No. 9

50-537
4/7/75

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CLINCH RIVER
BREEDER REACTOR PLANT
ENVIRONMENTAL REPORT

VOLUME II

PROJECT MANAGEMENT CORPORATION

4071

TABLE 2.7-24

MELTON HILL DAM

DAILY DISCHARGE FOR 1974 AND 1975

Discharges in Day-Second-Feet* for 1974

Day	January Turbine	January Gate	February Turbine	February Gate	March Turbine	March Gate	April Turbine	April Gate	May Turbine	May Gate	June Turbine	June Gate	July Turbine	July Gate	August Turbine	August Gate	September Turbine	September Gate	October Turbine	October Gate	November Turbine	November Gate	December Turbine	December Gate
1	19,586	0	20,918	0	8,912	0	7,421	0	4,343	0	6,135	0	8,100	0	6,721	0	7,520	0	4,809	0	4,422	0	4,575	0
2	19,660	0	20,647	0	12,179	0	9,234	0	4,015	0	4,288	0	6,097	0	4,592	0	2,158	0	4,519	0	4,719	0	3,167	0
3	20,029	4,406	21,978	0	11,242	0	9,812	0	3,467	0	5,388	0	6,890	0	4,900	0	6,117	0	7,333	0	4,267	0	2,504	0
4	22,252	2,453	22,170	0	8,284	0	10,246	0	4,877	0	5,895	0	3,740	0	2,870	0	5,114	0	5,690	0	5,245	0	2,038	0
5	22,756	2,441	22,450	0	7,673	0	12,320	0	3,182	0	5,510	0	5,645	0	4,929	0	4,284	0	5,375	0	5,692	0	1,842	0
6	22,005	2,329	21,865	0	6,967	0	9,722	0	6,278	0	5,490	0	9,470	0	5,051	0	7,186	0	3,858	0	6,012	0	3,086	0
7	23,100	2,420	20,111	0	5,855	0	10,862	0	5,628	0	7,520	0	0	0	4,757	0	4,556	0	4,403	0	5,929	0	1,729	0
8	23,092	1,279	21,195	0	4,631	0	9,860	0	5,406	0	6,597	0	8,980	0	7,291	0	815	0	4,098	0	5,002	0	3,683	0
9	22,503	0	22,671	0	5,982	0	9,122	0	9,297	0	0	0	8,130	0	6,919	0	723	0	3,733	0	4,395	0	5,742	0
10	22,977	0	21,931	0	6,733	0	9,495	0	7,867	0	3,180	0	6,579	0	5,027	0	8,520	0	4,910	0	5,264	0	5,096	0
11	23,627	11,339	19,455	0	7,955	0	9,551	0	2,251	0	3,570	0	8,724	0	2,963	0	4,528	0	4,276	0	8,111	0	2,879	0
12	23,674	3,589	15,625	0	7,466	0	9,838	0	0	0	2,439	0	5,254	0	7,898	0	6,278	0	2,503	0	8,747	0	4,467	0
13	23,912	511	15,388	0	6,515	0	10,069	0	5,470	0	1,720	0	3,794	0	6,706	0	7,252	0	1,000	0	4,972	0	11,500	0
14	19,265	7,552	13,096	0	7,277	0	10,064	0	5,940	0	5,868	0	4,715	0	5,755	0	2,888	0	3,277	0	6,657	0	5,958	0
15	23,985	2,450	15,947	188	3,652	0	10,056	0	8,925	0	4,960	0	6,993	0	5,676	0	0	0	3,256	0	9,646	0	2,213	0
16	23,966	2,450	9,833	0	2,551	0	10,156	0	8,488	0	2,132	0	8,181	0	8,154	0	4,273	0	4,261	0	4,184	0	4,121	0
17	23,923	3,896	9,898	0	11,303	0	10,163	0	5,065	0	6,099	0	7,055	0	7,758	0	4,620	0	3,381	0	1,175	0	5,938	0
18	23,814	5,216	11,472	0	7,117	0	9,825	0	4,736	0	7,155	0	6,678	0	3,404	0	4,396	0	3,395	0	950	0	6,279	0
19	23,102	3,577	9,094	0	788	0	8,687	0	5,871	0	6,549	0	11,240	0	7,218	0	5,565	0	4,973	0	4,862	0	7,660	0
20	21,773	2,373	10,274	0	3,334	0	8,063	0	14,238	0	5,944	0	9,215	0	7,500	0	4,649	0	4,392	0	1,792	0	8,221	0
21	22,637	1,537	11,010	0	11,107	0	8,072	0	8,688	0	5,602	0	6,582	0	6,631	0	1,690	0	5,740	0	4,279	0	7,858	0
22	23,596	1,120	11,843	0	6,360	0	6,797	0	7,693	0	6,545	0	6,430	0	6,202	0	1,526	0	7,470	0	1,329	0	7,900	0
23	24,250	397	12,024	0	8,220	0	9,520	0	6,453	0	1,992	0	6,363	0	8,914	0	3,469	0	11,180	0	895	0	9,550	0
24	23,800	0	10,594	0	9,703	0	2,538	0	5,245	0	6,432	0	6,907	0	6,838	0	4,013	0	1,040	0	0	0	6,983	0
25	23,800	0	9,134	0	9,218	0	2,926	0	6,320	0	6,520	0	5,823	0	1,680	0	4,489	0	3,872	0	1,217	0	2,763	0
26	23,800	4,940	11,036	0	8,941	0	2,790	0	2,404	0	5,634	0	5,692	0	4,988	0	3,479	0	2,678	0	5,350	0	1,871	0
27	23,800	5,030	9,046	0	7,954	0	4,344	0	2,012	0	6,332	0	3,708	0	9,820	0	3,737	0	1,606	0	5,300	0	1,038	0
28	23,800	2,410	7,668	0	7,290	0	4,170	0	5,363	0	6,040	0	3,500	0	7,076	0	5,030	0	4,898	0	1,521	0	0	0
29	23,500	2,430			7,432	0	5,152	0	7,129	0	8,432	0	6,346	0	5,883	0	2,963	0	6,814	0	1,813	0	4,842	0
30	23,594	2,429			9,967	0	4,916	0	6,088	0	4,136	0	7,543	0	6,353	0	3,485	0	6,080	0	3,667	0	3,642	0
31	23,633	1,308			7,221	0			6,964	0			5,050	0	4,997	0			5,762	0			1,342	0
Avg.	22,878	2,577	15,299	7	7,414	0	8,193	0	5,797	0	5,137	0	6,433	0	5,983	0	4,177	0	4,535	0	4,247	0	4,532	0

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(Continued)

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TABLE 2.7-24 (Continued)

Discharges in Day-Second-Feet* for 1975

Day	January		February		March		April		May		June		July		August		September		October		November		December	
	Turbine	Gate	Turbine	Gate	Turbine	Gate	Turbine	Gate	Turbine	Gate	Turbine	Gate	Turbine	Gate	Turbine	Gate	Turbine	Gate	Turbine	Gate	Turbine	Gate	Turbine	Gate
1	2,730	0	9,779	0	9,133	0	25,346	0	5,083	0	3,242	0	7,438	0	7,150	0	5,017	0	4,875	0	4,496	0	3,642	0
2	1,121	0	12,063	0	8,442	0	25,179	0	4,829	0	5,075	0	10,600	0	7,046	0	5,800	0	6,638	0	2,163	0	2,342	0
3	0	0	13,367	0	11,046	0	24,904	0	4,142	0	4,733	0	9,938	0	6,717	0	6,521	0	8,996	0	0	0	3,471	0
4	1,554	0	10,125	0	6,754	0	21,488	227	4,208	0	7,742	0	6,038	0	7,645	0	11,571	0	7,433	0	4,496	0	2,196	0
5	2,788	0	12,542	0	5,375	0	19,558	0	5,808	0	5,358	0	6,867	0	7,250	0	7,892	0	1,658	0	4,154	0	2,708	0
6	4,517	0	11,363	0	5,333	0	18,708	0	7,025	0	4,792	0	4,383	0	6,408	0	3,875	0	4,054	0	4,625	0	1,750	0
7	3,617	0	10,125	0	2,533	0	19,721	0	4,867	0	6,283	0	5,925	0	6,054	0	4,138	0	5,142	0	4,071	0	2,929	0
8	2,704	0	12,125	0	6,146	0	16,417	0	3,767	0	4,538	0	7,883	0	5,608	0	6,008	0	3,029	0	3,300	0	6,554	0
9	2,887	0	12,196	0	0	0	13,271	0	5,608	0	8,975	0	8,392	0	7,500	0	6,392	0	2,250	0	1,538	0	6,650	0
10	3,333	0	9,913	0	1,629	0	9,842	0	6,829	0	12,275	0	6,292	0	4,292	0	5,671	0	617	0	1,450	0	7,021	0
11	3,408	0	10,562	0	1,004	0	11,538	0	5,163	0	10,375	0	5,933	0	10,963	0	6,921	0	1,192	0	3,967	0	4,321	0
12	4,863	0	14,575	0	5,575	0	10,871	0	5,071	0	10,142	0	5,679	0	8,538	0	5,942	0	1,342	0	3,162	0	3,738	0
13	8,321	0	18,329	0	23,942	0	9,454	0	7,825	0	11,783	0	3,829	0	10,683	0	4,808	0	2,396	0	7,929	0	0	0
14	7,296	0	20,063	0	13,679	0	11,229	0	6,758	0	4,804	0	6,058	0	6,363	0	3,571	0	2,563	0	3,250	0	0	0
15	3,496	0	17,571	0	9,075	0	9,892	220	6,588	0	3,338	0	5,250	0	6,608	0	4,875	0	2,279	0	1,071	0	0	0
16	4,425	0	17,333	0	3,454	0	8,988	0	8,900	0	5,983	0	5,800	0	3,463	0	4,842	0	2,146	0	508	0	5,492	0
17	5,242	0	19,188	0	9,650	161	8,092	0	5,421	0	6,063	0	10,300	0	2,129	0	6,808	0	2,713	0	0	0	11,533	0
18	6,604	0	18,588	0	15,660	0	8,488	0	4,413	0	8,000	0	7,000	0	3,617	0	6,333	0	0	0	0	0	10,775	0
19	6,021	0	12,375	0	15,221	0	7,333	0	5,229	0	8,100	0	7,000	0	7,379	0	6,063	0	1,867	0	0	0	6,317	0
20	10,371	0	12,908	0	15,171	0	7,596	0	8,696	0	6,400	0	7,500	0	11,013	0	4,875	0	1,100	0	3,596	0	5,217	0
21	8,125	0	11,679	0	20,288	0	7,238	0	7,400	0	9,000	0	9,800	0	7,483	0	1,058	0	0	0	7,217	0	10,192	0
22	6,971	0	8,675	0	16,617	0	5,638	0	10,000	0	7,400	0	7,800	0	7,913	0	4,821	0	0	0	5,475	0	6,963	0
23	8,413	0	9,979	0	22,263	0	9,225	0	7,000	0	7,700	0	8,767	0	8,083	0	4,013	0	438	0	4,196	0	7,571	0
24	9,871	0	12,079	0	18,725	0	4,320	0	11,600	0	8,600	0	5,000	0	3,658	0	0	0	492	0	0	0	7,017	0
25	11,900	0	12,846	0	14,088	0	2,860	0	7,800	0	8,350	0	8,067	0	5,533	0	0	0	0	0	1,479	0	4,146	0
26	10,350	0	10,696	0	21,130	0	1,980	0	6,400	0	7,529	0	7,396	0	7,392	0	0	0	0	0	4,221	0	7,008	0
27	9,058	0	7,779	0	23,754	0	1,300	0	9,000	0	7,346	0	4,954	0	7,463	0	4,163	0	4,854	0	3,554	0	2,696	0
28	7,517	0	6,838	0	23,517	0	5,900	0	4,870	0	8,350	0	8,608	0	6,592	0	3,083	0	5,058	0	5,496	0	2,771	0
29	9,596	0			23,100	333	4,100	0	4,450	0	6,604	0	7,229	0	5,488	0	6,717	0	5,771	0	4,592	0	1,767	0
30	10,046	0			24,879	8,394	4,654	0	3,725	0	8,238	0	8,933	0	6,392	0	4,313	0	8,054	0	3,729	0	3,050	0
31	9,737	160			25,320	1,322			2,429	0			8,117	0	5,813	0			9,775	0			492	0
Avg.	6,028	5	12,702	0	12,984	329	11,171	15	6,158	0	7,237	0	7,186	0	8,717	0	4,870	0	3,120	0	3,125	0	4,527	0

*Average day-second-feet equals the average daily discharge in cubic feet per second (cfs).

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TABLE 2.7-25

CLINCH RIVER WATER QUALITY DATA[32]

Date	Time ET 24-hr Clock	Location	Depth (ft)	Stream Disch. (cfs)	Coliforms Fecal (MPN/100 ml)	Coliforms Total (MPN/100 ml)	Water Temp. (°F)	DO (mg/l)	5-Day 20°C BOD (mg/l)	Color (PCU)	Turb (JCU)	Nitrogen* Org. (mg/l)	Nitrogen* NH_3 (mg/l)	Nitrogen* NO_2 (mg/l)	Nitrogen* NO_3 (mg/l)	Phosphate Sol. (mg/l)	Phosphate Total (mg/l)	pH	Alkalinity ($CaCo_3$) Phen. (mg/l)	Alkalinity ($CaCo_3$) Total (mg/l)	Total Hardness ($CaCo_3$) (mg/l)
CLINCH RIVER MILE 79.8																					
6/22/67	1055	Tailrace**	0.5	6,400	2	62	50.2	7.8	0.5	5	<5	0.37	0.00	0.01	0.43	0.01	0.01	7.8	0	89	115
7/27/67	0905	Tailrace	0.5	6,670	130	220	51.8	5.1	0.7	10	28	0.11	0.00	0.01	0.60	0.03	0.03	7.8	0	38	119
8/15/67	1050	Tailrace	0.5	8,500	6	130	57.2	2.9	1.2	15	6	0.08	0.13	0.01	0.48	0.01	0.01	7.6	0	10	129
9/26/67	1120	Tailrace	0.5	8,220	2	6	62.6	0.9	0.2	50	36	0.50	1.18	0.02	0.42	0.07	0.12	7.5	0	105	116
10/18/67	1820	Tailrace	0.5	7,220	11	11,000	64.4	2.3	0.3	30	43	0.27	0.09	0.01	0.23	0.06	0.11	7.7	0	105	128
11/8/67	1515	Tailrace	0.5	2,220	6	23	60.8	6.7	0.3	10	15	0.14	0.18	<0.01	0.19	0.05	0.09	7.6	0	35	101
2/15/68	0920	Tailrace	1.0	6,390	3	23	33.8	11.2	1.2	10	15	0.25	0.06	0.02	0.54	0.04	0.18	8.2	0	103	--
4/24/68	1700	Tailrace	1.0	0	160	620	42.8	10.5	<1.0	10	2	0.04	0.05	<0.01	0.80	0.05	0.05	7.8	0	92	96
CLINCH RIVER MILE 23.1																					
6/23/67	1415	Tailrace	0.5	16,500	94	940	64.6	8.6	0.0	5	14	0.40	0.01	0.02	0.40	0.01	0.11	7.8	0	96	128
7/28/67	1340	Tailrace	0.5	8,600	110	360	66.6	7.7	1.1	10	23	0.01	0.15	0.01	0.52	0.01	0.07	7.9	0	90	112
8/15/67	1535	Tailrace	0.5	15,260	3	230	63.5	7.9	0.9	15	31	0.09	0.09	0.01	0.47	0.05	0.25	7.5	0	92	124
9/26/67	1650	Tailrace	0.5	8,340	36	110	66.7	5.9	0.7	5	2	0.24	0.00	0.02	0.43	0.07	0.14	7.6	0	106	112
10/19/67	1305	Tailrace	0.5	8,340	16	3,400	62.6	6.2	1.6	10	8	0.34	0.17	0.03	0.31	0.06	0.16	7.9	0	100	125
11/8/67	1155	Tailrace	0.5	9,000	62	160	59.0	8.1	0.3	10	9	0.13	0.12	0.01	0.23	0.01	0.13	7.8	0	97	115
2/16/68	0900	Tailrace	1.0	7,500	3	36	41.0	11.7	<1.0	5	10	0.25	0.11	0.02	0.57	0.06	0.12	7.2	0	111	--
4/25/68	1815	Tailrace	1.0	0	<2	50	60.4	9.6	1.3	15	3	0.63	0.03	0.01	0.47	0.05	0.09	8.0	0	92	100

TABLE 2.7-25 (Continued)

CLINCH RIVER MILE 79.8

Date	Time ET 24-hr Clock	Location	Depth (ft)	Ca (mg/l)	Mg (mg/l)	Cl (mg/l)	Na (mg/l)	K (mg/l)	Iron Fe++ (mg/l)	Iron Total (mg/l)	Mn, Total (mg/l)	SO_4 (mg/l)	SiO_2 (mg/l)	Specific Conductance at 25°C (μmhos/cm)	Solids Sus. (mg/l)	Solids Dis. (mg/l)	Solids Total (mg/l)	
6/22/67	1055	Tailrace**	0.5	27.8	11.0	11	3.00	1.30	0.10	0.10	0.06	10	4.8	240	0	112	112	7
7/27/67	0905	Tailrace	0.5	28.8	11.4	3	2.50	1.40	0.01	0.12	0.06	12	3.9	241	13	131	144	
8/15/67	1050	Tailrace	0.5	32.8	11.4	3	4.20	1.40	0.01	0.07	0.04	8	3.8	235	26	102	128	
9/26/67	1120	Tailrace	0.5	31.0	9.4	7	2.50	1.30	0.01	0.10	0.21	18	3.4	284	4	130	134	
10/18/67	1820	Tailrace	0.5	35.0	9.3	2	2.20	1.40	0.02	0.80	0.43	16	4.2	249	1	143	144	
11/8/67	1515	Tailrace	0.5	26.0	8.8	3	2.40	1.50	0.02	0.73	0.09	14	--	222	0	129	129	
2/15/68	0920	Tailrace	1.0	--	--	2	2.70	1.20	<0.05	--	--	12	3.0	210	10	130	140	
4/24/68	1700	Tailrace	1.0	23.0	9.5	3	1.70	3.80	<0.05	0.06	0.02	10	2.7	240	--	--	--	

CLINCH RIVER MILE 23.1

Date	Time ET 24-hr Clock	Location	Depth (ft)	Ca (mg/l)	Mg (mg/l)	Cl (mg/l)	Na (mg/l)	K (mg/l)	Iron Fe++ (mg/l)	Iron Total (mg/l)	Mn, Total (mg/l)	SO_4 (mg/l)	SiO_2 (mg/l)	Specific Conductance at 25°C (μmhos/cm)	Solids Sus. (mg/l)	Solids Dis. (mg/l)	Solids Total (mg/l)	
6/23/67	1415	Tailrace$^{\nabla}$	0.5	27.7	14.4	2	2.00	3.00	--	0.47	0.20	12	4.3	253	27	121	148	
7/28/67	1340	Tailrace	0.5	28.8	9.6	5	2.30	1.50	0.01	0.40	0.07	16	4.6	201	2	120	122	7
8/15/67	1535	Tailrace	0.5	31.8	10.8	9	2.20	1.40	0.00	0.26	0.04	14	3.7	230	20	122	142	
9/26/67	1650	Tailrace	0.5	29.5	9.2	18	1.70	1.40	0.01	0.21	0.07	18	3.5	284	63	90	153	
10/19/67	1305	Tailrace	0.5	34.0	9.3	2	2.60	1.50	0.01	0.22	0.04	13	3.6	284	8	132	140	
11/8/67	1155	Tailrace	0.5	31.0	9.1	3	2.80	1.60	0.02	0.17	0.45	14	--	266	15	98	113	
2/16/68	0900	Tailrace	1.0	--	--	3	2.30	1.00	<0.05	--	--	14	4.0	240	--	140	140	
4/25/68	1815	Tailrace	1.0	26.0	9.0	3	3.00	4.00	<0.05	0.19	0.04	12	1.1	230	10	100	110	

*Nitrogen: Values shown are mg/l nitrogen in the forms listed.

**Tailrace: Norris Dam

$^{\nabla}$Tailrace: Melton Hill Dam 6

TABLE 2.7-26

NON-RADIOACTIVE WATER MONITORING DATA - ORGDP PUMPING STATION[33]

1971

Substance	Number of Samples	Concentration, mg/l Maximum	Minimum	Average	STD	Percent STD
Cr	11	0.008	0.005	0.005	0.05*	10
Phenols	3	0.0004	0.0001	0.0002	0.001*	20
$SO_4^{=}$	4	25.2	21.0	22.7	250*	9
NO_3^{-}	4	7.5	0.7	4.7	45*	10
Cl^{-}	4	5.5	1.6	3.1	250*	1
Hg	32	0.0070	< 0.0005	< 0.0018	0.002**	< 90
Pb	3	0.02	< 0.005	< 0.012	0.05*	< 24

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*U.S. Public Health Service <u>Drinking Water Standards</u>

**U.S. Environmental Protection Agency, <u>Water Quality Criteria, 1972</u>

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TABLE 2.7-27

NON-RADIOACTIVE WATER MONITORING DATA - ORGDP PUMPING STATION[33]

1972

Substance	Number of Samples	Concentration, mg/l Maximum	Minimum	Average	STD	Percent STD
Cr	4	0.01	< 0.005	< 0.005 ± 0.0005	0.05*	< 10
Phenols **	3	< 0.0001	< 0.0001	< 0.0001	0.001*	< 10
$SO_4^=$	19	17.0	8.5	13.0 ± 2.4	250*	5.2
NO_3^-	10	4.4	1.9	2.9 ± 0.2	45*	6.4
Cl^-	3	2.4	< 1.0	< 1.2 ± 0.07	250*	< 0.5

*U.S. Public Health Service Drinking Water Standards

**All values below limit of detection

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TABLE 2.7-28

WATER QUALITY MEASUREMENTS

HOURLY TURBINE DISCHARGES IN CUBIC FEET PER SECOND FROM MELTON HILL DAM

DURING AQUATIC BASELINE SURVEY FIELD TRIPS

Time**	March 26	May 29	June 27	July 22	August 26	Sept. 24	Nov. 19	Jan. 16	April 14
2 am	0	0	0	0	0	0	0	0	10,000
3	0	0	0	0	0	0	0	0	10,000
4	0	0	0	0	0	0	0	0	10,000
5	0	0	0	0	0	0	0	0	10,000
6	6,660	0	0	0	0	0	0	0	10,000
7	9,600	0	0	0	0	0	0	5,500	10,900
8	17,600	0	0	0	2,410	0	2,600	11,000	10,100
9	17,600	0	0	0	8,090	0	8,800	11,000	10,300
10	17,800	8,522	0	0	8,270	0	7,800	11,000	10,100
11	17,800	9,970	0	0	8,690	0	8,100	11,000	10,500
12 noon	12,000	9,860	8,020	0	8,200	4,550	8,000	9,100	20,100
1	12,800	9,940	9,000	6,750	7,670	7,670	7,800	0	20,900
2	9,000	9,870	10,700	10,350	7,900	7,620	8,200	0	19,900
3	9,220	9,850	10,730	10,000	7,900	7,890	8,000	0	11,000
4	9,440	9,880	10,630	19,800	7,900	0	7,800	0	11,800
5	8,990	16,860	16,260	19,800	7,900	3,950	8,000	0	11,000
6	9,400	19,270	19,410	19,800	7,900	7,410	8,000	0	21,600
7	9,870	20,430	19,400	19,800	7,900	9,060	7,800	2,800	22,200
8	9,640	12,020	12,450	11,000	7,900	15,210	8,100	10,700	15,600
9	9,860	11,200	10,710	10,000	7,900	15,520	7,800	10,300	11,000
Daily Ave.	8,941	7,129	6,332	6,433	4,988	4,013	4,862	4,425	11,229

*Bracketed hours of discharge in cubic feet per second correspond to periods when water quality measurements were made from March 1974 to April 1975.

**Local Oak Ridge time.

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TABLE 2.7-29

CHEMICAL AND PHYSICAL FIELD MEASUREMENTS - CLINCH RIVER

TEMPERATURE (°C) - MEAN, MINIMUM AND MAXIMUM VALUES*

COLLECTED MARCH 26, 1974 THROUGH APRIL 14, 1975

Collection Date --	March 26, 1974			May 29, 1974		
Location	Mean	Minimum	Maximum	Mean	Minimum	Maximum
Transect 1	10.9	10.8	11.0	18.1	18.0	18.2
Transect 2	11.0	10.8	11.3	18.6	18.0	20.0
Transect 3	10.9	10.8	11.2	18.6	18.1	20.0
Transect 4	11.0	10.9	11.1	18.5	18.3	18.6
Transect 5	11.0	10.9	11.1	18.5	18.5	18.6

Collection Date --	June 27, 1974			July 22, 1974		
Location	Mean	Minimum	Maximum	Mean	Minimum	Maximum
Transect 1	19.9	19.5	20.5	20.0	20.0	20.0
Transect 2	19.9	19.5	20.0	19.8	19.5	20.5
Transect 3	20.2	20.0	20.5	19.9	19.5	20.5
Transect 4	20.0	20.0	20.0	19.8	19.5	20.5
Transect 5	20.2	20.0	20.5	19.8	19.5	20.5

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(Continued)

TABLE 2.7-29 (Continued)

Location	Collection Date --	August 26, 1974			September 24, 1974		
		Mean	Minimum	Maximum	Mean	Minimum	Maximum
Transect 1		21.0	20.2	21.4	22.1	21.5	22.5
Transect 2		21.8	21.2	23.5	20.0	19.9	20.0
Transect 3		22.1	21.6	22.7	20.0	20.0	20.0
Transect 4		23.1	22.1	23.8	20.0	19.9	20.0
Transect 5		23.3	22.8	23.7	19.9	19.5	20.0

Location	Collection Date --	November 19, 1974			January 16, 1975		
		Mean	Minimum	Maximum	Mean	Minimum	Maximum
Transect 1		13.5	13.5	13.5	9.2	8.6	9.3
Transect 2		13.5	13.5	13.5	9.3	9.3	9.3
Transect 3		13.5	13.5	13.5	9.4	9.3	9.4
Transect 4		13.5	13.5	13.5	9.2	9.0	9.4
Transect 5		13.5	13.5	13.5	9.1	9.0	9.2

Location	Collection Date --	April 14, 1975		
		Mean	Minimum	Maximum
Transect 1		11.5	11.5	11.5
Transect 2		11.5	11.5	11.5
Transect 3		11.5	11.5	11.5
Transect 4		11.5	11.5	11.5
Transect 5		11.2	11.0	11.5

*Calculated from surface, mid-depth and bottom values at each station.

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TABLE 2.7-30

CHEMICAL AND PHYSICAL FIELD MEASUREMENTS - CLINCH RIVER

SPECIFIC CONDUCTIVITY (µmhos/cm) - MEAN, MINIMUM AND MAXIMUM VALUES*

COLLECTED MARCH 26, 1974 THROUGH APRIL 14, 1975

Collection Date --	March 29, 1974			May 29, 1974		
Location	Mean	Minimum	Maximum	Mean	Minimum	Maximum
Transect 1	--	--	--	181	180	182
Transect 2	--	--	--	182	180	185
Transect 3	--	--	--	184	181	200
Transect 4	--	--	--	182	181	182
Transect 5	--	--	--	184	182	185

Collection Date --	June 27, 1974			July 22, 1974		
Location	Mean	Minimum	Maximum	Mean	Minimum	Maximum
Transect 1	214	210	215	190	170	200
Transect 2	213	210	215	163	130	195
Transect 3	211	210	215	182	170	200
Transect 4	210	210	210	169	120	190
Transect 5	210	210	210	166	130	190

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(Continued)

TABLE 2.7-30 (Continued)

Collection Date --	August 26, 1974			September 24, 1974		
Location	Mean	Minimum	Maximum	Mean	Minimum	Maximum
Transect 1	233	226	237	254	250	260
Transect 2	235	232	238	244	235	250
Transect 3	238	238	240	241	225	250
Transect 4	232	228	237	242	225	250
Transect 5	236	233	238	241	230	245

Collection Date --	November 19, 1974			January 16, 1975		
Location	Mean	Minimum	Maximum	Mean	Minimum	Maximum
Transect 1	239	235	245	195	191	197
Transect 2	243	240	245	202	200	206
Transect 3	241	240	245	200	197	202
Transect 4	241	235	245	199	193	203
Transect 5	242	240	245	199	194	204

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Collection Date --	April 14, 1975		
Location	Mean	Minimum	Maximum
Transect 1	186	180	190
Transect 2	180	160	190
Transect 3	187	185	190
Transect 4	188	180	190
Transect 5	183	180	190

*Calculated from surface, mid-depth and bottom values at each station.

TABLE 2.7-31

PHYSICAL AND CHEMICAL ROUTINE LABORATORY ANALYSIS* - CLINCH RIVER

MARCH 26, 1974 TO APRIL 14, 1975

Location	Transect 1-Station 5								
Date	March 26	May 29	June 27	July 22	Aug. 26	Sept. 24	Nov. 19	Jan. 16	April 14
Parameter**									
Total Alkalinity ($CaCO_3$)	76	96	94	94	106	114	100	100	86
Hardness ($CaCO_3$)	96	102	106	104	116	136	126	114	104
Turbidity (J.T.U.)	80	10	5	15	10	10	10	10	<5
Color (true)	20	10	5	5	5	10	10	20	20
BOD	3.0	< 1	< 1.0	6.0	1.6	2.0	1.9	2.0	1.2
COD	9.6	7.0	5.0	8.0	3.7	16.0	7.0	5.7	2.2
TOC (total organic carbon)	7.0	3.0	3.0	3.0	4.0	10.0	2.0	3.0	1.0
Chloride	3.0	2.8	4.4	3.7	3.2	2.6	3.5	13.0	8.6
Chlorine residual (field method)	< 0.05	< 0.05	<0.05	< 0.05	< 0.05	< 0.05	<0.05	<0.05	<0.05
Sulfate	23	12	13	16	13	12	21	17	17
Sodium	1.1	2.1	2.1	2.3	2.2	2.5	2.4	2.4	2.3
Potassium	1.4	1.3	1.1	1.3	1.2	1.3	1.5	1.7	1.5
Solids									
Dissolved	154	138	146	154	142	136	146	114	123
Settleables	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	<0.1	<0.1	<0.1
Suspended	46	10	4	20	10	12	8	10	13
Volatile	4	2	4	4	2	0	8	6	2
Fixed	42	8	< 1	16	8	12	<1	4	11
Total	200	148	150	174	152	148	154	124	136
Volatile	44	46	46	38	56	38	80	10	56
Fixed	156	102	104	136	96	110	74	114	80
Nitrogen									
NO_2-N	0.068	0.009	0.009	0.001	< 0.001	0.002	<0.001	<0.001	0.003
NO_3-N	0.4	0.5	0.3	< 0.1	<0.1	0.4	0.1	<0.1	<0.1
NH_3-N	1.00	0.22	0.05	0.58	0.10	0.17	0.18	0.33	<0.02
Phosphate									
Total-PO_4-P	0.130	< 0.003	0.020	0.023	0.020	< 0.003	0.004	0.050	0.120
Ortho-PO_4-P	0.120	< 0.003	0.003	0.020	< 0.003	< 0.003	<0.003	<0.003	0.080

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(Continued)

TABLE 2.7-31 (Continued)

Location	Transect 4-Station 3									
Date	March 26	May 29	June 27	July 22	Aug. 26	Sept. 24+	Sept. 24+	Nov. 19	Jan. 16	April 14
Parameter**										
Total Alkalinity ($CaCO_3$)	76	94	94	94	106	116	112	101	100	86
Hardness ($CaCO_3$)	88	106	110	104	116	136	138	131	114	105
Turbidity (J.T.U.)	70	5	5	10	10	10	10	10	10	5
Color (true)	30	5	10	5	5	10	10	10	20	20
BOD	3.0	< 1	< 1.0	3.0	1.6	1.4	1.8	2.0	2.0	1.6
COD	8.4	6.0	15.0	5.0	2.4	13.0	5.0	5.0	8.6	2.8
TOC (total organic carbon)	6.0	3.0	7.0	2.0	9.0	6.0	5.0	3.0	3.0	1.0
Chloride	2.0	2.7	4.6	3.8	3.0	2.6	2.6	3.5	11.0	11.0
Chlorine residual (field method)	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	--	<0.05	<0.05	<0.05
Sulfate	21	12	13	14	14	11	12	20	18	15
Sodium	1.14	2.5	2.1	2.3	2.2	2.3	2.3	2.3	2.4	2.2
Potassium	1.9	1.4	1.1	1.5	1.2	1.3	1.3	1.4	1.6	1.4
Solids										
Dissolved	142	134	140	164	138	148	140	150	146	125
Settleables	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	<0.1	<0.1	<0.1
Suspended	42	10	12	8	8	4	10	8	6	11
Volatile	4	2	8	< 1	2	0	4	8	2	1
Fixed	38	8	4	8	6	4	6	<1	4	10
Total	184	144	152	172	146	152	150	158	152	136
Volatile	36	52	30	40	54	52	54	52	40	42
Fixed	148	92	122	132	92	100	96	106	112	94
Nitrogen										
NO_2-N	0.062	0.008	0.010	0.002	< 0.001	< 0.001	0.001	<0.001	<0.001	0.003
NO_3-N	0.5	0.5	0.3	< 0.1	< 0.1	0.4	0.4	0.1	0.4	<0.1
NH_3-N	0.93	0.17	0.04	0.52	0.18	0.19	0.18	0.19	0.30	<0.02
Phosphate										
Total-PO_4-P	0.130	< 0.003	0.008	0.027	0.010	< 0.003	< 0.003	0.004	0.030	0.230
Ortho-PO_4-P	0.060	< 0.003	0.003	0.017	< 0.003	< 0.003	< 0.003	<0.003	<0.003	0.030

(Continued)

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TABLE 2.7-31 (Continued)

Location	Transect 5-Station 5								
Date	March 26	May 29	June 27	July 22	Aug. 26	Sept. 24	Nov. 19	Jan. 16	April 14
Parameter**									
Total Alkalinity ($CaCO_3$)	76	90	94	94	106	90	101	100	86
Hardness ($CaCO_3$)	82	102	106	106	116	138	132	114	105
Turbidity (J.T.U.)	70	5	5	10	5	10	10	10	<5
Color (true)	30	5	10	5	5	10	10	20	20
BOD	3.0	< 1	1.2	3.0	2.2	2.0	3.4	2.3	1.9
COD	8.4	6.0	5.4	5.0	3.3	5.0	7.0	8.0	3.0
TOC (total organic carbon)	4.0	3.0	3.0	2.0	4.0	6.0	3.0	3.0	1.0
Chloride	1.0	2.6	4.6	4.4	3.1	2.4	3.3	10.0	9.6
Chlorine residual (field method)	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	<0.05	<0.05	<0.05
Sulfate	23	13	13	16	14	11	20	18	15
Sodium	1.1	2.1	2.1	2.3	2.2	2.2	2.4	2.4	2.2
Potassium	1.3	1.3	1.1	1.4	1.2	1.3	1.4	1.6	1.5
Solids									
Dissolved	142	130	136	154	130	174	160	144	120
Settleables	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	<0.1	<0.1	<0.1
Suspended	42	6	6	6	16	8	8	10	10
Volatile	4	2	6	< 1	2	4	8	6	<1
Fixed	38	4	< 1	6	14	4	<1	4	10
Total	180	136	142	160	146	182	168	154	130
Volatile	32	64	28	16	46	74	68	40	52
Fixed	148	72	114	144	100	108	100	114	78
Nitrogen									
NO_2-N	0.065	0.007	0.009	0.002	< 0.001	< 0.001	<0.001	<0.001	0.003
NO_3-N	0.4	0.5	0.4	0.1	< 0.1	0.3	0.1	<0.1	<0.1
NH_3-N	0.90	0.18	0.09	0.59	0.12	0.18	0.18	0.30	<0.02
Phosphate									
Total-PO_4-P	0.120	< 0.003	0.007	0.020	0.020	< 0.003	0.003	0.050	0.350
Ortho-PO_4-P	0.100	< 0.003	< 0.003	0.020	< 0.003	< 0.003	<0.003	<0.003	0.010

*Water samples were collected one foot below water surface.

**All values expressed in parts per million (ppm) unless otherwise indicated

†Duplicate water samples were taken for laboratory analyses at Transect 4-Station 3 on September 24, 1974.

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TABLE 2.7-32

PHYSICAL AND CHEMICAL ROUTINE LABORATORY ANALYSIS
MEAN, MINIMUM AND MAXIMUM VALUES - CLINCH RIVER
MARCH 26, 1974 TO APRIL 14, 1975

Location	Transect 1-Station 5		
Parameter*	Mean	Minimum	Maximum
Total Alkalinity ($CaCO_3$)	96	76	114
Hardness ($CaCO_3$)	112	96	136
Turbidity (J.T.U.)	17	<5	80
Color (true)	12	5	20
BOD	2.1	0.3	6.0
COD	7.1	2.2	16.0
TOC (total organic carbon)	4.0	1.0	10.0
Chloride	5.0	2.6	13.0
Chlorine residual (field method)	<0.05	<0.05	<0.05
Sulfate	16	12	23
Sodium	2.1	1.1	2.5
Potassium	1.4	1.1	1.7
Solids			
Dissolved	139	114	154
Settleables	<0.1	<0.1	<0.1
Suspended	15	4	46
Volatile	4	0	8
Fixed	11	<1	42
Total	154	124	200
Volatile	46	10	80
Fixed	108	74	156
Nitrogen			
NO_2-N	0.011	<0.001	0.068
NO_3-N	0.2	<0.1	0.5
NH_3-N	0.29	<0.02	1.00
Phosphate			
Total-PO_4-P	0.041	<0.003	0.130
Ortho-PO_4-P	0.026	<0.003	0.120

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(Continued)

TABLE 2.7-32 (Continued)

Location	Transect 4-Station 3		
Parameter*	Mean	Minimum	Maximum
Total Alkalinity ($CaCO_3$)	98	76	116
Hardness ($CaCO_3$)	115	88	138
Turbidity (J.T.U.)	15	5	70
Color (true)	13	5	30
BOD	1.8	0.9	3.0
COD	7.1	2.4	15.0
TOC (total organic carbon)	4.5	1.0	9.0
Chloride	4.7	2.0	11.0
Chlorine residual (field method)	<0.05	<0.05	<0.05
Sulfate	15	11	21
Sodium	2.2	1.1	2.5
Potassium	1.4	1.1	1.9
Solids			
Dissolved	143	125	164
Settleables	<0.1	<0.1	<0.1
Suspended	12	4	42
Volatile	3	0	8
Fixed	9	<1	38
Total	155	136	184
Volatile	45	30	54
Fixed	109	92	148
Nitrogen			
NO_2-N	0.009	<0.001	0.062
NO_3-N	0.3	<0.1	0.5
NH_3-N	0.27	<0.02	0.93
Phosphate			
Total-PO_4-P	0.045	<0.003	0.230
Ortho-PO_4-P	0.013	<0.003	0.060

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(Continued)

TABLE 2.7-32 (Continued)

Location	Transect 5-Station 5		
Parameter*	Mean	Minimum	Maximum
Total Alkalinity ($CaCO_3$)	93	76	106
Hardness ($CaCO_3$)	111	82	136
Turbidity (J.T.U.)	14	<5	70
Color (true)	13	5	30
BOD	2.2	<1.0	3.4
COD	5.7	3.0	8.4
TOC (total organic carbon)	3.2	1.0	6.0
Chloride	4.6	1.0	10.0
Chlorine residual (field method)	<0.05	<0.05	<0.05
Sulfate	16	11	23
Sodium	2.1	1.1	2.4
Potassium	1.3	1.1	1.6
Solids			
Dissolved	143	120	174
Settleables	<0.1	<0.1	<0.1
Suspended	12	6	42
Volatile	4	<1	8
Fixed	9	<1	38
Total	155	130	182
Volatile	47	16	74
Fixed	109	72	148
Nitrogen			
NO_2-N	0.010	<0.001	0.065
NO_3-N	0.2	<0.1	0.5
NH_3-N	0.28	<0.02	0.90
Phosphate			
Total-PO_4-P	0.064	<0.003	0.350
Ortho-PO_4-P	0.016	<0.003	0.100

*All values expressed in parts per million (ppm) unless otherwise indicated.

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TABLE 2.7-33

CHEMICAL AND PHYSICAL FIELD MEASUREMENTS - CLINCH RIVER

pH - MEAN, MINIMUM AND MAXIMUM VALUES*

COLLECTED MARCH 26, 1974 THROUGH APRIL 14, 1975

Collection Date --	March 26, 1974			May 29, 1974		
Location	Mean	Minimum	Maximum	Mean	Minimum	Maximum
Transect 1	--	--	--	7.9	7.7	8.15
Transect 2	8.0	7.8	8.1	7.9	7.8	7.95
Transect 3	8.0	7.9	8.3	7.9	7.8	8.0
Transect 4	7.9	7.8	8.1	7.8	7.7	7.9
Transect 5	7.9	7.7	8.1	7.9	7.8	8.0

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Collection Date --	August 26, 1974			September 24, 1974		
Location	Mean	Minimum	Maximum	Mean	Minimum	Maximum
Transect 1	8.1	8.0	8.1	8.2	8.1	8.2
Transect 2	8.1	8.1	8.1	8.1	7.9	8.2
Transect 3	8.1	8.1	8.2	8.1	8.0	8.1
Transect 4	8.1	8.1	8.1	8.0	8.0	8.1
Transect 5	8.1	8.0	8.1	7.8	7.6	7.9

(Continued)

TABLE 2.7-33 (Continued)

Location	November 19, 1974 Mean	November 19, 1974 Minimum	November 19, 1974 Maximum	January 16, 1975 Mean	January 16, 1975 Minimum	January 16, 1975 Maximum
Transect 1	8.0	8.0	8.0	6.7	6.5	6.8
Transect 2	8.0	7.9	8.0	8.0	7.9	8.0
Transect 3	8.0	7.9	8.0	8.0	7.8	8.1
Transect 4	8.0	7.9	8.0	7.2	6.7	7.5
Transect 5	7.9	7.8	7.9	7.1	6.7	7.5

Location	April 14, 1975 Mean	April 14, 1975 Minimum	April 14, 1975 Maximum
Transect 1	8.1	8.1	8.15
Transect 2	8.1	8.1	8.1
Transect 3	8.1	8.1	8.15
Transect 4	8.1	8.1	8.1
Transect 5	8.1	8.1	8.15

*Calculated from surface, mid-depth and bottom values at each station.

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TABLE 2.7-34

CHEMICAL AND PHYSICAL FIELD MEASUREMENTS - CLINCH RIVER
DISSOLVED OXYGEN (PPM) - MEAN, MINIMUM AND MAXIMUM VALUES*
COLLECTED MARCH 26, 1974 THROUGH APRIL 14, 1975

Collection Date --	March 26, 1974			May 29, 1974		
Location	Mean	Minimum	Maximum	Mean	Minimum	Maximum
Transect 1	10.8	10.7	11.0	9.0	8.9	9.1
Transect 2	10.8	10.5	11.2	9.2	9.0	9.4
Transect 3	10.8	10.6	11.1	9.0	9.0	9.2
Transect 4	10.6	10.4	10.6	8.9	8.85	9.1
Transect 5	10.6	10.3	10.7	8.9	8.9	9.0

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Collection Date --	June 27, 1974			July 22, 1974		
Location	Mean	Minimum	Maximum	Mean	Minimum	Maximum
Transect 1	8.4	8.2	8.6	8.2	7.75	8.6
Transect 2	8.4	8.3	8.5	8.2	7.6	8.5
Transect 3	8.5	8.3	8.8	8.3	7.95	8.7
Transect 4	8.4	8.4	8.5	8.1	8.05	8.3
Transect 5	8.5	8.4	8.5	8.1	8.0	8.2

(Continued)

TABLE 2.7-34 (Continued)

Location	Collection Date -- August 26, 1974 Mean	Minimum	Maximum	September 24, 1974 Mean	Minimum	Maximum
Transect 1	5.7	5.6	5.8	7.0	6.9	7.3
Transect 2	6.0	5.6	7.3	6.9	6.4	7.4
Transect 3	6.0	5.8	6.7	7.0	6.8	7.2
Transect 4	5.9	5.8	6.1	7.0	6.8	7.1
Transect 5	6.3	6.1	6.4	6.7	6.6	7.1

Location	Collection Date -- November 19, 1974 Mean	Minimum	Maximum	January 16, 1975 Mean	Minimum	Maximum
Transect 1	7.8	7.7	7.9	8.4	8.3	8.5
Transect 2	7.9	7.9	8.0	7.8	7.6	7.9
Transect 3	7.7	7.6	7.9	8.1	7.6	8.5
Transect 4	7.9	7.9	8.1	8.3	8.1	8.4
Transect 5	7.9	7.8	8.0	8.3	8.1	8.4

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Location	Collection Date -- April 14, 1975 Mean	Minimum	Maximum
Transect 1	10.1	10.1	10.2
Transect 2	10.1	10.1	10.2
Transect 3	10.2	10.1	10.2
Transect 4	10.2	10.1	10.2
Transect 5	10.2	10.1	10.2

*Calculated from surface, mid-depth and bottom values at each station.

TABLE 2.7-35

ADDITIONAL CHEMICAL ANALYSIS* - CLINCH RIVER

COLLECTED MARCH 26 AND SEPTEMBER 24, 1974

Date	March 26	September 24	
Location	Transect 4 Station 3	Transect 4 Station 3	
Parameter **			
Chlorine demand	< 0.5+	< 0.5	6
Fluoride	< 0.1	0.18	
Nitrogen gas	16.9	14.9	
Silicate	7.7	2.2	
Calcium	24.0	43.0	
Magnesium	7.0	8.5	
Molybdenum	< 0.03	< 0.03	
Selenium	< 0.01	< 0.01	
Tin	< 0.2	< 1	
Aluminum	3.32	< 0.1	
Manganese	0.07	0.02	
Zinc	0.03	0.02	
Copper	< 0.005	< 0.01	
Mercury (ppb)	< 4	< 1	
Silver	< 0.01	< 0.01	
Arsenic	< 0.03	< 0.03	
Cadmium	< 0.004	< 0.004	
Chromium	< 0.01	< 0.01	
Lead	< 0.03	< 0.03	
Nickel	< 0.01	< 0.01	
Cobalt	< 0.01	< 0.01	
Iron (total)	0.68	0.08	
Organic compounds			
Cyanide	< 0.005	< 0.005	
Detergents-surfactants (MBAS)	< 0.01	0.1	
Oil and grease (solvent extraction)	2.75	1.8	
Phthalate esters++	< 0.01 < 0.00001	< 0.00001	

(Continued)

TABLE 2.7-35 (Continued)

Date	March 26	September 24	
Location	Transect 4 Station 3	Transect 4 Station 3	
Parameter**			
Pesticides++			
Organochlorines (insecticides)			
BHC - total	< 0.001	< 0.00001	< 0.00001
Heptaepoxide	< 0.001	< 0.00001	< 0.00001
Dieldrin	< 0.001	< 0.00001	< 0.00001
DDE	< 0.001	< 0.00001	< 0.00001
DDD	< 0.001	< 0.00001	< 0.00001
DDT - total	< 0.001	< 0.00001	< 0.00001
Atrazine (herbicide)	< 0.01	< 0.00001	< 0.00001
2-4-D (herbicide)	< 0.01	< 0.0001	0.06

*Water samples were collected one foot below the water surface.

**All values are expressed in parts per million (ppm) unless indicated otherwise.

+This analysis was based on a water sample taken one foot below the water surface on May 29, 1974.

++Duplicate samples for phthalate esters and pesticide analyses were taken on September 24, 1974.

TABLE 2.7-36

CATEGORIZATION OF SEDIMENT ACCORDING TO PARTICLE DIAMETER

Diameter of Particle (in mm)	Name
>5.6	Gravel - boulder
1.70 - 5.6	Granule
0.500 - 1.70	Coarse sand
0.250 - 0.500	Medium sand
0.125 - 0.250	Fine sand
0.075 - 0.125	Very fine sand
<0.075	Silt-clay

TABLE 2.7-37

SEDIMENT ANALYSIS

PHOSPHATE AND HEAVY METAL CONTENT* - CLINCH RIVER

COLLECTED MARCH 25, 1974

Location	Transect 1	Transect 2	Transect 3	Transect 4	Transect 5
Parameter**					
PHOSPHATE (total)	55	70	160	80	70
HEAVY METAL CONTENT					
Molybdenum	< 15	< 15	< 15	< 15	< 15
Selenium	< 5	< 5	< 5	< 5	< 5
Tin	< 500	< 500	< 500	< 500	< 500
Aluminum	3,900	5,700	7,000	4,600	10,000
Manganese	2,700	2,100	1,100	700	2,900
Zinc	45	40	60	30	55
Copper	15	20	15	25	15
Mercury	< 100	< 100	< 100	< 100	< 100
Silver	< 5	< 5	< 5	< 5	< 5
Arsenic	< 15	< 15	< 15	< 15	< 15
Cadmium	< 2	< 2	< 2	< 2	< 2
Chromium (Total)	15	30	5	10	20
Lead	< 15	< 15	< 15	< 15	< 15
Nickel	5	10	5	5	10
Cobalt	< 5	< 5	< 5	< 5	< 5
Iron (total)	24,500	33,300	12,300	9,400	20,300

*Five composite samples were collected using a Ponar dredge. Each composite sample consisted of sediment collected from three sampling stations per transect.

**All values expressed in parts per million (ppm)

TABLE 2.7-38

CHEMICAL COMPOSITION OF BOTTOM SEDIMENTS
OF THE CLINCH RIVER*
COLLECTED APRIL 16, 1975

(concentrations in ppm)

Location	Transect 1	Transect 4	Transect 5	U.S. Mean**
Parameter				
Phosphate (total)	1,400	1,600	1,100	--
Molybdenum	<3	<3	<3	--
Selenium	<0.8	<0.8	<0.8	--
Tin	<3	<3	<3	--
Manganese	400	400	400	600
Zinc	30	40	30	55
Copper	7	10	15	25.0
Mercury	0.02	0.08	0.03	0.12
Silver	<1	<1	<1	--
Arsenic	15.3	18.7	10.0	5.0
Cadmium	<0.5	<0.5	<0.5	--
Chromium (total)	20	20	20	52.0
Lead	26	31	22	20
Nickel	40	40	40	20
Cobalt	50	40	50	10
Iron (total)	>10,000	>10,000	>10,000	25,000
Beryllium	0.5	0.5	0.5	1.0
Fluoride	88	134	74	--
Magnesium	500	600	500	9,000
Antimony	2.1	2.4	7.4	--
Vanadium	20	30	20	78
Bromine	30	30	30	--
Bismuth	<1	<1	<1	--
Calcium	>10,000	>10,000	>10,000	25,000
Strontium	20	20	20	270
Potassium	>10,000	>10,000	>10,000	24,000
Sodium	800	800	600	12,000
Niobium	<10	<10	<10	--
Aluminum	>10,000	>10,000	>10,000	--
Silica	>10,000	>10,000	>10,000	--
Titanium	500	1,000	400	3,000
Zirconium	100	200	80	275

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(Continued)

TABLE 2.7-38 (Continued)

(concentrations in ppm)

Location	Transect 1	Transect 4	Transect 5	U.S. Mean**
Parameter				
Barium	200	200	200	5
Lithium	30	30	30	--
Scandium	<5	<5	<5	10
Germanium	<1	<1	<1	--

6

*Three composite samples were collected using a Ponar dredge. Each composite sample consisted of sediment collected from three sampling stations per transect.

**Shacklette, H. T., et al, Elemental Composition of Surficial Materials in the Conterminous U.S., U.S. Geological Survey Professional Paper 574-D, 1971.

TABLE 2.7-39

SEDIMENT ANALYSIS

POLYCHLORINATED BIPHENYL AND INSECTICIDE CONTENT* - CLINCH RIVER

COLLECTED APRIL 16, 1975

Location	Transect 1	Transect 4	Transect 5	
Parameter**				
Polychlorinated biphenyl	0.00064	0.020	0.00028	
Polychlorinated biphenyl	--	0.012+	--	
Insecticides				
Chlordane (α)	<0.0001	0.00053	<0.0001	6
Chlordane (γ)	<0.0001	0.00023	<0.0001	
DDE	0.00021	0.0024	0.000089	
DDD	0.00018	0.0014	0.00022	
DDT	0.00028	0.0024	0.00017	

*Three composite samples were collected using a Ponar dredge. Each composite sample consisted of sediment collected from three sampling stations per transect.

**All values expressed in parts per million (ppm)

+Sediment sample from Transect 4 was analyzed two times since the value of the first analysis seemed high in comparison with values from Transect 1 and Transect 5.

TABLE 2.7-40

BACTERIA*

ENUMERATION** - CLINCH RIVER

MARCH 26, 1974 TO APRIL 14, 1975

Parameter	Standard Plate Count			
Location	Transect 1-Station 5	Transect 4-Station 3	Transect 5-Station 5	
Date				
March 26	15,600	20,900	22,500	
May 29	6,900	4,800	3,600	
June 27	13,800	8,100	9,500	
July 22	2,800	12,000	5,300	
August 26	11,000	13,900	4,200	
September 24+	2,900	1,300	1,200	
September 24+	--	1,500	--	
November 19	6,100	6,500	6,200	
January 16	7,500	13,000	14,000	6
April 14	6,500	6,000	7,000	

Parameter	Total Coliform Count			
Location	Transect 1-Station 5	Transect 4-Station 3	Transect 5-Station 5	
Date				
March 26	2,300	1,800	1,600	
May 29	100	50	100	
June 27	<5	<5	<5	
July 22	15	950	100	
August 26	<5	15	5	
September 24+	<5	<5	<5	
September 24+	--	<5	--	
November 19	5	10	<5	
January 16	96	220	36	6
April 14	36	24	30	

(Continued)

TABLE 2.7-40 (Continued)

Parameter	Fecal Coliform Count			
Location	Transect 1-Station 5	Transect 4-Station 3	Transect 5-Station 5	
Date				
March 26	1,000	600	900	
May 29	40	40	20	
June 27	<5	<5	<5	
July 22	5	250	100	
August 26	<5	<5	5	
September 24[+]	<5	<5	<5	
September 24[+]	--	<5	--	
November 19	<5	5	<5	
January 16	<4	<4	<4	6
April 14	5	8	8	

Parameter	Fecal Strep. Count			
Location	Transect 1-Station 5	Transect 4-Station 3	Transect 5-Station 5	
Date				
March 26	660	740	650	
May 29	<3	<3	<3	
June 27	<5	<5	<5	
July 22	30	545	90	
August 26	<5	<5	5	
September 24[+]	10	5	<5	
September 24[+]	--	<5	--	
November 19	<4	<4	4	
January 16	60	72	40	6
April 14	<4	4	8	

*Water samples were collected one foot below the water surface.

**All values expressed as number of colonies per 100 ml

[+] Duplicate samples for bacterial analyses were taken at Transect 4-Station 3 on September 24, 1974.

TABLE 2.7-41

DAILY PRECIPITATION AT BULL RUN STEAM PLANT*

	1974											
Day	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.03	0.14	0.01	0.03	0.01	0.13	0.00	0.00	0.24	0.01	0.00	0.16
2	0.81	0.90	0.02	0.05**	0.87	0.00	0.00	0.00	1.48	0.00	0.00	0.06
3	0.83	0.09	0.01	0.75**	0.03	0.02	0.01	0.34	0.07	0.00	0.00	0.01
4	0.01	0.03	0.01	0.45**	0.14	0.02	0.01	0.06	0.00	0.00	0.30	0.02
5	0.01	0.01	0.53	0.00	0.33	0.00	0.01	0.01	0.00	0.00	0.60	0.00**
6	0.29	0.27	0.60	0.00	0.03	0.75	0.01	0.01	0.54	0.02	0.01	0.00
7	0.03	0.08	0.10	0.00	0.01	0.00	0.56	0.01	0.00	0.00	0.00	0.44
8	0.14	0.09	0.07	0.78	0.61	0.01	0.01	0.24	0.21	0.00	0.00	0.22
9	1.37	0.00	0.12	0.01	---**	0.00	0.00	0.00	0.08	0.00	0.00	0.00
10	1.58	0.01	0.11	0.00	---**	0.01	0.11	0.00	0.01	0.01	0.00	0.00**
11	1.13	0.00	0.13	0.01	0.20	0.02	0.25	1.09	0.01	0.05	0.45	0.03**
12	0.02	0.00	0.18	0.18	0.97	0.03	0.00	0.03	0.00	0.01**	0.11	0.01
13	0.01	0.09	---**	0.24	0.03	0.00	0.01	0.01	0.01	0.00	0.00	0.00
14	0.34	0.29	---**	0.28	0.04	0.00	0.01	0.01**	0.00	0.01	0.27	0.00
15	0.03	0.00	---**	0.02	1.03	0.00	0.00	0.00	0.01	0.80	0.00	0.23
16	0.01	1.09	---**	0.05	0.03	0.33	0.00	0.40**	0.01	0.94	0.01	0.00**
17	0.00	0.01	---**	0.09	0.06	0.01	0.00	0.01	0.00	0.00	0.12	0.02
18	0.00	0.00	---**	0.01	0.01**	0.00	0.00	0.00	0.00	0.00	0.11	0.00**
19	0.00	0.46	---**	0.01	---**	0.00	1.30	0.00	0.01	0.00	0.94+	0.03
20	0.00	0.00	---**	0.03**	0.69**	0.00	0.02	0.01	0.01	0.00	0.56	0.01
21	0.01	0.02	2.42	0.01	0.01	0.00	0.00	0.08	0.98	0.00**	0.00	0.00**
22	0.01	0.68	0.12	1.12	0.38	0.01	0.00+	0.04	0.01	---**	0.00	0.00**
23	0.40	0.01	0.02	0.40	1.09	0.00	0.04	0.00	0.00	0.00**	0.01	0.00
24	0.87	0.04	0.04	0.15	0.01	0.01	0.34	0.00	0.00+	0.00	0.00	0.47
25	0.01	0.01	0.12	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.21	0.64
26	0.82	0.01	0.03+	0.00	0.56	0.00	0.02	0.00+	0.01	0.00	0.01	0.00**
27	0.01	0.00	0.17	0.14	0.03	0.11	0.01	0.01	0.17	0.00	---**	1.10
28	0.64	0.15	0.13	0.00	0.01	0.00+	0.01	0.00	0.02	0.00	---**	0.45
29	0.02		0.71	0.02	0.03+	0.00	0.01	0.17**	0.25	0.00	0.03	0.16
30	0.05		0.22	0.01	0.82	0.01	0.01	0.13	0.01	0.00	1.11	0.01
31	0.10		0.03		0.28		0.02	0.00		0.00		0.13**
Total	9.58	4.48	5.90**	4.81**	8.31**	1.48	2.77	2.66**	4.14	1.85**	4.85**	4.20**

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TABLE 2.7-41 (Continued)

Day	1975											
	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.03	0.00	0.00	0.00	0.14	0.31	0.00	0.00	0.00	0.00	0.00	0.70
2	0.00	0.92	0.29	0.00	0.00	0.00	0.00	0.00	0.00	0.48	0.00	0.00
3	0.00	0.32	0.00	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.61	0.39	0.00	0.00	0.06	0.00	0.00	0.13	0.00	0.00	0.00	0.00
5	0.00	0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.09	0.00	0.00	0.00	0.40	0.23	0.20	0.00	0.00	0.00	0.00
7	0.00	0.02	0.00	0.00	0.06	0.00	0.15	0.00	0.32	0.00	0.33	0.35
8	0.00	0.00	0.80	0.00	0.24	0.00	0.39	0.00	0.00	0.07	0.07	0.00
9	0.20	0.00	0.00	0.00	0.42	0.00	0.03	0.57	0.00	1.33	0.00	0.15
10	0.04	0.00	0.30	0.05	0.00	0.53	0.00	0.25	0.00	0.00	0.00	0.25
11	0.72	0.00	0.40	0.00	0.03	0.40	0.00	0.61	0.00	0.00	0.03	0.00
12	0.00	0.92	0.00	0.00	0.10	0.88	0.00	0.00	0.02	0.03	0.80	0.00
13	0.70	0.00	2.76	0.00	0.00	1.30	0.00	0.00	0.03	0.00	1.00	0.00
14	0.00	0.00	1.94	0.03+	0.00	0.50	0.00	0.00	0.00	0.00	0.02	0.00
15	0.00	0.00	0.00	0.30	0.10	0.00	0.13	0.00	0.00	0.00	0.00	0.00
16	0.00+	0.20	0.00	0.00	1.40	0.32	0.00	0.08	0.00	0.00	0.00	0.56
17	0.00	0.65	0.22	0.00	0.00	0.00	0.00	0.00	0.00	1.08	0.00	0.00
18	0.04	0.00	0.00	0.00	0.30	0.00	0.40	0.22	1.30	1.00	0.00	0.00
19	0.26	0.05	0.15	0.47	0.00	0.00	0.00	0.17	0.02	0.00	0.00	0.00
20	1.12	0.00	0.03	0.25	0.00	0.00	0.10	0.04	0.00	0.00	0.00	0.00
21	0.00	0.00	0.00	0.00	0.00	0.04	0.10	0.00	0.10	0.00	0.21	0.00
22	0.00	0.00	0.00	0.00	0.00	0.15	0.00	0.00	0.02	0.00	0.00	0.00
23	0.00	0.08	0.50	0.00	0.00	0.00	0.00	0.00	1.05	0.00	0.00	0.00
24	0.00	1.04	1.08	0.04	0.08	0.00	0.00	0.00	1.63	0.00	0.00	0.00
25	1.50	0.00	0.27	0.37	0.00	0.00	0.08	0.00	0.05	0.00	0.00	0.10
26	0.07	0.00	0.00	0.20	0.02	0.40	0.12	0.00	0.00	0.00	0.00	1.32
27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.30	0.10	0.04
28	0.00	0.00	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29	0.00		0.58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	0.10		2.15	0.00	0.78	0.00	0.02	0.00	0.00	0.38	0.00	0.19
31	0.00		0.00		0.50		0.20	0.00		0.00		0.95
Total	5.39	5.28	11.47	1.93	4.48	5.23	1.94	2.27	4.54	4.67	2.56	4.61

*Precipitation in inches for 24-hour period ending 12 midnight on date indicated. Data collected at Bull Run Steam Plant's meteorological station.

**Incomplete record

+Denotes days when water quality samples were collected during the Aquatic Baseline Survey Program.

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TABLE 2.7-42

BACTERIA*
MEAN, MINIMUM AND MAXIMUM VALUES - CLINCH RIVER
MARCH 26, 1974 TO APRIL 14, 1975

Location	Transect 1 - Station 5		
Parameter	Mean	Minimum	Maximum
Standard Plate Count	8,122	2,800	15,600
Total Coliform Count	285	5	2,300
Fecal Coliform Count	119	4	1,000
Fecal Strep. Count	87	3	660

Location	Transect 4 - Station 3			
Parameter	Mean	Minimum	Maximum	6
Standard Plate Count	8,800	1,200	20,900	
Total Coliform Count	308	5	1,800	
Fecal Coliform Count	93	4	600	
Fecal Strep. Count	139	3	740	

Location	Transect 5 - Station 5		
Parameter	Mean	Minimum	Maximum
Standard Plate Count	8,167	1,500	22,500
Total Coliform Count	210	5	1,600
Fecal Coliform Count	117	4	900
Fecal Strep. Count	90	3	650

*All values expressed as number of colonies per 100 ml.

TABLE 2.7-43

OCCURRENCE OF MICROSCOPIC ORGANISMS IN THE CLINCH RIVER SYSTEM IN THE SUMMER OF 1956*(51)

Blue Green Algae
- Anabaena spp.
  - " circinalis
- Anabaeniopsis sp.
- Aphanizomenon sp.
- Aphanocapsa sp.
  - " pulchra
- Chroococcus limneticus
  - " turgidus
- Coelosphaerium sp.
- Eucapsis sp.
- Gleocapsa sp.
- Gomphosphaeria lacustris
- Lyngbya spp.
  - " contorta
- Merismopedia spp.
- Microcystis aeruginosa
  - " incerta
- Nodularia sp.
- Oscillatoria spp.
- Spirulina sp.

Chlorococcales
- Acanthosphaera zachariasi
- Actinastrum hantschii
- Ankistrodesmus falcatus
  - " mirabilis
- Arthrodesmus sp.
- Asterococcus superbus

(Continued)

TABLE 2.7-43 (Continued)

Chlorella pyrenoidosa
" vulgaris
Chlorococcum sp.
Chodatella longiseta
Closteriopsis longissima
Closterium spp.
" acicularis
Clostridium lunula
Coelastrum cambricum
" microporum
" proboscoides
Cosmarium spp.
Crucigenia apiculata
" rectangularis
" tetrapedia
Dactylococcus infusionum
Desmatractum bipyramidatum
Dictyosphaerium pulchellum
Dimorphococcus lunatus
Euastrum spp.
" Novae zemblae
Franceia droescheri
" tuberculata
Gleoactinium limneticum
Gleococcus sp.
Golenkinia paucispina
" radiata
Kirchneriella lunaris
Kirchneriella obesa
" sp.

(Continued)

TABLE 2.7-43 (Continued)

Lagerheimia subsalsa
Micractinium pusillum
Mougeotia spp.
Oocystis spp.
Ourococcus bicaudatus
Pachycladon umbrinus
Pediastrum boryanum
" clathratum
" duplex
" simplex
" tetra
Planktosphaeria gelatinosa
Polyedriopsis spinulosa
Protococcus viridis
Quadrigula closteroides
Radiococcus nimbatus
Scenedesmus spp.
Schroederia setigera
Selenastrum gracile
Spirogyra spp.
Spondylosium sp.
Staurastrum spp.
Tetraedron spp.
" caudatum
" hastatum
" minimum
" multiseta
" muticum
" pentagonum

(Continued)

Tetraedron proteriforme
" punctulatum
" quadridens
" regulare
" trigonum
" trilobulatum
Tetrallantos lagerheimii
Tetrastrum heteracanthum
" punctatum
Treubaria triappendiculata
Westella botryoides
Unid. green cells
Volvocales
Carteria spp.
Cephalomonas granulata
Chlamydomonas spp.
Chlorogonium acutissimum
" euchlora
Coccomonas orbicularis
Collodictyon triciliatum
Dysmorphococcus fritschii
" variabilis
Eudorina elegans
Gonium pectorale
" sociable
Heteromastix angulata
Lobomonas rostrata
Mesostigma viridis
Pandorina morum

(Continued)

Pedinopera granulosa
Phacotus lenticularis
Platydorina caudata
Platymonas elliptica
Polytoma uvella
" scabra
Pteromonas aculeata
" angulosa
" cruciata
" ovoides
" spp.
Pyramidomonas sp.
Scherffelia phacus
Sphaerellopsis fluviatile
Spermatozopsis exultans
Spondylomorum quaternarium
Thoracomonas spp.
" alata
" phacotoides
Wislouchiella planctonica
Heterokontae
Centritractus belonophorus
Peroniella planctonica
Chloromonadida
Gonyostomum depressum
Cryptophyceae
Chroomonas setoniensis
" spp.
Cryptomonas erosa
Cyathomonas truncata

(Continued)

TABLE 2.7-43 (Continued)

Rhodomonas lacustris
" lens
" spp.

Chrysophyceae
- Chromulina globosa
- " ovalis
- " sp.
- Chrysochromulina spp.
- Chrysococcus asper
- " cylindrica
- " ollula
- " ovalis
- " rufescens
- " spirale
- Dinobryon spp.
- Lagynion scherffeli
- Mallomonas spp.
- Ochromonas ludibunda
- " variabilis
- Olisthodiscus luteus
- Synura uvella
- Uroglena volvox
- Uroglenopsis americana

Dinoflagellata
- Ceratium hirundinella
- " sp.
- Cochlodinium sp.
- Glenodinium gymnodinium
- " neglectum

(Continued)

TABLE 2.7-43 (Continued)

Glenodinium spp.
Gonyaulax monospinosum
" triacantha
Gymnodinium fusca
" palustre
" vorticella
" spp.
Hemidinium sp.
Massartia sp.
Peridinium umbonatum
" wisconiense
Spirodinium hyalinum
Unid. dinoflagellata

Bacillarieae

Acnanthes coarctata
Asterionella formosa
Attheya zachariasi
Caloneis sp.
Cocconeis spp.
Cyclotella spp.
Diatoma vulgare
Eunotia spp.
Epithemia sp.
Fragilaria crotonensis
" elongata
Gyrosigma sp.
Melosira granulata
" varians

(Continued)

TABLE 2.7-43 (Continued)

Navicula spp.
Nitzschia acicularis
" acutissimus
" elongata
Pinnularia sp.
Rhizosolenia eriensis
Rhopalodia sp.
Surirella sp.
Synedra actinastroides
" capitata
" longissima
" ulna
Tabellaria flocculosa
Unid. diatoma
Euglenophyceae
Anisonema ovale
Astasia klebsii
Distigma proteus
Entosiphon sulcatus
Euglena acus
" agilis
" baltica
" deses
" ehrenbergii
" fusca
" gracilis
" pisciformis
" polymorpha
" sanguinea

(Continued)

TABLE 2.7-43 (Continued)

Euglena sciotensis
" spirogyra
" tripteris
" velata
" viridis
" spp.
Lepocinclis fusiformis
" ovum
" texta
" sp.
Metanema variable
Notosolenus apocamptus
" orbicularis
Peranema tricophorum
Petalomonas carinata
" mediocanellata
Phacus anacoleus
" longicauda
" pleuronectes
" pyrum
" stokesii
" triqueter
" spp.
Sphenomonas teres
Trachelomonas armata
" crebea
" cylindrica
" euchlora
" eurystoma

(Continued)

TABLE 2.7-43 (Continued)

Trachelomonas	hispida
"	obovata
"	urceolata
"	volvocina
"	spp.

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*Samples were collected between June 15 and September 15, 1956

TABLE 2.7-44

PHYTOPLANKTON AND ZOOPLANKTON COLLECTIONS

HOURLY TURBINE DISCHARGES IN CUBIC FEET PER SECOND FROM MELTON HILL DAM

DURING AQUATIC BASELINE SURVEY FIELD TRIPS*

Time**	March 26	May 29	June 28	July 22	July 23	Aug. 26	Sept. 24	Nov. 19	Jan. 16	April 14
2 am	0	0	0	0	0	0	0	0	0	10,000
3	0	0	0	0	0	0	0	0	0	10,000
4	0	0	0	0	0	0	0	0	0	10,000
5	0	0	0	0	0	0	0	0	0	10,000
6	6,660	0	0	0	0	0	0	0	0	10,000
7	9,600	0	0	0	0	0	0	0	5,500	10,900
8	17,600	0	0	0	0	2,410	0	2,600	11,000	10,100
9	17,600	0	0	0	0	8,090	0	8,800	11,000	10,300
10	17,800	8,522	0	0	0	8,270	0	7,800	11,000	10,100
11	17,800	9,970	8,300	0	0	8,690	0	8,100	11,000	10,500
12 noon	12,000	9,860	10,600	0	0	8,200	4,550	8,000	9,100	20,100
1	12,800	9,940	10,600	6,750	4,000	7,670	7,670	7,800	0	20,900
2	9,000	9,870	1,000	10,350	10,400	7,900	7,620	8,200	0	19,900
3	9,220	9,850	9,370	10,000	18,230	7,900	7,890	8,000	0	11,000
4	9,440	9,880	9,370	19,800	20,000	7,900	0	7,800	0	11,800
5	8,990	16,800	14,040	19,800	20,000	7,900	3,950	8,000	0	11,000
6	9,400	19,270	18,660	19,800	20,000	7,900	7,410	8,000	0	21,600
7	9,870	20,430	18,570	19,800	20,000	7,900	9,060	7,800	2,800	22,200
8	9,640	12,020	9,520	11,000	20,000	7,900	15,210	8,100	10,700	15,600
9	9,860	11,200	9,480	1,000	10,000	7,900	15,520	7,800	10,300	11,000
Daily Ave.	8,941	7,129	6,040	6,433	6,363	4,988	4,013	4,862	4,425	11,229

*Bracketed hours of discharge in cubic feet per second correspond to periods when plankton samples were collected from March 1974 to April 1975.

**Local Oak Ridge time

6

TABLE 2.7-45

PHYTOPLANKTON*

PERCENT COMPOSITION (BASED ON SPECIES NUMBER) - CLINCH RIVER

MARCH 26, 1974 TO APRIL 14, 1975

Date Collected	Division	Transect 1-Station 5		Transect 4-Station 3		Transect 5-Station 5	
		Sample A	Sample B	Sample A	Sample B	Sample A	Sample B
March 26	Chrysophyta	92.9	93.1	96.8	97.7	93.1	88.6
	Pyrrophyta	7.1	6.9	3.2	2.3	6.9	11.4
May 29	Chlorophyta	5.6	2.6	2.8	6.8	9.3	7.6
	Chrysophyta	74.4	66.1	96.5	66.9	88.6	78.4
	Cyanophyta	19.5	31.2	0.3	26.3	2.0	14.0
	Euglenophyta	0.2	0.0	0.2	0.0	0.1	0.0
	Pyrrophyta	0.3	0.1	0.2	0.0	0.0	0.0
June 27 & 28	Chlorophyta	3.2	4.1	12.5	3.8	10.7	10.0
	Chrysophyta	25.2	54.6	47.0	21.6	37.0	49.3
	Cyanophyta	71.5	41.0	40.4	74.5	52.2	40.0
	Euglenophyta	0.0	0.1	0.0	<0.1	<0.1	0.6
	Pyrrophyta	0.1	0.2	0.1	0.1	0.1	0.1
July 22**	Chlorophyta	9.5	13.4	5.9	6.2	6.4	10.9
	Chrysophyta	16.2	29.5	31.3	22.2	25.0	39.9
	Cyanophyta	74.1	56.8	62.7	71.4	68.4	48.9
	Euglenophyta	0.2	0.3	0.1	0.2	0.2	0.2
	Pyrrophyta	0.0	0.0	<0.1	0.0	0.0	0.1
August 26	Chlorophyta	28.8	25.4	34.1	18.6	15.5	29.5
	Chrysophyta	58.8	58.8	40.1	61.2	71.5	39.1
	Cyanophyta	11.8	15.6	25.7	20.1	13.0	31.1
	Euglenophyta	0.4	0.2	0.1	0.1	0.0	0.3
	Pyrrophyta	0.2	0.0	0.0	0.0	0.0	0.0

(Continued)

TABLE 2.7-45 (Continued)

Date Collected	Division	Transect 1-Station 5 Sample A	Transect 1-Station 5 Sample B	Transect 4-Station 3 Sample A	Transect 4-Station 3 Sample B	Transect 5-Station 5 Sample A	Transect 5-Station 5 Sample B
September 24	Chlorophyta	22.2	30.9	19.9	36.7	27.1	17.6
	Chrysophyta	26.6	39.8	50.2	57.3	48.8	40.8
	Cyanophyta	50.3	29.0	29.3	4.9	22.2	41.6
	Euglenophyta	0.0	0.0	0.0	1.1	1.2	0.0
	Pyrrophyta	0.9	0.3	0.6	0.0	0.7	0.0
November 19	Chlorophyta	7.9	10.4	7.7	8.7	10.4	10.9
	Chrysophyta	74.9	79.4	82.2	89.9	86.1	86.3
	Cyanophyta	17.2	10.2	9.9	1.2	3.2	2.8
	Euglenophyta	0.0	0.0	0.2	0.2	0.3	0.0
	Pyrrophyta	0.0	0.0	0.0	0.0	0.0	0.0
January 16	Chlorophyta	5.8	7.8	5.2	4.2	9.1	9.0
	Chrysophyta	44.3	59.7	75.9	51.2	61.4	63.4
	Cyanophyta	26.5	0.0	6.1	31.8	15.8	0.0
	Euglenophyta	0.6	0.6	0.5	0.0	0.0	0.4
	Pyrrophyta	22.8	31.9	12.3	6.5	13.7	27.2
April 14	Chlorophyta	6.9	7.7	15.6	9.3	17.6	6.6
	Chrysophyta	54.9	82.0	82.6	89.1	80.5	93.4
	Cyanophyta	38.2	0.0	0.0	0.0	0.0	0.0
	Pyrrophyta	0.0	10.3	1.8	1.6	1.9	0.0

*Each one liter sample was collected using a Van Dorn sampler, one foot below the water surface.

**Each one liter sample was collected by filling a liter polyethylene bottle, one foot below the water surface.

6

TABLE 2.7-46

PHYTOPLANKTON

FOUR MOST ABUNDANT* SPECIES ON EACH FIELD TRIP

COLLECTED IN THE CLINCH RIVER - MARCH 26, 1974 TO APRIL 14, 1975

Date Collected	1st Most Abundant	2nd Most Abundant	3rd Most Abundant	4th Most Abundant
March 26	Melosira ambigua**	Glenodinium penardiforme+	Melosira distans**	Synedra ulna**
May 26	Melosira ambigua**	Cyclotella glomerata**	Melosira herzogii**	Synedra acus var. radians**
June 27 & 28	Oscillatoria sp.++	Melosira ambigua**	Melosira herzogii**	Asterionella formosa**
July 22	Oscillatoria angustissima++	Melosira ambigua**	Melosira herzogii**	Oscillatoria amphibia++
August 26	Dinobryon sociale▽	Oscillatoria amphibia++	Cyclotella glomerata**	Melosira herzogii**
September 24	Oscillatoria angustissima++	Dinobryon divergens▽	Melosira herzogii**	Oscillatoria amphibia++
November 19	Melosira ambigua**	Cyclotella stelligera**	Melosira herzogii**	Oscillatoria amphibia++
January 16	Melosira ambigua**	Oscillatoria amphibia++	Cyclotella stelligera**	Glenodinium Borgei+
April 14	Melosira granulata**	Oscillatoria limosa++	Cyclotella glomerata**	Coscinodiscus lacustris**

6

*Abundant species were determined by the total number of organisms per liter on each field trip.

**Is a diatom

+Is a dinoflagellate

++Is a blue-green algae

▽Is a golden or yellow-brown algae

TABLE 2.7-47

PHYTOPLANKTON

NUMBER OF ORGANISMS COLLECTED DURING CLINCH RIVER BASELINE SURVEY

MARCH 1974 TO APRIL 1975

	Transect 1		Transect 4		Transect 5	
Date Collected	Sample A (No./l)	Sample B (No./l)	Sample A (No./l)	Sample B (No./l)	Sample A (No./l)	Sample B (No./l)
March 26	311,108	322,219	344,441	477,773	322,219	488,884
May 29	993,663	721,697	893,219	1,342,971	1,052,778	1,282,538
June 28	1,503,484	732,469	1,154,426	1,686,203	1,606,649	1,305,760
July 22	2,940,145	1,428,284	1,867,823	2,079,346	2,107,788	1,357,874
August 26	1,056,786	904,321	1,214,999	1,486,946	1,685,610	2,653,476
September 24	2,781,057	1,620,284	1,638,505	1,024,787	1,203,432	1,350,089
November 19	1,469,187	1,675,834	1,744,715	1,120,778	1,399,415	1,156,774
January 16	859,024	879,465	667,934	1,889,144	1,066,115	608,829
April 14	349,066	230,408	250,186	223,523	190,192	203,079

6

TABLE 2.7-48

PHYTOPLANKTON

DIVERSITY OF ORGANISMS COLLECTED DURING CLINCH RIVER BASELINE SURVEY

MARCH 1974 TO APRIL 1975

		Transect 1		Transect 4		Transect 5	
Date Collected	d̄	Sample A	Sample B	Sample A	Sample B	Sample A	Sample B
March 26		1.09	1.38	1.19	1.12	1.00	0.84
May 29	*	2.03	1.84	1.82	2.16	2.06	2.23
	**	1.90	1.78	1.82	1.95	1.99	2.06
June 28	*	1.34	1.90	2.22	1.08	1.95	2.01
	**	1.77	2.00	2.57	2.00	2.40	2.18
July 22	*	1.28	2.24	1.88	1.51	1.53	2.39
	**	1.16	2.14	1.83	1.42	1.45	2.28
August 8	*	2.74	2.76	2.78	2.44	2.30	2.58
	**	2.69	2.73	2.93	2.45	2.20	2.60
September 24	*	1.84	2.41	2.35	2.79	2.67	2.30
	**	2.47	2.49	2.51	2.79	2.77	2.44
November 19	*	2.07	1.99	1.95	1.92	2.01	1.91
	**	1.85	1.86	1.84	1.92	1.93	1.91
January 16	*	2.30	2.35	2.24	1.82	2.65	2.61
	**	2.36	2.35	2.14	1.88	2.63	2.61
April 14	*	1.89	2.37	1.73	1.69	2.36	1.89
	**	2.03	2.37	1.73	1.69	2.36	1.89

*Filamentous forms included in calculation of diversity

**Filamentous forms not included in calculation of diversity

6

TABLE 2.7-49

PHYTOPLANKTON SPECIES* COLLECTED IN THE CLINCH RIVER

MARCH 26, 1974 TO APRIL 14, 1975

Division	Class	Genus	Species
Chlorophyta (green algae)	Chlorophyceae	Actinastrum	gracillimum
		A.	Hantzschii
		Ankistrodesmus	Braunii
		A.	convolutus
		A.	falcatus
		A.	sp.
		A.	spiralis
		Cerasterias sp.	sp.
		Chlorella	sp.
		Chlorella type unicells	
		Coelastrum	microporum
		C.	sp.
		Cosmarium	sp.
		Crucigenia	fenestrata
		C.	sp.
		C.	tetrapedia
		Echinosphaerella	limnetica
		Eudorina	elegans

(Continued)

TABLE 2.7-49 (Continued)

Division	Class	Genus	Species	
Chlorophyta (green algae)	Chlorophyceae	Eudorina	sp.	
		Franceia	Droescheria (?)	6
		Golenkinia	paucispina	
		G.	sp.	
		Gonium	sp.	
		Kirchneriella	lunaris	
		Lagerheimia	sp.	
		Micractinium	pusillum	
		M.	sp.	
		Oöcystis	sp.	
		Pandorina	morum	
		Pediastrum	boryanum	
		P.	duplex	
		P.	integrum	
		P.	simplex	
		P.	tetras	
		Planktosphaera	gelatinosa	
		Scenedesmus	acuminatus	
		S.	Bernardii	

(Continued)

TABLE 2.7-49 (Continued)

Division	Class	Genus	Species	
Chlorophyta (green algae)	Chlorophyceae	Scenedesmus	bijuga	
		S.	dimorphus	
		S.	quadricauda	
		S.	sp.	
		Selenastrum	sp.	
		S.	Westii	6
		Spermatozoopsis	sp.	
		Spirogyra	sp.	
		Staurastrum	chaetoceras	
		Stichococcus	subtilus	
		Tetraëdron	minimum	
		T.	sp.	
		Tetrastrum	punclatum	
		Treubaria	setigerum	
		T.	sp.	
		Trochiscia	sp.	
		Volvocalian unicells		
		Chlorophyta germlings		
		Chlorophyta sp.		
		Chlorophyta unicells		

(Continued)

TABLE 2.7-49 (Continued)

Division	Class	Genus	Species	
Chrysophyta	Bacillariophyceae (diatoms)	Achnanthes	brevipes	
		A.	laterostrata (?)	6
		Amphiprora	ornata (?)	
		A.	sp.	
		Amphora	ovalis	
		Anomoeoneis	sphaerophora	
		Asterionella	formosa	
		Cocconeis	pediculus	
		C.	sp.	
		Coscinodiscus	lacustris	
		C.	Rothii	6
		Cyclotella	antiqua	
		C.	glomerata	
		C.	stelligera	
		C.	sp.	
		Cymbella	affinis	6
		C.	cistula	
		C.	sp.	
		C.	ventricosa	
		Diatoma	sp.	
		D.	vulgare	

(Continued)

TABLE 2.7-49 (Continued)

Division	Class	Genus	Species	
Chrysophyta	Bacillariophyceae (diatoms)	Eunotia	exigua	
		Fragilaria	brevistriata	
		F.	crotonensis	
		F.	intermedia	6
		F.	pinnata	6
		Gomphonema	olivaceum	
		G.	sp.	
		Gyrosigma	scalproides	
		Hannaea	arcus (?sp.)	
		Hantzschia	amphioxys	
		Melosira	ambigua	
		M.	Binderana	6
		M.	distans	
		M.	granulata	6
		M.	herzogii	
		M.	islandica	
		M.	sp.	
		M.	varians	
		Meridion	circulare	
		Navicula	cryptocephala	
		N.	exigua	6

(Continued)

TABLE 2.7-49 (Continued)

Division	Class	Genus	Species	
Chrysophyta	Bacillariophyceae (diatoms)	Navicula	Reinhardtii	6
		N.	sp.	
		Neidium	dubium	
		N.	incurvum	
		N.	sp.	
		Nitzschia	acicularis	6
		N.	amphibia	
		N.	holosatica (?sp.)	
		N.	parvula (?)	6
		N.	sigmoidea	
		N.	sp.	
		Opephora	martyi	
		Ophiocytium	sp.	
		Pinnularia	sp.	
		Rhizosolenia	sp.	
		Rhoicosphenia	curvata	
		Rhopalodia	gibberula	
		Stephanodiscus	astrea	6
		S.	dubius	
		S.	sp.	
		Surirella	brightwellii (?)	

(Continued)

TABLE 2.7-49 (Continued)

Division	Class	Genus	Species	
Chrysophyta	Bacillariophyceae (diatoms)	Surirella	ovata (?)	6
		Synedra	actinastroides	
		S.	acus	
		S.	acus var. radians	
		S.	nana	
		S.	ulna	
		S.	vaucheriae	
		Tabellaria	fenestrata	
		T.	flocculosa	
		T.	sp.	
		Immature diatoms		
	Chrysophyceae (golden or yellow-brown algae)	Dinobryon	bavaricum	
		D.	divergens	
		D.	sertularia	
		D.	sociale	
Cyanophyta (blue-green algae)	Cyanophyceae	Agmenellum	quadruplicatum	6
		A.	sp.	
		Anabaena	sp.	

(Continued)

TABLE 2.7-49 (Continued)

Division	Class	Genus	Species	
Cyanophyta (blue-green algae)	Cyanophyceae	Anacystis	marina	
		A.	montana	
		A.	thermalis forma thermalis	6
		Chroococcus	limneticus	
		C.	sp.	
		Dactylococcopsis	fascicularis	
		Gloeocapsa	sp.	
		Lyngbya	hieronymusii	
		Nostoc	sp.	
		Oscillatoria	amphibia	
		O.	anguina (?)	
		O.	angustissima	
		O.	limosa	
		O.	lutea	
		O.	ornata	
		O.	sancta	6
		O.	spp.	
		Spirulina	princeps	

(Continued)

TABLE 2.7-49 (Continued)

Division	Class	Genus	Species	
Euglenophyta (euglenoids)	Euglenophyceae	Euglena	sp.	
		Trachelomonas	sp.	
Pyrrophyta	Dinophyceae (dinoflagellates)	Ceratium	hirundinella	
		Glenodinium	Borgei	6
		G.	palustre	
		G.	penardiforme	
		G.	pulvisculus	6
		Peridinium	cinctum	

*Classification of the above organisms is based primarily on the following sources:

1. Ward, H. B., and Whipple, G. C., Freshwater Biology, second edition, John Wiley & Sons, Inc., New York, 1959.
2. Smith, G. M., The Freshwater Algae of the United States, second edition, McGraw-Hill Book Company, Inc., New York, 1950.

TABLE 2.7-50

PHYTOPLANKTON*

AVERAGE BIOMASS PER FIELD TRIP - CLINCH RIVER

JUNE 1974 TO APRIL 1975

Date	Chlorophyll a (mg/m^3)	Chlorophyll b (mg/m^3)	Chlorophyll c (mg/m^3)	Pheophytin a Content Ratio**
June 28, 1974	3.50	1.75	3.30	1.30
July 22, 1974	2.83	1.23	1.98	1.16
August 26, 1974	4.63	2.03	2.83	1.42
September 24, 1974	5.03	1.93	3.30	1.35
November 19, 1974	3.83	1.53	2.30	1.38
January 16, 1975	3.40	1.43	1.77	1.52
April 14, 1975	2.73	1.62	1.42	1.47

6

*Each one liter sample was collected using a Van Dorn sampler, one foot below the water surface.

**Before:after acidification OD663 ratio
-ratio of 1.7 indicates complete absence of pheophytin a
-ratio of 1.0 indicates presence of only pheophytin a (no chlorophyll a)

TABLE 2.7-51

ZOOPLANKTON SPECIES* COLLECTED IN THE CLINCH RIVER
MARCH 26, 1974 THROUGH APRIL 14, 1975

Phylum	Class	Family	Genus and Species
Arthropoda			
	Crustacea		
	(Order - Cladocera)		
		Bosminidae	
			Bosmina longirostris
		Chydoridae	
			Alona rectangula
			Chydorus sphaericus
			Chydorus sp.
			Pleuroxus sp.
		Daphnidae	
			Ceriodaphnia reticulata
			Daphnia ambigua
			Daphnia parvula
			Daphnia retrocurva
			Moina micrura
			Scapholebris kingi
		Leptodoridae	
			Leptodora kindtii
		Sididae	
			Diaphanosoma leuchtenbergianum
	(Order - Copepoda)		
	(Suborder - Calanoida)		
		Diaptomidae	
			Diaptomus pallidus
			Diaptomus (reighardi)
			Diaptomus sanguineus 6

(Continued)

TABLE 2.7-51 (Continued)

Phylum	Class	Family	Genus and Species	
Arthropoda				
	Crustacea			
	(Order - Copepoda)			
	(Suborder - Cyclopoida)			
		Cyclopidae		
			Cyclops bicuspidatus thomasi	
			Cyclops vernalis	
			Eucyclops agilis	
			Mesocyclops edax	
		Egasilidae		
			Ergasilus sp.	
	(Suborder - Harpacticoida)			
		Canthocamptidae		
			Bryocamptus zschokkei	6
			Elaphoidella bidens coronata	
	Insecta			
	(Order - Diptera)			
		Culicidae		
			Chaoborus sp.	
Rotifera				
	Bdelloidea			
		Habrotrochidae		
			Habrotrocha sp.	
		Philodinidae		
			Rotaria neptunia	6
	Monogononta			
		Asplanchnidae		
			Asplanchna amphora	
			Asplanchna priodonta	

(Continued)

TABLE 2.7-51 (Continued)

Phylum	Class	Family	Genus and Species	
Rotifera				
	Monogononta			
		Brachionidae		
			Brachionus angularis	
			Brachionus budapestinensis	
			Brachionus calyciflorus	
			Brachionus caudatus	
			Brachionus havanaensis	
			Brachionus quadridentata	
			Brachionus urceolaris	
			Euchlanis dilatata	
			Kellicottia bostoniensis	
			Keratella americana	
			Keratella cochlearis	
			Keratella earlinae	
			Keratella quadrata	6
			Keratella taurocephala	
			Mytilina sp.	
			Notholca acuminata	
			Platyias patulus	
			Platyias quadracornis	
			Trichotria sp.	
			Trichotria tetractis	
		Collothecidae		
			Collotheca pelagica	
		Conochilidae		
			Conochiloides coenobasis	6
			Conochiloides dossuarius	
			Conochilus unicornis	

(Continued)

TABLE 2.7-51 (Continued)

Phylum	Class	Family	Genus and Species	
Rotifera				
	Monogononta			
		Flosculariidae		
			Floscularia sp.	
		Gastropidae		
			Gastropus stylifer	
		Hexarthridae		
			Hexarthra sp.	
		Lecanidae		
			Lecane lunaris	6
			Lecane sp.	
			Monostyla (*lunaris?*)	
			Monostyla quadridentata	
			Monostyla quadrata	
		Notommatidae		
			Cephalodella sp.	
			Notommata sp.	
		Proalidae		
			Proales sp.	6
		Synchaetidae		
			Ploesoma sp.	
			Ploesoma truncatum	
			Polyarthra dolichoptera	
			Polyarthra euryptera	
			Polyarthra remata	
			Polyarthra vulgaris	
			Polyarthra spp.	6
			Synchaeta (*pectinata?*)	
			Synchaeta spp.	

(Continued)

TABLE 2.7-51 (Continued)

Phylum	Class	Family	Genus and Species
Rotifera			
	Monogononta		
		Testudinellidae	
			Filinia longiseta
			Filinia longispina
			Pompholyx sulcata
			Testudinella patina
		Trichocercidae	
			Trichocerca agnata
			Trichocerca cylindrica
			Trichocerca multicrinis
			Trichocerca similis
			Trichocerca sp.
Tardigrada			

*Classification of zooplankters is primarily based on Ward, H. B., and Whipple, G. C., *Fresh-Water Biology*, second edition, John Wiley & Sons, Inc., New York, 1959.

TABLE 2.7-52

ZOOPLANKTON - TOWING*

NUMBER PER LITER AT EACH SAMPLING STATION - CLINCH RIVER

COLLECTED MARCH 26, 1974 THROUGH APRIL 14, 1975

	Transect 1-Station 5		Transect 4-Station 3		Transect 5-Station 5		
Collection Date	Sample A (No./l)	Sample B (No./l)	Sample A (No./l)	Sample B (No./l)	Sample A (No./l)	Sample B (No./l)	Mean (No./l)
March 26	6.87	3.76	3.66	4.12	2.09	3.38	3.98
May 29	89.81	146.37	206.35	206.94	92.31	135.44	146.20
June 27	5.47	19.58	6.43	5.80	8.39	8.01	8.95
July 23	35.58	28.18	33.14	46.54	72.96	18.69	39.14
August 26	40.06	33.37	99.50	60.18	74.32	74.10	63.59
September 26	29.86	11.79	29.81	29.43	7.31	9.49	19.62
November 19	9.52	6.36	11.61	6.14	8.55	5.86	8.01
January 16	29.62	38.58	34.58	11.67	22.39	17.24	25.68
April 14	6.39	3.55	3.55	6.01	6.95	5.82	5.38
Mean	30.26		44.75		31.85		

6

*Duplicate (A and B) vertical tow samples using a No. 20 mesh, one-half meter plankton net with attached inside and outside flow meters were collected at each station.

TABLE 2.7-53

ZOOPLANKTON - PUMPING*

NUMBER PER LITER AT EACH SAMPLING STATION - CLINCH RIVER

COLLECTED MARCH 27 THROUGH JULY 23, 1974

	Transect 1-Station 5			Transect 4-Station 3			Transect 5-Station 5			
Collection Date	S (No./l)	M (No./l)	B (No./l)	S (No./l)	M (No./l)	B (No./l)	S (No./l)	M (No./l)	B (No./l)	Mean (No./l)
March 27	0.98	0.88	1.59	1.74	1.78	1.38	2.52	1.68	1.47	1.56
May 29	63.50	50.89	33.52	48.58	62.49	38.75	47.84	54.63	19.81	46.67
June 27	15.79	9.94	17.49	32.15	13.46	13.93	40.22	23.46	18.83	20.59
July 23	33.52	11.07	9.00	111.02	11.57	6.08	119.71	9.37	6.46	35.31
Mean	28.45	18.20	15.40	48.37	22.33	15.04	52.57	22.29	11.64	

*Each sample is a composite of two, 2-minute pumpings, the water being strained through a No. 20 plankton net. Surface (S), mid-depth (M) and bottom (B) samples were collected at each station.

TABLE 2.7-54

ZOOPLANKTON - SURFACE TOWS*

NUMBER PER LITER AT EACH SAMPLING STATION - CLINCH RIVER

COLLECTED SEPTEMBER 26, 1974 THROUGH APRIL 14, 1975

Collection Date	Transect 1-Station 5 (No./l)	Transect 4-Station 3 (No./l)	Transect 5-Station 5 (No./l)	Mean (No./l)
September 26	67.12	35.36	38.07	46.85
November 19	22.46	16.49	15.79	18.25
January 16	14.51	9.04	9.02	10.86
April 14	6.62	5.85	5.68	6.05
Mean	27.68	16.68	17.14	

6

*Slow-speed surface tow samples were obtained at each station using a No. 20 mesh, one-half meter plankton net with attached inside and outside flow meters.

TABLE 2.7-55

ZOOPLANKTON - PUMPING AND TOWING*
MEAN NUMBER PER LITER FOR EACH COLLECTION** - CLINCH RIVER
COLLECTED MARCH 26 THROUGH AUGUST 26, 1974

Species	March 26 Tow (No./l)	March 27 Pump (No./l)	May 29 Tow (No./l)	May 29 Pump (No./l)	June 27 Tow (No./l)	June 27 Pump (No./l)	July 23 Tow (No./l)	July 23 Pump (No./l)	Aug. 26 Tow (No./l)
ARTHROPODA									
Immature Bosmina longirostris	--	--	--	--	--	--	0.09	--	--
Bosmina longirostris	0.37	0.42	4.31	3.65	1.63	2.83	0.79	0.58	1.74
Chydorus sp.	--	--	--	--	--	<0.01	--	--	--
Pleuroxus sp.	--	--	<0.01	--	<0.01	--	--	--	--
Ceriodaphnia reticulata	--	--	--	--	--	--	--	<0.01	0.05
Daphnia ambigua	<0.01	<0.01	--	--	--	--	--	--	--
Daphnia parvula	--	--	0.08	0.05	0.01	0.03	--	--	--
Daphnia retrocurva	<0.01	<0.01	0.09	0.05	0.46	0.58	0.42	0.30	0.37
Moina micrura	--	--	--	--	--	--	--	--	0.34
Scapholeberis kingi	--	--	--	--	<0.01	--	--	--	--
Leptodora kindtii	--	--	0.03	0.03	0.19	0.12	--	--	0.21
Diaphanosoma leuchtenbergianum	0.02	0.01	0.31	0.24	1.43	1.66	0.41	0.19	0.83
Calanoid copepodids (immature)	<0.01	0.01	0.10	0.16	0.12	0.04	--	0.01	0.01
Diaptomus pallidus	<0.01	--	--	--	0.03	0.03	--	--	0.03
Diaptomus (reighardi)	--	--	--	--	--	--	0.03	--	--
Cyclopoid copepodids (immature)	0.06	0.04	0.67	0.53	0.24	0.31	0.30	0.21	0.67
Cyclops bicuspidatus thomasi	--	--	0.04	0.29	--	--	--	--	0.03
Cyclops vernalis	--	--	--	<0.01	0.08	0.03	0.02	<0.01	--
Eucyclops agilis	--	--	--	--	--	--	--	<0.01	--
Mesocyclops edax	--	--	--	--	<0.01	0.02	--	0.03	0.02
Ergasilus sp.	--	--	--	--	<0.01	--	--	--	--
Harpacticoid copepods	<0.01	<0.01	--	--	--	--	--	--	--
Elaphoidella bidens coronata	--	--	--	--	--	<0.01	--	--	--
Nauplii	1.10	0.70	0.69	0.54	0.46	0.84	1.21	1.45	1.73
Chaoborus sp.	--	--	0.01	--	0.02	0.02	0.02	0.03	0.03

(Continued)

6

TABLE 2.7-55 (Continued)

Species	March 26 Tow (No./l)	March 27 Pump (No./l)	May 29 Tow (No./l)	May 29 Pump (No./l)	June 27 Tow (No./l)	June 27 Pump (No./l)	July 23 Tow (No./l)	July 23 Pump (No./l)	Aug. 26 Tow (No./l)
ROTIFERA									
Asplanchna amphora	<0.01	--	--	--	--	--	--	--	2.88
Asplanchna priodonta	0.06	0.02	27.11	11.38	0.03	0.18	4.19	6.97	2.95
Brachionus angularis	0.07	<0.01	0.22	0.09	0.44	1.25	0.37	0.37	0.58
Brachionus budapestinensis	--	--	--	--	0.89	2.51	1.60	1.24	7.37
Brachionus calyciflorus	0.02	--	0.54	0.32	<0.01	<0.01	--	0.02	3.24
Brachionus caudatus	--	--	0.02	<0.01	0.01	<0.01	0.11	0.03	0.56
Brachionus havanaensis	--	--	--	--	--	--	0.04	--	--
Brachionus quadridentata	0.08	<0.01	0.05	0.05	--	--	--	--	0.01
Brachionus urceolaris	0.04	<0.01	--	--	--	--	--	--	--
Euchlanis dilatata	0.02	0.04	--	--	--	--	--	--	--
Kellicottia bostoniensis	0.07	<0.01	--	--	--	--	0.08	--	0.05
Keratella americana	--	--	9.65	3.99	--	--	--	--	--
Keratella cochlearis	0.09	0.01	3.65	1.38	0.64	1.15	0.72	0.22	1.50
Keratella earlinae	--	--	--	--	--	--	1.03	0.79	2.98
Mytilina sp.	--	--	--	--	<0.01	<0.01	--	--	--
Notholca acuminata	<0.01	--	--	--	--	--	--	--	--
Platyias patulus	--	--	--	--	--	--	--	--	--
Platyias quadracornis	<0.01	--	--	--	--	--	--	0.04	0.02
Trichotria sp.	0.01	--	--	--	--	--	--	--	--
Trichotra tetractis	0.03	--	--	--	--	--	--	--	--
Collotheca pelagica	0.34	0.08	0.19	0.03	0.08	0.30	0.63	0.24	0.44
Conochilus unicornis	--	--	69.44	15.24	0.08	0.31	11.87	9.28	20.95
Floscularia sp.	--	--	--	--	<0.01	--	--	--	--
Gastropus stylifer	--	--	--	--	0.42	0.89	0.44	0.30	1.35
Hexarthra sp.	--	--	0.10	--	--	--	0.12	--	--

(Continued)

6

TABLE 2.7-55 (Continued)

Species	March 26 Tow (No./l)	March 27 Pump (No./l)	May 29 Tow (No./l)	May 29 Pump (No./l)	June 27 Tow (No./l)	June 27 Pump (No./l)	July 23 Tow (No./l)	July 23 Pump (No./l)	Aug. 26 Tow (No./l)
ROTIFERA (Continued)									
Monostyla (*lunaris*?)	--	--	--	--	--	--	0.02	<0.01	--
Monostyla quadridentata	--	--	--	--	--	--	--	--	0.14
Monostyla quadrata	--		--	--	--	<0.01	--	--	--
Cephalodella sp.	0.01	0.01	--	--	<0.01	0.14	--	--	--
Notommata sp.	<0.01	<0.01	--	--	--	--	--	--	--
Ploesoma sp.	--	--	0.50	0.29	--	--	--	--	--
Ploesoma truncatum	--	--	--	--	0.66	2.18	0.82	0.82	1.13
Polyarthra dolichoptera	0.05	0.02	12.75	4.85	--	--	--	--	--
Polyarthra remata	--	--	--	--	--	--	1.00	--	0.44
Polyarthra spp. (*remata* + *vulgaris*)	--	--	--	--	--	--	--	2.93	--
Polyarthra vulgaris	--	0.01	5.64	0.06	0.51	2.84	6.05	--	5.50
Synchaeta (*pectinata*?)	1.36	0.02	8.95	3.38	0.32	1.54	6.68	--	--
Synchaeta spp.	--	--	--	--	--	--	--	8.72	4.52
Filinia longiseta	0.09	0.04	0.63	0.02	0.05	0.55	0.05	0.01	0.10
Filinia longispina	--	--	--	--	--	--	--	<0.01	--
Pompholyx sulcata	<0.01	--	--	--	--	--	--	--	--
Testudinella patina	0.02	0.02	--	--	--	--	--	--	--
Trichocerca cylindrica	--	--	--	--	--	--	--	--	0.73
Trichocerca multicrinis	<0.01	<0.01	0.06	--	--	--	--	0.11	--
Trichocerca similis	--	--	0.28	0.03	0.02	0.04	0.05	0.26	0.12
Trichocerca sp.	--	--	--	--	0.09	0.15	0.05	0.11	--
Bdelloid rotifer	<0.01	0.02	0.02	--	--	--	--	--	--
Habrotrocha sp.	--	--	0.05	--	--	--	--	--	--
TARDIGRADA	0.04	0.04	0.05	--	<0.01	--	--	--	--
Total	3.95	1.51	146.23	46.65	8.91	20.54	39.21	35.26	63.62

*Each pump sample is a composite of two, 2-minute pumpings, the water being strained through a No. 20 plankton net. Surface, mid-depth and bottom samples were collected at each station. Each vertical tow sample was collected using a No. 20 mesh, one-half meter plankton net with attached inside and outside flow meters.

