Exhibit KR-3

Marble Mountain Ranch Water Rights Investigation:

Water Use Technical Memorandum




18 November 2014

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1.0 Introduction:

The Mid Klamath Watershed Council (MKWC) and Lennihan Law, LLC are conducting an independent evaluation of the water rights for the Marble Mountain Ranch (MMR), also known as the Cole diversion. MKWC has hired Cascade Stream Solutions LLC (Cascade) to assist with the investigation by providing physical descriptions and quantifications of use of the existing MMR water system, and to provide technical support regarding historic uses of water on the MMR. This Technical Memorandum accompanies and is in support of the *Cole Marble Mountain Ranch Stanshaw Creek Water Rights Report* ,(Lennihan Law, 2013), (the "Report").

2.0 Objective and Scope:

The project objective is assist MKWC and Lennihan Law by reviewing readily available information and conducting limited field investigations to:

- Determine and map the locations of the points of diversion, conveyance and other water delivery, storage, and related facilities, and places of use as they exist on the ground.
- Review history of water rights and use associated with the Marble Mountain Ranch.
- Estimate likely diversion and use rates based on the documents provided to Cascade and Lennihan Law by MKWC and other parties, which documents provide information on use. These documents are referenced in this Technical Memorandum, and described in the Report. Cascade also performed site visits to MMR and the Susan Dodd Trust Properties (also referred to as the Fisher Properties).

3.0 Report Organization:

This report is organized into eight sections. Sections 1, 2, 3, and 4 provide a brief introduction to the water rights investigation, project objectives, and background of present day Marble Mountain Ranch operations. Section 5 provides a brief description of the water distribution system. Section 5 provides a brief description of the present day water conveyance system and water use. Cascade's estimates of historic water diversion flow rates are summarized in Section 6. Section 7 briefly summarizes flow measurement data identified by Cascade in documents provided to the team. Cascades findings are summarized in Section 8.

4.0 Background:

Marble Mountain Ranch is located along Highway 96 in Somes Bar, California (Latitude 41° 28' 00", Longitude 123° 30' 12"). The Cole family own and operate the ranch, which presently serves as a commercial guest ranch that provides activities such as horseback trail riding, whitewater rafting, kayaking, shooting, fly fishing, and boating activities for guests. The ranch is located on properties identified by Siskiyou County Assessor Parcel Numbers (APN) 026-290-200-000 (43.17 acres), 026-290-240-000 (4.20 acres), 026-290-270-000 (0.00 acres). It should be noted that APN 026-290-270-000 likely has an area between 0.05 and 0.1 acres, based Cascade's review of Assessor Parcel Maps and Google Earth parcel boundaries. Figure 1. Provides ownership and parcel information from the Siskiyou County Tax Assessor.

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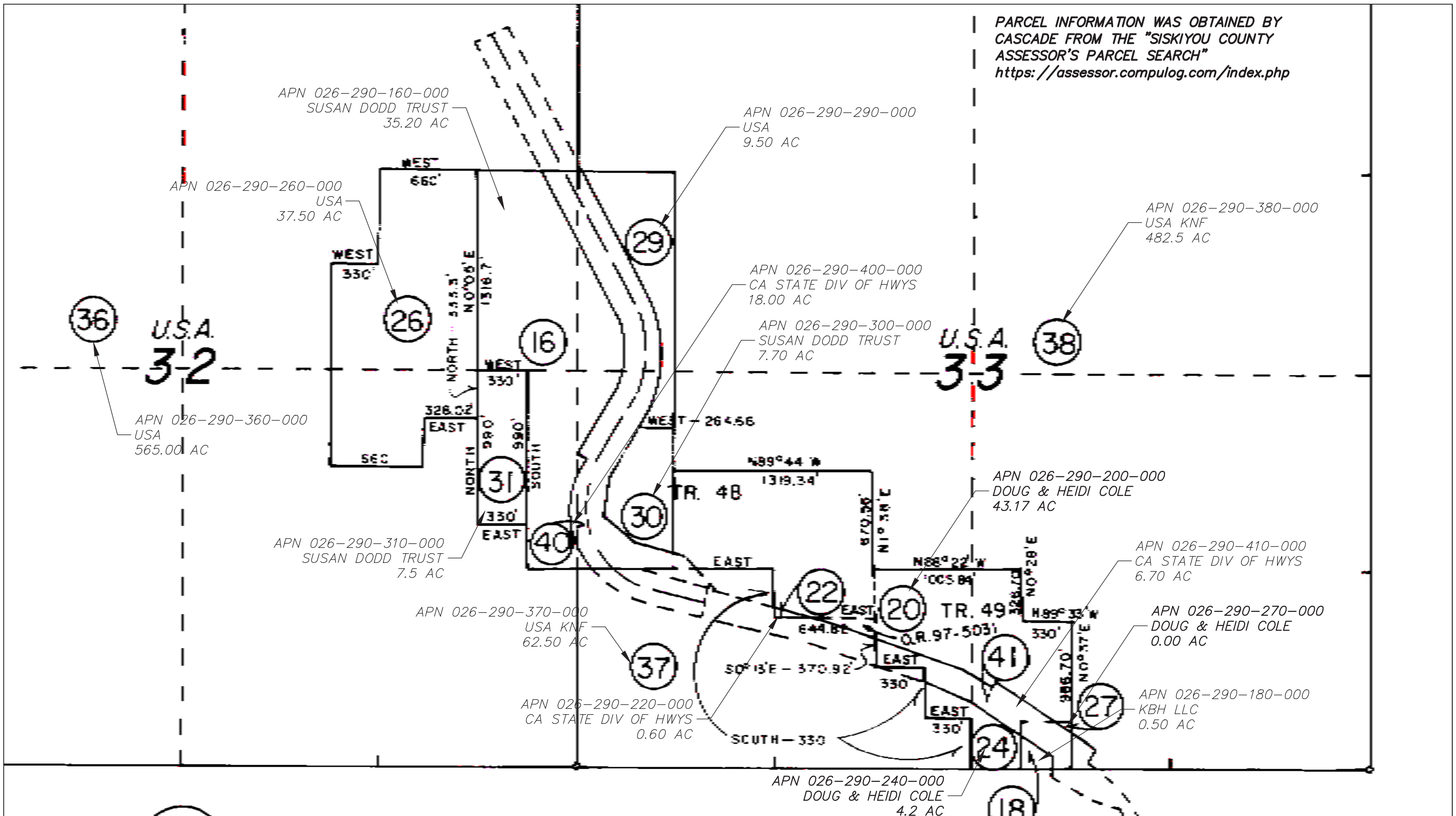

Mid Klamath Watershed Council 38150 California 96 Orleans, CA 95556 (530) 627-3202	295 East Main Street, Suite 11 Ashland, Oregon 97520 (541) 864-0492 www.cascadestreamsolutions.com	Job:jh Rev: Drft: Date: 22Aug14	Marble Mountain Ranch Water Rights Investigation Figure 1. Siskiyou County Assessor's Parcel Information

The ranch diverts water from Stanshaw Creek that supplies water for consumptive and non-consumptive uses.

5.0 Present Day Water Distribution System:

Diversion flows from Stanshaw Creek provide the water used to operate the Marble Mountain Ranch and serve onsite residences. The diversion is operated to convey as much flow as can be diverted using the hand constructed gravel and cobble dam up to about 3 to 4 cfs in to the diversion canal. Water is used for both consumptive and non-consumptive purposes. Consumptive uses include:

- irrigation of three pastures for livestock, a greenhouse, garden, orchard, and landscaping.
- water supply for commercial and private kitchens, toilets, laundry facilities, and drinking water.
- Evaporation and transpiration from water storage for periodic fire suppression.

The primary non-consumptive water use is power generation. Return flow from that use is channeled to Irving Creek which flows into the Klamath River. A small percentage (likely less than 5 percent) of the water used for hydropower generation is used non-consumptively as a heat sink to regulate power supplied to the transmission system. This flow is diverted in a small diameter pipe (about 1 to 2 inches in diameter) prior to the jet that powers the Pelton wheel to a heat sink resistor. Electricity in excess of the ranch's demands powers the heat sink resistor and heats the water that runs through the resistor. The heat sink resistor is necessary in this configuration to avoid overloading the electrical system. The heated water is returned to the ditch that flows to the pond and into Irving Creek. Marble Mountain Ranch does not measure power use.

Water for irrigation and domestic is handled separately.

There is also a small pond on the ranch which is used largely for non-consumptive purposes, recreation, aesthetics, fire suppression storage, and fish and wild0life. The consumptive use of water diverted from Stanshaw Creek into the pond is evaporation and transpiration.

Photographs of the water conveyance infrastructure are provided in Appendix A.

5.1 Water Distribution System

The point of diversion is located on Stanshaw Creek about 0.68 miles upstream of the Highway 96 crossing. A channel spanning gravel and cobble push-up dam diverts water that does not seep through the dam into a diversion ditch. The amount diverted typically varies with available stream flow, independent of demand. Under typical late spring, summer, and fall flow conditions (less than about 3 to 4 cfs), the majority of creek flow is diverted into the ditch. Conveyance from the point of diversion to the ranch is gravity driven. Flows are conveyed from the point of diversion about 0.5 miles to a junction where flows can be conveyed to a water treatment plant to the southwest, and to a forebay and penstock to the southeast that services the power generation facility and the pressurized irrigation system. The conveyance structures between the point of diversion and the junction consists of unlined and lined reaches of ditch. The lined reaches are lined with culvert pipe cut to form half round pipe sections. These semi-circular pipe sections include corrugated HDPE pipe with smooth interior walls and corrugated metal pipe. One section of pipe was measured to be 30 inches in diameter. The other sections appeared to be the same diameter.

The ditch follows along a steep heavily treed hillslope. Geomorphic processes and biotic activity influence the ditch conveyance capacity and requires frequent maintenance to maintain desired conveyance capacity. Douglas Cole states the ditch conveys a maximum of about 4 to 5 cfs when the ditch is in good condition. Sediment deposition in the canal results from ingestion of sediment from Stanshaw Creek, hillslope sloughing, and landslides. Changes in elevation of the outboard canal berm (side opposite the hillslope) have the potential to influence canal conveyance capacity as well. The berm elevation may change as a result of erosion due to overtopping and slumping and sloughing of the hill slope. Animal activity, such as trampling by elk, may also reduce the berm crest and result in increased overtopping and reduced conveyance capacity.

The water treatment plant receives diverted flow through a two inch diameter PVC pipe. The treated (domestic) water serves the residences, guest facilities, a greenhouse, and limited irrigation. Water that enters the two inch diameter PVC pipe is not measured by MMR.

Water conveyed to the forebay travels along lined and unlined ditches to the forebay tank where the water is screened for debris and enters the pressurized conveyance system. Water is conveyed a horizontal distance of about 430 feet and a vertical distance of about 200 feet through 13.5 inch interior diameter smooth walled plastic pipe and 14 inch steel pipe to a junction immediately upstream of the power plant. The power plant consists of a Pelton wheel driven by two pressurized jets. Discharge from the power plant is conveyed in a ditch to a pond. The pond is used for recreation and water storage for fire prevention. Flows from the pond are conveyed in a ditch to the south across the ranch, and then drops off a headcut, down a ravine and into Irving Creek. Excess diversion leaving the pond and flowing towards Irving Creek were measured on one occasion to be about 1 cfs. The water used for power generation is not re-used for irrigation or domestic purposes.

Irrigation and fire prevention flows are conveyed through a short run of nine inch diameter steel pipe to four inch diameter PVC pipe that extends from the junction at the power plant to sprinkler guns located in pastures and hose bibs and couplers located throughout the property.

5.2 Current Water Use

Water is diverted continuously throughout the year at the maximum rate possible up to about 3 to 4 cfs. MMR will stop diverting on rare occasions when extreme flows are in Stanshaw Creek and diversion flows risk damaging the ditch. During these rare events, the head of the diversion is blocked to prevent flow from entering the ditch. Diversion flows are used to support ranch guests and staff from June 1, to September 1, and lodgers and residents the remaining portion of the year. The ranch has also served as a camp to house fire crews and typically hosts one to two day community events annually. Water that is diverted from Stanshaw Creek and is not consumptively used is discharged into Irving Creek.

Water demand is greatest during the summer as it is used to generate power, irrigate, and provide domestic water. Summer power demand is estimated by Mr. Douglas Cole to be 35 to 40 kW, with peak power demands in the mid-afternoon when guests return from ranch activities. Actual power production and usage are not measured by MMR. Mr. Douglas Cole states that power and water needs are met when the volume of water diverted from Stanshaw Creek (including carriage losses) is about 3 cfs. When flows drop below this amount, water not conveyed to the water treatment plant can either be used to generate power or for irrigation.

Mr. Cole monitors diversion flow at a location in the canal downstream of the junction point that provides water to the water treatment plant. Water levels are monitored in a half section of corrugated metal pipe. He has marked the inner diameter of a 30 inch diameter corrugated metal pipe to create water level gage that he refers to as the Stanshaw Gage and the units as Stanshaw Units. At flows below 13.3 Stanshaw Units[1], there is insufficient water to generate hydropower to meet demand. The Ranch's power system is currently configured to accept power from one generation source: the hydropower generator or diesel generator. When Stanshaw Creek diversions are insufficient to meet all demands, the Ranch relies on a diesel generator for power and water is generally consumed for irrigation and guest needs. Diversion flows are not reduced when hydropower generation ceases. During these times, flows in excess of the flow required for irrigation and domestic use are conveyed to Irving Creek.

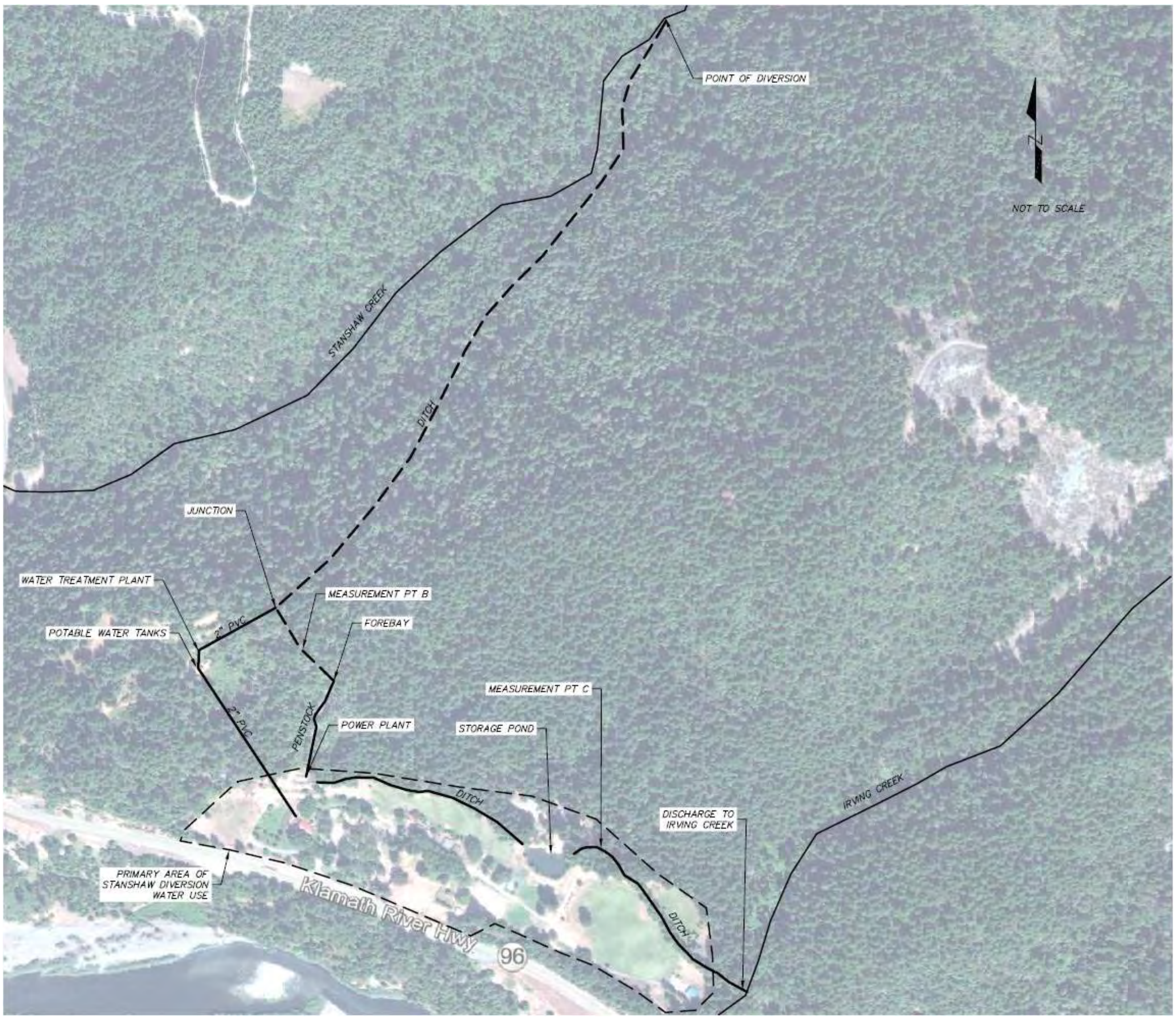

Figure 2. Water Conveyance Map

[1] This unit of measurement is unique and has not been correlated to commonly used units of measure (e.g. cubic feet per second.)

6.0 Past Water Use

The information provided to Cascade does not provide sufficient data to definitively quantify the volume of water diverted for mining, domestic, agricultural, and commercial beneficial uses. This is not surprising or abnormal given that we are looking back in time, and the local customs have not historically involved metering or similar measurements of water diversions and use. In an effort to reconstruct past water diversion and use rates, Cascade estimated historic water diversion and use rates from readily available information. This section describes the methodology used to estimate the diversion rates and use, methodology for estimating carriage losses, and estimated quantities.

6.1 Methodology

Estimates of past uses and areas of application provided in this Technical Memorandum are based upon information obtained from the documentation referenced in the Report. Seasonal variation in uses are not accounted for in these estimates; therefore, annual volumes are not presented.

This analysis relies on water uses described by Ken Harless (Harless 1997), Lue Hayes (Hayes 1998, Hayes 2000), correspondence related the Young's water rights application (Application No. 29450) and Mr. Douglas Cole's statements and interviews, and other accounts as referenced in this memo. Table 1 summarizes some of the documented water use used in this analysis.

The State Water Resources Control Board (SWRCB) lists use rates and occupancy for estimating irrigation and domestic flows in their response to the Young's water rights application (Application No. 29450) for domestic and irrigation purposes. Cascade used these values listed in Table 2 to estimate water use (Mrowka 1993). Subsequent to that letter, the current owner Douglas Cole listed additional uses. These uses included garden, fruit trees, livestock, and hydropower. Values for these uses are listed in Table 2 and Table 3.

Table 1. Land and Water use accounts

Lue Hayes July 7, 1998	At time of Hayes purchase in 1955: 16 homes and outbuildings, 100 head of cattle at times, and irrigated lands. Additions included: Built RV sites, 10 additional cabins Hydroelectric improvements: "put in a Pelton wheel generator"; upgraded 4" penstock to 14" and replaced Pelton wheel for a larger wheel.
Lue Hayes April 30, 2000	1955 purchase price included: 55 acres, 4 residences, 2 barns, all other buildings, equipment, 12" waterline (penstock), and 4 kW Pelton wheel. After purchasing the property, Hayes upgraded Pelton wheel to a 9 kW Pelton wheel 1965 Hayes upgraded the Pelton wheel to a 100 kW Pelton wheel
Correspondence regarding Young's water Rights Application No. 29450	Request a right to divert 0.22 cfs for domestic purposes to serve 3 residences, 44 recreational vehicle hookups, 11 housekeeping cabins, 14 mobile homes, and one lodge.

Douglas Cole	Current water use is described in Section 5.0 2009 Statement of Water Use S016375 Power generation, domestic use at resort serving about 50 persons, irrigation of about 25 acres of pasture, water for 20-30 livestock, irrigation of fruit trees, irrigation of about 2 acres of gardens. Diversion rate of 3 cfs from October through May, 2.5 in June, 2.25 in July, 2.0 in August, 2.0 in September.

Table 2. State Water Resources Control Board Use Rate Estimates (Mrowka Letter February 4, 1993)

Purpose	rate	Units	Comments
Use per person per residence	75	gal/day/person	4 persons per residence
Recreation vehicle use	30	gal/day/person	2 persons per RV
Housekeeping cabin	55	gal/day/person	4 persons per cabin
Mobile home	55	gal/day/person	4 persons per Mobile Home
Lodge guest	55	gal/day/person	20 guests per day
Irrigation	0.013	cfs/ac	7 acres of alfalfa

Table 3. Estimated Application and Use Rates

Use Rates	**Use Est**	**Unit**	**Source**
Garden	0.125	gpm/ac	Mrowka, 2000
Tree	15.6	gallon/tree/day	Vossen, 2000
Livestock	22.5	gallon/day/head	Montana
Hydropower	0.073	cfs/kW	Estimated

The above-referenced statements by individuals who had personal experiences (as owners or otherwise) with the Ranch water operations provide information regarding the type of use and the area the use occurred over. The statements do not include measurements of water use, therefore Cascade used water duties to estimate the volume of water used and diversion rates. Cascade calculated estimates of consumptive use by multiplying the use type (e.g. number of residences) by use rate (e.g. daily residential use rate) to estimate a consumptive water use. For example, Lue Hayes states that four residences existed onsite. To estimate consumptive use of the residences, Cascade used the following approach:

Reported No. of residences = 4

No. of people per residence[2] (estimated) = 4

Daily use rate per person per day[3] (estimated) = 75 gal

Total consumptive use for four residences per day = 4*4*100 = 1600 gal/day = 1600 gal/day * $1.54722865 \times 10^{-6}$ = 0.0025 cfs

6.2 Carriage Losses

For the purposes of this analysis, carriage (transmission) losses refer to infiltration, evaporation, spillage, or any other process that results in a reduction of the flow rate in the canal between the point of diversion and the junction where water is split between treated water and the water used for hydropower and irrigation. Carriage losses vary with flow rate, conditions in the canal, and season. These losses have been estimated to range from about 0.4 cfs to about 1 cfs. On 27 August 2013, Cascade measured a carriage loss of about 0.4 cfs. Determining acceptable carriage loss from the point of diversion to the point of use is outside the scope of this investigation; however, losses of 0.5 to 1 cfs per mile of unlined ditch is not uncommon in Siskiyou County.

Note that while water demands on the ranch changed significantly over time, diversion rates into the ditch from Stanshaw Creek may have continued to be high given that this is a gravity system, and it was relatively difficult to make adjustments to the diversion amount. This is supported by Lue Hayes' description of operations when he owned the ranch.

6.3 Estimated Water Use

For the purposes of this report, water use was categorized into the following categories: Pre-1955 mining, irrigation, and domestic use; post-1954 domestic and irrigation; and hydropower use. These uses are discussed below.

Pre-1955 Mining and Domestic Use

The original water right claim was for 15 cfs. Cascade does not have documentation of how much water was actually used for hydraulic mining. The land area upon which mining could have occurred was much larger than the current area of MMR. Stanshaw Creek flow may have been higher in historic times than it is today. However, it is not likely that Stanshaw Creek flowed at a rate sufficient to allow diversions of 15 cfs except possibly during very high flow periods. In any event, during the late 1800's and early 1900's, the majority of the water used was probably for mining, with smaller amounts devoted to domestic and irrigation purposes. This pattern probably persisted from the 1860's to the time hydraulic mining activities decreased and then ceased. From about 1920's or early 1930's to the early or mid-1950's, a period of approximately 15-30 years, seasonal irrigation appears to be the primary consumptive use with lesser amounts used for year round domestic purposes. Figure 3 shows locations outside of the Marble Mountain Ranch Property where mining related activities likely occurred.

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[2] Mr. Hayes did not report the number of occupants per residence. Cascade assumed four residents per household.

[3] Mr. Hayes did not report use rates by occupant.

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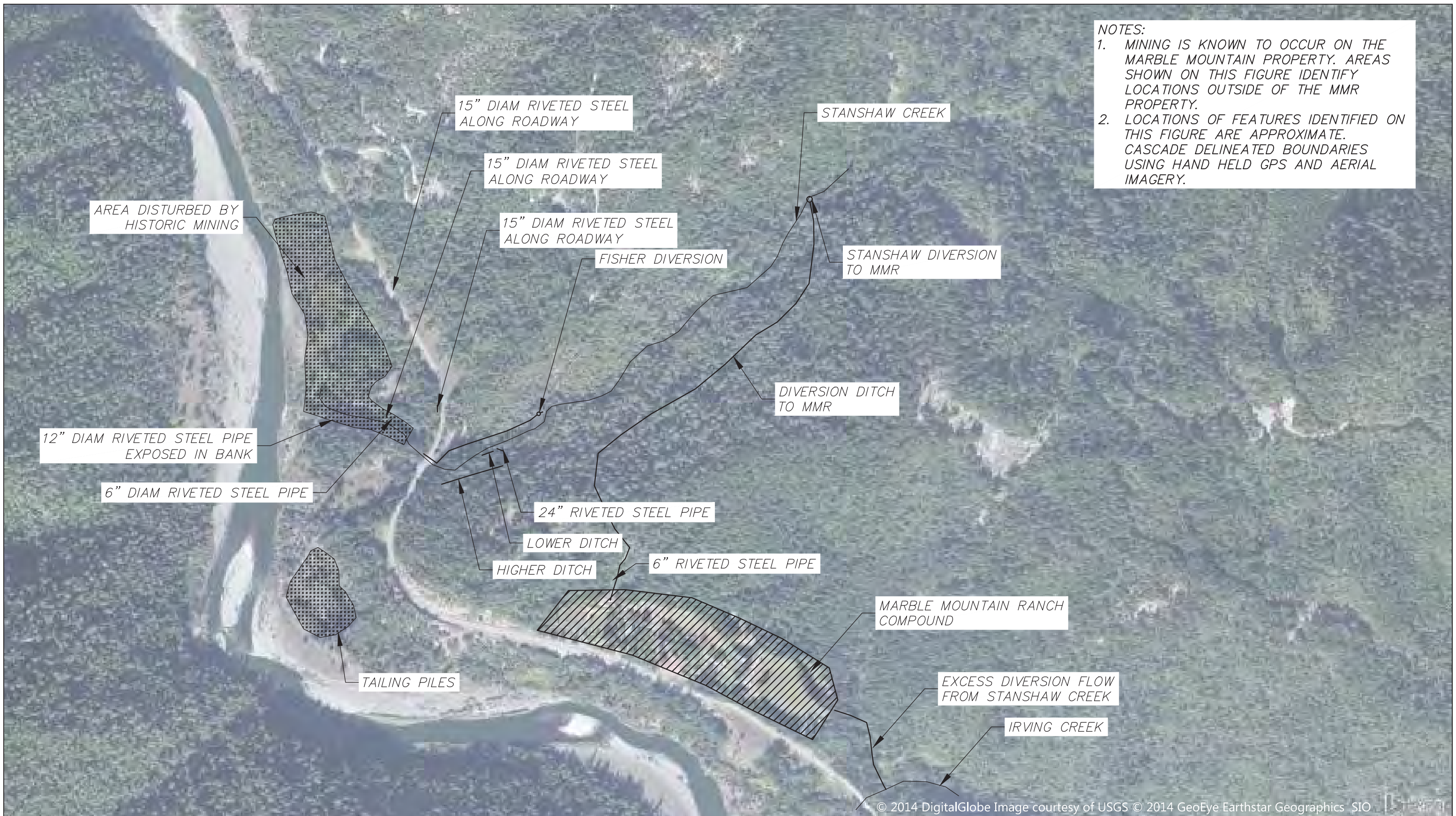

Mid Klamath Watershed Council 38150 California 96 Orleans, CA 95556 (530) 627-3202	Cascade STREAM SOLUTIONS 295 East Main Street, Suite 11 Ashland, Oregon 97520 (541) 864-0492 www.cascadestreamsolutions.com	Job: Rev: Drft: Date: 22Aug14	Marble Mountain Ranch Water Rights Investigation Figure 3. Location Map of Historical Mining Artifacts and Areas of Disturbance

Post-1955 Domestic and Irrigation Uses.

Domestic and irrigation water uses has changed over time with changes in land use following the mining era. Mr. Hayes describes land uses at the time he purchased the property and additions he made to the property after he purchased the property. His accounts are briefly summarized in Table 4 and Table 5. Applying the use rates listed in Table 2 and Table 3 to these accounts, Cascade estimates that Lue Hayes's additions to the domestic and irrigation infrastructure likely resulted in a relatively negligible change in domestic and irrigation water use from about 0.323 cfs to about 0.328 cfs. Table 4 and Table 5 summarize the changes in domestic and irrigation uses. As part of the Young's water rights application (No. 29449), the SWRCB estimated the beneficial use to be 0.11 cfs with about 0.02 for domestic use and about 0.09 for irrigation (Mrowka 1993). Cascade attempted to reproduce the SWRCB's estimate and computed 0.016 cfs for domestic use and 0.088 cfs for irrigation. Cascade assumes the differences between the SWRCB and Cascade's estimate is due to rounding error. Table 6 summarizes the Young's use as estimated by the SWRCB. Estimated water use was about 0.2 cfs less than the rate used by Hayes.

Douglas Cole purchased the property in 1994 and made significant changes to the commercial use. One of his primary changes to the commercial land use was discontinuing transient recreational motor lodging and starting a business that offers multi-day vacation holidays. Using information available in his 2009 statement of use (No. S016375) and use rates listed in Table 3 and Table 4 Cascade estimated domestic and irrigation rates for the Marble Mountain Ranch to be about 0.35 cfs. This amount is about a 0.24 cfs increase over the amount SWRCB estimated. The change in domestic and irrigation use is primarily a result of an increase in the area irrigated. During this period Mr. Cole implemented water conservation measures that included converting from flood to sprinkler irrigation.

Tables 4 through 7 address uses excluding hydropower use.

Table 4. Estimated Use When Lue Hayes Acquired Property Based on Lue Hayes Statements

Use	Unit	Use Rate	Flow, cfs
Residences/Homes	16	4	0.0074
Cattle	100	22.5	0.0035
Irrigated Land	25	0.013	0.313
		Total	0.323

Table 5. Estimated Use Shortly After Lue Hayes Acquired Property, Based on Lue Hayes Statements

Use	Unit	Use Rate	Flow, cfs
Residences/Homes	16	4	0.0074
RV Sites	44	60	0.0041
Cabins	10	55	0.0009
Cattle	100	100	0.0035
Irrigated Land	25	0.013	0.313
		Total	0.328

Table 6. Young's Water Use as Estimated by SWRCB (1993)

Use	Unit	Use Rate	Flow, cfs
Residences/Homes	3	300	0.0014
Lodge	1	1100	0.0017
RV Sites	44	60	0.0041
Cabins	11	220	0.0037
Mobile Homes	14	220	0.0048
Irrigated Land	7	0.013	0.088
		Total	0.103[4]

Table 7. Marble Mountain Ranch's Estimated Water Used[5]

Use	Unit	Use Rate	Flow, cfs
Residences/Homes	3	300	0.0014
Lodge	1	2750	0.0043
Fruit Trees	60	15.6	0.0014
Gardens	2	0.0125	0.0250
Livestock	25	220	0.0085
Irrigated Land	25	0.013	0.313
		Total	0.353

Power Generation

Power generation appears to have changed significantly over the years. The information on power generation prior to 1955 is conflicting. The April 2001 letter from Violet Anderson regarding water use at the time the McMurty's owned the ranch (purchased in 1922 from Stanshaw) does not mention power generation; however, the letter from Kronick, Moskovitz, Tiedemann, & Girard (August 20, 2001) states that Ms. Anderson "recalls that electricity was already in use at the time in connection with the dairy." The May 21, 1997 statement of Mr. Ken Harless indicates that the water uses in 1947-1948 when he lived on what is now Marble Mountain Ranch were domestic and agricultural, but does not mention power generation. Owners of MMR have indicated that power generation was probably initiated in the 1940's (e.g., Cole April 9, 2000 letter to Fisher; KMTG April 13, 1993 letter to SWRCB; County of Siskiyou Planning Department July 5, 2000 letter to SWRCB.) There are a few indications that some probably limited power generation could have commenced earlier (e.g., KMTG August 20, 2001 letter to SWRCB; photograph on MMR website described as showing aerial power lines in 1916 (http://www.marblemountainranch.com/ranch/ranch_history.html.) These accounts do not specify the flow rate dedicated to generating power. Hayes states in his July 7th 1998 declaration that "We also put

[4] Beneficial use was estimated to be 0.02 cfs for domestic use. Cascade believes this number was established by rounding up the calculated estimated domestic use from 0.0157 cfs to 0.02 cfs. Cascade also believe calculated irrigation flow rate was rounded up from 0.088 to 0.09 cfs.
[5] Use is based on the number types of uses and number of uses provided to Cascade during a December 19th

in a pelton wheel generator that gave us electricity. Our first penstock was a 4" line and it barely gave us enough power to keep the lights and refrigerator on", which could be interpreted to mean that the property did not have functional power generation facilities when he first purchased the property. In his April 30th, 2000 declaration, Hayes appears to contradict his 1998 declaration by stating "The property had an existing 12" main waterline and 4 kW Pelton wheel." The June 16, 2014 comment letter from Churchwell White, LLP states that Jerry Hayes declared that "there was an existing water wheel running on a two inch (2") line that, at the very least was used to power the main ranch house."

The statements by Lue Hayes in 1998 and 2000 and Jerry Hayes statement reported in the June 16th, 2014 comment letter appear contradictory; however, their reference to the power production remains relatively consistent. There is presently an approximately 6 inch diameter steel pipe that lies parallel and offset about 5 to 10 feet from the existing 14 inch pipe. A photograph of the pipe is provided in Appendix A. Cascade was unable to verify the origin or use of this pipe.

Based on the information from Lue and Jerry Hayes statements, it is reasonable to assume that hydropower generation before 1955 was in the range of 0-4 kW; however the volume of water used to generate this power is not easily estimated.

Lue Hayes's statements indicated that power generation may have been as much as 4 kW in 1955 when he acquired the ranch. He states that he increased the power generation capacity to 9 kW and then states that he later increased generation by installing a "100 kW Pelton wheel". Douglas Cole upgraded the power generation facilities after he purchased the property in 1994. The MMR 1989 water rights application (No. 29449) requests the right to divert 3 cfs to produce 33.9 kw of power at an efficiency of 80 percent. Douglas Cole stated to Cascade that MMR presently has the capacity of 35 to 38 kW when diversion flows are about 3 cfs.

Review of these records suggests that power generation increased by as much as 9.5 times from 1955 to present (4 kW to 38 kW). Quantifying the water demand associated with this increase in power generation is complicated by Lue Haye's statement that he installed a "100 kW Pelton wheel" and the uncertainty in the pipe size. Assuming the total static head did not change and the system efficiency was not increased, production of 100 kW would require about 7.7 cfs. This flow rate is significantly higher than the estimated maximum conveyance capacity of the ditch, which is about 3 to 4 cfs. Statements by Douglas Cole indicate that he upgraded the efficiency of the hydro power generation facility. Douglas Cole's statements suggest to Cascade that the power generation capacity prior to Douglas Cole's acquisition of the property was equal to or less than the current generation capacity; hence there was likely an increase in power over time since 1955 and the maximum power generated is likely to be 38 kw or less.

The flow rate required to generate power is a function of the total static head minus the headlosses referred to herein as net head. Headlosses include losses due to pipe friction and minor losses such at the inlet, bends, reducers, and outlet. For the purposes of this investigation, minor losses were considered to be small compared to friction losses in the pipe. Because we don't know the true pipe size used to convey water from the ditch to the power plant at the time Lue Hayes purchased the property, Cascade modeled headloss and potential power generation from a 4 inch and 6 inch diameter pipe as well as the 14 inch pipe that currently conveys water down the hillslope, a vertical distance of about 200 feet. As illustrated in Figure 2, the pipe diameter can significantly influence headloss. The headloss curves shown in Figure 2 were computed assuming a pipe length of 500 feet, the estimated length of the pipe, using Hazen-Williams formula for headloss. The loss coefficient was assumed to be 100, which is often used for "old unlined or tar-dipped cast-iron pipes in good condition" (Roberson et al. 1998). Figure 3 shows the change in net head with flow at the Pelton wheel for three different pipe sizes: a 4 inch diameter pipe, the pipe diameter Hayes stated conveyed water to the Pelton wheel prior to his purchase of the property; a 6 inch diameter pipe, the diameter of pipe that currently is abandoned near the existing 14 inch pipe; and a 14 inch pipe, which currently exists. Assuming a static head of 200 feet, the net head decreases dramatically with flow in a 4 inch diameter pipe and is relatively constant in a 14 inch pipe as shown in Figure 3.

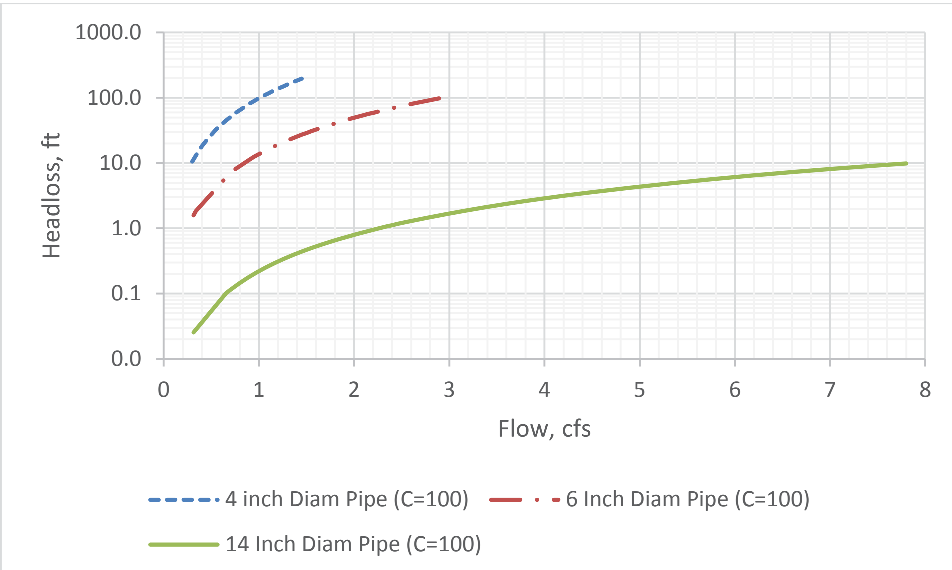

Figure 4. Pipe Headlosses

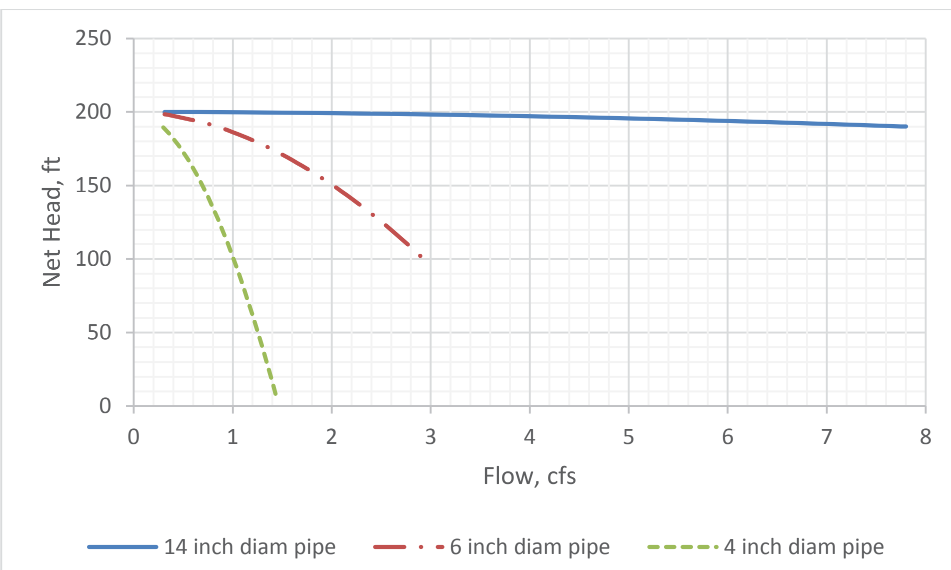

Figure 5. Net Head Change with Flow

The change in power production is dramatically influenced by the pipe size as shown in Figure 4. Assuming an efficiency of 70 percent for the time prior to Cole's power plant upgrades, peak power generation of 6.47 kW occurs at a peak flow of 0.85 cfs for a 4 inch diameter pipe, 18.8 kW at a flow of 2.4 cfs for a 6 inch diameter, and 174 kW at a flow of 22 cfs for a 14 inch pipe (the current pipe size.) These estimates are based on a static head of 200 feet, Hazen-Williams coefficient of 100, and pipe length of 500 feet and were calculated using Equation 1.

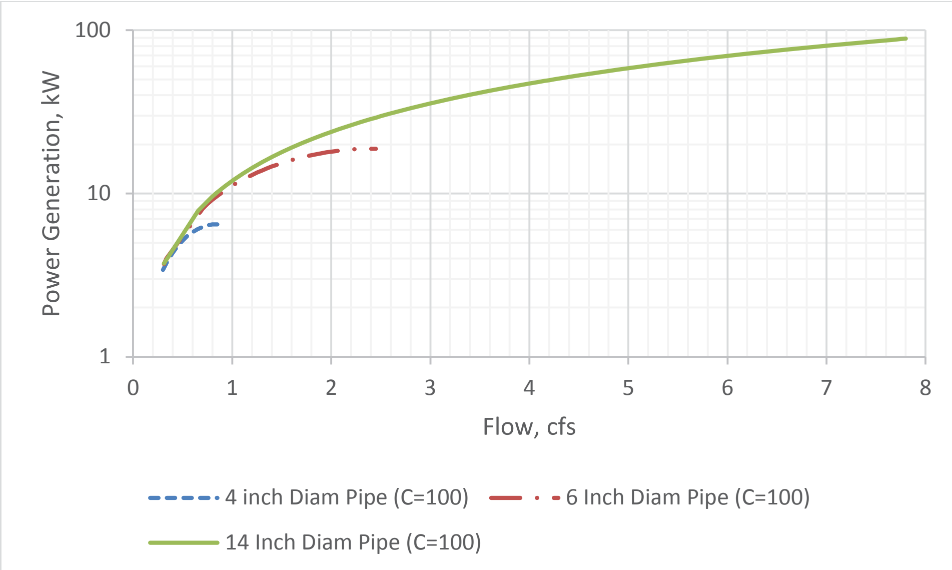

Figure 6. Power Generation Rating Curves

Table 8 lists Cascade's estimates for the flow required to generate the power at the existing power plant. These estimates likely are somewhat greater than actual generation rates as there are likely losses that are not accounted for in these calculations and power generation efficiency may be less than 80 percent as estimated, but not measured by Douglas Cole.

Table 8. Estimate of Flow Required to Generate Power under Present Day Conditions

Flow, cfs	Power, kW
0.29	4
0.66	9
2.47	34
2.80	38
7.68	100

Equation 1. Power Generation Equations

$$P_i = \rho \cdot g \cdot Q \cdot \Delta H \cdot \mu$$

Where:

P_i = Power

ρ = Fluid density

Q = Flow rate

ΔH= Net head change across turbine (static head minus head losses)

μ = Power generation efficiency

The analysis does show that power generation can be a significant nonconsumptive use of diversion flows, and that that use increased materially from the Hayes' acquisition of the MMR to the present.

Cascade used the power generation estimates and statements provided by Hayes and Cole as well as readily available information to estimate water use over time. During the active mining period from 1865 to 1920's/1930's, the shaded area in Figure 5 shows the amount of the water right Stanshaw acquired (approximately 15 cfs), and the average summer base flow for Stanshaw Creek (approximately 2 cfs). Diversion rates likely varied seasonally between these ranges, although an analysis of Stanshaw Creek average flows by season (Miller, 2000) showed that even average winter flows are well below 15 cfs. Uses from 1920's/1930's until 1955 when Lue Hayes purchased the property for based on available evidence, was between 0 and 0.36 cfs. Figure 2 illustrates how water use for mining and hydropower has changed over time.

Table 9. Estimated Water Use Rate for Mining and Power Generation

Date	Mining, cfs	Hydropower, cfs
1860's- 1920's or 1930's	up to 15	0-0.36[3]
Pre-1955[1]	0.00	0.00 to 0.36[2, 3]
1955[1]	0.00	0.36[2,3]
1960[1]	0.00	0.66[2,4]
1965[1]	0.00	3[2]
1998[2]	0.00	3
2010[2]	0.00	3 to 3.5

1. Multiple sources including Lue Hayes; see discussion in text
2. Douglas Cole account
3. Assumes power production was limited to 4 kW or less at an efficiency of 70 percent.
4. Assumes power production was limited to 9 kW at an efficiency of 70 percent.

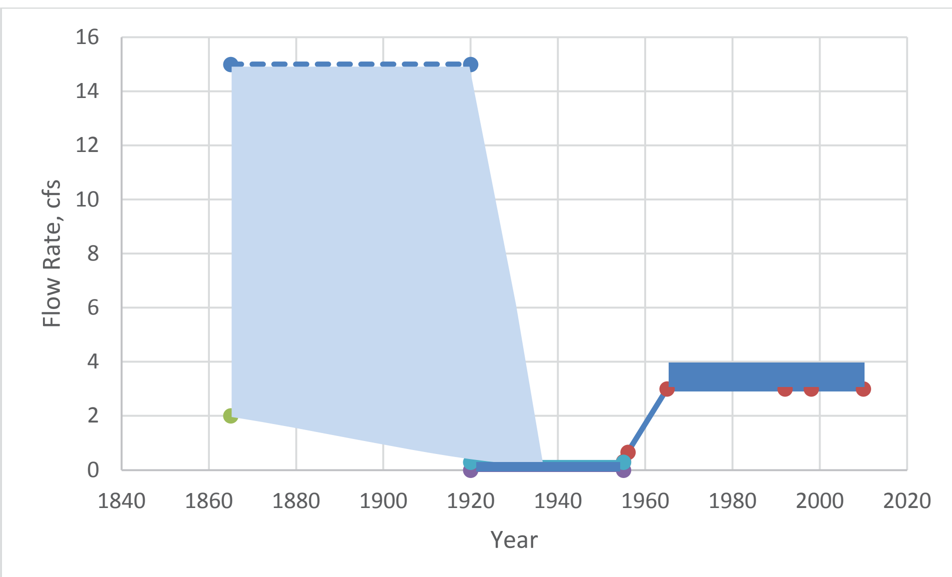

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Figure 7. Water Use for Mining and Hydropower Generation

7.0 Flow Measurements

Cascade identified four reported flow measurements of ditch flows. The first measurement of 0.49 cfs was conducted in 1958 and reported in DWR Bulletin No. 94-6. R.G. Squires measured 2.75 cfs in the fall of 1998 using a float method. State Water Resources Control Board (SWRCB) staff measured 2.75 cfs, date not listed in May 23 2002 memorandum, and 0.6 cfs in the fall of 2001. Cascade measured 1.68 cfs in the late summer of 2013. These flow measurements are listed in Table 10.

In addition to these reported measurements, in June of 2013, Doug Cole established three measurement locations to quantify flow through his diversion system. These locations are shown in Figure 1. They consist of rectangular metal boxes 1.57 feet deep by 2.5 feet wide. Mr. Cole measures velocity and flow depth at 0.417 feet (5 inches), 1.25 feet (15 inches), and 2.083 feet (25 inches) from the interior box edge to compute a flow rate. Measurement location A is near the point of diversion, B is located between the treated water and power/irrigation flow junction, and C is located near the outlet of the pond.

Cascade measured flows at flow measurement points A, B, and C on August 27, 2013. Measured flows are listed in Table 11. At the time of the measurements, 1.68 cfs was diverted into the ditch near the point of diversion. A combined amount of about 0.36 cfs was treated for use as potable water or infiltrated into the unlined ditch. About 1 cfs was discharged to Irving Creek. At the time of the measurement, the diesel generator was operating because diversion flows were insufficient for hydropower generation. As stated in Section 5.2, the electrical transmission system is currently setup to only accept power from one generation source: hydropower generator or diesel generator. At the time of these measurements, Cascade identified the maximum transmission loss was less than 0.36 cfs, the maximum consumptive use was 0.68 cfs, there was no hydropower generation, and flow discharged to Irving Creek was about 1 cfs.

Table 10. Ditch Flow Measurements

Date Reported	Date Measured	Flow Rate, cfs	Measured by	Measurement Method
5/1965	1958	0.49	unnamed DWR staff	N/A
11/5/1998	11/5/1998	2.75	R.G. Squires	Float
5/4/1999[1]		2.75	C. O. Murray, SWRCB	N/A
5/23/2002	10/17/2001	0.6	C.A. Rich and M.C. Contreras, SWRCB	Current Meter
	8/27/2013	1.68	J. Howard	Midsection using FlowTracker

Table 11. Cascade 27 August 2013 Flow Measurements

Measurement Location	Measurement Date And Time	Diversion Ditch Flow, cfs	Difference between u/s and d/s Locations, cfs
A	2013/08/27 12:41:54	1.68	
B	2013/08/27 11:38:43	1.32	0.36
C	2013/08/27 09:58:15	1.03	0.29

8.0 Summary:

The anecdotal record of use suggests that diversions from Stanshaw Creek at the point of diversion associated with the E. Stanshaw's claim has varied over time as land use has changed from largely mining to agriculture and domestic to commercial and domestic. As a result, water diversions from Stanshaw Creek likely varied greatly since the diversion was first established. Current maximum diversion rates are limited to the ditch capacity of about 4 cfs. The available accounts indicate that while the diversion rate may have been as high as the water rights claim of up to 15 cfs in the late 19th and early 20th century, the diversion necessary to satisfy consumptive use demands on MMR decreased to a low of less than about 0.3 cfs in the mid-20th century. Since this time, consumptive and nonconsumptive demands increased to the current rate of 3 - 4 cfs when that flow rate is available. Figure 2 shows how the two primary uses (mining and hydropower) have changed over time based upon data available for review.

References:

Vossen, P.M. 2000. Growing Temperate Tree Fruit and Nut Crops in the Home Garden, University of California Cooperative Extension. http://homeorchard.ucdavis.edu/daily-water-use-vossen.pdf

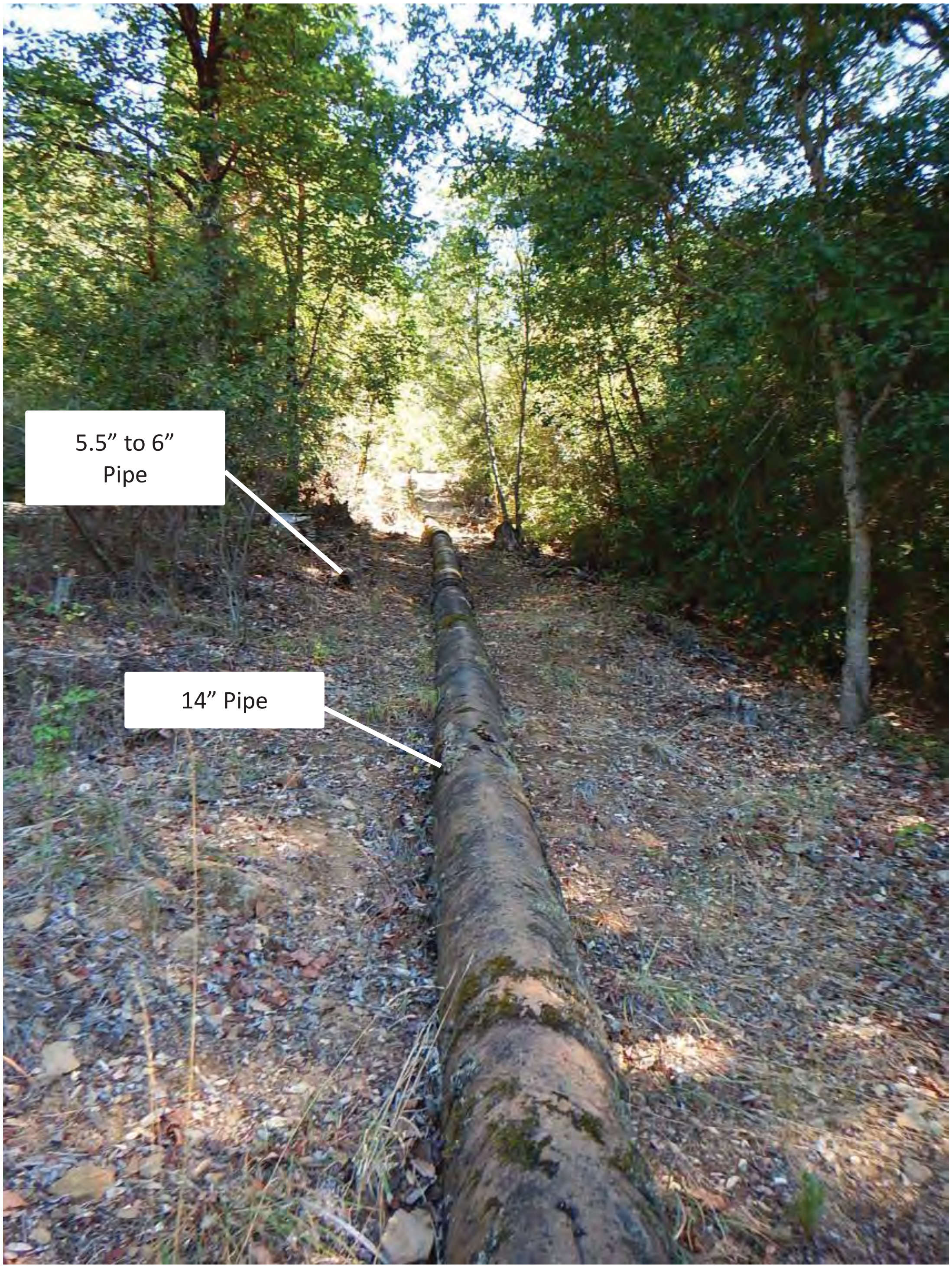
Miller, R. 2000. Environmental Field Report, Application No.: 29449. Prepared by Robert E. Miller SWRCB, Division of Water Rights, Environmental Assessment Section.

Roberson, J., Cassidy, J., Chaudhry, M. 1988. Hydraulic Engineering. Houghton Mifflin Company. Boston. ISBN: 0-395-38123-1.

Mrowka, Katherine. 1993 Feb 4. Letter: Application 29450 of Robert E. and Mary Judith Young - Stanshaw Creek in Siskiyou County.

Appendix A. Site Photographs

Photograph 1. Point of Diversion on Stanshaw Creek



Photograph 2. 14" Diameter Penstock installed by Lue Hayes after he purchased the property in 1955.

Photograph 3. Pipe adjacent to 14" Pipe. End of pipe was crimped making estimation of Interior diameter imprecise.

Photograph 4. Micro-hydro power plant diversion flows enter from the pipes on the left of the photograph. Heated effluent from the heat sink resistor is visible near the top of the photograph near the roof beam.

Photograph 5. Junction near hydro-power unit. Large diameter pipes convey water to Pelton wheel. Small diameter pipe that tees at a 90 degree angle conveys water to heat sink resistor and hose.

Photograph 6. Junctions near power plant. Tee near the bottom of the photograph serves as junction for flow to power plant and irrigation system. Flow conveyed into the pipe to the left of the photograph serves the irrigation system.

Photograph 7. Forebay to pressurized system. Flows enter system through the screen in the half pipe section.

Photograph 8. Stanshaw Gage developed by Douglas Cole.

Photograph 9. HDPE pipe lining ditch.

Photograph 10. Unlined ditch.

Photograph 11. Narrow location in canal, top width about 3.3 feet

Photograph 12. Measurement Point A established by Douglas Cole near point of diversion.

Photograph 13. Markings on metal bar indicate measurement locations.

Photograph 14. Measurement conducted using Swoffer meter.

Photograph 15. Measurement conducted using Swoffer meter.

Appendix B. Power Generation Analysis Methodology

Cascade developed power flow rating curves to estimate power production using readily available information and standard engineering equations. Energy production from a Pelton wheel can be characterized as a function of the fluid density (ρ), acceleration due to gravity (g), flow rate (Q), total dynamic head (ΔH), and the efficiency of the Pelton wheel and electrical system (μ) as shown in Equation 1. In this case, the fluid is water and assumed to a have a constant density of 1000 kg/m^3 (62.4 lbs/ft^3). Computations are based on a gravitational acceleration of 9.81 m/s^2 (32.2 ft/s^2). Total dynamic head was computed by subtracting the static head by the headloss through the pipe. Headlosses through the pipe was computed using the Hazen-Williams equation. The formula is presented in Equation 2. Power generation efficiency was assumed to be 70 percent prior to Douglas Coles acquisition of the property and 80 percent after his acquisition.

Equation 2. Power Generation Equation

$$P_i = \rho \cdot g \cdot Q \cdot \Delta H \cdot \mu$$

Where:
Pi = Power
ρ= Fluid density
Q = Flow rate
ΔH= total head change across turbine, approximately the same as the static head when the velocity and elevation head changes are small
μ = Power generation efficiency

Equation 3. Hazen-Williams Headloss Equation (Imperial Units)

$$h_L = \frac{4.73 * L * Q^{1.852}}{C^{1.852} * D^{4.87}}$$

Where:
L = Pipe length in feet
Q = Flow rate in cubic feet per second
C = loss coefficient
D = pipe diameter in ft