Basin Management Objective
Butte County
Sub-Inventory Unit – BUTTE SINK

Butte County Water Advisory Committee Member – Gary Kerhoulas

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Description of the Butte Sink Sub-inventory Unit –
The Butte Sink Sub-inventory Unit (SIU) covers an area of about 10,300 acres, bordered by the Biggs/West Gridley SIU to the north and east, Sutter County to the south, and Butte Creek (the Colusa County boundary) to the west. Much of the Butte Sink area consists of waterfowl refuges and privately managed wetlands habitats. These habitats are primarily composed of native riparian vegetation and support aquatic, terrestrial and avian threatened and/or endangered species along with a diverse component of wetland dependent and associated species. A smaller portion of the SIU supports agricultural production of rice and grain crops. Waterfowl refuges, wetlands and agricultural land use in this area are supported by the application of a combination of surface and groundwater. The Butte Sink SIU is the lowest point of elevation in Butte County and thus receives a tremendous amount of storm runoff. The reduced rate of surface elevation drop in the Butte Sink especially south the Gridley-Colusa highway (collectively known as the lower Butte Sink) allows for prolonged periods of flooding. There is significant opportunity for ground water recharge during the fall application of surface in the wetlands habitats and when weather events cause flooding. The southwestern most portion of the Butte Sink SIU has surface water rights and therefore uses little groundwater. Most of the groundwater pumping occurring within the Butte Sink SIU occurs at the Gray Lodge Wildlife Refuge, and outside of the Butte Sink SIU to the south in Sutter County. This surrounding groundwater pumping likely affects the groundwater levels monitored within the Butte Sink SIU. Land in the Butte Sink SIU receives extensive rice runoff and surface water from Biggs/West Gridley Water District, Richvale Irrigation District and Western Canal Water District. If surface water drainage or deliveries were cut to the Butte Sink SIU area, groundwater use would increase significantly.

Management Objective –
To maintain the groundwater surface elevation in all aquifer systems at a level that will assure the continued sustainability and health of the Butte Sink wetlands. It is also the intent of this management objective to assure a sustainable agricultural and wildlife management water supply of good quality for now and

into the future, and to assure the water supply can be utilized without injuring groundwater quality or inducing inelastic land subsidence. The management objective also strives to assure an adequate supply of good quality groundwater for all users in the sub-inventory unit.

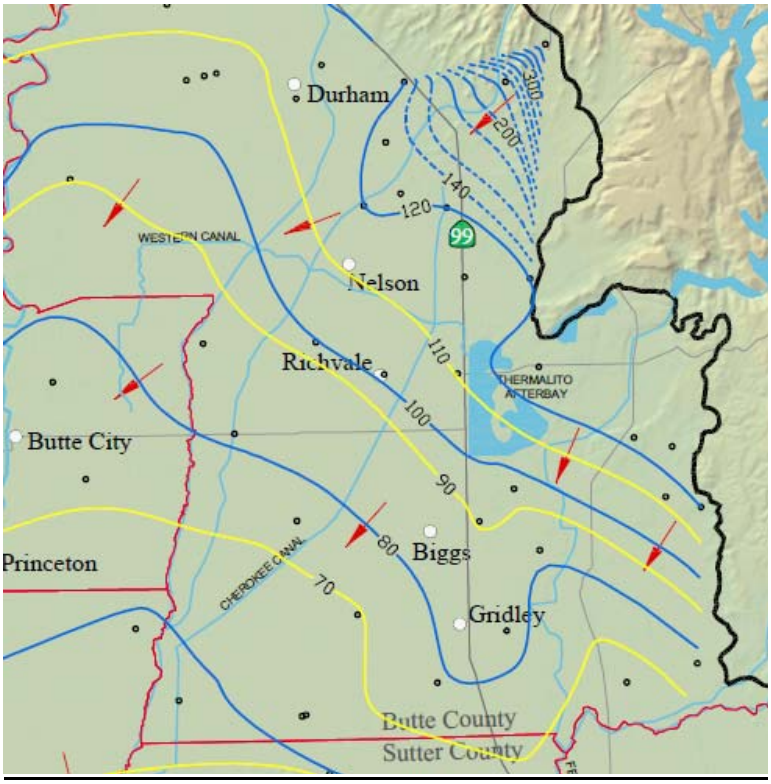
Geologic Formations Identified In Sub-Inventory Unit –
Geologic formations in the Butte Sink SIU, from youngest (shallowest) to oldest (deepest), include:

Quaternary Alluvium
Basin Deposits
Modesto Formation
Riverbank Formation

Fresh Water-bearing Units. In the Sacramento Valley Region of Butte County, fresh groundwater-bearing units include, from youngest (shallowest) to oldest (deepest), the Modesto, Riverbank, Laguna, Tehama and Tuscan Formations. Those included in the Butte Sink SIU are:

Modesto Formation
Riverbank Formation
Tuscan Formation
Sutter Formation

Groundwater Flow in the Butte Sink Sub-Inventory Unit –
The below figure is a cropped segment of a map prepared by DWR Northern District. It shows the groundwater elevation contours in your sub-inventory unit with arrows indicating the direction of groundwater movement. This graphic indicates that the regional pattern of spring groundwater movement in the Butte Sink SIU is in a southwesterly direction, at a gradient of about 3 feet per mile, toward Butte Creek.



Arrows show the direction of groundwater movement.

2009 Groundwater contours were constructed using groundwater level measurements taken by the Department of Water Resources and Local Cooperators between March 1st and March 20th, 2009. Groundwater contours are based on groundwater level measurements taken from wells constructed within the middle portion of the aquifer system (100 to 400 feet deep). This portion of the aquifer supplies approximately 70% of all domestic, agricultural and municipal wells. Blue contour lines represent 20 foot intervals and yellow contour lines represent 10 foot intervals. Full size contour maps are included in the annual Groundwater Status Report posted on the Department of Water and Resource Conservation website.

BMO Key Wells Selected for Groundwater Level Monitoring –

A new multi-completion dedicated monitoring well was installed by DWR Northern District within the Grey Lodge Wildlife Refuge, SWN 17N01E24A02-5. Groundwater elevation data will be presented in this BMO once enough years of data have been collected for analyzation.

