Basin Management Objective
Butte County
Inventory Unit – VINA

Butte County Water Advisory Committee Member – J. Knight

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Description of the Vina Sub-Inventory Unit –
The Vina Inventory Unit (IU) covers about 75,000 acres in the northern Sacramento Valley Region of Butte County. It is bordered by Tehama County to the north, Big Chico Creek to the south, the Sacramento River to the west, and the foothills to the east. In a normal water year, about 50% of the Vina IU is in summer agricultural production supported by groundwater. Another 10% of the inventory unit is within the Chico Urban Area, which uses groundwater for its municipal supply. A separate sub-inventory unit was developed for the Chico Urban Area.

Management Objective –
Our objective is to maintain the groundwater surface elevation during the peak summer irrigation season (July and August) in all aquifer systems at a level that will assure an adequate and affordable irrigation groundwater supply. It is the intent of this management objective to assure a sustainable agricultural supply of good quality water now and into the future, and to assure the water supply can be utilized without injuring groundwater quality or inducing land subsidence. The management objective is also to assure a groundwater supply of adequate quality and quantity from all aquifer systems for domestic users in inventory unit.

The Vina IU stakeholders are concerned with following issues specific to the Vina area:

1) Lack of collection area for precipitation: The North Butte/South Tehama area is influenced by the Sierra/Cascade Ridge which is close to the valley and is rarely breached. Much of N.E. California drains north to the Pit River or south to the North Fork of the Feather. Lake Almanor feeds the Feather River, not Deer Creek.

2) Lack of water available for recharge: Cohasset Ridge further exacerbates this situation in that Chico Creek and Butte Creek are diverted south. Creeks in Vina head below 4000 feet and have small catchments with little or no snow pack. Only Deer Creek and Big Chico Creek flow year round.

3) Surface water substitution is not an easy option: The seasonal nature of the streams flowing across the Vina Inventory Unit means that there is no obvious source for surface water.

4) Northern Butte County is subject to massive development pressure. When un-irrigated land is developed to housing or irrigated crops, consumption levels most likely will be increased. The eastern edges of the aquifer would suffer the most impacts from depressurization of the aquifer from unsustainable pumping.

The Vina IU stakeholders are working with Butte County staff to stay connected to the Tehama County BMO process. While their technical documents are still only in Draft format, the monitoring wells have been determined, and the Draft Management Objectives for their Vina sub-unit at this point include:

- Maintain groundwater at an elevation that promotes the continued economical use of groundwater for irrigation, domestic, and municipal needs.
- Protect groundwater supplies for current and future domestic and irrigation use.
- Maintain a stable trend of groundwater in storage to ensure adequate drinking water and agricultural supplies during future drought periods.
- Monitor groundwater levels to record and compare changes to aid in identifying conditions that cause declines in groundwater levels.

Geologic Formations Identified In Inventory Unit –
Geologic formations in the Vina IU from youngest (shallowest) to oldest (deepest) include:

Quaternary Alluvium
Basin Deposits
Modesto Formation
Riverbank Formation
Tuscan Unit C (Upper Tuscan)
Tuscan Unit B (Lower Tuscan)

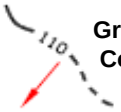
Fresh Water-bearing Units. In the Sacramento Valley Region of Butte County, fresh groundwater-bearing units include, from youngest (shallowest) to oldest (deepest), the Modesto, Riverbank, Laguna, Tehama and Tuscan Formations. Those included in the Vina IU are:

Modesto Formation
Riverbank Formation
Tuscan Unit C (Upper Tuscan)
Tuscan Unit B (Lower Tuscan)

Groundwater Flow in the Vina 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 Vina Inventory Unit is in a southwesterly direction toward the Sacramento River.

Locally, the movement of groundwater fluctuates in the municipal water service area surrounding Chico. Year-round extraction of groundwater for municipal use in the Chico area causes several small groundwater depressions that tend to alter the natural southwestward movement of groundwater in the area.

Butte County
Groundwater Elevations
Spring 1997

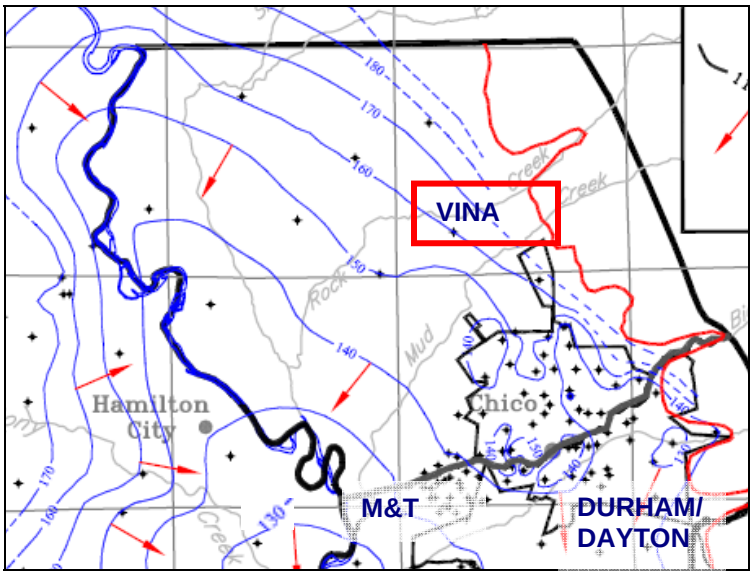


Groundwater Elevation Contour.

Dashed line indicates uncertainty.

Arrows show the direction of groundwater movement.

Well Location



1997 DWR groundwater contour map

BMO Key Wells Selected for Groundwater Level Monitoring –

SPRING

Well ID	Aquifer System	Well Type	Stage 1 & 2 Alert (Spring Avg minus 1 standard deviation) Elev. (ft)	Stage 3 Alert (Spring Avg minus 2 standard deviations) Elev. (ft)
22N01E02P01M	Lower Tuscan	Irrigation	144.91	143.79
22N01E09B01M	Upper Tuscan	Domestic	144.34	141.59
22N01E20K01M	Modesto Formation	Domestic	132.97	127.24
23N01E18A01M	Upper Tuscan	Domestic	169.44	165.41
23N01E29P02M	Upper Tuscan	Domestic	151.28	146.53
23N01E33A01M	Lower Tuscan	Irrigation	153.17	148.74
23N01W10E01M	Lower Tuscan	Irrigation	164.24	162.09
23N01W10M01M	Upper Tuscan	Monitoring	163.88	160.26
23N01W27L01M	Modesto Formation	Domestic	141.17	135.88
23N01W36P01M	Basin Deposits	Domestic	138.90	132.05
23N02W25C01M	Alluvium	Irrigation	135.71	131.94

FALL

Well ID	Aquifer System	Well Type	Stage 1 & 2 Alert (Fall Avg minus 1 standard deviation) Elev. (ft)	Stage 3 Alert (Fall Avg minus 2 standard deviations) Elev. (ft)
22N01E02P01M	Lower Tuscan	Irrigation	136.84	135.08
22N01E09B01M	Upper Tuscan	Domestic	138.25	133.42
22N01E20K01M	Modesto Formation	Domestic	124.87	119.33
23N01E18A01M	Upper Tuscan	Domestic	165.84	161.93
23N01E29P02M	Upper Tuscan	Domestic	135.54	128.13
23N01E33A01M	Lower Tuscan	Irrigation	146.30	141.90
23N01W10E01M	Lower Tuscan	Irrigation	151.34	147.96
23N01W10M01M	Upper Tuscan	Monitoring	152.82	149.25
23N01W27L01M	Modesto Formation	Domestic	132.05	128.36
23N01W36P01M	Basin Deposits	Domestic	129.09	122.54
23N02W25C01M	Alluvium	Irrigation	129.58	126.90

An additional irrigation well was added to the DWR monitoring network, SWN 23N01W25G001. 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–

Groundwater Temperature - 2002 through 2007

State Well Number	2002 Temp ^{o}C	2003 Temp ^{o}C	2004 Temp ^{o}C	2005 Temp ^{o}C	2006 Temp ^{o}C	2007 Temp ^{o}C
23N01E29LO3M	19.6	20.3	19.2	19.2	19.6	18.9

Groundwater pH - 2002 through 2007

State Well Number	2002 pH	2003 pH	2004 pH	2005 pH	2006 pH	2007 pH
23N01E29LO3M	7.5	7.6	6.9	6.2	7.7	7.5

Groundwater EC - 2002 through 2007

State Well Number	2002 EC	2003 EC	2004 EC	2005 EC	2006 EC	2007 EC
23N01E29LO3M	197	225	180	216	192	224

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 in the closest Sub-Inventory Unit at State Well number 21N01W24B01M, located within the M&T Sub-Inventory Unit.

BMO Alert Stage Definitions and Compliance Methodologies–

The Vina Sub-Inventory Unit will use the following guidelines in the management of the groundwater resources. The groundwater level and land subsidence

management objectives are intended to trigger 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. Further groundwater quality BMO management actions will be defined in 2008.

Groundwater Levels – Standard Deviation and Two Standard Deviations
Average spring level is defined as the level using all the available data for the years prior to, and including 2007.

Stage 1: The first year that spring groundwater levels falls one standard deviation below the average spring groundwater level established for that well.

Stage 2: Stage 2 is reached if spring groundwater levels, for a second consecutive year, remain one standard deviation below the average groundwater level established for the well.

Stage 3: Stage 3 is reached if the spring groundwater levels falls two standard deviations below the average spring groundwater level. Or, if at any time the water elevation falls below 80% of the average spring elevation.

Groundwater Quality –
Any change that exceeds a 20 percent change from Butte County's 2007 water quality assessment done in August of each year will be cause for review and investigation by the Technical Advisory Committee.

Land Subsidence –
Maximum annual inelastic land subsidence shall not exceed 0.01 feet per year.

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.

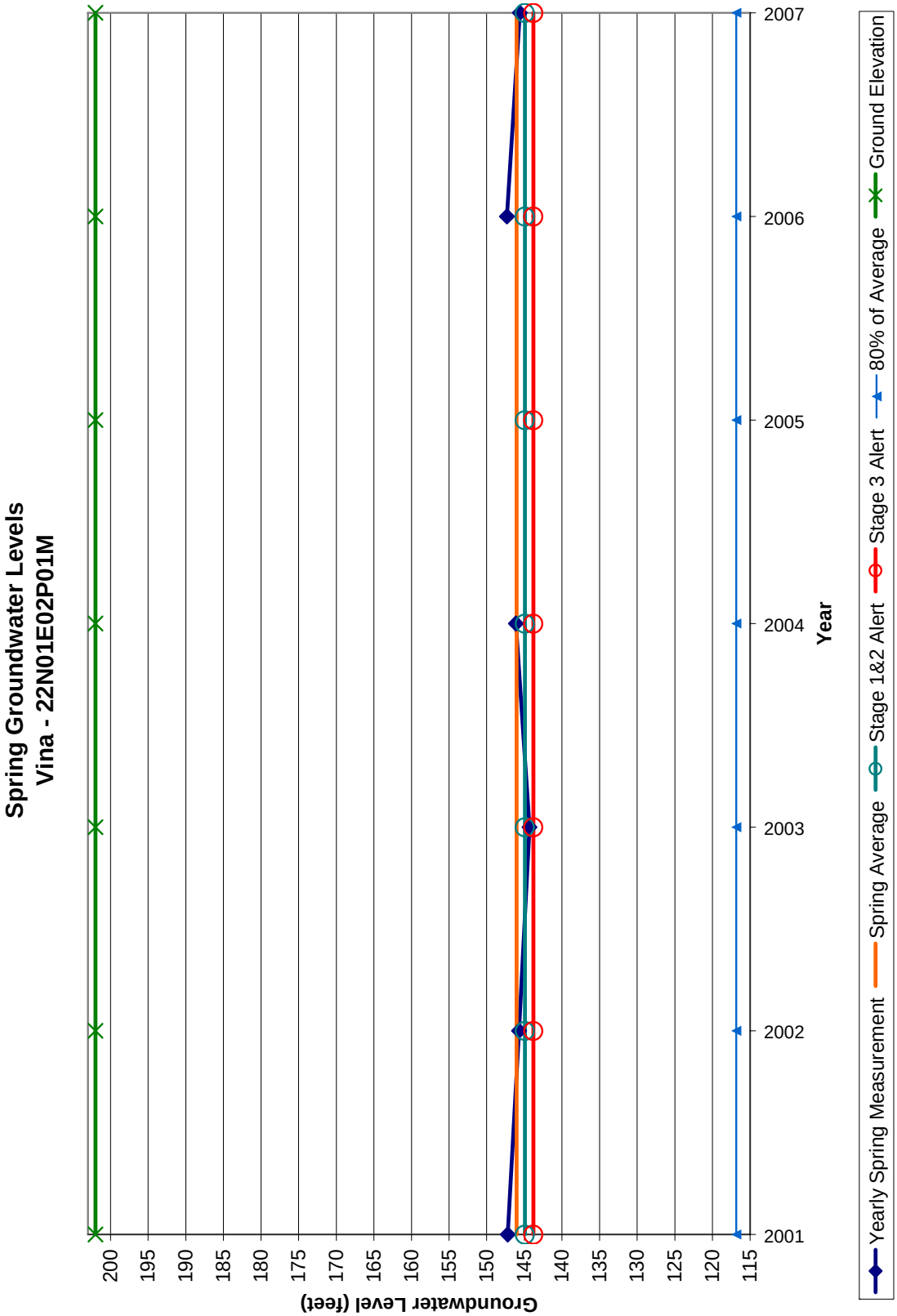
Future Monitoring Recommendations –
Efforts will be made to identify well characteristics of several domestic wells that could be added to the existing monitoring well network in the inventory unit to

