APPENDIX J
Evaluation of Water Treatment Options for Initial Well Development Water

Technical Memorandum

Evaluation of Disposal Options for Initial Development Water Generated during Operable Unit 3 Municipal Production Well Rehabilitation

National Aeronautics and Space Administration, Jet Propulsion Laboratory, Pasadena, California

Draft June 2008

1.0 INTRODUCTION

To address chemicals in off-facility groundwater, NASA has agreed to fund removal of target chemicals (perchlorate and VOCs) from the aquifer at four CoP drinking water wells by adding a treatment facility to treat pumped groundwater at the Windsor Reservoir. This treatment facility will be known as the Monk Hill Treatment System (MHTS). In this remedy, NASA will directly administer the work associated with designing, permitting, and constructing the MHTS. Groundwater from four CoP drinking water wells – Arroyo Well, Well 52, Windsor Well, and Ventura Well – will be cleaned in this new treatment facility by a liquid-phase granular activated carbon (LGAC) system to remove VOCs, and an ion exchange system to remove perchlorate.

Due to the age and recent inoperation of these wells, they must be rehabilitated prior to activation. A significant volume of water is expected to be generated during the initial phase of the rehabilitation effort (well cleaning) and during subsequent well development and performance testing activities. During the initial well cleaning, the anticipated water quality (elevated turbidity, sand content, and chemical concentrations) will be such that MHTS cannot be used for treatment due to design limitations. Therefore, an alternate means of treatment, such as off-site disposal or temporary on-site treatment and disposal, must be used. Because the initial well cleaning will substantially increase the quality of extracted water, it is anticipated that water generated during the latter stages of the rehabilitation effort (well development and performance testing) can be routed through the MHTS for treatment and subsequent disposal/reuse. This technical memorandum evaluates the cost/feasibility of different options for disposal of initial development water.

2.0 INITIAL WELL CLEANING ACTIVITIES

After the equipment has been removed from the well and inspected, an initial well cleaning will be performed to remove debris that may have accumulated on the well casing over time. During the initial well cleaning, it is anticipated that one or more of the procedures will be utilized: brushing, dual-swab airlifting, chemical treatment, air bursting, and AquaFreed®.

Brushing is utilized as a preparative step before other rehabilitation techniques are utilized in the well, and will likely be performed in each well. The inside of the existing well casing will be brushed with a wire or nylon brush to remove debris and incrustations. Following the brushing activities, material that has accumulated in the sump will be removed using a suction bailer, or open-ended air lift pumping tool.

Dual-Swab Airlifting is designed to dislodge debris from the casing and remove it from the well. The tool consists of a vertical discharge pipe (eductor) with a smaller airline suspended down the middle of the pipe. A perforated section of pipe with two rubber swab flanges is connected and located at the bottom of the eductor pipe. The swabs are primarily designed for cleaning and stabilization of the assembly in the well. The airline discharge is installed above the surge blocks inside the pipe. Compressed air is pumped through the airline from the surface with an air compressor and is released into the eductor pipe causing a

mixture of air bubbles and water. Continued injection of compressed air causes the mixture to flow up and out of the eductor pipe. It is anticipated that the dual-swab tool will be moved up and down within the well over an approximately 10-15 foot interval while simultaneously pumping the well. The actual field-applied method depends upon a number of factors, including air volume, submergence (i.e., the depth below the static water level at which the air is introduced), total lift, and the cross-sectional area of the discharge or eductor pipe (i.e., diameter of discharge pipe). Dual-swab airlifting will likely be implemented in each well following the initial brushing. This technique will be performed over a 24-hour period at a maximum flowrate of 300 gallons per minute (gpm), and will result in approximately 300,000 gallons of water and debris being removed from the well.

Chemical Treatment may be performed on the well casing using acids, dispersants, or disinfectants. The chemicals will be mixed above-ground and injected into the well via a tremie pipe between dual/swabs with rubbers set 10 feet apart. The injected chemicals will have a sufficient quantity to displace at least one complete borehole volume and have a concentration sufficient enough to not to become diluted. The injected chemical solution will remain in the well for a period of time (chemical-specific) that is sufficient for the chemicals to react with and dislodge or dissolve the debris that has accumulated on the well casing. Once the chemical treatment has reacted with the debris, the solution will be removed from the well.

