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Date: July 1, 2008
Refer To: ENV-RCRA-08-139

Mr. Robert George, Domestic Team Leader
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Santa Fe, New Mexico 87502-6110

Dear Mr. George:

SUBJECT: TA-50 RLWTF ANNUAL REPORT FOR 2007

Please find enclosed the following Los Alamos National Laboratory report: *Radioactive Liquid Waste Treatment Facility Annual Report for 2007* (LA-UR-08-03779, June 2008). This report is being provided to your agency as supporting documentation for the Laboratory's Ground Water Discharge Plan Application (DP-1132) for the Radioactive Liquid Waste Treatment Facility (RLWTF) at Technical Area (TA)-50.

The *RLWTF Annual Report for 2007* contains summary information about flows, concentrations, and quantities received and discharged at the three LANL radioactive liquid waste treatment facilities (TA-50, TA-21, and TA-53). The facility at TA-50 contains two different treatment processes, each treating a different radioactive liquid waste stream. The two processes are discussed separately throughout the report as though they were each a facility.

Please contact me at 505-667-7969 if you have any questions regarding this report.

Sincerely,

Bob Beers
Water Quality and RCRA Group

30457

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June 2008

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Acronyms and Abbreviations

AE-Ci	americium-241-equivalent curie
Ci	curie (3.7×10^{10} disintegrations per second)
COD	chemical oxygen demand
CY	calendar year
DCG	derived concentration guidelines
DOE	United States Department of Energy
EPA	United States Environmental Protection Agency
Final50	composite sample of effluent from the RLWTF
IX	ion exchange
Kg	kilogram
L	liter
LANL	Los Alamos National Laboratory
MDL	method detection limit
meq/L	milliequivalents per liter
mg/L	milligram per liter
mrem	millirem (10^{-3} rem)
nCi/L	nanocuries per liter (10^{-9} curies per liter)
NMED	New Mexico Environment Department
NPDES	National Pollutant Discharge Elimination System
pCi/L	picocuries per liter (10^{-12} curies per liter)
Pu-239	plutonium isotope with atomic weight of 239
Raw50	composite sample of daily influent to RLWTF via the RLWCS
RLW	radioactive liquid waste(s)
RLWCS	radioactive liquid waste collection system
RLWTF	radioactive liquid waste treatment facility
RO	reverse osmosis
SVOC	semi-volatile organic chemical(s)
TA	technical area
TDS	total dissolved solids
TSS	total suspended solids
TUF	tubular ultrafilter
VOC	volatile organic chemical(s)
µS/cm	microSiemens per centimeter
µg/L	microgram per liter

1. Overview of Facilities and Operations

There are three Radioactive Liquid Waste Treatment Facilities (RLWTF) at the Los Alamos National Laboratory, one each at TA21, TA53, and TA50. The RLW facility at TA50, however, contains two different treatment processes, each treating a different radioactive liquid waste (RLW) stream. These two processes are discussed separately throughout this report as though they were each a facility.

1.1 TA50 RLWTF for Low-Level RLW

The low-level RLW facility at TA50 receives and treats low-level RLW from more than 1000 generating points. RLW are sent from generator facilities to TA50 via truck or by underground pipe. The underground collection system that has about four miles of double-walled pipes that are tied to 25 buildings at six Technical Areas at LANL.

The low-level RLW facility is the only facility that discharges water to the environment. Treated waters are discharged through an outfall in Mortandad Canyon. One state and two federal agencies monitor the quality of these treated waters.

Primary structures at the TA50 RLWTF for the treatment of low-level RLW are Building 50-01, 50-02, 50-90, 50-248, and a trailer-based evaporator. These structures, with a combined area of approximately 55,000 square feet, house process equipment, operations support areas, analytical laboratories, and offices (Del Signore, 07/19/01). The facility has a main treatment process (MTP) with five unit operations, and a secondary treatment process consisting of two unit operations for the treatment of wastes generated by the MTP. The facility has been designated a Hazard Category 3 nuclear facility, and primarily has Management Level 3 quality assurance requirements.

The TA50 RLWTF was constructed in 1963. Because of its age, and because of changing regulations, the facility has undergone significant modifications. The infusion of capital into the TA50 facility for repairs and upgrades has exceeded $20 million since 1997, including projects for stack consolidation, repair of tanks and equipment, and the installation of new processes in 1999 and 2002 to address more stringent discharge standards.

1.2 TA50 RLWTF for Transuranic RLW

The transuranic facility receives and treats an acid waste stream and a caustic waste stream from the plutonium facility at TA55. These two streams are transferred to TA50 via two underground double-walled collection pipes. Treated transuranic waters are sent to the low-level evaporator for further treatment.

The transuranic RLW process was designed and installed in 1982, and brought online in 1983. Structures consist of a valve station at Building 50-201, two influent storage tanks in Building 50-66, and the treatment process within Room 60 of Building 50-01. This facility is part of the Hazard Category 3 nuclear facility at TA50, but primarily has Management Level 2 quality assurance requirements.

Current and recent facility modifications include the replacement of transfer lines between TA55 and TA50, replacement of the caustic waste tank in Building 50-66, and replacement of piping and treatment equipment in Room 60 itself.

1.3 TA53 Facility

The facility at TA53 treats RLW from accelerator research at the Los Alamos Neutron Science Center through water storage, to allow radioisotope decay, and solar evaporation. The TA53 facility started operation in December 1999, and is categorized as a radiological facility.

Water flows by gravity into lift stations adjacent to Experimental Area A and the Lujan center. The RLW is pumped from these lift stations through double-walled underground piping to one of three 30,000-gallon tanks inside Building 53-945 at the east end of TA53. The tanks allow decay of radioisotopes created by the LANSCE accelerator beam, most of which have short half-lives. After aging, the RLW is pumped to one of two evaporator basins, each with a capacity of 125,000 gallons.

1.4 TA21 Facility

The facility at TA21 pre-treats RLW from tritium research at TA21 using a clarifier and a gravity filter. Effluent from the facility is transferred to either the TA50 low-level RLWTF or the TA53 Facility for additional treatment.

The facility is small (4200 ft^2) and old, having been constructed in 1966 (LANL, 09/30/03, p.B-3). Process equipment is smaller than that at the TA50 RLWTF because volumes are smaller. For example, the TA21 clarifier has a capacity of 4,000 gallons, while that at TA50 can hold 18,000 gallons. Associated with the facility are an office trailer and a number of above-ground and below-grade storage tanks. The TA21 RLWTF is categorized as a radiological facility.

2. Operations Summary for 2007

2.1 Flows

Low-level RLW: As shown in Table 2-1, the TA50 RLWTF received 4,448,500 liters of influent during 2007, and discharged 4,585,100 liters to Mortandad Canyon. Influent included 119,820 liters of water transported from six generators via truck; no influent was received during 2007 from the TA21 facility. Water flows were the lowest in the 44-year history of the RLWTF. Influent and effluent volumes are detailed by month in Table 2-2.

Table 2-1
Radioactive Liquid Waste Flows During 2007

Facility	Influent (liters)	Effluent (liters)
Low-level RLW	4,448,500	4,585,100
Transuranic RLW	16,920	1,590
TA-53	176,830	95,730
TA-21	0	0

The influent brought with it 0.76 curie of alpha radioactivity and 0.02 curie of beta activity in 0.79 kilogram of radioactive materials. Uranium-238 accounted for nearly all of the radioactive mass, while plutonium and americium accounted for nearly all of the radioactivity. Effluent contained just 0.02 curie in six grams of radioactive materials. Approximately 99% of the radioactivity in the effluent was due to tritium, which cannot be removed by RLWTF processes.

Nearly 2,400 kilograms of impurities entered the plant in the form of suspended solids (44 kilograms) and dissolved solids (2,350 kilograms). A total of 459 kilograms of solids were discharged with effluent into Mortandad Canyon, of which 40% was sodium.

Transuranic RLW: Influent for the year consisted of 12,290 liters of acid waste plus 4,620 liters of caustic waste. Acid waste influent would have been larger but for the fact that the acid waste influent tank had filled up by mid-October. Transuranic effluent consisted of a single transfer on May 8th to the tanks in Building 50-248. These waters were generated by rinsing and flushing Room 60 piping and equipment.

TA53 RLWTF: All influent was from the TA53 lift stations; no waters were trucked to TA53 in 2007. At the end of the year, storage tanks were filled to 70% capacity (which explains why effluent was so much smaller than influent volume).

Table 2-2
Low-level RLW Flow Summary During 2007

Date	Influent (Liters)	No. of Discharges	Discharged (Liters)
Jan-07	343,036	6	451,200
Feb-07	374,507	5	364,600
Mar-07	418,018	7	518,000
Apr-07	375,281	4	297,500
May-07	413,123	8	593,900
Jun-07	309,752	4	297,500
Jul-07	343,053	3	222,700
Aug-07	433,850	4	293,900
Sep-07	364,786	6	444,400
Oct-07	384,881	6	432,700
Nov-07	372,600	4	295,700
Dec-07	315,612	5	373,000
Total	4,448,499	62	4,585,100

2.2 Effluent Quality: Low-level RLW

Three agencies monitor the quality of treated waters discharged from the TA50 RLWTF into Mortandad Canyon. The United States Department of Energy (DOE) regulates discharges of radioactive materials via Order 5400.5, "Radiation Protection of the Public and the Environment". (DOE, 01/17/93) The United States Environmental Protection Agency (USEPA) regulates 18 parameters via NPDES permit number NM0028355. (EPA, 06/08/07) LANL also has voluntary commitments (a) to the New Mexico Environment Department (NMED) to meet groundwater standards for fluoride, nitrate-nitrogen and total dissolved solids (TDS), (b) to the NMED to meet a proposed discharge standard for perchlorates, and (c) to the DOE to limit tritium to 1% of its published discharge standard.

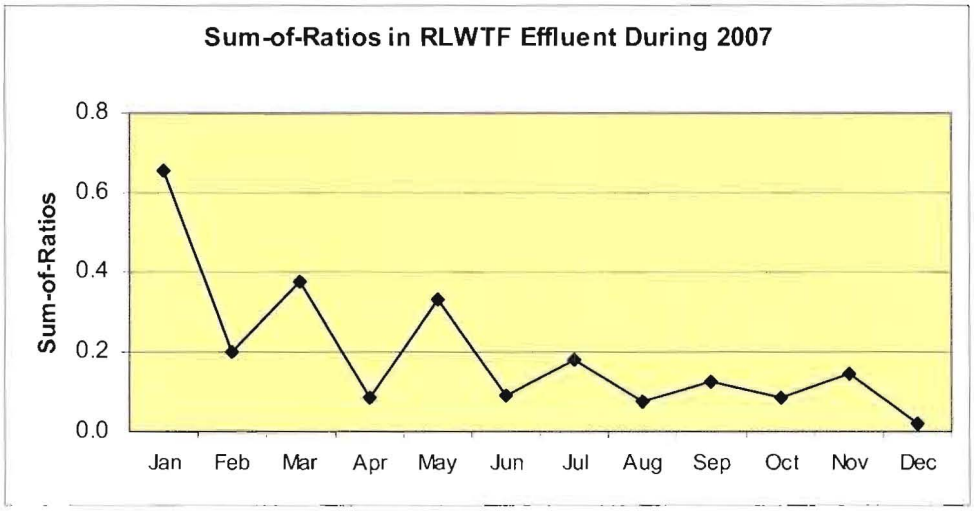
During calendar year 2007, TA50 RLWTF effluent:

- met all DOE standards set forth in Order 5400.5 for radiological discharges;
- was in compliance with all NPDES water quality parameters; and
- met all five voluntary standards.

DOE: Effluent radiological quality during 2007 is illustrated in Figure 2-1, a plot of sum-of-ratios for each month. The average sum-of-ratios for all of 2007 was 0.22, or less than one-fourth of the DOE discharge standard. RLWTF effluent has been compliant with the standard for 94 of the past 96 consecutive months[1].

[1] The monthly sum-of-ratios for discharge of radionuclides was 1.28 in January 2002 and 1.19 in February 2002, versus the DOE Guideline of 1.0.

Figure 2-1



EPA: Table 2-4 summarizes effluent quality versus NPDES discharge limits. The table lists regulated parameters, their discharge standards, and the maximum and average concentration of each parameter in monthly composite samples of effluent during 2007. Annual average discharge concentrations were less than 20% of the discharge standard for all regulated parameters; maximum monthly concentrations were less than half of discharge standards. RLWTF effluent has been compliant with NPDES discharge standards for the past 96 months.

Voluntary: Table 2-3 summarizes effluent quality versus voluntary discharge standards. The table lists the voluntary discharge standards, and the maximum and average concentration of each parameter in weekly composite samples of effluent during 2007. Annual average discharge concentrations were less than 30% of the voluntary standards; maximum weekly concentrations were less than half of the standards. RLWTF effluent has now been compliant with NMED voluntary standards for 441 of the last 443 weekly samples[2]; compliant with the tritium standard for the last 82 months; and compliant with the perchlorate standard for the last 69 months.

