NASA Jet Propulsion Laboratory (JPL) Remedial Project Manager (RPM) Meeting
April 30, 2013 Meeting Summary

Location: JPL Building 180 (9th Floor Conference Room), Pasadena, California
Date/Time: April 30, 2013 / 9:00 AM Pacific

Attendees (Sign-In Sheet Provided as Attachment No. 1):

<table>
<thead>
<tr>
<th>Name</th>
<th>Affiliation</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colleen Oinuma</td>
<td>Congressman Adam Schiff</td>
<td>Field Representative</td>
</tr>
<tr>
<td>Bryan Urias</td>
<td>Congresswoman Judy Chu</td>
<td>Field Representative</td>
</tr>
<tr>
<td>Steven Slaten</td>
<td>NASA</td>
<td>NASA JPL Program Manager</td>
</tr>
<tr>
<td>Merrilee Fellows</td>
<td>NASA</td>
<td>Manager for Community Involvement</td>
</tr>
<tr>
<td>Judy Huang</td>
<td>EPA Region 9</td>
<td>Remediation Project Manager</td>
</tr>
<tr>
<td>William Jeffers</td>
<td>California DTSC</td>
<td>Remediation Project Manager</td>
</tr>
<tr>
<td>Alice Campbell</td>
<td>California DTSC</td>
<td>Senior Geologist</td>
</tr>
<tr>
<td>Kwang Lee</td>
<td>California RWQCB</td>
<td>Sr. Water Resources Control Engineer</td>
</tr>
<tr>
<td>Chay Tang</td>
<td>California RWQCB</td>
<td>Remediation Project Manager</td>
</tr>
<tr>
<td>Karen Wong</td>
<td>California DPH</td>
<td>Associate Sanitary Engineer</td>
</tr>
<tr>
<td>Kelly Gardner</td>
<td>Raymond Basin Management Board</td>
<td>Administration Manager</td>
</tr>
<tr>
<td>Nina Jazmadarian</td>
<td>Foothill Municipal Water District</td>
<td>General Manager</td>
</tr>
<tr>
<td>Robert Hayward</td>
<td>Lincoln Avenue Water Company</td>
<td>General Manager</td>
</tr>
<tr>
<td>Shan Kwan</td>
<td>Pasadena Water and Power (PWP)</td>
<td>Assistant General Manager</td>
</tr>
<tr>
<td>David Kimbrough</td>
<td>PWP</td>
<td>Water Quality Manager</td>
</tr>
<tr>
<td>Brad Boman</td>
<td>PWP</td>
<td>Engineering Manager</td>
</tr>
<tr>
<td>Gary Takara</td>
<td>PWP</td>
<td>Principal Engineer</td>
</tr>
<tr>
<td>Roumiana Voutchkova</td>
<td>PWP</td>
<td>Engineer</td>
</tr>
<tr>
<td>Aileen Hermoso</td>
<td>PWP</td>
<td>Principal Analyst</td>
</tr>
<tr>
<td>Bill Mabey</td>
<td>TechLaw (EPA Contractor)</td>
<td>Consultant</td>
</tr>
<tr>
<td>Steve Johnson</td>
<td>Stetson (RBMB Contractor)</td>
<td>Consultant</td>
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<tr>
<td>Mark Williams</td>
<td>WMI (PWP Contractor)</td>
<td>Consultant</td>
</tr>
<tr>
<td>Dennis Williams</td>
<td>Geoscience (PWP Contractor)</td>
<td>Consultant</td>
</tr>
<tr>
<td>Neil Sturchio*</td>
<td>UIC (NASA Contractor)</td>
<td>Professor of Geochemistry</td>
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<tr>
<td>David Conner</td>
<td>Battelle (NASA Contractor)</td>
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<tr>
<td>Ben Headington</td>
<td>Battelle (NASA Contractor)</td>
<td>Consultant</td>
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<tr>
<td>Keith Fields</td>
<td>Tidewater (NASA Contractor)</td>
<td>Consultant</td>
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* Participated via teleconference

Summary:
- Following introductions, Steve Slaten the NASA JPL Program Manager presented an update on the JPL CERCLA Program. The presentation slides are provided as Attachment No. 2.
- Mr. Slaten’s presentation included the following:
  - A brief history of the JPL facility and CERCLA program.
  - The status of ongoing treatment efforts for the source area treatment system, the Monk Hill Treatment System (MHTS), and the Lincoln Avenue Water Company (LAWC) Treatment System.
  - NASA’s plans and rationale for expediting cleanup and improving remediation effectiveness for offsite groundwater treatment (referred to as Optimization plans),
including installing a new well for the City of Pasadena for the MHTS, installing a new well for LAWCA, and improvements to wastewater management at MHTS associated with groundwater cleanup efforts.

