

**GROUNDWATER STATION DESCRIPTION
EAST OBSERVATION WELL – 343017096561501
CHICKASAW NATIONAL RECREATION AREA, OK**

Updated by: Joseph Chafey	Date: August 18, 2010
Prepared by: Kathryn Converse	Date: March 19, 2007
Reviewed by: Kathryn Converse	Date: October 22, 2010
Reviewed by: Jennifer Back	Date: January 3, 2011
Approved by: William Hansen	Date: January 4, 2011

LOCATION

The station is located at latitude 34° 30' 18.34" longitude 96° 56' 15.23"; T1S R3E S1 ABA01; Murray County, OK; Hydrologic Unit 11130303. (NAD83¹, United States Geological Survey (USGS) National Water Inventory System (NWIS) site inventory web site). The National Park Service (NPS) is using the original USGS station number (343017096561501) in lieu of the corrected station number (343018096561501) determined from a 2005 precision Global Positioning System (GPS)² survey (http://waterdata.usgs.gov/nwis/inventory/?site_no=343017096561501). The USGS station number was likely derived from a 7.5 quadrangle topographic map latitude/longitude. The GPS survey is considered more precise.

ACCESS:

Chickasaw National Recreation Area (CHIC) is located on State Highway 177, just south of the town of Sulphur, Oklahoma. The park is approximately 90 miles south of Oklahoma City, Oklahoma and 120 miles north of Dallas, Texas. Driving south from Oklahoma City on US I- 35 take exit 55 to State Highway 7. Driving north from Dallas on US I-35 take exit 55 to State Highway 7. Drive through the towns of Davis (3 miles) and Sulphur (10 miles) to the intersection of Highway 7 and 177. Drive south on Highway 177. Park Headquarters is located at 1008 West Second Street in Sulphur, Oklahoma.

The East Observation Well is approximately 1000 ft N-NE of Buffalo Springs and 1000 ft E-NE of Antelope Springs at the northeast corner of the CHIC -Travertine District. Traveling from Park Headquarters go north on Highway 177 to Highway 7 and continue east for approximately two miles. Turn south and travel through private lands (access through a wire gated fence) a half mile to the fenced park boundary. Park vehicle at park boundary fence and enter through gate. Well is less than 100 feet from gate. Due to steep grades and variability of topography, high clearance and four-wheel drive is recommended.

View attached maps (**Figures 1 and 2**).

NOTIFICATION:

One must be accompanied by park personnel when visiting well. Permission to access private land has been obtained. Contact, Steve Burrough, Natural Resource Specialist.

ESTABLISHMENT

Drilled on August 7-14, 1972 by Delay and Bectel Drilling. Groundwater level monitoring began December 28, 1973 (Refer to **History** section for station operator details). The NPS uses the well to monitor groundwater levels and evaluate regional trends in spring flow at Antelope, Buffalo, and Hillside springs.

WELL CHARACTERISTICS

The well was drilled to a depth of 238 feet below land surface, with the upper 25 feet cased with six inch diameter casing. The Measuring Point (MP) gage datum³ is 2.59 feet above land surface. The elevation of land surface is 1151.52 feet above sea level⁴.

¹ North American Datum of 1983 (NAD83) is an earth-centered datum based on the Geodetic Reference System of 1980. The size and shape of the earth was determined through measurements made by satellites and other sophisticated electronic equipment; the measurements accurately represent the earth to within two meters.

² Global Positioning Systems (GPS) is a system of satellites, computers, and receivers that is able to determine the latitude and longitude of a receiver on Earth by calculating the time difference for signals from different satellites to reach the receiver

³ Gage datum is a horizontal surface used as a zero point for measurement of water levels.

HYDROLOGIC CONDITIONS

The East Observation Well is used to monitor groundwater levels of the Arbuckle-Simpson aquifer. The aquifer is composed of the Arbuckle group, characterized by hard, dense limestone and dolomite, and the Simpson group, consisting of limestone, shale and fine to medium-grained sandstone (Hanson and Cates, 1999). In the vicinity of the park, the Simpson and Arbuckle groups are overlain by a tightly cemented limestone conglomerate known as the Vanoss formation. The Vanoss formation acts as a confining unit controlling discharge of the park's springs and Sulphur's artesian wells.

