BOSQUE ECOSYSTEM MONITORING PROGRAM

Well Monitoring Directions

Well Monitoring Background

The five wells at each site are used to measure groundwater depths, which play a critical role in cottonwood and other vegetation health and are also important to understanding water cycle and evapotranspiration dynamics.

Well Installation

The following pages include instructions on how to install a well (by Jim Thibault, UNM Department of Biology).

Well Monitoring Materials

- Solinst water level meter ("beeper")
- monthly monitoring data sheet, clipboard and pen
- site map
- key to locks on wells

Well Monitoring Directions

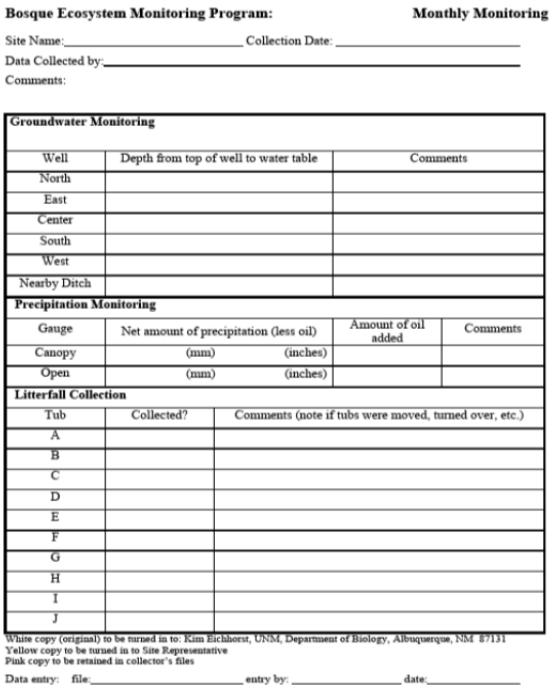
Gently remove the well cap and note what well you are at by looking on the inside of the cap or on the well. Turn on beeper by turning black power/sensitivity knob all the way and then back by a ¼. Test to see if it is on by pushing black button (machine should beep). Turn the knob on the opposite side to unlock the spool. Remove probe from holster. Using fingers to keep from dragging across the well's edge, lower and guide the tape, probe end first, into the well.

Once the meter beeps, carefully determine the water table level by gently raising and lowering the tape until you can determine at what point the water level meter first beeps. If beeper beeps constantly, turn down black sensitivity knob. Record the water table depth from notches on the top of the well. There will be a black line to indicate this. Be sure to write data in the correct location on the data sheet.

Using fingers to keep the tape from dragging across the well's edge, raise and guide the tape out of the well. At the same time, reroll the tape onto the spool while keeping the tape flat. Place the metal probe into the holster next to the handle. It is very important to keep the tape flat and to avoid dragging the tape across the well's edge – doing so will damage the wires inside the tape.

Turn off the beeper and lock the tape spool in place by turning the knob used to unlock the meter. Place the cap back on the well ***gently*** so that it can be easily removed the next time the well is used.

FACT: Cottonwood tree roots are typically only about 3 m (10 ft) deep! Think about how deep the water is at your site. Be sure to subtract the height of the well above ground!



Bosque Ecosystem Monitoring Program: **Monthly Monitoring**

Site Name:_____ Collection Date: _____

Data Collected by:_____

Comments:

Groundwater Monitoring

Well	Depth from top of well to water table	Comments
North		
East		
Center		
South		
West		
Nearby Ditch		

Precipitation Monitoring

Gauge	Net amount of precipitation (less oil)		Amount of oil added	Comments
Canopy	(mm)	(inches)		
Open	(mm)	(inches)		

Litterfall Collection

Tub	Collected?	Comments (note if tubs were moved, turned over, etc.)
A		
B		
C		
D		
E		
F		
G		
H		
I		
J		

White copy (original) to be turned in to: Kim Eichhorst, UNM, Department of Biology, Albuquerque, NM 87131
Yellow copy to be turned in to Site Representative
Pink copy to be retained in collector's files

Data entry: file:_____ entry by: _____ date:_____

BOSQUE ECOSYSTEM MONITORING PROGRAM

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BOSQUE PVC GROUND WATER MONITORING WELLS JRT June 02

I. Introduction

Shallow ground water (GW) wells are used in the bosque to monitor water table (WT) elevations and to provide representative water chemistry samples from the saturated zone. Networks of wells can be used to determine shallow subsurface flow paths and spatial and temporal biogeochemical characteristics of the GW.

