Appendix A
Modeling Memorandums

Memorandum

Environmental Resources Management

2875 Michelle Drive
Suite 200
Irvine, CA 92606
(949) 623-4700
(949) 623-4711 (fax)

To: Mr. Wayne Praskins

From: Mr. Truong Mai, P.E.
Ms. Heather Balfour, P.E.
Mr. Greg Murphy, P.G.

cc: Mr. Joe Hovermill (Miles & Stockbridge P.C.)
Mr. Jim Meeder and Mr. Kamran Javandel (Allen Matkins Leck Gamble Mallory & Natsis LLP)
Mr. David Towell (CH2M HILL)

Date: 15 February 2013

Subject: Data Gathering Summary
Source Area Operable Unit
B.F. Goodrich Superfund Site

As requested by the U.S. Environmental Protection Agency (USEPA), ERM-West, Inc. (ERM) has prepared this memorandum to summarize the data-gathering activities performed for the Source Area Operable Unit at the B.F. Goodrich Superfund Site on behalf of Emhart Industries, Inc. (Emhart). This memorandum summarizes the data gathered for the modeling task and presents data gathered for and development of groundwater elevation maps and anticipated combined target capture zone map based on recent datasets.

Data Gathered for Modeling Task

ERM compiled data from the City of Colton, City of Rialto, West Valley Water District, and Fontana Water Company for production wells throughout the basin, to incorporate into the updated USEPA model. Attachment A includes the following:

- Exhibit 1 - Map showing the well locations;
- Exhibit 2 - Pumping data compiled;
- Exhibit 3 - Summary of the annual pumping totals; and
- Exhibit 4 – Quarterly pumping information (For production wells where only annual data is available, ERM assumes that quarterly pumping patterns for these wells are similar to pumping patterns for other wells where monthly or quarterly data is available.).

Exhibits 1 through 4 were presented during the 11 December 2012 status conference call for the groundwater flow modeling task. These exhibits have been updated based on additional data gathered since that call. The most significant modifications included identifying and correcting a double-counting of one of the wells (it was identified under two different names) and including monthly data received from USEPA for Fontana Water Company. Emhart is currently in discussions with Fontana Water Company to obtain pumping data and to reconcile any potential discrepancies in the data provided by the USEPA and/or others.

Additional data gathered to update the USEPA model include:

- Specific Capacity Data – ERM reviewed data provided by CH2M HILL and purveyors and various reports to evaluate the transmissivity and hydraulic conductivity within the USEPA model. These sources are being used in the sensitivity analysis and calibration of the updated model.
- Data from additional models and modeling reports prepared for the Rialto-Colton Basin and Chino Basin. As appropriate, elements from these models are being incorporated into the updated USEPA model.
- Compiled streamflow data (U.S. Geological Survey [USGS]); precipitation data (NWS, San Bernardino Flood Control District, PRISM); and monthly Linden Pond recharge data (West Valley Water District) for review of mass balance of the USEPA model.

Water Level and Water Quality Data

ERM obtained water level and water quality data from the following sources:

- USEPA and CH2M HILL;
- State Water Resources Control Board;
- USGS;
- National Water Information System (USGS website);
- Cooperative monitoring program (Steve Mains);
- County of San Bernardino groundwater monitoring reports prepared by GeoLogic Associates;

- Goodrich Corporation Progress Report for the Month of February 2008 (Geosyntec 10 March 2008).
- Final Remedial Investigation Report (ENVIRON International Corporation, February 2010); and
- Additional data from purveyors (City of Colton, City of Rialto and West Valley Water District).

The figures in Attachment B post the perchlorate and trichloroethene (TCE) concentrations from the groundwater samples collected through third quarter 2012. Attachment C presents the groundwater elevation maps using the available data from April and May 2012.

Anticipated Combined Target Capture Zone

As set forth in the Statement of Work[1], the Target Area is defined in Section 2.4.8 - Area and Depth Targeted in the Operable Unit of the 2010 Record of Decision (ROD; USEPA, 2010) and repeated below:

- Portion of the Intermediate Aquifer impacted with perchlorate or TCE, at concentrations greater than their respective maximum contaminant levels (MCLs);
- Underlying portion of the Regional Aquifer impacted with perchlorate or TCE above MCLs; and
- Additional portion of the Regional Aquifer extending downgradient to where the Intermediate and Regional Aquifers merge.

Emhart's current understanding of the Target Area, as defined in the Statement of Work, is presented on Figures 3 and 4 within Attachment B. Figures 3 and 4 (Attachment B) also include the limits of capture for the County of San Bernardino remedy (County Remedy), as presented in their third quarter 2012 groundwater monitoring report (GeoLogic, 2012). Considering the potential combination of the County Remedy with the

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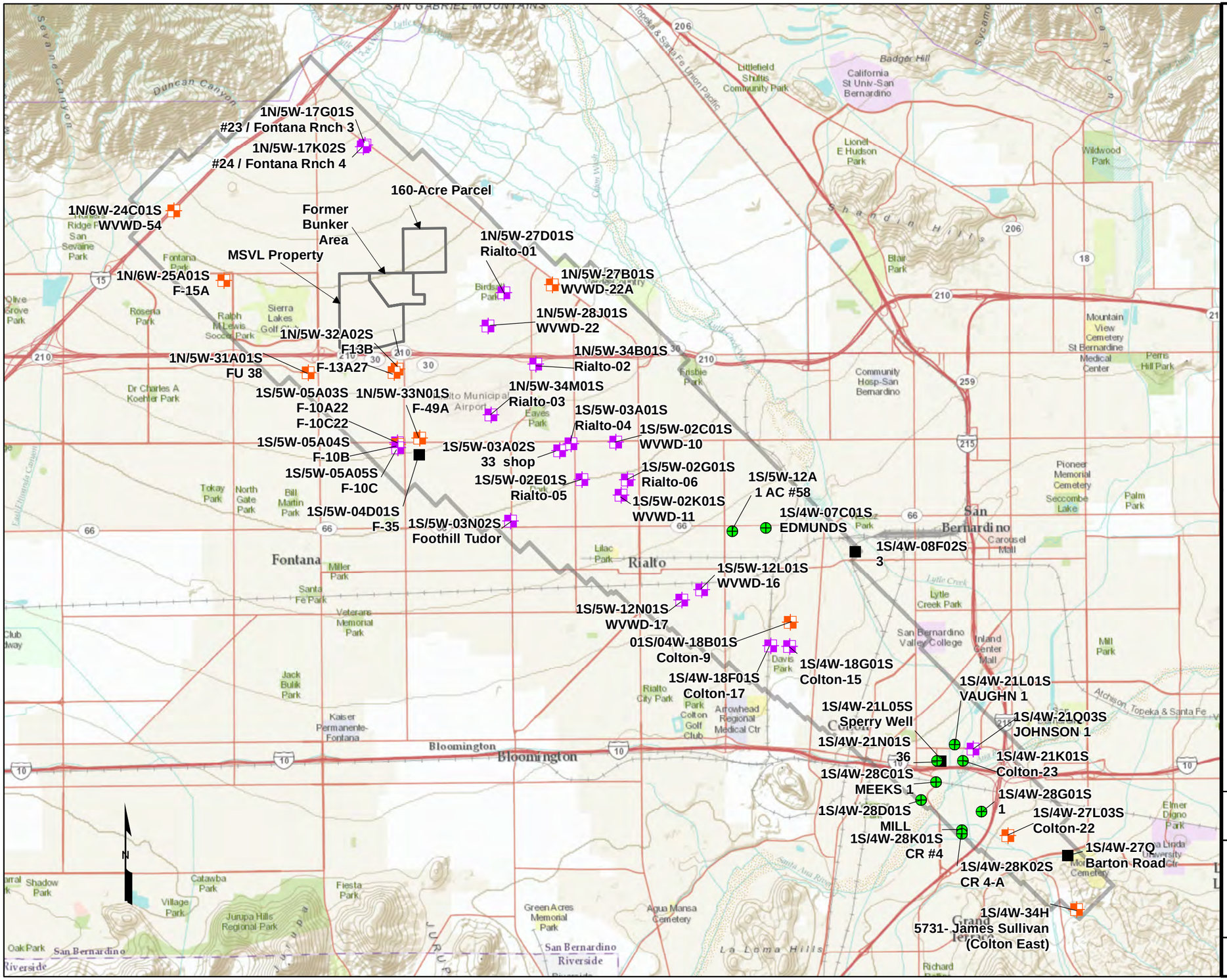
[1] *Statement of Work for Remedial Design and Remedial Action for the Source Area Operable Unit, B.F. Goodrich Superfund Site,* which is Attachment F to the Work Consent Decree that was lodged on 4 December 2012, with the U.S. District Court for the Central District of California in *City of Colton v. American Promotional Events, Inc. West, et al.*, Case No. ED CV 09-01864 PSG

Work Consent Decree (Work), an anticipated combined capture zone is shown on Figures 3 and 4 (Attachment B). Figures 5 and 6 (Attachment B) present cross-sectional views from the northwest corner of the 160-acre area downgradient to well PW-9.

Upon completion of the modeling work and/or remedial design investigation, as described in Sections 3.2.2 and 3.2.1 respectively of the *Remedial Design Work Plan*, the anticipated combined capture zone will be updated as appropriate based on updated groundwater quality data.

Attachment A



Legend

- EPA 2012 Model Boundary

Model Production Wells

- EPA 2012 Model
- EPA 2012 and USGS Model
- USGS Model
- Additional Wells

Riato-Colton Basin
San Bernardino County, California

EXHIBIT 1

Production Well Locations

ERM

PREPARED BY: (ERM)	JOB NO. 0179962.03.A FILE: Rialto_Production_Review.mxd

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Exhibit 2

Pumping Well Information
Source Area Operable Unit, B.F. Goodrich Superfund Site

Recordation No	State Well No	Owner	Watermaster Well Name	Alternate Name	Available Annual Pumping Date Range		Available Monthly Pumping Date Range		Comments Regarding Pumping Data	Well Screen Interval (ft. bgs)	Well Screen Interval (ft. MSL)		Boring Log Available?
											Screen Bottom	Screen Top	
3600178	01S/04W-08F02S	ATCHISON TOPEKA & SANTA FE RAILWAY	3		1970	1972				116-126,140-166,190-216,246-328,350-370	742.95	996.95	Yes
3603916	01S/04W-08Q04S	COLTON, CITY OF	#29		2004	2007	7/1/2003	8/1/2007			600	760	Yes
3601255	01S/04W-18B01S	COLTON, CITY OF	9		1970	1981			No monthly data available for time period when well pumping	201-216, 267-326	799.34	924.34	Yes
3601261	01S/04W-18F01S	COLTON, CITY OF	17	COLTON-17	1970	2011	1/1/1993	10/1/2012			342	874	Yes
3601259	01S/04W-18G01S	COLTON, CITY OF	15	COLTON-15	1970	2011	1/1/1993	10/1/2012		244-344,356-436,500-514,522-534	561	851	Yes
3603367	01S/04W-21K01S	COLTON, CITY OF	#23	COLTON-23	1991	2011	1/1/1993	10/1/2012			36	706	**No**
3602881	01S/04W-27L03S	COLTON, CITY OF	22	COLTON-22	1985	2011	2/1/1993	10/1/2012			152	842	Yes
3602356	01S/04W-34H	COLTON, CITY OF	5731- James Sullivan	Colton East	1970	1986			No monthly data available for time period when well pumping		201	845	**No**
3603060	01N/05W-29R15S	FONTANA UNION WATER COMPANY	FU 37		1989	2011			Duplicate of F-13A37. Not included in the model.	520-990	513	983	**n/a**
	01N/05W-31A01S	FONTANA UNION WATER COMPANY	FU38		1992	1999			1992-1999 data from CH2M HILL	1242-1055	1055	1242	Yes
3603739	01N/05W-32A02S	FONTANA UNION WATER COMPANY	F13B	F-13B	2001	2011	1/1/2001	7/31/2010	Monthly data from EPA (missing 2007 monthly data)		367	897	Yes
3603764	01N/05W-33N01S	FONTANA UNION WATER COMPANY	F49A	F-49A	2003	2011	1/1/2001	7/31/2010	Monthly data from EPA (missing 2007 monthly data)	300-1040	375	1115	Yes
3603726	01N/06W-25A01S	FONTANA UNION WATER COMPANY	F15A	F-15A	2000	2011	1/1/2001	7/31/2010	Monthly data from EPA (missing 2007 monthly data)		409	1159	Yes
3600589	01S/05W-04D01S	FONTANA UNION WATER COMPANY	35		1974	1988				290-530	865	1105	Yes
3600577	01S/05W-05A03S	FONTANA UNION WATER COMPANY	22	F10A22	1970	2000				240-525, 620-842	568	1132	Yes
3603765	01S/05W-05A05S	FONTANA UNION WATER COMPANY	F10C	F-10C	2003	2011	1/1/2001	7/31/2010	Monthly data from EPA (missing 2007 monthly data)	100-1010	416	966	Yes
		FONTANA UNION WATER COMPANY		F-13A37	1992	2011	1/1/2001	7/31/2010	1992-2011 data from CH2M HILL. Well is FU 37 in watermaster pumping database. Monthly data from EPA (missing 2007 monthly data).	520-990	513	983	Yes
3603626	01S/05W-05A04S	SAN GABRIEL VALLEY WATER COMPANY	F10B	F-10B	2003	2011	1/1/2001	7/31/2010	Monthly data from EPA	500-1030	381	911	Yes
3602228	01S/04W-18F01S	LA SIERRA WATER COMPANY	17		1970	1996			Not a well. Allocation of pumping from Colton-17 assigned to La Sierra - Requested information from City of Colton regarding how this pumping is reported.	n/a	n/a	n/a	n/a
3602227	01S/04W-18G01S	LA SIERRA WATER COMPANY	15		1970	1996			Not a well. Allocation of pumping from Colton-17 assigned to La Sierra - Requested information from City of Colton regarding how this pumping is reported.	n/a	n/a	n/a	n/a
3603950	01S/04W-21L05S	MEEKS & DALEY WATER COMPANY	Sperry Well		2011	2011				195-765 195-210,225-260,260-275,275-315,340-405,425-435,445-485,540-605,625-675,695-730,750-765	206.5	767.5	Yes
3601510	01S/04W-21N01S	MEEKS & DALEY WATER COMPANY	36		1973	2009				96-180,286-312,337-360, 283-286,416-435,437-457,620-635,552-602,645-670	293.6	867.6	Yes

Exhibit 2

Pumping Well Information
Source Area Operable Unit, B.F. Goodrich Superfund Site

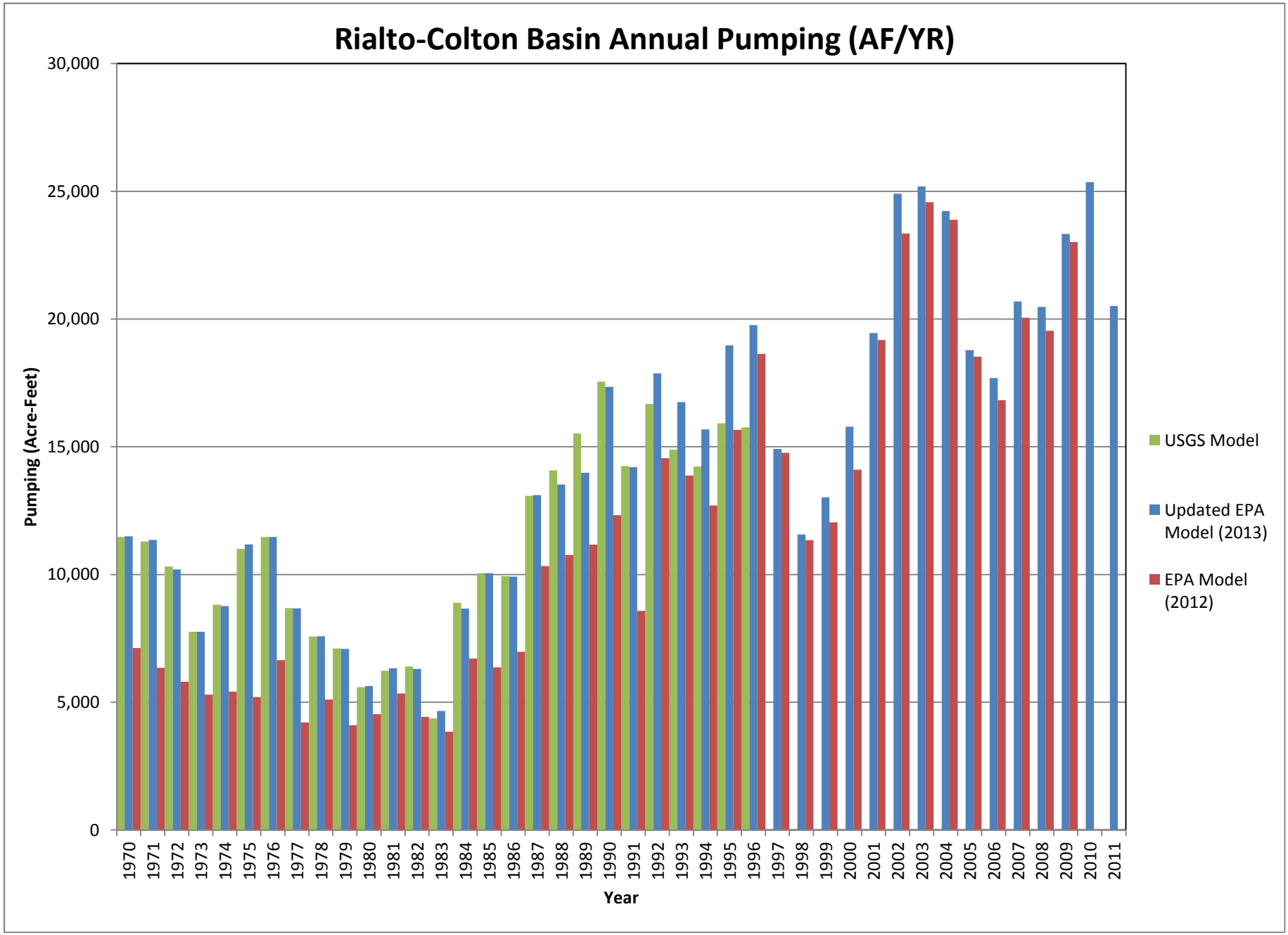
Recordation No	State Well No	Owner	Watermaster Well Name	Alternate Name	Available Annual Pumping Date Range		Available Monthly Pumping Date Range		Comments Regarding Pumping Data	Well Screen Interval (ft. bgs)	Well Screen Interval (ft. MSL)		Boring Log Available?
											Screen Bottom	Screen Top	
3603910	01S/04W-27Q	MONTECITO MEMORIAL PARK	Barton Road		2008	2011				100-120,170-260,290-370,470-530,560-620,680-760	935.6	275.6	Yes
3602253	01N/05W-27D01S	RIALTO, CITY OF	Rialto #1, Cedar	RIALTO-01	1970	2007	10/1/1965	4/1/2007		650-865, 890-958	583	891	Yes
3601993	01N/05W-34B01S	RIALTO, CITY OF	Rialto #2, Highland	RIALTO-02	1962	1997	10/1/1965	10/1/1997		588-1000	445	857	Yes
3602558	01N/05W-34M01S	RIALTO, CITY OF	Rialto #3, Airport	RIALTO-03	1973	2011	1/1/1973	1/1/2011		525-860	550	885	Yes
3603576	01S/05W-02E01S	RIALTO, CITY OF	Rialto #5	RIALTO-05	1995	2011	2/1/1995	1/1/2011		240-280, 360-820	475	955	Yes
3603103	01S/05W-02G01S	RIALTO, CITY OF	Rialto #6, Etiwanda	RIALTO-06	1990	2002	6/1/1990	5/1/2002		440-830, 930-970	477	867	Yes
3601264	01S/05W-03A01S	RIALTO, CITY OF	Rialto #4 / Duncan	RIALTO-04	1947	2006	1959	11/1/2006		355-425, 432-545, 554-564, 572-577, 600-637, 644-652, 664-688, 716-722, 726-758, 804-878	476	922	Yes
3602269	01S/05W-03N02S	RIALTO, CITY OF	Rialto #7, Tudor	foothilltudor	1972	1993	5/1/1972	7/1/1993		312-552	760	1000	Yes
3601525	01S/04W-28K01S	RIVERSIDE HIGHLAND WATER CO	CR #4		1970	1979				0-94,104-124,124-134,150-190,228-240,324-334,370-380	570.5	949.5	Yes
3602182	01S/04W-28K02S	RIVERSIDE HIGHLAND WATER CO	CR 4-A		1970	1992				18-45,45-74,78-94,94-98,98-114,164-170	778.7	930.7	Yes
3601481	01S/04W-21L01S	RIVERSIDE, CITY OF	VAUGHN 1		1970	1985				101-125,126-145,167-194, 227-242,264-270, 372-409	551.6	859.6	Yes
3601480	01S/04W-21Q03S	RIVERSIDE, CITY OF	JOHNSON 1		1970	1982				194-220,224-230,250-260,296-310,310-314	645.8	765.8	Yes
3601482	01S/04W-28C01S	RIVERSIDE, CITY OF	MEEKS 1		1970	1982				103-160,160-432	525.5	854.5	Yes
3602208	01S/04W-28D01S	RIVERSIDE, CITY OF	MILL		1970	2008				135-435	807.6	507.6	Yes
0000203	01S/04W-07C01S	SEQUOIA COUNTRY CLUB	EDMUNDS		1970	1978				205-235,290-293,308-312,330-357,378-382,398-402,400-410,410-422,510-537	664.6	996.6	Yes
3601008	01S/05W-12A	SOUTHERN CALIFORNIA EDISON	1 AC #58		1970	1995				boring log illegible. Assign well to model layers 3-4	n/a	n/a	Yes
3601548	01S/04W-28G01S	VILLELLI ENTERPRISES	1		1970	1980				106-116,130-135,189-193	764.6	851.6	Yes
3601691	01N/05W-17G01S	WEST VALLEY WATER DIST	#23 / Fontana Rnch 3	WVWD-23	1970	1979	5/1/1979	8/1/2002		54-204	1646	1796	Yes
3601931	01N/05W-17K02S	WEST VALLEY WATER DIST	#24 / Fontana Rnch 4	WVWD-24	1960	2011	2/1/1979	10/1/2012		61-220	1634.1	1794.1	Yes
3603770	01N/05W-27B01S	WEST VALLEY WATER DIST	#22A Linden Vineyard	WVWD-22A	2003	2006	7/1/2003	4/30/2006			474	1064	Yes
3601690	01N/05W-28J01S	WEST VALLEY WATER DIST	#22 / Fontana Rnch 2	WVWD-22	1981	1991	5/1/1981	1/1/1981		440-495, 530-555, 608-623, 690-709, 720-730, 750-773	741	1074	Yes
3603946	01N/06W-24C01S	WEST VALLEY WATER DIST	#54	WVWD-54	2007	2011				500-1000	472	982	Yes
3600309	01S/05W-02C01S	WEST VALLEY WATER DIST	#10 Baseline Willow	WVWD-10	1970	1971				384-420, 588-594, 609-614, 630-662, 696-720, 750-774, 832-844, 850-888	458.7	962.7	Yes
3600311	01S/05W-02K01S	WEST VALLEY WATER DIST	#11 Victoria/Willow	WVWD-11	1970	2011	3/1/1998	10/30/2012		684-706	500	977	Yes
3603465	01S/05W-03A02S	WEST VALLEY WATER DIST	#33 shop	33shop	1994	2011	1992	3/30/2012		460-950	405	895	Yes
3601001	01S/05W-12L01S	WEST VALLEY WATER DIST	#16 / Boyd	WVWD-16	1970	2011	1/1/1979	10/30/2012		292-388, 390-464	713.2	979.2	Yes
3600995	01S/05W-12N01S	WEST VALLEY WATER DIST	#17 Acacia/Merrel	WVWD-17	1972	2006	3/1/1979	10/1/2006		183-187, 195-200, 211-220, 228-237, 258-270, 280-409, 447-450, 520-524, 539-549, 600-613, 623-630	485.7	990.7	Yes

Exhibit 2

Pumping Well Information
Source Area Operable Unit, B.F. Goodrich Superfund Site

Recordation No	State Well No	Owner	Watermaster Well Name	Alternate Name	Available Annual Pumping Date Range		Available Monthly Pumping Date Range		Comments Regarding Pumping Data	Well Screen Interval (ft. bgs)	Well Screen Interval (ft. MSL)		Boring Log Available?
											Screen Bottom	Screen Top	
Extraction Well IN EPA Model but no assigned pumping - same as F10A22													
3600577	01S/05W-05A03S	FONTANA UNION WATER COMPANY		F-10C22					This is a zero pumping well in the model - removed	NA			No

Exhibit 3


Rialto-Colton Basin Annual Pumping (AF/YR)
Pumping (Acre-Feet)
30,000
25,000
20,000
15,000
10,000
5,000
0
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
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2007
2008
2009
2010
2011
Year
USGS Model
Updated EPA Model (2013)
EPA Model (2012)

Exhibit 4

Quarterly Pumpage Information
Source Area Operable Unit, B.F. Goodrich Superfund Site

Year	Quarter	Total Quarterly Pumpage per Records Available (AF/qtr)	% of annual	Data Source
1970	1	100.6	5%	R
1970	2	595.6	28%	R
1970	3	920.3	43%	R
1970	4	506.7	24%	R
1971	1	451.8	19%	R
1971	2	566.8	24%	R
1971	3	950.5	40%	R
1971	4	395.1	17%	R
1972	1	516.2	18%	R
1972	2	854.8	30%	R
1972	3	1,135.3	40%	R
1972	4	331.8	12%	R
1973	1	438.2	15%	R
1973	2	719.3	24%	R
1973	3	1,349.8	45%	R
1973	4	488.2	16%	R
1974	1	413.5	15%	R
1974	2	749.4	27%	R
1974	3	1,226.5	44%	R
1974	4	400.2	14%	R
1975	1	284.5	10%	R
1975	2	953.3	33%	R
1975	3	1,464.5	50%	R
1975	4	228.6	8%	R
1976	1	416.4	12%	R
1976	2	1,169.4	32%	R
1976	3	1,271.7	35%	R
1976	4	751.2	21%	R
1977	1	128.4	7%	R
1977	2	354.9	20%	R
1977	3	757.3	43%	R
1977	4	516.8	29%	R
1978	1	310.2	13%	R
1978	2	959.1	39%	R
1978	3	1,077.5	44%	R
1978	4	96.3	4%	R
1979	1	174.7	8%	R-WVWD
1979	2	635.9	29%	R-WVWD
1979	3	1,113.4	50%	R-WVWD
1979	4	292.8	13%	R-WVWD
1980	1	239.3	9%	R-WVWD
1980	2	723.2	27%	R-WVWD
1980	3	1,104.0	40%	R-WVWD
1980	4	660.3	24%	R-WVWD
1981	1	304.0	9%	R-WVWD
1981	2	1,082.4	33%	R-WVWD
1981	3	1,502.8	46%	R-WVWD
1981	4	367.7	11%	R-WVWD

Year	Quarter	Total Quarterly Pumpage per Records Available (AF/qtr)	% of annual	Data Source
1982	1	159.2	7%	R-WVWD
1982	2	616.0	29%	R-WVWD
1982	3	1,188.6	55%	R-WVWD
1982	4	183.1	9%	R-WVWD
1983	1	153.0	7%	R-WVWD
1983	2	812.3	35%	R-WVWD
1983	3	889.3	38%	R-WVWD
1983	4	464.8	20%	R-WVWD
1984	1	400.8	11%	R-WVWD
1984	2	1,142.5	30%	R-WVWD
1984	3	1,634.0	43%	R-WVWD
1984	4	608.5	16%	R-WVWD
1985	1	313.5	9%	R-WVWD
1985	2	1,287.2	35%	R-WVWD
1985	3	1,496.7	41%	R-WVWD
1985	4	539.9	15%	R-WVWD
1986	1	309.5	7%	R-WVWD
1986	2	1,283.5	28%	R-WVWD
1986	3	2,019.3	43%	R-WVWD
1986	4	1,051.4	23%	R-WVWD
1987	1	952.1	14%	R-WVWD
1987	2	2,336.9	36%	R-WVWD
1987	3	2,167.7	33%	R-WVWD
1987	4	1,119.1	17%	R-WVWD
1988	1	1,066.9	17%	R-WVWD
1988	2	1,870.3	31%	R-WVWD
1988	3	2,027.3	33%	R-WVWD
1988	4	1,146.8	19%	R-WVWD
1989	1	846.4	11%	R-WVWD
1989	2	1,999.0	25%	R-WVWD
1989	3	2,900.2	37%	R-WVWD
1989	4	2,110.9	27%	R-WVWD
1990	1	1,245.0	14%	R-WVWD
1990	2	2,840.9	32%	R-WVWD
1990	3	3,177.1	36%	R-WVWD
1990	4	1,531.1	17%	R-WVWD
1991	1	364.9	8%	R-WVWD
1991	2	1,125.6	24%	R-WVWD
1991	3	1,942.9	41%	R-WVWD
1991	4	1,285.6	27%	R-WVWD
1992	1	760.9	10%	R-WVWD
1992	2	2,703.0	34%	R-WVWD
1992	3	3,209.7	41%	R-WVWD
1992	4	1,213.5	15%	R-WVWD
1993	1	2,358.1	20%	C-R-WVWD
1993	2	4,426.1	37%	C-R-WVWD
1993	3	3,518.8	29%	C-R-WVWD
1993	4	1,645.5	14%	C-R-WVWD

Exhibit 4

Quarterly Pumpage Information
Source Area Operable Unit, B.F. Goodrich Superfund Site

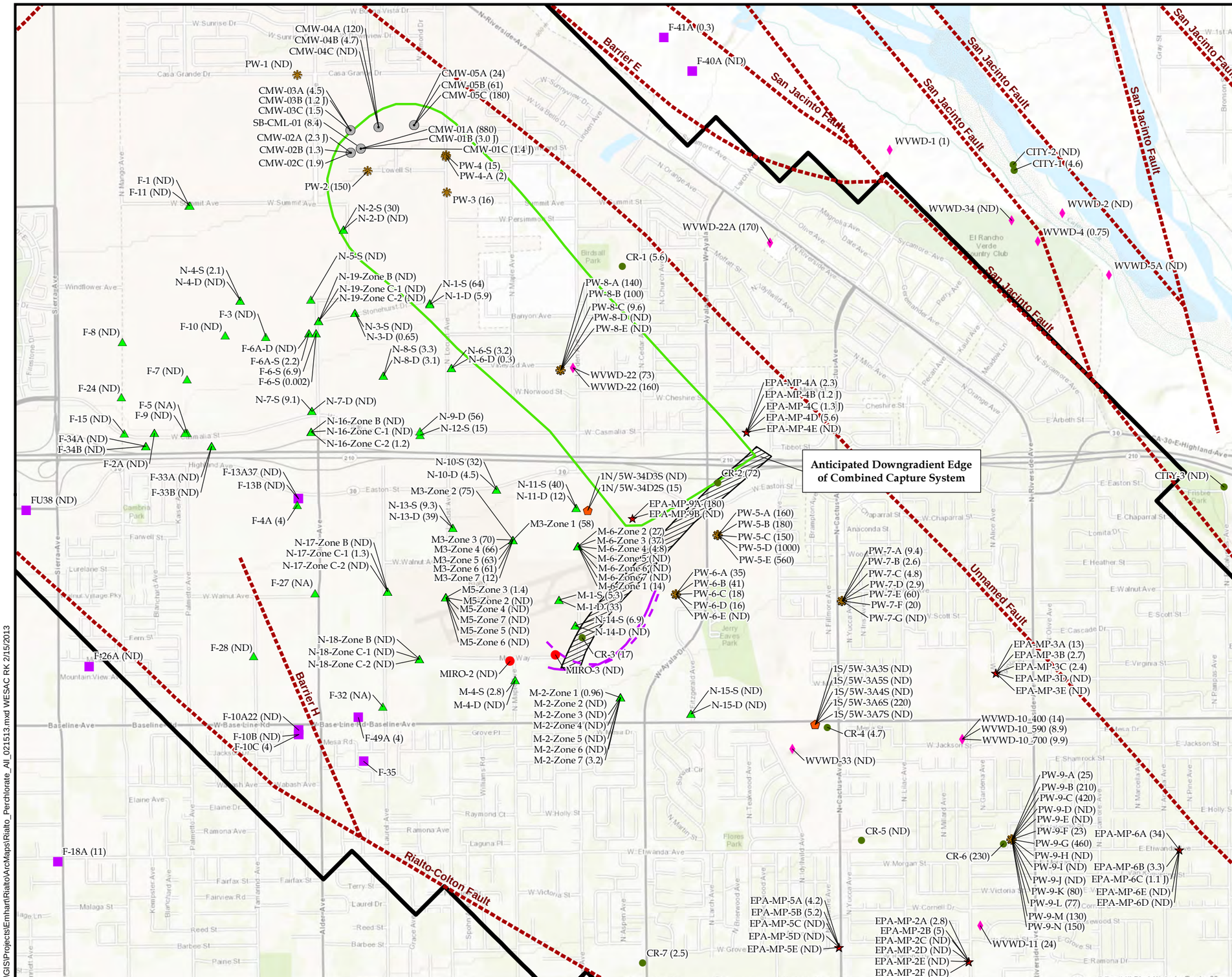
Year	Quarter	Total Quarterly Pumpage per Records Available (AF/qtr)	% of annual	Data Source
1994	1	1,726.4	16%	C-R-WVWD
1994	2	2,177.0	21%	C-R-WVWD
1994	3	4,575.7	44%	C-R-WVWD
1994	4	2,016.1	19%	C-R-WVWD
1995	1	1,437.7	11%	C-R-WVWD
1995	2	2,839.9	23%	C-R-WVWD
1995	3	5,108.2	41%	C-R-WVWD
1995	4	3,213.9	26%	C-R-WVWD
1996	1	2,269.5	17%	C-R-WVWD
1996	2	4,032.3	30%	C-R-WVWD
1996	3	4,617.8	35%	C-R-WVWD
1996	4	2,368.5	18%	C-R-WVWD
1997	1	1,909.7	19%	C-R-WVWD
1997	2	2,891.8	28%	C-R-WVWD
1997	3	3,685.8	36%	C-R-WVWD
1997	4	1,816.9	18%	C-R-WVWD
1998	1	1,542.8	18%	C-R-WVWD
1998	2	1,977.6	23%	C-R-WVWD
1998	3	3,107.7	37%	C-R-WVWD
1998	4	1,824.0	22%	C-R-WVWD
1999	1	1,527.5	17%	C-R-WVWD
1999	2	1,959.1	22%	C-R-WVWD
1999	3	3,090.8	34%	C-R-WVWD
1999	4	2,410.1	27%	C-R-WVWD
2000	1	1,464.8	15%	C-R-WVWD
2000	2	2,894.1	30%	C-R-WVWD
2000	3	3,387.4	35%	C-R-WVWD
2000	4	2,015.2	21%	C-R-WVWD
2001	1	3,333.6	17%	C-F-R-WVWD
2001	2	5,172.6	27%	C-F-R-WVWD
2001	3	6,476.9	34%	C-F-R-WVWD
2001	4	4,198.8	22%	C-F-R-WVWD
2002	1	4,214.9	18%	C--F-R-WVWD
2002	2	5,740.8	24%	C--F-R-WVWD
2002	3	7,489.0	32%	C--F-R-WVWD
2002	4	6,164.5	26%	C--F-R-WVWD
2003	1	5,522.2	23%	C-F-R-WVWD
2003	2	6,402.7	27%	C-F-R-WVWD
2003	3	7,289.1	30%	C-F-R-WVWD
2003	4	4,753.8	20%	C-F-R-WVWD

Year	Quarter	Total Quarterly Pumpage per Records Available (AF/qtr)	% of annual	Data Source
2004	1	4,713.7	20%	C--F-R-WVWD
2004	2	6,695.9	28%	C--F-R-WVWD
2004	3	7,073.3	30%	C--F-R-WVWD
2004	4	5,012.9	21%	C--F-R-WVWD
2005	1	4,221.3	23%	C-F-R-WVWD
2005	2	6,351.4	34%	C-F-R-WVWD
2005	3	4,711.6	25%	C-F-R-WVWD
2005	4	3,445.2	18%	C-F-R-WVWD
2006	1	3,777.0	22%	C--F-R-WVWD
2006	2	3,803.9	22%	C--F-R-WVWD
2006	3	4,399.6	25%	C--F-R-WVWD
2006	4	5,375.0	31%	C--F-R-WVWD
2007	1	1,835.7	20%	C-R-WVWD
2007	2	2,134.7	24%	C-R-WVWD
2007	3	3,163.6	35%	C-R-WVWD
2007	4	1,854.1	21%	C-R-WVWD
2008	1	2,909.6	16%	C-R-WVWD
2008	2	4,403.4	24%	C-R-WVWD
2008	3	5,394.5	29%	C-R-WVWD
2008	4	5,590.3	31%	C-R-WVWD
2009	1	4,537.2	21%	C-F-R-WVWD
2009	2	5,141.0	24%	C-F-R-WVWD
2009	3	5,589.6	26%	C-F-R-WVWD
2009	4	6,019.0	28%	C-F-R-WVWD
2010	1	5,231.6	28%	C--F-R-WVWD
2010	2	6,142.9	33%	C--F-R-WVWD
2010	3	4,362.4	23%	C--F-R-WVWD
2010	4	3,074.8	25%	C-R-WVWD
2011	1	2,814.0	27%	C-R-WVWD
2011	2	2,915.9	28%	C-R-WVWD
2011	3	2,928.9	28%	C-R-WVWD
2011	4	1,777.8	17%	C-R-WVWD
2012	1	2,001.2	26%	C-R-WVWD
2012	2	2,460.4	33%	C-R-WVWD
2012	3	2,396.8	32%	C-R-WVWD
2012	4	707.6	9%	C-R-WVWD

Sources:

R	Rialto
WVWD	West Valley Water District
C	Colton
F	Fontana Union Water Company

Attachment B



Legend

- Miro Wells
- 160 Acre Area - Downgradient Monitoring Well
- 160 Acre Area Monitoring Well
- City of Colton Production Well
- City of Rialto Production Well
- City of Riverside Production Well
- EPA Monitoring Well
- Fontana Water Company Production Well
- Other Production/Monitoring Well
- San Bernardino County Well
- USGS Cluster Well
- West Valley Water District Production Well
- Faults
- Target Capture Area as Presented in 2010 ROD
- Field-Based Limit of Capture as Presented in GLA 3rd Quarter Groundwater Monitoring Report.
- Modeled Limit of Capture as Presented in GLA 3rd Quarter Groundwater Monitoring Report.
- Model Boundary

NOTE:

( ) Perchlorate Concentration (micrograms per liter)
ND Not Detected
J Trace Concentration

REFERENCES:

USEPA. 2010. *EPA Superfund Interim Action Record of Decision, Source Area Operable Unit, B.F. Goodrich Superfund Site,* San Bernardino County, CA EPA ID: CAN000905945. 30 September

Geo-Logic Associates (GLA). 2012. *Groundwater Monitoring Report, Third Quarter (Summer) 2012.* October 2012.

N

0 2,000

Scale in Feet

Rialto-Colton Basin
Rialto, CA

FIGURE 3
Perchlorate Concentration in Groundwater and Anticipated Downgradient Edge of Combined Capture System

ERM

PREPARED BY: RK (ERM)

JOB NO. 0179962.03.A
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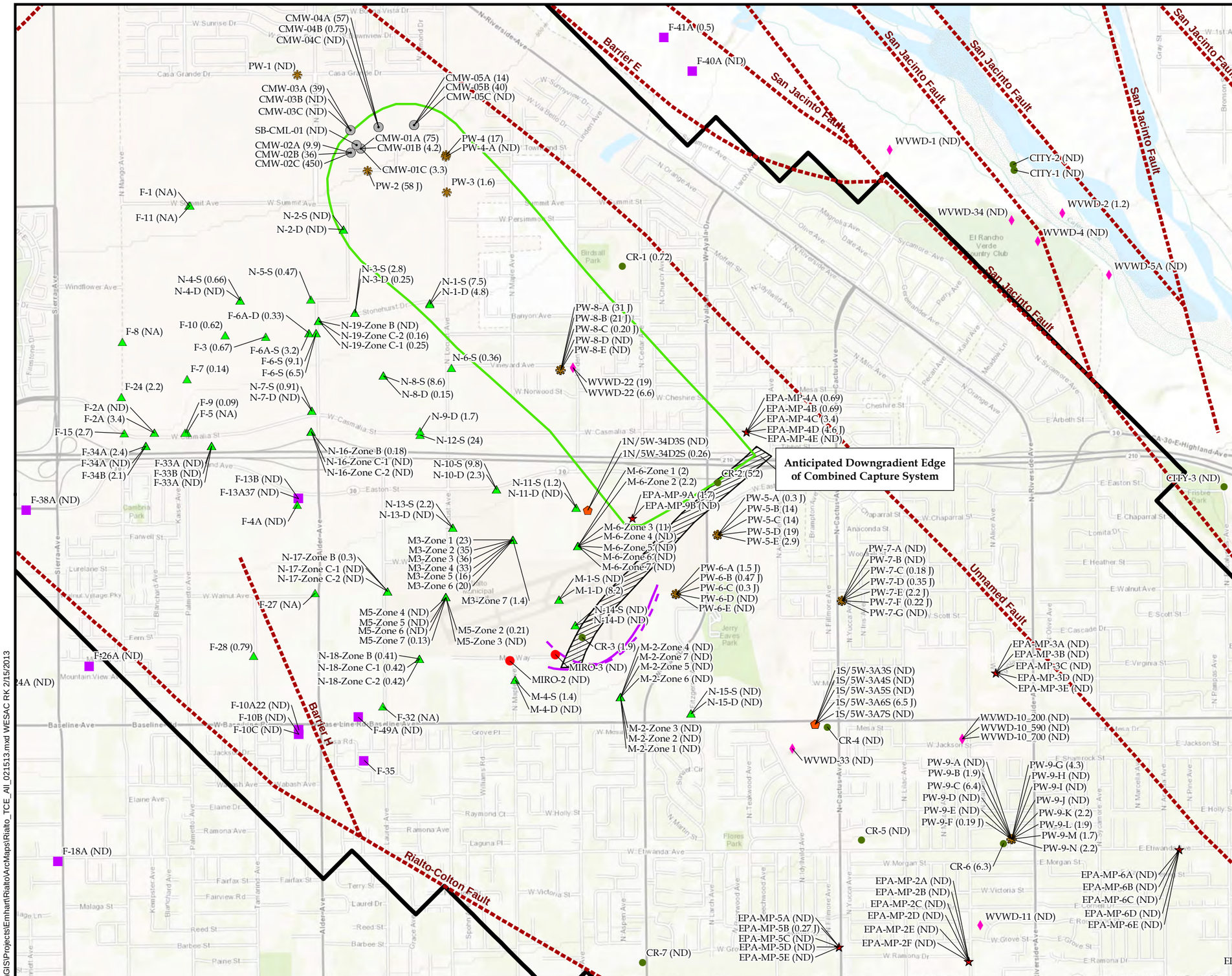

Legend

- Miro Wells
- 160 Acre Area - Downgradient Monitoring Well
- 160 Acre Area Monitoring Well
- City of Colton Production Well
- City of Rialto Production Well
- City of Riverside Production Well
- EPA Monitoring Well
- Fontana Water Company Production Well
- Other Production/Monitoring Well
- San Bernardino County Well
- USGS Cluster Well
- West Valley Water District Production Well
- Faults
- Target Capture Area as Presented in 2010 ROD
- Field-Based Limit of Capture as Presented in GLA 3rd Quarter Groundwater Monitoring Report.
- Modeled Limit of Capture as Presented in GLA 3rd Quarter Groundwater Monitoring Report.
- Model Boundary

NOTE:

( ) TCE Concentration (micrograms per liter)
ND Not Detected
J Trace Concentration

REFERENCES:

USEPA. 2010. *EPA Superfund Interim Action Record of Decision, Source Area Operable Unit, B.F. Goodrich Superfund Site,* San Bernardino County, CA EPA ID: CAN000905945. 30 September

Geo-Logic Associates (GLA). 2012. *Groundwater Monitoring Report, Third Quarter (Summer) 2012.* October 2012.

N

0 2,000

Scale in Feet

Rialto-Colton Basin
Rialto, CA

FIGURE 4
TCE Concentration in Groundwater and Anticipated Downgradient Edge of Combined Capture System

ERM

PREPARED BY: RK (ERM)

JOB NO. 0179962.03.A
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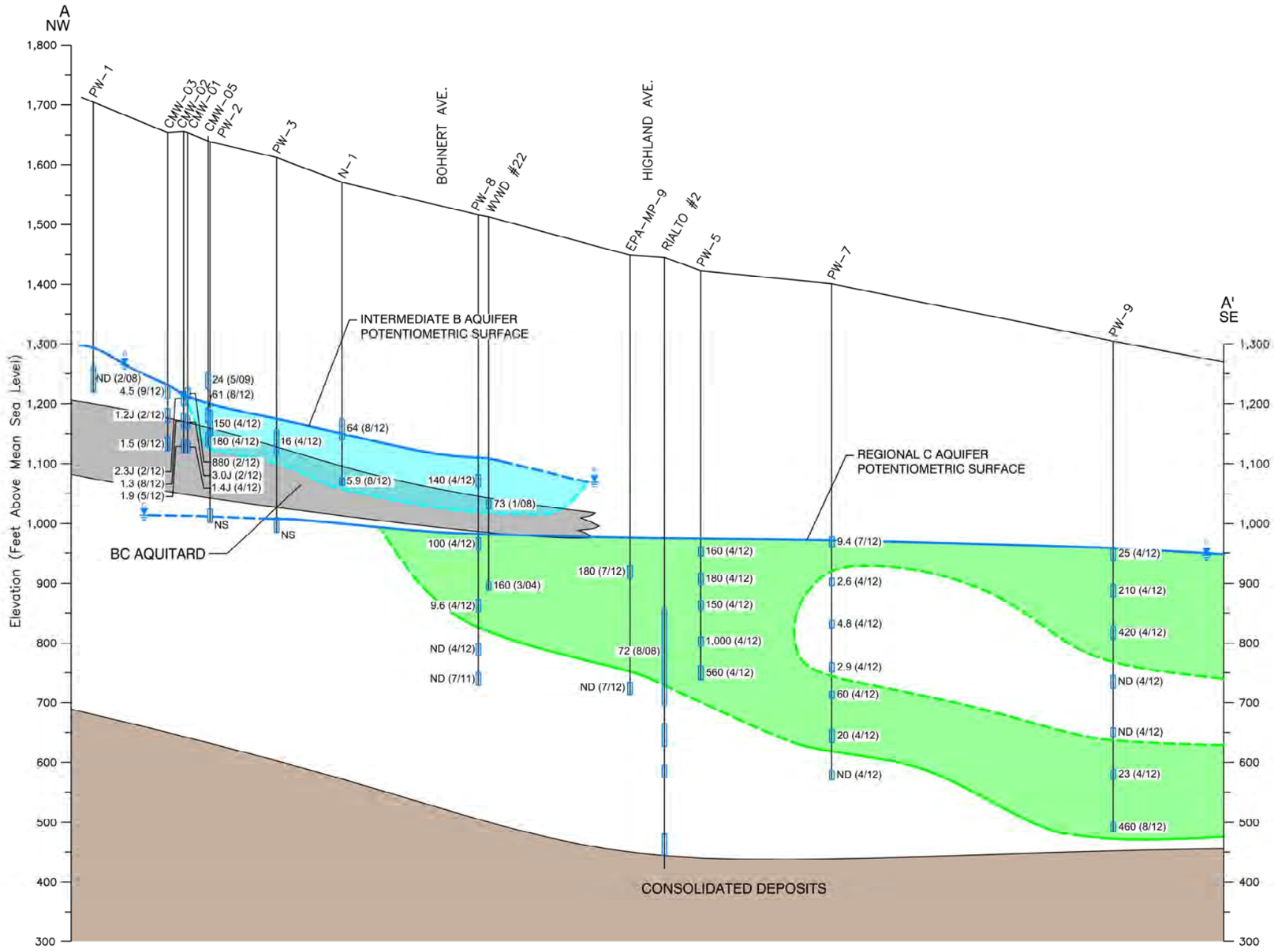


0
VERTICAL
SCALE IN FEET
1" = 200'
200

0
HORIZONTAL
SCALE IN FEET
1" = 2500'
2500

(Vertical Exaggeration = 12.5X)

Extent of Perchlorate Concentrations exceeding the Maximum Contaminant Level (6µg/L) in the Intermediate B Aquifer; dashed and queried where not certain

Extent of Perchlorate Concentrations exceeding the Maximum Contaminant Level (6µg/L) in the Regional C Aquifer; dashed and queried where not certain

ND Not Detected
NS Not Sampled
J Estimated Concentration
µg/L Micrograms per Liter

Note: Consolidated Deposits base on interpretation by the USGS (2001) and referenced by DPRA (2008)

Water Elevation; most recent data available as of April 2012 in the Intermediate B or Regional C Aquifer as noted; dashed where not certain

16 (10/12) Perchlorate Concentration in µg/L and (month/year sampled); most recent data available as of October 2012

Groundwater Screen Interval

Approximate Extent of BC Aquitard

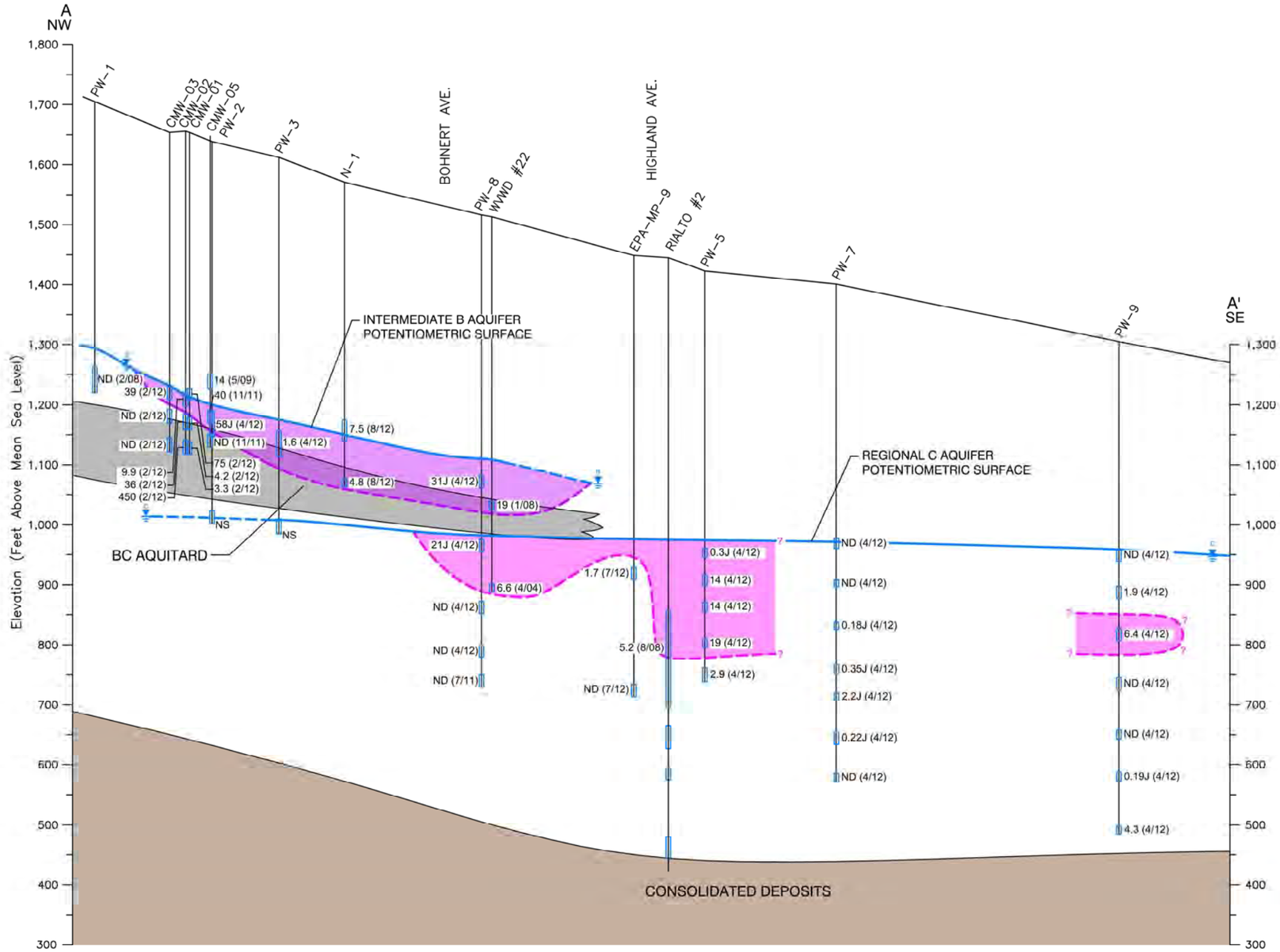
Consolidated Deposits

Figure 5

Cross Section A-A' of Perchlorate in Groundwater
Source Area Operable Unit
B. F. Goodrich Superfund Site
Rialto, California

ERM 02/13

Project No. 0179962.00
Date: 02/15/13
Drawn By: R. Olson
CAD File: G:\\0179962\00\01799620O-04.dwg



0
VERTICAL
SCALE IN FEET
1" = 200'
200
0
HORIZONTAL
SCALE IN FEET
2500
1" = 2500'
(Vertical Exaggeration = 12.5X)

Extent of TCE Concentrations exceeding the Maximum Contaminant Level (5 µg/L) in the Intermediate B Aquifer; dashed and queried where not certain

Extent of TCE Concentrations exceeding the Maximum Contaminant Level (5 µg/L) in the Regional C Aquifer; dashed and queried where not certain

ND Not Detected
NS Not Sampled
J Estimated Concentration
µg/L Micrograms per Liter
TCE Trichloroethene

Note: Consolidated Deposits base on interpretation by the USGS (2001) and referenced by DPRA (2008)

Water Elevation; most recent data available as of April 2012 in the Intermediate B or Regional C Aquifer as noted, dashed where not certain

2.5 (10/12) TCE Concentration in µg/L and (month/year sampled); most recent data available as of October 2012

Groundwater Screen Interval

Approximate Extent of BC Aquitard

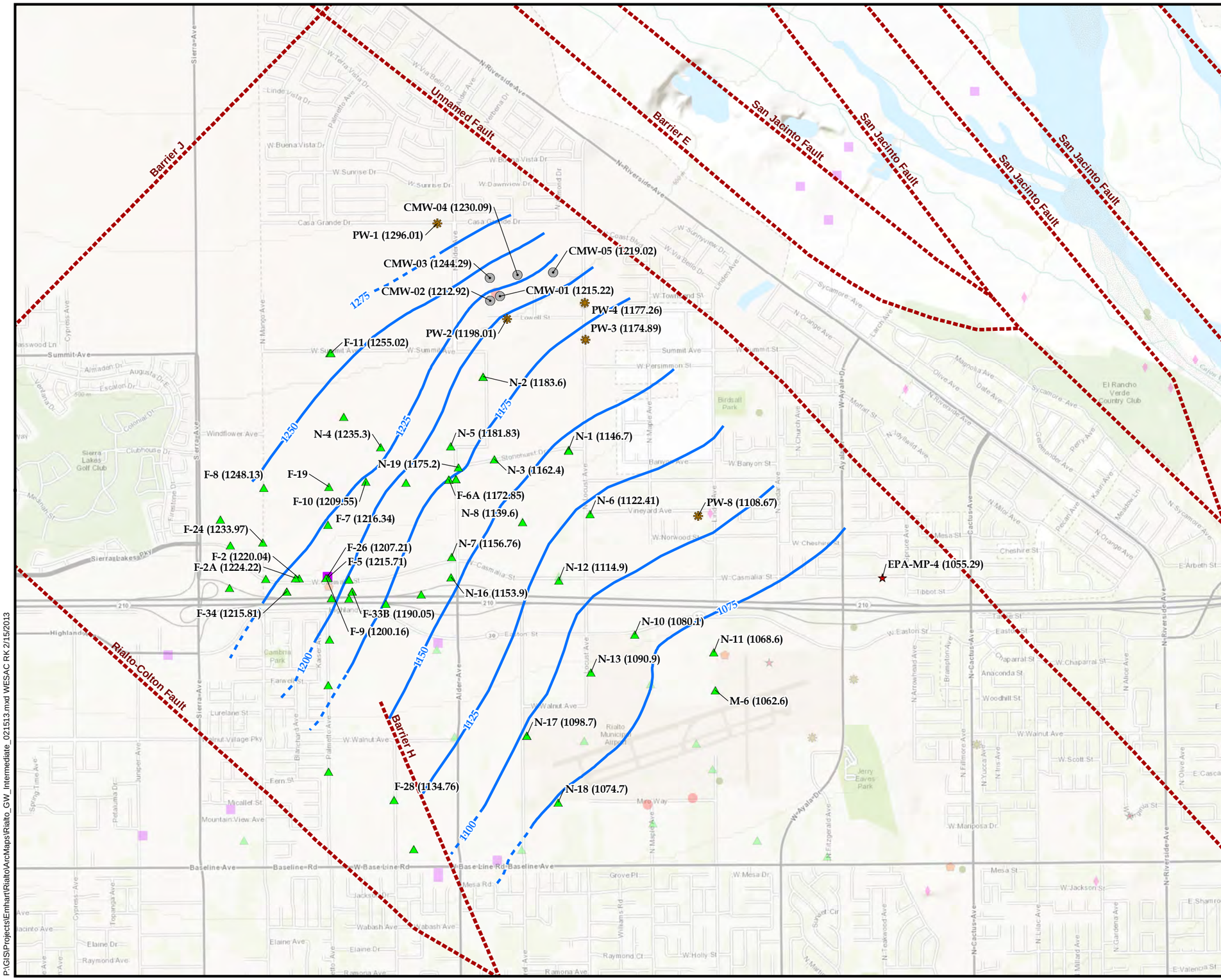
Consolidated Deposits

Figure 6
Cross Section A-A' of TCE in Groundwater
Source Area Operable Unit
B. F. Goodrich Superfund Site
Rialto, California

ERM 02/13

Project No. 0179962.00
Date: 02/15/13
Drawn By: R. Olson
CAD File: G:\0179962\00\01799200-04.dwg

Attachment C



Legend

- Miro Well
- 160 Acre Area - Downgradient Monitoring Well
- 160 Acre Area Monitoring Well
- City of Colton Production Well
- City of Rialto Production Well
- City of Riverside Production Well
- EPA Monitoring Well
- Fontana Water Company Production Well
- Other Production/Monitoring Well
- San Bernardino County MVSL Well
- USGS Cluster Well
- West Valley Water District Production Well
- Faults
- Model Boundary

N

0 2,000

Scale in Feet

Rialto-Colton Basin
Rialto, CA

FIGURE C-1
Intermediate Aquifer
Groundwater Elevation Contours
April-May 2012

ERM

PREPARED BY:
RK (ERM)

JOB NO. 0179962.03.A
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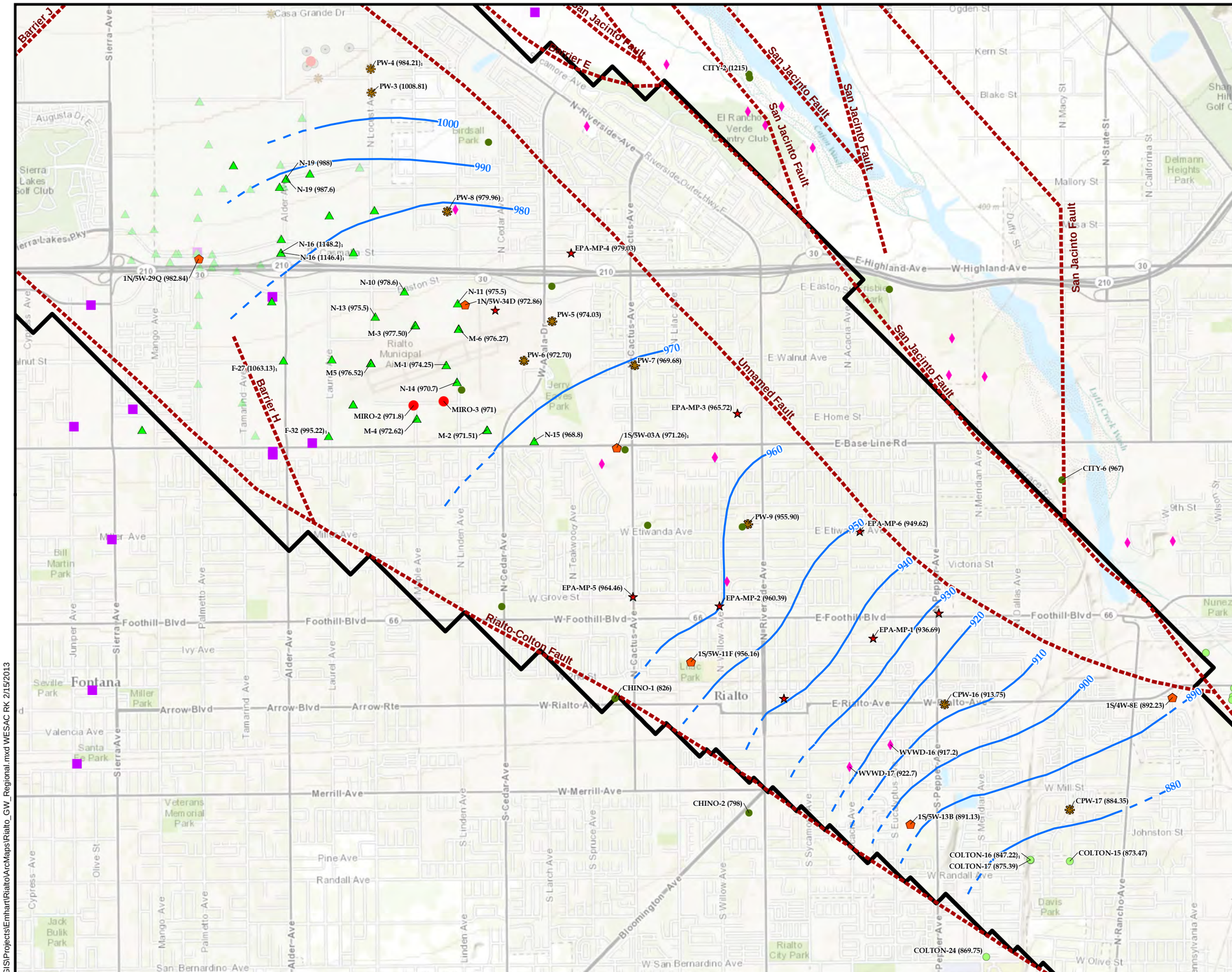

Rialto-Colton Basin
Rialto, CA

FIGURE C-2
Regional Aquifer
Groundwater Elevation Contours
April-May 2012

ERM

PREPARED BY: RK (ERM)	JOB NO. 179962.03.A FILE: Rialto_GW_Regional.mxd

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Memorandum

Environmental Resources Management

2875 Michelle Drive
Suite 200
Irvine, CA 92606
(949) 623-4700
(949) 623-4711 (fax)

To: Mr. Wayne Praskins, USEPA

From: Mr. Truong Mai, P.E.
Ms. Heather Balfour, P.E.

cc: Mr. Joe Hovermill (Miles & Stockbridge P.C.)
Mr. Jim Meeder and Mr. Kamran Javandel (Allen Matkins Leck Gamble Mallory & Natsis LLP)
Mr. David Towell (CH2M HILL)

Date: 28 February 2013

Subject: Source Area Operable Unit
B.F. Goodrich Superfund Site

The U.S. Environmental Protection Agency (USEPA) requested that Emhart Industries, Inc. (Emhart) provide a brief written submittal containing calibration results and a description of the approach to be used to conduct the predictive simulations, including examples of the predictive simulation outputs. Subsequently, the USEPA requested the pumping data used to update the USEPA's groundwater flow model. This memorandum responds to the USEPA's request. It should be noted that the content of this memorandum are draft working products and are intended to provide USEPA with a status update of Emhart's progress on the groundwater flow modeling effort. Upon completion of the groundwater flow modeling effort, a report containing detailed descriptions of the model updates, calibration results, predictive simulations, sensitivity analysis, findings, and recommendations will be submitted to USEPA.

MODEL UPDATE AND CALIBRATION

USEPA, supported by CH2M Hill, prepared a groundwater flow model for the Rialto-Colton Basin and provided model files to Emhart in the summer of 2012. Emhart obtained additional data between October 2012 and January 2013 and updated the USEPA Model (hence forth referred to as Emhart Model). A summary of the data gathering activities was presented in the Data Gathering Summary Memorandum, submitted to USEPA on 15 February 2013. As discussed on the 5 February 2013 bi-weekly status update call and at the 7 February 2013 meeting with water purveyors and regulators in San Bernardino, California, the Emhart Model contains a number of changes compared to the USEPA Model. The changes to the USEPA Model are listed, including rationale

for each change, in Table 1. Additional supporting materials for the rationale presented in Table 1 are listed below:

- Figure 1 – Shows the locations of production wells used in the Emhart Model. This figure also identifies which wells were incorporated within the U.S. Geological Survey (USGS) Model and USEPA Model. The wells incorporated into the Emhart Model that were not in the USEPA Model include: 1 AC #58*; 8F2; Barton Road; Colton-9*; CR4*; CR4A*; Edmunds*; F-35; Johnson 1*; MDWC 36*; Meeks 1*; Mill*; Sperry Well; Vaughn 1*; and Villelli 1*. Eleven of these wells (identified with asterisk) were included within the USGS Model (USGS, 2001)[1].
- Figure 2 – Presents the boundary conditions, model grid, and target wells used in the calibration.
- Table 2 – Presents a comparison of the boundary conditions water balance between the USGS Model, USEPA Model, and Emhart Model.
- Table 3 – Presents a summary comparison of the model layer thicknesses between the USEPA Model and Emhart Model. The model layer thicknesses were adjusted based on review of available boring logs and well construction details.
- Table 4 – Presents a comparison of the annual production well pumping between the USGS Model, USEPA Model, and Emhart Model.
- Table 5 - Presents a comparison of the differences between the production well pumping in the USEPA Model and the Emhart Model.
- Figure 3 - Presents a comparison of the location of the BC Aquitard in the USEPA Model and the Emhart Model.
- Figure 4 – Presents a comparison of the BC Aquitard terminus within the USEPA Model, San Bernardino County Model (GeoLogic Associates, 2010)[2], and Emhart Model.

Upon completion of the updates listed in Table 1, the Emhart Model was calibrated. The calibrated groundwater model reasonably reproduces variable groundwater elevations and gradients within the Rialto-Colton Basin,

---

[1] USGS. 2001. Numerical Simulation of Ground-Water Flow and Assessment of the Effects of Artificial Recharge in the Rialto-Colton Basin, San Bernardino County, California. Woolfenden, L. R. and Koczot, K. M. USGS WRI Report 00-4243, 2001

[2] GeoLogic Associates. 2010. Updated Hydrogeologic Model of Perchlorate Transport Conditions in the Northern Rialto-Colton Basin. February 2010.

particularly in the area proximate to the potential extraction well(s) contemplated for the Source Area Operable Unit (SAOU) remedy presented in the 2010 Interim Record of Decision (USEPA, 2010)[3]. Figures 5 through 7 present the observed versus simulated heads within Layers 1, 3, and 4 of the model in the area proximate to the potential extraction well(s). Upon completion of the groundwater flow modeling effort, a report containing detailed descriptions of the model updates and calibration results, including more thorough discussion of findings, statistics, and uncertainties, will be submitted to USEPA.

PREDICTIVE SIMULATIONS

Emhart will perform the predictive simulations in a manner similar to the USEPA with modifications as shown on the following attachments:

- Table 6 – Summarizes the changes in predictive simulations compared to the USEPA Model.
- Figure 8 – Presents a comparison of the target capture zones in the USEPA Model and Emhart Model.

Emhart will perform the following three predictive scenarios:

- Scenario 1 – Assess whether remedial action objectives (RAOs) are achievable using existing wells (Rialto 2, Rialto 3, Miro-2, and Miro-3);
- Scenario 2 – Assess whether RAOs are achievable using a combination of existing well(s) and new well(s); and
- Scenario 3 – Evaluate potential impact of groundwater recharge using the Cactus Basins for the recommended scenario.

Lastly, Figures 9 and 10 present an example of predictive simulation outputs (for a hypothetical scenario) that Emhart will prepare and present as part of the report to be submitted at the conclusion of the groundwater flow modeling effort. In this hypothetical scenario, groundwater is extracted from Rialto 2 and Rialto 3, with hydraulic capture not achieved. Figure 9 illustrates particle tracks of particle releases from the boundaries of the target capture zone for this hypothetical scenario. Figure 10 shows the frequency of capture estimates, consistent with visual representations prepared by USEPA (9 July 2012 presentation).

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[3] USEPA. 2010. *EPA Superfund Interim Action Record of Decision, Source Area Operable Unit, B.F. Goodrich Superfund Site*, San Bernardino County, CA EPA ID: CAN000905945. 30 September.

Tables

Parameter	USEPA Model	Emhart Model	Rationale
Simulation Time	1970-2009	1970-2011	To incorporate most recent data.
Stress Periods	40 Annual Stress Periods	168 Quarterly Stress Periods	To capture seasonal dynamics of the basin.
Target Wells	Annual averaged observations (spatially averaged in some cases).	Quarterly observations selected at middle of quarter. No spatial averaging. Included additional target wells.	To incorporate most recent data at each specific well location. Emhart included additional target wells (see Figure 2 for the target wells used in the Emhart Model).
Model Grid	Cell Size: 205 to 820 feet	Cell Size: 205 to 805 feet Refined in AOI	To evaluate capture of County Remedy and SAOU Remedy, 205-foot cell grid was expanded to the west (see Figure 2 for the grid used in the Emhart Model).
Updated Pumping Wells	30 wells	45 Production wells	When incorporating the additional data, we identified 15 wells located within the model domain, but not present within the USEPA Model. Figure 1 shows the locations of all the production wells used in the Emhart Model and identifies if they were within the USGS and USEPA Models.
Water Balance - Lytle Creek Fluxes	Fluxes are distributed 50% above Barrier J and 50% below Barrier J in Layer-3 only.	Fluxes are distributed 60% above Barrier J and 40% below Barrier J in Layers 1, 2 and 3 in the ratio of 15%, 15%, and 70%, respectively. There is no flux assigned in Layer 2 below Barrier J.	Based on USGS approach and calibration results. See Table 2.
Water Balance - San Gabriel Mountains Inflow	Fluxes are assigned in Layer-3 only	Fluxes are distributed in Layer 1, 2, and 3 in the ratio of 15%, 15%, and 70%, respectively.	Based on USGS approach and calibration results. See Table 2.
Water Balance - Rainfall Recharge	Up to 12 in/yr	0.5 in/yr	Based on USGS, GLA, and USEPA (as prepared during RI/FS) approaches. See Table 2.
Water Balance - Irrigation Return Flows	No irrigation return flows	15% of pumping in 2nd and 3rd Quarter 30% of pumping in 1st and 4th Quarter	Based on USGS approach. The change also captures seasonal dynamics. See Table 2.
Layer 3 and 4 Thickness		Adjusted thicknesses	Based on boring logs; intended to eliminate dry cells in AOI and improve stability of the model. See Table 3.
Updated Pumping Data	Annual pumping data	Quarterly pumping data	The Emhart model incorporates quarterly pumping data to capture seasonal dynamics of the basin. For production wells where only annual data was available, quarterly pumping patterns assumed for these wells are similar to pumping patterns for other wells where monthly or quarterly data was available.
Water Balance - Production Well Pumping (Annual Average in AF/yr)	11,589	14,370	There are three main differences (Table 4): 1. Emhart Model includes 15 additional pumping wells (See Figure 1). 2. The Emhart Model includes additional volume reported from Colton-15 and -17. Steven Mains (maintains Watermaster database) indicated that the total well production from these wells is sum of records provided by City of Colton and La Sierra Water Company. 3. The average for Emhart model includes 2010 and 2011. Additionally, Table 5 presents a comparison of the differences between the production well pumping in the USEPA Model and the Emhart Model.
Water Balance - Chino Basin Outflows (excluding Riverside Basin)	Outflow approximately 4000 AF/yr	Outflow set to zero	Based on USGS, GLA, and USEPA (as prepared during RI/FS) approaches and calibration results. Further, the head differences across the faults indicate minimal, if any, water transfer across the faults.
Extent of BC Aquitard		Updated	Based on review of vertical water level differences, Geologic Associates' interpretation and recent boring logs (e.g., USEPA-MP-9). Figures 3 and 4 present the BC Aquitard within the Emhart model.
Hydraulic Parameters		Revised	Based on calibration.

Abbreviations:

AF/yr = Acre-feet per year
AOI = Area of interest
in/yr = Inch per year
GLA = GeoLogic Associates
RI/FS = Remedial Investigation/Feasibility Study
SAOU = Source Area Operable Unit
USGS = U.S. Geological Survey
USEPA = U.S. Environmental Protection Agency

Table 2 - Water Balance Comparison *DRAFT*
Source Area Operable Unit, B.F. Goodrich Superfund Site

Components		USGS (1945-96)	USEPA Model (1970-2009)	Emhart Model (1970-2011)
INFLOW				
Underflow from Lytle Creek	Above Barrier J	4,460	4,552	7,144
	Below Barrier J	4,460	4,552	3,062
Underflow from Bunker Hill	Layer 1	9,100	7,704	8,072
	Layer 2	2,280	1,926	2,018
Imported Water		750	972	929
Run-off from San Gabriel Mountains		2,021	1,864	1,849
Inflow from San Gabriel Mountains		1,200	1,200	1,200
Inflow (The Badlands)		166	231	259
Rainfall Recharge		860	6,801	860
Seepage Loses from Santa Ana/Warm Creek		4,860	1,142	1,117
Seepage Losses from Diversion Canal		190	0	0
Irrigation Return Flows		3,324	0	3,507
Total Inflow		**33,671**	**30,944**	**30,017**
OUTFLOW				
Evaporation		<1	111	<1
Underflow from Rialto Basin to Chino Basin		0	4,000	0
Underflow from Rialto Basin to Riverside Basin		23,700	18,027	20,240
Seepage Loses to Santa Ana/Warm Creek		440	0	0
Production Well Pumping Annual Average (Model incorporates actual rate per stress period)		11,080	11,589	14,370
Total Outflow		**35,221**	**33,727**	**34,611**

Notes:

All inflow and outflow are in acre-feet per year.

Abbreviations:

USEPA = U.S. Environmental Protection Agency

USGS = U.S. Geological Survey

Table 3 -Summary of Model Layer Thicknesses *DRAFT*
Source Area Operable Unit, B.F. Goodrich Superfund Site

Model Layer	General Description		Moisture Conditions		Model Layer Thickness (feet)	
	USEPA Model	Emhart Model	USEPA Model	Emhart Model	USEPA Model	Emhart Model
1	Intermediate Aquifer / Upper Water-Bearing Unit	Intermediate Aquifer / Upper Water-Bearing Unit	Mostly Unsaturated	Mostly Unsaturated	108 to 781	108 to 781
2	BC Aquitard / Upper Water-Bearing Unit	BC Aquitard / Upper Water-Bearing Unit	Variable Saturated	Variable Saturated	0.5 to 133	0.5 to 133
3	Upper Regional Aquifer / Middle Water-Bearing Unit	Upper Regional Aquifer / Middle Water-Bearing Unit	Variable Saturated	Variable Saturated	14 to 345	10 to 345
4	Lower Regional Aquifer / Lower Water-Bearing Unit	Lower Regional Aquifer / Lower Water-Bearing Unit	Saturated	Saturated	42 to 479	201 to 688
5	Consolidated Deposits	Consolidated Deposits	Saturated	Saturated	300	300

Abbreviation:

USEPA = U.S. Environmental Protection Agency

Table 4 - Production Well Pumping Comparison Summary *DRAFT*
Source Area Operable Unit, B.F. Goodrich Superfund Site

Year	USGS (1945-96)	USEPA Model (1970-2009)	Emhart Model (1970-2011)
1970	11,469	7,126	11,531
1971	11,293	6,355	11,364
1972	10,319	5,805	10,219
1973	7,763	5,302	7,768
1974	8,817	5,418	8,778
1975	11,002	5,208	11,196
1976	11,470	6,650	11,499
1977	8,688	4,209	8,706
1978	7,571	5,110	7,584
1979	7,103	4,108	7,109
1980	5,595	4,532	5,660
1981	6,237	5,349	6,339
1982	6,402	4,426	6,318
1983	4,368	3,851	4,669
1984	8,892	6,716	8,688
1985	10,051	6,370	10,068
1986	9,932	6,975	9,951
1987	13,085	10,343	13,112
1988	14,076	10,771	13,550
1989	15,526	11,179	14,014
1990	17,551	12,335	17,363
1991	14,244	8,585	14,244
1992	16,675	14,566	17,927
1993	14,892	13,882	16,734
1994	14,227	12,709	15,704
1995	15,922	15,673	19,017
1996	15,758	18,652	19,809
1997		14,775	14,924
1998		11,352	11,576
1999		12,046	13,038
2000		14,117	15,832
2001		19,192	19,467
2002		23,367	24,931
2003		24,590	24,699
2004		23,898	24,003
2005		18,536	18,558
2006		16,836	17,376
2007		20,066	20,505
2008		19,555	20,541
2009		23,027	23,336
2010			25,351
2011			20,484
Average Production (1970-2009)		11,589	13,943
Average Production (1970-2011)		NA	14,370

Notes:
All production rates are in acre-feet per year.

Abbreviations:
NA = Not applicable
USGS = U.S. Geological Survey
USEPA = U.S. Environmental Protection Agency

Table 5 - Emhart Production Well Breakdown *DRAFT*
Source Area Operable Unit, B.F. Goodrich Superfund Site

Year	All Wells in Emhart Model	Wells in both USEPA and Emhart Model	Wells in Emhart Model but not in USEPA Model	La Sierra Allocation in Emhart Model but not USEPA Model *
1970	11,531	7,121	3,338	1,072
1971	11,364	6,350	3,887	1,127
1972	10,219	5,651	3,511	1,057
1973	7,768	5,294	1,568	906
1974	8,778	5,362	2,756	660
1975	11,196	5,391	5,177	628
1976	11,499	6,658	4,188	653
1977	8,706	4,208	3,992	506
1978	7,584	5,109	1,969	506
1979	7,109	4,097	2,477	535
1980	5,660	4,584	534	542
1981	6,339	5,433	365	541
1982	6,318	4,326	1,410	582
1983	4,669	3,866	251	552
1984	8,688	6,493	1,692	503
1985	10,068	6,369	3,209	490
1986	9,951	6,976	2,525	450
1987	13,112	10,362	2,232	518
1988	13,550	10,850	2,222	478
1989	14,014	11,297	2,233	484
1990	17,363	14,888	1,949	526
1991	14,244	11,756	1,980	508
1992	17,927	15,756	1,625	546
1993	16,734	15,715	329	690
1994	15,704	13,926	1,070	708
1995	19,017	16,947	533	1,537
1996	19,809	18,697	570	542
1997	14,924	13,807	1,117	0
1998	11,576	11,344	232	0
1999	13,038	11,925	1,113	0
2000	15,832	15,602	230	0
2001	19,467	19,182	285	0
2002	24,931	23,609	1,322	0
2003	24,699	23,684	1,015	0
2004	24,003	23,883	120	0
2005	18,558	18,528	30	0
2006	17,376	17,032	344	0
2007	20,505	19,823	682	0
2008	20,541	19,482	1,059	0
2009	23,336	22,894	442	0
2010	25,351	25,217	134	0
2011	20,484	20,214	270	0
Average Production (1970-2009)	13,943	11,857	1,640	446
Average Production (1970-2011)	14,370	12,374	1,571	425

Notes:

All production rates are in acre feet per year

* Steven Mains (maintains Watermaster database) indicated that the total well production from Colton-15 and Colton-17 wells is sum of records provided by City of Colton and La Sierra Water Company. This column represents the value reported by La Sierra Water Company that did not appear to be within the USEPA Model.

Abbreviation:

USEPA = U.S. Environmental Protection Agency

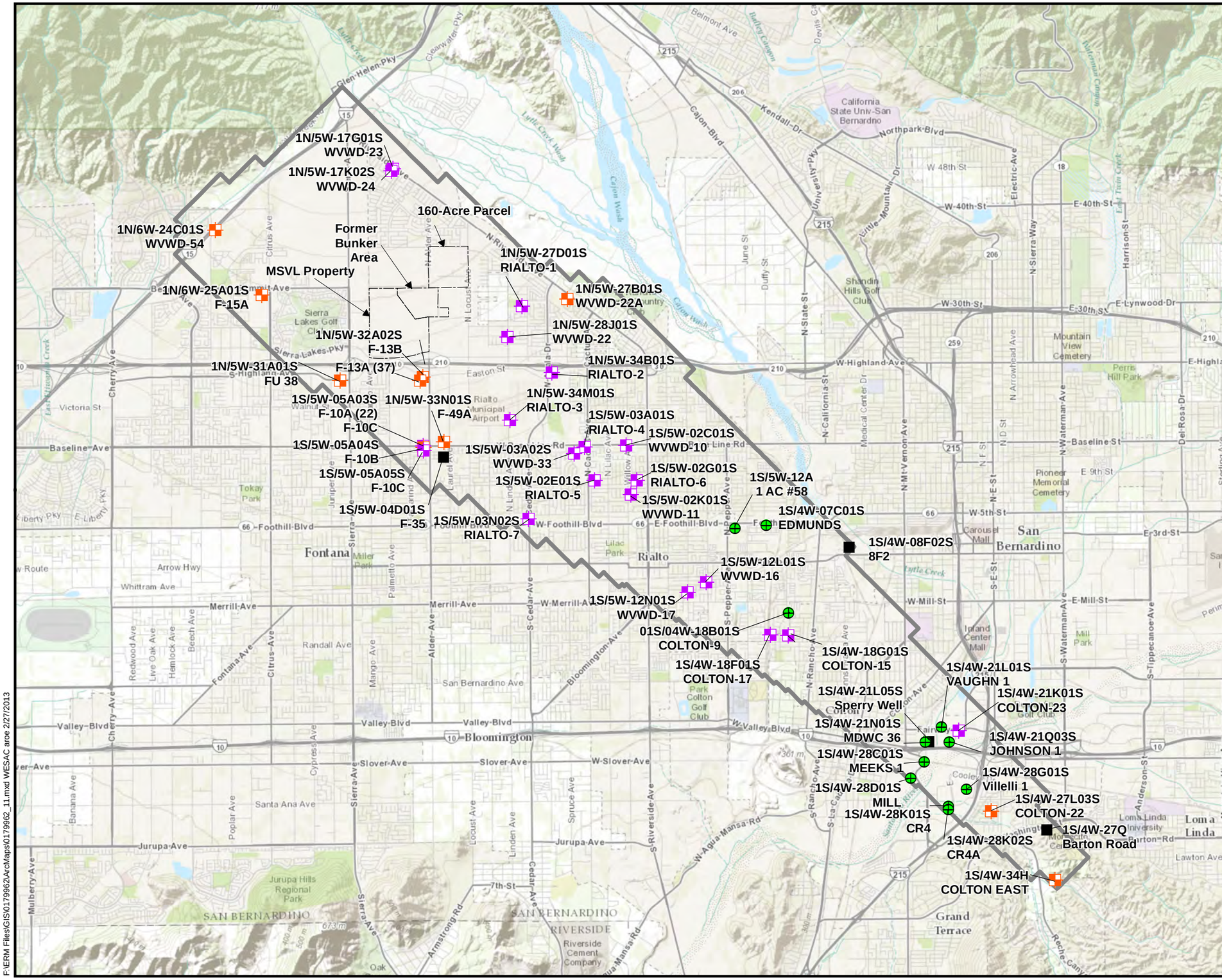
Table 6 - Changes In Predictive Simulations *DRAFT*
Source Area Operable Unit, B.F. Goodrich Superfund Site

Parameter	USEPA Model	Emhart Model	Rationale
Simulation Time	Calendar Years 2010 through 2048	Calendar Years 2012 through 2052	Update model calibration period is 1970 through 2011, extending the USEPA's calibration period by two years. The updated simulation period shifts by 2 years and extends by 2 years to reflect more current conditions captured by the Emhart Model.
Stress Periods	39 Annual Stress Periods	168 Quarterly Stress Periods	To provide an assessment seasonal dynamics of the basin, if necessary.
Predictive Pumping	Based on pumping rates provided by purveyors. Colton production wells were eliminated.	Purveyors' 2011 pumping rates with the following adjustments: - WVWD-11/Rialto-6 Project – Combined total of approximately 2,880 AF/yr. - Pumping at other WVWD wells may decrease to accommodate WVWD 11/Rialto-6 project and SAOU project (based on water rights and negotiations). - Pumping at Colton-15, -17, -22, and -23 will decrease to accommodate SAOU remedy (Colton-15 and -17 will be shut down first).	Based on data gathered to support update of the USEPA Model.
Target Capture Zone	As presented by USEPA in their 9 July 2012 presentation.	Based on the Target Area presented in the RI/FS and IROD.	Figure 8 presents a comparison of the Target Capture Areas.
Particle Release Time	Particles are released 2010-2039 (29 years).	Particles are released 2012-2031 (20 years).	Particles released in later time do not reach the extraction wells during the simulations time.
Particle Release Location (vertical)	In middle of the cell in all layers.	Layers 1 and 3 – Middle of the cell Layer 4 – Top of the cell	Changes in Layer 4 were made to match contaminant occurrence with extraction depths (vertical evaluation of the plume).

Abbreviations:

AF/yr = acre-feet per year
IROD = Interim Record of Decision (2010)
RI/FS = Remedial Investigation/Feasibility Study
SAOU = Source Area Operable Unit
USEPA = U.S. Environmental Protection Agency
WVWD = West Valley Water District

Figures



Legend

- USEPA Model
- USEPA and USGS Model
- USGS Model
- Additional Wells
- Site Boundary
- Model Boundary

Note:
All production wells shown are within the domain of the Emhart Model.