Air Bursting may be performed in the well to further clean the casing. This method is performed using an air gun device (BoreBlast®) that is lowered into the well on a high pressure hose. The gun is pressurized with an inert gas (e.g., nitrogen) when it reaches the perforations in the well casing. As the pressure is released, the pressure wave dislodges mineral scale from the casing and scours the casing surface as the inert gas rushes to the surface.

AquaFreed® is a method that involves the controlled injection of liquid and vapor-phase carbon dioxide (CO_2) into a well. The well is sealed after three injection lines have been strategically placed throughout the perforated zones of the well. The CO_2 expands up to 500 times when the liquid converts to a gas; this rapid expansion allows for excellent penetration of the gravel pack and formation. The groundwater in the well will become saturated with CO_2 forming a mild carbonic acid that will assist in the breakup the matrix of the mineral deposits within the well. The resulting physical agitation scours the casing and gravel pack. Injection of the CO_2 creates a pressurized environment inside the sealed well casing and depresses the column of water in the casing down to the top of the perforations where it begins to constantly surge the well in response to the injection process.

The initial well cleaning is anticipated to generate approximately 300,000 gallons of development water from each well, for a total of 1.2 million gallons. The vast majority of this water is generated during the dual-swab airlifting process at an estimated maximum flow rate of 300 gpm.

3.0 DEVELOPMENT WATER DISPOSAL OPTIONS

Water and debris removed from the production wells during initial well cleaning will have to be disposed of accordingly. Two disposal options have been evaluated: temporary containment and offsite disposal, and temporary on-site treatment and disposal. The following subsections discuss these options in detail.

3.1 Temporary Containment and Offsite Disposal

This disposal option consists of temporary on-site containment and subsequent offsite disposal of water generated during initial well cleaning activities. The containment process consists of connecting approximately eight 21,000-gallon Baker tanks to the discharge line in series. The tanks will be staged adjacent to each wellhead during well cleaning. Although the total capacity of these tanks is slightly more than half that of the estimated volume of development water (300,000 gallons), space restrictions at the

wellheads dictate that the use of additional tanks is not logistically feasible. The first one to two tanks in series will serve as settling tanks for the significant quantity of solids (i.e., sand and debris) that is expected to be generated during the initial well cleaning. As needed, water will be removed from the Baker tanks using a vacuum truck and transported offsite for disposal. Samples of the development water will need to be collected and analyzed prior to removal to determine the appropriate disposal method. The estimated volume of development water necessitates roughly 64 change-outs using vacuum trucks, resulting in significant increased traffic flow around the wells. The change-outs will need to occur during well cleaning activities due to the aforementioned storage restrictions. Table 1 presents the advantages, disadvantages, and approximate cost associated with the temporary containment and offsite disposal option.

Table 1. Summary of Development Water Disposal Options

Disposal Option	Advantages	Disadvantages	Approximate Cost
Temporary Containment and Offsite Disposal	• No temporary treatment system required to treat water prior to disposal • Wells developed in series, so only one set of equipment is necessary	• Cost and labor intensive • Required number of change-outs results in increased traffic and noise • Increased resource usage – 64 tanker truck change-outs required per well (consumes roughly 5,200 gallons of gasoline/diesel) • Logistical difficulties – space for Baker tanks is limited near the production wells • Extraction rate and duration limited by the number of tanks and the change-out frequency • Development water cannot be reclaimed • Must relocate equipment between wells	$725,000
On-Site Treatment and Disposal	• Wells developed in series, so treatment system can be installed at a single central location • Development water can be reclaimed through infiltration • Less labor intensive • Lower cost • Less resource usage • Minimal traffic and noise • Extraction rate not limited by storage volume	• Treated water must meet RWQCB WDRs prior to disposal. • Water must be routed significant distances (>2,000 ft) from the wellheads to the TTS • Discharge piping must cross access road	$540,000 to $690,000[(a)]

(a) Approximate cost is based on two subcontractor estimates for rental of equipment for on-site treatment and disposal.

3.2 On-Site Treatment and Disposal

This disposal option consists of on-site treatment and subsequent disposal of development water generated during well cleaning activities. Table 1 presents the advantages, disadvantages, and approximate cost associated with this treatment option. A temporary treatment system (TTS) capable of handling a 300 gpm influent would be installed at the Ventura well in the adjacent fenced yard. Development water from each of the wells would be transferred to the TTS for treatment via existing below-ground piping (from the Windsor well) or up to 2,500 ft of temporary above-ground piping (from Well 52, Arroyo Well, and Ventura Well). Water from each well will first be routed through two Baker tanks at the wellhead that will serve as settling tanks. The development water will be treated to meet the Regional Water Quality Control Board (RWQCB) General Waste Discharge Requirements (WDRs) prior to disposal. To meet these requirements, the TTS will be engineered to consist of a three-step process that includes a filtration step, an adsorption step, and an ion exchange (IX) step. The filtration step will consist of a sand filter that is designed to

remove particulate and coagulated particles, resulting in effluent water having turbidity less than 0.5 NTU. The second step will consist of volatile organic compound (VOC) adsorption by granular activated carbon (GAC), and the third step will consist of a perchlorate-sensitive IX resin that will be utilized to remove perchlorate (and to a lesser degree sulfate and nitrate) from the water.

Treated water leaving the TTS will be routed through a holding (Baker) tank, where composite samples will be periodically collected for analysis to ensure that the WDRs are being met. Water from the holding tank will be discharged via temporary above-ground piping to Arroyo Seco Spreading Basin 10, which is located approximately 200 ft northwest of the Ventura well. This temporary piping will cross the access road in at least one location.

4.0 RECOMMENDATIONS

Based on the information presented above, it is recommended that the on-site treatment and disposal option be implemented to handle the development water generated during the initial well cleaning. Although this option requires a significant up-front investment, it is less labor intensive, uses fewer resources, and does not limit the rate and duration of the initial cleaning process. In addition, this option is lower in cost and allows for reclamation of extracted water.

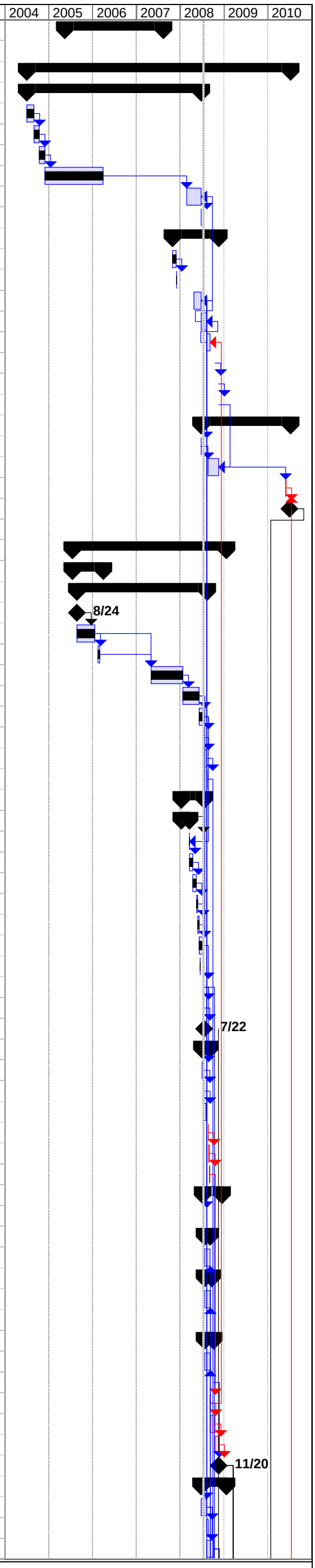
APPENDIX K
Expected Development Water Quality and Associated WDRs

Maximum Expected Influent Concentrations and Applicable Regulatory Criteria

COPC	Units	Influent Estimate	Regulatory Criteria	
1,1,1-Trichloroethane	µg/L	0.25	200	MCL
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	µg/L	4.51	1200	MCL
1,1-Dichloroethane	µg/L	0.249	5	MCL
1,2-Dibromo-3-chloropropane	µg/L	0.006	--	
1,2-Dichloroethane	µg/L	0.81	0.5	MCL
Bromodichloromethane	µg/L	0.419	--	
Bromoform	µg/L	0.452	--	
Carbon tetrachloride	µg/L	7.01	0.5	MCL
Chloroform	µg/L	2.67	--	
Chloromethane	µg/L	0.249	--	
cis-1,2-Dichloroethene	µg/L	0.246	6	MCL
Dibromochloromethane	µg/L	0.538	--	
Methylene chloride	µg/L	0.296	--	
Tetrachloroethene (PCE)	µg/L	0.98	5	MCL
Trichloroethene (TCE)	µg/L	5.9	5	MCL
Trichlorofluoromethane (Freon 11)	µg/L	1.578	150	
Perchlorate	mg/L	120	0.006	NL
Chlorate	mg/L	0.3	0.8	NL
1,2,3-Trichloropropane	µg/L	0.038	0.005	NL
1,4-Dioxane	µg/L	0.749	3	NL
HMX	µg/L	0.255	350	NL
RDX	µg/L	1.243	0.3	NL
Trinitrotoluene	µg/L	1.167	1	NL
Nitrobenzene	µg/L	1.644	--	
N-nitrosodiethylamine	µg/L	0.001	0.01	NL
N-nitrosodimethylamine	µg/L	0.001	0.01	NL
N-nitrosodi-n-butylamine	µg/L	0.001	--	
N-nitrosodi-n-propylamine	µg/L	0.004	0.01	NL
N-nitrosodiphenylamine	µg/L	0.003	--	
N-nitrosopiperidine	µg/L	0.0005	--	
Aluminum	mg/L	0.228	1	MCL
Arsenic	mg/L	0.002	0.05	MCL
Barium	mg/L	0.073	1	MCL
Boron	mg/L	0.143	1	NL
Calcium	mg/L	92.69	--	
Chloride	mg/L	69	250	SMCL
Chromium	mg/L	0.004	0.05	MCL
Chromium, Hexavalent	mg/L	0.002	--	
Copper	mg/L	0.01	1	SMCL
Fluoride	mg/L	0.522	2	MCL
Iron	mg/L	0.55	0.3	SMCL
Lead	mg/L	0.002	--	
Magnesium	mg/L	34.57	--	
Manganese	mg/L	0.011	0.05	SMCL
Nickel	mg/L	0.0072	0.1	MCL
Potassium	mg/L	2.367	--	
Silica	mg/L	24.68	--	
Sodium	mg/L	29.455	--	
Sulfate	mg/L	74	250	SMCL
Uranium	pCi/L	4.448	20	MCL
Vanadium	mg/L	0.011	0.05	NL
Zinc	mg/L	0.016	5	SMCL
Alpha, Gross	pCi/L	4.809	15	MCL
Beta, Gross	pCi/L	4.64	50	MCL
Radium-226	pCi/L	0.095	--	
Radium-226 and Radium-228	pCi/L	1.539	5	MCL
Radium-228	pCi/L	0.635	--	
Alkalinity as CaCO3	mg/L	188.6	--	
Ammonia	mg/L	0.12	--	
Bicarbonate as CaCO3	mg/L	246	--	
Carbonate as CaCO3	mg/L	0.209	--	
Color		1.21	15	SMCL
Conductivity	UMHO	672.1	900	SMCL
Foaming Agents	mg/L	0.00003	0.05	SMCL
Hardness as CaCO3	mg/L	277.15	--	
Nitrate (as NO3)	mg/L	41	45	MCL
pH		7.391	--	
Total Dissolved Solids	mg/L	656	500	SMCL
Turbidity	NTU	0.75	5	SMCL