The wells are composed of 2-inch internal diameter PVC pipe with a solid upper casing and an intake that intersects the WT. The intake is the screened segment of the well through which GW flows. In the shallow, mostly unconfined aquifers typical of the bosque research sites, the water level in the well is a good indicator of the depth to the water table (DWT).

Piezometers differ from monitoring wells in that they are constructed with a very short intake and are designed to measure hydraulic head from pressure head and elevation head. The water level in a piezometer generally does not give the direct position of the WT. Nested piezometers set at various depths are used to measure GW gradients and to construct flow nets. However, they are less suited for biogeochemical sampling than monitoring wells because the short intake restricts yield and represents a limited region of the saturated zone.

If possible, the well intake should be of sufficient length to encompass the range of expected WT elevations (Fig. 1). This may not be possible during flooding and high flows or during very dry periods with low flows.

The optimal time to install wells is during baseflow when low WT elevations facilitate hole boring in the bosque. Baseflow conditions depend of course on weather conditions, and vary in time and space along the Middle Rio Grande. We have observed low flows during:

1. April, when irrigation begins but prior to peak snowmelt runoff.
2. Late June, post snowmelt peak and prior to summer monsoon season.
3. Late September/early October, post monsoon season but before the end of irrigation season.

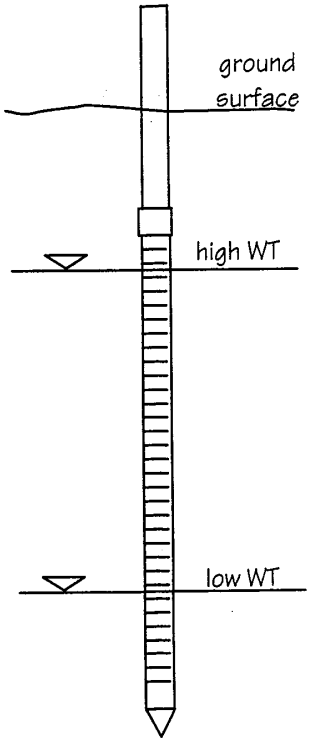

Figure 1. Intake screen should capture range in WT elevations if possible.

BOSQUE ECOSYSTEM MONITORING PROGRAM

Well Monitoring Directions

II. Supplies, Tools and Equipment

A. Supplies (available at Rodgers & Co., Inc., Isleta SE, ABQ--UNM POs accepted)

- PVC pipe--2" ID Sch 40, screened (0.01" or 10-slot, $30.30/10') for intake and solid ($5.60/10') for casing. Amount depends on DWT, flooding vs. non-flooding site, etc. Pipes come in various lengths, are sold by the foot, and come with male and female threaded ends. Solid pipe ends are also sold unthreaded, some with built-in coupling. Unthreaded solid pipes w/coupled joints are less likely to break during well insertion.
- 2" PVC drive points, male and female threaded ($7.50 ea) depending on your screened pipe ends. Slip-type points that are inserted into non-threaded screen pipe are also handy for cut lengths of screened PVC, but may not be available at Rodgers. 1/well.
- 2" slip couplers to join pipes as needed--depends on # of solid PVC ends w/built-in coupling, but slip couplers are handy for extending well lengths, etc. ($1.40 ea).
- 2" PVC well caps--slip type ($1.10 ea). 1/well. Locking types available, $15-20 each.
- PVC primer and cement for some joint connections, e.g. slip points w/cut screen pipe.
- Bentonite--to seal annular space near surface, sold in 50# bags ($7.40) as Hole- or Kwik-Plug. Go w/3/8" chips vs. pellets (costly) or powder. Enough for several wells.
- Silica sand--size 10-20 ($6.20/50# bag), for the well filter pack. Plan on ~ 1 bag/well.