DRAFT

N

0 6,500

Scale in Feet

SOURCE AREA OPERABLE UNIT
B.F. GOODRICH SUPERFUND SITE

FIGURE 1
PRODUCTION WELL LOCATIONS

ERM

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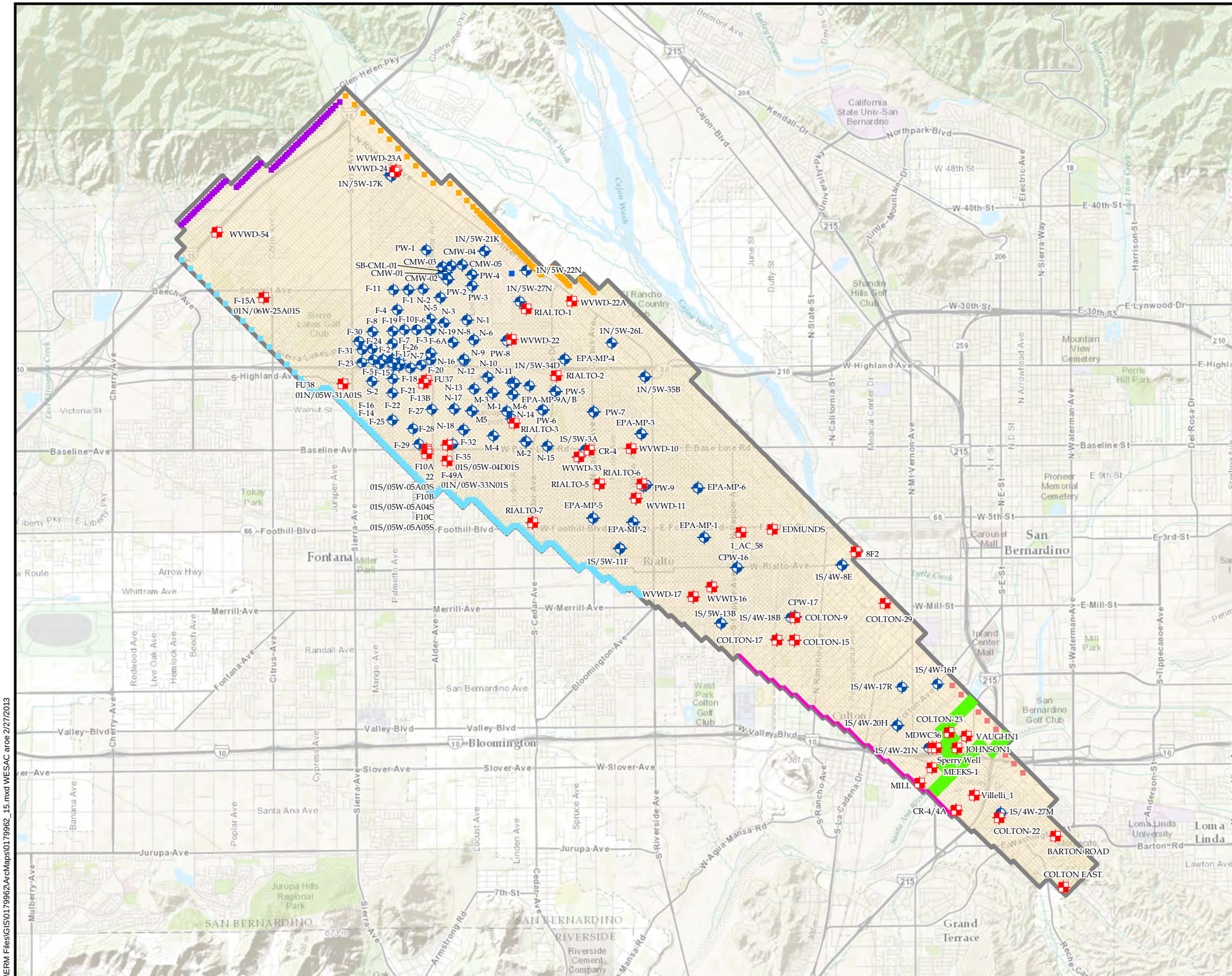

Legend

- Lytle Creek Inflow
- San Gabriel Mountains Inflow
- Linden Pond Recharge
- Chino Basin Outflows
- Inflow from Bunker Hill Basin
- Monitoring Well Used as Model Target Well
- Production Well
- Model Boundary
- River Boundary
- Riverside Basin Outflows
- Model Grid

DRAFT

N

0 6,500

Feet

SOURCE AREA OPERABLE UNIT
B.F. GOODRICH SUPERFUND SITE

FIGURE 2

MODEL BOUNDARY CONDITIONS, PRODUCTION WELLS AND TARGET WELLS

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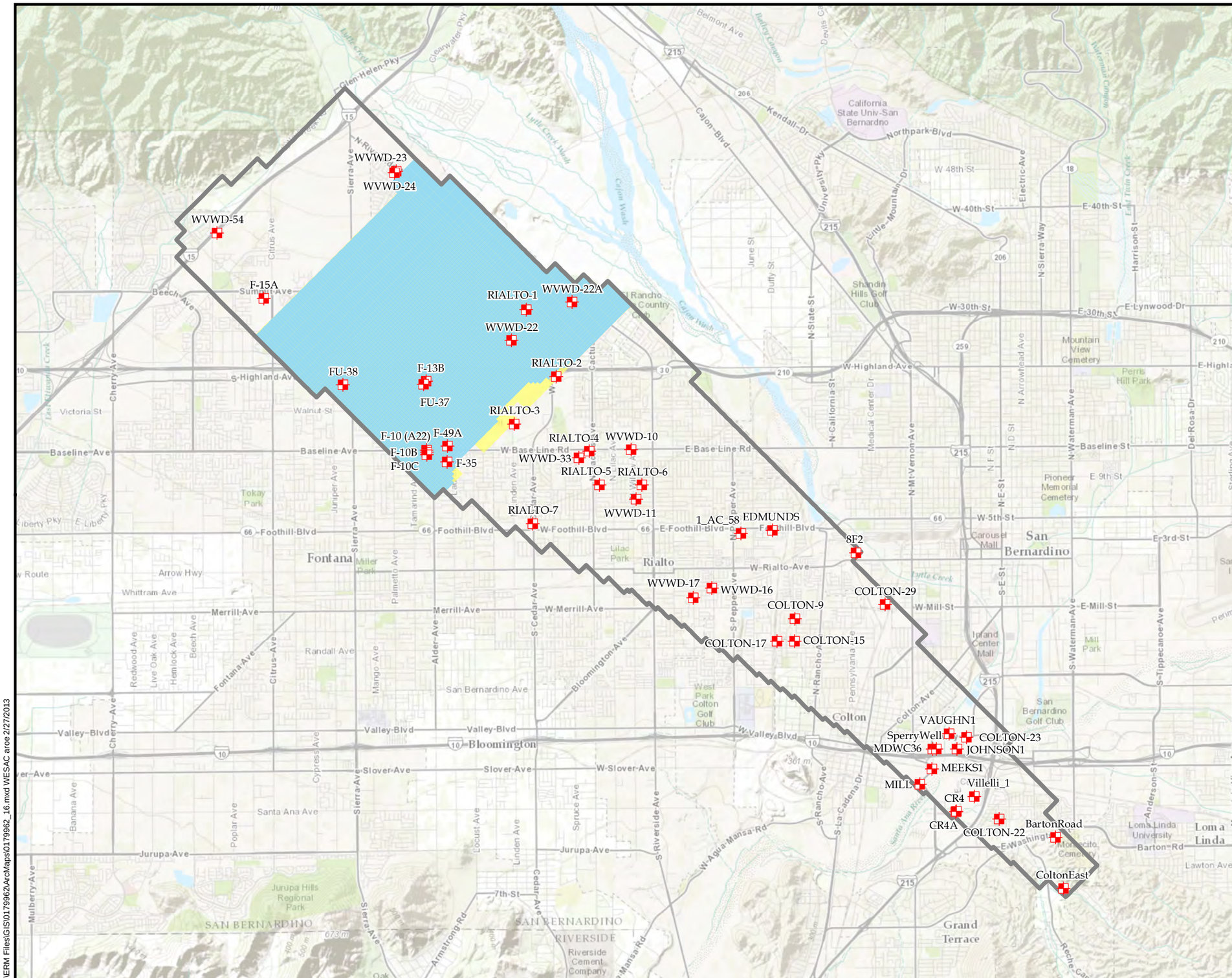

Legend

- Production Well
- Emhart Model
- USEPA Model
- Model Boundary

DRAFT

N

0 6,500
Feet

SOURCE AREA OPERABLE UNIT
B.F. GOODRICH SUPERFUND SITE

FIGURE 3

BC AQUITARD EXTENT

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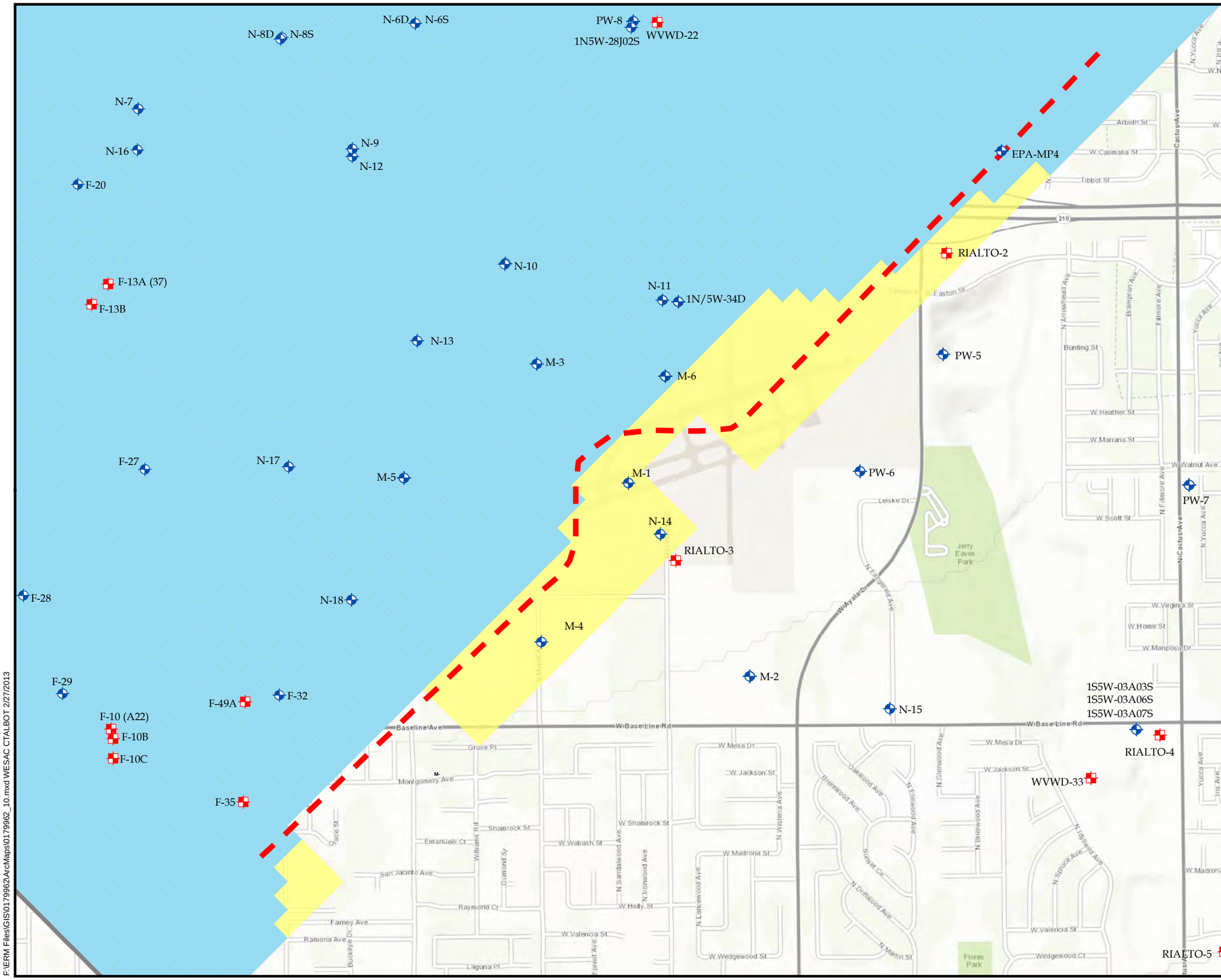

Legend

- Monitoring Well
- Production Well
- GLA BC Aquitard Terminus *
- Emhart Model
- USEPA Model
- Model Boundary

Reference:
*Updated Hydrogeologic Model of Perchlorate Transport Conditions in the Northern Rialto-Colton Basin, Geologic Associates Inc. February, 2010

DRAFT

N

0 1,000
Scale in Feet

SOURCE AREA OPERABLE UNIT
B.F. GOODRICH SUPERFUND SITE

FIGURE 4
INTERPRETATIONS OF THE
BC AQUITARD

ERM

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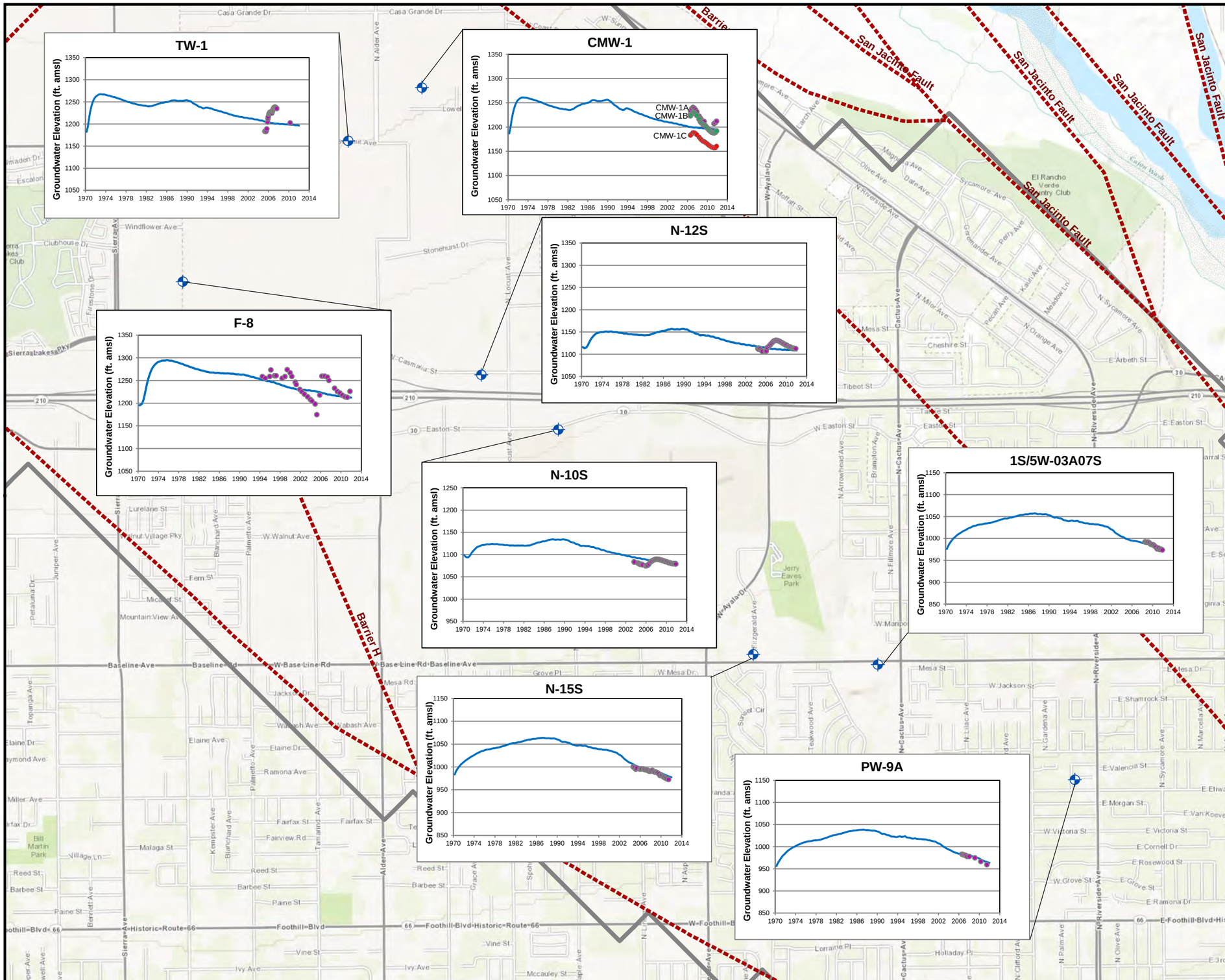

Legend

- Monitoring Well
- Faults
- Model Boundary
- Observed
- Simulated

DRAFT

N

0 2,000

Scale in Feet

SOURCE AREA OPERABLE UNIT
B.F. GOODRICH SUPERFUND SITE

FIGURE 5
MODEL CALIBRATION:
OBSERVED VS. SIMULATED
HEADS (MODEL LAYER 1)

ERM

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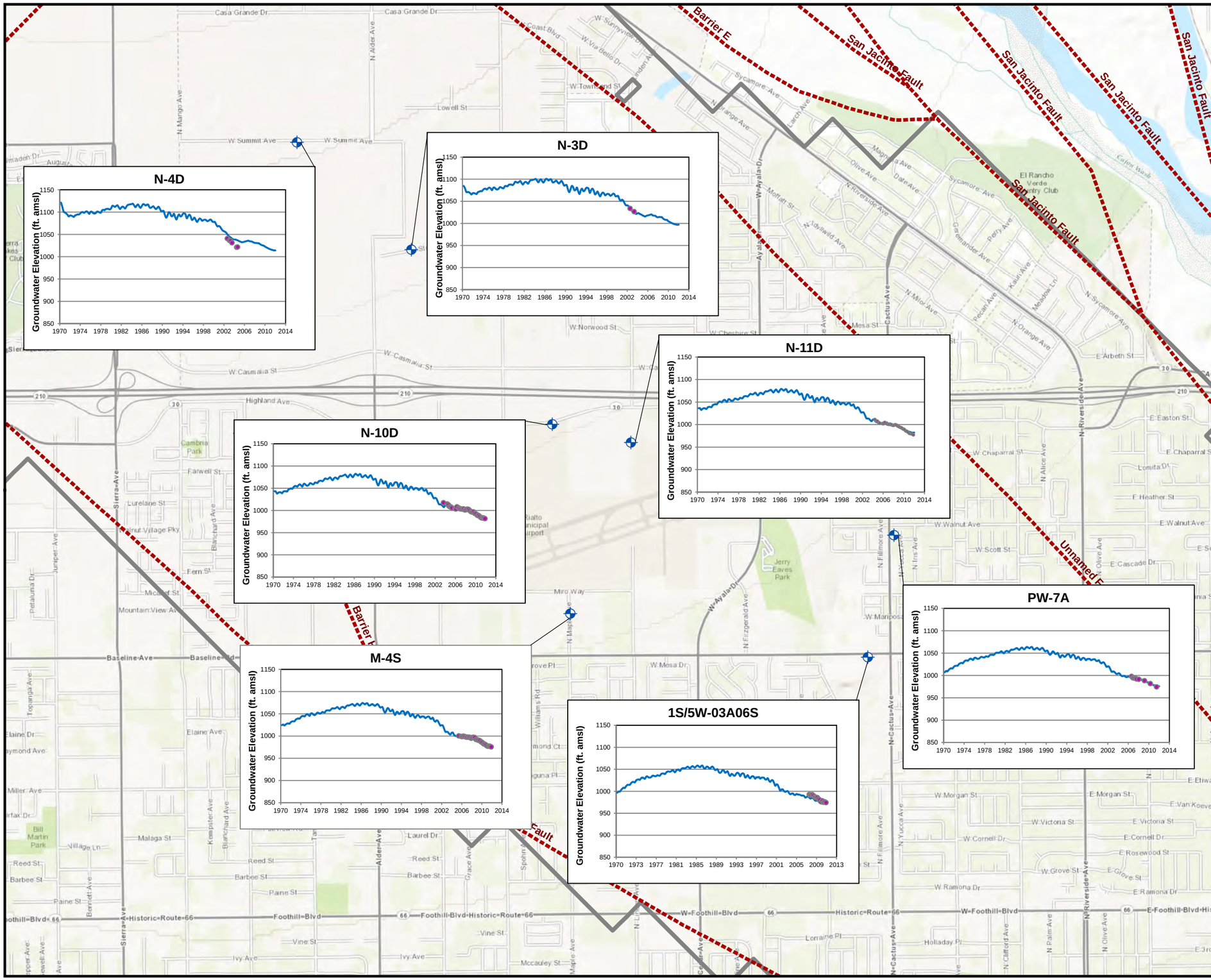

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SOURCE AREA OPERABLE UNIT
B.F. GOODRICH SUPERFUND SITE

FIGURE 6
MODEL CALIBRATION:
OBSERVED VS. SIMULATED
HEADS (MODEL LAYER 3)

ERM

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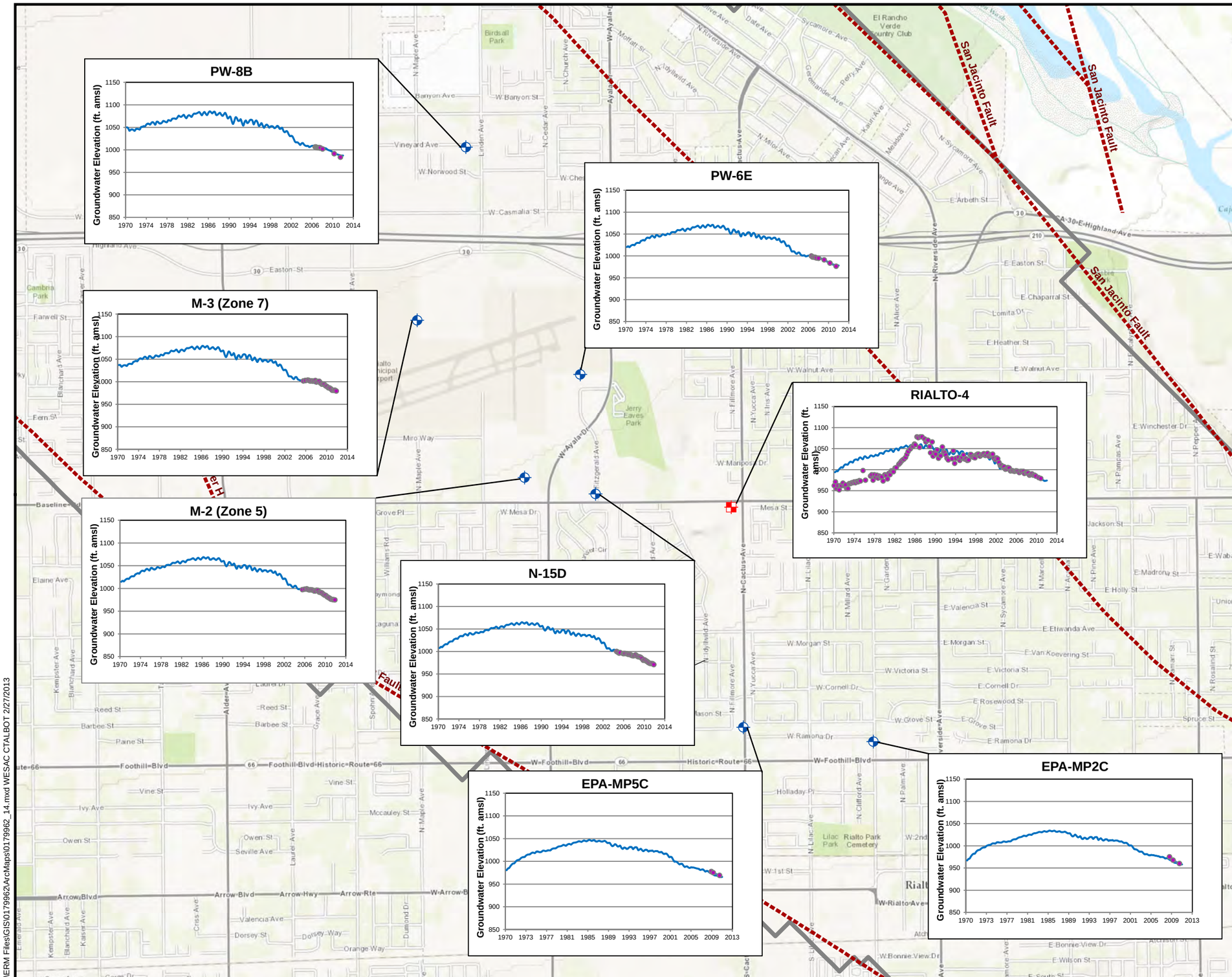

Legend

- Production Well
- Monitoring Well
- Faults
- Model Boundary
- Observed
- Simulated

DRAFT

N

0 2,000

Scale in Feet

SOURCE AREA OPERABLE UNIT
B.F. GOODRICH SUPERFUND SITE

FIGURE 7
MODEL CALIBRATION:
OBSERVED VS. SIMULATED
HEADS (MODEL LAYER 4)

ERM

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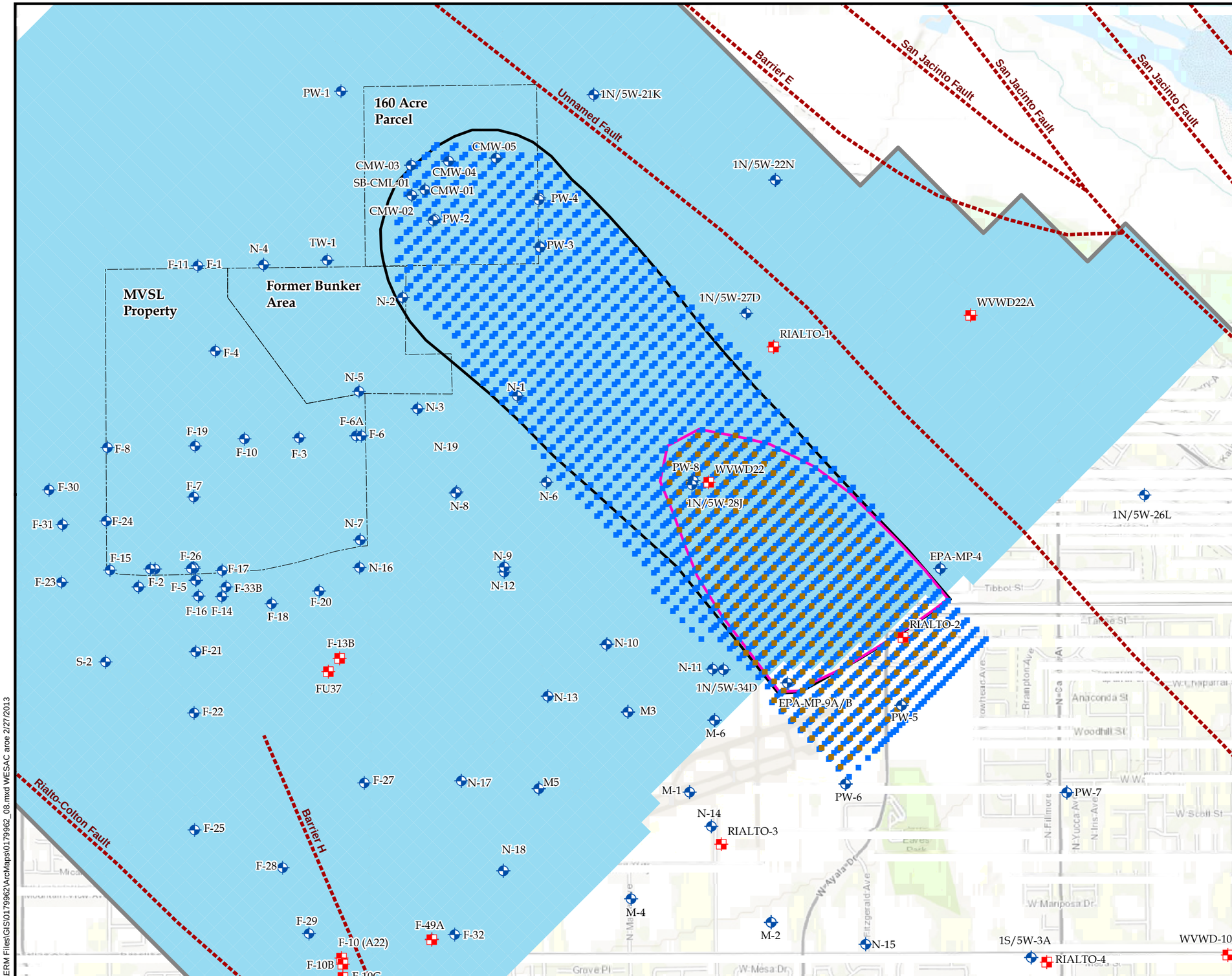

Legend

- Monitoring Well
- Production Well
- USEPA Model Intermediate Target Capture Zone
- USEPA Model Regional Target Capture Zone
- Faults
- IROD/Emhart Model Intermediate Target Capture Zone
- IROD/Emhart Model Regional Target Capture Zone
- Model Boundary
- Emhart Model BC Aquitard Extent
- Site Boundary

Reference:
USEPA. 2010. *EPA Superfund Interim Action Record of Decision, Source Area Operable Unit, B.F. Goodrich Superfund Site,* San Bernardino County, CA EPA IS: CAN000905945. 30 September

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N

0 1,500
Feet

SOURCE AREA OPERABLE UNIT
B.F. GOODRICH SUPERFUND SITE

FIGURE 8

TARGET CAPTURE ZONE

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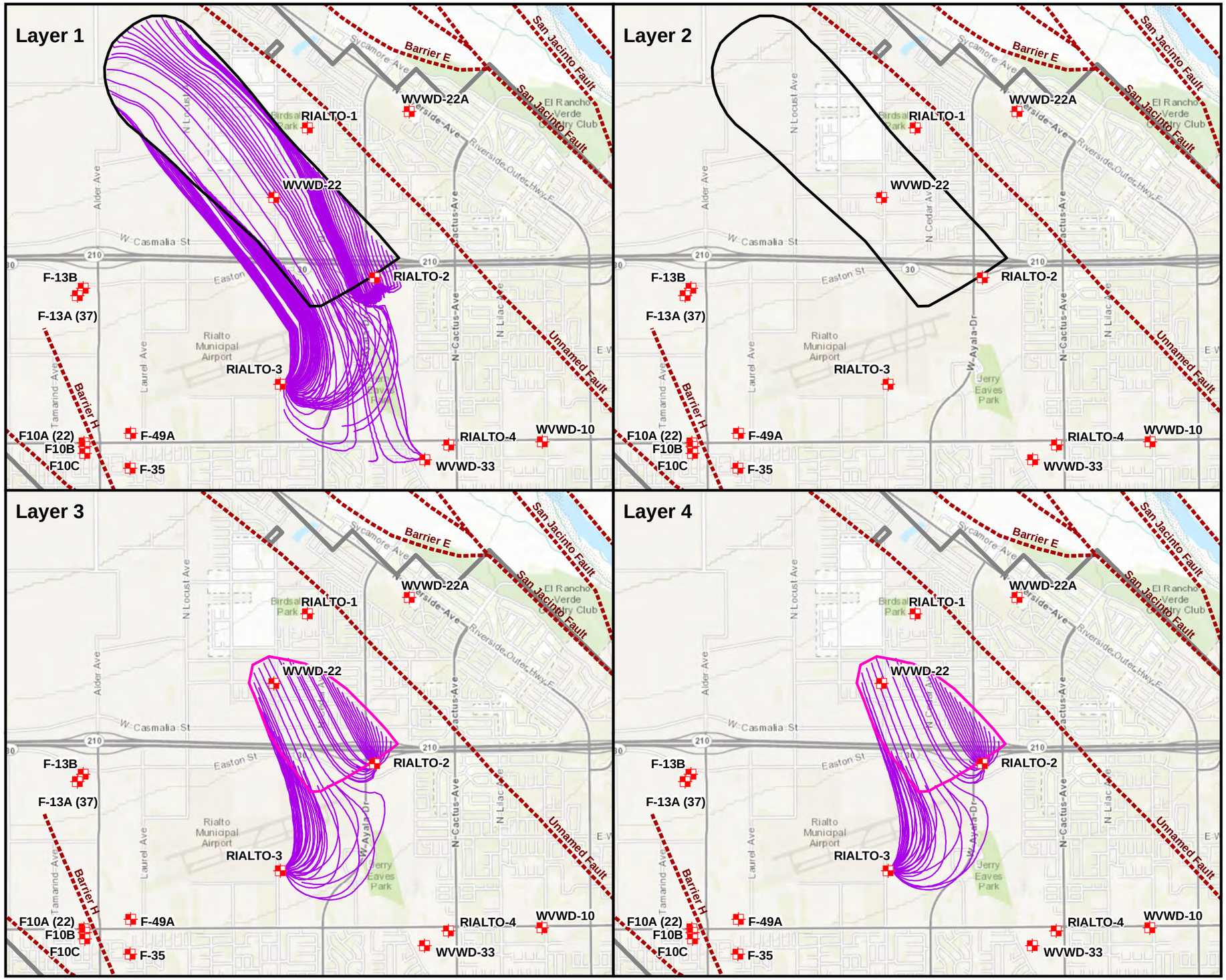

Legend

- Production Well
- Model Particle Tracks
- Faults
- Emhart Model Intermediate Capture Zone
- Emhart Model Regional Capture Zone
- Model Boundary

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N

0 3,000

Feet

SOURCE AREA OPERABLE UNIT
B.F. GOODRICH SUPERFUND SITE

FIGURE 9
HYPOTHETICAL EXAMPLE
PARTICLE TRACK OUTPUT

ERM

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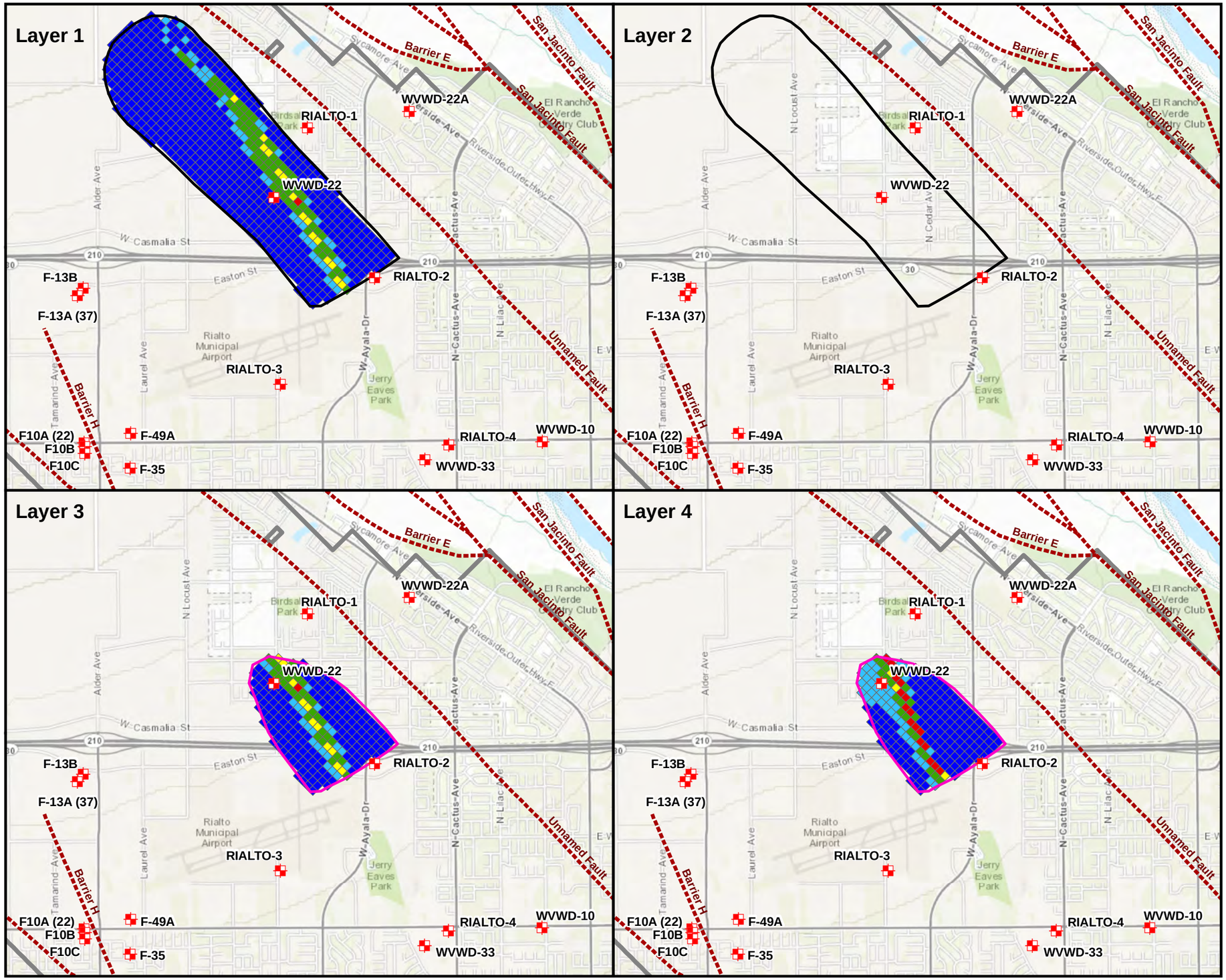

Legend

- Production Well
- Frequency of Capture (%)
  - < 20
  - 20 to 40
  - 40 to 60
  - 60 to 80
  - 80 to 100
- Faults
- Emhart Model Intermediate Capture Zone
- Emhart Model Regional Capture Zone
- Model Boundary

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N

0 3,000

Feet

SOURCE AREA OPERABLE UNIT
B.F. GOODRICH SUPERFUND SITE

FIGURE 10
HYPOTHETICAL EXAMPLE
FREQUENCY
OF CAPTURE OUTPUT

ERM

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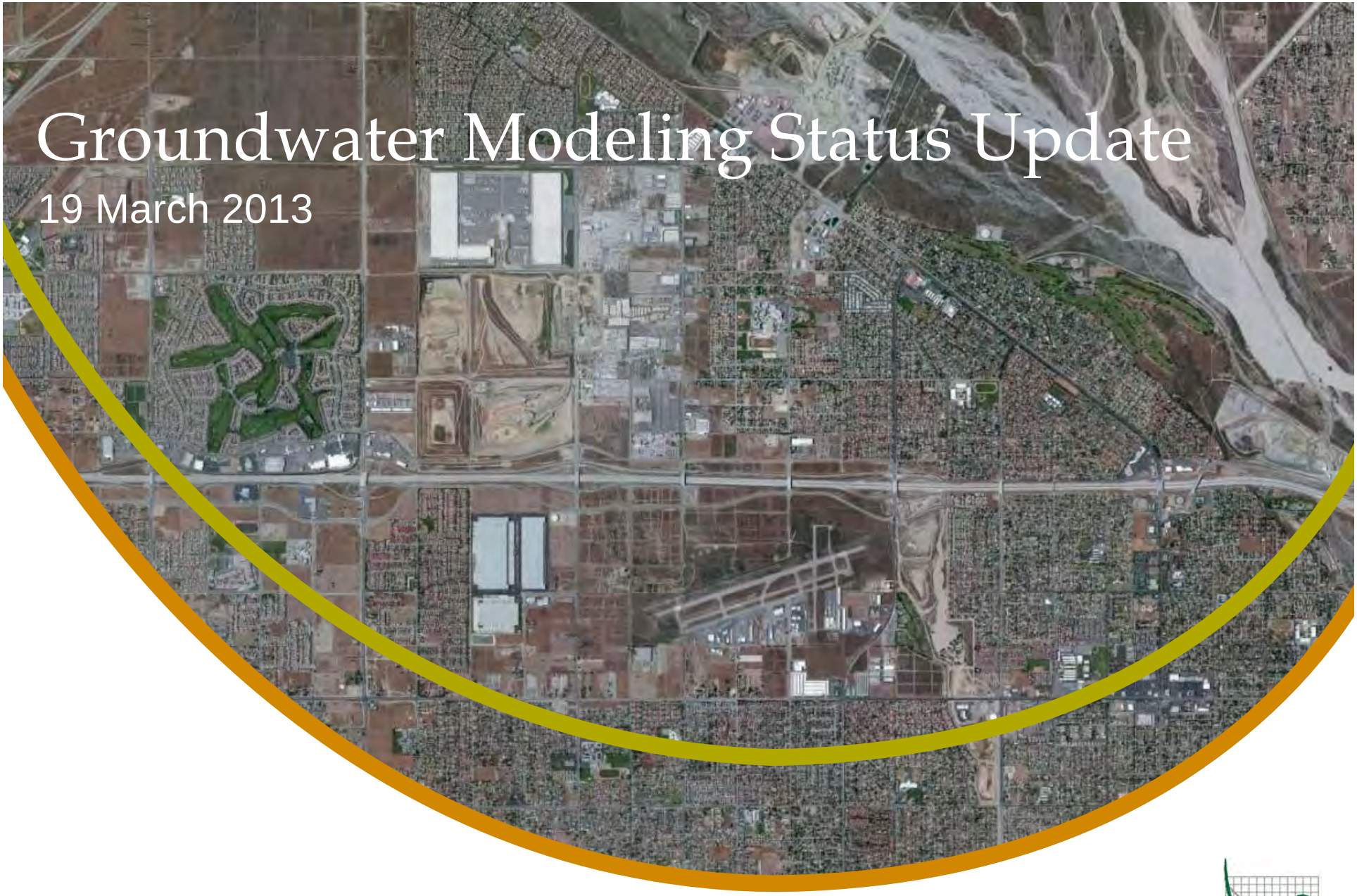
Groundwater Modeling Status Update

19 March 2013



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Agenda

- Headlines
- Work Process to Date
  - Model overview
  - Assumptions
  - Calibration
  - Preliminary predictive simulations
- Next Steps

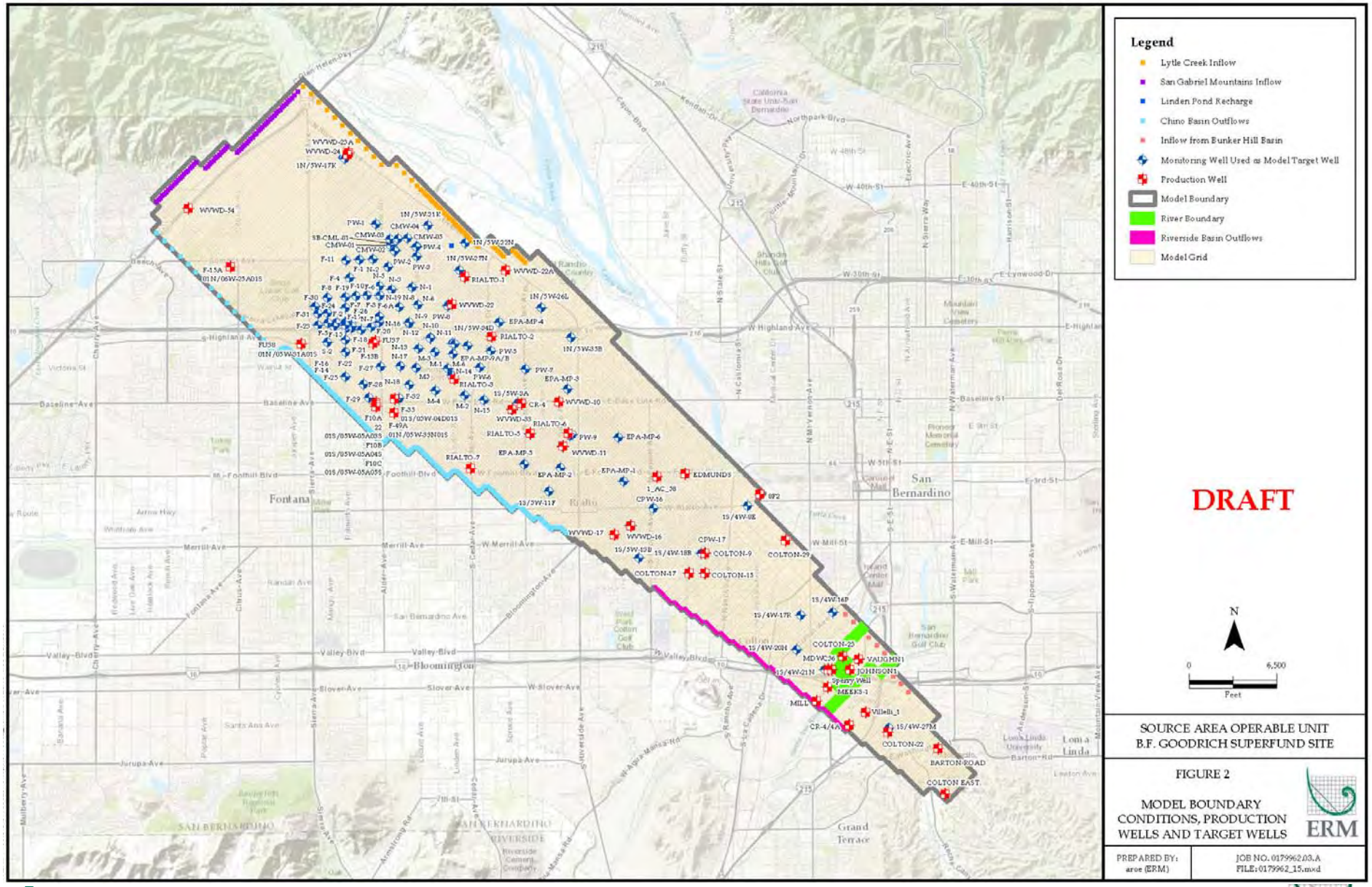
Headlines – Model Status

- Obtained and incorporated water purveyors' well data and anticipated future pumping changes (Fontana response pending)
- Incorporated basin-wide water balance into the model
- Calibrated model focused on the area of interest
- Running wide range of preliminary predictive scenarios

Headlines – Preliminary Predictive Simulations

- A proposed combined capture system that uses CR-3 and 1 or 2 new wells appears to meet the County's and Emhart's respective remedy objectives.
- Miro-2 and Miro-3 do not appear needed in the proposed combined capture system but could be brought online as “backstops” if, over time, groundwater flow direction shifts more westerly.
- CR-2 appears to have limited effectiveness for hydraulic capture of impacted groundwater in the proposed combined system; thus, it will not be used.
- The County's current pumping rate at CR-3 (1,157 gpm annual average) and multiple combinations of pumping rates at 1 or 2 new wells appear sufficient.
- Rialto's and Colton's current available water rights may be adequate for some combined capture scenarios.
- Rialto's and Colton's historical seasonal water demands appear to be in balance with the available water rights needed for a combined capture system.

