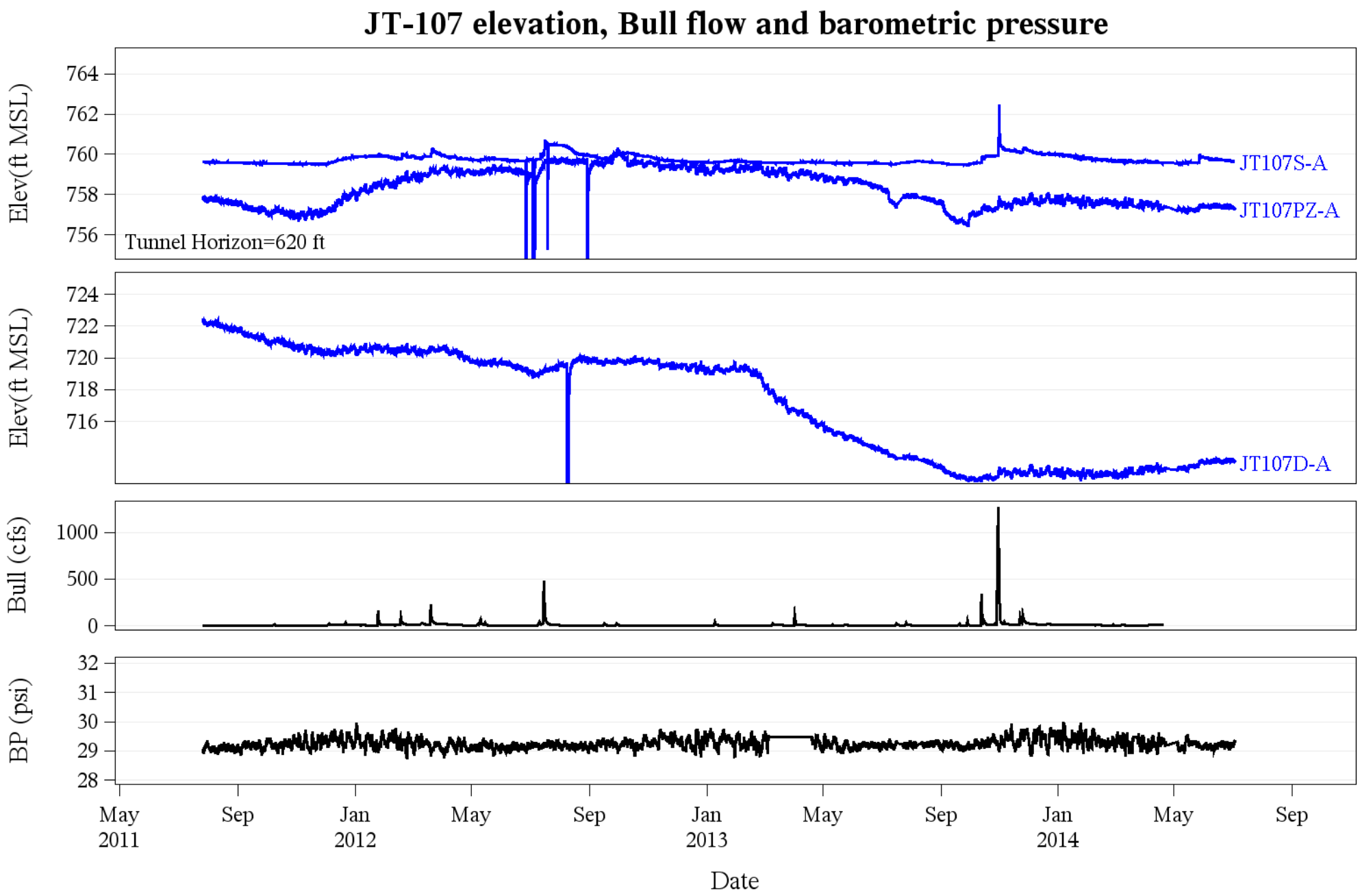
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Well JT-107PZa, Troll
GW Elevation
Groundwater Elevation (ft MSL)
760
740
720
700
Tunnel Horizon=620 ft
Bull Flow (cfs)
1250
1000
750
500
250
0
May 2011
Sep
Jan 2012
May
Sep
Jan 2013
May
Sep
Jan 2014
May
Sep
Date

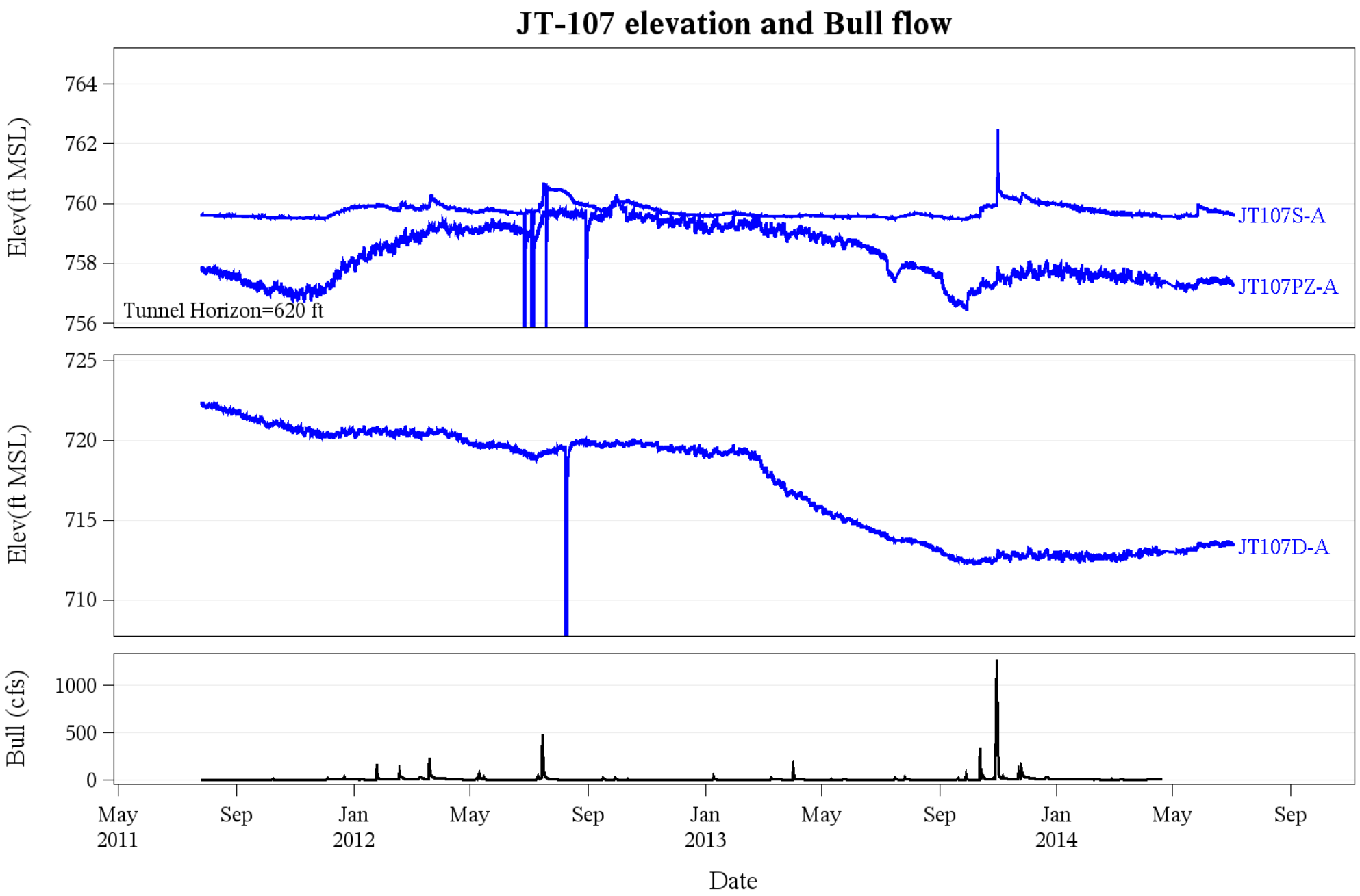

Well JT-107PZa, Troll
GW Elevation
Temp
Groundwater Elev (ft MSL)
760
740
720
700
Tunnel Horizon=620 ft
Water Temperature (C)
21.0
20.8
20.6
20.4
20.2
20.0
Bull Flow (cfs)
1250
1000
750
500
250
0
BaroPres(psi)
30.00
29.75
29.50
29.25
29.00
28.75
May 2011
Sep
Jan 2012
May
Sep
Jan 2013
May
Sep
Jan 2014
May
Sep
Date



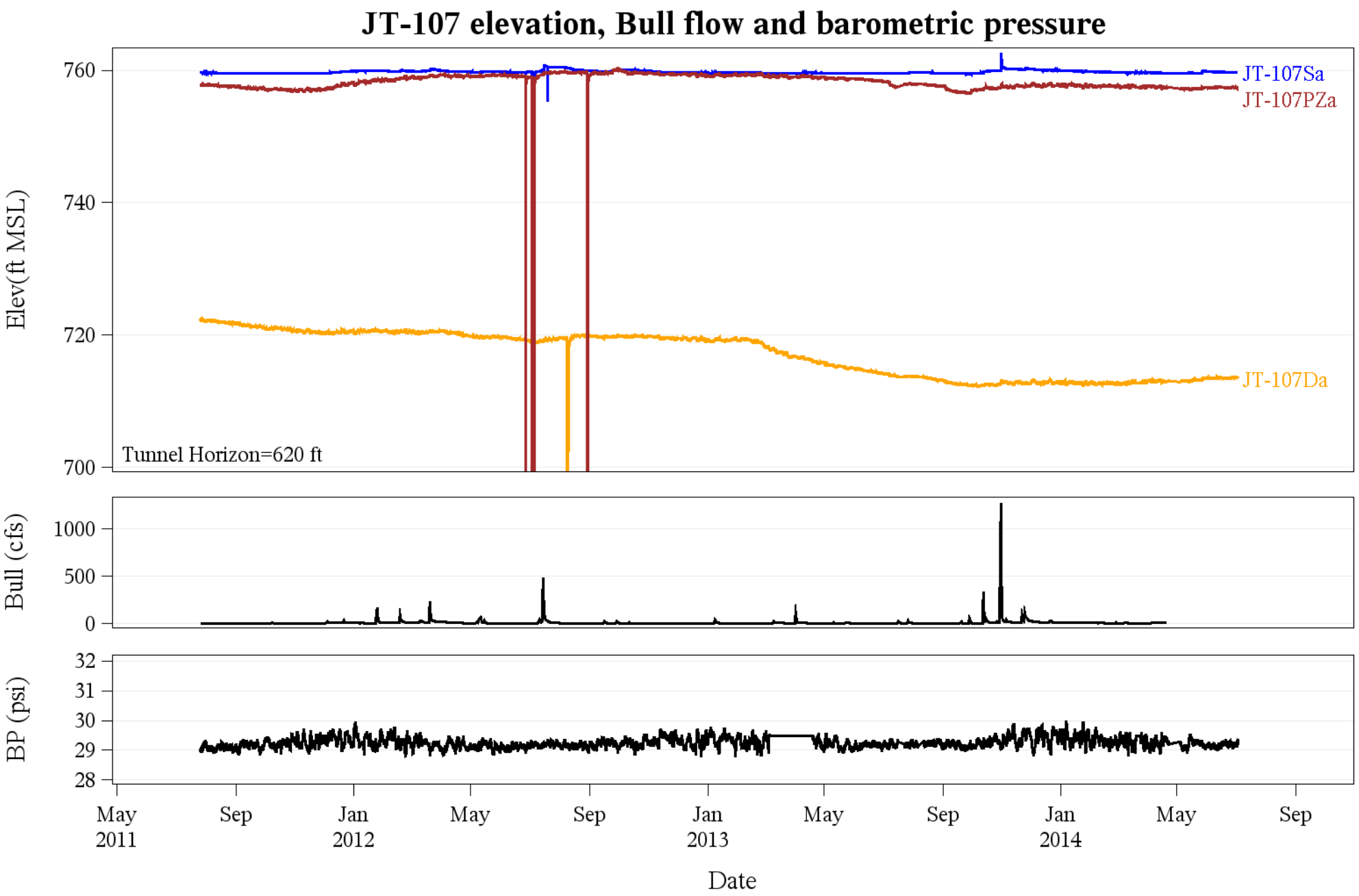
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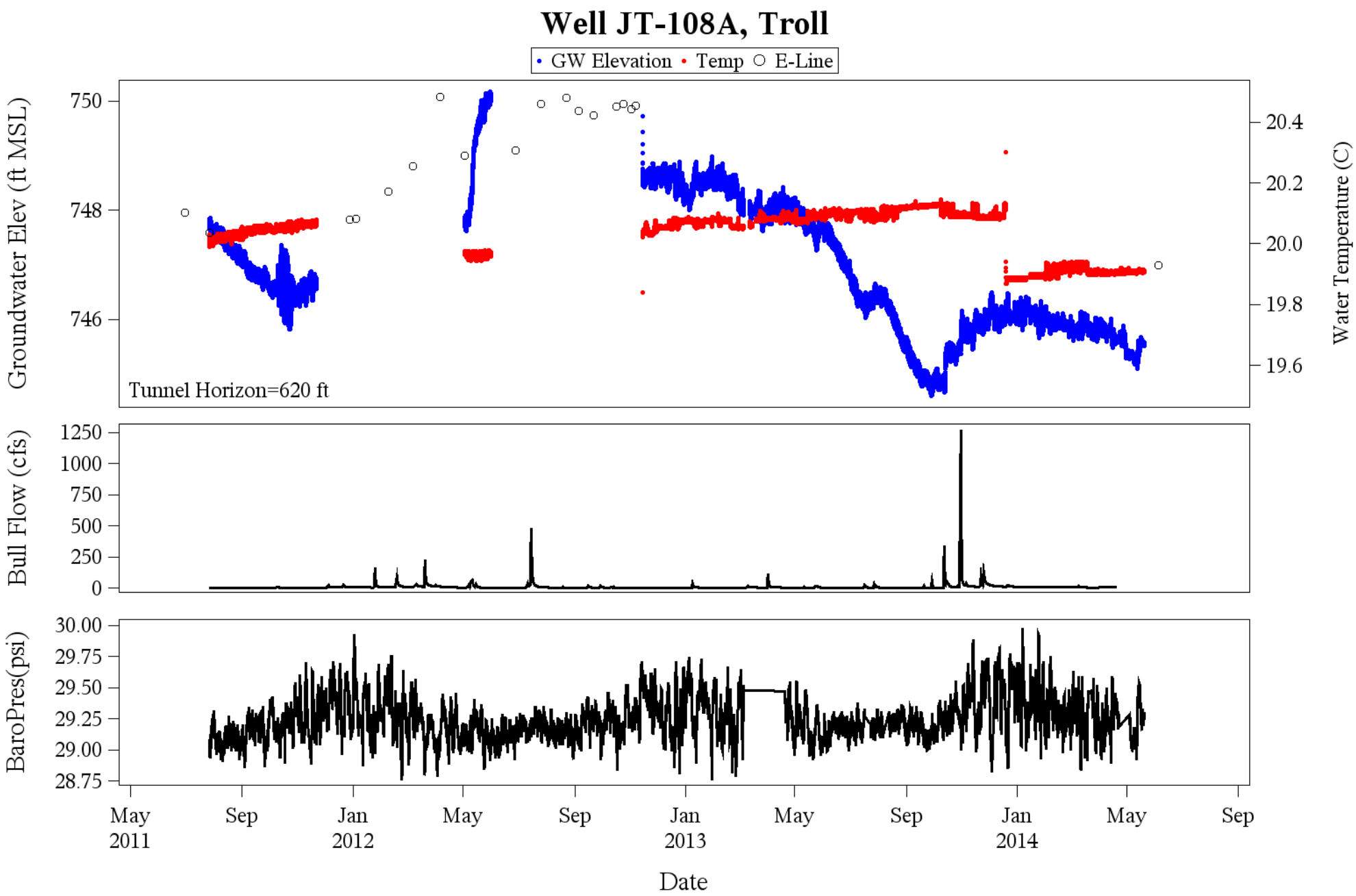
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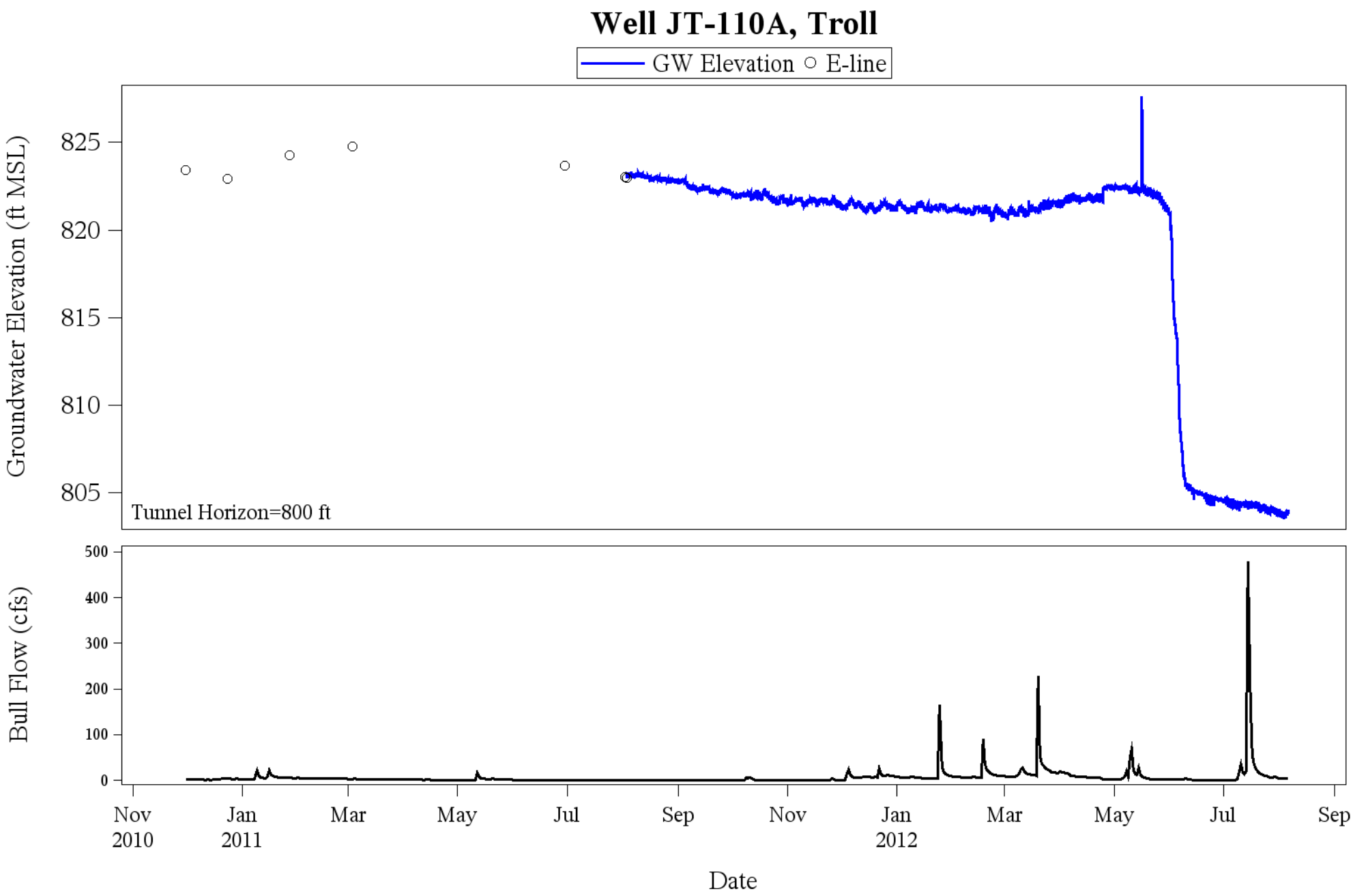


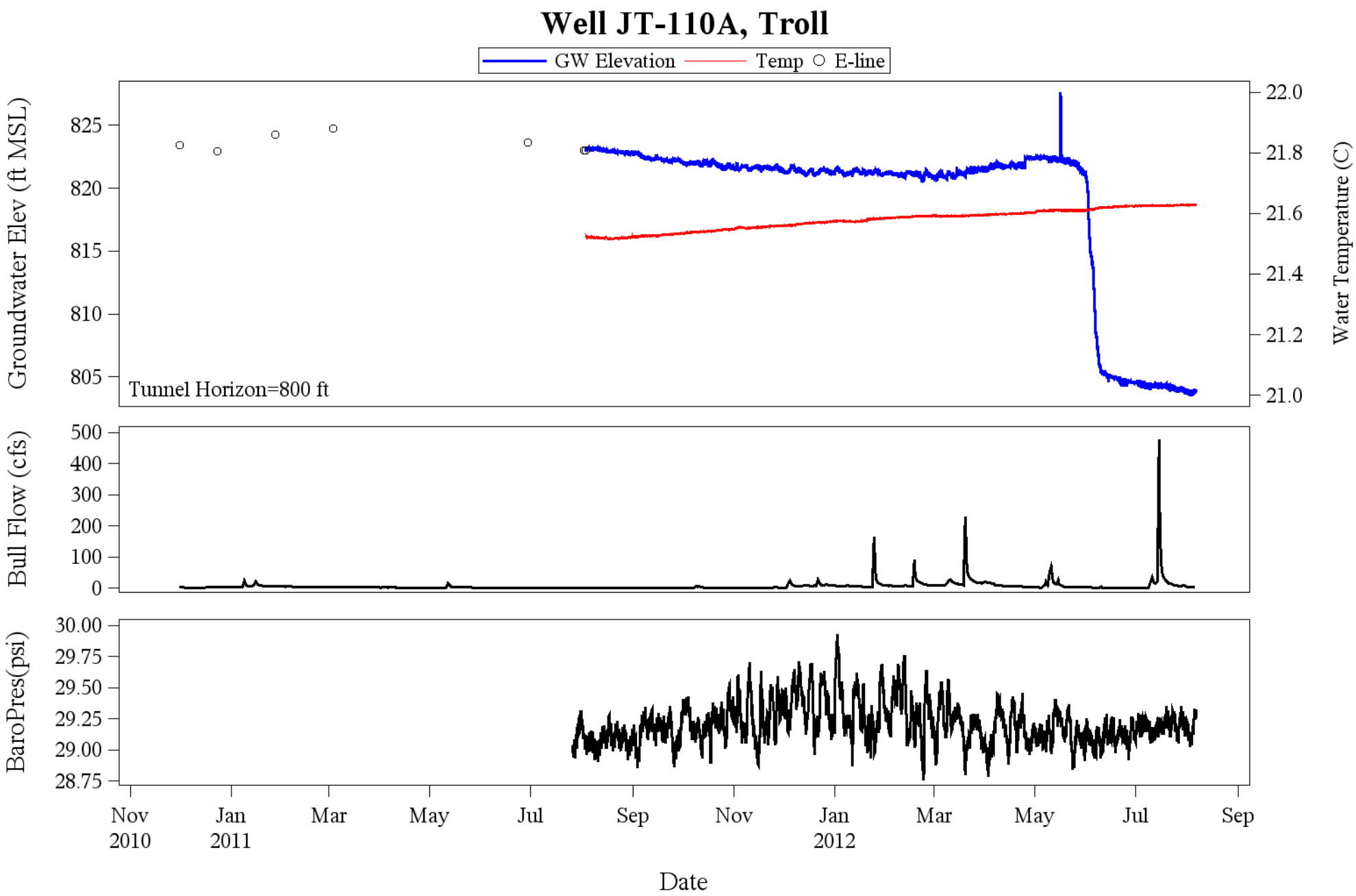
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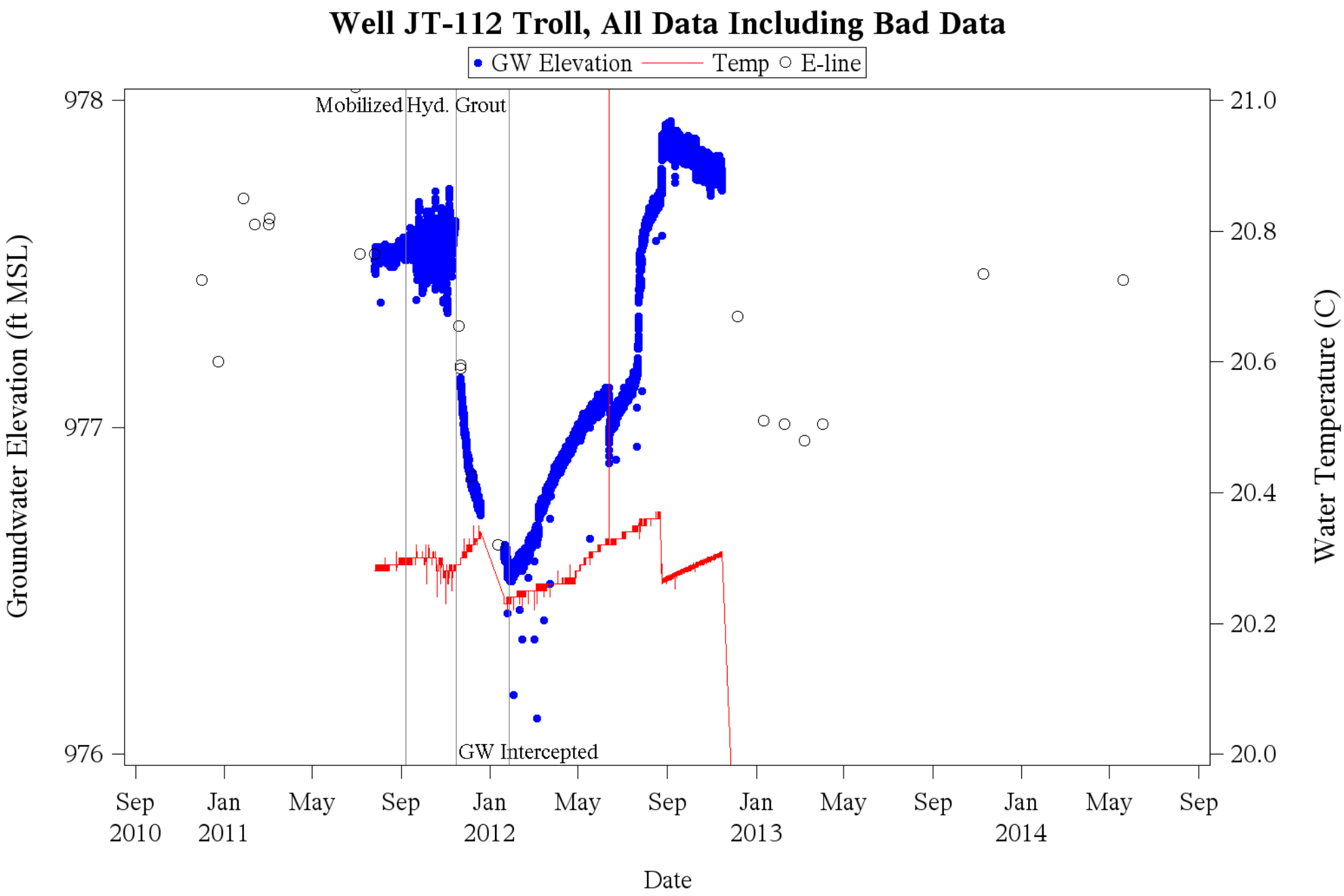


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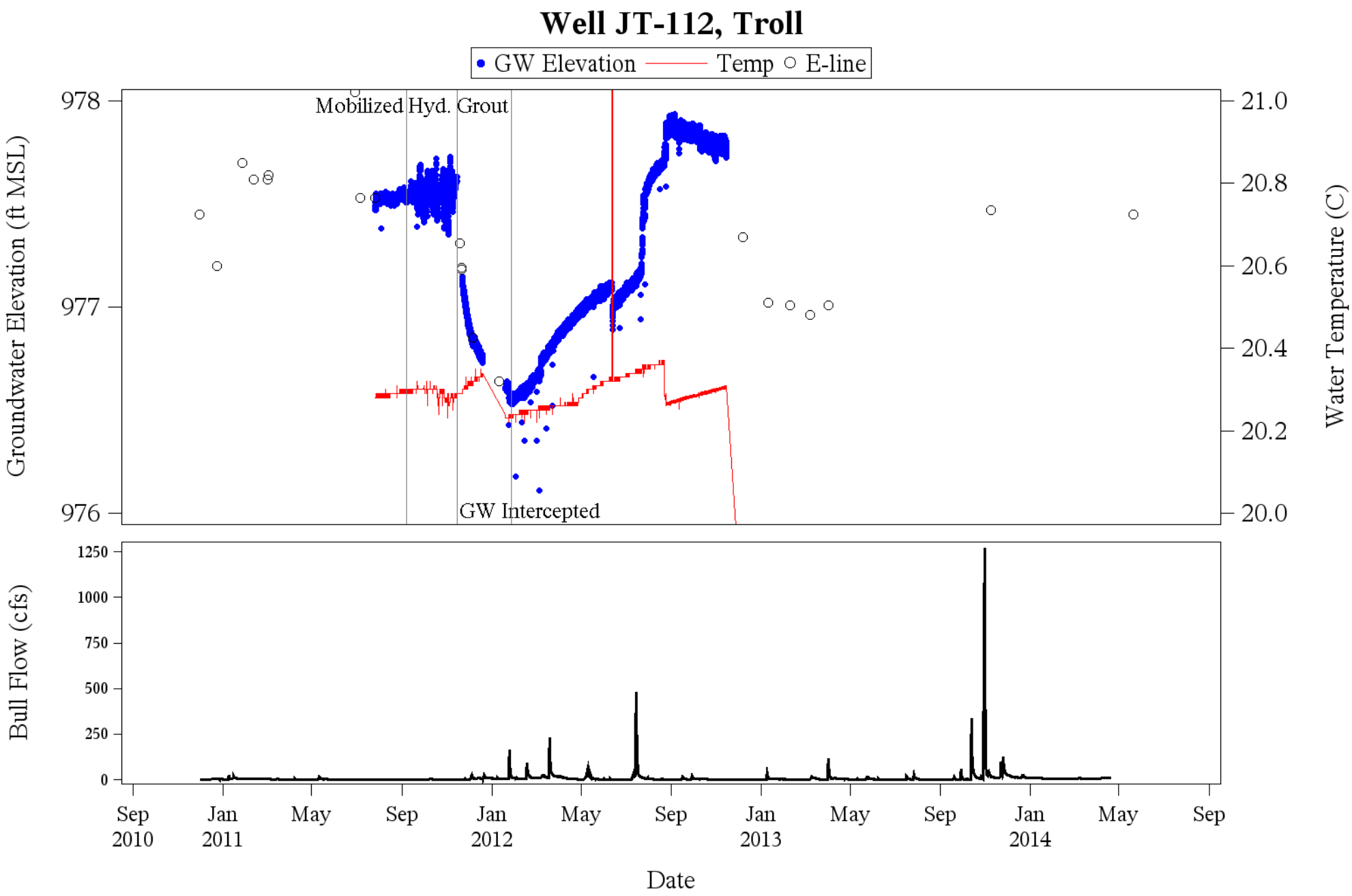

Well JT-108A, Troll
GW Elevation
Temp
E-Line
Groundwater Elev (ft MSL)
750
748
746
Water Temperature (C)
20.4
20.2
20.0
19.8
19.6
Tunnel Horizon=620 ft
Bull Flow (cfs)
1250
1000
750
500
250
0
BaroPres(psi)
30.00
29.75
29.50
29.25
29.00
28.75
May 2011
Sep
Jan 2012
May
Sep
Jan 2013
May
Sep
Jan 2014
May
Sep
Date


Well JT-110A, Troll
GW Elevation
E-line
Groundwater Elevation (ft MSL)
825
820
815
810
805
Tunnel Horizon=800 ft
Bull Flow (cfs)
500
400
300
200
100
0
Nov 2010
Jan 2011
Mar
May
Jul
Sep
Nov
Jan 2012
Mar
May
Jul
Sep
Date

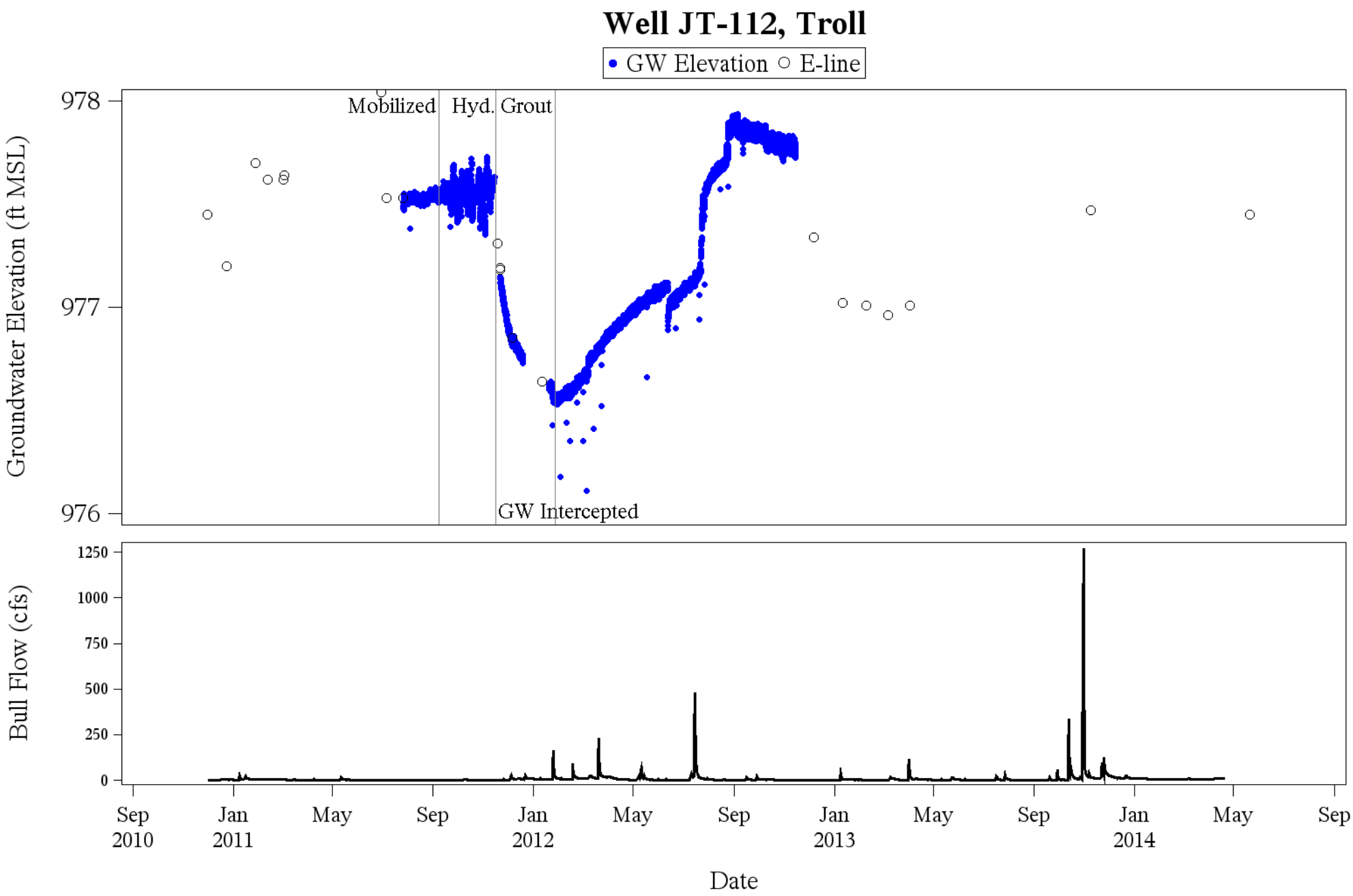

Well JT-110A, Troll
GW Elevation
Temp
E-line
Groundwater Elev (ft MSL)
825
820
815
810
805
Tunnel Horizon=800 ft
22.0
21.8
21.6
21.4
21.2
21.0
Water Temperature (C)
Bull Flow (cfs)
500
400
300
200
100
0
BaroPres(psi)
30.00
29.75
29.50
29.25
29.00
28.75
Nov 2010
Jan 2011
Mar
May
Jul
Sep
Nov
Jan 2012
Mar
May
Jul
Sep
Date

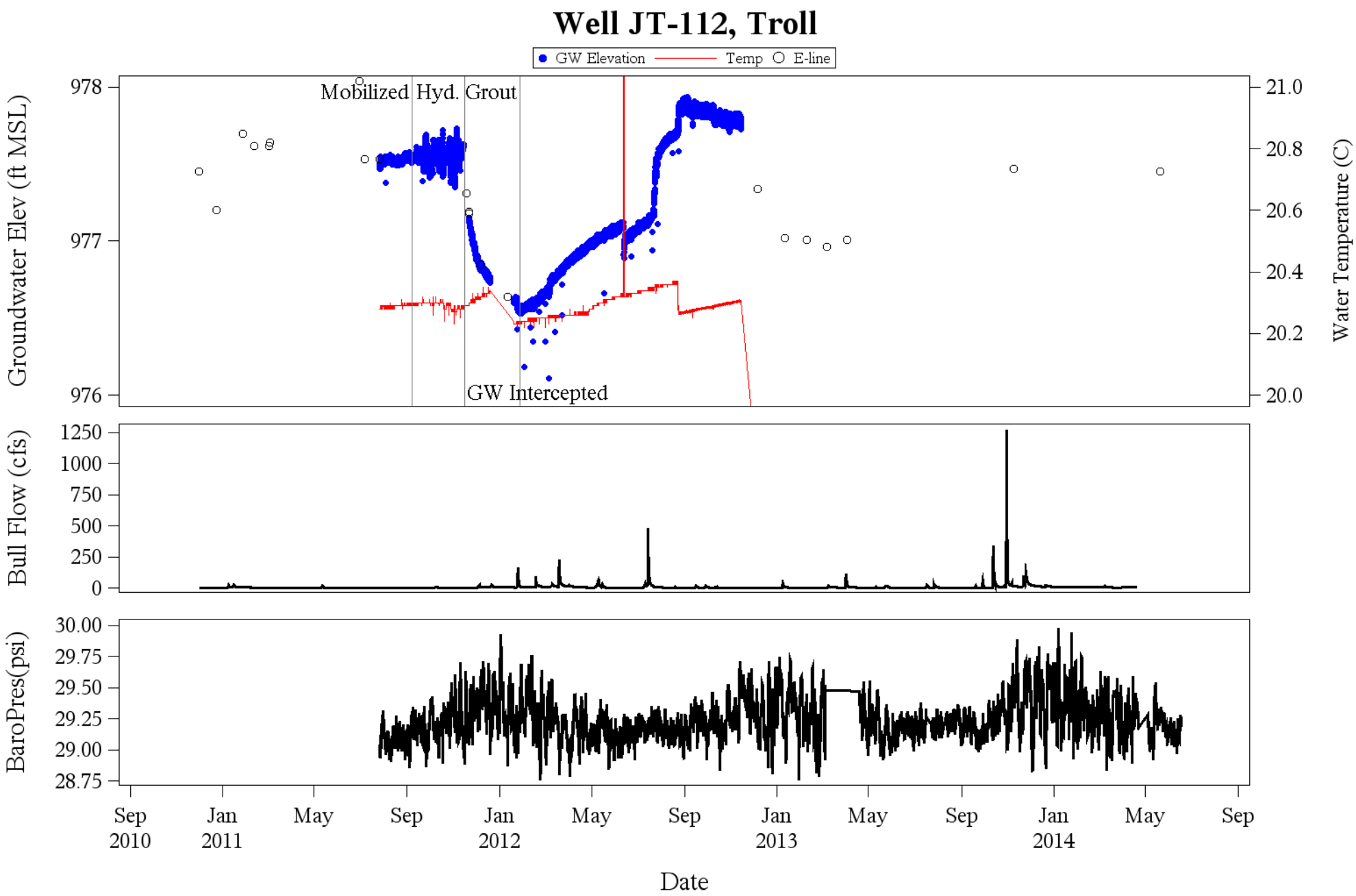


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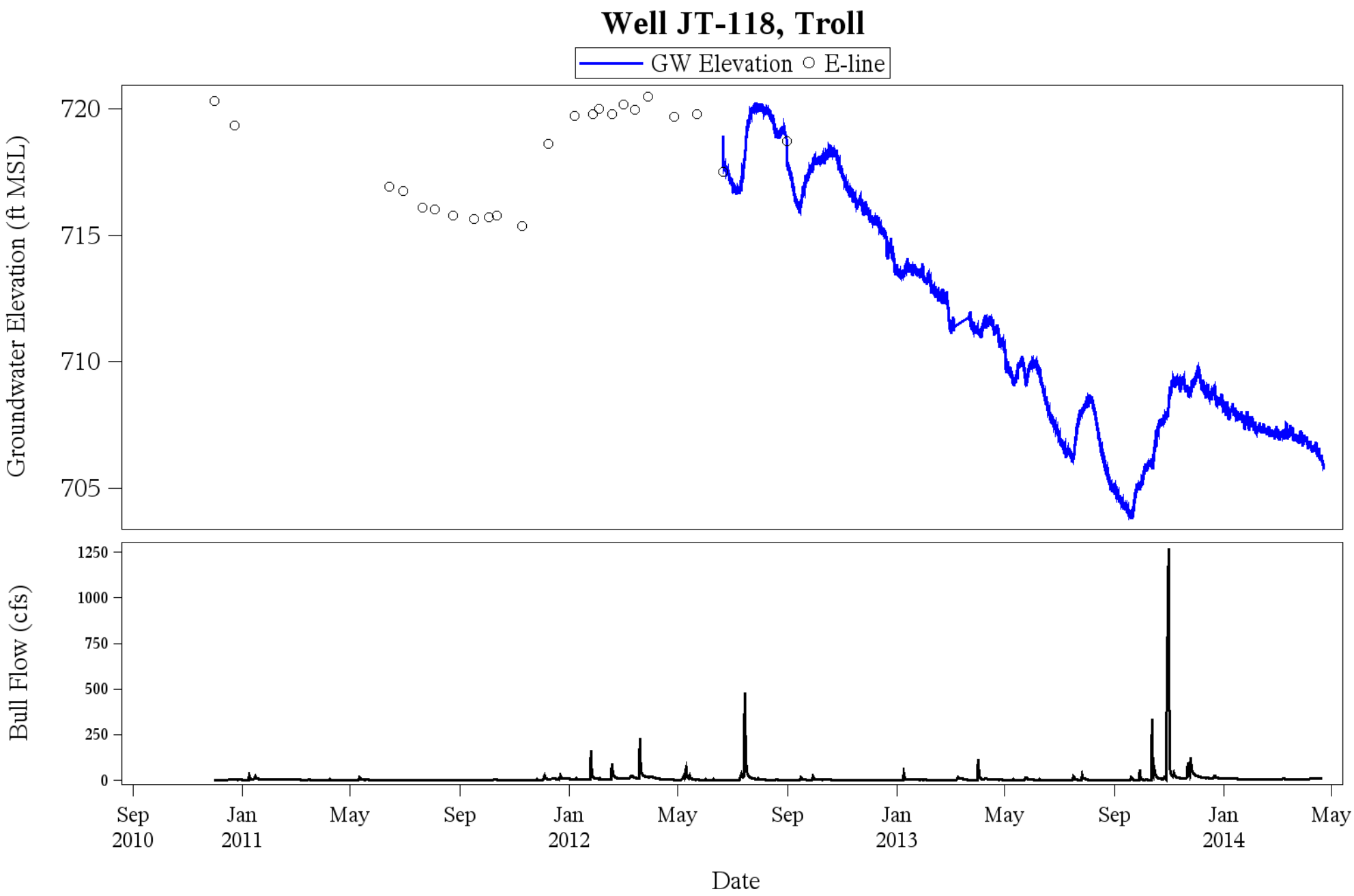


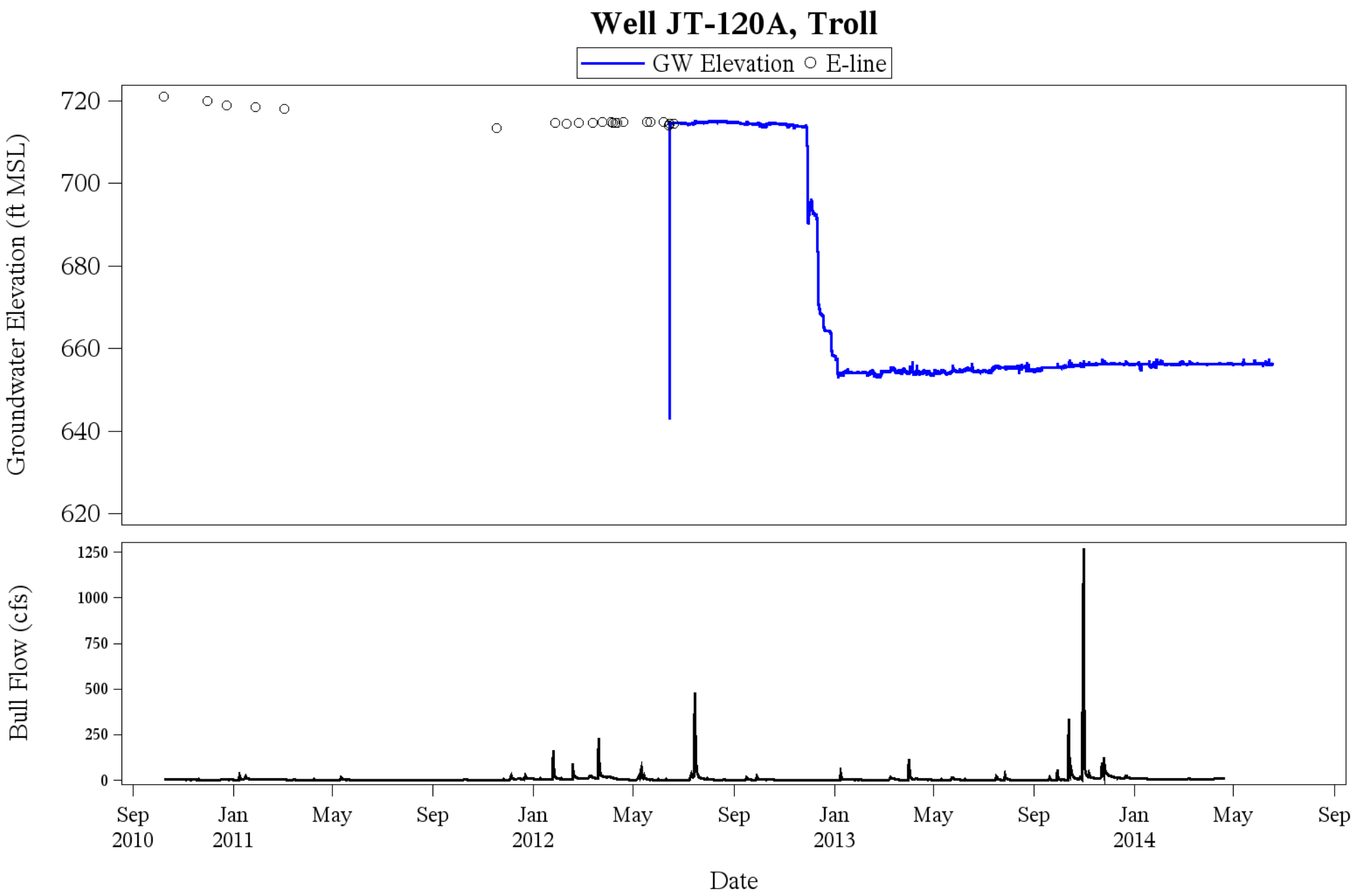
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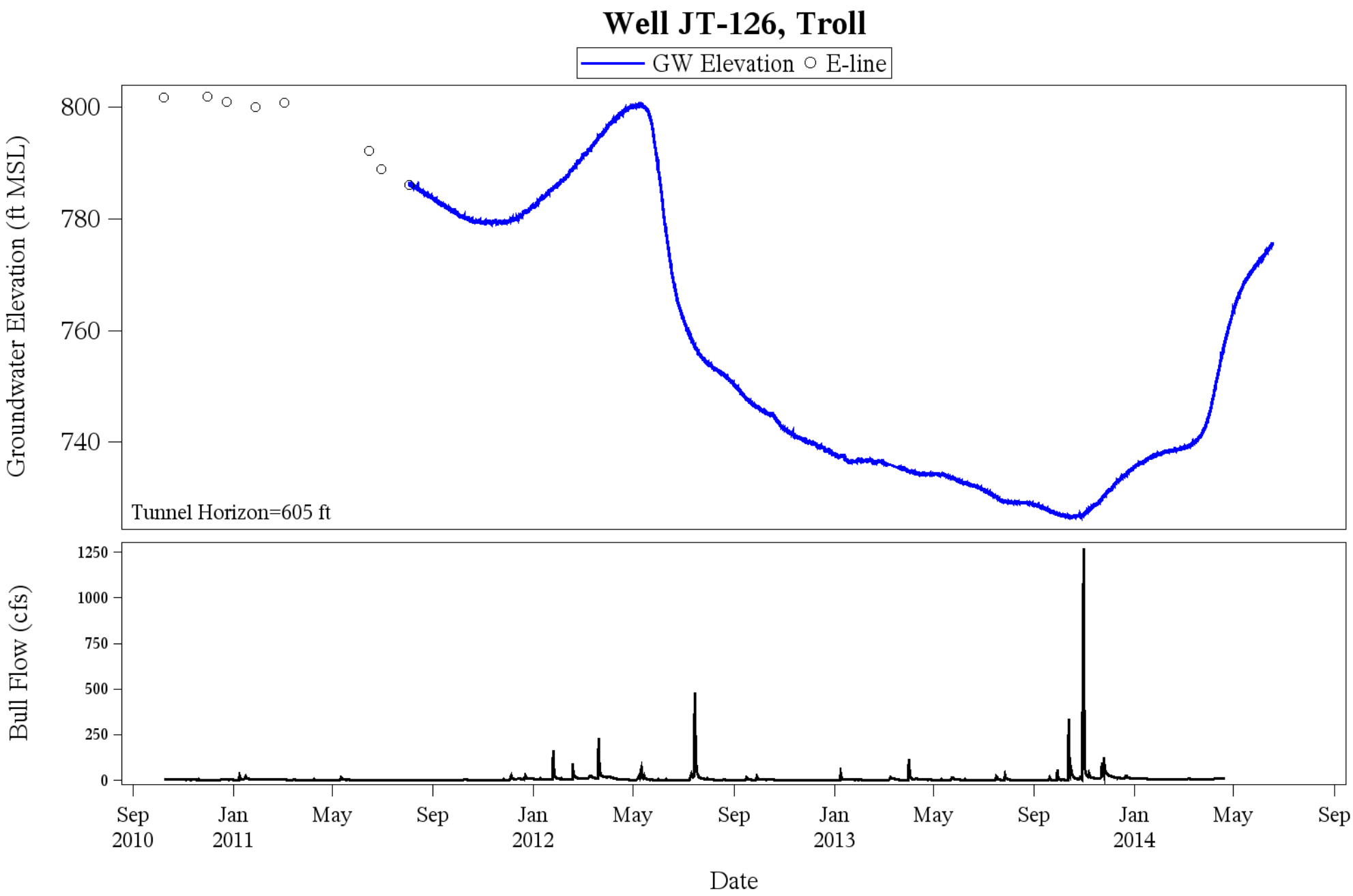

Well JT-112, Troll
GW Elevation
E-line
Mobilized
Hyd. Grout
GW Intercepted
Groundwater Elevation (ft MSL)
978
977
976
Bull Flow (cfs)
1250
1000
750
500
250
0
Sep 2010
Jan 2011
May
Sep
Jan 2012
May
Sep
Jan 2013
May
Sep
Jan 2014
May
Sep
Date

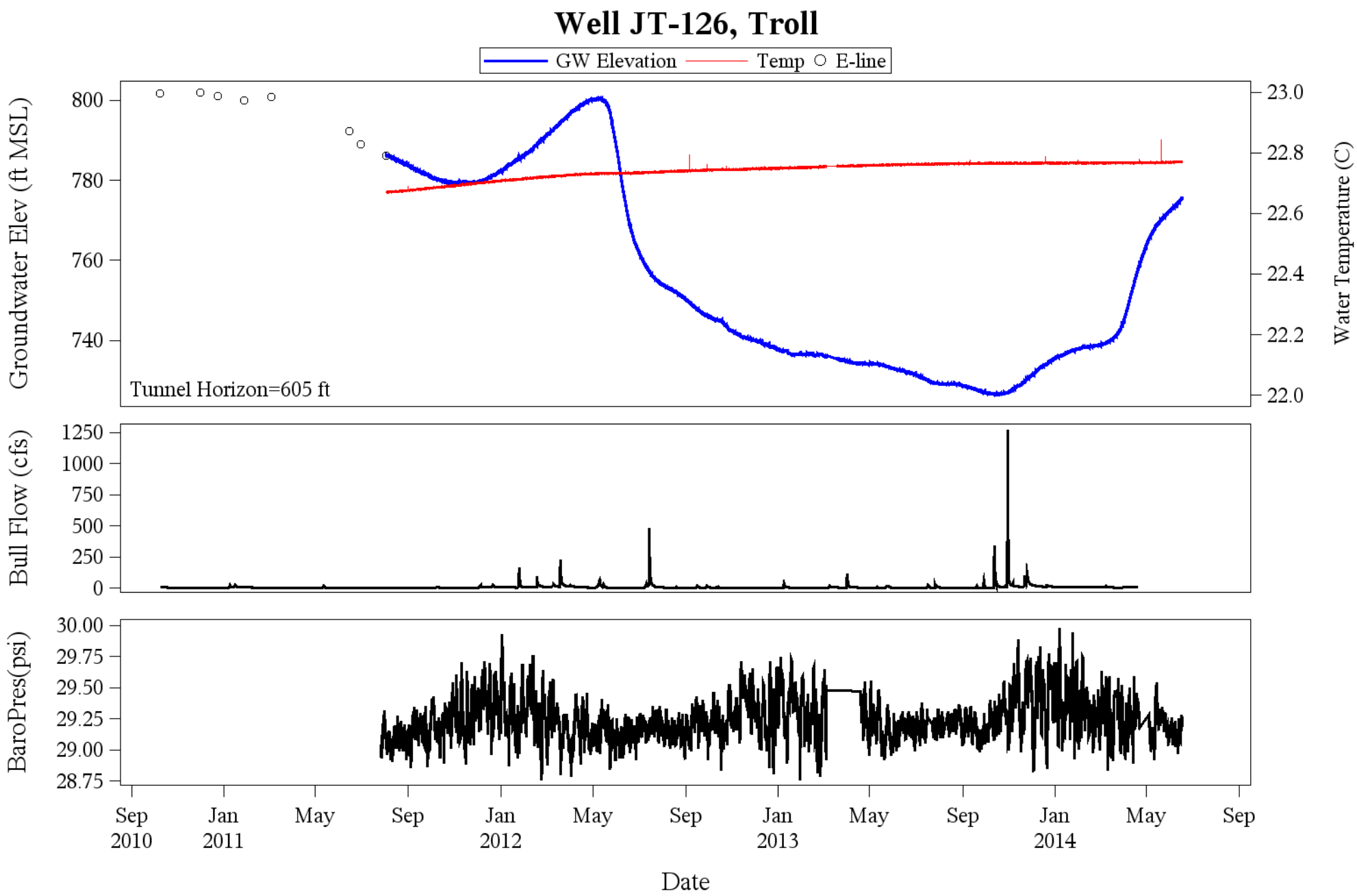


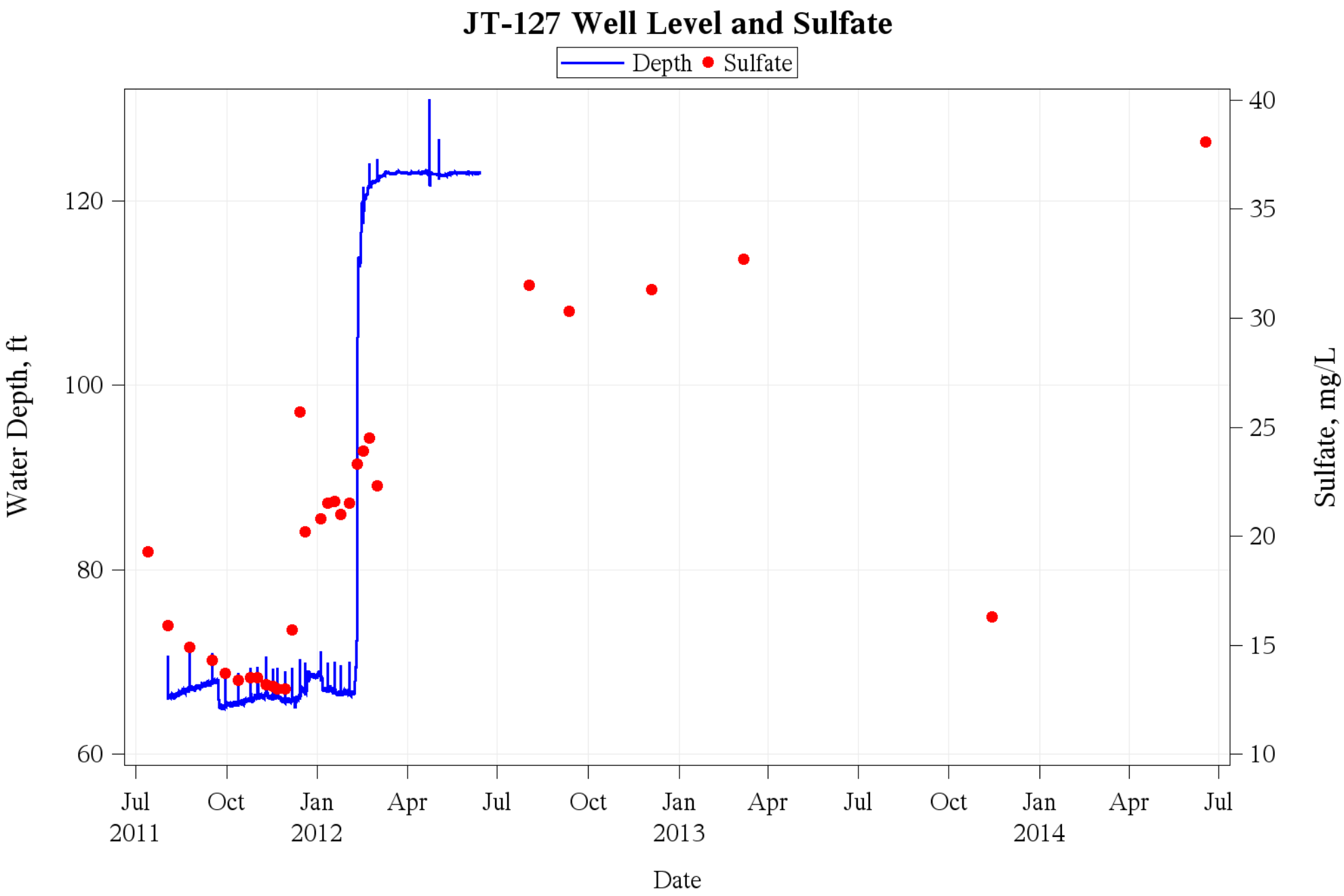
City of Austin DRAFT: QA/QC review pending


