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TECHNICAL MEMORANDUM

TO: Gary Spackman, Hearing Officer, Idaho Department of Water Resources

CC: Sean Vincent, Dennis Owsley, Mike McVay, Jeff Fereday, Bill Brownlee

FROM: Ed Squires, Mark Utting, and Loren Pearson of Hydro Logic, Inc.

DATE: April 1, 2009

SUBJECT: Response to IDWR's March 2, 2009 Staff Memorandum On M3 Eagle Hydrogeologic Studies

This Technical Memorandum and its attachments are submitted pursuant to the Hearing Officer's February 10, 2009 Order in this matter ("February 10 Order") authorizing parties to submit documents, technical information, or data to respond to other parties' technical reports, including the memorandum submitted by Dennis Owsley and Sean Vincent (the IDWR "Staff") March 2, 2009 ("Staff Memo"). The above staff from Hydro Logic, Inc., ("Hydro Logic" or "HLI"), with input on particular matters from Dr. S.H. Wood, Professor Emeritus, Boise State University; Peter Schwartzman of Pacific Ground Water Group ("PGG"); Richard Glanzman of Glanzman Geochemical; and Dr. James Osiensky of the University of Idaho, have prepared this Technical Memorandum on behalf of Applicant M3 Eagle LLC ("M3 Eagle") in response to the Staff Memo.

HLI appreciates the opportunity to respond to the Staff Memo's comments, questions, and observations about the hydrogeological system in the North Ada County area with respect to our ongoing research in the area and the studies we have completed concerning it. The Staff have provided an important service to the Department and the parties interested in the proposed use of ground water for the M3 Eagle planned community north of Eagle, Idaho ("M3 Eagle" or "M3"). This Technical Memorandum, which is intended as a response to the Staff's questions and uncertainty, we hope will shed additional light on the resource and potential effects of development for all interested parties and future investigations in the area.. We have included one new map (Figure 1) showing the locations of wells referenced in the Staff Memo and the wells we refer to in this Technical Memorandum.

The Staff Memo presents comment under four topics listed in the Hearing Officer's December 8, 2008 *Request for Staff Memorandum*, which asked the Staff to: a) make "a full analysis of the methods of gathering data, the data presented, and results of the . . . tests or modeling . . . submitted by the parties"; b) make "[a] secondary review of any review and analysis of the original documents submitted by the parties"; c) present and analyze "additional data available to Department staff to enhance the hearing officer's understanding of the hydrogeology and aquifers" in the area; and d) make "[c] onclusions about the impacts on other water users and aquifers caused by pumping of ground water as proposed" by M3 Eagle.

Often the Staff discusses a subject (the potential effects of structural geologic faulting, for example) under more than one of these headings. For this reason, this Technical Memorandum is organized according to the substantive hydrogeological matters the Staff Memo addresses, rather than the four tasks listed by the Hearing Officer. These are:

1) The North Ada County area's stratigraphy.
2) Geologic faults and their potential effects on ground water production.
3) Aquifer continuity between the Boise and Payette river basins.
4) M3 Eagle's aquifer testing.
5) Pierce Gulch Sand Aquifer boundaries and recharge sources.
6) Water levels (heads) and trends in the PGSA.
8) M3 Eagle's modeling of the PGSA.
9) Aquifer sustainability and future studies of the PGSA.

With regard to a particular subject, what we understand to be the Staff's primary comments and contentions are set out as indented, bold material. Our response follows in each case.

1. <u>The North Ada County area's stratigraphy.</u>

Staff states that "a highly productive sedimentary aquifer exists beneath a portion of the M3 property, that the stratigraphy here "is complex, consisting of a thick sequence of coarse and fine grained sediment layers that pinch out and are faulted," and that "the Pierce Gulch Sand (PGS) Formation" was defined by previous investigators "Othburg [sic] and Stanford." Staff Memo at 1 and 3.

The stratigraphy in this area is not particularly complex, although it may appear so on a cursory look. While we address the issues of faulting in some detail later in this Technical Memorandum, there prevailing evidence is that the deep basin structural faulting does not break the sands of the PGSA. There is also no evidence to indicate faulting and/or thinning of strata affect the productivity and sustainability of the Pierce Gulch Sand as a significant aquifer unit in the M3 area. The research cited above by the Staff did neither define, nor even address, the PGSA.

While Staff presumably is referring to the Pierce Gulch Sand Aquifer ("PGSA")—which is highly productive—other productive aquifers also exist beneath the M3 property, including the Terteling Springs Aquifer, the Willow Creek Aquifer, and as yet undifferentiated and/or unnamed aquifers overlying the PGSA See Figure 6,of Hydro Logic, Inc., 2007). M3 Eagle's intention to develop ground water from the PGSA is the main focus of both the Staff Memo and this Technical Memorandum.

The Staff does not explain what is intended by the term "complex," or what it might mean with regard to the availability of ground water at this site to support the M3 Eagle development. In any event, we do not consider the stratigraphy in this area to be overly complex, although it may appear so on a cursory look. Our evaluation of numerous geophysical logs and well bore cuttings have confirmed the conclusions contained in the geological investigations conducted in this area by Dr. S.H. Wood, Mr. Willis Burnham, and others. The logs and drill cuttings confirm the presence of extensive coarse permeable sands of the PGSA (and the Willow Creek Aquifer) and the less permeable underlying mudstones. The depositional environment is that of a delta prograding into a lake basin, as originally discussed in Wood (1995); Squires and Wood (2001); Wood and Clemens (2002); and Wood (2004). Geologic processes of erosion, lacustrine deposition, and fluvial action spread sediments in a wide swath across the basin. The geophysical logs confirm an expected sequence of units that fit the long-term conceptual model for the basin that has been developed by several workers over the last 30 years. The alternating layers of sand, silt, gravel, clay and mudstone are systematic layers typical of a lacustrine delta depositional system.

Othberg and Stanford (1992) compiled some of the mapping done earlier by S.H. Wood and W. Burnham, but did not define or investigate the PGS. Othberg and Stanford did not even map the Pierce Gulch Sand in the Eagle USGS quadrangle, although it outcrops there. Rather, their work focused entirely on the terrace gravels, which lie above the PGS and are not involved in M3 Eagle's application.

The PGS has not yet been formally classified with respect to the regional geologic section. We currently consider the unit as a Member of the Glenns Ferry Formation. Based on our understanding of the various formations and stratigraphic marker beds in southern Idaho, and the naming conventions involved, we do not believe it technically correct to refer to the PGS as a Formation at this time.

Staff suggests that these sediments may be "faulted." We take up the issue of faulting in more detail below, but note here that, with perhaps one exception, there is no evidence that the major faulting in the deep volcanic basement rocks, including that detected by the magnetometer survey conducted by M3 Eagle in 2007, offsets, or even breaks, the shallower water bearing units including the PGSA. The available evidence actually shows the opposite, that the deep-seated faults do not propagate to land surface or penetrate the younger sediments above, as shown by seismic reflection studies (see Figure 2 of this report and Figure 16 of Wood and Clemens, 2002).

An exception is the mapped, basin-bounding, West Boise-Eagle ("WBE") fault extending into, and apparently truncating, the sedimentary section. The WBE Fault, the trace of which generally is aligned with the Willow Creek Road at the NE boundary of the M3 Eagle properties, is already accepted as the sedimentary basin margin and a boundary of a portion of the PGSA in the area north of the Boise River where the aquifer meets the mountain front east-southeast of the M3 Eagle property. The WBE fault does not establish an aquifer margin for the PGSA on the M3 Eagle property. Its boundary effect, if any, is accounted for in HLI's hydraulic testing and modeling discussed elsewhere in this Technical Memorandum.

> **At page 6, the Staff Memo states that "the delineation of the hydrostratigraphy based on available geophysical and geologic data is a detailed, difficult, and subjective undertaking. Moreover, it is unclear based on our analysis of the presented data whether the PGS is a distinct, laterally continuous layer, as conceptualized by HLI, or if it possibly merges with overlying undifferentiated sediments basin ward [sic] and/or is hydrologically compartmentalized by faults."**

The delineation of the hydrostratigraphy in this case has involved a considerable amount of data gathering and analysis, some of it detailed, but the undertaking has been neither particularly difficult nor characterized by subjectivity. The geology and stratigraphy in this area have been studied for some 30 years and there is much known about it. This work has been based on objective data and credible scientific conclusions from a number of researchers. In the data submitted to the Staff, we clearly show the Pierce Gulch Sand Aquifer to be a widespread feature that can be correlated over much of the western plain, and in particular to the Payette River Valley (Figures 3 and 4). There is no evidence for "compartmentalization" of the PGSA by faults.

As to the possibility that the PGSA "merges" with overlying sediments, this is not news. We believe, and have noted in reports dating back at least 7 years, that at some locations the PGS does merge with overlying sands and is in hydraulic communication with overlying aquifer units. This is not possible beneath the M3 property, though, because, for the most part, the overlying sands at M3 are unsaturated. Where the PGSA does merge with overlying aquifer units, such a merging would serve to increase both the transmissivity and storativity of the aquifer. This is part of what we have postulated with regard to the PGSA's contact with the sand dominated section in the Payette Basin. Again, the evidence in published reports, together with the recent studies we have compiled, supports the conclusion that the PGSA is laterally extensive and hydraulically interconnected over a regional scale. All new evidence we have uncovered continues to point to this conclusion; we do not subscribe to the Staff's apparent belief that there is a lack of clarity with respect to this issue.

A major feature of the western Snake River Plain sedimentary basin fill is the progradation of sand deltas and river floodplain deposits over the thick lacustrine mudstone deposits, late in the history of Pliocene Lake Idaho. The deltaic sand deposits have long been recognized (Wood, 1994) as forming the important sand aquifer systems of the western plain (Wood and Clemens, 2002). A key feature that allows recognition of a prograding delta system is the upward coarsening sedimentary sequence of the prodelta mudstones, overlain by thick sand layers interbedded with the thinner mudstone layers. This feature is best observed with certainty on resistivity, single-point-resistance or natural-gamma ray geophysical logs.

Hydro Logic has identified this feature on geophysical logs of test wells of the M3-Eagle project, and has correlated the overlying sand aquifer in those wells to the Pierce Gulch Sand, defined in the subsurface by Wood (2004, page 98, Figure 24). This report shows that the Pierce Gulch Sand Aquifer is a widespread feature that can be correlated based on the prograding-delta signature on borehole geophysical logs of deep petroleum wells (Wood, 1994, p. 105, Figure 2) over much of the western plain, and in particular to the Payette River Valley (Figures 3 and 4).

The PGSA is characterized by relatively thick sand layers, with interbedded lower permeability silts and/or mudstone. Sands are shown to be coarse-to-medium-grained in the Star Well #3, M3 wells, and the UWID Swift Well. Farther into the basin the delta sands are finer-grained (see for example Wood (1994, p. 112, Figure 7). While grain size is not specifically stated, one can infer sands are coarse grained in the Payette River Valley, Virgil Johnson #2 well, using geophysical logs and drill-cuttings. The cuttings description published by Newton and Corcoran (1963, p. 40) describes the basal sand unit (410-520- ft depth) as arkosic sandstone. The arkosic nature of sand would most generally be associated with coarse sand. The interbedded and relatively thin, mudstones are a common feature of deltaic sands, either as mud drapes or mud deposits between sand-delta lobes. On the borehole geophysical logs (Figure4) the main body of the PGSA is 150-to-200 feet thick.

The top of the Pierce Gulch Sand has not been formally defined and therefore currently is referred to as consisting of "undifferentiated" aquifers and aquitards. That is, the top of the PGSA is defined by an irregular unit in which mudstone layers dominate sand layers in abundance and thickness (Figure 4). In some wells the top of the PGSA is an obvious thick mudstone unit (M3-Eagle Test Well #1, Star Sewer and Water District Supply Well #3, and Oroco Oil and Gas-Ted Daws #1 well, (Figure 4). This overlying lower-permeability unit dominated by mudstones is typically 80-to-200-ft thick, and is overlain by many thick sand units that serve as shallower aquifers. In the deeper parts of the basin the top of the PGSA is based upon the predominance of mudstone and clay layers, but interbedded sands do occur, some of which are up to 30 feet thick (see the Webber-State #1 log (Figure 4). This overlying lower-permeability unit has not been formally named, but it clearly causes some degree of hydraulic confinement of the PGSA as shown by the increasing potential with depth in M3-Eagle Test Well #4, the municipal wells for the City of Star, the artesian-flowing UWID State and Linder Test wells #1 & 2, UWID Island Woods Wells #1 & #2, and the UWID Redwood Creek well in the Eagle-Star area.

> **The Staff suggests it "is difficult to distinguish the PGSA from the 'undifferentiated alluvial aquifers and aquitards' in UWID test wells along the Boise River," and that HLI's cross-sections indicate "a lack of fine-grained sediments that define the top of the PGSA under the M3 property. The absence of a thick, laterally continuous confining layer provides a mechanism for hydraulic communication between the PGSA and overlying undifferentiated sediments." Staff Memo at 4.**

HLI has concluded that there is some degree of vertical hydraulic communication across the geologic section overlying the PGSA and that at least 200 feet of saturated aquifer sand is extensive across the north Eagle area and regionally beyond. However, this leakage is more pronounced east of Eagle where the PGSA aquifer sands rise closer to the surface and where the geologic section is more sand-dominated. This is discussed extensively in a number of the M3 Eagle reports previously submitted to the Department. To the west, however, and under portions of the M3 Eagle property, there is evidence of an extensive confining layer overlying the PGSA that, like the aquifer itself, extends to the Snake and Payette basins and across much of the Treasure Valley as well (Figure 4). Where there is no confining layer, the PGSA and overlying permeable deposits may be considered thicker, more transmissive, and more productive.

The base of the PGSA is clearly identified by the upward coarsening mudstone of the underlying pro-delta facies. The top of the Pierce Gulch Sand is identified by mudstone layers and lenses, and in some places, a relatively thick (100 to 200 feet) mudstone-dominated unit. Evidence for semi-confinement is the change in piezometric levels across this unit, and the generally higher pressures in the PGSA than in the overlying unit of "undifferentiated alluvial aquifers and aquitards." The overlying unit has not been studied in detail, although it is well characterized in geophysical logs in the Eagle area and outcrops in the bluffs on the south side of the Payette River to the west-northwest near Bramwell.

It is appropriate to be as specific as possible about the term "hydraulic communication," especially with respect to time and spatial scales. Based on the data, we conclude that the PGSA is "semi-confined," and that over a very long duration, pressure change and flow may occur in the overlying sediments based on water withdrawals from the PGSA (Squires and Wood, 2001). By "semi-confined," we mean that the PGSA is confined beneath the western edge of the M3 property but where it rises to higher elevations beneath the eastern and northern parts of the property, it is unconfined.

> **"The stratigraphic and geophysical logs for TW#4 do not show a strong correlation with the depiction of the mudstone unit drawn in the cross-section that runs from TW#3 to the UWID State and Linder well." Staff Memo at 4.**

It appears that Staff is searching for a clear definition of the top of the PGSA. We agree that the sediments overlying the PGSA, including some low permeability sediments and some thick, highly permeable sand sequences (depending on the location) are variable across this regionally extensive unit. In some locations, the aquifer has a well-defined low-permeability "top" over tens of square miles. In other areas, such as the State and Linder Test Well, the PGSA's top is less well defined by such low permeability sediments, resulting in a thicker sand section, higher transmissivities and a more productive aquifer.

In any case, the Pierce Gulch Sand Aquifer, its contact with the underlying Terteling Springs Formation mudstone, and a deeper sand aquifer (Terteling Springs Aquifer) are all clearly shown to extend between these wells. The point is that an extensive aquifer approximately 270 feet thick is present across this region and beyond. The fact that the Pierce Gulch sand is even thicker in some locations has been noted in our reports.

> **The Staff asserts that "[t]he stratigraphic profile of SVR#7 (the pumping well for a nine day aquifer test conducted on the M3 property) is not included on the cross-section that bisects Big Gulch. If included, the cross-section would require modification." Staff Memo at 4.**

There is no question that SVR#7 is completed into the PGSA. HLI has submitted <u>five</u> cross-sections that include this well showing this relationship. In any event, we disagree with the suggestion that including the SVR#7 data would change any substantive representation or interpretation of the cross section in question as shown on the cross-sections that do include the SVR#7 well data.

The SVR#7 well was included in five cross-sectional sketches submitted to IDWR, two of which bisect Big Gulch (See Figure 5 of HLI 2007 and cross sections A-A', B-B', E-E', and I-I' submitted to Department on November 26, 2008). SVR#7's geophysical profile also is included in several composite diagrams. We did not include the SVR#7 well on our most recently submitted cross-sections (January, 2008) because adding it would unnecessarily clutter the figure and would not change anything in the interpretation of the stratigraphy. Most importantly, we had more reliable data than the information we were able to obtain about the SVR#7 well. We had drilled and completed two new high-quality test wells in Big Gulch (M3 TW#4 and TW#2) for which we had precise and reliable geophysics.

M3 Eagle did not construct SVR#7. It was already cased and therefore could not be effectively logged. The existing lithologic and geophysical logs for SVR#7 are of poor quality. They were obtained with an uncalibrated geophysical logging unit operated by a driller having what we consider to be insufficient training and understanding of geophysical principles. This unit is an analog device with hard copy output as a pen-and-ink strip chart only. Our attempt to reproduce the original poor quality log response by shrinking down a printout that was several feet long and a foot wide is not the equivalent to a high quality, digitally-acquired log that can be plotted at any scale.

In summary, the area's stratigraphy is well understood in all respects relevant to determining how the PGSA lies across many tens of square miles in the M3 Eagle area.

2. **<u>Geologic faults and their potential effect on ground water production</u>.**

The potential existence and effect of faulting into the PGSA is a central focus of the Staff Memo. We do not believe the PGSA is truncated by faulting, and in this section respond to the Staff's comments on the subject.

> **The Staff Memo states that the "cross-section that bisects Big Gulch does not show the fault between TW#1 and TW#4 that was identified in surface geophysical work contracted by HLI (Wood, 2007)," and that "[t]he offset from this fault could account for, at least in part, some of the differences in elevation of the tops and bottoms of the various strata that are represented as uninterrupted. The identification of faults is important for the characterization of the hydrogeology because faults often affect hydraulic communication between hydrostratigraphic units." Staff Memo at 4.**

These statements by Staff do not reflect a correct analysis of the area's faulting. The "fault" is separate from the WBE Fault; it was not shown on the cross-sections because there is no evidence that this deep-seated fault offset propagates to land surface. There is no apparent interruption in ground water flow maps and no surface topographical feature that would suggest faulting here. The cross-sectional diagrams, which are based on borehole data, suggest that even if there were offsets, they would have to be minimal and insufficient to juxtapose the thick permeable sand strata against low-permeability clay layers in any appreciable amount in our studies of this area, we have found that faults do not often affect hydraulic interconnection within aquifers.

In our opinion, the inferred fault of HLI's magnetometer study does not break the upper sedimentary section, much less offset it significantly. The magnetic anomaly shows only that this fault exists in the deep basement volcanic rocks (approximately 3,000 feet below ground level (bgl)). Much of the fault relief on the basement volcanic rocks is older than 9.5 Ma (see Wood and Clemens, 2002, Fig. 7 and discussion on p. 81), whereas the PGSA sediments overlying the volcanics are much younger. In other words, this deep faulting appears to have predated the prograding delta sequence, possibly by millions of years.

While we agree it is appropriate to identify faulting in the subsurface, it is most important to understand the history of the fault and the amount of offset, if any, it produces in overlying aquifer units. Based upon our studies and review of other findings it is not probable that this inferred fault significantly offsets the PGSA.

In any case, we identified the faulting beneath the M3 Eagle property and discussed its potential effects in our report on the Kling well test. We addressed the possibility for some strata offset and noted that lower transmissivity values obtained in this area from this short aquifer test could be attributed, in part, to the faulting. But lower transmissivity values do not necessarily equate to aquifer discontinuity. Most importantly, the Kling well test produced no evidence of a negative hydraulic boundary in the pumping well drawdown plot. In short, there is no support for a suggestion that faulting offsets the PGSA, much less that it serves as a no-flow boundary as Staff perhaps implies in its memorandum.

Extensional faulting does not generally create a “fault gouge” that could form a lower permeability impedance to ground water flow across the fault plane. Faulting in this area has been shown to impede ground water flow only when the offsets are great enough that permeable materials are truncated against low-permeability units. This is the case with the WBE Fault, which some evidence shows offsets the PGSA against the Terteling Springs mudstone in the North Ada County area. More prevalent along the Boise Front are series of small-offset, cross-cutting faults within the older and deeper units that do not interrupt hydraulic interconnection even across those units that are faulted. Such is the case with the magnetometer-inferred deep fault the Staff references here.

As further evidence of the lack of a hydraulic boundary, we have included hydrographs showing continuous water level monitoring from M3 Test Wells TW #1 and TW #4, located on opposite sides of the presumed fault (Figure 5). These hydrographs demonstrate that the same hydraulic events are observable on water level plots for both wells. The changes in water levels in TW #4 are smaller and delayed in comparison to those observed in TW #1, as would be expected: TW #4 is closer to the edge of the aquifer where unconfined conditions result in much larger storativity values. Greater storativity can have the effect of delaying and attenuating hydraulic responses in wells.

Also note that the drawdown response to the pumping test of SVR #7 (discussed further below) can be observed in both TW #1 and TW #4 (Figure 5). These similar responses themselves indicate that the deep seated bedrock fault indicated by Wood (2008) does not act as a no-flow boundary as speculated by IDWR staff. Water level contour maps based on field measured data and surveyed well heads included in documents submitted to IDWR (HLI, 2007, 2008a, 23008c) all show ground water in the PGSA flowing to the west and west-northwest beneath the M3 site. Were the fault to act as a hydraulic barrier, ground water flow would be directed toward the north or to the south and not across the presumed no-flow barrier.

The Staff contends that “[t]he contribution of basin margin faults to hydrogeologic

uncertainty was previously identified in a study that was conducted for the Treasure Valley Hydrologic Project: ***In addition to complexity inherent in deposition and erosion, a series of major faults bisect the stratigraphic section along the northern basin margin. The hydrologic impact of these faults is poorly understood, but they are likely to be an important influence on ground water flow in the Boise-area aquifers.*** **(Hutchings and Petrich, 2002, p. 2)." Staff Memo at 6.**

There is no evidence for a fault barrier that impacts ground water flow in the PGSA or that produces a hydrologically compartmentalized PGSA in any location. Major faulting that formed the western Snake River Plain generally does not significantly cut or offset the younger sedimentary units (shallower than 1000 ft) in the basin on the north side of the plain. The well-known basin margin WBE fault and possibly the Middleton fault defined by Wood and Anderson (1981) may offset shallow units, but only a small (less than a few feet) offset is observed in outcrop. Figure 2 shows in detail the nature of faults in the basin, and this seismic-section interpretation likely applies to some of those faults detected in magnetometer surveys by Wood (2007). Fault offset of the deep Miocene basalt gives rise to a magnetic anomaly, but produces no information about faulting of the overlying sediments. The seismic section (Figure 2) shows that a major fault in the Miocene basalt does not extend upward to the Pierce Gulch Sand Aquifer, north of Middleton

Field mapping and magnetometer surveys have confirmed the location of the WBE fault at the northeast end of the M3-Eagle properties, and its likely extension to the road cut exposure at Freezeout Hill (Wood, 2007, Figure 1). This fault offsets the older Terteling Springs Formation. Note that the large case "U and D" symbol shown on that map (Wood, 2007, Figure 1) at Freezeout Hill is a typographical error. The southwest side is clearly downthrown at that locality. Field evidence for other faults southwest of that fault has not been found.

The down-dip cross section showing the base of the PGSA (HLI 2009, Figure 3) shows a maximum SW dip of less than 2½ degrees (200 ft/mile). That dip is typical of depositional dip (Wood, 2004, Figure 9, p. 115) and characteristic of the upper sedimentary section of the western Snake River Plain. Such a dip also is much less than the typical 5 degree dip in the deeper sediments (Squires et al., 1992, p. 25 and Figure 6, p. 83) of the basin. There is no reason to believe that faulting significantly affects the PGSA southwest of and on the M3 Eagle property.

High-resolution sections used by Wood (1994) also show that faulting does not extend into the upper 1000-ft in the Caldwell area There is no evidence that the Pierce Gulch Sand is significantly faulted west of the WBE Fault.

The Staff notes that "HLI commissioned magnetometer and seismic profiling surveys on and around the M3 property. . . . to obtain additional stratigraphic information beneath the area of investigation." The Staff Memo also states that this effort led to Dr. Wood identifying "two NW/SE trending 'major' faults that transect the M3 property…." Staff Memo at 3.

Dr. Wood, who evaluated the magnetometer data for HLI (and who has mapped the known faults in the area), did not describe the fault trace as transecting the M3 property but, rather, that the survey suggested a possible offset in the deeply buried volcanic bedrock several thousands of feet below the M3 property. HLI did commission seismic reflection and magnetometer surveys, mainly to determine deep structural features. The magnetometer data would not, and could not, show stratigraphic relationships because the technology relies on resident magnetism in the deeply buried, and faulted, volcanic rocks underlying the Idaho Group sediments.

> **"Four geologic cross-sections were developed by HLI based on geophysical and geological data collected from deep wells in the area." Staff Memo at 4.**

M3 Eagle submitted 16 sub-surface cross-sections with its materials on November 26, 2008 and an additional four cross-sections on January 29, 2009. It is unclear whether Staff evaluated the originally submitted 16; the Staff Memo does not discuss them. They all are significant to our analysis, and support our conclusions about the nature of the hydrogeology in this area and the lack of any PGSA-truncating faults here other than the WBE Fault.

3. Aquifer continuity between the Boise and Payette River basins.

Another important theme in the Staff's review has been the question whether the Pierce Gulch Sand Aquifer is continuous to the Payette basin. The answer to this question is not dispositive of the more fundamental question of the aquifer's productivity and ability to sustain an approximately 9 cfs average withdrawal for the M3 Eagle development. However, the question of inter-basin continuity is another indication of its regional extent and its access to large areas of recharge. In this section we address Staff's contentions about this issue.

> **The Staff observed that "[t]he contour map shows that only four wells west of the Ada/Canyon County line were used to determine the northwest regional flow direction," two of which "(Rio Lobo and Shalako) are located within the same section," and "the other two (Zigler and Caldwell Test Well #19) were not surveyed" as to ground surface elevation and location. The Staff concluded that "[t]he scarcity of surveyed control points west of the Ada/Canyon county line creates uncertainty in the determination of the regional flow direction. Staff Memo at 7.**

Slope of a piezometric surface is a conclusive indicator of flow direction. The piezometric level map for the PGSA wells, based on reliable data from available wells completed into the PGSA, shows that the ground water surface slopes west by northwest toward the Payette Valley, which itself is some 200 to 300 feet below the Boise River in the vicinity of Eagle. Based on the data, and the well-documented continuity of the PGSA to the Payette basin, we know of no credible hypothesis to contradict ground water flow toward the Payette Valley in this area.

<u>Any</u> water level taken in the north Caldwell area will be at a higher elevation than any water level in any well downstream of Emmett in the Payette Basin. Therefore, the Staff is incorrect to imply that these data points cannot be relied upon to show a regional head gradient toward the Payette basin.

HLI used these four wells to the west and west-northwest because they were deemed to produce reasonably reliable ground water level data. The fact that these four were not surveyed to the closest 0.01 foot of elevation is immaterial to the overall conclusion that ground water flows to the west-northwest. This is because every ground water level and/or well head elevation of which we are aware in the Payette Basin located toward where HLI has indicated a WNW ground water flow is significantly lower than the measured well heads and water levels in the vicinity of M3 Eagle.

Often, surveying well head elevations is quite important, such as where accurate aquifer levels or fluctuations are being studied (and HLI has done this with regard to certain portions of its ground water studies for M3 Eagle). However, the differences that surveying will reveal in head and elevation would not be material where the surface elevations being considered differ by some 300 hundred feet, which is the case when comparing the Boise and Payette River surface elevations in this area. In other words, all known ground water levels and well heads are at a much lower elevations in the Payette Valley, causing the flow gradient toward aquifers beneath the Payette Valley.

> **The Zigler well is the only control point in the Payette River valley. Well completion data for this well was not included in the HLI submittal (HLI 2008c). It has not been established that the PGSA is present at this location. Staff Memo at 7.**

We know of no evidence, and can discern no geological justification, for a conclusion that any well in the Payette Valley would have heads higher than those in the uplands or in the Boise basin to the south and southeast. Therefore, only a hydraulic interconnection would be needed to allow flow in the WNW direction. Because a permeable sand layer extends between the two basins, as HLI and other researchers have shown, this gradient inevitably results in significant ground water flow from the Boise Basin to the Payette Basin. There is substantial evidence to suggest such a hydraulic connection exists; no evidence whatsoever suggests the opposite.

We used data from the Zigler well because it is the best example of a fully sealed and competently documented well in that area; it is also one of the deeper (176-feet) wells so that the piezometric head of its completion interval (in this area of increasing potential with depth) is considered conservative with respect to its use as a gradient data point. The completion interval and well construction data for the Zigler well is readily available on IDWR's database. Its location near Letha in the Payette Basin also is important. The Zigler well has an above ground head of ~8 feet, which is about 200 feet below the heads of the wells in the M3 Eagle vicinity. As discussed in more detail below, the Zigler well also is not "the only control point in the Payette River Valley." Staff Memo at 7.

Finally, because continuity of the PGSA to the Payette Basin appears to be a central focus in the Staff Memorandum, we provide this additional discussion concerning the deep geophysical logs we submitted previously. The normal resistivity logs from the Ted Daws #1 well (submitted to IDWR in November 2008 and discussed in our January 2009 submittal) clearly show that the sand unit called the Pierce Gulch Sand Aquifer is a widespread deposit that extends to the Payette River Valley north of New Plymouth (Figures 3 and 4). The identical log characteristics that Hydro Logic has shown in Boise area wells occur in the Ted Daws #1 well and the adjacent

Virgil Johnson #1 well, and also in geophysical logs to the west near the town of Payette and south to Lake Lowell. The geological significance of the spreading of sand deposits over the former lake basin is discussed at length in Wood and Clemens (2002, p.93-94).

But again, we emphasize that proving continuity to the Payette basin is not seen as critical to our conclusions about the ability of the PGSA to support the M3 Eagle proposal because direct hydraulic continuity from beneath the M3 site to the Eagle-Star vicinity and further south has been established by our hydrogeologic studies (and also is supported by Dr. Ralston's affidavit).

> **The Staff observes that the water level for the Caldwell Test Well #19 on HLI's "updated contour map is 2,450 feet above mean sea level (ft-msl). The only water level measurement reported for this well is 2,442 ft-msl and this measurement was collected in 2005 rather than in 2007. In addition, the data submitted by HLI indicates that this well is '*above the PGSA*' (HLI, 2008c). These considerations suggest that the data point should not be relied upon for determining ground water flow direction in the PGSA." Staff Memo at 7.**

Staff omitted the question mark following the aquifer designation in Table 1 of HLI (2008c) that indicated that the Caldwell Test Well #19 may or <u>may not</u> be completed above the PGSA. However, Caldwell Test Well #19, even if not completed in the PGSA, is located in an area of increasing potential with depth, and has water levels above ground surface. Therefore, a deeper well, such as one that would be completed in the PGSA (were it deeper than Test Well #19 at this location), would have an even higher water level, thus increasing the ground water gradient toward the west-northwest presented by HLI.

In other words, to be conservative as to the gradient issue, HLI chose the higher range of water levels in the Payette basin and the lower range in the Boise basin. The point is For purposes of graphing gross water level gradient maps, water levels of widely varying dates from well driller reports is common practice. Staff has pointed to no water level data to contradict HLI's conclusion in any event. As to the difference that may exist between 2005 and 2007, it is unlikely that any change over that period would significantly affect the inferred direction of ground water flow, we see no evidence that it has, and the Staff presented no such evidence.

> **The Staff notes that "[a] previous study (Wood, 2007) indicates that the PGS outcrops along the southern bluffs of the Payette River Valley. These PGS outcrops are unsaturated with no visible springs or other evidence of ground water discharge. The HLI conceptual model does not include an explanation of where and how the PGSA discharges into the Payette River Basin Aquifer." Staff Memo at 7-8.**

The deep geophysical logs previously submitted to the Department, and the cross-sectional diagram of Figure 4, show that the lower part of the PGSA to the west-northwest of M3 Eagle lies below the Payette Valley floor. We are aware of no investigation of the shallow ground water system in the Payette Valley. So we withhold judgment on the nature or exact locations of PGSA discharge into the Payette Valley. But again, naming the exact mechanism of PGSA discharge is not critical to understanding the aquifer's productivity or its ability to support a water right such as that applied for by M3 Eagle.

We have shown that the upper reaches of the PGS are not saturated and the unconfined/unsaturated edge of the PGSA in part comprises the edge of the aquifer. The Zigler well shows confined, above-ground artesian heads in the Payette Valley. The unsaturated edge of the outcropping sequence of sand strata and confining underlying conditions within the PGSA or other aquifers would explain the absence of seeps along the base of the bluffs, although the absence of such seeps also has not been confirmed.

We do not see a major thick mudstone outcrop along the bluffs south of the Payette River. Instead, the section is dominated by coarse sand layers, with minor mud interbeds. If a mudstone layer exists, it may lie under the valley floor. The sediments cropping out in the Payette bluffs are either the as yet "undifferentiated" sediments overlying the PGSA or are part of the unsaturated (upper) portion of the PGS at this location. These outcropping sediments are possibly 600 ft thick and very sandy. It is not required that there be a spring discharge at the base of the bluffs just as it is not incumbent upon M3 Eagle to describe how the PGSA discharges into the Payette Basin other than to say that it happens in the same manner that all hydrogeologic discharge occurs in sedimentary basins of the West.

> **The Staff states that "available water level data clearly indicate a west ground water flow direction in the PGSA beneath the M3 property," but that positing a regional flow direction "northwest toward the Payette River is less convincing" due to a "scarcity of surveyed control points and an incomplete hydrogeologic conceptual model." Staff Memo at 8.**

The regional hydrogeologic setting and all available geophysical data support the conclusion that ground water moves over many miles in the PGSA, and passes under M3 Eagle from ESE to WNW. No data contradicts it.

We agree that the PGSA ground water flow beneath the M3 Eagle property is substantially in a westerly direction, as our gradient maps indicate, more or less parallel to the Boise and Payette Rivers. But to be more precise, the flow follows the regional geomorphologic features of the Boise and Payette River basins in this area, trending west-northwest, as do both rivers and the structural and depositional geologic fabrics. It is true that there are not as many measured wells in the less-populated areas to the west and west-northwest of M3 Eagle's property. But even so, it is not surprising, especially given the substantial amount of data we now have about the hydrogeological setting, that all available evidence leads us to conclude PGSA ground water moves under the M3 Eagle property in a direction parallel to both river valleys—that is, in a west-northwest direction.