Table 2-3
TA50 RLWTF Effluent During 2007 Compared To Voluntary Standards

	Agency	Units	Standard	Max.	Avg.
Dissolved Solids	NMED	mg/L	1,000	480	185
Fluoride	NMED	mg/L	1.6	0.45	0.10
Nitrate-Nitrogen	NMED	mg/L	10	6.5	1.3
Perchlorate	EPA	µg/L	4	0	0
Tritium	DOE	nCi/L	20	12	5.6

Data is from 41 weekly composite samples.

[2] Two weekly composite samples of RLWTF effluent slightly exceeded the groundwater standard for fluoride during 2003. Sample values were 2.07 mg/L (week of Jan 3rd) and 1.64 mg/L (week of Mar 3rd), versus the groundwater standard of 1.6 mg/L. (Watkins and Worland, March 2004, p. 30.)

Table 2-4
TA50 RLWTF Effluent During 2007 Compared To NPDES Standards

Regulated Parameter	Units	Standard (Jan-Jul)	Standard (Aug-Dec)	Max.	Avg.
Aluminum	µg/L	5,000	N.R.	54	11
Arsenic	µg/L	368	N.R.	30	4
Boron	µg/L	5,000	N.R.	170	107
Cadmium	µg/L	50	Report	*	*
Chromium	µg/L	1,340	1,340	*	*
Cobalt	µg/L	1,000	N.R.	*	*
COD	mg/L	125	125	62	14
Copper	µg/L	1,393	Report	23	9.5
Iron	µg/L	Report	N.R.	80	18
Lead	µg/L	423	423	10	1
Mercury	µg/L	0.77	Report	.11	.02
Nickel	µg/L	Report	Report	30	5
PCBs	µg/L	N.R.	Report	*	*
Perchlorate	µg/L	Report	Report	*	*
pH	s.u.	6 - 9	6 - 9	8.2	7
Radium	pCi/L	30	30	*	*
Residual Chlorine	µg/L	N.R.	11	*	*
Selenium	µg/L	5	Report	2	1
Suspended Solids	mg/L	30	30	12	2
Toxic Organics	µg/L	1,000	1,000	55	9
Tritium	nCi/L	20	N.R.	8.2	4.1
Vanadium	µg/L	100	N.R.	8	1
WET	%	N.R.	Report	100%	56%
Zinc	µg/L	4,370	Report	10	2

Data is from 12 monthly composite samples.
N.R. = Not Regulated WET = whole effluent toxicity * Less than detection limit.

2.3 Wastes and Secondary Liquids

RLW treatment processes generate both liquid streams that require further processing and solid wastes that must be disposed. The total volume of liquid wastes generated during 2007 probably approached three million liters, or 60% of the raw influent volume. More than half of this volume was generated via operation of the tubular ultrafilter, primarily from daily purging of influent tanks and recycle of spongeball waters.

Solid wastes totaled 7260 kilograms of low-level radioactive wastes, 4030 kilograms of chemical wastes, and 348 kilograms of mixed low-level wastes. No transuranic wastes, were generated during the year. All of the chemical wastes and mixed low-level wastes, and most of the radioactive wastes, were from construction projects.

2.4 Process and Facility Modifications

Process: The NPDES permit for the TA50 RKWTF was renewed effective August 2007; the former permit had been in effect since February 2001. The renewed permit changed NPDES sampling and analytical protocols by reducing the number of regulated parameters with

discharge standards from 18 to eight (Table 2-5), and by decreasing the frequency of sampling by two-thirds, from 533 to 173 samples per year (Table 2-6). The number of parameters with a discharge standard will increase to 11 in August 2010 when whole effluent toxicity testing, copper, and zinc cease to be "report only" parameters.

Table 2-5
Comparison of NPDES Regulated Parameters

	Effective Date		
	Feb-01	**Aug-07**	**Aug-10**
Discharge Std.	18	8	11
Report Only	3	9	6
Totals	**21**	**17**	**17**

Flow, a regulated (report only) parameter, is not included in the above table.

Table 2-6
Comparison of NPDES Sampling Frequency

	NUMBER OF ANALYSES				
	Weekly	**Monthly**	**Quarterly**	**Annually**	**Totals**
Feb-01:					
#Analytes	10	2	0	9	21
#Analyses/ yr	500	24	0	9	533
Aug-07:					
#Analytes	2	5	1	9	17
#Analyses/ yr	100	60	4	9	173
Aug-10:					
#Analytes	2	5	1	9	17
#Analyses/ yr	100	60	4	9	173

Facility: The capability of the TA50 RLWTF to receive acid and caustic liquid wastes from TA55 was restored 02/21/07. This achievement followed the activation of new underground influent lines, and installation of a new caustic waste tank, to replace a tank that had developed a leak in September 2003. These two construction projects required 11 months, 3500 labor hours, and 123 confined-space entries into WM66 and WM201 (Worland, 02/22/07). Contamination levels within WM66 were reduced by four orders of magnitude, from 10 million to 100 dpm/100 square centimeters. No contamination of personnel occurred; no CAMs reached alarm levels; and no injuries were suffered.

Also during 2007, work continued on two other TA50 facility modifications – Room 60 repairs, and installation of a new pump house and influent storage facility.

3. Radiological Nature of Low-level RLW

The influent wastewater to the TA50 RLWTF is radioactive due to the presence of radionuclides that emit alpha and beta particles, gamma rays and neutrons. RLWTF influent and effluent samples are analyzed for thirty-seven (37) such radionuclides which, from past experience, are possible in LANL radioactive liquid wastes.

Alpha-emitting radionuclides are of most concern because of quantities (both mass and radioactivity) and safety basis impacts. Specifically, whereas three-fourths of a kilogram and 0.76 curie of alpha-emitting radionuclides were received in RLWTF influent during 2007, less than one gram and just 0.02 curie of beta-emitting radionuclides were received. In the area of safety basis, alpha radionuclides have americium-241 weights ranging from 0.2-1.0, whereas beta radionuclides have weights that are four or more orders of magnitude smaller.

3.1 Influent Characteristics

As shown in Table 3-1, twelve radionuclides were detected in the RLWTF influent: seven alpha-emitting isotopes and five beta-emitting isotopes.

Alpha-emitting radionuclides had an average concentration of 171 nCi/L, or 157 americium-241-equivalent curies (AE-Ci) per liter. This concentration is about three times historical average concentrations (Del Signore, December 2006, p.25), and equates to an influent total of 0.76 curie. Am-241, Pu-238, and Pu-239 comprised all but 0.4% of the alpha radioactivity.

Beta-emitting radionuclides had an average concentration of 4.3 nCi/L, which equates to 0.02 curie. More than 97% of beta radioactivity was from tritium.

3.2 Effluent Characteristics

Also as shown in Table 3-1, thirteen radionuclides were detected in the RLWTF effluent: seven alpha-emitting isotopes and six beta-emitting isotopes. Alpha-emitting radionuclides had an average effluent concentration of 13.5 pCi/L, and beta-emitting radionuclides an average concentration of 4.1 nCi/L.

3.3 Radionuclide Removal

Table 3-2 summarizes radioactivity (curies) into and out of the RLWTF for 2007 for all radioisotopes. In the table, "alpha gross" indicates direct analytical measurement of alpha

activity by liquid scintillation counting, and "alpha sum" is the arithmetic sum of the concentrations of the nine alpha-emitting radionuclides by alpha spectroscopy. This double analysis of water samples provides an accuracy check for analytical results, and can indicate when re-analysis may be warranted.

Table 3-1
Radionuclide Analyses of RLWTF Influent and Effluent in CY 2007

Radionuclides Analyzed for in the RLWTF Influent and Effluent	Radionuclides Present in RLWTF Influent	Radionuclides Detected in RLWTF Effluent
Alpha Particle Emitters (9)		
Am-241	X	X
Np-237		
Ra-226		
Pu-238	X	X
Pu-239	X	X
Th-232	X	X
U-234	X	X
U-235	X	X
U-238	X	X
Beta Particle Emitters (28)		
As-74		X
Be-7		
Ce-141	X	
Co-56 and Co-57		
Co-58 and Co-60		
Cs-134		
Cs-137	X	X
Eu-152		
H-3	X	X
I-133		
Mn-52 and Mn-54		
Na-22		
Ra-228		
Rb-83		X
Rb-84		X
Sc-46 and Sc-48		
Se-75		X
Sn-113		
Sr-85	X	
Sr-89		
Sr-90	X	
V-48		
Y-88		
Zn-65		
37 Total	**12 Total**	**13 Total**

Table 3-2
TA50 RLWTF Radionuclide Summary For 2007

	RAW Avg (nCi/L)	Maxi-mum (nCi/L)	Mini-mum (nCi/L)	Total (Ci)	FINAL Avg (pCi/L)	Maxi-mum (pCi/L)	Mini mum (pCi/L)	TOTAL (Ci)
Alpha Gross	155.2 E0	730. E0	35. E0	690.5 E-3	13. E0	63. E0	2.5 E0	59.7 E-6
Alpha Sum	171.2 E0	740.3 E0	39. E0	761.8 E-3	13.5 E0	68.4 E0	460. E-3	62.1 E-6
Am-241	74.5 E0	210. E0	12. E0	331.3 E-3	3.6 E0	8.1 E0	460. E-3	16.6 E-6
As-74	*	*	*	*	1.5 E0	15. E0	*	6.8 E-6
Be-7	*	*	*	*	*	*	*	*
Ce-141	4.3 E-3	44. E-3	*	19.1 E-6	*	*	*	*
Co-56	*	*	*	*	*	*	*	*
Co-57	*	*	*	*	*	*	*	*
Co-58	*	*	*	*	*	*	*	*
Co-60	*	*	*	*	*	*	*	*
Cs-134	*	*	*	*	*	*	*	*
Cs-137	13.7 E-3	140. E-3	*	60.7 E-6	1.8 E0	9.9 E0	*	8.4 E-6
Eu-152	*	*	*	*	*	*	*	*
H-3	*	*	*	*	4.1 E3	8.2 E3	1.6 E3	19. E-3
I-133	*	*	*	*	*	*	*	*
Mn-52	*	*	*	*	*	*	*	*
Mn-54	*	*	*	*	*	*	*	*
Na-22	*	*	*	*	*	*	*	*
Np-237	*	*	*	*	*	*	*	*
Pu-238	62.6 E0	380. E0	17. E0	278.6 E-3	1.3 E0	4.9 E0	*	6. E-6
Pu-239	33.5 E0	150. E0	9.9 E0	149.2 E-3	1.5 E0	4.9 E0	*	6.8 E-6
Ra-226	*	*	*	*	*	*	*	*
Ra-228	*	*	*	*	*	*	*	*
Rb-83	*	*	*	*	20.4 E0	130. E0	*	93.4 E-6
Rb-84	*	*	*	*	610.1 E-	6.2 E0	*	2.8 E-6
Sc-46	*	*	*	*	*	*	*	*
Sc-48	*	*	*	*	*	*	*	*
Se-75	*	*	*	*	954.5 E-	9.7 E0	*	4.4 E-6
Sn-113	*	*	*	*	*	*	*	*
Sr-85	11.4 E-3	160. E-3	*	50.5 E-6	*	*	*	*
Sr-89	*	*	*	*	*	*	*	*
Sr-90	86.8 E-3	440. E-3	*	386.1 E-6	*	*	*	*
Th-232	183.3 E-6	790. E-6	*	815.4 E-9	3.6 E-3	38. E-3	*	16.4 E-9
U-234	548. E-3	3. E0	*	2.4 E-3	6.7 E0	48. E0	*	30.6 E-6
U-235	2.5 E-3	6.9 E-3	*	11.2 E-6	46.4 E-3	310. E-3	*	212.9 E-9
U-238	58.2 E-3	160. E-3	*	258.9 E-6	412.4 E-	2.7 E0	*	1.9 E-6
V-48	*	*	*	*	*	*	*	*
Y-88	*	*	*	*	*	*	*	*
Zn-65	*	*	*	*	*	*	*	*

Twelve influent samples and 12 effluent samples for each isotope.
* Less than Detection Limit

Table 3-3 shows the *mass* of the nine alpha-emitting radionuclides analyzed for in the RLWTF influent and effluent from the RLWTF in 2007. The table shows that 786 grams of alpha emitters were received in influent, and that treatment removed 99.25% of the mass of these alpha emitters from the wastewater stream (5.9 grams out). The table also shows that uranium-238 comprised nearly all of the mass of these radionuclides in both influent and effluent.

