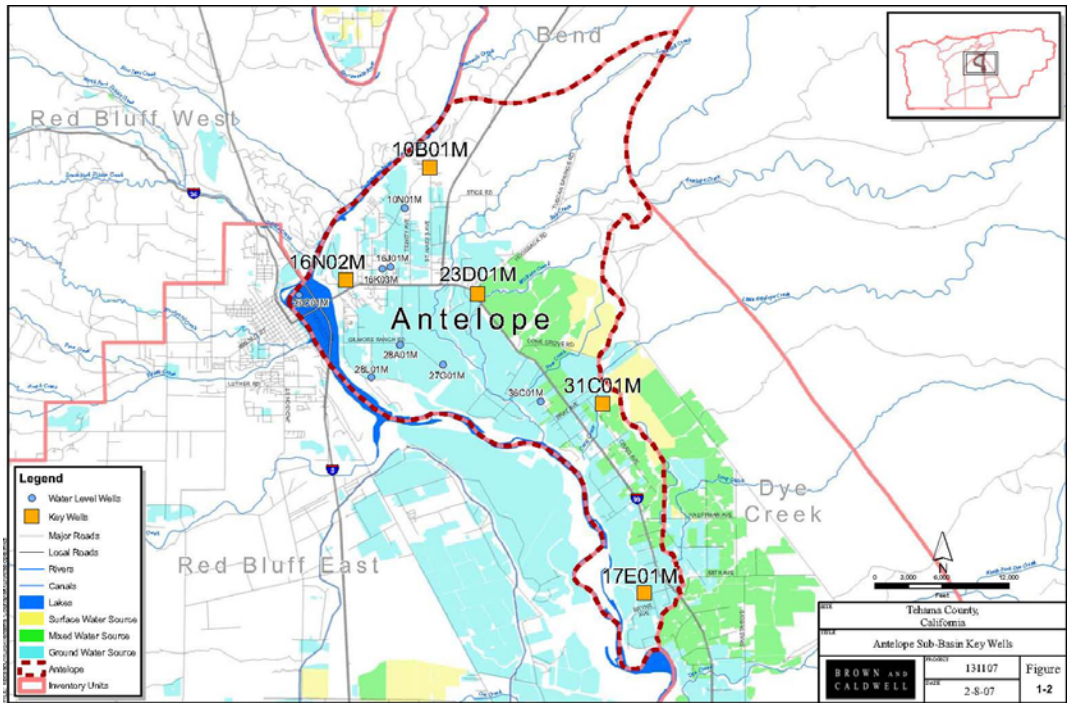
Tehama County AB-3030 Groundwater Management Plan

Technical Memorandum

For the Antelope Sub-basin of Tehama County



Draft for Public Review and Comment

Proposed Groundwater Trigger Levels and Awareness Actions

July 1, 2008

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Technical Memorandum

DRAFT

Prepared for: Tehama County Flood Control and Water Conservation District

Project Title: BMO Trigger Level Development

Project No: 131107

Technical Memorandum

Subject: Proposed Groundwater Trigger Levels and Awareness Actions for the Antelope Sub-basin

Date: July 1, 2008

To: Mr. Ernie Ohlin, Water Resources Manager

From: John Ayres, PG

Prepared by: John Ayres, PG

Reviewed by: Robert Vince, PG, CHG

1. INTRODUCTION

The Tehama County Flood Control and Water Conservation District (District) cooperated with private landowners, County groups, and local agencies overlying the groundwater basin to develop a Groundwater Management Plan (Plan) focusing on groundwater resources protection and management. The Plan took three years to develop with citizen input, review, approval, and achieving final adoption by the Tehama County FCWCD in 1998.

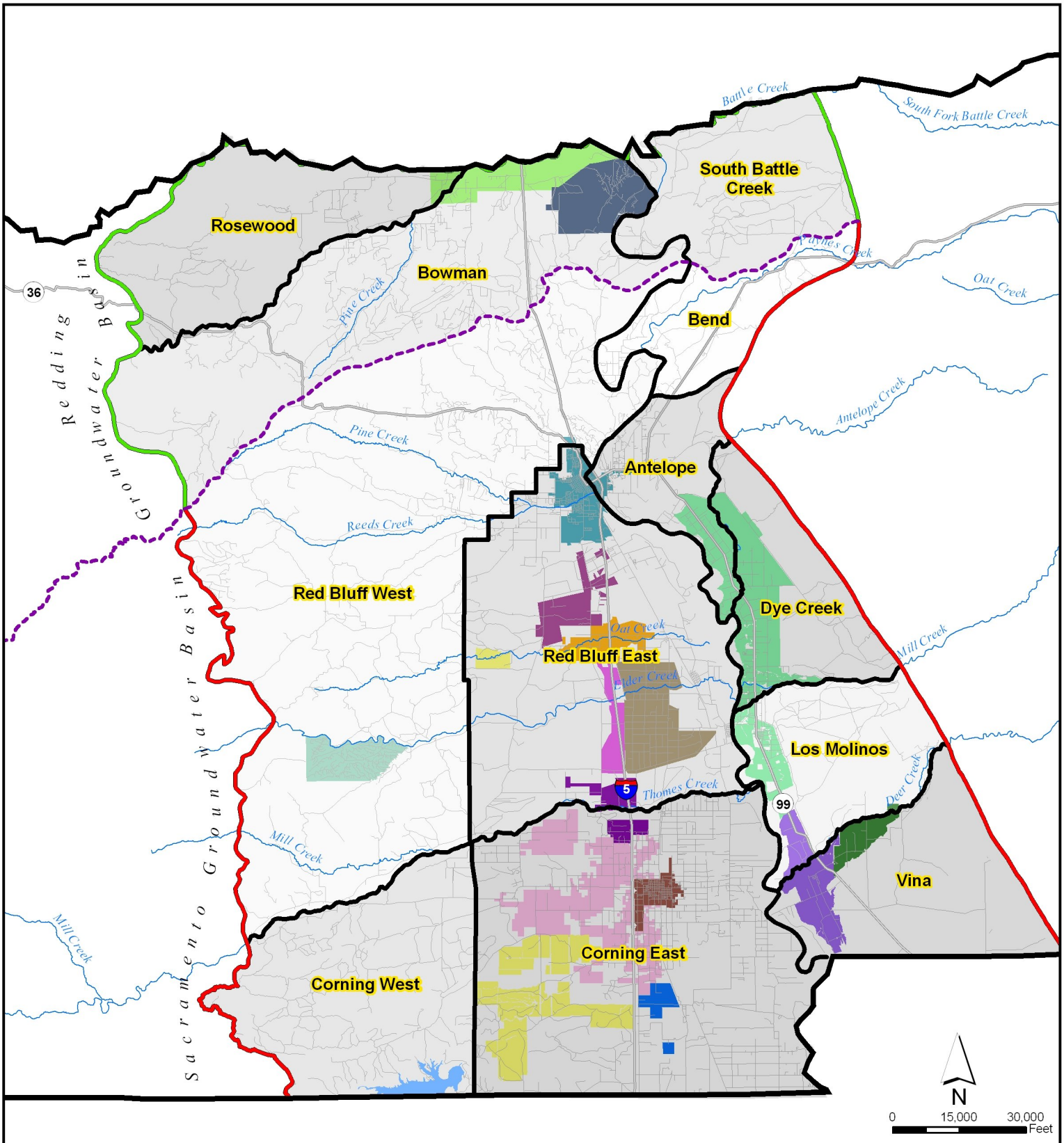
This Plan has provided guidance related to groundwater activities since adoption. Landowners and water purveyors alike recognize the need to move forward with groundwater resource protection by developing measures (trigger levels) that determine the level of active management needed within each sub-basin. Trigger levels can be established for groundwater levels, groundwater quality, or inelastic land subsidence due to groundwater extraction. This Technical Memorandum (TM) focuses on groundwater level trigger level development for the Antelope sub-basin.

Groundwater trigger levels represent declines in groundwater levels that, when reached or exceeded, may cause some type of action such as public outreach, increased monitoring, or consideration of modifying the groundwater trigger level. The Plan defines trigger levels as increasing stages of groundwater decline that correspond with various levels of increased groundwater discussion, investigation or local management actions. This TM identifies trigger levels that correspond to three decreasing levels of groundwater in the spring, and one trigger level that corresponds with decreasing levels of groundwater in the summer and fall.

The Plan states that one of the District's functions under the Plan is to provide guidance in the development of trigger levels. Sections 325 through 329 of the Plan describe the trigger level concept and the District's role in Trigger level development. The District, working with a Technical Advisory Committee (TAC) composed of local representatives, identified twelve groundwater sub-basins where trigger levels may be established (Figure 1-1).

This TM presents the process for developing groundwater elevation trigger levels and provides specific suggestions for the Antelope sub-basin. Additional information on the trigger level development process and regional hydrogeology is available in the *Trigger Level Background Technical Memorandum,* available on the District's website at: http://www.tehamacountywater.ca.gov/ .

The District understands that final trigger levels should reflect stakeholders' in-depth knowledge and management objectives for their sub-basin. Representatives from each sub-basin will review and provide input on the proposed trigger levels and suggested management actions contained herein for use in their sub-basin. The District is open to revisions that reflect stakeholder knowledge of groundwater conditions in their sub-basin. Ultimately, it is the District's desire to have management objectives that are understood and supported by groundwater users in the respective sub-basin.



Irrigation Districts

- Aaction
- Anderson-Cottonwood
- City of Corning
- City of Red Bluff
- Corning WD
- Deer Creek
- El Camino ID
- Elder Creek ID
- Kirkwood ID
- LMMWC
- Proberta ID
- Rancho Tehama
- Rawson ID
- Rio Alto WD
- Stanford Vina
- Thomes Creek ID

Legend

- Red Bluff Arch
- Redding Groundwater Basin
- Sacramento Valley Groundwater Basin

BROWN AND CALDWELL

PROJECT	SITE	Figure
131107	Tehama County	1-1
DATE	TITLE	
1/18/07	Groundwater Sub-Basins	

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1.1 Groundwater Level Trigger Level Development Methodology

Groundwater trigger levels are derived through interpretation of historic groundwater levels. A series of awareness actions are proposed for each trigger level stage. Development of groundwater level triggers is a five-step process as illustrated below:

Step 1: Describe the trigger level's purpose.

Step 2: Select one or more key wells within the sub-basin.

Step 3: Designate the time of seasonal measurement.

Step 4: Establish trigger levels in the selected key wells.

Step 5: Define awareness actions associated with each trigger level.

Step 1: Describe the trigger level's purpose

The Antelope sub-basin is primarily a rural area, with agriculture throughout the area and with a portion of Red Bluff in the western portion of the area. Additional water use information is available in the Tehama County Water Inventory and Analysis, available in PDF format at: http://www.tehamacountywater.ca.gov/grndwtr_inv_ana.htm. Groundwater is used for agricultural, municipal, and domestic purposes. The trigger level's purpose in this sub-basin should reflect the needs of local water users. Some suggested trigger level purposes are:

Groundwater Use in Antelope:	
Irrigation:	88% (15,800 acre-ft)
Municipal, and Industrial:	12% (2,200 acre-ft)
Number of wells by type in Antelope:	
Irrigation:	112 wells
Domestic:	770 wells
Municipal and Industrial:	11 wells

- 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.

