Idaho Department of Water Resources
Open-File Report

Summary of Ground Water Conditions in the Big Wood River Ground Water Area

2016 Update

By
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Introduction

The Idaho Department of Water Resources maintains a ground water level monitoring network in the Wood River and Camas Valleys, Idaho. The monitoring network currently consists of 48 wells that are visited on a semi-annual basis (Figure 1). Twenty-one of the wells have transducers installed (Figure 1). The wells are labeled in Figures 2-4. Figures 2-4 focus on different areas within the Big Wood Ground Water Management Area (GWMA). The purpose of the ground water monitoring program is to observe water levels within the Big Wood GWMA and to provide data for a future recalibration of the Wood River Valley Aquifer Model. The GWMA was designated on June 28, 1991. The area was designated to address the connection between ground and surface water within the Camas Creek, Silver Creek, and Big Wood River drainages above Magic Reservoir.

A groundwater model by Fisher and others (in press) has been developed since designation of the GWMA to evaluate the groundwater and surface water connection with the Wood River and Silver Creek drainages. The US Geological Survey (USGS) published several studies of the hydrogeology of the Big Wood River and Camas basins. USGS studies of the Big Wood River basin include Stearns and others (1938), Jones (1952), Smith (1959), Smith (1960), Moreland (1977), Frenzel (1989), Skinner and others (2007), Bartolino (2009), Bartolino and Adkins (2012), Hopkins and Bartolino (2013), and Bartolino (2014). USGS studies of the Camas Creek basin include Stearns and others (1938), Jones (1952), Smith (1960), Walton (1962), Young (1978), and Young and others (1978). A management plan has not been developed for the area, nor has an advisory committee been formed. An advisory committee for development of the Wood River Valley Groundwater Flow Model was established in April, 2013 and continues to meet on a regular basis to monitor model performance and evaluate the need for a recalibration of the model. Currently, data from this monitoring network provides input for the Wood River Valley Aquifer Model and is a source of information for the management of the ground water resource in this area.

Purpose and Scope

The purpose of this report is to provide an updated summary of the status of the ground water monitoring network and to present water level data collected over the network's history.

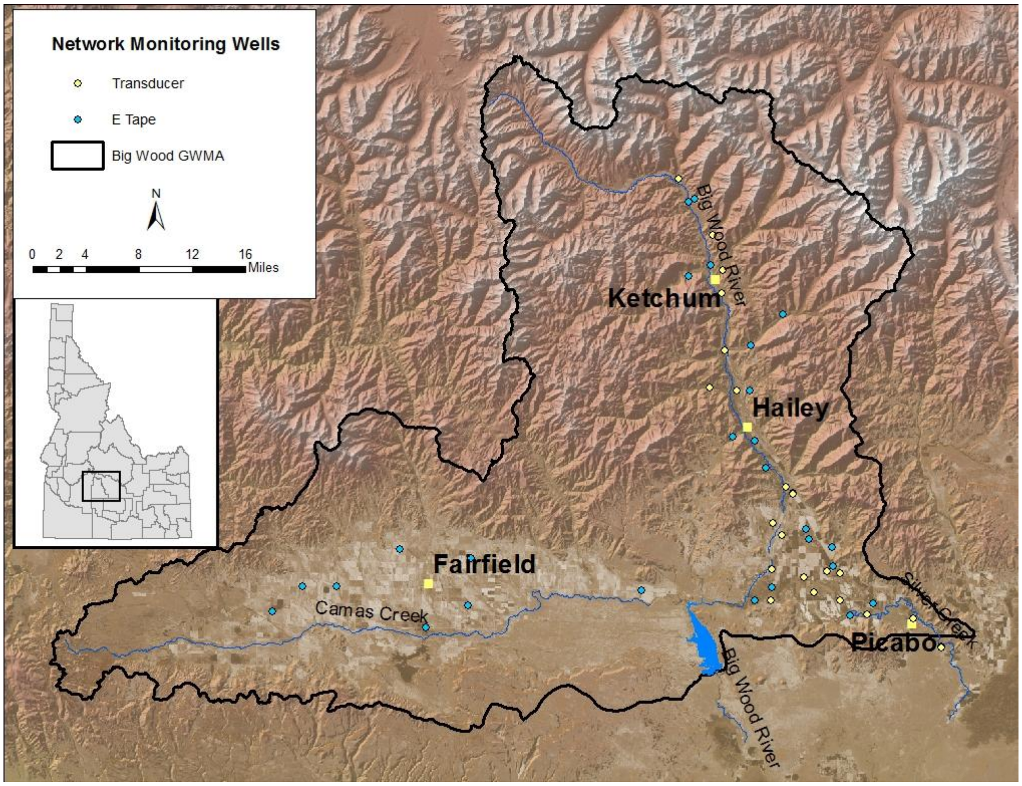


Figure 1. Current Big Wood GWMA monitoring network.

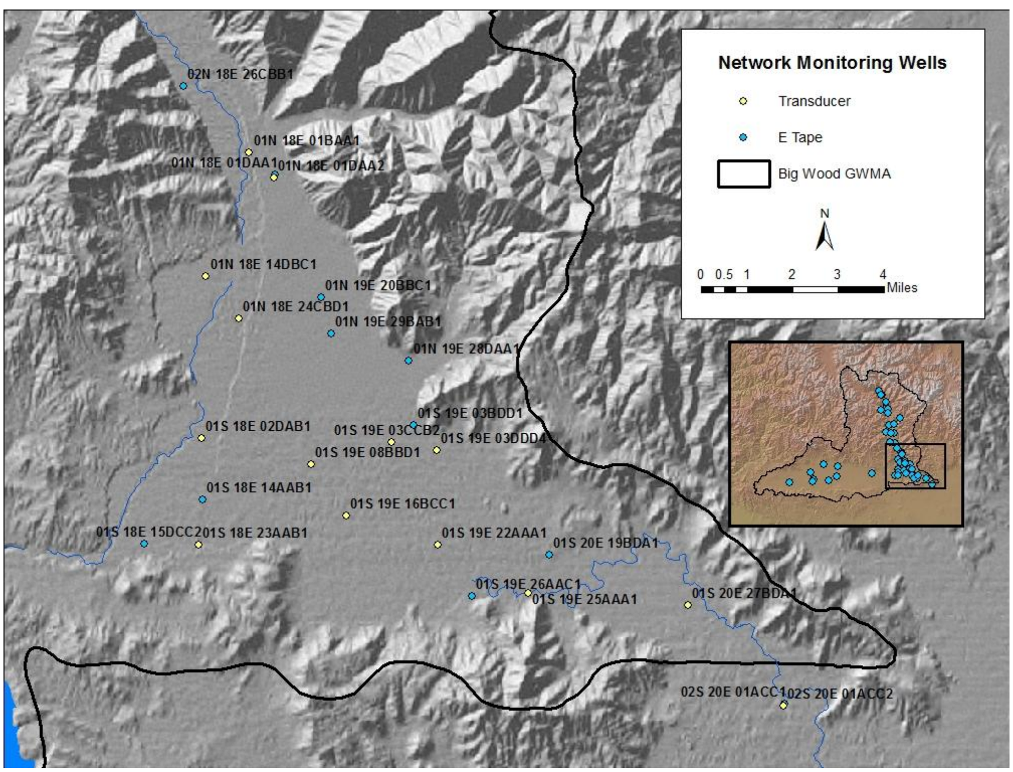


Figure 2. Southeast portion of the Big Wood groundwater monitoring network.

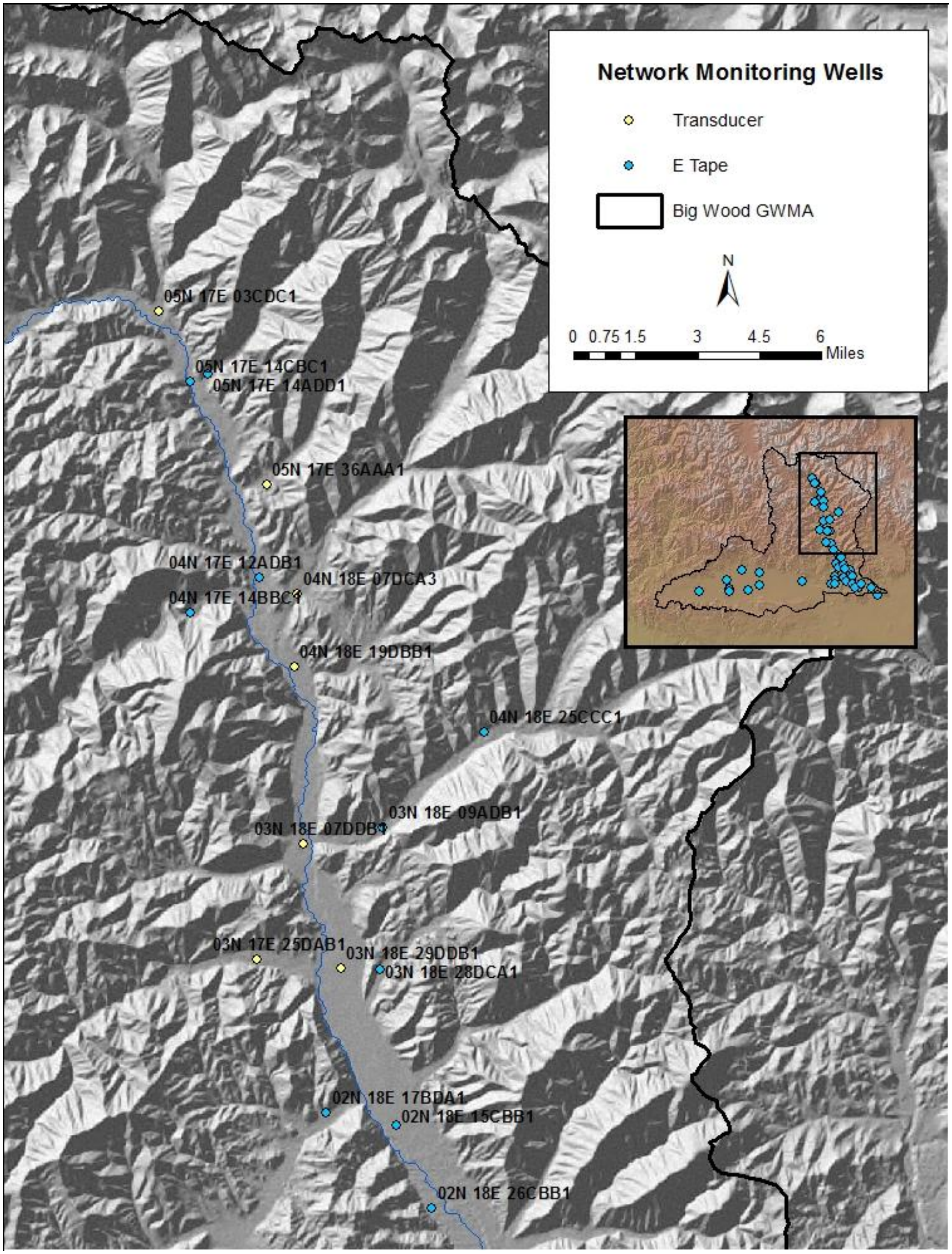


Figure 3. Northeast portion of the Big Wood GWMA groundwater monitoring network.

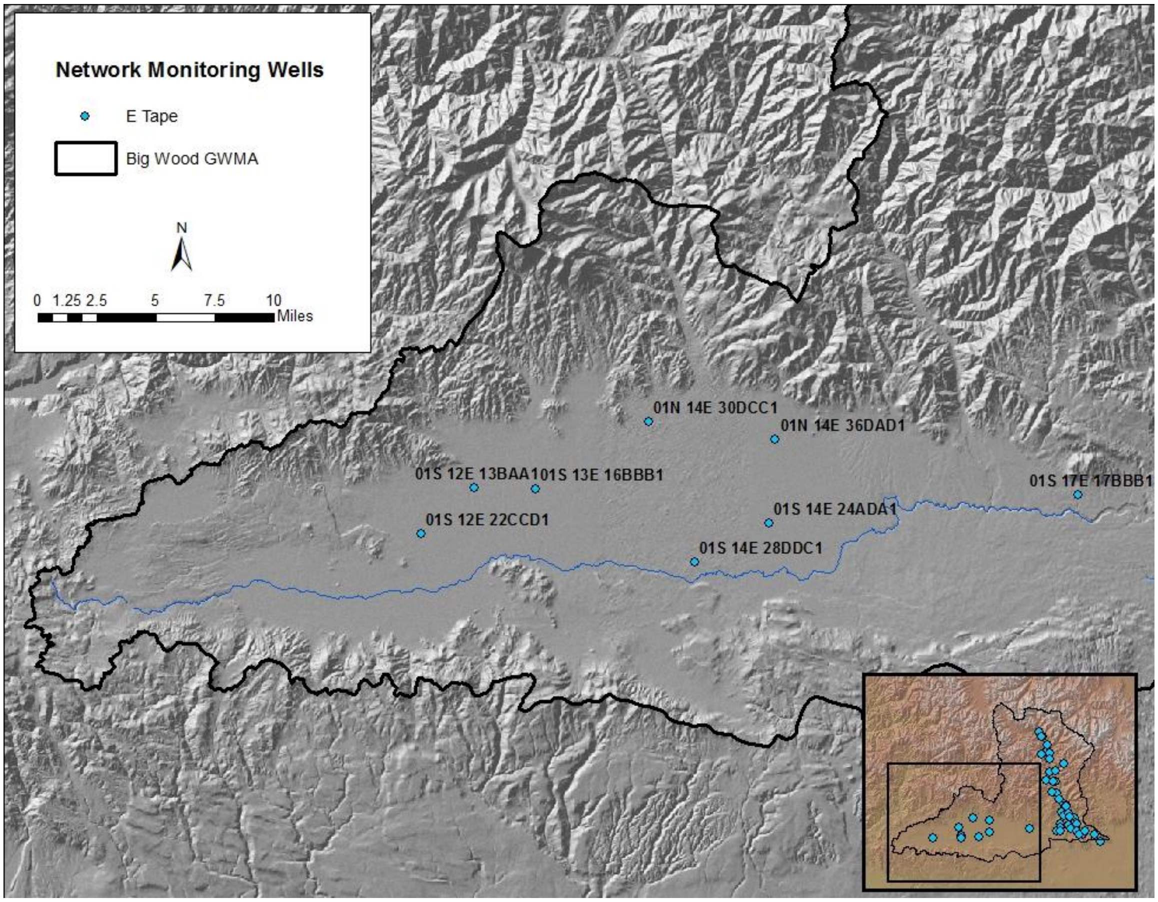


Figure 4. Western portion of the Big Wood groundwater monitoring network.

Status of the Monitoring Network

Monitoring data exists dating back to 1944 (Table 1). Twenty-one of the wells have transducers installed (Figures 1-4). The transducers are programmed to collect water levels twice a day. This water level network is not static, the wells included in the network change as circumstances indicate more need for wells in specific areas. Five wells have only two water levels because they were added recently, while well 01S 19E 03CCB2 has 5,152 because it has been in the network since 1954 and had a transducer installed in it in July, 2012. The median number of water-levels is 205. The average period of record is about 32 years.

Table 1. Summary of wells in the Big Wood monitoring network. The Well ID corresponds to the well labels in Figures 2-4.

Well ID	WL Date Min	WL Date Max	Site Status	# of Water-Level Readings & Comments
01N 14E 30DCC1	9/22/1977	10/23/2015	Active	10 WL
01N 14E 36DAD1	3/24/1977	10/23/2015	Active	184 WL
01N 18E 01BAA1	5/21/1955	11/3/2015	Active	2433 WL Transducer installed Jul 2012
01N 18E 01DAA1	7/22/1954	11/3/2015	Active	889 WL
01N 18E 01DAA2	7/14/1954	11/3/2015	Active	2431 WL Transducer installed Jul 2012
01N 18E 14DBC1	7/11/2012	11/3/2015	Active	2268 WL Transducer installed Jul 2012

01N 18E 24CBD1	10/16/2014	11/3/2015	Active	767 WL Transducer installed Oct 2014
01N 19E 20BBC1	5/8/1963	11/4/2015	Active	32 WL
01N 19E 28DAA1	5/19/1970	11/3/2015	Active	5 WL
01N 19E 29BAB1	5/8/1963	3/3/2015	Active	3 WL
01S 13E 16BBB1	4/17/1978	10/23/2015	Active	172 WL
01S 12E 13BAA1	7/14/1944	4/12/2013	Destroyed	298 WL
01S 12E 22CCD1	10/25/1995	11/18/2015	Active	4 WL
01S 14E 24ADA1	3/16/1978	10/23/2015	Active	166 WL
01S 14E 28DDC1	12/6/1976	10/23/2015	Active	290 WL
01S 17E 17BBB1	3/11/1977	10/23/2015	Active	226 WL
01S 18E 02DAB1	4/15/1953	11/3/2015	Active	651 WL Transducer installed Dec 2014
01S 18E 14AAB1	7/12/1954	11/3/2015	Active	390 WL
01S 18E 15DCC2	5/7/1970	10/23/2006	Active	4 WL
01S 18E 23AAB1	7/29/1975	11/3/2015	Active	766 WL Transducer installed Oct 2014
01S 19E 03BDD1	9/30/1952	11/10/2015	Active	12 WL
01S 19E 03CCB2	7/23/1954	11/3/2015	Active	5152 WL Transducer installed Jul 2012
01S 19E 03DDD4	7/12/2012	11/3/2015	Active	2425 WL Transducer installed Jul 2012
01S 19E 08BBD1	7/11/2012	11/3/2015	Active	2425 WL Transducer installed Jul 2012
01S 19E 16BCC1	4/29/1970	10/20/2015	Active	428 WL Transducer installed Apr 2015
01S 19E 22AAA1	8/11/1954	11/3/2015	Active	307 WL Transducer installed Nov 2015
01S 19E 25AAA1	10/17/2014	10/20/2015	Active	740 WL Transducer installed Oct 2014
01S 19E 26AAC1	5/5/1970	10/20/2015	Active	28 WL
01S 20E 19BDA1	5/15/1963	11/10/2015	Active	29 WL
01S 20E 27BDA1	9/10/1954	11/3/2015	Active	1265 WL Transducer installed Jun 2014
02N 18E 15CBB1	10/24/2006	11/3/2015	Active	3 WL
02N 18E 17BDA1	10/24/2006	11/3/2015	Active	3 WL
02N 18E 26CBB1	7/20/1983	11/3/2015	Active	7 WL
02S 20E 01ACC1	7/20/1983	11/3/2015	Active	7 WL
02S 20E 01ACC2	9/10/1954	10/20/2015	Active	11 WL
03N 17E 25DAB1	11/5/2012	11/3/2015	Active	2192 WL Transducer installed Nov 2012
03N 18E 07DDB1	7/12/2012	11/3/2015	Active	2416 WL Transducer installed Jul 2012
03N 18E 09ADB1	10/25/2006	11/4/2015	Active	2 WL
03N 18E 28DCA1	10/25/2006	11/3/2015	Active	3 WL
03N 18E 29DDB1	7/12/2012	11/3/2015	Active	2410 WL Transducer installed Jul 2012
04N 17E 12ADB1	8/24/1983	10/24/2006	Active	10 WL
04N 17E 14BBC1	8/19/1983	11/4/2015	Active	95 WL
04N 18E 07DCA3	10/1/2015	11/4/2015	Active	69 WL Transducer installed Oct 2014
04N 18E 19DBB1	4/10/1986	11/4/2015	Active	2428 WL Transducer installed Jul 2012
05N 17E 03CDC1	7/12/2012	11/4/2015	Active	1933 WL Transducer installed Jul 2012
05N 17E 14ADD1	10/23/2006	11/4/2015	Active	2 WL
05N 17E 14CBC1	8/25/1983	10/23/2006	Active	4 WL

05N 17E 36AAA1	10/23/2006	9/30/2015	Active	2357 WL Transducer installed Jul 2012

Summary of Water Level Data

A review of the data from the wells included in the current monitoring network was conducted to evaluate seasonal water level fluctuations, determine trends, and establish short and long-term changes. Appendix A contains hydrographs of the wells shown in Figure 2, Appendix B contains hydrographs of the wells shown in Figure 3, and Appendix C contains wells shown in Figure 4. Hydrographs in Appendices A-C with a record beginning prior to year 2000 have a second hydrograph beginning in 2000. Figure 5 is a map showing the location of the wells with at least 20 years of record without significant gaps. The hydrographs for these wells along with a computed trend line and p[1] value for the slope in the trend line are shown in Appendix D. All wells with at least 10 years of record, regardless of gaps in the record, show a declining trend except for 04N 17E 14BBC1, 01S 13E 16BBB1, and 01S14E24ADA1. These wells are highlighted in Figure 5.

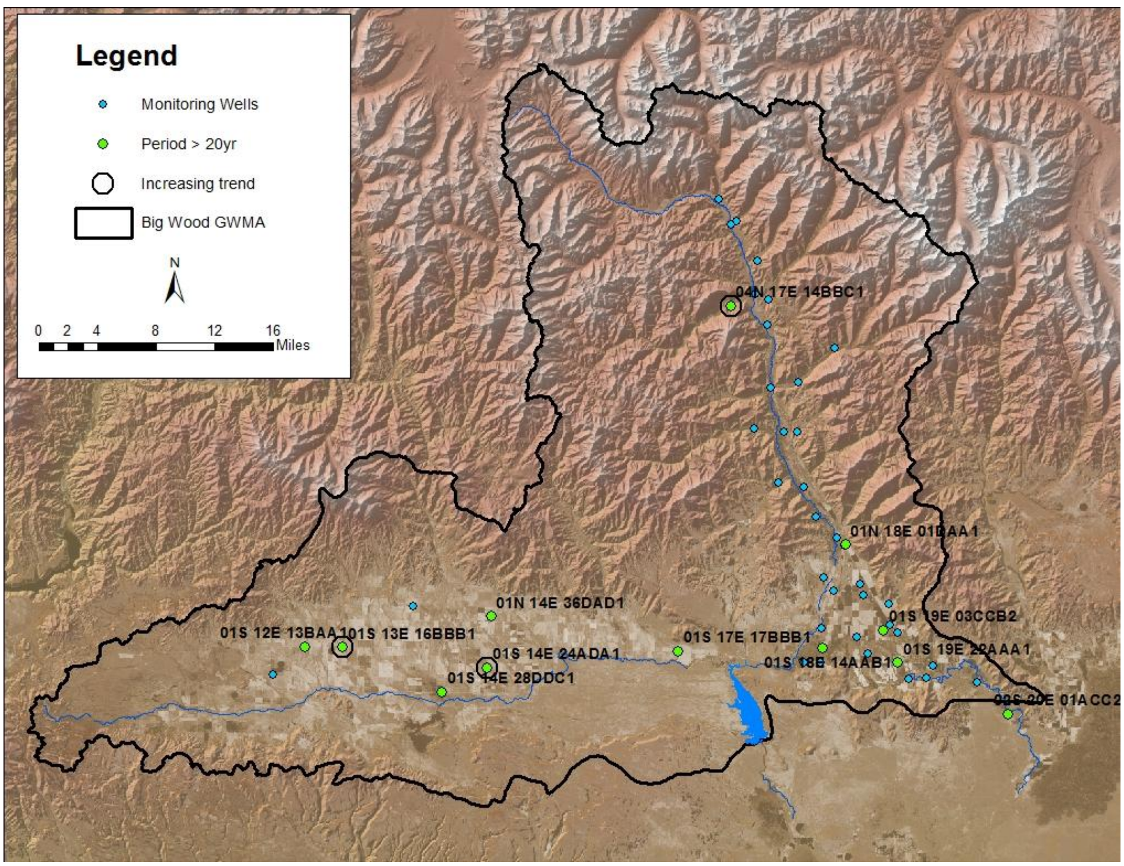


Figure 5. Wells with a record of over 20 years and at least 100 observations. Wells with a halo have an increasing trend, all other wells show a decreasing trend.

[1] The p value is the probability of obtaining the existing dataset when in fact the null hypothesis is true. In this case the null hypothesis is that the water-level trend is flat. If the p value is less than 0.05, then the null hypothesis is rejected at the 95% confidence level.

General Water Level Elevation Analysis

Bartolino (2014) produced water table contour maps for the Wood River Valley for October 2012. Figure 6 shows Bartolino's (2014) water table surface for October, 2012 for the shallow, unconfined aquifer in the Wood River Valley.

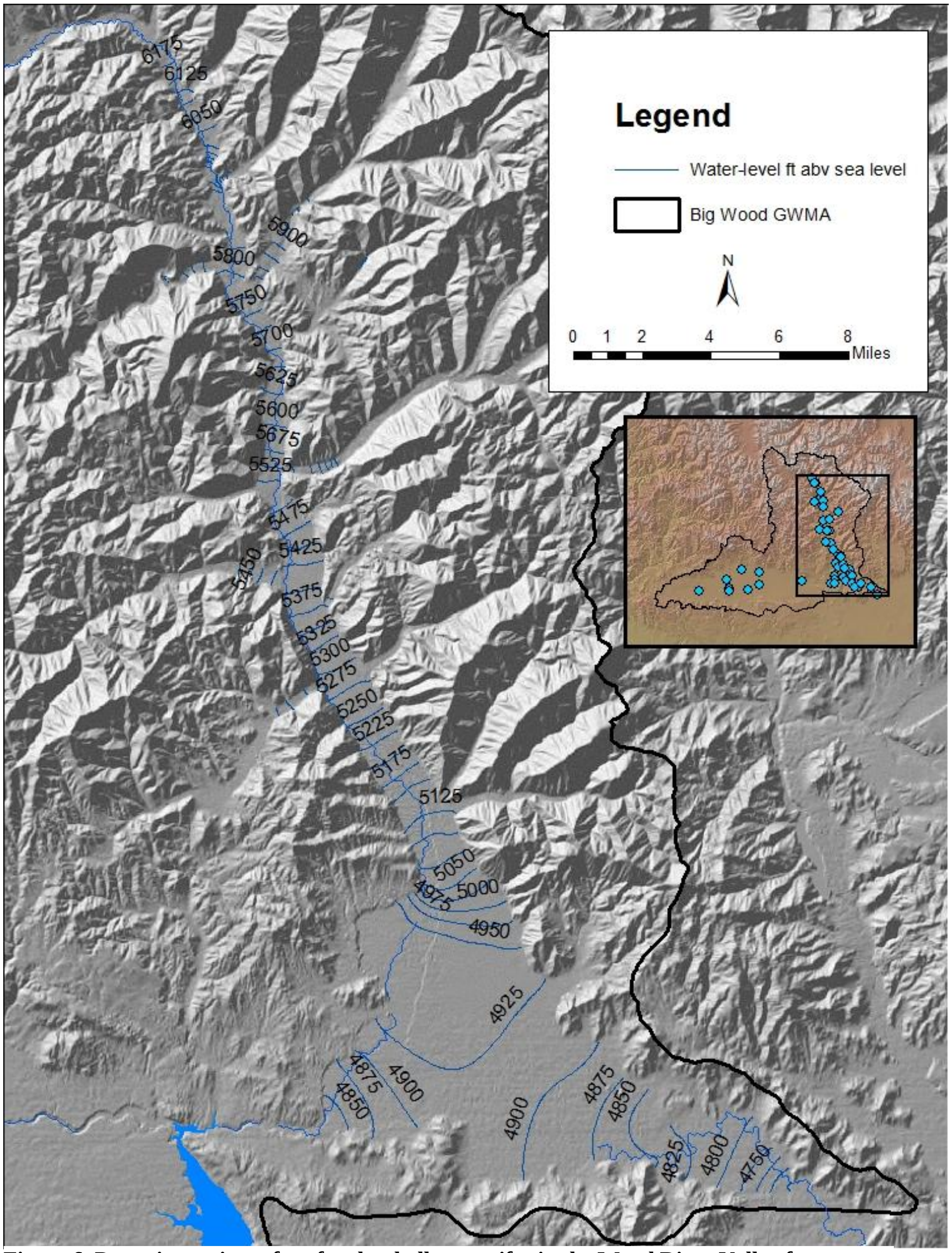


Figure 6. Potentiometric surface for the shallow aquifer in the Wood River Valley from October 2012 (Bartolino, 2014).

Figure 7 contains a potentiometric surface map for the confined aquifer in the Wood River Valley.

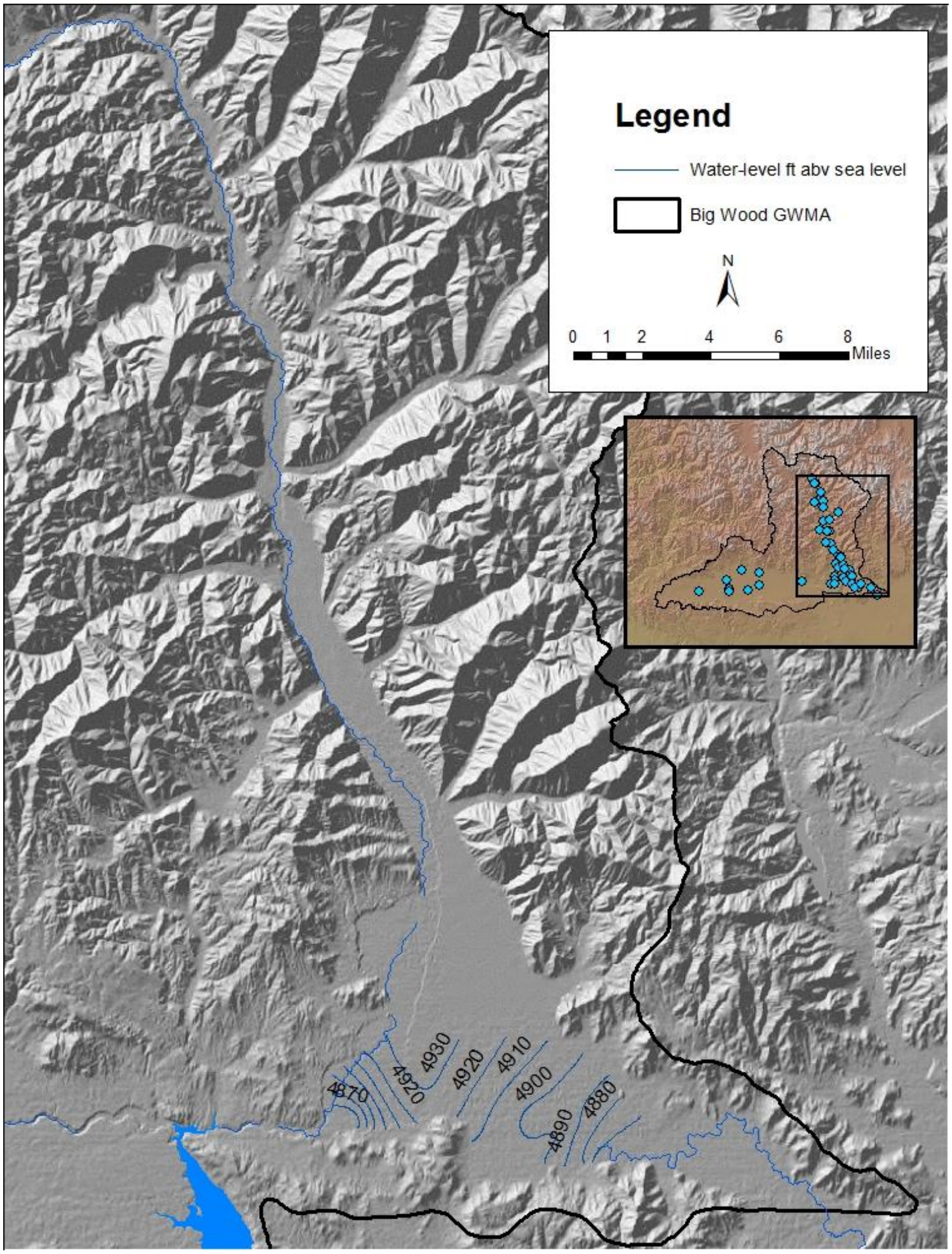


Figure 7. Potentiometric surface for the confined aquifer in the Wood River Valley from October 2012 (Bartolino, 2014).

The Camas Prairie can also be divided into shallow and deep aquifer systems. Figure 8 shows wells with water-levels collected during October 2012 in the Camas Prairie shallow and deep aquifer systems.

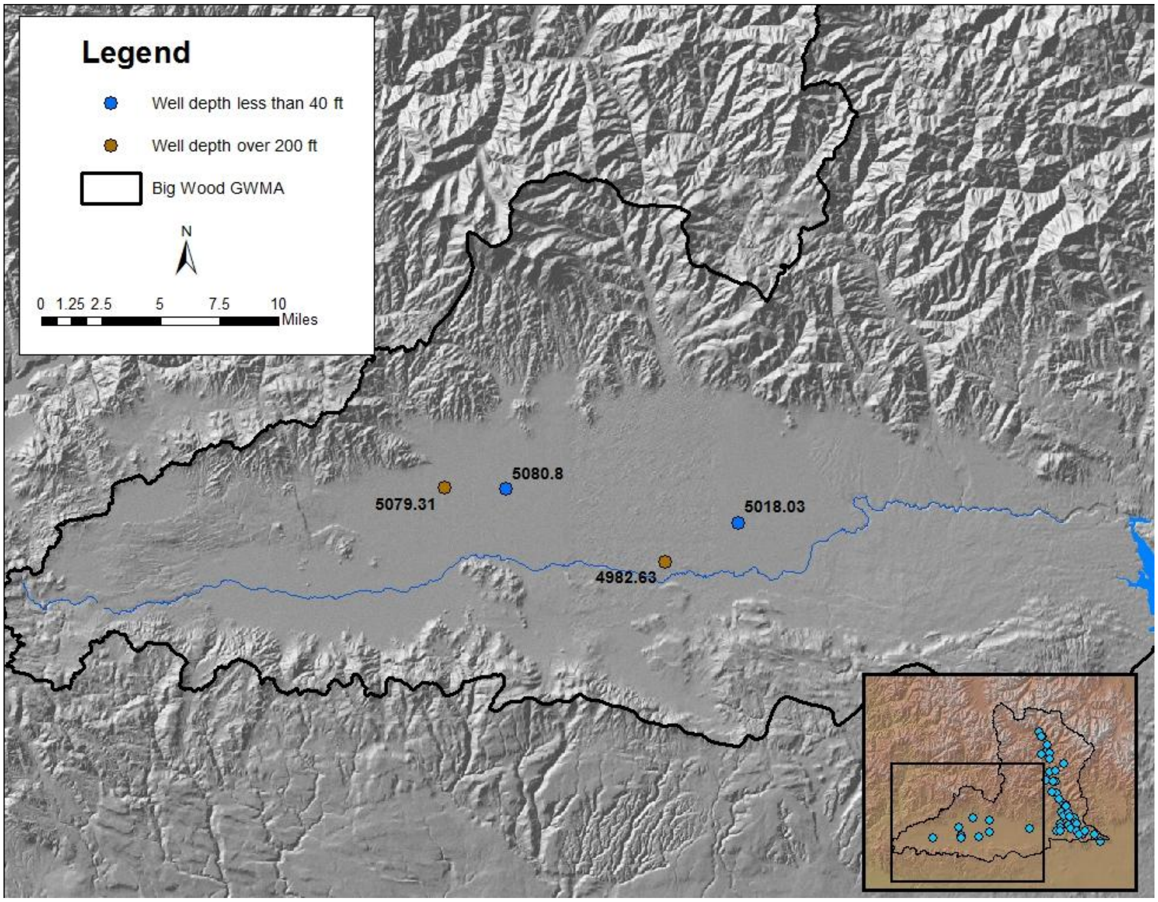
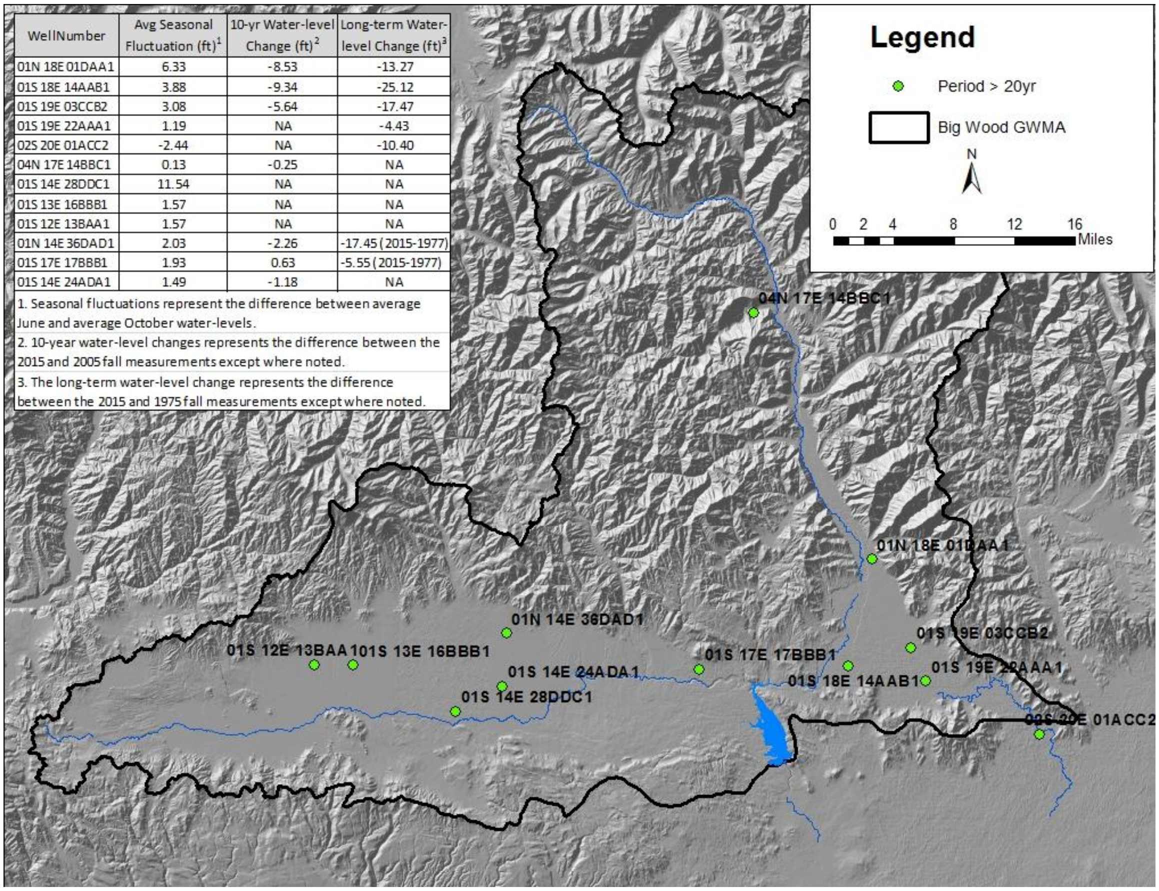


Figure 8. Water-levels in the shallow unconfined and deep confined aquifers in the Camas Prairie.

The maps indicate that groundwater flows from north to south in the Wood River Valley and out the basin to the east and west. The wells in the Camas Prairie suggest that the flow direction in both the shallow unconfined aquifer and the deep confined aquifer is from the west to the east.

