Final

Travis Air Force Base
Environmental Restoration Program
Remedial Program Manager's
Meeting Minutes

19 May 2010, 0930 Hours

Mr. Mark Smith, Travis Air Force Base (AFB), conducted the Remedial Program Manager's (RPM) meeting on 19 May 2010 at 0930 in the Main Conference Room, Building 571, Travis AFB, California. Attendees included:

• Glenn Anderson	Travis AFB
• Lonnie Duke	Travis AFB
• Mark Smith	Travis AFB
• Gregory Parrott	Travis AFB
• Merrie Schilter-Lowe	Travis AFB
• Brian Sassaman	Travis AFB
• Dezso Linbrunner	United States Army Corp of Engineers (USACE), Omaha District
• Jose Salcedo	California Department of Toxic Substances Control (DTSC)
• Mary Snow	Tech Law, Inc.
• Rachel Hess	ITSI
• Doug Berwick	CH2M HILL
• Mike Wray	CH2M HILL

Handouts distributed at the meeting and presentations included:

• Attachment 1	Meeting Agenda
• Attachment 2	Master Meeting and Document Schedules
• Attachment 3	SBBGWTP Monthly Data Sheet (April 2010)
• Attachment 4	CGWTP Monthly Data Sheet (April 2010)
• Attachment 5	Presentation: 2010 Field Installations Update
• Attachment 6	Presentation: Comparison of ISCO and ERD
• Attachment 7	Presentation: Phytostabilization Study Report
• Attachment 8	Presentation: Program Update: Activities Completed, In progress and Upcoming

1. ADMINISTRATIVE

A. Previous Meeting Minutes

The 22 April 2010 RPM meeting minutes were approved and finalized as written.

B. Action Item Review

Action items from April were reviewed.

Action item one still open.

Action item two still open. Mr. Chang asked for the time frame for completion. Mr. Wray said early July.

Action item three has been closed.

Master Meeting and Document Schedule Review (attachment 2)

The Travis AFB Master Meeting and Document Schedule was discussed during this meeting (see Attachment 2).

Travis AFB Annual Meeting and Teleconference Schedule

— The next RPM meeting will be 23 June 2010.

Travis AFB Master Document Schedule

— Focused Feasibility Study (FFS): No change. Mr. Chang voiced his concern about not having enough data to support 2012 RIP goal. EPA would like to see four quarters (one year) of EVO injection data to make sure that the EVO will not create unwanted breakdown products.

— Proposed Plan (PP): No change in dates.

— Groundwater Record of Decision (ROD): No change.

— Comprehensive Site Evaluation Phase II: This is new document and new to the schedule.

— Potrero Hills Annex: (FFS, PP, and ROD): No change.

— Union Creek Sites SD001 and SD033 Remedial Action Report: No Change.

— Natural Attenuation Assessment Report (NAAR): Dates have been updated based on the results of the teleconference with EPA, CH2M HILL and Travis AFB.

— DP039 RPO Work Plan: EPA is reviewing Travis' response to EPA comments.

— FT005 Data Gap Work Plan: Move to historical.

— SD036/SD037 RPO Work Plan: No changes.

— ST027B Site Characterization Report: No changes.

— Phytostabilization Study Report: Dates were changed due to the amount of revisions Travis made to the initial document. The team that conducted the study was not familiar with Travis AFB document style.

— Quarterly Newsletter (July 2010): Dates changed to reflect the July quarterly Newsletter deadlines.

— 2009 GWTP RPO Annual Report: No changes.

— 2008-2009 CAMU Monitoring Annual Report: Added the document to the schedule. According to the original CAMU design, the lysimeter needed to be monitored for one year. Based on concerns over the lysimeter's performance, the base needs to take the necessary steps to remove the lysimeter from the CAMU cap.

2. CURRENT PROJECTS

Treatment Plant Operation and Maintenance Update

Mr. Duke reported on the water treatment plant status.

South Base Boundary Groundwater Treatment Plant (see Attachment 3)

The South Base Boundary Groundwater Treatment Plant (SBBGWTP) performed at 97.3% uptime, (downtime was to replace a pump at an extraction well at SS029), and 4.3 million gallons of groundwater were extracted and treated during the month of April 2010. All of the treated water was discharged to Union Creek. The average flow rate for the SBBGWTP was 100 gallons per minute (gpm) and electrical power usage was 18,960 kWh; 26,000 pounds of CO_2 was created (based on DOE calculation). Approximately 1.2 pounds of volatile organic compounds (VOCs) were removed in April. The total mass of VOCs removed since the startup of the system is 379 pounds (see Attachment 3).

Central Groundwater Treatment Plant (see Attachment 4)

The Central Groundwater Treatment Plant (CGWTP) performed at 90.1% uptime with approximately 1.79 million gallons of groundwater extracted and treated during the month of April 2010. All treated water was diverted to the storm drain. The average flow rate for the CGWTP, while operating, was 44.5 gpm and electrical power usage was 16,044 kWh for all equipment connected to the Central plant; approximately 22,000 pounds of CO_2 was created. Natural gas usage for the ThOx was 1,286 therms. Approximately 8.01 pounds of VOCs were removed from groundwater, and 4.42 pounds from vapor, in April. The total mass of VOCs removed since the startup of the system is 11,178 pounds (see Attachment 4).

The ThermOx unit was taken off-line on 22 April 2010 and moth-balled for long-term storage. Mr. Duke said that this action will result in a significant reduction in the generation of green house gasses. Mr. Smith mentioned we would need to get rid of the ThermOx unit at some point, once the new solar-powered bioreactor has proven its ability to remediate the SS016 solvent source area.

Mr. Smith asked what was using 12,000 kWh at the WTTP. Mr. Duke explained it is due to a large eductor pump motor that originally provided the operating pressure for 25 eductors; when first installed, it was cheaper than to run electricity to extraction wells on a per-well basis. The WTTP is now operating 12 eductor wells. The unit design does not allow for energy savings when the number of wells in the network is decreased.

North Groundwater Treatment Plant is still off line waiting for the vernal pool at Site LF007C to dry up.

3. Presentations

2010 Field Installations Update (see Attachment 5)

Mr. Wray reported on the 2010 Field Installations Update.

The key points made in the presentation include:

Site DP039

- Install three new monitoring wells to complete the performance-monitoring network, for a total of fifteen wells (six monitoring well pairs and three injection wells). Need to install two more MWs when the ground dries out.
- Install thirteen EVO injection wells across the plume. Nine have been installed, waiting for the ground to dry before the remaining four can be installed.
- Approximately 25,000 lb of EVO will be injected to form the biobarrier, scheduled for June.
- Baseline sampling is scheduled for May for the existing wells, and June for the new wells.
- Prepare a completion report after the EVO injection is finished.
- Evaluate ongoing progress in GSAP reports.

Site SS016

- The Therm/Ox unit has been removed and is in long-term storage. One dual completion monitoring well is planned to be installed at the former location of the Therm/Ox unit.

- A bioreactor will be installed in the Wash Rack area to remove a large mass of VOCs down to below the bedrock surface – the excavation will be approximately 20ft by 20ft by 20ft (and more likely 25ft deep).
- The existing horizontal extraction well (EW03x16) will be tied into the bioreactor for recirculation. The existing horizontal extraction well pumps about 1 ½ gallons per minute, which is ideal for these conditions.
- Received analytical results from the five new monitoring wells (see results on map/attached).
- Canopy removal and bioreactor installation is scheduled for June/July.

Site SS030

- Maximize groundwater extraction. Restart EW03x30 (complete).
- Monitor groundwater levels and TCE concentrations.
- Determine if additional monitoring and/or extraction wells are needed to capture TCE plume. The annual GSAP event is currently in progress. Once the data has been received, a decision on optimization of the SS030 GET system will be made.

Site SD036

- The hot spot has been defined; need to develop an EVO injection plan.
- Conduct remedy optimization, followed by implementation of performance monitoring.
- Prepare completion report after EVO injection.

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Site SD037

- Conduct baseline sampling in May. Inject 36,000 lbs of EVO into the seven injection wells. Attached map shows monitoring, extraction, and injection wells and the TCE concentration levels associated with each well.
- Initiate performance monitoring of the remedy optimization.
- Injection of 36,000 lbs of EVO is scheduled for June.

Site SS015

- Contaminant plume of TCE originated from three former facilities in the vicinity of building 554.
- In 1997 a treatability study of enhanced MNA using vegetable oil (soybean oil, not emulsified vegetable oil). The injection system was only able to place 150 gallons into the subsurface.
- Source area Chemicals of Concern (COCs) were affected by the vegetable oil treatability study. TCE, PCE, and cis1,2-DCE concentrations decreased in the source area from 2004 to 2007. The COCs rebounded from 2007 through 2009. Vinyl Chloride concentrations are increasing.
- Elevated cis1,2-DCE and Vinyl Chloride confirm that ERD was working

and that the biological component of natural attenuation can be effectively enhanced at the site. Rebound of TCE and PCE indicate that insufficient vegetable oil remains to complete the degradation process.

- The plume appears to be slowly migrating eastward.
- Investigate extent of VOCs in the source area and downgradient by installing monitoring wells. Mr. Wray pointed to the map (see attached) where the monitoring wells (three rounds) have been installed.
- Evaluate investigation results and report findings.

Comparison of In Situ Chemical Oxidation (ISCO) and Enhanced Reductive Dechlorination (ERD) (see attachment 6)

Mr. Berwick reported on the Comparison of ISCO and ERD. Please see attachment 6 for details.

Travis AFB has used Pump-and-Treat systems at most of the sites on the base. Pump and Treat works well at first; the plumes start shrinking, until asymptotic conditions are reached and the system becomes less and less effective. Then further steps are needed to make more progress with the cleanup.

ISCO and ERD are both technologies that can further the remediation process at Travis AFB. Each technology has its strengths and weaknesses.

ISCO involves injecting an oxidizing reagent into the treatment area. Some of the oxidizing agents are: Fentons Reagent, Persulfate, Permanganate, and Ozone. Permanganate lasts the longest and is a relatively mild oxidant. All these oxidizers can rust anything that is not stainless steel or glass. All of these agents require direct contact with the contamination.

ERD can be accomplished by injecting emulsified vegetable oil (EVO) which provides nutrients to naturally occurring bacteria, which in turn creates a reducing environment. The oil coats the surface area of the soil. It does not directly remediate contamination; it enhances the bacterial environment in the treatment zone.

Benefits of ISCO include

- Rapid contamination reduction.
- Easy to distribute.
- Distribution is easy to confirm.
- Byproducts of ISCO not persistent beyond treatment zone.
- Can be effective on DNAPL if good contact is established.
- Can persist in treatment zone for more than three months.

Benefits of EVO include

- EVO will last for years.
- Easy to distribute.
- Distribution is easy to confirm.
- Byproducts of EVO (e.g. vinyl chloride) degrade beyond treatment zone.
- Minimal environmental impact.
- Food-grade material poses no health and safety risks
- Relatively inexpensive

Disadvantages of ISCO

- High contaminant rebound likely in diffusion-limited contamination zones.
- High soil oxidant demand can require additional oxidant mass.
- Highly toxic byproducts (e.g. selenium, arsenic).
- Strong oxidizers necessitate stringent health and safety requirements.
- Relatively high cost for manufactured chemicals.

Disadvantages of EVO

- Remediation time on the order of years.
- Strong aerobic conditions will initially inhibit development of reducing environment.
- Byproducts include reduced metals (manganese, iron), vinyl chloride.
- Does not directly affect DNAPL sources.

Travis AFB site conditions are predominantly silt and clay alluvium on top of bedrock; with few small sand intervals. A soil sample was collected at Site SD036 to analyze for 'soil oxidant demand' and the results came back high. Permanganate was used in 5%, 10% and 30% solutions. In other words, the soil has a high oxidant demand, so a large volume of reagent will be required just to satisfy that demand – before any contaminants are oxidized. Mr. Wray added that if we used permanganate it would oxidize the soil before it would oxidize the contaminants. Source areas are diffusion limited (which typically means it will rebound to where it was before) and the contamination has diffused into clays and silts.

Travis AFB is a better candidate for ERD via EVO injection. EVO is more suited for slow, diffusion limited processes, and will continue to remediate for years.

Mr. Chang asked why not use both technologies, ISCO and EVO, getting faster results. He added that Travis needs to consider clean up time. Mr. Berwick answered because of the soil conditions at Travis with the sand and clay layers. Once you inject ISCO it takes care of the TCE in the sand but it just fills back up again with TCE coming from the clay. You will have to just keep injecting which will run into a lot of money. EVO is more cost effective and conducive to the lithology at Travis AFB. Mr. Chang asked how often you would have to inject EVO. Mr. Berwick said the general rule of thumb is every 3 to 5 years. Mr. Wray added that is why we installed injection wells at these sites. We can go back and re-inject if needed. Mr. Salcedo asked how

will you monitor/control daughter product of vinyl chloride. Mr. Wray said the plan is to inject a lot of EVO to attack TCE and vinyl chloride. Ms. Snow asked how do you know how much EVO to inject. Mr. Berwick answered it depends on the contaminant concentration and the area of distribution from the injection well, and you use the one which is greater.

Phytostabilization Study Report (see attachment 7)

Mr. Anderson gave a presentation on 'Lessons learned on Phyto-remediation, can it be used to reach RIP'. This project was started twelve years ago. At the time there wasn't much literature on the type of tree for use in this type of application. The objective was to contain and control the contaminant migration or at least retard the migration. Mr. Anderson used a map to show where the Phytostabilization site is located, known as Site DP039. Travis used Red Iron Bark Eucalyptus trees. The phytostabilization treatability study evaluated several mechanisms for the trees to remove TCE from the subsurface: Leaf Flux, Trunk Flux and Soil Flux. Samples were collected at different times during the growing season. The attachment shows the analytical results for each of the sample types and locations. Mr. Anderson said the trees are responding well to the conditions they live in.

Program Update: Activities Completed, In Progress and Upcoming (see attachment 8)

4. New Action Item Review

There were no new action items.

5. PROGRAM/ISSUES/UPDATE

None.

6. Potential Response To Comments Meetings

General Discussion

Mr. Chang said he was briefing EPA's new attorney, Sarah Goldsmith for the Travis program. Ms. Goldsmith gave Mr. Chang an email she received from Suzanne Leith. The email is regarding the WABOU SOIL ROD; the Travis team decided to defer some issues to the final Base Groundwater ROD. One of the deferred issues was Potrero Hills which Mr. Chang knows and is familiar with. Other issues include the

active Skeet Range and Reservoir Facilities 1514/1518 . Mr. Anderson said the skeet range is still active. Reservoir Facilities 1514/1518 is currently having construction right now. The hydrofluosilicic acid tank, since removed, at that site leaked and resulted in fluoride in the groundwater. Mr. Chang said he didn't need to know right now, just wanted to keep it in their radar.

7. Action Items

Item #	Responsible	Action Item Description	Due Date	Status
1.	Travis AFB	Review CAMU design to determine if lysimeter is a regulatory requirement.	19 May 2010	Open
2.	Travis AFB	Schedule a RAB tour at site SS016 for when the bioreactor is being installed.	Open	Provide 30 days notice to RAB members for tour.
3.	Travis AFB	Schedule a teleconference on MNA with EPA.	Done	Completed

TRAVIS AIR FORCE BASE
ENVIRONMENTAL RESTORATION PROGRAM
REMEDIAL PROGRAM MANAGER'S MEETING
BLDG 570, Main Conference Room
19 May 2010, 9:30 P.M.
AGENDA

1. ADMINISTRATIVE

   A. PREVIOUS MEETING MINUTES
   B. ACTION ITEM REVIEW
   C. MASTER MEETING AND DOCUMENT SCHEDULE REVIEW

2. CURRENT PROJECTS

   A. TREATMENT PLANT OPERATION AND MAINTENANCE UPDATE (LONNIE)

3. PRESENTATIONS

   A. 2010 FIELD WORK UPDATE
   B. COMPARISON OF ISCO AND ERD
   C. PHYTOSTABILIZATION STUDY REPORT (GLENN)
   D. PROGRAM UPDATE: ACTIVITIES COMPLETED, IN PROGRESS AND UPCOMING

4. NEW ACTION ITEM REVIEW

5. PROGRAM/ISSUES/UPDATE

6. POTENTIAL RESPONSE TO COMMENTS MEETINGS
   DP039 REMEDIAL PROCESS OPTIMIZATION WORK PLAN

Travis AFB Master Document Schedule

Annual Meeting and Teleconference Schedule

Monthly RPM Meeting (Begins at 9:30 a.m.)	RPM Teleconference (Begins at 9:30 a.m.)	Restoration Advisory Board Meeting (Begins at 7:00 p.m.) (Poster Session at 6:30 p.m.)
01-27-10	—	—
—	—	—
03-30-10	—	—
04-22-10 *(1:00 PM)	—	04-22-10
05-19-10	—	—
06-23-10	—	—
07-21-10	—	—
08-25-10	—	—
09-22-10	—	—
10-21-10 *(1:00 PM)	—	10-21-10
—	11-17-10	—
12-08-10	—	—

* RPM meeting moved to coincide with the RAB meeting.

Travis AFB Master Document Schedule

PRIMARY DOCUMENTS			
Life Cycle	**Basewide Groundwater**		
	Focused Feasibility Study **Travis, Glenn Anderson** **CH2M Hill, Loren Krook**	**Proposed Plan** **Travis, Glenn Anderson** **CH2M HILL, Loren Krook**	**Record of Decision** **Travis, Glenn Anderson** **CH2M HILL, Tony Jaegel**
Scoping Meeting	**03-30-10**	NA	**01-24-07**
Predraft to AF/Service Center	06-30-10	12-08-10	06-08-11
AF/Service Center Comments Due	07-14-10	01-03-11	06-22-11
Draft to Agencies	07-28-10	01-10-11	07-06-11
Draft to RAB	07-28-10	01-10-11	07-06-11
Agency Comments Due	09-27-10	03-09-11	08-31-11
Response to Comments Meeting	**10-21-10**	**03-23-11**	09-22-11
Agency Concurrence with Remedy	NA	NA	09-29-11
Public Comment Period	NA	03-31-11 to 04-27-11	NA
Public Meeting	**NA**	***04-21-11**	**NA**
Response to Comments Due	11-18-10	06-14-11	10-27-11
Draft Final Due	11-18-10	06-14-11	10-27-11
Final Due	12-20-10	07-14-11	11-24-11

*Public meeting to coincide with RAB meeting.

PRIMARY DOCUMENTS	
	Comprehensive Site Evaluation Phase II **Travis AFB, Glenn Anderson** **Sky Research, Ian Roberts**
Life Cycle	**Report**
Scoping Meeting	**NA**
Predraft to AF/Service Center	04-23-10
AF/Service Center Comments Due	05-04-10
Draft to Agencies	07-05-10
Draft to RAB	07-05-10
Agency Comments Due	08-06-10
Response to Comments Meeting	**08-11-10**
Agency Concurrence with Remedy	NA
Public Comment Period	NA
Public Meeting	**NA**
Response to Comments Due	08-20-10
Draft Final Due	08-20-10
Final Due	09-23-10

PRIMARY DOCUMENTS				
	Potrero Hills Annex Travis, Glenn Anderson			Union Creek Sites SD001 &SD033 Remedial Action Travis, Lonnie Duke ITSI, Rachel Hess
Life Cycle	FFS	**Proposed Plan**	**ROD**	**Completion Report**
Scoping Meeting	**180 days after Water Board Order Rescinded**	**+470 days**	**+735 days**	**NA**
Predraft to AF/Service Center	+ 270 days	+530 days	+ 915 days	01/06/10
AF/Service Center Comments Due	+ 300 days	+560 days	+ 975 days	02/05/10
Draft to Agencies	+330 days	+590 days	+ 1035 days	03/30/10
Draft to RAB	+ 330 days	+590 days	+ 1035 days	03/30/10
Agency Comments Due	+390 days	+650 days	+ 1095 days	06/01/10
Response to Comments Meeting	**+ 405 days**	**+665 days**	**+ 1110 days**	**06/23/10**
Agency Concurrence with Remedy	NA	NA	+ 1130 days	NA
Public Comment Period	NA	+735 to 765 days	NA	NA
Public Meeting	**NA**	**+745 days**	**NA**	**NA**
Response to Comments Due	+430 days	+695days	+ 1190 days	07/21/10
Draft Final Due	+430 days	+695 days	+ 1190 days	07/21/10
Final Due	+460 days	+725 days	+ 1250 days	08/20/10

SECONDARY DOCUMENTS		
Life Cycle	**Natural Attenuation Assessment Report Travis AFB, Glenn Anderson CH2M HILL, Leslie Royer**	**DP039 RPO Work Plan Travis AFB, Glenn Anderson CH2M HILL, Loren Krook**
Scoping Meeting	**NA**	**NA**
Predraft to AF/Service Center	07-07-09	09-17-09
AF/Service Center Comments Due	07-21-09	10-01-09
Draft to Agencies	08-26-09	10-11-09
Draft to RAB	08-26-09	10-11-09
Agency Comments Due	10-15-09	11-13-09 (01-27-10)
Response to Comments Meeting	**05-13-10 (Teleconference w/EPA)**	**04-22-10**
Response to Comments Due	02-02-10 (06-03-10)	05-26-10
Draft Final Due	NA	NA
Final Due	06-03-10	06-02-10
Public Comment Period	NA	NA
Public Meeting	**NA**	**NA**

SECONDARY DOCUMENTS			
Life Cycle	**SD036/SD037 RPO Work Plan Travis AFB, Lonnie Duke CH2M HILL, Loren Krook**	**ST027B Site Characterization Report Travis AFB, Lonnie Duke CH2M HILL, Gavan Heinrich**	**Phytostabilization Study Report Travis AFB, Glenn Anderson Parsons, Bill Plaehn**
Scoping Meeting	**NA**	**NA**	**10-09-08**
Predraft to AF/Service Center	08-13-09	02-23-10	04-12-10
AF/Service Center Comments Due	08-27-09	03-08-10	04-30-10
Draft to Agencies	10-01-09	03-29-10	05-27-10
Draft to RAB	10-01-09	03-29-10	05-27-10
Agency Comments Due	11-02-09 (01-27-10)	04-28-10	06-29-10
Response to Comments Meeting	**TBD**	**05-19-10**	**07-07-10**
Response to Comments Due	TBD	05-26-10	07-14-10
Draft Final Due	NA	NA	NA
Final Due	TBD	05-26-10	07-14-10
Public Comment Period	NA	NA	NA
Public Meeting	**NA**	**NA**	**NA**

INFORMATIONAL DOCUMENTS			
Life Cycle	**Quarterly Newsletters (July 2010) Travis, Glenn Anderson**	**2009 GWTP RPO Annual Report Travis AFB, Lonnie Duke CH2M HILL, Doug Berwick**	**2008-2009 CAMU Monitoring Annual Report Travis AFB, Lonnie Duke ITSI Rachel Hess**
Scoping Meeting	**NA**	**NA**	**NA**
Predraft to AF/Service Center	NA	03-09-10	11-24-09
AF/Service Center Comments Due	NA	03-30-10	12-24-09
Draft to Agencies	07-05-10	04-28-10	01-27-10
Draft to RAB	NA	04-28-10	03-08-10
Agency Comments Due	07-19-10	05-28-10	03-08-10
Response to Comments Meeting	**TBD**	**06-23-10**	**TBD**
Response to Comments Due	07-21-10	07-14-10	05-19-10
Draft Final Due	NA	NA	NA
Final Due	07-26-10	07-14-10	05-19-10
Public Comment Period	NA	**NA**	**NA**
Public Meeting	**NA**	**NA**	**NA**

HISTORICAL		
Life Cycle	**Phases 1 and 2 Vapor Intrusion Report Travis, Glenn Anderson CH2M HILL, Leslie Royer**	**Vapor Intrusion Assessment Report** Travis, Glenn Anderson CH2M HILL, Leslie Royer**
Scoping Meeting	**NA**	**NA**
Predraft to AF/Service Center	12-08-08	01-04-10
AF/Service Center Comments Due	12-15-08	01-14-10
Draft to Agencies	01-12-09	01-22-10
Draft to RAB	01-12-09	01-22-10
Agency Comments Due	02-17-09	02-26-10
Response to Comments Meeting	**02-25-09**	03-03-10
Response to Comments Due	TBD*	03-25-10
Draft Final Due	NA	NA
Final Due	TBD*	03-25-10
Public Comment Period	NA	NA
Public Meeting	**NA**	**NA**

*The Vapor Intrusion report will be rescheduled to incorporate the Phase 3 data and evaluation per discussion with EPA on 30 March 2009.

**The Vapor Intrusion Assessment Report contains the results of Phases 1, 2, and 3 of the Vapor Intrusion Assessment and a data evaluation. This report complies with the decisions made during the 30 March 2009 EPA-Travis AFB meeting.

HISTORICAL		
Life Cycle	**2008/2009 GSAP Travis AFB, Lonnie Duke CH2M HILL, Leslie Royer**	**FT005 Data Gap Work Plan Travis, Lonnie Duke ITSI, Rachel Hess**
Scoping Meeting	**NA**	**NA**
Predraft to AF/Service Center	10-26-09	10/22/09
AF/Service Center Comments Due	11-09-09	11/20/09
Draft to Agencies	12-07-09	02/05/10
Draft to RAB	12-07-09	02/05/10
Agency Comments Due	01-15-10	03/08/10
Response to Comments Meeting	**01-27-10**	**03/30/10**
Response to Comments Due	04-15-10	04/22/10
Draft Final Due	NA	NA
Final Due	04-15-10	04/22/10
Public Comment Period	**NA**	NA
Public Meeting	**NA**	**NA**

South Base Boundary Groundwater Treatment Plant
Monthly Data Sheet

Report Number: 117 **Reporting Period: 31 March – 30 April 2010** **Date Submitted: 17 May 2010**

This data sheet includes the following: results for the operation of the South Base Boundary Groundwater Treatment Plant (SBBGWTP), a summary of flow rates for the individual extraction wells, a brief description of any shutdowns or significant events related to the system, and a summary of analytical results for selected samples collected.

Operations Summary – April 2010

Operating Time: **724 hours** Percent Uptime: **97.3%**

Electrical Power Usage: **18,960 kWh**

Gallons Treated: **4.3million gallons** Gallons Treated Since July 1998: **686 million gallons**

Volume Discharged to Union Creek: **4.3 million gallons**

VOC Mass Removed: **1.2 pounds**[a] VOC Mass Removed Since July 1998: **379 pounds**

Rolling 12-Month Cost per Pound of Mass Removed[c]: $4,722

Monthly Cost per Pound of Mass Removed[c]: $5,425

[a] Calculated using April 2010 EPA Method SW8260B analytical results.
[b] Costs include operations and maintenance, reporting, analytical laboratory, project management, and utility costs related to operation of the system.
[c] Increased costs are due to annual reporting expenses

Flow Rates

Average Groundwater Total Flow Rate: 100 gpm[a]

Average Flow Rate (gpm)[b]							
FT005[c]				SS029		SS030	
EW01x05	Off line	EW736x05	Off line	EW01x29	0.8	EW01x30	6.1
EW02x05	Off line	EW737x05	Off line	EW02x29	5.4	EW02x30	1.9
EW03x05	Off line	EW742x05	Off line	EW03x29	Off line[d]	EW03x30	1.4
EW731x05	Off line	EW743x05	Off line	EW04x29	4.9	EW04x30	21.6
EW732x05	Off line	EW744x05	Off line	EW05x29	9.7	EW05x30	10.5
EW733x05	Off line	EW745x05	Off line	EW06x29	18.6	EW06x30	Dry
EW734x05	Off line	EW746x05	Off line	EW07x29	17.2	EW711x30	10.0[e]
EW735x05	Off line						
FT005 Total:		**Off line**		**SS029 Total:**	**56.6**	**SS030 Total:**	**51.5**

[a] The average groundwater flow rate was calculated using the Union Creek Discharge Totalizer and dividing it by the operating time of the plant.
[b] Extraction well flow rates are based on the average of the weekly readings.
[c] Extraction wells at FT005 were taken off line in accordance with the *2008 Annual Remedial Process Optimization Report for the Central Groundwater Treatment Plant, North Groundwater Treatment Plant, and South Base Boundary Groundwater Treatment Plant.*
[d] Extraction well is off line due to low VOC concentrations.
[e] Extraction well online, but has a faulty flow meter. Average flow rate is from previous month's readings.

gpm—gallons per minute

Shutdown/Restart Summary

Location	Shutdown		Restart		Cause
	Date	Time	Date	Time	
SBBGWTP	22 April 2010	12:00	23 April 2010	12:00	Replace pump at SS029 EW

SBBGWTP = South Base Boundary Groundwater Treatment Plant

Summary of O&M Activities

Monthly groundwater samples at the SBBGWTP were collected on 1 April 2010. Sample results are presented in Table 1. The total VOC concentration (33.5 µg/L) in the influent sample has decreased since the March 2010 sample (37.6 µg/L) was collected. TCE and cis-1,2-DCE were the only VOCs detected in the influent sample. VOCs were not detected in the effluent sample, indicating good treatment efficiency.

A sample result of 67 J µg/L (estimated) for TPH-diesel was detected in the effluent sample at the SBBGWTP in March 2010. A confirmation sample from the SBBGWTP effluent stream was collected on 19 April 2010, and no TPH-diesel was detected in this confirmation sample. A sample was also collected from the influent process stream during the confirmation sampling event and analyzed for TPH-D. The influent process stream did not contain any detectable amounts of TPH-D.

On 23 April 2010, the pump in extraction well EW05x29 was replaced and returned to service.

Optimization Activities

No optimization activities were performed in April 2010.

Table 1
Summary of Groundwater Analytical Data for April 2010 – South Base Boundary Groundwater Treatment Plant

Constituent	Instantaneous Maximum[a] (µg/L)	Detection Limit (µg/L)	N/C	1 April 2010 (µg/L)	
				Influent	Effluent
Halogenated Volatile Organics					
Bromodichloromethane	5.0	0.15	0	ND	ND
Carbon Tetrachloride	0.5	0.14	0	ND	ND
Chloroform	5.0	0.16	0	ND	ND
Dibromochloromethane	5.0	0.13	0	ND	ND
1,1-Dichloroethane	5.0	0.19	0	ND	ND
1,2-Dichloroethane	0.5	0.15	0	ND	ND
1,1-Dichloroethene	5.0	0.19	0	ND	ND
cis-1,2-Dichloroethene	5.0	0.19	0	1.8	ND
trans-1,2-Dichloroethene	5.0	0.33	0	ND	ND
Methylene Chloride	5.0	0.66	0	ND	ND
Tetrachloroethene	5.0	0.21	0	ND	ND
1,1,1-Trichloroethane	5.0	0.14	0	ND	ND
1,1,2-Trichloroethane	5.0	0.20	0	ND	ND
Trichloroethene	5.0	0.19	0	31.7	ND
Vinyl Chloride	0.5	0.18	0	ND	ND
Non-Halogenated Volatile Organics					
Benzene	1.0	0.17	0	ND	ND
Ethylbenzene	5.0	0.22	0	ND	ND
Toluene	5.0	0.14	0	ND	ND
Xylenes	5.0	0.23 – 0.5	0	ND	ND
Other					
Total Petroleum Hydrocarbons – Gasoline	50	8.5	0	NM	ND
Total Petroleum Hydrocarbons – Diesel	50	50	0	ND	ND
Total Suspended Solids (mg/L)	NE	1.0	0	10 J	NM

[a] In accordance with Appendix B of the *Travis AFB South Base Boundary Groundwater Treatment Plant Operations and Maintenance Manual* (CH2M HILL, 2004).

J = analyte concentration is considered an estimated value
mg/L = milligrams per liter
N/C = number of samples out of compliance with discharge limits
ND = not detected
NE = not established
NM = not measured
µg/L = micrograms per liter

Central Groundwater Treatment Plant Monthly Data Sheet

Report Number: 129 **Reporting Period: 31 March 2010 – 30 April 2010** **Date Submitted: 17 May 2010**

This data sheet includes the following: results for the operation of the Central Groundwater Treatment Plant (CGWTP), West Treatment and Transfer Plant (WTTP), and thermal oxidation (ThOx) system (previously referred to as the two-phase extraction [TPE] system). A summary of flow rates for the CGWTP, WTTP, ThOx, and extraction wells EW01x16, EW02x16, EW03x16, EW605x16, and EW610x16; a brief description of any shutdowns or significant events related to the systems, and a summary of analytical results for selected samples collected are also included on this data sheet.

Operations Summary – April 2010

Operating Time:		Percent Uptime:		Electrical Power Usage:	
CGWTP:	670 hours	**CGWTP:**	90.1%	**CGWTP:**	59 kWh
WTTP:	Water: 668 hours	**WTTP:**	Water: 92.3%	**WTTP:**	12,451 kWh
	Vapor: 0 hours		Vapor: 0%		
ThOx:	298 hours	**ThOx:**	41.4%	**ThOx:**	3,534 kWh

ThOx: Natural Gas Usage: 1,286 therms

Gallons Treated: **1.79 million gallons**

Gallons Treated Since January 1996: **429 million gallons**

VOC Mass Removed:

8.01 lbs (groundwater only)[a]

4.42 lbs (vapor only)[b]

VOC Mass Removed Since January 1996:

2,492 lbs from groundwater

8,686 lbs from vapor

ThOx DRE: 100%

Rolling 12-Month Cost per Pound of Mass Removed: $1,515[c]

Monthly Cost per Pound of Mass Removed: $885 [c]

[a] Calculated using April 2010 EPA Method SW8260B analytical results.
[b] Total VOC vapor mass removed was calculated using EPA Method TO-14 analytical results for the ThOx system.
[c] Costs include operations and maintenance, reporting, analytical laboratory, project management, and electric and natural gas costs related to operation of the system.

DRE = destruction removal efficiency

Flow Rates

Average Groundwater Flow Rate: **44.5 gpm**[a]

Location	Average Flow Rate	
	Groundwater (gpm)[b]	Soil Vapor (scfm)
EW01x16	23.1	NA
EW02x16	6.7	NA
EW03x16	1.1	NA[c]
EW605x16	Off line	NA[c]
EW610x16	Off line	NA[c]
WTTP	11.0 [d]	Off line
ThOx	0.08 [d]	47.6

[a] as measured by the effluent discharge to the storm drain divided by the operating time during the month.
[b] as measured by extraction well totalizer divided by the operating time.
[c] soil vapor was extracted from this well; however, the flow rates are not measured at individual wells at SS016.
[d] as measured by the effluent groundwater pumped to the CGWTP divided by the operating time of the WTTP or ThOx.

gpm = gallons per minute
NA = not applicable/not available
scfm = standard cubic feet per minute

Flow Rates from Wells Sites that Feed into the WTTP

Average Flow Rate from the WIOU, DP039, and LF008 Extraction Wells (gpm)[a]							
SD037/ SD043				SD033/SD034/ DP039		LF008/SD036	
EW599x37	NA	EW705x37	1.1	EW501x33	0.2	EW719x08	Off line[c]
EW700x37	3.3	EW706x37	1.9	EW503x33	0.1	EW720x08	Off line[c]
EW701x37	NA	EW707x37	1.1	EW01x34	0.8	EW721x08	Off line[c]
EW702x37	NA	EW510x37	2.7	EW03x34	0.0	EW593x36	1.0
EW703x37	NA	EW511x37	1.2	EW563x39	Off line[b]	EW594x36	0.5
EW704x37	0.5	EW555x43	0.1	EW782x39	Off line[b]	EW595x36	1.2

gpm—gallons per minute
NA – not available / not recorded

Flow rates for EW599x37, and EW701x37 – EW703x37 were not recorded due to the discovery of leaks within each of these well vaults.

[a] Extraction well flow rates are based on instantaneous readings during April 2010. These rates are not consistent with the overall effluent flow rate from the WTTP to the CGWTP.
[b] Extraction wells were shut off to facilitate the Bioreactor Sustainability Study at Site DP039.
[c] Extraction wells shut off to support a rebound study at Site LF008.

Shutdown/Restart Summary

Location	Shutdown		Restart		Cause
	Date	Time	Date	Time	
CGWTP (Groundwater):					
CGWTP	28 April 2010	11:15			Unscheduled due to Fire Station construction activities
WTTP (Groundwater):					
WTTP	28 April 2010	11:15			Unscheduled due to Fire Station construction activities
WTTP (Vapor):					
WTTP	28 April 2010	11:15			Unscheduled due to Fire Station construction activities
ThOx (Vapor):					
ThOx	22 April 2010	09:15			Disassembled and removed due to upcoming bioreactor installation

CGWTP = Central Groundwater Treatment Plant
WTTP = West Treatment and Transfer Plant
ThOx = Thermal Oxidation System

Summary of O&M Activities

Monthly groundwater and vapor sampling at the CGWTP was performed on 1 April 2010. Groundwater sample results are summarized in Table 1. The total VOC concentration (536.46 µg/L) in the April 2010 CGWTP influent groundwater sample has increased since the March 2010 (375.06 µg/L) sample was taken. No VOCs were detected in the effluent sample.

The leak in the well vault for EW510x37 was repaired in April 2010; however, there are still system leaks in the well vaults for EW599x37, EW701x37, EW702x37, and EW703x37. Pending repair of the leaks found within these well vaults, these wells remained off line. Details on the status of these repairs will be presented in the May 2010 data sheet.

The CGWTP was taken offline on 28 April 2010 due to Fire Station construction activities. The expected timeline for system restart is two to three weeks. Additionally, the system will be taken offline in the future to relocate piping from the extraction wells that are near the new Fire Station.

The influent, carbon midpoint, and system effluent sample collected at the CGWTP all contained detectable (estimated) amounts of benzene (Table 1). The validity of these concentrations is currently being investigated since benzene has not been detected at any point in the CGWTP process stream for prior to April 2010. Results from this investigation will be presented in the May 2010 data sheet.

Optimization Activities

The ThOx unit was removed in order to provide space for the installation of a bioreactor and monitoring wells to address contamination in the OSA. The Unit was moved to a nearby storage location and will remain offline to facilitate bioreactor operation.

Table 1
Summary of Groundwater Analytical Data for April 2010 – Central Groundwater Treatment Plant

Constituent	Instantaneous Maximum[a] (µg/L)	Detection Limit (µg/L)	1 April 2010 (µg/L) N/C	Influent	After Carbon 1 Effluent	After Carbon 2 Effluent	System Effluent
Halogenated Volatile Organics							
Bromodichloromethane	5.0	0.15	0	ND	ND	ND	ND
Carbon Tetrachloride	0.5	0.14	0	ND	ND	ND	ND
Chloroform	5.0	0.16	0	0.55 J	ND	ND	ND
1,2-Dichlorobenzene	5.0	0.08	0	0.4 J	ND	ND	ND
1.3-Dichlorobenzene	5.0	0.15	0	0.27 J	ND	ND	ND
1,4-Dichlorobenzene	5.0	0.15	0	0.26 J	ND	ND	ND
1,1-Dichloroethane	5.0	0.15	0	ND	ND	ND	ND
1,2-Dichloroethane	0.5	0.15	0	ND	ND	ND	ND
1,1-Dichloroethene	5.0	0.19	0	0.69	ND	ND	ND
cis-1,2-Dichloroethene	5.0	0.19	0	99.8	ND	ND	ND
trans-1,2-Dichloroethene	5.0	0.33	0	2.7	ND	ND	ND
Methylene Chloride	5.0	0.66	0	ND	ND	ND	ND
Tetrachloroethene	5.0	0.21	0	1.0	ND	ND	ND
1,1,1-Trichloroethane	5.0	0.14	0	ND	ND	ND	ND
1,1,2-Trichloroethane	5.0	0.2	0	ND	ND	ND	ND
Trichloroethene	5.0	1.9	0	430	ND	ND	ND
Vinyl Chloride	0.5	0.18	0	0.79	ND	ND	ND
Non-Halogenated Volatile Organics							
Benzene	1.0	0.17	0	0.24 J	0.18 J	ND	0.18 J
Ethylbenzene	5.0	0.22	0	ND	ND	ND	ND
Toluene	5.0	0.14	0	ND	ND	ND	ND
Total Xylenes	5.0	0.5 – 0.23	0	ND	ND	ND	ND

[a] In accordance with Appendix G of the *Travis AFB Central Groundwater Treatment Plant Operations and Maintenance Manual* (URS Group, Inc., 2002).

J = analyte concentration is considered an estimated value
N/C = number of samples out of compliance with discharge limits
ND = not detected
µg/L = micrograms per liter

2010 Field Installations Update

Travis Air Force Base, California

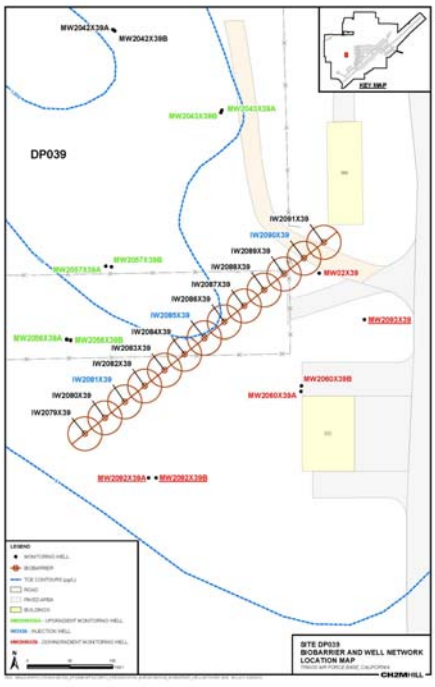
May 19, 2010

Installations in Progress

- Site DP039 Mid-Plume
- Site SS016 OSA Source Area
- Site SS030 Eastern Edge of Plume
- Site SD036 Hot Spot
- Site SD037 Hot Spot
- Site SS015 Plume

Site DP039 — Plan

- Install 3 new monitoring wells to complement the existing well pairs (for total of 15 wells in the EVO performance monitoring network)
- Install 13 EVO injection wells across the plume, downgradient of the 500 µg/L contour (change well radius from 40 ft to 30 ft
- Inject about 25,000 lbs of EVO to form the biobarrier
- Initiate performance monitoring of the remedy optimization
- Prepare a completion report after EVO injection is finished
- Evaluate ongoing progress in GSAP reports



Site DP039 – Field Work Status

- Installed 9 injection wells (IW2083x39 through IW2091x39)
- Installed 1 monitoring well (MW2093x39)
- Developed the newly installed wells
- Installation of 4 remaining injection wells and 2 remaining monitoring wells is scheduled for late May or early June
- Baseline sampling scheduled for May (for existing wells) and June (for new wells)
- EVO injection planned for June

Site DP039 Biobarrier Performance Monitoring Plan

- **Monitoring Well Network**
  -six (6) upgradient wells (MW2056x39A&B, MW2057x39A&B, and MW2043x39A&B)
  -three (3) performance wells (IW3x39, IW7x39, and IW12x39)
  -six (6) compliance wells (MW2060A&B, MW02x39, new well pair to the southwest, and new well to the northeast)
- **Analytes**
  -VOCs (including VC), Dissolved Hydrocarbon Gasses, Total Organic Carbon, Nitrate/Nitrite, Sulfate, Chloride, Sulfide, Ferrous Iron, Alkalinity, pH, ORP, Temperature, EC, DO
- **Frequency**
  -Pre-Installation: All wells sampled in baseline event
  -Post-Installation: Semi-Annually for first two (2) years, Annually thereafter

Site SS016 — Plan

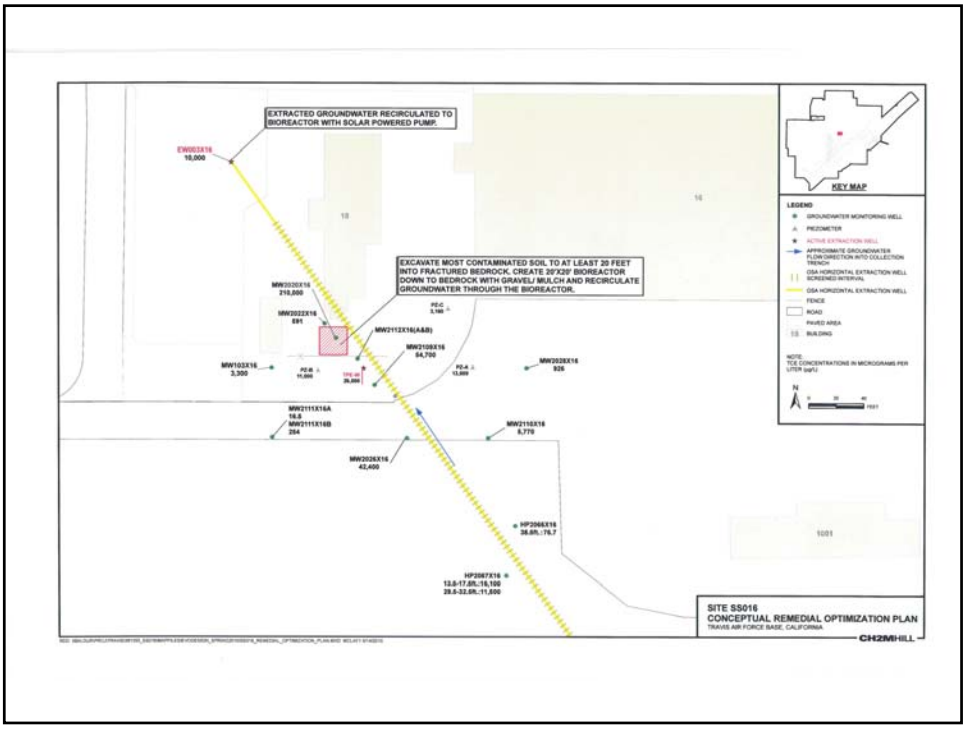
- Discontinue SVE at SS016 due to limited effectiveness and to promote anaerobic conditions in source area
- Remove the Therm/Ox unit
- Remove the Wash Rack canopy

Site SS016 — Plan

- Excavate the highly contaminated soil in Wash Rack area (at least 20’x20’x20’) down to below bedrock interface – Will remove a large mass of TCE in soil
- Create a gravel/mulch bioreactor in the excavation
- Tie the existing EW03x16 (horizontal well) into the bioreactor for recirculation

Site SS016 — Plan

- Install five new wells to complement existing monitoring of the effectiveness of the bioreactor)
- Prepare completion report after optimization is accomplished
- Evaluate ongoing progress in GSAP reports



Site SS016 – Field Work Status

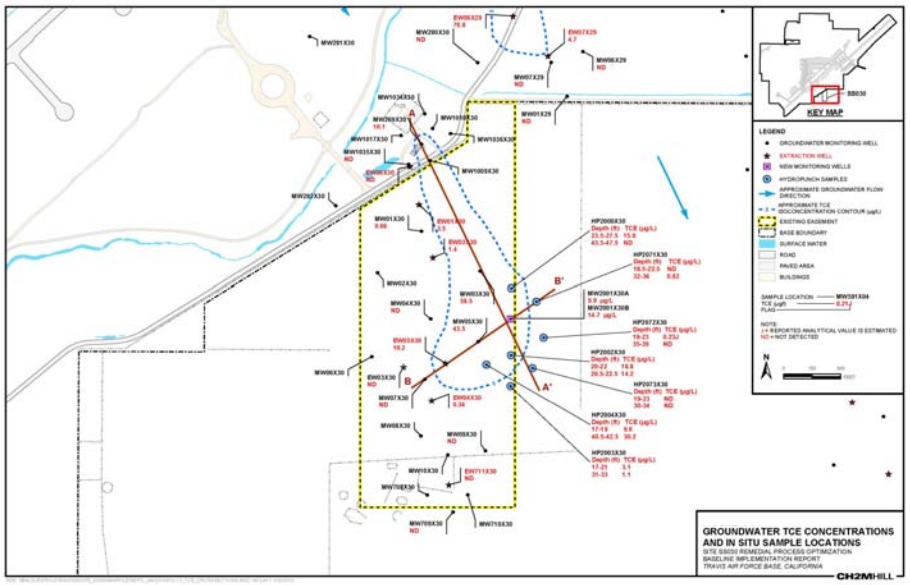
- Received analytical results for monitoring wells MW2022x16, MW2109x16, MW2110x16, MW2111x16A, and MW2111x16B
- Therm/Ox system was dismantled in April
- Wells MW2112x16A and MW2112x16B to be installed now that the Therm/Ox system has been removed
- Canopy removal and bioreactor Installation is scheduled for June/July

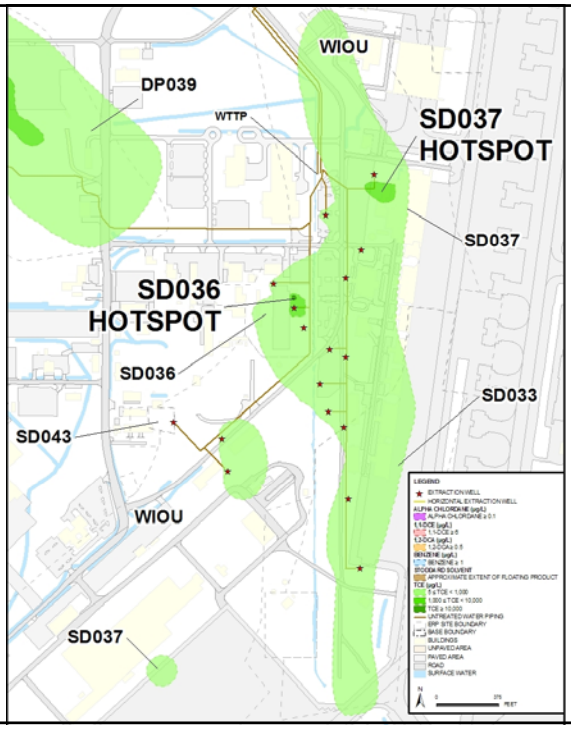
Site SS016 Performance Monitoring Plan

- **Monitoring Well Network**
  -two (2) downgradient from bioreactor, (MW2112x16 and MW2109x16)
  -three (3) further downgradient from bioreactor (MW2026x16, MW2111x16, and MW2110x16)
  -one (1) upgradient from the bioreactor (new well:MW2022x16)
  Analytes
  -VOCs (including VC), Dissolved Hydrocarbon Gasses, Total Organic Carbon, Nitrate/Nitrite, Sulfate, Chloride, Sulfide, Ferrous Iron, Alkalinity, pH, ORP, Temperature, EC, DO
- **Frequency**
  -Pre-Installation: All wells sampled in baseline event
  -Post-Installation: Semi-Annually for first two (2) years, Annually thereafter

Site SS030 - Plan

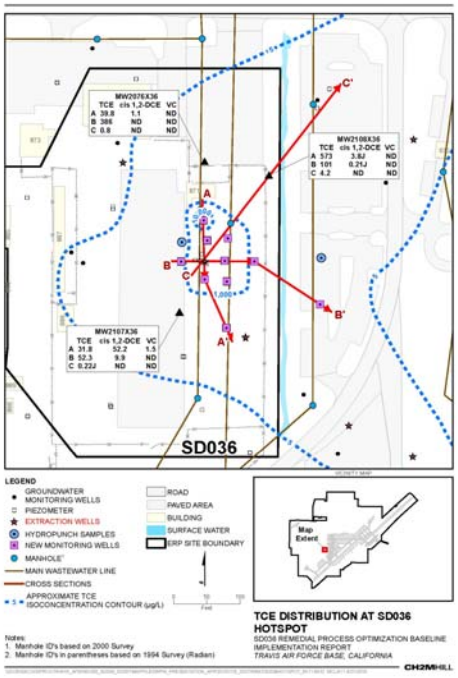
- Maximize groundwater extraction at the site – restart EW03x30 (in progress)
- Monitor groundwater levels and TCE concentrations across the site during annual GSAP event in May/June 2010
- Determine if additional monitoring wells and extraction wells are needed to obtain capture of the SS030 TCE plume following the GSAP event
- Currently…waiting on data from annual GSAP event (in progress)





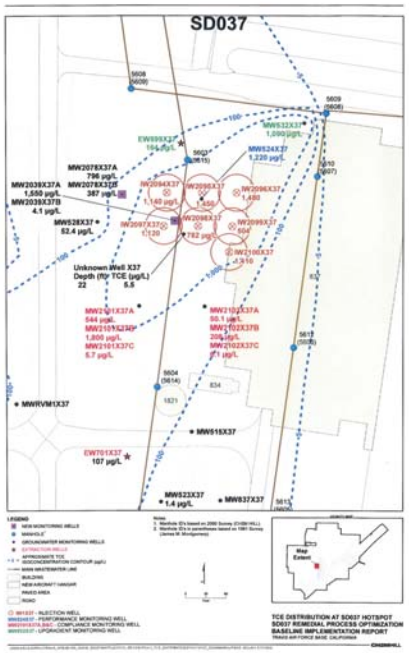
Site SD036 — Plan

- Now that the hot spot is defined, need to optimize the EVO injection design
- Conduct remedy optimization followed by implementation of performance monitoring
- Prepare completion report after EVO injection is accomplished
- Evaluate ongoing progress in GSAP reports



Site SD037 — Plan

- Inject 36,000 lbs of EVO into 7 injection wells
- Initiate performance monitoring of the remedy optimization
- Prepare completion report after EVO injection is accomplished
- Evaluate ongoing progress in GSAP reports



Site SD037 – Field Work Status

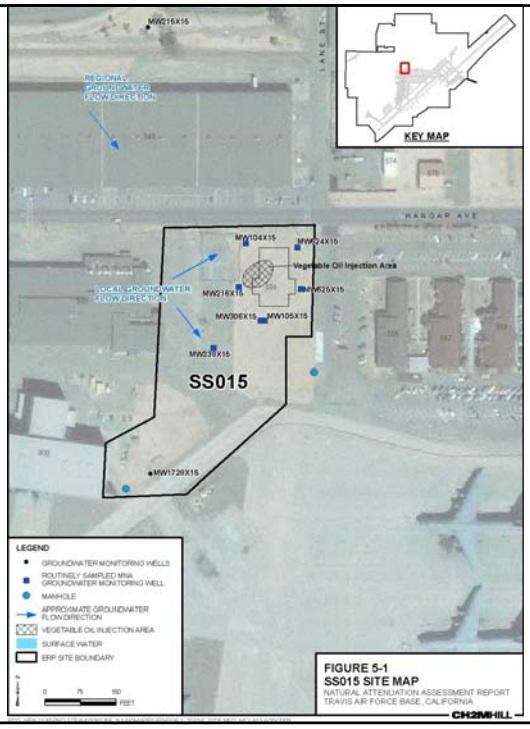
- Developed all newly installed wells
- Conducted the Baseline sampling in May
- MW2101x37B has a TCE concentration of 1,800 µg/L – MW 532x37 has a TCE concentration of 1,090 µg/L
- Determining additional well locations based the high TCE concentration in MW2101x37B and MW532x37
- EVO injection planned for June

Site SD037 Performance Monitoring Plan

- **Monitoring Well Network**
  -two (2) upgradient wells (EW599x37 and MW532x37)
  -three (3) performance wells (MW2039x37A, MW2039x37B, and MW524x37)
  -four (4) compliance wells (two (2) new well pairs to the south and southeast of the treatment zone)
- **Analytes**
  -VOCs (including VC), Dissolved Hydrocarbon Gasses, Total Organic Carbon, Nitrate/Nitrite, Sulfate, Chloride, Sulfide, Ferrous Iron, Alkalinity, pH, ORP, Temperature, EC, DO
- **Frequency**
  -Pre-Installation: All wells sampled in baseline event (complete)
  -Post-Installation: Semi-Annually for first two (2) years, Annually thereafter

Site SS015 Description

- Contaminant Plume of TCE originated from 3 former facilities in vicinity of Bldg 554
- In 1997, a treatability study of enhanced MNA using vegetable oil was conducted
- Source area COCs were affected by the vegetable oil treatability study



Site SS015 Status

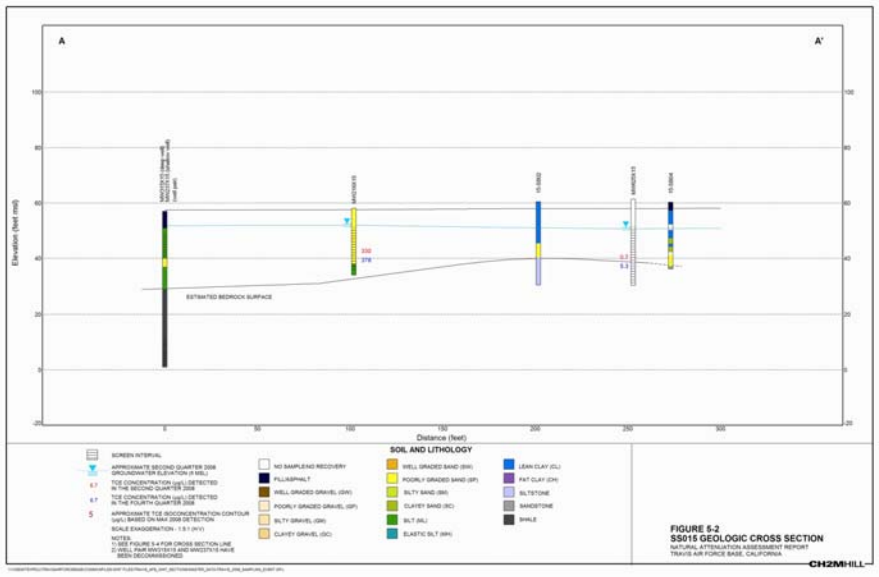
- TCE, PCE, and cis1,2-DCE decreased in the source area from 2004 to 2007
- The COCs rebounded from 2007 through 2009
- Vinyl Chloride concentrations are increasing

Site SS015 Status (cont'd)

- Elevated cis1,2-DCE and VC confirm that ERD was working and that the biological component of natural attenuation can be effectively enhanced at the site
- Rebound of TCE & PCE indicate that insufficient vegetable oil remains to complete the degradation process
- The plume appears to be slowly migrating eastward

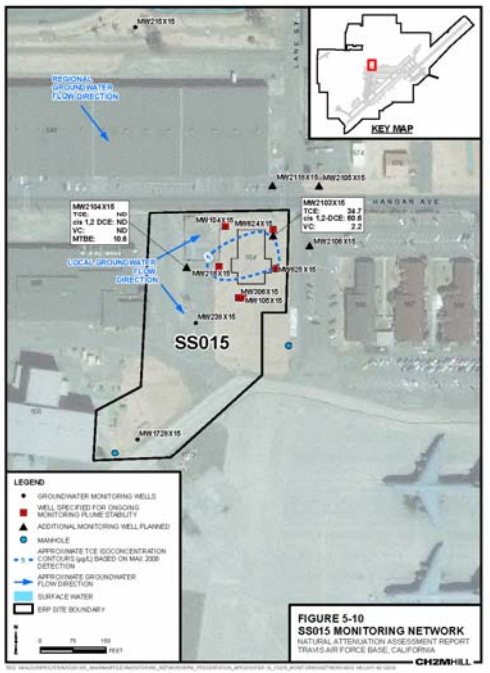
Site SS015 Hydrogeology

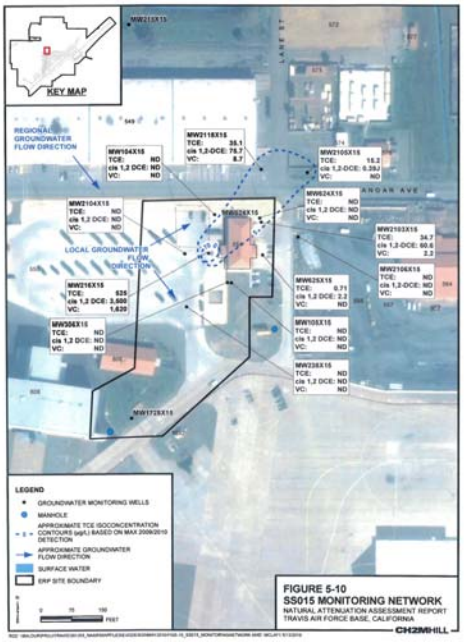
- ~ 20 ft of unconsolidated alluvium overlies sedimentary bedrock
- The bedrock consists of shale and sandstone
- The alluvium is composed of discontinuous lenses of sand, silt, and clay
- The water table is ~10 ft bgs, and the saturated zone is ~10 ft thick



Site SS015 - Plan

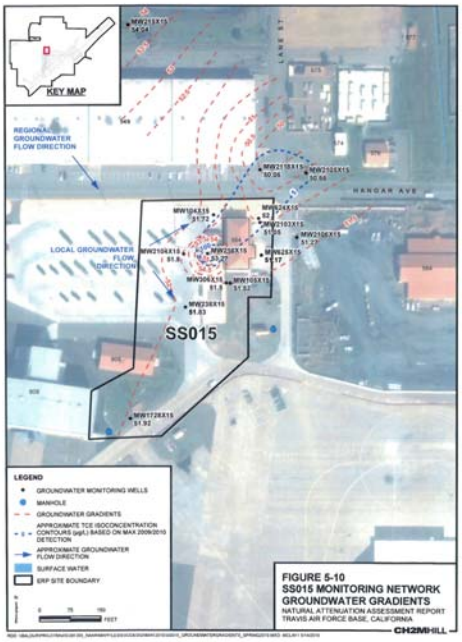
- Investigate extent of VOCs in the source area and downgradient
- Install alluvium-screened shallow well adjacent to MW624x15 (complete)
- Install monitoring well west of source-area well MW216x15 (complete)
- Install 2nd round of monitoring wells based on results of 1st round wells (complete)
- Install 3rd round of monitoring wells based on results of 2nd round wells (in progress)
- Evaluate investigation results and report back to the RPM in the May meeting (as we speak)


KEY MAP
REGIONAL GROUNDWATER FLOW DIRECTION
LOCAL GROUNDWATER FLOW DIRECTION
SS015
HANGAR AVE
LANE ST
LEGEND
GROUNDWATER MONITORING WELLS
WELL SPECIFIED FOR ONGOING MONITORING PLUME STABILITY
ADDITIONAL MONITORING WELL PLANNED
MANHOLE
APPROXIMATE TCE ISOCONCENTRATION CONTOURS (µg/L) BASED ON MAX 2009 DETECTION
APPROXIMATE GROUNDWATER FLOW DIRECTION
SURFACE WATER
ERP SITE BOUNDARY
FIGURE 5-10
SS015 MONITORING NETWORK
NATURAL ATTENUATION ASSESSMENT REPORT
TRAVIS AIR FORCE BASE, CALIFORNIA
CH2MHILL


KEY MAP
REGIONAL GROUNDWATER FLOW DIRECTION
LOCAL GROUNDWATER FLOW DIRECTION
HANGAR AVE
LANE ST
LEGEND
GROUNDWATER MONITORING WELLS
MANHOLE
APPROXIMATE TCE ISOCONCENTRATION CONTOURS (µg/L) BASED ON MAX 2009/2010 DETECTION
APPROXIMATE GROUNDWATER FLOW DIRECTION
SURFACE WATER
ERP SITE BOUNDARY
FIGURE 5-10
SS015 MONITORING NETWORK
NATURAL ATTENUATION ASSESSMENT REPORT
TRAVIS AIR FORCE BASE, CALIFORNIA
CH2MHILL

Site SS015 – Field Work Status

- Developed round 2 monitoring wells (MW2105x15, MW2106x15, and MW 2118x15)
- Sample results from well MW2106x15 indicate ND for TCE and daughter products
- Sample results from new downgradient wells MW2105x15 and MW2118x15 indicated elevated TCE, cis1,2-DCE, and VC
- Groundwater plume trends to the northeast
- Groundwater gradient survey conducted in May
- Groundwater gradient appears to have strong component to the northeast



Questions/Comments?

Comparison of In Situ Chemical Oxidation (ISCO) and Enhanced Reductive Dechlorination (ERD) Using Emulsified Vegetable Oil (EVO)

Why Focus on ISCO and EVO?

- Both technologies are another step in the remediation process at Travis Air Force Base
  - Pump and treat technology decreases in efficiency following reduction of contamination in treatment area
- In Situ technologies both address contamination, but do so in different ways, and have different strengths and weaknesses
- Proper selection of in situ technology can lead to effective and efficient remediation

How to Implement ISCO or EVO?

- In Situ Chemical Oxidation (ISCO) involves injecting an oxidizing reagent into the treatment area
  - Fentons Reagent, persulfate, permanganate, ozone
  - Permanganate (MnO4) lasts longest, relatively mild oxidant
  - Requires direct contact with contamination
- Reductive dechlorination can be "enhanced" by creating a reducing environment.
  - Injecting emulsified vegetable oil (EVO) provides nutrients to naturally occurring bacteria, which in turn creates a reducing environment
  - EVO coats surface area of soil – the "Pepto" effect
  - EVO does not directly remediate contamination, only enhances bacterial environment in the treatment zone

Benefits of ISCO and EVO

ISCO

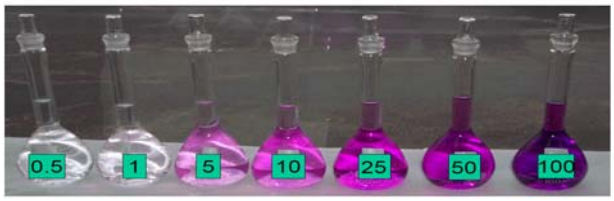
- Rapid contamination reduction
- Easy to distribute
- Distribution is easy to confirm
- Byproducts of ISCO not persistent beyond treatment zone
- Can be effective on DNAPL if good contact is established
- Can persist in treatment zone for more that 3 months

EVO

- EVO will last for years
- Easy to distribute
- Distribution is easy to confirm
- Byproducts (e.g. vinyl chloride) degrade beyond treatment zone
- Minimal environmental impact
- Food-grade material poses no health and safety risks
- Relatively inexpensive

Visual Confirmation of Reagent in Aquifer

- Permanganate (MnO_4)



- EVO

Disadvantages of ISCO and EVO

ISCO

- High contaminant rebound likely in diffusion limited contamination zones
- High soil oxidant demand can require additional oxidant mass
- Highly toxic byproducts (e.g. selenium, arsenic)
- Strong oxidizers necessitate stringent health and safety requirements
- Relatively high cost for manufactured chemicals

EVO

- Remediation time on the order of years
- Strong aerobic conditions will initially inhibit development of reducing environment
- Byproducts include reduced metals (manganese, iron), vinyl chloride
- Does not directly affect DNAPL sources

Travis AFB Site Conditions

- Predominantly silt and clay alluvium on top of bedrock; few small sand intervals
- High soil oxidant demand – sample collected at Site SD036
- Source areas are diffusion limited – contamination diffused into clays and silts

Which Technique Should be Used?

- ISCO and EVO are both valid methods of contamination reduction, but effectiveness and efficiency must be considered
- Conceptual Site Models identify the nature of contamination at a given Site, so the remediation strategy should compliment Site conditions

Putting it All Together

- Travis Air Force Base is a better candidate for ERD via EVO injection than ISCO
- Predominantly diffusion limited contamination
  - ISCO will remediate contamination in permeable zones, but will rebound as soon as ISCO reagent is depleted
  - EVO is more suited toward slow, diffusion limited processes, will continue to remediate for years
- Representative soil samples from Travis AFB indicate very high oxidant demand, thus reducing efficiency of implementation
  - Effectively limits radius of influence, thus requiring many injection wells spaced <10 feet apart

Lessons Learned from Phytoremediation

Can it be used to reach RIP?

Glenn Anderson
Travis Air Force Base
May 19, 2010

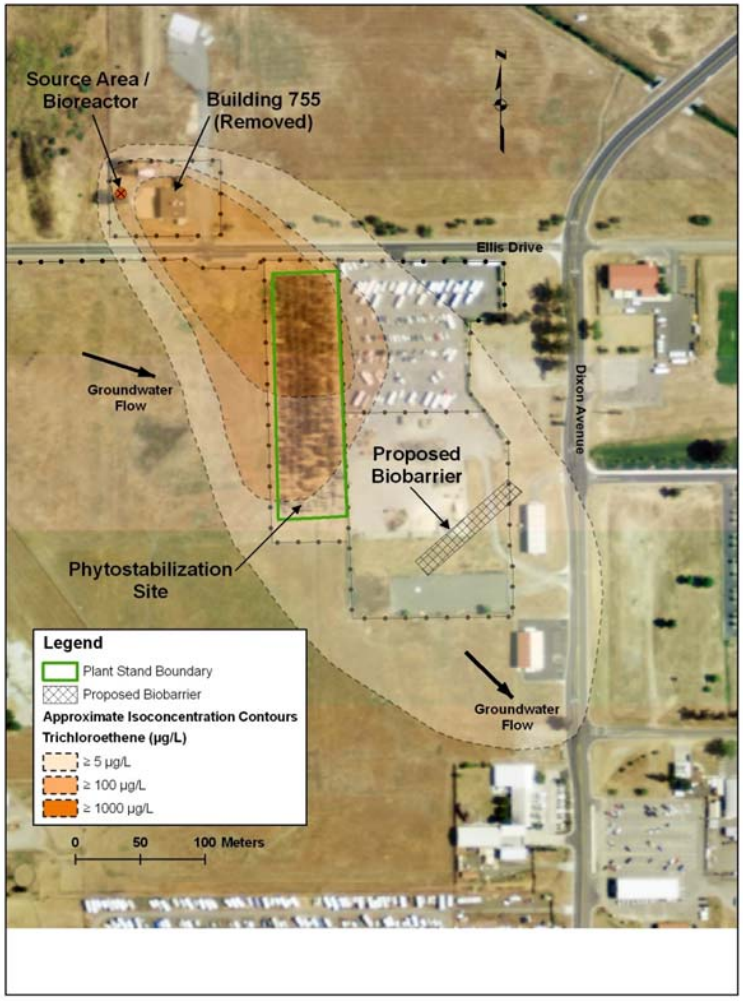
Definition

- Phytostabilization or Phytohydraulics:

"…the use of plants to remove groundwater through uptake and consumption in order to contain or control the migration of contaminants."

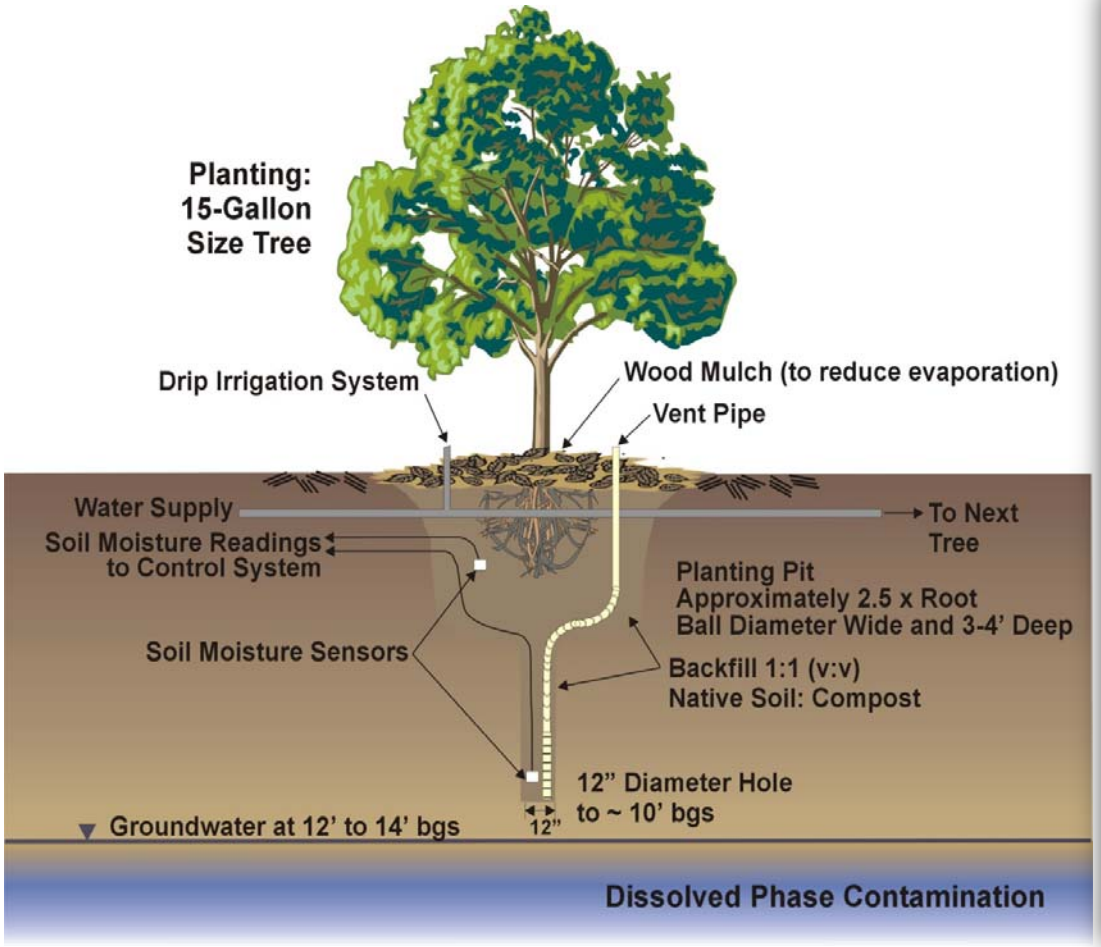
(USEPA, 2000)

Background


Source Area / Bioreactor
Building 755 (Removed)
Ellis Drive
Dixon Avenue
Groundwater Flow
Proposed Biobarrier
Phytostabilization Site
Groundwater Flow
Legend
Plant Stand Boundary
Proposed Biobarrier
Approximate Isoconcentration Contours
Trichloroethene (µg/L)
≥ 5 µg/L
≥ 100 µg/L
≥ 1000 µg/L
0
50
100 Meters


Plant Stand
Source Area

Different Planting Methods

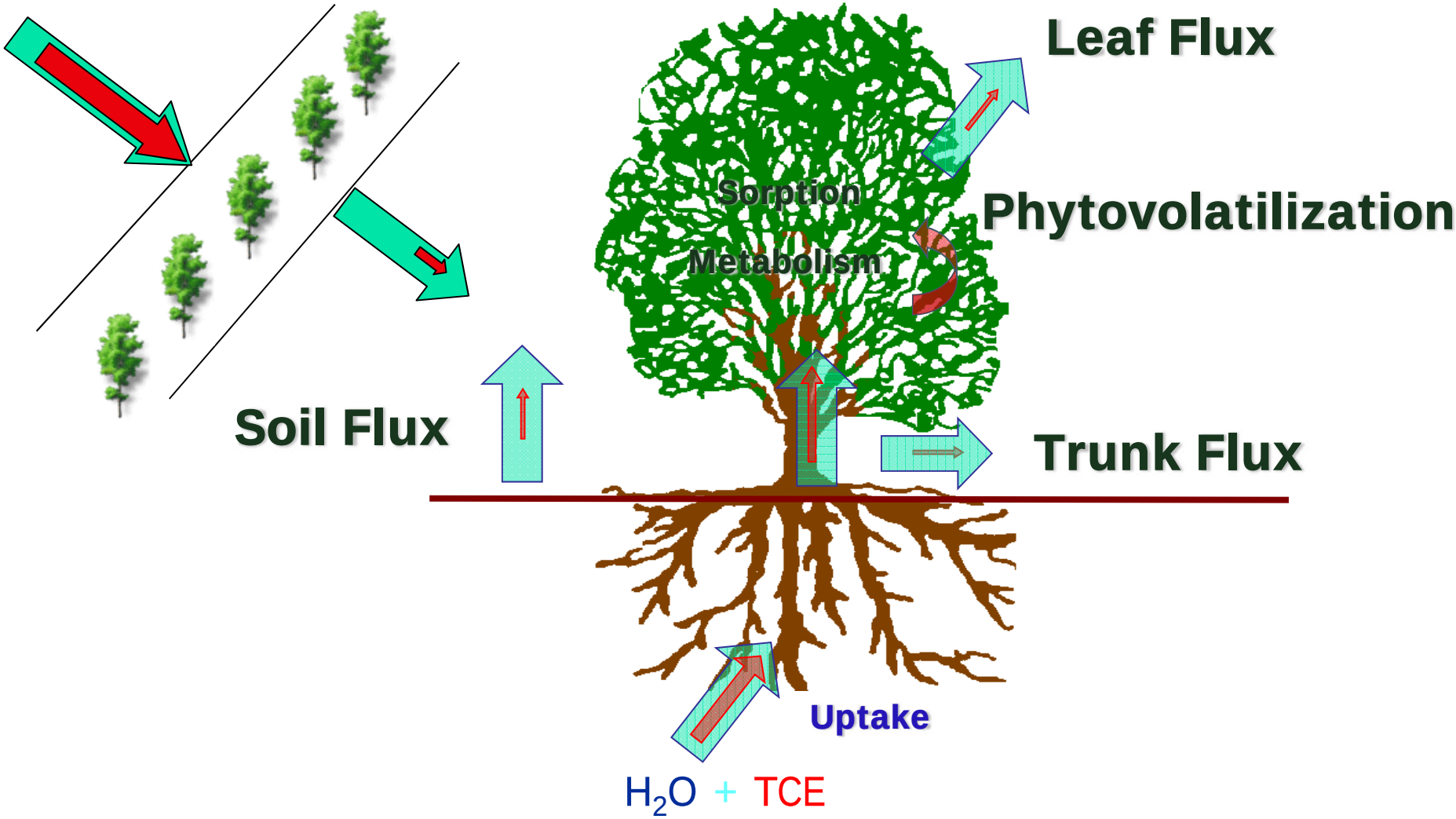


Trees: 480 ***Area: 2.2*** ***Type: Eucalyptus sideroxylon 'Rosea'***

Current Project

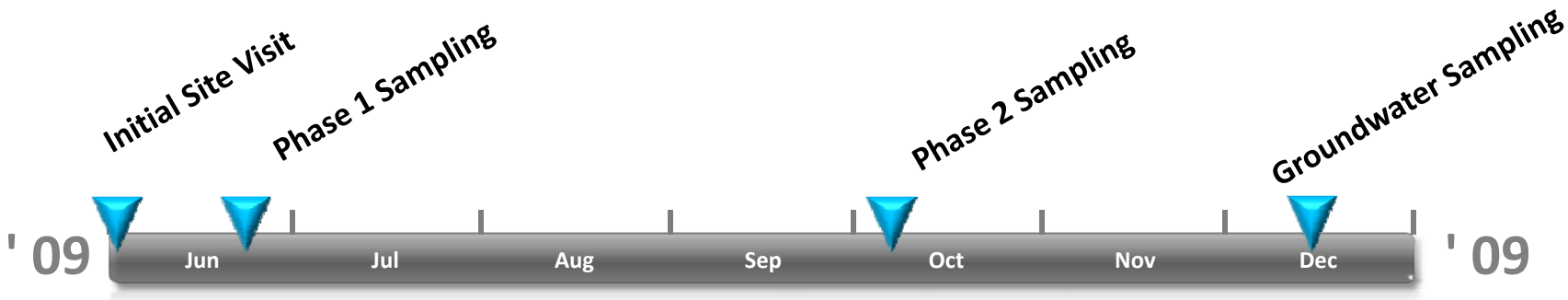
- Revisit Plant Stand 10 Years After Initial Planting
- Measure Growth/Vitality of Trees
- Collect Plant Tissue Samples
- Assess Leaf and Trunk Flux
- Assess Soil Flux
- Collect Groundwater Samples to Evaluate Impact

Removal of TCE

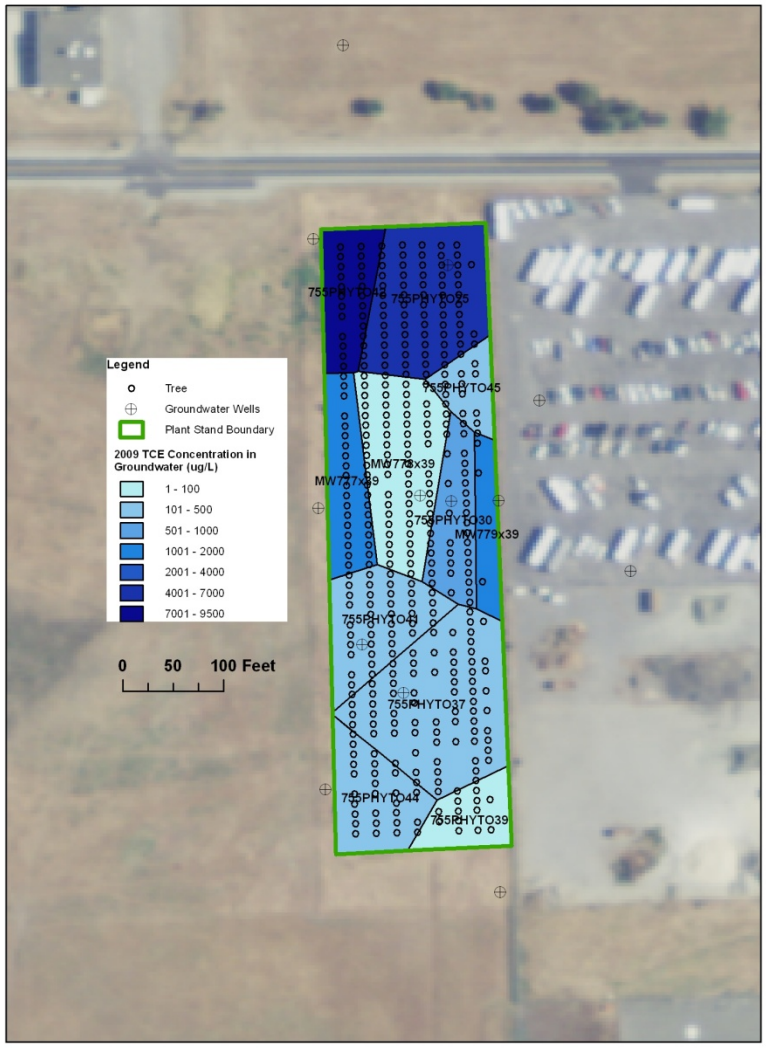


Field Work Timeline

- **Initial Site Visit – Confirm Contaminant Uptake**
- **Phase 1 and 2 Sampling – Collect Samples at Different Times during Growing Season**
- **Groundwater Sampling – Increase Available Data Set**

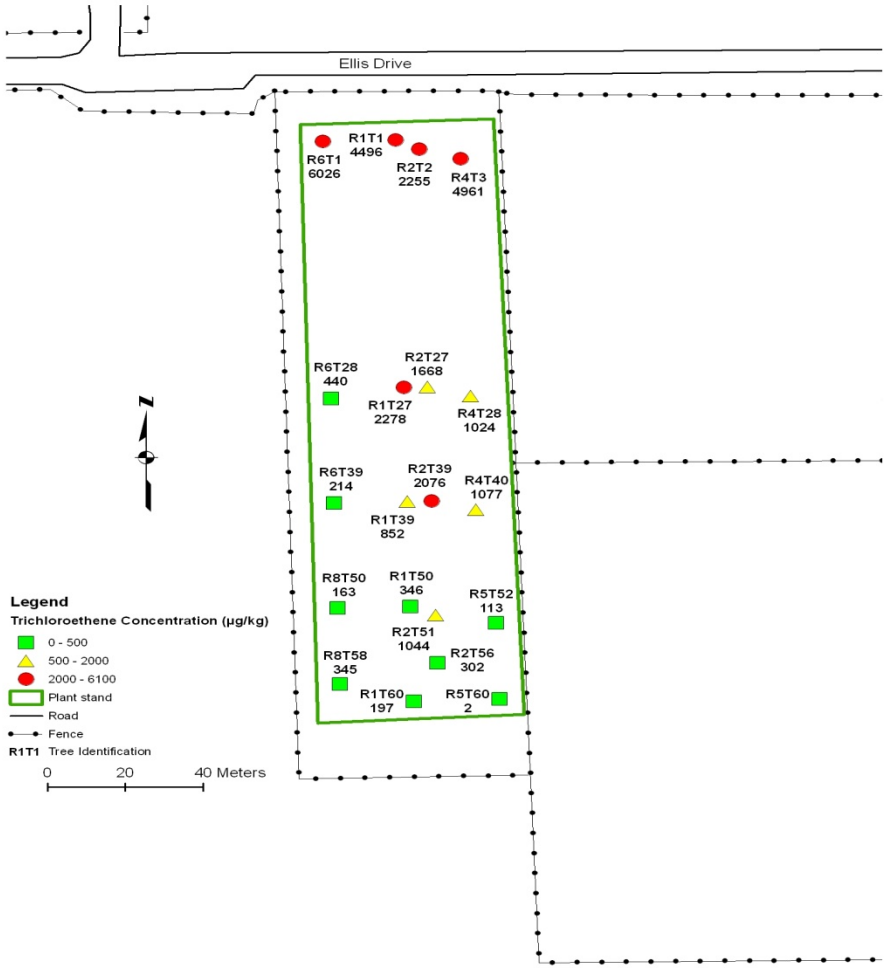


Groundwater Sampling

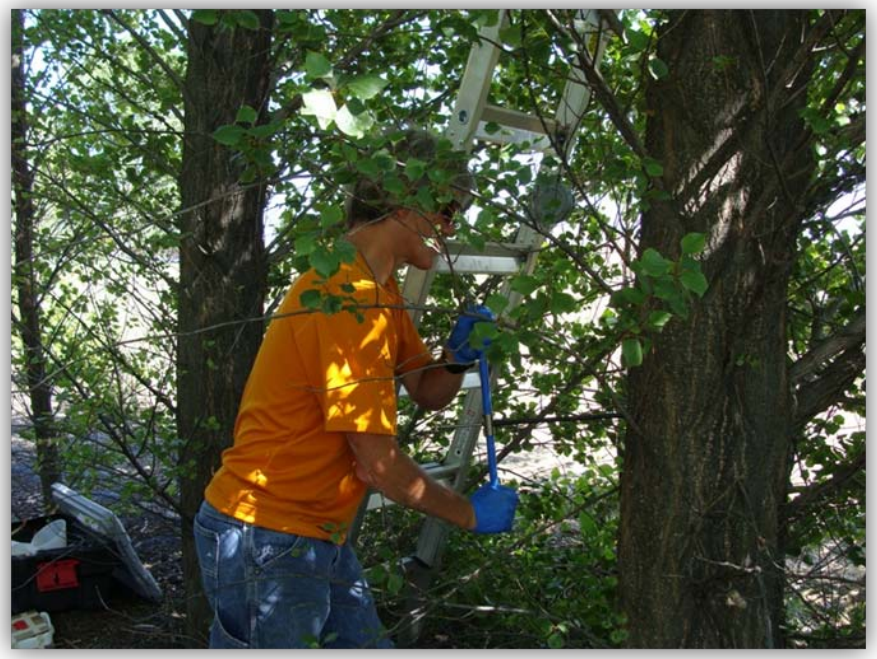


- **In 2009 TCE Concentrations under plant stand range from <100 - >9,000 μg/L**
- **Similar distribution to what was seen in 1998**
- **Some evidence of reductive dechlorination**

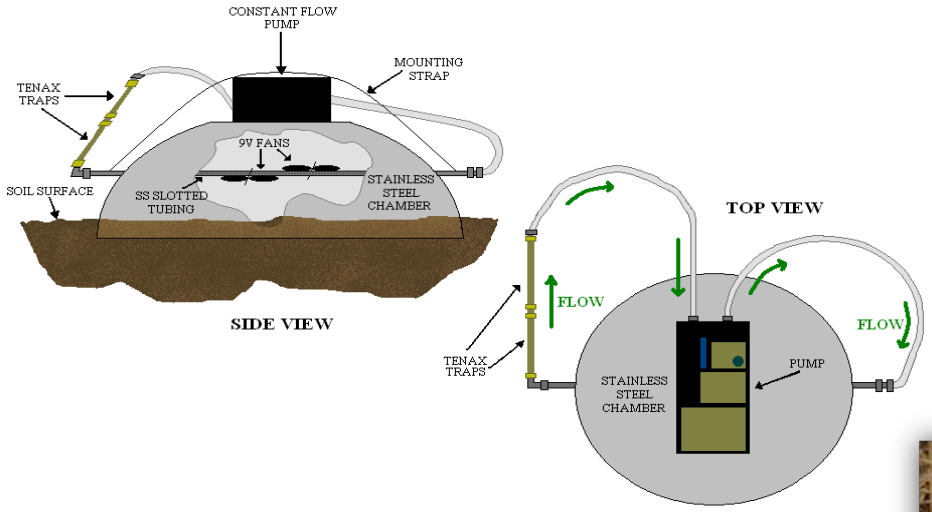
Plant Tissue Sampling



- **Ranged from ND - > 6,000 µg/kg TCE**
- **Correlated with groundwater concentrations**

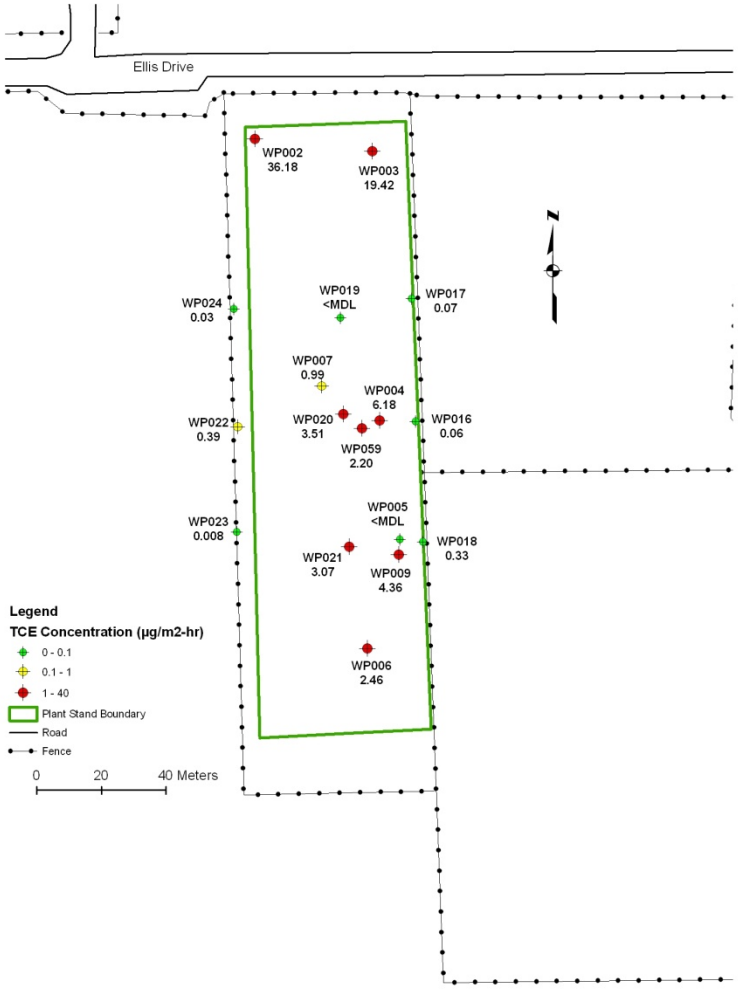


Soil Flux Sampling

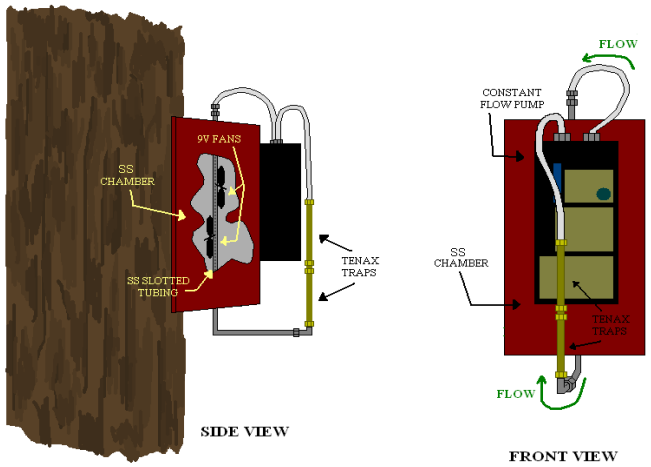


Soil Flux Results

- **Ranged from 0.1 – 36 μg/m²-hr**
- **Location within or outside plant stand appears to have an effect**

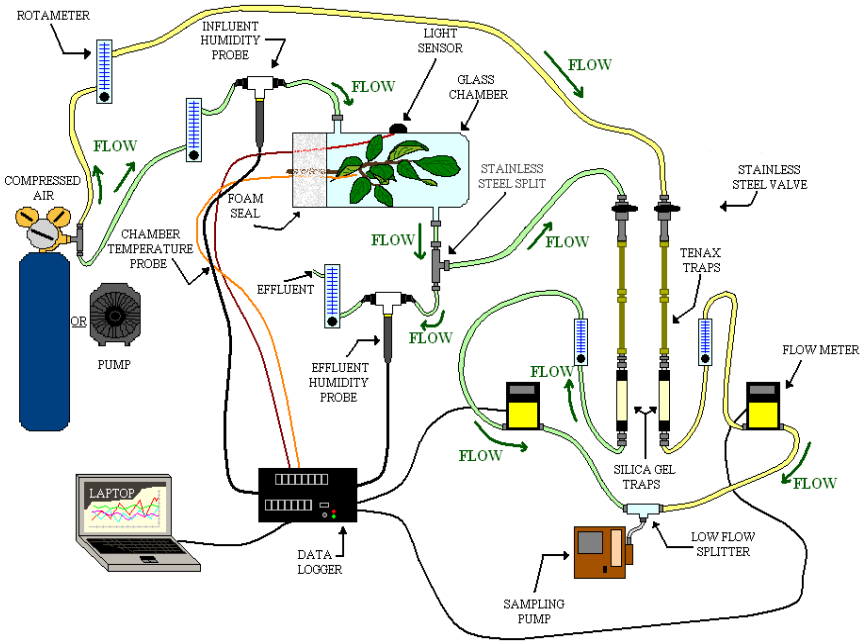


Trunk Flux Sampling

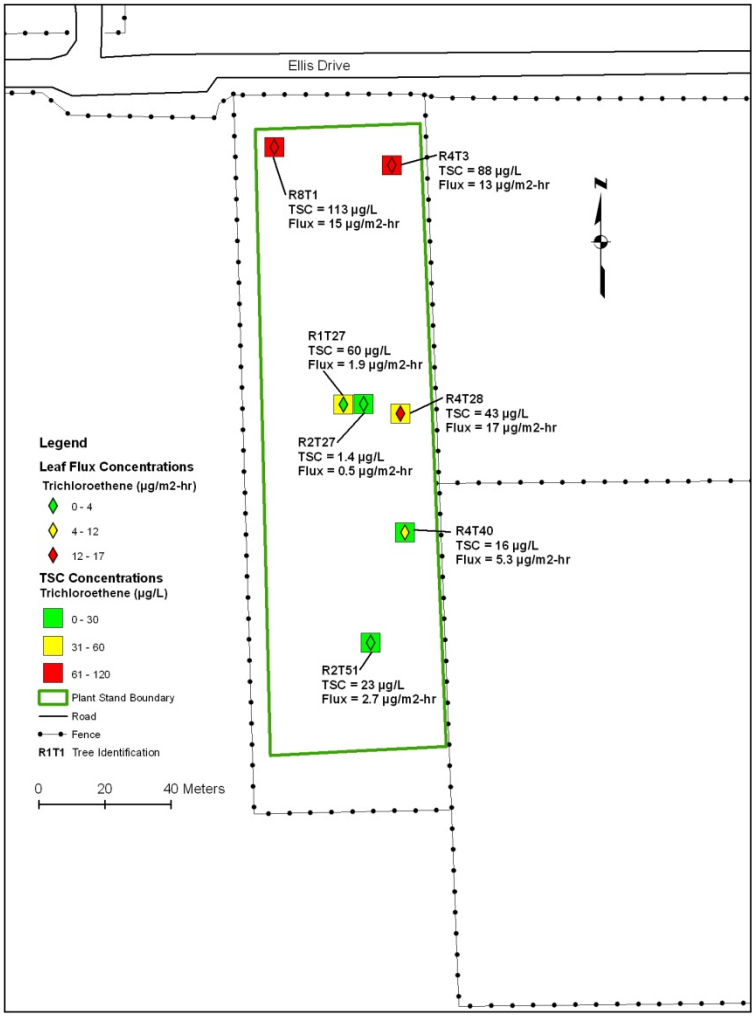


- **Ranged from 0.02 – 3.2 μg/m^2-hr**

Leaf Flux Sampling

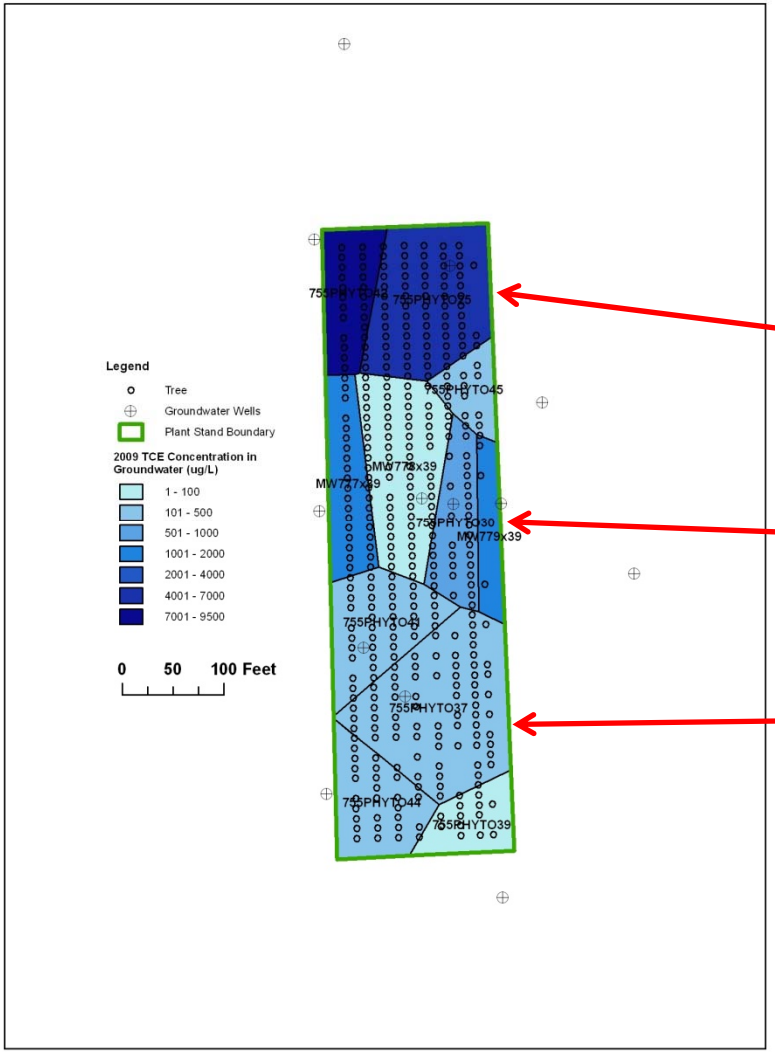


Leaf Flux Sampling Results



- **Flux Ranged from 0.5 – 17 µg/m^2-hr**
- **TSC Ranged from 1.4 - 130 µg/L**
- **TSCF Ranged from 0.01 – 0.10**
- **No significant seasonal changes**

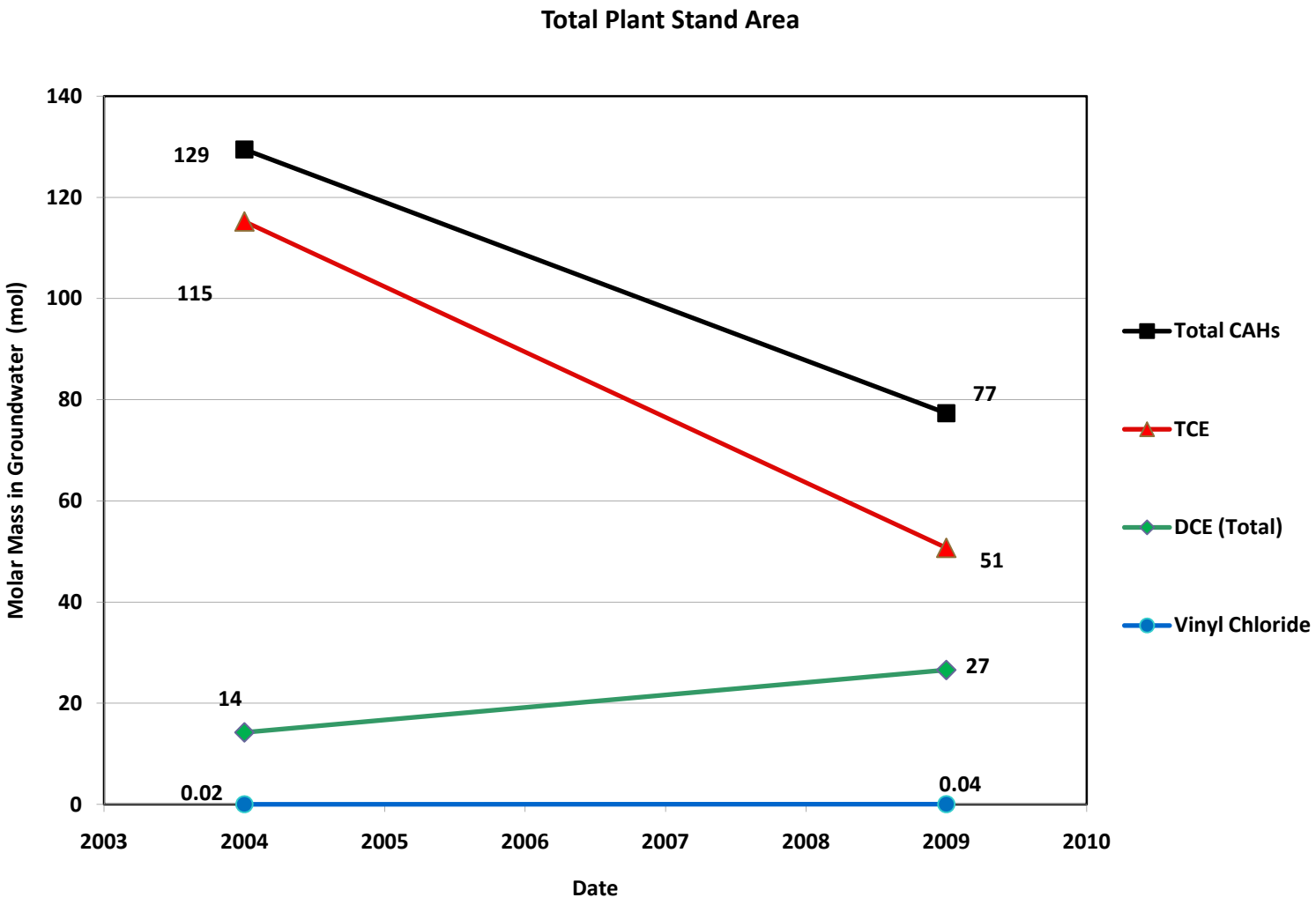
Estimating Impact



	2004 (kg TCE)	2009 (kg TCE)
Area 1	12	5.5
Area 2	2.7	0.7
Area 3	0.6	0.5
Total	15	6.7

Note: Estimate of contaminant in groundwater below plant stand.

Groundwater Quality Impact

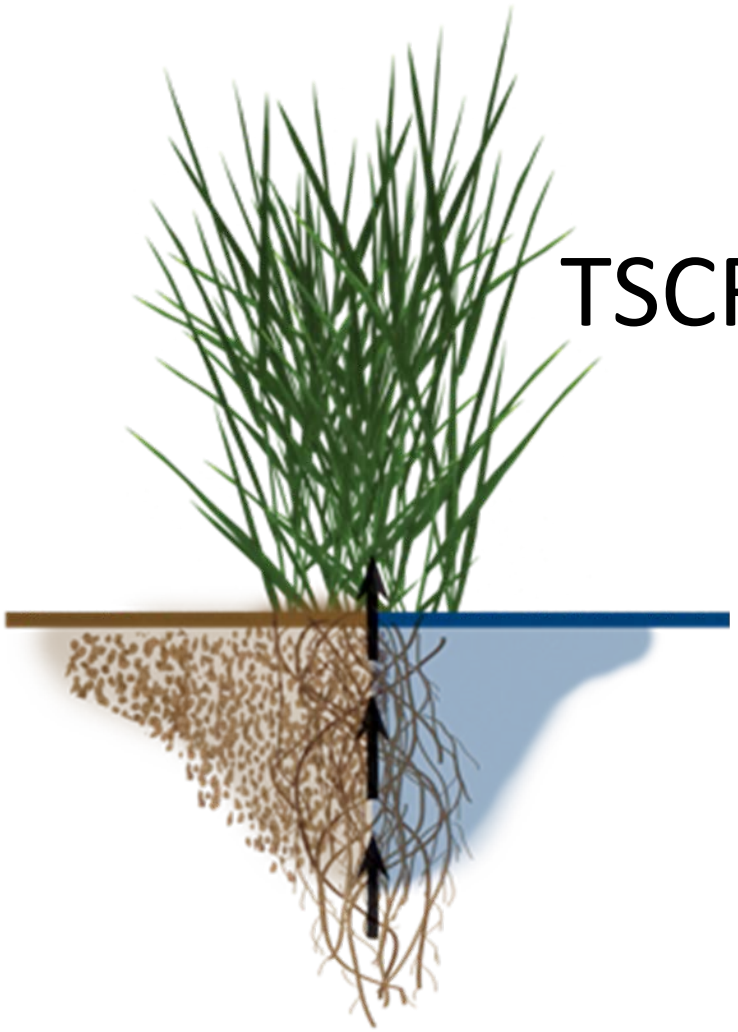


Estimated TCE Removal Rates

	Leaves (kg/yr)	Trunk (kg/yr)	Soil (kg/yr)	Total (kg/yr)
Area 1	0.2	0.005	0.4	0.56
Area 2	0.1	0.004	0.07	0.19
Area 3	0.08	0.002	0.04	0.19
Total	0.4	0.01	0.5	0.9

Note: Maximum value based on laboratory measured TSCF (Dettenmaier, 2009).

Transpiration stream concentration factor



$$TSCF = \frac{C_{xylem}}{C_{solution}}$$

	Maximum (kg/yr)
Area 1	5.4
Area 2	1.0
Area 3	0.4
Total	6.8

Plant Uptake (ug) = TSCF x (C_S, ug/L) x water transpired (L)

Note: Maximum value based on laboratory measured TSCF (Dettenmaier, 2009).

After 10 Years

- Long start-up period – even after 10 years
  - Initial excitement followed by when is it going to work?
  - Ways to mitigate
- Monitoring approach is important
- Needs to be part of treatment train
- Touted as “green” and “sustainable” technology
- Ancillary benefits cannot be ignored
- Keeps getting better with age…

Questions

THANK-YOU

Travis AFB
Groundwater Program

Management Overview Briefing

RPM Meeting

May 19, 2010

Completed Documents

Documents

- Basewide Health & Safety Plan (HSP)
- Action Plan
- 2007/2008 GSAP Annual Report
- LF007C RPO Work Plan
- LF008 Rebound Study Work Plan
- SS014 Tier 1 POCO Evaluation WP
- ST027B Site Characterization WP
- SS030 RPO Work Plan
- ST032 POCO Technical Memo
- DP039 Bioreactor Work Plan
- 2008 Annual GWTP RPO Report
- Passive Diffusion Bag (PDB) Technical Memo
- RD/RA QAPP Update
- ST032 Tier 1 POCO Evaluation WP
- Phytostabilization Demonstration Tech Memo
- Model QAPP
- LF008 Rebound Test Tech Memo

Documents

- Comprehensive Site Evaluation Phase II Work Plan
- Field Sampling Plan (FSP)
- SS016 RPO Work Plan
- ST018 POCO RA Work Plan
- Vapor Intrusion Assessment Report
- 2008/2009 GSAP Annual Report
- ***FT005 Data Gap Work Plan***
- ***First and Second Site DP039 Sustainable Bioreactor Demonstration Progress Reports***

Completed Field Work

Field Work

- ST027B Gore Sorber Survey – Ph 1
- ST027B Field Sampling – Phase 2
- GSAP 2008 Semi-annual Event
- ST027B Installation of Wells – Phase 3
- SS014 Site Characterization
- LF008 Rebound Study
- GSAP Annual Sampling Event - 2009
- SS030 Site Characterization – Ph 1
- ST027 Site Characterization -Ph 3
- ST014 Monitor Well Install - Subsite 3
- SD001/SD033 Sediment RA
- SS016 Site Characterization (OSA source area)

Field Work

- ST018 Site Characterization
- SS030 Site Characterization (Off-base VOC Plume)
- DP039 Site Characterization (for Biobarrier Placement)
- SS014 & ST032 Q1 2010 MNA Sampling (2nd of 4 quarterly events)
- ***SD036 Additional Site Characterization (north & east)***
- ***Therm/Ox System Removal***

In-Progress Documents & Field Work

Documents

- Natural Attenuation Assessment Report (NAAR) (Draft)
- SD036/SD037 RPO Work Plan (Draft)
- DP039 RPO Work Plan (Draft)
- Union Creek Sites SD001 & SD033 Remedial Action Report(Draft)
- ST027B Site Characterization Report (Draft)
- ***2009 GWTP RPO Annual Report (Draft)***
- ***CAMU 2008-2009 Monitoring Annual Report (Draft)***

Field Work

- DP039 Monitoring Well & Biobarrier Injection Well Installation
- SD037 Monitoring Well & EVO Injection Well Installation
- SS016 Monitoring Well Installation
- SS015 Site Characterization (Round ***3***)
- 2010 GSAP Annual Sampling Event - 2010

Upcoming Documents & Field Work

Documents

• ***Phytostabilization Study Report***	***June***
• Focused Feasibility Study (FFS)	July

Field Work

• LF007C Site Characterization (Wetlands)	TBD
• ST018 GETS Installation	TBD
• SS016 Bioreactor Installation	TBD
• ***FT005 Sample Collection***	***May***
• ***EVO Injection – Sites SD037 & DP039***	***June***
• ***SD036 Injection Well Installation***	***TBD***