**The values in this table represent the mean number of organisms of each species collected at all sampling stations during one field trip.

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TABLE 2.7-56

ZOOPLANKTON - TOWING*

MEAN NUMBER PER LITER FOR EACH COLLECTION** - CLINCH RIVER

COLLECTED SEPTEMBER 26, 1974 THROUGH JANUARY 14, 1975

Species	Sept. 26 Tow (No./l)	Sept. 26 Surf. Tow (No./l)	Nov. 19 Tow (No./l)	Nov. 19 Surf. Tow (No./l)	Jan. 16 Tow (No./l)	Jan. 16 Surf. Tow (No./l)	Apr. 14 Tow (No./l)	Apr. 14 Surf. Tow (No./l)
ARTHROPODA								
Bosmina longirostris	0.77	0.74	1.25	0.88	1.58	0.31	2.44	2.60
Alona rectangula	--	--	<0.01	<0.01	--	--	--	--
Ceriodaphnia reticulata	<0.01	--	--	--	--	--	--	--
Daphnia parvula	0.04	--	--	--	0.01	<0.01	--	--
Daphnia retrocurva	1.22	0.03	<0.01	--	0.02	<0.01	0.02	0.02
Immature Daphnia	--	--	<0.01	--	0.06	0.04	--	--
Leptodora kindtii	0.04	<0.01	0.01	--	--	--	--	--
Diaphanosoma leuchtenbergianum	1.19	0.35	<0.01	<0.01	--	--	<0.01	0.01
Calanoid copepodids (immature)	0.14	<0.01	0.02	0.01	0.06	<0.01	0.02	0.01
Diaptomus pallidus	--	--	<0.01	--	0.01	--	--	--
Cyclopoid copepodids (immature)	0.82	0.46	0.04	0.02	0.22	0.09	0.08	0.09
Cyclops bicuspidatus thomasi	--	--	--	--	0.01	--	0.01	0.02
Cyclops vernalis	0.11	0.06	<0.01	<0.01	--	--	--	--
Eucyclops agilis	--	--	--	--	--	<0.01	--	--
Mesocyclops edax	0.04	0.01	--	--	--	--	--	--
Nauplii	2.71	2.29	0.37	0.33	2.00	1.03	1.68	1.92
Chaoborus sp.	--	--	--	--	--	<0.01	--	--
Bryocamptus zschokkei	--	--	--	--	--	--	<0.01	--
Chydorus sphaericus	--	--	--	--	--	--	<0.01	--
Diaptomus sanguineus	--	--	--	--	--	--	<0.01	<0.01
Chydorid	--	--	--	--	--	--	--	<0.01
ROTIFERA								
Asplanchna amphora	0.07	0.08	--	--	<0.01	<0.01	--	--
Asplanchna priodonta	0.06	0.10	0.08	0.03	--	--	0.30	0.20
Brachionus angularis	0.07	0.22	--	<0.01	--	--	--	--
Brachionus budapestinensis	0.27	0.49	0.01	--	--	--	--	--
Brachionus calyciflorus	0.01	0.05	<0.01	<0.01	0.03	0.02	--	--
Brachionus caudatus	0.11	0.23	--	0.01	--	--	--	--
Brachionus urceolaris	--	--	--	--	--	--	0.01	<0.01
Euchlanis dilatata	--	--	--	--	<0.01	<0.01	--	--
Kellicottia bostoniensis	--	--	0.01	0.02	<0.01	<0.01	--	<0.01
Keratella cochlearis	0.26	7.01	0.95	5.13	0.13	0.28	0.03	0.08
Keratella earlinae	1.79	11.97	0.30	0.51	0.10	0.10	0.06	0.14
Keratella quadrata	--	--	<0.01	--	--	--	--	--

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(Continued)

TABLE 2.7-56 (Continued)

Species	Sept. 26 Tow (No./l)	Sept. 26 Surf. Tow (No./l)	Nov. 19 Tow (No./l)	Nov. 19 Surf. Tow (No./l)	Jan. 16 Tow (No./l)	Jan. 16 Surf. Tow (No./l)	Apr. 14 Tow (No./l)	Apr. 14 Surf. Tow (No./l)
ROTIFERA (Continued)								
Keratella taurocephala	--	<0.01	--	--	--	--	--	--
Trichotria sp.	--	--	--	--	--	--	--	<0.01
Trichotria tetractis	--	--	--	--	0.01	<0.01	<0.01	0.01
Collotheca pelagica	0.13	0.30	1.88	2.01	0.44	0.06	0.04	0.06
Conochiloides coenobasis	--	--	0.01	0.17	--	--	--	--
Conochiloides dossuarius	0.06	0.13	--	--	--	--	--	--
Conochilus unicornis	0.41	1.62	--	--	--	--	--	<0.01
Gastropus stylifer	1.76	3.42	--	--	--	--	--	--
Hexarthra sp.	<0.01	0.03	--	--	--	--	--	--
Lecane sp.	<0.01	0.02	--	--	--	<0.01	<0.01	--
Monostyla (lunaris?)	--	--	<0.01	<0.01	<0.01	<0.01	--	--
Cephalodella sp.	--	--	0.01	--	--	<0.01	--	--
Rotaria neptunia	--	--	--	--	--	--	<0.01	--
Proales sp.	--	--	--	<0.01	--	--	--	--
Ploesoma truncatum	0.13	0.30	0.02	0.01	--	--	<0.01	<0.01
Polyarthra euryptera	0.01	0.02	--	--	--	--	--	--
Polyarthra remata	0.37	4.73	0.51	2.51	--	--	0.04	0.02
Polyarthra spp.	--	--	--	--	0.58	0.27	--	--
Polyarthra spp. (remata + vulgaris)	3.06	--	--	--	--	--	--	--
Polyarthra vulgaris	3.44	10.95	1.04	2.70	--	--	0.02	0.05
Synchaeta (pectinata?)	--	--	--	--	17.37	7.14	--	--
Synchaeta spp.	0.42	0.66	1.42	3.79	2.89	1.37	0.46	0.76
Filinia longiseta	0.03	0.22	--	--	0.14	0.06	0.01	<0.01
Trichocerca agnata	<0.01	0.06	0.01	0.03	--	--	--	--
Trichocerca cylindrica	0.03	0.09	--	0.02	--	--	--	--
Trichocerca multicrinis	--	--	--	--	--	--	--	<0.01
Trichocerca similis	0.05	0.16	--	--	--	--	--	--
Trichocerca sp.	--	--	--	--	--	--	0.10	--
Bdelloid	--	--	--	<0.01	<0.01	<0.01	<0.01	0.01
Habrotrocha sp.	--	0.02	--	--	--	--	<0.01	<0.01
Lecane lunaris	--	--	--	--	--	--	<0.01	--
TARDIGRADA	--	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.01
Total	19.62	46.82	8.04	18.27	25.71	10.91	5.45	6.11

*Each vertical tow sample was collected using a No. 20 mesh, one-half meter plankton net with attached inside and outside flow meters. Same equipment was used for the slow-speed surface tows.

**The values in this table represent the mean number of organisms of each species collected at all sampling stations during one field trip.

TABLE 2.7-57

ZOOPLANKTON - SURFACE TOWS*

MOST ABUNDANT ORGANISMS ON EACH SAMPLING DATE - CLINCH RIVER

COLLECTED SEPTEMBER 26, 1974 THROUGH APRIL 14, 1975

Collection Date	Cladocera	Copepoda	Rotifera
September 26	*Bosmina longirostris* *Diaphanosoma leuchtenbergianum*	Nauplius larva Cyclopoid copepodid (immature)	*Keratella earlinae* *Polyarthra vulgaris* *Keratella cochlearis*
November 19	*Bosmina longirostris*	Nauplius larva	*Keratella cochlearis* *Synchaeta* spp. *Polyarthra vulgaris*
January 16	*Bosmina longirostris* Immature *Daphnia*	Nauplius larva Cyclopoid copepodid (immature)	*Synchaeta pectinata* *Synchaeta* spp.
April 14	*Bosmina longirostris*	Nauplius larva Cyclopoid copepodid (immature)	*Synchaeta* spp. *Asplanchna priodonta* *Keratella earlinae*

6

*Slow-speed surface tow samples were collected at each station using a No. 20 mesh, one-half meter plankton net with attached inside and outside flow meters.

TABLE 2.7-58

ZOOPLANKTON - TOWING*

MOST ABUNDANT ORGANISMS ON EACH SAMPLING DATE - CLINCH RIVER

COLLECTED MARCH 26, 1974 THROUGH APRIL 14, 1975

Collection Date	Cladocera	Copepoda	Rotifera
March 26	Bosmina longirostris	Nauplius larva	Synchaeta (pectinata ?) Collotheca pelagica
May 29	Bosmina longirostris Diaphanosoma leuchtenbergianum	Nauplius larva Cyclopoid copepodid (immature)	Conochilus unicornis Asplanchna priodonta Polyarthra dolichoptera
June 27	Bosmina longirostris Diaphanosoma leuchtenbergianum Daphnia retrocurva	Nauplius larva Cyclopoid copepodid (immature)	Ploesoma truncatum Synchaeta (pectinata ?) Polyarthra vulgaris
July 23	Bosmina longirostris Daphnia retrocurva Diaphanosoma leuchtenbergianum	Nauplius larva	Conochilus unicornis Synchaeta (pectinata ?) Polyarthra vulgaris
August 26	Bosmina longirostris Diaphanosoma leuchtenbergianum	Nauplius larva Cyclopoid copepodid (immature)	Conochilus unicornis Brachionus budapestinensis Polyarthra vulgaris
September 26	Daphnia retrocurva Diaphanosoma leuchtenbergianum Bosmina longirostris	Nauplius larva Cyclopoid copepodid (immature)	Polyarthra vulgaris Keratella earlinae Gastropus stylifer
November 19	Bosmina longirostris	Nauplius larva Cyclopoid copepodid (immature)	Collotheca pelagica Synchaeta spp. Polyarthra vulgaris
January 16	Bosmina longirostris Immature Daphnia	Nauplius larva Cyclopoid copepodid (immature)	Synchaeta pectinata Synchaeta spp. Polyarthra spp.
April 14	Bosmina longirostris Daphnia retrocurva	Nauplius larva Cyclopoid copepodid (immature)	Synchaeta spp. Asplanchna priodonta Trichotria sp.

6

*Each vertical tow sample was collected using a No. 20 mesh, one-half meter plankton net with attached inside and outside flow meters.

TABLE 2.7-59

ZOOPLANKTON - PUMPING*
MOST ABUNDANT ORGANISMS ON EACH SAMPLING DATE - CLINCH RIVER
COLLECTED MARCH 27 THROUGH JULY 23, 1974

Collection Date	Cladocera	Copepoda	Rotifera
March 27	Bosmina longirostris	Nauplius larva	--
May 29	Bosmina longirostris Diaphanosoma leuchtenbergianum	Nauplius larva Cyclopoid copepodid (immature)	Conochilus unicornis Asplanchna priodonta
June 27	Bosmina longirostris Diaphanosoma leuchtenbergianum	Nauplius larva Cyclopoid copepodid (immature)	Polyarthra vulgaris Brachionus budapestinensis Ploesoma truncatum
July 23	Bosmina longirostris Daphnia retrocurva Diaphanosoma leuchtenbergianum	Nauplius larva Cyclopoid copepodid (immature)	Conochilus unicornis Synchaeta sp. Asplanchna priodonta

*Each pump sample is a composite of two, 2-minute pumpings, the water being strained through a No. 20 plankton net. Surface, mid-depth and bottom samples were collected at each station.

TABLE 2.7-60

ZOOPLANKTON - TOWING*

SUMMARY OF DIVERSITY INDICES - CLINCH RIVER

COLLECTED MARCH 26, 1974 THROUGH APRIL 14, 1975

Collection Date	Transect 1-Station 5		Transect 4-Station 3		Transect 5-Station 5		Mean
	Sample A	Sample B	Sample A	Sample B	Sample A	Sample B	
March 26	1.65	1.66	1.73	1.76	1.87	2.07	1.79
May 29	1.76	1.64	1.69	1.67	1.52	1.71	1.67
June 27	2.29	2.28	2.25	2.20	2.36	2.52	2.32
July 23	2.12	2.14	1.99	2.03	1.86	1.95	2.02
August 26	2.37	2.36	2.41	2.36	2.32	2.20	2.34
September 26	2.29	2.17	2.19	1.75	2.25	2.38	2.17
November 19	1.93	1.85	1.93	1.99	1.86	1.88	1.91
January 16	0.70	0.79	0.97	0.99	1.22	1.11	0.96
April 14	0.97	0.89	0.90	1.17	1.01	1.19	1.02
Mean	1.77		1.78		1.85		

6

*Duplicate (A and B) vertical tow samples using a No. 20 mesh, one-half meter plankton net with attached inside and outside flow meters were collected at each station.

TABLE 2.7-61

ZOOPLANKTON - PUMPING*

SUMMARY OF DIVERSITY INDICES - CLINCH RIVER

COLLECTED MARCH 27 THROUGH JULY 23, 1974

	Transect 1-Station 5			Transect 4-Station 3			Transect 5-Station 5			
Collection Date	S	M	B	S	M	B	S	M	B	Mean
March 27	1.44	0.54	1.22	1.49	1.95	1.59	1.51	1.08	1.47	1.37
May 29	1.67	1.79	1.85	1.96	1.78	1.82	1.79	1.91	1.77	1.82
June 27	2.47	2.24	2.20	2.18	2.46	2.53	2.13	2.16	2.33	2.30
July 23	1.78	2.34	2.08	1.78	2.41	2.32	1.61	2.54	2.49	2.15
Mean	1.84	1.73	1.84	1.85	2.65	2.07	1.76	1.92	2.02	

*Each sample is a composite of two, 2-minute pumpings, the water being strained through a No. 20 plankton net. Surface (S), mid-depth (M) and bottom (B) samples were collected at each station.

TABLE 2.7-62

ZOOPLANKTON - SURFACE TOWS*

SUMMARY OF DIVERSITY INDICES - CLINCH RIVER

COLLECTED SEPTEMBER 26, 1974 THROUGH APRIL 14, 1975

Collection Date	Transect 1-Station 5	Transect 4-Station 3	Transect 5-Station 5	Mean
September 26, 1974	1.93	1.97	2.01	1.97
November 19, 1974	1.84	1.86	1.84	1.85
January 16, 1975	0.97	1.01	0.88	0.95
April 14, 1975	0.96	1.15	1.44	0.18
Mean	1.42	1.50	1.54	

6

*Slow-speed surface tows were obtained at each station using a No. 20 mesh, one-half meter plankton net with attached inside and outside flow meters.

TABLE 2.7-63

ZOOPLANKTON COLLECTED BY THE TVA[55] AT CLINCH RIVER MILE 17.1 ON JULY 26, 1973*

Species	No./l
ROTIFERA	
Asplanchna sp.	2.98
Brachionus budapestinensis	2.61
Brachionus caudatus	1.13
Brachionus angularis	2.93
Conochiloides sp.	8.02
Conochilus unicornis	12.40
Filinia sp.	0.32
Keratella cochlearis	0.86
Keratella crassa	3.11
Keratella earlinae	0.41
Keratella americana	0.05
Ploesoma sp.	12.98
Polyarthra sp.	11.90
Synchaeta sp.	30.83
Trichocerca sp.	0.23
Collotheca sp.	0.72
Epiphanes macroura	0.05
ARTHROPODA - Cladocera	
Bosmina longirostris	12.26
Ceriodaphnia lacustris	0.32
Ceriodaphnia sp.	0.41
Daphnia retrocurva	0.18
Daphnia sp.	0.54
Diaphanosoma leuchtenbergianum	26.15

(Continued)

TABLE 2.7-63 (Continued)

Species	No./l
ARTHROPODA - Cladocera (cont.)	
Ilyocryptus sordidus	0.05
Leydigia quadrangularis	0.05
Leptodora kindtii	0.27
Moina micrura	0.05
Moina sp.	0.05
Sida crystallina	0.02
ARTHROPODA - Copepoda	
Calanoid (immature)	0.81
Diaptomus pallidus	0.18
Cyclopoid (immature)	0.68
Cyclops bicuspidatus thomasi	<0.01
Cyclops vernalis	0.05
Mesocyclops edax	0.05
Nauplii	5.68
Total	139.25

*Samples collected by oblique tow

TABLE 2.7-64

PERIPHYTON

TOTAL NUMBER OF ORGANISMS PER SQUARE CENTIMETER AT EACH SAMPLING STATION

COLLECTED IN THE CLINCH RIVER - MARCH 26, 1974 - MAY 14, 1975

Date Collected	Transect 1		Transect 4		Transect 5		Mean
	Sample A (No./cm^2)	Sample B (No./cm^2)	Sample A (No./cm^2)	Sample B (No./cm^2)	Sample A (No./cm^2)	Sample B (No./cm^2)	
March 26 & 27	151,544	188,854	85,616	68,284	89,401	88,327	112,004
May 1*	**	**	876,063	717,048	711,884	629,437	733,609
June 24	1,229,625	972,341	971,598	674,228	1,589,376	1,625,426	1,177,098
August 9	1,684,933	1,161,105	1,879,116	1,828,109	2,688,137	2,181,228	1,903,771
October 23	2,156,208	2,478,104	4,294,430	10,429,108	2,121,314	2,253,406	3,955,428
January 15	433,086	696,786	1,645,426	2,460,243	697,035	809,859	1,123,739
May 14	475,306	509,097	1,143,204	961,973	1,439,015	1,160,736	948,222

6

*Samplers exposed for two week period

**No samples were collected at this transect due to inability to recover periphyton samplers.

TABLE 2.7-65

PERIPHYTON SPECIES* COLLECTED IN THE CLINCH RIVER
MARCH 26, 1974 TO MAY 14, 1975

Division	Class	Genus	Species	
Chlorophyta (green algae)	Chlorophyceae	*Ankistrodesmus*	*falcatus*	
		A.	sp.	
		A.	*spiralis*	6
		Chaetophora	*pisiformis*	
		Chaetospheridium	*pringsheimii*	
		Chlorella	sp.	
		Chorella like unicells		
		Cladophora	sp.	
		Closterium	sp.	
		Micractinium	*pusillum*	
		Oedogonium	sp.	
		Pandorina	*morum*	
		Pediastrum	*boryanum*	
		P.	*duplex*	
		Rhizoclonium	*fontanum*	
		Scenedesmus	*acuminatus*	
		S.	*Bernardii*	

(Continued)

TABLE 2.7-65 (Continued)

Division	Class	Genus	Species	
Chlorophyta (green algae)	Chlorophyceae	Scenedesmus	bijuga	
		S.	dimorphus	
		S.	quadricauda	
		S.	sp.	
		Selenastrum	Westii	6
		Spermatozoopsis	sp.	
		Spirogyra	sp.	6
		Stigeoclonium	lubricum	
		S.	sp.	
		S.	subsecundum	6
		S.	tenue	
		Tetraëdron	regulare	
		Chlorphyta filaments		
		Chlorophyta germlings		
		Chlorophyta germlings of filamentous sp.		
		Chlorophyta sp.		
		Volvocalian unicells		
Chrysophyta	Bacillariophyceae (diatoms)	Achnanthes	brevipes	
		A.	lanceolata var. haynaldii	

(Continued)

TABLE 2.7-65 (Continued)

Division	Class	Genus	Species	
Chrysophyta	Bacillariophyceae (diatoms)	Achnanthes	sp.	
		Amphora	coffaeiformis	
		A.	ovalis	
		Anomoeoneis	sphaerophora	6
		A.	sp.	
		Asterionella	formosa	
		Caloneis	amphisbaena	
		C.	sp.	
		Cocconeis	diminuta (?)	
		C.	pediculus	6
		C.	sp.	
		Coscinodiscus	lacustris	
		C.	Rothii	6
		Cyclotella	glomerata	
		C.	Meneghiniana	
		C.	sp.	6
		C.	stelligera	
		Cymatopleura	solea	
		Cymbella	affinis	

(Continued)

TABLE 2.7-65 (Continued)

Division	Class	Genus	Species	
Chrysophyta	Bacillariophyceae (diatoms)	Cymbella	cistula	
		C.	prostrata	6
		C.	sp.	
		Diatoma	anceps	
		D.	sp.	
		D.	vulgare	
		Eunotia	exigua	
		Fragilaria	arcus	
		F.	brevistriata	
		F.	capucina	6
		F.	crotonensis	
		F.	intermedia	6
		F.	leptostauron (?)	
		F.	sp.	
		Frustulia	rhomboides	
		Gomphonema	acuminatum	
		G.	angustatum	
		G.	augur	
		G.	constrictum	

(Continued)

TABLE 2.7-65 (Continued)

Division	Class	Genus	Species	
Chrysophyta	Bacillariophyceae (diatoms)	Gomphonema	olivaceum	
		G.	sp.	
		Gyrosigma	acuminatum	
		G.	attenuatum	
		G.	scalproides	
		G.	sp.	
		G.	stiligilis (?)	6
		G.	terryanum	6
		Melosira	ambigua	
		M.	Binderana	6
		M.	granulata	6
		M.	herzogii	
		M.	varians	
		Meridion	circulare	
		M.	sp.	6
		Navicula	cryptocephala	
		N.	peregrina	
		N.	sigmoidea	
		N.	sp.	

(Continued)

TABLE 2.7-65 (Continued)

Division	Class	Genus	Species	
Chrysophyta	Bacillariophyceae (diatoms)	Neidium	sp.	
		Nitzschia	amphibia	6
		N.	filiformis	
		N.	holosatica (? sp.)	
		N.	linearis	
		N.	sigmoidea	
		N.	sp.	
		N.	tryblionella var. victoriae	
		Opephora	martyi	
		O.	sp.	
		Pinnularia	gibba	
		Rhopalodia	gibberula	
		Stephanodiscus	astrea	6
		S.	niagarae	
		Surirella	ovata	6
		S.	sp.	
		Synedra	actinastroides	
		S.	acus	
		S.	acus var. radians	

(Continued)

TABLE 2.7-65 (Continued)

Division	Class	Genus	Species	
Chrysophyta	Bacillariophyceae (diatoms)	Synedra	nana	
		S.	pulchella	6
		S.	tabulata	
		S.	ulna	
		S.	ulna var. oxyrhynchus	
		S.	vaucheriae	
		Tabellaria	fenestrata	
		T.	sp.	
	Chrysophyceae (golden or yellow-brown algae)	Dinobryon	divergens	
		D.	sertularia	
Cyanophyta (blue-green algae)	Cyanophyceae	Agmenellum	quadruplicatum	
		A.	sp.	
		Anacystis	marina	
		A.	montana	
		A.	thermalis	
		Chroococcus	sp.	
		C.	turgidus	
		C.	varius	

(Continued)

TABLE 2.7-65 (Continued)

Division	Class	Genus	Species	
Cyanophyta (blue-green algae)	Cyanophyceae	Lyngbya	aestaurii	
		L.	lagerheimii	
		L.	nana	6
		L.	sp.	
		L.	subtilis	
		Microcystis	sp.	
		Nodularia	harveyana	
		N.	spumigena	
		Nostoc	sp.	
		Oscillatoria	amphibia	
		O.	angustissima	
		O.	articulata	
		O.	chalybea	
		O.	curviceps	6
		O.	formosa	
		O.	geminata	
		O.	lacustris	6
		O.	ornata	
		O.	princeps	

(Continued)

TABLE 2.7-65 (Continued)

Division	Class	Genus	Species	
Cyanophyta (blue-green algae)	Cyanophyceae	Oscillatoria	proboscidea	6
		O.	prolifica	
		O.	sancta	
		O.	sp.	
		hormogonia		
Euglenophyta (euglenoids)	Euglenophyceae	Euglena	sp.	
Pyrrophyta	Dinophyceae (dinoflagellates)	Glenodinium	Borgei	6
		G.	palustre	
		G.	penardiforme	
		Peridinium	cinctum	6

*Classification of periphyton is based primarily on the following sources:

1. Ward, H. B., and Whipple, G. C., Fresh-Water Biology, second edition, John Wiley & Sons, Inc., New York, 1959.
2. Smith, G. M., The Fresh-Water Algae of the United States, second edition, McGraw-Hill Book Company, Inc., New York, 1950.

TABLE 2.7-66

PERIPHYTON

DIVERSITY OF ORGANISMS COLLECTED DURING CLINCH RIVER BASELINE SURVEY

MARCH 1974 TO MAY 1975

		Transect 1		Transect 4		Transect 5	
Date Collected	$\bar{d}$	Sample A	Sample B	Sample A	Sample B	Sample A	Sample B
March 26 and 27	*	2.09	1.94	2.13	1.99	2.02	1.97
	**	2.09	1.94	2.12	1.99	2.02	1.97
May 1	*	--+	--+	2.08	2.44	2.69	2.69
	**	--+	--+	2.30	2.40	2.56	2.54
June 24	*	1.56	0.79	0.93	1.32	0.96	1.21
	**	1.13	0.37	0.47	1.03	0.49	1.92
August 9	*	1.47	1.51	1.82	1.32	1.99	1.46
	**	1.34	1.29	1.58	1.01	1.67	1.01
October 23	*	1.24	1.17	2.00	0.85	1.51	2.32
	**	2.75	2.81	2.04	2.42	2.30	2.60
January 15	*	2.59	2.36	2.49	2.62	2.28	2.17
	**	2.47	2.36	2.38	2.65	2.11	1.96
May 14	*	2.49	2.47	2.35	2.77	1.96	2.38
	**	2.62	2.44	2.60	2.76	2.72	2.71

6

*Filamentous forms included in calculation of diversity

**Filamentous forms not included in calculation of diversity

+Samples could not be located

TABLE 2.7-67

PERIPHYTON

PERCENT COMPOSITION (BASED ON SPECIES NUMBER) - CLINCH RIVER COLLECTED MARCH 26, 1974 TO MAY 14, 1975

	Transect 1		Transect 4		Transect 5	
	Sample A	Sample B	Sample A	Sample B	Sample A	Sample B
March 26 & 27						
Chlorophyta	0.0	0.0	0.0	0.0	7.9	4.4
Chrysophyta	99.9	100.0	84.5	100.0	92.0	95.6
Cyanophyta	0.0	0.0	15.3	0.0	0.0	0.0
Euglenophyta	0.0	0.0	< 0.1	0.0	0.0	0.0
Pyrrophyta	0.1	0.0	< 0.1	0.0	0.1	0.0
May 1						
Chlorophyta	*	*	19.5	22.7	27.1	22.6
Chrysophyta	*	*	42.1	52.7	56.8	61.3
Cyanophyta	*	*	38.3	24.5	16.1	15.8
Euglenophyta	*	*	0.0	0.0	0.0	0.0
Pyrrophyta	*	*	< 0.1	< 0.1	0.0	0.3
June 24						
Chlorophyta	0.1	0.1	1.1	1.5	0.1	0.6
Chrysophyta	49.5	85.9	70.1	60.7	65.2	30.3
Cyanophyta	50.4	14.0	28.8	37.8	34.7	69.1
Euglenophyta	< 0.1	< 0.1	0.0	0.0	0.0	0.0
Pyrrophyta	< 0.1	0.0	0.0	0.0	0.0	0.0
August 9						
Chlorophyta	2.2	7.9	8.9	12.2	23.0	17.2
Chrysophyta	56.4	70.7	44.6	53.5	43.9	47.6
Cyanophyta	41.3	21.4	46.5	34.2	33.1	35.2
Euglenophyta	< 0.1	0.0	0.0	< 0.1	0.0	0.0
Pyrrophyta	0.0	0.0	0.0	0.0	0.0	0.0
October 23						
Chlorophyta	1.8	2.1	19.7	3.9	6.7	32.6
Chrysophyta	18.5	17.1	17.2	6.8	30.9	31.8
Cyanophyta	79.7	80.8	63.1	89.3	62.4	35.6
Euglenophyta	0.0	0.0	0.0	0.0	0.0	0.0
Pyrrophyta	0.0	0.0	0.0	0.0	0.0	0.0
January 15						
Chlorophyta	0.9	2.2	18.2	0.4	6.7	2.2
Chrysophyta	83.0	97.6	55.7	52.0	83.6	81.1
Cyanophyta	16.0	0.0	25.8	47.4	8.8	15.8
Euglenophyta	0.0	0.0	0.0	0.0	0.0	0.0
Pyrrophyta	0.1	0.2	0.3	0.2	0.9	0.9
May 14						
Chlorophyta	6.4	14.4	3.6	5.6	3.1	6.8
Chrysophyta	65.5	85.2	50.6	72.8	43.9	56.4
Cyanophyta	28.0	0.4	45.5	21.0	53.0	36.8
Euglenophyta	0.0	0.0	0.0	<0.1	0.0	0.0
Pyrrophyta	0.1	<0.1	0.3	0.6	<0.1	<0.1

*No samples were collected at this transect due to inability to recover periphyton samplers.

6

TABLE 2.7-68

PERIPHYTON

MEAN NUMBER OF ORGANISMS PER SQUARE CENTIMETER ON EACH FIELD TRIP

COLLECTED IN THE CLINCH RIVER - MARCH 26, 1974-MAY 14, 1975

Date Collected	Chlorophyta (No./cm^2)	Chrysophyta (No./cm^2)	Cyanophyta (No./cm^2)	Euglenophyta (No./cm^2)	Pyrrophyta (No./cm^2)	Total (No./cm^2)
March 26 & 27	1,822	107,914	2,173	20	75	112,004
May 1	167,313	384,342	181,322	0	633	733,609
June 24	5,432	677,327	494,175	123	41	1,177,098
August 9	252,256	967,917	683,454	144	0	1,903,771
October 23	369,818*	607,695	2,977,915	0	0	3,955,428
January 15	65,597	745,654	308,376	0	4,112	1,123,739
May 14	53,627	551,685	341,099	41	1,770	948,222

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*In addition to the number of organisms per square centimeter indicated, there were also several clumps of filamentous green algae which could not be broken apart, and therefore, not enumerated.

TABLE 2.7-69

PERIPHYTON

FOUR MOST ABUNDANT* SPECIES ON EACH FIELD TRIP

COLLECTED IN THE CLINCH RIVER - MARCH 26, 1974 TO MAY 14, 1975

Date Collected	1st Most Abundant	2nd Most Abundant	3rd Most Abundant	4th Most Abundant
March 26 & 27	Melosira varians**	Gomphonema olivaceum**	Navicula cryptocephala**	Synedra actinastroides**
May 1	Oscillatoria amphibia+	Melosira varians**	Stigeoclonium sp.++	Chaetospheridium pringsheimii++
June 24	Eunotia exigua**	Oscillatoria geminata+	Oscillatoria sp.+	Synedra nana**
August 9	Eunotia exigua**	Oscillatoria amphibia+	Oscillatoria ornata+	Oscillatoria articulata+
October 23	Oscillatoria amphibia+	Rhizoclonium fontanum++	Oscillatoria sancta+	Navicula sp.**
January 15	Gomphonema olivaceum**	Lyngbya nana+	Oscillatoria amphibia+	Synedra actinastroides**
May 14	Oscillatoria amphibia+	Cymbella affinis**	Melosira varians**	Navicula cryptocephala**

*Abundant species were determined by the total number of organisms per square centimeter on each field trip.

**Is a diatom

+Is a blue-green algae

++Is a green algae

6

TABLE 2.7-70

PERIPHYTON*

AVERAGE CHLOROPHYLL VALUES AND AUTOTROPHIC INDEX

CLINCH RIVER FIELD TRIPS - MAY 1974 TO MAY 1975

Date	Chlorophyll a (mg/m^2)	Chlorophyll b (mg/m^2)	Chlorophyll c (mg/m^2)	Pheophytin a** Content Ratio	Ash-Free Dry Weight (mg/m^2)	Autotrophic Index
May 29, 1974[+]	39.31	4.17	12.99	1.67	3,631	90.6
June 29, 1974	9.92	0.98	2.87	1.56	1,524	328.2
August 9, 1974	8.41	0.88	1.70	1.70	1,447	185.6
October 23, 1974	55.76	6.60	11.45	1.67	++	++
January 15, 1975	28.36	3.14	13.77	1.41	2,208	76.7
May 14, 1975	51.32	4.21	16.91	1.62	19,913	504.0

*Plexiglass slides were collected from floating samples and preserved by freezing.

**Before:after acidification OD 663 ratio
- -ratio of 1.7 indicates complete absence of pheophytin a
- -ratio of 1.0 indicates presence of only pheophytin a (no chlorophyll a)

[+]May values are the average of two samplers, one exposed for six weeks and one exposed for two weeks. Other results are the average of samplers exposed during each month. Monthly exposures varied from three to four weeks.

[++]Values not available

6

TABLE 2.7-71

BENTHIC MACROINVERTEBRATE SPECIES* COLLECTED IN THE CLINCH RIVER
BY DREDGING
MARCH 25, 1974 THROUGH APRIL 16, 1975

Phylum	Class	Family	Genus and Species	
Annelida				
	Oligochaeta			
		Aeolosomatidae		
			Aeolosoma sp.	
		Lumbriculidae		
			Lumbriculus sp.	
		Naididae		
			Chaetogaster sp.	6
			Naidium sp.	
			Nais sp.	
		Tubificidae		
			Branchiura sp.	
			Limnodrilus sp.	
			Tubifex sp.	6
Arthropoda				
	Arachnida			
		Unionicolidae		6
			Neumania sp.	
	Crustacea			
	(Order - Amphipoda)			
		Talitridae		
			Hyalella sp.	
	(Order - Isopoda)			
		Asellidae		6
			Lirceus sp.	

(Continued)

TABLE 2.7-71 (Continued)

Phylum	Class	Family	Genus and Species	
Arthropoda				
	Insecta			
	(Order - Coleoptera)			
		Elmidae		
			Dubiraphia sp.	6
	(Order - Collembola)			
		Isotomidae		
			Isotomurus sp.	
	(Order - Diptera)			
		Ceratopogonidae		
			Bezzia sp.	6
			Palpomyia sp.	
		Chironomidae		
			Calopsectra sp.	
			Chironomini sp.	
			Chironomus sp.	
			Cladotanytarsus sp.	
			Corynoneura sp.	
			Cricotopus sp.	
			Cryptochironomus sp.	
			Dicrotendipes sp.	
			Eukiefferiella sp.	6
			Epiococladius sp.	
			Glyptotendipes sp.	
			Harnischia sp.	
			Heterotrissocladius sp.	6
			Larsia sp.	
			Microcricotopus bicolor	
			Microcricotopus sp.	

(Continued)

TABLE 2.7-71 (Continued)

Phylum	Class	Family	Genus and Species	
Arthropoda				
	Insecta			
	(Order - Diptera)			
		Chironomidae		
			Micropsectra sp.	
			Microtendipes sp.	
			Natarsia sp.	
			Nilothauma sp.	6
			Orthocladius sp.	
			Parachironomus sp.	6
			Paralauterborniella sp.	
			Paratanytarsus sp.	
			Paratendipes sp.	
			Pentaneura sp.	6
			Phenopsectra sp.	
			Polypedilum (*scalaenum* type)	
			Polypedilum sp.	
			Procladius sp.	6
			Psectrocladius sp.	
			Pseudochironomus sp.	
			Rheotanytarsus exigus	6
			Rheotanytarsus sp.	
			Stenochironomus sp.	6
			Stictochironomus sp.	
			Tanypus sp.	6
			Tanytarsus sp.	
			Thiennemannimyia sp.	6
			Tribelos sp.	
			Xenochironomus (*anceus* group)	
			Xenochironomus sp.	

(Continued)

TABLE 2.7-71 (Continued)

Phylum	Class	Family	Genus and Species	
Arthropoda				
	Insecta			
	(Order - Diptera)			
		Simuliidae		6
			Simulium sp.	
	(Order - Ephemeroptera)			
		Ephemeridae		
			Hexagenia sp.	
		Heptageniidae		
			Stenonema sp.	
	(Order - Lepidoptera)			
		Pyralidae		
			Synclita sp.	
	(Order - Megaloptera)			
		Sialidae		
			Sialis sp.	6
	(Order - Odonata)			
		Libellulidae		
			Tetragoneuria sp.	
	(Order - Plecoptera)			
		Capniidae		
			Allocapnia sp.	
	(Order - Trichoptera)			
		Hydropsychidae		
			Cheumatopsyche sp.	
		Hydroptilidae		
			Hydroptila sp.	6
			Oxyethira sp.	

(Continued)

TABLE 2.7-71 (Continued)

Phylum	Class	Family	Genus and Species	
Arthropoda				
	Insecta			
	(Order - Trichoptera)			
		Leptoceridae		
			Athripsodes sp.	6
			Mystacides sp.	
		Psychomyiidae		
			Cyrnellus sp.	6
			Psychomyiid Genus A	
Coelenterata				
	Hydrozoa			
		Clavidae		
			Cordylophora sp.	
		Hydridae		
			Hydra sp.	
Mollusca				
	Gastropoda			
		Ancylidae		
			Ferrissia sp.	
		Planorbidae		6
			Gyraulus sp.	
	Pelecypoda			
		Corbiculidae		
			Corbicula manillensis	
		Unionidae		
			Quadrula pustulosa	6

(Continued)

TABLE 2.7-71 (Continued)

Phylum	Class	Family	Genus and Species
Nematoda			
	Secernentea		
		Diplogasteridae	
			Diplogaster sp.
Nemertea			
	--		
		--	
			Prostoma rubrum
Platyhelminthes			
	Turbellaria		
		Planariidae	
			Curtisia sp.
			Dugesia sp.
			Phagocata sp.

6

*Classification of macroinvertebrates is based primarily on Ward, H. B. and Whipple, G. C., Fresh-Water Biology, second edition, John Wiley & Sonc, Inc., New York, 1959.

TABLE 2.7-72

RELATIVE ABUNDANCE OF BENTHIC MACROINVERTEBRATE SPECIES COLLECTED BY DREDGING ON EACH SAMPLING TRIP AT THE CLINCH RIVER FROM MARCH 25, 1974 THROUGH APRIL 16, 1975

Species	Relative Abundance (%)								
	March 25 and March 29	June 1	June 26	July 25	August 26 and August 28	September 25	November 21	January 14	April 16
ANNELIDA									
Aeolosoma sp.	--	--	--	0.5	--	--	--	4.8	--
Branchiura sp.	1.0	0.1	1.1	--	--	0.7	0.1	0.7	0.2
Chaetogaster sp.	--	--	--	--	--	--	--	--	1.3
Limnodrilus sp.	--	8.5	10.9	13.8	4.9	31.3	11.6	19.6	8.9
Lumbriculus sp.	2.0	--	--	7.8	--	--	--	--	--
Naidium sp.	--	8.4	--	--	--	0.7	--	0.4	0.2
Nais sp.	41.6	--	27.2	1.4	--	0.2	0.2	1.2	0.6
Tubifex sp.	--	--	--	--	--	--	--	--	1.4
ARTHROPODA									
Allocapnia sp.	--	--	--	--	--	--	--	0.1	--
Athripsodes sp.	--	--	--	--	--	--	--	--	0.1
Bezzia sp.	--	--	--	--	--	--	--	--	0.3
Calopsectra sp.	--	--	--	--	--	0.2	--	0.1	--
Cheumatopsyche sp.	--	--	--	--	--	0.5	--	0.7	--
Chironomini sp.	--	--	--	--	--	0.2	--	--	--
Chironomus sp.	--	--	1.1	--	--	--	0.3	0.5	0.1
Cladotanytarsus sp.	--	--	--	--	--	0.9	--	--	--
Corynoneura sp.	--	--	--	1.8	--	--	--	--	--
Cricotopus sp.	--	0.8	12.0	3.7	0.3	0.7	0.3	0.3	0.9
Cryptochironomus sp.	--	0.7	4.3	5.5	1.6	0.9	1.0	1.8	0.4
Cyrnellus sp.	--	--	--	--	--	--	--	--	3.5
Dicrotendipes sp.	1.0	0.5	9.2	2.8	3.2	--	2.4	5.0	0.2
Dubiraphia sp.	--	--	--	--	--	--	0.1	--	--
Epiococladius sp.	--	--	--	--	--	--	--	0.3	--
Eukiefferiella sp.	--	--	--	--	--	--	--	--	0.1
Glyptotendipes sp.	1.0	--	--	--	--	1.2	0.5	0.7	0.1
Harnischia sp.	--	--	0.5	--	--	--	--	--	--

6

TABLE 2.7-72 (Continued)

Species	Relative Abundance (%)								
	March 25 and March 29	June 1	June 26	July 25	August 26 and August 28	September 25	November 21	January 14	April 16
ARTHROPODA (Continued)									
Heterotrissocladius sp.	--	--	--	--	--	--	--	--	0.2
Hexagenia sp.	1.0	--	2.2	1.4	0.6	0.5	2.5	4.3	1.4
Hyalella sp.	--	--	--	--	--	0.2	--	--	--
Hydroptila sp.	--	--	--	--	--	--	0.2	0.1	--
Isotomurus sp.	--	--	--	--	--	--	0.2	--	--
Larsia sp.	--	--	--	--	--	--	0.1	0.2	--
Lirceus sp.	--	--	--	--	--	--	0.1	--	--
Microcricotopus bicolor	1.0	--	--	--	--	--	--	--	--
Microcricotopus sp.	--	2.0	1.1	2.3	0.3	--	--	0.1	--
Micropsectra sp.	--	--	--	--	--	0.2	--	--	0.2
Microtendipes sp.	--	0.1	0.5	--	--	--	0.3	0.5	--
Mystacides sp.	--	0.1	--	--	--	--	--	--	--
Natarsia sp.	--	--	--	--	--	0.2	--	--	--
Neumania sp.	--	--	--	--	--	--	--	0.1	--
Nilothauma sp.	--	--	--	--	--	--	--	0.1	--
Orthocladius sp.	--	0.7	--	--	--	--	--	0.7	0.1
Oxyethira sp.	--	--	--	--	--	--	--	0.2	--
Palpomyia sp.	--	--	--	--	--	--	--	1.0	0.7
Parachironomus sp.	--	--	--	--	--	--	0.1	2.1	0.2
Paralauterborniella sp.	1.0	--	--	--	--	--	0.7	--	0.2
Paratanytarsus sp.	1.0	--	--	--	--	--	--	--	--
Paratendipes sp.	2.0	--	--	--	0.6	--	--	--	0.4
Pentaneura sp.	--	--	--	--	--	--	--	0.2	--
Phenopsectra sp.	--	--	--	0.5	--	--	--	--	--
Polypedilum (scalaenum type)	17.8	--	--	4.1	--	--	4.5	--	6.1
Polypedilum sp.	--	0.3	1.6	0.5	--	0.2	0.3	3.9	0.2
Procladius sp.	--	--	--	--	--	--	0.2	--	--

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TABLE 2.7-72 (Continued)

Species	Relative Abundance (%) March 25 and March 29	June 1	June 26	July 25	August 26 and August 28	September 25	November 21	January 14	April 16
ARTHROPODA (Continued)									
Psectrocladius sp.	--	0.1	--	--	0.3	--	--	--	0.6
Pseudochironomus sp.	--	0.7	1.1	--	0.3	--	0.1	1.0	--
Psychomyiid Genus A	--	--	--	--	0.3	0.5	3.0	2.1	--
Rheotanytarsus exigus	--	--	--	--	--	--	0.2	--	--
Rheotanytarsus sp.	--	5.6	1.6	0.9	3.6	0.5	0.4	0.2	0.6
Sialis sp.	--	--	--	--	--	--	--	0.1	--
Simulium sp.	--	--	--	--	--	--	0.1	--	--
Stenochironomus sp.	--	--	--	--	--	--	0.1	--	--
Stenonema sp.	--	--	--	--	--	--	--	0.2	--
Stictochironomus sp.	1.0	--	--	1.8	--	--	0.1	0.1	--
Synclita sp.	--	--	--	--	--	--	--	--	--
Tanypus sp.	--	--	--	--	--	--	--	0.2	--
Tanytarsus sp.	--	0.5	2.2	4.1	0.6	--	--	0.8	0.6
Tetragoneuria sp.	--	--	--	--	--	--	--	--	0.1
Thiennemannimyia sp.	--	--	--	--	--	--	--	0.6	--
Tribelos sp.	--	--	--	--	--	--	--	--	0.1
Xenochironomus (Anceus group)	1.0	--	--	--	--	--	--	--	--
Xenochironomus sp.	--	--	--	0.9	1.9	--	0.4	--	0.2
COELENTERATA									
Cordylophora sp.	--	*	*	--	*	*	*	*	*
Hydra sp.	--	55.9	--	0.5	31.4	0.5	4.0	1.6	3.7
MOLLUSCA									
Corbicula sp.	26.7	14.8	22.8	44.5	48.5	56.8	64.0	42.1	65.3
Quadrula sp.	--	--	--	0.5	--	--	--	--	--
Ferrissia sp.	--	--	--	--	--	0.9	0.3	--	--
Gyraulus sp.	--	--	--	--	--	--	--	--	0.1

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TABLE 2.7-72 (Continued)

Species	Relative Abundance (%) March 25 and March 29	June 1	June 26	July 25	August 26 and August 28	September 25	November 21	January 14	April 16
NEMATODA									
Diplogaster sp.	--	0.3	--	0.9	0.6	0.5	0.1	1.2	0.6
NEMERTEA									
Prostoma rubrum	--	--	--	--	--	--	1.0	0.2	0.1
PLATYHELMINTHES									
Curtisia sp.	--	--	--	--	0.6	--	0.1	--	--
Dugesia sp.	--	0.1	--	--	--	--	--	--	--
Phagocata sp.	1.0	--	--	--	--	0.2	--	--	--
Number of organisms	101	744	184	218	309	428	914	1,218	1,247

*Colonial organisms present but not enumerated, so relative abundance could not be determined.

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TABLE 2.7-73

ABUNDANCE OF BENTHIC MACROINVERTEBRATES FROM EACH SAMPLING TRIP*
COLLECTED BY DREDGING
MARCH 25, 1974 THROUGH APRIL 16, 1975

	March 25		June 1		June 26		July 25		August 26		September 25		November 21		January 14		April 16		
Species	No.	No./m^2	No.	No./m^2	No.	No./m^2	No.	No./m^2	No.	No./m^2	No.	No./m^2	No.	No./m^2	No.	No./m^2	No.	No./m^2	% of Total No.
ANNELIDA	45	33.4	124	78.0	72	48.5	51	36.3	15	11.8	141	114.0	109	68.6	327	205.7	159	100.0	19.4
ARTHROPODA																			
Arachnida	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	0.6	--	--	<0.1
Crustacea	--	--	--	--	--	--	--	--	--	--	1	0.8	1	0.6	--	--	--	--	<0.1
Coleoptera	--	--	--	--	--	--	--	--	--	--	--	--	1	0.6	--	--	--	--	<0.1
Collembola	--	--	--	--	--	--	--	--	--	--	--	--	2	1.3	--	--	--	--	<0.1
Diptera	27	19.6	90	56.6	65	43.8	63	49.9	40	31.4	23	18.1	113	71.0	247	155.3	155	97.5	15.3
Ephemeroptera	1	0.7	--	--	4	2.7	3	2.2	2	1.6	2	1.6	23	14.5	55	34.6	17	10.7	2.0
Lepidoptera	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	0.6	--	--	<0.1
Megaloptera	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	0.6	--	--	<0.1
Odonata	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	0.6	<0.1
Plecoptera	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	0.6	--	--	<0.1
Trichoptera	--	--	1	0.6	1	0.7	--	--	1	0.8	4	3.1	29	18.2	36	22.6	45	28.3	2.2
COELENTERATA	--	--	416	261.6	--	--	1	0.7	97	76.3	2	1.6	37	23.3	20	12.6	46	28.9	11.5
MOLLUSCA	27	19.6	110	69.2	42	28.3	98	71.1	150	117.9	252	198.1	588	369.8	513	322.6	815	512.6	48.4
NEMATODA	--	--	2	1.2	--	--	2	1.5	2	1.6	2	1.6	1	0.6	14	8.8	8	5.0	0.6
NEMERTEA	--	--	--	--	--	--	--	--	--	--	--	--	9	5.7	2	1.3	1	0.6	0.2
PLATYHELMINTHES	1	0.7	1	0.6	--	--	--	--	2	1.6	1	0.8	1	0.6	--	--	--	--	0.1
Totals	101	74.0	744	467.8	184	124.0	218	161.7	309	243.0	428	339.7	914	574.8	1,218	765.9	1,247	784.2	

*Number per meter squared computed from the total number per trip divided by the number of dredge samples and corrected to meter squared area.

6

TABLE 2.7-74

SIZE FREQUENCY DISTRIBUTION OF CORBICULA SP. LESS THAN TEN MILLIMETERS
COLLECTED BY DREDGING ON THE CLINCH RIVER
MARCH 25, 1974 TO APRIL 16, 1975

	Frequency of Occurrence								
Length (mm)	March 25 and 29	June 1	June 26	July 25	August 26 and 28	September 25	November 24	January 14	April 16
0.5	--	3	1	2	--	17	129	140	60
1.0	1	34	4	39	63	183	500	584	1,020
1.5	4	52	6	38	63	83	241	167	294
2.0	2	61	9	68	68	84	184	88	146
2.5	2	23	9	8	41	25	50	36	42
3.0	1	20	15	18	23	40	71	36	24
3.5	1	5	11	4	8	13	41	14	10
4.0	5	12	17	11	29	30	38	15	9
4.5	1	2	1	2	4	3	12	12	1
5.0	--	5	4	3	14	14	10	12	6
5.5	1	--	3	--	1	7	9	5	9
6.0	2	--	1	2	2	4	6	2	3
6.5	2	--	1	--	2	--	1	--	1
7.0	1	--	2	--	2	2	2	--	2
7.5	--	--	1	--	--	1	--	--	2
8.0	--	--	--	1	1	--	1	3	1
8.5	--	--	--	1	--	--	--	--	--
9.0	1	--	--	--	--	2	1	2	--
9.5	--	--	--	--	--	--	1	--	--
10.0	--	--	--	--	1	--	1	--	--
Total	24	217	85	197	322	508	1,298	1,116	1,630
Mean	3.9	1.3	3.3	1.4	1.2	0.9	1.7	1.4	1.3
Standard Deviation	2.09	0.35	1.41	0.40	0.24	0.19	1.14	1.02	0.78

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TABLE 2.7-75

PERCENT COMPOSITION OF CORBICULA SP. LESS THAN TEN MILLIMETERS
COLLECTED BY DREDGING ON THE CLINCH RIVER
MARCH 25, 1974 TO APRIL 16, 1975

Length (mm)	Percent Composition: March 25 and 29	June 1	June 26	July 25	August 26 and 28	September 25	November 24	January 14	April 16
0.5	0.0	1.4	1.4	1.0	0.0	3.3	9.9	12.5	3.7
1.0	4.2	15.7	4.7	19.9	19.7	36.0	38.5	52.3	62.6
1.5	16.6	24.0	7.1	19.3	19.7	16.3	18.6	15.0	18.0
2.0	8.3	28.1	10.6	34.5	21.1	16.5	14.2	7.9	9.0
2.5	8.3	10.6	10.6	4.1	12.7	4.9	3.8	3.2	2.6
3.0	4.2	9.2	17.6	9.1	7.1	7.9	5.4	3.2	1.5
3.5	4.2	2.3	12.9	2.0	2.5	2.6	3.2	1.3	0.6
4.0	20.8	5.5	20.0	5.6	9.0	5.9	2.9	1.3	0.5
4.5	4.2	0.9	1.2	1.0	1.2	0.6	0.9	1.1	0.1
5.0	0.0	2.3	4.7	1.5	4.3	2.8	0.8	1.1	0.3
5.5	4.2	0.0	3.5	0.0	0.3	1.4	0.7	0.4	0.5
6.0	8.3	0.0	1.2	1.0	0.6	0.8	0.5	0.2	0.2
6.5	8.3	0.0	1.2	0.0	0.6	0.0	0.1	0.0	0.1
7.0	4.2	0.0	2.3	0.0	0.6	0.4	0.1	0.0	0.1
7.5	0.0	0.0	1.2	0.0	0.0	0.2	0.0	0.0	0.1
8.0	0.0	0.0	0.0	0.5	0.3	0.0	0.1	0.3	0.1
8.5	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0
9.0	4.2	0.0	0.0	0.0	0.0	0.4	0.1	0.2	0.0
9.5	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
10.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0

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TABLE 2.7-76

THREE MOST ABUNDANT BENTHIC MACROINVERTEBRATES COLLECTED BY DREDGING ON EACH SAMPLING TRIP AT THE CLINCH RIVER FROM MARCH 25, 1974 THROUGH APRIL 16, 1975

Collection Date	
March 25 and 29	1. Nais sp. 2. Corbicula sp. 3. Polypedilum (scalaenum type)
June 1	1. Hydra sp. 2. Corbicula sp. 3. Limnodrilus sp.
June 26	1. Nais sp. 2. Corbicula sp. 3. Cricotopus sp.
July 25	1. Corbicula sp. 2. Limnodrilus sp. 3. Lumbriculus sp.
August 26 and 28	1. Corbicula sp. 2. Hydra sp. 3. Limnodrilus sp.
September 25	1. Corbicula sp. 2. Limnodrilus sp. 3. Glyptotendipes sp.
November 21	1. Corbicula sp. 2. Limnodrilus sp. 3. Polypedilum (scalaenum type)

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(Continued)

TABLE 2.7-76 (Continued)

Collection Date		
January 14	1. *Corbicula* sp. 2. *Limnodrilus* sp. 3. *Dicrotendipes* sp.	6
April 16	1. *Corbicula* sp. 2. *Limnodrilus* sp. 3. *Polypedilum* (*scalaenum* type)	

TABLE 2.7-77

SPECIES DIVERSITIES* FOR BENTHIC MACROINVERTEBRATES COLLECTED BY DREDGING AT THE CLINCH RIVER - MARCH 25, 1974 THROUGH APRIL 16, 1975

	Transect 1			Transect 2			Transect 3			Transect 4			Transect 5			
	Station			Station			Station			Station			Station			
Collection Date	3	5	7	3	5	7	3	5	7	3	5	7	3	5	7	Mean**
March 25 and 29	0.00	--	0.00	0.00	--	1.10	1.10	0.00	0.75	0.62	--	0.91	0.21	0.00	--	0.43
June 1	1.33	0.70	0.00	0.68	0.31	0.00	0.80	0.62	0.72	0.68	1.55	0.77	0.88	--	0.95	0.71
June 26	0.69	1.28	0.64	0.00	0.69	1.17	1.10	0.00	1.90	1.63	1.16	0.23	0.64	0.87	--	0.86
July 25	1.10	1.24	0.00	0.00	--	1.73	1.10	--	1.33	1.75	1.68	0.43	0.24	0.00	0.60	0.86
August 26 and 28	0.88	0.80	1.71	0.33	--	1.59	1.03	0.00	0.74	0.00	1.03	--	0.66	1.13	--	0.83
September 25	0.21	0.64	0.00	0.00	--	1.39	1.52	0.00	0.99	0.49	1.53	0.00	--	0.00	--	0.56
November 21	0.92	1.85	0.25	0.47	1.10	1.89	1.26	0.00	1.80	1.61	1.65	0.32	0.64	0.59	0.00	0.96
January 14	0.86	0.90	0.11	0.56	0.00	2.32	2.09	1.20	1.51	2.35	0.72	0.58	1.26	1.95	1.57	1.20
April 16	1.26	1.40	0.07	1.18	0.26	2.10	1.71	0.15	2.33	1.35	0.76	0.34	0.00	1.14	0.00	0.94
Mean**	0.81	1.10	0.31	0.36	0.47	1.24	1.30	0.25	1.34	1.16	1.26	0.45	0.57	0.71	0.62	

*Calculated from number of organisms per square meter

**Station at which no organisms were obtained (indicated by dashes) are not included in the calculations of mean species diversities.

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TABLE 2.7-78

DISTRIBUTION OF BENTHIC MACROINVERTEBRATES BY SEDIMENT (PARTICLE) SIZE* MEAN NUMBER PER STATION** AND MEAN NUMBER PER METER SQUARED+ MARCH 25, 1974 THROUGH APRIL 16, 1975

	March 25						June 1					
	Gravel		Sand		Fine Sand		Gravel		Sand		Fine Sand	
	$\bar{X}$	No./m²	$\bar{X}$	No./m²	$\bar{X}$	No./m²	$\bar{X}$	No./m²	$\bar{X}$	No./m²	$\bar{X}$	No./m²
Coelenterates	0.0	0.0	0.0	0.0	0.0	0.0	78.8	743.1	9.7	91.5	4.0	37.7
Annelids	0.3	2.8	0.0	0.0	5.0	47.2	14.8	139.6	1.5	14.1	52.0	490.4
Chironomids	6.1	57.5	0.0	0.0	5.5	51.9	21.8	205.6	0.3	2.8	1.0	9.4
Mollusks	2.8	26.4	2.7	25.4	0.5	4.7	2.3	21.7	10.4	98.1	2.0	18.9

	July 25						September 25					
	Gravel		Sand		Fine Sand		Gravel		Sand		Fine Sand	
	$\bar{X}$	No./m²	$\bar{X}$	No./m²	$\bar{X}$	No./m²	$\bar{X}$	No./m²	$\bar{X}$	No./m²	$\bar{X}$	No./m²
Coelenterates	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	5.7
Annelids	1.1	10.4	1.0	9.4	13.0	122.6	0.3	2.8	0.2	1.9	47.0	443.2
Chironomids	5.3	50.0	1.0	9.4	15.0	141.5	1.6	15.1	0.2	1.9	4.6	43.4
Mollusks	5.8	54.7	9.6	90.5	1.3	12.3	3.3	31.1	33.2	313.1	13.0	122.6

	January 14						April 16					
	Gravel		Sand		Fine Sand		Gravel		Sand		Fine Sand	
	$\bar{X}$	No./m²	$\bar{X}$	No./m²	$\bar{X}$	No./m²	$\bar{X}$	No./m²	$\bar{X}$	No./m²	$\bar{X}$	No./m²
Coelenterates	0.0	0.0	0.8	7.5	0.2	1.9	12.0	113.2	1.3	12.3	0.0	0.0
Annelids	0.5	4.7	15.8	149.1	43.8	413.2	8.5	80.2	1.0	9.4	27.8	262.3
Chironomids	10.0	94.3	0.8	7.5	34.2	322.6	1.5	14.2	4.0	37.7	21.4	201.9
Mollusks	71.5	674.5	69.3	653.8	14.8	139.6	256.5	2,419.8	77.3	729.2	13.6	128.3

*Categorization of sediment according to particle diameter: gravel (1.70 to >5.6 mm); sand (0.25 to 1.70 mm) and fine sand (<0.075 to 0.25 mm).

**Mean number of organisms for station categorized by specific sediment particle diameter

+Mean number converted to number of organisms per meter squared.

TABLE 2.7-79

BIOMASS OF BENTHIC MACROINVERTEBRATES COLLECTED BY DREDGING
COMPOSITE ASH-FREE DRY WEIGHT BY TRANSECT
MARCH 25, 1974 THROUGH APRIL 16, 1975

Transect	March 25 mg/m²	June 1 mg/m²	June 26 mg/m²	July 25 mg/m²	August 26 mg/m²	September 25 mg/m²	November 21 mg/m²	January 14 mg/m²	April 16 mg/m²	Transect Mean
1	426	71	11,533	4,790	5,350	369	7,285	6,219	915	4,106.4
2	28	132	5,197	166	567	293	758	563	383	898.6
3	5,355	69	1,731	0	1,193	3,906	3,175	423	3,405	2,139.7
4	4,682	7,851	6,013	252	6,364	365	15,440	737	3,630	5,037.1
5	5,502	4,488	94	13,290	81	23	26	510	1,770	2,864.9
Sampling Mean	3,198.6	2,522.2	4,913.6	3,699.6	2,711.0	991.2	5,336.8	1,690.4	2,020.6	

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TABLE 2.7-80

BENTHIC MACROINVERTEBRATE SPECIES* COLLECTED IN THE CLINCH RIVER BY ARTIFICIAL SUBSTRATES - JUNE 3, 1974 THROUGH MAY 28, 1975

Phylum	Class	Family	Genus and Species
Annelida			
	Oligochaeta		
		Lumbriculidae	
			Lumbriculus sp.
		Naididae	
			Naidium sp.
			Nais sp.
			Pristina sp.
			Stylaria sp.
		Tubificidae	
			Limnodrilus sp.
Arthropoda			
	Crustacea		
	(Order - Copepoda)		
	(Suborder - Calanoida)		
		Diaptomidae	
			Diaptomus sp. 6
	(Order - Cladocera)		
		Daphnidae	
			Daphnia sp.
		Sididae	
			Sida sp.

(Continued)

TABLE 2.7-80 (Continued)

Phylum	Class	Family	Genus and Species	
Arthropoda				
	Insecta			
	(Order - Diptera)			
		Ceratopogonidae		6
			Palpomyia sp.	
		Chironomidae		
			Calopsectra sp.	
			Chironomus sp.	
			Corynoneura sp.	
			Cricotopus sp.	
			Cryptochironomus sp.	
			Dicrotendipes cf. *neomodestus*	
			Dicrotendipes cf. *nervosus*	
			Dicrotendipes sp.	
			Diplocladius sp.	
			Endochironomus sp.	6
			Eukiefferiella sp.	
			Glyptotendipes sp.	
			Heterotrissocladius sp.	6
			Labrundinia sp.	
			Larsia sp.	
			Microcricotopus sp.	
			Micropsectra sp.	6
			Orthocladius sp.	
			Parachironomus sp.	
			Parametriocnemus sp.	6
			Pentaneura sp.	
			Phaenopsectra sp.	

(Continued)

TABLE 2.7-80 (Continued)

Phylum	Class	Family	Genus and Species	
Arthropoda				
	Insecta			
	(Order - Diptera)			
		Chironomidae		
			Polypedilum (scalaenum type)	
			Polypedilum sp.	
			Procladius sp.	
			Psectrocladius sp.	
			Pseudochironomus sp.	6
			Rheotanytarsus sp.	
			Stictochironomus sp.	
			Tanypus sp.	6
			Tanytarsus sp.	
			Thienemannimyia (series)	
			Trissocladius sp.	6
			Xenochironomus sp.	
		Empididae		
			Hemerodromia sp.	
	(Order - Ephemeroptera)			
		Caenidae		
			Tricorythodes sp.	
		Heptageniidae		
			Stenonema sp.	
		Leptophlebiidae		
			Leptophlebia sp.	
	(Order - Odonata)			6
		Aeshnidae		
			Boyeria sp.	

(Continued)

TABLE 2.7-80 (Continued)

Phylum	Class	Family	Genus and Species	
Arthropoda				
	Insecta			
	(Order - Plecoptera)			
		Capniidae		6
			Allocapnia sp.	
	(Order - Trichoptera)			
		Hydropsychidae		
			Cheumatopsyche sp.	
			Hydropsyche sp.	
			Smicridea sp.	
		Hydroptilidae		
			Agraylea sp.	
			Hydroptila sp.	
			Oxyethira sp.	
		Leptoceridae		6
			Athripsodes sp.	
		Psychomyiidae		
			Cyrnellus sp.	
			Polycentropus sp.	6
			Psychomyiid Genus A	
Bryozoa				
	Ectoprocta			
		Lophopodidae		
			Pectinatella sp.	
Coelenterata				
	Hydrozoa			
		Clavidae		
			Cordylophora sp.	

(Continued)

TABLE 2.7-80 (Continued)

Phylum	Class	Family	Genus and Species	
Coelenterata				
	Hydrozoa			
		Hydridae		
			Hydra sp.	
Mollusca				
	Gastropoda			
		Ancylidae		
			Ferrissia sp.	6
		Planorbidae		
			Gyraulus sp.	
	Pelecypoda			
		Corbiculidae		
			Corbicula sp.	
Nematoda				
	Secernentea			
		Diplogasteridae		
			Diplogaster sp.	
Nemertea				
	--			
		--		6
			Prostoma rubrum	
Platyhelminthes				
	Turbellaria			
		Planariidae		
			Curtisia sp.	
			Phagocata sp.	6

*Classification of macroinvertebrates is based primarily on Ward, H. B. and Whipple, G. C., *Fresh-Water Biology*, second edition, John Wiley & Sons, Inc., New York, 1959.

TABLE 2.7-81

ABUNDANCE OF BENTHIC MACROINVERTEBRATES - ARTIFICIAL SUBSTRATES
TOTAL NUMBER AND NUMBER PER SQUARE METER FOR EACH COLLECTION DATE
COLLECTED IN THE CLINCH RIVER - JULY 25, 1974 THROUGH MAY 28, 1975

	July 25		August 9		September 26	
	No.	No./m^2	No.	No./m^2	No.	No./m^2
Ephemeroptera	3	11	17	31	11	20
Trichoptera	5	18	166	298	297	538
Diptera	368	1,306	371	667	439	792
Annelida	329	1,168	56	102	409	743
Coelenterata	154	547	4,702	8,518	1,666	3,019
Mollusca	13	46	38	69	68	123
Total		3,095		9,684		5,235

	November 20		January 15 & 17		May 28		
	No.	No./m^2	No.	No./m^2	No.	No./m^2	
Ephemeroptera	24	43	5	11	12	22	
Trichoptera	323	585	35	77	28	51	
Diptera	681	1,235	130	276	428	775	
Annelida	48	87	170	369	642	1,163	6
Coelenterata	3,026	5,488	422	918	2,421	4,386	
Mollusca	16	29	2	4	18	33	
Total		7,468		1,655		6,430	

TABLE 2.7-82

BENTHIC MACROINVERTEBRATES - ARTIFICIAL SUBSTRATES
IMPORTANT ORGANISMS FOR EACH SAMPLING DATE
AND TOTAL NUMBER PER STATION COLLECTED IN THE CLINCH RIVER -
JULY 25, 1974 THROUGH MAY 28, 1975

COLLECTED JULY 25

Genera	Transect 1 Nearshore Station	Transect 1 Midchannel Station	Transect 4 Nearshore Station	Transect 4 Midchannel Station	Transect 5 Nearshore Station	Transect 5 Midchannel Station	Mean
Dicrotendipes	48	66	27	25	51	30	41.2
Nais	46	15	18	4	98	53	39.0
Hydra	42	15	3	0	77	17	25.7
Stylaria	0	0	17	73	0	0	15.0
Glyptotendipes	6	18	3	11	5	14	7.8
Corbicula	0	0	8	2	3	0	2.2

COLLECTED AUGUST 9

Genera	Transect 1 Nearshore Station	Transect 1 Midchannel Station	Transect 4 Nearshore Station	Transect 4 Midchannel Station	Transect 5 Nearshore Station	Transect 5 Midchannel Station	Mean
Hydra	900	250	350	60	2,212	930	783.7
Dicrotendipes	62	62	56	48	52	33	52.7
Psychomyiid	31	0	3	17	74	30	25.8
Nais	19	3	2	4	12	5	7.5
Corbicula	0	0	10	22	4	0	6.0

COLLECTED SEPTEMBER 26

Genera	Transect 1 Nearshore Station	Transect 1 Midchannel Station	Transect 4 Nearshore Station	Transect 4 Midchannel Station	Transect 5 Nearshore Station	Transect 5 Midchannel Station	Mean
Hydra	484	144	94	86	256	602	277.7
Nais	11	29	190	53	31	0	52.3
Dicrotendipes	29	38	88	62	42	41	50.0
Psychomyiid	54	12	81	55	64	23	48.2
Corbicula	2	0	15	29	13	9	11.3

(Continued)

TABLE 2.7-82 (Continued)

COLLECTED NOVEMBER 20

Genera	Transect 1 Nearshore Station	Transect 1 Midchannel Station	Transect 4 Nearshore Station	Transect 4 Midchannel Station	Transect 5 Nearshore Station	Transect 5 Midchannel Station	Mean
Hydra	1,128	838	98	822	6	134	504.3
Dicrotendipes	39	32	154	25	77	75	67.0
Psychomyiid	42	8	39	55	59	23	37.7
Cricotopus	0	0	52	1	10	36	16.5
Nais	5	0	12	9	3	10	6.5
Corbicula	0	0	8	5	1	0	2.3
COLLECTED JANUARY 15 AND 17							
Hydra	122	74	22	114	*	90	84.4
Nais	16	0	58	43	*	24	28.2
Dicrotendipes	4	1	40	9	*	11	13.0
Hydroptila	1	2	22	0	*	1	5.2
Corbicula	0	0	1	2	0	1	0.7
COLLECTED MAY 28							
Hydra	1,172	1,874	826	540	264	166	807.0
Naidium	14	2	124	0	200	5	57.5
Nais	19	0	10	150	0	116	49.2
Cricotopus	2	1	28	3	74	1	18.2
Parachironomous	0	9	29	27	5	3	12.2
Corbicula	0	0	9	0	8	1	3.0

*Substrate could not be located at the end of the exposure period.

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TABLE 2.7-83

BIOMASS OF BENTHIC MACROINVERTEBRATES COLLECTED BY ARTIFICIAL SUBSTRATES
COMPOSITE ASH-FREE DRY WEIGHT BY TRANSECT
JULY 25, 1974 THROUGH MAY 28, 1975

Transect		July 25 mg/m^2	August 9 mg/m^2	September 26 mg/m^2	November 20 mg/m^2	January 14 and 17 mg/m^2	May 28 mg/m^2	Mean
1	Nearshore	185	833	626	370	39	1,260	552.2
1	Midchannel	302	152	826	372	54	293	333.2
4	Nearshore	635	874	765	900	117	559	641.7
4	Midchannel	266	509	857	639	117	330	453.0
5	Nearshore	537	535	663	711	*	567	602.6
5	Midchannel	458	580	602	465	78	393	429.3
	Mean	397.2	580.5	723.2	576.2	81.0	567.0	

*Substrate could not be located at the end of exposure period

6

TABLE 2.7-84

BENTHIC MACROINVERTEBRATES - ARTIFICIAL SUBSTRATES
NUMBER PER SQUARE METER AND SPECIES DIVERSITY
COLLECTED IN THE CLINCH RIVER - JULY 25, 1974 THROUGH MAY 28, 1975

		July 25		August 9		September 26		November 20		January 15 & 17		May 28	
Transect		No./m^2	$\bar{d}$	No./m^2	$\bar{d}$	No./m^2	$\bar{d}$	No./m^2	$\bar{d}$	No./m^2	$\bar{d}$	No./m^2	$\bar{d}$
1	Nearshore	3,344	1.54	11,272	0.61	6,512	0.75	13,702	0.52	1,860	1.21	13,230	0.22
1	Midchannel	2,660	1.46	3,512	0.70	2,891	1.58	9,807	0.38	924	0.58	20,928	0.19
4	Nearshore	1,830	1.90	4,742	0.77	5,598	1.74	5,197	2.06	1,836	1.85	11,750	1.01
4	Midchannel	2,704	1.37	1,793	1.66	3,425	1.87	10,312	0.64	2,122	1.35	8,219	0.95
5	Nearshore	5,301	1.49	25,825	0.36	4,990	1.56	2,370	2.03	*	*	7,274	1.75
5	Midchannel	2,748	1.69	11,011	0.41	8,055	0.87	3,451	1.77	1,697	1.55	3,641	1.40
	Mean	3,097.8	1.58	9,692.5	0.75	5,245.2	1.40	7,473.2	1.23	1,687.8	1.31	10,840.3	0.92

*Substrate could not be located at the end of exposure period

6

TABLE 2.7-85

SIZE FREQUENCY DISTRIBUTION OF CORBICULA SP. LESS THAN TEN MILLIMETERS
COLLECTED BY BENTHIC ARTIFICIAL SUBSTRATES - CLINCH RIVER
JULY 26, 1974 THROUGH MAY 28, 1975

Length (mm)	Frequency of Occurrence					
	July 26	August 9	September 25 & 26	November 20	January 15 & 17	May 28
0.5	--	--	4	--	--	1
1.0	12	37	64	11	4	1
1.5	5	15	20	4	--	6
2.0	5	6	13	4	--	6
2.5	2	1	4	--	--	3
3.0	4	3	6	1	--	9
3.5	1	1	2	1	--	3
4.0	--	5	6	2	--	--
4.5	--	--	--	--	--	--
5.0	--	1	2	--	--	--
5.5	--	--	--	--	--	--
6.0	--	--	1	--	--	--
6.5	--	--	--	--	--	--
7.0	--	--	--	--	--	--
7.5	--	--	--	--	--	--
8.0	--	--	--	--	--	--
8.5	--	--	--	--	--	--
9.0	--	--	--	--	--	--
9.5	--	--	--	--	--	--
10.0	--	--	--	--	--	--
Total	29	69	122	23	4	29
Mean	1.7	1.6	1.2	1.7	1.0	2.3
Standard Deviation	0.78	0.97	0.37	0.96	0.00	0.80
Exposure Period (days)	53	45-46	47	55	56	42

6

TABLE 2.7-86

PERCENT COMPOSITION OF CORBICULA SP. LESS THAN TEN MILLIMETERS
COLLECTED BY BENTHIC ARTIFICIAL SUBSTRATES - CLINCH RIVER
JULY 26, 1974 TO MAY 28, 1975

Length (mm)	Percent Composition					
	July 26	August 9	September 25 & 26	November 20	January 15 & 17	May 28
0.5	0.0	0.0	4.3	0.0	0.0	3.4
1.0	41.4	53.6	52.5	47.9	100.0	3.4
1.5	17.2	21.7	16.4	17.4	0.0	20.7
2.0	17.2	8.7	10.7	17.4	0.0	20.7
2.5	6.9	1.5	3.3	0.0	0.0	10.4
3.0	13.8	4.3	4.9	4.3	0.0	31.0
3.5	3.5	1.5	1.6	4.3	0.0	10.4
4.0	0.0	7.2	4.9	8.7	0.0	0.0
4.5	0.0	0.0	0.0	0.0	0.0	0.0
5.0	0.0	1.5	1.6	0.0	0.0	0.0
5.5	0.0	0.0	0.0	0.0	0.0	0.0
6.0	0.0	0.0	0.8	0.0	0.0	0.0
6.5	0.0	0.0	0.0	0.0	0.0	0.0
7.0	0.0	0.0	0.0	0.0	0.0	0.0
7.5	0.0	0.0	0.0	0.0	0.0	0.0
8.0	0.0	0.0	0.0	0.0	0.0	0.0
8.5	0.0	0.0	0.0	0.0	0.0	0.0
9.0	0.0	0.0	0.0	0.0	0.0	0.0
9.5	0.0	0.0	0.0	0.0	0.0	0.0
10.0	0.0	0.0	0.0	0.0	0.0	0.0
Exposure Period (days)	53	45-46	47	55	56	42

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TABLE 2.7-87

ENUMERATION OF FISH SPECIES* COLLECTED IN THE CLINCH RIVER - MARCH 28, 1974 - JANUARY 17, 1975

General Category	Family	Genus and Species	Common Name	Total No. Collected	No. Collected Electroshocking	No. Collected Gill Netting	
Game	Centrarchidae	Ambloplites rupestris	Rock bass	13	13	0	
		Lepomis auritus	Redbreast sunfish	5	4	1	7
		Lepomis macrochirus	Bluegill	79	71	8	
		Lepomis megalotis	Longear sunfish	2	2	0	
		Lepomis microlophus	Redear sunfish	4	4	0	
		Micropterus punctulatus	Spotted bass	14	14	0	
		Micropterus salmoides	Largemouth bass	20	19	1	
		Pomoxis annularis	White crappie	3	2	1	
	Percidae	Perca flavescens	Yellow perch	2	2	0	
		Stizostedion canadense	Sauger	18	1	17	
	Percichthyidae	Morone chrysops	White bass	19	7	12	
		Morone saxatilis	Striped bass	1	0	1	
Forage	Atherinidae	Labidesthes sicculus	Brook silverside	8	8	0	
	Clupeidae	Dorosoma cepedianum	Gizzard shad	128	119	9	
		Dorosoma petenense	Threadfin shad	383	103	280	
	Cottidae	Cottus carolinae	Banded sculpin	7	7	0	
	Cyprinidae	Hybopsis storeriana	Silver chub	4	0	4	
		Notemigonus crysoleucas	Golden shiner	6	6	0	
		Notropis ardens	Rosefin shiner	1	1	0	6
		Notropis atherinoides	Emerald shiner	154	154	0	
		Pimephales notatus	Bluntnose minnow	17	17	0	
	Percidae	Etheostoma blennioides	Greenside darter	1	1	0	
		Percina caprodes	Logperch	5	5	0	
Rough	Catostomidae	Carpiodes cyprinus	Quillback carpsucker	14	3	11	
		Hypentelium nigricans	Northern hogsucker	2	0	2	
		Ictiobus bubalus	Smallmouth buffalo	11	8	3	
		Moxostoma carinatum	River redhorse	6	1	5	
		Moxostoma duquesnei	Black redhorse	2	1	1	
		Moxostoma erythrurum	Golden redhorse	50	39	11	
	Clupeidae	Alosa chrysochloris	Skipjack herring	74	2	72	
	Cyprinidae	Cyprinus carpio	Carp	33	21	12	
	Hiodontidae	Hiodon tergisus	Mooneye	16	7	9	
	Ictaluridae	Ictalurus punctatus	Channel catfish	12	0	12	
	Sciaenidae	Aplodinotus grunniens	Freshwater drum	20	12	8	
			TOTAL	1,134	654	480	

*Classification is based on Bailey, R. M., et al, A List of Common and Scientific Names of Fishes from the United States and Canada, third edition, American Fisheries Society Special Publication No. 6, Washington, 1970.

TABLE 2.7-88

FISH POPULATIONS*

RELATIVE ABUNDANCE - CLINCH RIVER

COLLECTED MARCH 28, 1974 - JANUARY 17, 1975

Species	Number	Percentage of Total Number	Weight (grams)	Percentage of Total Weight	
GAME					
Rock bass	13	1.1	744	0.4	
Redbreast sunfish	5	0.4	452	0.2	
Bluegill	71	7.0	4,815	2.5	
Longear sunfish	2	0.2	168	0.1	
Redear sunfish	4	0.4	514	0.3	6
Spotted bass	14	1.2	92	<0.1	
Largemouth bass	20	1.8	8,124	4.3	
White crappie	3	0.3	315	0.2	
Yellow perch	2	0.2	320	0.2	
Sauger	18	1.6	7,935	4.2	
White bass	19	1.7	9,025	4.8	
Striped bass	1	0.1	128	0.1	
FORAGE					
Brook silverside	8	0.7	9	<0.1	
Gizzard shad	128	11.3	25,619	13.6	
Threadfin shad	383	33.8	14,192	7.5	

(Continued)

TABLE 2.7-88 (Continued)

Species	Number	Percentage of Total Number	Weight (grams)	Percentage of Total Weight
FORAGE (Continued)				
Banded sculpin	7	0.6	48	<0.1
Silver chub	4	0.4	231	0.1
Golden shiner	6	0.5	32	<0.1
Rosefin shiner	1	0.1	8	<0.1
Emerald shiner	154	13.5	824	0.4
Bluntnose minnow	17	1.5	27	<0.1
Greenside darter	1	0.1	2	<0.1
Logperch	5	0.4	108	0.1
ROUGH				
Quillback carpsucker	14	1.2	10,215	5.4
Northern hogsucker	2	0.2	270	0.1
Smallmouth buffalo	11	1.0	15,215	8.1
River redhorse	6	0.5	6,900	3.7
Black redhorse	2	0.2	1,295	0.7
Golden redhorse	50	4.4	22,023	11.7
Skipjack herring	74	6.5	28,503	15.1
Carp	33	2.9	22,358	11.9
Mooneye	16	1.4	2,848	1.5

6

(Continued)

TABLE 2.7-88 (Continued)

Species	Number	Percentage of Total Number	Weight (grams)	Percentage of Total Weight
ROUGH (Continued)				
Channel catfish	12	1.0	3,065	1.6
Freshwater drum	20	1.8	1,823	1.0
TOTAL	1,134	100.0	188,247	100.0

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*Fish were obtained in eight electroshocking and eight gill netting collections. Total duration of gill netting was 44 - 60 hours per station. Nets were set for 1 - 2 hours per station on March 28 and 29, 1 - 3 per station on May 31 and June 1, 17 - 21 hours per station (overnight setting) on June 24, 25 and 26, 2 hours per station on July 24 and 26 and August 28 and 29, 17 - 25 hours per station (overnight setting) on September 25 and 26 and 2 - 3 hours per station on November 20 and January 17.

TABLE 2.7-89

FISH POPULATIONS

TOTAL WEIGHT AND PERCENTAGE OF TOTAL WEIGHT FOR EACH SPECIES PER FIELD TRIP COLLECTED IN THE CLINCH RIVER - MARCH 28, 1974 TO JANUARY 17, 1975

Species	March 28 & 29		May 29, 31 and June 1		June 24, 25 and 26		July 24, 25 and 26		Aug. 27, 28 and 29		Sept. 23, 25 and 26		Nov. 18 and 20		Dec. 16		Jan. 15 and 17	
	Weight (grams)	% of Weight	Weight (grams)	% of Weight	Weight (grams)	% of Weight	Weight (grams)	% of Weight	Weight (grams)	% of Weight	Weight (grams)	% of Weight	Weight (grams)	% of Weight	Weight (grams)	% of Weight	Weight (grams)	% of Weight
GAME																		
Rock bass	--	--	--	--	210	0.3	--	--	53	0.4	75	0.4	--	--	278	1.3	128	0.6
Redbreast sunfish	--	--	--	--	--	--	--	--	--	--	326	1.6	--	--	51	0.2	73	0.4
Bluegill	--	--	86	0.4	1,462	2.2	37	0.9	315	2.3	708	3.4	--	--	2.142	10.1	65	0.3
Longear sunfish	--	--	--	--	105	0.2	--	--	63	0.5	--	--	--	--	--	--	--	--
Redear sunfish	--	--	--	--	240	0.4	--	--	--	--	--	--	--	--	274	1.3	--	--
Spotted bass	--	--	--	--	--	--	--	--	3	<0.1	--	--	--	--	56	0.2	33	0.2
Largemouth bass	--	--	815	4.0	115	0.2	445	10.9	205	1.5	133	0.6	640	4.7	5.731	27.1	40	0.2
White crappie	--	--	--	--	--	--	37	0.9	--	--	--	--	--	--	270	1.3	8	<0.1
Yellow perch	--	--	--	--	165	0.3	--	--	155	1.1	--	--	--	--	--	--	--	--
Sauger	1,245	15.0	1,650	8.0	1,200	1.8	685	16.8	--	--	1,175	5.7	1,980	14.6	--	--	--	--
White bass	545	6.5	--	--	375	0.6	470	11.5	--	--	3,246	15.8	--	--	4,119	19.5	270	1.4
Striped bass	--	--	--	--	--	--	--	--	128	0.9	--	--	--	--	--	--	--	--
FORAGE																		
Brook silverside	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	<0.1	8	<0.1
Gizzard shad	240	2.9	130	0.6	8,782	13.1	600	14.7	1,540	11.3	1,978	9.6	1,530	11.3	5,719	27.0	5,100	26.1
Threadfin shad	180	2.2	1,220	5.9	5,583	8.3	252	6.2	586	4.3	1,808	8.8	244	1.8	293	1.4	4,026	20.6
Banded sculpin	--	--	--	--	--	--	--	--	--	--	5	<0.1	--	--	18	0.1	25	0.1
Silver chub	--	--	--	--	--	--	120	2.9	61	0.5	--	--	50	0.4	--	--	--	--
Golden shiner	--	--	--	--	--	--	--	--	--	--	--	--	--	--	18	0.1	14	0.1
Rosefin shiner	--	--	--	--	--	--	--	--	--	--	8	<0.1	--	--	--	--	--	--
Emerald shiner	--	--	--	--	84	0.1	--	--	--	--	--	--	6	<0.1	589	2.8	145	0.7
Bluntnose minnow	--	--	--	--	--	--	--	--	--	--	--	--	--	--	12	<0.1	15	0.1
Greenside darter	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	<0.1	--	--
Logperch	--	--	--	--	62	0.1	--	--	--	--	--	--	35	0.3	11	<0.1	--	--
ROUGH																		
Quillback carpsucker	810	9.8	580	2.8	6,385	9.5	--	--	870	6.4	--	--	1,570	11.6	--	--	--	--
Northern hogsucker	--	--	--	--	--	--	270	6.5	--	--	--	--	--	--	--	--	--	--
Smallmouth buffalo	--	--	--	--	10,215	15.3	--	--	--	--	1,615	7.8	3,385	25.0	--	--	--	--
River redhorse	--	--	--	--	6,380	9.5	--	--	--	--	--	--	--	--	520	[illegible]	--	--
Black redhorse	--	--	--	--	--	--	--	--	--	--	1,085	5.3	--	--	--	--	210	1.1
Golden redhorse	--	--	1,435	7.0	11,619	17.4	--	--	2,630	19.4	2,109	10.2	1,860	13.7	1,030	4.9	1,340	6.9
Skipjack herring	5,270	63.6	13,898	67.5	2,300	3.4	602	14.7	987	7.3	1,241	6.0	--	--	28	0.1	4,177	21.4
Carp	--	--	490	2.4	8,460	12.6	570	13.9	4,945	36.4	3,755	18.3	615	4.6	--	--	3,523	18.1
Mooneye	--	--	137	0.7	1,170	1.7	--	--	870	6.4	178	0.9	385	2.8	--	--	108	0.5
Channel catfish	--	--	--	--	990	1.5	--	--	165	1.2	785	3.8	1,125	8.3	--	--	--	--
Freshwater drum	--	--	152	0.7	1,021	1.5	--	--	--	--	337	1.6	113	0.8	--	--	200	1.0
Total	8,290		20,593		66,923		4,088		13,576		20,569		13,538		21,162		19,508	

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TABLE 2.7-90

FISH POPULATIONS - GILL NETTING*

TOTAL NUMBER AND DIVERSITY INDEX OF FISH COLLECTED PER SAMPLING STATION COLLECTED IN THE CLINCH RIVER - MARCH 28, 1974 - JANUARY 17, 1975

Side of River** -	Transect 1		Transect 2		Transect 3		Transect 4		Transect 5	
Species	Left	Right	Left++	Right	Left++	Right	+	Right	Left	Right
GAME										
Redbreast sunfish	1	--	--	--	--	--	--	--	--	--
Bluegill	1	2	--	2	--	1	--	1	1	--
Largemouth bass	--	--	--	--	--	--	--	--	1	--
White crappie	--	1	--	--	--	--	--	--	--	--
Sauger	3	1	2	2	3	2	1	1	1	1
White bass	1	--	--	--	3	--	6	2	--	--
Striped bass	1	--	--	--	--	--	--	--	--	--
FORAGE										
Gizzard shad	--	--	--	2	3	--	--	--	--	4
Threadfin shad	15	26	24	6	12	3	68	40	50	36
Silver chub	--	--	--	--	1	--	--	2	--	1
ROUGH										
Quillback carpsucker	--	--	3	1	1	--	--	1	4	1
Smallmouth buffalo	--	--	1	--	--	--	--	--	1	1
Northern hogsucker	--	--	--	--	--	--	1	--	1	--
River redhorse	--	--	--	--	2	1	--	--	--	2
Black redhorse	1	--	--	--	--	--	--	--	--	--
Golden redhorse	1	--	1	--	2	2	2	2	1	--
Skipjack herring	8	3	10	4	16	5	5	8	4	9
Carp	--	--	1	--	4	2	1	2	1	1
Mooneye	2	--	1	--	1	--	1	--	4	--
Channel catfish	--	--	3	--	3	--	--	--	2	4
Freshwater drum	1	1	1	--	3	--	--	--	2	--
Total	35	34	47	17	54	16	85	59	73	60
Diversity Index	1.79	0.90	1.57	1.63	2.16	1.80	0.83	1.20	1.34	1.41

*Total duration of gill netting was 44-60 hours per station. Nets were set for 1-2 hours per station on March 28 and 29, 1-3 hours per station on May 31 and June 1, 17-21 hours per station (overnight setting) on June 24, 25 and 26, 2 hours per station on July 24 and 26 and August 28 and 29, 17-25 hours per station (overnight setting) on September 25 and 26 and 2-3 hours per station on November 20 and January 17.

**Left and right sides of the river as oriented downstream

+Right side of midriver sand bar

++Gill nets set across mouths of creeks on March 28 and 29, and from shore toward midchannel during the other samplings.

TABLE 2.7-91

FISH POPULATIONS - ELECTROSHOCKING
TOTAL NUMBER AND DIVERSITY INDEX OF FISH COLLECTED PER SAMPLING STATION IN THE CLINCH RIVER - MAY 29, 1974 - JANUARY 15, 1975

Species / Side of River* -	Transect 1 Left	Transect 1 Right	Transect 2 Left	Transect 2 Right	Transect 3 Left	Transect 3 Right	Transect 4 **	Transect 4 Right	Transect 5 Left	Transect 5 Right
GAME										
Rock bass	--	6	4	--	--	--	--	2	1	--
Redbreast sunfish	1	2	--	--	--	--	--	--	1	--
Bluegill	10	9	7	4	15	6	--	3	14	2
Longear sunfish	--	--	1	1	--	--	--	--	--	--
Redear sunfish	1	--	--	--	--	--	--	--	2	1
Spotted bass	2	2	2	3	--	1	--	3	1	--
Largemouth bass	1	2	2	--	9	1	--	1	3	--
White crappie	--	--	--	--	--	--	--	--	2	--
Yellow perch	--	1	--	--	--	--	--	1	--	--
Sauger	--	--	--	1	--	--	--	--	--	--
White bass	1	--	1	1	1	2	--	--	--	1
FORAGE										
Brook silverside	--	--	4	--	--	--	--	--	3	1
Gizzard shad	5	1	25	2	14	13	22	20	10	6
Threadfin shad	2	11	2	10	26	4	1	14	32	--
Banded sculpin	3	--	2	--	--	2	--	--	--	--
Golden shiner	--	1	--	--	--	5	--	--	--	--
Rosefin shiner	--	--	--	--	--	1	--	--	--	--
Emerald shiner	8	4	4	13	18	98	1	7	1	--
Bluntnose minnow	1	1	--	1	3	3	1	5	1	1
Greenside darter	--	--	--	--	1	--	--	--	--	--
Logperch	1	1	--	--	--	2	--	--	--	1
ROUGH										
Quillback carpsucker	--	1	--	1	--	--	--	--	1	--
Smallmouth buffalo	1	1	--	1	--	1	1	1	--	2
River redhorse	--	--	1	--	--	--	--	--	--	--
Black redhorse	--	--	--	--	1	--	--	--	--	--
Golden redhorse	1	5	2	2	4	2	4	6	3	8
Skipjack herring	--	--	--	--	--	--	--	2	--	--
Carp	2	--	6	3	3	--	1	1	3	1
Mooneye	--	1	3	1	--	--	2	--	--	--
Freshwater drum	2	--	1	--	4	2	--	--	1	2
Total	42	49	67	44	99	143	33	66	79	26
Diversity Index	2.39	2.37	2.24	2.16	2.05	1.35	1.23	2.09	2.00	2.04

*Left and right side of the river as oriented downstream
**Right side of midriver sand bar

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TABLE 2.7-92

FISH POPULATIONS - GILL NETTING*
TOTAL NUMBER OF FISH COLLECTED ON EACH FIELD TRIP
COLLECTED IN THE CLINCH RIVER - MARCH 28, 1974 - JANUARY 17, 1975

Species	March 28 and 29	May 31 and June 1	June 24, 25 and 26	July 24 and 26	Aug. 28 and 29	Sept. 25 and 26	Nov. 20	Jan. 17
GAME								
Redbreast sunfish	--	--	--	--	--	1	--	--
Bluegill	--	--	2	--	1	5	--	--
Largemouth bass	--	1	--	--	--	--	--	--
White crappie	--	--	--	1	--	--	--	--
Sauger	2	2	3	2	--	2	6	--
White bass	1	--	1	1	--	9	--	--
Striped bass	--	--	--	--	1	--	--	--
FORAGE								
Gizzard shad	3	--	2	--	--	3	--	1
Threadfin shad	3	35	136	6	5	29	8	58
Silver chub	--	--	--	2	1	--	1	--
ROUGH								
Quillback carpsucker	1	1	7	--	--	--	2	--
Smallmouth buffalo	--	--	1	--	--	1	1	--
Northern hogsucker	--	--	--	2	--	--	--	--
River redhorse	--	--	5	--	--	--	--	--
Black redhorse	--	--	--	--	--	1	--	--
Golden redhorse	--	2	6	--	1	--	2	--
Skipjack herring	10	39	7	3	3	3	--	7
Carp	--	--	2	1	5	4	--	--
Mooneye	--	1	--	--	4	1	2	1
Channel catfish	--	--	4	--	1	4	3	--
Freshwater drum	--	2	3	--	--	1	2	--
TOTAL	20	83	179	18	22	64	27	67

*Total duration of gill netting was 44-60 hours per station. Nets were set for 1-2 hours per station on March 28 and 29, 1-3 hours per station on May 31 and June 1, 17-21 hours per station (overnight setting) on June 24, 25 and 26, 2 hours per station on July 24 and 26 and August 28 and 29, 17-25 hours per station (overnight setting) on September 25 and 26 and 2-3 hours per station on November 20 and January 17.

TABLE 2.7-93

FISH POPULATIONS - ELECTROSHOCKING

TOTAL NUMBER OF FISH COLLECTED ON EACH FIELD TRIP

COLLECTED IN THE CLINCH RIVER - MAY 29, 1974 - JANUARY 15, 1975

Species	May 29	June 24	July 25	Aug. 24	Sept. 23	Nov. 18	Dec. 16	Jan. 15
GAME								
Rock bass	--	1	--	2	1	--	5	4
Redbreast sunfish	--	--	--	--	2	--	1	1
Bluegill	1	12	1	2	2	--	39	14
Longear sunfish	--	1	--	1	--	--	--	--
Redear sunfish	--	2	--	--	--	--	2	--
Spotted bass	--	--	--	1	--	--	8	5
Largemouth bass	--	1	1	1	2	1	12	1
White crappie	--	--	--	--	--	--	1	1
Yellow perch	--	1	--	1	--	--	--	--
Sauger	--	1	--	--	--	--	--	--
White bass	--	2	1	--	1	--	2	1
FORAGE								
Brook silverside	--	--	--	--	--	--	1	7
Gizzard shad	1	48	3	8	6	6	26	21
Threadfin shad	1	3	--	9	7	--	30	53
Banded sculpin	--	--	--	--	1	--	3	3
Golden shiner	--	--	--	--	--	--	3	3
Rosefin shiner	--	--	--	--	1	--	--	--
Emerald shiner	--	15	--	--	--	3	109	27
Bluntnose minnow	--	--	--	--	--	--	7	10
Greenside darter	--	--	--	--	--	--	1	--
Logperch	--	2	--	--	--	2	1	--
ROUGH								
Quillback carpsucker	--	2	--	1	--	--	--	--
Smallmouth buffalo	--	7	--	--	--	1	--	--
River redhorse	--	--	--	--	--	--	1	--
Black redhorse	--	--	--	--	--	--	--	1
Golden redhorse	2	20	--	5	5	2	2	3
Skipjack herring	--	--	--	--	1	--	1	--
Carp	1	13	--	2	2	1	--	2
Mooneye	--	7	--	--	--	--	--	--
Freshwater drum	--	10	--	--	1	--	--	1
TOTAL	6	148	6	33	32	16	255	158

6

TABLE 2.7-94

FISH POPULATIONS

BACK CALCULATED STANDARD LENGTHS OF SEVEN MOST ABUNDANT SPECIES COLLECTED FROM THE CLINCH RIVER - MARCH 28, 1974 - JANUARY 17, 1975

Species*	Statistic	Age (Years) I	II	III	IV	V	VI	VII	VIII	IX	X	XI
Saug.	Mean Length++	10.07	19.49	25.89	30.50	33.98						
	n$^{\nabla}$	18	18	15	10	5						
	s.d.**	3.92	2.78	3.14	4.09	4.76						
	s.e.+	0.92	0.65	0.81	1.29	2.13						
W.B.	M.L.	5.94	12.49	19.27	23.21	24.60	42.8					
	n	18	18	13	8	3	1					
	s.d.	2.84	3.26	3.78	3.73	7.79	--					
	s.e.	0.67	0.77	1.05	1.32	4.50	--					
S.H.	M.L.	10.68	15.08	17.54	19.14	20.98	24.21	26.53	29.04	31.20	32.80	34.7
	n	30	29	25	21	14	10	8	5	3	2	1
	s.d.	4.04	5.18	4.87	3.19	2.36	2.17	2.13	1.92	3.11	0.84	--
	s.e.	0.74	0.96	0.97	0.69	0.63	0.68	0.75	0.85	1.80	0.60	--
G.S.	M.L.	13.27	17.45	20.25	21.06							
	n	30	28	18	5							
	s.d.	2.73	2.44	2.37	1.99							
	s.e.	0.50	0.46	0.56	0.89							
T.S.	M.L.	9.88	12.09	14.56	15.1							
	n	30	12	3	1							
	s.d.	2.00	0.99	0.11	--							
	s.e.	0.37	0.28	0.06	--							
Carp	M.L.	20.96	24.15	26.58	28.19	29.49	30.67	29.2				
	n	19	19	18	12	8	6	1				
	s.d.	2.41	1.73	1.63	1.22	1.44	1.98	--				
	s.e.	0.55	0.40	0.38	0.35	0.51	0.81	--				
S.B.	M.L.	25.25	28.20	31.50	33.26	35.11	36.26	36.05	38.0			
	n	11	11	11	11	9	5	2	1			
	s.d.	0.86	1.52	1.86	2.02	1.28	1.55	0.21	--			
	s.e.	0.25	0.45	0.56	0.61	0.42	0.69	0.15	--			

*Saug.=sauger; W.B.=white bass; S.H.=skipjack herring; G.S.=gizzard shad; T.S.=threadfin shad; S.B.=smallmouth buffalo

**Standard deviation

+Standard error of the mean

++In centimeters

$^{\nabla}$n=number of fish

6

TABLE 2.7-95

FISH POPULATIONS

DATA COLLECTED BY THE TVA ON THE CLINCH RIVER (68)

	Station 1*								
	February 1-2, 1973			April 30, May 1-9, 1973			August 9-10, 1973		
	Gill Net Data No.	Gill Net Data Wt. (gms)	Electro-Fishing No.	Gill Net Data No.	Gill Net Data Wt. (gms)	Electro-Fishing No.	Gill Net Data No.	Gill Net Data Wt. (gms)	Electro-Fishing No.
Walleye	1	2,525	--	--	--	--	--	--	--
Sauger	6	4,425	--	7	4,525	--	--	--	--
White bass	1	650	--	2	600	3	--	--	--
Carp	--	--	17	10	19,720	2	--	--	--
Quillback	3	3,050	--	3	3,875	--	--	--	--
River carpsucker	--	--	--	1	1,550	--	--	--	1
Golden redhorse	1	350	1	2	800	--	--	--	1
Black redhorse	1	600	--	--	--	--	--	--	--
Silver redhorse	--	--	--	1	2,050	--	--	--	--
Smallbouth buffalo	--	--	1	21	35,550	1	--	--	--
Black buffalo	--	--	--	2	7,320	--	--	--	--
Gizzard shad	5	910	76	5	800	43	1	186	57
Skipjack herring	1	650	--	24	14,910	--	3	1,138	12
Drum	--	--	--	1	150	--	1	164	1
Channel catfish	--	--	--	--	--	--	--	--	--
Minnows	--	--	7	--	--	3	--	--	60

(Continued)

TABLE 2.7-95 (Continued)

	Station 2**								
	February 1-2, 1973			April 30; May 1-9, 1973			August 9-10, 1973		
	Gill Net Data		Electro-Fishing	Gill Net Data		Electro-Fishing	Gill Net Data		Electro-Fishing
	No.	Wt.(gms)	No.	No.	Wt.(gms)	No.	No.	Wt.(gms)	No.
Sauger	4	3,700	--	10	8,125	--	1	1,025	--
White bass	1	375	--	5	1,675	1	--	--	--
Bluegill	--	--	2	--	--	--	--	--	3
Carp	1	2,800	9	5	7,700	--	2	3,600	--
Quillback	2	2,450	--	7	7,725	--	--	--	--
River carpsucker	4	7,850	--	2	3,300	--	--	--	--
Golden redhorse	--	--	--	1	500	--	--	--	--
Silver redhorse	--	--	--	1	2,200	--	--	--	--
Smallmouth buffalo	1	1,350	--	27	42,925	--	--	--	--
Black buffalo	--	--	--	--	--	--	1	1,850	--
Gizzard shad	4	525	70	1	200	9	--	--	83
Mooneye	1	250	--	--	--	--	--	--	--
Skipjack herring	1	1,125	--	9	5,800	--	1	458	--
Drum	--	--	--	--	--	--	1	138	--
Longnose gar	--	--	--	--	--	3	--	--	--
Channel catfish	--	--	--	--	--	--	1	340	--
Emerald shiner	--	--	--	--	--	3	--	--	--
Minnows	--	--	256	--	--	--	--	--	35

(Continued)

TABLE 2.7-95 (Continued)

	Station 3+								
	February 1-2, 1973			April 30; May 1-9, 1973			August 9-10, 1973		
	Gill Net Data No.	Gill Net Data Wt. (gms)	Electro-Fishing No.	Gill Net Data No.	Gill Net Data Wt. (gms)	Electro-Fishing No.	Gill Net Data No.	Gill Net Data Wt. (gms)	Electro-Fishing No.
Walleye	1	3,200	--	--	--	--	--	--	--
Sauger	6	3,575	1	16	No Wt.	--	--	--	--
White bass	2	750	--	38	13,130	--	--	--	--
Largemouth bass	--	--	--	--	--	--	--	--	1
Carp	1	3,150	9	2	2,340	--	1	193	--
Quillback	--	--	--	4	4,620	--	--	--	--
River carpsucker	--	--	--	1	1,690	--	--	--	--
Golden redhorse	1	425	2	1	300	--	--	--	1
Black redhorse	1	775	--	--	--	--	--	--	--
Silver redhorse	--	--	--	4	7,430	--	1	1,360	--
Smallmouth buffalo	5	8,625	--	43	65,610	--	--	--	--
Hogsucker	1	350	--	--	--	--	--	--	--
Gizzard shad	5	875	95	2	370	7	--	--	84
Skipjack herring	1	600	--	28	17,120	--	4	1,575	2
Minnows	--	--	296	--	--	2	--	--	2

*Vicinity of Clinch River Mile 15.7, right bank (facing downstream)

**Vicinity of Clinch River Mile 16.5, left bank (facing downstream)

+Vicinity of Clinch River Mile 17.9, right bank (facing downstream)

TABLE 2.7-96

FISH POPULATIONS DATA COLLECTED BY THE TVA

FEBRUARY 1 AND 2, APRIL 30, MAY 1-9 AND AUGUST 9 AND 10, 1973[68]

Numbers and Percentage of Fish Sampled* at
LMFBR Demonstration Project Site

	Game	Rough	Forage
February	8	25	88
	7	19	330
	10	21	396
	25	65	814
	2.8%	7.2%	90%
April - May	12	68	51
	16	55	13
	54	83	11
	82	206	75
	22.6%	56.7%	20.7%
August	0	19	118
	4	6	118
	1	9	86
	5	34	322
	1.4%	9.4%	89.2%

Results of All Three Samples

Game	Rough	Forage
6.9%	18.7%	74.4%

*Samples taken at Clinch River Mile 15.7, right bank; Clinch River Mile 16.5, left bank; and Clinch River Mile 17.9, right bank. (Right and left banks facing downstream.)

TABLE 2.7-97

FISH EGGS AND LARVAE - STATIONARY NETTING*

ENUMERATION - CLINCH RIVER

COLLECTED MARCH 28 - JUNE 2, 1974

Collection Date	March 28		April 18		May 1		May 16		June 2	
	No. Counted	No./m^3	No. Counted	No./m^3	No. Counted	No./m^3	No. Counted	No./m^3	No. Counted	No./m^3
EGGS										
Fertilized	1	<0.01	--	--	5	0.02	106	0.48	169	0.48
Unfertilized	1	<0.01	--	--	--	--	1	<0.01	--	--
LARVAE										
	1	<0.01	--	--	--	--	--	--	--	--

*Samples were collected one foot above the bottom using a 1,000 micron mesh, one-half meter diameter plankton net with attached inside and outside flow meters. For each sample the net was placed in a stationary position facing upstream for 10 minutes.

TABLE 2.7-98

FISH EGGS AND LARVAE - STATIONARY NETTING*

ENUMERATION PER FIELD TRIP - CLINCH RIVER

COLLECTED JUNE 17 - AUGUST 29, 1974

Collection Date	June 17		June 25-26		July 12		July 25		August 9		August 29	
	No. Counted	No./m^3	No. Counted	No./m^3	No. Counted	No./m^3	No. Counted	No./m^3	No. Counted	No./m^3	No. Counted	No./m^3
EGGS												
Fertilized	3	< 0.10	7	< 0.02	1	0.01	1	< 0.01	--	--	--	--
Unfertilized	--	--	1	<0.01	--	--	--	--	--	--	--	--
LARVAE	--	--	13	< 0.03	--	--	--	--	--	--	--	--

*Samples were collected one foot above the bottom using a 1,000 micron mesh, one-half meter diameter plankton net with attached inside and outside flow meters. For each sample the net was placed in a stationary position facing upstream for ten minutes.

TABLE 2.7-99

FISH EGGS AND LARVAE - STATIONARY NETTING*
ENUMERATION PER SAMPLING STATION - CLINCH RIVER
COLLECTED MARCH 28 - AUGUST 29, 1974

	Transect 1-Station 3		Transect 2-Station 3		Transect 3-Station 3		Transect 4-Station 3		Transect 5-Station 3	
	No. Counted	No./m^3	No. Counted	No./m^3	No. Counted	No./m^3	No. Counted	No./m^3	No. Counted	No./m^3
EGGS										
Fertilized	44	0.12	57	0.16	58	0.19	69	0.20	49	0.11
Unfertilized	--	--	1	< 0.01	--	--	1	< 0.01	1	< 0.01
LARVAE										
Percidae	--	--	--	--	1	< 0.01	--	--	--	--

6

	Poplar Springs Creek**		Caney Creek**	
Location	No. Counted	No./m^3	No. Counted	No./m^3
EGGS				
Fertilized	3	< 0.01	13	0.07
Unfertilized	--	--	--	--
LARVAE				
Clupeidae	12	0.01	1	< 0.01

6

*Samples were collected one foot above the bottom using a 1,000 micron mesh, one-half meter diameter plankton net with attached inside and outside flow meters. For each sample the net was placed in a stationary position facing upstream for ten minutes.

**Mid-depth tow samples were obtained using a slow speed tow on April 18, June 2 and June 26 and August 29, 1974.

TABLE 2.7-100

FISH FOOD PREFERENCE

CLASSIFICATION OF FISH - CLINCH RIVER

COLLECTED MARCH 28, 1974 - JANUARY 17, 1975

Species		Number Collected	Percentage of Total Number
PLANKTIVORES			
Gizzard shad		128	11.3
Threadfin shad		383	33.8
Golden shiner		6	0.5
Rosefin shiner		1	0.1
Emerald shiner		154	13.6
	SUBTOTAL	672	59.3
BOTTOM FEEDERS			
Mooneye		16	1.4
Carp		33	2.9
Quillback carpsucker		14	1.2
Northern hogsucker		2	0.2
Smallmouth buffalo		11	1.0
River redhorse		6	0.5
Black redhorse		2	0.2
Golden redhorse		50	4.4
Freshwater drum		20	1.8
	SUBTOTAL	154	13.6
INSECTIVORES			
Bluntnose minnow		17	1.5
Rock bass		13	1.1
Redbreast sunfish		5	0.4

6

(Continued)

TABLE 2.7-100 (Continued)

Species	Number Collected	Percentage of Total Number
INSECTIVORES (Continued)		
Bluegill	79	7.0
Longear sunfish	2	0.2
Redear sunfish	4	0.3
Logperch	5	0.4
Banded sculpin	7	0.6
Brook silverside	8	0.8
Greenside darter	1	0.1
Silver chub	4	0.3
SUBTOTAL	145	12.7
PISCIVORES		
Skipjack herring	74	6.5
Channel catfish	12	1.0
White bass	19	1.7
Striped bass	1	0.1
Spotted bass	14	1.2
Largemouth bass	20	1.8
White crappie	3	0.3
Yellow perch	2	0.2
Sauger	18	1.6
SUBTOTAL	163	14.4
TOTAL	1,134	100.0

6

Due to revisions in the

Aquatic Section pages 2.7-344

through 2.7-500 are no longer used

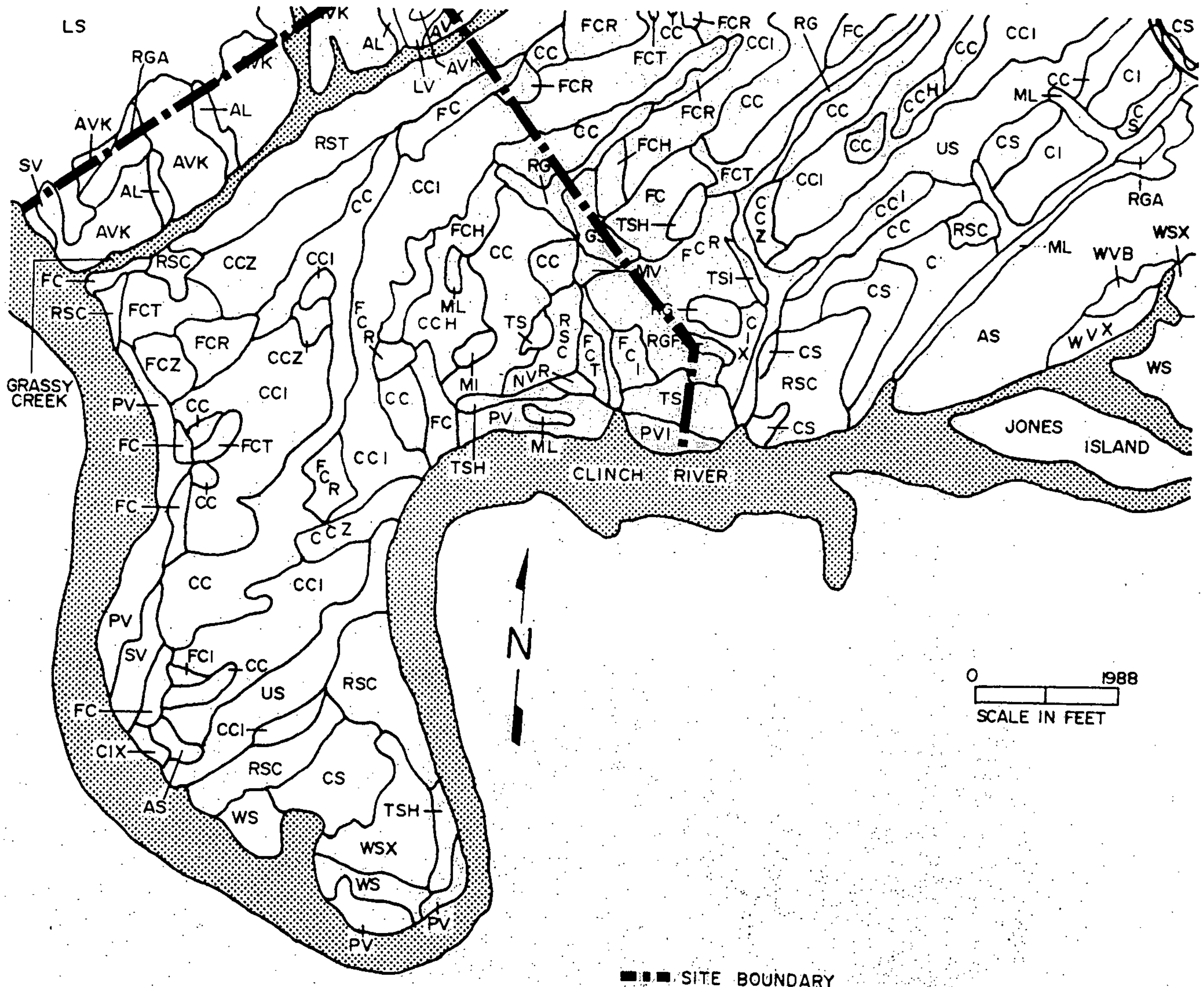


Figure 2.7-1 SOIL TYPES OF THE CLINCH RIVER SITE(6)
(Refer to Table 2.7-1 for an explanation of soil types.)

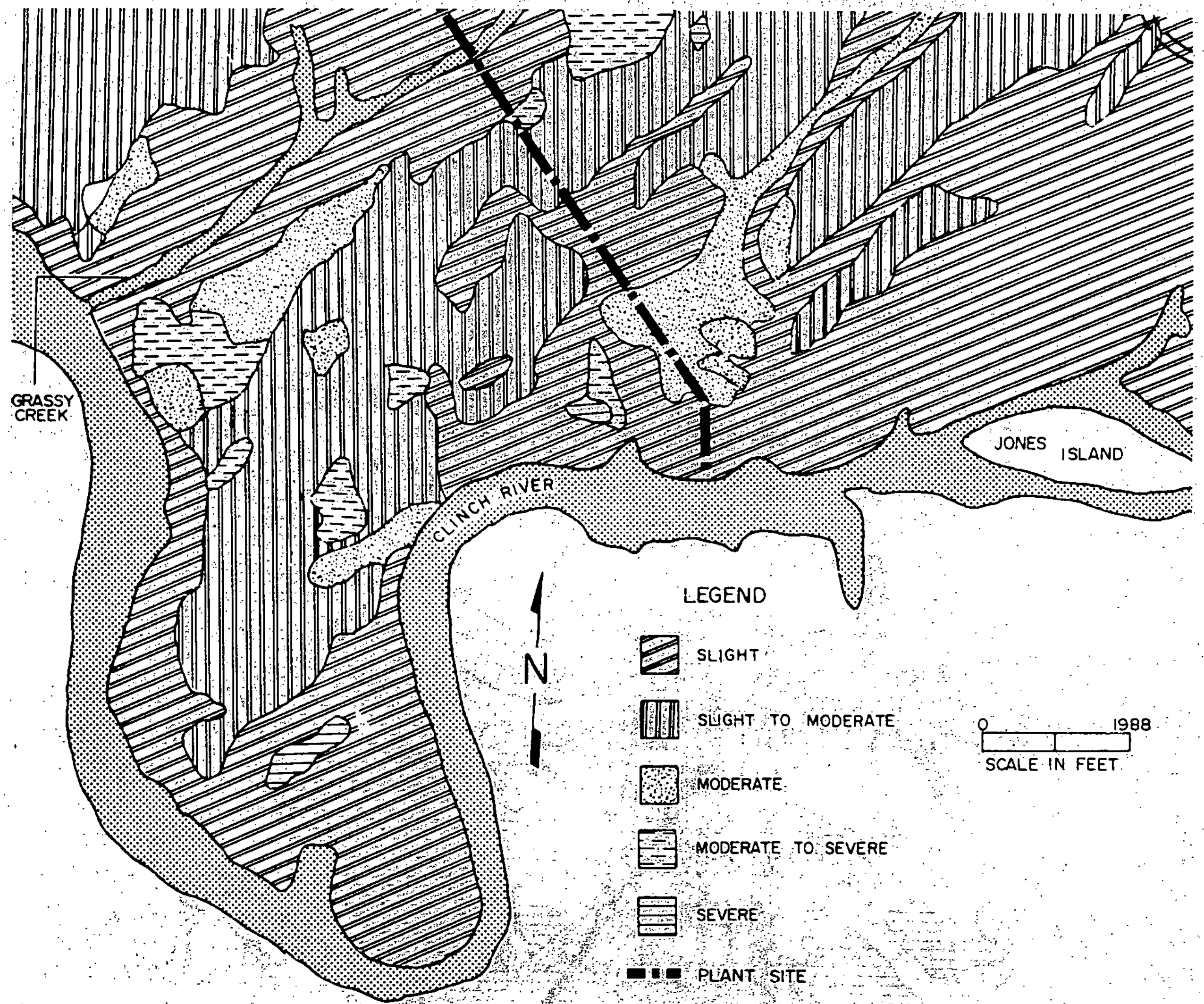


Figure 2.7-2 SOIL ERODIBILITY INTERPRETATIONS, CRBRP SITE[6]

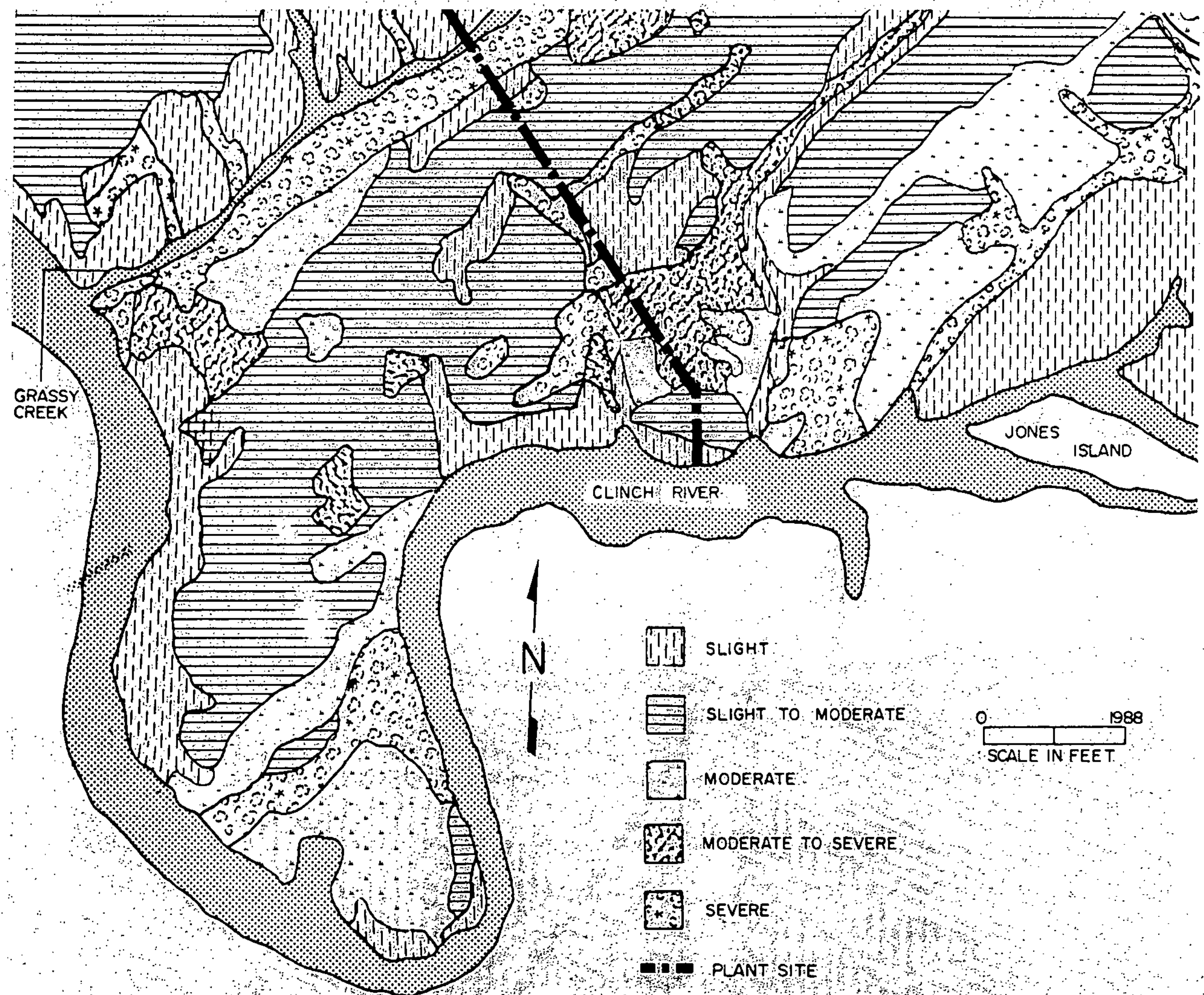


Figure 2.7-3 HEAVY EQUIPMENT IMPACT POTENTIAL INTERPRETATIONS, CRBRP SITE[6]

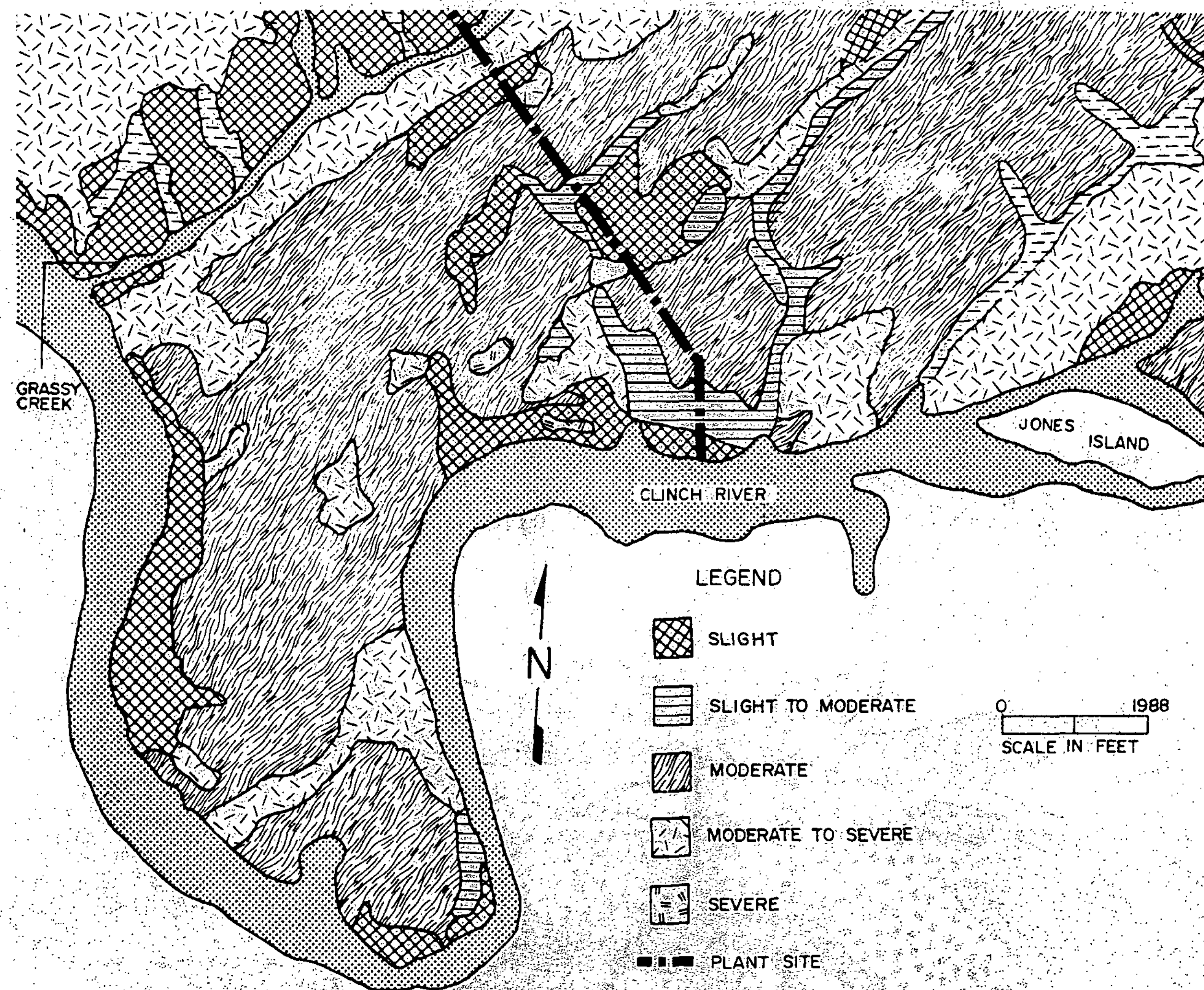


Figure 2.7-4 SEEDLING MORTALITY SOIL INTERPRETATIONS, CRBRP SITE[(6)]

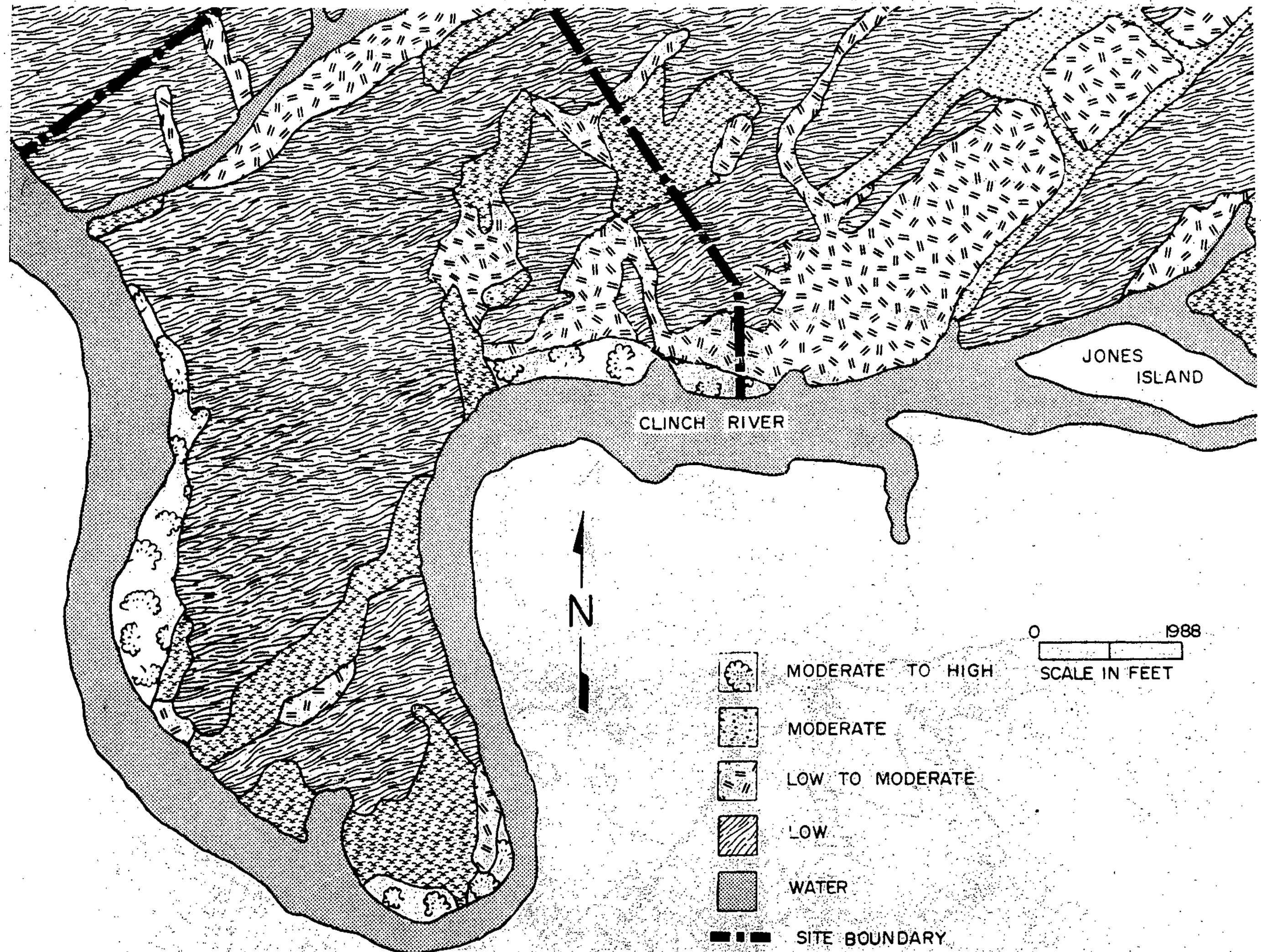


Figure 2.7-5 NATURAL PRODUCTIVITY SOIL INTERPRETATIONS, CRBRP SITE[6]

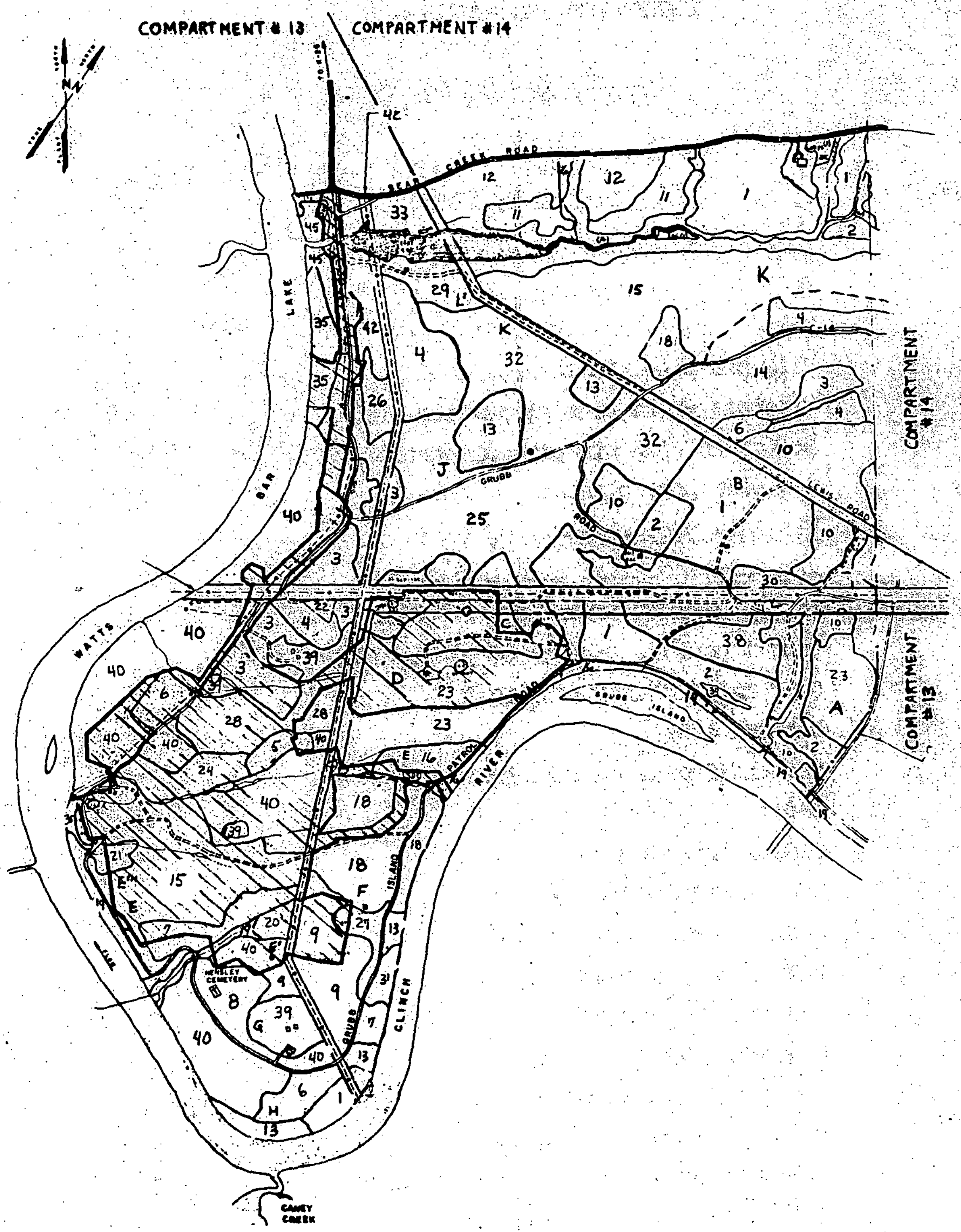


Figure 2.7-6. SITE STUDY AREAS AND OVERSTORY VEGATATION (Legend on Pages 2.7-507, 2.7-508 and 2.7-509. Alphabetic letters designate study areas.)

13

LEGEND FOR FIGURE 2.7-6

Compartment No. 13 | 13

Stratum No.	Forest Cover Type	Acreage TVA
1	Loblolly pine plantation, 1951	63
2	White pine plantation, 1951	32
3	White pine plantation, 1952	32
4	Virginia pine plantation, 1952	24
5	Virginia white pine plantation, 1952	4
6	Shortleaf Virginia pine plantation, 1952	13
7	Loblolly pine plantation, 1954	13
8	Virginia pine plantation, 1954	11
9	Virginia shortleaf pine plantation, 1954	23
10	Loblolly pine plantation, 1979	55
11	Hybrid poplar, cottonwood plantation, 1979	1
12	Cottonwood plantation, 1979	3
13	Natural pine	31
14	Shortleaf pine, white pine	3
15	Cedar	48
16	Cedar, natural pine	28
17	Cedar, red oak, white oak	0
18	Cedar, white oak, red oak	40
19	Cedar, ash, hackberry	13
20	Red oak, shortleaf pine	3
21	Red oak, cedar, poplar	3
22	Red oak, white oak	1
23	Red oak, white oak, poplar	66
24	Southern red oak, white oak, cedar	11
25	Red oak, hickory, poplar	49
26	Red oak, poplar	32
27	Southern red oak, poplar, shortleaf pine	6
28	White oak, red oak, poplar	20

13

LEGEND FOR FIGURE 2.7-6
(Continued)

Compartment No. 13 | 13

Stratum No.	Forest Cover Type	Acreage TVA
29	White oak, beech	8
30	Hickory, red oak	4
31	Poplar, red oak	6
32	Poplar, red oak, hickory, white oak, cottonwood	76
33	Sweetgum, Virginia pine, sycamore	10
34	Sweetgum, maple	3
35	Elm, boxelder, ash	9
36	Elm, maple	2
37	Ash, sycamore	6
38	Chinkapin oak, ash, red oak	12
39	Non Forested	23
40	Clearcut, cutover	126
41	Cemeteries, Homesites, Indian Mound	1
42	Powerline, Gasline, Right-of-way	55
43	Roads	28
44	Quarry	1
45	Inundated Land	14
46	Rivers, Streams and creeks	37
47	Beetle Kill	0
	TOTALS	1049

13

LEGEND FOR FIGURE 2.7-6
(Continued)

Compartment No. 14 13

Stratum No.	Forest Cover Type	Acreage TVA	
1	Loblolly plantation, 1948	39	13
2	Loblolly plantation, 1949	3	
3	Loblolly plantation, 1951	7	
4	White pine plantation, 1952	12	
5	Loblolly plantation, 1978	0	
6	Loblolly plantation, 1979	4	
7	White pine, 1979	0	
8	Walnut plantation, 1979	2	
9	Cottonwood, plantation, 1979	0	
10	Cottonwood sycamore, 1979	30	
11	Natural pine, shortleaf pine, Virginia pine	16	
12	Sweetgum, Virginia pine, shortleaf pine	25	
13	Shortleaf pine, Virginia pine, cedar	2	
14	Southern red oak, poplar, cottonwood	37	
15	Cottonwood, red oak, poplar	57	
16	Ash, sweetgum, elm	34	
17	Sludge Plot (cottonwood, sycamore)	1	
18	Clear cut	6	
19	Roads	14	
20	Powerlines, Gasline, Right-of-way	17	
21	Non-Forested Land	0	
22	Buildings	4	
23	Inundated	5	
	TOTALS	315	

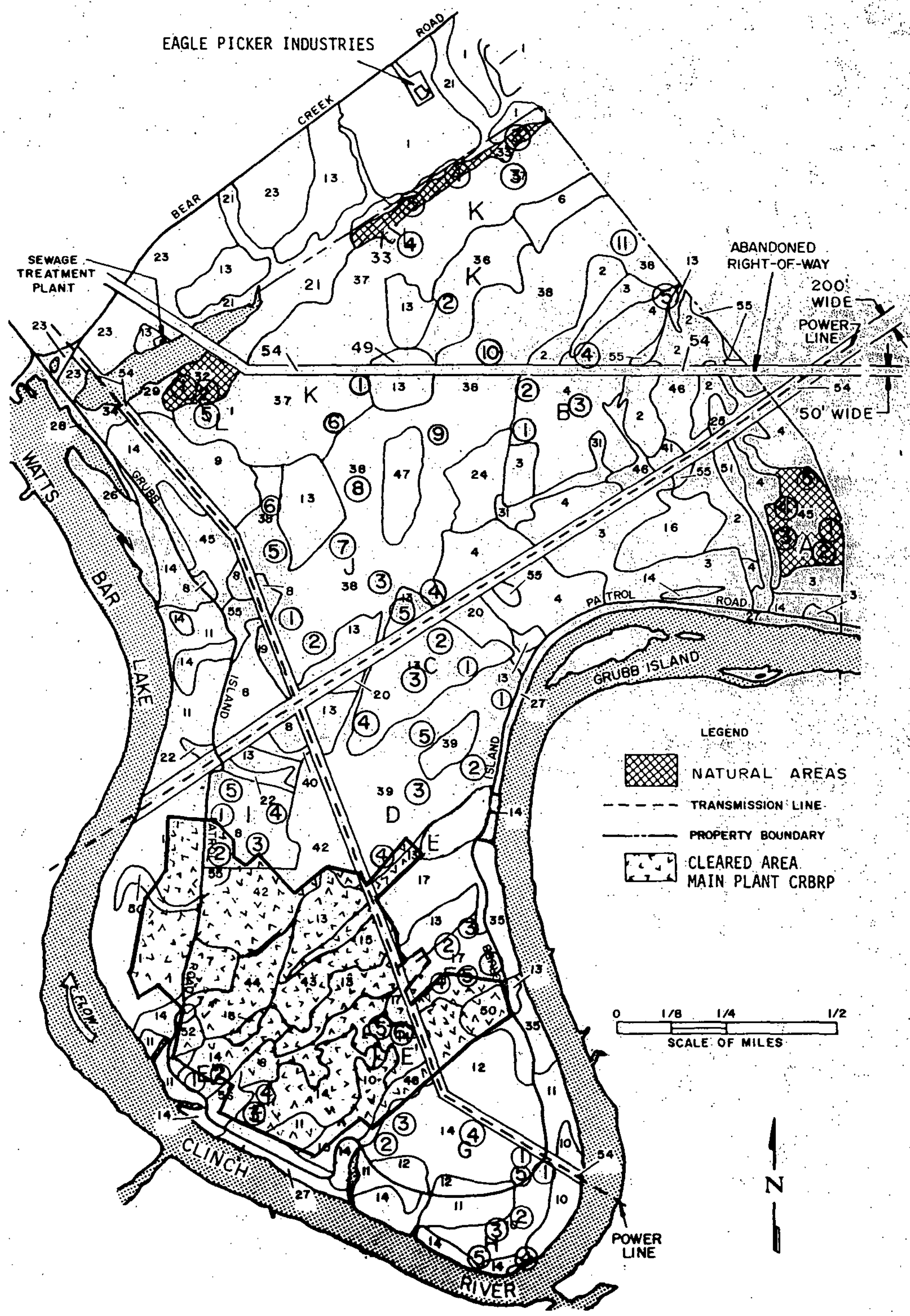


Figure 2.7-7 VEGETATION SAMPLING PLOTS FOR THE CLINCH RIVER SITE (Legend as for Figure 2.7-6. Alphabetic letters designate study areas, circled numerals designate sample locations).

Figure 2.7-8 DISTRIBUTION OF CIMICIFUGA RUBIFOLIA (1R)

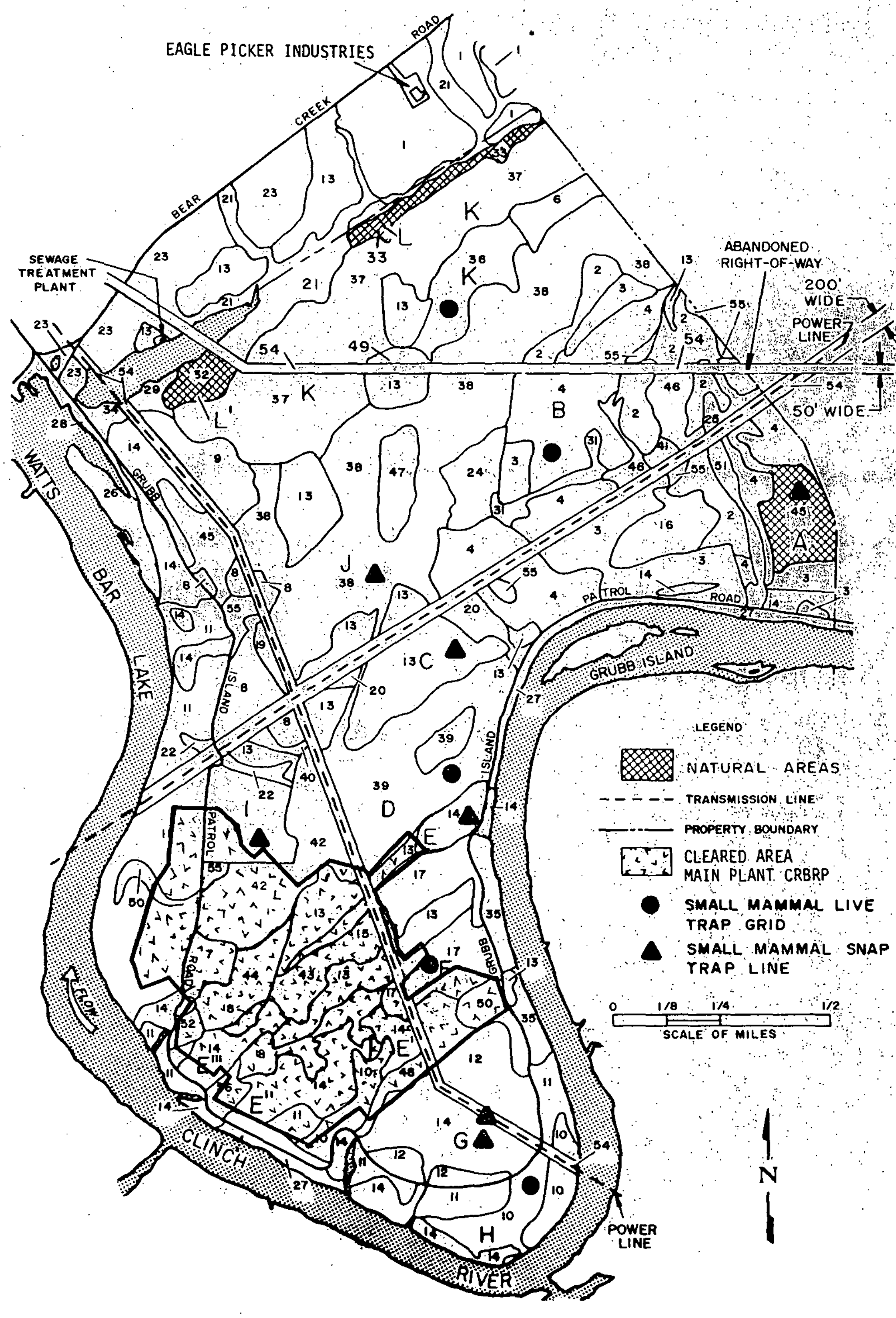


Figure 2.7-A SMALL MAMMAL SAMPLING LOCATIONS ON THE CLINCH RIVER SITE (Legend as for Figure 2.7-6)

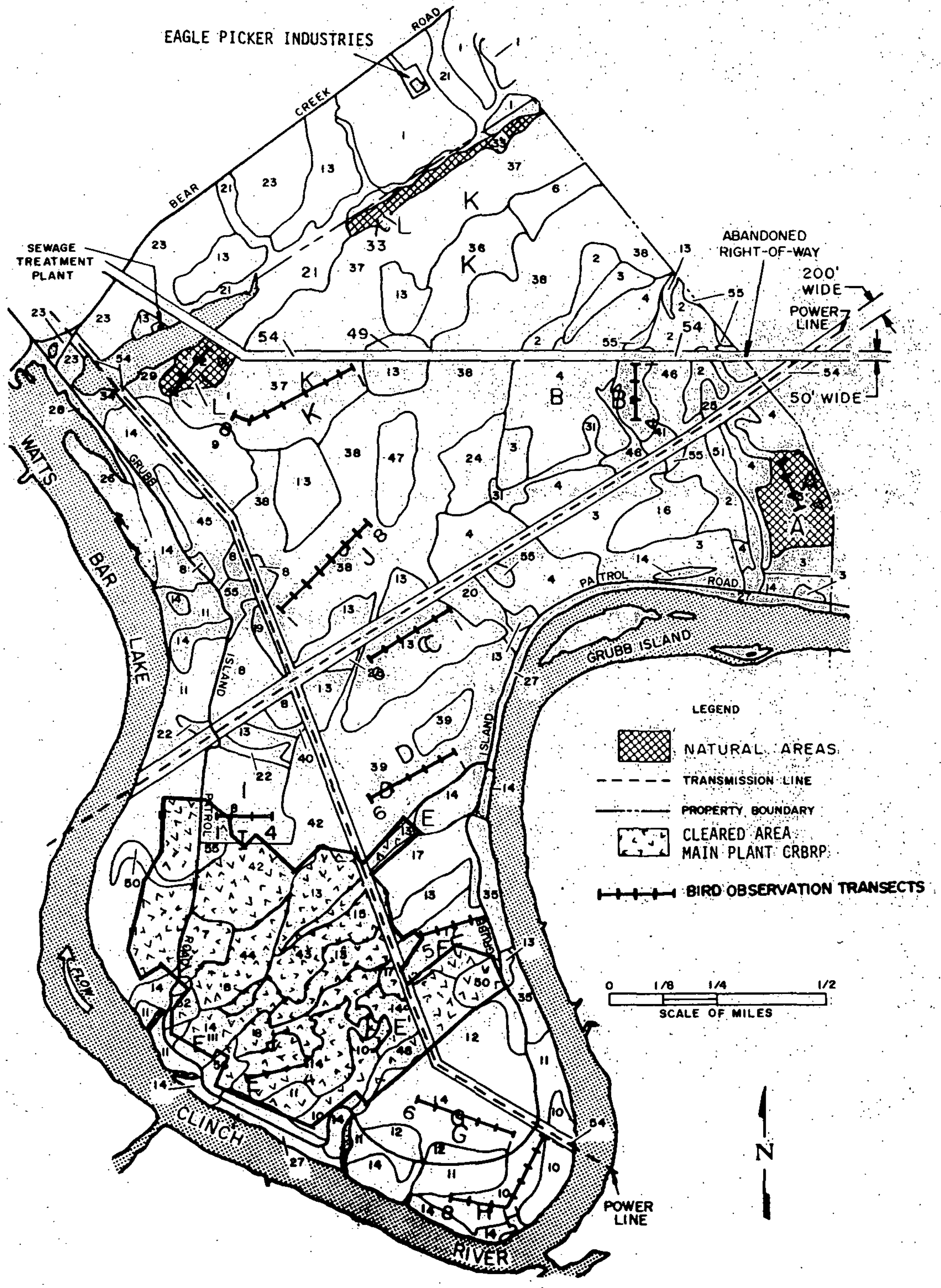


Figure 2.7-B LOCATIONS OF BIRD OBSERVATION TRANSECTS ON THE CLINCH RIVER SITE (Legend as for Figure 2.7-6)

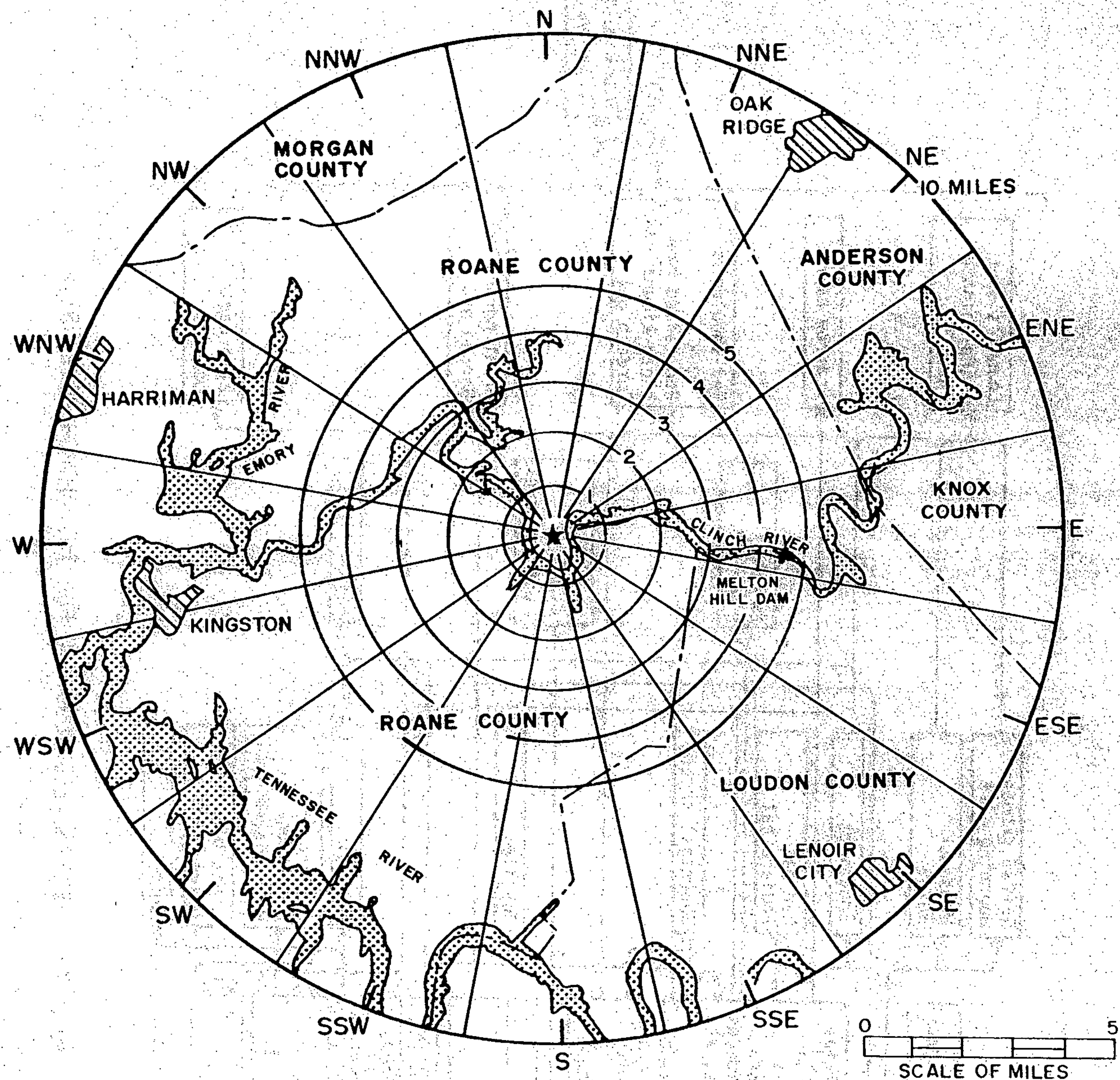


Figure 2.7-C SECTOR DESIGNATIONS FOR 1, 2, 3, 4, 5 AND 10 MILES FROM THE CRBRP SITE

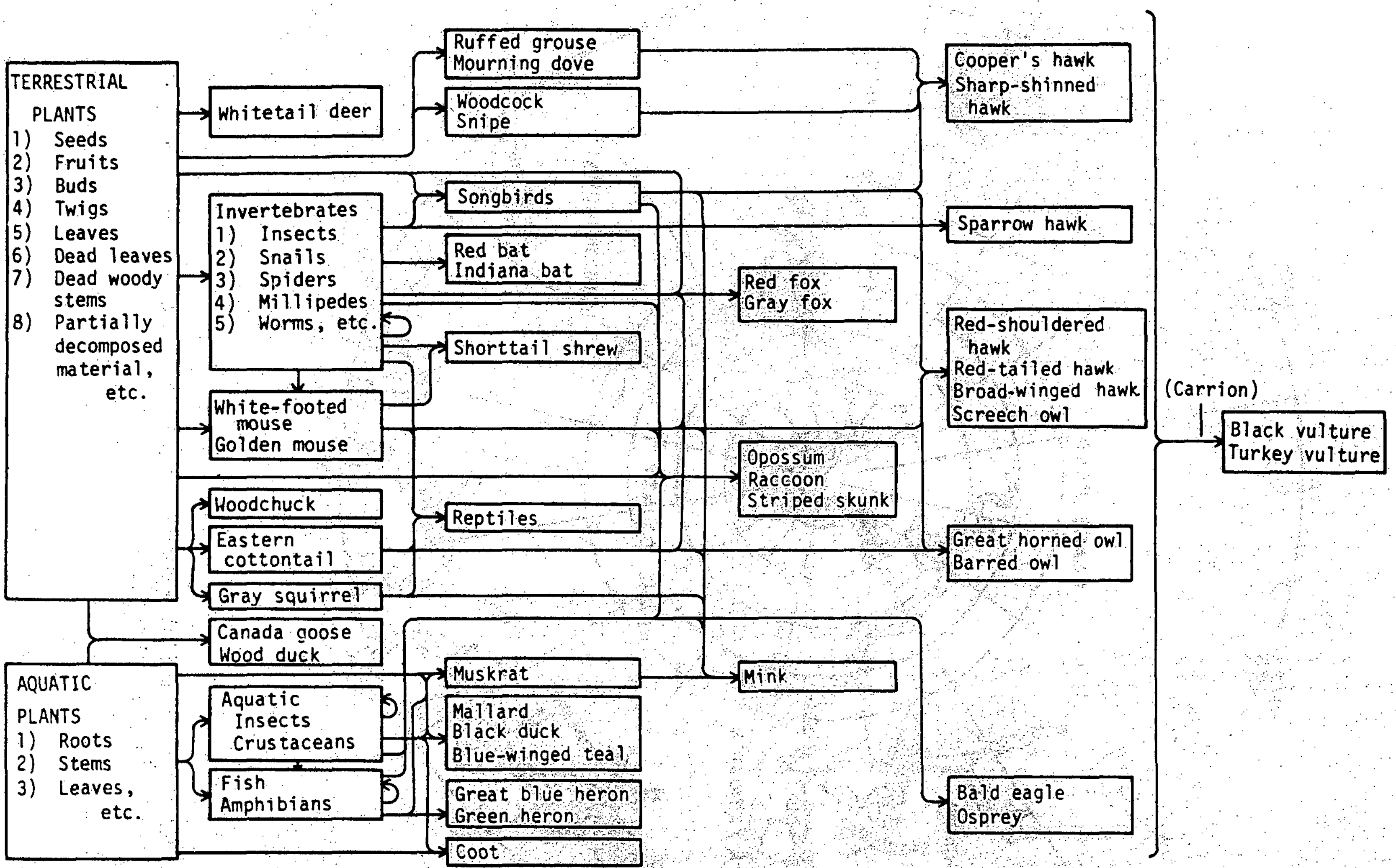
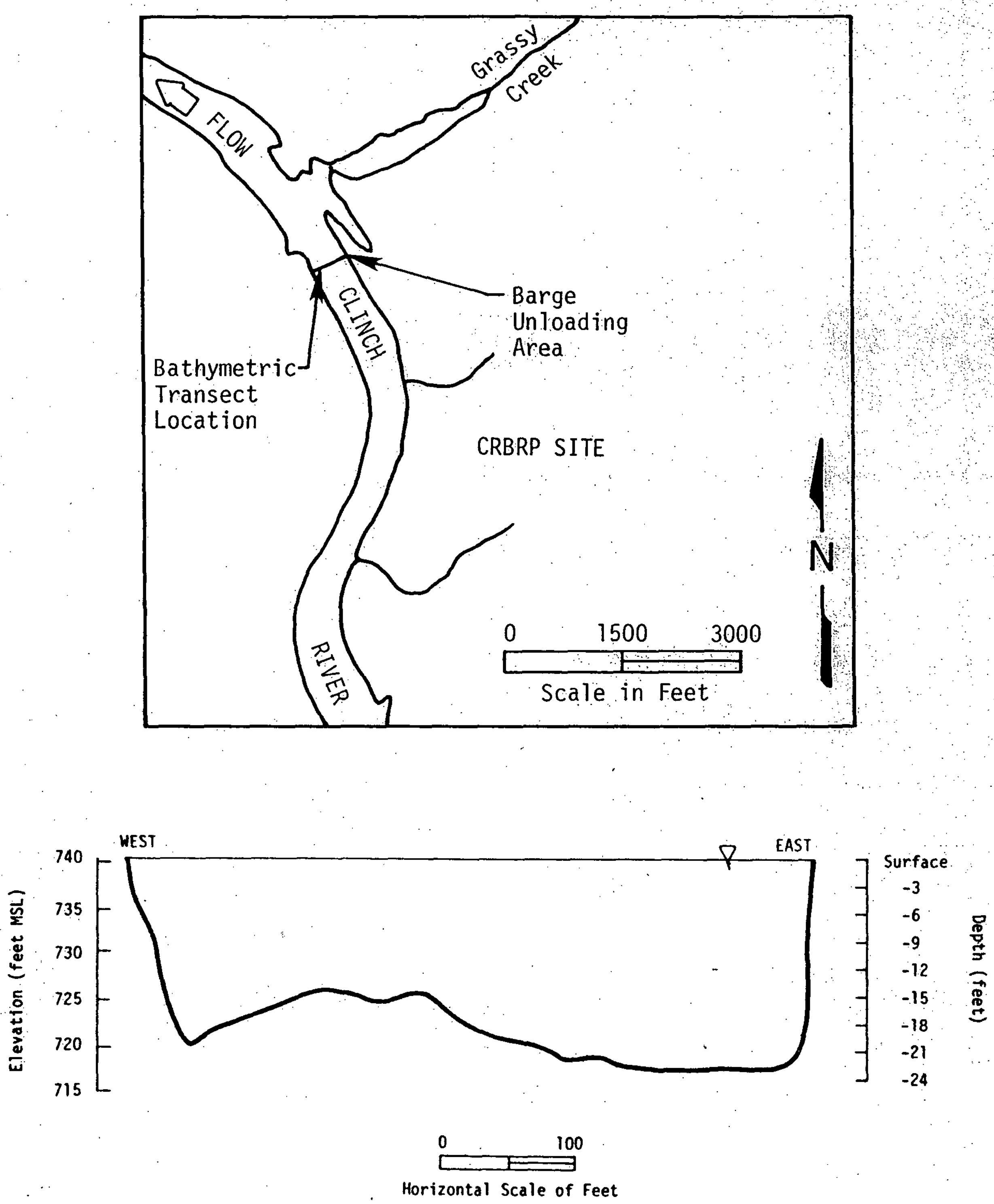


Figure 2.7-D GENERALIZED FOOD WEB FOR THE CLINCH RIVER SITE



9

Figure 2.7-9. Bathymetric Profile of the Clinch River Near the Proposed Location of the Barge Unloading Area

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2.8 BACKGROUND RADIOLOGICAL CHARACTERISTICS

2.8.1 GENERAL

The plant site is located in the Oak Ridge area which has, over the past 37 years, served as the site for a variety of nuclear facilities. Location of the demonstration plant in the Oak Ridge area is not expected to contribute significantly to the environmental radioactivity levels. It is known that certain radionuclides have been introduced into the environment (especially the river) by various sources listed below. Therefore, the objective of the preoperational characterization of the radiological environment is to provide baseline information useable to separate the effects of this plant, if any, from those imposed by other sources including the several Oak Ridge operations. The radionuclide population is made up of the natural radio-elements, fallout from nuclear weapons testing and releases from nearby nuclear facilities.

Programs for environmental monitoring have been in effect since initiation of operations in the Oak Ridge area. The Department of Energy (DOE) 9
currently conducts the Oak Ridge Environmental Monitoring Program in the general area shown in Figure 2.8-1. The Oak Ridge Environmental Monitoring Program, for the Oak Ridge DOE facilities, includes sampling and analysis of air, water, rainwater, creek sediment, biota, soil and 9
external gamma radiation from surface streams. This program makes use of nine perimeter air monitoring stations, eight remote air monitoring stations, five CLinch River sampling locations, five surface stream sampling stations and fourteen milk sampling stations for monitoring 9
radioactivity levels. Continuous samples are taken at all 17 air monitoring stations and gross alpha and beta determinations are made weekly. 9
The samples are compositved quarterly for specific radionuclide analysis. Continuous proportional samples are taken at five water monitoring stations located along the Clinch River, White Oak Dam, Poplar Creek and Bear Creek. Daily samples are taken at one station along the Clinch River and one station along Poplar Creek. Milk samples are analyzed

weekly from each of the eight Oak Ridge immediate environs stations. Six more remotely located milk stations are sampled at a rate of one station each week. External gamma radiation background measurements are made routinely at the perimeter air monitoring stations and at the remote monitoring stations. Semiannual soil samples are taken near the perimeter air monitoring stations and annual samples from the remote stations, to be analyzed for plutonium, uranium and other specific radionuclides. 9 Ten samples of earth, measuring approximately eight centimeters in diameter by five centimeters thick, are collected within one square meter area and composited. Uranium analyses are also performed on soil, pine needles and grass samples collected semiannually at five points on a five-mile radius from the Oak Ridge Gaseous Diffusion Plant (ORGDP). The location of the sampling points, the data on the samples collected and the sampling periods provide an indication of the source of the radionuclide and the quantity released at the time the release occurred. Remote stations are particularly important in assessing the contribution of atmospheric fallout to the radionuclide concentrations. For example, by comparing the data from these stations to that from local monitors, 9 it can be determined whether the radioactivity is from Oak Ridge facilities or from a foreign country's above-ground weapons test.

A baseline monitoring program has been planned by TVA for the Clinch 9 River Site which will be coordinated with the Oak Ridge Environmental Monitoring Program. Data from thermoluminescent dosimeters, which measure external radiation levels, are part of the environmental monitoring 9 program described in Section 6.0.

2.8.2 RADIOACTIVITY IN AIR

Atmospheric concentrations of radioactive materials occurring in the general environment of East Tennessee are monitored by two systems of monitoring stations.[1] One system consists of nine stations (HP-31 9 through HP-39) which encircle the perimeter of the Oak Ridge area, providing data for evaluating releases from Oak Ridge facilities to the immediate environment, Figure 2.8-2. A second system consists of eight stations (HP-51 through HP-58) encircling the Oak Ridge area at distances of from 19 to 121 kilometers, Figure 2.8-3. This system provides background data to aid in evaluating local conditions. Sampling for radioactive particulates is carried out by passing air continuously through filter papers. Filter papers are evaluated weekly by gross beta and gross alpha counting techniques and composited, by system, quarterly for specific radionuclide analysis during normal operations. More frequent detailed analyses are performed if concentrations in the environment are significantly above normal. Airborne radioactive iodine is monitored in the immediate environment (HP-31 through HP-39) by passing air continuously through cartridges containing activated charcoal. Charcoal cartridges are evaluated for radioactive iodine by gamma spectrometry. 9

Long-lived gross beta activity for particulates in air at each of the perimeter locations and the remote locations during the year 1979 is shown in Table 2.8-1. The average annual level for the perimeter stations ($0.27 \pm 0.02 \times 10^{-13}$ μCi/ml) is not statistically different from the average annual level for the remote stations ($0.24 \pm 0.02 \times 10^{-13}$ μCi/ml). Based on this comparison, it is reasonable to assume that releases by the facilities in the Oak Ridge area during 1979 have not significantly varied the beta activity associated with the airborne particulates. Such concentrations as seen in Table 2.8-1 are only a small percent of the applicable Maximum Permissible Concentration (MPC) specified in NRC regulations in 10 CFR 20, Appendix B, Table II, Column I and, as discussed below, would result in small doses. 9

The long-lived gross alpha activity associated with the particulates collected at the perimeter and at the remote stations of the Oak Ridge Environmental Monitoring Program during 1979 is shown in Table 2.8-2. 9 Specific radionuclides responsible for the alpha activity are not identified unless gross activity is significantly above normal concentration.(1) 9 Thoron and radon decay products are excluded by choice of counting times. 9 The average gross alpha activity observed for particulates at the perimeter stations, $1.2 \pm 0.12 \times 10^{-15}$ μCi/ml, is higher than that for the 9 remote stations, $0.9 \pm 0.1 \times 10^{-15}$ μCi/ml. Observed alpha activity levels are small percentages of the MPC's allowed by 10 CFR 20, Appendix B, Table II, column 1, for single unidentified alpha emitters, and as discussed below, resultant doses are less than the dose limit guide of 10 CFR 50, Appendix I.

The results of specific radionuclide analyses of composited filters are given in Table 2.8-3. The environmental concentrations tabulated are all at least a thousand times less than the applicable MPC's of 10 CFR 20, Appendix B, Table II, Column 1. 9

Radioiodine concentrations in air as measured by the perimeter air monitoring system during the year 1979 are listed in Table 2.8-4. The average ^{131}I value was less than 0.01 percent of the MPC of 10^{-10} μCi/ml given by 10 CFR 20, Appendix B, Table II, Column 1. Reconcentration of iodine by way of the grass-cow-milk pathway and the subsequent buildup in the thyroid of milk consumers makes the minimization of the I-131 releases an important objective.

Table 2.8-5 lists the total quantities of both particulates and gases released to the atmosphere during 1979 by the Oak Ridge facilities. Potential doses to the public are discussed in Subsection 2.8.6.

In earlier years, when above-ground weapons tests were being conducted by all major powers, the Environmental Protection Agency - Radiation Alert Network (EPA-RAN) program collected hemispheric data which showed that most long-lived airborne radioactivity detected in the Oak Ridge area was weapons produced.(2-6) The EPA-RAN program has been phased out. However, EPA continues to conduct some measurements after a nuclear detonation by one of the foreign powers.(7) 9

2.8.3 RADIOACTIVITY IN THE AQUATIC ENVIRONMENT

2.8.3.1 HISTORY OF RELEASE TO STREAMS

The Clinch River receives run off and discharges from the Oak Ridge area
through three surface creeks as shown in Figure 2.8-4. Discharge from 9
the White Oak Dam into the Clinch River occurs at Clinch River Mile (CRM)
20.8. White Oak Creek has received much of the low level liquid radio-
active waste produced in Oak Ridge National Laboratories (ORNL) opera-
tions. The Clinch River Breeder Reactor Plant Site, located between
CRM 15 and 18, is approximately two miles downstream of White Oak Creek
outfall. Monitoring at White Oak Dam, the last liquid control point for
ORNL, was started in the late 1940's and has continued to date. 9

These creeks and their tributary surface streams flow through the Oak
Ridge reservation and receive treated low-level radioactive liquid waste
which originates from various facility operations. The streams receive
additional low-level liquid waste generated by seepage of radioactive
materials from solid-waste burial grounds and intermediate-level liquid-
waste sites.[8] Over the years, various liquid-waste treatment and
disposal processes have been employed at ORNL; some of these processes
have included: settling basins, impoundment, storage tanks, evaporation,
ground disposal in trenches and pits, and hydrofracture. Burial of solid
radioactive waste was initiated in the early 1940's, and there are six 9
burial grounds at ORNL with two currently in use (1980). Seven trenches
were used in the past for intermediate-level liquid-waste disposal.

Table 2.8-6, as compiled by EPA in two of its special reports on environmental levels of radioactivity at nuclear energy installations,[9,10] lists quantities of yearly discharges of radionuclides to the Clinch River from 1949 to 1971.

A large amount of ^{106}Ru was released from ORNL's liquid-waste sites during 1959-1964 due to the fact that Conasauga shale, a soil component of the ponds being used as solar evaporation sites having ion exchange properties that inhibit the migration of water soluble nuclides through the soil, did not retain this element as it retained other radionuclides.[8] 9

R. J. Pickering studied the distribution of radionuclides which were found in the bottom sediment of the Clinch River.[11,12] Distribution 9 of gross gamma radioactivity as a function of depth along a core sample reflected not only the pattern of annual discharges of Cs-137 shown in Table 2.8-6, but also ^{60}Co to a lesser extent. The distribution of gross gamma, ^{137}Cs, ^{60}Co and ^{106}Ru as a function of depth is shown by 9 Figure 2.8-5.

P. H. Carrigan, Jr.[12,13] made an inventory of the radionuclides associated with the bottom sediment of the Clinch River between the outfall to the Tennessee River and three miles upstream from the CRBRP. He concluded that in July 1962, 150 Curies of ^{137}Cs, 18 Curies of ^{60}Co, 16 Curies of ^{106}Ru, 10 Curies of rare earth radionuclides and 2.9 Curies 9 of ^{90}Sr were associated with the bottom sediment between CRM 0.0 and 21.0. Ninety-five percent of the activity was downstream from mile 15 and therefore downstream from the CRBRP. However, the largest single concentration occurred near the mouth of White Oak Creek which is upstream of the Site. High concentrations in this area are expected since dispersion of water and suspended sediments is restricted due to incomplete lateral diffusion. The concentrations at CRM 15, 16, 17 and 18 adjacent to the CRBRP, as shown in Figure 2.8-6 were, in general, high compared 9 to levels at CRM 1.

Chemical and physical properties of the bottom sediment have been described. However, variations in annual releases and dilution of radioactive sediment by non-radioactive sediment prevented an accurate assessment of the impact associated with the radioactive content of the Clinch River bottom sediment.[13] 9

An earlier study sponsored by the Public Health Service, U.S. Department of Health, Education and Welfare, described a similar distribution of radioactivity in Clinch River sediment with maximum activity near White Oak Creek outfall (see Figure 2.8-7).(14) The relative contribution of each radionuclide to the total activity is approximately the same as reported by Pickering and Carrigan. However, the total quantities of each radionuclide reported for 1960 by the Public Health Service are approximately 100 to 1,000 times higher than those reported in the later studies. 9

Retention factors for Clinch River sediment were calculated by Carrigan to be 9 percent for ^{60}Co, 21 percent for ^{137}Cs and 0.2 percent for ^{90}Sr.(13) Retention of radionuclides is not expected to limit the usefulness of the Clinch River to nearby facilities. 9

Data collected by the Health Physics Division, ORNL, for Clinch River sediment samples in July and August, 1972 are shown in Table 2.8-7.(15) Distribution of activities in this study are similar to the above distributions reported by Carrigan and the Public Health Service. The sharp increase in activity below the White Oak Creek outfall was still evident in these data. The data indicated that ^{60}Co activity was maximum at CRM 5.8. Concentrations of ^{137}Cs were still present and indications of a maximum could be seen at CRM 5.8. Ruthenium concentration differences below White Oak Creek outfall were not nearly as pronounced. Maximum concentration of ruthenium at CRM 5.8 coincided with the cesium and cobalt maxima. 9

TVA investigated radioactivity in Clinch River sediment during 1974 through 1976 in the part of the river forming the peninsula of the Clinch River Site. The results obtained in these studies indicate that radioactivity levels in the bottom sediment varied widely with the depth from which the sample was taken, with the river mile cross section, and with time at specific locations. Radioactivity levels found in the over-bank regions near the proposed locations of the barge unloading facility, the 9 water intake, and the discharge site were not significantly different from background levels found in the Tennessee River. However, samples of sedimentary material deposited farther off the bank showed radioactivity levels up to 100 times these levels. Table 2.8-8 shows radioactivity found in 1976 at the intake site, the barge unloading site and the discharge site.[16]

With these quantities of radionuclides known to be in the bottom sediment as well as the quantities which were being released, it is of interest to see what were the concentrations of radionuclides found in the Clinch River water as measured by the Oak Ridge Environmental Monitoring Program during 1971 and 1972.[2,3] These data are summarized in Table 2.8-9. The quantities include both dissolved and suspended portions. 9
In all cases, the average radionuclide concentrations found were less than one percent of the MPC's outlined in 10 CFR 20, Appendix B, Table II, Column 2.

The results of a sampling and analysis program operated by the U.S. Environmental Protection Agency, Office of Water Planning and Standards, may be compared to the concentrations found by ORNL (Table 2.8-9). Values reported for 1971 and 1972 for the Clinch River at Kingston, Tennessee, are given in Table 2.8-10. All levels are within MPC.

The tritium concentrations shown in Table 2.8-9 reported by the Oak Ridge Environmental Monitoring Program for the Clinch River can be compared to the concentrations found in surface water at the EPA-RAN stations for the April to June 1972 period. During this period, the average concentration for 39 RAN stations was 600 pCi/liter.[30] This comparison 9
indicates that the tritium levels in the Clinch River resulting from releases from ORNL facilities on an average were a factor of three higher than the average level for the 39 RAN stations.[31] However, the highest concentration reported in Table 2.8-9, 6,570 pCi/l, is only 0.2 percent 9
of MPC. Concentrations of other specific radionuclides were not routinely reported for the RAN stations.

Concentration of Clinch River radionuclides by the aquatic biota must be considered in the evaluation of possible effects of the CRBRP on the local environment. In 1972, the Oak Ridge Environmental Monitoring 9
Program sampled and analyzed fish found in the Clinch River at CRM 14.5 for ^{90}Sr and ^{137}Cs; 1971 data for ^{106}Ru were also included. The data for a composite of 10 fish in each species are given in Table 2.8-11. Assuming an annual consumption rate of 14 pounds of fish per year per person, the percent of Maximum Permissible Intake (MPI) was calculated for each radionuclide.(2,3) MPI is comparable to a daily intake of 2,200 9
ml of water containing the Maximum Permissible Concentration (MPC_w) for each radionuclide.

$$(\text{MPI uCi/yr} = \text{MPC}_w \text{ uCi/ml} \times 2200 \text{ ml/da} \times 365 \text{ da/yr})$$

Therefore,

$$\% \text{ MPI} = \frac{\text{uCi/kg} \times 14 \text{ lb/yr} \times 0.45 \text{ kg/lb}}{\text{MPI}} \times 100$$

Values for % MPI shown in Table 2.8-11 are well below one percent. 9

Data on reconcentration of radionuclides by fresh water organisms have been reported by Jinks and Eisenbud.(32) They defined the concentration factors (CF) by the equation $CF = C_o/C_w$ where C_o is the concentration 9
in the organism and C_w is the concentration in the ambient water. Strontium concentration by fresh water fish was 0.85 to 90 with a mean at 14. Cesium concentration by fresh water fish was 120 to 22,000 with 9
a mean of 3,680. These values are subject to large variations since environmental conditions are not static.

Following through on the average river radioactivity concentrations found in Table 2.8-9 and the radionuclide content of the three species of fish of Table 2.8-11 for 1971 and 1972, ORNL calculated concentration 9
factors for ^{90}Sr and ^{137}Cs.(2,3) The results are seen in Table 2.8-12.

Although the concentration factor calculated for ^{90}Sr is out of the range indicated by Jinks and Eisenbud, these data emphasize that concentration of Clinch River radionuclides by the aquatic biota must be considered in the evaluation of possible effects of the CRBRP on the local environment. 9

2.8.3.2 PRESENT MONITORING PROGRAM FOR THE AQUATIC ENVIRONMENT (1980)(1)

The Clinch River Site, located between CRM 15 and 18, is approximately two miles downstream from White Oak Creek outfall. Water samples are collected by ORNL in the Clinch River for radioactivity analyses at the following stations, shown in Figure 2.8-8: Melton Hill Dam (Station C-2) 2.5 miles above White Oak Creek outfall, at the ORGDP sanitary water intake (C-3) 6 miles downstream from the entry of White Oak Creek, at the ORGDP recirculating water intake (Station C-4) downstream from the Poplar Creek outfall, near Brashear Island (Station C-6), and at Center's Ferry (Station C-5) near Kingston, Tennessee. Samples are collected continuously at all locations except for Station C-5 and Station C-6 which are collected on a daily and monthly grab-sample basis, respectively. 9 Samples are composited for monthly or quarterly analysis depending upon location.

Water samples are also collected for radioactivity analyses at White Oak Dam (Station W-1), at the outlet of New Hope Pond on East Fork Poplar Creek (Station E-1), in Bear Creek (Station B-1), and in Poplar Creek (Stations P-1 and P-2), all shown on Figure 2.8-8. The samples collected at Stations W-1, E-1, and B-1 are continuous proportional samples. Twenty-four hour composite samples are collected at Stations P-1 and P-2 on a weekly basis. Water samples are collected also at the juncture of White Oak Creek and the Clinch River. All samples are composited for monthly analysis.

The concentrations of fission product radionuclides present in detectably significant amounts are determined by specific radionuclide analysis and gamma spectrometry. Uranium analysis is by the fluorometric method. Transuranic alpha emitters are determined by ion exchange and alpha range analysis. The concentration of each radionuclide is compared with its respective MPC value and calculation of the percent of MPC for a known mixture of radionuclides is performed as specified in 10 CFR 20, Appendix B.

Data on the concentrations of radionuclides measured in the Clinch River for 1979 are given in Table 2.8-13. Data on the concentrations of uranium in surface streams and the quantities of radioactivity released to surface streams are given in Tables 2.8-14 and 2.8-15.

Analysis of water supplies collected at the juncture of White Oak Creek and the Clinch River indicated that the yearly average concentration of radionuclides was approximately 16 percent of the applicable MPC for uncontrolled areas. The calculated average concentration of radionuclides in the Clinch River, based on the analysis of water samples collected at 9
White Oak Dam (Station W-1) and the dilution afforded by the river, was determined to be 0.2 percent of the applicable concentration guide for uncontrolled areas assuming complete mixing. The average dilution factor for 1979, based on the flow of White Oak Creek and the Clinch River, was 511. The measured average concentrations of radionuclides in the Clinch River upstream and downstream of White Oak Creek outfall were less than 0.25 percent of the applicable MPC.

The calculated average concentration of transuranic alpha emitters in the Clinch River resulting from effluent releases was 4×10^{-12} uCi/ml, which is less than 0.01 percent of the MPC for water containing a known mixture of radionuclides.

Trends in water discharges and calculated percent MPC levels in the Clinch River are presented in Figures 2.8-9 and 2.8-10. Discharges of ^{90}Sr and ^{3}H are shown in Figure 2.8-9 as these nuclides contribute the majority of the radiological dose downstream. These graphs and a comparison of Table 2.8-9 with Table 2.8-13 indicate a decline in radioactivity released to the Clinch River by Oak Ridge facilities.

Several species of fish which are commonly taken by fishermen from the
Clinch River and sampled each year for radionuclides. The scales, head, 13
and entrails are removed from the fish before ashing. Ten fish of each species are composited for each sample, and the samples are analyzed by gamma spectrometry and radiochemical techniques for the critical radionuclides which may contribute significantly to the potential radiation dose to man.

Data on the 1979 concentrations of radionuclides in Clinch River fish are given in Table 2.8-16. Consumption of 16.8 kilograms of bluegill per year[33] taken from the river near White Oak Creek outfall would result in approximately 2 percent of the maximum permissible intake,
which represents the highest dose potential to the public from fish 9
consumption. The maximum permissible intake is calculated to be equal to a daily intake of 2.2 liters of water, over a period of one year, containing one MPC of the radionuclides in question.

A comparison of the data in Table 2.8-16 with that in Table 2.8-11, which comprises the Sr and Cs data for 1971 and 1972, shows two facts: (1) the quantity of ^{90}Sr in fish flesh is reduced on the average by a factor of three, correlating with the factor of three reduction in Curies discharged as seen in Figure 2.8-9; and (2) the large variation in concentration as reported above from Jinks and Eisenbud's work[32] is confirmed. One variant indicated is fish species.

A resurvey of radioactivity in Clinch River sediment by ORNL's Division of Health, Safety and Environmental Affairs has been completed and is expected to be reported in early 1981.[34] Data showing ranges of fission product activity found in bottom sediments of the Clinch, Emory and Tennessee Rivers within the area of interest are provided in Figures 2.8-11 and 2.8-12. Similar data for ranges of transuranic activities are presently being prepared and will be supplied in a following amendment.

Uranium was included in a creek sediment sampling program initiated at ORGDP in 1975 to determine the concentrations of various metallic ions in the sediment of Poplar Creek. The current sampling program consists of 14 sampling locations (Figure 2.8-16), including two Clinch River stations (CS1, CS20). Samples are collected twice during the year and analyzed by atomic absorption spectrometry. The concentrations of metals in the stream sediment samples, as seen in Table 2.8-17, generally exceed background levels for metals in remote streams, except for cadmium and thorium which were below detectable limits. An examination of the effluent sources during 1979, however, indicates that only very small quantities of any of these metals are currently being released, suggesting that existing concentrations found in sediment are residual metals from earlier plant operations.[1] 9

2.8.4 RADIOACTIVITY FROM TERRESTRIAL PRODUCTS

2.8.4.1 SOIL, PRECIPITATION AND VEGETATION

Exposure of man to radioactive materials may occur through the soil-plant-animal-food pathway. Soil samples are collected by the Environmental Monitoring Program for the Oak Ridge facilities semiannually from near the perimeter and annually from the remote stations. Five 1/5 meter-squared plots are used for soil radioactivity determinations. Two cores, 8 cm in diameter and 5 cm in depth, are taken from each plot; a composite of 10 cores is used for each station. These samples are analyzed by gamma spectrometry and radiochemical techniques. Data on specific radionuclide concentrations in soil are given in Table 2.8-18. The plutonium concentrations found were comparable to the value of 0.05 pCi/g considered 9 to be a representative concentration of plutonium in U.S. surface soil resulting from atmospheric weapons test fallout.[35]

Maximum permissible concentrations have not been generally established for radionuclides in soil. However, 5 pCi/g of ^{226}Ra in any 5 cm thickness of soils has been proposed by the EPA as a limit for residual radioactivity at inactive uranium sites.[36] EPA also has derived a soil contamination level for transuranics of 0.2 $\mu Ci/m^2$ (1 cm depth, soil particles less than 2 mm) as a reasonable "screening" level, one at which the resultant dose rates to the critical segment of the exposed population could reasonably be predicted to be less than guidance recommendations of 1 millirad per year to the pulmonary lung, or 3 millirad per year to the bone.[37] The low and relatively uniform concentrations of both plutonium and uranium in Table 2.8-18 indicate that atmospheric fallout is the most likely source of the human-made activities observed. Biological reconcentration would be required to make the human exposures important. According to an early BEIR Report, and other recent 9
experiments,[38,39] this does not occur with plutonium or uranium contamination. Therefore, existing concentration levels found in the soil are not expected to present a hazard to man, but will provide a baseline to measure significant releases from the CRBRP, if any.

Gross beta radioactivity in precipitation (rain and snow) for 1979 is shown in Table 2.8-19. The fluctuations among the stations for both the perimeter and remote networks are due to statistical random variation. It is noted that the average radioactivity is greater for the remote stations than the perimeter stations. This indicates that the Oak Ridge DOE facilities in 1979 contributed no significant radioactivity, if any, to fallout which would be removed by precipitation.

Radiological environmental monitoring of vegetation for the Oak Ridge Environmental Monitoring Program consists of sampling and analysis of grass and pine needles. Samples of grass are collected semiannually from the perimeter and annually from the remote air-sampling stations (see Figures 2.8-2 and 2.8-3). At each station, all the grass from five 1/5-meter-squared plots (the same plots as are used for soil samples) is collected. One plot is taken beside the station, the other four are taken at 15 m from the station at 90° directions from each other. The grass from each station is then composited and analyzed by gamma spectrometry and radiochemical techniques for a variety of radionuclides. Data on the radionuclide concentrations in grass for 1979 are presented in Table 2.8-20.

Samples of both grass and pine needles are collected semiannually from a second set of 17 area stations (VS-1 through VS-17, Figure 2.8-2) and analyzed for uranium content by fluorometric analysis. Data on the uranium content in vegetation for 1979 are presented in Table 2.8-21. This sampling system, as is the ORGDP Poplar Creek sediment system above, is basically for industrial hygiene monitoring. Uranium quantities are reported in micrograms per gram of sample (μg/g) instead of microcuries per gram. The uranium concentrations, as seen in Table 2.8-21, are found to be below levels of environmental concern based on the reasonable assumption that the mixture of the uranium isotopes (and, therefore, the resultant specific activity) in Table 2.8-21, is not significantly different from the mixture in Table 2.8-20. 9

In the pre-operational and operational radiological monitoring program for the CRBRP, discussed in Section 6, TVA will sample and analyze vegetation samples for plutonium radioactivity.

2.8.4.2 MILK

2.8.4.2.1 HISTORICAL PERSPECTIVE

During the 1950's and 1960's, when extensive testing of nuclear devices was conducted in the atmosphere, large quantities of man-made radioactive materials were produced and distributed to the environment throughout the world in the form of fallout. Although much of this debris decayed in a relatively short time, the small amounts that remain will be a source of exposure of the U.S. population for some time to come. The U.S. population dose to the thyroid of 68,000 man-rads from radioiodine in milk was estimated by the EPA to have resulted from a November 1976 People's Republic of China nuclear test.[40] Table 2.8-22 summarizes the estimated 50-year dose commitment for several organs of the body in people in the north temperate zone due to atmospheric nuclear tests conducted before 1971. Table 2.8-23 summarizes projections of the annual whole-body dose equivalent (DE) for the U.S. population from global fallout through the year 2000. As may be noted, the projected annual average whole-body DE rate for the U.S. population from these sources is 4-5 mrems/yr.[41]

Milk has been found to be the most useful indicator of the general population's intake of radionuclide contaminants resulting from environmental releases. Although many of the possible radiocontaminants of grass and water are eliminated by the selective metabolism of the cow, five fission-product radionuclides, ^{89}Sr, ^{90}Sr, ^{131}I, ^{137}Cs, and ^{140}Ba, commonly occur in milk. 9

Data collected and reported originally by the U.S. Department of Health, Education and Welfare, and later by the U.S. Environmental Protection Agency's Pasteurized Milk Network (EPA-PMN) best describes historically the extent and quantities of radioactive contamination resulting from the weapons tests. Figures 2.8-17 and 2.8-18 show ^{90}Sr in milk for typical locations in the U.S., for the period 1961 to mid-1968. Figures 2.8-19 and 2.8-20, with Table 2.8-24, show regional distribution contours and frequency distribution, respectively, for June 1964 fallout, while tables 2.8-25 and 2.8-26 show typical frequency distribution for 1966 and 1967 fallout.[42,44] The shapes of the contours depend on meteorological conditions, and precipitation is the most influential factor. The quantities of ^{90}Sr and ^{137}Cs are seen to have been decreasing as a result of the nuclear weapons Limited Test Ban Treaty.

After 1963, ^{131}I was not routinely reported since levels at the majority of the network status were below the practical reporting level of 10 uCi/l.[45]

It is useful to see data from results of routine sampling by the Oak Ridge Environmental Monitoring Program for the years 1971 and 1972,[2,3] where the average ^{90}Sr and ^{137}Cs in U.S. milk had decreased to 10 pCi/liter for both radionuclides. (See Table 2.8-27 showing the average concentration for all EPA-PMN samples taken for fiscal 1972.)[46]

The data for 1972 can be examined to discriminate local and non-local releases. Tables 2.8-28 and 2.8-29 show data for each sample collected in the immediate environs during 1972. Table 2.8-30 shows data for each sample collected in the remote environs. Table 2.8-31 gives the overall average for each of the set of tables of the Oak Ridge stations. Looking at ^{90}Sr for 1972, we see that the value of 10.9 ± 0.30 pCi/liter is tabulated for the remote stations. It would appear that Oak Ridge facilities contaminated the immediate environs to an average amount of 2.3 ± 0.35 pCi ^{90}Sr/liter. The potential low doses resulting from these low concentrations are discussed below. 9

Well established atmospheric diffusion principles[47,48,49] confirm that the contour patterns of Figures 2.8-19 and 2.8-20 are normal for long distance pollution transport. The magnitude of variance is determined by local weather conditions. The ^{90}Sr concentrations observed at selected EPA-PMN stations within 100 miles of Oak Ridge (Table 2.8-32) do not differ significantly from the average-value data in Table 2.8-31 for the remote and immediate environs stations. Therefore, it can be concluded that worldwide fallout contributed about 80 percent of the contamination to the grass-cow-milk-human pathway of the immediate Oak Ridge facilities environment, while Oak Ridge contributed about 20 percent for the years 1971 and 1972.

Similarly, information from such data can be used to determine the source of radioiodine, whether locally released or not. Radioiodine was detected during the third week of 1972 in one remote sampling station (Table 2.8-30, Watts Bar station). It is noted that no radioiodine was detected in any immediate environs station, thereby lending strong evidence that no Oak Ridge facility was the source. In addition, the EPA-RAN reported the few U.S. stations for that January which had detectable radioiodine (Table 2.8-33), one of which was a Tennessee station.[53] EPA-RAN reported that the worldwide source was from a foreign detonation.[54] 13

Although the EPA no longer publishes fallout data, reports of the ongoing sampling program are available.[7]

The CRBRP monitoring program will be able to measure and evaluate contamination in the environs. TVA plans to have both immediate and remote environs sampling, as seen in Section 6, and thus shall be able to distinguish between contamination from its own facility and that from other facilities or from world-wide fallout. 9

2.8.4.2.2 PRESENT MONITORING PROGRAM FOR MILK

The Department of Energy's Environmental Monitoring Program[1] for the Oak Ridge facilities monitors raw milk for ^{131}I and ^{90}Sr by the collection and analysis of samples from 14 sampling stations located within a radius of 50 miles (80 kilometers) of Oak Ridge. Samples are normally collected weekly at each of eight stations located near the Oak Ridge area. Six stations, located more remotely with respect to Oak Ridge operations, are sampled at a rate of one station each week. Milk sampling locations for all stations are shown in Figures 2.8-21 and 2.8-22. Samples are analyzed by ion exchange and gamma spectrometry; results are compared to concentration limits and dose guides specified by the Federal Government.

The average concentrations of ^{131}I and ^{90}Sr in raw milk in 1979 are given in Tables 2.8-34 and 2.8-35, respectively. The average level of radioiodine in milk in the immediate environs is less than 0.2 percent of the MPC for drinking water. Data for radioiodine in the remote environs (Figure 2.8-34) indicate no detectable activity was present during the whole year. The average level of ^{90}Sr in milk was less than 1.5 percent of the MPC for drinking water (Figure 2.8-35).

Table 2.8-36 shows recent and current levels of ^{90}Sr in milk(7) for selected Tennessee stations and the U.S. average. It can be seen that for the remote environs (Figure 2.8-35), the ^{90}Sr level is from background due to weapons testing fallout of former years. Nonetheless, it can be seen by the average difference that the Oak Ridge facilities still contaminate the immediate environs to a reduced, very low yet measurable level (Figure 2.8-35). The data emphasize that the CRBRP monitoring program, similar to the ORNL program as seen in Section 6, shall be able to detect significant release of radioactivity to the grass-cow-milk-human pathway. 9

2.8.4.3 DEER

Frequently, deer are killed by automobiles on the DOE Reservation. Twenty-three deer samples were analyzed during 1979; twenty samples were collected on the DOE Reservation and three samples were collected off the Reservation. Summary data of the ^{137}Cs content in deer muscle are presented in Table 2.8-37. The behavior and fate of ^{137}Cs have been studied in a variety of organisms and ecosystems.(55) The route to human through deer and caribou has been accurately documented.(55,56) Potential doses from the levels of ^{137}Cs in deer flesh are discussed in Section 2.8.6.

2.8.4.4 HONEY

Honey samples from several hives located on the Oak Ridge facilities reservation were analyzed for radioactivity. Only trace amounts of ^{60}Cs and ^{137}Cs were found.(1)

2.8.5 EXTERNAL GAMMA RADIATION

External gamma radiation background measurements for the DOE Environmental Monitoring Program[1] are made routinely at the perimeter air monitoring stations and at the remote monitoring stations using calcium fluoride thermoluminescent dosimeters suspended one meter above the ground. Dosimeters at the perimeter stations are collected and analyzed monthly. Those at the remote stations are collected and analyzed semiannually.

Data on the average external gamma radiation background for 1979 are given in Table 2.8-38. A considerable variation in background levels is normally experienced in East Tennessee depending upon elevation, topography, and geological character of the surrounding soil.[57]

External gamma radiation measurements were performed along the stream course of East Fork Poplar Creek to evaluate radioactivity which might be contained in the sediments as a result of effluent releases. Additionally, measurements were made along the bank of the Clinch River from the mouth of White Oak Creek several hundred yards downstream to evaluate gamma radiation levels resulting from effluent releases and air scatter from an experimental ^{137}Cs plot located near the river bank. Measurements were made using scintillation detectors and/or thermoluminescent dosimeters suspended one meter above the ground surface. The average background level determined at the remote stations was subtracted from the measured gamma radiation levels to determine the incremental increases resulting from plant operations. 9

Gamma levels along East Fork Poplar Creek ranged from 0 to 10 μR/hr above background. The external gamma radiation levels along the bank of the Clinch River ranged from 5 to 27 μR/hr above background. Potential doses to individuals in the environment from these elevated gamma radiation levels were calculated and are included, where significant, in Section 2.8.6.

2.8.6 POTENTIAL RADIATION DOSE TO THE PUBLIC

Potential radiation doses resulting from Oak Ridge facilities effluents for 1979 were calculated for a number of dose reference points within the Oak Ridge environs. All significant sources and modes of exposure were examined, and a number of general assumptions were used in making the calculations.[1]

The site boundary for the Oak Ridge Complex was defined as the perimeter of the DOE controlled area. (See Figure 2.8-23.)

Gaseous effluents are discharge from several locations within each of the three Oak Ridge facilities. For calculational purposes, the gaseous discharges are assumed to occur from only one vent from each site. Since the release points at ORGDP and the Y-12 Plant do not physically approximate an elevated stack, their discharges are assumed to be from 10 meters above ground level; releases from ORNL are through elevated 9 stacks. The meteorological data collected at the ORNL site were used for dispersion calculations. Concentrations of radionuclides contained in the air and deposited on the ground were estimated at distances up to 80 kilometers from Oak Ridge facilities with the Gaussian plume model developed by Pasquill[58] and Gifford[59] incorporated into a computer program.[60] The concentration was averaged over the crosswind direction to give the estimated ground level concentration downwind of the source of emission.[61] The deposition velocities used in the calculations were 10^{-6} cm/sec for krypton and xenon, 10^{-2} cm/sec for iodine, and 1 cm/sec for particulates.[62] Meteorological data are shown in Figure 2.8-24; the length of the bars indicates the percentage of time the wind was blowing in that direction.

Potential pathways of exposure to man from radioactive effluents released by the Oak Ridge operations that are considered in the dose estimates are presented in Figure 2.8-25. The pathways shown in the figure are not exhaustive, but they include the principal pathways of exposure based on experience.

Exposures to radionuclides that originate in the effluents released from the Oak Ridge facilities were converted to estimates of radiation dose to individuals using models and data presented in publications of the International Commission on Radiological Protection,[63-68] other recognized literature on radiation protection,[69-71] personal communication,[72] and computer programs incorporating some of these models and data.[73,74] Radioactive material taken into the body by inhalation or ingestion will continuously irradiate the body until removed by processes of metabolism and radioactive decay; thus, the estimates for internal dose are called "dose commitments;" they are obtained by integrating over the assumed remaining lifetime (50 years) of the exposed individual.[63]

The radiation doses to the total body and to internal organs from external exposures to penetrating radiation are approximately equal, but they may vary considerably for internal exposures because some radionuclides concentrate in certain organs of the body. For this reason, estimates of radiation dose to the total body, thyroid, lungs, bone, liver, kidneys, and gastrointestinal tract were considered for various pathways of exposure. These estimates were based on parameters applicable to an average adult.[63,68] The population dose estimate (in man-rem) is the sum of the total body doses to exposed individuals within an 80-kilometer radius of the Oak Ridge facilities.

9

2.8.6.1 MAXIMUM POTENTIAL EXPOSURE

The point of maximum potential exposure ("fence-post" dose) on the site boundary (Figure 2.8-23, Coordinate G-6) is located along the bank of the Clinch River adjacent to a cesium field experimental plot and is due primarily to air scatter from the plot. A maximum potential total body exposure of 240 millirem/yr was calculated for this location assuming that an individual remained at this point for 24 hours/day for the entire year. The calculated maximum potential exposure is 48 percent of the allowable standard.[75] This is an atypical exposure location and the probability of an exposure of the magnitude calculated is considered remote since access is only by boat.

The total body dose to a "hypothetical maximum exposed individual" at the same location was calculated using a more realistic residence time of 240 hours/yr. The calculated dose under these conditions was 6.6 millirem/yr which is 1.3 percent of the allowable standard[75] and represents what is considered a probable upper limit of exposure.

More likely exposure potential is considered to occur at other locations beyond the site boundary as a result of airborne or liquid effluent releases.

The dose commitment to an individual continuously occupying the residence nearest the site boundary would result from inhalation and is based on an inhalation rate for the average adult of 2×10^4 liters/day. The 9
calculated dose commitments at this location were 5.1 millirem to the lung (the critical organ) and 0.5 millirem to the total body; uranium-234 is the important radionuclide contributing to this dose. These levels are 0.34 percent and 0.1 percent, respectively, of the allowable annual standard.[76] Due to inherent uncertainties in the meteorological data, stack sampling data and calculative techniques, the calculated doses may be in error as much as 300 percent.[77]

The most important contribution to dose from radioactivity within the terrestrial food chain is by the atmosphere-pasture-cow-milk pathway. Measurements of the two principal radionuclides entering this pathway, ^{131}I and ^{90}Sr (see Tables 2.8-34 and 2.8-35), indicate that the maximum dose to an individual in the immediate environs from ingestion of one liter of milk per day is 0.1 millirem to the thyroid and 7.3 millirem to the bone at Station 6 (Figure 2.8-21). The average concentrations for the remote stations were assumed to be background and were subtracted from the perimeter station data in making the calculations. In comparison, the maximum 1972 ^{90}Sr concentration in excess of background, as discussed above in Section 2.8.4.2.1 (see Table 2.8-31), would have potentially resulted in a dose of 49.2 millirem to the bone. This dose commitment is about 3.3 percent of the allowable annual standard.[76]

The public water supply intake closest to the liquid discharges from the Oak Ridge facilities is located approximately 26 kilometers downstream at Kingston, Tennessee. The intake to the water filtration plant is located on the Tennessee River approximately one-half mile upstream from the confluence of the Clinch and Tennessee Rivers. Normally, Tennessee River water is used for the Kingston water supply but under certain conditions of power generation, backflow can occur. Under backflow conditions, Clinch River water may move upstream in the Tennessee River and be used as the source of water for the Kingston filtration plant. It is estimated that these conditions would prevail a maximum of 20 percent of the time. Measurements of untreated river water samples at Kingston (see Table 2.8-13) indicate that the maximum dose commitment result-
ing from the ingestion of 20 percent of the daily adult requirement (about 9
two liters per day) is 2.3 millirem to the bone and 0.05 millirem to the total body. The average concentrations in Melton Hill Dam water were considered background levels and were subtracted from the values obtained at Kingston.

Estimates of the 50-year dose commitment to an adult were calculated for consumption of 16.8 kilograms of fish per year from the Clinch River. The consumption of 16.8 kilograms[33] is about 2.5 times the national average fish consumption[78] and is used because of the popularity of fishing in eastern Tennessee. From the analysis of edible parts of the fish examined (see Table 2.8-16), the maximum possible organ dose commitment to an individual from the highest quarterly bluegill sample taken from CRM 20.8 is estimated to be 118 millirem to the bone from ^{90}Sr. The maximum total body dose to an individual was calculated to be 2.4 millirem.

A more probable dose commitment, based on the annual average concentration of ^{90}Sr in bluegill samples taken from CRM 20.8, was calculated to be 35 millirem to the bone and 0.7 millirem to the total body. These dose commitments are about 2.3 percent and 0.14 percent, respectively, of the allowable annual standards. Fish samples taken from Melton Hill Lake were analyzed to determine background conditions. Fish caught from other locations in the Clinch River and consumed would result in significantly smaller doses than the maximum calculated for CRM 20.8, as shown in Table 2.8-16.

Consumption of deer with the highest concentration of ^{137}Cs would result in a dose of 0.03 millirem to the total body and 0.07 millirem to the liver (critical organ), assuming consumption of 1 kilogram of meat. It should be noted that no hunting is allowed on the Reservation.(1)

Summaries are given in Table 2.8-39 of the potential radiation doses to adult members of the general public at the points of highest potential exposure from gaseous and liquid effluents from the Oak Ridge facilities. 9

2.8.6.2 DOSE TO THE POPULATION

The Oak Ridge population received the largest average individual total body dose as a population group. The average total body dose to an Oak Ridge resident from radioactivity release from the Oak Ridge nuclear facilities was estimated to be 0.02 millirem as compared to approximately 100 millirem/yr from natural background radiation; the average dose commitment to the lung of an Oak Ridge resident was 0.4 millirem. The maximum potential dose commitment to an Oak Ridge resident was calculated to be 5.1 millirem to the lung. This calculated dose is 0.3 percent of the allowable annual standard.(76)

The cumulative total body dose to the population within an 80 kilometer radius of the Oak Ridge facilities resulting from 1979 plant effluents was calculated to be 5.3 man-rem. This cumulative dose was calculated using the population distribution given in Table 2.8-40.

This dose may be compared to an estimated 74,000 man-rem to the same population resulting from natural background radiation. About 14 percent of the collective dose from the effluents of the Oak Ridge facilities is estimated to be to the Oak Ridge population.

2.8.7 OTHER SOURCES OF RADIATION EXPOSURE

The radiation exposure to the public from natural sources and medical applications is quite large compared to that from operation of the Oak Ridge facilities. Radiation in the environment from natural sources is the major source of radiation exposure to man.[79] For this reason it is frequently used as a standard of comparison for exposures to various unnatural (man-made) sources of ionizing radiation.

2.8.7.1 NATURAL RADIATION

The human is subjected to all types of natural radiation in our environment. It is appropriate to divide the types into two classes: (1) exposure arising from terrestrial activity, and (2) exposures caused by radiation from extraterrestrial (cosmic) sources. Both of these have an external component of radiation, i.e., impinging on the outside of the human body, and an internal component, i.e., radiations from radioactive material taken into the body by ingestion and inhalation. 9

2.8.7.1.1 COSMIC RADIATION[80]

Cosmic radiation is composed largely of galactic radiation with a varying component of solar radiation. The term "cosmic radiation" refers both to the primary energetic particles of extraterrestrial origin that strike the earth's atmosphere and to the secondary particles generated by their interaction with the atmosphere. "Cosmogenic radionuclides" is the term applied to those radionuclides produced by a variety of spallation or neutron capture reactions of the primary and secondary cosmic particles with nuclei, chiefly gases, of the earth's biosphere. The majority of cosmogenic radionuclides are of the middle or lower atomic numbers. Radiations from these are beta- and gamma-ray or X-ray and range in half-life from millions of years down to a fraction of a second (see Table 2.8-41). The four major cosmogenic radionuclides which are contributors to human dose are ^{7}Be, ^{14}C, ^{3}H, and ^{22}Na; the latter three are isotopes of major body elements, and thus comprise the internal component of cosmic radiation exposure. Doses from cosmic radiation are seen in Table 2.8-42.

