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DEPARTMENT OF ECOLOGY

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M E M O R A N D U M

July 2, 1985

To: Dave Wright

From: Marc Heffner

Subject: Olympus Terrace Sewer District Sewage Treatment Plant Class II Inspection - November 7/8, 1984

INTRODUCTION

A Class II inspection was conducted at the Olympus Terrace Sewer District (OT) sewage treatment plant (STP) on November 7/8, 1984. Conducting the inspection were Brad Hopkins and Marc Heffner from the Washington State Department of Ecology (WDOE) Water Quality Investigations Section and Dave Wright from the WDOE Northwest Regional Office (NWRO). Assisting from the OT staff were John Borja (operator), Craig Hook (assistant operator), and Larry Ostler (public works supervisor).

The OT plant is located south of Mukilteo (Figure 1). The service area includes residential flow plus a portion of the industrial development adjoining Paine Field. The plant is an oxidation-type secondary facility (Figure 2). Treatment units include an oxidation ditch, two secondary clarifiers, and two chlorine contact chambers. Flow is measured by a continuous recorder/totalizer unit at the Parshall flume located between the clarifiers and chlorine contact chambers. Waste-activated sludge is dried on a Wedgewater screen, then along with screenings is shoveled into a dumpster for disposal at a landfill by the local garbage service.

The Class II inspection was requested to meet the following objectives:

1. Review sampling and laboratory procedures associated with NPDES permit compliance monitoring, including sample splits.

2. Characterize plant operation and treatment efficiency.

3. Evaluate plant metals loadings.

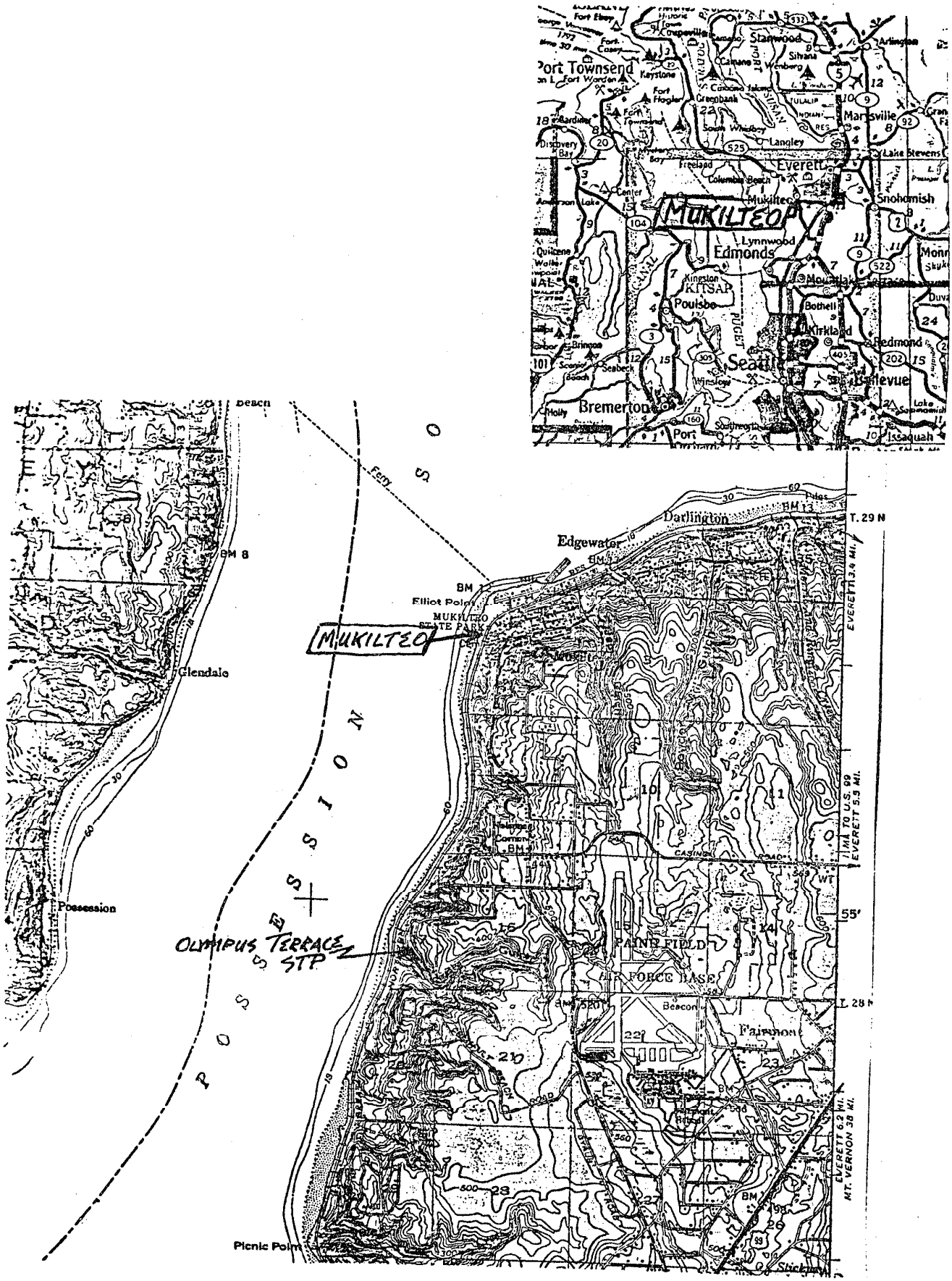

FIGURE 1 - LOCATION MAP - OLYMPUS TERRACE STP, 11/84.

