SWCA
ENVIRONMENTAL CONSULTANTS

Memorandum

To: Project File – Rosemont - 15998

CC:

From: Chris Garrett

Date: May 31, 2011

Re: Revised Springs Inventory for Rosemont Project Area – for Cooperating Agency Draft of DEIS

Following receipt of Regional Office/Washington Office comments on the DEIS, and prior to release for review by Cooperators, the springs inventory used in the Groundwater Quantity, Heritage, Biology, and Livestock Grazing sections was extensively revised by SWCA.

As originally prepared, the springs inventory relied on consultant reports prepared for Rosemont (Errol L. Montgomery & Associates 2009a, Tetra Tech 2010e, Westland 2007a). These reports contained details on springs as observed in the field, including flow and water quality data. This core of well-documented springs was built upon with additional data obtained from water rights reports conducted for Rosemont (Pearce 2007), and other selected springs identified in review comments or specifically requested to be included.

Prior to the Regional Office/Washington Office draft, the BLM conducted an extensive review of the DEIS and noted several springs missing from the inventory that they felt should be included. This triggered a top-to-bottom review of the springs inventory. Several limitations in the previous inventory were noted: although all of the springs identified by BLM but were readily identifiable on USGS topographic maps they were not in the existing inventory, and in any case the search radius used previously for the springs analysis was much too small to incorporate these springs.

SWCA determined that the springs inventory required complete revision, with a view to revising both raw data sources as well as search radius from the mine pit.

<u>Raw Data Sources</u>

1. Rosemont Sources (Pearce 2007 water rights memorandum, WestLand Resources 2007a springs assessment, Errol L. Montgomery and Associates 2009a hydrogeologic investigations, TetraTech 2010e spring impact assessment)

2. Springs depicted on USGS topographic map using ARCGIS Service. National Geographic online variable scale topographic maps available at http://services.archgisonline.com/arcgis/services.
3. USGS Geographic Names Information System (GNIS) GIS database.
4. Arizona Department of Water Resources Statement-of-Claimant (SOC) database.

Reliability of Data Sources

The data sources above are listed in order of their expected reliability. Springs included in the original Rosemont sources were identified or observed in the field and are expected to be of the highest reliability, albeit for a limited area.

Springs identified on USGS topographic maps, as well as the USGS GNIS database, are expected to be of moderate reliability. For these sources, the locations of the springs aren't in question so much as the continued existence of the springs. It is recognized that springs mapped decades ago may or may not still be in existence.

The final source—the ADWR SOC database—was determined to have the lowest reliability of the data sources. The SOC database contains records filed by water users requesting the inclusion of a perceived water right in the legal water right adjudication process for the Gila River watershed. The court has yet to determine any validity or priority of these statements of claimant. While there is a fairly good chance that springs included in the SOC database represent true sources of water, these are located based on cadastral locations (township/range/section) as filed by landowners. These are notoriously incorrect.

It should be noted that ALL data sources listed above were used. The perceived reliability only comes into play when reconciling potential duplicate records between the different data sources, as described later in this memo.

Search Radius from Mine Pit

The mine pit is the point from which the cone of depression in the regional groundwater table will expand, and around which the drawdown contours are roughly centered. Springs impact analysis is based on the 5-foot drawdown contour as modeled by the Montgomery Mine Site Model (Montgomery & Associates 2010) and Tetra Tech Mine Site Model (Tetra Tech 2010h). It was determined that to fully encompass the area within the 5-foot drawdown contour, springs within a 12-mile radius of the mine pit would need to be inventoried.

Reconciling Conflicting Records

In order to combine the various data sources into one comprehensive spring inventory, a series of scenarios and rules were formulated based on the perceived reliability of the data. Where no conflict occurred between data sources, springs from any data source were assumed to be valid and incorporated into the inventory.

For these scenarios, the term "primary database" refers to data sources #1, #2, and #3 above. These data sources largely had no conflict among themselves. The rules formulated below are largely aimed at reconciling the SOC database with the primary database, and determining when unnamed springs are identical to named springs. Note that the distance of 640 feet is the smallest linear increment in the cadastral numbering system, equaling the length of the side of a quarter-quarter-quarter section; in other words, springs occurring within 640 feet of each other are considered to be identical in location.

Scenarios:

1. **IF** there is a named spring in the primary database, **AND** an unnamed spring in the SOC database occurs within 640 feet, **THEN** throw out SOC data. **Underlying assumption:** the unnamed spring is likely the same physical spring as the named spring.

2. **IF** there is a named spring in the primary database, **AND** a named spring of a different name in the SOC database occurs within 640 feet, **THEN** throw out SOC data. **Underlying assumption:** the springs refer to the same physical spring, and the name given on the topographic maps or field surveys is likely the appropriate name.

3. **IF** there is an unnamed spring in the primary database, **AND** the named spring in the SOC database occurs within 640 feet, **THEN** keep the SOC data. **Underlying assumption:** the springs refer to the same physical spring, and the name given by the SOC applicant is likely the appropriate name.

4. **IF** there is a named spring in Rosemont Sources that occurs on the USGS topo **OR** in GNIS database with the same name but in different locations (within reason), **THEN** rely on the Rosemont Source data. **Underlying assumption:** the springs refer to the same physical spring, but the Rosemont data sources were field-verified and likely reference the correct location. However, some spring names are fairly common, so if the springs are far distant, then they are likely to be different springs entirely.

5. **IF** there is a named spring in the primary database that occurs in the SOC database with the same name but in different location, **THEN** rely on primary data and do not include the SOC data in the inventory. **Underlying assumption:** the springs refer to the same physical spring, but the SOC location is likely incorrect.

Overview of Approach to Impacts Analysis

For many of the seeps and springs now in the inventory, not only is the existence of the spring not known with certainty, but the exact source of groundwater that might feed the spring is also unknown. The following qualitative thresholds were established to reflect this uncertainty in the impacts analysis:

- Major – Reduction in flow can be estimated with high certainty and would impact resource function. The water source for the spring (regional or local groundwater) is known.

- Minor – Reduction in flow can be estimated with high certainty but is not likely to impact resource function. The water source for the spring is known.
- Possible – Reduction in flow could occur, but uncertainty exists regarding the source of the water.
- Unlikely – Reduction in flow is unlikely to occur. The water source for the spring is known.

For the purposes of the impacts analysis, springs are considered impacted if they are in the "major" or "possible" categories. Springs with "major" impacts are primarily those well that have been investigated and are suspected of relying on regional groundwater, and those springs that are very near the mine pit. Springs with "possible" impacts reflect the majority of springs in the database. These are almost all springs that are observed on topographic maps that fall within the 5-foot drawdown contour in the regional water table. The present-day existence of these springs is not known with any certainty, nor is their source of water known. The underlying logic for including them in the impacts analysis is: a) the regional bedrock aquifer is known to support springs, b) if they were obvious enough in the field to be labeled on a topographic map, that implies a level of seasonal persistence that would reflect a steady groundwater source, and c) the conservative approach in the face of uncertainty is to assume they will be impacted, while acknowledging the uncertainty exists.

Attachments

The full springs inventory is attached. Springs are identified by name, cadastral location, and a reference number that matches the attached reference map.

References

Errol L. Montgomery and Associates, Inc. 2009a. *Results of Phase 2 Hydrogeologic Investigations and Monitoring Program, Rosemont Project, Pima County, Arizona*. 2 vols. Prepared for Rosemont Copper Company. Tucson, Arizona: Errol L. Montgomery and Associates, Inc. February 26.

Montgomery & Associates, Inc. 2010. Groundwater Flow Modeling Conducted for Simulation of Proposed Rosemont Pit Dewatering and Post-Closure. Prepared for Rosemont Copper Company. Tucson, Arizona: Errol L. Montgomery and Associates, Inc. August 30.

Pearce, M.J. 2007. Re: Rosemont Copper Company Mine Plan of Operations. Water Rights data requested by CNF. November 20.

Tetra Tech. 2010e. *Davidson Canyon Hydrogeologic Conceptual Model and Assessment of Spring Impacts.* Tetra Tech Project No. 114-320869. Prepared for Rosemont Copper. Tucson, Arizona. July.

Tetra Tech. 2010h. *Regional Groundwater Flow Model Rosemont Copper Project*. Tetra Tech Project No. 114-320874. Prepared for Rosemont Copper. Tucson, Arizona. November.

Westland Resources, Inc. 2007a. *Rosemont Project Preliminary Springs Assessment [Issue SW-2; Item No. 12]*. Prepared for US Forest Service, Coronado National Forest. Tucson, Arizona: Westland Resources, Inc. December 3.

	MPO	Barrel	Barrel Trail	Scholefield	Phased Tailings
Total Springs in Inventory	132	132	132	132	132
Springs Directly Impacted by Footprint	12	11	12	19	12
Springs with expected drawdown or water losses:					
- Major Impact	6	7	6	7	6
- Minor Impact	2	2	2	2	2
- Possible Impact	66	66	66	60	66
- Unlikely Impact	8	8	8	6	8
-Total Indirectly Impacted (i.e., Major and Possible)	72	73	72	67	72
TOTAL SPRINGS IMPACTED (DIRECT OR INDIRECT)	**84**	**84**	**84**	**86**	**84**
TOTAL SPRINGS NOT IMPACTED	**48**	**48**	**48**	**46**	**48**

	A	B	C	D	E
1	**Name of Spring**	**Cadastral Location**	**Observed Flow Rate***	**Data Source**	**Map ID**
2	Alamo Spring	D-21-16 1dda		USGS topographic map	50
3	Aliso Spring	D-19-15 34cd		USGS Geographical Name InformatiionSystem database	19
4	Apache Spring	D-20-16 6dc		USGS Geographical Name Information System database	20
5	Armour Spring	D-20-15 6db		USGS Geographical Name Information System database	21
6	Baldy spring	D-20-15 18ab		USGS Geographical Name Information System database	22
7	Barrel Spring	D-18-16 14cab	Small seep; <1 gallon per minute (gpm)	WestLand Resources, Inc. (WestLand) (2007b); Montgomery and Associates (M&A) (2009)	89
8	Basin Spring	D-19-15 11bab		USGS topographic map	130
9	Batamout Spring	D-18-16 8ba		ADWR Statement of Claimant	86
10	Bear Spring	C-20-15 22b		USGS Geographical Name Information System database	23
11	Bee Spring	D-18-16 31bb		ADWR Sttement of Claimant	18
12	Bellows Spring	D-20-15 18ba		USGS Geographical Name Information System database	24
13	Big Spring	D-18-16 18caa		USGS Geographical Name Information System database	14
14	Bobo Spring	D-17-17 21b		USGS Geographical Name Information System database	25
15	Bog Spring	D-20-14 1ac		USGS Geographical Name Information System database	26
16	Bootlegger Spring	D-17-18 31cc		USGS topographic map	45
17	Bowman Spring	D-19-15 13ac		USGS topographic map	128
18	Box Canyon Spring	D-19-15 12ba		ADWR Statement of Claimant	56
19	California Mine Spring	D-17-17 19db		USGS topographic map	125
20	Chavez Spring	D-18-15 14dbb	Unknown	BLM	120
21	Chet Spring	D-21-16 4cc		USGS topographic map	52
22	Cold Water Spring	D-18-17 23dbc		ADWR Statement of Claimant	64
23	Cottonwood Spring	D-20-16 33ad		USGS topographic map	53
24	Cow Spring	D-17-16 19dca		ADWR Statement of Claimant	70
25	Crucero Spring	D-18-16 9cbd	Dry, up to <1 gpm	M&A (2009)	111
26	Dam Spring	D-17-16 32aac		ADWR Statement of Claimant	Not shown on map
27	Davidson Spring†	D-17-17 19ac	Unknown	Tetra Tech (2010a)	117
28	Deering Spring	D-19-15 1dbd	~1 gpm	M&A (2009)	116
29	Develop Spring	D-20-15 13ab		ADWR Statement of Claimant	60
30	Diesler Spring	D-18-15 24cc		ADWR Statement of Claimant	2
31	Double Spring	D-18-16 8baa		ADWR Statement of Claimant	87
32	Dutch John Spring	D-19-14 36dc		USGS Geographical Name Information System database	27

	A	B	C	D	E
33	Escondido[†]	D-16-17 30a	Unknown	Tetra Tech (2010a)	131
34	Faber Spring	D-19-14 24da		USGS Geographical Name Information System database	28
35	Feliz Spring	D-18-15 35ba		ADWR Statement of Claimant	5
36	Fence Spring	D-17-15 35bdb		ADWR Statement of Claimant	66
37	Fig Tree Spring	D-18-16 19abb	<0.1 gpm	M&A (2009)	107
38	Florida Spring	D-20-15 6aa		USGS Geographical Name Information System database	29
39	Grader Spring	D-18-16 27ca		ADWR Statement of Claimant	16
40	Heiter Spring	D-18-15 1ddb		ADWR Statement of Claimant	75
41	Helvetia Spring	D-18-15 14DBA	~0.2-1.6 gpm	BLM	122
42	Hilton Spring	D-17-17 32caa		ADWR Statement of Claimant	65
43	Hole Seep Spring	D-19-15 1bc		ADWR Statement of Claimant	58
44	Horse Pasture Spring	D-18-16 15aa	Unknown	Pearce (2007)	97
45	HQ Water Spring	D-18-16 16cd		ADWR Statement of Claimant	6
46	Indian Spring	D-17-15 36cbc		ADWR Statement of Claimant	67
47	Kent Spring	D-20-14 12aa		USGS Graphical Name Information System database	30
48	La Cholla Spring	D-18-16 5cba		ADWR Statement of Claimant	76
49	Lazy Boy spring	D-18-16 18ad		ADWR Statement of Claimant	13
50	Little Indian Spring	D-17-15 36cbc		ADWR Statement of Claimant	68
51	Locust Spring	D-19-15 1bdb	Dry, occasional damp	M&A (2009)	115
52	Lower Mulberry Spring	D-18-16 9dbb	Moist, up to <0.1 gpm	M&A (2009)	112
53	Lower Spring	D-18-16 8abc		ADWR Statement of Claimant	82
54	McBeth Spring	D-20-14 13da		USGS Geographic Name Information System database	31
55	McCleary Dam	D-18-16 29bda	Flow under dam, 2 to 3 gpm	M&A (2009)	108
56	McCleary No. 1	D-18-16 30abc	Varies from dry to small seep; ~1 gpm	WestLand (2007b); M&A (2009); Pearce (2007)	95
57	McCleary No. 2	D-18-16 19cdd	No flow – ground moist; <1 gpm	WestLand (2007b); M&A (2009)	93
58	Melon Spring	D-18-16 17bba		ADWR Statement of Claimant	9
59	Mescal Spring	D-17-17 21a		USGS Geographical Name Information System database	32
60	Mesquite Flat Spring	D-18-16 7aaa		USGS Topographic Map	127
61	Mine Water Spring	D-19-15 24dc		ADWR Statement of Claimant	61
62	Monkey Spring	D-21-16 3cb		USGS Topographic Map	51
63	Mud Spring	D-19-18 28bc		USGS Topographic Map	46
64	Mudhole Spring	D-18-16 17bb		ADWR Statement of Claimant	8
65	Mueller Spring	D-18-16 29cc		ADWR Statement of Claimant	17

	A	B	C	D	E
66	Mulberry Spring	D-18-16 9abc	Dry, up to <0.1 gpm	M&A (2009)	110
67	Oak Spring	D-18-16 17bbc		ADWR Statement of Claimant	10
68	Ojo Blanco Spring	D-18-16 4cd		USGS Geographical Name Information System database	33
69	Paja Verde Spring	D-19-15 23ca		USGS Geographical Name Information System database	34
70	Papago Spring	D-21-17 17da		USGS Topographical Map	49
71	Papago Spring (No. 2)	D-18-16 16bba	Dry, up to 1.7 gpm	M&A (2009)	113
72	Peligro Adit	D-18-15 24dcc	Seep	M&A (2009)	106
73	Pole Cat Spring	D-18-16 7bd		ADWR Statement of Claimant	80
74	Proctor Box Spring	D-19-15 12bc		ADWR Statement of Claimant	57
75	Proctor Spring	D-19-15 3acc		USGS Topographic Map	129
76	Questa Spring	D-18-16 27ddd	Small pond present; <1 gpm	WestLand (2007b); M&A (2009); Pearce (2007)	94
77	Robinson Spring	D-19-15 29cb		USGS Geographical Name Information System database	35
78	Rock Spring	D-18-16 6ddd		ADWR Statement of Claimant	79
79	Rockhouse Spring	D-18-17 10cda		ADWR Statement of Claimant	62
80	Rosemont Spring	D-18-16 32bbc	~1 to 2 gpm	WestLand (2007b); M&A (2009); Pearce (2007)	96
81	Ruelas Spring	D-18-15 35bdc	Dry, occasional damp	M&A (2009)	109
82	Ruelas Spring Number Two and Thre	D-18-15 26aa		USGS Geographical Name Information System database	36
83	Rust Spring	D-18-15 1acb		ADWR Statement of Claimant	74
84	Sanford Spring	D-18-17 15daa		ADWR Statement of Claimant	63
85	Sawmill Spring	D-20-15 4bb		USGS Geographical Name Information System database	37
86	Scholefield No. 1	D-18-16 16ccc	No flow – ground dry	WestLand (2007b); M&A (2009)	90
87	Scholefield No. 2	D-18-16 17adb	No flow – ground moist	WestLand (2007b); M&A (2009)	91
88	Scholefield No. 3	D-18-16 17caa	No flow – ground dry	WestLand (2007b)	92
89	Shamrod Spring	D-18-15 14BCD	Unknown	BLM	119
90	Siphon Spring	D-17-16 31cda		ADWR Statement of Claimant	73
91	Soldier Spring	D-18-15 25bb		ADWR Statement of Claimant	3
92	Sprung Spring	D-20-14 13ab		USGS Geographical Name Information System database	38
93	SS-2	D-18-15 13aab	Dry	M&A (2009)	105
94	Sulfur Spring			USGS Geographical Name Information System database	12
95	SW	D-19-15 1bbb	Dry, occasional damp	M&A (2009)	114
96	Sweetwater Spring	D-20-15 11bbb		USGS Geographical Name Information System database	39
97	Sycamore Spring	D-18-15 12dba	Dry, to 1 gpm	M&A (2009)	104
98	Sylvester Spring	D-20-14 1dc		USGS Geographical Name Information System database	40

	A	B	C	D	E
99	Tree Spring	D-18-16 8acc		ADWR Statement of Claimant	84
100	Tub Spring	D-1816 6dd		ADWR Statement of Claimant	78
101	Tunnel Spring	D-17-16 32cb		USGS Topographic Map	124
102	Tunnel Spring #2	D-17-16 31bbd		ADWR Statement of Claimant	71
103	Unnamed Spring (Reach 2)†	D-17-17 06bd	Unknown	Tetra Tech (2010a)	118
104	Unnamed Spring No. 1	D-18-15 23ba	Unknown	Pearce (2007)	98
105	Unnamed Spring No. 2	D-18-16 30cd	Unknown	Pearce (2007)	99
106	Unnamed Spring No. 3	D-18-16 30cd	Unknown	Pearce (2007)	100
107	Unnamed Spring No. 4	D-18-16 26bc	Unknown	Pearce (2007)	101
108	Unnamed Spring No. 5	D-18-16 29ab	Unknown	Pearce (2007)	102
109	Unnamed Spring No. 6 (Possibly sam	D-18-16 19cd	Unknown	Pearce (2007)	103
110	Unnamed Spring No.7	D-17-17 28b		USGS Topographic Map	44
111	Unnamed Spring No.8	D-20-14 12ac		USGS Topographic Map	47
112	Unnamed Spring No.9	D-20-14 14aa		USGS Topographic Map	48
113	Unnamed Spring No.10	D-20-15 21cd		USGS Topographic Map	54
114	Unnamed Spring No. 11	D-20-15 27bb		USGS Topographic Map	55
115	Unnamed Spring No.12	D-18-17 6ac		USGS Topographic Map	126
116	Unnamed Spring No. 13	D-18-15 34aa		ADWR Statement of Claimant	4
117	Unnamed spring No. 14	D18-16 21bc		ADWR Statement of Claimant	15
118	Unnamed Spring No. 15	D-20-14 10ddc		USGS Geographical Name Information System database	42
119	Unnamed Spring No. 16	D-17-15 36cc		ADWR Statement of Claimant	69
120	Unnamed Spring No. 17	D-18-16 8ac		ADWR Statement of Claimant	83
121	Unnamed Spring No. 18	D-18-15 13ac		ADWR Statement of Claimant	0
122	Unnamed Spring No. 19	D-18-15 13ad		ADWR Statement of Claimant	1
123	Unnamed Spring No. 20	D-17-16 31cd		ADWR Statement of Claimant	72
124	Unnamed Spring No. 21	D-18-16 6dc		ADWR Statement of Claimant	77
125	Unnamed Spring No. 22	D-18-16 7da		ADWR Statement of Claimant	81
126	Unnamed Spring No. 23	D-18-16 8ba		ADWR Statement of Claimant	85
127	Unnamed Spring No. 24	D-18-16 8ca		ADWR Statement of Claimant	88
128	Upper Empire Gulch Spring†	D-19-17 18AAD	Unknown	BLM	123
129	Walnut Spring	D-20-14 11ccc		USGS Geographical Name Information System database	41
130	Willow Spring	D-19-15 22bc		USGS Geographical Name Information System database	43
131	Wood Spring	D-18-16 17cbb		ADWR Statement of Claimant	11

	A	B	C	D	E
132	Water Develop Spring	D-18-16 17ab		ADWR Statement of Claimant	7
133	Zackendorf Spring	D-18-15 14ADA	Unknown	BLM	121

Figure x. Springs.