2.8.7.1.2 TERRESTRIAL RADIATION(80)

Human exposure to terrestrial radiation arises from radionuclides which are present in the earth's crust, or which have been transferred from the earth's crust to the atmosphere or hydrosphere. Since all the parent natural terrestrial radionuclides have a half-life of at least the same 9
order of magnitude as the estimated age of the earth (4.5×10^{9} years), they are called primordial radionuclides. These primordial radionuclides are conveniently classified into the "series radionuclides," which decay to a stable isotope of lead through a sequence of radionuclides of wide-ranging half-lives, and the "non-series radionuclides," which decay directly to a stable element. The two series important to human exposure are those headed by ^{238}U and ^{232}Th. These are illustrated in Figure 2.8-26. Of the non-series primordial radionuclides listed in Table 2.8-43, only ^{40}K and ^{87}Rb contribute significantly to human exposure (Table 2.8-42).

Considering only the external radiation component of the radionuclides present in the atmosphere and the soil, Figure 2.8-27 shows that the United States is divided into two major parts. The absorbed dose rates illustrated represent exposure at one meter above ground and were derived from aerial survey measurements adjusted for cosmic radiation.(80)

The series radionuclides, when not separated by physical or chemical means, reach a state of radioactive equilibrium. However, as seen in Figure 2.8-26, each series has one descendent nuclide which is an isotope of the noble gas radon that can escape from the earth's crust. The short-lived daughters of radon then become attached to particulates in the air, which increases the potential for human inhalation. The radon sub-series contributes a few millirem per year to the dose equivalent rate (see Table 2.8-42), contributing to the external component chiefly by the gammas of ^{214}Bi, and to the internal radiation component by alphas of the radon subseries.

Potassium-40, an emitter of beta and gamma radiations, comprises both an external and an internal radiation source; rubidium-87 is a beta emitter only and contributes less than 1 mrem/year of chiefly internal radiation.

2.8.7.1.3 SPECIAL STUDY ON INDOOR NATURAL RADIATION(81) 9

Measurements were made of exposure rates from penetrating natural background gamma radiation using thermoluminescent dosimeters (TLD's) placed within 84 residences in the Oak Ridge/Knoxville area from fall 1977 through summer 1978.

Analysis of the data indicated that several parameters must be considered including season, geographic location, and building material. Seasonal varaition was apparent: the highest average TLD reading reported was in the fall, while the lowest was in the spring (Figure 2.8-28).

Predictably higher dose values were obtained in brick/stone homes than in houses made principally of wood (Figures 2.8-29 and 2.8-30). Both types of houses showed approximately the same trend of seasonal variations including higher TLD readings in the fall and lower values in the spring. The higher dose values in brick/stone houses were caused by the atmospheric increase of radon-emanation from the stone itself, as shown in the following. Three control TLDs were placed in basements located in Knoxville, Oak Ridge, and Kingston to investigate increased dose from radon emanation from stone. An average dose equivalent rate of 11.9 ± 1.4 microrems/h or 104.6 millirems/year was obtained. These dose equivalent rate values were higher than those indicated in Figures 2.8-29 and 2.8-30, which was attributed to the enhancement of radon concentration caused by increased stone content and decreased ventilation.

Another parameter that appeared to affect the exposures was geographic location. Table 2.8-44 shows the quarterly and yearly dose values determined as a function of geographic location. All the yearly dose rates were within two standard deviations about the mean. However, it is interesting to note that the highest dose was not obtained in Oak Ridge, which is in close proximity to a complex of nuclear facilities. The average dose equivalent rate obtained from this indoor study was 78 ± 3.4 millirem per year compared to the average outdoors natural gamma background radition in the entire United States of approximately 70 millirem per year.(80) 9

2.8.7.2 MEDICAL IRRADIATION(79,83)

Medical radiation exposures are of particular interest since they contribute the highest man-made per capita doses to the population. They are acutely administered using high dose rates, thereby causing the highest individual organ doses with the exception of accidental exposures. The main contributor of the total dose from medical exposures is diagnostic X-irradiation, accounting for at least 90 percent of the total man-made radiation dose to which the U.S. population is exposed.

Early emphasis by investigators on the genetically significant dose (GSD) from medical irradiation quantified this hazard. Recent evaluations, however, have shifted emphasis to the somatic effects (non-genetic bodily effects) of radiation.(79) Use of medical radiation has increased, both in diagnostic examinations and in dental radiography, at a rate about 10 percent greater than the rate of population increase. However, the GSD itself during the six year interval 1964 to 1970 did not change significantly (see Table 2.8-45). Table 2.8-45 also shows typical skin doses for medical diagnostic and dental radiographic procedures. Table 2.8-46 shows typical somatic (bone marrow) doses from routine diagnostic examinations for the same years.[85]

United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) reports were the basis for GSD estimates in former years. However, the 1964 and 1970 dosimetry surveys have been revised downward to 16 mrad for 1964 and 20 mrad for 1970.[86] These values, 16 and 20 mrad, are not statistically different from each other. It is important to note that although the medical dose is low, it nevertheless is large compared to doses resulting from Oak Ridge facilities operations, and is approximately equal to natural cosmic radiation.

Table 2.8-42 presents doses from all medical irradiation. 9

2.8.7.3 MISCELLANEOUS OTHER SOURCES

A wide variety of consumer products contain radionuclides that have been deliberately incorporated to satisfy a specific purpose. In addition, some electronic products, the most common one being color television, have the potential to emit X-radiation. Table 2.7-47 presents a list of such products classified into six categories.[79] Due to present government regulations concerning these devices, the use of them by individuals results in all cases in doses that are small. It is likely that the average annual genetic dose due to the use of consumer products is less than one mrad.

2.8.8 CONCLUSIONS

The area surrounding the Clinch River Site is presently characterized by air and aquatic radioactivity levels that are well below maximum permissible concentrations (MPC's) as specified in 10 CFR 20, Appendix B,

Table II for unrestricted areas. Any significant releases of radioactivity from the CRBRP into the air or into the Clinch River water should be distinguishable from the present background levels by the effluent and environmental monitoring programs discussed in Section 6.0. In addition, any significant exposure of man to radioactivity through the food chain should also be detectable since the dual system of immediate and remote biological environs monitoring has proven effective even with relatively high enhanced background levels from worldwide fallout. Continued monitoring of soil and other terrestrial products for plutonium should result in detection of possible releases from the CRBRP.

Studies made of the Clinch River sediment indicate that the total radionuclide inventory may be substantial. However, since these inventories have not made significant contributions to the activities present in the Clinch River water nor to the radionuclide content of Clinch River fish, it may be assumed that present radioactivity levels in the Clinch River sediment present no potential hazard to man.

In conclusion, the background radiological characteristics have been adequately characterized to allow detection of releases from the CRBRP which may significantly impact the environment.

TABLE 2.8-1

CONTINUOUS AIR MONITORING DATA

LONG-LIVED GROSS BETA ACTIVITY OF PARTICULATES IN AIR

1979

Station Number	Location	Number of Samples Taken	Units of 10^{-13} μCi/ml Maximum*	Minimum**	Average	% MPC+
Perimeter Area++						
HP-31	Kerr Hollow Gate	50	0.7	0.12	0.25±.02	0.02
HP-32	Midway Gate	52	0.8	0.08	0.31±.04	0.03
HP-33	Gallaher Gate	51	0.5	0.09	0.27±.02	0.03
HP-34	White Oak Dam	52	0.7	0.10	0.28±.02	0.03
HP-35	Blair Gate	50	0.6	0.09	0.27±.04	0.03
HP-36	Turnpike Gate	52	0.5	0.05	0.23±.02	0.02
HP-37	Hickory Creek Bend	52	0.8	0.11	0.35±.04	0.04
HP-38	East of EGCR	52	0.5	0.10	0.26±.02	0.03
HP-39	Townsite	52	0.6	0.08	0.25±.02	0.02
Average			0.6	0.10	0.27±.02	0.03
Remote AreaΔ						
HP-51	Norris Dam	52	1.1	0.08	0.26±.04	0.03
HP-52	Loudoun Dam	52	0.7	0.07	0.25±.04	0.03
HP-53	Douglas Dam	50	0.6	0.07	0.24±.02	0.02
HP-54	Cherokee Dam	52	0.4	0.06	0.20±.02	0.02
HP-55	Watts Bar Dam	50	0.4	0.01	0.13±.02	0.01
HP-56	Great Falls Dam	50	0.6	0.07	0.27±.04	0.03
HP-57	Dale Hollow Dam	51	0.7	0.05	0.34±.04	0.03
HP-58	Knoxville	51	0.6	0.05	0.22±.04	0.02
Average			0.7	0.06	0.24±.02	0.02

9

* Maximum weekly average concentration.

** Minimum weekly average concentration; minimum detectable level is 1×10^{-15} μCi/ml.

\+ MPC is 10^{-10} μCi/ml for unidentified radionuclides (10 CFR 20, Appendix B, Table II, Col. 1).

++ See Figure 2.8-2.

Δ See Figure 2.8-3.

TABLE 2.8-2

CONTINUOUS AIR MONITORING DATA

LONG-LIVED GROSS ALPHA ACTIVITY OF PARTICULATES IN AIR

1979

Station Number	Location	Number of Samples Taken	Units of 10-15 μCi/ml Maximum*	Minimum**	Average	% MPC+
Perimeter Area++						
HP-31	Kerr Hollow Gate	50	7.2	0.5	1.1±0.3	0.03
HP-32	Midway Gate	52	4.8	0.7	1.4±0.2	0.03
HP-33	Gallaher Gate	51	4.5	0.6	1.2±0.2	0.03
HP-34	White Oak Dam	52	3.3	0.5	1.2±0.2	0.03
HP-35	Blair Gate	50	10.1	0.3	1.5±0.4	0.04
HP-36	Turnpike Gate	52	2.9	0.5	1.1±0.2	0.03
HP-37	Hickory Creek Bend	52	3.0	0.5	0.9±0.1	0.02
HP-38	East of EGCR	52	17.8	0.5	1.4±0.7	0.04
HP-39	Townsite	52	3.8	0.6	1.2±0.2	0.03
Average			6.4	0.5	1.2±0.12	0.03
Remote AreaΔ						
HP-51	Norris Dam	52	2.4	0.4	1.0±0.2	0.02
HP-52	Loudoun Dam	52	2.5	0.5	0.9±0.1	0.02
HP-53	Douglas Dam	50	2.6	0.5	0.9±0.1	0.02
HP-54	Cherokee Dam	52	2.5	0.5	0.9±0.1	0.02
HP-55	Watts Bar Dam	50	1.3	0.1	0.7±0.1	0.02
HP-56	Great Falls Dam	50	2.8	0.5	1.0±0.2	0.02
HP-57	Dale Hollow Dam	51	2.7	0.5	1.0±0.2	0.03
HP-58	Knoxville	51	2.9	0.5	0.9±0.2	0.02
Average			2.5	0.4	0.9±0.1	0.02

9

* Maximum weekly average concentration.

** Minimum weekly average concentration; minimum detectable level is 1×10^{-16} μCi/ml.

\+ MPC is 40×10^{-13} μCi/ml for a mixture of uranium isotopes (10 CFR 20, Appendix B, Footnote 4).

++ See Figure 2.8-2.

Δ See Figure 2.8-3.

TABLE 2.8-3

CONTINUOUS AIR-MONITORING DATA
SPECIFIC RADIONUCLIDES IN AIR
COMPOSITE SAMPLES, 1979[1]
(10^{-15} µCi/ml)

	Perimeter Stations					Remote Stations				
Radionuclide	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	Yearly Average	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	Yearly Average
^{7}Be	109	119	91	104	106	113	100	84	85	95
^{90}Sr	0.15	0.27	0.05	0.13	0.15	0.09	0.38	0.06	0.22	0.19
^{106}Ru	2.27	2.72	0.72	0.54	1.56	1.93	2.37	0.73	0.41	1.36
^{125}Sb	0.48	0.60	0.27	0.14	0.37	0.41	0.57	0.18	0.16	0.33
^{137}Cs	0.75	1.14	0.49	0.29	0.67	0.82	1.06	0.31	0.23	0.61
^{144}Ce	3.13	3.48	0.72	0.08	1.85	0.25	3.07	0.67	0.33	1.10
^{228}Th	0.006	0.020	0.008	0.007	0.010	0.008	0.020	0.006	0.003	0.009
^{230}Th	0.050	0.020	0.011	0.010	0.023	0.009	0.020	0.006	0.004	0.010
^{232}Th	0.004	0.020	0.008	0.008	0.010	0.008	0.040	0.002	0.003	0.013
^{234}U	0.65	0.18	0.25	0.68	0.44	0.26	0.045	0.053	0.033	0.10
^{235}U	0.060	0.013	0.012	0.045	0.030	0.020	0.0003	0.006	0.003	0.010
^{238}U	0.23	0.13	0.20	0.48	0.26	0.012	0.010	0.020	0.022	0.020
^{238}Pu	0.001	0.005	0.001	0.001	0.002	ND*	0.0002	0.002	0.0004	0.0007
^{239}Pu	0.008	0.15	0.005	0.012	0.040	0.006	0.012	0.004	0.002	0.010

* ND - Not Detectable.

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TABLE 2.8-4

CONCENTRATION OF ^{131}I IN AIR AS MEASURED BY THE
PERIMETER AIR MONITORING STATIONS*
1979(1)

Station Number	Location	Number of Samples Taken	Units of 10-14 μCi/ml			% MPC++	
			Maximum**	Minimum+	Average		
HP-31	Kerr Hollow Gate	51	7.7	0.03	0.5±0.3	<0.01	
HP-32	Midway Gate	52	1.5	0.02	0.4±0.1	<0.01	
HP-33	Gallaher Gate	51	7.1	0.04	0.5±0.3	<0.01	
HP-34	White Oak Dam	52	6.4	0.01	0.5±0.2	<0.01	
HP-35	Blair Gate	52	1.1	0.01	0.3±0.1	<0.01	9
HP-36	Turnpike Gate	52	6.0	0.02	0.3±0.1	<0.01	
HP-37	Hickory Creek Bend	52	3.0	0.03	0.4±0.1	<0.01	
HP-38	East of EGCR	52	6.0	0.03	0.4±0.3	<0.01	
HP-39	Townsite	51	0.8	0.06	0.4±0.1	<0.01	
Average					0.4±0.1	<0.01	

* See Figure 2.8-2.

** Maximum weekly average concentration.

\+ Minimum weekly average concentration; minimum detectable amount of ^{131}I is 1 x 10-16 μCi/ml.

++ MPC is 1 x 10^{-10} μCi/ml (10 CFR 20, Appendix B, Table II).

TABLE 2.8-5

DISCHARGES OF RADIOACTIVITY TO THE ATMOSPHERE 1979[1]

Radionuclide	Curies Discharged	
Uranium*	0.11	
^{131}I	0.3	
^{3}H	5,100	
^{133}Xe**	<51,200	
^{85}Kr**	<10,500	9
^{99}T+	1.4	
Alpha+	4.8×10^{-6}	

* Uranium of varying enrichments; curie quantities calculated using the appropriate specific activity for material released.

** Upper limit values based on direct radiation measurements in the stack gas stream and an assumed mixture of noble gases.

\+ Unidentified alpha.

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TABLE 2.8-6

YEARLY DISCHARGES OF RADIONUCLIDES TO CLINCH RIVER[9,10]

Curies

Year	Gross Beta	Cs-137	Ru-106	Sr-90	TRE*(-Ce)	Ce-144	Zr-95	Nb-95	I-131	Co-60	H-3
1949	718	77.0	110.0	150.0	77.0	18.00	180.00	22.00	77.00	--	--
1950	191	19.0	23.0	38.0	30.0	--	15.00	42.00	19.00	--	--
1951	101	20.0	18.0	29.0	11.0	--	4.50	2.20	18.00	--	--
1952	214	9.9	15.0	72.0	26.0	23.00	19.00	18.00	20.00	--	--
1953	304	6.4	26.0	130.0	110.0	6.70	7.60	3.60	2.10	--	--
1954	384	22.0	11.0	140.0	160.0	24.00	14.00	9.20	3.50	--	--
1955	437	63.0	31.0	93.0	150.0	85.00	5.20	5.70	7.00	6.6	--
1956	582	170.0	29.0	100.0	140.0	59.00	12.00	15.00	3.50	46.0	--
1957	397	89.0	60.0	83.0	110.0	13.00	23.00	7.10	1.20	4.8	--
1958	544	55.0	42.0	150.0	240.0	30.00	6.00	6.00	8.20	8.7	--
1959	937	76.0	520.0	60.0	94.0	48.00	27.00	30.00	0.50	77.0	--
1960	2190	31.0	1900.0	28.0	48.0	27.00	38.00	45.00	5.30	72.0	--
1961	2230	15.0	2000.0	22.0	24.0	4.20	20.00	70.00	3.70	31.0	--
1962	1440	5.6	1400.0	9.4	11.0	1.20	2.20	7.70	0.36	14.0	--
1963	470	3.6	430.0	7.8	9.4	1.50	0.34	0.71	0.44	14.0	--
1964	234	6.0	191.0	6.6	13.0	0.30	0.16	0.07	0.29	15.0	--
1965	95	2.1	69.0	3.4	5.9	0.10	0.33	0.33	0.20	12.0	--
1966	48	1.6	29.0	3.0	4.9	0.10	0.67	0.67	0.24	7.0	--
1967	40	2.7	17.0	5.1	8.5	0.20	0.49	0.49	0.91	3.0	--
1968	16	1.1	5.0	2.8	4.4	0.03	0.27	0.27	0.31	1.0	--
1969	--	1.7	1.7	3.1	4.6	0.02	0.18	0.18	0.54	1.0	12,247
1970	--	2.0	1.2	3.9	4.7	0.06	0.02	0.02	0.32	1.0	9,473
1971	--	0.9	0.5	3.4	2.9	0.05	0.01	0.01	0.21	0.8	8,945

*TRE = Trivalent Rare Earths (Less Ce)

TABLE 2.8-7

RADIONUCLIDES IN THE CLINCH RIVER SEDIMENT 1972[15]

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pCi/g

Clinch River Mile	Date	Co-60	Ru-103-106	Cs-137
4.7	8/5/72	3.2	0.9	25.0
5.8	8/5/72	3.8	1.4	59.0
8.0	8/5/72	2.0	1.4	22.0
11.0	7/29/72	1.5	0.9	24.0
14.0	7/29/72	1.2	0.4	7.0
16.3	7/29/72	0.8	0.5	8.0
21.5	7/29/72	0.09	0.3	0.09
51.6	8/12/72	0.09	0.7	0.60

TABLE 2.8-8

RADIOACTIVITY IN CLINCH RIVER SEDIMENT NEAR THE CRBRP JULY 14, 1976[16] pCi/gm, DRY WEIGHT*

Location** CRM	#	Gross α	Gross β	^{214}Bi	^{214}Pb	^{212}Pb	^{225}Ra	^{228}Ac	^{208}Tl	^{212}Bi	^{137}Cs	^{60}Co	^{40}K	^{149}La
14.8	M-1	1.94±.46	8.79±.46	.649±.060	.507±.051	.438±.040	.649±.060	.876±.168			2.025±.050	.600±.043	7.00±.443	
14.8	M-2	2.21±.49	13.55±.55	.503±.043	.496±.039	.567±.027	.503±.043	.664±.087	.177±.017		1.953±.039	.228±.023	7.451±.338	
14.8	M-3+	2.74±.54	22.25±.68	.660±.066	.501±.062	.638±.041	.660±.066	.859±.124	.126±.021		9.866±.107	.328±.034	9.042±.459	
14.8	R-1	1.58±.43	10.61±.50	.411±.023	.396±.019	.349±.014	.411±.023	.594±.055	.127±.008		3.050±.036	.740±.022	4.469±.191	
14.8	R-2	4.10±.64	27.62±.76	.836±.034	.850±.029	.948±.023	.836±.034	1.229±.065	.301±.015	.533±.115	.913±.023	.180±.175	16.14±.390	
14.8	L-1	2.21±.49	8.76±.45	.388±.026	.404±.022	.427±.015	.388±.026	.610±.054			1.715±.029	.532±.021	5.010±.215	
14.8	L-2	2.57±.52	22.94±.69	.582±.025	.560±.023	.605±.016	.362±.025	.870±.056	.212±.010		2.174±.031	.237±.014	12.08±.301	
16.0	R-1	1.40±.41	6.54±.41	.253±.021	.277±.020	.312±.015	.253±.021	.562±.051	.098±.009		2.138±.033	.474±.019	2.847±.153	
16.0	R-2	3.74±.63	28.60±.77	.919±.075	.779±.065	.968±.046	.919±.075	1.063±.120	.350±.034		13.96±.114	1.033±.047	13.61±.519	
16.0	L-1	1.85±.47	6.69±.43	.358±.024	.305±.020	.340±.015	.358±.024	.466±.043	.164±.011		2.305±.032	.477±.018	2.886±.169	
16.0	L-2	4.91±.71	27.95±.77	.865±.066	.744±.060	.699±.046	.865±.066	1.050±.114	.364±.030		12.69±.010	.899±.041	14.03±.476	
17.9	R-1	2.30±.51	7.59±.45	.447±.030	.474±.031	.363±.020	.447±.030	.548±.062	.148±.013		3.029±.044	.550±.024	4.807±.237	
17.9	R-2	7.34±.85	26.41±.76	.906±.031	.932±.027	1.043±.021	.906±.031	1.166±.067	.319±.013		.968±.022	.132±.014	15.58±.357	5.303±1.07
17.9	R-3	5.00±.71	22.69±.70	.889±.055	.848±.047	.876±.034	.889±.055	1.169±.111	.334±.025		1.963±.044	.248±.034	14.64±.507	
17.9	L-1	2.66±.54	8.05±.46	.474±.026	.430±.022	.334±.015	.474±.026	.500±.054	.129±.010		4.419±.051	.579±.023	4.286±.211	
17.9	L-2	7.79±.87	21.47±.70	.507±.030	.538±.027	.587±.020	.507±.030	.812±.061	.214±.012		2.604±.037	.422±.021	9.451±.312	
17.9	L-3	7.16±.84	28.60±.78	.867±.032	.842±.027	1.021±.022	.867±.032	1.357±.080	.333±.013		1.499±.028	.184±.015	17.21±.386	

* The error term reported is the 1-sigma counting error.

** CRM 14.8 = Proposed barge unloading facility.
CRM 16.0 = Discharge site
CRM 17.9 = Water Intake site

+ Soil sample taken approximately 50 feet from the shoreline.

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TABLE 2.8-9

RADIONUCLIDES IN THE CLINCH RIVER WATER, 1971 AND 1972[15]

p Ci/liter (or 10^{-9} μCi/ml)

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Clinch River Mile	Year	Quarter	Sr-90	Ce-144	Cs-137	Ru-103-106	Co-60	Zr-Nb-95	H-3
CRM 23.1	1971	1	0.70	0.18	0.15	0.80	0.40	0.19	990
		2	0.27	0.12	0.30	0.70	0.40	0.12	990
		3	0.42	0.40	0.05	1.70	0.14	0.02	990
		4	0.52	0.50	0.10	2.10	0.16	0.04	990
	1972	1	0.50	0.40	0.20	0.80	<0.10	0.05	*
		2	0.50	0.20	0.10	0.70	0.20	0.04	*
		3	0.50	0.10	0.10	0.20	0.20	0.05	*
		4	0.50	0.20	0.10	0.90	0.20	0.02	*
CRM 14.5	1971	1	1.70	0.08	1.50	1.90	0.80	0.08	6570
		2	1.40	0.16	2.00	1.00	0.50	0.50	1350
		3	1.60	0.70	0.90	4.80	0.90	0.10	2970
		4	2.70	0.18	0.60	3.00	0.30	0.09	990
	1972	1	1.10	0.20	0.60	0.70	0.40	0.07	1800
		2	1.40	0.10	0.50	0.50	0.30	0.10	1440
		3	2.10	0.80	0.60	0.50	0.50	0.20	1000
		4	1.20	0.80	1.10	1.20	0.50	0.07	3290
CRM 4.5	1971	1	1.50	0.18	1.30	2.10	0.60	0.09	5080
		2	1.00	0.19	1.10	0.50	0.50	0.30	590
		3	1.20	0.47	0.50	3.30	1.90	0.05	2070
		4	0.50	0.11	0.80	2.20	1.80	0.03	990
	1972	1	1.00	0.10	0.60	0.70	0.50	0.10	2070
		2	1.30	0.09	0.30	0.20	0.20	0.08	1620
		3	1.20	0.30	0.50	0.40	0.20	0.04	1000
		4	1.40	0.10	0.90	1.10	0.20	0.03	1760
	MPC**		300	1×10^4	2×10^4	1×10^4	3×10^4	6×10^4	3×10^6

* Indicates no readings

**10 CFR 20, Appendix B, Table II, Column 2

TABLE 2.8-10

GROSS ALPHA AND BETA RADIOACTIVITY EXCLUDING TRITIUM FOR THE CLINCH RIVER WATER

AT KINGSTON, 1971 AND 1972 9

pCi/liter (10^{-9} μCi/ml)*

	1971											
Parameter	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Gross Alpha-Suspended Solids	<0.2	<0.2	<0.2	<0.8	<0.2	<0.2	<0.2	<0.2	<0.2	<0.4	<0.6	<0.3
Gross Alpha-Dissolved Solids	<0.2	<0.8	<0.2	<0.2	<0.2	<0.2	<0.2	<1	0.5	<0.8	<1.0	<0.5
Gross Beta-Suspended Solids	<1	<1	1	4.7	<1	2	2	1	<1.8	2.5	<4	<1.2
Gross Beta-Dissolved Solids	10	10	6.7	4.7	5.8	3	4	3	4	5.2	<5	8

	1972											
Parameter	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Gross Alpha-Suspended Solids	<0.5	<0.4	<0.4	<0.2	<0.4	3.3	<0.3	<0.3	-	-	-	-
Gross-Alpha-Dissolved Solids	<0.6	<0.5	<0.5	<0.4	<0.5	<1.0	2.4	<0.4	-	-	-	-
Gross Beta-Suspended Solids	<3	<2	<2	3	2	7	<1	<1	-	-	-	-
Gross Beta-Dissolved Solids	5	<4	6	6	6	5	2	5	-	-	-	-

* References 17-27, 9, 10, 28, 29.

** MPC is 30 pCi/l for unidentified radionuclides (10 CRF 20, Appendix B, Table II, Column 2). 9

TABLE 2.8-11

RADIONUCLIDE CONTENT OF CLINCH RIVER FISH WET WEIGHT[2,3] 9
pCi/kg

	1971				1972		
	Sr-90	Cs-137	Ru-106	%MPI*	Sr-90	Cs-137	%MPI*
White Crappie	135	343	<180	<0.38	62	185	0.18
Smallmouth Buffalo	108	336	<315	<0.32	--	--	--
Carp	--	--	--	--	35	43	0.10

*Maximum Permissible Intake - Assumes intake of radionuclide from eating fish to be comparable to a daily intake of 2.2 liters of water for the year containing the concentration guide level of the radionuclides in question.

TABLE 2.8-12

CONCENTRATION FACTORS FOR CLINCH RIVER FISH 9

$$CF^* = \frac{C_o}{C_w} \text{ Wet Weight Basis}$$

	1971		1972	
	Sr-90	Cs-137	Sr-90	Cs-137
White Crappie	142	570	67	617
Smallmouth Buffalo	114	561	NA	NA
Carp	NA	NA	38	143

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*CF = Concentration Factor
C_o = Concentration of radioisotope in the organism
C_w = Concentration of radioisotope in the ambient water

NA = Not available

TABLE 2.8-13

RADIONUCLIDES IN THE CLINCH RIVER WATER
1979[1]

Location	Number of Samples	Range	Concentration of Radionuclides of Primary Concern Units of 10^{-9} µCi/ml ^{90}Sr	^{137}Cs	^{106}Ru	^{60}Co	^{3}H	% MPC*
C-2, CRM 23.1	4	Max.	0.16	0.02	0.09	0.01	720	
		Min.	0.05	0.01	0.02	0.01	590	
		Avg.	0.10±0.06	0.01±0.01	0.05±0.03	0.01	650±80	0.06
C-3, CRM 14.5	4	Max.	0.68	0.05	0.14	0.11	2,200	
		Min.	0.16	0.01	0.03	0.01	1,000	
		Avg.	0.40±0.31	0.02±0.02	0.08±0.05	0.05±0.05	1,400±700	0.15
C-5, CRM 4.5	4	Max.	0.37	0.05	0.23	0.05	1,800	
		Min.	0.14	0.01	0.02	0.02	1,400	
		Avg.	0.33±0.21	0.03±0.02	0.11±0.09	0.04±0.01	1,600±200	0.21

* Most restrictive MPC for each isotope used for calculating percent MPC. The method for calculating percent of MPC for a known mixture of radionuclides is given in NRC 10 CFR 20 Appendix B.

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TABLE 2.8-14

URANIUM CONCENTRATION IN SURFACE STREAMS
1979[1]

Station Number*	Location	Number of Samples	Units of 10^{-8} µCi/ml Maximum	Minimum	Average	% MPC**
P-1	Poplar Creek	12	0.7	<0.07	<0.4±0.3	<0.1
P-2	Poplar Creek	12	0.8	0.2	0.5±0.2	<0.1
C-3	Clinch River	12	0.5	<0.07	<0.2±0.1	<0.1
C-4	Clinch River	12	0.8	<0.07	<0.3±0.2	<0.1
C-6	Clinch River	12	0.5	<0.07	<0.2±0.1	<0.1
E-1	East Fork Poplar Creek	12	1.6	0.5	1.0±0.3	<0.1
B-1	Bear Creek	10	3.7	1.5	2.6±0.5	<0.1

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* See Figure 2.8-8.

** MPC is 3×10^{-5} µCi/ml in all cases (for calculations for a mixture of uranium isotopes, see NRC 10 CFR 20, Appendix B, Table II, Column 2, Footnote 4).

TABLE 2.8-15

DISCHARGES OF RADIOACTIVITY TO SURFACE STREAMS
1979[1]

Radionuclide	Curies Discharged	
^{137}Cs	0.24	
^{60}Co	0.9	
^{3}H	7,770	
^{131}I	0.06	
^{106}Ru	0.13	
^{90}Sr	2.44	9
^{99}Tc	7.3	
Uranium*	0.6	
^{237}Np	0.002	
^{239}Pu	0.0005	
^{232}Th	0.011	
Alpha**	0.03	

* Uranium of varying enrichments; curie quantities calculated using the appropriate specific activity for material released.

** Unidentified alpha.

TABLE 2.8-16

RADIONUCLIDE CONTENT IN CLINCH RIVER FISH
1979(1)
pCi/kg-Wet Weight

Location	Species*	^{90}Sr	^{239}Pu	^{238}Pu	^{238}U	^{235}U	^{234}U	^{137}Cs	^{60}Co	^{40}K	% MPI**	Hg (ng/g)	% of A.L.+
CRM 5.0	Bass	2	0.03	0.02	0.4	0.03	0.5	151	6	327	0.03	157	31
	Blue Gill	7	0.05	0.02	0.7	0.16	1.2	77	4	4137	0.05	220	44
	Carp	5	0.01	0.02	0.6	0.08	0.8	59	3	3525	0.04	199	40
	Shad	9	0.05	0.02	6.2	0.34	9.2	66	5	2508	0.07	25	5
	Crappie	5	0.02	0.02	0.4	0.04	0.8	56	4	2819	0.11	65	13
CRM 12.0	Bass	9	0.06	0.03	1.2	0.23	2.3	1649	13	16177	0.21	430	86
	Blue gill	1	0.88	0.88	9.4	2.31	11.7	120	15	12876	0.16	470	94
	Carp	18	0.23	0.17	8.1	0.68	13.0	406	16	18976	0.17	102	20
	Shad	47	0.26	0.03	104	0.79	135	416	20	7288	0.38	18.2	0.3
	Crappie	14	0.03	0.10	1.3	8.50	3.1	683	14	18089	0.17	122	0.8
CRM 20.8++	Bass	11	0.01	0.01	0.2	0.06	0.4	1252	9	3275	0.14	99	20
	Blue Gill	255	0.03	0.08	0.7	0.09	1.3	3955	92	3159	2.20	219	44
	Carp	57	0.02	0.03	0.3	0.08	0.6	502	17	3314	0.45	192	39
	Shad	23	0.06	0.09	2.1	0.27	3.3	513	82	2668	0.23	24	5
	Crappie	14	0.01	0.15	0.7	0.09	1.9	393	11	4021	0.14	45	9
CRM 25.0	Bass	7	0.04	0.08	1.2	0.23	1.7	219	12	23870	0.07	11	2
	Blue Gill	7	0.07	0.70	1.9	1.40	5.2	153	21	20126	0.07	59	12
	Carp	4	0.08	0.08	1.1	0.56	1.8	29	18	13875	0.03	109	4
	Shad	7	0.07	0.07	2.4	0.33	3.3	32	7	10528	0.07	7.4	1

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* Composite of 10 fish in each species.

** Maximum Permissible Intake - Intake of radionuclide from eating fish is calculated to be equal to a daily intake of 22 liters of water over a period of one year, containing the one MPC of radionuclides in question. Consumption of fish is assumed to be 16.8 kg/yr of the species in question. Only man-made radionuclides were used in the calculation.

\+ Percent of proposed FDA Mercury in fish action level of 500 ng/g; Mercury data included in this table as a matter of convenience. (A.L. is allowable limit)

++ Average of quarterly samples.

TABLE 2.8-17

STREAM SEDIMENT SAMPLES
JULY/NOVEMBER 1979[1]
AVERAGE CONCENTRATION (μg/g dry weight basis)

Station	U*	Hg**	Pb	Ni	Cu	Zn	Cr	Mn	Cd	Al	Th	
CS1	2	<0.2	33	30	15	48	25	985	<5	26000	<40	
PS2	17	35	63	135	110	163	219	600	<5	93000	<40	
PS5	5	<0.3	48	88	31	103	60	360	<5	60000	<40	
PS6	14	11	54	147	45	172	224	525	<5	52500	<40	
PS9	6	3	40	61	92	82	50	570	<5	34500	<40	
PS10	4	3	40	79	29	84	77	810	<5	34000	<40	9
PS12	17	<9	44	75	34	104	98	813	<5	43500	<40	
PS15	14	6	43	109	39	97	62	523	<5	39500	<40	
PS17	181	<13	76	790	412	237	97	570	<5	52000	<40	
PS18	6	4	48	103	38	84	59	496	<5	36500	<40	
PS19	17	21	54	120	43	95	88	422	<5	29000	<40	
PS21	7	<1	68	110	81	124	101	543	<5	73000	<40	
PS22	12	7	65	157	44	103	88	513	<5	34000	<40	
CS20	1	<0.2	37	26	65	47	244	386	<5	26500	<40	

* 1 microgram of ^{238}U has 0.333 pCi of radioactivity.

** Average of two samples; some results were below detectable limit.

TABLE 2.8-18

RADIOACTIVITY IN SOIL SAMPLES FROM PERIMETER AND REMOTE MONITORING STATIONS

1979(1)

pCi/g-Dry Weight

Sampling Location*	^{90}Sr	^{137}Cs	^{226}Ra	^{234}U	^{235}U	^{238}U	^{238}Pu	^{239}Pu
Perimeter**								
HP-31	.3	1.0	1.5	0.4	.01	.23	.003	.02
HP-32	.3	1.5	0.9	1.4	.05	.86	.002	.02
HP-33	.4	1.8	0.9	0.3	.02	.21	.001	.01
HP-34	.5	2.6	0.9	0.3	.01	.21	.001	.06
HP-35	.1	2.0	1.2	0.5	.03	.37	.001	.04
HP-36	.2	1.8	1.1	0.4	.02	.31	.001	.03
HP-37	.2	0.7	0.7	0.4	.02	.27	.010	.01
HP-38	.3	1.4	0.6	0.3	.01	.24	.003	.02
HP-39	.4	2.4	1.1	1.1	.03	.90	.002	.03
Average	.4	1.5	1.0	0.6	.02	.38	.003	.03
Remote+								
HP-51	.12	0.9	1.0	.30	.01	.25	.002	.01
HP-52	.38	1.7	1.4	.62	.02	.49	.001	.02
HP-53	.30	1.5	2.1	.89	.04	.76	.001	.04
HP-54	.17	2.8	1.5	.57	.02	.54	.001	.05
HP-55	.43	1.5	1.1	.43	.03	.32	.002	.02
HP-56	.21	1.6	1.1	.32	.02	.26	.002	.03
HP-57	.20	2.3	1.4	.62	.02	.49	.001	.04
HP-58	.24	1.4	1.0	.38	.02	.30	.001	.02
Average	.29	1.7	1.3	.52	.02	.43	.001	.03

9

* See Figures 2.8-2 and 2.8-3.

** Average of two samples.

\+ One sample.

TABLE 2.8-19

LONG-LIVED GROSS BETA ACTIVITY IN PRECIPITATION
1979(1)

Station Number	Location	Number of Samples Taken	Units of 10^{-8} μCi/ml*	
Perimeter Area**				
HP-31	Kerr Hollow Gate	41	0.9±0.3	
HP-32	Midway Gate	27	0.7±0.3	
HP-33	Gallaher Gate	22	1.1±0.4	
HP-34	White Oak Dam	26	1.0±0.4	
HP-35	Blair Gate	26	1.0±0.3	
HP-36	Turnpike Gate	27	1.0±0.3	
HP-37	Hickory Creek Bend	27	1.0±0.3	
HP-38	East of EGCR	28	1.1±0.4	
HP-39	Townsite	44	0.8±0.2	9
Average			1.0±0.1	
Remote Area+				
HP-51	Norris Dam	43	1.2±0.5	
HP-52	Loudoun Dam	27	1.4±0.5	
HP-53	Douglas Dam	26	1.4±0.5	
HP-54	Cherokee Dam	27	1.5±0.6	
HP-55	Watts Bar Dam	28	1.2±0.4	
HP-56	Great Falls Dam	30	1.7±0.5	
HP-57	Dale Hollow Dam	27	1.3±0.5	
HP-58	Knoxville	37	1.1±0.5	
Average			1.4±0.1	

* Weekly averaged concentration.

** See Figure 2.8-2.

\+ See Figure 2.8-3.

TABLE 2.8-20

RADIOACTIVITY IN GRASS SAMPLES FROM PERIMETER AND REMOTE MONITORING STATIONS 1979(1)

(Units of pCi/g-Dry Weight)

Sampling Location*	^{7}Be	^{90}Sr	^{137}Cs	^{239}Pu	^{238}Pu	^{238}U	^{235}U	^{234}U
Perimeter								
HP-31	13	.6	.2	.002	.001	.04	.010	.08
HP-32	10	.6	ND**	.010	.010	.01	.010	.36
HP-33	10	.5	ND	.001	.001	.02	.004	.03
HP-34	8	.6	.3	.001	.001	.03	.004	.03
HP-35	4	.1	.1	.002	.002	.03	.001	.04
HP-36	10	.6	.1	.003	.003	.03	.004	.05
HP-37	10	.4	ND	.001	.003	.02	.002	.03
HP-38	6	.3	ND	.004	.004	.03	.004	.04
HP-39	19	.5	.2	.002	.001	.04	.002	.04
Average	11	.5	.1	.003	.003	.03	.005	.03
Remote								
HP-51	14	.6	.1	.001	.0014	.08	.008	.09
HP-52	14	.1	.1	.001	.0022	.02	.004	.01
HP-53	13	.3	.1	.001	.0005	.09	.010	.10
HP-54	12	.4	.1	.001	.0003	.01	.003	.01
HP-55	12	.4	.2	.002	.0005	.06	.006	.08
HP-56	20	.2	.3	.002	.0003	.02	.005	.03
HP-57	26	.3	.1	.002	.0005	.03	.005	.05
HP-58	16	.4	.1	.001	.0003	.04	.004	.06
Average	16	.3	.1	.001	.0008	.04	.010	.05

* See Figures 2.8-2 and 2.8-3.

** ND = Not Detectable.

9

TABLE 2.8-21

VEGETATION SAMPLING DATA
1979(1)

Station Number*	U (Total) Concentration** µg/g (ppm) Grass	Pine Needles
1	0.1	--
2	0.1	0.06
3	0.1	0.05
4	0.1	0.1
5	0.1	0.2
6	0.08	0.09
7	0.1	0.1
8	0.2	0.3
9	0.2	0.09
10	0.1	0.1
11	0.7	0.5
12	0.2	0.2
13	0.1	--
14	0.04	--
15	0.04	--
16	0.1	--
17	0.4	--

9

* See Figure 2.8-2.

** Average concentration of two sample collections, January and July.

NOTE: Analytical results are on a dry weight basis;
One µg of ^{238}U has 0.333 pCi of radioactivity.

TABLE 2.8-22

50-YEAR DOSE COMMITMENT FROM NUCLEAR TESTS CONDUCTED BEFORE 1971, NORTH TEMPERATE ZONE[41]

Source of Exposure	Dose Commitment, mrads			
	Gonads	Bone-Lining Cells	Bone Marrow	
External exposure:				
Short-lived radionuclides*	65	65	65	
Cesium-137	59	59	59	
Krypton-85	2×10^{-4}	2×10^{-4}	2×10^{-4}	
Internal Exposure:				9
Hydrogen-3	4	4	4	
Carbon-14	12	15	12	
Iron-55	1	1	0.6	
Strontium-90	--	85	62	
Cesium-137	26	26	26	
Plutonium-239**	--	0.2	--	
TOTAL+	170	260	230	

* Includes radioiodine.

** Dose commitment to bone-lining cells has been taken to be equal to integrated dose over 50 years to bone.

\+ Total rounted to two significant figures.

TABLE 2.8-23

PROJECTION OF ANNUAL WHOLE-BODY DE TO U.S. POPULATION FROM GLOBAL WEAPONS TESTING FALLOUT[41]

Year	Per Capita DE, mrems
1963	13
1965	6.9
1969	4.0
1980	4.4
1990	4.6
2000	4.9

9

TABLE 2.8-24

DISTRIBUTION OF SAMPLING STATIONS IN VARIOUS RANGES OF RADIONUCLIDE CONCENTRATIONS IN MILK, JUNE 1964

Strontium-89		Strontium-90		Iodine-131		Cesium-137		Barium-140	
(pc/ liter)	Number of Stations	(pc/ liter)	Number of Stations	(pc/ liter)	Number of Stations	(pc/ liter)	Number of Stations	(pc/ liter)	Number of Stations
<5	49	<1-9	4	<10	63	<5-45	1	<10	63
5	7	10-19	6			50-95	19		
10	6	20-29	23			100-145	24		
20	1	30-39	17			150-195	13		
		40-49	10			200-245	4		
		50-59	2			250-295	2		
		60-69							
		70-79	1						

9

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TABLE 2.8-25

FREQUENCY DISTRIBUTION, STRONTIUM-90
CONCENTRATIONS IN MILK AT PMN STATIONS
JUNE 1966, JANUARY-JUNE 1967

Strontium-90 (pCi/liter)	Number of Stations						
	1966	1967					
	June	Jan.	Feb.	Mar.	Apr.	May	June
Under 10	9	24	21	25	25	25	27
10-19	41	36	38	35	34	35	34
20-29	10	3	4	2	4	3	2
30-39	3	0	0	1	0	0	0

9

TABLE 2.8-26

FREQUENCY DISTRIBUTION, CESIUM-137
CONCENTRATIONS IN MILK AT PMN STATIONS, JUNE 1966
JANUARY-JUNE 1967

	Number of Stations						
Cesium-137	1966	1967					
(pCi/liter)	June	Jan.	Feb.	Mar.	Apr.	May	June
Under 50	56	62	62	62	62	61	61
50-99	6	1	1	1	1	2	2
100-149	1	0	0	0	0	0	0

9

TABLE 2.8-27

AVERAGE CONCENTRATIONS OF RADIONUCLIDES IN MILK FOR EPA-PMN STATIONS 1972[46]

9

Radionuclide	Concentration (pCi/liter)
Strontium-90	6
Cesium-137	6

TABLE 2.8-28

CONCENTRATIONS OF I-131 AND SR-90 IN MILK FOR FIRST HALF 1972, IMMEDIATE ENVIRONS[15]

pCi/liter

9

Week No.	Blair		Broadacre		Clinton		Nancy Lee		Oliver Springs		Poplar Springs		Robinson Crossroad		White Wing	
	I-131	Sr-90	I-131	Sr-90	I-131	Sr-90	I-131	Sr-90	I-131	Sr-90	I-131	Sr-90	I-131	Sr-90	I-131	Sr-90
1	BDC	7.2	BDC	4.5	BDC	13.9	BDC	8.6	BDC	16.2	BDC	18.9	BDC	17.1	BDC	10.8
2	BDC	9.0	BDC	4.1	BDC	5.9	BDC	9.0	BDC	8.6	BDC	17.1	BDC	21.2	BDC	12.2
3	53.7	9.5	BDC	4.5	BDC	6.8	BDC	10.8	26.8	9.9	BDC	12.6	BDC	9.9	BDC	20.3
4	26.7	9.5	BDC	3.2	BDC	12.2	BDC	9.0	29.8	12.6	BDC	10.4	BDC	11.3	BDC	NA
5	11.9	8.1	BDC	5.9	BDC	7.2	BDC	8.1	11.9	9.9	BDC	13.9	BDC	22.1	BDC	6.3
6	BDC	8.6	BDC	4.5	BDC	9.0	BDC	8.6	12.7	12.2	BDC	15.8	BDC	6.8	BDC	18.9
7	BDC	7.2	BDC	3.6	BDC	6.8	BDC	7.2	BDC	10.4	BDC	12.6	BDC	NA	BDC	15.8
8	BDC	9.9	BDC	4.5	BDC	6.3	BDC	7.2	BDC	7.7	BDC	12.2	BDC	NA	BDC	16.2
9	BDC	7.2	BDC	5.4	BDC	7.7	BDC	8.1	BDC	7.2	BDC	15.8	BDC	NA	BDC	16.7
10	BDC	3.6	BDC	2.0	BDC	8.1	BDC	8.6	BDC	9.9	BDC	12.2	BDC	17.1	BDC	11.7
11	BDC	12.6	BDC	4.1	BDC	10.4	BDC	9.9	BDC	12.6	BDC	15.3	BDC	5.9	BDC	19.8
12	BDC	11.7	BDC	2.8	BDC	5.0	BDC	7.7	BDC	12.6	BDC	12.6	BDC	17.0	BDC	25.8
13	BDC	11.3	BDC	3.5	BDC	7.7	BDC	10.4	11.7	14.4	BDC	14.4	66.9	17.6	34.4	23.4
14	130.0	27.9	BDC	3.9	12.1	7.2	BDC	14.9	16.4	15.3	23.9	9.9	64.7	25.2	36.7	29.3
15	43.9	15.8	BDC	5.4	BDC	7.7	BDC	7.2	11.0	11.7	22.5	10.8	BDC	21.2	18.1	21.1
16	BDC	17.1	14.9	7.6	11.1	8.6	BDC	10.8	12.3	13.1	10.4	15.3	15.0	19.4	13.8	18.0
17	BDC	14.4	BDC	2.4	BDC	2.7	BDC	11.7	BDC	13.5	BDC	14.9	BDC	16.7	BDC	23.9
18	BDC	9.5	BDC	4.5	BDC	6.3	BDC	9.5	BDC	13.9	BDC	16.2	BDC	13.9	BDC	18.0
19	BDC	10.8	BDC	3.6	BDC	6.3	BDC	16.2	BDC	9.9	BDC	9.5	BDC	24.3	BDC	20.7
20	BDC	8.6	BDC	4.1	BDC	9.0	BDC	15.8	BDC	11.7	BDC	19.4	BDC	14.9	BDC	20.7
21	11.3	9.5	BDC	4.1	BDC	6.3	BDC	19.4	BDC	9.5	BDC	16.7	BDC	14.4	13.7	19.8
22	BDC	18.8	BDC	4.9	BDC	3.6	BDC	14.0	BDC	12.6	BDC	15.8	BDC	14.8	BDC	18.9
23	BDC	10.4	BDC	4.2	BDC	5.9	BDC	13.5	BDC	20.7	BDC	15.8	BDC	15.8	BDC	22.9
24	NA	NA	15.2	5.4	BDC	6.3	BDC	12.6	BDC	12.6	BDC	13.1	BDC	12.6	BDC	18.9
25	BDC	6.3	BDC	3.1	BDC	4.5	BDC	10.8	BDC	13.9	BDC	11.7	BDC	15.8	BDC	19.4
26	BDC	9.0	BDC	4.5	BDC	5.4	BDC	13.9	BDC	15.3	BDC	13.5	BDC	23.9	BDC	18.9

9

BDC = below detectable concentration (10 pCi/liter)
NA = value not available

9

TABLE 2.8-29

CONCENTRATIONS OF I-131 AND SR-90 IN MILK FOR SECOND HALF 1972, IMMEDIATE ENVIRONS[15]

pCi/liter

Week No.	Blair		Broadacre		Clinton		Nancy Lee		Oliver Springs		Poplar Springs		Robinson Crossroad		White Wing	
	I-131	Sr-90	I-131	Sr-90	I-131	Sr-90	I-131	Sr-90	I-131	Sr-90	I-131	Sr-90	I-131	Sr-90	I-131	Sr-90
27	BDC	8.1	BDC	3.5	BDC	7.2	BDC	26.1	BDC	10.4	BDC	14.4	BDC	18.0	BDC	13.1
28	BDC	8.6	BDC	3.6	BDC	7.7	BDC	13.9	BDC	16.2	BDC	7.7	BDC	18.5	BDC	18.0
29	BDC	6.3	BDC	3.9	BDC	7.7	BDC	8.1	BDC	11.7	BDC	12.6	BDC	25.7	BDC	18.9
30	BDC	9.9	BDC	2.0	BDC	5.9	BDC	17.6	BDC	13.9	BDC	13.1	BDC	21.6	BDC	22.5
31	BDC	8.1	BDC	4.9	BDC	6.8	NA	NA	BDC	15.8	BDC	17.1	BDC	24.8	BDC	18.9
32	BDC	7.2	BDC	3.9	BDC	5.9	BDC	11.3	BDC	17.1	BDC	12.6	BDC	14.9	BDC	14.4
33	BDC	8.6	BDC	6.8	BDC	5.9	BDC	NA	BDC	16.7	BDC	14.9	BDC	20.7	BDC	15.8
34	BDC	5.4	BDC	2.0	BDC	2.0	BDC	7.2	BDC	10.4	BDC	9.5	BDC	19.8	BDC	14.4
35	BDC	6.7	BDC	2.9	BDC	4.3	BDC	10.8	BDC	16.7	BDC	12.6	BDC	19.4	BDC	16.7
36	BDC	7.7	BDC	4.5	BDC	7.7	BDC	14.4	BDC	10.8	BDC	13.1	BDC	17.1	BDC	20.7
37	BDC	4.0	BDC	3.7	BDC	6.3	BDC	9.5	BDC	13.5	BDC	9.0	BDC	15.3	BDC	18.5
38	BDC	4.5	BDC	2.5	BDC	5.0	BDC	9.9	BDC	NA	BDC	11.3	BDC	20.3	BDC	16.2
39	BDC	4.9	BDC	2.0	BDC	5.9	BDC	9.9	BDC	11.7	BDC	9.9	BDC	14.4	BDC	7.2
40	BDC	2.1	BDC	4.5	BDC	7.2	NA	NA	BDC	11.3	BDC	15.3	BDC	13.5	BDC	17.1
41	BDC	4.5	BDC	4.5	BDC	6.3	NA	NA	BDC	13.1	BDC	8.6	BDC	18.0	BDC	17.1
42	BDC	4.9	BDC	3.6	BDC	5.4	NA	NA	BDC	13.9	BDC	14.4	BDC	13.1	BDC	16.7
43	BDC	4.5	BDC	3.8	BDC	3.2	NA	NA	BDC	11.7	BDC	13.1	BDC	18.9	BDC	13.1
44	BDC	2.0	BDC	2.0	BDC	2.0	NA	NA	BDC	2.8	BDC	5.8	BDC	9.9	BDC	2.8
45	BDC	10.8	BDC	4.5	BDC	4.9	NA	NA	BDC	14.4	BDC	9.9	BDC	10.4	BDC	13.1
46	BDC	5.9	BDC	4.5	BDC	6.8	BDC	5.0	BDC	10.8	BDC	12.6	BDC	8.6	BDC	14.9
47	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
48	BDC	4.5	BDC	2.7	BDC	4.5	BDC	8.1	BDC	11.3	BDC	11.3	BDC	7.7	BDC	9.9
49	BDC	5.4	BDC	5.9	BDC	6.8	BDC	10.8	BDC	9.0	BDC	9.0	BDC	6.3	BDC	10.8
50	BDC	5.4	BDC	3.6	BDC	7.2	BDC	11.3	BDC	11.2	BDC	13.5	BDC	9.9	BDC	12.2
51	BDC	4.5	BDC	4.3	BDC	4.1	BDC	8.6	BDC	13.6	BDC	10.9	BDC	9.1	BDC	NA
52	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

BDC = below detectable concentration (10 pCi/liter).

NA = value not available.

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TABLE 2.8-30

CONCENTRATIONS OF I-131 AND SR-90 IN MILK FOR 1972, REMOTE ENVIRONS[15] 9

pCi/liter

Week No.	Rockwood		Sevierville		Wartburg		Watts Bar	
	I-131	Sr-90	I-131	Sr-90	I-131	Sr-90	I-131	Sr-90
1	BDC	23.4	--	--	--	--	--	--
3	--	--	--	--	--	--	104.2	12.2
4	--	--	--	--	BDC	6.3	--	--
5	--	--	BDC	6.8	--	--	--	--
6	BDC	9.9	--	--	--	--	--	--
8	--	--	--	--	--	--	BDC	BDC
9	--	--	--	--	BDC	NA	--	--
10	--	--	BDC	9.0	--	--	--	--
11	BDC	19.8	--	--	--	--	--	--
13	--	--	--	--	--	--	NA	NA
14	--	--	--	--	12.1	12.1	--	--
15	--	--	BDC	10.4	--	--	--	--
16	BDC	9.0	--	--	--	--	--	--
18	--	--	--	--	--	--	13.8	9.0
19	--	--	--	--	BDC	12.6	--	--
20	--	--	BDC	9.5	--	--	--	--
21	BDC	6.8	--	--	--	--	--	--
23	--	--	--	--	--	--	BDC	6.3
24	--	--	--	--	BDC	6.8	--	--
25	--	--	BDC	9.5	--	--	--	--
26	BDC	11.3	--	--	--	--	--	--
28	--	--	--	--	--	--	BDC	12.6
29	--	--	--	--	BDC	6.3	--	--
30	--	--	BDC	7.7	--	--	--	--
31	BDC	11.3	--	--	--	--	--	--
33	--	--	--	--	--	--	BDC	8.1
34	--	--	--	--	BDC	7.7	--	--
35	--	--	NA	NA	--	--	--	--
36	BDC	8.1	--	--	--	--	--	--
38	--	--	--	--	--	--	BDC	7.7
39	--	--	--	--	BDC	7.7	--	--
40	--	--	BDC	8.1	--	--	--	--
41	BDC	5.4	--	--	--	--	--	--
43	--	--	--	--	--	--	BDC	6.3
44	--	--	--	--	BDC	2.2	--	--
45	--	--	BDC	2.8	--	--	--	--
46	BDC	BDC	--	--	--	--	--	--
48	--	--	--	--	--	--	BDC	5.9
49	--	--	--	--	BDC	6.3	--	--
50	--	--	BDC	4.4	--	--	--	--
51	BDC	7.7	--	--	--	--	--	--

BDC = below detectable concentration (10 pCi/liter)
NA = value not available

TABLE 2.8-31

SUMMARY CONCENTRATIONS OF SR-90 AND I-131 IN RAW MILK FOR 1971 AND 1972(2,3) 9

pCi/liter

Location	No. of Samples	I-131 Max	I-131 Min	I-131 Ave*	Sr-90 Max	Sr-90 Min	Sr-90 Ave**
			1971				
Immediate Environs	389	21	<10	<10.1	32	2.4	11.4
Remote Stations	38	<10	<10	<10	15	6.8	9.4
			1972				
Immediate Environs	396	130	10	$<11.4\pm0.84^{+}$	29	2.0	10.9 ± 0.30
Remote Stations	39	104	10	$<10\pm2.5$	23^{++}	2.0^{++}	$8.6\pm0.65^{++}$

*Applicable NRC Standard (1 MPC) is 300 pCi/l, assuming all water intake is via milk.

**Applicable NRC Standard (1 MPC) is 200 pCi/l, assuming all water intake is via milk. 9

+95% Confidence Level

++38 samples analyzed

TABLE 2.8-32 9

CONCENTRATIONS OF RADIONUCLIDES IN MILK FOR THE 12-MONTH PERIODS ENDING DECEMBER 1971 AND DECEMBER 1972, SELECTED TENNESSEE PMN STATIONS(50-52) 9

pCi/liter*

Location	Type of Sample	1971 Sr-90	1971 Cs-137	1972 Sr-90	1972 Cs-137
Chattanooga, Tenn.**	Pasteurized	9	10	8	7
Chattanooga, Tenn.	Pasteurized	8	15	10	10
Clinton, Tenn.	Raw	9+	14+	10	12
Kingston, Tenn.	Raw	7+	10+	10	7
Knoxville, Tenn.	Pasteurized	7	11	8	8
Average++		8.0	12.0	9.2	8.8

*Yearly averages

**Pasteurized milk network stations. All other sampling locations are part of the state or national network.

+Pasteurized

++ Applicable NRC standard (MPC) for ^{90}Sr is 200 pCi/l, assuming all water intake is via milk. For ^{137}Cs, the MPC is 20,000 pCi/l. 9

TABLE 2.8-33

STRONTIUM-89 AND IODINE-131 IN MILK
JANUARY 1972[53]

Sampling Location		Strontium-89 (pCi/liter)	Iodine-131* (pCi/liter)	
Calif:	Del Norte (State)	9		
	Mendocino (State)	17		
Colo :	Denver (PMN)		44 (2)**	
	East (State)		26 (2)	
	Northeast (State)		38 (6)	9
Kans :	Dodge City (State)		17	
	Wichita (State)		20	
La :	New Orleans (PMN)	6		
Tenn :	Fayetteville (State)		18 (2)	
Utah :	Salt Lake City (PMN)		20 (2)	
Wyo :	Laramie (PMN)		39 (2)	

* Attributed to atmospheric nuclear detonation by the Peoples Republic of China on January 7, 1972.

** Number in parentheses indicates number of samples.

TABLE 2.8-34

CONCENTRATION OF ^{131}I IN MILK*

1979

Station Number	Number of Samples	Units of 10^{-9} µCi/ml** Maximum	Minimum+	Average	Comparison With Standard++
Immediate EnvironsΔ					
1	45	0.45	<0.45	<0.45	3×10^{-7} µCi/ml
2	48	1.20	<0.45	<0.47±0.03	3×10^{-7} µCi/ml
3	46	0.45	<0.45	<0.45	3×10^{-7} µCi/ml
4	45	0.45	<0.45	<0.45	3×10^{-7} µCi/ml
5	48	8.00	<0.45	<0.61±0.31	3×10^{-7} µCi/ml
6	46	1.40	<0.45	<0.50±0.05	3×10^{-7} µCi/ml
7	46	7.00	<0.45	<0.60±0.28	3×10^{-7} µCi/ml
8	45	8.00	<0.45	<0.61±0.30	3×10^{-7} µCi/ml
Average				<0.52±0.06	
Remote EnvironsΔΔ					
51	8	<0.45	<0.45	<0.45	3×10^{-7} µCi/ml
52	8	<0.45	<0.45	<0.45	3×10^{-7} µCi/ml
53	7	<0.45	<0.45	<0.45	3×10^{-7} µCi/ml
56	3	<0.45	<0.45	<0.45	3×10^{-7} µCi/ml
57	10	<0.45	<0.45	<0.45	3×10^{-7} µCi/ml
58	8	<0.45	<0.45	<0.45	3×10^{-7} µCi/ml
Average				<0.45	

9

* Raw milk samples, except for station 2 which is a dairy.

** Numerically equals 1 pCi/l.

\+ Minimum detectable concentration of ^{131}I is 0.45×10^{-9} µCi/ml.

++ Applicable NRC standard (1 MPC) assuming 1 liter per day intake by infant.

Δ See Figure 2.8-16.

ΔΔ See Figure 2.8-17.

TABLE 2.8-35

CONCENTRATION OF ^{90}Sr IN MILK*

1979

Station Number	Number of Samples	Units of 10^{-9} µCi/ml** Maximum	Minimum+	Average	Comparison With Standard++
Immediate Environs∆					
1	41	3.7	0.9	2.6±0.2	2×10^{-7} µCi/ml
2	46	3.0	0.7	1.8±0.1	2×10^{-7} µCi/ml
3	44	3.4	0.7	1.7±0.2	2×10^{-7} µCi/ml
4	40	3.1	0.9	1.9±0.2	2×10^{-7} µCi/ml
5	45	4.1	0.7	2.1±0.2	2×10^{-7} µCi/ml
6	45	8.9	1.8	4.3±0.5	2×10^{-7} µCi/ml
7	44	4.1	0.9	2.2±0.2	2×10^{-7} µCi/ml
8	43	4.0	1.2	3.1±0.3	2×10^{-7} µCi/ml
Average				2.5±0.1	
Remote Environs∆∆					
51	8	3.4	1.4	2.8±0.5	2×10^{-7} µCi/ml
52	7	2.3	0.9	1.5±0.5	2×10^{-7} µCi/ml
53	7	2.1	0.9	1.3±0.3	2×10^{-7} µCi/ml
56	3	1.8	1.4	1.6±0.3	2×10^{-7} µCi/ml
57	10	4.1	1.6	2.6±0.5	2×10^{-7} µCi/ml
58	8	1.8	0.9	1.4±0.2	2×10^{-7} µCi/ml
Average				1.9±0.5	

9

* Raw milk samples, except for station 2 which is a dairy.

** Numerically equals 1 pCi/l.

\+ Minimum detectable concentration of ^{90}Sr is 0.5×10^{-9} µCi/ml.

++ Applicable NRC standard (1 MPC) assuming all beverage is milk.

∆ See Figure 2.8-16.

∆∆ See Figure 2.8-17.

TABLE 2.8-36

^{90}Sr IN MILK,

pCi/liter(7)

Station	1978	1979	Jan thru Sept. 1980
Knoxville	not given	3.2	4.3
Chattanooga	not given	4.8	4.8
Memphis	not given	6.5	1.5
U.S. Average	4.0	3.6	2.9

9

TABLE 2.8-37

^{137}Cs CONCENTRATION IN DEER SAMPLES[1]

pCi/kg Wet Weight

Location	Number of Samples	Maximum	Minimum	Average
On-site	20	589	24	99
On-site	3	548	95	264

9

TABLE 2.8-38

EXTERNAL GAMMA RADIATION MEASUREMENTS
1979(1)

Station Number	Location	Number of Measurements Taken	Background μR/hr	Background mR/yr	
Perimeter Stations*					
HP-31	Kerr Hollow Gate	12	9.9±1.3	87±12	
HP-32	Midway Gate	10	9.8±2.2	86±19	
HP-33	Gallaher Gate	12	9.3±1.5	82±13	
HP-34	White Oak Dam	11	11.4±2.0	100±18	
HP-35	Blair Gate	12	9.9±1.9	87±17	
HP-36	Turnpike Gate	11	8.7±1.5	76±13	
HP-37	Hickory Creek Bend	12	8.5±1.2	75±11	
HP-38	East of EGCR	12	8.6±1.2	76±11	
HP-39	Townsite	12	8.2±1.7	72±15	9
Average			9.4±0.7	82±6	
Remote Area**					
HP-51	Norris Dam	2	5.6±0.5	49±4	
HP-52	Loudoun Dam	2	7.1±2.2	62±19	
HP-53	Douglas Dam	2	5.7±5.5	50±48	
HP-54	Cherokee Dam	2	5.4±5.3	47±46	
HP-55	Watts Bar Dam	2	6.1±1.0	54±8	
HP-56	Great Falls Dam	2	6.0±0.1	53±1	
HP-57	Dale Hollow Dam	2	10.3±5.8	91±51	
HP-58	Knoxville	2	11.0±4.3	97±38	
Average			7.2±1.6	63±14	

* See Figure 2.8-2.

** See Figure 2.8-3.

TABLE 2.8-39

SUMMARY OF THE ESTIMATED RADIATION DOSE COMMITMENT TO AN ADULT INDIVIDUAL DURING 1979 AT LOCATIONS OF MAXIMUM EXPOSURE

Pathway	Location	Dose (Millirem) Total Body	Dose (Millirem) Critical Organ
Gaseous Effluents			
All pathways	Nearest resident	0.5*	5.1 (lung)*
Terrestrial food chains to milk	Milk sampling station number 6 (^{90}Sr)	0.2	7.3 (bone)
Liquid Effluents			
Aquatic food chains to fish	Clinch River (^{90}Sr)	0.7	35 (bone)
Drinking water**	Kingston, Tennessee (^{90}Sr)	0.05	2.3 (bone)
Direct radiation along water, shores, and mud flats+	In Clinch River, downstream from White Oak Creek near experimental Cs field plots	6.6	6.6 (total body)

* Uncertainties in these calculated doses may be as much as 300 percent.

** Based on the analysis of raw (unprocessed) water;

\+ Assuming a residence time of 240 hr/yr.

NOTE: Average background total body dose in the U.S.[37] is 106 mrem/yr.

9

TABLE 2.8-40

INCREMENTAL POPULATION TABLE IN THE VICINITY OF ORNL[1]

Distance, Miles Distance, Km	0-1 0-1.6	1-2 1.6-3.2	2-3 3.2-4.8	3-4 4.8-6.4	4-5 6.4-8.0	5-10 8-16	10-20 16-32	20-30 32-48	30-40 48-64	40-50 64-80
Direction										
E	0	0	0	0	0	3,059	44,880	100,500	11,790	12,390
ENE	0	0	0	0	0	0	27,460	74,690	18,720	13,870
NE	0	0	0	0	0	9,713	12,480	7,167	4,392	7,476
NNE	0	0	0	0	1,461	13,780	4,362	11,190	12,670	6,119
N	0	0	0	0	1,490	5,578	2,177	1,441	2,223	4,508
NNW	0	0	0	0	0	1,495	0	1,152	4,559	4,676
NW	0	0	0	0	0	1,073	4,804	1,538	1,896	7,552
WNW	0	0	0	0	0	587	2,971	1,543	0	4,151
W	0	0	0	0	0	666	13,100	4,595	9,038	7,318
WSW	0	0	0	0	0	622	9,862	3,495	4,562	4,204
SW	0	0	0	0	0	733	1,840	1,909	3,962	8,578
SSW	0	0	0	0	0	721	2,055	7,897	21,580	10,530
S	0	0	0	0	0	943	8,742	7,309	6,560	1,222
SSE	0	0	0	0	1,374	7,277	1,290	4,091	469	0
SE	0	0	0	0	0	1,167	4,304	15,010	46	0
ESE	0	0	0	0	0	6,096	5,343	36,020	4,132	6,840
TOTAL	0	0	0	0	4,325	53,510	145,670	279,547	106,599	99,434
CUMULATIVE TOTAL	0	0	0	0	4,325	57,835	203,505	483,052	589,651	689,085

9

AMEND. IX
OCT. 1981

TABLE 2.8-41

PARTIAL LIST OF COSMOGENIC NATURAL RADIONUCLIDES PRODUCED IN AIR[79]

Radionuclide	Half-Life*	Main Radiation*	Main Target Nuclides	
^{10}Be	2.5 X 10^{6} years	β 555 keV	N, O	
^{26}Al	7.4 X 10^{5} years	β+ 1.17 MeV; γ 1.81 MeV, 511 keV	Ar	
^{36}Cl	3.08 X 10^{5} years	β 714 keV	Ar	
^{81}Kr	2.1 X 10^{5} years	K-x-ray	Kr	
^{14}C	5730 years	β 156 keV	N, O	
^{32}Si	280 years	β 210 keV	Ar	
^{39}Ar	269 years	β 565 keV	Ar	
^{3}H	12.262 years	β 18.6 keV	N, O	
^{22}Na	2.62 years	β+ 0.545, 1.82 MeV; γ 1.275 MeV, 511 keV	Ar	
^{35}S	87.9 days	β 167 keV	Ar	
^{7}Be	53.6 days	(E.C.), γ 477 keV	N, O	9
^{37}Ar	35.1 days	K-x-ray, Bremsstrahlung to 0.81 MeV	Ar	
^{33}P	24.4 days	β 248 keV	Ar	
^{32}P	14.28 days	β 1.710 MeV	Ar	
^{28}Mg	21.2 hours	β 0.459, γ 1.35, 0.031, 0.95, 0.40 MeV	Ar	
^{24}Na	14.96 hours	β 1.389 MeV; γ 1.369, 2.754 MeV	Ar	
^{38}S	2.87 hours	β 3.0, γ 1.88 MeV, γ 1.6, 2.17 MeV	Ar	
^{31}Si	2.62 hours	β 1.48 MeV; γ 1.26 MeV	Ar	
^{18}F	109.7 minutes	β+ 0.635 MeV, 511 keV	Ar	
^{39}Cl	55.5 minutes	β 1.91 to 3.45 MeV, γ 0.246, 1.27, 1.52 MeV	Ar	
^{38}Cl	37.29 minutes	β 4.91 MeV; γ 1.6, 2.17 MeV	Ar	
^{34m}Cl	31.99 minutes	β+ 2.48 MeV; e^- 0.142 MeV; γ 1.17, 2.12, 3.30 MeV; 0.511 keV	Ar	

* Half-lives and decay characteristics of atmospheric cosmic-ray produced radionuclides

TABLE 2.8-42

ANNUAL AVERAGE GENETICALLY SIGNIFICANT DOSE* TO THE POPULATION IN EASTERN TENNESSEE DUE TO NATURAL RADIATION, MEDICAL RADIATION, AND MISCELLANEOUS RADIATION

Source of Exposure	Annual Dose (mrem/yr)
Natural Radiation	
External Component	
Terrestrial Gamma	46
Cosmic	31
Internal Component	
Primordial Radionuclides	
^{40}K	19
^{87}Rb	0.4
^{238}U Series	6
^{232}Th Series	2
Cosmogenic Radionuclides 9	
^{3}H, ^{7}Be	0.009
^{22}Na	0.02
^{14}C	2.2
Subtotal	107
Medical Irradiation	
Diagnostic	20
Dental Radiography	3 [87]
Radiation Therapy	2.6
Nuclear Medicine	0.4
Subtotal	26
Miscellaneous other sources**	1
TOTAL	27

* Equals whole body dose.

** Includes radiation from TV, consumer products and air transportation.

TABLE 2.8-43

NON-SERIES PRIMORDIAL NATURAL RADIONUCLIDES

Radionuclide	Half-Life (years)	Isotopic Abundance (percent)	Elemental Abundance in Crustal Rock (ppm)	Concentration in Crustal Rock (pCi/g)
Potassium-40	1.26×10^{9}	0.0118	2.09×10^{4}	17
Vanadium-50	6×10^{15}	0.25	135	4×10^{-7}
Rubidium-87	4.8×10^{10}	27.85	90	2
Cadmium-113	$>1.3 \times 10^{15}$	12.26	0.2	$<6 \times 10^{-8}$
Indium-115	6×10^{14}	95.77	0.1	5×10^{-7}
Tellurium-123	1.2×10^{13}	0.87	0.002	4×10^{-9}
Lanthanum-138	1.12×10^{11}	0.089	30	6×10^{-4}
Cerium-142	$>5 \times 10^{16}$	11.07	60	$<3 \times 10^{-7}$
Neodymium-144	1.4×10^{15}	23.87	28	7×10^{-8}
Samarium-147	1.05×10^{11}	15.07	6.0	0.02
Gadolinium-152	1.1×10^{14}	0.20	5.4	2×10^{-7}
Hafnium-174	2.0×10^{15}	0.163	3	5×10^{-9}
Lutecium-176	2.2×10^{10}	2.60	0.50	0.001
Rhenium-187	4.3×10^{10}	62.93	0.001	3×10^{-5}
Platinum-190	6.9×10^{11}	0.0127	0.005	2×10^{-9}
Platinum-192	1×10^{15}	0.78	0.005	7×10^{-8}
Bismuth-209	$>2 \times 10^{18}$	100	0.17	$<1 \times 10^{-10}$

9

TABLE 2.8-44

DOSE EQUIVALENT RATES CALCULATED FROM MEASUREMENTS INSIDE TEST HOUSES IN THE OAK RIDGE AREA*

Location	Quarter 1 (Fall 1977)	Quarter 2 (Winter 1978)	Quarter 3 (Spring 1978)	Quarter 4 (Summer 1978)	Average Microrems Per Hour+	Average Millirems Per Year
Knoxville	10.2 ± 1.8**	9.1 ± 2.6	8.5 ± 2.1	9.6 ± 2.3	9.4 ± 0.7	82
Oak Ridge	9.9 ± 1.7	8.5 ± 1.0	7.9 ± 1.4	9.1 ± 1.9	8.9 ± 0.9	78
Kingston	9.9 ± 1.7	9.2 ± 1.6	8.7 ± 0.5	9.4 ± 2.2	9.3 ± 0.5	82
Clinton	10.1 ± 1.1	8.8 ± 1.3	8.1 ± 1.4	8.9 ± 1.9	9.0 ± 0.9	79
Oliver Springs	9.2 ± 0.7	7.9 ± 0.0	8.6 ± 1.6	8.6 ± 1.1	8.6 ± 0.5	75
Lenoir City	9.8 ± 1.8	8.4 ± 1.9	7.6 ± 1.4	8.8 ± 1.4	8.6 ± 0.9	75
Powell	9.4 ± 0.7	7.9 ± 1.1	8.0 ± 1.0	8.4 ± 0.8	8.3 ± 0.5	73
Miscellaneous towns	10.4 ± 2.1	10.2 ± 1.4	9.6 ± 0.8	8.8 ± 1.1	9.7 ± 0.7	85

9

* External whole body dose, i.e., from penetrating radiation.(82)

** Standard deviation of the average of TLDs per quarter.

\+ Standard deviation of the average of the four quarters.

TABLE 2.8-45

CHANGES IN DATA PERTAINING TO DIAGNOSTIC X-RAY PROCEDURES IN A SIX-YEAR PERIOD, UNITED STATES OF AMERICA, 1964 AND 1970 (84)

	1964	1970	Increase (percent)	
Number of persons having x-ray examinations	108×10^6	130×10^6	+20	
Number of x-ray procedures	173×10^6	212×10^6	+22	
Number of films exposed	506×10^6	661×10^6	+30	
Average number of films per examination	2.2	2.4	+ 9	9
Fraction of thoracic examinations with two or more films	31%	47%	+52	
Mean ratio of beam area to film area (in hospitals)	1.9	1.2	-37	
Estimated mean skin exposures for posterior-anterior and anterior-posterior views of the abdomen	480 mR	620 mR	+29	
Mean skin exposure per dental film	1140 mR	910 mR	-20	

TABLE 2.8-46

ANNUAL PER CAPITA DOSE TO BONE MARROW, USA[85]

(mrem)

Type of Examination	1964	1970
Hip and femur	0.7	0.7
Pelvis	1.4	1.1
Lumbosacral joint	4.0	5.7
Lumbar spine	6.7	8.1
Urography	9.9	10.1
Stomach, upper GI tract	17.9	24.3
Small intestine	0.7	1.0
Colon	13.7	21.2
Abdomen	3.6	2.9
Cholecystography	3.2	3.7
Dorsal spine	2.0	2.5
Lung	2.0	3.2
Lung (photofluorography)	7.8	3.2
Head	1.0	1.6
Other	8.4	13.7
Total	83	103

TABLE 2.8-47

CURRENTLY AVAILABLE PRODUCTS CONTAINING RADIONUCLIDES[79]

Products	Nuclide	Activity or Mass per Product (Range of Approximate Values)	
1. Radioluminous products			
(a) Radionuclide contained in paint or plastic			
(1) Timepieces	^{3}H ^{147}Pm ^{226}Ra	1-25 mCi 65-200 μCi 0.1-3 μCi	
(2) Aircraft instruments	^{3}H ^{147}Pm ^{226}Ra	<10 Ci <0.3 Ci <20 μCi	
(3) Compasses	^{3}H ^{147}Pm	5-50 mCi 10 μCi	
(4) Instrument dials and markers	^{3}H	25 mCi	
(5) Instruments, signs and indicators	^{147}Pm	0.75 Ci	
(6) Thermostat dials and pointers	^{3}H	25 mCi	
(7) Automobile lock illuminators	^{3}H ^{147}Pm	2-15 mCi 2 mCi	
(8) Automobile shift quadrants	^{3}H	25 mCi	9
(9) Bell pushes	^{3}H	0.3 mCi	
(10) Speedometers	^{147}Pm	0.1 mCi	
(11) Rims for underwater watches	^{3}H	0.3 mCi	
(12) Fishing lights	^{14}C	3-4 mCi	
(13) Spirit levels	^{3}H	5-25 mCi	
(b) Radionuclide contained in sealed tubes			
(1) Timepieces	^{3}H	0.2-0.4 Ci	
(2) Ordinary compasses	^{3}H	0.2-0.4 Ci	
(3) Marine compass	^{3}H	0.2-2 Ci	
(4) Marine navigational instruments	^{3}H	0.25 Ci	
(5) Markers	^{3}H ^{85}Kr	4 Ci 0.3 Ci	
(6) Instruments, signs and indicators	^{3}H ^{85}Kr	2 Ci 0.25 Ci	
(7) Exit signs for commercial buildings	^{3}H	15 Ci	
(8) Large signs	^{3}H	30 Ci	
(9) Small exit signs	^{3}H	2 Ci	
(10) Step markers	3H	2 Ci	
(11) Mooring buoys and lights	^{3}H	2 Ci	
(12) Public telephone dials	^{3}H	0.5 Ci	
(13) Light switch markers	^{3}H	0.2 Ci	
(14) Bell pushes	^{3}H	10 mCi	
(15) Minature light sources	^{3}H	20 mCi	

TABLE 2.8-47 (Continued)

Products	Nuclide	Activity or Mass per Product (Range of Approximate Values)
2. Electronic and electrical devices		
(a) Electronic tubes	^{3}H	$1-10^{4}$ μCi
	^{63}Ni	1-5 μCi
	^{147}Pm	1 μCi
	^{85}Kr	1-5 μCi
	^{60}Co	0.15-5 μCi
	^{226}Ra	0.1 μCi
	^{137}Cs	5 μCi
(b) Glow-discharge tubes	^{85}Kr	0.01-10 μCi
(c) Voltage-discharge tubes	^{147}Pm	3 μCi
(d) Cold-cathode tubes	^{3}H	90 μCi
(e) Fluorescent lamp starters	^{226}Ra	1 μCi
(f) Gas-discharge lamps (high-pressure mercury-vapour lamps	Natural Th	6 nCi
(g) Vacuum tubes	Natural Th	0.8-1.2 wt%
(h) Electric lamps	Natural Th	50 mg
(i) Germicidal lamps, sun lamps, lamps for outdoor and industrial lighting	Natural Th	2 g
(j) Glow lamps	^{3}H	0.01 mCi
(k) Spark-gap tubes	^{147}Pm	30 μCi
	^{60}Co	5 μCi
	^{63}Ni	5 μCi
	^{137}Cs	5 μCi
(l) High-voltage protection devices	^{147}Pm	3 μCi
(m) Low-voltage fuses	^{147}Pm	3 μCi
3. Antistatic devices		
(a) Lightning rod	^{226}Ra	0.2-1 mCi
	^{241}Am	0.06-0.7 mCi
(b) Antistatic devices contained in instruments	^{226}Ra	10 μCi
(c) Antistatic brushes	^{210}Po	0.05-0.5 mCi
	^{241}Am	2-25 μCi
(d) Antistatic devices contained in precision balances	^{3}H	1 m Ci
4. Gas and aerosol (smoke) detectors		
Smoke and fire detectors	^{241}Am	1-100 μCi
	^{226}Ra	0.01-15 μCi
	^{85}Kr	7 mCi
	Natural or depleted U	7.5 mg
	^{238}Pu	20 μCi

9

TABLE 2.8-47 (Continued)

Products	Nuclide	Activity or Mass per Product (Range of Approximate Values)
5. Ceramic, glassware, alloys etc. containing uranium or thorium		
(a) Chinaware	Natural U	10^{-2} μCi cm^{-2} surface
(b) Ceramic tableware glaze	Natural Th	20 wt% (glaze)
	Natural or depleted U	20 wt% (glaze)
(c) Glassware, glass enamel, glass-enamel frit	Natural Th	10 wt%
	Natural or depleted U	10 wt%
(d) Optical lenses		<30 wt%
(e) Incandescent gas mantles	Natural Th	<0.5 g
(f) Magnesium-thorium alloys	Natural Th	<4 wt%
(g) Products containing rare earths: arc carbons, lighter flints, metallurgical additives, precision lenses, television tubes, electronic ceramics, microwave devices etc.	Natural Th	0.25 wt%
	Natural or depleted U	0.25 wt%
(h) Welding rods	Natural Th	1-2 wt%
6. Other devices, including scientific instruments		
(a) Gas chromatographs	^{3}H	250 mCi
	^{63}Ni	12 mCi
(b) Static meters	^{241}Am	0.5-50 μCi
(c) Vending-machine coins	^{14}C	2 μCi
(d) Bank cheques	^{14}C	0.01 μCi

9

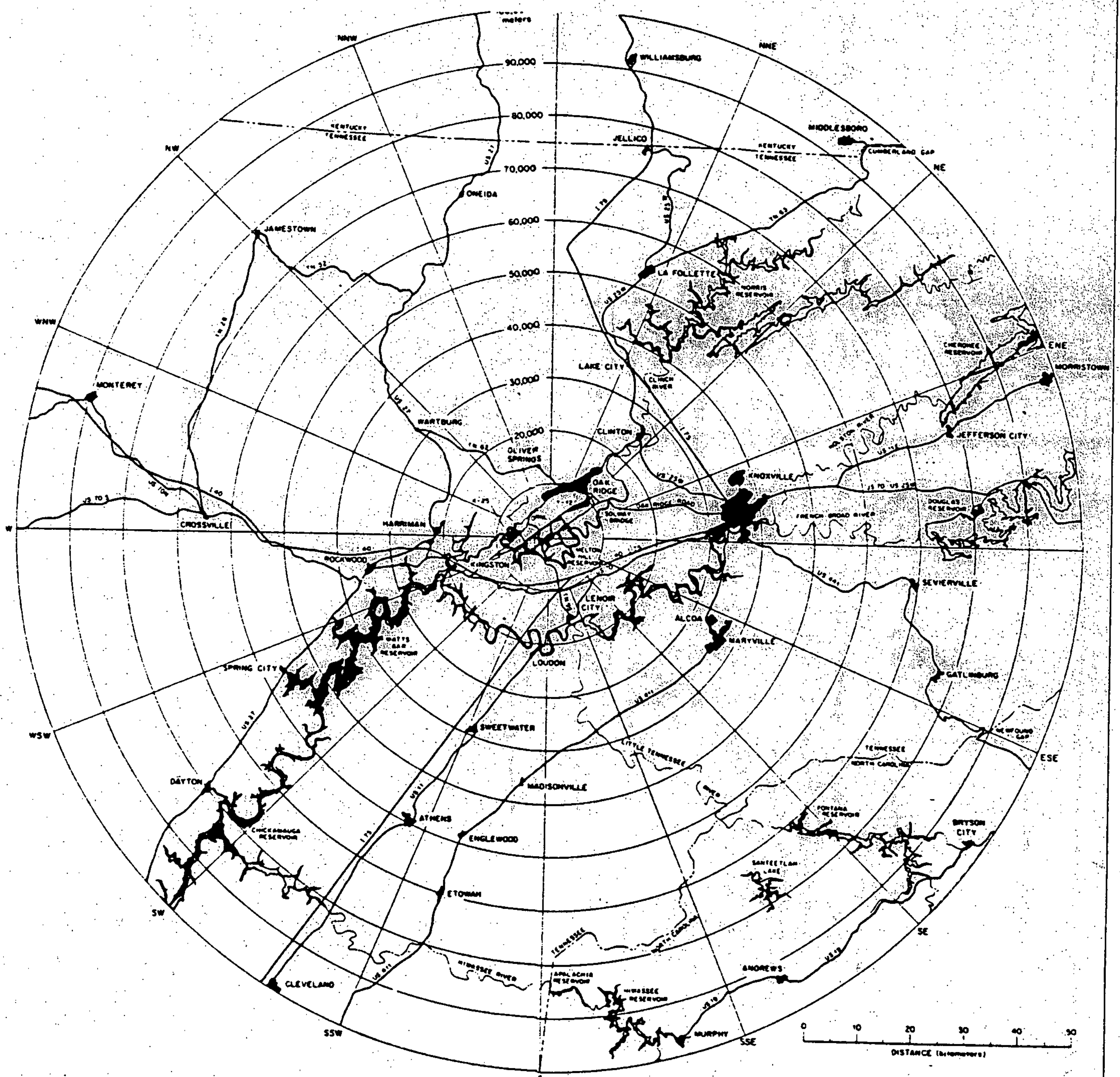

Figure 2.8-1 OAK RIDGE FACILITIES AS 100 KILOMETER CENTER

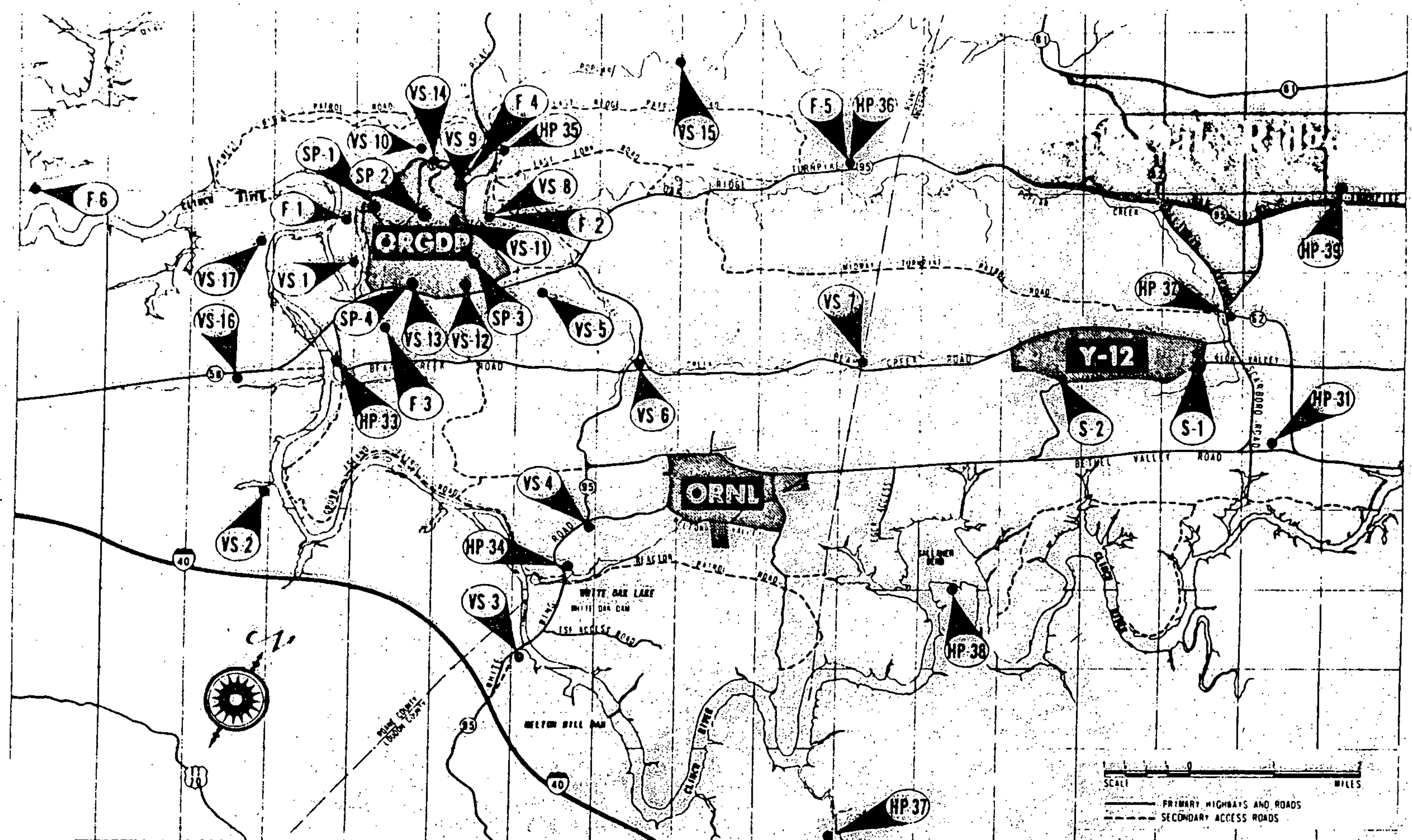

Figure 2.8-2 AIR, VEGETATION AND SOIL SAMPLING LOCATIONS[1]

2.8-82

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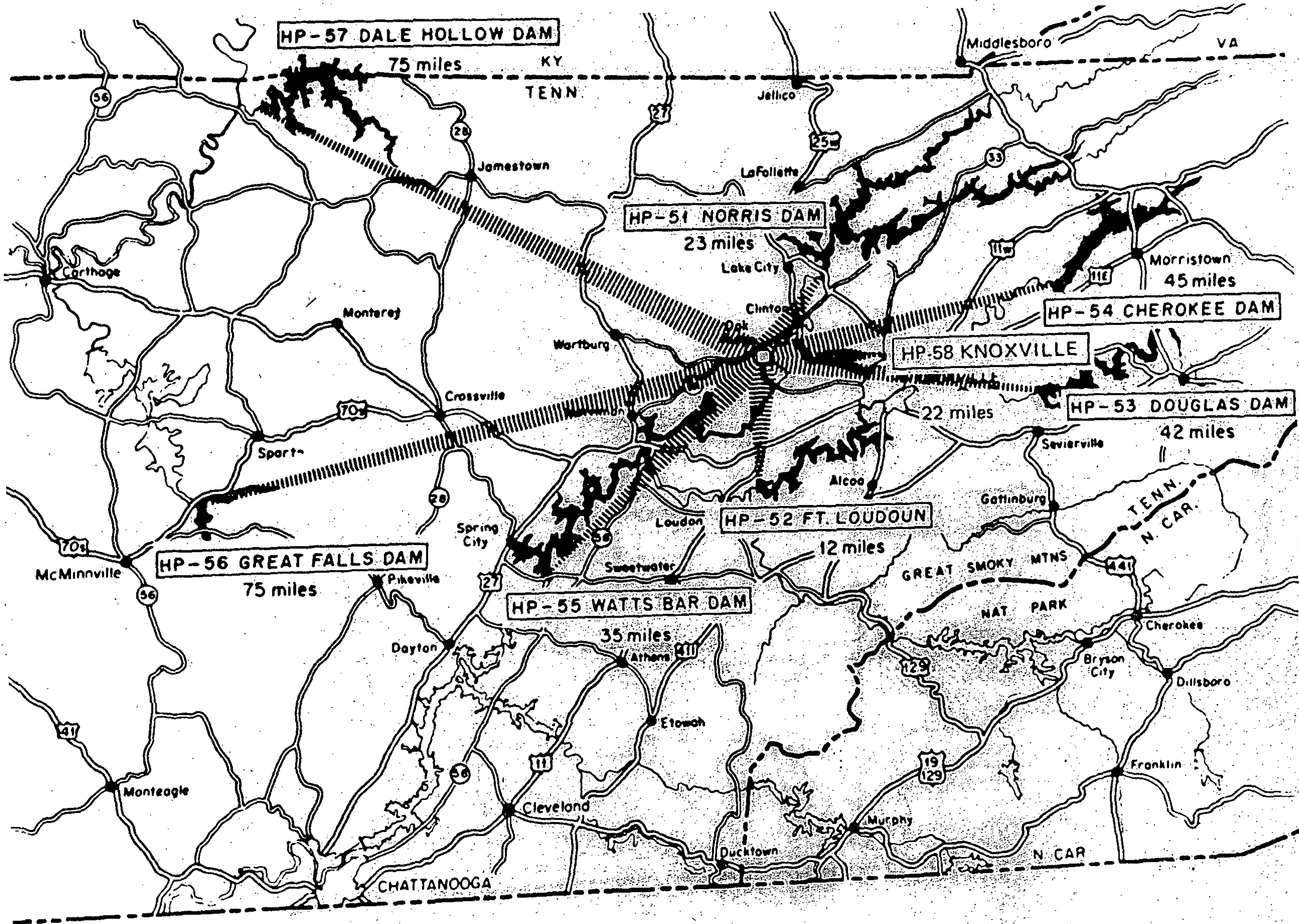

Figure 2.8-3 REMOTE AIR MONITORING LOCATIONS(1)

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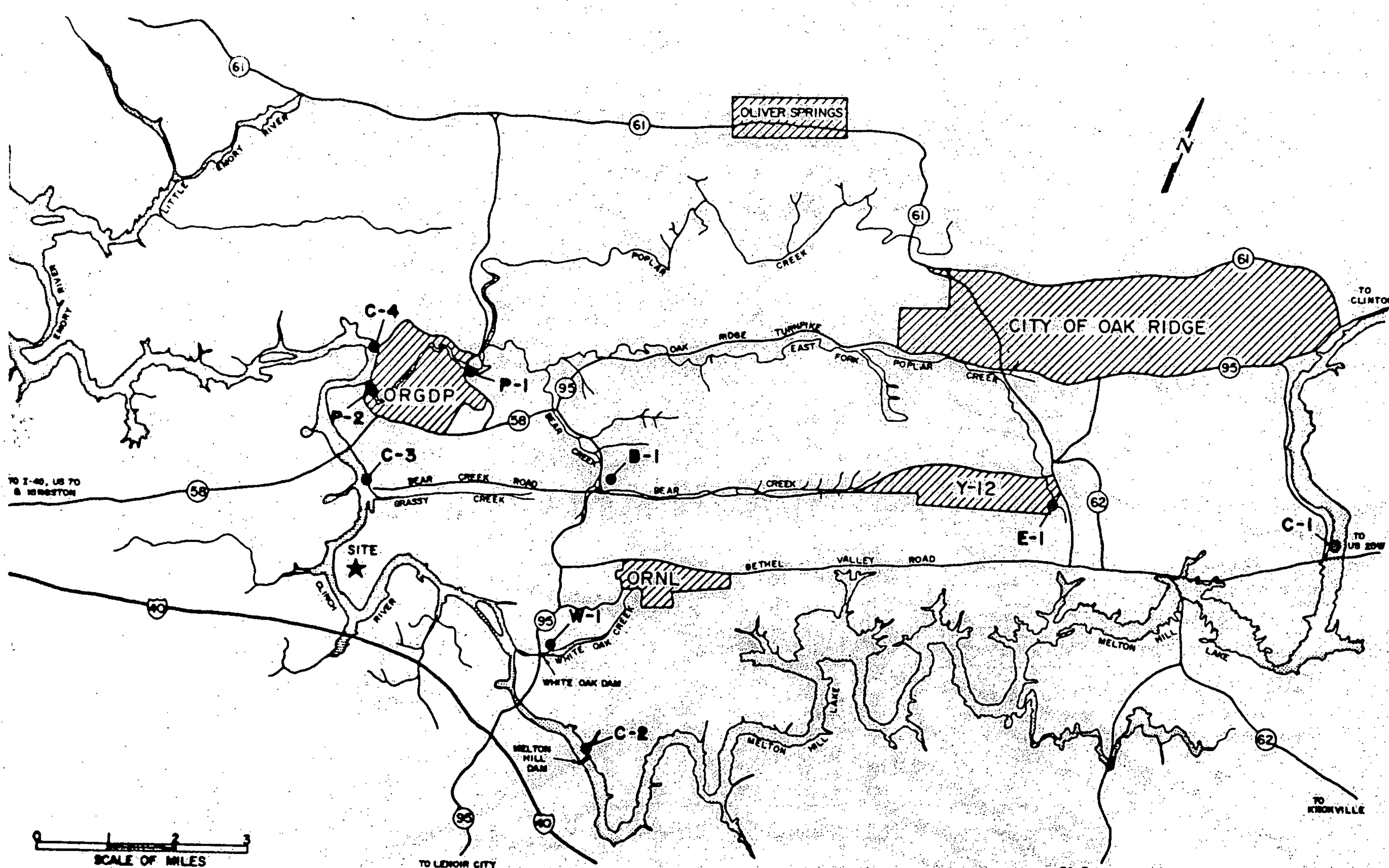

Figure 2.8-4 CLINCH RIVER AND TRIBUTARIES IN THE OAK RIDGE AREA

9

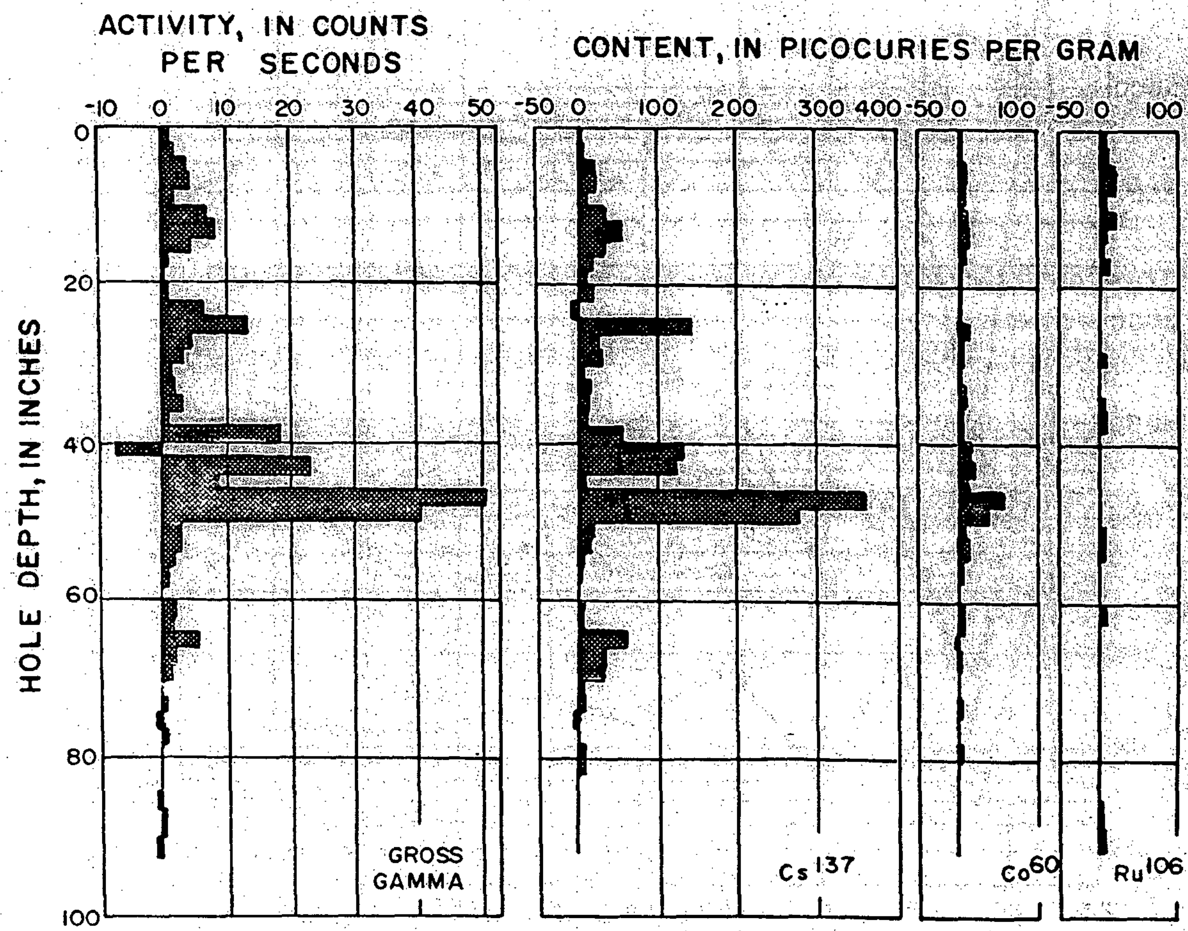

Figure 2.8-5 VARIATIONS IN CONTENTS OF Cs-137, Co-60 AND Ru-106 WITH DEPTH IN HOLE 6, CRM 7.5, 1969(11,12) 9

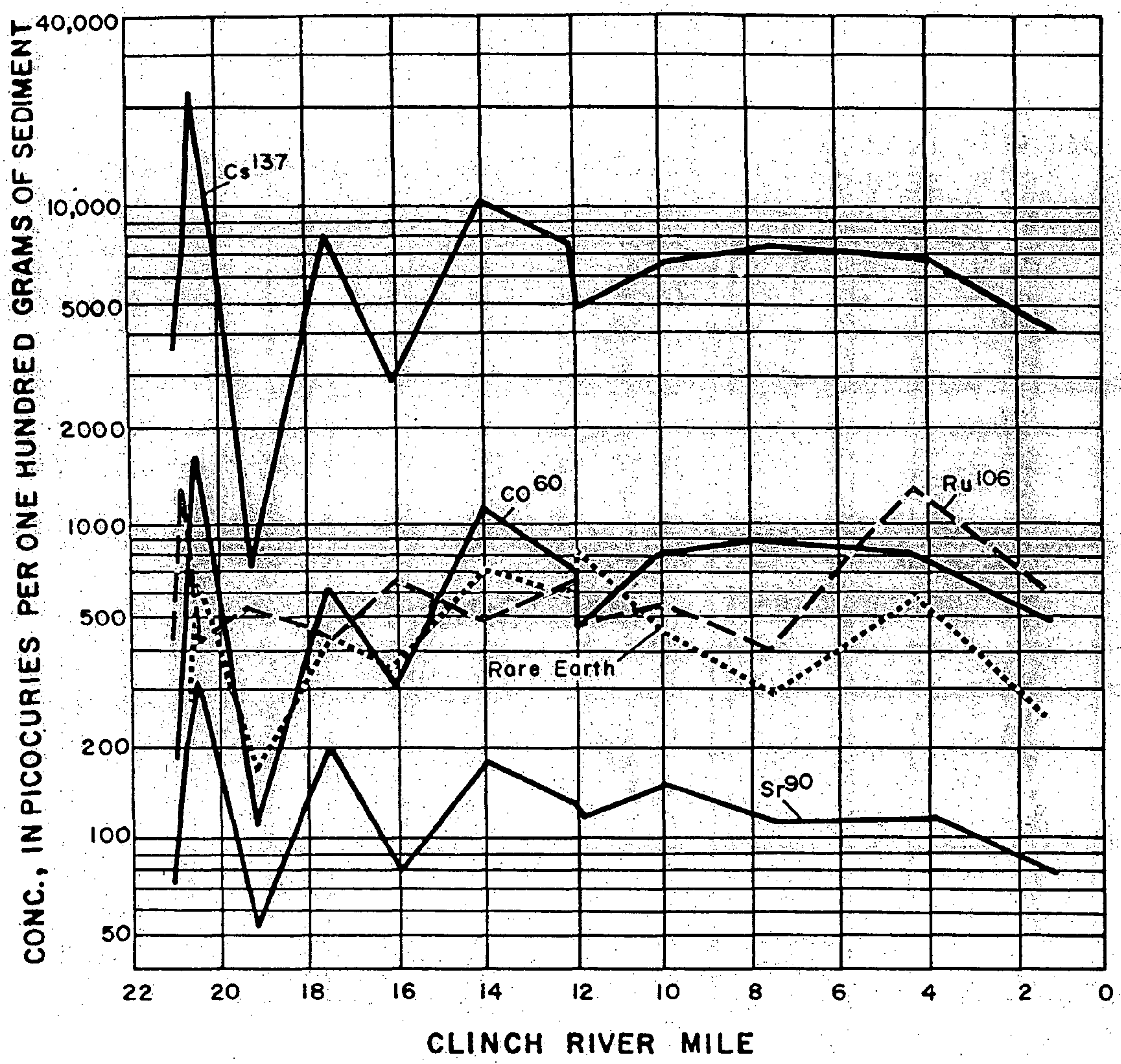

Figure 2.8-6 LOGITUDINAL DISTRIBUTION OF RADIONUCLIDES IN BOTTOM SEDIMENT OF THE CLINCH RIVER 1969[13]

9

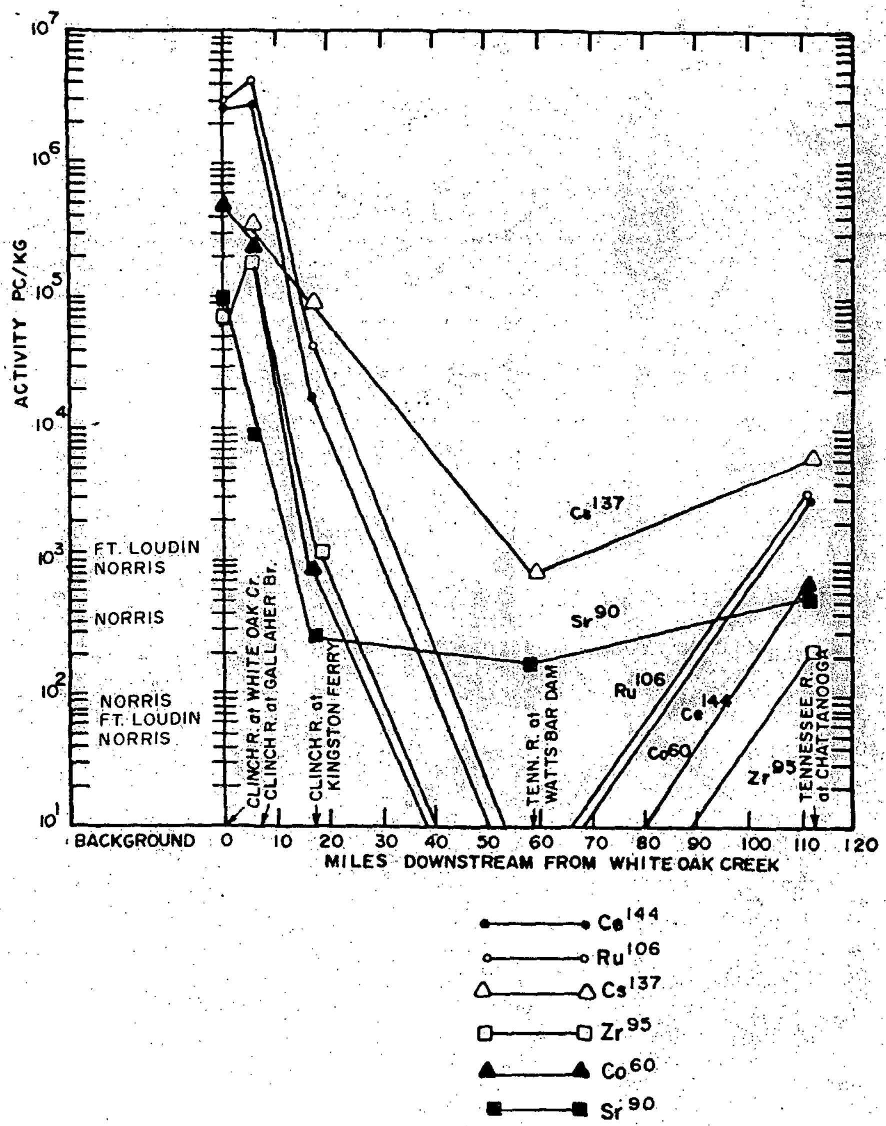

Figure 2.8-7 RADIONUCLIDE CONCENTRATIONS IN BOTTOM MUDS, CLINCH AND TENNESSEE RIVERS 1969[14] | 9

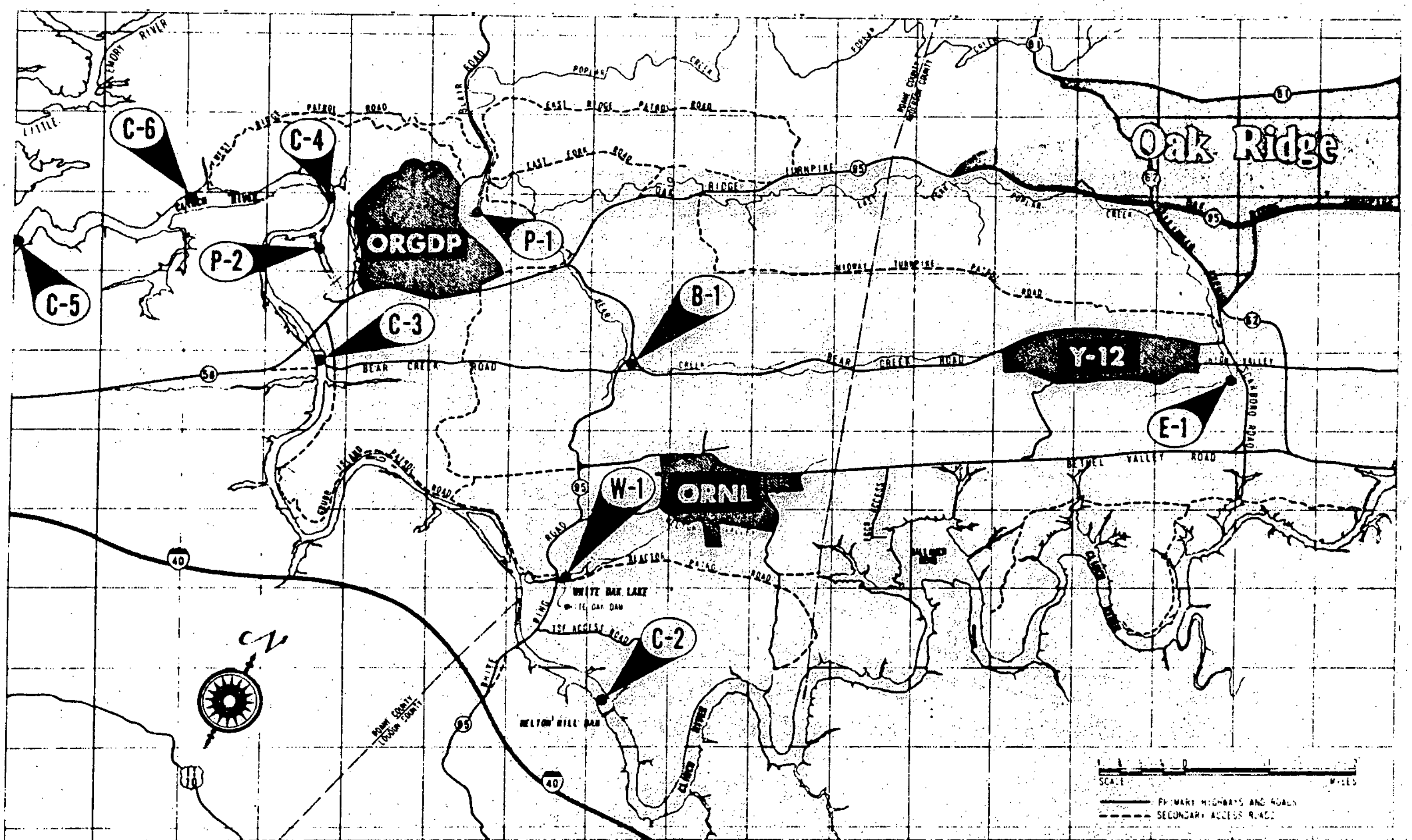

Figure 2.8-8 STREAM MONITORING LOCATIONS[1]

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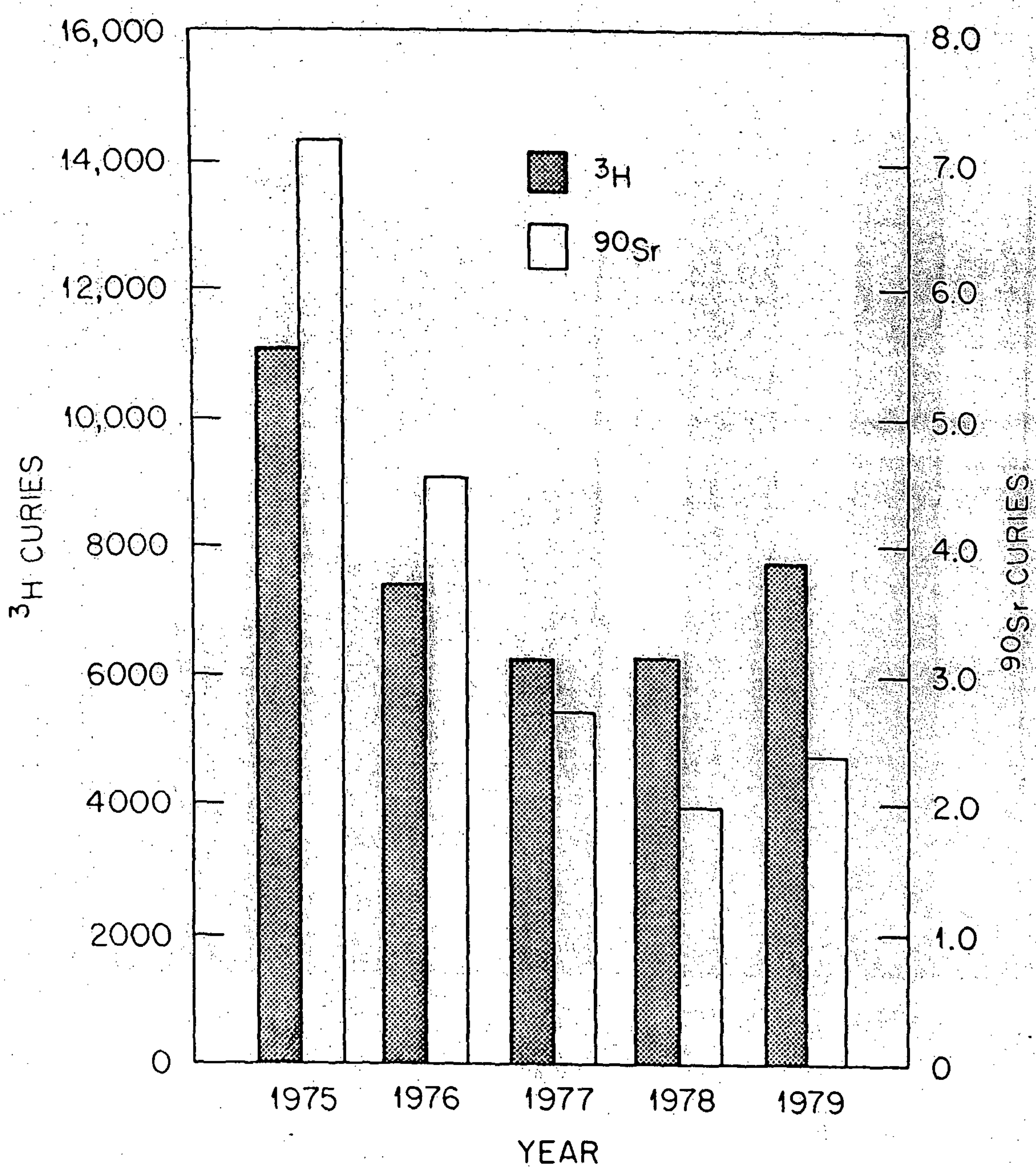

Figure 2.8-9 CURIES DISCHARGED OVER WHITE OAK DAM[1]

9

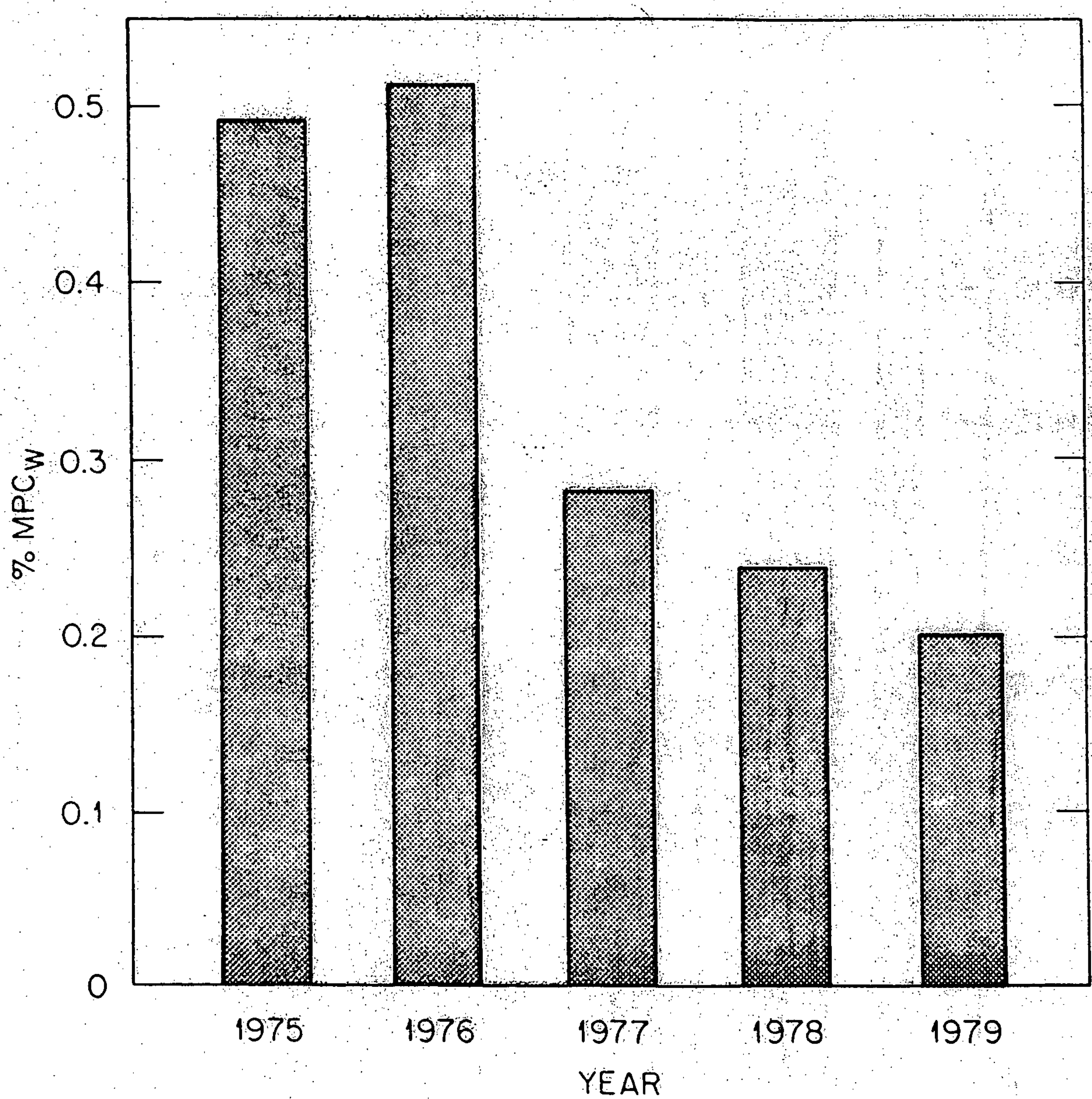

Figure 2.8-10 PERCENTAGE MPC LEVELS IN THE CLINCH RIVER (VALUES GIVEN ARE CALCULATED VALUES BASED ON THOSE CONCENTRATIONS MEASURED AT WHITE OAK DAM AND DILUTION AFFORDED BY THE CLINCH RIVER)[1]

9

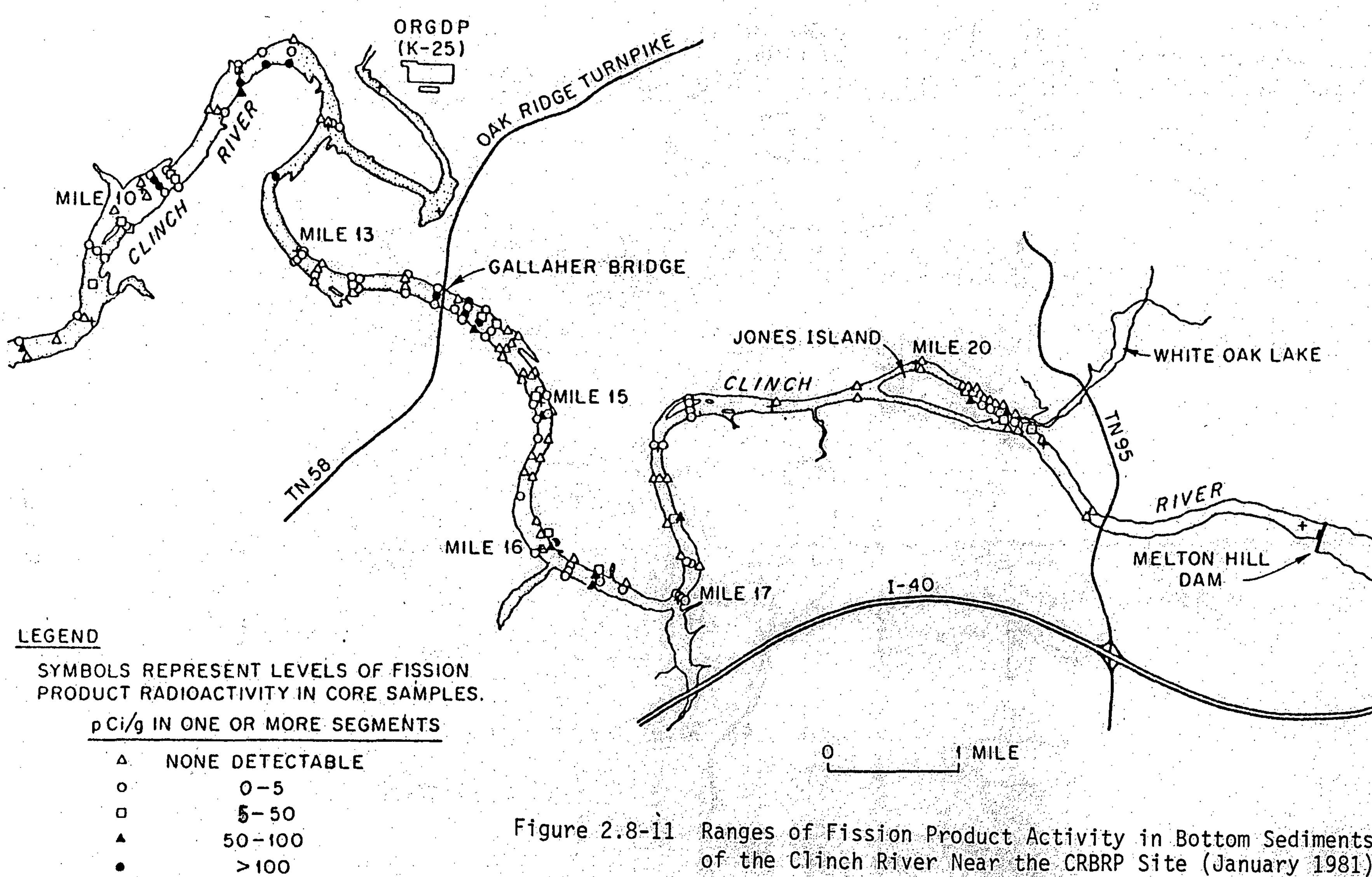

Figure 2.8-11 Ranges of Fission Product Activity in Bottom Sediments of the Clinch River Near the CRBRP Site (January 1981)

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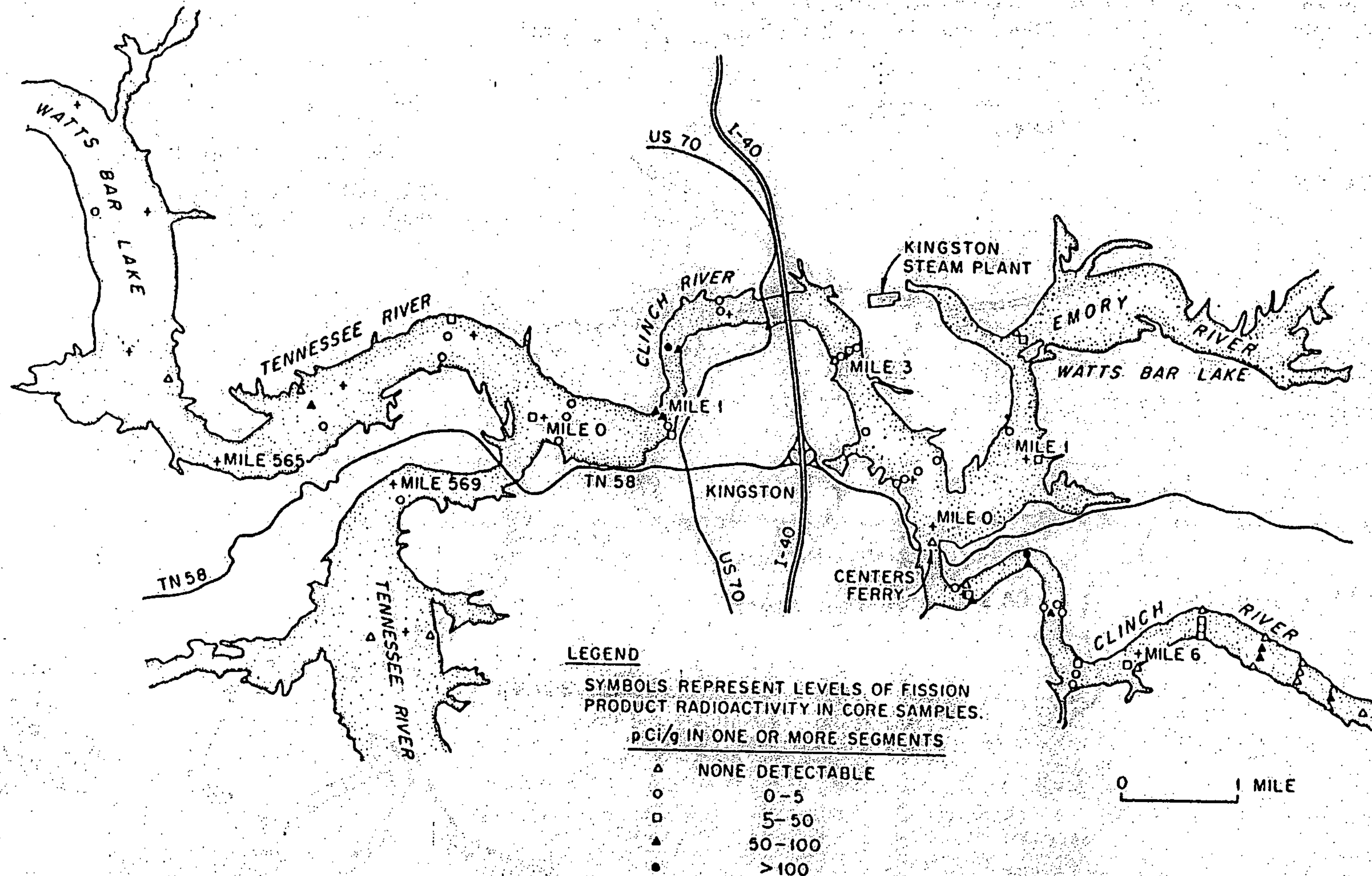

Figure 2.8-12 Ranges of Fission Product Activity in Bottom Sediments of the Clinch, Emory and Tennessee Rivers Downstream of the CRBRP Site (January 1981)

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Figure 2.8-13

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Figure 2.8-14

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Figure 2.8-15

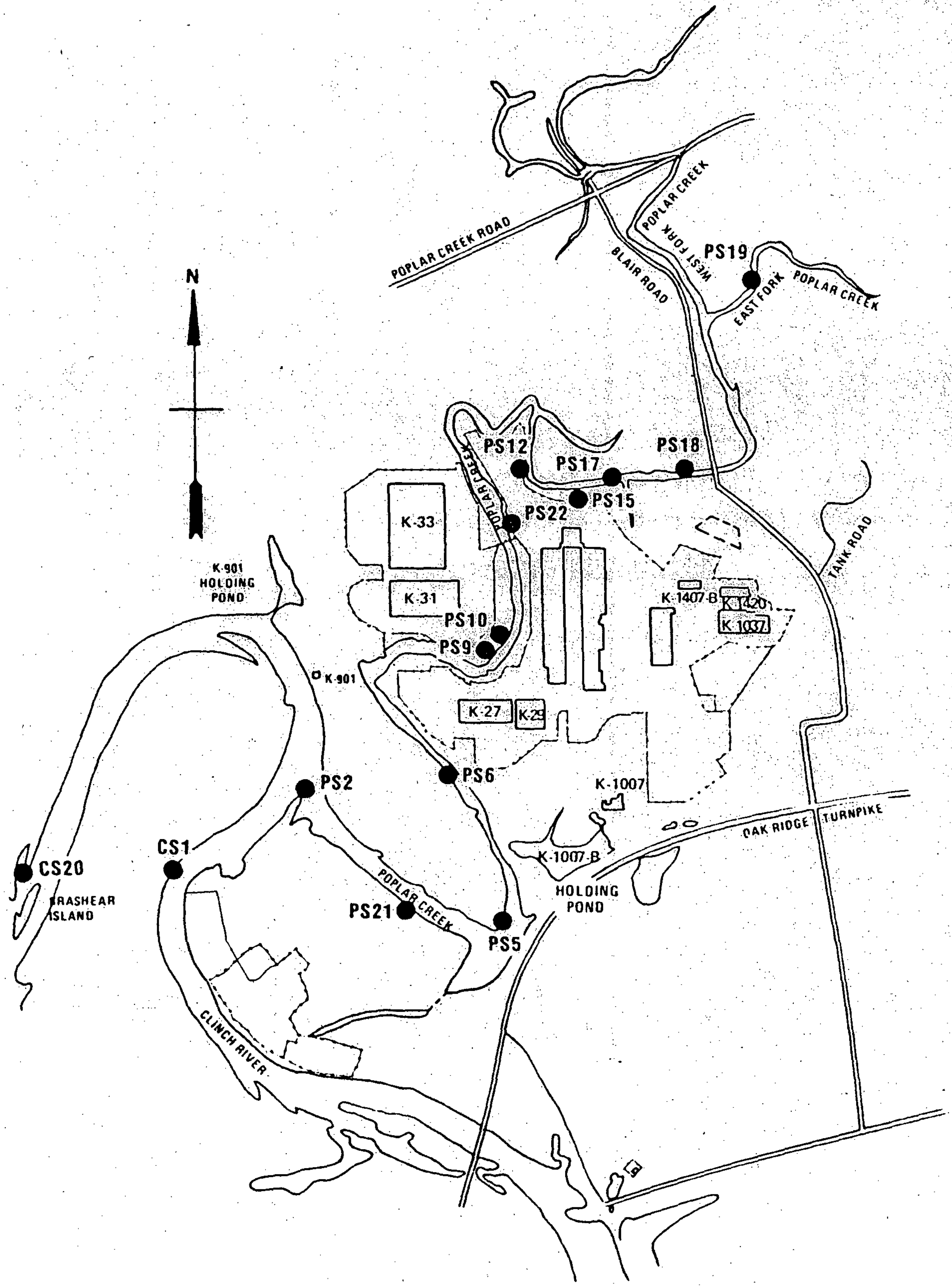

Figure 2.8-16 OAK RIDGE GASEOUS DIFFUSION PLANT SEDIMENT SAMPLING LOCATIONS

9

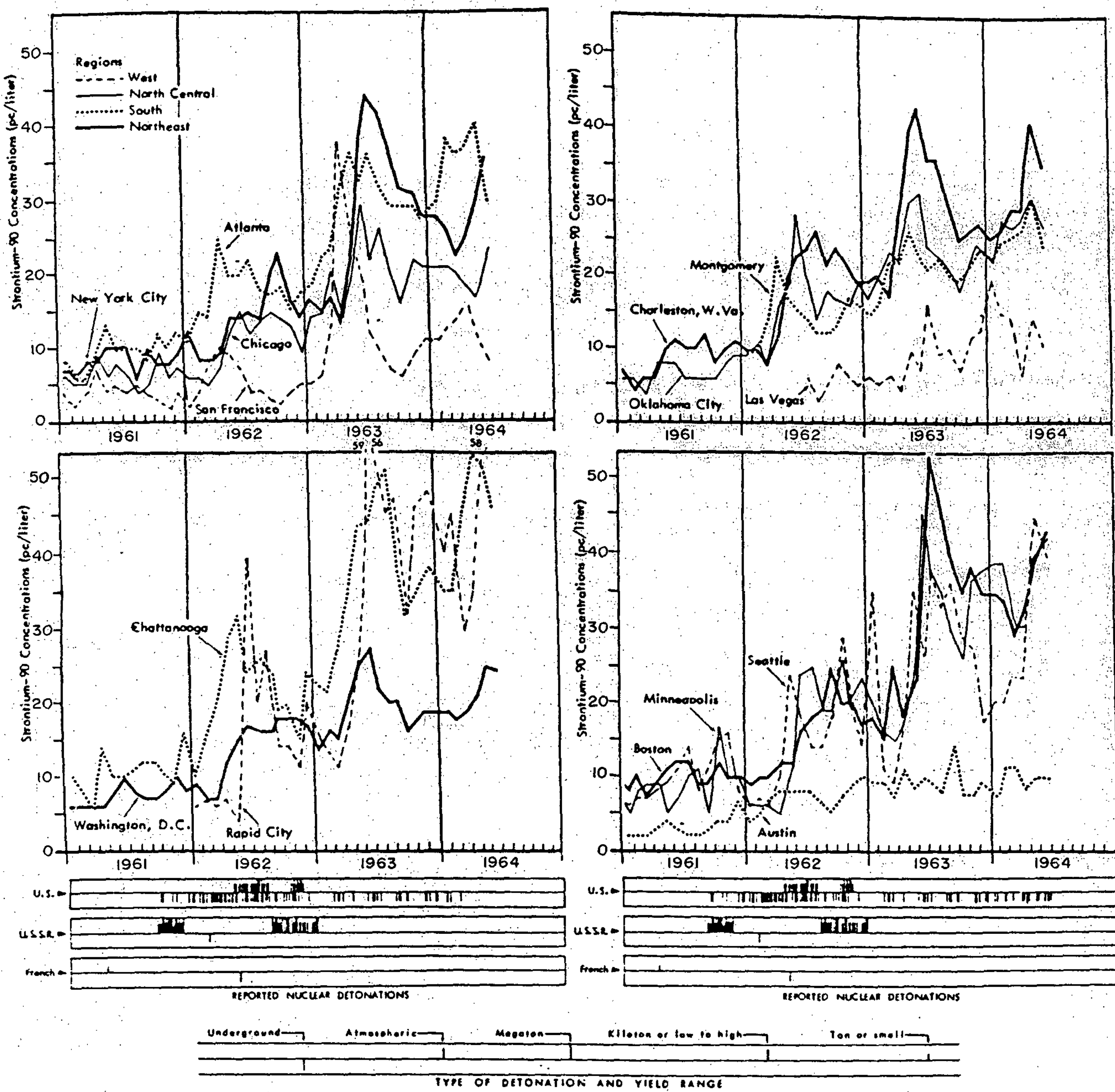

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Figure 2.8-17 STRONTIUM-90 IN PASTEURIZED MILK, 1961-JUNE 1964[42]

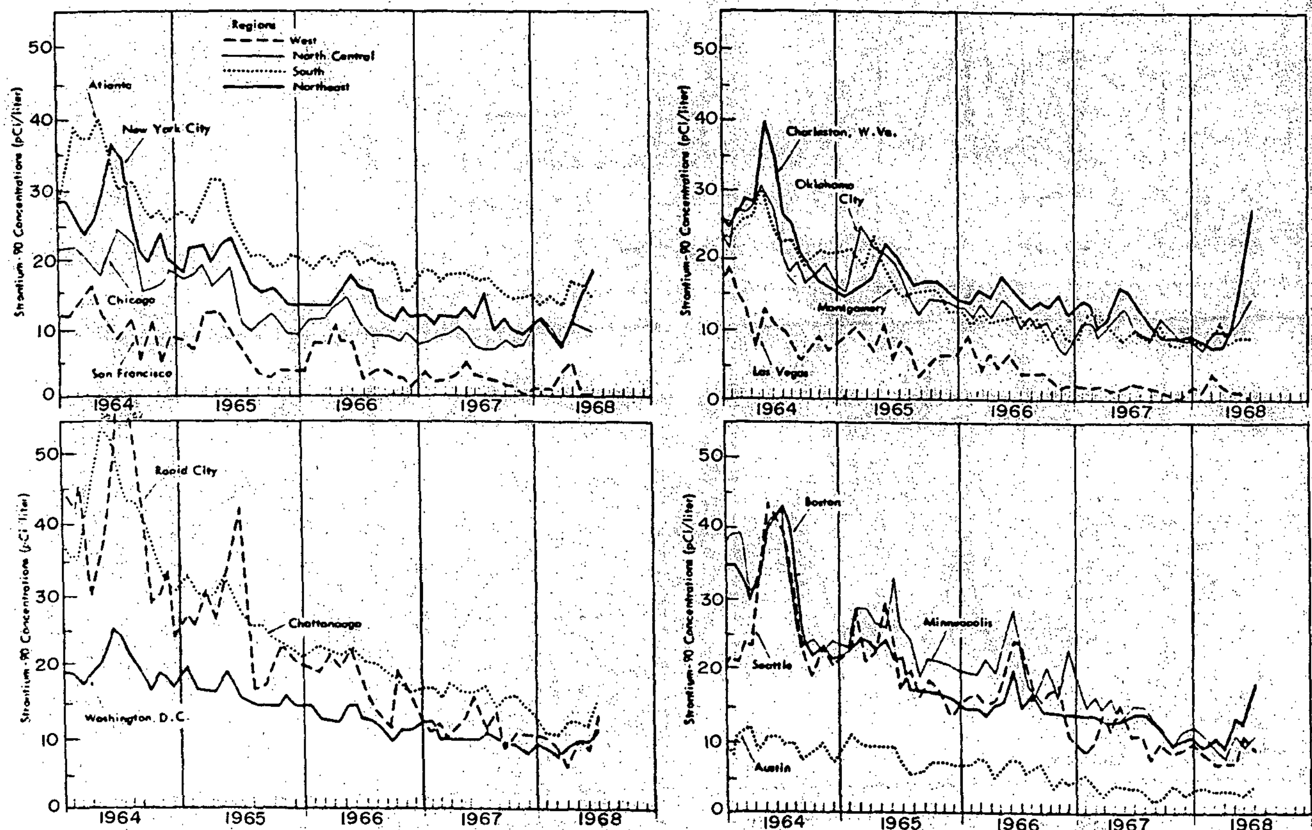

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Figure 2.8-18 STRONTIUM-90 CONCENTRATIONS IN PASTEURIZED MILK, 1964-JUNE 1968[43]

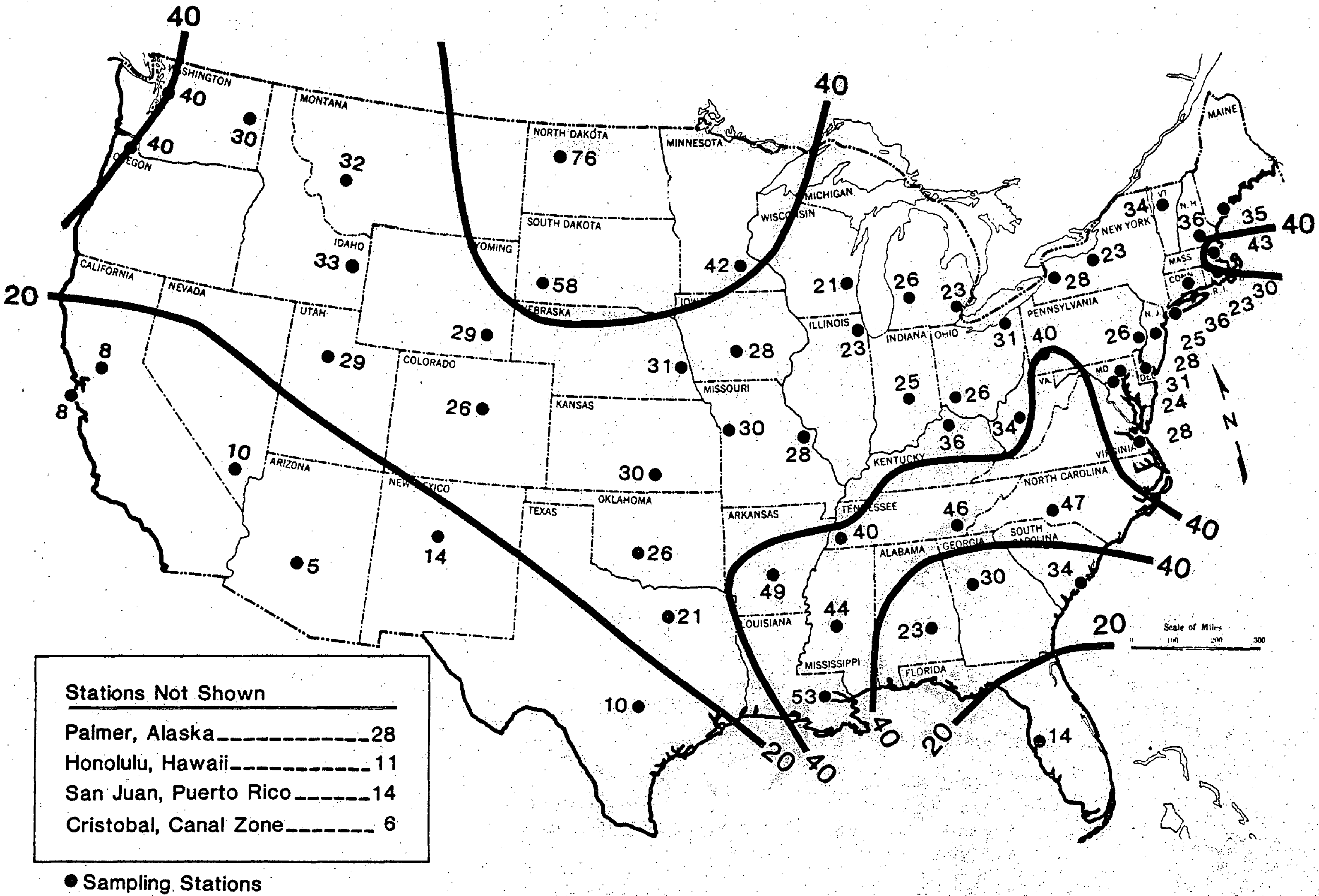

Figure 2.8-19 STRONTIUM-90 CONCENTRATIONS IN PASTEURIZED MILK, JUNE 1964[42]

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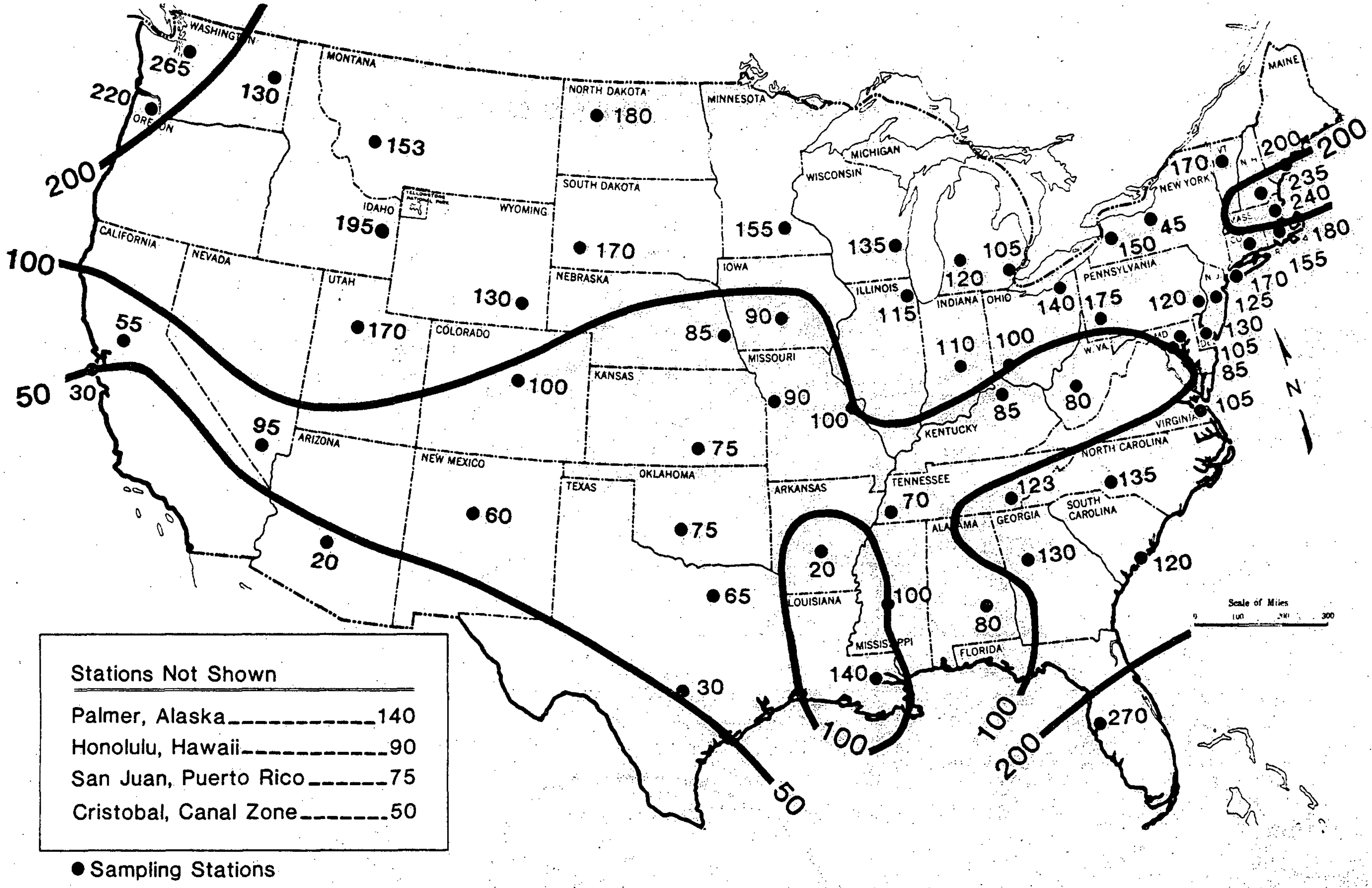

Figure 2.8-20 CESIUM-137 CONCENTRATIONS IN PASTEURIZED MILK, JUNE 1964 (42)

9

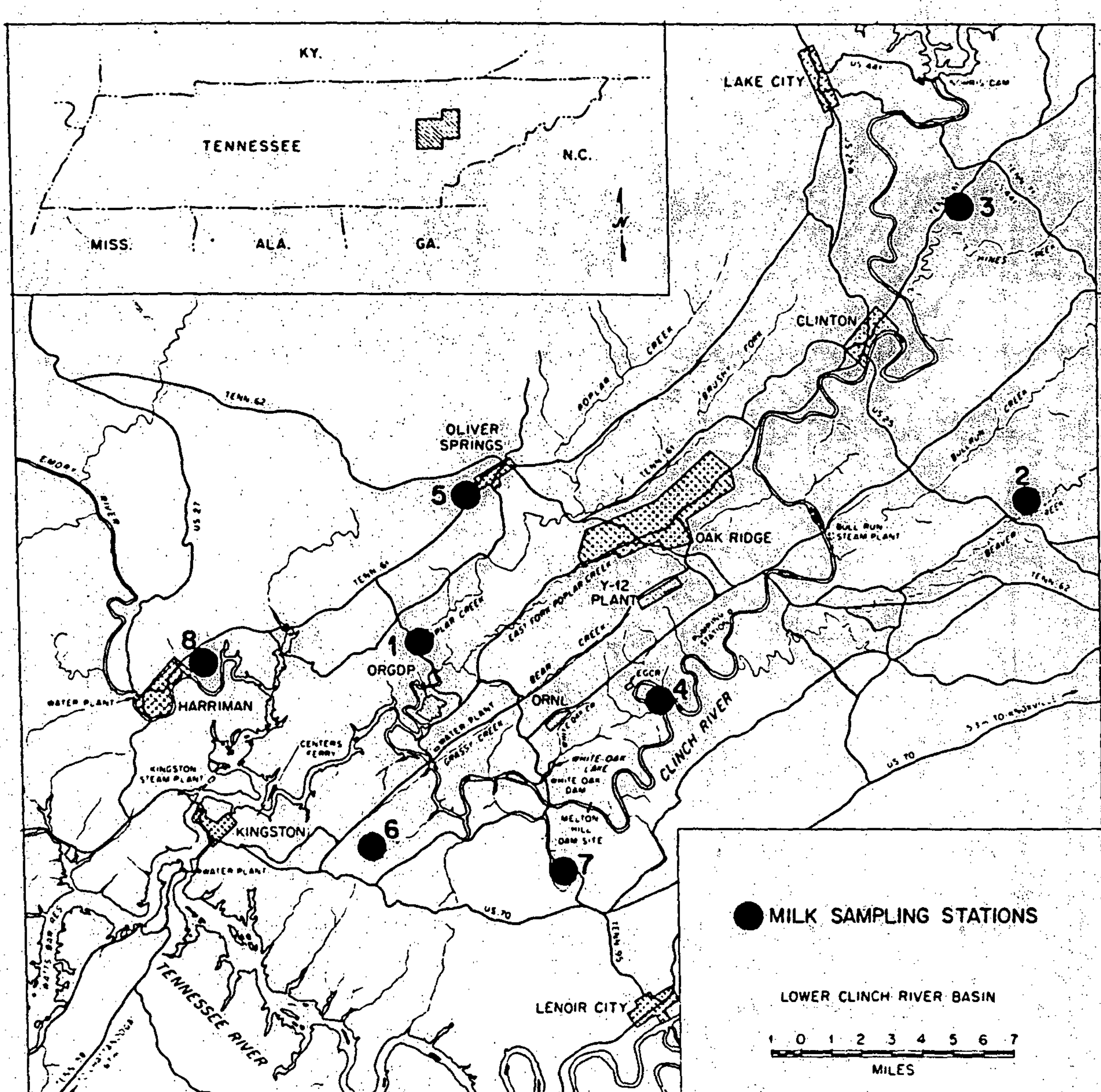

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Figure 2.8-21 IMMEDIATE ENVIRONS MILK SAMPLING LOCATIONS

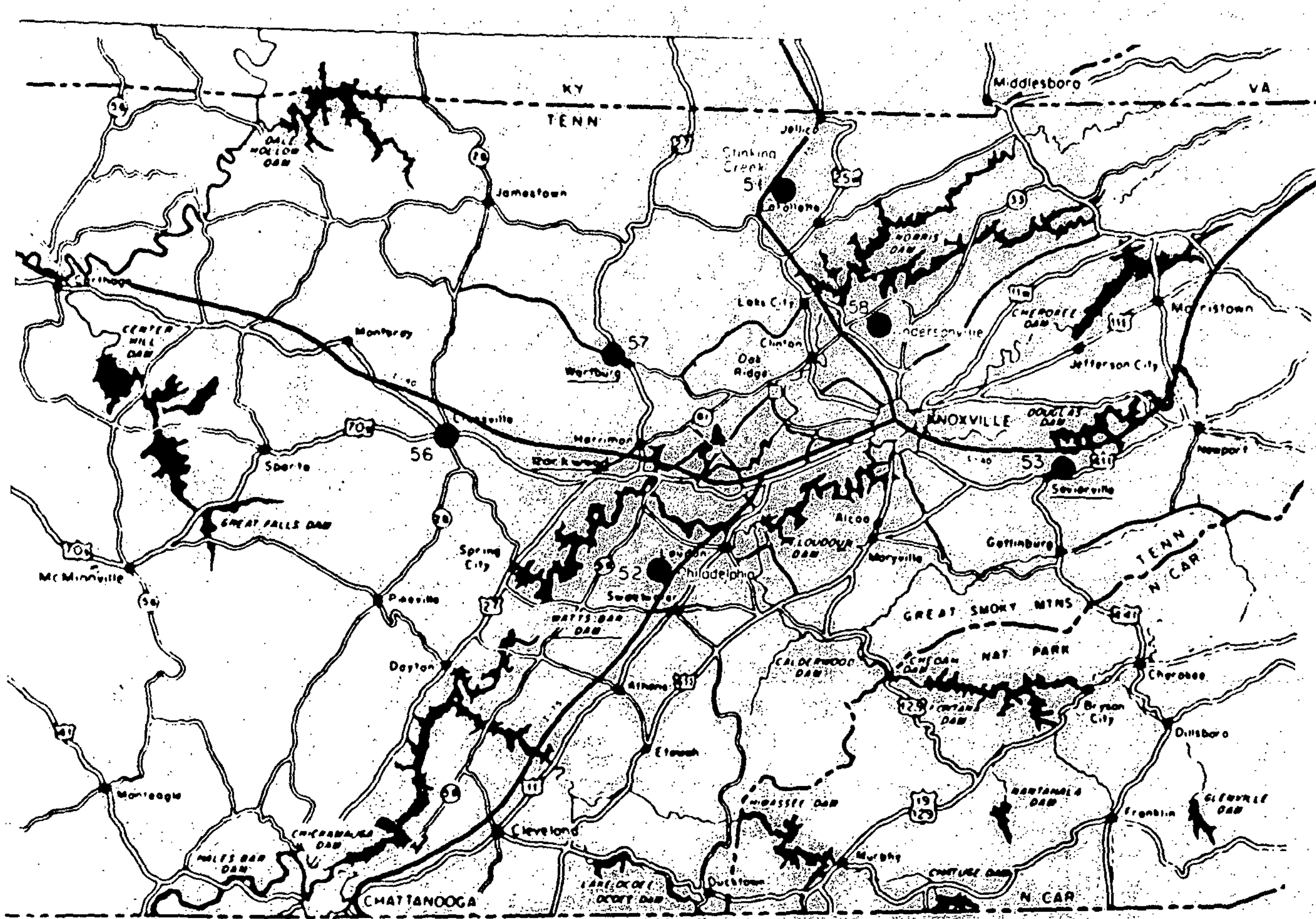

Figure 2.8-22 REMOTE ENVIRONS MILK SAMPLING LOCATIONS

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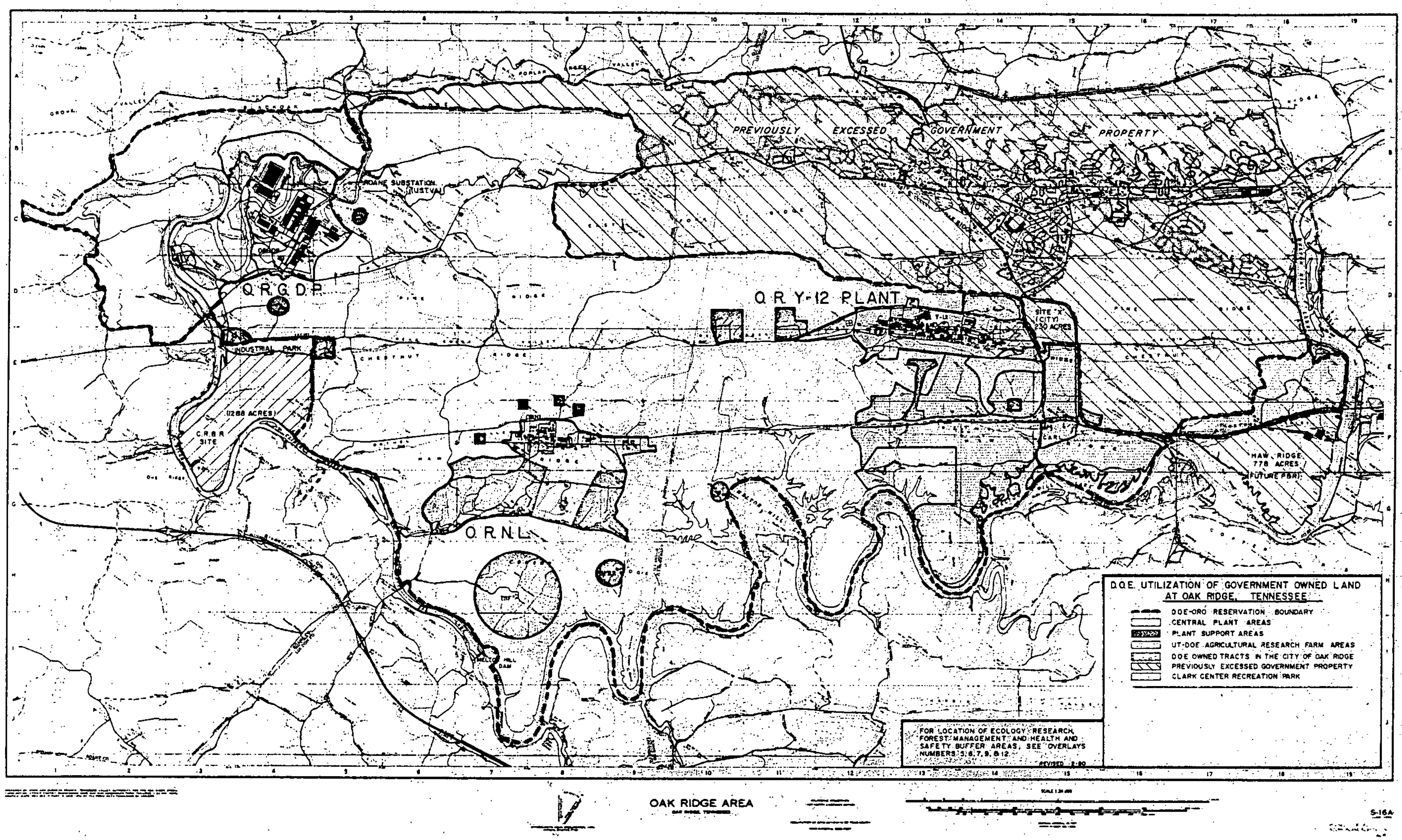

Figure 2.8-23 DOE UTILIZATION OF GOVERNMENT OWNED LAND AT OAK RIDGE, TENNESSEE

9

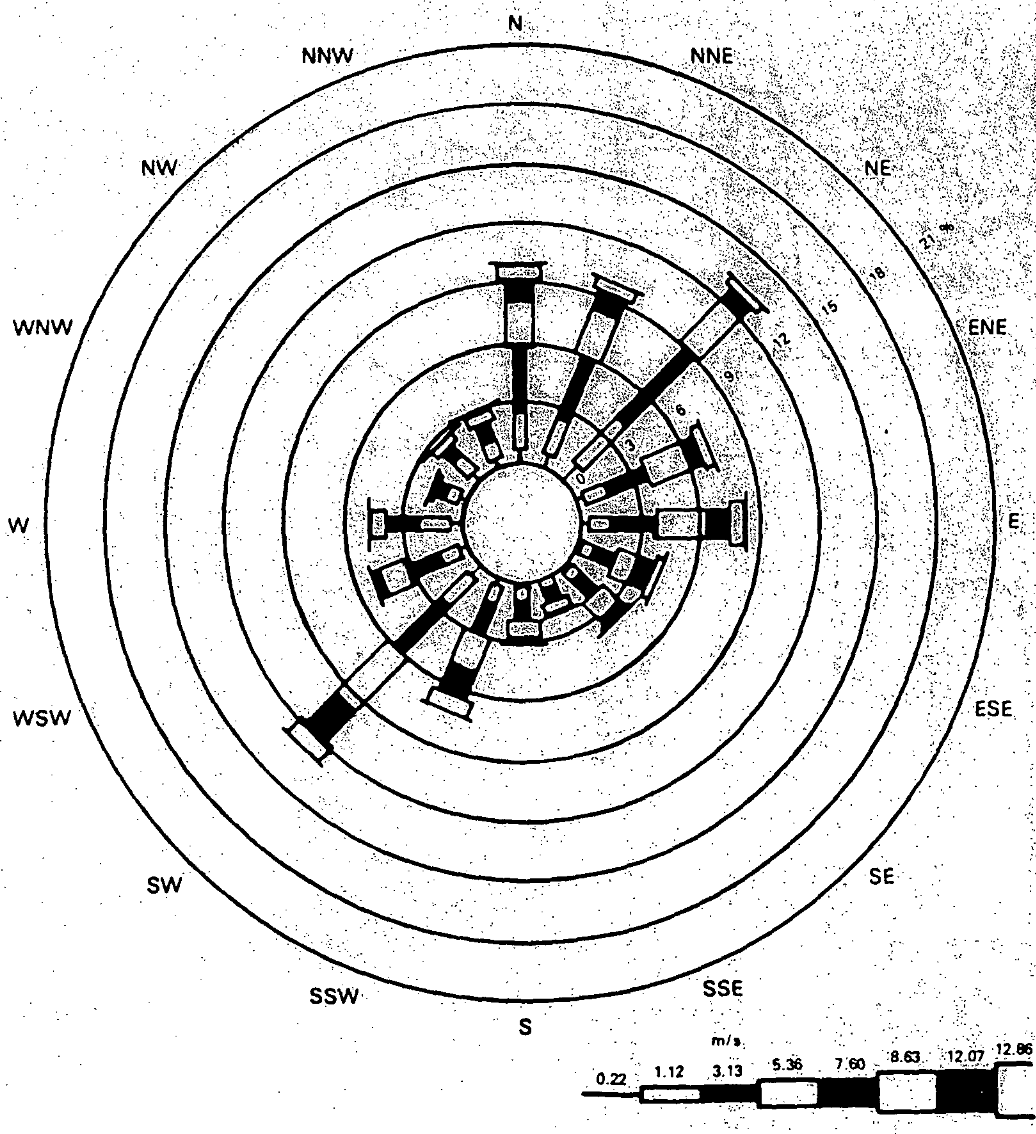

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Figure 2.8-24 METEOROLOGICAL DATA FOR THE OAK RIDGE RESERVATION

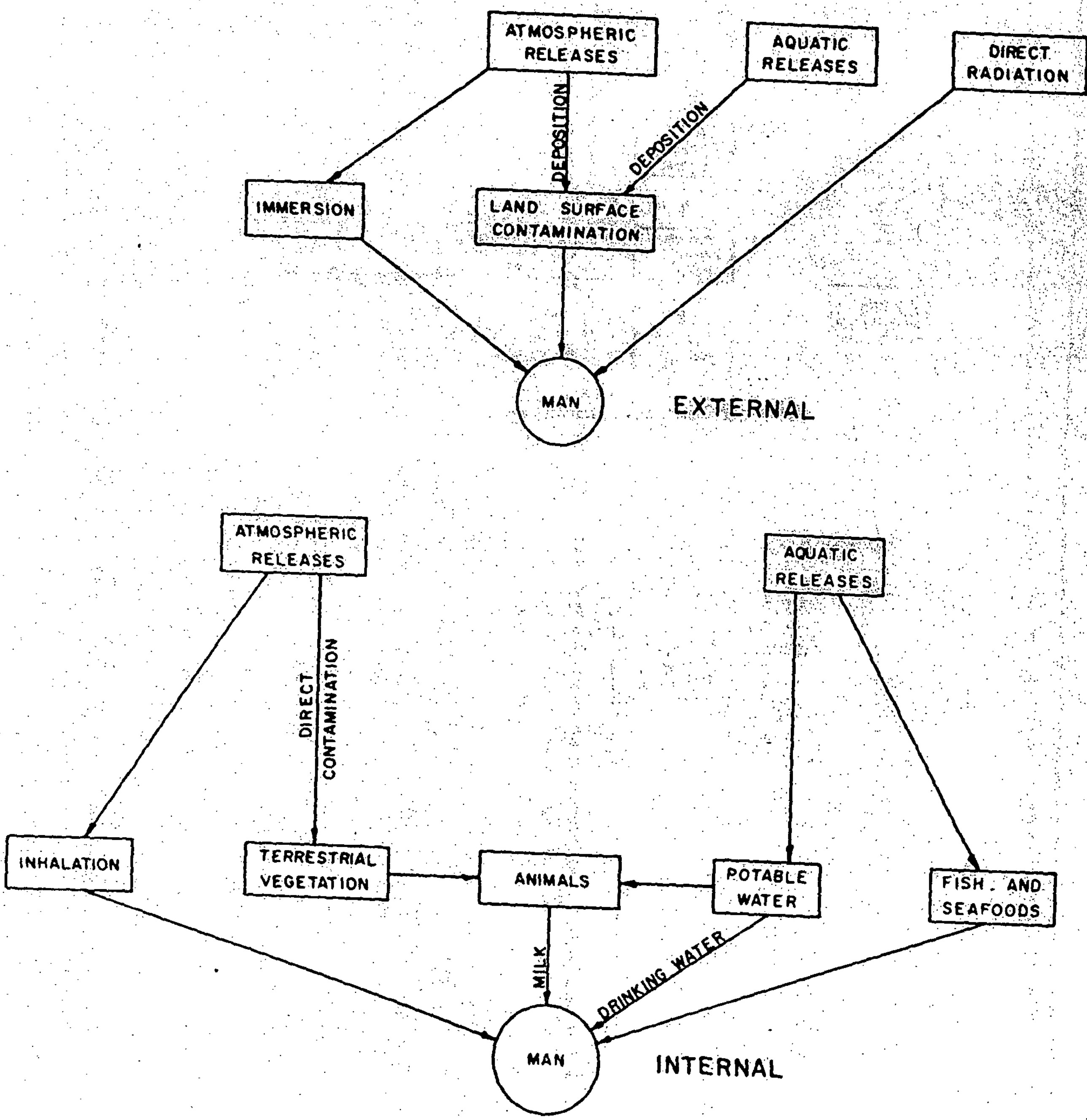

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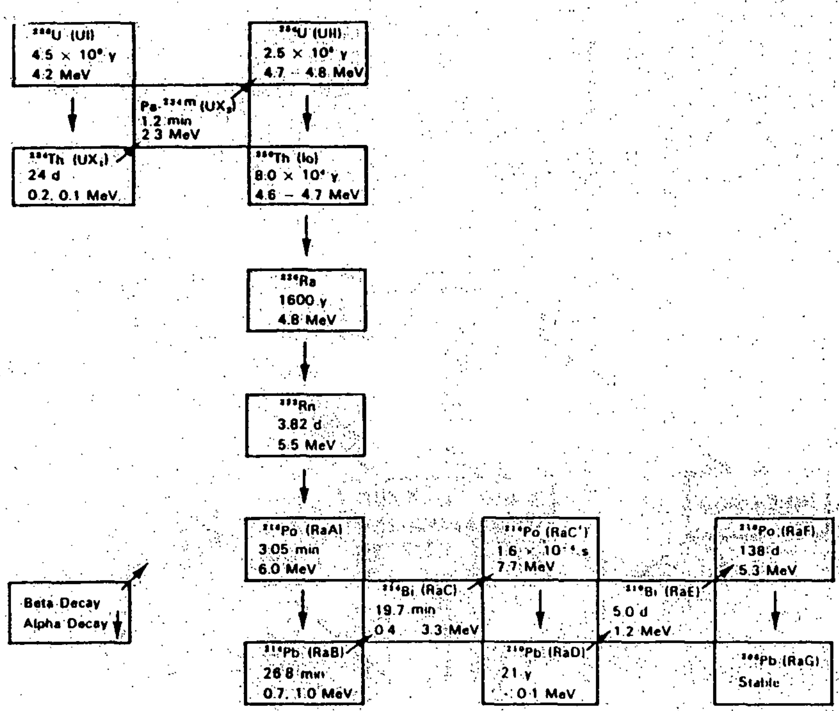
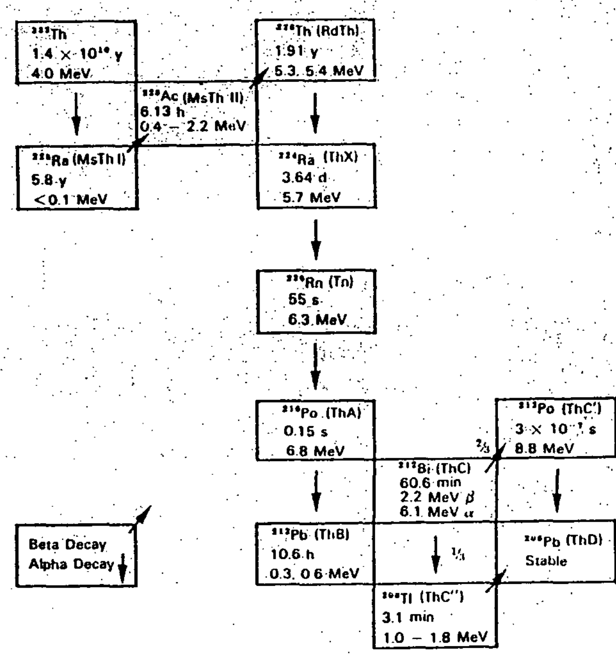
Figure 2.8-25 EXPOSURE PATHWAYS



Principal decay scheme of the uranium series.



Principal decay scheme of the thorium series.

Figure 2.8-26 THE PRIMORDIAL SERIES NATURAL RADIONUCLIDES 9
HEADED BY ^{238}U AND ^{232}TH

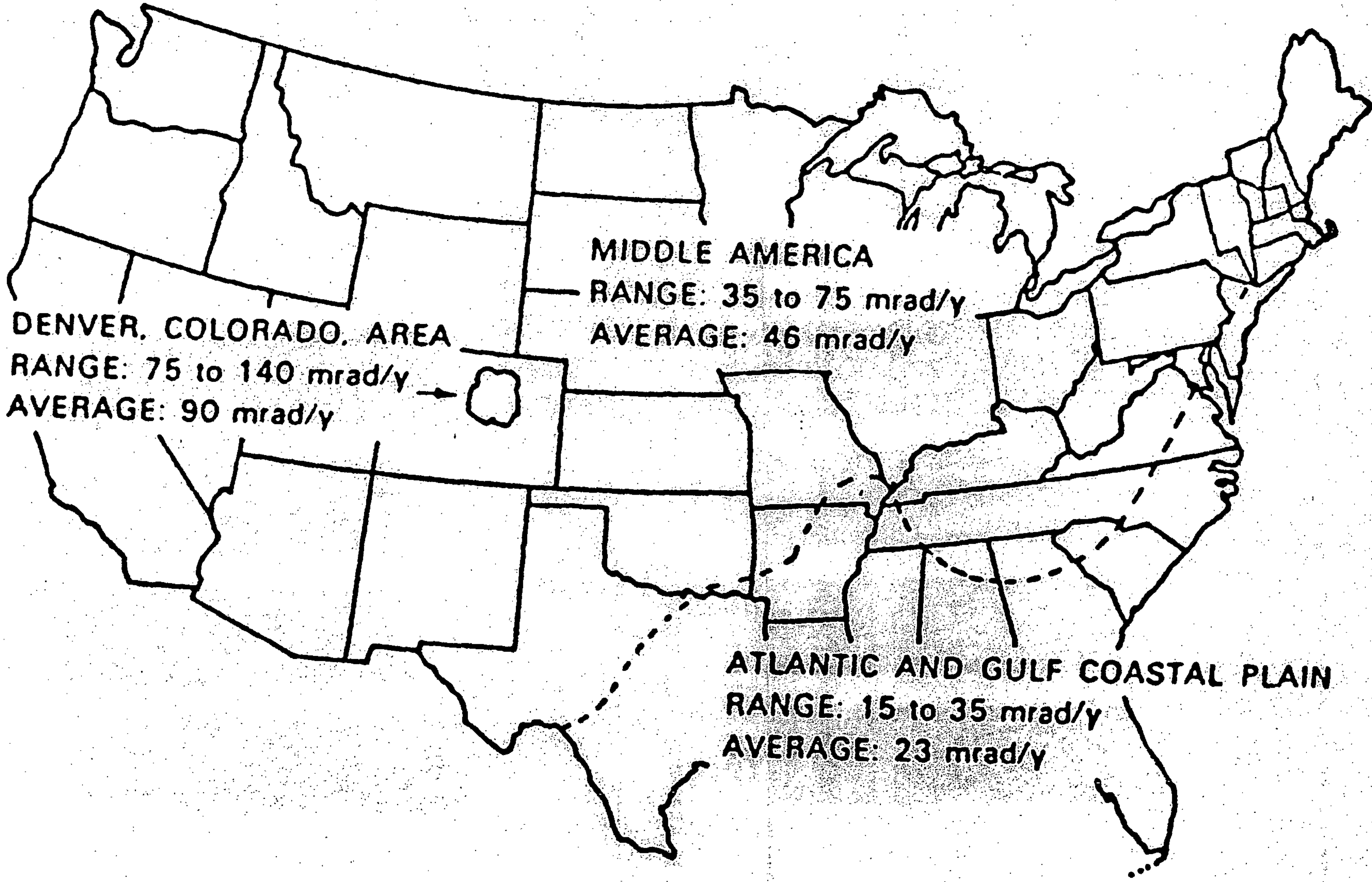


Figure 2.8-27 TERRESTRIAL EXTERNAL RADIATION ABSORBED DOSE RATES IN AIR IN THE U.S. (THE AREA INDICATED FOR DENVER PROBABLY IS QUITE EXTENSIVE ALONG THE SLOPES OF THE ROCKY MOUNTAINS BUT THERE ARE NO DATA AVAILABLE)(76)

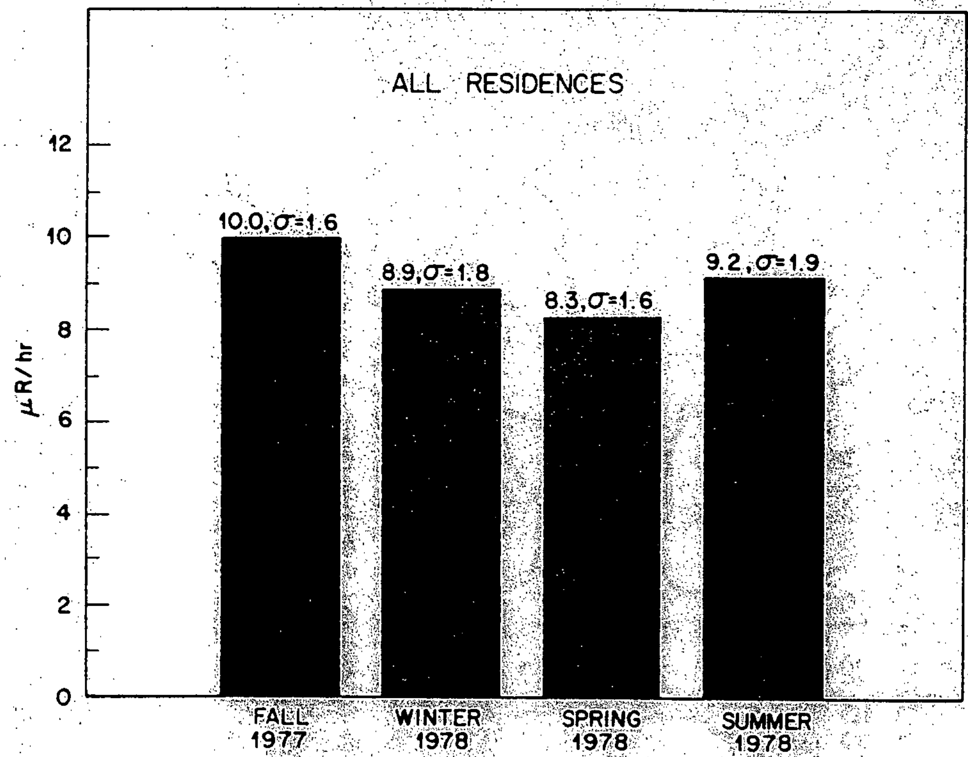


Figure 2.8-28 SEASONAL VARIATIONS OF TLD READINGS AMONG ALL TEST HOMES 9

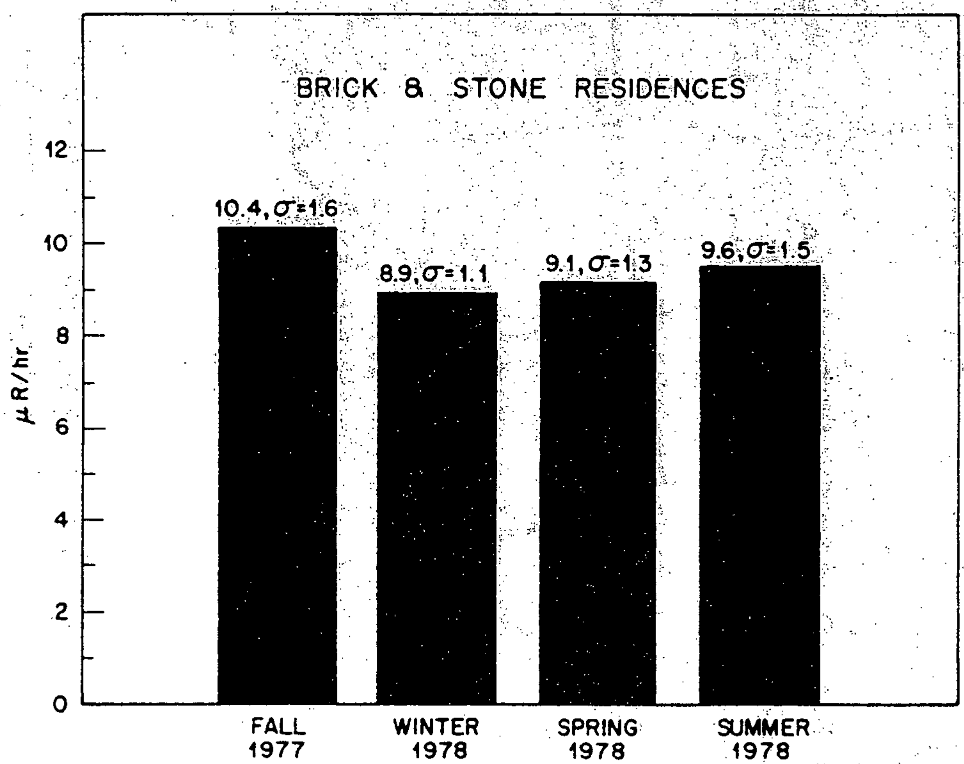


Figure 2.8-29 SEASONAL VARIATIONS OF TLD READINGS IN BRICK AND STONE TEST HOMES

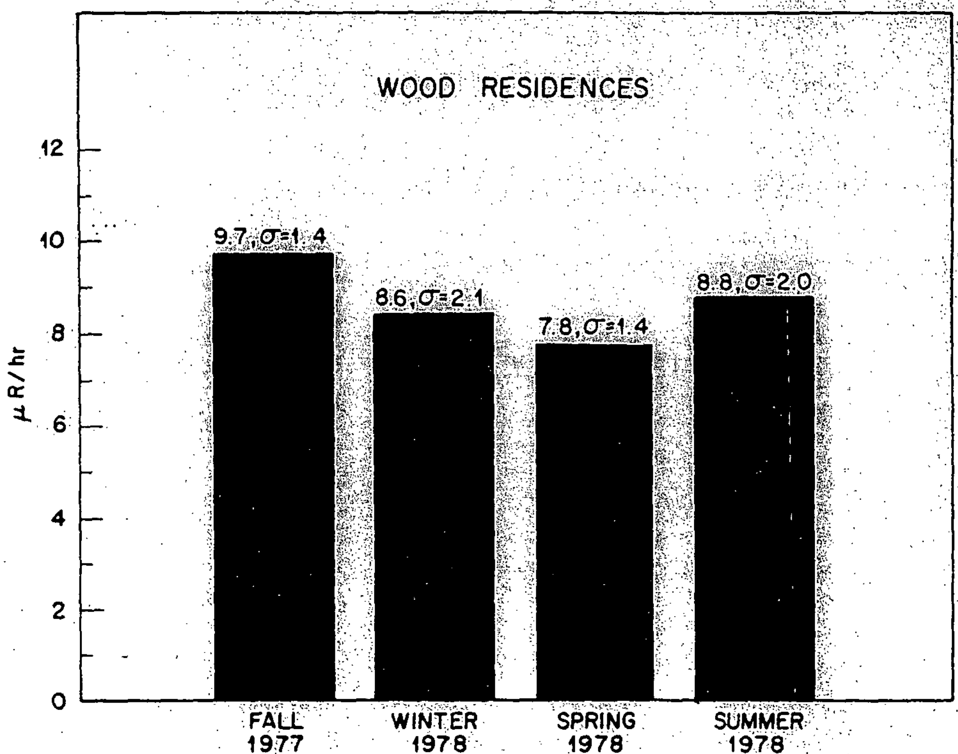


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Figure 2.8-30. SEASONAL VARIATIONS OF TLD READINGS IN WOOD TEST HOMES

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2.9 OTHER ENVIRONMENTAL FEATURES

2.9.1 LOCAL CONDITIONS

The Oak Ridge National Laboratory and other facilities within the Oak Ridge area have been involved with the handling of nuclear materials for approximately 30 years. Proximity of the plant to the Oak Ridge area will permit the CRBRP project to take advantage of the following:

1. Established surveillance programs which include the sampling and analysis of air, flora, soil, fish and food products, water and silt from surface streams;
2. A labor force accustomed to working in an area in which nuclear research and development programs are being conducted;
3. Trained local crews of support personnel available to help in emergency situations; and
4. An available labor pool of scientific, technical and skilled personnel in the Oak Ridge area.

A program for the monitoring of background radiological characteristics at the Site and the established surveillance programs mentioned above are described in Section 2.8. Although established surveillance programs do exist in the area, an on-site monitoring program will be initiated for the CRBRP.

2.9.2 LOCAL INDUSTRIAL ACTIVITIES

The small industrial activities, located within the Clinch River Consolidated Industrial Park at the northern boundary of the Site, were discussed in Section 2.2. Other sites are available in the park for future development. As these sites are utilized, a determination of the effect on the local environmental conditions will be made for each of the new industries.

3.1 EXTERNAL APPEARANCE

The Clinch River Breeder Reactor Plant (CRBRP) will consist of a functionally arranged cluster of buildings located on a plateau 815 feet above mean sea level. Other facilities necessary for operation of the plant such as cooling towers and switchyards will be located within the plant complex. This complex will be enclosed by a security fence at a 9 minimum distance of 50 feet from the perimeter road, and an animal fence 33 feet from the security fence. Figure 3.1-1 is a conceptual architectural rendering of the CRBRP.

Steep limestone ridges, hills and knobs are characteristic features of the region. The plant site and the surrounding area are heavily wooded as can be seen in Figure 3.1-2, an aerial photograph of the Site. Public view of the plant will be limited by the combination of forest and natural terrain. A portion of the dome of the Reactor Confinement Struc- 8 ture may be visible to traffic crossing the Gallaher Bridge on the Oak Ridge Turnpike and approximately ten homes on the southern side of the Clinch River will have a limited view of the plant. Description and location of the Site may be found in Section 2.1.

Of the 1,364 acres contained within the Site boundaries, approximately 90 acres will be required for the CRBRP and related facilities such 9 as roads, railroad and transmission corridors. Relation of the CRBRP to the entire Site is shown in Figure 3.1-3. The layout of plant structures in relation to the security barrier is shown in Figure 3.1-4. Summary descriptions of the external appearance of buildings and facilities are given below.

3.1.1 PLANT BUILDINGS AND FACILITIES

The dominant feature of the CRBRP is the concrete dome-capped, cylind- 8 9 rical shell of the confinement structure which completely encloses the Reactor Containment Building. The top of the concrete dome rises to an elevation of 994' - 3" above MSL. The outside diameter of the cylindrical portion of the concrete confinement structure is approximately 204'. 8 9

Buildings of steel-frame construction, shown in Figure 3.1-5 will include: the Turbine Generator Building, 169' x 196'; Maintenance Shop and Warehouse Building, 147' x 209'; Radwaste building, 86' x 130'; Steam Generator Maintenance Bay, 88' x 87'; Plant Service Building, 183' x 189'; Gate House, 50' x 60'; Circulating Water Pumphouse, 218' x 41'; and the Fire Protection Pumphouse, 71' x 27'. All of these buildings will be steel structures enclosed with insulated metal curtain walls, except the Gate House and the Plant Service Building which will be enclosed in masonry and curtain wall construction. Exterior wall colors will be selected to harmonize with other building finishes and to blend with the environment. An aesthetically pleasing appearance will be achieved by using walls with horizontal recessed bands and wide roof fascias proportioned to the scale of the buildings. 8

The Plant Service Building will be a one-story steel frame structure and will contain office and service areas. A textured masonry will be used for the exterior walls. Concrete walks will lead from the Gate House to two separate entrances for administrative and general plant operating personnel. 9

Buildings of "poured-in-place" concrete construction, shown in Figure 3.1-5, will include: The Control Bulding, 78' x 128'; Reactor Service Building, 180' x 189'; Diesel Generator Building, 107' x 80'; Steam Generator Building and Auxiliary Bay, 231' x 113'; and the Intermediate Bay which surrounds the northwest half of the Reactor Confinement Structure which has an irregular shape in plan dimension; and the cylindrical-shaped Reactor Containment Building. 8 9

Buildings of load bearing concrete block masonry units shown in Figure 3.1-5 will include the Switchyard Relay House 45' x 35'.

The external appearance of these concrete buildings will be enhanced by horizontal recesses (bands), vertical pronounced joints and a textured finish. All exposed concrete wall finishes will be treated with clear water repellent to increase weather resistance and reduce maintenance.

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Exposed concrete design patterns will be coordinated with metal curtain wall work of adjacent buildings to achieve an architecturally attractive complex.

Two electrical yards, the Generating Switch Yard and the Reserve Switch Yard will be located within a radius of approximately 800 feet northeast of the Reactor Containment Building as shown in Figure 3.1-4. The 9
Generating Switch Yard's dimensions will be 180' x 240' and the Reserve Switch Yard will measure 165' x 240'. The equipment layout of power transmission facilities within the switchyards will be functional and arranged in an aesthetical pattern. High steel structures will be painted in dark neutral colors and low-lying equipment will be painted in bright colors for contrast. Transmission lines are discussed in Section 3.9. The Switch Yard Relay House is located at the southwest corner of the Generating Switch Yard and measures 35' x 45' and is of 9
concrete block construction.

The prefabricated mechanical draft cooling tower structure will be 9
located within a radius of approximately 600 feet to the southeast of the Reactor Containment Building as shown in Figure 3.1-4 and will consist of two towers approximately 250' x 70'. A Circulating Water 9
Pump House, approximately 218' x 41' will be located between the plant 6
and the Cooling Tower. The Emergency Cooling Tower structure is located within a radius of approximately 650 feet to the northeast of the Reactor Containment Building near the Generating Switch Yard. It consists of 2 mechanical draft cooling towers 37' x 88' x 36' high located at the northwest side of the deck of the 128' diameter Emergency 9
Water Storage Basin with two adjacent Pump Houses.

3.1.2 SITE

Plant Buildings, Cooling Towers, Emergency Cooling Tower structure, Circu- 9
lating Water Pump House and Electrical Switch Yards will be located within an area of approximately 37 acres, enclosed and protected by a security barrier consisting of

an eight-foot high chain link fence and an outside five foot high animal 9
fence, as shown in Figure 3.1-4. Cleared areas will be maintained on
both sides of the fence for a distance of at least 20 feet outside the
animal fence and 50 feet inside the security barrier. An inside
perimeter security patrol road will parallel the fence at a 50-foot
maximum distance from the security barrier and a 50-foot minimum distance
from the plant buildings. The area between the patrol road and the
barrier will be clear of structures and plantings. Security lighting
will provide adequate illumination for the protected area. A Gatehouse
will be located at the main entrance on the northwest side of the plant
to control pedestrian and vehicular access traffic. This building will
have provisions for maximum visual surveillance. Further information 8
on plans for protection against industrial sabotage is provided in 9
Chapter 13 of the Preliminary Safety Analysis Report (PSAR).

Site landscaping will be limited to grassed areas, shrubs and trees for
aesthetic purposes. Plantings will not be located where they would 9
hinder security surveillance of the Plant complex.

3.1.3 OTHER FACILITIES

A paved parking area with accommodations for approximately 155 cars will 4 9
be located southwest of the main gate. 4

3.1.4 RELEASE POINTS

The release point for liquid effluents from the CRBRP will be the cooling tower blowdown discharge line to the Clinch River, elevation 731 feet MSL, as shown in Figure 3.1-3. Storm water collected by roof and yard drains will be sent to a catch basin. The catch basin effluent is discharged to the Clinch River via a separate line, whose elevation and location have not been determined. 9

Evaporation and drift from the main mechanical draft wet-cooling tower will be released 55 feet above grade or at elevation 870 feet MSL. Release point for the emergency towers will be 40 feet above grade or at elevation 855 feet MSL. Locations and dimensions of liquid release points are described in Section 3.4. 9

Design release points for gaseous radiological effluents will be through the following exhausts:

1. Intermediate Bay (IB) H&V Exhaust, elevation 857 feet MSL;

2. Three Reactor Service Building (RSB) H&V Exhausts: two at elevation 884 feet MSL from the Service Area, and one at elevation 884 feet MSL, from the Radwaste Area; 13

3. Six Steam Generator Building (SGB) H&V Exhausts (one main for each SG cell at elevation 886 feet MSL, and one other exhaust for each SG cell at 874 feet MSL).

4. One Reactor Containment Building annulus H&V exhaust at elevation 987 feet MSL.

5. Twelve Turbine Generator Building (TGB) H&V Exhausts, one at elevation 878 feet MSL, three at elevation 862 feet MSL, five at elevation 910 feet 6 inches MSL, and three at elevation 921 feet MSL. 9

6. One Plant Service Building (PSB) H&V Exhaust, elevation 830 feet MSL.

7. Eight additional release points are provided at the top of the Reactor Containment Building, elevation 991 feet MSL, for events which are beyond the design basis.

The above-mentioned nuclear island and balance of plant design gaseous radiological effluent release points are described in Sections 3.5.2.5 and 3.5.2.7, respectively. 8

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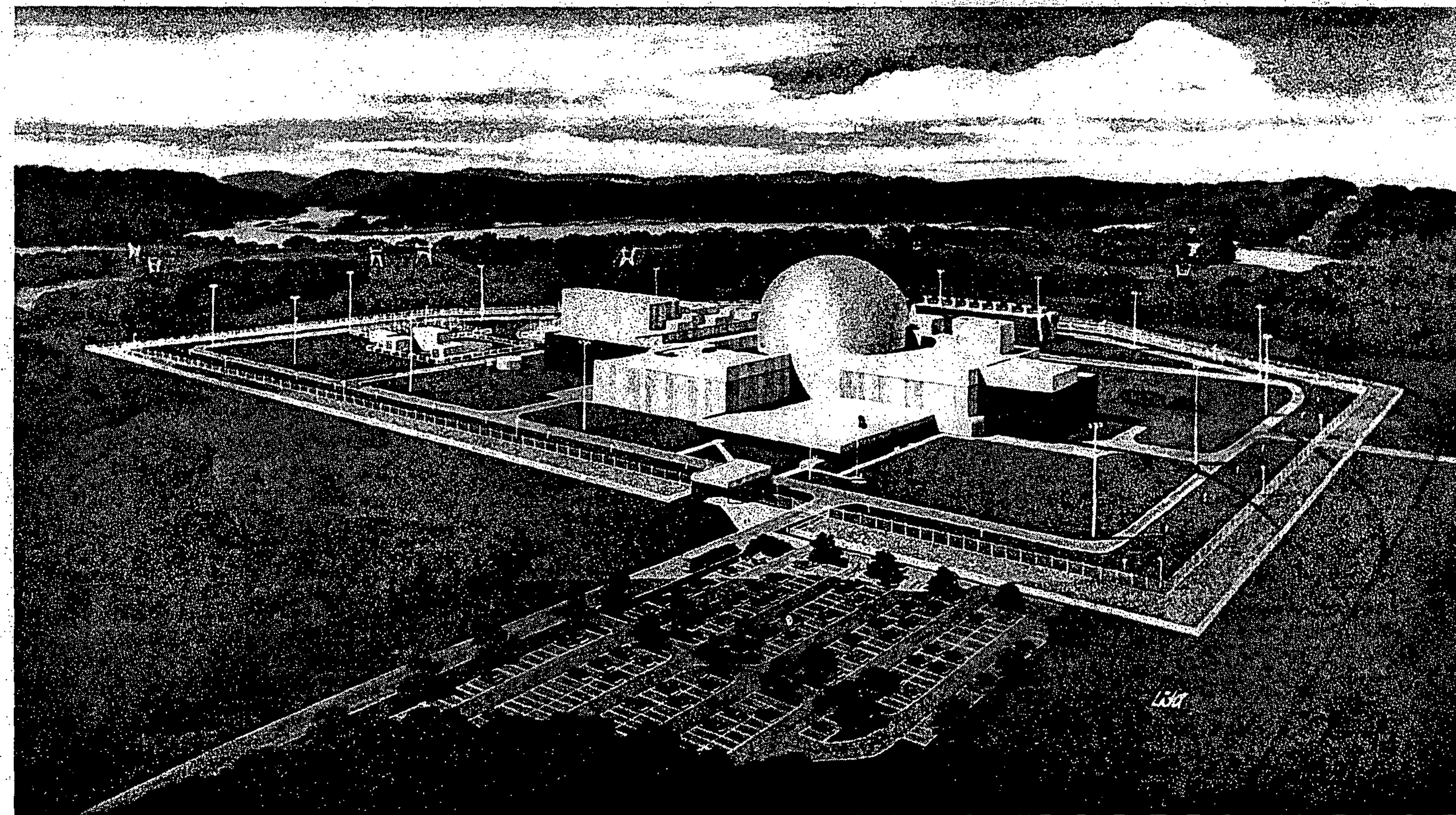


Figure 3.1-1 A CONCEPTUAL ARCHITECTURAL RENDERING OF THE CRPRP

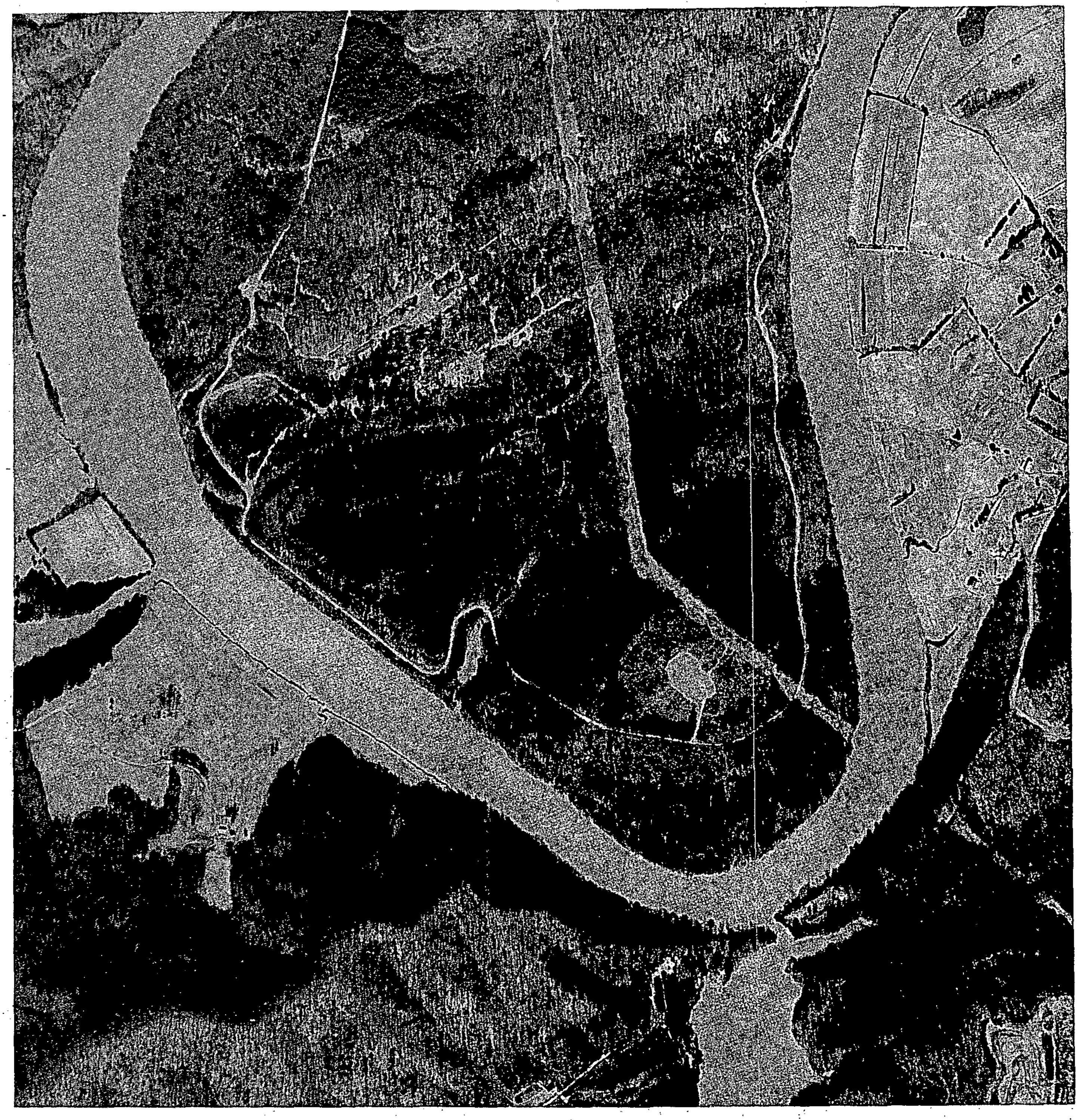


Figure 3.1-2 AERIAL PHOTOGRAPH OF THE CRBRP SITE

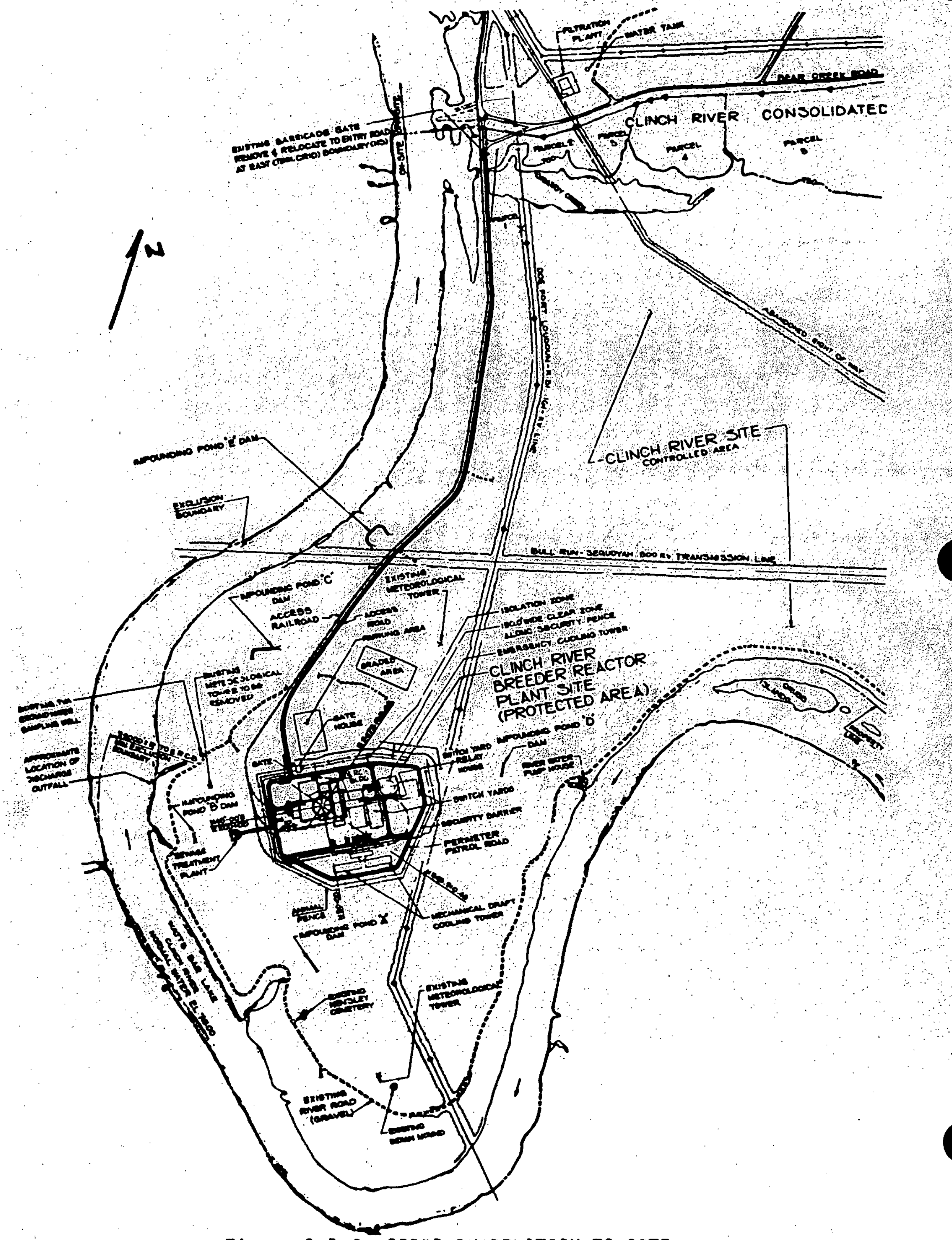


Figure 3.1-3 CRBRP IN RELATION TO SITE

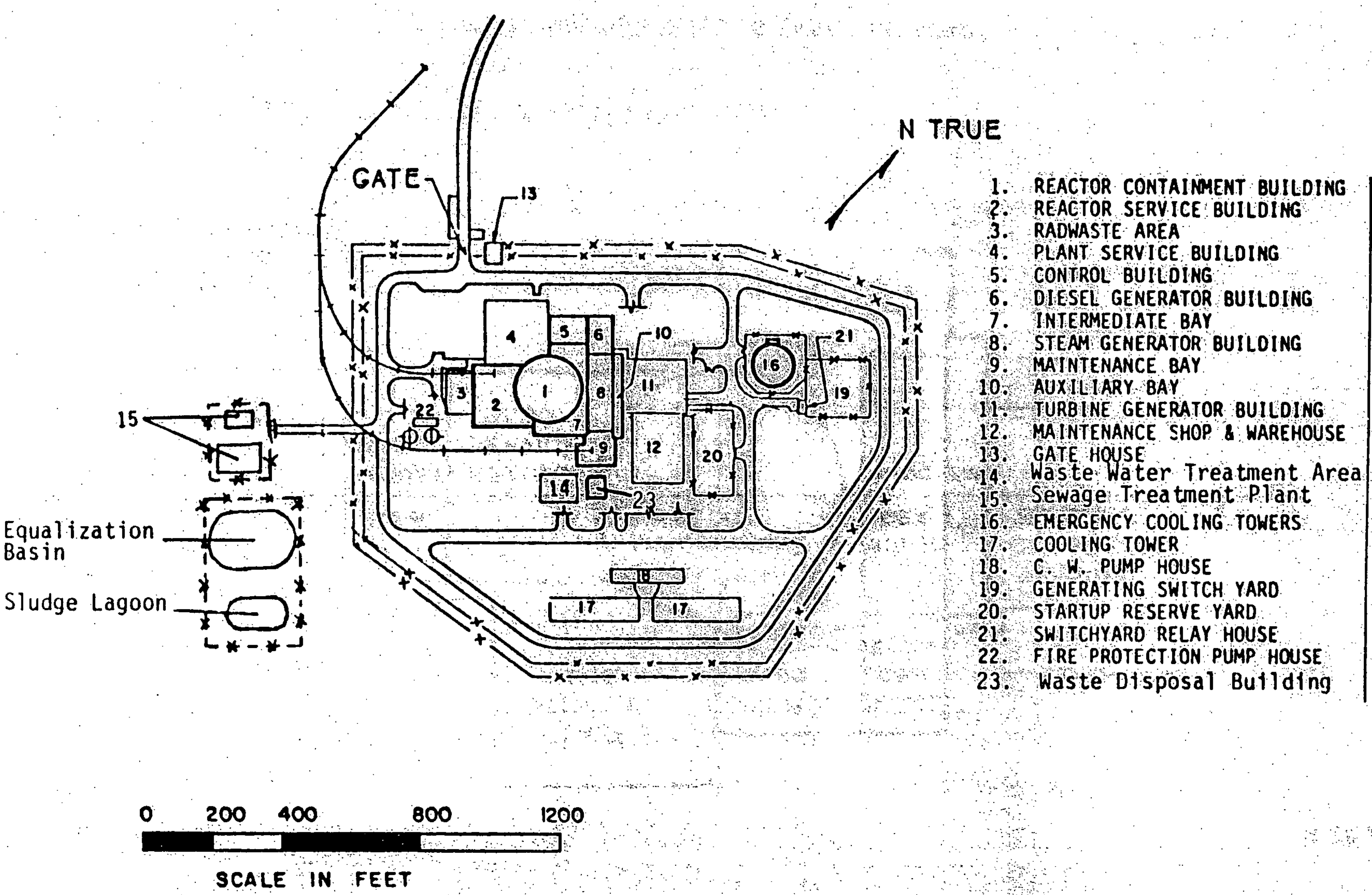
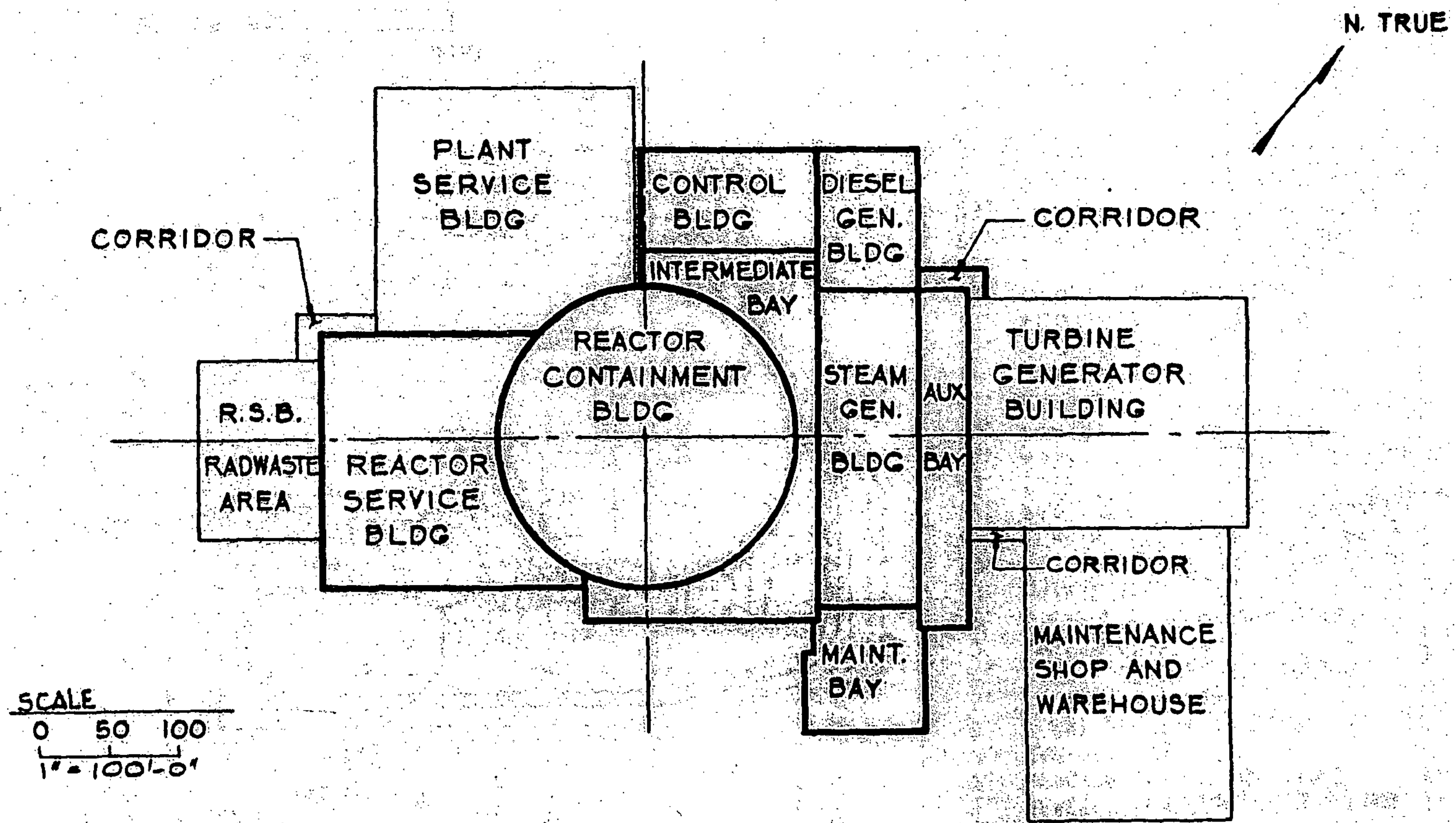


Figure 3.1-4 LAYOUT OF PLANT STRUCTURES IN RELATION TO THE SECURITY BARRIER



NOTE: HEAVY LINES INDICATE CATEGORY I STRUCTURES

Figure 3.1-5 MAIN BUILDING LAYOUT OF CRBRP

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3.2 REACTOR AND STEAM-ELECTRIC SYSTEM

3.2.1 SYSTEM DESCRIPTION

The Clinch River Breeder Reactor Plant (CRBRP) will utilize a Liquid Metal Fast Breeder Reactor in the Nuclear Steam Supply System designed by Westinghouse Electric Corporation as the lead reactor manufacturer under contracts to the Project Management Corporation (PMC) and the Department of Energy (DOE). DOE will provide technical super- 10 4
vision and administration of the Nuclear Island aspects of the Westinghouse activities. Atomics International and General Electric are participating as major sub-contractors in the Nuclear Steam Supply System design.

Assignment of responsibilities for the Nuclear Island can be identified as follows: Westinghouse is responsible for the overall Nuclear Island, Reactor System and Primary Heat Transport System; General Electric is responsible for the Intermediate Heat Transport System and Steam Generator Systems; and Atomics International is responsible for the Fuel Handling System, maintenance and auxiliary systems. Burns and Roe, Inc. is the architect-engineer for the project. Stone and Webster is the con- 6
structor. Tennessee Valley Authority (TVA) will operate the plant and will use the generated electrical power in the TVA system. General Electric is providing the Turbine Generator.

The CRBRP will be an integrated single-unit electric power plant and will include: (a) a liquid sodium cooled reactor and steam generation system; (b) a steam turbine-driven electric generation system; (c) a heat rejection system; (d) an electrical switchyard; and (e) related auxiliaries and supporting structures and facilities.

Three parallel primary and intermediate heat transport loops will be used in the Heat Transport System (HTS). The primary loops will be located 6
in an inert atmosphere in shielded vaults within a containment structure. Sodium coolant in the primary loops will remove heat from the reactor core

and the radial blanket. As a result of neutron activation, the primary sodium will become radioactive. The primary sodium will also contain dissolved radioactive fission and corrosion products. Heat from the primary sodium is transferred to the three intermediate loops through the Intermediate Heat Exchangers (IHX). In the IHX the operating pressure of the Intermediate Heat Transport Loop is slightly higher than that in the primary loop. As a result, leakage of radioactive primary sodium into the intermediate system is minimized and the intermediate loop is maintained in a non-radioactive state. Non-radioactive sodium in the intermediate loops circulates through the evaporators of the Steam Generation System and converts feedwater on the water side into steam. This steam is then superheated in the Steam Generator System superheaters to drive 6 the tandem-compound turbine. A single-shaft, multi-stage turbine generator, which will produce 380 MWe with steam conditions of 1,450 psig at 900 degrees F, is used to produce electricity. The generator delivers 22 to 24 kV at a 0.9 power factor to a step-up transformer which delivers 161 kV to the TVA network.

Condensation of the steam is accomplished in a single-pass condenser. Condenser heat load is dissipated to the atmosphere by a multi-cell cooling tower. The Heat Dissipation System is described in detail in Section 3.4. Deaeration of the condensate is accomplished in the feed-water cycle deaerator and the main condenser. A schematic diagram of the CRBRP cycle is shown in Figure 3.2-1.

Physical containment and shielding will be provided throughout the plant for normal operation and as required for accident prevention. Major components of the Primary Heat Transport System and the reactor vessel will be located in an inert atmosphere in reinforce-concrete cells within the Reactor Containment Building (RCB). The RCB will be a leak-tight steel shell structure aboveground with a flat, steel-lined concrete base below grade. The steel shell of the Reactor Containment Building will be completely enclosed by a reinforced concrete confinement structure. 8

Shielding will be provided to limit radiation exposure to personnel in accordance with 10 CFR 20. Exposure records for plant personnel will be maintained and filed regularly with governmental agencies. Principal plant characteristics and reactor parameters are provided in Tables 3.2-1 and 3.2-2, respectively.

3.2.2 FUEL DESCRIPTION

The reactor of the CRBRP has a central core zone, consisting of a 9 heterogeneous mixture of fuel and blanket assemblies, surrounded by radial and axial blankets. Fuel used will be in the form of sintered ceramic pellets of mixed uranium-plutonium dioxide which are encapsulated in stainless steel rods. 9 Each fuel assembly consists of an array of 217 such rods placed in a hexagonal 9 channel which acts as a support for the rods and as a coolant channel.

The initial core consists of 156 fuel assemblies, all containing the same plutonium enrichment. Eighty-two inner blanket assemblies are dispersed heterogeneously through the central region of the core. The core is surrounded by 126 radial blanket 14 assemblies. Fourteen-inch thick axial blankets lie above and below the 36-inch fueled core region. Plutonium enrichments range from 32-33 w/o PuO_2 in $PuO_2 + UO_2$. 9 Depleted uranium dioxide (0.2 w/o U^{235}) is used throughout the fuel and blankets. The inner and radial blanket assemblies contain 61 stainless-steel-clad UO_2 rods enclosed in hexagonal channels.

Further information on the fuel elements may be found in Section 3.8.1.

3.2.3 POWER OUTPUT

Power output rating for the initial core of the CRBRP is 975 6
megawatts thermal (MWt) which will result in a gross electrical
output of approximately 375 megawatts electric (MWe). 16

The CRBRP will have a design capability for a power output rating
of 1,121 MWt 437 for cores other than the initial core. 16

TABLE 3.2-1

PRINCIPAL PLANT CHARACTERISTICS

Reactor power	975 MWt
Gross electrical power	375 MWe
Number of primary and intermediate heat transport loops	3
Location for sodium pumps, primary	Hot Leg
Location for sodium pumps, intermediate	Cold Leg
Principal plant materials	316/304 SS/2-1/4 Cr-1 Mo
Reactor vessel outlet temperature	995^{o} F
Total core sodium flowrate	41.45×10^{6} lb/hr
Total intermediate sodium flowrate	40.47×10^{6} lb/hr
Feedwater temperature	468^{o} F
Steam pressure at turbine throttle	1,450 psig
Steam temperature at turbine throttle	900^{o} F
Total steam flow to turbine	3.32×10^{6} lb/hr
Turbine generator plant gross efficiency	39.0%

16

16

TABLE 3.2-2

PRINCIPAL REACTOR PARAMETERS

Core Fuel Assemblies		
Core fuel material	PuO_2/UO_2	
Fuel cladding and assembly duct material	316 SS (20% cold worked)	9
Fuel rod outer diameter	0.23 in.	
Cladding thickness	15 mils.	
Rod pitch to diameter ratio	1.25	
Core height	36 in.	
Axial blanket height at both ends	14 in.	
Fuel rods per assembly	217	
Number of fuel assemblies (initial core)	156	
Peak fuel burnup goal (equilibrium)	110,000MWd/T	9
Maximum linear power	15.9 kW/ft.	
Average liner power	8.2 kW/ft.	
Inner/Radial Blanket Assemblies		
Blanket fuel material	Depleted UO_2	
Rod outer diameter	0.506 in.	9
Cladding thickness	15 mils.	
Blanket rods per assembly	61	
Number of inner/radial blanket assemblies	82/126	9 14
Maximum linear power	20.0 kW/ft.	
Control Rod Assemblies		
Poison material	B_4C	
Number of control rods	15	9

(Continued)

TABLE 3.2-2 (Continued)

Refueling		
Frequency, mo	12	
Average number of fuel assemblies replaced:	81	9
Average number of inner/radial blanket assemblies replaced:	41/28	9 14
Nuclear Performance		
Initial fissile loading to power ratio	4.0 kg/MWe	9
Initial breeding ratio	1.29	9
Equilibrium breeding ratio	1.24	9

6

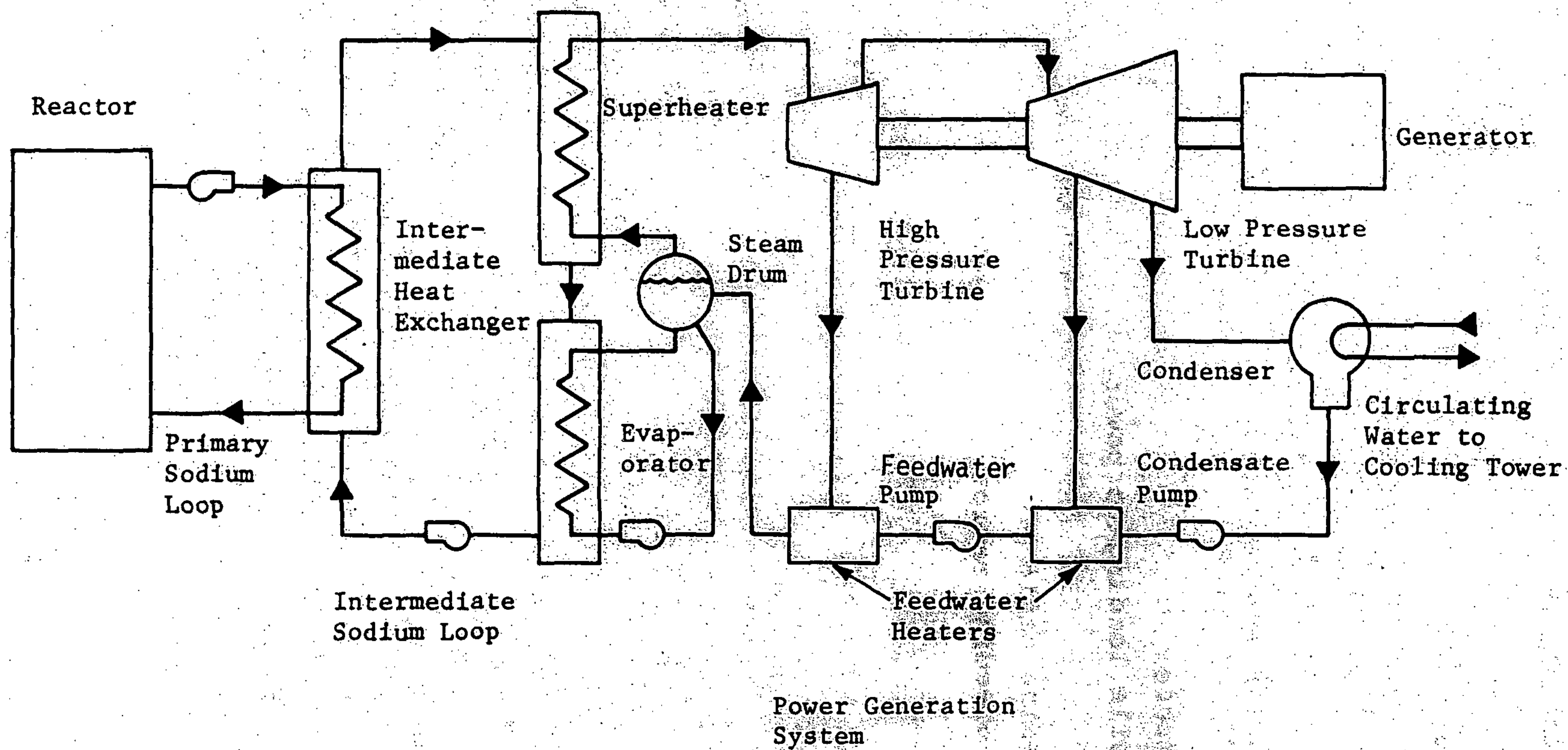

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Figure 3.2-1 SCHEMATIC DIAGRAM OF THE CRBRP CYCLE

3.3 PLANT WATER USE

3.3.1 OVERALL PLANT

Described in this section is the water usage expected at the Clinch River Breeder Reactor Plant. All water for plant operation will be supplied by the Clinch River. Hydrological data for the river are presented in Section 2.5. The greatest consumptive water use will take place in the Heat Dissipation System. The amount of plant makeup water is primarily dependent upon the quantity of water lost due to evaporation, the quantity of water lost due to drift and the amount of blowdown necessary for control of cooling water chemistry. Other systems considered in the plant water balance include process water treatment, Waste Water Disposal, Sewage Disposal, Potable Water and Radwaste. Potable water will be supplied from the Bear Creek Road Water 9 16
Filtration Plant. Figure 3.3-1 is a water usage flow diagram for the plant. Table 3.3-1 lists overall plant quantitative water usage when operating at maximum power (100 percent load factor). 6 16
Annual average consumptive water use at maximum power is approximately 3,730 gpm which is 0.15 percent of the annual average Clinch River flow. Tables 3.3-1, 3.3-2 and 3.3-3 list quantitative water usage for maximum power (100% load factor), 9
minimum power operation (40% load factor) and temporary shutdown (10% load factor), respectively. The seasonal variation of consumptive water use (100% load factor) is shown in Table 3.3-4.

3.3.2 HEAT DISSIPATION SYSTEM

In order to minimize the thermal effects on the Clinch River from normal plant operation, a recirculating cooling water system will be employed to dissipate the heat gained from condensing steam in the main condenser and other plant auxiliary heat exchanger equipment. The Cooling system will utilize two mechanical draft 6
cooling towers which will dissipate heat and minimize the thermal effects on the Clinch River from plant operation. Temperature

rise of the water passing through the condenser is approximately
22 degrees F. During maximum power operation, the flowrate to 6
the mechanical draft cooling tower will be 212,200 gpm. Cooling 9
water temperature will be reduced in the cooling tower by the
evaporation of a portion of the water and by sensible heat
transfer mechanisms. Evaporation rate from the cooling tower
will vary with plant operating power and the ambient air
temperature and humidity. Evaporation rates decrease in winter
and increase in summer. Operation of the cooling tower will
cause droplets of water to be discharged from the system in a
process called drift. Drift eliminators will be used to minimize
this loss. A detailed discussion of the Heat Dissipation System
is given in Section 3.4 and its environmental effects are
described in Section 5.1

3.3.3 PROCESS WATER TREATMENT SYSTEMS

Process water treatment systems include the Makeup Water
Treatment System and the Condensate Polishing System. The Makeup 9
Water Treatment System will provide up to 74 gpm of treated water 16
to replace water used for demineralizer regenerations and other
plant demineralized water uses such as: steam cycle makeup,
radwaste system consumption, component chemical cleaning and
miscellaneous plant losses. The potable water source will be the 9 16
Bear Creek Road Water Filtration Plant. The Condensate Polishing
System treats condensate to maintain the feedwater chemistry
required for use in the steam generator. The Condensate Polisher
requires a peak flow of 40,000 gpd from the Makeup Water
Treatment System for regeneration of ion exchange resins. Makeup
water to the process water treatment systems are provided by the 9
Clinch River via the Intake System.

3.3.4 WASTE WATER DISPOSAL SYSTEM

Backwashes, regenerant wastes and rinse water from the process 16
water treatment systems and non-radioactive building floor 9

drainage are collected and treated in the Waste Water Disposal System.

After the required level of treatment has been provided, waste water is sent to the Clinch River via the common plant discharge. The design basis flowrate into the Waste Water Disposal System is approximately 100 gpm, average annual flow. Whenever chemistry permits, treated effluent can be recycled to the cooling tower basin. A description of the Waste Water Disposal System is given in Section 3.6 and additional information is found in Section 10.4. 9

3.3.5 RADWASTE SYSTEMS

Consumptive water usage by the Radwaste System is approximately 15 gpd. This represents the amount of concentrated radwaste liquids from the Liquid Radwaste System which will be disposed of after solidification. Solidification will entail pouring this concentrated radwaste liquid into a drum containing cement, sealing the drum and tumbling until mixed. The solidified drum will be removed by a licensed contractor for processing or burial. 9

Radwaste liquids having intermediate and low activity levels will be collected separately according to activity, subjected to decontamination processing and analyzed to determine wheter the fluids are adequately decontaminated and suitable to reuse or discharge. A detailed discussion of the Radwaste System is given in Section 3.5. 9

A 5 gpm continuous blowdown from secondary sampling discharge 16
maintains an equilibrium with tritium inventory. The blowdown is sent to the circulation water system for ultimate disposal to the Clinch River. Release flowrate will be controlled so that the

concentration in the dilution stream and total activity released to the river will be in accordance with applicable Federal and State Regulations.

3.3.6 POTABLE WATER SYSTEM

Plant potable water is supplied directly from DOE's Bear Creek Road Filtration Plant. 9 16

3.3.7 SANITARY WASTE SYSTEM

A portion of the potable water is provided for sanitary purposes. Figure 3.3-1 shows the design basis flow rate during the normal plant operating period to be approximately five gpm or 7000 gpd. The sanitary waste treatment system is designed to accommodate a flow rate of 13,000 gpd to handle peak man loads during plant 8
shutdown periods and infiltration from ground-water. Following treatment, the effluent from the sanitary treatment plant is discharged to the Clinch River via the common plant discharge. Details concerning the Sanitary Waste System are provided in Section 3.7.

Table 3.3-1
CLINCH RIVER BREEDER REACTOR PLANT WATER USAGE*
(100% Load Factor - Maximum Power)

Item	Flow Rate	Consumptive Use	Return to River
A. Water Intake			
Plant Makeup	6109	--	--
Potable Water	26	--	--
Atmospheric (HVAC Condensate)	26	--	--
B. Water Usage			
Cooling Tower**			
Evaporation	--	3623	--
Drift	--	106	--
Blowdown	--	--	2327
Waste Water Disposal+	100	<1	100
Radwaste+	<1	<1	<1
Sewage Disposal+	5	--	5
Total		3729	2432
% River Flow Rate Consumed ++		0.15%	

* All values are in gpm, unless otherwise noted.

** Cooling tower values are based on annual averages at maximum power operation.

\+ These flow rates are annual average values and are assumed to be independent of operating power.

++ Based on annual average flow of Clinch River of 5380 cfs (2.415×10^6 gpm).

Note: See Figure 3.3-1 for CRBRP Water Usage Diagram.

TABLE 3.3-2

CLINCH RIVER BREEDER REACTOR PLANT WATER USAGE* - MINIMUM POWER (40% Load Factor)

Water Use	Flow Rate	Consumptive Use	Returned to River	
A. Plant Makeup	2,527	--	--	9
B. Cooling Tower**				
Evaporation	1,450	1,450	0	
Drift	42	42	0	6
Blowdown	925	0	925	
C. Other Systems+				9
Process Waste Treatment	110	--	--	
Waste Water Disposal	100	<1	100	
Radwaste	~1	<1	~1	6
Potable Water	9	4	0	
Sewage Disposal	5∇	0	5	
Totals - B & C	--	1,496	1,031	
D. Clinch River Flow Rate++	2,415,000	--	--	9
% River Flow Rate Consumed	--	0.062	--	

* All values in gpm

** Cooling tower values are annual averages at minimum power operation

\+ These flow rates are design values and are assumed to be independent of operating power.

++ Annual average flow. 9

∇ The source of sanitary water is the Potable Water System. 6

TABLE 3.3-3

CLINCH RIVER BREEDER REACTOR PLANT WATER USAGE* - TEMPORARY SHUTDOWN
(10% Load Factor)

Water Use	Flow Rate	Consumptive Use	Returned to River	
A. Plant Makeup	715	--	--	
				9
B. Cooling Tower**				
Evaporation	363	363	0	
Drift	11	11	0	6
Blowdown	231	0	231	
C. Other Systems+				9
Process Waste Treatment	110	--	--	
Waste Water Disposal	100	<1	100	
Radwaste	~1	<1	~1	
Potable Water	9	4	0	6
Sewage Disposal	5∇	0	5	
Totals - B & C	--	378	337	
D. Clinch River Flow Rate++	2,415,000	--	--	9
% River Flow Rate Consumed	--	0.016	--	

* All values in gpm

** Cooling tower values are annual averages during temporary shutdown operation.

\+ These flow rates are design values and are assumed to be independent of operating power.

++ Annual average flow.

∇ The source of sanitary water is the Potable Water System. 6 9

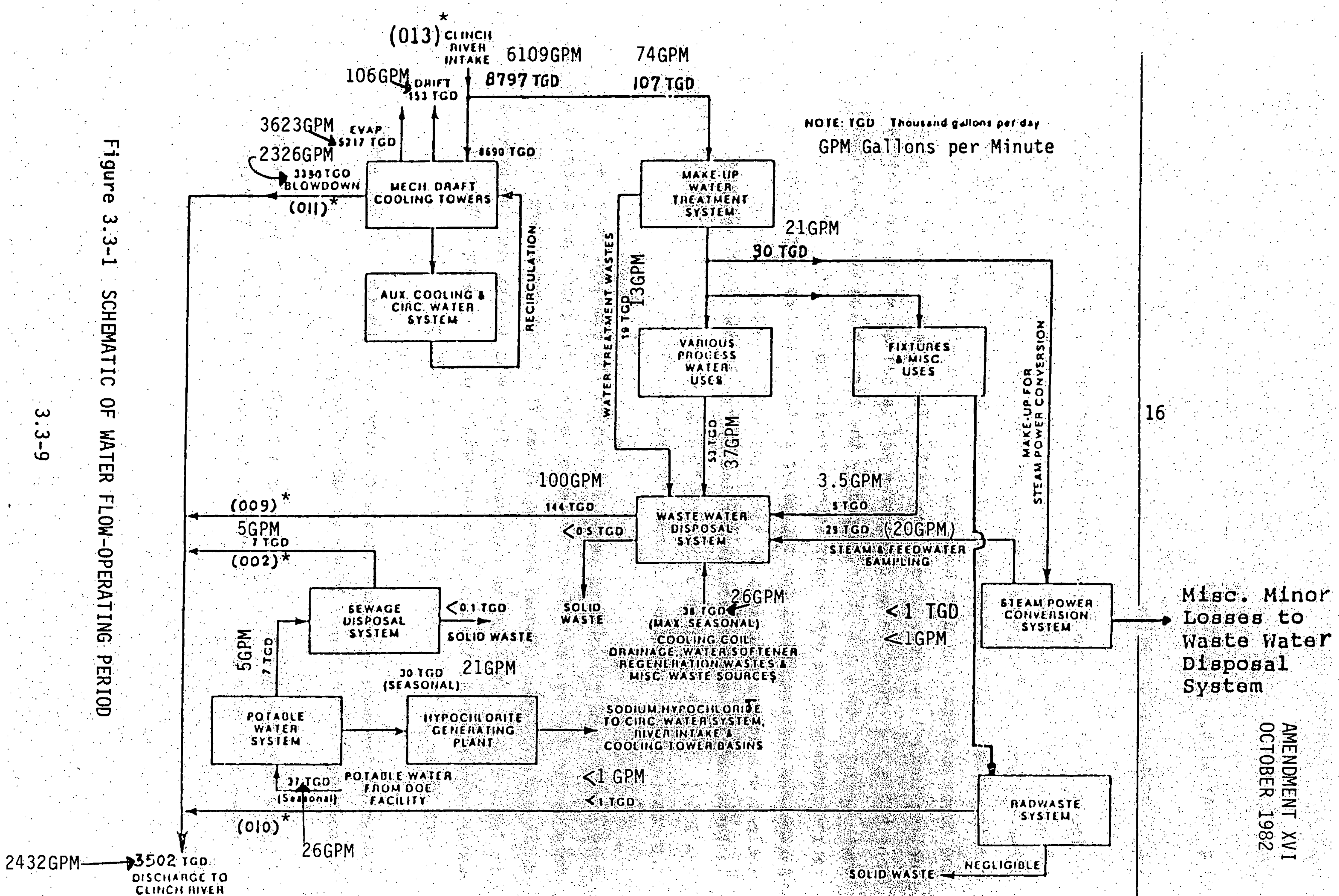
TABLE 3.3-4

CRBRP WATER USAGE* - SEASONAL VARIATION
(100% Load Factor)

Water Use	Winter	Spring	Summer	Fall	Annual	
A. Plant Makeup	5,219	6,053	7,022	6,172	6,109	16
B. Consumptive Use						9
1. Cooling Tower Evaporation	3,073	3,558	4,130	3,630	3,623	
2. Cooling Tower Drift	106	106	106	106	106	
3. Potable Water	4	4	4	4	4	6
Total Consumption	3,183	3,668	4,240	3,740	3,733	
C. Discharge to Clinch River						9
1. Cooling Tower Blowdown	1,955	2,273	2,650	2,320	2,327	16
2. Waste Water Disposal	75	106	126	106	100	
3. Sewage Disposal	5	5	5	5	5	
4. Radwaste	1	1	1	1	<1	
Total Discharge	2,036	2,385	2,782	2,432	2,432	9 16

* All values in gpm.

SCHEMATIC OF WATER FLOW - OPER[illegible]NG PERIOD



*NPDES Outfall serial number

Figure 3.3-1 SCHEMATIC OF WATER FLOW-OPERATING PERIOD

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3.4 HEAT DISSIPATION SYSTEM

3.4.1 GENERAL DESCRIPTION

During operation of the Clinch River Breeder Reactor Plant, the condenser and other heat exchange equipment reject heat to the circulating water system. Heated circulating water flows to a mechanical draft wet cooling tower. Circulating water is evenly distributed at the top of the tower and cascades down over the fill as the air induced by the cooling tower fans flows across the fill. The water is cooled by both sensible and evaporative heat transfer and is collected in the cooling tower basin, from which it is pumped by the circulating water pumps back to the condenser and other heat sources requiring cooling. Design parameters and conditions for the major system components are given in Table 3.4-1 and descriptions of the major system components are given in Table 3.4-2. A flow diagram for the system is depicted in Figure 3.4-1, the performance of the cooling tower is shown in Figure 3.4-2 and cooling tower location is shown in Figure 3.4-9.

Only part of the circulating water flowing to the cooling tower is returned to the system. The three major water loss paths are evaporation, drift and blowdown. Annual average values for these losses are given in Table 3.4-2. In order to compensate for these losses and the process water requirements, the cooling tower makeup water is pumped from the Clinch River at the annual average value of 6,035 gpm. 6 9

System performance and characteristics vary as a function of the ambient meteorological conditions given in Table 3.4-3.

Evaporation from the cooling tower is a function of wet bulb temperature, as shown in Figure 3.4-3. Drift from the cooling tower is estimated as a fixed percentage (0.05%) of the circulating water flow rate. This value is based on information provided for cooling towers equipped with standard drift eliminators by cooling tower vendors.[1]

Blowdown is provided to maintain the quality of the circulating water in
a non-corrosive, non-scaling condition and, as shown in Figure 3.4-4, is
a function of ambient wet bulb temperature. The annual average total
dissolved solids (TDS) concentration in the circulating water is approxi- 9
mately 266 ppm. The makeup water compensates for the operational losses 4 16
of the system and is also a function of ambient wet bulb temperature as
shown in Figure 3.4-5.

3.4.2 INTAKE

The intake structure for the makeup water is located on the shore of the
Clinch River at Site grid coordinates 2481.112 and 550.878, as shown in
Figure 3.4-9 and will be designed in accordance with the requirements set by
the U.S. Army Corps of Engineers and will be monitored in compliance with 9
the NPDES requirements developed pursuant to the Federal Clean Water Act.
7

Screening of the withdrawn river water is accomplished by two 100-percent capacity perforated pipe inlets, Figures 3.4-6 and 3.4-7. The pipe inlets are positioned approximately 26 feet from the present shoreline (at elevation 741), supported above the river bottom and aligned parallel to the direction of flow in the river. The inlets will be recessed into the river bank such that they will lie below the existing river bed contour (see Figure 3.4-10) and, hence, will not present a navigation hazard. 7
Final position of the perforated pipes is subject to hydraulic model tests to be performed on the perforated pipes and the river bottom in the vicinity of these pipes. Perforations in the pipes are 3/8-inch diameter maximum. Maximum average velocity of entering water measured 0.75 inch from the front of the perforated pipe is estimated to be less than 0.4 feet per second. Under normal operation, with both pipes in service, the maximum inlet water velocity is estimated to be less than 0.2 feet per second.

Due to the low inlet water velocity, no substantial accumulation of trash is expected on the perforated pipe, as discussed in Section 10.2;

therefore, trash racks and screens are not necessary. Redundancy, provisions for access and maintenance to the perforated pipe, as well as provisions for backwash have been incorporated in the perforated pipe intake design to insure reliability of the intake system during all plant operating modes.

The intake system includes, two, 100-percent capacity river water pumps
with a design flow rate for the system of 9,000 gpm. The river water 9
system will operate between a flow rate of 2,500 gpm to 9,000 gpm during
normal plant operation. The major makeup water demand of the plant
results from cooling tower operating losses. Makeup water will be
supplied to the cooling tower basin to control basin water level. A flow
control valve in the cooling tower makeup line will modulate supply to
the basin. A recirculation line is provided for the river water supply
pumps. This line will open to prevent pump damage when the basin is at
high level and the other plant demands are less than the minimum flow
requirements of the pump. The recirculation line returns flow into the
intake structure. 4

The annual average river flow rate is approximately 2,415,000 gpm and 4 8 9
the one day low flow rate is zero, as discussed in Section 2.5.

3.4.3 DISCHARGE

Blowdown from several plant streams is combined with the cooling tower
blowdown and is discharged to the Clinch River by means of a submerged
single port discharge, as shown in Figure 3.4-8. Discharge velocity to 13
the river, at 100 percent load factor, is approximately 15 feet per second,
based on an eight-inch diameter opening at the end of the single port dif- 9
fuser. The discharge structure is designed to insure that the plant releases
meet the thermal discharge limits given in the Draft National Pollutant Dis- 9
charge Elimination System (NPDES) Permit. Depth of the discharge is four
feet below minimum river water level and extends approximately 25 feet into 7

the river from the present shoreline (at elevation 741). The discharge will be recessed into the river bank such that it will lie below the existing river bed contour and, hence, will not present a navigation hazard. The discharge is located at Site grid 7 coordinates 548.500 and 2477.623, as shown on Figure 3.4-9. Temperature of the discharge and the Clinch River temperature characteristics are given in Table 3.4-4. The blowdown has a total dissolved solids concentration as indicated in Table 3.6-1 compared with the river water. Cooling tower blowdown is continuous except during periods of intermittent chlorination of the circulating water to alleviate algae and slime growth. The blowdown is stopped whenever the average free available chlorine concentration exceeds .14 mg/l, as discussed in Section 3.6. | 16

The treated chemical wastes, sanitary effluent and, occasionally, liquid radwaste are combined with the cooling tower blowdown prior to discharge. Where control of blowdown flow is required, the individual waste systems have storage capacity for the periods when cooling tower blowdown is not available.

Estimated time of travel of the cooling water across the condenser and to the end of contained discharge lines is approximately two and one-half minutes. Since the Clinch River Breeder Reactor Plant utilizes a closed cycle cooling system for heat dissipation, the mortality of organisms entrained in the cooling system is assumed to be 100 percent.

TABLE 3.4-1

DESIGN PARAMETERS AND CONDITIONS

Ambient Conditions		
Design Wet Bulb Temperature	76°F	
Relative Humidity	50%	
Condenser		
Steam Flow Rate to Condenser (100 % Load)	2.2×10^6 lb/hr	
Condensate Flow Rate from Condenser (100 % Load)	2.8×10^6 lb/hr	
Circulating Water Flow Rate	185,200 gpm (Condenser) 400 gpm (Exhauster)	9
Heat Rejected	2.052×10^9 Btu/hr	6
100% Load	975 MWt	
Temperature Rise	22°F	6
Cooling Tower		
Circulating Water Flow Rate	212,200 gpm	9
Heat Rejected	2.256×10^9 Btu/hr	9
Approach to Wet Bulb	11°F	6
Range	21.34°F	9
Circulating Water Pumps		
Quantity	3	6
Design Flow	63,000 gpm per pump	9

TABLE 3.4-2
COMPONENT DESCRIPTION

Condenser

Tube Length	60 ft.	6
Tube Material	90-10 Cu-Ni (Main Section)	
	70-30 Cu-Ni (Peripheral &	9
	Air Cooler Section)	
Number of Passes	1	
Number of Tubes	19,464	9
Tube Size	0.875 in., O.D.	
	20 BWG (Main Section)	
	18 BWG (Peripheral and	
	Air Cooler Section)	

Cooling Tower

Number of Towers	2	6
Cells per Tower	5	1
Tower Size	247' x 76' x 41'	
Air Flow (Total)	16×10^6 ft^3/min	
Number of Concentrations	2.5	
Total Dissolved Solids (Average)	266 ppm	1
Blowdown (Annual Average)	2,326 gpm	9
Drift (Annual Average)	106 gpm	1
Evaporation (Annual Average)	3,623 gpm	
Makeup (Annual Average)	6,109 gpm	1

TABLE 3.4-3

ESTIMATED WET BULB TEMPERATURES BASED ON READILY AVAILABLE DRY BULB TEMPERATURES AND RELATIVE HUMIDITIES AT KNOXVILLE, TENNESSEE

	Dry Bulb Temperature* (°F)	Relative Humidity* (%)	Wet Bulb Temperature** (°F)
January	41.4	70.8	40.0
February	43.1	67.0	42.0
March	49.6	63.3	48.0
April	58.9	62.5	56.5
May	67.7	67.3	64.5
June	75.7	73.5	73.5
July	78.4	75.8	75.5
August	77.4	76.0	74.5
September	72.2	74.3	69.5
October	60.9	71.0	58.5
November	48.7	71.3	48.0
December	41.6	71.5	41.0

*Local Climate Copy Data, Annual Summary with Comparative Data, Knoxville, Tennessee, 1931-1960, No. AA, U.S. Department of Interior, 1971.

**Psychrometric chart conversion of columns 1 and 2

TABLE 3.4-4

WATER TEMPERATURES OF THE CLINCH RIVER
AND THE COOLING TOWER BLOWDOWN*

	River Water**			Mechanical Wet Cooling Tower Blowdown		
	Average	Average Maximum	Average Minimum	Average	Daily Maximum	Daily Minimum
January	42.7	48.0	37.9	66.3	69	60.5
February	42.1	48.0	37.6	67.5	69.2	60.5
March	47.0	54.9	40.9	70.5	72	63.0
April	55.1	62.3	48.1	75	77.5	66.5
May	60.9	66.4	56.0	79.5	83	71
June	63.5	69.9	58.5	85	88.5	75.5
July	64.4	69.4	60.3	86.5	91	78
August	65.7	70.1	61.9	86	90	77.2
September	66.9	70.4	63.4	83	87.5	73.7
October	64.6	68.7	60.2	76	81	68.5
November	57.0	63.4	50.4	70.5	73	63
December	47.7	53.8	43.0	67	69	60.5

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* All temperatures are in degrees Fahrenheit.

** June 1963 to October 1972, Whitewing Bridge Temperature Data from TVA.

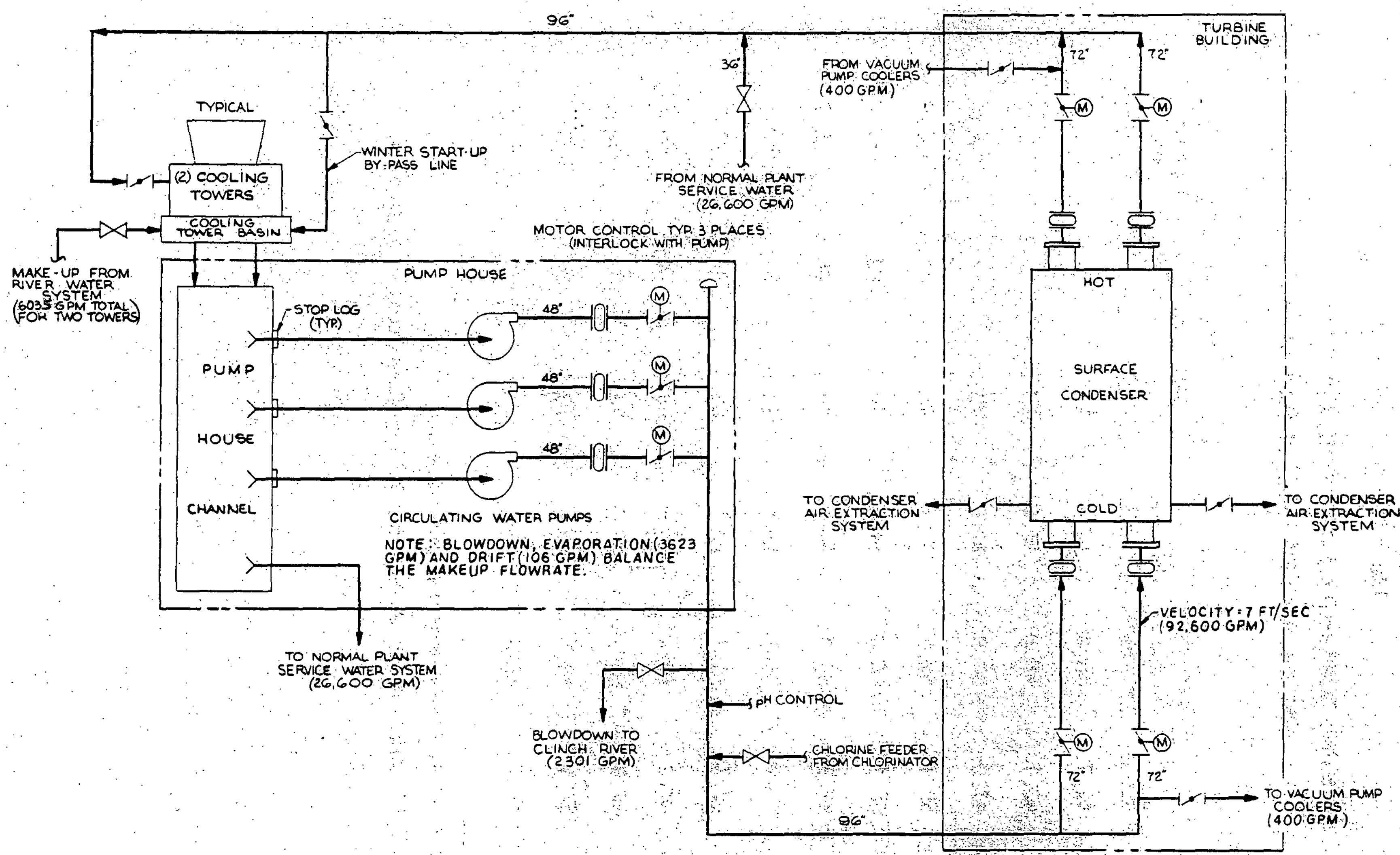

Figure 3.4-1 COOLING WATER SYSTEM MECHANICAL DRAFT WET TOWER

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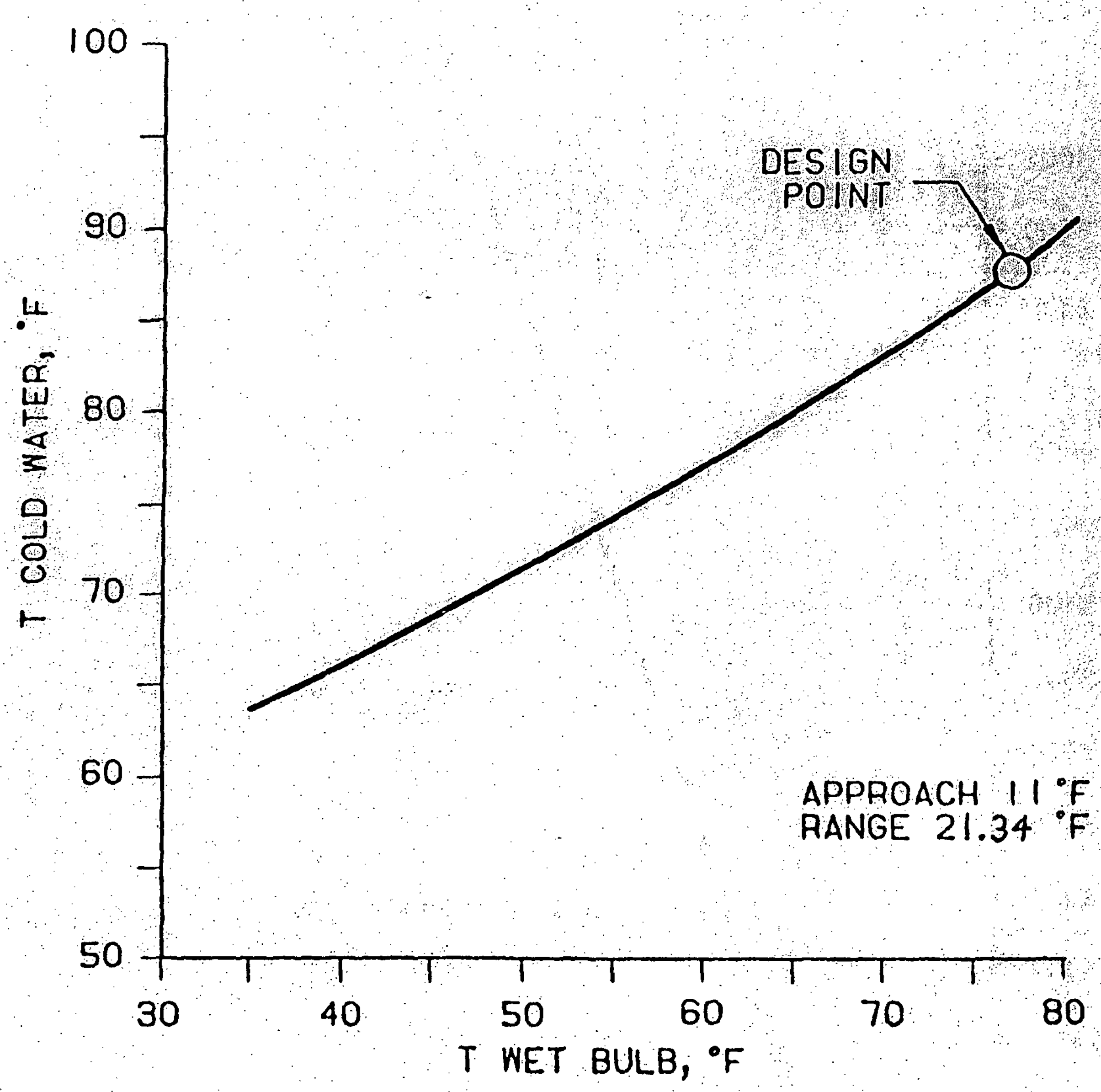

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Figure 3.4-2 COOLING SYSTEM PERFORMANCE - MECHANICAL DRAFT WET TOWER

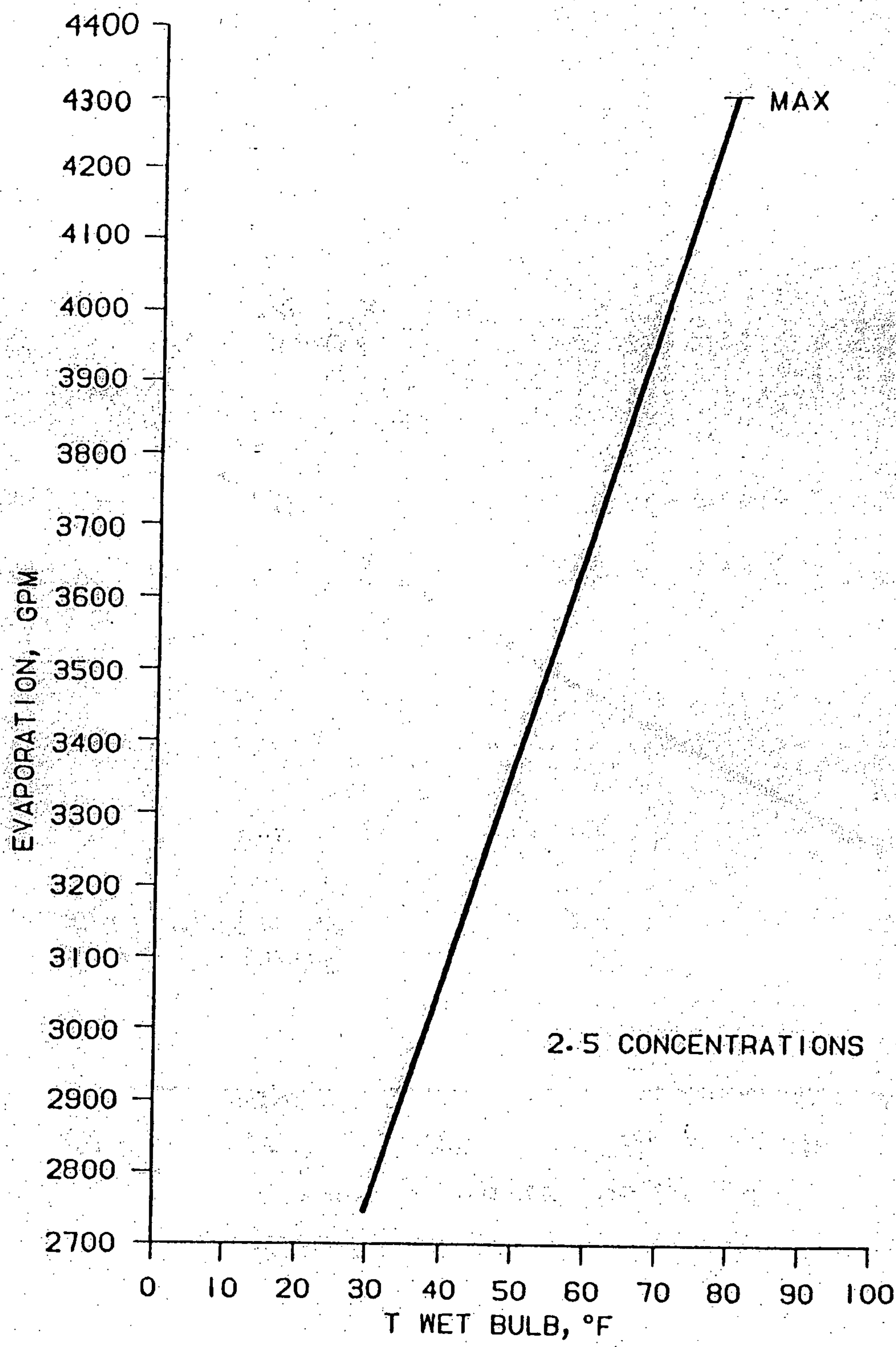

Figure 3.4-3 MECHANICAL DRAFT WET TOWER EVAPORATION

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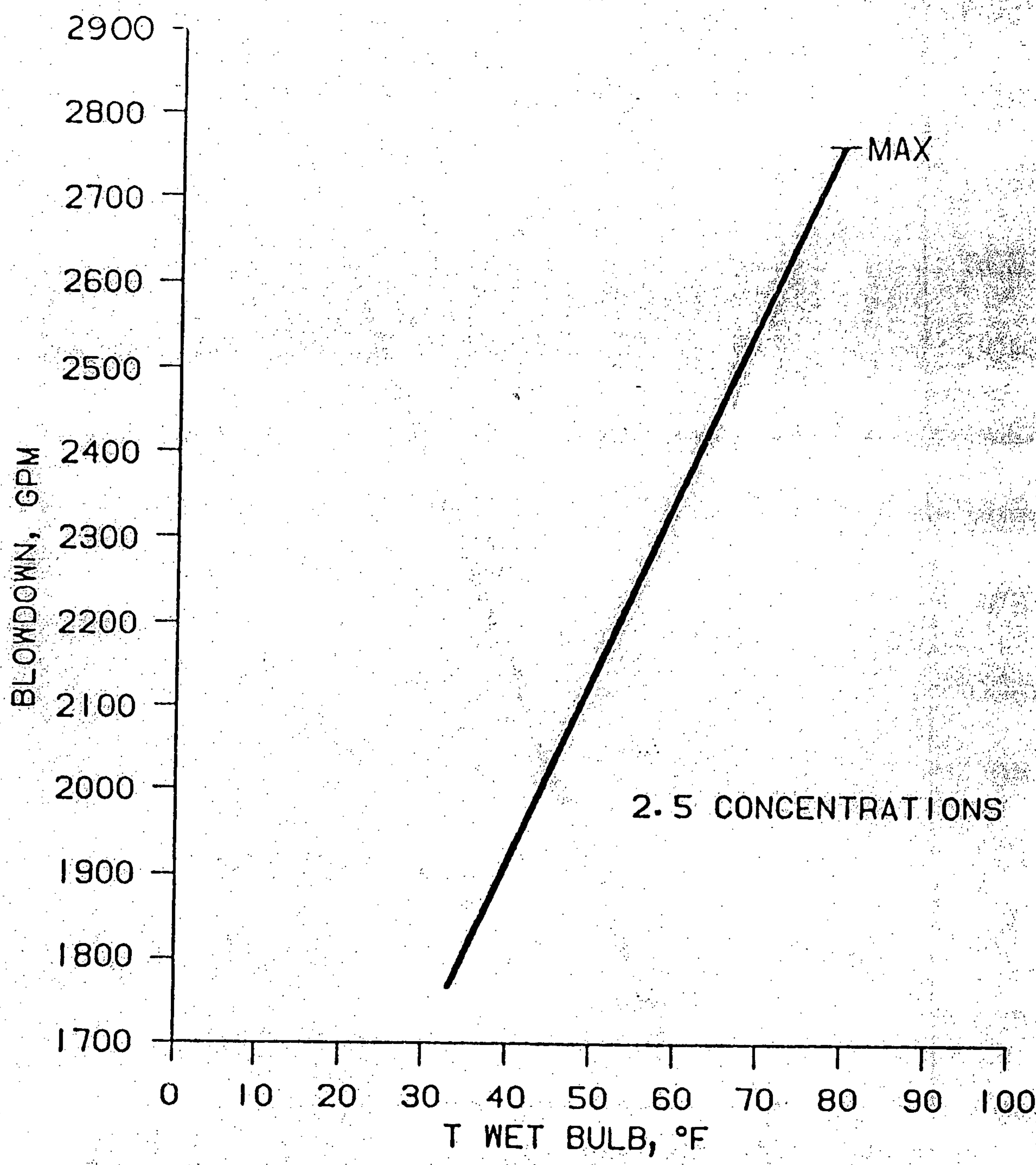

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Figure 3.4-4 MECHANICAL DRAFT WET TOWER BLOWDOWN

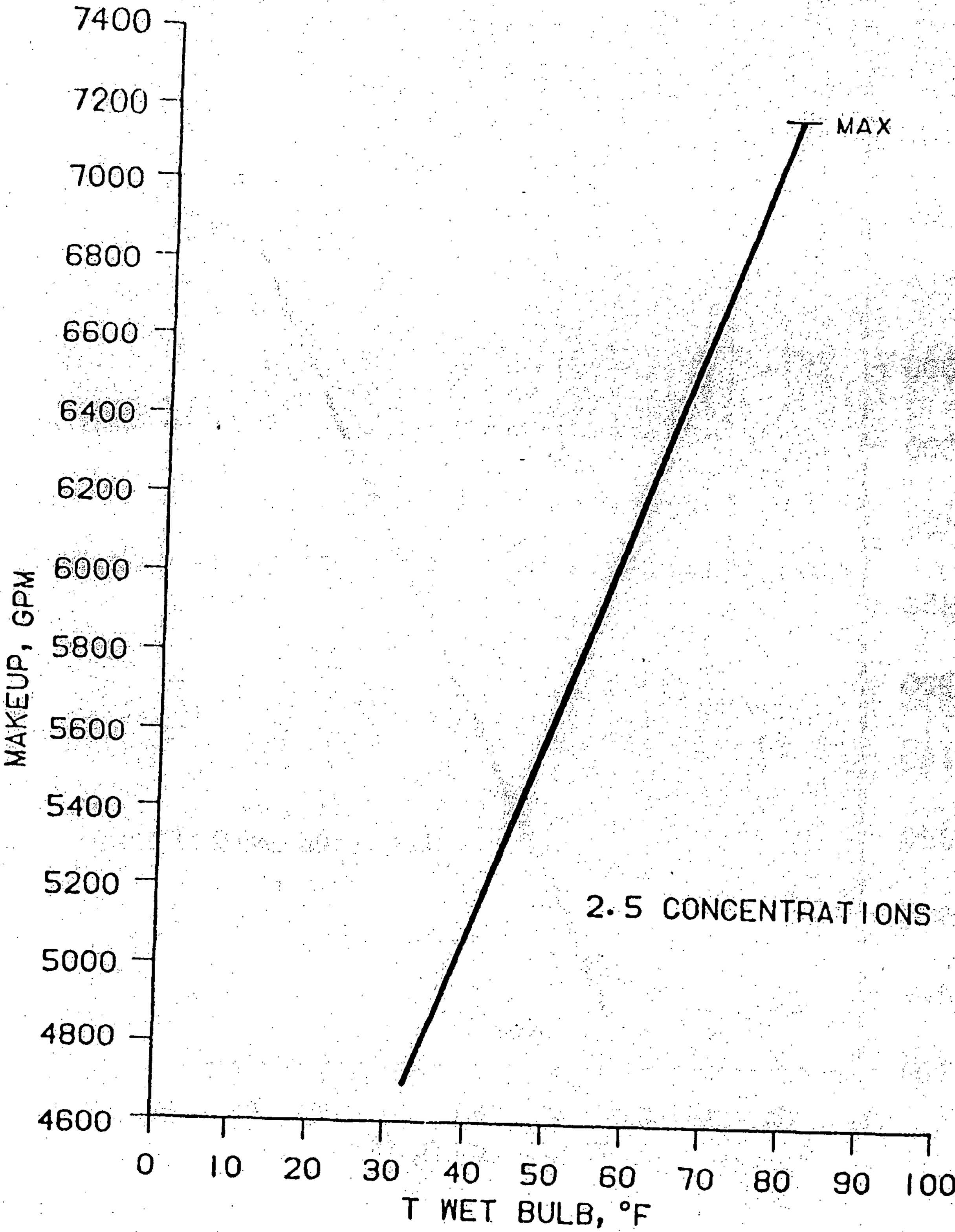

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Figure 3.4-5 MECHANICAL DRAFT WET TOWER MAKEUP

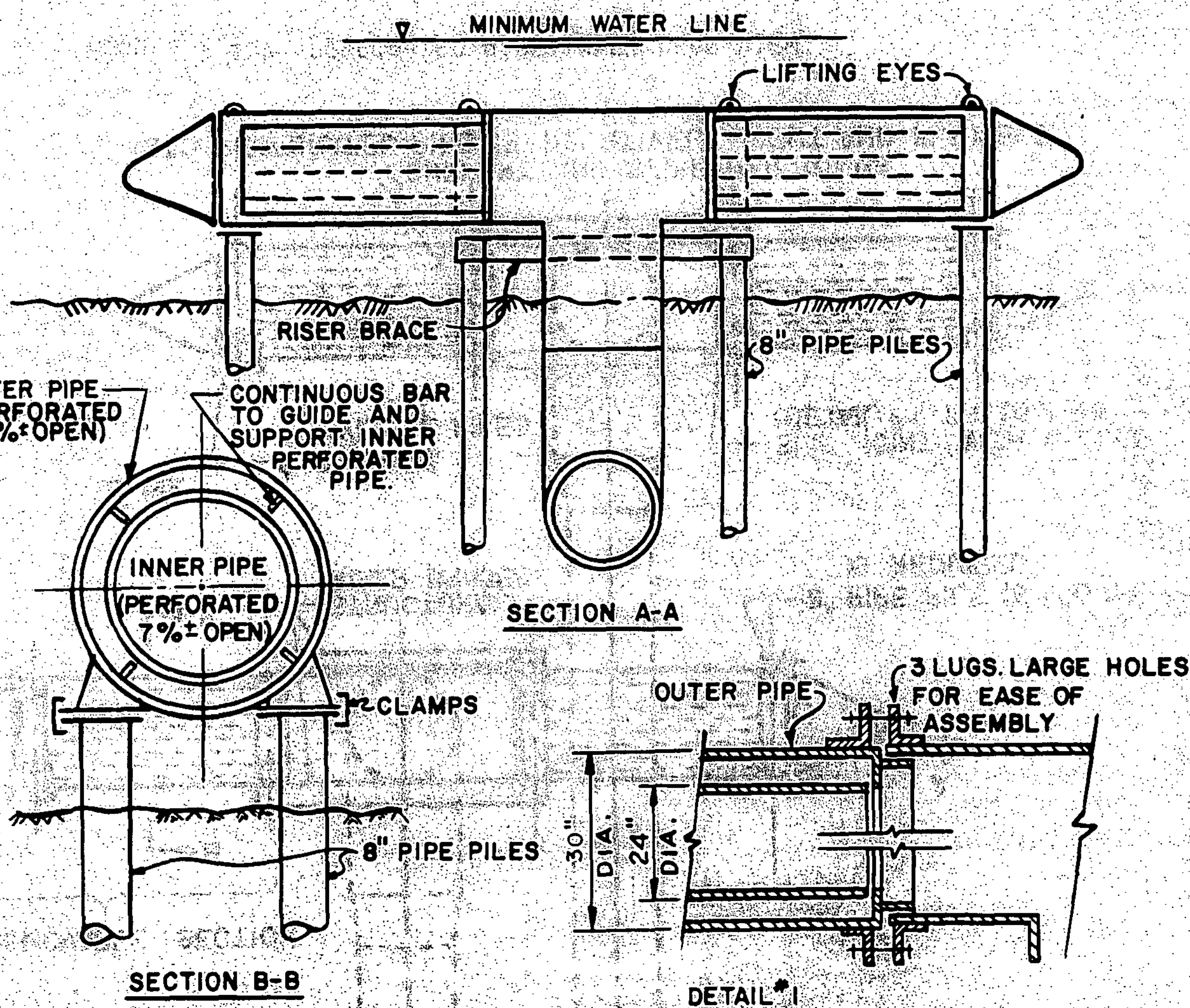

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Figure 3.4-6 PERFORATED PIPE INLET SECTIONAL VIEW

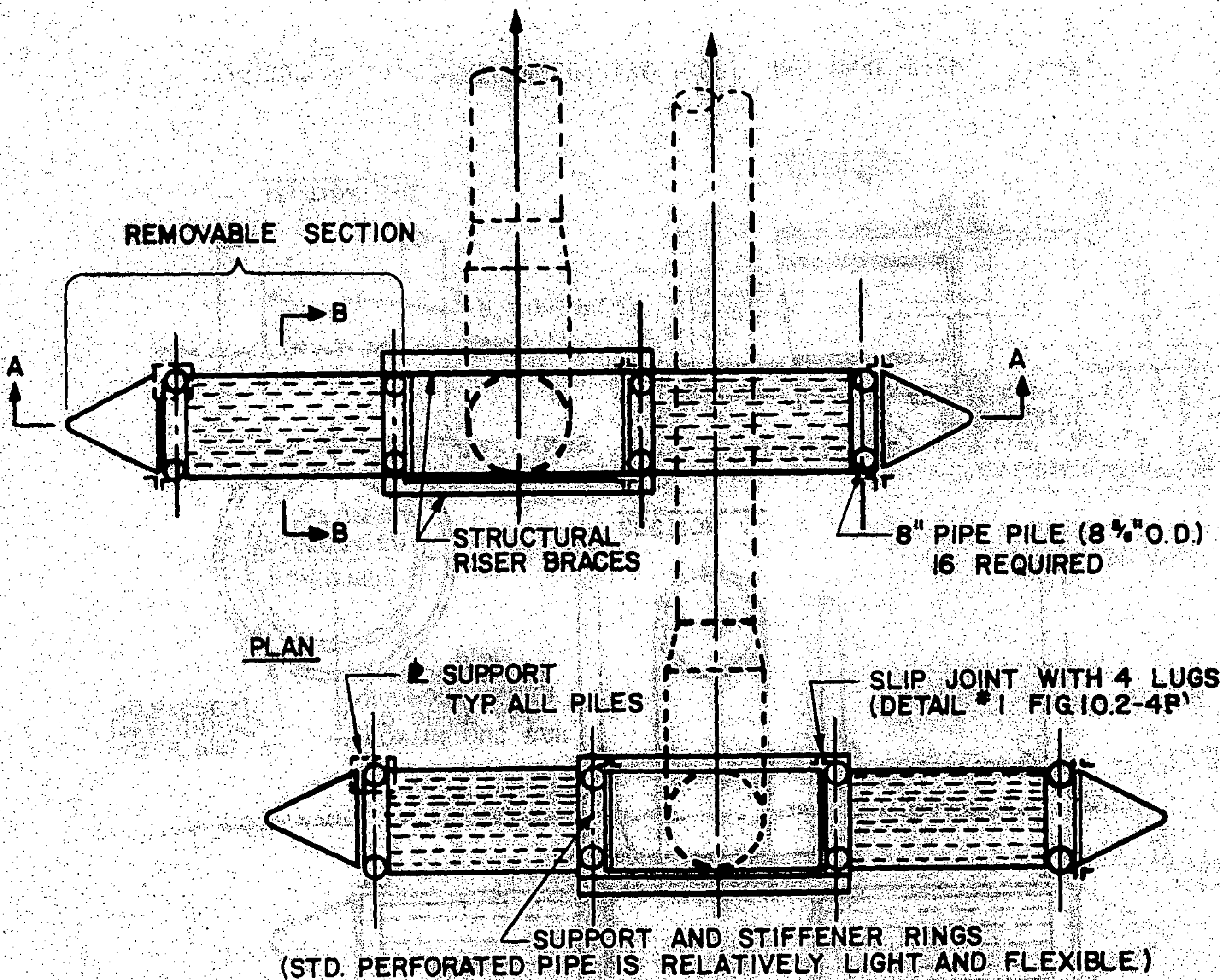

Figure 3.4-7 PERFORATED PIPE INLET PLAN VIEW

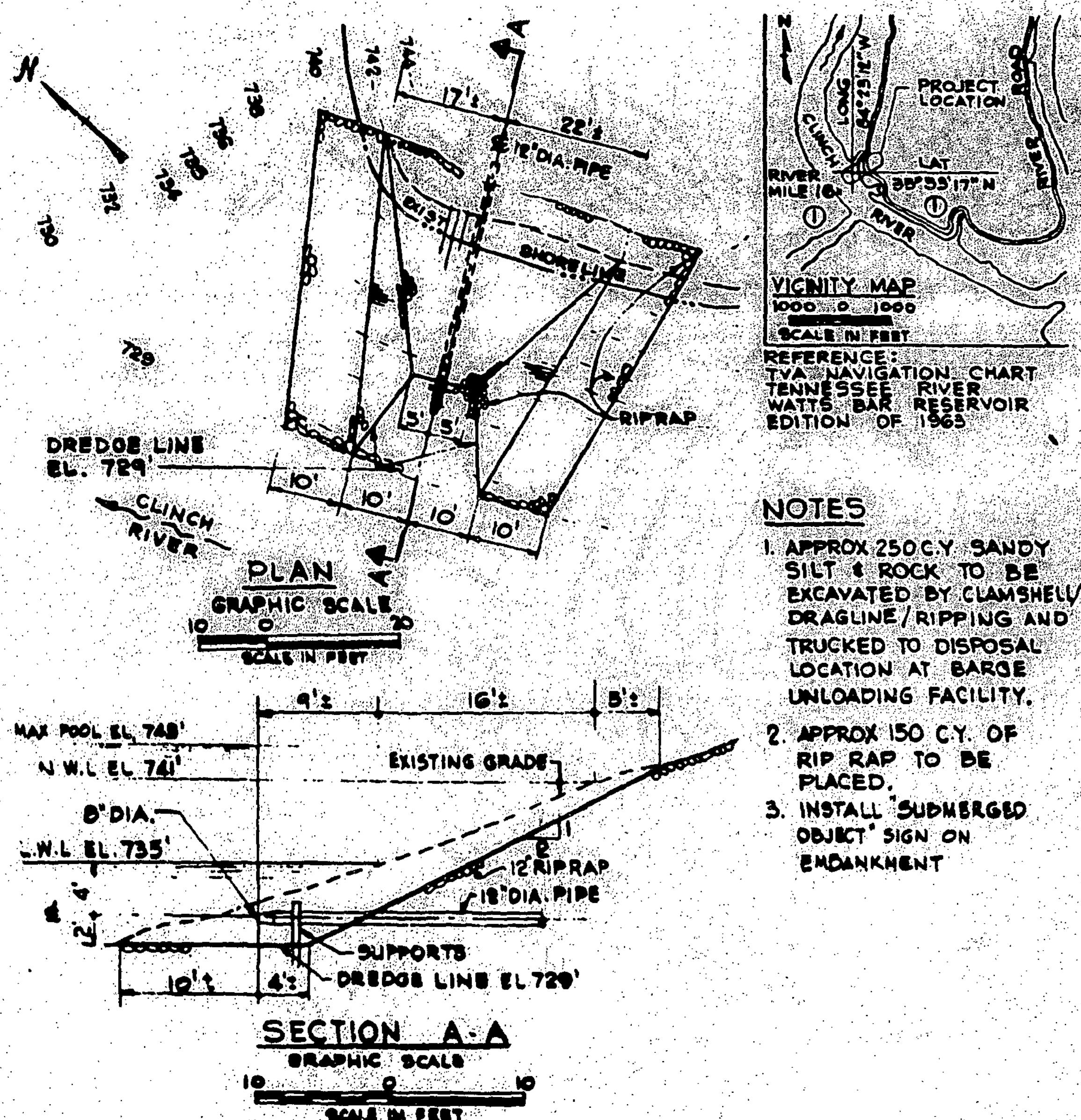

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Figure 3.4-8. DISCHARGE STRUCTURE

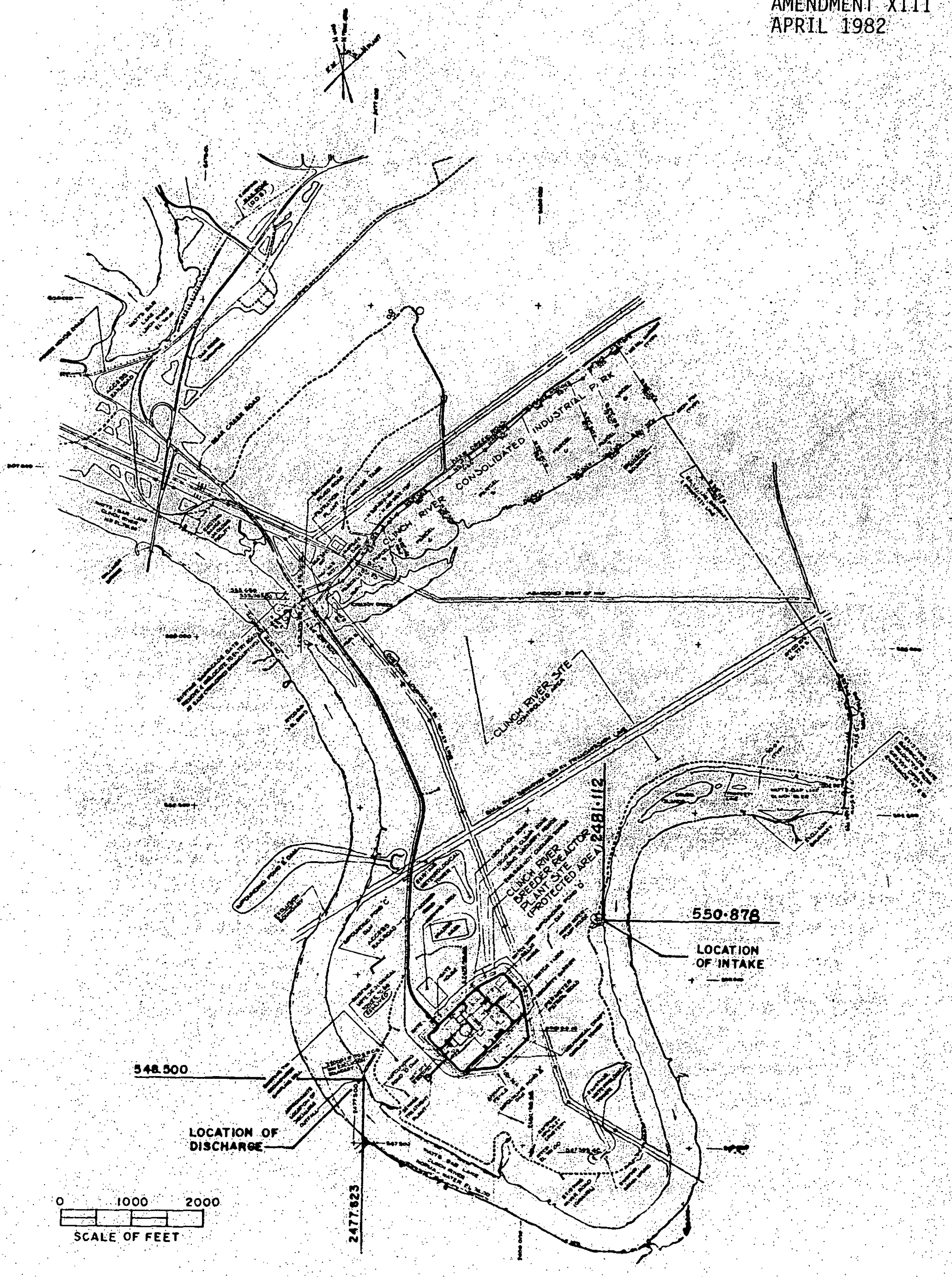

Figure 3.4-9 SITE LOCATION

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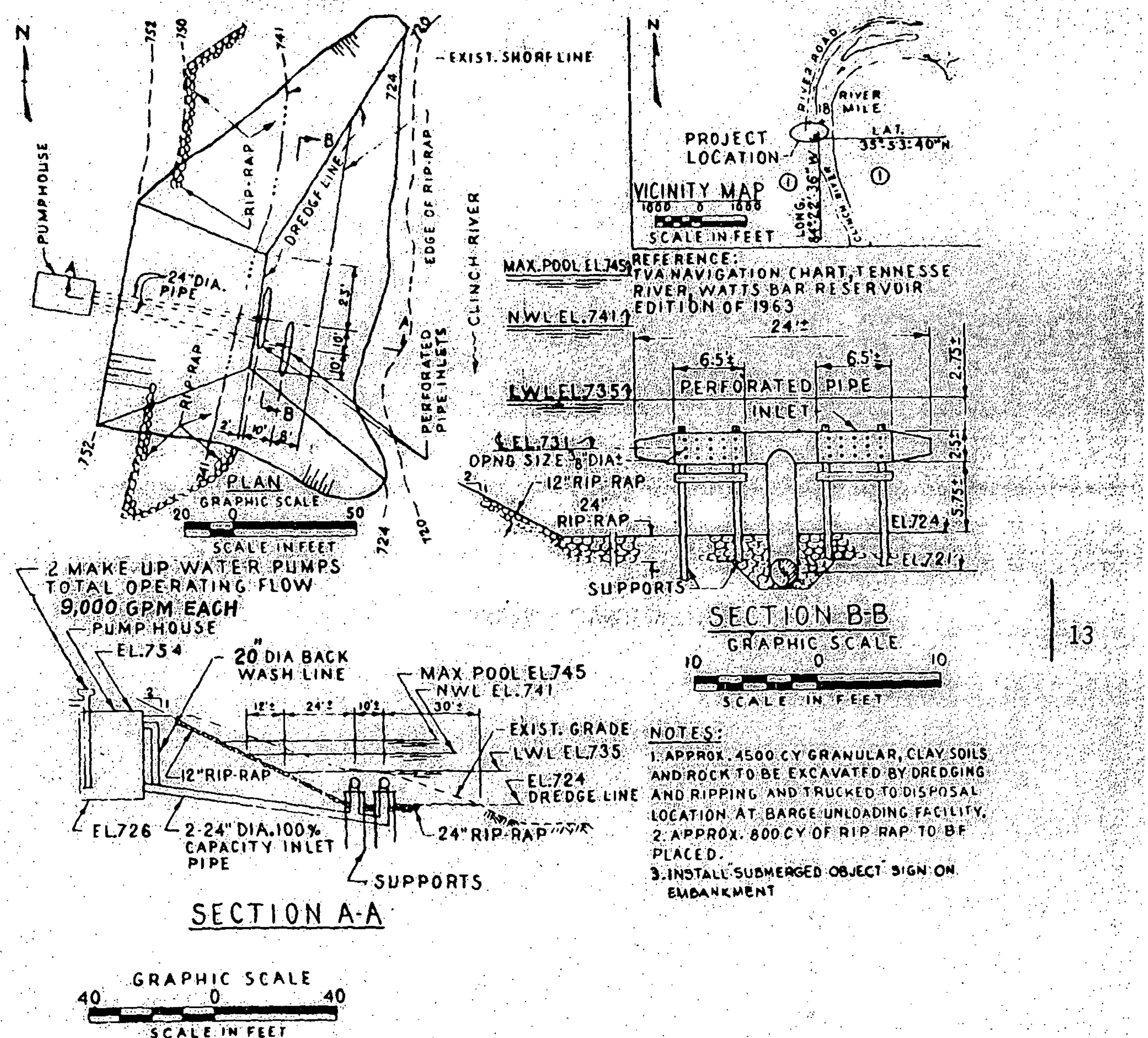

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Figure 3.4-10. PLANT INTAKE STRUCTURE

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3.5 RADWASTE SYSTEM

3.5.1 LIQUID RADWASTE SYSTEM

The Liquid Radwaste System is designed to process contaminant
liquids from the Clinch River Breeder Reactor Plant (CRBRP) prior
to reuse or release into the environment. The basic approach is
to process liquid radwaste so that essentially all of the 8
activity is contained in solid material, to load all solid
radioactive material into containers that meet the Department of
Transportation (DOT) and other appropriate regulations and to
transfer the containers to a licensed contractor for processing 8 10
and burial.

3.5.1.1 SYSTEM DESCRIPTION

The Liquid Radwaste System is designed to decontaminate liquids 1
by filtration, evaporation and demineralization. Evaporator
bottoms, which contain essentially all of the radioactivity, will
be transferred to the solid radwaste system for solidification
and processing along with spent filter cartridges and resin. 1
Processing of solid radwastes is described in detail in Section
3.5.3.

A flow diagram for the Liquid Radwaste System is shown in Figure 3.5.1. The system consists of two subsystems. The first subsystem is designed to process liquids with intermediate levels of radioactivity that are reused after decontamination, and the second subsystem is designed to process liquids with low levels of radioactivity that are released, after decontamination, into a dilution stream. Decontamination of liquids with intermediate or low level activities is carried out in the following sequence: liquids are collected and then processed through one or more cycles of filtration, evaporation and demineralization. Condensate from an evaporator is pumped to a storage or monitoring tank prior to reuse or discharge. The first cycle

through the evaporator and demineralizer results in a
decontamination factor (DF) of 10^5, except for iodine and tritium 10
where the decontamination factors are 10^4 and 1, respectively.
The concentrated liquid radwaste will be collected from the
bottom of the evaporators and transferred to the solid radwaste
system for solidification and ultimate disposal. These
intermediate and low level liquid process subsystem are described 8
in more detail in Sections 3.5.1.2 and 3.5.1.3, respectively.

3.5.1.2 INTERMEDIATE ACTIVITY LEVEL LIQUID PROCESS SYSTEM

The intermediate activity level liquid (IALL) subsystem collects
and processes effluents from the Large Component Cleaning Vessel 8 10
(LCCV) and the Small Component Cleaning Autoclave (SCA). Liquids
are pumped from the cleaning cells to collection tanks located in 6
the radwaste building. The cleaning process in the LCCV consists
of a moist nitrogen treatment followed by multiple rinses. The
moist nitrogen and water rinse treatments essentially remove the
residual sodium on components from the primary and secondary
sodium systems. The LCCV can also perform an acid 10
decontamination etch of selected components. Decontamination of 8
a Primary Heat Transport System pump is the principal anticipated
use of the acid etch and is only expected three times in the life
of the plant. Table 3.5-1 shows the design annual concentration 6
of activities by isotope flowing into the IALL System. The
criteria for these isotopes are contained in the footnotes on
Table 3.5-1. Column 4 of Table 3.5-1 identifies the average
activities in the sodium cleaning rinse of the cleaning process.
The calculation is based on the removal of 100 percent of the
average annual activity in the sodium and 10 percent of the
average annual fission and corrosion products plated on the 10
components in a total of 100,000 gallons of water per year. The
last column shows the activity concentration in the acid etch
solutions collected in the IALL system. This calculation is
based on removal of the remaining 90 percent of the deposited
activity in an acid etch batch volume of 16,000 gallons. Such an

acid etch batch is expected only about three times in the life of 10
the plant. Expected activity concentration levels in the LCCV
outflow have been made utilizing models which compute the fission
and corrosion, tritium, and transuranium specific activities in 6
the sodium that is deposited on the exposed surfaces in the
primary system. Expected concentrations have been estimated from
the number of components to be cleaned, their surface area, the
quantity of sodium on each component and the volume of fluid used
to clean each component. Tritium is the predominant radioactive
isotope in the sodium attached to the components from the
Intermediate Heat Transport System. Supplemental discussion of 8
the subsystem is provided in Section 10.7. 10

While in the collection tanks, the pH of the liquid radwaste is 10
adjusted during recirculation by the injection of a caustic or an
acid solution. Neutralized liquid radwaste is then passed
through a filter, fed to the evaporator for distillation, and
then to a demineralizer for polishing.

Liquids, primarily consisting of water radwaste, are stored in
two 20,000 gallon tanks prior to distillation in the evaporators.
Concentrated wastes generated during the evaporation process are
discharged from the evaporators into the concentrated waste tank.
Collected fluids are sampled for radioactivity, nuclide identity
and chemical purity. Sampling analysis results will determine 10
whether the fluids are adequately decontaminated and suitable for
reuse or discharge. Batches exceeding purity limits will be
recycled through the evaporators or demineralizers. Ordinarily,
there will be no discharges of the water distillate from the
intermediate activity radwaste system to the environment. 10
However, if the system should contain a surplus inventory, the
design allows for controlled discharge into a diluting stream.
Activities accumulated in the water storage or monitoring tanks,
under the assumption that the process water has been
decontaminated by a factor of 10^5 (except as noted in Section 10
3.5.1.1) for one cycle of evaporation and demineralization, are

shown in Table 3.5-2. Both the intermediate and low level systems inventories in the process streams are shown in this table. The table has added conservatism in its values since no credit is taken for decay due to collection, processing and hold-up.

Table 3.5-3 shows the concentration of activities by nuclides in the diluting stream for both systems. The assumptions used in developing this information are identified in the table footnotes. The released activity is diluted by the cooling tower blowdown, at an annual average of flow rate of 3.1×10^{12} cc/yr. In all cases, if a batch of liquid in a storage tank fails to meet the purity requirements for reuse or discharge, the batch will be recycled to a collection tank and reprocessed until it meets acceptable standards for reuse or discharge. Water will only be discharged from the storage tank to the effluent stream if reuse is not practical and then only after sampling and analysis are complete and show that the discharge meets regulatory standards.

Concentrated evaporator bottoms are discharged from the evaporator into a collection tank. The concentrate will be sampled for radioactivity and monitored volumes will be transferred to the solid radwaste system for solidification in cement and processing and shipment to a licensed burial site for ultimate disposal.

Adequate shielding is provided by the walls of the cells which house the filters, collection tanks, evaporators, concentrated waste tank, decanting tanks, and the solidification drumming station, (based on the worst case input stream) to maintain personnel exposures as low as reasonably achievable.

Radiation levels in the areas housing the filters and demineralizers will be monitored. Removal and replacement of the filter cartridges and resins will be controlled by the area radiation

level, pressure drop and conductivity (for resin). Filter
cartridges and resins that are removed will be transferred to the 10
solid raswaste system for processing and ultimate disposal.

3.5.1.3 LOW ACTIVITY LEVEL LIQUID RADWASTE SYSTEM

This subsystem is used to collect and process the liquid,
primarily water, effluents from the floor drains, personnel
decontamination shower drains and laboratory drains located in 10
the Plant and Reactor Service Buildings. Concentration of
activity in the effluents from these sources is expected to be 8
less than 10^{-4} μCi/cc. Input isotopic concentrations to
collection tanks are shown in Table 3.5-1. Low activity
concentrations are computed by assuming that listed isotopes are
present in 3.5 pounds of primary sodium per year diluted by
3.1×10^5 gallons of water per year. Stored inventory in the 10
monitoring tanks prior to discharge is given in Table 3.5-2.
Discharge concentration is given in Table 3.5-3. The presence of
3.5 pounds of primary sodium per year, containing a total of
approximately 15 μCi/cc of fission products, and 1.5 μCi/cc of 8 10
tritium into a drainage stream of 850 gpd and discharge into a
blowdown stream of 3.1×10^{12} cc/year is assumed. If the 8
activity is found to be acceptable for release after
decontamination, that batch of water (which has been monitored)
will be released to the discharge stream. Otherwise, it is
transferred to the low level activity collection tank and
reprocessed. The reprocessed low activity waste may then be
released to the discharge stream or again recycled. Processing
of low level radioactive waste includes adjustment of pH,
defoaming, filtration, evaporation and demineralization similar
to that described in the previous paragraph. The decontaminated 10
product collection system consists of two tanks. One tank can be
utilized for sampling and monitoring of the condensate being
discharged, while the other tank is used to collect additional
fluid.

Discharge water from the low activity level system and the
assumed discharge from the intermediate activity level system is 10
released through the same header equipped with a flow control
valve, flowmeter and radiation monitor. Flow rate, based on the
radioactivity level of the discharge water, is controlled so that
the concentration in the dilution stream and the total activity
released to the river is only a small fraction of existing Code 8 10
of Federal Regulations, 10 CFR 20.

3.5.1.4 ASSUMPTIONS

Data presented in Tables 3.5-1, 3.5-2 and 3.5-3 for the IALL 10
system is based on the assumption that 10 percent of the fission
and corrosion products plated out activity and 100 percent of the
sodium activity adhering to the processed components is removed
in a first rinse volume of 100,000 gallons of water per year. It 8
is further assumed that 90 percent of the remaining plated out
activity will be removed if an acid etch is used. These values
are conservative and it is likely that the actual activity
removed will be less.

Tabulated data for the low level system are based on a water flow
rate of 850 gpd and an assumed concentration of 10^{-4} μCi/cc due
to mixed fission products and tritium. It is assumed that this 10
activity is due to sodium which is removed from the reactor for
chemical analysis or due to maintenance, spills and clean up
during normal plant operations. The assumption that all of the
tritium contained in sodium remains in the water following the 10
reaction of sodium with water is conservative. It is likely that
a fraction of the tritium is released as a gas due to the
reaction of sodium tritide (NaT) with the controlled moist
nitrogen during component cleaning in the LCCV. This low
activity gas which is processed through an atmospheric processing 8
system is not significant relative to other gaseous tritium
source terms in Table 3.5-8.

3.5.1.5 BALANCE OF PLANT CONSIDERATIONS

Tritium which enters the main stream in the steam generator becomes chemically bonded to form tritiated water vapor. The steam is condensed and the water contains tritium. Any outflow from the steam water system contains tritiated water, which cannot be separated from non-tritiated water.

CRBRP operation will utilize a direct discharge into the cooling tower blowdown (2.3×10^3 gpm) of 5 gpm bleed from the 10
steam/water cycle. The expected curie release is 8.45×10^{-3} Ci 8
per day.

3.5.2 GASEOUS RADWASTE SYSTEM

3.5.2.1 NATURE AND ORIGIN OF RADWASTE GASES

Volatile radwaste gases processed by the gaseous radwaste system consist of noble gas radionuclides and tritium generated by fission and/or neutron activation. The noble gases, xenon and 10
krypton, result from fission in the fuel and would be released into the sodium coolant by failure of fuel elements. The noble gases, argon and neon, are produced by neutron activation from, respectively, the potassium impurity in the sodium and from the sodium itself, by the reactions, K-39(n,p) Ar-39; K-41(n,p) 10
Ar-41; Na-23(n,p) Ne-23. A small fraction of the Ar-39 and Ar-41 are produced by direct activation of Ar-38 and Ar-40. This source of activated argon is directly proportional to the quantity of reactor cover gas. Tritium has several sources; ternary fission in fuel, neutron interaction with B-10 coolant impurity and with B-10 in control rods, and neutron interaction with lithium impurity in the coolant.

Noble gas radionuclides will migrate to the reactor cover-gas space, although a time lag will occur in the leakage from defective fuel and the movement to the cover gas. Elemental iodine and particulate forms of radioactive isotopes are not 8

expected to be present in the gaseous radwaste system. Although some vaporization of non-gaseous isotopes from the liquid sodium into the reactor cover gas may occur, all cover gas entering the system is processed through two vapor traps which are expected to remove essentially all non-gaseous isotopes including any trace 8
quantities of sodium iodide. Continuous monitoring of the gases processed through the vapor traps is provided by the process monitoring of RAPS.

Tritium will largely remain in solution (99.8 percent) in the sodium and will then be removed by cold-trapping. Further, tritium concentration in the cover gas will be affected by the sodium temperature, the cover gas temperature and pressure, the cold trapping rate and the concentration of hydrogen in the sodium. The latter factor, in turn, depends on the diffusion rate of hydrogen from the steam-generator tubes into the intermediate sodium, the resulting hydrogen concentration in this sodium and its diffusion rate into the primary system sodium through the Intermediate Heat Exchanger walls.

3.5.2.2 PROCESSING METHOD

The general processing system involves two subsystems: (1) the 8
Radioactive Argon Processing Subsystem (RAPS); and (2) the Cell Atmosphere Processing Subsystem (CAPS). RAPS is a decontaminating and recycling system for controlling the radioactivity in the reactor and Primary Heat Transport System cover gas. RAPS achieves decontamination of the cover gas by the use of a cryogenic distillation column. Krypton and xenon isotopes accumulate in the cryostill and are periodically removed by transferring them to the noble gas storage vessel. After the short-lived radionuclides have been removed by radioactive decay, the remaining gases in the noble gas storage vessel are slowly transferred to CAPS.

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CAPS processes cell gases or waste gases which may contain radioactivity. CAPS achieves decontamination by the use of two cryogenic charcoal delay beds which provide holdup of the radionuclides, thus allowing them to decay before they reach the 1(Heating and Ventilation System and are exhausted to the atmosphere. CAPS also removes tritium from the process gas stream by the use of an oxidizer and a tritium water removal unit. The tritiated water collected is eventually disposed of as solid waste.

3.5.2.3 PROCESS FLOW DIAGRAMS (TYPICAL SYSTEM)

A schematic flow diagram of RAPS incorporating typical values is shown in Figure 3.5-2; the solid-line blocks represent RAPS components and subsystem, the brokenline blocks represent components that are served by RAPS and that are part of the recycled-gas system. Output of the Recycle Argon Tank is at a 10 nominal flow of 5.15 scfm; this is divided into 1.5 scfm fed to the three Primary Heat Transport System (PHTS) pumps and 3.65 10 scfm fed to the reactor cover-gas space. The PHTS pumps' gas effluent is divided equally (by design) so that 0.75 scfm passes through the shaft seal spaces and the three oil traps to the RAPS input (Vacuum Tank); the other 0.75 scfm bleeds to the common pressure-equalization line that joins the Reactor, the Reactor Overflow Tank, and the PHTS Pumps cover-gas spaces. From this line, a gas sample of 1.0 scfm is diverted through the Impurity Analysis and Monitoring System before entering the RAPS input. 4 The output of RAPS, 5.15 scfm, is delivered to the Recycle Argon 1(Tank.

The Cell Atmosphere Processing Subsystem (CAPS) is shown in 1 Figure 3.5-3. The Reactor, PHTS Pumps and Reactor Overflow tank cells and associated pipeways are vented to CAPS and have 1 controlled atmospheres, with a nominal nitrogen-two percent oxygen composition. This ensures that any radioactivity that escapes into these cells from the recycle-argon cover gas will be contained and processed to control the release of radioactivity. Nominal input to CAPS is the time averaged total flow of the influent gases. If a high level of radioactivity is detected in the CAPS exhaust, the exhaust line is automatically closed and the CAPS compressors are shut down.

RAPS and CAPS employ similar process methods. In each subsystem the gas input is collected in a vacuum tank, from which it is compressed and transferred under pressure to a surge tank. In CAPS, the surge vessel effluent gas passes through an oxidizer and a tritium water removal unit which are used to remove tritium. The gas then passes through two cryogenic charcoal delay beds which allow the radionuclides to decay before they are released to the RSB Heating, Ventilating and Air Conditioning system (HVAC) and exhausted to the atmosphere.

In RAPS, the surge vessel effluent gas passes through a cryogenic still which removes xenon and krypton isotopes from the argon cover gas.

3.5.2.4 LEAKAGE PATHS AND ESTIMATED DISCHARGE RATES

The separate paths of leakage and/or discharge to the environment are discussed in detail, as follows. Radioactive gas flow paths are detailed in Figure 3.5-4.

3.5.2.4.1 COVER-GAS LEAKAGE

Reactor cover gas diffuses through the various head seals into the Head Access Area. The conservatively estimated total leakage rate for all of the seals is 0.0044 standard cc/min of cover gas.

3.5.2.4.2 BUFFERED-SEAL LEAKAGE

Buffered head seals are fed by recycled argon (processed in
RAPS); a maximum seven standard cc/min of this gas is expected to
leak into the Head Access Area. Cover-gas and buffered seal
leakages both diffuse into the Head Access Area atmosphere and
are vented into the RCB operating floor and to the RCB HVAC 10
exhaust and discharged to the atmosphere without processing.

3.5.2.4.3 PRIMARY PIPING LEAKAGE

An estimation of the total leakage through piping connections,
welds, valves and components of the PHTS and of the Reactor Cover
Gas System indicates that the assumption of one standard cc/min 8
of cover gas is conservative regarding leakage into the
corresponding Reactor Containment Building (RCB) cells. Small
amounts of tritium will diffuse through the piping wall into the 10
PHTS and auxiliary Na cells. These gases will be vented to CAPS
by the normal feed and bleed nitrogen gas cell-atmosphere
inerting and pressure control system. 10

3.5.2.4.4 RAPS AND CAPS LEAKAGE

Similarly, a maximum of one standard cc/min of RAPS cold box 10
influent gas is assumed for the total leakage from RAPS and CAPS
components into their respective cell atmospheres, which vent to
the RCB HVAC, and RSB HVAC, respectively.

3.5.2.4.5 INTERMEDIATE CELLS

Tritium that diffuses from the primary into the Intermediate Heat
Transport System will also diffuse at a small but finite rate
through piping and components into the Steam Generator Building 10
Intermediate Bay cell atmosphere. In the cell atmosphere, it
will reach an equilibrium concentration dependent upon
natural-convection air turn-over in those cells. 10

3.5.2.5 RADIOLOGICAL RELEASE POINT DESCRIPTIONS

There are a total of nineteen Nuclear Island ventilation exhaust air releasing points which are designed for monitoring/sampling of exhaust air. These are: one located in the Intermediate Bay (IB) of the Steam Generator Building, one located in the Radwaste Area of the Reactor Service Building (RSB-RWA), two located in the Fuel Handling Area of the Reactor Service Building (RSB-FHA), six located in the Steam Generator Building (SGB) and nine located in the Reactor Containment Building (RCB). Of these release points, only two are expected to contain radioactivity in their effluents during normal operation of the CRBRP. These are the SGB-IB exhaust, and the RCB normal exhaust release point located in the RSB.

The release point associated with the Intermediate Bay (IB) of the SGB will exhaust air at 54,500 scfm at an elevation of 857' with an exhaust air velocity of 1520 fpm.

Three release points are located in the RSB. One receives ventilation exhaust air from the Radwaste Area of the RSB. A ventilation exhaust air quantity of 46,000 scfm will be released at an elevation of 884'-0". Exhaust air temperature will vary from 55^{o}F to 140^{o}F. Exhaust air velocity is 940 fpm.

The second release point located in the RSB receives normal exhaust from the Reactor Containment Building. A ventilation exhaust air quantity of 14,000 scfm will be released at an elevation of 884'-0". Exhaust air temperature will vary from 55^{o}F to 120^{o}F. Exhaust air velocity is 1750 fpm.

The third release point located in the RSB receives exhaust from the RSB clean up filter unit. A ventilation exhaust air quantity of 18,000 scfm during normal operation and 1700 scfm during

refueling will be released at an elevation of 884'-0". Exhaust
air velocity is 1800 fpm and 170 fpm, respectively. The 10
temperature will vary from 55°F to 120°F.

Six design radiological release points are located in the SGB. 8 13
Three, one in each of the steam generator loop cells, receive
ventilation exhaust air from their respective cells. Ventilation
exhaust air quantities of 65,000; 55,000 and 73,000 scfm will be 8 13
released from loop cells 1, 2 and 3, respectively, at an
elevation of 886'0", and the exhaust air velocity will be 1,350, 10 13
1,150 and 1,520 fpm for loop cells 1, 2 and 3, respectively.
Each loop cell has an additional release point which receives
ventilation exhaust air from the same area as stated above. A
ventilation exhaust air quantity of 16,000 cfm will be released 13
from each of the additional release points at elevation 874'-0".
Exhaust air velocity will be 1,600 fpm. 13

Located near the top of the Reactor Containment Building at
elevation 987'-0" is the combined exhaust of the Annulus Pressure
Maintenance System, the Annulus Filtration System, and the RCB
Containment Clean Up System. The exhaust air quantity and 8
exhaust velocity through this exhaust opening varies from 3,000
scfm and 425 fpm during normal and accident conditions, to 14,000 13
scfm and 1980 fpm during refueling, to a 21,770 scfm and 3,080
fpm which represents the RCB Clean Up System exhaust during the 10
TMBDB event (Thermal Margin Beyond Design Basis). The
temperature of the air varies from 55°F to 200°F.

An additional eight (8) release points associated with the
Thermal Margin Beyond Design Basis (TMBDB) event are located at
the top of the Reactor Containment Building for the Annulus Air
Cooling System at elevation 991'. A nominal total of 400,000
scfm or 50,000 scfm per exhaust point, will be exhausted at each

point with an outlet velocity of 780 fpm. This annulus cooling system is not required to operate during normal operation, or to mitigate the consequences of any design basis accidents. Activity would only be released from these points in the event of 10
very low probability accidents beyond the design basis. No on-line radioactivity monitor will be provided for these exhausts and offsite/emergency monitoring techniques will be adopted.

The radiological discharge points described are sampled and/or 4 8
monitored. Section 6.2.1.1.1 describes the plant effluent monitoring system for gaseous effluents.

3.5.2.6 SYSTEM PERFORMANCE

Steady-State Inventory of a specific radionuclide in the reactor cover gas can be calculated from the formula:

$$I = \frac{\dot{I}}{\lambda + \varepsilon F/V}$$

where,

- I = Inventory
- $\dot{I}$ = Input rate (presented in Table 3.5-6)
- λ = Decay constant (0.693 ÷ half-life)
- ε = Processing efficiency factor (typically taken as unity)
- F = Purge rate
- V = Cover-gas-space volume
- F/V = Purge factor

Concentration of a radionuclide in the cover-gas space is its inventory divided by the total gas volume adjusted to standard temperature and pressure.

Performance of RAPS for each radionuclide is summarized in Table
3.5-4. The reactor cover gas radionuclide concentrations, the
radionuclide concentrations in the RAPS vessel output and the
RAPS cryostill decontamination factor are presented in this
table. These data are calculated for the conditions of full
reactor power, at one year's operation, with 0.1 percent failed
fuel. CAPS performance is indicated in Table 3.5-5 which gives 10
the decontamination factor of the two delay beds for each
radionuclide. Table 3.5-7 contains a list of the radionuclides
released from the plant from various sources. The sources are
based on reactor operation with 0.1% failed fuel. The Failed
Fuel Monitoring System sources are shown for the processing of
two samples per day. The refueling system sources are the sum of
those for normal and anticipated events. Table 3.5-8 gives the
annual releases from the RSB and the RCB for the sources given in
Table 3.5-7.

3.5.2.7 BALANCE OF PLANT CONSIDERATIONS

A small fraction of tritium produced in the fuel and control rods
passes into the steam-water system by diffusion through stainless
steel. Tritium is expected to be in the steam-water system in
the form of tritiated water. The condenser off-gas system
removes non-condensable gases (vapors) from the condensing steam.
Tritiated water vapor present in the off-gas flow constitutes the
only expected gaseous radiological release contribution from the 8
balance of plant.

Mechanical vacuum pumps will remove the vapors together with the 6
noncondensable gases and discharge them into the exhaust duct
serving the lube oil areas of the Turbine Generator Building.
The combined gases will then be released from the exhaust fans at
elevation 878'0", at a rate of 8,000 scfm. The exhaust flow 10
velocity will be 900 feet/minute with a temperature range of 55°F

to 120°F. The resulting gaseous tritium release rate is provided in Table 3.5-9. There are eleven other TGB exhaust points which 6 receive ventilation exclusively from the TGB atmosphere and could 10 potentially contain some activity. This potential contribution would not alter the values reported in Table 3.5-9. 8

One release point is located in the Plant Service Building (PSB). The release point receives exhaust air from the hot laboratories, 8 10 counting room, and from the decontamination area. The release point is located at an elevation of 831'2". 8

The design radiological discharge points discussed above are sampled and/or monitored. Section 6.2.1.1.1 describes the 4 monitoring systems for gaseous effluents.

3.5.3 SOLID RADWASTE SYSTEM DESCRIPTION

The Solid Radwaste System is designed to process and package solid wastes so that they can be shipped to licensed burial 10 sites. Packaging and shipping container design will be such that the surface dose rate will be in compliance with Department of 10 Transportation (DOT)/NRC regulations as well as all other applicable State and Federal regulations.