SPRING

Well ID	Well Type	Aquifer	Spring Stage 1 & 2 Alerts**		Stage 3 Alerts**	
			Elev. (ft)	Depth (ft)	Elev. (ft)	Depth (ft)
17N01E17F001M	Monitoring	Riverbank	54.1	7.9	51.3	10.7
17N01E17F002M	Monitoring	Sutter Formation	56.9	5.9	54.9	7.9
17N01E17F003M	Monitoring	Sutter Formation	57.5	5.0	55.0	7.5
17N01E24A002M	Monitoring	Sutter & Tuscan				
17N01E24A003M	Monitoring	Sutter Formation				
17N01E24A004M	Monitoring	Sutter Buttes Rampart				
17N01E24A005M	Monitoring	Sutter Buttes Rampart				
17N02E19J001M	Irrigation	Sutter Formation	63.7	7.0	60.5	10.2

FALL

Well ID	Well Type	Aquifer	Fall Stage 1 & 2 Alerts**		Fall Stage 3 Alerts**	
			Elev. (ft)	Depth (ft)	Elev. (ft)	Depth (ft)
17N01E17F001M	Monitoring	Riverbank	50.9	11.1	47.5	14.5
17N01E17F002M	Monitoring	Sutter Formation	51.1	11.7	47.4	15.4
17N01E17F003M	Monitoring	Sutter Formation	51.0	11.5	47.0	15.5
17N01E24A002M	Monitoring	Sutter & Tuscan				
17N01E24A003M	Monitoring	Sutter Formation				
17N01E24A004M	Monitoring	Sutter Buttes Rampart				
17N01E24A005M	Monitoring	Sutter Buttes Rampart				
17N02E19J001M	Irrigation	Sutter Formation	60.5	10.2	53.4	17.3

The multi-completion monitoring well (SWN 17N01E24A02-5) was installed at the Gray Lodge Wildlife Refuge in 2007. Groundwater elevation data will be presented in this BMO once enough years of data have been collected for analyzation.

BMO Key Wells Selected for Groundwater Quality Monitoring–
Stakeholders in the Butte Sink SIU will continue to work with staff to locate additional wells, either irrigation or domestic with sufficient historical construction information, suitable to include in the water quality monitoring network, and initiate data collection in August 2009.

BMO Key Well(s) Selected for Land Subsidence Monitoring–
Land Subsidence is continuously monitored by the Department of Water Resources and Butte County Department of Water and Resource Conservation. The closest extensometer to the sub-inventory unit is in Biggs West-Gridley Water District (18N01E35L001M).

Butte County staff participated in the Sacramento Valley Height Modernization Project during March 2008 as a means to enhance the subsidence monitoring program in the county and the region. This cooperative project between the Department of Water Resources (DWR), the Bureau of Reclamation and local County agencies helped to establish baseline ground elevations in Butte County

and other portions of the valley. Land elevations were measured using Global Positioning System (GPS) survey equipment and survey monuments located on an approximate three to five mile grid. Re-observations are to be done in approximately three years, and will give measurements to compare against the baseline data in order to determine whether or not any subsidence has occurred.

BMO Alert Stage Definitions and Compliance Methodologies–
The Butte Sink Sub Area will use the following guidelines in the management of the groundwater resources. The groundwater level and land subsidence management objectives are intended to initiate predetermined voluntary Ground Water Management Actions, as defined in the accompanying cover report, to remedy declining ground water levels that are not recovering to compliance levels for each index well, or prevent further inelastic land subsidence. Stakeholders in the Butte SIU will work with staff to locate additional wells, either irrigation or domestic, with sufficient historical construction information to include in the water quality monitoring network, and possibly initiate data collection in August 2009.

Groundwater Level –
For the Butte Sink SIU the groundwater level objectives were chosen to support both groundwater levels that support wetland habitat and available groundwater in storage in the deeper aquifer systems. The spring groundwater level measurement is intended to reflect the change in groundwater in storage in the deeper aquifers and the fall measurements are intended to support the wetlands habitat.

The Butte Basin Groundwater model uses the historical hydrology (e.g. precipitation pattern, stream inflows) from October 1970 through October 1999 in the base case simulation. Using historical hydrology allows for the assessment of water resources conditions based on a known range of hydrology, from wet to critical. Each hydrograph for the BMO process shows the static groundwater elevation measurements from the time period of 1970 to 2006, or as many recent years of data available for each selected key wells. The measurements taken during this 36 year window reflect periods of drought and recovery, as well as wet years. These methodologies will apply for both Spring and Fall analysis.

A. For wells that have a period of record dating back to at least 1970, the subcommittee suggests that the range of measurements from the first year through 2006 be used in calculating Alert Stages 1 and 2 and the Historic Low will be used as the Alert Stage 3. Once the range is defined for each well, 20% of that range will be calculated and added to the Historic Low to establish Alert Stages 1 and 2. The measurements plotted after 2006 are for reference purposes only, and are not included in the calculation of the range.

B. In the instances where the period of record does not date back to 1970, the Historic Low before 2006 will be used for Alert Stages 1 and 2, and the Historical Low minus the range of measurements shall be used for Alert Stage 3. The measurements plotted after 2006 are for reference purposes only, and are not included in the calculation of the range.

Groundwater Quality –
Stakeholders in the Butte SIU will work with staff to locate additional wells, either irrigation or domestic, with sufficient historical construction information to include in the water quality monitoring network, and possibly initiate data collection in August 2009.

Land Subsidence –
Stage 1 is reached when the annual elastic subsidence exceeds the average annual elastic subsidence measured over the period of record of the extensometer.