The Staff evidently does not dispute that PGSA ground water moves many miles from the east-southeast into the area beneath the M3 Eagle property north of Eagle, and that it comes from at least as far away as Garden City. There is no evidence to suggest that it somehow changes its WNW course at M3 Eagle and all then flows to the west, or southwest back toward the Boise River

As noted above, it also is important to note that it has been previously postulated, and accepted by IDWR in the context of granting water right permits, that the adjacent Willow Creek Aquifer (which underlies a substantial portion of the M3 Eagle property) flows toward the Payette Valley in this same direction. (See discussion below accompanying Attachment A.) The WCA has the same depositional controls and was formed by similar depositional processes as those that formed the PGSA.

We do not contend that <u>all</u> of the PGSA's ground water flows to the Payette Valley. Ground water flow maps, both HLI's and those prepared by others, show what one would expect from the geologic conceptual model involving a regionally-extensive aquifer: water in the PGSA moves many miles from the east-southeast to the west-northwest along and under the Boise front in the same general direction as the Boise and Payette Rivers; it moves under a gradient from areas of greater head to areas of lower head, such as the head difference between the Boise and Payette basins, so long as a hydraulic connection exists. However, in the immediate area of the PGSA under M3 Eagle, all of our investigations indicate a west-northwest flow, some of which we believe flows to the Payette Basin. This is what we and other workers have reported. A significant and growing body of hydrogeologic and hydrologic data, including data from as far back as 1988, supports this concept and no data disputes it. See Figure 1, USGS Hydrologic Investigations Atlas HA-703, 1988, attached to letter from Scanlan Engineering (1994), included here as Attachment A.

Said differently, even if the exact direction of ground water flow and/or the precise locations of discharge far to the west of the M3 site have not been defined definitively, this does not mean there is insufficient ground water in the PGSA for development of 6,535 acre-feet of ground water annually at M3 Eagle. The studies completed to date demonstrate the PGSA to be a highly productive and regionally extensive aquifer with strong sources of recharge and little evidence of significant drawdown despite many decades of development and water usage.

> **The Staff states that "[u]se of water levels that were collected during the irrigation season adds uncertainty to the determination of ground-water flow direction." Staff Memo at 7.**

We disagree that collecting ground water levels in the vicinity of M3 Eagle during the irrigation season "adds uncertainty" to the analysis. If anything, it adds more conservatism. This is because irrigation season water levels in a given well will be lower than non-irrigation season levels, and adjusting for this (which we did not do) would make the average aquifer levels higher and the gradient toward the Payette even greater. Thus, using irrigation season measurements and still calculating a west-northwest gradient only adds support to HLI's conclusion that the ground water gradient slopes to the west-northwest; it should not add uncertainty on this point.

The season during which ground water levels are collected is relevant information, and the researcher always should take it into account. In some cases, irrigation season ground water levels will be higher, in other cases, lower. Here, we expect ground water levels to be lower in the irrigation season due to irrigation pumping, and this indeed is what the available hydrographs demonstrate. Hydrographs in this area clearly show steady, if modest, ground water level declines in the April through August period, followed by increasing trends through about March. These also seem to respond to drought to some degree.

Moreover, we have been monitoring ground water levels in this area for three years, and have documented the seasonal fluctuation. Area ground water levels change annually with essentially equal magnitude during the non-irrigation season as is clearly evident on every hydrograph produced in the Treasure Valley of which we are aware. These hydrographs, as well as our monitoring well network on the M3 Eagle property, show that the downward change during the irrigation season is equal, or nearly equal (sometimes slightly more, sometimes slightly less) to upward change during the non-irrigation season. In other words, if measuring during the annual irrigation season drawdown is seen as adding uncertainty, the researcher also then would need to carefully account for the annual recovery during the non-irrigation season. Even though the water levels are rebounding annually in amounts equal to the seasonal drawdown, the Staff does not appear to have accounted for this in its analysis.

We consider the best times to measure water levels for aquifer characterization purposes to be all times the aquifer can be measured—that is, continuously, as M3 Eagle has done for the last three years. It is only after knowing the nature of the annual fluctuation that one can make assumptions about when best to measure water levels. For example, in the McVay analysis of water level trends, he chose water levels between March 1 and May 31. However, reviewing the hydrographs submitted by HLI shows that this time period is one of the fastest changing portions of the annual fluctuation. In the absence of continuous data, we believe it is best to measure ground water levels during those periods that will capture the seasonal high and the seasonal low of the annual fluctuation.

> **The Staff references Dr. Ralston's reports stating his belief that "postulated ground-water flow through a laterally continuous sand aquifer from the Boise River valley to the Payette River valley is not supported by field data." Staff Memo at 16.**

Staff summarized two reports and two memoranda submitted by Dr. Dale Ralston of Ralston Hydrologic Services, Inc. on behalf of Protestant North Ada County Groundwater Users Association ("NACGUA"). Staff did not analyze Dr. Ralston's materials or conclusions, but rather merely quoted from them. It is unclear what Staff intends by quoting the Ralston conclusions, such as his belief that "postulated ground-water flow through a laterally continuous sand aquifer from the Boise River valley to the Payette River valley is not supported by field data." Staff Memo at 16.

We believe that an analysis of Dr. Ralston's contentions would have underscored the fact that the PGSA is regionally extensive at least from M3 Eagle's property back toward Garden City, that there is a substantial amount of "field data" (including well logs) to support continuity of the PGSA to the Payette Valley, and that Dr. Ralston provided no evidence to support his main hypothesis—namely, that the PGSA is not continuous to the Payette Valley. Furthermore, nowhere did Dr. Ralston present evidence to suggest that the PGSA, wherever it might extend, contains insufficient water supplies to support the M3 Eagle water right application.

Moreover, Staff failed to mention one of Dr. Ralston's significant filings in this matter: his November 24, 2008 affidavit in which he states:

> ***"The Pierce Gulch Sand Aquifer is the target water supply source for M3 Eagle production wells. This means that operation of the M3 Eagle productions wells will have hydraulic impacts on ground water and connected surface water systems within the Boise Basin. I believe that this hydrogeologic conceptual model is correct."***

Attachment B. This affidavit cites no new data or analysis beyond what has been described by others. However, it does confirm Dr. Ralston's agreement with the evidence that the PGSA extends into the Boise River basin; it is on file with the Department and could have been noted along with Dr. Ralston's reports that Staff cited.

Furthermore, in his deposition (which Ed Squires and Mark Utting of HLI attended), Dr. Ralston made this point even more clearly. The relevant pages of Dr. Ralston's are Attachment C, but this is the central passage on the point of aquifer continuity to the Boise basin:

> Q. (BY MR. FEREDAY) Dr. Ralston, I've handed you what has been marked as Ralston Exhibit 3, which is an affidavit that you signed and filed on November 24th, and I just wanted to ask you about this. . . .
> This critical paragraph 3 in the affidavit says: "The Pierce Gulch Sand Aquifer is the target water supply source for M3 Eagle production wells." Do you agree with that?
> A. Yes, sir.
> Q. The second sentence says: This means that operation of these wells will have hydraulic impacts on ground water and connected surface water systems within the Boise Basin; is that correct?
> A. Yes, sir.
> Q. That includes on the Boise River, correct, or at least by the "Boise Basin" do you mean the whole area stretching at least into Garden City and up perhaps into Boise?
> A. What it says is "ground water and connected surface water systems within the Boise Basin." Yes, in a broad sense that includes all the way up from Garden City.
> Q. Then by saying that you believe that this hydrogeologic conceptual model is correct, would it be accurate to say that you are saying that: At least I agree that the Pierce Gulch

> Sand Aquifer exists and it extends to Garden City, let's just say?
>
> A. That was what I thought I signed, and I think that is what these words say. But what I intended to say is the conceptual model from the M3 Eagle to the southeast toward the Boise was well supported, in my opinion, by the technical work and I agreed with that. And that is what my intent on signing that was.

As to continuity of the Pierce Gulch Sand Aquifer between the Boise and Payette River Valleys, M3 Eagle has submitted significant evidence to support this contention (although it is not necessary to calculate the PGSA's productivity). Again, the normal resistivity logs from the Ted Daws #1 well clearly show that the sand aquifer unit called the PGSA is a widespread deposit that extends to the Payette River Valley north of New Plymouth. The identical log characteristics that HLI has shown in Boise area wells occur in the Ted Daws #1 well and the adjacent Virgil Johnson #1 well, and also in geophysical logs to the west near the town of Payette and south to Lake Lowell. The geological significance of the spreading of sand deposits over the former lake basin is discussed at length in Wood and Clemens (2002, pp. 93-94).

In his deposition Dr. Ralston testified that the kind of evidence he would use to determine whether "the groundwater does flow toward the Payette Basin" would be "any existing wells out there [to the west-northwest of M3 Eagle] that are of suitable depth and suitable location that have good geologic information that I can interpret." Attachment C at 101-02. However, Dr. Ralston did not evaluate these geophysical logs from just such wells that are described above, and did not evaluate the Zigler well. *Id.* at 103-04. It appears that the Staff also did not.

4. <u>HLI's aquifer testing.</u>

> **The Staff noted that the duration of M3 Eagle's SVR#7 aquifer test "exceeded most of the previous aquifer tests in the area," but suggested that "a longer duration test (~30 days) with additional monitoring in the shallow aquifers, would stress a greater portion of the aquifer, facilitate evaluation of hydrologic boundaries, and provide data for better estimating the long term impacts of pumping." Staff Memo at 11.**

At the end of nine days of continuous pumping, the cone of depression in observation wells was growing so slowly that we had reached a point where we would not see appreciably different results with longer testing. And as noted, at the nine-day point we had reached a situation where barometric effects, earth tides, and water level trends were far greater in magnitude that the drawdown effects. This is where the aquifer test had reached the point where additional pumping would produce no additional useful data.

> **Staff concludes its comment on the aquifer test by stating: "Several lines of evidence suggest that the aquifer may be bounded by faults. An aquifer test of longer duration could be used to evaluate the hydrologic significance of the fault." Staff Memo at 11.**

As explained above, we are aware of no "lines of evidence" on which to base a conclusion that the PGSA is bounded by faults. Stating that it "may be" so bounded, without actual geological evidence in the aquifer unit itself, adds nothing to our understanding of the PGSA. The actual lines of evidence are that the PGSA is regionally extensive, has scientifically supportable boundaries at its basement and along its NE edge in the vicinity of M3 Eagle's property, and otherwise shows no evidence of boundaries that would prevent M3 Eagle from obtaining ground water right in quantities easily sufficient to support its development.

> **Staff provides these comments about HLI's "16 Aquifer Report" study: "the compilation and reanalysis of data from 16 previous aquifer tests represents a significant undertaking on the part of HLI. The reanalysis yielded an updated hydrogeologic conceptual model and revised estimates of aquifer properties for vicinity aquifers. HLI concludes that other vicinity aquifers have limited long-term sustainability owing to hydraulic isolation and limited on-site recharge. In our opinion, the possibility of limited long-term sustainability for the PGSA also cannot be discounted based upon currently available data." Staff Memo at 12.**

There is no basis to conclude that the PGSA is similarly limited or is in the same category as the other smaller and relatively unimportant aquifers in the area. The available data shows the opposite; that the regional PGSA, including that portion of it that extends under M3, is sustainable over the long-term.

The aquifers HLI refers to as "isolated" and of "limited long-term sustainability" are the Sandy Hill Aquifer and the Willow Creek Aquifer, both of which lie to the north and east and are separate from the regional PGSA. The Sandy Hill Aquifer, by all accounts, is a small and finite "pod" or stranded outlier of Terteling Springs Formation sand that is contained within the mudstone facies of the Terteling Springs Formation with recharge coming only from a small amount of direct precipitation. The limited nature of this sand unit is well known among area hydrogeologists.

The Willow Creek Aquifer was informally named by Scanlan Engineering (now SPF Water Engineering, LLC) and Feast Geosciences during studies for SunCor in 2005. Mr. Scanlan had identified it as being tributary to the Payette Basin in 1994 in connection with the Lynn water right application. Attachment A. Although Scanlan and Feast again correctly confirmed that WCA ground water flows to the Payette Basin (for many of the same reasons that we conclude the PGSA flows to that basin) they did not investigate or describe the geological framework of the WCA, its recharge or its discharge locations. HLI has not questioned the long-term sustainability of the WCA as stated by Staff. We recognize that it is of limited width in the uplands of the M3 Eagle and SunCor properties and it is truncated at its head by the WBE fault; this is what we reported. We do suggest that lowering of WCA water levels would be necessary to reverse the ground water flow gradient and induce recharge from the Payette Basin back to the SE.

> **Staff observes that, "In addition to mass measurements, HLI has installed data loggers to collect water levels on a regular basis. Thirteen wells (four with multiple**

observation ports) currently are equipped with data loggers to monitor different levels within the PGSA. Data submitted to the Department spans back to July of 2006 for some of these wells." Staff Memo at 8.

The multiple tubes in the piezometer nests actually are individual wells, and should be counted as such. Therefore, M3 Eagle is monitoring 22 wells, some of which are completed within the same well bore but carefully sealed from each other unlike most of the local area domestic wells which interconnect the entire drilled geologic section.

The Staff references the data logger measurements M3 Eagle obtained from nine of the PGSA wells during the SVR #7 aquifer test, and questions why "water levels in the Kling domestic well are not discussed in any of the HLI submittals." The Staff says that the Kling domestic well apparently "did not fully recover from the Kling irrigation well aquifer test that was conducted in January 2007." Staff Memo at 8.

We did not use the Kling domestic well data because we had more reliable geophysical and well construction data from a newly constructed test well (TW#1) M3 Eagle installed less than 50 feet away. The Kling domestic well's construction is unknown, but we believe it is unsealed and may not provide an accurate response to the test due to commingling of aquifers, potential caving, improper perforation or screen size, or similar problems. As to lack of full recovery in the Kling domestic well, we do not see this as an indication of declining ground water trends. The Staff has not presented any data to show this and they have apparently not corrected the data for barometric effects and/or pre-test and post-test water level trends necessary to make such inferences.

HLI has explained why the water levels in measured wells did not recover to pre-test levels during the recovery measurement period, including the annual fluctuation in regional water levels shown in all monitored wells in the area. It would be unusual (and a contradiction to standard well recovery analyses using methods based on the Theis equations) for water levels in Boise River Valley wells to fully recover in hydraulic tests within the same amount of time as the drawdown occurred. However, to assure IDWR that the aquifer did indeed recover, the attached Figure 5 shows that water levels in TW #1 (completed in the PGSA about 50 feet from the Kling domestic well (which is also completed in the PGSA) recovered within 2 weeks.

For comparison purposes, the Staff grouped the wells used in the SVR#7 aquifer test as follows: Group 1 is "the State and Linder monitoring well, TW#1, and the Kling domestic well." These are south and west of the area the Staff suggests a PGSA fault may lie. Group 2 apparently includes "Big Gulch Stock Well, TW#4, SVR#7, SVR#9, TW#2, and TW#3." These wells are on the north and east of this postulated fault. The Staff observes that "[t]he seasonal fluctuation seen in Group 1 wells is nearly an order of magnitude greater than the fluctuations seen in Group 2 wells. For example, the seasonal fluctuation was approximately 13 feet in TW#1, but was only 1.5 feet in TW#3. Responses to *"hydraulic events"* (April 2007, June 2007, August 2007, and May 2008) are apparent in the hydrographs for Group 1 wells but are not apparent in the Group 2 hydrographs." Staff Memo at 8.

There is no scientific basis for classifying the M3 Eagle monitoring wells into these groups. This is because the physical hydrogeologic setting, which imparts differences to the drawdown plots, represents a continuum within the aquifer and not a "no-flow" or other boundary or separation. The data HLI has submitted shows this clearly and it is discussed in detail in our aquifer test reports. The geochemistry data also support this connection, as shown in the HLI-Glanzman report.

The wells the Staff cites as having a large fluctuation—Kling Domestic, Kling Irrigation, and M3 #1—are on the western portion of the M3 Eagle property and relatively close to other pumping wells of the Boise Valley. The Staff's second grouping of wells are on the higher, more easterly portions of the M3 Eagle property and are farther from pumping wells; these show fluctuations consistent with the measured hydraulic test results and monitoring hydrographs. The monitoring wells further up Big and Little Gulches are also closer to the up-dip unconfined portions of the PGSA characterized by higher storativities (less confinement) and associated lower swings in water levels. The PGSA as monitored by M3 Eagle's more westerly wells are more confined with lower storativity and thus show a greater water level drawdown and recovery from the collective pumping from the aquifer to the south. Such responses are consistent with basic principles of hydrogeology.

Even so, attached to this Memorandum as Figure 5 is a composite hydrograph correlating water levels and hydraulic events across the area Staff evidently believes may be a fault-induced no-flow boundary. This figure shows that the same hydraulic pumping events affect M3 TW-1 and M3 TW-4. These two wells are on opposite sides of the postulated fault/no-flow boundary, and each is a member of a separate Staff-defined well group. The fact that the water level fluctuation between the two wells is "nearly an order of magnitude greater" does not justify Staff's implication that the two well groups lie in separated geologic units. Such a difference would be expected given the locations of these wells relative to the pumping wells that are causing the seasonal drawdowns and the effects of being closer to the unconfined edge of the aquifer.

The figure also shows that drawdown occurred in both wells during the course of the SVR #7 Aquifer test (discussed below). Although the HLI report on this test indicated that drawdown was too small to be quantitatively analyzed, the attached figure shows that qualitatively, a water level change consistent with the general shape of a drawdown curve can be observed in the TW #1 hydrograph in the figure from pumping of SVR#7. The data show hydraulic communication between these wells—regardless of how they are grouped—not separation and not evidence of a no-flow boundary.

> **Staff asserts that the "NW/SE trending normal fault identified by Wood (2007) separates the two well groups and potentially accounts for the different water level fluctuation patterns." Staff Memo at 8.**

There is no evidence that this normal fault (which, again, is different from the WBE Fault), truncates the PGSA. HLI has proposed several alternative explanations for the greater drawdown in the more westerly, lower elevation wells, including potential effects from a slightly faulted aquifer. The faulted aquifer rationale seems least likely to us because there is no observable scientific basis for it beyond an inconclusive magnetometer survey of volcanic rocks several thousand feet below land surface. The reasons for observed differences in the magnitude of the annual aquifer pressure fluctuation were explained above.

The wells located at higher elevations in the gulches, penetrate a less confined portion of the PGSA. As such they are closer to the up-dip portion of the aquifer which is more affected by direct precipitation. The geochemistry study of Glanzman and Squires (2008) confirms that ground water in the PGSA in this area has a component of precipitation. As discussed below in our response to the memo by McVay, precipitation in the greater Boise vicinity has been decreasing over the past few years. Any decline in water level observed in the data collected from these wells over the past 2 years is consistent with this precipitation trend. In addition (and a significant point) the McVay trend analyses are deeply flawed and do not show a regional decline in water levels. In fact (as is discussed below) all but one well completed in the PGSA showed a <u>rising</u> water level trend over the past 6 to 12 years.

> **"The hydrograph for the Big Gulch Well was not included in Figure 46 even though this well had the greatest drawdown among the observation wells measured during the SVR#7 aquifer test." Staff Memo at 9.**

The fact that the Big Gulch Stock well had drawdown in the SVR #7 aquifer test (as expected) has no relevance to the presented hydrographs of Figure 46 in the HLI SVR #7 Aquifer Test Report. In any case, the drawdown response in the Big Gulch Stock well is fully documented and shown on several hydrographs of the SVR#7 Aquifer Test Report.

In conducting aquifer tests for M3 Eagle, HLI elected to use monitoring wells having reliable water level records and known construction. The purpose was to ensure presentation of the best data available. The nearby (~800 feet away) SVR#7 well with its sealed construction (and despite its less-than-precise well log) is a better monitoring well than the Big Gulch Stock Well, for which construction details are unknown. In addition, continuous data logger monitoring in SVR #7 began in July of 2006 while similar monitoring in the Big Gulch stock well began in May of 2007. The longer-term data from SVR #7 provide a better understanding of the PGSA than the shorter-term data from the Big Gulch well.

> **"In summary, water levels collected with data loggers on the M3 property over the past three years have provided valuable information regarding water level fluctuations beneath the site. Analysis of these data reveals two distinct patterns of water level fluctuations in the PGSA. The patterns are different on each side of a mapped normal fault. Knowledge of the hydrologic significance of basin margin faults appears to be critical to understanding the hydrogeology in the vicinity of M3." Staff Memo at 9.**

The Staff presents no scientific analysis to support a conclusion that there is any hydraulic disconnect between these well groupings, whether caused by a normal structural geologic fault or other feature. As indicated above, the differences in water level fluctuations may be explained by distance from pumping centers and some differences in confinement and storativity in these portions of the dipping PGSA. A couple of years of water level data that shows a recovery or decline of less than a foot is hardly compelling evidence. Our calculations indicate that, depending on transmissivity and storativity, it could take up to 10 days for pumping wells onsite to affect M3 Eagle wells closer than those referenced by Staff; it would therefore take even longer for wells further away. Therefore, the small responses in more distant wells are not cause for defining a different pattern. In some cases the small responses were observable but not analyzable because the responses were too small in comparison to barometric effects, seasonal water level trends (even with corrections) and pumping effects from other wells.

> **The Staff noted that "[w]ater level data were collected in the Kling domestic well (see Figure 46 of HLI, 2009), but were not discussed in the write-up for the aquifer test analysis." Staff Memo at 9.**

As noted, we did not rely on the poorly-constructed and unsealed Kling domestic well because we had constructed a specially designed monitoring well (TW-1) less than fifty feet away. We collected and reported water level data from the TW-1 monitoring well. The small amount of data from the Kling domestic well, however, were presented on November 26th and were available for the Staff to evaluate. Inclusion of the Kling domestic well data would not change any of HLI's findings.

> **Staff returns to the idea that there is a fault "between the pumping well and the non-responding observation wells," and states that, "[a]lthough HLI modeled this fault as a no-flow/barrier boundary in their computer-aided analysis of aquifer test data, they seem less certain of its impact in concluding '*A no-flow boundary could, in theory, have affected responses in the lower part of the aquifer*' (HLI, 2008b, p. 206)." Staff Memo at 9-10. Staff concludes that the Kling aquifer test "highlighted the potential importance of a NW/SE trending fault on water level declines caused by pumping in the PGSA." Staff Memo at 10.**

As explained above, this is an inferred fault, not an observed or proven feature. We find no evidence that the fault propagates to land surface, offsets the PGSA, or creates a no-flow boundary or even an impedance to ground water flow. However, because of the evidence of deep faulting, we felt it important to at least mention the possibility that it could present some impedance or slight off-set. But our conclusion, given all of the available geologic, geophysical, and hydraulic data (including work done since HLI 2008a was completed), is that the inferred structural fault is not a factor affecting ground water flow. We believe it is inaccurate to read the Kling aquifer test as "highlighting the potential importance" of a fault in this area as Staff contends. In fact, the evidence, including the results of the Kling Well test, provides no support for the conclusion that there is a truncating fault here, much less that it presents a no-flow boundary.

> **The Staff notes that HLI conducted a second aquifer test in March 2008 in which the SVR#7 well, completed in the PGSA on M3 Eagle property, was pumped at approximately 900 gpm for nine days. Staff states that this test was intended "to collect on-site hydrogeologic data to further characterize the PGSA and to evaluate possible constraints that would impact the execution of a longer duration aquifer test." Staff Memo at 10.**

The SVR#7 aquifer test is a long-term test and is the most thorough and revealing test done to date in this area. Staff's last comment here is not completely correct. We designed and carried out this test to ensure that it was the long-term aquifer test recommended by HLI for the foothills area, and this is how it turned out. High-quality data were obtained through thorough design and around-the-clock monitoring and supervision. By the end of the nine-day test, aquifer levels and drawdowns had diminished and slowed to the extent that small variations caused by barometric pressure and the annual water level trend in the aquifer were overwhelming the even smaller amounts of change in drawdown in the observation wells. Extending the test would have added no significant information.

Furthermore, data from observation wells were collected for up to five days before the test and for 12 days after, making it effectively a 26-day test. It is a common misconception that "the longer the test, the better." As a practical matter, aquifer tests of constant discharge are extremely difficult to accomplish under the best of circumstances; there are just too many things that can go wrong in a 24/7 operation. The large expense of such tests also cannot be ignored. A better and more beneficial test of a given aquifer is the use of automatic data loggers, verified by period hand measurements, to monitor the collective pumping effects of all wells drawing from it over the course of years. This is the technique HLI has used to produce the monitoring hydrographs presented for the PGSA.

> **With regard to the SVR#7 aquifer test, the Staff notes "an increase in slope on the semi-logarithmic plot of drawdown versus time for the Big Gulch stock well" about four days into the test (HLI, 2009, Figure 24), and states that "[a]n increase in slope is characteristic of the cone of depression encountering a no flow/barrier boundary (Driscoll, 1986; p. 231 and USBR, 1995, p. 251). HLI instead attributes the slope increase to a declining regional aquifer water level trend, which is a plausible concept. Unfortunately, a plot of trend-corrected drawdown is not presented for the Big Gulch stock well. Our calculations indicate that the regional trend (Figure C2) does not fully account for the increase in slope that was observed on the semi-logarithmic plot for the Big Gulch stock well." Staff Memo at 11.**

The water levels in the Big Gulch stock well fully recovered to the annual fluctuation of the regional water level trend. The apparent lack of full recovery in both the pumping well (SVR #7) and the nearby observation well (Big Gulch stock well) is best explained by the seasonal declining water level trend observed in the long-term monitoring data. Figures C-2 and C-4 presented in HLI (2009) and available for staff review show that water levels in this portion of the Pierce Gulch Sand Aquifer were rising during the months of January and February and began to decline just before the start of the test. Linear projection of the water levels measured during late May back toward the time when the water level trend reversed from rising to declining, shows that both well SVR #7 and the Big Gulch stock well recovered to the projected non-pumping water levels during mid-April.

Adjusting the drawdown data from the Big Gulch stock well to correct for this trend (using a linear correction of 0.009869 ft per day, as calculated using a straight-line plot through the mid-April through the end of May water level data and shown in Figure C-4) generated a drawdown plot (Figure 6) with almost all of the apparent end-of-test increase in drawdown removed (as compared with the plot shown in Figure 24 of SVR #7 aquifer test report (HLI 2009) which did not have this correction). The small remaining residual rise near the end of the test may be an artifact of the noted incomplete removal of the seasonal water level decline or it may be the result of the boundary effects of the nearest known no-flow boundary, the outcropping edge of the PGSA, which lies about one mile to the northeast of the pumping well. Since the no-flow boundary postulated by the Staff is further away, it is highly likely that the closest boundary would affect the data before one further away. In addition, the postulated no-flow boundary effect was not seen in the data plotted for the other observation wells. In fact, many of these wells showed just the reverse; a decline in the rate of drawdown consistent with the effects of the proximity of the unconfined edge of aquifer that acts in effect as a positive boundary.

During the process of reviewing our analysis as part of this response, we realized that the water level trend correction applied to the recovery plot and analysis for the Big Gulch stock well (Figure 27 in the SVR#7 aquifer test report) was misapplied. We inadvertently omitted a minus sign to the correction. Comparison of Figure 27 with the uncorrected data plot in Figure 26 shows that the flawed "correction" caused the residual drawdown in Figure 27 to rise to higher levels than the uncorrected drawdown in Figure 26—the result of the omission. By applying the minus sign to the correction, the revised recovery plot (Figure 7 below) now projects close to the total recovery point of the graph, as is expected through standard well pumping and recovery theory (Theis, 1935). The small difference between the actual plot and a perfect projection may be the result of incomplete correction for trend or it could be the effects of the edge of aquifer boundary discussed above and noted in our reports.

> **The Staff notes that the Big Gulch stock well "had not fully recovered from pumping at the end of the 12-day water level recovery monitoring period," and suggests a reason for this could "that the aquifer may be of limited extent (Driscoll, 1986, p. 259)." HLI attributes incomplete recovery to the declining regional water level trend but the residual drawdown after correcting for the declining trend was still approximately 0.5 feet at the end of the water level recovery monitoring period. Staff Memo at 11.**

We believe that the analyses presented above explain most if not all of the apparent lack of full recovery noted by Staff. In addition, having conducted scores of aquifer tests throughout Idaho, we have <u>never</u> seen a monitored water level fully recover within a "recovery period" defined as the same duration as the drawdown portion of the test. In fact, standard well test analytical methods based on the Theis equation do not allow for full water level recovery during a time period equal to the pumping period. The Theis recovery-method plots residual drawdown vs. time from the initiation of pumping divided by time from the initiation of recovery (t/t'). Only when t/t' is equal to 1.0 does the Theis recovery method predict complete recovery because the Theis equations assume no recharge to the aquifer; the infinite aquifer assumed in the Theis analyses requires an infinite time for full recovery to occur. A recovery period equal in length to the pumping period generates a t/t' value of 2.0 (and not 1.0) and therefore <u>cannot</u> allow complete recovery if the assumption of no recharge is valid.

In fact, a no-recharge assumption is not valid. As discussed in more detail below, recharge <u>does</u> occur in the PGSA, as shown by annual water level fluctuations and stable long-term average water levels. The hydrographs we submit in connection with our discussion below about the McVay Memo show annual aquifer pressure-head (water level) fluctuations related to pumping wells and varying annual recharge events over the years. Many of these hydrographs show periods of multi-year declines and multi-year increases in water levels, not a continuous decline that would occur were there no recharge to the PGSA.

5. **PGSA boundaries and recharge sources**

The Staff Memo states: "Hydrologic boundaries and recharge mechanisms are not well defined for the target aquifer." Staff Memo at 1.

Some PGSA boundaries are well identified, and in any event this aquifer's boundaries are defined far beyond what, in our experience, is customarily deemed necessary in evaluating a water right application. The boundaries that are specifically defined by HLI in its analyses are the WBE fault, the unsaturated edge of the aquifer running along the north margin of the aquifer, and the base of the aquifer. We also have shown the aquifer to be aerially extensive and to interconnect at least two basins. The Staff did not refer to it, but the Affidavit of Dr. Dale Ralston, and his deposition testimony about it (Attachments B and C), document his concurrence with Hydro Logic's conclusion that the PGSA is laterally contiguous to the south and southeast at least to the area under the Boise River in the vicinity of Garden City. Again, the submitted geophysical logs, geological findings, and geochemical evidence all point to the same conclusion. No evidence suggests otherwise.

There are a number of high-volume production wells in the PGSA over an area up to about 15 miles to the southeast of the M3 Eagle site, and these also have not been negatively affected by sub-surface boundaries. To determine PGSA productivity and pumping effects on ground water levels over the long term, it is not necessary to define a boundary to the southeast given what we know about the aquifer's extension in that direction.

Negative hydraulic boundaries can be confirmed by pumping tests of properly constructed wells in the aquifer under investigation where they are evidenced by an increased rate of drawdown. Significant negative hydraulic boundaries did not show up in the 9-day SVR#7 aquifer test or in the 30-day Lexington Hills test, both of which we consider to be of sufficient duration to have revealed boundaries. Indeed, as our previously-submitted reports show, positive (recharge) boundaries were evident in those tests; these tests' observation wells showed that boundaries were remote from these pumping wells.

Based on HLI's hydrogeologic framework research in the Boise basin over the last 20 years, we are of the opinion that the PGSA is recharged from a number of sources. There likely is recharge at least at these locations: 1) the Boise River in the upper basin (above Capitol Bridge); 2) where the PGSA rises up dip to the present-day Boise River gravels east of the United Water Idaho ("UWID") Swift well (in the vicinity of Farmers Union Ditch Co.'s river diversion); 3) added pressure head from the flood irrigation and irrigation laterals off the NY Canal and other main canals; 4) recharge along the eastern edge of the basin NE of Eagle; and 5) ground water moving into the aquifer under an upward gradient from below.

Furthermore. recharge mechanisms often are not well defined, even for many aquifers that have been productive (and studied) for decades, such as many of the western Snake River Plain aquifers. As discussed in more detail above, we have completed a numerical model for the project based upon the TVHP which is cited by the staff as a reliable study for recharge in this basin. Although the TVHP recharge mechanisms are described only "conceptually" in Hutchings and Petrich (2002). The fact that the precise boundaries of an aquifer are not yet described does not mean that the aquifer should be off limits to additional development, especially where there has been aquifer testing, modeling, and substantial uncontradicted evidence of high productivity and the lack of significant drawdown in response to steadily increasing withdrawals over many decades of pumping, such as the case with the PGSA.

> **The Staff notes that "[t]he intersection of the geologic contact between the PGSA and the Willow Creek Aquifer and surficial sediments on the M3 property was treated as a no flow/barrier boundary," and its existence "helps explain water level and water chemistry differences between the PGSA and the Willow Creek Aquifer." However, the Staff questions why this flow barrier, which was used for contouring, "abruptly stops approximately three miles to the northwest of the M3 property, allowing PGSA water to flow north and merge with ground water in the Willow Creek Aquifer." The Staff does not see a clear basis "for terminating the no-flow/barrier boundary" in this manner. Staff Memo at 7.**

The no flow barrier represented by the inferred outcropping PGSA (the green line on our maps, which also conceptually depicts the unsaturated edge of the aquifer) was not extended further to the west-northwest because our hydrogeologic studies for M3 Eagle, though extensive, did not extend that far along that line. Moreover, based on our geological interpretation, we believe the barrier fades out to the west-northwest as the aquifer trends in that direction. In fact, as noted above our sub-surface cross-sectional diagrams and our flow-gradient maps suggest that the ground water in the PGSA may merge with that of the Terteling Springs Aquifer and/or another sand dominated geologic section in the Payette Basin in the up-dip area west-northwest of the M3 Eagle site. This is based on observed water levels and an increase in sand percentage in the geologic section in that direction. In other words, the saturated portion of the PGSA descends beneath the saturated sandy sediments of the Payette Basin. We believe it likely that the PGSA's edge-of-aquifer boundary (water table) ceases to exist in this area.

As noted, it is likely the PGSA merges with and discharges into the sand facies of the Terteling Springs Formation and other sand units in the sand-dominated section to the WNW under the Payette Valley. All existing ground water contours suggest this. Moreover, geological studies by Wood and others indicate that the regional-scale PGSA sand was deposited upon the dipping sand facies of the Terteling Springs Formation in the Payette basin, just as it was in the Boise basin. These conclusions are supported by our own work, as observed in the lithologic logs and ground water levels shown in Cross Section E-E', which we submitted to the Department previously (although the Staff Memo does not mention it).

As discussed below, the geophysical logs of deep oil company exploration wells (which were submitted to the Department in November 2008) also show the preponderance of sand in a west-northwest direction from M3 Eagle, and that is what the outcrop geology suggests. Our work to date presents what we believe to be the best understanding of the hydrogeology of this area. In any event, none of these indicators suggests that the ground water resource beneath M3 Eagle is insufficient to support the proposed development.

The Staff states that "historical and newly acquired water quality analyses have been interpreted to indicate that there is a difference between the water chemistry in the PGSA and the water chemistry in surrounding aquifers. The data also have been interpreted to indicate that PGSA water originated almost exclusively from the ancestral Boise River. Department staff believe that an isotopic study of ground water in the PGSA could help to evaluate the determination that modern day recharge sources are not contributing recharge to the PGSA." Staff Memo at 13.

