RPM TELECONFERENCE/WEB MEETING: SUMMARY
NASA JET PROPULSION LABORATORY CERCLA PROGRAM

Date/Time: December 16, 2008/10:00AM to 2:00PM Pacific

Location: Teleconference/Web Meeting

List of Attendees:

- Steve Slaten (NASA)
- Merrilee Fellows (NASA)
- Judy Huang (U.S. EPA)
- Jeff O'Keefe (DPH)
- Alan Sorsher (DPH)
- Milagros Alora (DPH)
- Bob Hayward (LAWC)
- Gary Takara (PWP)
- Brad Boman (PWP)
- Inna Babbitt (PWP)
- Roumiana Voutchkova (PWP)
- Tony Zampiello (RBMB)
- Nina Jazmadarian (FMWD)
- Chuck Buril (JPL)
- Steve Johnson (Stetson)
- Dennis Williams (Geoscience)
- Mark Williams (Geoscience)
- Neil Sturchio (University of Illinois, Chicago)
- Susan Santos (FOCUS GROUP)
- Bruce Sass (Battelle)
- Andrew Barton (Battelle)
- Keith Fields (Battelle)

Attachments:

- Agenda
- Landscaping pictures
- Presentation slides
- Fourth Quarter 2008 JPL groundwater monitoring results

Summary and Action Items:

Operable Unit 3 Update

Lincoln Avenue Water Company (LAWC) System Update

- Bob Hayward mentioned that LAWC is currently working through a situation where all three activated carbon vessels experienced breakthrough at the same time. This resulted in the need to use imported water until the carbon vessels get back online.
- Bob noted the importance of alternative sources of potable water.

City of Pasadena System Update

- The Draft Final RD/RA Work Plan was submitted to the regulators and stakeholders on November 10. DPH plans to submit comments soon. No others indicated they were planning to submit comments.

- The 90% Design Plans were submitted to the Building Department on November 12. NASA and PWP are awaiting comments from various departments at the City of Pasadena.
- ***ACTION ITEM***: Battelle to provide DPH with an estimate of the amount of utility water produced and an estimated system downtime associated with processing utility water at the Monk Hill Treatment System.
- Battelle initiated the construction contractor selection process. A site walk was conducted on December 10.
- Initiated initial landscaping in November, which is now nearing completion. Several pictures of the landscaping work were displayed via Live Meeting (see attached).
- ***ACTION ITEM***: DPH (Jeff/Alan) to submit comments on the 97-005 documentation in January 2009.

Sunset Wells Update

- Perchlorate levels have been consistent over the past several months: Sunset Well at 10 µg/L, Copelin Well at 9 µg/L, Bangham Well at 6 µg/L, and Garfield Well at 4 µg/L. Villa Well is currently offline for repairs.
- PWP's East Side wells are all at or below 4 µg/L.

Public Involvement Update

- NASA and PWP are working on a groundbreaking ceremony for the Monk Hill Treatment System in late February or early March.
- ***ACTION ITEM***: Gary mentioned that we need to coordinate the groundbreaking with the Windsor Reservoir seismic contractor who is expecting a large shipment of roofing materials during that time.
- The JPL CERCLA Program Web site has been updated, including improved search capabilities, a photo gallery, a separate Spanish page, and many other enhancements.
- NASA is working on a 2008 Year-In-Review summary to post to the program Web site.

OU-1 Operations Update:

System Operational Status:

- NASA continued system operations. The system has removed over 1,120 lbs. of perchlorate and 29 lbs. of VOCs since startup (February 2005). Influent concentrations of perchlorate are currently near 150 µg/L.
- Initiated routine well rehabilitation on November 10.

Other Items:

Groundwater Monitoring Update

- The Third Quarter 2008 Groundwater Monitoring Technical Memorandum was submitted on October 27, 2008
- Completed the Fourth Quarter 2008 groundwater monitoring field activities in November.

MW-20 Evaluation

- Following detections of perchlorate in MW-20 (Screens 4 and 5) in July and October, NASA collected an additional round of samples from this well in November 2008. We then evaluated all available perchlorate, carbon tetrachloride, and geochemical data collected from MW-20 and nearby production wells. Operational data from RCLWA was also evaluated.
- Sporadic detections of perchlorate have been observed in MW-20 (Screens 4 and 5) since 1998. Prior to July 2008, perchlorate had not been detected in these screens for approximately 5 years. Carbon tetrachloride has never been detected in this well. Even so, perchlorate detections in MW-20 (Screens 4 and 5) are believed to represent the further migration of perchlorate originating from JPL.
- Perchlorate and carbon tetrachloride concentrations in LAWC#3 have been decreasing since 2005, while concentrations in LAWC#5 have been increasing since 2005. LAWC#5 is the furthest dowgradient extraction well associated with NASA's cleanup efforts at JPL. LAWC#5 is located approximately 1,000 feet upgradient (northwest) of MW-20.
- Geochemical data from MW-20 (Screens 4 and 5) is consistent with historical results. Therefore, we do not believe flow patterns have changed significantly.
- Over the past year RCLWA has increased production by approximately 30-40%. RCLWA#7 is located approximately 1000 feet downgradient (southeast) of MW-20. Modeling results indicate that groundwater represented by samples collected from MW-20 (Screens 4 and 5) will be captured by RCLWA production wells.
- RCLWA wells are now being sampled weekly with a reduced detection limit of 2 ppb. Results will be forwarded to NASA, who will notify other stakeholders.
- ***ACTION ITEM***: NASA to add Milagros Alora (DPH staff working with RCLWA) to the RPM Meeting distribution list (Milagros.Alora@cdph.ca.gov).

OU-2 Well Abandonment

- NASA initiated development of a technical memorandum to document the abandonment of OU-2 wells and monitoring point installations.

Additional Investigation Responses to Comments:

- NASA presented an overview presentation of their responses to comments from PWP, EPA, and DTSC. See attached slides.
- Discussed groundwater modeling results, including the use of the RBMB model to evaluate reverse particle tracking results from 1980 to 2002 and forward particle tracking results from the JPL source area.
- ***ACTION ITEM***: NASA to coordinate a meeting to discuss groundwater modeling in more detail. Meeting to include modeling experts/developers from EPA, Battelle, Stetson, and Geoscience.
- Dennis Williams and Steve Johnson recommended further evaluation of the extent of perchlorate originating from JPL to the south of MW-10. They suggested that if perchlorate traveled south of MW-10, there is a possibility of mixing with groundwater flow from La Cañada.

- Discussed the applicability of carbon tetrachloride as a tracer.
- Discussed the redox conditions in the deeper screens of MW-20.
- ***ACTION ITEM***: NASA to conduct additional evaluation of redox conditions near MW-20. NASA's analysis of redox conditions will be discussed during the groundwater modeling meeting.
- Discussed perchlorate isotope results.
- Dennis Williams and Steve Johnson requested that the data be evaluated with respect to statistical significance. They also suggested that the conveyance of Colorado River water to Southern California could result in some degradation of perchlorate in anoxic regions of reservoirs.
- Discussed whether perchlorate isotope results from MW-25 (Screen 1) and MW-25 (Screen 4) could be degraded forms of JPL perchlorate.
- Dr. Sturchio discussed other perchlorate isotope data that he has evaluated since the JPL study, including other natural sources, sodium hypochlorite, additional fireworks, and additional road flares.
- ***ACTION ITEM***: Discuss statistical evaluation of data and potential for shift in perchlorate isotope signature due to degradation and as part of the groundwater modeling meeting.
- Discussed the "Tools Applied" chart in the presentation (second to last slide), and whether or not the data are conclusive at certain locations (e.g., perchlorate isotope results for Sunset Well). Planning to work toward consensus on this chart as part of the groundwater meeting.
- ***ACTION ITEM***: NASA to add Dennis Williams (dwilliams@geoscience-water.com), Mark Williams (mwilliams@wmi-engineering.com), and Steve Johnson (stevej@stetsonengineers.com) to the distribution list for topics related to the Additional Investigation.

