Other chronic losses are associated with leakage through the concrete bottoms of the holding tank and water troughs as well as from leaks associated with interconnecting pipe fittings and valves. Infrastructure at the well 10A-5-W06 location was 45 years old in 2000 when last used significantly for livestock watering purposes. To reduce excessive leakage, the Defendants have replaced or repaired the concrete bottom of two tanks, three times in the past ten years. The Defendants removed one water drinker in 2007 to mitigate these kinds of losses (Figure 23). Despite Tom Cox testimony that he didn't recall any leaks (Cox Dep. 75:14-20), Figure 24 shows at least seven leak repairs in this drinker as well as corrosion failure at the base.

Figure 23 – Removal of Leaking Drinker

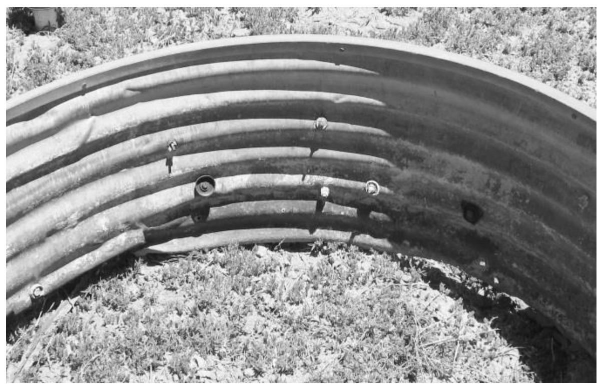

Figure 24 – Prior Repairs to Drinker

Evidence of previous leaks and repairs is readily observable at the well site; Figures 25 and 26 represent examples. Failure of the concrete is associated with freeze-thaw cycling, frost heave and weathering of the concrete itself. The main holding tank is known to be a significant and unmitigated source of leakage as evidenced by standing water below ground level in the main storage tank valve box, Figure 27. Valve stem packing failure and aging piping and fittings contribute smaller amounts to the chronic leakage total as well.

Figure 25 – Storage Tank Leak

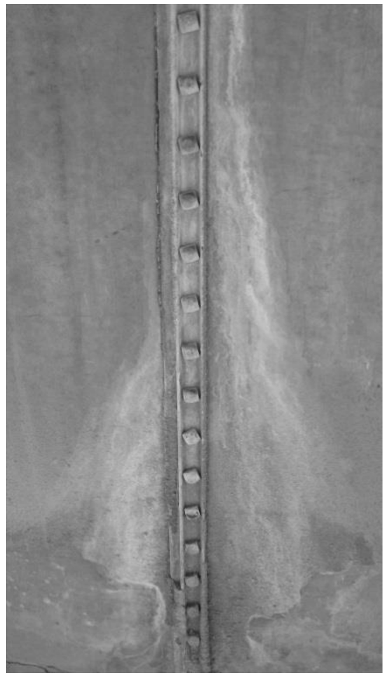

Figure 26 – Seam Leak

Figure 27 - Water in Valve Box

The cumulative effect of chronic leaks for the well 10A-5-W06 infrastructure can be determined by observing the rate of water level drop in the 10-foot tall, main holding tank. Based on my observation, the water level drops approximately one foot per week. Subtracting evaporation and wildlife usage, the system leakage rate appears to be at least 0.1 gpm. The historic annual loss of water due to chronic leaks is projected to have been 52,560 gallons.

Although the leaks are likely to be distributed throughout the entire water delivery and storage system, this annual loss is the equivalent of leakage through a single, 0.05-inch diameter hole in the bottom of the main holding tank at 10 feet of pressure head. Chronic leakage associated with water delivery systems is reported by the cattle industry and is not unique to the subject infrastructure. A study of water use in feedyards found that 7% of total water delivered to troughs was lost through threaded fittings alone (Parker, 2000). The annual leakage of 52,560 gallons per year calculated above is similar in magnitude to the 57,106 gallon loss that can be calculated by applying a 7% loss rate to the 815,802 gallons of water consumed each year as determined in Section 5.5.