The data indicate that the PGSA water currently being withdrawn from wells originated almost exclusively from the ancestral Boise River based on the major ion chemistry of wells completed in the PGSA on both sides of the current position of the Boise River and their similarity with the chemistry of the current Boise River surface water. These relationships are unique to the PGSA chemistry, a relationship not shared with any of the ground water from the other aquifers or well locations. The term "ancestral" in this case refers to the approximate age of the ground water from the PGSA in ground water from several of the wells completed in the PGSA analyzed for carbon-13 and carbon-14 reported in the regional Treasure Valley report prepared by Hutchings and Petrich (2002). Their age designations should perhaps have been described in this report to define the term "ancestral."

Staff's statement that modern day recharge sources are not contributing to the PGSA is contradicted by the relative stability of long-term water levels in the PGSA. As shown in our response to the McVay Memo (below), many of the wells completed in the PGSA have water level elevations that are at or above the levels reported by the well driller when the well was initially completed. Since water has been pumped from the PGSA over the past 40-plus years and these levels either have not declined or have declined very slightly, it follows that recharge to the PGSA is occurring during modern times; an absence of recharge would require that water levels fall over time as pumping increased, a condition that has not occurred.

In the regional Treasure Valley Hydrologic Project ("TVHP") report, Hutchings and Petrich state that the youngest waters entered the subsurface several thousand years ago along the northeastern boundary of the Boise basin adjacent to the Boise foothills (p. 58, Summary statement 5). They considered ground water ages estimated using the del-carbon-13-mixing model to most accurately represent ground water residence times. From this model, they estimated the PGSA groundwater from the Goddard No. 2 and HP wells to be about 2,960 years old. These sealed production wells are located about one mile south of the Boise River and have been pumped for at least a decade, so the estimated age should be accurate.

Ground water ages derived from the TVHP-sampled deep wells have been measured in thousands of years and there is no obvious reason to believe that the deep M3 wells, within the same ground water flow path with nearly identical inorganic geochemistry, would be different.

Under the heading "Recharge Sources," the Staff states that the "water budget for the Treasure Valley aquifer system (Urban, 2004, Table 8) indicates that over 80% of the annual recharge returns to the Boise River, limiting the amount available to the deeper aquifers." Staff Memo at 17.

Obviously, HLI's finding of ground water flow to the Payette renders the Treasure Valley Hydrologic Project ("TVHP") water budget inaccurate. The Staff Memo itself appears to disagree with the TVHP water budget. The issue of water availability for the proposed project does not, in our view, require M3 Eagle to work out the exact PGSA recharge mechanisms in the Boise Basin. The evidence shows that substantial recharge occurs.

> **Staff concludes that Hydro Logic "has not presented geologic data to support the existence of the PGSA beneath the Boise River or provided an explanation of how the canal and river losses end up recharging the PGSA instead of the shallow alluvial system." Staff Memo at 19**.

HLI's 2007 report clearly shows the PGSA geophysical signature 400 feet beneath the river at the UWID Swift wells which are located on the banks of the Boise River at Lake Harbor. The "base of aquifer" map clearly shows that the PGSA continues up-dip under the Boise River at least well into west Boise and probably beyond.

> **Staff observes that HLI used TVHP reports (Urban and Petrich, 1998; Urban, 2004) to estimate losses from the Boise River above Capitol Bridge, but Staff questions whether the TVHP is correct on this point. Staff says the "river reach between Lucky Peak and Glenwood Bridge may actually be gaining during certain time of the year." Staff also states that water level contour maps by Dion (1972) and Newton (1991) "show groundwater flow toward the Boise River through the reach between Lucky Peak and Glenwood Bridge." Staff Memo at 18.**

In their analysis of seepage loss from the Boise River, Staff for some reason combines reaches long known to be gaining with reaches long known to be losing, apparently to suggest" considerable uncertainty" in seepage analysis. Table 1 in the Staff Memo purports to compare gains and losses along the reach from Lucky Peak Reservoir to Glenwood Bridge. But the table combines two different reaches and is therefore misleading.

The 2009 IDWR listing of a 14 cfs gain is followed by a 1997 USGS gain of 52 cfs, a 1998 IDWR 21 cfs loss and a 2005 [sic] IDWR loss of 110 cfs. However, only the first two listings (both gains) are for the reach <u>above the Glenwood Bridge</u>. The second two are for the reach <u>above the Capitol Bridge</u>, the area in which well water levels indicate downward flow to underlying aquifers and the USGS indicates an average loss of 21 cfs based on 38 years of data collection. According to IDWR in Urban (2004), the data collection period from 1958-1996 was a "period of time reflecting a wide variety of river flow conditions." The long time period used to calculate the average surface water loss demonstrates that the reach above Capitol Bridge has long been known as a losing reach. By inappropriately combining two different reaches to demonstrate "uncertainty," Table 1 and Staff comments are misleading.

> **Staff concludes that "[i]nformation that could be used to estimate the percentage of the [New York] canal leakage that would recharge the PGSA is lacking." Staff Memo at 19.**

In past studies and HLI's more recent, it is shown that the PGSA receives substantial recharge, primarily from the Boise River and its associated canal systems. As explained on pages 27-27 of he HLI-PGG modeling report (HLI, 2008c), the Boise River and New York Canal seepage values were not directly input to the model. Rather, they were used to check the reasonableness of the inflow through the southeastern model boundaries as calculated by the model using field data, as explained below.

The HLI model's analysis of PGSA recharge sources were based on data developed and presented as part of the TVHP. No new data were collected, nor was there any reanalysis of data previously collected by IDWR, the USGS and others associated with the TVHP. We accepted and incorporated the IDWR data into the M3 model pertaining to the amounts of recharge at ground surface as a function of land use (page 2-14 in Urban, 2004), the amounts of seepage from the Boise River upstream from Capitol Bridge (page 2-6 in Urban, 2004 with reference to Berenbrock, 1999), and the amounts of seepage from the New York Canal (page 19 in Hutching and Petrich, 2002, with reference to Carlson and Petrich, 1999).

The amounts of loss to ground water aquifers beneath these surface water bodies was totaled to represent a maximum using the highest values for each reach and the minimum using the lowest values for each reach. The minimum and maximum of 101 and 260 cfs (on an average annual basis) were then compared with the inflow to the southeast boundary of the model (layers 5, 6 and 7 representing the PGSA) calculated by the model using a general head boundary condition using mean aquifer transmissivities from pumping tests in the area and flow gradient based on difference in water levels in the Boise River at Capitol Bridge and in wells just inside the model boundary.

This calculated inflow to the PGSA of 102 to 115 cfs was then compared with the documented loss to the aquifer of 101 to 260 cfs to assess the reasonableness of the calculated model boundary inflow, as explained on pages 27-28 of HLI, (2008c). This inflow was then converted to a constant flux (flow) boundary such that pumping simulated from beneath the M3 site would not induce additional inflow from the Boise River upgradient from the model boundary—a conservative assumption.

6. **Water levels (heads) and trends in the PGSA.**

   The Staff Memo's comments on ground water levels in the M3 Eagle area rely on Mike McVay's March 2, 2009 memorandum to Dennis Owsley and Sean Vincent ("McVay Memo"), which is Appendix A to the Staff Memo. McVay reviewed selected water level data from the IDWR's water level data base measurements in ten wells in the North Ada County area and then plotted a linear regression line for each well which McVay says show trends in ground water levels at these locations. The Staff Memo states that a "review of available water level data indicates that water levels in the PGSA near M3 are declining and suggests that current aquifer discharge rates exceed current recharge rates." Staff Memo at 19-20.

Based on our review of the data and the McVay Memo, we respectfully disagree with its method of analysis, the wells used in the analysis, the data points selected for the analysis, and the Staff's conclusions with respect to this data. We especially disagree that water levels are declining in the PGSA or that there is evidence to conclude that withdrawal rates exceed recharge rates. In fact, all but one of the wells analyzed by HLI and McVay show increasing water levels over the past 6-to-12 years.

The McVay Memo states that it evaluated certain water level data collected from ten wells, three of which are completed into the PGSA. The other seven are completed, variously, into overlying undifferentiated aquifers, the Terteling Spring Formation, the shallow gravels, and, in one case, an aquifer unit listed as "unknown." McVay Memo at 2. According to the McVay Memo:

1. These water depth data were collected over varying time spans, but the Memo presents only those for the 1996 through 2008 period. McVay Memo at 1. This time period is further modified by the fact that one well had data only for the years 1996-2004, and four had data only for 1996-2002.

2. McVay "filtered" the data further by choosing the "yearly spring measurements in each well," meaning measurements taken between March 1 and May 31. *Id*. He attempted to select the "most similar date for each year," and gave preference to "the earliest date in the spring range." However, McVay used fall season data for one of the wells, which also was one of the three wells completed into the PGSA.

3. In charting water level trends, McVay used only 8 to 13 data points for each well when hundreds of data points were available for analysis. McVay did not provide the actual dates of measurement or the measured water levels for any of the data he plotted.

4. The "variable length of data records and sporadic data collection intervals did not allow a statistically rigorous data evaluation." McVay Memo at 4.

5. However, McVay plotted "linear trends" and concluded that "[a]ll wells in the area" except one in an "undifferentiated" aquifer, "exhibit negative water level trends that range from 0.11 ft/year to -1.06 ft/year, with an average trend for all wells of -0.29 ft/year." McVay Memo at 4.

The linear regression analyses McVay uses are misleading and incorrect in their representation of the ground water conditions they are used to portray. It is very difficult if not impossible to select a small percentage of data points from a large population in an unbiased manner that accurately represents actual conditions. The discipline of applied statistics was developed to describe the collection of data, account for randomness and uncertainty in the data and draw inferences about the population being studied. As far as we can ascertain, rigorous statistical methods were not used to select statistically valid and unbiased data points for the linear regression described in the McVay Memo.

The selection of a limited number of data points (i.e., 8 to 13 periodic water level measurements per well) evidently based on judgment rather than accepted statistical methods, incorporates unintentional bias and significant errors. We contend it is not appropriate to extend the regression line across the entire data set based on only a small number of points, <u>especially</u> here, as in this case, there is a clear change in slope of the plotted data. To do so is equivalent to ignoring boundaries in a Cooper Jacob plot and place a single straight line through all of the points.

For example, the McVay Memo shows a decline in a measured well's water level over the 12-year analysis period. However, placing a regression line through all of the data points would show that the data points from the last several years all would plot above the McVay Memo's regression line—in other words, the last several years show no decline, and in fact show a recovery. This is a major change in trend within that aquifer in the most recent period of record. The reported water levels on driller's reports for these same wells also indicate that water level increases occurred in these same wells during this period. The McVay Memo's selection of a few data points results in a misleading, and statistically incorrect, depiction of water level trends in the aquifer.

A case in point is Well 4N1E3DAD1, the data points of which are presented on Figure 8. Plotting all available data shows three distinct water level trends. Over the last seven years the well has exhibited a steadily rising trend in both the maximum drawdown level and maximum recovery level. We believe it is incorrect to use this well, and the data from it, to conclude that "water levels near M3 are declining" or that "current aquifer discharge rates exceed current recharge rates." Staff Memo at 20. The fact is that water levels near M3 are rising, and have been for the last seven years (Figure 8).

There are several additional problems with the approach described in the McVay Memo.

The McVay Memo does not present the actual dates of data collection for any of the ten wells it evaluated (Figures 8-13). A review of IDWR online records, however, indicates that most of these data were not collected within the March 1-May 31 timeframe to which the study supposedly was restricted. HLI's analyses for the same wells analyzed by McVay, and additional wells deemed representative of the PGSA are presented as Figures 14-26. Table 1 lists the summary of well data comparing the wells analyzed by McVay to those analyzed by HLI. The complete water level data set for well 05N01E-32DBD1 (Figure 14), one of three McVay describes as being in the PGSA, contains no data that were obtained during that time period. All 1996-2008 water levels from this well posted on IDWR's web site were measured during late June through late August, times of seasonal decline.

In another example, well 04N01E-03DAD1 (described as being in an undifferentiated aquifer) was measured monthly beginning in 1996 but only 5 or 6 times after 2001. This resulted in this well having only one spring season measurement available for inclusion in the analyses over the period 2001-2008. The last four water levels for this well were obtained later each year, with the last measurement made during late May, which is several weeks into the irrigation pumping season.

HLI conducted linear regression analyses for all ten of the McVay Memo wells, but instead of using the 8-13 water level data points for each that were relied upon there, we used all available data points for the 1996-2008 period. In some cases this involved over 500 data points as compared to 13 or fewer measurements analyzed by McVay.

As noted above, the McVay Memo plotted its regression curves over the 1996 through 2008 time period, but did so by using data from a shorter period for five of the ten wells it analyzed. It is not clear why McVay selected these data points or these varying time periods. In any event, the HLI analyses, which used all available data points, reveal visual trends in each of these wells. None of these trends agree with the Staff's suggestion of declining water levels.

Complete plots of all available data, typically the first step in any water level analysis, should have guided the Staff into assessing water level trends using more than one period of analysis. By using only one period of analysis, the most recent trends were obscured. These trends became apparent in some wells when HLI analyzed precipitation data (228 monthly data points resolved to 19 yearly data points). This indicated an increasing precipitation trend from 1990-1996 and a decreasing trend from 1997 - 2008. These periods should be considered particularly relevant to the shallower, non-PGSA aquifers McVay included in his analysis. We then used these two time periods to group the water level data into two groups to assess water level trends. This process allowed the more recent trends to become apparent.

As noted, only three of the ten McVay Memo wells were completed in the Pierce Gulch Sand Aquifer. The McVay memo concludes that "all wells in the area (except 04N01E11BBB1) exhibit negative [declining] water level trends" a conclusion that is incorrect generally for the wells reviewed, and certainly is incorrect with respect to conditions in the Pierce Gulch Sand Aquifer.

HLI conducted a linear regression analysis on two dedicated, purposefully constructed monitoring wells in the Pierce Gulch Sand Aquifer with long-term data: the United Water Idaho State and Linder TW #1 – Zone 2 well (04N01W 11DDA1) and the United Water Idaho State Street well(04N01E14CCB2), which now is the TVHP#1 well. In all likelihood, these wells represent the most complete and representative recent (past 10 years) water-level data set for the Pierce Gulch Sand Aquifer. For the State and Linder well, over 16,000 data points since 1998 were sent to IDWR as part of the information to support the M3 Eagle water right application. The HLI analysis using this information indicates a rise in water level in this portion of the PGSA since the well was constructed and monitoring began in 1998. It is not clear why McVay did not consider the water level trend in this well.

We also evaluated each of the wells used as monitoring points in the McVay analysis (Table 1. Most, if not all, of these wells are poorly constructed and unsealed, or have unknown details of well construction. We do not believe they should be relied upon for monitoring and administering an aquifer.

For example, one of the McVay Memo wells is one we are quite familiar with and in fact have worked on. This is Well 5N1E35ACA1, a low-temperature geothermal well on the property previously owned by the late Julius Jeker in the Dry Creek Valley. It has an above-ground water level (flowing artesian). HLI was involved in this well's reconstruction when it ceased flowing due to a corroded casing. Mr. Jeker called in Stevens Drilling, who overshot the corroded casing and restored flowing conditions. Stevens' modification record the only record of the well and it addresses only his overshot casing to 100 feet below land surface. In our opinion, this well should not be used as a basis to speculate on the conditions in the PGSA. The well is not even completed into the PGSA; it is completed in the deeper volcanic rocks, as are other geothermal wells on the Boise Front. Furthermore, the PGSA is not present beneath the Dry Creek Valley, which is on the east side of the WBE fault. In any case, the Jeker well has experienced a rising water level for the last eleven years, contrary to the declining trend depicted by McVay (Figure 21).

The remaining wells evaluated in the McVay Memo produce water level measurements are not particularly representative of the PGSA. The factors contributing to the non-representative data are listed, on an individual well-by-well basis, on Table 2

As an aside, the Staff Memo refers to their water level analysis as involving 16 wells, half of which are in the PGSA (Staff Memo at 19), while the McVay Memo expressly describes only 10 wells, 3 of which are in the PGSA. This discrepancy is yet another concern we have with the Staff's approach in preparing its analysis. As stated in the McVay Memo, there were two separate memoranda and/or analyses. HLI received only one set of analyses (without supporting data) but the Staff referenced two.

> **The Staff notes that in 2006 HLI collected 167 water level measurements and developed "a water elevation contour map for the PGSA" suggesting "that ground water flows to the west underneath the M3 property and northwest toward the Payette River after leaving M3 (HLI, 2007b)." The Staff states, "[a]ccording to HLI well completion data, water levels used to create this contour map were collected from wells within the PGSA, the Willow Creek Aquifer, and in *"undifferentiated alluvial aquifers."***
>
> **The Staff then noted that HLI selected 59 of these wells for a second ground water "mass measurement . . . to refine the assessment of ground water direction in the PGSA," and also included "16 additional wells that were chosen to provide additional control points for determining ground water flow direction in the PGSA." The Staff accurately noted that "[t]wenty-eight of the wells had wellhead elevations surveyed to the nearest 0.01 ft prior to the measurements," and that the resulting technical memorandum (March 19, 2008) again "suggests that the ground water flow direction beneath the M3 property is to the west, and the flow direction is northwest toward the Payette River after leaving M3 (HLI, 2008c)." Staff Memo at 6.**

We selected the 59 wells for our second measurement because these were the only ones we were confident were completed within the PGSA and they were the only ones that remained as candidates after a rigorous analysis weeded out wells of poor and/or unknown construction. As previously referenced, the use of poorly-constructed and unsealed wells to base a conclusion on is not prudent.

7. **<u>HLI's modeling of the PGSA</u>.**

The Staff criticized the HLI/PGG ground water model because: 1) "the use of the general head boundary at the inlet to the model should be used cautiously," 2) its use of two different versions (H-Match and T-Match) "doesn't necessarily bracket uncertainty," 3) it does not discuss model sensitivity to "vertical hydraulic conductivity," and 4) it does not incorporate a fault (presumed no-flow boundary) into the model. Staff Memo at 14.

The four concerns voiced by the Staff are easily addressed:

(1) <u>The use of a general head boundary</u>: Staff apparently did not read the statement on page 5 of the November 14, 2008 memo from Pacific Groundwater Group of Seattle, WA ("PGG"), included in HLI (2008c) stating that the general head boundary ("GHB") used in both models to represent subflow into the PGSA along the southeast corner of the model in layers 5, 6, and 7 <u>was</u> converted to a constant flux boundary based on the steady-state calibrated solutions." Staff's criticism to the use of the GHB is unwarranted and based on an in accurate or incomplete review of the presented material.

(2) <u>The use of two different versions of the model</u>: M3 Eagle contracted with PGG to develop a multi-layered, three-dimensional numerical ground water flow model to predict the impacts of pumping at and beyond the time period for the full build out of the M3 Eagle project. This model was constructed subsequent to an early (2006) simplified, analytical model that was used initially by HLI to predict impacts. HLI felt that its initial analytical model, though useful, could be improved substantially by including data obtained through its subsequent hydrogeologic characterization studies.

Accordingly, the HLI-PGG Modflow model (the "M3 Model" as presented in HLI, 2008c) was developed and constructed based on HLI's conceptual model of the ground water flow system. This model achieved acceptable calibration to conditions in the deeper portions of the flow system (Pierce Gulch Sand Aquifer and Willow Creek Aquifer), which was the objective of the model development. The model was calibrated to both quasi-steady state groundwater elevations and time-drawdown responses to two aquifer tests. As more data became available over time, the model was refined slightly to maintain the calibration and provide reasonable matches to the new data. Sensitivity analyses also were performed to address uncertainties that are common in hydrogeologic characterization and associated modeling. Two versions of the model were generated—the "T-match" model (which is calibrated closer to transmissivity values estimated from aquifer tests) and the "H-match" model (which is calibrated closer to heads observed in the field, with slightly more degrees of freedom for specifying aquifer properties).

In addition, sensitivity analyses were performed to evaluate reduced recharge from the Boise River and the New York Canal (believed to be main sources of recharge for the PGSA) and reduced hydraulic connections to the Payette River. In all cases (applying the H-match and T-match models, and for both sensitivity analyses), predictions of PGSA drawdowns showed minimal variation. This indicates that the model is very robust in its capability to predict M3 drawdowns, and that predictions are relatively insensitive to the uncertainties evaluated with various versions of the model.

We presented the results of both the T-match and the H-match models to ensure transparency in the model development process, to allow reviewers to see the range of data used, and to provide the results of both calibration approaches (emphasizing heads and emphasizing previous aquifer test interpretation), and to demonstrate the relative insensitivity between these two approaches for prediction of M3 drawdown. In his constructive review of the M3 models, IDWR's Allan Wylie stated that the multiple model approach allowed "some evaluation of predictive uncertainty" (January 15, 2009 memo to Dennis Owsley). As noted above, the predictions made by the two model versions differ only slightly—on the order of a few feet or less at any one location, after projecting 50 years of constant pumping.

Both versions of the model also were used to assess the potential role of changes in recharge entering the model from southeast of the model boundary—recharge that we believe originated as, and continues to be provided head from, leakage from the New York Canal and seepage to underlying aquifers from the Boise River upstream from Capital Bridge.

(3) Lack of discussion on sensitivity to vertical hydraulic conductivity: The discussion in the HLI model report and the PGG memoranda on their modeling progress was brief, as noted by Staff who also speculate on the sensitivity of drawdown predictions to these values. To further provide insight and reduce the need to speculate, we offer the following.

PGG used a vertical hydraulic conductivity (Kv) value of 0.02 ft/day (7E-6 cm/sec) for the model aquitards overlying the PGSA. Aquitards were not simulated in the Willow Creek Aquifer because test well drilling indicated an absence of significant aquitards there. Instead, the WCA was assigned bulk properties that included anisotropy, with an effective Kv of 0.18 ft/d over the entire thickness of the unit. Early in the model calibration, PGG performed a sensitivity analysis to model parameters, and concluded that the vertical hydraulic conductivity had a relatively large influence on calibration residuals (an indication of differences between modeled and field-measured water levels).

PGG's analysis indicated that reducing the vertical hydraulic conductivity by a factor of 10 caused poor (non-calibration) results. Increasing the vertical hydraulic conductivity by a factor of 10 allowed the model to calibrate but resulted in predicted impacts to existing well in the PGSA to be smaller. In other words, the values used in the model were conservative for PGSA predictions.

The model used a vertical hydraulic conductivity value of 7×10^{-6} cm/sec which is on the low end of the published range for silt (Freeze & Cherry, 1979). Based on samples obtained during test well drilling, the results of geophysical logging and materials reported in well driller's reports for the area, this value appears quite reasonable and is supported by the calibration itself which resulted in selection of this value.

In order to further address Staff's concern, PGG evaluated the model sensitivity to aquitard Kv quantitatively. They found that the model showed high sensitivity to decreasing the Kv below the calibrated value, but relatively low sensitivity to increasing it. During calibration, one main objective is to minimize the parameter "sum of squared residuals" ("SSR") for the model targets. PGG varied the aquitard Kz by an order of magnitude from the existing calibrated value, and obtained the following SSR results:

Kv Multiplier	Sum of Square Residual
0.1	124,306
1	6,730
10	16,660

This table shows that reasonably good calibration could still be achieved by increasing the aquitard Kv, but calibration would have been poor if Kv had been reduced.

As for the role of aquitard Kv on model prediction of drawdown, if the Kv value were increased by an order of magnitude (e.g. more into the center of the silt range or towards a representative range for silty sand), predicted PGSA drawdown would be reduced, as it would allow more of the M3 Eagle pumping to be satisfied by a change in leakage between the PGSA and overlying aquifers. However, drawdowns in the overlying shallow, unnamed alluvial aquifers (a subject not directly addressed by the model), could be increased. If the Kv value were reduced by an order of magnitude (e.g. closer to the upper end of the clay range defined by Freeze and Cherry), the model would predict more drawdown due to M3 pumping in the PGSA. However, the sensitivity analysis above suggests that decreasing Kv below the calibrated value would not support acceptable model calibration in its current configuration, and is therefore less likely as a reasonable representation of the groundwater flow system.

(4) <u>Lack of incorporation of the presumed hydraulic impacts of the fault</u>: As discussed elsewhere in this Response, the bedrock fault noted by Wood does not appear to cause significant, or even measurable, hydraulic impacts on flow within the PGSA. For this reason, it was not included in any versions of the model. To have included it would not have been justified by the hydraulic, geologic, geophysical or geochemical data collected to date.

> **Using M3 model inputs, Staff made "preliminary calculations of travel time . . . of "water entering the regional aquifer from the southeast corner of the M3 model domain [to the] M3 property." Staff noted that this travel time is an order of magnitude less than the TVHP-estimated age of water in the regional aquifer. This led Staff to conclude that "[a]dditional data collection and analysis are needed in order to resolve the apparent discrepancy between the HLI conceptual and numerical models." Staff Memo at 18-19.**

Because heads are maintained by relatively rapid water pressure changes rather than water molecule movements over large distances, travel time calculations are very difficult to verify. In addition, travel time estimates probably have little meaning except in portions of the aquifer that are unconfined and where uniform steady state gradients exist.

The calculated travel times are relatively fast as would be expected for a high hydraulic conductivity aquifer such as the Pierce Gulch Sand Aquifer; however, they are very short compared with the estimated age of the ground water as indicated by the TVHP study and the ground water geochemistry presented by Glanzman and Squires, 2009. We conclude that the recharge to this system from the Boise River and canal systems provides the head needed to maintain relatively stable water levels throughout most of the aquifer, but that relatively old ground water may remain in residence in certain portions of the aquifer because of limited mixing and interaction between all portions of the system on decadal time scales.

> **The Staff ran drawdown calculations "using the same general methodology" employed by HLI except that the Staff assumed the PGSA receives no recharge and "extends infinitely to the southwest (down-dip) direction." Staff Memo at 21. Based on this, the Staff calculated "drawdown after one year of pumping at 10 cfs is approximately 8 feet at the intersection of Floating Feather Road and Highway 16," (Staff Memo at 21) and that, "[b]ased on the existence of a delayed hydraulic connection between the PGSA and overlying aquifers, pumping in the PGSA is likely to eventually impact the majority of area well owners." Staff Memo at 24.**

The Staff's drawdown predictions also are inconsistent with actual historical water level measurements, with production well performance in the greater M3-Eagle-Star vicinity, and with Staff's own water level measurements (the Staff's interpretation of which we believe inaccurately portrays the current water level trends in the area, as discussed in our rebuttal to the McVay memo, below). Numerous water supply wells have been pumping in the greater Eagle-Star vicinity at rates between 700 and 3,000 gpm over the past 18 years (and some, like the Eagle Pines irrigation well, for up to 50 years) without significant declines. Analysis of water levels from these wells shows nothing like the large amounts of drawdown predicted by the IDWR model.

For example, we obtained water level data from UWID's large-yield municipal production wells in the Eagle area. These data are attached as Figure 15. The UWID Floating Feather Well, which was drilled in May 1995, is completed into the Pierce Gulch Sand Aquifer in Eagle. UWID hydrogeologist Roger Dittus manually measured the well's water level in the well in April 2003, February 2007, and November 2008 at 44.51 ft below measuring point ("bmp") 42.25 ft bmp, and 40.94 ft bmp respectively. The well's production records for those years show the total annual volume of ground water pumped was 433 MGY, 602 MGY, and 517 MGY, respectively. The ten year average of water production from the UWID Floating Feather well is 460 MGY; the last five year production average is 490 MGY and the last three year average is 558 MGY. This shows the steady increase of ground water withdrawals that in turn tracks the growth in the community.

This yearly pumping from Floating Feather alone is equal to <u>nearly 25 percent</u> of the estimated total annual production of M3 Eagle at full build-out, yet the Floating Feather well has not caused water levels to decline measurably even at observation wells close by (such as State and Linder). In fact, the water levels measured by UWID's hydrogeologist at Floating Feather itself document a measurable (3.6 feet) <u>increase</u> in the wells' non-pumping water level over the last 6 years.

When compared with the water level reported by the well's driller in May 1995 (55 feet bgl), the well's current water level in Floating Feather is over ten feet higher. Taking into account an increase in measurement datum (from the original ground level to the site grading and pump house floor) the current water level as measured in November 2008 is actually at least 15 feet higher than when the well was drilled. In other words, the water level in November 2008 is estimated to be at least 15 feet higher than that reported by the driller at the well's completion in 1995, even after more than a decade of pumping from this and many more surrounding wells. This analysis tells us that the Pierce Gulch Sand Aquifer is not only highly productive, but strongly recharged. Although the number of Floating Feather well measurements are few, because this well rarely is shut off (and in fact typically pumps continually at a high rate), the fact the well recovers to or above its level of 14 years ago tells us that the aquifer pressures are not in decline as suggested by Staff.

Another example of remarkably stable water levels in the PGSA is the Eagle Pines (formerly Charles Fisher) irrigation well. According to Department records, this well has been used for irrigation since it was first drilled in February 1955 (Figure 27). This 54-year old well casing apparently collapsed in 2001. The well driller responsible for the abandonment of the old well measured the water level at 112 feet bgl in May 2001 (2 months into the irrigation season) compared to 105 feet bgl 54 years earlier in February. This small difference indicates that PGSA ground water levels are quite stable, even in the face of substantial ground water development in the area over several decades. Even if one were to assume that the driller's measurements are precise, that the full 7 foot decline over 54 years could be substantiated, that the time of year difference (lower level measured in irrigation season) need not be accounted for, and that such a decline occurred steadily while unaffected by precipitation trends (all unlikely in our opinion), this still would equate to a decline of 0.13 feet per year. In our opinion, a decline of that amount should be seen as small and acceptable rate of decline at a pumping center.

M3 Eagle and HLI decided to improve HLI's simpler 2006 analytical model by developing the HLI-PGG numerical model(s). Staff developed what appears to be an analytical model that is simpler even than the initial HLI approach. The purpose of the Staff's effort presumably was to evaluate or double check predicted drawdowns simulated by the HLI-PGG model. The Staff's analytical model incorporated an average pumping rate of 4,500 gpm (~10 cfs)-an average rate that is slightly higher than the full build-out average pumping rate for the M3 project (4.05 cfs non-irrigation season; 11.66 cfs irrigation season; 9.03 cfs annual average). After an assumed 50 years of continual pumping at the 10 cfs rate, the Staff's model predicted 18 feet of drawdown in the aquifer at the intersection of Highway 16 and Floating Feather Road, and as much as 35 feet of drawdown along parts of the M3 Eagle property.

The Staff's calculations were based on 50 years of pumping while assuming <u>zero</u> recharge to the system and <u>zero</u> hydraulic connection with shallower portions of the ground water flow system. These assumptions are not realistic based on existing data. Recharge in the form of both water and head believed to occur from the Boise River, from New York Canal seepage, and to a limited extent leakage from overlying and underlying aquifers. Hydraulic connections across aquitards, despite their relatively low hydraulic conductivities, are significant on a regional scale and provide some degree of "leaky aquifer" response to aquifer testing We know of no support for the assumptions implicit in Staff's model, nor do we consider them typical assumptions used to assess the viability of a water right or realistic from a scientific perspective. Based on the aquifer tests conducted in this area (and presented in HLI, 2008b), the known geological setting, and the measured water level changes resulting from substantial ground water development, it is not scientifically plausible to conclude that the Pierce Gulch Sand Aquifer receives no recharge. The preponderance of available data show just the opposite: that the aquifer is strongly recharged and exhibits some degree of hydraulic connection to overlying portions of the ground water flow system.

The difference in accounting for recharge and (limited) hydraulic connection across aquitards is illustrated by comparing the results of Staff's simple analytical model and the numerical models used by HLI and PGG. Whereas the Staff's analytical model predicted 18 feet of drawdown at the intersection of Highway 16 and Floating Feather Road after 50 years of pumping, the M3 Eagle numerical model predicted drawdowns of 4 to 7 feet at this same location after 50 years of pumping with recharge to the system based on rates derived from the TVHP.

The Staff's 50-year drawdown predictions also are inconsistent with the theory of well hydraulics. Wells draw down until the cone of depression extends outward sufficiently to capture recharge (ground water and/or surface water) equal to the amount of water being pumped. In theory, the cone of depression will equilibrate only if captured recharge equals the rate of well discharge. The documented behavior of high-yield production wells, such as the UWID Floating Feather Well, indicates that the cones of depression of pumping wells completed in the PGSA in the North Eagle area are capturing a sufficient amount of recharge to equal the withdrawals from these wells. The data collected to date indicate that withdrawal of ground water from the PGSA ultimately does have a connection to shallow ground water and/or surface water. It is the nature, path, timing, and distance of the various sources of recharge that are currently not completely determined.

The Staff evidently made no attempt to calibrate the model based on their assumptions. It would appear that the Staff's model run would not reasonably calibrate to any known data such as the UWID Floating Feather supply well described above.

Finally, although Staff states that M3 Eagle's pumping "is likely to eventually impact the majority of area well owners," it does not describe which well owners, in which aquifer units, or to what level of impact. HLI believes the impacts to those wells in the PGSA will be in the range predicted in its modeling. It will be less in other aquifers. In either case, these projected effects should be seen as well within acceptable limits and likely non-injurious to any water right of which we are aware.

> **The Staff asserts that "pumping in the PGSA at M3 would cause a reduction in ground water discharge to the river" of indeterminate magnitude and unknown locations. Staff Memo at 21.**

There has been no study of the potential effect on Boise River flows that could occur by pumping some 6,500 acre-feet annually from the PGSA for the M3 Eagle project. However, because PGSA ground water in the M3 Eagle vicinity is tributary in large part to the Payette

River, we do not anticipate measurable impacts to the Boise River in the reaches down gradient from the M3 Eagle site.

Moreover, according to the Department's "200-foot guidance," with regard to conjunctive administration of rights in the Boise River basin, applications for ground water wells completed beneath 200 feet bgl will be processed because they are considered "probably tributary" to the Boise River below Star Bridge. A copy of the Department's February 22, 2008 Memorandum containing the guidance is included as Attachment D. Below Star Bridge there currently are no restrictions on surface water appropriations. The proposed M3 Eagle wells are planned to be completed below the 200 foot level. Accordingly, we have not seen potential impacts to the Boise River as a relevant area of study for the M3 Eagle water right application.

8. Sustainability and future studies of the PGSA.

The Staff contends that "[t]he long-term sustainability of the aquifer beneath the M3 property is difficult to assess; some lines of evidence suggest that it may be limited." Staff Memo at 1.

We have seen no indication in any of our studies, mapping, water level monitoring, hydrogeologic testing, geological analysis, or geochemical evaluations that would indicate that the PGSA is not sustainable, or that it could not sustain over the long term an annual withdrawal of 6,535 acre-feet as proposed by M3 Eagle. All of M3 Eagle's studies suggest aquifer sustainability. No studies have caused us to conclude that the aquifer cannot sustain substantial additional development, including that proposed by M3 Eagle.

Although the Staff refers to "lines of evidence" suggesting the aquifer "may be limited," not even a listing of such evidence appears in the Staff Memo.

The Staff states that "[d]espite remaining uncertainties, the work that was commissioned by M3 has significantly improved our understanding of the hydrogeology in North Ada County," and that the "ongoing North Ada County Hydrogeologic Investigation will help reduce the uncertainty." Staff Memo at 2.