APPENDIX L
MHTS Project Schedule

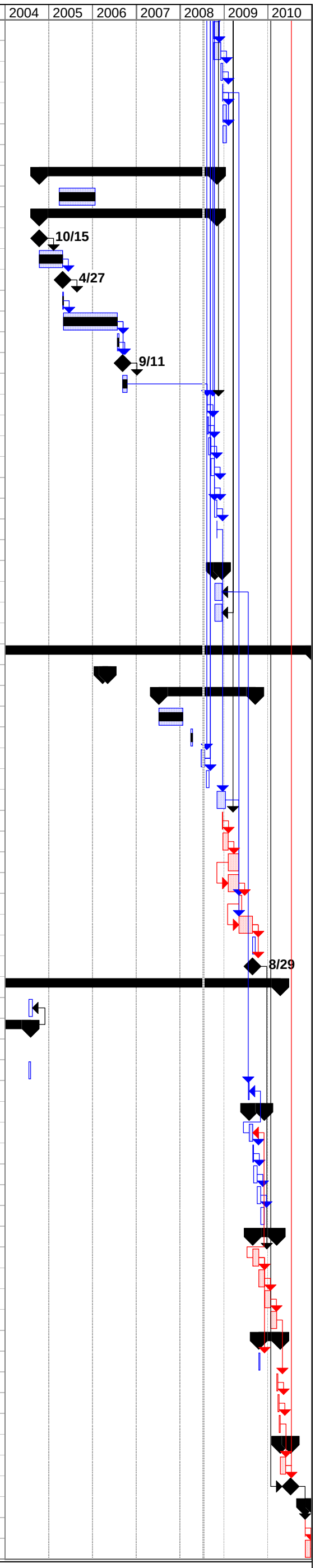
ID	Task Name	Duration	Start	Finish
1	**CERCLA Documentation**	**823 days**	**Mon 5/16/05**	**Thu 8/16/07**
23				
24	**DPH Permitting**	**2201 days**	**Sat 7/3/04**	**Mon 7/12/10**
25	**Policy Memo 97-005**	**1455 days**	**Sat 7/3/04**	**Thu 6/26/08**
26	Prepare Draft 97-005 Document	60 days	Sat 7/3/04	Tue 8/31/04
27	PWP Review	44 days	Wed 9/1/04	Thu 10/14/04
28	Prepare Revised Draft 97-005 Document	47 days	Fri 10/15/04	Tue 11/30/04
29	DPH Review	486 days	Wed 12/1/04	Fri 3/31/06
30	Prepare Final 97-005 Document	120 days	Wed 2/27/08	Thu 6/26/08
31	Submit Final 97-005 Document	1 day	Thu 6/26/08	Thu 6/26/08
32	**Technical Report/RD-RA Work Plan/PSP**	**386 days**	**Thu 11/1/07**	**Thu 11/20/08**
33	Prepare Conceptual Design Report	30 days	Thu 11/1/07	Fri 11/30/07
34	Regulatory Review Meeting	1 day	Tue 12/4/07	Tue 12/4/07
35	Prepare Draft TR/RD-RA WP/PSP (50% Design)	60 days	Sun 4/27/08	Thu 6/26/08
36	Regulatory (including DPH) Review	45 days	Thu 6/26/08	Sun 8/10/08
37	Prepare Revised Draft TR/RD-RA WP/PSP (90% Design)	30 days	Sun 8/10/08	Mon 9/8/08
38	Regulatory Review	42 days	Tue 9/9/08	Mon 10/20/08
39	Prepare Final TR/RD-RA WP/PSP (100% Design)	30 days	Tue 10/21/08	Wed 11/19/08
40	Submit Final Report to DPH	1 day	Thu 11/20/08	Thu 11/20/08
41	**DPH Permit Amendment: Pasadena Water Permit**	**747 days**	**Thu 6/26/08**	**Mon 7/12/10**
42	Application to DPH	1 day	Thu 6/26/08	Thu 6/26/08
43	DPH Engineering Report	90 days	Sat 8/23/08	Thu 11/20/08
44	Public Hearing	1 day	Wed 6/2/10	Wed 6/2/10
45	DPH Evaluation and Permit Issuance	10 days	Sat 7/3/10	Mon 7/12/10
46				
47	**City of Pasadena Permitting**	**1284 days**	**Tue 7/19/05**	**Thu 1/22/09**
48	**Predevelopment Plan Review**	**258 days**	**Tue 7/19/05**	**Sun 4/2/06**
60	**CEQA**	**1087 days**	**Wed 8/24/05**	**Fri 8/15/08**
61	Draft Initial Study to NASA/City	0 days	Wed 8/24/05	Wed 8/24/05
62	PWP Review	150 days	Thu 8/25/05	Sat 1/21/06
63	Conducting Tree Survey at Windsor Reservoir	16 days	Thu 2/16/06	Fri 3/3/06
64	Incorporating City Comments	265 days	Sun 5/6/07	Fri 1/25/08
65	City Review of Final Initial Study Document	136 days	Sat 1/26/08	Mon 6/9/08
66	CEQA Posted for Public Review	30 days	Tue 6/10/08	Wed 7/9/08
67	Approval of CEQA/MND	1 day	Thu 7/10/08	Thu 7/10/08
68	Statute of Limitations	30 days	Wed 7/16/08	Thu 8/14/08
69	CEQA Final	1 day	Fri 8/15/08	Fri 8/15/08
70	**Conditional Use Permit (CUP) Processing**	**191 days**	**Mon 1/14/08**	**Tue 7/22/08**