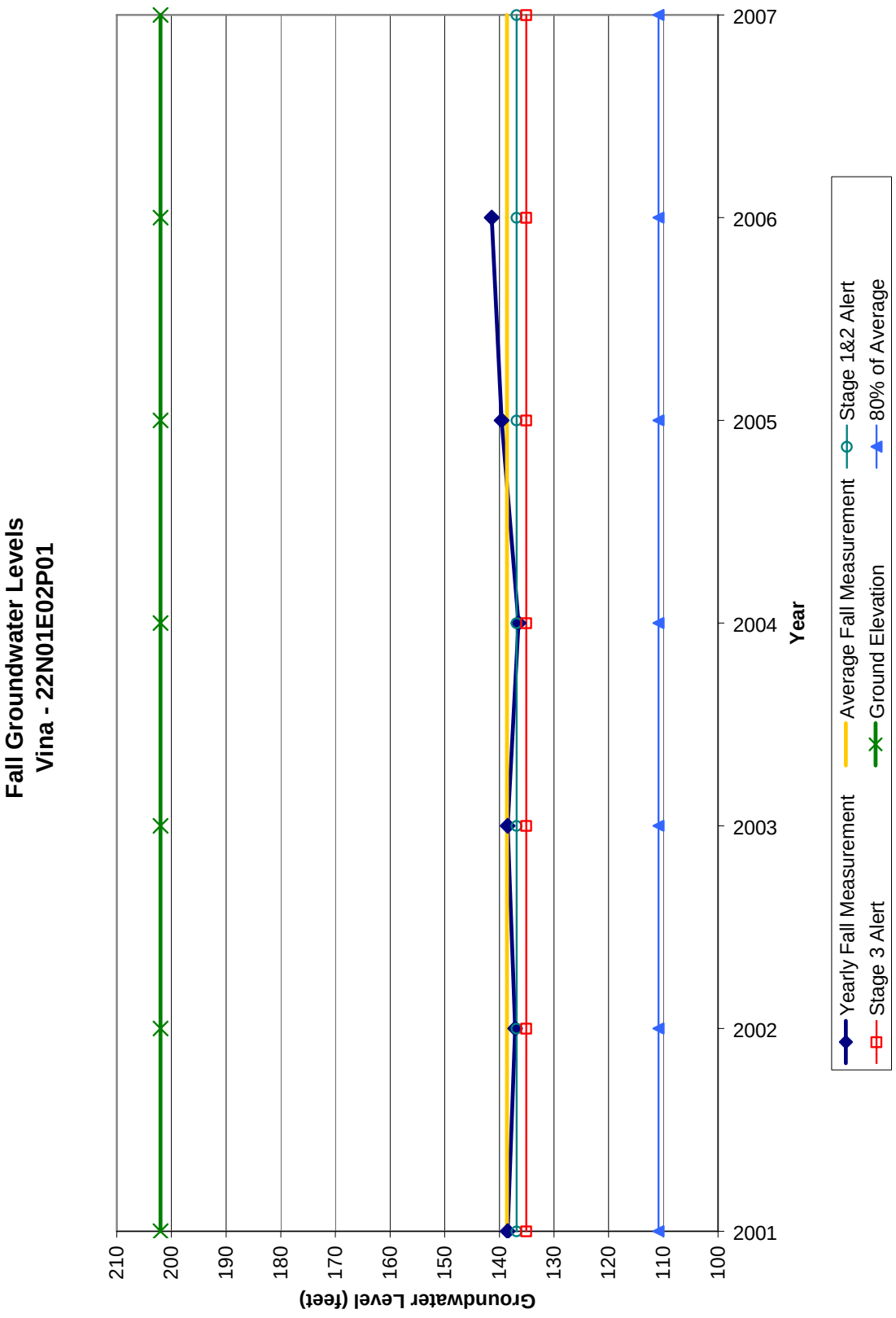
allow development of management objectives for the alluvial aquifer system. Stakeholders will work to bring additional wells with sufficient historical data into the water quality monitoring network.

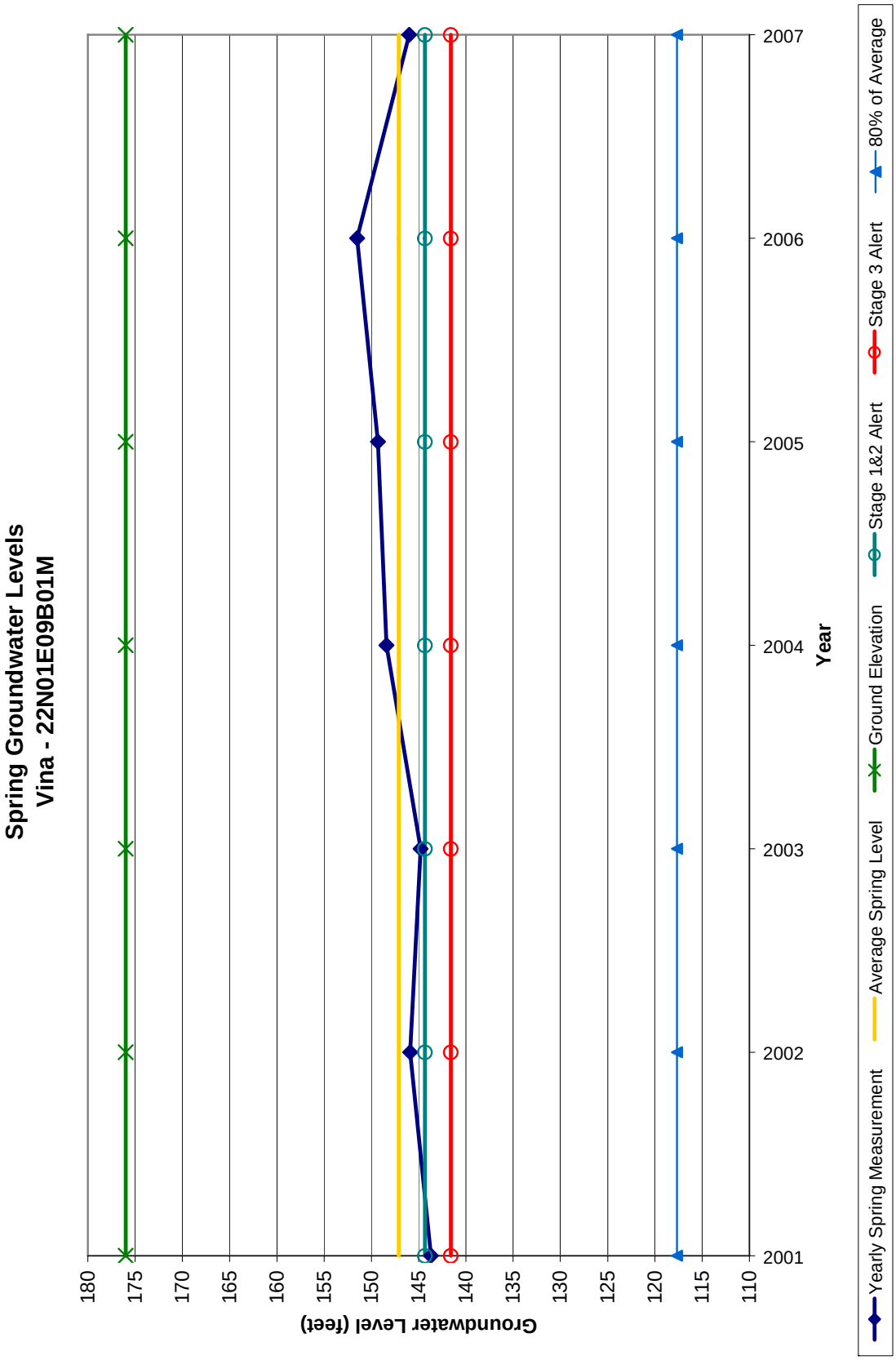
Supporting Data –
Hydrographs depicting yearly spring level measurements, including 2007 data, with established alert levels.

Summary charts of water quality monitoring.

Draft version map of Tehama County's Vina sub-basin key BMO wells.


Spring Groundwater Levels
Vina - 22N01E02P01M
Groundwater Level (feet)
200
195
190
185
180
175
170
165
160
155
150
145
140
135
130
125
120
115
Year
2007
2006
2005
2004
2003
2002
2001
Yearly Spring Measurement
Spring Average
Stage 1&2 Alert
Stage 3 Alert
80% of Average
Ground Elevation


Fall Groundwater Levels
Vina - 22N01E02P01
Groundwater Level (feet)
210
200
190
180
170
160
150
140
130
120
110
100
Year
2007
2006
2005
2004
2003
2002
2001
Yearly Fall Measurement
Average Fall Measurement
Stage 1&2 Alert
Stage 3 Alert
Ground Elevation
80% of Average


Spring Groundwater Levels
Vina - 22N01E09B01M
Groundwater Level (feet)
180
175
170
165
160
155
150
145
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135
130
125
120
115
110
Year
2007
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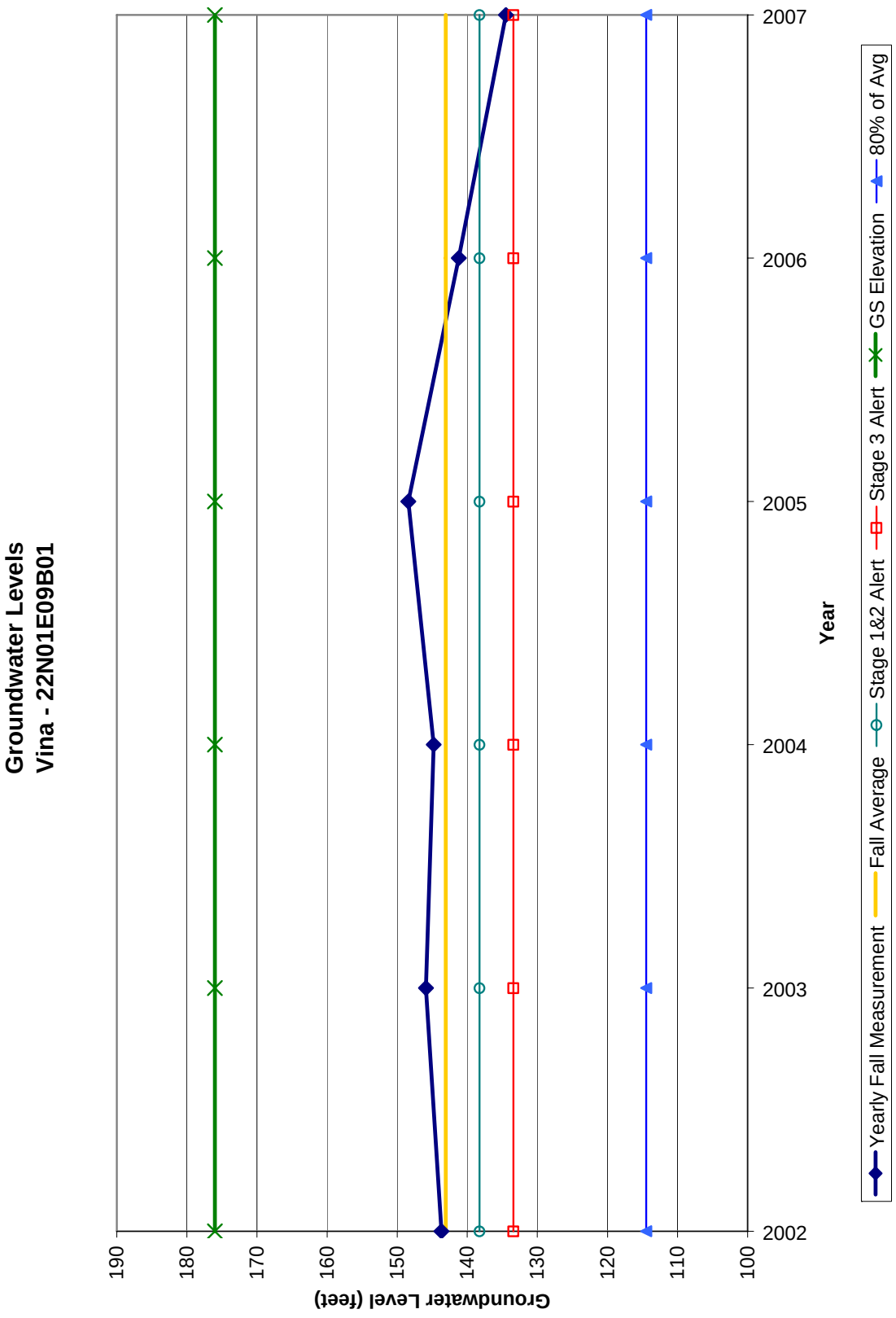
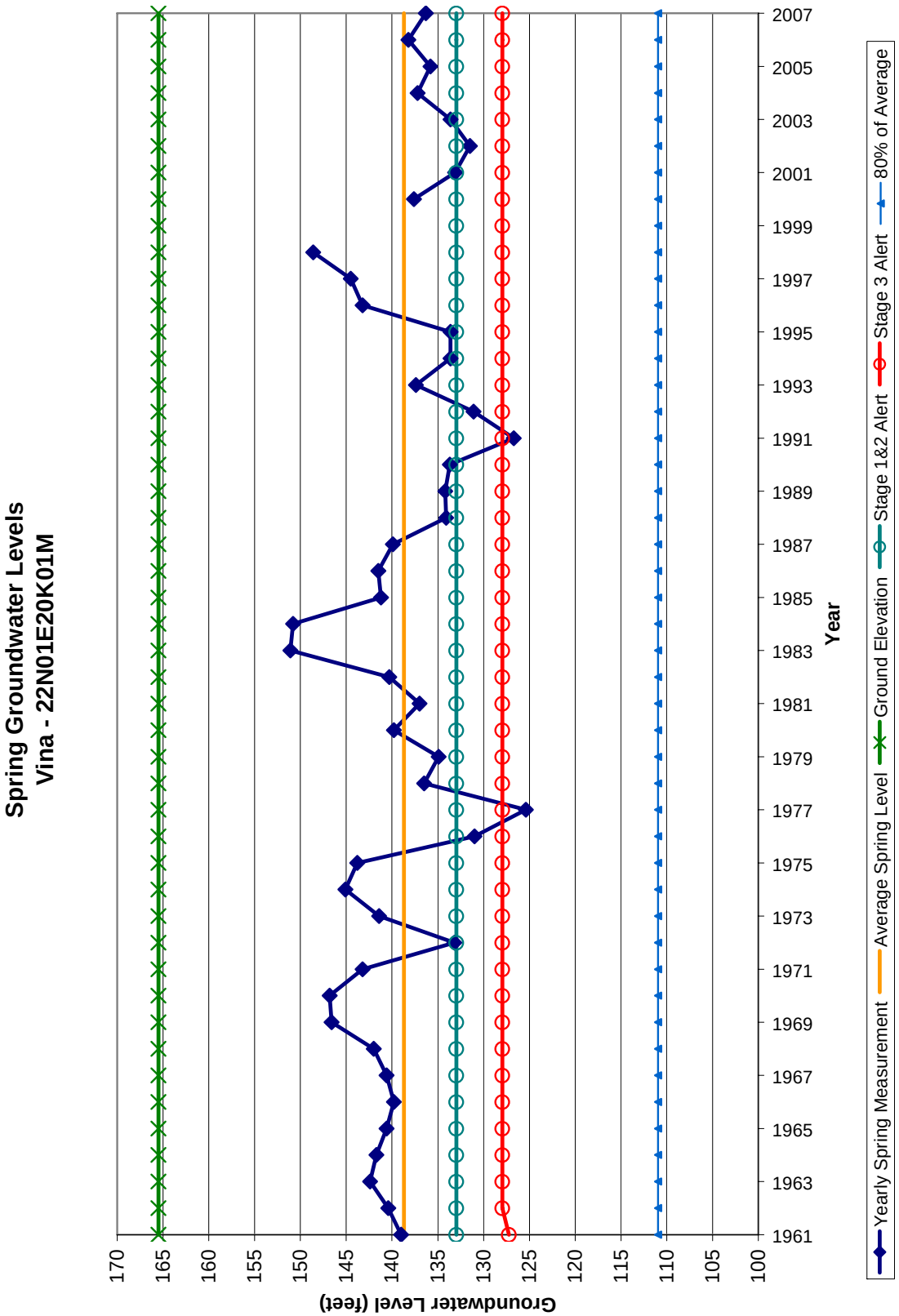
2001
Yearly Spring Measurement
Average Spring Level
Ground Elevation
Stage 1&2 Alert
Stage 3 Alert
80% of Average


Groundwater Levels
Vina - 22N01E09B01
Groundwater Level (feet)
190
180
170
160
150
140
130
120
110
100
Year
2007
2006
2005
2004
2003
2002
Yearly Fall Measurement
Fall Average
Stage 1&2 Alert
Stage 3 Alert
GS Elevation
80% of Avg


Spring Groundwater Levels
Vina - 22N01E20K01M
Groundwater Level (feet)
170
165
160
155
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145
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135
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120
115
110
105
100
Year
2007
2005
2003
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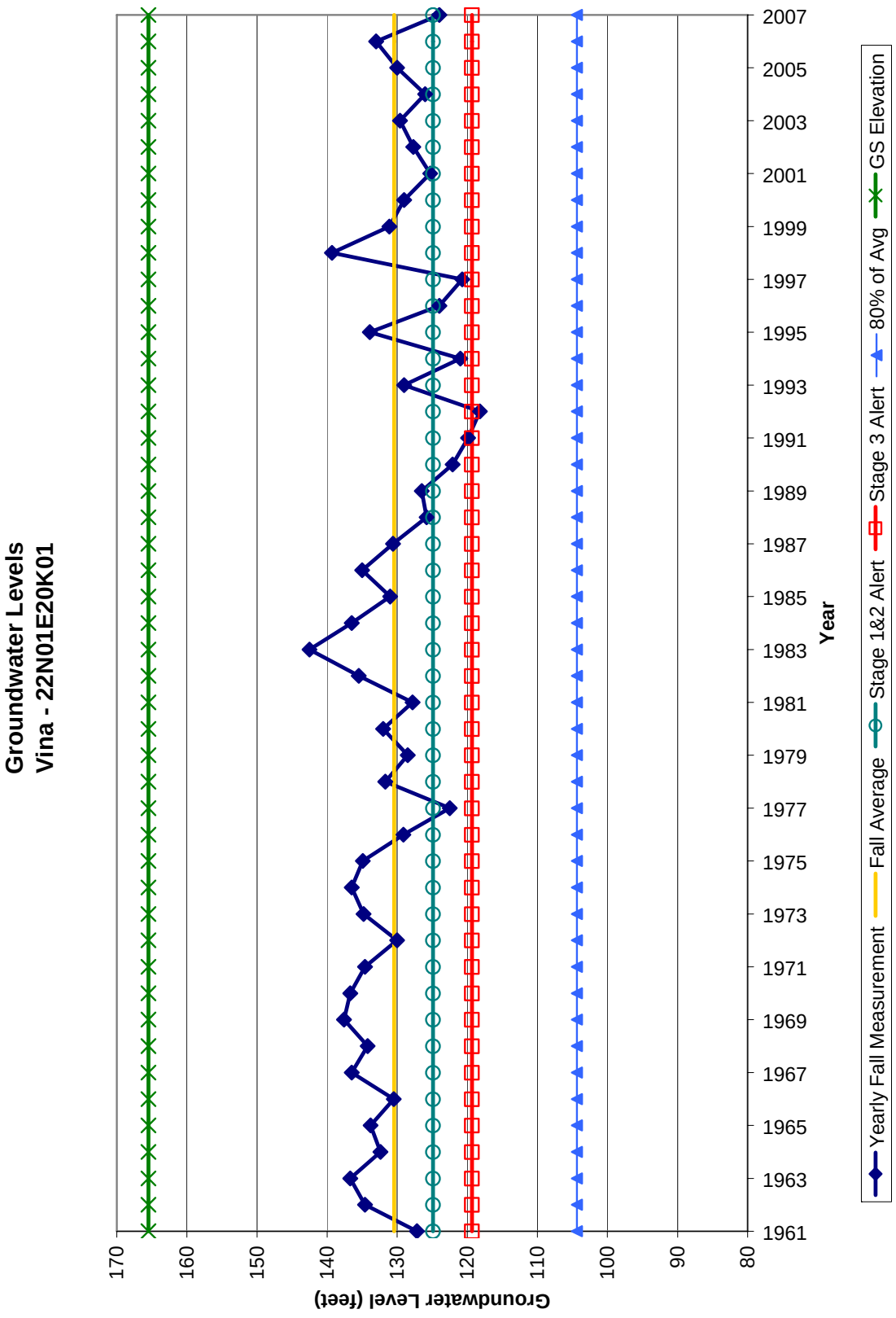
Yearly Spring Measurement
Average Spring Level
Ground Elevation
Stage 1&2 Alert
Stage 3 Alert
80% of Average


Groundwater Levels
Vina - 22N01E20K01
Groundwater Level (feet)
170
160
150
140
130
120
110
100
90
80
Year
2007
2005
2003
2001
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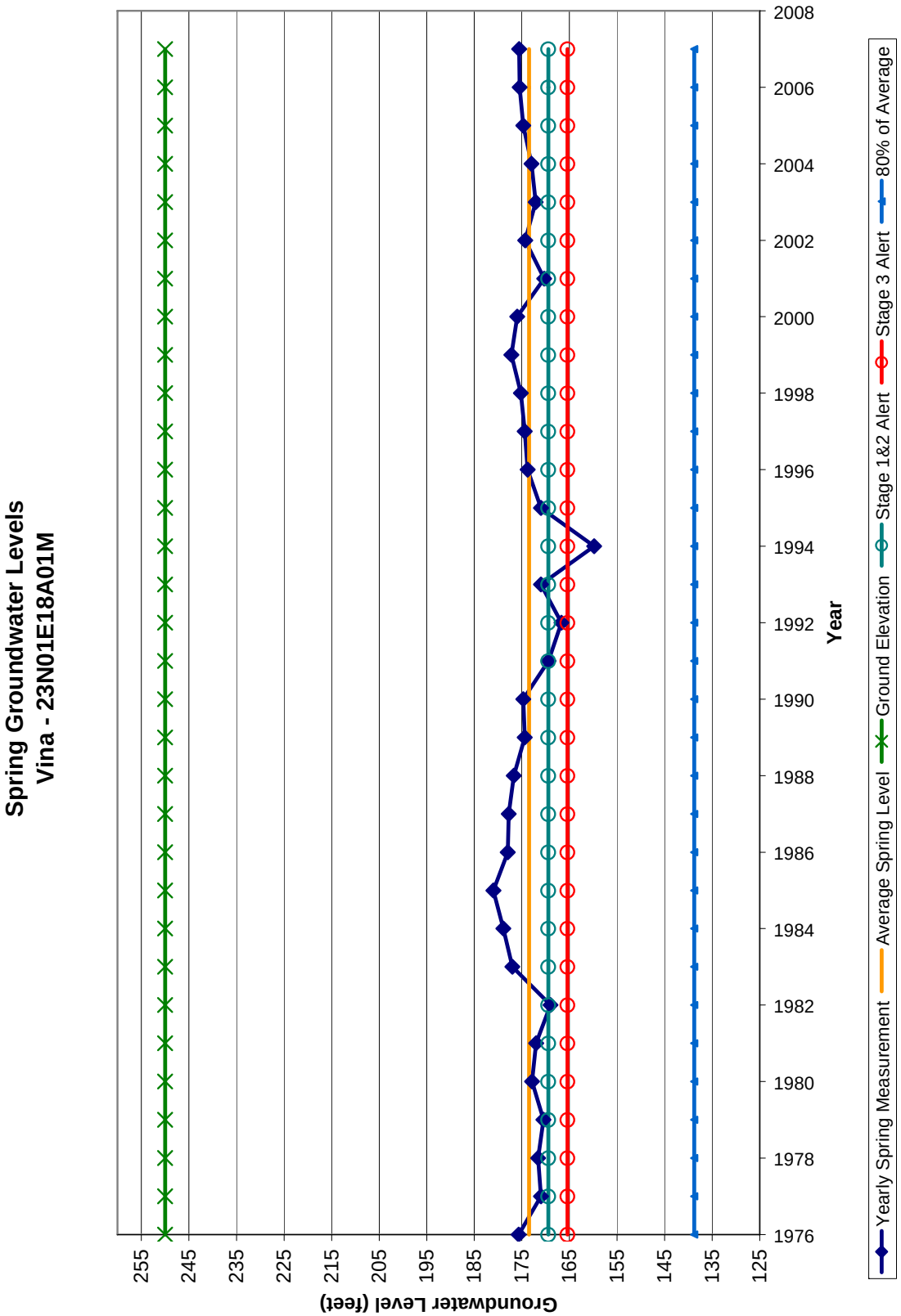
1963
1961
Yearly Fall Measurement
Fall Average
Stage 1&2 Alert
Stage 3 Alert
80% of Avg
GS Elevation


Spring Groundwater Levels
Vina - 23N01E18A01M
Groundwater Level (feet)
255
245
235
225
215
205
195
185
175
165
155
145
135
125
Year
2008
2006
2004
2002
2000
1998
1996
1994
1992
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1982
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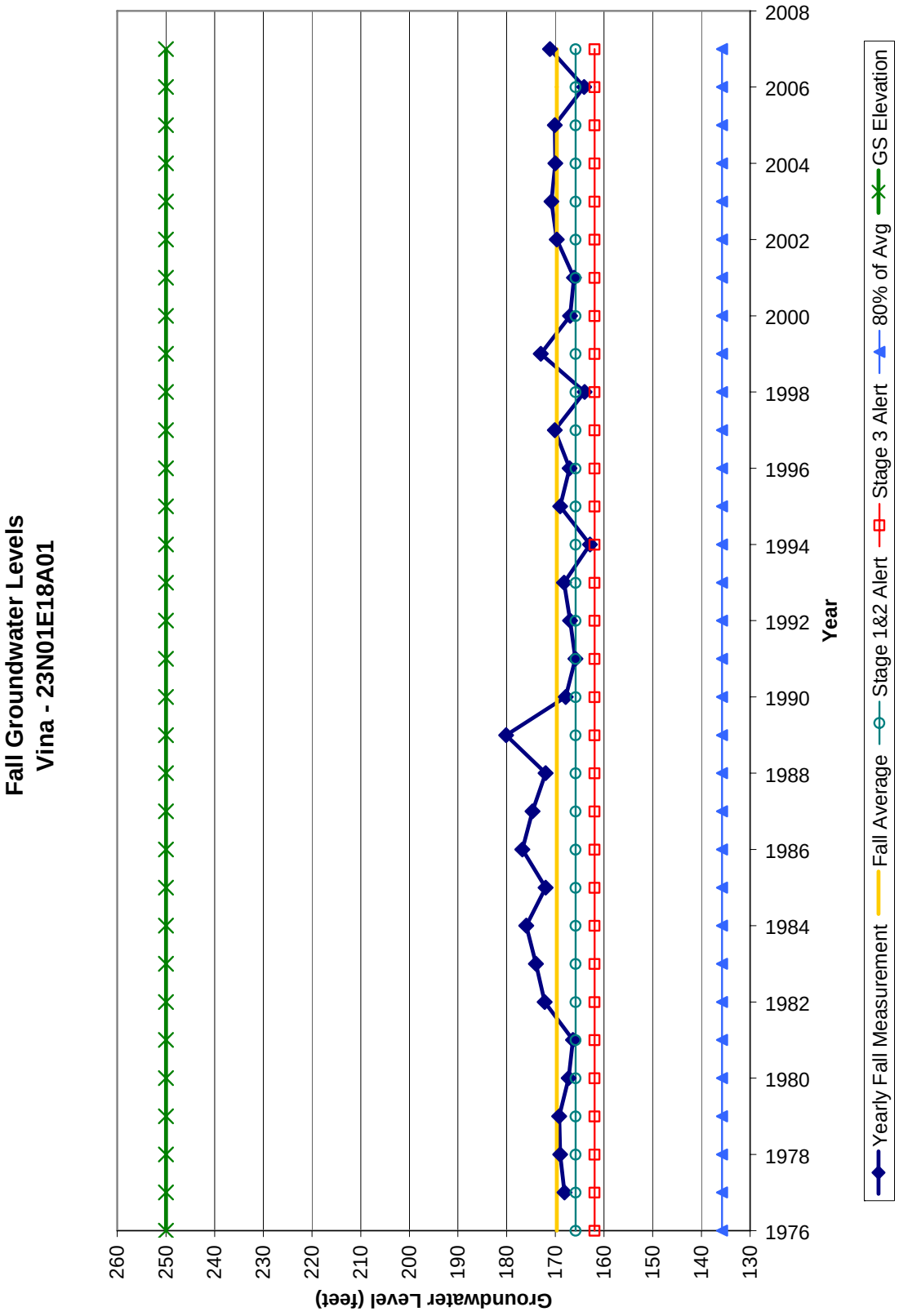
1976
Yearly Spring Measurement
Average Spring Level
Ground Elevation
Stage 1&2 Alert
Stage 3 Alert
80% of Average


Fall Groundwater Levels
Vina - 23N01E18A01
Groundwater Level (feet)
260
250
240
230
220
210
200
190
180
170
160
150
140
130
Year
2008
2006
2004
2002
2000
1998
1996
1994
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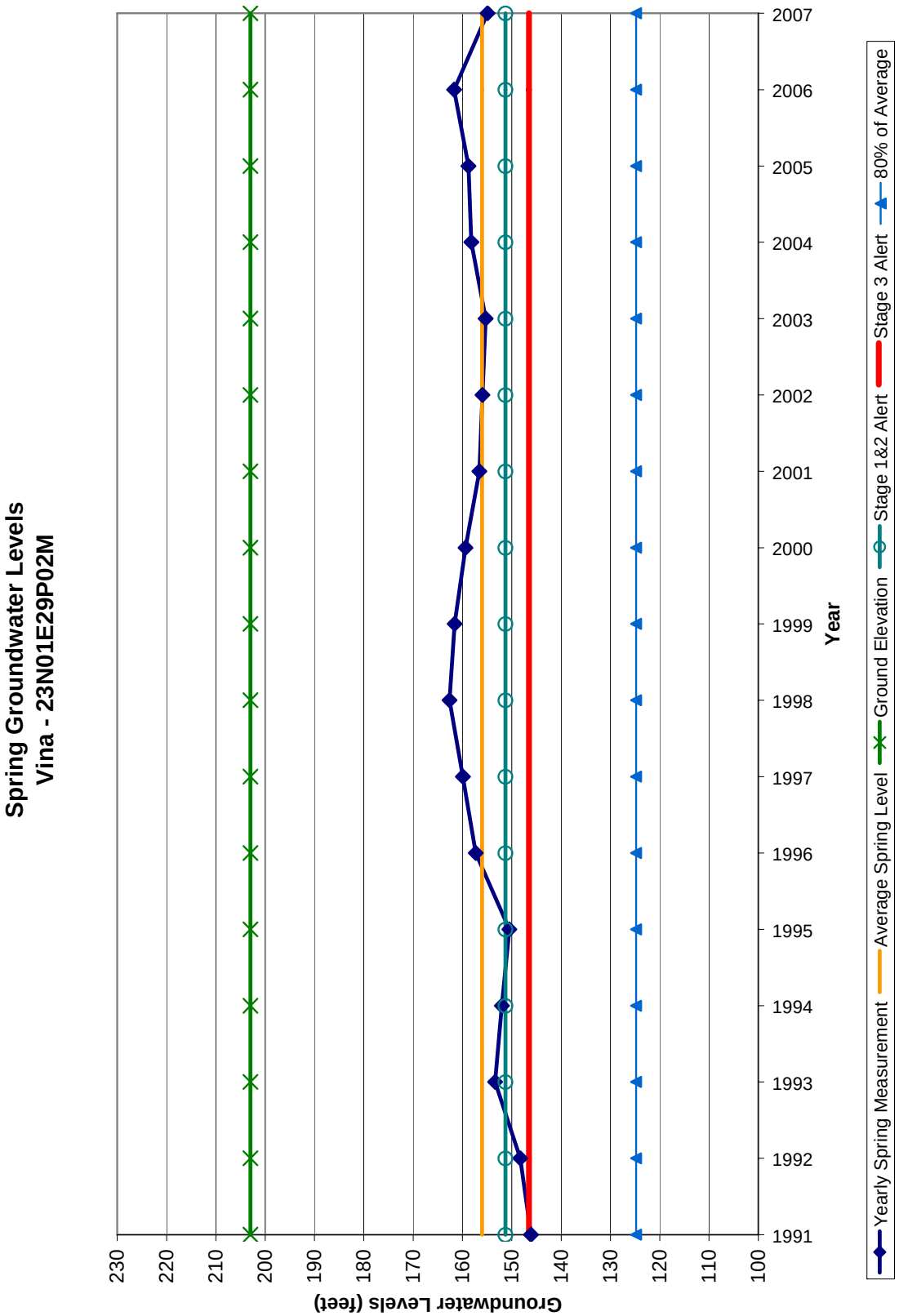
1976
Yearly Fall Measurement
Fall Average
Stage 1&2 Alert
Stage 3 Alert
80% of Avg
GS Elevation


Spring Groundwater Levels
Vina - 23N01E29P02M
Groundwater Levels (feet)
230
220
210
200
190
180
170
160
150
140
130
120
110
100
Year
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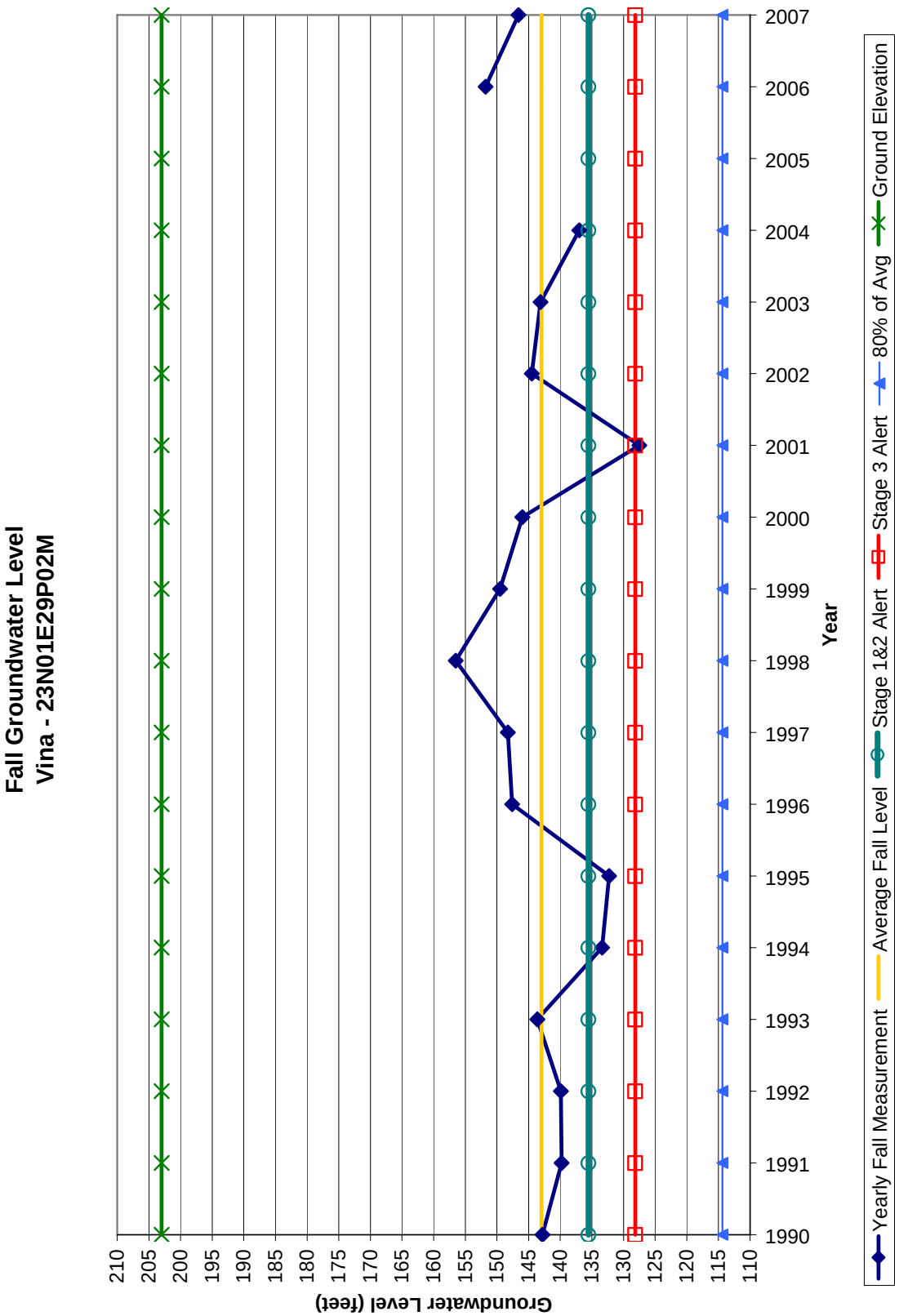
Yearly Spring Measurement
Average Spring Level
Ground Elevation
Stage 1&2 Alert
Stage 3 Alert
80% of Average