Well JT-118, Troll
GW Elevation
E-line
Groundwater Elevation (ft MSL)
720
715
710
705
Bull Flow (cfs)
1250
1000
750
500
250
0
Sep 2010
Jan 2011
May
Sep
Jan 2012
May
Sep
Jan 2013
May
Sep
Jan 2014
May
Date

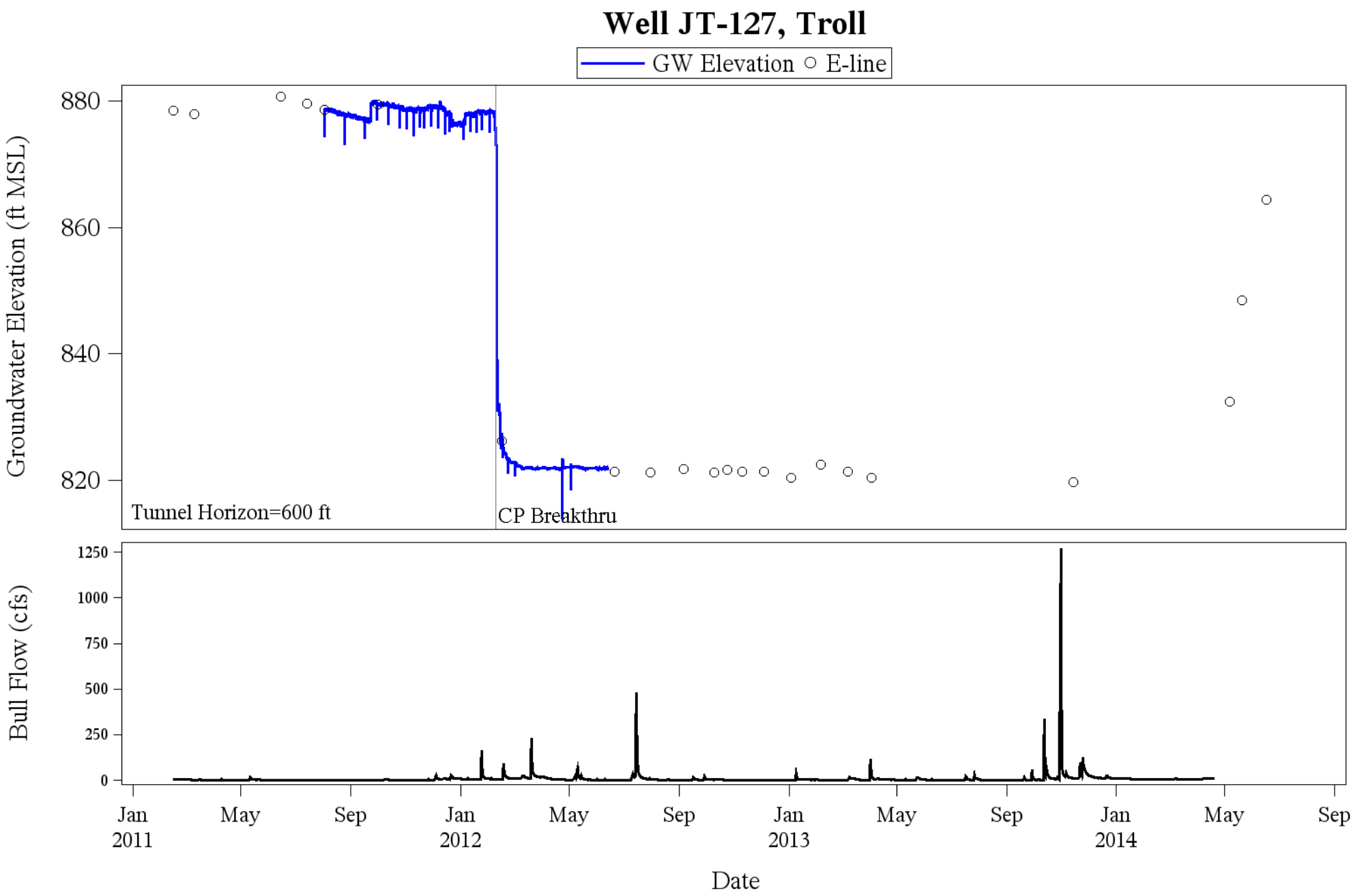

Well JT-120A, Troll
GW Elevation
E-line
Groundwater Elevation (ft MSL)
720
700
680
660
640
620
Bull Flow (cfs)
1250
1000
750
500
250
0
Sep 2010
Jan 2011
May
Sep
Jan 2012
May
Sep
Jan 2013
May
Sep
Jan 2014
May
Sep
Date

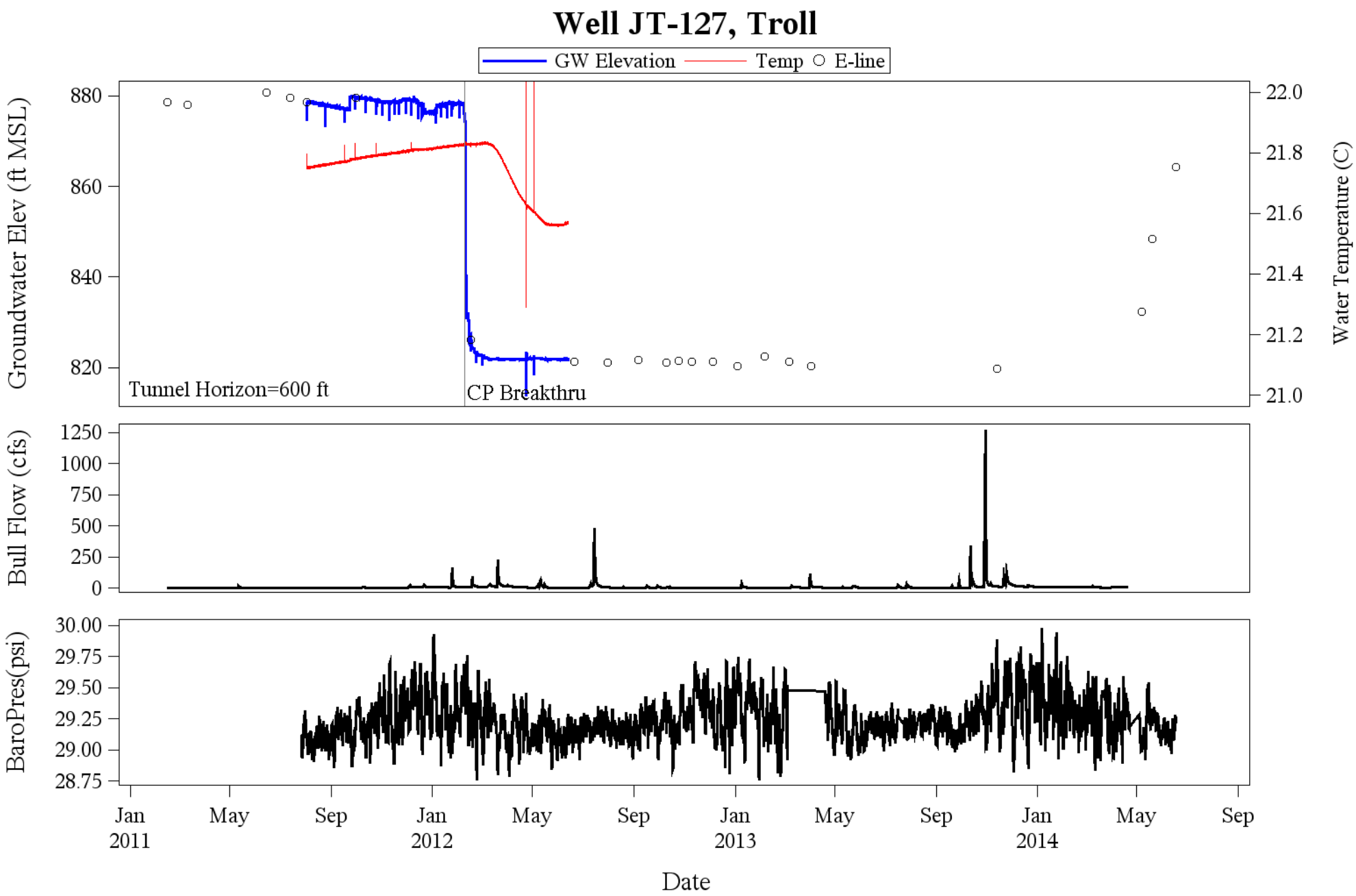

Well JT-126, Troll
GW Elevation
E-line
Groundwater Elevation (ft MSL)
800
780
760
740
Tunnel Horizon=605 ft
Bull Flow (cfs)
1250
1000
750
500
250
0
Sep 2010
Jan 2011
May
Sep
Jan 2012
May
Sep
Jan 2013
May
Sep
Jan 2014
May
Sep
Date


Well JT-126, Troll
GW Elevation
Temp
E-line
Groundwater Elev (ft MSL)
800
780
760
740
Tunnel Horizon=605 ft
Water Temperature (C)
23.0
22.8
22.6
22.4
22.2
22.0
Bull Flow (cfs)
1250
1000
750
500
250
0
BaroPres(psi)
30.00
29.75
29.50
29.25
29.00
28.75
Sep 2010
Jan 2011
May
Sep
Jan 2012
May
Sep
Jan 2013
May
Sep
Jan 2014
May
Sep
Date

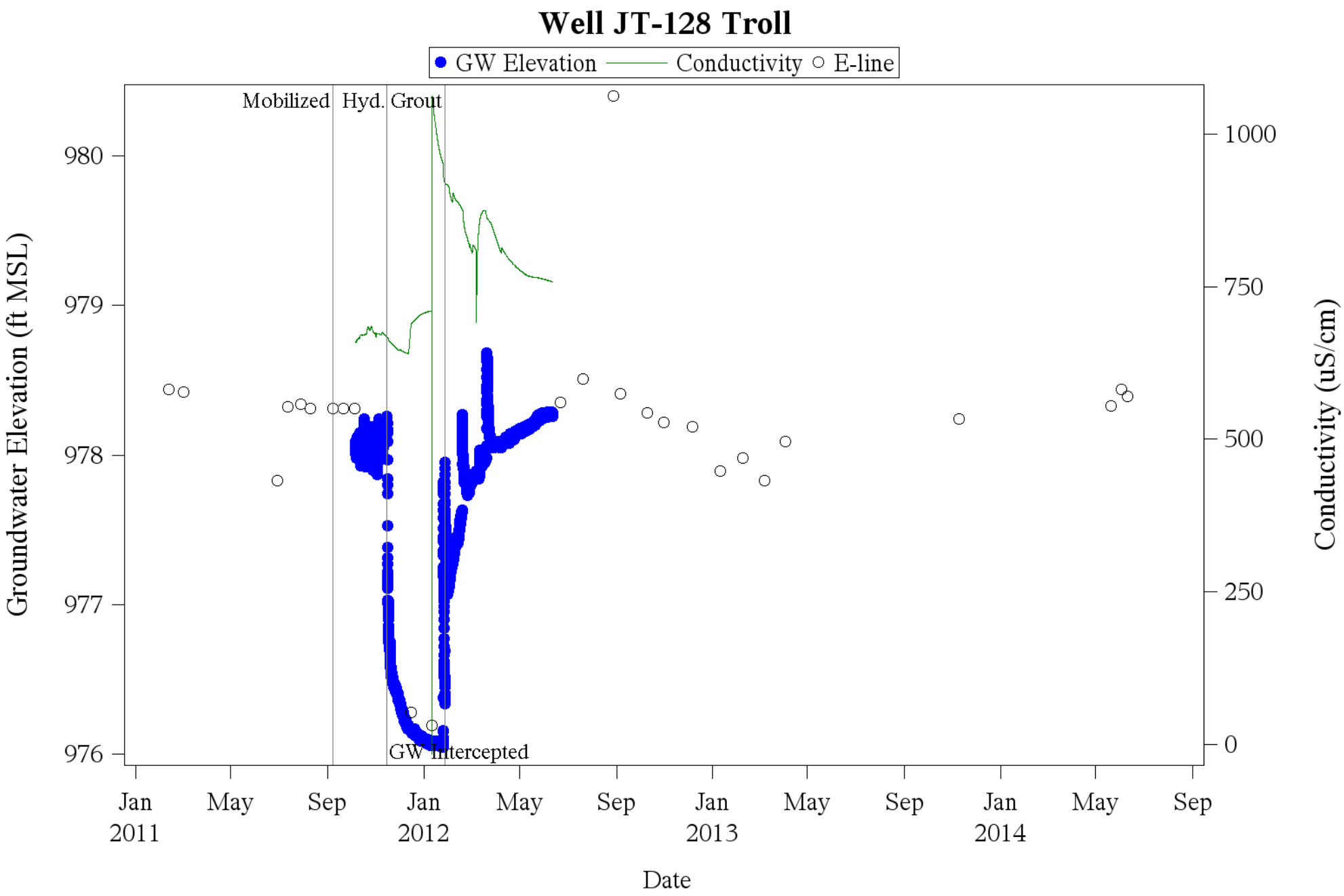


City of Austin DRAFT: QA/QC review pending

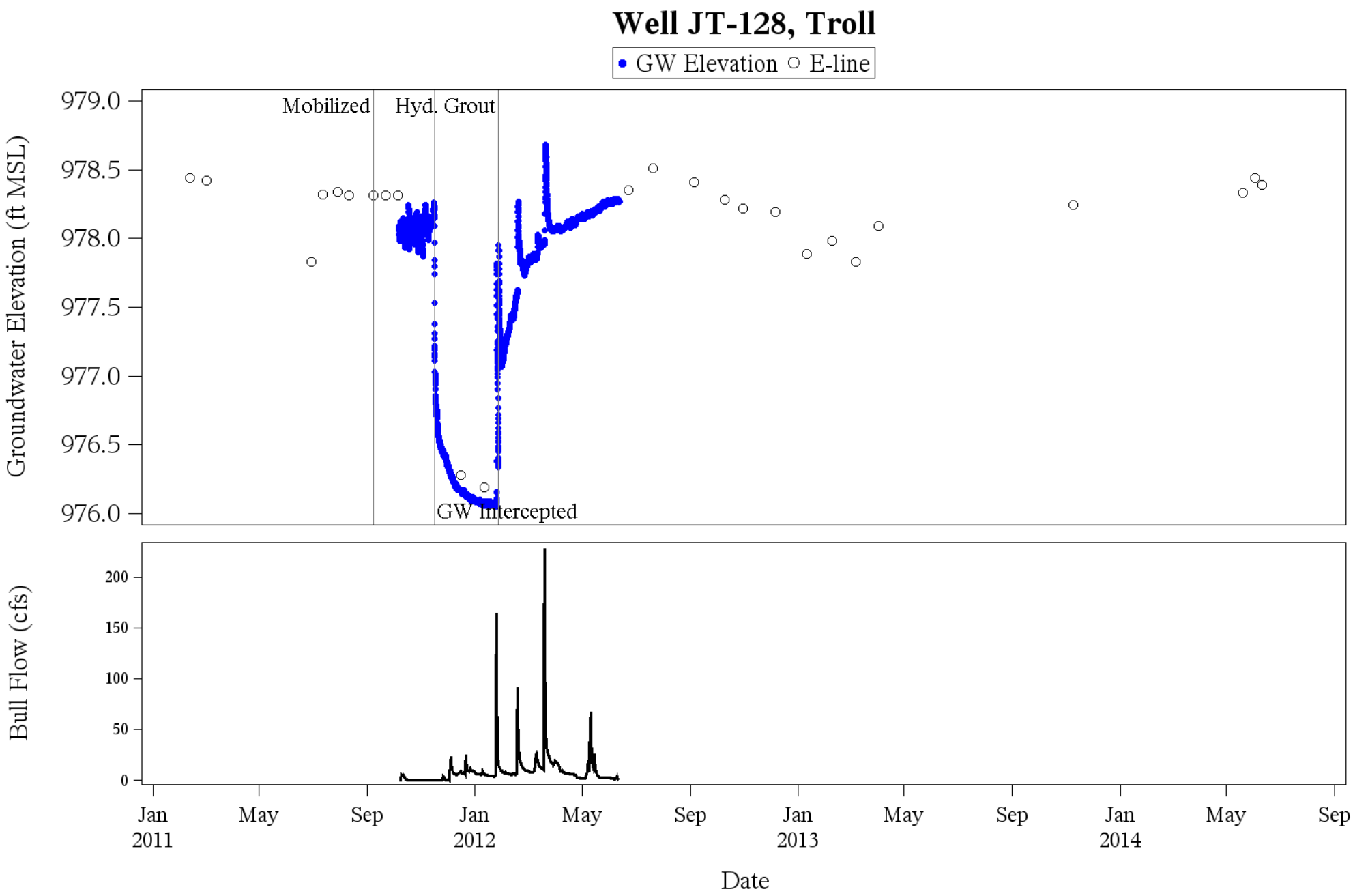

Well JT-127, Troll
GW Elevation
E-line
Groundwater Elevation (ft MSL)
880
860
840
820
Tunnel Horizon=600 ft
CP Breakthru
Bull Flow (cfs)
1250
1000
750
500
250
0
Jan 2011
May
Sep
Jan 2012
May
Sep
Jan 2013
May
Sep
Jan 2014
May
Sep
Date

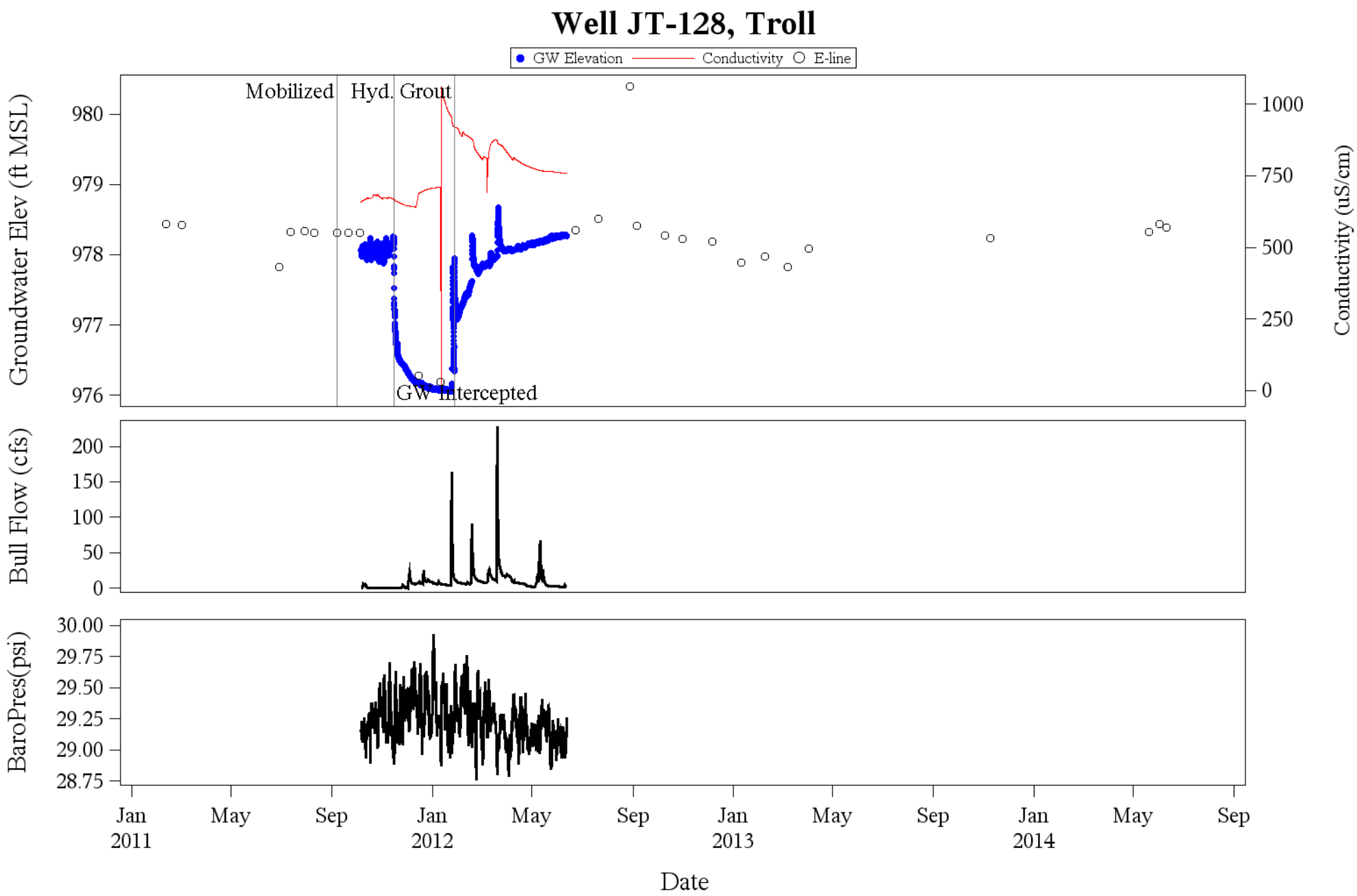


City of Austin DRAFT: QA/QC review pending



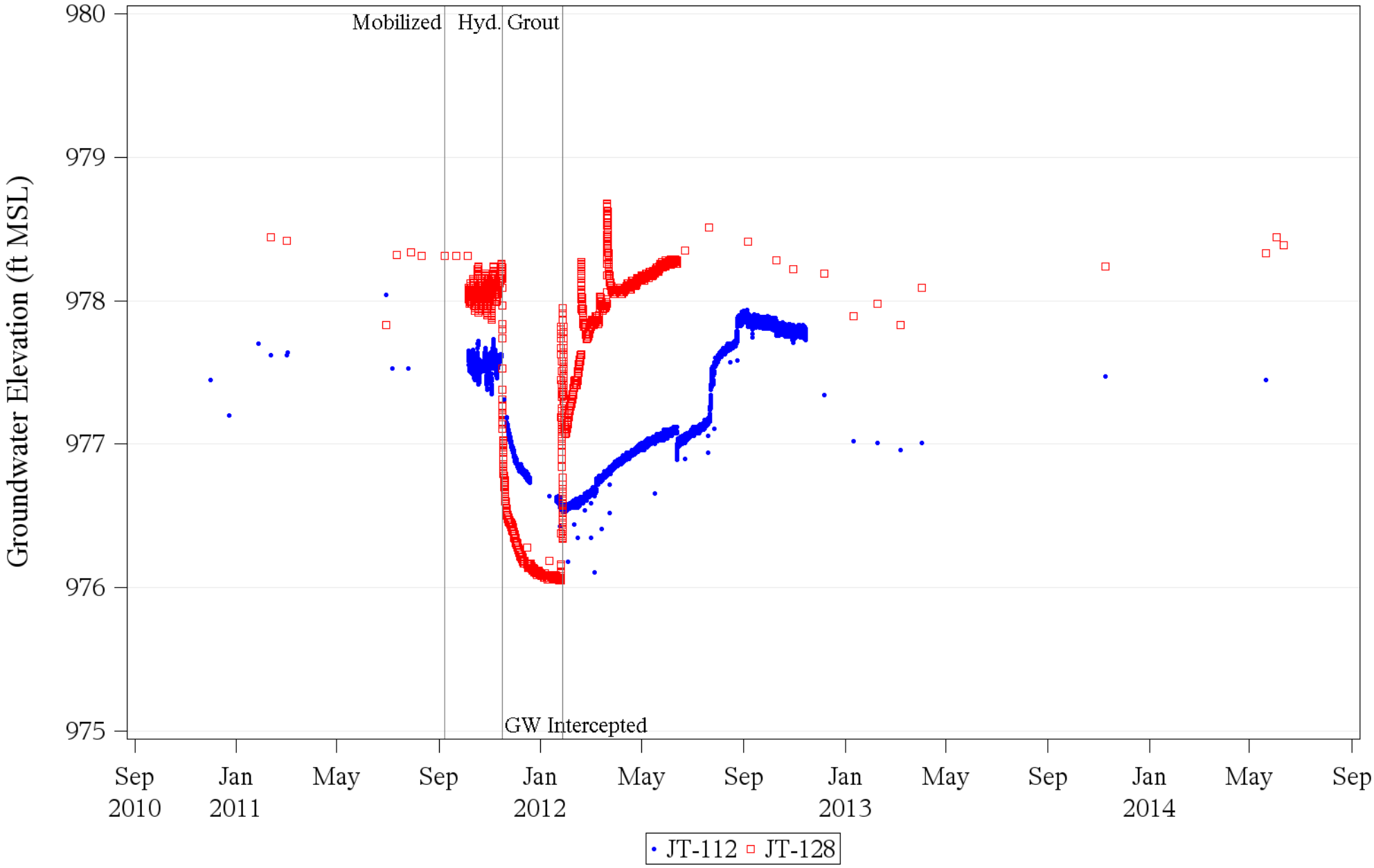
City of Austin DRAFT: QA/QC review pending


Well JT-128, Troll
GW Elevation
E-line
Groundwater Elevation (ft MSL)
979.0
978.5
978.0
977.5
977.0
976.5
976.0
Mobilized
Hyd. Grout
GW Intercepted
Bull Flow (cfs)
200
150
100
50
0
Jan 2011
May
Sep
Jan 2012
May
Sep
Jan 2013
May
Sep
Jan 2014
May
Sep
Date

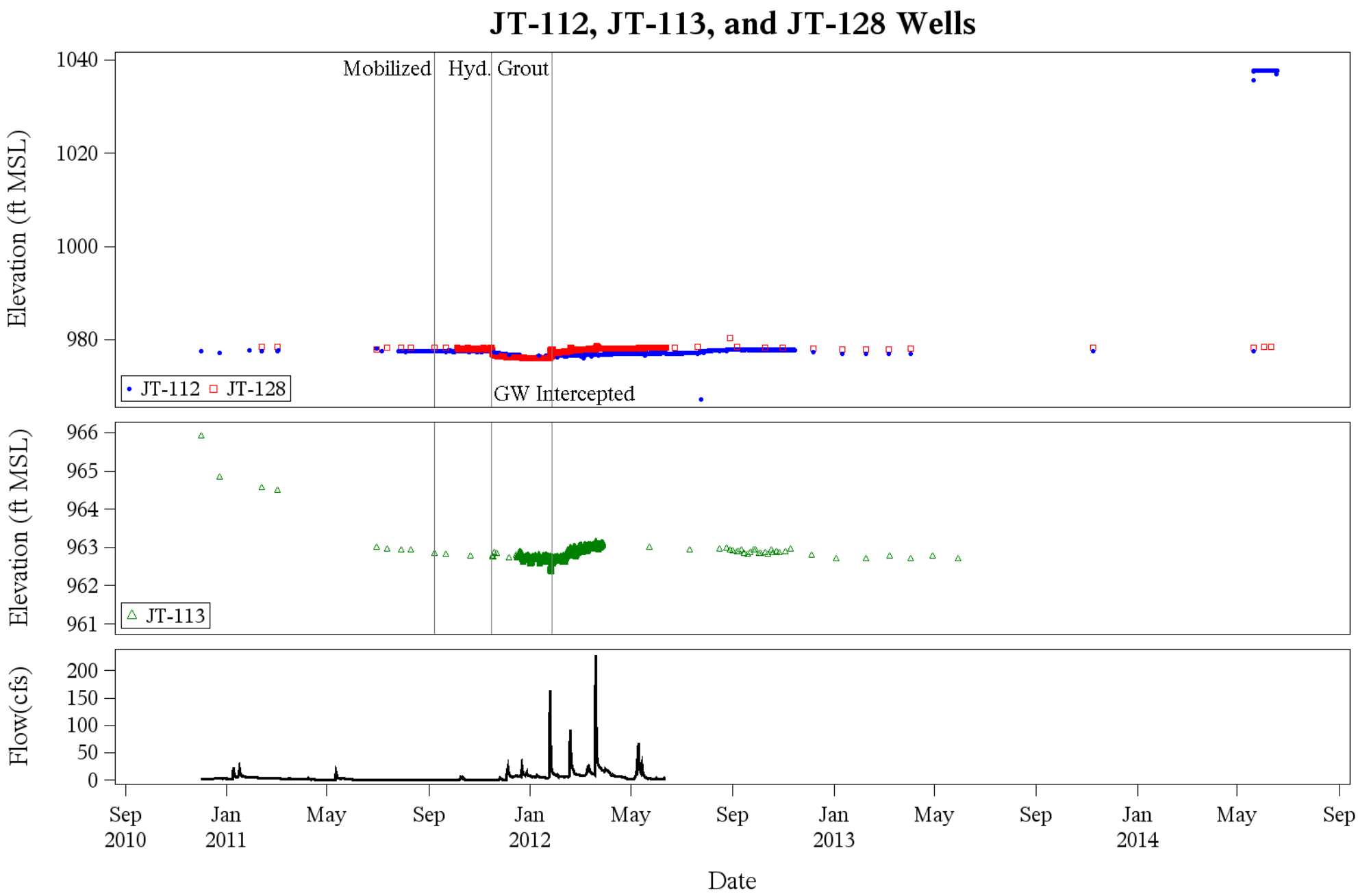


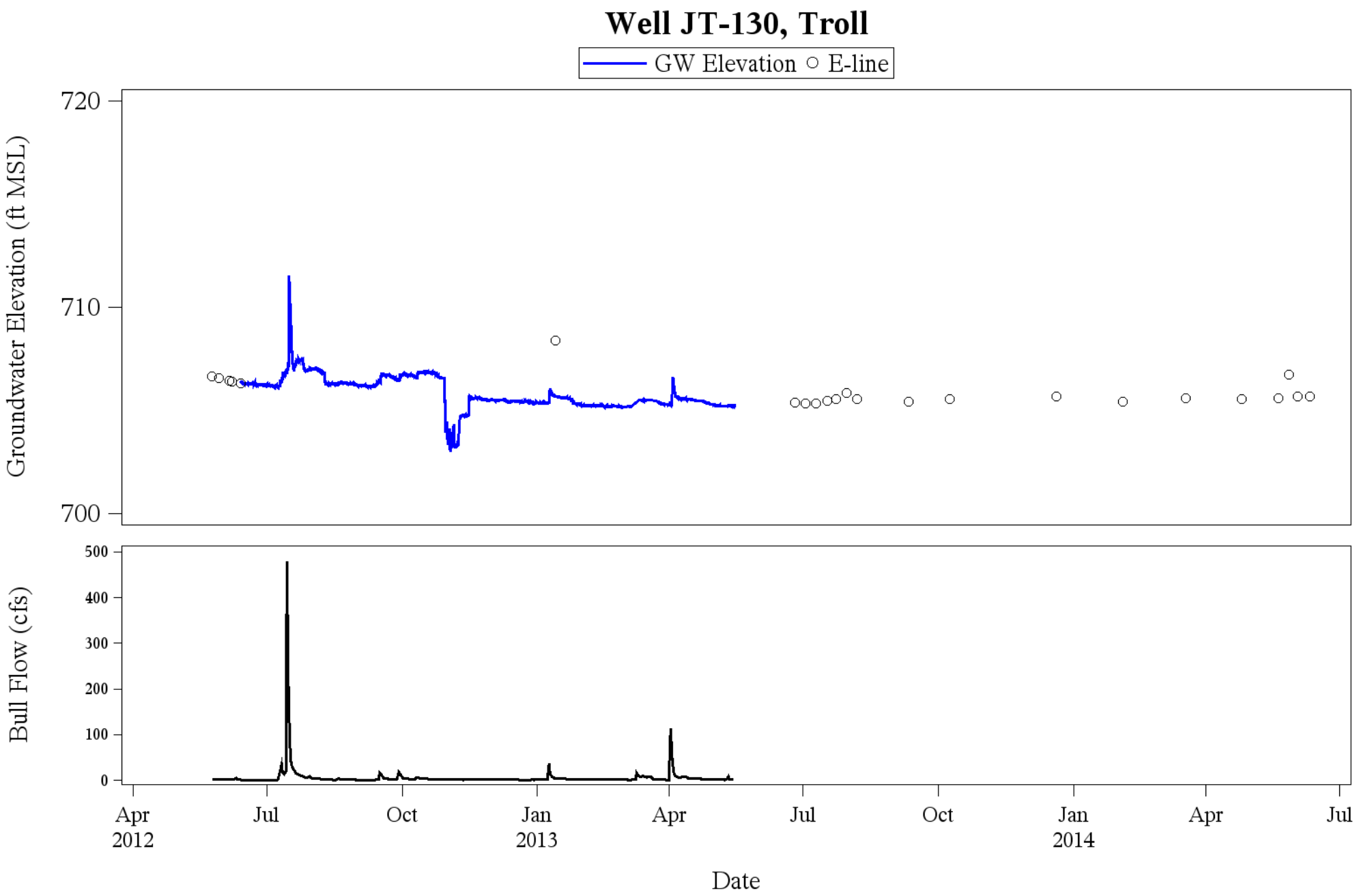
City of Austin DRAFT: QA/QC review pending

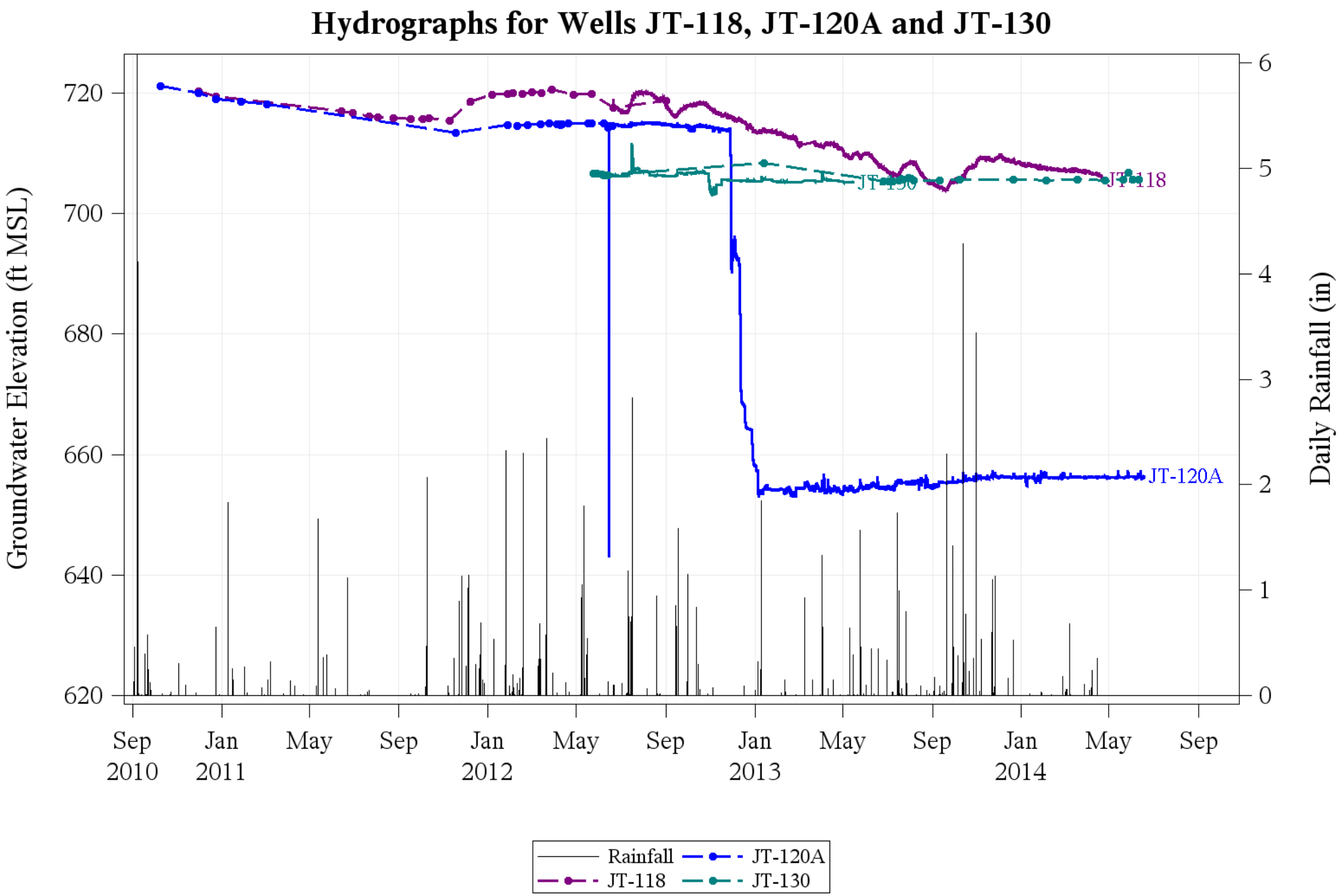
Wells JT-112 and JT-128, Troll and E-line Data



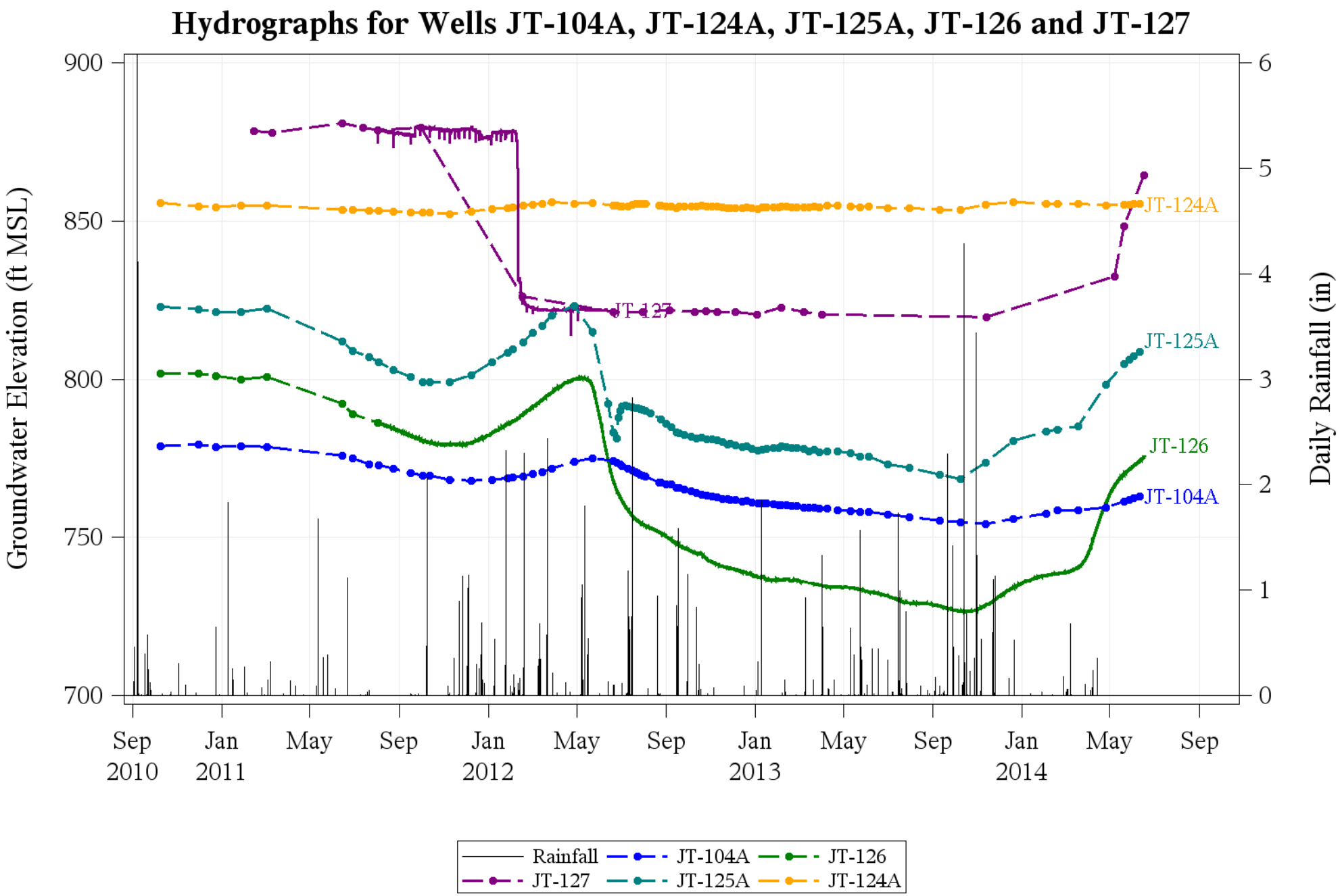
City of Austin DRAFT: QA/QC review pending


JT-112, JT-113, and JT-128 Wells
Mobilized
Hyd. Grout
GW Intercepted
JT-112
JT-128
JT-113
Elevation (ft MSL)
Elevation (ft MSL)
Flow(cfs)
1040
1020
1000
980
966
965
964
963
962
961
200
150
100
50
0
Sep 2010
Jan 2011
May
Sep
Jan 2012
May
Sep
Jan 2013
May
Sep
Jan 2014
May
Sep
Date

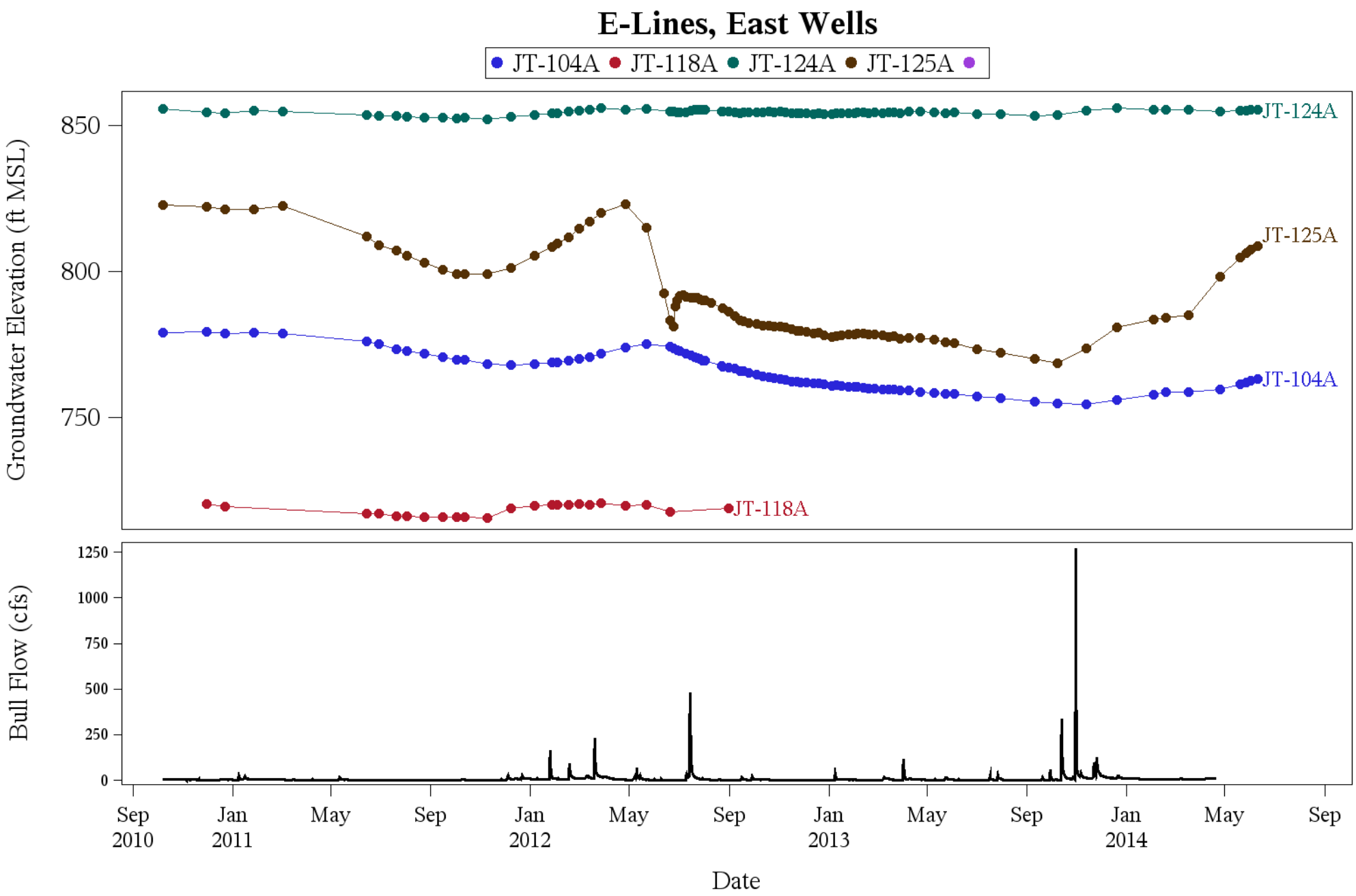

Well JT-130, Troll
GW Elevation
E-line
Groundwater Elevation (ft MSL)
720
710
700
Bull Flow (cfs)
500
400
300
200
100
0
Apr
2012
Jul
Oct
Jan
2013
Apr
Jul
Oct
Jan
2014
Apr
Jul
Date



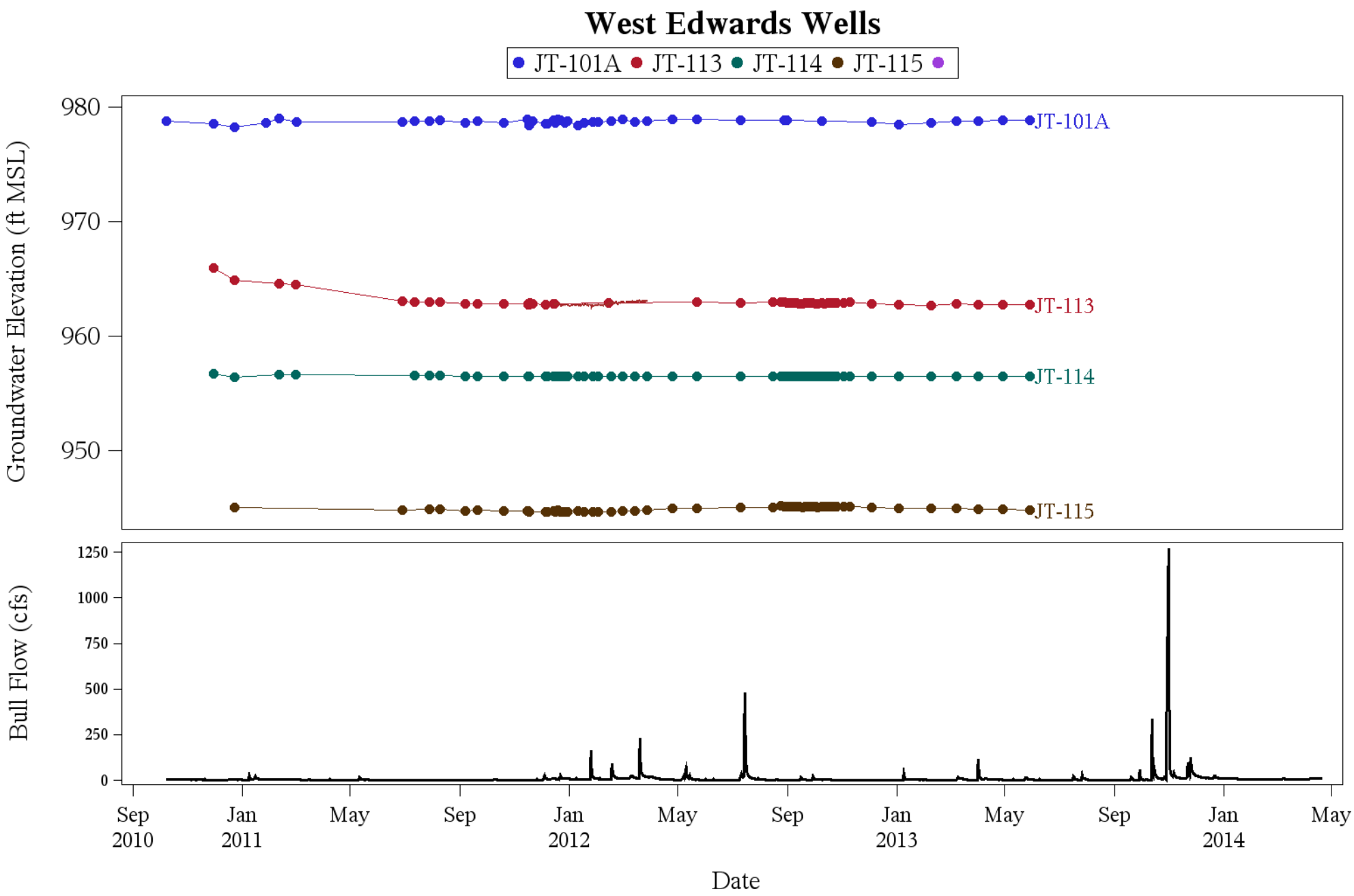
City of Austin DRAFT: QA/QC review pending



City of Austin DRAFT: QA/QC review pending

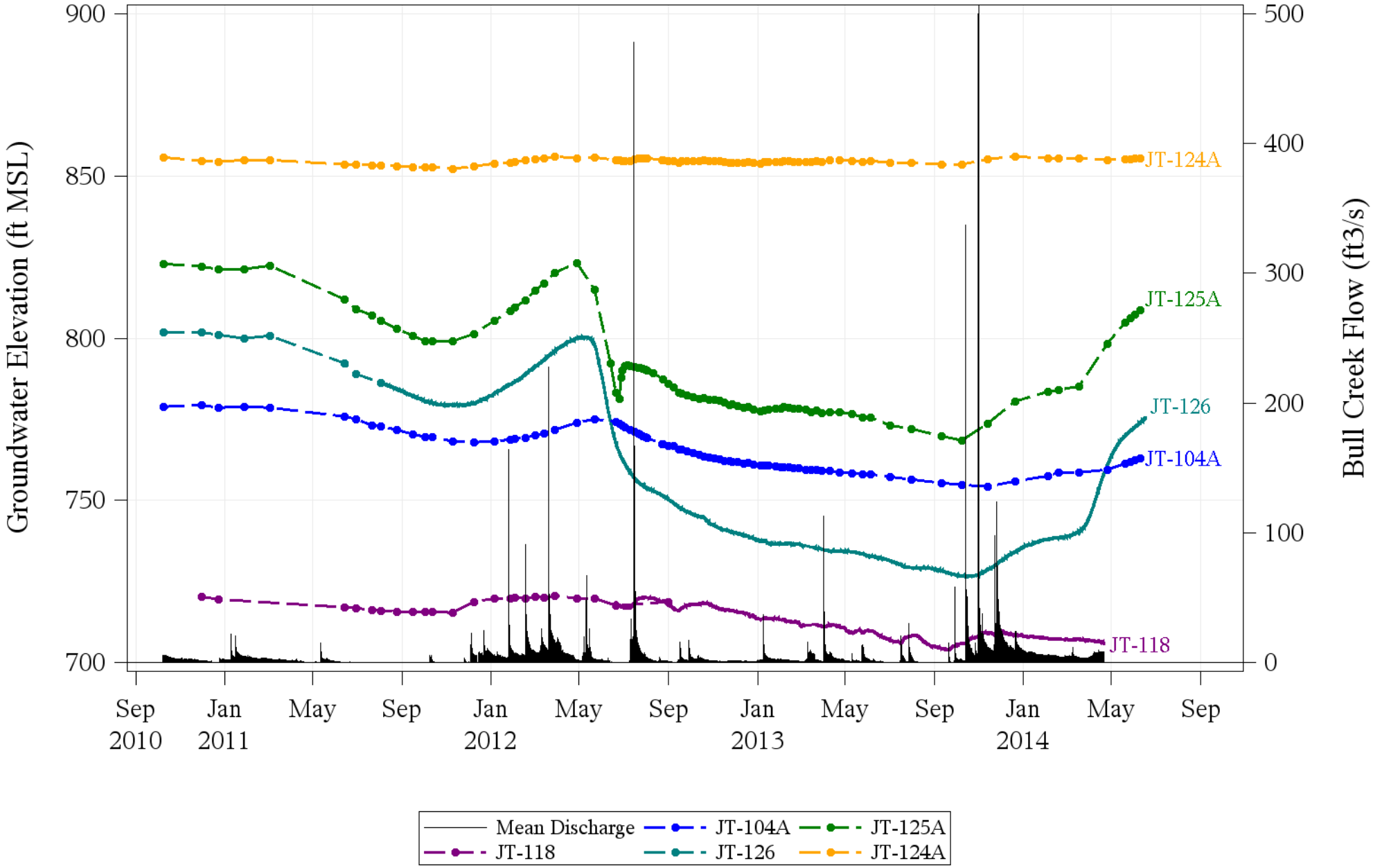


City of Austin DRAFT: QA/QC review pending



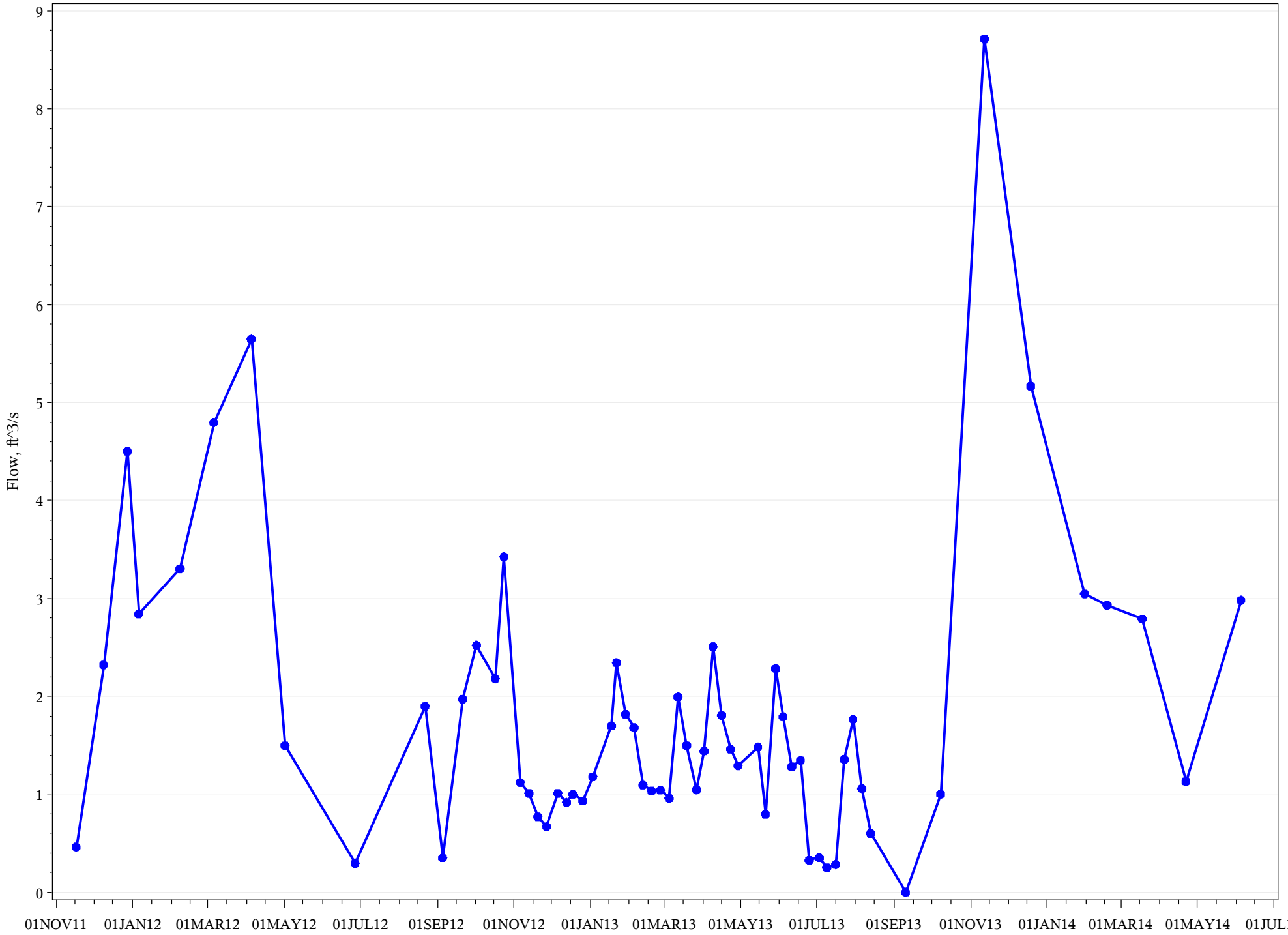
City of Austin DRAFT: QA/QC review pending