Step 2: Select one or more key wells within the sub-basin

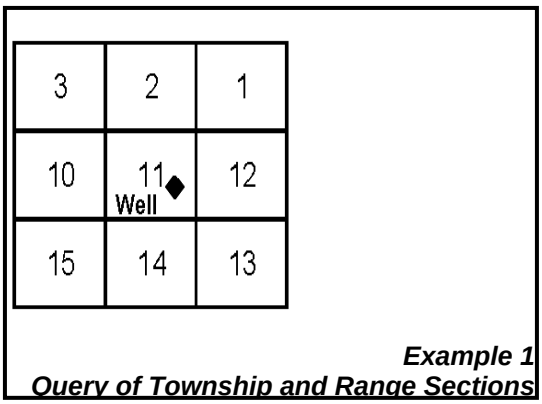
Key wells are monitoring wells that are representative of groundwater conditions within a particular aquifer interval, or range of aquifer intervals underlying the sub-basin. Groundwater levels in key wells provide information necessary to begin management activities.

Key wells should be selected from the County groundwater level monitoring well network with consideration of duration of monitoring. The monitoring period of record in some wells is more than 30 years; the long period of record helps identify seasonal and long-term aquifer response over a wide range of climatic conditions (wet, normal or drought), changes in agricultural and domestic development, and changes in available water supply. Some monitoring wells may have short periods

of record, but are located in a key area and have preferable depth and screened intervals. These wells may be useful as key wells also.

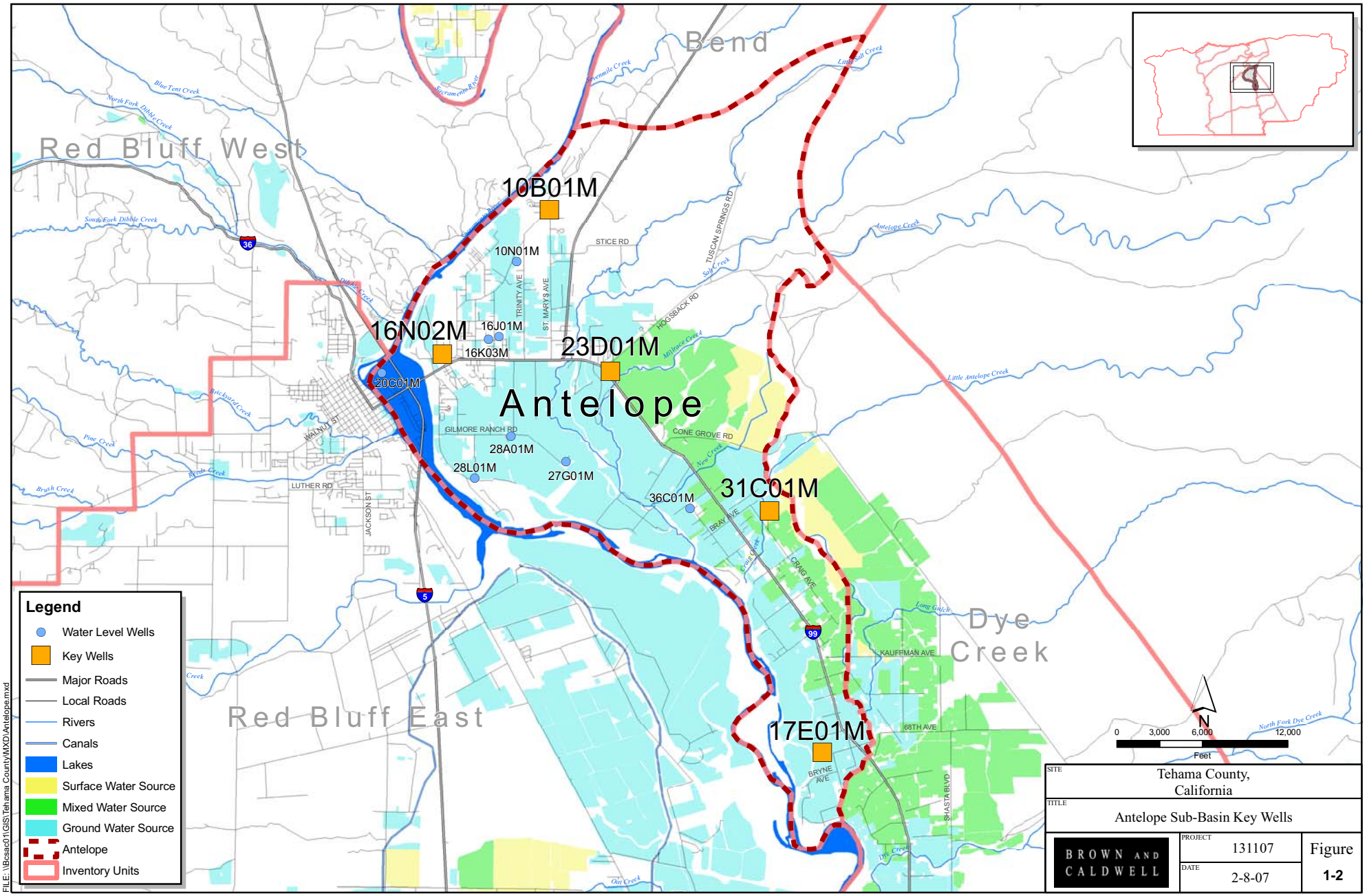
Key wells should be selected from the County groundwater level monitoring well network with consideration of location, total well depth, perforated interval from which the well produces water, and other well drilling records. Key wells should be distributed as evenly as possible throughout the sub-basin. Monitoring wells with screened intervals or depths near 100 to 250 feet below ground surface correspond to the average depth of domestic wells in the sub-basin and are good candidates for monitoring aquifer conditions associated with domestic use.

The locations of five proposed key wells are presented in Figure 1-2. Each of these proposed wells have a period of record of more than 30 years, which provides information on water levels during the drought of 1976-1977 and the drought during the late 1980s and early 1990s. A query was conducted to find nearby wells, their uses, and average depths. The query located wells in the section the well was in, and the eight sections surrounding that section (Example 1). Each section is one square mile in size. Each well is described in detail below:



Example 1
Query of Township and Range Sections

- **27N03W10B01M (10B01M) –** This monitoring well is in the northern portion of the sub-basin and is 92 feet deep with a screened interval from 80 to 92 feet below ground surface (bgs). This well is situated near urban land use, native vegetation, and orchards and pasture irrigated with groundwater. The nine square miles near this well contain 520 domestic wells with an average depth of 114 feet bgs, and 29 irrigation wells with an average depth of 225 feet bgs.
- **27N03W16N02M (16N02M) –** This monitoring well is in the northwest portion of the sub-basin and is 126 feet deep with a screened interval from 118 to 126 feet bgs. This well is situated near urban land use and hay crops irrigated with groundwater. The nine square miles near this well contain 614 domestic wells with an average depth of 128 feet bgs, and 39 irrigation wells with an average depth of 210 feet bgs.
- **27N03W23D01M (23D01M) –** This monitoring well is in the central portion of the sub-basin and is 250 feet deep with a screened interval from 30 to 250 feet bgs. This well is situated near orchards irrigated with groundwater to the west, and orchards irrigated with both surface and groundwater to the east. The nine square miles near this well contain 212 domestic wells with an average depth of 96 feet bgs, and 30 irrigation wells with an average depth of 215 feet bgs.
- **27N02W31C01M (31C01M) –** This monitoring well is in the east portion of the sub-basin and is 540 feet deep with a screened interval from 289 feet to 500 feet bgs. This well is situated near orchards and pasture irrigated with both surface water and groundwater. The nine square miles near this well contain 151 domestic wells with an average depth of 88 feet bgs, and 38 irrigation wells with an average depth of 167 feet bgs.
- **26N02W17E01M (17E01M) –** This monitoring well is in the southern portion of the sub-basin and is 152 feet deep with a screened interval from 55 to 145 feet bgs. This well is situated near orchards that are irrigated with groundwater. The nine square miles near this well contain 126


Bend
Red Bluff West
Red Bluff East
Antelope
Dye Creek
10B01M
10N01M
16N02M
16J01M
16K03M
23D01M
20C01M
28A01M
28L01M
27G01M
36C01M
31C01M
17E01M
STICE RD
TUSCAN SPRINGS RD
HOGSBACK RD
GILMORE RANCH RD
CONE GROVE RD
LUTHER RD
WALNUT ST
JACKSON ST
TRINITY AVE
ST. MARYS AVE
BRAY AVE
CRAIG AVE
KAUFFMAN AVE
68TH AVE
BRYNE AVE
SHASTA BLVD
Legend
Water Level Wells
Key Wells
Major Roads
Local Roads
Rivers
Canals
Lakes
Surface Water Source
Mixed Water Source
Ground Water Source
Antelope
Inventory Units
N
0
3,000
6,000
12,000
Feet
SITE
Tehama County, California
TITLE
Antelope Sub-Basin Key Wells
BROWN AND CALDWELL
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1-2
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domestic wells with an average depth of 82 feet bgs, and 44 irrigation wells with an average depth of 125 feet bgs.

There are currently no monitoring wells in the northeastern corner of the Antelope sub-basin reflecting that no wells are monitored in that area. This may represent an area within the sub-basin where an additional monitoring well may eventually need to be established to begin to develop a groundwater level history in the southwestern area.

Step 3: Designate the time of seasonal measurement

Groundwater levels fluctuate seasonally, and measurements from the different seasons provide different snapshots of groundwater conditions. Spring measurements provide information on whether the basin has recharged during the wet season to elevations observed in previous years. Typically, spring water levels are the highest water levels observed during the year. Summer and fall water level elevation measurements provide information about decreased water levels during groundwater pumping and illustrate the cumulative pumping impacts from a sub-basin within a season.