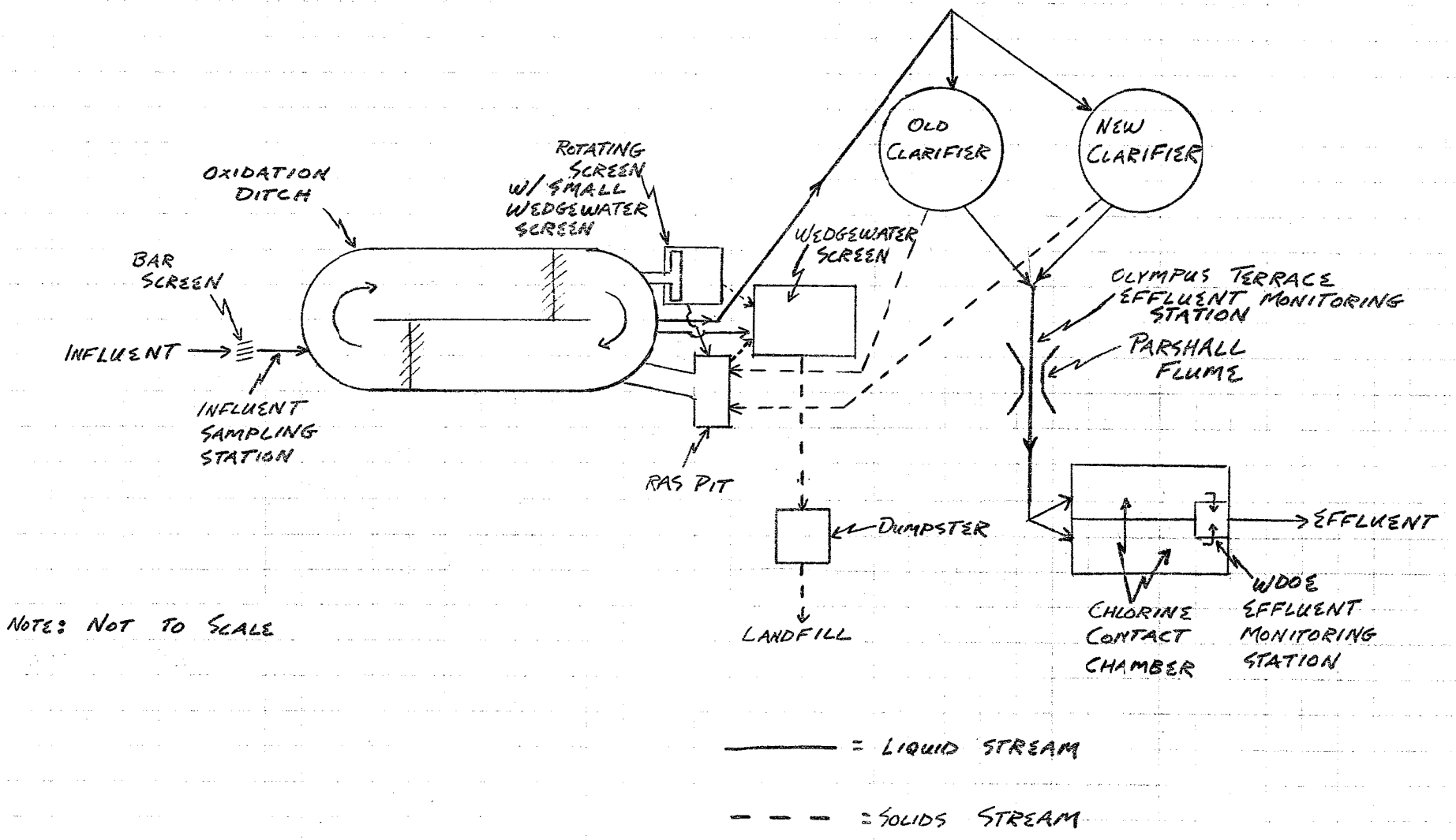

FIGURE 2 - STP FLOW SCHEME AND SAMPLING STATIONS - OLYMPUS TERRACE, 11/84.

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PROCEDURES

The sampling schedule followed during the inspection, including both samples collected and analyses performed, is presented in Table 1. The sampling program included both composite samples and numerous grab samples. Influent and chlorinated effluent WDOE composite samples were collected, and influent and unchlorinated effluent OT composite samples were collected (Figure 2). All samplers were set to collect a 200 mL sample every 30 minutes. The compositing period ran from 0900 on November 7 to 0900 on November 8. Composite samples were split for analysis of NPDES permit parameters by both the OT and WDOE laboratories.

Table 1. Sampling schedule - Olympus Terrace, November 1984.

			Field Analyses							Laboratory Analyses													
																		Metals					
Sample	Date	Time	pH	Cond.	Temp	Chl. Resid.	Sludge depth	Flow	Diss. Oxygen	F. Coli.	Oil & Grease	BOD_5	COD	Solids (4)	Turb.	pH	Cond.	Nutr. (5)	Alk.	Total	Dissolved	EP TOX.	TSS	TVSS	% Solids
Grab Samples																									
Influent	11/7	0855	X	X	X															X					
		1010																							
		1455	X	X	X						X									X					
	11/8	0700	X	X	X															X					
		0945	X	X	X															X					
Effluent	11/7	0910	X	X	X																				
		1005				X				X										X					
		1440	X	X	X	X				X	X									X					
	11/8	0710	X	X	X	X				X										X					
		0945	X	X	X	X				X										X					
Clarifier	11/7	a.m.					X	X																	
Oxidation ditch	11/7	1015																				X	X		
		1500					X		X													X	X		
	11/8	0715																				X	X		
		0945																				X	X		
Return activated sludge (RAS)	11/7	1015*																		X	†	X	X	X	
		1500*																		X	†	X	X	X	
	11/8	0715*																		X	X	X	X	X	
		0945*																		X	X	X	X	X	
Screenings from oxidation ditch	11/7	0955																		X	X			X	
	11/8	0945																		X	X			X	
Waste activated sludge (WAS)	11/7	0955																		X	†			X	
	11/8	0945																		X	X			X	
Composite Samples																									
Influent	11/7-8	0900-0900																							
WDOE			X	X	X							X	X	X	X	X	X	X	X	X	X				
OT												X	X	X	X	X	X	X	X	X	X				
Effluent	11/7-8	0900-0900																							
WDOE			X	X	X							X	X	X	X	X	X	X	X	X	X				
OT												X	X	X	X	X	X	X	X	X	X				

*Separate samples of return sludge from the new and old clarifiers were collected for TSS and TVSS analyses. A combined return sample was collected for the total metals and EPTOX metals analyses.
†Analyses not done due to laboratory accident.

Flows were measured by the plant meter at the Parshall flume. Instantaneous measurements were made by WDOE at the flume to estimate meter accuracy.