Seasonal Fluctuations

Responses to seasonal hydrologic changes are apparent in the hydrographs for each of the wells presented in Appendix D. In general, the hydrographs show similar responses over time. The average seasonal fluctuations for each well were determined by finding the difference between the summer and fall measurements (Figure 9). The average seasonal fluctuation for the selected wells is 2.7 ft. The average 10-year change is a decline of 3.8 ft and the average change from 1975 to 2015 is a decline of 13.4 ft.



WellNumber	Avg Seasonal Fluctuation (ft)[1]	10-yr Water-level Change (ft)[2]	Long-term Water-level Change (ft)[3]
01N 18E 01DAA1	6.33	-8.53	-13.27
01S 18E 14AAB1	3.88	-9.34	-25.12
01S 19E 03CCB2	3.08	-5.64	-17.47
01S 19E 22AAA1	1.19	NA	-4.43
02S 20E 01ACC2	-2.44	NA	-10.40
04N 17E 14BBC1	0.13	-0.25	NA
01S 14E 28DDC1	11.54	NA	NA
01S 13E 16BBB1	1.57	NA	NA
01S 12E 13BAA1	1.57	NA	NA
01N 14E 36DAD1	2.03	-2.26	-17.45 (2015-1977)
01S 17E 17BBB1	1.93	0.63	-5.55 (2015-1977)
01S 14E 24ADA1	1.49	-1.18	NA

1. Seasonal fluctuations represent the difference between average June and average October water-levels.
2. 10-year water-level changes represents the difference between the 2015 and 2005 fall measurements except where noted.
3. The long-term water-level change represents the difference between the 2015 and 1975 fall measurements except where noted.

Figure 9. Summary of water-level changes in the Big Wood GWMA.

Conclusions and Recommendations

The average rate of decline from 1975 to 2015 was 0.33 ft per year. The average rate of decline over the last 10 years was 0.38 ft per year. The increase from 0.33 to 0.38 ft/yr represents an increase of about 12%. This increase could be primarily due to changes in water use, or to climate related issues, or a combination of both.

The current network only includes eight wells in the Camas Prairie. An effort should be made to include more active wells in the both the shallow and deep aquifers in this network and add some transducer wells in both aquifers.

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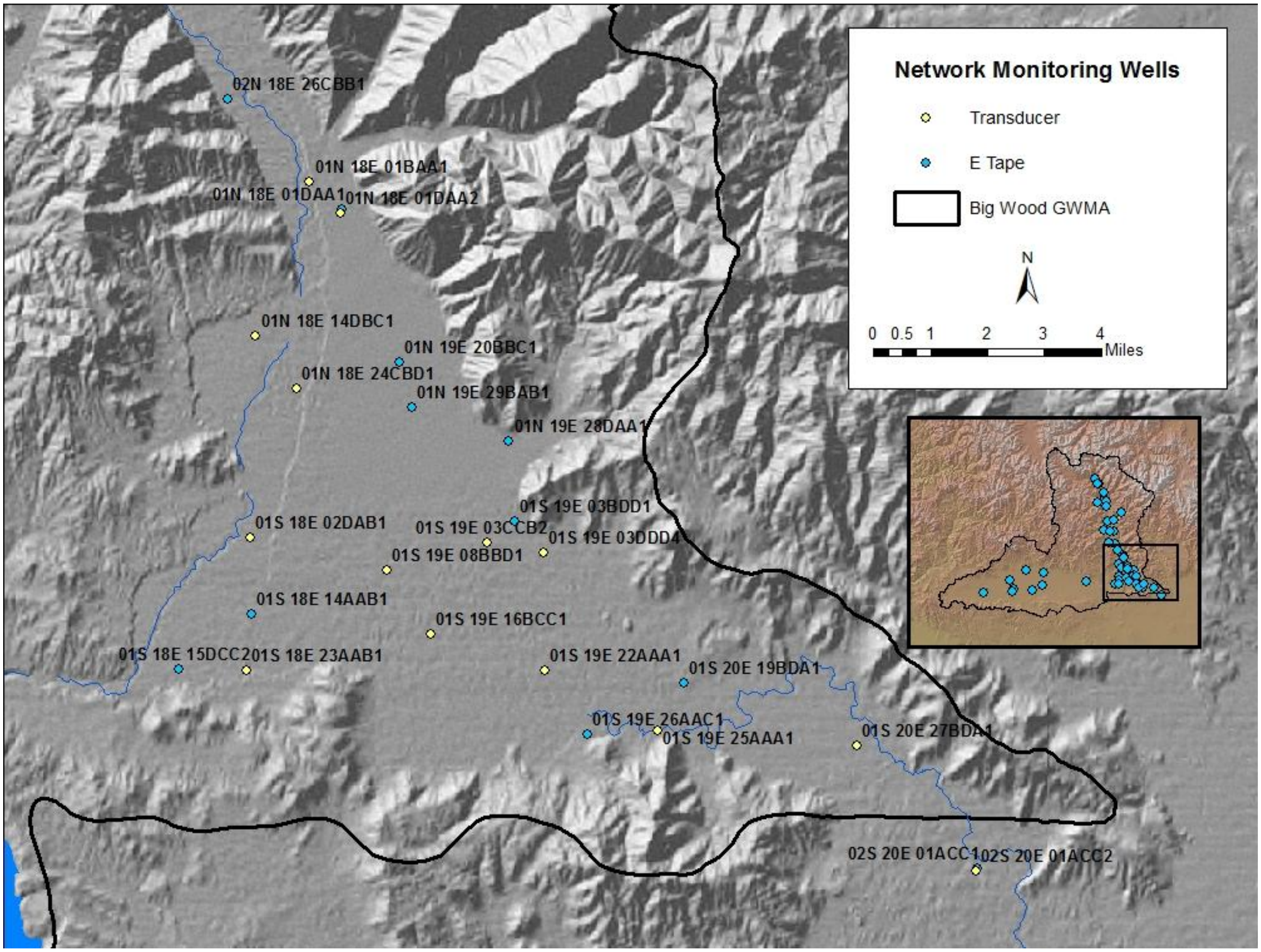
APPENDIX A

HYDROGRAPS



Network Monitoring Wells
Transducer
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Big Wood GWMA
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01N 18E 01BAA1
01N 18E 01DAA1
01N 18E 01DAA2
01N 18E 14DBC1
01N 19E 20BBC1
01N 18E 24CBD1
01N 19E 29BAB1
01N 19E 28DAA1
01S 19E 03BDD1
01S 18E 02DAB1
01S 19E 03CCB2
01S 19E 03DDD4
01S 19E 08BBD1
01S 18E 14AAB1
01S 19E 16BCC1
01S 18E 15DCC2
01S 18E 23AAB1
01S 19E 22AAA1
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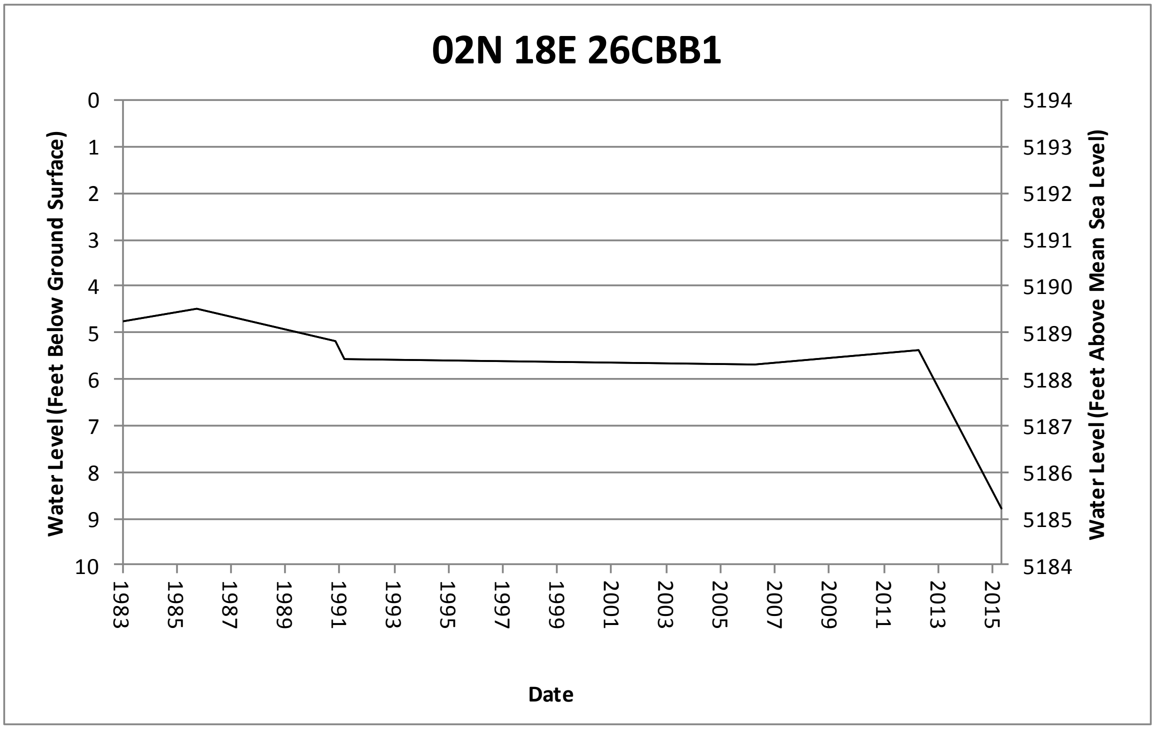
02S 20E 01ACC1
02S 20E 01ACC2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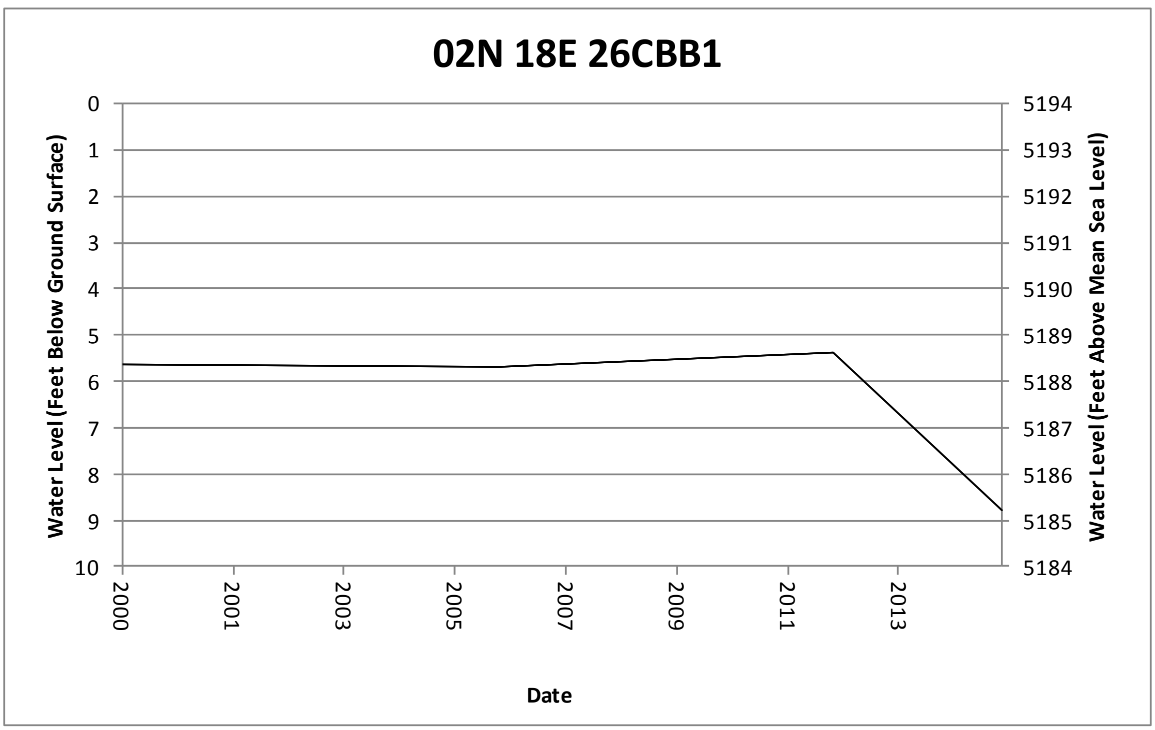
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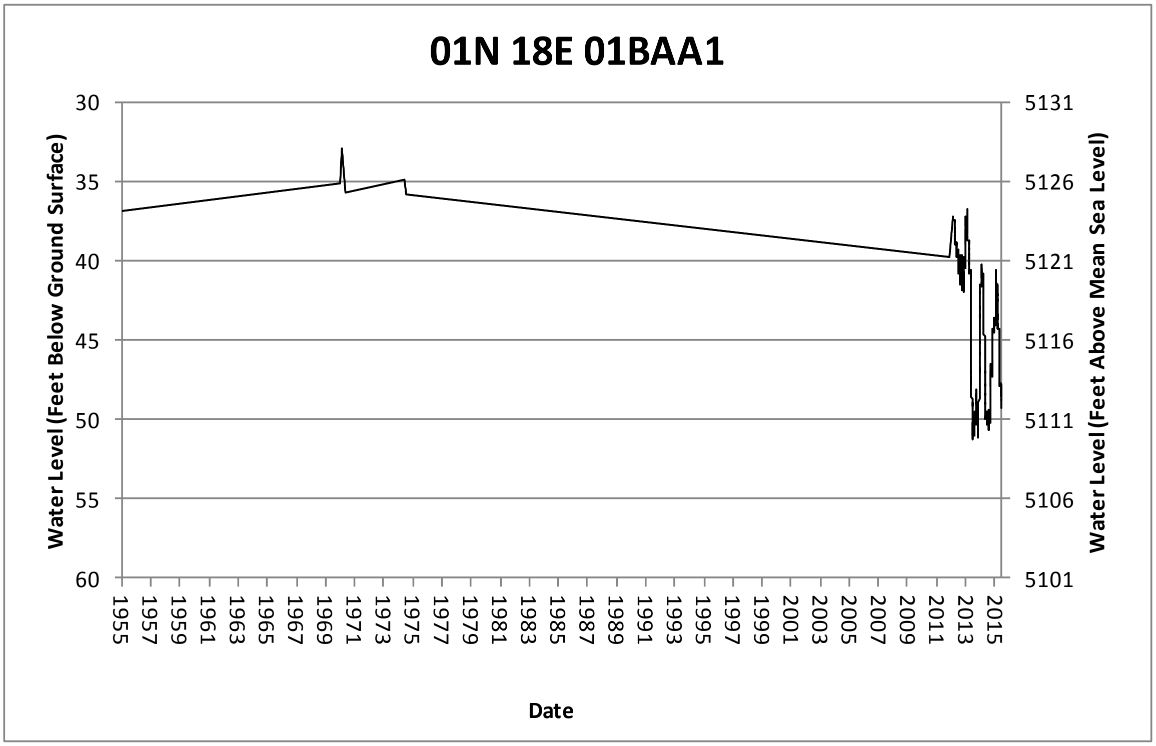
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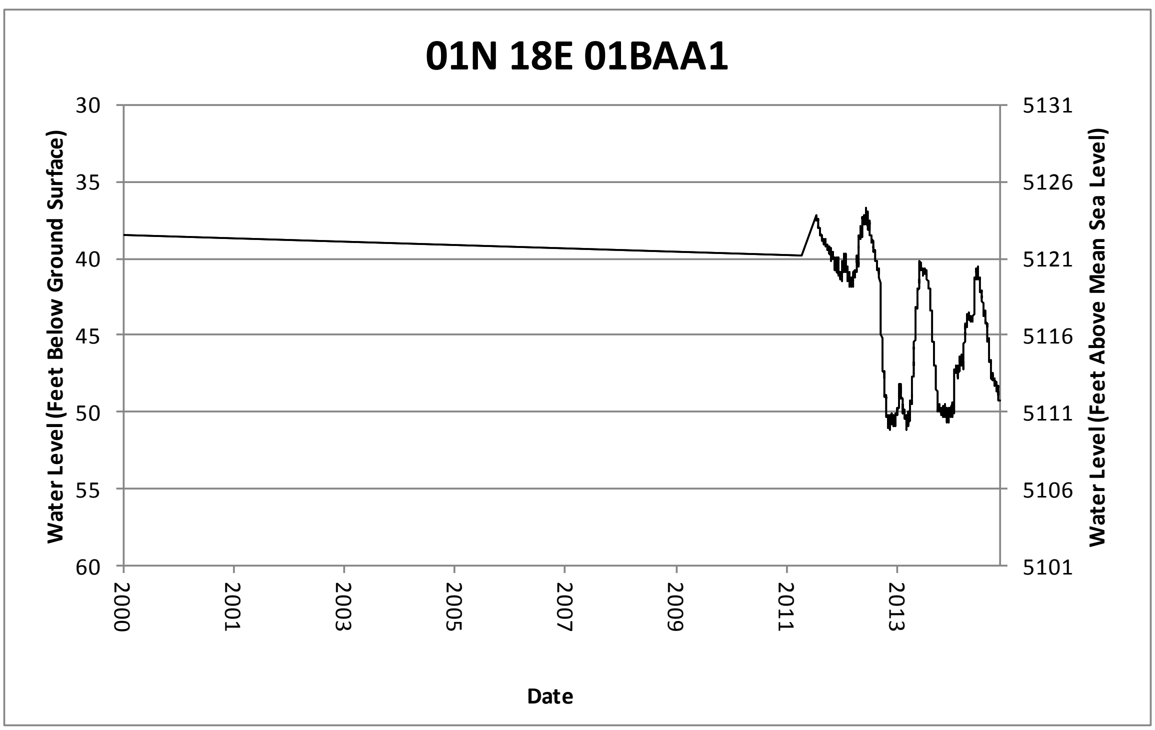
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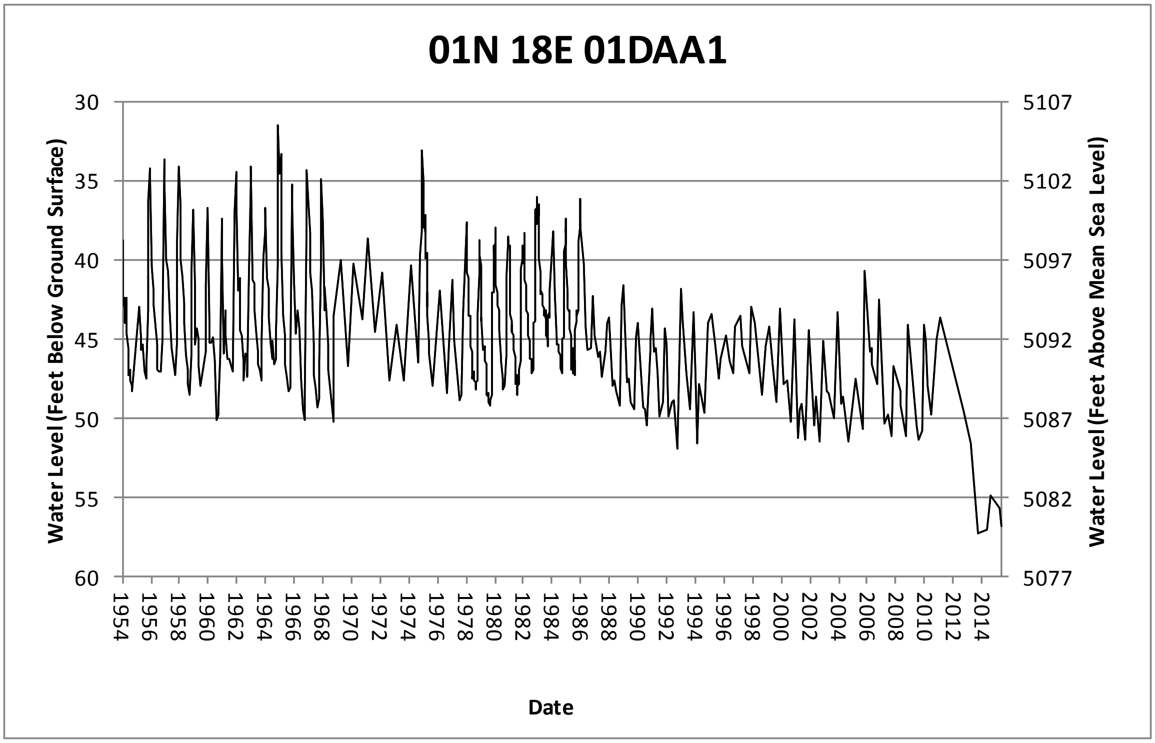
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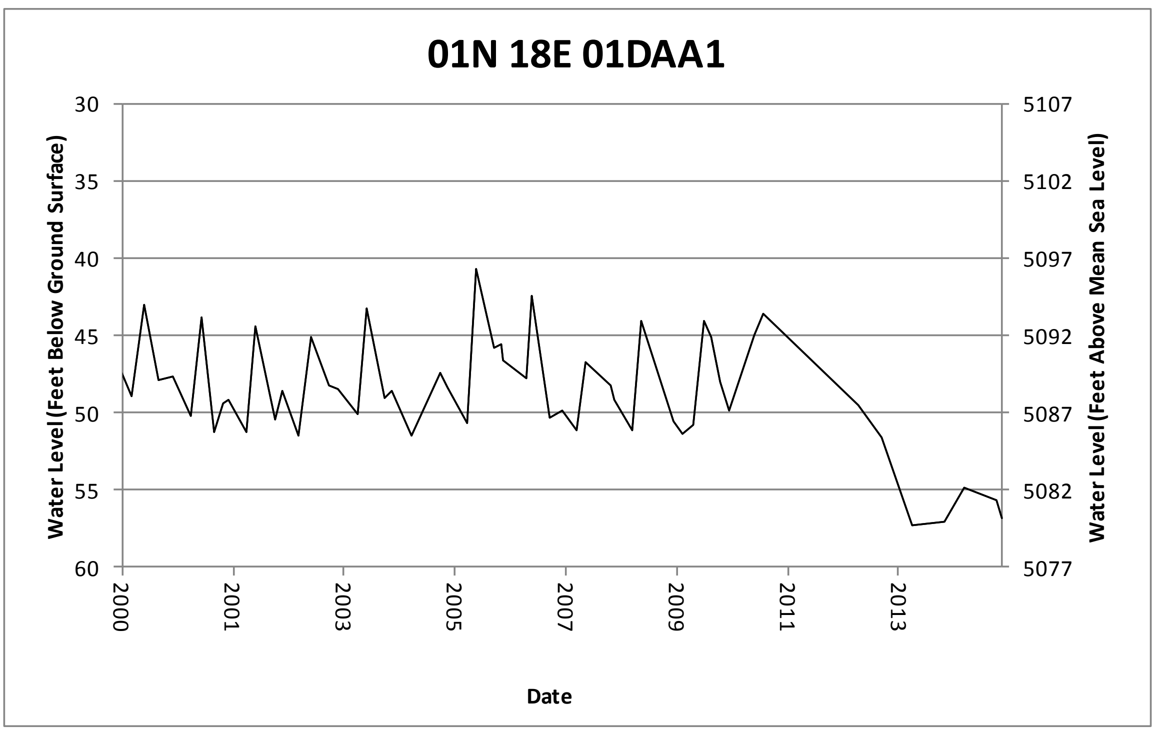
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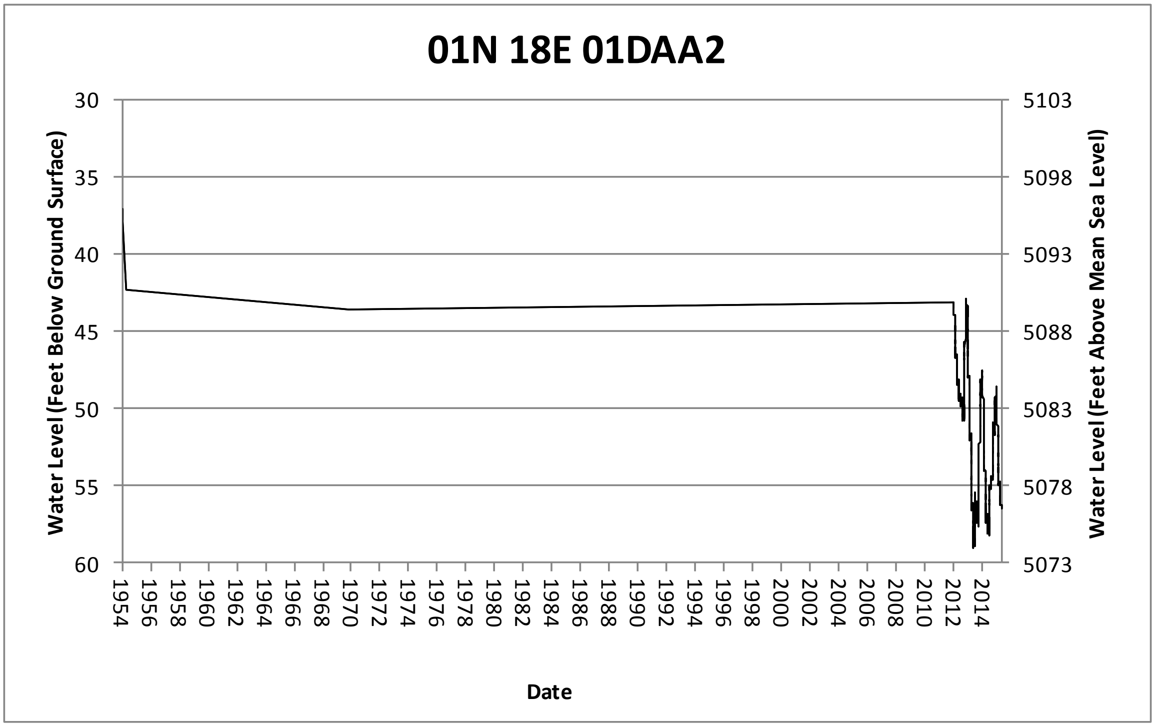

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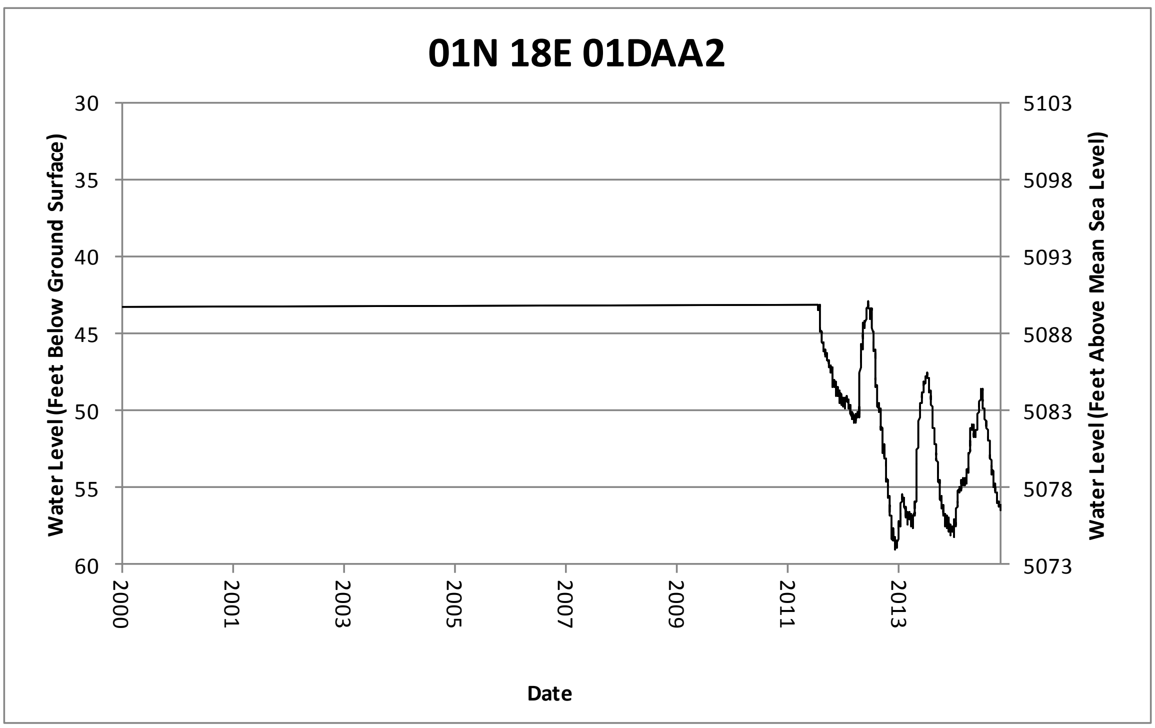

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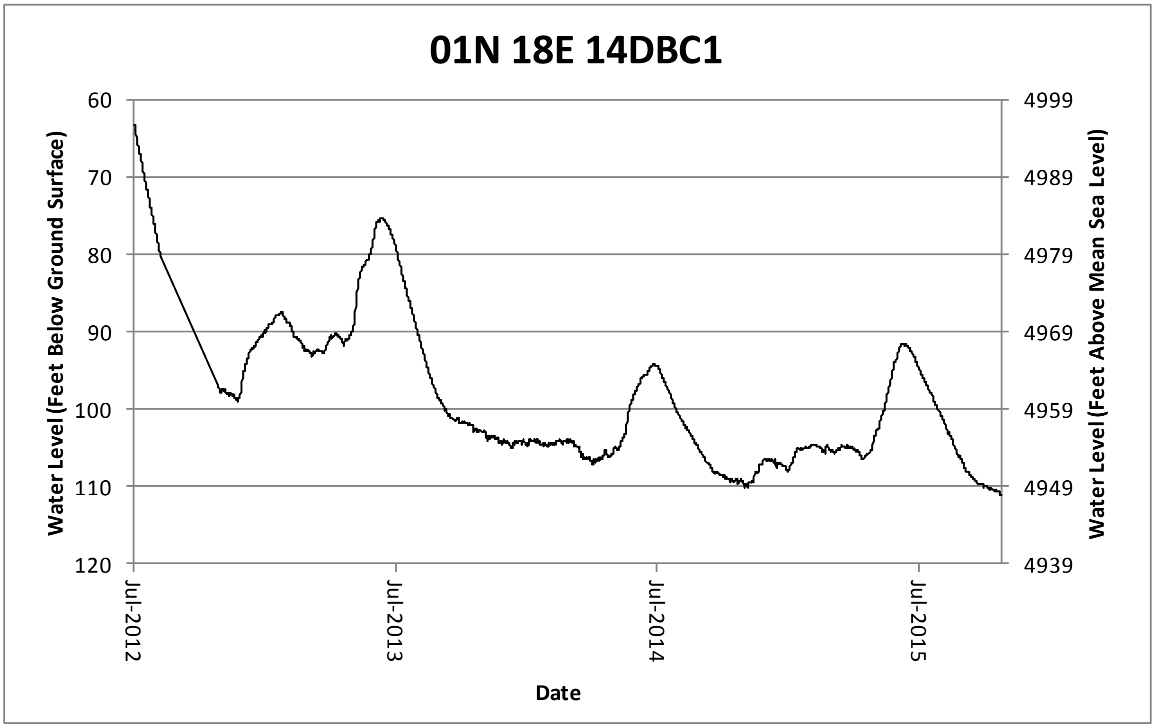

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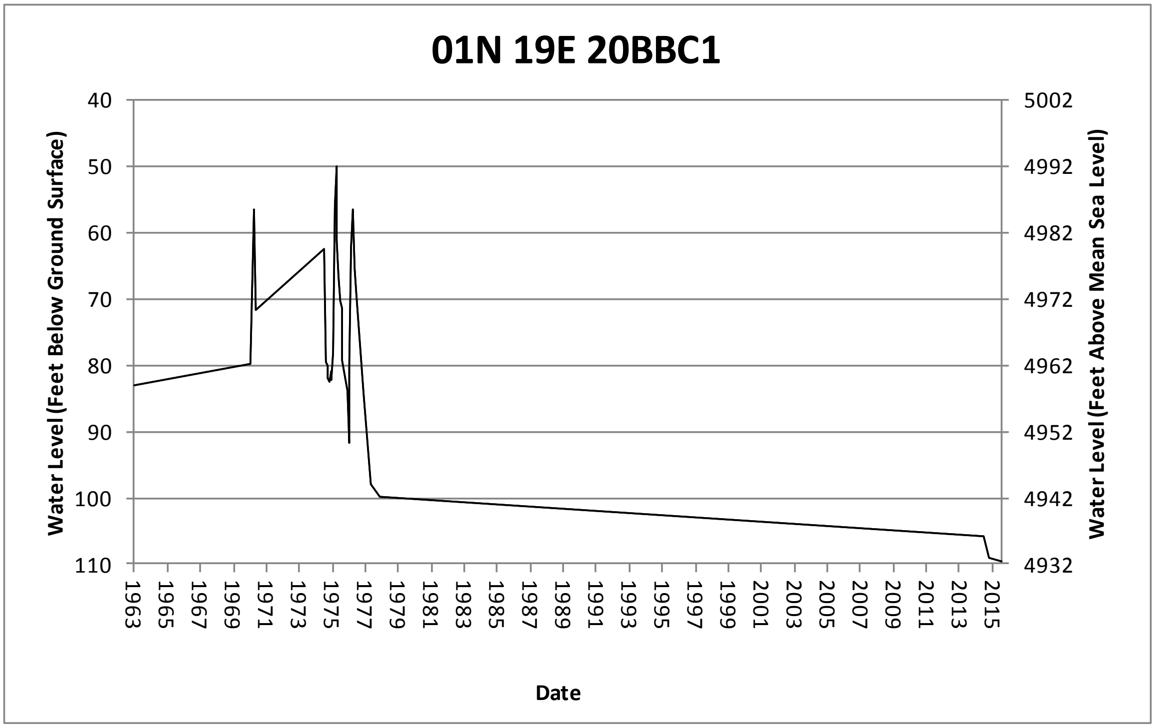
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Water Level (Feet Above Mean Sea Level)
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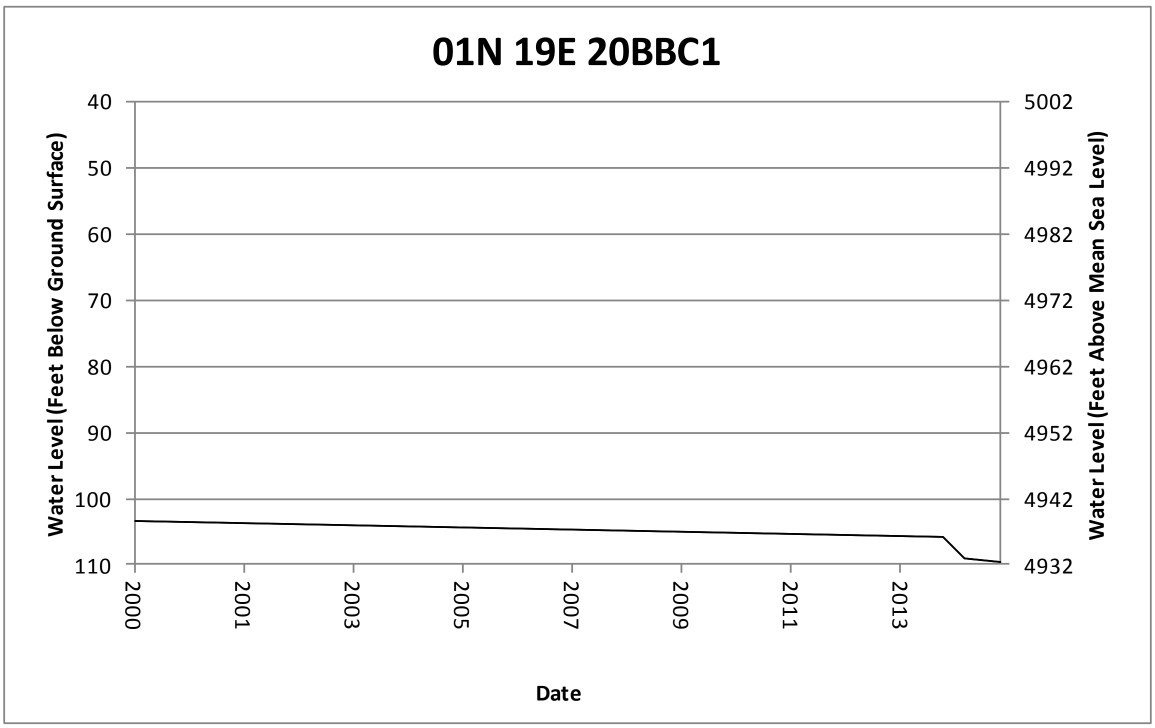
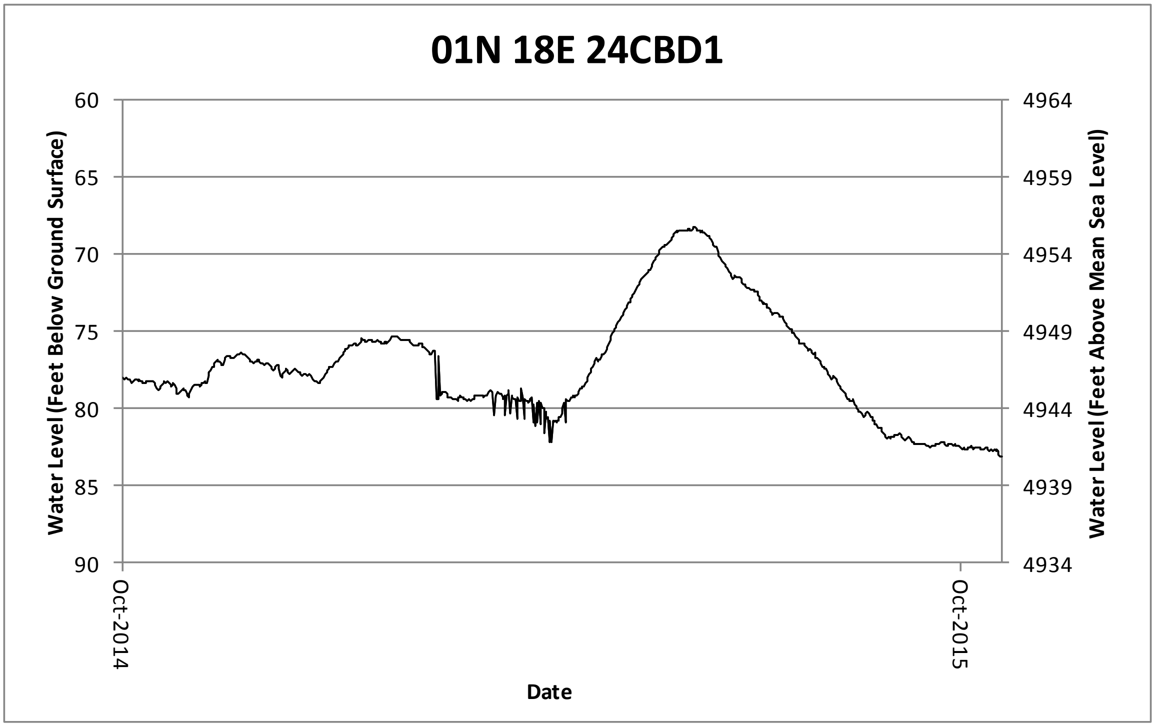
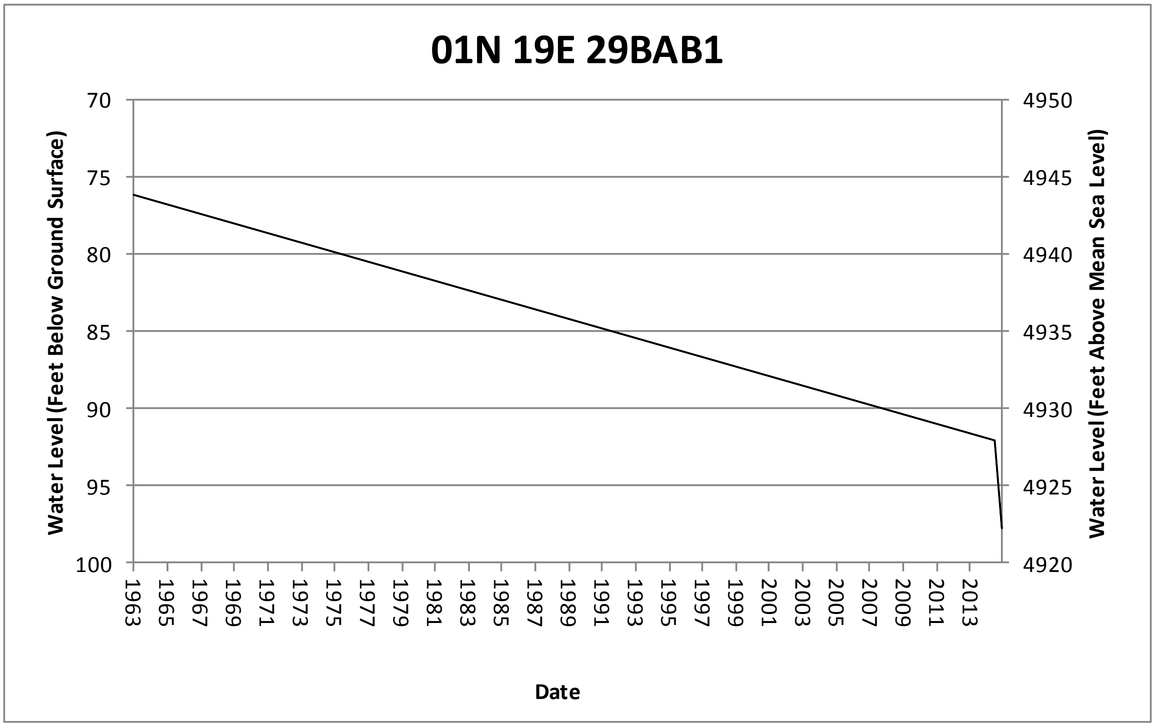
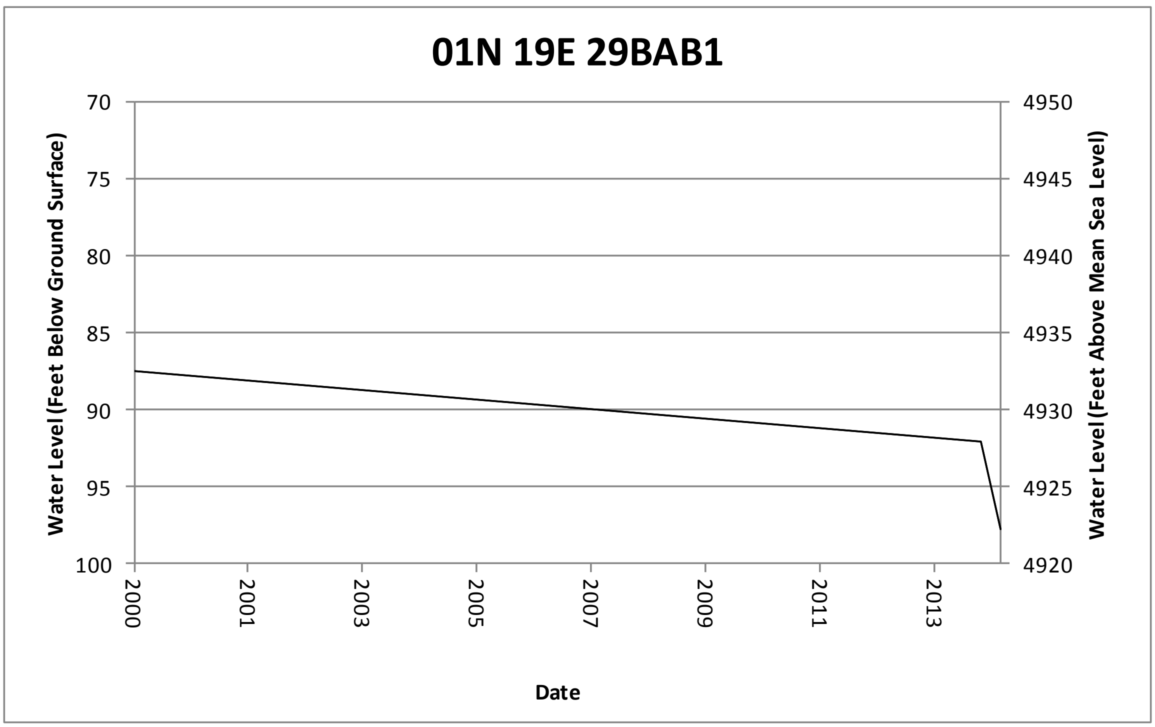
2015
Date

