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THE TENNESSEE VALLEY AUTHORITY

Clinch River Small Modular Reactor Site

Regional Surface Water Use Study

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This engineering study has been prepared as a supporting document for the Clinch River Small Modular Reactor Site (CR SMR) Early Site Permit and is being distributed for project use only. The study provides a summary of historical, present and predicted future surface water use in the CR SMR region based on available information sources. Estimated surface water demands of the proposed small modular reactor are also discussed.

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1. INTRODUCTION

1.1 Purpose

The purpose of this document is to provide information regarding surface water use in the region of the Clinch River Small Modular Reactor site (CR SMR) to be used for the preparation of the Early Site Permit.

The CR SMR is located on the Clinch River arm of Watts Bar Reservoir in Roane County near the city of Oak Ridge, Tennessee. The land is owned by the U.S. Government and is under the custody and control of the Tennessee Valley Authority (TVA). The site is bounded to the east, south, and west by the Clinch River. The northern boundary is the Department of Energy's Oak Ridge Reservation.

1.2 Scope

This study focuses on surface water use, including withdrawals and returns, within a seven-county area (referred to as the surface water study area) surrounding the CR SMR as shown in Figure 1. The counties are Anderson, Knox, Loudon, Meigs, Morgan, Rhea, and Roane. This discussion includes historical and current water use, projections of water use, surface water regulations, and local hydrology in the region. Water availability for the site is addressed. Water intakes and returns within the surface water study area are identified.

1.3 TVA Reservoir Operating Policy

TVA manages the 652-mile Tennessee River and its tributaries for a number of objectives including navigation, flood damage reduction, power production, water quality, water supply, and recreation. TVA's integrated river control system consists of 49 dams, including nine dams on the Tennessee River, 39 tributary dams, and one pumped storage facility.

TVA adopted a reservoir operating policy in 2004 based upon the comprehensive Reservoir Operations Study (ROS), which was conducted in cooperation with the U.S. Army Corps of Engineers and the U.S. Fish and Wildlife Service as well as representatives of other agencies and members of the public.[1] Two of the features of the operating policy pertinent to this discussion are that it was designed to meet the future off-stream water needs in the Tennessee Valley as well as maintain minimum stream flow at critical locations in the Valley.

The operating policy requires TVA to store water in tributary reservoirs during the spring when there is relatively high inflow into the reservoir system for release during the summer when there is relatively little inflow into the system. An important requirement of the operating policy is to meet minimum flow targets. Each of the 10 major tributary projects has such a target. There are also system minimum flow targets on main-stem projects. Chickamauga and Kentucky are projects with key system minimum flow targets.

The individual tributary project minimum releases provide for instream flow uses such as aquatic habitat in the tailwaters below the projects. These project minimum flows plus local inflow between the tributaries and Chickamauga or Kentucky Dams comprise the system minimum flow. When the local inflows are too low to meet the governing system minimum flow target, the tributary project releases are increased until the governing system minimum flow target is reached.

Because rainfall varies across the watershed from year to year, there are some years when reservoirs on one tributary river have relatively less water in them than reservoirs on another tributary river. The operating policy requires TVA to balance the drawdown from all the tributary projects, which slows the drawdown on reservoirs with relatively low water levels and increases the drawdown on reservoirs with relatively high water levels.

2. REGIONAL SURFACE WATER HYDROLOGY AND REGULATIONS

2.1 Clinch River Surface Water Hydrology

The Clinch River originates in Southwest Virginia an flows through the Great Appalachian Valley southwest into Tennessee. The Clinch River is dammed twice, by Norris Dam and Melton Hill Dam. Norris Reservoir is the confluence of the Powell and Clinch River basins and it is one of the largest of TVA's 10 tributary storage reservoirs. The Clinch River discharges into the Tennessee River at Kingston, TN and forms the upper arm of the Watts Bar Reservoir. The Clinch River Basin has a drainage area of 4,413 square miles. It has five primary tributaries; Powell River, Coal Creek, Beaver Creek, Poplar Creek, and Emory River.

2.2 Norris Reservoir Surface Water Hydrology

Norris Dam, 55 miles upstream from CR SMR, is the only large multipurpose tributary storage project located on the Clinch River. Like many of TVA's multipurpose tributary dams, Norris Dam is operated for flood control, navigation, hydropower, water supply, recreation, and aquatic ecology. Above Norris Dam, the Clinch River has a drainage area of 2,912 square miles and a length of nearly 300 miles. The Powell River is the Clinch River's main tributary with a drainage area of 938 square miles. The rugged topography and steep slopes of the drainage area favor quick runoff. However, the elongated nature of the drainage area tends to attenuate flood peaks. The average annual rainfall within the drainage area is approximately 48.5 inches.[2]

2.3 Melton Hill Reservoir Surface Water Hydrology

Melton Hill Dam, approximately five river miles upstream from CR SMR, is a multipurpose reservoir providing for navigation, hydroelectric power production, water supply, water quality, and recreation. Unlike most of TVA's multipurpose tributary projects, Melton Hill Dam does not provide any significant flood damage reduction benefits, nor does it provide any significant seasonal flow regulation because of the little useful storage volume available.[3]

Melton Hill Dam has an average weekly discharge is 4,832 cfs[a] (3,123 mgd[b]) with a maximum weekly discharge of 25,455 cfs. Figure 2 shows the expected flow frequency from Melton Hill based on 100 years of reservoir and system simulation conducted for the development of the current reservoir operating policy. The minimum discharge requirement for Melton Hill is 400 cfs average daily flow, but the frequency of this minimum flow continuing for as long as seven days is less than 0.1 percent as shown in Figure 2.

Melton Branch (DA[c] 1.51 sq mi) and Pawpaw Creek (DA 8.71 sq mi) are two minor tributaries that flow into the Clinch River between Melton Hill Dam and the proposed CR SMR intake at RM 17.9. Between the proposed intake structure and the proposed discharge structure at RM 15.45 Caney Creek (DA 3.22 sq mi) and Poplar Springs Creek at RM 16.2 (DA 2.48 sq mi) discharge into the Clinch River.

2.4 Watts Bar Reservoir Surface Water Hydrology

The CR SMR is approximately five river miles downstream of Melton Hill Dam on the Clinch River arm of Watts Bar reservoir. Discharging from Melton Hill Dam, the Clinch River forms the north leg of the Watts Bar Reservoir. The Tennessee River below Fort Loudoun Dam comprises the south leg. Watts Bar's water elevation is controlled by Watts Bar Dam, 55 miles downstream of CR SMR. Watts Bar's elevation is generally maintained between 735 MSL[d] and 741 MSL. The Probable Maximum Flood (PMF) elevation at Watts Bar Dam is 768.27 MSL with a flow rate of 550,000 cfs and the 500-Year Flood Elevation is 747.1 MSL at the dam with a flow rate of 260,000 cfs.[4]

River flow at the site can be upstream, downstream or quiescent, depending on the modes of operation of Melton Hill Dam, Watts Bar Dam and Fort Loudon Dam on the Tennessee River. Flow reversal would occur from an abrupt shutdown of Melton Hill and Watts Bar Dams and by releasing water from Fort Loudon Dam.[5]

2.5 Regional Surface Water Regulations

The Tennessee Department of Environment and Conservation (TDEC) requires that all alterations to a stream, river, lake or wetland must first obtain a water quality permit. Physical alterations to properties of waters of the state requires an Aquatic Resource Alteration Permit (ARAP) or a §401 Water Quality Certification. TDEC also requires that persons discharging directly from a point source into surface waters of the state must obtain a National Pollutant Discharge Elimination System (NPDES) discharge permit from the Tennessee Division of Water Resources.

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[a] cfs – cubic feet per second
[b] mgd – million gallons per day
[c] DA – drainage area
[d] MSL – feet above mean sea level

The U.S. Army Corps of Engineers (Corps) also require that any project that dredges or fills material into the waters of the U.S. must obtain a §404 permit. In addition, TVA requires a §26a permit to ensure that construction activities along the shoreline and in waters of the Tennessee River system do not have a negative effect on TVA's management of the river system. TVA does not self permit for §26a permits, but will follow environmental procedures to ensure its projects do not have a negative impact on the Tennessee River system.

The above regulatory information is described at: http://tn.gov/environment/permits, http://www.tva.com/river/26apermits/index.htm, and http://www.lrd.usace.army.mil/.

3. REGIONAL SURFACE WATER USE AND AVAILABILITY

3.1 Current Water Use[6]

As described in section 1.3, TVA's reservoirs are managed as an integrated system to meet TVA's diverse operating objectives at various locations across the system. As such we begin the discussion of water use at the watershed level.

Total water withdrawals (surface and groundwater) for the TVA watershed during 2010 was estimated to average 11,951 MGD of freshwater for off-stream uses. Surface water withdrawals accounted for 98.3% (11,747 MGD) of the total withdrawals and groundwater withdrawals accounted for the other 1.7% (204 MGD) . The total return flow was estimated to be 11,480 MGD or 96.1 percent of the water withdrawn. The net water demand, which is the difference between the withdrawals and the returns, is a measure of consumptive use. Consumptive use is water that evaporates, transpires, or is consumed by humans, livestock, or crops. The total net water demand in 2010 was 471 MGD or 3.9 percent of the total withdrawals.

Out of the 11,747 MGD of surface water withdrawn from the Tennessee River system in 2010, thermoelectric power withdrawals were an estimated 10,046 MGD (100% of total thermoelectric withdrawal); industrial, 1,116 MGD (97.2% of total industrial withdrawal); public supply, 558 MGD (77.2% of public supply withdrawal); and irrigation, 27 MGD (79.4% of total irrigation withdrawal).

In 2010, net water demand was 52 MGD for thermoelectric, 75 MGD for industrial, 310 MGD for public supply, and 34 MGD for irrigation.

3.2 Future Water Use Projections[7]

By 2035, total water withdrawals are projected to decline about 21 percent to 9,449 MGD. By category, water withdrawals are projected to increase as follows: industrial increases 31 percent to 1,502 MGD, public supply increases 30 percent to 938 MGD, and irrigation increase 35 percent to 46 MGD. Thermoelectric water withdrawal is expected to decline 31 percent to 6,963 MGD, reflecting a change in both generating and cooling technologies for power plants.

3.3 Trends in Water Use

Table 1 shows historical off-stream water use in the Tennessee River watershed from 1995 to 2010 and projected water use to 2035. Total water use peaked in 2005 and has fallen mostly due to decline in thermoelectric water use. Industrial and irrigation use has been little changed over 1995 to 2010, but public supply has increased steadily closely following population growth.

3.4 Off-Site Surface Water Users near the CR SMR

TVA's 2010 Water Use database was queried for Surface Water Users in the surface water study area surrounding the CR SMR. The results for water withdrawal are summarized in Table 2. Table 3 contains the individual data records from the query for withdrawals and Figure 3 shows the locations of the withdrawals.

As shown in Table 2, total 2010 withdrawal was 1478.91 mgd. By far, thermoelectric water use (1366.17 mgd) was the highest due to withdrawals for Bull Run, Kingston, and Watts Bar power plants. Public supply is the second highest use at 102.62 mgd.

Of the 42 water intakes shown in Figure 3, only the Oak Ridge Bear Creek Road Plant would have a Surface Water Protection Area[e,8] which would include the CR SMR. Presently, Oak Ridge has plans to close down the Bear Creek Road Plant in September of 2014.[9]

3.5 Off-Site Surface Wastewater Returns near the CR SMR

TVA's 2010 Water Use database was queried for Wastewater Returns in the surface water study area surrounding the CR SMR. The results for returns are summarized in Table 2. Table 4 contains the individual data records for the 69 discharges and Figure 4 shows their locations.

As shown in Table 2, total 2010 returns totaled 1441.41 mgd, which is 97.5 percent of the withdrawal returned back to the system. By far, thermoelectric returns (1348.38 mgd; 98.7 percent of the thermoelectric withdrawal) was the largest returns due to returns for Bull Run, Kingston, and Watts Bar power plants. Public supply is the second largest returns at 80.47 mgd (78.4 percent of the public supply withdrawal).

3.6 CR SMR On-Site Surface Water Needs and Analysis

The current CR SMR design has circulating cooling water sourced from the Clinch River arm of Watts Bar Reservoir with the planned intake at RM 17.9 and a planned discharge at RM 15.45. The current design CR SMR cooling water requirement for two twin-packs is 22.9 mgd. Potable water and other water needs will come from the Oak Ridge Department of Public Works. There

[e] Public water suppliers are required to identify potential contamination sources upstream of their intakes. In Tennessee, the distance upstream is generally a maximum of 15 miles. The area so identified is the Surface Water Protection Area for the intake.

are no anticipated plant operation impacts to local groundwater resources. The planned return would be 6.8 mgd resulting in a net water demand of 16.1 mgd.

TVA's reservoir operating policy was designed to meet the off-stream water needs of the Tennessee Valley out to the year 2030. The forecast of 2030 water needs was based upon a water use estimate prepared using year 2000 data. The estimates used to develop the reservoir operating policy were a total withdrawal of 13,990 mgd with a return of 13,010 mgd with a net water demand of 980 mgd. For the Clinch River Basin the assumption used for the operating plan development was a net water demand above the CR SMR of 63 mgd for 2030.

The current watershed projection of water demand for 2035 indicates a total withdrawal of 9,449 mgd with a return of 8,737 mgd for a net water demand of 712 mgd. The current 2035 net water demand projection for the Clinch River upstream of the CR SMR is 26 mgd. With addition of the estimated consumptive loss for the CR SMR of 16.1 mgd to the 2035 projection results in a net system-wide net water demand of 728 mgd and a net water demand above the CR SMR of 42 mgd. Both of these revised projections are within the net water demands of 980 mgd (system-wide) and 63 mgd (Clinch River Basin) used for the operating policy development.

4. CONCLUSION

Surface water is the primary source for approximately 98.3% of the users in the Tennessee Valley watershed. Total surface water withdrawals in the watershed have declined from 2000 to 2010, primarily due to changes in thermoelectric cooling water patterns and industrial demands in the watershed. Water use in the surface water study area is about 13 percent of the total watershed use.

The current CR SMR design for two twin-packs will have a consumptive loss of 16.1 mgd. This added demand falls within the assumptions used for the development of TVA's reservoir operating policy, which was designed to supply the off-stream water needs of Tennessee Valley out to at least 2030. Recent water use projections suggest that the policy will meet off-stream needs until at least 2035.

The CR SMR would have little effect on water intakes downstream of the site. The only water intake close enough to the CR SMR to affect its Surface Water Protection Area is the Oak Ridge water plant intake on Bear Creek Road.

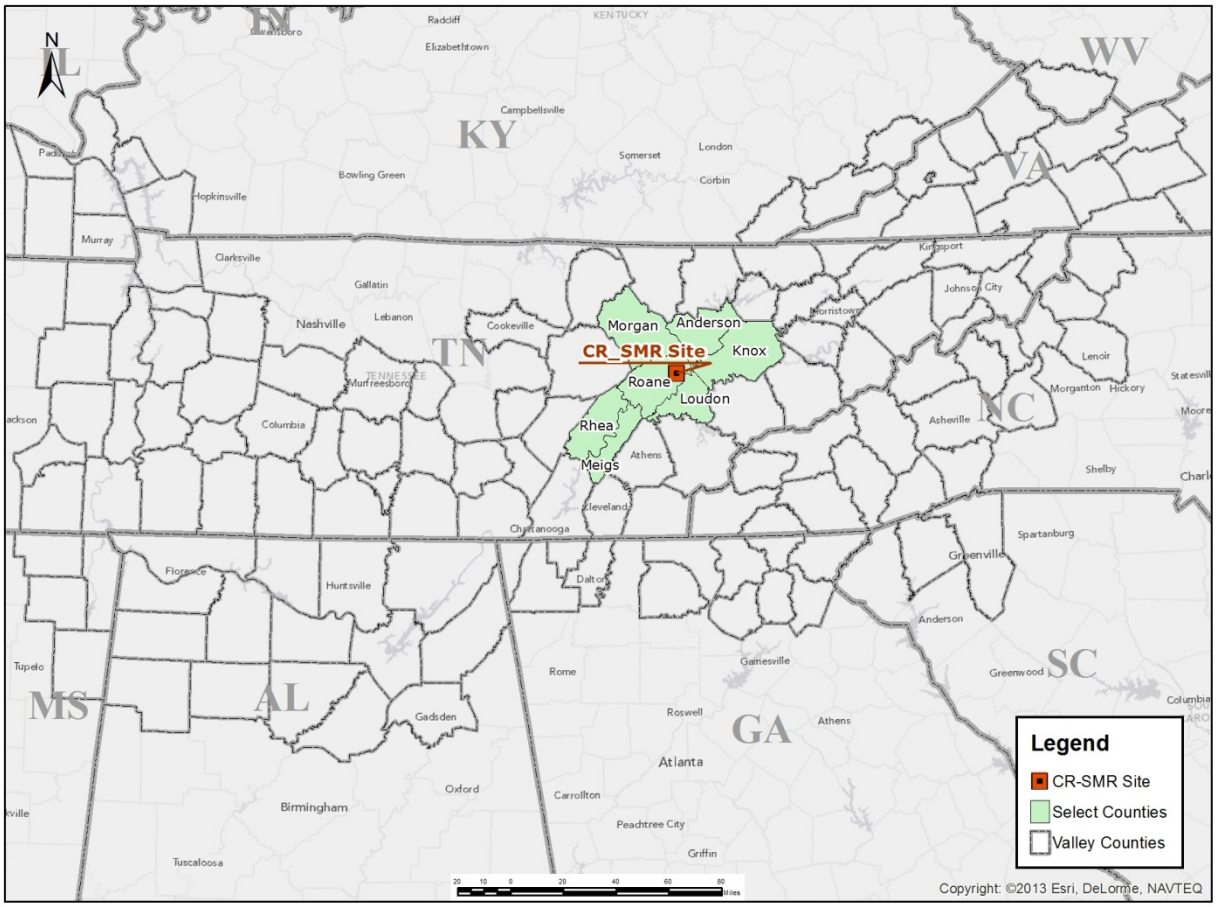

Figure 1: Surface Water Study Area

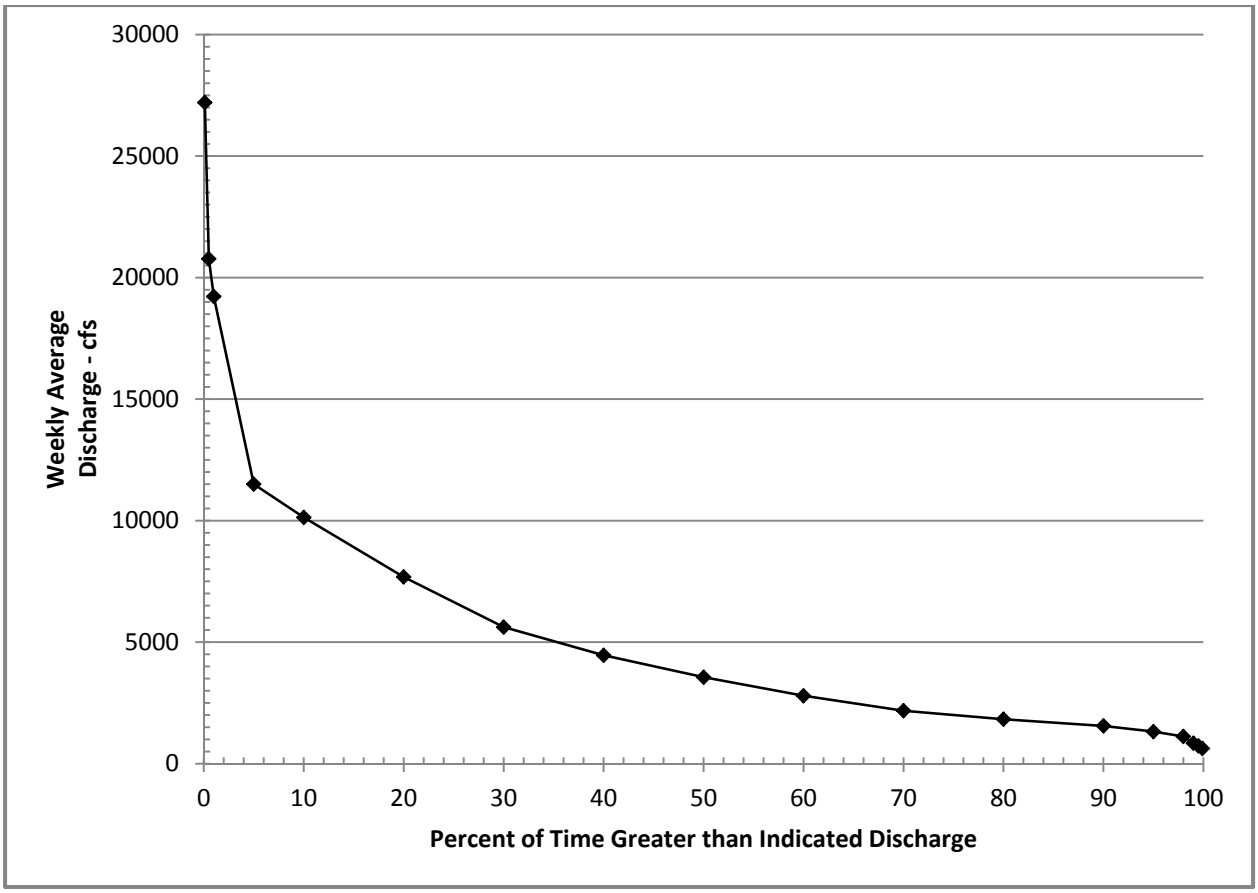

Figure 2: Melton Hill Weekly Discharge Frequency

Table 1: Trends of Estimated Water Use in the Tennessee River Watershed 1995 to 2035[10]

Off-stream use (mgd)	1995	2000	2005	2010	2035	Percent change 2010-2035
Total withdrawals	10,008	12,211	12,437	11,951	9,449	-21
Thermoelectric	8,010	10,276	10,531	10,046	6,963	-31
Industrial	1,030	1,205	1,179	1,148	1,502	31
Public supply	574	662	684	723	938	30
Irrigation	48	69	43	34	46	35
Source of water						
Surface	9,750	11,996	12,237	11,747		
Ground	258	215	200	204		
Net water demand (consumptive use)		649	432	471	712	51

Table 2: 2010 Surface Water Use in the Surface Water Review Area in million gallons per day

County	Thermoelectric	Industrial	Public Supply	Irrigation[1]	Total
Withdrawal					
Anderson	430.18	0.52	13.20	0.45	444.35
Knox		2.08	66.99	0.29	69.35
Loudon		5.65	11.23	0.57	17.45
Meigs					0.00
Morgan			1.13		1.13
Rhea	207.91		3.42	0.22	211.55
Roane	728.08	0.30	6.65	0.04	735.07
Total	1366.17	8.54	102.62	1.57	1478.91
Return					
Anderson	429.57	4.46	6.85	NA	440.88
Knox		3.14	57.78	NA	60.92
Loudon		4.00	8.85	NA	12.85
Meigs			0.33	NA	0.33
Morgan			0.65	NA	0.65
Rhea	191.40		3.01	NA	194.41
Roane	727.41	0.96	3.00	NA	731.37
Total	1348.38	12.56	80.47	NA	1441.41

[1]Includes known intakes and estimated irrigation from agricultural surveys.

Table 3: Surface Water Withdrawals in Anderson, Knox, Loudon, Meigs, Morgan, Rhea, and Roane Counties

Name	County	User Type	Water Source	Average Annual Withdrawal 2010 - mgd	Record #
Oak Ridge Dept Of Public Works	Anderson	PS	Melton Hill Reservoir	8.07	6520
Centennial Golf Course	Anderson	IR	Melton Hill Reservoir	0.42	4427
Bull Run Fossil Plant	Anderson	TH	Melton Hill Reservoir	430.18	5833
Anderson County Utility Board	Anderson	PS	Melton Hill Reservoir	1.41	6775
Rexnord Corporation Link-Belt Bearing	Anderson	IN	Melton Hill Reservoir	0.52	4423
Clinton Utilities Board	Anderson	PS	Melton Hill Reservoir	2.26	5992
North Anderson County U D	Anderson	PS	Clinch River	1.46	6507
First UD Of Knox County	Knox	PS	Fort Loudoun Reservoir	12.70	6305
West Knox Utility District	Knox	PS	Melton Hill Reservoir	4.81	6307
Knox-Chapman Utility District	Knox	PS	Fort Loudoun Reservoir	4.00	6302
Knoxville Ub#1 Whitaker Plant	Knox	PS	Fort Loudoun Reservoir	35.96	6299
West Knox Utility District	Knox[1]	PS	Melton Hill Reservoir	0.76	6308
Hallsdale Powell U D	Knox[1]	PS	Melton Hill Reservoir	6.77	6203
Cemex, Inc.	Knox	IN	Holston River	1.95	4557
Northeast Knox U D	Knox	PS	Holston River	1.98	6510
Valley Proteins	Knox	IN	Lyons Creek	0.01	8892
Rinker Materials South Central - Midway Quarry	Knox	MI	Quarry Pit	0.07	4563
Rinker Materials South Central - I-75 Quarry	Knox	MI	Quarry Pit	0.04	4560
Rinker Materials South Central - I-75 Quarry	Knox	MI	Williams Branch	0.00	4561
Tellico Village Public Works	Loudon	PS	Tellico Reservoir	0.22	9622
Loudon Utilities Board	Loudon	PS	Watts Bar Reservoir	9.28	6352
Viskase Corp.	Loudon	IN	Watts Bar Reservoir	1.58	4569
Kimberly Clark Corporation	Loudon	IN	Watts Bar Reservoir	4.07	4568

Table 3: Surface Water Withdrawals in Anderson, Knox, Loudon, Meigs, Morgan, Rhea, and Roane Counties - Continued

Name	County	User Type	Water Source	Average Annual Withdrawal 2010 - mgd	Record #
Tennessee National, Llc	Loudon	IR	Watts Bar Reservoir	0.46	8830
Lenoir City Utility Board	Loudon	PS	Watts Bar Reservoir	1.72	6331
Plateau Utility District	Morgan	PS	Crooked Fork Creek	1.13	6717
Dayton Water Dept	Rhea	PS	Chickamauga Reservoir	2.94	6039
Watts Bar Nuclear Plant	Rhea	TH	Chickamauga Reservoir	52.81	7223
Watts Bar Nuclear Plant	Rhea	TH	Chickamauga Reservoir	155.10	7222
Spring City Water System	Rhea	PS	Watts Bar Reservoir	0.48	6463
Rockwood Water System	Roane	PS	Watts Bar Reservoir	2.48	6612
Lakeside Golf Course	Roane	IR	Watts Bar Reservoir	0.00	4614
Kingston Water System	Roane	PS	Watts Bar Reservoir	0.77	6295
Kingston Fossil Plant	Roane	TH	Watts Bar Reservoir	728.08	5835
Harriman Utility Board	Roane	PS	Watts Bar Reservoir	2.01	6217
Cumberland Utility District	Roane	PS	Watts Bar Reservoir	1.39	6540
Oak Ridge Country Club	Roane	IR	East Fork Poplar Creek	0.03	8955
Oak Ridge Bear Creek Plant	Roane	IN	Watts Bar Reservoir	0.30	9723

[1]Intake is in Anderson County

IN - Industrial , IR - Irrigation, PS - Public Supply, TH - Thermoelectric, MI - Mining

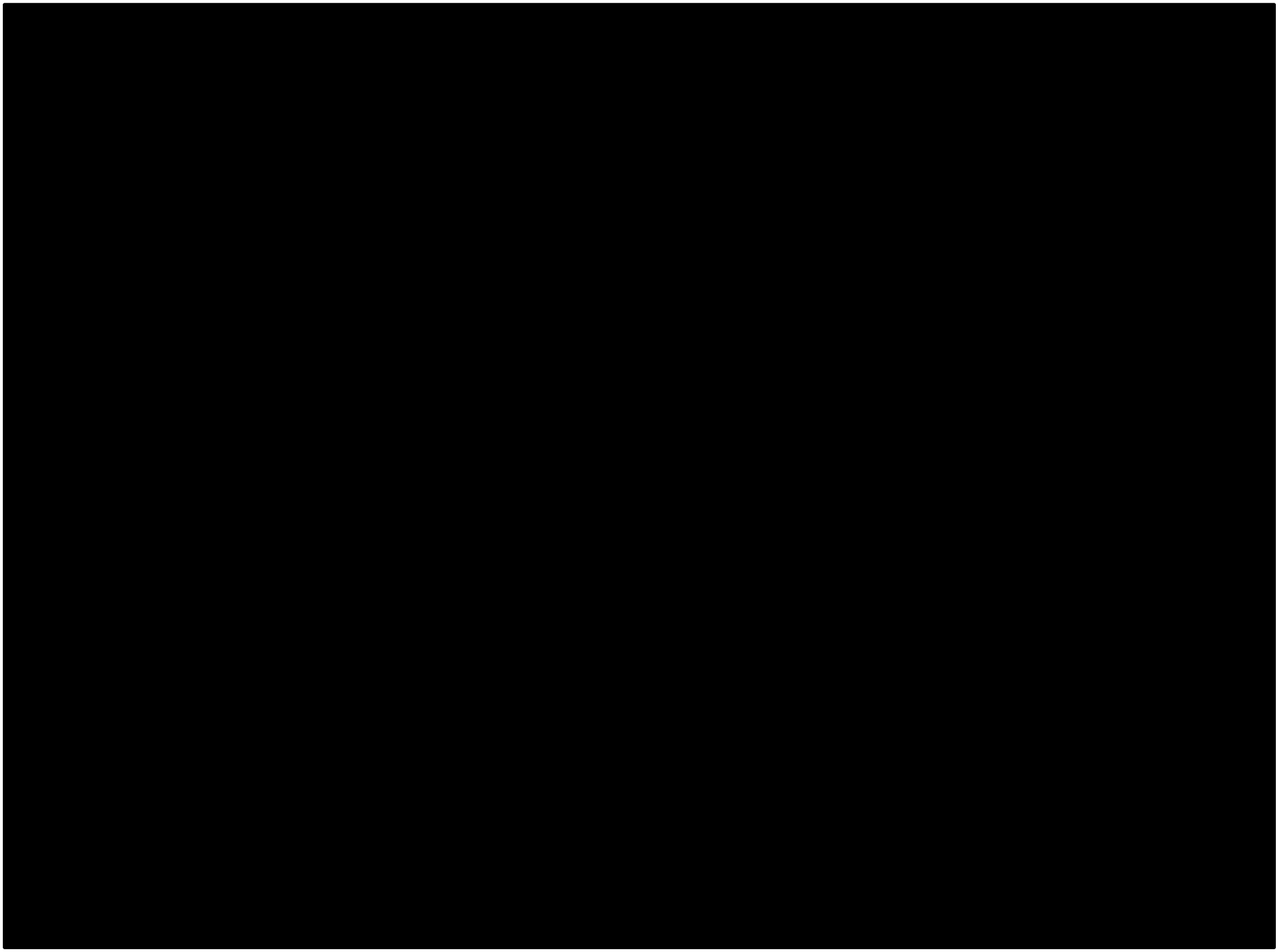

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Table 4: Wastewater Returns in Anderson, Knox, Loudon, Meigs, Morgan, Rhea, and Roane Counties

Name	County	User Type	Receiving Water	Average Annual Discharge 2010 - mgd	Record #
Lake City Stp	Anderson	WW	Coal Creek	0.52	3325
Becromal Of America Inc.	Anderson	IN	Melton Hill Reservoir	0.05	3296
Bull Run Fossil Plant	Anderson	TH	Melton Hill Reservoir	429.57	3290
Clinton Stp #1	Anderson	WW	Melton Hill Reservoir	1.61	3298
Norris Stp	Anderson	WW	Buffalo Creek	0.10	3355
Oak Ridge Stp	Anderson	WW	East Fork Poplar Creek	4.53	3370
Rexnord Bearings	Anderson	IN	Melton Hill Reservoir	0.56	3294
Rexnord Bearings	Anderson	IN	Melton Hill Reservoir	0.01	3295
USDOE-Oak Ridge Y12 Plt	Anderson	IN	Melton Hill Reservoir	0.03	3358
USDOE-Oak Ridge Y12 Plt	Anderson	IN	Melton Hill Reservoir	3.35	3359
USDOE-Oak Ridge Y12 Plt	Anderson	IN	Melton Hill Reservoir	0.04	3361
USDOE-Oak Ridge Y12 Plt	Anderson	IN	Melton Hill Reservoir	0.01	3364
USDOE-Oak Ridge Y12 Plt	Anderson	IN	Melton Hill Reservoir	0.38	9328
Dalen Products, Inc.	Knox	IN	Turkey Creek	0.11	9117
First U.D. Knox Co.-Turkey Cr	Knox	WW	Fort Loudon Reservoir	5.99	3423
Hallsdale Powell Utility	Knox	WW	Beaver Creek	6.54	9228
Hallsdale-Powell-Raccoon Valley Stp	Knox	WW	Bull Run Creek	0.15	3414
Johnson Bible College	Knox	WW	French Broad River	0.07	9301
Kinder Morgan	Knox	IN	Third Creek	0.01	3417
Knoxville-Fourth Creek Stp	Knox	WW	Fort Loudon Reservoir	6.46	3415
Knoxville-Kuwahee Stp	Knox	WW	Fort Loudon Reservoir	29.12	3413
Knoxville-Loves Creek Stp	Knox	WW	Holston River	2.80	3411
KUB-Eastbridge Stp	Knox	WW	Holston River	0.48	3339
Asarco Inc. - Tn Mines Div.	Knox	MI	Holston River	0.74	3388

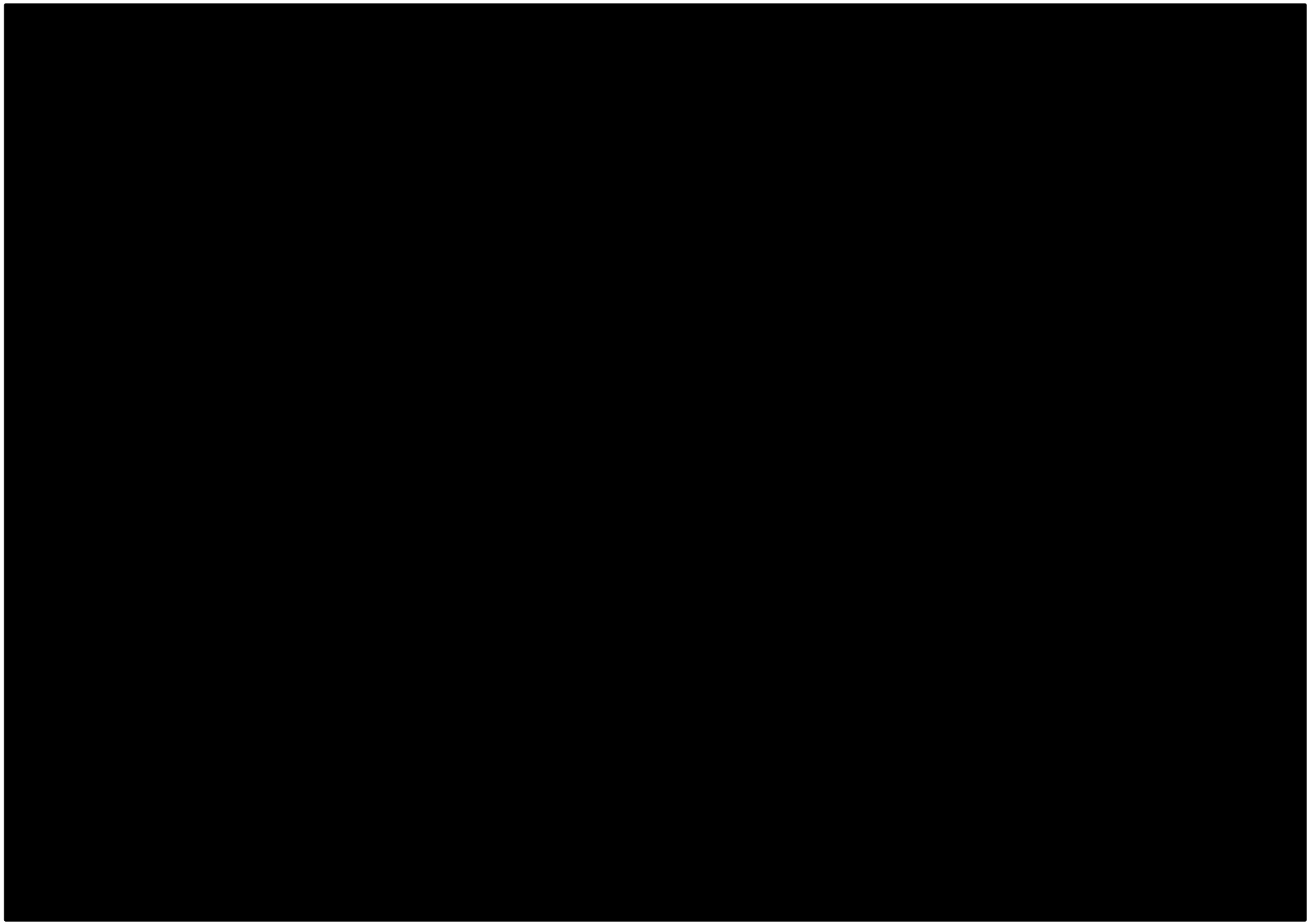
Table 4: Wastewater Returns in Anderson, Knox, Loudon, Meigs, Morgan, Rhea, and Roane Counties - Continued