Fall Groundwater Level
Vina - 23N01E29P02M
Groundwater Level (feet)
210
205
200
195
190
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160
155
150
145
140
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130
125
120
115
110
Year
2007
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Yearly Fall Measurement
Average Fall Level
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Stage 3 Alert
80% of Avg
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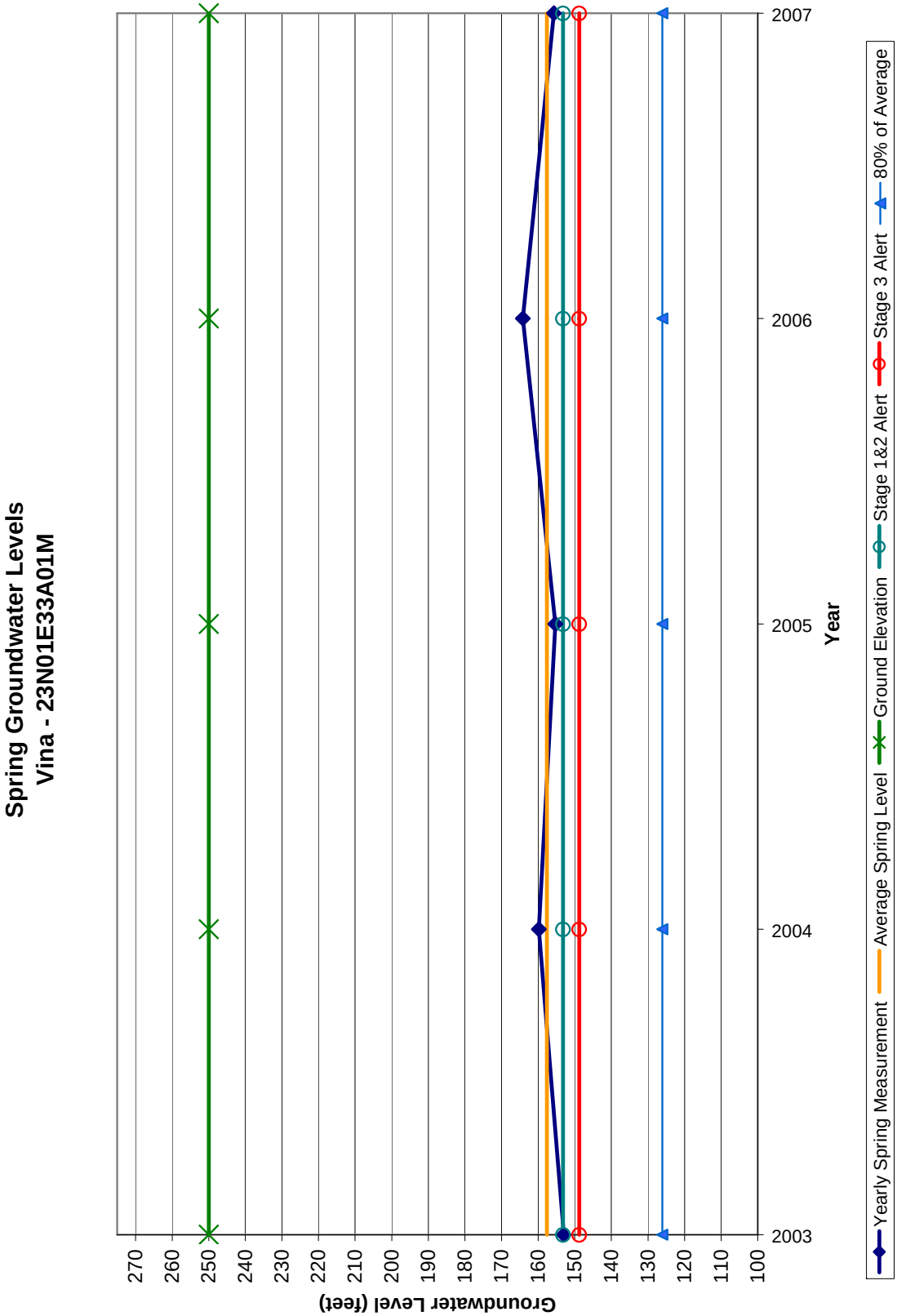
Spring Groundwater Levels
Vina - 23N01E33A01M
Groundwater Level (feet)
270
260
250
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220
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2003
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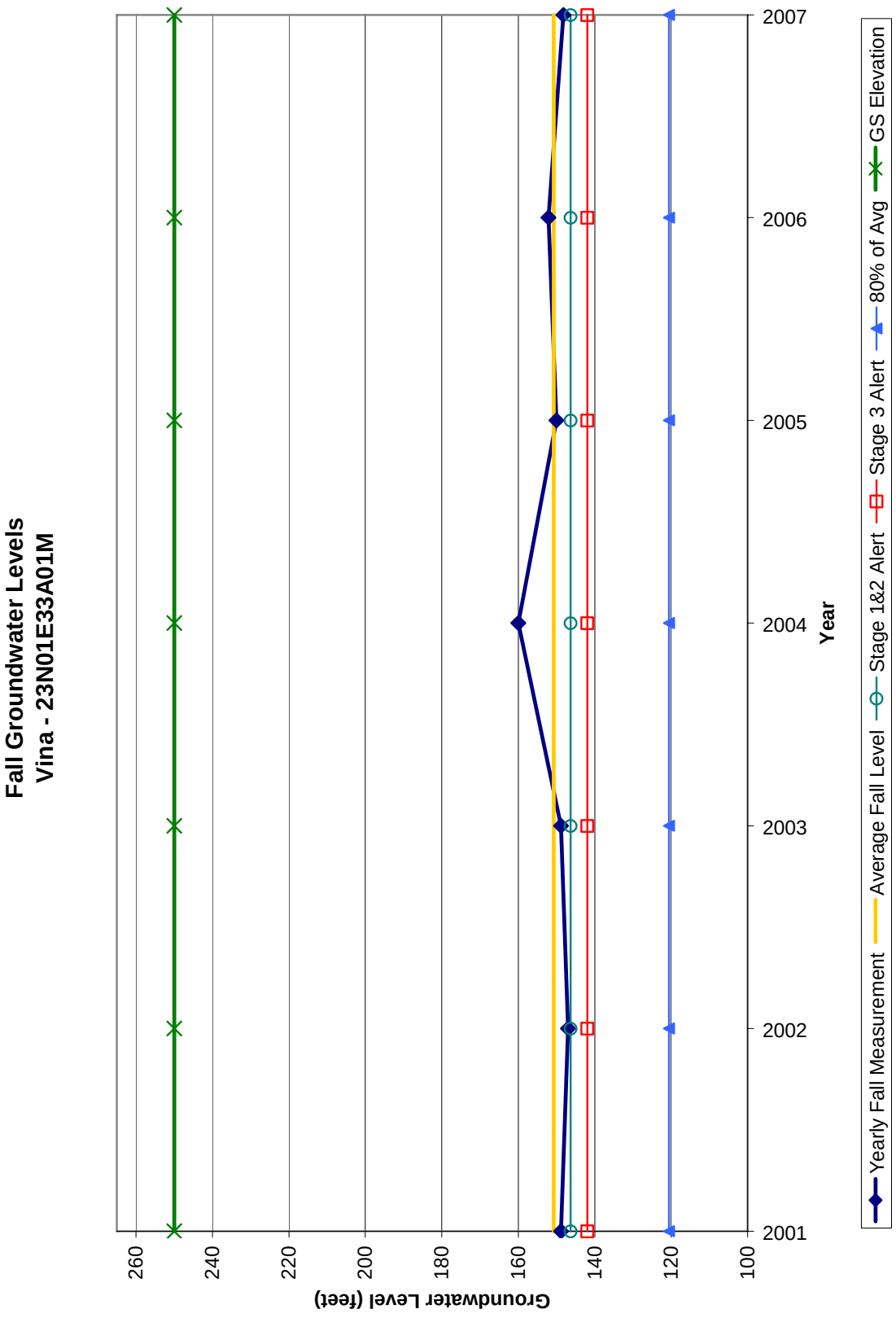
Fall Groundwater Levels
Vina - 23N01E33A01M
Groundwater Level (feet)
260
240
220
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2007
Year
Yearly Fall Measurement
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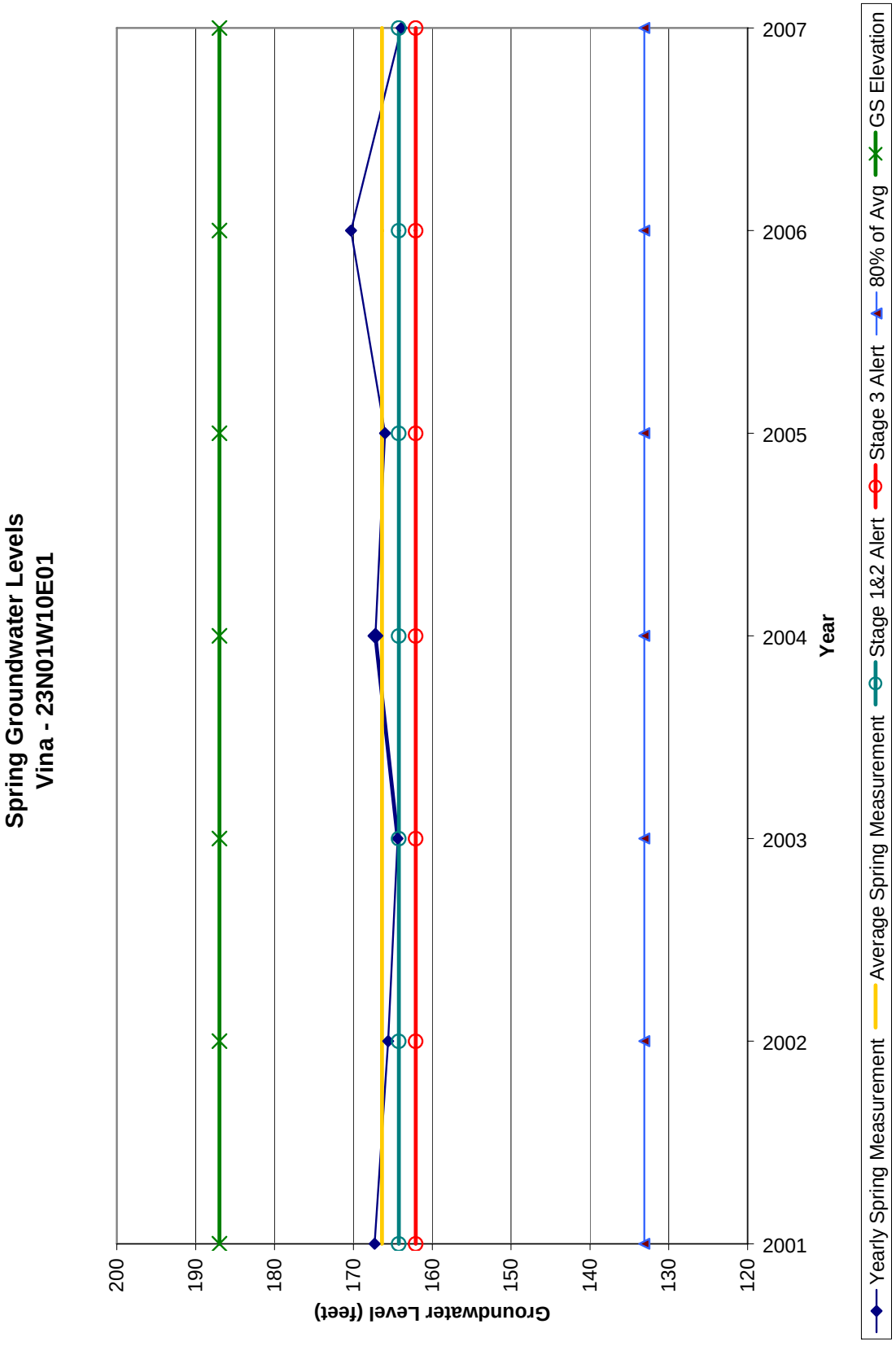
80% of Avg
GS Elevation


Spring Groundwater Levels
Vina - 23N01W10E01
Groundwater Level (feet)
200
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Year
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Yearly Spring Measurement
Average Spring Measurement
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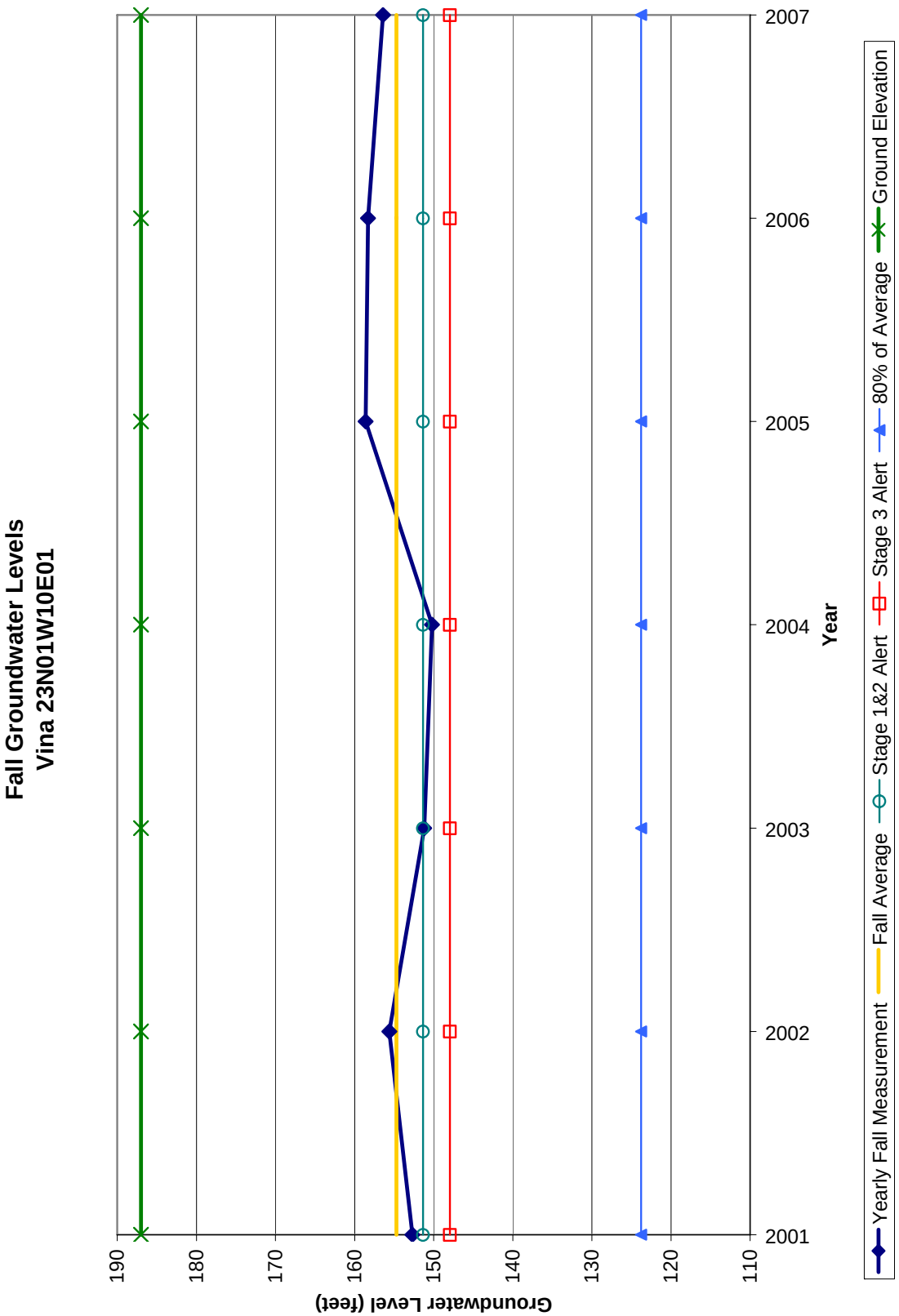
Stage 3 Alert
80% of Avg
GS Elevation


Fall Groundwater Levels
Vina 23N01W10E01
Groundwater Level (feet)
190
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Fall Average
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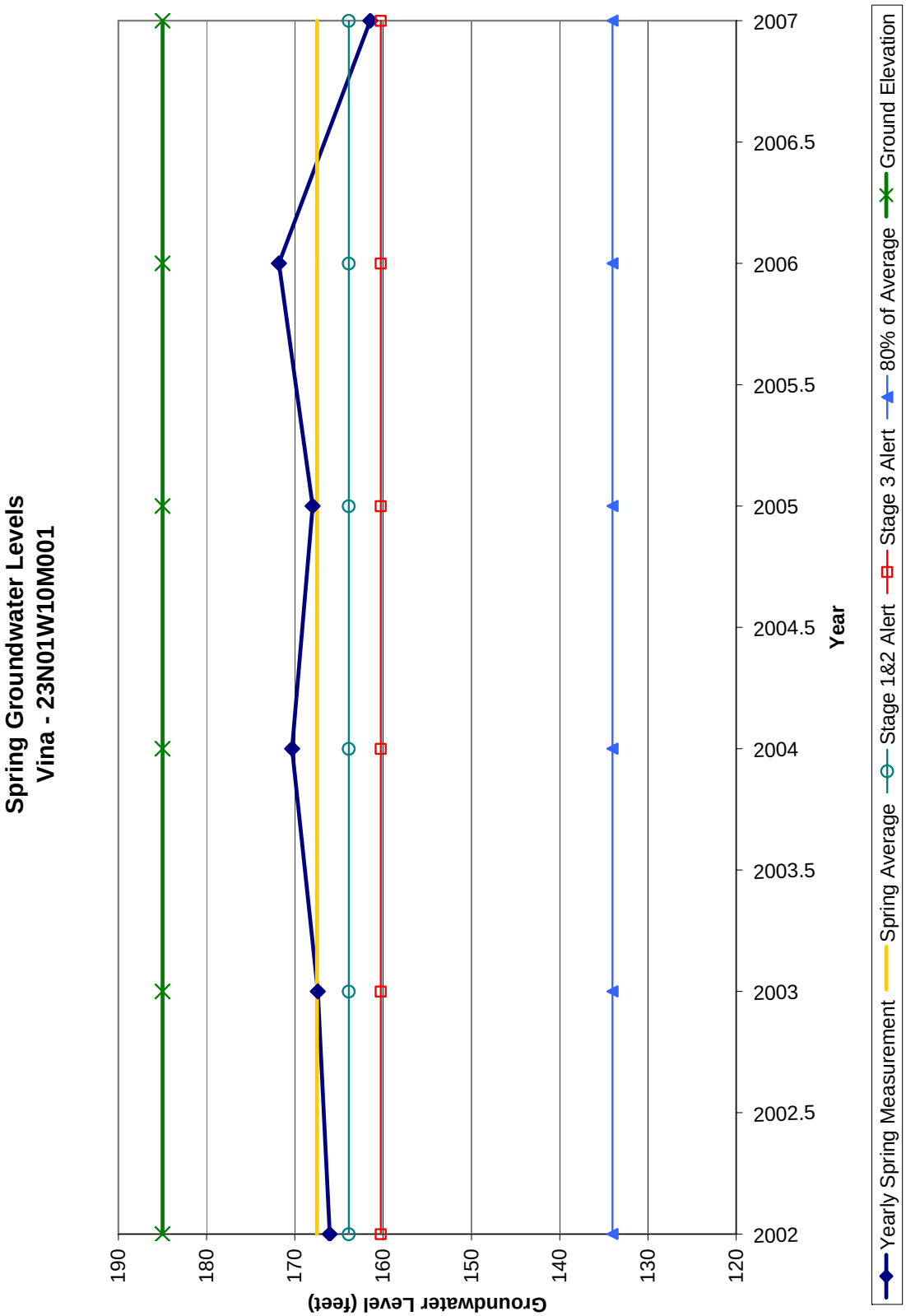
Stage 3 Alert
80% of Average
Ground Elevation


Spring Groundwater Levels
Vina - 23N01W10M001
Groundwater Level (feet)
190
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Year
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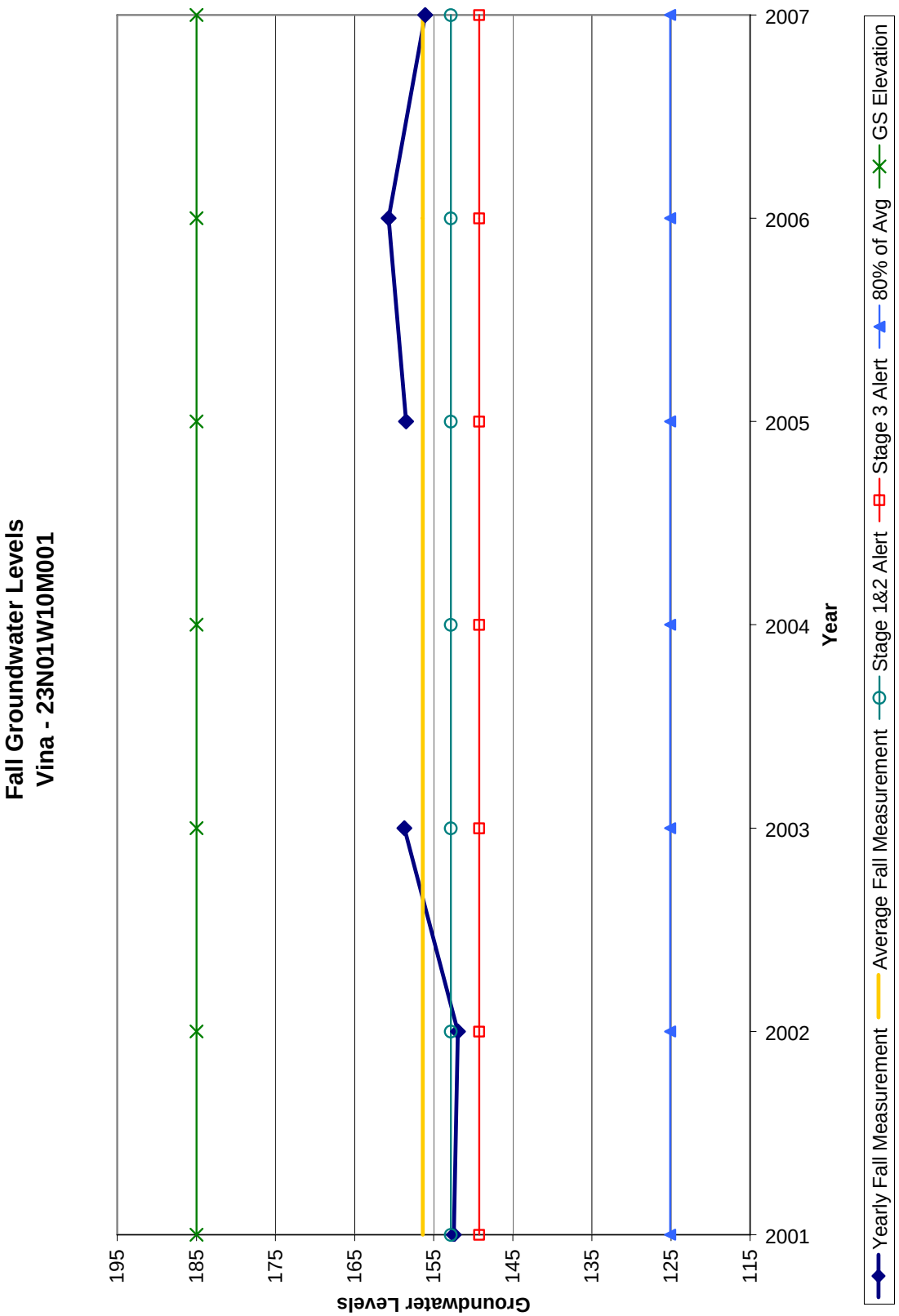
Yearly Spring Measurement
Spring Average
Stage 1&2 Alert
Stage 3 Alert
80% of Average
Ground Elevation


Fall Groundwater Levels
Vina - 23N01W10M001
Groundwater Levels
195
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Year
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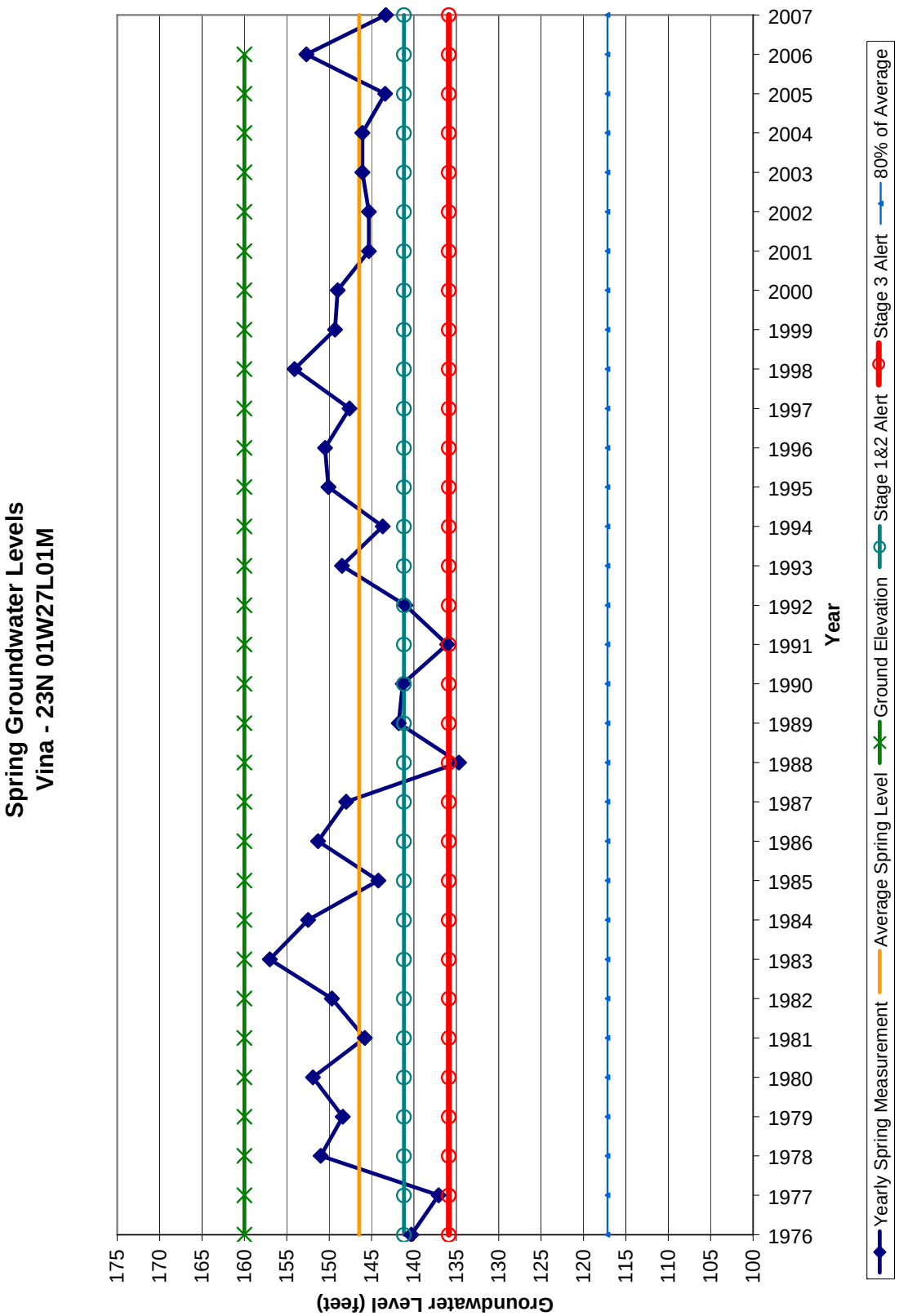
Yearly Fall Measurement
Average Fall Measurement
Stage 1&2 Alert
Stage 3 Alert
80% of Avg
GS Elevation