Hydrographs for Wells JT-104A, JT-118, JT-124A, JT-125A and JT-126

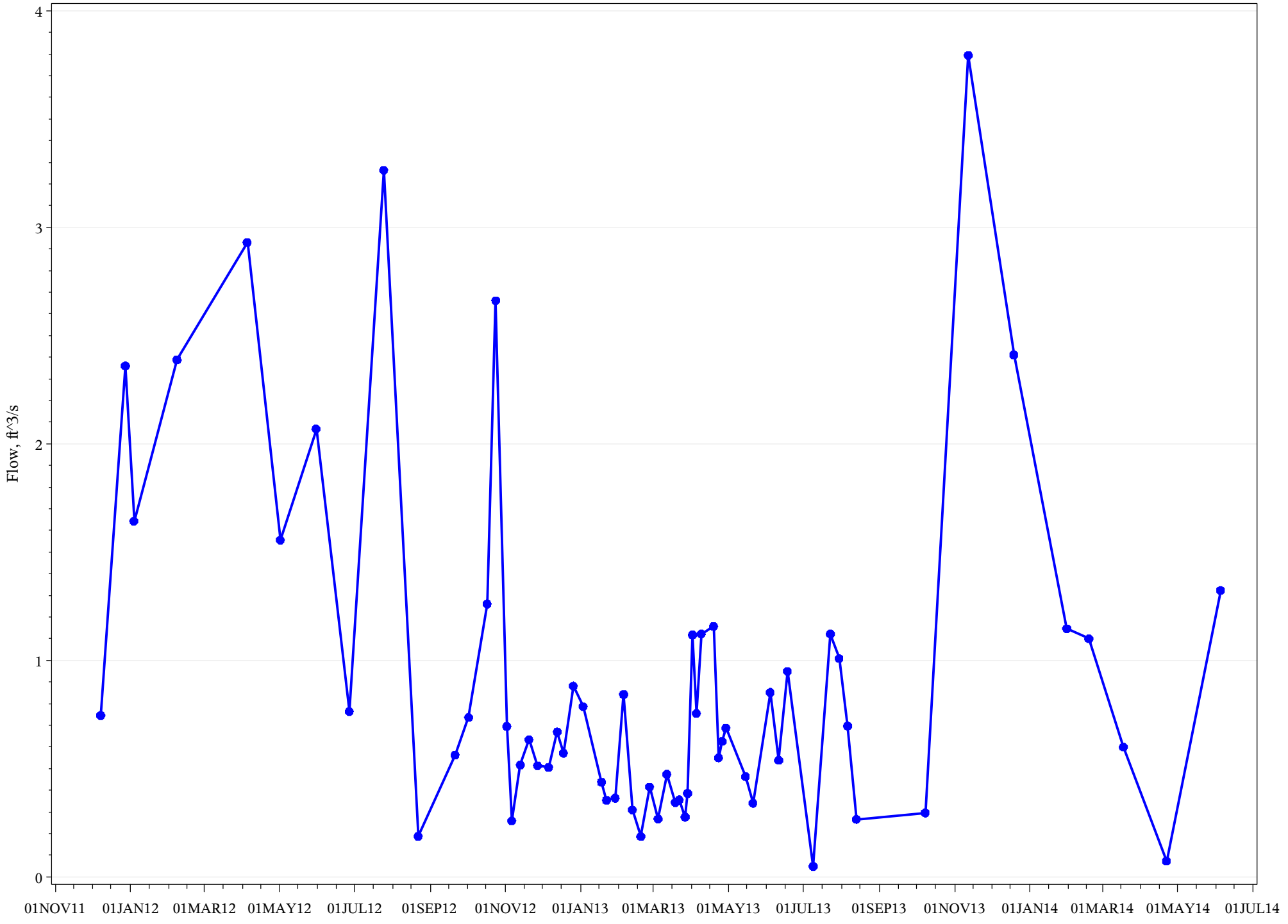


City of Austin DRAFT: QA/QC review pending

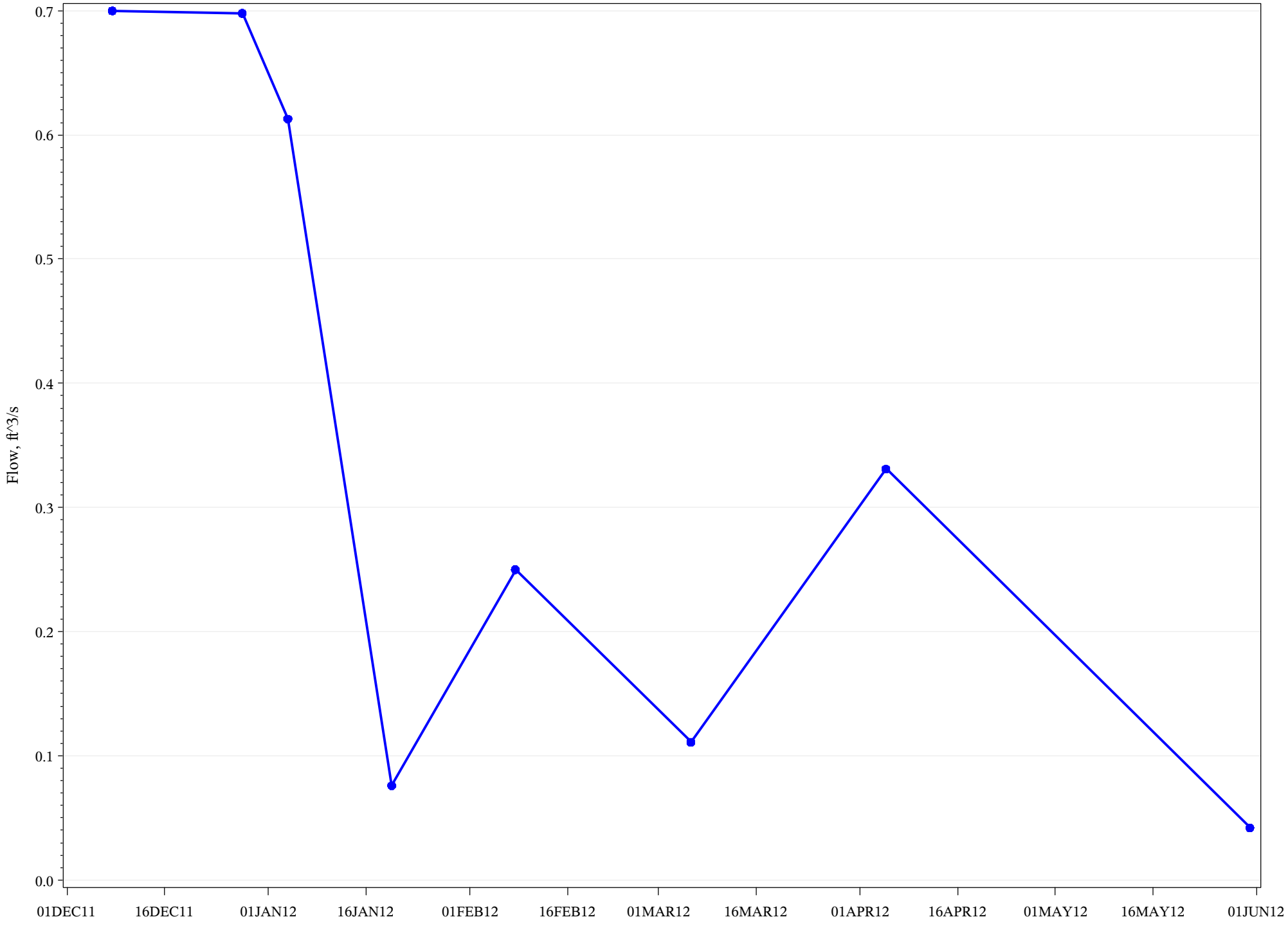
DESCRIPTION=FLOW NAME=Bull Creek @ Spicewood Springs 7th Crossing (TG)



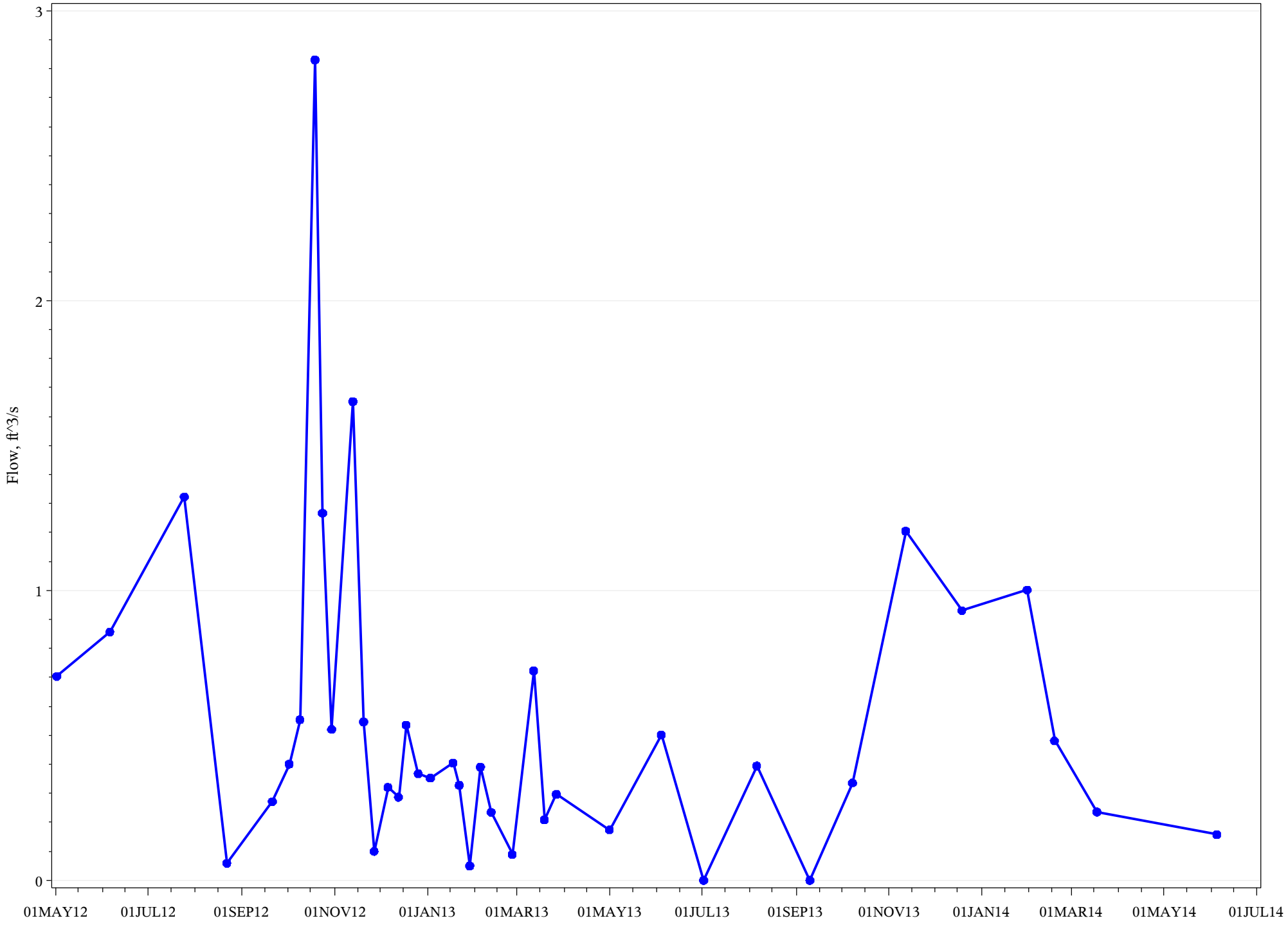
DESCRIPTION=FLOW NAME=Bull Creek @ Tributary 7 [aqua troll]



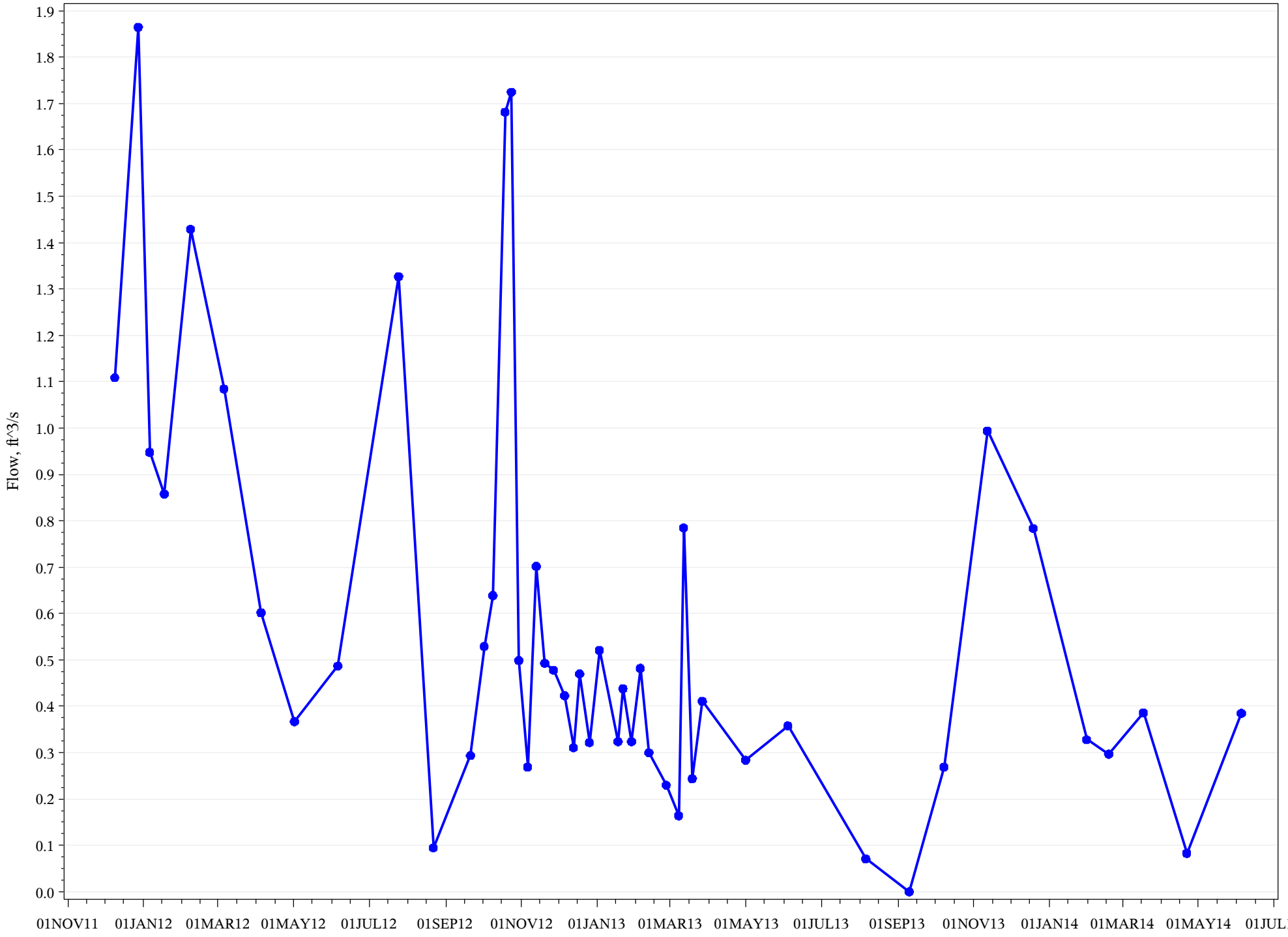
DESCRIPTION=FLOW NAME=Bull Creek Above WTP4



DESCRIPTION=FLOW NAME=Bull Creek Trib 4 upstream Spicewood Springs Road



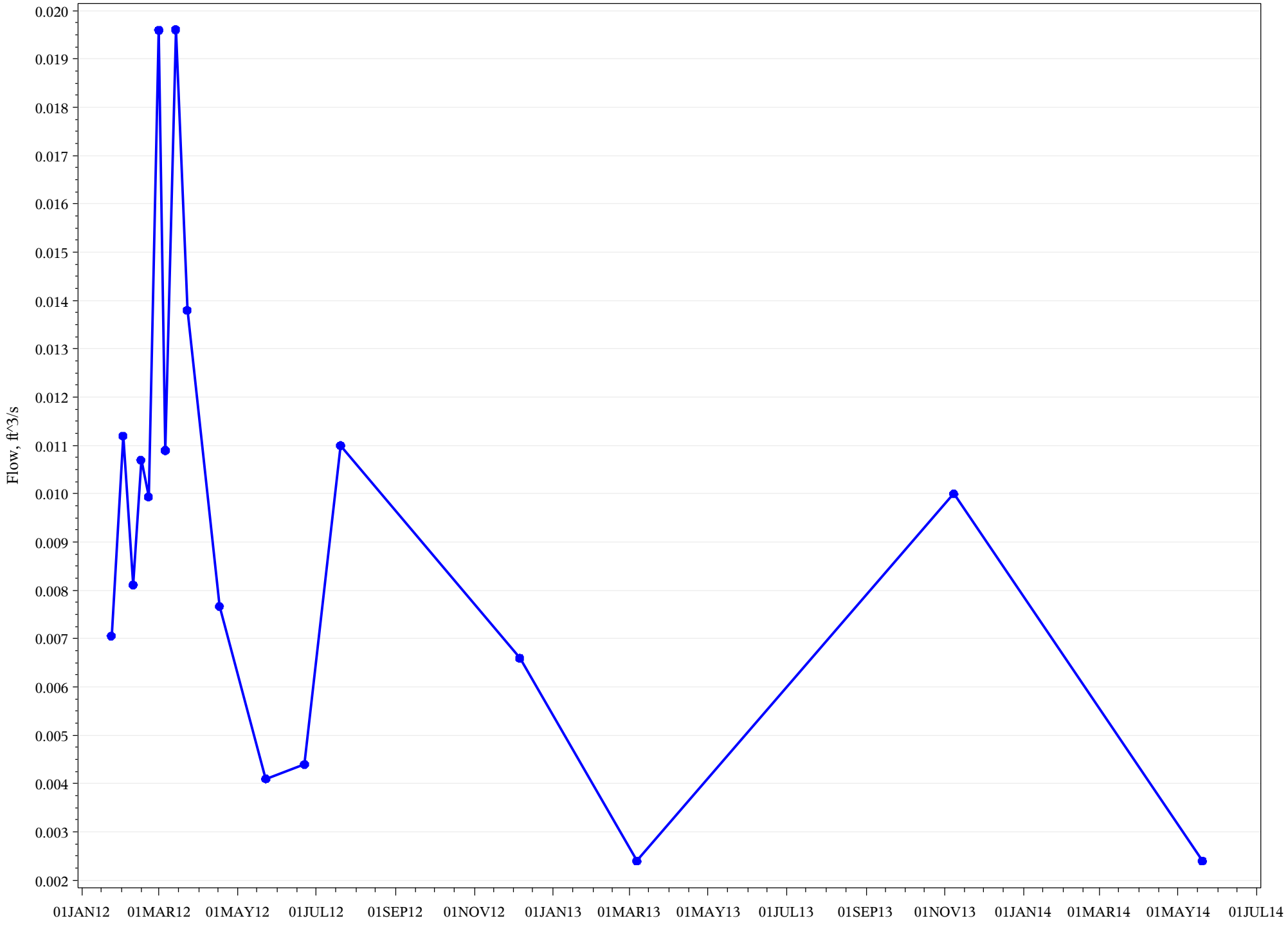
DESCRIPTION=FLOW NAME=Bull Creek Tributary 4 Downstream Spicewood Shaft



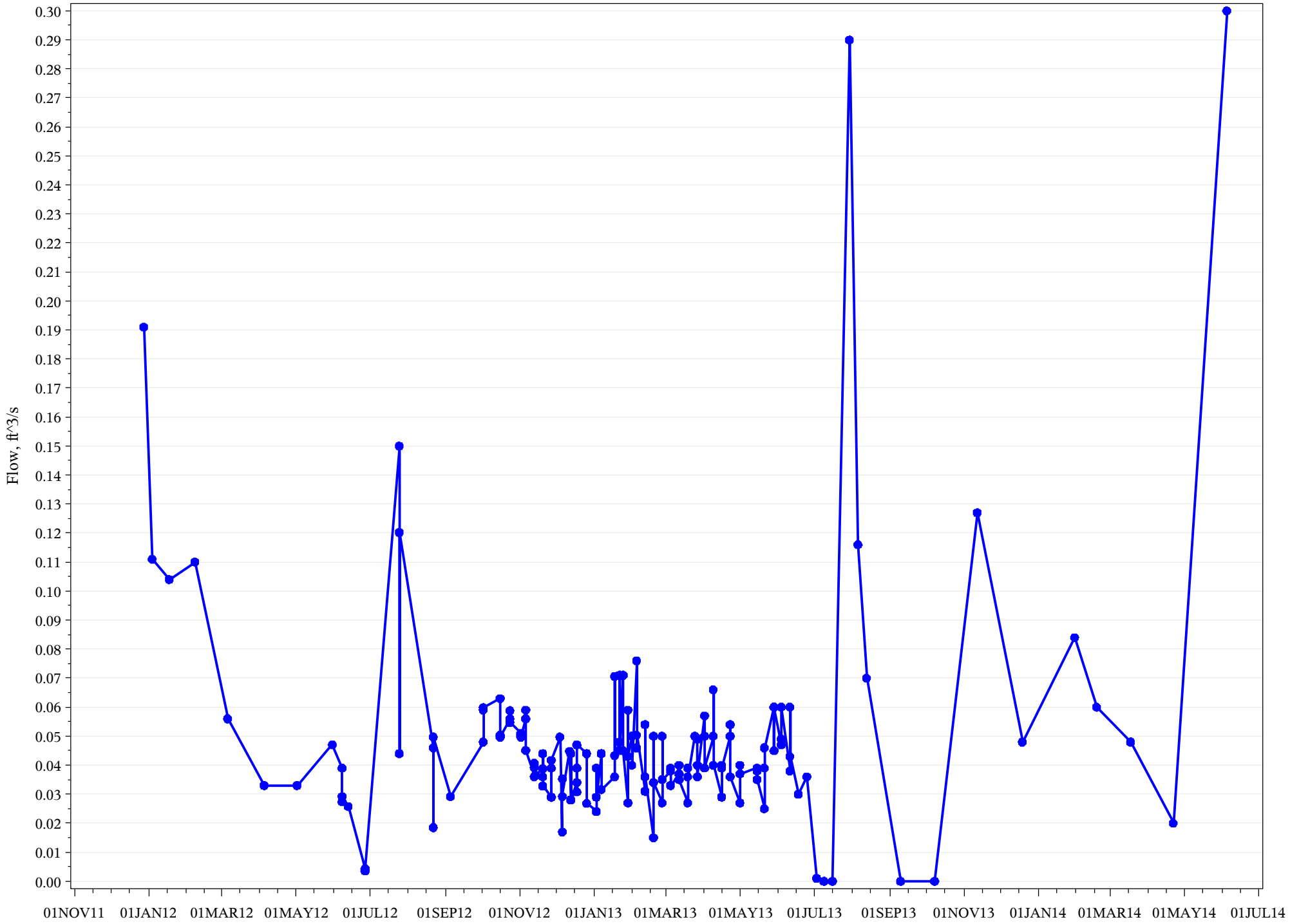
DESCRIPTION=FLOW NAME=Bull Creek Tributary 4 Upstream Spicewood Shaft



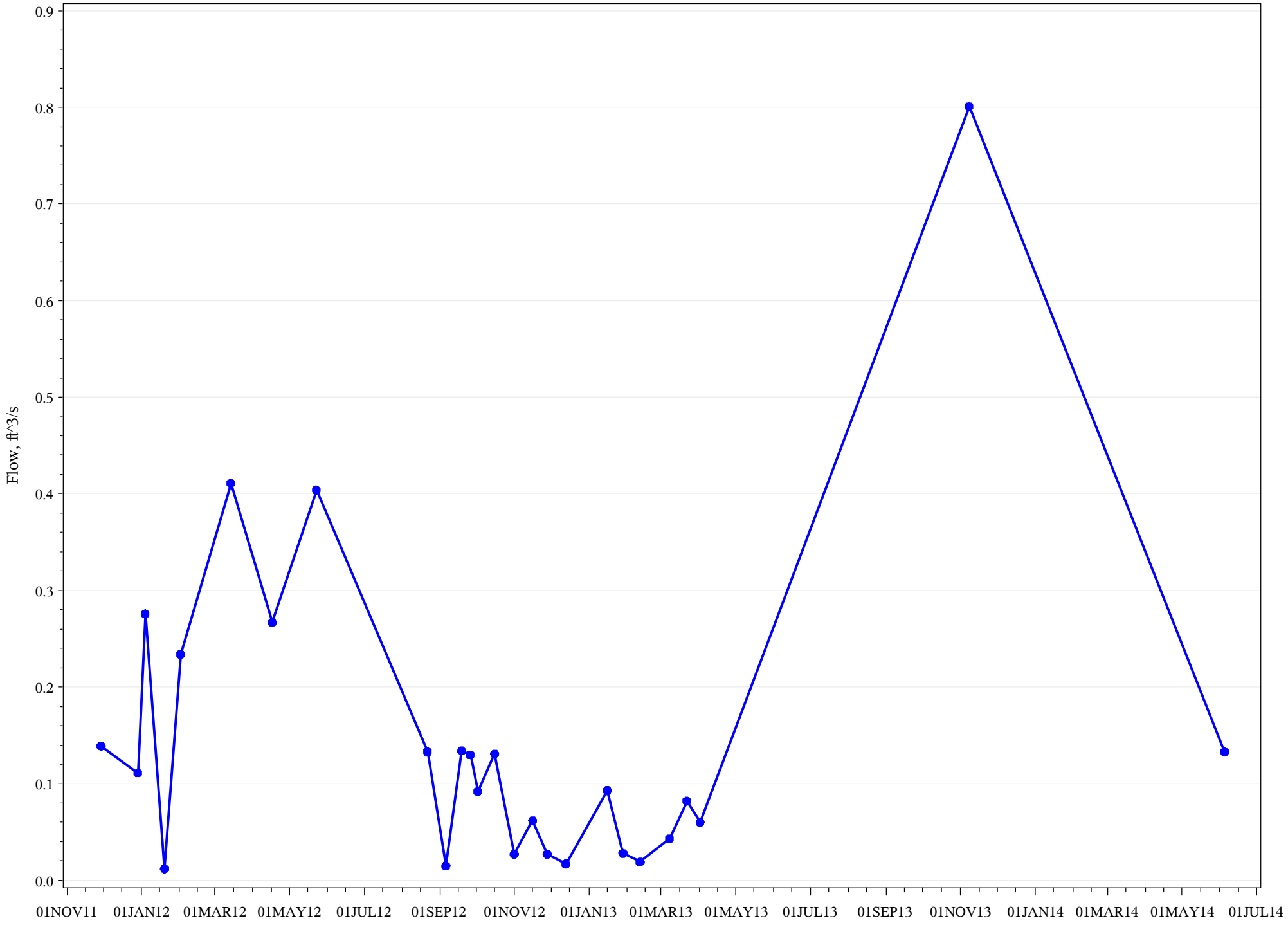
DESCRIPTION=FLOW NAME=Gaas Spring



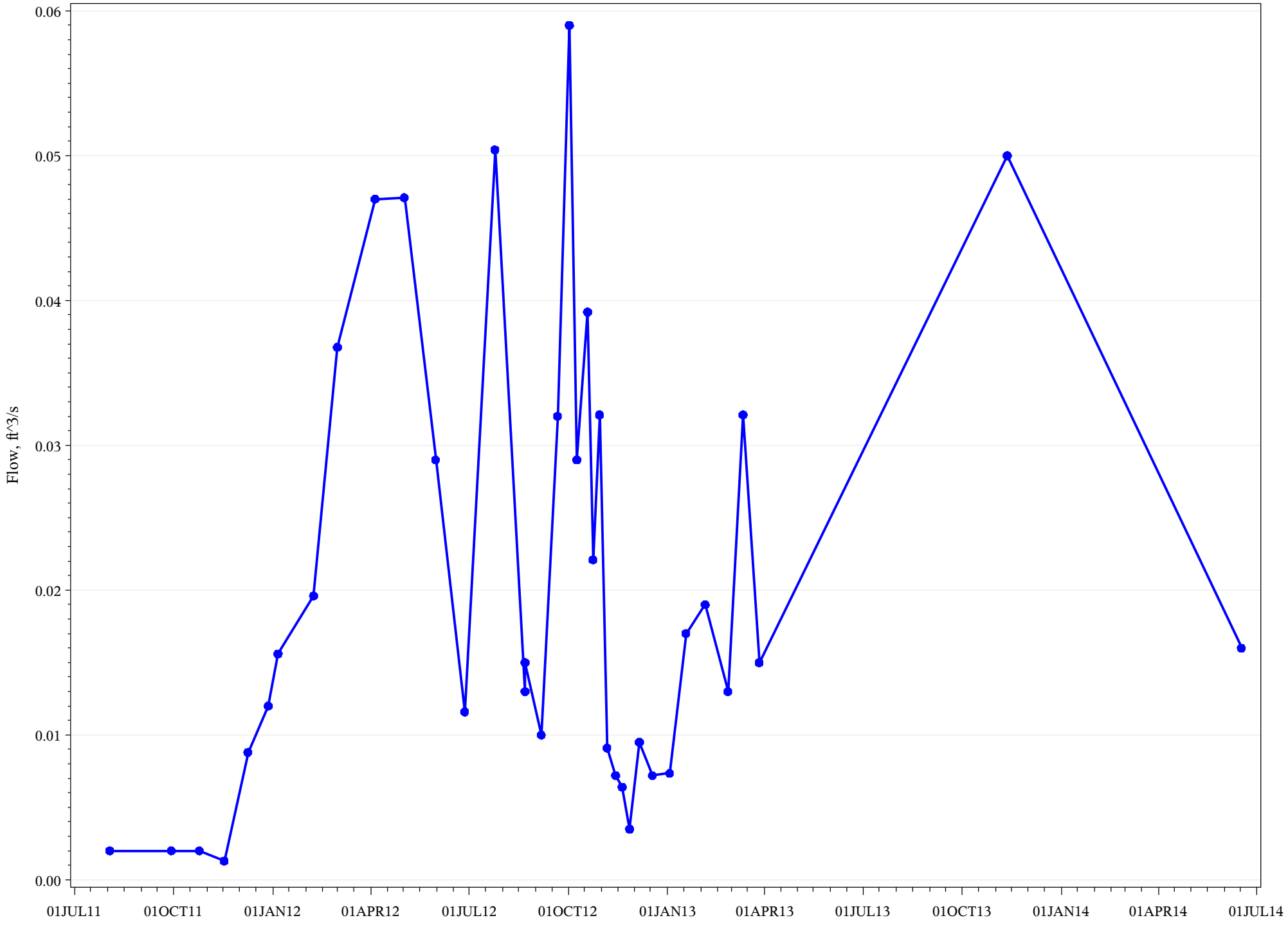
DESCRIPTION=FLOW NAME=Lanier Spring

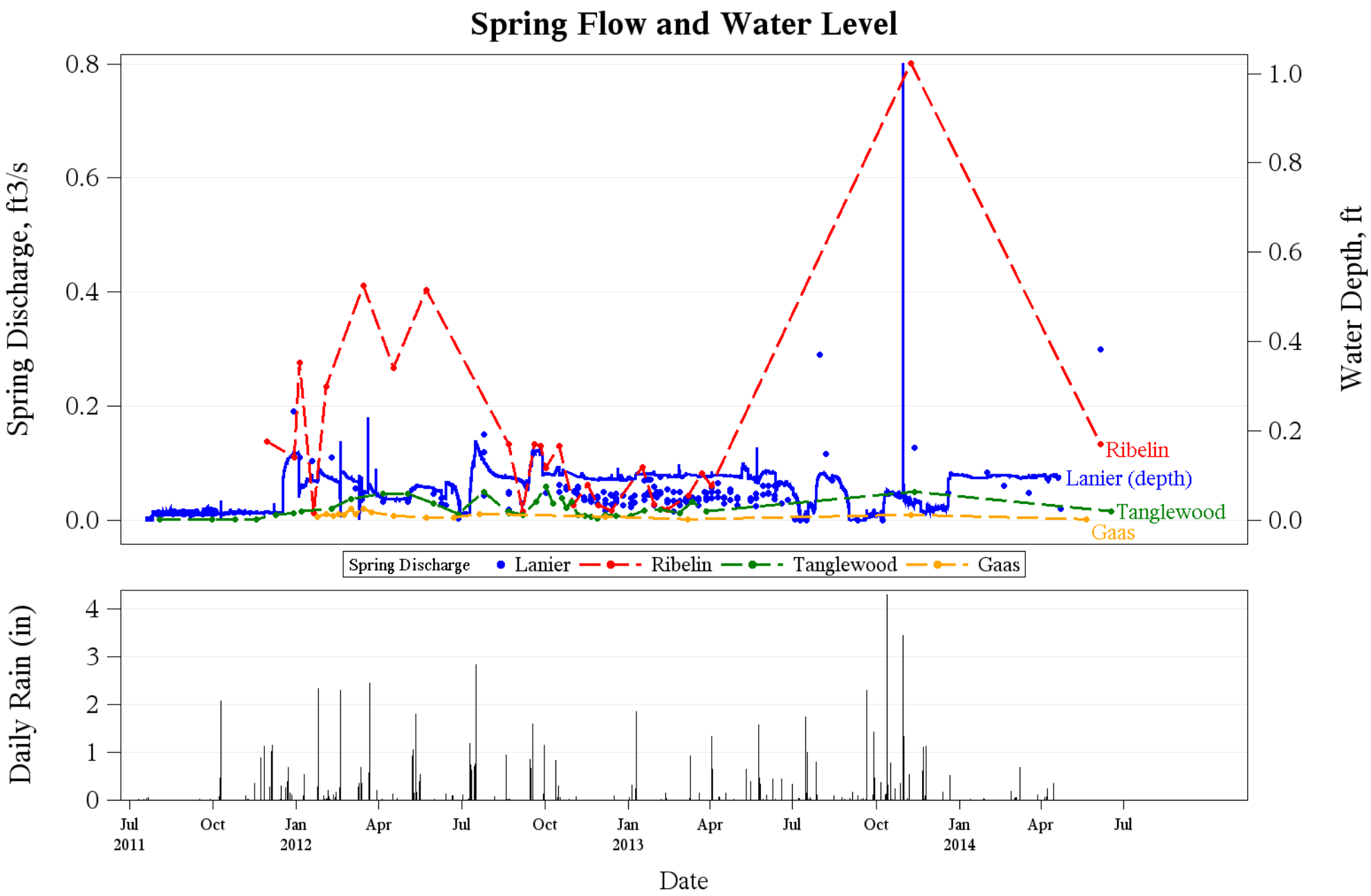


DESCRIPTION=FLOW NAME=Ribelin Spring 2 (Lower Ribelin)

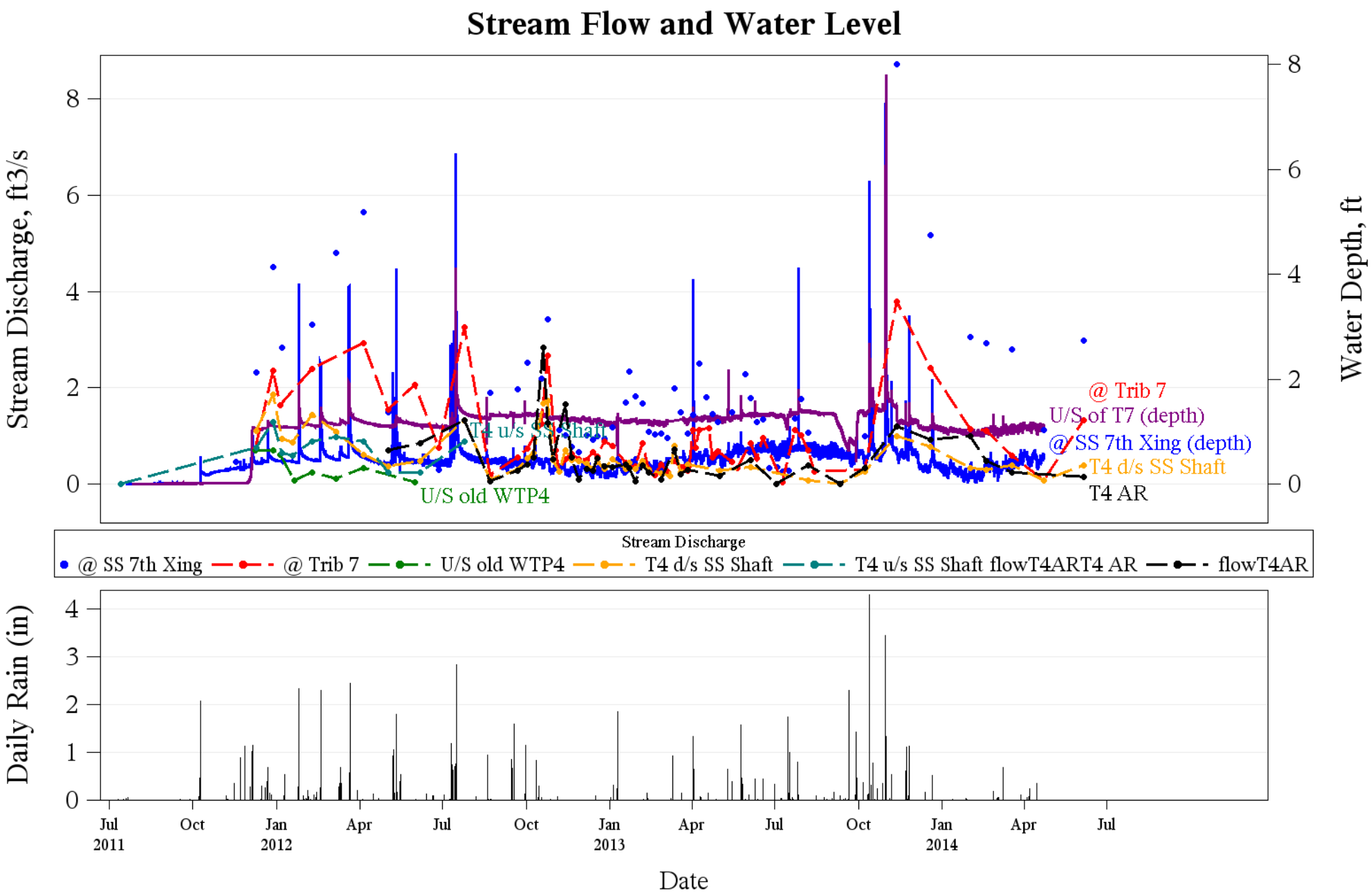


DESCRIPTION=FLOW NAME=Tanglewood Spring

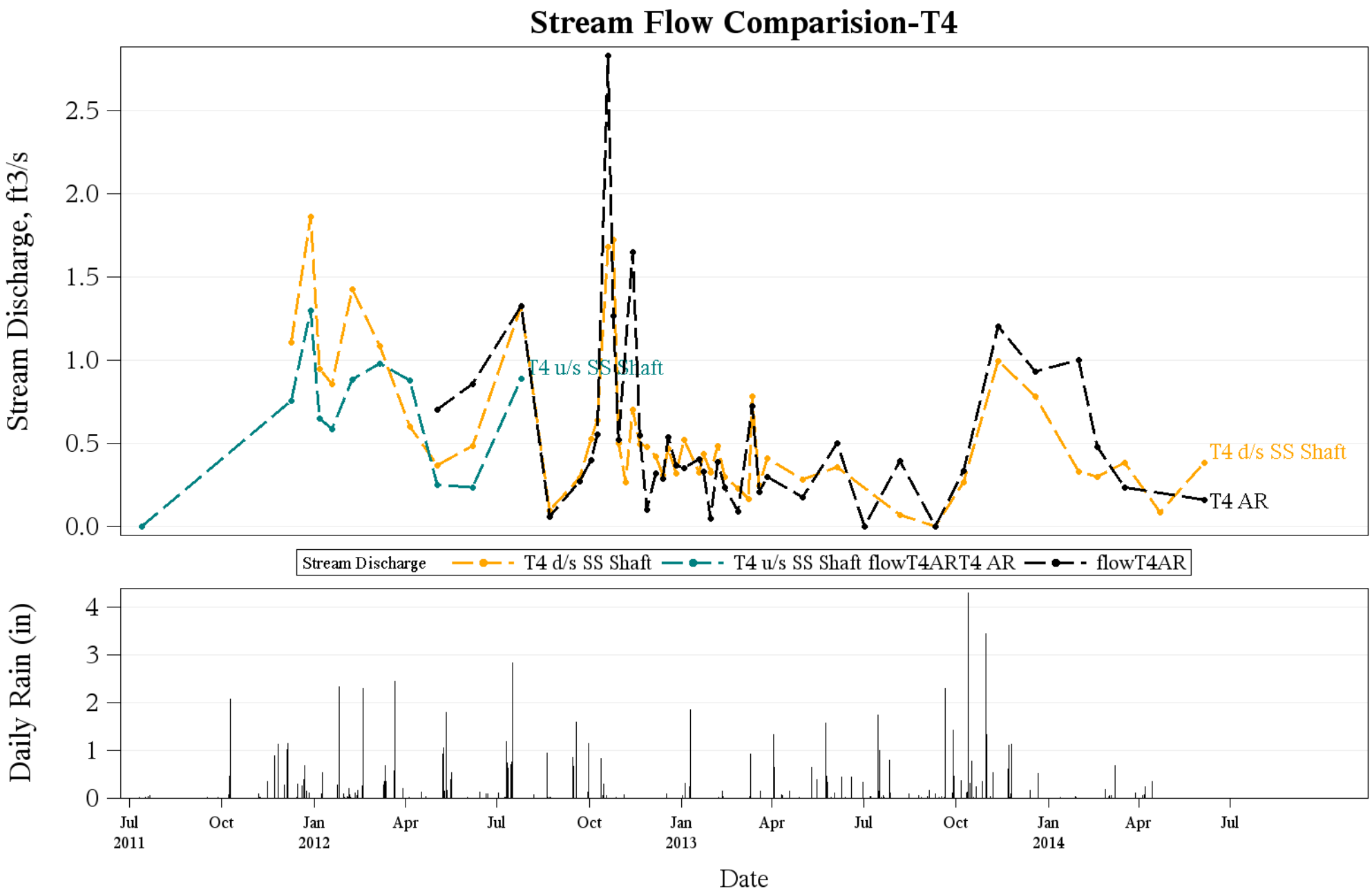




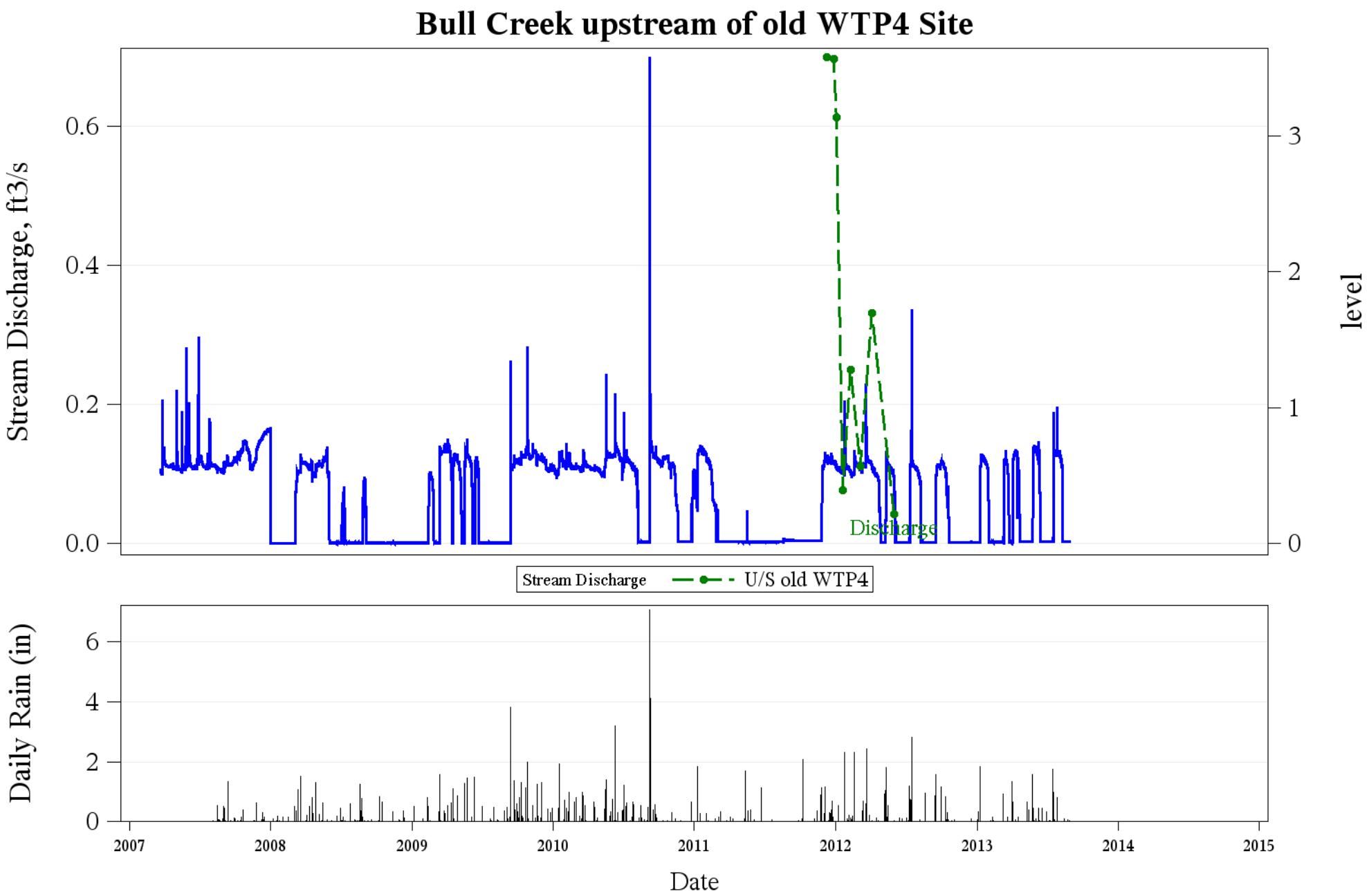
City of Austin DRAFT: QA/QC review pending



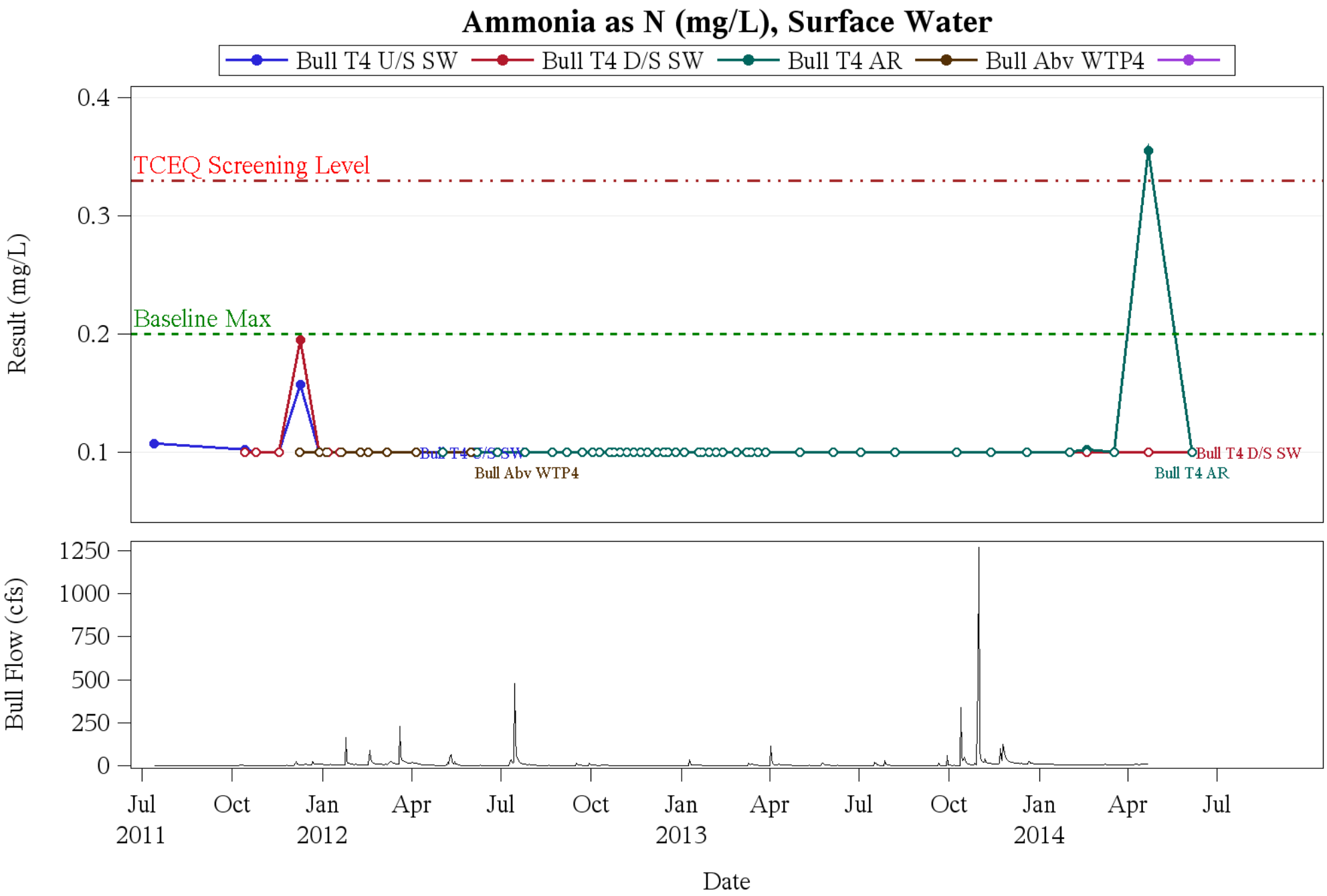
City of Austin DRAFT: QA/QC review pending

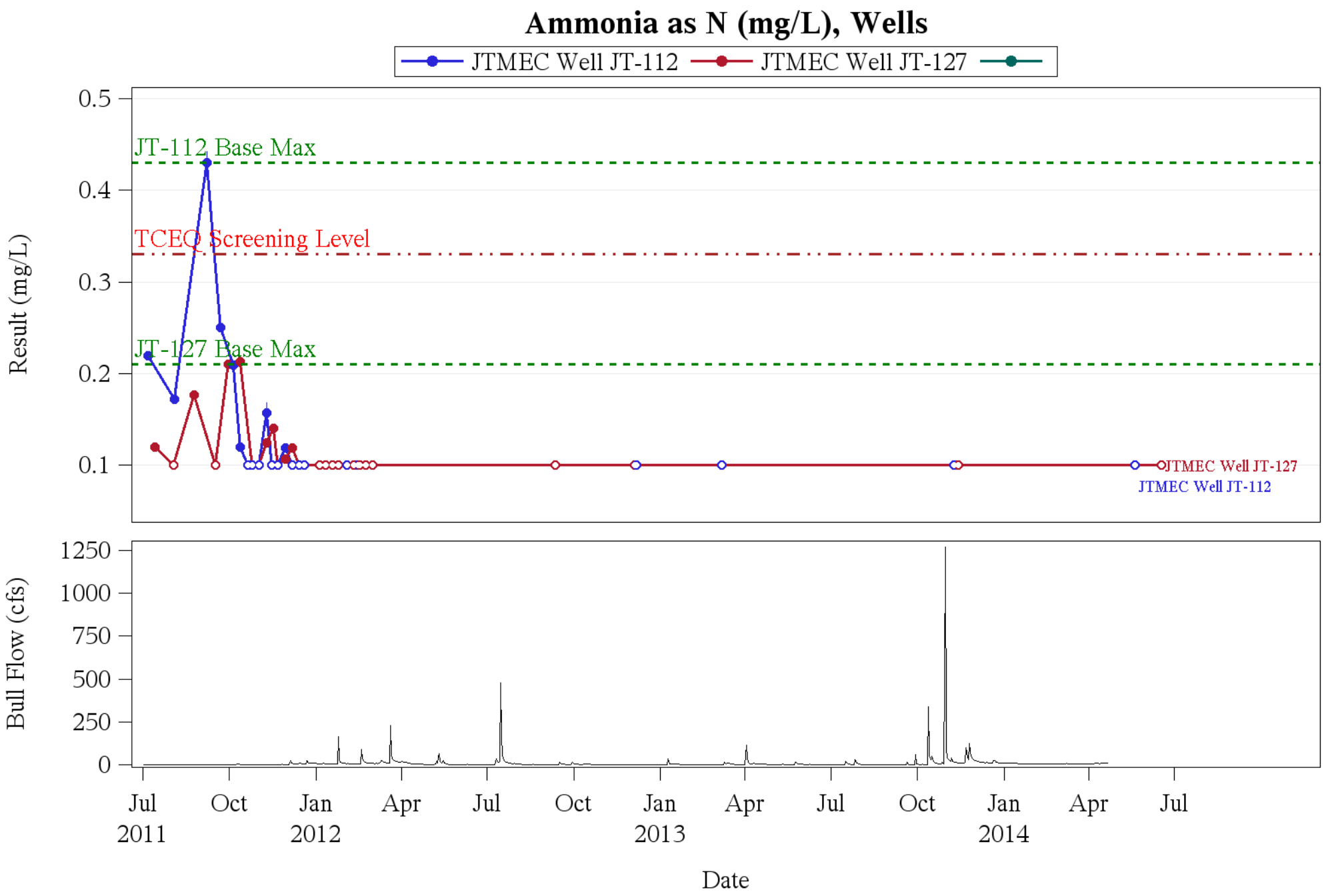


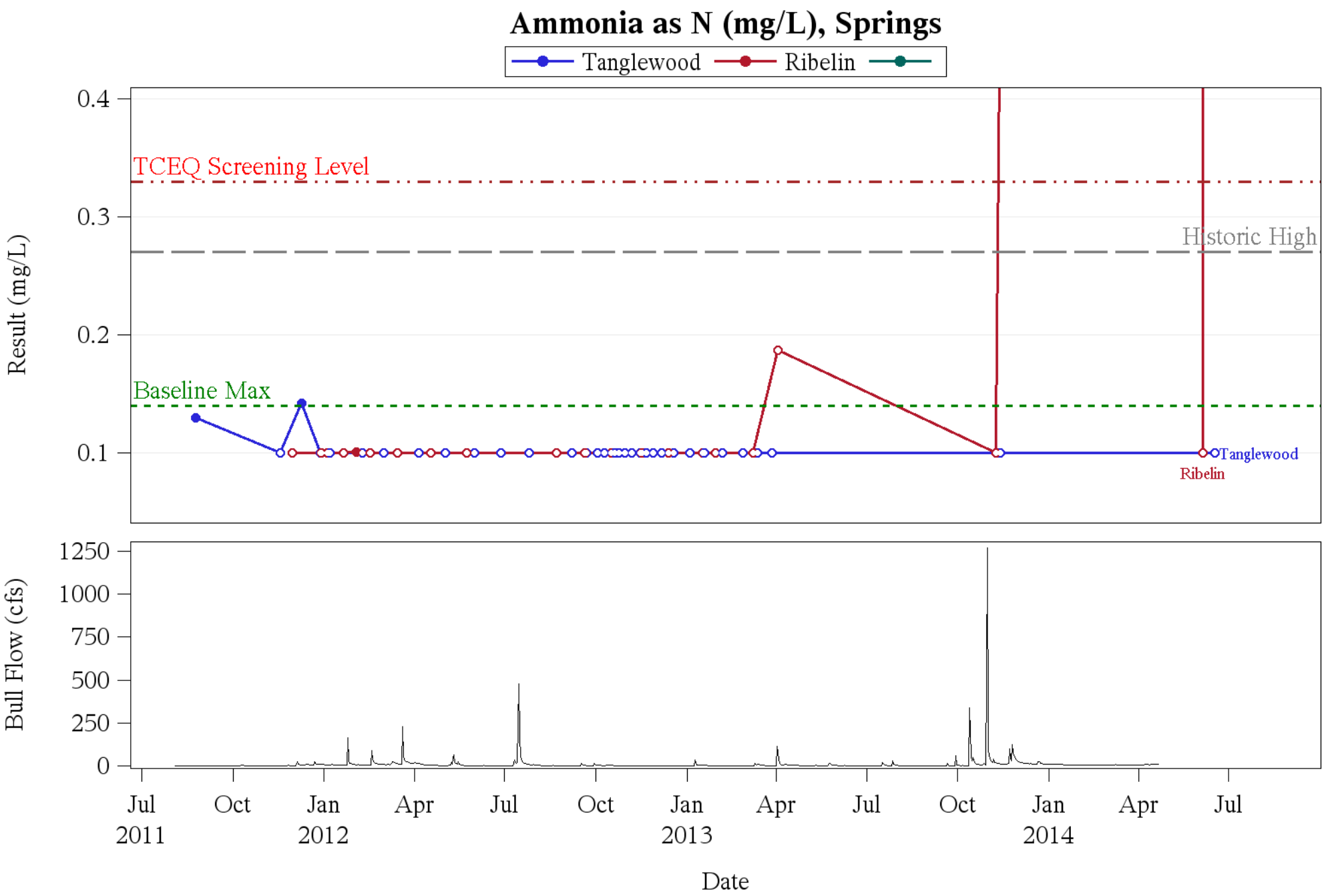
City of Austin DRAFT: QA/QC review pending

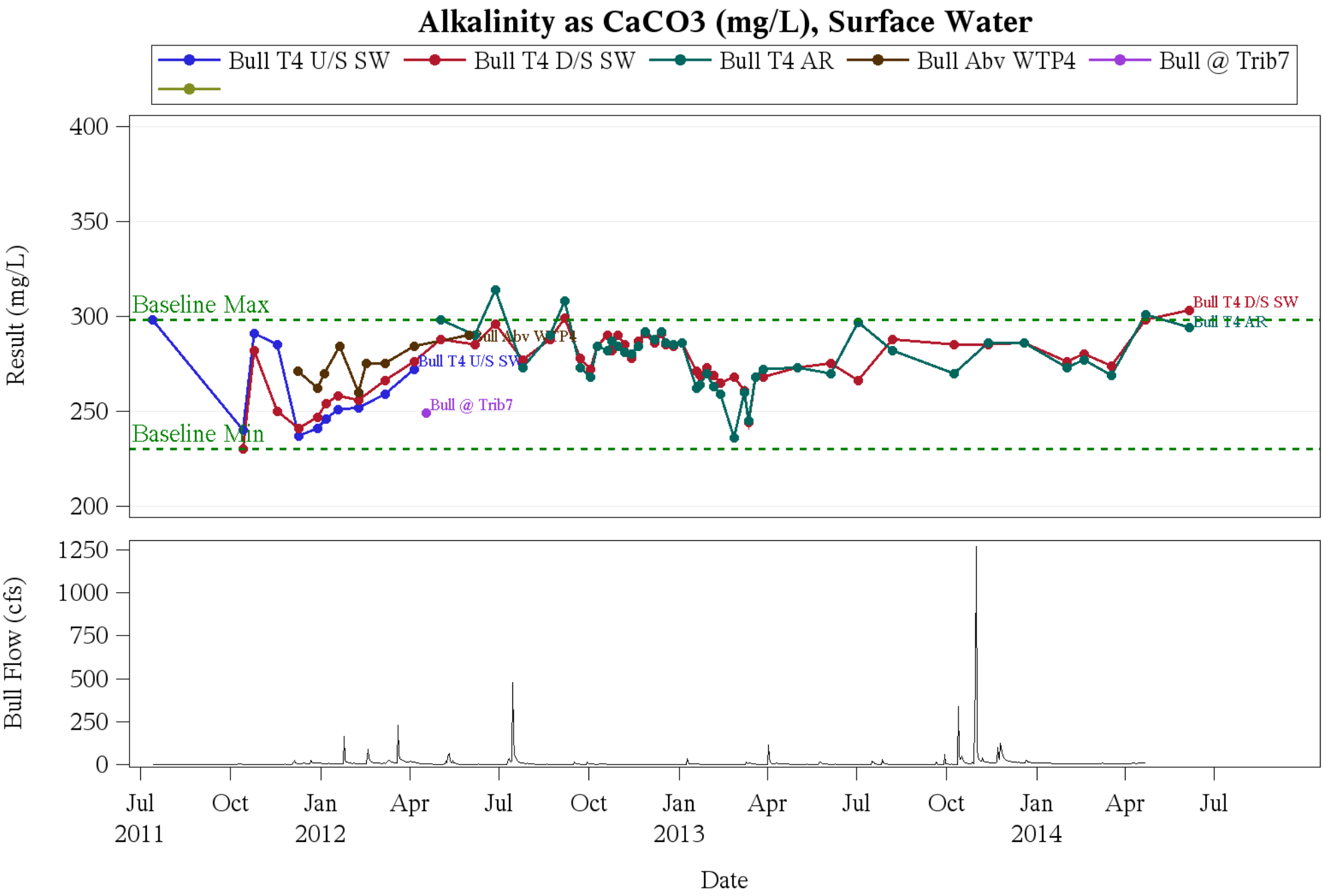


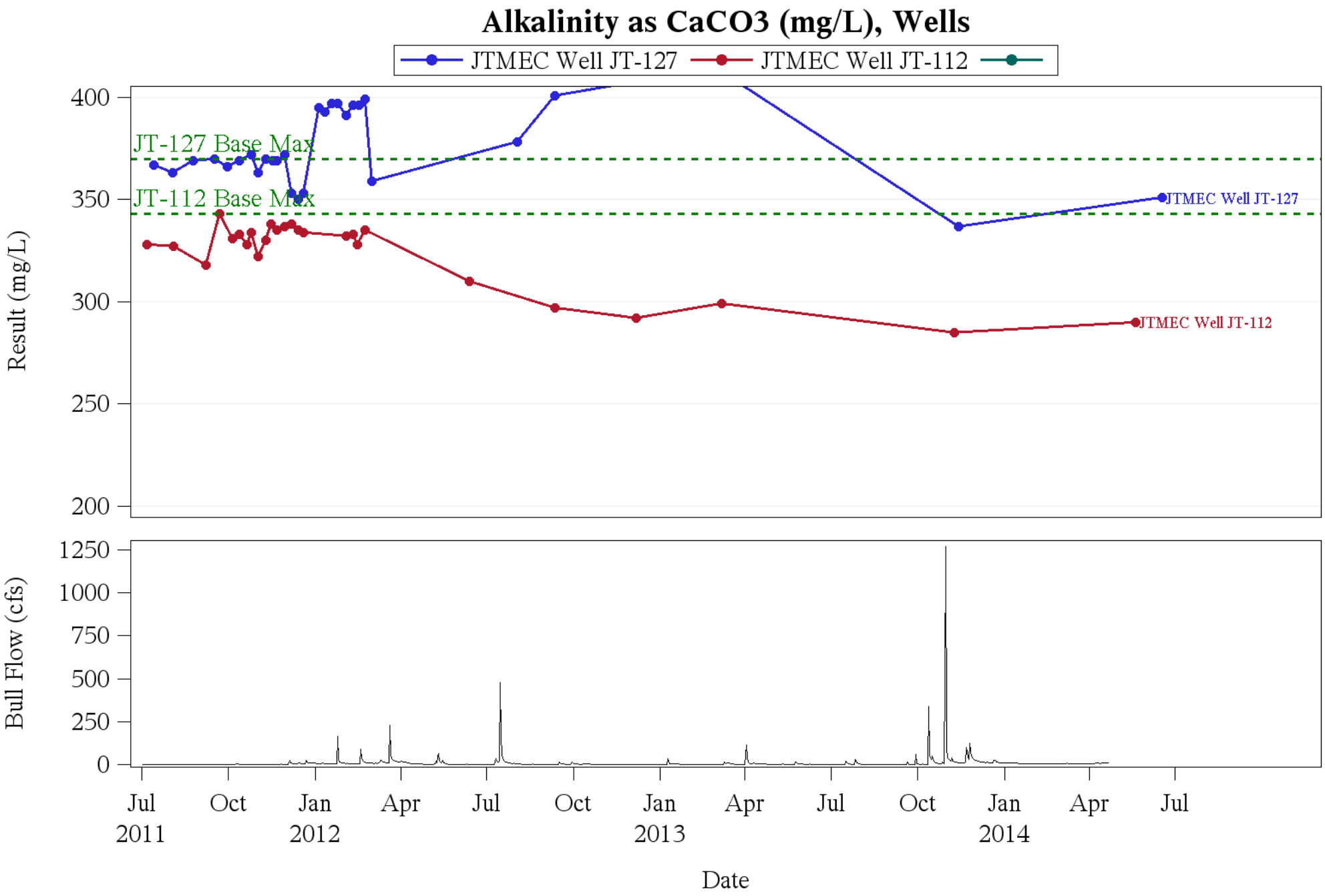
City of Austin DRAFT: QA/QC review pending

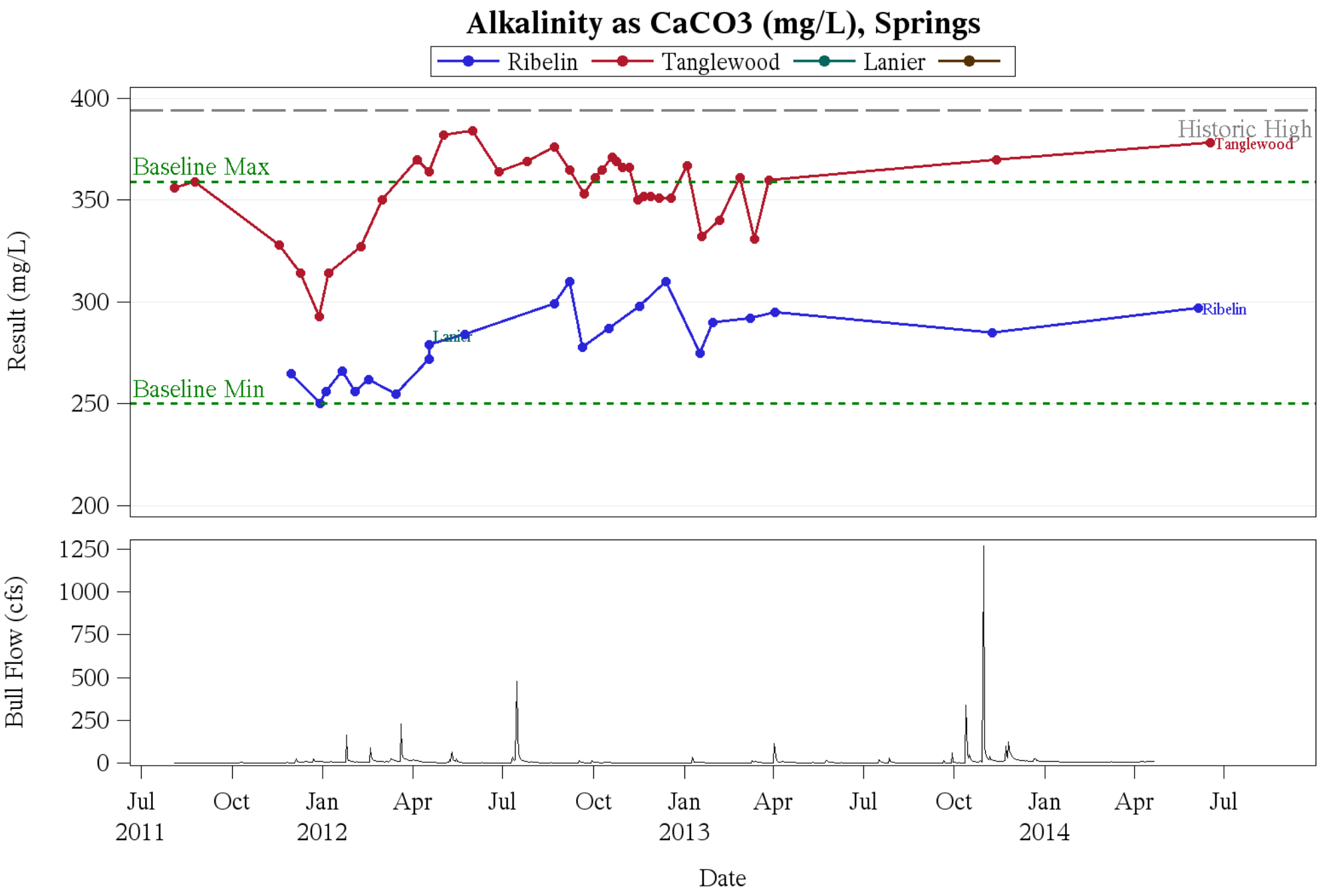

Ammonia as N (mg/L), Surface Water
Bull T4 U/S SW
Bull T4 D/S SW
Bull T4 AR
Bull Abv WTP4
0.4
0.3
0.2
0.1
TCEQ Screening Level
Baseline Max
Result (mg/L)
Bull T4 U/S SW
Bull Abv WTP4
Bull T4 D/S SW
Bull T4 AR
1250
1000
750
500
250
0
Bull Flow (cfs)
Jul
2011
Oct
Jan
2012
Apr
Jul
Oct
Jan
2013
Apr
Jul
Oct
Jan
2014
Apr
Jul
Date

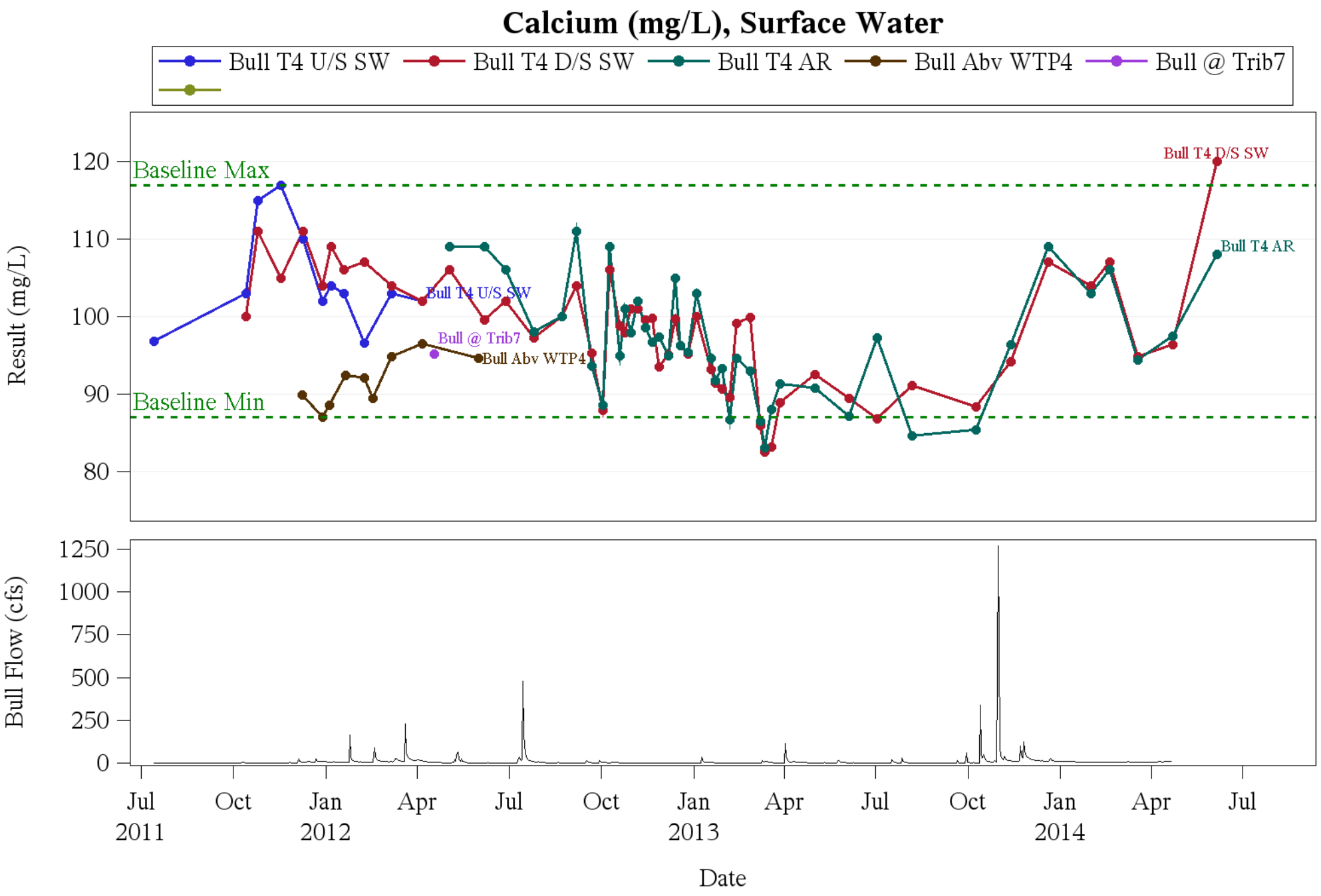

Ammonia as N (mg/L), Wells
JTMEC Well JT-112
JTMEC Well JT-127
Result (mg/L)
0.5
0.4
0.3
0.2
0.1
JT-112 Base Max
TCEQ Screening Level
JT-127 Base Max
JTMEC Well JT-127
JTMEC Well JT-112
Bull Flow (cfs)
1250
1000
750
500
250
0
Jul 2011
Oct
Jan 2012
Apr
Jul
Oct
Jan 2013
Apr
Jul
Oct
Jan 2014
Apr
Jul
Date

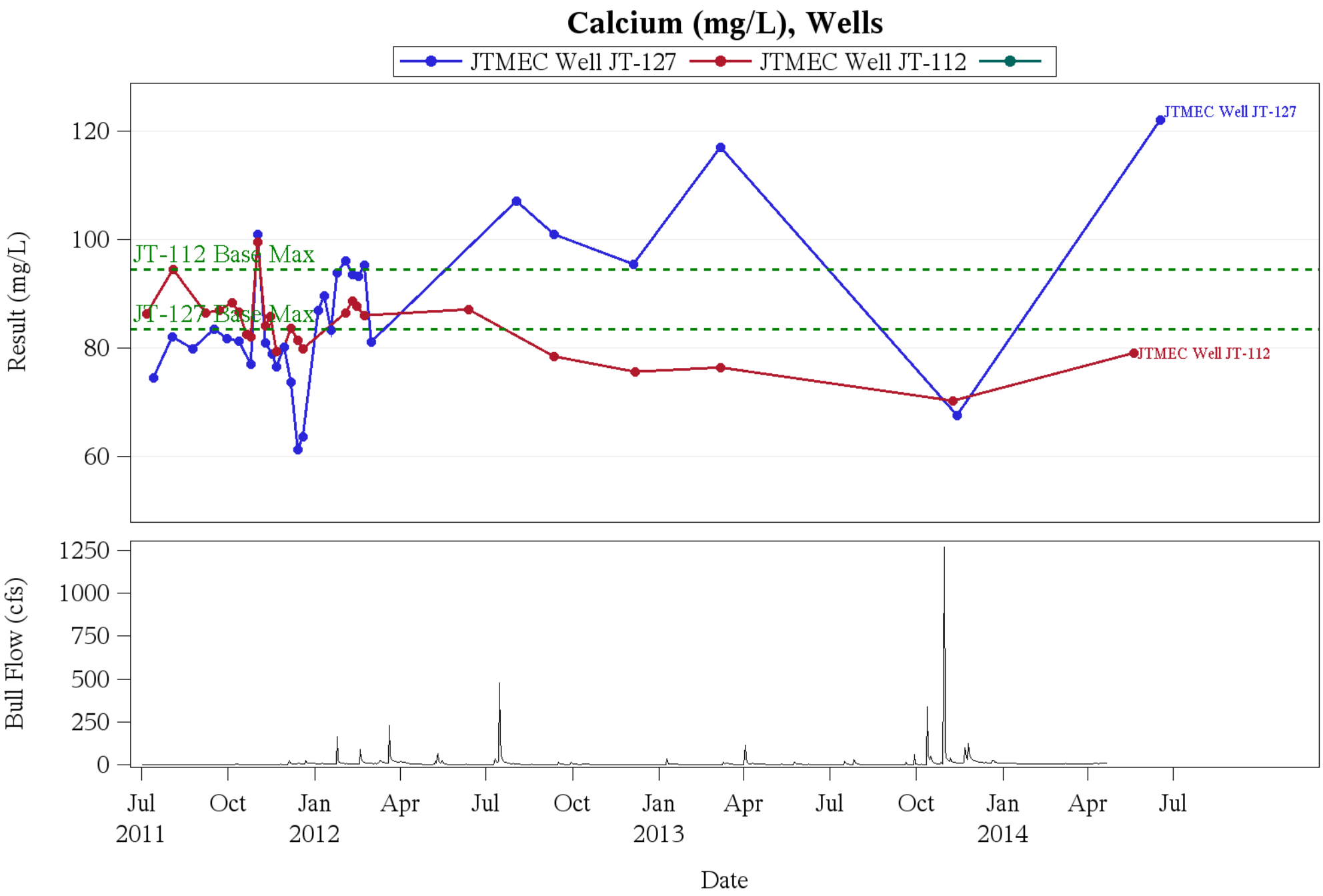

Ammonia as N (mg/L), Springs
Tanglewood
Ribelin
0.4
0.3
0.2
0.1
TCEQ Screening Level
Historic High
Baseline Max
Result (mg/L)
Tanglewood
Ribelin
1250
1000
750
500
250
0
Bull Flow (cfs)
Jul
2011
Oct
Jan
2012
Apr
Jul
Oct
Jan
2013
Apr
Jul
Oct
Jan
2014
Apr
Jul
Date

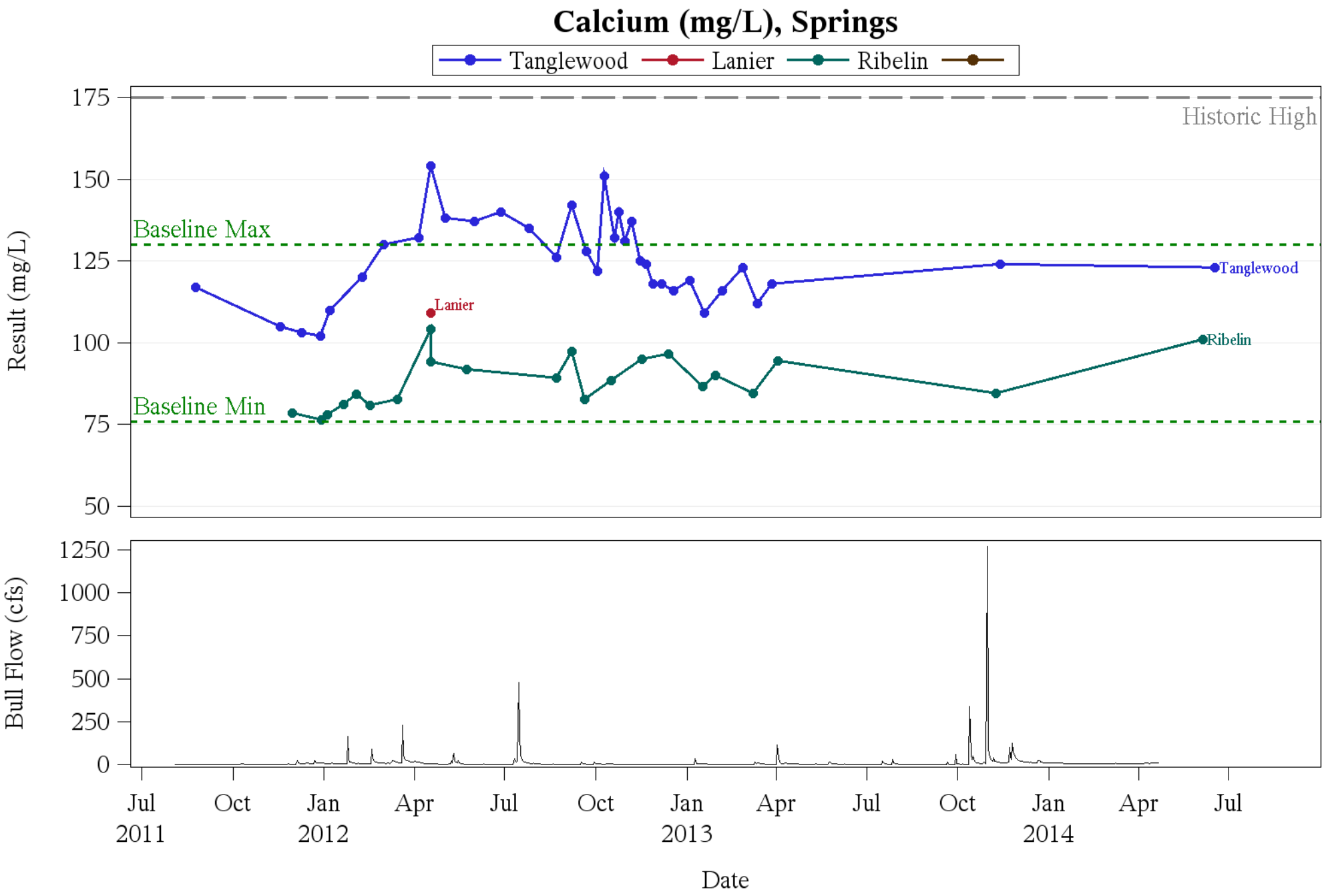

Alkalinity as CaCO3 (mg/L), Surface Water
Bull T4 U/S SW
Bull T4 D/S SW
Bull T4 AR
Bull Abv WTP4
Bull @ Trib7
Result (mg/L)
400
350
300
250
200
Baseline Max
Baseline Min
Bull T4 D/S SW
Bull T4 AR
Bull Abv WTP4
Bull T4 U/S SW
Bull @ Trib7
Bull Flow (cfs)
1250
1000
750
500
250
0
Jul
2011
Oct
Jan
2012
Apr
Jul
Oct
Jan
2013
Apr
Jul
Oct
Jan
2014
Apr
Jul
Date

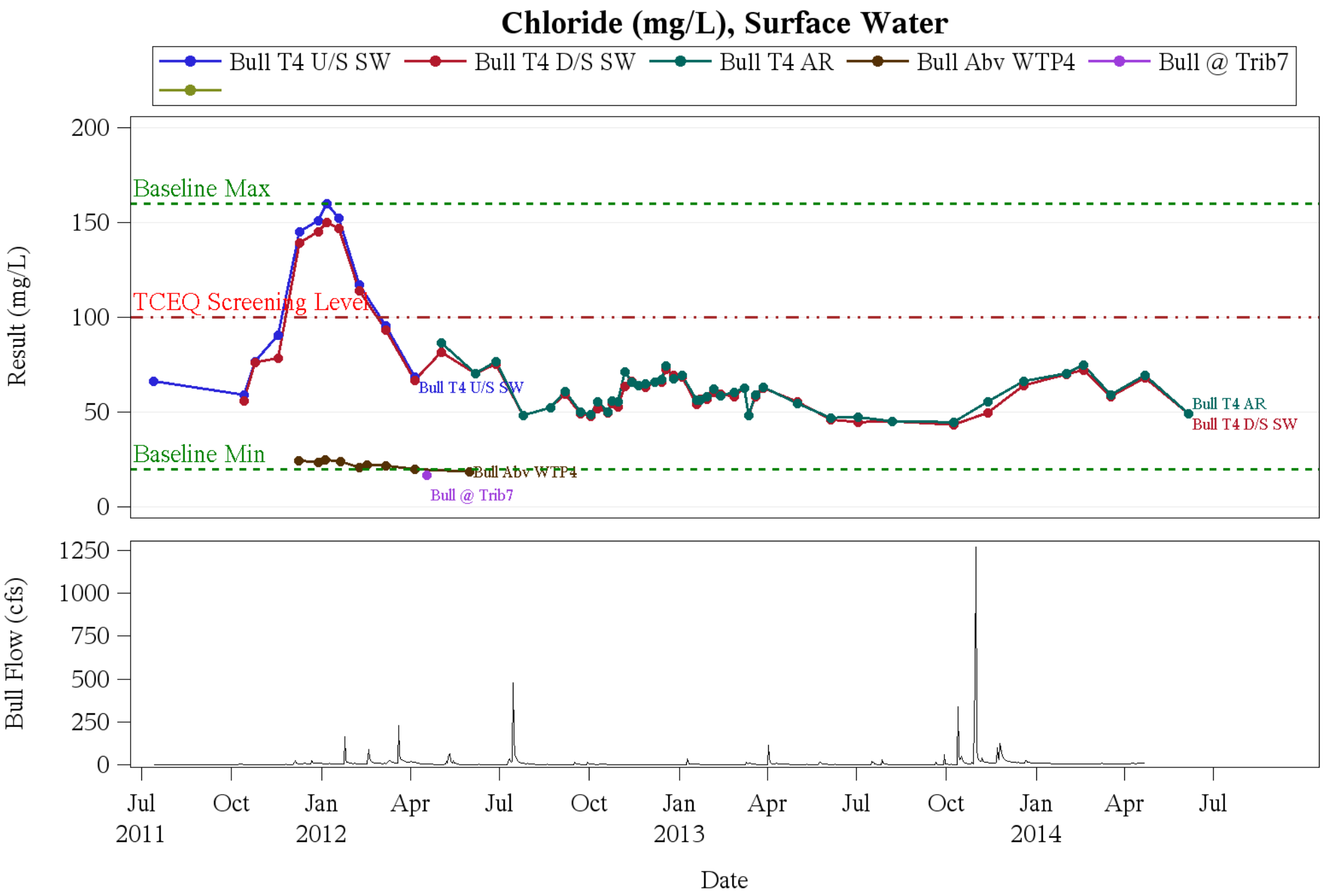

Alkalinity as CaCO3 (mg/L), Wells
JTMEC Well JT-127
JTMEC Well JT-112
JT-127 Base Max
JT-112 Base Max
JTMEC Well JT-127
JTMEC Well JT-112
Result (mg/L)
400
350
300
250
200
Bull Flow (cfs)
1250
1000
750
500
250
0
Jul 2011
Oct
Jan 2012
Apr
Jul
Oct
Jan 2013
Apr
Jul
Oct
Jan 2014
Apr
Jul
Date

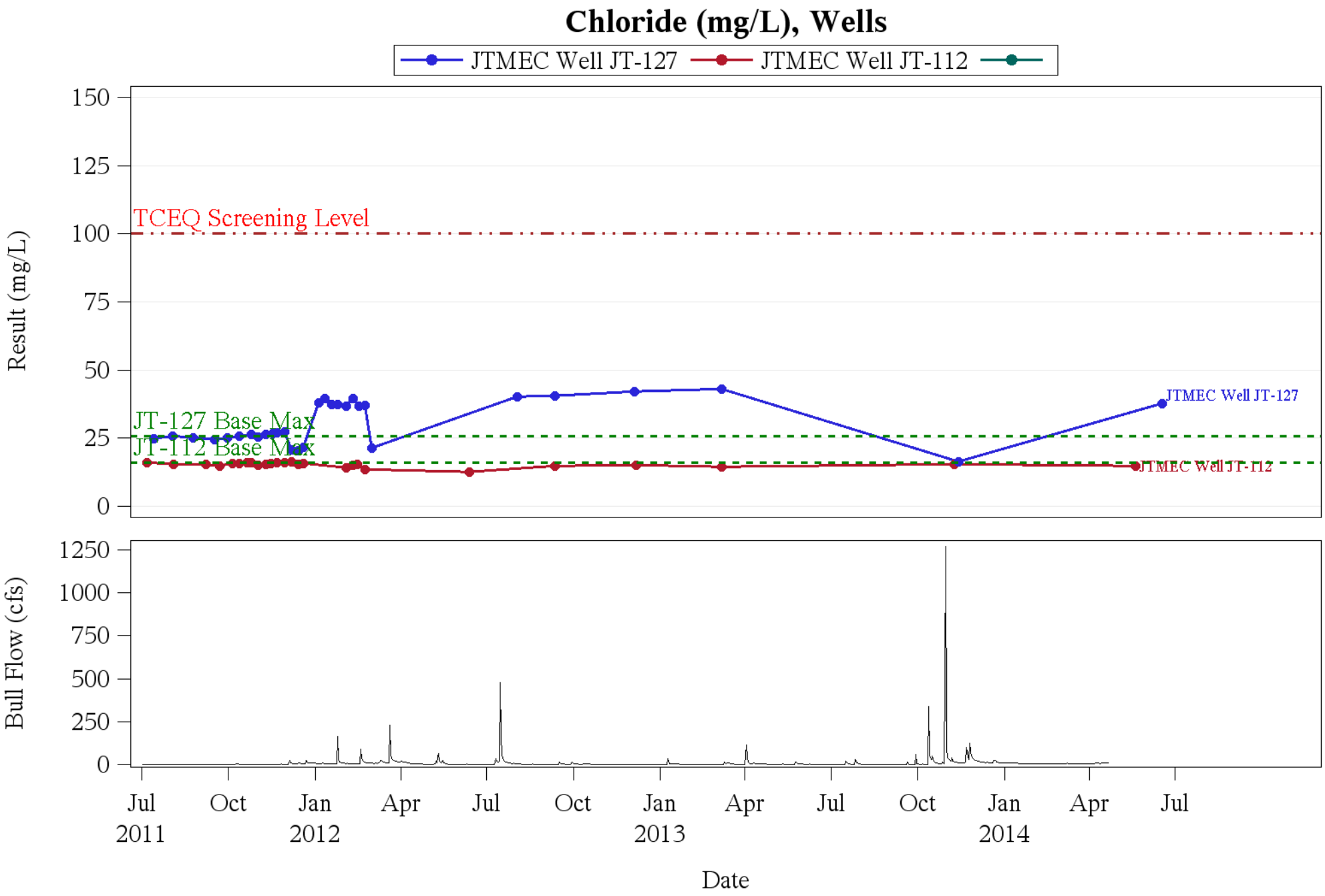

Alkalinity as CaCO3 (mg/L), Springs
Ribelin
Tanglewood
Lanier
Result (mg/L)
400
350
300
250
200
Historic High
Tanglewood
Baseline Max
Baseline Min
Lanier
Ribelin
Bull Flow (cfs)
1250
1000
750
500
250
0
Jul
2011
Oct
Jan
2012
Apr
Jul
Oct
Jan
2013
Apr
Jul
Oct
Jan
2014
Apr
Jul
Date

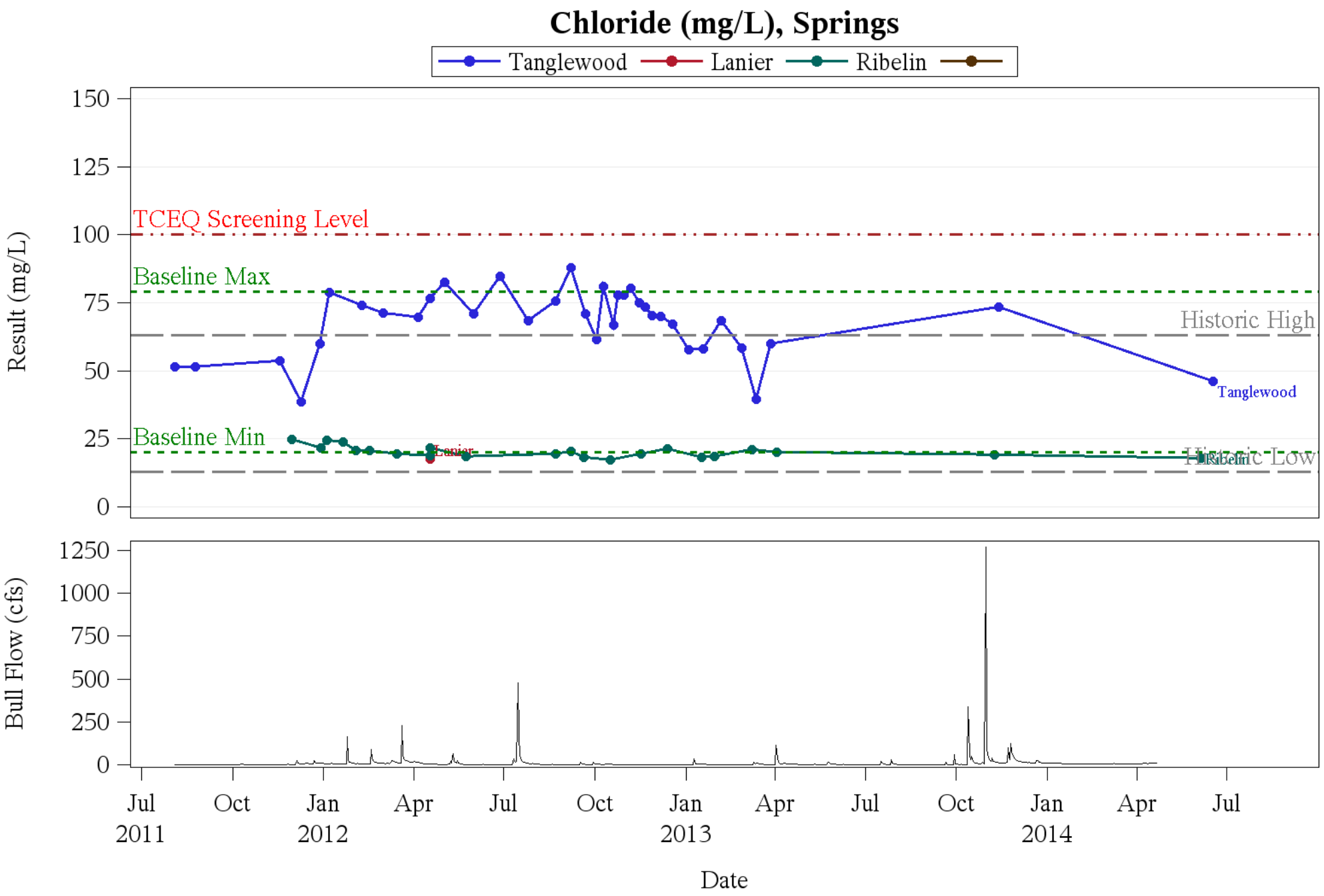

Calcium (mg/L), Surface Water
Bull T4 U/S SW
Bull T4 D/S SW
Bull T4 AR
Bull Abv WTP4
Bull @ Trib7
Baseline Max
Baseline Min
Result (mg/L)
120
110
100
90
80
Bull T4 D/S SW
Bull T4 AR
Bull T4 U/S SW
Bull @ Trib7
Bull Abv WTP4
Bull Flow (cfs)
1250
1000
750
500
250
0
Jul 2011
Oct
Jan 2012
Apr
Jul
Oct
Jan 2013
Apr
Jul
Oct
Jan 2014
Apr
Jul
Date

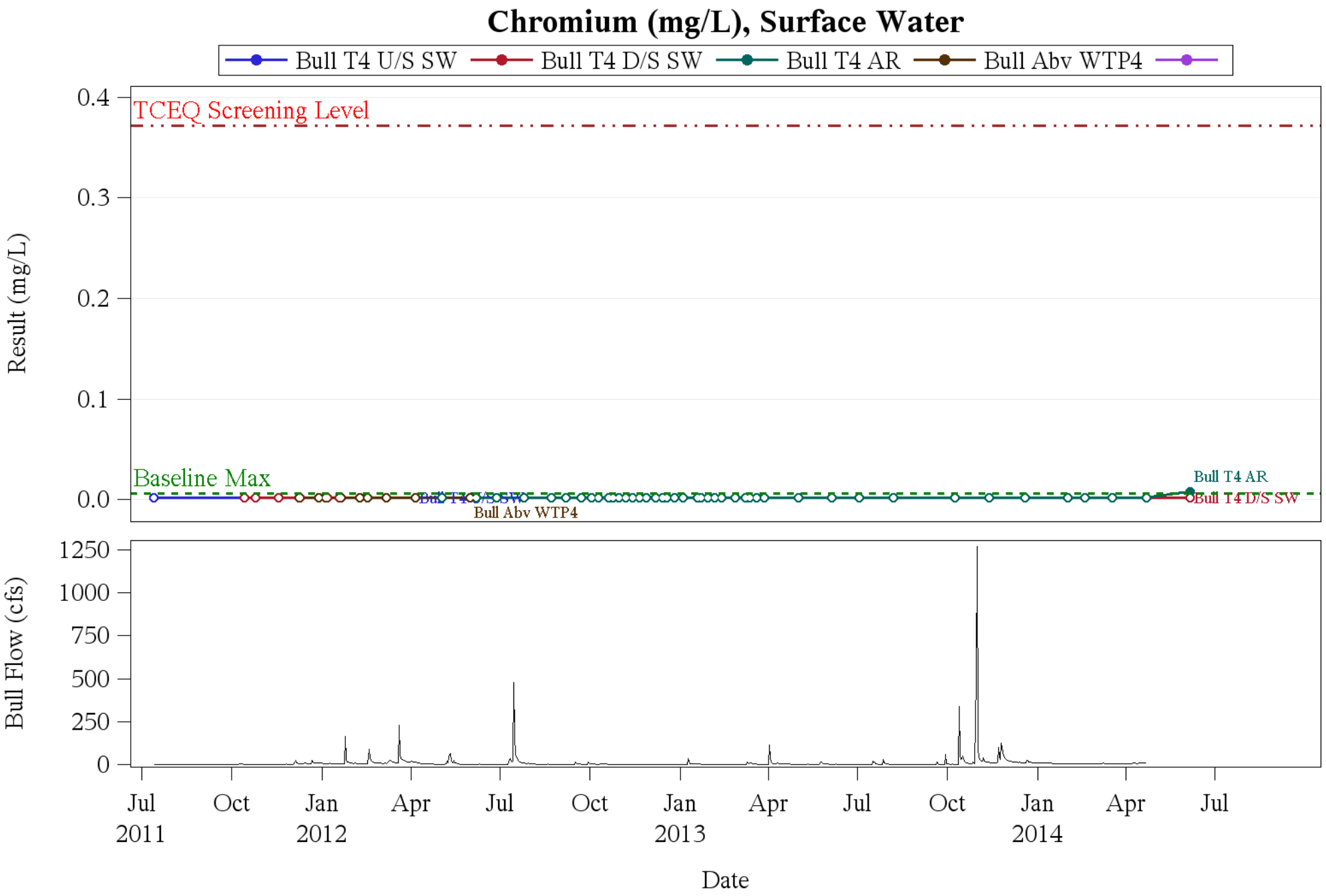

Calcium (mg/L), Wells
JTMEC Well JT-127
JTMEC Well JT-112
Result (mg/L)
120
100
80
60
JT-112 Base Max
JT-127 Base Max
JTMEC Well JT-127
JTMEC Well JT-112
Bull Flow (cfs)
1250
1000
750
500
250
0
Jul
2011
Oct
Jan
2012
Apr
Jul
Oct
Jan
2013
Apr
Jul
Oct
Jan
2014
Apr
Jul
Date

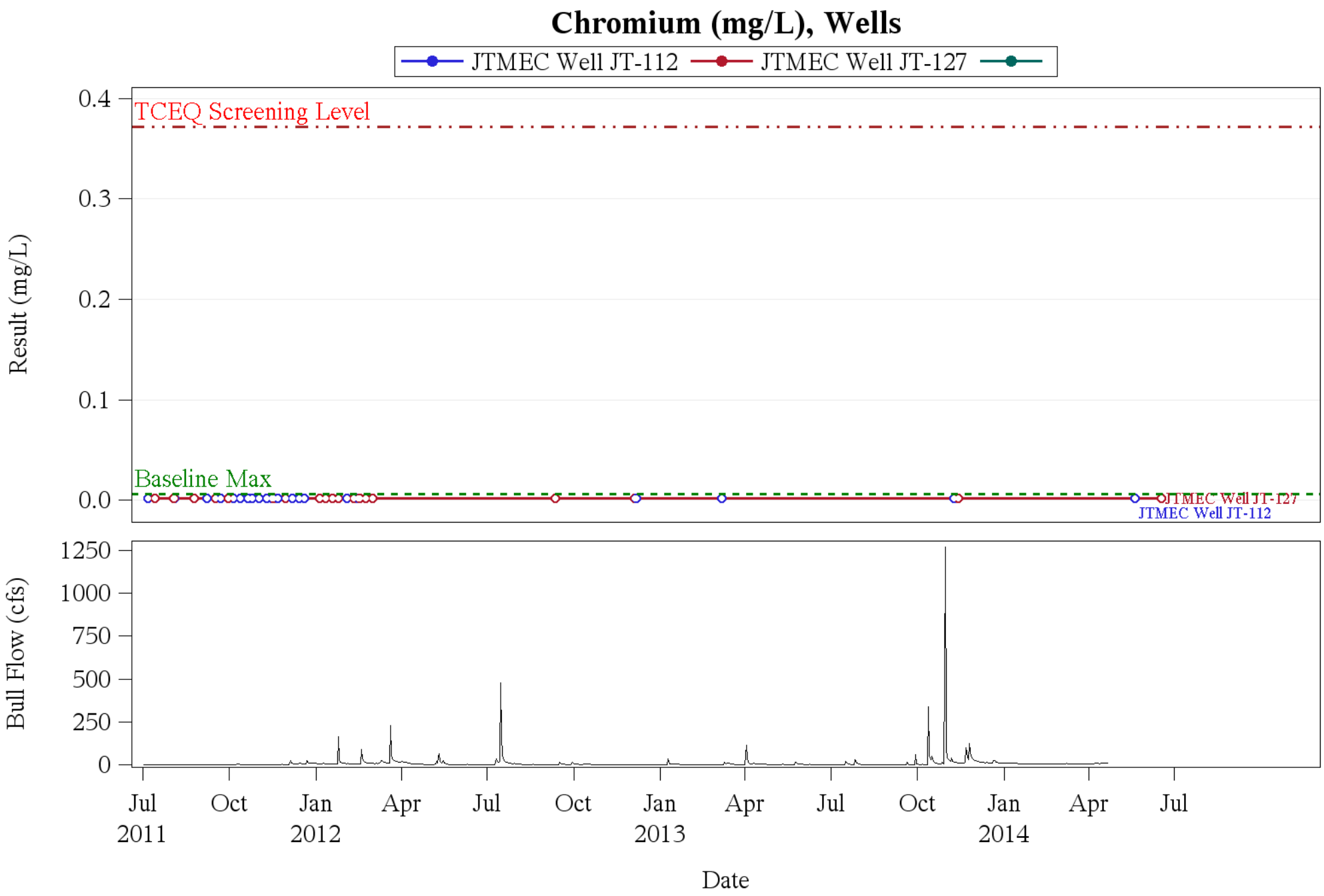

Calcium (mg/L), Springs
Tanglewood
Lanier
Ribelin
Historic High
Baseline Max
Baseline Min
Tanglewood
Lanier
Ribelin
Result (mg/L)
175
150
125
100
75
50
Bull Flow (cfs)
1250
1000
750
500
250
0
Jul 2011
Oct
Jan 2012
Apr
Jul
Oct
Jan 2013
Apr
Jul
Oct
Jan 2014
Apr
Jul
Date

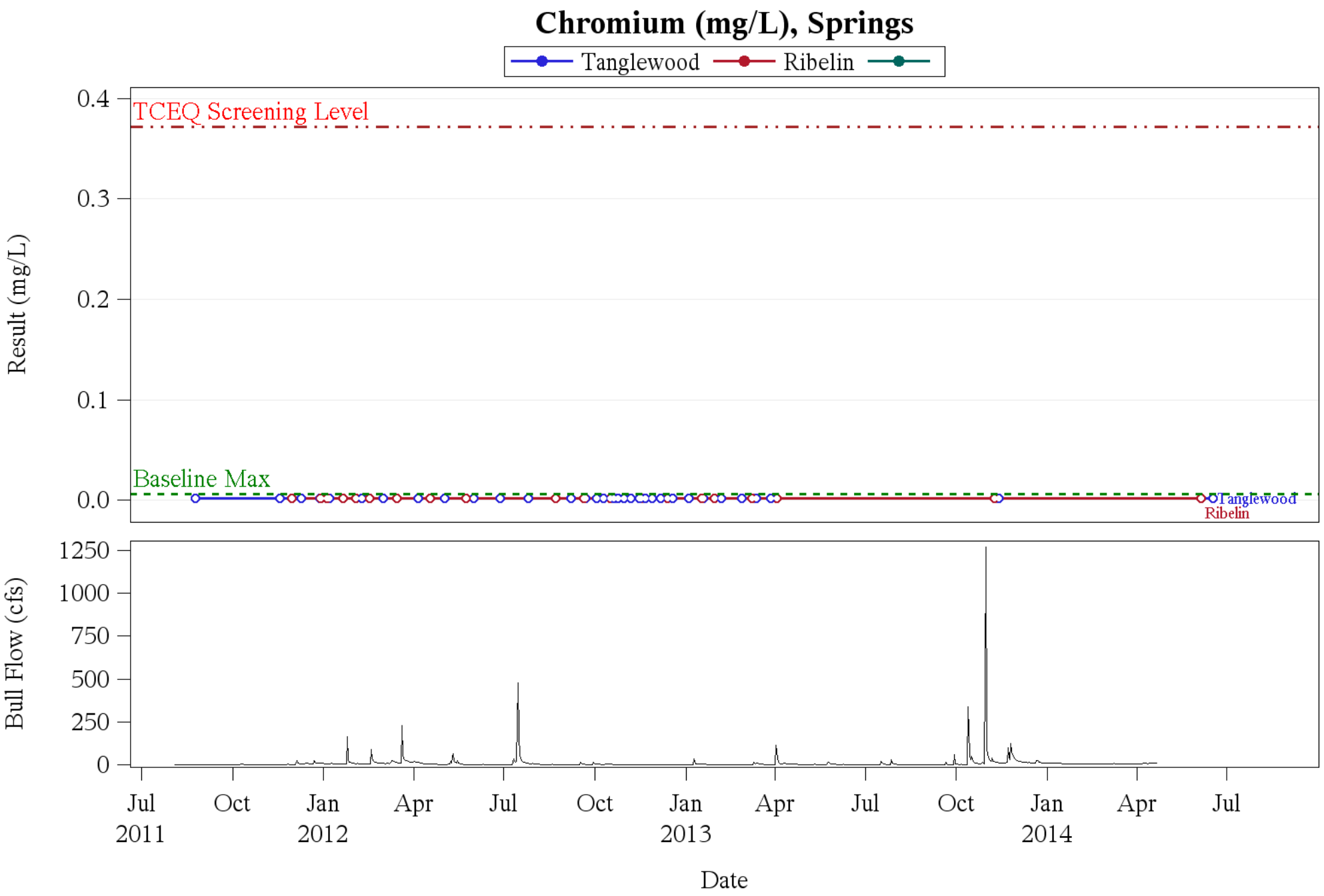

Chloride (mg/L), Surface Water
Bull T4 U/S SW
Bull T4 D/S SW
Bull T4 AR
Bull Abv WTP4
Bull @ Trib7
Result (mg/L)
200
150
100
50
0
Baseline Max
TCEQ Screening Level
Baseline Min
Bull T4 U/S SW
Bull T4 AR
Bull T4 D/S SW
Bull Abv WTP4
Bull @ Trib7
Bull Flow (cfs)
1250
1000
750
500
250
0
Jul 2011
Oct
Jan 2012
Apr
Jul
Oct
Jan 2013
Apr
Jul
Oct
Jan 2014
Apr
Jul
Date

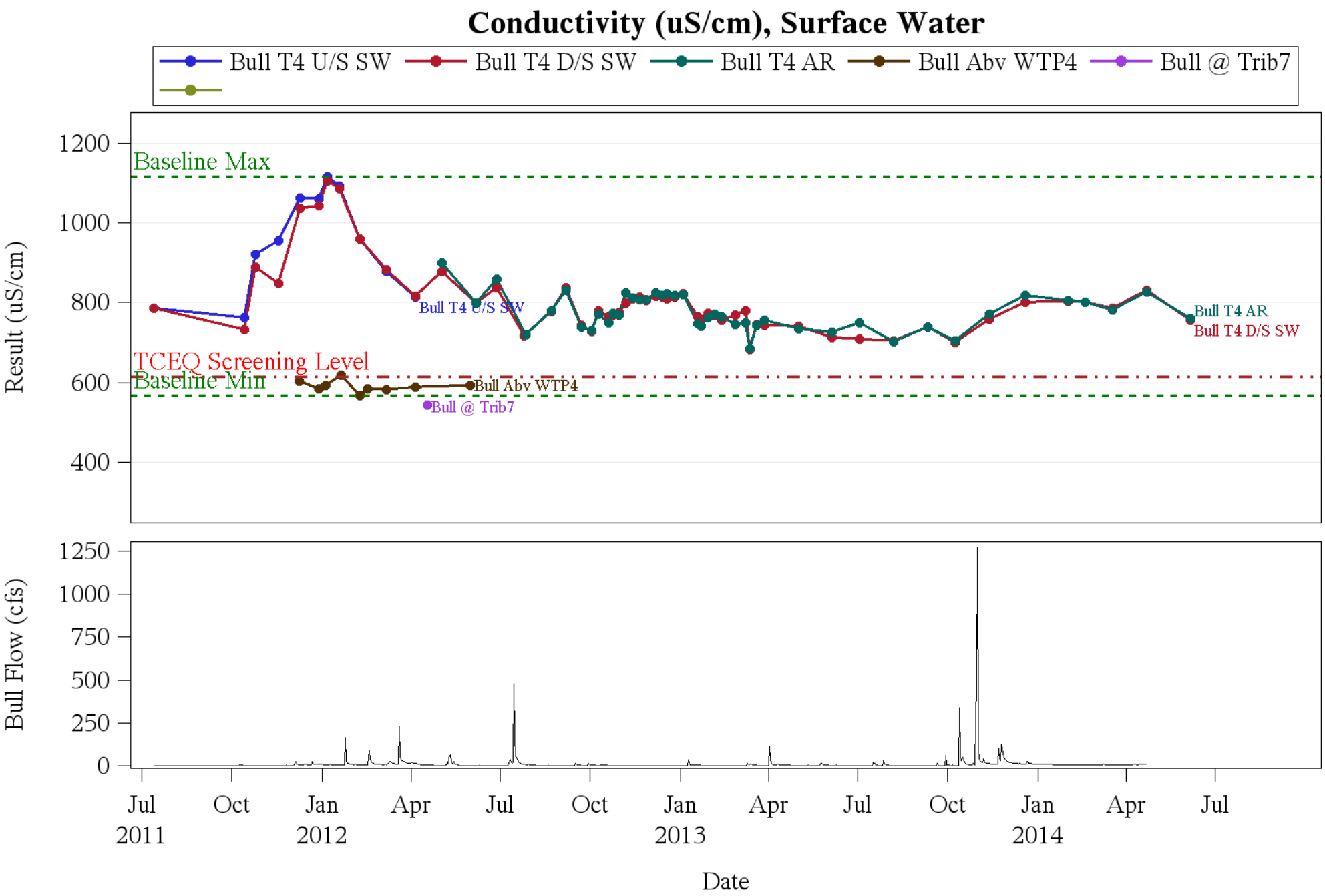

Chloride (mg/L), Wells
JTMEC Well JT-127
JTMEC Well JT-112
Result (mg/L)
150
125
100
75
50
25
0
TCEQ Screening Level
JT-127 Base Max
JT-112 Base Max
JTMEC Well JT-127
JTMEC Well JT-112
Bull Flow (cfs)
1250
1000
750
500
250
0
Jul 2011
Oct
Jan 2012
Apr
Jul
Oct
Jan 2013
Apr
Jul
Oct
Jan 2014
Apr
Jul
Date

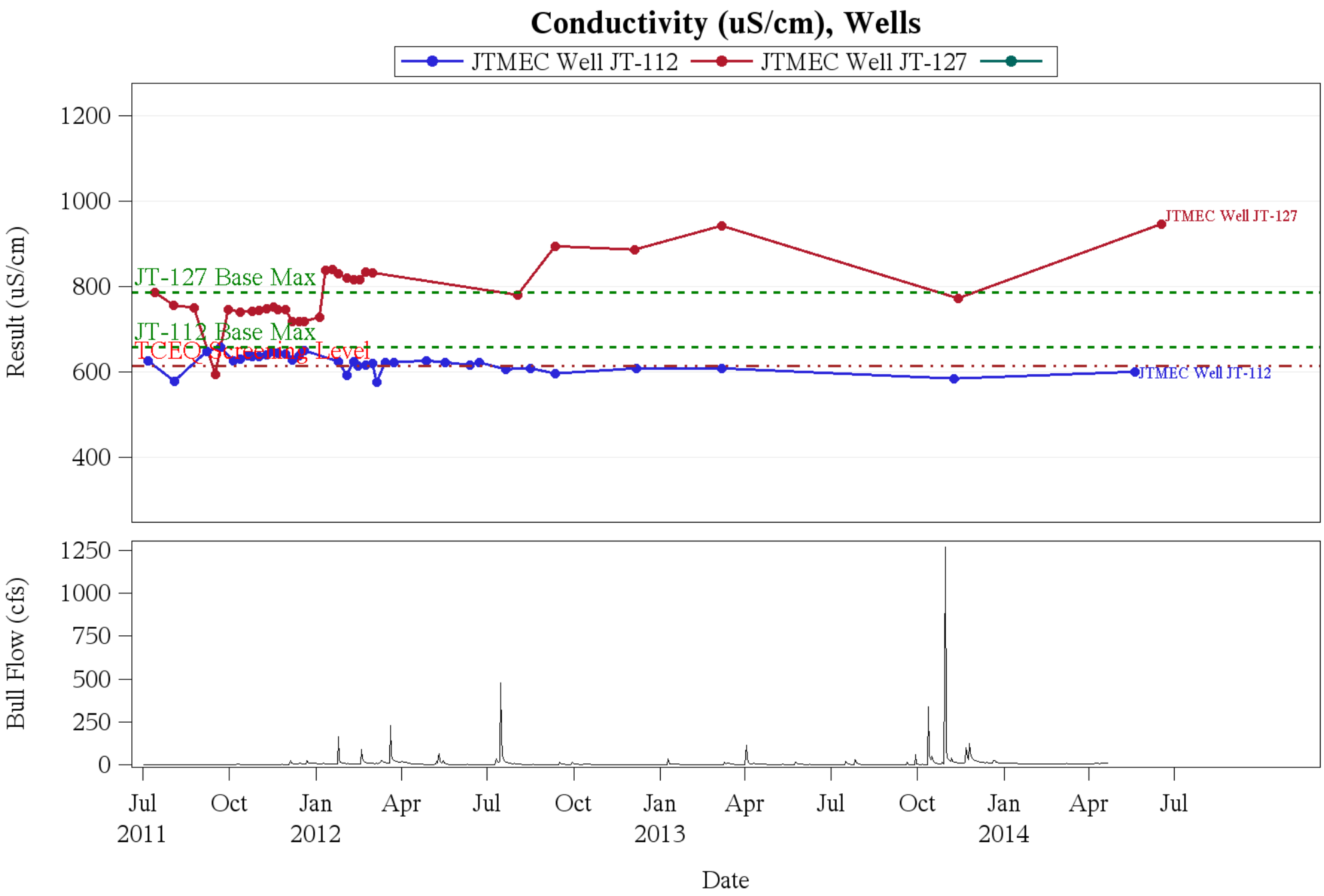

Chloride (mg/L), Springs
Tanglewood
Lanier
Ribelin
Result (mg/L)
150
125
100
75
50
25
0
TCEQ Screening Level
Baseline Max
Historic High
Baseline Min
Historic Low
Tanglewood
Lanier
Ribelin
Bull Flow (cfs)
1250
1000
750
500
250
0
Jul 2011
Oct
Jan 2012
Apr
Jul
Oct
Jan 2013
Apr
Jul
Oct
Jan 2014
Apr
Jul
Date

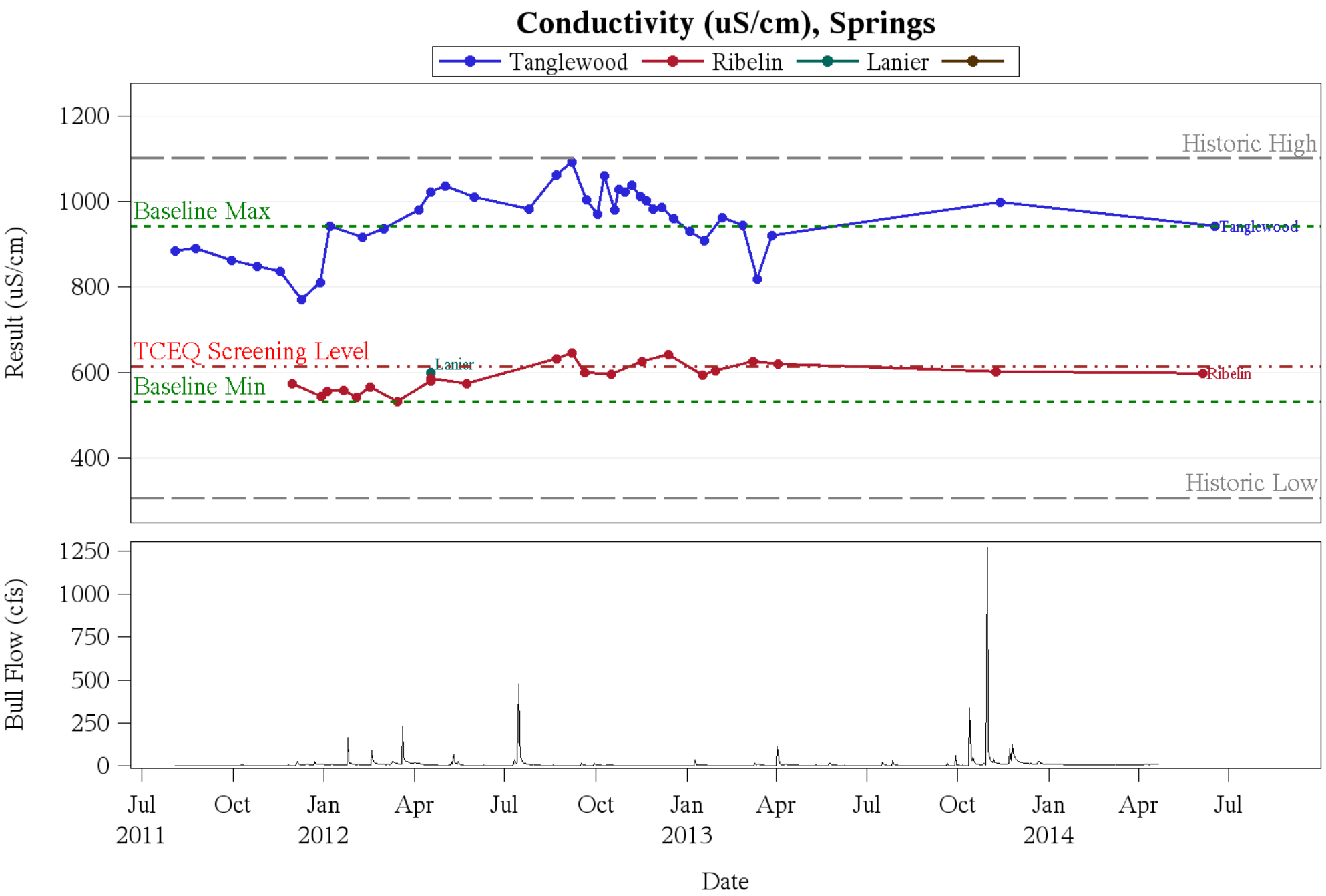

Chromium (mg/L), Surface Water
Bull T4 U/S SW
Bull T4 D/S SW
Bull T4 AR
Bull Abv WTP4
TCEQ Screening Level
Baseline Max
Result (mg/L)
0.4
0.3
0.2
0.1
0.0
Bull T4 AR
Bull T4 D/S SW
Bull Abv WTP4
Bull Flow (cfs)
1250
1000
750
500
250
0
Jul 2011
Oct
Jan 2012
Apr
Jul
Oct
Jan 2013
Apr
Jul
Oct
Jan 2014
Apr
Jul
Date

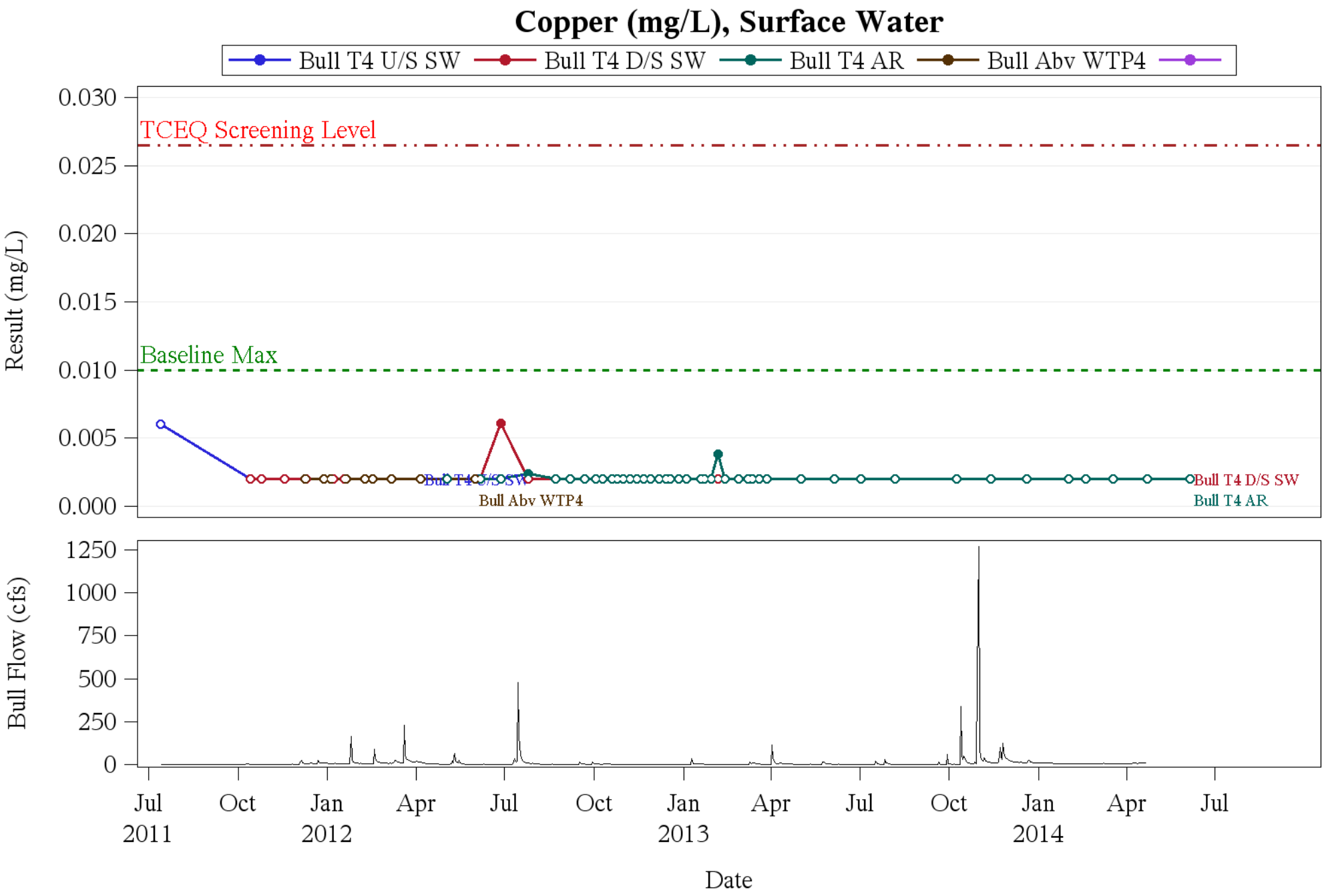

Chromium (mg/L), Wells
JTMEC Well JT-112
JTMEC Well JT-127
TCEQ Screening Level
Baseline Max
Result (mg/L)
0.4
0.3
0.2
0.1
0.0
JTMEC Well JT-127
JTMEC Well JT-112
Bull Flow (cfs)
1250
1000
750
500
250
0
Jul 2011
Oct
Jan 2012
Apr
Jul
Oct
Jan 2013
Apr
Jul
Oct
Jan 2014
Apr
Jul
Date

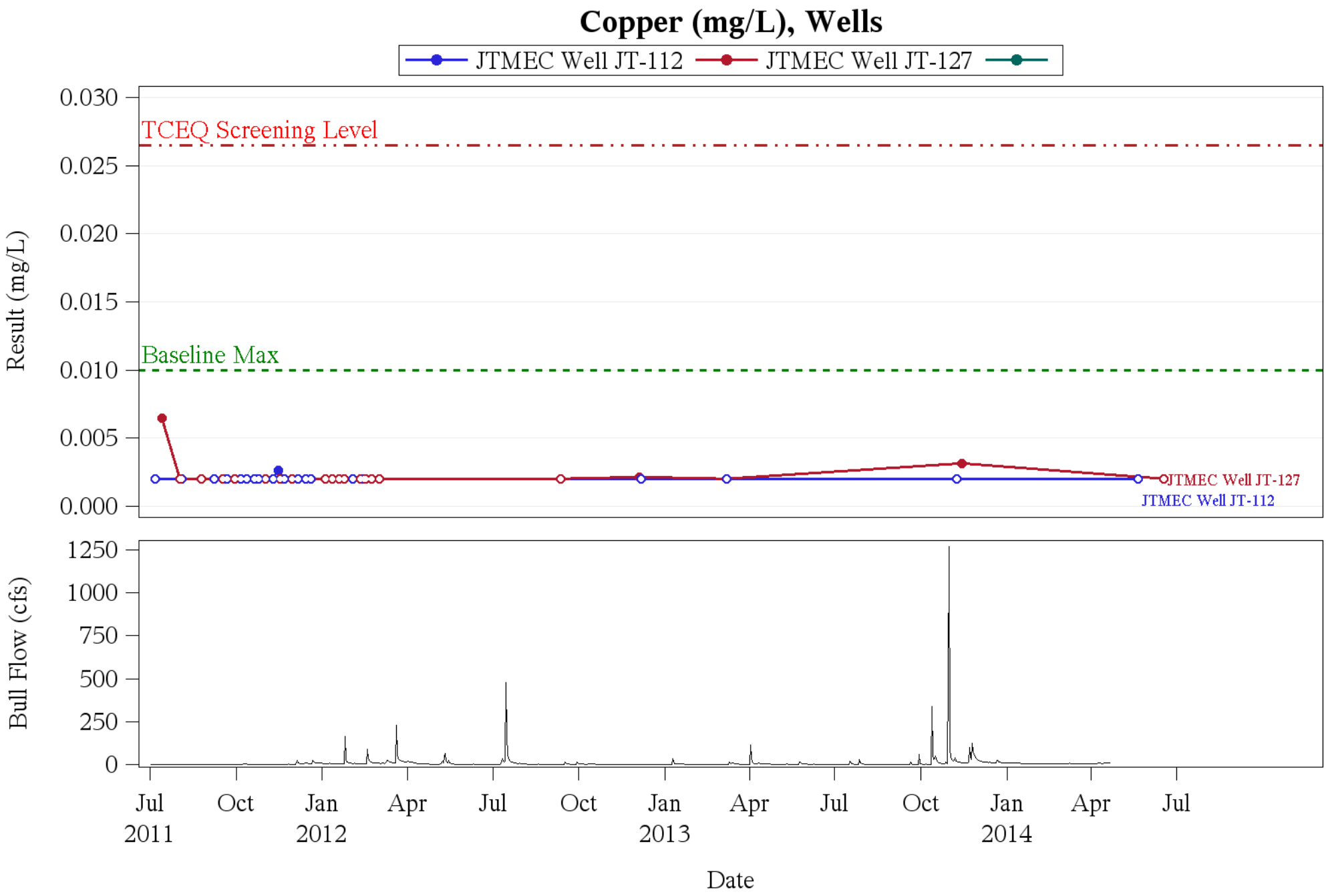

Chromium (mg/L), Springs
Tanglewood
Ribelin
TCEQ Screening Level
Baseline Max
Result (mg/L)
0.4
0.3
0.2
0.1
0.0
Tanglewood
Ribelin
Bull Flow (cfs)
1250
1000
750
500
250
0
Jul 2011
Oct
Jan 2012
Apr
Jul
Oct
Jan 2013
Apr
Jul
Oct
Jan 2014
Apr
Jul
Date

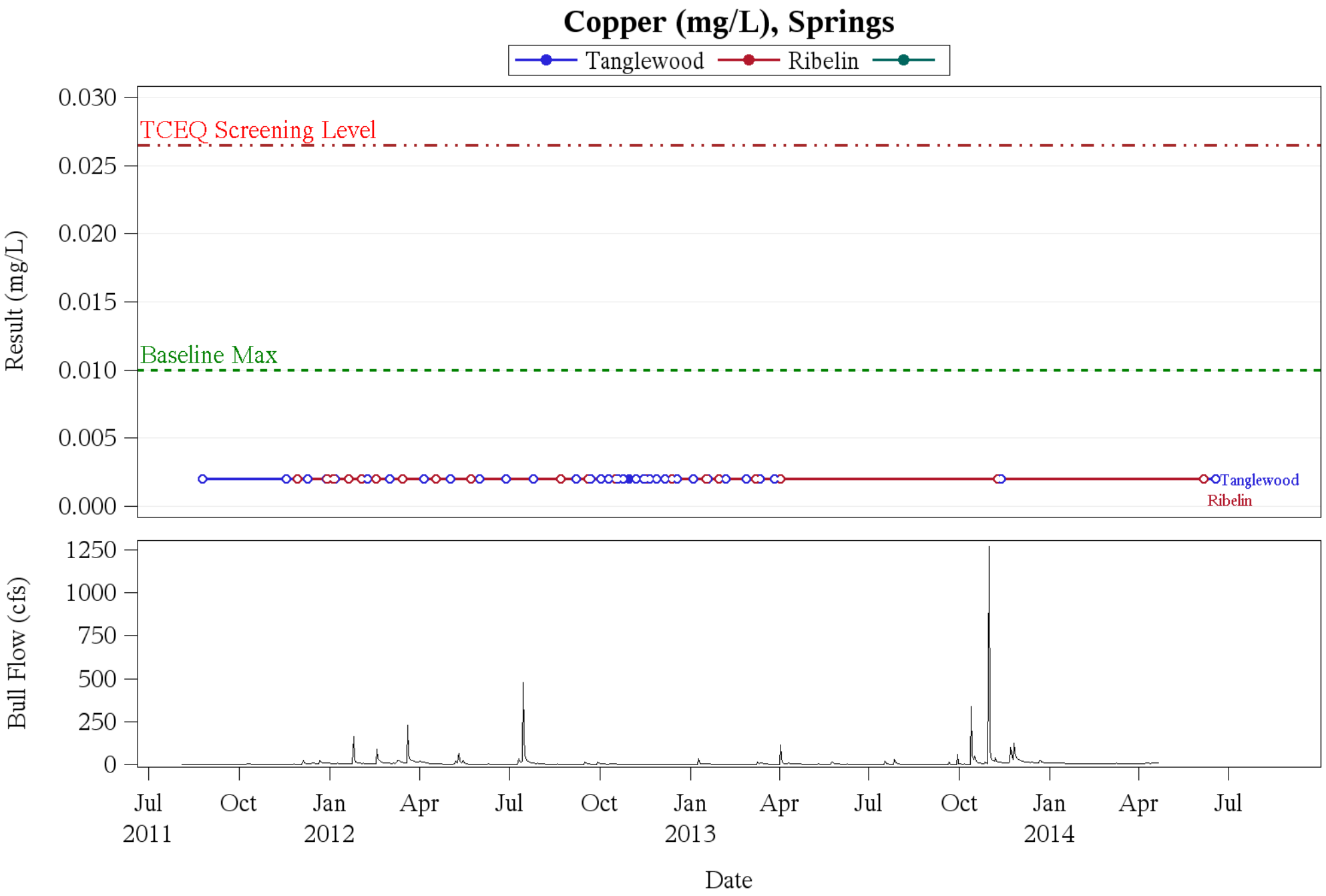

Conductivity (uS/cm), Surface Water
Bull T4 U/S SW
Bull T4 D/S SW
Bull T4 AR
Bull Abv WTP4
Bull @ Trib7
Result (uS/cm)
1200
1000
800
600
400
Baseline Max
TCEQ Screening Level
Baseline Min
Bull T4 U/S SW
Bull T4 AR
Bull T4 D/S SW
Bull Abv WTP4
Bull @ Trib7
Bull Flow (cfs)
1250
1000
750
500
250
0
Jul 2011
Oct
Jan 2012
Apr
Jul
Oct
Jan 2013
Apr
Jul
Oct
Jan 2014
Apr
Jul
Date

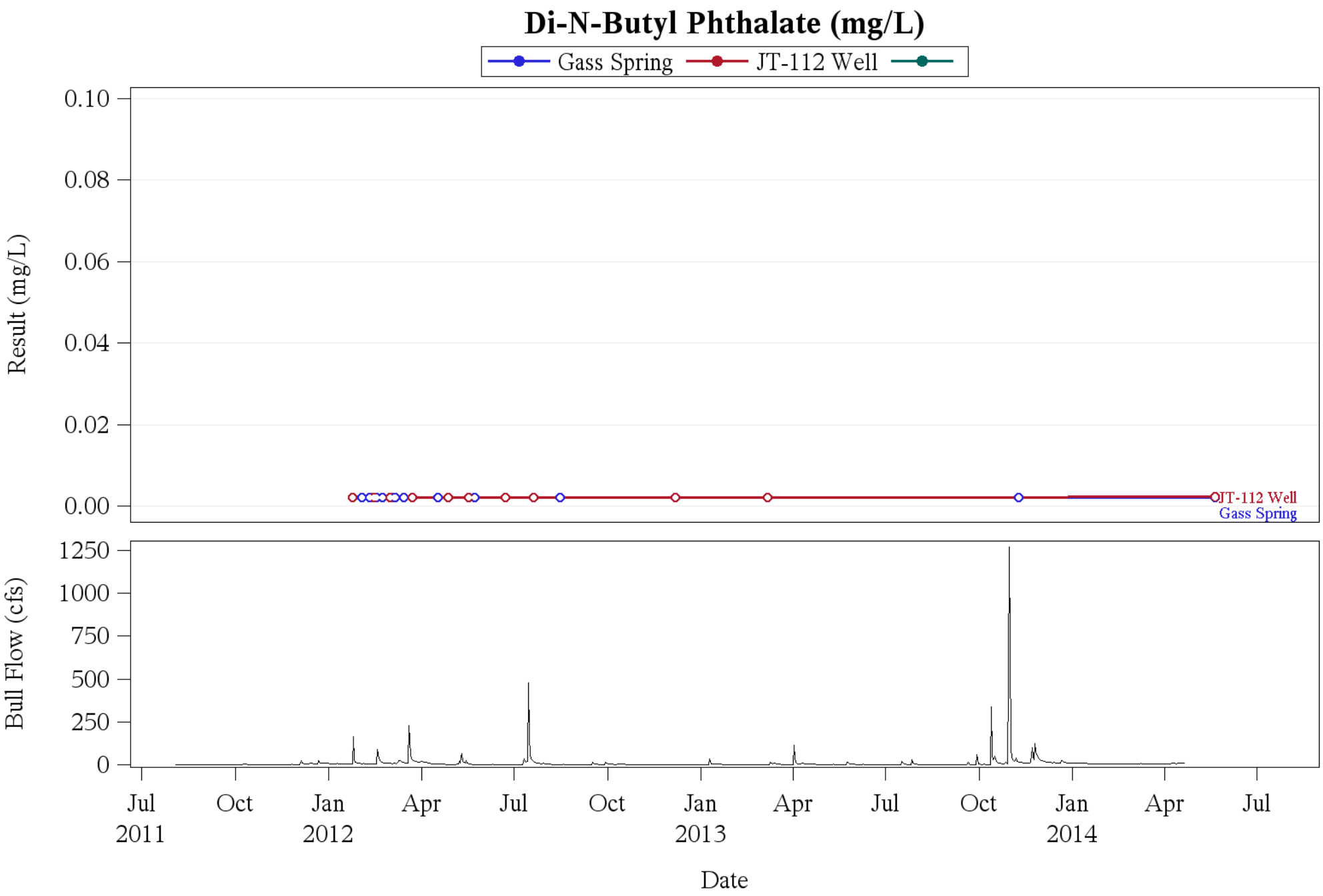

Conductivity (uS/cm), Wells
JTMEC Well JT-112
JTMEC Well JT-127
Result (uS/cm)
1200
1000
800
600
400
JT-127 Base Max
JT-112 Base Max
TCEQ Screening Level
JTMEC Well JT-127
JTMEC Well JT-112
Bull Flow (cfs)
1250
1000
750
500
250
0
Jul 2011
Oct
Jan 2012
Apr
Jul
Oct
Jan 2013
Apr
Jul
Oct
Jan 2014
Apr
Jul
Date

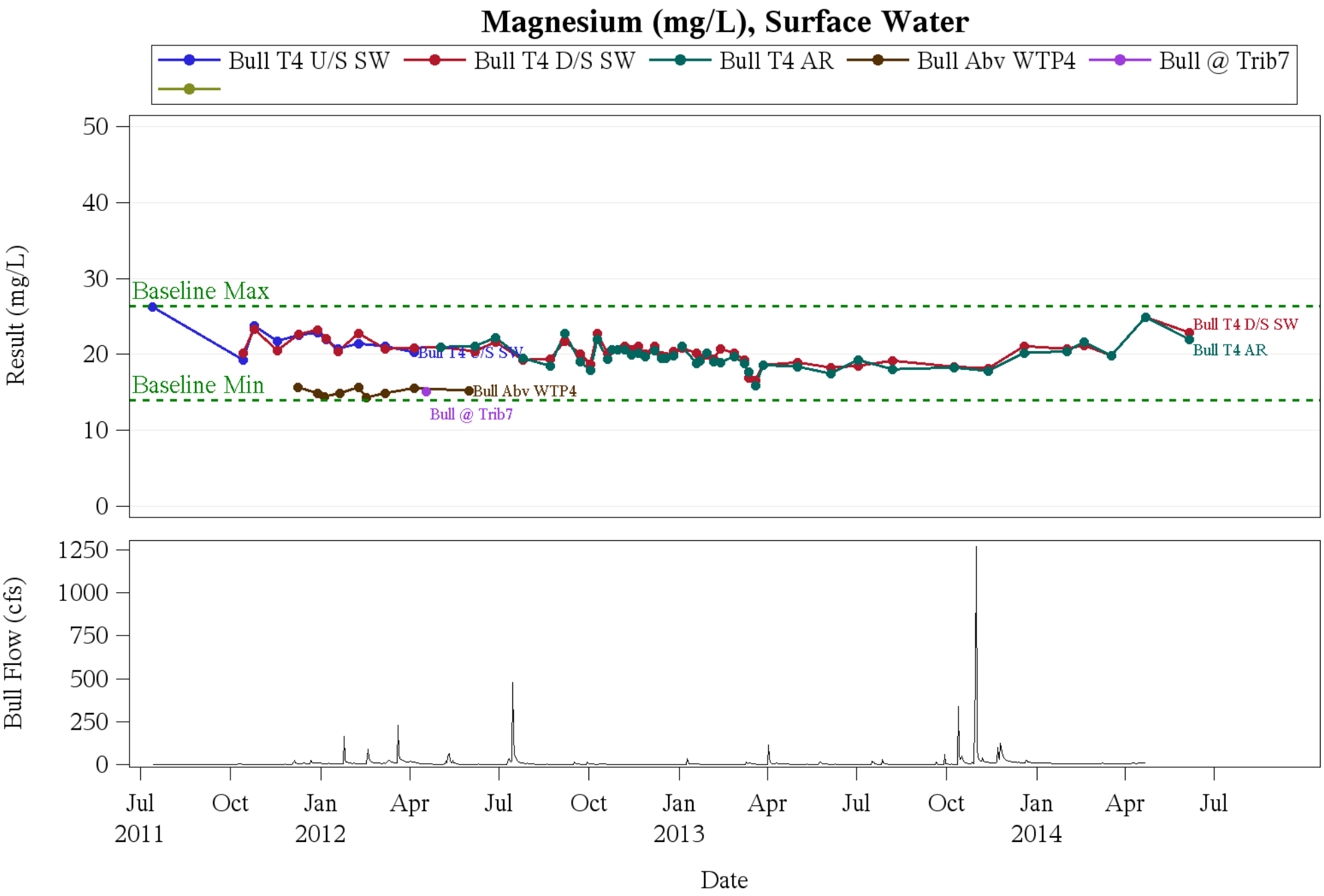

Conductivity (uS/cm), Springs
Tanglewood
Ribelin
Lanier
Result (uS/cm)
1200
1000
800
600
400
Historic High
Baseline Max
TCEQ Screening Level
Baseline Min
Historic Low
Tanglewood
Lanier
Ribelin
Bull Flow (cfs)
1250
1000
750
500
250
0
Jul 2011
Oct
Jan 2012
Apr
Jul
Oct
Jan 2013
Apr
Jul
Oct
Jan 2014
Apr
Jul
Date

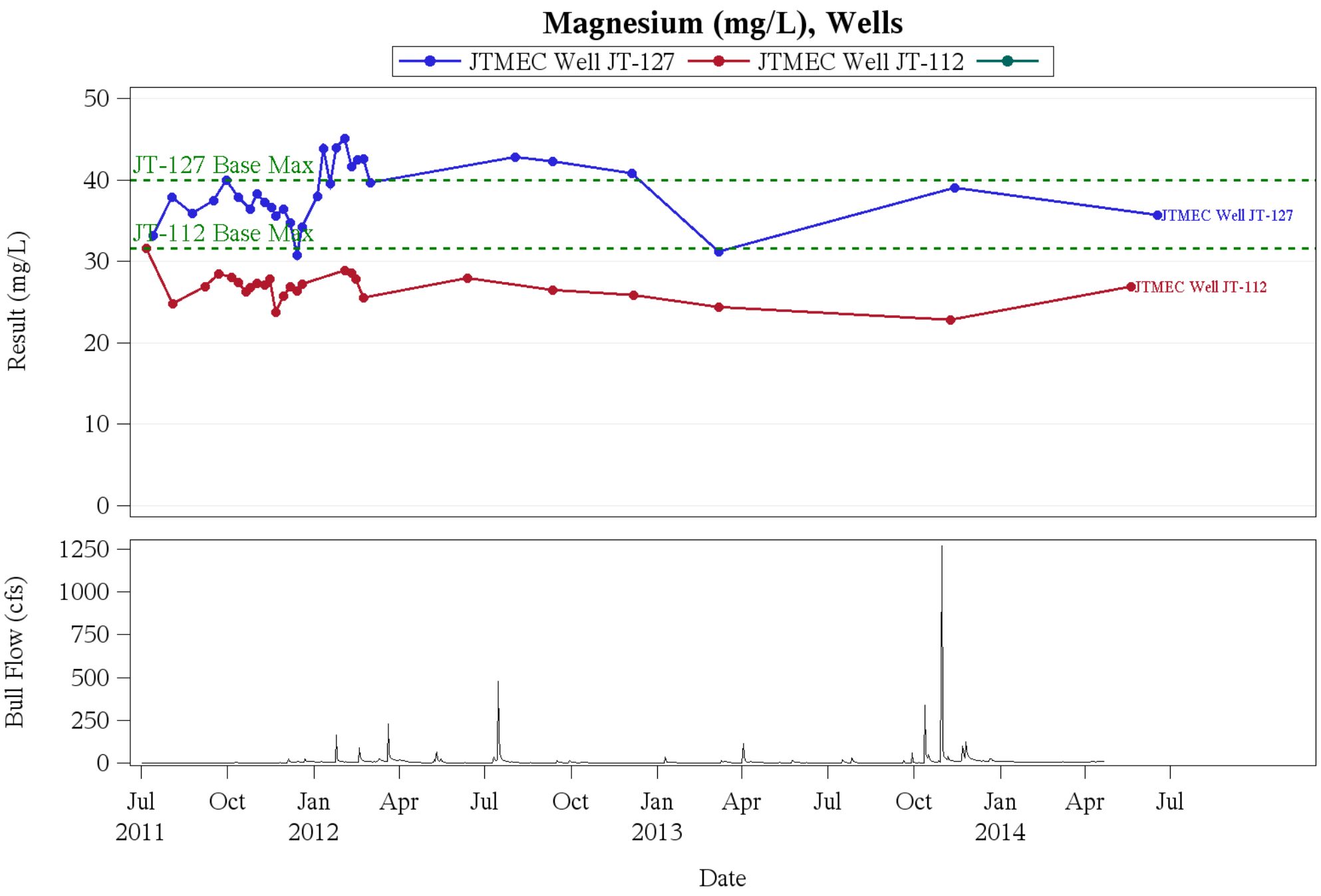

Copper (mg/L), Surface Water
Bull T4 U/S SW
Bull T4 D/S SW
Bull T4 AR
Bull Abv WTP4
TCEQ Screening Level
Baseline Max
Result (mg/L)
0.030
0.025
0.020
0.015
0.010
0.005
0.000
Bull T4 D/S SW
Bull Abv WTP4
Bull T4 AR
Bull Flow (cfs)
1250
1000
750
500
250
0
Jul 2011
Oct
Jan 2012
Apr
Jul
Oct
Jan 2013
Apr
Jul
Oct
Jan 2014
Apr
Jul
Date

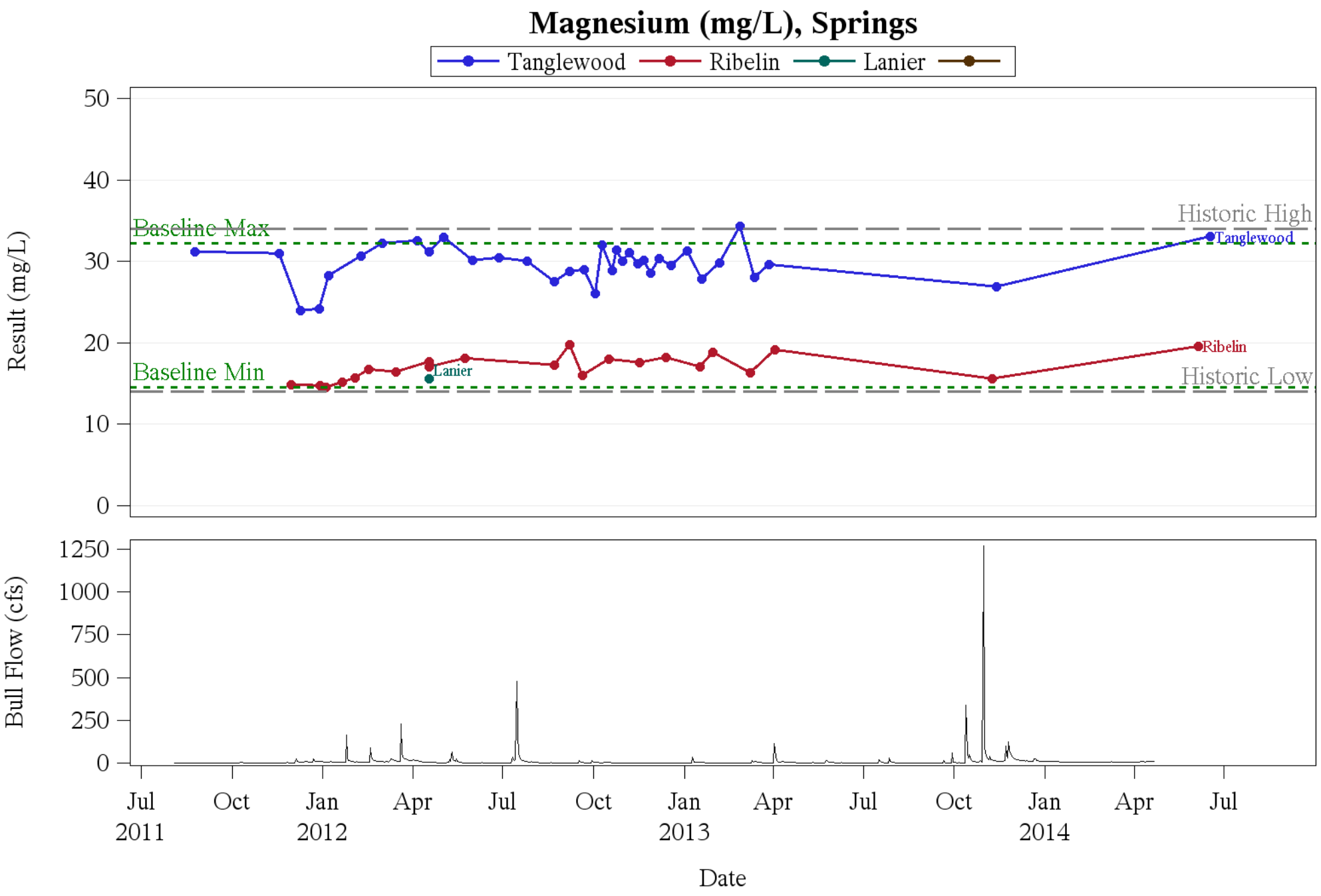

Copper (mg/L), Wells
JTMEC Well JT-112
JTMEC Well JT-127
Result (mg/L)
0.030
0.025
0.020
0.015
0.010
0.005
0.000
TCEQ Screening Level
Baseline Max
JTMEC Well JT-127
JTMEC Well JT-112
Bull Flow (cfs)
1250
1000
750
500
250
0
Jul 2011
Oct
Jan 2012
Apr
Jul
Oct
Jan 2013
Apr
Jul
Oct
Jan 2014
Apr
Jul
Date

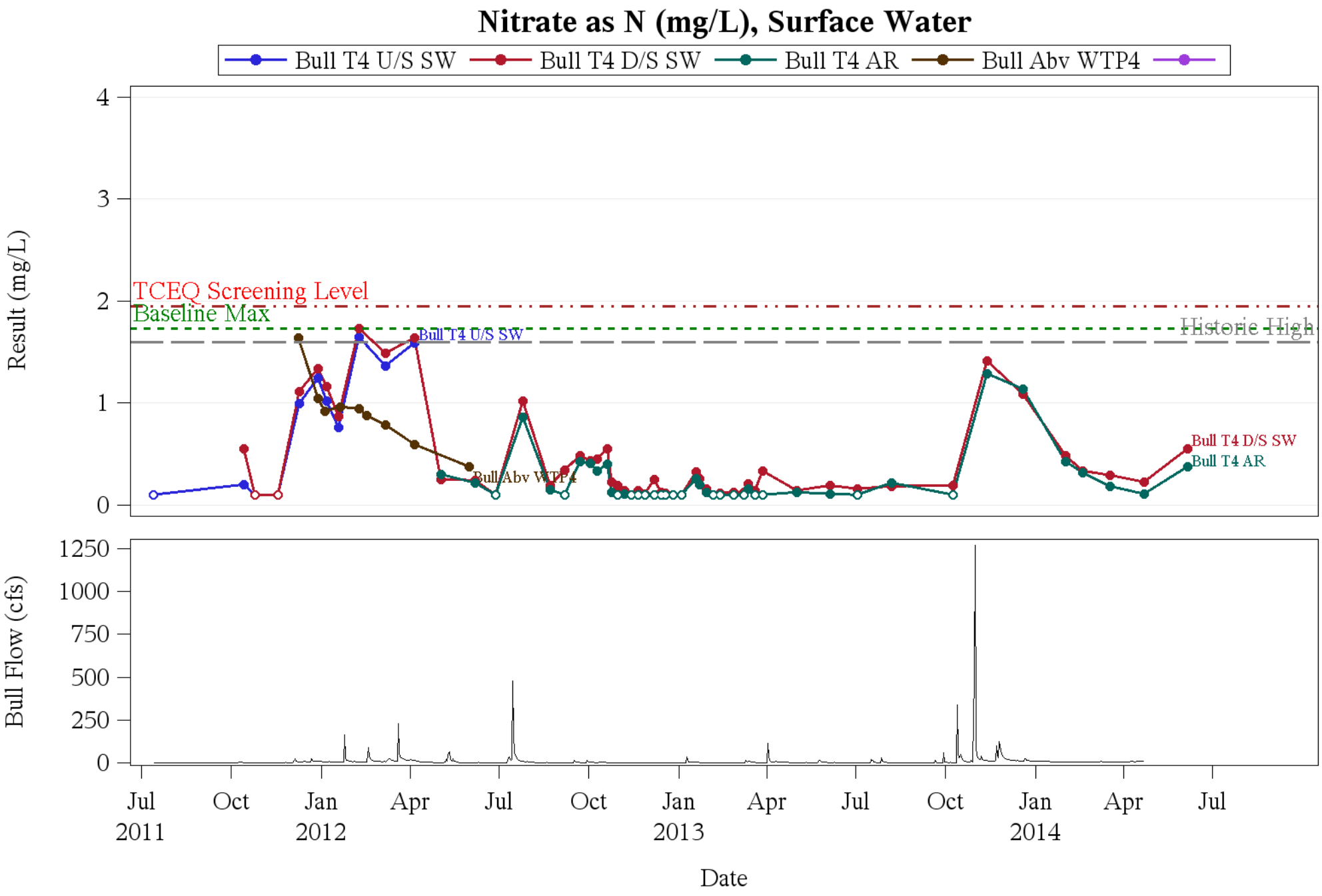

Copper (mg/L), Springs
Tanglewood
Ribelin
0.030
0.025
0.020
0.015
0.010
0.005
0.000
Result (mg/L)
TCEQ Screening Level
Baseline Max
Tanglewood
Ribelin
1250
1000
750
500
250
0
Bull Flow (cfs)
Jul 2011
Oct
Jan 2012
Apr
Jul
Oct
Jan 2013
Apr
Jul
Oct
Jan 2014
Apr
Jul
Date

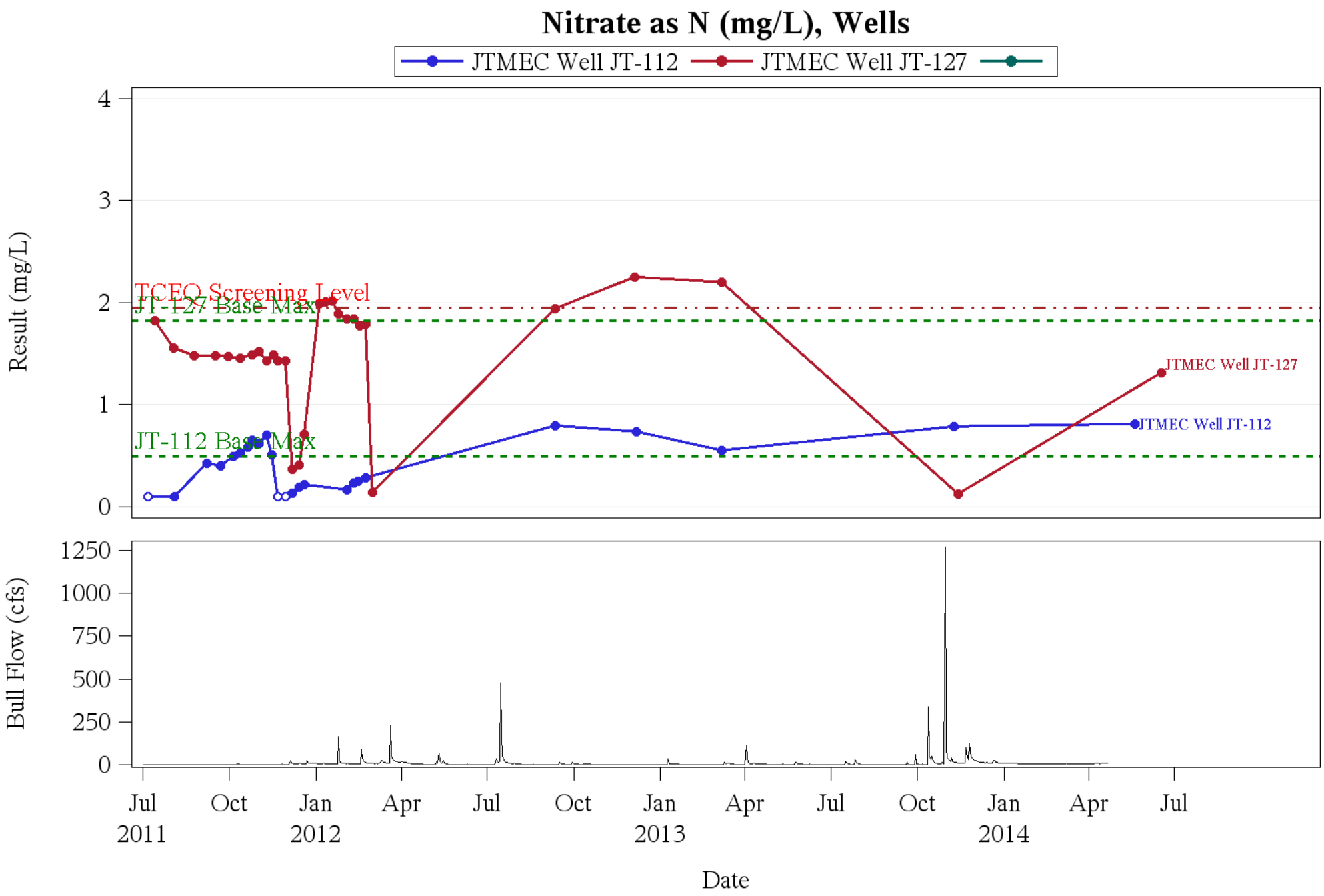

Di-N-Butyl Phthalate (mg/L)
Gass Spring
JT-112 Well
Result (mg/L)
0.10
0.08
0.06
0.04
0.02
0.00
JT-112 Well
Gass Spring
Bull Flow (cfs)
1250
1000
750
500
250
0
Jul 2011
Oct
Jan 2012
Apr
Jul
Oct
Jan 2013
Apr
Jul
Oct
Jan 2014
Apr
Jul
Date

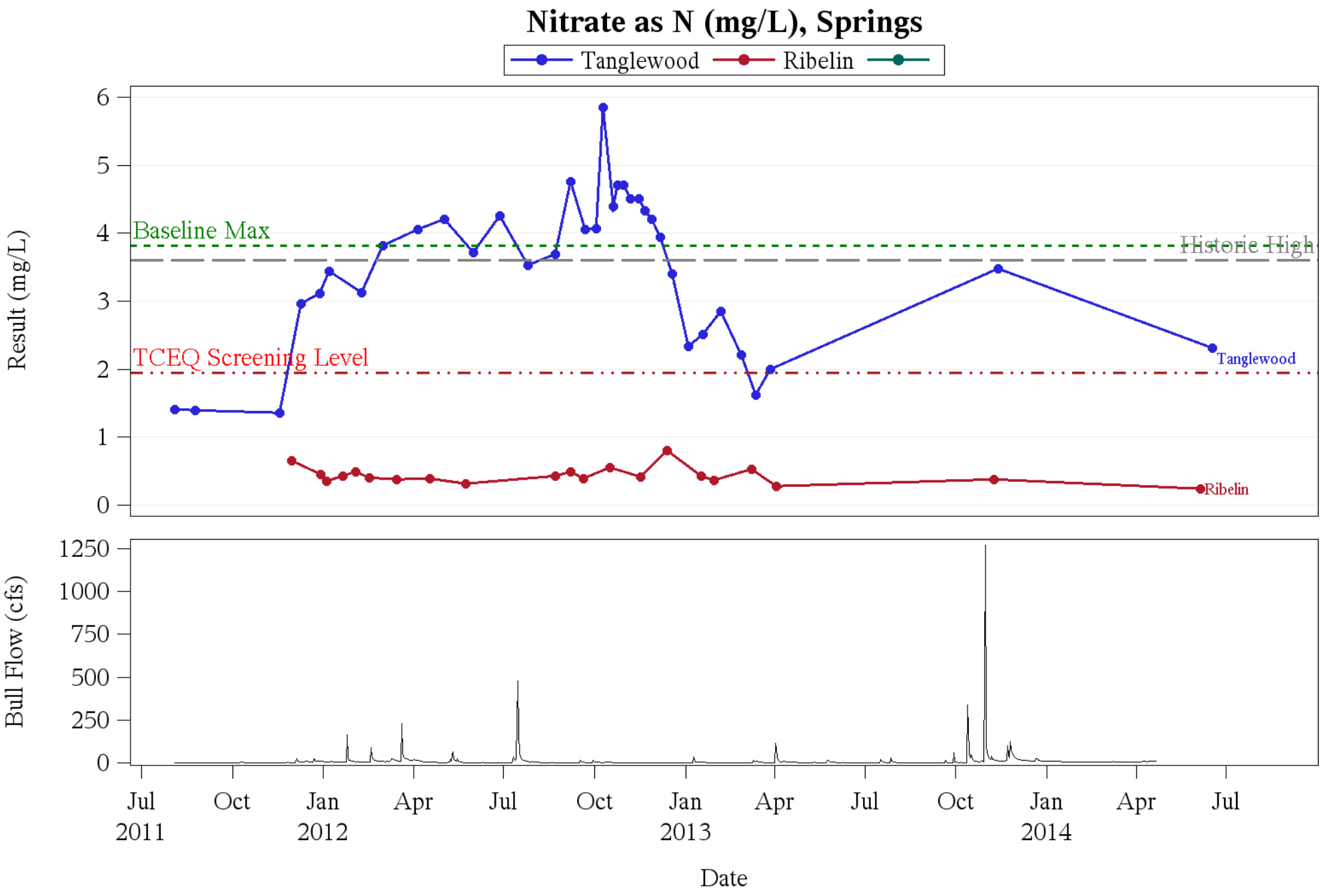

Magnesium (mg/L), Surface Water
Bull T4 U/S SW
Bull T4 D/S SW
Bull T4 AR
Bull Abv WTP4
Bull @ Trib7
Result (mg/L)
50
40
30
20
10
0
Baseline Max
Baseline Min
Bull T4 U/S SW
Bull Abv WTP4
Bull @ Trib7
Bull T4 D/S SW
Bull T4 AR
Bull Flow (cfs)
1250
1000
750
500
250
0
Jul 2011
Oct
Jan 2012
Apr
Jul
Oct
Jan 2013
Apr
Jul
Oct
Jan 2014
Apr
Jul
Date

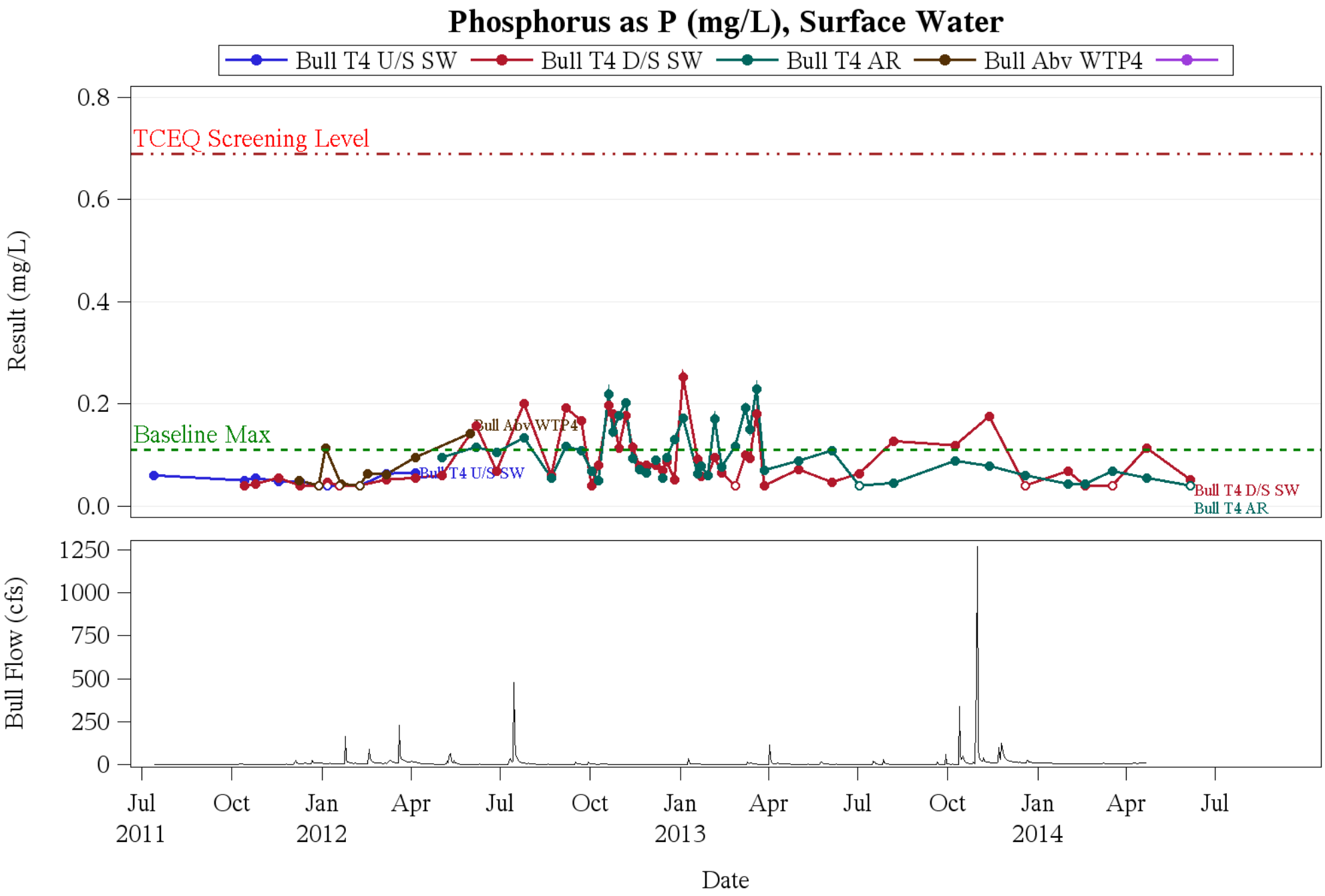

Magnesium (mg/L), Wells
JTMEC Well JT-127
JTMEC Well JT-112
JT-127 Base Max
JT-112 Base Max
JTMEC Well JT-127
JTMEC Well JT-112
Result (mg/L)
50
40
30
20
10
0
Bull Flow (cfs)
1250
1000
750
500
250
0
Jul 2011
Oct
Jan 2012
Apr
Jul
Oct
Jan 2013
Apr
Jul
Oct
Jan 2014
Apr
Jul
Date

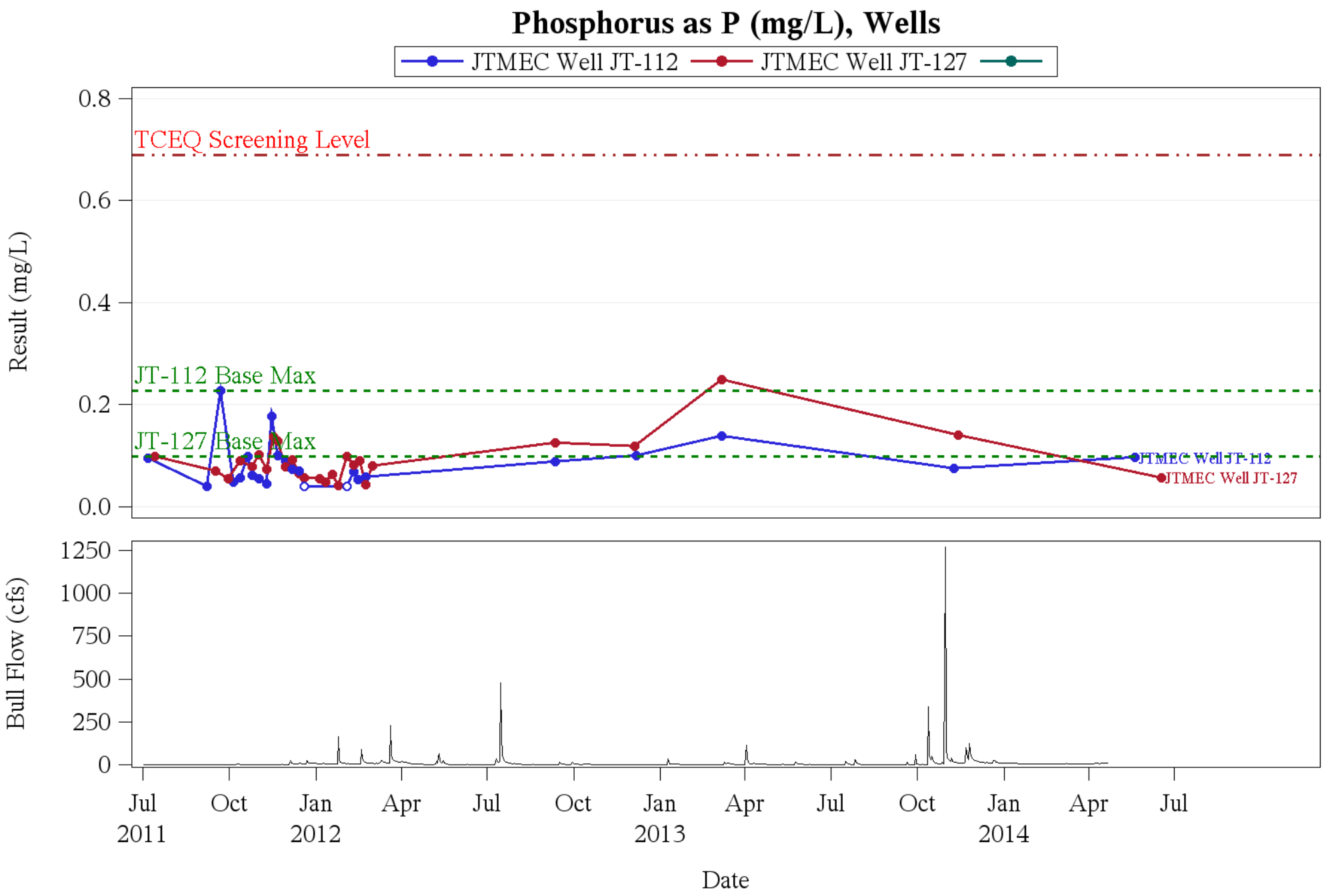

Magnesium (mg/L), Springs
Tanglewood
Ribelin
Lanier
Result (mg/L)
50
40
30
20
10
0
Baseline Max
Baseline Min
Historic High
Historic Low
Tanglewood
Ribelin
Lanier
Bull Flow (cfs)
1250
1000
750
500
250
0
Jul 2011
Oct
Jan 2012
Apr
Jul
Oct
Jan 2013
Apr
Jul
Oct
Jan 2014
Apr
Jul
Date

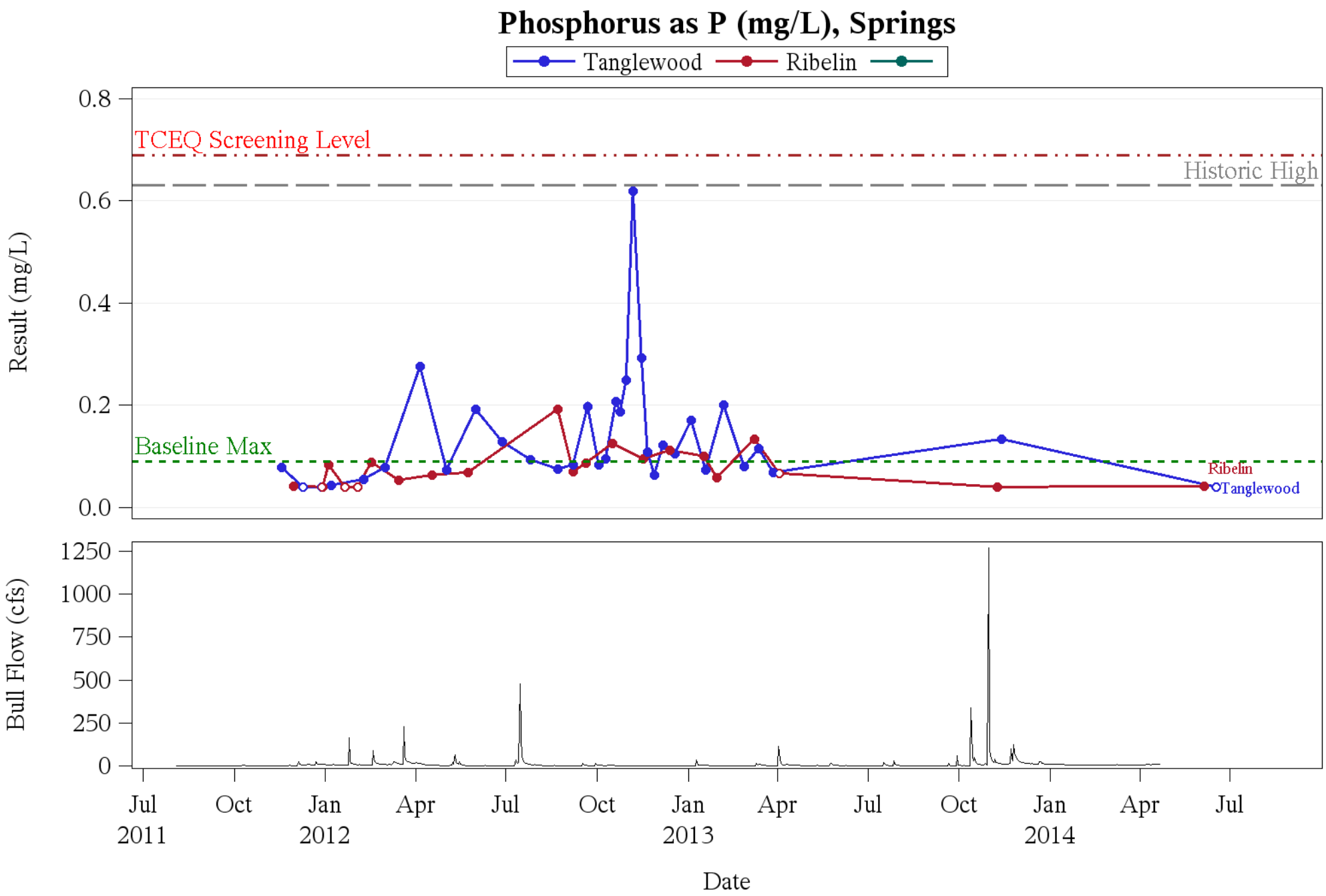

Nitrate as N (mg/L), Surface Water
Bull T4 U/S SW
Bull T4 D/S SW
Bull T4 AR
Bull Abv WTP4
Result (mg/L)
TCEQ Screening Level
Baseline Max
Historic High
Bull T4 U/S SW
Bull Abv WTP4
Bull T4 D/S SW
Bull T4 AR
Bull Flow (cfs)
Jul 2011
Oct
Jan 2012
Apr
Jul
Oct
Jan 2013
Apr
Jul
Oct
Jan 2014
Apr
Jul
Date