There always will be some degree of uncertainty in hydrogeology; uncertainty is inherent in virtually all natural science. However, we believe that our investigations and findings to date provide a high degree of scientific certainty as to the nature, extent, and productivity of the PGSA. These findings also are consistent with all of the published, peer-reviewed reports of North Ada County geology which have been produced over the past thirty years.

The largest uncertainties in understanding the hydrogeology of the North Ada County area, in our opinion, derive from the data available from poor-quality driller's reports and poorly constructed or dilapidated domestic and irrigation wells that are so prevalent here. The Staff does not address in its report the uncertainty inherent in its use of data from wells that are not sealed, whose construction is both unknown and questionable, and that may be receiving ground water from (or leaking it to) aquifers other than the PGSA, this omission is significant.

M3 Eagle has spent over $2,000,000 over the last 3 years studying the North Ada County hydrology, obtaining independent peer review, and conducting significant testing. M3 Eagle's studies have included modeling based on data rigorously collected from reliable sealed wells of known construction and the new construction of four permanent monitoring wells.

> **Staff concludes that "[s]ignificant questions still remain regarding aquifer recharge and sustainability" or with its suggestion that Hydro Logic's analysis is incomplete because "[i]mpacts to surface water users have not been evaluated." Staff Memo at 25.**

HLI agrees there is more that could be done in the Boise and Payette Basins to better understand the recharge to the regional PGSA; we would welcome the opportunity to bring what we have learned about the aquifer system to an investigation of those mechanisms. However, such an exercise is not the responsibility of the M3 Eagle, particularly not where it seek to obtain a relatively small amount of municipal water. While HLI does not yet know all of the intricacies of the recharge mechanisms of the Boise and Payette River Basins, we have made substantial progress toward that understanding. For the purposes of M3 Eagle, though, the knowledge that the aquifer is strongly recharged and that there are no indications of over-appropriation (or even significant declines) of the ground water resource at this time would seem to be the information that is relevant at this point.

In our experience, it is not customary to require applicants for ground water permits to answer all questions regarding the recharge mechanisms for a basin; this would seem an onerous and unrealistic requirement for a basin which is not approaching an overdraft situation. Indeed, just a few months ago, IDWR concluded in the City of Eagle administrative proceeding that additional ground water was available for appropriation in the Eagle area. The only data and/or information that has changed since that decision is the elucidation that the PGSA is far more extensive than was previously thought and that new data from large production wells in the area show essentially zero impacts to existing water users after decades of large ground water production. Other than the substantial additional ground water monitoring data developed by M3 Eagle, there is no substantive change in the monitoring data available for analysis.

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TABLE

Table 1. Comparison of HLI and March 2, 2009 IDWR Linear Regression Analyses

Well		HLI April 2, 2009 Analyses						IDWR March 2, 2009 Analyses			
IDWR Well Number	Local Well Name	Well Opening Depth ft bgl	Recent[1] Depth to Water Trend feet/year	Trend Period	Data used for entire analysis	Aquifer[2] as designated by HLI	HLI Comment	Water Level Trend feet/year	Trend Period	Data used for entire analysis	Aquifer[3] as designated by IDWR
04N01E 03DAD1	Terteling Well No.2	100-140	-0.04	2001-2008	549	TSF		0.19	1996-2008	12	Undiff
04N01E 05CD??	**UWID Redwood Creek**	**298-401**	**-0.50**	**2002-2008**	**4**	**PGSA**	Limited data	-	-	-	-
04N01E 07BD??	**UWID Floating Feather**	**183-255**	**-0.63**	**2003-2008**	**3**	**PGSA**	Limited data	-	-	-	-
04N01E 11BBB1	Moore	120-203	-0.22	1997-2008	109	TSF		-0.13	1996-2008	13	Undiff
04N01E 14CCB2	**TVHP #1**	**270-290**	**-0.19**	**2000-2008**	**52**	**PGSA**		-	-	-	-
04N01W 11DDA1	**UWID State and Linder**	**280-380**	**-0.11**	**1999-2008**	**16,010**	**PGSA**		-	-	-	-
04N02W 07AAC1	Hayes	40-42	0.11	1997-2008	99	river gravel		0.07	1996-2008	12	Shallow
05N01E 32DBD1	Killerman	120-125	-	-	13	alluvial	too shallow to be PGSA	1.06	1996-2008	12	PG
05N01E 34DBB1	Unknown	175?	0.30	1997-2008	109	TSF		0.20	1996-2008	13	Tert
05N01E 35ACA1	Jeker domestic	63?	-0.01	1997-2008	113	TSF		0.01	1996-2008	12	Tert
05N01E 36AAB1	Jerker irrigation	144-214	0.74	2000-2008	93	TSF		0.27	1996-2008	12	UNK
05N01W 36ABB1	**Frasier?**	**204-208**	**0.11**	**2001-2008**	**102**	**PGSA?**	too shallow to be PGSA?	0.40	1996-2008	13	PG
05N02W 22CAD1	**Unknown**	**279-403**	**-0.30**	**1997-2003**	**71**	**PGSA**		-	-	-	-
05N03W 12CCA1	**Unknown**	**60-314**	**-0.07**	**2004-2008**	**38**	**PGSA?**	too shallow to be PGSA?	**0.32**	**1996-2008**	**8**	**PG**
05N03W 15DDC1	Hozen	147-152	0.15	2002-2008	100	alluvial		0.49	1996-2008	13	Undiff
Precipitation	Boise WSFO		0.20 in/yr decrease	1997-2008	19		based on 228 monthly data points	-	-	-	-
			- = rising					- = rising			
			+ = falling					+ = falling			

CONCLUSION: ALL wells known to be completed in the PGSA have shown a RISING water level elevation trend over the past 6 to 12 years. One well that may be too shallow to be completed in the PGSA shows a DECLINING trend over the past 7 years. IDWR analyses using reduced number of data points for a 12-year period obscure identification of these trends.

NOTE 1: "Recent" trend is for past 6 to 12 years for wells still monitored. If monitoring has been discontinued, "recent" trend is for latest 6 to 7 years of monitc
NOTE 2: "TSF" = Terteling Springs Formation, "PGSA" = Pierce Gulch Sand Aquifer, "alluvial" = unnamed alluvial aquifer overlying the PGSA, "river gravel" = shallow ri sand and gravel of Boise Rive
NOTE 3: "Tert" = Terteling Springs Formation, "PG" = Pierce Gulch Sand Aquifer, "Undiff" = undifferentiated aquifer, "Shallow" = shallow aquifer, UNK = unknown aqu
NOTE 4: All listings that are believed to b**PGSA** or may be PGSA are highlighted ir**bold**

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Table 2. Assessment of Well Suitability for Use in Monitoring Trend in the Pierce Gulch Sand Aquifer

IDWR Designation	Local Name	HLI Aquifer Designation	Driller's Report on line	Seal	Drilling Method	Age Yrs	Casing	Deterioration	Screen	Use	West of EWB Fault	IDWR mon. well	Overall Suitability
04N01E 03DAD1	Terteling Well No.2	TSF	yes	Poor, "40" ft cuttings	Cable tool	37	1/4-in steel	Yes	Perforated	Unused	no	yes	NOT Suitable
04N01E 07BD??	Redwood Creek	PGSA	yes	Full depth bentonite	Rev mud rotary	15	3/8-in steel	Unlikely	SS wire-wound	Muni. Supply	yes	no	Suitable
04N01E 05CD??	Floating Feather	PGSA	yes	Full depth bentonite	Rev mud rotary	14	3/8-in steel	Unlikely	SS wire-wound	Muni. Supply	yes	no	Suitable
04N01E 11BBB1	Moore	TSF	yes	None reported	Cable	77	3/16-in steel	Likely	Perforated	Domestic	no	yes	Not Suitable
04N01E 14CCB2	TVHP #1	PGSA	yes	Full depth bentonite	Mud rotary	13	sch 80 PVC	Unlikely	Factory-slot PVC	Monitoring	yes	yes	Ideal
04N01W 11DDA1	State & Linder	PGSA	yes	Full depth bentonite	Mud rotary	11	sch 80 PVC	Unlikely	Factory-slot PVC	Monitoring	yes	no	Ideal
04N02W 07AAC1	Hayes	river gravel	yes	Poor, 20 ft cuttings	Air rotary	20	1/4-in steel	Possible	None	Domestic	yes	yes	NOT Suitable
05N01E 32DBD1	Killerman	unnamed alluvial	yes	Poor, 18 ft cuttings	Cable tool	17	1/4-in steel	Possible	SS wire-wound	Domestic	yes	yes	NOT Suitable
05N01E 34DBB1	Unknown	TSF	no	Unknown	Unknown	29+_	Unknown	Possible	Unknown	Irrigation	no	yes	NOT Suitable
05N01E 35ACA1	Jeker domestic	TSF	yes	None reported	Air rotary	20+	1/4-in steel	Yes	None	Dom/Geothermal	no	yes	NOT Suitable
05N01E 36AAB1	Jerker irrigation	TSF	yes	Poor, cuttings	Cable tool	41	1/4-in steel	Probable	Iron wire-wound	Irrigation	no	yes	NOT Suitable
05N01W 36ABB1	Frasier?	PGSA?	yes	Poor, "50" ft cuttings	Cable tool	41?/24?	1/4-in steel	Possible	SS wire-wound	Domestic	yes	yes	Poor
05N02W 22CAD1	Unknown	PGSA	yes	None reported	Cable tool	61+	3/8-in steel	Probable	Perforated	Irrigation	yes	yes	Poor
05N03W 12CCA1	Unknown	PGSA?	no	Unknown	Unknown	30	Unknown	Possible	Unknown	Domestic	yes	yes	Poor
05N03W 15DDC1	Hozen	unnamed alluvial	yes	Poor, 20 ft cuttings?	Cable tool	39	1/4-in steel	Probable	None	Domestic	yes	yes	NOT Suitable

Ideal: a properly constructed, dedicated monitoring well completed in the PGSA. **Suitable**: A properly constructed, full-depth sealed well completed in the PGSA but used for supply purposes.**Poor**: A well completed in the PGSA or what may be the PGSA but used for water supply and flawed in construction.**Not suitable**: Completed in the wrong aquifer, flawed in construction, located on the east side of the Eagle-West-Boise fault and/or of unknown construction. Cable tool and Air rotary drilling typically produce wells NOT suitable or Poorly suitable for monitoring.

CONCLUSION: Most of the wells used in the IDWR trend analysis are either not suitable for use as a monitoring well for the PGSA (wrong aquifer, wrong side of fault, poorly sealed, and/or known or possible deterioration of casing or screen). Wells believed to be completed in the PGSA but having poor construction and uses beyond monitoring were judged to be poorly suited for monitoring.

FIGURES

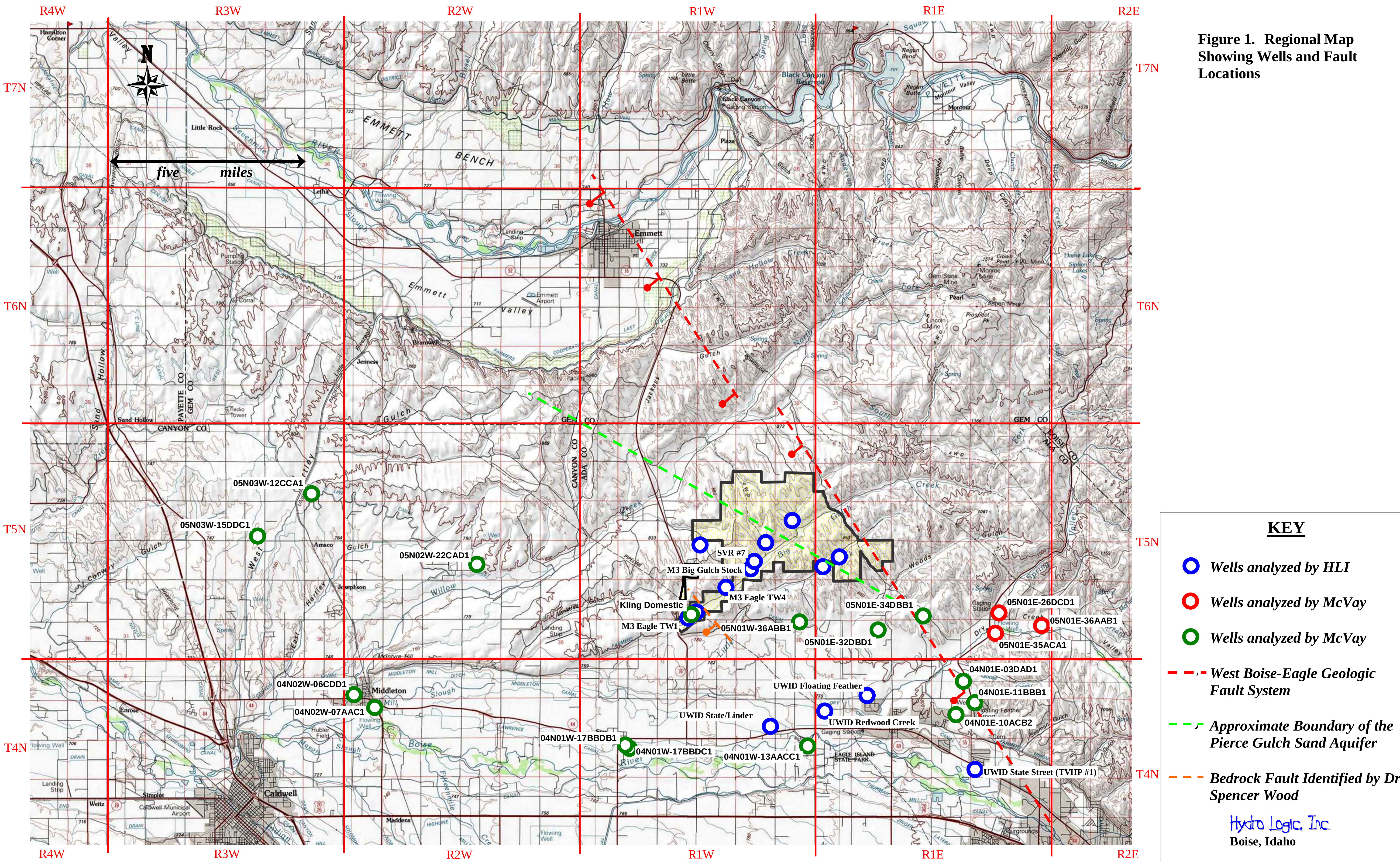


Figure 1. Regional Map Showing Wells and Fault Locations

Figure 2. Subsurface Seismic Reflection Profiles (from Wood)

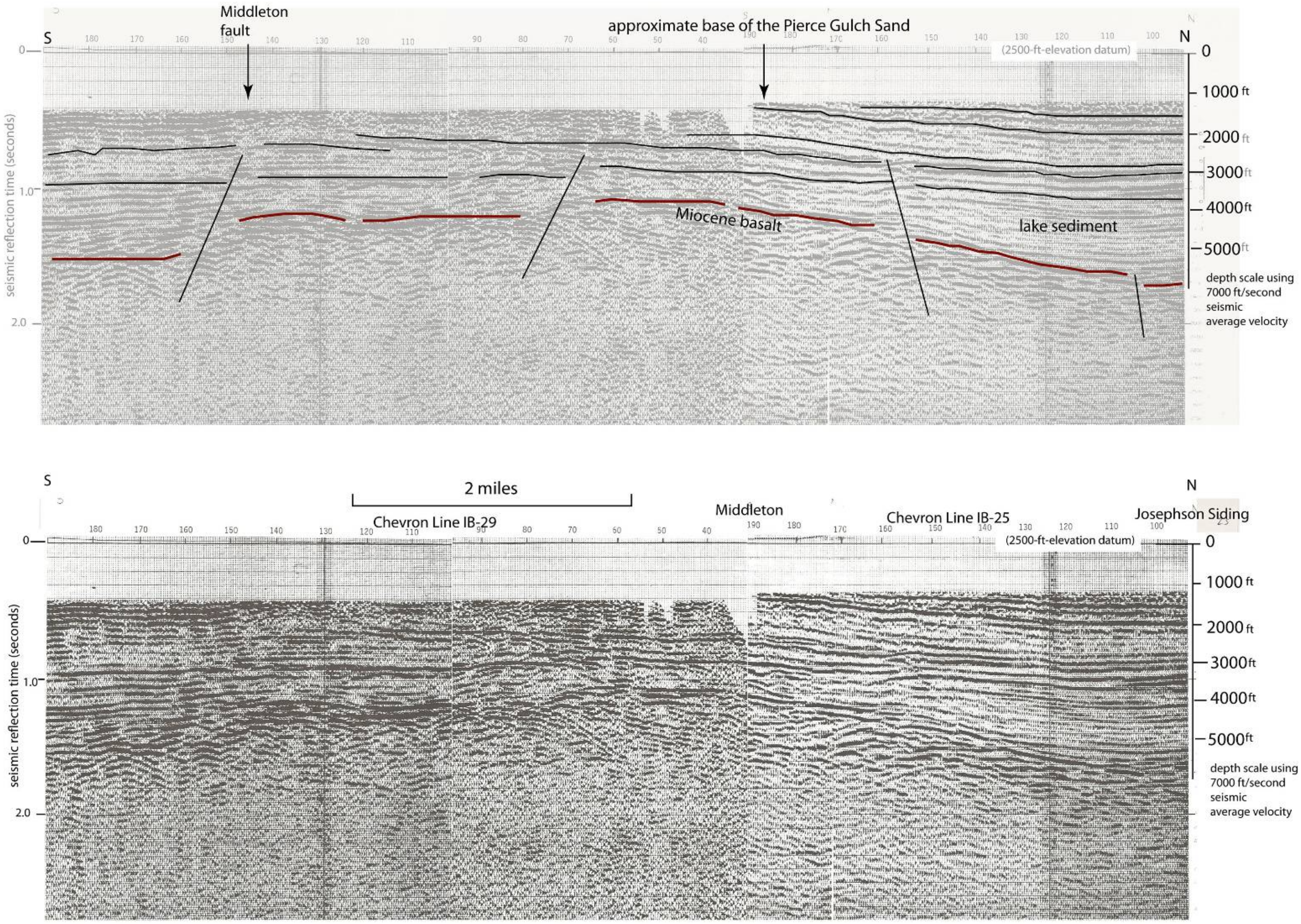


Figure 3. Interpretation of a north-south seismic reflection line through Middleton, Idaho to Josephson siding. Seismic section shows the deep basin north of Middleton that likely extends to the Eagle area. Faulting does not extend to the level of the upper sedimentary section where the Pierce Gulch Sand regional aquifer is situated. Location of seismic line shown on Figure 1 of this report.

Figure 3. Deep Well Locations and Transect Lines for Hydrogeologic Cross-Sections

Figure 1. Map showing locations of deep wells with geophysical logs through the Pierce Gulch Sand Aquifer (Figure 2) and location Chevron seismic lines shown in Figure 3.

Figure 4. Hydrogeologic Cross Sections based on Deep Exploration Well Borehole Geophysical Analyses (from Wood)

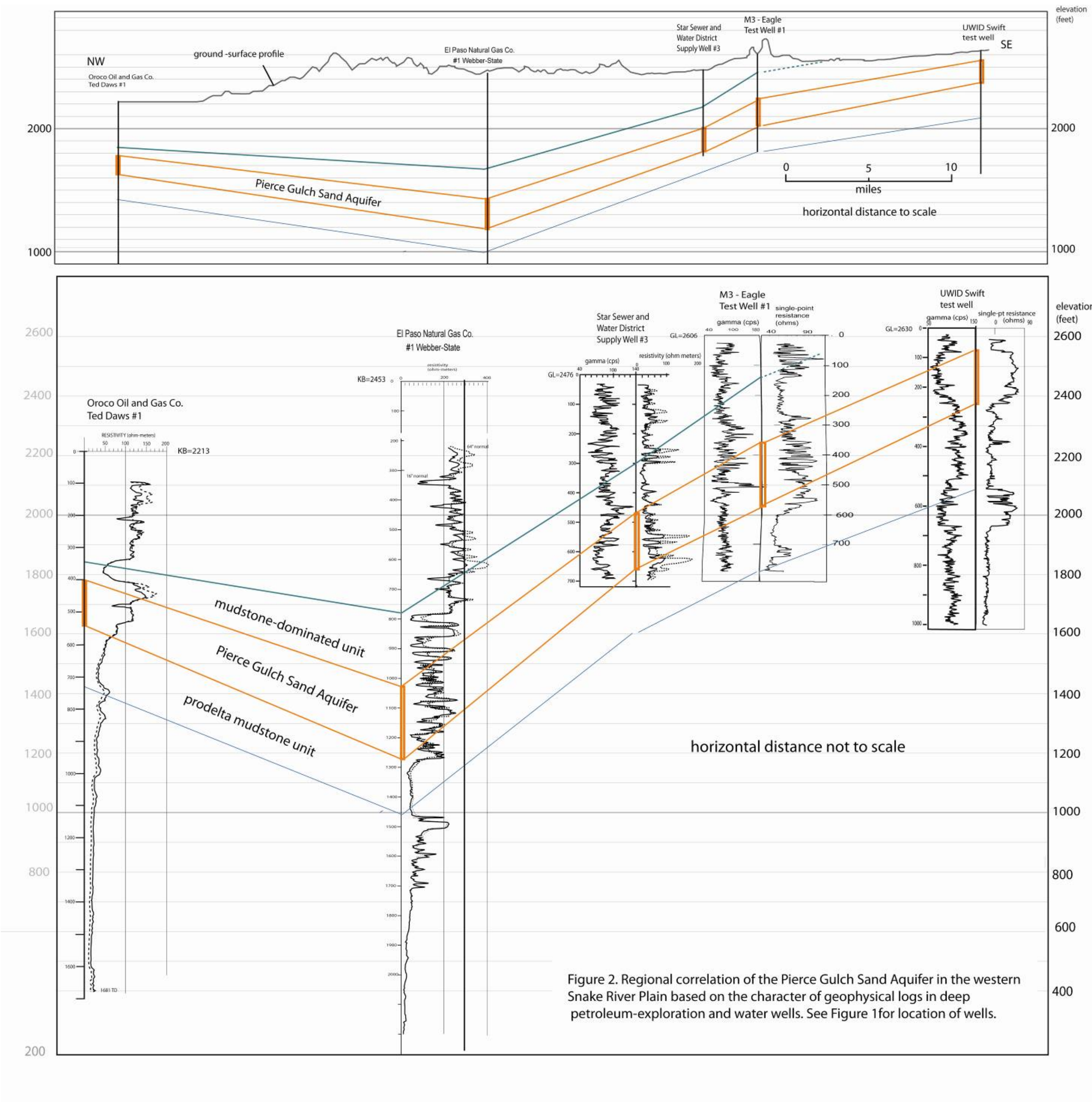


Figure 2. Regional correlation of the Pierce Gulch Sand Aquifer in the western Snake River Plain based on the character of geophysical logs in deep petroleum-exploration and water wells. See Figure 1for location of wells.

Figure 5. Comparison of Water Level Responses in TW #1 and TW #4

Figure 5.

From Continuous Water Level Monitoring

Monitored For M3 Eagle By: Hydro Logic, Inc.

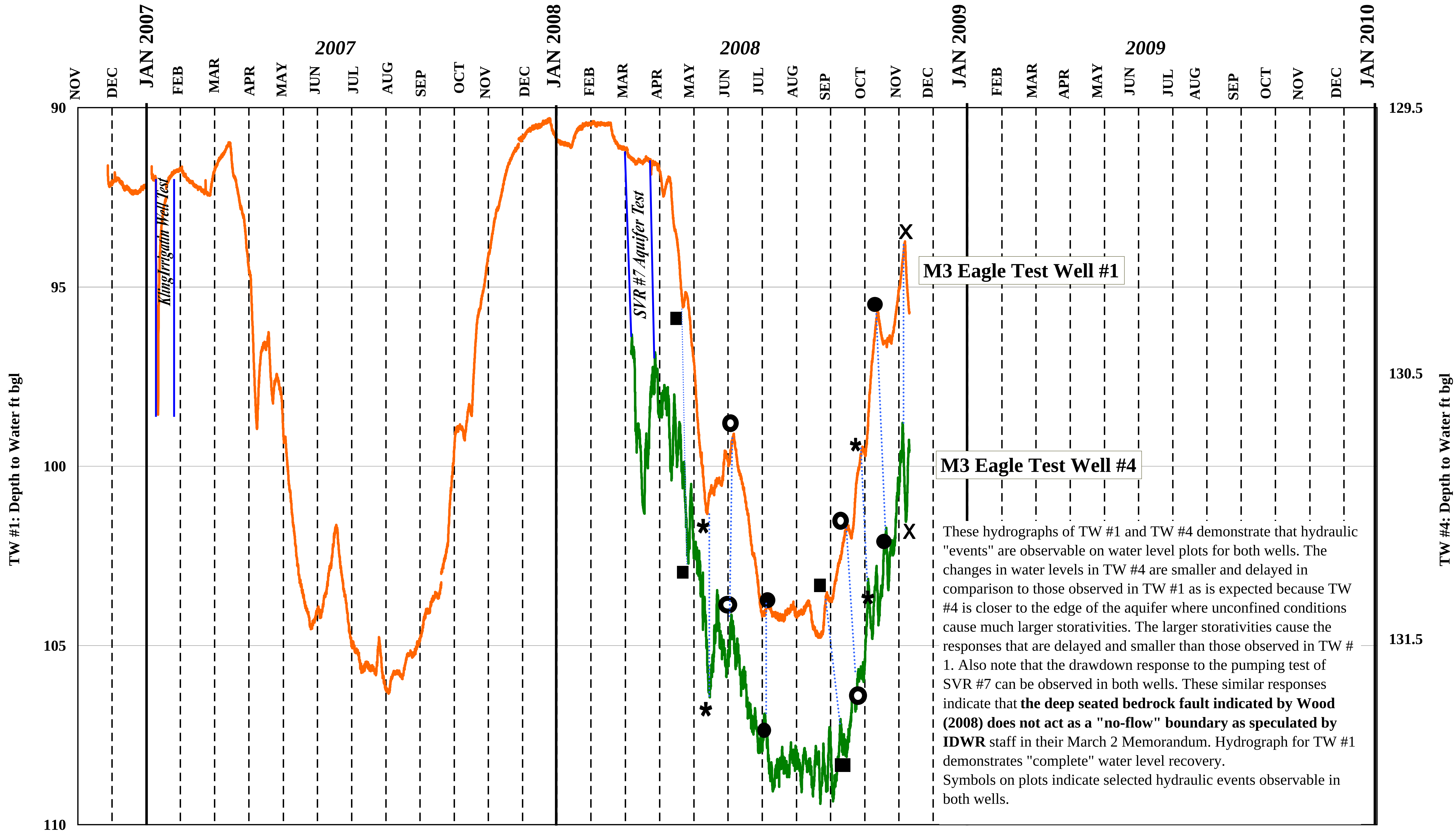
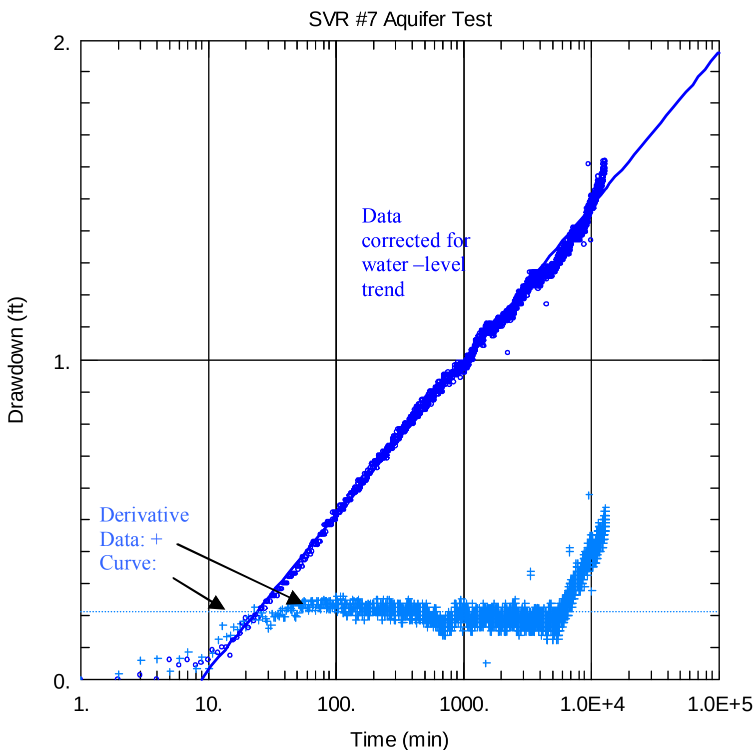


Figure 6. Cooper-Jacob Analysis for the Big Gulch Stock Well with Water-Level Trend Corrections



Screen = 180 ft bgl (open hole)
T=500,000 gpd/ft
S = 1.3x 10^{-3}
Kv/Kh=0.1
b = 340 ft
t_c = 95 min
r = 845 ft
Q = 917gpm (at SVR #7)

Derivative analysis indicates method is valid for data between 100 and 6,000 min. Rise in apparent drawdown and derivatives after 6,000 minutes may reflect boundary effect of nearest known "no-flow" boundary – the edge of the aquifer shown in the site plan as the "green line." Correction for water-level trend results in an indicated storativity (S) about 8 percent greater than value indicated without this correction. Transmissivity remains unchanged.

$T = 264Q/\Delta s$ Where:
- T = Transmissivity in gallons per day per foot (gpd/ft)
- Q = Pumping rate in gallons per minute (gpm) and
- Δs = Change in drawdown of water level over one log cycle of time, in feet (ft)

t_c = critical time where "u assumption" is met (where u = 0.05) such that method may be valid, is 95 minutes as shown by dashed vertical line.

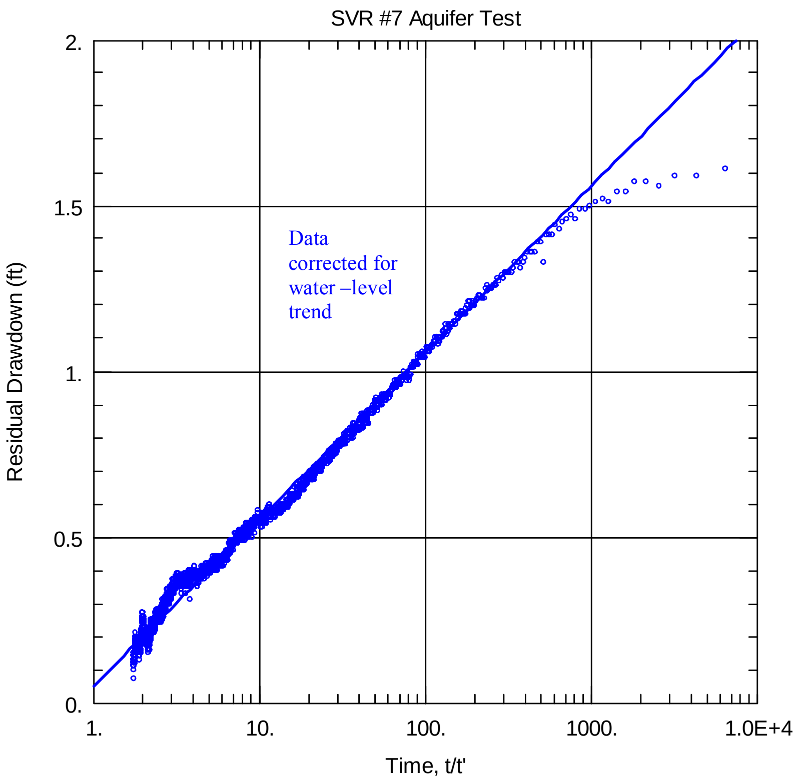
$u = 1.87r^2S/Tt$
- t = time in days
- r = distance to pumping well (ft)

b = aquifer thickness in feet (ft), estimated from geophysical log of well SVR #7.

Based on the analytical method of Cooper and Jacob (1946).

No partial penetration corrections needed because well is more than 2x aquifer thickness from pumping well.

Figure 7. Theis Recovery Analysis for the Big Gulch Stock Well with Revised Water-Level Trend Correction



Screen = 180 ft bgl (open hole)
T=480,000 gpd/ft
S/S' =0.8
Kv/Kh=0.1
b = 340 ft
r = 845 ft
Q = 917gpm (at SVR #7)

S/S' less than 1 suggests "late" or "incomplete" recovery. Apparent "late" recover caused by either, a) incomplete correction for seasonal (declining), regional, water- level trend or b) hydraulic effects of nearest known no-flow boundary – the edge of the aquifer ("green line" on the site plan.

Partial penetration corrections neither needed nor applied.

$T = 264Q/\Delta s$ Where:
- T = Transmissivity in gallons per day per foot (gpd/ft)
- Q = Pumping rate in gallons per minute (gpm) and
- Δs = Change in drawdown of water level over one log cycle of time, in feet (ft)

t = time since pumping started (minutes)
t' = time since pumping stopped (minutes)

S/S' = storativity ratio (unitless) where:
- S/S' < 1 indicates no-flow boundary ("late" recovery)
- S/S' = 1indicates no recharge or discharge boundaries ("normal" recovery)
- S/S' >1 indicates recharge boundary ("early" recovery)

Kv/Kh = Bulk vertical to horizontal ratio of hydraulic conductivity (unitless), see text for details
b = aquifer thickness in feet (ft), estimated from geophysical logs, Well Driller's Reports and well logs in the area
r = distance to pumping well (ft)

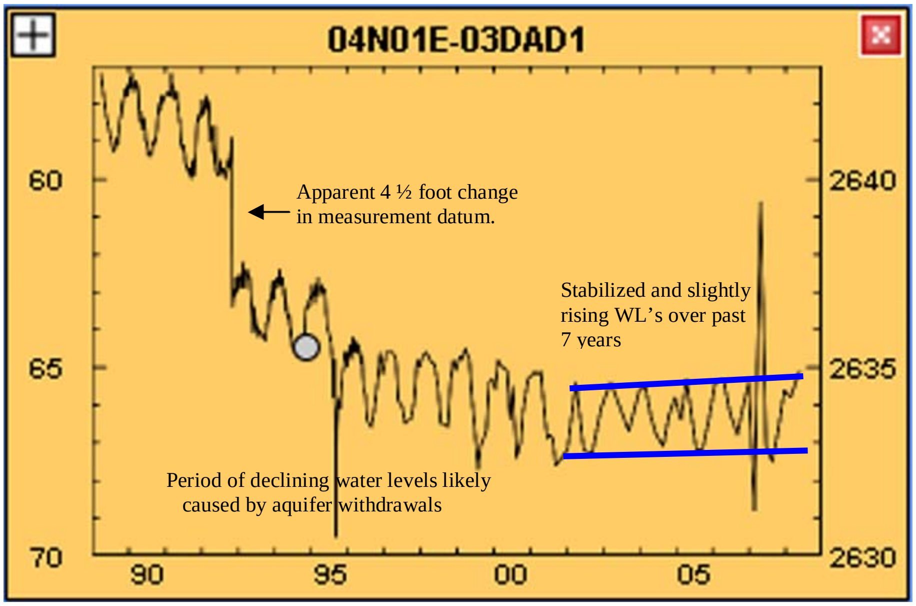
Based on the analytical method of Theis (1935).