- A summary of NASA’s Additional Investigation efforts associated with determining the extent of contamination associated with the JPL CERCLA site, in particular, the occurrence of perchlorate in the Sunset Reservoir Wells (2004 to present). Based on an integrated evaluation of all available data/evidence including consideration of comments received, NASA continues to conclude that (1) the chemicals from the JPL facility are captured within the Monk Hill Subarea, and (2) the perchlorate detected at the Sunset Reservoir Wells is of a different origin than that used at, and originating from, JPL.

- NASA’s recommended path forward for the groundwater remediation at the JPL CERCLA Site, which includes moving forward with the optimization efforts and moving toward a final groundwater Record of Decision (ROD) for JPL. The first step in moving toward the ROD is a Focused Feasibility Study (FS) that will be submitted for regulator and stakeholder review this summer.

  - Judy Huang stated EPA’s position regarding perchlorate in the Sunset Reservoir Wells. Specifically:
    - EPA has thoroughly reviewed the May and August 2012 Technical Memoranda prepared by PWP and the Technical Responses to the PWP memoranda prepared by NASA.
    - The studies by NASA and PWP are inconclusive.
    - The studies by NASA and PWP do not indicate that the Sunset Reservoir Wells should be part of the JPL CERCLA Site at this time. Even if NASA were a contributor to perchlorate as the Sunset Reservoir Wells, the contribution would be minimal.
    - EPA recommends that NASA moves forward with the optimization plans and the final groundwater remedy.
    - As part of the final groundwater remedy, EPA recommends that NASA continue monitoring wells between JPL and the Sunset Reservoir Wells (e.g., MW-26 and MW-25). If future data demonstrate NASA is a source of perchlorate in the Sunset Reservoir Wells, NASA would be required to address the contamination.
    - Data will be evaluated, at a minimum, as part of the CERCLA Five-Year Reviews for JPL. The JPL regulators and local water purveyors would be part of the review process for the Five-Year Reviews.

- David Kimbrough provided a presentation on PWP’s studies regarding the perchlorate in Sunset Reservoir Wells. The presentation slides are provided as Attachment No. 3.
  - PWP has concluded that there was not containment of perchlorate originating from JPL within the Monk Hill Subarea and that NASA is the source of perchlorate in the Sunset Reservoir Wells.
  - Some discussion occurred regarding the interpretation of data by NASA and PWP, options for funding removal of perchlorate from the Sunset Reservoir Wells outside of the JPL CERCLA Program (e.g., EPA grant programs), and potential impacts of a revised perchlorate MCL.
  - Steve Johnson mentioned RBMB’s concern that if perchlorate continues to migrate downgradient from the Sunset Reservoir Area, additional drinking water production wells could be impacted.

- The meeting was concluded and a site tour was offered to interested attendees.
• Shan Kwan and David Kimbrough accompanied Steve Slaten on a tour of the source area treatment plant.
• Note: All slides, including backup slides prepared by PWP but not used during the meeting, will be posted on the JPL CERCLA Program Website (http://jplwater.nasa.gov/).
Attachment No. 1

Sign-In Sheet
Ailene Hermosa
Steve Johnston
Kelly Gardner
Mark Williams
Dennis Williams
Karen Wong
Ben Heedington

NAME
Colleen Oinuma
David Kimbrough
Brad Boman
Robert Hayward
Bryan Urias
Bill Mooney
Judy Huang
Chay Tang
Kwang Lee
Shan Kwan
Roukiana Vehvikova
Gary Takara

ORGANIZATION
NASA Consultant/TIDEWATER
Congressman Adam Schiff
PWP
LA WWC - RBMB
Rep. Judy Chu
Consult TZ EPA
US EPA
LARWACB
LA RWACB
Pasadena
PWP - 626-744-4486
PWP

STETSON/RBMB
RBMB
WMI / PWP
GEOSCIENCE / PWP
Calif. Dept of Public Health
NASA Consultant/Battelle

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614-424-5489
<table>
<thead>
<tr>
<th>NAME</th>
<th>ORG</th>
<th>Contact</th>
</tr>
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<tbody>
<tr>
<td>William Jeffers, P.E.</td>
<td>California DTSC</td>
<td><a href="mailto:william.jeffers@dtsc.ca.gov">william.jeffers@dtsc.ca.gov</a>, 818-717-6586</td>
</tr>
<tr>
<td>Alice Campbell, PG, CTg</td>
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<td><a href="mailto:alice.campbell@dtsc.ca.gov">alice.campbell@dtsc.ca.gov</a>, 818 717 6623</td>
</tr>
<tr>
<td>Nina Jazmadarian</td>
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<td><a href="mailto:njazmadarian@fmwd.com">njazmadarian@fmwd.com</a>, 818 790-4036</td>
</tr>
<tr>
<td>David Corner</td>
<td>Battelle</td>
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</tr>
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<td>Steve Slaten</td>
<td>NASA</td>
<td><a href="mailto:ssslaten@nasa.gov">ssslaten@nasa.gov</a>, 818 393 6683</td>
</tr>
<tr>
<td>Merrilee Fellows</td>
<td>NASA</td>
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Attachment No. 2

Steve Slaten’s Presentation Slides
NASA Jet Propulsion Laboratory
CERCLA Program

April 30, 2013 RPM Meeting

Meeting Agenda
(1) Introductions
(2) Background
(3) Status of Treatment
(4) Optimization Concepts
(5) Sunset Reservoir Wells
(6) Site Tour

Introductions
• Opportunity for the team to meet our two new State RPMs
  » William Jeffers (Department of Toxic Substances Control)
  » Chay Tang (Regional Water Quality Control Board)
• Other agencies represented:
  » Congress member Chu’s Field Rep, Bryan Urias
  » Congress member Schiff’s Field Rep, Colleen Oinuma
  » EPA Region 9
  » California Department of Public Health
  » City of Pasadena, Pasadena Water and Power and consultants
  » Lincoln Avenue Water Company
  » Raymond Basin Management Board and consultants
  » Foothill Municipal Water Company
  » NASA and consultants
In the 1930s and during the years of World War II, the area that is now JPL was a site for testing some of the first rockets.
CERCLA Program Milestones

- 1936 – First rocket firings in the Arroyo Seco, at the site later to become JPL
- December 1958 – NASA takes over control of JPL from the Army
- 1958 to 1963 – Seepage pits backfilled and sanitary sewer system installed
- 1980 – TCE and carbon tetrachloride detected in Pasadena’s Arroyo Well
- 1990 – NASA funds water treatment plant to remove VOCs from four City of Pasadena production wells (Arroyo Well, Well 52, Ventura Well, and Windsor Well)
- October 1992 – JPL placed on the National Priorities List (NPL)
- 1992 – NASA funds water treatment plant to remove VOCs from two Lincoln Avenue Water Company (LAWC) production wells (LAWC#3 and LAWC#5)
- 1997 – Perchlorate detected in Arroyo Well (which is then shut down)
- 2002 – Pasadena shuts down Well 52, Ventura Well, Windsor Well, Sunset Well, Bangham Well, and Copelin Well due to perchlorate
- 2004 – NASA funds 2,000 gpm ion exchange system at LAWC to remove perchlorate

CERCLA Program Milestones (Cont.)

- 2005 – NASA completed construction of a source area treatment system to address the highest levels of perchlorate and VOCs within the JPL fenceline
- 2007 – NASA completed expansion of the source area treatment system
- August 2007 – Final Interim Record of Decision for OU-3 Groundwater, including the Monk Hill Treatment System (MHTS)
- July 2011 – Completed construction of the MHTS, operation begins
- February 2012 – Completed the First Five-Year Review for the JPL CERCLA Site
Community Outreach

- **Merrilee Fellows** – NASA Manager for Community Involvement
- Conducted numerous public meetings and community information sessions
- Prepared numerous mailings and annual summaries that have been distributed to our mailing list. Relatively recent community outreach items:
  - Five-Year Review Fact Sheet
  - 2012 Year in Review
- Frequently interact with and respond to questions from the media and community members
- Updated the Community Involvement Plan in August 2006
- Update/Maintain the JPL CERCLA Program Website ([http://jplwater.nasa.gov](http://jplwater.nasa.gov))
OU-1 Operational Summary  
(January 2005 Through March 2013)

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<tr>
<th>Parameter</th>
<th>Units</th>
<th>Result</th>
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<tr>
<td>Total Volume of Groundwater Extracted</td>
<td>ac-ft</td>
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<td>Mass of Perchlorate Removed</td>
<td>lbs</td>
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<tr>
<td>Mass of CCl₃ Removed</td>
<td>lbs</td>
<td>35.1</td>
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<tr>
<td>Mass of TCE Removed</td>
<td>lbs</td>
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- First Quarter 2013 groundwater monitoring report to be submitted in May.
- Semi-annual OU-1 progress report to be submitted in May.

Source Area Treatment System – Perchlorate Removal
LAWC Treatment System

**Ion Exchange**
- USFilter Model HP1200DS
- Hi-Flow System

**Liquid-Phase Granular Activated Carbon**
- Calgon Carbon Model 12 Adsorption Systems

**Bag Filter**
- Hayward Maxline MBF0802HE
- Filter Vessel

**Explanation**
- Pump
- Valve
- Sampling Port
- Chlorine
- Olive Sump

Note: The Liquid-Phase Granular Activated Carbon removes volatile organic compounds from the water.
LAWC Operational Summary
(July 2004 Through March 2013)

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<tr>
<td>Total Volume of Groundwater Extracted</td>
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<tr>
<td>Mass of Perchlorate Removed</td>
<td>lbs</td>
<td>896</td>
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<tr>
<td>Mass of CCl₄ Removed</td>
<td>lbs</td>
<td>79</td>
</tr>
<tr>
<td>Mass of TCE Removed</td>
<td>lbs</td>
<td>121</td>
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- NASA funds LAWC to operate system via a legal agreement
- Annual progress report to be submitted in May
Monk Hill Treatment System

Disinfection System Building

Existing Windsor Wall

Disinfection System Building

Treatment Vessels (18)

Treatment Pad

Filtration System

Simplified Process Flow Diagram

Extraction Wells (4) 7,000 gpm

Booster Pumps

Perchlorate Removal

VOC Removal

Clean Water

Granular Activated Carbon

Windsor Res.

National Aeronautics and Space Administration
MHTS Operational Summary
(January 2011 Through March 2013)

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<td>Mass of CCl₄ Removed</td>
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<tr>
<td>Mass of TCE Removed</td>
<td>lbs</td>
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- NASA funds PWP to operate system via a legal agreement
- Annual progress report to be submitted in May
Optimization Concepts

- **November 2012**: Initiated a Project to Evaluate Optimization Concepts That Would Expedite Cleanup and Improve Effectiveness
- Identified Three Potential Optimization Concepts:
  - New LAWC Well – Enhanced Leading-Edge Containment, Operational Flexibility
  - New MHTS Well – Enhanced Mid-Plume Capture, Operational Flexibility
  - Wastewater Management Improvements at MHTS – Incorporate Storage Capacity of Behner Treatment Plant
- Technical Memoranda Prepared to Document Conceptual Design and Implementation Requirements – Developed in Coordination with PWP and LAWC
- Met with CDPH on March 19 to Introduce Projects
- Introduced Projects to RBMB on April 17
Sunset Reservoir Wells

• 2004 – NASA prepares a work plan to conduct an Additional Investigation associated with perchlorate in the Sunset Reservoir Wells. Plan approved by EPA and State agencies, in consultation with PWP.

• 2005 to 2006 – NASA conducts the Additional Investigation to evaluate the occurrence of perchlorate in the Sunset Reservoir Wells, including installation of two additional monitoring wells (MW-25 and MW-26), groundwater monitoring, groundwater modeling, and a state-of-the-art perchlorate isotope study (working with Dr. Neil Sturchio, University of Illinois, Chicago).

• January 2007 – NASA submitted the Additional Investigation Technical Memorandum summarizing the integrated findings from the four lines of evidence. NASA concludes that (1) the chemicals from the JPL facility are captured within the Monk Hill Subarea, and (2) the perchlorate detected at the Sunset Reservoir wells is of a different origin than that used at, and originating from, JPL.

• NASA met with PWP and separately with the RPMs to present findings, and encouraged technical discussions associated with perchlorate in the Sunset Reservoir Wells.

Sunset Reservoir Wells (Cont.)

• December 2008 – NASA responds to all comments received from EPA, DTSC, and PWP on the Additional Investigation

• October 2009 – Pasadena contractor, Geoscience submits, a technical report.

• January 2010 – NASA responds to the Geoscience technical report, providing comments and recommendations.

• February 2010 – During a teleconference on technical aspects of modeling results, NASA, PWP, and EPA conclude that Geoscience did not provide sufficient analysis in their groundwater modeling results to substantiate their interpretations. PWP and Geoscience initially agreed to re-run their model with appropriate particle release locations. PWP ultimately decided not to pursue this additional analysis, citing the expense.

• NASA provided all the JPL Groundwater Model source files to PWP and Geoscience, and offered to run the additional modeling analysis for PWP using the Geoscience Model if their source files were provided.
**Sunset Reservoir Wells (Cont.)**

- NASA decides to submit AI findings to outside peer review for publication.
- 2011-2012 – NASA responds to all requests from PWP for data related to the Additional Investigation.
- May 2012 and August 2012 – PWP submits additional technical memoranda to EPA prepared by a PWP staff member, David Kimbrough, Ph.D.
- NASA thoroughly evaluates findings and has Dr. Neil Sturchio re-evaluate the perchlorate and geochemical data considering PWP’s technical memoranda. Dr. Sturchio concludes, “The opinions of PWP are found to be based on flawed assumptions and incogent arguments leading to erroneous and unfounded conclusions regarding the origin of perchlorate in the Sunset Reservoir wells.”
- September 2012 – NASA thoroughly evaluated and provided a technical response to the PWP memoranda. NASA again concludes based on all available data/evidence that (1) the chemicals from the JPL facility are captured within the Monk Hill Subarea, and, (2) the perchlorate detected at the Sunset Reservoir wells is of a different origin than that used at, and originating from, JPL.

**Path Forward**

- Recommend Concurrently Moving Forward with the Following:
  - Optimization Work Plan for the Three Optimization Projects
  - Focused Feasibility Study (First Step in Moving Toward a Final Groundwater Remedy)
- Final Groundwater Remedy:
  - Combine the Two Existing Interim Remedies/RODs for OU-1 and OU-3 into a Single Final Groundwater Remedy
  - Will Require a Focused Feasibility Study, Proposed Plan and Record of Decision (by June 2015)
  - Continue Monitoring Groundwater, Including MW-25 and MW-26
  - Evaluate All Available Data at the Next Five-Year Review (2017)
- Planning to Submit the Focused Feasibility Study in May
Attachment No. 3

David Kimbrough’s Presentation Slides
Sunset Reservoir Wells Investigation
Presented by
David Kimbrough, Ph.D., Water Quality Manager

Presented to
United States Environmental Protection Agency
at the Jet Propulsion Laboratories, Pasadena

April 30, 2013

Jet Propulsion Laboratory
Pasadena Water and Power

Figure 3.4. Potential Historic Chemical Waste Disposal Locations
Today’s Question
Pasadena Water and Power

• Is Water Flowing from JPL which Contains VOCs and Perchlorate Confined in the Monk Hill Sub-Basin?
• Or has this Water Moved into the Pasadena Sub-Basin and is Contaminating the Sunset Reservoir Wells?
• Was there Containment Between 1940 and Today?

Modeled Flows in the Raymond Basin

Figure 2. Particle tracking simulations using the independently-developed REMB Model indicate that capture zones of the Sunset Reservoir Wells are south of the JPL Facility.
Figure R3. The southern extent of the JPL perchlorate plume is defined by MW-19, MW-20, MW-21, and MW-26; therefore, it is contained within the Monk Hill Subarea. Groundwater modeling and carbon tetrachloride data corroborate our understanding of extent of JPL perchlorate.
Testing the Two Hypotheses

- No CTC
- Low ClO$_4$
- High NO$_3$

- CTC
- High ClO$_4$
- Low NO$_3$

Testing Containment

Pasadena Water and Power

- If the Containment Hypothesis is Correct, the Water in the Sunset Reservoir Wells Should Resemble the Water in the La Cañada – Flintridge area.
- If the Non-Containment Hypothesis is Correct, then the Water in the Sunset Reservoir Wells Should be a Blend of water from the La Cañada – Flintridge area, the San Gabriel Mountains, and JPL.
Median Concentrations of ClO₄ and NO₃ from Raymond Basin Wells 1985 - 2011

Sampling & Production Wells

NO₃ mg/L
LCID, VWC, LAWC, PWP - DPH Records
NASA Records
Median Perchlorate in Different Sample Locations in the Raymond Basin

<table>
<thead>
<tr>
<th>Well Locations</th>
<th>LCID</th>
<th>VWC</th>
<th>MW-14</th>
<th>MW-21</th>
<th>MW-19</th>
<th>MW-25</th>
<th>Sunset</th>
<th>Monk Hill</th>
<th>JPL</th>
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<tbody>
<tr>
<td>NASA &amp; DPH Data</td>
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Median Nitrate Concentrations in Different Sample Locations in the Raymond Basin

<table>
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<tr>
<th>Well Locations</th>
<th>LCID</th>
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</tbody>
</table>
Median Nitrate Concentrations in Different Sample Locations in the Raymond Basin

<table>
<thead>
<tr>
<th>Well Locations</th>
<th>LCID</th>
<th>NO_3 mg/L (as NO_3^-)</th>
<th>ClO_4^- μg/L</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MW-19</td>
<td>20</td>
<td>10</td>
</tr>
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<td>MW-25</td>
<td>40</td>
<td>100</td>
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<tr>
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<td>Sunset</td>
<td>80</td>
<td>1000</td>
</tr>
<tr>
<td></td>
<td>JPL</td>
<td>100</td>
<td>10000</td>
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NASA & DPH Data
Conclusions

Pasadena Water and Power

The Only Reasonable Explanation of this data is that the Water in Sunset Reservoir Wells is a Blend of Water from LCF, JPL, and the SGMs.

There was no Containment
Sunset Reservoir Wells Investigation
Chlorate (ClO$_3$)

Presented by
David Kimbrough, Ph.D., Water Quality Manager

Presented to
United States Environmental Protection Agency
April 30, 2013

Chlorate (ClO$_4$)

- Samples are Routinely Collected for Chlorate at MHTS and the Upgradient Monitoring Wells.
- Additional Samples were Collected from other Sites
  - Valley Water Co.
  - Sunset Reservoir Wells
  - Eastside Wells
Chlorate (ClO₃) in the Raymond Basin

VWC 330 - 420
Sunset Res. 122 - 246
Monk Hill 111 - 258
JPL On-Site <1 - 240
JPL Off-Site 18 - 680

Chlorate in the Monk Hill Sub-Basin

MW-19-2 680
MW-18-4 18
Arroyo 111
MW-17-3 230
Ventura 358

Figure 2. Particle tracking simulations using the independently-developed RBMB Model indicate that capture zones of the Sunset Reservoir Wells are south of the JPL Facility.
Conclusions

Pasadena Water and Power

- Samples from the La Cañada – Flintridge area have Chlorate Concentrations much Higher than in the Sunset Reservoir Wells but Lower Concentrations of Fluoride.
- Samples from JPL have Much Lower Concentrations of Chlorate than the Sunset Reservoir Wells.
- Samples from the Monk Hill Sub-Basin have Higher Concentrations of Fluoride than the LCF area.
- The Amount of Chlorate and Fluoride found in Sunset Reservoir Wells Indicates that the Majority of Water Comes from JPL.