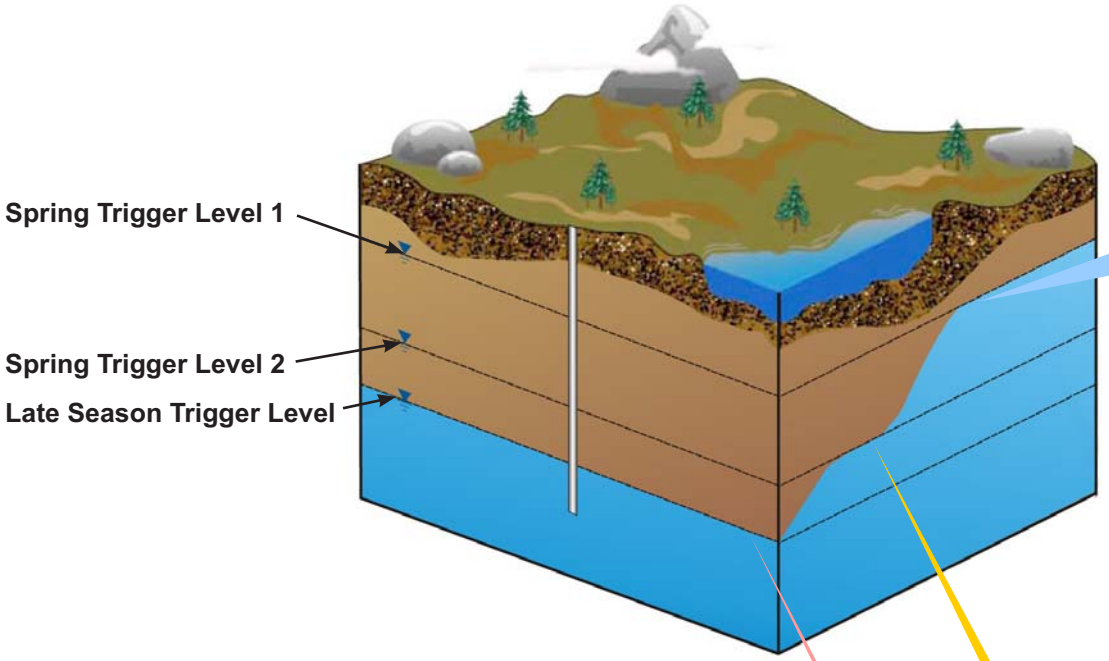
The District suggests that spring measurements be used to set trigger levels with associated awareness actions, and late season measurements (summer and fall) be used to set an additional trigger level with associated awareness actions that is sensitive to groundwater levels during the seasons of heavy groundwater use and can provide a warning of potential issues such as increased groundwater demand.

Steps 4 and 5: Establish trigger levels in selected key wells and define awareness actions associated with each trigger level

Trigger levels act as an early warning system for identifying potential problems. A trigger level corresponds to a predetermined target groundwater level during a season of measurement. For example, if a trigger level is set at a water surface elevation of 50 feet below ground surface (bgs) in the spring, then only spring measurements should be compared to the trigger level. A spring measurement of 40 feet bgs would not require an awareness action in this case. A spring measurement of 60 feet bgs, on the other hand, would be below the trigger level, and should prompt awareness actions (Figure 1-3).

Sub-basin representatives review and provide input on the proposed trigger levels within their sub-basin and the awareness actions associated with each level. Potential trigger levels, and the accompanying awareness actions, may range from a small decrease in groundwater levels compared to historical levels, indicating a need to disseminate information or further investigation of groundwater levels to a larger change in groundwater levels, indicating a need to take action to stop or reduce the lowering of groundwater levels.

For each trigger level, sub-basin representatives should work with local groundwater users and the District to implement the awareness actions associated with the trigger level. Management actions may include providing information on trigger level exceedance to the public, investigating the trigger level exceedance, and taking action to remedy the issue.



AWARENESS ACTIONS

Spring Trigger Level 1 Awareness Actions

ONE YEAR BELOW TRIGGER LEVEL 1

- TAC meetings to address issues in the area
- Water user/stakeholder meeting for the subbasin
- Send mail to known water users in subbasin, notifying them about a overall decrease in water levels or quality in the subbasin
- Notify public of groundwater issue
  - County to make a press release
  - Updates to the District website
  - District to attend agriculturally related and city meetings
  - Site visits
- Review recent precipitation trends to look for drought trends

CONSECUTIVE YEARS BELOW TRIGGER LEVEL 1

- Continue to inform water users and general public
- Verify data
- Increase monitoring frequency in subbasin
- Add new monitoring location in subbasin
- Begin monitoring land subsidence
- Install data loggers
- Investigate cause of low groundwater levels

AWARENESS ACTIONS

Spring Trigger Level 2 Awareness Actions

- Continue Spring Trigger Level 1 Awareness Actions
- Solicit voluntary public involvement in resolving issues in the area
- Consider groundwater recharge efforts
- Review condition of approval for new development reliant on groundwater by the County
- Review of the County's approval process regarding water supply for development or additional groundwater pumping projects
- Increase land subsidence monitoring

AWARENESS ACTIONS

Late Summer Trigger Level Awareness Actions

- Perform Spring Trigger Level 1 and 2 Awareness Actions
- Investigate potential higher groundwater demand or other causes

Figure 1-3
Trigger Levels and Awareness Actions

Suggested trigger levels and corresponding awareness actions were selected by the TAC and the District to provide the appropriate level of management in response to exceedance of trigger levels. The trigger levels and corresponding awareness actions should coincide with the severity of groundwater issues in the sub-basin. Figure 1-3 shows two suggested spring trigger levels and one suggested late season trigger level with corresponding actions. The methodology for the suggested trigger levels is provided in Table 1-1. A summary of associated awareness actions include:

Spring Trigger Level 1: The first trigger level would cause the dissemination of information to the public about the potential groundwater issue. Additional awareness actions are triggered by a second consecutive year of groundwater levels at or below Spring Groundwater Trigger Level 1.

Spring Trigger Level 2: The second and deeper spring groundwater trigger level would lead to increased monitoring activities and continued public information on the groundwater condition plus investigations and the development of actions to remedy the groundwater issue.

Late Season Trigger Level: The late season trigger level would cause the dissemination of information to the public and the beginning of investigations to understand the cause. Late season measurements are sensitive to groundwater levels during the seasons of heavy groundwater use and can provide a warning of potential issues such as increased groundwater demand.

Figures 1-4 through 1-18 present hydrographs and suggested trigger levels for each of the five Antelope key wells. The figures are groundwater level hydrographs, showing water level elevation measurements over the monitoring period of record and the suggested trigger levels during a particular season. On each figure, the date of measurement is indicated on the bottom axis, the depth to water below ground surface in feet is on the right vertical axis, and the water surface elevation is indicated on the left vertical axis. The methodologies used to determine the suggested trigger levels for the key wells in the Antelope sub-basin are provided in Table 1-1.

Table 1-1. Trigger Level Methodology

Groundwater Trigger Level and Awareness Action	Antelope Monitoring Well Number				
	10B01M	16N02M	23D01M	31C01M	17E01M
Spring Trigger Level 1 – Notify and Inform Public	Historical low of spring measurements plus 20 % of the range of spring measurements				
Monitor and investigate Cause	Second consecutive year of groundwater levels at or below Spring Trigger Level 1				
Spring Trigger Level 2 – Consider Management Options	Historical low of spring measurements				
Late Season Trigger Level – Notify public and begin investigations	Historical low of late season groundwater measurements				
Data Anomalies	None	None	None	None	None

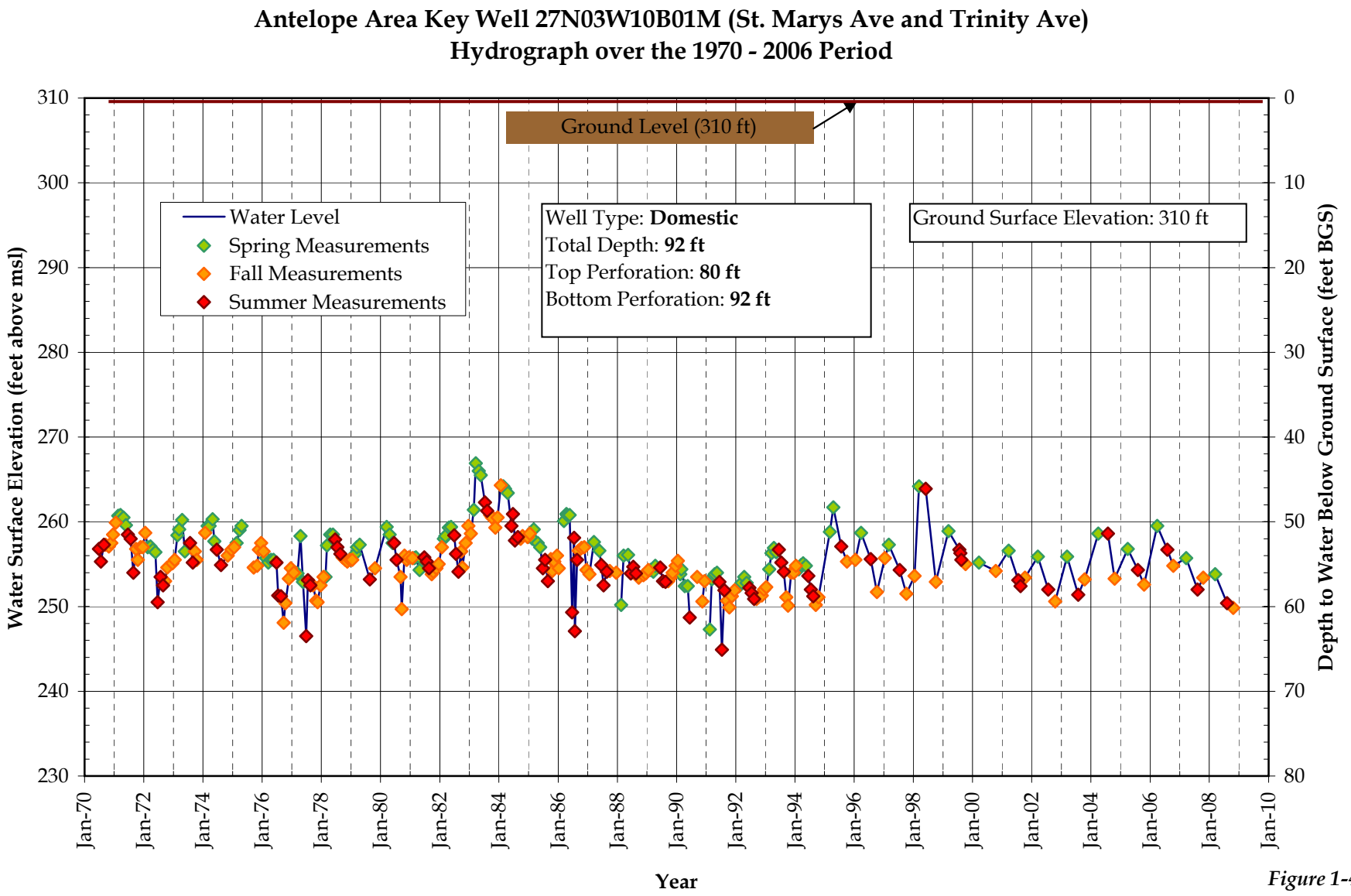


Figure 1-4
Hydrograph of Key Well 27N03W10B01M

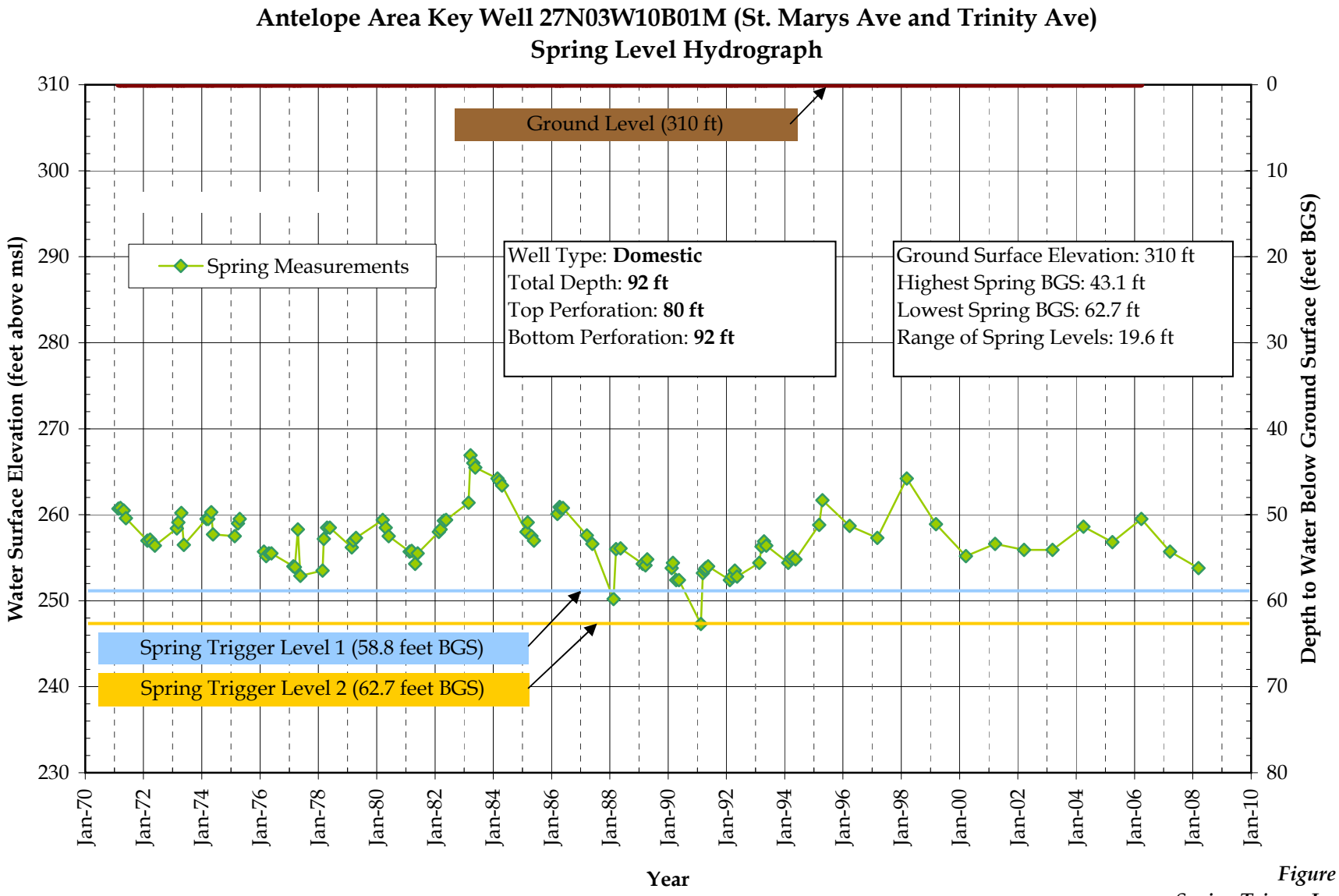


Figure 1-5
Spring Trigger Levels

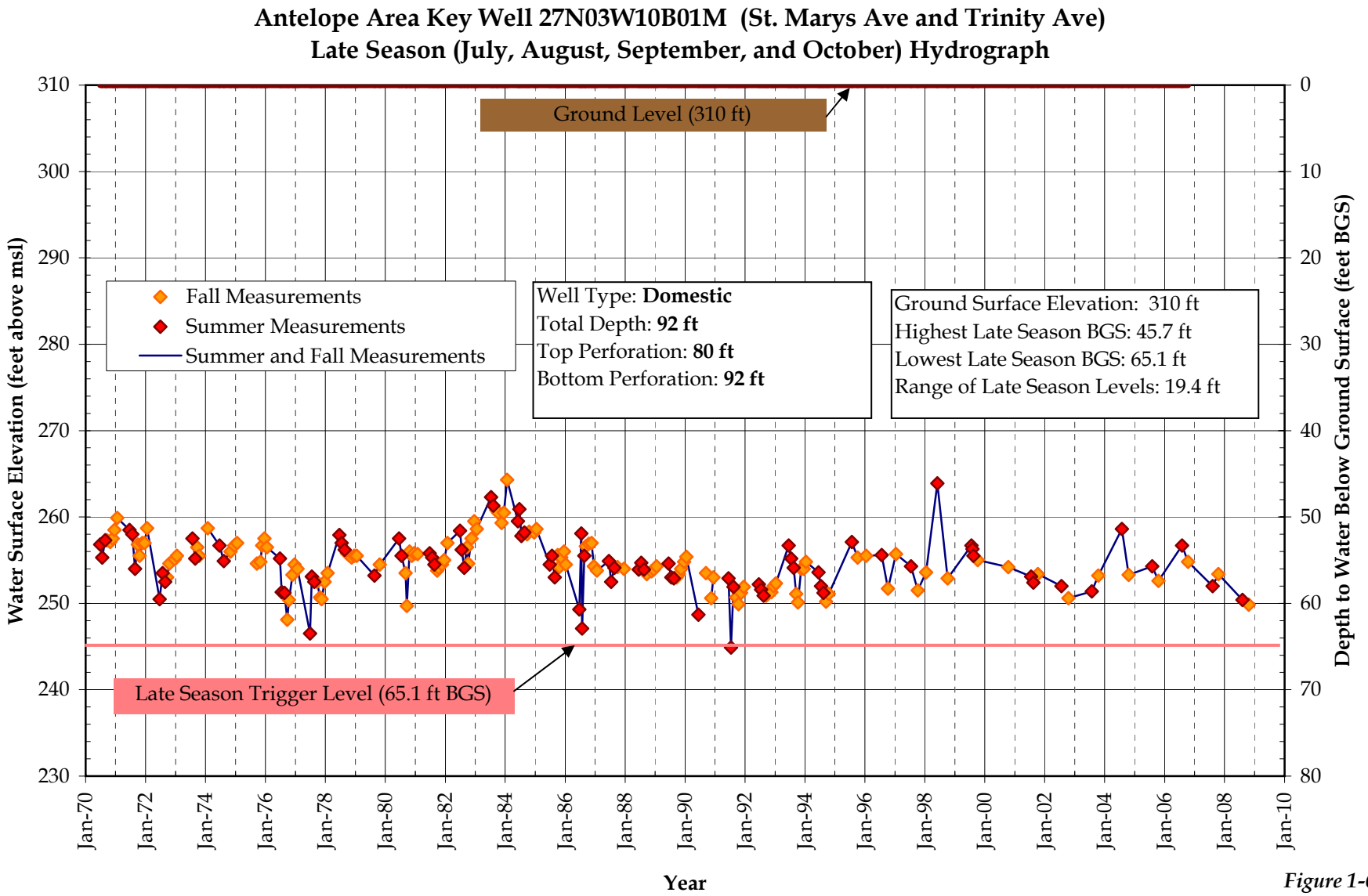


Figure 1-6
Late Season Trigger Levels

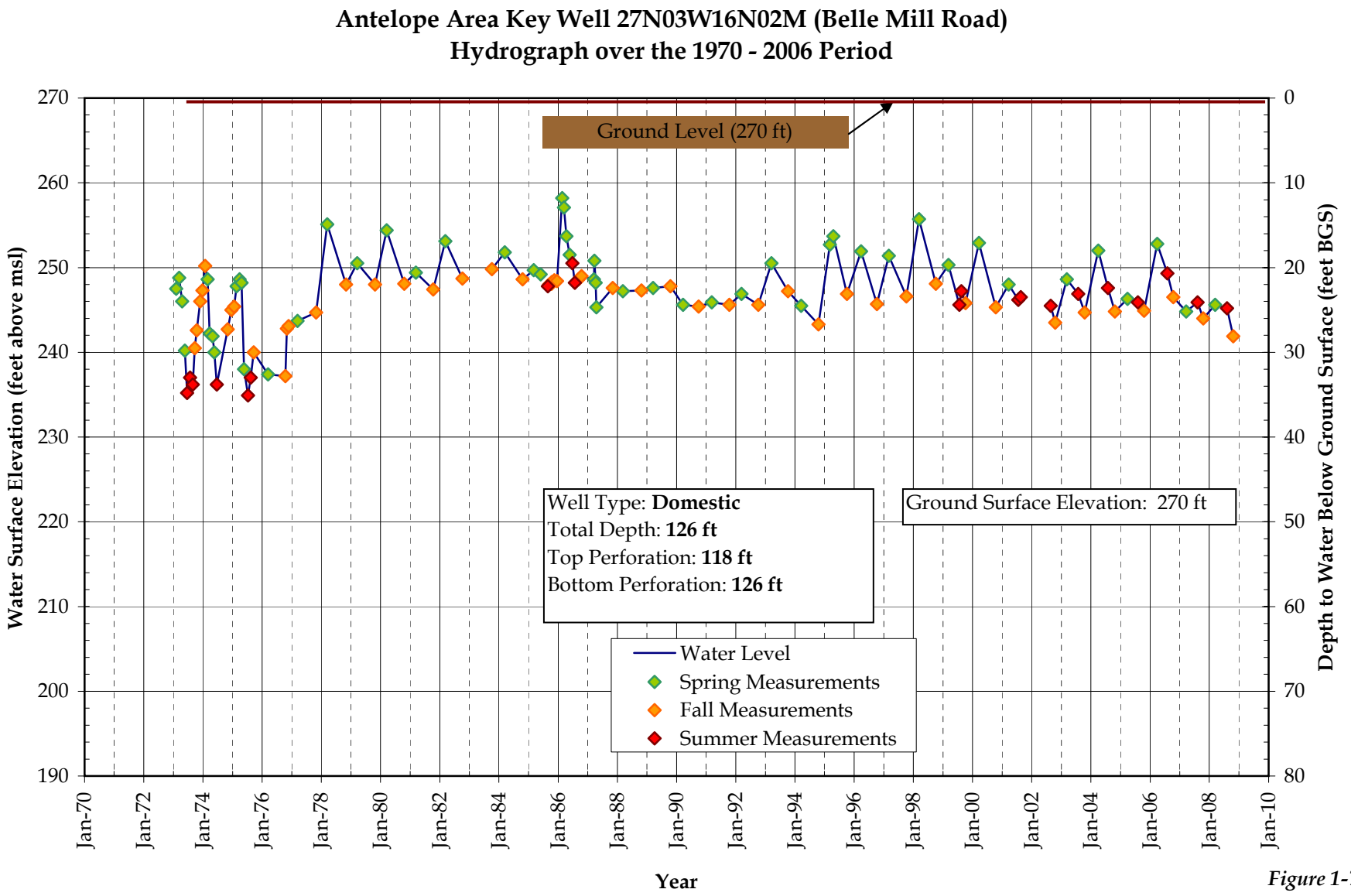