Another significant loss was associated with the removal of ice from the drinkers during the winter months. Based on testimony, the drinkers serviced by well 10A-5-W06 would ice over, generally from mid-December until the first of March. Daily average temperatures are at or below freezing from December 7 through February 1 (Intellicast, 2016); cold air accumulates at the well location and air temperature is frequently sub-zero on winter mornings (see Figures 28 and 29).

Figure 28 – Ice Covered Drinker at -7 °F

Figure 29 – Ice Covered Float Tank at - 15 °F

Cattle require water daily and sub-freezing winter temperatures demand that active measures be taken to remove ice cover. The well location would be visited every other day (Cox Dep. 64:23-65:13); the ice would be broken up with an axe and thrown out (Cox Dep. 66:3-16). To account for this loss, it is estimated that the combined, average thickness of ice and water removed from the two drinkers was four inches and that the well location was visited every other day, mid-December until March, for ice removal purposes. The volumetric loss is determined to have been 6,917 gallons per year.

A further water loss can be assigned to accident-related spills. The author has experienced seven major accidental spills over the past ten years, resulting in an average loss of approximately 15,000 gallons of water per event. Three spills were associated with the pan float in the regulating tank, two by freeze failure of the pan float and one attributed to an elk decoupling the pan float from the float valve lever. Two additional accident-related spills were associated with windmill component failures that allowed the windmill to pump water unabated for an extended period of time, spilling water out the holding tank overflow outlet. Of these, one spill resulted from a vane spring failure and the other resulted from the failure of the furl cable. Two additional spills resulted from freeze-related longitudinal failure of piping, one being a failure of the well stand pipe and another being a failure of an undrained syphon inserted into the main holding tank. In the case of failure of the well stand pipe, iron bacteria had partially clogged the weep hole and, coupled with sub-zero temperatures, led to failure of the stand pipe.

To account for these types of unforeseen events, it is assumed that an average of 15,000 gallons of water was lost in association with accidental spills at a frequency of 0.7 per year. The resulting historic loss is calculated to have averaged 10,500 gallons per year.

<u>Environmental Losses</u>: Two types of environmental losses of water are of interest, evaporation and infiltration. Evaporation is associated with temperature, humidity, solar radiation and wind, and is offset, in part, by rainfall. Pan evaporation measurement data has been compiled for the region including the Gallup Ranger Station (annual average of 62.46 inches per year) and Laguna (annual average of 63.23 inches per year), both of which appear representative of local conditions (WRCC, 2005). As such, a pan evaporation loss of approximately 63 inches per year appears appropriate for the Zuni River Basin.

The pan evaporation data were collected using "Class A" evaporation pans, most of which were installed above ground allowing heating of the side walls and heat exchange with the pan material. Since these containers and their placement are similar to that associated with the drinkers and troughs at the location of well 10A-5-W06, no adjustment of the measured evaporation rate is required as would otherwise be the case for water impounded in livestock ponds. The pan evaporation rate should be reduced by approximately 14 inches per year to account for historic rainfall at Fence Lake, NM (WRCC, 2010). As such, the net evaporation rate for the location of well 10A-5-W06 is 49 inches per year.

Evaporation-related losses are also a function of the surface area associated with the water delivery system. Evidence of at least six open tanks and drinkers exists in association with the well with a combined surface area of approximately 291 square feet (Table 1). The historic evaporation-related loss is therefore projected to have been 8,904 gallons per year. Although the float tank is partially covered as shown in Figure 30, this heavy steel plate does not impede evaporation from the surface of the water contained therein nor does it inhibit livestock use, see Figure 31. This fact contradicts testimony provided by Tom Cox (Cox Dep. 47:3-11).