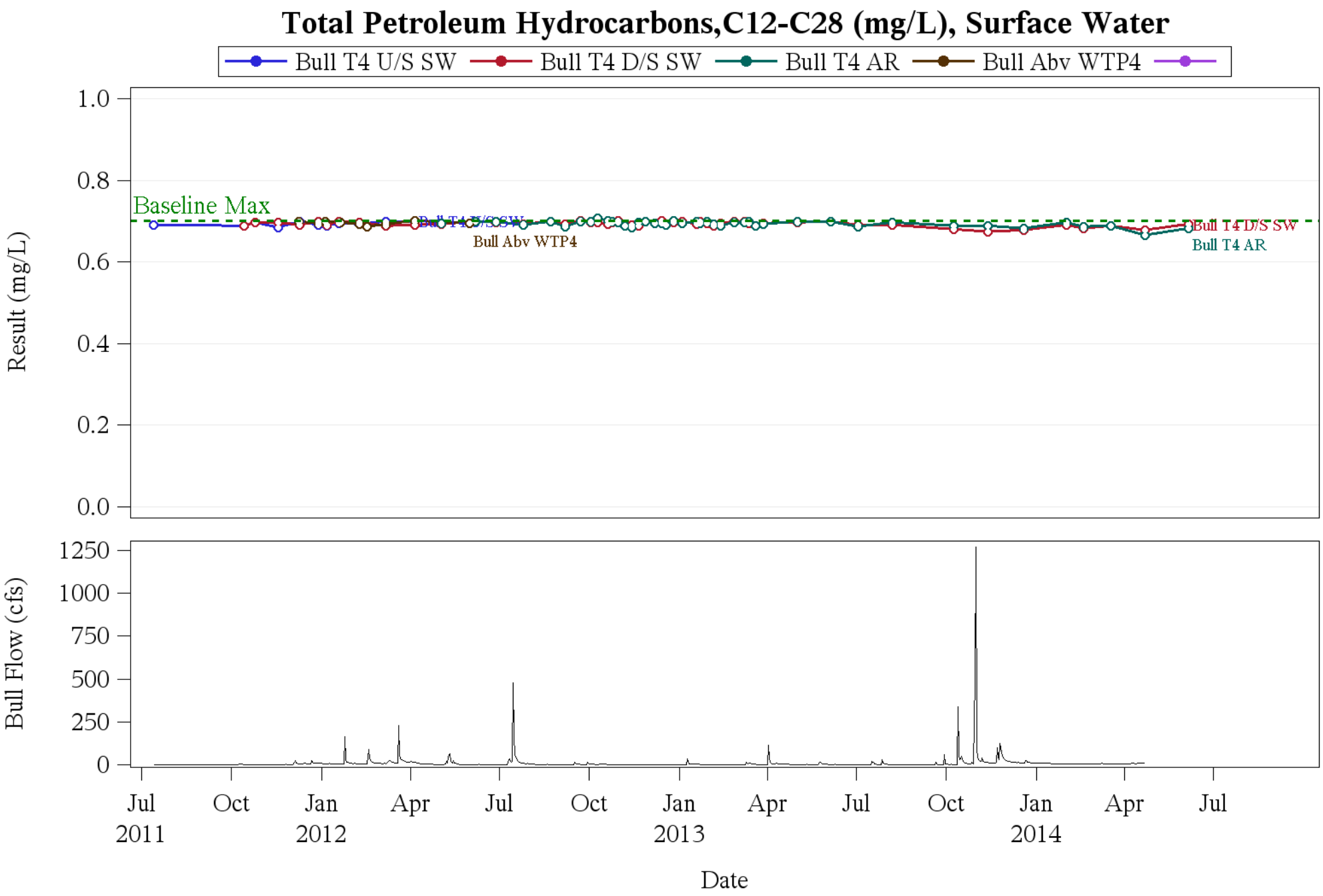

Nitrate as N (mg/L), Wells
JTMEC Well JT-112
JTMEC Well JT-127
Result (mg/L)
TCEQ Screening Level
JT-127 Base Max
JT-112 Base Max
JTMEC Well JT-127
JTMEC Well JT-112
Bull Flow (cfs)
Jul 2011
Oct
Jan 2012
Apr
Jul
Oct
Jan 2013
Apr
Jul
Oct
Jan 2014
Apr
Jul
Date

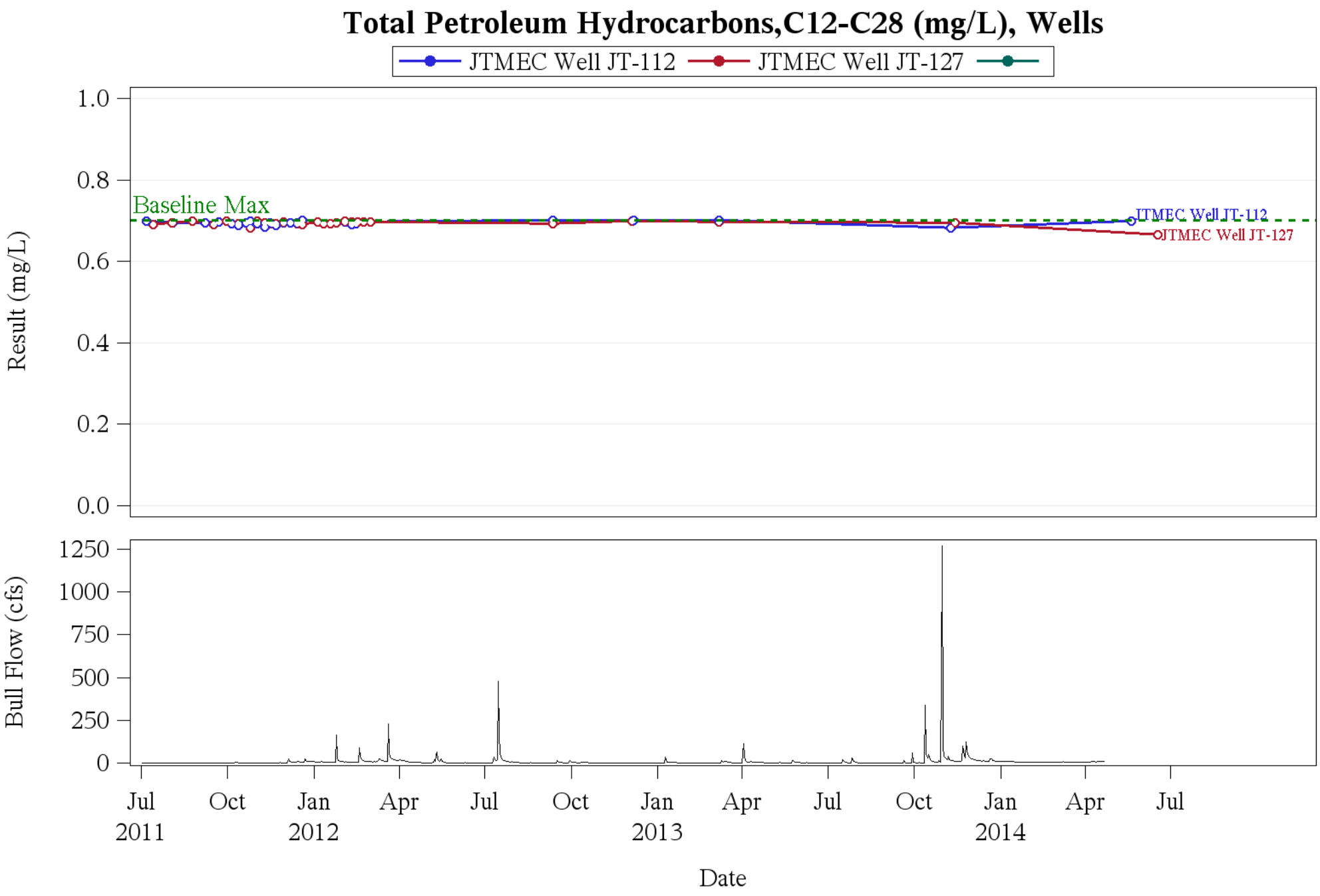

Nitrate as N (mg/L), Springs
Tanglewood
Ribelin
Result (mg/L)
Baseline Max
Historic High
TCEQ Screening Level
Tanglewood
Ribelin
Bull Flow (cfs)
Jul 2011
Oct
Jan 2012
Apr
Jul
Oct
Jan 2013
Apr
Jul
Oct
Jan 2014
Apr
Jul
Date

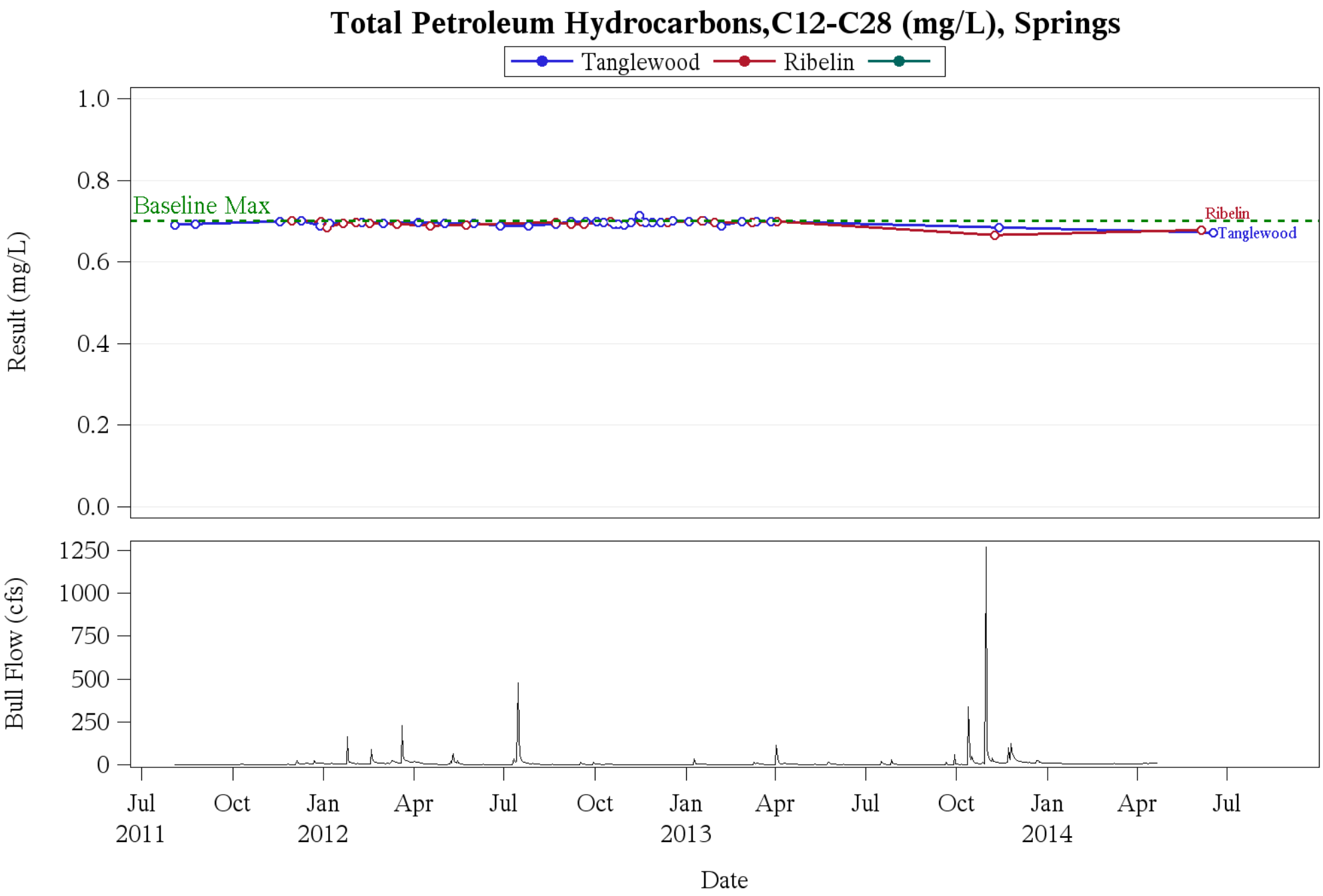

Phosphorus as P (mg/L), Surface Water
Bull T4 U/S SW
Bull T4 D/S SW
Bull T4 AR
Bull Abv WTP4
Result (mg/L)
0.8
0.6
0.4
0.2
0.0
TCEQ Screening Level
Baseline Max
Bull Abv WTP4
Bull T4 U/S SW
Bull T4 D/S SW
Bull T4 AR
Bull Flow (cfs)
1250
1000
750
500
250
0
Jul
2011
Oct
Jan
2012
Apr
Jul
Oct
Jan
2013
Apr
Jul
Oct
Jan
2014
Apr
Jul
Date

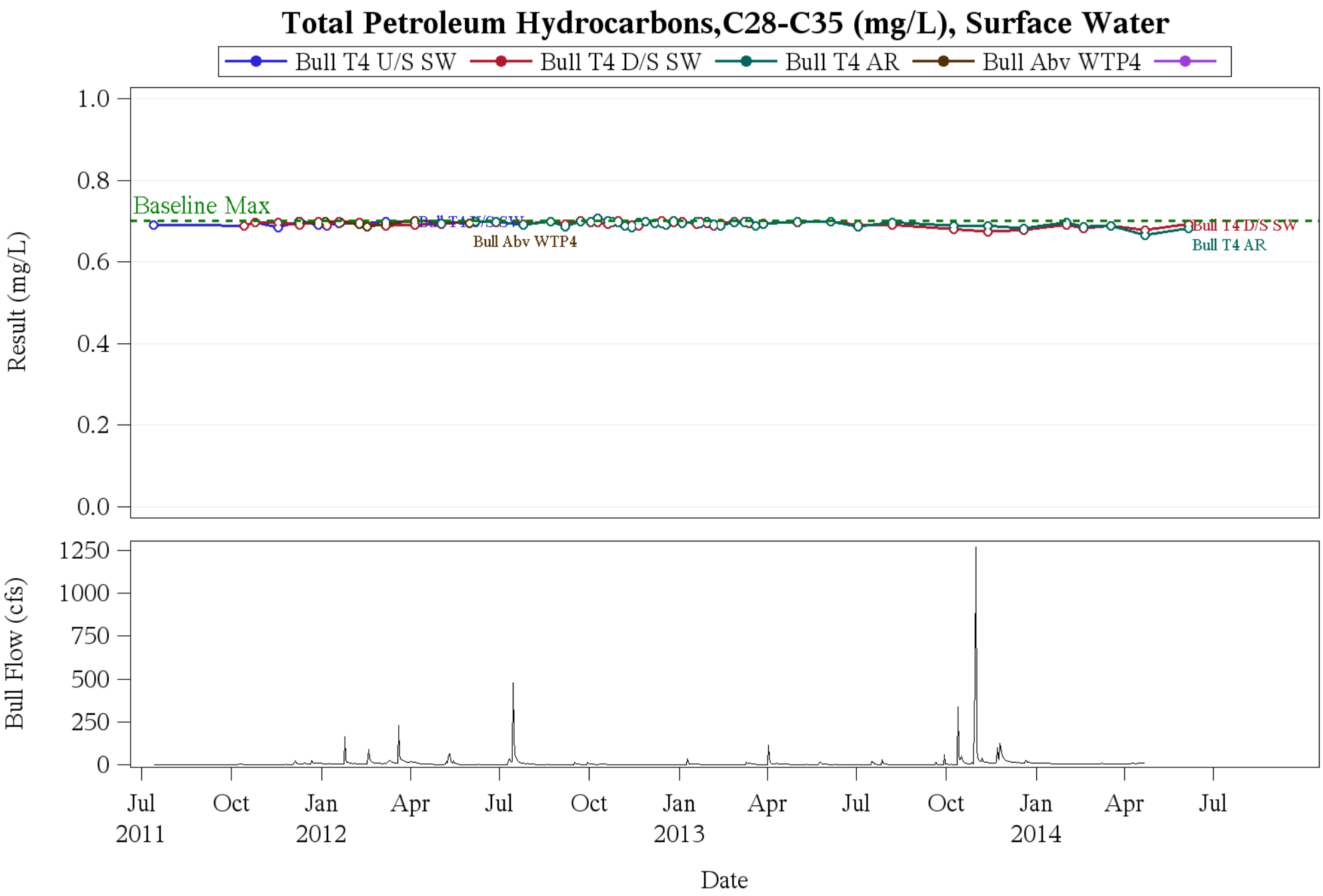

Phosphorus as P (mg/L), Wells
JTMEC Well JT-112
JTMEC Well JT-127
Result (mg/L)
0.8
0.6
0.4
0.2
0.0
TCEQ Screening Level
JT-112 Base Max
JT-127 Base Max
JTMEC Well JT-112
JTMEC Well JT-127
Bull Flow (cfs)
1250
1000
750
500
250
0
Jul 2011
Oct
Jan 2012
Apr
Jul
Oct
Jan 2013
Apr
Jul
Oct
Jan 2014
Apr
Jul
Date

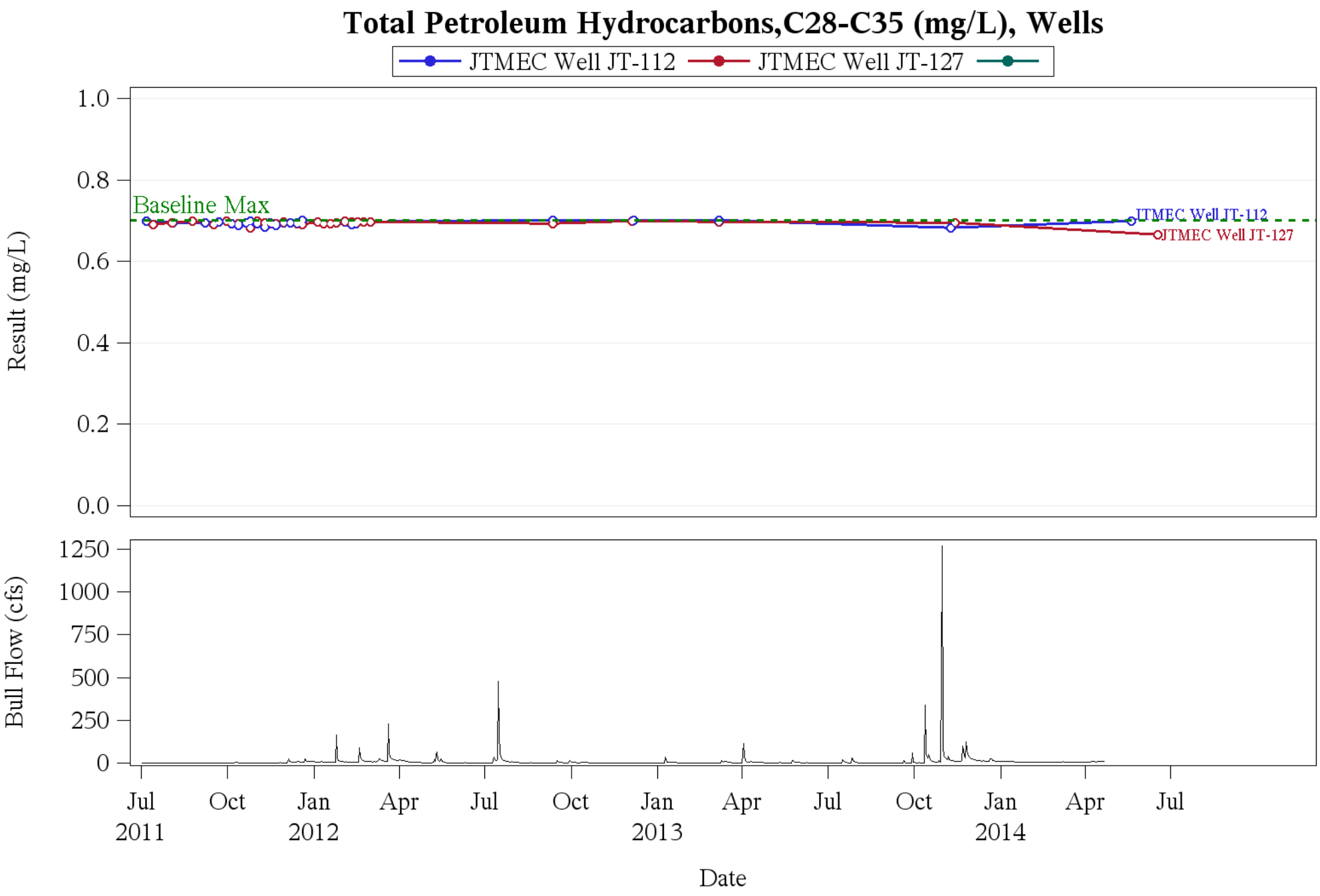

Phosphorus as P (mg/L), Springs
Tanglewood
Ribelin
TCEQ Screening Level
Historic High
Baseline Max
Result (mg/L)
0.8
0.6
0.4
0.2
0.0
Ribelin
Tanglewood
Bull Flow (cfs)
1250
1000
750
500
250
0
Jul 2011
Oct
Jan 2012
Apr
Jul
Oct
Jan 2013
Apr
Jul
Oct
Jan 2014
Apr
Jul
Date

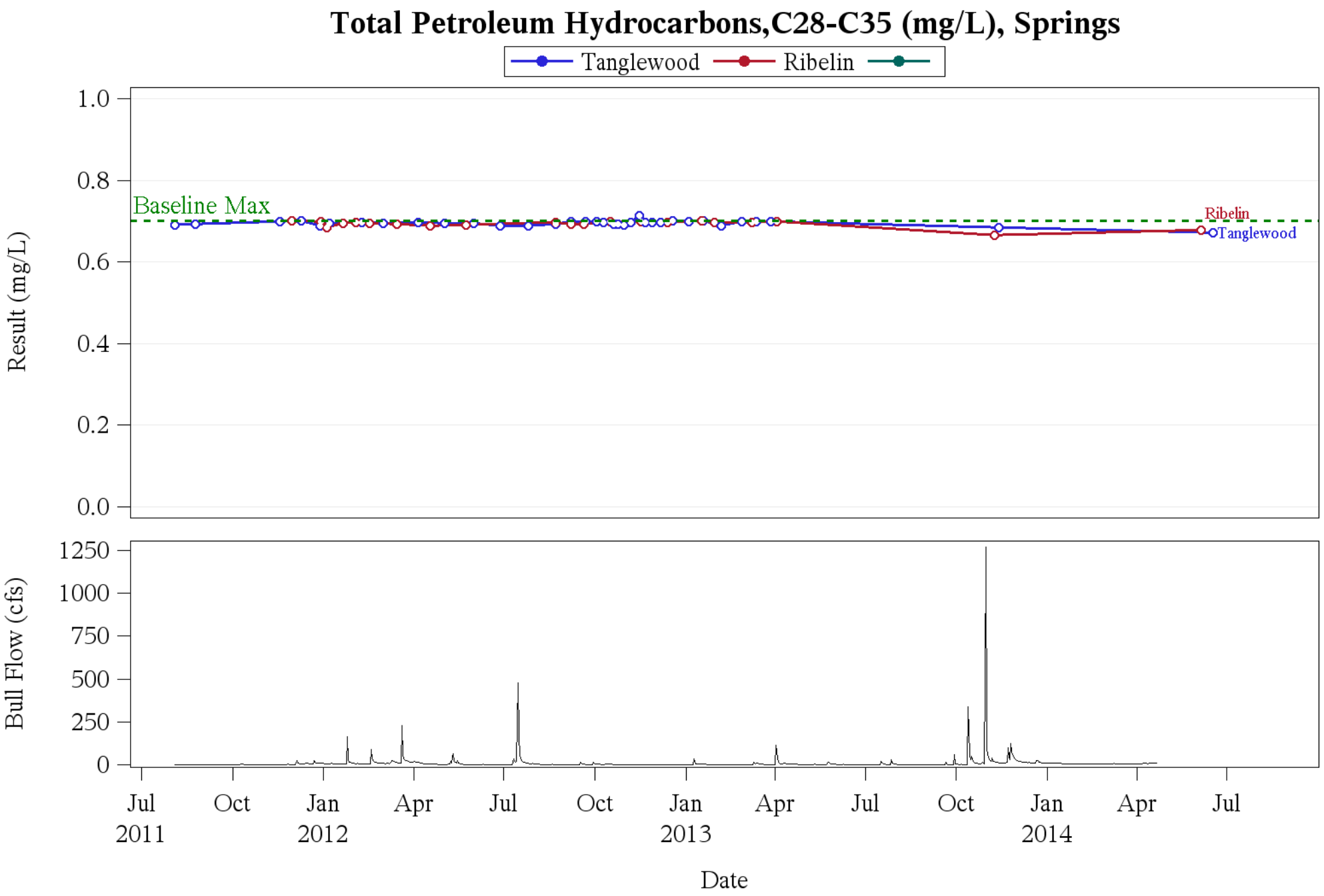

Total Petroleum Hydrocarbons,C12-C28 (mg/L), Surface Water
Bull T4 U/S SW
Bull T4 D/S SW
Bull T4 AR
Bull Abv WTP4
Result (mg/L)
1.0
0.8
0.6
0.4
0.2
0.0
Baseline Max
Bull T4 D/S SW
Bull T4 AR
Bull Abv WTP4
Bull Flow (cfs)
1250
1000
750
500
250
0
Jul
2011
Oct
Jan
2012
Apr
Jul
Oct
Jan
2013
Apr
Jul
Oct
Jan
2014
Apr
Jul
Date

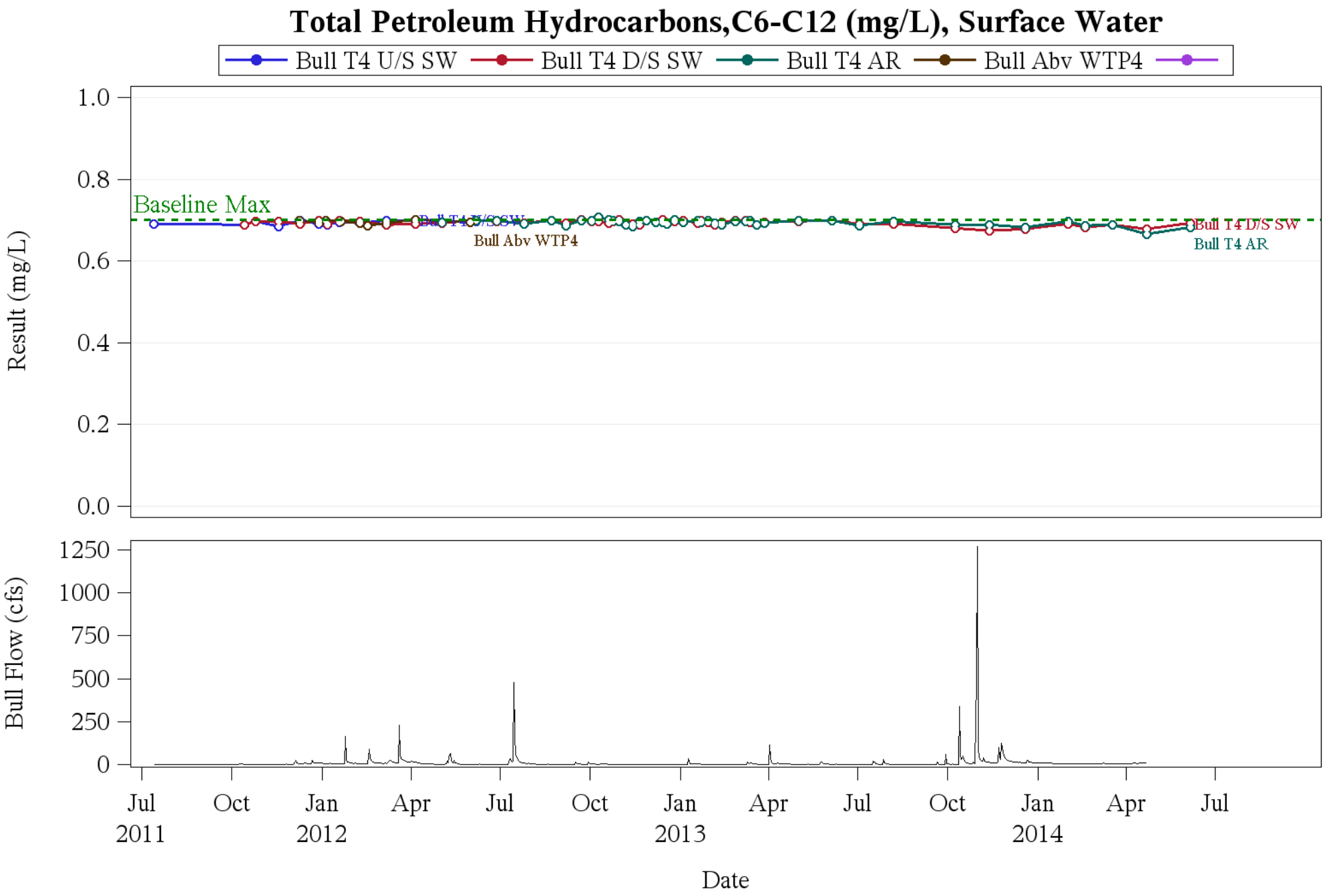

Total Petroleum Hydrocarbons,C12-C28 (mg/L), Wells
JTMEC Well JT-112
JTMEC Well JT-127
Result (mg/L)
1.0
0.8
0.6
0.4
0.2
0.0
Baseline Max
JTMEC Well JT-112
JTMEC Well JT-127
Bull Flow (cfs)
1250
1000
750
500
250
0
Jul 2011
Oct
Jan 2012
Apr
Jul
Oct
Jan 2013
Apr
Jul
Oct
Jan 2014
Apr
Jul
Date

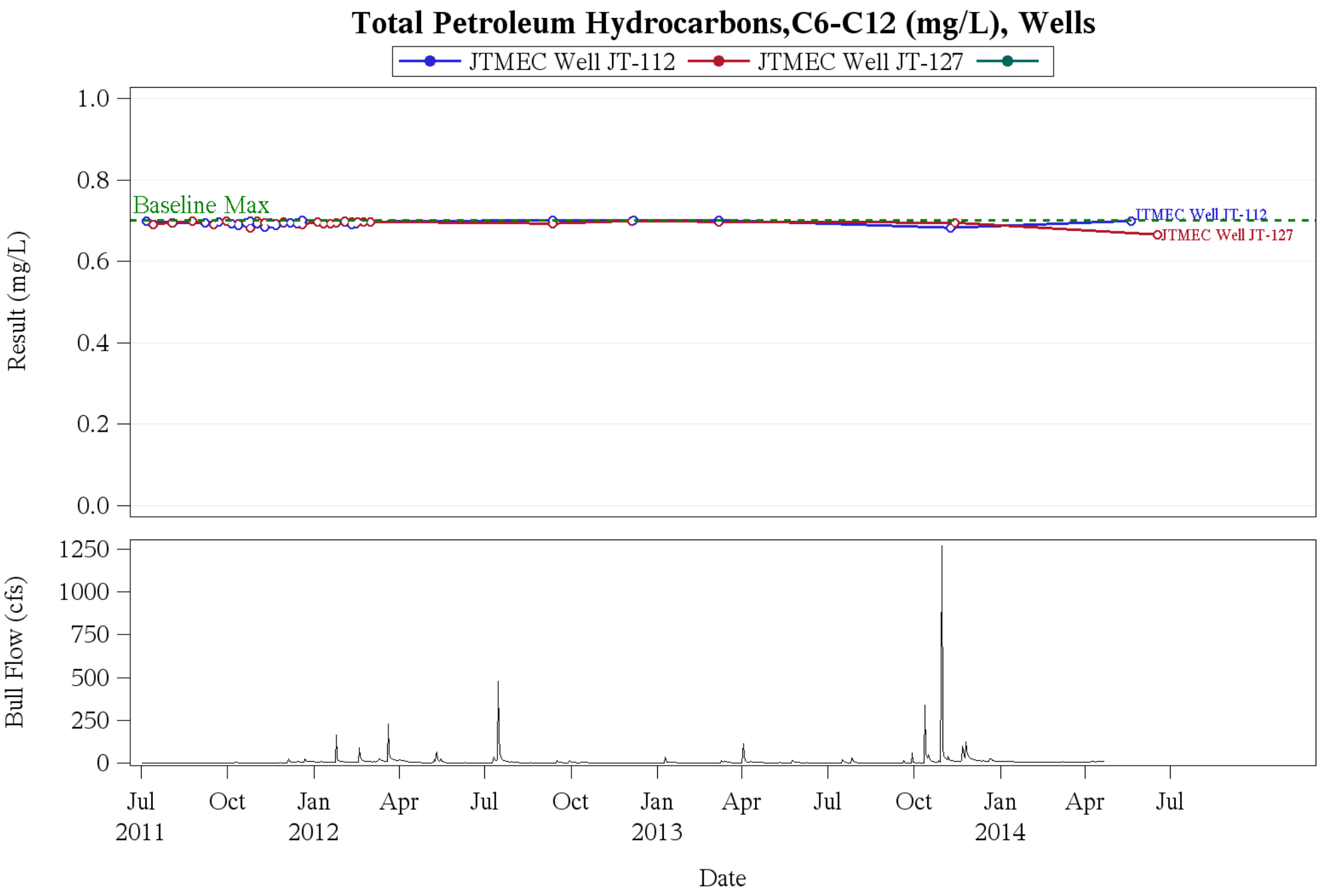

Total Petroleum Hydrocarbons,C12-C28 (mg/L), Springs
Tanglewood
Ribelin
Result (mg/L)
1.0
0.8
0.6
0.4
0.2
0.0
Baseline Max
Ribelin
Tanglewood
Bull Flow (cfs)
1250
1000
750
500
250
0
Jul 2011
Oct
Jan 2012
Apr
Jul
Oct
Jan 2013
Apr
Jul
Oct
Jan 2014
Apr
Jul
Date

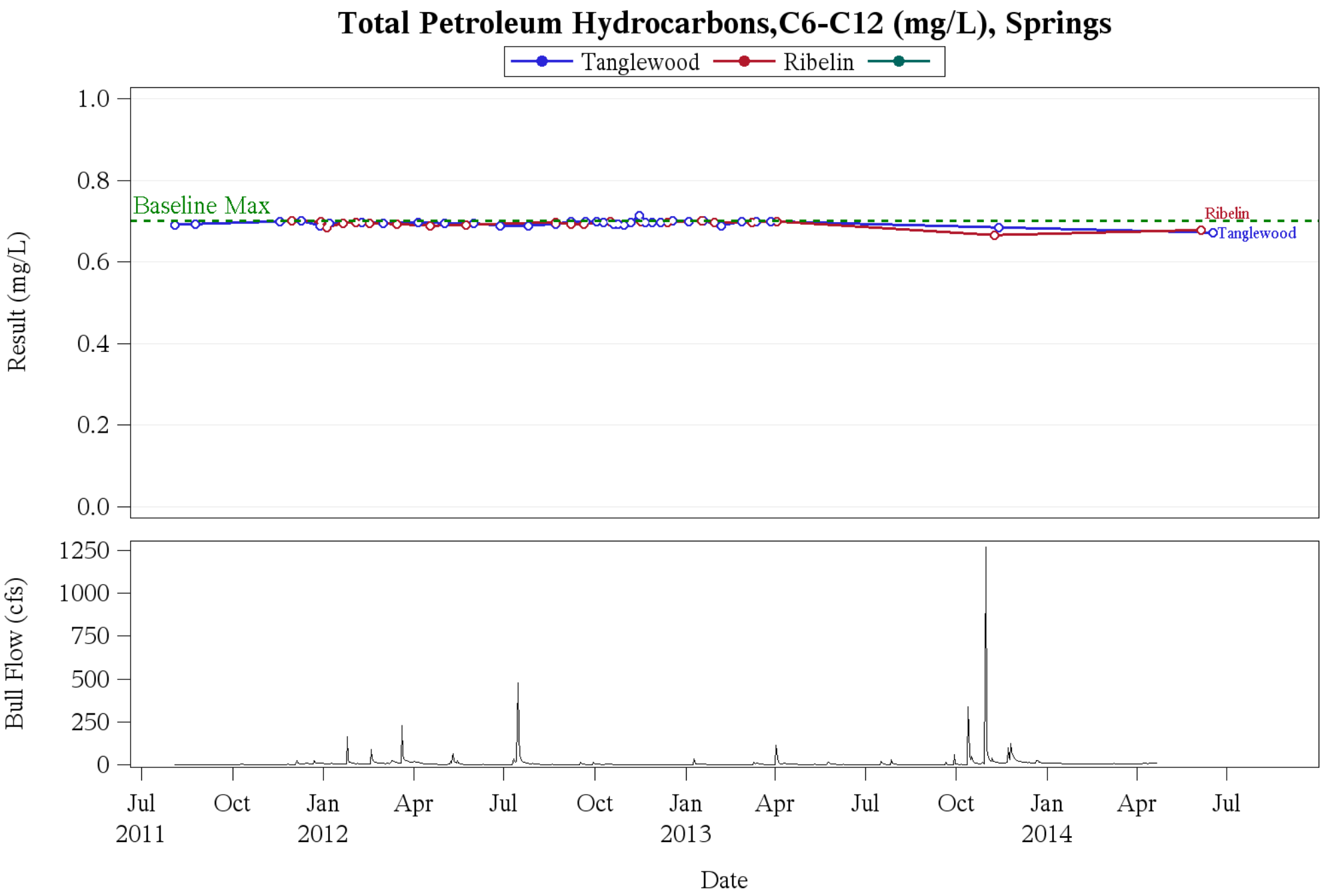

Total Petroleum Hydrocarbons,C28-C35 (mg/L), Surface Water
Bull T4 U/S SW
Bull T4 D/S SW
Bull T4 AR
Bull Abv WTP4
Result (mg/L)
1.0
0.8
0.6
0.4
0.2
0.0
Baseline Max
Bull T4 D/S SW
Bull T4 AR
Bull Abv WTP4
Bull Flow (cfs)
1250
1000
750
500
250
0
Jul
2011
Oct
Jan
2012
Apr
Jul
Oct
Jan
2013
Apr
Jul
Oct
Jan
2014
Apr
Jul
Date

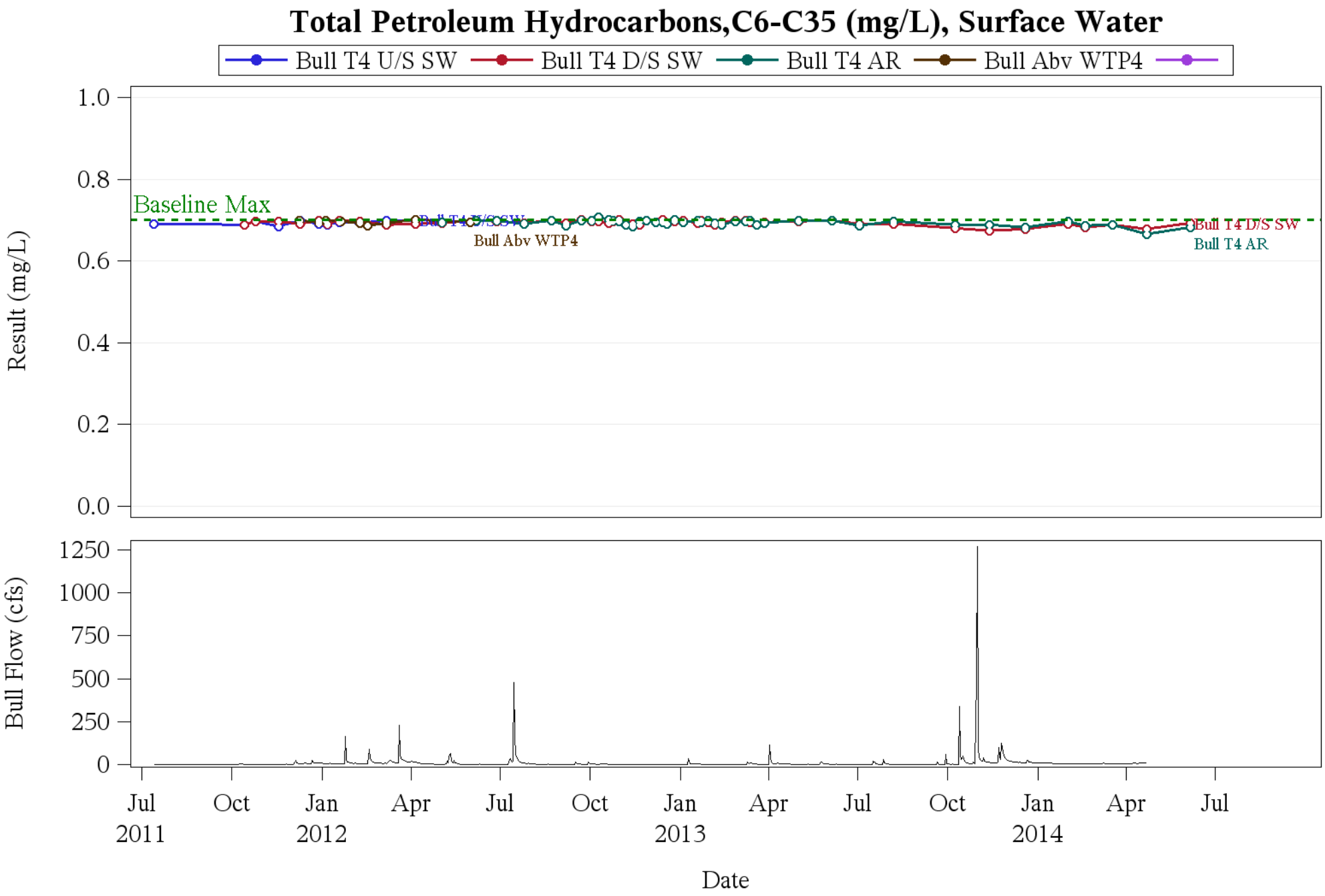

Total Petroleum Hydrocarbons,C28-C35 (mg/L), Wells
JTMEC Well JT-112
JTMEC Well JT-127
Result (mg/L)
1.0
0.8
0.6
0.4
0.2
0.0
Baseline Max
JTMEC Well JT-112
JTMEC Well JT-127
Bull Flow (cfs)
1250
1000
750
500
250
0
Jul 2011
Oct
Jan 2012
Apr
Jul
Oct
Jan 2013
Apr
Jul
Oct
Jan 2014
Apr
Jul
Date

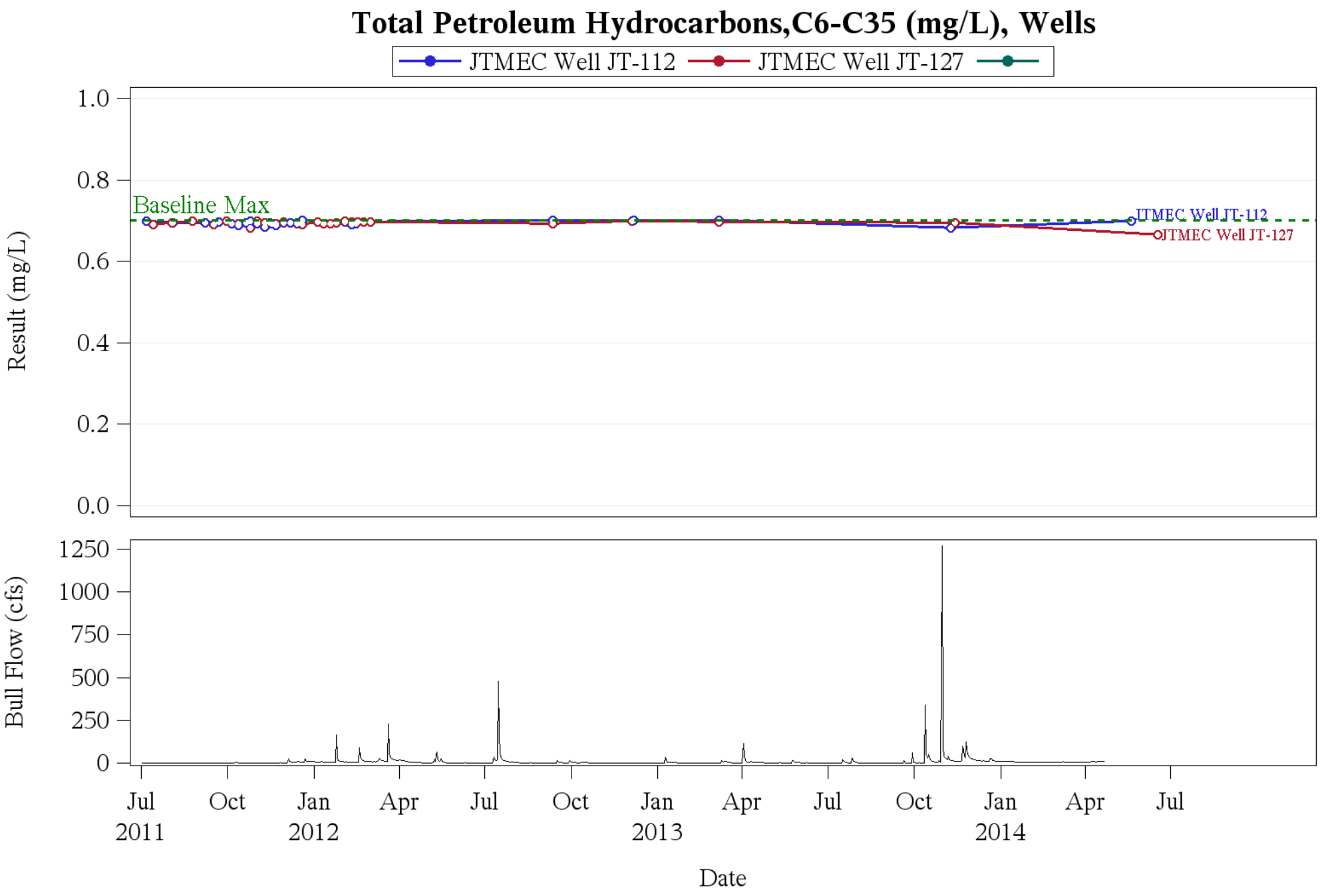

Total Petroleum Hydrocarbons,C28-C35 (mg/L), Springs
Tanglewood
Ribelin
Result (mg/L)
1.0
0.8
0.6
0.4
0.2
0.0
Baseline Max
Ribelin
Tanglewood
Bull Flow (cfs)
1250
1000
750
500
250
0
Jul 2011
Oct
Jan 2012
Apr
Jul
Oct
Jan 2013
Apr
Jul
Oct
Jan 2014
Apr
Jul
Date

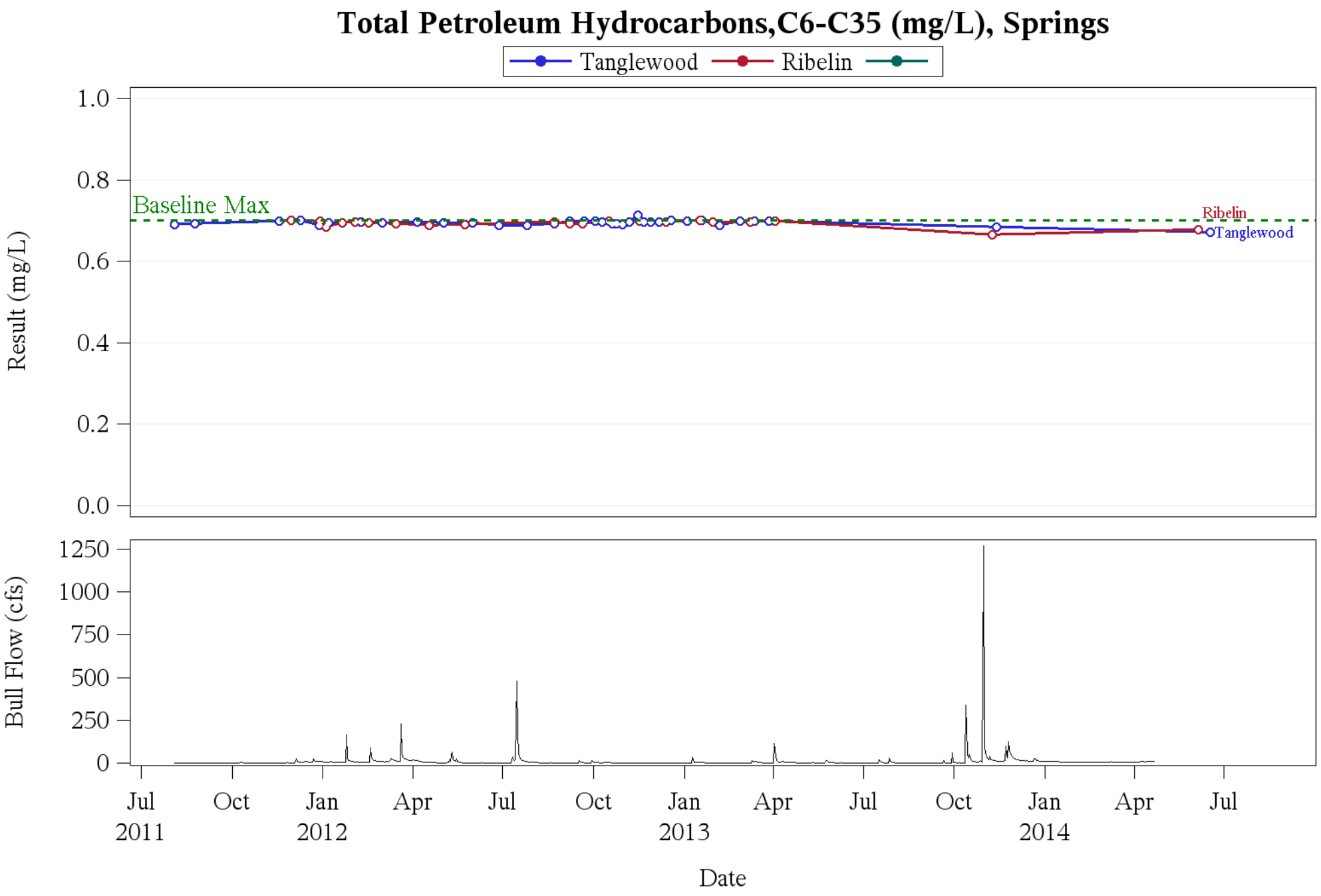

Total Petroleum Hydrocarbons,C6-C12 (mg/L), Surface Water
Bull T4 U/S SW
Bull T4 D/S SW
Bull T4 AR
Bull Abv WTP4
Result (mg/L)
1.0
0.8
0.6
0.4
0.2
0.0
Baseline Max
Bull T4 D/S SW
Bull T4 AR
Bull Abv WTP4
Bull Flow (cfs)
1250
1000
750
500
250
0
Jul 2011
Oct
Jan 2012
Apr
Jul
Oct
Jan 2013
Apr
Jul
Oct
Jan 2014
Apr
Jul
Date

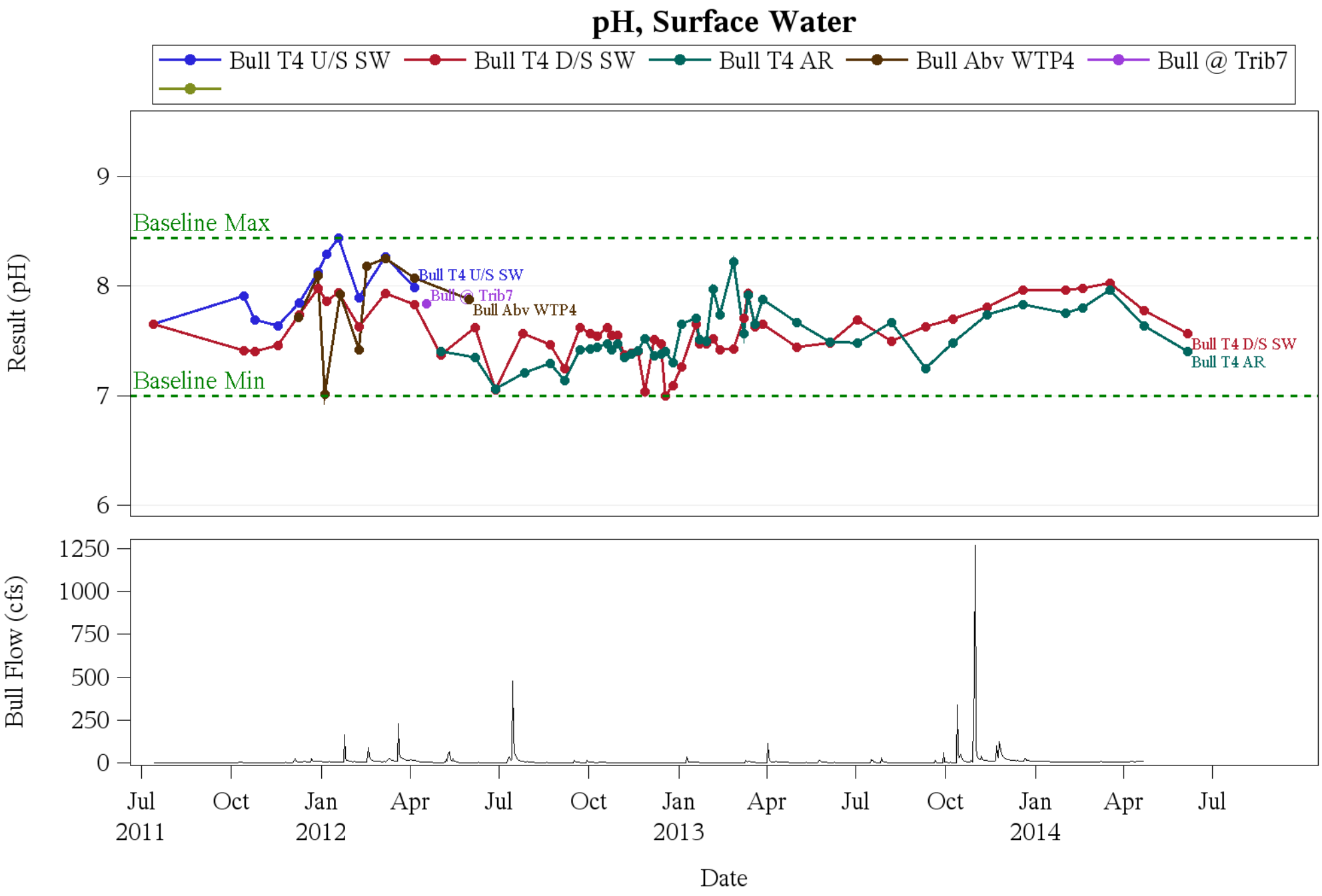

Total Petroleum Hydrocarbons,C6-C12 (mg/L), Wells
JTMEC Well JT-112
JTMEC Well JT-127
Result (mg/L)
1.0
0.8
0.6
0.4
0.2
0.0
Baseline Max
JTMEC Well JT-112
JTMEC Well JT-127
Bull Flow (cfs)
1250
1000
750
500
250
0
Jul 2011
Oct
Jan 2012
Apr
Jul
Oct
Jan 2013
Apr
Jul
Oct
Jan 2014
Apr
Jul
Date