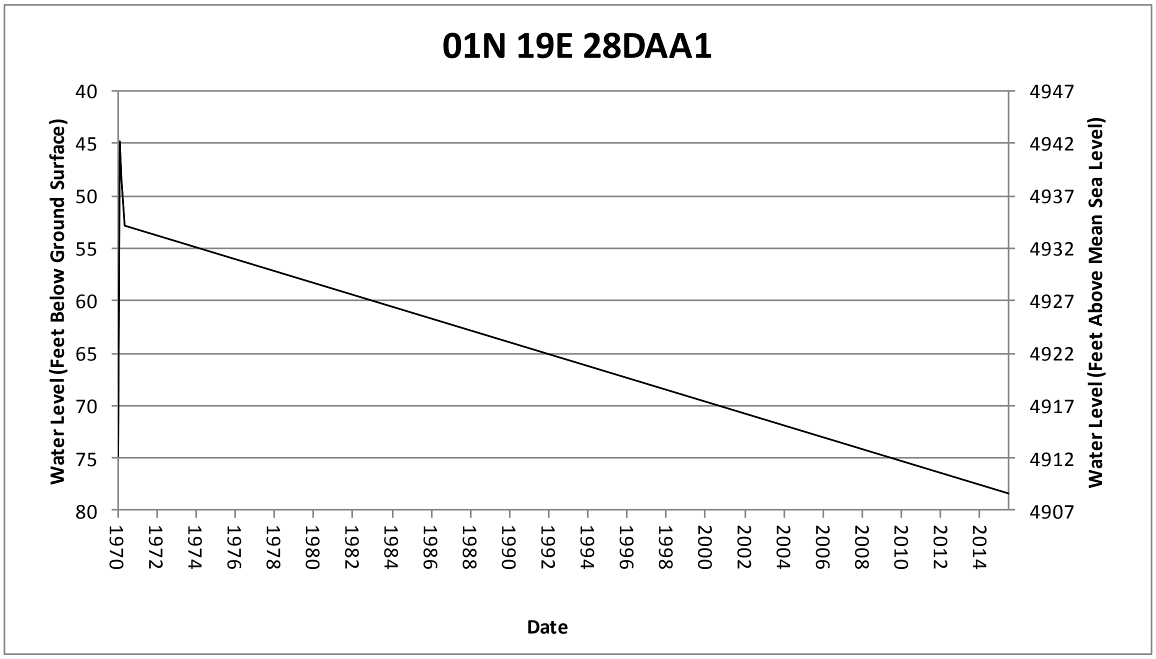

01N 19E 20BBC1
Water Level (Feet Below Ground Surface)
Water Level (Feet Above Mean Sea Level)
40
50
60
70
80
90
100
110
5002
4992
4982
4972
4962
4952
4942
4932
2000
2001
2003
2005
2007
2009
2011
2013
Date

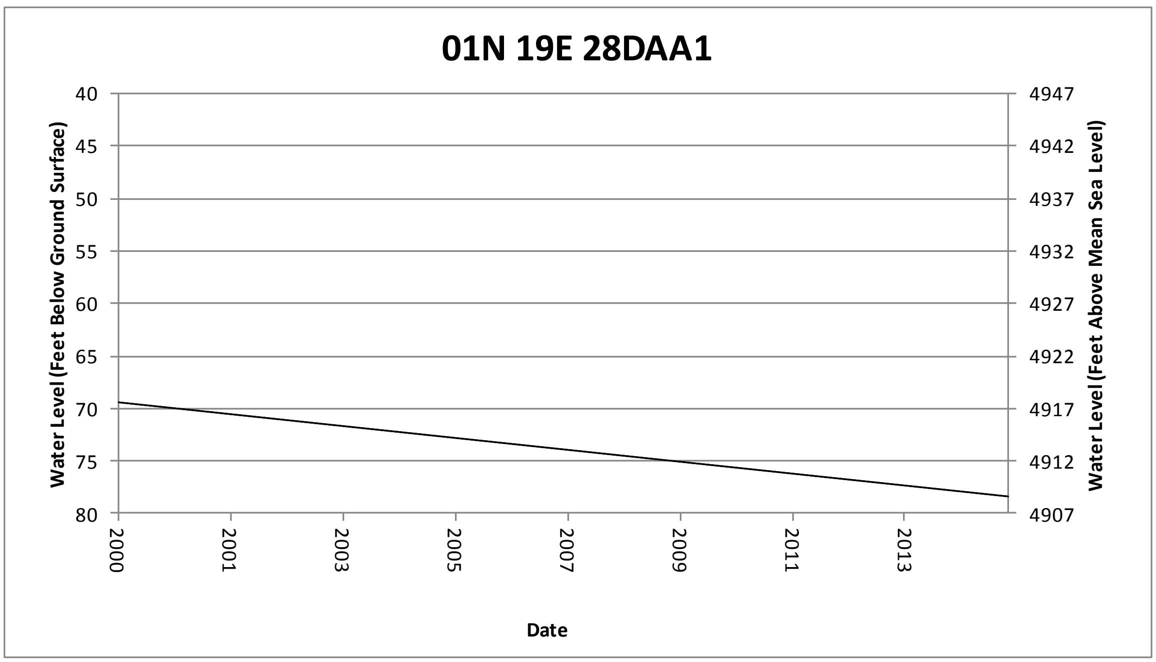


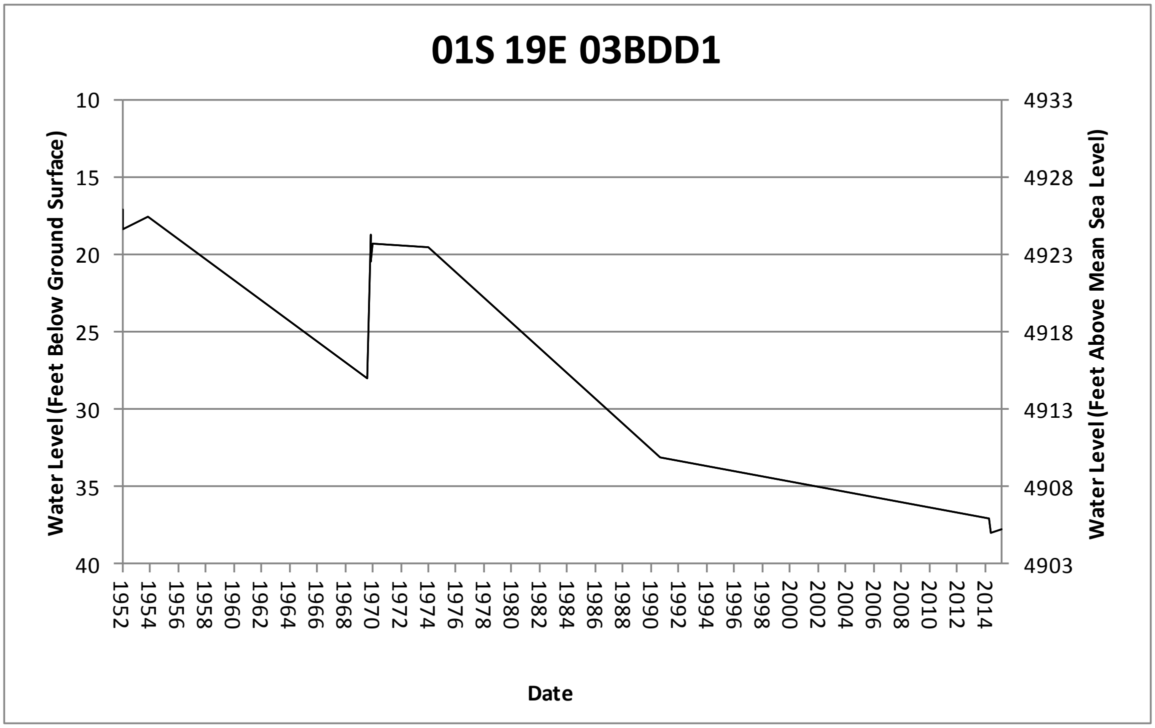
01N 18E 24CBD1
Water Level (Feet Below Ground Surface)
60
65
70
75
80
85
90
Water Level (Feet Above Mean Sea Level)
4964
4959
4954
4949
4944
4939
4934
Oct-2014
Oct-2015
Date

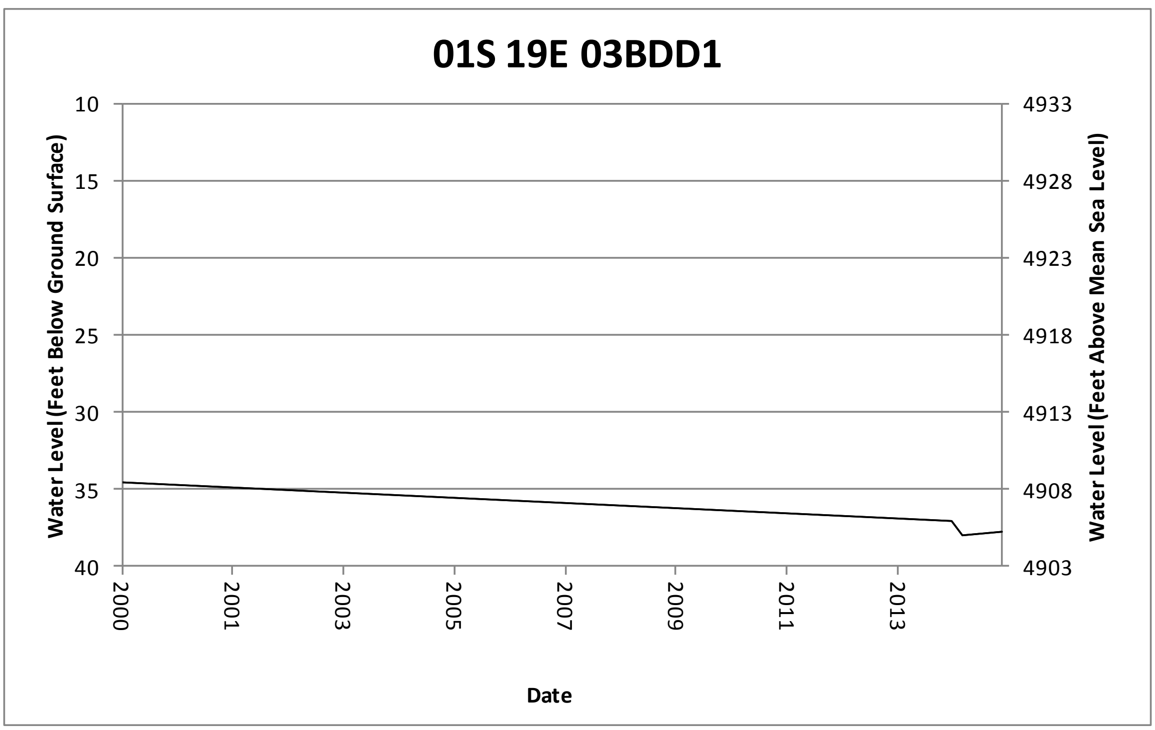

01N 19E 29BAB1
Water Level (Feet Below Ground Surface)
70
75
80
85
90
95
100
Water Level (Feet Above Mean Sea Level)
4950
4945
4940
4935
4930
4925
4920
1963
1965
1967
1969
1971
1973
1975
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009
2011
2013
Date

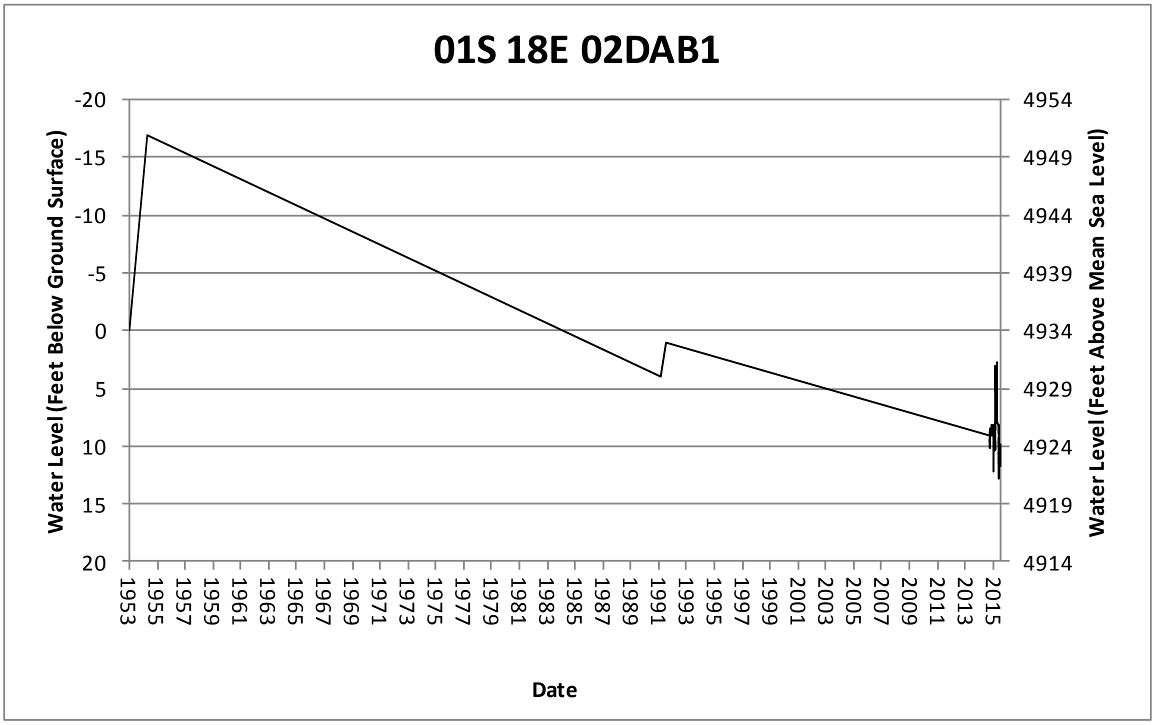

01N 19E 29BAB1
Water Level (Feet Below Ground Surface)
70
75
80
85
90
95
100
Water Level (Feet Above Mean Sea Level)
4950
4945
4940
4935
4930
4925
4920
2000
2001
2003
2005
2007
2009
2011
2013
Date

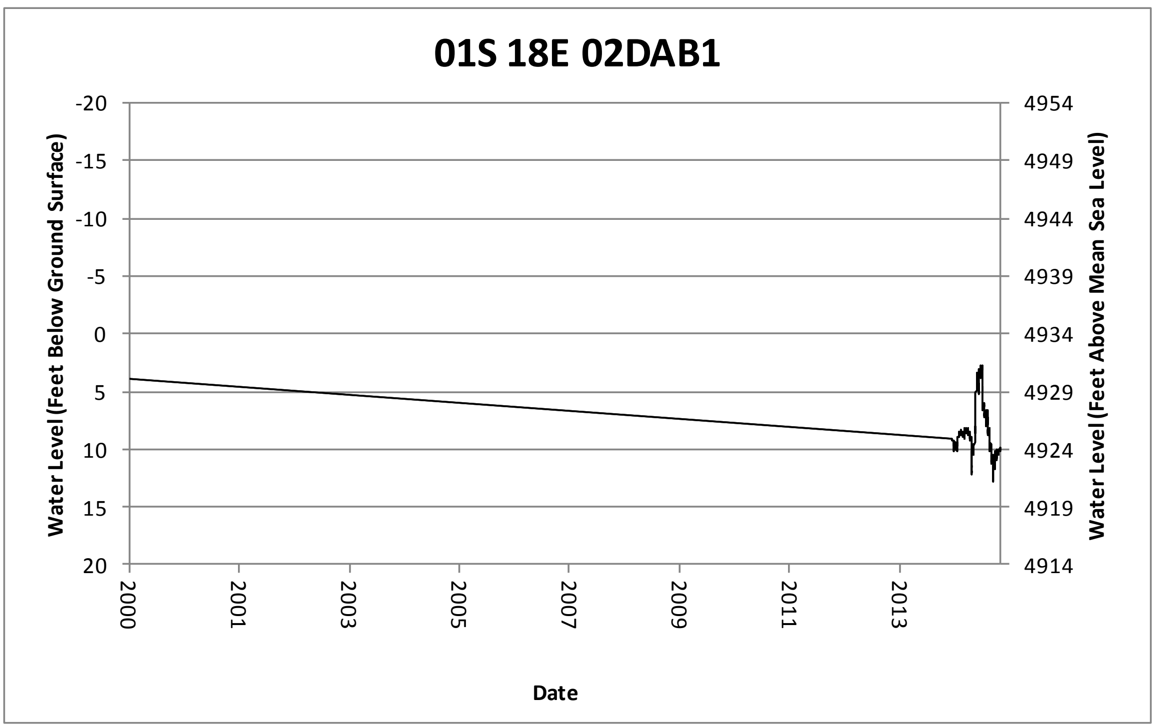

01N 19E 28DAA1
Water Level (Feet Below Ground Surface)
40
45
50
55
60
65
70
75
80
Water Level (Feet Above Mean Sea Level)
4947
4942
4937
4932
4927
4922
4917
4912
4907
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
Date

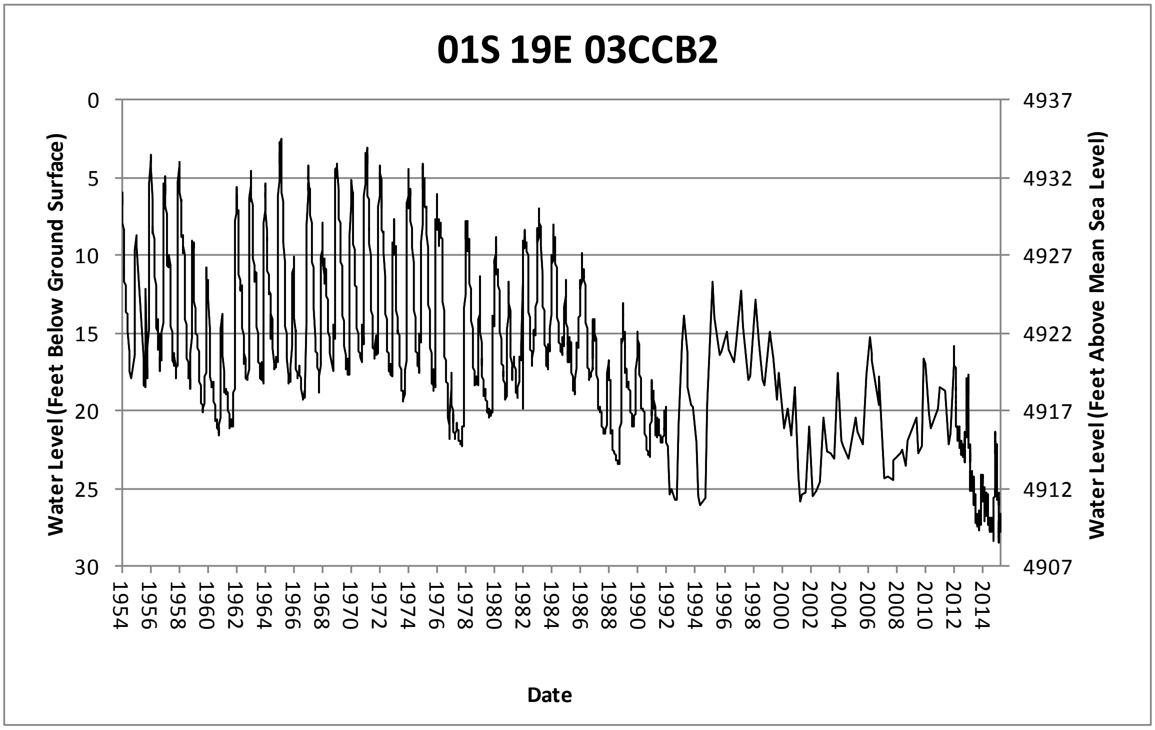

01N 19E 28DAA1
Water Level (Feet Below Ground Surface)
40
45
50
55
60
65
70
75
80
Water Level (Feet Above Mean Sea Level)
4947
4942
4937
4932
4927
4922
4917
4912
4907
2000
2001
2003
2005
2007
2009
2011
2013
Date

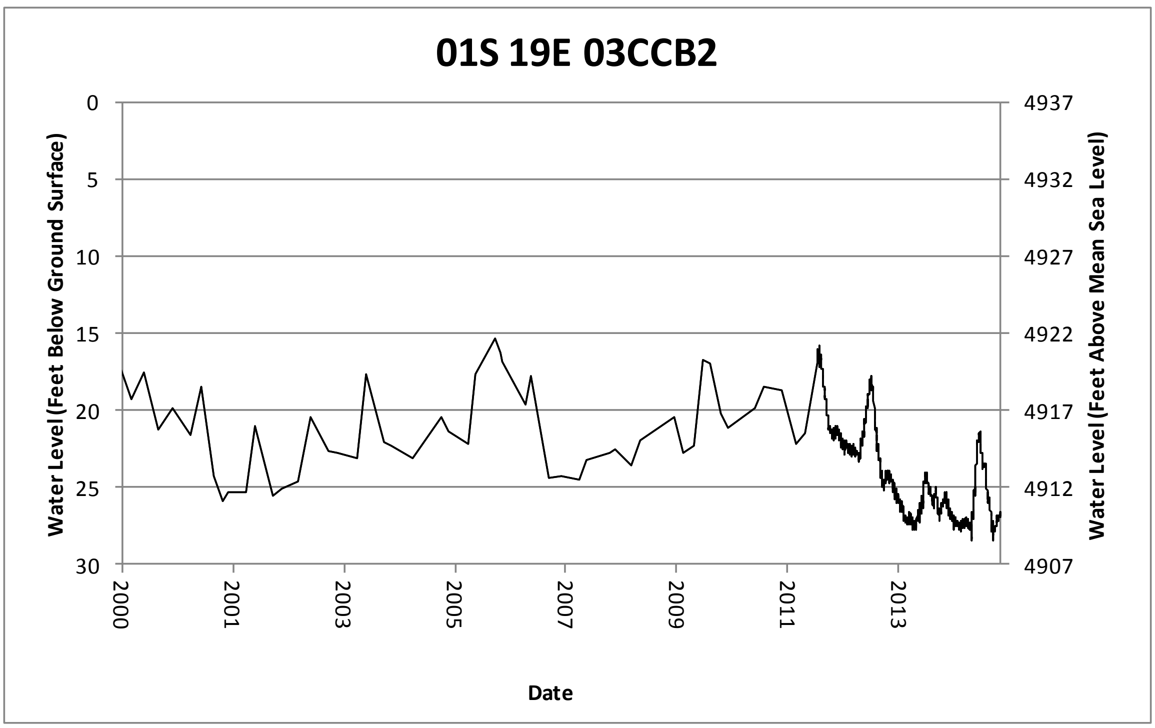

01S 19E 03BDD1
Water Level (Feet Below Ground Surface)
Water Level (Feet Above Mean Sea Level)
10
15
20
25
30
35
40
4933
4928
4923
4918
4913
4908
4903
1952
1954
1956
1958
1960
1962
1964
1966
1968
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
Date

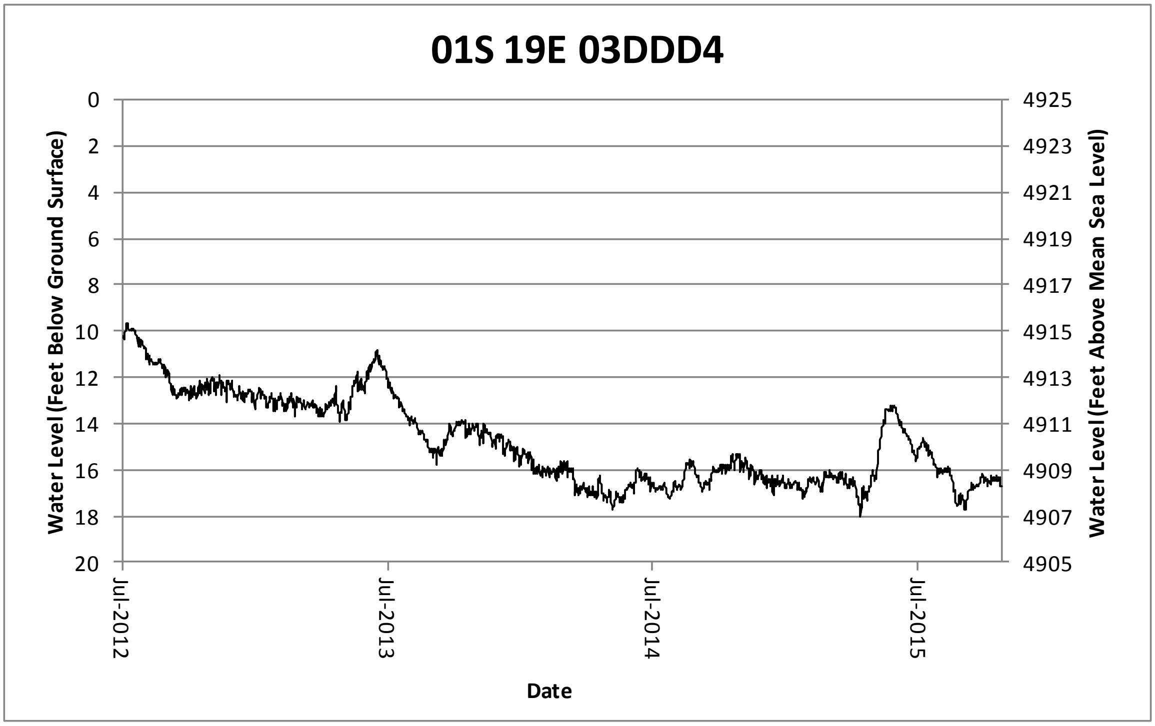

01S 19E 03BDD1
Water Level (Feet Below Ground Surface)
Water Level (Feet Above Mean Sea Level)
10
15
20
25
30
35
40
4933
4928
4923
4918
4913
4908
4903
2000
2001
2003
2005
2007
2009
2011
2013
Date


01S 18E 02DAB1
Water Level (Feet Below Ground Surface)
Water Level (Feet Above Mean Sea Level)
-20
-15
-10
-5
0
5
10
15
20
4954
4949
4944
4939
4934
4929
4924
4919
4914
1953
1955
1957
1959
1961
1963
1965
1967
1969
1971
1973
1975
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009
2011
2013
2015
Date

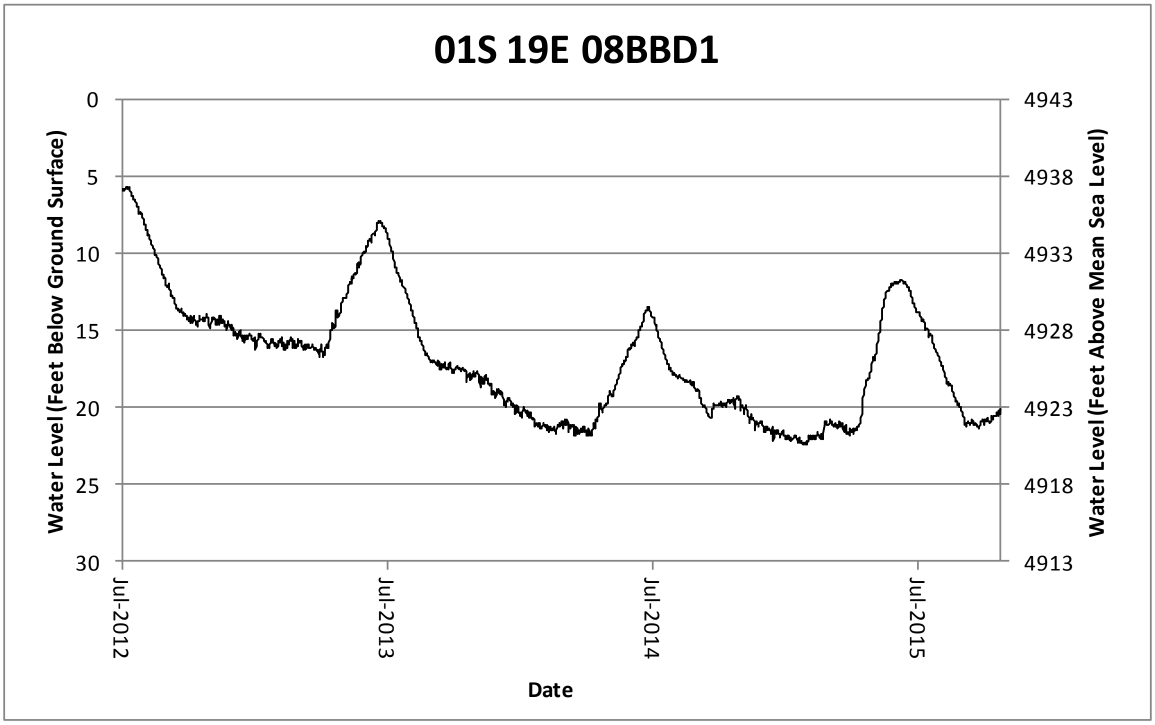

01S 18E 02DAB1
Water Level (Feet Below Ground Surface)
Water Level (Feet Above Mean Sea Level)
-20
-15
-10
-5
0
5
10
15
20
4954
4949
4944
4939
4934
4929
4924
4919
4914
2000
2001
2003
2005
2007
2009
2011
2013
Date


01S 19E 03CCB2
Water Level (Feet Below Ground Surface)
Water Level (Feet Above Mean Sea Level)
0
5
10
15
20
25
30
4937
4932
4927
4922
4917
4912
4907
1954
1956
1958
1960
1962
1964
1966
1968
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
Date

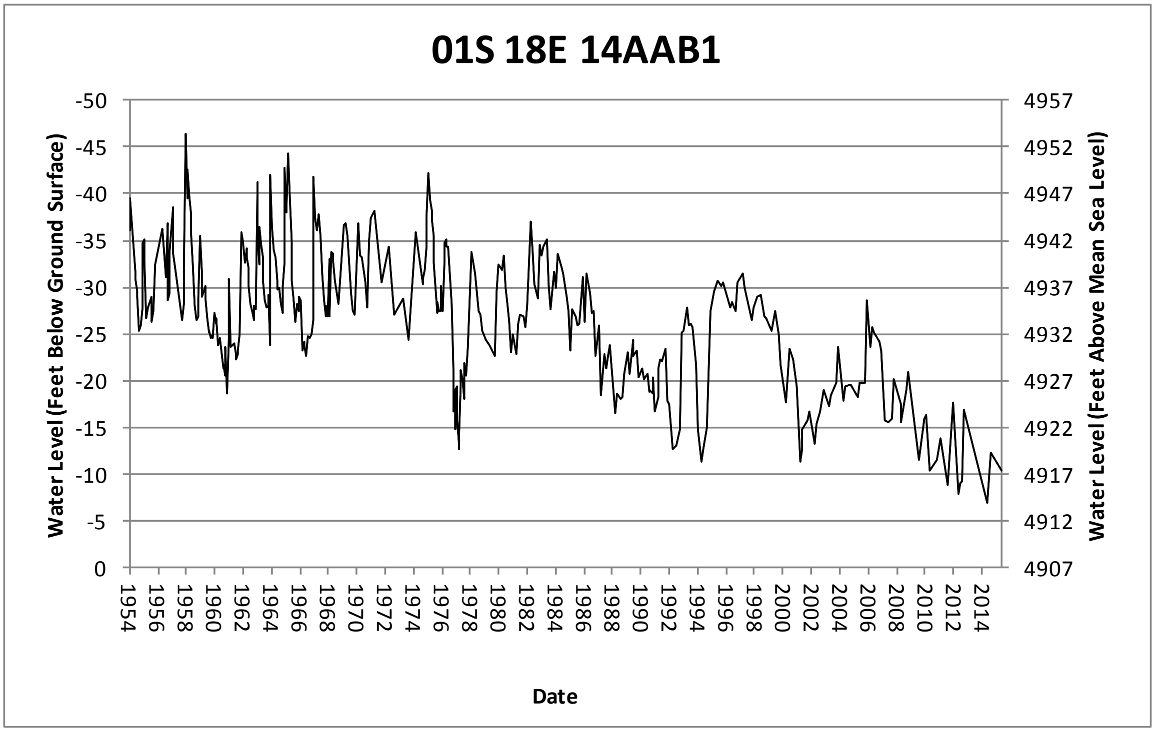

01S 19E 03CCB2
Water Level (Feet Below Ground Surface)
Water Level (Feet Above Mean Sea Level)
0
5
10
15
20
25
30
4937
4932
4927
4922
4917
4912
4907
2000
2001
2003
2005
2007
2009
2011
2013
Date

