The Source Group, Inc.

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March 8, 2004

Ms. Janet Goldsmith
Kronick, Moskovitz, Tiedemann & Girard
400 Capitol Mall, 27th Floor
Sacramento, California 95814-4417

Subject: Pump Testing Report
El Sur Ranch, Point Sur, California

Dear Ms. Goldsmith:

This Pump Testing Report has been prepared by The Source Group, Inc. (The Source Group) to present results of pump testing activities conducted for El Sur Ranch (the Site) during the week of February 16, 2004. Pump tests were performed on two agricultural supply wells located within Molera State Park adjacent to El Sur Ranch. The purpose of the pump tests was to document operational parameters and limits under different pumping scenarios in order to determine pump efficiencies and provide additional data for the ongoing water use evaluation being conducted by El Sur Ranch.

BACKGROUND

The El Sur Ranch is located north of Big Sur and adjacent to Molera State Park (Figure 1). The portion of the ranch where the pump tests were performed is pastureland just north of the Big Sur River along the Pacific Ocean (Figure 2). Two agricultural supply wells are used to irrigate the pastures as necessary. The initial pump (old pump) was installed in 1955. It is a 60 horsepower centrifugal suction pump capable of irrigating all of the pastures. A second pump (new pump) was installed in 1983 to irrigate the lower elevation fields because the old pump was not as efficient in that configuration. The new pump is a vertical turbine pump with a 50 horsepower motor.

As part of an ongoing water use evaluation being performed by El Sur Ranch, The Source Group was contracted to perform pump-testing activities on the two pumps for the following purposes:

- Determine overall pumping plant efficiencies for each pump at normal operating conditions in each pasture;
- Document well yield for each of the pumping conditions; and
- Determine flow rates vs. power usage for each of the pumping conditions.

Originally, it was anticipated that pump curves for each pump would be available and theoretical flow rates and pump efficiencies could be calculated based on pump curves, motor size, and calculated head losses. As information was gathered; however, it was determined that accurate pump curves were not available because of various pump, motor, and impeller modifications performed over the years. Additionally, the old pump is operated at a constant pressure to prevent cavitation, rather than varying pressures caused by natural elevation changes and piping losses. Because of these reasons, basic theoretical calculations were only performed for verification purposes on the new pump after the pump tests were performed. Using the actual flow rates, elevation gain, and theoretical pipe losses, actual backpressure readings were checked against theoretical values to verify they were in the range expected.

The following sections of the report detail pump testing preparation and field activities performed to gather necessary operational parameters.

PUMP TEST PREPARATION

Before mobilizing to the Site to perform the pump tests, ranch personnel were contacted to discuss typical irrigation valve configurations, and the physical layout of the irrigation system was analyzed to determine test valve settings for each pasture. To better visualize the piping systems for the two pumps, the site plan layout and topographic contours were used to prepare an irrigation piping profile drawing (Figure 3). Using the figure and information regarding typical numbers of valves open for each pasture, pump test scenarios were devised to collect flow, pressure, and power use information for each pasture.

In addition to developing the pump test scenarios, an agricultural pump testing contractor (Wayne Cooper Ag Services) with necessary flow measuring equipment was brought in to collect operating parameters during the tests.

PUMP TESTING

Once the pump testing scenarios were established, the pump testing was conducted. On February 17, 2004, The Source Group and pump testing contractor met on the Site with ranch personnel to perform pump tests. The pump testing scenarios were discussed, and equipment set up and initial valve configurations were prepared. Pump test locations are shown on Figure 3 and the valves that were open during each test are shown in Table 1. Data collection for each pump test included the following:

- Pasture or pasture area being tested;
- Valves open during test;
- Standing water level in well prior to test initiation (feet);
- Water level in well during test at equilibrium (feet);
- Discharge pressure (psi);
- Flow rate (gpm); and
- Kilowatt input to motor during test (KW).

Using this collected data, calculations to determine the following parameters were performed:

- Drawdown in well (feet);
- Discharge head (feet);
- Total dynamic head (feet);
- Well yield (gpm/ft of drawdown);
- Acre-feet /24hr;
- HP input to motor;
- KW-Hr/Acre-Foot; and
- Overall plant efficiency.

The collected and calculated data are presented in Table 1. Provided below are specific activities and information gathered during the tests on each pump.

Pump Tests on Old Pump

Pump testing began with the old pump to the furthest pasture from the pump, the upper north pasture. Valves 1 through 6 were opened and the pump was started. Initially, it was thought that pumping to the north and south pastures created enough backpressure that the pump could operate fully open. After discussing pump operation with ranch personnel; however, it was determined that the flow needs to be restricted at the pump discharge to maintain pump suction. This is the case for all pumping configurations for the old pump.

Flow, backpressure, drawdown, and power usage data were collected for the initial test, prior to moving on to subsequent tests. Tests for the old pump included two tests at different elevations in the north pasture, two tests at different elevations in the south pasture, one test in pastures 1 through 4, and one test in the pump house field. Valves that were open during each test are listed in Table 1. Because the old pump is operated at a constant backpressure to allow continued operation, rather than pushing against different heads, the pumping scenario results are very similar. Overall plant efficiencies were measured between 58.8 and 63.1 percent.

Two additional observations were made during the old pump tests. Because the pump is operated at a constant backpressure, opening individual alfalfa valves further to wider open settings has little effect on flow rate. Also, it was noted that if the old pump is used to irrigate the pump house field, which is reportedly infrequent, plumbing modifications made when the new pump was installed in 1983 require water from the old pump to be pumped up to the lateral between pastures 4 and 5 prior to flowing back down to the pump house lateral. This piping configuration is different than the configuration prior to 1983.

Pump Tests on New Pump

After completing the pump tests on the old pump, tests were initiated on the new pump. Unlike the old pump, the discharge head on the new pump affects the pump operating parameters. Tests on the new pump included one test in pastures 1 through 8, and one in the pump house

field. Valves that were open during each test are listed in Table 1. As expected, flow rates and drawdowns were highest when pumping to the pump house field (lowest discharge head), lower when pumping to pastures 5 through 8, and the lowest when pumping to pastures 1 through 4 (highest discharge head). Overall plant efficiencies ranged between 63.4 and 67.7 percent.

During the tests on the new pump, valve configurations typical for irrigating each pasture were used just as when testing the old pump. An additional test was performed in pasture 4 to determine the effect of opening the alfalfa valves to wider open settings with the same number of valves open. The effects were negligible.

RESULTS AND CONCLUSION

Data collected during the pump testing activities were entered into a data spreadsheet that calculated required information for pump performance analyses. The pump testing results are provided in Table 1. During each pump-testing scenario, care was taken to operate the irrigation valves in a manner that was consistent with standard practices at the ranch. Data is provided for each test performed, and will allow an evaluation of water use in relation to power consumption for each pasture at the ranch based on current irrigation procedures.

This Pump Testing Report has been prepared by The Source Group for use by representatives of the El Sur Ranch. If you have any questions regarding the information provided in this report, please feel free to call us in our Pleasant Hill, California office at (925) 944-2856.

Sincerely,

The Source Group, Inc.

Matthew C. Sutton, P.E.
Senior Engineer

Paul D. Horton, R.G., C.HG.
Principal Hydrogeologist

Attachments: Table 1 – Pump Testing Results
Figure 1 – Site Location Map
Figure 2 – Site Plan
Figure 3 – Irrigation Piping Profile and Pump Test Locations

Table 1
Pump Testing Results
El Sur Ranch
Point Sur, California

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OLD PUMP TESTS

Old Pump	Test Number	Valve(s) Open	Standing Water (feet)	Pumping Water Level (feet)	Drawdown (feet)	Discharge Pressure (psi)	Discharge Head (feet)[1]	Total Dynamic Head (feet)[2]	Flow Rate (gpm)[3]	Well Yield (gpm/ft)	Acre-Feet/24 hr (AF/24 hr)	KW Input to Motor (KW)	HP Input to Motor (HP)	KW-Hr/Acre-Foot (KW-Hr/AF)	Overall Plant Efficiency (%)
North Pasture "A"	1	1-6	7.6	15.9	8.3	54.0	124.6	140.5	1208.0	145.5	5.3	50.7	67.9	227.8	63.1%
North Pasture "B"	2	37-46	7.6	16.1	8.5	54.0	124.6	140.7	1130.0	132.9	5.0	51.1	68.5	245.6	58.6%
South Pasture Upper	3	306-309	7.6	16.0	8.4	54.0	124.6	140.6	1130.0	134.5	5.0	50.3	67.4	241.6	59.5%
South Pasutre Lower	4	271-277	7.6	16.0	8.4	54.0	124.6	140.6	1137.0	135.4	5.0	50.5	67.8	241.4	59.6%
Pasture 1	5	47-58	7.6	16.1	8.5	54.0	124.6	140.7	1165.0	137.1	5.1	50.5	67.8	235.6	61.1%
Pasture 2	6	114-123	7.6	15.9	8.3	54.0	124.6	140.5	1143.0	137.7	5.1	49.9	67.0	237.2	60.6%
Pasture 3	7	213-215	7.6	16.0	8.4	54.0	124.6	140.6	1145.0	136.3	5.1	50.2	67.3	237.9	60.4%
Pasture 4	8	241-251	7.6	16.0	8.4	54.0	124.6	140.6	1110.0	132.1	4.9	49.9	67.0	244.3	58.8%
Pump House Field	9	341-355	7.6	16.1	8.5	54.0	124.6	140.7	1142.0	134.4	5.0	50.1	67.1	238.1	60.4%

NEW PUMP TESTS

New Pump	Test Number	Valve(s) Open	Standing Water (feet)	Pumping Water Level (feet)	Drawdown (feet)	Discharge Pressure (psi)	Discharge Head (feet)[1]	Total Dynamic Head (feet)[2]	Flow Rate (gpm)[3]	Well Yield (gpm/ft)	Acre-Feet/24 hr (AF/24 hr)	KW Input to Motor (KW)	HP Input to Motor (HP)	KW-Hr/Acre-Foot (KW-Hr/AF)	Overall Plant Efficiency (%)
Pasture 1	10	47-58	7.8	11.2	3.4	38.0	87.7	98.9	963.0	283.2	4.3	26.6	35.6	149.9	67.4%
Pasture 2	11	114-123	7.8	11.2	3.4	38.0	87.7	98.9	948.0	278.8	4.2	26.3	35.3	150.7	67.1%
Pasture 3	12	213-215	7.8	11.2	3.4	38.0	87.7	98.9	952.0	280.0	4.2	26.2	35.1	149.4	67.7%
Pasture 4	13	241-251	7.8	10.8	3.0	39.0	90.0	100.8	872.0	290.7	3.9	25.4	34.0	157.9	65.3%
Pasture 5	14	325-171[4]	7.8	12.8	5.0	30.0	69.2	82.0	1302.0	260.4	5.8	30.1	40.4	125.7	66.7%
Pasture 6	15	203-212	7.8	13.0	5.2	29.5	68.0	81.0	1345.0	258.7	5.9	30.8	41.3	124.2	66.7%
Pasture 7	16	157-80[4]	7.8	12.7	4.9	30.0	69.2	81.9	1294.0	264.1	5.7	29.8	39.9	125.0	67.0%
Pasture 8	17	98-112	7.8	12.9	5.1	29.5	68.0	80.9	1361.0	266.9	6.0	30.9	41.4	123.1	67.2%
Pump House Field	18	341-355	7.8	13.2	5.4	24.0	55.4	68.6	1567.0	290.2	6.9	31.9	42.8	110.6	63.4%

Notes:
psi = pounds per square-inch
gpm = gallons per minute
gpm/ft = gallons per minute per foot of drawdown
AF/24hr = acre-feet per 24 hours
KW = kilowatt
HP = horsepower
KW-HR/AF = kilowatt-hour per acre-foot
Shading denotes measured inputs for each test.
[1] Discharge Head correspondes to data input labeled "Discharge Level" on pump test reports from previous years.
[2] Total Dynamic Head corresponds to data input labeled "Total Lift" on pump test reports from previous years.
[3] Poor hydraulic test section for flow rate measurements. Based on diagnostics of equipment during test, though, measurements were within tolerances. Pump testing contractor estimated potential error to be +/- 6%.
[4] Odd valve numbering taken from figure provided by Rasmussen Land Surveying, Inc. who received valve numbering from photogramatist working on project.

ESR-3

The Source Group, Inc. 3451-C Vincent Road Pleasant Hill, CA 94523	**SITE LOCATION MAP**		DATE 02/20/04
	LOCATION EL SUR RANCH POINT SUR, CALIFORNIA	SCALE 0 MILES 1.6 SCALE	FIGURE NO. 1

NOTES:

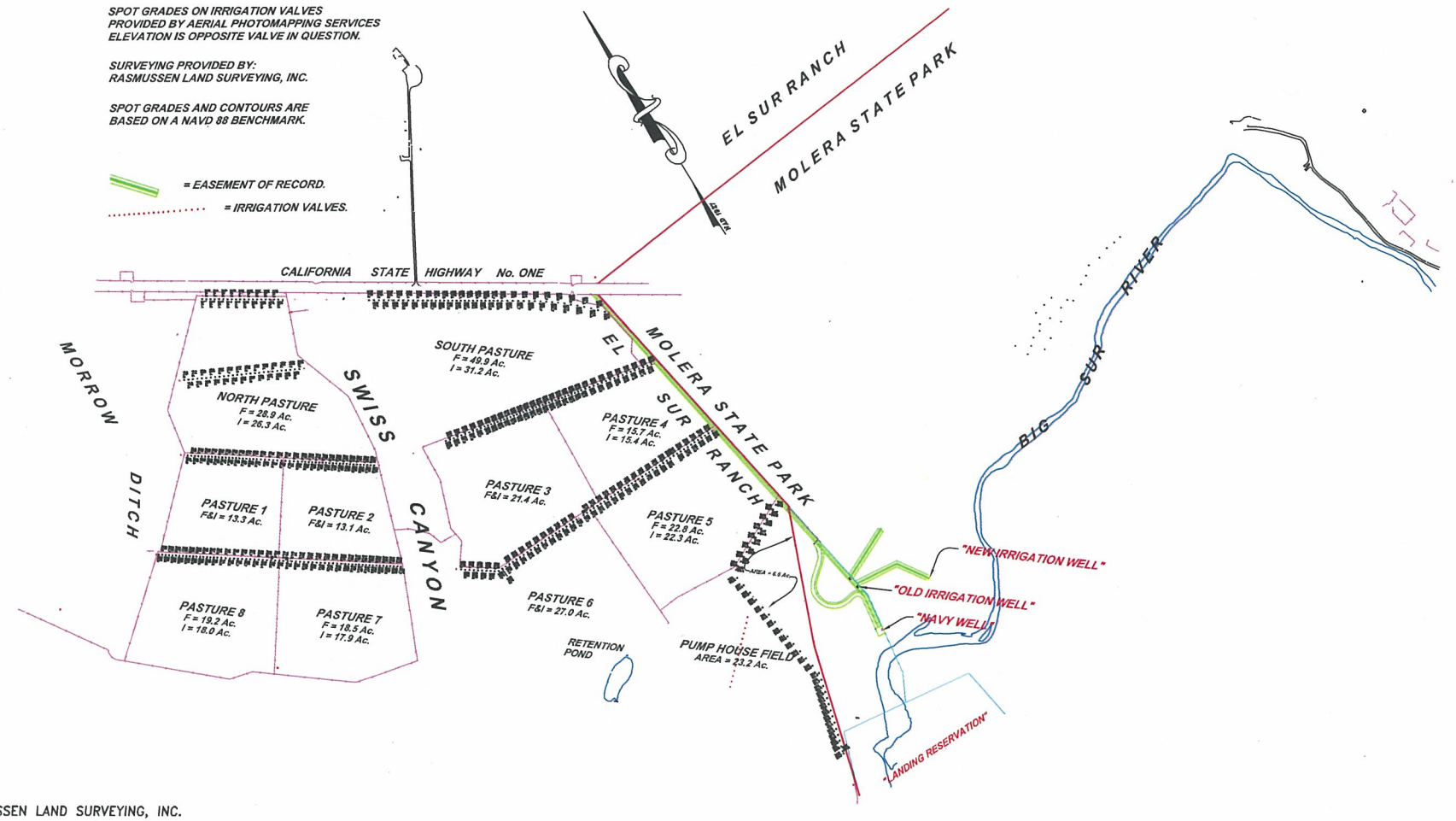
SPOT GRADES ON IRRIGATION VALVES PROVIDED BY AERIAL PHOTOMAPPING SERVICES ELEVATION IS OPPOSITE VALVE IN QUESTION.

SURVEYING PROVIDED BY: RASMUSSEN LAND SURVEYING, INC.

SPOT GRADES AND CONTOURS ARE BASED ON A NAVD 88 BENCHMARK.

= EASEMENT OF RECORD.

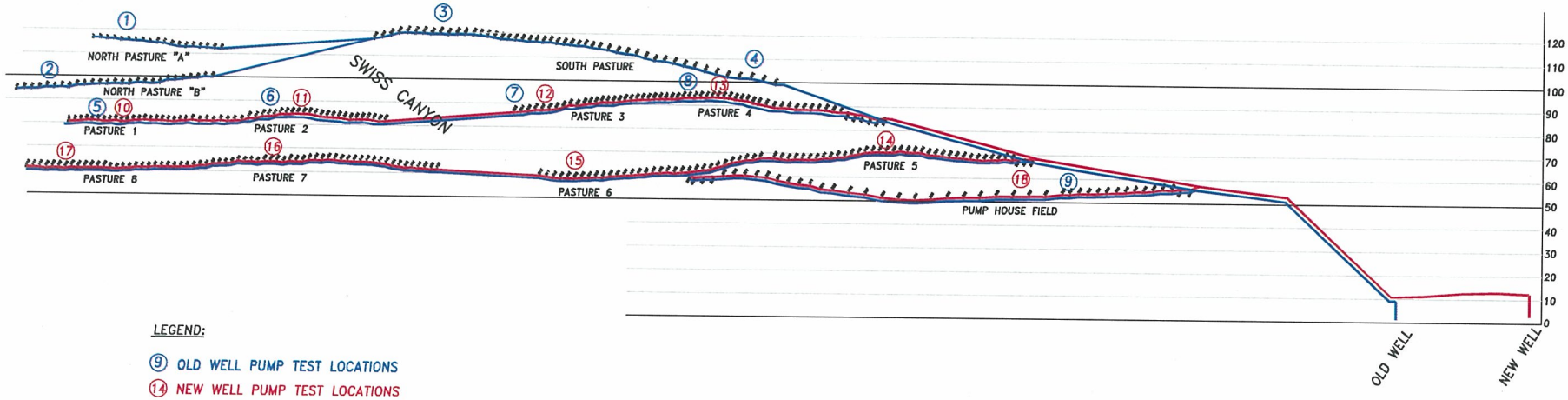
= IRRIGATION VALVES.



REF: RASMUSSEN LAND SURVEYING, INC.

The Source Group, Inc. 3451-C VINCENT ROAD PLEASANT HILL, CA 94523	SCALE 0 750 1500 SCALE IN FEET	EL SUR RANCH POINT SUR, CALIFORNIA			SITE PLAN	
	FILE NAME	DATE 2/19/04	DR. BY DB	APP. BY MS	PROJECT NO. 01-ESR-001	FIGURE NO. 2

ESR-3



LEGEND:

⑨ OLD WELL PUMP TEST LOCATIONS

⑭ NEW WELL PUMP TEST LOCATIONS

The Source Group, Inc.
3451-C VINCENT ROAD
PLEASANT HILL, CA 94523

HORIZONTAL SCALE
0 450 900
SCALE IN FEET

FILE NAME: El Sur Ranch\Figure 3

EL SUR RANCH
POINT SUR, CALIFORNIA

IRRIGATION PIPING PROFILE AND TEST LOCATIONS

DATE	DR. BY	APP. BY	PROJECT NO.	FIGURE NO.
2/19/04	DB	MS	01-ESR-001	3

ESR-3