Figure 3.5-5 is a flow diagram for the solid waste operations. Weights, volumes and expected activities (0.1 percent failed fuel) of solid waste to be shipped and the frequency of shipments 4 per year are given in tables 3.5-10 and 3.5-11. All shipment containers are transferred to a licensed contractor for 10 processing or burial.

The system will be designed to process or handle five types of wastes: concentrated liquids, compactible solids, non-compactible solids, metallic sodium and sodium bearing components.

Description of disposal of additional materials is provided in Section 3.8, Radioactive Materials Inventory.

3.5.3.1 CONCENTRATED LIQUIDS

Concentrated liquids and spent bead-type resins from the liquid 4
radwaste are solidified. The equipment in the solid radwaste 10
system is shown schematically in Figure 3.5-5.

The equipment includes a cement filling station, a decanting 10
station, a concentrated waste collection tank, a drumming
station, a filter handling machine and a compactor. Equipment
has been selected, arranged and shielded to permit operation,
inspection and maintenance with minimal exposure to personnel.
The solid radwaste system will process approximately one-hundred 4
eighty-one 55 gallon drums of concentrated liquids per year as 13
shown in Table 3.5-11. Total plutonium in 181 drums is expected
to be less than 0.3 Ci or less than 2×10^{-3} Ci per drum,
assuming that no plutonium is removed by the liquid radwaste
filtration system.

3.5.3.2 COMPACTIBLE SOLIDS

Compactible solids such as rags, paper, and rubber seals, which
can be potentially contaminated, will be collected at various
points throughout the plant and transferred to the solid radwaste
system. These types of solids, after compaction, are estimated 8 10
to have an average activity of less than 9.5×10^{-5} Ci/ft^3 as
shown in Table 3.5-10. Compactible solids will be placed in
55-gallon drums and compacted by a hydraulic compacting machine. 8
It is estimated that a total of twenty-eight 55-gallon drums per
year will be produced. Transport to a burial site by licensed
burial contractors will be carried out after a suitable number of
drums are accumulated.

3.5.3.3 NON-COMPACTIBLE SOLIDS 10

Low activity, non-compactible solids (less than 0.12 Ci/ft^3) 4 13
include used support tools, metal from cutting operations such as 10
an IHX tube bundle, valves and vapor traps. All components
previously exposed to sodium will be cleaned of metallic sodium
in the LCCV or the SCA.

The low activity non-compactible solids will be placed in
55-gallon drums, capped, decontaminated, monitored and placed
into temporary storage. Other types of non-compactible solids
such as spent cartridge filters, will be prepared for off-site 10
disposal in concrete-lined 55 gallon drums. It is estimated that
there will be a total of one hundred and twelve (112) 55-gallon 4 8
drums per year containing non-compactible solids.

3.5.3.4 METALLIC SODIUM IN CONTAINERS

Radioactive sodium will be present in the Fuel Handling Cell as a
result of fuel handling operations. This metallic sodium will be
transferred to the radwaste system from the Fuel Handling Cell in
55-gallon drums. The number of drums of waste is estimated to be
two per year, each containing about 20 Ci. Since no burial sites
will accept sodium, the drums will either be placed in storage on 8 10
site or processed to a disposal form in a to-be-determined
manner.

3.5.3.5 SODIUM BEARING SOLIDS

Sources of sodium bearing solids are the primary, intermediate and Ex-Vessel Storage Tank cold traps. The total estimated 4
activity in the primary cold traps at the end of plant life is about 2.8 x 10^5 Ci. of fission and corrosion products and 3.7 x 10^5 Ci. of tritium.

The six intermediate cold traps have an expected life of about 3.25 years. At the time of removal, each of the intermediate cold traps will contain about 7100 Ci. of tritium. The single 10
Ex-Vessel Storage Tank cold trap will remain in place for the entire life of the plant. The total estimated activity in the Ex-Vessel Storage Tank cold trap at end of plant life is about 7.6 x 10^3 Ci. of fission products and about 180 Ci. of tritium.

No current disposal site will accept sodium bearing wastes. For off-site disposal of this type of waste, sodium is required to be removed. Where sodium removal is not practical the waste will be stored on site.

All operations of solid waste system will be monitored to assure that operating personnel exposures are within 10 CFR 20 guidelines.

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TABLE 3.5-1

ESTIMATED ANNUAL CONCENTRATION OF LOW AND INTERMEDIATE ACTIVITY LEVEL INPUT STREAMS (μCi/cc)(1)

Isotope	Half-Life	Low Level (2)	Sodium Cleaning Solution (3)	Intermediate Acid Etch (4)	
H-3	12.3Y	2.44E-6	1.11E-3	-	
Na-22	2.6Y	4.55E-6	1.65E-3	-	
Na-24	15H	5.67E-7	2.05E-4	-	
Cr-51	28D	-	2.01E-4	1.31E-2	10
Mn-54	312D	-	1.45E-3	9.45E-2	
Co-58	71D	-	1.13E-3	8.75E-1	
Co-60	5.2Y	-	3.17E-4	2.45E-1	
Fe-59	45D	-	8.72E-6	6.40E-3	
Sr-89	51D	1.26E-8	1.74E-4	-	
Sr-90	28.8Y	8.93E-9	1.25E-4	-	
Y-90	64.1H	8.93E-9	1.25E-4	-	
Y-91	58D	3.65E-9	5.11E-5	-	
Nb-95	35D	6.88E-9	8.78E-5	6.42E-2	4
Zr-95	35D	6.88E-9	8.78E-5	6.42E-2	
Mo-99	67H	-	1.06E-5	-	
Ru-103	40D	9.17E-9	1.29E-4	8.50E-2	
Ru-106	1Y	7.41E-9	1.06E-4	6.88E-2	
Rh-106	2.2H	7.41E-9	1.06E-4	6.88E-2	
Ag-111	7.5D	-	3.43E-6	-	
Sb-125	2.7Y	6.31E-8	2.28E-5	-	
Te-127m	109D	2.56E-8	3.56E-4	-	
Te-127	9.35H	2.56E-8	3.56E-4	-	
Te-129m	34D	7.70E-8	1.07E-3	-	
Te-129	70M	7.70E-8	1.07E-3	-	
Te-132	78H	5.46E-8	7.70E-4	-	
I-131	8.1D	2.75E-6	9.99E-4	1.49E-3	
I-132	2.3H	5.19E-7	1.88E-4	-	
Cs-134	2.1Y	1.39E-6	5.04E-4	6.10E-4	
Cs-136	13D	1.38E-6	4.99E-4	6.20E-4	
Cs-137	30Y	1.11E-5	4.00E-3	4.76E-3	
Ba-140	12.8D	4.99E-9	6.97E-5	4.64E-2	
La-140	40H	4.99E-9	6.97E-5	4.64E-2	
Ce-141	32.5D	8.22E-9	1.15E-4	-	
Ce-143	33.7D	4.33E-9	2.01E-4	-	
Pr-143	13.7D	4.33E-9	2.01E-4	-	
Ce-144	285D	5.88E-9	8.22E-5	-	
Pr-144	17M	5.88E-9	8.22E-5	-	
Nd-147	11.1D	1.81E-9	2.53E-5	-	
Pm-127	2.7D	3.35E-9	2.46E-5	-	
Eu-155	1.8Y	-	4.40E-6	-	
Ta-182	115D	-	6.08E-5	4.15E-2	
Pu-238	86Y	1.05E-8	5.10E-6	-	
Pu-239	2.0E4Y	2.79E-9	1.37E-6	-	

TABLE 3.5-1 (Continued)

Isotope	Half-Life	Low Level (2)	Sodium Cleaning Solution (3)	Intermediate Acid Etch (4)
Pu-240	6.7E3Y	3.64E-9	1.78E-6	-
Pu-241	13Y	3.02E-7	1.51E-4	-
Pu-242	3.8E5Y	7.75E-12	3.83E-9	-
Np-238	2D	1.18E-13	5.60E-11	-
Np-239	2.4D	5.40E-10	2.71E-7	-
Am-241	433Y	1.08E-9	5.30E-7	-
Am-242m	152Y	4.24E-11	2.09E-8	-
Am-242	16H	4.24E-11	2.09E-8	-
Am-243	7.4E3Y	1.73E-11	2.45E-8	-
Cm-242	163D	7.55E-10	3.76E-7	-
Cm-243	30Y	1.04E-11	5.20E-9	-
Cm-244	18Y	2.18E-10	1.08E-7	-

(1) 0.1% failed fuel for fission products and 50 ppb Pu in the primary sodium. 30 year irradiation and 10 days decay of fission and activated corrosion products. Decay times during collection, processing and holdups are neglected. 4 10

(2) Low activity concentrations are computed by assuming that the listed isotopes are present in 3.5 lbs of primary sodium per year diluted by 3.1×10^5 gallons of water per year.

(3) Intermediate activity concentrations for the Sodium Cleaning Solution are computed assuming 10% of plated out activity and 100% of sodium activity adhering to the processed components are dissolved in 100,000 gallons of water per year. The solution is present in the input streams to the collection tanks.

(4) The average annual acid etch consists of 90% of the plated out activity from the processed components in an average annual volume of 1600 gallons. Cell sodium activity is assumed to have been removed in the first water rinse. This input stream is only expected to occur three times during plant life.

TABLE 3.5-2

EXPECTED ACTIVITY INVENTORY STORED AFTER PROCESSING (1)

Isotope	Half-Life	Low Level Activity (2) Monitor Tank (Ci)	Intermediate Activity (3) Storage Tanks (Ci)	
H-3	12.3Y	2.31E-5	1.01E-1	
Na-22	2.6Y	4.31E-10	1.50E-6	
Na-24	15H	5.36E-11	1.86E-7	
Cr-51	28D	-	8.16E-6	
Mn-54	312D	-	5.85E-5	
Co-58	71D	-	5.31E-4	
Co-60	5.2Y	-	1.49E-4	
Fe-59	45D	-	3.88E-6	
Sr-89	51D	1.19E-12	1.58E-7	
Sr-90	28.8Y	8.45E-13	1.14E-7	
Y-90	64.1H	8.45E-13	1.14E-7	
Y-91	58D	3.45E-13	4.64E-8	
Nb-95	35D	6.51E-13	3.90E-5	
Zr-95	64D	6.51E-13	3.90E-5	
Mo-99	67D	-	9.63E-9	
Ru-103	40D	8.68E-13	5.16E-5	
Ru-106	1Y	7.01E-13	7.84E-7	
Rh-106	2.2H	7.01E-13	7.84E-7	
Ag-111	7.5D	-	3.12E-9	
Sb-125	2.7Y	5.97E-12	2.07E-8	4 10
Te-127m	109D	2.42E-12	3.23E-7	
Te-127	9.35D	2.42E-12	3.23E-7	
Te-129m	34D	7.28E-12	9.72E-7	
Te-129	70M	7.28E-12	9.72E-7	
Te-132	78H	5.16E-12	6.99E-7	
I-131	8.1D	2.60E-9	1.81E-5	
I-132	2.3H	4.91E-10	1.71E-6	
Cs-134	2.1Y	1.26E-10	8.26E-7	
Cs-136	13D	1.31E-10	8.29E-7	
Cs-137	30Y	1.05E-9	3.25E-5	
Ba-140	12.8D	4.72E-13	2.82E-5	
La-140	40H	4.72E-13	2.82E-5	
Ce-141	32.5D	7.78E-13	1.04E-7	
Ce-143	33.7D	4.09E-13	1.83E-7	
Pr-143	13.7D	4.09E-13	1.83E-7	
Ce-144	285D	5.56E-13	7.47E-8	
Pr-144	17M	5.56E-13	7.47E-8	
Nd-147	11.1D	1.71E-13	2.30E-8	
Pm-147	2.7D	3.17E-13	2.23E-8	
Eu-155	1.8Y	-	4.08E-9	
Ta-182	115D	-	2.52E-5	
Pu-238	86Y	1.01E-12	4.63E-9	
Pu-239	2.0E4Y	2.64E-13	1.24E-9	
Pu-240	6.7E3Y	3.45E-13	1.62E-9	
Pu-241	13Y	2.86E-11	1.37E-7	

TABLE 3.5-2 (Continued)

Isotope	Half-Life	Low Level Activity[2] Monitor Tank (Ci)	Intermediate Activity[3] Storage Tanks (Ci)
Pu-242	3.8E5Y	3.45E-13	3.48E-12
Np-238	2D	1.12E-17	5.09E-14
Np-239	2.4D	5.15E-14	2.46E-10
Am-241	433Y	1.02E-13	4.81E-10
Am-242m	152Y	4.01E-15	1.90E-11
Am-242	16H	4.01E-15	1.90E-11
Am-243	7.4E3Y	1.64E-15	2.23E-11
Cm-242	163D	7.15E-14	3.42E-10
Cm-243	30Y	9.90E-16	4.72E-12
Cm-244	18Y	2.07E-14	9.81E-11

(1) 0.1% failed fuel for fission products and 50 ppb in the primary sodium, 30 years irradiation and 10 days decay of fission and activated corrosion products. Decay due to collection, processing and holdup are neglected. 4 10

(2) Low activity is based on Table 3.2-1 with a $DF=10^5$ for all isotopes except iodine ($DF=10^4$) and tritium ($DF=1$) 2400 gallon monitoring tank volume.

(3) Intermediate Activity is based on 40,000 gallon storage capacity containing the activity inventory in 16,000 gallons of acid etch and in 24,000 gallons of sodium cleaning solution. A decontamination factor of 10^5 is applicable to all isotopes except iodine ($DF=10^4$) and tritium ($DF=1$). This is a worst combination of expected operations, with the decontamination acid etch from one PHTS pump decontamination, which occurs three times in the life of the plant.

TABLE 3.5-3

CONCENTRATION OF RADIONUCLIDES AT DISCHARGE

TO CLINCH RIVER: EXPECTED VALUES

Isotope	Half-Life	Low Activity (μ Ci/cc) (1)	Intermediate Activity (μ Ci/cc) (2)	Total Activity (μ Ci/cc) (3)
H-3 (4)	12.3Y	9.53E-10	3.26E-8	3.36E-8
Na-22	2.6Y	1.95E-14	4.84E-14	6.79E-14
Na-24	15Y	2.22E-15	6.00E-14	6.22E-14
Cr-51	28D	-	2.63E-12	2.63E-12
Mn-54	312D	-	1.89E-11	1.89E-11
Co-58	71D	-	1.71E-10	1.71E-10
Co-60	5.2Y	-	4.81E-11	4.81E-11
Fe-59	45D	-	1.25E-12	1.25E-12
Sr-89	51D	4.93E-17	5.10E-14	5.10E-14
Sr-90	28.8Y	3.47E-17	3.68E-14	3.68E-14
Y-90	64.1H	3.47E-17	3.68E-14	3.68E-14
Y-91	58D	4.90E-17	1.50E-14	1.50E-14
Nb-95	35D	7.60E-17	1.26E-11	1.26E-11
Zr-95	64D	7.60E-17	1.26E-11	1.26E-11
Mo-99	67D	-	3.11E-15	3.11E-15
Ru-103	40D	1.12E-16	1.66E-11	1.66E-11
Ru-106	1Y	1.41E-16	2.53E-13	2.53E-13
Rh-106	2.2H	1.41E-16	2.53E-13	2.53E-13
Ag-111	7.5D	-	1.01E-15	1.01E-15
Sb-125	2.7Y	2.47E-16	6.71E-15	6.96E-15
Te-127m	109D	1.00E-16	1.04E-13	1.04E-13
Te-127	9.35H	1.00E-16	1.04E-13	1.04E-13
Te-129m	34D	4.00E-16	3.14E-13	3.14E-13
Te-129	70M	4.00E-16	3.14E-13	3.14E-13
Te-132	78H	2.14E-16	2.25E-13	2.25E-13
I-131	8.1D	1.08E-13	5.84E-12	5.95E-12
I-132	2.3H	2.03E-14	5.52E-13	5.72E-13
Cs-134	2.1Y	5.26E-15	2.66E-13	2.71E-13
Cs-136	13D	6.53E-13	2.67E-13	2.73E-13
Cs-137	30Y	4.33E-14	1.05E-11	1.05E-11
Ba-140	12.8D	1.95E-17	9.10E-12	9.10E-12
La-140	40H	1.95E-17	9.10E-12	9.10E-12
Ce-141	32.5D	5.16E-17	3.35E-14	3.35E-14
Ce-143	32.5D	1.69E-17	5.90E-14	5.90E-14
Pr-143	13.7D	1.69E-17	5.90E-14	5.90E-14
Ce-144	285D	2.30E-17	2.41E-14	2.41E-14
Pr-144	17M	2.30E-17	2.41E-14	2.41E-14
Nd-147	11.1D	9.90E-18	7.42E-15	7.42E-15
Pm-147	2.7D	1.31E-17	7.42E-15	7.42E-15
Eu-155	1.8Y	-	1.32E-15	1.32E-15
Ta-182	115D	-	8.13E-12	8.13E-12
Pu-238	86Y	4.00E-17	1.49E-15	1.53E-15
Pu-239	2.0E4Y	1.09E-17	4.00E-16	4.11E-16

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TABLE 3.5-3 (Continued)

Isotope	Half-Life	Low Activity (μCi/cc) (1)	Intermediate Activity (μCi/cc) (2)	Total Activity (μCi/cc) (3)
Pu-240	6.7E3Y	1.43E-17	5.23E-16	5.47E-16
Pu-241	13Y	1.18E-15	4.42E-14	4.54E-14
Pu-242	3.8E5Y	3.02E-20	1.12E-18	1.15E-18
Np-238	2D	4.62E-22	1.64E-20	1.69E-21
Np-239	2.4D	2.12E-18	7.94E-17	8.15E-17
Am-241	433Y	4.20E-18	1.55E-16	1.59E-16
Am-242m	152Y	1.66E-19	6.13E-18	6.29E-18
Am-242	16H	1.66E-19	6.13E-18	6.29E-18
Am-243	7.4E3Y	6.80E-20	7.19E-18	7.26E-18
Cm-242	163D	2.95E-18	1.10E-16	1.13E-16
Cm-243	30Y	4.08E-22	1.52E-18	1.52E-18
Cm-244	18Y	8.55E-18	3.16E-17	4.02E-17

Notes of Table 3.5-3

(1) Low Activity Liquid Waste Assumptions

a) 0.1% failed fuel and 50 ppb Pu in the primary sodium, 30 years irradiation and 10 days decay of fission and activated corrosion products. Decay time in collecting, processing and holdup are ignored.

b) 850 gallons per day containing 10^{-4} μCi/cc is decontaminated by a factor of 10^5 except iodine (DF=10^4) and tritium (DF=1) and released to the common plant discharge header of 3.1×10^{12} cc/year. 8 10

c) The activity level of 10^{-4} μCi/cc comes from spillage of 3.5 lbs per year of primary sodium into the drainage stream of 850 gallons per day.

(2) Intermediate Activity Liquid Waste Assumptions

a) 0.1% failed fuel and 50 ppb Pu in the primary sodium 30 years irradiation and 10 days decay of fission and activated corrosion products. Decay time in collecting processing and holdup are ignored.

b) 4,000 gallons per year discharged to the common plant discharge header. This activity is based on the inventory in 1600 gallons of acid etch and in 2,400 gallons of sodium cleaning solution. A DF = 10^5 is used for all isotopes except iodine (DF = 10^4) and tritium (DF=1).

(3) Sum of columns 3 and 4.

(4) BOP discharge concentration of 7.0E-7 μCi/cc is not included.

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TABLE 3.5-4

RAPS PERFORMANCE SUMMARY DATA

Isotope	Cover Gas Inventory* Curies	Cover Gas Concentration (μ Ci/scc)	RAPS Output Concentration** (μ Ci/scc)	Cryostill Decontamination Factor
Xe-131m	8.6E-1	7.4E-2	1.8E-6	>>1.5E4
Xe-133m	2.8E1	2.4E0	5.4E-5	>>1.5E4
Xe-133	5.0E2	4.2E1	1.0E-3	>>1.5E4
Xe-135m	1.2E2	1.1E1	2.0E-6	>>1.5E4
Xe-135	2.2E3	1.9E2	2.6E-3	>>1.5E4
Xe-138	2.0E2	1.8E1	2.8E-6	>>1.5E4
Kr-83m	7.4E1	-	2.2E-5	>1.5E4
Kr-85m	1.8E2	1.6E1	1.3E-4	>1.5E4
Kr-85	1.6E-2	1.4E-3	3.4E-8	>1.5E4
Kr-87	2.0E2	1.7E1	3.8E-5	>1.5E4
Kr-88	3.4E2	3.0E1	1.6E-4	>1.5E4
Ar-39++	3.1E-1	2.7E-2	2.7E-2	1.0E0
Ar-41++	1.4E1	1.2E0	7.6E-2	1.8E0
Ne-23++	8.9E5	7.7E4	9.4E-3	1.2E0
H-3++	1.7E-4	1.5E-5	1.5E-5	1.0E0

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*After 1 year of operation and with 0.1 percent failed fuel

**Concentration in cryostill effluent

++Inventories independent of failed-fuel percentage

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TABLE 3.5-5

CAPS PERFORMANCE SUMMARY DATA

Isotope	Delay Beds Decontamination Factor	
Xe-131m	1.8E6	
Xe-133m	9.2E32	
Xe-133	1.5E14	
Xe-135m	>1.0E50	
Xe-135	>1.0E50	8
Xe-138	>1.0E50	
Kr-83m	1.8E6	
Kr-85m	4.3E2	10
Kr-85	1.0E0	
Kr-87	1.4E9	8
Kr-88	1.4E4	
Ar-39	1.0E0	
Ar-41	1.9E0	
Ne-23	>1.0E50	8
H-3	1.0E0	

TABLE 3.5-6

PRODUCTION RATES OF RADIONUCLIDES

(0.1 Percent Failed Fuel) 10

Isotope	Half-Life	Generation Rate (Ci/day)	
Xe-131m	11.96 days	1.1E1	
Xe-133m	2.26 days	3.8E2	
Xe-133	5.27 days	6.5E3	
Xe-135m	15.7 minutes	9.6E3	
Xe-135	9.16 hours	3.3E4	
Xe-138	14.2 minutes	1.7E4	
Kr-83m	1.86 hours	1.6E3	
Kr-85m	4.4 hours	3.0E3	
Kr-85	10.76 year	2.0E-1	10
Kr-87	76 minutes	5.2E3	
Kr-88	2.79 hours	6.4E3	
Ar-39	269 years	1.3E-1	
Ar-41	110 minutes	3.1E2	
Ne-23	38 seconds	1.4E9	
H-3	12.5 years	2.0E-7	

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TABLE 3.5-7

(Sheet 1 of 2)
RADIONUCLIDE RELEASE RATES AND RELEASE PATHS FOR THE 0.1% FAILED FUEL SERVICE CONDITION

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Isotope	Cover Gas Leakage RCB H&V Exhaust (Ci/day)	Buffer Seal Leakage-RCB H&V Exhaust (Ci/day)	Primary Piping Leakage-RCB Cells to CAPS to RSB H&V Exhaust (Ci/day)	RAPS +++ Components Leakage - RCB Cells to RCB H&V Exhaust (Ci/day)	Noble Gas Effluent to CAPS to RSB H&V Exhaust (Ci/day)	Fuel Failure Monitoring System Effluent to CAPS to RSB H&V Exhaust (Ci/day)
Xe^{131m}	4.7E-7	1.8E-8	5.9E-11	3.9E-5	*	2.9E-9
Xe^{133m}	1.5E-5	4.9E-7	*	1.2E-3	*	*
Xe^{133}	2.7E-4	9.7E-6	*	2.2E-2	*	*
Xe^{135m}	7.0E-5	1.1E-9	*	4.5E-5	*	*
Xe^{135}	1.2E-3	1.7E-5	*	5.6E-2	*	*
Xe^{138}	1.1E-4	1.3E-9	*	6.0E-5	*	*
Kr^{83m}	4.1E-5	6.4E-8	3.7E-9	4.9E-4	*	8.9E-8
Kr^{85m}	9.5E-5	6.0E-7	4.3E-5	2.7E-3	*	1.5E-3
Kr^{85}	+	+	+	+	1.9E-1	+
Kr^{87}	1.1E-4	8.0E-8	1.1E-11	8.4E-4	*	2.0E-10
Kr^{88}	1.8E-4	5.8E-7	2.3E-6	3.5E-3	*	7.0E-5
Ar^{39}	5.0E-6	7.9E-3	1.1E-3	1.1E-3	7.8E-2	4.4E-2
Ar^{41}	1.3E-5	3.5E-4	1.1E-3	1.8E-4	*	3.0E-2
Ne^{23}	*	*	*	*	*	*
H^{3}++	9.5E-11	1.5E-7	1.9E-5	2.2E-8	< 1E-5	8.5E-9
Total	2.1E-3	8.1E-3	2.2	8.8E-2	0.27	7.6E-2

4 10 13

*Less than E-15
+Leakage of Kr-85 is not included, since it is removed by the cryostill and, therefore, is accounted for in the Noble Gas Effluent Column.
++BOP Tritium Release (6.3E-5 Ci/day for a plant capacity factor of 0.68) from T-G Building Exhaust not included. Also, allowance for 2 weeks per year bypass of the oxidizer unit (amounts to 0.04 curies of tritium exhausted to the RSB H&V exhaust) is not included.
+++CAPS components leakage is negligible.

TABLE 3.5-7

(Sheet 2 of 2)
RADIONUCLIDE RELEASE RATES AND RELEASE PATHS FOR THE 0.1%
FAILED FUEL SERVICE CONDITION

Isotope	Refueling Effluent to CAPS to RSB H&V Exhaust (Ci/day)	Maintenance Effluent to CAPS to RSB H&V Exhaust (Ci/day)	Aux. Liquid Metal Effluent to CAPS to RSB H&V Exhaust (Ci/day)	Impurity Monitoring & Analysis Effluent to CAPS to RSB H&V Exhaust (Ci/day)	Intermediate Bay Leakage (Ci/day)	Totals (Sheets 1 and 2) (Ci/day)	
Xe^{131m}	3.5E-8	*	7.8E-9	2.9E-12	0	3.9E-5	16
Xe^{133m}	*	*	*	*	0	1.2E-3	
Xe^{133}	1.3E-14	*	*	*	0	2.2E-2	16
Xe^{135m}	*	*	*	*	0	1.1E-4	
Xe^{135}	*	*	*	*	0	5.7E-2	
Xe^{138}	*	*	*	*	0	1.7E-4	
Kr^{83m}	*	*	*	1.8E-10	0	5.3E-4	4
Kr^{85m}	*	*	*	2.2E-6	0	4.5E-3	10
Kr^{85}	0.18	*	*	9.7E-8	0	0.37	16
Kr^{87}	*	*	*	5.5E-13	0	9.5E-4	13
Kr^{88}	*	*	*	1.2E-7	0	3.7E-3	
Ar^{39}	2.3E-2	*	*	5.6E-5	0	0.15	16
Ar^{41}	*	*	*	3.4E-5	0	3.2E-2	
Ne^{23}	*	*	*	*	0	*	
H^{3++}	*	*	*	1.1E-11	1.6E-4	1.9E-4	
Total	0.20	**	7.8E-8	9.2E-5	1.6E-4	0.58	16

*Less than E-15
++BOP Tritium Release (6.3E-5 Ci/day for a plant capacity factor of 0.68) from T-G Building Exhaust not included. Also, allowance for 2 weeks per year bypass of the oxidizer unit (amounts to 0.04 curies of tritium exhausted to the RSB H&V exhaust) is not included.

TABLE 3.5-8

ANNUAL ACTIVITY RELEASE RATES FOR THE 0.1% FAILED FUEL+ SERVICE CONDITION

Radionuclide	Main RCB H&V Exhaust (Ci/yr)	RSB H&V Exhaust (Ci/yr)	Intermediate Bay Leakage (Ci/yr)	Total Release (Ci/yr)	
Xe-131m	1.4E-2	4.9E-5	0	1.4E-2	
Xe-133m	0.43	*	0	0.43	
Xe-133	8.0	1.8E-10	0	8.0	
Xe-135m	4.2E-2	*	0	4.2E-2	
Xe-135	21	*	0	21	
Xe-138	6.4E-2	*	0	6.4E-2	
Kr-83m	0.19	3.4E-5	0	0.19	
Kr-85m	1.0	0.58	0	1.6	4
Kr-85	**	1.4E2	0	1.4E2	10 16
Kr-87	0.34	7.8E-8	0	0.34	
Kr-88	1.3	2.6E-2	0	1.3	
Ar-39	3.3	26	0	29	16
Ar-41	0.12	7.0	0	7.1	
Ne-23	*	*	0	*	
H-3***	6.3E-5	1.1E-2	5.8E-2	6.9E-2	
Total	36	1.7E2	5.8E-2	2.1E2	16

*<E-13

**Leakage of Kr-85 is not included since it is removed by the cryostill and, therefore, accounted for in the RSB H&V Exhaust Column.

***BOP tritium release (0.023 Ci/yr for a plant capacity factor of 0.68) from the T-G building exhaust not included. Also allowance for 2 weeks per year bypass of the oxidizer unit (0.04 Ci/yr of tritium) is not included.

+The reactor refueling system inputs are based on normal and anticipated events. The fuel failure monitoring system inputs are based on 2 samples per day. Ar-39 inputs are based on the thirtieth year of reactor operation.

TABLE 3.5-9

BOP GASEOUS TRITIUM RELEASE*

<u>Source Terms</u>

Plant Capacity Factor	0.68	
Vacuum Pump Operating Factor	0.85	
Condenser Off-Gas Removal	7 scfm	
Unrecovered Drains From The Steam Water Sampling System	5 gpm	10
Radioactivity Input to Steam-Water System (100% Reactor Power)	1.6×10^{-2} Ci/day	10

*BOP Tritium Release: 6.3×10^{-5} Ci/day 10

TABLE 3.5-10

ESTIMATES OF SOLID RADWASTE SHIPMENTS PER YEAR 11

IN TERMS OF ANNUAL QUANTITIES

	Volume (ft^3)	Weight (lbs.)	Estimated Activity (Ci)	Comments
Compactible Solids*	210	1.2E4	<0.02 Ci	Rags, paper, and seals
Non-Compactible Solids				
Scrapped Components	705	5.7E4	82	valves, vapor traps, small components cleaned of sodium
Resins	125	5.6E3	280	Activated corrosion and fission products
Filters	118	1.3E4	170	Activated corrosion and fission products
Solidified Liquid Radwaste	1000	1.4E5	2.8E3	Concentrated evaporator bottoms
Solidified Tritiated Water	67	1.0E4	0.7	RAPS and CAPS
Solidified Sodium Contaminated Ethyl Alcohol	140	2.1E4	1.2	Cleaning Solution from FHC
Total	2365	2.6E5	3.4E3	

8 10 13

*Assume compaction has decreased volume by factor of 10.

10

TABLE 3.5-11

SOLID RADWASTE SHIPMENTS PER YEAR

Material	Shipments Per Year	Volume (ft^3)	Containers Per Year*
Compactible Solids	0.3	210	28
Non-Compactible Solids			
Scrapped Components	1.5	705	96
Filters	1.1	118	16
Resins	1.2	125	17
Solidified Liquid Radwaste	3.5	1000	136
Solidified Tritiated Water	0.1	67	9
Solidified Sodium Contaminated Ethyl Alcohol	0.3	140	19

4 8 10 13 10

*55-gal Drums

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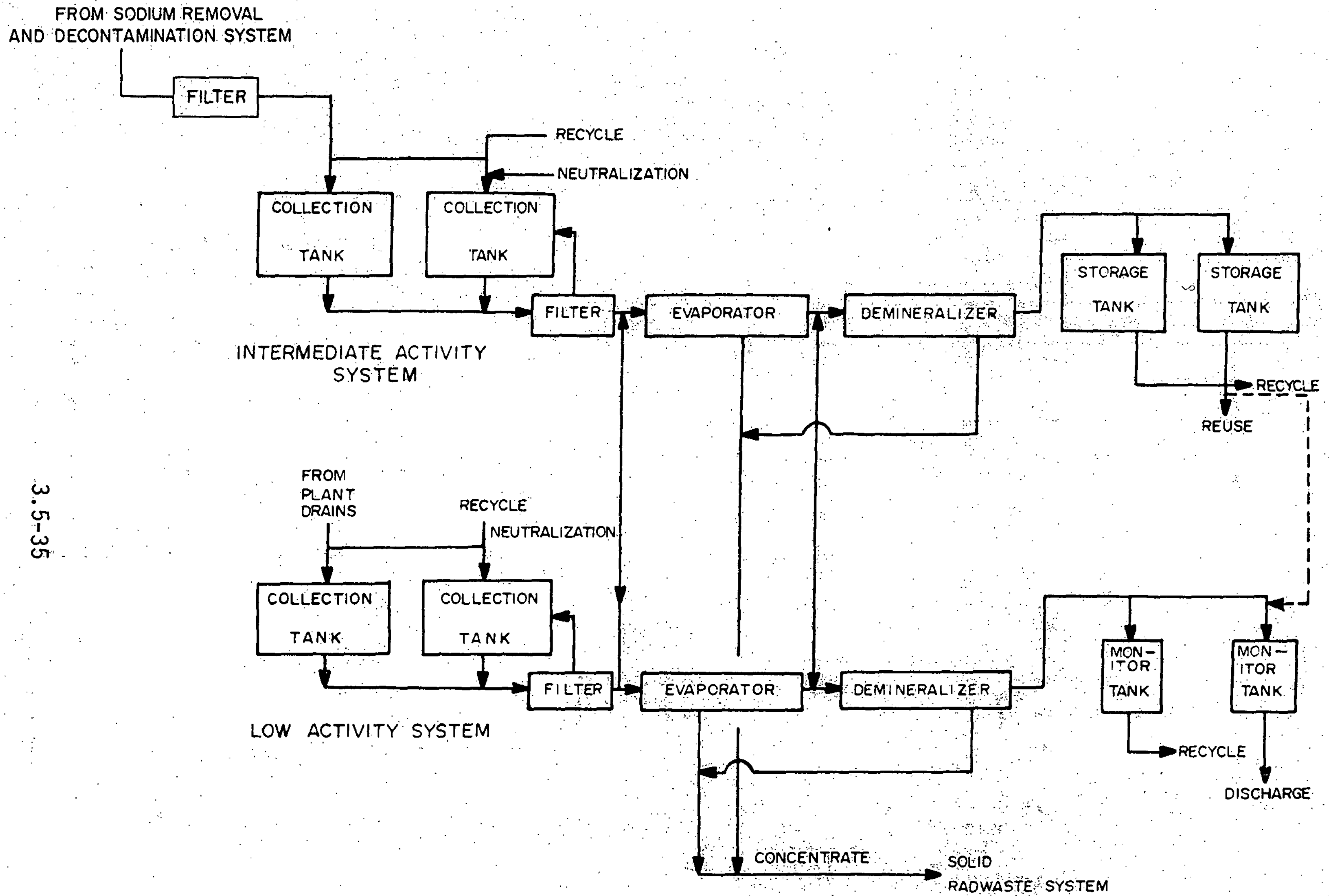

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Figure 3.5-1 LIQUID RADWASTE SYSTEM FLOW DIAGRAM

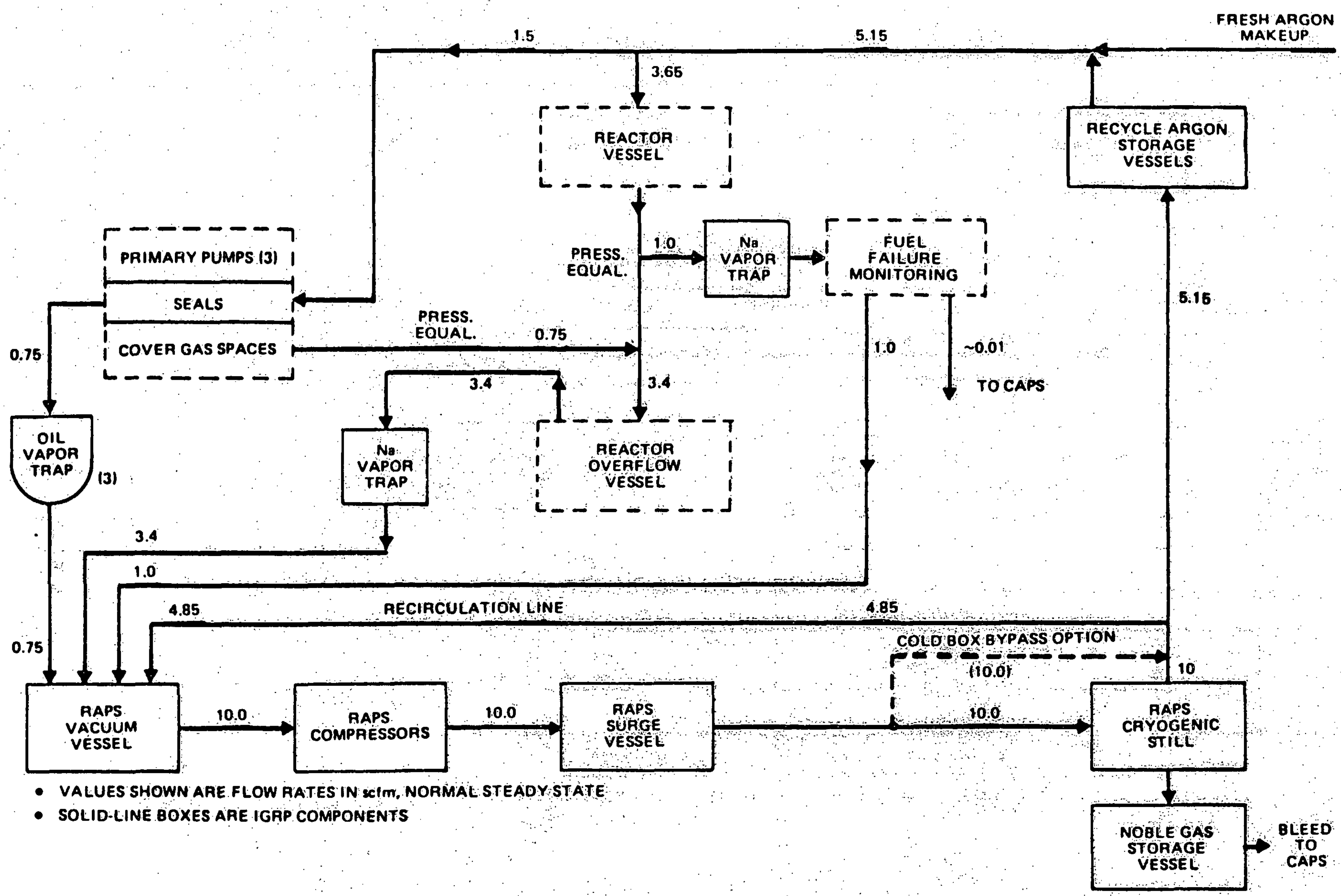

Figure 3.5-2. Schematic Diagram of the RAPS Recycle Argon Circuit

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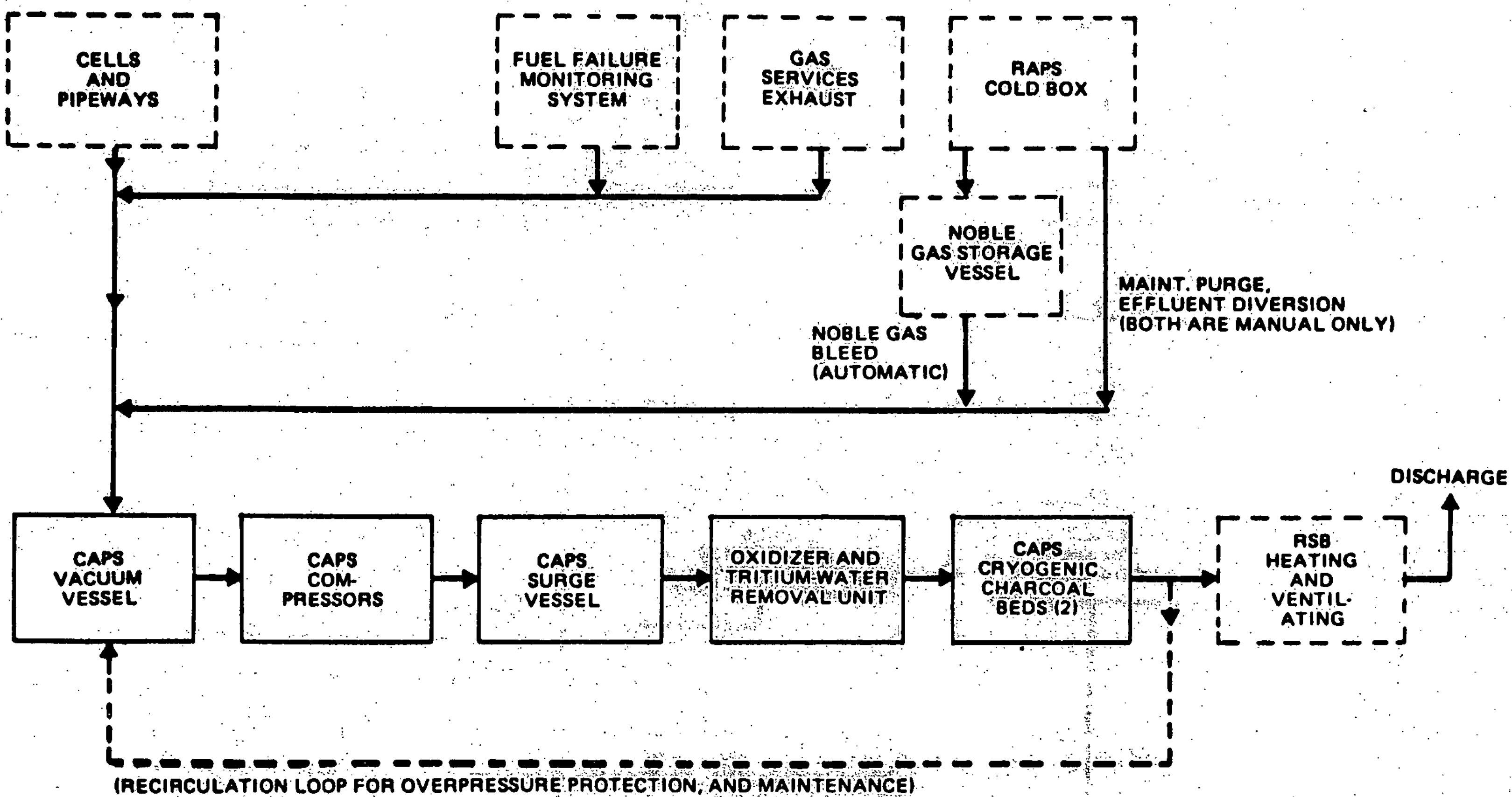

SOLID BOXES ARE CAPS COMPONENTS

Figure 3.5-3. Schematic Diagram of CAPS

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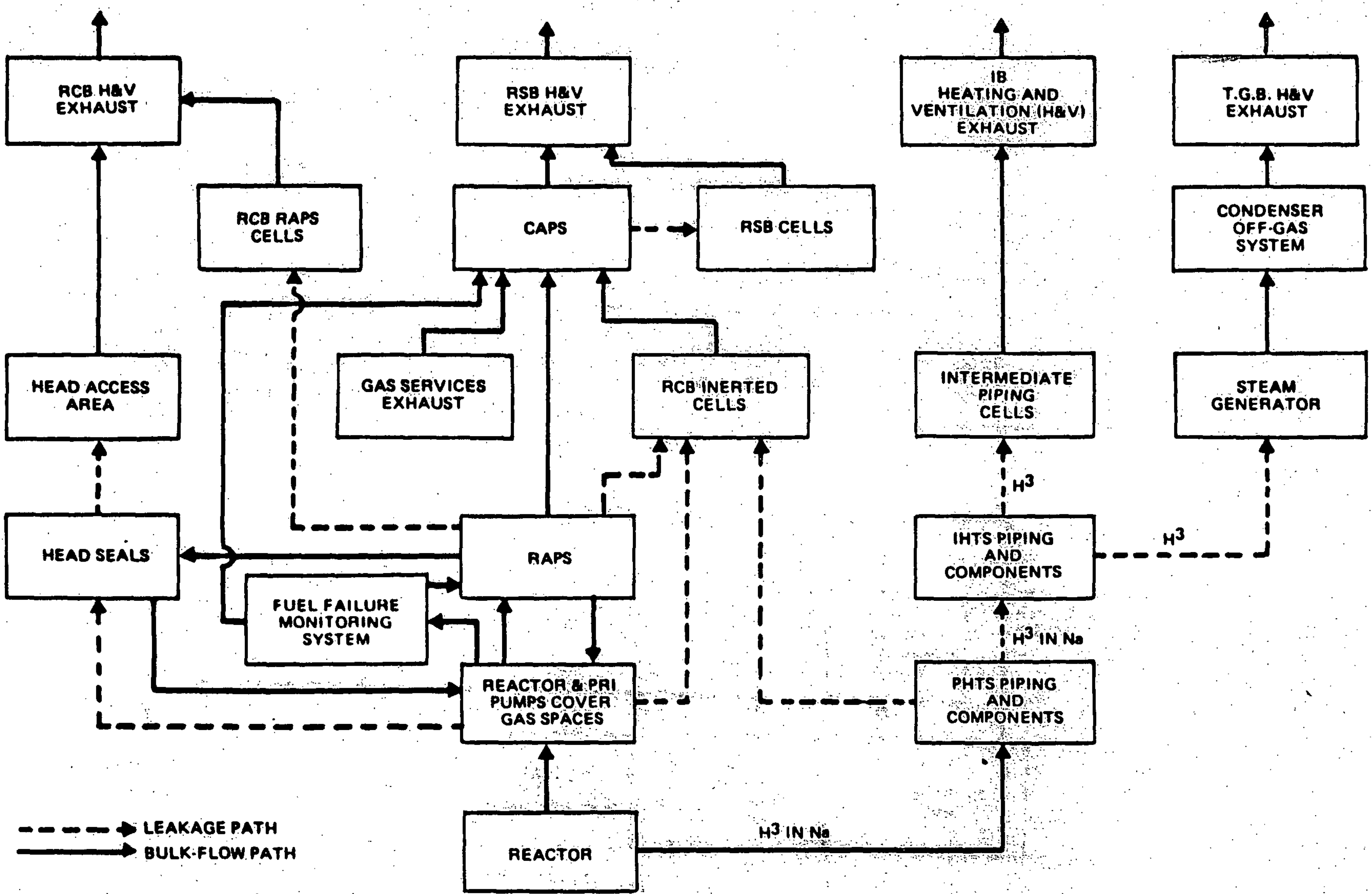

Figure 3.5-4. Radioactive Gas Flow Paths

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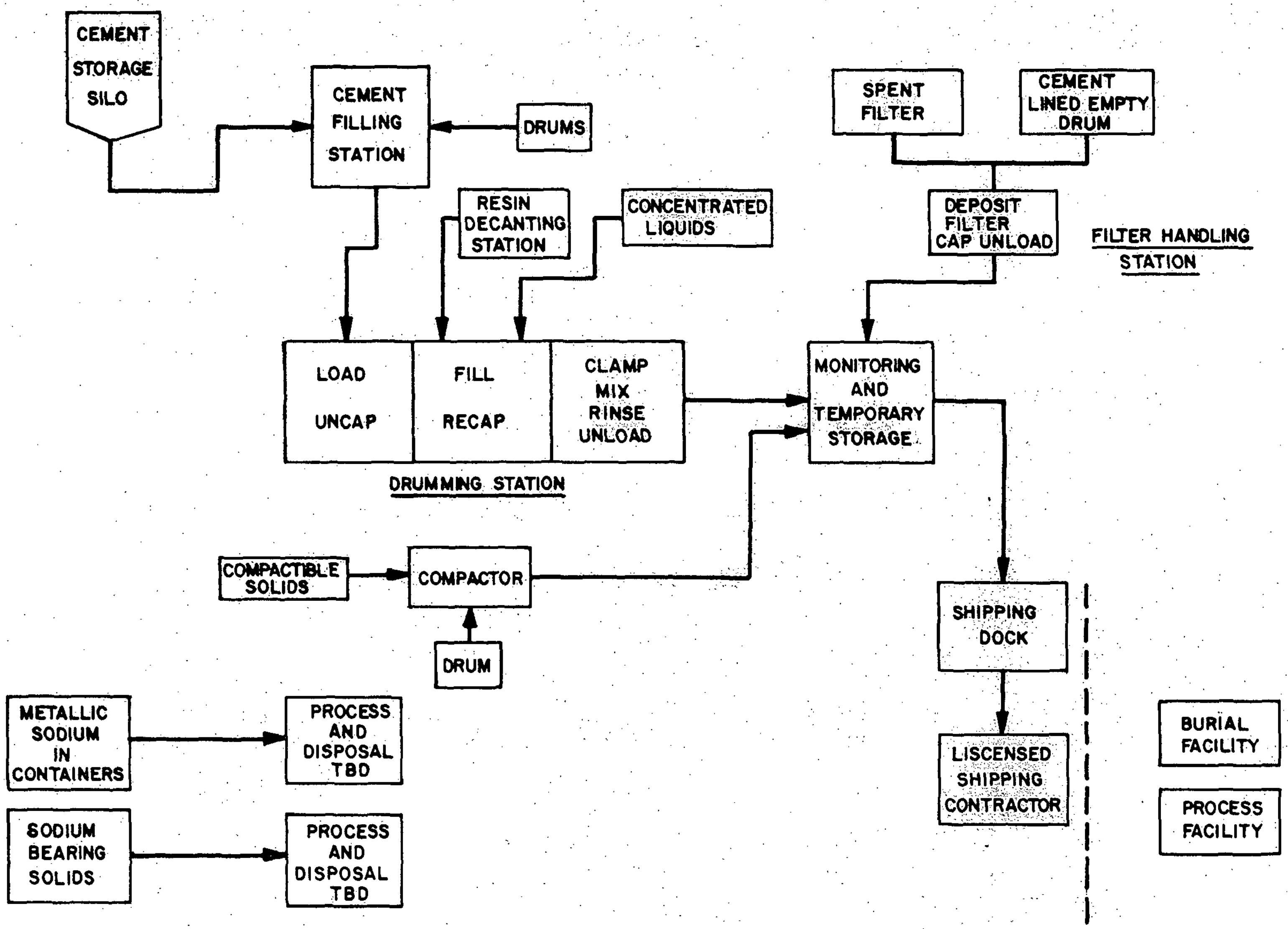

Figure 3. 5-5 SOLID RADWASTE SYSTEM FLOW DIAGRAM

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3.6 CHEMICAL AND BIOCIDE WASTES

3.6.1 GENERAL

Source for all makeup water for the Clinch River Breeder Reactor Plant (CRBRP) will be the Clinch River. The makeup water will replace the water lost from the Heat Dissipation System by evaporation, blowdown and drift. In addition, the makeup water, after treatment in the Makeup Water Treatment System, will 9
provide the water for steam cycle makeup and other plant consumptive uses requiring demineralized water. Overall plant water input, consumption and discharge is discussed in Section 3.3. Figure 3.3-1 is a flow chart of water usage. It indicates that the plant has a single discharge point to the Clinch River for cooling tower blowdown, process wastewater, treated sanitary effluent and liquid radwaste effluent. These effluents and points of chemical addition are also shown in Figure 3.6-1.

The chemical composition of the discharge water depends largely on the concentrations in the source water due to the potential 2.5 fold concentration factor in the plant cooling water system. Chemical contributions from other plant sources are insignificant by comparison. A substantial portion of the constituents 16
identified in the river are expected to be deposited via precipitation, filming, scaling, etc. as a sludge or residual within the cooling tower basin[1,2]. A condition of EPA's proposed NPDES Permit (Part III.C) requires quantitative verification of key parameters in the discharge. In this manner, actual operational effluent data can be used to substantiate the conservatism of expected effluent discharge.

4

Plant effluents will be treated, controlled and discharged in accordance with the applicable governing water quality criteria indicated in Table 10.4-1. Descriptions of control procedures for chemicals contained in cooling tower blowdown discharge are provided in Section 3.6.2.

3.6.2 HEAT DISSIPATION SYSTEM

Heat removal facilities have been discussed in Section 3.4. Evaporation in the cooling tower will cause the solids concentrations in the circulating water to increase, as discussed in Section 3.3. To preclude reductions in plant efficiency and service life, cooling water blowdown is required. The blowdown maintains the cooling water concentration of solids in a non-scaling or non-corrosive condition. Blowdown will contain primarily the same constituents as the river water concentrated by a factor of two to three. Average and maximum concentrations
in the Clinch River, in the blowdown, in other plant waste 4
streams and in the combined discharge are shown in Table 3.6-1.

The quantity of cooling tower blowdown has been discussed in
Sections 3.3 and 3.4. Normally, sulfuric acid addition will not 4
be required to control scaling conditions. Provisions for sulfuric acid addition will be provided, as shown in Figure 3.6-1, if needed to correct an unexpected high pH condition in
the circulating water system due to high river water pH. The 4 9
feed rate for sulfuric acid in this application cannot be determined since there are no river water quality data indicating
that the pH will exceed 8.5. The pH control scheme will be 9
adequate to serve the circulating water and the plant auxiliary service water systems. Should blowdown pH exceed acceptable
range, that is 6.5 to 8.5, the blowdown valve will be closed 9
automatically.

Use of corrosion inhibitors in the circulating cooling water will not be required.

No oil, grease or debris will be present in the cooling tower blowdown.

Wood will not be used in the cooling towers. Therefore, chemical preservatives or color will not be extracted and discharged to the river. 8

4

Makeup water from the river will contain numerous types of microbiological organisms. Biological growth on heat transfer surfaces can cause fouling and lead to loss of efficiency. Algae, slimes and bacteria can also increase the corrosion rate of the metal surfaces. Chlorine injection for bio-fouling control will occur at two locations; the Circulating Water System and the River Waste Pumphouse. 4 9

Provisions are made for equipment and piping needed to inject 9
chlorine into the space between the outer perforated pipe and the inner sleeve. The chlorinated water will travel through the internal sleeve into the main inlet pipe and the pump structure. Interlocks are pro-
vided to ensure that chlorine injection can take place only when the 9
river water pump is taking suction from the inlet pipe so that chlorination will occur only when the perforated pipe inlets are in service. This will be a continuous low level addition during treatment periods occurring in the spring, summer and fall. The amount of sodium hypochlorite added will be sufficient to provide a chlorine residual con-
sistent with the need for controlling infestations of Asiatic clams into 9
the Circulating Water System.

The chlorination system will also be employed to control algae, slimes and 9
bacteria in the main condenser, cooling tower, circulating water piping, valves, pumps and auxiliary heat transfer surfaces. Sodium hypochlorite may be injected continuously or intermittently into the circulating water system of the main condenser or into the cooling tower basins.

Chlorine dosage will be controlled to ensure the presence of free available 9
chlorine in the cooling and makeup water systems. In order to avoid the discharge of cooling tower blowdown containing unacceptable chlorine concentrations, a recording analyzer is furnished on the blowdown line. Should the chlorine concentration, as measured by the recording analyzer, be greater than a preset value, alarms will sound and an automatically controlled valve on the blowdown line will close. The valve will remain
closed until monitoring indicates the chlorine concentration has dropped 9
to an acceptable level due to aeration of water circulating through the cooling tower. An acceptable level is one which ensures that the chlorine residual of the discharge complies with the effluent limitations cited in the Draft NPDES Permit, namely .14 mg/l. 16

Operation of the cooling tower will cause drift deposition on the ground in the vicinity of the cooling tower. Since solids are entrained in this spary fallout, ground deposition of chemicals will occur. The drift will contain the same dissolved solids concentrations as the blowdown. These concentrations are indicated in Table 3.6-1. Drift eliminators will be used to limit the quantity of drift to 106 gpm, during maximum 9
power operation, as discussed in Section 3.4. Most of the drift will be deposited in the immediate area around the cooling tower. Quantities of drift which are deposited in the vicinity of the cooling tower are discussed in Section 5.4.

Maximum and average concentration of solids expected in the cooling tower 4
blowdown are given in Table 3.6-1. This discharge will be continuous during normal operation and the quantity of blowdown will vary as discussed in Section 3.3. The discharge varies with changes in ambient temperature and humidity. These variations are described in Section 3.4. Environmental impacts associated with the Heat Dissipation System are discussed in Secton 5.1.

3.6.3 WASTE WATER DISPOSAL SYSTEM 9

The demineralization of plant process makeup water and the maintenance of steam cycle water quality will result in the production of process wastewater which will be neutralized, stored and treated prior to disposal. The demineralization process will use sulfuric acid and sodium hydroxide for regeneration of ion exchange beds. The regenerant waste-water, following equalization and blending with other plant wastes will 9
be combined with the cooling tower blowdown. The maximum and average concentrations of solids in the Waste Water Disposal System are given in Table 3.6-1.

9

When chemical cleaning of various components is required, resulting chemical cleaning wastes will be disposed of off-site by a chemical cleaning contractor. Chemical cleaning wastes are not expected to be discharged to the Clinch River. 16

Other non-radioactive chemical wastes such as DOWTHERM, sodium, sodium potassium alloy and the reaction products associated with these systems will be accumulated in specially designated tanks and shipped off-site periodically.

The environmental impact associated with the Waste Water Disposal 9
System is discussed in Section 5.4.

3.6.4 SEWAGE DISPOSAL SYSTEM 9

The volume of treated water discharged from the Sewage Disposal 9
System will be approximately 7,000 gal/day, during normal
operation. Maximum discharge from the Sewage Disposal System 9
will be approximately 10,500 gal/day, during plant shutdown 8
periods. This flow rate is based on 300 men at 35 gal/day each.
The effluent from the Sewage Treatment Plant will be continuously 9
chlorinated as discussed in Section 3.7. The dosage of chlorine
will be determined during startup and periodically checked
thereafter, in order to meet the fecal coliform limits set forth 9
in the draft NPDES permit, namely, 200 organisms/100 ml. It is 16
planned to combine the sanitary discharge with the cooling tower 9
blowdown. Other chemical concentrations in the treated sanitary effluent are indicated in Tables 3.6-1 and 3.7-1. The environmental effects of the sanitary discharge are addressed in Section 5.5.

TABLE 3.6-1
PRELIMINARY ESTIMATES OF EFFLUENT WATER CONCENTRATIONS

	Clinch River (Background)(1)		CRBRP Waste Streams				Discharge to River		
			Cooling Tower Blowdown(2)		Neutralized Plant Wastes(3)	Sanitary Wastes	Annual Quantity	Concentration	
	Avg. Conc. (mg/l)	Max. Conc. (mg/l)	Based on Avg. River Conc. (mg/l)	Based on Max. River Conc. (mg/l)	Based on Avg. Discharge - 100 gpm (mg/l)	Based on the Design Loading (mg/l)	(10^3 lbs/yr)	Average (mg/l)	Maximum (mg/l)
Total Alkalinity (as $CaCO_3$)	87.0	100.0	40.0	40.0	50.0	—	—	40.0	40.0
Ammonia Nitrogen (as N)	0.04	0.23	.10	0.58	—	<5.0	0.7	<0.1	<0.6
BOD	<1.0	1.3	<2.0	<3.0	—	<30.0	<14.5	<2.0	<3.0
Calcium	29.0	35.0	72.0	87.5	43.0	—	518.0	71.0	86.0
Chloride	3.0	40.0	7.50	100.0	43.0	—	71.0	9.0	97.0
Residual Chlorine	- -(4)	- - (4)	<0.14	<0.14	—	1.0	1.0	<0.14	<0.14
COD	<4.0	12.0	<10.0	<30.0	—	NA	<69.0	9.6	28.7
Copper(5)	0.036	0.170	<0.2	<0.5	<1.0	—	<1.7	<0.20	<0.5
Total Dissolved Solids (TDS)	125.0	150.0	266.0	320.0	1,350	—	2,436.0	310.0	362.0
Total Iron (5)	0.530	6.50	<1.3	<16	—	—	9.2	<1.27	<15.5
Lead	<0.011	0.035	<0.028	0.088	—	—	<0.2	<0.026	<0.084
Magnesium	7.7	9.4	19.25	23.5	12.0	—	138.0	19.0	23.0
Manganese	0.055	0.180	0.138	0.450	1.0	—	1.4	0.13	0.43
Nickel(5)	<0.050	0.060	<0.13	0.150	<1	—	1.3	0.17	0.19
Nitrate (NO_3)	0.45	1.4	1.13	3.5	3.2	—	9.2	1.2	3.5
pH	7.6	8.2	7.6	6.5-8.5	6.5-8.5	6-9	NA	6.5-8.5	6.5-8.5
Total Phosphate	0.02	0.04	—	—	1.0	5.0	—	—	—
Potassium	1.26	1.7	3.2	4.2	2.0	—	23.0	3.1	4.1
Silica (SiO_2)	4.3	6.0	10.8	15.0	6.5	—	78.0	10.6	14.6
Sodium	3.3	7.0	8.2	17.5	345.0	—	208.0	22.0	31.0
Sulfate (SO_4)	16.0	27.0	210.0	269.0	780.0	—	1,798.0	233.0	290.0
Total Suspended Solids (TSS)	7.0	40.0	20.0	100.0	<30.0	30.0	152.0	20.0	100.0
Zinc (5,6)	0.025	0.120	0.064	0.310	—	—	0.4	0.061	0.30

16

(1) Based on "Status of the Nonradiological Water Quality and Nonfisheries Biological Communities in the Clinch River Breeder Reactor Plant, 1975-78", TVA, Feb. 1979. 15

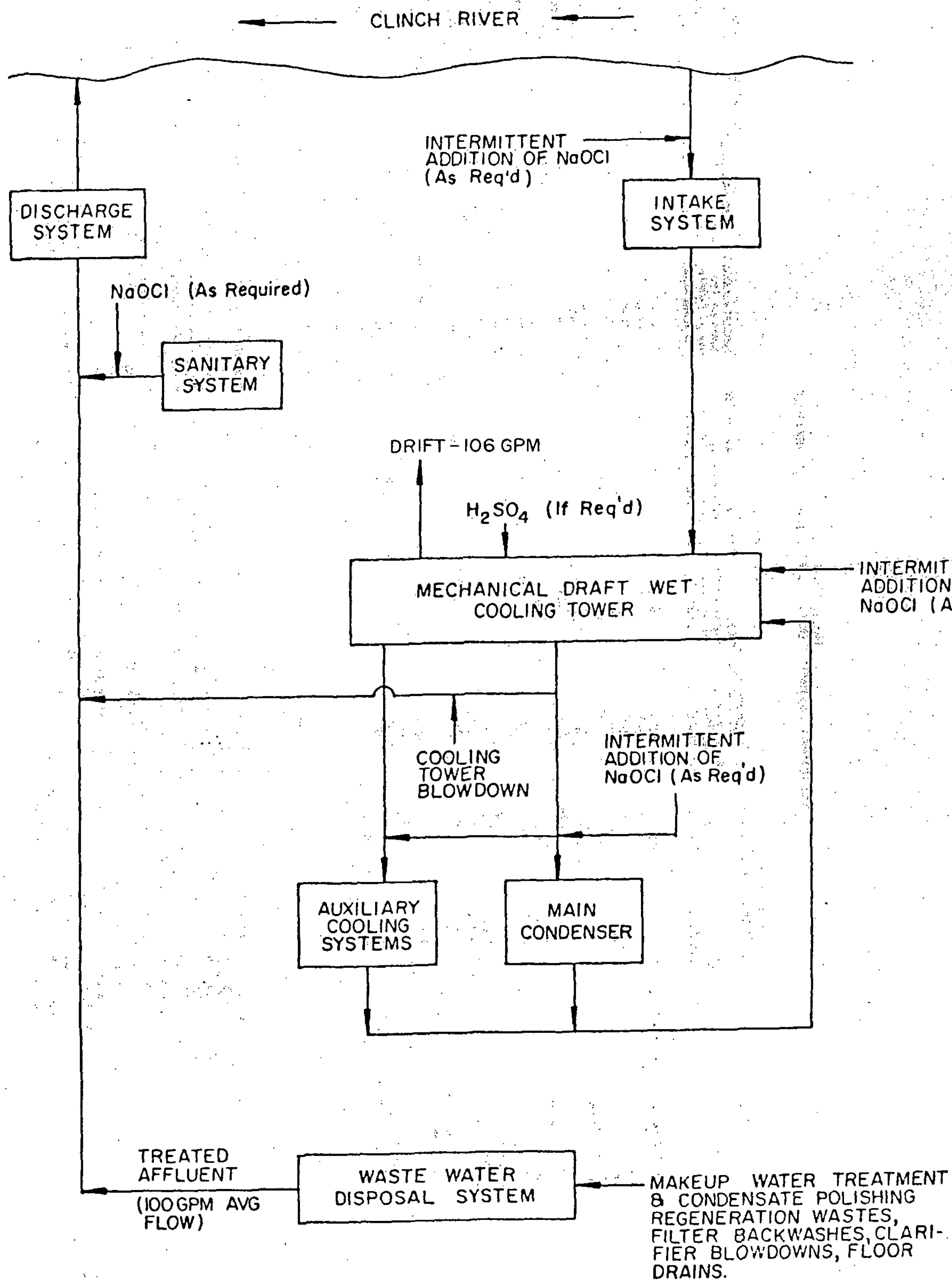
(2) Includes several minor recycled waste streams (Make-Up Water System equipment rinses, backwashes and blowdown; non-radioactive floor drains). These do not measureably affect the Cooling Tower Blowdown Chemical Concentrations.

(3) Includes Make-up Water Demineralizer and Steam Condensate Polisher regeneration wastes, Auxiliary Boiler blowdown and Non-Radioactive Lab and Sampling wastes. 16

(4) Field measurements using the orthotolidine calorimetric method repeatedly showed the chlorine residual concentration to be below the limits of detection (<0.05 mg/l). As there are no nearby sources of chlorine additions to the river, it can be assumed that the ambient level is zero.

(5) Includes contribution to effluent quantities from condenser erosion/corrosion.

(6) A single occurrence of Zinc in the concentration of 570 ug/L was reported for April 14, 1976 at a 16-ft depth. The same station on the same date reported a concentration at 3-ft and duplicate field samples at a 10-ft depth were <10, <10 and 20 ug/L respectively. The reason for the outlier value at the 16 ft depth is unknown, but sample contamination is suspected. The 570 ug/L value was not included in the table because of its questionable validity.



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9
9

Figure 3.6-1 CHEMICAL AND BIOCIDE ADDITIONS AND DISCHARGES AT MAXIMUM POWER OPERATION

3.7 SANITARY AND OTHER WASTE SYSTEMS

3.7.1 SANITARY WASTES

There will be two periods of sanitary wastewater generation: construction and normal plant operation. During both of these periods the sanitary wastewater may be characterized as normal domestic sanitary wastewater, except that no laundry wastes are expected for the CRBRP during normal operation because laundry will be processed off-site. The sanitary system for the construction periods is designed for peak manning of 2,450 persons. Maximum daily sanitary wastewater design flow will be 61,250 gallons or 25 gal/person/day. Figure 3.7-1 depicts the construction Sewage Disposal System. The average daily sanitary wastewater flow during normal operation will be 7,000 gallons. This is based upon 200 plant personnel or 35 gal/person/day for normal plant operation. Present projected number of plant personnel is 179 persons with a peak manning of 300 persons anticipated for annual shutdown. The permanent plant 9
design flow of 13,000 gal/day will be adequate for this peak loading. 8

Sanitary wastewater generated during the construction period will be treated by two package sewage treatment plants. The package plants, installed in parallel will have treatment capacities of 13,000 gpd and 52,000 gpd. Upon completion of CRBRP construction, the smaller plant will continue operation for the life of the project.

Treatment will be by the extended aeration variation of the activated sludge process, with chlorination of the effluent prior to discharge 9
into the Clinch River. Pretreatment is provided by means of a screening basket and an influent comminutor. Prior to installation of the sewage treatment plants, portable toilets will be used by construction personnel. Portable toilets may be used after operation of the Sewage Treatment Facilities to serve remote areas during the construction period.

The 13,000 gal/day capacity treatment plant, as described above, 8 9
will remain as part of the plant Sewage Disposal System for
normal plant operation. The normal plant operation Sewage
Disposal System will consist of the extended aeration unit, with 16
chlorination of the effluent prior to discharge into the Clinch
River. The extended aeration system alone is expected to effect
90 percent removal of suspended solids and biochemical oxygen
demand. Effluent concentration limits placed on the sewage
disposal system are provided in Table 3.7-1. Solid wastes 16
(sludge) generated by the Processes Water, Waste Water Disposal
and Sewage Disposal Systems will be trucked off-site for ultimate 9
disposal.

The Sewage Disposal System is designed in accordance with
applicable State standards.[1] Design capacity of the construc-
tion system is based on the peak construction force to assure
adequate treatment capacity throughout the construction period.
Similarly, the permanent plant system is designed to provide a
treatment capacity of 6,000 gal/day more than the normal plant 8
flow of 7,000 gal/day to handle the peak manning load and
infiltration from groundwater. Treated effluent discharge into 9
the Clinch River, during both construction and normal plant
operation, will meet the Draft NPDES permit limits.

3.7.2 OTHER WASTES

Since an electric auxiliary steam generator is being utilized, the only gaseous effluents discharged into the atmosphere will be exhaust from emergency operation or periodic testing of the diesel generators and the diesel driven fire pump. Estimated products of combustion during the expected test periods for untreated discharge to the atmosphere are listed in Table 3.7-2. Environmental effects of these gaseous effluents are discussed in Section 5.5.

The Radwaste Systems are discussed in Section 3.5. Chemical and Biocide Wastes are discussed in Section 3.6. Trash from the plant and solid, non-radioactive chemical wastes will be disposed of off-site by an independent contractor. 9

TABLE 3.7-1
SEWAGE DISPOSAL SYSTEM
EFFLUENT LIMITATIONS

	Draft NPDES Permit Limits (mg/l)	
	Daily Avg.	Daily Max.
Suspended Solids	30	45*
BOD	30	45*
Residual Chlorine	N.A.	2.0*
pH	6.0 - 9.0	6.0 - 9.0
Fecal Coliform (colonies/100ml)	N.A.	200*
Settleable Solids	1.0	1.0
Dissolved Oxygen	Shall contain a minimum of 1.0 mg/l at all times.	

*Section 401 Certification condition (Attachment D of the NPDES Permit)

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TABLE 3.7-2

EXHAUST EFFLUENTS FROM PLANT DIESEL ENGINES OPERATION (DURING TESTING)

	DIVISION 1 & 2 DIESEL GENERATOR (DG) UNITS	DIVISION 3 DIESEL GENERATOR (DG) UNITS	DIESEL FIRE PUMPS (DFP)	TOTAL
1. Quantity	2	1	2	5
2. Test				
a. Frequency per Unit	1 start test per month & at least 1 full loading test every 18 months	Same as Division 1 & 2 DG units	1 start test per week	-
b. Duration, per Unit	2 hours & 24 hours, respectively	Same as Division 1 & 2 DG units	30 min.	-
3. Maximum pollutants released to atmosphere, lbs/year:				
a. Particulates	48*	8.9*	0.68#	57.58
b. Sulfur dioxide (SO_2)	3,446*	637*	49#	4,132
c. Nitrogen oxides (NO_X)	19,296*	3,570*	272#	23,138
d. Organic compounds	336*	62*	4.73#	402.73
e. Carbon monoxide (CO)	691*	128*	9.72#	828.72

*Based on 48 hours running time per year per DG Unit and the maximum emission rates given in TABLE 5.5-1.

#Based on 26 hours running time per year per DFP unit and the maximum emission rates given in TABLE 5.5-1.

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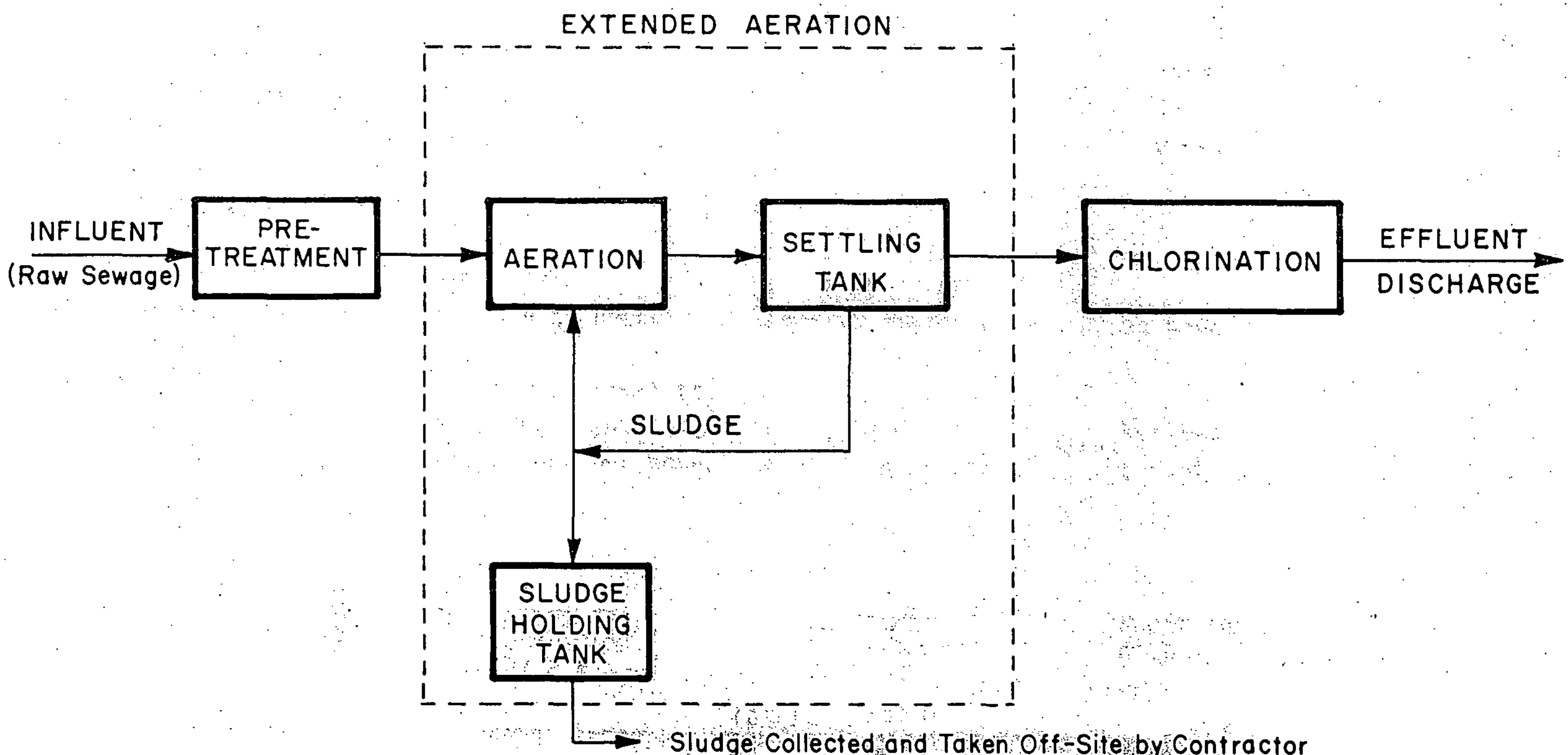

FIGURE 3.7-1 CONSTRUCTION AND OPERATIONAL SANITARY WASTE SYSTEM SCHEMATIC |9 |16

FIGURE 3.7-2

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3.8 RADIOACTIVE MATERIALS INVENTORY

3.8.1 NEW FUEL ELEMENTS

3.8.1.1 CORE ASSEMBLIES

A core fuel assembly is composed of 217 rods arranged in a triangular pitch and supported in a hexagonal metal duct. Rods are made of stainless steel and have an outer diameter of 0.230 inches. The dimension across the flats of the duct is approximately 4.7 inches; the total weight of the assembly is about 443 pounds. Longitudinally, each rod consists of a 36-inch active
fuel region, 14-inch axial blankets on top and bottom of the fuel 9
and a fission gas plenum. Figure 3.8-1 represents a plan view of the core. Figure 3.8-2 presents a schematic drawing of a single,
core fuel rod. Fuel for the core consists of oxides of plutonium 9
and depleted uranium sintered into pellets and encapsulated in the rods. The 36-inch core length of 156 fuel assemblies contains 5.2 metric tons of heavy metal (fertile and fissile
plutonium plus uranium) with a plutonium enrichment of 33.2 9
weight percent. The case where CRBRP spent fuel is reprocessed and recovered Pu is recycled as feed is discussed in the appendix
to Section 5.7. In this case the Pu enrichment is 35.7 weight 16
percent. In the 156 upper and lower axial blanket sections of
the fuel assemblies, the total weight of heavy metal is 9
approximately 4.2 metric tons.

An annual shutdown for refueling is planned for all operating cycles. The fuel management scheme calls for the replacement of all fuel assemblies as a batch at two-year intervals. In alternating years, under equilibrium conditions, six inner
blanket assemblies are removed and replaced by six fresh fuel 9
assemblies in order to add sufficient excess reactivity to the system to complete the two-year burnup interval. A total of 162 fresh fuel assemblies are therefore required every two years.

New fuel assemblies will be packaged in special containers and
shipped to the site in the Safe Secure Trailer (SST) provided by 9
DOE's Division of Military Application. The shipping containers
will be DOT (Department of Transportation) and NRC approved. Six
fuel assemblies per shipment is expected. On this basis, average 6 9 12
yearly shipments of fuel assemblies would be about 14.

3.8.1.2 INNER/RADIAL BLANKET ASSEMBLIES 9

A blanket assembly is composed of 61 rods arrayed in a triangular
pitch and supported in a hexagonal metal duct similar to that of
the fuel assembly. Rods are made of stainless steel and have an 9
outer diameter of 0.506 inches. The dimension across the flats
of the duct is the same as the fuel assembly, 4.7 inches; the
total weight of the assembly is about 536 pounds. Longitudinally,
each rod consists of a 64-inch blanket region and associated 9
fission gas plenum.

The fertile material in the blanket region is depleted uranium
oxide sintered into pellets and encapsulated in stainless steel
rods. The 64-inch blanket length of 208 blanket assemblies (82
inner blankets and 126 radial blankets) contains approximately 9 14
21.0 tons of heavy metal (99.8 w/o U-238 and 0.2 w/o U-235).

The inner blanket assemblies are replaced as a batch at two year
intervals, with the exception of six assemblies which are
replaced by fresh fuel assemblies at the mid-term refueling. 9
Radial blanket assemblies in the first and second radial blanket
rows are replaced as a batch at four and five year intervals,
respectively. Therefore, on the average, during annual
refueling, approximately 69 blanket assemblies will be shipped in 6 9 14
a similar container as the unirradiated fuel assemblies. Based
upon 6 assemblies per shipment there will be, on the average, 12
shipments arriving each year at the CRBRP carrying blanket 6 12
assemblies.
9

3.8.2 IRRADIATED FUEL ELEMENTS

3.8.2.1 CORE ASSEMBLIES

Irradiated properties of the Clinch River core fuel assemblies were developed based on annual refueling and a core full power capacity factor of 75 percent (equivalent to 274 full power days of operation). An average of 81 fuel assemblies will be discharged from the plant per year at equilibrium core conditions. Total weight of these irradiated assemblies is approximately 18 tons. The burnup averaged over all the fuel assemblies discharged from the plant is approximately 80,000 MWD/Ton of heavy metal in the core portion of the assembly. The peak pellet burn-up design goal is 110,000 MWD/Ton of heavy metal.

Burnup averaged over all the axial blankets in the discharged assemblies is approximately 2,200 MWD/Ton of heavy metal in the blanket region of the assembly. During irradiation, neutron capture in the fertile material (U-238) of the axial blankets breeds, on the average, 0.3-0.4 kg of fissile plutonium per discharged assembly. This gain in fissile content partially compensates for the loss of fissile material in the core region during operation.

The In-Vessel Transfer Machine (IVTM) mounted in the reactor head carries out withdrawal of spent fuel assemblies from their positions in the reactor core and deposits them into a sodium filled Core Component Pot (CCP) in a transfer position outside the core but inside the reactor vessel. Horizontal motion of the In-Vessel Transfer Machine is accomplished by means of triple rotating plugs mounted in the reactor head.

By rotating these plugs in sequence, the In-Vessel Transfer Machine, which is a simple straight pull device, can be indexed over any core or transfer position in the reactor.

After the spent fuel assembly has been placed in the transfer position, the Ex-Vessel Transfer Machine (EVTM) withdraws the CCP container with the assembly and transfers it to the sodium-filled Ex-Vessel Storage Tank (EVST) located in the Reactor Service Building.

Fuel assemblies will remain in the EVST for at least 100 days prior to being loaded into a shipping cask for transportation.

Irradiated fuel assemblies will be transported and protected in a cask approximately eight feet in diameter by 22 feet in length. Irradiated fuel assemblies are inserted in removable canisters. The approximate weight of the cask is 100 tons and is designed for transportation on a standard high capacity railroad flatcar. The cask and car combination is designed in accordance with NRC and DOT regulations and is provided with crash protection and passive cooling capability. The actual number of fuel assemblies per cask shipped will be determined on the basis of economic considerations and the heat load limit of the cask.

It is estimated that during the spent fuel shipping phase there will be 14 shipments per year.

3.8.2.2 INNER/RADIAL BLANKET ASSEMBLIES

Irradiated properties of the blanket assemblies were developed based on the same reactor operation conditions as those used for

the core fuel assemblies. On the average, 69 blanket assemblies 6 9 14
will be discharged from the plant per year. The burnup averaged
over all the discharged blanket assemblies is approximately 8,000 9
MWD/Ton of heavy metal (depleted uranium). During irradiation,
neutron captures in the fertile material (U-238) of the radial
blanket breeds on the average 2.5-3.0 kg of fissile plutonium per 9
discharged blanket assembly.

The expected mode of protection for packaging of the discharged 9
blanket assemblies for shipment is the same as the core fuel
assemblies. One day after shutdown, the peak inner/radial
blanket assembly heat generation would be 19.7/12.0 kW. Thirty 9
days after shutdown, these heat generation values are 2.61/1.64 6
KW and 2.53/0.88 KW, respectively. This lower heat generation
rate would allow for shipment of blanket assemblies earlier than
the 100 days assumed for fuel assemblies. It is estimated that 14
the number of inner/radial blanket assemblies removed from the
reactor will require about 12 shipments per year.

3.8.3 Radioactive Waste Material

3.8.3.1 Replacement In-Vessel Components

3.8.3.1.1 Control Rod Assemblies and Drive Lines

Control rod assembly consists of a bundle of stainless steel
clad, boron carbide pins. The 9 primary control rod assemblies
have bundles of 37 pins while the 6 secondary control rod
assemblies have bundles of 31 pins each. The bundles of pins are 9
arranged in hexagonal inner ducts within outer ducts having the
same external geometry as the fuel assembly ducts. The 20
percent cold worked Type 316 stainless steel tubing is

of sufficient wall thickness and plenum size to safely contain the full volume of helium released in one year of operation (up to 2,700 psi for 275 Full Power Days -- 75 percent core capacity factor). Due to lifetime limitations from pressure buildup in the rods, pellet swelling, and bowing considerations it is anticipated that the fifteen control rod assemblies will be replaced after either one or two year lifetimes. Each of these assemblies weighs approximately 300 pounds. 9

Expected mode of protection for shipment of these assemblies from the plant is in the same casks used for the fuel assemblies. The use of such a cask is proposed due to possible leaks and migration of activated gases from the control assemblies. 9

The control rod assembly drive lines are fabricated with Inconel-718. Each of the fifteen drive lines are 30 feet long and consist of three concentric shafts with a two-inch outside diameter. 9

Current estimates indicate that the 15 drive lines will be replaced over 15 year intervals. It is expected that the drive lines will be cut into shorter sections and shipped in approved shipping casks. 9

3.8.3.1.2 RADIAL SHIELD ASSEMBLIES

A shield assembly is constructed of a 20% cold worked type 316 stainless steel duct tube that is drawn into a hexagonal shape. The duct tube contains closely packed, 20% cold worked, type 316 stainless steel rods. 9
The dimension across the flats of the assembly is approximately 4.7 inches; the total weight of the assembly is about 362 pounds. Relative positioning of the shield assemblies is shown in Figure 3.8-1. 9

Based on the expected neutron flux levels in the CRBRP, the 14
entire first row of shield assemblies (72 assemblies, total 9
weight approximately 13 tons) will be replaced every 10 or 15
years to maintain their required mechanical properties. Being in
a lower neutron radiation environment, part of the second row (78
assemblies, total weight approximately 14 tons) will be replaced 9 14
after 10 to 25 years of service. The third row (84 assemblies,
total weight approximately 15 tons) and the fourth row (78
assemblies, total weight approximately 14 tons) are not expected 9 4
to be replaced during the operating lifetime of the plant.

The expected form of shipment of these assemblies from the plant is in the casks designed for transporting spent fuel and blanket assemblies.

On removal from the reactor, the shield assemblies can be
immediately shipped from the plant without exceeding the heat
load limitation of the cask (36 kW). The decay heat associated 8 16
with the shield assemblies would be 0.34 kW/assembly one day
after shutdown.

Current judgment is that shield assemblies will be shipped immediately upon removal from the reactor. The result is a full utilization of the shipping casks.

Current considerations call for not more than twelve assemblies
per year after 10 years of plant operation except for
miscellaneous assemblies used for surveillance specimens. This
will require two shipments per year. The number of shipments is 9
based on six shield assemblies loaded per cask. The actual 4
number of assemblies per cask will be determined on the basis of
economics and on heat load considerations in the casks and in
accordance with applicable NRC and Department of Transportation
regulations.

Proven suitability of the casks for their use in shipment of spent fuel will assure the acceptability for shipping the radial shield assemblies, as well as control rod assemblies and radial blanket assemblies.

3.8.3.2 OTHER RADIOACTIVE WASTE MATERIAL

Processing procedures for radwaste are discussed in Section 3.5. Radioactive waste material will be shipped off-site and disposed of at an approved burial ground. The source of these radioactive wastes is 9
the solid radwaste described in Section 3.5.3. The estimated weight, volume and activity of solid radwaste shipments per year are shown in Table 3.5-10. Estimated number of shipments per year are shown in Table 3.5-11.

All drums and special containers being shipped off-site will be monitored for radioactivity to assure that the dose rates conform to the regulations set by the Department of Transportation and 10 CFR 71. Temporary storage space is provided on-site prior to shipment of the drums and containers. 9

The inert gas receiving and processing system has liquid radioactive
waste in the form of tritiated water which is collected in a holding tank in 10
the Cell Atmosphere Processing System. It is periodically transferred to the Radioactive Waste Disposal System for processing and ultimate disposal. The routinely generated solid waste will consist of compressor diaphragms and spent filter-type vapor traps. These solid wastes will be transferred to the Radioactive Waste Systems for disposal and are included
in Tables 3.5-10 and 3.5-11. 13

At the present time there are no plans for disposal of radioactive metallic sodium waste and sodium bearing cold traps. The quantity, activity and onsite storage of the metallic sodium and sodium bearing solids are described in Section 3.5.3. 13

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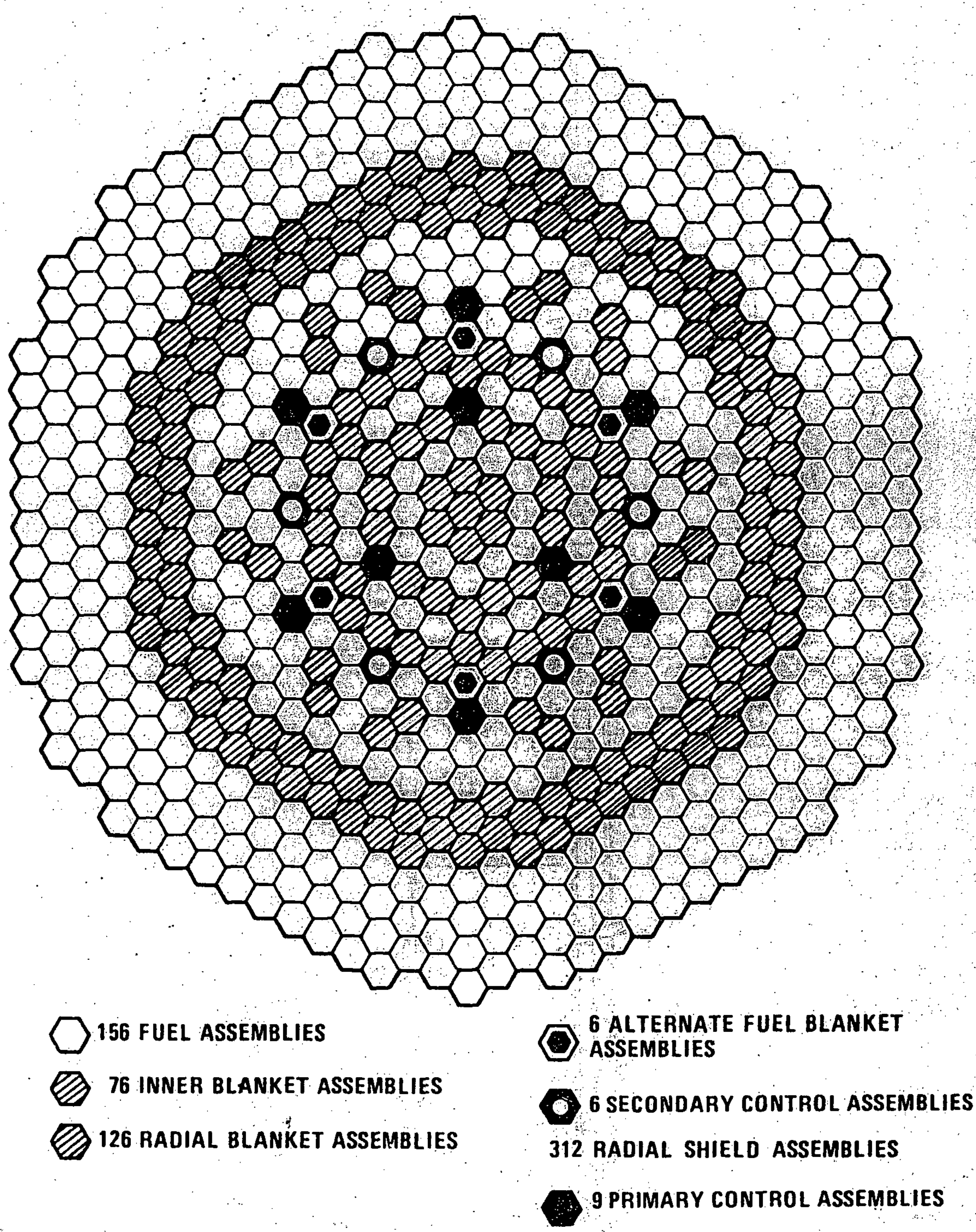

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Figure 3.8-1. Clinch River Breeder Reactor Core Layout

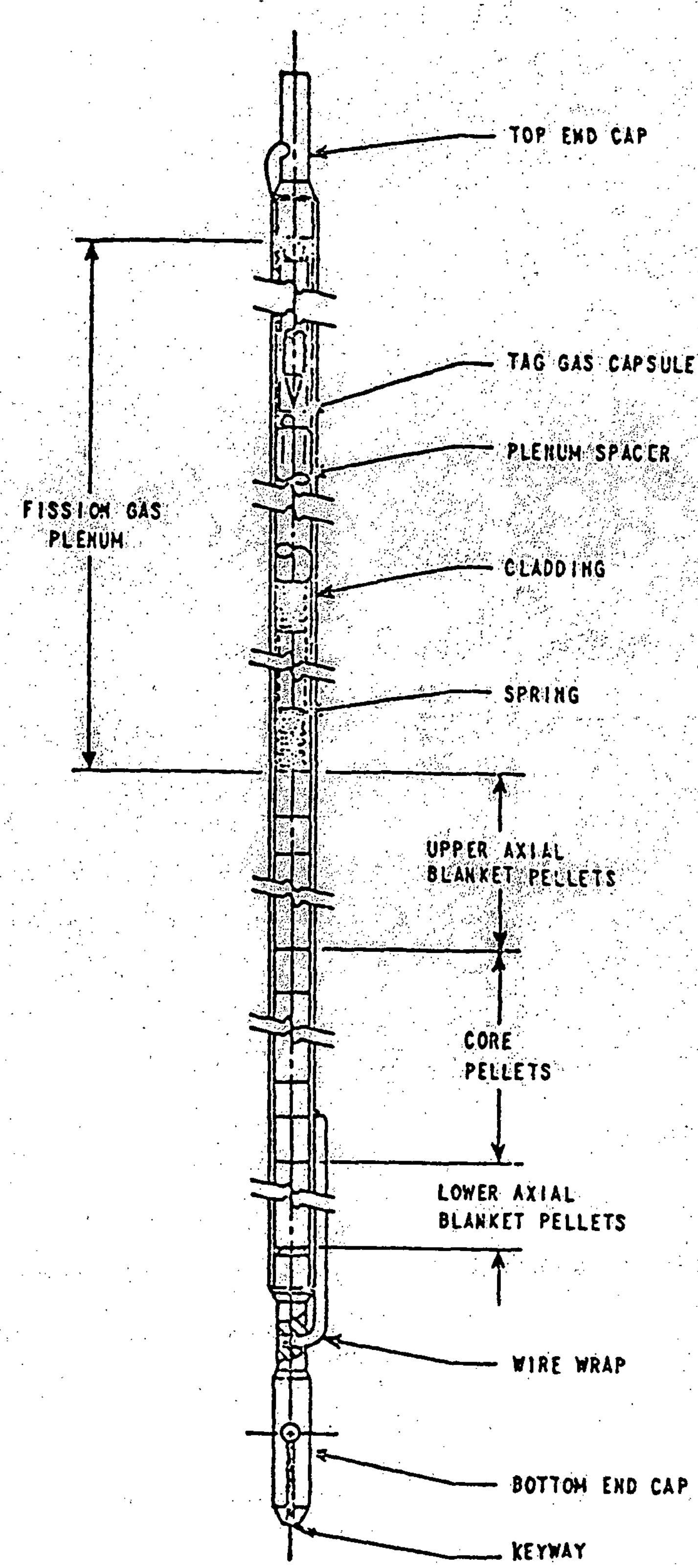

Figure 3.8-2. FUEL ROD

9

3.9 TRANSMISSION FACILITIES

3.9.1 LOCATION AND DESCRIPTION OF RIGHT-OF-WAY

The transmission route and related facilities are discussed in this section. Environmental impacts of construction are discussed in Section 4.2, the impacts of operation are discussed in Section 5.6 and alternatives are discussed in Section 10.9.

The proposed transmission line has been divided into two
segments, A-B Compartment-15 and B-C Compartment-13, for purpose 13
of description in this section and facilitation of the discussion
of the alternate and proposed routes in Section 4.2, 5.6 and
10.9. Point A marks the beginning of the proposed route at the
junction of the existing Sequoyah-Bull Run 500-kV transmission
line and the TVA-owned Ft. Loudoun-Roane 161 kV transmission
line, as shown in Figures 3.9-1a and 3.9-1b. From this point, 13
the proposed route travels in an east-west direction parallel to
the existing 500-kV line to the DOE-owned Ft. Loudoun K-31 161-kV 9
transmission line which runs north and south. The proposed
corridor then veers south, parallel to this DOE-owned line, into 9
the proposed switchyard of the CRBRP at point C. Segments A-B
and B-C are 1.4 and 1.8 miles long, respectively.

3.9.2 PHYSICAL DESCRIPTION OF CORRIDOR

The transmission line route is situated between two major ridges of the Site area, Chestnut Ridge and Haw Ridge. Within the proposed corridor, the topography consists of rolling hills which range between elevations of 800 and 960 feet. Between the crests of these hills, two streams which drain into the Clinch River near CRM 18 will be crossed by the proposed transmission system. Due to the drainage pattern of the area, intermittent streams of lesser importance are also found along the proposed route.

Soils found within the proposed corridor are quite variable as shown in Figure 2.7-1. A detailed discussion of all soil types for the CRBRP Site is given in Section 2.7. The following discussion of soil types is taken from the 1942 Soil Survey of Roane County.[1]

Clarksville, Upshur, Fullerton and Colbert are the major soil types found within the proposed transmission corridor.[1] Of these four major types, Clarksville is the predominant (34%) soil type found. Clarksville soils are low in fertility, contain little organic matter and are highly acid. This soil responds only slightly to management as a result of low moisture-supplying capacity and low natural fertility. The next most abundant soil type is the Upshur series (27%), which is highly susceptible to accelerated erosion because of the prevailingly rolling topography. Crops are unsuited for this soil, but grass grows very well. The Fullerton Series (20%) consists of deep well-drained soils developed on broad rounded hills and ridges in residuum, weathered from cherty dolomitic limestone. It is found on all slopes. Productivity is influenced by the amount of chert, slope and degree of erosion on this soil. Lack of proper management by the agricultural families who inhabited the area prior to 1942 caused a high degree of erosion on all the soils named above.

Remaining soils are of minor importance compared with those already discussed. For details concerning description and impact on these soils, see Sections 2.7 and 4.2, respectively.

3.9.3 LAND USE

The area through which the proposed transmission line will pass is presently composed of pine plantations and second growth | 13
hardwoods. Prior to 1942, this land was used for various | 13
agricultural and forestry practices by resident farmers. It has reverted back to forest or reforested under the Doe Forest | 13

Management Program. No land in the proposed transmission line
area is presently under agriculture cultivation. One half acre 13
of cottonwood is being cultivated under the Forest Management
Program. Recent Forest Management has consisted of harvesting
about five percent of the trees. Loblolly pine plantations are
being selectively cut and short leaf pine plantations will be
clear cut.

No part of the area through which the proposed line will pass has been developed for recreational use. There are no wildlife refuges in the vicinity and the general Site area is closed to hunting. There are no homes in the area nor do any public roads cross the proposed corridor route.

An underground gas pipeline owned and maintained by the East
Tennessee Natural Gas Company crosses the proposed corridor. The
pipeline presently crosses the existing 500-kV right-of-way (ROW)
just west of point B, as shown in Figure 3.9-1b. It is a six 13
inch spur pipe-line serving Lenoir City. An underground Bell 13
Telephone crossing at New Zion Road provides service to K-25.

3.9.4 TERRESTRIAL ECOLOGY

3.9.4.1 SEGMENT A-B (COMPARTMENT 15) 13

Hardwood and hardwood-successional pine-cedar communities
predominate along this segment of the proposed ROW, as shown in
Table 3.9-1. The dominant overstory trees are species of oak and
hickory with tulip poplar and sweetgum found on the moister
sites. Within this ROW, these communities cover 21.5 acres or 13
nearly 69 percent of the corridor.

The coniferous forests consist of successional stands of Virginia
and shortleaf pine and plantations of loblolly, and shortleaf 13
pine. These coniferous forests cover approximately 9 acres or
nearly 29 percent. Approximately 2 percent of this segment or 13

1/2 acre is unforested. These areas characteristically have 13
shrubby growth and herbaceous species mixed with hardwood and
cedar seedlings.

3.9.4.2 SEGMENT B-C (COMPARTMENT 13) 13

Plantations of white and loblolly pine are the major overstory 13
types along segment B-C, comprising 63 percent of the total
acreage. 13

Hardwood areas along this segment of the transmission line corridor are generally fingerlike extensions of larger stands. Communities of tulip poplar, sycamore, sweetgum and northern red oak comprise approximately 28 percent of the total acreage along this corridor. These hardwood communities are found just west of point B and east of point C with the coniferous forest concentrated in the central portion of the segment.

In areas that have been disturbed, eastern red cedar is also
present. As in segment A-B, 20 percent of the corridor has been
cut-over or disturbed and has been forested with loblolly and
Cottonwood plantations. Harvested portions of short leaf pine 13
and thinned portions of loblolly and white pine plantations
border the transmission line. 13

3.9.4.3 WILDLIFE

A variety of game and non-game species inhabit the vegetative communities along the corridor.

White-tailed deer, probably the only big game species in the area, prefer hardwood-pine forests and shrub-grown areas. Eastern cottontails and eastern gray squirrels are the two major small game species present. Cottontails prefer open fields and edge areas of the transmission line corridor while gray squirrels reside in deciduous forests.

Red and gray foxes are the most common predators along the transmission line corridor. They range through many community types in search of their diet of small animals. The omnivorous opossums, raccoons and striped skunks also utilize the woodlands along the proposed route.

Woodchucks, the largest rodents in the vicinity, burrow and feed in the wooded areas and open fields. Other small rodents present include the chipmunk in hardwood forests and brushy areas, white-footed mouse in open woodlands and brushy areas and golden mouse in forested areas.

Insectivorous mammals of the forest and fields, such as the smoky shrew, southeastern shrew and eastern mole, may also be present, but only the short-tailed shrew, a forest dweller, was observed in the area.

Four upland game birds known to inhabit the transmission line area are the ruffed grouse in deciduous woodlands, bobwhite and mourning doves in open brushy fields and woodcock in the moist woods and fields. Both game birds and raptorial species utilize the transmission corridors. Several species of raptors, including the red-shouldered, broad-winged Cooper's and sharp-shinned hawks, great horned owl and screech owls nest in the bordering woodlands and hunt in the open woods and fields of the transmission corridor. Barred owls nest and hunt in the dense woodlands. Hardwood communities in the transmission line area had the highest number of avian species, with border areas between woods and fields or ROWs having the second highest number and old fields and open areas the third highest. Species found in each respective community type are listed in Table 2.7-15.

The two streams crossing the proposed right-of-way support a large number of herpetofauna species, with open fields supporting the second highest species number. Species composition is similar to that described for the entire Site.

A wide variety of forest-dwelling worms, crustaceans, spiders and insects occur in the Oak Ridge area. These species are listed in Table 2.7-22.

A more detailed discussion of mammals, avifauna, herpetofauna and invertebrates is contained in Section 2.7.

3.9.5 EXISTING OR PROPOSED ACCESS ROADS

In the construction of transmission facilities, the movement of equipment, material and personnel from the network of existing highways and roads to the transmission line corridor sometimes requires the construction of new access roads to supplement the existing farm and woods roads.