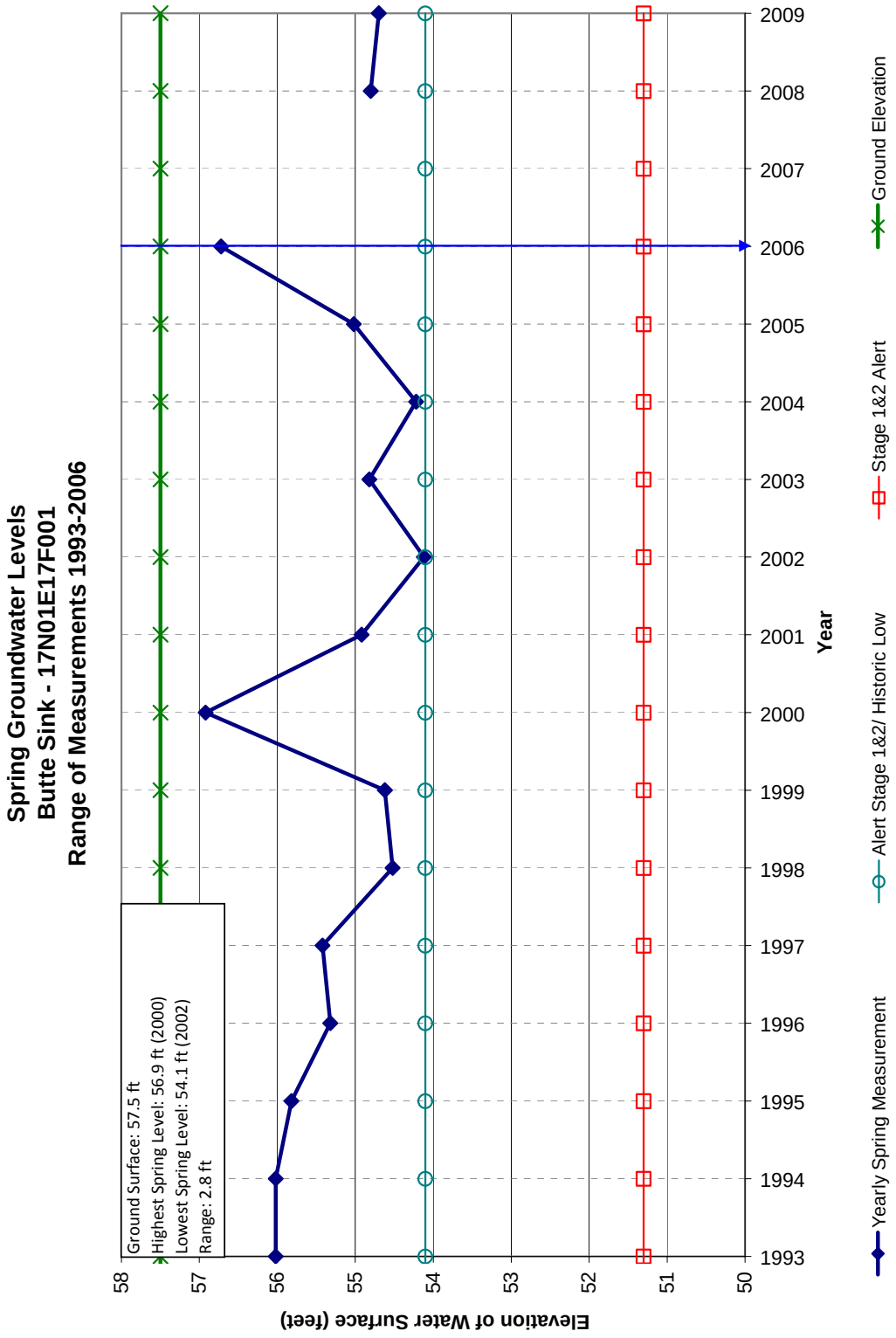
Stage 2 is reached when the annual elastic subsidence exceeds the maximum recorded elastic subsidence over the period of record for the extensometer.

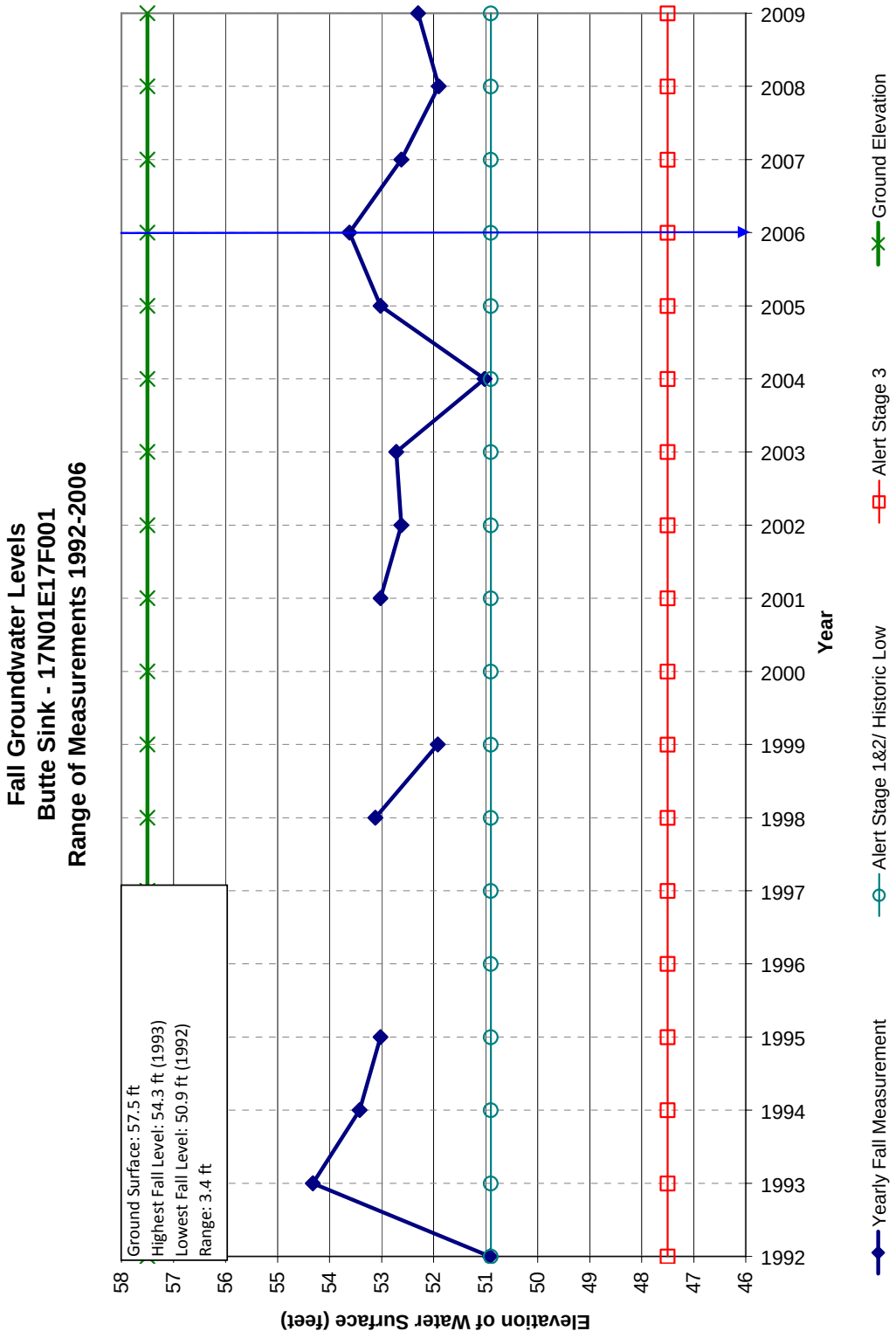
Stage 3 is when inelastic subsidence is detected. Inelastic subsidence shall be detected by comparing reading from the extensometer taken on March 1 of each year against previous March 1 measurements.