Spring Groundwater Levels
Vina - 23N 01W27L01M
Groundwater Level (feet)
175
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125
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115
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Year
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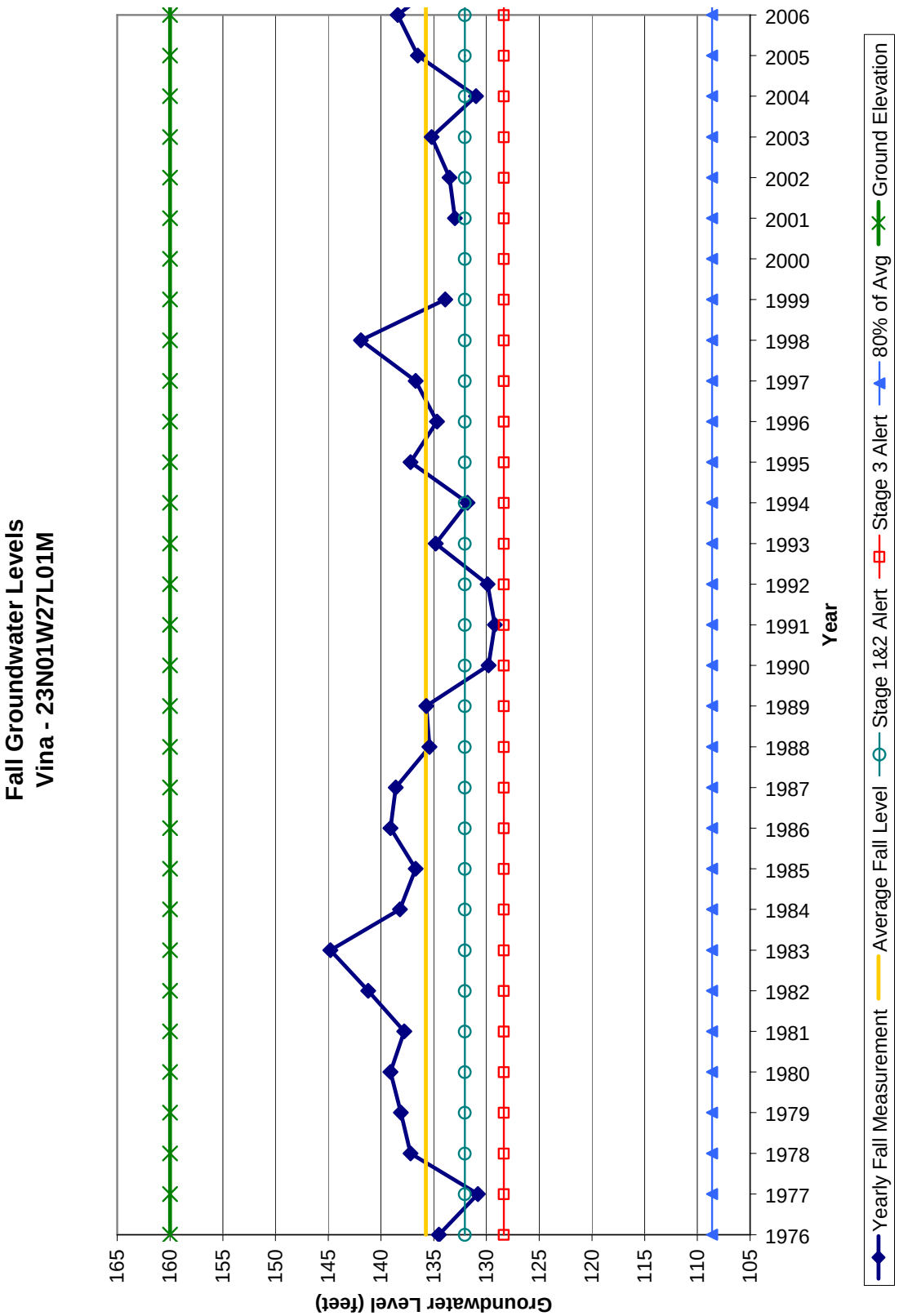
Yearly Spring Measurement
Average Spring Level
Ground Elevation
Stage 1&2 Alert
Stage 3 Alert
80% of Average


Fall Groundwater Levels
Vina - 23N01W27L01M
Groundwater Level (feet)
165
160
155
150
145
140
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130
125
120
115
110
105
Year
2006
2005
2004
2003
2002
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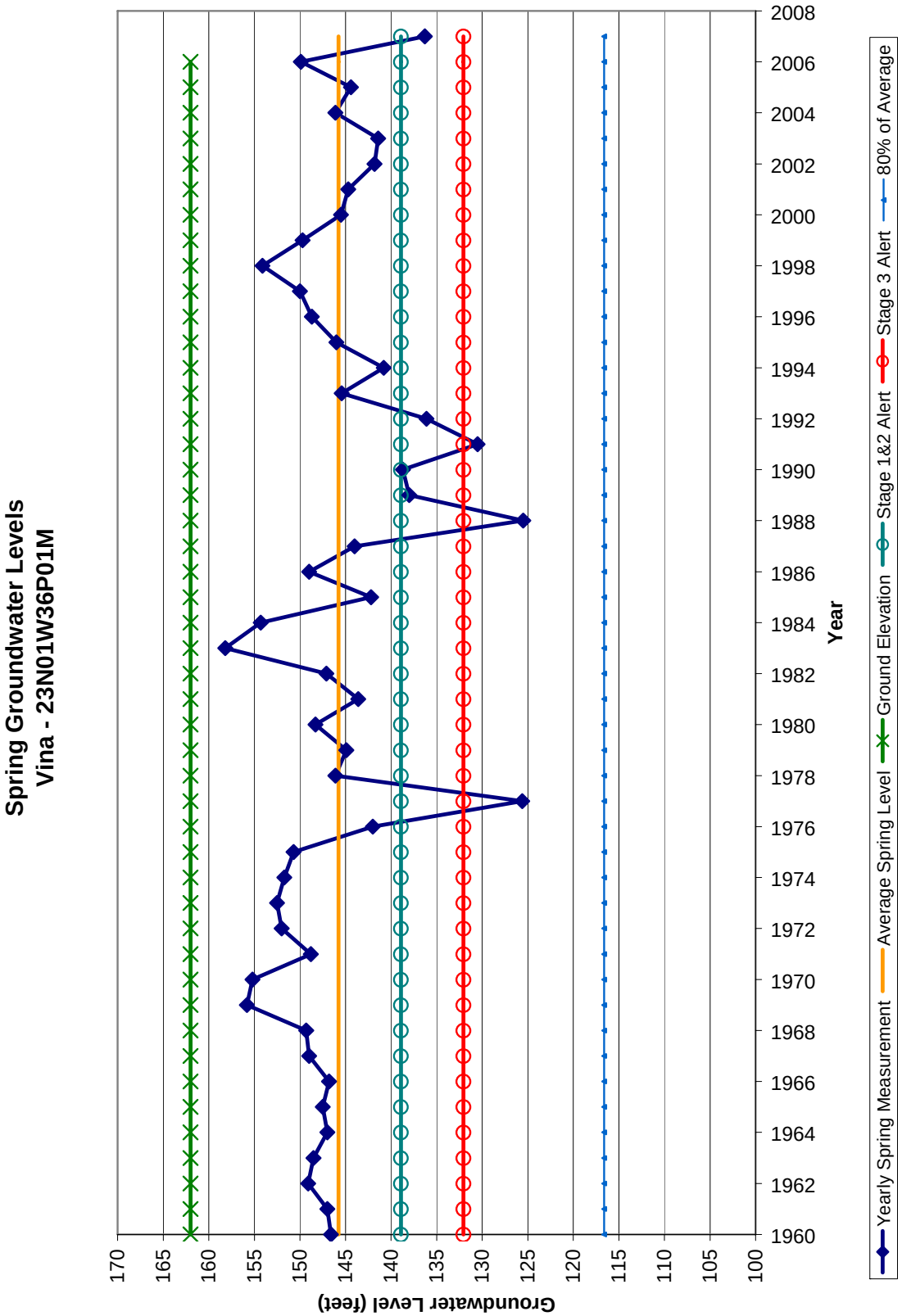
Yearly Fall Measurement
Average Fall Level
Stage 1&2 Alert
Stage 3 Alert
80% of Avg
Ground Elevation


Spring Groundwater Levels
Vina - 23N01W36P01M
Groundwater Level (feet)
170
165
160
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120
115
110
105
100
Year
2008
2006
2004
2002
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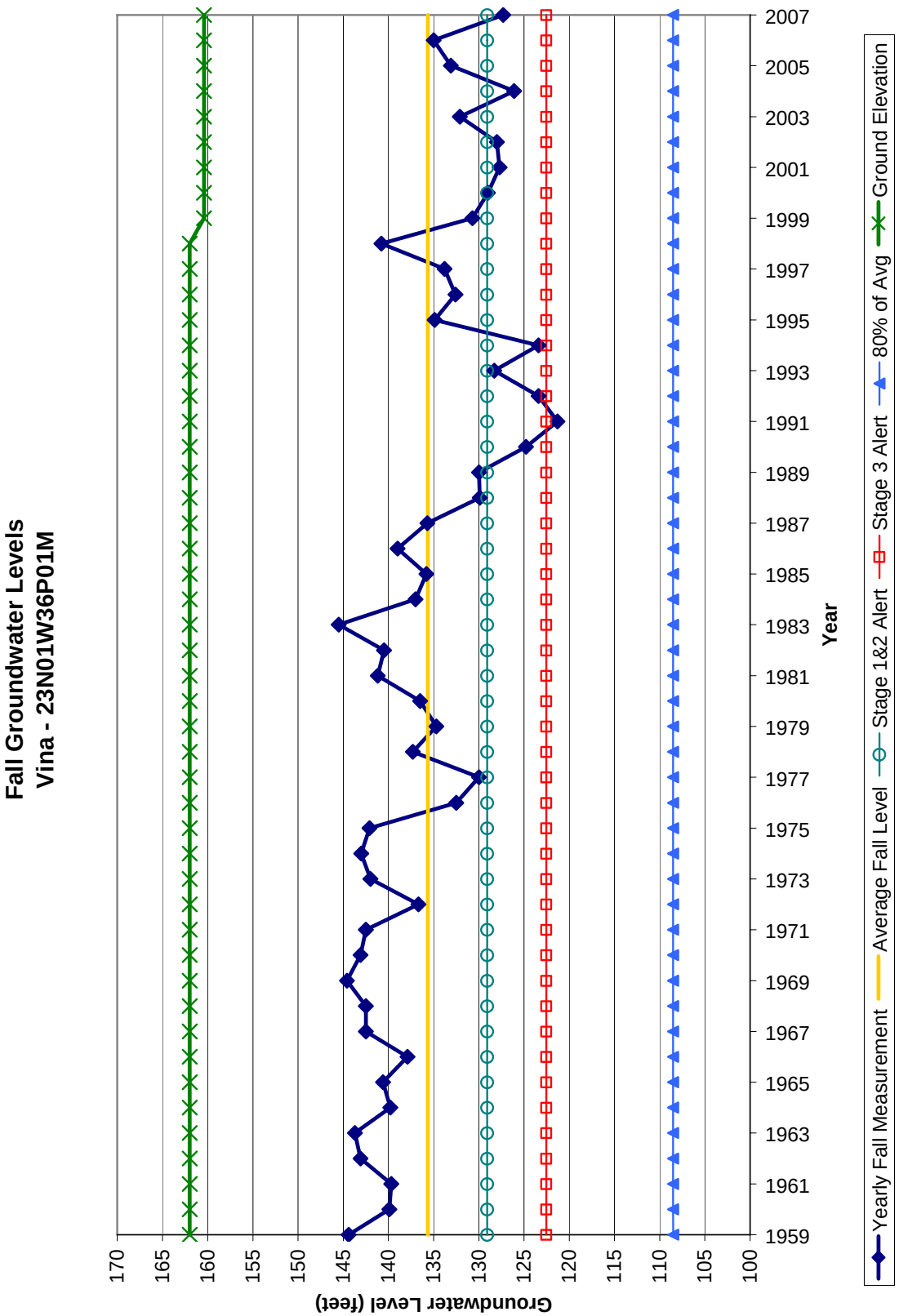
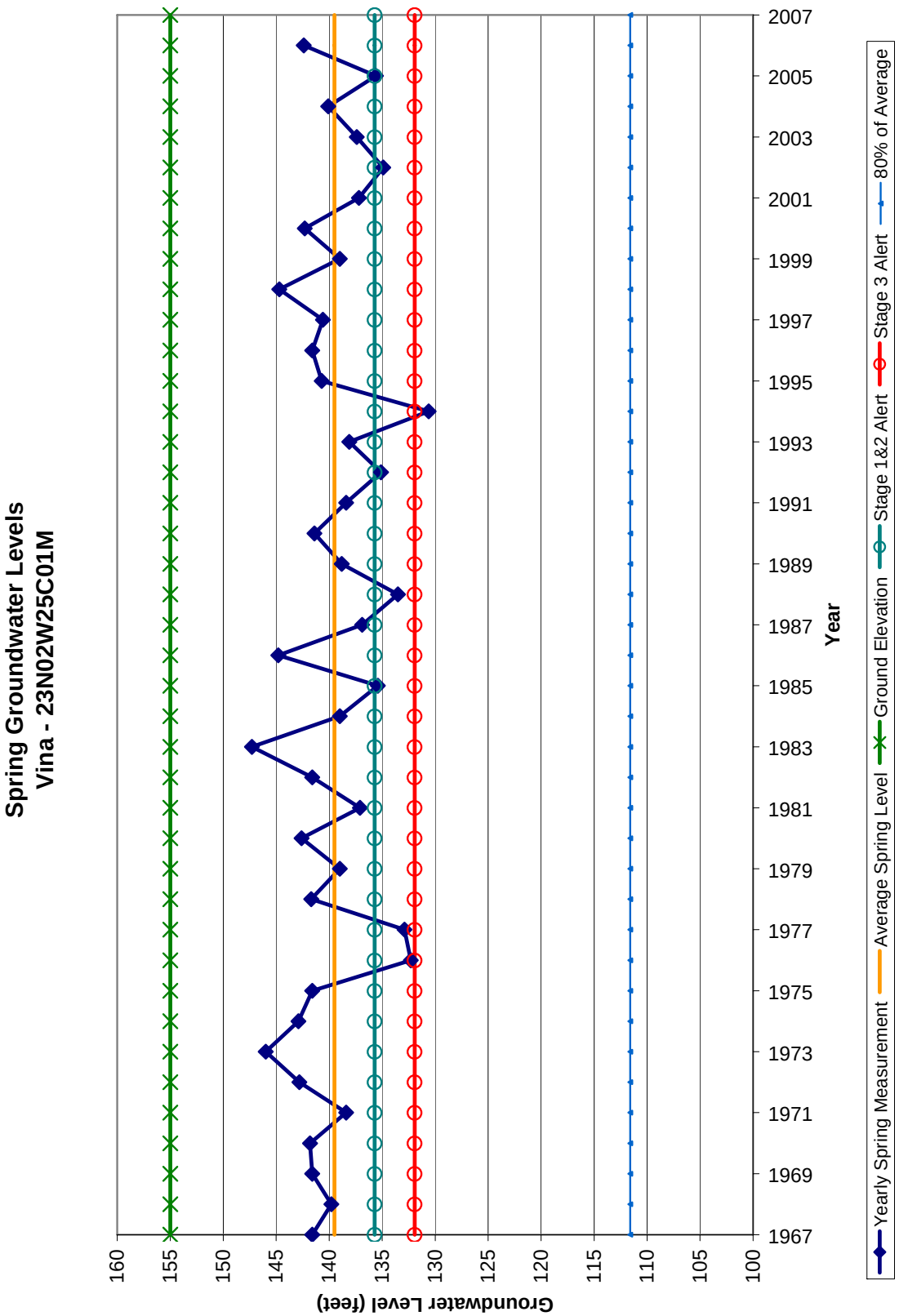
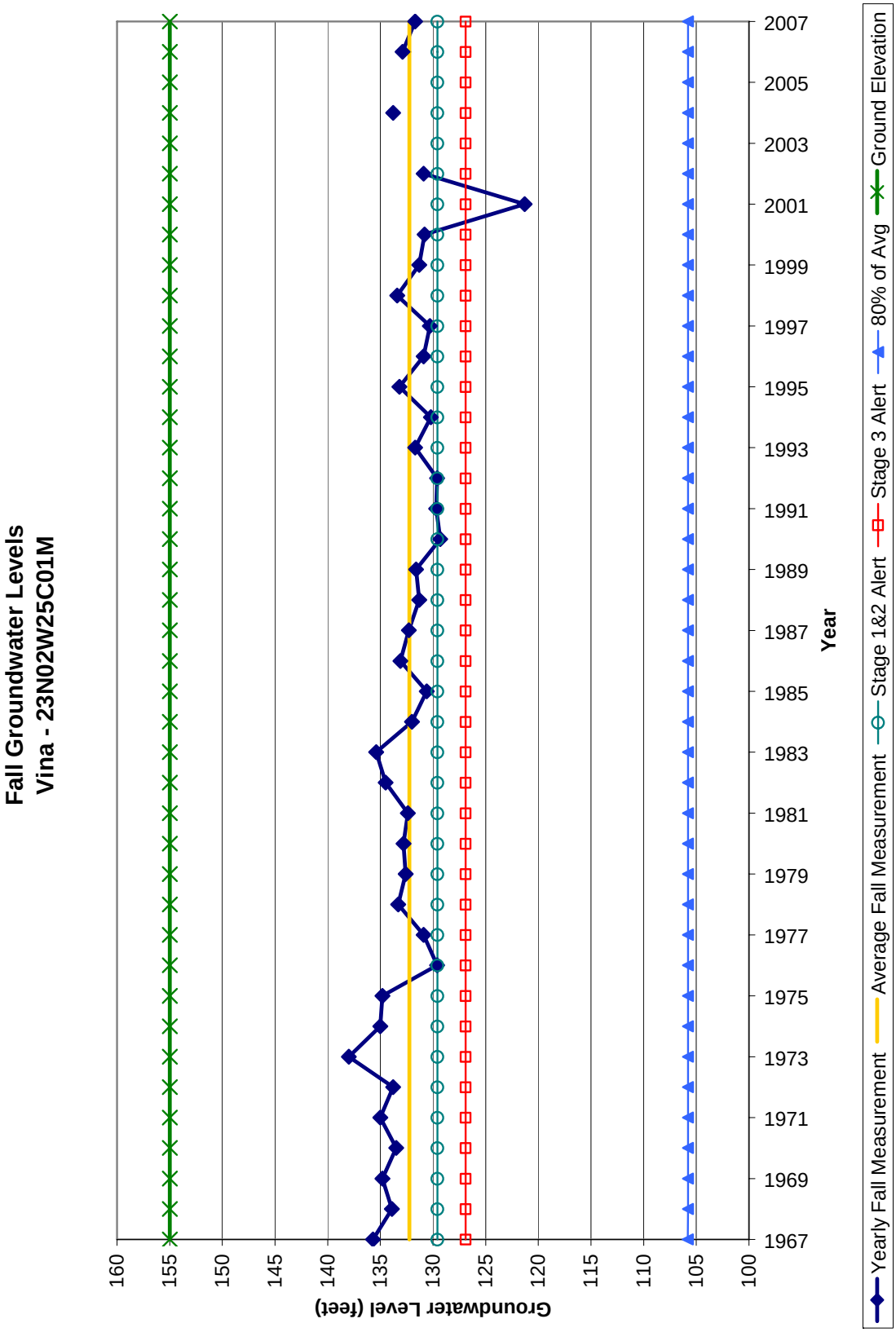
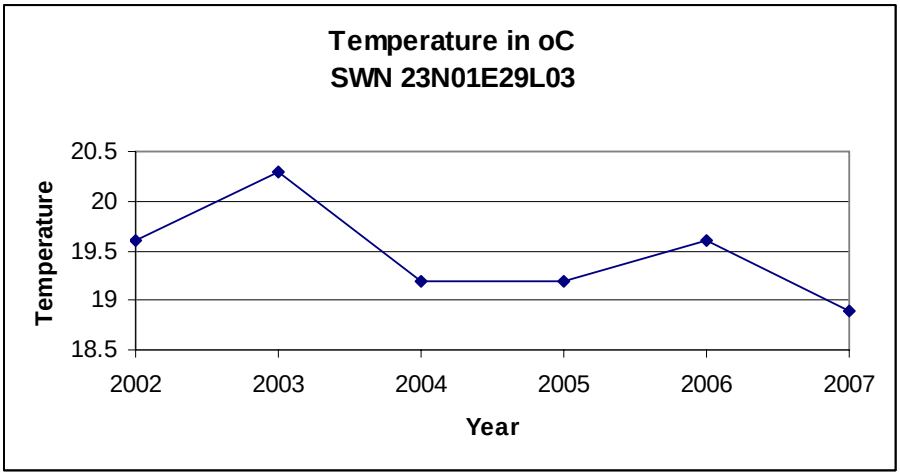
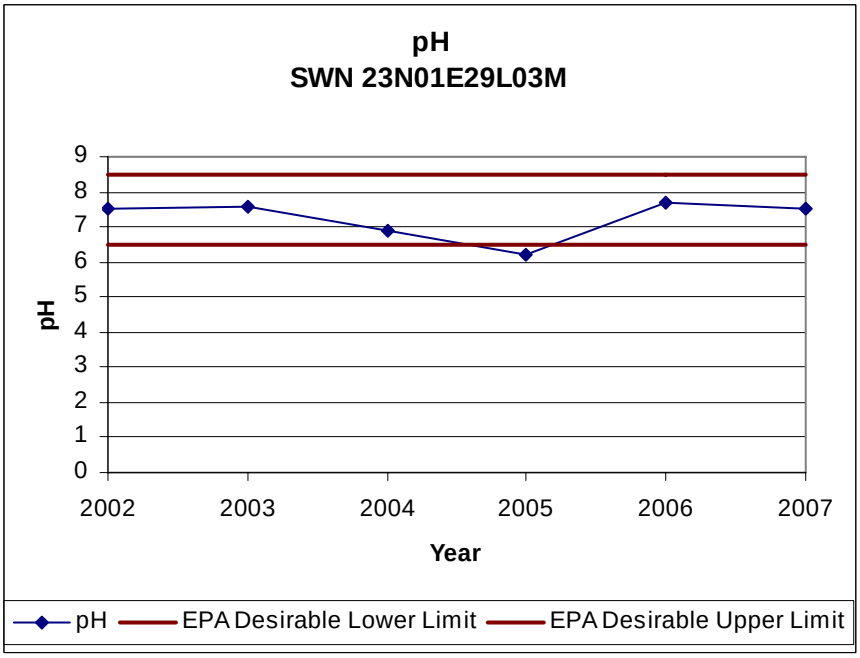
1980
1978
1976
1974
1972
1970
1968
1966
1964
1962
1960
Yearly Spring Measurement
Average Spring Level
Ground Elevation
Stage 1&2 Alert
Stage 3 Alert
80% of Average

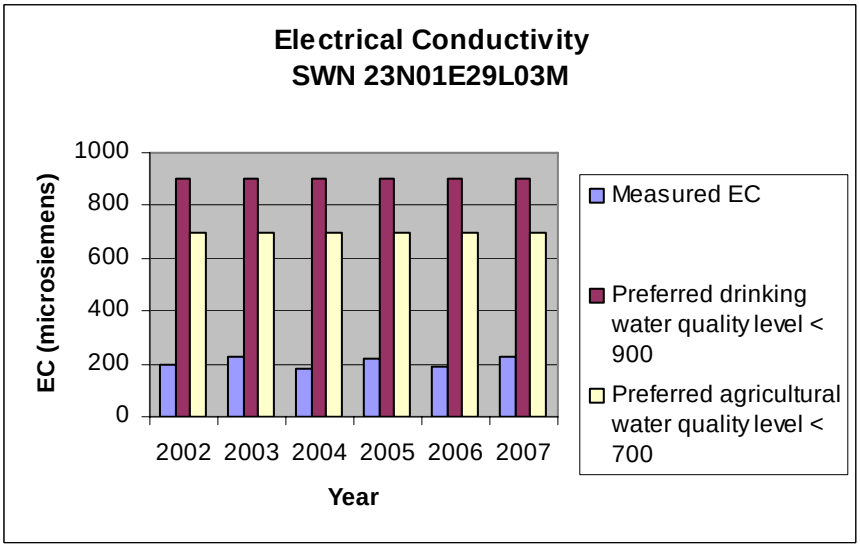

Fall Groundwater Levels
Vina - 23N01W36P01M
Groundwater Level (feet)
170
165
160
155
150
145
140
135
130
125
120
115
110
105
100
Year
2007
2005
2003
2001
1999
1997
1995
1993
1991
1989
1987
1985
1983
1981
1979
1977
1975
1973
1971
1969
1967
1965
1963
1961
1959
Yearly Fall Measurement
Average Fall Level
Stage 1&2 Alert
Stage 3 Alert
80% of Avg
Ground Elevation


Spring Groundwater Levels
Vina - 23N02W25C01M
Groundwater Level (feet)
160
155
150
145
140
135
130
125
120
115
110
105
100
Year
2007
2005
2003
2001
1999
1997
1995
1993
1991
1989
1987
1985
1983
1981
1979
1977
1975
1973
1971
1969
1967
Yearly Spring Measurement
Average Spring Level
Ground Elevation
Stage 1&2 Alert
Stage 3 Alert
80% of Average


Fall Groundwater Levels
Vina - 23N02W25C01M
Groundwater Level (feet)
160
155
150
145
140
135
130
125
120
115
110
105
100
Year
2007
2005
2003
2001
1999
1997
1995
1993
1991
1989
1987
1985
1983
1981
1979
1977
1975
1973
1971
1969
1967
Yearly Fall Measurement
Average Fall Measurement
Stage 1&2 Alert
Stage 3 Alert
80% of Avg
Ground Elevation


Temperature in oC
SWN 23N01E29L03
Temperature
20.5
20
19.5
19
18.5
2002
2003
2004
2005
2006
2007
Year


pH
SWN 23N01E29L03M
pH
9
8
7
6
5
4
3
2
1
0
2002
2003
2004
2005
2006
2007
Year
pH
EPA Desirable Lower Limit
EPA Desirable Upper Limit


Electrical Conductivity
SWN 23N01E29L03M
EC (microsiemens)
1000
800
600
400
200
0
2002
2003
2004
2005
2006
2007
Year
Measured EC
Preferred drinking water quality level < 900
Preferred agricultural water quality level < 700

DRAFT map of Tehama County's Vina sub-unit key BMO wells: