Mr. Mike Whitney
Newell County Water District
405 5th Street
Tulelake, CA 96134

Our ref: 8410996-05

Subject: Recommendations For Increasing Pumping Capacity of Well 1, Newell County Water District

Dear Mr. Whitney,

This letter outlines GHD's recommendations for addressing groundwater production concerns of the Newell County Water District (Newell CWD). GHD had discussions about the issues with the Newell CWD. During these telephone conversations Newell CWD provided information regarding a decrease in flow rates which coincided with a decrease in static water elevation. This letter focuses on groundwater production from Well 1. Newell CWD also provided GHD with a copy of the well construction log for Well 1 and a cost estimate for a new pump and motor, which is attached to this letter for reference. Both of these are attached to this letter for reference. Based on the water elevations and other information provided during discussions with the District, GHD has concluded that the low pumping flow rate could be the result of one or more of the following conditions:

1) Potential Root Cause Conditions:

   a) The existing pump is not designed to operate at the higher pressure required to lift water from deeper depths
   b) The existing pump has been damaged by sand erosion, corrosion or other wear
   c) The depth of the well is not sufficient
   d) The well has become clogged due to fouling or corrosion

Based on the information provided, Conditions a) or b) are the most likely root causes. It appears that the existing pump cannot provide enough pressure to maintain the flow rate of groundwater into the distribution system. This change in function of the pump in Well 1 is due either to pump wear or the decreasing static water elevation in the groundwater basin. Neither Condition c) or d) can be eliminated as a root cause based on available information. However, Conditions c) and d) are far more expensive to remedy and therefore Conditions a) and b) should be addressed first. The recommendations provided in this letter address all four of the potential causes listed above.

Another problem which was discussed with the District is the potential overdraft of the regional aquifer by the operation of other wells in the basin. This pumping could result in depletion of the groundwater resource. GHD has not been engaged to address this complex issue.

This letter is specific to Well 1 and provides a summary of the construction information available for Well 1 along with recommendations to provide the Newell CWD with a specific path towards restoring the production capacity of Well 1 under Conditions a) and/or b). The recommendations also include developing the information required to evaluate options under Conditions c) and d). The recommendations are provided in detail with the goal of providing the Newell CWD with the basis for developing a request for grant or loan to implement these required improvements.

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Well Construction

The available well log of Well 1 is lacking in detail. Key information is missing that would assist in evaluating the well. Assumptions have been made by GHD relative to the construction of Well 1 based on experience with typical methods of construction. In the recommendations are tasks associated with resolving these well construction unknowns. The bottom of the well could be either 211 feet or 265 feet below ground surface (bgs). It is assumed that the well is 211 feet deep. The perforations in the well casing are not specified. It is assumed that the steel casing was installed and then perforated by machine after installation. Below are key features of the well as they are shown on the well log or assumed by GHD:

1) Boring construction
   a) Boring was installed by cable tool
   b) 0 to 211 drilled to 16 inch diameter
   c) 211 to 320 drilled at 12 inch diameter.
   d) It is assumed that the lower interval of the boring from 211 to 320 feet was backfilled.

2) Seal and gravel pack:
   a) Cement seal 0 to 50 ft
   b) Pea gravel 50 to 191 ft
   c) Cement seal 191 to 211 ft

3) Well casing
   a) Well is made with corrodible steel well materials
   b) Well is assumed to be machine perforated after installation. This method is susceptible to sand production

4) Pump and flow rate
   a) Pump and motor not specified
   b) Pump intake depth not specified

Recommendations

GHD is recommending that the existing pump be replaced or repaired such that it can operate over a wider range of water elevations and that the condition of the well be assessed prior to additional investment in pumping equipment. The first task in this process is to verify the condition of the existing pump and measure the production of sand. The second task is to remove the existing pump and inspect the condition of both the pump and the well. The third task is to repair the well if needed. The fourth task is to replace/repair the pump as needed. Task 1 can be performed by the District at little cost. Tasks 2, 3 and 4 will require the services of a groundwater pump contractor and groundwater consultant. These tasks are further outlined below:

Task 1 – Access the Condition of the Existing Pump

Much of this task can be completed by Newell CWD. Compile historic water level measurements at the well with the pump off and pump on with notation regarding the flow rate. Then perform the pumping test described below to evaluate if the existing pump has been damaged by sand erosion or other causes. Evaluating sand production is important so that repairs can be made to the well to reduce sand production so that the same problem does not occur with the repaired/replaced pump. GHD recommends that the Newell CWD perform the following pumping test after the well has been off for at least 24 hours and at a time when there is little pumping from other nearby wells.

1) Operate the pump for a total of four hours and measure the following immediately prior to pump start, then again at 2 hours and 4 hours of pumping:
   a) Well head distribution pipe pressure (convert units of psi into units of feet of water pressure)
   b) Water level in the well (measured in feet below well head distribution pipe)
   c) Flow rate (gpm), and
   d) Sand content (ppm), retain sand samples.

2) Obtain a copy of the pump curve for the existing pump and verify that the pumping flow rate (gpm) and total dynamic head fall (feet water pressure) on the original pump curve. Note: to calculate total dynamic head add "well head distribution pipe pressure (units of feet water pressure)" and "water level in the well". Determine if the existing pump is operating at the same flow and pressure capacity as when it was originally manufactured. Determine if the existing pump is appropriate for the lower water elevations which are currently present in the basin.

3) Identify a groundwater pump contractor who can provide a pump that will operate at both the currently depressed water elevation and at the higher water elevations which may be present once this drought has ended. This may require the purchase and installation of a Variable Frequency Drive (VFD) control system on the pump motor.

4) Evaluate funding sources and rough costs to replace the existing pump and motor and add a VFD if required.

Task 2 – Remove Pump and Assess Condition of Well

This task will require the services of a well pump contractor and a groundwater consultant. During the removal and repair/replacement of the pump a well video should be taken to assist in evaluating the condition of the well.

1) During the removal of the pump ensure that the following are completed:
   a) Corrosion and wear inspection of the pump and column pipe,
   b) Verify the make / model of the pump to confirm the data used in Task 1
   c) Measure the depth to the intake of the existing pump relative the top of the well casing

2) Perform a video of the well which includes the following:
   a) Video through clear water for accurate viewing of the well condition
   b) Video equipment with down hole and side scan capabilities
   c) Real-time interpretation by the operator (audio comments)
   d) Video to the entire depth of the well with side scan at a minimum of every 10 feet and at all joints
   e) Detailed side scan at the depth where the pump intake was located to identify sand erosion

3) Prepare a revised well log which provides the well construction details that are not provided in the original log. This revised well log should include at a minimum:
   a) Screened interval
   b) Density and width of perforations
   c) Condition of perforations
   d) Depth of well
   e) Well construction materials
   f) Location of well sections in need of repair

4) Evaluate the production potential of the well and verify that the pump choice made in Task 1 is still valid.

Task 3 – Repair Well if Needed

This task will require the services of a well pump contractor and a groundwater consultant. If the assessment of the well indicates damage from sand intrusion then the well should be repaired prior to the installation of the repaired or replacement pump. Repair of a section of a well that has been damaged is often done by installing a swage. This is a 5 to 10 foot long cylinder of thin metal that is slightly smaller in diameter than the well casing. The swage is slid down inside the well casing to cover the location of the damage then a tool is used to expand the thin metal into the area of the well damage. This blocks flow from the section of the well which has the damage. The disadvantage of the swage is that the inside diameter of the repaired section of well is now reduced and the pump may not fit past this repaired section of well. Below are typical tasks which are associated with the repair of a well:

1) Well repair design
   a) Evaluate if the well can be repaired without unacceptable risk of well failure: Corrosion in older wells can often complicate repair because the undamaged casing may fail when disturbed by the repair process,
   b) Options should be evaluated for replacing the lost capacity in the event that the well fails during repair.
   c) Recalculate the expected pumping rate from the well
   d) Redesign the pump intake location such that it is not across a section of well screen

2) Well repair completion
   a) Hire well pump or well drilling company to complete the repair
   b) Re-video the well after the work to verify that no other damage occurred

3) The total depth of the well should also be evaluated to determine if the well is deep enough to be a viable source of groundwater in the future.

Task 4 –Install Repaired/Replaced Pump

This task will require the services of a well pump contractor and a groundwater consultant. The evaluation of repairing or replacing the pump should consider that the seasonal change in groundwater elevation may be greater now that more pumping by others is occurring in the groundwater basin. Because of this, the pump needs to have a pump curve which can accommodate a greater range of pressure without significantly affecting the rate at which water is pumped. Below are tasks associated with the selection and installation of a repaired or replaced pump:

1) Select repair or replacement of pump
   a) Evaluate if existing pump can be repaired
   b) Evaluate the pump curve of the exiting pump to verify that it can perform under the expected range of pressure
   c) Evaluate the cost and availability of a new pump and motor which meets the pressure range and flow requirements.
   d) Evaluate the cost and suitability of a VFD power system to increase the operating range of the pump.

2) Install repaired or replacement pump and motor

a) The column pipe will likely need to be replace to match the pump, motor and new position of pump intake
b) The pump intake should be located in a unscreened section of the well to avoid excessive water velocity through screen

The recommendations provided in Task 1 can be effectively completed by the Newell CWD. With this information available, accurate costs can be estimated for Tasks 2, 3 and 4. GHD appreciates the opportunity to assist the Newell CWD with this project. Should you have questions please contact the undersigned.

Sincerely

Rebecca Crow
GHD Inc
707.267.2244

Attachments

Replacement Pump Cost Estimate
Well 1 Well Log

Klamath Pump Center, Inc
4000 Hwy 39
Klamath Falls, OR 97603
CCB# 96655

Estimate

Date	Estimate #
11/26/2014	[illegible]

Name / Address
Newell Water District 405 Fifth St Tulelake, CA 96134

Project

Description	Qty	Rate	Total
10LC American Marsh Pump Stages	2	503.10	1,006.20
1.250 x 5' Tube	1	106.60	106.60
1.25 x 10' Tube	19	195.00	3,705.00
Barstock	1	449.50	449.50
1 1/4" Line Shaft Couplings	21	102.70	2,156.70
Retainer Assembly	3	54.60	163.80
Spider Inserts	15	10.40	156.00
US VMS WP-1 NRR Premium Efficient Motor	1	6,354.40	6,354.40
Labor to pull existing pump	8	150.00	1,200.00
Shop Labor to add stages	4	65.00	260.00
Labor to reinstall pump	8	150.00	1,200.00

Subtotal	$16,758.00
Sales Tax (7.75%)	$1,092.00
Total	$17,850.00

Est. Panel
$2,500

DUPLICATE
Driller's Copy
Page ..... of .....
Owner's Well No. ______

STATE OF CALIFORNIA
WELL COMPLETION REPORT
Refer to Instruction Pamphlet
No. 502820

DWR USE ONLY — DO NOT FILL IN
STATE WELL NO./STATION NO.
LATITUDE | LONGITUDE
APN/TRS/OTHER

Date Work Began 2/12/97, Ended 3/30/97
Local Permit Agency Modoc County Health Dept.
Permit No. 97-01 Permit Date 1-29-97

GEOLOGIC LOG

ORIENTATION (✓) X VERTICAL ___ HORIZONTAL ___ ANGLE ___ (SPECIFY)
DEPTH TO FIRST WATER 60' (Ft.) BELOW SURFACE

DEPTH FROM SURFACE Ft.	to Ft.	DESCRIPTION (Describe material, grain size, color, etc.)
0	33	Loose pack sand
33	43	Gray sandstone
43	50	Sand, pumice, yellow clay
50	60	Loose gray sand
60	105	Layers loose sand & pumice
105	136	Soft gray sandstone
136	208	Soft gray sandstone
208	212	Bubbly gray lava
212	215	Gray sandstone/layers of lava
[illegible]	220	Gray bubbly lava
[illegible]	250	Layers hard sandstone & lava
[illegible]	265	Gray lava
[illegible]	281	Layers sandstone, soft and hard
[illegible]	297	Gray&green clay with seams of sand
[illegible]	325	Layers clay and a white pumice
		Bottom 5' smells strong

TOTAL DEPTH OF BORING 325 (Feet)
TOTAL DEPTH OF COMPLETED WELL 265 (Feet)

WELL OWNER

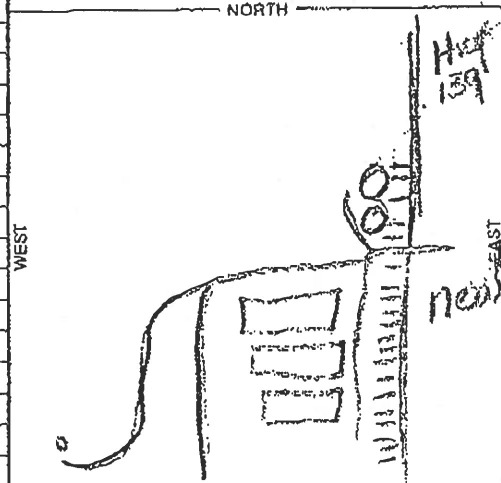
Name Newell County Water Dist.
Mailing Address Rt. 2, Box 42
Tulelake CA 96134
CITY STATE ZIP

WELL LOCATION

Address ______
City ______
County Modoc
APN Book ___ Page ___ Parcel 34
Township 47N Range 5E Section 27
Latitude ___ DEG. MIN. SEC. NORTH Longitude ___ DEG. MIN. SEC. WEST

LOCATION SKETCH

NORTH



WEST EAST
SOUTH

Illustrate or Describe Distance of Well from Landmarks such as Roads, Buildings, Fences, Rivers, etc.
PLEASE BE ACCURATE & COMPLETE.

ACTIVITY (✓)
X NEW WELL
MODIFICATION/REPAIR
___ Deepen
___ Other (Specify)
DESTROY (Describe Procedures and Materials Under "GEOLOGIC LOG")

PLANNED USE(S) (✓)
___ MONITORING
WATER SUPPLY
___ Domestic
X Public
___ Irrigation
___ Industrial
___ "TEST WELL"
___ CATHODIC PROTECTION
___ OTHER (Specify)

DRILLING METHOD cable FLUID water

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH OF STATIC WATER LEVEL 60' (Ft.) & DATE MEASURED 3/29/97
ESTIMATED YIELD* 500 (GPM) & TEST TYPE pump
TEST LENGTH 5 (Hrs.) TOTAL DRAWDOWN 135 (Ft.)
** May not be representative of a well's long-term yield.*

CASING(S)

DEPTH FROM SURFACE Ft.	to Ft.	BORE-HOLE DIA. (Inches)	BLANK	SCREEN	CON-DUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
0	211	16	x				A53B	12¼	.250	
211	320	12								

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft.	to Ft.	CE-MENT (✓)	BEN-TONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
0	50	x			
50	191			x	pea gravel
191	211	x			

ATTACHMENTS (✓)

___ Geologic Log
___ Well Construction Diagram
___ Geophysical Log(s)
___ Soil/Water Chemical Analyses
___ Other ______

ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.

NAME Larry G. DeSpain
(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)

3114 Boardman Ave Klamath Falls Or 97603
ADDRESS CITY STATE ZIP

Signed Larry G. DeSpain 4/2/97 [illegible]
WELL DRILLER/AUTHORIZED REPRESENTATIVE DATE SIGNED C-57 LICENSE NUMBER

DWR 188 REV. 7-90

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM