UNITED STATES MARINE CORPS
MARINE CORPS BASE
BOX 555010
CAMP PENDLETON, CALIFORNIA 92055-5010

Item No. 16
Supporting Document No. 7

IN REPLY REFER TO:
5090.7C
ENVSEC/42
September 3, 2008

Mr. Alan Tell
California Department of Public Health
1350 Front Street, Room 2050
San Diego, CA 92101

Dear Mr. Tell:

SUBJECT: TRACER TEST REPORT

Enclosed please find the tracer test report, prepared on the basis of the test conducted at the Disinfection Contact Basin of the Southern Region Tertiary Treatment Plant (SRTTP).

The test resulted in a modal contact time of 156 minutes at a flow rate of 2.0 MGD, which exceeds Title 22 requirements of a minimum modal contact time of 90 minutes.

If there are any questions, please do not hesitate to contact me at (760) 725-9753 or Mr. Luis Ledesma, Wastewater Branch Head at (760) 725-0141.

Sincerely,

KHALIQUE A. KHAN, Ph.D., P.E.
Head, Environmental Engineering Division
Assistant Chief of Staff,
Environmental Security
By direction of the Commanding Officer

Enclosure: Tracer Test Report, SRTTP, Camp Pendleton

Copy to:
Mr. Sean Sterchi, District Engineer, California Department of Public Health
Mr. Robert Pierce, Regional Water Quality Control Board, San Diego Region

Camp Pendleton

Water and Wastewater System
Design, Build, Operate and Maintain
Contract N68711-04-D-5110-0016
DO 0016 (2nd Yr OM)

September 2, 2008

Tracer Test Report
Southern Region Tertiary Treatment Plant
Marine Corps Base Camp Pendleton

Title 22 Disinfection Criteria for Tertiary Recycled Water using Chlorine Disinfection (California Health Laws Related to Recycle Water, "The Purple Book" June 2001 Edition)

Title 22, 60301.230 defines disinfected tertiary recycled water as a filtered and subsequently disinfected wastewater that meets the following criteria when disinfected with chlorine:

The filtered wastewater has been disinfected by a "chlorine disinfection process following filtration that provides a CT (the product of total chlorine residual and modal contact time measured at the same point) value of not less than 450 milligram-minutes per liter at all times with modal contact time of at least 90 minutes, based on peak dry weather design flow . . ."

Characteristics of Disinfection Contact Basins (DCB) (Attachment A)

Configuration: There are two identical 'mirrored' sides of the DCB of which each is 10.5 feet wide, 10 feet deep with 3 serpentine passes of lengths 148 feet, 148 feet, and 134 feet for a total length 430 feet.

DCB Volume: Volume (V) = 10.5′ x 10.0′ x 430′ = 45,150 ft^3

$$V = 45{,}150\ ft^3 \times 7.48\ gal/ft^3 = 337{,}722\ gallons$$

$$V = 337,722\ gal \times 3.785\ l/gal = 1{,}278{,}278\ liters$$

Selected Flow Rate

DCB Maximum Flow Rate is 2.0 Million Gallons per Day (MGD) through one side of DCB.

Tracer Selection

Hydrofluosilicic acid (Fluoride) was selected upon the recommendation of the California Department of Public Health (CDPH).

Slug-Dose Method
A slug-dose test method was required by the CDPH. The dose of 3968 grams of fluoride was selected to provide sufficient concentration to be easily monitored at the sample point throughout the test.

Determination of Modal Contact Time
Title 22, 60301.600 defines Modal Contact Time as "the amount of time elapsed between the time that a tracer, such as salt or dye, is injected into the influent at the entrance to the chamber and the time that the highest concentration of the tracer is observed in the effluent from the chamber."

Data from the slug-dose test are attached. The dose was added just up-stream of the flash mixers at time 0. Samples were taken at the effluent end of the basin. The test was run at a flow rate of 2 MGD for 6 hours and 40 minutes (Attachment B). Fluoride concentration samples were taken at recorded times (Attachment C). Measured fluoride concentrations minus background concentrations were plotted against time (Figure 1). The resulting modal contact time as indicated in Figure 1 below is 156 minutes, which exceeds Title 22 requirement of a minimum modal contact time of 90 minutes.