Figure 1-7
Hydrograph of Key Well 27N03W16N02M

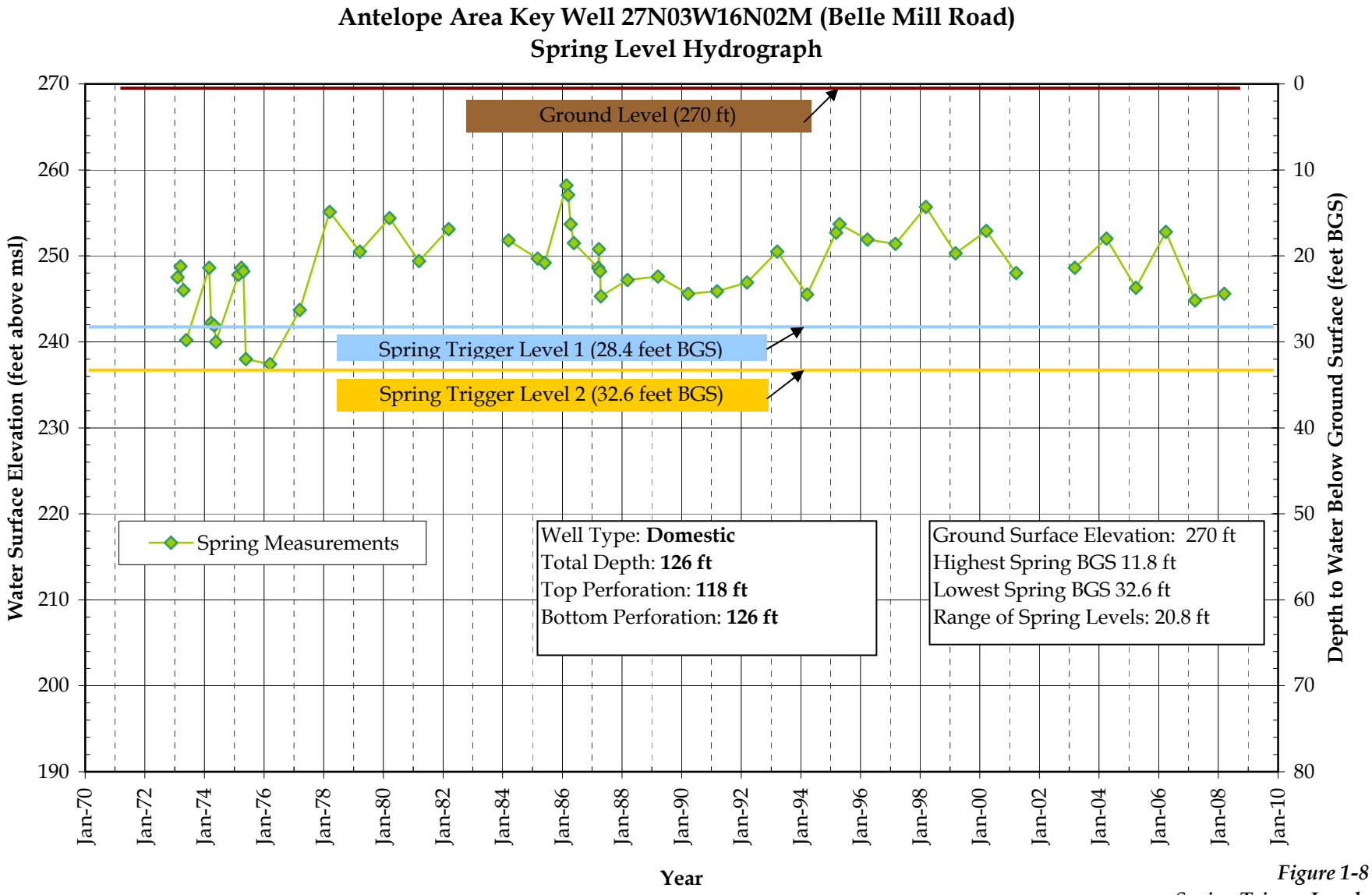


Figure 1-8
Spring Trigger Levels

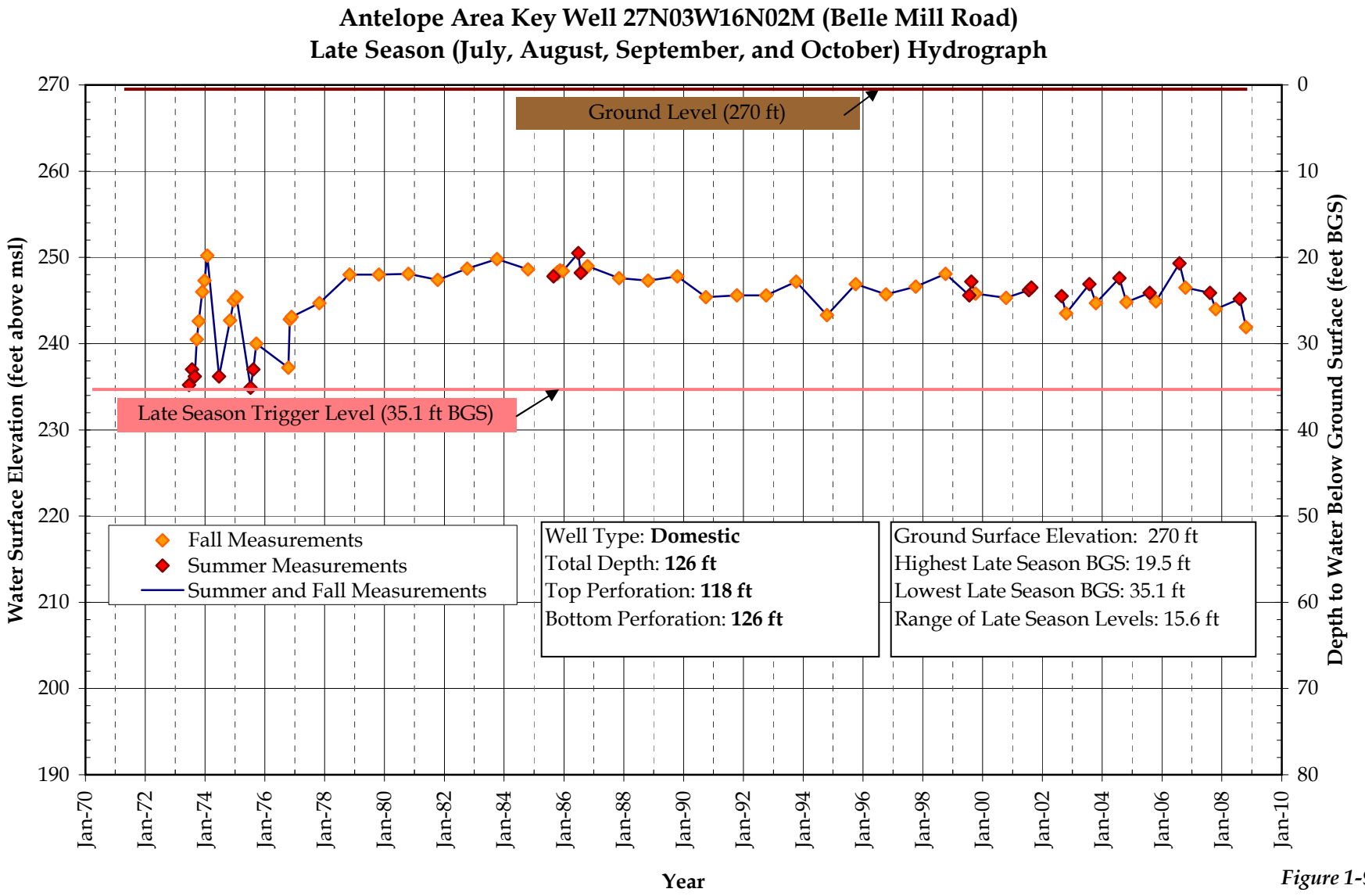


Figure 1-9
Late Season Trigger Level

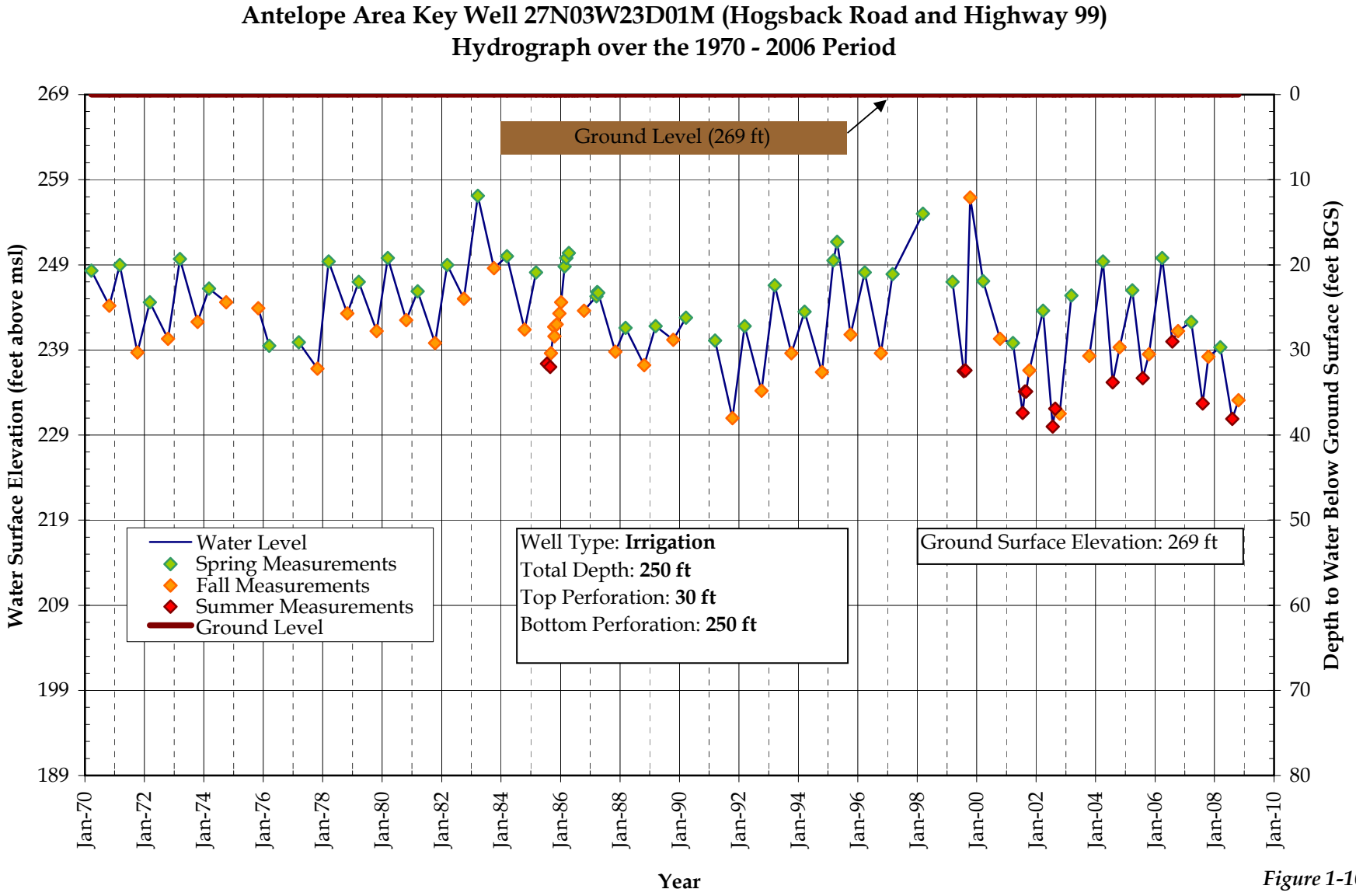


Figure 1-10