Figure 8. Comparison of Water Level Data Plot on IDWR Website with Analysis of Selected Data by McVay for Well 04N01E 03DAD1

Water level hydrograph from IDWR's Website using all 582 measured water levels.

IDWR's plot shows:
a) declining water levels through about 2001,
b) measurement datum shift during 1992, and
c) an **apparent water level rise from 2001 through 2008**

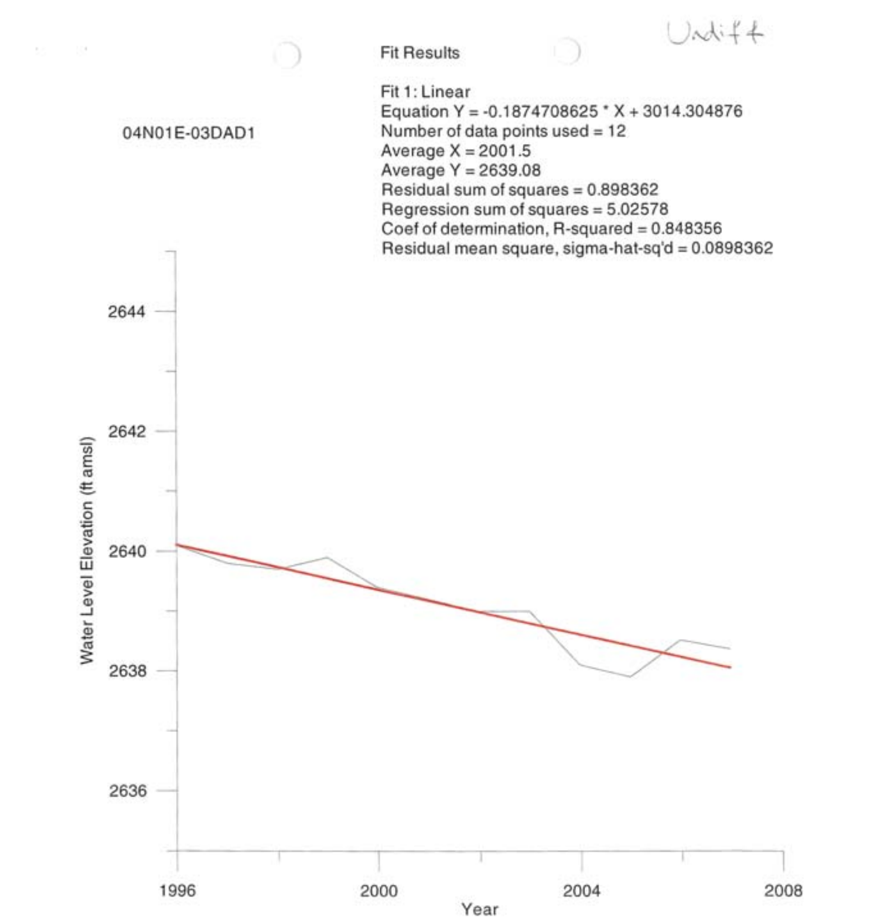
[blue lines and text on figure added by HLI]



a. IDWR Website Plot

Water level hydrograph by McVay using 12 selected water levels.

McVay's plot purports to show a steadily declining "non-irrigation season" water level. By ignoring the visual trend apparent in the complete data plot, McVay's analysis combines data from a period of water level decline with a period of water level rises and gives a **false indication of true conditions in the Terteling Springs Formation mudstone aquifer.**



b. McVay Memo Plot

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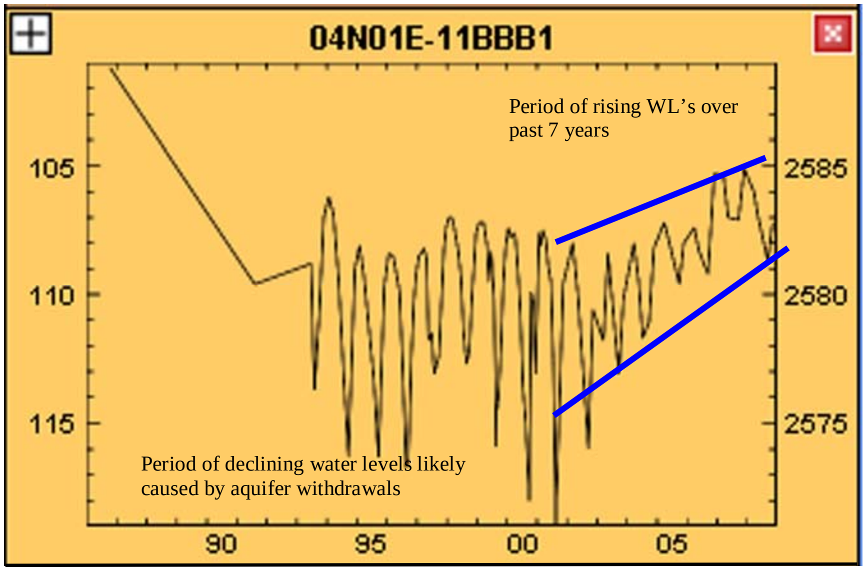
Boise, Idaho

Figure 9. Comparison of Water Level Data Plot on IDWR Website with Analysis of Selected Data by McVay for Well 04N01E 11BBB1

Water level hydrograph from IDWR's Website using all 111 measured water levels.

IDWR's plot shows:
a) declining water levels through about 2001, and b), an **apparent water level rise from 2001 through 2008**

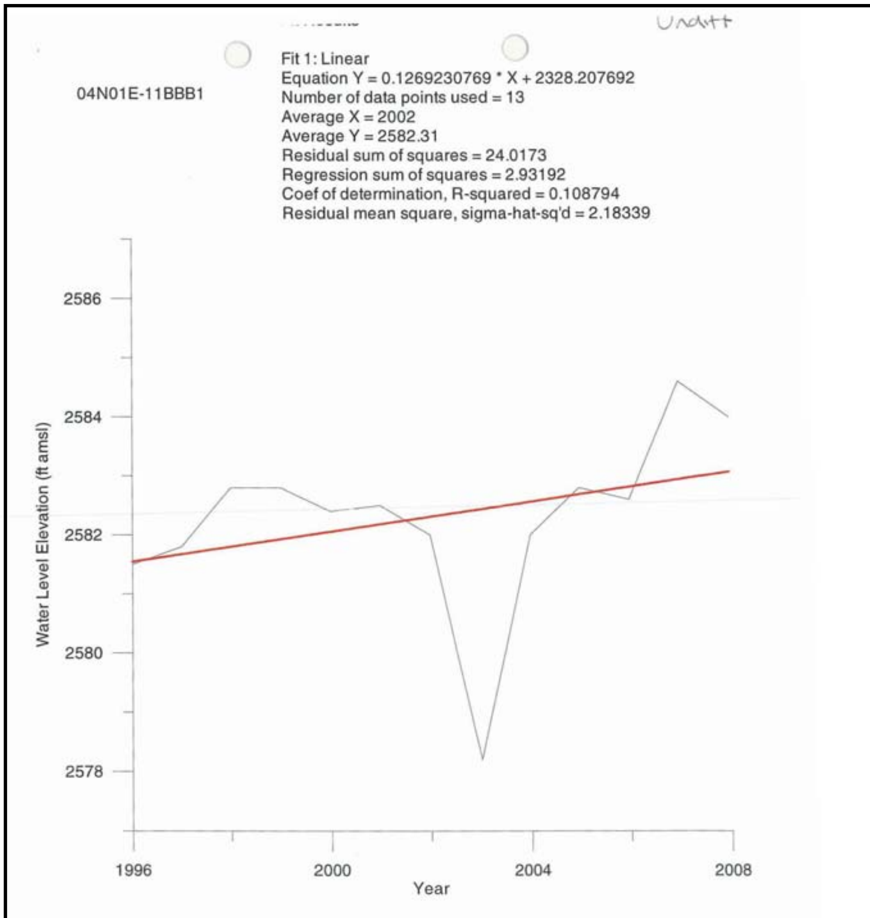
[blue lines and text on figure added by HLI]



a. IDWR Website Plot

Water level hydrograph by McVay using 13 selected water levels.

McVay's plot shows a steadily rising "non-irrigation season" water level. McVay's analysis of 13 data points **agrees with the apparent rise in water levels in this portion of the Terteling Springs Formation mudstone aquifer** as shown in the plot of all 111 data points.



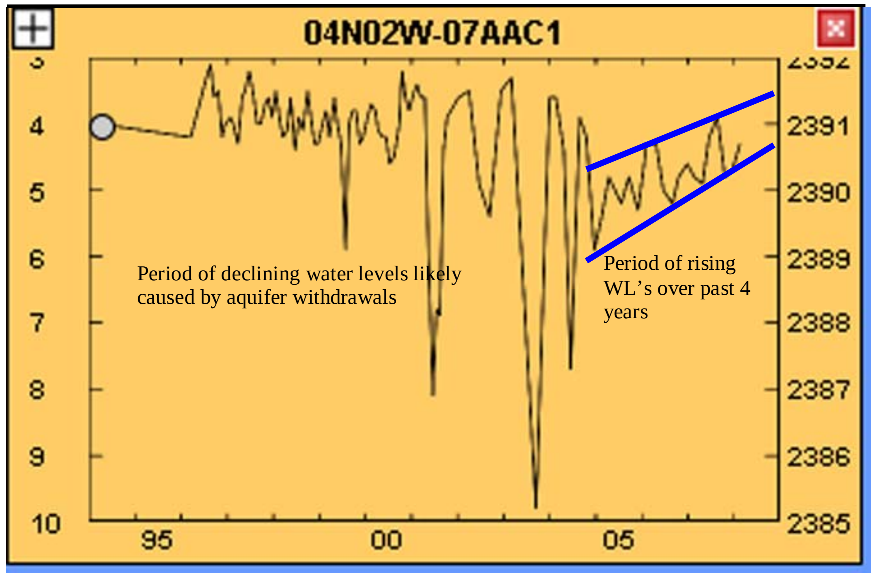
b. McVay Memo Plot

Figure 10. Comparison of Water Level Data Plot on IDWR Website with Analysis of Selected Data by McVay for Well 04N02W 07AAC1

Water level hydrograph from IDWR's Website using all 99 measured water levels.

IDWR's plot shows:
a) declining water levels through about 1999,
b) an ambiguous water level trend from 1999 through 2004, and
c) **an apparent water level rise from 2005 through 2008**

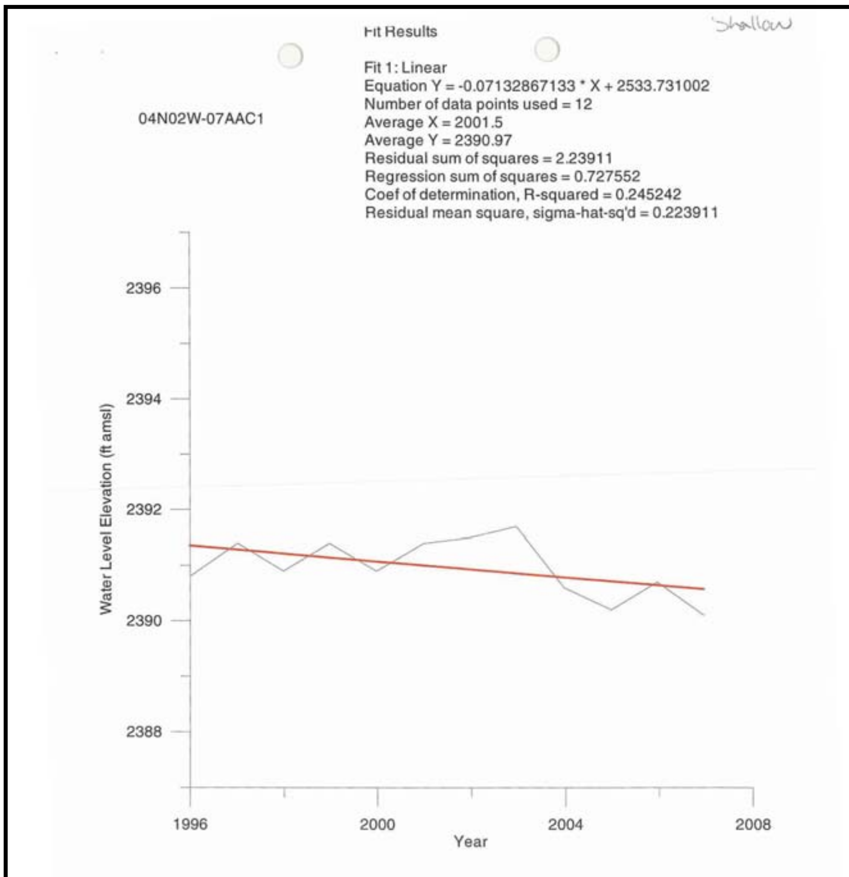
[blue lines and text on figure added by HLI]



a. IDWR Website Plot

Water level hydrograph by McVay using 12 selected water levels.

McVay's plot purports to show a steadily declining "non-irrigation season" water level. By ignoring the visual trend apparent in the complete data plot, McVay's analysis combines data from a period of water level decline with a period of water level rises and gives a **false indication of true conditions in the Boise River gravel aquifer.**



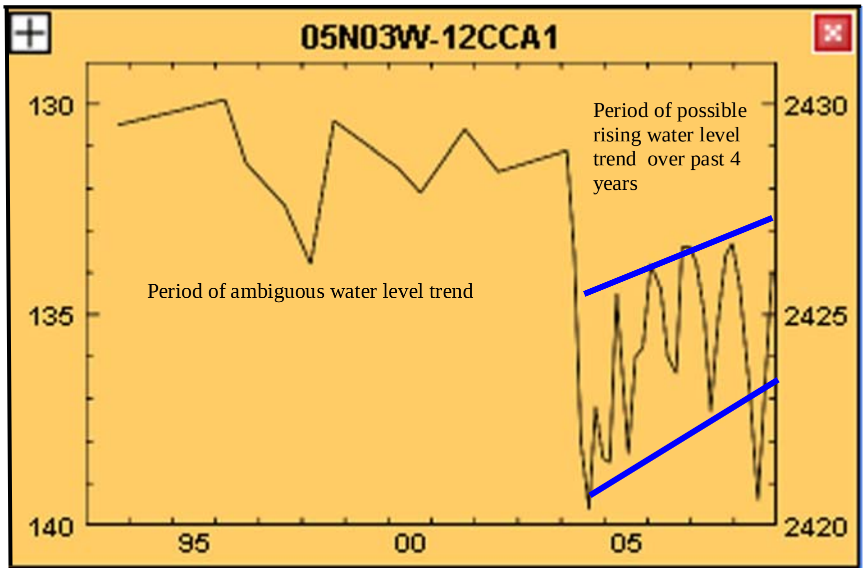
b. McVay Memo Plot

Figure 11. Comparison of Water Level Data Plot on IDWR Website with Analysis of Selected Data by McVay for Well 05N03W 12CCA1

Water level hydrograph from IDWR's Website using all 99 measured water levels.

IDWR's plot shows:
a) an ambiguous water level trend into 2004, and
b) **an apparent water level rise from 2005 through 2008**

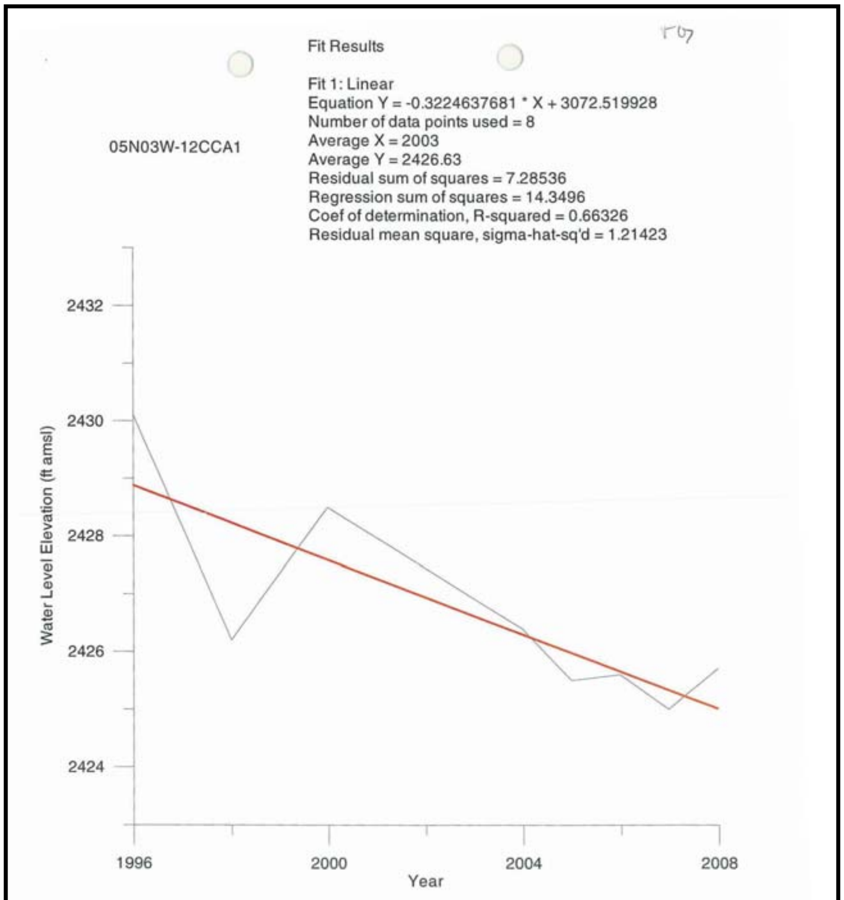
[blue lines and text on figure added by HLI]



a. IDWR Website Plot

Water level hydrograph by McVay using 8 selected water levels.

McVay's plot purports to show a steadily declining "non-irrigation season" water level. By ignoring the visual trend apparent in the complete data plot, McVay's analysis combines data from a period of water level decline with a period of water level rises and gives a **false indication of true conditions in the Pierce Gulch Sand Aquifer.**



b. McVay Memo Plot

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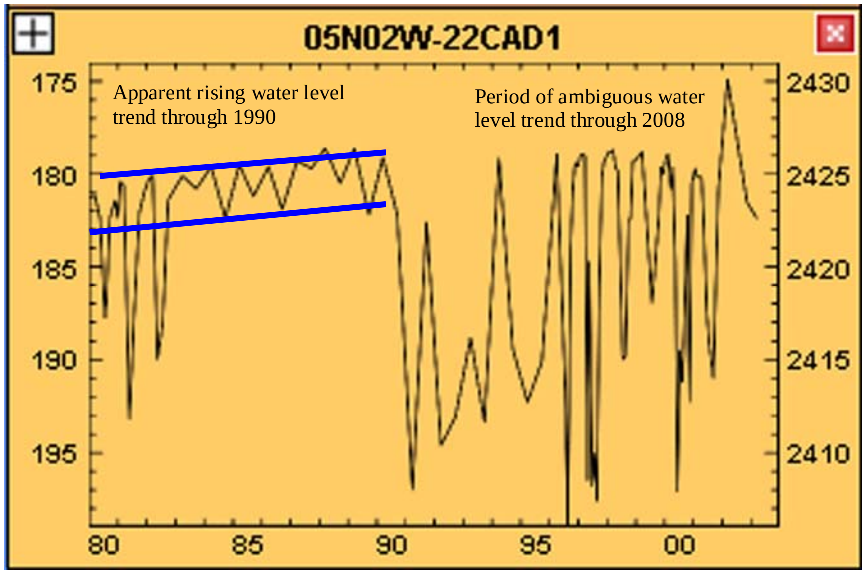
Figure 12. Comparison of Water Level Data Plot on IDWR Website with Analysis of Selected Data by McVay for Well 05N02W 22CAD1

Water level hydrograph from IDWR's Website using all 104 measured water levels.

IDWR's plot shows:
a) an apparent period of little production use from 1984 through 1990,
b**)** an apparent water level rise throughout this period, and
c) ambiguous but possible rising water levels from 1990 -2008

[blue lines and text on figure added by HLI]



a. IDWR Website Plot

McVay did not analyze the data from this well even though it is one of the deepest monitoring wells in the region to the near-west of the M3 site and is **completed in the Pierce Gulch Sand Aquifer.**

No analysis by McVay in the March 2, 2009 memo

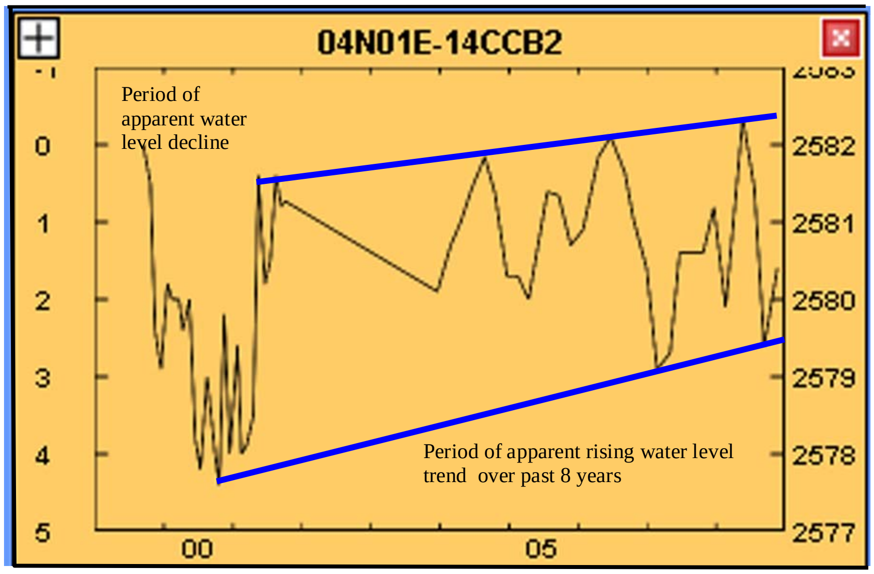
b. McVay Memo Plot

Figure 13. Comparison of Water Level Data Plot on IDWR Website with Analysis of Selected Data by McVay for Well 04N01E 14CCB2

Water level hydrograph from IDWR's Website using all 54 measured water levels.

IDWR's plot shows:
a) an apparent decline in water level during 1999 through 2000, and
b) **an apparent water level rise from 2000 through 2008**

[blue lines and text on figure added by HLI]



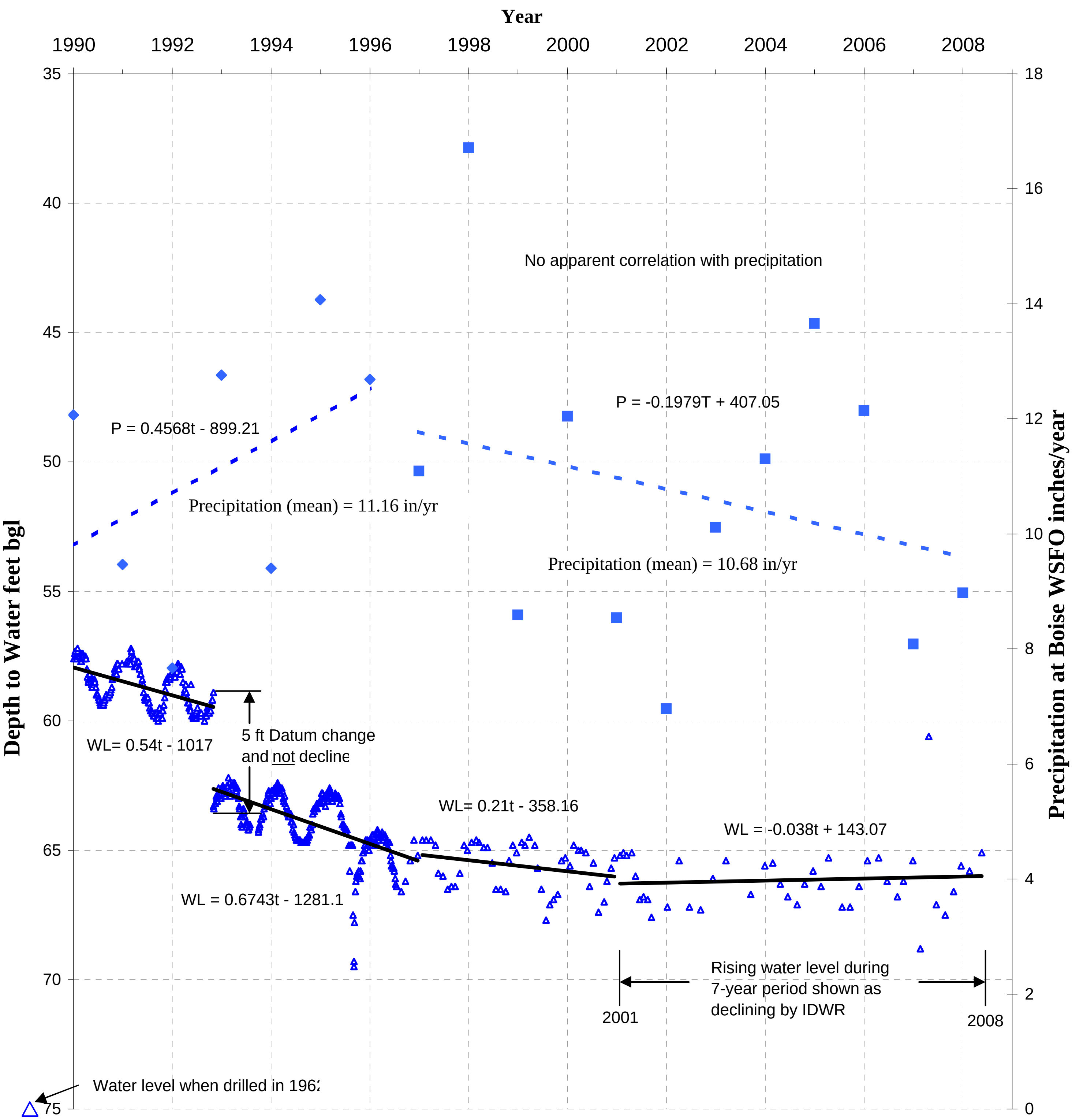
a. IDWR Website Plot

McVay did not analyze the data from this well even though it is one of the **best monitoring wells in the East Eagle area** to indicate the **true conditions in the Pierce Gulch Sand Aquifer.**

No analysis by McVay in the March 2, 2009 memo

b. McVay Memo Plot

Figure 14. Water Level Trends in Well 04N01E 3DAD1



Linear regression analysis indicates that precipitation was increasing during the period 1990 through 19 and was decreasing during the period 1996-2008. These linear regression analyses using all 549 data points indicates that water levels were declining from 1990 through 2000 but were rising from 2001 through 2008 at an average rate of 0.04 ft/yr. This analysis contradicts the analysis by McVay using 12 selected data points that he used to portray a decline of 0.19 ft/yr. This well is not completed in the PGS and is NOT suitable for monitoring water levels in the PGSA. See tables for details.

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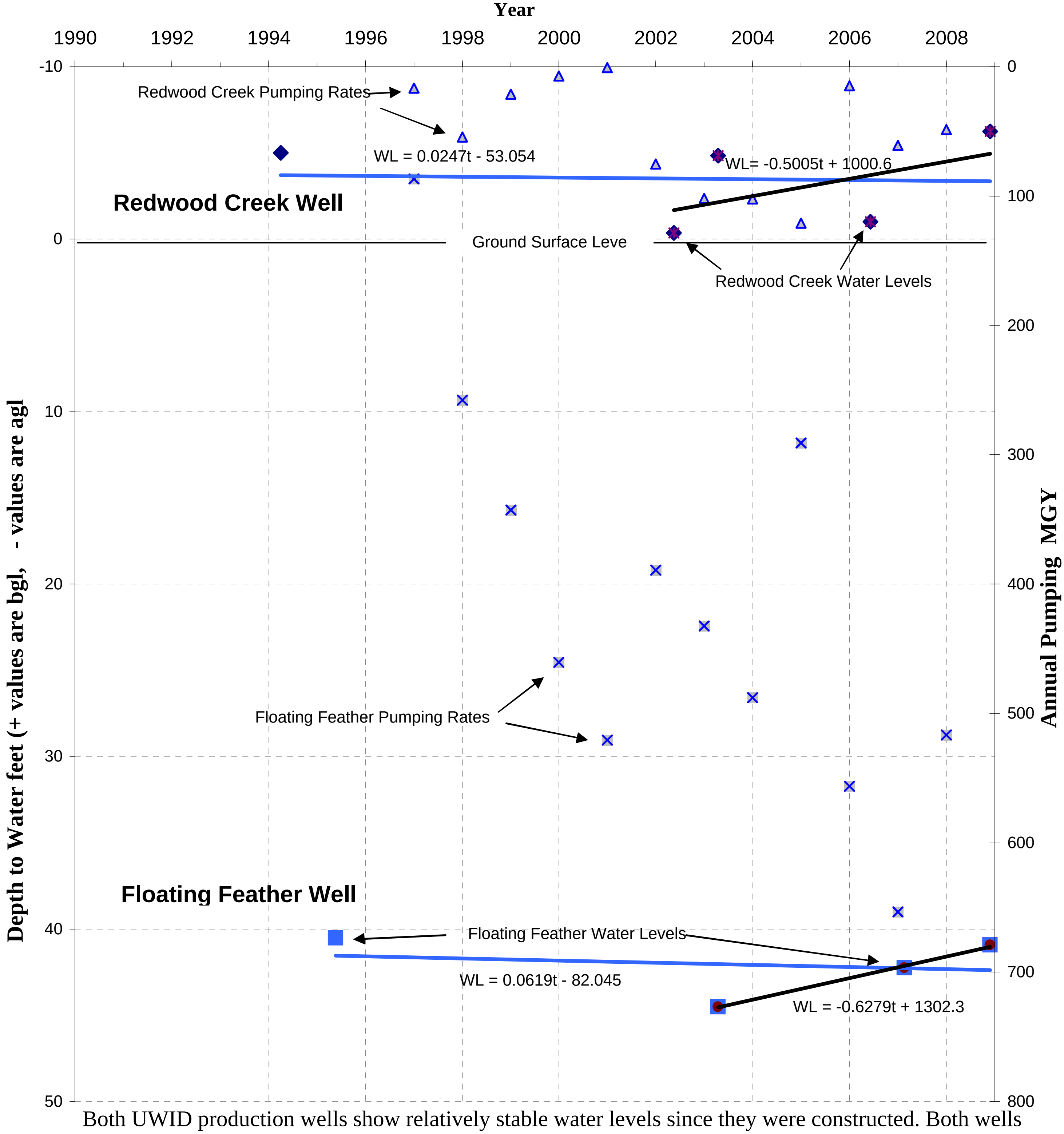
Boise, Idaho

Figure 15. Water Level Trends in the UWID Redwood Creek and Floating Feather Wells 04N01E 7BD and 04N01E 5CD



Both UWID production wells show relatively stable water levels since they were constructed. Both wells show a rise in water levels from 2002-2008 in spite of generally increasing levels of production. Both wells have too few data points for statistically valid trend analysis, but qualitatively - water levels appear to be rising over the past 5 to 6 years. Initial water level for each well measured from ground surface. Subsequent measurements relative to well house floor. The difference in elevations estimated to be 2 feet. Both wells are completed in the PGSA and have well documented construction and testing. This well is suitable for monitoring water levels in the PGSA. See tables for details. Data provided by Roger Dittus of UWID.

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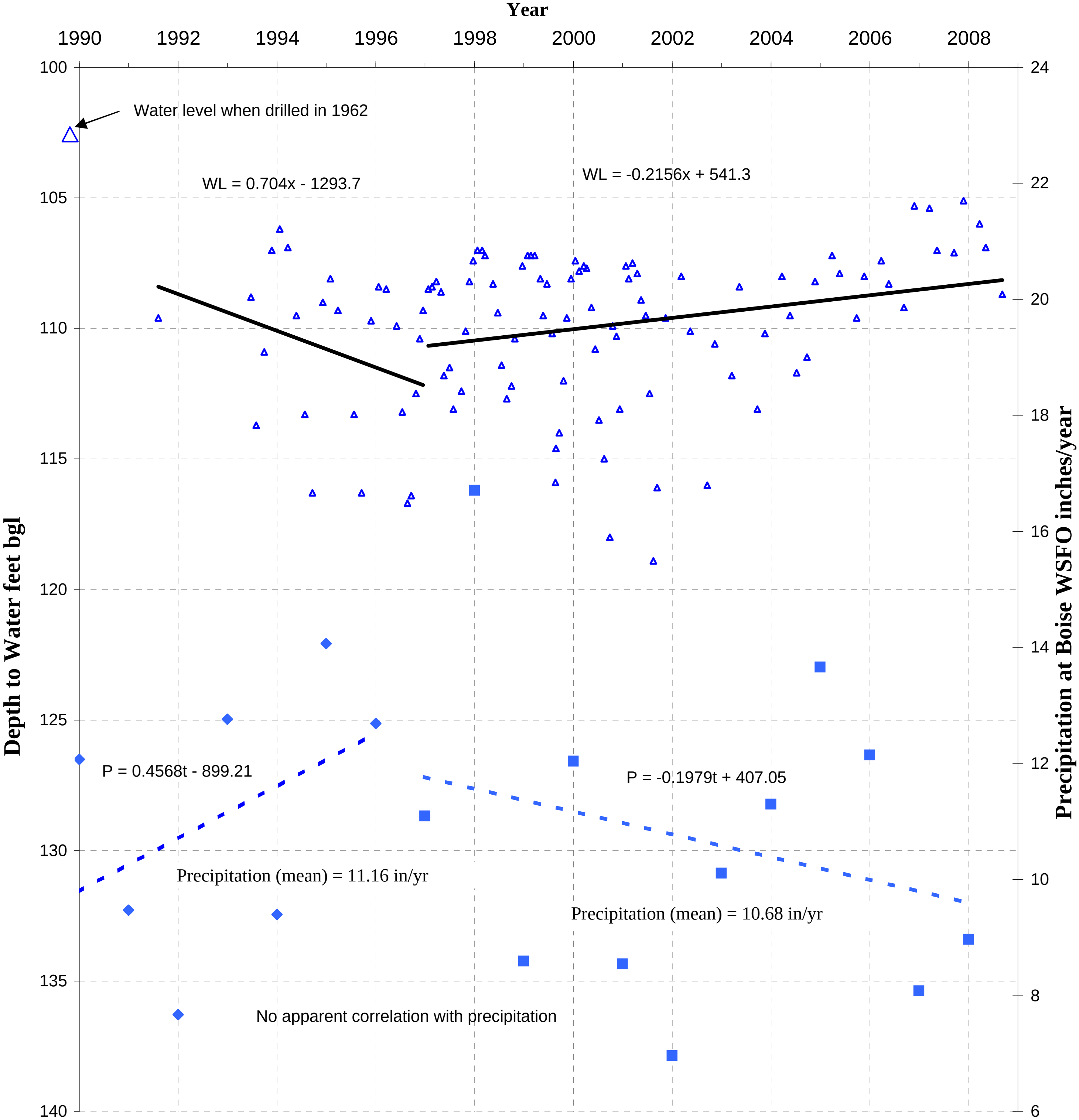
Figure 16. Water Level Trends in Well 04N01E 11BBB1



Linear regression of water levels measured from 1990-1996 (25 data points) indicate a declining water level trend of 0.7 ft/yr while a similar analysis of 84 data points collected from 1997-2008 indicate a rising water level trend of 0.2 ft/yr. Linear regression analysis indicates that precipitation was increasing during the period 1990 through 1996 and was decreasing during the period 1997-2008. This well is NOT completed in the PGSA and is NOT suitable for monitoring water levels ir the PGSA. See tables for details.