Determination of Required chlorine residual
To determine chlorine residual required to meet a CT of 450 milligram-minutes per liter, use Modal Contact Time of 156 minutes. CT is the product of total chlorine residual (C) and modal contact time (T) measured at the same point. Therefore;

Required Chlorine Residual = CT / T = 450 mg-minutes per liter/ 156 minutes

Required Chlorine Residual = 2.88 mg/l

Conclusion
SRTTP chlorine contact basins meet Title 22 requirements based on slug-dose tests. It should be noted these chlorine contact basins have a very high length to width ratio resulting from the serpentine configuration. This places them in a category somewhere between "Superior" and "Perfect (Plug flow)" according to Appendix G, Baffling Factors of EPA Guidance Manual, Disinfection Profiling and Benchmarking, May 2003. As such, operational CT values will be higher than estimated by the slug-dose test.

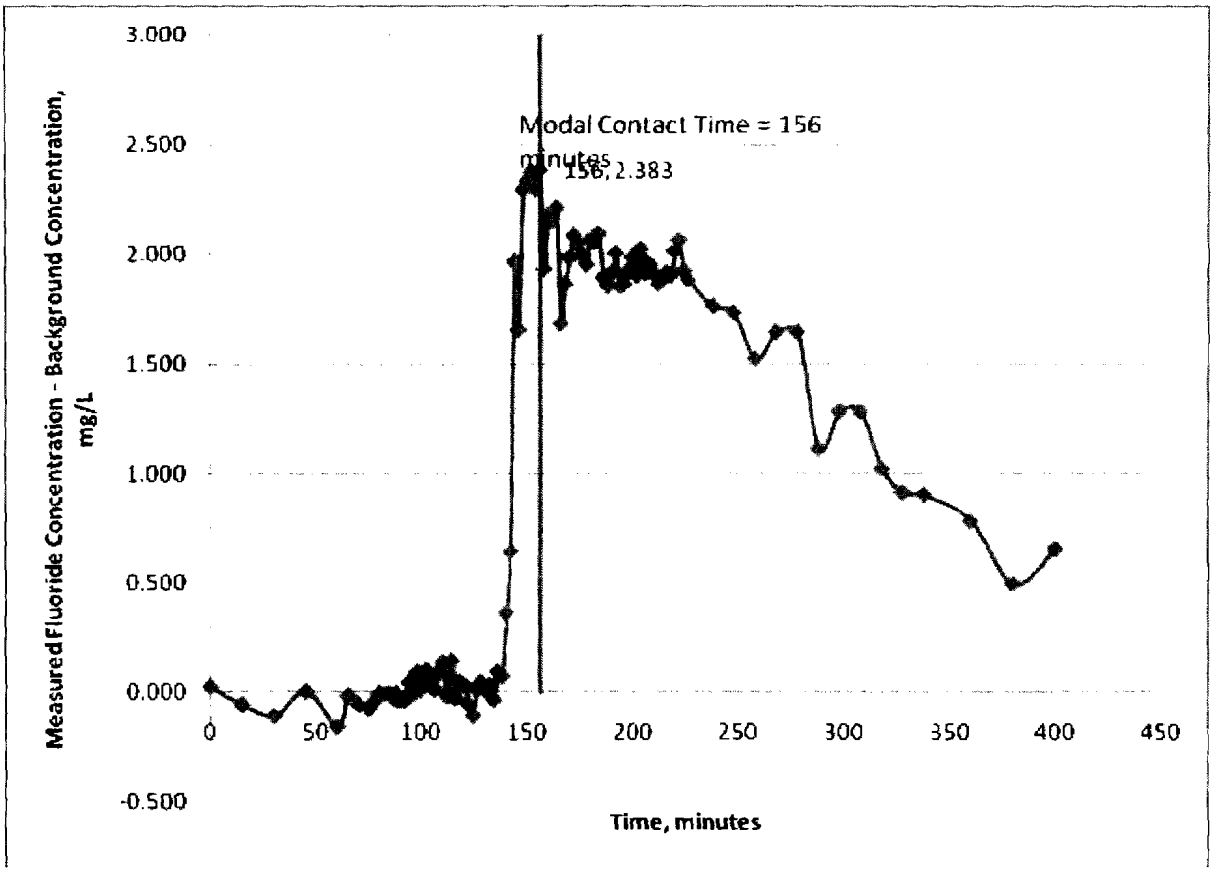


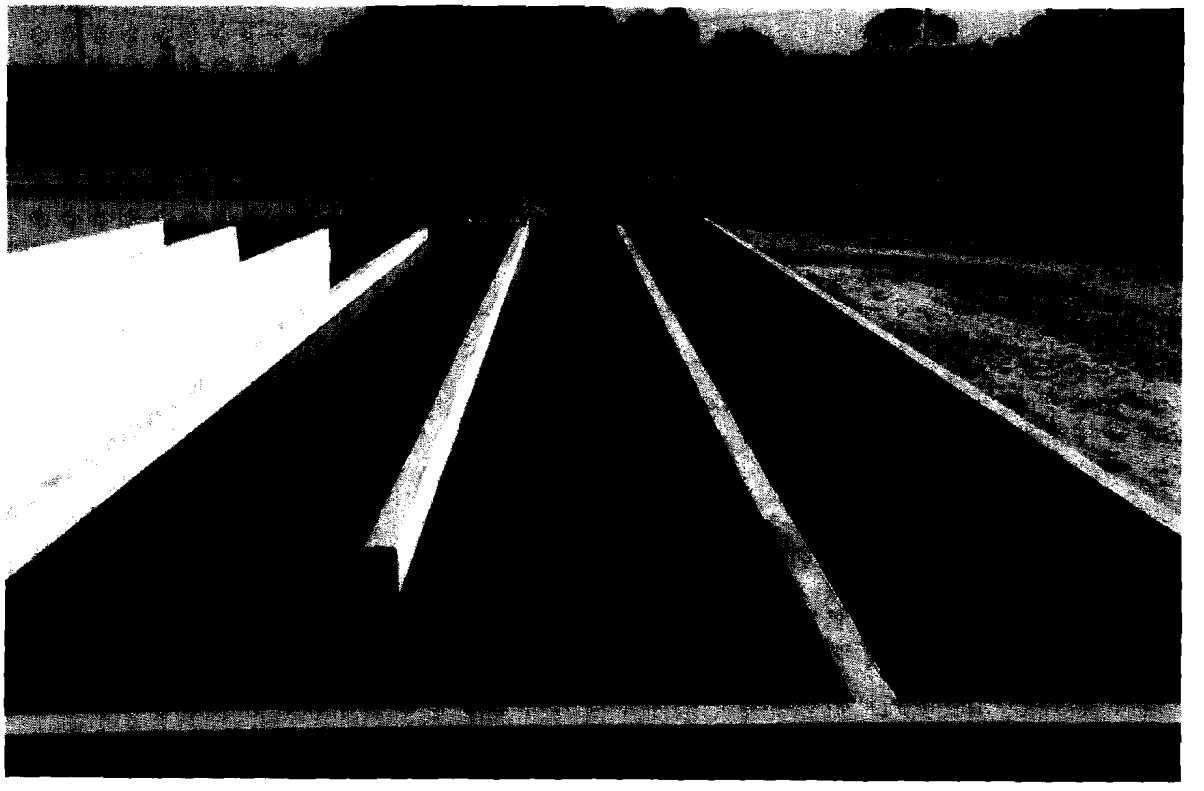
Figure 1
Fluoride Concentration Over Time

Attachments

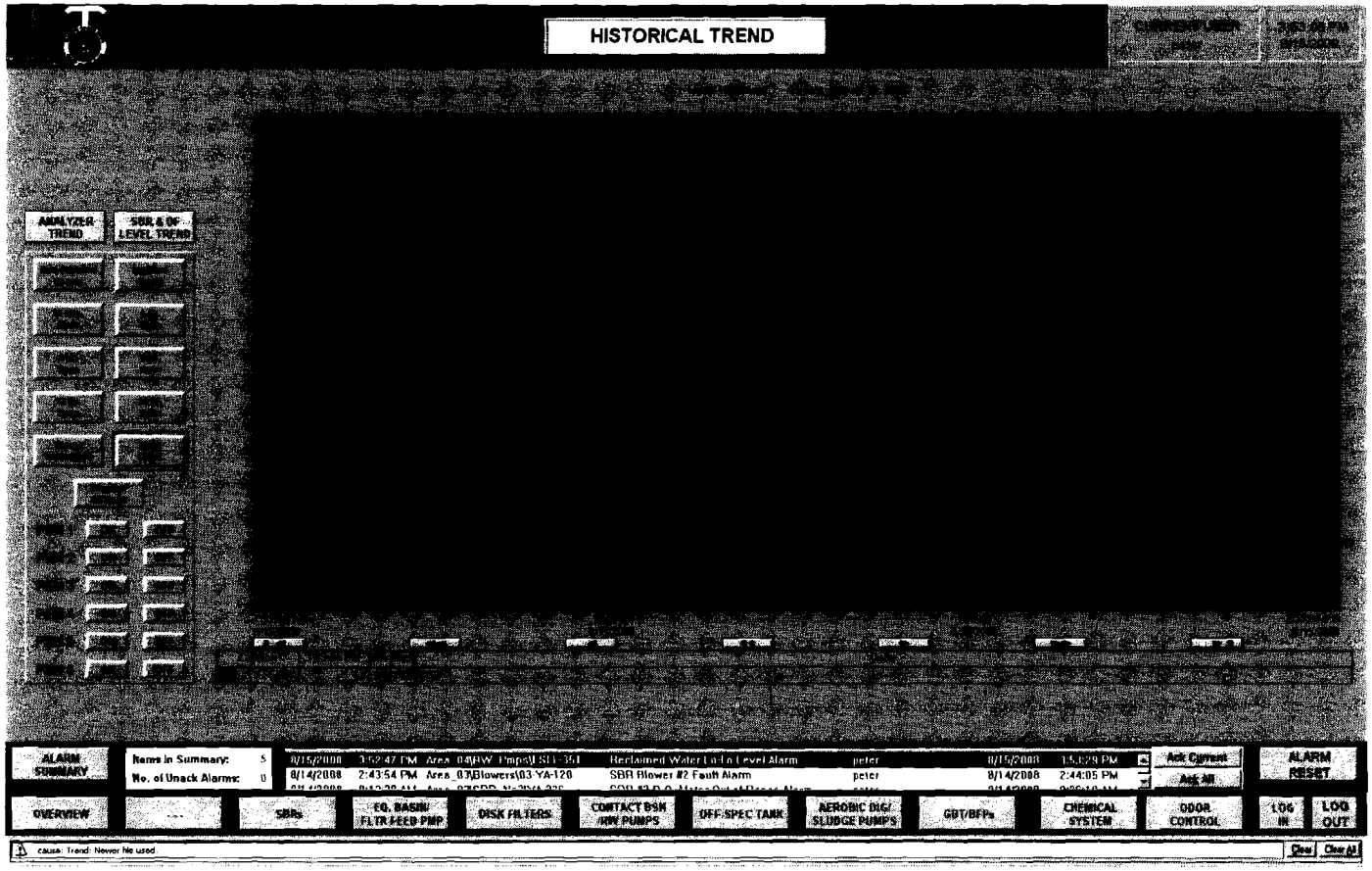
A SRTTP Disinfection Contact Basins
B SRTTP Flow Chart
C SRTTP Tracer Test Results

ATTACHMENT A

SRTTP Disinfection Contact Basins



ATTACHMENT B
SRTTP Flow Chart August 15, 2008



Flow Meter Reading in Gallons

Finished	847954625	
Start	847397425	
Total Flow	557200	Average flow rate during tracer test 1,393 gpm = 2.0 MGD