Hydrograph of Key Well 27N03W23D01M

Updated 12-01-08

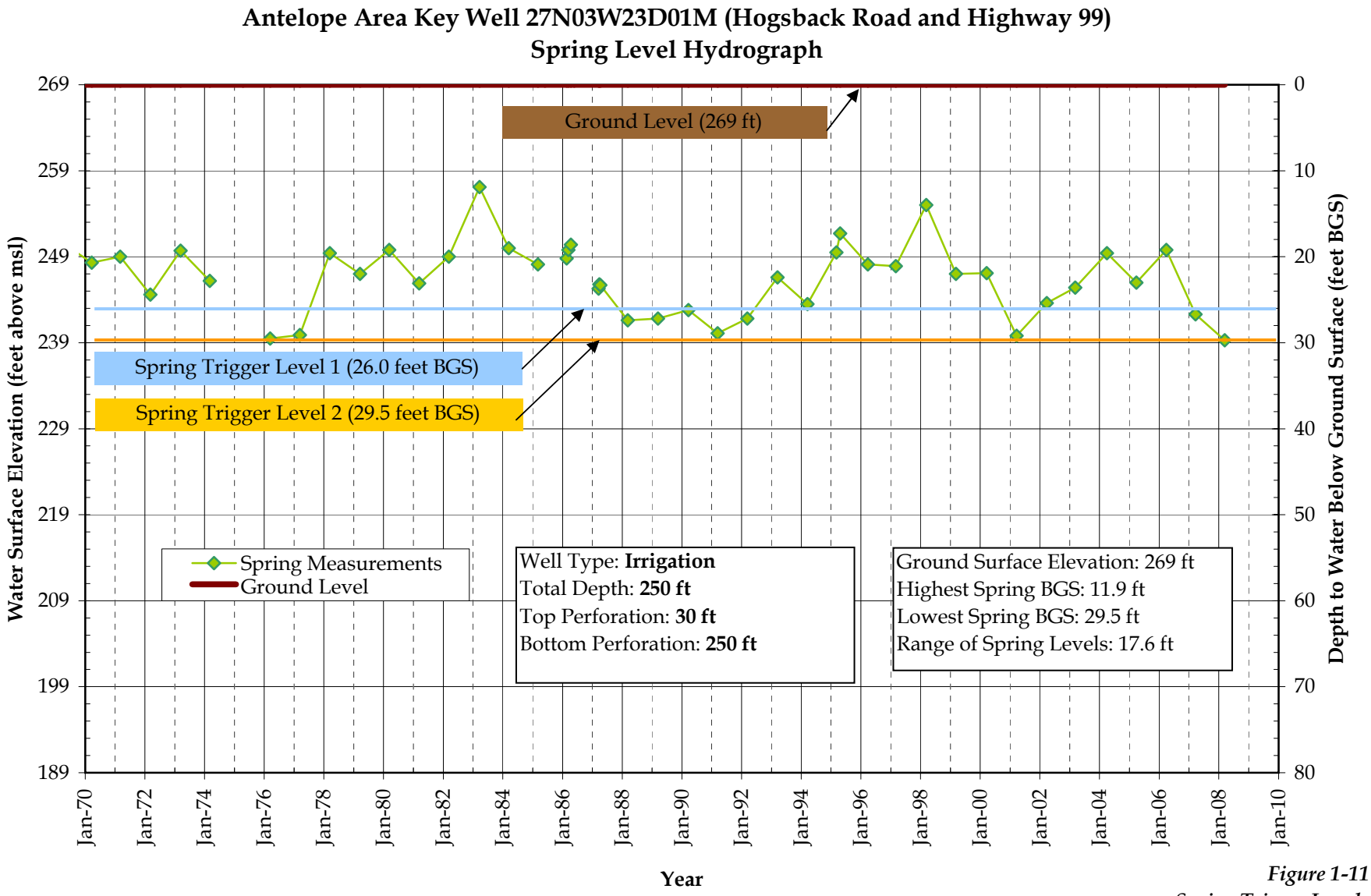


Figure 1-11
Spring Trigger Levels

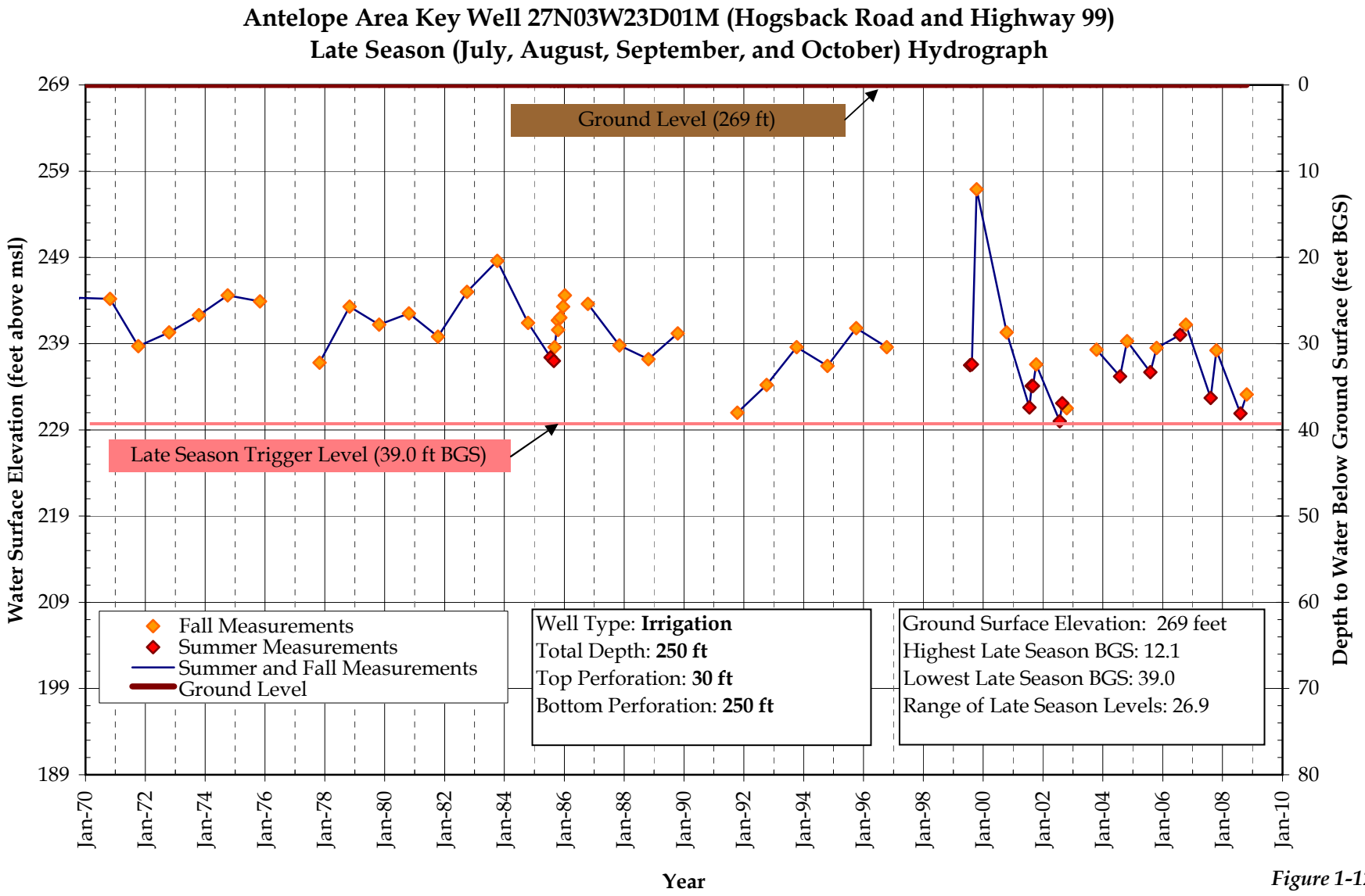


Figure 1-12
Late Season Trigger Levels

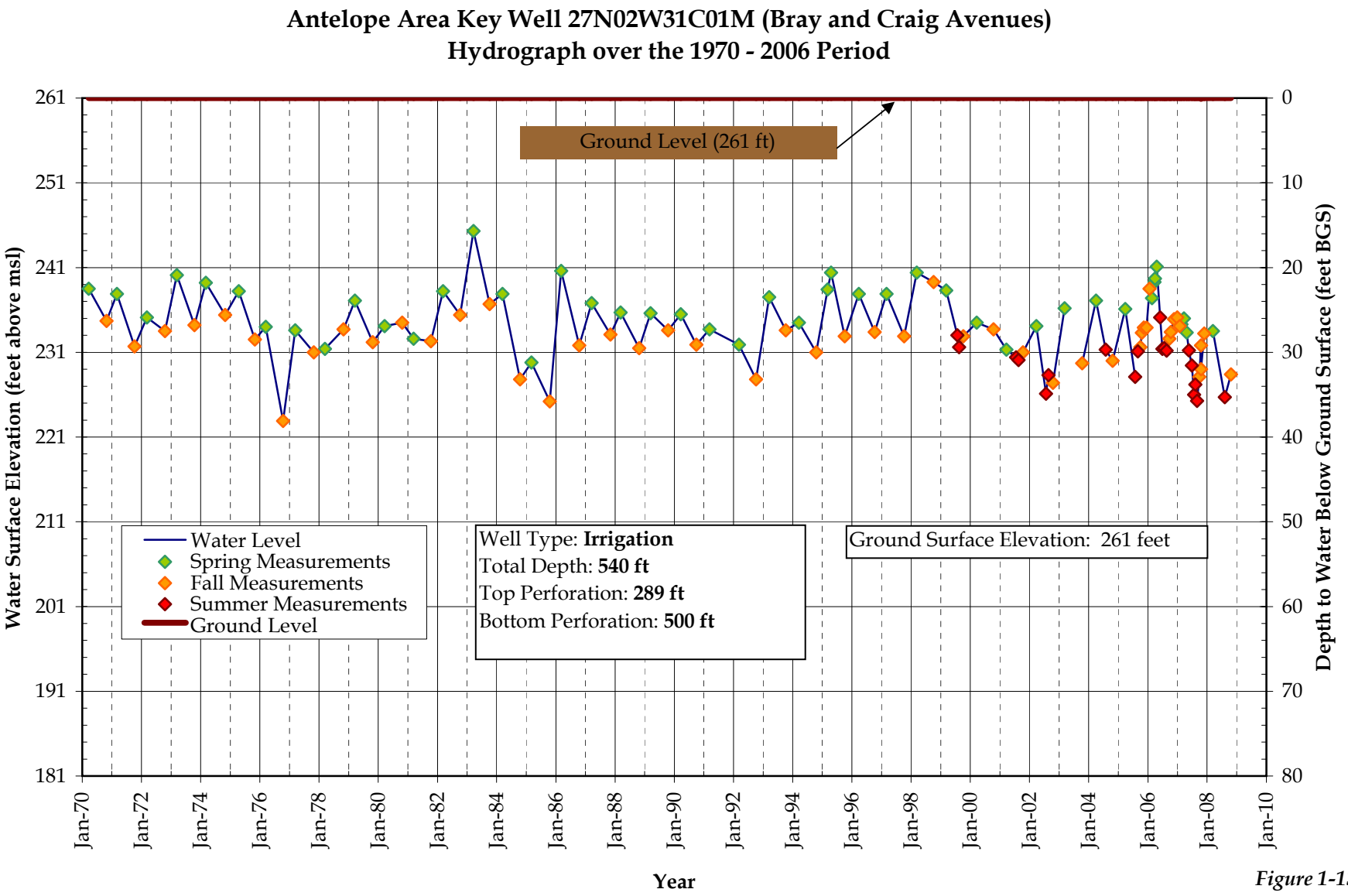


Figure 1-13
Hydrograph of Key Well 27N02W31C01M