Water from the Arbuckle-Simpson aquifer is likely forced upward through fractures in the confining layer, feeding five spring groups in the park. Antelope Spring and Buffalo Spring are two fresh water springs near the eastern boundary of the Travertine District. Hillside, Pavilion and Black Sulphur are the only three remaining spring groups characterized by higher mineral concentrations. These three springs and the famous flowing Vendome Well are located in the center of the Travertine District, west of the fresh water springs.

CHIC is located at the intersection of the eastern woodland and mixed-grass prairie ecological communities. Vegetation includes sycamore, pecan, hickory, and eastern red cedar of the eastern woodland community and grasses and prickly pear of the western prairie community. The predominant land use east of the park is grazing. The climate includes hot and humid summers with mild winters. The park receives about 38 inches of rainfall a (Hanson and Cates, 1999).

GAGE

Water levels were measured by an In-Situ miniTROLL 0-15 PSIG pressure transducer (**Figure 3**) (serial number 012150) from June 17, 2003 through September 30, 2008. On September 9, 2008 a Design Analysis Associates Inc. WaterLOG DH-21 0-15 PSI submersible pressure/temperature transducer/data logger pack (**Figure 4**) (serial number 02024) was installed and used to measure water levels starting October 1, 2008.

The In-Situ miniTROLL includes an onboard "logger" powered by two alkaline cells and is suspended by a spring wire cage (In-Situ, 2010). The WaterLOG DH-21 is powered by a 7.2 volt lithium battery and is suspended by a stainless steel drop cable and weighted ballast (Design Analysis Associates, Inc. 2010a). Both pressure transducers attach to a metal ring insert glued to the well casing (6-inch outer diameter) (**Figure 5**). The well is housed in a corrugated cylinder supporting a rusted box shelter (**Figure 6**).

The MP for measuring down to water level is located on the right inside lip of the box shelter and is marked with a slight v-notch (**Figure 7**).

Naturally occurring tar (**Figure 8**) found in the groundwater may affect logger readings. At each station visit during water year (WY) 2009 the logger was cleaned and water level readings did not seem affected.

HISTORY

CHIC was originally established as Platt National Park in 1906. The name was changed to Chickasaw National Recreation Area in 1976 when an area of land, including the Lake of the Arbuckles, was added to the park.

August 7-14, 1972 Well drilled. Groundwater level recorded at 68.5 feet below land surface.

December 28, 1973 Stevens F type recorder installed by USGS. NPS monitored well from December 28, 1973 to January 28, 1986. Original copies of records for October 1, 1978 to January 28, 1986 are in the permanent files of the NPS – Water Rights Branch (WRB). Periodic water-level measurements were made by the NPS June 9, 1980 through October 27, 1981 and February 13, 1984 through January 26, 1987. Water levels entered into Groundwater Site Inventory (GWSI) at 5-day intervals when the record was considered reliable, otherwise only periodic water-level measurements made by NPS entered.

⁴ Elevation vertical datum is Geoid Model 2003 (GEOID03) a refined model of the geoid in the conterminous United States (CONUS). It is constructed specifically to relate GPS ellipsoid heights in the NAD 83 datum and orthometric heights in the NAVD 88 datum.

January 28, 1987	Stevens F type recorder replaced with a Floppy Disk (FD) digital recorder (W8354) by USGS. (land surface datum = 2.20 ft, and depth to water = 55.88 ft). Operation began on this day. Daily values from digital record are stored on Automatic Data Processing (ADP) files on a continuing basis. The USGS collected data from January 28, 1987 to November 6, 2002. Record is sporadic and irregular with a gap of seven years between 1995 and 2002. Data from August 14, 1972 to November 6, 2002 are reported on the USGS's website http://nwis.waterdata.usgs.gov/ .
November 6, 2002 – June 17, 2003	No record.
June 17, 2003	In-Situ miniTROLL installed for monitoring groundwater levels by the NPS. Darryl Carter, CHIC staff began recording instantaneous groundwater level measurements.
October 19 and 20, 2005	Precision GPS survey conducted to establish Reference Mark ⁵ (RM) 2 elevation (1151.247 ft) and latitude and longitude. Land surface elevation at well, 1151.52 feet, determined using RM2 base ⁶ elevation.
May 22, 2007	Datum elevation changed to 1151.52 feet in ADAPS. Datum latitude and longitude in ADAPS confirmed accurate using RM2 base latitude and longitude.
September 9, 2008	Design Analysis Associates Inc. WaterLog DH-21 0-15 PSI submersible pressure/temperature transducer/data logger (serial number 02024) installed. Data from WaterLOG DH-21 not included in WY 2008 folder.
October 1, 2008	WaterLog DH-21 established as primary record for water year 2009 In-Situ miniTROLL data from 10/1/2008 through 12/19/2008 not included in WY 2009 folder.
January 15, 2010	Began calculating water elevation, first reported starting Water Year 2007 folder. Water elevation calculation formula is $WLE_n = LSE - DTW_n$ Where WLE_n is the water level elevation at time n, LSE is the land surface elevation (1151.52 feet NAVD88) - DTW_n is the depth to water at time n.

REFERENCE AND BENCHMARKS

The NPS established three RMs and a MP for elevation control. Elevations for the RMs and MP were surveyed March 30, 2004.

Precision GPS survey conducted October 19-20, 2005. The original 2005 elevations were calculated and converted to feet before rounding final elevations. RM2 (**Figure 9**) elevation 1151.247 feet established as base. The base elevation was rounded to reflect the GPS survey accuracy limit of 0.066 meter (refer to "Precision Global Positioning System Survey Summary" located in Section 4 of WY 2006 Folder), and used to recalculate final elevations for the 2004 and 2005 surveys. Recalculating the 2004 and 2005 survey elevations reduced rounding and conversion differences between the two surveys.

The rounding and conversion differences are inconsequential, because groundwater levels fluctuate more than one tenth foot. Survey elevation calculations are located in the WY 2006 Folder, Section 4: Survey Analysis.

Locations and descriptions of MP, Top of Casing⁷ (TOC) and RMs are depicted in (**Figures 10 – 13**) and elevations are listed in **Table 1**.

⁵ Reference Mark (RM) also referred to as a Reference Point (RP) is a permanent marker installed in the ground or on a structure in the vicinity of the gage. Its' elevation above the gage datum is known.

⁶ The base is the reference mark on which all reference mark elevations are based. It is considered the most stable.

⁷ Top of Casing (TOC) is the steel casing extended from the hole of the well.

Table 1: Elevations in feet above mean sea level of MP and RMs.

Date	MP	TOC	Land Surface	RM1	RM2 (Base)	RM3
03/30/04	1154.11	1152.11	1151.52	1151.84	1151.25	1155.54
10/19/05	1154.11	1152.13	1151.52	1151.84	1151.25	1155.54

REGULATION AND DIVERSION

There are no known sources of direct regulation and diversion.

ACCURACY

The Water level record was considered excellent when station equipment was working. The In-Situ miniTROLL reported accuracy was $\pm 0.1\%$ of its full scale output (15psi) and $\pm 0.05\%$ when at 15° Celsius (In-Situ Inc. 2010). The WaterLog DH-21 reported accuracy was $\pm 0.1\%$ of its full scale output (15psi) at a depth of 0 to 34.60 feet when operated at 0 to 60° Celsius (Design Analysis Associates, Inc. 2010a). Accuracy may be downgraded when data corrections applied for equipment settling, unit conversion, seismic events, pump tests, measuring tape accuracy and/or tar.

COOPERATION

USGS monitored the well between January 1986 and November 2002 under the state-wide data collection program. Park staff maintains the East Observation Well and performs monthly station visits. The WRB reviews monitoring efforts and processes the collected data.

LOCAL PARK PARTNER

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REFERENCES

Design Analysis Associates, Inc. 2010a DH-21 Brochure,

<http://www.waterlog.com/Downloads/Brochures/DH-21%20Brochure.pdf>: last checked November 22, 2010.

Design Analysis Associates, Inc. 2010b DH-21 Logger/Submersible Pressure Sensor,

http://www.waterlog.com/Products/DH21/dh_21.html: last checked November 22, 2010.

Hanson, R.L. and S. W. Cates. 1994, Hydrogeology of the Chickasaw National Recreation Area, Murray County, Oklahoma. USGS Report WRIR 94-4102.

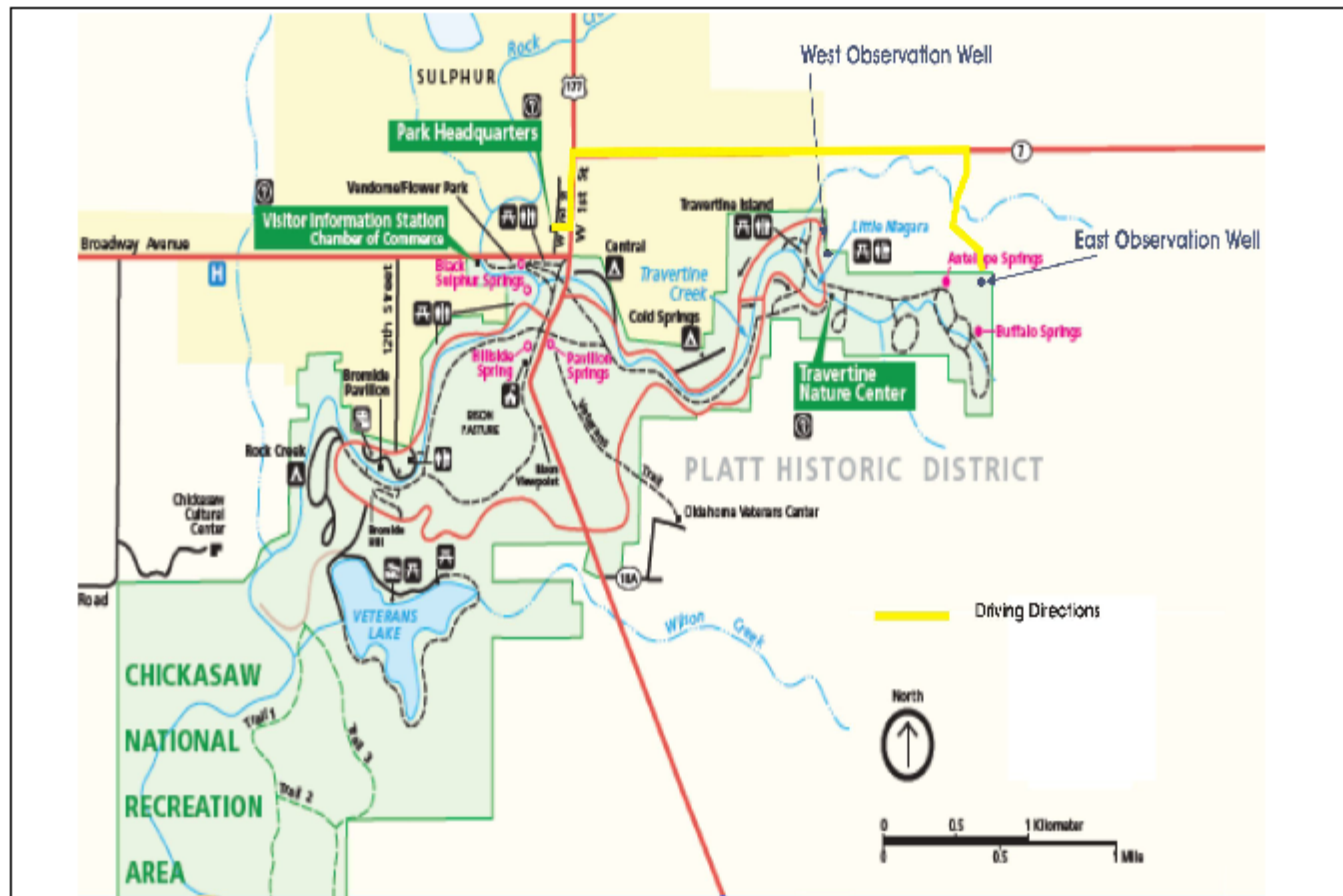
In-Situ Inc. 2010 miniTROLL Operator's Manual,

http://www.in-situ.com/Obsolute_product_support: last checked November 22, 2010.