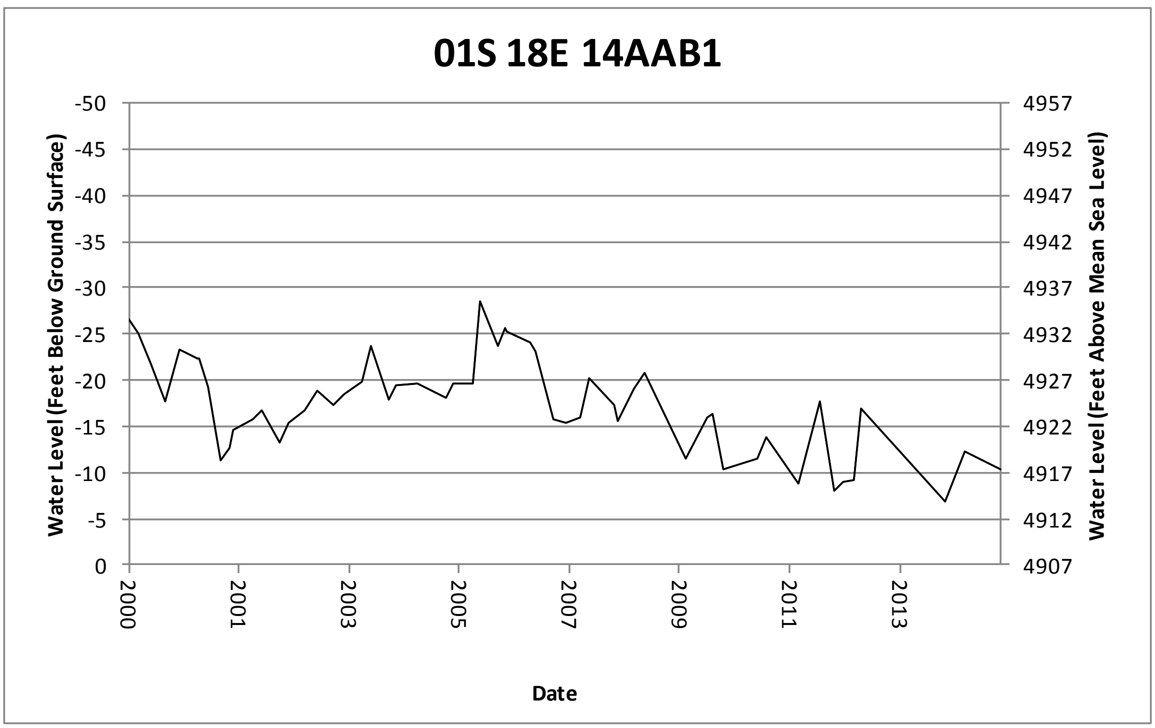


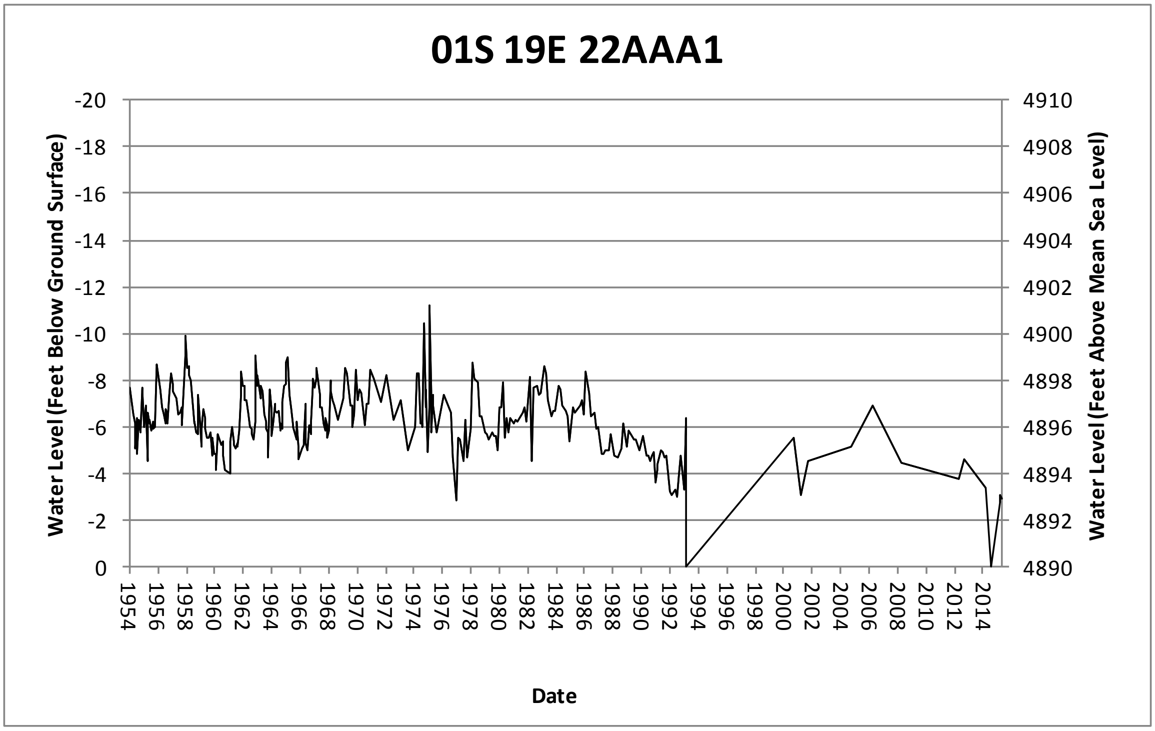
01S 19E 03DDD4
Water Level (Feet Below Ground Surface)
0
2
4
6
8
10
12
14
16
18
20
Water Level (Feet Above Mean Sea Level)
4925
4923
4921
4919
4917
4915
4913
4911
4909
4907
4905
Jul-2012
Jul-2013
Jul-2014
Jul-2015
Date



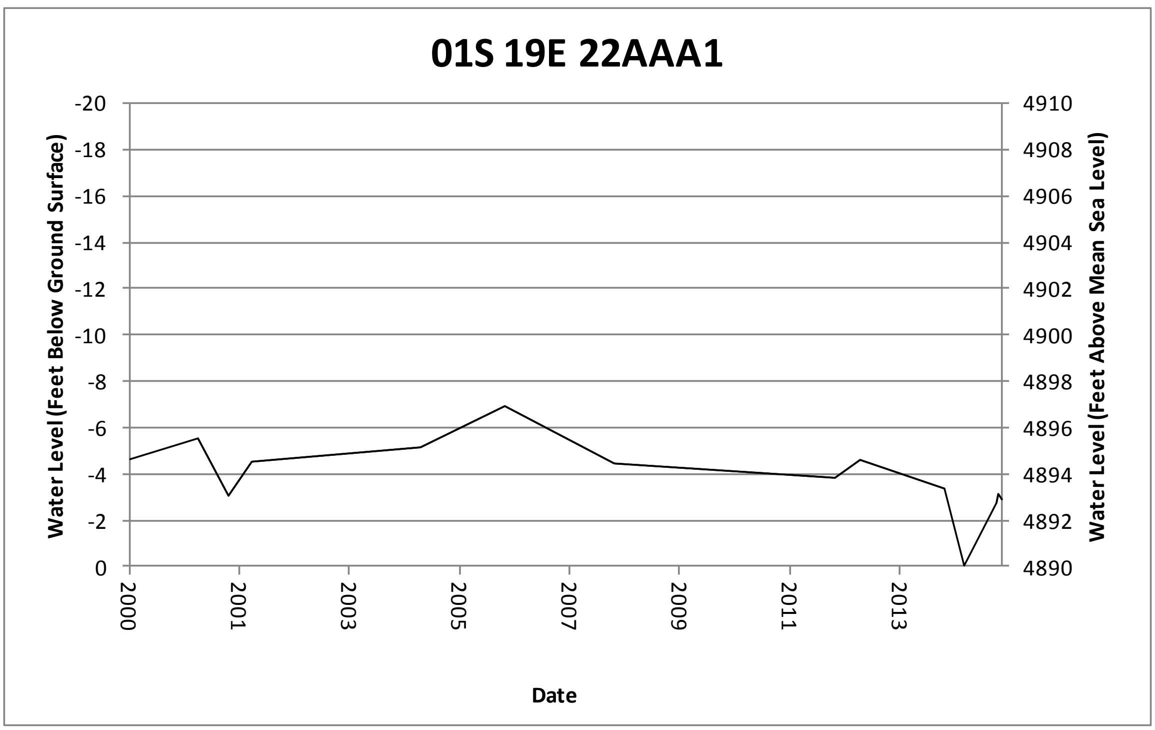
01S 19E 08BBD1
Water Level (Feet Below Ground Surface)
0
5
10
15
20
25
30
Water Level (Feet Above Mean Sea Level)
4943
4938
4933
4928
4923
4918
4913
Jul-2012
Jul-2013
Jul-2014
Jul-2015
Date


01S 18E 14AAB1
Water Level (Feet Below Ground Surface)
Water Level (Feet Above Mean Sea Level)
Date
-50
-45
-40
-35
-30
-25
-20
-15
-10
-5
0
4957
4952
4947
4942
4937
4932
4927
4922
4917
4912
4907
1954
1956
1958
1960
1962
1964
1966
1968
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014

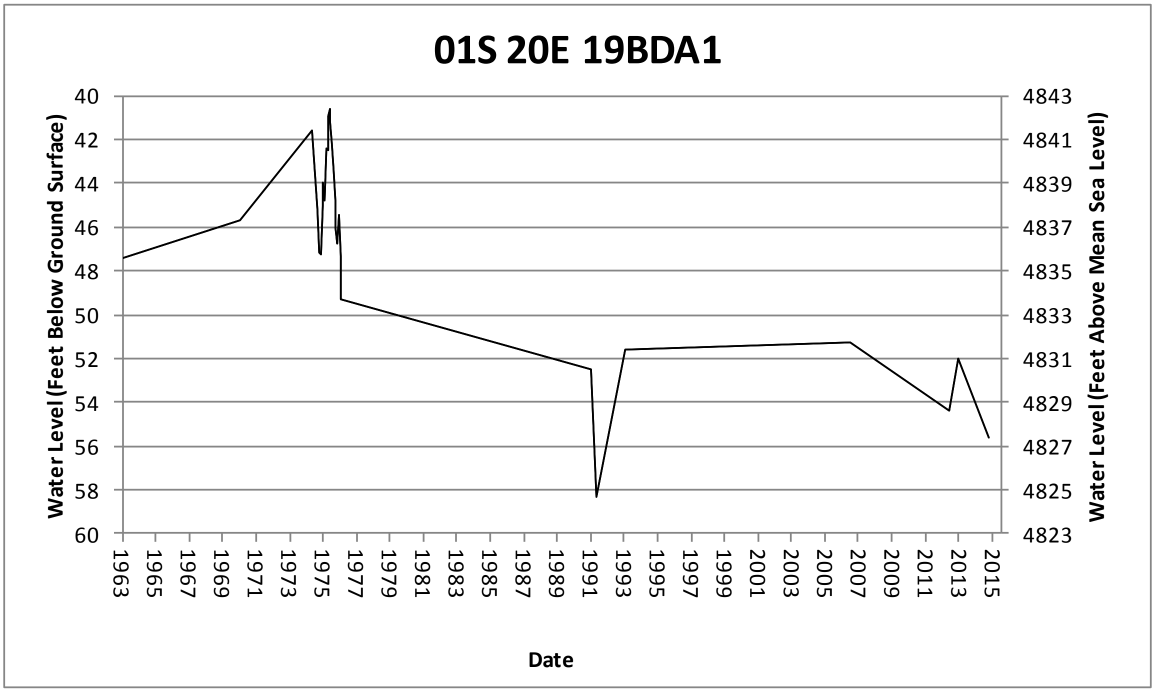

01S 18E 14AAB1
Water Level (Feet Below Ground Surface)
Water Level (Feet Above Mean Sea Level)
Date
-50
-45
-40
-35
-30
-25
-20
-15
-10
-5
0
4957
4952
4947
4942
4937
4932
4927
4922
4917
4912
4907
2000
2001
2003
2005
2007
2009
2011
2013

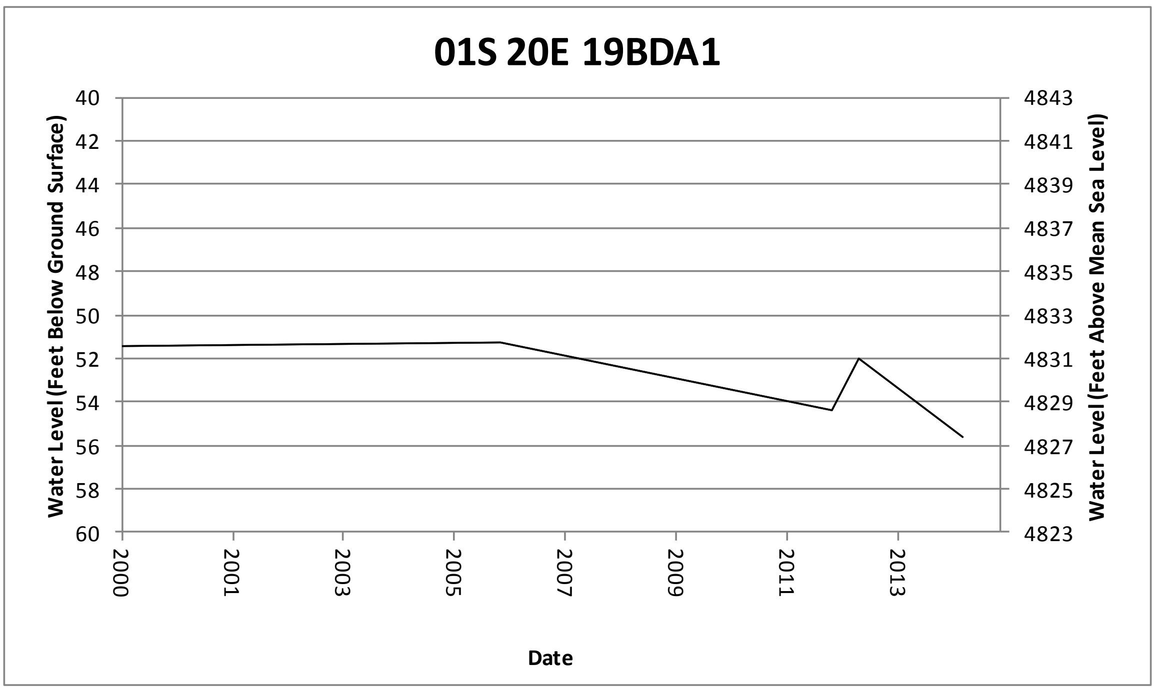


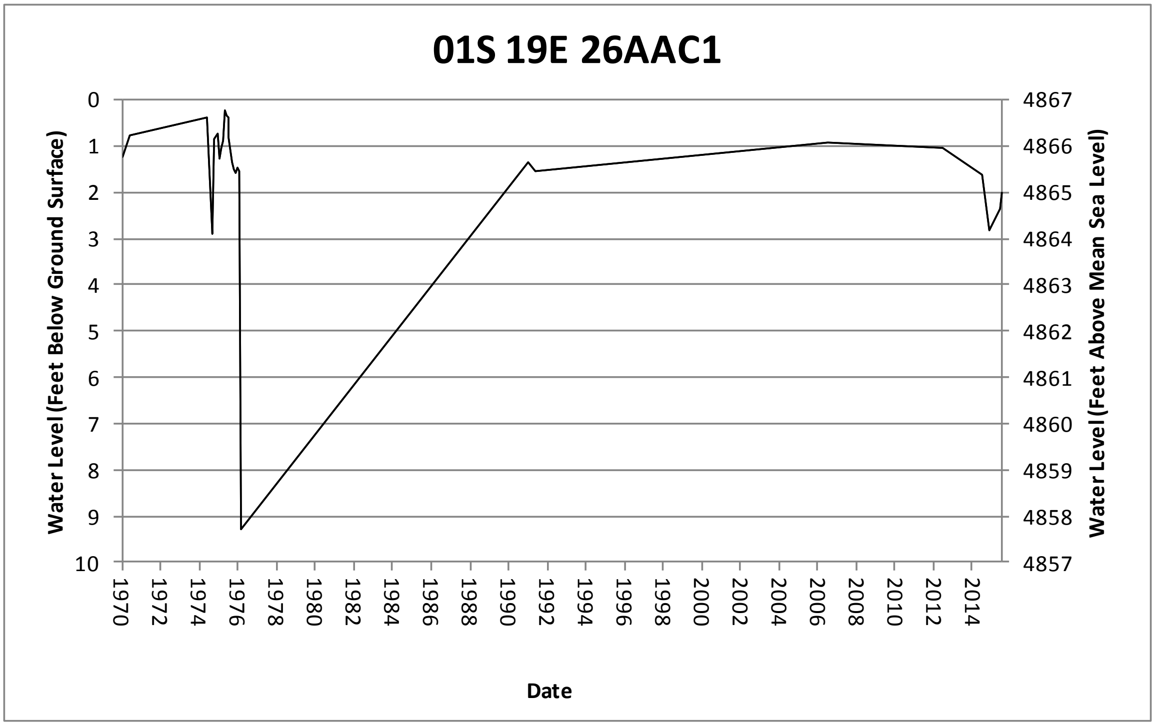
01S 19E 22AAA1
Water Level (Feet Below Ground Surface)
Water Level (Feet Above Mean Sea Level)
Date
-20
-18
-16
-14
-12
-10
-8
-6
-4
-2
0
4910
4908
4906
4904
4902
4900
4898
4896
4894
4892
4890
1954
1956
1958
1960
1962
1964
1966
1968
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014

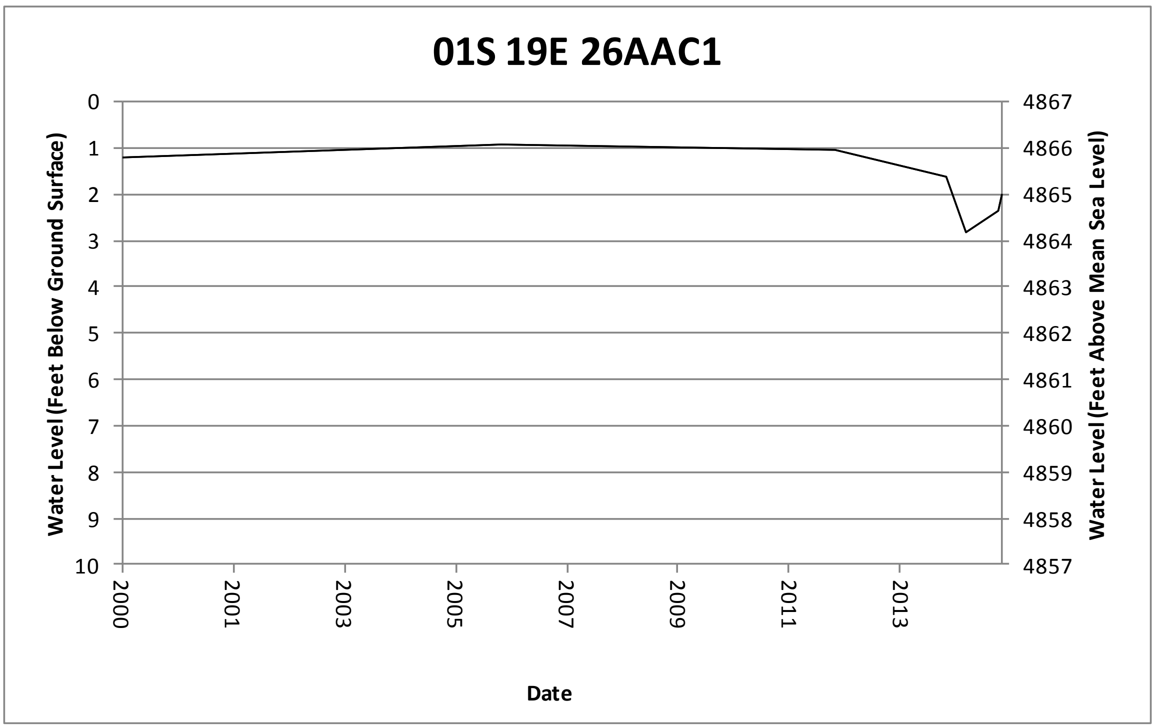


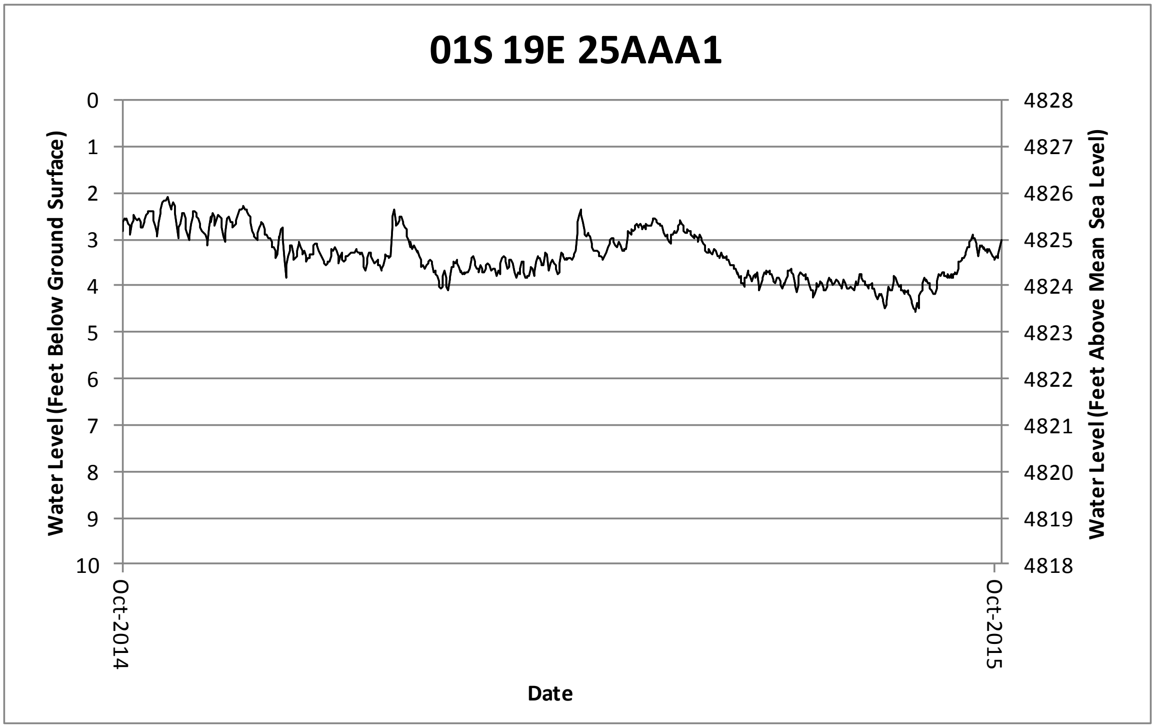
01S 19E 22AAA1
Water Level (Feet Below Ground Surface)
Water Level (Feet Above Mean Sea Level)
Date
-20
-18
-16
-14
-12
-10
-8
-6
-4
-2
0
4910
4908
4906
4904
4902
4900
4898
4896
4894
4892
4890
2000
2001
2003
2005
2007
2009
2011
2013

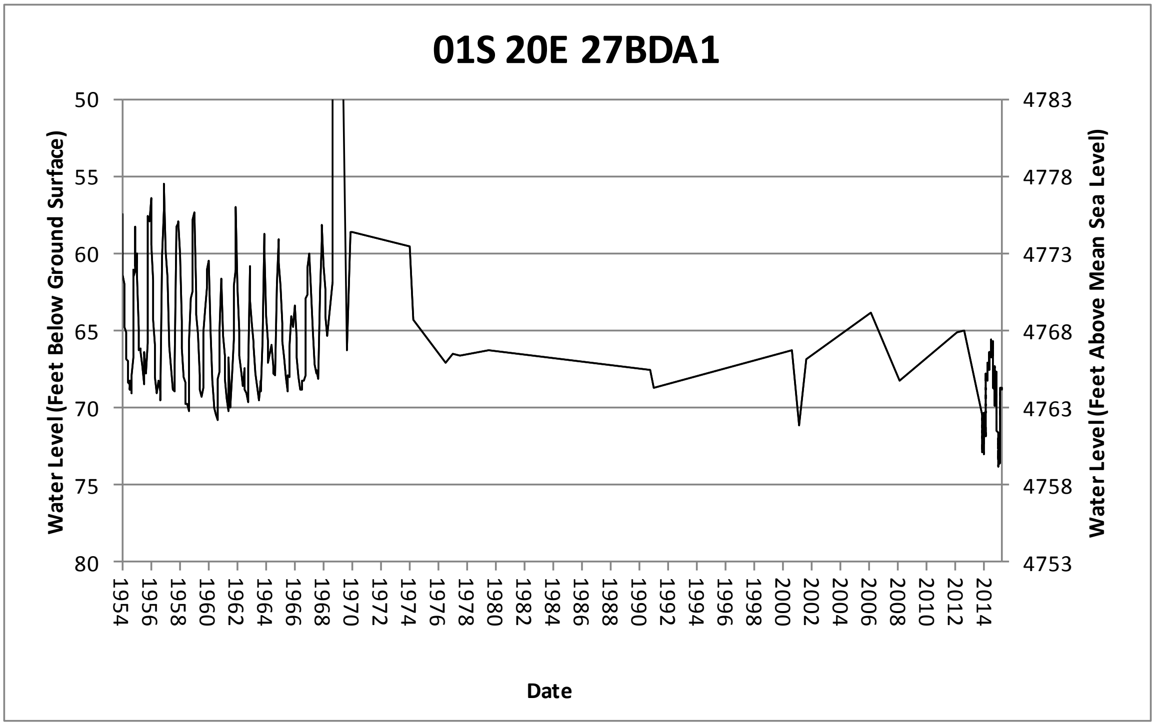

01S 20E 19BDA1
Water Level (Feet Below Ground Surface)
40
42
44
46
48
50
52
54
56
58
60
Water Level (Feet Above Mean Sea Level)
4843
4841
4839
4837
4835
4833
4831
4829
4827
4825
4823
1963
1965
1967
1969
1971
1973
1975
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009
2011
2013
2015
Date

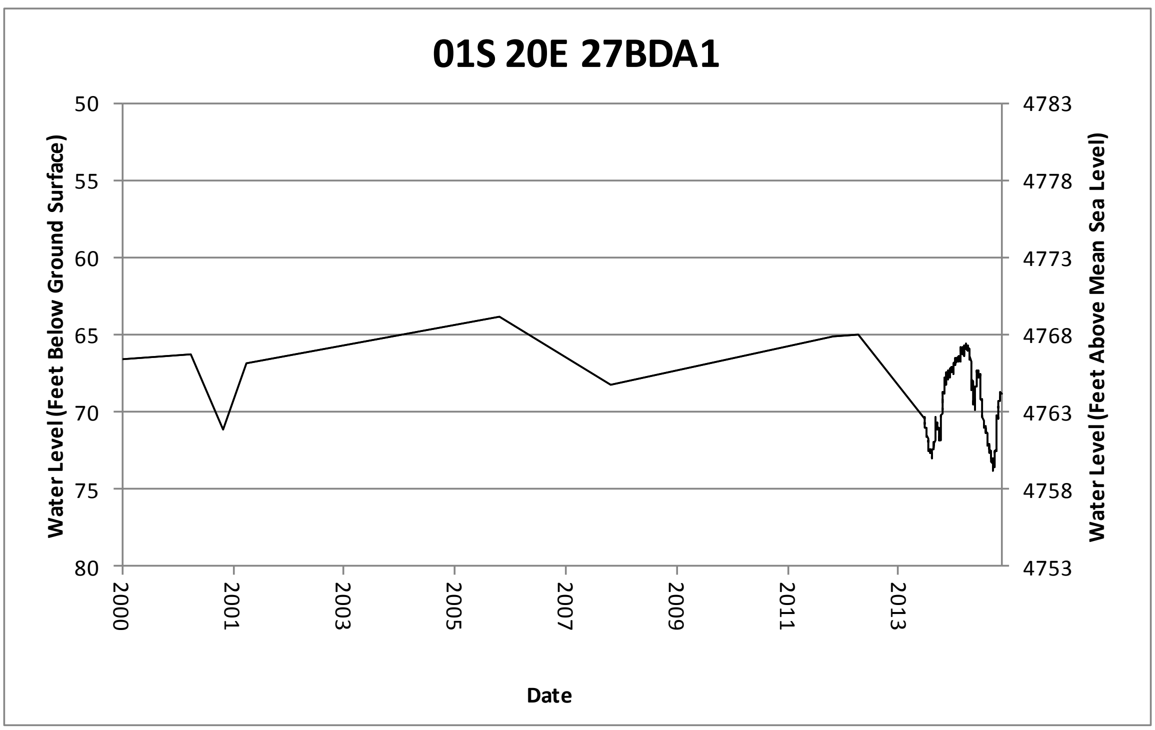

01S 20E 19BDA1
Water Level (Feet Below Ground Surface)
40
42
44
46
48
50
52
54
56
58
60
Water Level (Feet Above Mean Sea Level)
4843
4841
4839
4837
4835
4833
4831
4829
4827
4825
4823
2000
2001
2003
2005
2007
2009
2011
2013
Date

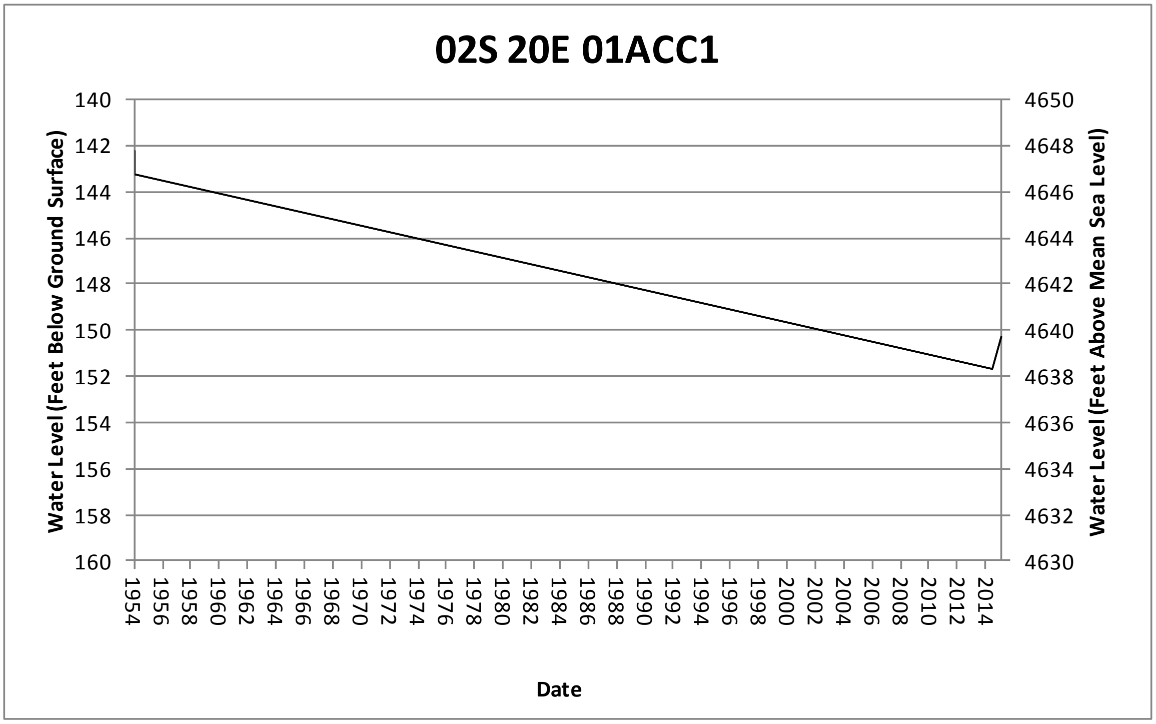

01S 19E 26AAC1
Water Level (Feet Below Ground Surface)
0
1
2
3
4
5
6
7
8
9
10
Water Level (Feet Above Mean Sea Level)
4867
4866
4865
4864
4863
4862
4861
4860
4859
4858
4857
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
Date

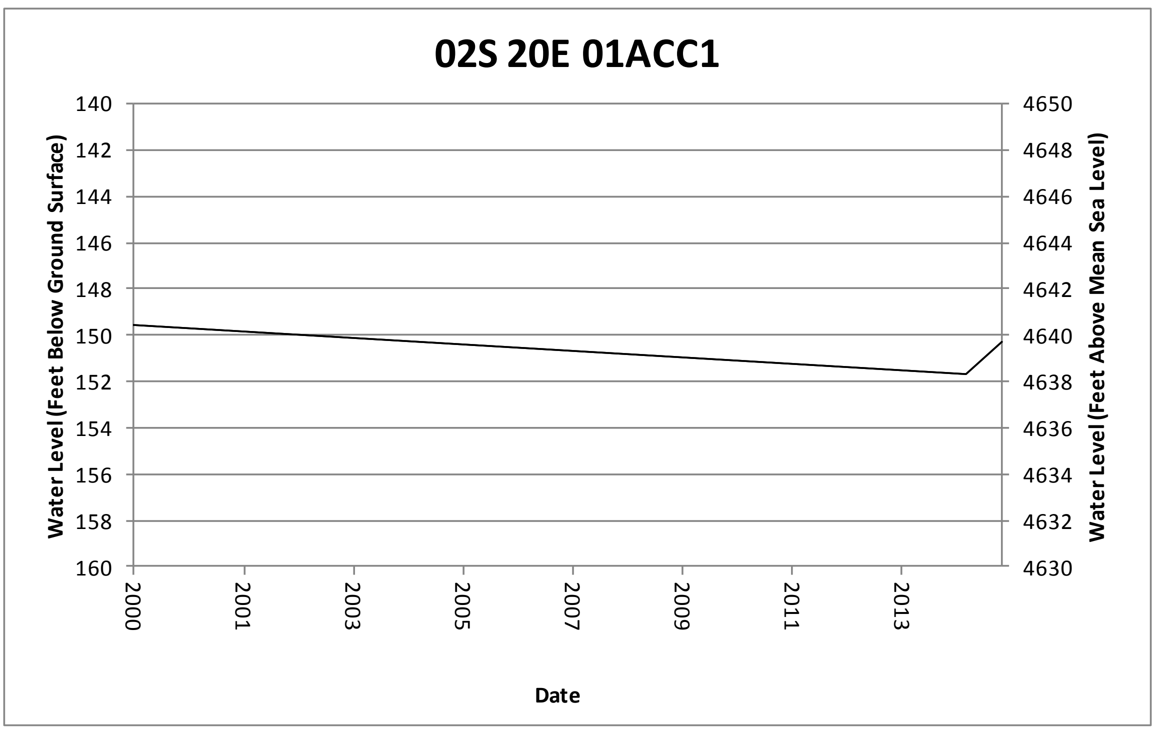

01S 19E 26AAC1
Water Level (Feet Below Ground Surface)
0
1
2
3
4
5
6
7
8
9
10
Water Level (Feet Above Mean Sea Level)
4867
4866
4865
4864
4863
4862
4861
4860
4859
4858
4857
2000
2001
2003
2005
2007
2009
2011
2013
Date

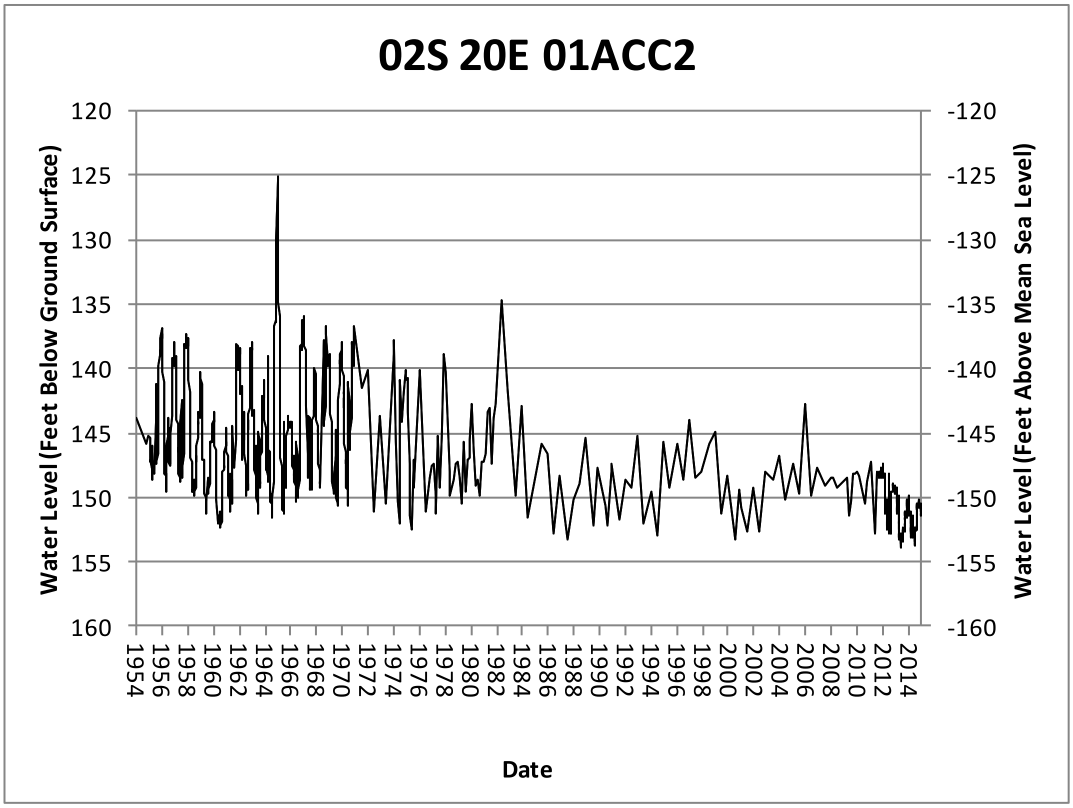

01S 19E 25AAA1
Water Level (Feet Below Ground Surface)
Water Level (Feet Above Mean Sea Level)
0
1
2
3
4
5
6
7
8
9
10
4828
4827
4826
4825
4824
4823
4822
4821
4820
4819
4818
Oct-2014
Oct-2015
Date

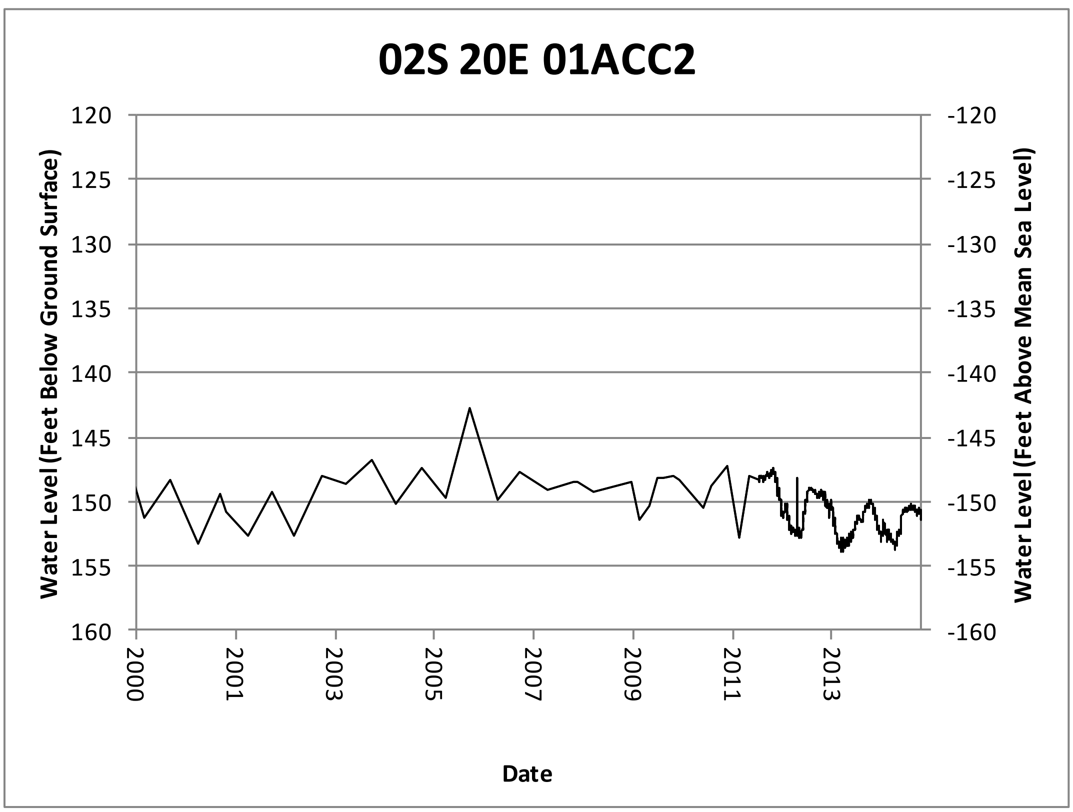

01S 20E 27BDA1
Water Level (Feet Below Ground Surface)
Water Level (Feet Above Mean Sea Level)
50
55
60
65
70
75
80
4783
4778
4773
4768
4763
4758
4753
1954 1956 1958 1960 1962 1964 1966 1968 1970 1972 1974 1976 1978 1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014
Date


01S 20E 27BDA1
Water Level (Feet Below Ground Surface)
Water Level (Feet Above Mean Sea Level)
50
55
60
65
70
75
80
4783
4778
4773
4768
4763
4758
4753
2000 2001 2003 2005 2007 2009 2011 2013
Date


02S 20E 01ACC1
Water Level (Feet Below Ground Surface)
Water Level (Feet Above Mean Sea Level)
140
142
144
146
148
150
152
154
156
158
160
4650
4648
4646
4644
4642
4640
4638
4636
4634
4632
4630
1954 1956 1958 1960 1962 1964 1966 1968 1970 1972 1974 1976 1978 1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014
Date

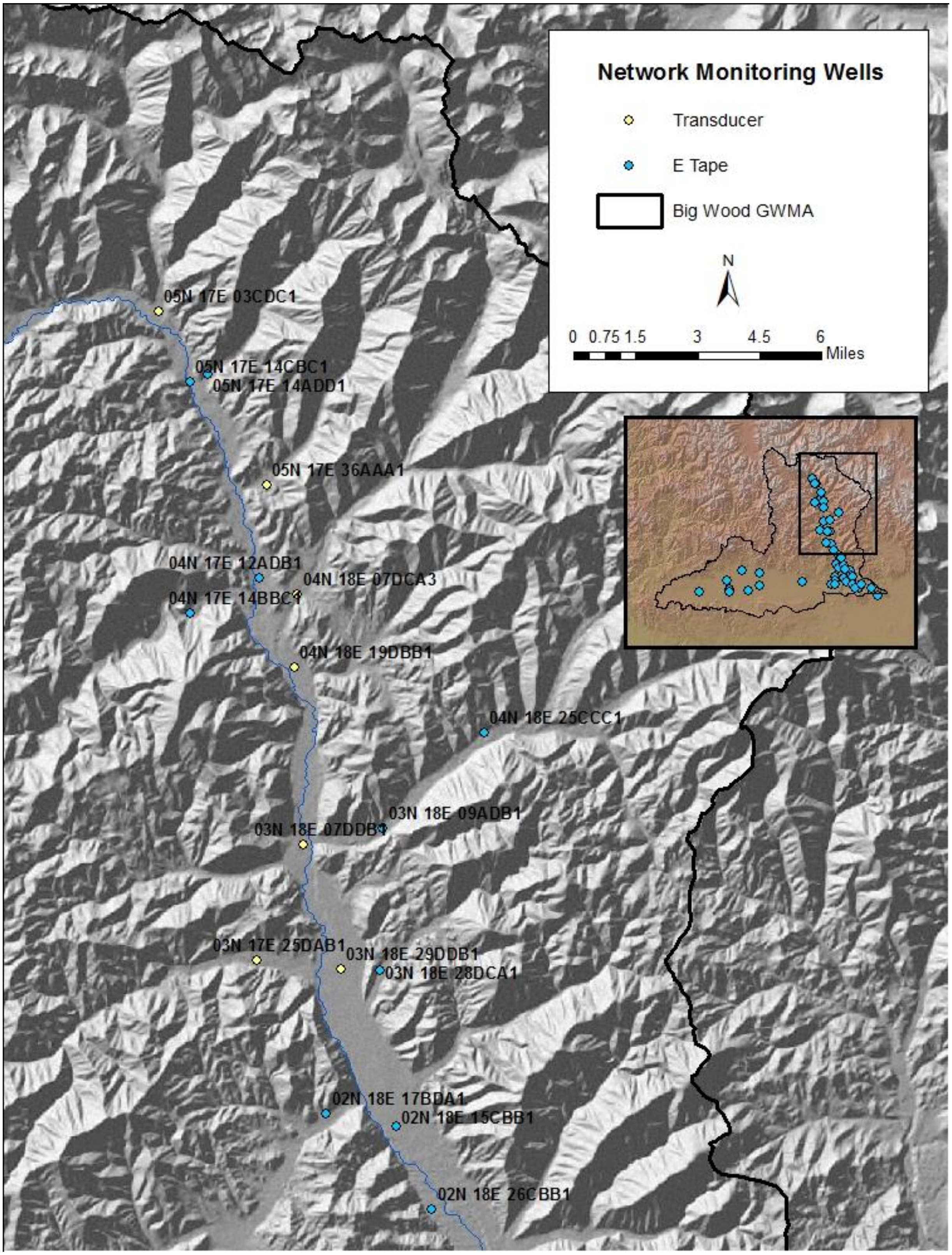

02S 20E 01ACC1
Water Level (Feet Below Ground Surface)
Water Level (Feet Above Mean Sea Level)
140
142
144
146
148
150
152
154
156
158
160
4650
4648
4646
4644
4642
4640
4638
4636
4634
4632
4630
2000 2001 2003 2005 2007 2009 2011 2013
Date

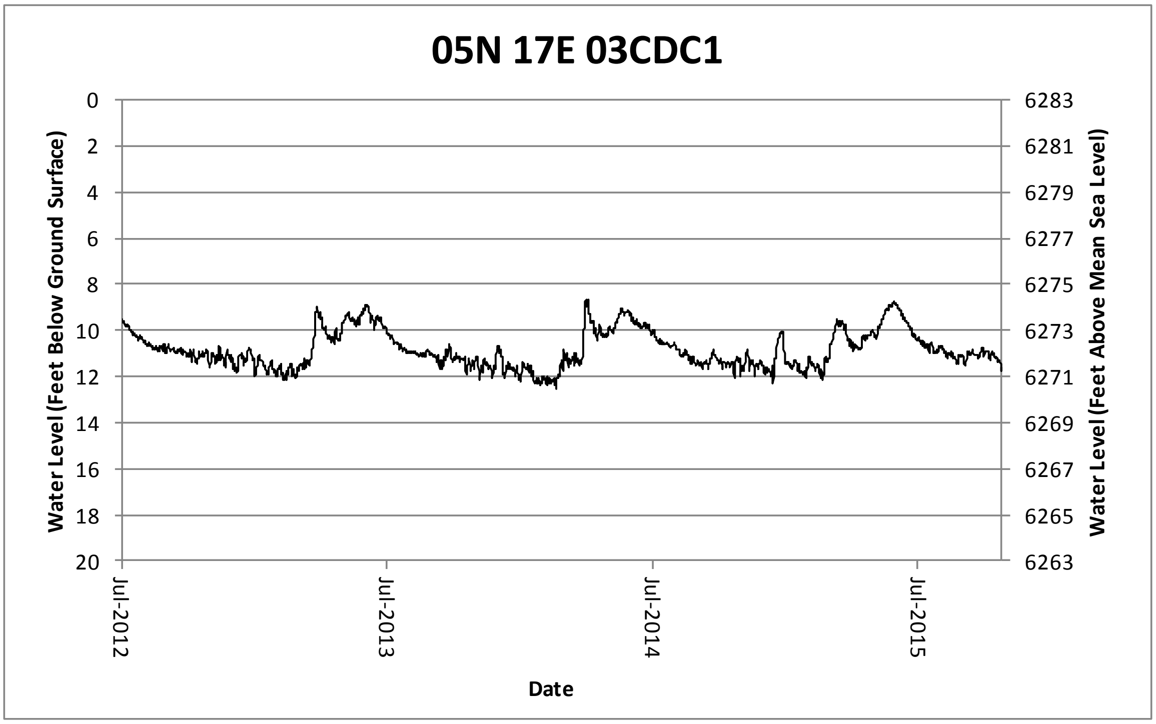

02S 20E 01ACC2
Water Level (Feet Below Ground Surface)
Water Level (Feet Above Mean Sea Level)
120
125
130
135
140
145
150
155
160
-120
-125
-130
-135
-140
-145
-150
-155
-160
1954
1956
1958
1960
1962
1964
1966
1968
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
Date

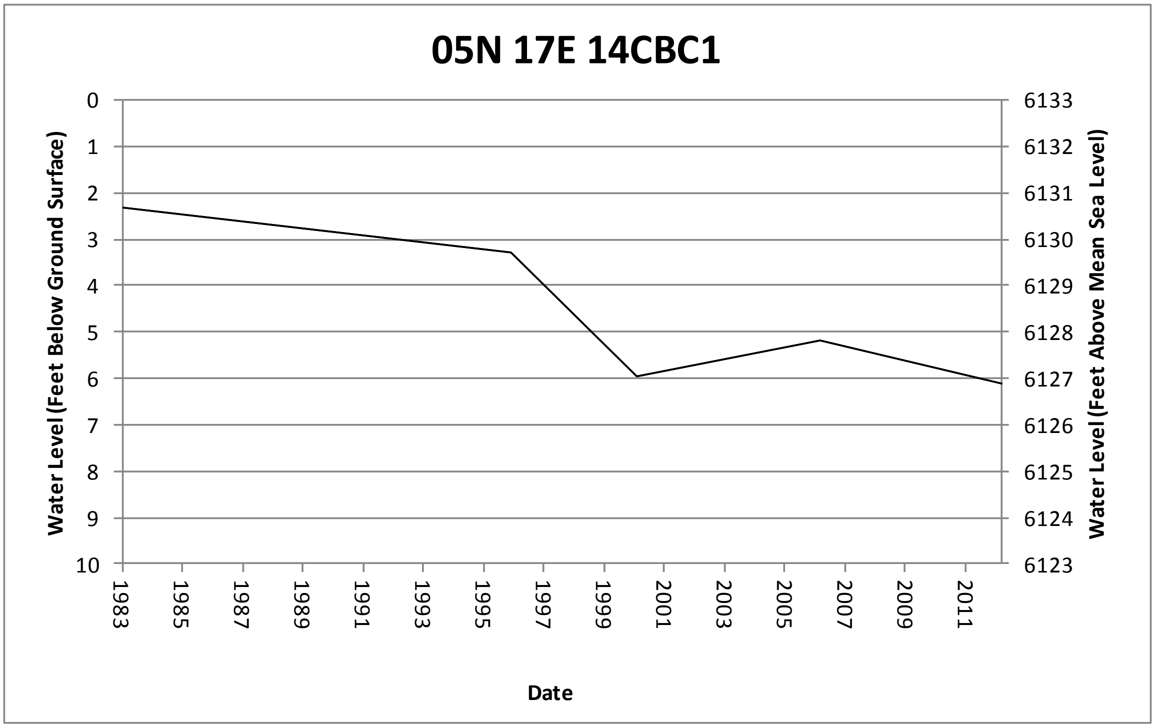

02S 20E 01ACC2
Water Level (Feet Below Ground Surface)
Water Level (Feet Above Mean Sea Level)
120
125
130
135
140
145
150
155
160
-120
-125
-130
-135
-140
-145
-150
-155
-160
2000
2001
2003
2005
2007
2009
2011
2013
Date

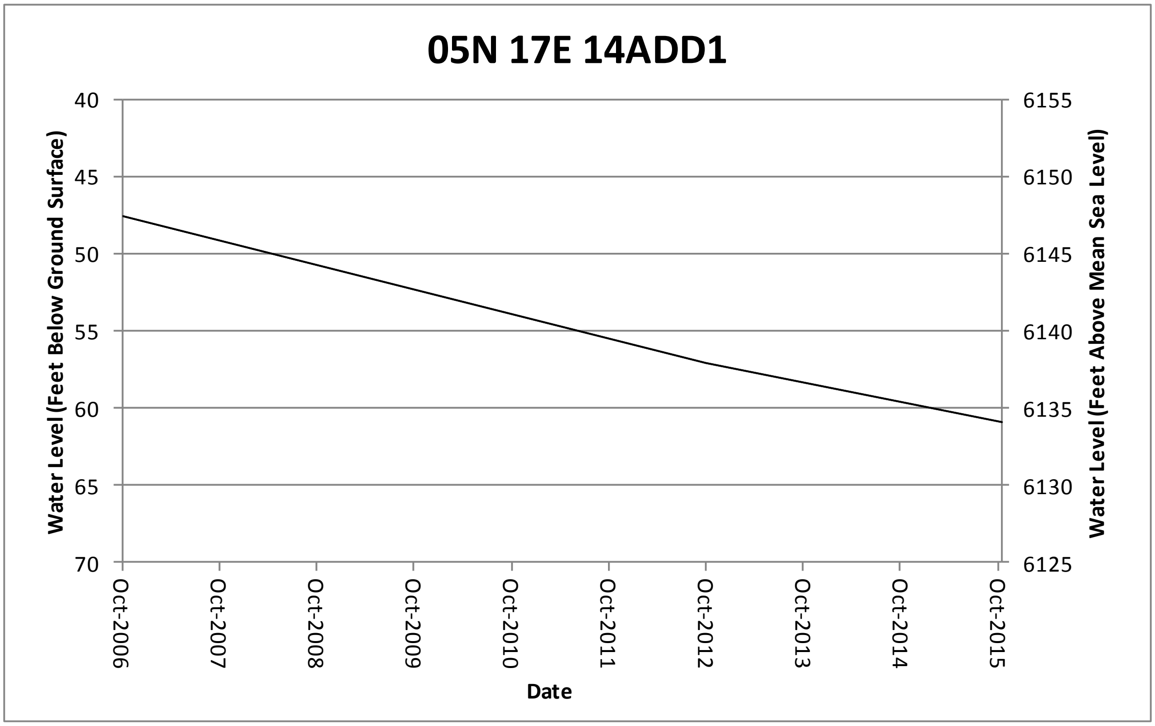
APPENDIX B

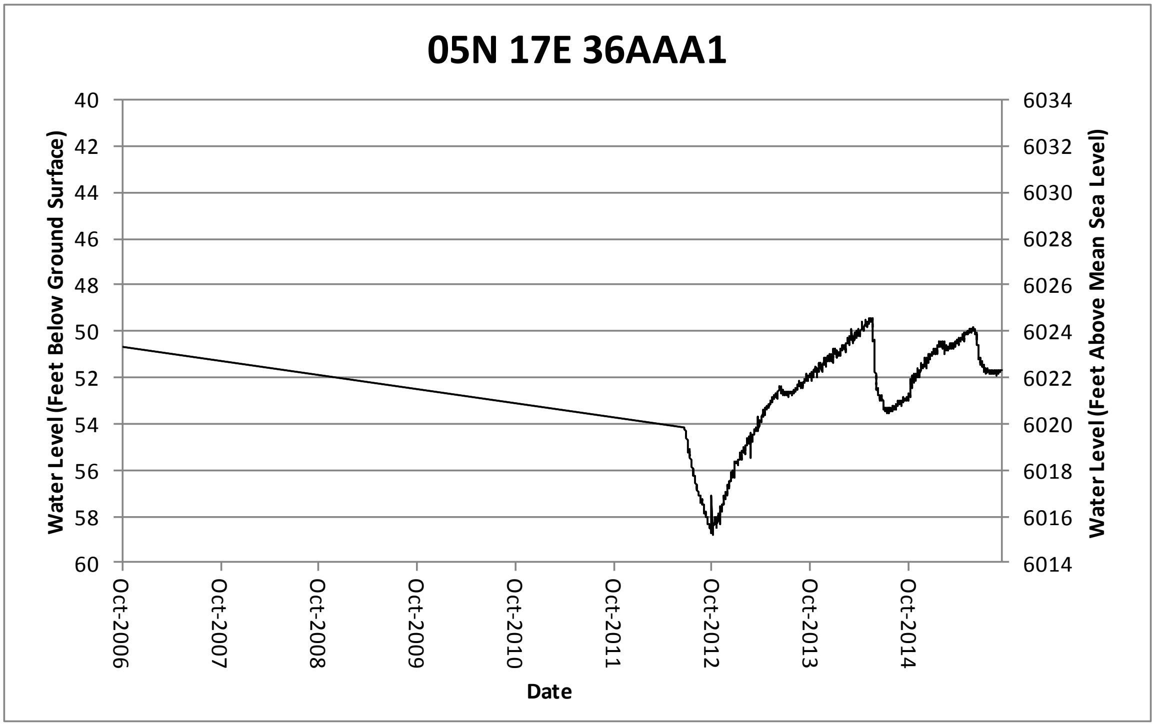
HYDROGRAPS

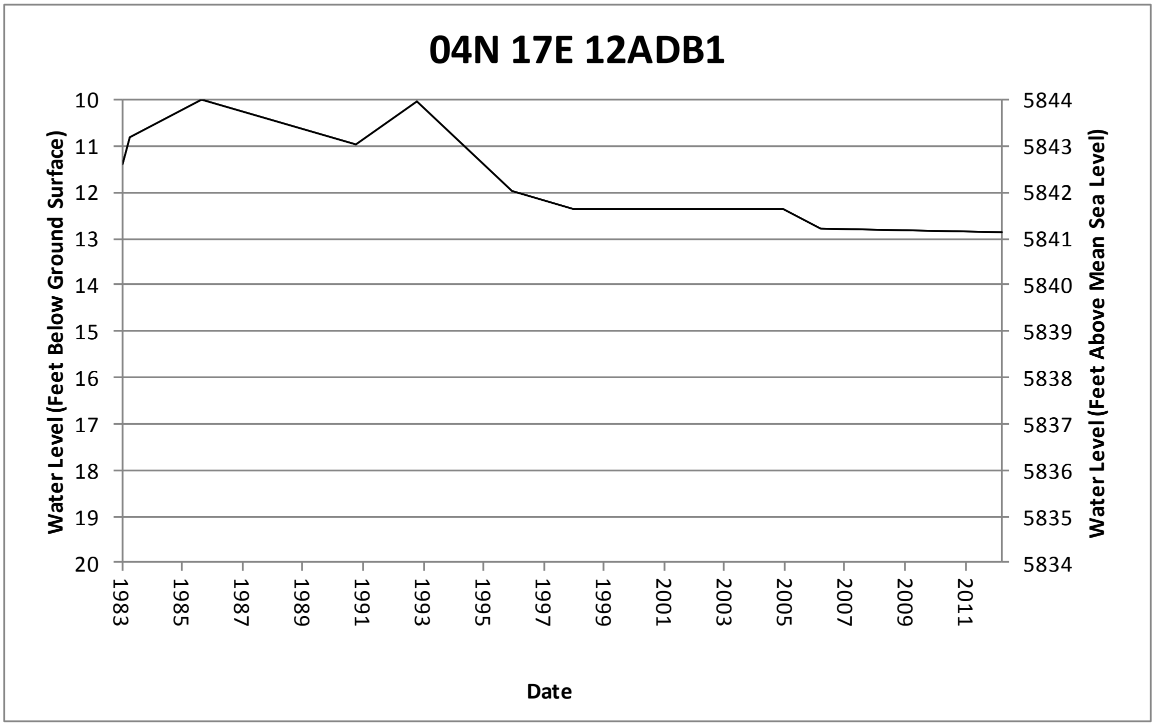

Network Monitoring Wells
Transducer
E Tape
Big Wood GWMA
N
0 0.75 1.5 3 4.5 6 Miles
05N 17E 03CDC1
05N 17E 14CBC1
05N 17E 14ADD1
05N 17E 36AAA1
04N 17E 12ADB1
04N 18E 07DCA3
04N 17E 14BBC1
04N 18E 19DBB1
04N 18E 25CCC1
03N 18E 09ADB1
03N 18E 07DDB1
03N 17E 25DAB1
03N 18E 29DDB1
03N 18E 28DCA1
02N 18E 17BDA1
02N 18E 15CBB1
02N 18E 26CBB1

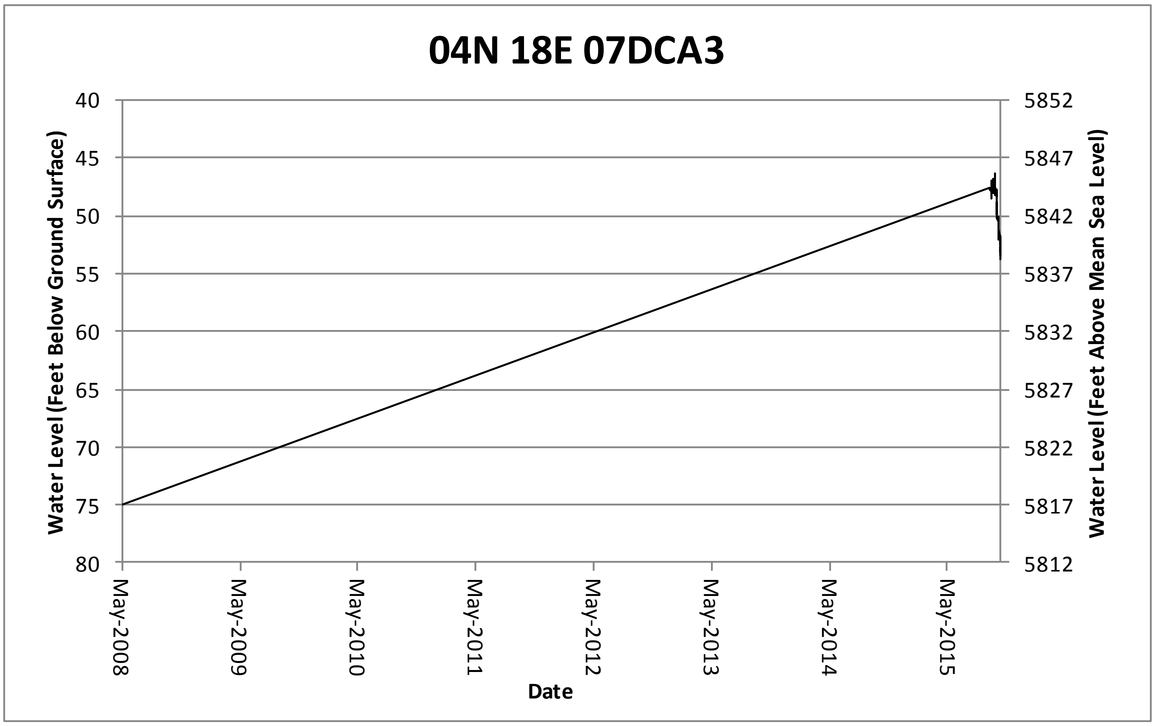

05N 17E 03CDC1
Water Level (Feet Below Ground Surface)
Water Level (Feet Above Mean Sea Level)
0
2
4
6
8
10
12
14
16
18
20
6283
6281
6279
6277
6275
6273
6271
6269
6267
6265
6263
Jul-2012
Jul-2013
Jul-2014
Jul-2015
Date

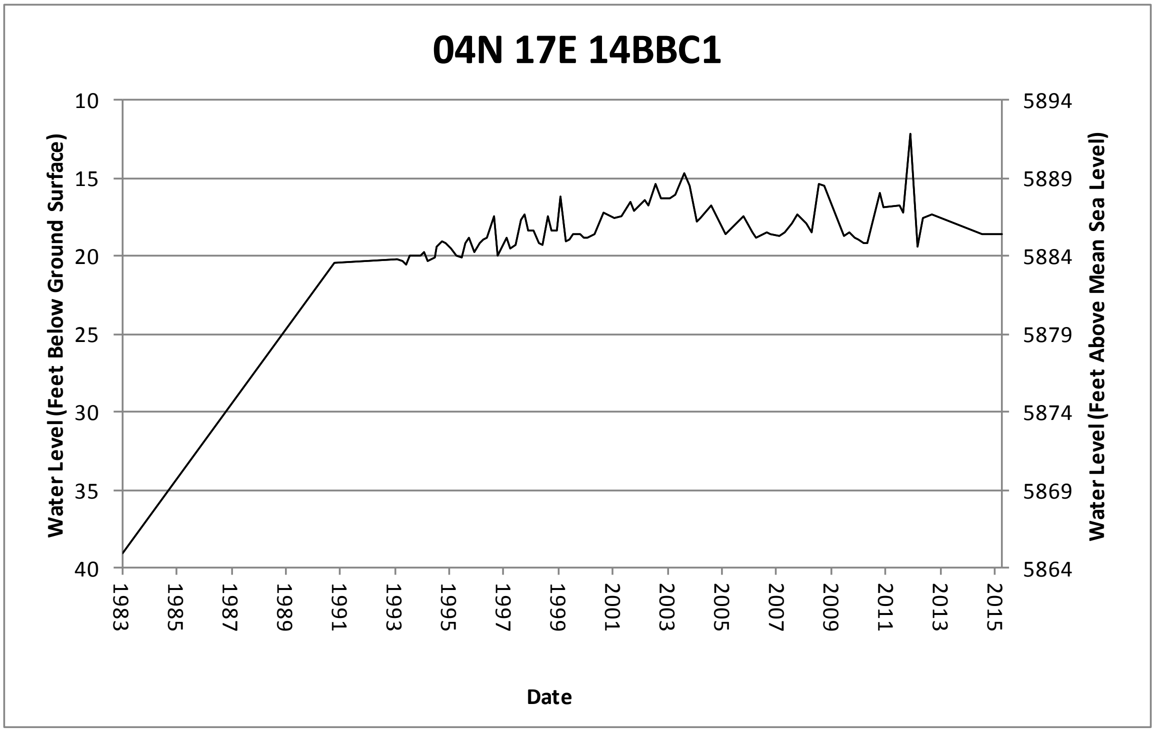

05N 17E 14CBC1
Water Level (Feet Below Ground Surface)
0
1
2
3
4
5
6
7
8
9
10
Water Level (Feet Above Mean Sea Level)
6133
6132
6131
6130
6129
6128
6127
6126
6125
6124
6123
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009
2011
Date

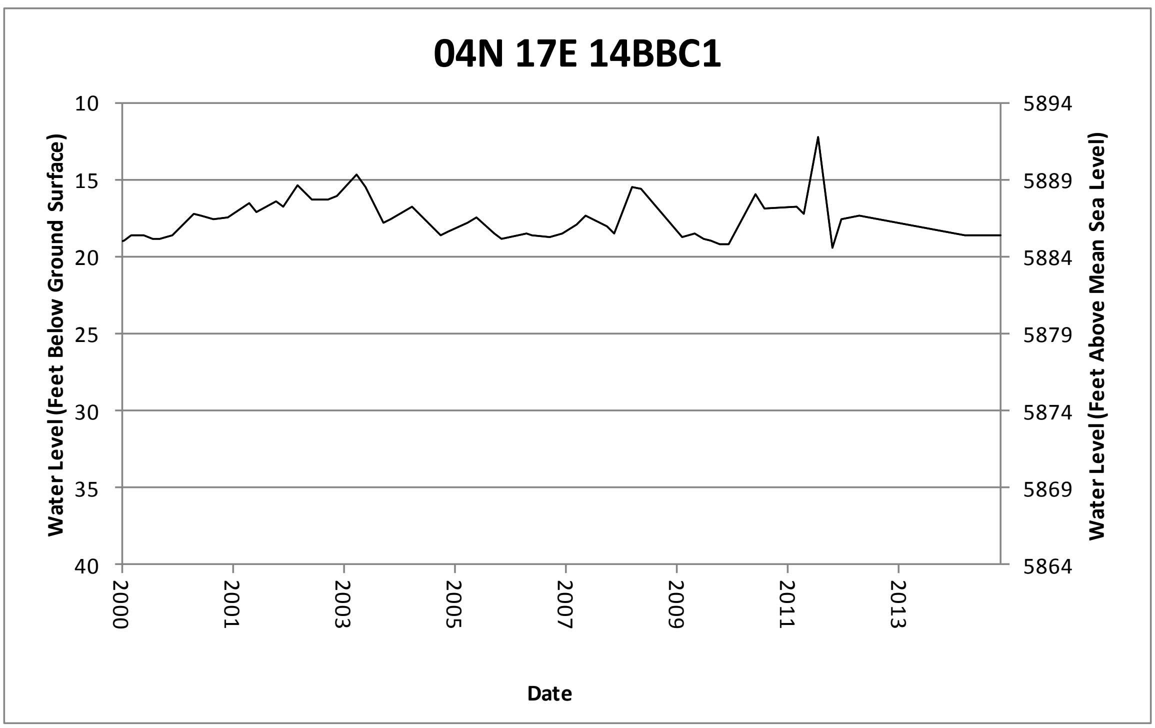

05N 17E 14ADD1
Water Level (Feet Below Ground Surface)
40
45
50
55
60
65
70
Water Level (Feet Above Mean Sea Level)
6155
6150
6145
6140
6135
6130
6125
Oct-2006
Oct-2007
Oct-2008
Oct-2009
Oct-2010
Oct-2011
Oct-2012
Oct-2013
Oct-2014
Oct-2015
Date

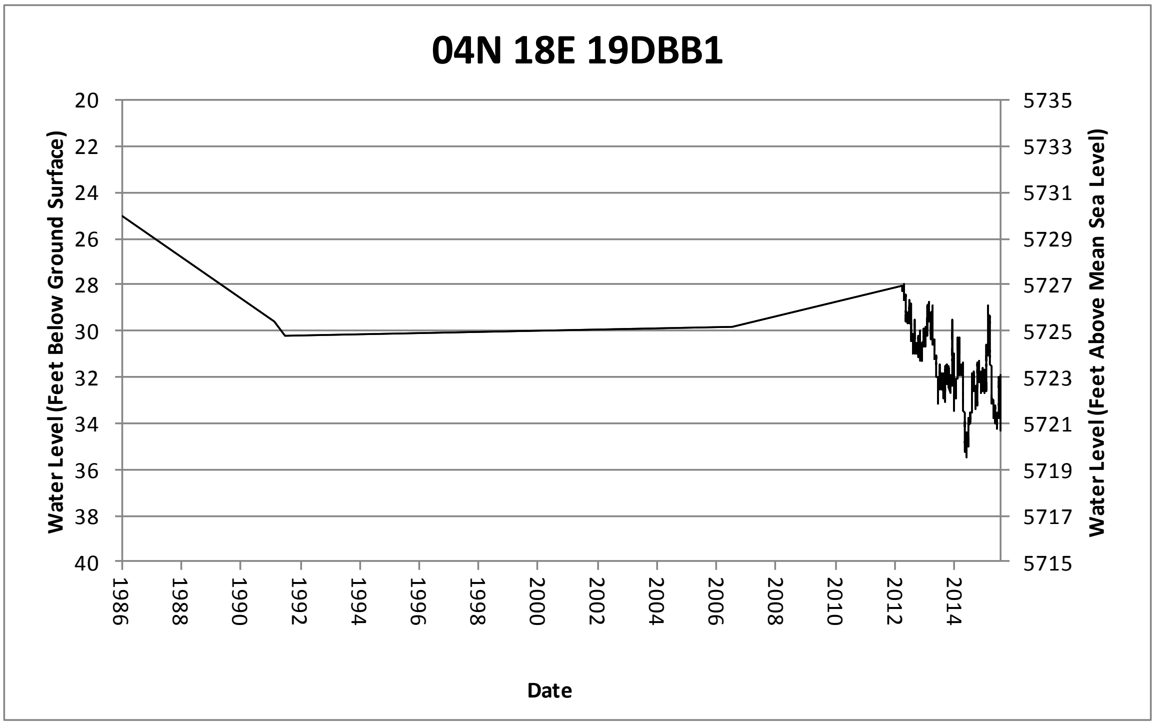

05N 17E 36AAA1
Water Level (Feet Below Ground Surface)
Water Level (Feet Above Mean Sea Level)
40
42
44
46
48
50
52
54
56
58
60
6034
6032
6030
6028
6026
6024
6022
6020
6018
6016
6014
Oct-2006
Oct-2007
Oct-2008
Oct-2009
Oct-2010
Oct-2011
Oct-2012
Oct-2013
Oct-2014
Date


04N 17E 12ADB1
Water Level (Feet Below Ground Surface)
10
11
12
13
14
15
16
17
18
19
20
Water Level (Feet Above Mean Sea Level)
5844
5843
5842
5841
5840
5839
5838
5837
5836
5835
5834
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009
2011
Date


04N 18E 07DCA3
Water Level (Feet Below Ground Surface)
40
45
50
55
60
65
70
75
80
Water Level (Feet Above Mean Sea Level)
5852
5847
5842
5837
5832
5827
5822
5817
5812
May-2008
May-2009
May-2010
May-2011
May-2012
May-2013
May-2014
May-2015
Date


04N 17E 14BBC1
Water Level (Feet Below Ground Surface)
Water Level (Feet Above Mean Sea Level)
10
15
20
25
30
35
40
5894
5889
5884
5879
5874
5869
5864
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009
2011
2013
2015
Date


04N 17E 14BBC1
Water Level (Feet Below Ground Surface)
Water Level (Feet Above Mean Sea Level)
10
15
20
25
30
35
40
5894
5889
5884
5879
5874
5869
5864
2000
2001
2003
2005
2007
2009
2011
2013
Date