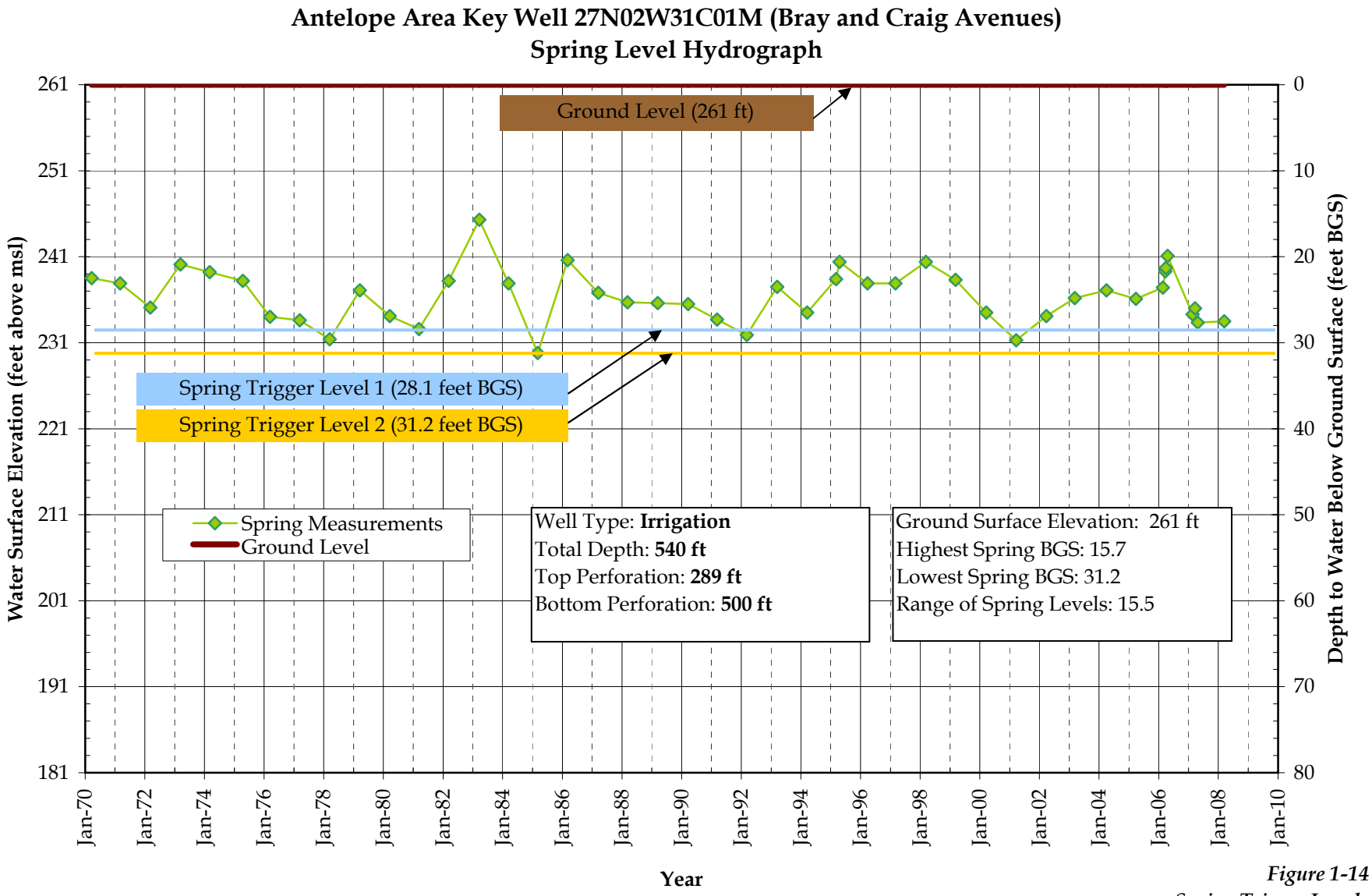


Figure 1-14
Spring Trigger Levels

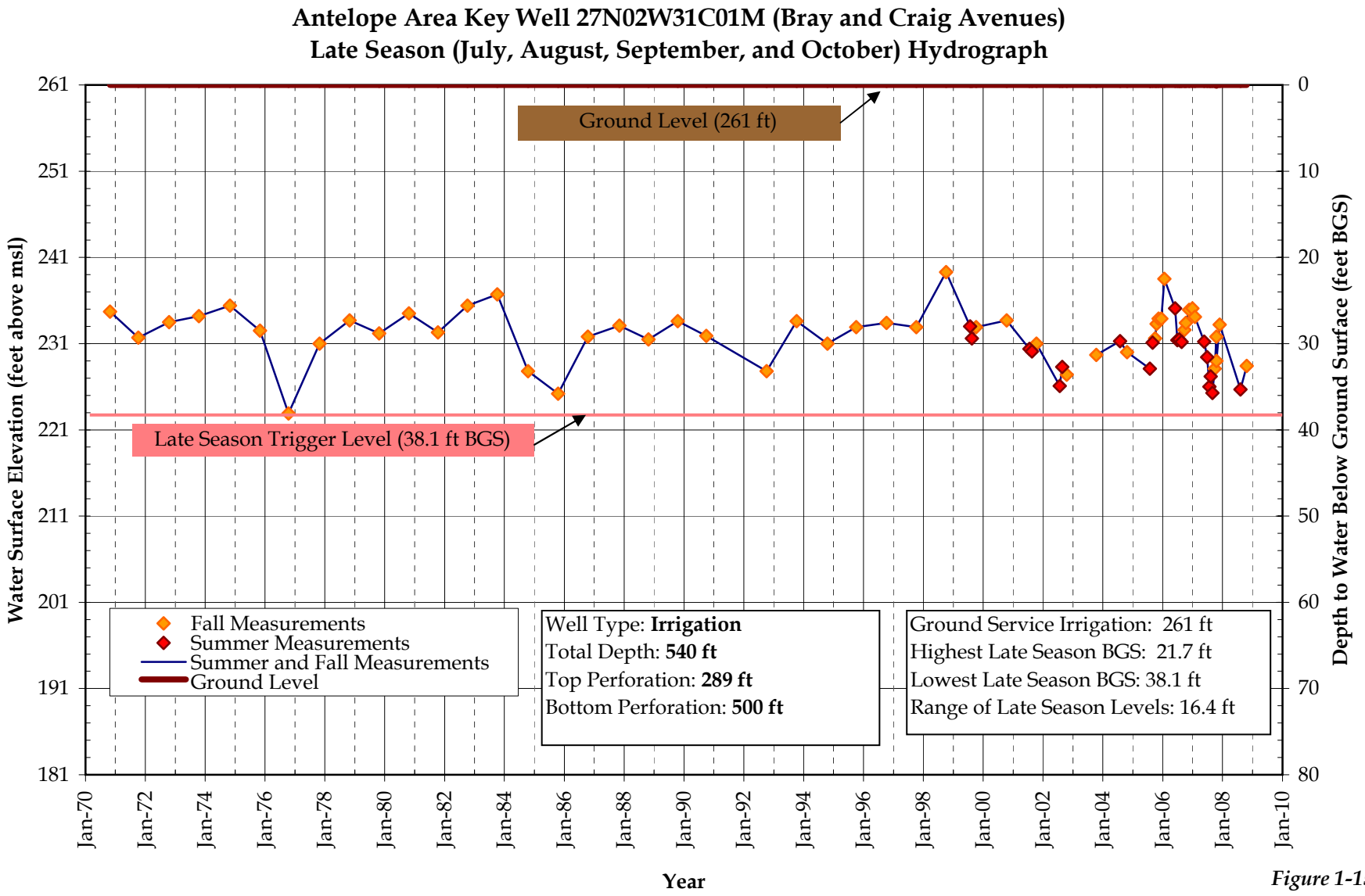


Figure 1-15
Late Season Awareness Stage

Antelope Area Key Well 26N02W17E01M (Le Claire and Decker Avenues)
Hydrograph over the 1970 - 2006 Period