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In addition to the Class II inspection, data collected by Dave Wright (WDOE, NWRO) on August 15, 1983; Craig Baker (WDOE, NWRO) on March 23, 1984; and Marc Heffner on an August 7, 1984, pre-inspection survey are included in this report.

RESULTS AND DISCUSSION

Plant Operation

Plant operation involves several unusual modifications in addition to conventional operating procedures. After passing through the headworks screen, the influent enters the oxidation ditch. Accumulation of floating debris in the oxidation ditch and clarifiers had been a problem, so a rotating screen was set up in conjunction with the ditch (Figure 2). During the eight hours when the operator is working, a portion of the surface water in the ditch is drawn off and run through the screen, with the screenings disposed of with the waste-activated sludge (WAS) and the liquid fraction returned with the return activated sludge (RAS) for further treatment in the oxidation ditch. To enhance floating debris capture, a board laid across the surface of the oxidation ditch pools the floating debris in the area of the rotating screen draw-off. The brush aerator near the rotating screen is run intermittently which further aids floating debris removal.

Oxidation ditch operation involves running one of the two brush aerators continuously during the night (time when the operator is off duty). During the day, one aerator is operated continuously while the other is operated intermittently. As noted on Figure 3, dissolved oxygen (D.O.) concentrations were fairly low (0.1 to 1.2 mg/L) when the WDOE instantaneous measurements were made. The operator reported that typical D.O. concentrations in the ditch vary from 0.2 to 0.4 mg/L. These concentrations are at the bottom end of the 0.3 to 8 mg/L range necessary to maintain good bacterial respiration (WPCF, 1976). Sludge depth measurements along the side of the ditch are also noted on Figure 3. Data gathering was possible only along the outside wall, so significance of the data is questionable. The sediment noted suggests that the operator should make some channel-wide sludge depth measurements and clean as necessary. The plant does not have an oxidation ditch bypass, so sediment removal may be difficult.

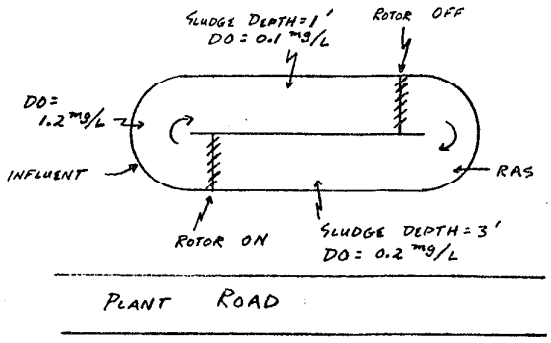

FIGURE 3 - OXIDATION DITCH DO & SLUDGE DEPTH MEASUREMENTS - OLYMPUS TERRACE, 11/84.

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Sludge was wasted directly from the oxidation ditch to a Wedgewater screen-type drying bed. Recently the operator has been wasting half of the drying bed volume from the oxidation ditch and the other half from the RAS basin. Wasting only from the RAS basin to maximize the solids load to the drying bed is desirable if it is operationally feasible. From the drying bed, the dried sludge is hand-shoveled into a dumpster for collection and disposal with other solid wastes along the garbage pick-up route. The maximum wasting rate is governed by the one-dumpster-per-week haul-off schedule. Accurate sludge wasting records should be kept.

The two secondary clarifiers following the oxidation ditch include one center-feed unit (the old clarifier) and one rim-feed unit (the new clarifier). The units are of equal size. Sludge depth in both units was approximately 7 feet, leaving a clearwater depth of approximately 2.5 feet. The operator noted that the operational benchmark they use for sludge blanket depth is keeping the sludge level below the launder weir discharge line. Clarifier operation with the shallow clearwater depth is generally more susceptible to solids carryover during high flow periods. Trying to maintain a five- to six-foot clearwater depth is recommended if the operator notices a solids carryover problem.

The operator noted that sending equal hydraulic loads to the two clarifiers is difficult. Presently, flows are estimated in the launder weirs and adjusted by eye. A WDOE Marsh-McBernie magnetic flow meter was used to make an instantaneous flow measurement in each of the clarifier launder weir channels (Table 2). The measurements indicated that flow to the clarifiers was not balanced during the inspection. A complicating factor with clarifier hydraulic load balancing involves sludge withdraw from the rim-feed clarifier. The operator suspects a sporadic air lock problem exists in the sludge line. This plugging causes difficulty in maintaining a balanced situation. A temporary bleed-off valve had been installed with plans to install a permanent valve. Once the air lock problem is solved, a more accurate system of flow measurement to balance the clarifier should be instituted. Until a system is in place, allowing 1.4 inches of flow in the launder weir channel of the rim-feed clarifier per one inch of flow in the center-feed clarifier launder weir channel should approximately balance the flows (measurements are the sum of the flow depth coming from each side of the exit chute in the launder weir channel).

Table 2. Clarifier launder weir flow measurements - Olympus Terrace, November 1984.

	Left Launder Weir Channel*				Right Launder Weir Channel*				Total
Clarifier	Width (ft.)	Depth of flow (in.)	Velocity (ft/sec)†	Flow (cfs)	Width (ft.)	Depth of flow (in.)	Velocity (ft/sec)†	Flow (cfs)	Flow (cfs)
Center feed (old)	2.0	1.75	1.33	0.39	2.0	1.0	1.20	0.20	0.59
Rim feed (new)	1.25	3.0	1.45	0.45	1.25	3.6	1.42	0.53	0.98
Total									1.57*†

*Direction when facing center of clarifier from bridge over launder weir.
†Average velocity based on measurements at three stations across the width of the channel.
*†Instantaneous flow from plant meter: 1.54 cfs.

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From the clarifiers, flow is combined and routed through a Parshall flume. A WDOE instantaneous flow measurement (1.05 MGD) at the flume did not agree with the plant meter reading (0.85 MGD). After confirming the instantaneous flow, the plant meter was recalibrated by the operators. Subsequent instantaneous checks agreed with the plant flow meter measurements. The plant totalizer measurements appeared reasonable in relation to the instantaneous measurements. Flow measurements made during the inspection after plant meter recalibration are presented in Table 3. A rating table was left with the operators so that the meter could routinely be checked with the in-flume staff gauge. The inacccurate flow measurements have been reflected on the STP's discharge monitoring reports (DMRs) for an undetermined length of time. Downstream from the flume the flow is chlorinated and sent through the chlorine contact chamber prior to discharge.