04N 18E 19DBB1
Water Level (Feet Below Ground Surface)
Water Level (Feet Above Mean Sea Level)
20
22
24
26
28
30
32
34
36
38
40
5735
5733
5731
5729
5727
5725
5723
5721
5719
5717
5715
1986
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1994
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1998
2000
2002
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2006
2008
2010
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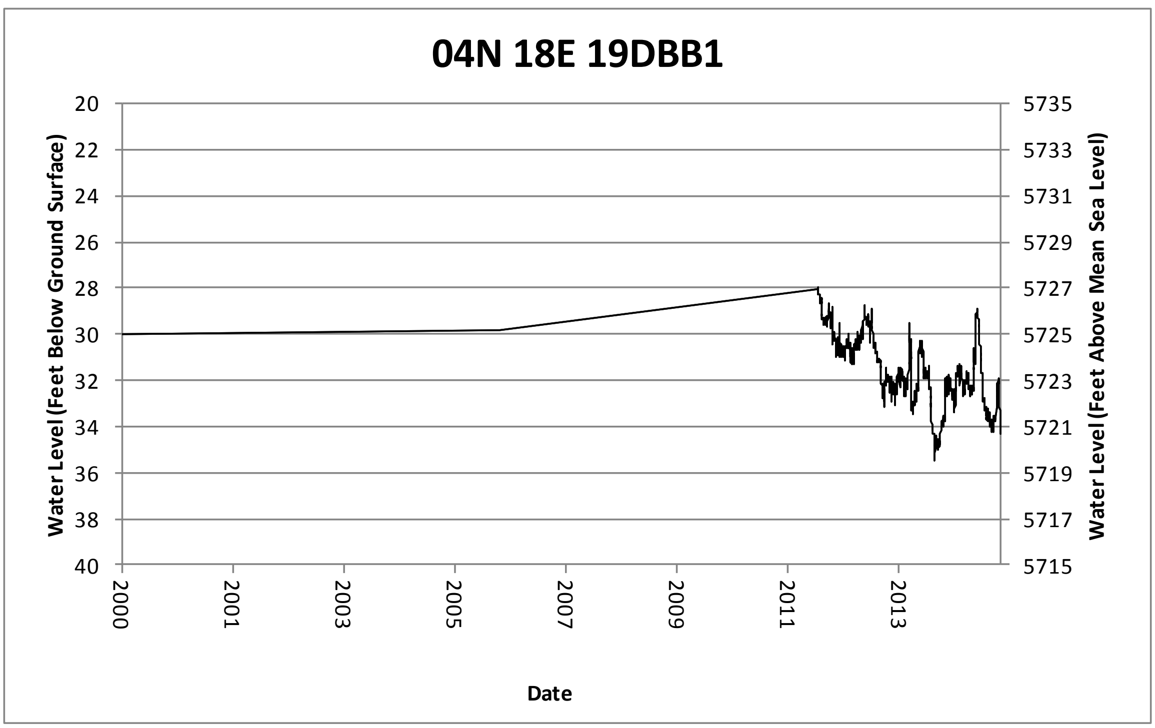
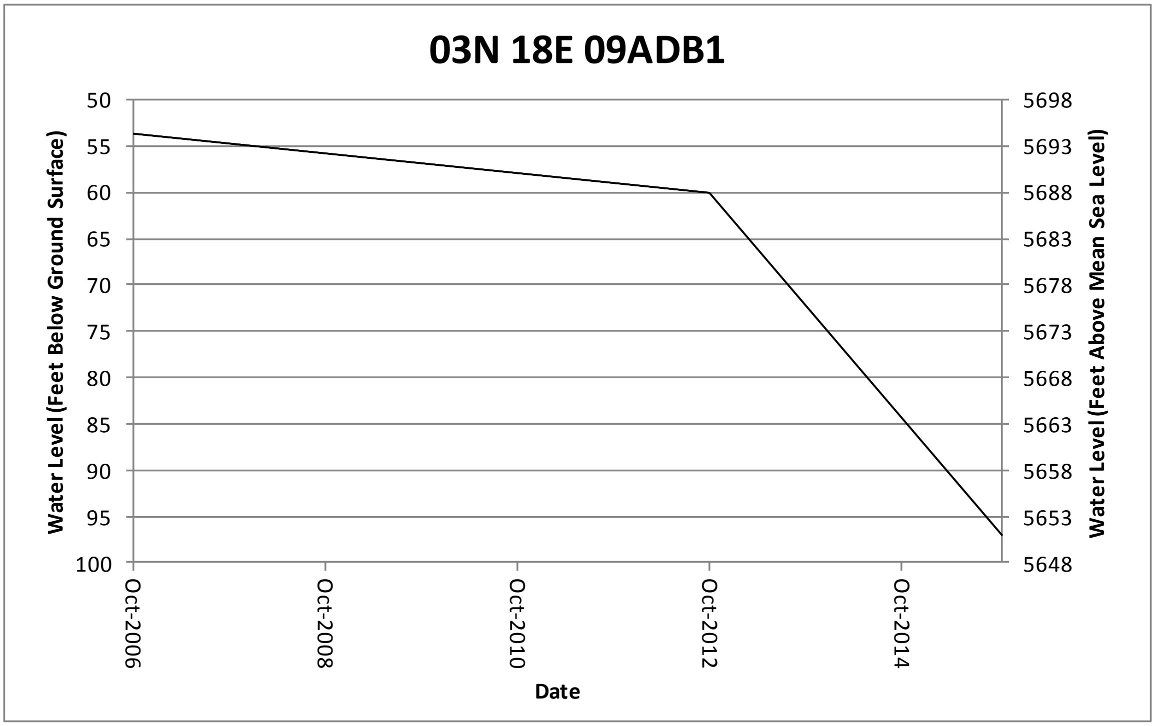
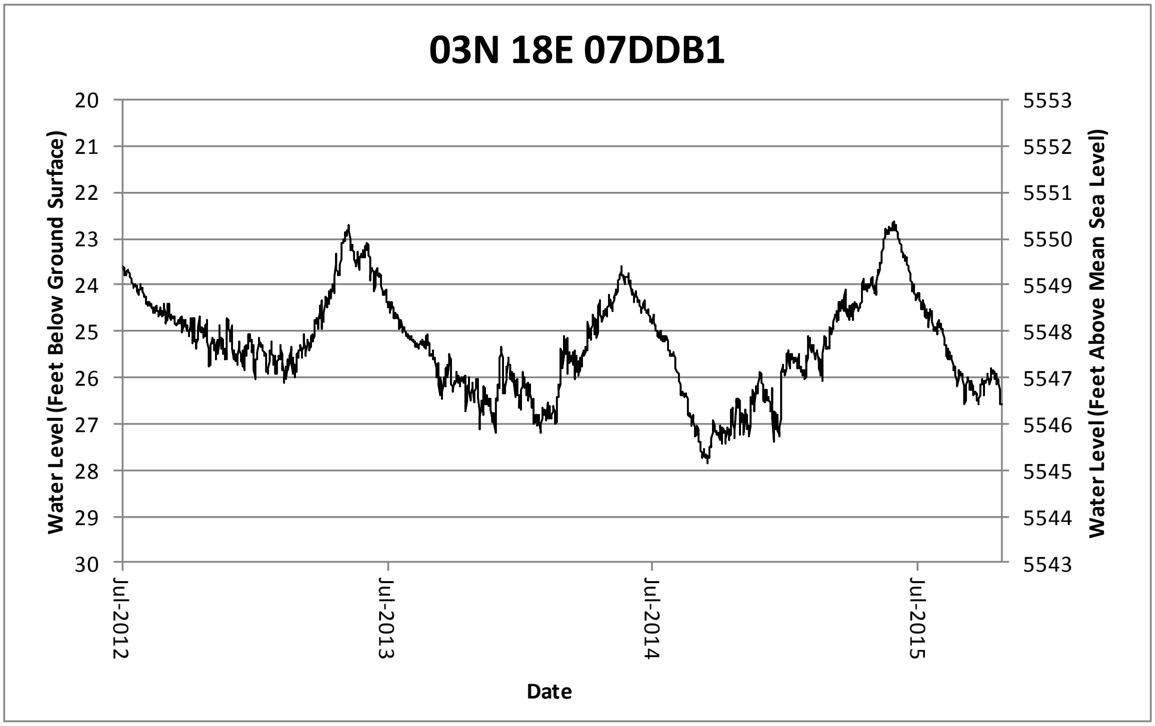
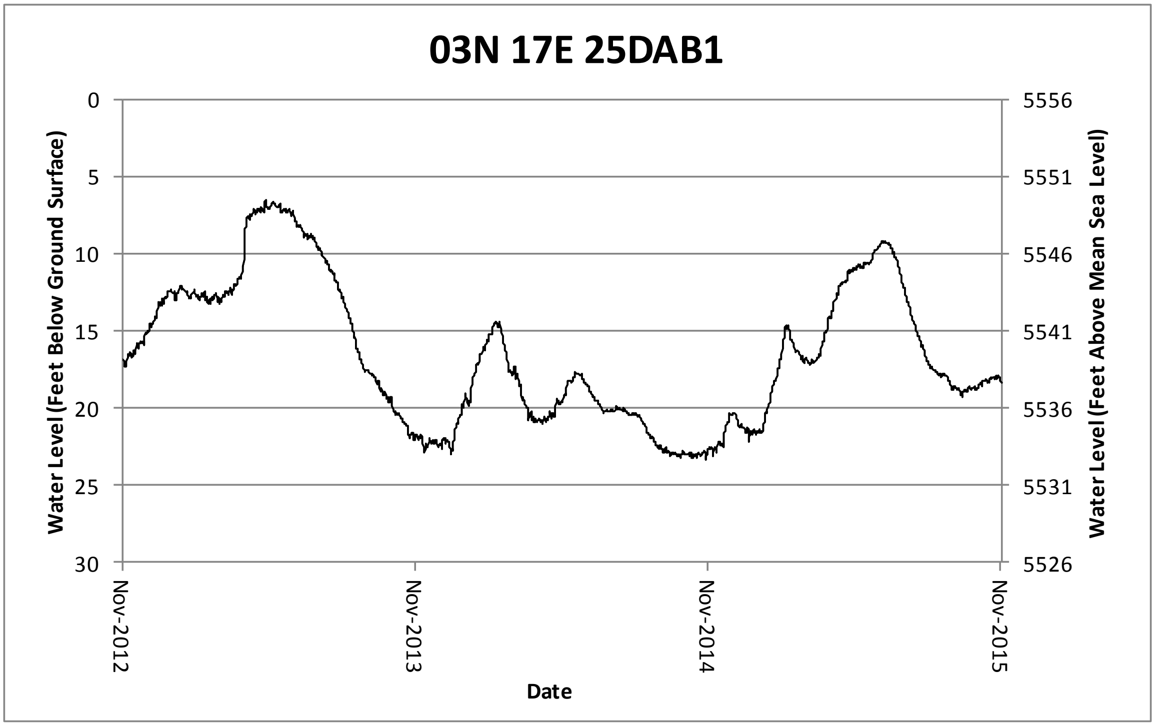
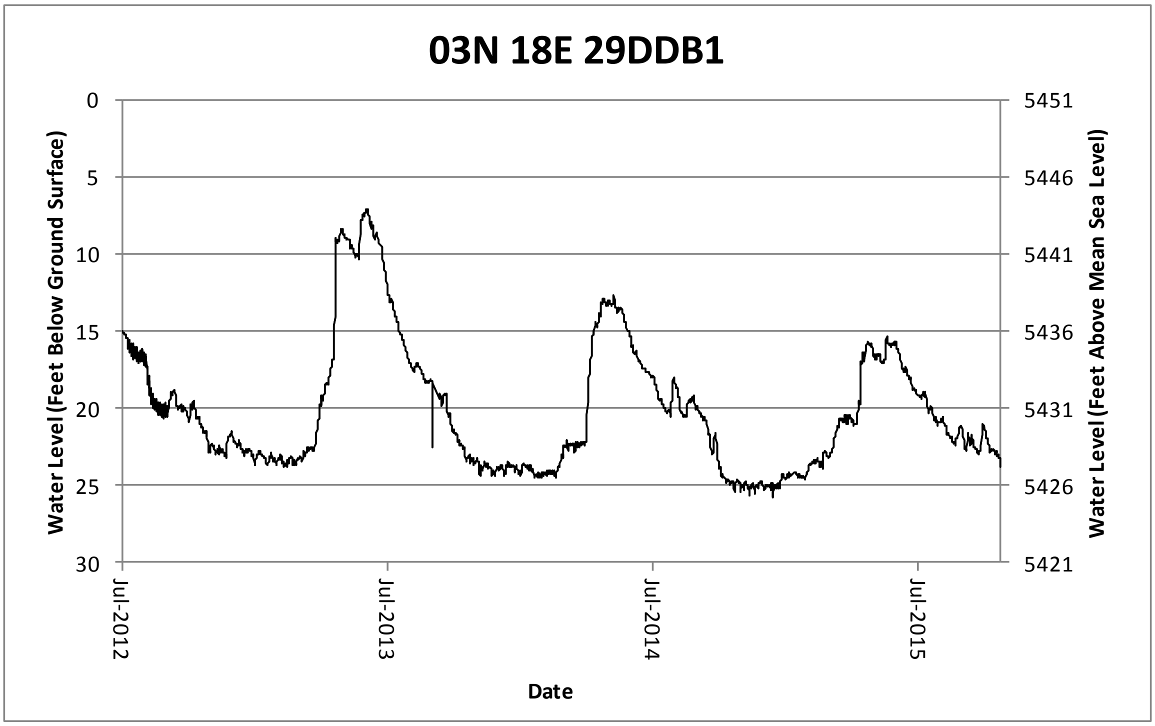
2014
Date

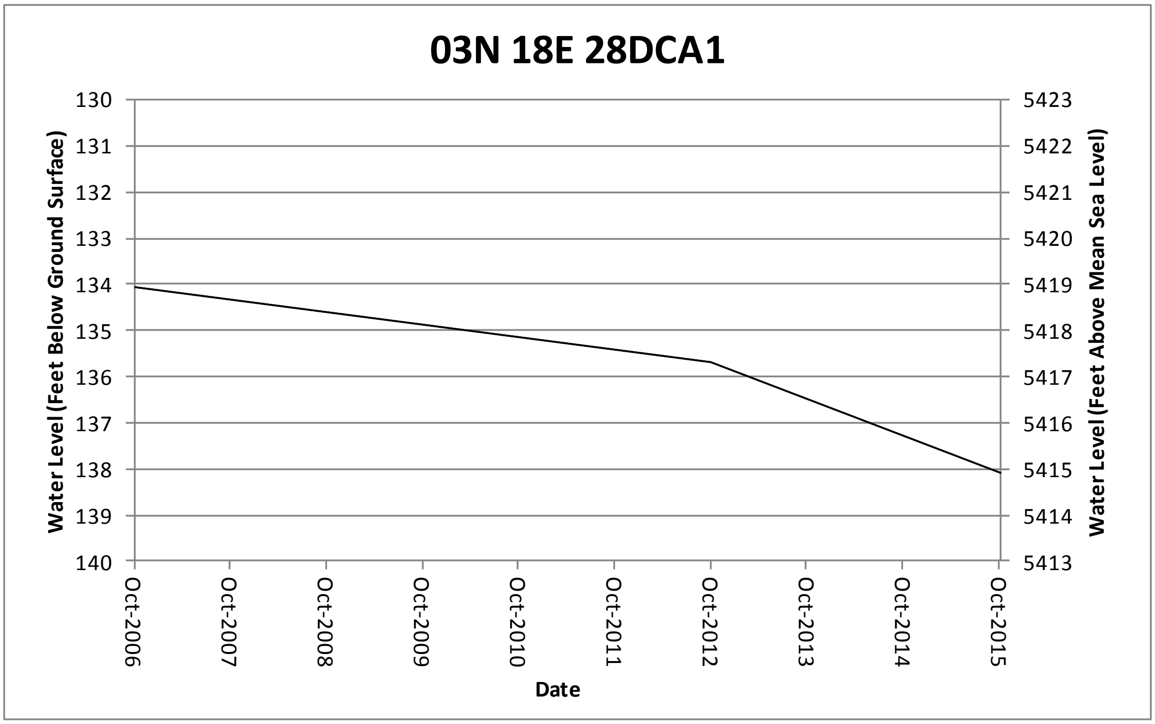

04N 18E 19DBB1
Water Level (Feet Below Ground Surface)
Water Level (Feet Above Mean Sea Level)
20
22
24
26
28
30
32
34
36
38
40
5735
5733
5731
5729
5727
5725
5723
5721
5719
5717
5715
2000
2001
2003
2005
2007
2009
2011
2013
Date

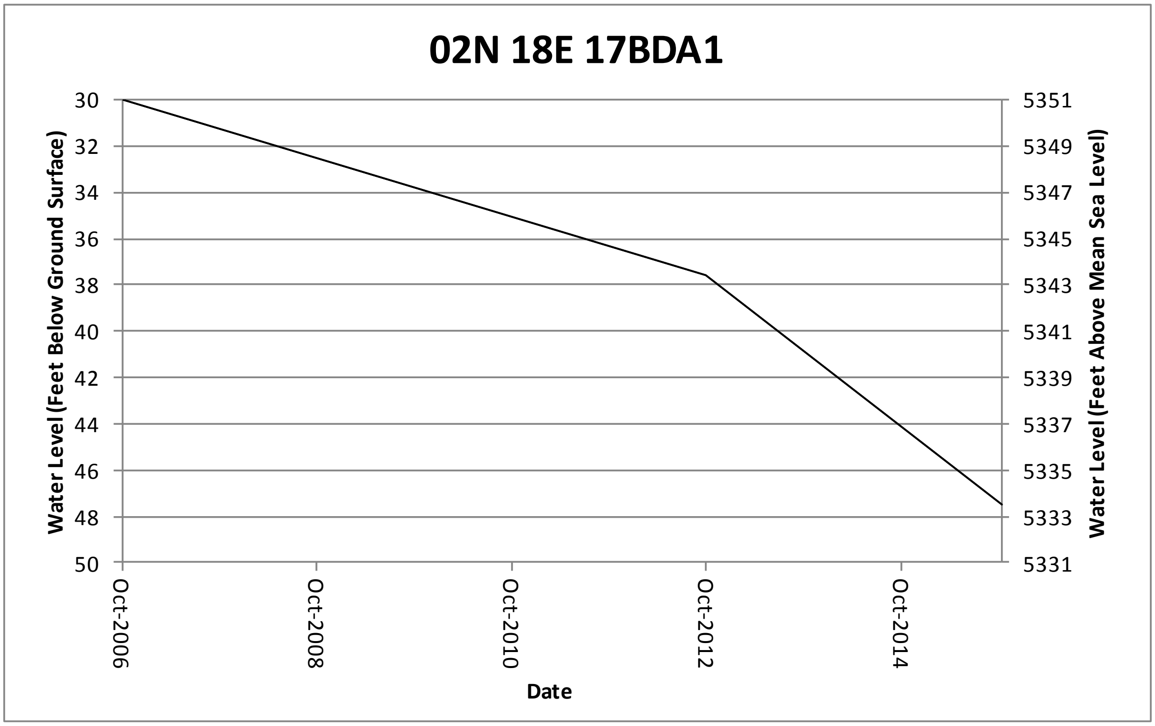

03N 18E 09ADB1
Water Level (Feet Below Ground Surface)
50
55
60
65
70
75
80
85
90
95
100
Water Level (Feet Above Mean Sea Level)
5698
5693
5688
5683
5678
5673
5668
5663
5658
5653
5648
Oct-2006
Oct-2008
Oct-2010
Oct-2012
Oct-2014
Date


03N 18E 07DDB1
Water Level (Feet Below Ground Surface)
Water Level (Feet Above Mean Sea Level)
20
21
22
23
24
25
26
27
28
29
30
5553
5552
5551
5550
5549
5548
5547
5546
5545
5544
5543
Jul-2012
Jul-2013
Jul-2014
Jul-2015
Date

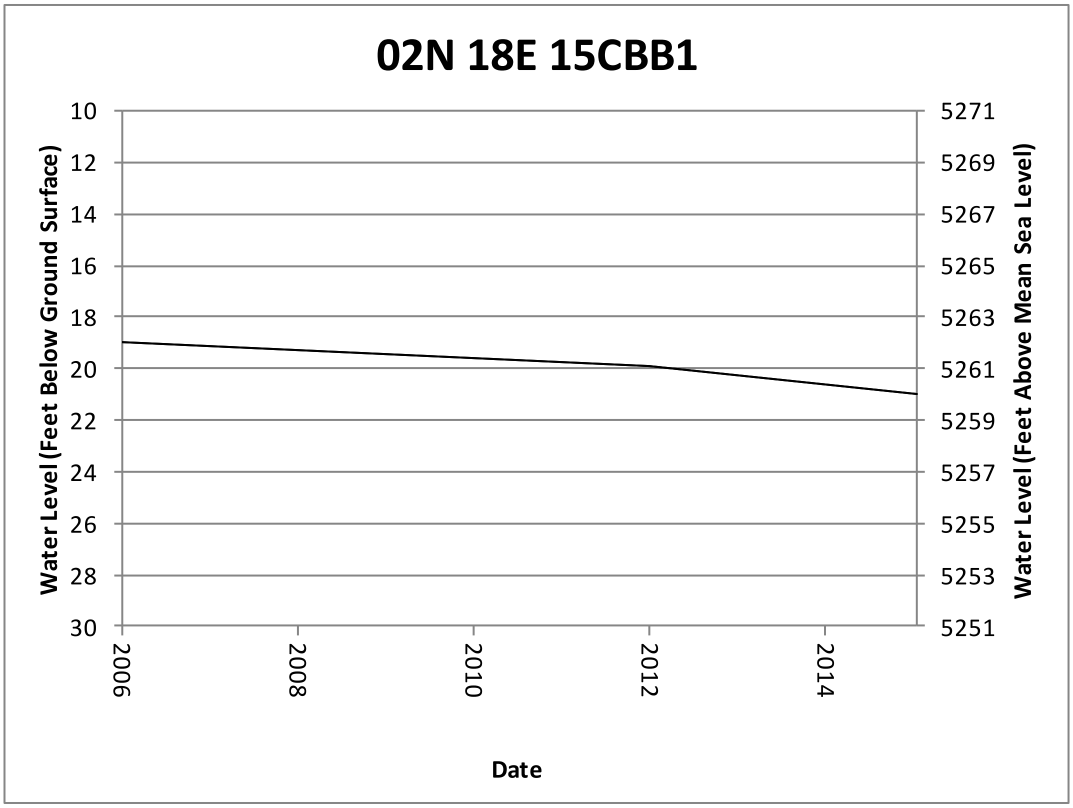

03N 17E 25DAB1
Water Level (Feet Below Ground Surface)
Water Level (Feet Above Mean Sea Level)
0
5
10
15
20
25
30
5556
5551
5546
5541
5536
5531
5526
Nov-2012
Nov-2013
Nov-2014
Nov-2015
Date

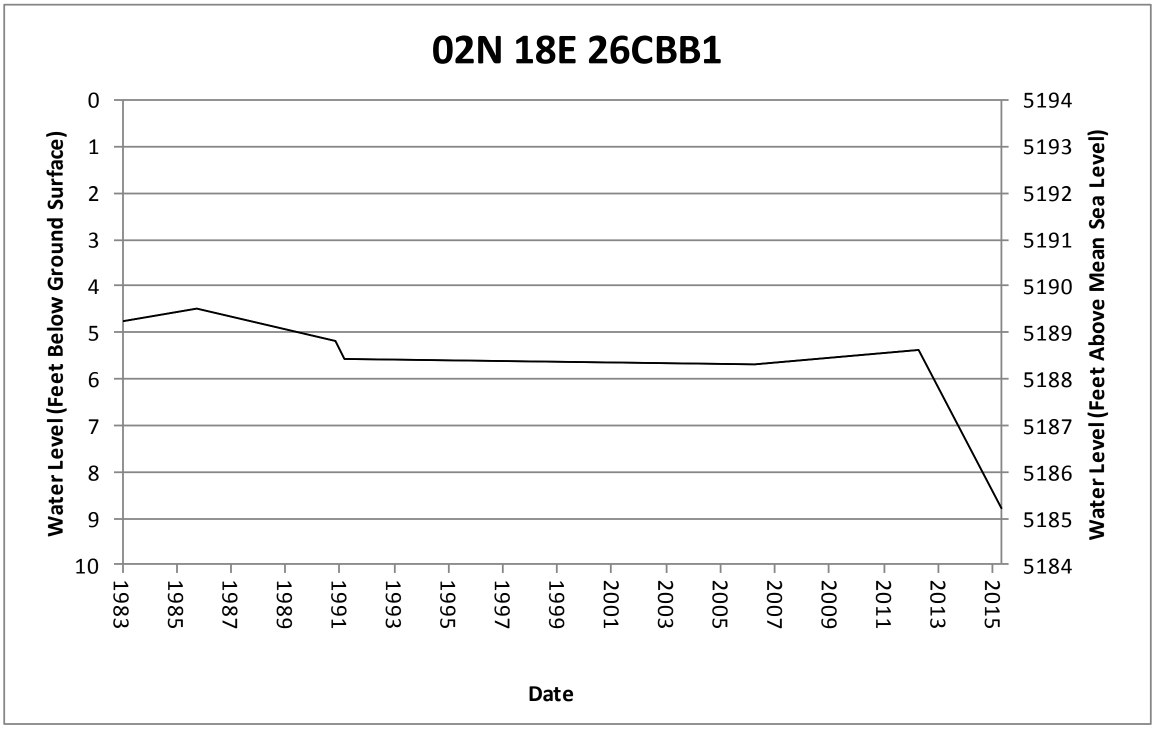

03N 18E 29DDB1
Water Level (Feet Below Ground Surface)
Water Level (Feet Above Mean Sea Level)
0
5
10
15
20
25
30
5451
5446
5441
5436
5431
5426
5421
Jul-2012
Jul-2013
Jul-2014
Jul-2015
Date


03N 18E 28DCA1
Water Level (Feet Below Ground Surface)
130
131
132
133
134
135
136
137
138
139
140
Water Level (Feet Above Mean Sea Level)
5423
5422
5421
5420
5419
5418
5417
5416
5415
5414
5413
Oct-2006
Oct-2007
Oct-2008
Oct-2009
Oct-2010
Oct-2011
Oct-2012
Oct-2013
Oct-2014
Oct-2015
Date



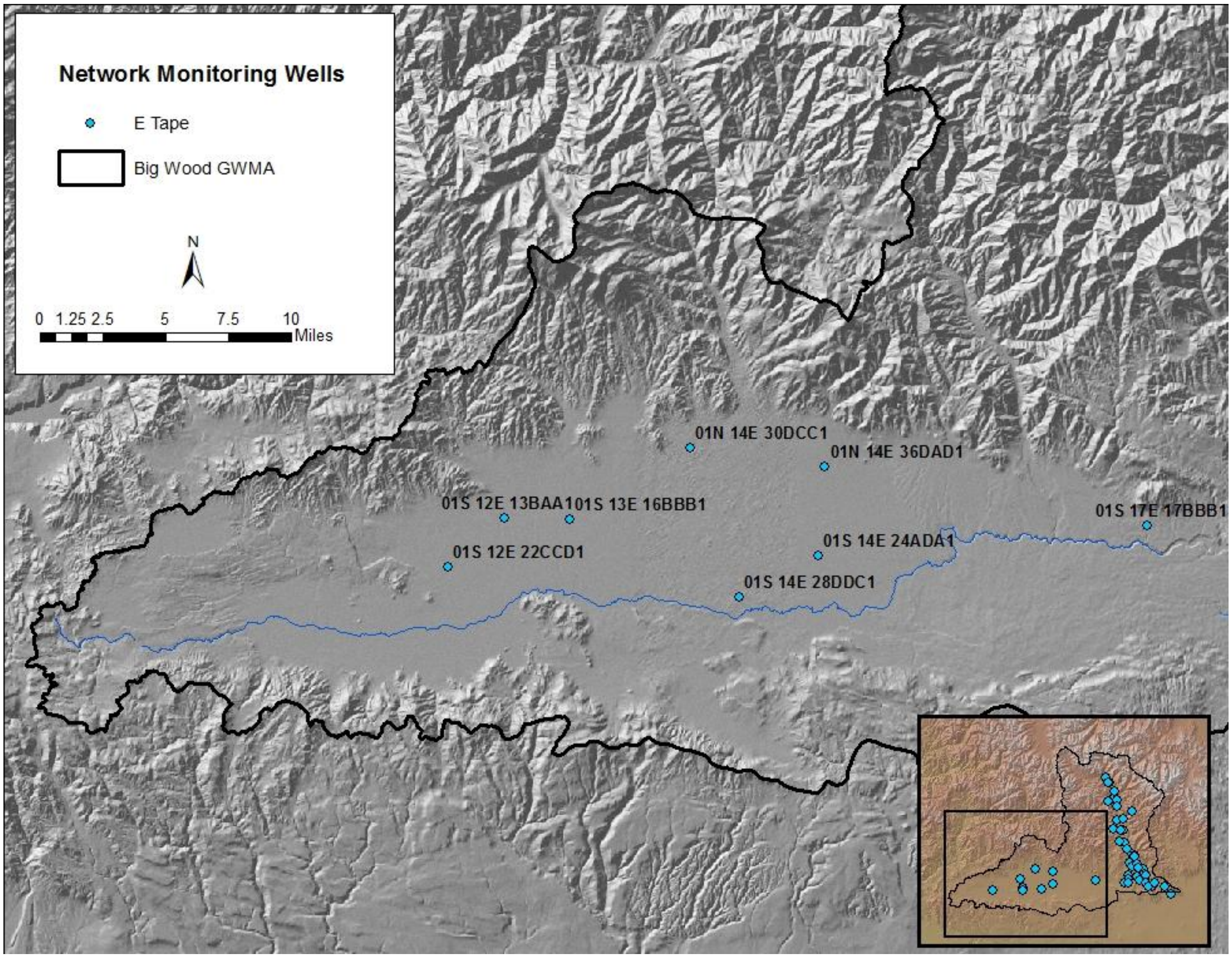
02N 18E 17BDA1
Water Level (Feet Below Ground Surface)
30
32
34
36
38
40
42
44
46
48
50
Water Level (Feet Above Mean Sea Level)
5351
5349
5347
5345
5343
5341
5339
5337
5335
5333
5331
Oct-2006
Oct-2008
Oct-2010
Oct-2012
Oct-2014
Date

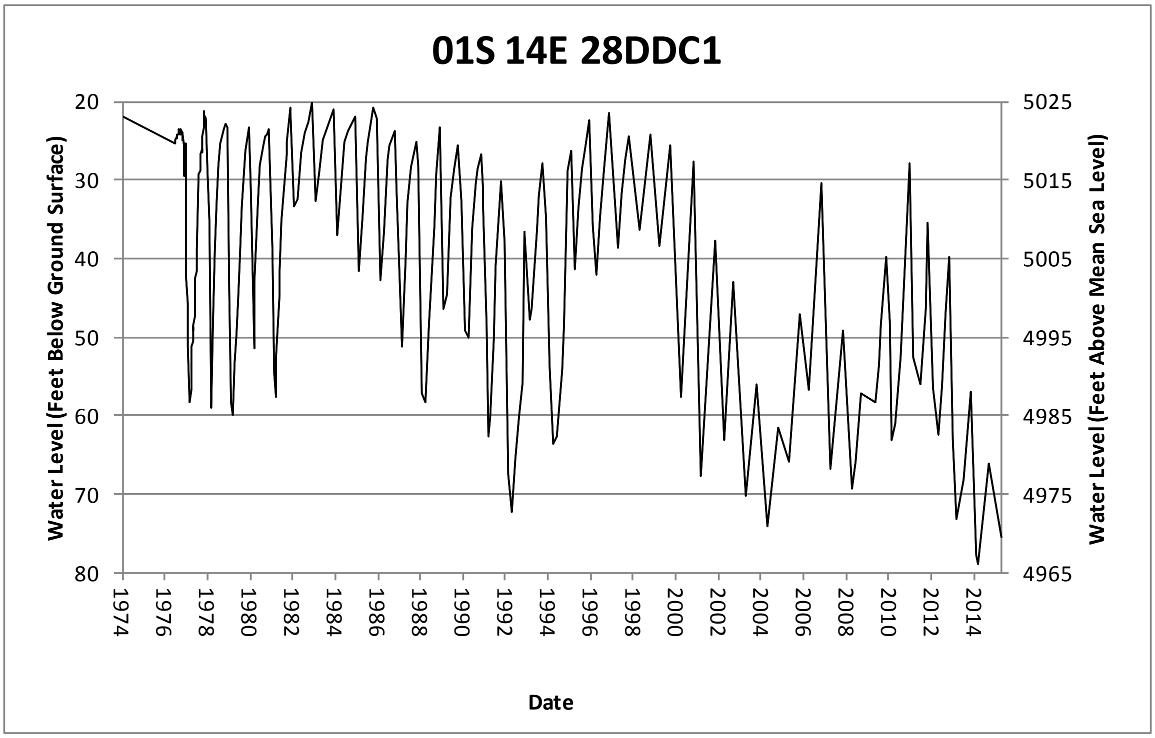

02N 18E 15CBB1
Water Level (Feet Below Ground Surface)
10
12
14
16
18
20
22
24
26
28
30
Water Level (Feet Above Mean Sea Level)
5271
5269
5267
5265
5263
5261
5259
5257
5255
5253
5251
2006
2008
2010
2012
2014
Date

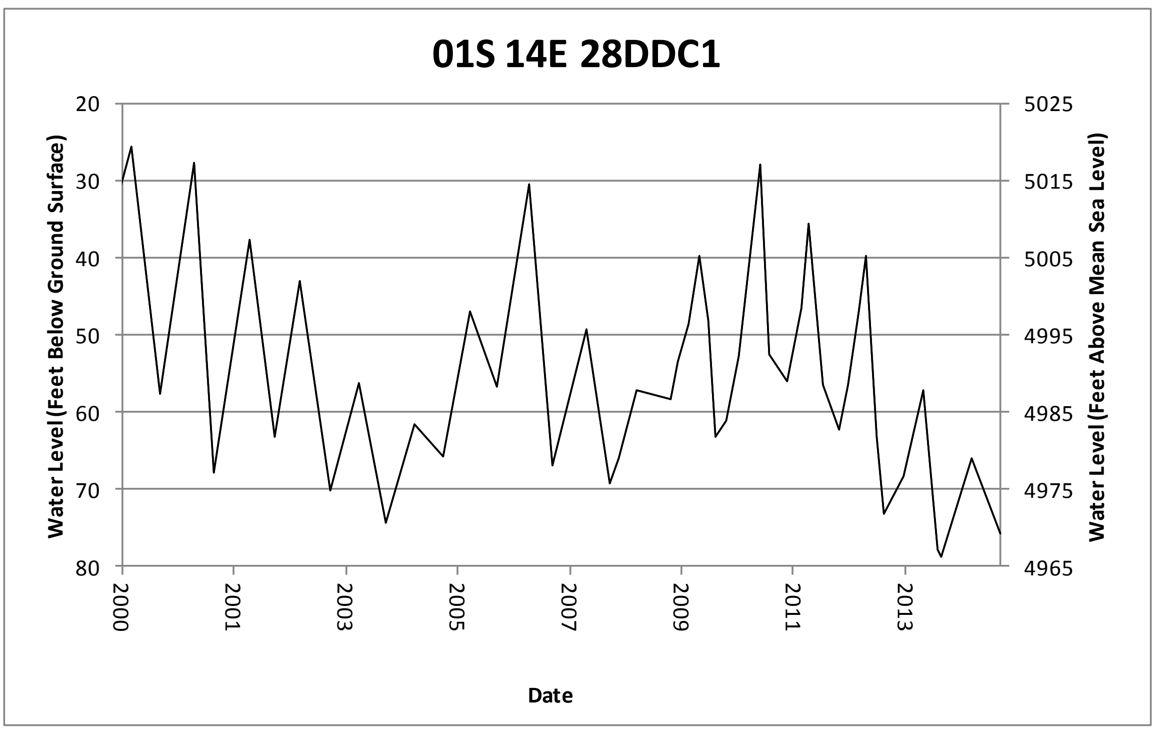

02N 18E 26CBB1
Water Level (Feet Below Ground Surface)
0
1
2
3
4
5
6
7
8
9
10
Water Level (Feet Above Mean Sea Level)
5194
5193
5192
5191
5190
5189
5188
5187
5186
5185
5184
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009
2011
2013
2015
Date

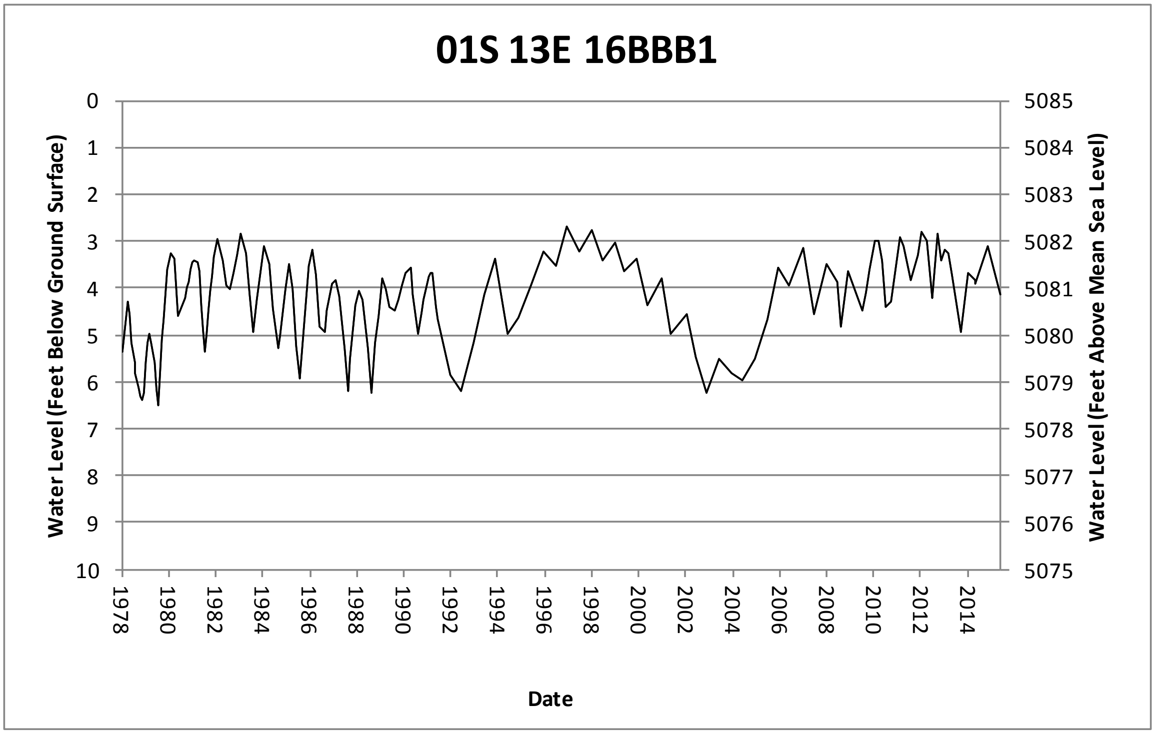
APPENDIX C

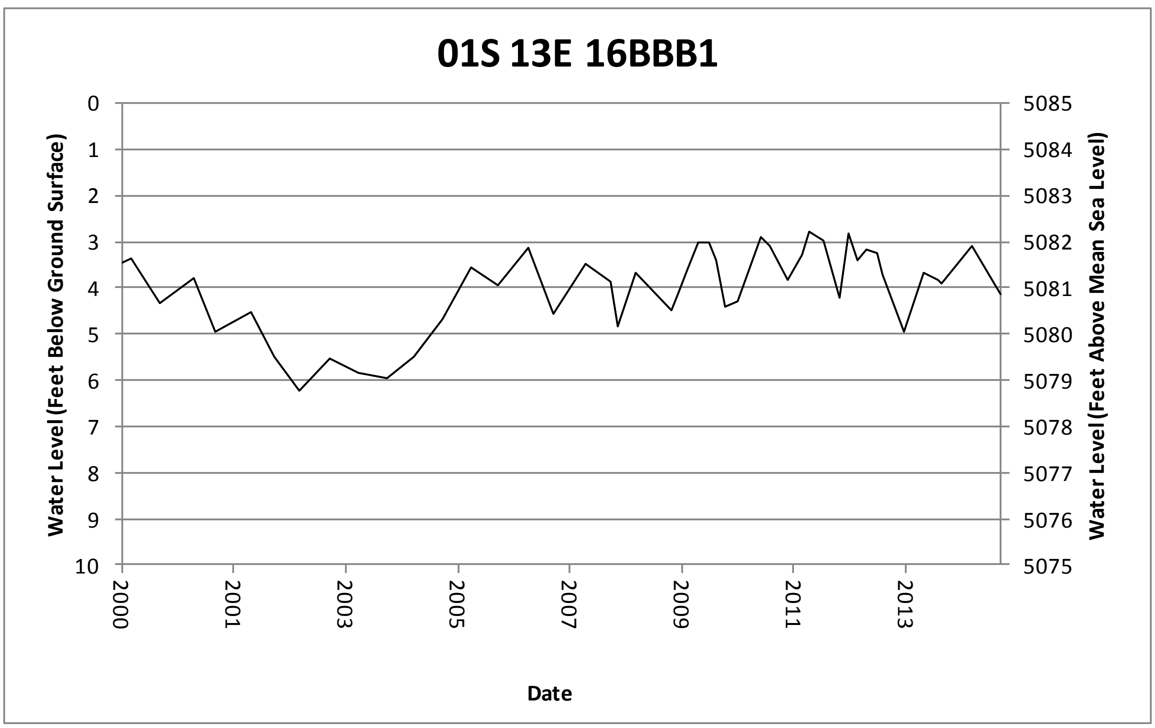
HYDROGRAPS

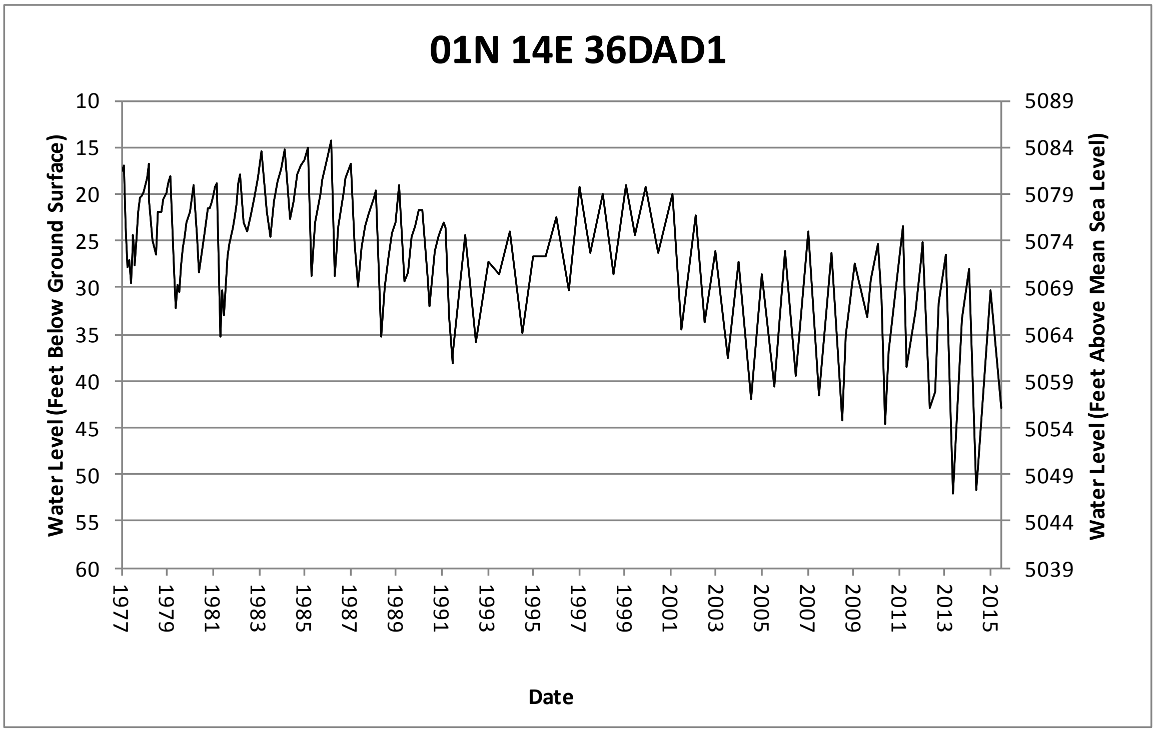

Network Monitoring Wells
E Tape
Big Wood GWMA
N
0 1.25 2.5 5 7.5 10
Miles
01N 14E 30DCC1
01N 14E 36DAD1
01S 12E 13BAA1
01S 13E 16BBB1
01S 17E 17BBB1
01S 14E 24ADA1
01S 12E 22CCD1
01S 14E 28DDC1

