WELL NAME: WSW-75
PROJECT: CAMP BULLIS
SAN ANTONIO, TEXAS

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LEGEND

GEOPHYSICAL LOGS

Gamma
Standard gamma ray (includes K, U, and Th)

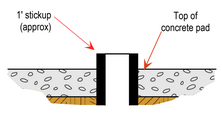
Resistivity/Conductivity
Induction Resistivity
Short Normal Resistivity
Long Normal Resistivity
Deep Guard Resistivity
Single Point Resistance

Neutron Porosity/Relative Hydrogen Content
Compensated neutron tool with 5 Ci Am 241 Be source.

Density
Compensated, two detector, focuser density using a 2.0 Ci Cesium 137 source.

All Geophysical Logs conducted in well condition as presented.

Wellhead Construction Detail



Top of steel casing approximately 1 foot above top of concrete pad

LITHOLOGY

Topsoil/fill
Red Clay
Gray shale
White limestone
Gray limestone
Light tan limestone
Light brown limestone
Dark brown limestone
Fracture
Bedding plane
Weathered bedding plane
Vugs (light)
Vugs (medium)
Vugs (major)

DERIVED WELL CONSTRUCTION/LITHOLOGY

Annular Seal
Good - solid with no voids
Marginal - 10% to 50% voids or native backfill
Poor 50% to 100 % voids (no annular material)

Geology
Water bearing zone
Argillaceous limestone

HYDROPHYSICAL LOGGING RESULTS:

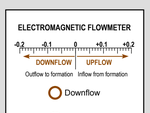
Total Flow rate and Interval Specific Flow rate derived from pumping during deionized water injection hydrophysical data.

Horizontal flow observed during ambient conditions, inflows also evaluated during stressed (constant pumping or slug test) conditions. Horizontal flowrates base on integral method for q (Lowe, et. al., 1989).

Fluid Resistivity and Fluid temperature
Log performed during ambient conditions

Hydraulic conductivity estimates based on Hvorslev (1962), (Pedler, *et al.* 1988) and Theim, G. *Hydrolgische Methoden.* Leipzig: Gebhart, 1906, p 56. Flow and velocity estimates based on hydrophysical logging results only.

ELECTROMAGNETIC FLOWMETER

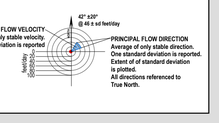


EMFM applied without flow diverters. Flow rate presented was flow through sensor.

RAS STRADDLE PACKER TESTS

Interval specific hydraulic conductivity plotted over lengthof tested Interval

SCANNING COLLOIDAL BORESCOPE FLOWMETER (SCBFM)



MISCELLANEOUS NOTES:

1. Ground surface elevation: 1125 feet (NGVD 1929).
2. All depths referenced to top of steel casing.
3. Coordinates of well:
   Northing: 3280736.4m Easting: 539981.6m (UTM Zone 14 Meters)
4. Lithology from original drillers log (1994).
5. Well construction from original drillers log (1994).
6. Geophysical logging conducted by RAS, Inc. on December 8, 2006.
7. Nuclear logging conducted by Century Geophysical Corp. on December 11, 2006.
8. Hydrophysical logging conducted by RAS, Inc. on November 13 & 14, 2006.
9. Packer testing conducted by RAS, Inc. on November 29 & 30, 2006.

Geophysics

Gamma (API units)
Caliper (inches)

Induction Resistivity (ohm-m)
Short Normal Resistivity (ohm-m)
Long Normal Resistivity (ohm-m)
Deep Guard Resistivity (ohm-m)
Single Point Resistance (ohms)

Neutron (near) (cps)
Neutron (near) (cps) Above Water Level
Neutron (near) (cps) Below Water Level
Relative Hydrogen Content Above Water Level
Relative Hydrogen Content Below Water Level
Relative Hydrogen Content Increasing →

Density (near) (g/cc) In Steel Casing
Density (near) (g/cc) Below Steel Casing
Density (far) (g/cc) In Steel Casing
Density (far) (g/cc) Below Steel Casing
Compensated Density (g/cc) In Steel Casing
Compensated density (g/cc) Below Steel Casing
Scale In Steel Casing
Scale Below Steel Casing

Well Construction (based on 1994 driller's log)
8" Steel Casing
13" Borehole
Grout
Water Level 141.02'
Bottom of Casing 160'
10" Open Borehole

Geology
Lithology (based on 1994 driller's log)
No Return Suspected Cave

Elevation, ft above MSL

Image Logs

Acoustic Amplitude
Travel Time

Image Analysis

Karst Frequency (per foot)
Karst Aperture (feet)

Hydrophysics

Ambient Fluid Temperature (C)
Conductivity (mS/cm)
Total Flow During Pumping (gpm)
Interval Specific Flow During Pumping (gpm)
Ambient Flow (gpm)
Electromagnetic Flowmeter (gpm)
OUTFLOW / DOWNFLOW
INFLOW / UPFLOW

Estimated Hydraulic Conductivity (ft/day)

Hydrologic

Straddle Packer Testing Hydraulic Conductivity (ft/day)

Geophysically & Hydrophysically Derived Lithology and Well Construction

8.25" ID Steel Casing
13" Borehole
Grout
Void
Marginal
Void
Marginal
Good
Poor
Voids
Water Level 141.02'
~11.5 feet
~13 feet
~26 feet
~35 feet
~57 feet
Bottom of Casing 164' (observed)
10" Open Borehole
185.1 feet
190° ±5°
@ 86 ±14 feet/day
172.7 feet
251° ±9°
@ 78 ±2 feet/day
+1.1 to +1.3 gpm
-1.1 to -1.3 gpm
4.37E+01
1.11E+01
5.43E+01
2.66E+00
1.71E+00
1.77E-02
8.60E+01 to 9.20E+01
9.56E-01 to 3.42E+01
8.14E-01
5.03E-01 to 1.02E+00
1.77E-02 to 2.59E-02
1.20E-01
Well Obstructed by Pipes at 484'
500' Borehole Total Depth

Depth, ft

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