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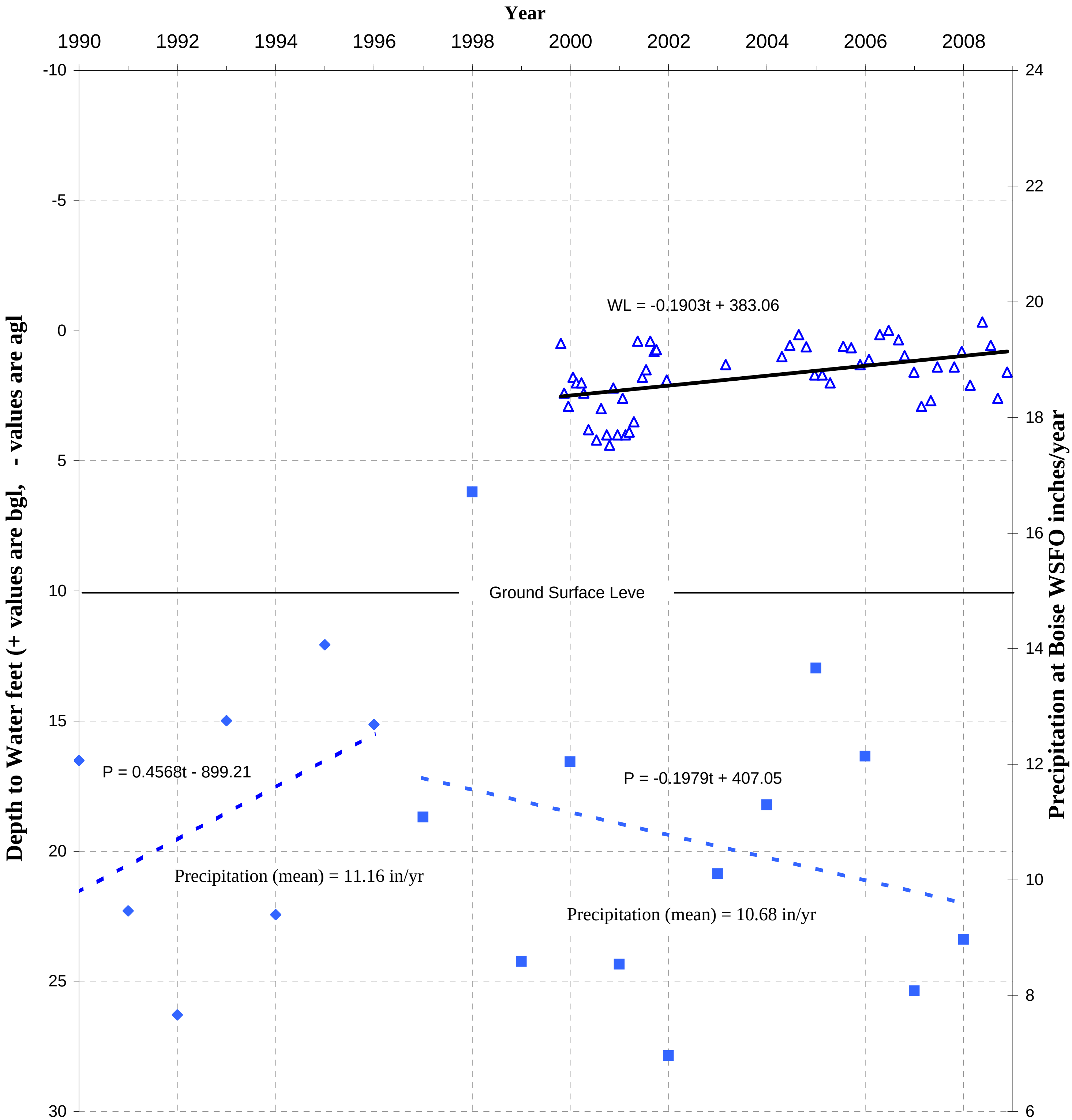
Boise, Idaho

Figure 17. Water Level Trends in TVHP #1
04N01E 14CCB2



The TVHP #1 State Street test well is a dedicated monitoring well completed in the Pierce Gulch Sand Aquifer and sealed from ground surface to the screened interval. As such, this well is ideal for representing conditions in the Pierce Gulch Sand Aquifer in the east-Eagle vicinity. Linear regression of water levels measured by hand (54 data points) indicate a rising water level trend of 0.19 ft/yr over the period of measurement (1999-2008). This rise in water levels does not correlates with the decline in precipitation, suggesting poor correlation between recharge and aquifer response. This analysis contradicts the conclusion presented the McVay memo which states that "all wells in the area (except 04N01E11BBBB1) exhibit negative [declining] water level trends."

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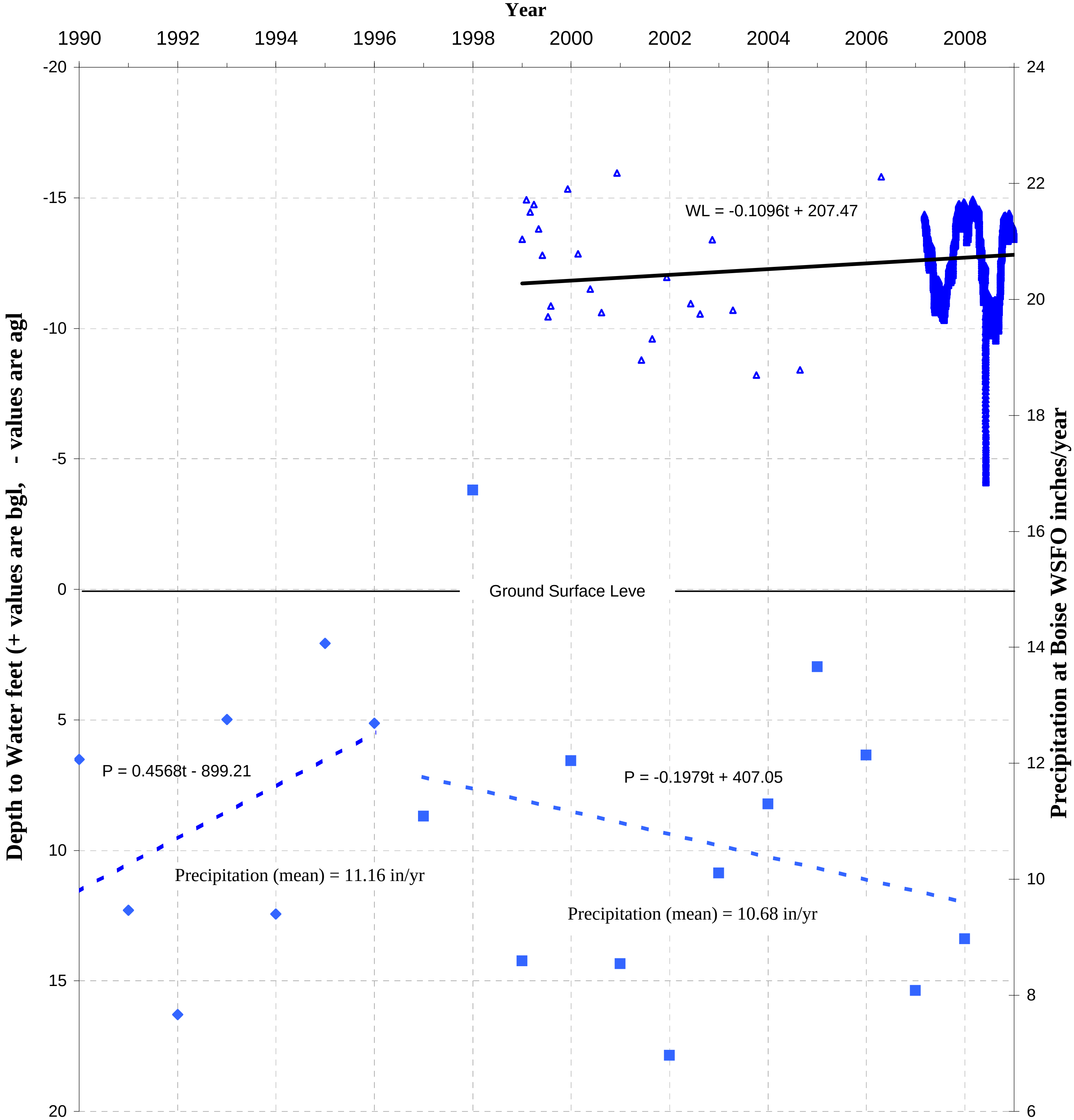
Boise, Idaho

Figure 18. Water Level Trends in UWID State and Linder TW #1 Zone 2 04N01W11DDA1



The UWID State and Linder test well is a dedicated monitoring well completed in the Pierce Gulch Sand Aquifer and sealed from ground surface to the screened interval and is representative of conditions in the PGSA in the west-Eagle vicinity. Linear regression of water levels measured by hand (23 data points) and by data logger (15, 987 data points) indicate a rising water level trend of 0.1 ft/yr from 1999-2008. This analysis contradicts McVay who states "all wells in the area (except 04N01E11BBBB1) exhibit negative [declining] water level trends."

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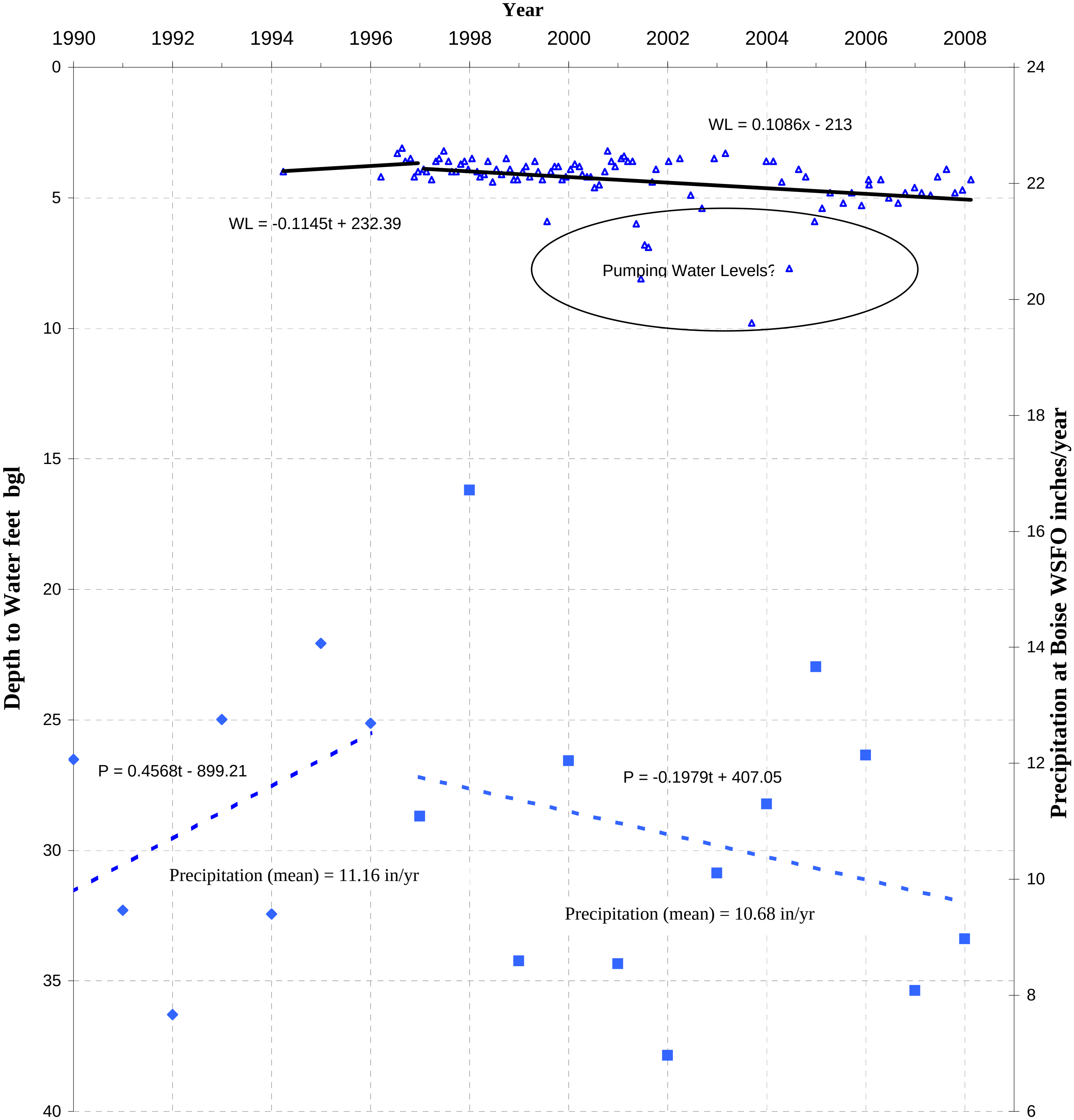
Boise, Idaho

Figure 19. Water Level Trends in 04N02W 7AAC1



Linear regression analysis using the limited number of 8 data points for the period 1994-1996 suggest a rising water level trend of about 0.1 ft year. A linear regression analysis using 91 data points for the period 1997-2008 indicates a declining water level trend of 0.1 ft/yr. These water level trends appear to correlate with the trends in precipitation (increasing precipitation during the period 1990-1996 and decreasing precipitation for the period 1997-2008). The results of the water level trend analysis are similar to the 12-data-point analysis of McVay who indicated a declining water level trend of 0.07 ft/yr. This well is NOT completed in the PGSA and is NOT suitable for monitoring water levels in the PGSA. See tables for details.

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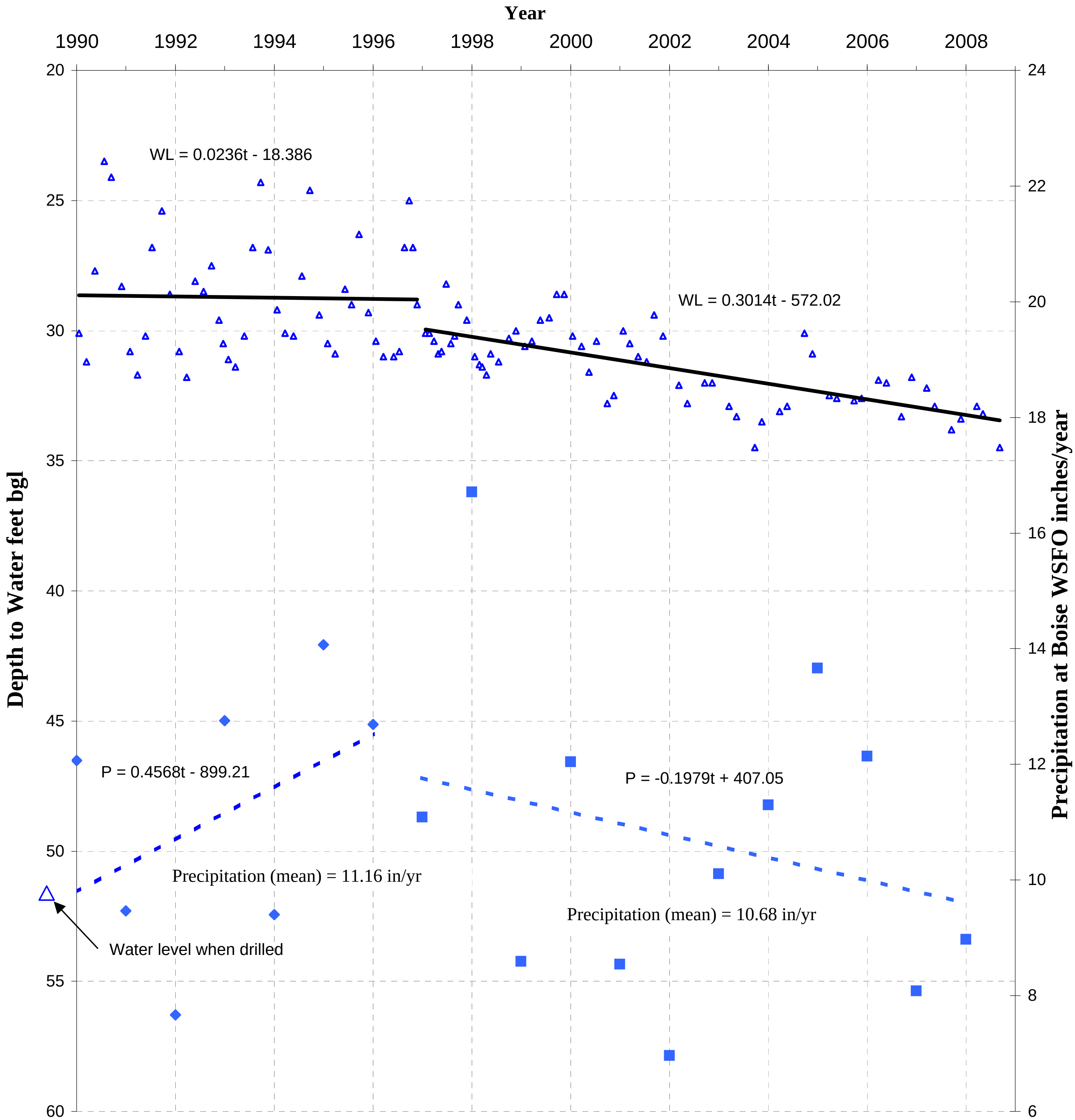
Figure 20. Water Level Trends in 05N1E 34DBB1



Linear regression analysis using all 46 data points from the period 1990-1996 suggest a relatively stable to a slightly declining water level trend of less than 0.03 ft/yr. A similar analysis using all 63 data points for the period 1997-2008 indicates a declining water level trend of 0.3 ft/yr. These water level trends appear to correlate with the trends in precipitation (increasing precipitation 1990 through1996 and decreasing from 1997through 2008. The results of the HLI analysis are similar to the 13-data-point analysis of McVay who indicated a declining water level trend of 0.2 ft/yr. No monitored water levels below driller's data.This well is NOT completed in the PGSA and is NOT suitable for monitoring water levels in the PGSA. See tables for details.

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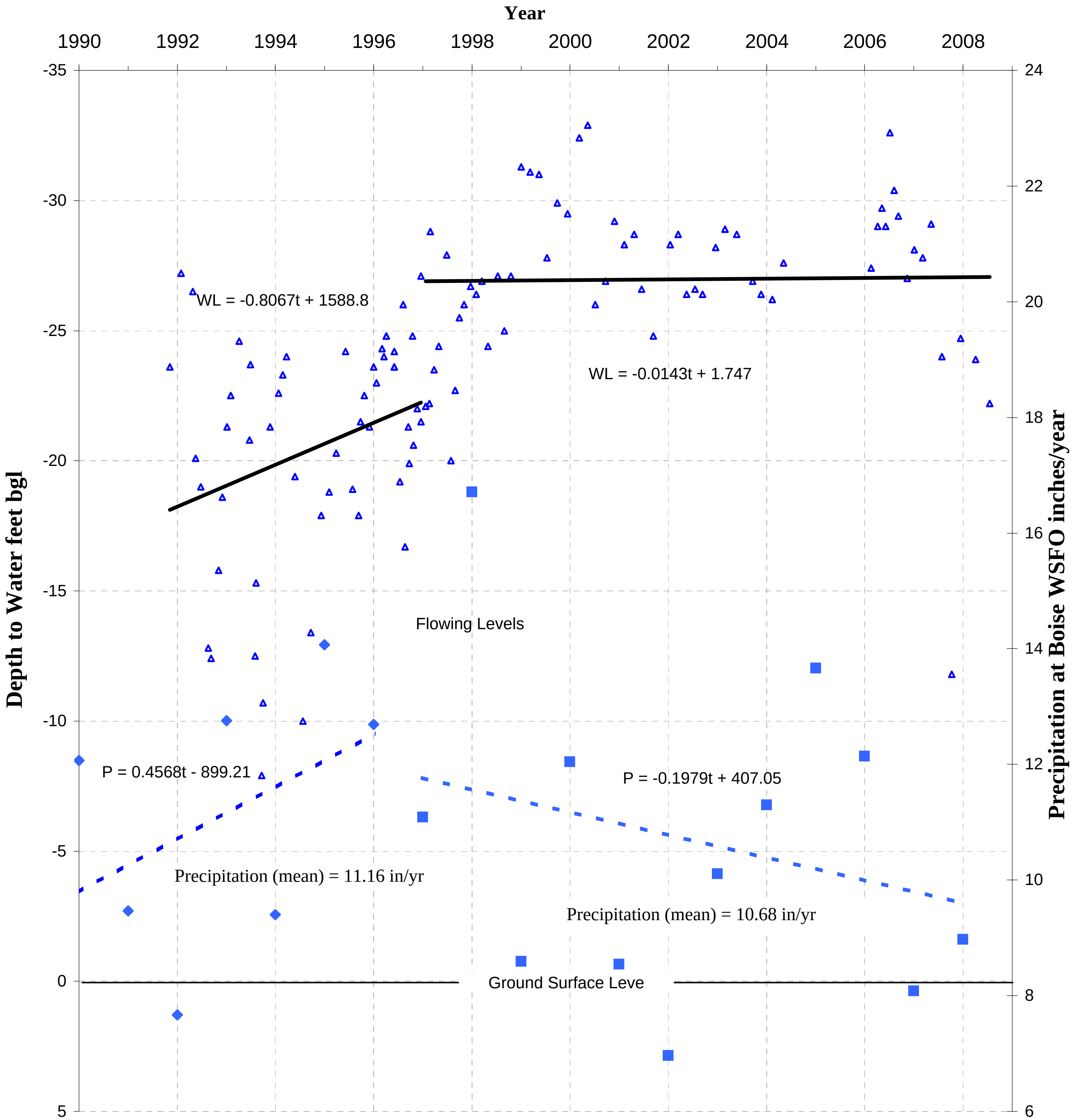
Boise, Idaho

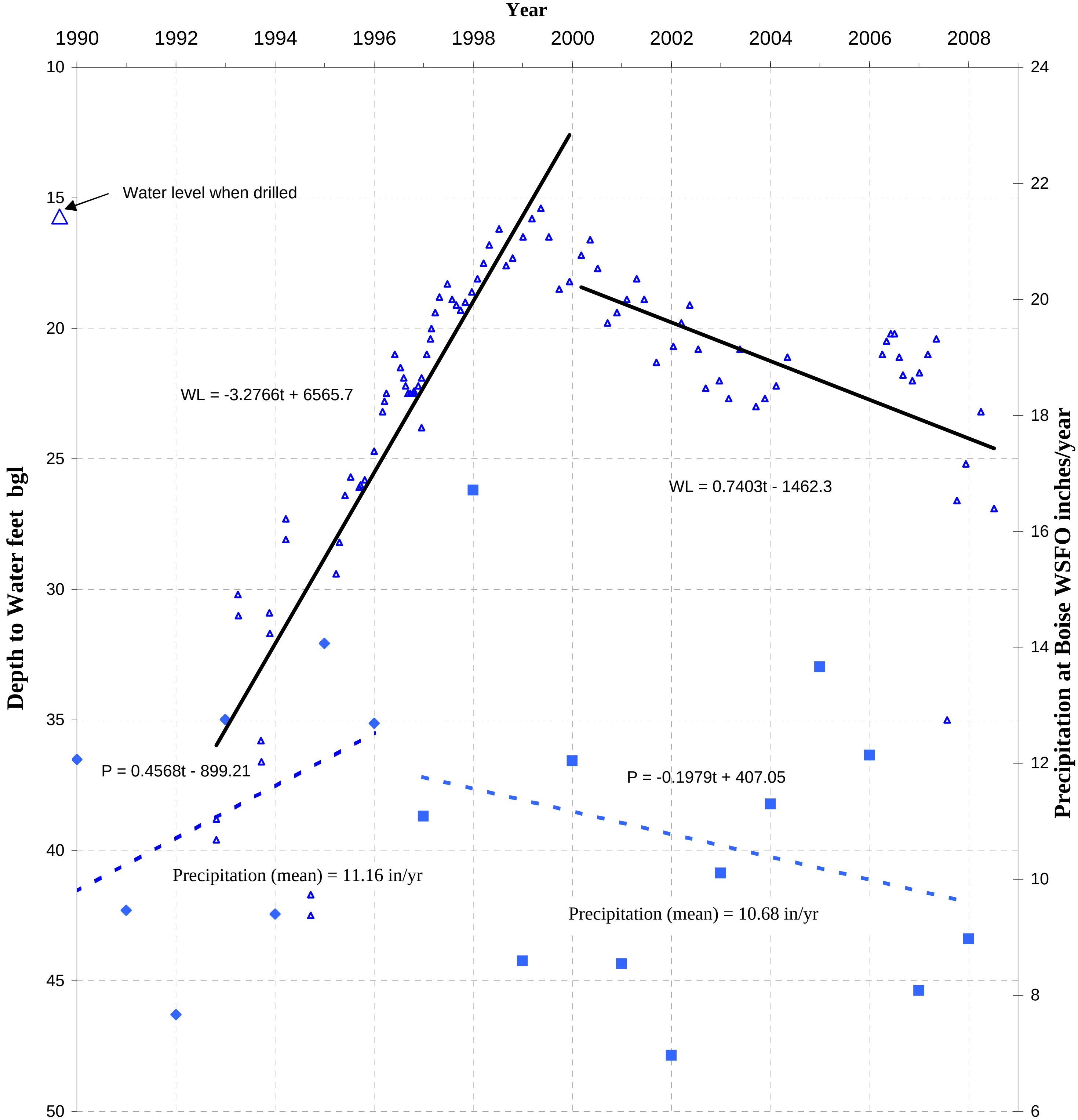
Figure 21. Water Level Trends in 05N1E 35ACA1



Linear regression analysis using all 53 data points from 1990-1996 indicates a rising water level trend of 0.8 ft/yr. A similar analysis using all 60 data points for the period 1997-2008 indicates a slight rise of about 0.01 ft/yr. These water level trends do not correlate with the trends in precipitation (increasing precipitation 1990 through1996 and decreasing from 1997 through 2008). This well is completed in the Terteling Springs Formation, in the Dry Creek vicinity, and is not indicative of conditions in the Pierce Gulch Sand Aquifer. This well is NOT suitable for monitoring water levels in the PGSA. See tables for details.

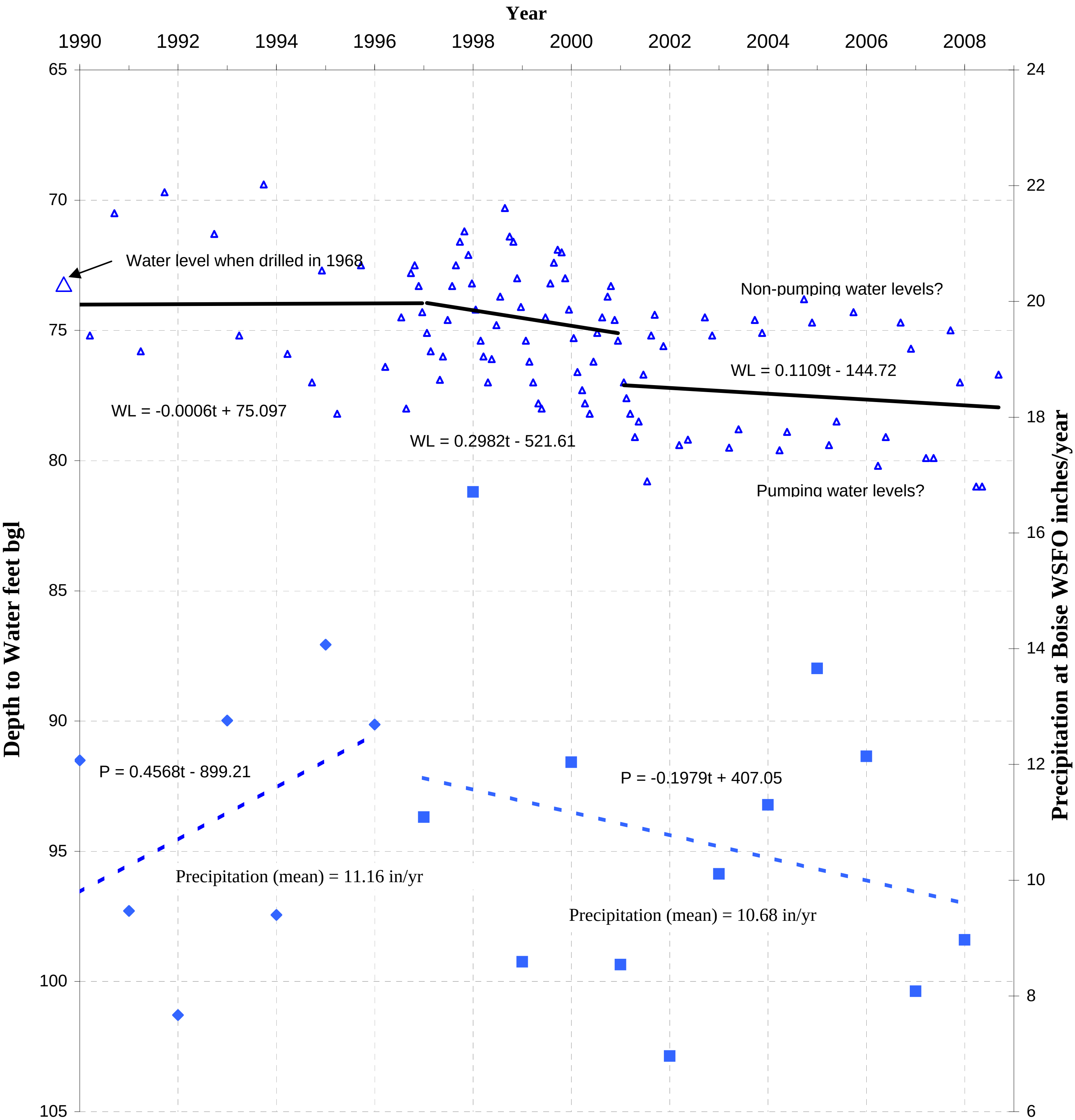
Hydro Logic, Inc.
Boise, Idaho

Figure 22. Water Level Trends in 05N01E36AAB1



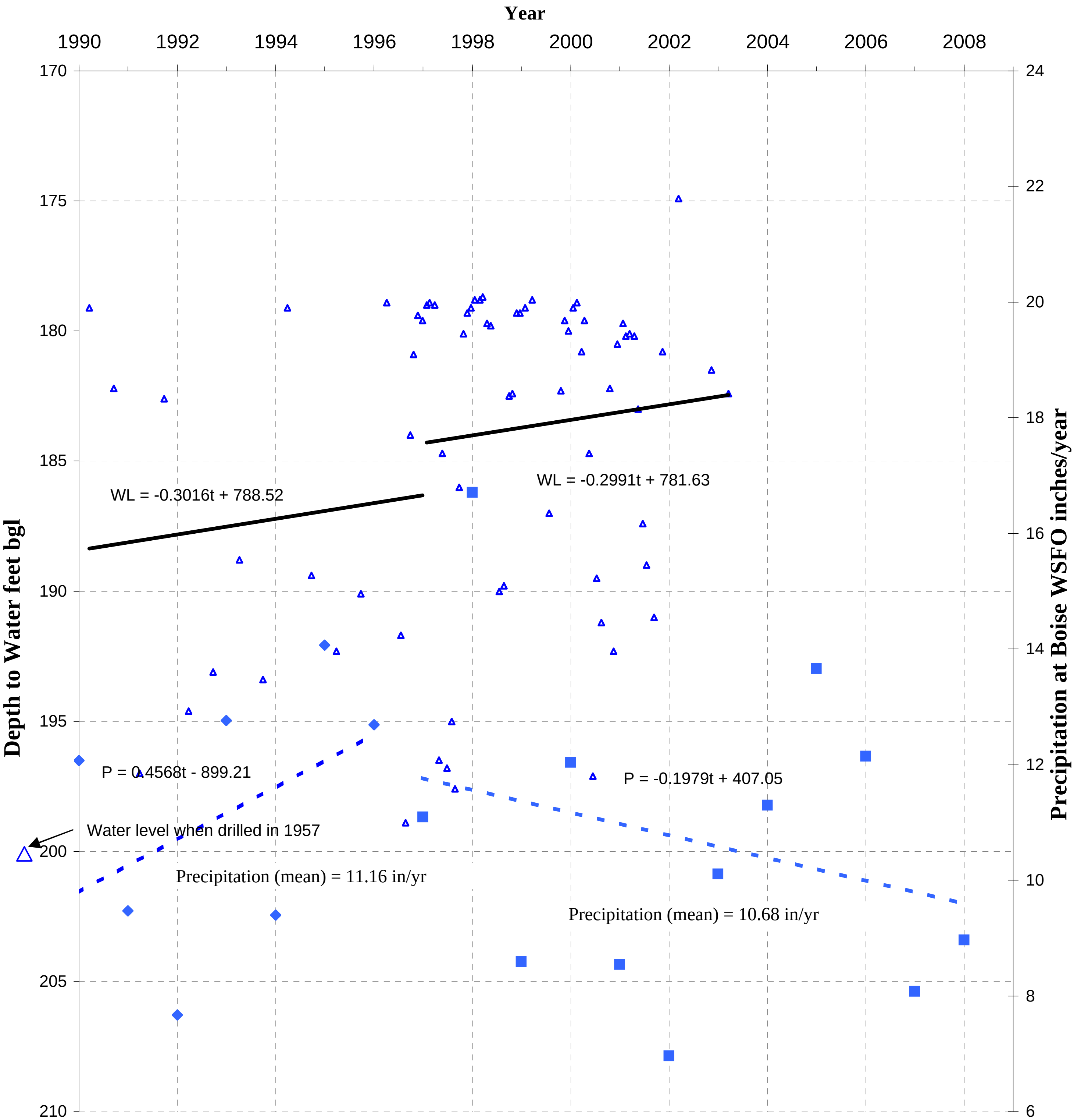
Linear regression analysis using all 57 data points from 1990-1999 indicates a strong rising water level trend of over 3 ft/yr. A similar analysis using all 36 data points for the period 2000-2008 indicates a declining water level trend of about 0.7 ft/yr. These water level trends lag the trends in precipitation (increasing 1990 through 1996 and decreasing from 1997 through 2008), but with an apparent 2-year lag time between recharge and aquifer response. This relationship to precipitation is what would be expected here. This well is NOT completed in the PGSA and is NOT suitable for monitoring water levels in the PGSA. See tables for details.