Model Boundary Conditions, Production & Target Wells



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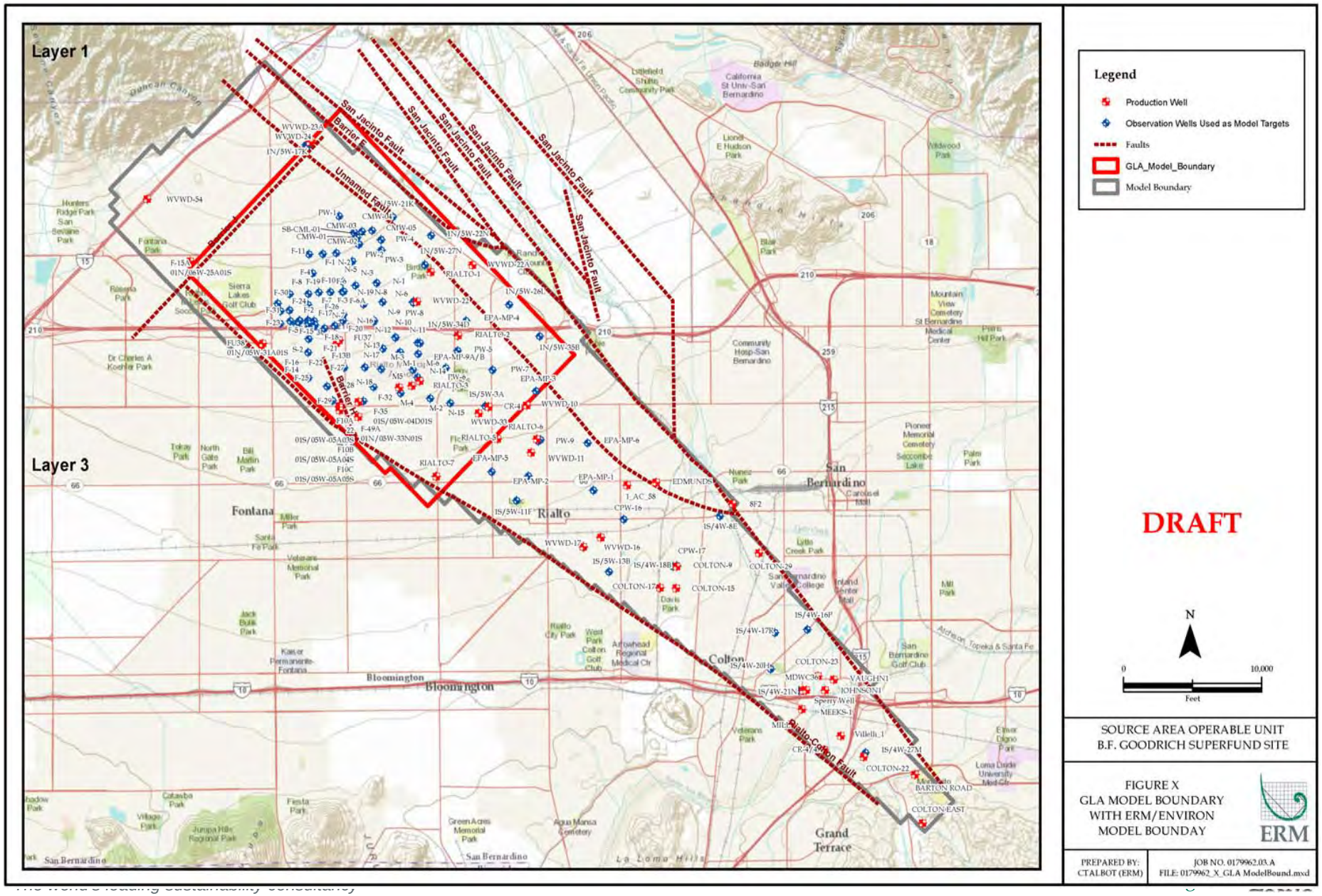
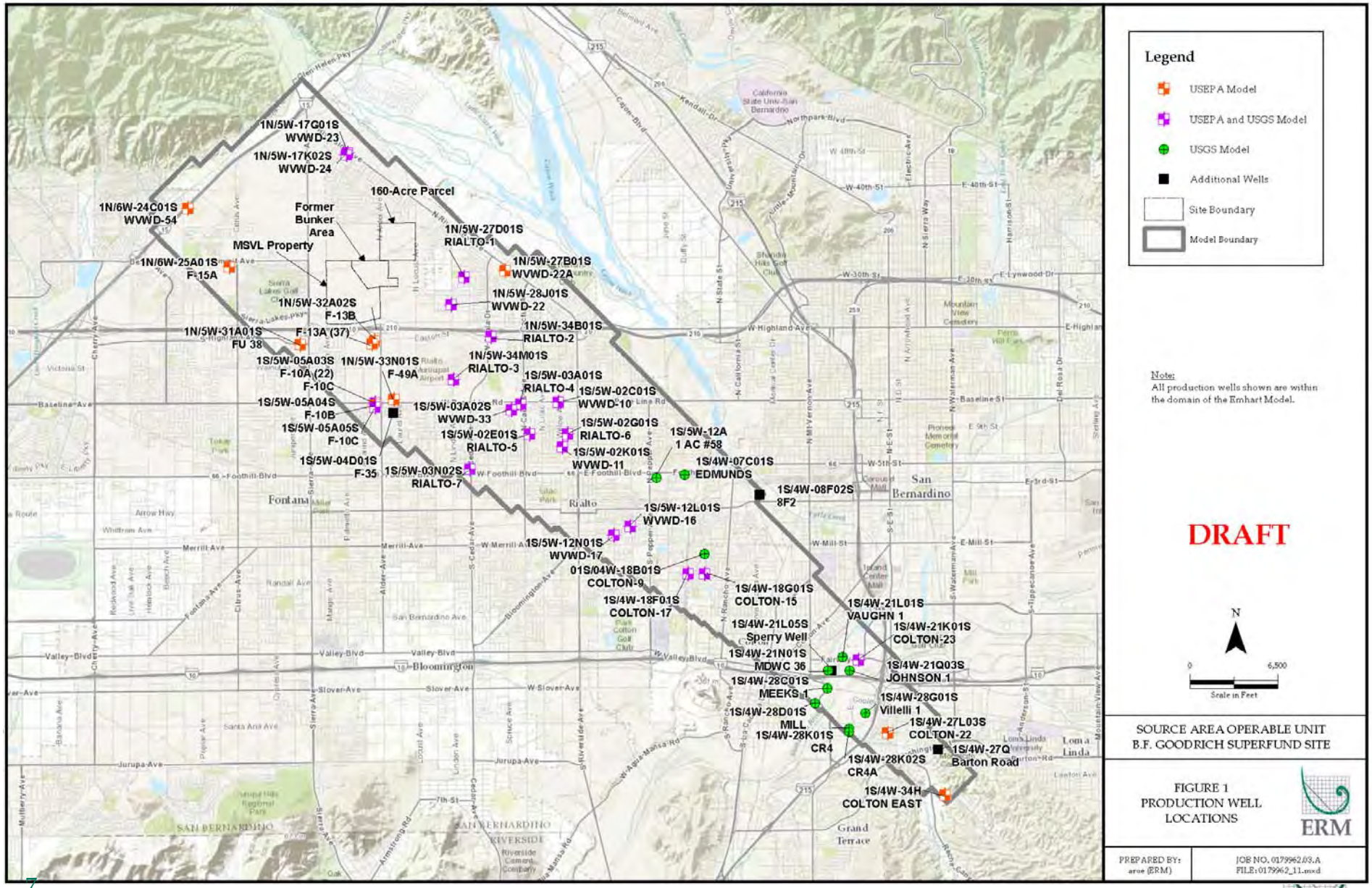
Model Boundaries – County/USEPA/Emhart



Production Wells



BC Aquitard

N-8D
N-8S
N-6D
N-6S
PW-8
1N5W-28J02S
WVWD-22
N-7
N-16
N-9
N-12
F-20
EPA-MP4
RIALTO-2
N-10
F-13A (37)
F-13B
N-11
1N/5W-34D
EPA-MP-9A/B
N-13
M-3
M-6
PW-5
F-27
N-17
M-5
M-1
PW-6
PW-7
N-14
RIALTO-3
F-28
N-18
M-4
M-2
F-29
F-49A
F-32
F-10 (A22)
F-10B
F-10C
N-15
1S5W-03A03S
1S5W-03A06S
1S5W-03A07S
RIALTO-4
WVWD-33
F-35
RIALTO-5
Legend
Monitoring Well
Production Well
Embart Model
USEPA Model
Model Boundary
DRAFT
N
0
1,000
Scale in Feet
SOURCE AREA OPERABLE UNIT
B.F. GOODRICH SUPERFUND SITE
FIGURE 4
INTERPRETATIONS OF THE
BC AQUITARD
ERM
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Tables

Table 1 – Key Modeling Assumptions Comparison

Table 2 - Production Well Pumping Comparison

Table 3 – Production Well Comparison USEPA-Emhart

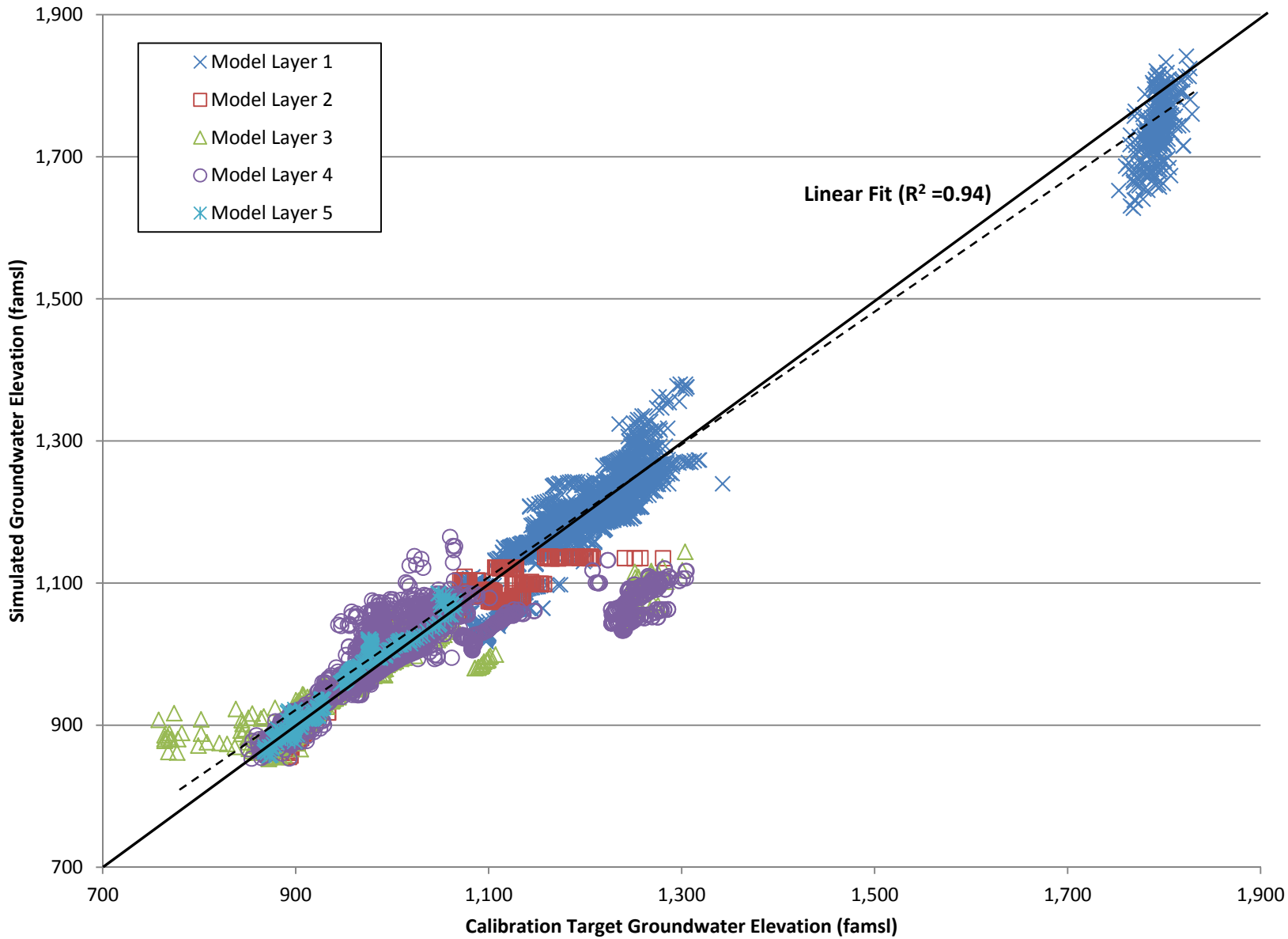
Table 4 – Water Balance Comparison

Table 5 – Comparison of Predictive Simulations

Model Calibration

- Comparison of observed vs. modeled groundwater elevation
- Considered water chemistry data as part of qualitative review of model calibration
- Calibrated groundwater model reasonably reproduces variable groundwater elevations and gradients within the RCB
- Calibrated groundwater model reproduces more accurate elevations and gradients proximate to the area of interest
- Updated examples of observed vs. simulated heads are shown on the following slides
- Incorporate additional refinement if necessary based on County and USEPA feedback

Calibration Plot



Calibration Statistics Comparison

Parameters	USEPA Model		Emhart Model	
	Full Domain	AOI	Full Domain	AOI
ME (in feet)	0.09	1.1	8.2	-0.03
RMSE (in feet)	26.29	29.06	44.8	21.72
Range in calibration-target head values (in feet)	1,033.95	405.8*	1,071	376.5
RMSE/Range	0.03	0.07*	0.04	0.06
R^2	0.97	0.996	0.94	0.97
No. of Measurements	1,690	1,086	8,766	4,602

* Head Difference Targets are not included

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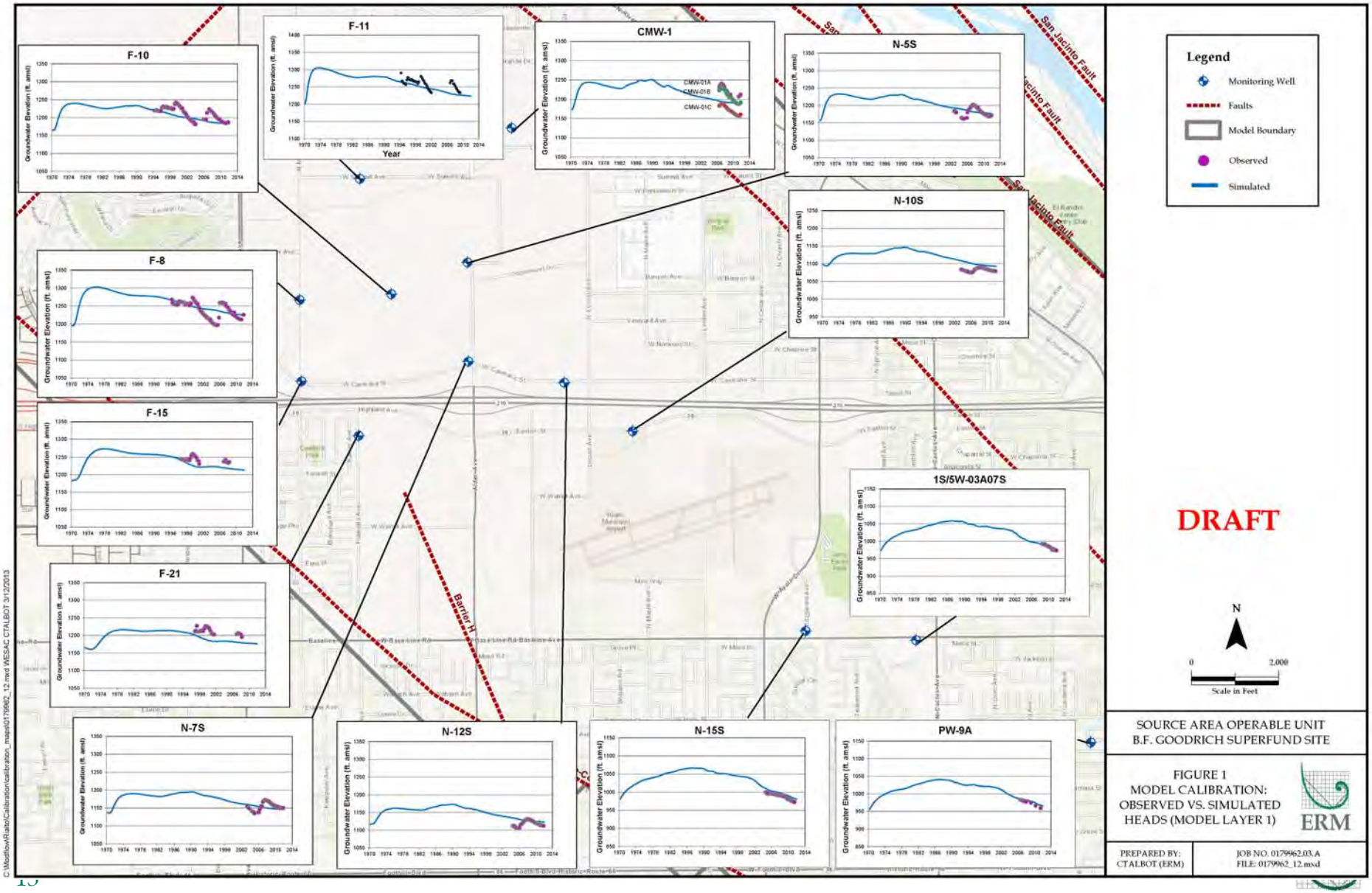
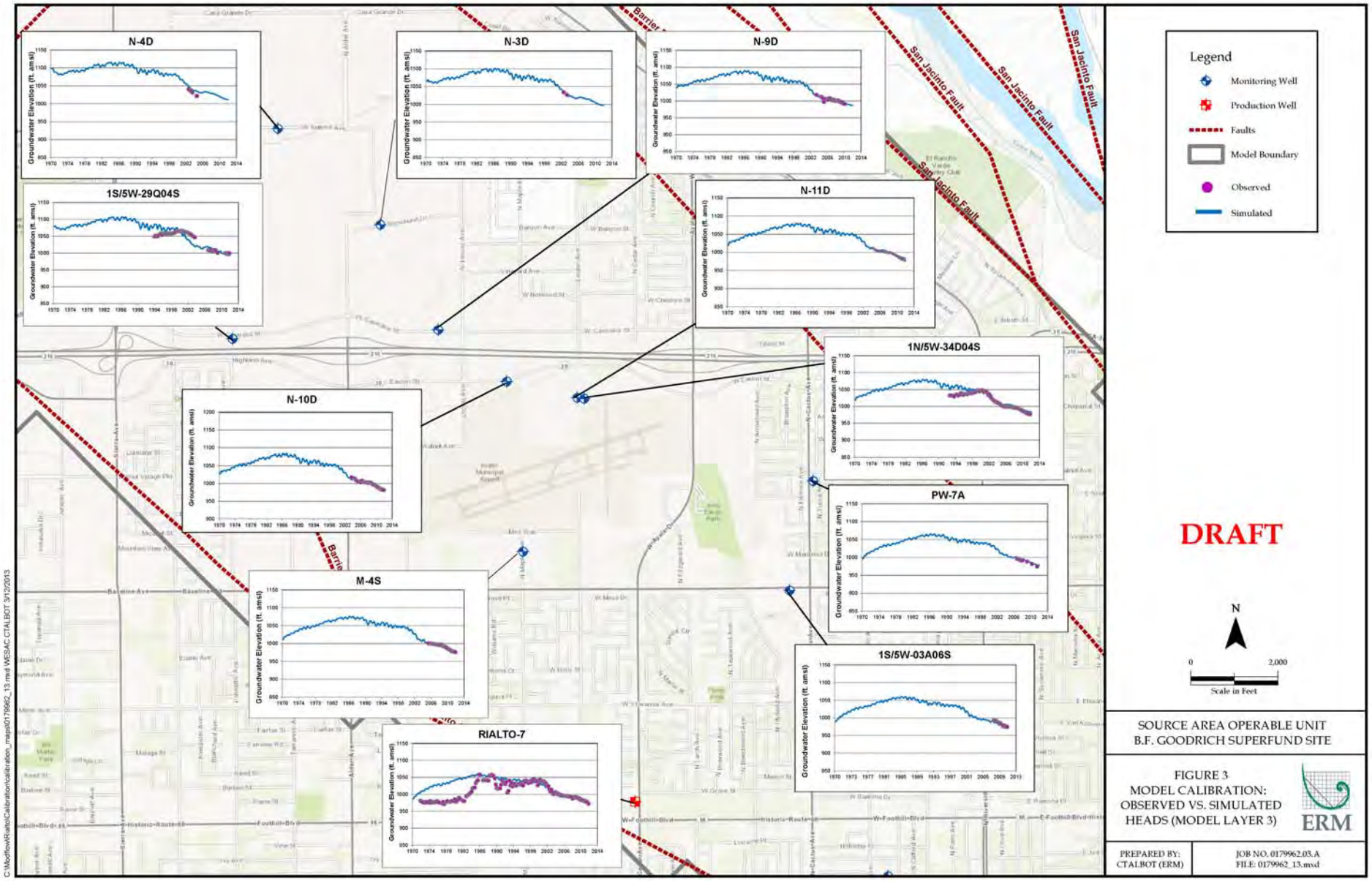
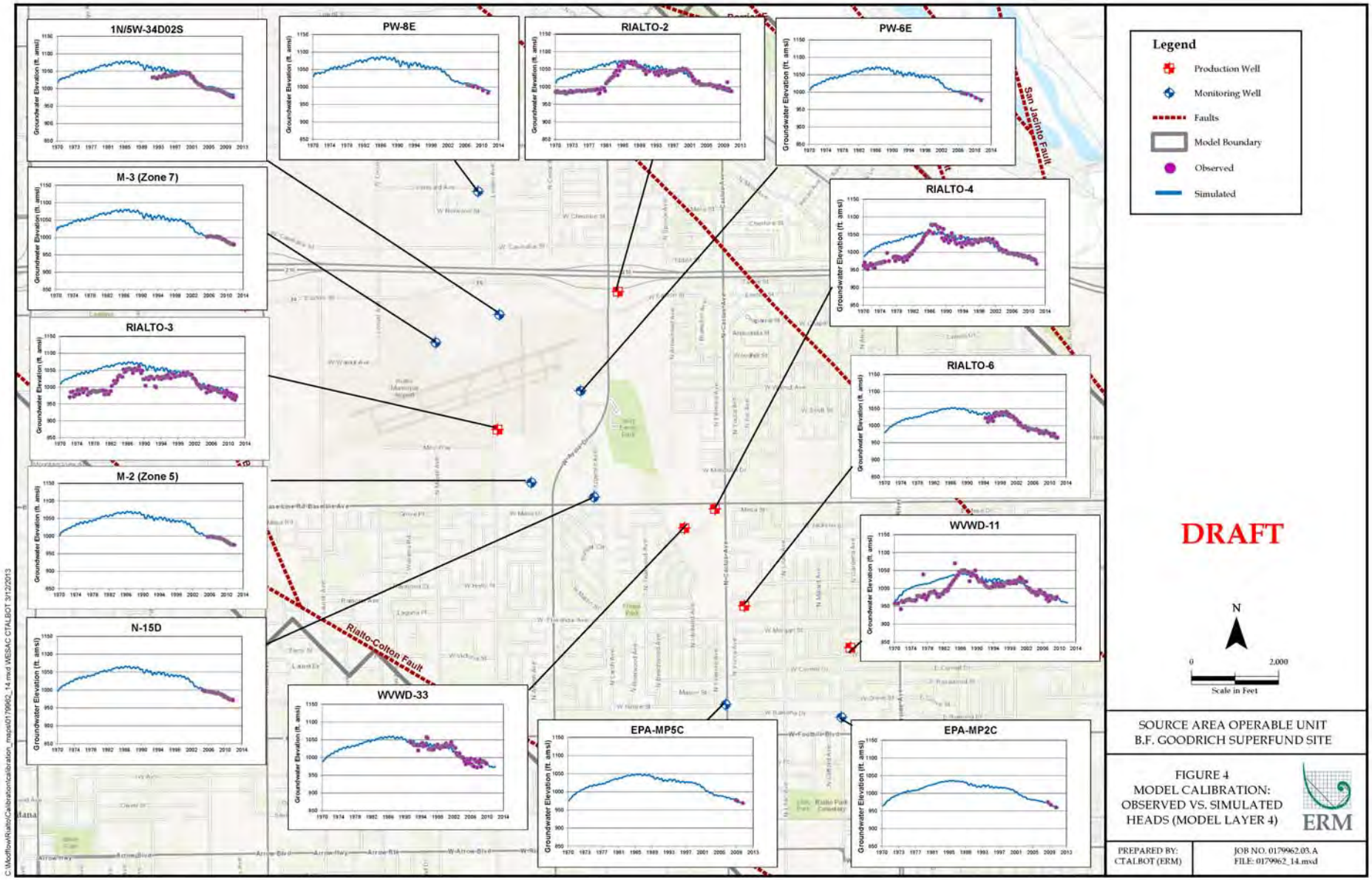
Model Calibration: Observed vs. Simulated Heads (Layer 1)



Model Calibration: Observed vs. Simulated Heads (Layer 3)



Model Calibration: Observed vs. Simulated Heads (Layer 4)



Proposed Pumping Scenarios *(work to date)*

- Scenario 1 – Assess whether RAOs are achievable using existing wells (CR-3, CR-2, Miro-2, and Miro-3) - ongoing
- Scenario 2 – Assess whether RAOs are achievable using a combination of existing and new well(s) - ongoing
- Scenario 3 – Evaluate potential impact of groundwater recharge using Cactus Basins for recommended scenario - pending

Notes: Purveyors' 2011 pumping rates are used as baseline conditions with the following adjustments:

- WVWD-11/Rialto-6 project - combined total of approximately 2,880 AF/yr.
- Pumping at WVWD-33 will decrease to accommodate WVWD-11/Rialto-6 project and SAOU project (based on water rights and negotiations).
- Pumping at Colton 15, 17, 22 and 23 will decrease to accommodate SAOU remedy.

Additional Considerations for Predictive Simulations

- Available water rights:
  - County: 1,300 gpm from Rialto & 120 gpm from Colton
  - Emhart: 1,950 gpm from Colton & potentially up to 1,000 gpm from WVWD
  - Combined: 3,370 gpm (4,370 gpm with WVWD)
- Practical capacity of existing wells (CR-2, CR-3, Miro-2, and Miro-3)
- CR-3's current pumping plan:
  - Winter months ~900 gpm
  - Summer months ~1,850 gpm
- Water demand/seasonal variations

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Summary of Preliminary Predictive Simulations (Attachments)

Predictive Scenarios (gallons per minute)
Source Area Operable Unit, B.F. Goodrich Superfund Site

	Scenario 1		Scenario 2					
Well	**A**	**B**	**A**	**B**	**C**	**D-1**	**D-2**	**D-3**
RIALTO-2	2,000	1,110	310	0	0	0	0	0
RIALTO-3	1,630	1,630	1,425	1,157	1,157	1,157	1,157	1,157
Miro-2	0	815	0	0	800	0	0	0
Miro-3	0	815	0	0	800	0	0	0
New Well -1	0	0	1,549	1,859	1,250	929	1,239	1,239
New Well -2	0	0	0	0	0	743	929	929
Total Flow Rate	3,630	4,370	3,284	3,016	4,007	2,830	3,326	3,326
Average Frequency of Capture	87%	99%	97%	96%	99%	94%	99%	99%

	Scenario 1		Scenario 2					
Well	**A**	**B**	**A**	**B**	**C**	**D-1**	**D-2**	**D-3**
RIALTO-2	2,000	805	232	0	0	0	0	0
RIALTO-3	1,630	1,180	1,157	1,157	1,157	1,157	1,157	1,157
Miro-2	0	580	0	0	400	0	0	0
Miro-3	0	580	0	0	400	0	0	0
New Well -1	0	0	1,162	1,394	625	813	539	768
New Well -2	0	0	0	0	0	651	431	576
Total Flow Rate	3,630	3,145	2,551	2,551	2,582	2,621	2,128	2,502
Average Frequency of Capture	87%	90%	89%	90%	91%	89%	90%	90%

Next Steps

- Finalize future purveyor pump rates
- Assess impact of potential recharge
- Further technical discussions with County re: BCA
- Complete sensitivity analysis
- Finalize scenarios and coordinate with Rialto re: well locations
- Submit draft modeling report to USEPA (10 April 2013)
- Finalize implementation agreements
- Coordinate with WVWD re: potential need for additional water rights
- Commence remedial design

Tables

Parameter	USGS Model (2001)	County Model (2010)	USEPA Model (2012)	Emhart Model (2013)	Rationale
Simulation Time	1945-1996	1960-2009	1970-2009	1970-2011	To incorporate most recent data.
Stress Periods	42 Annual Stress Periods	50 Annual Stress Periods	40 Annual Stress Periods	168 Quarterly Stress Periods	To capture seasonal dynamics of the basin.
Production Wells					
Production Wells	47 Production wells	21 Production wells	30 Production wells	45 Production wells	When incorporating the additional data, ERM / ENVIRON identified 15 wells located within the model domain, but not present within the USEPA Model. All but one of these wells are located outside the Area of Interest (AOI). The model domain for County Model is smaller and only contains 21 production wells.
Production Well Data	Annual pumping data	Annual pumping data	Annual pumping data	Quarterly pumping data	The Emhart model incorporates quarterly pumping data to capture seasonal dynamics of the basin. For production wells where only annual data was available, quarterly pumping patterns assumed for these wells are similar to pumping patterns for other wells where monthly or quarterly data was available.
Production Well Pumping (Annual Average in AF/yr)	11,080	7,014	11,589	14,370	There are two main differences between USEPA and Emhart Models: 1. Emhart Model includes 15 additional pumping wells. 2. The Emhart Model includes additional volume reported from Colton-15 and -17. Steven Mains (maintains Watermaster database) indicated that the total well production from these wells is sum of records provided by City of Colton and La Sierra Water Company. USEPA included only City of Colton portion of well production. Table 2 presents a summary of annual production well pumping in the USGS, USEPA, County, and Emhart Models. Table 3 presents a comparison of annual production well pumping in the USEPA and Emhart Models and shows that almost all of the difference between the two models is due to the 15 additional pumping wells and the La Sierra allocation. There are two main differences between County and Emhart Models: 1. County Model Boundary is smaller and only includes 21 pumping wells. 2. Emhart Model has slightly different pumping rates for Fontana wells.
Water Balance Terms					
Lytle Creek Underflow	Boundary flux based on correlation with stream flow. Fluxes are distributed 50% above Barrier J and 50% below Barrier J in Layer-3 only.	Flux in northeast corner of the model domain in Layer 1 based on USGS annual average	Boundary flux based on correlation with stream flow. Fluxes are distributed 50% above Barrier J and 50% below Barrier J in Layer-3 only.	Boundary flux based on correlation with stream flow. Fluxes are distributed 60% above Barrier J and 40% below Barrier J in Layers 1, 2 and 3 in the ratio of 15%, 15%, and 70%, respectively. There is no flux assigned in Layer 2 below Barrier J.	Based on USGS and USEPA approach and Emhart calibration.
Bunker Hill Underflow	Based on head differences in wells in the basin, assigned to layers 1 and 2 in the ratio of 80 / 20 in the southern part of the basin near Santa Ana River	Not considered because outside model domain.	Same as USGS approach	The annual underflow volumes are taken directly from EPA / USGS model and distributed quarterly based on streamflow data.	Based on USGS and USEPA approach.
Imported Water	Linden Pond recharge records	Not considered.	Linden Pond recharge records	Linden Pond recharge records	Based on USGS and USEPA approach.
Run-off from San Gabriel Mountains	Boundary flux based on correlation with stream flow.	Not considered because outside model domain.	Boundary flux based on correlation with stream flow.	Boundary flux based on correlation with stream flow.	Based on USGS and USEPA approach and Emhart calibration.
Inflow from San Gabriel Mountains	Fluxes are assigned in Layer-3 only	Not considered because outside model domain.	Fluxes are assigned in Layer-3 only	Fluxes are distributed in Layer 1, 2, and 3 in the ratio of 15%, 15%, and 70%, respectively.	Based on USGS approach and calibration results.
Rainfall Recharge	0.5 in/yr	0.5 in/yr	Up to 12 in/yr	0.5 in/yr	Based on USGS, GLA, and USEPA (as prepared during RI/FS) approaches.
Seepage Losses from Santa Ana River/Warm Creek	Simulated by streamflow package	Not considered because outside model domain.	Simulated by river package	Same as EPA	Based on USEPA approach.

Parameter	USGS Model (2001)	County Model (2010)	USEPA Model (2012)	Emhart Model (2013)	Rationale
Seepage Losses from Diversion Canal	Based on records (1945-1955)	Not considered.	Not considered.	Not considered.	Outside period of interest
Irrigation Return Flows	30% of pumpage for the entire simulation period (1945–96).	30% of average pumping rates reported by USGS	No irrigation return flows	15% of pumping in 2nd and 3rd Quarter 30% of pumping in 1st and 4th Quarter	Based on USGS approach. The change also captures seasonal dynamics.
Evapotranspiration	Same approach as in Bunker Hill Model (Daskin et al., 2005)	Not considered.	Same approach as in Bunker Hill Model (Daskin et al., 2005)	Same approach as in Bunker Hill Model (Daskin et al., 2005)	Based on USGS and USEPA approach.
Underflow from Rialto Basin to Chino Basin (excluding Riverside Basin)	Outflow set to zero	Outflow set to zero	Outflow set to 4000 AF/yr	Outflow set to zero	Based on USGS, GLA, and USEPA (as prepared during RI/FS) approaches and calibration results. Further, the head differences across the faults indicate minimal, if any, water movement across the faults.
Underflow from Rialto Basin to Riverside Basin	General Head Boundary (GHB) condition	Not considered because outside model domain.	General Head Boundary (GHB) condition	General Head Boundary (GHB) condition	Based on USGS and USEPA approach and Emhart calibration.
Seepage Losses to Santa Ana/Warm Creek	Simulated by streamflow package	Not considered because outside model domain.	NA	NA	Based on USEPA approach.
Initial Flow Conditions	Heads from 1945	Heads from 1960	Heads from 2009	Heads from 2009	Based on USEPA approach
Extent of BC Aquitard	BCA is not represented in the USGS Model	See figure in presentation	See figure in presentation	See figure in presentation	Extent of BCA adjusted based on review of vertical water level differences and recent boring logs (e.g., USEPA-MP-9). Figure in presentation shows the terminus of the BC Aquitard in the County, USEPA, and Emhart models.
Target Wells	Observed water levels	Observed water levels	Annually averaged observations. Spatially averaged observations in some cases.	Quarterly observations selected at middle of quarter. No spatial averaging. Included additional target wells.	Quarterly observations used to capture seasonal variability.
Model Layers					
Layer 1	- River Channel deposits - 0 to 200 feet thick	- Intermediate Aquifer / Upper Water-Bearing Unit - approx. 240 feet thick	- Intermediate Aquifer / Upper Water-Bearing Unit - Mostly Saturated - 108 to 781 feet thick	- Intermediate Aquifer / Upper Water-Bearing Unit - Mostly Saturated - 108 to 781 feet thick	Based on USEPA approach
Layer 2	-Upper Water Bearing Unit -0 to 300 feet thick	- BC Aquitard / Middle Water-Bearing Unit - 1 to 90 feet thick	- BC Aquitard / Upper Water-Bearing Unit - Variably Saturated - 0.5 to 133 feet thick	- BC Aquitard / Upper Water-Bearing Unit - Variably Saturated - 0.5 to 133 feet thick	Based on USEPA approach; updated to incorporate recent boring logs
Layer 3	-Middle Water Bearing unit - 240 to 600 feet thick	- Upper Regional Aquifer / Middle Water-Bearing Unit - approx. 150 feet thick	- Upper Regional Aquifer / Middle Water-Bearing Unit - Variably Saturated - 14 to 345 feet thick	- Upper Regional Aquifer / Middle Water-Bearing Unit - Variably Saturated - 10 to 345 feet thick	Modified layer thickness from USEPA Model based on boring logs; intended to eliminate dry cells in AOI and improve stability of the model.
Layer 4	-Lower Water bearing unit -the bottom is defined by consolidated deposits - 100 to 400 feet thick	- Lower Water-Bearing Unit - 75 feet thick	- Lower Regional Aquifer / Lower Water-Bearing Unit - Saturated - 42 to 479 feet thick	- Lower Regional Aquifer / Lower Water-Bearing Unit - Saturated - 201 to 688 feet thick	Modified layer thickness from USEPA Model based on boring logs; intended to eliminate dry cells in AOI and improve stability of the model.
Layer 5	No layer 5	- Lower Water-Bearing Unit - 75 feet thick	- Consolidated Deposits - Saturated - 300 feet thick	- Consolidated Deposits - Saturated - 300 feet thick	Based on USEPA approach
Layer 6	No layer 6	- Lower Water-Bearing Unit - 75 feet thick	No layer 6	No layer 6	GLA included additional layers for transport simulation purposes.
Layer 7	No layer 7	- Lower Water-Bearing Unit - 75 feet thick	No layer 7	No layer 7	GLA included additional layers for transport simulation purposes.

Abbreviations:

AF/yr = Acre-feet per year
AOI = Area of interest
in/yr = Inch per year
GLA = GeoLogic Associates
NA = Not Applicable
RI/FS = Remedial Investigation/Feasibility Study
SAOU = Source Area Operable Unit
USGS = U.S. Geological Survey
USEPA = U.S. Environmental Protection Agency

Table 2 - Production Well Pumping Comparison *DRAFT*
Source Area Operable Unit, B.F. Goodrich Superfund Site

Year	USGS Model (1945-96)	USEPA Model (1970-2009)	County Model (1960-2009)	Emhart Model (1970-2011)
1960	11,244	NA	1,560	NA
1961	14,471	NA	2,574	NA
1962	10,580	NA	1,883	NA
1963	9,732	NA	2,442	NA
1964	13,029	NA	3,094	NA
1965	13,186	NA	2,875	NA
1966	13,684	NA	2,827	NA
1967	11,543	NA	2,157	NA
1968	14,184	NA	2,331	NA
1969	11,729	NA	3,209	NA
1970	11,469	7,126	2,796	11,531
1971	11,293	6,355	3,235	11,364
1972	10,319	5,805	3,706	10,219
1973	7,763	5,302	3,290	7,768
1974	8,817	5,418	3,182	8,778
1975	11,002	5,208	3,831	11,196
1976	11,470	6,650	5,058	11,499
1977	8,688	4,209	2,845	8,706
1978	7,571	5,110	3,144	7,584
1979	7,103	4,108	1,273	7,109
1980	5,595	4,532	2,050	5,660
1981	6,237	5,349	3,249	6,339
1982	6,402	4,426	2,003	6,318
1983	4,368	3,851	1,366	4,669
1984	8,892	6,716	3,418	8,688
1985	10,051	6,370	3,176	10,068
1986	9,932	6,975	3,463	9,951
1987	13,085	10,343	6,154	13,112
1988	14,076	10,771	5,147	13,550
1989	15,526	11,179	6,721	14,014
1990	17,551	12,335	10,483	17,363
1991	14,244	8,585	5,453	14,244
1992	16,675	14,566	7,778	17,927
1993	14,892	13,882	6,561	16,734
1994	14,227	12,709	7,363	15,704
1995	15,922	15,673	8,976	19,017
1996	15,758	18,652	8,957	19,809
1997	NA	14,775	8,144	14,924
1998	NA	11,352	7,870	11,576
1999	NA	12,046	8,402	13,038
2000	NA	14,117	8,361	15,832

Table 2 - Production Well Pumping Comparison *DRAFT*
Source Area Operable Unit, B.F. Goodrich Superfund Site

Year	USGS Model (1945-96)	USEPA Model (1970-2009)	County Model (1960-2009)	Emhart Model (1970-2011)
2001	NA	19,192	13,270	19,467
2002	NA	23,367	18,896	24,931
2003	NA	24,590	17,859	24,699
2004	NA	23,898	15,779	24,003
2005	NA	18,536	12,754	18,558
2006	NA	16,836	10,496	17,376
2007	NA	20,066	11,434	20,505
2008	NA	19,555	10,135	20,541
2009	NA	23,027	12,476	23,336
2010	NA	NA	NA	25,351
2011	NA	NA	NA	20,484
Average Production (prior to 2001)	11,414	8,855	4,449	11,751
Average Production (since 2001)	-	21,007	13,678	21,750

Notes:
All production rates are in acre-feet per year.

Abbreviations:
NA = Not analyzed
USGS = U.S. Geological Survey
USEPA = U.S. Environmental Protection Agency

Table 3 - Production Well Comparison USEPA-Emhart *DRAFT*
Source Area Operable Unit, B.F. Goodrich Superfund Site

Year	All Wells in Emhart Model	Wells in both USEPA and Emhart Model	Wells in Emhart Model but not in USEPA Model*	La Sierra Allocation in Emhart Model but not USEPA Model **
1970	11,531	7,121	3,338	1,072
1971	11,364	6,350	3,887	1,127
1972	10,219	5,651	3,511	1,057
1973	7,768	5,294	1,568	906
1974	8,778	5,362	2,756	660
1975	11,196	5,391	5,177	628
1976	11,499	6,658	4,188	653
1977	8,706	4,208	3,992	506
1978	7,584	5,109	1,969	506
1979	7,109	4,097	2,477	535
1980	5,660	4,584	534	542
1981	6,339	5,433	365	541
1982	6,318	4,326	1,410	582
1983	4,669	3,866	251	552
1984	8,688	6,493	1,692	503
1985	10,068	6,369	3,209	490
1986	9,951	6,976	2,525	450
1987	13,112	10,362	2,232	518
1988	13,550	10,850	2,222	478
1989	14,014	11,297	2,233	484
1990	17,363	14,888	1,949	526
1991	14,244	11,756	1,980	508
1992	17,927	15,756	1,625	546
1993	16,734	15,715	329	690
1994	15,704	13,926	1,070	708
1995	19,017	16,947	533	1,537
1996	19,809	18,697	570	542
1997	14,924	13,807	1,117	0
1998	11,576	11,344	232	0
1999	13,038	11,925	1,113	0
2000	15,832	15,602	230	0
2001	19,467	19,182	285	0
2002	24,931	23,609	1,322	0
2003	24,699	23,684	1,015	0
2004	24,003	23,883	120	0
2005	18,558	18,528	30	0
2006	17,376	17,032	344	0
2007	20,505	19,823	682	0
2008	20,541	19,482	1,059	0
2009	23,336	22,894	442	0
2010	25,351	25,217	134	0
2011	20,484	20,214	270	0
Average Production (prior to 2001)	11,751	9,231	1,945	576
Average Production (since 2001)	21,750	21,232	518	0

Notes:

All production rates are in acre-feet per year

* 14 of 15 wells are located outside the Area of Interest

** Steven Mains (maintains Watermaster database) indicated that the total well production from Colton-15 and Colton-17 wells is sum of records provided by City of Colton and La Sierra Water Company. This column represents the value reported by La Sierra Water Company that did not appear to be within the USEPA Model.

Abbreviation:

USEPA = U.S. Environmental Protection Agency

Table 4 - Water Balance Comparison *DRAFT*

Source Area Operable Unit, B.F. Goodrich Superfund Site

Components		USGS Model (1945-96)	USEPA Model (1970-2009)	Emhart Model (1970-2011)
INFLOW				
Underflow from Lytle Creek	Above Barrier J	4,460	4,552	7,144
	Below Barrier J	4,460	4,552	3,062
Underflow from Bunker Hill	Layer 1	9,100	7,704	8,072
	Layer 2	2,280	1,926	2,018
Imported Water		750	972	929
Run-off from San Gabriel Mountains		2,021	1,864	1,849
Inflow from San Gabriel Mountains		1,200	1,200	1,200
Inflow - The Badlands		166	231	259
Rainfall Recharge		860	6,801	860
Seepage Losses from Santa Ana/Warm Creek		4,860	1,142	1,117
Seepage Losses from Diversion Canal		190	0	0
Irrigation Return Flows		3,324	0	3,507
Total Inflow		**33,671**	**30,944**	**30,017**
OUTFLOW				
Evaporation		<1	111	<1
Underflow from Rialto Basin to Chino Basin		0	4,000	0
Underflow from Rialto Basin to Riverside Basin		23,700	18,027	20,240
Seepage Losses to Santa Ana/Warm Creek		440	0	0
Production Well Pumping Annual Average (Model incorporates actual rate per stress period)		11,080	11,589	14,370
Total Outflow		**35,221**	**33,727**	**34,611**

Notes:

All inflow and outflow are in acre-feet per year.

Abbreviations:

USEPA = U.S. Environmental Protection Agency

USGS = U.S. Geological Survey

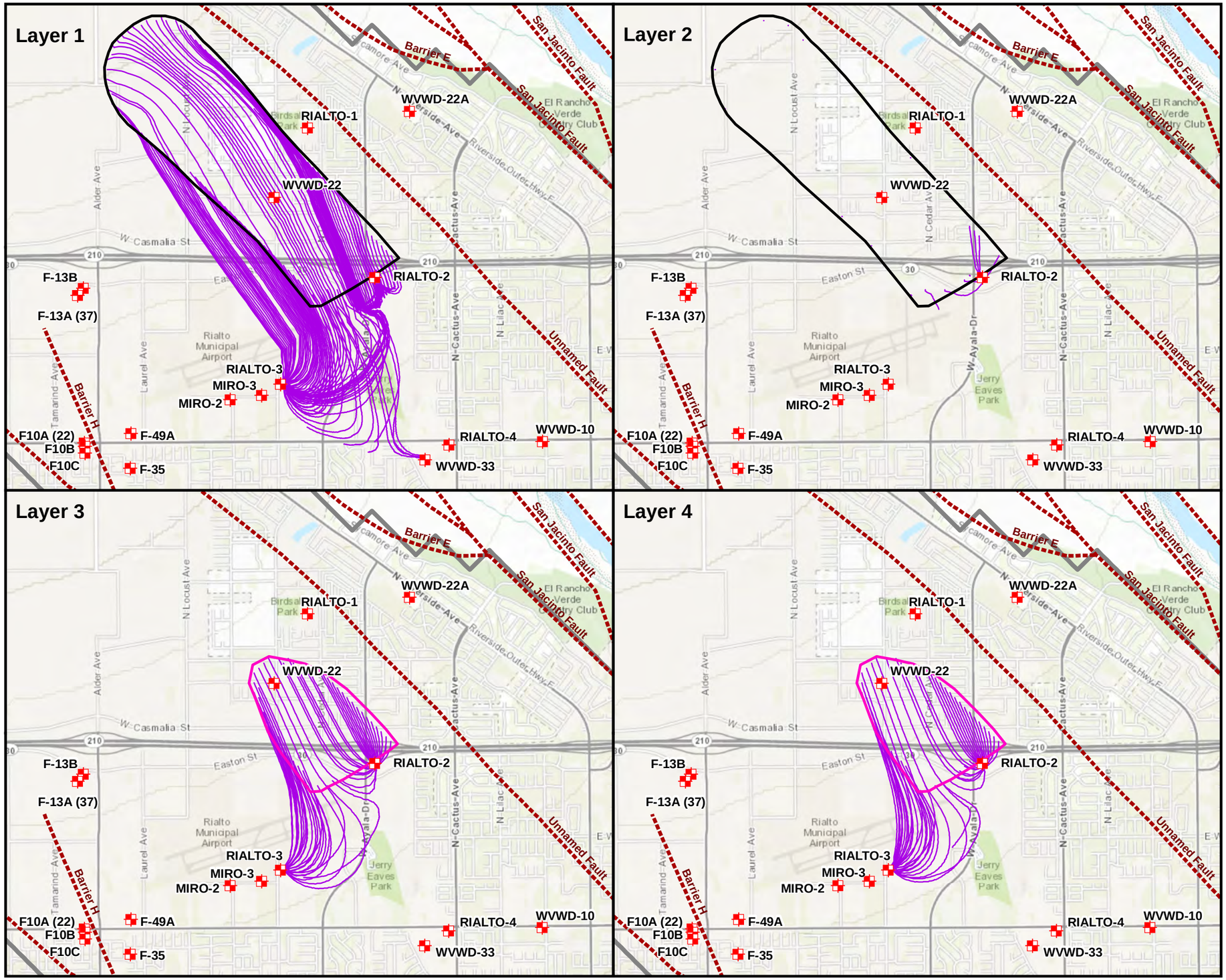
Table 5 - Comparison of Predictive Simulations *DRAFT*
Source Area Operable Unit, B.F. Goodrich Superfund Site

Parameter	USEPA Model	Emhart Model	Rationale
Simulation Time	2010 to 2048 (39 years)	2012 to 2052 (41 years)	The Emhart Model calibration period is 41 years (1970 through 2011), extending the USEPA's calibration period of 39 years by two years. Following the USEPA's approach for specifying the duration of the predictive scenario, the Emhart Model predictive simulation period is also 41 years, 2012 to 2052.
Stress Periods	39 Annual Stress Periods	168 Quarterly Stress Periods	Quarterly stress periods to allow assessment of seasonal dynamics of the basin.
Predictive Pumping	Based on pumping rates provided by purveyors. Colton production wells were eliminated.	Purveyors' 2011 pumping rates with the following adjustments: - WVWD-11/Rialto-6 Project – Combined total of approximately 2,880 AF/yr. - Pumping at other WVWD wells may decrease to accommodate WVWD 11/Rialto-6 project and SAOU project (based on water rights and negotiations). - Pumping at Colton-15, -17, -22, and -23 will decrease to accommodate SAOU remedy (Colton-15 and -17 will be shut down first).	Based on data gathered to support update of the USEPA Model.
Available Water Rights	Water rights not considered	Available water rights from : City of Colton - 1,950 gpm (3,147 AF/yr) WVWD - 1,000 gpm (1,614 AF/yr)	Water rights represent actual constraints on pumping rates.
Target Capture Zone	As presented by USEPA in their 9 July 2012 presentation.	Based on the Target Area presented in the RI/FS and IROD.	Specified in RI/FS and IROD.
Particle Release Time	Particles are released 2010-2039 (29 years).	Particles are released 2012-2031 (20 years).	Particles released in later time do not reach the extraction wells during the simulations time.
Particle Release Location (vertical)	In middle of the cell Layers 1 through 4	Layers 1 and 3 – Middle of the cell Layer 4 – Top of the cell	Changes in Layer 4 were made to match contaminant occurrence with extraction depths (vertical evaluation of the plume).

Abbreviations:

AF/yr = acre-feet per year
IROD = Interim Record of Decision (2010)
RI/FS = Remedial Investigation/Feasibility Study
SAOU = Source Area Operable Unit
USEPA = U.S. Environmental Protection Agency
WVWD = West Valley Water District

Scenario 1A



Legend

- Production Well
- Model Particle Tracks
- Faults
- Intermediate Aquifer Target Capture Zone
- Regional Aquifer Target Capture Zone
- Model Boundary

Well	Pumping Rate GPM	Pumping Rate AF/yr
RIALTO-2	2,000	3,228
RIALTO-3	1,630	2,631
Miro-2	0	0
Miro-3	0	0
Proposed Well 1	0	0
Proposed Well 2	0	0
Total Flow Rate	3,630	5,859

DRAFT

Note:
GPM - Gallons per Minute
AF/yr - Acre-Feet per Year

N

0 3,000
Feet

SOURCE AREA OPERABLE UNIT
B.F. GOODRICH SUPERFUND SITE

FIGURE 1A
SCENARIO 1A
PARTICLE TRACK
SIMULATION

ERM

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CTALBOT (ERM)

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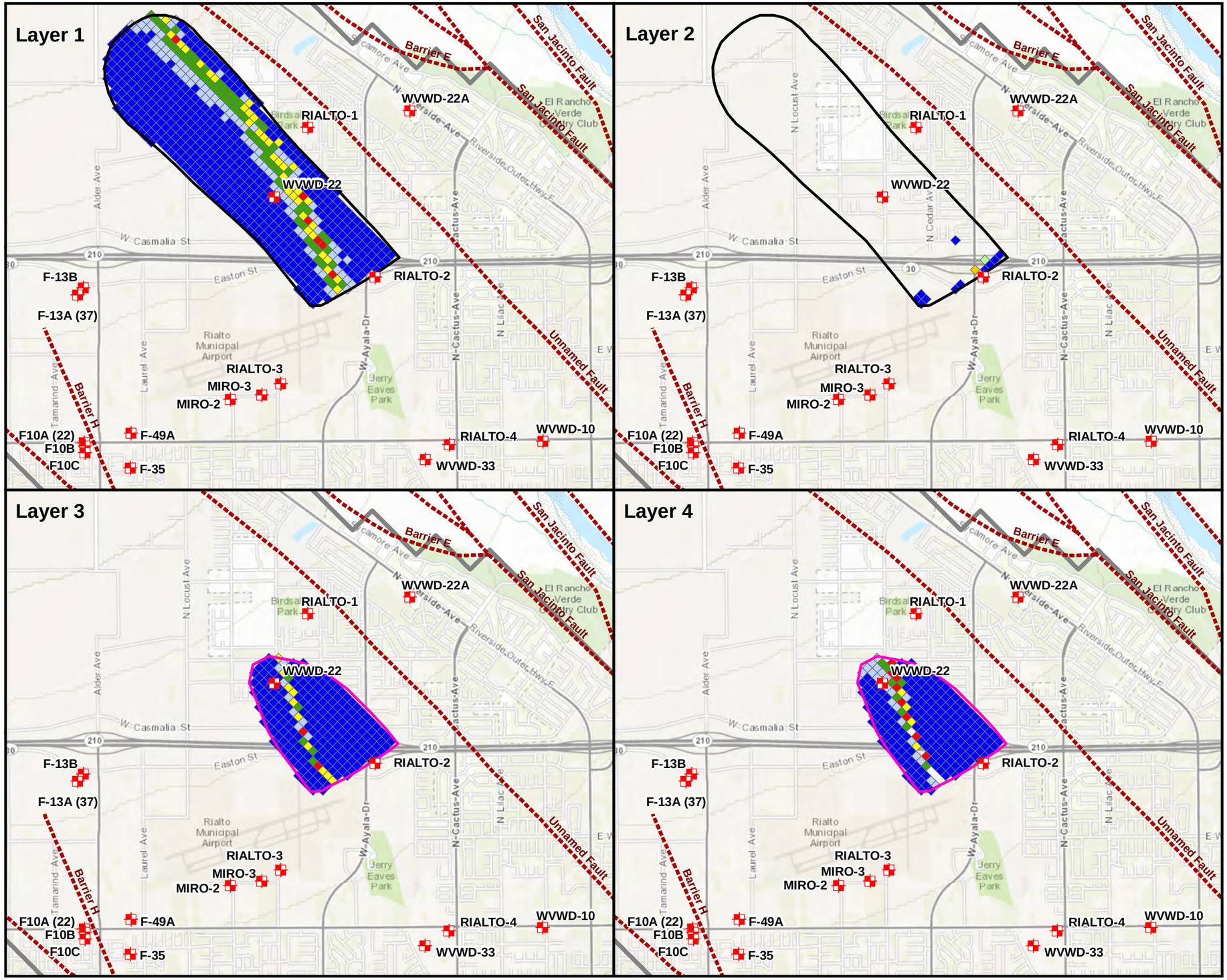

Legend

- Production Well
- Frequency of Capture (%)
  - < 20
  - 20 to 40
  - 40 to 60
  - 60 to 80
  - 80 to 100
- Faults
- Intermediate Aquifer Target Capture Zone
- Regional Aquifer Target Capture Zone
- Model Boundary

Well	Pumping Rate GPM	Pumping Rate AF/yr
RIALTO-2	2,000	3,228
RIALTO-3	1,630	2,631
Miro-2	0	0
Miro-3	0	0
Proposed Well 1	0	0
Proposed Well 2	0	0
Total Flow Rate	3,630	5,859

DRAFT

Note:
GPM - Gallons per Minute
AF/yr - Acre-Feet per Year

N

0 3,000
Feet

SOURCE AREA OPERABLE UNIT
B.F. GOODRICH SUPERFUND SITE

FIGURE 1B
SCENARIO 1A
FREQUENCY OF
CAPTURE

ERM

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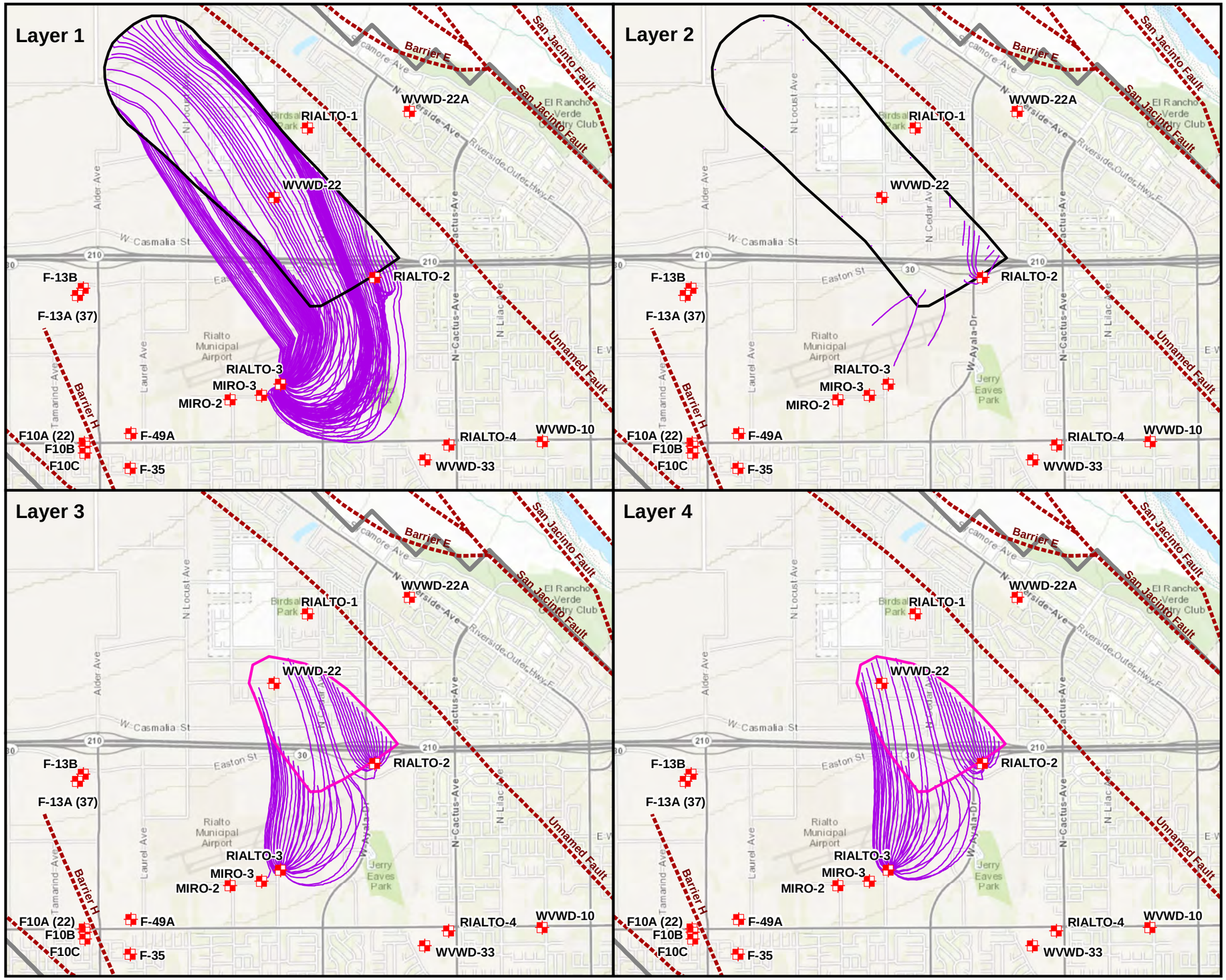
Scenario 1B



Legend

- Production Well
- Model Particle Tracks
- Faults
- Intermediate Aquifer Target Capture Zone
- Regional Aquifer Target Capture Zone
- Model Boundary

Well	Pumping Rate GPM	Pumping Rate AF/yr
RIALTO-2	1,110	1,792
RIALTO-3	1,630	2,631
Miro-2	815	1,315
Miro-3	815	1,315
Proposed Well 1	0	0
Proposed Well 2	0	0
Total Flow Rate	4,370	7,053

DRAFT

Note:
GPM - Gallons per Minute
AF/yr - Acre-Feet per Year

N

0 3,000
Feet

SOURCE AREA OPERABLE UNIT
B.F. GOODRICH SUPERFUND SITE

FIGURE 2A
SCENARIO 1B
PARTICLE TRACK
SIMULATION

ERM

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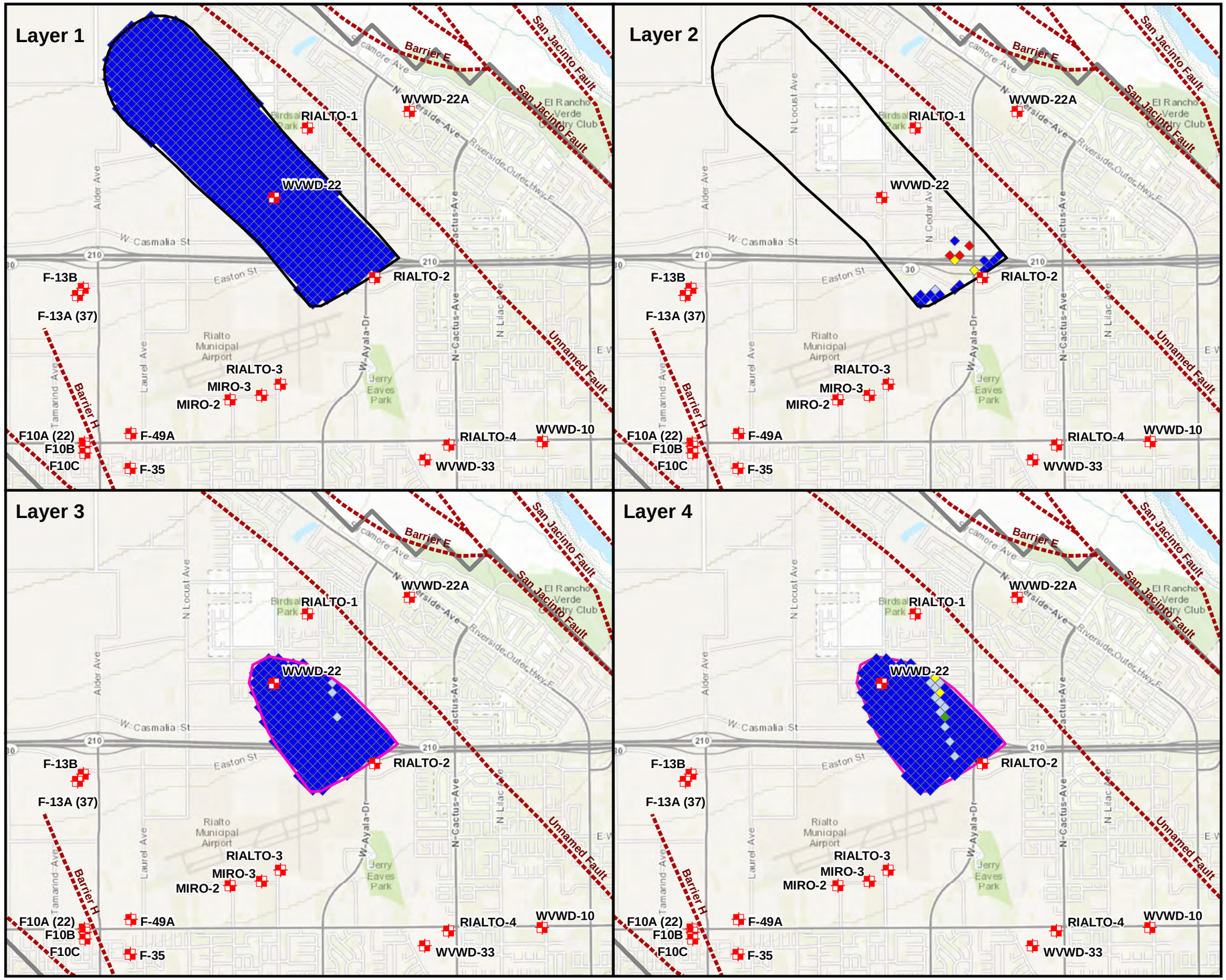

Legend

- Production Well
- Frequency of Capture (%)
  - < 20
  - 20 to 40
  - 40 to 60
  - 60 to 80
  - 80 to 100
- Faults
- Intermediate Aquifer Target Capture Zone
- Regional Aquifer Target Capture Zone
- Model Boundary

Well	Pumping Rate GPM	Pumping Rate AF/yr
RIALTO-2	1,110	1,792
RIALTO-3	1,630	2,631
Miro-2	815	1,315
Miro-3	815	1,315
Proposed Well 1	0	0
Proposed Well 2	0	0
Total Flow Rate	4,370	7,053

DRAFT

Note:
GPM - Gallons per Minute
AF/yr - Acre-Feet per Year

N

0 3,000
Feet

SOURCE AREA OPERABLE UNIT
B.F. GOODRICH SUPERFUND SITE

FIGURE 2B
SCENARIO 1B
FREQUENCY OF
CAPTURE

ERM

PREPARED BY:
CTALBOT (ERM)

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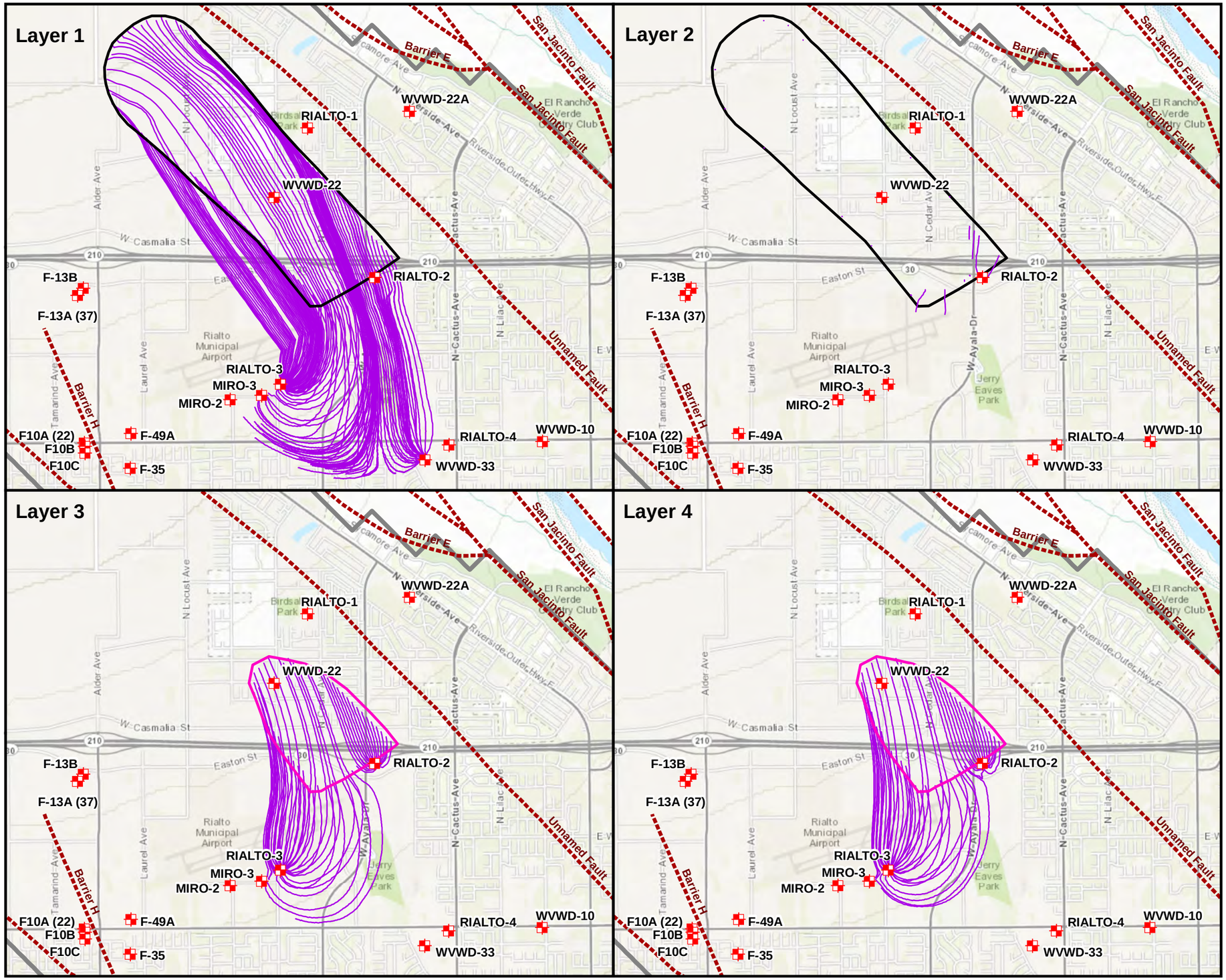


Legend

- Production Well
- Model Particle Tracks
- Faults
- Intermediate Aquifer Target Capture Zone
- Regional Aquifer Target Capture Zone
- Model Boundary

Well	Pumping Rate GPM	Pumping Rate AF/yr
RIALTO-2	805	1,299
RIALTO-3	1,180	1,905
Miro-2	580	936
Miro-3	580	936
Proposed Well 1	0	0
Proposed Well 2	0	0
Total Flow Rate	3,145	5,076

DRAFT

Note:
GPM - Gallons per Minute
AF/yr - Acre-Feet per Year

N

0 3,000
Feet

SOURCE AREA OPERABLE UNIT
B.F. GOODRICH SUPERFUND SITE

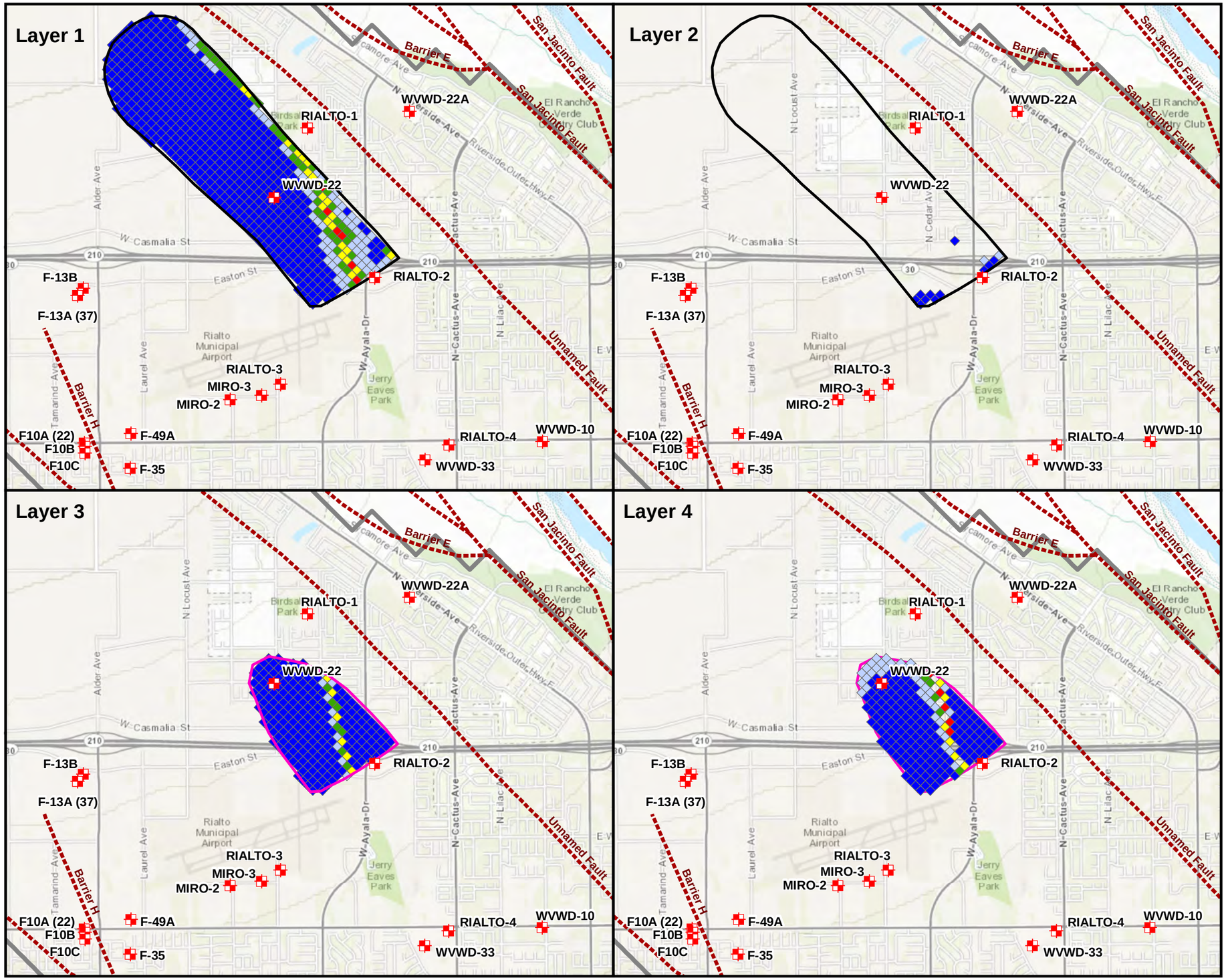
FIGURE 2A
SCENARIO 1B
PARTICLE TRACK
SIMULATION

ERM

PREPARED BY:
CTALBOT (ERM)

JOB NO. 0179962.03.A
FILE: R_0179962_2A_PT.mxd

C:\Modflow\Rialto\Calibration\predictive\RevisedScenarios\Results\R_0179962_2A_PT.mxd WESAC CTALBOT 3/11/2013



Legend

- Production Well
- Frequency of Capture (%)
  - < 20
  - 20 to 40
  - 40 to 60
  - 60 to 80
  - 80 to 100
- Faults
- Intermediate Aquifer Target Capture Zone
- Regional Aquifer Target Capture Zone
- Model Boundary

Well	Pumping Rate GPM	Pumping Rate AF/yr
RIALTO-2	805	1,299
RIALTO-3	1,180	1,905
Miro-2	580	936
Miro-3	580	936
Proposed Well 1	0	0
Proposed Well 2	0	0
Total Flow Rate	3,145	5,076

DRAFT

Note:
GPM - Gallons per Minute
AF/yr - Acre-Feet per Year

N

0 3,000
Feet

SOURCE AREA OPERABLE UNIT
B.F. GOODRICH SUPERFUND SITE

FIGURE 2B
SCENARIO 1B
FREQUENCY OF
CAPTURE

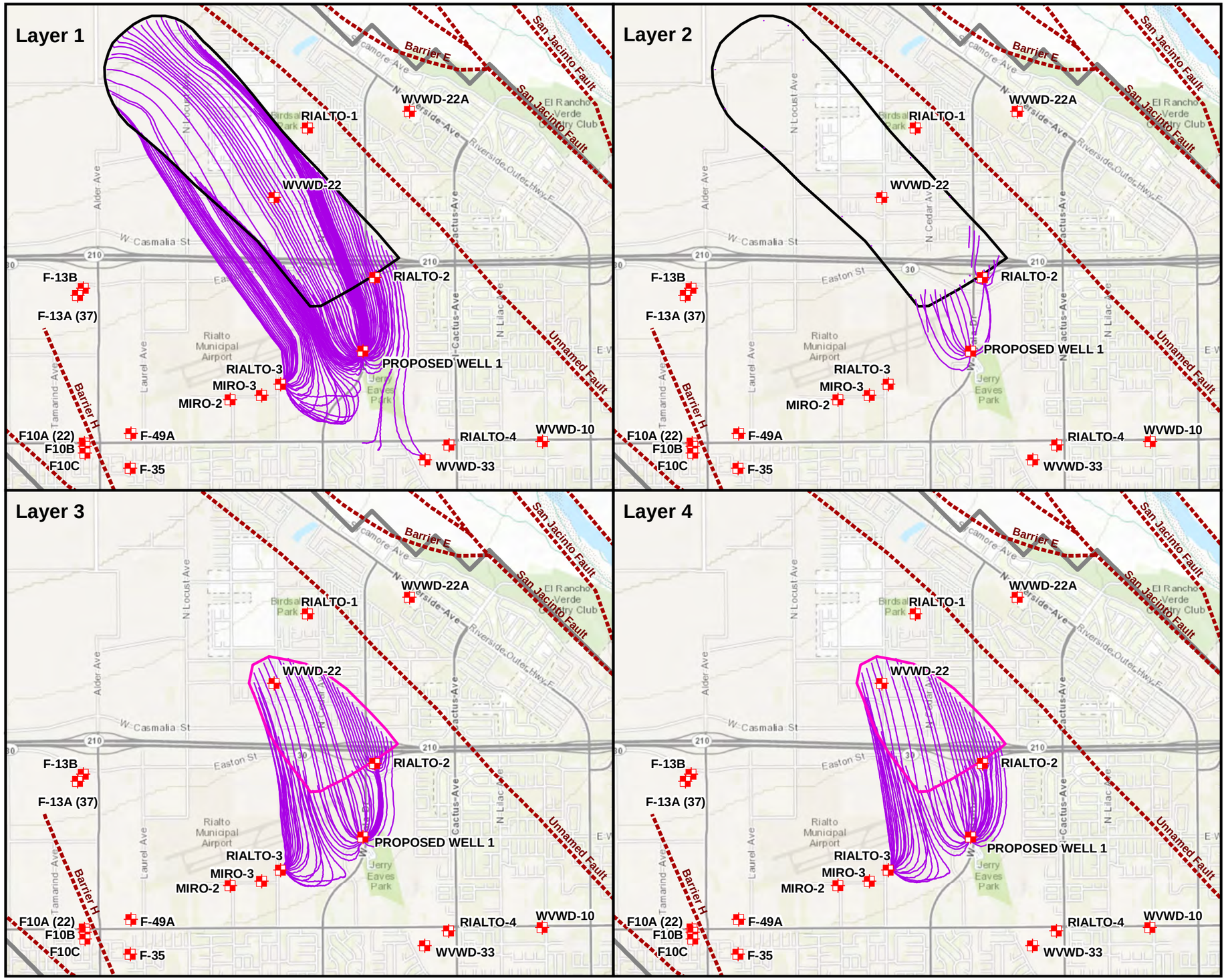
ERM

PREPARED BY:
CTALBOT (ERM)

JOB NO. 0179962.03.A
FILE: R_0179962_2B_EPT.mxd

C:\Modflow\Rialto\Calibration\predictive\RevisedScenarios\Results\R_0179962_2B_EPT.mxd WESAC CTALBOT 3/11/2013

Scenario 2A



Legend

- Production Well
- Model Particle Tracks
- Faults
- Intermediate Aquifer Target Capture Zone
- Regional Aquifer Target Capture Zone
- Model Boundary

Well	Pumping Rate GPM	Pumping Rate AF/yr
RIALTO-2	310	500
RIALTO-3	1,425	2,300
Miro-2	0	0
Miro-3	0	0
Proposed Well 1	1,549	2,500
Proposed Well 2	0	0
Total Flow Rate	3,284	5,300

DRAFT

Note:
GPM - Gallons per Minute
AF/yr - Acre-Feet per Year

N

0 3,000
Feet

SOURCE AREA OPERABLE UNIT
B.F. GOODRICH SUPERFUND SITE

FIGURE 3A
SCENARIO 2A
PARTICLE TRACK
SIMULATION

ERM

PREPARED BY:
CTALBOT (ERM)

JOB NO. 0179962.03.A
FILE: 0179962_3A_PT.mxd

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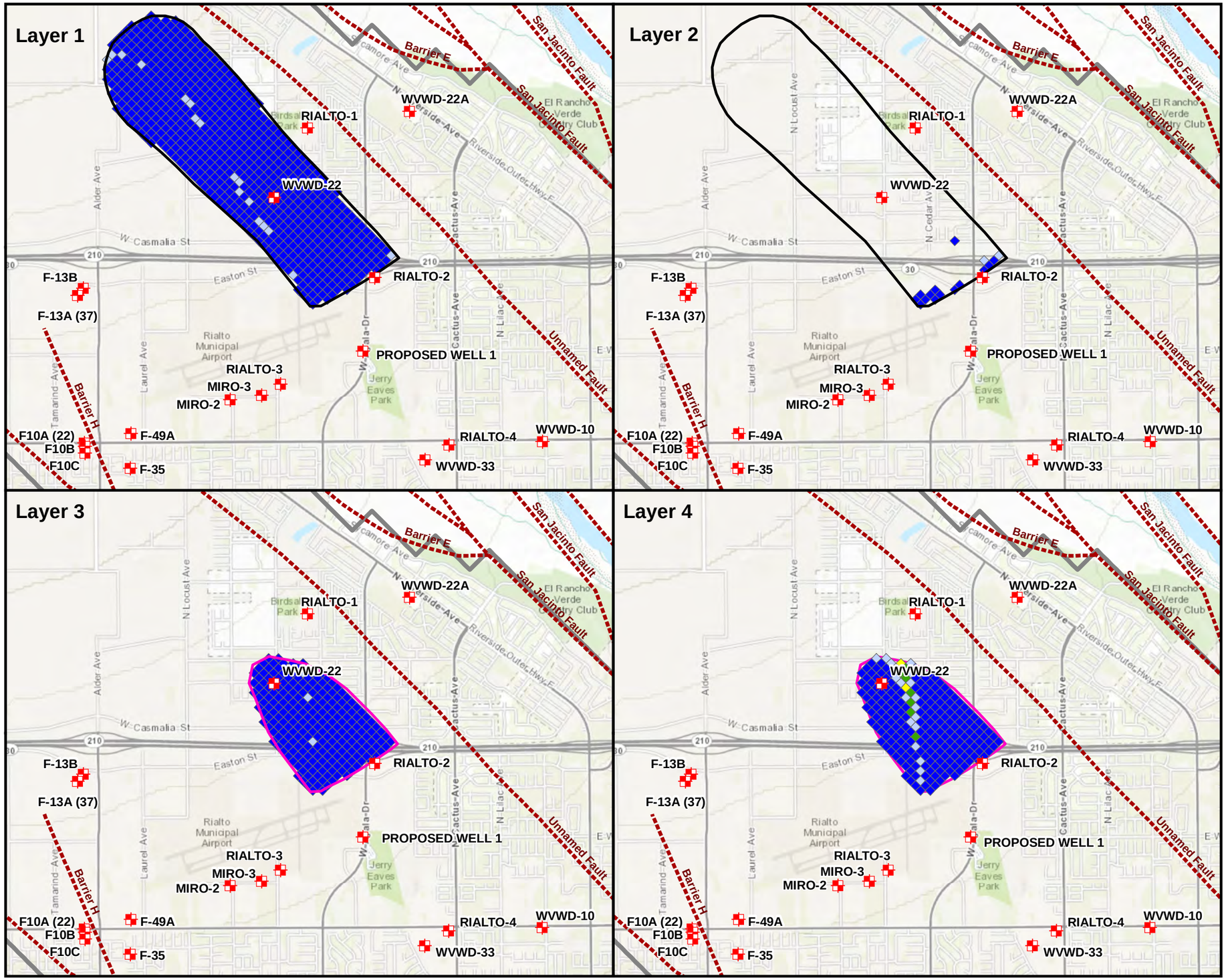


Legend

- Production Well
- Frequency of Capture (%)
  - < 20
  - 20 to 40
  - 40 to 60
  - 60 to 80
  - 80 to 100
- Faults
- Intermediate Aquifer Target Capture Zone
- Regional Aquifer Target Capture Zone
- Model Boundary

Well	Pumping Rate GPM	Pumping Rate AF/yr
RIALTO-2	310	500
RIALTO-3	1,425	2,300
Miro-2	0	0
Miro-3	0	0
Proposed Well 1	1,549	2,500
Proposed Well 2	0	0
Total Flow Rate	3,284	5,300

DRAFT

Note:
GPM - Gallons per Minute
AF/yr - Acre-Feet per Year

N

0 3,000
Feet

SOURCE AREA OPERABLE UNIT
B.F. GOODRICH SUPERFUND SITE

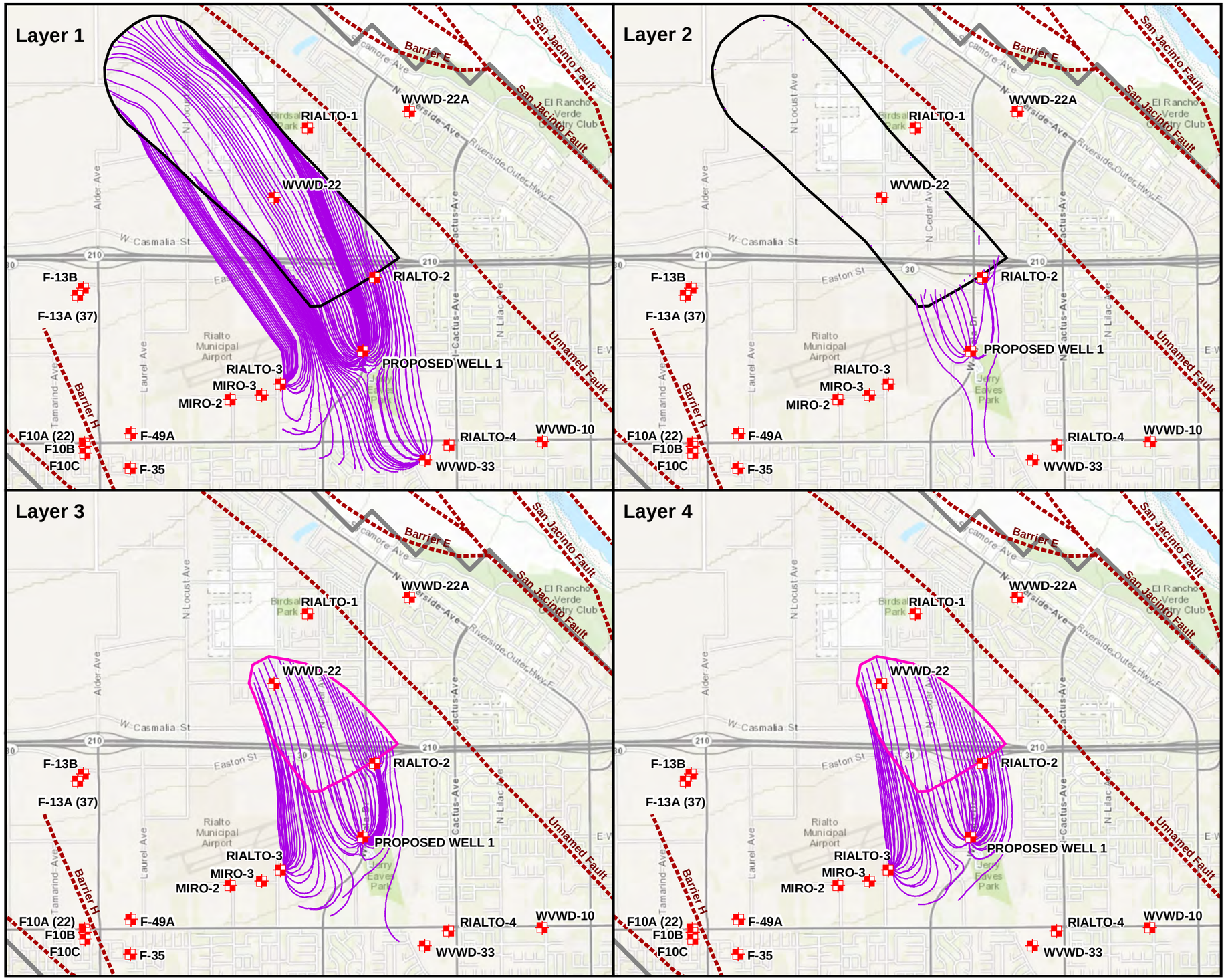
FIGURE 3B
SCENARIO 2A
FREQUENCY OF
CAPTURE

ERM

PREPARED BY:
CTALBOT (ERM)

JOB NO. 0179962.03.A
FILE: 0179962_3B_EPT.mxd

C:\Modflow\Rialto\Calibration\predictive\RevisedScenarios\Results\0179962_3B_EPT.mxd WESAC CTALBOT 3/11/2013



Legend

- Production Well
- Model Particle Tracks
- Faults
- Intermediate Aquifer Target Capture Zone
- Regional Aquifer Target Capture Zone
- Model Boundary

Well	Pumping Rate GPM	Pumping Rate AF/yr
RIALTO-2	232	375
RIALTO-3	1,157	1,868
Miro-2	0	0
Miro-3	0	0
Proposed Well 1	1,162	1,875
Proposed Well 2	0	0
Total Flow Rate	2,551	4,118

DRAFT

Note:
GPM - Gallons per Minute
AF/yr - Acre-Feet per Year

N

0 3,000
Feet

SOURCE AREA OPERABLE UNIT
B.F. GOODRICH SUPERFUND SITE

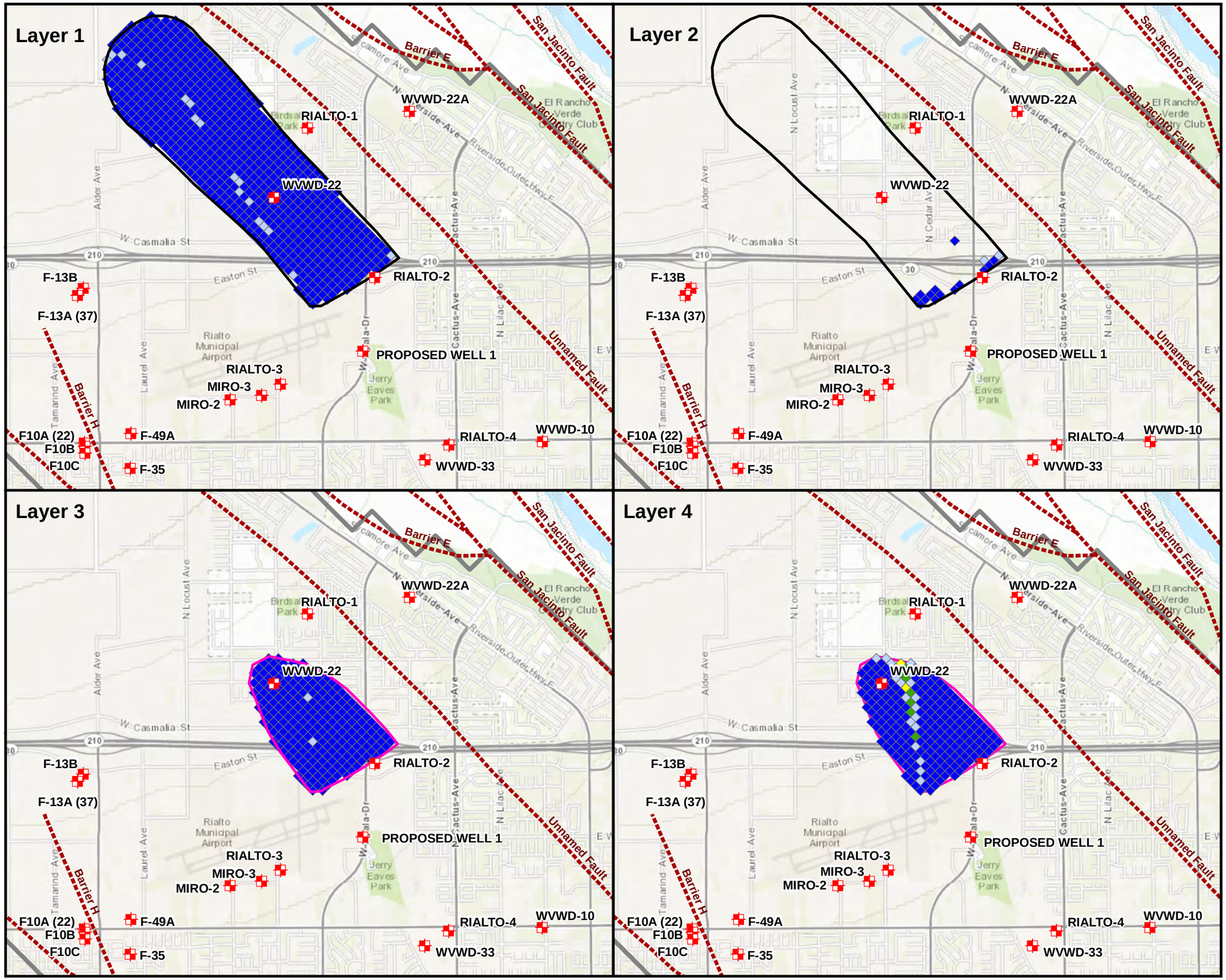
FIGURE 3A
SCENARIO 2A
PARTICLE TRACK
SIMULATION

ERM

PREPARED BY:
CTALBOT (ERM)

JOB NO. 0179962.03.A
FILE: R_0179962_3A_PT.mxd

C:\Modflow\Rialto\Calibration\predictive\RevisedScenarios\Results\R_0179962_3A_PT.mxd WESAC CTALBOT 3/11/2013



Legend

- Production Well
- Frequency of Capture (%)
  - < 20
  - 20 to 40
  - 40 to 60
  - 60 to 80
  - 80 to 100
- Faults
- Intermediate Aquifer Target Capture Zone
- Regional Aquifer Target Capture Zone
- Model Boundary

Well	Pumping Rate GPM	Pumping Rate AF/yr
RIALTO-2	310	500
RIALTO-3	1,425	2,300
Miro-2	0	0
Miro-3	0	0
Proposed Well 1	1,549	2,500
Proposed Well 2	0	0
Total Flow Rate	3,284	5,300

DRAFT

Note:
GPM - Gallons per Minute
AF/yr - Acre-Feet per Year

N

0 3,000
Feet

SOURCE AREA OPERABLE UNIT
B.F. GOODRICH SUPERFUND SITE

FIGURE 3B
SCENARIO 2A
FREQUENCY OF
CAPTURE

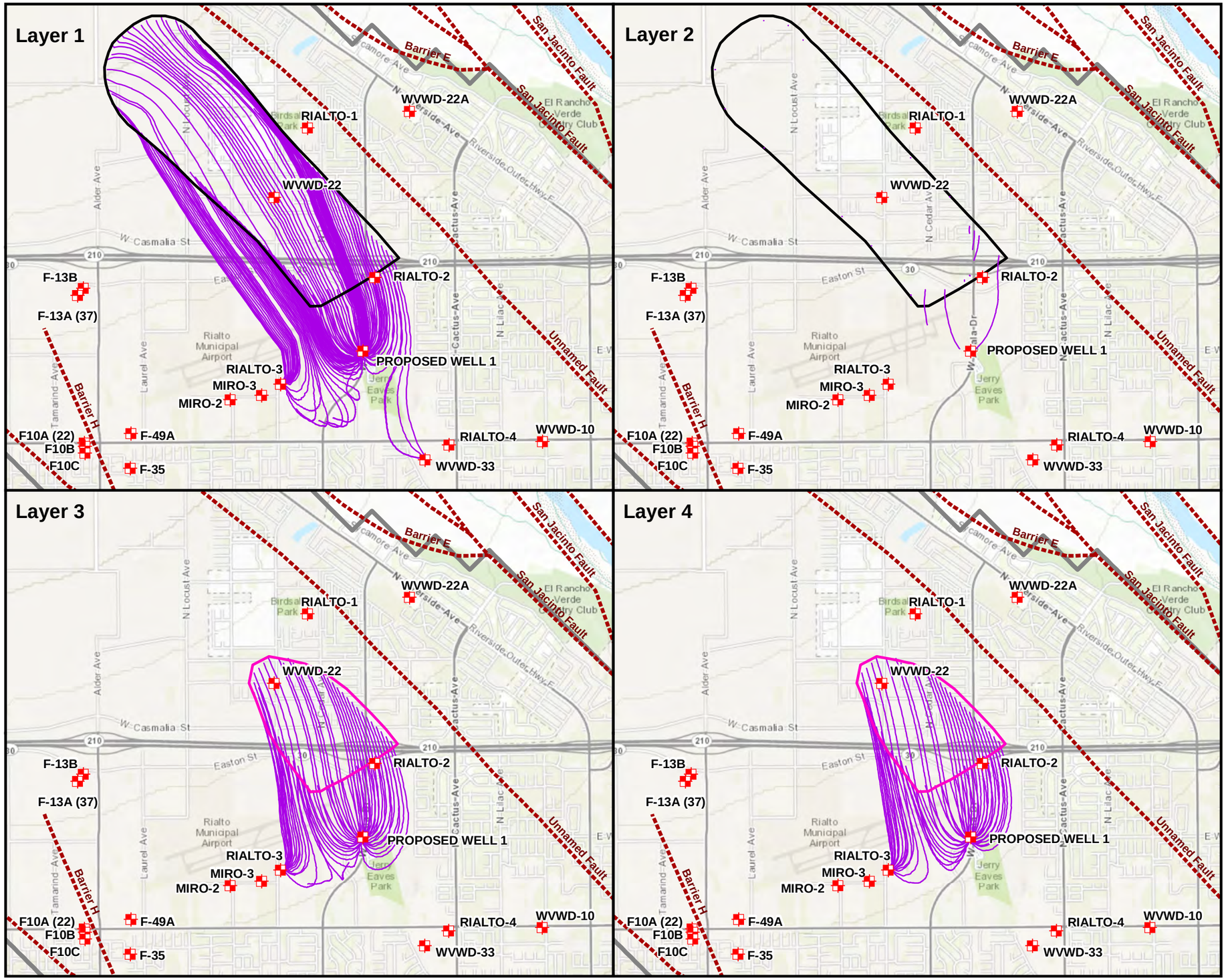
ERM

PREPARED BY:
CTALBOT (ERM)

JOB NO. 0179962.03.A
FILE: 0179962_3B_EPT.mxd

C:\Modflow\Rialto\Calibration\predictive\RevisedScenarios\Results\0179962_3B_EPT.mxd WESAC CTALBOT 3/11/2013

Scenario 2B



Legend

- Production Well
- Model Particle Tracks
- Faults
- Intermediate Aquifer Target Capture Zone
- Regional Aquifer Target Capture Zone
- Model Boundary

Well	Pumping Rate GPM	Pumping Rate AF/yr
RIALTO-2	0	0
RIALTO-3	1,157	1,868
Miro-2	0	0
Miro-3	0	0
Proposed Well 1	1,859	3,000
Proposed Well 2	0	0
Total Flow Rate	3,016	4,868

DRAFT

Note:
GPM - Gallons per Minute
AF/yr - Acre-Feet per Year

N

0 3,000
Feet

SOURCE AREA OPERABLE UNIT
B.F. GOODRICH SUPERFUND SITE

FIGURE 4A
SCENARIO 2B
PARTICLE TRACK
SIMULATION

ERM

PREPARED BY:
CTALBOT (ERM)

JOB NO. 0179962.03.A
FILE: 0179962_4A_PT.mxd

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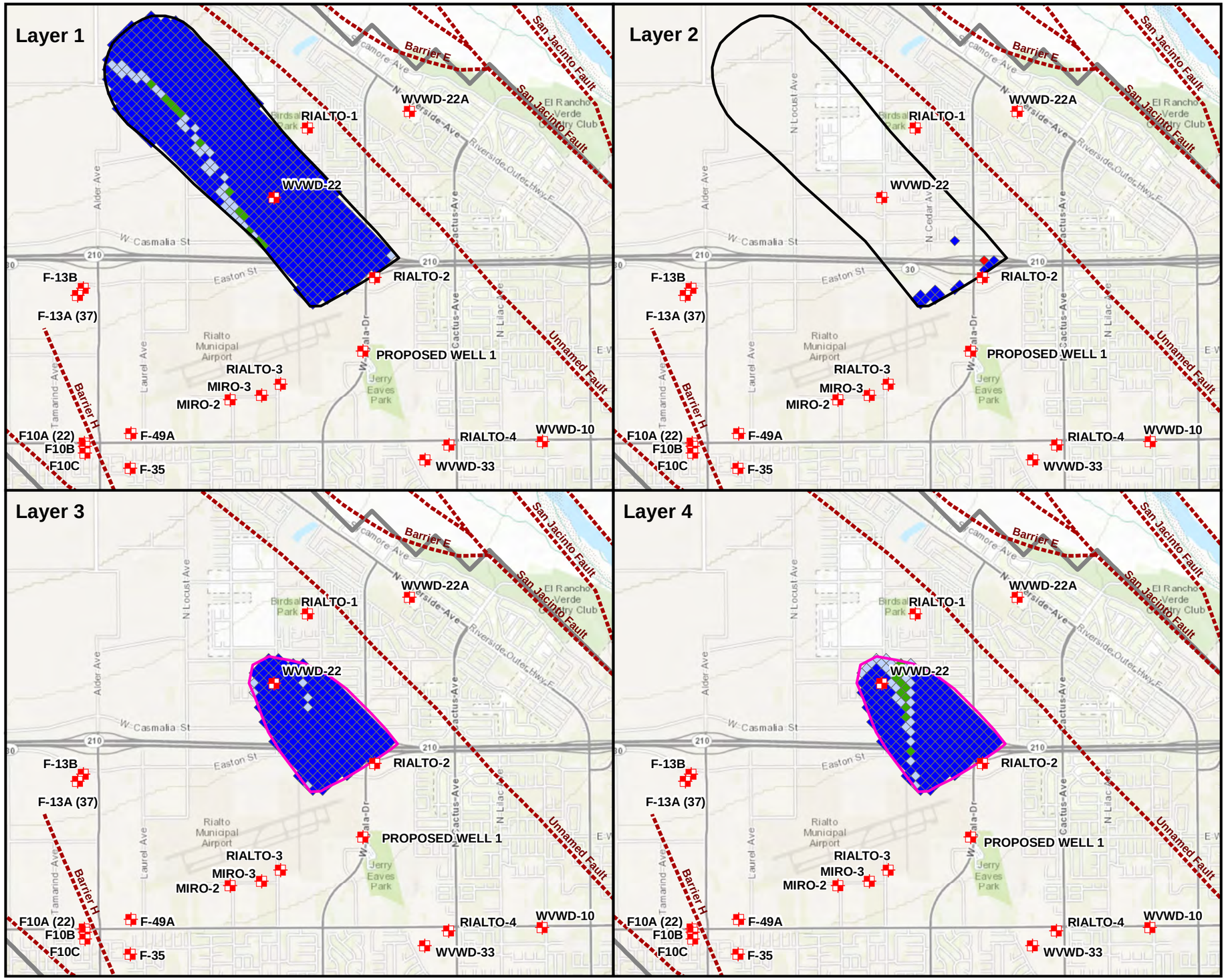


Legend

- Production Well
- Frequency of Capture (%)
  - < 20
  - 20 to 40
  - 40 to 60
  - 60 to 80
  - 80 to 100
- Faults
- Intermediate Aquifer Target Capture Zone
- Regional Aquifer Target Capture Zone
- Model Boundary

Well	Pumping Rate GPM	Pumping Rate AF/yr
RIALTO-2	0	0
RIALTO-3	1,157	1,868
Miro-2	0	0
Miro-3	0	0
Proposed Well 1	1,859	3,000
Proposed Well 2	0	0
Total Flow Rate	3,016	4,868

DRAFT

Note:
GPM - Gallons per Minute
AF/yr - Acre-Feet per Year

N

0 3,000
Feet

SOURCE AREA OPERABLE UNIT
B.F. GOODRICH SUPERFUND SITE

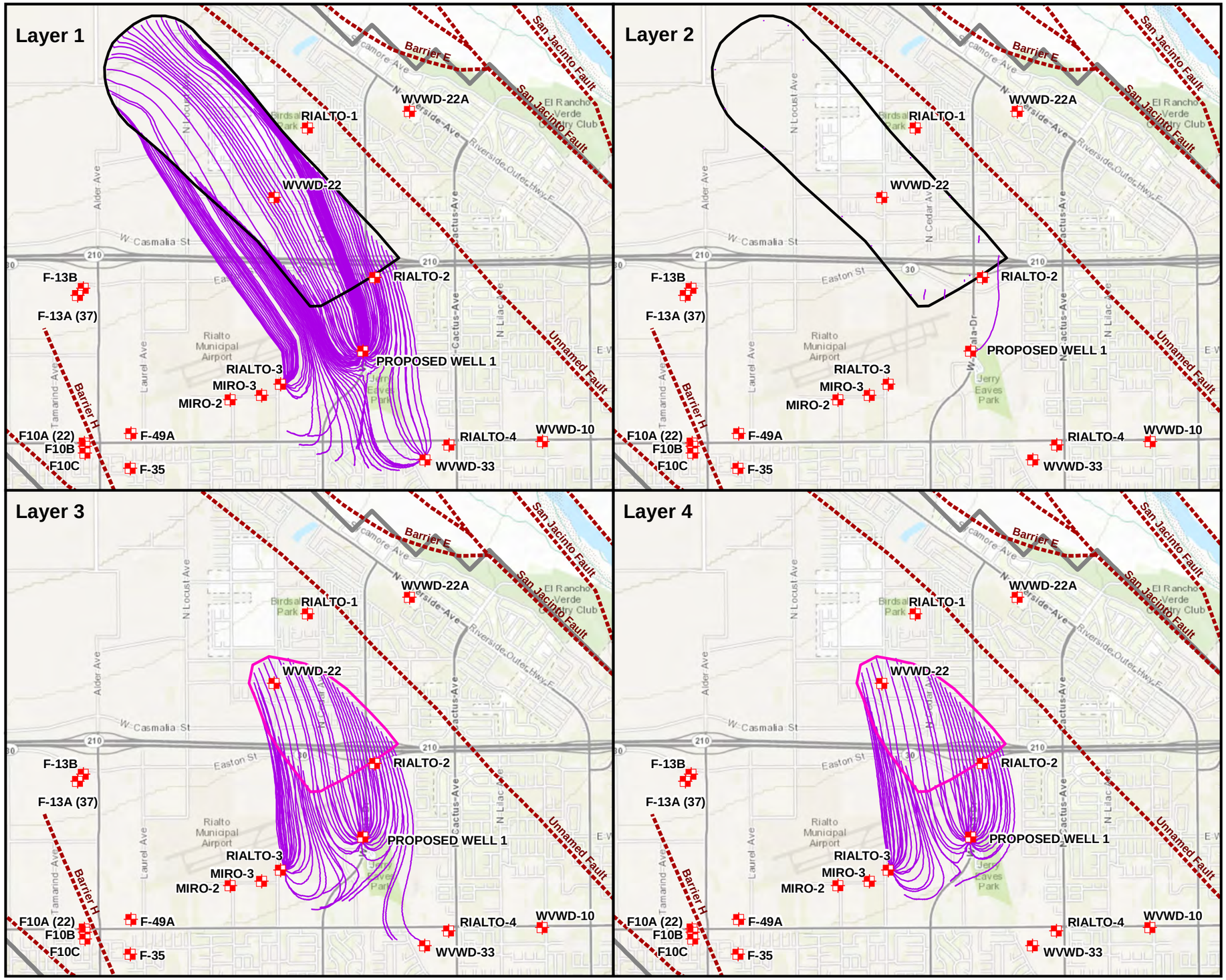
FIGURE 4B
SCENARIO 2B
FREQUENCY OF
CAPTURE

ERM

PREPARED BY:
CTALBOT (ERM)

JOB NO. 0179962.03.A
FILE: 0179962_4B_EPT.mxd

C:\Modflow\Rialto\Calibration\predictive\RevisedScenarios\Results\0179962_4B_EPT.mxd WESAC CTALBOT 3/11/2013



Legend

- Production Well
- Model Particle Tracks
- Faults
- Intermediate Aquifer Target Capture Zone
- Regional Aquifer Target Capture Zone
- Model Boundary

Well	Pumping Rate GPM	Pumping Rate AF/yr
RIALTO-2	0	0
RIALTO-3	1,157	1,868
Miro-2	0	0
Miro-3	0	0
Proposed Well 1	1,394	2,250
Proposed Well 2	0	0
Total Flow Rate	2,551	4,118

DRAFT

Note:
GPM - Gallons per Minute
AF/yr - Acre-Feet per Year

N

0 3,000
Feet

SOURCE AREA OPERABLE UNIT
B.F. GOODRICH SUPERFUND SITE

FIGURE 4A
SCENARIO 2B
PARTICLE TRACK
SIMULATION

ERM

PREPARED BY:
CTALBOT (ERM)

JOB NO. 0179962.03.A
FILE: R_0179962_4A_PT.mxd

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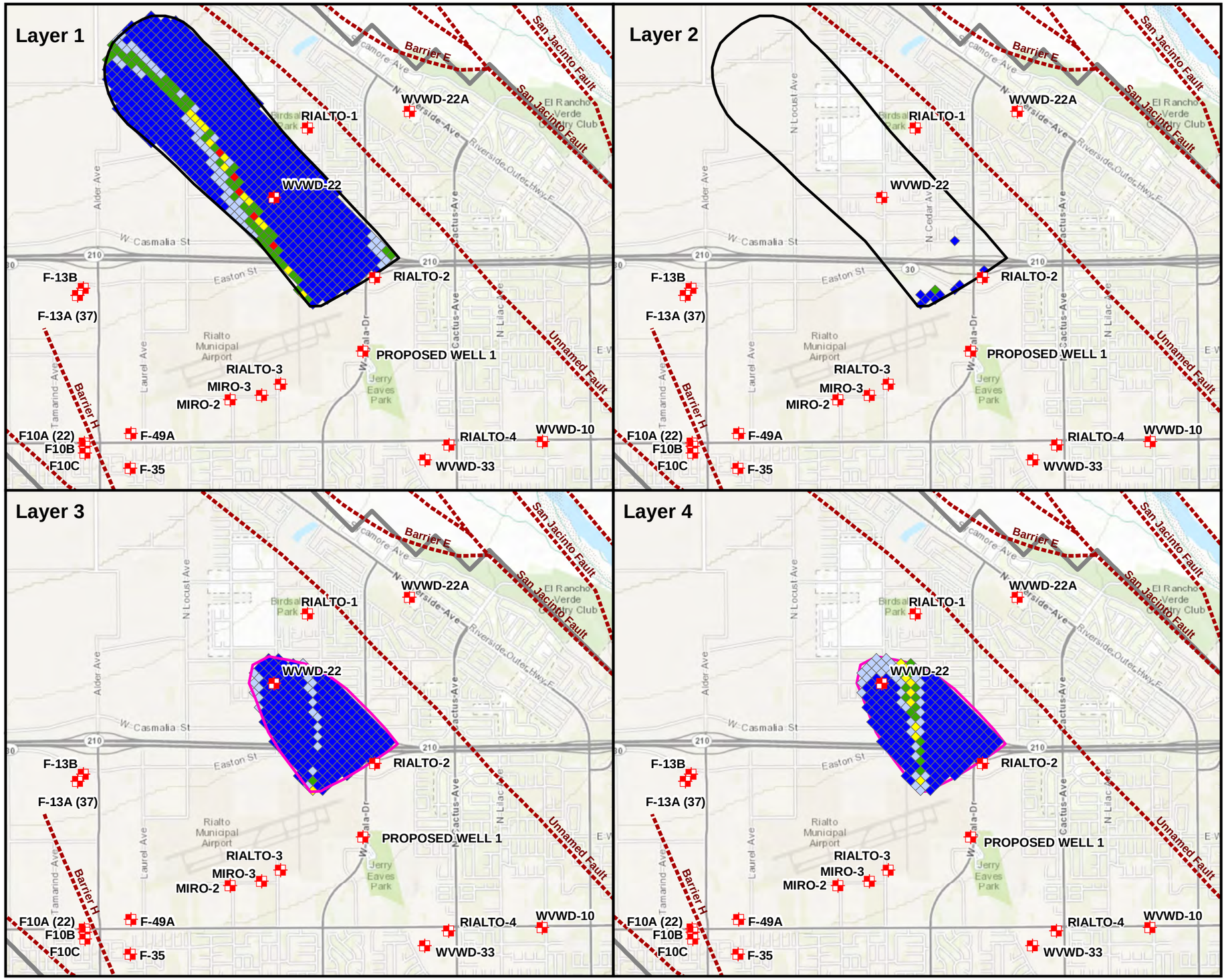


Legend

- Production Well
- Frequency of Capture (%)
  - < 20
  - 20 to 40
  - 40 to 60
  - 60 to 80
  - 80 to 100
- Faults
- Intermediate Aquifer Target Capture Zone
- Regional Aquifer Target Capture Zone
- Model Boundary

Well	Pumping Rate GPM	Pumping Rate AF/yr
RIALTO-2	0	0
RIALTO-3	1,157	1,868
Miro-2	0	0
Miro-3	0	0
Proposed Well 1	1,394	2,250
Proposed Well 2	0	0
Total Flow Rate	2,551	4,118

DRAFT

Note:
GPM - Gallons per Minute
AF/yr - Acre-Feet per Year

N

0 3,000
Feet

SOURCE AREA OPERABLE UNIT
B.F. GOODRICH SUPERFUND SITE

FIGURE 4B
SCENARIO 2B
FREQUENCY OF
CAPTURE

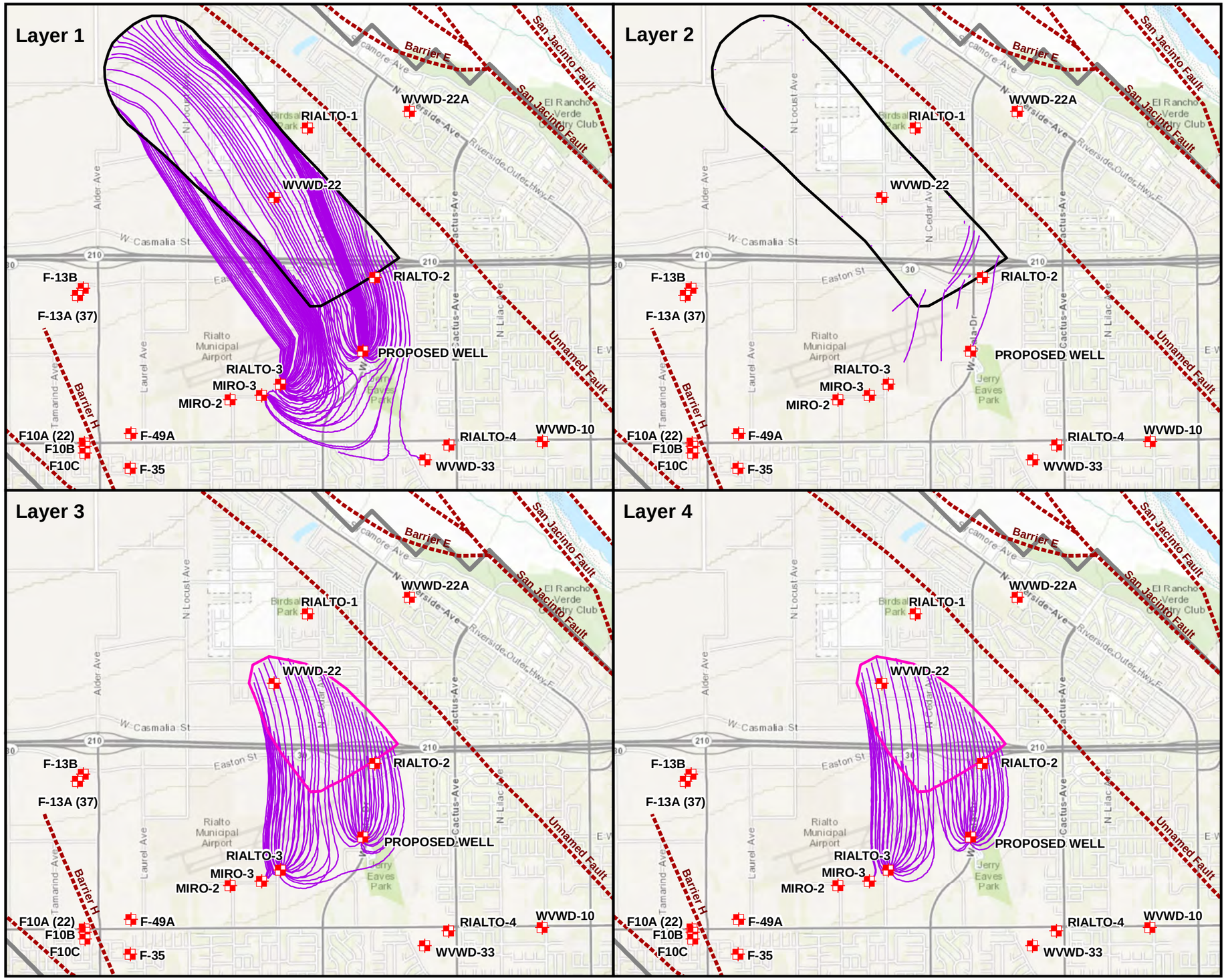
ERM

PREPARED BY:
CTALBOT (ERM)

JOB NO. 0179962.03.A
FILE: R_0179962_4B_EPT.mxd

C:\Modflow\Rialto\Calibration\predictive\RevisedScenarios\Results\R_0179962_4B_EPT.mxd WESAC CTALBOT 3/11/2013

Scenario 2C



Legend

- Production Well
- Model Particle Tracks
- Faults
- Intermediate Aquifer Target Capture Zone
- Regional Aquifer Target Capture Zone
- Model Boundary

Well	Pumping Rate GPM	Pumping Rate AF/yr
RIALTO-2	0	0
RIALTO-3	1,157	1,868
Miro-2	800	1,291
Miro-3	800	1,291
Proposed Well 1	1,250	2,018
Proposed Well 2	0	0
Total Flow Rate	4,007	6,468

DRAFT

Note:
GPM - Gallons per Minute
AF/yr - Acre-Feet per Year

N

0 3,000
Feet

SOURCE AREA OPERABLE UNIT
B.F. GOODRICH SUPERFUND SITE

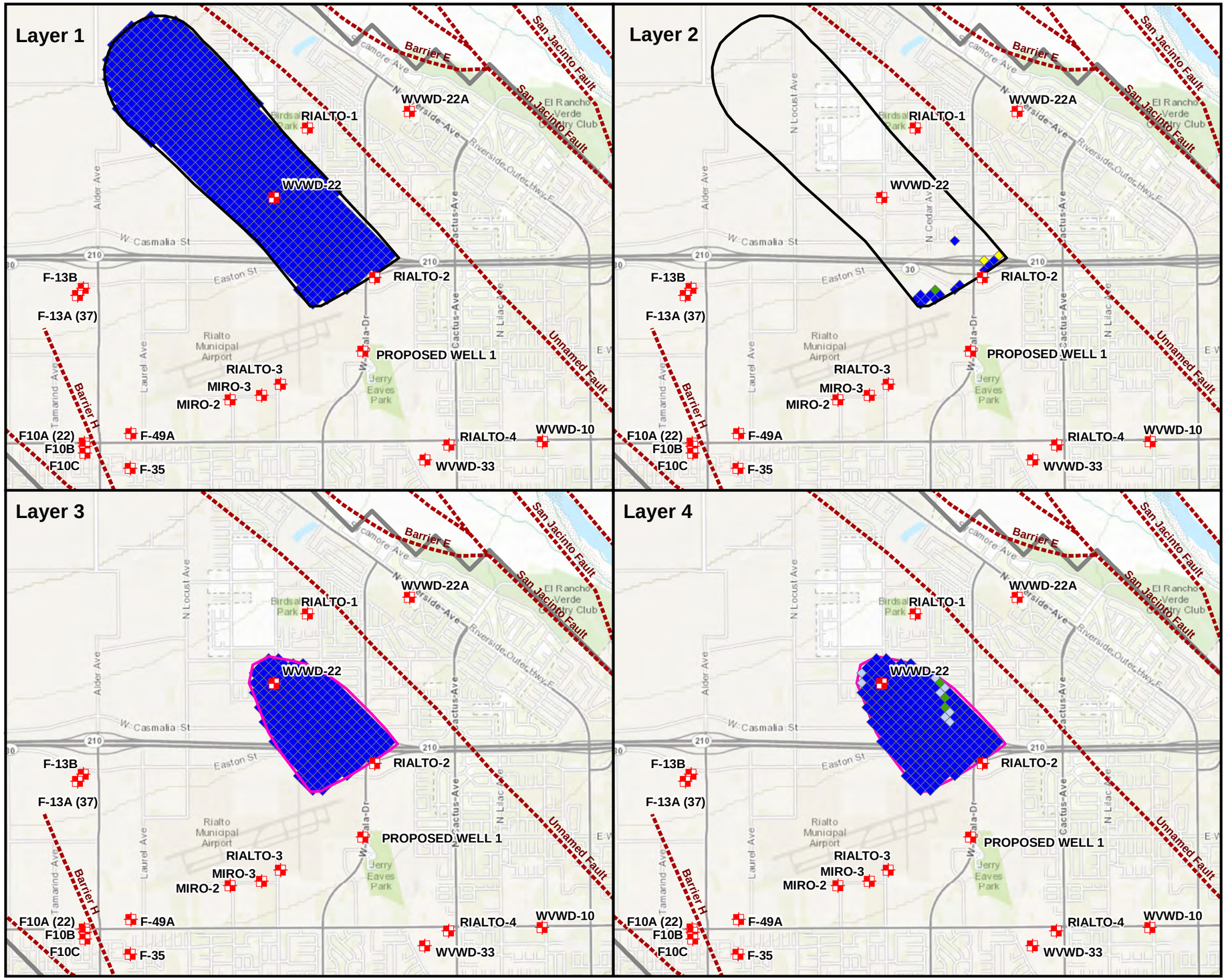
FIGURE 5A
SCENARIO 2C
PARTICLE TRACK
SIMULATION

ERM

PREPARED BY:
CTALBOT (ERM)

JOB NO. 0179962.03.A
FILE: 0179962_5A_PT.mxd

C:\Modflow\Rialto\Calibration\predictive\RevisedScenarios\Results\0179962_5A_PT.mxd WESAC CTALBOT 3/8/2013



Legend

- Production Well
- Frequency of Capture (%)
  - < 20
  - 20 to 40
  - 40 to 60
  - 60 to 80
  - 80 to 100
- Faults
- Intermediate Aquifer Target Capture Zone
- Regional Aquifer Target Capture Zone
- Model Boundary

Well	Pumping Rate GPM	Pumping Rate AF/yr
RIALTO-2	0	0
RIALTO-3	1,157	1,868
Miro-2	800	1,291
Miro-3	800	1,291
Proposed Well 1	1,250	2,018
Proposed Well 2	0	0
Total Flow Rate	4,007	6,468

DRAFT

Note:
GPM - Gallons per Minute
AF/yr - Acre-Feet per Year

N

0 3,000
Feet

SOURCE AREA OPERABLE UNIT
B.F. GOODRICH SUPERFUND SITE

FIGURE 5B
SCENARIO 2C
FREQUENCY OF
CAPTURE

ERM

PREPARED BY:
CTALBOT (ERM)

JOB NO. 0179962.03.A
FILE: 0179962_5B_EPT.mxd

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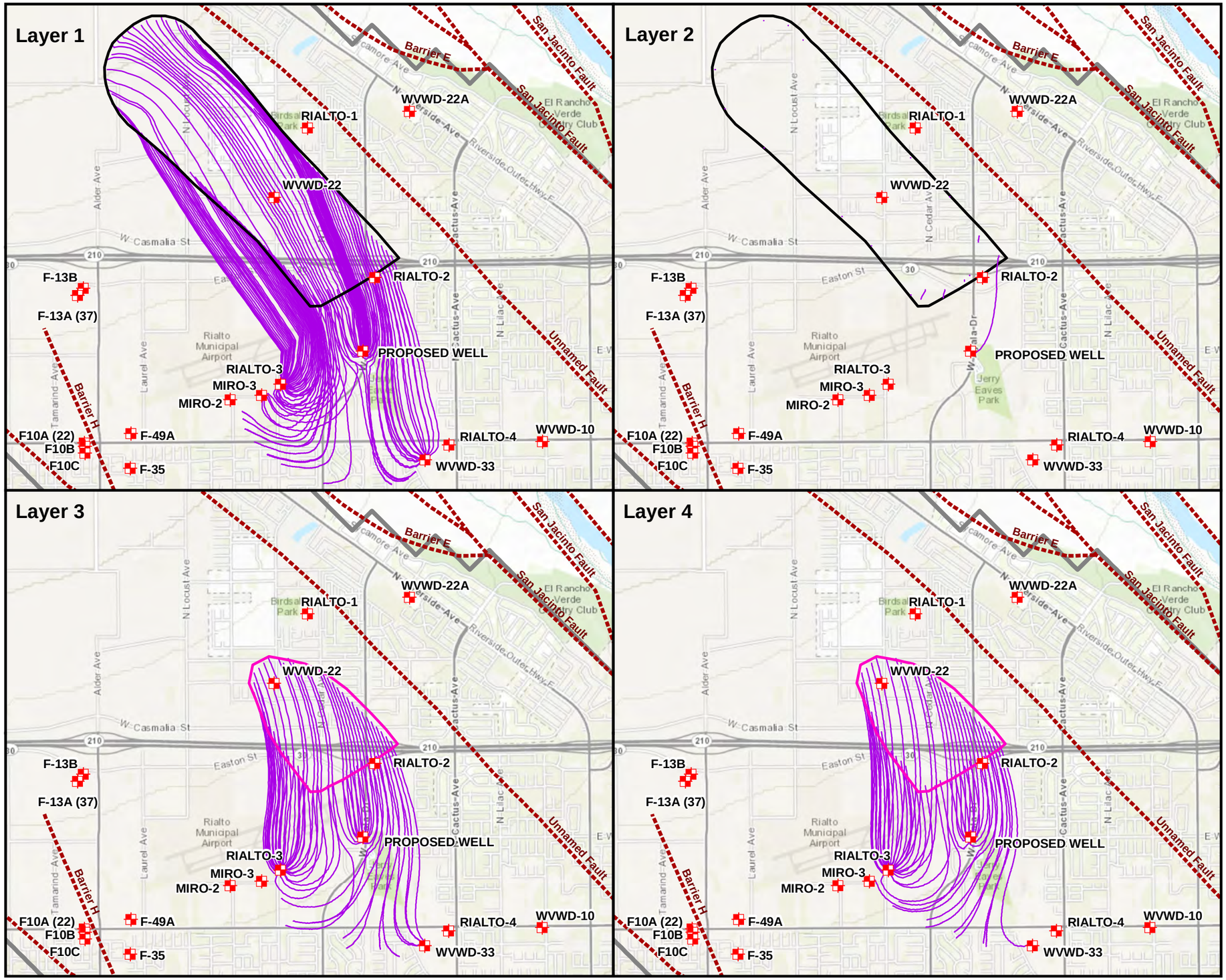

Legend

- Production Well
- Model Particle Tracks
- Faults
- Intermediate Aquifer Target Capture Zone
- Regional Aquifer Target Capture Zone
- Model Boundary

Well	Pumping Rate GPM	Pumping Rate AF/yr
RIALTO-2	0	0
RIALTO-3	1,157	1,868
Miro-2	400	646
Miro-3	400	646
Proposed Well 1	625	1,009
Proposed Well 2	0	0
Total Flow Rate	2,582	4,168

DRAFT

Note:
GPM - Gallons per Minute
AF/yr - Acre-Feet per Year

N

0 3,000
Feet

SOURCE AREA OPERABLE UNIT
B.F. GOODRICH SUPERFUND SITE

FIGURE 5A
SCENARIO 2C
PARTICLE TRACK
SIMULATION

ERM

PREPARED BY:
CTALBOT (ERM)

JOB NO. 0179962.03.A
FILE: R_0179962_5A_PT.mxd

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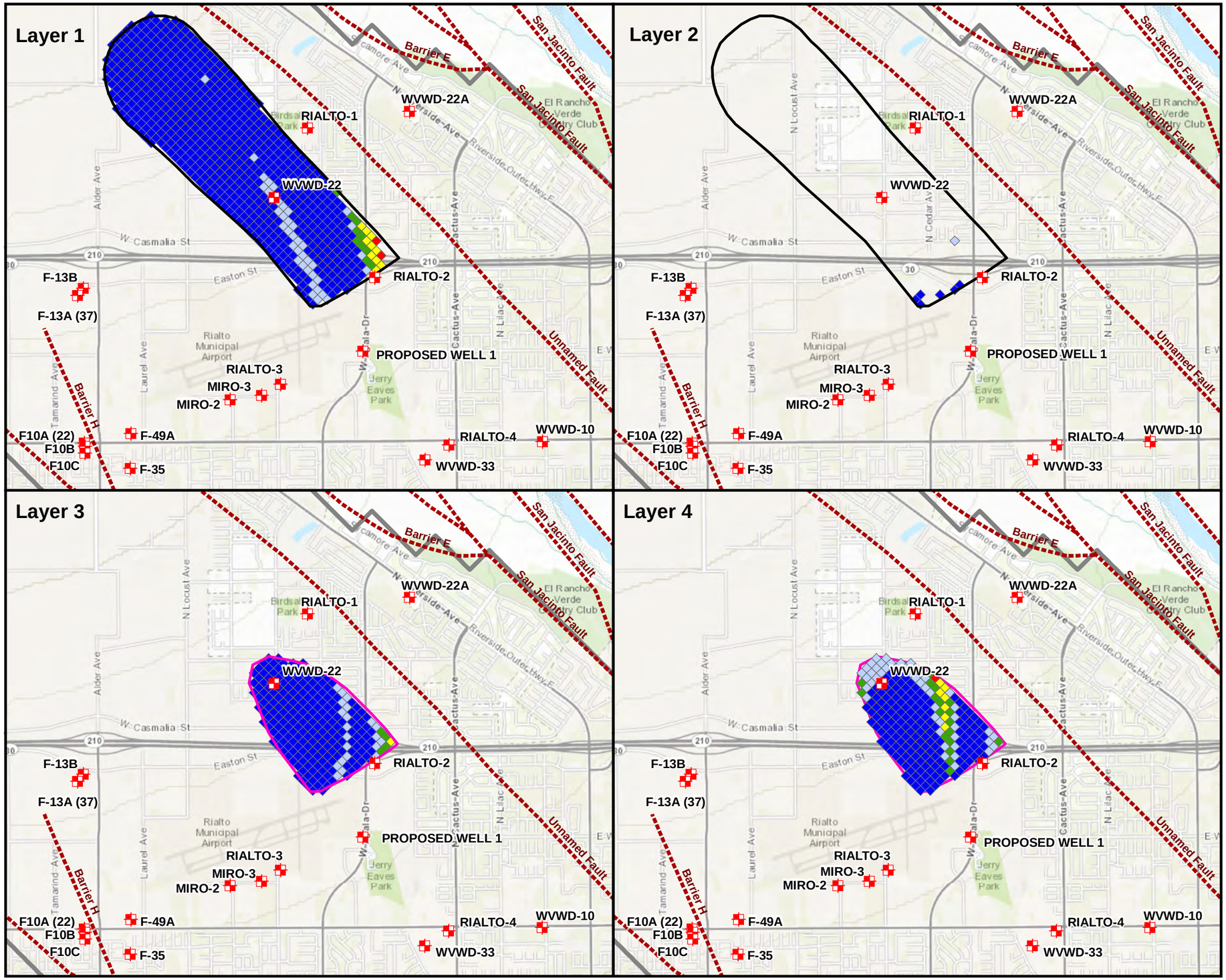


Legend

- Production Well
- Frequency of Capture (%)
  - < 20
  - 20 to 40
  - 40 to 60
  - 60 to 80
  - 80 to 100
- Faults
- Intermediate Aquifer Target Capture Zone
- Regional Aquifer Target Capture Zone
- Model Boundary

Well	Pumping Rate GPM	Pumping Rate AF/yr
RIALTO-2	0	0
RIALTO-3	1,157	1,868
Miro-2	400	646
Miro-3	400	646
Proposed Well 1	625	1,009
Proposed Well 2	0	0
Total Flow Rate	2,582	4,168

DRAFT

Note:
GPM - Gallons per Minute
AF/yr - Acre-Feet per Year

N

0 3,000
Feet

SOURCE AREA OPERABLE UNIT
B.F. GOODRICH SUPERFUND SITE

FIGURE 5B
SCENARIO 2C
FREQUENCY OF
CAPTURE

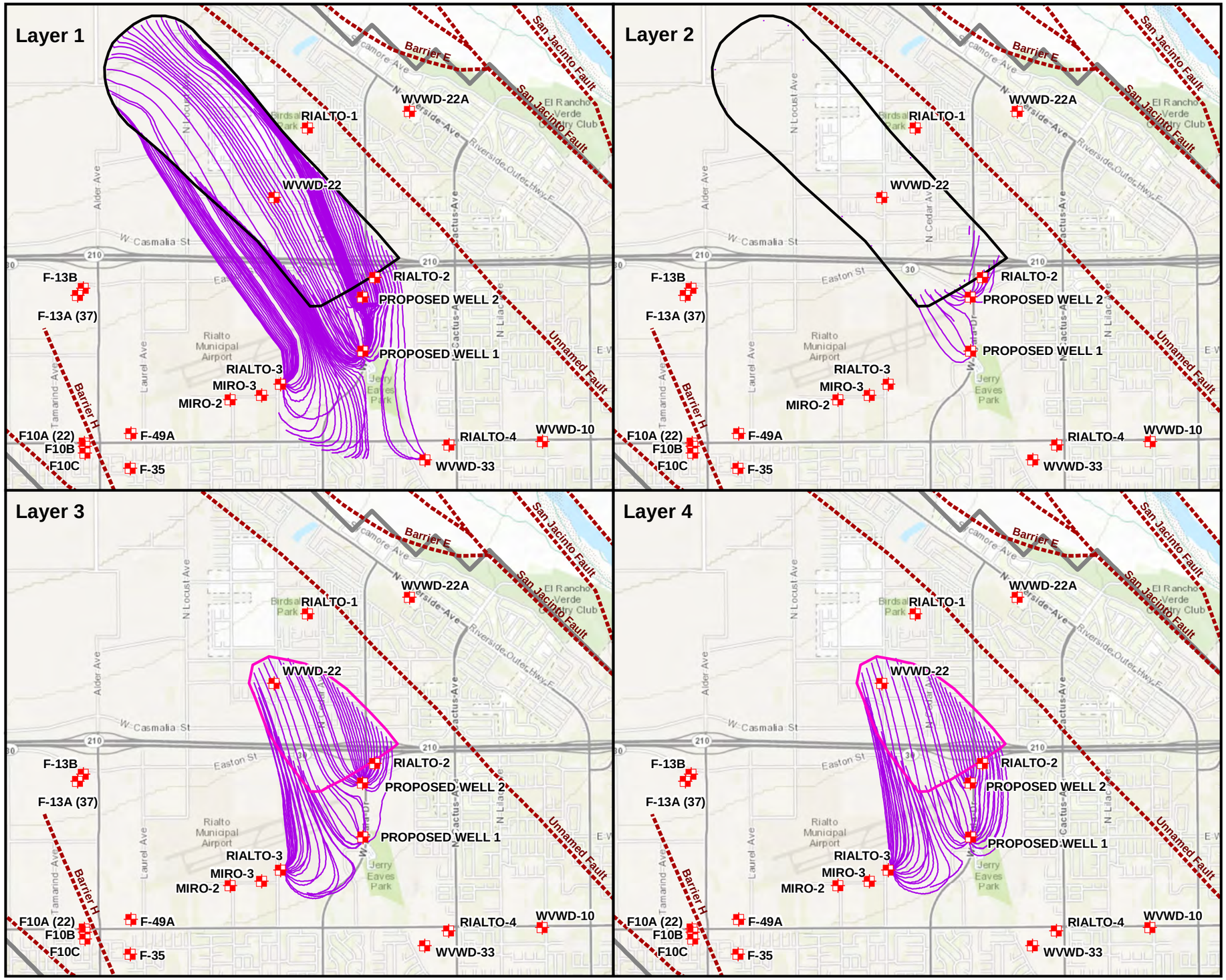
ERM

PREPARED BY:
CTALBOT (ERM)

JOB NO. 0179962.03.A
FILE: R_0179962_5B_EPT.mxd

C:\Modflow\Rialto\Calibration\predictive\RevisedScenarios\Results\R_0179962_5B_EPT.mxd WESAC CTALBOT 3/11/2013

Scenario 2D-1



Legend

- Production Well
- Model Particle Tracks
- Faults
- Intermediate Aquifer Target Capture Zone
- Regional Aquifer Target Capture Zone
- Model Boundary

Well	Pumping Rate GPM	Pumping Rate AF/yr
RIALTO-2	0	0
RIALTO-3	1,157	1,868
Miro-2	0	0
Miro-3	0	0
Proposed Well 1	929	1,500
Proposed Well 2	743	1,200
Total Flow Rate	2,830	4,568

DRAFT

Note:
GPM - Gallons per Minute
AF/yr - Acre-Feet per Year

N

0 3,000
Feet

SOURCE AREA OPERABLE UNIT
B.F. GOODRICH SUPERFUND SITE

FIGURE 6A
SCENARIO 2D-1
PARTICLE TRACK
SIMULATION

ERM

PREPARED BY:
CTALBOT (ERM)

JOB NO. 0179962.03.A
FILE: 0179962_6A_PT.mxd

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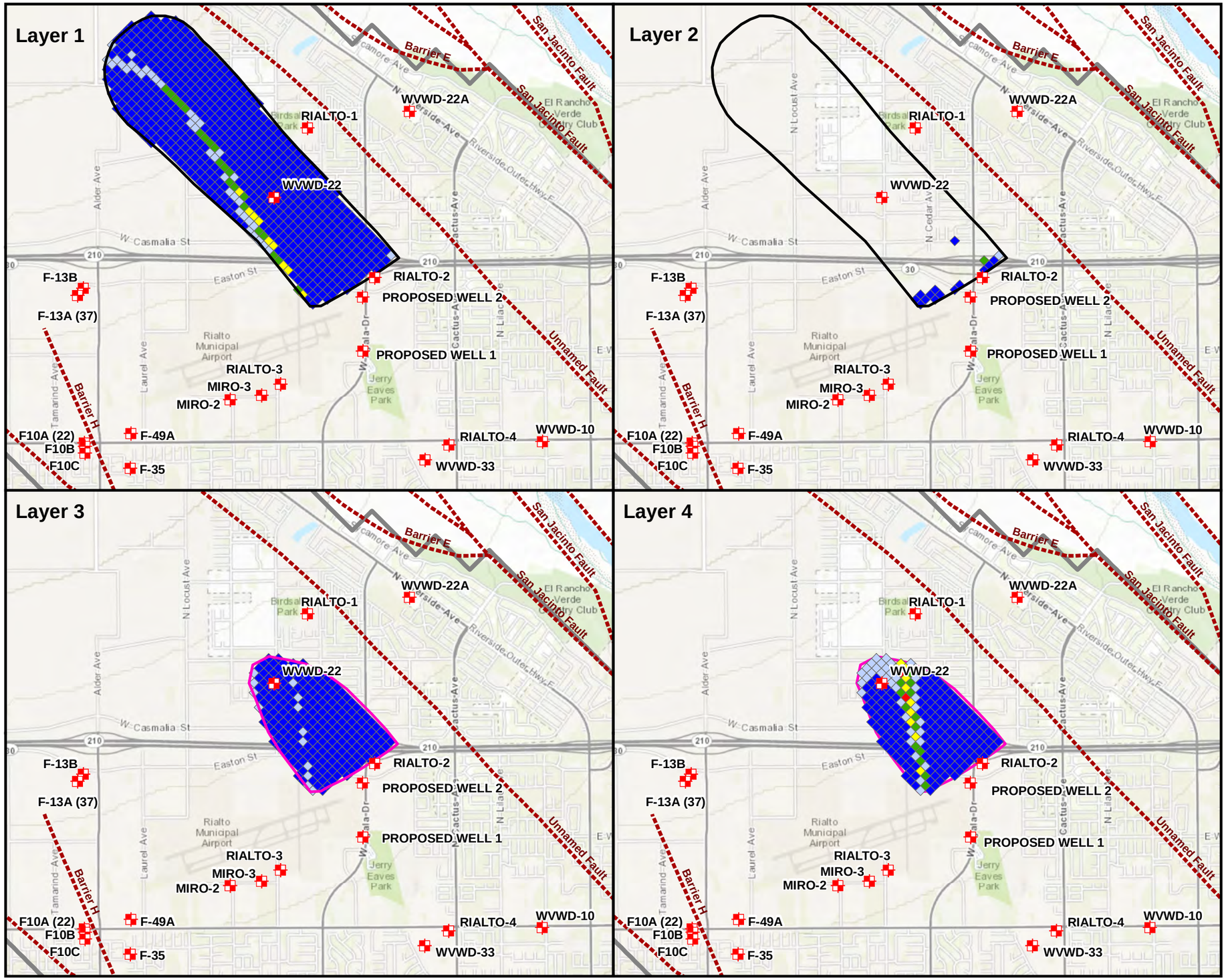

Legend

- Production Well
- Frequency of Capture (%)
  - < 20
  - 20 to 40
  - 40 to 60
  - 60 to 80
  - 80 to 100
- Faults
- Intermediate Aquifer Target Capture Zone
- Regional Aquifer Target Capture Zone
- Model Boundary

Well	Pumping Rate GPM	Pumping Rate AF/yr
RIALTO-2	0	0
RIALTO-3	1,157	1,868
Miro-2	0	0
Miro-3	0	0
Proposed Well 1	929	1,500
Proposed Well 2	743	1,200
Total Flow Rate	2,830	4,568

DRAFT

Note:
GPM - Gallons per Minute
AF/yr - Acre-Feet per Year

N

0 3,000
Feet

SOURCE AREA OPERABLE UNIT
B.F. GOODRICH SUPERFUND SITE

FIGURE 6B
SCENARIO 2D-1
FREQUENCY OF
CAPTURE

ERM

PREPARED BY:
CTALBOT (ERM)

JOB NO. 0179962.03.A
FILE: 0179962_6B_EPT.mxd

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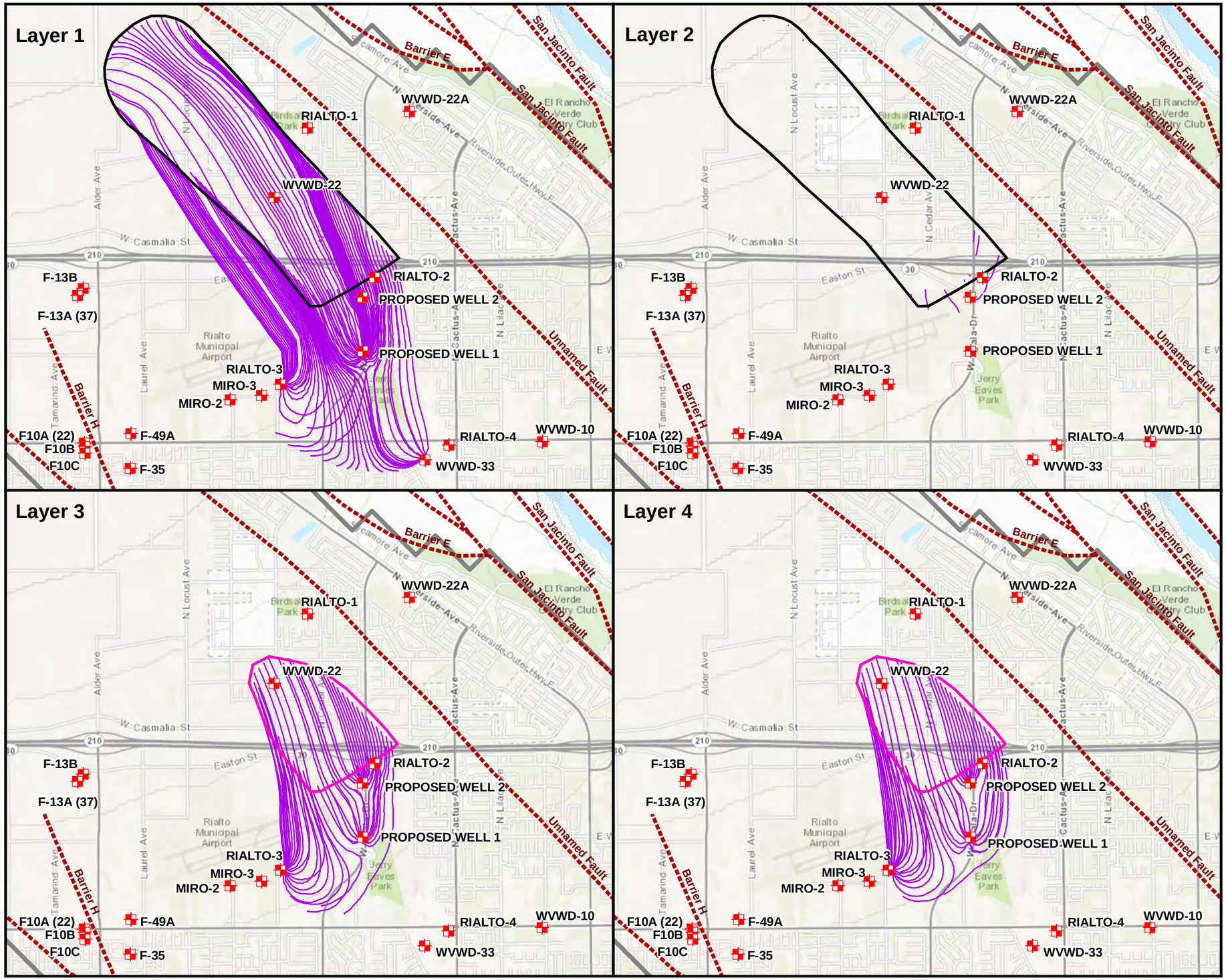

Legend

- Production Well
- Model Particle Tracks
- Faults
- Intermediate Aquifer Target Capture Zone
- Regional Aquifer Target Capture Zone
- Model Boundary

Well	Pumping Rate GPM	Pumping Rate AF/yr
RIALTO-2	0	0
RIALTO-3	1,157	1,868
Miro-2	0	0
Miro-3	0	0
Proposed Well 1	813	1,313
Proposed Well 2	651	1,050
Total Flow Rate	2,621	4,231

DRAFT

Note:
GPM - Gallons per Minute
AF/YR - Acre-Feet per Year

N

0 3,000
Feet

SOURCE AREA OPERABLE UNIT
B.F. GOODRICH SUPERFUND SITE

FIGURE 6A
SCENARIO 2D-1
PARTICLE TRACK
SIMULATION

ERM

PREPARED BY:
CTALBOT (ERM)

JOB NO. 0179962.03.A
FILE: R_0179962_6A_PT.mxd

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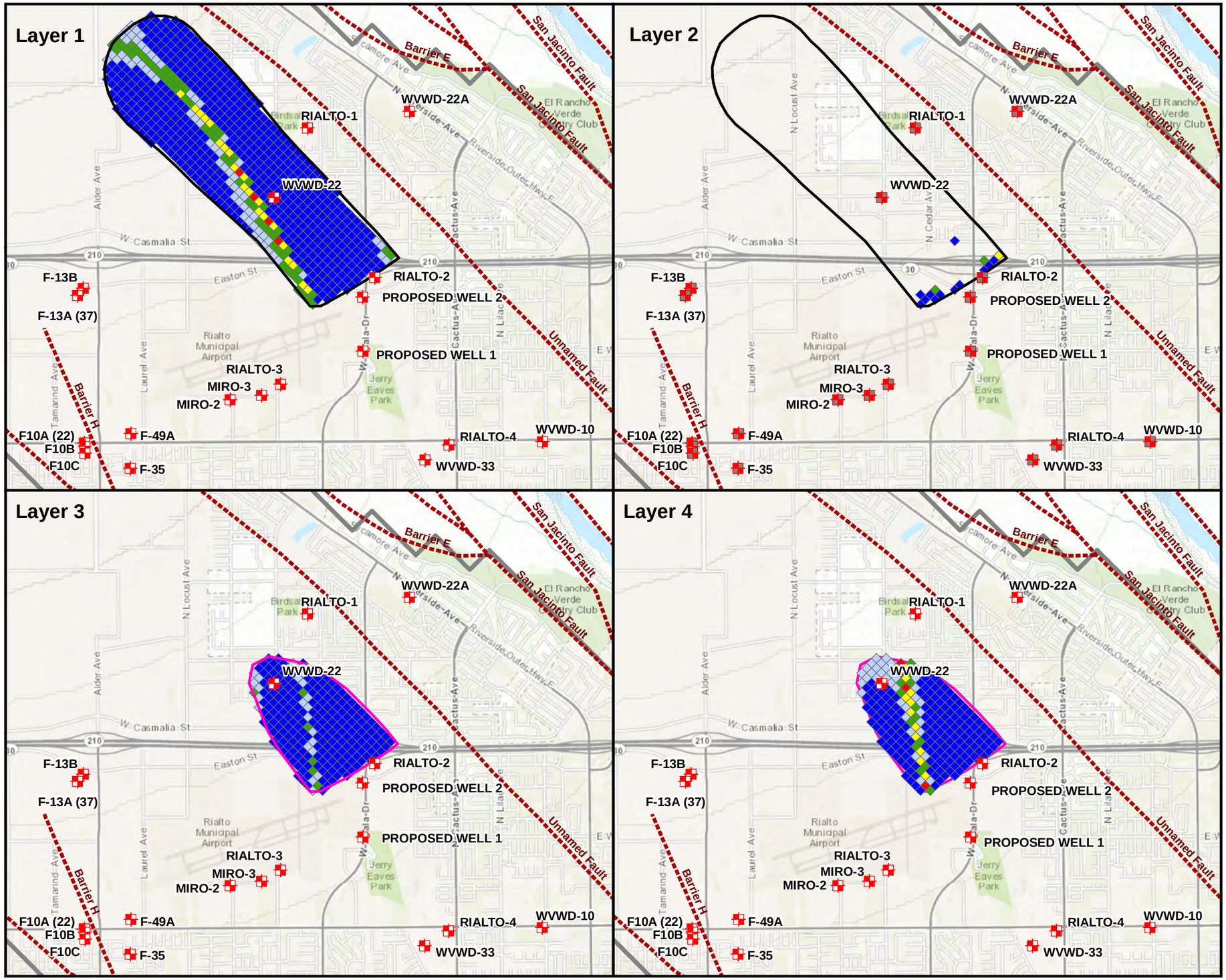


Legend

- Production Well
- Frequency of Capture (%)
  - < 20
  - 20 to 40
  - 40 to 60
  - 60 to 80
  - 80 to 100
- Faults
- Intermediate Aquifer Target Capture Zone
- Regional Aquifer Target Capture Zone
- Model Boundary

Well	Pumping Rate GPM	Pumping Rate AF/yr
RIALTO-2	0	0
RIALTO-3	1,157	1,868
Miro-2	0	0
Miro-3	0	0
Proposed Well 1	813	1,313
Proposed Well 2	651	1,050
Total Flow Rate	2,621	4,231

DRAFT

Note:
GPM - Gallons per Minute
AF/yr - Acre-Feet per Year

N

0 3,000
Feet

SOURCE AREA OPERABLE UNIT
B.F. GOODRICH SUPERFUND SITE

FIGURE 6B
SCENARIO 2D-1
FREQUENCY OF
CAPTURE

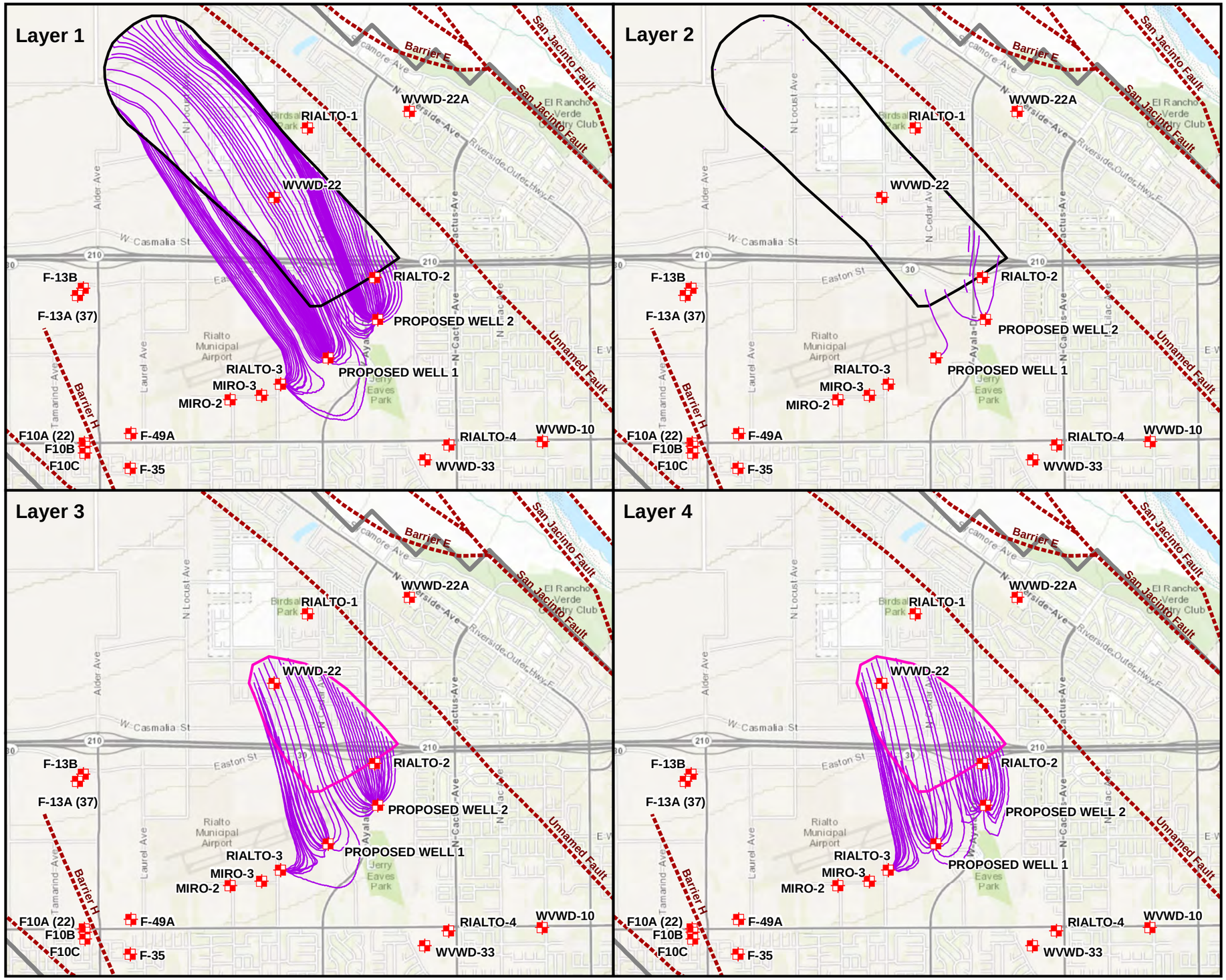
ERM

PREPARED BY:
CTALBOT (ERM)

JOB NO. 0179962.03.A
FILE: R_0179962_6B_EPT.mxd

C:\Modflow\Rialto\Calibration\predictive\RevisedScenarios\Results\R_0179962_6B_EPT.mxd WESAC CTALBOT 3/11/2013

Scenario 2D-2



Legend

- Production Well
- Model Particle Tracks
- Faults
- Intermediate Aquifer Target Capture Zone
- Regional Aquifer Target Capture Zone
- Model Boundary

Well	Pumping Rate GPM	Pumping Rate AF/yr
RIALTO-2	0	0
RIALTO-3	1,157	1,868
Miro-2	0	0
Miro-3	0	0
Proposed Well 1	1,239	2,000
Proposed Well 2	929	1,500
Total Flow Rate	3,326	5,368

DRAFT

Note:
GPM - Gallons per Minute
AF/yr - Acre-Feet per Year

N

0 3,000
Feet

SOURCE AREA OPERABLE UNIT
B.F. GOODRICH SUPERFUND SITE

FIGURE 7A
SCENARIO 2D-2
PARTICLE TRACK
SIMULATION

ERM

PREPARED BY:
CTALBOT (ERM)

JOB NO. 0179962.03.A
FILE: 0179962_7A_PT.mxd

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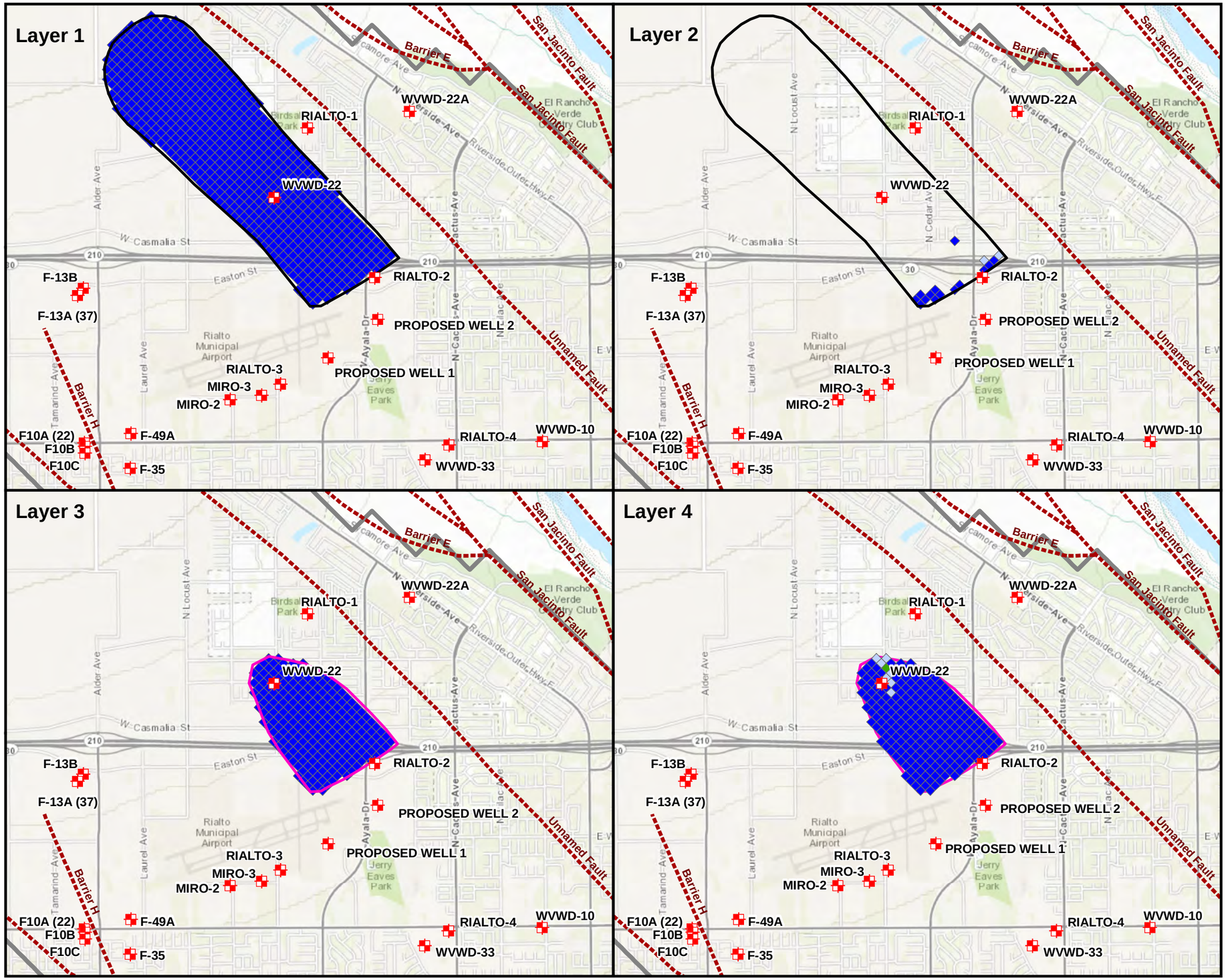

Legend

- Production Well
- Frequency of Capture (%)
  - < 20
  - 20 to 40
  - 40 to 60
  - 60 to 80
  - 80 to 100
- Faults
- Intermediate Aquifer Target Capture Zone
- Regional Aquifer Target Capture Zone
- Model Boundary

Well	Pumping Rate GPM	Pumping Rate AF/yr
RIALTO-2	0	0
RIALTO-3	1,157	1,868
Miro-2	0	0
Miro-3	0	0
Proposed Well 1	1,239	2,000
Proposed Well 2	929	1,500
Total Flow Rate	3,326	5,368

DRAFT

Note:
GPM - Gallons per Minute
AF/yr - Acre-Feet per Year

N

0 3,000
Feet

SOURCE AREA OPERABLE UNIT
B.F. GOODRICH SUPERFUND SITE

FIGURE 7B
SCENARIO 2D-2
FREQUENCY OF
CAPTURE

ERM

PREPARED BY:
CTALBOT (ERM)

JOB NO. 0179962.03.A
FILE: 0179962_7B_EPT.mxd

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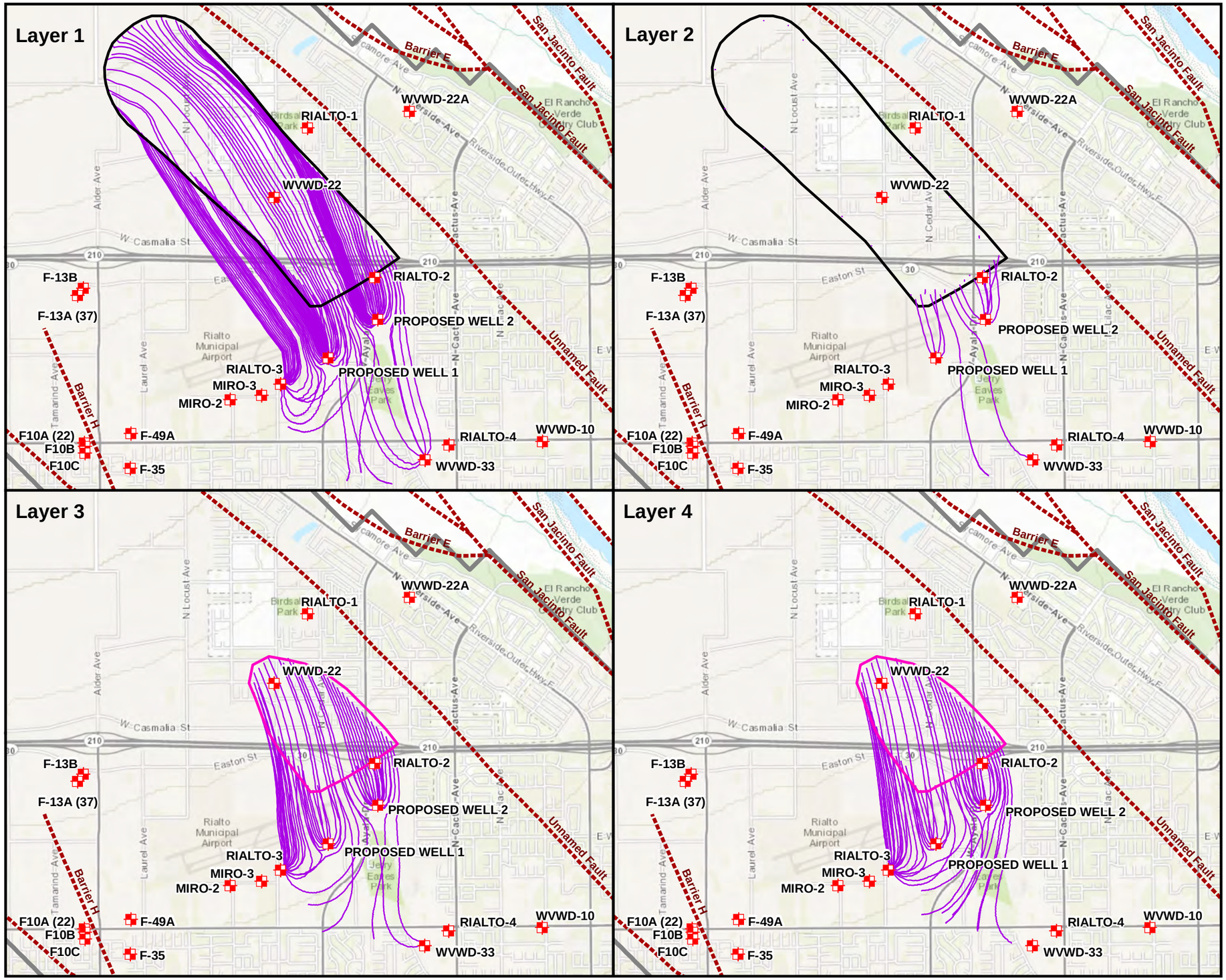


Legend

- Production Well
- Model Particle Tracks
- Faults
- Intermediate Aquifer Target Capture Zone
- Regional Aquifer Target Capture Zone
- Model Boundary

Well	Pumping Rate GPM	Pumping Rate AF/yr
RIALTO-2	0	0
RIALTO-3	1,157	1,868
Miro-2	0	0
Miro-3	0	0
Proposed Well 1	539	870
Proposed Well 2	431	696
Total Flow Rate	2,128	3,434

DRAFT

Note:
GPM - Gallons per Minute
AF/yr - Acre-Feet per Year

N

0 3,000
Feet

SOURCE AREA OPERABLE UNIT
B.F. GOODRICH SUPERFUND SITE

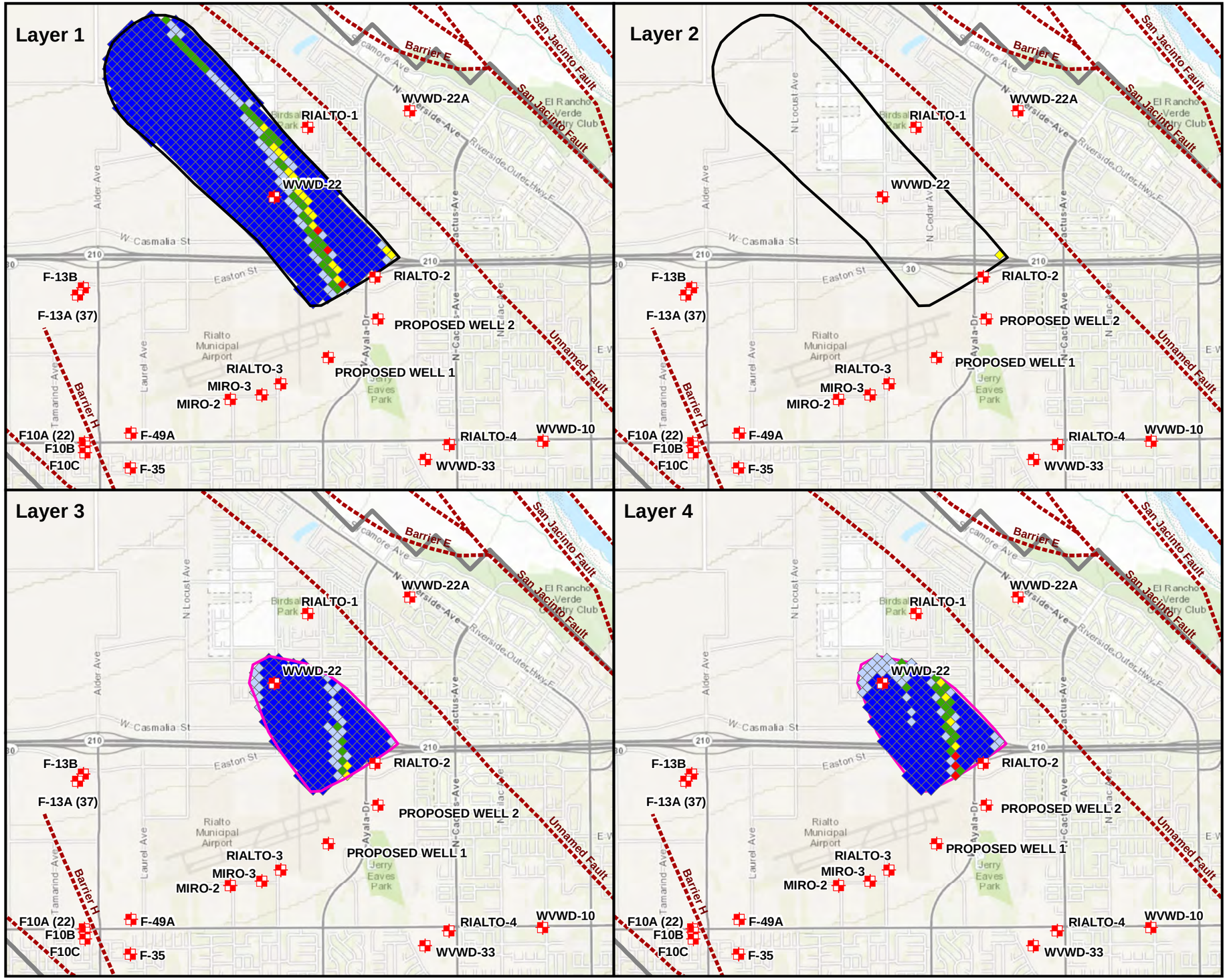
FIGURE 7A
SCENARIO 2D-2
PARTICLE TRACK
SIMULATION

ERM

PREPARED BY:
CTALBOT (ERM)

JOB NO. 0179962.03.A
FILE: R_0179962_7A_PT.mxd

C:\Modflow\Rialto\Calibration\predictive\RevisedScenarios\Results\R_0179962_7A_PT.mxd WESAC CTALBOT 3/11/2013



Legend

- Production Well
- Frequency of Capture (%)
  - < 20
  - 20 to 40
  - 40 to 60
  - 60 to 80
  - 80 to 100
- Faults
- Intermediate Aquifer Target Capture Zone
- Regional Aquifer Target Capture Zone
- Model Boundary

Well	Pumping Rate GPM	Pumping Rate AF/yr
RIALTO-2	0	0
RIALTO-3	1,157	1,868
Miro-2	0	0
Miro-3	0	0
Proposed Well 1	539	870
Proposed Well 2	431	696
Total Flow Rate	2,128	3,434

DRAFT

Note:
GPM - Gallons per Minute
AF/yr - Acre-Feet per Year

N

0 3,000
Feet

SOURCE AREA OPERABLE UNIT
B.F. GOODRICH SUPERFUND SITE

FIGURE 7B
SCENARIO 2D-2
FREQUENCY OF
CAPTURE

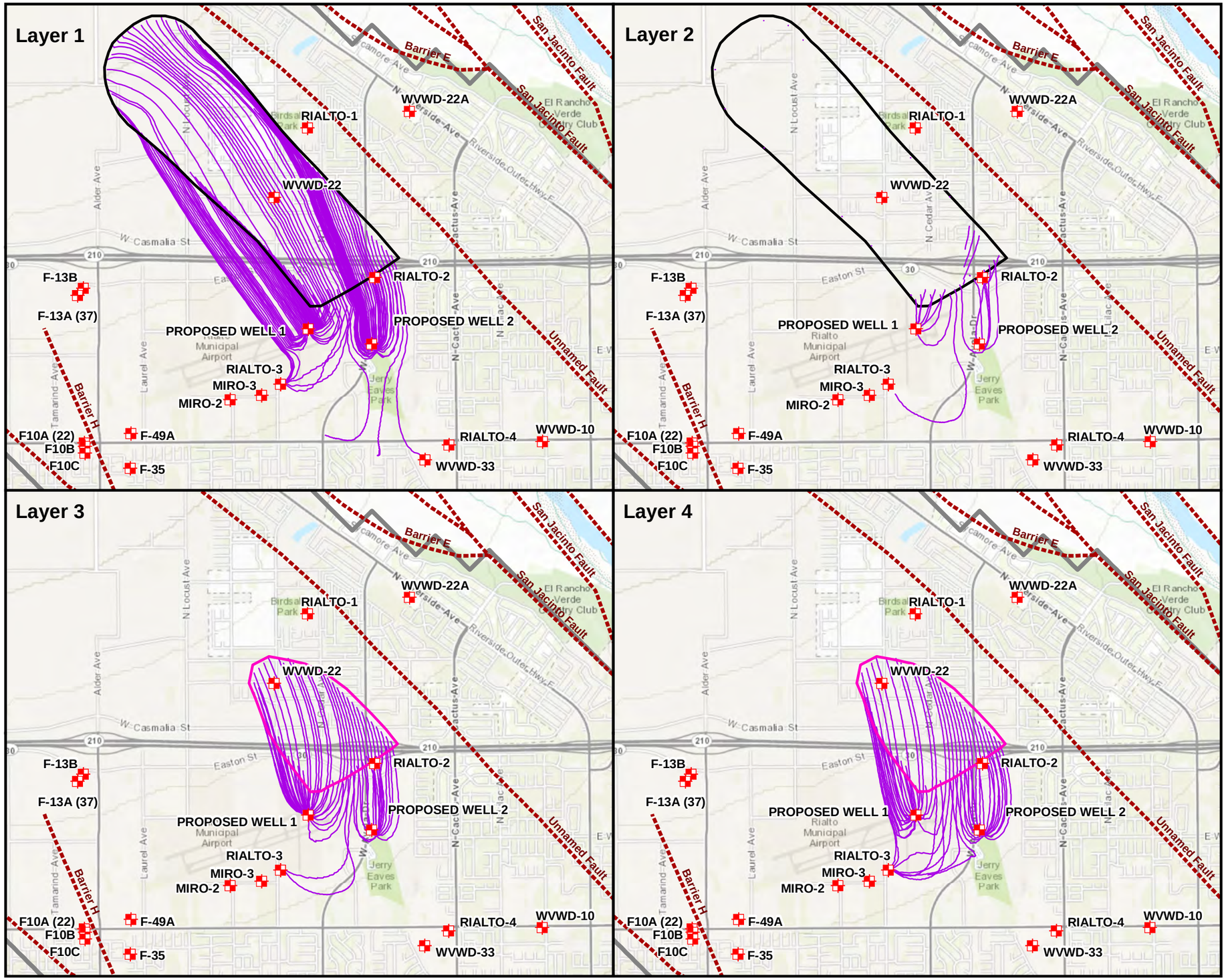
ERM

PREPARED BY:
CTALBOT (ERM)

JOB NO. 0179962.03.A
FILE: R_0179962_7B_EPT.mxd

C:\Modflow\Rialto\Calibration\predictive\RevisedScenarios\Results\R_0179962_7B_EPT.mxd WESAC CTALBOT 3/11/2013

Scenario 2D-3



Legend

- Production Well
- Model Particle Tracks
- Faults
- Intermediate Aquifer Target Capture Zone
- Regional Aquifer Target Capture Zone
- Model Boundary

Well	Pumping Rate GPM	Pumping Rate AF/yr
RIALTO-2	0	0
RIALTO-3	1,157	1,868
Miro-2	0	0
Miro-3	0	0
Proposed Well 1	1,239	2,000
Proposed Well 2	929	1,500
Total Flow Rate	3,326	5,368

DRAFT

Note:
GPM - Gallons per Minute
AF/yr - Acre-Feet per Year

N

0 3,000
Feet

SOURCE AREA OPERABLE UNIT
B.F. GOODRICH SUPERFUND SITE

FIGURE 8A
SCENARIO 2D-3
PARTICLE TRACK
SIMULATION

ERM

PREPARED BY:
CTALBOT (ERM)

JOB NO. 0179962.03.A
FILE: 0179962_8A_PT.mxd

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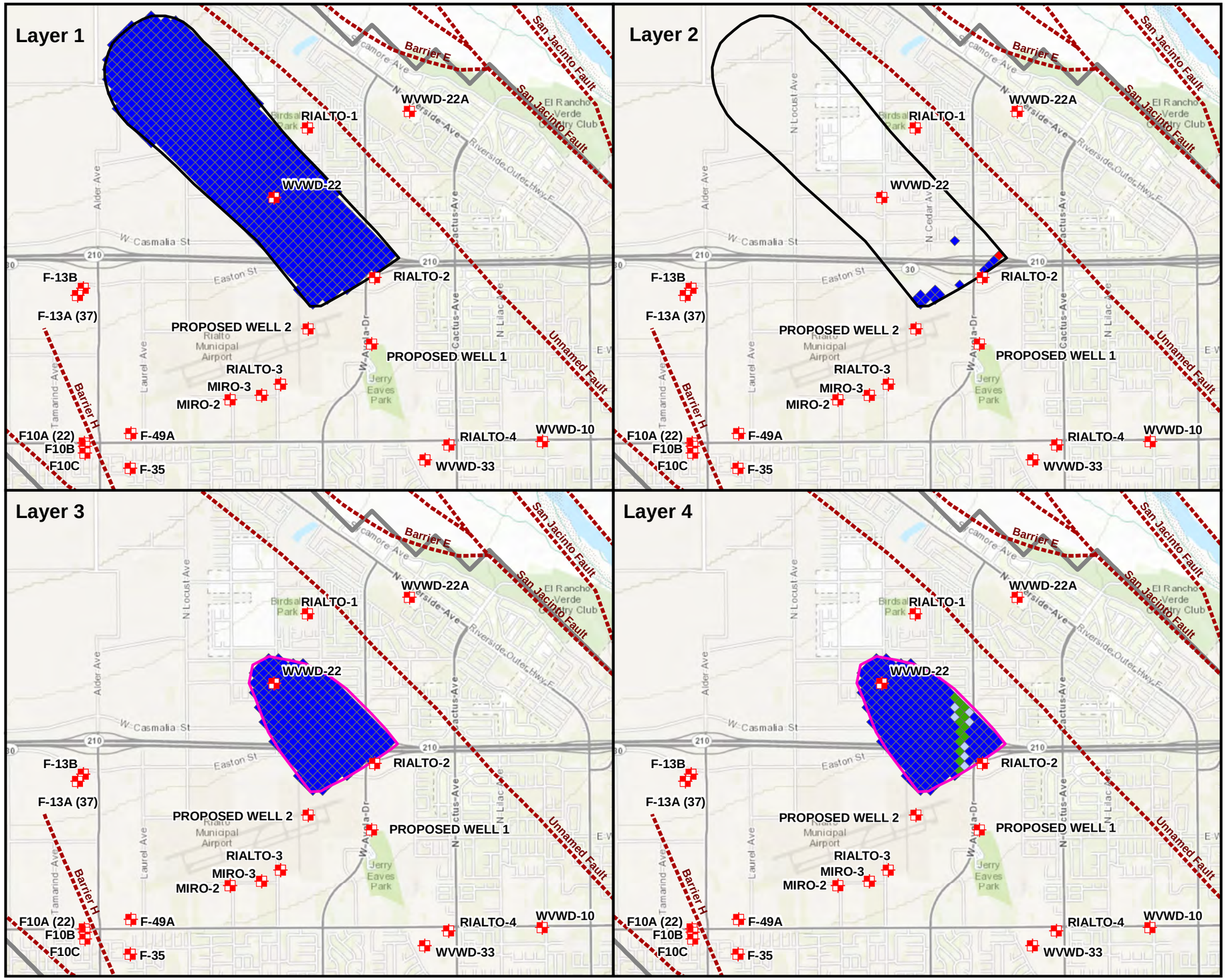

Legend

- Production Well
- Frequency of Capture (%)
  - < 20
  - 20 to 40
  - 40 to 60
  - 60 to 80
  - 80 to 100
- Faults
- Intermediate Aquifer Target Capture Zone
- Regional Aquifer Target Capture Zone
- Model Boundary

Well	Pumping Rate GPM	Pumping Rate AF/yr
RIALTO-2	0	0
RIALTO-3	1,157	1,868
Miro-2	0	0
Miro-3	0	0
Proposed Well 1	1,239	2,000
Proposed Well 2	929	1,500
Total Flow Rate	3,326	5,368

DRAFT

Note:
GPM - Gallons per Minute
AF/yr - Acre-Feet per Year

N

0 3,000
Feet

SOURCE AREA OPERABLE UNIT
B.F. GOODRICH SUPERFUND SITE

FIGURE 8B
SCENARIO 2D-3
FREQUENCY OF
CAPTURE

ERM

PREPARED BY:
CTALBOT (ERM)

JOB NO. 0179962.03.A
FILE: 0179962_8B_EPT.mxd

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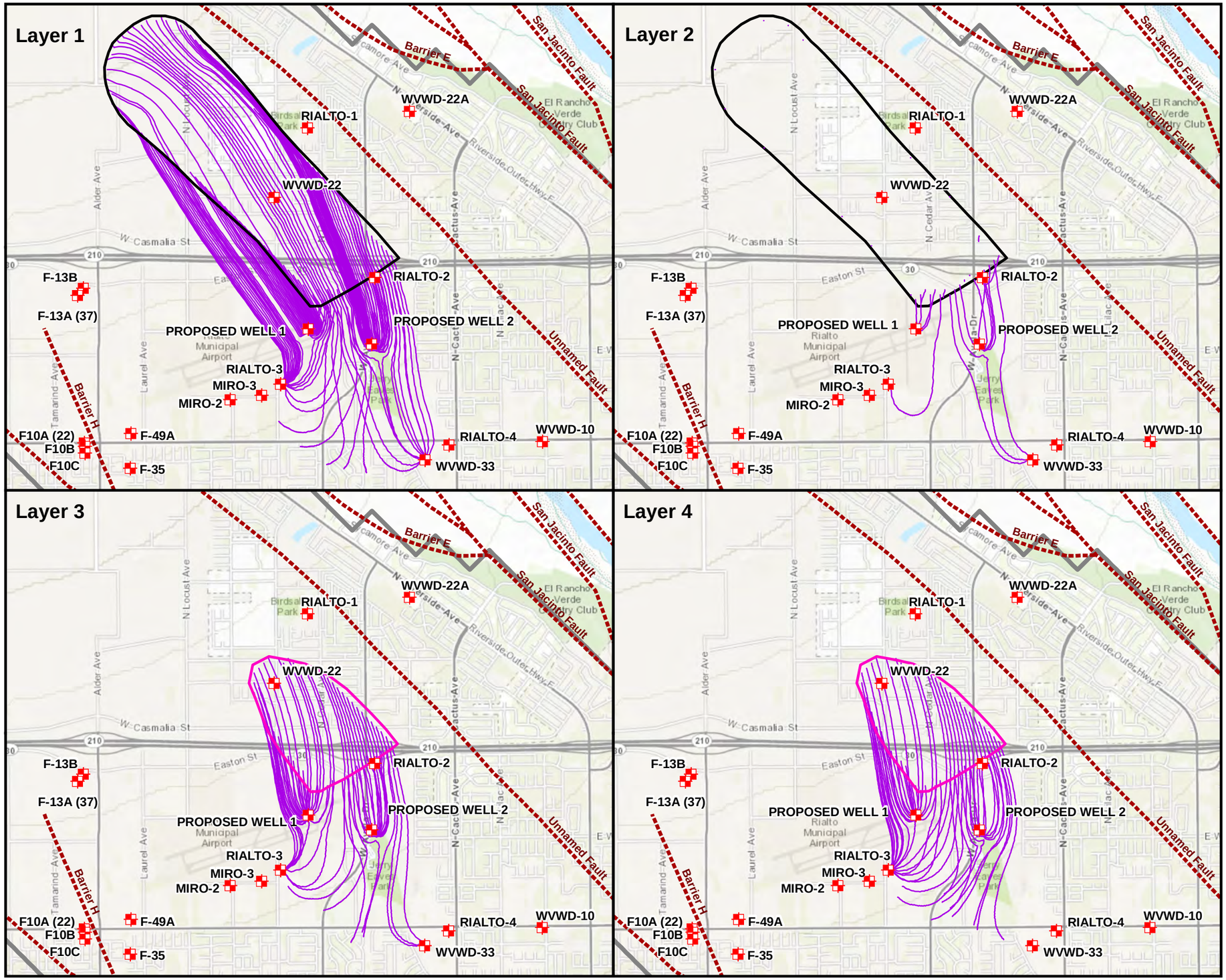

Legend

- Production Well
- Model Particle Tracks
- Faults
- Intermediate Aquifer Target Capture Zone
- Regional Aquifer Target Capture Zone
- Model Boundary

Well	Pumping Rate GPM	Pumping Rate AF/yr
RIALTO-2	0	0
RIALTO-3	1,157	1,868
Miro-2	0	0
Miro-3	0	0
Proposed Well 1	768	1,240
Proposed Well 2	576	930
Total Flow Rate	2,502	4,038

DRAFT

Note:
GPM - Gallons per Minute
AF/yr - Acre-Feet per Year

N

0 3,000
Feet

SOURCE AREA OPERABLE UNIT
B.F. GOODRICH SUPERFUND SITE

FIGURE 8A
SCENARIO 2D-3
PARTICLE TRACK
SIMULATION

ERM

PREPARED BY:
CTALBOT (ERM)

JOB NO. 0179962.03.A
FILE: R_0179962_8A_PT.mxd

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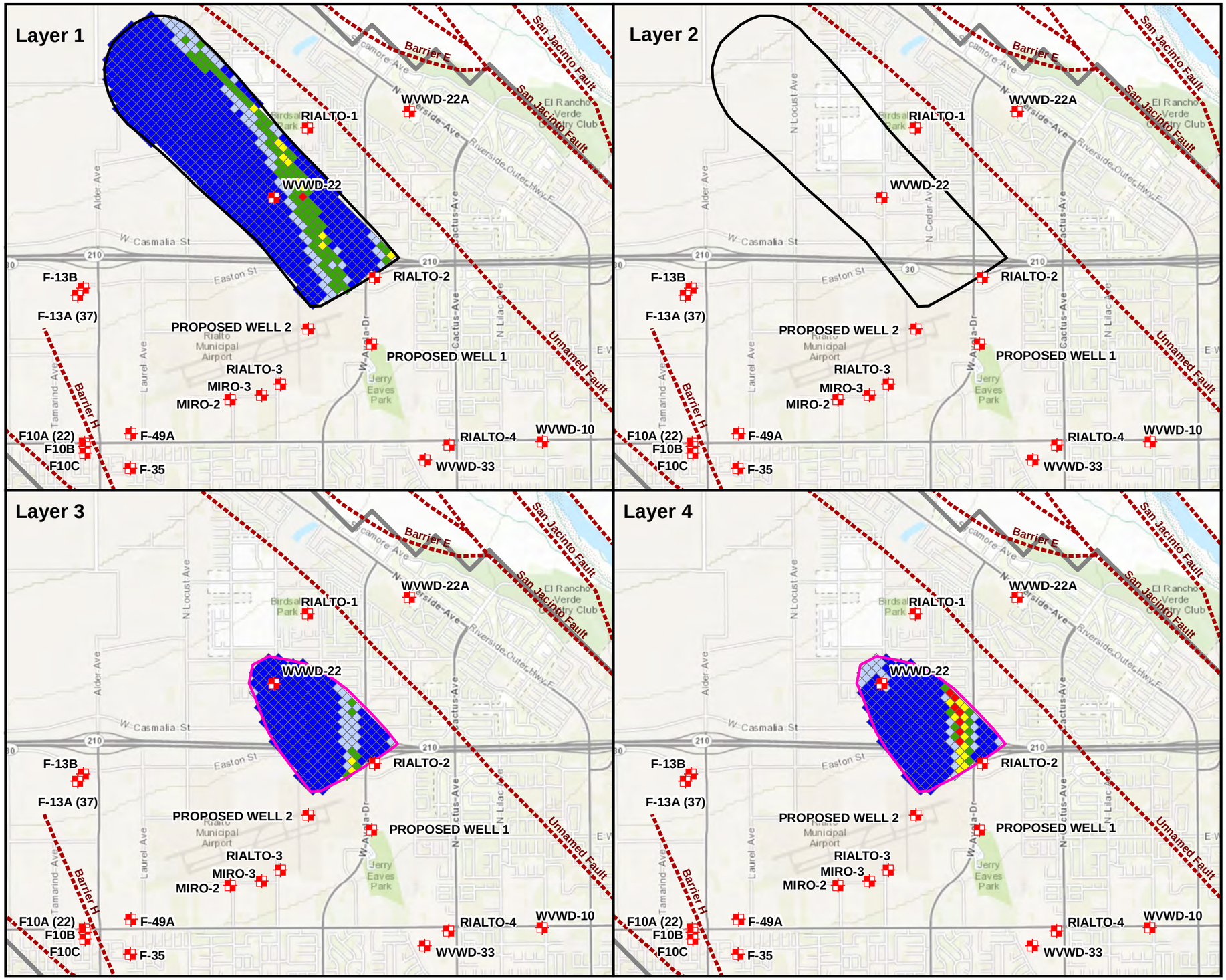


Legend

- Production Well
- Frequency of Capture (%)
  - < 20
  - 20 to 40
  - 40 to 60
  - 60 to 80
  - 80 to 100
- Faults
- Intermediate Aquifer Target Capture Zone
- Regional Aquifer Target Capture Zone
- Model Boundary

Well	Pumping Rate GPM	Pumping Rate AF/yr
RIALTO-2	0	0
RIALTO-3	1,157	1,868
Miro-2	0	0
Miro-3	0	0
Proposed Well 1	768	1,240
Proposed Well 2	576	930
Total Flow Rate	2,502	4,038

DRAFT

Note:
GPM - Gallons per Minute
AF/yr - Acre-Feet per Year

N

0 3,000
Feet

SOURCE AREA OPERABLE UNIT
B.F. GOODRICH SUPERFUND SITE

FIGURE 8B
SCENARIO 2D-3
FREQUENCY OF
CAPTURE

ERM

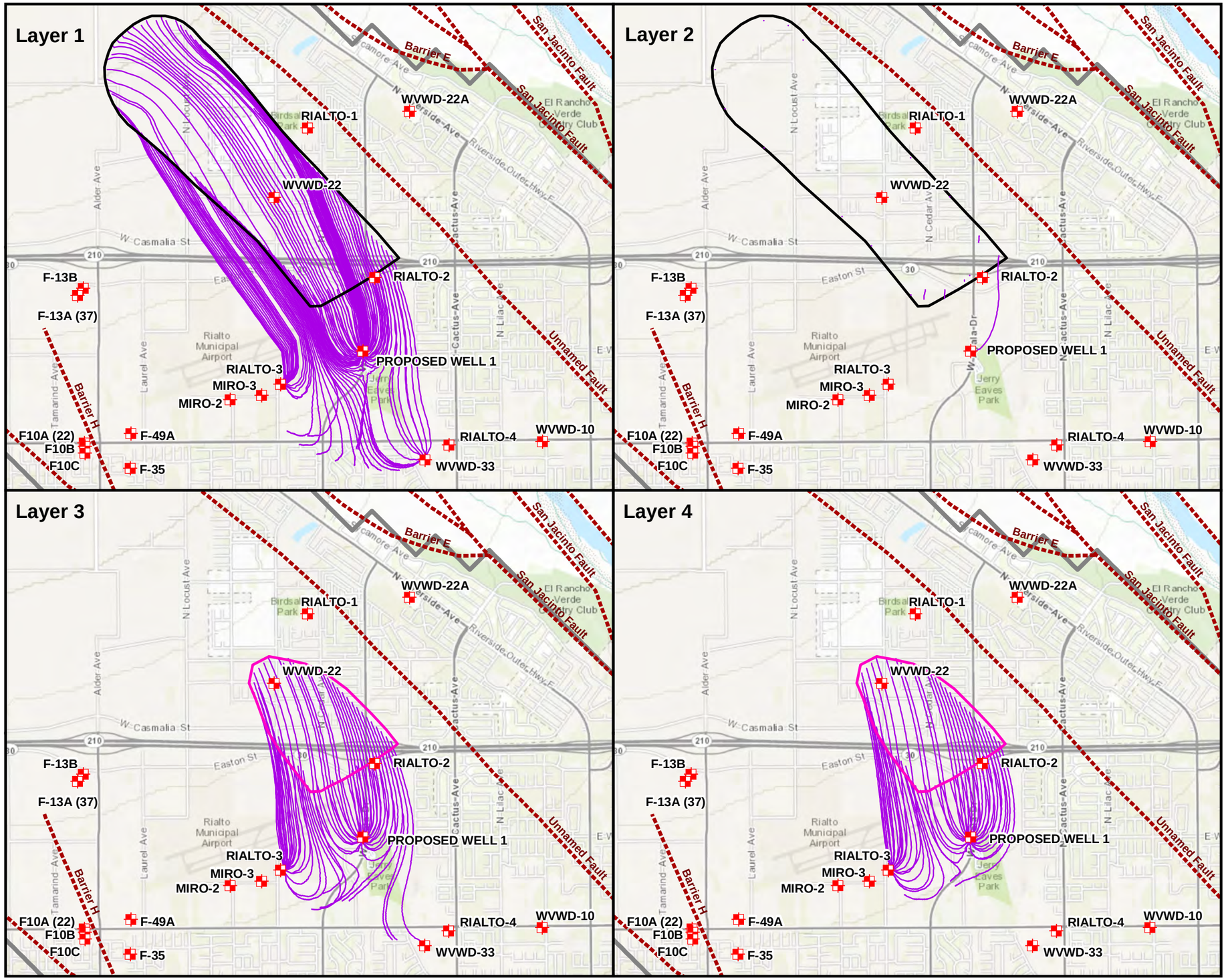
PREPARED BY:
CTALBOT (ERM)

JOB NO. 0179962.03.A
FILE: R_0179962_8B_EPT.mxd

C:\Modflow\Rialto\Calibration\predictive\RevisedScenarios\Results\R_0179962_8B_EPT.mxd WESAC CTALBOT 3/11/2013

Scenario 2B

(with reduced WVWD 33 pumping)



Legend

- Production Well
- Model Particle Tracks
- Faults
- Intermediate Aquifer Target Capture Zone
- Regional Aquifer Target Capture Zone
- Model Boundary

Well	Pumping Rate GPM	Pumping Rate AF/yr
RIALTO-2	0	0
RIALTO-3	1,157	1,868
Miro-2	0	0
Miro-3	0	0
Proposed Well 1	1,394	2,250
Proposed Well 2	0	0
Total Flow Rate	2,551	4,118

DRAFT

Note:
GPM - Gallons per Minute
AF/yr - Acre-Feet per Year

N

0 3,000
Feet

SOURCE AREA OPERABLE UNIT
B.F. GOODRICH SUPERFUND SITE

FIGURE 4A
SCENARIO 2B
PARTICLE TRACK
SIMULATION

ERM

PREPARED BY:
CTALBOT (ERM)

JOB NO. 0179962.03.A
FILE: R_0179962_4A_PT.mxd

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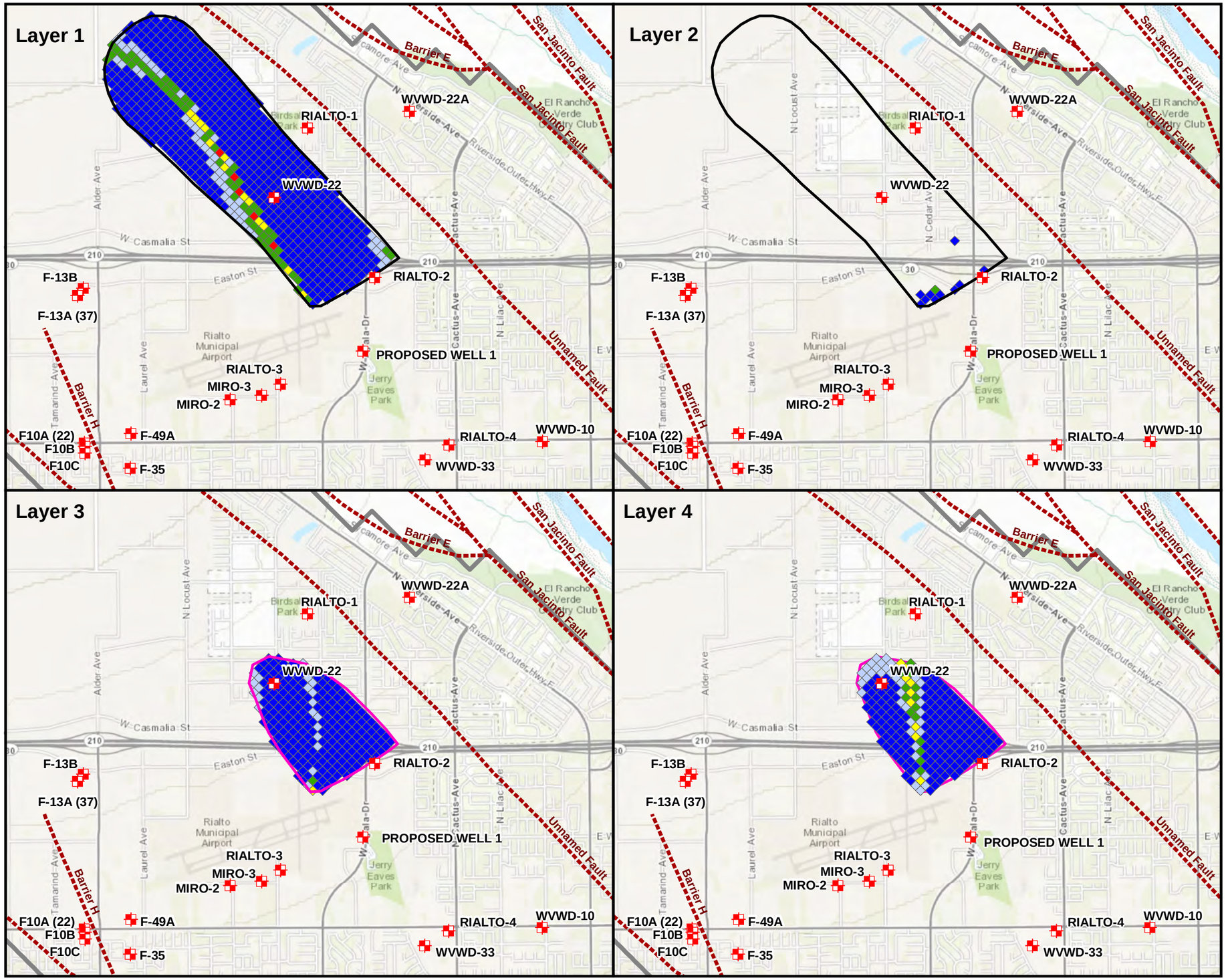


Legend

- Production Well
- Frequency of Capture (%)
  - < 20
  - 20 to 40
  - 40 to 60
  - 60 to 80
  - 80 to 100
- Faults
- Intermediate Aquifer Target Capture Zone
- Regional Aquifer Target Capture Zone
- Model Boundary

Well	Pumping Rate GPM	Pumping Rate AF/yr
RIALTO-2	0	0
RIALTO-3	1,157	1,868
Miro-2	0	0
Miro-3	0	0
Proposed Well 1	1,394	2,250
Proposed Well 2	0	0
Total Flow Rate	2,551	4,118

DRAFT

Note:
GPM - Gallons per Minute
AF/yr - Acre-Feet per Year

N

0 3,000
Feet

SOURCE AREA OPERABLE UNIT
B.F. GOODRICH SUPERFUND SITE

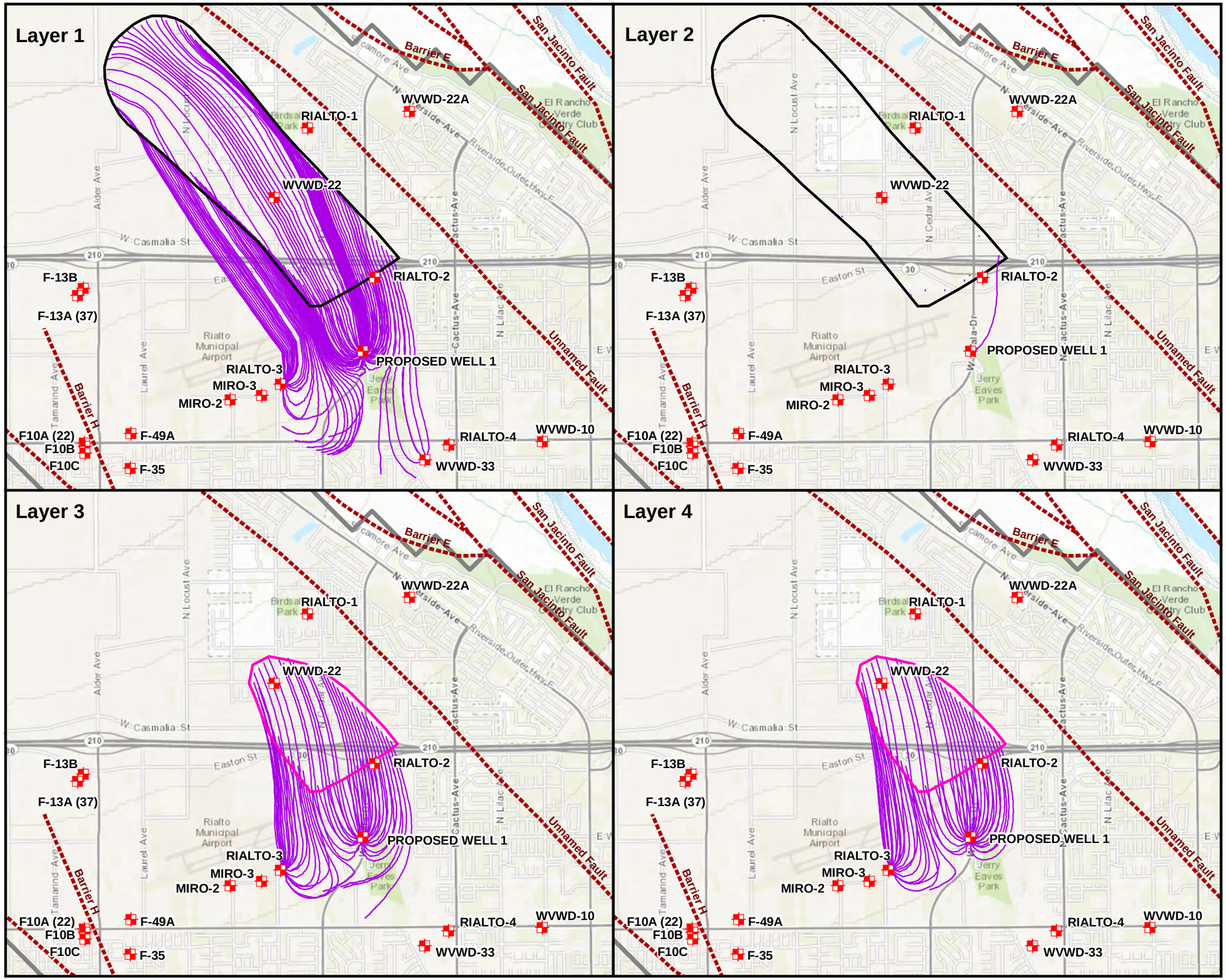
FIGURE 4B
SCENARIO 2B
FREQUENCY OF
CAPTURE

ERM

PREPARED BY:
CTALBOT (ERM)

JOB NO. 0179962.03.A
FILE: R_0179962_4B_EPT.mxd

C:\Modflow\Rialto\Calibration\predictive\RevisedScenarios\Results\R_0179962_4B_EPT.mxd WESAC CTALBOT 3/11/2013



Legend

- Production Well
- Model Particle Tracks
- Faults
- Intermediate Aquifer Target Capture Zone
- Regional Aquifer Target Capture Zone
- Model Boundary

Well	Pumping Rate GPM	Pumping Rate AF/yr
RIALTO-2	0	0
RIALTO-3	1,157	1,868
Miro-2	0	0
Miro-3	0	0
Proposed Well 1	1,394	2,250
Proposed Well 2	0	0
Total Flow Rate	2,551	4,118

DRAFT

Note:
GPM - Gallons per Minute
AF/yr - Acre-Feet per Year

N

0 3,000
Feet

SOURCE AREA OPERABLE UNIT
B.F. GOODRICH SUPERFUND SITE

FIGURE 4A
SCENARIO 2B
PARTICLE TRACK SIMULATION
WVWD-16 & WVWD-33 PUMPING
TOTAL 775 AF/YR

ERM

PREPARED BY:
CTALBOT (ERM)

JOB NO. 0179962.03.A
FILE: R_0179962_4A_W_PT.mxd

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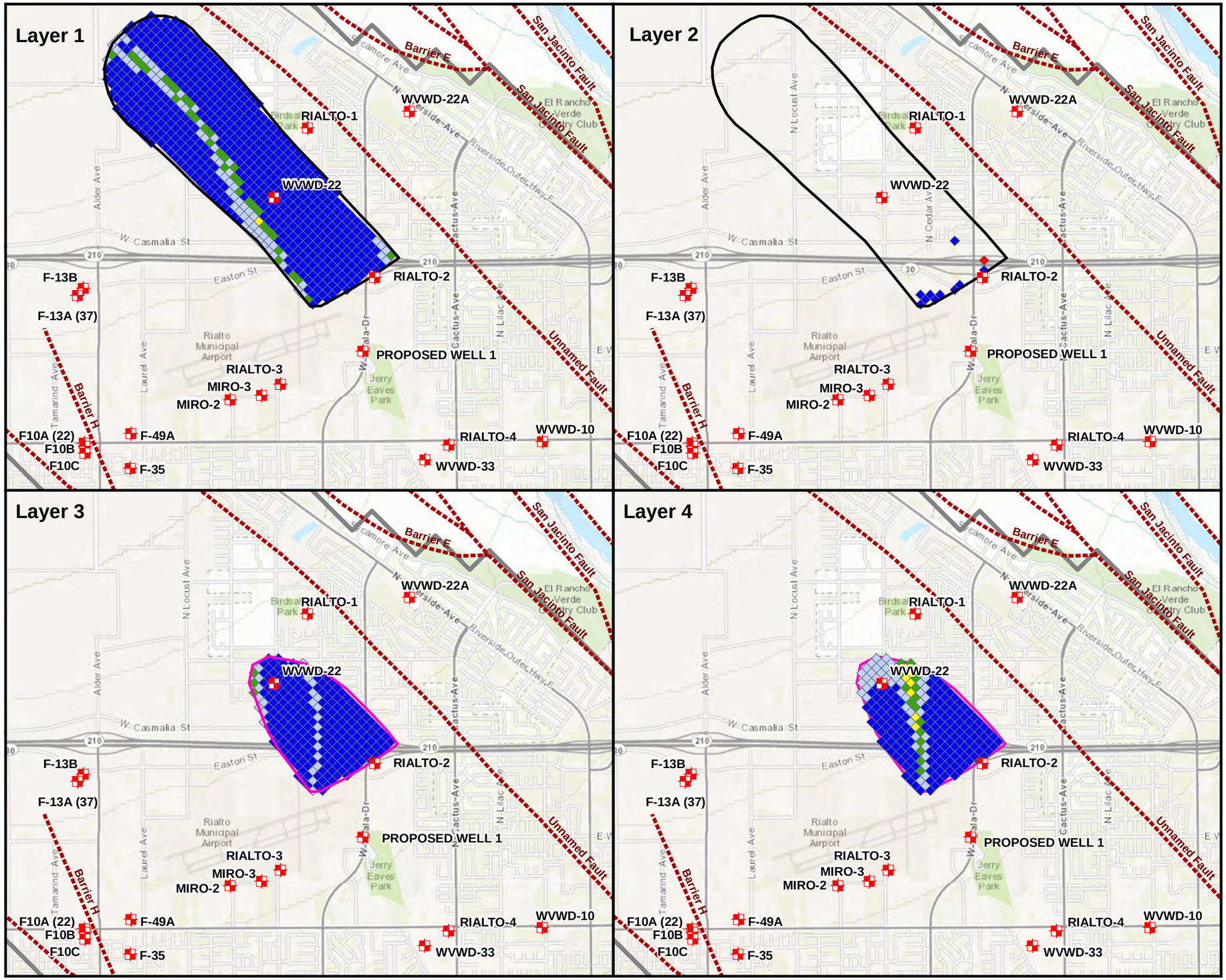


Legend

- Production Well
- Frequency of Capture (%)
  - < 20
  - 20 to 40
  - 40 to 60
  - 60 to 80
  - 80 to 100
- Faults
- Intermediate Aquifer Target Capture Zone
- Regional Aquifer Target Capture Zone
- Model Boundary

Well	Pumping Rate GPM	Pumping Rate AF/yr
RIALTO-2	0	0
RIALTO-3	1,157	1,868
Miro-2	0	0
Miro-3	0	0
Proposed Well 1	1,394	2,250
Proposed Well 2	0	0
Total Flow Rate	2,551	4,118

DRAFT

Note:
GPM - Gallons per Minute
AF/yr - Acre-Feet per Year

N

0 3,000
Feet

SOURCE AREA OPERABLE UNIT
B.F. GOODRICH SUPERFUND SITE

FIGURE 4B
SCENARIO 2B
FREQUENCY OF CAPTURE
WVWD-16 & WVWD-33 PUMPING
TOTAL 775 AF/YR

ERM

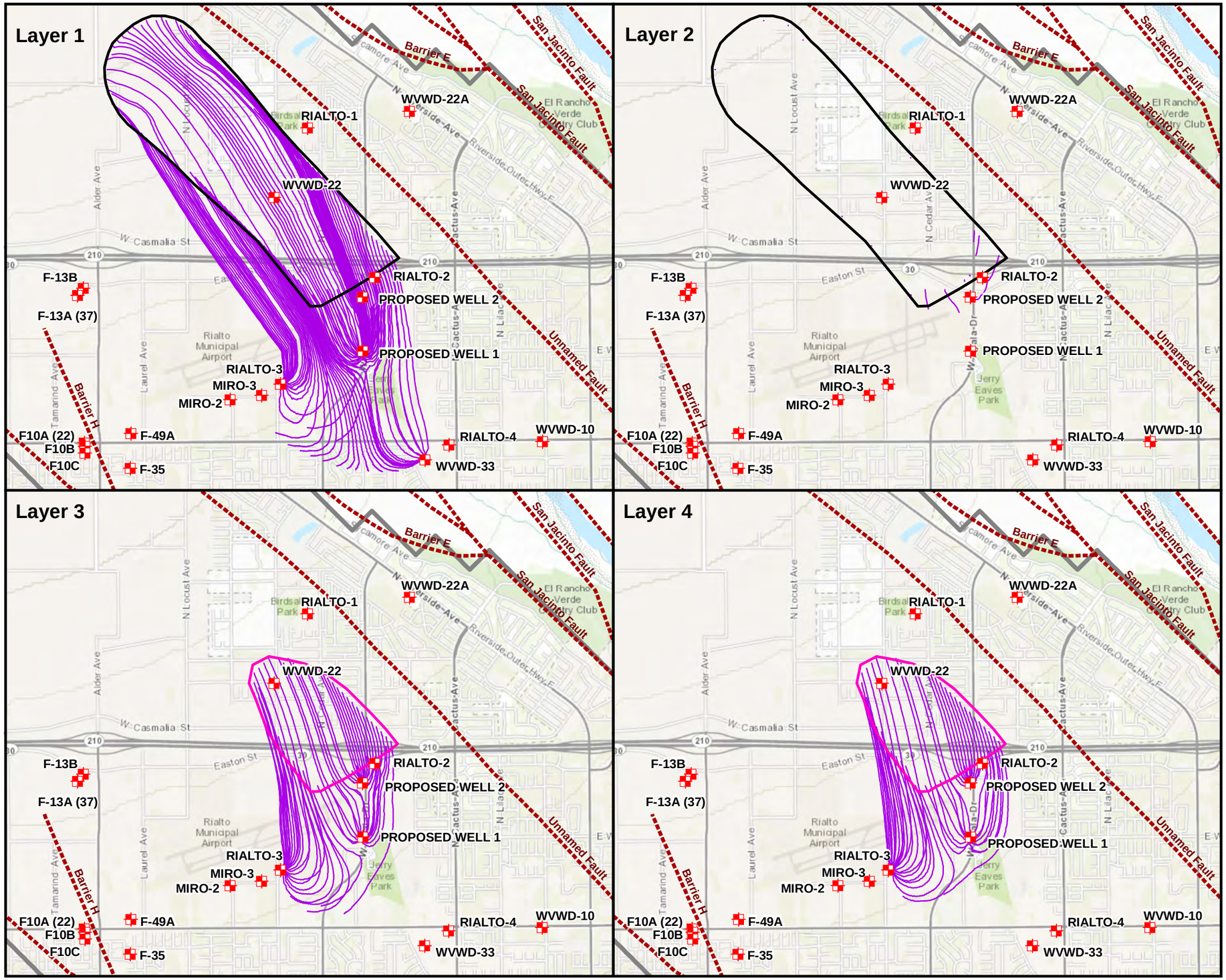
PREPARED BY:
CTALBOT (ERM)

JOB NO. 0179962.03.A
FILE: R_0179962_4B_W_EPT.mxd

C:\Modflow\Rialto\Calibration\predictive\RevisedScenarios\Results\R_0179962_4B_W_EPT.mxd WESAC CTALBOT 3/11/2013

Scenario 2D-1

(with reduced WVWD 33 pumping)



Legend

- Production Well
- Model Particle Tracks
- Faults
- Intermediate Aquifer Target Capture Zone
- Regional Aquifer Target Capture Zone
- Model Boundary

Well	Pumping Rate GPM	Pumping Rate AF/yr
RIALTO-2	0	0
RIALTO-3	1,157	1,868
Miro-2	0	0
Miro-3	0	0
Proposed Well 1	813	1,313
Proposed Well 2	651	1,050
Total Flow Rate	2,621	4,231

DRAFT

Note:
GPM - Gallons per Minute
AF/YR - Acre-Feet per Year

N

0 3,000
Feet

SOURCE AREA OPERABLE UNIT
B.F. GOODRICH SUPERFUND SITE

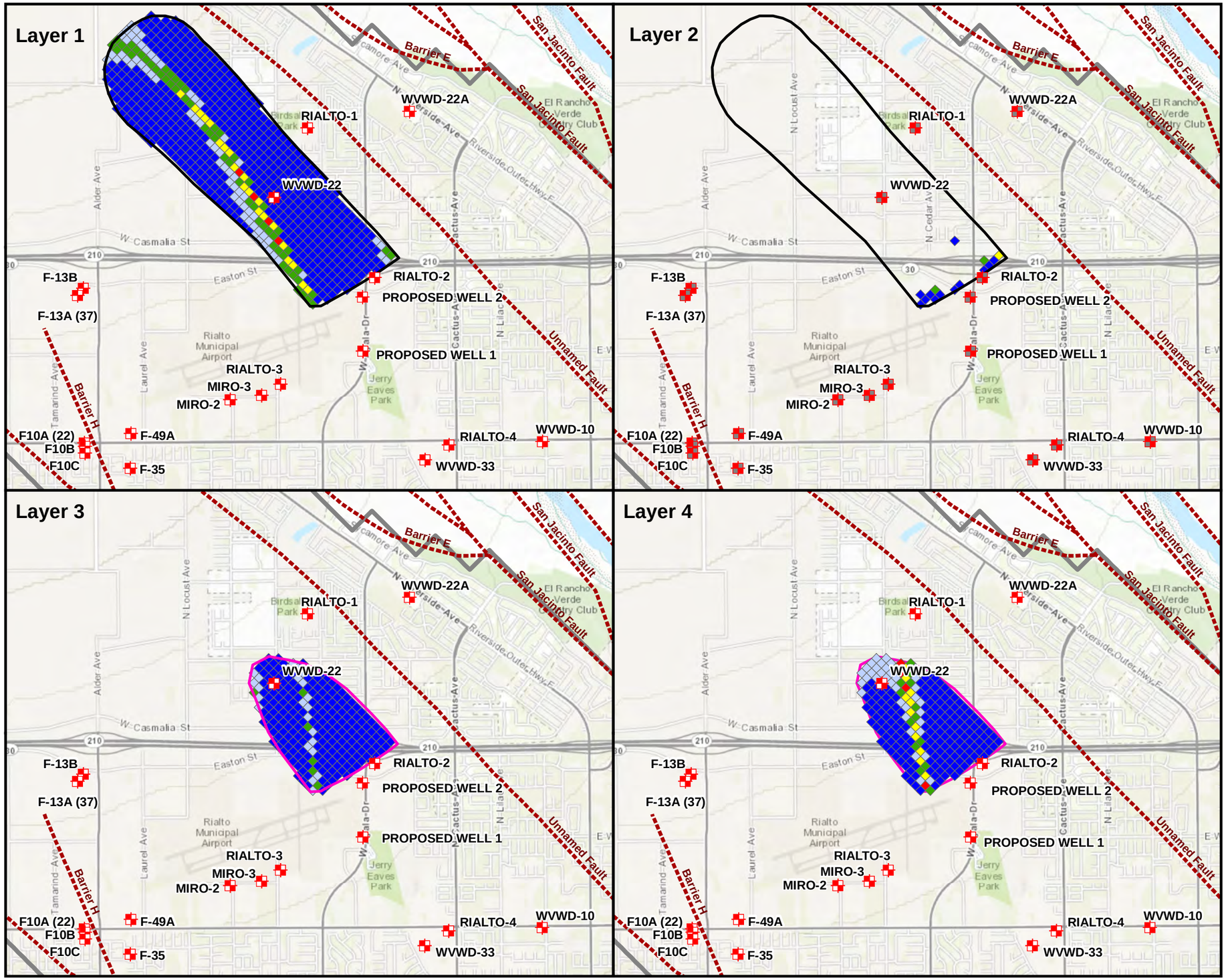
FIGURE 6A
SCENARIO 2D-1
PARTICLE TRACK
SIMULATION

ERM

PREPARED BY:
CTALBOT (ERM)

JOB NO. 0179962.03.A
FILE: R_0179962_6A_PT.mxd

C:\Modflow\Rialto\Calibration\predictive\RevisedScenarios\Results\R_0179962_6A_PT.mxd WESAC CTALBOT 3/11/2013



Legend

- Production Well
- Frequency of Capture (%)
  - < 20
  - 20 to 40
  - 40 to 60
  - 60 to 80
  - 80 to 100
- Faults
- Intermediate Aquifer Target Capture Zone
- Regional Aquifer Target Capture Zone
- Model Boundary

Well	Pumping Rate GPM	Pumping Rate AF/yr
RIALTO-2	0	0
RIALTO-3	1,157	1,868
Miro-2	0	0
Miro-3	0	0
Proposed Well 1	813	1,313
Proposed Well 2	651	1,050
Total Flow Rate	2,621	4,231

DRAFT

Note:
GPM - Gallons per Minute
AF/yr - Acre-Feet per Year

N

0 3,000
Feet

SOURCE AREA OPERABLE UNIT
B.F. GOODRICH SUPERFUND SITE

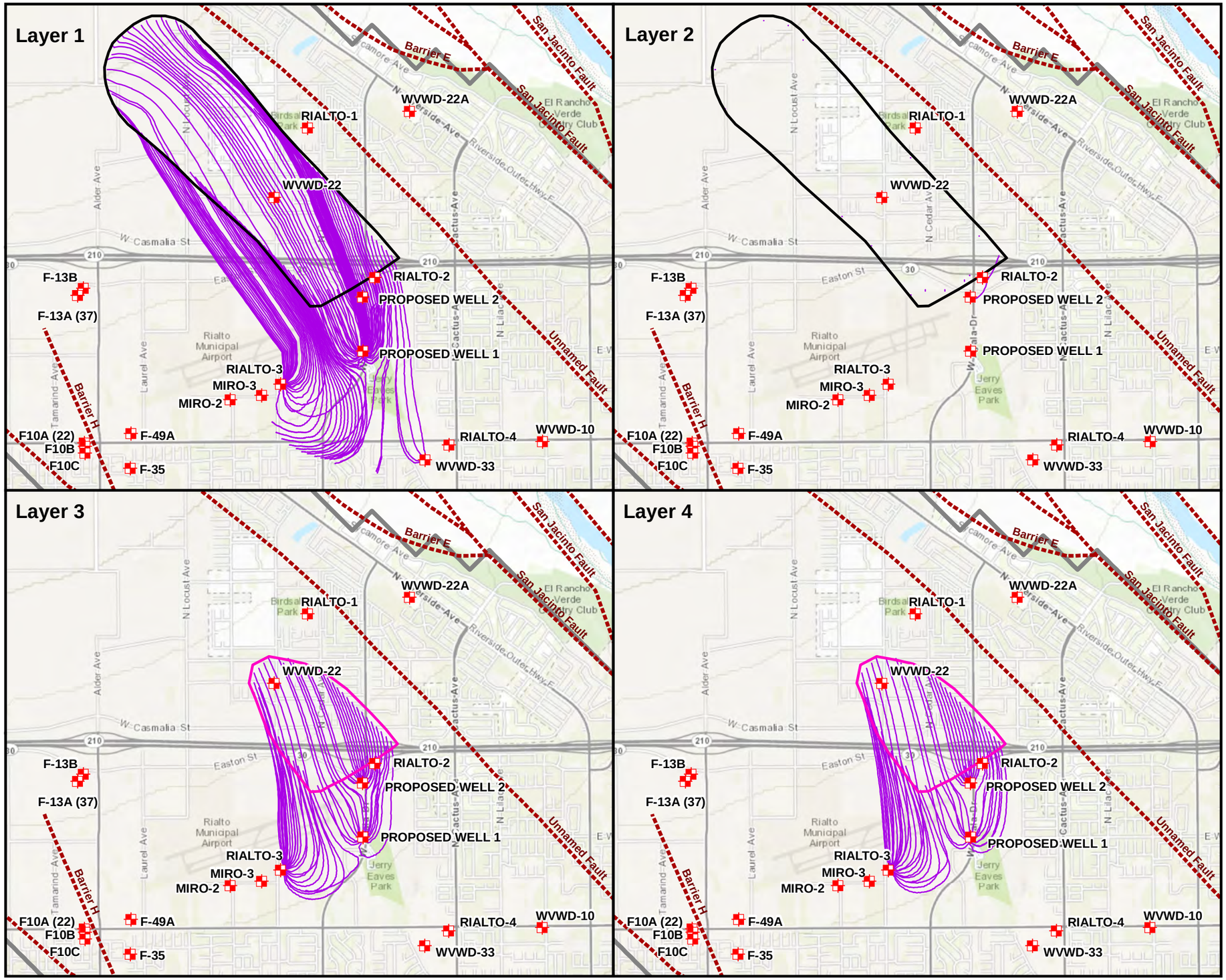
FIGURE 6B
SCENARIO 2D-1
FREQUENCY OF
CAPTURE

ERM

PREPARED BY:
CTALBOT (ERM)

JOB NO. 0179962.03.A
FILE: R_0179962_6B_EPT.mxd

C:\Modflow\Rialto\Calibration\predictive\RevisedScenarios\Results\R_0179962_6B_EPT.mxd WESAC CTALBOT 3/11/2013



Legend

- Production Well
- Model Particle Tracks
- Faults
- Intermediate Aquifer Target Capture Zone
- Regional Aquifer Target Capture Zone
- Model Boundary

Well	Pumping Rate GPM	Pumping Rate AF/yr
RIALTO-2	0	0
RIALTO-3	1,157	1,868
Miro-2	0	0
Miro-3	0	0
Proposed Well 1	813	1,313
Proposed Well 2	651	1,050
Total Flow Rate	2,621	4,231

DRAFT

Note:
GPM - Gallons per Minute
AF/YR - Acre-Feet per Year

N

0 3,000
Feet

SOURCE AREA OPERABLE UNIT
B.F. GOODRICH SUPERFUND SITE

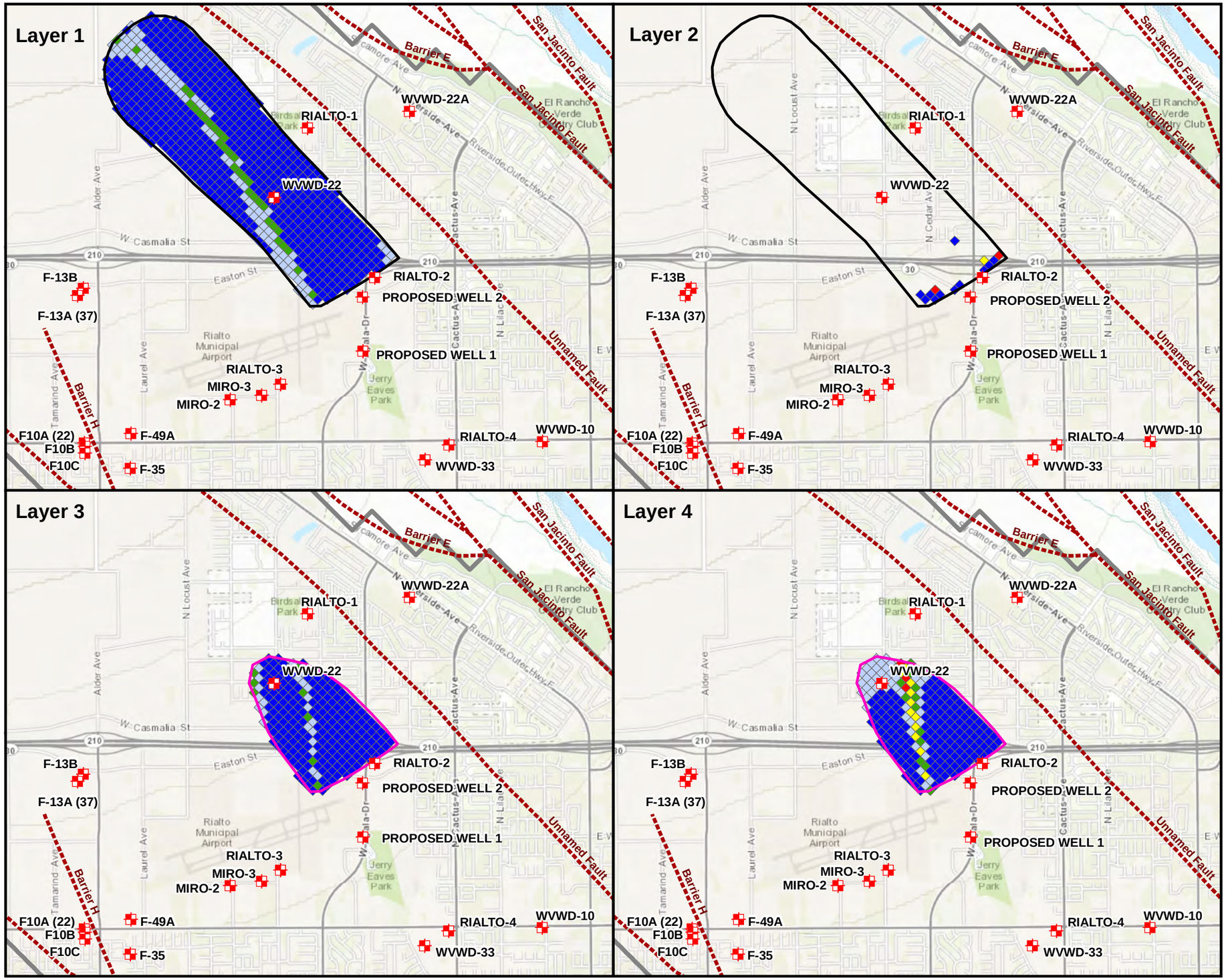
FIGURE 6A
SCENARIO 2D-1
PARTICLE TRACK SIMULATION
WVWD-16 & WVWD-33 PUMPING
TOTAL 775 AF/YR

ERM

PREPARED BY:
CTALBOT (ERM)

JOB NO. 0179962.03.A
FILE: R_W_0179962_6A_PT.mxd

C:\Modflow\Rialto\Calibration\predictive\RevisedScenarios\Results\R_W_0179962_6A_PT.mxd WESAC CTALBOT 3/12/2013



Legend

- Production Well
- Frequency of Capture (%)
  - < 20
  - 20 to 40
  - 40 to 60
  - 60 to 80
  - 80 to 100
- Faults
- Intermediate Aquifer Target Capture Zone
- Regional Aquifer Target Capture Zone
- Model Boundary

Well	Pumping Rate GPM	Pumping Rate AF/yr
RIALTO-2	0	0
RIALTO-3	1,157	1,868
Miro-2	0	0
Miro-3	0	0
Proposed Well 1	813	1,313
Proposed Well 2	651	1,050
Total Flow Rate	2,621	4,231

DRAFT

Note:
GPM - Gallons per Minute
AF/yr - Acre-Feet per Year

N

0 3,000
Feet

SOURCE AREA OPERABLE UNIT
B.F. GOODRICH SUPERFUND SITE

FIGURE 6B
SCENARIO 2D-1
FREQUENCY OF CAPTURE
WVWD-16 & WVWD-33 PUMPING
TOTAL 775 AF/YR

ERM

PREPARED BY:
CTALBOT (ERM)

JOB NO. 0179962.03.A
FILE: R_W_0179962_6B_EPT.mxd

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