City of Troy I-35 Well

A Lower Trinity Public Water Supply Well Case Study
PROJECT TEAM

City of Troy – Jeff Straub (City Manager)
Clearwater Underground Water Conservation District
  – Dirk Aaron (General Manager)
BSP Engineers – Anthony Beach
Braun Intertec Corporation – William Gamblin
Texas Water Development Board
Texas Commission on Environmental Quality
Hydro Resources Mid-Continent
City of Troy Needs Assessment

- Accelerated Growth Expected
  - I-35 Construction
  - Commute to Waco and Temple
  - Water Usage Expected to be 4 times Current in 2035
- City Strives to a Balance an Diversity of Sources
  - 60/40 split between surface and groundwater.
- Currently Operates one Public Supply Well (City of Troy Well #2).
  - Historical Use Permit
  - Declining Yield
- City of Temple “Take or Pay” Contract
CUWCD Drilling Permit

- Drilling Permit Submitted in 2015
  - Class 2 Non Exempt
  - Proposed Well Location
    - Setback Criteria
  - Proposed Well Construction Details
    - Gauge Lines
  - Engineered Drawings and Specifications
  - Proposed CUWCD Forms and Checklists
  - Drought Contingency Plan
  - Projection of an Additional 250 ac-ft/year
    - 220.5 ac-ft Existing Use
    - 470.5 Needed in 2035
CUWCD Drilling Permit

- Lower Trinity Aquifer
  - Hosston Formation
    - Artesian conditions
  - Other Possible Aquifers
    - Edwards BFZ
    - Upper Trinity
    - Middle Trinity
CUWCD Drilling Permit

- Clearwater Underground Water Conservation District
  - Pro-Active
  - Guidance and Assistance
    - Pre-Permit Meeting
    - Administrative Assistance with Notifications
      - Surrounding Property and Well Owners
      - Local Media Notifications
  - Virtual Core
West - East Fence Diagram #2
(Lat: 31.217931, Long: -97.295158)

Potentiometric Surfaces
- 2012-2013 Hosston Water Level Elevation (Confined Conditions)

Geology
- Layer 1 - Taylor Marl and Austin Chalk
- Layer 2 - Del Rio, Georgetown, Main Street and Paw Paw Limestone
- Layer 3 - Edwards and Comanche Peak Limestone
- Layer 4 - Walnut
- Layer 5 - Glen Rose
- Layer 6 - Hensell
- Layer 7 - Pearsall, Cow Creek Limestone and Hammett Shale
- Layer 8 - Hosston
- Layer 9 - Undifferentiated

Location (State Plane 4203)
W: 3232950, 10419660
E: 3259350, 10419660

Drilling Prognosis for Planned Well

<table>
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<tr>
<th>Depth (feet bgs)</th>
<th>*Predicted Geology</th>
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<tbody>
<tr>
<td>From</td>
<td>To</td>
</tr>
<tr>
<td>0</td>
<td>168</td>
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<tr>
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<td>1812</td>
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*The formation surfaces in this 3-D model are based on geological interpretation and extrapolation of available well data by Allen R. Standen LLC. Additional well data may modify the interpretation and extrapolation of these formation surfaces.

Wells are labeled with tracking numbers from 3-D Hydrostratigraphic Model, Standen et al., 2014.
CUWCD Drilling Permit

- Drilling Permit was submitted in June 2015 and approved by the CUWCD Board in August 2015.
- Subsequent drilling permit extensions extended the active Drilling Permit through November 2018.
- Drilling Operations began in July 2018.
TCEQ “Approval to Construct” Permit

- Texas Commission on Environmental Quality
  - Conformance with TAC Title 30 Chapter 290 Regulations
- Business Plan
- Engineering Report
- Project and Hydrogeologic Background
- Set Back Criteria
- Sanitary Control Easements
- Proposed Well Construction Details
- Engineered Drawings and Specifications
Contract Documents

- Detailed Contract Documents (~300 Pages)
  - Utilized EJCDC Format
  - Instruction to Bidders
  - Bid Forms
  - Bonding Requirements
  - Standard and Supplementary Conditions
  - TWDB Requirements
    - MBE
    - Davis Bacon Act
  - Detailed Specifications
Drilling Design

- Basic Design
  - Single Tube Design
    - Differs from the traditional drilling method of telescoping
    - Better control of screen construction
    - Flexibility of downhole pump placement as aquifer conditions change.
Supply Well Construction

Casing and Screen

- All materials conform to AWWA A100-15
- Engineer will determine final well construction details
- Surface Casing
  - 24” Carbon steel
- Production Well Casing
  - 12” Carbon steel
- Dielectric coupling
- Screens
  - 12” Wire Wrap, Rod Based, Stainless Steel
- Gauge Line – 1.5” Steel
Supply Well Construction

- Filter Pack Material
  - Finalized after Geophysical Logs and Gradation Tests have been reviewed
Supply Well Construction