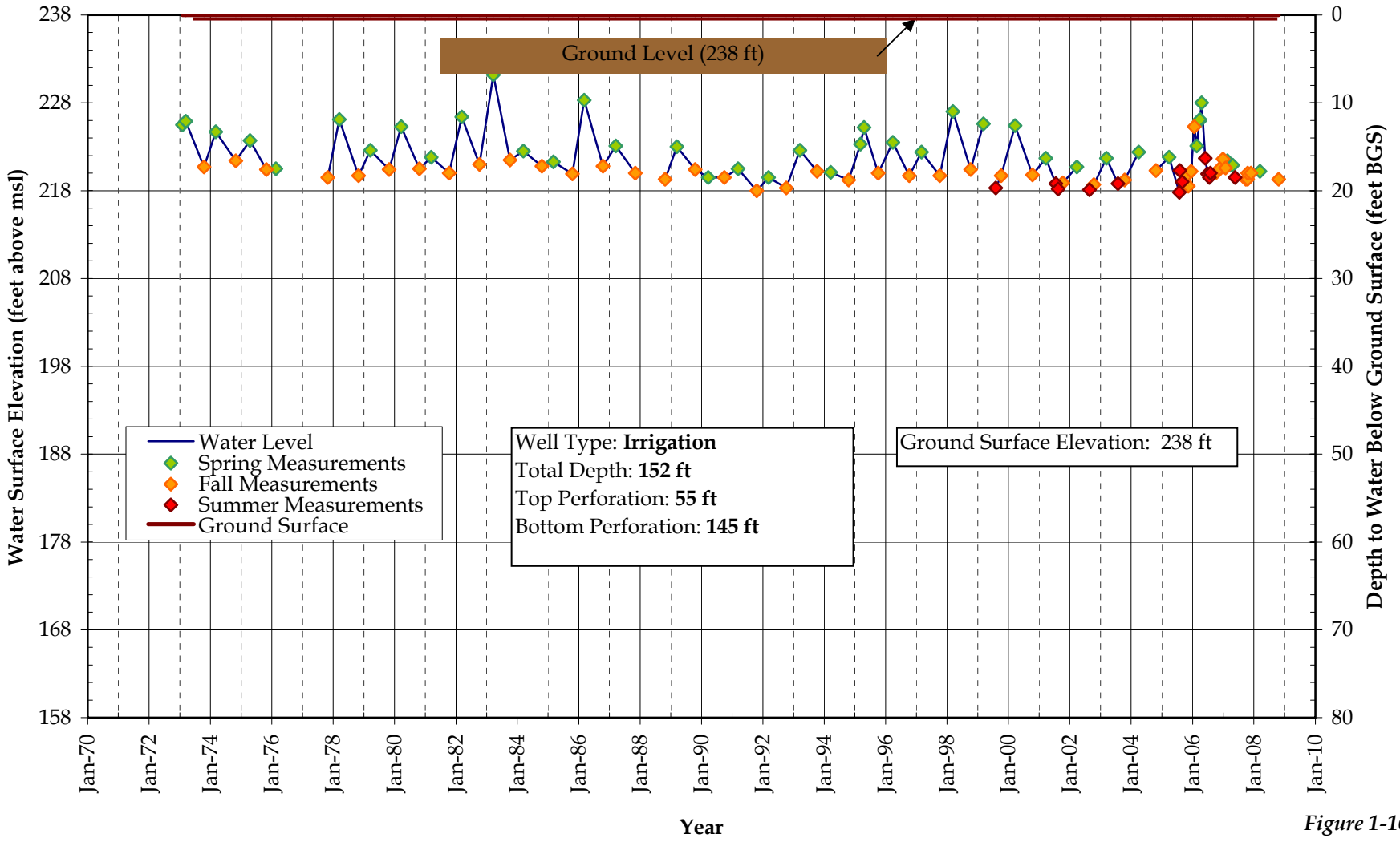


Figure 1-16
Hydrograph of Key Well 26N02W17E01M

Updated 12-01-08

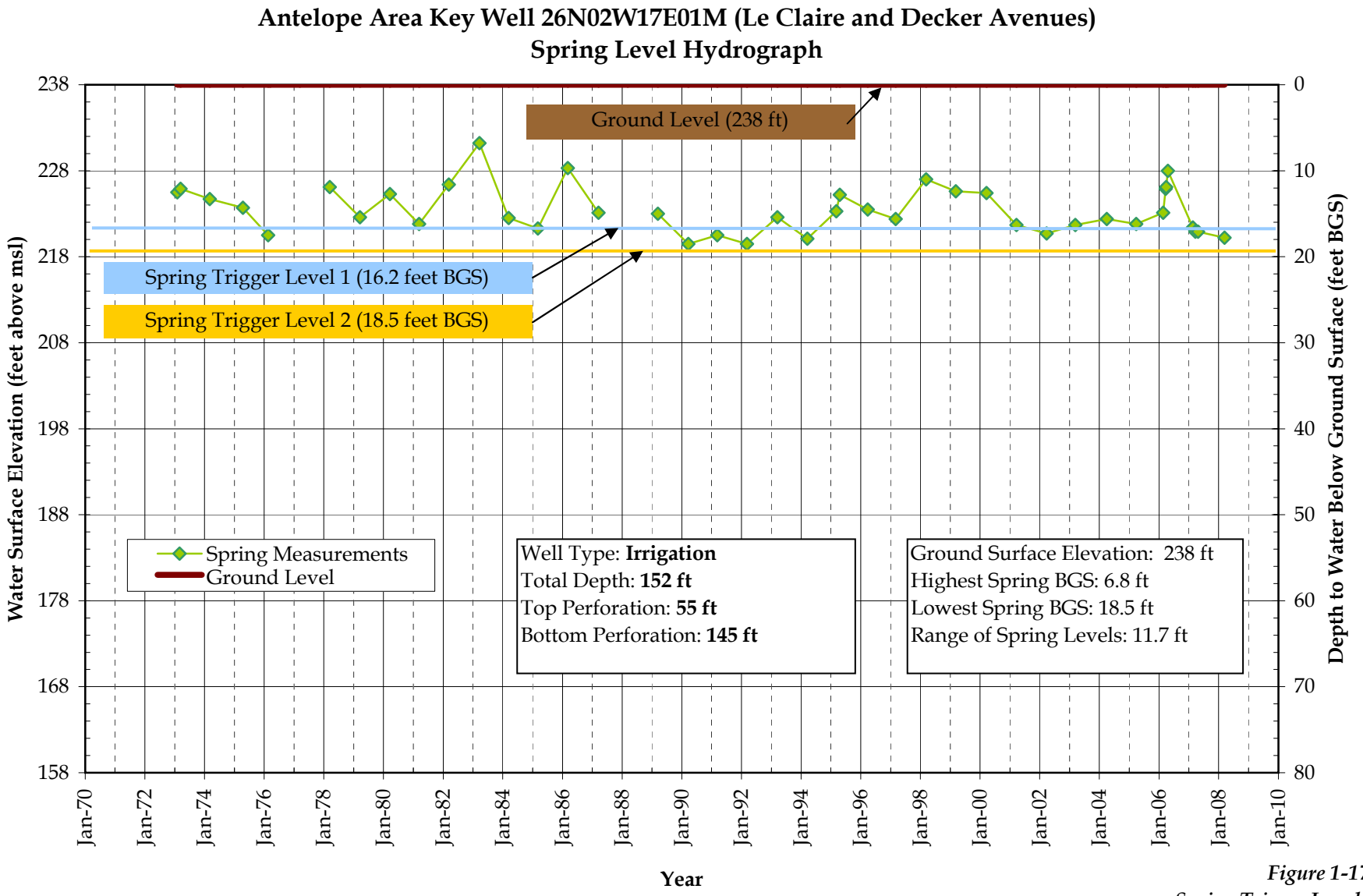


Figure 1-17
Spring Trigger Levels

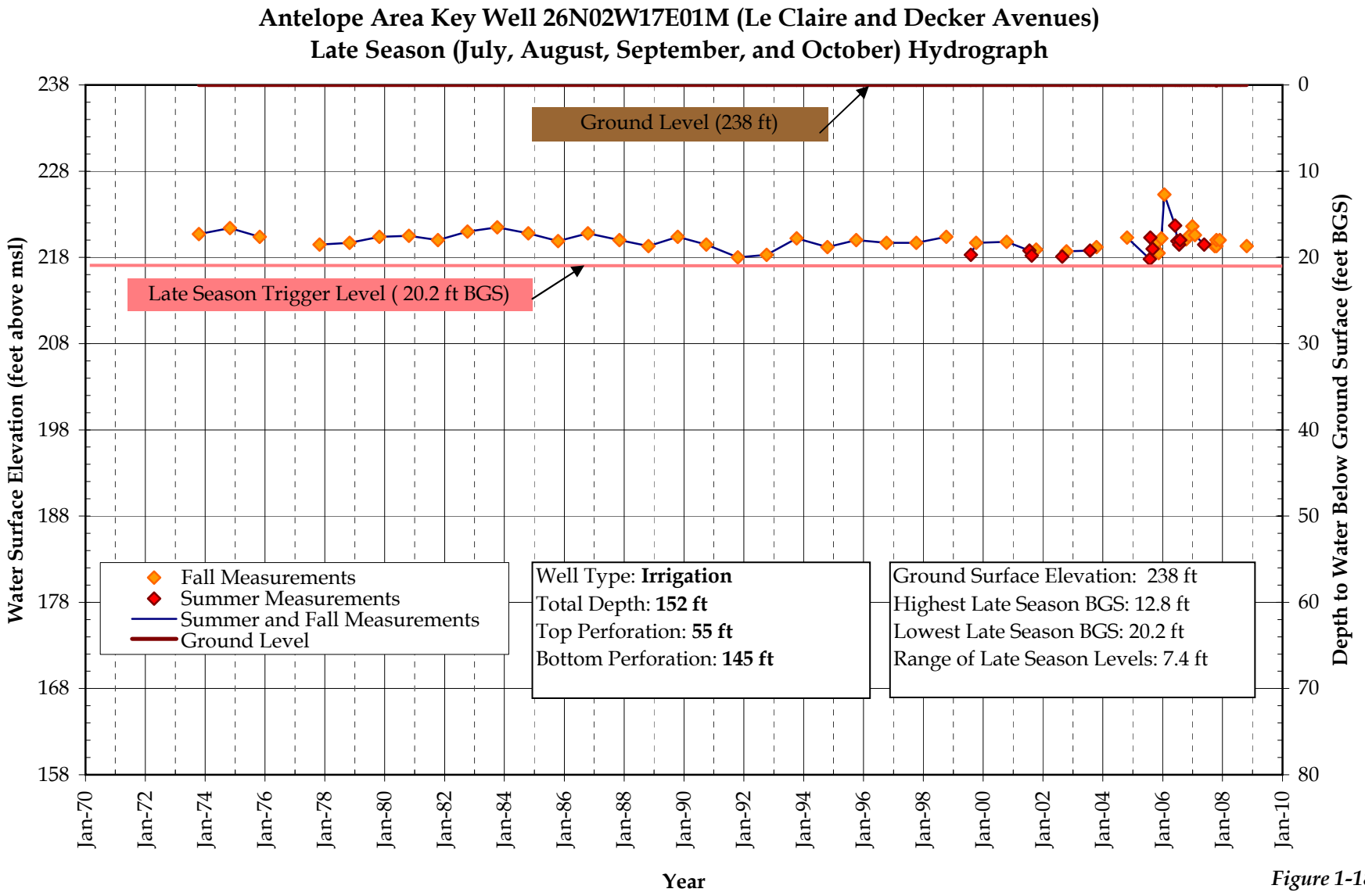


Figure 1-18
Late Season Trigger Levels