FIGURE 1
Fig1

Driving Directions to East Observation Well 343017096561501



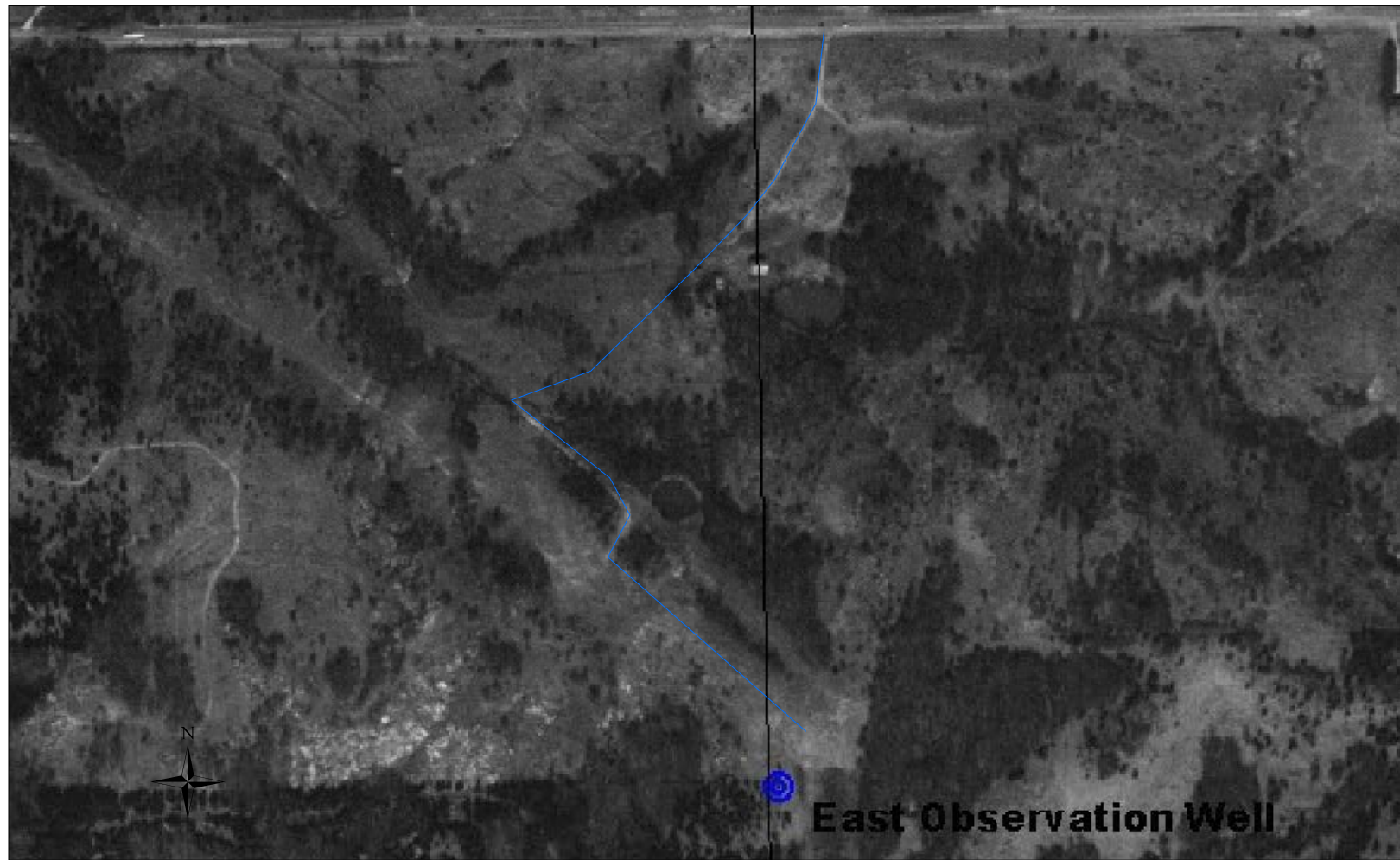
Produced by the Water Resources Division

December 8, 2010

Data Source: NPS



Driving Directions to Station 343017096561501 through Private Land



Produced by the Water Resources Division - Water Rights Branch

May 25, 2006

STATION EQUIPMENT PICTURES

Station Photos by Jennifer Back
Taken November 7, 2003

343017096561501
East Observation Well
CHIC

FIGURE 3: East Observation Well In-Situ miniTROLL 0-15 PSIG transducer - data logger.