A similar perspective is obtained by examining removal of alpha *radioactivity* during 2007 (Table 3-4). The RLWTF performed even better from this perspective, removing 99.99% of the radioactivity of the alpha emitters from the wastewater stream (0.76 curie in, 62 microcuries out) during 2007.

Table 3-3
Mass of Alpha Radionuclides During 2007

Radionuclide	Influent (grams)	Effluent (grams)
Am-241	0.1	<0.001
Np-237	*	*
Ra-226	*	*
Pu-238	<0.1	<0.001
Pu-239	2.4	<0.001
Th-232	7.4	0.149
U-234	0.4	0.005
U-235	5.1	0.098
U-238	770.3	5.640
Totals	**785.8**	**5.900**

* Less than Detection Limit

Removal of beta-emitting radioisotopes is also depicted in Table 3-4. Approximately three-fourths of non-tritium beta activity was removed during 2007 (0.52 millicurie in; 0.12 millicurie out). Tritium quantities entering and leaving the plant were the same (18.8 millicuries). This is because tritium is present *as* water, and the RLWTF is not equipped to treat or remove tritium. Although treatment for and removal of beta-emitting radioisotopes was not as effective as for alpha-emitting radioisotopes, the quantities encountered were smaller. Influent contained just 18.8 millicuries of beta activity, versus 762 millicuries of alpha activity.

Table 3-4
Removal of Radioactivity From RLWTF Influent During 2007

Month	Raw (Ci)	Final (Ci)	%Removed
Alpha radioactivity	7.62 E-01	6.21 E-05	99.99
Beta radioactivity*	5.17 E-04	1.16 E-04	77.6
Tritium (beta)	1.88 E-02	1.88 E-02	0

* Non-tritium beta

3.4 Regulatory Performance

In 1990 DOE issued Order 5400.5, "Radiation Protection of the Public and the Environment," which revised Derived Concentration Guidelines (DCGs) for all radionuclides discharged from DOE facilities. The concentration of each radionuclide divided by its particular DCG value results in a ratio. For waters containing more than one radionuclide, a ratio is to be found for each radionuclide, and these ratios are to be summed. To be in compliance with Order 5400.5, the sum of the ratios cannot exceed 1.0.

Table 3-5 provides flow-weighted sum-of-the-ratios for individual isotopes, and shows that the average for all of 2007 was 0.22. Americium accounted for 55% of the sum of the ratios in the RLWTF effluent during 2007, and another three isotopes (^{234}U, ^{238}Pu, and ^{239}Pu) accounted for nearly all the rest.

Table 3-5
TA-50 RLWTF Effluent During 2007 Compared With DOE Order 5400.5

Radioactive Isotopes *	Average Concentration (picoCi/L)	DCG 5400.5 (picoCi/L)	Percent Of DCG
Am-241	3.6 E0	30	12.1
As-74	1.5 E0	40,000	< 0.1
Cs-137	1.8 E0	3,000	< 0.1
H-3	4.1 E3	2,000,000	0.21
Pu-238	1.3 E0	40	3.26
Pu-239	1.5 E0	30	4.94
Rb-83	20.4 E0	20,000	0.10
Rb-84	6.1 E-1	10,000	< 0.1
Se-75	9.545 E-1	20,000	< 0.1
Th-232	3.6 E-3	50	< 0.1
U-234	6.7 E0	500	1.33
U-235	4.64 E-2	600	< 0.1
U-238	4.124 E-1	600	< 0.1
Sum of Ratios = 0.221			

* Other isotopes were not detected in RLWTF effluent.

3.5 Graphs of Radiological Data

Figures 3-1 and 3-2 chart concentrations in RLWTF influent and effluent for each month of 2007 for alpha-emitting isotopes (i.e., sum of the concentration of the nine alpha radionuclides listed in Table 3-1). Note that the ordinate of Figure 3-1 is scaled in nanocuries per liter while Figure 3-2 is scaled in picocuries per liter, a factor of one thousand. Examination of these graphs shows the following:

- The decontamination factor for alpha radioisotopes was four orders of magnitude (i.e., 10,000) or more. This was also indicated in Table 3-4.

- Effluent concentrations averaged less than 25 pCi/L for 11 months, and less than 10 pCi/L for nine months.

- January discharges were unusually high (average of 68 pCi/L) due to the presence of ^{234}U at an average concentration of 48 pCi/L. Uranium-234 had been sloughed from the ion exchange unit operation as resins neared end-of-life during the final three months of 2006. (Del Signore and Watkins, May 2007, p.17). Although the January effluent concentration was unusually high, January discharges had a sum-of ratios value of 0.65, and were thus below DOE's discharge standard.

- There was no pattern for influent concentrations for the alpha-emitting isotopes. The December average concentration of 740 nCi/L, however, was a jump to more than four times the average influent concentration for all of 2007. No particular isotope was the cause, as ^{238}Pu, ^{239}Pu, and ^{241}Am concentration each increased by factors of 3-5 times the annual average. No generator was identified as the source of the spike. (Influent concentrations returned to a more typical concentration of 100 nCi/L in January 2008.)

Figure 3-3 shows effluent concentrations for U-234, and demonstrates that it was the chief constituent of the higher effluent concentration in January 2007. Figure 3-4 charts average concentrations, in picocuries per liter, of tritium by month in RLWTF effluent. Tritium was the only significant beta-emitting radionuclide in RLWTF effluent, accounting for 98% of the total beta activity discharged during 2007.

Figure 3-1
Alpha-Emitting Isotopes in RLWTF Influent During 2007

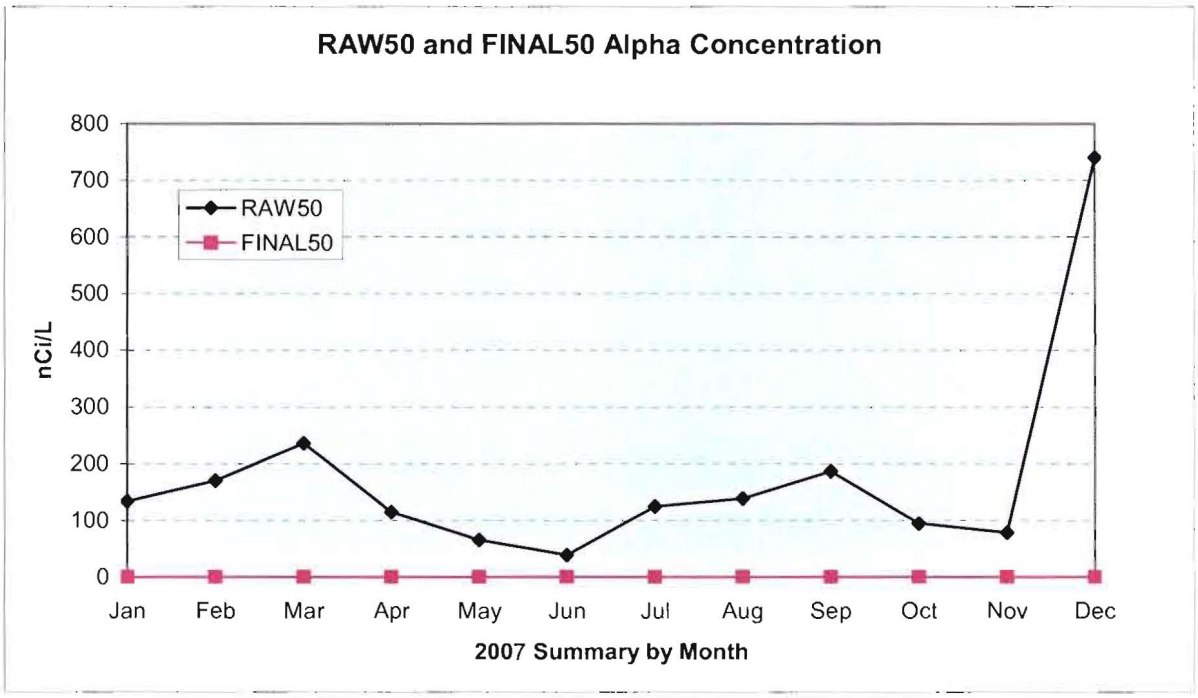


Figure 3-2
Alpha-Emitting Isotopes in RLWTF Effluent During 2007

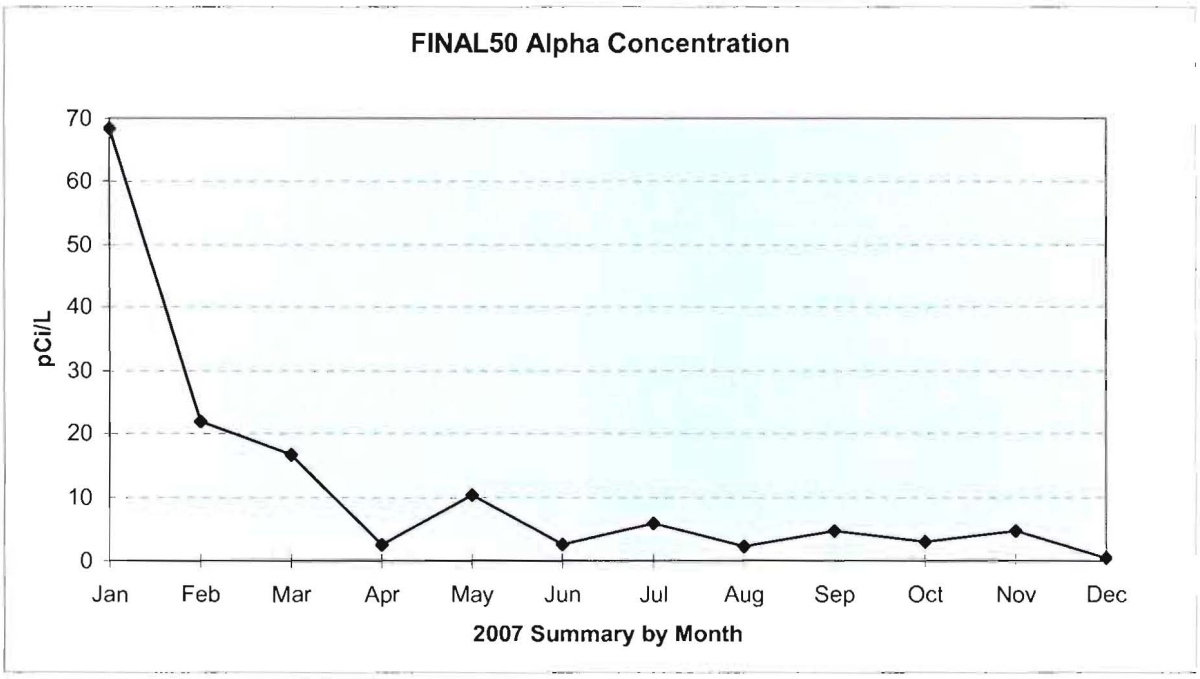


Figure 3-3
U-234 in RLWTF Effluent During 2007

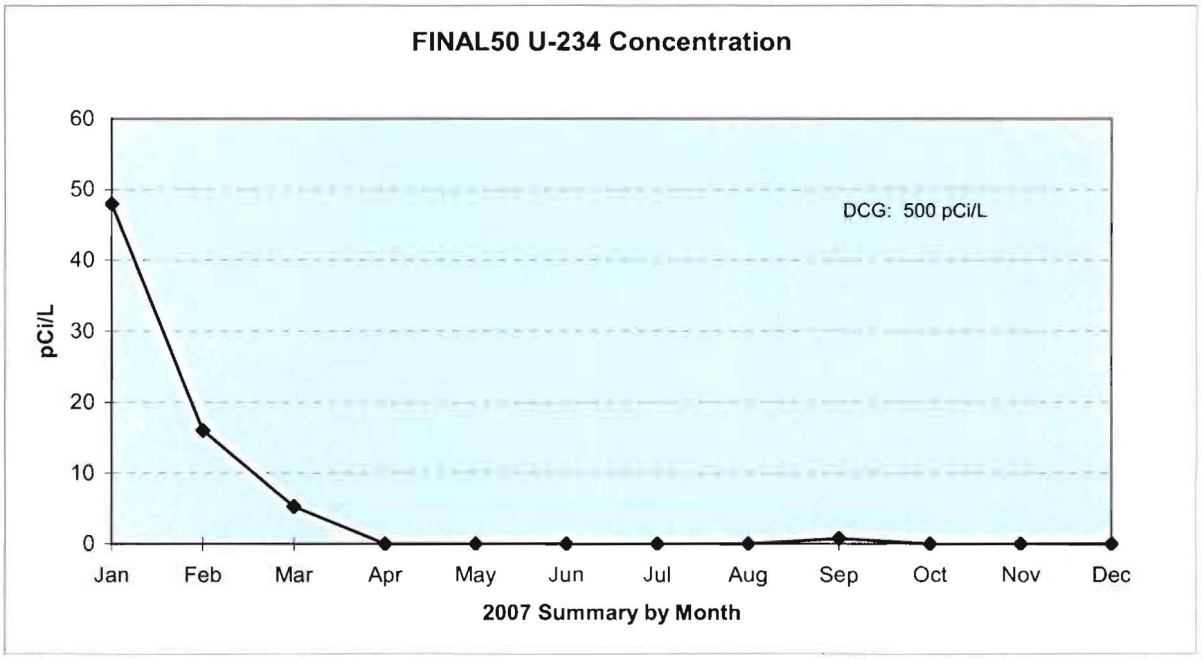
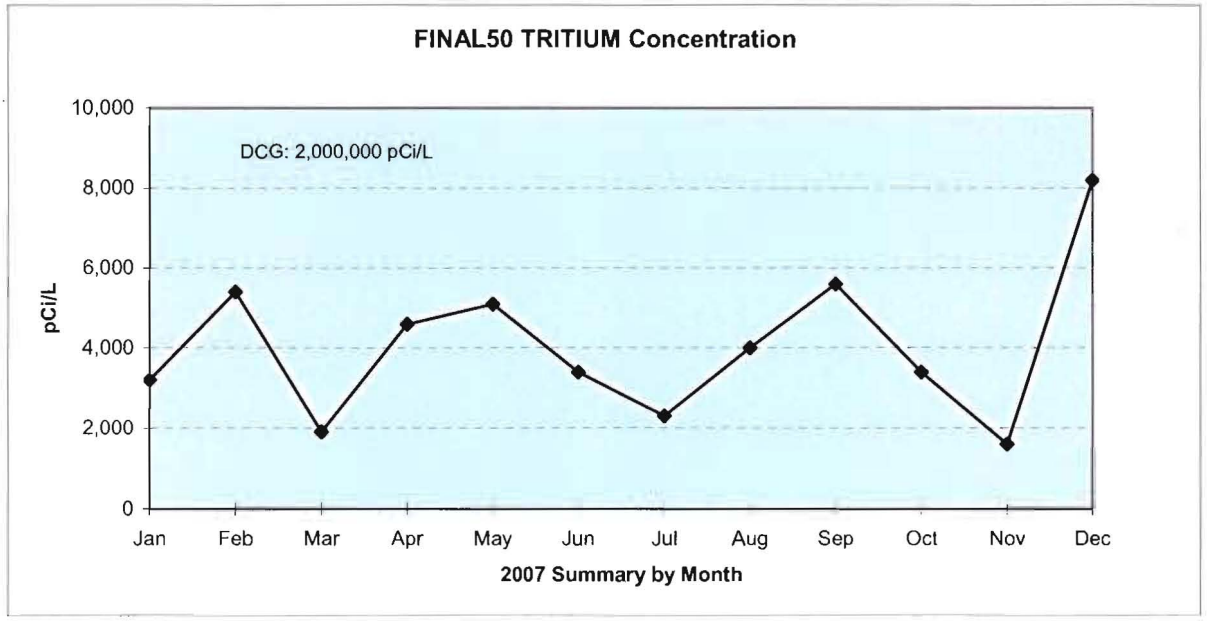


Figure 3-4
Tritium in RLWTF Effluent During 2007



4. Non-Radiological Nature of Low-level RLW

Wastewater received at the TA50 RLWTF also contains nonradioactive constituents, most of which are present in tap water. RLWTF influent samples are analyzed for 42 non-radioactive, inorganic water quality parameters, and for volatile and semi-volatile organic compounds. Effluent samples are analyzed for the same 42 inorganic parameters, and for total toxic organics.

Inorganic parameters can be aggregated as follows:

(a) eight conventional water quality measures – chemical oxygen demand, conductivity, hardness, pH, total dissolved solids, total suspended solids, and two measurements for alkalinity.
(b) a total of 25 cation (metals) measurements, including total cations.
(c) five anions: chloride, fluoride, cyanide, sulfate, and perchlorate.
(d) four nitrogen measurements – nitrogen as nitrates, nitrogen as ammonia, nitrogen as nitrites, and total Kjedahl nitrogen.

Effluent is analyzed for 90 toxic organic compounds. Influent is analyzed for these 90 toxic organic compounds plus 40 other volatile and semi-volatile organic compounds.

4.1 Influent Characteristics

As shown in Table 4-1, all 42 inorganic parameters were detected in the RLWTF influent in 2007. Table 4-1 also shows, however, that sixteen of these were reported at less than the analytic detection limit for at least one month during the year. On average, in fact, five minerals were reported each month at less than the analytic detection limit. Average influent concentration of all minerals for the entire year was 540 mg/L.

As shown in Table 4-2, the total mass of minerals entering the RLWTF was nearly 2400 kilograms. This was quite different from radioactive contaminants, which had a combined influent mass of less than one kilogram. Table 4-2 indicates significant quantities of sodium and chloride, which could pose long-term corrosion concerns. Table 4-2 also shows appreciable quantities of nitrogen compounds in RLWTF influent.

Influent was also analyzed for volatile and semi-volatile organic compounds. A total of 29 samples were collected during 2007, and each were analyzed for ~130 organic compounds. Of these analyses, 206 (5%) were found to exceed minimum detection level. Annual average influent concentration was 0.8 mg/L organic compounds.

Table 4-1
TA50 RLWTF Mineral Summary For 2007

	RAW Average	Maxi-mum	Mini-mum	Total In (Kg)	FINAL Average	Maxi-mum	Mini-mum	Total Out (Kg)
ALKALINITY-MO**	2.44E+02	9.35E+02	*	1.09E+03	2.23E+02	1.38E+03	2.60E+01	1.02E+03
ALKALINITY-P**	4.16E+00	5.40E+01	*	1.85E+01	8.51E+01	8.65E+02	*	3.90E+02
ALUMINUM	1.14E+00	8.30E+00	1.40E-01	5.08E+00	1.14E-02	5.40E-02	*	5.25E-02
AMMONIA-N	1.17E+01	1.85E+01	7.87E+00	5.18E+01	6.49E+00	1.01E+01	*	2.97E+01
ARSENIC	2.46E-03	3.00E-02	*	1.09E-02	4.24E-03	3.00E-02	*	1.95E-02
BARIUM	4.17E-02	1.00E-01	2.00E-02	1.85E-01	3.20E-04	3.00E-03	*	1.47E-03
BERYLLIUM	7.99E-03	3.00E-02	*	3.55E-02	4.52E-04	4.00E-03	*	2.07E-03
BORON	9.28E-02	2.00E-01	*	4.13E-01	1.07E-01	1.70E-01	7.00E-02	4.90E-01
CADMIUM	2.05E-03	1.00E-02	*	9.14E-03	*	*	*	*
CALCIUM	1.09E+01	1.90E+01	3.00E+00	4.86E+01	9.59E-01	3.95E+00	*	4.40E+00
CHLORIDE	1.37E+02	7.60E+02	1.92E+01	6.12E+02	7.52E+00	1.80E+01	3.20E+00	3.45E+01
COBALT	1.09E-02	7.00E-02	*	4.84E-02	*	*	*	*
COD	2.50E+02	5.54E+02	5.50E+01	1.11E+03	1.40E+01	6.20E+01	*	6.40E+01
CONDUCTIVITY**	1.44E+03	6.60E+03	2.90E+02	6.40E+03	2.65E+02	5.90E+02	1.20E+02	1.22E+03
COPPER	7.27E-01	2.50E+00	2.20E-01	3.23E+00	9.51E-03	2.30E-02	2.60E-03	4.36E-02
CYANIDE	8.21E-04	7.00E-03	*	3.65E-03	4.54E-04	3.00E-03	*	2.08E-03
FLUORIDE	8.55E-01	1.70E+00	4.00E-01	3.81E+00	1.33E-01	3.40E-01	*	6.09E-01
HARDNESS**	3.92E+01	7.22E+01	1.86E+01	1.75E+02	2.65E+00	9.86E+00	*	1.21E+01
IRON	3.66E+00	3.60E+01	4.90E-01	1.63E+01	1.82E-02	8.00E-02	*	8.36E-02
LEAD	1.99E-01	1.00E+00	6.00E-02	8.84E-01	1.13E-03	1.00E-02	*	5.18E-03
MAGNESIUM	2.90E+00	6.00E+00	1.40E+00	1.29E+01	6.12E-02	7.80E-01	*	2.81E-01
MERCURY	2.25E-03	4.60E-03	8.50E-04	1.00E-02	1.82E-05	1.10E-04	*	8.36E-05
NICKEL	6.11E+00	5.90E+01	5.00E-03	2.72E+01	5.16E-03	3.00E-02	*	2.37E-02
NITRATE-N	1.17E+01	2.40E+01	6.00E+00	5.22E+01	1.50E+00	6.50E+00	*	6.90E+00
NITRITE-N	1.10E+00	2.48E+00	*	4.91E+00	1.05E+00	2.44E+00	*	4.83E+00
PERCHLORATE	2.43E-01	5.00E-01	*	1.08E+00	*	*	*	*
pH	6.59E+00	1.19E+01	2.20E+00	--	7.47E+00	8.21E+00	6.72E+00	--
PHOSPHORUS	2.35E+00	3.40E+00	5.10E-01	1.05E+01	3.63E-02	1.50E-01	*	1.66E-01
POTASSIUM	2.07E+00	6.50E+00	2.00E-01	9.20E+00	7.19E-01	4.00E+00	5.00E-02	3.30E+00
SELENIUM	1.67E-03	5.20E-03	*	7.41E-03	1.04E-03	2.20E-03	4.20E-04	4.78E-03
SILICON	2.96E+01	4.10E+01	1.95E+01	1.32E+02	1.15E+00	3.39E+00	3.20E-01	5.29E+00
SILVER	3.04E-03	1.40E-02	*	1.35E-02	8.43E-04	4.00E-03	*	3.86E-03
SODIUM	1.48E+02	5.67E+02	1.40E+01	6.57E+02	4.17E+01	1.28E+02	1.00E+01	1.91E+02
SULFATE	2.96E+01	9.00E+01	1.13E+01	1.32E+02	5.81E+00	2.45E+01	2.60E-01	2.67E+01
TDS	5.28E+02	1.46E+03	1.96E+02	2.35E+03	9.84E+01	2.49E+02	2.20E+01	4.51E+02
TKN	1.61E+01	3.60E+01	*	7.16E+01	6.15E+00	8.80E+00	3.71E+00	2.82E+01
TOTAL CATIONS**	8.51E+00	2.70E+01	2.76E+00	3.78E+01	5.45E+00	2.96E+01	1.02E+00	2.50E+01
TOTAL CHROMIUM	2.19E-01	1.30E+00	1.00E-02	9.73E-01	*	*	*	*
TOXIC ORGANICS	n.m.	n.m.	n.m.	n.m.	9.07E-03	5.46E-02	*	4.16E-02
TSS	9.83E+00	5.60E+01	*	4.37E+01	1.82E+00	1.20E+01	*	8.36E+00
URANIUM	1.50E-01	3.30E-01	*	6.68E-01	1.23E-03	8.00E-03	*	5.62E-03
VANADIUM	2.13E-02	9.00E-02	*	9.49E-02	8.43E-04	8.00E-03	*	3.86E-03
ZINC	1.80E-01	9.00E-01	1.00E-03	8.02E-01	2.25E-03	1.00E-02	*	1.03E-02

Twelve influent samples and 12 effluent samples for each mineral.
* Less than Detection Limit n.m.: Not measured
**Units: All figures in mg/L except:
Alkalinities and hardness as mg CaCO3/L; Conductivity as uS/cm; Total Cations as meq/L.

4.2 Effluent Characteristics

As shown in Table 4-1, 38 of the 42 inorganic constituents were detected in the RLWTF effluent; cadmium, chromium, cobalt, perchlorate were not detected in any of the 12 monthly composite samples. Table 4-1 also shows, that 28 of these were reported at less than the analytic detection limit for at least one month during the year. On average, in fact, 17 minerals were reported each month at less than the analytic detection limit. Average effluent concentration of all minerals for the entire year was 100 mg/L.

As shown in Table 4-2, the total mass of minerals leaving the RLWTF was 459 kilograms, a reduction of nearly two metric tonnes from influent waters. This, too, was quite different from radioactive contaminants, which had a combined effluent mass of just six grams.

Effluent is also analyzed for toxic organic compounds. A total of 12 samples were collected during 2007, and each were analyzed for ~90 organic compounds. Of these analyses, just five (0.5%) were found to exceed minimum detection level. Annual average influent concentration was 0.009 mg/L organic compounds.