B. Tools/Equipment

- Soil auger w/4" bucket and extensions, 2 adj. wrenches and strap wrench
- San Angelo rod w/spade end for breaking up roots, hard soils
- Steel rods for packing sand--1-2, 1 long enough to reach near depth of well if possible
- Fence post driver that fits over PVC pipe
- Sledgehammers--1 large (10-12-lb. head), one small (for packing rods, etc.)
- Sledgehammer blocks--~15" L 4"x4" blocks w/hole bored part way through that fits over the 2" PVC pipe (also bring pieces of 2x4 wood)
- Pipecutter--for ≥ 2" pipe
- 10 m graduated ½" PVC pole for measuring depths in bore hole
- Water level indicator (beeper)
- Tape measure (w/metric highly preferable)
- Well bailer
- Duct tape, hacksaw, large screwdriver, WD-40, pipewrench, shovel
- Spray paint--cans of gray and brown spray paint to camouflage wells as needed
- Compass (or GPS unit), 100 m tape, flagging, loppers, and bow saw for siting well locations
- Sediment sampling materials--Whirli-bags, dumping bin, trowel
- 5 gal bucket--for supplies and to stand on if necessary, e.g. starting the well driving

C. Misc--head protection (hard hats/goggles), work gloves, site keys & permits, fieldbook, pencil, calculator, black sharpie, drinking water, bug spray

Well Monitoring Directions

III. Well Installation

A. Bore Hole

- Auger down to WT, collecting sediment samples for texture analysis if desired. The seds should be sloppy-wet at the WT. If just damp you may have only reached the capillary fringe--keep digging.

- At the WT the hole will collapse and boring deeper will be limited. Use the auger to try to work (loosen) the seds at the WT and advance the hole as best you can (Fig. 2). This will facilitate driving in the well. Estimate DWT using the PVC rod or beeper.

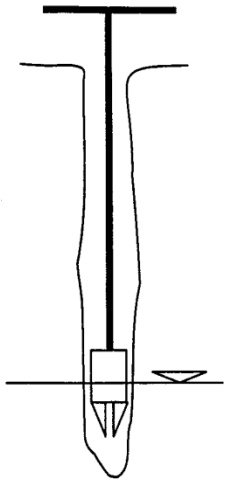

Figure 2. Work the seds with the auger to to advance the hole.

B. Assemble the Well

- Determine the intake length based on the DWT. Try to extend the well ~ 75 cm below the WT (more if WT is not near baseflow). The intake should end up ~ 25 cm below ground. So, cut the screened PVC to the DWT plus 50 cm (Fig. 3) It's best to use the pipecutter to ensure that connections are tight.

- Attach a drive point and a length of solid PVC for the casing to the intake screen. Use male/female or slip-type points and slip couplings as necessary. Use PVC primer and cement if necessary. The solid PVC should be long enough to cover the 25 cm below ground depth and to fit the fence post driver (150 cm is a good length).

- Now that the well is assembled, measure the effective screen length (Fig. 4), correcting for sections covered by couplings, etc. For example, a slip-type drive point inserted into a cut piece of screened PVC pipe will eliminate ~3.3 cm of intake.