Table 3. Flow measurements - Olympus Terrace, November 1984.

Date	Time	Instantaneous Reading (MGD)	Totalizer Reading	Flow Rate (MGD)
11/7	0945	1.05	876205000	
				0.99
	1325	0.95	876357000	
				0.79
11/8	0710	1.1	876938000	
				1.12
	0915	1.0	877035000	
				1.07
	1005	1.1	877072000	

Average flow rate for inspection: 0.86 MGD.

Conventional Parameters

Results of conventional analysis of composite samples (Table 4) and grab samples (Table 5) indicate good effluent quality at the time of the inspection. Table 6 compares inspection data to NPDES permit limits. All measurements fell well within permit limits with the exception of one fecal coliform count of 2000/100 mL. The high count was attributed to chlorinator failure during the night. The system was repaired and a lower count (16 est./100 mL) was made approximately 2 1/2 hours after the high count (Table 5).

Table 4. Composite sample WDOE laboratory conventional analyses results - Olympus Terrace, November 1984.

				Solids (mg/L)							Nutrients (mg/L)					
Sample	Sampler	BOD_5 (mg/L)	COD (mg/L)	TS	TNVS	TSS	TNVSS	Turb. (NTU)	pH (S.U.)	Conductivity (umhos/cm)	NH_3-N	NO_2-N	NO_3-N	O-PO_4-P	T-PO_4-P	Alkalinity (mg/L as $CaCO_3$)
Influent	WDOE	190	350	410	180	160	28	24	8.0	458	18	0.10	0.20	3.9	7.8	160
	Olympus Terrace	190	390	430	190	170	22	100	8.1	548	25	0.10	0.10	4.4	8.6	190
Effluent	WDOE	6	23	220	150	4	2	19	7.3	322	1.2	0.05	5.8	4.1	4.5	66
	Olympus Terrace	6	27	220	140	5	2	12	7.3	340	0.90	0.05	5.1	4.6	4.7	74

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Table 5. WDOE grab sample conventional analyses results - Olympus Terrace, November 1984.

			Field Analysis					Laboratory Analysis				
						Chlorine Residual (mg/L)				Sludge		
Sample	Date	Time	pH (S.U.)	Conductivity (umhos/cm)	Temp. (°C)	Free	Total	Fecal Coliform (#/100 mL)	Oil & Grease (mg/L)	TSS (mg/l)	TVSS (mg/L)	Percent Volatile
Influent	11/7	0855	7.8	400	15.7							
		1455	8.0	480	14.2				2			
	11/8	0700	7.6	360	14.5							
		WDOE Comp.	8.1	440	3.2							
		0945	7.7	380	14.4							
Effluent	11/7	0915	7.0	330	12.5							
		1005				0.25	0.35	3 est.				
		1440	7.0	320	13.4	0.15	0.6*	2 est.	<1			
	11/8	0710	7.1	325	12.8		<0.1**	2,000**				
		WDOE Comp.	7.2	330	2.4							
		0945	7.1	325	12.4		0.35	16 est.				
Mixed Liquor	11/7	1015								6,600	4,500	68
		1500								6,500	4,400	68
	11/8	0715								6,900	4,700	68
		0945								6,700	4,700	70
RAS†												
New	11/7	1015								9,900	6,800	
Old		1015								12,000	8,200	
New		1500								9,800	6,700	
Old		1500								11,000	7,500	
New	11/8	0715								11,000	7,600	
Old		0715								8,400	5,700	
New		0945								11,000	7,600	
Old		0945								9,100	6,300	

est. = Estimated.
*Sample split with operator - his result = 0.6 mg/L.
**Chlorinator plugged during the night. Repairs made by 0800 hours on November 8.
†New = return from rim-feed clarifier; old = return from center-feed clarifier.

Table 6. Comparison of WDOE inspection data to NPDES permit limits - Olympus Terrace, November 1984.

	NPDES Permit Limits		
Parameter	Monthly Average	Weekly Average	Inspection Results†*
BOD_5			
(mg/L)	30	45	6
(lbs/D)	213	319	43
(% removal)	85		97
TSS			
(mg/L)	30	45	4
(lbs/D)	213	319	29
(% removal)	85		98
Fecal Coliforms (#/100 mL)	200	400	2*, 3*, 16*, 2000†
pH (S.U.)	6.0 ≤ pH ≤ 9.0		
Flow			0.86

†*Results of WDOE analysis of WDOE samples.
*Estimated value.
†Chlorinator plugged for several hours before sample collected.

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In addition to good BOD_5 and TSS removals during the inspection, nitrogen content of the waste appeared to be reduced through the treatment process (NH_3-N in approximately 20 mg/L; NO_3-N in approximately 0.15 mg/L; NH_3-N out approximately 1.0 mg/L; NO_3-N out approximately 5.5 mg/L). Oxidation of NH_3-N to NO_3-N is common during long detention time activated sludge processes such as an oxidation ditch. Denitrification which results in removal of nitrogen from the wastewater ($NO_3 \rightarrow NO_2 \rightarrow N_2$) is usually associated with anoxic conditions and has not commonly been seen during Class II inspections at oxidation ditch systems. The OT operational system suggests why the N removal may be occurring. The low D.O. concentrations in the oxidation ditch (0.2 and 0.1 mg/L) and N removal suggest that the system may sometimes be operating in anoxic conditions. Operation as an aerobic-anoxic system, which has been shown to provide N reduction (Palis, 1985), is likely the reason N reduction occurred at the Olympus Terrace plant.

Measured oxidation ditch operating conditions are compared to WDOE design criteria in Table 7 (WDOE, 1980). Conditions fell within design criteria for comparisons made. The 18-hour detention time during the inspection is equal to the minimum design criteria, suggesting that the hydraulic load may become a limiting factor in the system. The 0.03 F:M along with the 6700 mg/L MLSS suggest that solids reduction in the ditch is possible while still maintaining a good F:M ratio. These can be adjusted as the operator feels necessary based on plant performance.