Figure 3.9-2 has been marked to identify major access roads in the vicinity of the proposed transmission line route. Some of these roads were constructed when the existing transmission line was built. Additional roads have been added to provide access for recent forest management harvesting operations and are not shown on the figure.

Although specific access roads will not be determined until the line structure locations are finalized, it is anticipated that the existing roads, the existing transmission line corridor and the proposed transmission line corridor will satisfy future construction and maintenance requirements.

However, in the event that additional roads are required, routes approximately 12 feet wide will be cleared and graded. These new roads will be located to avoid large, dense stands of mature trees to the extent practicable. Drainage ditches, terraces and ground cover will be provided to reduce potential soil erosion. Existing area roads and roads along the transmission line corridor will suffice for future maintenance work; therefore, no maintenance on existing or new access roads is anticipated.

Probable access availability to the various line segments has been identified along the proposed corridor route by numerical designation or reference points, as shown in Figure 3.9-2. Access availability at these reference points is discussed below.

3.9.5.1 POINTS 1 AND 2

The transmission route will utilize the existing cleared right-of-way for construction and maintenance access. Entry would be provided by use of the existing access roads at points "1" and "2".

3.9.5.2 POINTS 3, 4 AND 5

Existing right-of-way access will be used with entry at point "2" and by previous routes, points "3", "4" and "5", developed for the parallel Bull Run-Sequoyah 500-kV line.

3.9.5.3 POINTS 5 AND 6

The right-of-way will be used for access with entry at the proposed switchyard, point "6", and previously identified point "5".

3.9.5.4 POINTS 6 AND 7

The parallel River Road will be used for access at point "7" as well as entry to the right-of-way from the proposed switchyard, point "6".

3.9.6 AREAS OF HISTORICAL AND ARCHAEOLOGICAL INTEREST

In developing the route for the proposed transmission line corridor, the National Register of Historic Places, published by the National Park Service, was consulted to determine if the proposed corridor would conflict with any previously identified significant historical or archaeological sites. This review failed to reveal any conflicts. For the CRBRP Site, which would include approximately one half of the proposed transmission line corridor, an extensive historical and archaeological investigation was conducted by personnel from the Department of Anthropology, University of Tennessee. The results of these studies are given in Section 2.3, Regional Historic, Scenic, Cultural and Natural Landmarks. Figure 2.3-1a shows the archaeological and historical sites within the CRBRP area and the existing transmission line corridors. The proposed corridor does not pass through or near any areas of known significance.

Coordination with the State Historic Preservation Office was completed in May 1982 for the off-site portions of the expanded transmission line right-of-way. No field survey was required because records and past experience for the area and for the terrain show no significant potential for sites in the zone to be effected.(2) 16

TVA will follow its normal construction procedures and when an artifact is uncovered during excavation or grading, work will stop until appropriate authorities are consulted and a determination of the finding's significance can be made.

3.9.7 DESCRIPTION OF RIGHT-OF-WAY

The location of the CRBRP on the Clinch River will allow the introduction of generated electricity from the CRBRP into the TVA power system with a minimum of new transmission line construction. The existing TVA 161-kV power system in this area has been developed to supply relatively large quantities of power to the DOE complex from several generating plants and is capable 9 of receiving the power generated by or of supplying power to the CRBRP. The system is also capable of experiencing a total loss of output from the plant without serious effects to the system. Off-site power requirements for the CRBRP dictate development of a redundant power supply system that guarantees, under single contingency emergency conditions, sufficient quantities of electric power for the orderly shutdown of the CRBRP. Therefore, the plant will utilize transmission line connections for station service requirements which are distinctly separate and remote from the plant power circuit connections. 13

The DOE-owned Ft. Loudoun K-31 161-kV Transmission Line crosses the proposed Site and will be utilized to provide emergency shutdown power. The DOE-owned line crosses the eastern edge of the 161-kV switchyard. This permits the line to be opened and the two resulting sections to be connected to the station service switchyard by the installation of two short spans of conductor. This will provide reliable and independent power sources for station service in accordance with applicable NRC guides, standards and criteria. The conductor will be removed from existing structures along the 0.5 mile of right-of-way (ROW) to its juncture with the Bull Run-Sequoyah 500-kV line and transferred to new structures on the eastern side of the expanded 0.5 mile ROW. One of the line connections will be from Kingston and Bull Run Steam Plants via the K-31 switchyard and the other connection will be from the Ft. Loudoun Hydro Plant. At the juncture with the 500-kV line ROW. the DOE owned line will cross under to two 161kV lines looped to TVA's power circuits through a protective safety structure engineered so that physical failure of either circuit would not endanger the station service line. 9 9 9 13 9

To connect the CRBRP generation into the area power system, TVA will utilize the TVA-owned Ft. Loudoun-Roane 161-kV Transmission Line which is located approximately 2.7 miles northeast of the CRBRP Site. This transmission line will be opened and the ends reconnected as shown on Figure 3.9-2, to two separate single-circuit lines which will be constructed to the plant switchyard. 13

The proposed access utilizes right-of-way common with the Sequoyah-Bull Run 500-kV line. To accommodate the two 161-kV circuits along this 2.7 mile section, the existing 200-foot-wide right-of-way will be expanded an additional 160 feet. This will 13
provide 100 feet separation between the 161-kV circuits with 110 feet separation between the 500-kV circuit and the inside 161-kV circuit and 50 feet from the outer 161-kV circuit to the edge of the right-of-way. This corridor will require 52.4 acres of new 16
right-of-way easement.

At the intersection of the 500-kV and the DOE-owned 161-kV, the 9 13
route turns southeastward and parallels the existing DOE-owned 161-kV Transmission Line to the CRBRP switchyard at point C, a 9
distance of approximately 0.5 mile. This section of parallel line will be constructed so that the northern loop line will be suspended on the existing DOE owned Fort Loudoun K-31 towers while the southern loop line will be placed on new towers. The separation of the lines will be such that the northern loop will be on existing towers, the southern loop on towers 100 feet away, 13
and the existing DOE circuit transferred to new structures 100 feet further away with the ROW edge 50 feet east of the third line. This 0.5 mile section will require approximately 10.6 acres of new rights-of-way.

The bases for determining the amount of horizontal separation that is provided for various voltage transmission lines are reliability, safety, good engineering practice, and past experience. The proposed 100-foot separation between the centerline location of the existing 161-kV line and the centerline of proposed 161-kV loop connection will provide the necessary reliability and operating safety required for the emergency shutdown power requirements of the Clinch River project.

3.9.8 DESIGN DESCRIPTION OF PROPOSED TRANSMISSION LINE

To connect the CRBRP generation into the area power system, a new loop connection will be constructed connecting the existing TVA-owned Ft. Loudoun-Roane 161-kV Transmission Line located approximately 2.8 miles northeast of the plant site. The loop connection will be constructed on separate rows of structures with adequate lateral separation to assure that the structural failure of one of the circuits would not jeopardize the integrity of the other circuit.

These transmission line connections will be designed to meet the medium design loading requirements of the National Electrical Safety code. In addition, TVA design cases provide for wind loadings of approximately 85 mile per hour winds on bare conductor and vertical loading strength based on one inch of radial ice. These loading conditions assure adequate strength even under extreme weather conditions.

Structures proposed for this loop connection will be compact, narrow based steel towers.

15

Each circuit of the loop connection will consist of three 2,034,500 C mil (1.68-inch diameter), 72/7 stranding ACSR conductors, one conductor per phase and one 7 No. 9 alumoweld shield wire. Wire tensions for the conductors and shield wire will be selected to assure that vibration damage will not occur. Long experience with transmission lines in the Tennessee Valley area have verified that where everyday tensions are kept below 18 percent of the ultimate strength of the cable, vibration will not be a problem.

Galloping of conductors is a condition that has never been observed on lines in the eastern portion of the TVA system. TVA has had only minor reports of galloping in its entire operating experience; these have occurred only on short span lines in the central and western portions of TVA's service area.

As stated earlier, shield wires will be installed on the loop connections to provide lightning protection for the circuits. Even though the lines are located in an area with an isokeraunic level of 50, TVA's experience has shown that the outages on similar type lines in this area varies from zero to three flashover interruptions annually per 100 miles of line. The use of circuit breakers with high speed reclosing relays results in the majority of these interruptions being momentary.

3.9.9 EXISTING SUBSTATIONS AFFECTED

No existing substation will be affected by the construction of the proposed CRBRP with the possible exception of some possible adjustments in switching facilities. The need for these facilities will be determined as the Clinch River Project develops. If such adjustments are deemed necessary, they will be very minor in nature.

TABLE 3.9-1

COMMUNITY TYPES OF THE PROPOSED TRANSMISSION LINE ROUTE

OF THE CRBRP SITE AREA

Segment A-B, Compartment-15 13

Stratum #	Forest Cover Type	Acreage %	On Site
	Hardwood:		
10	White oak - Northern and Southern Red oak	4.0	
18	Red oak - White oak	6.0	
	Pine:		
2	Shortleaf Plantation - 1948	1.5	
3	Loblolly Plantation - 1950	2.0	
5	Loblolly Plantation - 1951	4.5	
23	Loblolly Plantation - 1979	1.0	
	Hardwood - Pine - Cedar:		
9	Cedar - Virginia Pine - Red oak	3.5	
	Hardwood - Pine:		
12	Red oak - Shortleaf Pine	5.0	
20	Shortleaf Pine - Hickory - Yellow Poplar	3.0	
27	Woods - Roads	0.5	
		31.0	

13

TABLE 3.9-1
(Continued)

Segment B-C, Compartment-13 13

Stratum #	Forest Cover Type	Acreage %	On Site
	Hardwood:		
12	Cottonwood Plantation - 1979	0.5	
23	Red oak - White oak - Yellow Poplar	5.5	2.5
26	Red oak - Yellow Poplar	2.0	
31	Yellow Poplar - Red oak	2.5	2.5
37	Ash - Sycamore	0.5	
	Pine:		
1	Loblolly Plantation - 1951	7.0	
2	White Pine Plantation - 1951	4.5	
3	White Pine Plantation - 1952	1.5	0.5
10	Loblolly Plantation - 1979	6.5	3.0
43	Woods - Roads	0.5	
		31.0	8.5

13

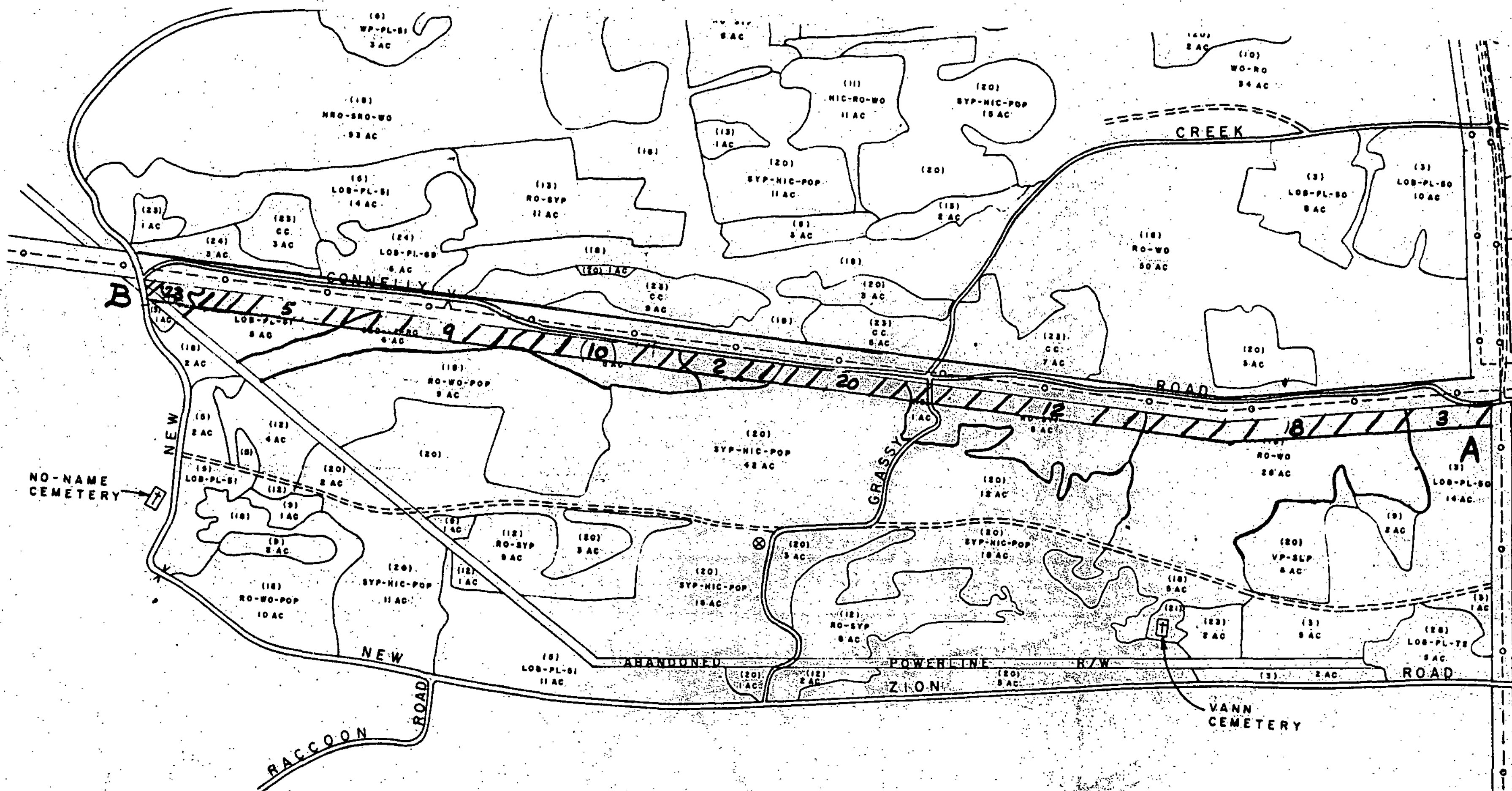

FIGURE 3.9-1a. Proposed Transmission Line Route of the CRBRP Area, Segment A-B, Compartment #14.

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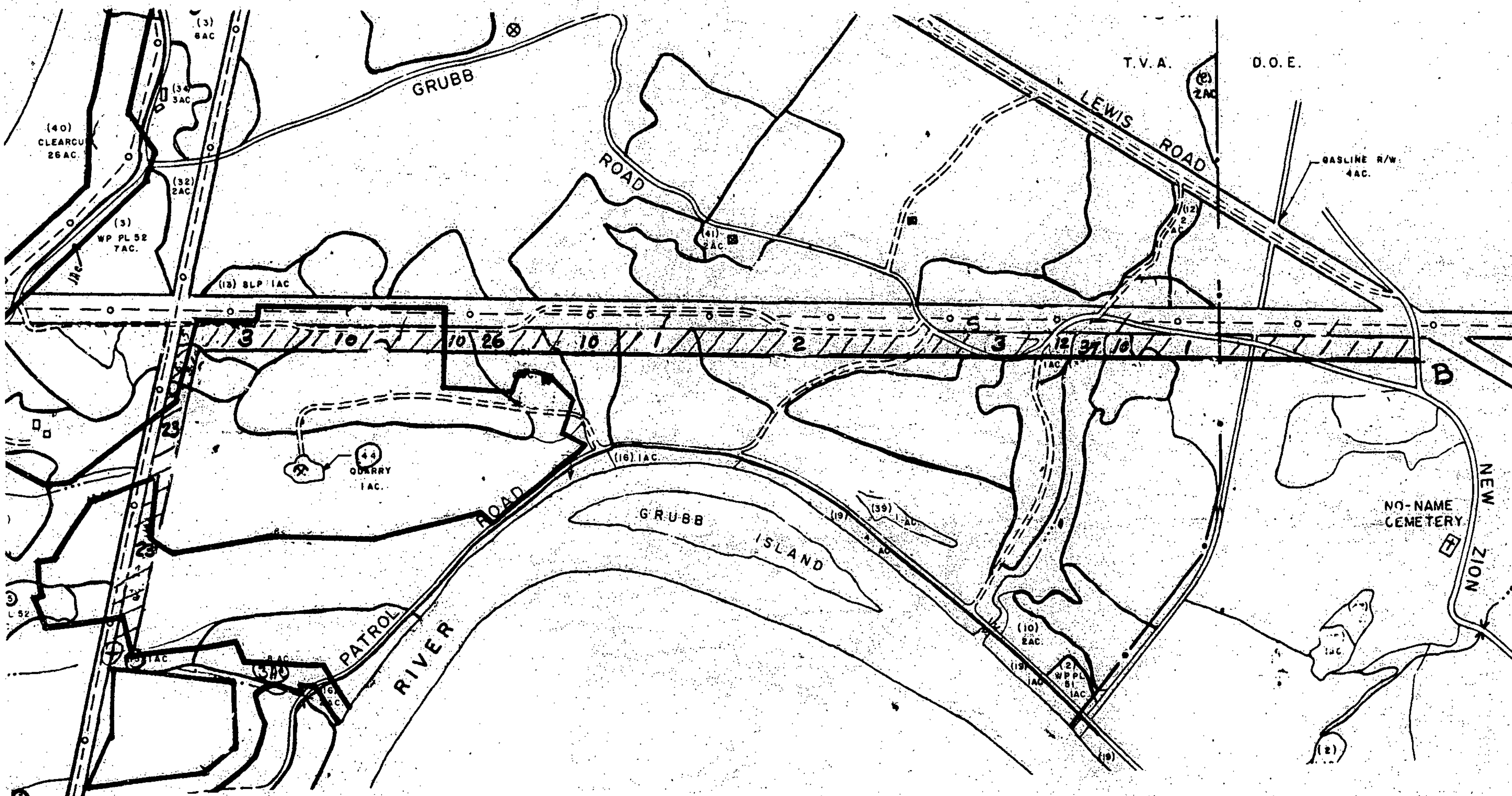

FIGURE 3.9-1b. Proposed Transmission Line Route of the CRBRP Site Area Segment B-C, Compartment #13.

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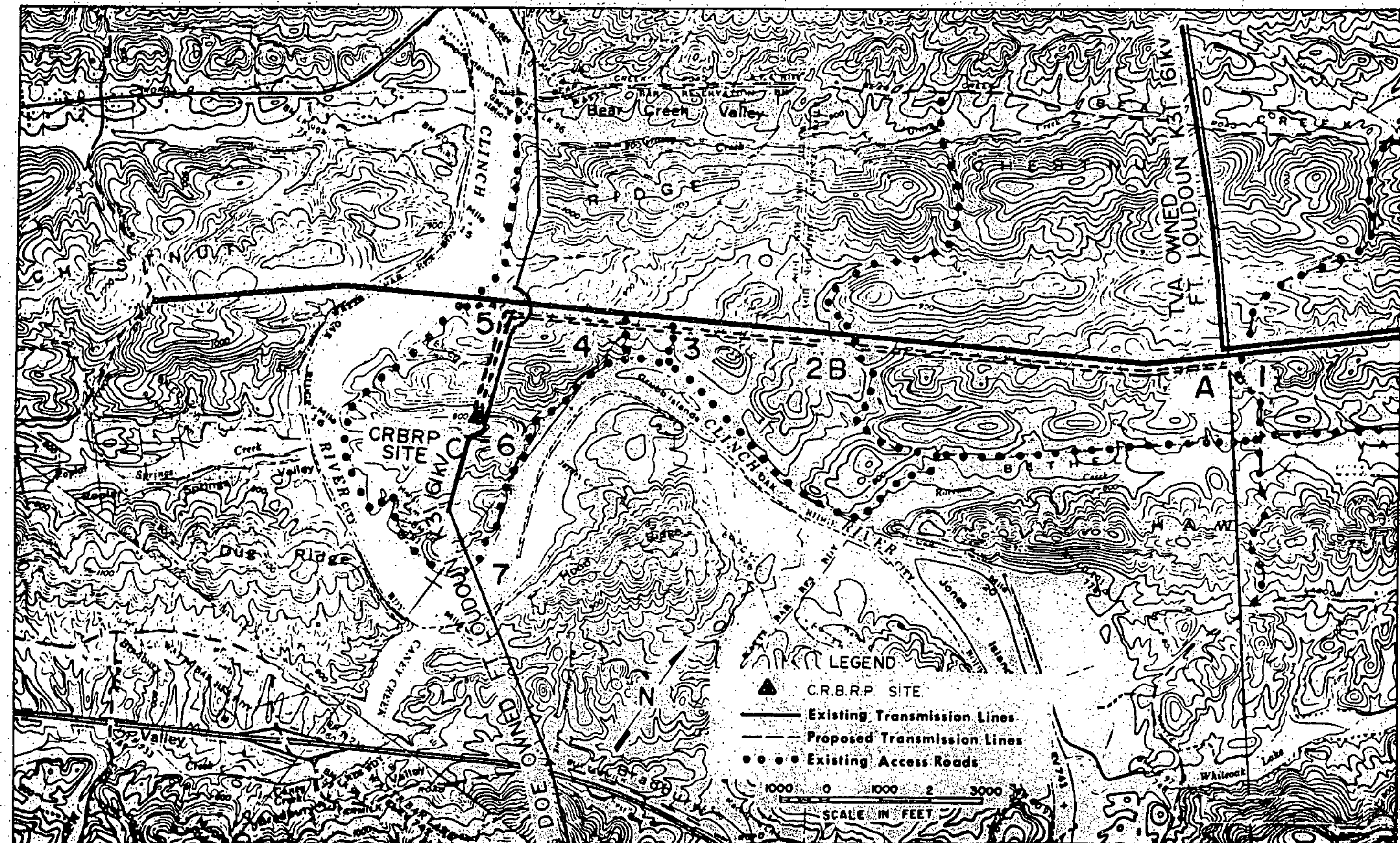

13

9

Figure 3.9-2 EXISTING ACCESS ROADS OF THE CRBRP SITE AREA

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4.0 ENVIRONMENTAL EFFECTS OF SITE PREPARATION, PLANT AND TRANSMISSION FACILITIES CONSTRUCTION

4.1 SITE PREPARATION AND PLANT CONSTRUCTION

Discussion of the environmental effects that may be associated with site preparation and plant construction is divided into two general categories: (1) effect on land use and (2) effect on water use. Potential environmental effects from operation of the Clinch River Breeder Reactor Plant (CRBRP) are discussed in Section 5. Effects which are primarily social or economic in character are discussed in Section 8.

Site preparation will consist of clearing and grubbing, 9
excavation and backfilling, and construction of access roads,
rail lines, laydown and storage facilities, on-site quarry and
crusher facilities, and barge unloading facilities. Site 9
preparation and construction activities for the plant will cover 8
a period of approximately six years. The environmental
monitoring program as described in Section 6.1 will be employed
to monitor the impact of site preparation and plant construction.
This monitoring program will determine whether methods being 8
employed to mitigate impact are effective.

The Clinch River Site consists of approximately 1,364 acres,
nearly all in woodland. Of this total acreage, approximately 292 9
acres will be required for the CRBRP and related facilities, as
shown in Figure 4.1-1. Main plant buildings and surrounding land
within the security barrier, shown in Figure 4.1-2, will occupy
approximately 37 acres. Approximate amount of land area to be 9
affected by the various construction activities is shown in Table
4.1-1. Locations of temporary structures are shown in Figure 9
4.1-3.

Major impact on the terrestrial ecology from construction activities at the Site will be within the plant complex area of

approximately 37 acres and the quarry stockpile and crushing area 9 13
which may be as large as 60 acres. An additional security area
required for a 150' line of sight beyond the security barrier 13
will occupy approximately 19 acres. This area will be grassed
and mowed. The impact of the quarry, concrete batching and 9
mixing activity will be temporary, whereas the impact of the
plant complex will continue during the life of the plant. Other
smaller impacts of a temporary nature will arise from 9
construction of the barge unloading facilities, discharge pipes,
inlet pipes, river water pumphouse and lay-down areas. Permanent
impact consists of land area that contains facility buildings,
roads or railroads that will be disturbed repeatedly during the 9
life of the plant. Temporary impact consists of land area that
will be revegetated and is not expected to be repeatedly
disturbed during the life of the plant.

4.1.1 EFFECTS ON LAND USE

4.1.1.1 CLEARING AND EXCAVATION

Areas of the Site will first be cleared, grubbed and stripped
during the site-preparation phase. The plant area will undergo a
major land use change from woodland to industrial use. Trees of
commercial value will be harvested and removed from the Site in
accordance with the DOE Forest Management Program. 8 9

Open burning will be employed for disposal of forest slash 9
cleared from the Site in accordance with State and Federal air
pollution regulations. Burning will result in some releases of
particulates and gases into the atmosphere; however, these
releases will be local and generally short-lived. Non-
combustible waste and residue from burning will be buried on-site
and the disturbed area will be graded and seeded with appropriate 8
ground cover species to minimize soil erosion. 9

Topsoils in the areas to be excavated will be removed and
stockpiled separately for subsequent use in landscaping. Topsoil
thickness varies from 0 to approximately 12 inches. Subsequent
to the removal of topsoil, the excavated material (except for the 4
on-site quarry), which will include residual overburden, 8
weathered and sound rock, will be utilized by direct placement
methods to establish the required plant area grade elevation of
815 feet and to bring the main access roads and the railroad to
the design gradient. 13

Depending on the degree of rippability of weathered siltstone and
limestone, a pre-drilling and blasting pattern will be
established to permit excavation to the required elevation for
the Reactor Containment Building and its auxiliary buildings and 13
excavation of the quarry. For the Reactor Containment Building, 13
average excavation depths are expected to range from
approximately 40 to 104 feet below the existing grade elevation.
An average depth of excavation into sound siltstone of
approximately 20 feet is anticipated. The quarry will be
excavated from the side of an existing hill, with average 8 9
excavation depths expected to range from 40 to 100 feet below the
existing grade. Multiple small blasts of dynamite will be used
to facilitate removal of the material. Explosives will be used
intermittently starting shortly after initial clearing and 6
grubbing and extending through the construction period. Raw
water for aggregate washing and dust control will be recirculated
through the aggregate wash settling pond which is designed for 13
total recirculation with no discharges of water required. Quarry
operation will last approximately 4 years and will involve
removal of between 1.0 and 1.7 million cubic yards depending on
the quality of rock found. Disturbance from explosives will be 9 13
limited by use of small multiple charges to minimize noise, dust
and vibration effects in the vicinity of the plant and quarry
sites. Topsoil in the quarry will be scraped off, separately
stockpiled and replaced over the quarry when excavating 9
activities have ceased. After quarrying operations have been

completed, all temporary facilities will be dismantled, excess
materials will be hauled off-site for disposal and disturbed
areas will be reshaped and replanted. The quarry floor will be
covered in sequence with waste rock first, subsoil second and
topsoil on top, such that each layer is shaped for drainage
before the next is evenly spread. Reclamation of the quarry will 9
consist of loosening the topsoil and then planting a mixture of
native grasses and forbs such as broomsedge, purpletop, aster,
goldenrod, plume-grass and Lespedeza.

A concrete batch plant will consist of two identical central mix
concrete plants, each rated at 100 cubic yards per hour, each
with cement, flyash and aggregate storage and handling facilities
with a common ice plant and boiler plant, all complete with parts
and equipment for automatic operation. The cement and flyash
handling facilities will be equipped with a reverse-air-flow
pollution control system. All cement and aggregate from the wash
out of transit-mix trucks will be processed through a waste
water/concrete separator to reclaim waste cement and aggregate. 13
Wash water will be recirculated, eliminating the need for an
impounding pond. Dust control will be maintained for truck
traffic by sprinkling with water.

The site storm drainage system will be developed along with
permanent site access roads, temporary construction roads, spoil
and laydown areas to assure that construction activities will not
interfere with natural watercourse runoff. Runoff treatment 16
ponds will be constructed to protect the river from suspended
solids. These ponds will effectively contain most of the
suspended solids and ensure that discharges into the river will
be in accordance with the NPDES permit.

4.1.1.2 CONSTRUCTION FACILITIES

Because the CRBRP will be located in an undeveloped area,
temporary construction facilities will be essential. Temporary
construction buildings and facilities are to be arranged in an
orderly manner to minimize the impact on terrestrial ecology,
reduce land use requirements, expedite construction operations
and facilitate routine groundskeeping. Acreage required for the
temporary facilities are listed in Table 4.1-1. Following
completion of the plant and termination of quarry operations, all 8
temporary facilities will be dismantled, excess materials will be
hauled off-site for disposal and all disturbed areas will be
reshaped and replanted. Utilization facilities such as laydown 13
areas, parking areas, plant site railroad spurs, concrete batch
plant areas and areas assigned to various contractors are time
sequenced to minimize requirements. They are indicated in 9
Figures 4.1-1 and 4.1-3.

4.1.1.3 ACCESS FACILITIES

No off-site construction of new roads is planned, however, some 8
off-site road improvements may be necessary. Bear Creek Road
which parallels the northern boundary of the Site is a paved
two-lane road with little traffic in the vicinity of the Site. A
gravel road, River Road, parallels the river on the Site
property. Plans call for improving and paving that portion of
River road from its junction with Bear Creek Road to the plant as
shown in Figure 4.1-1. Access to the quarry will be provided by
a gravel road of approximately 0.3 mile connecting with the 8
Concrete Batch Plant. The quarry haul road will be built along
natural contours to minimize erosion. 9

Railroad access to the Site will consist of a spur line from the
existing rail facilities at the Oak Ridge Gaseous Diffusion Plant
north of the Site. The railroad will enter the Site on the
northwest corner and will run parallel to River Road and connect

to the various plant buildings as shown in Figure 4.1-3. Total 13
on-site land area required for construction of access roads and 9
railroad is estimated to be approximately 30 acres. In addition, 13
approximately four acres will be required for the off-site portion of the railroad.

The improvement of the existing road and the construction of the railroad spur will require an existing culvert passing beneath them at Grassy Creek and another adjacent to Bear Creek Road to be extended to accommodate the granular fill on which the access road and railroad will be constructed. A new culvert will be installed in an existing ditch near Gallaher Bridge and an existing box culvert at Grassy Creek will be replaced with a corrugated metal pipe. Embankment slopes below maximum pool elevation (745 feet) will be protected by riprap. 13

The barge-unloading facility, indicated on Figure 4.1-1, will be 7 9 1
constructed on the right bank facing downstream of the Clinch River for the purpose of unloading large construction equipment or large plant components such as the reactor vessel and guard vessel, turbine generator, stator, diesel generator, etc. The concrete slab on piling type of barge unloading facility will
occupy a 185 by 125 foot area recessed into the river bank at 13
latitude 35^{o} 54' 11"N and longitude 84^{o} 23' 16"W. One one side and one end of the area, steel sheet piling will be driven to form two sides of the area to be excavated. Approximately 11,000 cubic yards (5,000 cubic yards below minimum water level,
elevation 735 feet) of sandy silt material will be removed from 9
the river bank using clam-shell and/or dragline, radiologically surveyed, deposited in spoil area one, and covered with
uncontaminated spoil. Except for the dredging, all work will be 16
accomplished without disturbing the river. In order to control
turbidity and preclude dredged material from returning to the 9
river, a dike will be constructed around the disposal area.

Approximately 700 cubic yards of sand will be placed on the bottom of the slip to cushion grounded barges during unloading of the major nuclear components. The sequence of construction will 9
be as follows: (1) drive piling; (2) construct concrete slab; (3) excavate bottom and (4) place sand as required. Approximately 600 linear feet of shoreline will be disturbed during barge-unloading facility construction.

Telephone lines needed during construction and operation will be installed along the site access road. Electric power will be taken from existing transmission lines [1] following completion 8
of the construction substation. Prior to this time, electric power will be supplied by the City of Oak Ridge or by portable 1
generators.

4.1.1.4 CHEMICAL WASTES

Major chemicals used on-site during the construction period include soaps, detergents, paints, cleaning fluids, concrete admixtures, chemical fire extinguishers, sweeping compounds, oils and fuels such as propane, gasolines and diesel oil. The dissemination, release, or spillage of such materials on the Site will be controlled in accordance with applicable State and Federal regulations. Spill prevention control plans will be 9
developed and submitted per EPA requirements.

Used oil will be hauled off-site and disposed of. The use of fire extinguishers is expected to be minimal, but, if they are 8
used, the waste will be cleaned up and buried off-site. Soaps and detergents will be directed to the construction sanitary system. 13
Sweeping compounds will be disposed of off-site or buried on-site. All potentially hazardous materials will be transported and/or disposed in accordance with appropriate 9 1
Federal and State requirements.

4.1.1.5 SANITARY AND OTHER WASTES

The sanitary system for the construction period is designed to
accommodate 2450 persons. Average daily sanitary waste water 6
design flow will be 61,250 gallons or 25 gal/person/day. 13
Sanitary wastewater will be treated in packaged sewage treatment
systems prior to discharge into the Clinch River. All wastewater
discharged into the Clinch River will comply with NPDES Permit
conditions. If necessary, chemical toilets will be used in 13
isolated or remote areas. Further details of the sanitary system 9
may be found in Section 3.7.

Conventional garbage will be generated during construction. This waste will be collected by an outside contractor and disposed of off-site in a local disposal facility. No incineration of garbage will be allowed on the Site.

4.1.1.6 IMPACTS ON TERRESTRIAL ECOLOGY

The most significant effects of the CRBRP on the terrestrial
ecology of the area will occur in connection with site-
preparation activities and with plant construction. A smaller
impact will result from construction of the railroad and access
road. Impacts associated with transmission line construction are
discussed in Section 4.2. Site biota will be affected by
construction, but the effects are expected to be minor. 9

Approximately 292 acres (on-site plus off-site excluding the 13
transmission line discussed in Section 4.2) of land surface will
be disturbed by construction of the CRBRP. Community types,
acreages and percentages of each are listed in Table 4.1-2 based
on disturbance locations shown in Figure 4.1-1 and vegetation 9
types shown in Figure 2.7-6. Approximately 203 acres (70 13
percent) of disturbance land is covered with four communities
including hardwood, pine plantation, cedar-pine and hardwood-
cedar. Three community types will have more than 20 acres 13

disturbed representing approximately 171 acres (59 percent of disturbance land). Approximately 89 acres of non-forested including clear cut areas, powerlines, quarry area and inundated 13
land will be disturbed by construction activities. The 292 acres of disturbance land constitutes only 0.7 percent of all land on the 36,993 acre Oak Ridge Reservation (ORR). 13

Construction activities will disturb terrestrial biological survey sampling locations in communities D, E, F, G and I, shown in Figures 2.7-7, 2.7-A and 2.7-B. Community C was harvested in 1975 and converted to a shortleaf pine plantation in 1976 and will be partly disturbed by the quarry. Maintenance of the terrestrial biological survey sampling locations is not required. 10

Planned forest management activities on the CRBRP Site from 1974 through 1976 included thinning hardwood forests on Chestnut Ridge and all pine plantations, limited harvest cutting, southern pine beetle control cuttings and pitch canker fungus control cuttings.[2,3] Approximately 500 acres were affected by pine thinning and by cuttings to control southern pine beetle and pitch canker.[3] Approximately 25 acres of shortleaf-Virginia pine successional forest (Community C of Figure 2.7-6) was clearcut and replanted to shortleaf pine in 1976.[3] Hardwood thinning on Chestnut Ridge disturbed approximately 50 acres.[3] Seventy-seven acres of shortleaf pine plantation-1954 were clearcut to control pitch canker.[2] This included all of the shortleaf pine-1954 plantation listed in Table 4.1-2. Forest tree growth and reproduction are expected to increase following these thinnings. Timber on disturbance land will be harvested as part of site cleaning activities.

Construction activities have been planned to avoid all rare community types and rare plant species discussed in Sections 2.7.1.3.3 and 2.7.1.3.4. 9

Wildlife will be affected in proportion to effective habitat loss. White-tailed deer (Odocoileus virginianus) utilize the relatively open cedar-pine and mixed hardwood communities where browse and cover are available. Forest thinning provided additional relatively open habitat and additional browse and cover. Construction clearing and other activities are expected to decrease deer habitat and populations on the site by approximately 20 percent. Population reductions of gray squirrel, raccoon, gray fox, opossum and bobcat are also expected to be approximately 20 percent since they occupy forestland. Wildlife residing in open habitat such as cottontail, woodchuck and striped skunk will initially experience population reductions of approximately 20 percent during site clearing followed by population increases to approximately equal those prior to construction as cleared habitat peripheral to most site activities becomes available for habitation. Populations of white-footed mice, cotton rats, house mice, golden mice and short-tail shrews will initially decrease by approximately 15 percent during site clearing followed by a population increase of approximately 20 percent above pre-construction levels as open, cleared habitat becomes available for habitation.

Populations of forest dwelling birds such as ruffed grouse, American woodcock, woodpeckers, blue jay, flycatchers, vireos and warblers will decrease by approximately 20 percent due to habitat loss during construction. Following construction, populations of these birds will increase slightly to approximately 85 percent of those prior to construction. Species typical of open habitat such as mockingbird, grackle, cowbird, cardinal, indigo bunting, American goldfinch and most sparrows will initially decrease by approximately 15 percent during clearing and then increase approximately to preconstruction populations during construction as abundant open habitat becomes available. Pest birds such as crows, starlings and house sparrows will increase during construction to approximately 20 percent greater than prior to construction. 9 15

Reptile populations are expected to decrease by approximately 50 percent during site clearing and construction because of habitat loss and construction roadkills. Amphibian species' populations are expected to initially decrease by approximately 20 percent followed by a 100 percent increase during construction as they colonize ponds and as insect pests become abundant near construction activities.

Threatened and endangered wildlife will be affected in proportion to effective habitat loss the same as other wildlife. The bald eagle and

osprey species have active nests along Watts Bar Lake and may occassionally visit the Clinch River to feed. Neither species is expected to be affected by CRBRP construction. The bald eagle is listed as endangered in the U.S. and Tennessee, while the osprey is listed as endangered in Tennessee. The eastern cougar, if present on ORR, ranges widely and is not expected to be affected by construction. The cougar is listed as endangered in the U.S. and in Tennessee. Cooper's hawk, listed as threatened in Tennessee, resides in mature hardwood forests of ORR where it feeds on songbirds. The sharp-shinned hawk, also listed as threatened in Tennessee, resides in open forest where it feeds on birds as large as pigeons. Both species have ample feeding habitat and range widely in search of food. They are not expected to be affected by facility construction. The marsh hawk is a winter resident of ORR and is listed as threatened in Tennessee. It feeds on small mammals and an occasional reptile in open habitat and may benefit from increased small mammal populations on disburbance land. Other threatened and endangered species discussed in Section 2.7.1.4.5 are only possible residents of ORR and 9
are not expected to be affected by construction activities.

Within the proposed areas of construction, soil erosion potential, equipment limitations, revegetation potential and natural productivity have been identified using the general information provided by the 1942 soil survey of Roane County(3) and from Figures 2.7-2, 2.7-3, 2.7-4 and 2.7-5. Soil types have been identified and the acres of soil affected by construction activities have been determined by soil map analysis. Soil ratings and estimates of acres affected by construction activities are shown in Table 4.1-3. Only approximately 10 acres of soil that will be disturbed by construction have a moderate to severe erosion potential due to steep, erosable slopes. Approximately 40 acres of disburbance land have wetness or stoniness that severely restricts equipment use. Approximately 40 acres of disturbance land have a severe or moderate to severe seedling mortality rating. Natural productivity of disturbance land is generally low or moderate.

The location and extent of specific problem soils, relative to proposed construction activity, will be determined by on-site investigation. Construction guidelines will be responsive to 9
consideration of erosion and revegetation problem areas.

4.1.1.7 IMPACT ON HUMAN HABITATION

The CRBRP Site is a forest area devoid of human habitation; therefore, construction of the CRBRP will involve no relocation or association problems.

A small industrial park is located 1.5 miles to the north, a commercial camping area is located about one mile southeast and several houses are scattered throughout the area south of the Clinch River within one or two miles of the Site. Noise associated with construction activities could disturb people in these areas to some degree because of the natural quietness of the area. Construction noise will vary with the particular phase of construction, the mix of equipment used for each phase and the cycle of the equipment. Phases of construction for the CRBRP will include preparing the Site, excavating, placing foundations, erecting structures, finishing details and cleanup as shown in 15
Figure 4.1-4. Construction equipment noise ranges are listed in
Table 4.1-4 and the noisiest equipment types operating during 9
each construction phase at an industrial construction site are listed in Table 4.1-5. To characterize the noisiness, a Noise Pollution Level (NPL)

has been calculated for each phase of the construction. The NPL in decibels (dB) is defined as the sum of the A-weighted average sound pressure level and 2.5 times the standard deviation of the A-weighted average sound pressure level.[4] Table 4.1-6 is a list of descriptors of NPL values which can be used in interpreting the NPL levels in Table 4.1-5.

Locations of existing dwellings are given in Figure 2.1-7. The two dwellings nearest the generation portion of the facility are more than 0.6 mile away. Another dwelling is located over 0.3 mile from the river-water pumphouse. Construction noise impact may be assessed with consideration of: (1) probable construction noise levels (see Table 4.1-4 and 4.1-5), (2) NPL Descriptors (see Table 4.1-6), (3) the distances involved, (4) the temporary nature of construction and (5) the intermittent nature of construction noise. Construction noise would be noticed by few residents south of the site and, for occasional, limited time periods, may cause some annoyance.

As stated earlier, explosion noise will be minimized by the use of small multiple charges. 6

Construction of plant and transmission facilities will cause negligible aesthetic disturbance to resident and transient populations because of the limited construction duration, the limited number of viewing locations and the distances involved. Plant and transmission facilities are described in Section 3.0. Existing and projected resident and transient populations are described in Section 2.2 and site layout and topography are described in Section 2.1. The main plant structures are to be located in a wooded area with higher elevations northward and a slope southward down to the Clinch River.

Locations for viewing construction of the main plant structures are limited by the natural terrain and the surrounding forest (see Section 3.1). A portion of the largest structure, the reactor containment building may be visible at a distance of approximately 1.6 miles to motorists crossing the Gallaher Bridge. Construction of facilities associated with the main plant (e.g., water intake and discharge, railroad extension and barge unloading area) involves 6 only low height equipment and structures. Approximately 10 homes on the southern side of the Clinch River will have a limited view of some portion of plant construction.

No provision for living quarters will be made for workers or their families on the Site. Housing and school facilities will be available in nearby communities as discussed in Section 8. 6
The peak construction force is estimated to be approximately 10
5,400 persons. 8

Full compliance with fire laws and regulations will be considered a necessity and a fire plan will be proposed that will set forth in detail the plan for prevention, control and extinction of fires on and in the vicinity of the project area and quarry site. 8

Several archaeological sites have been investigated in the area as described in Section 2.3; however, all field work at these sites was completed as of June, 1982. 15 8 The Hensley family cemetery, described in Section 2.3, is located on the tip of the peninsula and is to be preserved with the family retaining the right of access. 9 The cemetery is not in the immediate construction area. Care will be exercised to insure that the cemetery remains intact.

4.1.1.8 SOIL EROSION AND SEDIMENT CONTROL

A soil erosion and sediment control plan will be developed and 15 implemented for the planned construction activities at the plant site. The objective of the plan will be to control the erosion and sedimentation resulting from construction activities by minimizing soil exposure, collecting and controlling rainfall runoff in the construction area, and by shielding and/or binding soil on cut slopes where stabilization is required. Sedimentaton in the Clinch River will be controlled by placing runoff treatment ponds and sand filters in such a manner to collect and treat rainfall runoff. These ponds will be installed prior to major earthwork commencing in their respective watershed.

Inspections of the site will be performed on an on-going basis to identify areas of evident and potential erosion to assure that timely corrective action is taken. Corrective action will include, but not be limited to, seeding, placement of rip-rap or crushed stone on slopes and exposed surfaces, temporary diversion ditches and sediment traps such as hay bales, sand bags, filter screens and stone traps. 15

A 25-foot buffer zone will be provided between the Clinch River and the site construction activities except in the following areas:

a. The railroad spur going underneath Highway 58 Gallaher Bridge, RR Station 31 + 00 (RM 14.0);

b. The 48" corrugated metal pipe for drainage underneath the railroad spur, RR Station 29 + 39 (RM 14.0);

c. The 36" corrugated metal pipe for drainage underneath the railroad spur, RR Station 50 + 00 (RM 14.25);

d. The extension of the 6-foot concrete culvert underneath the railroad spur and access road, Rd. Station 1 + 84 (RM 14.5);

e. The 14-foot corrugated metal pipe underneath the railroad spur and access road, Rd. Station 5 + 35 (RM 14.6);

f. Road and railroad enbankment closer than 25 feet to the Clinch River between Rd. Station 5 + 35 and Rd. Station 19 + 50;

g. The barge unloading facility (RM 14.75);

h. The water discharge outfall (RM 16.0);

i. The water intake (RM 17.9);

j. The corrugated metal pipe for the quarry treatment pond discharge (RM 18.25); and

k. Where existing River Road appurtenances are presently closer than 25 feet to the Clinch River. 15

In addition, all existing vegetation such as trees, shrubs, and grass which do not interfere with the construction, will be left in place and preserved to stabilize these areas and prevent unnecessary soil exposure.

Dredge material will be disposed of in Spoil Area One. In areas where fill material is placed within the 25-foot buffer zone but not within the confines of sheet piling or coffer dams, erosion control measures including, but not limited to, berms, straw bale barriers, check dams, filter barriers and mulching will be used. 16

Water sprinkling on laydown, storage, and parking areas, unpaved roads and other areas of the Site will be used to control dust formation. Dust control will be accomplished through the use of sprinkler trucks which will obtain water from the Clinch River. Specific areas will be designated along the river at which the trucks may obtain water. These areas will be inspected during the normal inspection tours for evidence of damage to the river bank. Any observed damage to the river bank will be repaired and corrective actions taken. 15

The CRBRP Erosion and Sediment Control Plan will incorporate the Environmental Protection Agency and State of Tennessee standards of performance for new sources, best management practices, best professional judgement and other applicable guidance documents to control the potential pollution resulting from the construction activity.

The extent and comprehensiveness of the plan will allow the aforementioned agencies to no longer require an aquatic biological monitoring program. The plan will require that specific mitigation methods be taken to minimize erosion from water, wind and gravity.

4.1.2 EFFECTS ON WATER USE

4.1.2.1 WATER USE

Water used during the site preparation, plant construction and 8
quarry preparation and operation will come from two sources; raw water from the Clinch River and potable water from the Bear Creek Water Filtration Plant.

Raw water will be used in dust control, compaction of fill material and aggregate crushing and washing, with a peak demand of less than 60,000 gallons per day. Water for the quarry operations will be initially pumped from the Clinch River and then recycled through a settling basin, with makeup from the
river required only for losses and evaporation. The intake for 13
water drawn from the Clinch River will be floated to insure sediment is not disturbed.

Potable water will be used in fire protection, sanitary facilities and production of concrete with a peak demand of 150,000 gallons per day. It is presently planned that potable water from the Bear Creek Filtration Plant will be piped to the site along existing roadways. Further into the construction period, the supply system will consist of a yard storage tank with make-up water coming from the potable water supply.

4.1.2.2 GROUNDWATER

Movement of groundwater at the Site is from groundwater highs to adjacent groundwater lows and hence to the Clinch River which serves as a ground water sink to the Site area. Thus, the Clinch River acts as a barrier to the movement of groundwater from the Site to the wells and springs presently in use south of the Clinch River, as discussed in Section 2.5.

During excavation, perched water tables and seep areas may be encountered and will be controlled by installing drainage ditches at the bottom of designated slopes and by installing drain pipes into the rock foundation. 8

Water will be collected in sump pits located at the periphery of 8 the excavated slopes to permit pumping to a holding basin for settlement of suspended solids prior to discharging into the river. Since ther normal river water elevation is 741 feet, is is anticipated that additional dewatering control and rock treatment may be required from elevation 741 to the base of excavation at 712.5 feet, primarily in the weathered limestone on 8 the east side of the excavation (plant north as reference). The normal pattern of groundwater movement to the river will be restored after the plant has been constructed and backfill has been placed around the structures.

4.1.2.3 IMPACT ON AQUATIC ECOLOGY

Construction of the River Water Intake Facility, Plant Discharge Structure and Barge Unloading Facility on the Clinch River will necessitate excavation and dredging, fill placements (including riprap) and other construction activities below normal water level, elevation 741 feet. In addition, limited dredging and placement of fill (including riprap) below elevation 741 feet will be required for improvement of the access road and construction of the railroad spur. Impact of these construction 7 activities on various forms of aquatic life, benthic habitat and other aquatic uses is expectd to be minor and of short duration.

During construction of the barge unloading facility, the proposed construction sequence, described in Section 4.1.1.3, will tend to minimize siltation in the Clinch River. Only 0.4 acre of river bottom below the 741-foot elevation will be disturbed during construction. Dredging will be from the river bank near river mile 15.0 and the dredged material (as will all dredged material resulting from the intake and discharge structures, access road and railroad construction) will be deposited in Spoil Area One so 1 as to prevent material from re-entering the river. 15

Revised positioning of the barge unloading facility results in an estimated
dredging of 11,000 cubic yards of material, and filling with 700 cubic yards 9
of sand. This disturbed area is more limited than that previously planned,
so adverse impacts are expected to be correspondingly reduced.

Construction of the intake and discharge facilities will impact approxi-
mately 0.22 and 0.06 acres, respectively, of river and shoreline below
elevation 741 feet. A cofferdam will be constructed near the location
of the river water pumphouse to permit work to proceed "in the dry."
This cofferdam will eliminate siltation in the river during construction
of the pumphouse. However, some turbid water will enter the river during
cofferdam construction.

The limited dredging and placement of granular fill and riprap associated 7
with the access road and railroad will impact less than 0.8 acre of
existing river bottom below normal water level. Dredging and excavation
activities, in summary then, will be limited to several small areas of
the right bank and river bottom of the Clinch River between CRM 9
14 and 18, amounting to less than 1.5 acres. The impact of these con-
struction activities is minimal and is expected to be of relatively short
duration. Impacted aquatic organisms are expected to recover within a
relatively short period.

A baseline survey, as described in Section 2.7.2, was conducted on the Clinch River at the Site to identify and characterize the existing biological communities. The results of this survey indicate that communities in areas where construction impact may occur are dominated by common chironomid and oligochaete species. These species will recover rapidly in the construction area. Fish species are expected to avoid areas of high turbidity and will not be impacted by construction activities.

4.1.2.4 RUNOFF TREATMENT PONDS

Five runoff treatment ponds and a quarry runoff treatment pond serve the Site during the construction period. One pond will remain during the operating period of the plant in order to 16 collect and treat runoff from the permanent parking facility. The ponds are designed to process water from a 24-hour storm (5 inches) having a recurrence interval of 10 years in addition to anticipated dewatering flows. Rainfall events greater than the design event will be discharged by means of the riser overflow pipe.

The primary function of the ponds is to provide a quiescent settling environment and filtration system so that stormwater discharged to the Clinch River meets the conditions cited in the NPDES Permit. Consequently, the pond configurations have been developed on the principles of sedimentation/filtration theory 15 and best management practices.

Suspended solids are removed by processing the collected stormwater through the sand/aggregate filter. Individual pond filters will vary in total filter area and number of perforated risers.

The pond outlets are provided with energy dissipation structures to minimize potential erosion caused by the discharge to the river.

When settled solids reach a predetermined thickness, the individual pond and filter medium will be physically cleaned. Maintenance frequency will vary from a period of several weeks during construction, to upwards of four to six months during the plant operational phase. In the event total suspended solids concentration in the effluent exceeds 50 mg/l, treatment pond system performance will be evaluated. Appropriate corrective action will be taken as required.

TABLE 4.1-1

APPROXIMATE LAND AREAS AFFECTED BY CRBRP
CONSTRUCTION ACTIVITIES 10

Category	Acres Disturbed		
	Temporary	Permanent	
Access Roads and Railroads (on-site)	30	30	
Access Railroad (off-site)	4	4	
Parking Area	19	2	
Barge Unloading Area	4	4	
Impounding Ponds	7	7	9 13
Quarry Including Stock Pile Area, Crusher and Facility	60*	-	
Concrete Batch Plant	5	-	
Riverwater Intake, Pumphouse, Discharge Line	6	.5	
Spoil Areas and Sanitary Land Fill Area	43*	-	
Storage and Other Work Areas	67	-	
Permanent Plant Buildings and All Land within Security Barrier	37	37	
Meterorological Tower Areas	10	10	
Additional Security Areas Required For 150 foot line of sight beyond security barrier - to be grassed, mowed - not restored to original condition	-	19	
TOTAL	292	113.5	9

*All May Not Be Required 13

TABLE 4.1-2

PLANT COMMUNITY TYPES AFFECTED BY CRBRP CONSTRUCTION*

Stratum #	Community Type	Acreage	Percent Of Disturbed Land
	Hardwood		
23	Red Oak-White Oak-Yellow Poplar	29	
24	Red Oak-Hickory-Yellow Poplar	11	
26	Red Oak-Yellow Poplar	3	
28	White Oak-Red Oak-Yellow Poplar	17	
31	Yellow Poplar-Red Oak	2	
33	Sweetgum-Virginia Pine-Sycamore	1	
35	Elm Boxelder-Ash	4	
Total Hardwoods		67	23%
	Pine Plantation		
3	White Pine Plantation	15	
5	Virginia Pine-Plantation	3	
7	Loblolly Plantation 1954	8	
10	Loblolly Plantation 1979	16	
13	Natural Pine	3	
Total Pine Plantation		45	15%

13

TABLE 4.1-2 (Continued)

Stratum #	Community Type	Acreage	Percent Of Disturbed Land
	Successional Pine		
6	Short Leaf Pine-Virginia Pine-Plantation	6	
9	Virginia Pine-Short Leaf Pine-Plantation	7	
Total Successional Pine		13	5%
	Cedar Pine		
15	Cedar	49	
16	Cedar Natural Pine	10	
Total Cedar-Pine		59	20%
	Hardwood Cedar		
18	Cedar-White Oak-Red Oak	13	
19	Cedar-Ash-Hackberry	2	
21	Red Oak-Cedar-Yellow Poplar	2	
Total Hardwood-Cedar		15	6%
	Hardwood Pine		
20	Red Oak-Short Leaf Pine	3	
Total Hardwood-Pine		3	1%

TABLE 4.1-2 (Continued)

Stratum #	Community Type	Acreage	Percent Of Disturbed Land
	Hardwood-Cedar-Pine		
27	Southern Red Oak-Poplar-Short Leak Pine	1	
	Total Hardwood-Cedar-Pine	1	<1%
	Non-Forested		
39	Non-Forested	5	
40	Clearcut	54	
42	Powerlines	11	
43	Roads	16	
44	Quarry	1	
45	Inundated Land	2	
	Total Non-Forested	89	30%
	TOTAL	292	

13

* On-site plus off-site excluding transmission line.

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TABLE 4.1-3

SOIL SERIES RATINGS AND ESTIMATE OF ACRES AFFECTED BY CONSTRUCTION ACTIVITIES AT THE CRBRP SITE

Soil Symbol	Soil Type	Acreage	Degree of Erosion Potential	Heavy Equipment Impact Potential	Degree of Seedling Mortality	Level of Productivity
Cc	Clarksville cherty silt loam	52.4	Slight to Moderate	Slight to Moderate	Moderate	Low
Ccl	Clarksville cherty silt loam, Hilly phase	60.0	Slight to Moderate	Slight to Moderate	Moderate	Low to Moderate
Ccz	Clarksville cherty silt loam, Steep phase	12.8	Moderate	Slight	Moderate	Low
Cs	Colbert silty clay loam	11.9	Slight	Moderate	Moderate	Low
Clx	Colbert silt loam, Slope phase	6.0	Slight	Slight	Moderate	Low to Moderate
As	Armuchee silt loam	3.9	Slight	Slight	Moderate to Severe	Low
Avk	Apison very fine sandy loam, Eroded slope phase	1.0	Slight	Slight	Slight	Low
Al	Atkins very fine sandy loam	0.2	Slight	Severe	Severe	Low to Moderate
Fc	Fullerton cherty silt loam	3.5	Slight	Severe	Slight	Moderate
Fcr	Fullerton cherty silt loam, Eroded phase	6.4	Moderate to Severe	Moderate to Severe	Moderate to Severe	Low
Fct	Fullerton cherty silt loam, Eroded	3.7	Moderate to Severe	Moderate to Severe	Moderate to Severe	Low
Fcz	Fullerton cherty silt loam, Steep phase	6.7	Moderate	Slight	Moderate	Low
Fcl	Fullerton cherty silt loam, Hilly phase	2.7	Slight	Moderate	Slight to Moderate	Low
Ls	Lehew stoney very fine sandy loam	2.4	Slight to Moderate	Slight to Moderate	Moderate to Severe	Low
Nyr	Nolichucky very fine sandy loam, Slope phase	0.5	Slight to Moderate	Slight	Slight	Low to Moderate
Ps	Philo very fine sandy loam	0.6	Slight	Moderate	Moderate	Moderate
Pv	Pope very fine sandy loam	7.9	Slight	Slight	Slight	Moderate to High
Sv	Sequatchie very fine sandy loam	9.5	Slight	Slight	Slight	Moderate to High
Rsc	Rolling stony land, Colbert and Talbott soil materials	30.3	Slight	Severe	Moderate to Severe	Low
Us	Upshur silty clay loam, Valley phase	29.6	Slight	Moderate	Moderate	Moderate
Ws	Wolftever silt loam	2.5	Slight	Slight	Moderate	Moderate
Wsx	Wolftever silt loam, Slope phase	3.7	Slight	Slight	Moderate	Moderate
	TOTAL	258.2				

NOTE: Based on description of soils from 1942 soil study of Roane County, Tennessee. For an explanation of soil series ratings see Section 2.7.

9

AMEND. IX
OCT. 1981

TABLE 4.1-4

CONSTRUCTION EQUIPMENT NOISE RANGES(4)

Type of Equipment	Approximate Range of Noise Level (dBA) at 500 feet
Internal Combustion, Earthmoving	
Compacters (Rollers)	73-75
Front Loaders	72-84
Backhoes	72-93
Tractors	76-95
Scrapers, Graders	80-92
Pavers	86-88
Trucks	82-93
Internal Combustion, Materials Handling	
Concrete Mixers	75-88
Concrete Pumps	81-83
Cranes (Movable)	76-87
Cranes (Derrick)	86-88
Internal Combustion, Stationary	
Pumps	69-71
Generators	71-82
Compressors	75-86
Impact	
Pneumatic Wrenches	83-88
Jack Hammers and Rock Drills	81-98
Pile Drivers (peaks)	95-105
Other	
Vibrator	69-81
Saws	72-81

Note: Based on limited available data samples.

TABLE 4.1-5

NOISIEST EQUIPMENT TYPES OPERATING AT INDUSTRIAL CONSTRUCTION SITES[4]

Construction Phase	Equipment	dBA Level (50 feet)	NPL (dB) (50 feet)	dBA Level (1/2 mile)	NPL (dB) (1/2 mile)	dBA Level (1 mile)	NPL (dB) (1 mile)
Site Preparation	Truck	91	102	57	68	51	62
	Scraper	88		54		48	
Excavation	Rock Drill	98	105	64	71	58	65
	Truck	91		57		51	
Foundation	Jack Hammer	88	89	54	55	48	49
	Concrete Mixer	85		51		45	
Erection	Derrick Crane	88	97	54	63	48	57
	Jack Hammer	88		54		48	
Finishing	Rock Drill	98	105	64	71	58	65
	Truck	91		57		51	

TABLE 4.1-6

DESCRIPTION OF NPL LEVELS[4]

Clearly Acceptable: The noise exposure is such that both the indoor and outdoor environments are pleasant.	NPL less than 62 dB
Normally Acceptable: The noise exposure is great enough to be of some concern but common building constructions will make the indoor environment acceptable, even for sleeping quarters and the outdoor environment will be reasonably pleasant for recreation and play.	NPL between 62 and 74 dB
Normally Unacceptable: The noise exposure is significantly more severe so that unusual and costly building constructions are necessary to ensure some tranquility indoors, and barriers must be erected between the site and prominent noise sources to make the outdoor environment tolerable.	NPL between 74 and 88 dB
Clearly Unacceptable: The noise exposure at the Site is so severe that the construction costs to make the indoor environment acceptable would be prohibitive and the outdoor environment would still be intolerable.	NPL greater than 88 dB

Note: These criteria have not been officially or unofficially adopted as "standards", but are only to be used as an aide in determining the amount of acceptable noise.

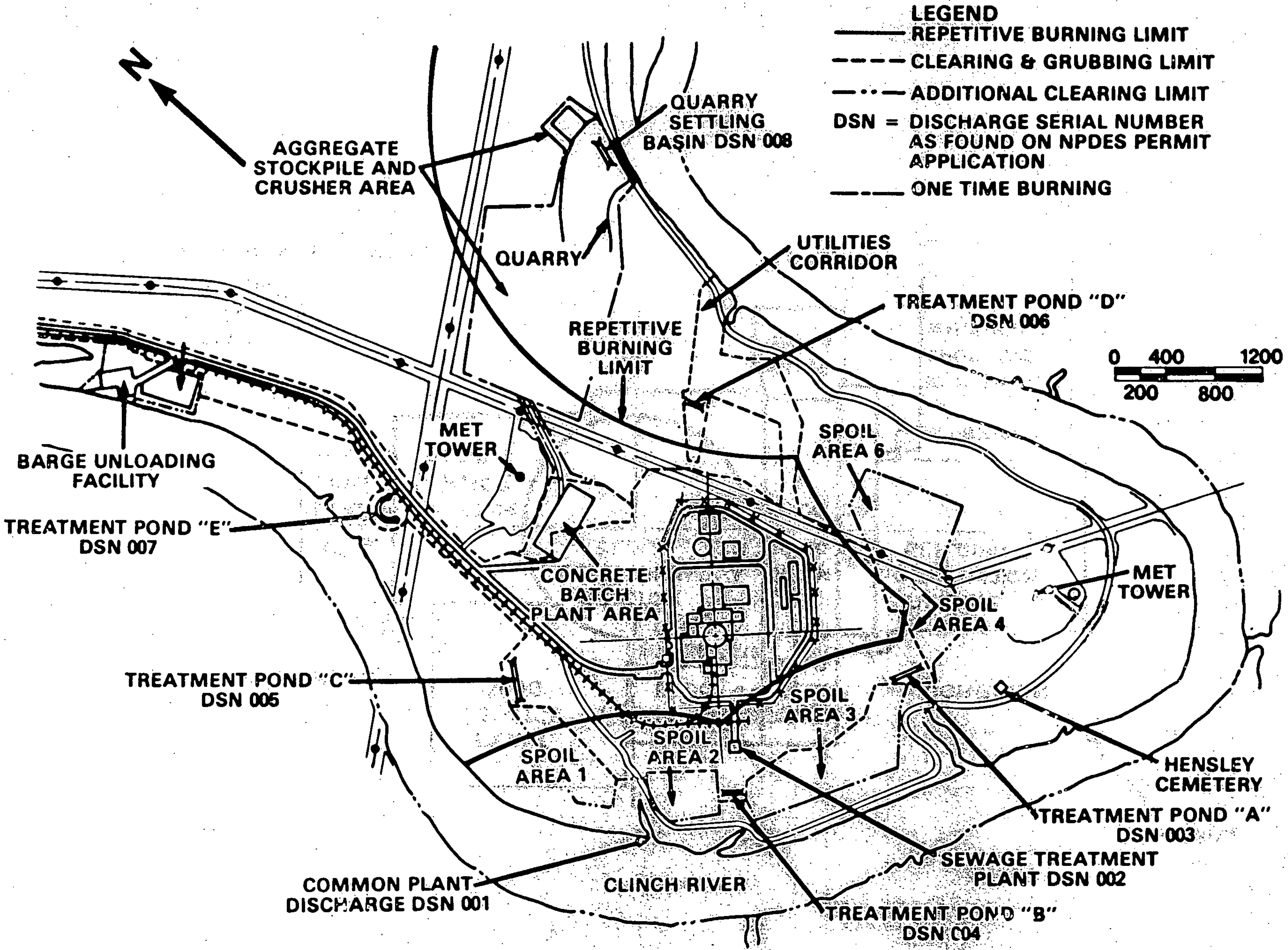

FIGURE 4.1-1 Site Construction Layout

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15
16

AMENDMENT XVI
OCTOBER 1982

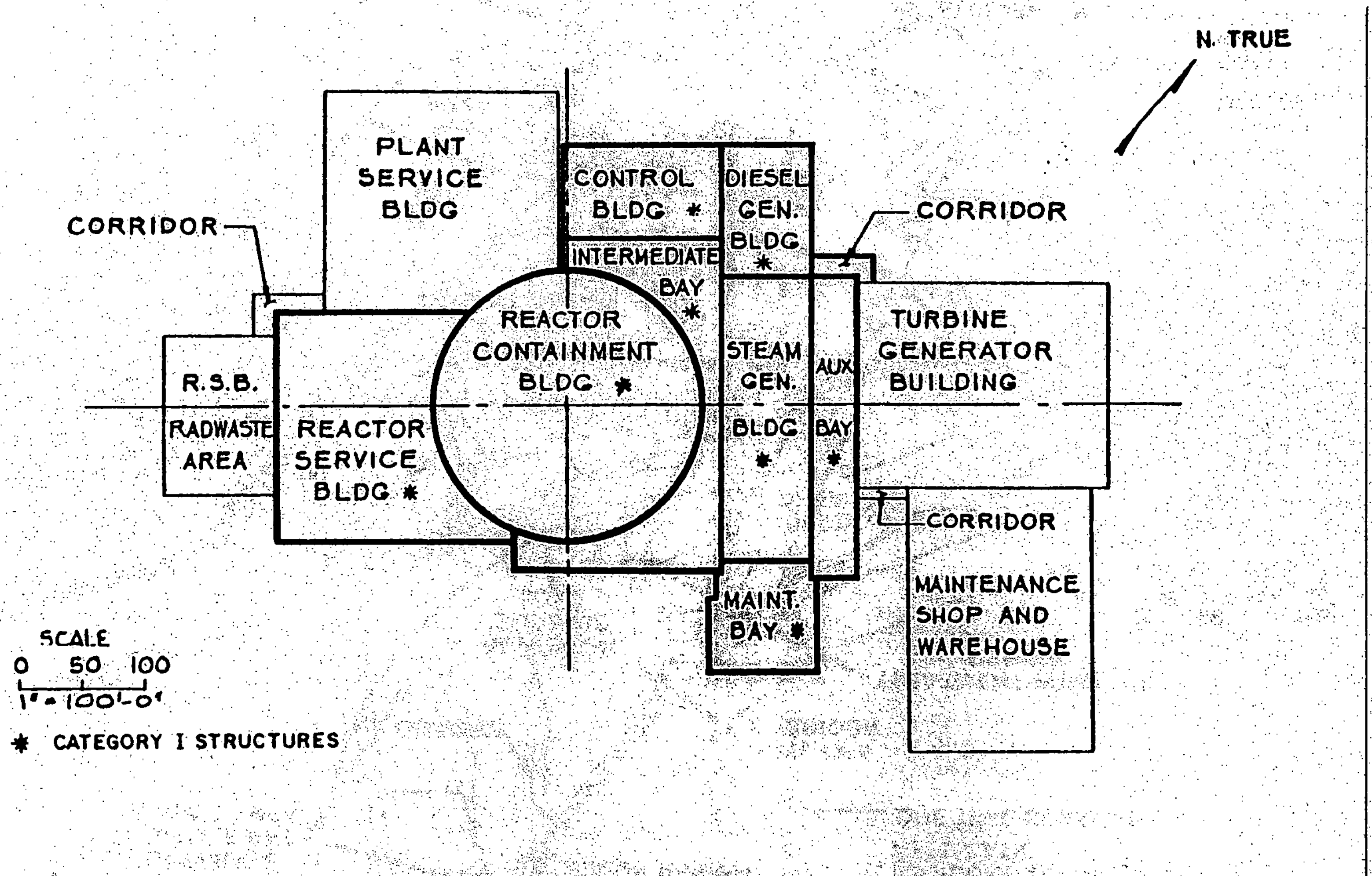


Figure 4.1-2 ARRANGEMENT OF PLANT STRUCTURES

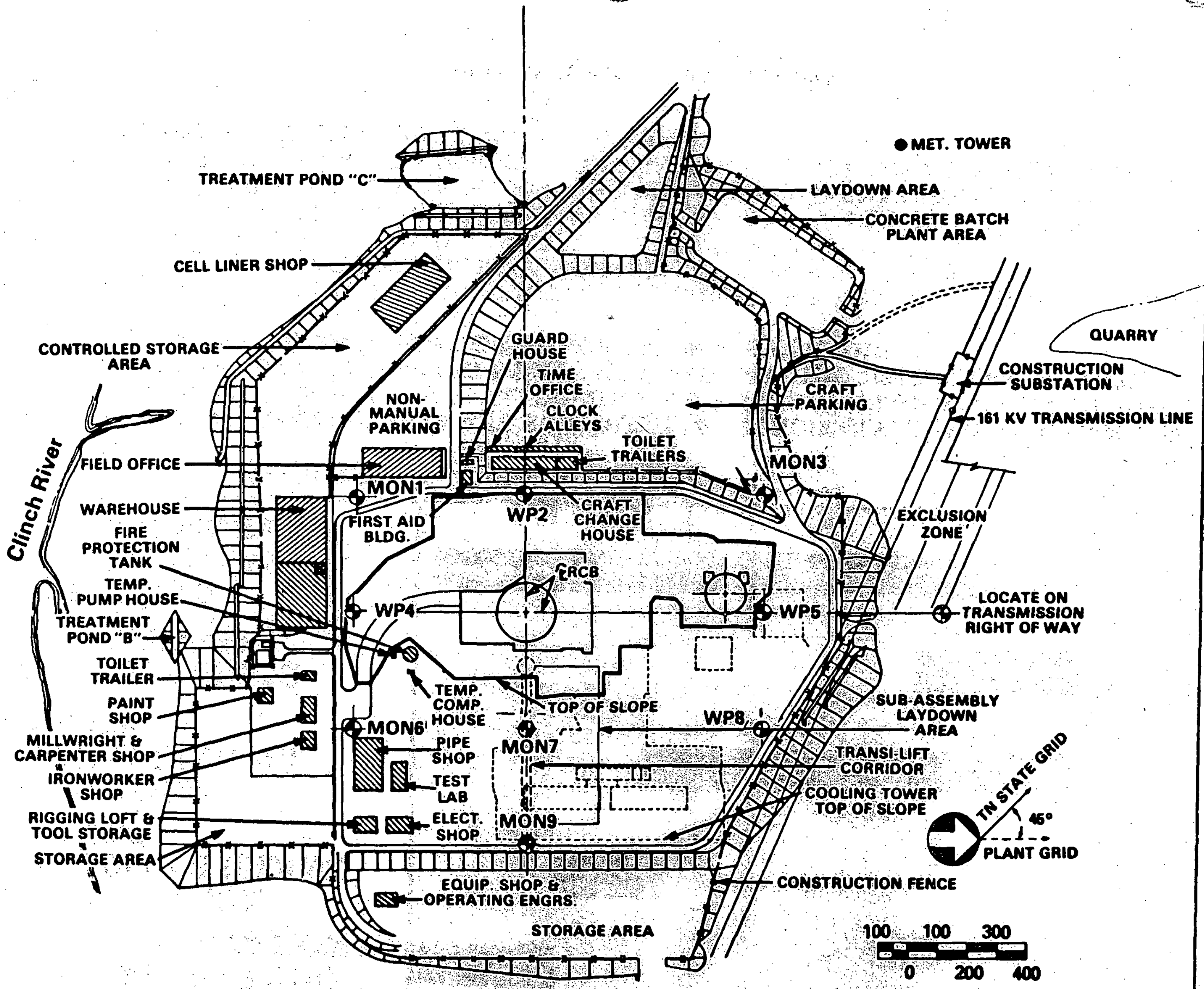
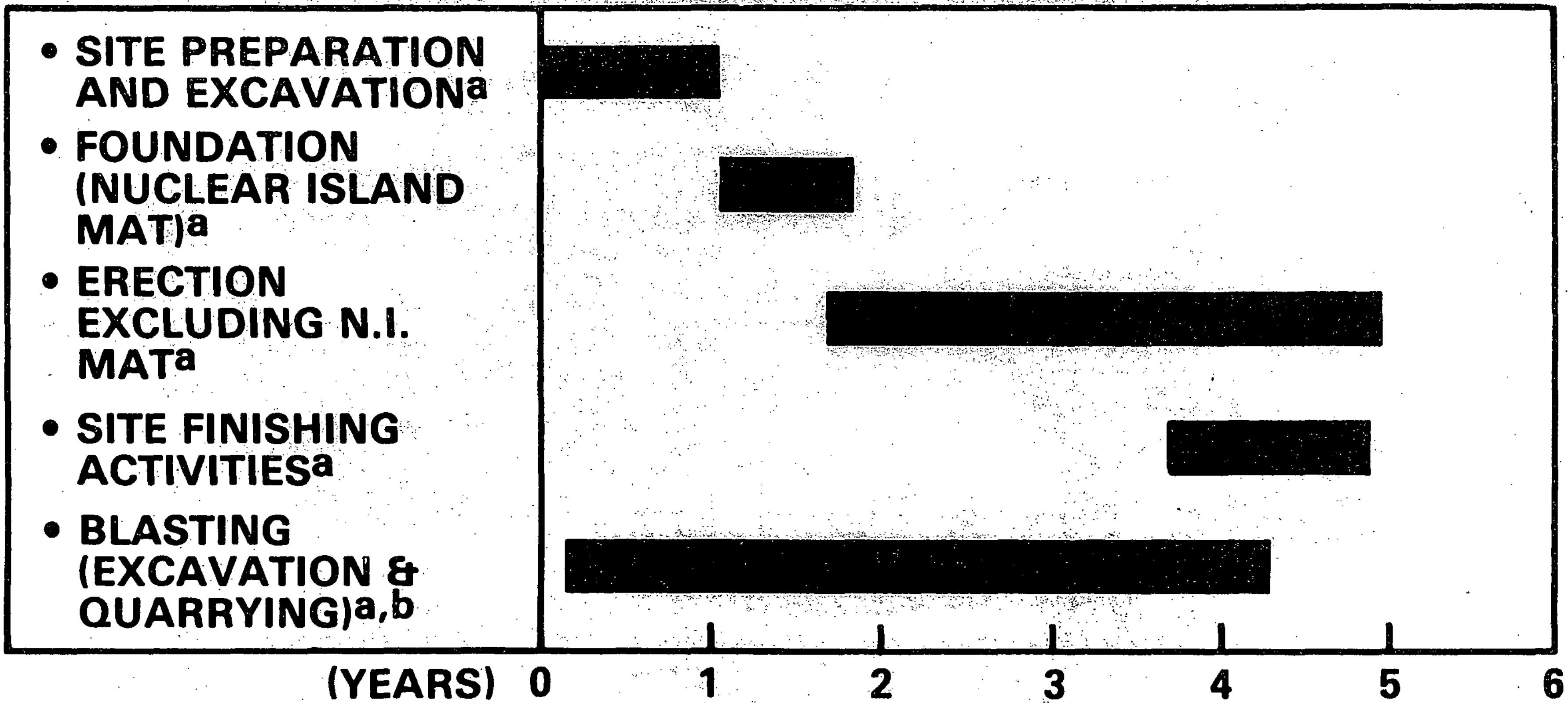


Figure 4.1-3 Temporary Construction Facility Layout

AMENDMENT XIII
APRIL 1982



a. ALL PHASES OF CONSTRUCTION ARE SCHEDULED ACCORDINGLY. 7:00 A.M. TO 3:30 P.M. AND 3:30 P.M. TO 11:00 P.M. (WITH ALLOWANCE OF ± 1/2-HOUR FOR STAGGERED SHIFTS TWO SHIFTS PER DAY; ESTIMATED 5 DAYS PER WEEK AT THIS TIME, USING A 5-8 DOUBLE SHIFT SCHEDULE, NO SATURDAY OR SUNDAY WORK IS SCHEDULED.

b. THE PRESENT SCHEME IS TO DRILL AND LOAD DURING THE FIRST SHIFT (DAY) AND BLAST DURING THE EARLY PART OF THE SECOND SHIFT.

NOTE: UNUSUAL SHIFT ACTIVITIES THAT MAY CONTINUE FOR A PERIOD OF 24-HOURS COULD INCLUDE LARGE CONCRETE POURS OR SPECIAL EQUIPMENT INSTALLATION ACTIVITIES (I.E. REACTOR VESSEL, CONTAINMENT DOME). NO ACTIVITIES SHOULD LAST MORE THAN 24-HOURS, CONSECUTIVELY.

Figure 4.1-4 General Construction Phases

4.2 TRANSMISSION FACILITIES CONSTRUCTION

The proposed line will connect the CRBRP switchyard with a
TVA-owned Ft. Loudoun-Roane k31 161-kV line located approximately 16
2.7 miles northeast of the plant site as shown in Figure 3.9-1.
Two separate single-circuit 161 kV transmission lines on 2.7 13
miles of a 160-foot wide and 0.5 mile of a 175-foot wide 16
right-of-way (ROW) will be cleared parallel and adjacent to the existing rights-of-way. A detailed description of the proposed transmission line and structure design is contained in Sect. 3.9.

Environmental effects as a result of transmission line construction are unavoidable. The corridors for constructing these transmission lines have been located so that no private property owners are involved. Approximately one-half of the
required line construction will be located on TVA's Watts Bar
Reservation and the remainder on DOE property. The conversion of 9
woodland to open habitat destroys a large amount of vegetation and the habitats of numerous forest-dwelling species. It creates habitats for fewer species which are adaptable or originally suited to brushy and open conditions.

Clearing the acreage, moving heavy equipment along the ROW and access roads and installation procedures will mean some soil erosion and possible stream siltation. Such effects will be minor and short-lived; care will be taken and revegetation will be carried out quickly.

Open burning to dispose of forest slash cleared from the ROW will result in the release of some particulates and gases to the atmosphere. These effects on air quality will be local and short-lived. All construction waste and other trash will be transported to a designated land fill or dump.

In general, both the transmission lines and the cleared ROW's can have a visual impact on the environment. However, the Clinch River Site is in a secluded area that has been inaccessible to the general public for many years. The topographic features which provide natural screening and the continuation of a limited access policy for the area will minimize visual impact of the transmission lines.

4.2.1 ACCESS ROADS

Although specific access routes will not be selected until line structure locations are finalized, it is anticipated that existing roads, portions of the Bull Run-Sequoyah 500-kV transmission line ROW now used for maintenance access and the proposed transmission line ROW will satisfy future construction and maintenance access requirements. The majority of these roads have restricted access, are gravel surfaced and are regularly maintained. Locations of these roads are shown in Figure 3.9-2. Moving construction equipment onto the ROW will likely cause some rutting on existing roads. Temporary drainage ditches, to direct rain water off the roadways, terracing and ground cover will be provided as needed to prevent excessive soil erosion.

Following construction, access and maintenance roads will be restored or upgraded to equal or better than original condition. Rutted gravel roads will be leveled and resurfaced with gravel.

4.2.2 RIGHT-OF-WAY CLEARING METHODS

Construction of the proposed lines on the preferred route will involve clearing of approximately 62 acres of woodland and old field communities for which "shear clearing" methods (clearing of trees and other vegetation to the ground level) will be employed. |16

Approximately one acre is existing woods roads. On steeper slopes or rocky outcrops, conditions may necessitate hand-clearing with power saws and piling brush in scattered brush piles along the edge of the ROW. It is expected, however, that nearly all clearing will be done by bulldozers with cutter blades which mechanically cut all vegetation off at ground level. |16

Using this method leaves no cut timber of any merchantable value. No herbicides will be used during clearing operations. The effects of clearing on vegetation and wildlife are discussed in Sections 4.2.7 and 4.2.8.

4.2.3 EROSION CONTROL

Construction of transmission lines usually involves the use of heavy equipment for structure erection and stringing of conductors. Although this equipment may cause minor and temporary rutting along the ROW, the following precautionary measures will be taken so that the effects of soil erosion and the subsequent effects on regional water quality are not significant. Erosion in local areas that may result from construction activity will be controlled by limiting the use of heavy equipment in areas of high erosion potential, diverting runoff from exposed land to settling ponds and keeping vegetation on the land as long as possible before construction. Whenever possible, construction activities in areas with a high degree of erosion potential will also be scheduled to coincide with favorable dry weather conditions.

For the proposed corridor, 16.7 percent of the soil has been classified by the Tennessee Valley Authority (TVA) as being of only slight natural erodibility, 66.6 percent of slight to moderate erodibility and 16.7 percent of moderate to severe erodibility.[1] No area through which the proposed ROW passes is classified for severe natural erodibility. Locations of these erosion classes are illustrated in Figure 4.2-1.

According to the same TVA document,[1] impact of heavy equipment on the corridor soils ranges from slight to severe as shown in Figure 4.2-2. A slight impact is expected on 12.3 percent of the soil, slight to moderate impact on 66.9 percent, moderate to severe on 16.9 percent and severe impact on 3.9 percent of the soils.

With these figures in mind, it is expected that despite the precautionary measures listed above some erosion and siltation will occur during the construction phase on both the access roads and the ROW. Such effects should be minor and short-term since prompt restoration procedures will be initiated following construction activity. Restoration procedures are discussed in Section 4.2.6.

4.2.4 INSTALLATION PROCEDURES

To provide the desired level of reliability, separate transmission structures are proposed for each of the required transmission lines. These structures were identified for their aesthetic value as well as structural capability. Structures are expected to be free-standing narrow-based steel towers of approximately 85 feet in height, with epoxy fiberglass crossarms six to eight feet long. The actual location of each tower has not yet been determined, but the normal spans will be approximately 600 feet apart. This means, approximately 56 towers would be installed along the 3.2 miles of corridor.

A rubber-tired earth auger truck will excavate for the foundation of each structure. Depth of the excavation will vary from 8 to 12 feet depending on the height of the tower and slope of the land.

Precast concrete foundations will be installed thus eliminating form work and shoring which would be required if conventional reinforced concrete foundations were used. In addition this will eliminate the need for concrete mix equipment to be operated on this ROW. Towers will be assembled on the ground and raised by crane to their position on the foundations. This procedure, involving the activity of men and machines near each excavation, will mean some additional disturbance to the area around the foundation. The use of precast concrete foundations will make it possible to complete the backfill operations immediately and eliminate erosion which could occur if the soil were left piled along the ROW for an extended period of time. The small amount of soil and smaller rocks that are not replaced in the hole will be leveled around the base of the tower.

Whenever stream crossing is necessary, construction vehicles will use established bridges, construct temporary bridges or perform the work on each side of the stream rather than disturb the existing channels.

4.2.5 SOLID WASTE DISPOSAL

In compliance with State and Federal air pollution guidelines, open burning will be employed for disposal of all cleared vegetation. This will result in particulate and gas releases into the atmosphere. However, these effects will be local and short-lived. The use of a chipper was explored but found to be prohibitively expensive along the transmission line.

In general, other solid waste generated by transmission line construction will be very small. These minor construction waste items consist of protective wood cribbing attached to conductor reels, cardboard shipping cartons and steel bands used to bind structural items and other line hardware. All waste material which accumulates will be transported to approved dumps or landfill sites. All trash and garbage will also be regularly carried out of the area. Portable sanitary facilities will be provided for construction workers.

4.2.6 RESTORATION

The ROW will be restored by grading (where necessary) and soil will be cultivated, fertilized at the rate of 400 pounds of Triple 13 fertilizer per acre and seeded with Kentucky 31 fescue. Reseeding will be accomplished as quickly as possible to control erosion and enhance appearance. Revegetation potential of the CRBRP area is shown in Figure 4.2-3. Following the initial seeding, native herbs, shrubs and tree seedlings will be allowed to invade.

4.2.7 VEGETATION

Construction of the proposed transmission line necessitates the clearing of approximately 62 acres of forest land and approximately one acre of 16 existing woods roads. Acreages of forest types to be cleared 13 are listed in Table 4.2-1. The open shrubby areas are being invaded by seedlings and sapling hardwood species. More detailed descriptions of these vegetation types can be found in Sections 2.7 and 3.9. None of the acreages in question is under cultivation.

Clearing of the wooded and old field communities on the proposed corridor will produce approximately 62 acres of new open shrubby habitat. 16

4.2.8 WILDLIFE

Hardwood (especially mixed oak) and hardwood-conifer community types were found to have the highest species diversity for mammals, avifauna and herpetofauna, as shown in Section 2.7. Approximately 62 acres or 16 98 percent of the total cleared area consists of these cover types. 13 In contrast, pine plantations and other predominately pine forest types support relatively few species except that winter avifauna populations in conifer habitats were much higher than in deciduous habitats as shown in Table 2.7-18.

The removal of wooded acreage means a loss of habitat available to forest-dwelling species. The gray squirrel and the Eastern chipmunk live in hardwood forests and the squirrel, especially, depends on nuts for food. Ruffed grouse inhabit deciduous woodlands in summer and coniferous stands in winter. All three species will probably emigrate to surrounding habitats as the transmsission corridor is cleared. The unsuitability of some habitats, population pressures in suitable ones and increased susceptibility to predators will eventually decrease these animal populations. Raccoons will also lose preferred habitat. They are generally a species 9 found in wooded areas near lakes or streams, although they may forage in open areas; acorns are a main fall and winter food. Opposums may also experience a loss in numbers as they are woodland animals which may, like the raccoon, forage in open fields. Skunks, which prefer forest edge and open meadow, may increase slightly in numbers with the creation of new fields.

Although deer need woodlands for food and cover, they may browse the vegetation in open fields. Rabbits and woodchucks may increase in numbers with the development of shrubby field areas. The short tail shrew is a species with no restricted habitat requirements and will probably not change in numbers with the conversion of woods to fields. The effect of clearing on white-footed mouse populations will probably be minor as these species will inhabit brushy and open areas. The golden mouse, however, is mainly a forest species and will lose habitat.

Hawks, owls and foxes may experience no number change. They will probably search the open areas for prey.

Other species will gain preferred habitat as a result of corridor construction. Bobwhite quail, especially, may increase in numbers with the expansion of their favored open field habitat. Mourning doves may forage in the weedy areas and several species of songbirds may utilize the ROW for nesting and feeding. In general, however, the number of bird species utilizing the area will decrease with the conversion to open fields.

The number and variety of herpetofauna in the area will also decrease as the acres of mixed oak forest are eliminated. Clearing will | 16
cause destruction of habitats in the ROW and the loss of some animals which depended on those specific environmental conditions. Different species and species with less specific habitat requirements will invade the ROW only after sufficient cover has developed. For a more detailed discussion of habitat requirements of fauna in the transmission line area, see Section 2.7.

4.2.9 AESTHETIC EFFECTS OF CONSTRUCTION 9

The proposed corridor will pass through an area that is approximately 95 percent forested. No construction will be done in sensitive areas such as the following: marshlands; wildlife refuges; parks; National and State monuments; scenic, recreational, or historical areas; or national forests.

Access to the area is controlled by security patrols and/or 8
locked barriers. There are no houses within the controlled area. Therefore, most of the clearing and construction operations will not be witnessed by the general public. The exception to this is in the area where the proposed corridor meets White Wing Road, as shown in Figure 3.9-1. Motorists on this road will see the
clearing operations and impacts for the 175' foot wide ROW and 13 16
the construction of transmission line facilities for a few hundred feet of the rights of way; however, a hill prevents a direct view down the transmission ROW. The corridor is perpendicular to White Wing Road where the road makes a sharp curve and consequently, viewing time will consist of only a few seconds and the motorist will not have a direct line of sight. The additional aesthetic impact of new pole structures will also be minor compared to the visual impact of the existing towers and lines.

TABLE 4.2-1

WOODY PLANT COMMUNITIES AFFECTED BY THE PROPOSED CRBRP TRANSMISSION ROUTE

Community Type	Acreage Compartment-13	Acreage Compartment-15	%	
Hardwood	11	10	34	
Pine	19	9	46	9
Hardwood Pine Cedar		3.5	6	
Hardwood Pine		8.5	14	
	30	31	100	

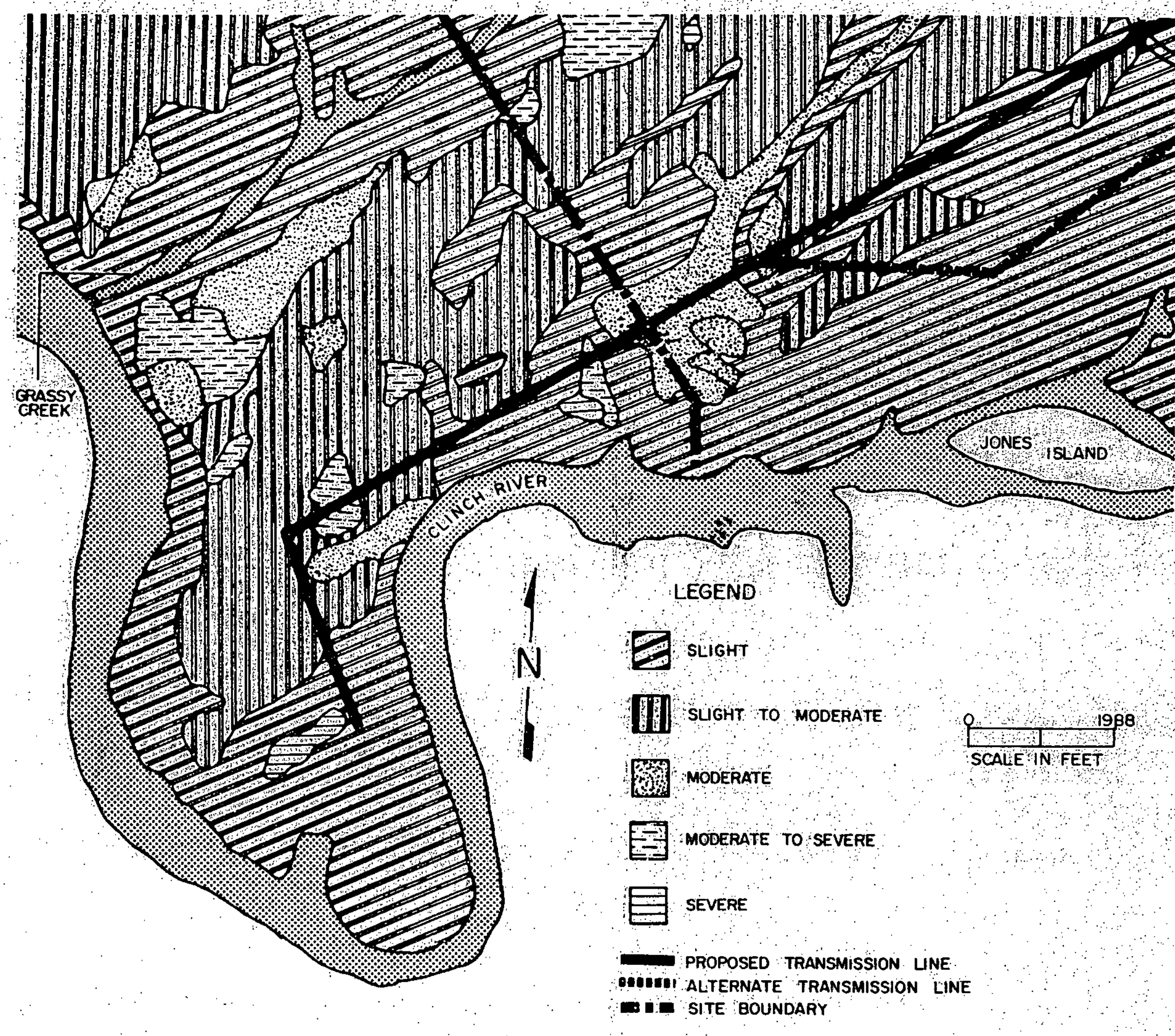


Figure 4.2-1 SOIL ERODIBILITY OF THE CRBRP AREA

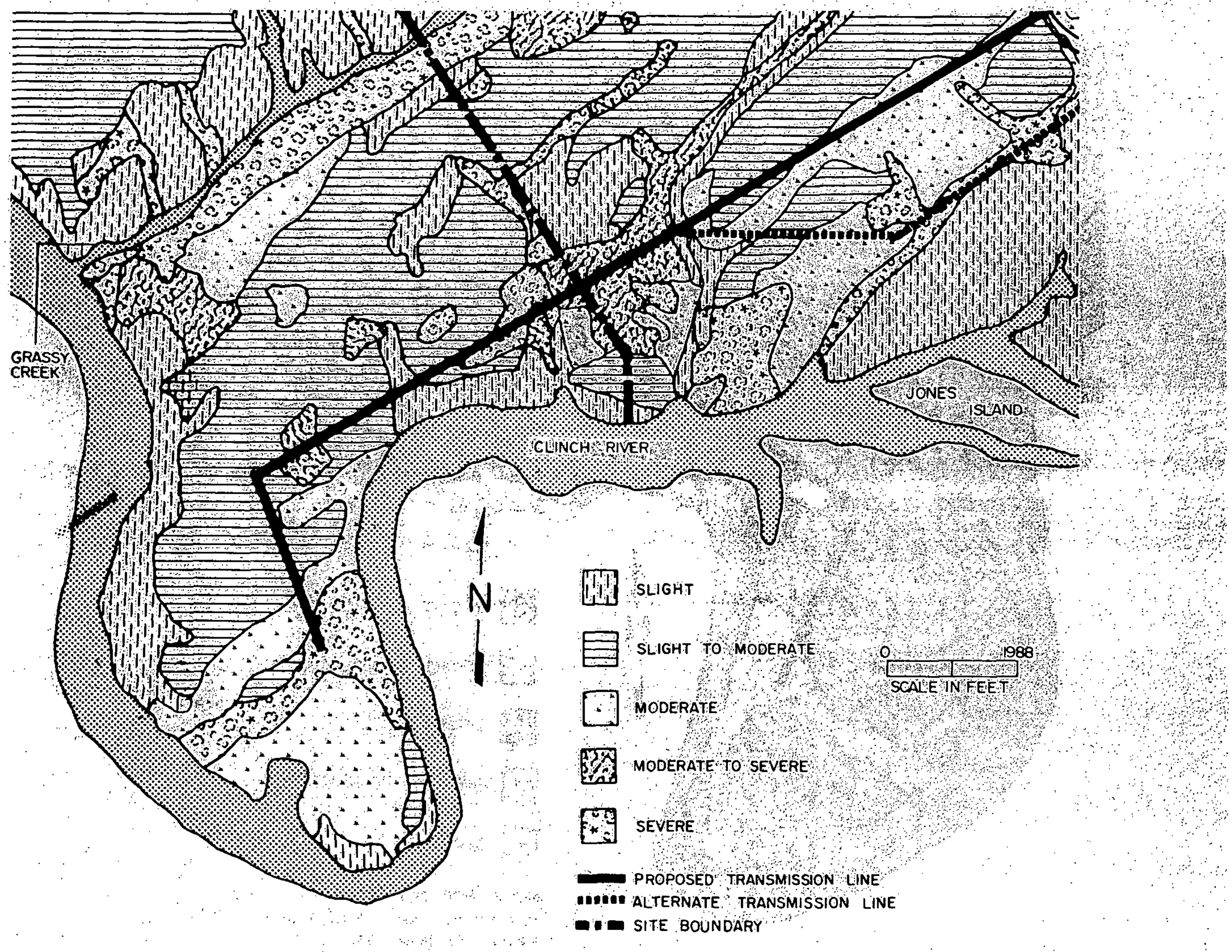


Figure 4.2-2 HEAVY EQUIPMENT IMPACT POTENTIAL OF THE CRBRP AREA

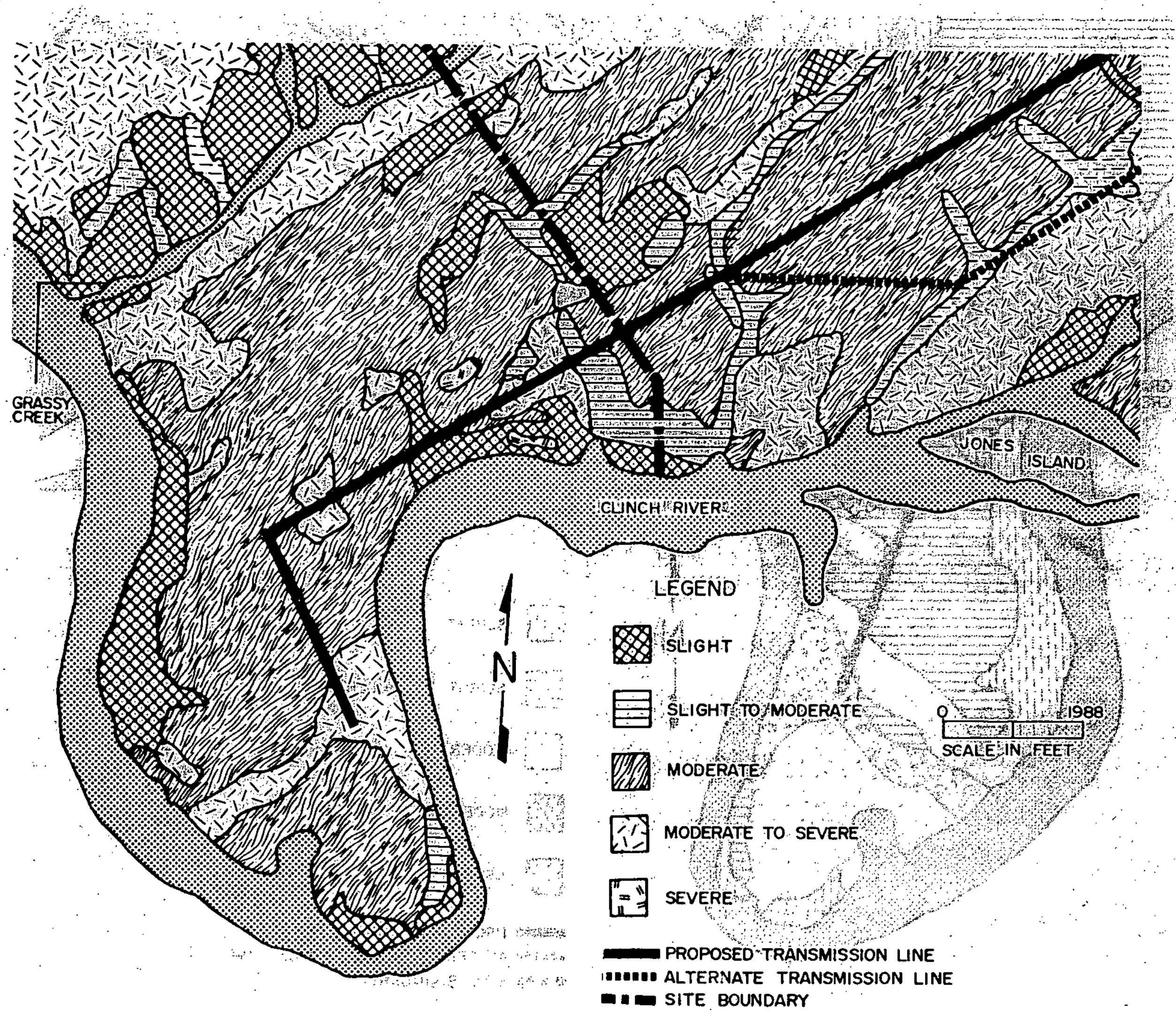


Figure 4.2-3 REVEGETATION POTENTIAL OF THE CRBRP AREA

4.3 RESOURCES COMMITTED

4.3.1 PLANT CONSTRUCTION

The CRBRP Site is on undeveloped land which has already been committed to industrial development and is presently owned by the U.S. Government and in TVA custody. During construction of the CRBRP, a small area of the Site will be changed permanently from forest land to industrial usage. As many tree stands as possible will be left within the plant construction area where they will not create costly or dangerous obstacles to construction, equipment or personnel movement. Based on present design data available, it is assumed that approximately 292 acres will be cleared |8 |9 |16
during construction of the plant complex and related facilities as discussed in Section 4.1. This comprises approximately 21 percent of the |8 |9 |16
total Site area.

Construction of the CRBRP will have both short and long range effects on terrestrial ecosystems. Habitats will be altered during the life of the plant. Initially this will create biotic stress in the peripheral areas. Peripheral populations however, can be expected to eventually return to a normal level. No rare or endangered species or uncommon flora are known to occur on land affected by plant construction. Permanent effects of plant construction will include modification of preplant physiography at the plant complex and quarry areas. Another permanent impact will be |9
the removal of material from the quarry area and its placement at the plant complex. Expected impacts of Site clearing and plant construction have been discussed in Section 4.1.

Since the Site is devoid of human habitation, the socioeconomic impacts will be in the surrounding region and in the counties of Anderson, Knox, Loudon and Roane as discussed in Section 8.0.

4.3.2 TRANSMISSION LINE CONSTRUCTION

The transmission line route will cross pine plantations and natural forest lands removing approximately 62 acres from forest production. While the transmission lines are functional, land use will be limited to those areas which are below minimum electrical clearances in height. 16

4.3.3 CONSTRUCTION MATERIALS

The construction of the nuclear power plant and all supporting facilities will require an extensive supply of materials commonly utilized, including steel, cement, sand aggregates, lumber and so on. It is estimated that approximately 330,000 cubic yards of concrete will be utilized in the building structures; this concrete will consist of cement, sand and aggregates for the concrete structures and will be irretrievably committed. To a considerable degree, other basic materials are reclaimable, renewable or replaceable with some penalty; their commitment to the CRBRP should generally be considered a relatively short-term and reversible commitment of resources. 16

4.3.4 WATER RESOURCES

Present plans indicate no significant commitment of water resources during the construction period. The only permanent change will be in those areas covered by plant structures that are not removed. In these areas water will infiltrate into the soil at slower rates and runoff will be greater than in the preconstruction condition. However, since the plant complex only occupies approximately 37 acres no significant effects on local groundwater conditions and runoff volumes are expected. 9

4.3.5 MINERAL RESOURCES

Dolomite rock on the Site will be quarried for concrete aggregate for the CRBRP. Current plans call for the closure of this quarry following CRBRP construction. A small terrace deposit of sand and gravel at the southern 9
tip of the Site has a limited commercial value. No other mineral deposits of commercial value are known to exist in the area.

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