71	**Preparation of MAF**	**67 days**	**Mon 1/14/08**	**Thu 3/20/08**
81	Submit MAF to the Pasadena Planning Dept	1 day	Thu 3/20/08	Thu 3/20/08
82	CUP Application Deemed Complete	28 days	Fri 3/21/08	Thu 4/17/08
83	City Review of CUP	29 days	Fri 4/18/08	Fri 5/16/08
84	Revise CUP Application per City Comments	10 days	Mon 5/19/08	Wed 5/28/08
85	City Review of Final CUP	12 days	Thu 5/29/08	Mon 6/9/08
86	Public Comment Period for CUP & CEQA	30 days	Tue 6/10/08	Wed 7/9/08
87	Neighborhood Meeting	1 day	Wed 6/18/08	Wed 6/18/08
88	Public Hearing and CUP Decision	1 day	Thu 7/10/08	Thu 7/10/08
89	Appeals Period for CUP Decision	11 days	Fri 7/11/08	Mon 7/21/08
90	CUP Approval	1 day	Tue 7/22/08	Tue 7/22/08
91	**Design Commission Review**	**64 days**	**Fri 7/4/08**	**Fri 9/5/08**
92	Prepare Design Commission Package	18 days	Fri 7/4/08	Mon 7/21/08
93	Submit Design Commission Package	1 day	Tue 7/22/08	Tue 7/22/08
94	Design Review Notice Period	14 days	Tue 7/22/08	Mon 8/4/08
95	Design Review Hearing	1 day	Mon 8/25/08	Mon 8/25/08
96	Design Review Appeals Period	10 days	Tue 8/26/08	Thu 9/4/08
97	Design Commission Approval	1 day	Fri 9/5/08	Fri 9/5/08
98	**Building Department Permitting**	**161 days**	**Thu 7/10/08**	**Wed 12/17/08**
99	Building Permit Review Meeting	1 day	Thu 7/10/08	Thu 7/10/08
100	**Storm Water Pollution Prevention (SUSMP)**	**45 days**	**Sat 7/26/08**	**Mon 9/8/08**
101	SUSMP Preparation and Submittal	45 days	Sat 7/26/08	Mon 9/8/08
102	**Construction and Demolition Waste Management Plan**	**60 days**	**Sat 7/26/08**	**Tue 9/23/08**
103	Plan Preparation and Submittal	45 days	Sat 7/26/08	Mon 9/8/08
104	Plan Review and Approval	15 days	Tue 9/9/08	Tue 9/23/08
105	**Construction/Traffic Plans**	**75 days**	**Sat 7/26/08**	**Wed 10/8/08**
106	Prepare and Submit of Plans	45 days	Sat 7/26/08	Mon 9/8/08
107	Plan Review/Approval	30 days	Tue 9/9/08	Wed 10/8/08
108	Submit Bldg Permit Application (90% Design)	1 day	Mon 9/8/08	Mon 9/8/08
109	Building Dept Review of Revised Draft Design	42 days	Tue 9/9/08	Mon 10/20/08
110	Incorporate Comments and Re-submit (100% Design)	30 days	Tue 10/21/08	Wed 11/19/08
111	Obtain Building Department Approval	28 days	Thu 11/20/08	Wed 12/17/08
112	**California Accidental Release Plan**	**211 days**	**Thu 6/26/08**	**Thu 1/22/09**
113	CalARP Preparation and Submittal	45 days	Thu 6/26/08	Sat 8/9/08
114	Public Notification	15 days	Sun 8/10/08	Sun 8/24/08
115	Completeness Review	60 days	Sun 8/10/08	Wed 10/8/08