FIGURE 4: Design Analysis Associates Inc. WaterLog DH-21 0-15 PSI submersible pressure/temperature transducer/data logger (Design Analysis Associates, Inc. 2010a).



FIGURE 5: East Observation Well, well dock and carabineer within well casing.



STATION EQUIPMENT PICTURES

Station Photos by Jennifer Back
Taken November 7, 2003

343017096561501
East Observation Well
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FIGURE 6: East Observation Well corrugated cylinder and rusted box shelter.



FIGURE 7: Measuring Point (MP) on instrument shelf.



FIGURE 8: Electric tape covered in tar.



STATION EQUIPMENT PICTURES

Photos by Jennifer Back
Taken October 19, 2005

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FIGURE 9: Reference Mark 2 (RM2) 1/2 inch rebar with aluminum cap.



FIGURE 10: Reference Mark 1 (RM1) 1/2 inch rebar with yellow cap, centered in front of corrugated housing

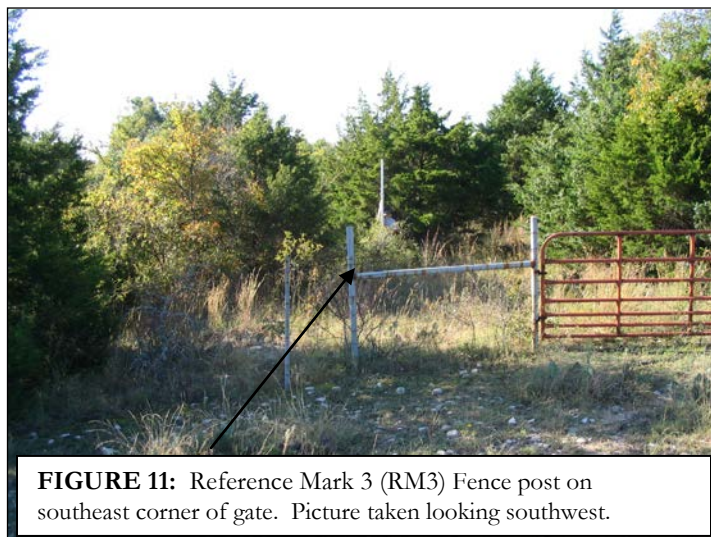


FIGURE 11: Reference Mark 3 (RM3) Fence post on southeast corner of gate. Picture taken looking southwest.

Figure 12: Sketch of East Observation Well (Not to Scale)