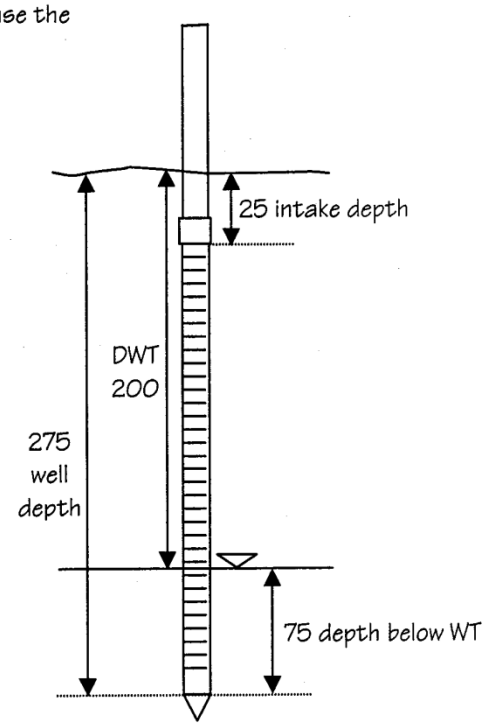

Figure 3. Determine intake length. For example, if DWT = 200 cm, cut 250 cm of screen length.

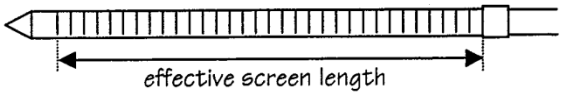

Figure 4. Measure effective screen length.

Well Monitoring Directions

- Measure the well from the bottom, marking the casing at convenient intervals (e.g. 10 cm, Fig. 5). Also mark the casing at the point at which the well driving should stop, i.e., ~25 cm above the intake.

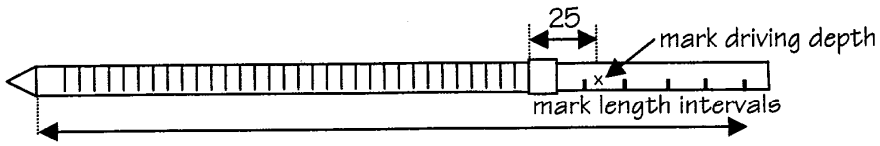

Figure 5. Mark length intervals and the endpoint on the casing before driving the well into the ground.

C. Insert the Well

- Drive the assembled well into the bored hole, working it in by hand as deep as possible.

- Cover the top of the well casing with a couple of strips of duct tape.

- Drive the well to the desired depth using the fence post driver or by placing a wood block atop the casing and striking it with the sledgehammer (the block will need to be held in place by a crewmember--wear your hard hat, goggles and gloves). The sledgehammer can also be used to advance the fence post driver if it becomes too difficult to advance by hand--use a 2x4 scrap atop the post driver. With either method, don't slam too hard or you risk shattering the well, particularly the intake. This is the main reason that it's best to install wells at baseflow, since the hole can be bored deeper and pounding the well is minimized. Hammering may require a bucket or stepladder to stand on.

- When the well is at the desired depth, record the depth to intake, e.g. 25 cm. If the well was driven to a point above or below the mark you made on the casing, compute the difference.

D. Pack the Well

- Temporarily cap the well.

- Fill the annular space around the well with the filter pack (silica sand). The filter pack enhances well yield and helps filter out fine materials that can accumulate in the well and clog the intake. Pour some sand, pack, and repeat as necessary (see next step).

Well Monitoring Directions

- Tamp the sand with steel rods (Fig. 6) to eliminate gaps and make a tight packing. Wiggle the well to help move sand down the borehole. Fill and pack to just above the coupling between the intake and the casing. The well should be packed tight, difficult to spin by hand.

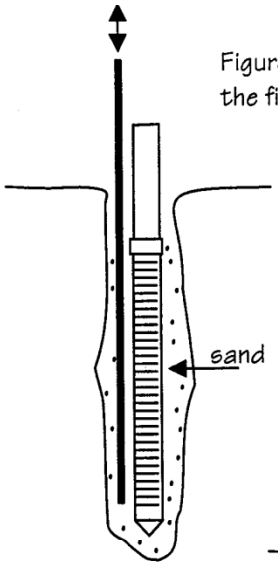

Figure 6. Tamp the filter pack.

- Next, fill and pack with some of the extracted bosque sediments to within ~ 10 cm of the ground surface, then add a thin layer (~2-3 cm thick) of bentonite around the casing (Fig. 7). Pour a couple of bailers' worth of water onto the bentonite and allow to soak in. Fill the remainder of the hole with more of the extracted sediments and pack tightly around the base of the well with a short blunt object, e.g. the end of a hammer or wrench. Don't use the long rod, which could trash your bentonite layer.

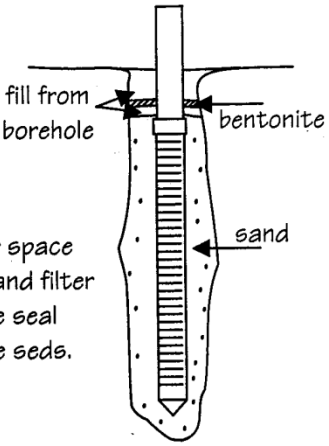

Figure 7. The annular space should include the sand filter pack and a bentonite seal sandwiched by native seds.

E. Well Specs

- Adjust the casing height to the desired length by cutting or extending with a coupler, e.g. ≤ 20 cm in non-flooding sites, above potential flood level in flooding sites. A pipecutter makes a more level cut than a hacksaw and eliminates PVC shavings.

- Cut 2 notches in the casing ~ ½" apart with a hacksaw (Fig. 8). This area serves as the tape position when beeping the well.

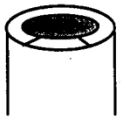

Figure 8. Cut two notches at top of casing to locate beeper tape.

- Label the well on the inside and outside of the casing.

- Beep the well. Measure the casing height, the distance from the base of the well at the ground surface to the rim at the top of the casing between the 2 notches. Calculate and record the well specs in your fieldbook (see next page). It is helpful to sketch the well and fill in some of these data, similar to Fig. 9, next page.

Well Monitoring Directions

- Effective screen length (measured before you installed well): _____
- Intake depth (determined before you packed the well): _____
- Casing height (CH): _____
- Total well length (TWL, measure from marked intervals on casing): _____
- Well depth (TWL - CH): _____
- Beep: _____
- DWT (beep - CH): _____
- Depth below WT (TWL - beep): _____

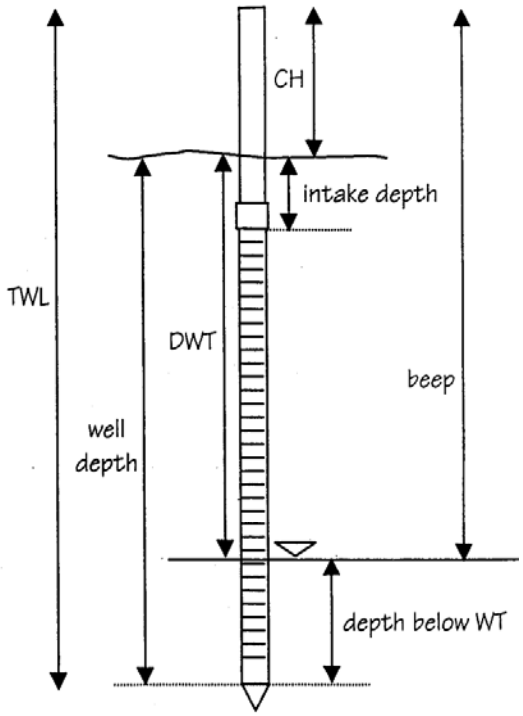

Figure 9. Well specs.

- Other info that might be useful to hydrogeology types:

-Auger/borehole diam.: 10 cm (4")
-Intake diam.: 5 cm (2")
-Casing diam.: 5 cm (2")
-Screen slot size: 0.25 mm (0.01")
-Filter pack: 10-20 mesh silica sand
-Surface seal: 3/8" bentonite chips

F. Work the Well

- Wells should be worked extensively after they are installed to clear fine materials and leach solvents if used (PVC cement).

- Elevate and drop the bailer several times to flush fines, etc. out of the well and filter pack annular space. Also bail the well several times. Cap the well LOOSELY.

- Wells should be worked regularly, especially prior to GW sampling.

- Make the well inconspicuous if it is in area susceptible to vandalism. Dry off the well casing and apply a coating of gray spray paint, then a few splotches of brown spray paint. Try to hide the well with branches, leaves, etc.