Figure 30 – Float Tank with Lid

Figure 31 – Cow Drinking from Float Tank

As previously discussed, there is no evidence that water from well 10A-5-W06 was diverted to a livestock pond. The Soil Conservation Service (SCS) classifies the valley soil as Hickman-Catman complex; the Hickman soil is not suitable for livestock ponds because of seepage (SCS, 1993). As such there is no historic evaporative loss or infiltration loss associated with impounded water at the well location.

<u>Wildlife Losses</u>: Wildlife make significant use of well 10A-5-W06 as documented through more than 100,000 images captured on game cameras during the past five years. Based on site-specific observations, the largest water consumers by frequency and consumption are mule deer and elk (see Figures 32 and 33). When available, mule deer and elk make good use of distributed water associated with rain and snow-melt that collects in plunge pools and tinajas in and around Rincon Hondo Canyon.

Figure 32 – Mule Deer at Well 10A-5-W06 (Note Residual Ice)

Figure 33 – Cow Elk at Well 10A-5-W06

Based on game camera observations, the resident population of mule deer is approximately 15 individual animals sharing a home range that includes the subject well. The visitation frequency averages twice per day, 75% of the days per year, predominantly during spring, summer and fall. The population appears stable and is controlled by local predators including mountain lion, black bear, coyote, bob cat and golden eagle (author's observation).

Mule deer in arid regions of New Mexico are typically found within a 1.6 mile radius of a water source (Innes, 2013). Although these mule deer would share Rincon Hondo Canyon with cattle, there is very little dietary overlap between them (Launchbaugh, Not dated). Mule deer water intake ranges from 1 to 1.5 quarts per 100 pounds live weight in winter to twice that amount in summer (Nichol, 1938). Free water intake is calculated for 15 mule deer at an average live weight of 200 pounds per animal. Using a free water intake rate of 1.0 gallons per day per animal, and an annual well use frequency of 75%, the total water loss by mule deer is projected to be 4,106 gallons per year.

Based on game camera observations, the elk visitation rate averages 20 individual animals per day with the same animals reappearing approximately once every three days. The elk browse over the long distances separating sources of water, those currently being distributed five-miles apart in the near region. Home ranges for elk average between one and 95 square miles (Innes, 2011). The visitation frequency averages once per day, 75% of the days per year. The population appears stable and is dominated by many small groups of bull elk in the summer and larger herds of cow elk in the winter (author's observations). Spatial patterns and the timing of habitat use are important factors in elk and cattle interaction. Although these elk would share Rincon Hondo Canyon with cattle, elk range over a much larger area than cattle and there is not complete dietary overlap between them (Launchbaugh, Not dated).

For the purpose of this analysis, free water intake is estimated to vary between 3 and 10 gallons per day depending on time of year and animal size and status. Using a free water intake rate of 6.5 gallons per day, and an annual well use frequency of 75%, the historic total water loss by elk is projected to be 35,588 gallons per year.

Other wildlife observed and photographed drinking at well 10A-5-W06 include mountain lion, black bear, coyote, bob cat, fox, badger, skunk, jack rabbit, rock squirrel, chipmunk, bat, and a large variety of birds. Stray cattle and horses are less frequently observed. Although antelope and cottontails are also present, they have never been observed drinking water at the well. The combined free water use by these animals is considered to be small by comparison to that of mule deer and elk and is conservatively ignored.

Summary: Consumptive and other losses associated with well 10A-5-W06 are compiled in Table 8 and are conservatively determined to total 415,522 gallons per year, i.e., 1.275 acre-