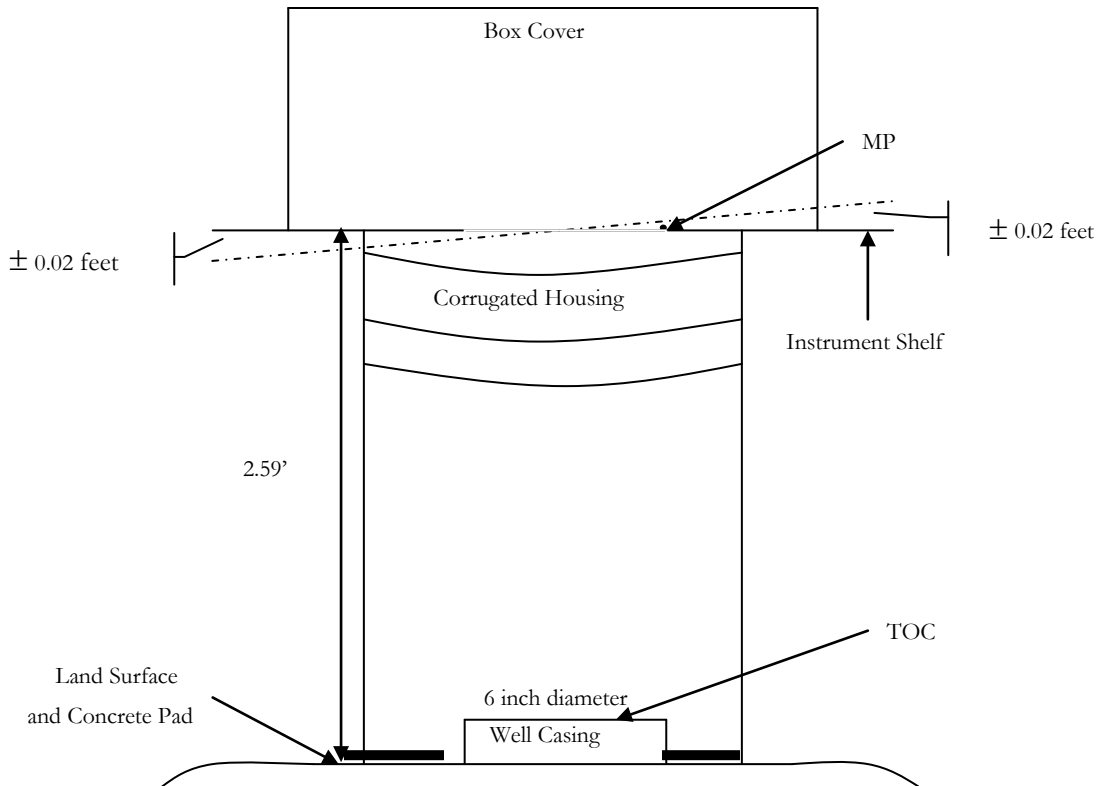
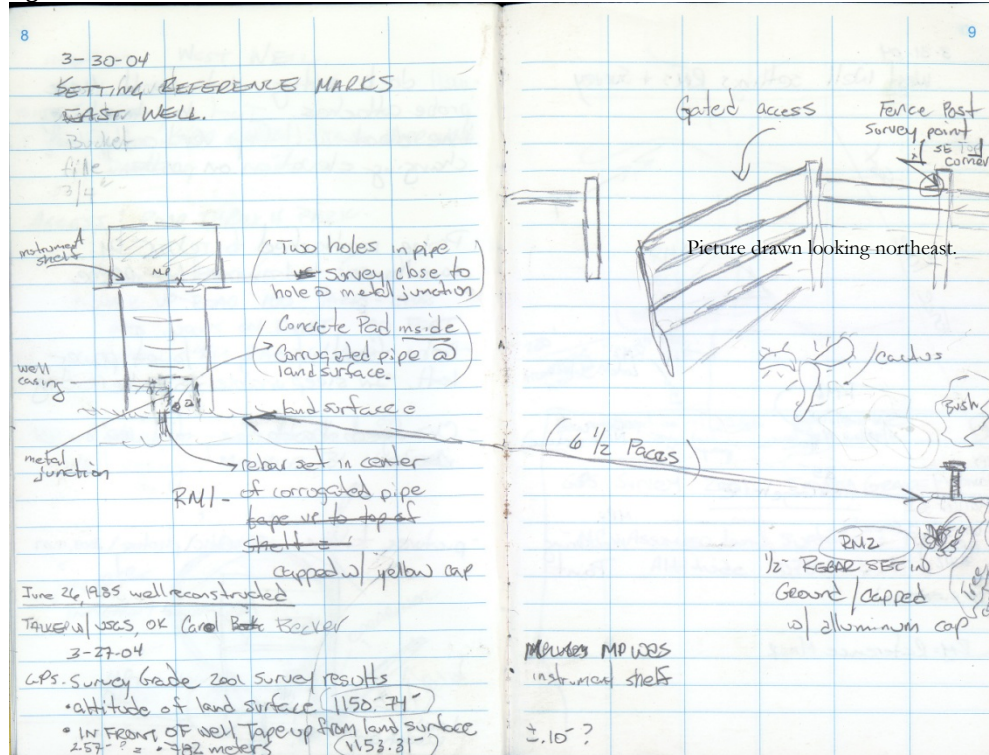


Figure 13: Field Note Reference Marker Locations



MP – V-Notch and arrow on instrument shelf (gage datum)

RM1 – ½ inch rebar with yellow cap, centered in front of corrugated housing.
Latitude 34 30' 18.34"
Longitude 96 56' 15.40"
(WGS 84)

RM2 – ½ inch rebar with aluminum cap
Latitude 34 30' 18.34"
Longitude 96 56' 15.23"
(WGS 84)

RM3 – Fence post on southeast corner of gate

TOC – In line with MP marked on instrument shelf

Land Surface – At the front and inside the the corrugated housing on the concrete floor near the metal seam and a visible hole in the metal