Project: Windsor Reservoir Treatment
Date: Thu 7/10/08

Task		Summary	
Project Guide: Critical Task		Project Summary	
Split		External Tasks	
Progress		External Milestone	
Milestone		Deadline	

ID	Task Name	Duration	Start	Finish
116	Public Comment Period	45 days	Thu 10/9/08	Sat 11/22/08
117	Technical Review by Fire Department	60 days	Thu 10/9/08	Sun 12/7/08
118	Address All Comments and Revise Plan	15 days	Mon 12/8/08	Mon 12/22/08
119	CalARP Approval by Pasadena Fire Department	1 day	Tue 12/23/08	Tue 12/23/08
120	Prepare and Submit Process Safety Management Plan (OSHA)	30 days	Wed 12/24/08	Thu 1/22/09
121	Prepare and Submit Risk Management Plan (EPA)	30 days	Wed 12/24/08	Thu 1/22/09
122				
123	**PWP System Procurement**	**1483 days**	**Fri 10/15/04**	**Wed 11/5/08**
124	Monk Hill Treatment System Agreement	300 days	Wed 3/30/05	Mon 1/23/06
125	**System Procurement**	**1483 days**	**Fri 10/15/04**	**Wed 11/5/08**
126	Battelle Submit Input on RFP	0 days	Fri 10/15/04	Fri 10/15/04
127	PWP Updates	195 days	Fri 10/15/04	Wed 4/27/05
128	PWP Submit Standard RfP for NASA Review	0 days	Wed 4/27/05	Wed 4/27/05
129	Caltech and NASA Review	7 days	Thu 4/28/05	Wed 5/4/05
130	City Review of the RfP	450 days	Thu 5/5/05	Fri 7/28/06
131	NASA Finalization of the RfP	14 days	Sat 7/29/06	Fri 8/11/06
132	Distribute RFP to Potential Bidders	0 days	Mon 9/11/06	Mon 9/11/06
133	Receive Vendor Quotations	37 days	Mon 9/11/06	Tue 10/17/06
134	Recommendation by Staff	1 day	Sat 8/16/08	Sat 8/16/08
135	Contract Drafting	10 days	Sun 8/17/08	Tue 8/26/08
136	Negotiate Contract with Selected Vendor	21 days	Wed 8/27/08	Tue 9/16/08
137	Agenda Report Routing and Approval	28 days	Wed 9/17/08	Tue 10/14/08
138	City Council Approval	1 day	Wed 10/15/08	Wed 10/15/08
139	Contract Review, City Signatures, and City Approval	20 days	Thu 10/16/08	Tue 11/4/08
140	Notice to Proceed to the Vendor	1 day	Wed 11/5/08	Wed 11/5/08
141				
142	**Coordination with Other Agencies**	**60 days**	**Sun 10/19/08**	**Wed 12/17/08**
143	Coordinating with Raymond Basin	60 days	Sun 10/19/08	Wed 12/17/08
144	Coordinating with LA RWQCB Permitting	60 days	Sun 10/19/08	Wed 12/17/08
145				
146	**Treatment System Installation/Startup**	**2704 days**	**Tue 9/2/03**	**Wed 1/26/11**
147	**Contracting-Installation**	**42 days**	**Tue 3/28/06**	**Mon 5/8/06**
151	**System Installation (NASA)**	**804 days**	**Tue 7/10/07**	**Sun 9/20/09**
152	Pipeline Survey	200 days	Tue 7/10/07	Fri 1/25/08
153	Pipeline Pressure Tests	15 days	Tue 4/1/08	Tue 4/15/08
154	Establish Subcontracts	30 days	Thu 6/26/08	Fri 7/25/08
155	Landscaping - Phase I	23 days	Sat 8/9/08	Sun 8/31/08
156	Equipment Procurement	70 days	Thu 11/6/08	Wed 1/14/09
157	Mobilize Construction Equipment	3 days	Sun 12/21/08	Tue 12/23/08
158	Concrete Pad	45 days	Wed 12/24/08	Fri 2/6/09
159	Underground Pipeline Installation	90 days	Sat 2/7/09	Thu 5/7/09
160	Site Grading and Driveway Construction	90 days	Sat 2/7/09	Thu 5/7/09
161	Electrical Systems	23 days	Fri 5/8/09	Sat 5/30/09
162	Install Ion Exchange, GAC Units, and Misc Piping	113 days	Fri 5/8/09	Fri 8/28/09
163	Landscaping - Phase II	23 days	Sat 8/29/09	Sun 9/20/09
164	System Operational	1 day	Sat 8/29/09	Sat 8/29/09
165	**Well Rehabilitation (NASA)**	**2420 days**	**Tue 9/2/03**	**Sat 4/17/10**
166	Establish Subcontracts	30 days	Tue 7/20/04	Wed 8/18/04
167	**Initial Well/Pump Inspection**	**337 days**	**Tue 9/2/03**	**Tue 8/3/04**
168	Arroyo and Well 52 Inspections	15 days	Tue 9/2/03	Tue 9/16/03
169	Windsor and Ventura Inspections	15 days	Tue 7/20/04	Tue 8/3/04
170	Install Temporary Treatment System	7 days	Sat 7/25/09	Sat 8/1/09
171	**Well Repair/Rehab**	**127 days**	**Sat 8/1/09**	**Sat 12/5/09**
172	Windsor Well	30 days	Sat 8/1/09	Mon 8/31/09
173	Move Temporary Treatment System	7 days	Mon 8/31/09	Sun 9/6/09
174	Arroyo Well	30 days	Mon 9/7/09	Tue 10/6/09
175	Ventura Well	30 days	Wed 10/7/09	Thu 11/5/09
176	Well 52	30 days	Fri 11/6/09	Sat 12/5/09
177	**Test Pumping/Spinner and Video Logging**	**200 days**	**Mon 8/31/09**	**Thu 3/18/10**
178	Windsor Well	50 days	Mon 8/31/09	Mon 10/19/09
179	Arroyo Well	50 days	Tue 10/20/09	Tue 12/8/09
180	Ventura Well	50 days	Wed 12/9/09	Wed 1/27/10
181	Well 52	50 days	Thu 1/28/10	Thu 3/18/10
182	**Pump Installation and Well Performance Testing**	**180 days**	**Tue 10/20/09**	**Sat 4/17/10**
183	Windsor Well	10 days	Tue 10/20/09	Thu 10/29/09
184	Arroyo Well	10 days	Fri 3/19/10	Sun 3/28/10
185	Ventura Well	10 days	Mon 3/29/10	Wed 4/7/10
186	Well 52	10 days	Thu 4/8/10	Sat 4/17/10
187	**System Operation**	**87 days**	**Sun 4/18/10**	**Tue 7/13/10**
188	Startup Testing	45 days	Sun 4/18/10	Tue 6/1/10
189	Water Delivery	1 day	Tue 7/13/10	Tue 7/13/10
190	**Installation Report**	**77 days**	**Thu 11/11/10**	**Wed 1/26/11**
191	Submit Draft Report	1 day	Thu 11/11/10	Thu 11/11/10
192	StakeHolders Review	45 days	Fri 11/12/10	Sun 12/26/10



Project: Windsor Reservoir Treatment
Date: Thu 7/10/08

Task		Summary	
Project Guide: Critical Task		Project Summary	
Split		External Tasks	
Progress		External Milestone	
Milestone		Deadline	

ID	Task Name	Duration	Start	Finish	2004	2005	2006	2007	2008	2009	2010
193	Prepare Final Report	30 days	Mon 12/27/10	Tue 1/25/11							
194	Submit Final Report	1 day	Wed 1/26/11	Wed 1/26/11							

Project: Windsor Reservoir Treatment
Date: Thu 7/10/08

Task		Summary	
Project Guide: Critical Task		Project Summary	
Split		External Tasks	
Progress		External Milestone	
Milestone		Deadline	

APPENDIX M
MHTS Operations and Maintenance Manual

(not provided at this time)