Table 4-2
Removal of Major Inorganic Minerals From RLWTF Influent During 2007

Mineral	Mass in Influent (Kgs)	Mass in Effluent (Kgs)	Percent Removed
Sodium	657	191	71
Chloride	612	34	94
Silicon	132	5	96
Sulfate	132	27	80
Kjedahl Nitrogen	72	28	61
Nitrate-Nitrogen	52	7	87
Ammonia-Nitrogen	52	30	43
Calcium	49	4	91
Nickel	27	0	100
Subtotal, Major Minerals	1784	326	82
Total Solids *	2392	459	81

* Total Dissolved Solids + Total Suspended Solids

4.3 Removal of Minerals

Table 4-1 provides a summary of mineral concentrations and quantities received by (influent) and discharged from (effluent) the RLWTF during 2007. The information shows that 2,392 kilograms of contaminants entered the facility in the form of suspended solids (44 kilograms) and dissolved solids (2350 kilograms). This quantity is similar to the 2890 kilograms received

during 2004, but twice the amounts received in 2005 and 2006 (1460 and 1300 kilograms, respectively).

In treating the influent, RLWTF personnel added lime at the clarifier to soften the water, ferric sulfate at the clarifier to precipitate radionuclides, and potassium permanganate and sodium hydroxide at the neutralization chamber to adjust pH. Other chemicals, including sodium hydroxide and hydrochloric acid were used to clean the TUF and RO membranes. Data does not exist for the quantities of these additional chemicals required for water treatment, so that the total quantity of chemicals seen in RTLWTF waters in 2007 is not known. As a rule of thumb, however, the sum of chemicals added during treatment approximates the quantity of inorganic chemicals that enter the RLWTF with the influent.

As can be derived from the final column of Table 4-1, the total amount of chemicals leaving the facility with the effluent was 459 kilograms, the sum of total dissolved solids and total suspended solids. This was 19% of the total quantity entering as influent, and an estimated 11% of the total of influent chemicals plus chemicals required for water treatment.

Nine inorganic chemicals comprised the majority (~71%) of these chemicals in effluent; they are summarized in Table 4-2, along with percent removed from the RLWTF influent. With respect to influent, nickel was received in surprising concentrations, and three nitrogen compounds were among the major minerals.

4.4 Regulatory Performance

From January through July, 22 parameters in the effluent from the RLWTF were regulated by the National Pollutant Discharge Elimination System in compliance with the Federal Clean Water Act (EPA, 12/29/00). The NPDES Permit was revised effective August 1st, after which the number of regulated parameters was reduced to 18, of which only eight have discharge standards. LANL also has a voluntary commitment with the New Mexico Environment Department to discharge effluent from the TA-50 RLWTF below groundwater standards set by the New Mexico Water Quality Control Commission (NMED, 04/20/08) for three water quality parameters: fluoride, nitrogen-as-nitrate, and total dissolved solids.

Table 4-3 identifies these parameters regulated from January through July, and Table 4-4 identifies parameters regulated beginning August 1, 2007. The tables also show sampling frequency required for each, and their regulatory limits.

During calendar year 2007, TA50 RLWTF effluent, for the eighth consecutive year, was in compliance with all NPDES water quality parameters. TA50 effluent also met NMED ground water standards for fluoride, nitrate, and TDS every week of the year, and has now met these voluntary standards for all but two weeks over the last eight years [3].

[3] Two weekly composite samples of RLWTF effluent slightly exceeded the groundwater standard for fluoride during 2003. Sample values of 2.07 mg/L (January 3rd) and 1.64 mg/L (March 25th) were obtained, versus the groundwater standard of 1.6 mg/L. (Watkins and Worland, March 2004, p. 30.)

Table 4-3
NPDES and NMED Regulated Parameters
January 2007 through July 2007

Parameter	Sampling Frequency	Units	Monthly Average	Daily Max
NPDES Parameters (22)				
Chemical Oxygen Demand	1	mg/L	125	125
Flow	4	Liters	Report	Report
Perchlorate	3	µg/L	Report	Report
pH	1	s.u.	6 – 9	6 – 9
Radium 226 + Radium 228	3	pCi/L	30	30
Tritium (accelerator produced)	3	pCi/L	20,000	20,000
Total Aluminum	3	µg/L	5,000	5,000
Total Arsenic	3	µg/L	368	368
Total Boron	3	µg/L	5,000	5,000
Total Cadmium	1	µg/L	50	50
Total Chromium	1	µg/L	1,340	2,680
Total Cobalt	3	µg/L	1,000	1,000
Total Copper	1	µg/L	1,393	1,393
Total Iron	1	mg/L	Report	Report
Total Lead	1	µg/L	423	524
Total Mercury	1	µg/L	0.77	0.77
Total Nickel	2	smg/L	Report	Report
Total Selenium	3	µg/L	5	5
Total Suspended Solids	1	mg/L	30	45
Total Toxic Organics	2	µg/L	1,000	1,000
Total Vanadium	3	µg/L	100	100
Total Zinc	1	µg/L	4,370	8,750
NMED Parameters (3)				
Fluoride	5	mg/L	1.6	
Nitrogen-as-Nitrate	5	mg/L	10	
Total Dissolved Solids	5	mg/L	1,000	

Sampling frequencies:

1 weekly grab sample
2 monthly grab sample
3 yearly grab sample
4 continuous record
5 weekly composite sample

Table 4-4
NPDES and NMED Regulated Parameters
August 2007 through December 2007

Parameter	Sampling Frequency	Units	Monthly Average	Daily Max
NPDES Parameters (18)				
Chemical Oxygen Demand	2	mg/L	125	125
Flow	5	----	Report	Report
Perchlorate	4		Report	Report
pH	1	s.u.	6 – 9	6 – 9
Radium 226 + Radium 228	4	pCi/L	30	30
Total Cadmium	4	µg/L	Report	Report
Total Chromium	4	µg/L	Report	Report
Total Copper	2	µg/L	Report	Report
Total Lead	4	µg/L	423	524
Total Mercury	4	µg/L	Report	Report
Total Nickel	4	µg/L	Report	Report
Total PCBs	4	µg/L	Report	Report
Total Residual Chlorine	1	µg/L	----	11
Total Selenium	4	µg/L	Report	Report
Total Suspended Solids	2	mg/L	30	45
Total Toxic Organics	2	µg/L	1,000	1,000
Total Zinc	2	µg/L	Report	Report
Whole Effluent Toxicity	3	%	Report	Report
NMED Parameters (3)				
Fluoride	6	mg/L	1.6	
Nitrogen-as-Nitrate	6	mg/L	10	
Total Dissolved Solids	6	mg/L	1,000	

Sampling frequencies:
1 weekly grab sample
2 monthly grab sample
3 quarterly grab sample
4 yearly grab sample
5 continuous record
6 weekly composite sample

4.5 Graphs of Non-Radiological Data

The following series of graphs highlight important information about non-radiological components of the TA50 RLWTF influent and effluent. Although influent and effluent are analyzed for 42 non-radioactive parameters, just seven have been chosen for display in this report. Each figure plots mineral concentration in RLWTF influent and effluent by month during 2007.

Figures 4-1 and 4-2 show total dissolved solids and total suspended solids in RLWTF influent and effluent during 2007. These two parameters provide general information about water purity since they represent the sum of all contaminants present. Both parameters also have regulatory

Figure 4-1
Dissolved Solids in RLWTF Waters During 2007

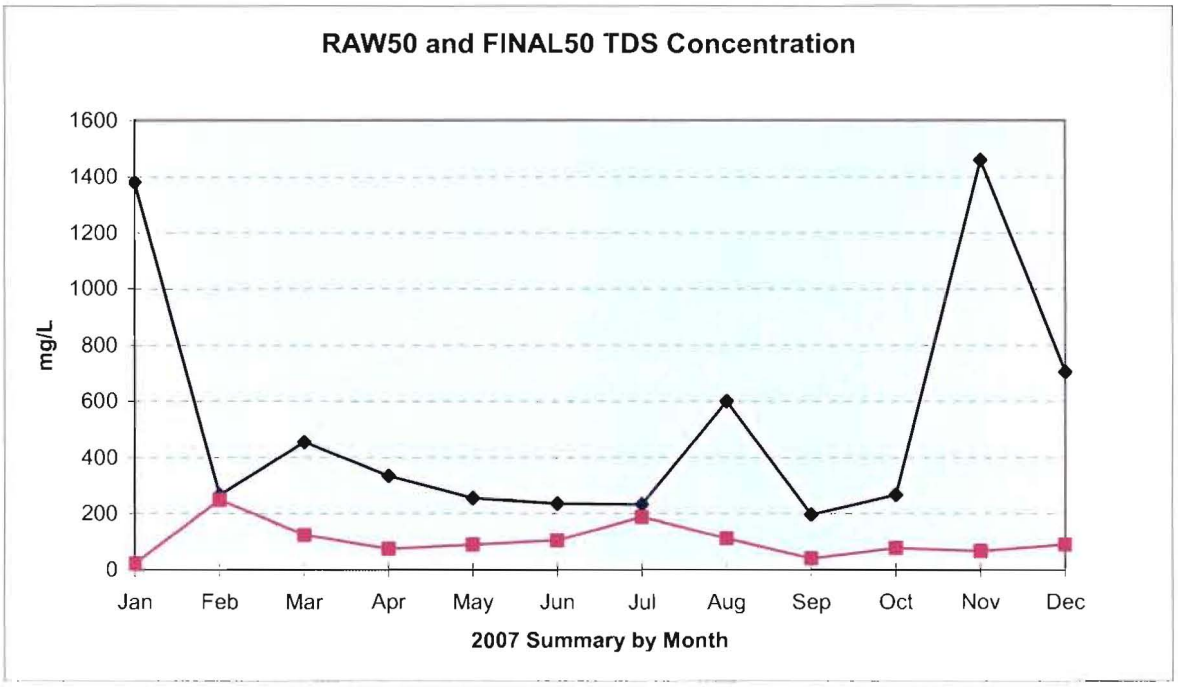
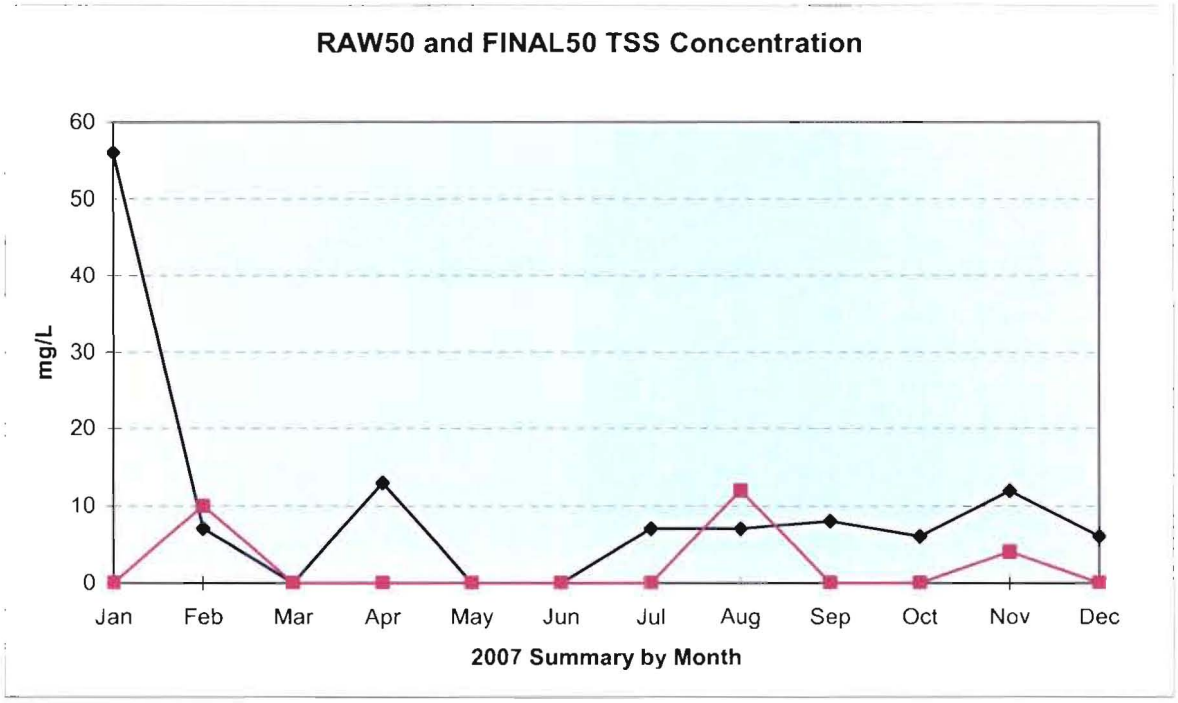


Figure 4-2
Suspended Solids in RLWTF Waters During 2007



discharge limits – 1000 mg/L for TDS and 30 mg/L for TSS. In the RLWTF treatment process, the gravity filter and ultrafilter remove essentially all suspended solids. Reverse osmosis removes varying percentages of dissolved solids, depending upon particle mass and size.

- The TDS graph shows spikes in influent concentrations in January and December. These spikes created process upsets due to the practice of recycling reverse osmosis concentrate. The January spike contributed to membrane damge, which led to a change of membranes on February 27th. The December spike required the purge of 15,000 gallons of RO concentrate in order to meet discharge standards, and to avoid a repeat of membrane damage.

- The TSS graph shows a spike in influent concentrations in January, but with typical influent concentrations of less than 20 mg/L for the remainder of the year. This spike was one of just six months in the last eight years where influent TSS concentrations exceeded 50 mg/L. Effluent concentrations show three non-zero months (February, August, and November), which is very unusual. These were the *only* three months in the past five years with non-zero TSS concentrations in the effluent.

Figure 4-3 shows concentrations of nitrate-as-nitrogen in RLWTF influent and effluent during 2007. Nitrate is not a regulated parameter, but LANL has volunteered to discharge at concentrations less than 10 mg/L. At the RLWTF, waste acceptance criteria limit influent nitrate concentrations, and reverse osmosis removes 80% - 90% of nitrates that are received with the influent. Figure 4-3 shows that influent concentrations ranged from 6-24 mg/L, and exceeded the waste acceptance criterion of 10 mg/L. Despite this, effluent concentrations were consistently below the voluntary discharge standard.

Figure 4-3
Nitrogen-as-Nitrate in RLWTF Waters During 2007

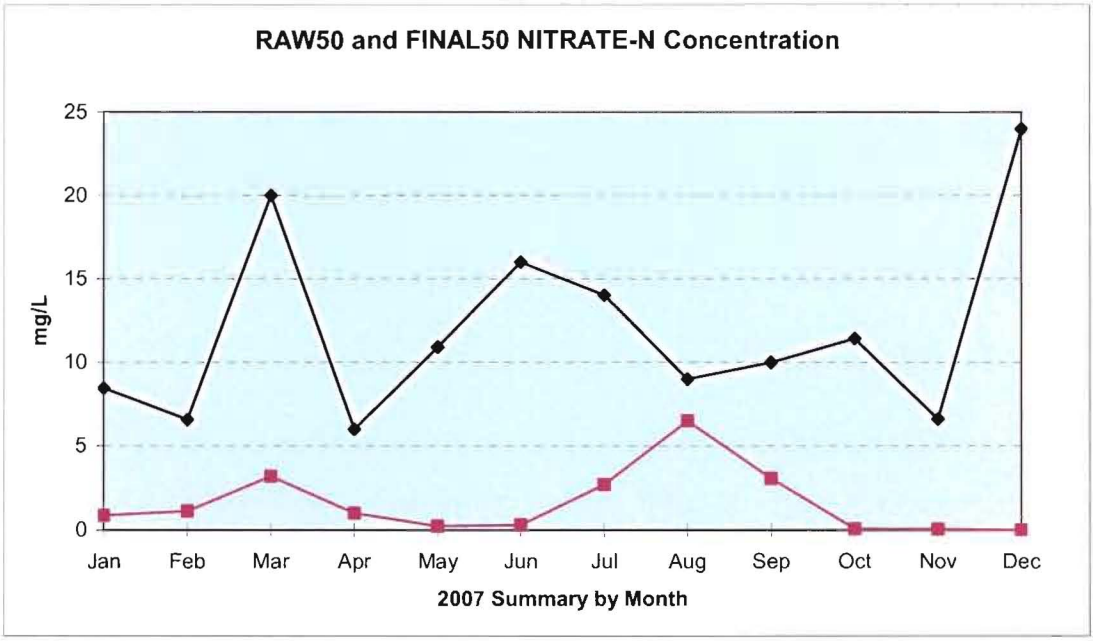


Table 4-5 presents average concentrations for nitrogen compounds for the year. Influent concentrations were higher than historical averages, and continued a trend that started in 2002 of increasing influent nitrogen concentrations. Effluent concentrations were consistent with those since 2002.

Table 4-5
Nitrogen Compounds in RLWTF Waters During 2007

	Influent*	Effluent*
Total Kjedahl Nitrogen	16.1	6.2
Nitrogen-as-Ammonia	11.7	6.5
Nitrogen-as-Nitrate	11.7	1.5
Nitrogen-as-Nitrite	1.1	1.1
All Nitrogen	40.5	15.3

* Average concentration for 2007, in mg/L.

Figures 4-4 and 4-5 show copper and zinc concentrations in RLWTF influent and effluent during 2007. Both parameters are of regulatory concern because reduced discharge standards become effective August 2010. The discharge standard for zinc will decrease by a factor of 2,000 to 2.2 μg/L, and that for copper will decrease by a factor of 9,950 to 0.14 μg/L

- The zinc graph reveals little about the ability of RLWTF to meet the 2010 discharge standard. Nine months had concentrations below the method detection limit, and hence were reported at zero. The method detection limit, nearly four times greater than the 2010 discharge standard, will be lowered during 2008 so that more meaningful data can be obtained.

- The copper graph shows, quite clearly, that the 2010 discharge standard cannot be met without additional treatment. A Plant Test conducted during 2005 (Del Signore and McClenahan, March 2006, p.33) showed that copper is one of several metals that exist in both the soluble and insoluble states. Enough of the soluble fraction survives the Main Treatment Process to appear in plant effluent in concentrations greater than the proposed discharge standard. A cation exchange treatment step has been proposed.

Finally, Figures 4-6 and 4-7 shows influent and effluent concentrations for sodium and chloride. As shown in Table 4-2, these two chemicals accounted for more than half of all contaminants in both the influent and effluent to the RLWTF during 2007. The figures show dramatic increases of influent concentrations by factors of 10-15 for both sodium and chloride during November and/or December. The causes of these jumps were not determined, but they were conclusively the source of TDS increase, the reason that processing difficulties were encountered, and the reason that 15,000 gallons of RO concentrate had to be purged in December.

Figure 4-4
Zinc in RLWTF Effluent During 2007

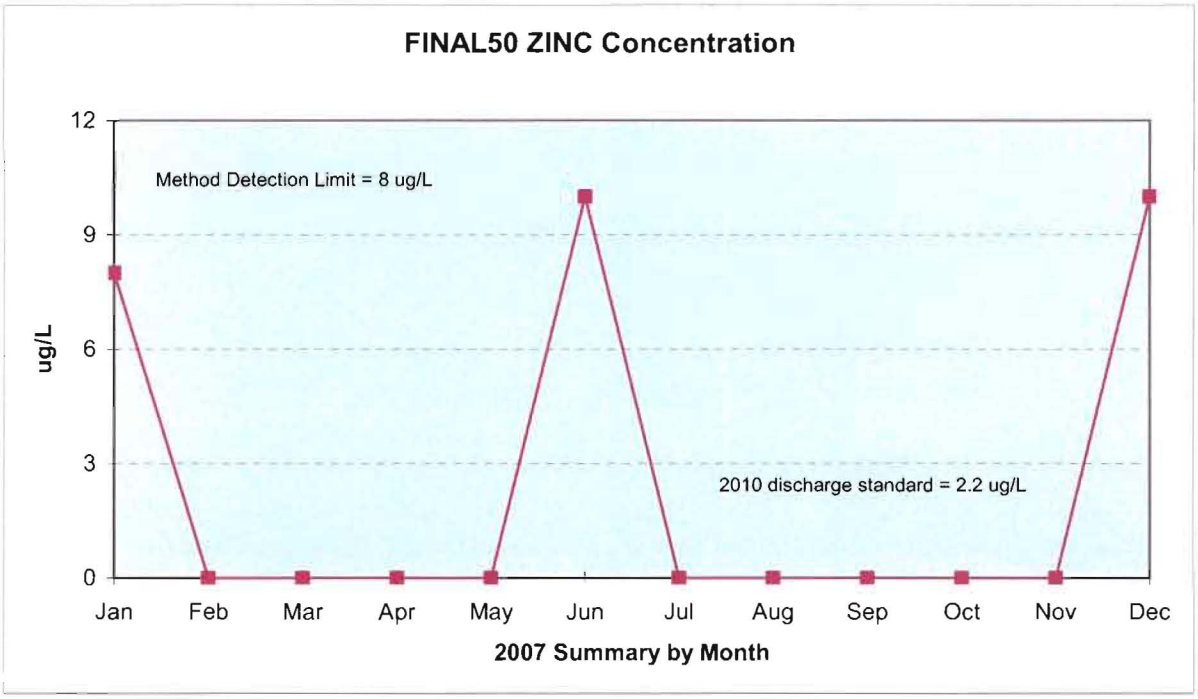


Figure 4-5
Copper in RLWTF Effluent During 2007

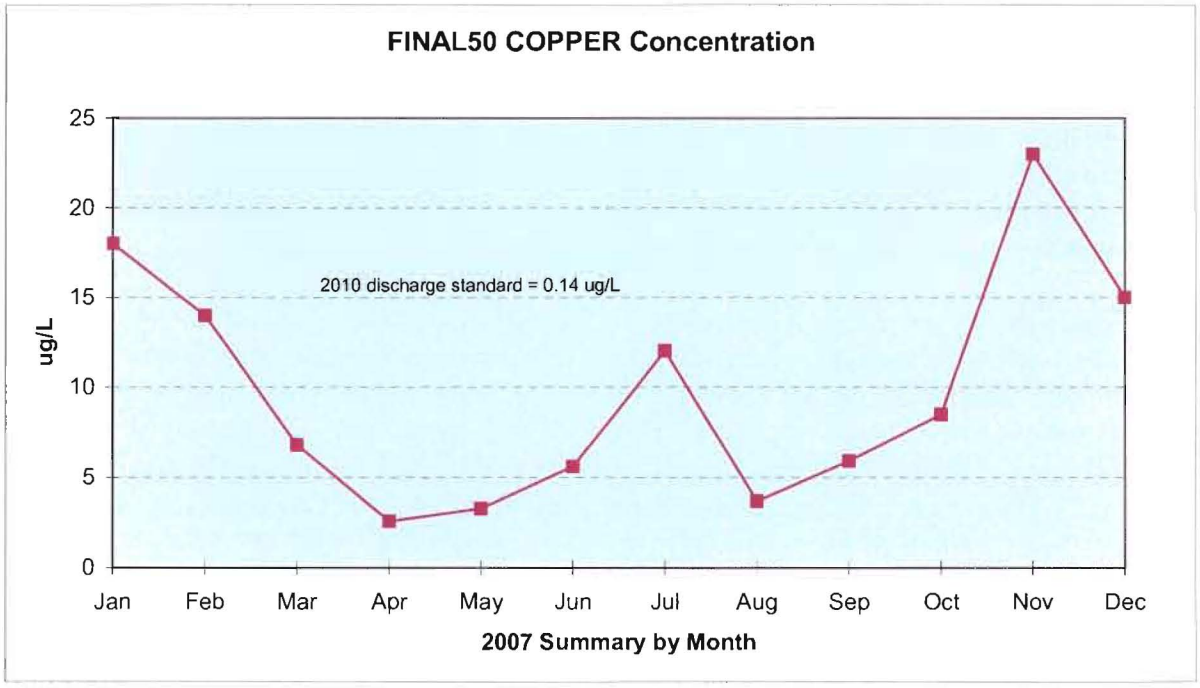


Figure 4-6
Sodium in RLWTF Waters During 2007

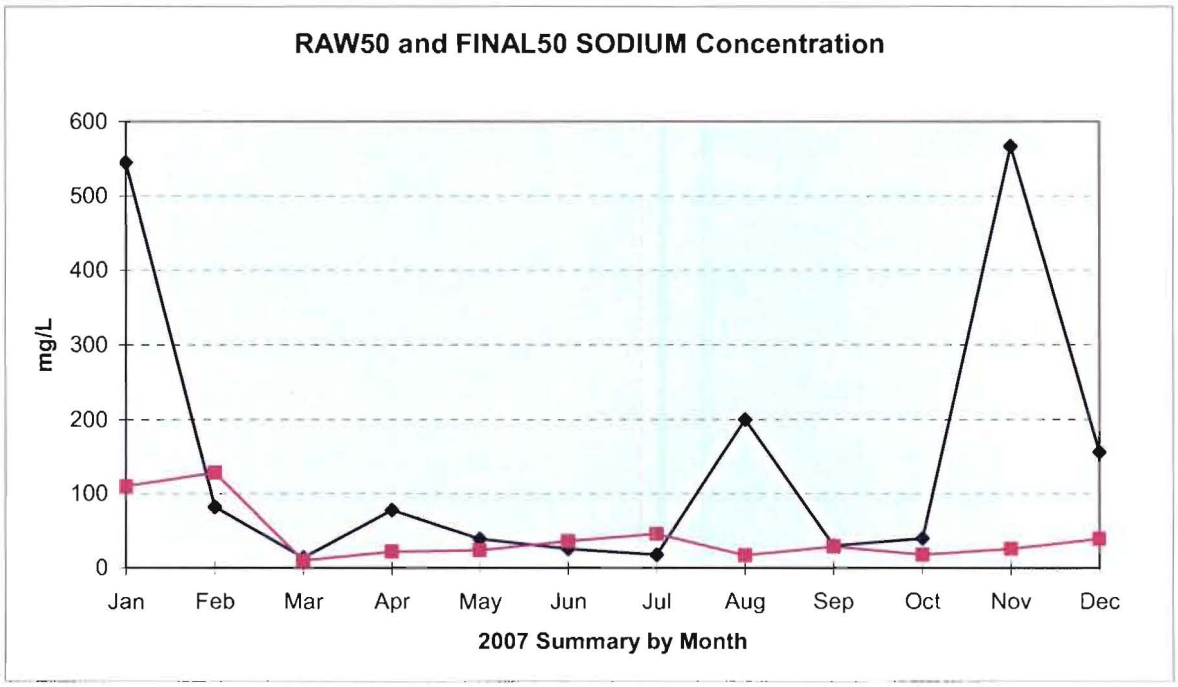
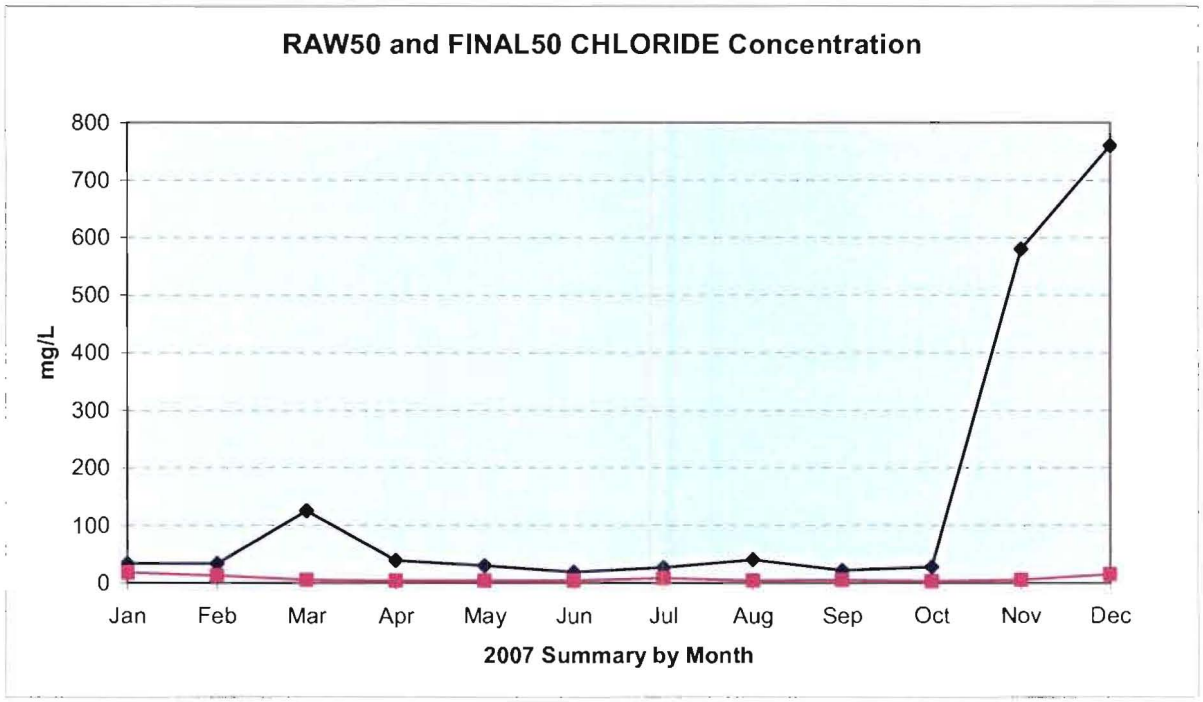


Figure 4-7
Chloride in RLWTF Waters During 2007



4.6 Organic Chemicals

Monthly grab samples of influent, monthly grab samples of effluent, and individual batches of sludge are analyzed for volatile organic chemicals (VOC) and semi-volatile organic chemicals (SVOC). Analyses are performed by an external EPA-certified laboratory according to EPA approved methods 624 for VOC, and 625A and 625B for SVOC.

4.6.1 Influent

Tables 4-6 and 4-7 summarize the VOC and SVOC detected in the RLWTF influent during 2007 and the concentration range of these chemicals. The "No. of Detects" column in these tables indicates the number of samples in which a particular chemical was detected. This influent sampling had the following results:

- A total of 29 influent samples were collected during the year, and each were analyzed for ~130 organic compounds. Samples were collected once per week at first; frequency was reduced to once per month in the middle of the year.

- Of these ~3800 analyses, a total of 206 (5%) were found to exceed minimum detection level. This is an average of seven detects per sample.

- While 16 volatile organic and 17 semi-volatile organic compounds were detected in RLWTF influent, just three compounds accounted for one-third of the "detects": 2-nitrophenol (22 detects), acetone (25 detects), and bis(2-ethylhexyl)phthalate (26 detects).

- Maximum concentration was 3.4 mg/L (acetone); the second-highest analyzed concentration was just 0.17 mg/L. Annual average influent concentration was 0.8 mg/L organic compounds. These concentrations are far below the waste acceptance ceiling of 25 mg/L for total organics.

4.6.2 Effluent

Table 4-8 summarizes the VOC and SVOC detected in the RLWTF effluent during 2007. The "No. of Detects" column in these tables indicates the number of samples in which a particular chemical was detected. Effluent sampling had the following results:

- A total of 12 effluent samples were collected during the year, and each were analyzed for ~90 organic compounds.

- Of these ~1080 analyses, just five (0.5%) were found to exceed minimum detection level.

- Maximum concentration was 55 μg/L (chloroform). Annual average effluent concentration was 8.3 μg/L organic compounds. These concentrations are far below the NPDES discharge standard of 1,000 μg/L for total toxic organics.

Table 4-6
VOC Detected in RLWTF Influent During 2007

VOC (EPA Method 624)	No. of Detects	Minimum (µg/L)	Maximum (µg/L)
1,2,4-TRIMETHYLBENZENE	2	3.3	4.1
2-BUTANONE	2	4.5	21.0
4-METHYL-2-PENTANONE	15	4.0	72.0
ACETONE	25	61.0	3400
BROMODICHLOROMETHANE	1	1.5	1.5
BROMOMETHANE	2	1.1	12.0
CARBON DISULFIDE	1	1.1	1.1
CHLOROETHANE	1	1.4	1.4
CHLOROFORM	4	8.5	44.7
CHLOROMETHANE	3	1.7	2.4
IODOMETHANE	2	2.2	4.9
M,P-XYLENES	1	0.5	0.5
METHYLENE CHLORIDE	17	6.6	37.0
O-XYLENE	1	0.6	0.6
TOLUENE	8	1.2	7.7
TRICHLOROETHENE	1	1.7	1.7

Table 4-7
SVOC Detected in RLWTF Influent During 2007

SVOC (EPA Methods 625A and 625B)	No. of Detects	Minimum (µg/L)	Maximum (µg/L)
2,4-DINITROPHENOL	1	15.0	15.0
2-NITROPHENOL	22	1.2	36.0
4,6-DINITRO-2-METHYLPHENOL	1	8.8	8.8
4-NITROPHENOL	5	5.4	20.0
AZOBENZENE	1	3.1	3.1
BENZOIC ACID	11	9.2	140.
BENZYL ALCOHOL	4	1.7	8.4
BIS(2-ETHYLHEXYL)PHTHALATE	26	3.6	150.
BUTYLBENZYLPHTHALATE	2	1.5	1.8
DI-N-BUTYLPHTHALATE	2	1.3	3.3
DI-N-OCTYL PHTHALATE	1	17.4	17.4
DIETHYLPHTHALATE	4	1.4	2.4
N-NITROSO-DI-N-PROPYLAMINE	11	1.3	170.
N-NITROSODIMETHYLAMINE	1	4.7	4.7
NITROBENZENE	2	1.3	1.8
PHENOL	14	4.5	49.0
PYRIDINE	12	6.5	15.0

Table 4-8
Organics Detected in RLWTF Effluent During 2007

Organic Compound	Type	No. of Detects	Minimum (ug/L)	Maximum (ug/L)
Chloroform	VOC	4	4.8	54.6
Phenol	SVOC	1	17.7	17.7

4.6.3 Sludge

Sludge samples are also analyzed for organic compounds. However, since sampling is not performed on all sludge drums, and since sludge operations were limited during 2007, no samples were collected.

5. Wastes and Secondary Liquids

RLW treatment processes generate both liquid streams that require further processing and solid wastes that must be disposed. The disposition of both requires resources that include materials, labor, and dollars (e.g., disposal fees).

5.1 Secondary Liquids to Process

Secondary liquids include a wide variety of process streams from each of the treatment operations. For example, clarifier and gravity filter operations produce backwash waters and a liquid, solids-containing slurry. The reverse osmosis unit creates a concentrate stream and membrane cleaning solutions.

More than 20 such secondary streams are generated by the seven unit operations at the TA50 RLWTF; all but evaporator bottoms are treated at TA50 RLWTF [4]. Clarifier sludge, for example, is processed through the rotary vacuum filter in Room 116; gravity filter backwash waters are returned to the influent tanks to be re-processed through the clarifier; and RO concentrate is processed through an evaporator.

Table 5-1
RLWTF Secondary Liquid Streams During 2007

Secondary Stream	Volume (liters)	From	Additional Processing
01. UF Feed tank purge waters	n.e.	Ultrafilter	Process through MTP
02. Spongeball waters	n.e.	Ultrafilter	Process through MTP
03. UF concentrate	n.e.	Ultrafilter	Process through MTP
04. UF Cleaning solutions	n.e.	Ultrafilter	Process through MTP
05. RO Cleaning solutions	n.e.	Reverse osmosis	Process through MTP
06. GF Backwash waters	100,980	Gravity filter	Process through MTP
07. Off-spec effluent	83,210	Reverse osmosis	Process through MTP
08. Evap. Overheads	0	Evaporator	Process through MTP
09. C-T bleed and Boiler Blowdown	0	Evaporator	Process through MTP
10. TK8 Decant	24,820	TK8	Process through MTP
11. RVF filtrate	9,540	Vacuum filter	Process through MTP
12. RO concentrate	226,270	Reverse osmosis	Evaporate
13. Evap. Bottoms	0	Evaporator	Dry (off-site)
14. R60 filtrate & decant	1,590	Room 60	Evaporate
15. Transuranic sludge	0	Room 60	Solidify with cement

n.e.: No estimate

[4] Evaporator bottoms are shipped to an off-site subcontractor for drying.

A listing of the more important of these secondary liquid streams appears in Table 5-1, along with volumes generated during 2007. The total volume of these streams during the year probably approached three million liters, or 60% of the raw influent volume. More than half of this volume was generated via operation of the tubular ultrafilter, primarily from daily purging of influent tanks and recycle of spongeball waters.

5.2 Solid Wastes

Influent to the TA50 RLWTF contained 2,390 kilograms of dissolved and suspended solids. Treatment of this influent to achieve compliance with DOE, EPA, and NMED discharge standards resulted in the generation of 11,640 kilograms of solid wastes, as summarized in Table 5-2. These solid wastes can be broadly grouped as wastes stemming from major construction projects, and wastes from treatment operations.

Construction Wastes: Solid wastes were generated (a) during the construction of the new pump house and influent storage tank building that is part of the Cerro Grande Rehabilitation Project and (b) during the replacement of equipment and piping in Room 60. Such wastes take the form of used protective equipment and clothing, dismantled equipment, and project-related debris and soils. During 2007, six cubic meters and 4,916 kilograms of this non-routine waste was shipped. The majority was petroleum-contaminated soil (3.2 cubic meters, 4031 kilograms).

Table 5-2
Solid Wastes Shipped From the TA50 RLWTF During 2007

	Chem-ical	LLW	MLLW	TRU	Totals
No. Items:					
Construction wastes	16	2	2	0	20
Operations	0	12	0	0	12
Salts from Bear Creek	0	0	0	0	0
Sludge	0	16	0	0	16
Totals	16	30	2	0	48
Volume (m^3):					
Construction wastes	3.2	2.7	0.1	0	6.0
Operations	0	30.3	0	0	30.3
Salts from Bear Creek	0	0	0	0	0.0
Sludge	0	3.3	0	0	3.3
Totals	3.2	36.4	0.1	0	39.7
Weight (Kg):					
Construction wastes	4,031	537	348	0	4,916
Operations	0	4,062	0	0	4,062
Salts from Bear Creek	0	0	0	0	0
Sludge	0	2,664	0	0	2,664
Totals	4,031	7,263	348	0	11,643

Operations Wastes: Operations wastes result from both day-to-day water treatment activities and from facility and equipment repairs and modifications. A total of 30 cubic meters weighing 4,062 kilograms of operations wastes were generated at the TA50 RLWTF during 2007. Operations wastes consisted broadly of compactible and other trash generated in radiation control areas at the RLWTF. Compactible trash includes paper, discarded plastic sample vials and bottles, protective gloves, and similar materials needed for day-to-day activities. Other trash included empty containers, process consumables such as spent filter cartridges, and waste from repairs and modifications such as piping and worn pumps and motors.

Salts From Bear Creek: Salts form a special category of operations wastes. Bottoms from the interim evaporator are shipped to a subcontractor in Bear Creek, TN, where the bottoms are dried. The resultant dried salts are returned for disposal at Area G as LLW. During 2007, no shipments of evaporator bottoms were made to Bear Creek, and no drums of dried salts were returned to LANL.

Process Sludge: Process sludge is another special category of operations wastes. MTP clarifier sludge, after being processed through the rotary vacuum filter, is drummed and then shipped to Area G for disposal as LLW. During 2007, 16 drums containing 2,664 kilograms of process sludge were shipped for disposal as LLW at Area G in a single shipment on 13 December. A second sludge waste stream, Room 60 sludge, is drummed, then solidified, prior to disposal as transuranic waste at the Waste Isolation Pilot Plant. No drums of solidified transuranic sludge were shipped from TA50 during 2007.

6. Operations in 2007 at the Other RLW Facilities

Chapters 2 through 5 of this annual report discussed the treatment of low-level radioactive liquid wastes at the TA50 RLWTF. This chapter discusses the other RLW treatment processes.

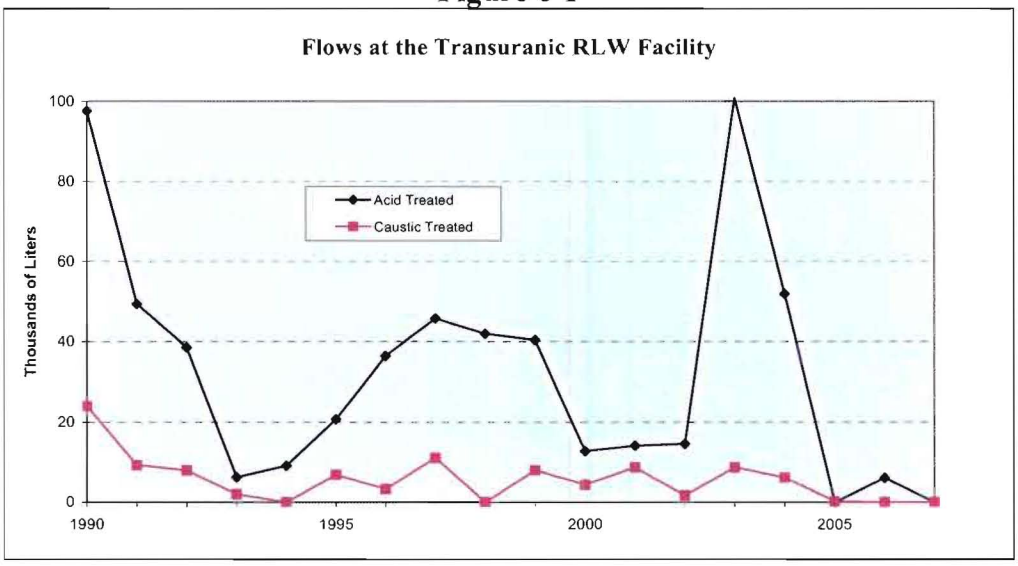
6.1 Transuranic RLW Process

Two events limited transuranic RLW operations during 2007: the discovery in September 2003 that the influent storage tank for caustic wastes was leaking, and the shutdown of Room 60 in July 2004 due to deteriorating equipment and vessels. Maintenance efforts to repair these items have been underway ever since.

Installation of the new caustic waste tank was completed in February 2007, and the receipt of acid and caustic wastes resumed shortly thereafter. Totals of 12,290 liters of acid waste (33 transfers) and 4,260 liters of caustic waste (18 transfers) were received during the year. Acid waste transfers were suspended in mid-October 2007 because the acid waste tank had been filled; caustic waste transfers were not impeded.

Room 60 repairs proceeded throughout the year, and Room 60 was operated sparingly during 2007 as a result. No transuranic RLW were treated during the year, but 1590 liters of effluent were generated by the rinsing and draining of Room 60 piping and equipment. These effluent waters were transferred to the low-level evaporator feed tanks in Building 50-248. Figure 6-1 provides an historical perspective for volumes of transuranic RLW treated in Room 60.

Figure 6-1



6.2 TA53 RLW Facility

The TA53 RLWTF treats radioactive liquid waste from accelerator research at the Los Alamos Neutron Science Center. The treatment process includes wastewater storage to allow short-lived radioisotope decay, followed by solar evaporation. Three flows are of importance.

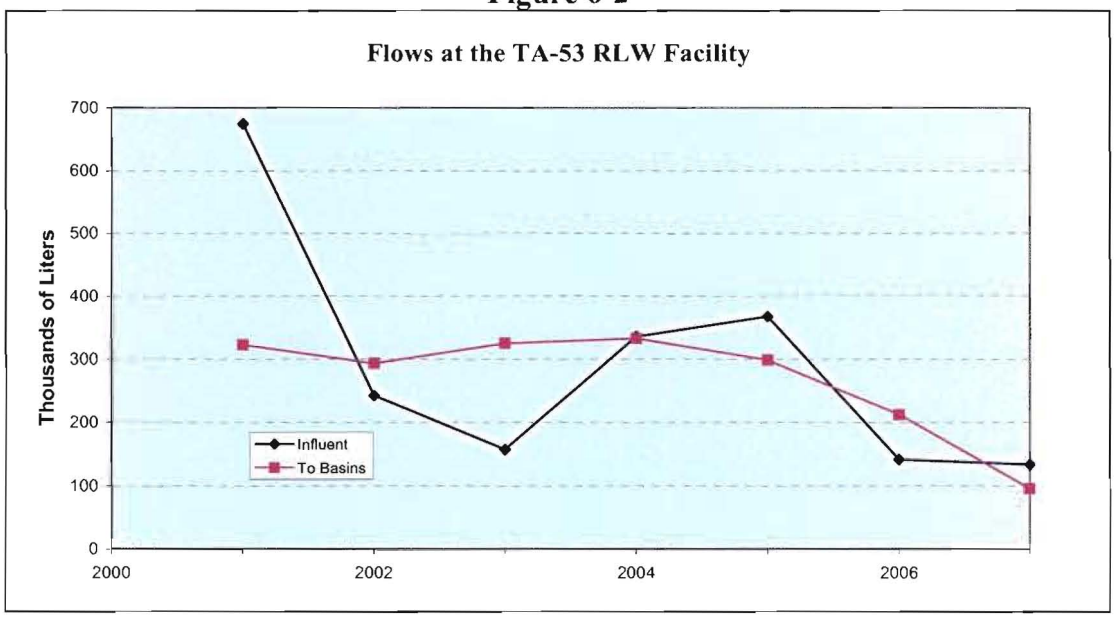
- Water flows by gravity into lift stations adjacent to Experimental Area A and the Lujan Center. The RLW is pumped from the lift stations through double-walled underground piping to one of three 30,000-gallon tanks inside Building 53-945. A total of 122,160 liters of RLW were transferred from the lift stations to the RLWTF during 2007.

- Tritiated waters are occasionally trucked to the TA53 influent tanks. During 2007, 11,820 liters were trucked to the basins from TA16. These trucked wastewaters met the waste acceptance criteria for the TA53 RLWTF. This additional trucked quantity raised total influent volume for the year to 133,980 liters.

- After aging in the influent tanks, the RLW is pumped to the evaporator basins. During 2007, a single pump-out occurred (TK1), totaling 95,730 liters.

Figure 6-2 provides an historical perspective for RLW flows at the TA53 facility. The graph shows that flows in 2007 were the lowest since the facility went into operation in December 1999. There is no conclusive trend to the flows, however, and they remain well below the evaporative capacity (1.4 million liters per year) of the basins.

Figure 6-2



6.3 TA21 RLW Facility

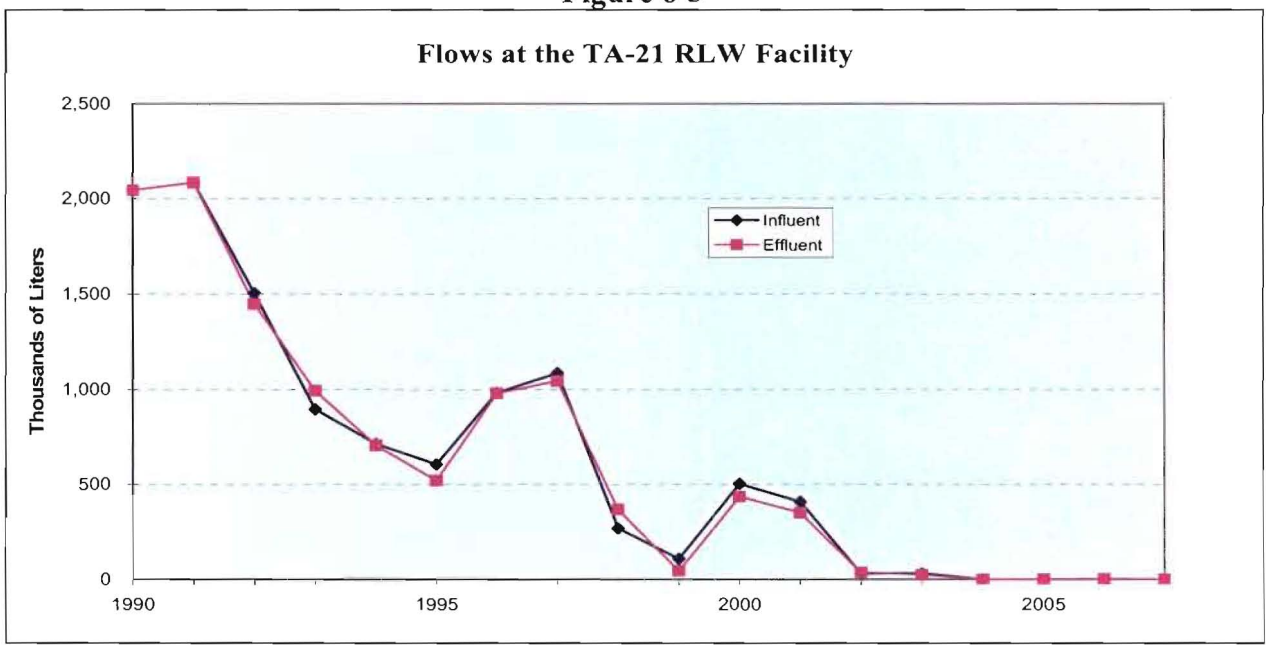
The facility at TA21 treats RLW from tritium research at TA21 using a clarifier and a gravity filter. From 1966 through 2000, effluent from this facility was transferred via underground piping to TA50. Beginning in 2001, treated TA21 waters have been transferred to TA50 by truck. Effluent from the TA21 Facility may also be trucked to the TA53 Facility.

Volumes and concentrations of tritiated RLW have declined as tritium activities have been scaled back at TA21. Although influent volumes historically exceeded one million liters, they declined to just 30,000 liters in 2002, 32,000 liters in 2003, and nearly zero since. The TA21 RLWTF was last operated in 2003. During 2007, influent approximated zero, and the facility was again not operated. The facility had no effluent.

The TA21 facility has an inventory of waters in tanks and process equipment, estimated to be about 250,000 liters. Condition of the equipment for the processing of this inventory is of concern, however, due to age and intermittent use. A return to operation will require major efforts, including procedure reviews and walkdowns, equipment checks and tests, processing trials using non-radioactive waters, a Management Self Assessment, and perhaps a LANL Readiness Assessment. After the existing inventory of waters have been processed, the TA21 facility will be placed in cold shutdown status to await decommissioning.

Figure 6-3 provides an historical perspective for RLW flows at the TA21 facility. It clearly shows the closure of TA21 tritium operations beginning in 2002.

Figure 6-3



7. References

Much of the information presented in this Annual Report come from the RLWTF process control system, RS View, which automatically records temperatures, flow rates, flow totals, pressures, tank levels, and similar readings of process conditions. Another large segment of the information presented in graphs and tables in this Annual Report comes from analytical data results for process control samples. The below list of references points to the third major data source used in compiling the Annual Report – published reports that are cited within the text of the Annual Report.

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