



CH2MHILL



Twin Oaks Valley Water Treatment Plant “Meeting the Challenge”

September 20, 2011

CH2MHILL Retirees Retreat, San Diego

Project Highlights

- Owner is San Diego County Water Authority (SDCWA)
- Greenfield 100-mgd drinking water treatment plant
- Competitive Cost and Non-Cost Selection Process
- CH2M HILL Signed Service Contract in Fall 2005
 - US \$157M design/build contract
 - US \$6M/yr operating contract (15 years with potential for 5 year add on)
- Delivering treated water since Spring 2008

Sources of Imported Water from MWD



- State Water Project Operated by CA DWR – 700 Miles Canals & Pipelines
- Colorado River Aqueduct Operated by MWD – 242 Miles Canals & Pipelines

Service Area & Supply

- San Diego County Water Authority (SDCWA) purchases raw and treated water from Metropolitan Water District of Southern California (MWD)
- SDCWA serves 24 member agencies
- 97% of county population (~ population 3,000,000)

■ PIPELINES

- Two aqueducts containing 5 pipelines
- Nearly 300 miles (gravity flow)
- 3'-9' diameter



San Diego County
Water Authority

The Challenge

- Provide new, local supply of high-quality drinking water to residents of San Diego County from highly variable sources
- Deliver treated water in 30 months from NTP
 - Design
 - Secure all permits (building, environmental, operating)
 - Negotiate contracts and purchase all major equipment
 - Construct
 - Startup and demonstrate performance
- Meet site challenges (constrained site, highly variable topography and geology)

The Challenge

- Minimize impact to community and environment
 - No gaseous chlorine use
 - Zero discharge
 - Minimize traffic
 - Low noise levels (≤ 45 dBA)
 - Minimize visual impacts
- Meet extremely high water quality goals
- Sustain the water supply to San Diego County during construction and operation

The First Challenge – Win the Contract!

- Intense, comprehensive 1-year competition
- Selection 30% on Cost, 70% on Non-Cost Factors
- Design-Build-Operate Contract Key Objectives
 - Meet Tight Schedule
 - Minimize overall costs by effectively integrating design, construction and operational tradeoffs
 - Secure treatment expertise beyond SDCWA's capabilities

Non-Cost Divided into 3 Categories

Business Terms & Conditions

Examples:

- Project Guarantor
- Acceptance Date
- Quantity/Quality relief
- Schedule Relief

Organization & Management Approach

Examples:

- Qualifications & Experience
- Key Staff
- Work Schedule
- Team Integration

Technical Approach

Examples:

- Treatment Processes
- Process Reliability
- Corrosion Control
- Environmental Stewardship

Single entity DBO delivery best ensures SDCWA objectives are achieved

Integrated
DBO

- Single-entity project delivery results in optimized solutions
- Treatment solution produces the best water now... and in the future

Quality
Water

On
Schedule

- Design and construction approach reduces risk to ensure on-time completion
- Each aspect of CH2M HILL's proposal minimizes lifecycle impacts

Least
Impact

CH2M HILL's Integrated DBO Team



Project Executives		
Jim Bloomquist Vice President	Bob Pruitt Area Office Manager	Mark Lasswell President, OMI

Program/Project Manager
Bob Chapman

QA/QC Managers
Programwide - Dan Reynolds
Design - Scott Trusler
Construction - Ray Selvy
Operations - Bill Gierer

Permitting and Regulatory Compliance Manager
John Gaston

Equipment Supply Manager
Greg Vialpando

Senior Design Support
Dan Wetstein

Design Manager
Bill Bellamy

Onsite Project Manager
Dennis Nelson

Operations Manager
Gary Wood

Conventional Treatment
Process - Mark Carlson
Design - Dave Grigsby

Membrane Treatment
Process - Jim Lozier
Design - Paul Mueller

Construction Manager
Dave Williams

Startup/Testing Manager
Bill Gierer

Chief Operator
Brian MacDonald

Tom Searle, President, Water Business Group
Mark Alpert, Project Signatory
Jeff Pearson, Design Project Development
Shawn Sock, O&M Project Development
Leofwin Clark, DBO Project Development

Integrated DBO

O&M startup leadership ensures successful Acceptance

Single-entity DBO delivery ensures ample O&M resources are committed early...and continuously

Notification of Award
Sept 8, 2005

Water Production
April 15, 2008

Brian MacDonald involved full time during design and construction

Design Period

Construction Period

Testing and Start-up (4 months)

O&M plays key role during systems testing, leading to functional leadership of startup

O&M Period

Eliminates "handover" in favor of continuous O&M integration through Acceptance

Q3

Q4

Q1

2005

Q2

MILL

Selection Summary

	Team A	Team B	Team C
Non-Price Criteria			
Business Terms and Conditions	1	1	3
Organization and Management Approach	1	2	3
Technical Approach	1	3	2
Price Criteria			
Net Present Value Analysis	1	2	3
Overall Ranking	1	2	3

Schedule Acceleration Approach

- Two design centers working simultaneously
 - >800 drawings and 1,500 pages of specs in < 6 months.
 - Construct while still designing
 - 3D-design
 - optimize coordination, space utilization, equipment accessibility, cost/space savings, public outreach
- Lessons practiced
 - CH2M HILL and GE Zenon carried same design, construction and startup teams from 96-mgd Lakeview WTP.
 - Early procurement of membranes



Aerial Overview and Schedule

Ground Breaking January 2006



April 2008

- *Contract NTP - 24 Oct 05*
- *Basis of Design Report - Dec 05*
- *Ground Breaking – Jan 06*
- *First concrete pour - April 06*
- *Final Design - Aug06*
- *Membranes installation - Nov 07*
- *Start-up/commissioning - Jan 08*
- *First treated water delivery – April 4 08*

300,000 cu yd earthwork
25,000 cu yd concrete

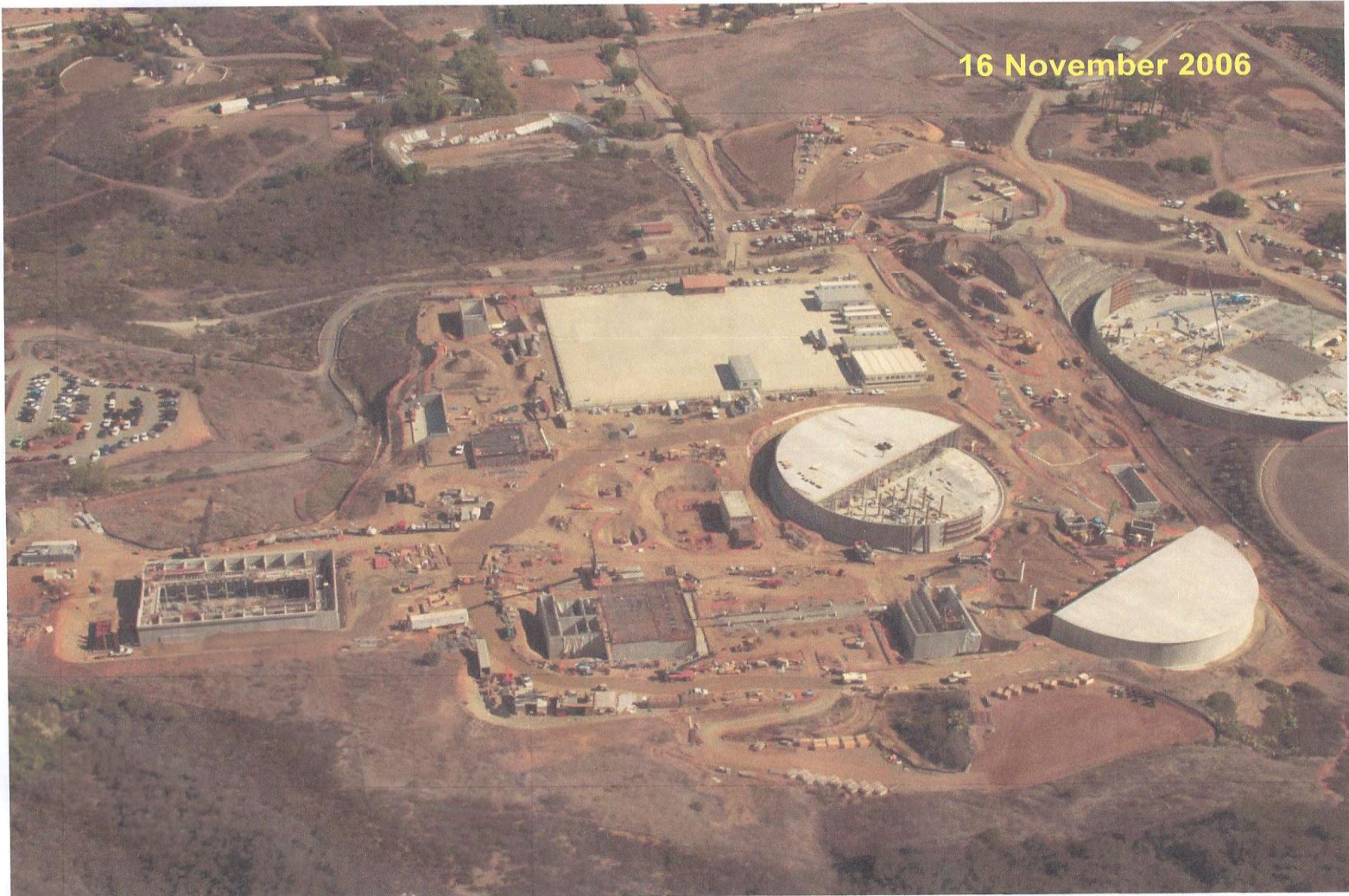


6 June 2006

16 November 2006



16 November 2006



14 December 2007



5 March 2008



World's Largest Submerged Membrane Water Treatment Plant

- Twin Oaks has **302.4-Million fibers in 8,064 modules** in 14 trains (>100,000 miles of fiber length)



ZeeWeed1000:
>37,500 fibers per module



Membranes - from Manufacture to Commissioning



Module manufacture - Feb - June '07



Cassette prep and shipment



Cassette uncrating and header installation - Nov '07



Commissioning - Sep '07 - Feb '08



Cassette install in tank - Nov '07



Cassette loaded on ZAP - Nov '07



Submerged Membrane Facility

Untreated Water Flow Control Facility

ESP Pump Station

Ozonation Facilities

Chemical Facilities

Biological Activated Carbon Contactors

Solids Processing

Switchgear Facility & Generators

Chemical Mix Chamber

Clearwell #2

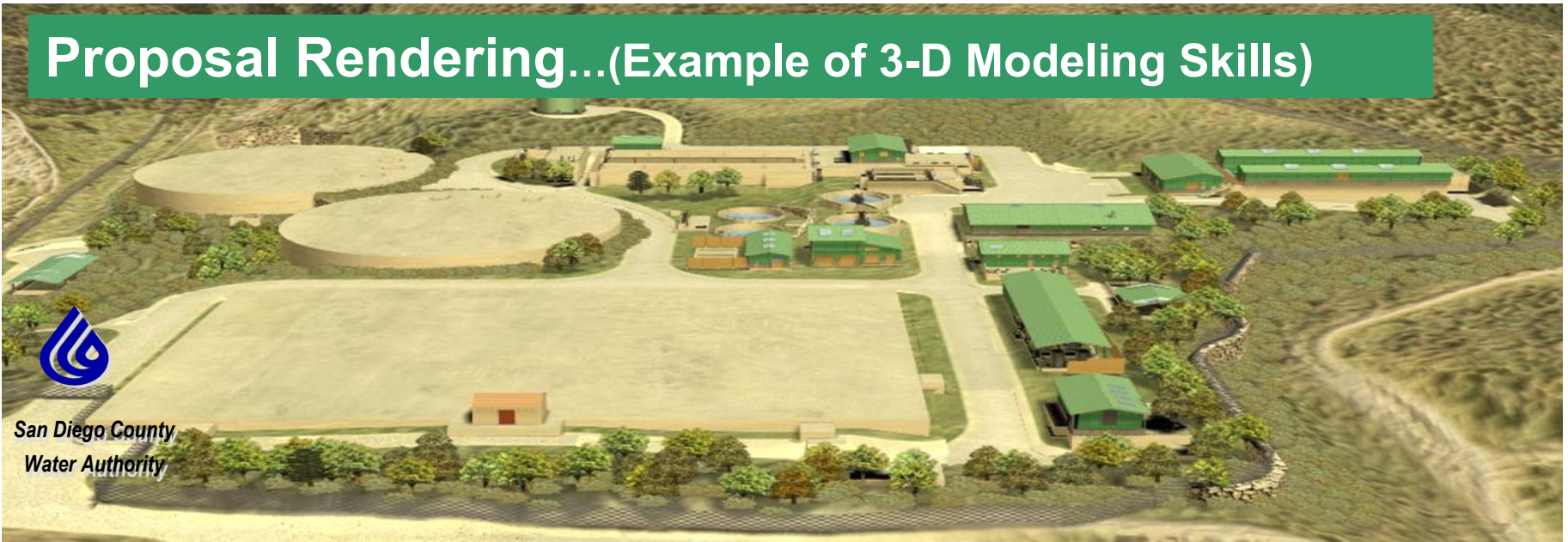
Clearwell #1

Treated Water Flow Control Facility



**San Diego County
Water Authority**

Proposal Rendering...(Example of 3-D Modeling Skills)

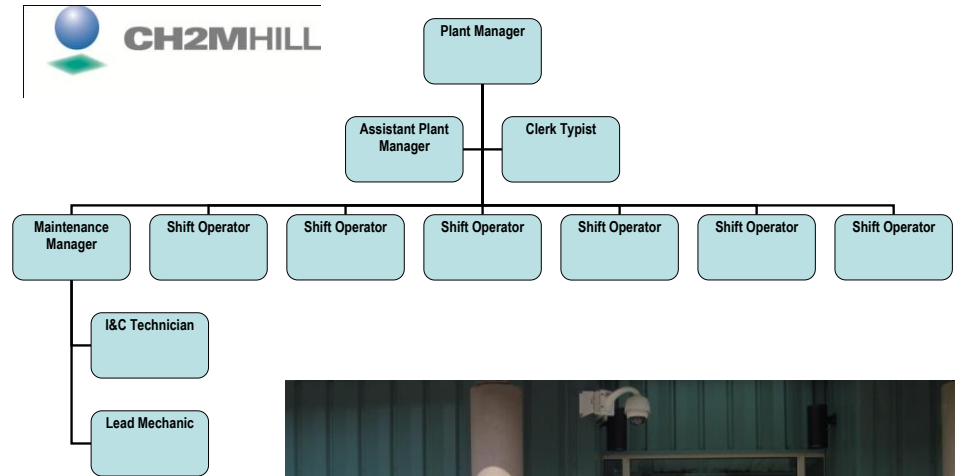


Completed Facility...(Neighbors selected final color scheme)



O&M Staff – Meeting the Challenge(s)

- 12-Total FTE's
- 7 Shift Operators (24/7/365)
- 3 Maintenance
 - ✓ 11 Chemical Feed Systems
 - ✓ 4 Emergency Generators
 - ✓ 41 Tanks
 - ✓ 32 Continuous WQ Analyzers
 - ✓ 40 Pumps
 - ✓ 100's Valves
 - ✓ ~ 28 Lab Analysis/Day
 - ✓ ~ 5 Bulk Chemical Deliveries/Week



Operational Environmental Challenge

- ≤ 45 dBA at Fence Line
- No Detectable Offsite Odors
- Lighting Compliant With County San Diego “Dark Sky Ordinance”
- Only 2 Neighbor Complaints Since April 2008



Guaranteed Maximum Electrical Use Challenge

Utilities Utilized (11.5.2 -6)

Type	Unit	Contractual Amount	Actual Amount Billed	Percent Difference	Comments
Guaranteed Maximum Electrical Usage	kWh/MG	336	299	-11.0%	Based on 72.23mgd for the billing period between 08/01/11 - 08/30/11
Guaranteed Maximum Electrical Usage	kWh	703,809	626,697	-11.0%	Based on 72.23mgd for the billing period between 08/01/11 - 08/30/11
Guaranteed Maximum Electrical Demand (Peak)	kW	2495	1280	-48.7%	Based on 72.23mgd for the billing period between 08/01/11 - 08/30/11
Guaranteed Maximum Electrical Cost	\$	103,537	92,136	-11.0%	Based on 72.23mgd for the billing period between 08/01/11 - 08/30/11
Other Utilities	none				

Achieved Contract Target 39 of 40 Months to Date

- Ozone Generator Optimization
- Chlorine Generation during Off Peak hrs
- Flow Smoothing of membrane process



Water Quality Challenge

- Client Contract Quality Requirements Greater than Regulatory Requirements
- 24– Contract WQ Parameters Monitored & Measured (Continuously, Daily, Weekly, Monthly)
- 3rd Party Taste and Odor Panel Review Rating



Water Quality Challenge

Parameter	Units	Contractual Limits	Regulatory Limits	Average	Max	Min
Turbidity (each membrane train and combined)	NTU	≤ 0.10 NTU 95% of the time (5% of a day is 72-mins)	< 1.0 NTU for 100% of time; and ≤ 0.3 NTU 95% of time	0.02	0.028	0.006
pH		Water Authority -Specified Level ± 0.15 95% of the time	Secondary standard range 6.5 - 8.5	8.08	8.139	8.047
Fluoride	mg/L	Water Authority -Specified Level ± 0.1 mg/L 95% of the time	Between 0.7 - 1.3 mg/L	0.84	0.88	0.805
Chloramine Residual	mg/L	Water Authority - Specified Residual ± 0.3 mg/L 95% of the time	≥ 0.5 mg/L to ≤ 4.0 mg/L	2.74	2.979	2.55
Fishy, Swampy, Grassy Tastes and Odors	TON	Flavor profile analysis intensity rating ≤ 2.0 TON	NA	ND	ND	ND

Tools for Meeting Water Quality Challenge

Login: Brian MacDonald (F2 to login) 9/13/2011 3:11:30 PM T_46 SHC Compliance v22540 Plant On

Sodium Hypochlorite Compliance

Instrument Select: Raw Water Treated Water

Raw Water Temp: 26.25 degC

Raw Water pH: 8.39 pH

Plant Flow: 68.28 Mgd

Free Chlorine Conc: 2.89 mg/L

Time T10: 1.94 mins

CT Actual: 5.59 mg*min/L

CT Required, Giardia: 11.74 mg*min/L

CT Required, Virus: 1.00 mg*min/L

Actual IR, Giardia: 0.48

Actual IR, Virus: 5.59

Log Inactivation, Virus:

Log Inactivation, Giardia:

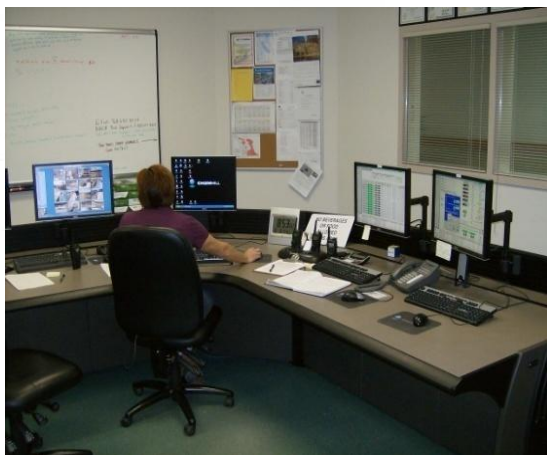
Effluent Water Out of Compliance Data

Alarm Trigger @ 19 Min Remaining	Compliance Sample	Minutes ODC Today	Number of ODC Events Today	Minutes ODC Yesterday	Number of ODC Events Yesterday
T_46_Turb_OOC_Alarm	Turbidity	2.0 min	1	0.0 min	0
T_46_pH_OOC_Alarm	pH	1.8 min	1	13.3 min	6
T_46_Cl2_OOC_Alarm	Total Cl2	0.0 min	0	0.5 min	1
T_46_Ratio_OOC_Alarm	Cl2 to NH3 Ratio	0.0 min	0	0.0 min	0
T_46_Fl_OOC_Alarm	Flouride	0.0 min	0	0.0 min	0

Average Ratio for Today is 5.195 ntu

Time	Group	Name	Alarm Comment	Priority	Value	State
09/13/2011 15:11:02	T_46	T_46_04x_RATIO.oHiHiAlarm	HiHi Alarm	2	True	ACK
09/13/2011 15:11:02	T_46	T_46_04x_RATIO.oHiAlarm	High Alarm	2	True	ACK
09/13/2011 15:09:20	T_46	T_46_04DC_RET.oHiAlarm	High Alarm	2	True	ACK
09/13/2011 14:06:07	T_36	T_36_962_LIT.oHiAlarm	High Alarm	2	True	ACK
09/13/2011 11:30:38	HMI	dHostStatus	HMI Host Status	3	Backup	ACK

Displaying 1 to 5 of 20 alarms. All 100 % Complete



97% Daily WQ Contract Compliance July 2010 to June 2011

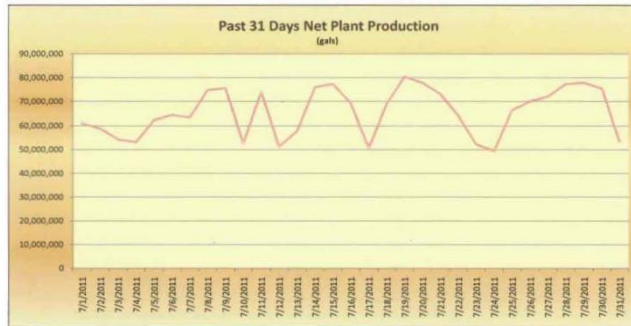
July 2010	28 of 31
August 2010	31 of 31
September 2010	26 of 30
October 2010	29 of 31
November 2010	29 of 30
December 2010	27 of 27
January 2011	17 of 17
February 2011	26 of 26
March 2011	31 of 31
April 2011	30 of 30
May 2011	31 of 31
June 2011	30 of 30

Continued Reporting of Operations & Maintenance Meeting the Challenge



Daily Plant Production Report

Report Processed 08/07/11 11:33:19 AM
For the period ending July 31, 2011



Date	(Total Treated Flow - Total Plant Water Usage) / Total Untreated Flow	= % Efficiency
7/1/2011	(60,946,304 - 89,794) / 60,999,428	99.77%
7/2/2011	(58,839,748 - 96,525) / 58,960,016	99.63%
7/3/2011	(54,212,096 - 40,164) / 54,276,928	99.81%
7/4/2011	(53,204,588 - 76,991) / 53,427,080	99.44%
7/5/2011	(62,157,008 - 53,354) / 62,230,864	99.80%
7/6/2011	(64,330,576 - 69,213) / 64,592,736	99.49%
7/7/2011	(63,280,916 - 99,055) / 63,466,732	99.55%
7/8/2011	(74,801,304 - 80,031) / 74,938,284	99.71%
7/9/2011	(75,648,064 - 92,549) / 75,638,696	99.89%
7/10/2011	(52,539,852 - 78,861) / 52,812,850	99.33%
7/11/2011	(74,090,168 - 64,670) / 76,739,184	96.46%
7/12/2011	(51,247,360 - 89,790) / 51,547,468	99.24%
7/13/2011	(57,696,824 - 52,655) / 57,936,924	99.49%
7/14/2011	(76,041,992 - 80,180) / 76,110,920	99.80%
7/15/2011	(77,376,344 - 91,001) / 77,492,864	99.73%
7/16/2011	(69,414,336 - 103,522) / 69,452,576	99.50%
7/17/2011	(50,661,132 - 60,350) / 50,987,904	99.24%
7/18/2011	(68,884,424 - 48,619) / 70,776,056	97.26%
7/19/2011	(80,541,680 - 94,775) / 80,785,800	99.58%
7/20/2011	(77,942,432 - 67,261) / 78,090,656	99.72%
7/21/2011	(73,218,000 - 82,896) / 73,391,192	99.65%
7/22/2011	(63,990,900 - 102,512) / 64,050,140	99.75%
7/23/2011	(52,250,060 - 82,933) / 52,471,576	99.42%
7/24/2011	(49,441,108 - 57,771) / 49,746,624	99.27%
7/25/2011	(66,336,720 - 49,010) / 66,685,968	99.40%
7/26/2011	(70,075,256 - 84,729) / 70,219,976	99.87%
7/27/2011	(72,124,880 - 79,624) / 72,357,832	99.57%
7/28/2011	(77,389,608 - 85,542) / 77,535,760	99.70%
7/29/2011	(77,965,536 - 94,272) / 78,127,592	99.67%
7/30/2011	(75,528,632 - 108,322) / 75,699,384	99.63%
7/31/2011	(53,596,052 - 97,165) / 53,963,560	99.14%

Weighted Average 99.41%

Note: All units in gals

Chlorine to Ammonia Ratio

Report Processed 08/07/11 11:19:28 AM
For the period ending July 31, 2011

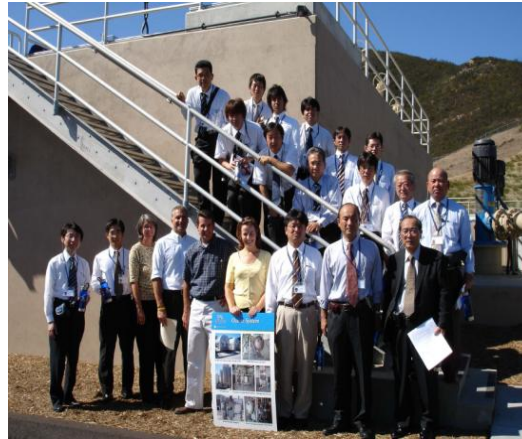
Treated Water - Chlorine to Ammonia Ratio is 'On-Spec' average for the day (< +/- 0.3 mg/L from setpoint)

Weekly Average - Chlorine to Ammonia Ratio

Date	Treated Water - Chlorine to Ammonia Ratio is 'On-Spec' average for the day (< +/- 0.3 mg/L from setpoint)	Weekly Average - Chlorine to Ammonia Ratio
6/26/2011	YES	
6/27/2011	YES	
6/28/2011	YES	
6/29/2011	YES	YES
6/30/2011	YES	
7/1/2011	YES	
7/2/2011	YES	
7/3/2011	YES	
7/4/2011	YES	
7/5/2011	YES	YES
7/6/2011	YES	
7/7/2011	YES	
7/8/2011	YES	
7/9/2011	YES	
7/10/2011	YES	
7/11/2011	YES	
7/12/2011	YES	YES
7/13/2011	YES	
7/14/2011	YES	
7/15/2011	YES	
7/16/2011	YES	
7/17/2011	YES	
7/18/2011	YES	
7/19/2011	YES	YES
7/20/2011	YES	
7/21/2011	YES	
7/22/2011	YES	
7/23/2011	YES	
7/24/2011	YES	
7/25/2011	YES	
7/26/2011	YES	
7/27/2011	YES	YES
7/28/2011	YES	
7/29/2011	YES	
7/30/2011	YES	
7/31/2011	YES	

O&M Involvement: Awards – Workshops - Tours

- National AWWA Technical Tours - 2008
- AWWA National Membrane Workshop - 2009
- SWMOA Workshop - 2010
- WEF Tours
- Colorado Basin Tours
- MWD Board of Director Tours



- ASCE - 2009 “Outstanding Water Project State CA”
- AAEE - 2009 “Excellence Environmental Engineering” (National Press Club D.C.)
- GWI - 2009 “Water Project of the Year” (Zurich Switzerland)
- SD Engineering Council 2010 “Outstanding Engineering Project”

Summary

- The TOVWTP represents the largest drinking water facility world-wide using submerged membrane filtration.
- The project successfully demonstrates how the DBO model can be used to cost effectively deliver a 100-mgd WTP on a demanding schedule.
- Innovative use of advanced treatment technologies (membranes, ozone and BAC) produce the highest quality drinking water while minimizing impacts on the community and the environment.

Significance of Meeting the Twin Oaks Challenge

- Further forged teamwork and integration within CH2MHILL
- Further strengthened our competitive DBO advantage
 - *Unique Integrated Full Service Capability*
 - *Won 4 out of 5 major DBO Contracts*
- *Great learning and professional growth opportunities for many employee-owners...our heritage and our future!*