RPM Teleconference: Agenda
NASA-JPL CERCLA Site
Tuesday, December 16, 2008 – 10:00 AM-1:00 PM
CALL IN NO.: 866-762-9067
PASSCODE: 740439
(*Web Link Provided Separately*)

No.	Item	Time	Discussion Lead
1	Introductions	10:00	NASA

2	Operable Unit 3 Update:
	• Lincoln Avenue Water Company (LAWC) System Update
	• City of Pasadena System Update
	  o System Design
	  o Building Permit
	  o DHS 97-005
	• Sunset Wells Update (City of Pasadena)
		10:00-10:20	NASA/ Steve

3	Public Involvement Update	10:20-10:30	NASA/ Merrilee
4	Other Items: • Operable Unit 1 System Operation Update • Groundwater Monitoring Update • OU-2 Well Abandonment	10:30-10:45	NASA/ Steve
5	Additional Investigation: • Responses to Comments • Presentation	10:45-1:00	NASA/ Steve
6	Upcoming Meetings • RPM Telecon: January 27, 2009, 10 AM • RPM Telecon: February 24, 2009, 10 AM	1:00	All
7	Adjournment	1:00	NASA

December 2008 Meeting
OU-3 Additional Investigation

December 16, 2008

Presentation Summary

(1) Study Objectives and Background

(2) Discussion of the Five General Comments

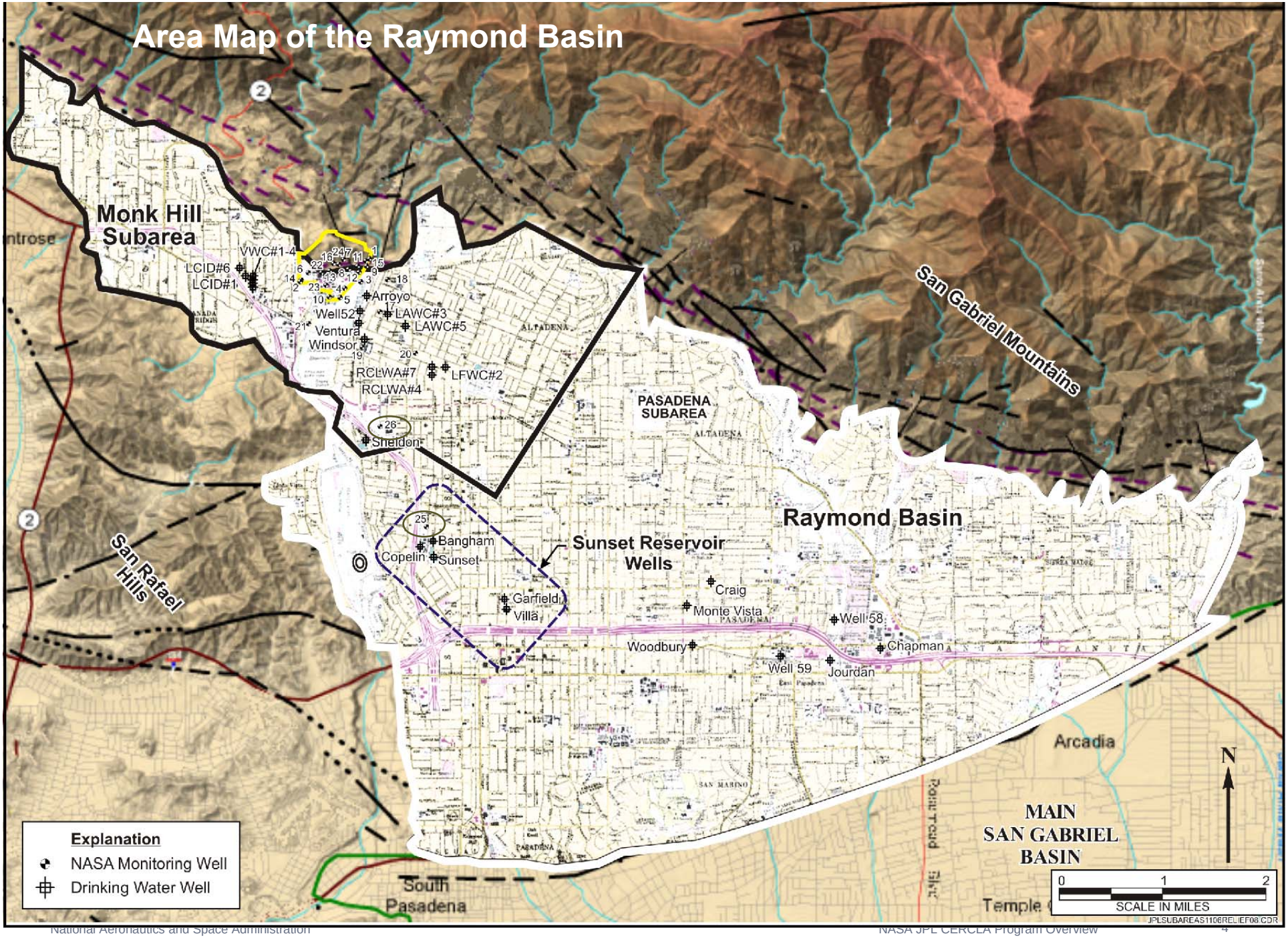
Timeline

- January 31, 2007 – NASA released the Additional Investigation Technical Memorandum
- June 5, 2007 – Comments received from the City of Pasadena (with support from Geoscience Support Services, Inc.)
- October 22, 2007 – Comments received from EPA
- May 21, 2008 – Comments received from DTSC. DSTC provided initial input on February 6, 2007.

Additional Investigation Objectives

1. Evaluate the downgradient (southern) extent of chemicals that originate from the JPL facility and,
2. Determine if the occurrence of perchlorate in the Sunset Reservoir area were associated with migration from the JPL facility

The Additional Investigation was conducted according to the Work Plan approved by EPA, DTSC, and RWQCB. In addition, DPH and the City of Pasadena provided input on the Work Plan.


Area Map of the Raymond Basin
Monk Hill Subarea
VWC#1-4
LCID#6
LCID#1
Arroyo
Well52
LAWC#3
LAWC#5
Ventura
Windsor
RCLWA#7
LFWC#2
RCLWA#4
Sheldon
PASADENA SUBAREA
San Gabriel Mountains
Raymond Basin
Sunset Reservoir Wells
Bangham
Copelin
Sunset
Garfield
Villa
Craig
Monte Vista
Well 58
Woodbury
Chapman
Well 59
Jourdan
San Rafael Hills
Arcadia
MAIN SAN GABRIEL BASIN
South Pasadena
Explanation
NASA Monitoring Well
Drinking Water Well
N
0
1
2
SCALE IN MILES
JPLSUBAREAS1106RELIEF08.CDR

Additional Investigation Lines of Evidence

- Groundwater Geochemistry
  - Dissolved Cation and Anion Data
    - » Production Well Data Available Beginning in the Early 1900s
    - » JPL Monitoring Well Data Available Beginning in the mid-1990s
  - Additional Investigation Included Isotopic Evaluation of Groundwater (Oxygen and Hydrogen), Strontium, and Tritium/Helium.
- Groundwater Modeling
  - NASA Model
  - Independently-Developed Raymond Basin Management Board Model
- Groundwater Chemical Data
- Perchlorate Isotope Analysis

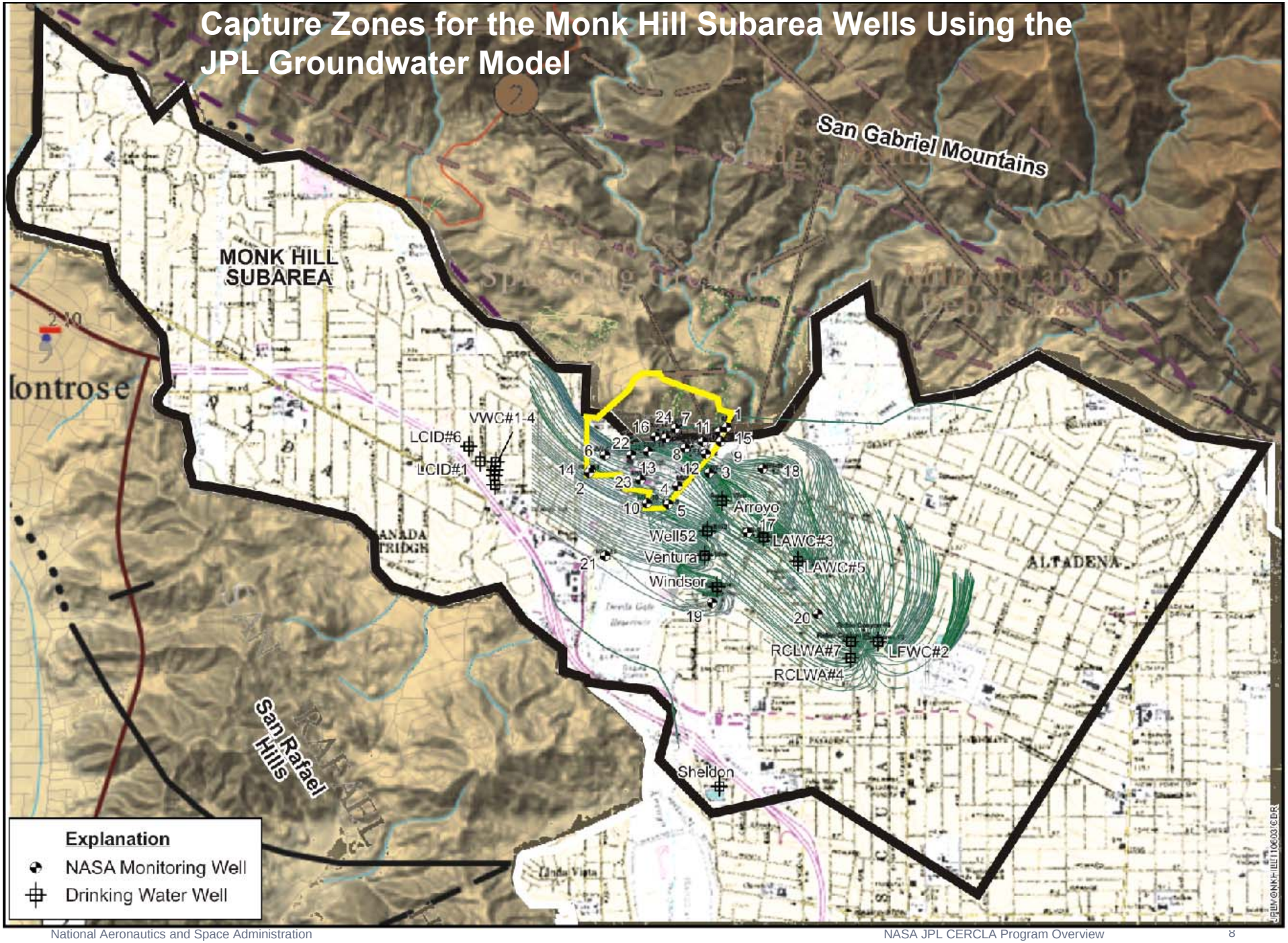
Five General Comments on the Additional Investigation

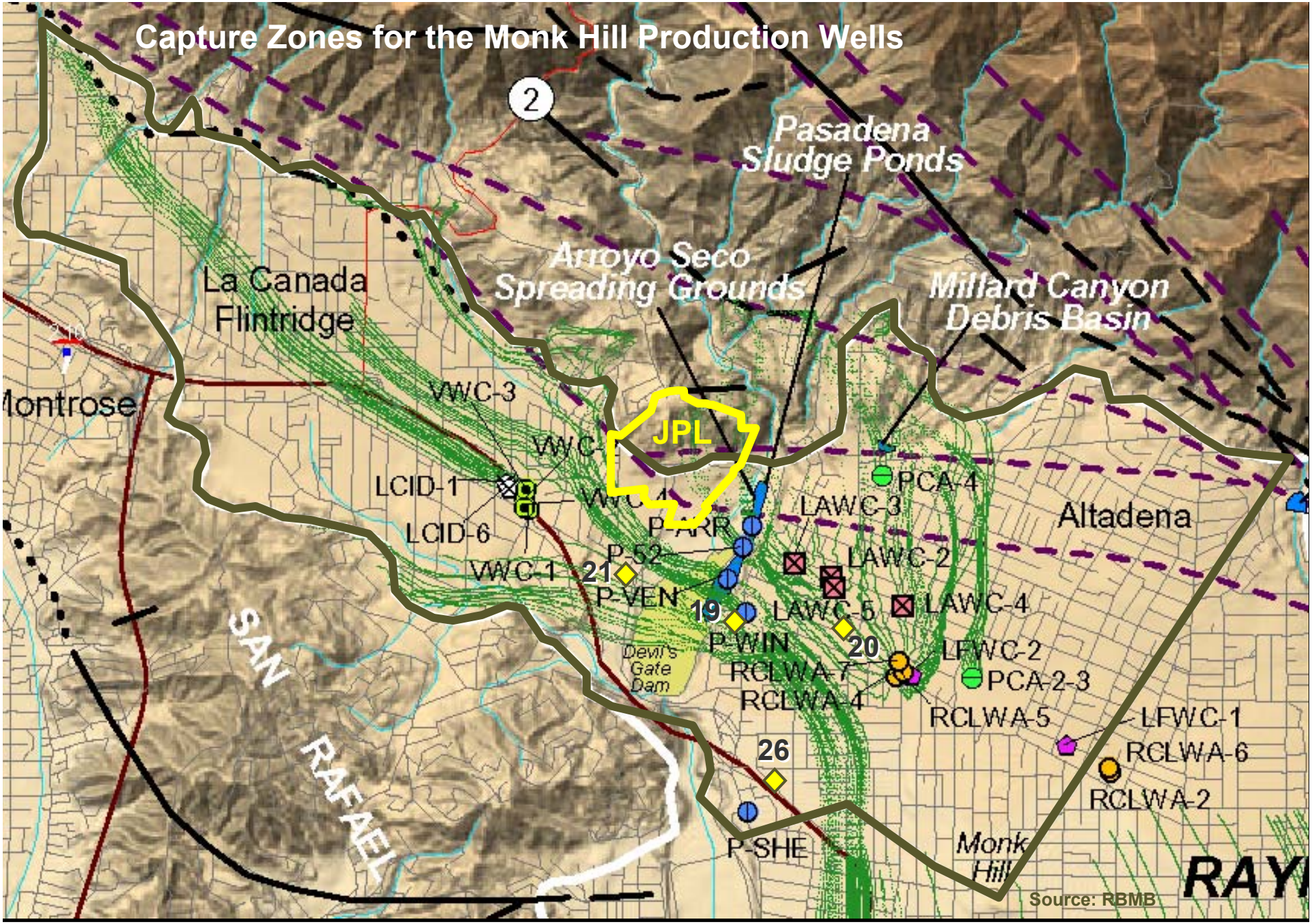
1. Applicability of the two groundwater models to chemical fate and transport, considering that the models were developed for water management (RBMB Model) and plume containment (JPL Model) and considering the potential for preferential pathways.
2. Evidence that the leading edge of NASA's perchlorate plume has been established.
3. Applicability of carbon tetrachloride as a tracer, considering concentrations, potential biological degradation, and sorption.
4. Oxidation-reduction (redox) conditions in the aquifer.
5. Perchlorate isotope data indicate there are multiple sources of perchlorate in the Basin, but alone may not eliminate JPL as a source in the Sunset Wells.

General Comment No. 1: Applicability of Groundwater Models

- The JPL Model Applicability
  - » Designed to evaluate plume containment alternatives for JPL.
  - » Demonstrates containment has occurred by production wells installed in the early 1900s.
  - » JPL Model is appropriate for evaluating groundwater flow paths near JPL because containment has occurred with existing production wells.
- JPL Model is more appropriate than the RBMB Model for evaluating groundwater flow in the Monk Hill Subarea. Even so, the flow paths generated by the RBMB Model appear to be consistent with those generated by the JPL Model.
- Evaluated JPL Model approach against recent EPA Guidance for evaluating capture zones. This evaluation showed that the JPL Model was developed consistent with EPA Guidance, providing an accurate understanding of capture zones.

Capture Zones for the Monk Hill Subarea Wells Using the JPL Groundwater Model

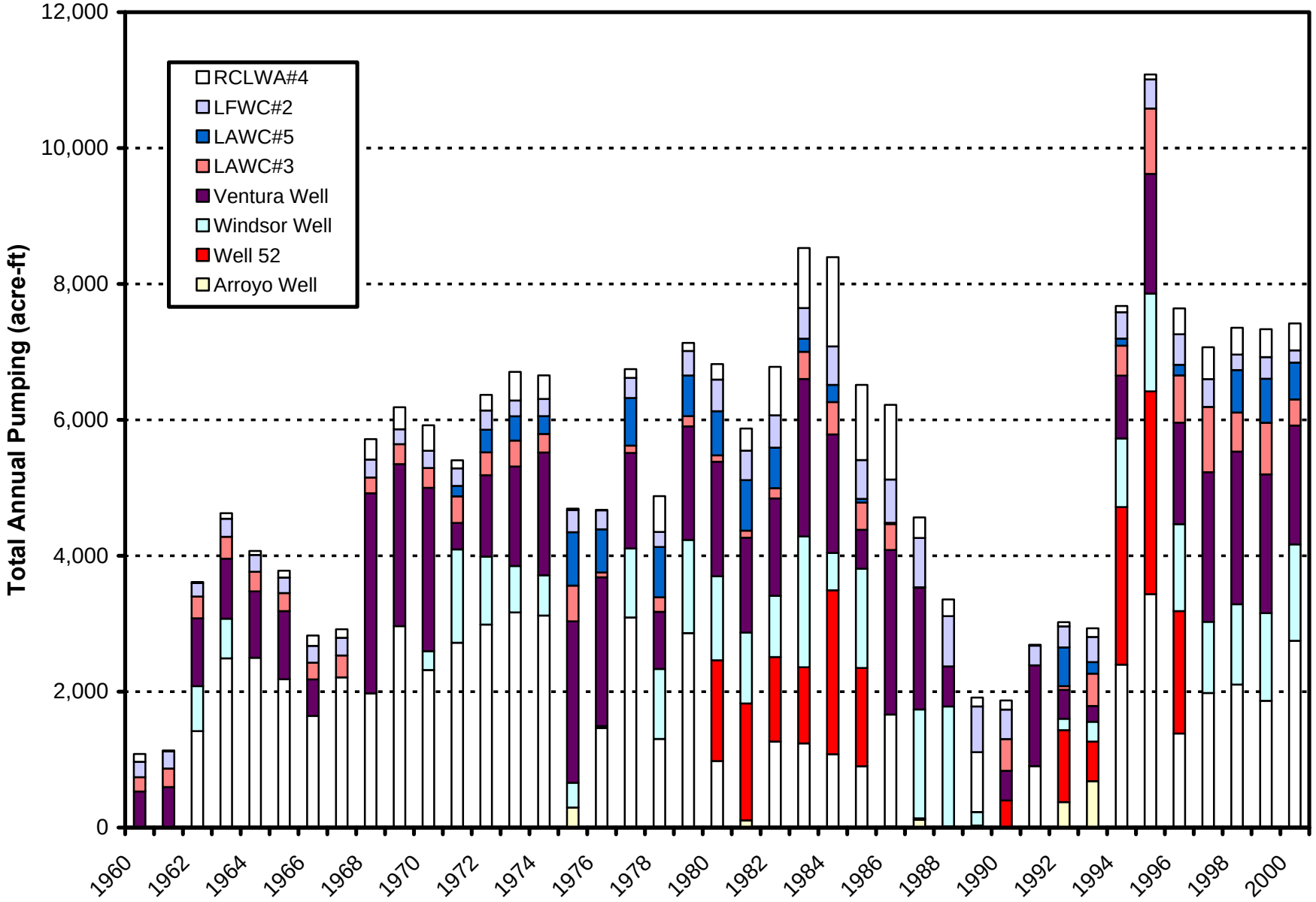



Capture Zones for the Monk Hill Production Wells
2
Pasadena Sludge Ponds
Arroyo Seco Spreading Grounds
Millard Canyon Debris Basin
La Canada Flintridge
Montrose
JPL
WWC-3
WWC-1
LCID-1
LCID-6
WWC-1
21
P-52
P-ARR
P-VEN
19
P-WIN
Devil's Gate Dam
RCLWA-7
RCLWA-4
LAWC-3
PCA-4
LAWC-2
LAWC-5
LAWC-4
20
LFWC-2
PCA-2-3
RCLWA-5
Altadena
LFWC-1
RCLWA-6
RCLWA-2
26
P-SHE
Monk Hill
SAN RAFAEL
Source: RBMB

General Comment No. 1 (Cont.)

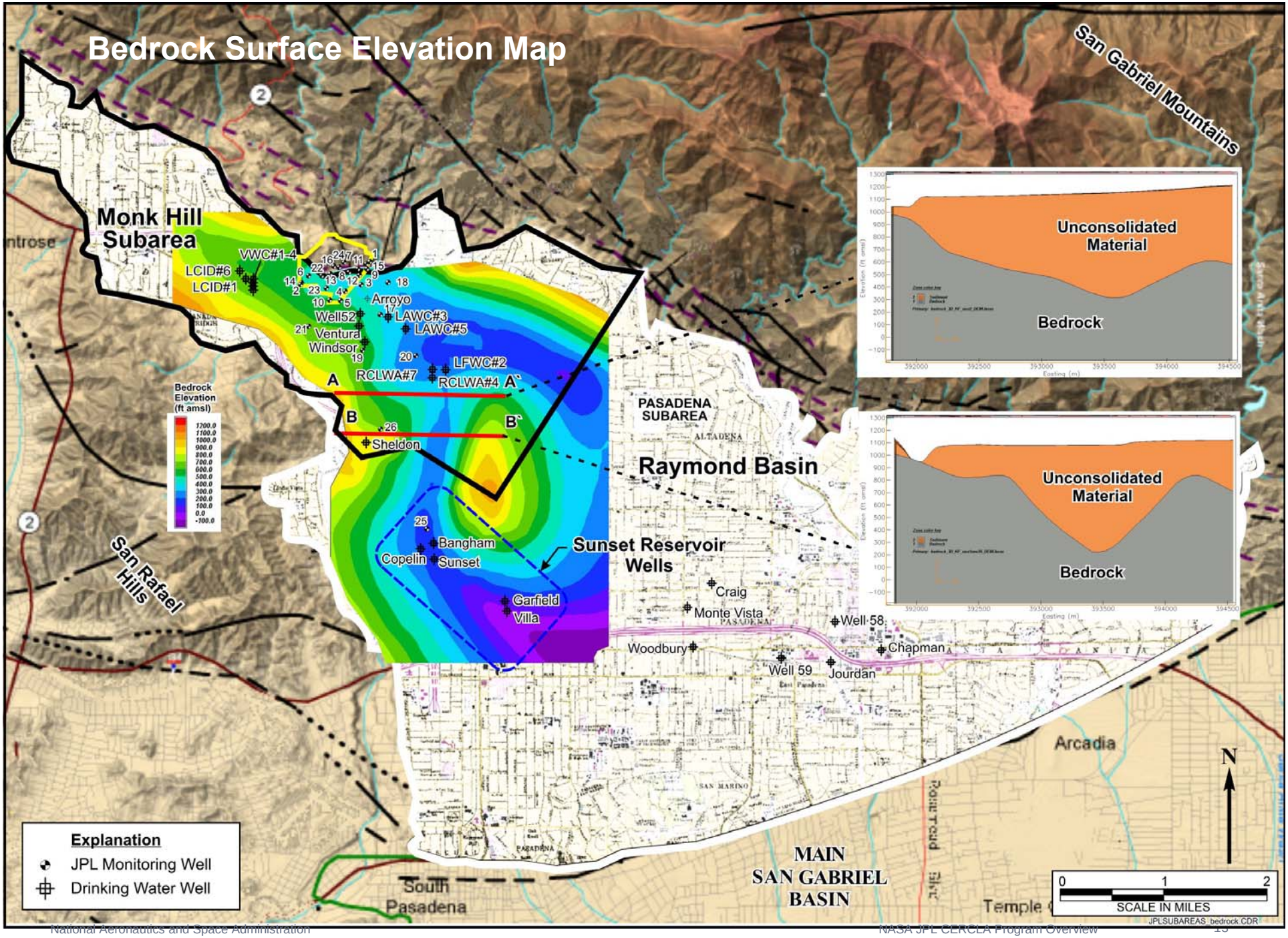
- As part of the Additional Investigation, the average extraction rates between 1960 and 2000 were used to evaluate capture zones. This is believed to be the most appropriate given the release timeframe and estimated travel times.
  - » Perchlorate used during testing at JPL in the mid-1940s and 1950s.
  - » Travel from seepage pits to groundwater estimated to be at least 7 years.
  - » Travel in groundwater over 2,500 feet to Arroyo Well estimated to be at least 11 years.
- Pumping records show consistent and significant pumping by Monk Hill Subarea production wells since the 1960s.

Annual Pumping from Monk Hill Subarea Wells

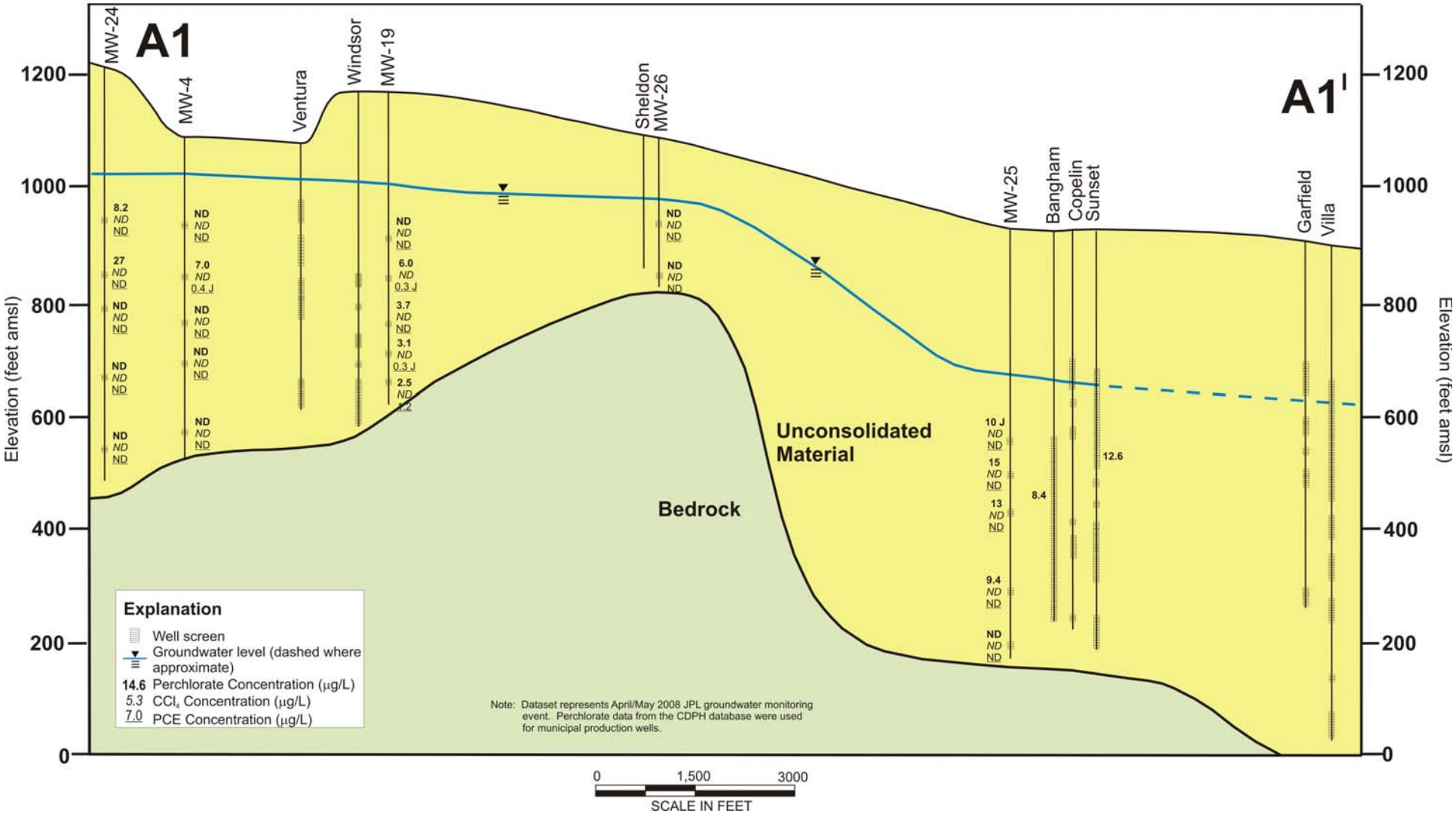


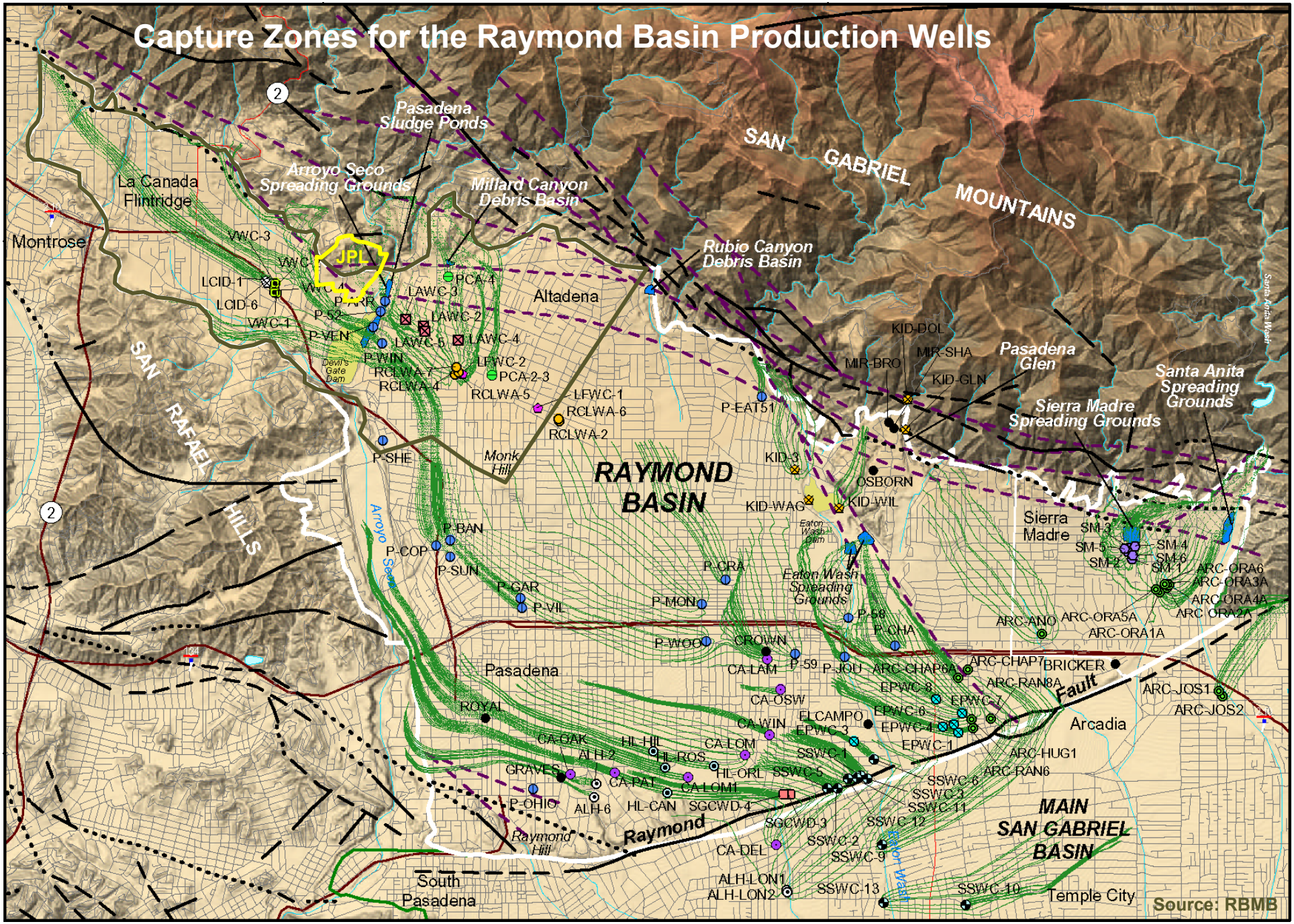
General Comment No. 1 (Cont.)

- Preferential pathways and lateral anisotropy:
  - » Recognize that preferential pathways exist at the site at a relatively small scale.
  - » At the scale of our study, bulk flow drives our understanding of chemical transport.
- Pumping and the bedrock surface are primary factors influencing groundwater flow.


Bedrock Surface Elevation Map
San Gabriel Mountains
Monk Hill Subarea
VWC#1-4
LCID#6
LCID#1
Arroyo
Well52
LAWC#3
LAWC#5
Ventura
Windsor
LFWC#2
RCLWA#7
RCLWA#4
A
A`
B
B`
Sheldon
Bedrock Elevation (ft amsl)
PASADENA SUBAREA
Raymond Basin
Bangham
Copelin
Sunset
Sunset Reservoir Wells
Carfield
Villa
Craig
Monte Vista
Well 58
Woodbury
Chapman
Well 59
Jourdan
San Rafael Hills
Arcadia
MAIN SAN GABRIEL BASIN
South Pasadena
Temple
Unconsolidated Material
Bedrock
Explanation
JPL Monitoring Well
Drinking Water Well
N
0
1
2
SCALE IN MILES
JPLSUBAREAS_bedrock.CDR

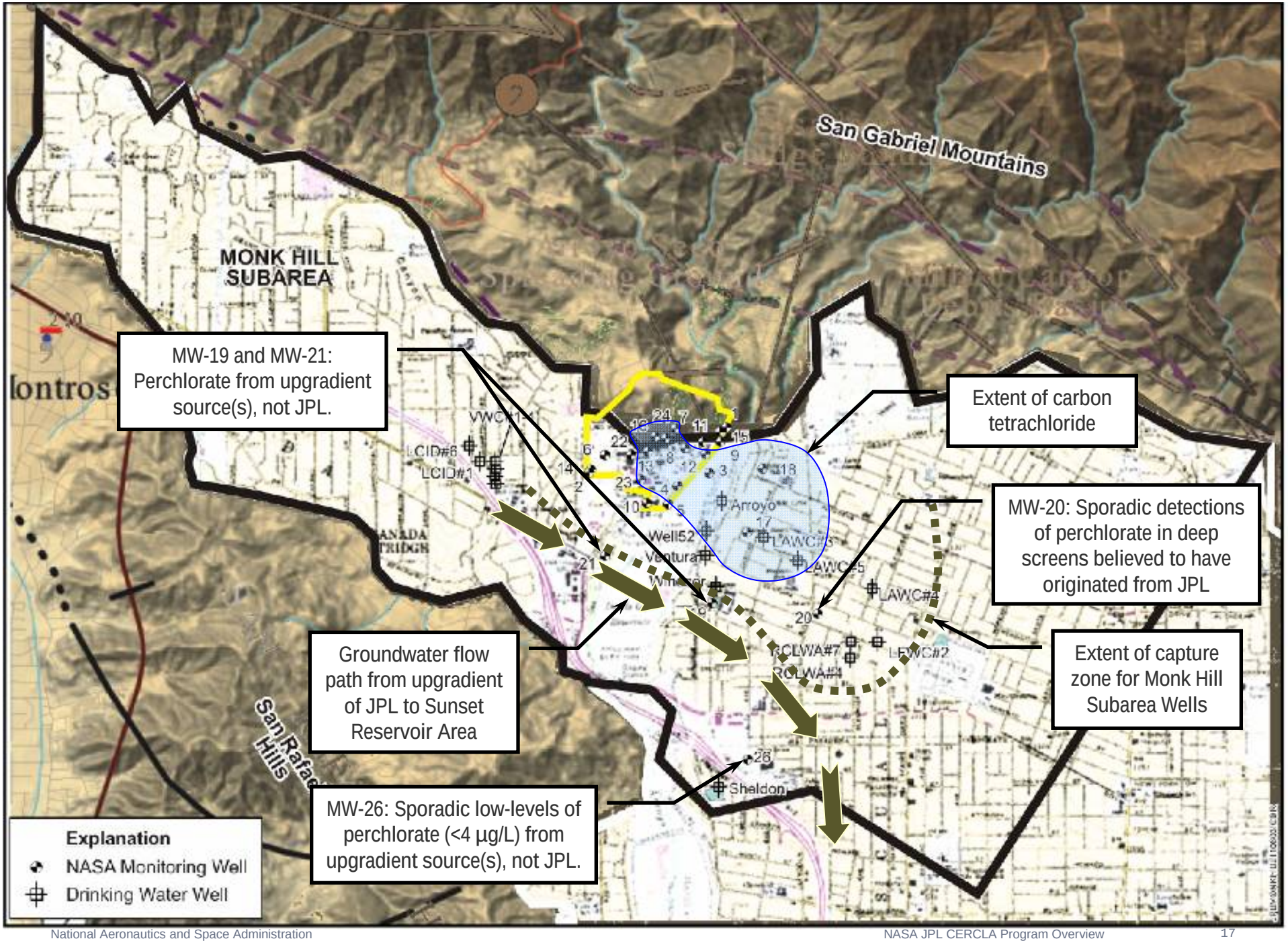
Cross-Section: JPL Source Area to Sunset Reservoir Area




Capture Zones for the Raymond Basin Production Wells
Pasadena Sludge Ponds
Arroyo Seco Spreading Grounds
Millard Canyon Debris Basin
Rubio Canyon Debris Basin
SAN GABRIEL MOUNTAINS
La Canada Flintridge
Montrose
JPL
Altadena
SAN RAFAEL HILLS
Devil's Gate Dam
Monk Hill
RAYMOND BASIN
Arroyo Seco
Pasadena Glen
Santa Anita Spreading Grounds
Sierra Madre Spreading Grounds
Sierra Madre
Eaton Wash Dam
Eaton Wash Spreading Grounds
Pasadena
ROYAL
Raymond Hill
Raymond Fault
Arcadia
MAIN SAN GABRIEL BASIN
South Pasadena
Temple City
Source: RBMB

General Comment No. 2: Leading Edge of the Perchlorate Plume

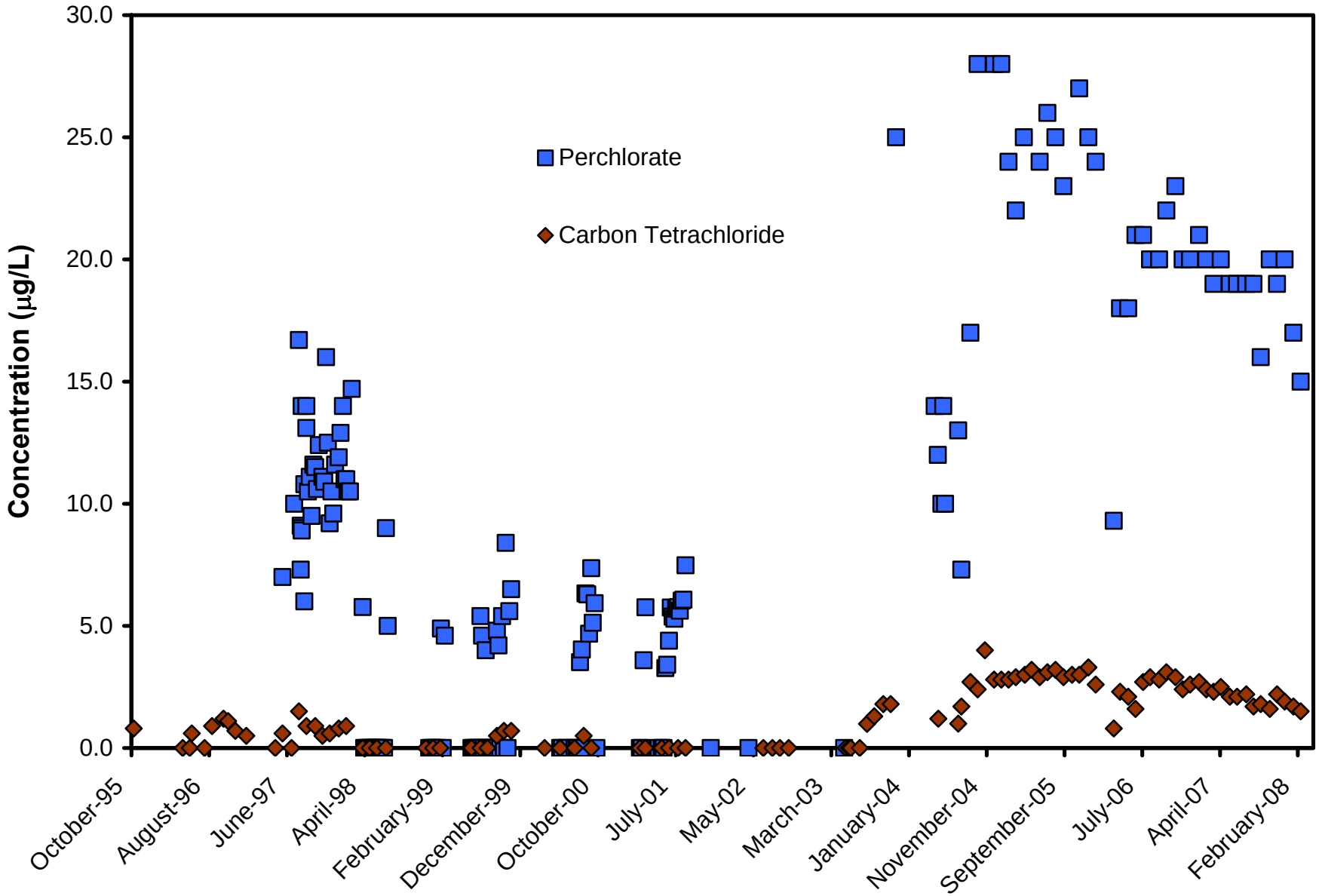
- MW-20 – sporadic detections in the Screen 4 in 1998, 2002, 2003, and 2008 believed represent the furthest migration of perchlorate originating from JPL. Groundwater modeling indicates that MW-20 is within the capture zone of the RCLWA wells.
- MW-21 and MW-19 bound plume south of JPL. Perchlorate detected in these wells is from cross-gradient sources.
- MW-26 Screen 1 (located half way in between JPL and the Sunset Reservoir wells)
  - » No perchlorate detected April 2005 through September 2007; April 2008
  - » October/December 2007 = 2.7 µg/L; PCE too
  - » January/February 2008 = 3.2 µg/L; PCE too
  - » Shallow detection and co-location of PCE is consistent with sources upgradient of JPL (i.e., La Cañada-Flintridge) and with groundwater modeling.
- MW-26 Screen 2 – No perchlorate detected April 2005 through April 2008
- Conclusion – JPL chemicals contained within the Monk Hill Subarea


San Gabriel Mountains
MONK HILL SUBAREA
MW-19 and MW-21: Perchlorate from upgradient source(s), not JPL.
Extent of carbon tetrachloride
MW-20: Sporadic detections of perchlorate in deep screens believed to have originated from JPL
Groundwater flow path from upgradient of JPL to Sunset Reservoir Area
Extent of capture zone for Monk Hill Subarea Wells
MW-26: Sporadic low-levels of perchlorate (<4 µg/L) from upgradient source(s), not JPL.
LCID#8
LCID#1
Arroyo
Well52
Ventura
LAWC#4
Sheldon
Explanation
NASA Monitoring Well
Drinking Water Well

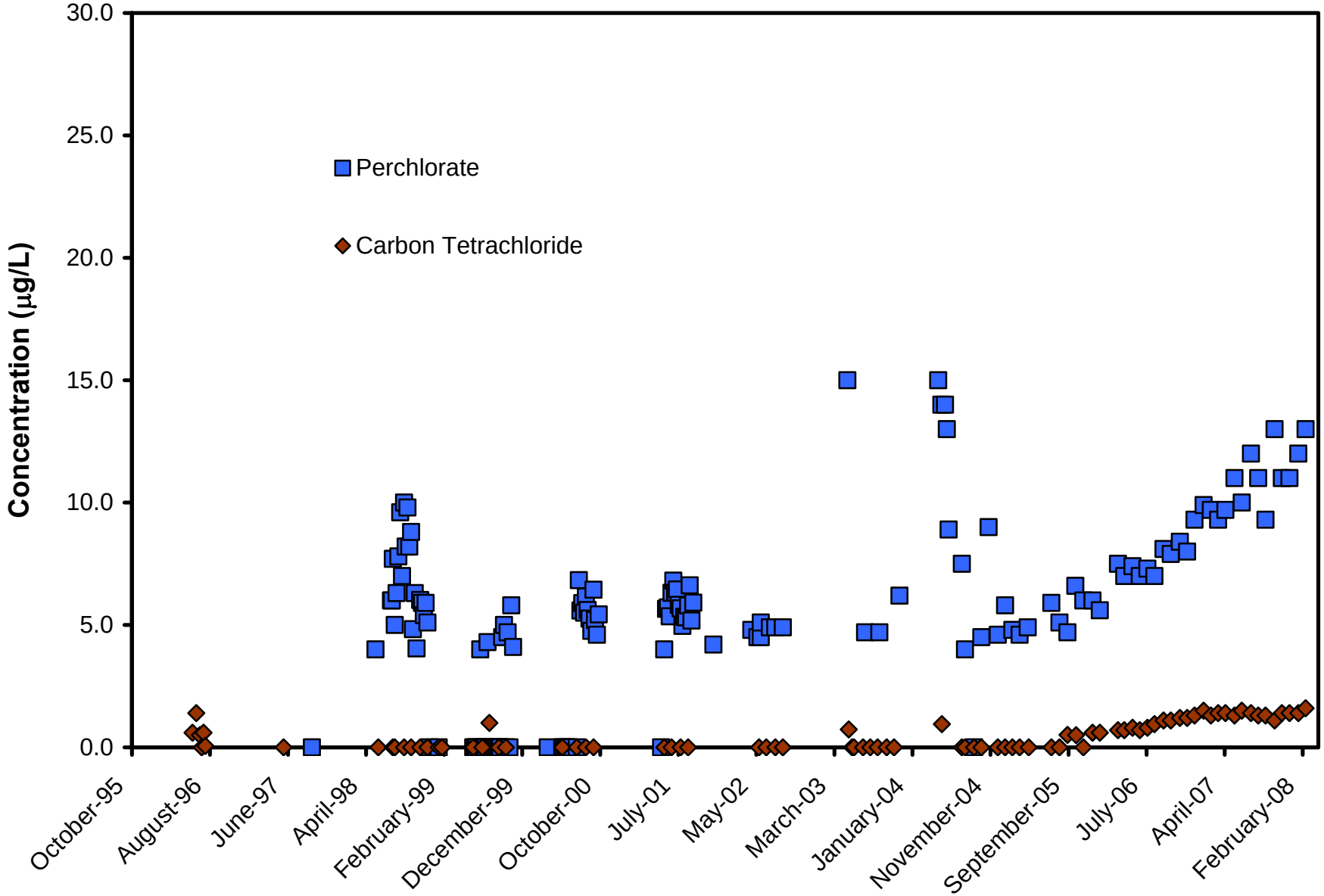
General Comment No. 3: Applicability of Carbon Tetrachloride as a Tracer

- Carbon tetrachloride is a primary targeted chemical at the JPL site. The only known source of carbon tetrachloride in the Monk Hill Subarea groundwater is associated with the JPL facility.
- A strong correlation between perchlorate and carbon tetrachloride is observed at the JPL source area and as far downgradient as the LAWC wells, located approximately one mile from JPL.
- Understanding the extent of carbon tetrachloride strengthens our understanding JPL's perchlorate plume because the carbon tetrachloride data support the groundwater modeling results and our understanding capture zones.

