

# **Nevada Well Construction Regulations**

**Well Modifications to Improve Quality & Quantity**

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# Nevada Well Construction Regulations

**1. WELL DEVELOPMENT**

**1. WELL PERFORMANCE**

**1. WELL REHABILITATION**

**1. WELL ABANDONMENT**



# Well Development - Objective

## How to maximize Specific Capacity:

1. Dislodge and remove fine-grained material from the annular space
2. Compaction of filter pack (gravel or sand)
3. Remove drilling fluids from the annular space
4. Pump a sufficient volume of water to ensure water quality criteria have been met (typically 3 well volumes)

<b>Parameter</b>	<b>Stabilization Criteria</b>
pH	Difference of $\pm 0.2$
specific electric conductance	Difference of $\pm 3\%$
temperature	Difference of $\pm 0.5$ °C
turbidity	$\pm 10\%$ (when turbidity is greater than 10 NTUs)
oxidation -reduction potential (ORP)	$\pm 20$ millivolts
dissolved oxygen (DO)	10% or $\pm 0.2$ mg/L, whichever is greater

# Well Development Methods

1. **Pumping:** Pumping water at discrete intervals until a specific water quality or quantity criteria is met.
1. **Surging:** Forcibly moving water through the screened interval in an attempt to flush fine grained particles from the annulus and settle the gravel pack. Flushing action is accomplished with a surge block.
1. **Jetting:** High velocity washing of discrete intervals in an attempt to agitate and rearrange the sand and gravel particles in the annular space.
1. **Additives:** *Approved* chemicals added to the well water that break down drill muds and clays making them available for removal.

# Well Performance

Required initial well information to determine well performance:

- Well depth
- Static water
- Pumping water level
- Pumping rate
- Pumping sand content
- Well specific capacity
- Impact from nearby wells

*How WAS the well performing*



# Well Performance – Preventable Problems

Poor well performance can be prevented by paying attention to these well design criteria:

1. Site location

- Proximity to contamination or potential contamination:

**NAC 445A.66865**

- (a) Within 50 feet of a gravity sanitary sewer or gravity storm sewer; or
- (b) Within 150 feet of a wastewater force main, wastewater lift station, septic tank or absorption field, or any other source of pollution or contamination.
- Proximity to sensitive receptors - Surface water, wetlands, etc...
- Proximity to other wells
- Well security – damage, locks, etc...

# Well Performance – Preventable Problems

Poor well performance can be prevented by paying attention to these well design criteria:

## 2. Well Design

- Screened interval – **Appropriate aquifer**
- Screen type
- Proper casing length
- Depth

## 3. Casing Material - **Discussed earlier**

- Strength
- Reactivity

## 4. Well Development – **To be discussed further**





# Causes of Poor Well Performance

- **Scaling / Encrustation** – The precipitation and accumulation of dissolved minerals from the water on to the well casing and screen.
- **Biofouling** – Clogging of the wells screen and casing by a community of microorganisms.
- **Physical Plugging** – Physical obstructions in the well or annular space that prohibit flow.
- **Corrosion** – Deterioration of the well material.

**Important to video the inside of the well to identify and fully understand the extent of the problem.**

# Scaling/Incrustation

**Cause:** Geochemistry - DO, pH, Hydrogen Sulfide ( $H_2S$ ), TDS,  $CO_2$ , Chloride, Temperature, Calcium Carbonate ( $CaCO_3$ )

**Fix:**

- Chemical additives
- Mechanical agitation by surging
- Water jetting
- Scrubbing
- Air sparging – *air injection*
- Pumping



# Biofouling

**Cause:** Chemicals from soil, gas or well materials react with introduced or indigenous bacteria that cause colonies to flourish inside the well and annular space

**Fix:**

- Mechanical agitation by surging, water jetting, scrubbing, or air sparging the well bore.
- Acidification to solubilize minerals as well as the polysaccharide portion of biological slimes. Flushing to remove suspended or soluble debris that have been physically removed by mechanical agitation.
- The use of bactericides to suppress bacterial populations.



**Note: special care must be taken in contaminated sites to not induce unwanted reactions or microbial kills.**

# Physical Plugging

**Cause:** Object enters well or annular space that prohibits flow or prevents pumping

**Fix:**

- Physical removal
- Chemical dissolution
- Removal by drilling
- Segregation/partial abandonment
- Over drilling
- Abandon and replace



# Corrosion

**Cause:** reaction between minerals in the water reacts with the casing material causing the material to deteriorate:

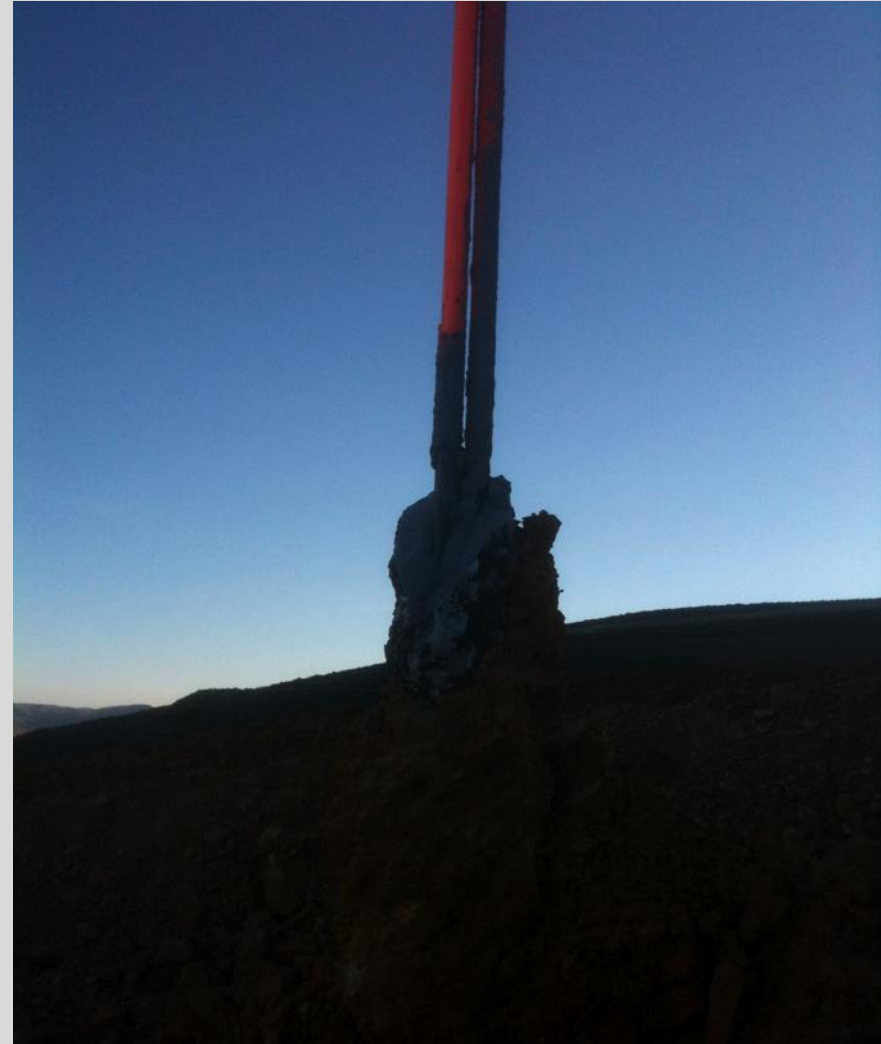
**Fix:**

- Casing sleeve
- Grouting and Re-drilling existing well



# Well Rehabilitation

- Mechanical agitation by surging
- Water jetting
- Scrubbing
- Physical removal
- Chemical treatment
- Removal by drilling
- Abandon and replace
- Over drilling
- Air sparging – *air injection*
- Pumping
- **Casing Sleeve**
- **Deepening**
- Grouting and Re-drilling existing well



# Well Abandonment – Options

- Pull Casing
- Over Drill
- **Plug**



# Well Abandonment – General Requirements

## NAC 534.420 Plugging of well: General Requirements

NRS 534.420, 534.110 – **Abbreviated**

1. **Notice of Intent (NOI)** – 3 working days prior to drilling
2. Notify the Division not less than 24 hours before abandonment
3. Obtain well logs
4. Must remove Pump & Break casing free if possible
5. **Casing:**
  - a) If it breaks free – Pull casing and abandon from bottom up
  - b) If it doesn't break free – Perforate the casing to 50 feet above groundwater surface. Perforations in wells less than 8 inches must not be less than 4 times for each 2 linear feet. If greater than 8 inches, the well driller shall then plug the well from the total depth of the well *with neat cement, cement grout, bentonite chips or bentonite grout containing not less than 20 percent sodium bentonite by weight of water (abandonment material)* to 50 feet above the uppermost saturated groundwater stratum or to within 20 feet of the surface of the well.



# Well Abandonment – General Requirements

## NAC 534.420 Plugging of well: General Requirements

### Continued: NRS 534.420, 534.110 – **Abbreviated**

If the *abandonment material* is not brought to within 50 feet above the uppermost saturated groundwater stratum or to within 20 feet of the surface of the well, the well driller shall:

(1) Measure the depth of the top of the lower plug with the appropriate equipment after he or she has allowed sufficient time for the lower plug to set up; - *Measure depth to plug after settling*

(2) Continue to install abandonment material until the top of the lower plug remains at least 50 feet above the top of the uppermost saturated groundwater stratum; and – *Get the abandonment material 50 feet above the water level*

(3) Install uncontaminated fill material or one of the plugging materials described in subsection 3 of NAC 534.4371 (*Boreholes: Plugging Requirements*) from the top of the lower plug to within 20 feet of the surface of the well. – *Approved (uncontaminated) fill material can be used between 50 feet above the water table to 20 feet from surface*

# Well Abandonment – General Requirements

## NAC 534.420 Plugging of well: General Requirements

Continued: NRS 534.420, 534.110) – **Abbreviated**

6. The well driller shall place a surface plug in the well consisting of neat cement, cement grout or concrete grout from a depth of at least 20 feet to the surface of the well.

7. If the well casing does not break free and there is no evidence of a sanitary seal around the well casing, the well driller shall, in addition to the requirements of subsection 5, perforate the upper 50 feet of casing before setting the surface plug. The casing must have at least four perforations per each 2 linear feet of casing, and the surface plug must consist of neat cement and must extend from 50 feet below ground level to the surface of the well. – *The upper casing can also be perforated to ensure surface seal*

# Well Abandonment – General Requirements

## NAC 534.420 Plugging of well: General Requirements

Continued: NRS 534.420, 534.110) – **Abbreviated**

8. If there is evidence that water-bearing formations of different water quality or hydraulic head were encountered during the original well construction and the well casing does not break free, and if bentonite chips are used as the plugging material, the well driller must, in addition to the requirements of this section, perforate the casing, as needed, and place neat cement across each confining formation so that the plugging fluid penetrates the annular space and the geologic formation in that interval. – *Each hydrologic unit must be sealed from each other*

9. If the well casing does not break free and there is no well log available, the well driller must plug the well in accordance with paragraph (b) of subsection 5, except that bentonite chips must not be used as the plugging material, so that the plugging fluid penetrates the annular space and the geologic formation in the perforated intervals. – *Perforate as above*

# Well Abandonment – General Requirements

## NAC 534.420 Plugging of well: General Requirements

**Continued:** NRS 534.420, 534.110 – **Abbreviated**

10. A well driller shall submit a log and record of work to the Division within 30 days after a water well has been plugged. The log and record of work must contain the location of the well by public land survey and county assessor's parcel number, the name of the owner of the well, the condition of the well, the static water level before plugging and a detailed description of the method of plugging, including, but not limited to:

- (a) The depth of the well;
- (b) The depth to which the materials used to plug the well were placed;
- (c) The type, size and location of the perforations which were made in the casing;
- (d) The debris encountered in, milled out of or retrieved from the well; and
- (e) The materials used to plug the well.

*Create a record of what you did and submit it to the state*

# Well Abandonment – General Requirements

## NAC 534.420 Plugging of well: General Requirements

Continued: NRS 534.420, 534.110) – **Abbreviated**

11. If there is any standing liquid in the interval of the well bore that is being plugged, all grout materials used pursuant to this section must be placed by tremie pipe in an upward direction. – **If there is standing water, grout from bottom up with a trimmie pipe**

12. If sodium bentonite chips or pellets are placed in the well, the chips or pellets must be placed in such a manner that a bridge does not occur. If bentonite chips are poured in standing water, the bentonite chips must be screened to eliminate the fines. – **If there is standing water, & you are using bentonite chips, avoid bridging and screen the chips to eliminate fines**

# Well Abandonment – Use of Exceptional Method

## NAC 534.420 Plugging of well: General Requirements Continued: NRS 534.420, 534.110 – **Abbreviated**

1. A well driller who wishes to plug a well in a manner that does not comply with the provisions set forth in NAC 534.420 must request approval from the Division. – **Ask for permission from the Division**
2. If the Division authorizes the well driller to plug the well in a manner other than the manner set forth in NAC 534.420, the well driller shall comply with the instructions he or she receives from the Division, if any, relating to the manner in which the well must be plugged. – **Use the agreed upon method**

(Added to NAC by St. Engineer, eff. 12-30-97; A by R009-06, 6-1-2006; R039-12, 6-29-2012)

# Well Abandonment - Bentonite Grout

## **NAC 534.438 Prerequisites to using bentonite grout to seal, grout or plug borehole. NRS 534.020, 534.110**

Before using bentonite grout to seal, grout or plug a borehole, the responsible project geologist, hydrologist or engineer using the bentonite grout must:

1. Consider the geology encountered in the borehole and any requirements set forth in this chapter or chapter 534 of NRS in his or her selection of the bentonite grout;
2. Mix the bentonite grout and place the bentonite grout in accordance with specifications recommended by the manufacturer; and
3. Place additional cement plugs as necessary, across low permeability geologic formations encountered in the borehole, to ensure that no water can move vertically in the borehole.

*Grout should be appropriate to seal the native material*

# Well Abandonment – Responsible Parties

**NAC 534.420 Boreholes: Responsibility for plugging.**  
NRS 534.020, 534.110) The owner and lessor of the land on which a borehole is located, the operator of the exploration project and the plugging contractor for the project are jointly and severally responsible for the plugging of the borehole pursuant to this chapter.

(Added to NAC by St. Engineer, eff. 12-30-1997)

***EVERYONE INVOLVED***



# Well Abandonment – Special Circumstances

**NAC 534.426 – *Artesian***

**NAC 534.427 – *No permit, Well damaged, No legal use***

**NAC 534.432 – *Well is noncompliant***

# Well Abandonment - Waiver

**NAC 534.449 Waiver of requirement to plug well.  
(NRS34.020, 534.060, 534.110) – Highly Abbreviated**

1. Apply for and receive a 1 year waiver from the State Engineer. This can be extended for 1 year if it doesn't expire if it doesn't expire.
2. Waiver requests must be:
  - 1) On the State Engineer form;
  - 2) Include information about the good condition of the well;
  - 3) Notarized form indicating who is responsible for abandonment (private = land owner/company rep; Public = land manager)

# Discussion