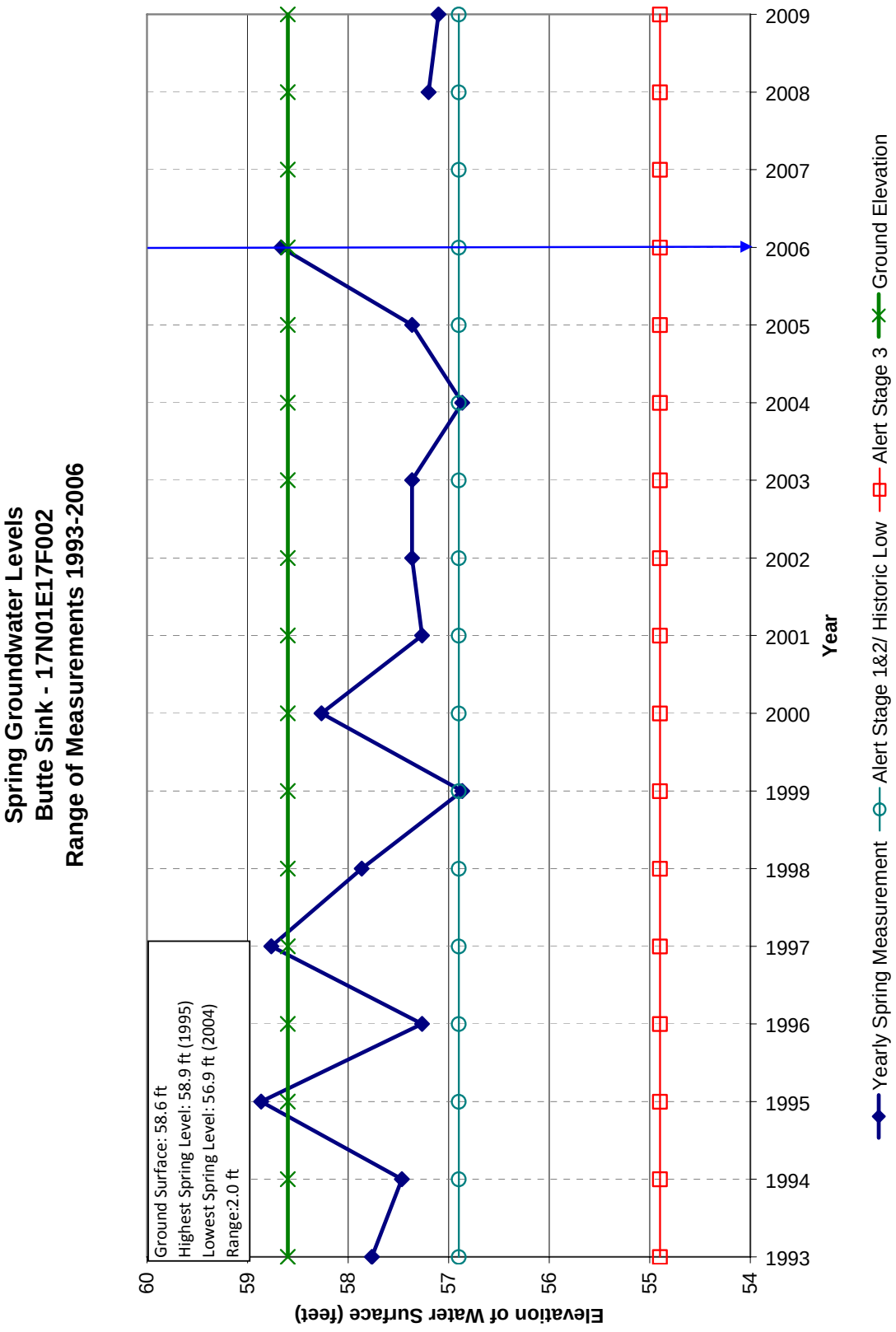
Future Monitoring Recommendations –
Efforts will be made to identify additional wells that could be added to the existing monitoring well network for water quality trend monitoring. Locate additional wells, either irrigation or domestic, with sufficient historical construction information to include in the water quality monitoring network, and initiate data collection in August 2009.

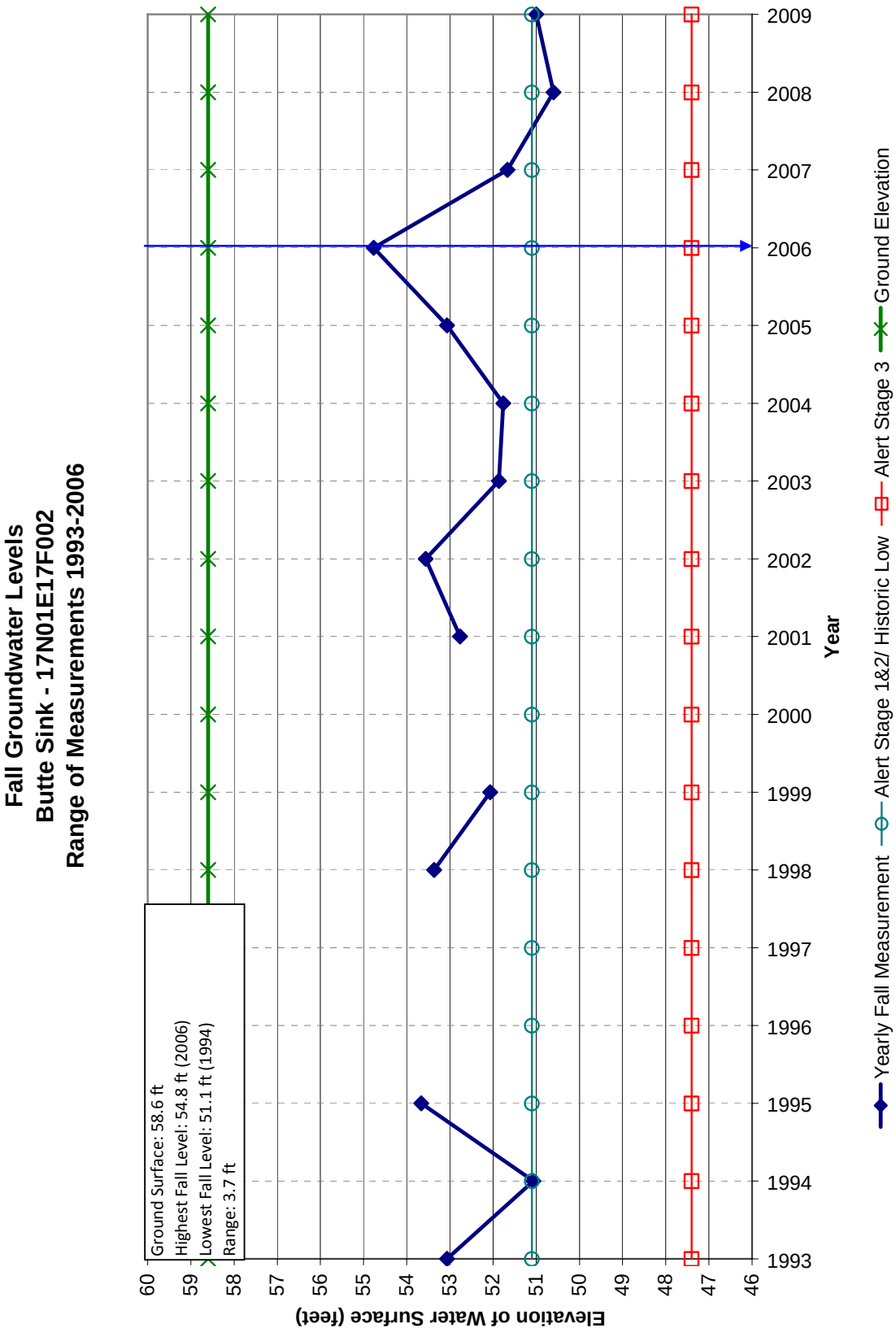
Supporting Data –
Hydrographs depicting yearly spring level measurements, including 2009 data, with established alert levels for calendar year 2010.

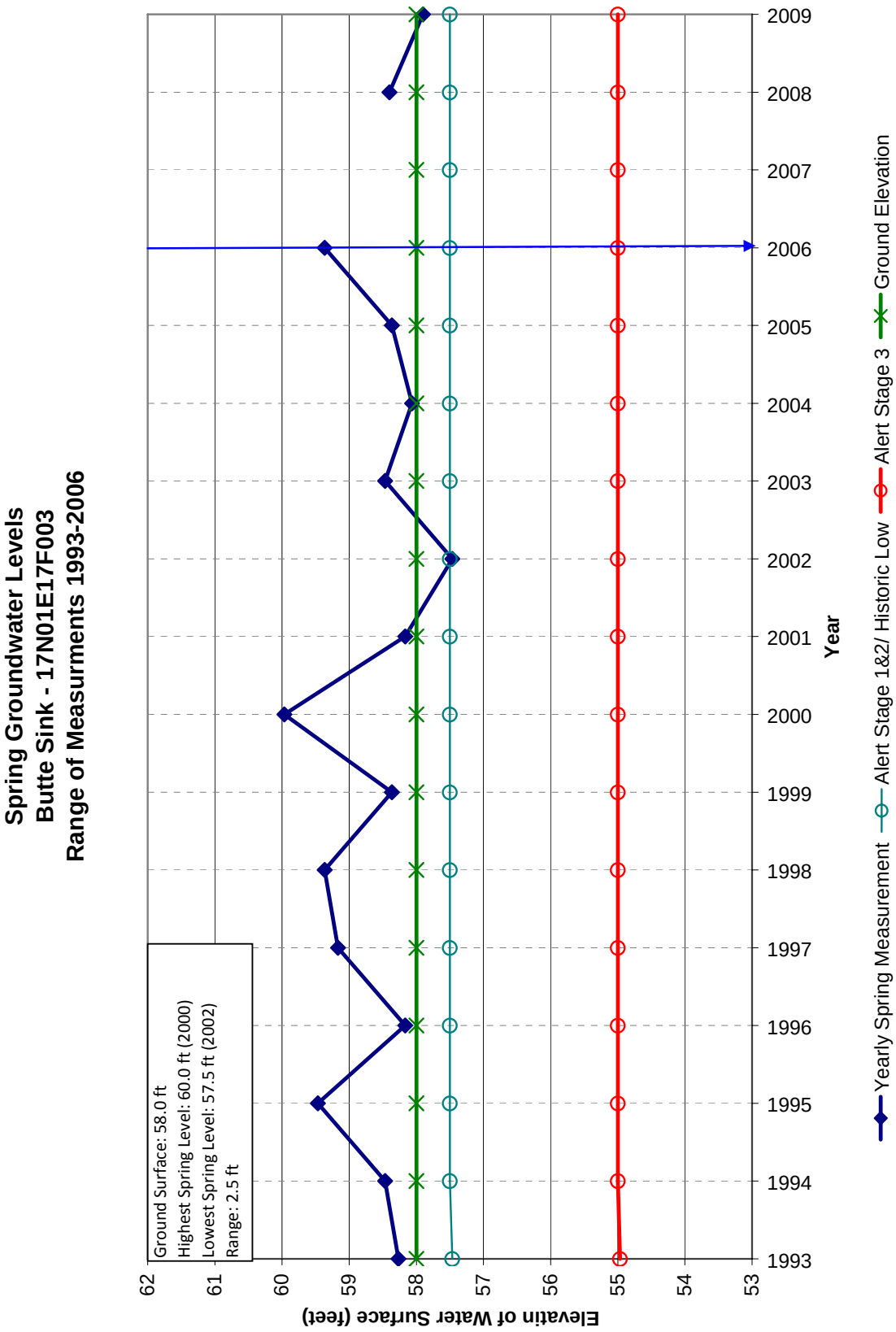
As-built diagram for the SWN 17N01E24A02-5 multi-completion dedicated monitoring well installed by DWR Northern District within the Grey Lodge Wildlife Refuge.

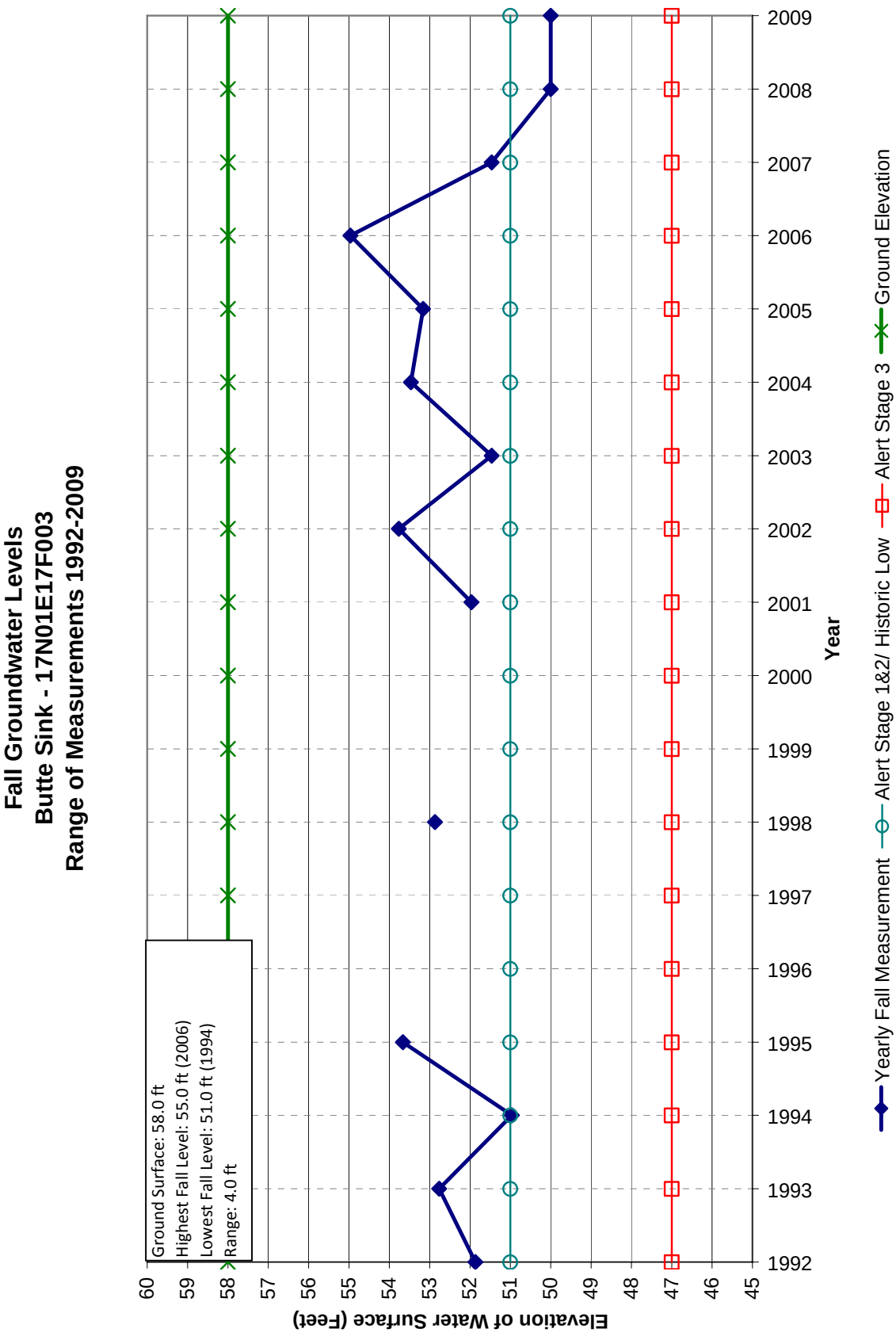

Spring Groundwater Levels
Butte Sink - 17N01E17F001
Range of Measurements 1993-2006
Ground Surface: 57.5 ft
Highest Spring Level: 56.9 ft (2000)
Lowest Spring Level: 54.1 ft (2002)
Range: 2.8 ft
Elevation of Water Surface (feet)
58
57
56
55
54
53
52
51
50
Year
2009
2008
2007
2006
2005
2004
2003
2002
2001
2000
1999
1998
1997
1996
1995
1994
1993
Yearly Spring Measurement
Alert Stage 1&2/ Historic Low
Stage 1&2 Alert
Ground Elevation

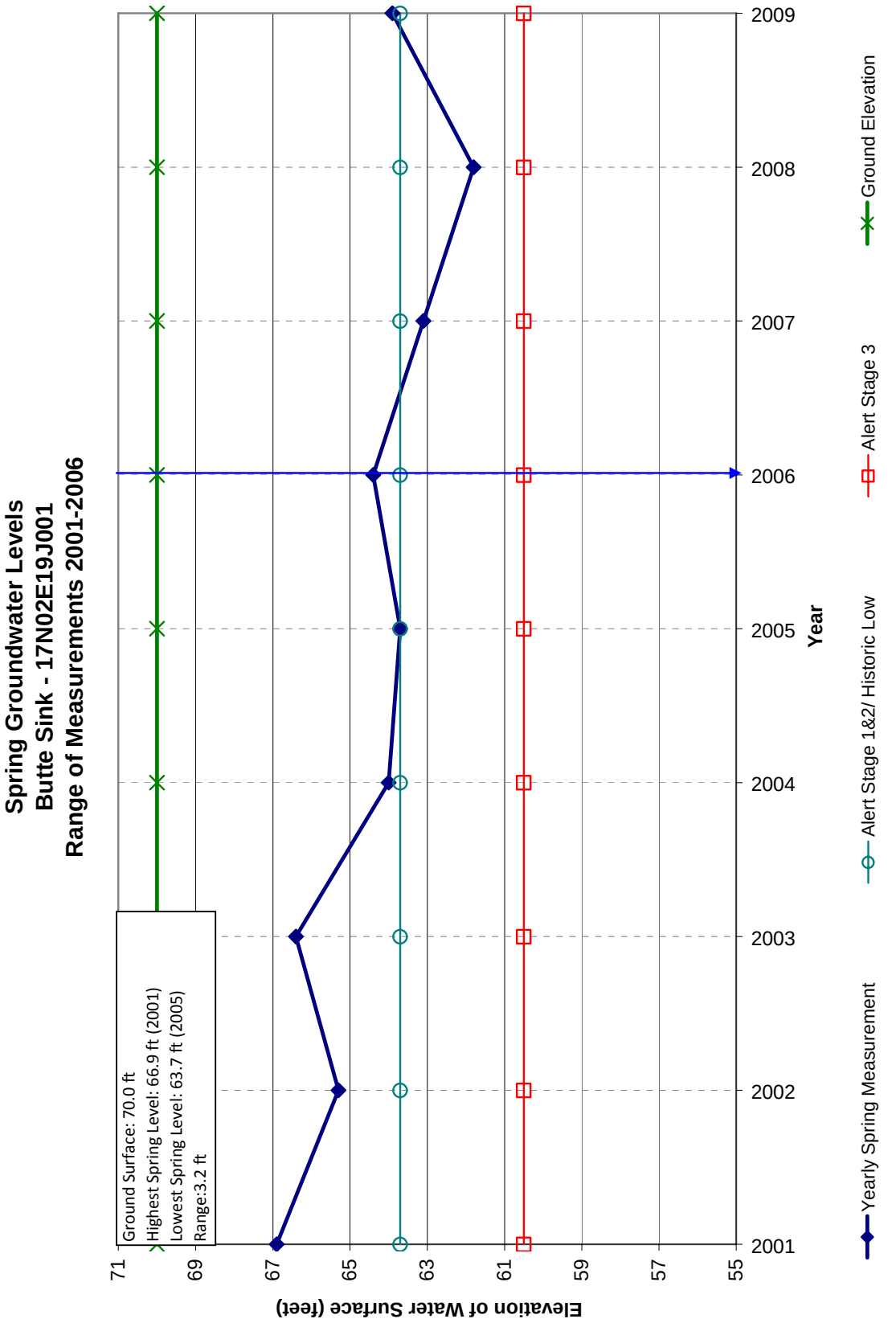

Fall Groundwater Levels
Butte Sink - 17N01E17F001
Range of Measurements 1992-2006
Ground Surface: 57.5 ft
Highest Fall Level: 54.3 ft (1993)
Lowest Fall Level: 50.9 ft (1992)
Range: 3.4 ft
Elevation of Water Surface (feet)
58
57
56
55
54
53
52
51
50
49
48
47
46
Year
2009
2008
2007
2006
2005
2004
2003
2002
2001
2000
1999
1998
1997
1996
1995
1994
1993
1992
Yearly Fall Measurement
Alert Stage 1&2/ Historic Low
Alert Stage 3
Ground Elevation

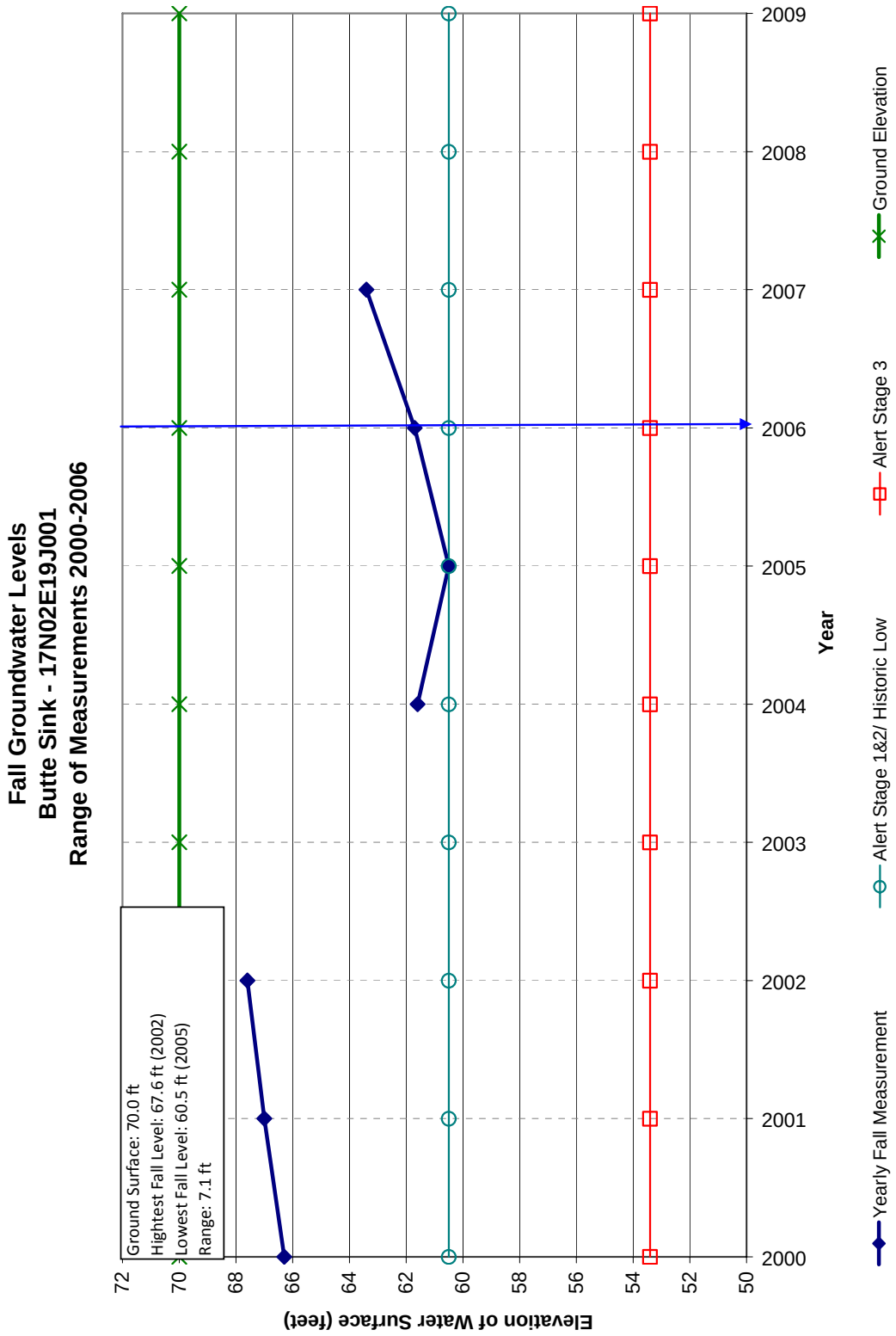

Spring Groundwater Levels
Butte Sink - 17N01E17F002
Range of Measurements 1993-2006
Ground Surface: 58.6 ft
Highest Spring Level: 58.9 ft (1995)
Lowest Spring Level: 56.9 ft (2004)
Range:2.0 ft
Elevation of Water Surface (feet)
60
59
58
57
56
55
54
Year
2009
2008
2007
2006
2005
2004
2003
2002
2001
2000
1999
1998
1997
1996
1995
1994
1993
Yearly Spring Measurement
Alert Stage 1&2/ Historic Low
Alert Stage 3
Ground Elevation

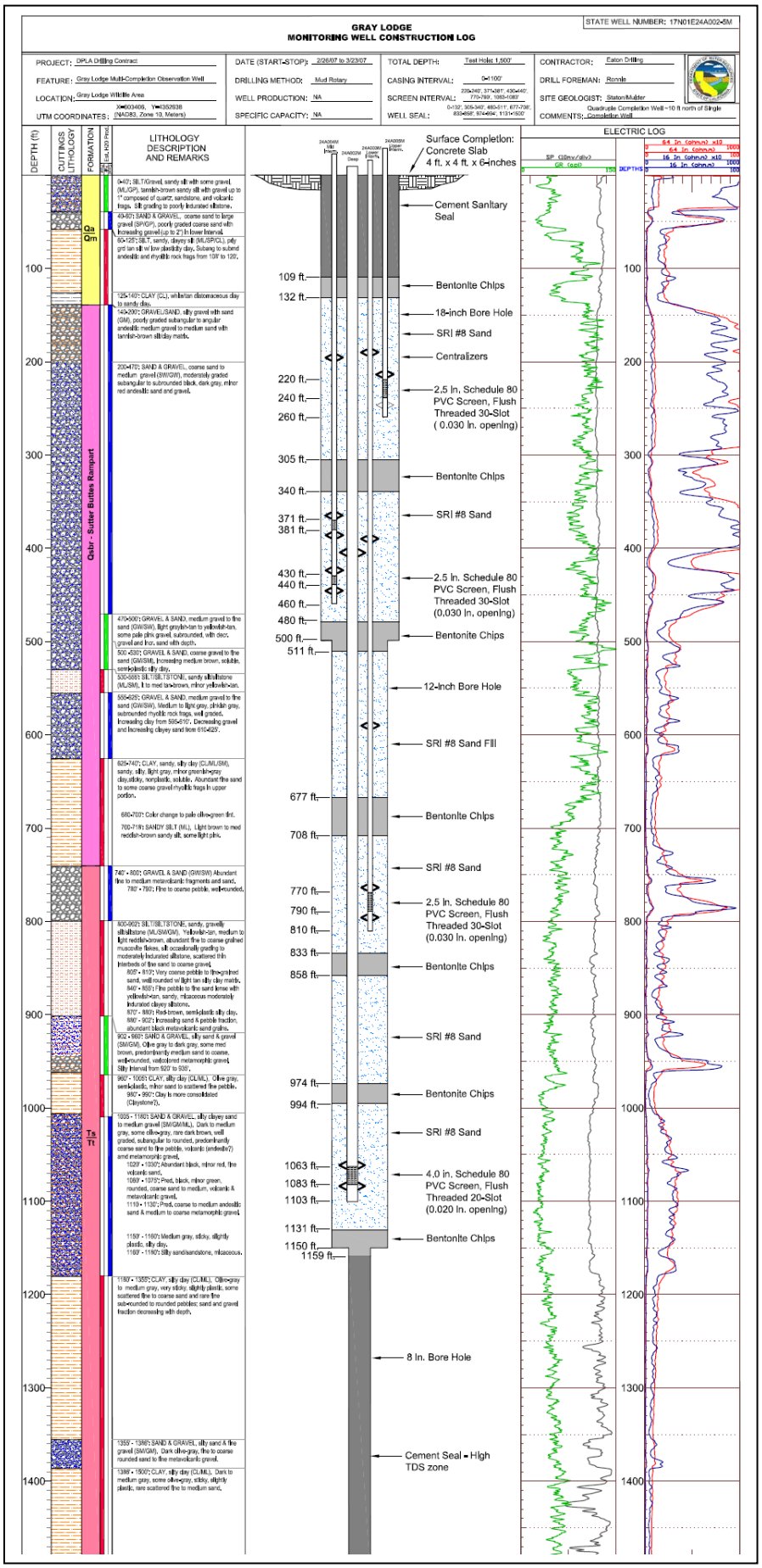

Fall Groundwater Levels
Butte Sink - 17N01E17F002
Range of Measurements 1993-2006
Ground Surface: 58.6 ft
Highest Fall Level: 54.8 ft (2006)
Lowest Fall Level: 51.1 ft (1994)
Range: 3.7 ft
Elevation of Water Surface (feet)
60
59
58
57
56
55
54
53
52
51
50
49
48
47
46
Year
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
Yearly Fall Measurement
Alert Stage 1&2/ Historic Low
Alert Stage 3
Ground Elevation


Spring Groundwater Levels
Butte Sink - 17N01E17F003
Range of Measurments 1993-2006
Ground Surface: 58.0 ft
Highest Spring Level: 60.0 ft (2000)
Lowest Spring Level: 57.5 ft (2002)
Range: 2.5 ft
Elevatin of Water Surface (feet)
62
61
60
59
58
57
56
55
54
53
Year
2009
2008
2007
2006
2005
2004
2003
2002
2001
2000
1999
1998
1997
1996
1995
1994
1993
Yearly Spring Measurement
Alert Stage 1&2/ Historic Low
Alert Stage 3
Ground Elevation


Fall Groundwater Levels
Butte Sink - 17N01E17F003
Range of Measurements 1992-2009
Ground Surface: 58.0 ft
Highest Fall Level: 55.0 ft (2006)
Lowest Fall Level: 51.0 ft (1994)
Range: 4.0 ft
Elevation of Water Surface (Feet)
60
59
58
57
56
55
54
53
52
51
50
49
48
47
46
45
Year
2009
2008
2007
2006
2005
2004
2003
2002
2001
2000
1999
1998
1997
1996
1995
1994
1993
1992
Yearly Fall Measurement
Alert Stage 1&2/ Historic Low
Alert Stage 3
Ground Elevation


Spring Groundwater Levels
Butte Sink - 17N02E19J001
Range of Measurements 2001-2006
Ground Surface: 70.0 ft
Highest Spring Level: 66.9 ft (2001)
Lowest Spring Level: 63.7 ft (2005)
Range:3.2 ft
Elevation of Water Surface (feet)
71
69
67
65
63
61
59
57
55
Year
2001
2002
2003
2004
2005
2006
2007
2008
2009
Yearly Spring Measurement
Alert Stage 1&2/ Historic Low
Alert Stage 3
Ground Elevation


Fall Groundwater Levels
Butte Sink - 17N02E19J001
Range of Measurements 2000-2006
Ground Surface: 70.0 ft
Hightest Fall Level: 67.6 ft (2002)
Lowest Fall Level: 60.5 ft (2005)
Range: 7.1 ft
Elevation of Water Surface (feet)
72
70
68
66
64
62
60
58
56
54
52
50
Year
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
Yearly Fall Measurement
Alert Stage 1&2/ Historic Low
Alert Stage 3
Ground Elevation



As-built diagram of Gray Lodge multi-completion monitoring well.