Carbon Tetrachloride and Perchlorate at LAWC#3



Carbon Tetrachloride and Perchlorate at LAWC#5



General Comment No. 4: Redox Conditions of the Aquifer

- Bulk of data suggest aerobic conditions in aquifer
  - » Elevated DO and ORP >100 mV (except deeper screens in MW-20)
  - » General absence of ferrous iron
  - » Elevated concentrations of nitrate and perchlorate
  - » Lack of dechlorination compounds (e.g., cis-1,2-DCE, VC)
  - » Perchlorate isotope data do not suggest perchlorate degradation
- The presence of chloroform alone can not be used to indicate anaerobic degradation of carbon tetrachloride since chloroform is a compound used during historic laboratory operations and a disinfection byproduct.

General Comment No. 5: Isotope Data Eliminating JPL as a Contributor to Perchlorate at Sunset

- There are many different sources of perchlorate

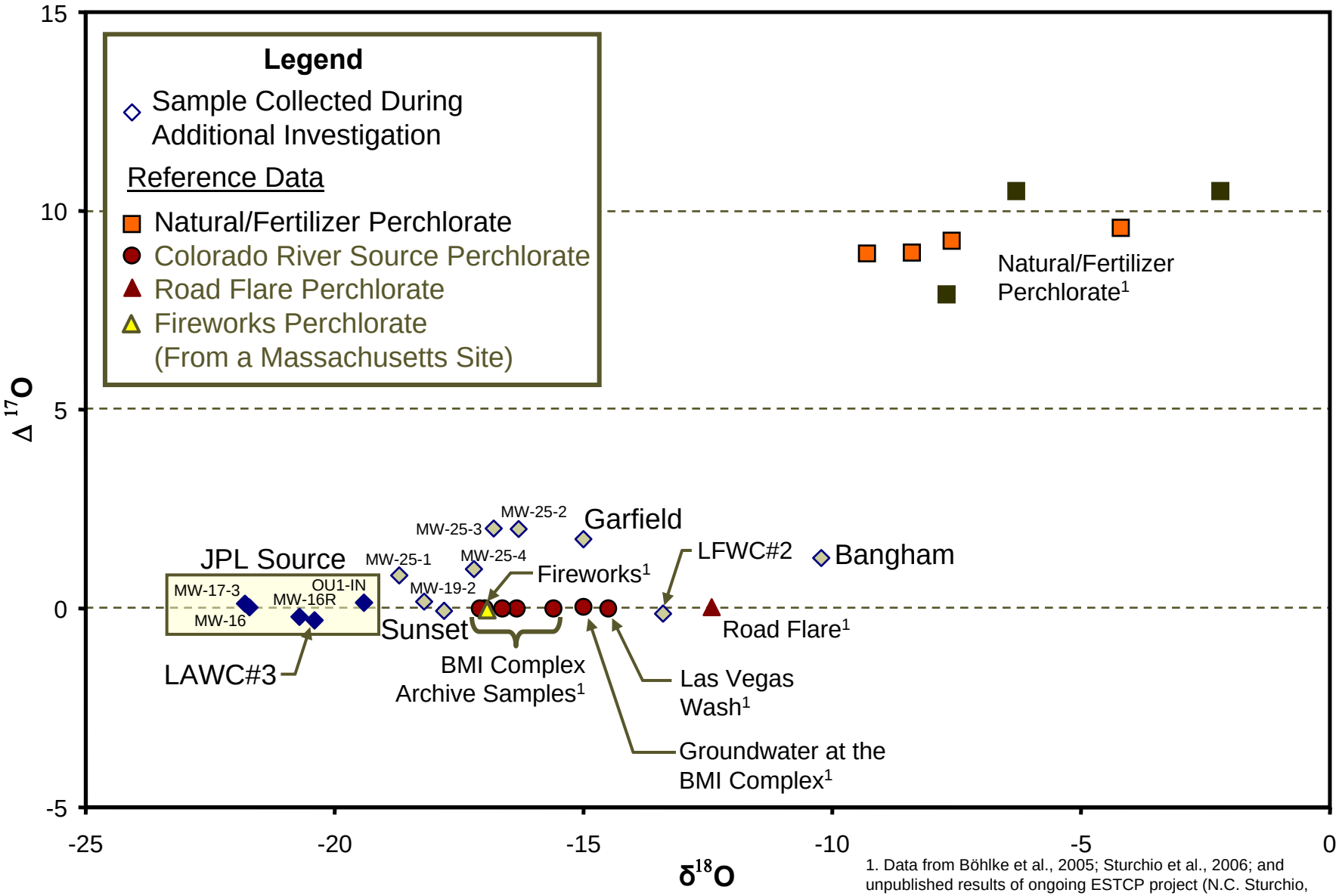
  (including solid rocket propellant, road flares, fireworks, blasting operations, and naturally occurring mineral deposits used for fertilizer production)

- Naturally occurring perchlorate and different synthetic sources of perchlorate have unique isotopic fingerprints.
- In 2005 and 2006, NASA analyzed samples for perchlorate isotopes from seven monitoring well locations, the influent of the OU-1 treatment plant, and five production wells, including three of the five Sunset Reservoir wells.
- Analysis was performed under the direction of Professor Neil Sturchio, Ph.D., University of Illinois at Chicago.

General Comment No. 5 (Cont.)

- Perchlorate isotope data collected from three of the five Sunset Reservoir wells: Garfield Well, Bangham Well, and Sunset Well
- Garfield Well and Bangham Well
  - » Perchlorate isotopic signature is significantly different from JPL perchlorate and can not be explained by mixing of JPL perchlorate and other sources
  - » Both show a contribution of natural/fertilizer perchlorate
- Sunset Well
  - » Perchlorate isotopic signature of Sunset Well and MW-19-2 are indistinguishable
  - » MW-19 is a JPL monitoring well that we know a lot about, including that the source of perchlorate in this well did not originate from JPL based on groundwater modeling, carbon tetrachloride data, and geochemical data

Perchlorate Isotopes Results



1. Data from Böhlke et al., 2005; Sturchio et al., 2006; and unpublished results of ongoing ESTCP project (N.C. Sturchio, personal communication).

Well	Distance From JPL Source Area (Feet)	Tools Applied: Groundwater Geochemistry	Tools Applied: Groundwater Modeling	Tools Applied: Groundwater Chemical Data	Perchlorate Isotope Results	Conclusion
MW-16	0	○	□	◇	△	JPL Source
MW-17-3	3,000	○	□	◇	△	JPL Source
LAWC#3	3,500	○	□	◇	△	JPL Source
LFWC#2	7,800	●	■	◆	▲	Non-JPL Source
Bangham Well	15,500	●	■	◆	▲	Non-JPL Source
Sunset Well	16,000	●	■	◆	▲	Non-JPL Source
Garfield Well	21,000	●	■	◆	▲	Non-JPL Source
MW-19-2	4,000	●	■	◆	▲	Non-JPL Source
MW-25	15,000	●	■	◆	▲	Non-JPL Source
MW-21	3,000	●	■	◆	NA	Non-JPL Source

JPL Source
- ○ Type 1 Water
- □ Located downgradient and within the flow path of chemicals originating from JPL based on JPL and RBMB Groundwater Models.
- ◇ Co-located carbon tetrachloride (JPL tracer) and perchlorate in groundwater samples.
- △ Perchlorate isotopic fingerprint consistent with JPL source

Non-JPL Source
- ● Type 3 or more direct mixing with Colorado River Water, sulfate
- ■ Not located in the flow path of chemicals originating from JPL on JPL and RBMB Groundwater Models.
- ◆ No carbon tetrachloride (JPL tracer) detected in groundwater samples.
- ▲ Perchlorate isotope fingerprint indicates non-JPL source(s).

Conclusion

The investigation employed the use of four different analytic tools. Taken together, the results of the groundwater chemistry, groundwater modeling, groundwater chemical concentration data and groundwater monitoring, and isotopic analysis, lead to the conclusion that (1) we have determined that the chemicals from the JPL facility are captured within the Monk Hill Subarea, and, (2) the perchlorate detected at the Sunset area wells is of a different origin than that used at, and originating from, JPL.

NASA

NDS