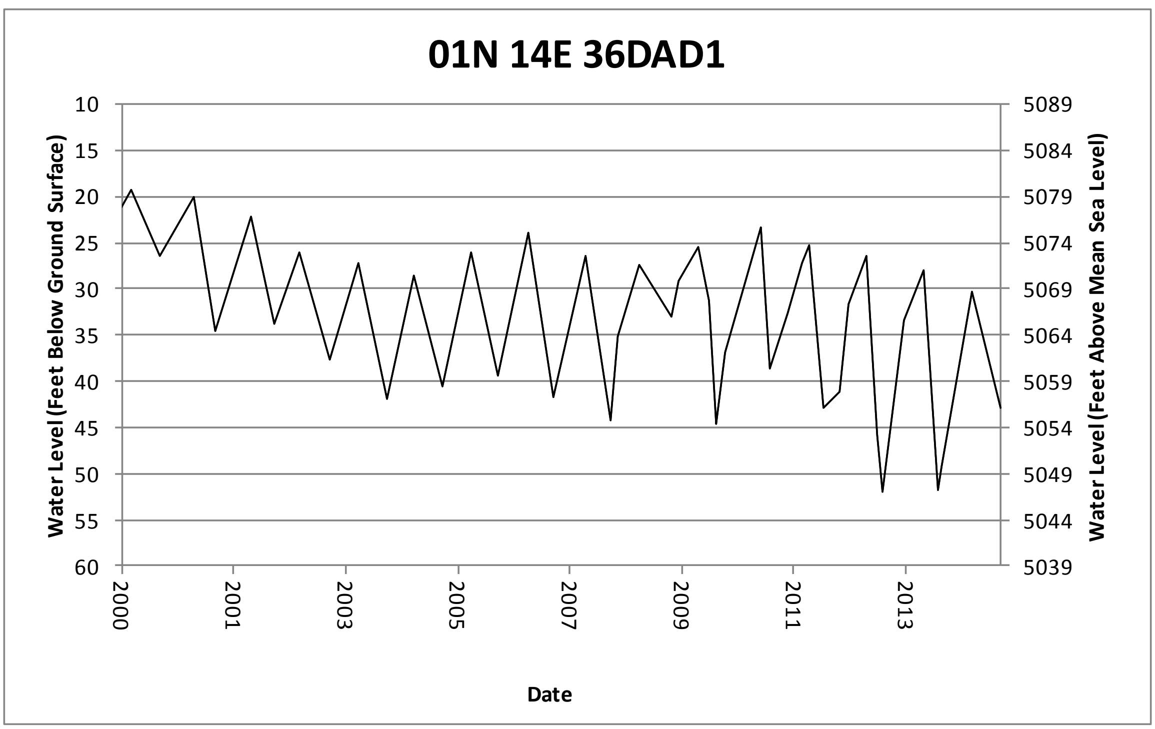

01S 14E 28DDC1
Water Level (Feet Below Ground Surface)
Water Level (Feet Above Mean Sea Level)
Date
20
30
40
50
60
70
80
5025
5015
5005
4995
4985
4975
4965
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014

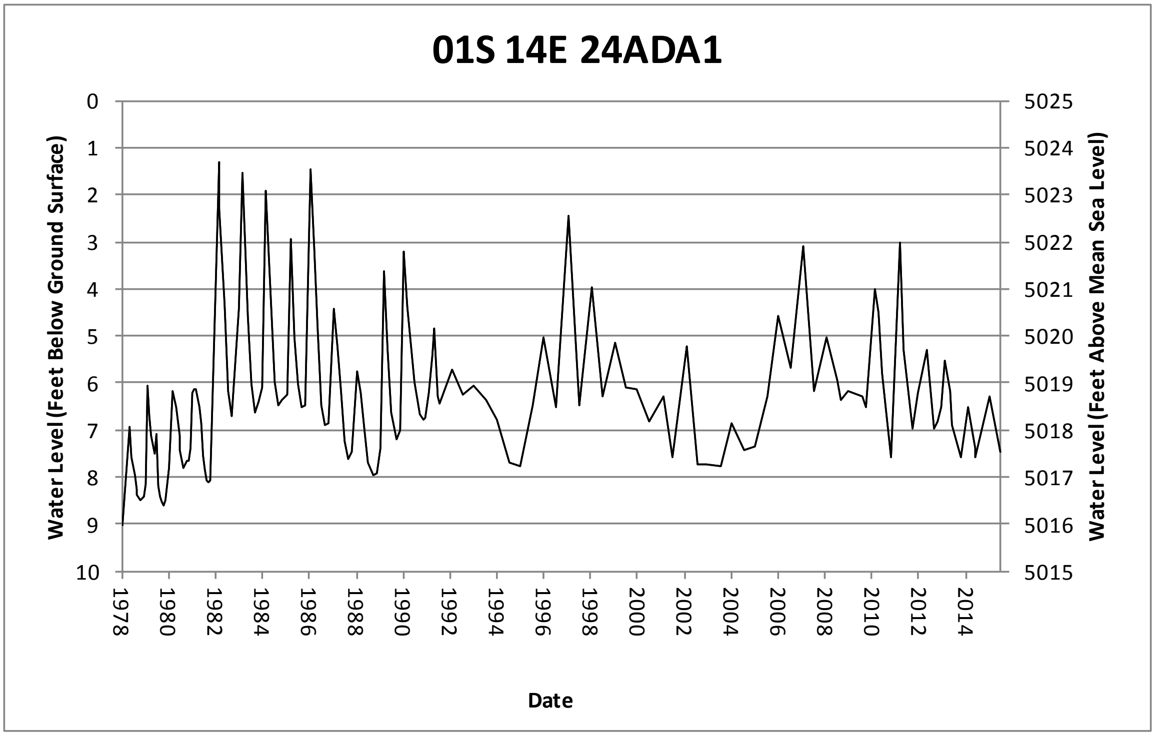

01S 14E 28DDC1
Water Level (Feet Below Ground Surface)
Water Level (Feet Above Mean Sea Level)
Date
20
30
40
50
60
70
80
5025
5015
5005
4995
4985
4975
4965
2000
2001
2003
2005
2007
2009
2011
2013

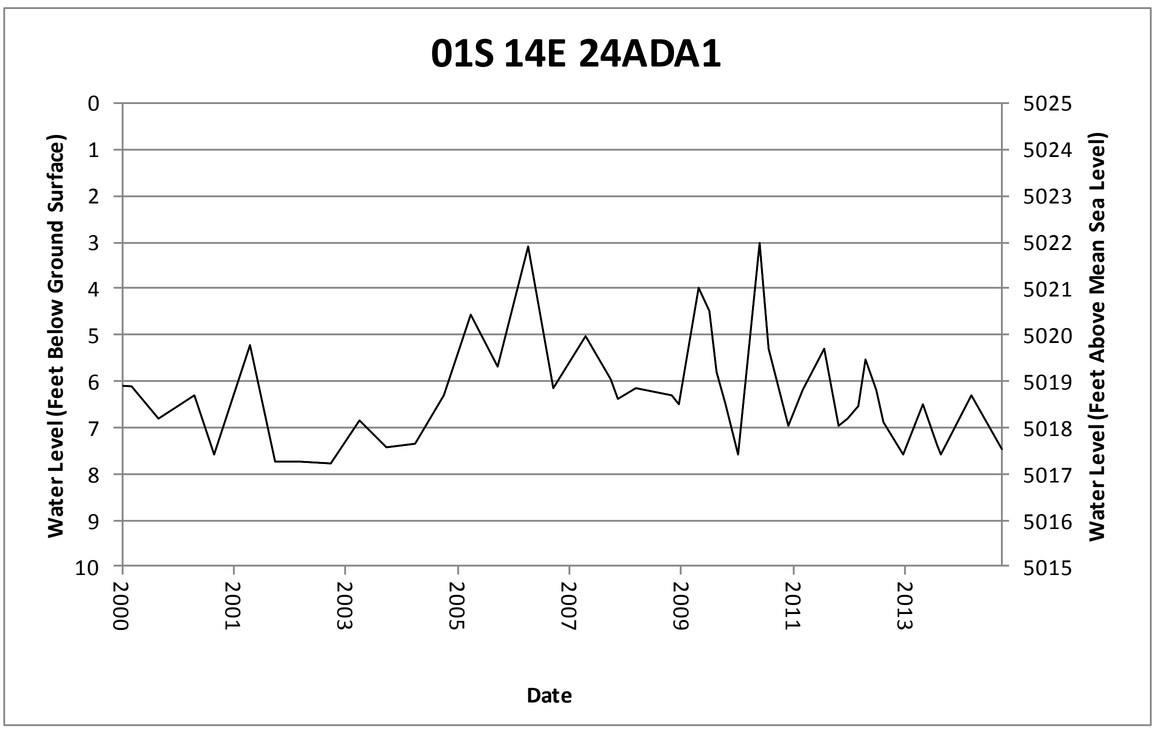

01S 13E 16BBB1
Water Level (Feet Below Ground Surface)
Water Level (Feet Above Mean Sea Level)
0
1
2
3
4
5
6
7
8
9
10
5085
5084
5083
5082
5081
5080
5079
5078
5077
5076
5075
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
Date

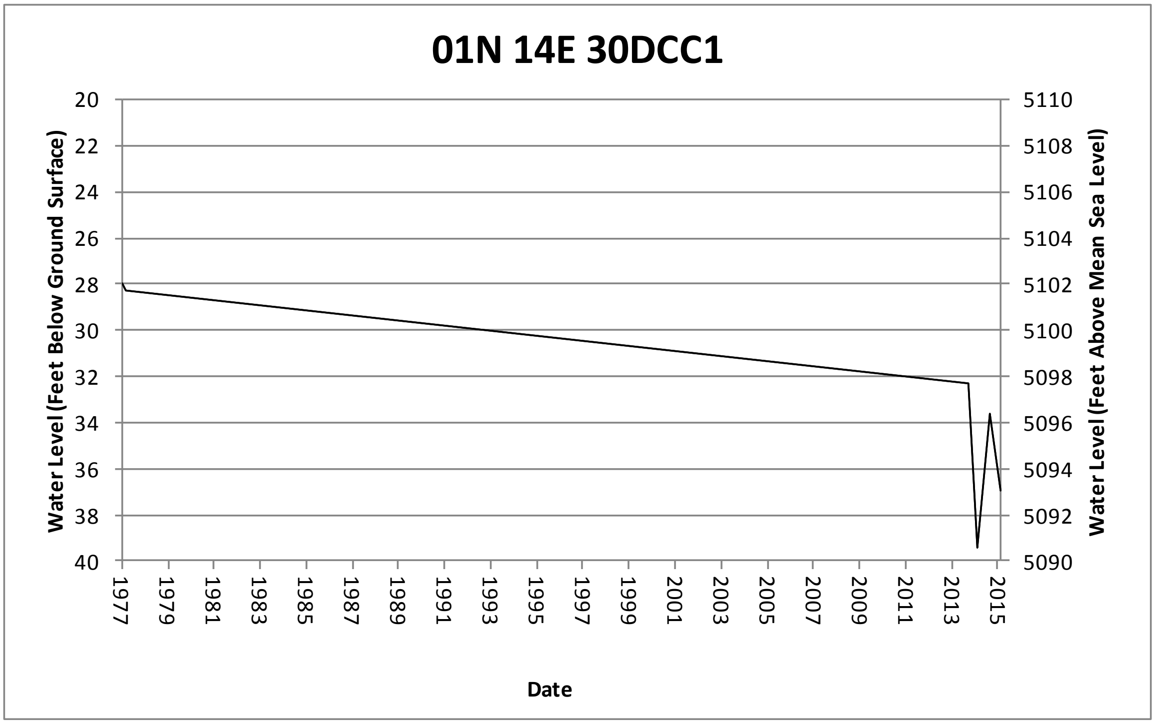

01S 13E 16BBB1
Water Level (Feet Below Ground Surface)
Water Level (Feet Above Mean Sea Level)
0
1
2
3
4
5
6
7
8
9
10
5085
5084
5083
5082
5081
5080
5079
5078
5077
5076
5075
2000
2001
2003
2005
2007
2009
2011
2013
Date


01N 14E 36DAD1
Water Level (Feet Below Ground Surface)
Water Level (Feet Above Mean Sea Level)
Date
10
15
20
25
30
35
40
45
50
55
60
5089
5084
5079
5074
5069
5064
5059
5054
5049
5044
5039
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009
2011
2013
2015


01N 14E 36DAD1
Water Level (Feet Below Ground Surface)
Water Level (Feet Above Mean Sea Level)
Date
10
15
20
25
30
35
40
45
50
55
60
5089
5084
5079
5074
5069
5064
5059
5054
5049
5044
5039
2000
2001
2003
2005
2007
2009
2011
2013


01S 14E 24ADA1
Water Level (Feet Below Ground Surface)
Water Level (Feet Above Mean Sea Level)
0
1
2
3
4
5
6
7
8
9
10
5025
5024
5023
5022
5021
5020
5019
5018
5017
5016
5015
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
Date


01S 14E 24ADA1
Water Level (Feet Below Ground Surface)
Water Level (Feet Above Mean Sea Level)
0
1
2
3
4
5
6
7
8
9
10
5025
5024
5023
5022
5021
5020
5019
5018
5017
5016
5015
2000
2001
2003
2005
2007
2009
2011
2013
Date


01N 14E 30DCC1
Water Level (Feet Below Ground Surface)
Water Level (Feet Above Mean Sea Level)
20
22
24
26
28
30
32
34
36
38
40
5110
5108
5106
5104
5102
5100
5098
5096
5094
5092
5090
1977
1979
1981
1983
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1989
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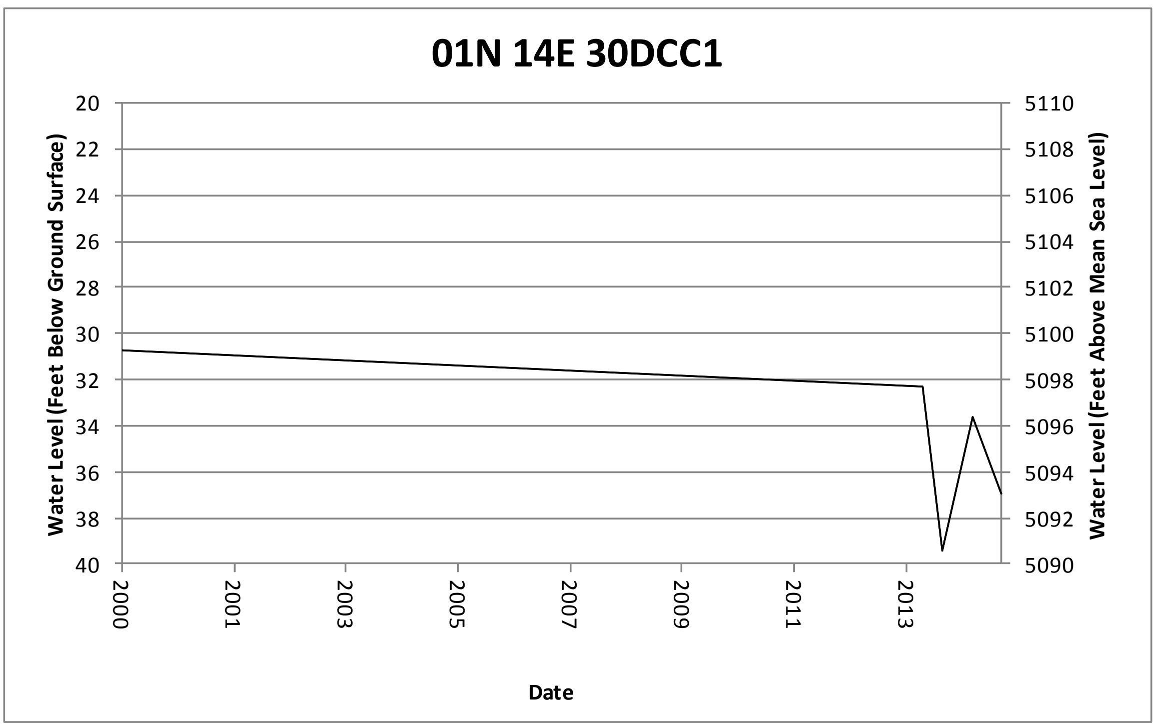
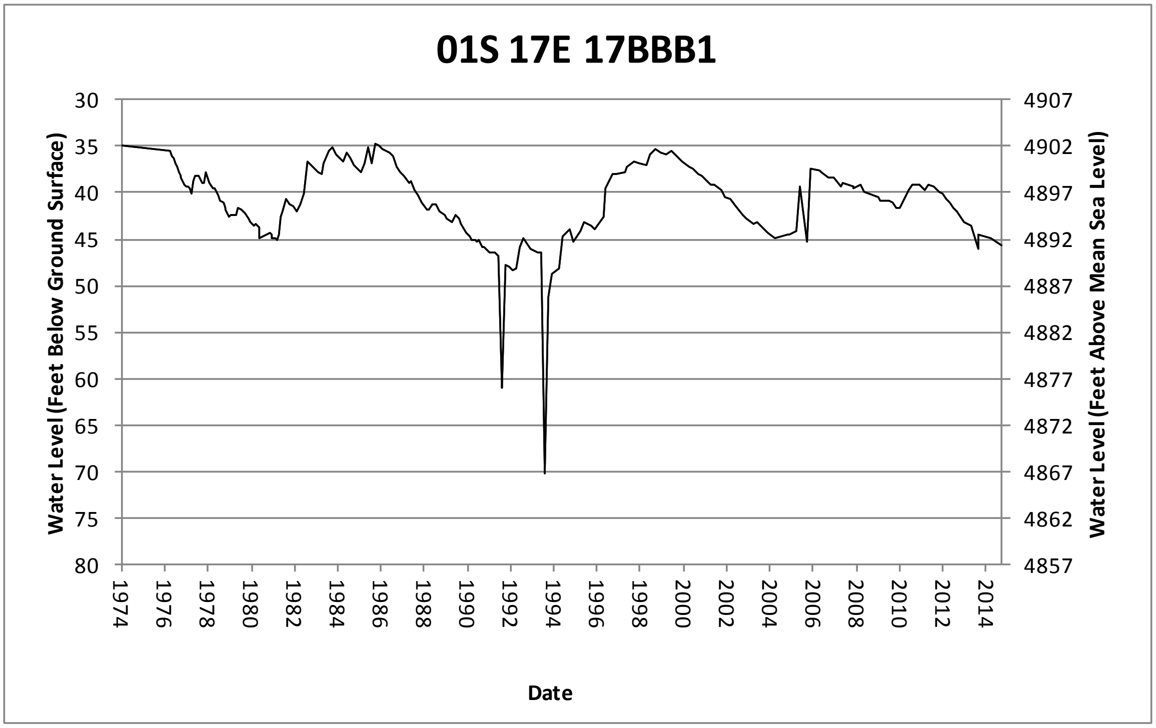
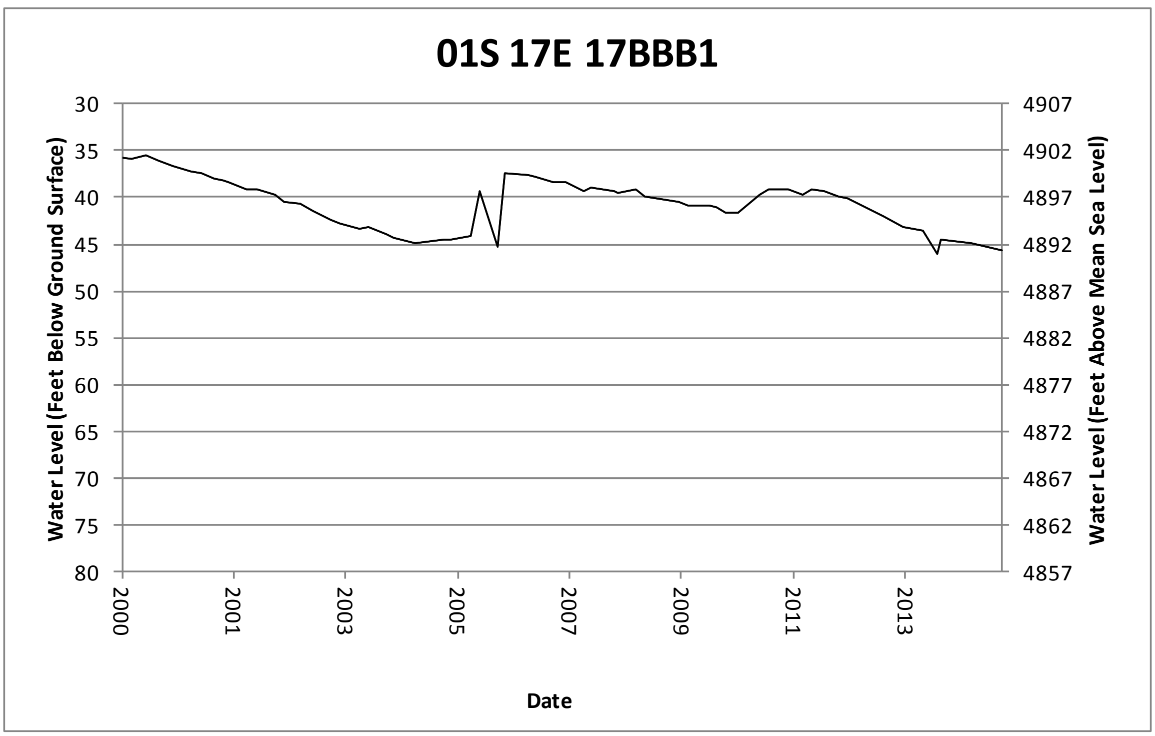
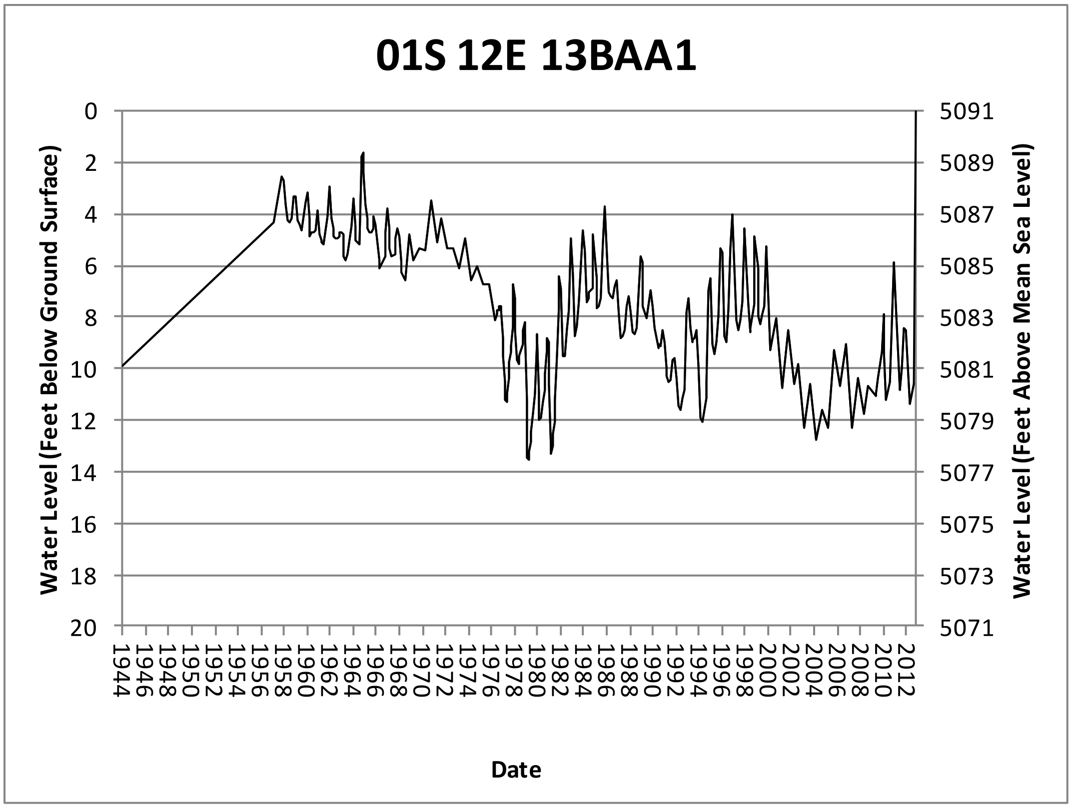
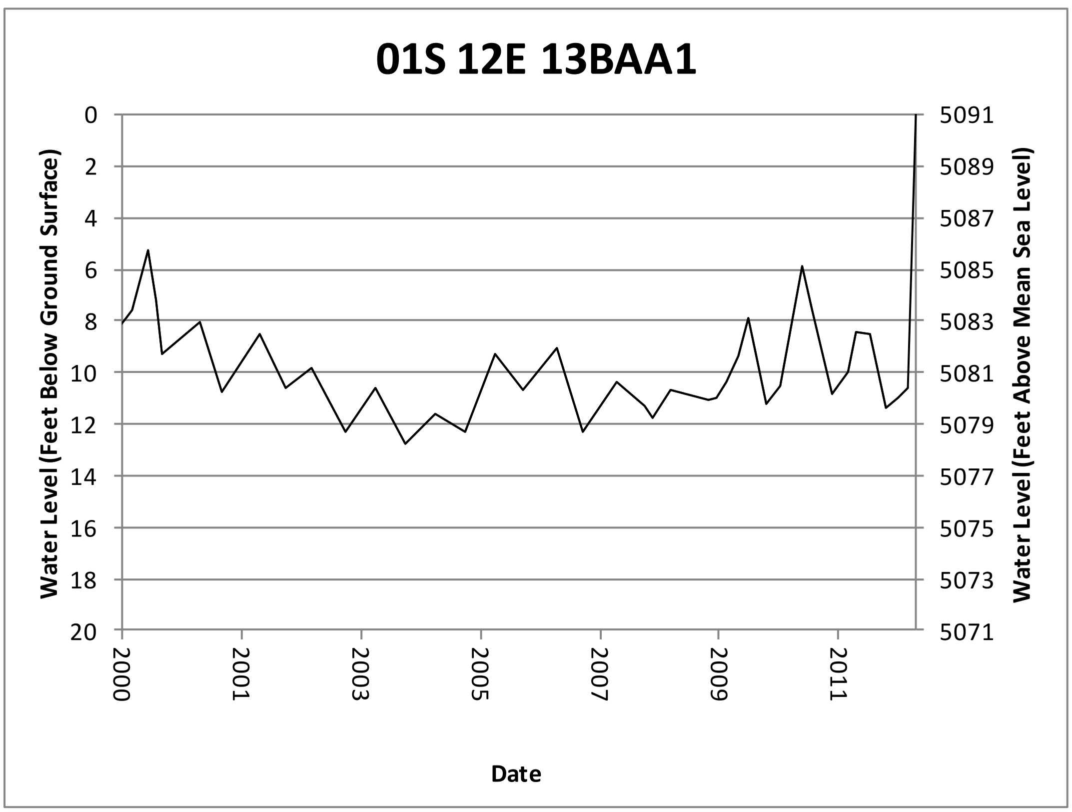
1993
1995
1997
1999
2001
2003
2005
2007
2009
2011
2013
2015
Date

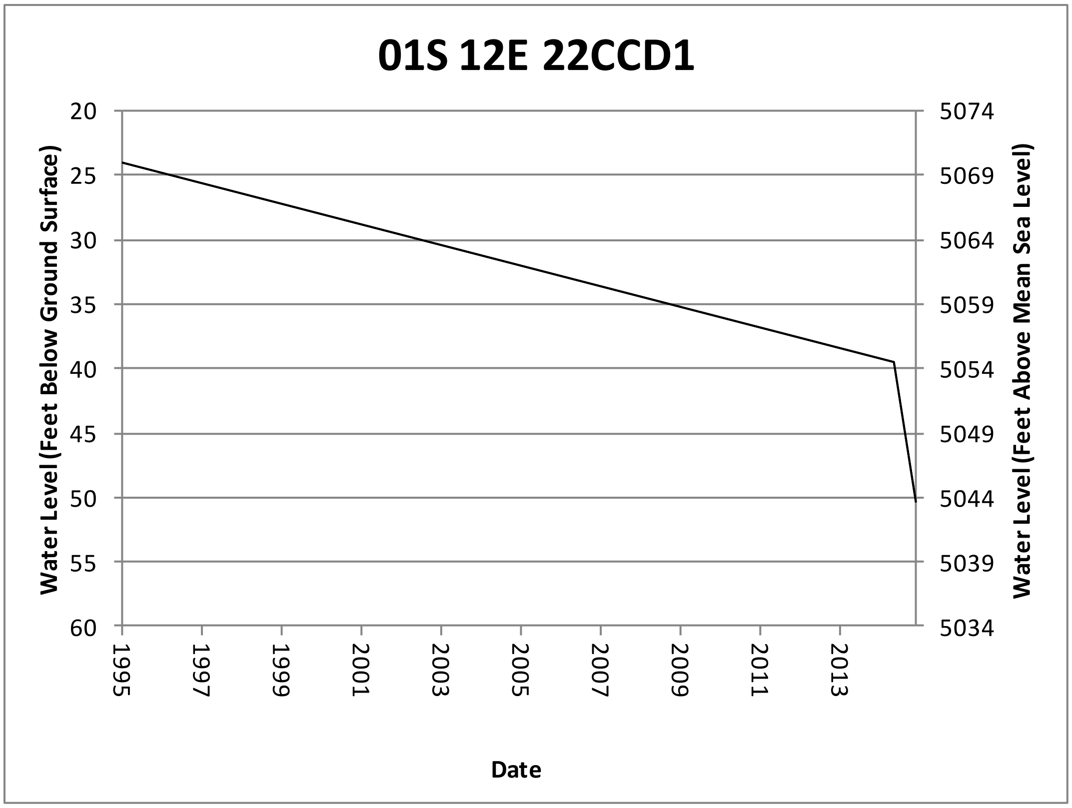

01N 14E 30DCC1
Water Level (Feet Below Ground Surface)
Water Level (Feet Above Mean Sea Level)
20
22
24
26
28
30
32
34
36
38
40
5110
5108
5106
5104
5102
5100
5098
5096
5094
5092
5090
2000
2001
2003
2005
2007
2009
2011
2013
Date


01S 17E 17BBB1
Water Level (Feet Below Ground Surface)
Water Level (Feet Above Mean Sea Level)
30
35
40
45
50
55
60
65
70
75
80
4907
4902
4897
4892
4887
4882
4877
4872
4867
4862
4857
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
Date


01S 17E 17BBB1
Water Level (Feet Below Ground Surface)
Water Level (Feet Above Mean Sea Level)
30
35
40
45
50
55
60
65
70
75
80
4907
4902
4897
4892
4887
4882
4877
4872
4867
4862
4857
2000
2001
2003
2005
2007
2009
2011
2013
Date


01S 12E 13BAA1
Water Level (Feet Below Ground Surface)
Water Level (Feet Above Mean Sea Level)
0
2
4
6
8
10
12
14
16
18
20
5091
5089
5087
5085
5083
5081
5079
5077
5075
5073
5071
1944
1946
1948
1950
1952
1954
1956
1958
1960
1962
1964
1966
1968
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
Date


01S 12E 13BAA1
Water Level (Feet Below Ground Surface)
Water Level (Feet Above Mean Sea Level)
0
2
4
6
8
10
12
14
16
18
20
5091
5089
5087
5085
5083
5081
5079
5077
5075
5073
5071
2000
2001
2003
2005
2007
2009
2011
Date

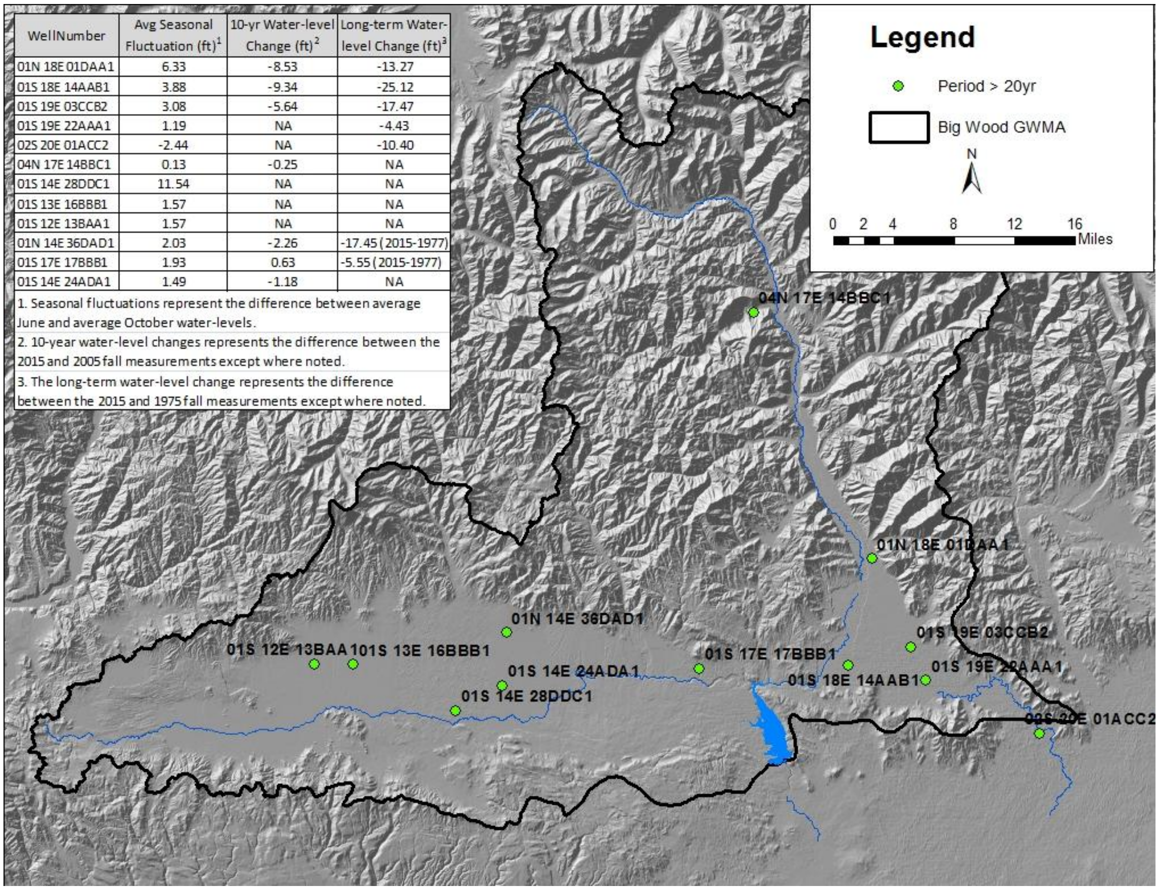

01S 12E 22CCD1
Water Level (Feet Below Ground Surface)
20
25
30
35
40
45
50
55
60
Water Level (Feet Above Mean Sea Level)
5074
5069
5064
5059
5054
5049
5044
5039
5034
1995
1997
1999
2001
2003
2005
2007
2009
2011
2013
Date

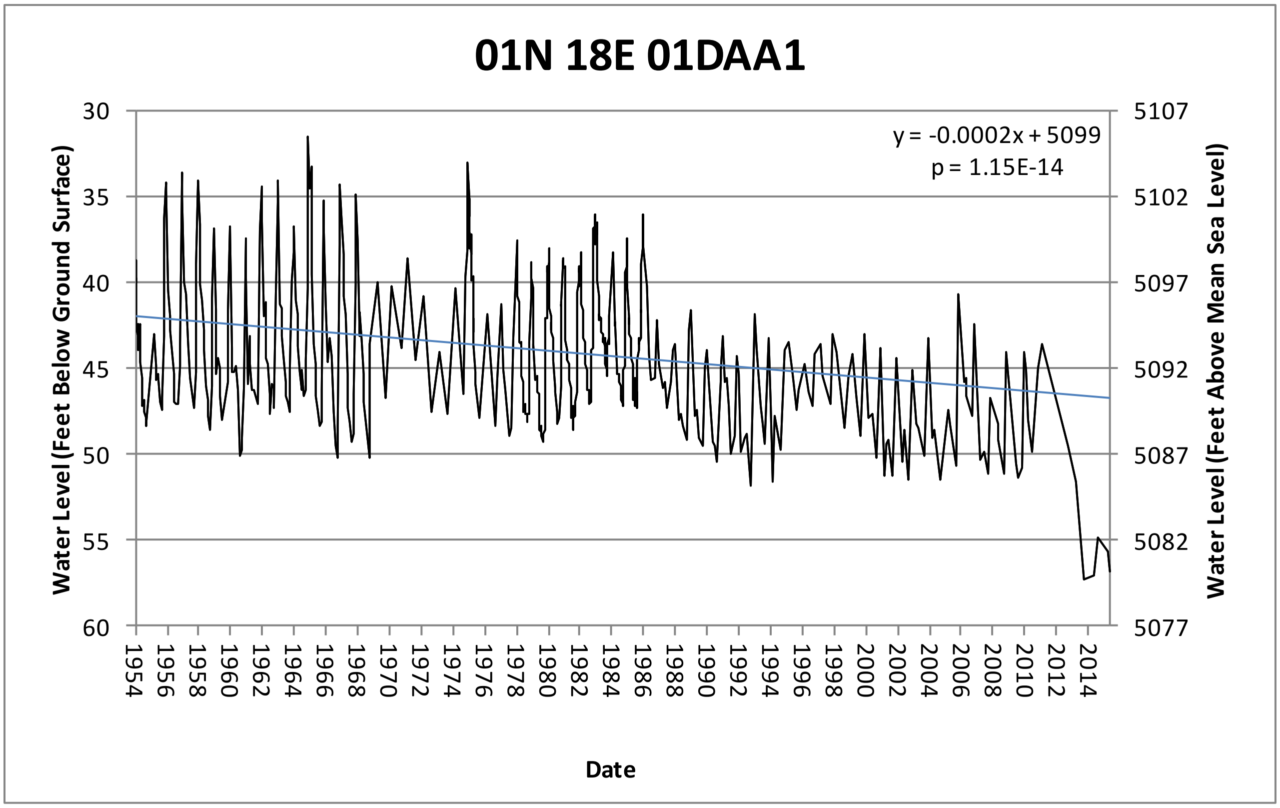
APPENDIX D

HYDROGRAPS AND TRENDLINES

WellNumber	Avg Seasonal Fluctuation (ft)[1]	10-yr Water-level Change (ft)[2]	Long-term Water-level Change (ft)[3]
01N 18E 01DAA1	6.33	-8.53	-13.27
01S 18E 14AAB1	3.88	-9.34	-25.12
01S 19E 03CCB2	3.08	-5.64	-17.47
01S 19E 22AAA1	1.19	NA	-4.43
02S 20E 01ACC2	-2.44	NA	-10.40
04N 17E 14BBC1	0.13	-0.25	NA
01S 14E 28DDC1	11.54	NA	NA
01S 13E 16BBB1	1.57	NA	NA
01S 12E 13BAA1	1.57	NA	NA
01N 14E 36DAD1	2.03	-2.26	-17.45 (2015-1977)
01S 17E 17BBB1	1.93	0.63	-5.55 (2015-1977)
01S 14E 24ADA1	1.49	-1.18	NA

1. Seasonal fluctuations represent the difference between average June and average October water-levels.
2. 10-year water-level changes represents the difference between the 2015 and 2005 fall measurements except where noted.
3. The long-term water-level change represents the difference between the 2015 and 1975 fall measurements except where noted.




01N 18E 01DAA1
y = -0.0002x + 5099
p = 1.15E-14
Water Level (Feet Below Ground Surface)
Water Level (Feet Above Mean Sea Level)
30
35
40
45
50
55
60
5107
5102
5097
5092
5087
5082
5077
1954
1956
1958
1960
1962
1964
1966
1968
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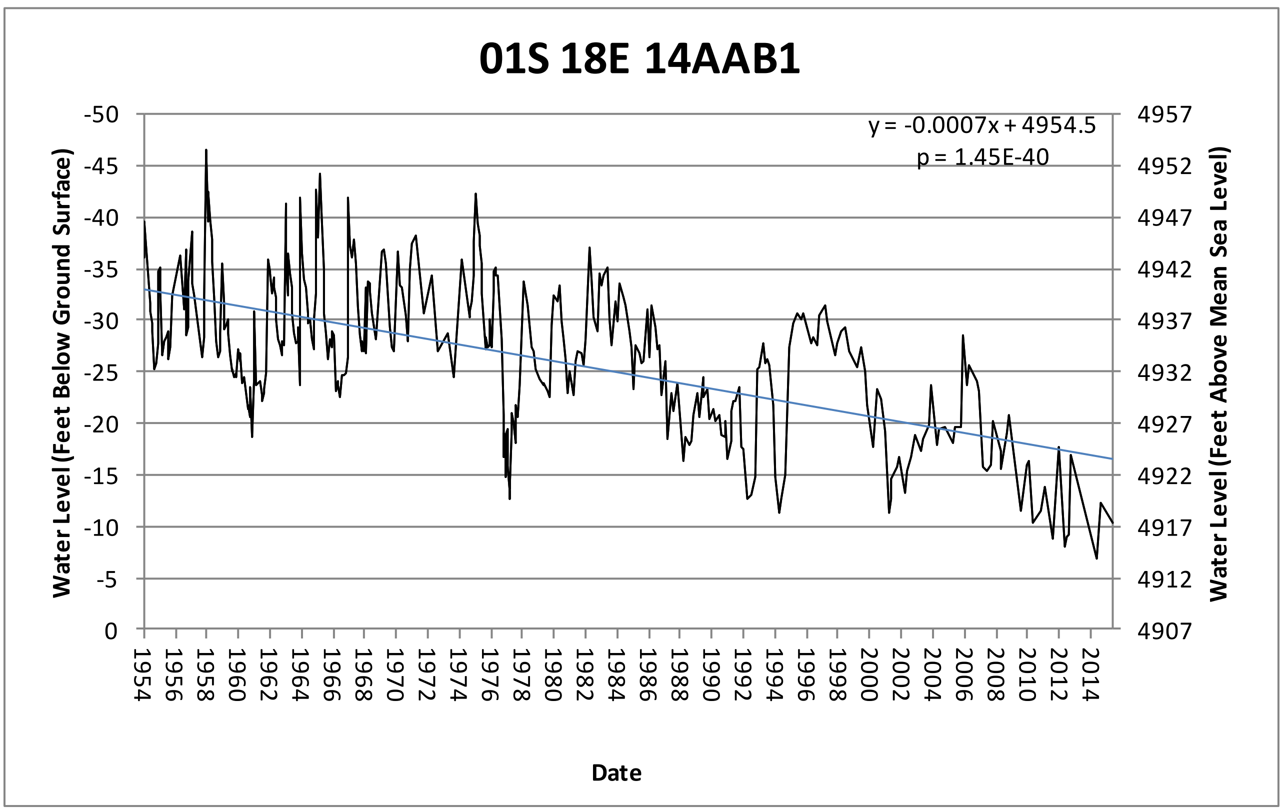
2012
2014
Date


01S 18E 14AAB1
y = -0.0007x + 4954.5
p = 1.45E-40
Water Level (Feet Below Ground Surface)
Water Level (Feet Above Mean Sea Level)
-50
-45
-40
-35
-30
-25
-20
-15
-10
-5
0
4957
4952
4947
4942
4937
4932
4927
4922
4917
4912
4907
1954
1956
1958
1960
1962
1964
1966
1968
1970
1972
1974
1976
1978
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1984
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1992
1994
1996
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2008
2010
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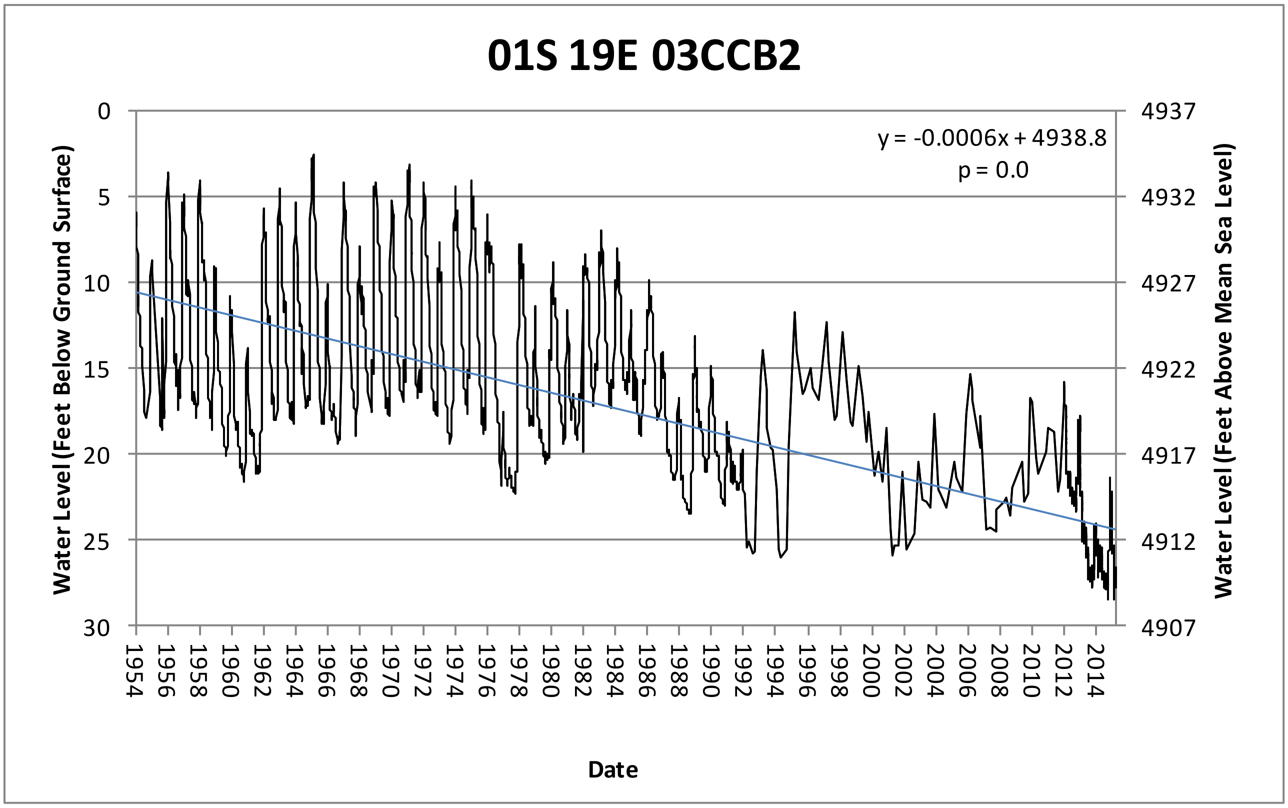
Date


01S 19E 03CCB2
y = -0.0006x + 4938.8
p = 0.0
Water Level (Feet Below Ground Surface)
Water Level (Feet Above Mean Sea Level)
0
5
10
15
20
25
30
4937
4932
4927
4922
4917
4912
4907
1954
1956
1958
1960
1962
1964
1966
1968
1970
1972
1974
1976
1978
1980
1982
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1990
1992
1994
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1998
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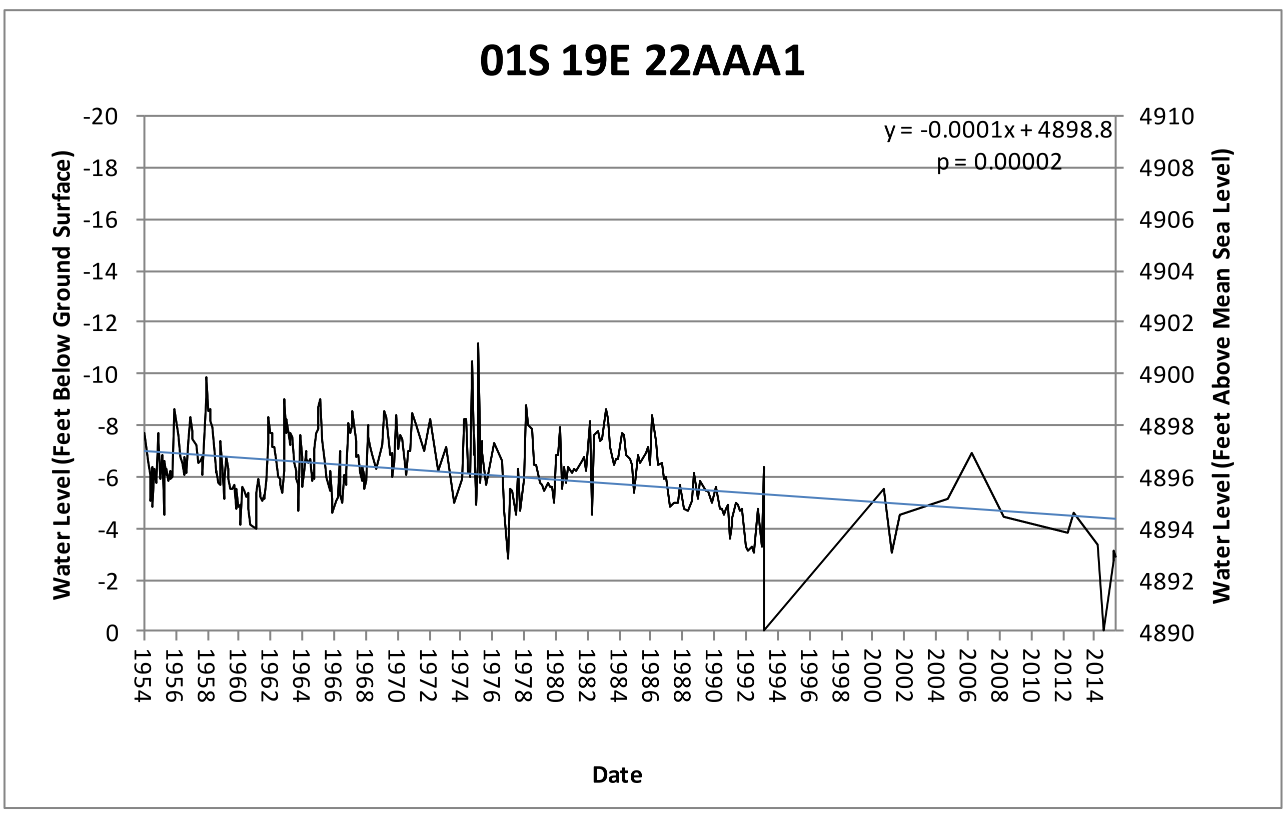
2006
2008
2010
2012
2014
Date


01S 19E 22AAA1
y = -0.0001x + 4898.8
p = 0.00002
Water Level (Feet Below Ground Surface)
Water Level (Feet Above Mean Sea Level)
-20
-18
-16
-14
-12
-10
-8
-6
-4
-2
0
4910
4908
4906
4904
4902
4900
4898
4896
4894
4892
4890
1954
1956
1958
1960
1962
1964
1966
1968
1970
1972
1974
1976
1978
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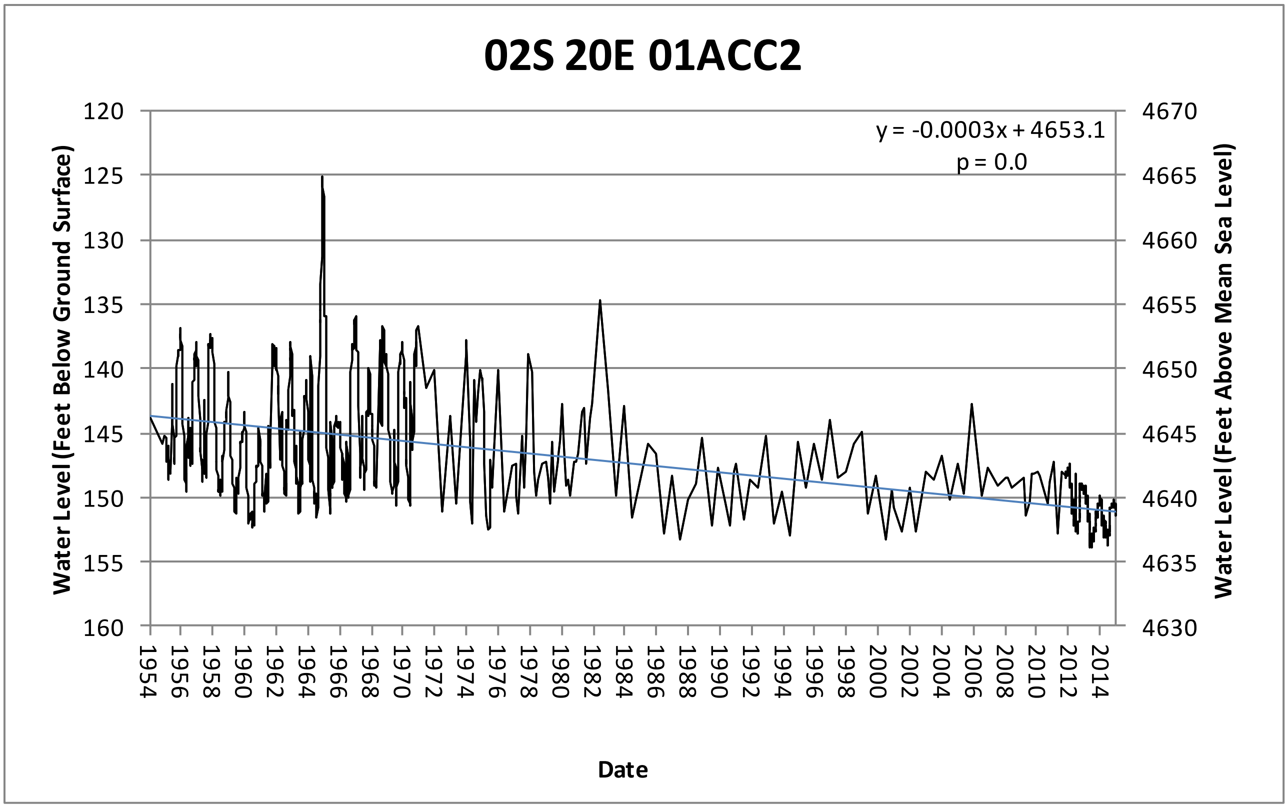
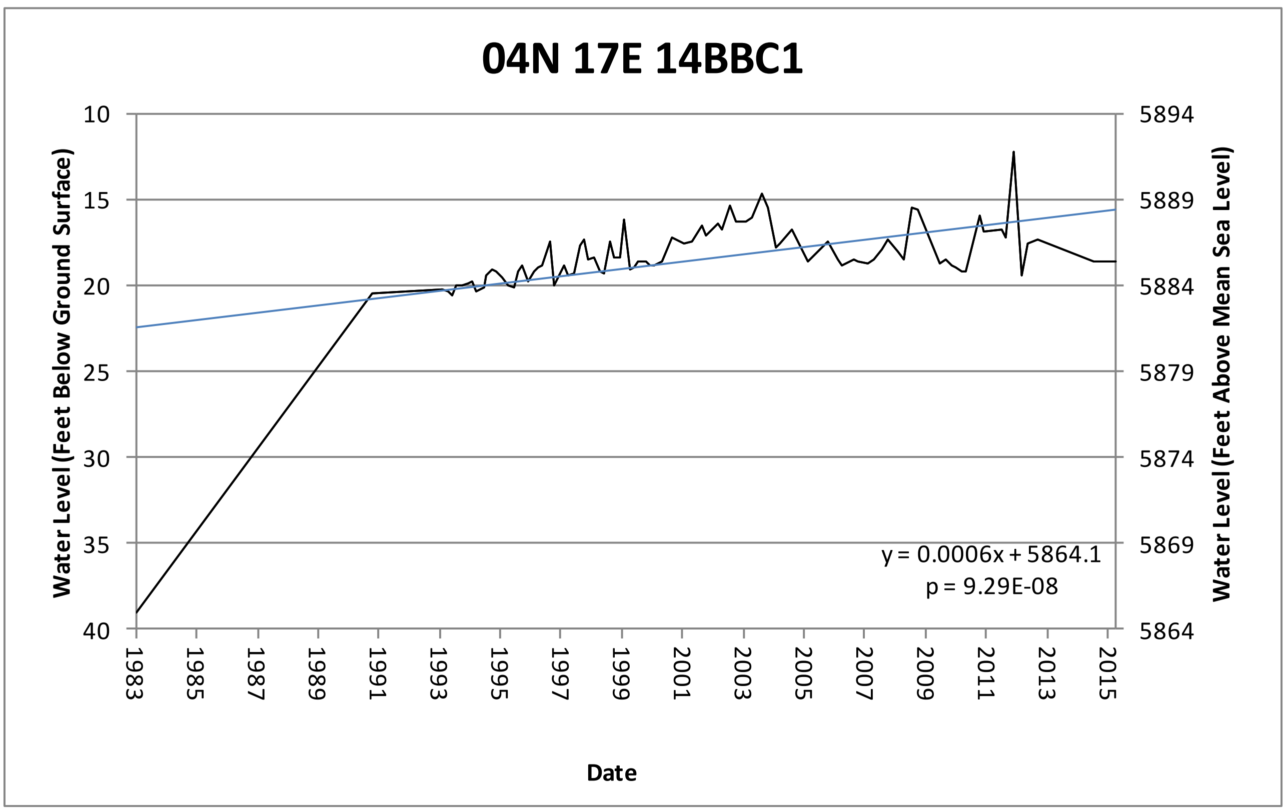
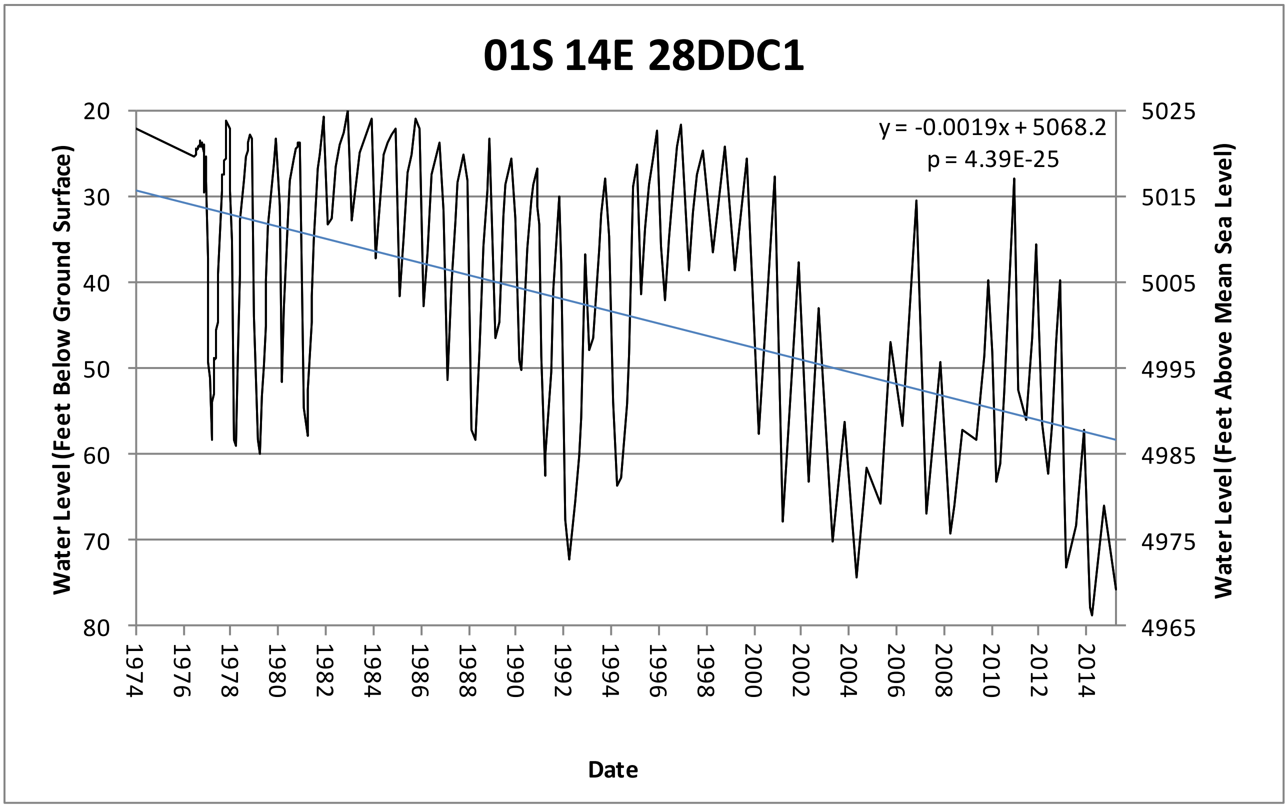
2012
2014
Date


02S 20E 01ACC2
y = -0.0003x + 4653.1
p = 0.0
Water Level (Feet Below Ground Surface)
Water Level (Feet Above Mean Sea Level)
Date


04N 17E 14BBC1
y = 0.0006x + 5864.1
p = 9.29E-08
Water Level (Feet Below Ground Surface)
Water Level (Feet Above Mean Sea Level)
Date


01S 14E 28DDC1
y = -0.0019x + 5068.2
p = 4.39E-25
Water Level (Feet Below Ground Surface)
Water Level (Feet Above Mean Sea Level)
20
30
40
50
60
70
80
5025
5015
5005
4995
4985
4975
4965
1974
1976
1978
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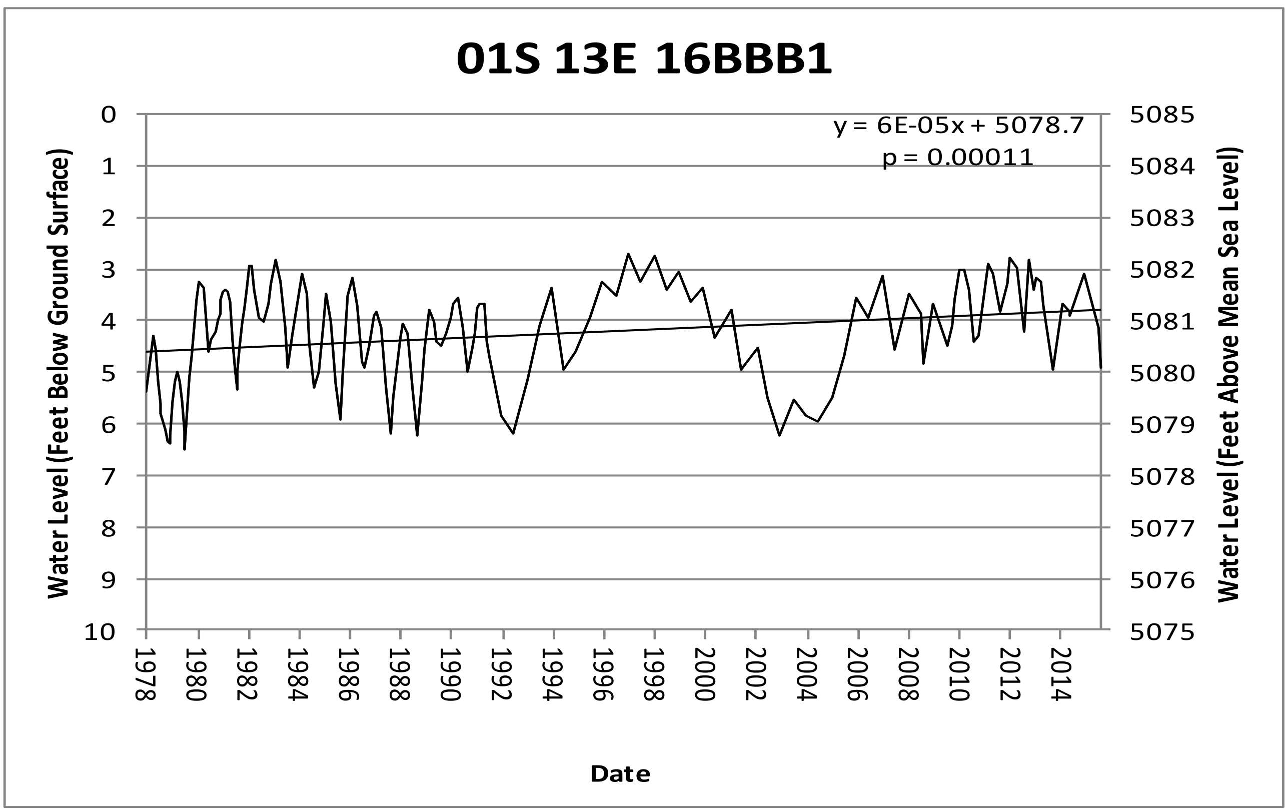
Date


01S 13E 16BBB1
y = 6E-05x + 5078.7
p = 0.00011
Water Level (Feet Below Ground Surface)
Water Level (Feet Above Mean Sea Level)
0
1
2
3
4
5
6
7
8
9
10
5085
5084
5083
5082
5081
5080
5079
5078
5077
5076
5075
1978
1980
1982
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1986
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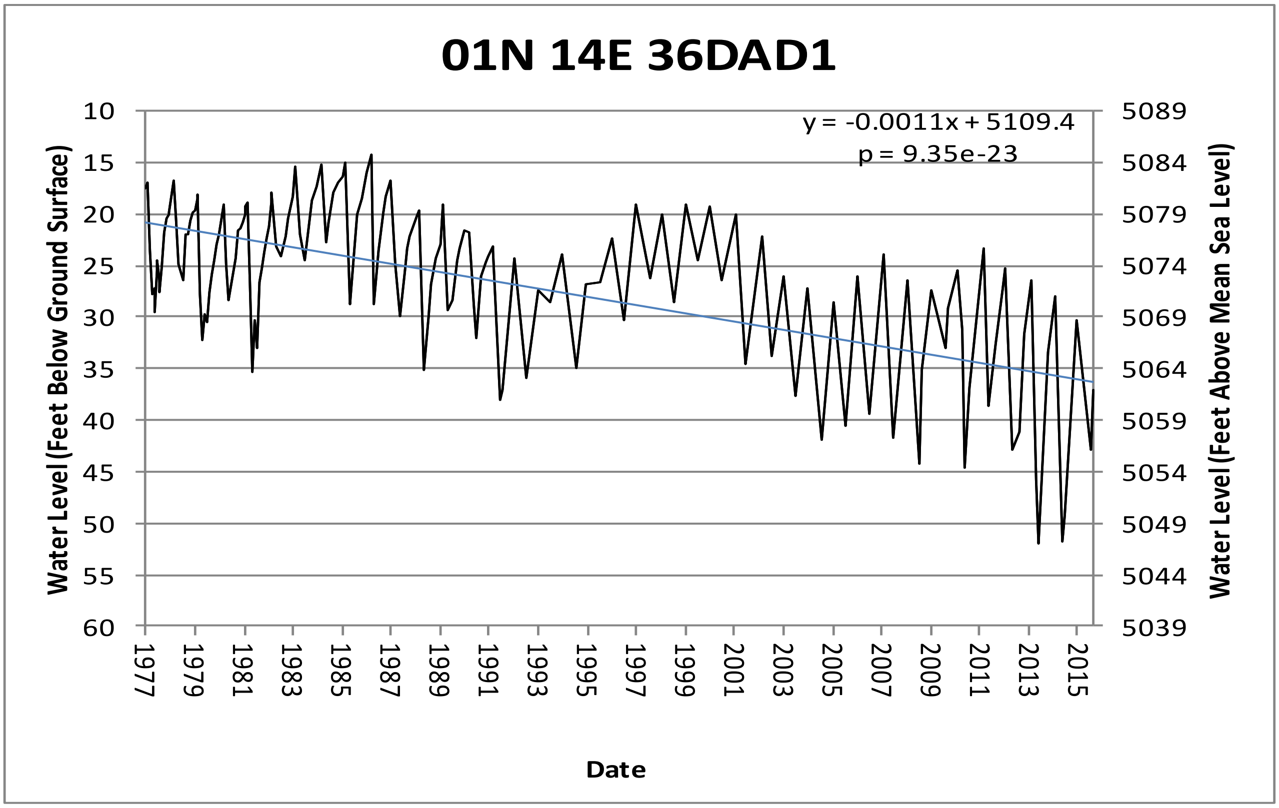
Date


01N 14E 36DAD1
y = -0.0011x + 5109.4
p = 9.35e-23
Water Level (Feet Below Ground Surface)
Water Level (Feet Above Mean Sea Level)
10
15
20
25
30
35
40
45
50
55
60
5089
5084
5079
5074
5069
5064
5059
5054
5049
5044
5039
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
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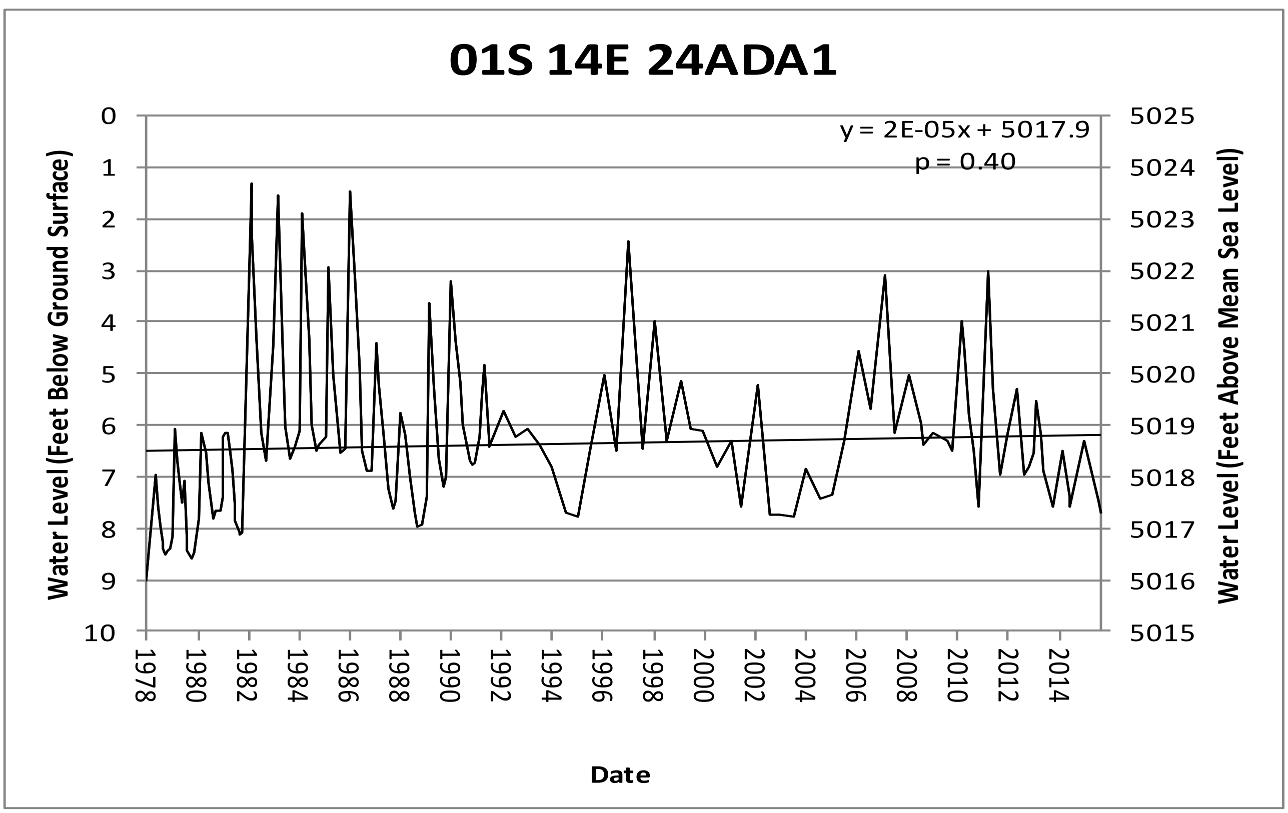
1999
2001
2003
2005
2007
2009
2011
2013
2015
Date


01S 14E 24ADA1
y = 2E-05x + 5017.9
p = 0.40
Water Level (Feet Below Ground Surface)
Water Level (Feet Above Mean Sea Level)
0
1
2
3
4
5
6
7
8
9
10
5025
5024
5023
5022
5021
5020
5019
5018
5017
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1978
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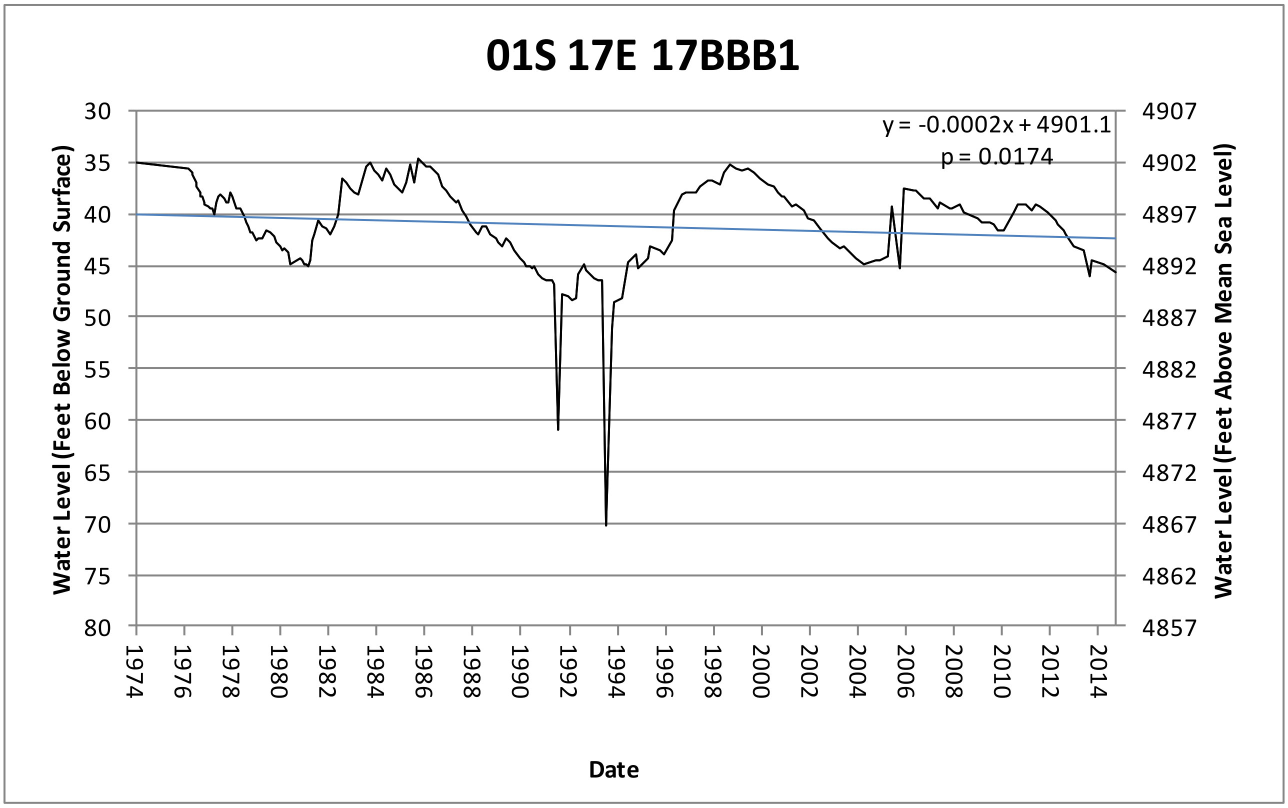
01S 17E 17BBB1
y = -0.0002x + 4901.1
p = 0.0174
Water Level (Feet Below Ground Surface)
Water Level (Feet Above Mean Sea Level)
30
35
40
45
50
55
60
65
70
75
80
4907
4902
4897
4892
4887
4882
4877
4872
4867
4862
4857
1974
1976
1978
1980
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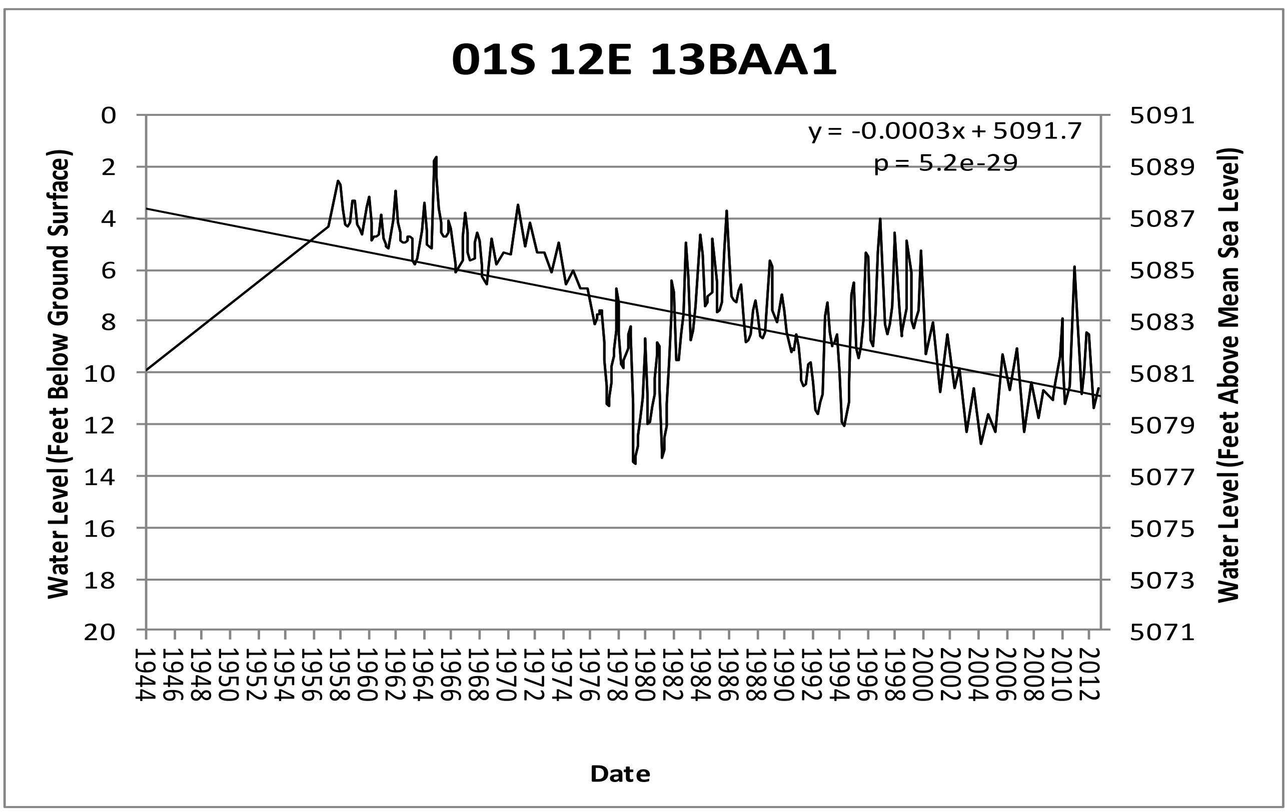
Date


01S 12E 13BAA1
y = -0.0003x + 5091.7
p = 5.2e-29
Water Level (Feet Below Ground Surface)
Water Level (Feet Above Mean Sea Level)
0
2
4
6
8
10
12
14
16
18
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5091
5089
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1944
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