Figure 23. Water Level Trends in Well 05N01W 36ABB1



Linear regression analysis using all 102 data points indicates that water levels were essentially constant from 1990 through 1996 but were declining slightly from 1997 through 2001 at an average rate of 0.3 ft/yr. Between 2001 through 2008, the rate of decline decreased significantly to 0.1 ft per year. The decline in water levels correlates with the decrease in precipitation. This analysis better represents recent trends than McVay's 13-selected-data-points analysis that indicated a decline of 0.4 ft/yr. Water level about 2 ft lower in 2008 compared with 1968 - 40 years ago. This well is NOT completed in the PGSA and is NOT suitable for monitoring water levels in the PGSA. See tables for

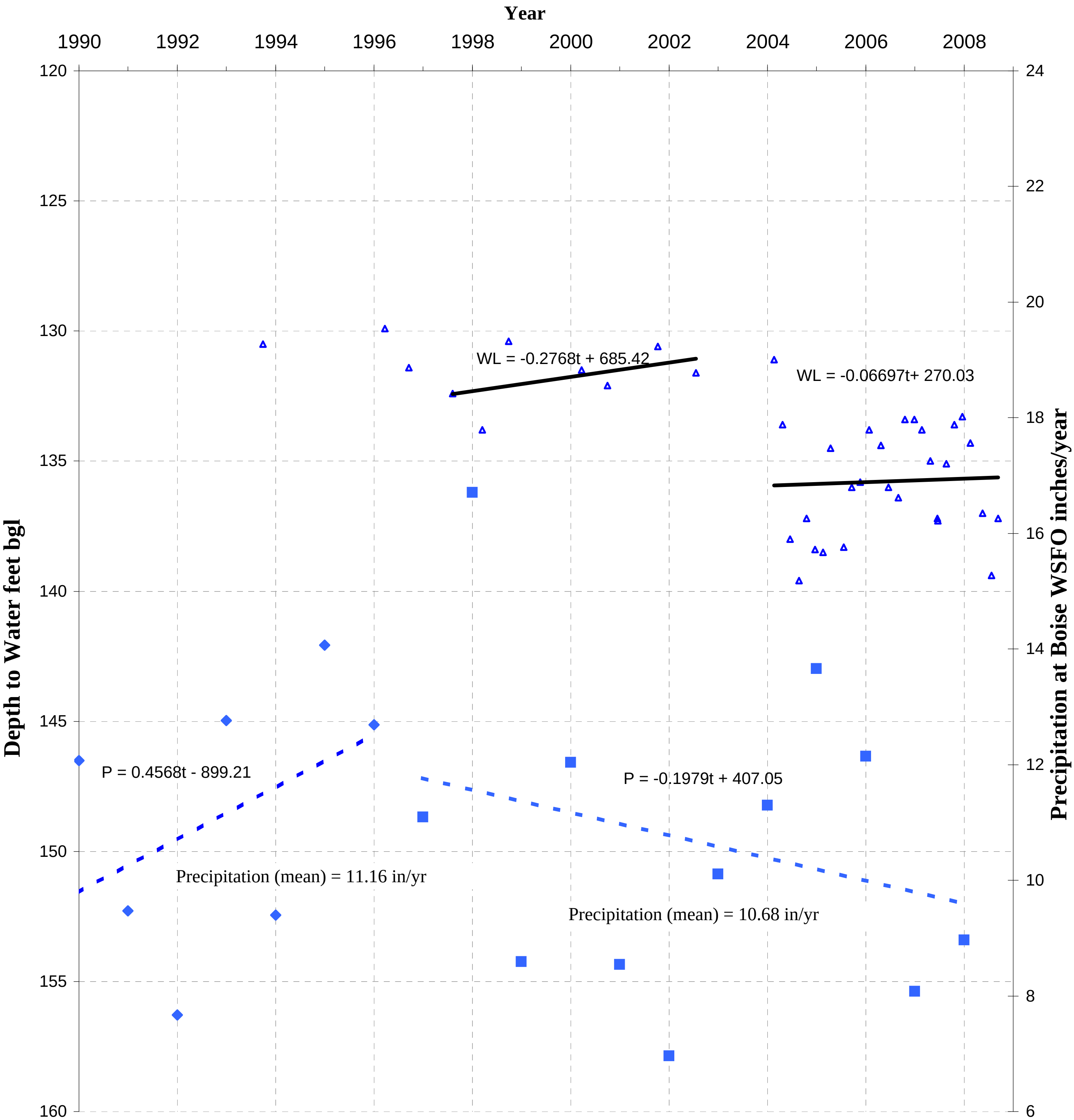
Figure 24. Water Level Trends in Well 05N2W 22CAD1



Linear regression analysis using all 71 data points indicates that water levels were rising from 1990 through 1996 at a rate of 0.3 ft/yr and continued to rise through the period 1997 through 2000 at an average rate of 0.06 ft/yr. Between 2001 and the end of data collection (2003) water levels continued to rise at a rate of 0.5 ft/yr. No monitored water levels below driller's data. The rises in water levels do not correlate with the changes in precipitation. The McVay analysis for this well was not presented in the March 2 memo. This well appears to be completed in the PGSA but is only poorly suitable for monitoring water levels in the PGSA because of poor well construction. See tables for details.

Hydro Logic, Inc.
Boise, Idaho

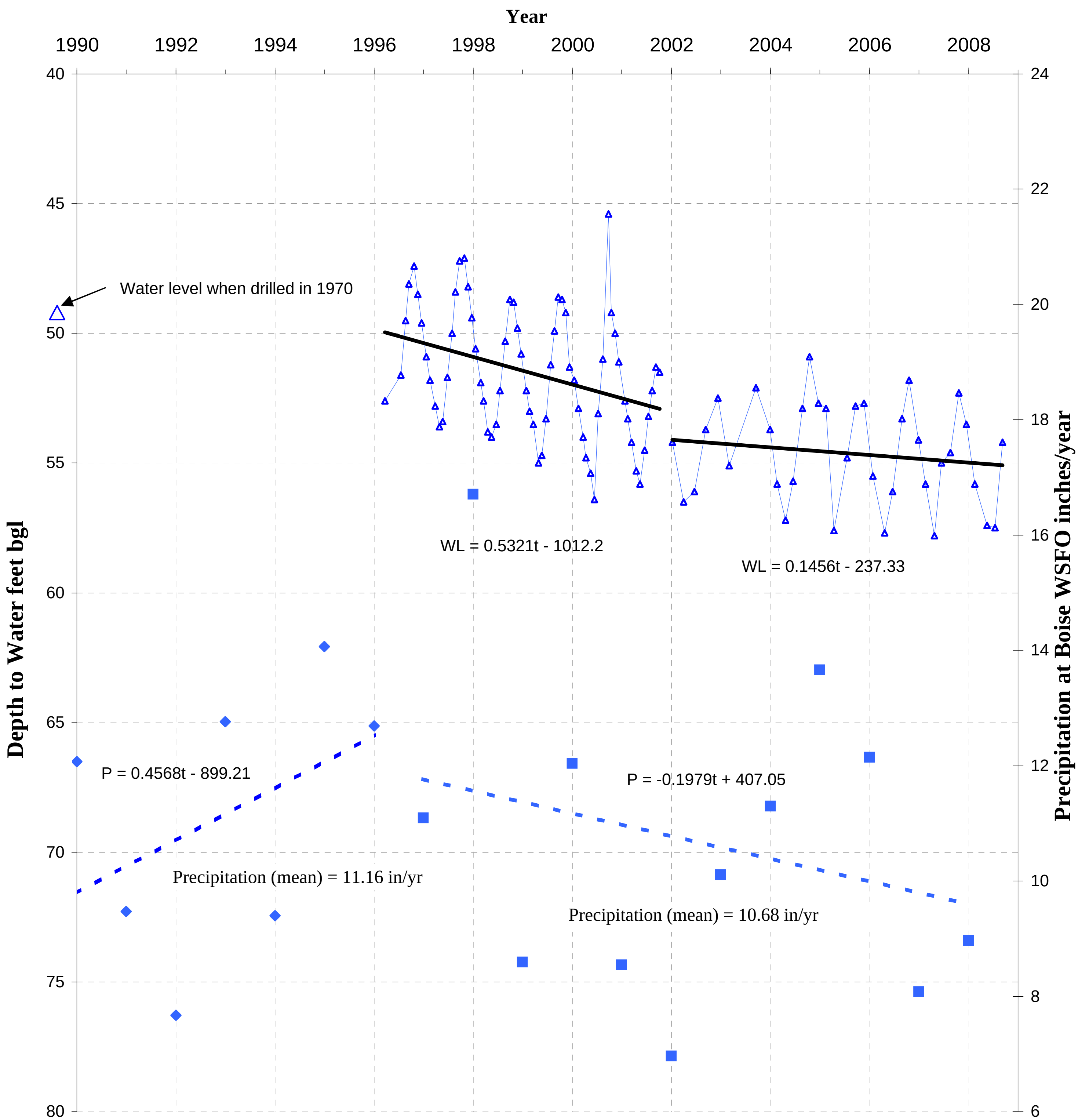
Figure 25. Water Level Trends in Well 05N03W 12CCA1



Water levels were measured too infrequently (0 to 2 times per year) for credible linear regression analysis using the data collected during the period 1990 through 2003. Between 2004 and the end of 2008 the well was measured more frequenlty. Linear regression using 29 data points from this time period indicates that water levels rose slightly at a rate of 0.07 ft/yr. This rise in water levels does not correlate with the decline in precipitation. This analysis contradicts the McVay analysis using 8 data points from the period 1996-2008 that indicated a rate of decline of 0.3 ft/yr. This well may or may not be completed in the PGSA and is pooly suitable for monitoring water levels in the PGSA. See tables for details.

Hydro Logic, Inc.
Boise, Idaho

Figure 26. Water Level Trends in Well 05N03W 15DDC1



Linear regression of water levels measured by over the period 1996-2001 (65 data points) indicate a declining water level trend of about 0.5 ft/yr while a similar analysis of 35 data points collected over the period 2002-2008 indicate a declining rising water level trend of about 0.15 ft/yr. These declining water level trends may correlate with the declining precipitation trend over the period 199 2008. The water level decline indicated by this analysis is significantly less than the decline of almo 0.5 ft/yr indicated by McVay in his 13-data-point analysis for the entire period. This well is completed in a shallow alluvial aquifer. This well is NOT completed in the PGSA and is NOT suitable for monitoring water levels in the PGSA. See tables for details.

Hydro Logic, Inc.
Boise, Idaho

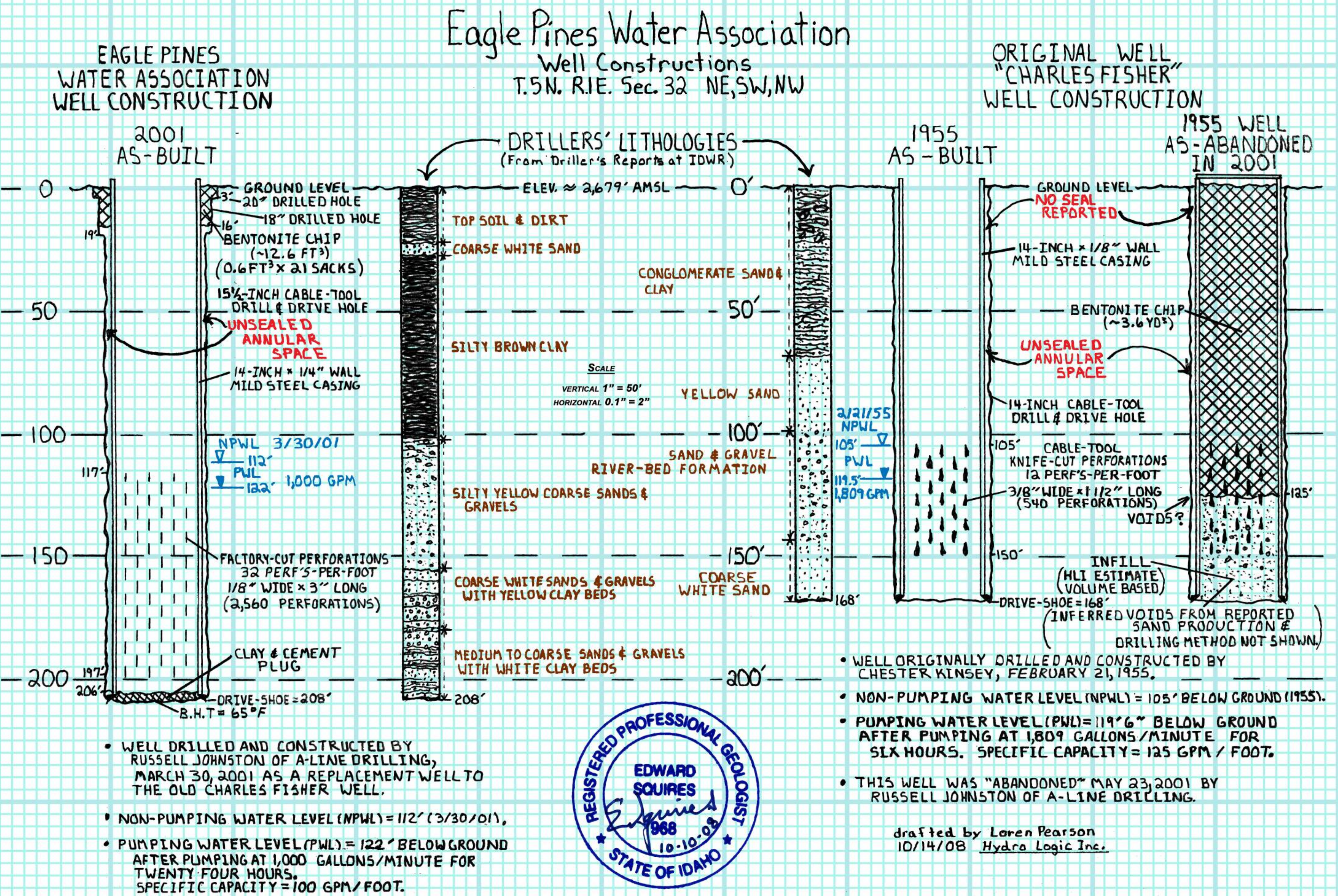


Figure 27. Cross-sectional sketch of the Eagle Pines Water Association's irrigation wells (1955 and 2001) showing 1) the details of as-built construction, 2) conflicting lithologic logs of the drilled geologic section by the two drillers, and 3) the unsealed annular spaces outside of the casing in the cable-tool, drill-and-drive wells. Also evident is the, essentially unchanged, non-pumping water level in the well(s) reported by the drillers, after 46 years of pumping from the well and the collective pumping of other surrounding Eagle-area wells during significant population growth and increased withdrawals from the aquifer. The Eagle Pines Water Association's irrigation well is completed into the Pierce Gulch Sand Aquifer.

APPENDIX A

SCANLAN ENGINEERING
Groundwater and Environmental Engineering

September 2, 1994

Mr. David Tuthill
Idaho Department of Water Resources
2735 Airport Way
Boise, ID 83705

Subject: Request to Reactivate Applications for Permit

Dear Mr. Tuthill:

Mr. D. Mark Lynn currently has two applications for permit on file with the Idaho Department of Water Resources. The applications (63-11995 and 63-11996) seek to appropriate groundwater for irrigation of a total of 378 acres located along Willow Creek in Sections 34 and 35, T6N, R1W and Sections 2, 3 and 4, T5N, R1W.

As you and I discussed at our meeting of August 22, 1994, Mr. Lynn is aware of the current moratorium on processing new applications for permit in the Boise River Basin. However, as provided for under item 9.b. of the amended moratorium order dated April 30, 1993, Mr. Lynn seeks approval of these applications based on (1) USGS data which indicate that the aquifer is tributary to the Payette River rather than to the Boise River, (2) the remote location of the proposed points of diversion (Mr. Lynn's wells) relative to other wells, and (3) no evidence of local long-term water-level declines.

Mr. Lynn requests that Application Nos. 63-11995 and 63-11996 are processed as primary water rights and that his existing Willow Creek rights become supplemental water rights. Typically by June or July each year flows in Willow Creek are insufficient to supply water to Mr. Lynn. When snow levels are low, Willow Creek can become unavailable even by March or April. It would be preferable for the Willow Creek rights to become supplemental.

Details are related to the proposed application are provided in the following sections.

LOCAL HYDROLOGY

Groundwater is found in Mr. Lynn's existing wells at an approximate static depth of 400 feet (elevation 2360). The wells and proposed place of use are located along Willow Creek, an intermittent stream that drains the granitic highlands in the vicinity of Pearl. Willow Creek is a losing stream in the vicinity of the proposed points of diversion and for several miles upstream and downstream. Willow Creek and tributary gulches are thought to be the primary source of local groundwater recharge. Additional recharge is probably derived from direct infiltration of precipitation and from canal leakage in the Boise Valley.

by USGS 12/20/
Admitted

ATTACHMENT A

600 East River Park Lane, Suite 105
Boise, Idaho 83706
Telephone (208) 383-4140
Facsimile (208) 383-4156

This report was copied from file 63-11995 SC 7/2/99

Groundwater beneath the site is found in sedimentary aquifers of the Idaho Group. Review of local well logs suggests that the aquifer beneath the property should have a relatively high transmissivity, based on a predominance of coarse sand in the material descriptions on the driller's logs. The upper portion of the aquifer is probably semiconfined to unconfined, due to the apparent scarcity of significant clay layers. Deeper portions of the aquifer are probably semiconfined.

Given the thick unsaturated zone beneath the site, the proposed appropriation will not be capable of inducing additional losses from Willow Creek. As a result, no impact to Willow Creek surface water flows are anticipated.

Groundwater Flow Direction

The proposed points of diversion and place of use are both located within the Boise River surface water drainage basin. However, groundwater flow direction appears to be toward the Payette River Valley, approximately 3 miles to the northeast. This flow direction is based on the USGS Hydrologic Investigations Atlas HA-703 (Configuration of the Water Table and Depth to Water, Spring 1980, Water-Level Fluctuations, and Water Movement in the Snake River Plain Regional Aquifer System, Idaho and Eastern Oregon), which provides a water table contour map of the western Snake River Plain. As shown on Figure 1, this map clearly indicates that the proposed points of diversion are tributary to the Payette River. As a result, these groundwater applications would not be subject to the Boise River Basin Groundwater Moratorium.

Note that the water surface elevations in three USGS observation wells located to the southeast (Well 5N, 1W, 36ABB1), south (Well 05N, 01W, 16CAB1), and southwest (Well 5N, 2W, 22CAD1) are higher than the groundwater elevation at the proposed points of diversion by approximately 185 feet, 165 feet, and 65 feet, respectively. These elevations also suggest a northwesterly regional flow direction (i.e., toward the Payette River Basin) in the Willow Creek vicinity.

Documented Water-Levels

We are not aware of any significant long-term water-level declines in the general vicinity of Willow Creek. The hydrographs of USGS-monitored observation wells in the area, discussed below, provide no indication of water-level decline.

- Well 5N, 2W, 22CAD1 is located on the north side of Willow Creek, approximately seven miles southwest (downstream) of the proposed points of diversion. The hydrograph of this well (bottom of Figure 2) shows an overall rising water-level trend since the late 1960s, except for a few years in the early 1990s. The spring 1994 water level in the well was within one foot of the historic high for this well. The water surface elevation at this well is approximately 2425 feet.

- Another observation well (Well 5N, 1W, 36ABB1) in the general vicinity of Willow Creek is located along the north edge of the Boise Valley, about 6 miles southeast of the proposed points of diversion. The hydrograph of this well (top of Figure 2) shows no sign of long-term water-level decline. The water-surface elevation at this well is approximately 2545 feet.

- The currently monitored observation well that is closest to the proposed points of diversion is Well 6N, 1W, 18DAA2. This is a shallow (31 feet) well located about five miles to the northwest of the proposed points of diversion. The hydrograph of this well (Figure 3) does not show a long-term decline. However, this well appears to taps a shallow perched aquifer, probably in direct hydraulic connection with Willow Creek, and is therefore not representative of regional aquifer groundwater levels in the vicinity of the proposed points of diversion.
- Historic data are available for a well (5N, 1W, 16CAB1) which is located three miles southwest of the proposed points of diversion, near the south side of Chaparrel Subdivision (where most of the existing local water rights and domestic wells are located). This well was monitored for several years during the 1970s, and the elevation of the water surface was approximately 2,525 feet (Figure 4).

DESCRIPTION OF LOCAL WATER USE

Visual Well Search in the Vicinity of the Proposed Points Of Diversion

The proposed points of diversion are located more than one mile from any existing wells (not including existing wells owned by Mr. Lynn). A well search by Scanlan Engineering on August 13, 1994 found only six wells within a two-mile radius of the property (not including the existing wells owned by Mr. Lynn). These wells include four domestic wells and what appear to be two stock water wells.

There are numerous wells located between two and three miles from the proposed points of diversion. The majority of these wells are domestic wells in the vicinity of Chaparrel subdivision. There also are two or more wells used for irrigation in the Chaparrel subdivision area. The only other irrigation wells that were located are two wells found along the North Fork of Willow Creek, northeast of the proposed points of diversion.

Existing well locations are shown on Figure 5.

Recorded Groundwater Rights In The Vicinity Of The Proposed Point Of Diversion

Recorded water rights with points of diversion within an approximate radius of 3 to 4 miles are shown on Figure 6 and listed on Table 1. A total of 28 recorded water rights were found in the search area outlined on Figure 6.

Within a one-mile radius of the proposed points of diversion are three recorded water rights. These rights are three licenses in the name of Albert Helmick. Mr. Lynn is current owner of these licenses.

There are two recorded water rights with points of diversion located between one and two miles from the proposed points of diversion. One of these water rights is for domestic use and the other water right is for domestic and stockwater. Thus, there are no recorded irrigation groundwater rights within two miles of the proposed points of diversion.

There are approximately 13 recorded water rights that appear to have points of diversion within a radius of between two and three miles of the points of diversion proposed by these applications. The majority of these water rights are for domestic and irrigation uses.

Licensed or permitted diversions for irrigation from groundwater sources within three miles of the proposed points of diversion (not including the existing applications and licenses owned Mr. Lynn) total 4.53 cfs. Mr. Lynn's existing licenses total an additional 0.59 cfs.

Adjudication Claims for Groundwater In The Vicinity Of The Proposed Point Of Diversion

A listing of Snake River Basin Adjudication claims (Table 2) for groundwater within the search area in Figure 6 includes no additional irrigation claims not included in the listing of water rights in Table 1. However, a few additional domestic and stockwater claims within a three-mile radius of the proposed points of diversion are listed in Table 2 but are not listed on Table 1.

SUMMARY

The Department should approve the applications given (1) the aquifer is tributary to the Payette River, (2) the wells are in a remote location, and (3) there are no documented water-level decline problems in the area.

Please call me with any questions concerning these applications.

Sincerely,

Terry M. Scanlan

Terry M. Scanlan, P.E., P.G.
Engineer/Hydrogeologist

cc: Mark Lynn
Dana Hofstetter

MICROFILMED
AUG 0 9 1999

TABLE 1
LOCAL WATER RIGHTS
(See Figure 6 for search area)

(OD-5816)
WR5816NP
SELECTION FILE: ISF

IDAHO DE...RTMENT OF WATER RESOURCES
SOURCE SUMMARY REPORT
BY WATER SOURCE/POINT OF DIVERSION

DATE: 06/30/94
TIME: 08:17:13
PAGE: 1

WATER SOURCE: GROUNDWATER

Map #	WATER RIGHT NUMBER	OWNER NAME	O C	PRIORITY DATE	STG	POINT OF DIVERSION	POD FLAG	TOTAL DIVERSION	TOTAL ACRES	WATER USES
1	63-08044	HELMICK, ALBERT F.	C	10/01/1974	L	05N 01W 3 NWNE		0.050 CFS	1.0	01,04,43
2	63-10775	HELMICK, ALBERT F	C	09/08/1989	L	05N 01W 3 NWNE		0.040 CFS	0.2	01,04
3	63-11996	LYNN, D MARK	C	02/25/1993	A	05N 01W 3 NWNE	2	2.000 CFS	183.0	01
4	63-04093	BOEHM, STELLA	C	02/01/1938	S	05N 01W 4 SWSE		0.020 CFS		43
5	63-11539	WATKINS, ARTHUR DONALD	C	05/31/1991	L	05N 01W 9 NENE		0.040 CFS		04,43
6	63-03574	LEACH, WILLIAM	C	12/30/1966	L	05N 01W 9 NESW		0.150 CFS	28.0	01,43
7	63-07416	KLINGER, WERT H.	C	04/16/1971	L	05N 01W 9 SWSW		0.030 CFS		04,43
8	63-07700	CHAPARREL WATER ASSN.	C	12/18/1972	L	05N 01W 9 SWSW		1.070 CFS	129.0	01,43
9	63-04438	SMITH, CLYDE J.	C	04/15/1929	S	05N 01W 9 SWSW		0.380 CFS	19.0	01
10	63-03576	CHAPARREL WATER ASSN.	C	01/16/1967	L	05N 01W 16 NENW		1.010 CFS	36.0	01,43
11	63-07700	CHAPARREL WATER ASSN.	C	12/18/1972	L	05N 01W 16 NENW		1.070 CFS	129.0	01,43
12	63-09210	LYTLE, BUD	C	01/26/1979	L	05N 01W 16 SENW		0.160 CFS	4.0	01,43
13	63-10860	FIREBIRD RACEWAY INC	C	07/25/1989	L	05N 01W 16 NWSW		0.090 CFS	2.0	01,10,43
14	63-07396	BOISE VALLEY RACING ASSN. INC.	C	02/21/1971	L	05N 01W 16 SWSW		0.200 CFS		07
15	63-07534	KEZAR, BERTHA E.	C	12/21/1971	L	05N 01W 17 NENE		0.020 CFS		43
16	63-10596	STEELE, ROBERT W.	C	03/09/1988	P	05N 01W 17 NENE		0.110 CFS	10.0	01
17	63-03269	WILLOWBROOK PROPERTY OWNERS ASSN.	C	12/07/1961	L	05N 01W 17 NWNE		0.200 CFS		43
18	63-08190	TARTER, C. D.	C	08/15/1975	L	05N 01W 17 SWNE		0.120 CFS	4.0	01,04,43
19	63-08252	WARD, ELMER K.	C	01/12/1976	L	05N 01W 17 SWNE		0.140 CFS	5.0	01,43
20	63-03269	WILLOWBROOK PROPERTY OWNERS ASSN.	C	12/07/1961	L	05N 01W 17 SWNW		0.200 CFS		43
21	63-07623	WILLOWBROOK PROPERTY OWNERS ASSN.	C	09/07/1972	L	05N 01W 17 SENW		1.150 CFS	121.0	01
22	63-08254	SHOCKLEY, BURREL J.	C	01/16/1976	L	05N 01W 17 SENW		0.200 CFS	10.0	01
23	63-00896	HEMBREE, LEON R.	C	03/04/1905	D	06N 01W 21 NWNW		0.040 CFS		43
24	63-01366	HETHERINGTON, HERBERT G.	C	02/06/1955	D	06N 01W 21 NWNW		0.040 CFS		43,10
25	63-07002	SMITH, ELWOOD T.	C	06/05/1967	L	06N 01W 25 NWNW		1.560 CFS	127.0	01,04
26	63-01714	WABE, DALE E.	C	04/01/1967	D	06N 01W 29 NWNW		0.040 CFS		43,04
27	63-11995	LYNN, D MARK	C	02/25/1993	A	06N 01W 34 SESE		2.000 CFS	195.0	01
28	63-03000	HELMICK, ALBERT	C	11/04/1954	L	06N 01W 34 SESE		0.500 CFS	25.0	01,43

TABLE 2
LOCAL ADJUDICATION CLAIMS
(See Figure 6 for search area)

(00-5816)
AJ5816NP
SELECTION FILE: TSF

IDAHO DEPARTMENT OF WATER RESOURCES
ADJUDICATION SOURCE SUMMARY REPORT
BY WATER SOURCE/POINT OF DIVERSION

DATE: 06/30/94
TIME: 08:23:17
PAGE: 1

WATER SOURCE: GROUNDWATER

WATER RIGHT NUMBER	CURRENT OWNER NAME	PRIORITY DATE	STG	POINT OF DIVERSION	POD FLAG	TOTAL DIVERSION	TOTAL ACRES	WATER USES
A63-08044	LYNN, D MARK	10/01/1974	L	05N 01W 3 NWNE		0.050 CFS	1.0	01,04,43
A63-18564	HIGHLAND LIVESTOCK & LAND CO.	05/01/1979	J	05N 01W 3 NESENW		0.040 CFS		04
A63-22357	MCFADDEN, LYLE	09/15/1979	J	05N 01W 5 NWNE		0.060 CFS		43,04
R63-22357	MCFADDEN, LYLE	09/15/1979	J	05N 01W 5 NWNE		0.060 CFS		43,04
A63-22204	RACHILLA, DEE	05/20/1967	J	05N 01W 8 NESE		0.010 CFS		43
A63-22203	RACHILLA, DEE	05/20/1970	J	05N 01W 8 SESE		0.040 CFS		43
A63-20917	CLUFF, WALTER S.	07/21/1977	J	05N 01W 9 NESW		0.040 CFS		43
A63-04438	RICHARD, MERT G.	04/15/1929	S	05N 01W 9 SWSW		0.380 CFS	19.0	01,43
A63-07700	CHAPARREL WATER ASSN.	12/18/1972	L	05N 01W 9 SWSW		1.070 CFS	129.0	01,43
A63-15963	ANDERSON, MARTIN	06/14/1972	J	05N 01W 9 SESW		0.080 CFS		43,04
A63-03576	CHAPARREL WATER ASSN.	01/16/1967	L	05N 01W 16 NENW		1.010 CFS	36.0	01,43
A63-07700	CHAPARREL WATER ASSN.	12/18/1972	L	05N 01W 16 NENW		1.070 CFS	129.0	01,43
R63-18391	SWAFFORD, CRAIG A	01/23/1976	J	05N 01W 16 NWSE		0.060 CFS		43,04
A63-18391	SWAFFORD, CRAIG A	01/23/1976	J	05N 01W 16 NWSE		0.060 CFS		43,04
A63-07534	STEELE, ROBERT W.	12/21/1971	L	05N 01W 17 NENE		0.020 CFS		43,04
A63-03269	WILLOWBROOK PROPERTY OWNERS ASSN.	12/07/1961	L	05N 01W 17 NWNE		0.200 CFS		43
A63-08252	WARD, JOHN M.	01/12/1976	L	05N 01W 17 SWNE		0.140 CFS	5.0	01,43
A63-08190	FRANKS, STEVE E.	08/15/1975	L	05N 01W 17 NWSWNE		0.120 CFS	4.0	01,04,43
A63-17891	MOORE, DON G.	08/20/1979	J	05N 01W 17 SWNWNW		0.040 CFS		43
A63-03269	WILLOWBROOK PROPERTY OWNERS ASSN.	12/07/1961	L	05N 01W 17 SWNW		0.200 CFS		43
A63-07623	WILLOWBROOK PROPERTY OWNERS ASSN. I	09/07/1972	L	05N 01W 17 SENW		1.150 CFS	121.0	01
A63-08254	LITTLE LAND & LIVESTOCK CO.	01/16/1976	L	05N 01W 17 SENW		0.200 CFS	10.0	01
A63-16717	GEIER, TRUSTE, LOWELL	08/12/1982	J	06N 01E 19 NENE		0.060 CFS		43,04
A63-18924	JENKINS, HOWARD B.	03/31/1982	J	06N 01E 19 SENW		0.090 CFS		43,04
A65-00896	HEMBREE, LEON R.	03/04/1905	D	06N 01W 21 NWNW		0.040 CFS		43
R65-00896	HEMBREE, LEON R	03/04/1905	J	06N 01W 21 NWNW		0.040 CFS		43
A65-01366	HETHERINGTON, HERBERT G.	02/06/1955	D	06N 01W 21 NWNW		0.040 CFS		43,10
A63-07002	JENSEN, DONALD B.	06/05/1967	L	06N 01W 25 SENWNW		1.560 CFS	127.0	01,04
A65-01714	WERBER, KENT W.	04/01/1967	D	06N 01W 29 NWNW		0.040 CFS		43,04
A63-20810	LITTLE LAND & LIVESTOCK, CO.	01/01/1959	J	06N 01W 32 SESW		0.230 CFS		04
A63-03004	LYNN, D MARK	11/04/1954	L	06N 01W 34 SESE		0.500 CFS	25.0	01,43
A63-20963	HIGHLAND LAND & LIVESTOCK CO., INC.	01/01/1877	J	06N 01W 36 SENW		0.160 CFS		43,04

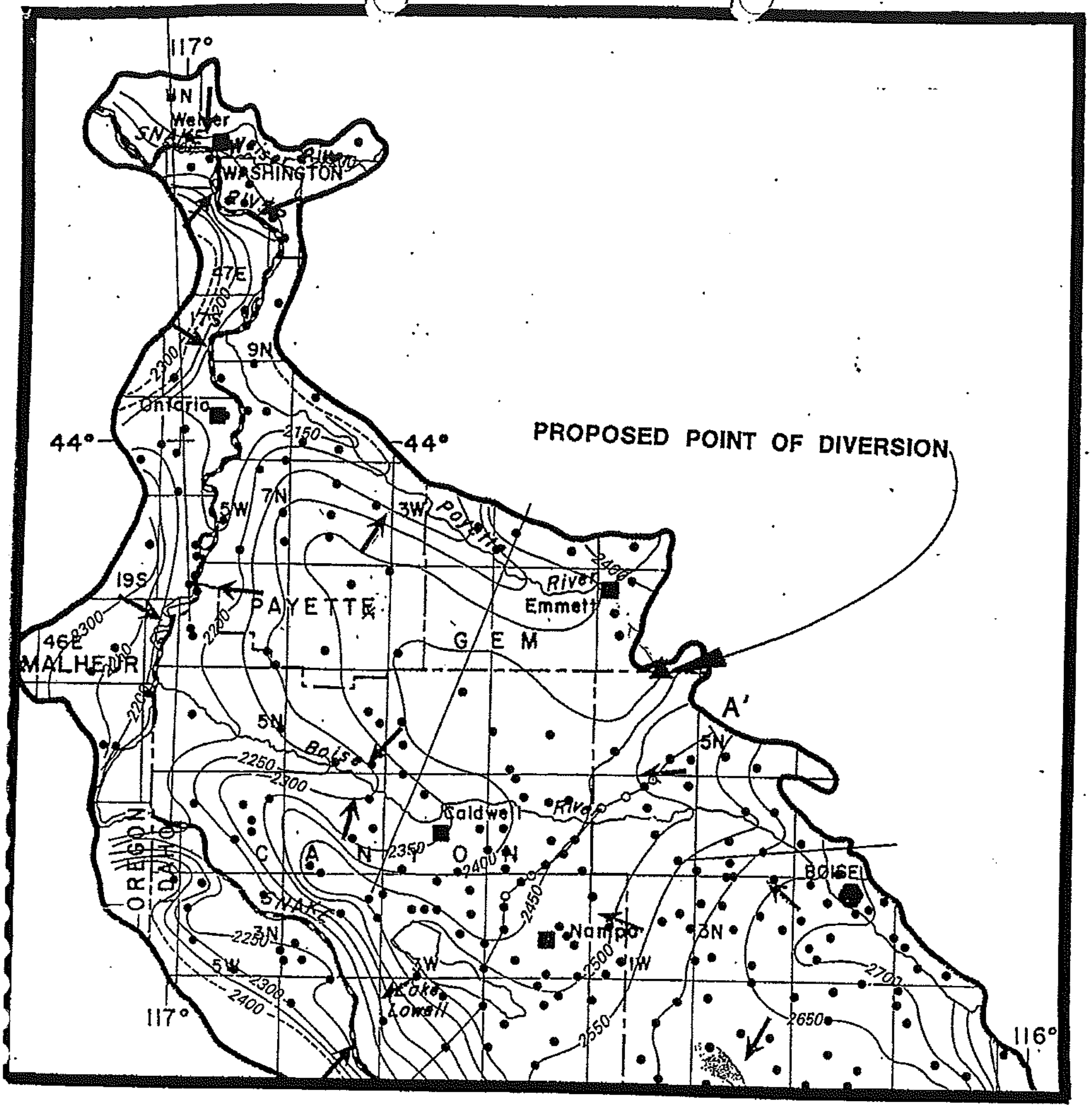


FIGURE 1
WATER-TABLE CONTOUR MAP FOR THE WESTERN SNAKE RIVER PLAIN
(source: USGS Hydrologic Investigations Atlas HA-703, 1988)

WELL 05N 01W 36ABB1 SITE NUMBER 434406116240801

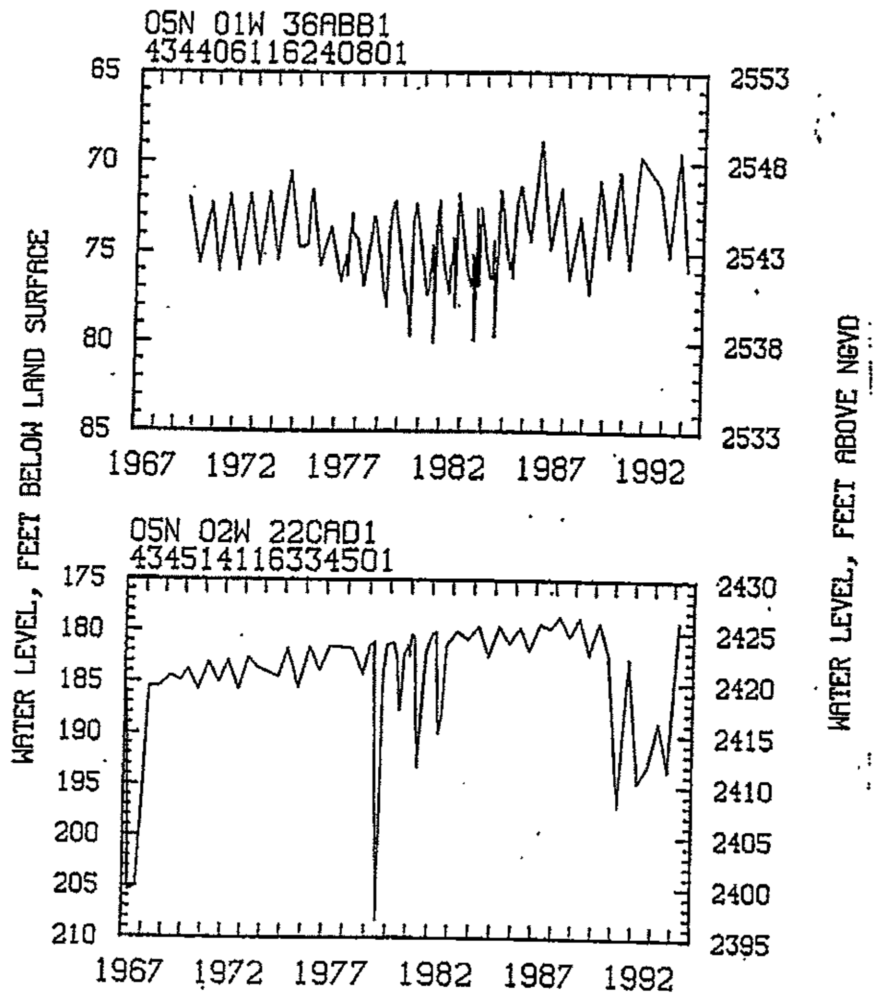
DRILLED DOMESTIC WATER-TABLE WELL IN IDAHO GROUP, DIAM 6 IN, REPORTED DEPTH 105 FT, CASED TO 105 FT. LSD ABOUT 2,618 FT NGVD OF 1929. MP NO. 1 TOP OF PIPE IN WELL SEAL, 0.70 FT BELOW LSD (SINCE AUG. 27, 1969).

RECORDS AVAILABLE 1969 TO CURRENT YEAR.

HIGHEST WATER LEVEL 68.84 FEET BELOW LAND SURFACE DATUM SEP 16, 1986.

LOWEST WATER LEVEL 78.02 FEET BELOW LAND SURFACE DATUM MAY 18, 1979.

	WATER LEVEL			WATER LEVEL	
MAR 22, 1989	75.83	S	SEP 11, 1989	69.59	S



WELL 05N 02W 22CAD1 SITE NUMBER 434514116334501

FORMERLY SITE ID NO. 434601116342601, WELL NO. 05N 02W 22CAA1. DRILLED IRRIGATION WATER-TABLE WELL IN IDAHO GROUP, DIAM 12 TO 8 IN, REPORTED DEPTH 450 FT, 12-IN CASING TO 303 FT, 8-IN CASING 284-403 FT, PERFORATED 279-403 FT. LSD ABOUT 2,610 FT NGVD OF 1929. MP NO. 1 TOP OF 1 1/2-IN VERTICAL ACCESS PIPE ON SOUTH SIDE OF PUMP, 1.50 FT ABOVE LSD (SINCE FEB. 21, 1967).

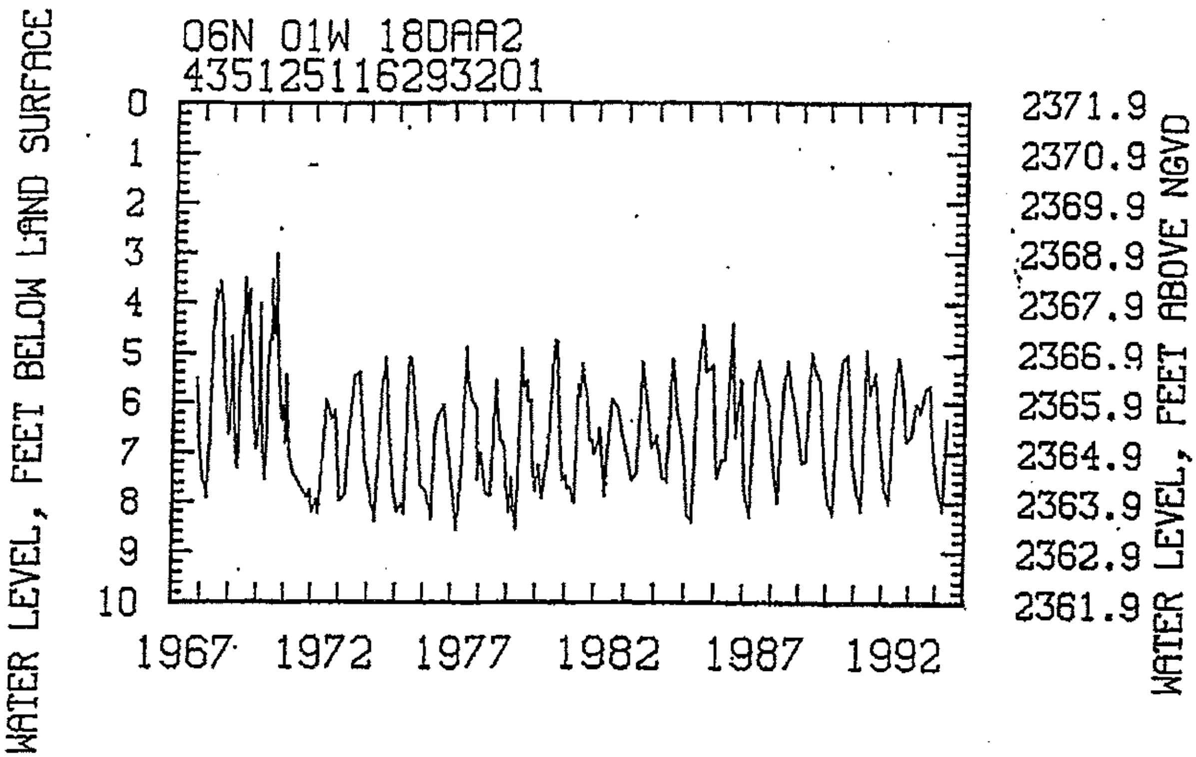
RECORDS AVAILABLE 1967 TO CURRENT YEAR.

HIGHEST WATER LEVEL 178.55 FEET BELOW LAND SURFACE DATUM MAR 15, 1988.

LOWEST WATER LEVEL 187.83 FEET BELOW LAND SURFACE DATUM JUL 22, 1981.

	WATER LEVEL			WATER LEVEL	
MAR 22, 1989	178.63	SV	SEP 21, 1989	182.23	SV

FIGURE 2



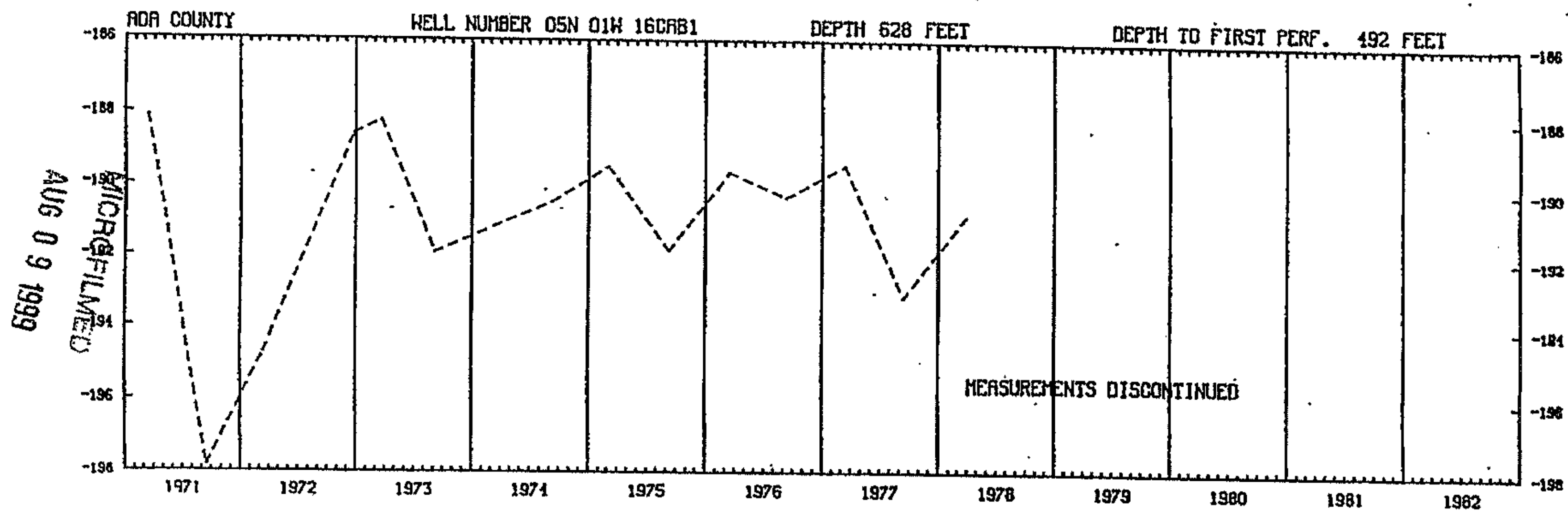
WELL 06N 01W 18DAA2 SITE NUMBER 435125116293201

FORMERLY SITE NO. 435125116293501. DRILLED DOMESTIC WATER-TABLE WELL IN SAND AND GRAVEL OF QUATERNARY AGE, DIAM 4 IN, DEPTH 30.9 FT, CASED TO 22 FT. LSD 2,371.90 FT ABOVE SEA LEVEL, SUPPLEMENTARY ADJUSTMENT OF 1961. MEASUREMENTS PRIOR TO NOV. 9, 1971, MADE BY US BUREAU OF RECLAMATION. RECORDER INSTALLED OCT. 17, 1968. RECORDER REMOVED MAY 28, 1971. MP NO. 1 TOP OF 4-IN CASING NORTH SIDE, 0.26 FT ABOVE LSD (SINCE NOV. 9, 1967).

RECORDS AVAILABLE	1967 TO CURRENT YEAR
HIGHEST WATER LEVEL	3.04 FEET BELOW LAND SURFACE DATUM AUG 24, 1970.
LOWEST WATER LEVEL	8.57 FEET BELOW LAND SURFACE DATUM MAR 14, 1977.

	WATER LEVEL		WATER LEVEL		WATER LEVEL
NOV 16, 1992	6.77 S	MAR 29, 1993	6.01 S	JUL 30, 1993	5.74 S
JAN 25, 1993	6.67 S	MAY 24	6.19 S	SEP 21	5.66 S

FIGURE 3



434615N1162758.1   05N 01W 16CAB1   DARRELL FISHER   ADA COUNTY

DRILLED DOMESTIC WATER-TABLE WELL IN IDAHO GROUP, DIAM 8 IN (20 CM), REPORTED DEPTH 628 FT (191 M), CASED TO 492 FT (150 M), OPEN HOLE. LSD ABOUT 2,715 FT (828 M) ABOVE MSL DATUM OF 1929. MP NO. 1 TOP OF 8-IN (20-CM) CASING SOUTHWEST SIDE, 1.50 FT (0.457 M) ABOVE LSD (SINCE MAR. 10, 1967).

HIGHEST WATER LEVEL 188.12 FT (57.339 M) BELOW LSD, MAR. 15, 1971.
LOWEST WATER LEVEL 191.90 FT (58.491 M) BELOW LSD, SEP. 7, 1973.
RECORDS AVAILABLE 1967-74.

WATER LEVELS IN FEET BELOW LSD.

DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL
FEB. 27, 1974	195.07A	SEP. 11, 1974	190.44		

A WELL BEING PUMPED.

FIGURE 4

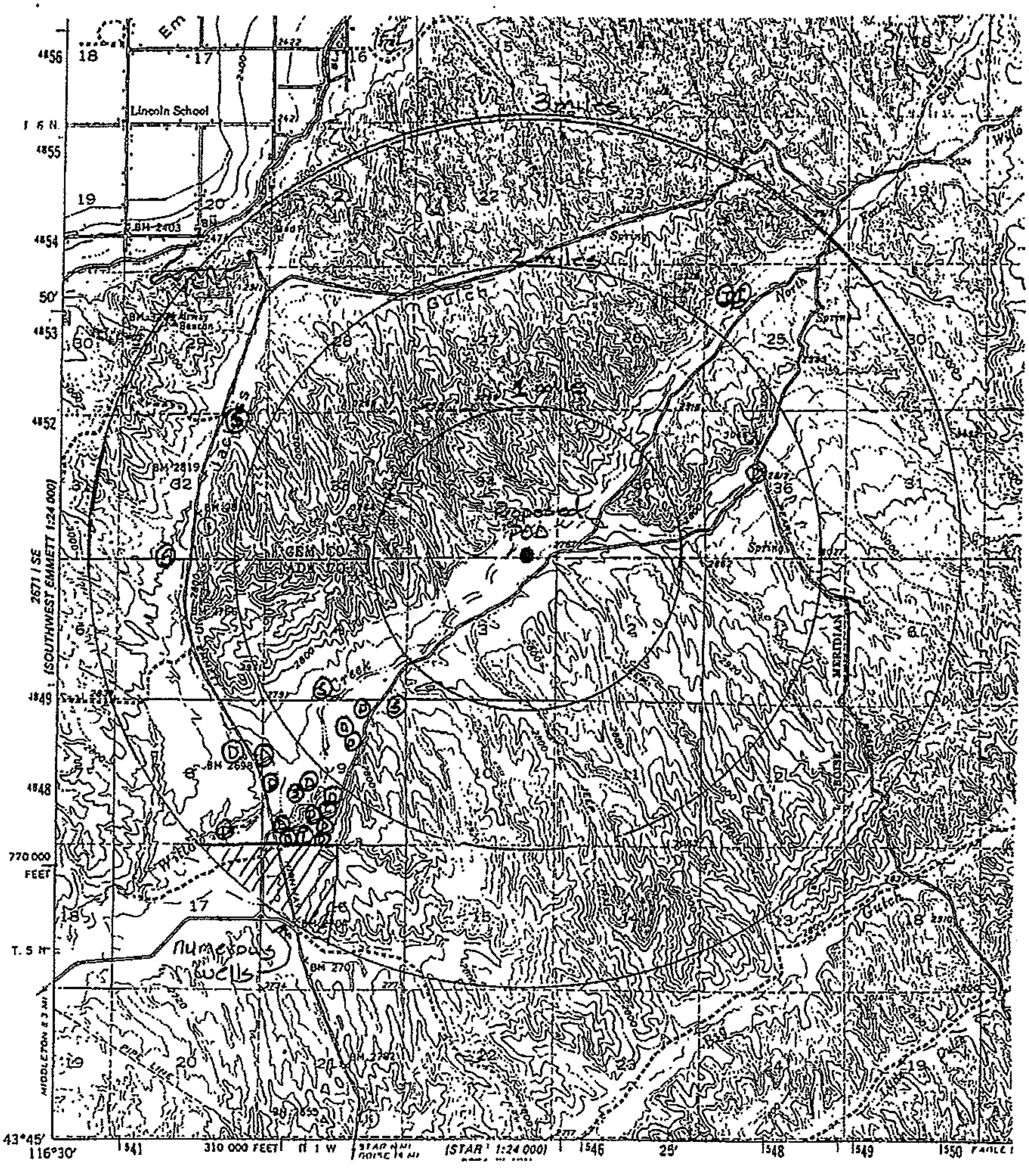


FIGURE 5
WELLS LOCATED WITHIN 3 MILES OF THE
PROPOSED POINT OF DIVERSION
(Wells were located visually on 8/13/94. Applicant's wells are not shown. Uses are assumed (D=domestic, S=stock, I=irrigation))

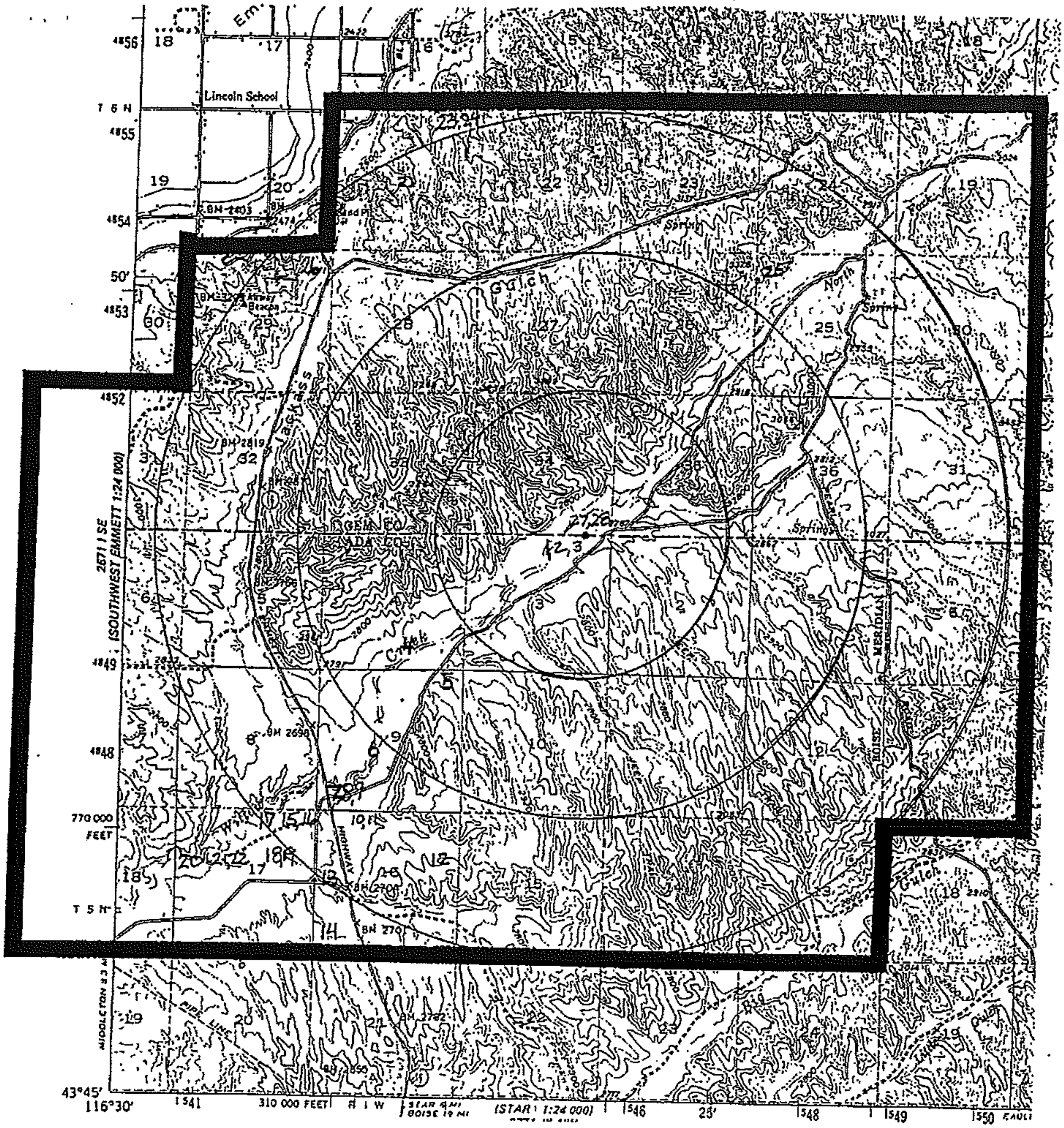


FIGURE 6
RECORDED WATER RIGHTS WITHIN 3 MILES OF THE PROPOSED POINT OF DIVERSION
(Map numbers correspond to numbers listed on Table 1. Search area outlined by black line.)

APPENDIX B

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Attorney for North Ada County Groundwater Users Association

**BEFORE THE DEPARTMENT OF WATER RESOURCES
FOR THE STATE OF IDAHO**

IN THE MATTER OF APPLICATION FOR PERMIT NO. 63-32573, IN THE NAME OF M3 EAGLE, LLC	**AFFIDAVIT OF DALE R. RALSTON IN SUPPORT OF NACGUA'S REPLY TO M3 EAGLE'S RESPONSE TO NACGUA'S MOTION FOR STAY, AND LIMITED DISCOVERY FOR PURPOSES OF SETTLEMENT**

STATE OF IDAHO)
) ss:
COUNTY OF ____________)

I, Dale R. Ralston, after first being duly sworn upon oath, depose and state that:

1. I am over 18 and a resident of the State of Idaho. I am a Professor Emeritus of Hydrogeology at the University of Idaho, have a Ph.D. in civil engineering, and have 41 years experience in ground water studies. I have owned and operated Ralston Hydrologic Services, Inc., a ground water consulting and education business, since 2000.

2. I reviewed the 2008 report entitled **"Re-Analysis of 16 Aquifer Tests in the Greater Eagle-Star area of North Ada County, Idaho"** (page i), which states in part:

> A report released by Hydro Logic, Inc. in the spring of 2007 (HCI, 2007), demonstrates that a regional water-supply aquifer, named therein the Pierce Gulch Sand Aquifer, underlies the Boise River Valley in the greater Eagle-Star and Meridian area, and the foothills lying to the north of these cities.

 ATTACHMENT B

3. The Pierce Gulch Sand Aquifer is the target water supply source for M3 Eagle production wells. This means that operation of the M3 Eagle production wells will have hydraulic impacts on ground water and connected surface water systems within the Boise Basin. I believe that this hydrogeologic conceptual model is correct.

FURTHER YOUR AFFIANT SAYETH NAUGHT.

DATED this 24 day of November 2008.

Dale R. Ralston

SUBSCRIBED AND SWORN to before me this 24 day of November 2008.

BRYAN W HANSON NOTARY PUBLIC STATE OF IDAHO

Notary Public in and for the State of Idaho
My Commission Expires: 9-26-2013

CERTIFICATE OF SERVICE

I certify that on this 24th day of November 2008, I caused to be served a true and correct copy of the foregoing document on the following by the method indicated.

Original to:

IDWR Hearing Officer
P. O. Box 83720
Boise, ID 83720-0098
(Fax and Email)

Norman L. Edwards
884 W. Beacon Light Road
Eagle ID 83616
(U.S. Mail)

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Josephine P. Beeman

Josephine P. Beeman

APPENDIX C

BEFORE THE DEPARTMENT OF WATER RESOURCES

OF THE STATE OF IDAHO

IN THE MATTER OF APPLICATION)
FOR PERMIT NO. 63-32573)
IN THE NAME OF M3 EAGLE, LLC)
______________________________)

DEPOSITION OF DR. DALE R. RALSTON, PE, PG

FEBRUARY 3, 2009

REPORTED BY:

BEVERLY A. BENJAMIN, CSR No. 710, RPR

Notary Public

ATTACHMENT C

A. I have no opinion on it.
Q. What about the claims of the protestants, who are your clients here, have you made any independent review of their claims of potential injury from pumping the M3 wells?
A. No, sir.
Q. Do you have evidence of water level declines in the Eagle M3 area over the last 10 or 15 years in groundwater wells?
A. No, sir.
Q. Are you familiar with any other pending groundwater rights in the north Eagle or north Ada County area other than this?
A. During discussions with ERO folks, they mentioned in passing the water rights. I don't recall those conversations, but at least that discussion did occur.
Q. Is it your opinion that M3 Eagle has provided insufficient information at this point to support the granting of a groundwater right, just based on your experience with the Department of Water Resources and water rights cases?
A. I believe that M3 Eagle has insufficient information to estimate the impacts of M3 Eagle on the protestants' wells.

Q. That is based on what? I know you may be repeating yourself here, but --
A. It's based on the fact that the hydrogeologic conceptual model that is put forth in the 2007 report and on through indicates and presumes the lateral continuity of the Pierce Gulch Sand Aquifer as identified on to the northwest. And that is what is represented in the computer model as existing under the Payette River Valley. I don't believe there is information to support that.
The second thing is that the water level contours that are shown and that were matched as has been shown in the computer model show flow to the north, and I don't believe the measured water levels support those contours.
So if those two aspects, the conceptual model was used to build the computer model, the water levels were used to calibrate the computer model, then the projections from the computer model, I don't believe, are useful in predicting impacts.
Q. Is there any other model out there that would be useful in predicting impacts?
A. I don't believe there is a model

constructed right now that -- with a caveat that I am totally unaware of what Dennis Ousley is constructing, if he is constructing something for IDWR.
Q. That makes two of us then.
I notice that your reports include a November 6, 2008 memorandum, correct, a January aquifer evaluation that we've been discussing at some length here, and third your evaluation of the Glanzman geochem report; correct?
A. That is correct.
Q. Are these three reports, do these three contain all of your opinions to date that you have in this matter?
A. Yes, sir.
Q. Now, there also is an affidavit that you filed that I would like you to describe to me.
MR. FEREDAY: If we can go off the record for a second so I can find that.
(Off the record.)
(Exhibit 3 marked.)
Q. (BY MR. FEREDAY) Dr. Ralston, I've handed you what has been marked as Ralston Exhibit 3, which is an affidavit that you signed

and filed on November 24th, and I just wanted to ask you about this.
You state on page 2 that you believe this hydrogeologic conceptual model is correct, and I'd like to just get clarification on what you meant by that.
A. Okay. I believe I signed something that I didn't agree with.
The intent of me doing this was to indicate that my memorandum that I filed on November 6th expressed my opinion. And this was shipped up to me and I did not effectively read that last sentence.
But I did sign it. That is my signature and I did have it notarized. I'm not sure I know what that last sentence means.
Q. Well, let's see if we can reconstruct this, just so I'm sure about what your views are.
This critical paragraph 3 in the affidavit says: "The Pierce Gulch Sand Aquifer is the target water supply source for M3 Eagle production wells." Do you agree with that?
A. Yes, sir.
Q. The second sentence says: This means that operation of these wells will have hydraulic

impacts on ground water and connected surface water systems within the Boise Basin; is that correct?
A. Yes, sir.
Q. That includes on the Boise River, correct, or at least by the "Boise Basin" do you mean the whole area stretching at least into Garden City and up perhaps into Boise?
A. What it says is "ground water and connected surface water systems within the Boise Basin." Yes, in a broad sense that includes all the way up from Garden City.
Q. Then by saying that you believe that this hydrogeologic conceptual model is correct, would it be accurate to say that you are saying that: At least I agree that the Pierce Gulch Sand Aquifer exists and it extends to Garden City, let's just say?
A. That was what I thought I signed, and I think that is what these words say. But what I intended to say is the conceptual model from the M3 Eagle to the southeast toward the Boise was well supported, in my opinion, by the technical work and I agreed with that. And that is what my intent on signing that was.

Q. I will just point out to you that at the time that this was signed, I don't believe -- well, I know that the Hydro Logic-PGG model had not yet been released.
A. That is correct.
Q. So when you used the word "model," you weren't referring -- I'm not trying to tie you down that you are conceding that the HLI-PGG model is correct or that any other model is correct, but you are talking about the geology and the hydrogeology back to the southeast is correct?
A. That is correct. That is the conceptual model. I continually differentiate a numerical model from a conceptual model. This is a conceptual model and to the southeast. That is what I thought I signed.
Q. Okay. Great.
With regard to your November 6 memorandum, I think you have it there in your materials. Again, I'm not making exhibits of these, Dr. Ralston, for this deposition because if I made exhibits of all these things we would have a very large amount of paper, and I think we all know what we are referring to here; is that

okay with you?
A. Yes, sir.
Q. In your November 6 memorandum, you make several conclusions. Have any of your opinions or conclusions changed since your November 6th memo?
A. I don't believe so, sir.
Q. The memo states that you anticipate having a more detailed hydrogeologic analysis, and I take it that that is your January analysis that followed on this; is that correct?
A. Yes, sir.
MR. FEREDAY: Let's take a break here and have lunch, be back at 12:35.
(Luncheon recess taken.)
Q. (BY MR. FEREDAY) Dr. Ralston, why are Mr. Young, Mr. Hannula, and Mr. Drury no longer experts in this case; do you know?
A. I have no direct knowledge of why that is.
Q. Do you have a guess?
A. I'm presuming it's financial, but I have no direct knowledge that that is the case.
Q. Did NACGUA or its counsel provide you with copies of our written discovery questions

that we sent to the protestants; do you recall any of that?
A. I don't honestly recall.
Q. Do you recall whether you received any documents that M3 Eagle provided in response to discovery from NACGUA?
A. Everything that I have seen is listed here.
Q. Is listed on Exhibit 1?
A. So if it's on there and it came via that, then I got it.
Q. Have you discussed proposed settlement in this case with NACGUA or its counsel or any of the individual protestants?
A. To the extent to which questions were raised on like water level monitoring, that I have been party to that sort of discussion, which is just the question of: If there was to be monitoring where might it be? And I have not written anything on that, but I've been party to those discussions.
Q. What about water quality monitoring as an item of settlement; is that something that you would see as a reasonable thing that M3 Eagle could provide in some sort of a settlement?

APPENDIX D

MEMORANDUM

DATE: February 22, 2008 Amended Application Processing No. 59

TO: Water Management Division

FROM: Gary Spackman

RE: Processing of Applications to Appropriate Water in the Lower Boise River Basin

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This memorandum replaces the original Application Processing Memorandum No. 59 issued in 1996.

Until further instructions are given, the following provisions apply to the processing of applications to appropriate water in the Boise River Basin (Administrative Basin 63) downstream from Lucky Peak dam.[1]

1. Surface water in the Boise River or tributary to the Boise River upstream from Star Bridge is fully appropriated during the irrigation season and during much of the rest of the year. As stated in the May 3, 1995, Amended Moratorium Order for the Boise River drainage:

> Applications which propose use of surface water upstream from Star Bridge will be denied unless the applicant files an acceptable plan to mitigate or avoid any material injury to existing water rights.

2. Surface water in the Boise River or tributary to the Boise River downstream from Star Bridge is generally available for appropriation. Applications to appropriate surface water in this reach shall be evaluated on a case-by-case basis in accordance with applicable Idaho law and the Water Appropriation Rules.

3. The map on page 4 depicts an area in which ground water shallower than 200 feet below ground surface is probably tributary to the Boise River upstream from Star Bridge. New applications for consumptive uses of ground water in this area, including applications for municipal purposes, should be held without further processing unless one or more of the following conditions applies:

   A. The applicant demonstrates that the holders of water rights to divert from the Boise River will not be injured by the proposed appropriation or the applicant files an acceptable plan to mitigate for a water use that would otherwise cause injury to existing water rights from the Boise River.

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[1] For guidance regarding applications to appropriate water upstream from Lucky Peak Dam, see Application Processing Memorandum No. 13.

B. The application seeks the appropriation of ground water for domestic purposes as such term is defined in Idaho Code § 42-111.

C. The application seeks the appropriation of ground water for multiple ownership subdivisions or mobile home parks in which each unit satisfies the definition for the exemption of requirement to file an application for permit as described in Idaho Code § 42-111.

D. The application proposes to appropriate ground water deeper than 200 feet below ground surface. Applications meeting this criterion shall be evaluated on a case-by-case basis in accordance with applicable Idaho law, the Water Appropriation Rules, and the May 3, 1995, Amended Moratorium Order for the Boise River drainage.

4. Applications to appropriate ground water outside the area depicted in the attached map shall be evaluated on a case-by-case basis in accordance with applicable Idaho law, the Water Appropriation Rules, and the May 3, 1995, Amended Moratorium Order for the Boise River drainage.

5. The May 3, 1995, Amended Moratorium Order for the Boise River drainage states that the advertisement for each ground water application shall include the proposed depth interval from which the applicant wants to withdraw water. IDWR will adhere to this advertising directive. However, the depth interval shall be required in the conditions of approval for permits only within the area where ground water shallower than 200 feet below ground surface is tributary to the Boise River, as shown on the attached map, or when otherwise deemed necessary by IDWR on a case-by-case basis. In the area where ground water shallower than 200 feet below ground surface is tributary to the Boise River, the depth interval shall be included in the conditions of approval for each ground water permit, regardless of whether the proposed depth is more or less than 200 feet below ground surface.

6. IDWR has established two ground water management areas, the Boise Front GWMA and the Southeast Boise GWMA, in the Boise River Basin. (See the map on page 4.) These instructions do not change, affect, or override instructions or management plans issued for the administration of water within any Ground Water Management Area or Critical Groundwater Area that is designated or may be designated within the Boise River Basin.

7. These instructions do not prevent the Director from reviewing for approval on a case-by-case basis an application which otherwise would not be processed and/or approved at this time if:

   A. The public interest, as determined by the Director, requires immediate consideration of approval of the application, or

B. The Director determines that the development and use of the water pursuant to an application will have no effect on prior surface and ground water rights because of its location, insignificant consumption of water, or mitigation provided by the applicant to offset injury to other rights.

8. Applications being held pursuant to the previous version of this memorandum shall be processed in accordance with this memorandum as time, resources, and competing priorities allow. The "thirty (30) applications for permit per month" limitation in the May 3, 1995, Amended Moratorium Order can be exceeded.

Map Depicting the Area in which Ground Water Shallower than 200 Feet Below Ground Surface is Tributary to the Boise River Upstream from Star Bridge.