**Well Drilling**

- Pilot/Test Borehole
  - Minimum 7 & 7/8” (larger is acceptable)
  - Geophysical Logging and Formation Sampling
  - If not reamed, it must be Plugged and Abandoned
- Surface Casing Borehole
  - 30” diameter borehole to ~40 feet bgs
- Production Borehole
  - 20” diameter borehole
  - Caliper and Deviation Logs
- Formation Sampling
  - 10’ intervals or as directed
  - During all drilling activities
Supply Well Construction

Casing, Screen, Gauge Line Installation

- Drilling fluid thinned
- Centering guides will be employed
- Utilize Certified Welders

Filter Pack Installation

- Drilling fluid removed as filter pack installed
- Placed vis tremie pipe
- Disinfected
- Flushed and swabbed as need to settle
Supply Well Construction

**Grout**
- Bentonite Plug place on top of filter pack ~10 feet
- Pump through Tremie Pipe - Positive Displacement Method
- Gravity Feed is Unacceptable
- 48 Hour Minimum Set Up Time

**Sanitary Seal and Vents**
- Install as in Drawings

**Well Cap**
- Whenever Work Ceases, the Top of Casing shall be Capped

**Plumbness and Alignment**
- Drift Indicator Survey Shall be Conducted
Supply Well Construction

Well Development

- ~300 feet of discharge pipe will be needed
- Swabbing and Zoned Air Lift Pumping
  - Intervals of 20 foot sections of screen
  - No less than one hour of rig time per five feet of screen
- Bailing
  - Dropped to just above the bottom of the well
  - Ten hour duration
Supply Well Construction

Well Development

- Pumping
  - Driller Furnish a Pump
  - Dedicated Water Level Transducer
  - Furnish and install a 1.25 " diameter PVC water level gauging access pipe
  - Pump and Surge
  - Minimum of 12 hours
  - Sand Production will Dictate Duration
Supply Well Construction

**Test Pumping**

- Furnish a Pump
- Furnish a Wire-Line Electric Sounder
- Provide a Dedicated Water Level Transducer
- Furnish and install a 1.25 “ diameter PVC water level gauging access pipe
- 800-minute (13.3 hour) Step Test
  - Minimum 12 hour Recovery
- Two Day (48 hour) Constant Rate Test
  - Minimum 24 hour Recovery
Supply Well Construction

**Water Quality Testing**

- Water Sample Collected Near the End of the Constant Rate Pumping Test
- Laboratory Analysis
- Coliform Water Analysis
Supply Well Construction

Wellhead Completion

- Area to be Graded to Ensure Water Will Drain Away
- Concrete Sealing Block
  - As in Drawings
  - Sloped 0.5 inches per foot
- Locking Cap on Well
- Seal and Vent the Wellhead
Bid Process

- Bids Solicited in Spring 2018
  - Hydro Resources Mid-Continent Selected
  - Drilling Began in July 2018
  - Surface Casing was installed to 40 feet
  - Pilot Test hole was installed to 1,799 ft bgs.
  - Test bore was plugged up to the bottom of the Hosston and reamed to 22 inches in diameter.
Grouting Operations
Drill Bits
Cutting Samples
Geophysical Logging by Legacy – Geocam
Casing and Screens
Well Head
CUWCD Hydrogeological Report

- Required for obtaining an Operating Permit
- Includes Details on
  - Well Construction
  - Pumping Tests
  - Aquifer Parameter Derivations
  - Drawdown Projections
As Built – Lower Section

Braun Intertec Corporation
Texas P.E. Firm #12228

City of Troy, Tx
North I-35 Well - Record Drawing

Figure 4
As Built – Well Head

2" nominal black steel gauge line with cap

#5 rebar mat, 12" centers

1" chamfer (typ.)

#5 bent bar typ. @ 12" o/c (typ.)

#5 cont. (typ. of 2) Provide #5 corner bar corner

Annulus filled with cement under pressure from the top of the bentonite plug to the surface

Carbon steel well casing

Section View
City of Troy - N. I-35 Well
PUMPING TEST DRAWDOWN AND RECOVERY

Figure 8
WELL TEST ANALYSIS

Data Set: C:\Clients\City of Troy\2018\Permitting\CUWCD\Troy Forward Solution - 30 day.aqt
Date: 06/20/19
Time: 09:40:29

PROJECT INFORMATION

Company: Braun Interci
cClient: City of Troy
Project: North I-35 Well
Test Well: North I-35 Well
Test Date: 11/26/18

WELL DATA

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<tr>
<th>Pumping Wells</th>
<th>Observation Wells</th>
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<td>Well Name</td>
<td>X (ft)</td>
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<td>North I-35 Well</td>
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<table>
<thead>
<tr>
<th>Well Name</th>
<th>X (ft)</th>
<th>Y (ft)</th>
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<tbody>
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<td>North I-35 Well</td>
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<tr>
<td>Pendleton #2</td>
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SOLUTION

Aquifer Model: Confined

\[ T = 1516.3 \text{ ft}^2/\text{day} \]
\[ K_z/K_r = 1 \]

Solution Method: Theis

\[ S = 0.0001 \]
\[ b = 98 \text{ ft} \]
Drawdown Projections
Question or Comments?

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