ATTACHMENT C

SRTTP TRACER TEST RESULTS

Camp Pendleton Water and Wastewater System

Design, Build, Operate and Maintain Contract N68711-04-D-511-0016

DO 0016 (2nd Yr OM) Average Background 0.507 mg/l

SRTTP Tracer Test, August 15, 2008 Slug-dose grams Fluoride 3968 grams

Injection Pt. Before Flash Mixer

Sample Pt, DCB Effluent	Sample Time	Fluoride Concentration mg/l	Background Fluoride mg/l	Fluoride Concentration less background
Sample Number				
1	0:00	0.530	0.507	0.000
2	0:15	0.450	0.507	0.000
3	0:30	0.400	0.507	0.000
4	0:45	0.510	0.507	0.000
5	1:00	0.350	0.507	0.000
6	1:05	0.490	0.507	0.000
7	1:10	0.450	0.507	0.000
8	1:15	0.430	0.507	0.000
9	1:18	0.470	0.507	0.000
10	1:20	0.500	0.507	0.000
11	1:22	0.470	0.507	0.000
12	1:24	0.500	0.507	0.000
13	1:26	0.490	0.507	0.000
14	1:28	0.500	0.507	0.000
15	1:30	0.470	0.507	0.000
16	1:32	0.470	0.507	0.000
17	1:34	0.550	0.507	0.000
18	1:36	0.500	0.507	0.000
19	1:38	0.600	0.507	0.000
20	1:40	0.530	0.507	0.000
21	1:42	0.610	0.507	0.000
22	1:44	0.570	0.507	0.000
23	1:46	0.520	0.507	0.000
24	1:48	0.590	0.507	0.000
25	1:50	0.640	0.507	0.000
26	1:52	0.490	0.507	0.000
27	1:54	0.650	0.507	0.000
28	1:56	0.480	0.507	0.000
29	1:58	0.550	0.507	0.000
30	2:00	0.540	0.507	0.000
31	2:02	0.450	0.507	0.000
32	2:04	0.400	0.507	0.000

Sample Pt, DCB Effluent	Sample Time	Fluoride Concentration mg/l	Background Fluoride mg/l	Fluoride Concentration less background
Sample Number				
33	2:06	0.520	0.507	0.000
34	2:08	0.550	0.507	0.000
35	2:10	0.520	0.507	0.000
36	2:12	0.540	0.507	0.000
37	2:14	0.470	0.507	0.000
38	2:16	0.600	0.507	0.093
39	2:18	0.580	0.507	0.073
40	2:20	0.870	0.507	0.363
41	2:22	1.150	0.507	0.643
42	2:24	2.470	0.507	1.963
43	2:26	2.160	0.507	1.653
44	2:28	2.800	0.507	2.293
45	2:30	2.840	0.507	2.333
46	2:32	2.880	0.507	2.373
47	2:34	2.800	0.507	2.293
48	2:36	2.890	0.507	2.383
49	2:38	2.440	0.507	1.933
50	2:40	2.680	0.507	2.173
51	2:42	2.660	0.507	2.153
52	2:44	2.720	0.507	2.213
53	2:46	2.190	0.507	1.683
54	2:48	2.370	0.507	1.863
55	2:50	2.490	0.507	1.983
56	2:52	2.590	0.507	2.083
57	2:54	2.550	0.507	2.043
58	2:56	2.500	0.507	1.993
59	2:58	2.460	0.507	1.953
60	3:00	2.570	0.507	2.063
61	3:02	2.560	0.507	2.053
62	3:04	2.600	0.507	2.093
63	3:06	2.400	0.507	1.893
64	3:08	2.360	0.507	1.853
65	3:10	2.420	0.507	1.913
66	3:12	2.510	0.507	2.003
67	3:14	2.360	0.507	1.853
68	3:16	2.370	0.507	1.863
69	3:18	2.430	0.507	1.923
70	3:20	2.490	0.507	1.983
71	3:22	2.410	0.507	1.903
72	3:24	2.530	0.507	2.023
73	3:26	2.420	0.507	1.913
74	3:28	2.460	0.507	1.953
75	3:30	2.420	0.507	1.913
76	3:32	2.370	0.507	1.863
77	3:34	2.390	0.507	1.883
78	3:36	2.420	0.507	1.913

Sample Pt, DCB Effluent	Sample Time	Fluoride Concentration mg/l	Background Fluoride mg/l	Fluoride Concentration less background
Sample Number				
79	3:38	2.410	0.507	1.903
80	3:40	2.520	0.507	2.013
81	3:42	2.570	0.507	2.063
82	3:44	2.430	0.507	1.923
83	3:46	2.390	0.507	1.883
84	3:58	2.270	0.507	1.763
85	4:08	2.240	0.507	1.733
86	4:18	2.030	0.507	1.523
87	4:28	2.150	0.507	1.643
88	4:38	2.150	0.507	1.643
89	4:48	1.620	0.507	1.113
90	4:58	1.790	0.507	1.283
91	5:08	1.790	0.507	1.283
92	5:18	1.530	0.507	1.023
93	5:28	1.420	0.507	0.913
94	5:38	1.410	0.507	0.903
95	6:00	1.290	0.507	0.783
96	6:20	1.000	0.507	0.493
97	6:40	1.160	0.507	0.653