Consumptive Uncertainty		
	NRC Method Cow-Calf Water Consumed (gal) =	685,254
	NMSU Method Cow-Calf Water Consumed (gal) =	887,334
	Total Calculated Consumptive Uncertainty (gal) =	202,080
	Total Credited Consumptive Uncertainty (gal) =	0
Consumptive Loss During Drinking		
	Total Water Consumed (gal) =	815,802
	Spilled to Ground (%) =	5%
	Total Consumptive Loss (gal) =	40,790
Infrastructure-Related Losses		
	Rountine Maintenance Loss	
	Drinker volume (gal) =	615.14
	Volumes/Cleaning =	1
	Cleanings/Season =	96
	Total Maintenance Loss (gal) =	59,054
	Weep Hole Loss	
	Weep Hole Leakage Rate (gal/min) =	0.69
	Pumping Frequency =	59.3%
	Minutes/11 months =	482,400
	Weep Hole Loss (gal) =	197,103
	Chronic Leakge Loss	
	System Leakage Rate (gal/min) =	0.1
	Minutes/Year =	525,600
	System Loss (gal) =	52,560
	Ice Removal Loss	
	Ice Removal Visits (Dec 15-Mar 1) =	37
	Surface area of drinkers (ft^2) =	74.98
	Average thickness of ice (ft) =	0.33
	Ice Loss (gal) =	6,917
	Accident-Related Loss	
	Accident Related Loss (gal) =	15,000
	Accidents/Year =	0.7
	Accident Related Loss (gal) =	10,500
Evaporative Losses		
	Net evaporation loss (ft) =	4.08
	Surface area of tanks (ft^2) =	291.48
	Total Evaporative Loss (gal) =	8,904
Wildlife Usage Loss		
	Elk/Day =	20
	Elk Water Intake (gal/day) =	6.5
	Mule Deer/Day =	15
	Mule Deer Water Intake (gal/day) =	1
	Days/Year =	365
	Visitation Frequency	75%
	Wildlife Usage Loss(gal) =	39,694
Total of Losses (gal) =		**415,522**
Total (ac-ft) =		**1.275**

Table 8 – Annual Consumptive and Other Losses

feet per year. This is considered to be a lower case determination since conservatism was built into the subcomponents that make up this total calculated loss. Moreover, additional losses, such as consumptive uncertainty, use of water by cowhands and their horses, use of water for concrete repairs, water used to wash down equipment, water lost during annual well maintenance, water lost due to wave action, etc. are not included in the total.

5.7 Total Quantity

The quantity of water directly consumed by cattle at well 10A-5-W06, when added to the consumptive losses and other losses associated with the delivery of that water, represents the total amount of water beneficially used each year for livestock watering. As described in Section 5.5, the maximum historic quantity of water consumed by livestock is calculated to have been 815,802 gallons per year, i.e. 2.504 acre-feet per year. As described in Section 5.6, consumptive and other losses associated with well 10A-5-W06 are determined to total 415,522 gallons per year, i.e., 1.275 acre-feet per year. When combined, a total of 1,231,324 gallons per year represents the amount of water beneficially used for livestock watering. As such, **with a reasonable degree of scientific certainty, the maximum amount of groundwater diverted through well 10A-5-W06 for the beneficial purpose of livestock watering was 3.779 acre-feet per annum**.

CONCLUSIONS

The elements of a livestock use component of water rights can reasonably be determined from a combination of documentary evidence, field observation and technical analysis. With the exception of the amount of water used per annum, the Defendants and the Plaintiffs have arrived at similar conclusions regarding the elements of the livestock use component of water rights for well 10A-5-W06.

I have made a determination of the historic beneficial amount of water used for livestock watering at well 10A-5-W06 based upon accepted methods and published scientific data applicable to the classes of livestock associated with the cow-calf operation in the Rincon Hondo Canyon region. With a reasonable degree of scientific certainty, the maximum amount of groundwater diverted through well 10A-5-W06 for the beneficial purpose of livestock watering was 3.779 acre-feet per annum. The Parties have stipulated that 0.7 acre-feet per annum is the historic beneficial use of water for domestic purposes at well 10A-5-W06 (Attachment A to the Unopposed Joint Motion to Set Pretrial Conference [Doc. 3167-1], Case No. 01 cv 00072 MV/WPL). Therefore, the water rights for Subfile No. ZRB-2-0038 amount to 4.479 acre-feet per annum.

The Plaintiffs have proposed to recognize water rights for Subfile No. ZRB-2-0038 totaling 3.724 acre-feet per annum, 3.024 acre-feet associated with livestock use and 0.7 acre-feet associated with domestic use (Attachment 1 to the Unopposed Joint Motion to Set Pretrial Conference [Doc. 3167-2], Case No. 01 cv 00072 MV/WPL).

In general, Plaintiffs used an oversimplified approach for estimating livestock water use throughout the Zuni Basin. The primary reason for the difference in livestock use amount, Defendants' 3.779 acre-feet per annum versus Plaintiffs' 3.024 acre-feet per annum, is the presumption by the Plaintiffs that a drinking water rate said to be applicable to 800-pound beef cattle in a feedlot is representative of the drinking water rate of a 1,000-pound lactating cow with calf on rangeland. The 10 gallon per day drinking water rate used by the Plaintiffs was not only misapplied but was based on hearsay. Plaintiffs attempted to compensate for the "innumerable, unknowable factors that might possibly affect livestock water consumption" by simply doubling the presumed drinking water rate to 20 gallons per day. For Subfile No. ZRB-2-0038, this was not enough.

Attachment 6 addresses exhibits derived from this report that may be used at trial.

DATED this 27th day of June, 2016.

/s/ Craig Fredrickson

Craig L. Fredrickson, Defendant
2742 Veranda Rd, NW
Albuquerque, NM 87107

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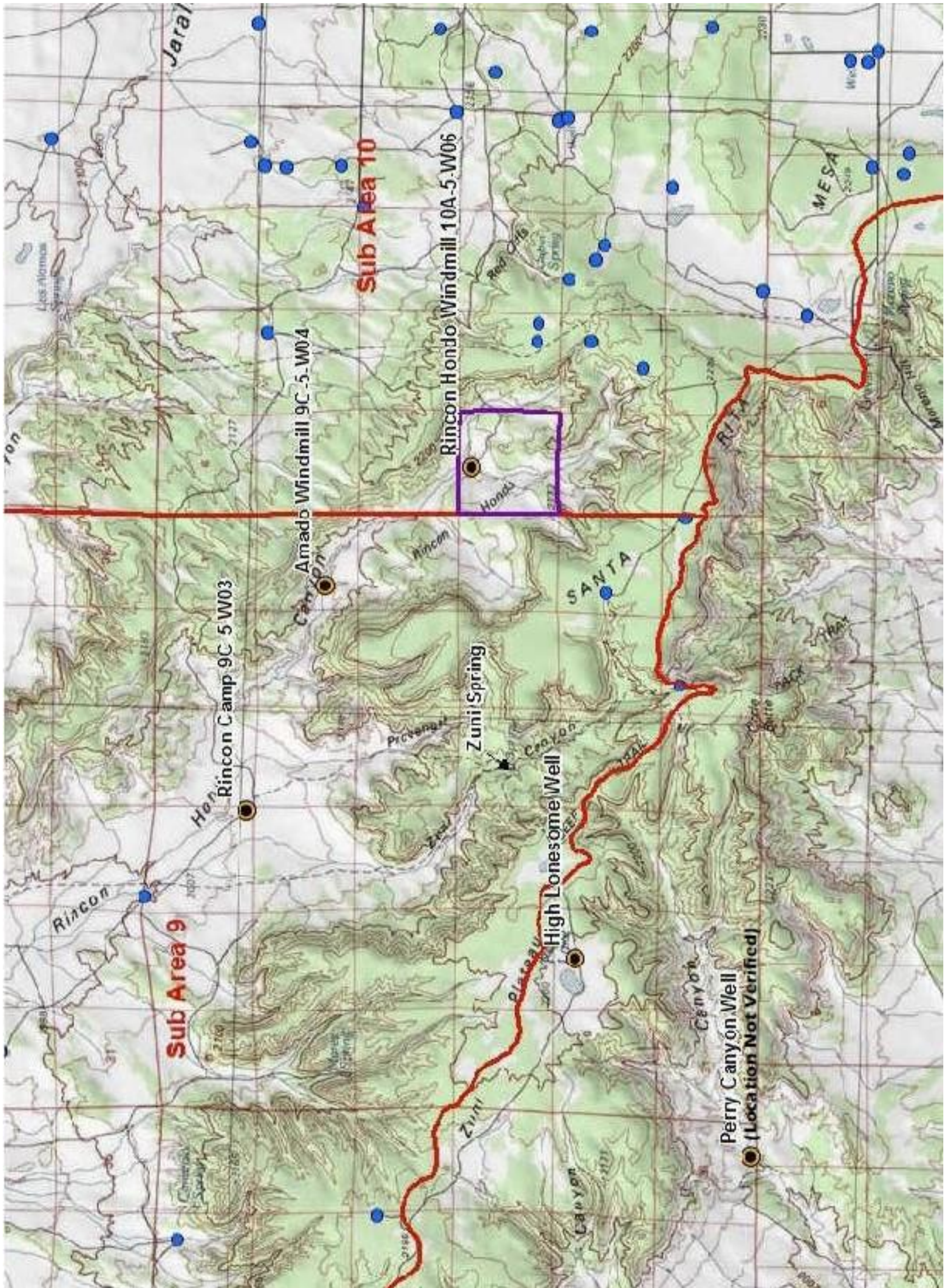
ATTACHMENT 1

Rincon Hondo Canyon Regional Map


Sub Area 10
Rincon Hondo Windmill 10A-5.W06
Amado Windmill 9C-5.W04
Rincon Camp 9C-5.W03
Zuni Spring
High Lonesome Well
Sub Area 9
Perry Canyon Well
(Location Not Verified)
SANTA
RITA
MESA
Rincon
Canyon

ATTACHMENT 2

Declaration of Ownership of Underground Water Right

STATE OF NEW MEXICO

STATE ENGINEER OFFICE

DEMING

S. E. REYNOLDS
STATE ENGINEER

March 27, 1990

215 S. SILVER
P.O. BOX 844
DEMING, NEW MEXICO 88031
(505) 546-2851
(505) 546-7452

FILES: 02-189 through 02-192
✓33-3 through 33-9

Tommy Cox
P.O. Box 368
Quemado, New Mexico 87829

Dear Mr. Cox:

Enclosed are your copies of Declaration of Ownership of Underground Water Right, which have been accepted for filing and given numbers 02-189 through 02-192 and 33-3 through 33-9. Please refer to these numbers in correspondence concerning these Declarations.

Under New Mexico Law a declaration is only a statement of declarant's claim. Acceptance for filing does not constitute approval or rejection of the claim.

Sincerely,

R Q Rogers

R. Q. Rogers
Supervisor, District 3

RQR:jp
Encls: 11 Declarations
cc: State Engineer

15055462290 OFFICE OF THE STATE 12:19:27 p.m. 03-01-2006 1 /4

RC - 135443 - $13.00

'90 MAR 21 AM

IMPORTANT — READ INSTRUCTIONS ON BACK BEFORE FILLING OUT THIS FORM.

Revised December 1975

Declaration of Owner of Underground Water Right

CIBOLA COUNTY
BASIN NAME

Declaration No. 33-8 Date received March 14, 1990

STATEMENT

1. Name of Declarant Tommy Cox
Mailing Address PO Box 368 Quemado, N.M. 87829
County of Catron, State of New Mexico
2. Source of water supply Shallow water (artesian or shallow water aquifer) Rincon Hondo
3. Describe well location under one of the following subheadings:
a. NE ¼ NE ¼ NW ¼ of Sec. 19 Twp. 5N Rge. 18W N.M.P.M., in Cibola County.
b. Tract No. ____ of Map No. ____ of the ____
c. X = ____ feet, Y = ____ feet, N. M. Coordinate System ____ Zone in the ____ Grant.
On land owned by ____
4. Description of well: date drilled 1955 driller ____ depth 505 feet.
outside diameter of casing 6 inches; original capacity 18+ gal. per min.; present capacity 18+ gal. per min.; pumping lift 470 feet; static water level 470 feet (above) (below) land surface;
make and type of pump Airmotor windmill
make, type, horsepower, etc., of power plant ____
Fractitional or percentage interest claimed in well Full
5. Quantity of water appropriated and beneficially used not calculated, see #8 below (acre feet per acre) (acre feet per annum) for livestock watering purposes.
6. Acreage actually irrigated 0 acres, located and described as follows (describe only lands actually irrigated):

Subdivision	Sec.	Twp.	Range	Acres Irrigated	Owner

(Note: location of well and acreage actually irrigated must be shown on plat on reverse side.)

90 MAR 14

7. Water was first applied to beneficial use 1955 (month day year) and since that time has been used fully and continuously on all of the above described lands or for the above described purposes except as follows: ____

8. Additional statements or explanations This well is equiped with a windmill and an auxillary pump jack and does not pump the full capasity the year-round, however, should we have the need for full production in the future, we reserve that right. (Example: future irrigation or domestic use)

I, ____ being first duly sworn upon my oath, depose and say that the above is a full and complete statement prepared in accordance with the instructions on the reverse side of this form and submitted in evidence of ownership of a valid underground water right, that I have carefully read each and all of the items contained therein and that the same are true to the best of my knowledge and belief.

OFFICIAL SEAL SUSAN J. RAFFAY NOTARY PUBLIC STATE OF NEW MEXICO My Commission Expires 2-16-92

by: Tom Cox, declarant.

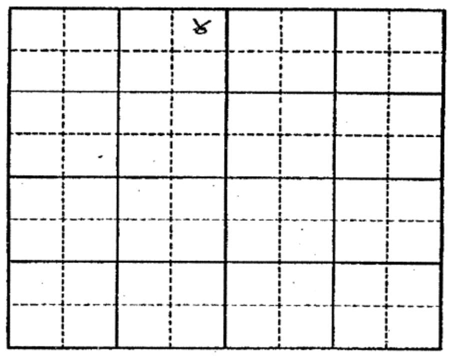
Subscribed and sworn to before me this 14th day of March, A.D. 1990

My commission expires 2-16-92 Susan J Raffay Notary Public

FILED
UNDER NEW MEXICO LAW A DECLARATION IS ONLY A STATEMENT OF DECLARANT'S CLAIM
ACCEPTANCE FOR FILING DOES NOT CONSTITUTE APPROVAL OR REJECTION OF THE CLAIM

Locate well and areas actually irrigated as accurately as possible on following plat:

Section (s) 19, **Township** 5N, **Range** 18W **N. M. P. M.**



INSTRUCTIONS

Declaration shall be executed (preferably typewritten) in triplicate and must be accompanied by a $1.00 filing fee. Each of triplicate copies must be properly signed and attested.

A separate declaration must be filed for each well in use.

All blanks shall be filled out fully. Required information which cannot be sworn to by declarant shall be supplied by affidavit of person or persons familiar with the facts and shall be submitted herewith.

Secs. 1-3. Complete all blanks.

Sec. 4. Fill out all blanks applicable as fully as possible.

Sec. 5. Irrigation use shall be stated in acre feet of water per acre per year applied on the land. If used for domestic, municipal, or other purposes, state total quantity in acre feet used annually.

Sec. 6. Describe only the acreage actually irrigated. When necessary to clearly define irrigated acreages, describe to nearest 2½ acre subdivision. If located on unsurveyed lands, describe by legal subdivision "as projected" from the nearest government survey corners, or describe by metes and bounds and tie survey to some permanent, easily-located natural object.

Sec. 7. Explain and give dates as nearly as possible of any years when all or part of acreage claimed was not irrigated.

Sec. 8. If well irrigates or supplies supplemental water to any other land than that described above, or if land is also irrigated from any other source, explain under this section. Give any other data necessary to fully describe water right.

If additional space is necessary, use a separate sheet or sheets and attach securely hereto.