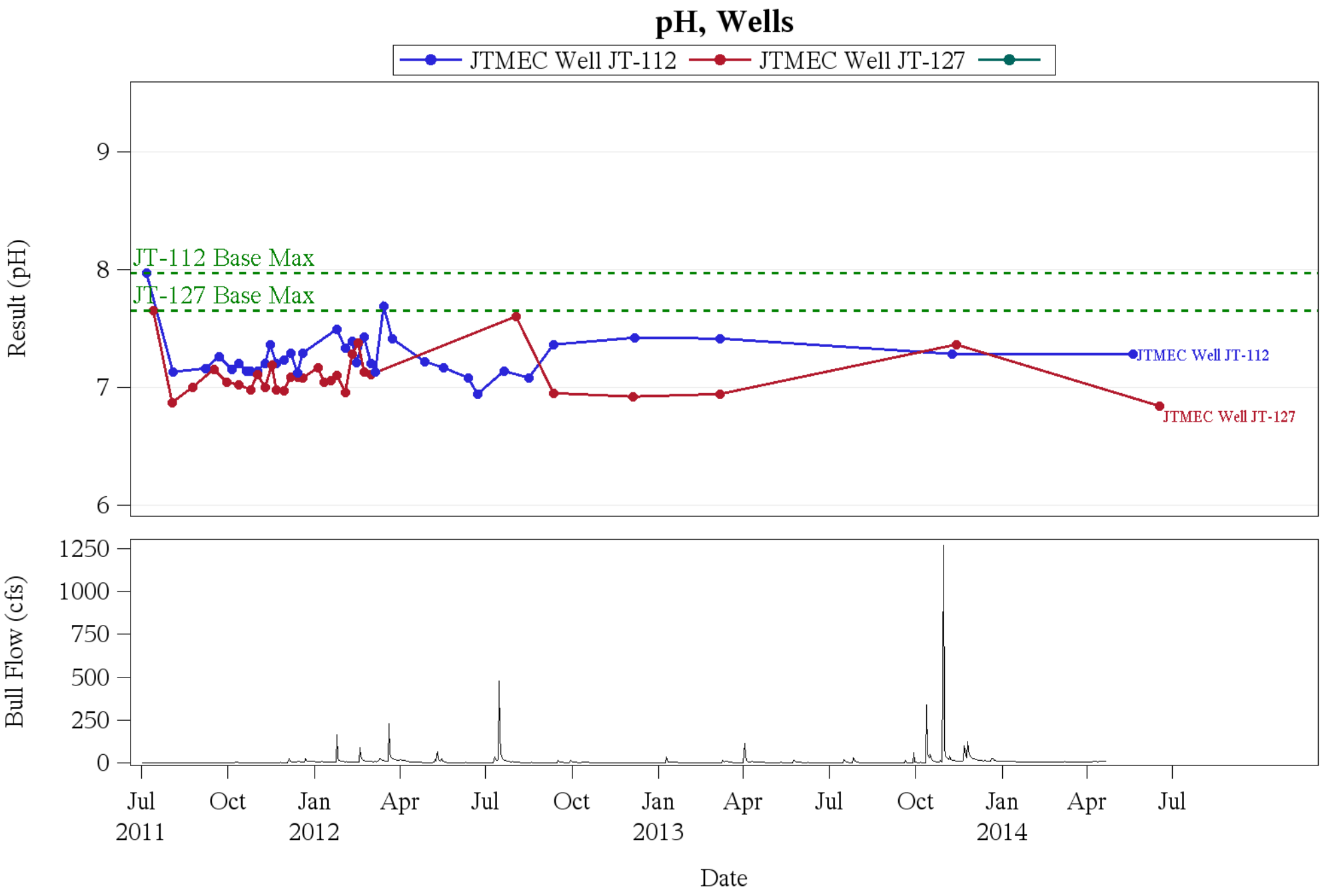

Total Petroleum Hydrocarbons,C6-C12 (mg/L), Springs
Tanglewood
Ribelin
Result (mg/L)
1.0
0.8
0.6
0.4
0.2
0.0
Baseline Max
Ribelin
Tanglewood
Bull Flow (cfs)
1250
1000
750
500
250
0
Jul 2011
Oct
Jan 2012
Apr
Jul
Oct
Jan 2013
Apr
Jul
Oct
Jan 2014
Apr
Jul
Date

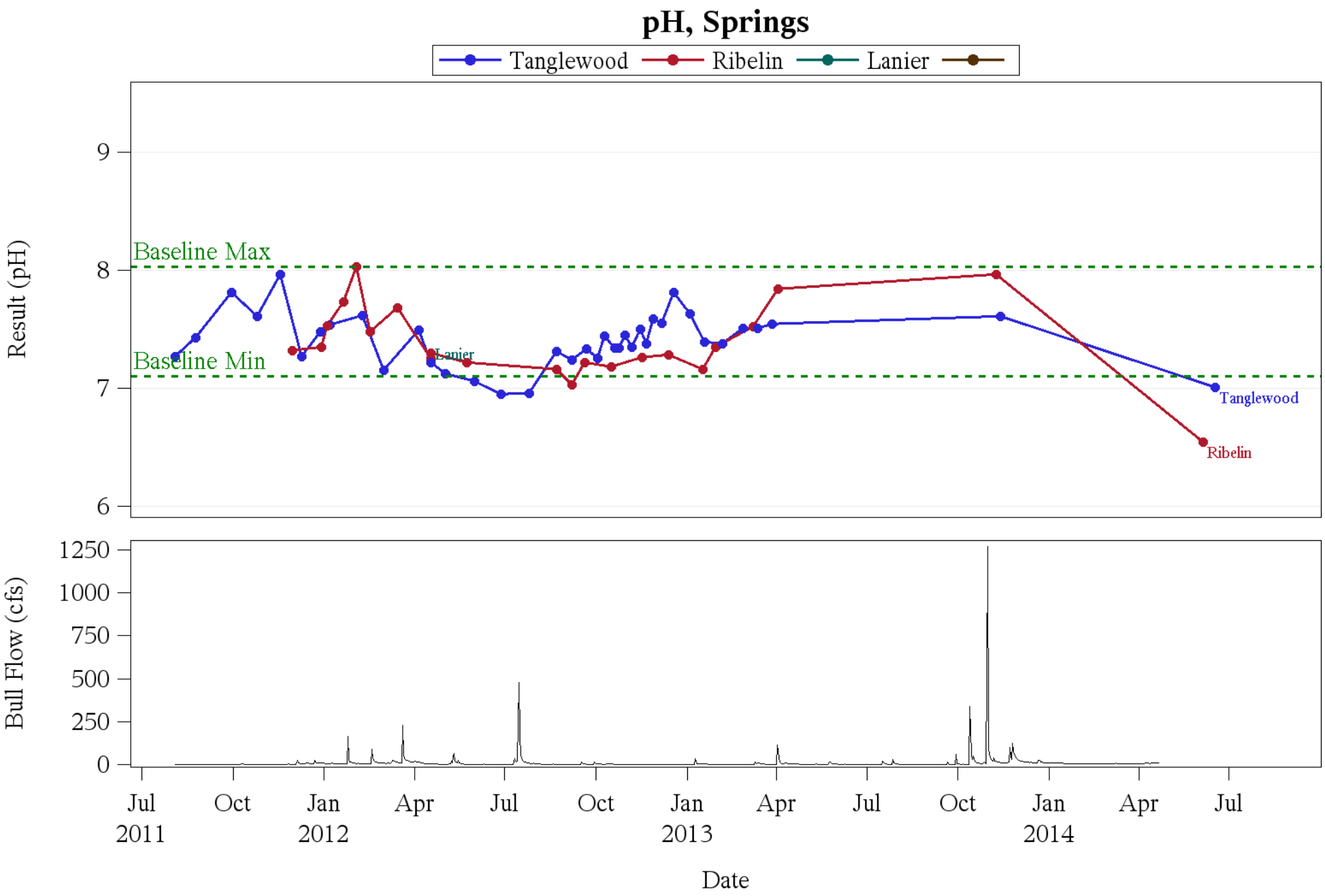

Total Petroleum Hydrocarbons,C6-C35 (mg/L), Surface Water
Bull T4 U/S SW
Bull T4 D/S SW
Bull T4 AR
Bull Abv WTP4
Result (mg/L)
1.0
0.8
0.6
0.4
0.2
0.0
Baseline Max
Bull T4 D/S SW
Bull T4 AR
Bull Abv WTP4
Bull Flow (cfs)
1250
1000
750
500
250
0
Jul 2011
Oct
Jan 2012
Apr
Jul
Oct
Jan 2013
Apr
Jul
Oct
Jan 2014
Apr
Jul
Date

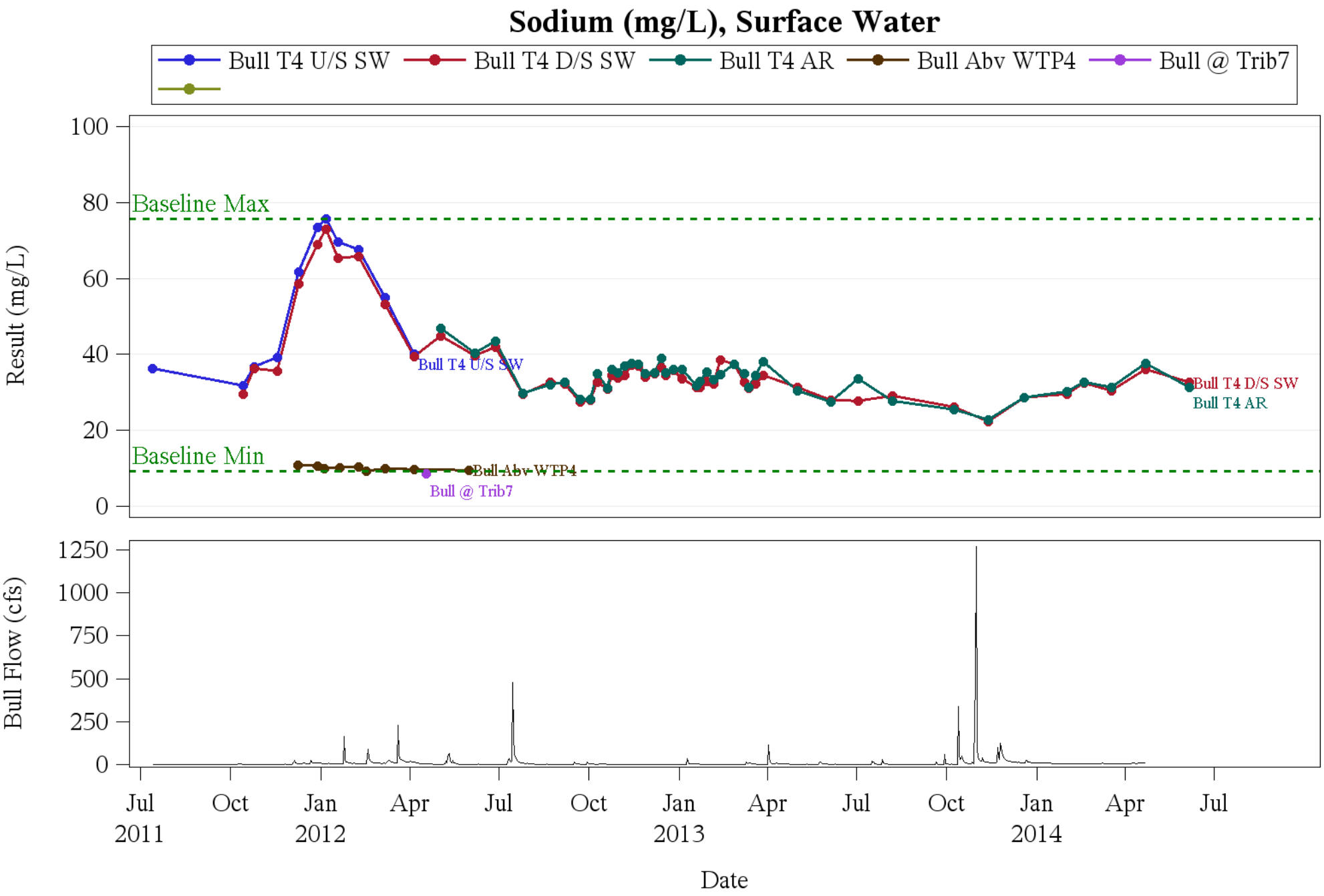

Total Petroleum Hydrocarbons,C6-C35 (mg/L), Wells
JTMEC Well JT-112
JTMEC Well JT-127
Result (mg/L)
1.0
0.8
0.6
0.4
0.2
0.0
Baseline Max
JTMEC Well JT-112
JTMEC Well JT-127
Bull Flow (cfs)
1250
1000
750
500
250
0
Jul 2011
Oct
Jan 2012
Apr
Jul
Oct
Jan 2013
Apr
Jul
Oct
Jan 2014
Apr
Jul
Date

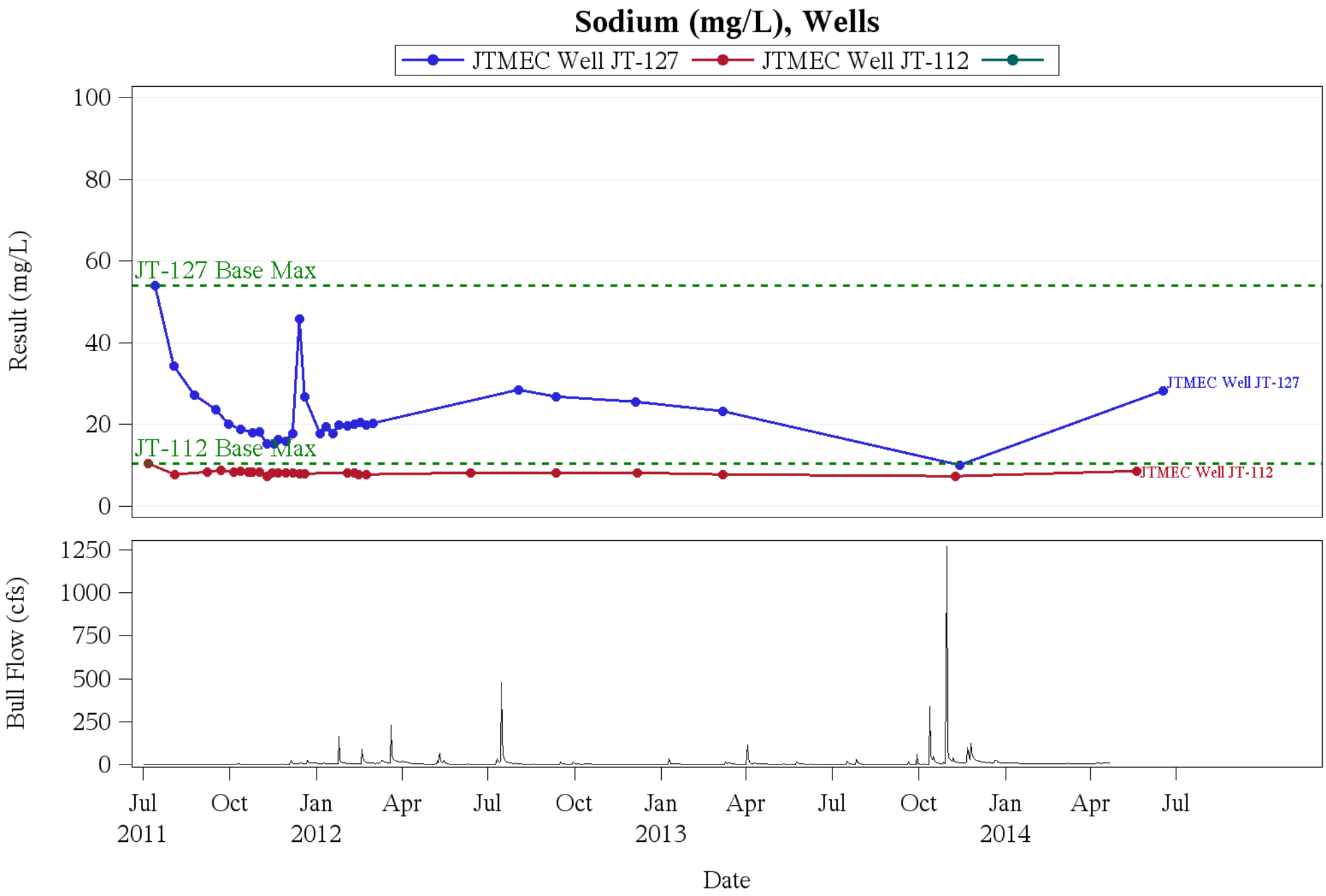

Total Petroleum Hydrocarbons,C6-C35 (mg/L), Springs
Tanglewood
Ribelin
Result (mg/L)
1.0
0.8
0.6
0.4
0.2
0.0
Baseline Max
Ribelin
Tanglewood
Bull Flow (cfs)
1250
1000
750
500
250
0
Jul 2011
Oct
Jan 2012
Apr
Jul
Oct
Jan 2013
Apr
Jul
Oct
Jan 2014
Apr
Jul
Date

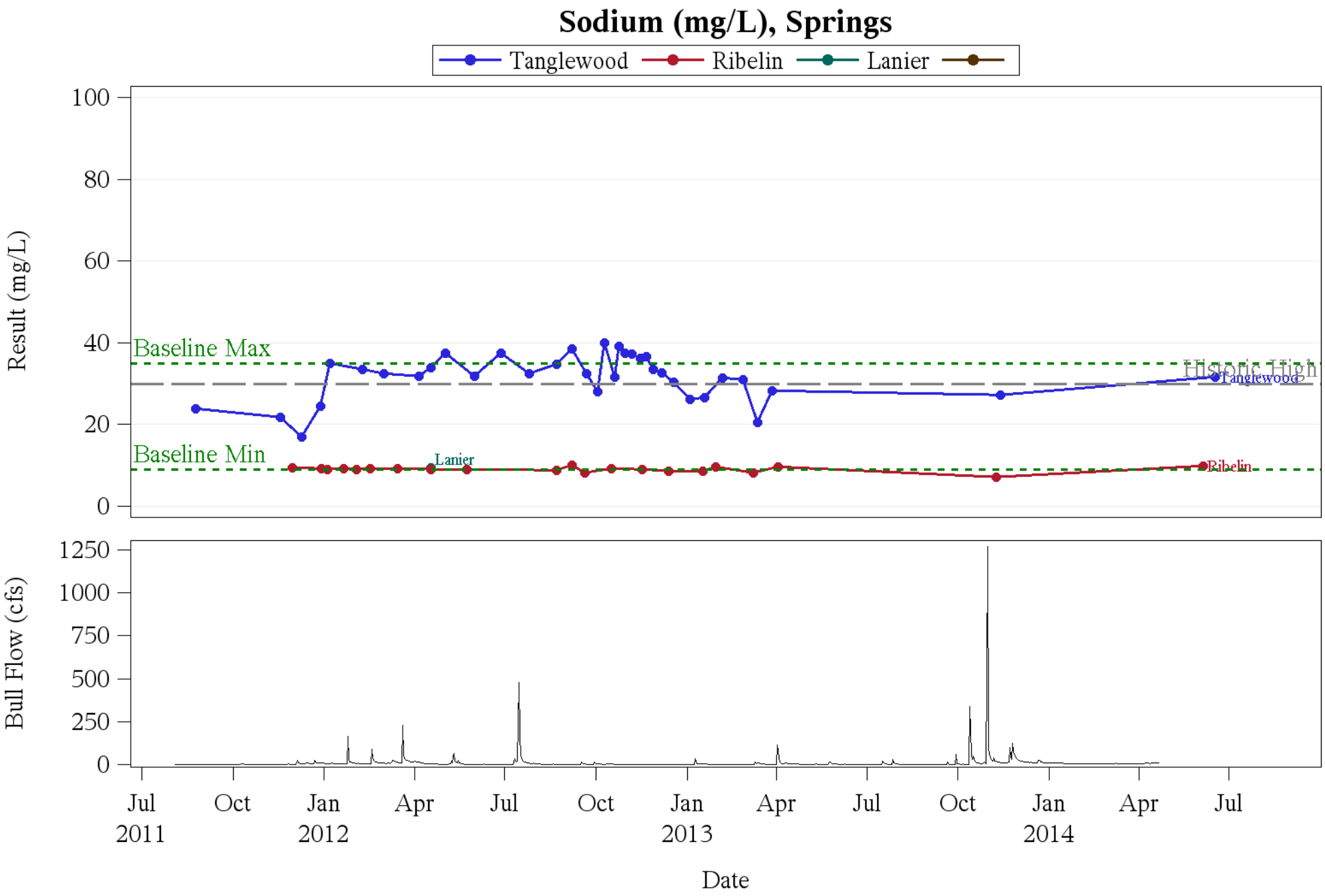

pH, Surface Water
Bull T4 U/S SW
Bull T4 D/S SW
Bull T4 AR
Bull Abv WTP4
Bull @ Trib7
Result (pH)
9
8
7
6
Baseline Max
Baseline Min
Bull T4 U/S SW
Bull @ Trib7
Bull Abv WTP4
Bull T4 D/S SW
Bull T4 AR
Bull Flow (cfs)
1250
1000
750
500
250
0
Jul 2011
Oct
Jan 2012
Apr
Jul
Oct
Jan 2013
Apr
Jul
Oct
Jan 2014
Apr
Jul
Date

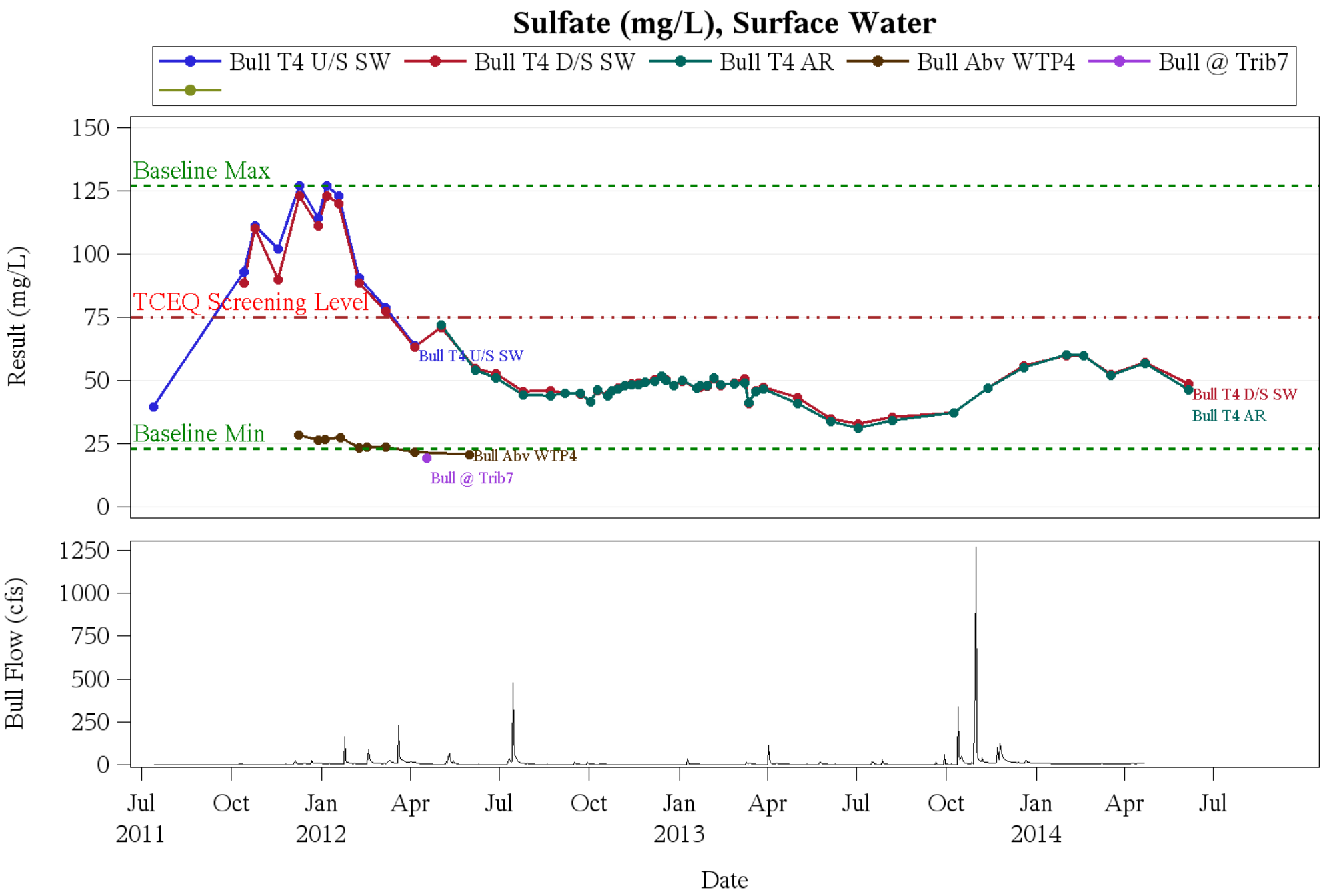

pH, Wells
JTMEC Well JT-112
JTMEC Well JT-127
Result (pH)
9
8
7
6
JT-112 Base Max
JT-127 Base Max
JTMEC Well JT-112
JTMEC Well JT-127
Bull Flow (cfs)
1250
1000
750
500
250
0
Jul 2011
Oct
Jan 2012
Apr
Jul
Oct
Jan 2013
Apr
Jul
Oct
Jan 2014
Apr
Jul
Date

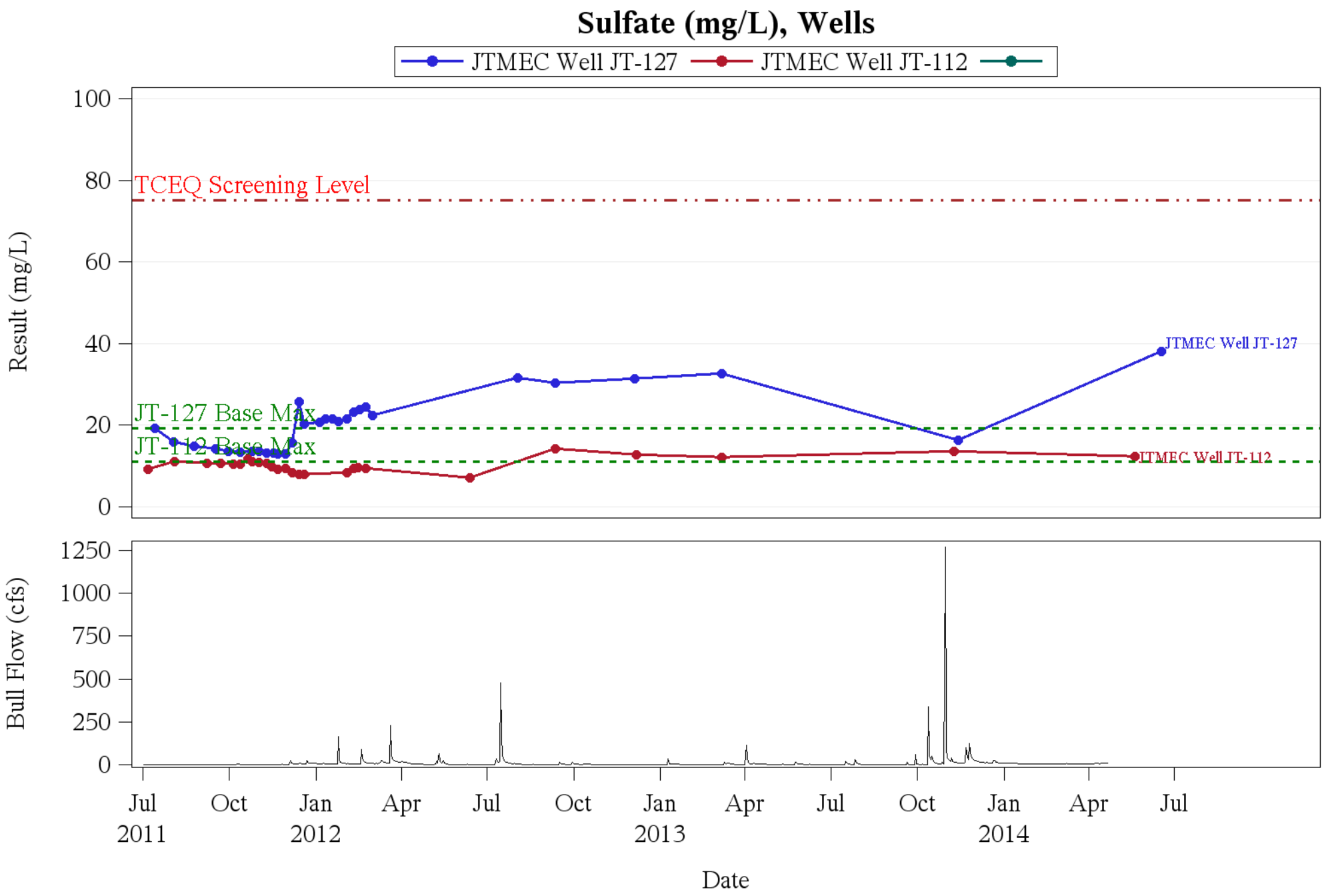

pH, Springs
Tanglewood
Ribelin
Lanier
Result (pH)
9
8
7
6
Baseline Max
Baseline Min
Lanier
Tanglewood
Ribelin
Bull Flow (cfs)
1250
1000
750
500
250
0
Jul
2011
Oct
Jan
2012
Apr
Jul
Oct
Jan
2013
Apr
Jul
Oct
Jan
2014
Apr
Jul
Date

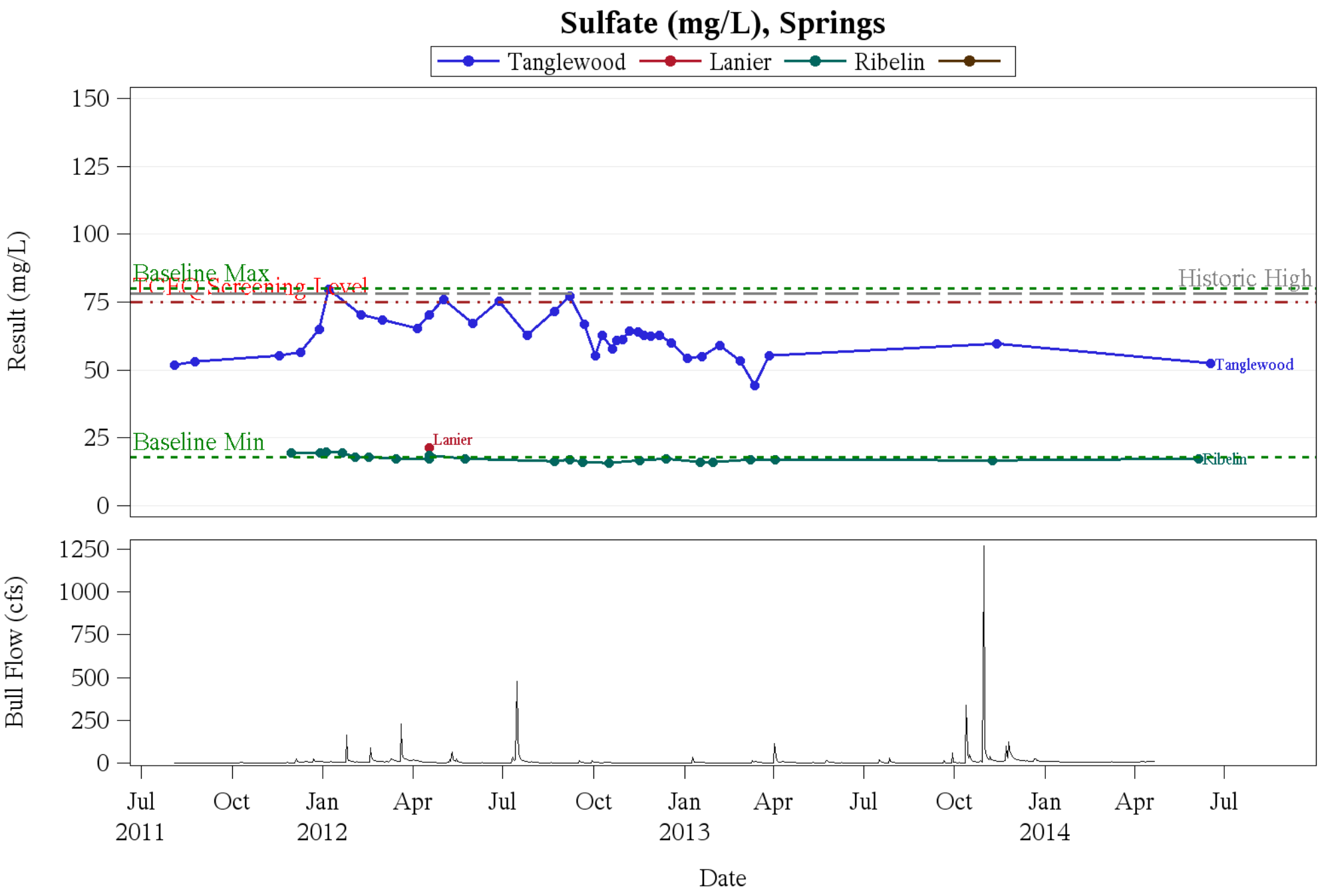

Sodium (mg/L), Surface Water
Bull T4 U/S SW
Bull T4 D/S SW
Bull T4 AR
Bull Abv WTP4
Bull @ Trib7
Result (mg/L)
100
80
60
40
20
0
Baseline Max
Baseline Min
Bull T4 U/S SW
Bull T4 D/S SW
Bull T4 AR
Bull Abv WTP4
Bull @ Trib7
Bull Flow (cfs)
1250
1000
750
500
250
0
Jul 2011
Oct
Jan 2012
Apr
Jul
Oct
Jan 2013
Apr
Jul
Oct
Jan 2014
Apr
Jul
Date

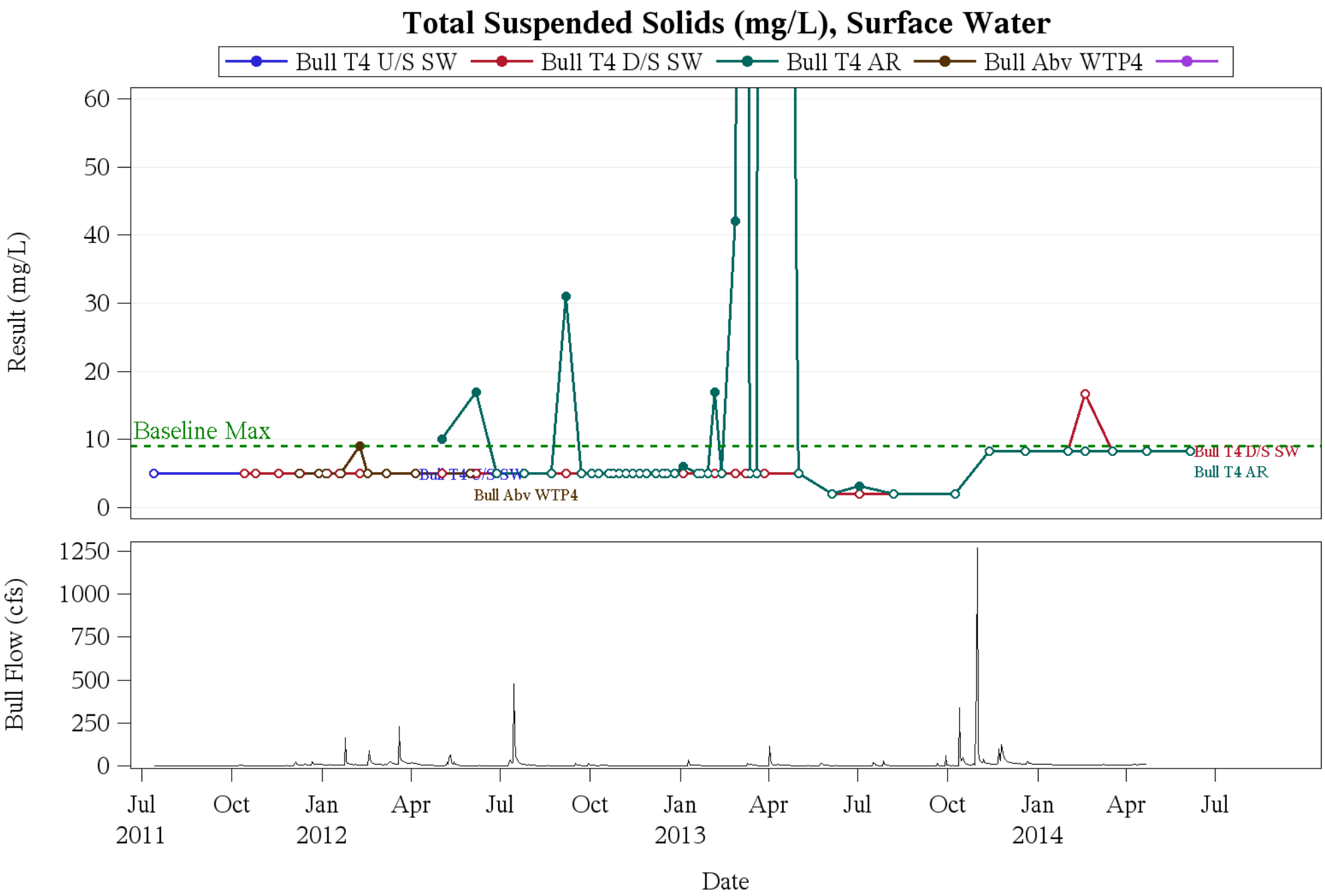

Sodium (mg/L), Wells
JTMEC Well JT-127
JTMEC Well JT-112
Result (mg/L)
100
80
60
40
20
0
JT-127 Base Max
JT-112 Base Max
JTMEC Well JT-127
JTMEC Well JT-112
Bull Flow (cfs)
1250
1000
750
500
250
0
Jul 2011
Oct
Jan 2012
Apr
Jul
Oct
Jan 2013
Apr
Jul
Oct
Jan 2014
Apr
Jul
Date

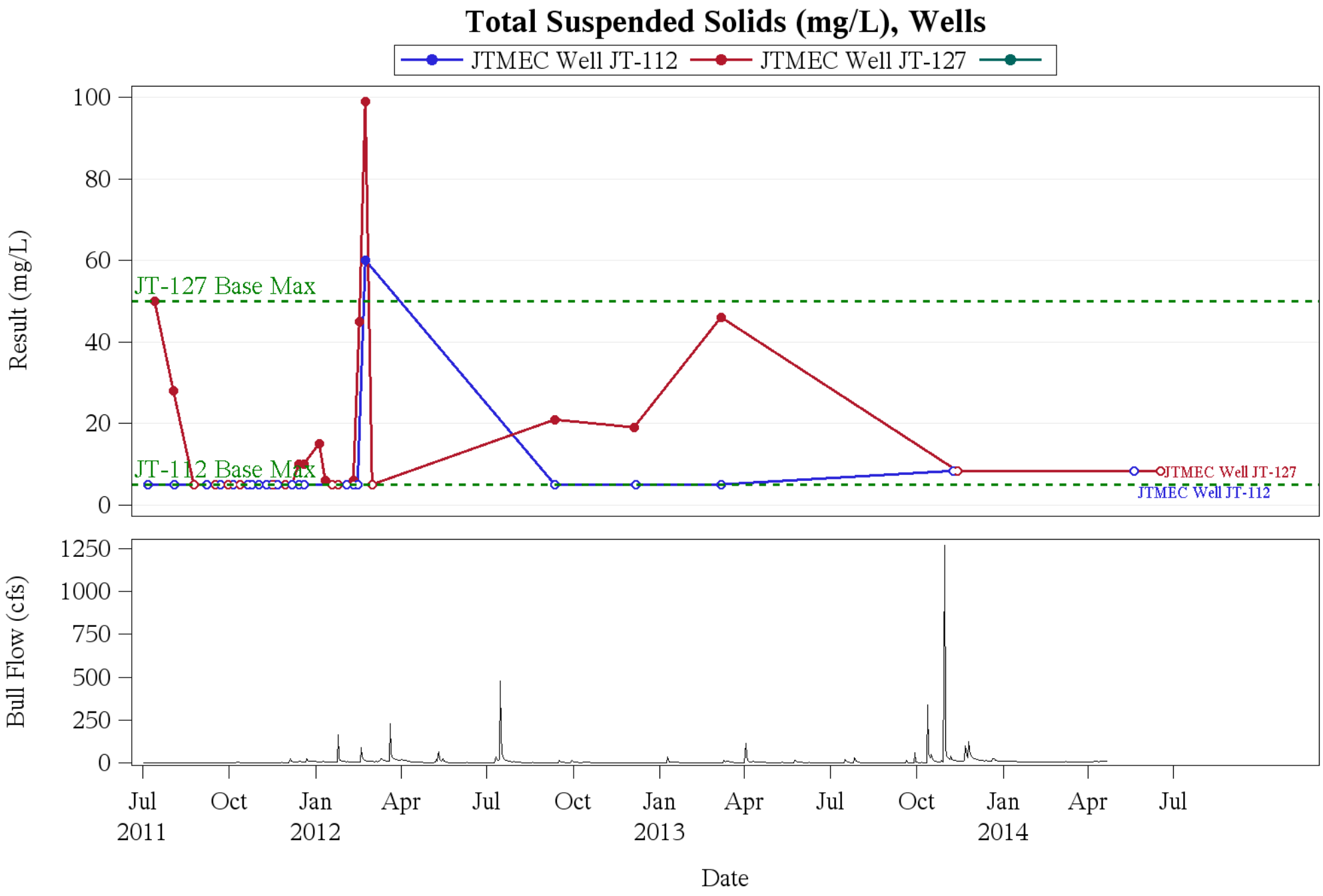

Sodium (mg/L), Springs
Tanglewood
Ribelin
Lanier
Result (mg/L)
100
80
60
40
20
0
Baseline Max
Baseline Min
Historic High
Tanglewood
Lanier
Ribelin
Bull Flow (cfs)
1250
1000
750
500
250
0
Jul
2011
Oct
Jan
2012
Apr
Jul
Oct
Jan
2013
Apr
Jul
Oct
Jan
2014
Apr
Jul
Date

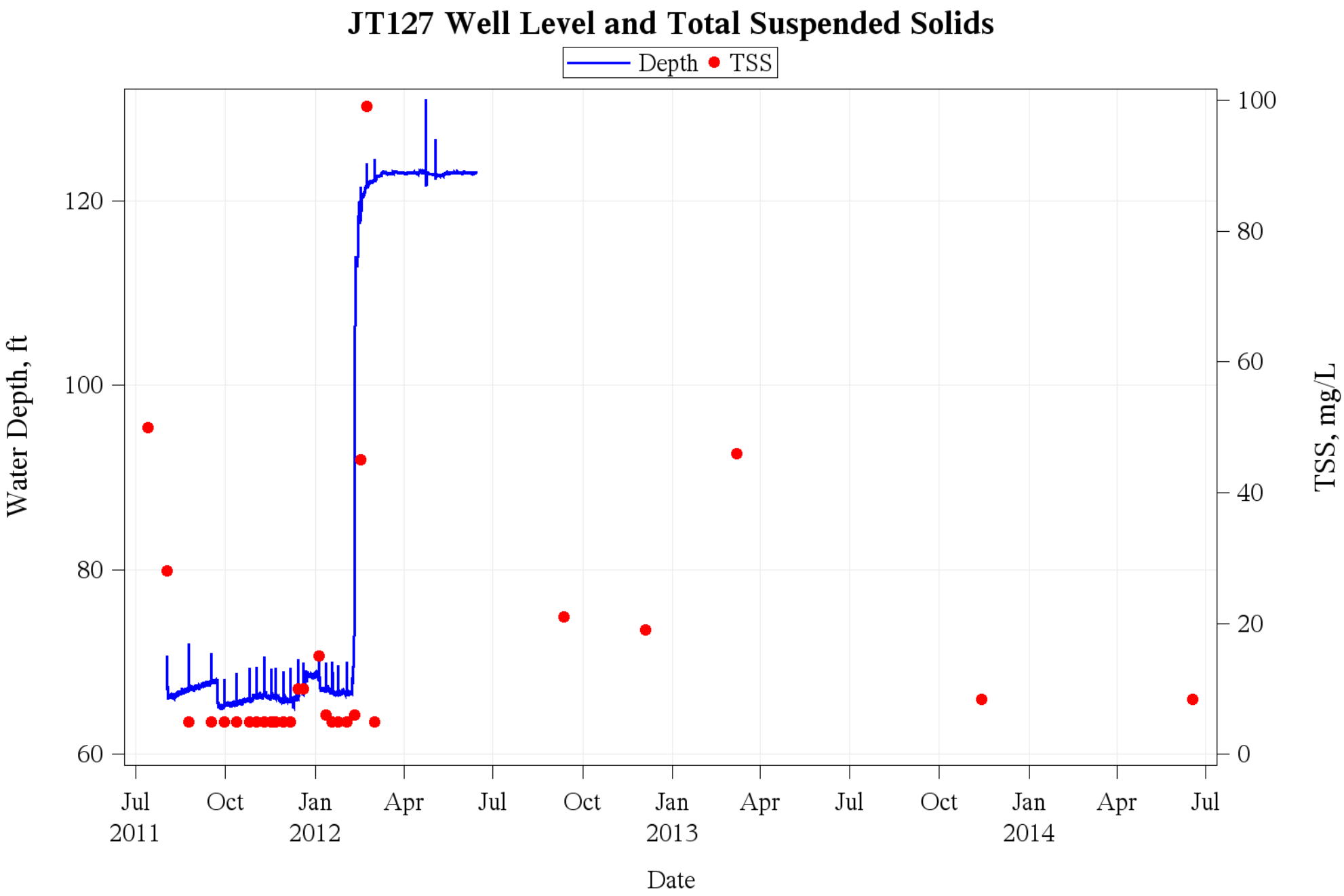

Sulfate (mg/L), Surface Water
Bull T4 U/S SW
Bull T4 D/S SW
Bull T4 AR
Bull Abv WTP4
Bull @ Trib7
Result (mg/L)
150
125
100
75
50
25
0
Baseline Max
TCEQ Screening Level
Baseline Min
Bull T4 U/S SW
Bull T4 D/S SW
Bull T4 AR
Bull Abv WTP4
Bull @ Trib7
Bull Flow (cfs)
1250
1000
750
500
250
0
Jul 2011
Oct
Jan 2012
Apr
Jul
Oct
Jan 2013
Apr
Jul
Oct
Jan 2014
Apr
Jul
Date


Sulfate (mg/L), Wells
JTMEC Well JT-127
JTMEC Well JT-112
Result (mg/L)
100
80
60
40
20
0
TCEQ Screening Level
JT-127 Base Max
JT-112 Base Max
JTMEC Well JT-127
JTMEC Well JT-112
Bull Flow (cfs)
1250
1000
750
500
250
0
Jul 2011
Oct
Jan 2012
Apr
Jul
Oct
Jan 2013
Apr
Jul
Oct
Jan 2014
Apr
Jul
Date

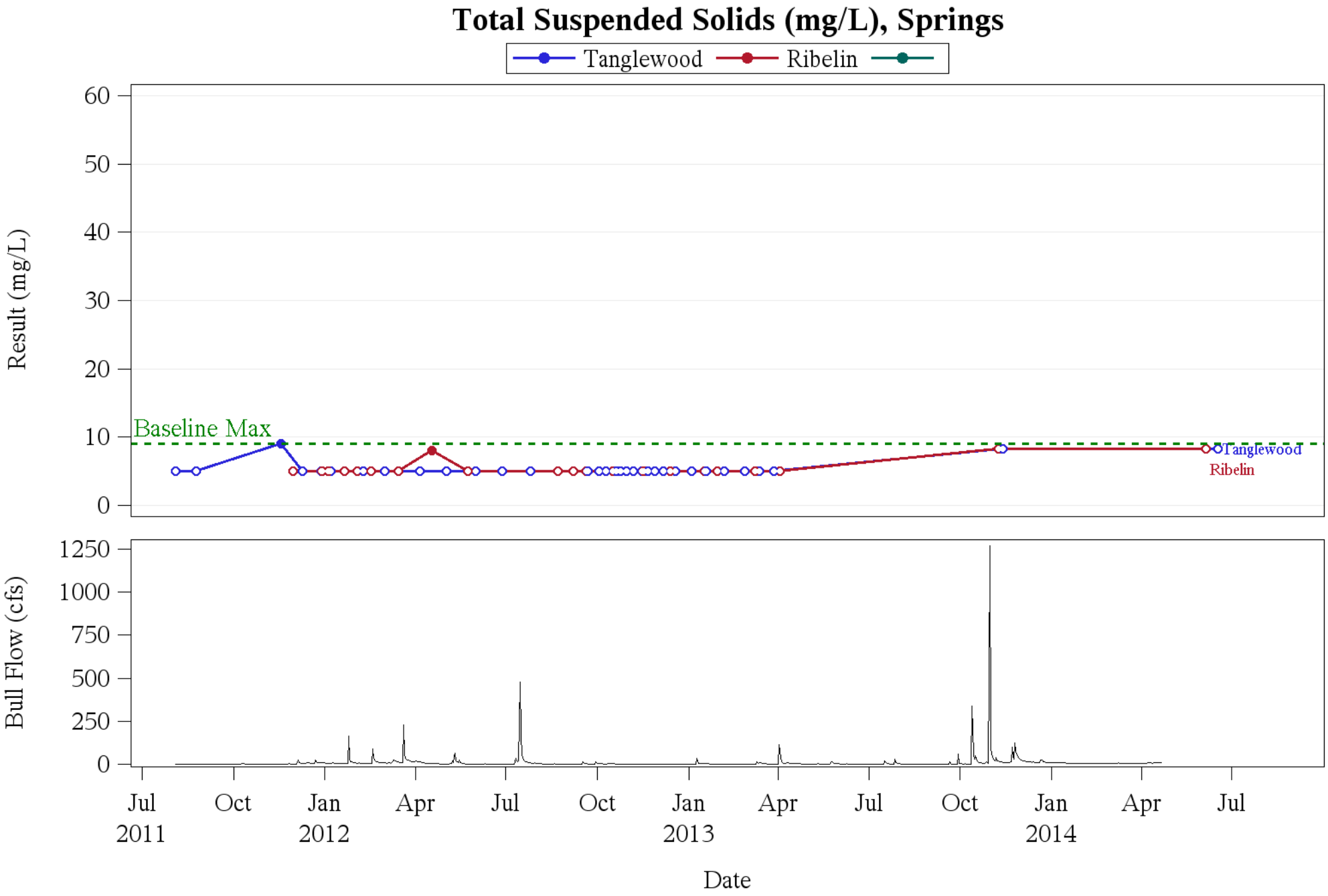

Sulfate (mg/L), Springs
Tanglewood
Lanier
Ribelin
Result (mg/L)
150
125
100
75
50
25
0
Baseline Max
TCEQ Screening Level
Historic High
Tanglewood
Baseline Min
Lanier
Ribelin
Bull Flow (cfs)
1250
1000
750
500
250
0
Jul
2011
Oct
Jan
2012
Apr
Jul
Oct
Jan
2013
Apr
Jul
Oct
Jan
2014
Apr
Jul
Date

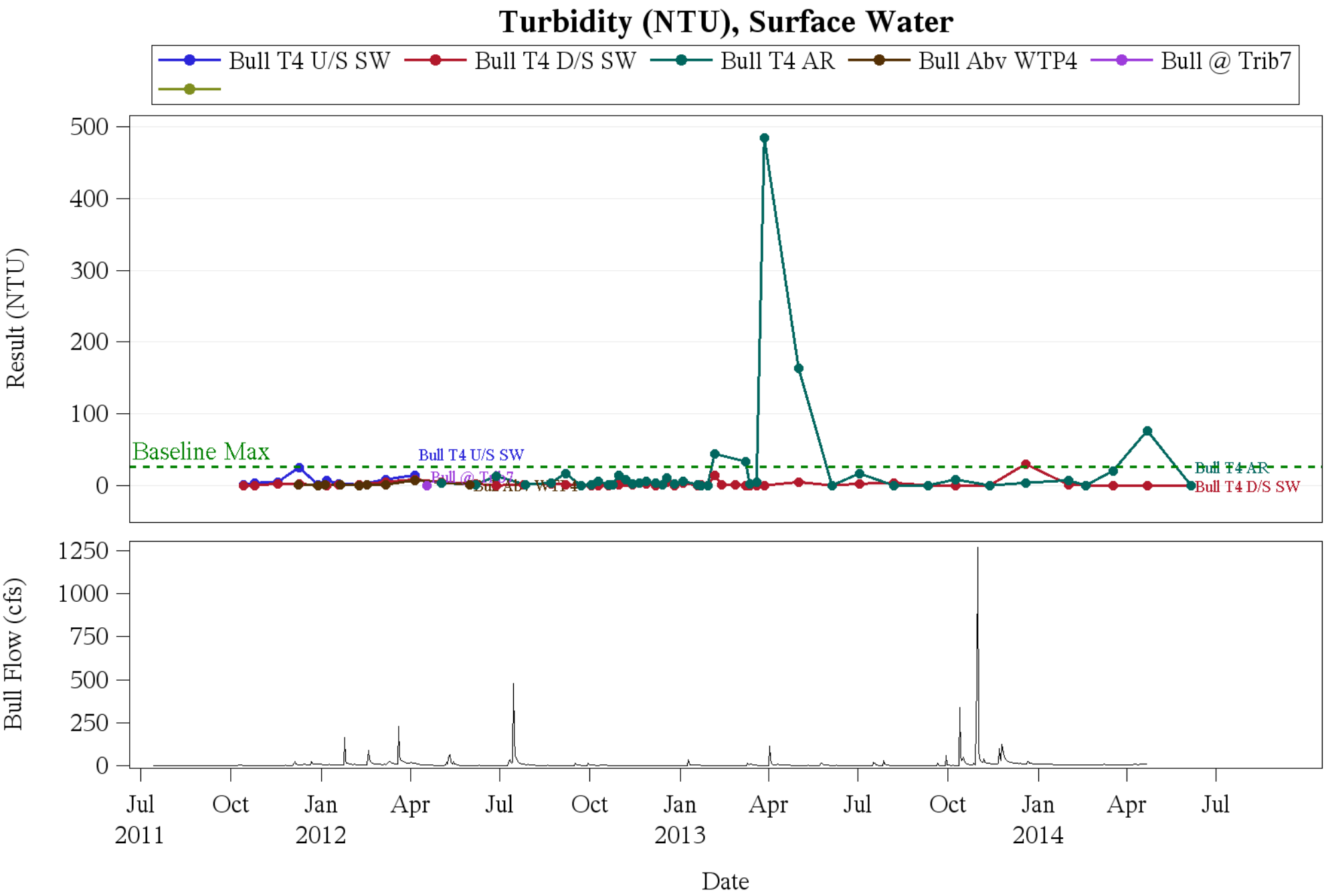

Total Suspended Solids (mg/L), Surface Water
Bull T4 U/S SW
Bull T4 D/S SW
Bull T4 AR
Bull Abv WTP4
Result (mg/L)
60
50
40
30
20
10
0
Baseline Max
Bull T4 D/S SW
Bull Abv WTP4
Bull T4 D/S SW
Bull T4 AR
Bull Flow (cfs)
1250
1000
750
500
250
0
Jul
2011
Oct
Jan
2012
Apr
Jul
Oct
Jan
2013
Apr
Jul
Oct
Jan
2014
Apr
Jul
Date

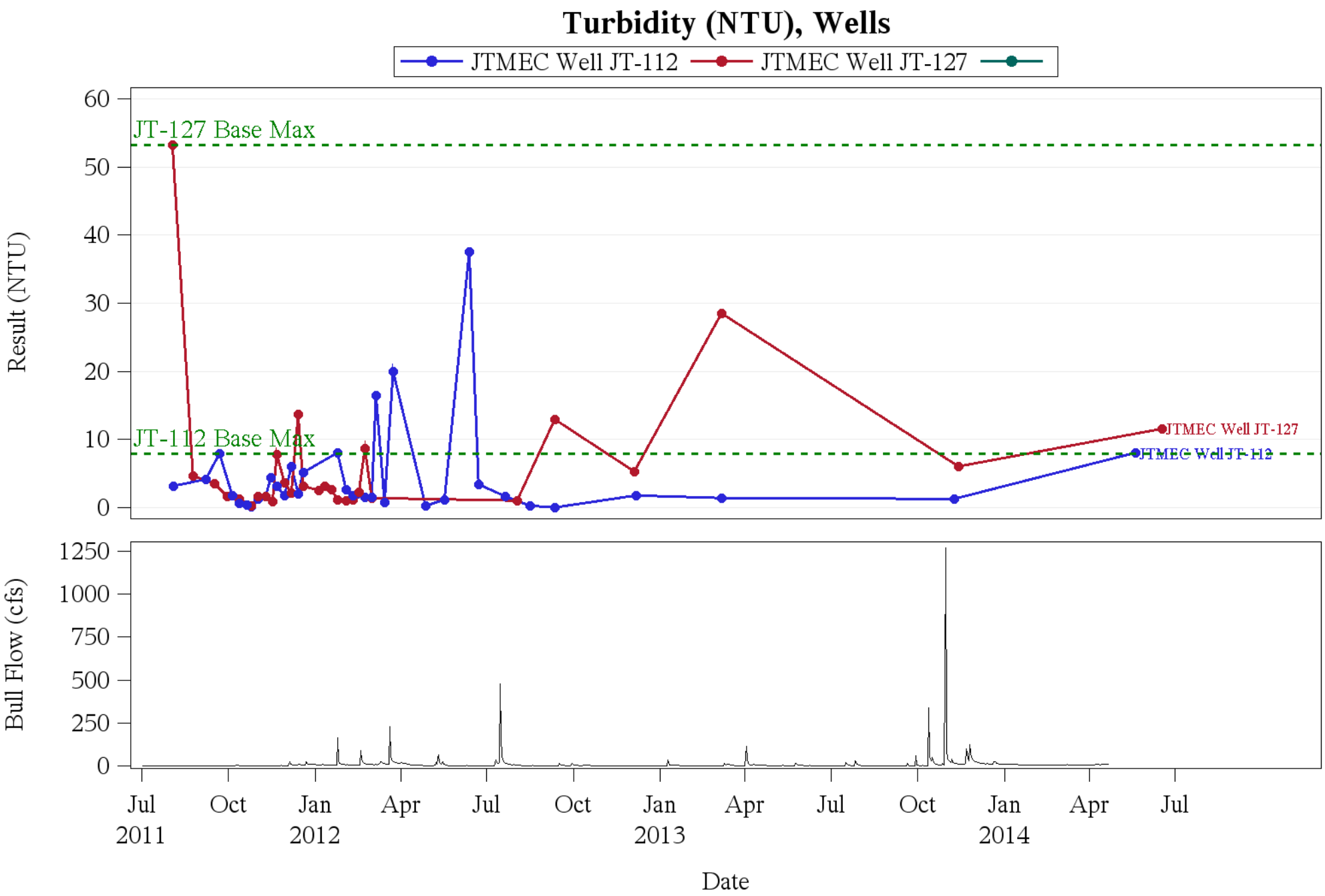

Total Suspended Solids (mg/L), Wells
JTMEC Well JT-112
JTMEC Well JT-127
Result (mg/L)
100
80
60
40
20
0
JT-127 Base Max
JT-112 Base Max
JTMEC Well JT-127
JTMEC Well JT-112
Bull Flow (cfs)
1250
1000
750
500
250
0
Jul 2011
Oct
Jan 2012
Apr
Jul
Oct
Jan 2013
Apr
Jul
Oct
Jan 2014
Apr
Jul
Date

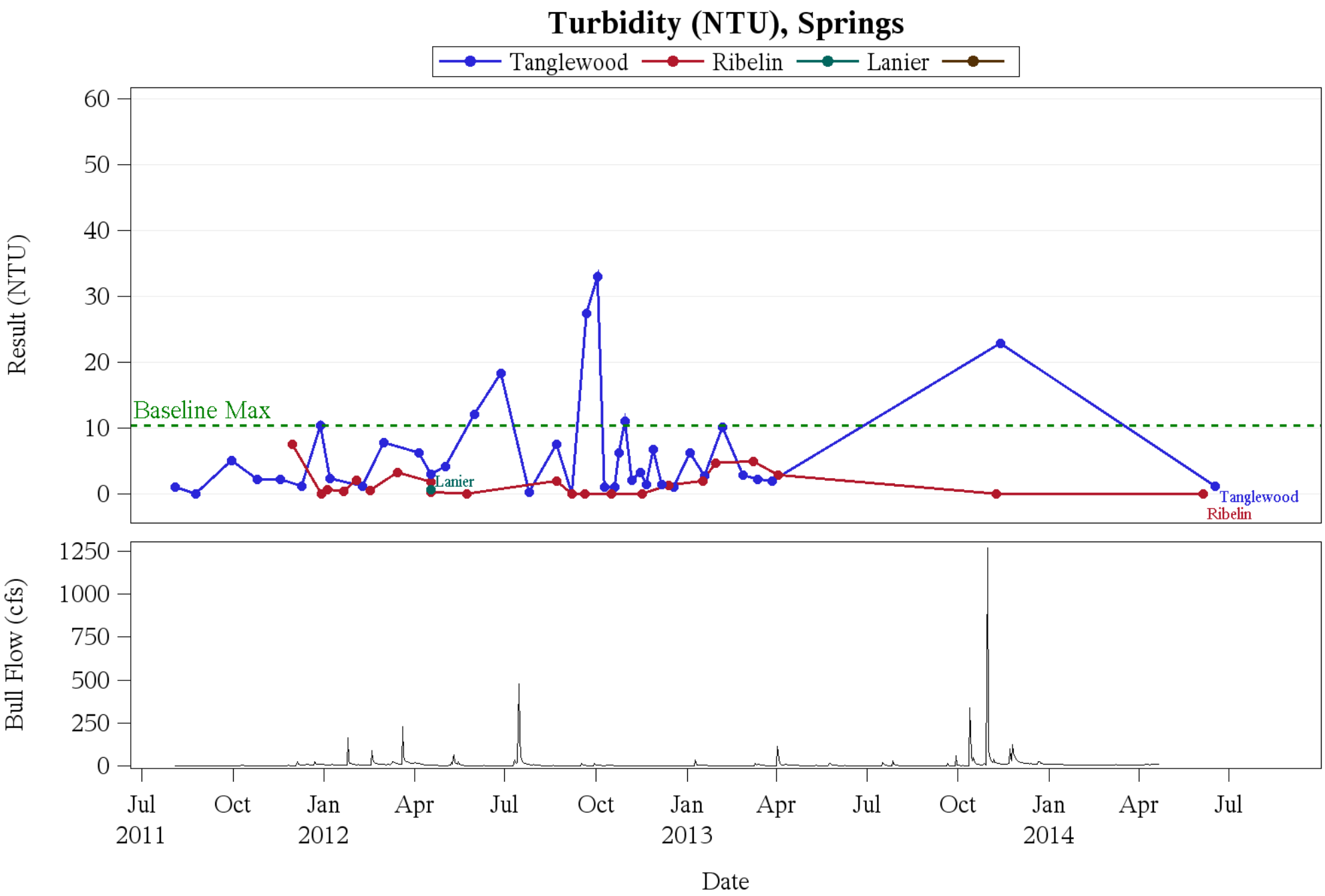


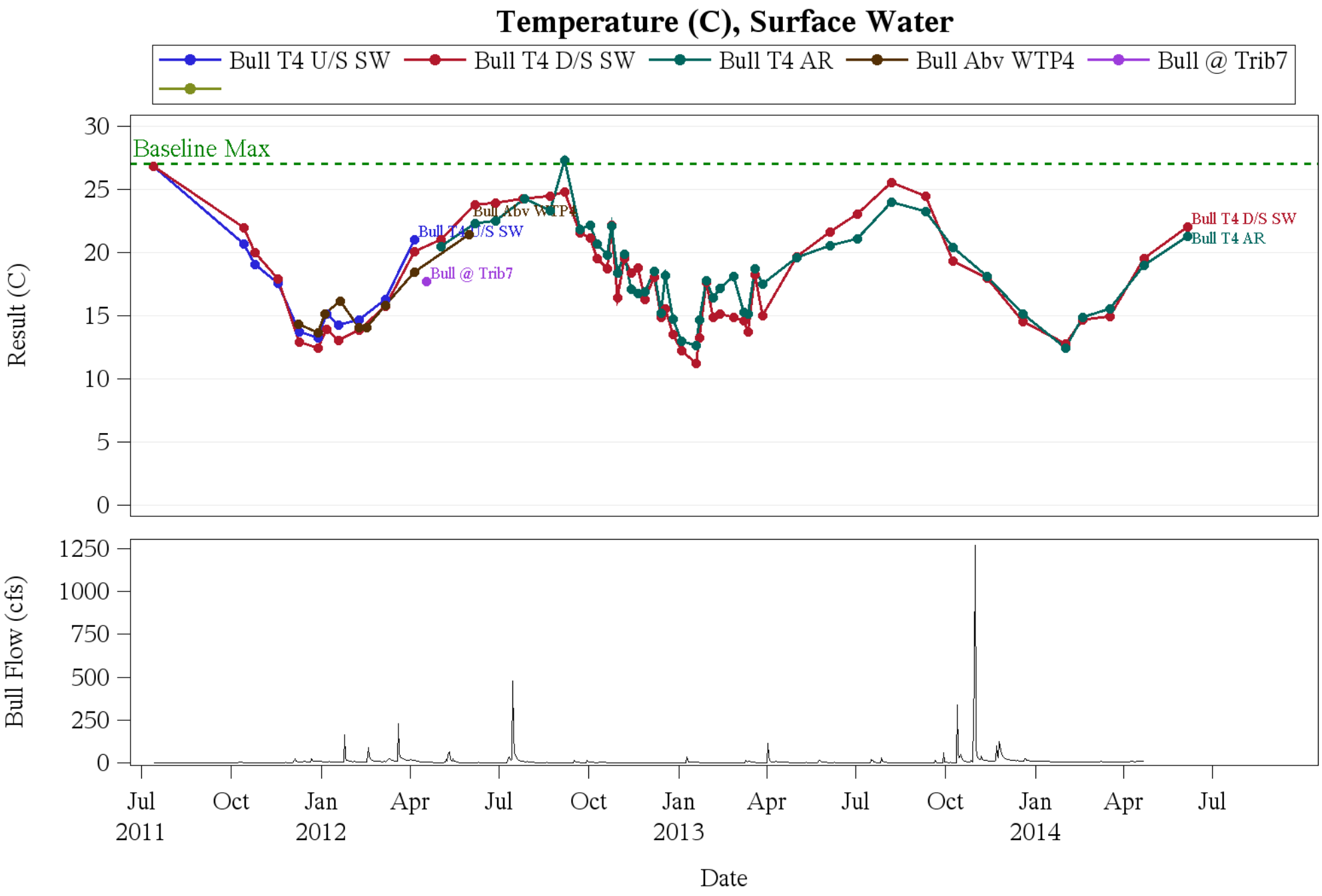
City of Austin DRAFT: QA/QC review pending

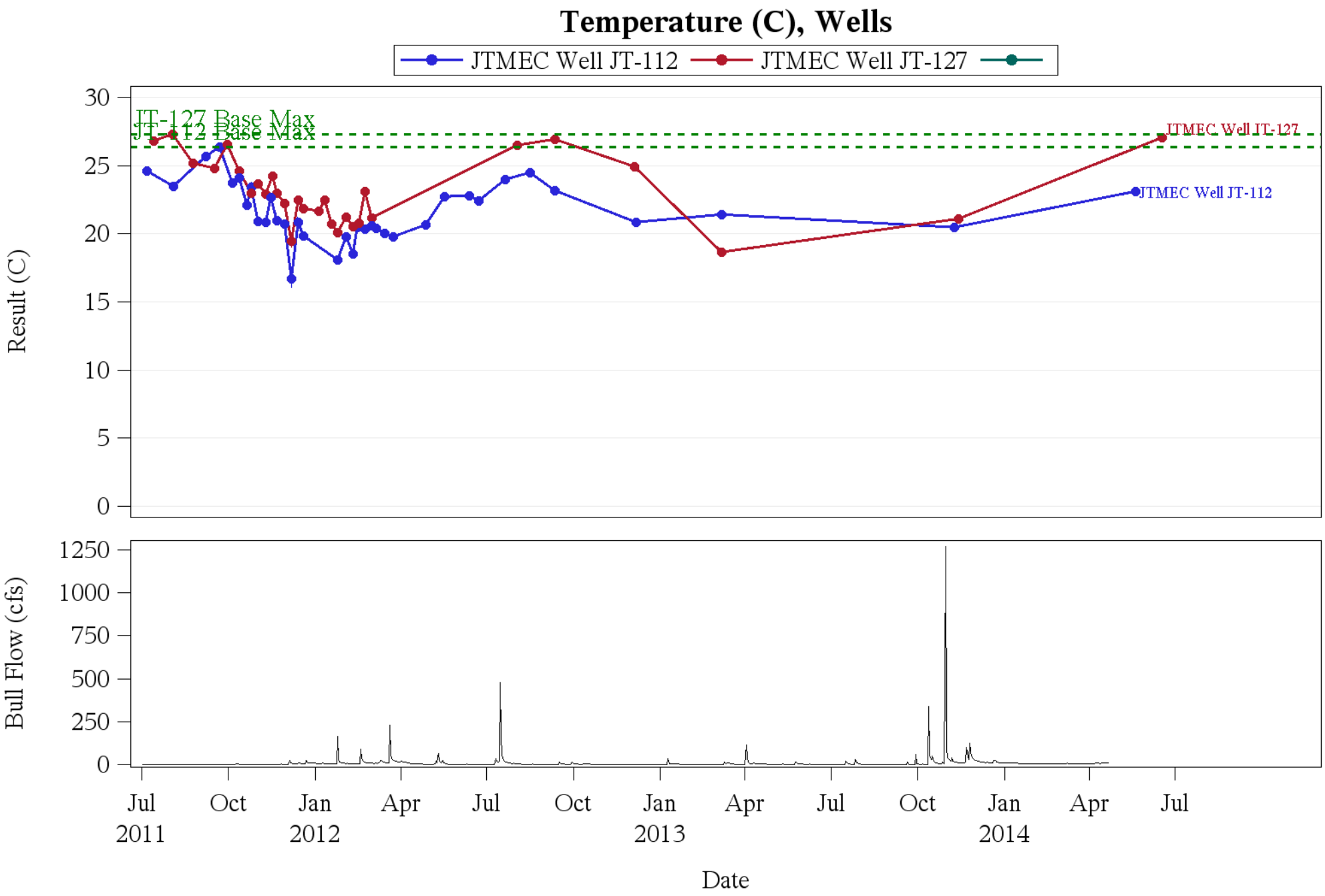

Total Suspended Solids (mg/L), Springs
Tanglewood
Ribelin
Result (mg/L)
60
50
40
30
20
10
0
Baseline Max
Tanglewood
Ribelin
Bull Flow (cfs)
1250
1000
750
500
250
0
Jul 2011
Oct
Jan 2012
Apr
Jul
Oct
Jan 2013
Apr
Jul
Oct
Jan 2014
Apr
Jul
Date

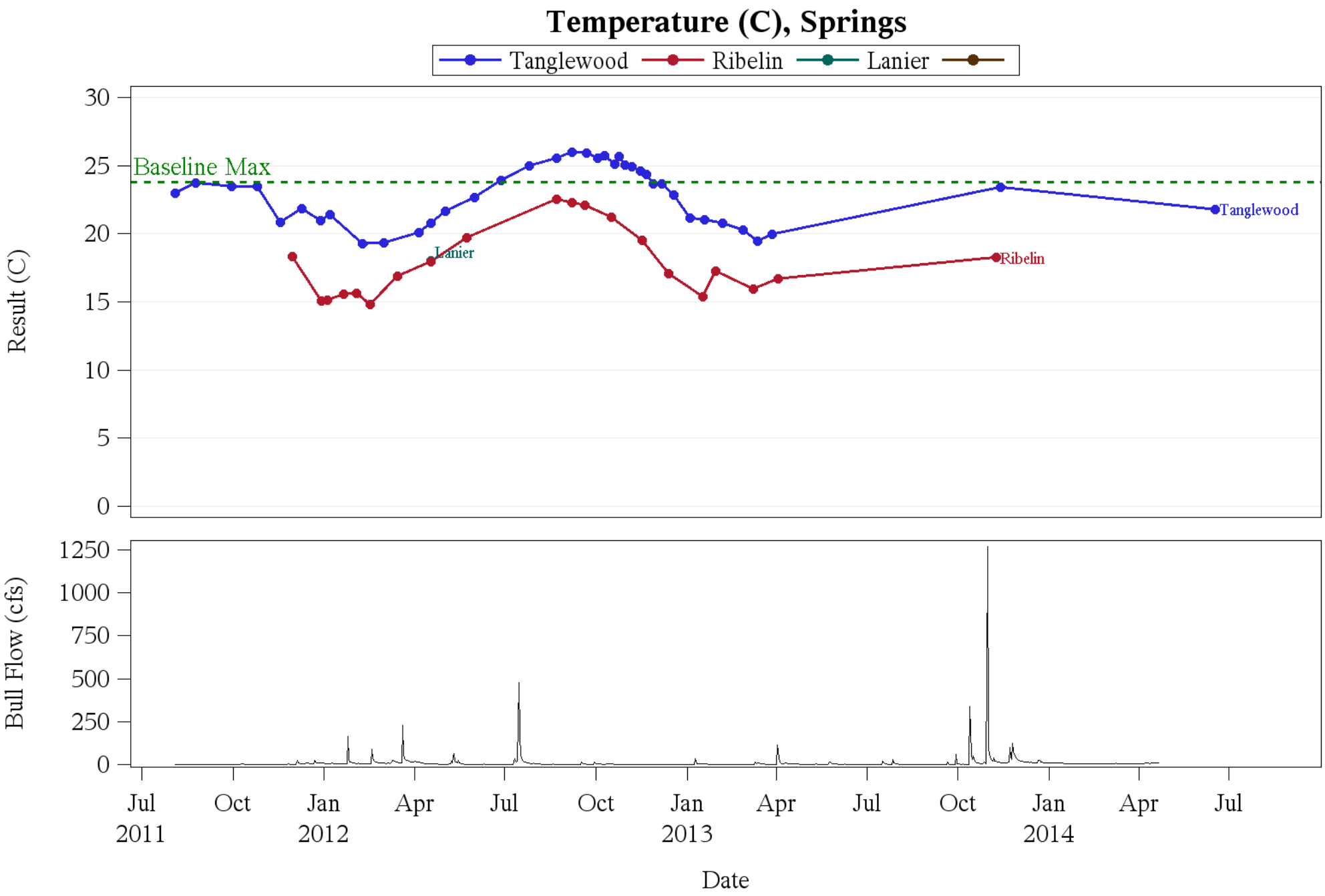

Turbidity (NTU), Surface Water
Bull T4 U/S SW
Bull T4 D/S SW
Bull T4 AR
Bull Abv WTP4
Bull @ Trib7
Result (NTU)
500
400
300
200
100
0
Baseline Max
Bull T4 U/S SW
Bull @ Trib7
Bull Abv WTP4
Bull T4 AR
Bull T4 D/S SW
Bull Flow (cfs)
1250
1000
750
500
250
0
Jul
2011
Oct
Jan
2012
Apr
Jul
Oct
Jan
2013
Apr
Jul
Oct
Jan
2014
Apr
Jul
Date

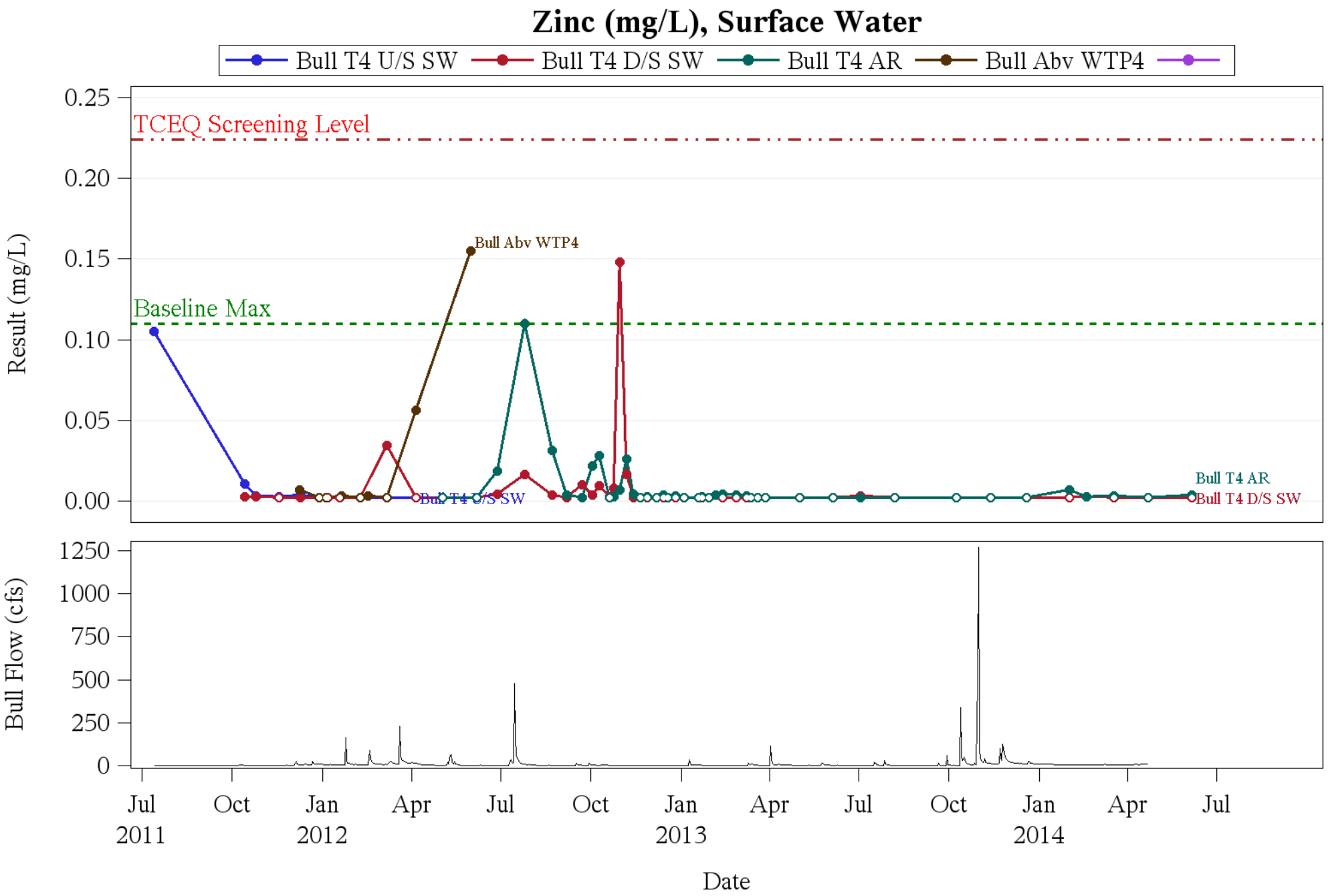

Turbidity (NTU), Wells
JTMEC Well JT-112
JTMEC Well JT-127
Result (NTU)
60
50
40
30
20
10
0
JT-127 Base Max
JT-112 Base Max
JTMEC Well JT-127
JTMEC Well JT-112
Bull Flow (cfs)
1250
1000
750
500
250
0
Jul 2011
Oct
Jan 2012
Apr
Jul
Oct
Jan 2013
Apr
Jul
Oct
Jan 2014
Apr
Jul
Date

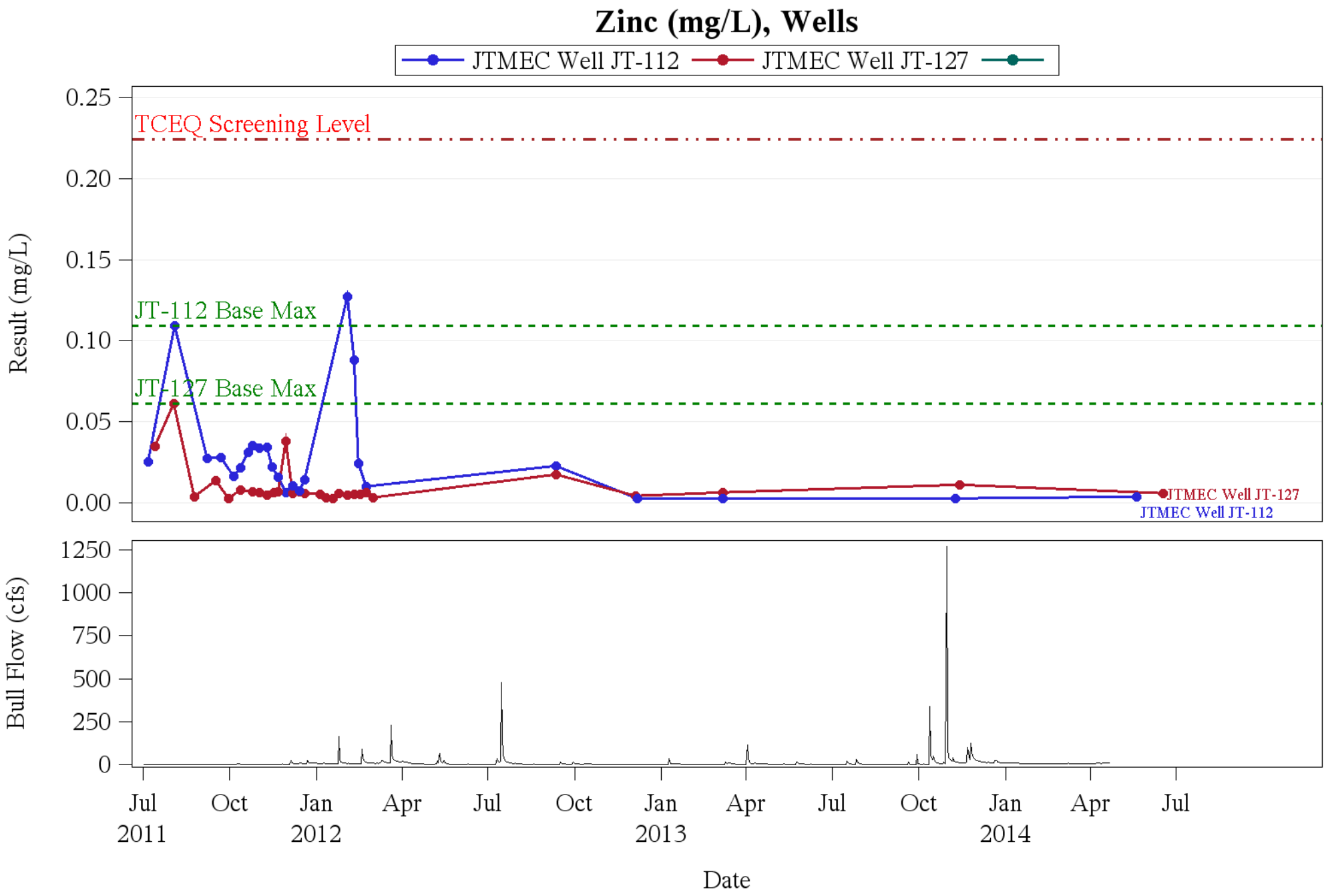

Turbidity (NTU), Springs
Tanglewood
Ribelin
Lanier
Result (NTU)
60
50
40
30
20
10
0
Baseline Max
Lanier
Tanglewood
Ribelin
Bull Flow (cfs)
1250
1000
750
500
250
0
Jul
2011
Oct
Jan
2012
Apr
Jul
Oct
Jan
2013
Apr
Jul
Oct
Jan
2014
Apr
Jul
Date

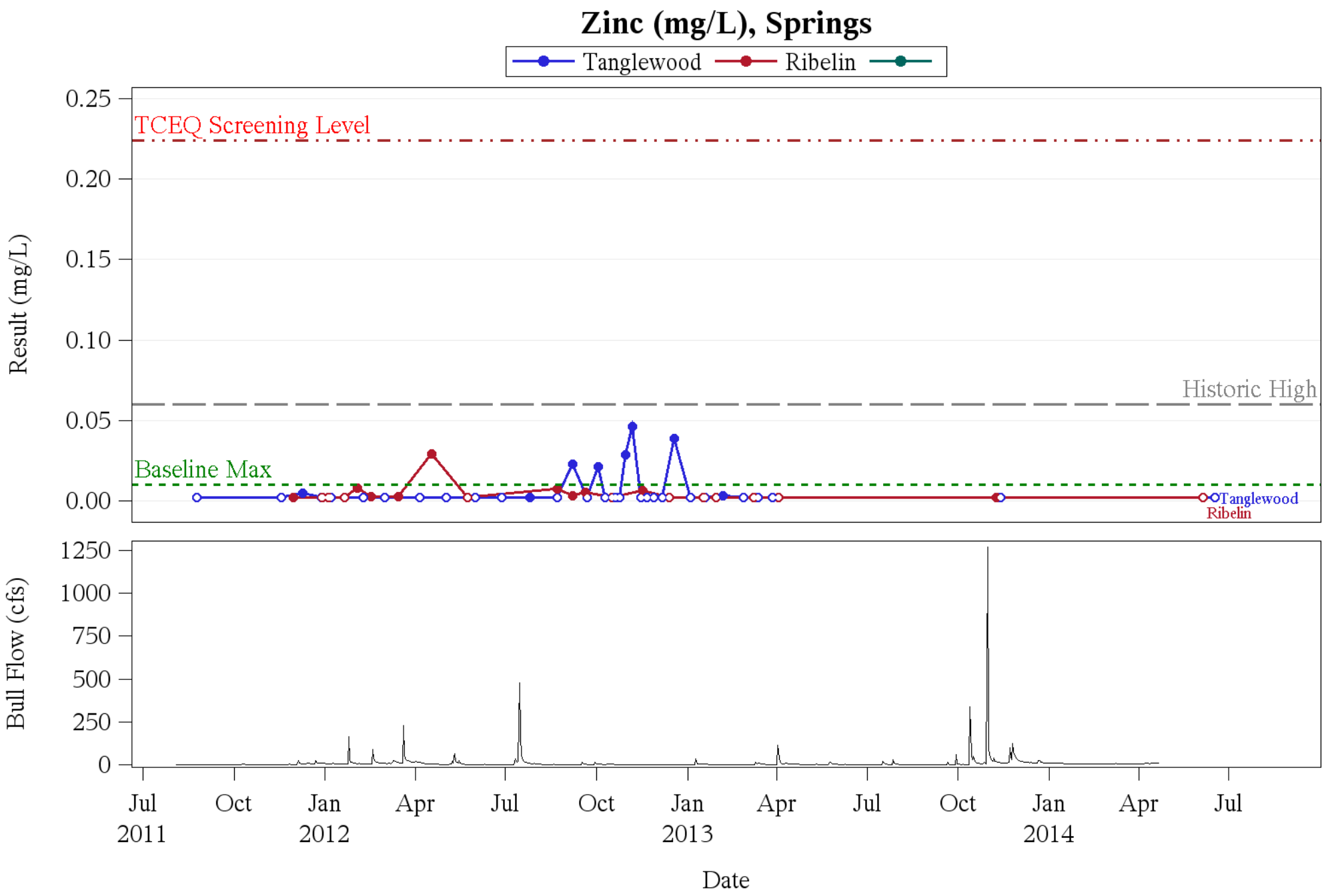

Temperature (C), Surface Water
Bull T4 U/S SW
Bull T4 D/S SW
Bull T4 AR
Bull Abv WTP4
Bull @ Trib7
Baseline Max
Result (C)
30
25
20
15
10
5
0
Bull Abv WTP4
Bull T4 U/S SW
Bull @ Trib7
Bull T4 D/S SW
Bull T4 AR
Bull Flow (cfs)
1250
1000
750
500
250
0
Jul 2011
Oct
Jan 2012
Apr
Jul
Oct
Jan 2013
Apr
Jul
Oct
Jan 2014
Apr
Jul
Date


Temperature (C), Wells
JTMEC Well JT-112
JTMEC Well JT-127
JT-127 Base Max
JT-112 Base Max
JTMEC Well JT-127
JTMEC Well JT-112
Result (C)
30
25
20
15
10
5
0
Bull Flow (cfs)
1250
1000
750
500
250
0
Jul 2011
Oct
Jan 2012
Apr
Jul
Oct
Jan 2013
Apr
Jul
Oct
Jan 2014
Apr
Jul
Date

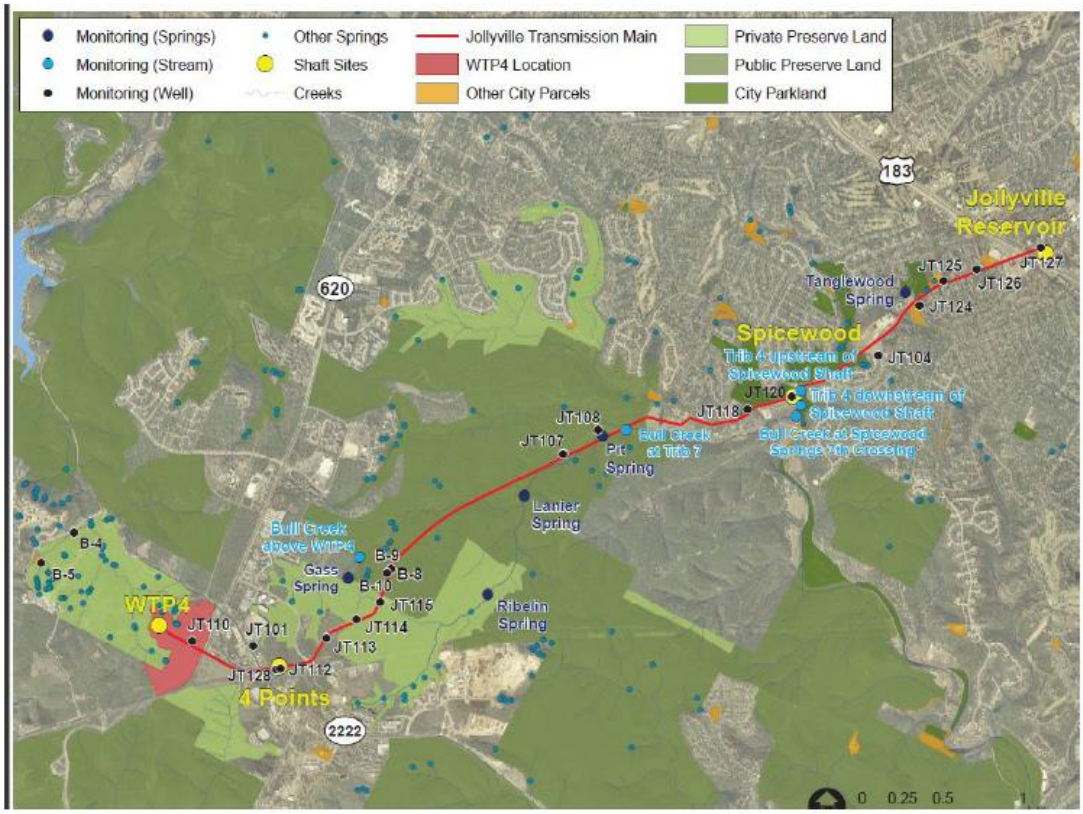

Temperature (C), Springs
Tanglewood
Ribelin
Lanier
Result (C)
30
25
20
15
10
5
0
Baseline Max
Lanier
Ribelin
Tanglewood
Bull Flow (cfs)
1250
1000
750
500
250
0
Jul
2011
Oct
Jan
2012
Apr
Jul
Oct
Jan
2013
Apr
Jul
Oct
Jan
2014
Apr
Jul
Date


Zinc (mg/L), Surface Water
Bull T4 U/S SW
Bull T4 D/S SW
Bull T4 AR
Bull Abv WTP4
TCEQ Screening Level
Baseline Max
Result (mg/L)
0.25
0.20
0.15
0.10
0.05
0.00
Bull Abv WTP4
Bull T4 U/S SW
Bull T4 AR
Bull T4 D/S SW
Bull Flow (cfs)
1250
1000
750
500
250
0
Jul 2011
Oct
Jan 2012
Apr
Jul
Oct
Jan 2013
Apr
Jul
Oct
Jan 2014
Apr
Jul
Date


Zinc (mg/L), Wells
JTMEC Well JT-112
JTMEC Well JT-127
TCEQ Screening Level
JT-112 Base Max
JT-127 Base Max
Result (mg/L)
0.25
0.20
0.15
0.10
0.05
0.00
JTMEC Well JT-127
JTMEC Well JT-112
Bull Flow (cfs)
1250
1000
750
500
250
0
Jul 2011
Oct
Jan 2012
Apr
Jul
Oct
Jan 2013
Apr
Jul
Oct
Jan 2014
Apr
Jul
Date

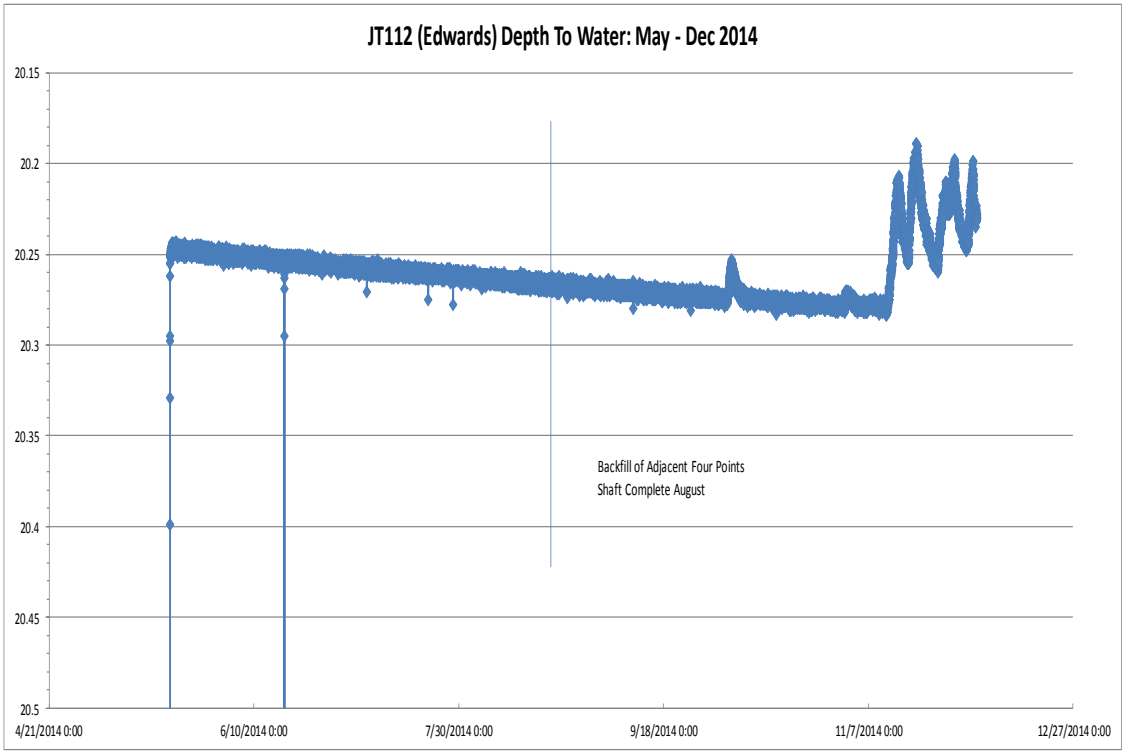

Zinc (mg/L), Springs
Tanglewood
Ribelin
TCEQ Screening Level
Historic High
Baseline Max
Result (mg/L)
0.25
0.20
0.15
0.10
0.05
0.00
Tanglewood
Ribelin
Bull Flow (cfs)
1250
1000
750
500
250
0
Jul 2011
Oct
Jan 2012
Apr
Jul
Oct
Jan 2013
Apr
Jul
Oct
Jan 2014
Apr
Jul
Date

Attachment 2: Water Levels in Selected Monitoring Wells

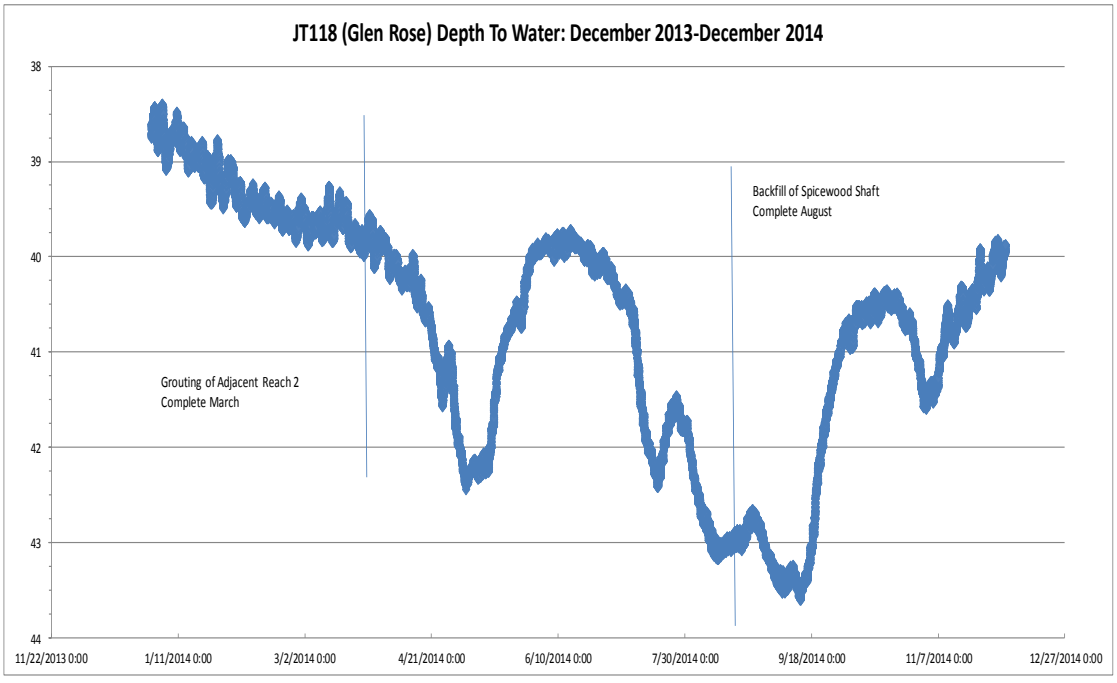


Attachment 2: Water Levels in Selected Monitoring Wells

Water Level Data from Continuous Monitoring Sensors

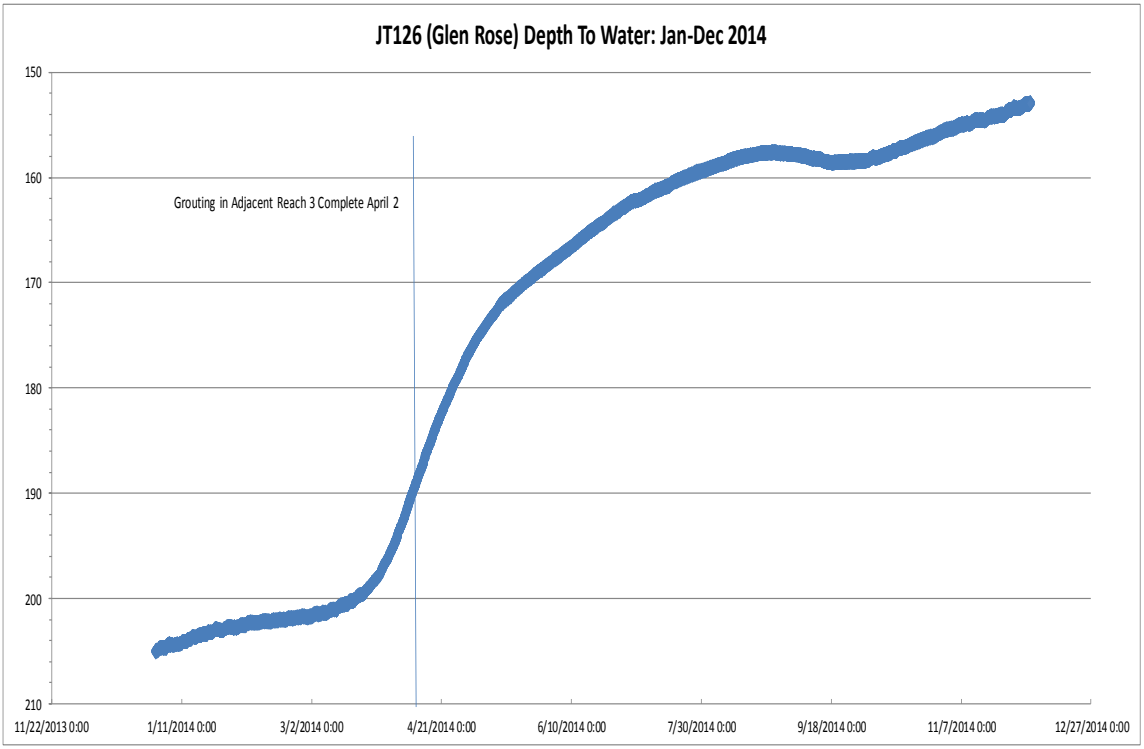


Well JT112 – Water levels from continuous sensors, this well is located close to the former Four Points shaft and has been shown to be hydrologically connected by water levels changes and dye tracing.



Well118 – Water levels from continuous sensors, this well is adjacent to Reach 2 and is completed to a depth approximately 10 ft below the floor of the tunnel.

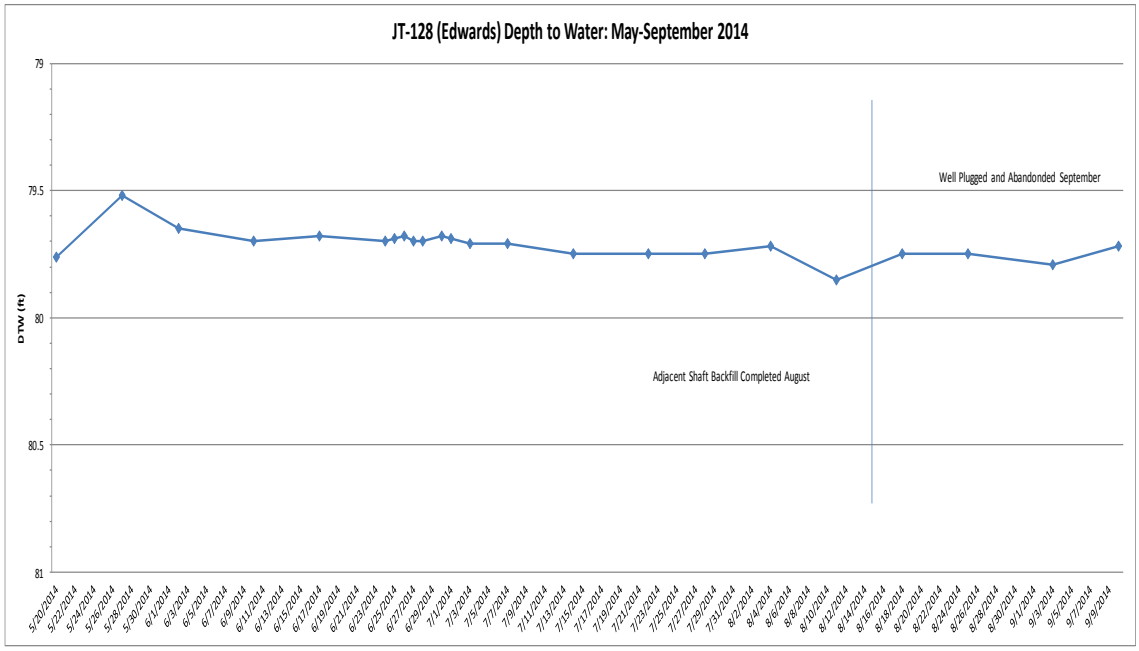
Attachment 2: Water Levels in Selected Monitoring Wells



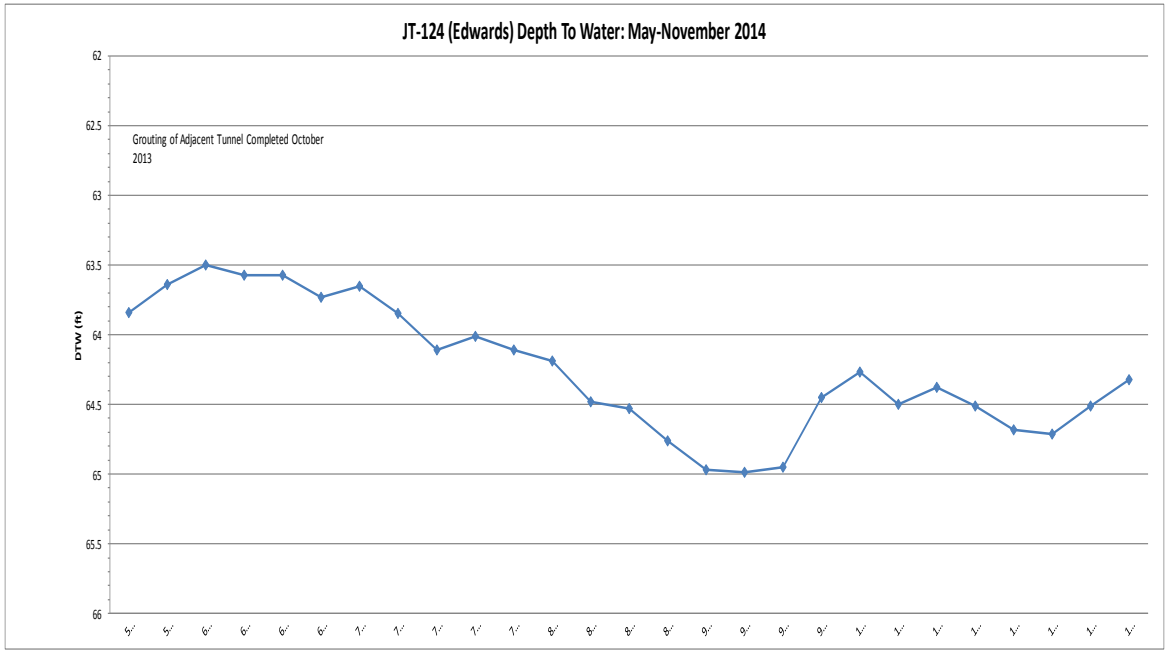
Well JT126 – Water levels from continuous sensors, this well is adjacent to the Reach 3 and is completed to the tunnel horizon. Previous data has suggested water levels in this well may be affected by pumping from nearby golf courses.

Attachment 2: Water Levels in Selected Monitoring Wells

Water Level Data from Elines

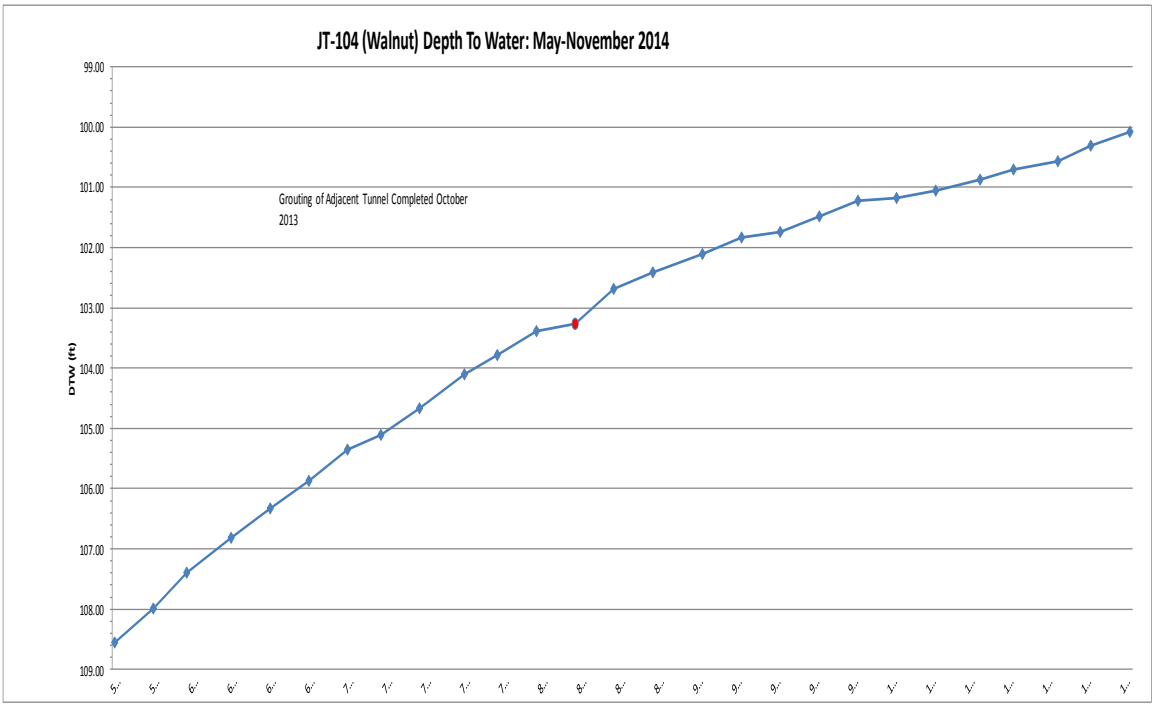


Well JT128 – Data from periodic grab water level measurements. This well was located within a few ft. of the former Four Points shaft and completed to the base of the Edwards Formation.

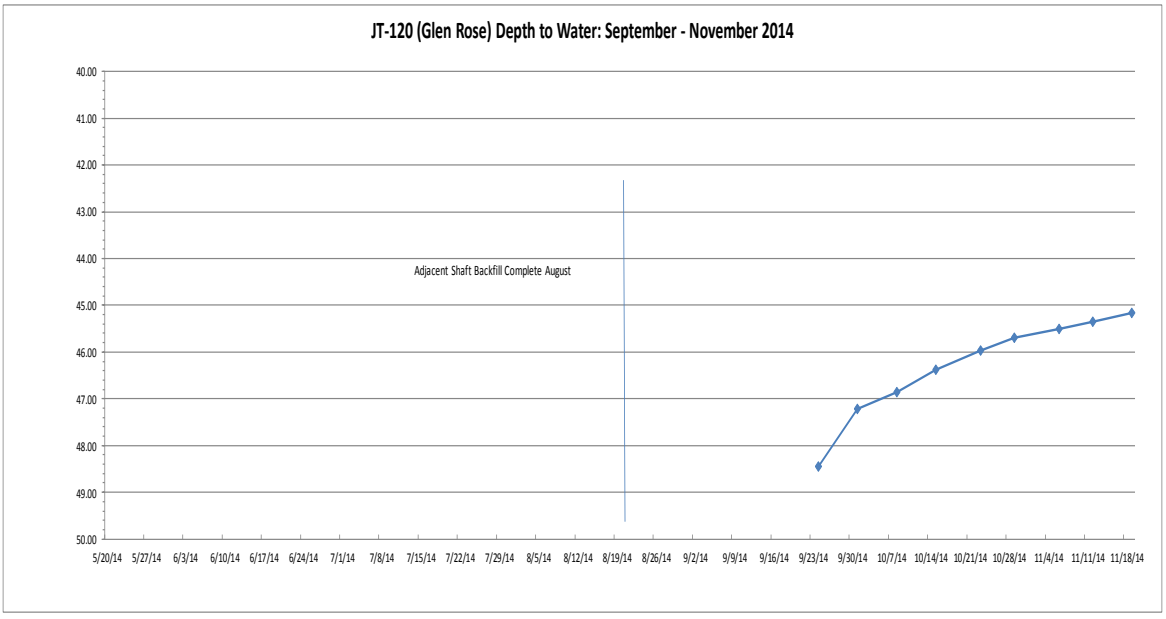


Well JT124 - Data from periodic grab water level measurements. This well is located adjacent to Reach 3 and completed to the base of the Edwards Formation above tunnel horizon.

Attachment 2: Water Levels in Selected Monitoring Wells

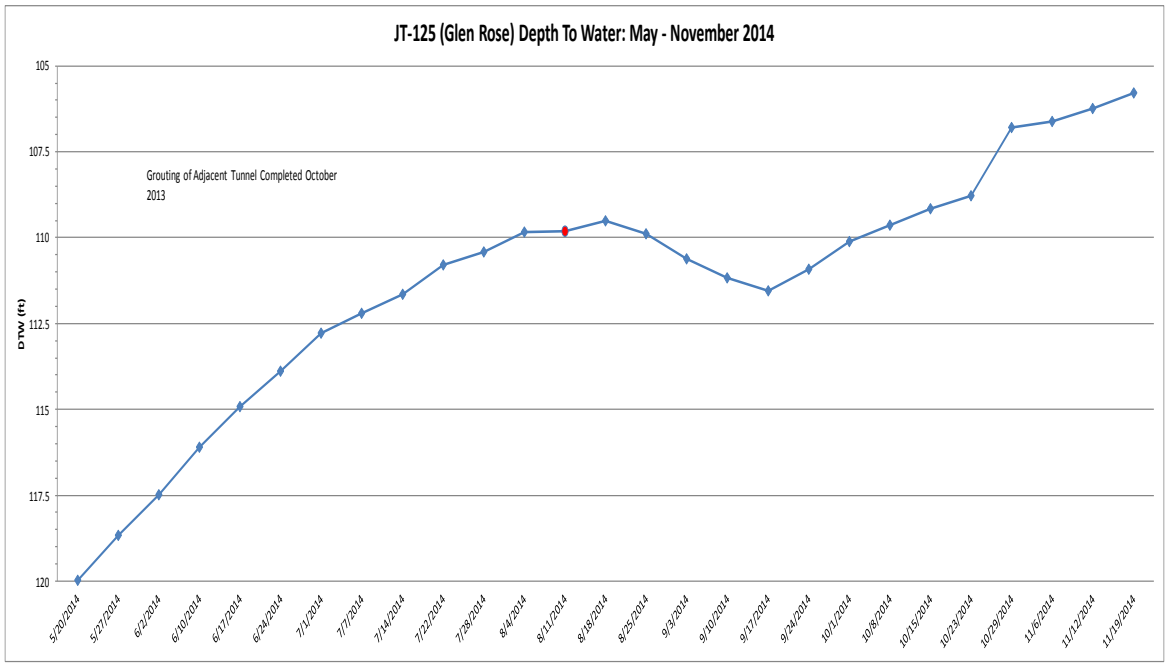


Well JT104 - Data from periodic grab water level measurements. This well is adjacent to Reach 3 and completed to the base of the Walnut Formation above tunnel horizon.

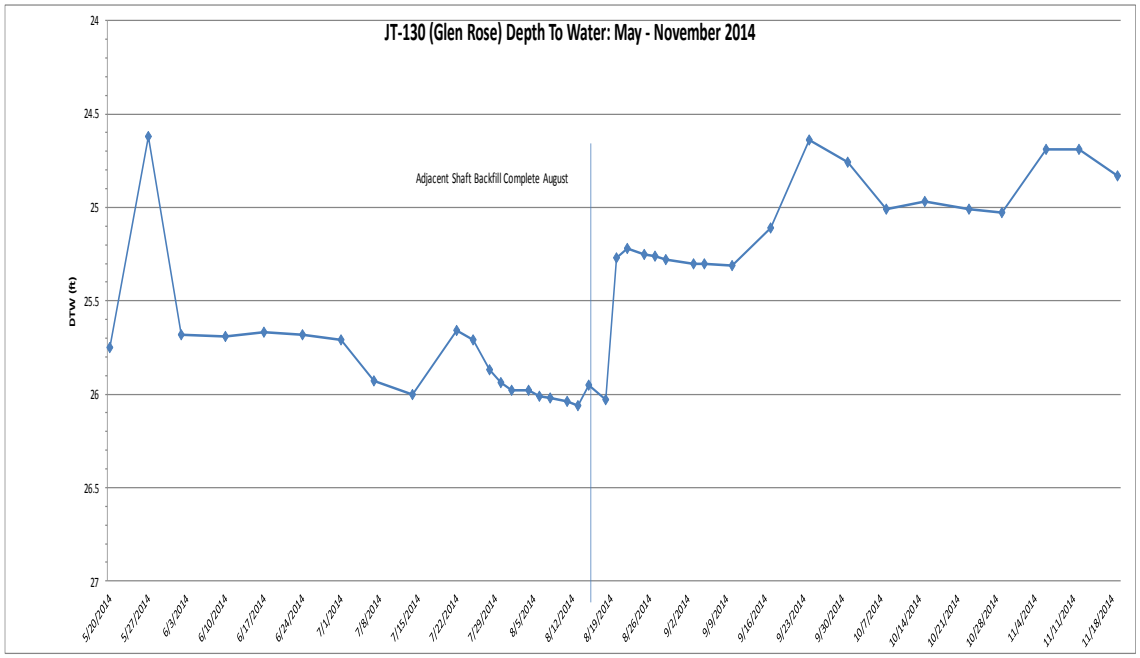


Well JT120 - Data from periodic grab water level measurements. This well is located within a few ft. of the former Spicewood shaft and is completed approximately 10 ft below the shaft floor.

Attachment 2: Water Levels in Selected Monitoring Wells



Well JT125 - Data from periodic grab water level measurements. This well is adjacent to Reach 3 and is completed approximately 15 ft above the crown of the tunnel. Like JT 126, this well may be influenced by pumping from nearby golf courses.



Well JT 130 - Data from periodic grab water level measurements. This well is located approximately 90 ft. from the former Spicewood shaft and was installed to monitor groundwater possibly linked to a Jollyville Plateau Salamander site in a nearby Bull Creek tributary.