Table 7. Comparison of oxidation ditch inspection conditions to design criteria - Olympus Terrace, November 1984.

Inspection Measurements

Flow	= 0.86 MGD
OD volume	= 0.64 MG
Clarifier volume	= 0.16 MG each = 0.32 MG total
Inf. BOD_5	= 190 mg/L = 1360 lbs/D
MLSS	= 6700 mg/L
Sludge inventory	= 53600 lbs

Comparison to Criteria

	Inspection Conditions	Design Criteria*
DT (hrs)	18	18-24
F:M (lbs BOD_5/D/lbs MLSS)	0.03	0.03-0.10
MLSS (mg/L)	6700	3000-8000
Volumetric loading (lbs BOD_5/D/1000 ft^3)	16	12.5-30

*(WDOE, 1980)

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Metals

High sludge metals concentrations in grab samples of OT sludge collected by WDOE NWRO inspectors and on a WQIS reconnaissance trip were a primary reason the inspection was conducted. Table 8 compares sludge metals concentrations from these pre-inspection samples to concentrations found at other plants inspected by WDOE. Cadmium, chromium, and nickel concentrations all were high in relation to the data from other plants around the state.

Table 8. Pre-inspection sludge samples - Olympus Terrace, November 1984.

Date	mg/Kg dry weight basis (ppm)** Cd	Cr	Cu	Pb	Ni	Zn	Sb	Tl	Hg	As	Se	Ag	Ba	Be	% Solids
Sampling at OT prior to Inspection															
8/15/83* (total)	1400	1200	1500	<26	335	1400									1.25
3/23/84† (total)	1975	2040	1020	215	1275	3440									1.56
8/07/84*† (total)	53.2	691	382	51.5	408	1314	0.39	<0.13	1.45	3.08	1.41	1.14		1.62	0.78
(EP-TOX**)	0.43	<0.02	0.02	0.05		10			<0.0002	0.009	<0.001	<0.02	0.90		
Summary of Previous Inspection Data at Similar Plants															
Range	<0.1-25	15-300	75-1700	34-600	<0.1-62	165-3370									
Geometric Mean	6.9	59.8	366	224	22.4	1160									
Geometric mean ± 1 standard deviation	2.3-20.5	27.8-129	200-670	113-444	5.7-87.5	665-2020									
Number of samples	28	28	28	28	24	28									
Highest concentration from all plants sampled previously	61	540	3100	1140	130	3370									

*Sample collected by Dave Wright.
†Sample collected by Craig Baker.
+†Sample collected by Marc Heffner.
**EP-TOX concentrations in mg/L (WDOE, 1984).

Results of solids grab samples collected during the inspection are summarized in Table 9. RAS and WAS samples had similar concentrations of metals as might have been expected. Metals concentrations in the screenings of the floating material on the oxidation ditch varied from the WAS concentrations, but not by sufficient amounts to warrant separate disucssion. Also included on Table 9 is EP-TOX metals data for the screenings and WAS samples. All samples were less than the criteria for a dangerous waste. The cadmium concentration of 0.58 mg/L approached the criteria (approximately half the minimum criteria concentration of 1 mg/L in the leachate from the waste as prescribed by the EP-TOX procedures [WDOE, 1984]). This is of some concern as the total cadmium concentrations of the two samples analyzed using the EP-TOX procedures (8/7/84 sample, EP-TOX 0.43 mg/L, total cadmium 53.2 mg/Kg dry weight; 11/8/84 sample, EP-TOX 0.58 mg/L, total cadmium 422 mg/Kg dry weight) were much lower than the total metals concentrations in the samples collected by the NWRO (8/15/83 sample, 1400 mg/Kg dry weight; 3/23/84 sample, 1975 mg/Kg dry weight). Special disposal methods for dangerous wastes are described in Chapter 173-303 WAC (WDOE, 1984).

Table 9. Inspection sludge metals measurements - Olympus Terrace, November 1984.

				Metal†																			
				As		Ba		Cd		Cr		Cu		Pb		Hg		Ni		Se		Ag		Zn	
Sample	Date	Time	% Solids	Total	EP-TOX	Total	EP-TOX	Total	EP-TOX	Total	EP-TOX	Total	EP-TOX	Total	EP-TOX	Total	EP-TOX	Total	EP-TOX	Total	EP-TOX	Total	EP-TOX	Total	EP-TOX
RAS	11/7	1015	1.14	9		1750		456		711		609		99		1.8		321				<5		1920	
		1500	1.10	9				458		773		622		71		2.3		345						1920	
	11/8	0715	.94	6	.013	138	1.0	438	<.01	749	<.02	611	<.02	99	.10	2.5	<.00006	311	.35	3.3	.002	9.6	<.02	1817	.68
		0945	1.04	5	.017	202	2.6	431	.74	690	.25	583	.05	89	.10	2.2	.00011	298	1.1	1.7	.005	9.1	<.02	1788	9.0
Screen-ings	11/7	0955	14.9	6	.003	87	1.0	374	.06	310	<.02	414	.02	25	.05	.56	<.00006	417	.35		.0006	4.6	<.02	1704	1.7
	11/8	0945	10.23	3	.008	86	.45	424	.03	370	<.02	458	<.02	23	<.02	.47	<.00006	449	.40	1.1	.003	5.7	<.02	1792	.88
WAS	11/7	0955	2.46	6		222		437		689		568		61		2.6		291				20		1829	
	11/8	0945	3.27	4	.009	210	.60	422	.58	729	.05	643	.05	83	.05	2.8	<.00006	258	.60	2.9	.003	19	<.02	1704	4.0
EP-TOX DW Criteria*					5-500		100-10,000		1-100		5-500				5-500		.2-20				1-100		5-500		

†Total metal concentrations in mg/Kg dry weight; EP-TOX metal concentrations in mg/L.
*Dangerous waste criteria (WDOE, 1984).

The high total cadmium concentrations in the sludge are also of concern when considering disposal alternatives. Presently the sludge is disposed of as garbage, being picked up as part of the residential garbage collection route in the area. Land-application was being considered as an alternative method. The high cadmium concentration would require consideration when studying land-application of sludge (WDOE, 1982; Federal Register, 1980).

Influent and effluent samples collected during the inspection are summarized in Table 10. Influent concentrations are compared to "typical background" non-industrial sewage influent metals concentrations in Table 11 (EPA, 1983). Concentrations at OT were higher than "typical background" for all metals except lead, being much higher for arsenic (approximately 9 times) and cadmium (approximately 13 times). Although concentrations were high, when the dissolved fractions were compared to threshold concentrations for inhibition of biological activity (Table 12), OT concentrations were less than the threshold concentrations. The OT arsenic concentration in relation to activated sludge inhibition and the copper and nickel concentrations in relation to nitrification inhibition were approaching threshold concentrations.

Table 10. Influent and effluent metals - Olympus Terrace, November 1984.

			Metal (ug/L)													
			As		Cd		Cr		Cu		Pb		Hg		Ni		Zn	
Sample	Date	Time	Total	Diss.	Total	Diss.	Total	Diss.	Total	Diss.	Total	Diss.	Total	Diss.	Total	Diss.	Total	Diss.
Influent	11/7	1010	74		18.1		50		88		11		0.32		60		352	
		1455	56		38.8		110		104		11		0.47		46		428	
	11/8	0700	9		7.8		16		53		31		0.16		3		71	
	11/7-8	WDOE Comp	27	25	38.6	11.2	92	21	92	24	39	9	0.21		74	48	287	37
		OT Comp	24	13	42.0	13.4	97	21	79	18	14	13	0.05		54	44	304	38
	11/8	0945	4		10.1		49		81		36		0.26		4		143	
Effluent	11/7	1005	47		9.9		5		32		5		0.37		40		60	
		1440	42		9.8		7		30		11		0.16		39		57	
	11/8	0710	4		10.3		5		22		11		0.11		37		54	
	11/7-8	WDOE Comp	13	16	9.3	7.5	5	<1	23	6	11	<1	<0.05		33	30	53	34
		OT Comp	13	13	9.5	8.0	3	<1	27	5	10	5	<0.05		35	34	54	35
	11/8	0945	4		11.7		4		26		23		0.11		34		52	

Table 11. Comparison of OT influent metals concentrations to "typical background" concentrations for non-industrial wastewaters - Olympus Terrace, November 1984.

Metal	"Background" Concentration (total metal - ug/L)*	WDOE Influent Composite (total metal - ug/L)	OT Influent Composite (total metal - ug/L)
As	3	27	24
Cd	3	38.6	42.0
Cr (total)	50	92	97
Cu	61	92	79
Pb	50	39	14
Ni	21	74	54
Zn	175	287	304

*From (EPA, 1983, p.L-24).

Table 12. Comparison of OT influent metals concentrations to threshold inhibitory concentrations* - Olympus Terrace, November 1984.

Metal	Threshold of Inhibitory Effect on Activated Sludge* (ug/L dissolved metal)	Threshold of Inhibitory Effect on Nitrification* (ug/L dissolved metal)	WDOE Influent Composite (ug/L dissolved metal)	OT influent Composite (ug/L dissolved metal)
As	50	---	25	13
Cd	1,000	---	11.2	13.4
Cr (total)	10,000	---	21	21
Cu	1,000	100	24	18
Pb	100	500	9	13
Hg	100	---	0.21**	0.05**
Ni	1,000	500	48	44
Zn	1,000	100	37	38

*From (EPA,1983, p.L-7).
**Total Hg.

Metals removal through the plant is compared to "typical" removals at secondary plants in Table 13 (EPA, 1983). Removals at OT were better than the typical median removals for all metals studied except copper. Table 14 compares OT metals concentrations to EPA criteria for saltwater. Concentrations of metals found in the literature for central Puget Sound were used to estimate background concentrations in the receiving water (Joy, 1985). Effluent concentrations during the inspection required at most a 14:1 dilution in the receiving water (to meet the proposed copper criteria), so 24-hour exposure criteria were not exceeded. The effluent concentrations were less than the anytime criteria for all metals, but would require a 7:1 dilution to meet the proposed copper criterion. Influent concentrations were also compared to the receiving water criteria to estimate dilution necessary in a worst-case, no-treatment situation. A maximum dilution requirement of 60:1 (to meet the proposed 24-hour copper criterion) was estimated for the influent.

Table 13. Comparison of OT metal removal to "typical" median removals - Olympus Terrace, November 1984.

Metal	"Typical" Median Percent Removal*	WDOE Compositor Percent Removal	OT Compositor Percent Removal
As	--	52	46
Cd	50	76	77
Cr (total)	71	95	97
Cu	82	75	66
Pb	57	72	29
Hg	51	--	--
Ni	32	55	35
Zn	76	82	82

*From (EPA, 1983, p.L-9).

Table 14. Comparison of inspection data to saltwater toxicity criteria - Olympus Terrace, November 1984.

						Inspection Data					
						Influent			Effluent		
	Saltwater Toxicity Criteria (ug/L)†				Background Concentration†*	WDOE Sample	Dilution Required*		WDOE Sample	Dilution Required*	
Metal	24-hr.	Anytime	Acute	Chronic	(ug/L)	(ug/L)	24-hr.	Anytime	(ug/L)	24-hr.	Anytime
As**	(63)	(120)	508		2.0	27	--	--	13	--	--
Cd	4.5(12)	59(38)			0.3	38.6	8:1(2:1)	--	9.3	1:1	--
Cr††	18(54)	1260(1200)			--	92	4:1(1:1)	--	5	--	--
Cu	4(2)	23(3.2)			0.5	92	25:1(60:1)	3:1(33:1)	23	5:1(14:1)	(7:1)
Pb	(8.6)	(220)	688	25	2.8	39	(5:1)	--	11	--	--
Hg	0.1(0.1)	3.7(1.9)			--	0.21	1:1(1:1)	--	<0.05	--	--
Ni	7.1	140			1.3	74	12:1	--	33	4:1	--
Zn	58	170			1.9	287	4:1	1:1	53	--	--

( ) = Proposed criteria.
† = From (Joy, 1985).
†* = Metals concentrations found in Central Puget Sound (Joy, 1985).
* = Dilution required is the amount of dilution water at the background concentration necessary to reduce the influent or effluent concentration to the toxicity criteria concentration.
** = Arsenic (+3) criteria given.
†† = Chromium (+6) criteria given.

Results of influent and effluent grab samples collected for metals analyses are also included in Table 10. Figure 4 presents bar graphs to help better estimate the daily fluctuations that occur. The graphs are similar for cadmium, chromium, copper, mercury, and zinc; all suggesting that daytime activities generate wastes with much higher metals concentrations that at night. This pattern agrees with the NWRO theory that day-operated, small industrial shops in the service district may be the source of the problem.

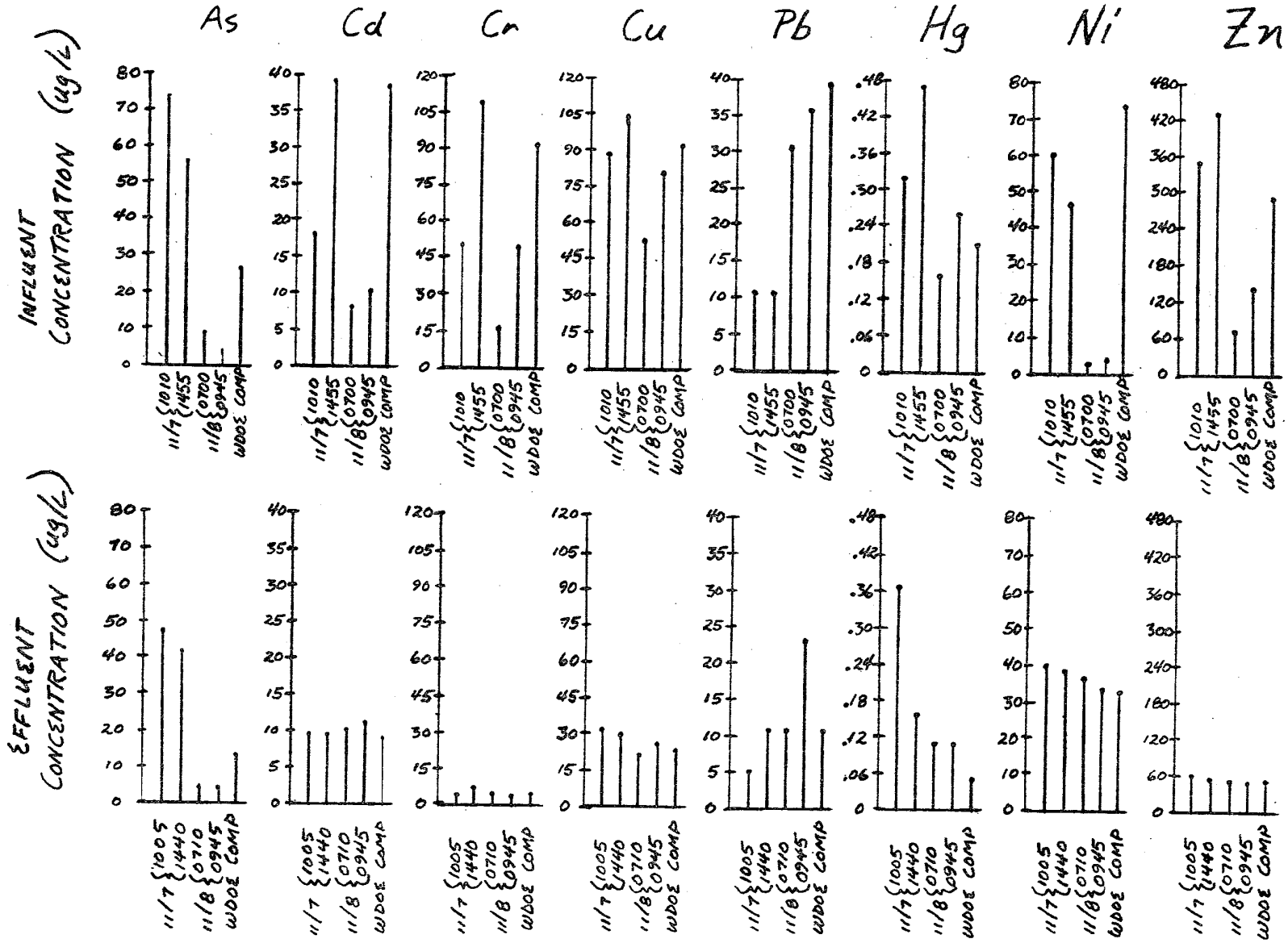

FIGURE 4 - GRAB SAMPLE METALS RESULTS - OLYMPUS TERRACE, 11/84.

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In summary, high metals concentrations in comparison to "typical" domestic plants were present in OT influent, and sludge metals concentrations were higher in OT sludge than samples collected during previously conducted inspections in the state. Although the concentrations are below critical criteria used for comparison, concentrations are at a point where serious concerns arise. Areas causing concern include:

1. Influent arsenic concentrations are approaching threshold concentrations of activated sludge inhibition.
2. Effluent dilution required to prevent toxicity effects in the outfall area was as high as 14:1 (for copper using the proposed 24-hour criteria). The dilution requirement goes to 60:1 for the influent, a discharge situation that could occur if a plant upset severely limits treatment in the single oxidation ditch unit.
3. Sludge cadmium concentrations are approaching dangerous waste concentrations based on the EP-TOX test results. Higher concentrations of total cadmium were measured in the sludge prior to the inspection, suggesting that higher EP-TOX concentrations may have also occurred.

The data collected during the inspection suggest that classification of OT influent as "typical domestic sewage" is likely inappropriate. Thus, consideration of OT as a special case seems reasonable. Given the metals situation at OT, there is a need to prevent increased metals concentrations/loads to the plant and to reduce the present metals concentrations/loads at the plant. NPDES monitoring for metals appears to be necessary. The frequency of monitoring is somewhat dependent on the efforts to reduce the incoming load to the plant. Locating sources and requiring pretreatment to reduce the incoming load would require a less frequent monitoring. The monitoring program would be designed to assure that the lower loading level is being maintained; perhaps monthly influent, effluent, and sludge sample metals analysis would be adequate (the influent and effluent samples could be a flow-weighted composite of weekly conventional parameter composites). More extensive monitoring would be necessary until the loadings at the source(s) are reduced. Weekly metals analysis of influent, effluent, and sludge samples should be encouraged. An EP-TOX analysis for cadmium would also be desirable when total cadmium in the sludge is >500 mg/Kg dry weight.

LABORATORY PROCEDURES

Laboratory procedures appeared to be fairly good at OT. Comparison of results of samples split for WDOE and OT laboratory analysis are presented on Table 15. Results compare well for BOD_5, TSS, and TVSS analyses, with marginal comparison for fecal coliform results. A media problem was noted with the fecal coliform test that may have contributed to the difference. The OT media was old and discolored. Tests at the WDOE laboratory using the OT media found that plate counts were reduced on the OT media in comparison to the samples run with media from the WDOE lab. The operator reported that since the inspection, a smaller package of new media had been purchased. The media should only be used for six months after the package is opened and then replaced with fresh media. Comments pertinent to other tests include:

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Table 15. Comparison of WDOE and Olympus Terrace analytical results - Olympus Terrace, November 1984.

		BOD_5 (mg/L)		TSS (mg/L)		TVSS (mg/L)		Fecal Coliforms (#/100 mL)	
Sample	Sampler	WDOE Analysis	Olympus Terrace Analysis	Expected* Concentration	Olympus Terrace Analysis	Expected* Concentration	Olympus Terrace Analysis	WDOE Analysis	Olympus Terrace Analysis
Influent									
	WDOE	190	172						
	Olympus Terrace	190	178						
Effluent									
	WDOE	6	†						
	Olympus Terrace	6	10						
	Grab							2 est.	45
EPA*									
QC #1				114	106	49	43		
QC #2				113	119	49	40		
QC #3				532	510	292	270		

*A laboratory accident resulted in loss of the TSS samples by the Olympus Terrace lab. "EPA, Quality Control Samples" were then provided for analysis by the Olympus Terrace lab. The expected concentration is the average analytical result by EPA reference laboratories for the quality control sample.

†Analysis not requested because Olympus Terrace does not routinely seed samples and the chlorinated effluent sample collected by WDOE required seed.

BOD_5 Test

1. Samples for testing should be warmed to room temperature prior to test setup (WDOE, 1983, p. 15, #27). This can be accomplished by removing the sample from refrigeration for approximatley one hour before starting the test.

2. Distilled water to be used in dilution water should be stored in the dark in cotton-plugged containers for approximately one week prior to use. Nutrients should be added to the stored water not more than one or two hours before use in the BOD_5 test.

3. A valid BOD_5 test requires that (WDOE, 1983, p. 19-20):

   a. A minimum oxygen depletion occurs--the initial D.O.concentration should be at least 2.0 mg/L greater than the five-day D.O. concentration. Thus, the D.O. depletion should be at least 2.0 mg/L.

b. A minimum D.O. concentration be left in the bottle when the test is complete--the five-day D.O. concentration in the bottle must be at least 1.0 mg/L.

TSS Test

After the test is complete, the dried filters should occasionally be redried and reweighed to assure that sample drying is adequate.

RECOMMENDATIONS AND CONCLUSIONS

During the inspection the plant was operating within NPDES permitted limits. Laboratory procedures for the permitted parameters were generally good. Suggestions for minor modifications of laboratory procedures are included in the discussion. Problem areas that may have affected the accuracy of DMRs submitted prior to the inspection include:

1. The OT fecal coliform media had exceeded its shelf life and resulted in underestimation of plate counts. New media was purchased by Olympus Terrace soon after the inspection. A shelf life of six (6) months for the media once opened should be observed.

2. The plant flow meter read 0.85 MGD in comparison to an instantaneous measurement of 1.05 MGD at the beginning of the inspection. The meter was recalibrated for the inspection and a rating table was left for the operator to occasionally check the calibration.

Although the plant was meeting the NPDES permit parameters, several potential problem areas were noted. These included:

1. The system used for balancing clarifier loading (by eye) was not working satisfactorily during the inspection. The sludge return air lock problem that contributes to the imbalance should be resolved and a more accurate method of balancing loads instituted.

2. A high sludge blanket was being maintained in the clarifiers. Lowering the blanket would make the plant less susceptible to solids loss during periods of higher hydraulic loading. Also, some sediment deposits were noted on the floor of the oxidation ditch. Channel-wide sludge depth measurements would be necessary to define the extent of deposition and need for clean-out.

3. Oxidation ditch solids wasting was limited to the rate of one garbage dumpster full per week. During the inspection, the MLSS concentration appeared to be higher than necessary, indicating that making provision for a higher wasting rate may be necessary. Accurate sludge wasting records should be kept.

4. Hydraulic loading in the oxidation ditch was at the point where detention time in the ditch was at the minimum WDOE design criteria (18 hours, WDOE, 1978). This may become a limiting factor at the facility.

5. Metals concentrations are of concern. Influent arsenic and cadmium concentrations were particularly high in relation to "typical domestic" influent (arsenic approximately 9 times typical; cadmium approximately 13 times typical). The influent arsenic concentration was approaching the threshold concentration for inhibition of activated sludge. Sludge cadmium, chromium, and nickel concentrations were high in comparison to sludge metals concentrations in previously sampled municipal sludges. The sludge cadmium is of particular concern because the EP-TOX test cadmium concentration of 0.58 mg/L was approaching the dangerous waste criteria of 1 mg/L. The higher metals concentrations in the influent and sludge suggest that the sewage is not strictly a "domestic sewage", and exemption from further consideration of the sludge as a dangerous waste may be inappropriate. A slightly higher EP-TOX cadmium concentration in the sludge would result in a dangerous waste classification. Special handling and disposal techniques as described in Chapter 173-303 WAC are applicable to dangerous wastes (WDOE, 1984).

   A metals monitoring program as part of the Olympus Terrace Sewer District NPDES monitoring program is suggested. As noted in the text, frequency of monitoring would be somewhat dependent on the success of any efforts to locate and control metals inputs into the system.

MH:cp

Attachments

REFERENCES

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