Name	County	User Type	Receiving Water	Average Annual Discharge 2010 - mgd	Record #
BP Oil, Inc.	Knox	IN	Third Creek	0.02	9143
Cemex Inc	Knox	IN	Woods Creek	1.73	3418
Cemex Construction Materials Atlantic, Llc	Knox	IN	Woods Creek	0.10	9281
Cemex Construction Materials Atlantic, Llc	Knox	IN	Woods Creek	0.01	9282
Magellan Terminals Holdings Lp	Knox	IN	Third Creek	0.12	9268
Petro Stopping Ctr.	Knox	WW	Grable Branch	2.00	9292
Pilot Oil Company #270	Knox	WW	Turkey Creek	0.04	9272
Pilot Oil Store #219	Knox	IN	Swan Pond Creek	0.01	3407
Rocore- Knoxville	Knox	IN	Fort Loudon Reservoir	0.02	3408
Rocore- Knoxville	Knox	IN	Fort Loudon Reservoir	0.02	9267
Rohm Haas	Knox	IN	Second Creek	0.03	9294
Rohm Haas	Knox	IN	Second Creek	0.03	9295
Southern Railway-John Sevier	Knox	IN	Holston River	0.03	3410
Southern Railway-John Sevier	Knox	IN	Holston River	0.01	9291
Travelcenters Of America	Knox	IN	Turkey Creek	0.01	3421
Travelcenters Of America	Knox	WW	Turkey Creek	0.01	9278
Valley Protein	Knox	IN	Lyons Creek	0.12	3389
West Knox UD-Karns Beaver Creek Stp	Knox	WW	Beaver Creek	4.11	3427
Kimberly-Clark Corporation	Loudon	IN	Watts Bar Reservoir	3.95	3051
Lenoir City Stp	Loudon	WW	Watts Bar Reservoir	1.24	3330
Loudon Stp	Loudon	WW	Watts Bar Reservoir	7.39	3331
Tellico Village Public Works	Loudon	WW	Tellico Reservoir	0.22	9623
Yale Security Inc.	Loudon	IN	Watts Bar Reservoir	0.04	3326
Yale Security, Inc.	Loudon	IN	Watts Bar Reservoir	0.01	9486

Table 4: Wastewater Returns in Anderson, Knox, Loudon, Meigs, Morgan, Rhea, and Roane Counties - Continued

Name	County	User Type	Receiving Water	Average Annual Discharge 2010 - mgd	Record #
Yale Security Inc.	Loudon	IN	Watts Bar Reservoir	0.04	3326
Yale Security, Inc.	Loudon	IN	Watts Bar Reservoir	0.01	9486
Decatur Stp	Meigs	WW	Chickamauga Reservoir	0.33	3118
TDOC-Brushy Mtn Prison Stp	Morgan	WW	Stockstill Creek	0.06	3373
Wartburg Stp	Morgan	WW	Crooked Fork Creek	0.60	3403
Dayton Stp	Rhea	WW	Chickamauga Reservoir	1.79	3116
AJ's Market	Rhea	WW	Broyles Branch	1.22	9247
Spring City Stp	Rhea	WW	Watts Bar Reservoir	0.49	3149
TVA-Watts Bar Nuclear	Rhea	TH	Chickamauga Reservoir	0.29	9409
Watts Bar Nuclear Plant	Rhea	TH	Chickamauga Reservoir	162.04	3146
Watts Bar Nuclear Plant	Rhea	TH	Chickamauga Reservoir	29.07	3147
ETTP-Central Neutraliz. Fac	Roane	IN	Watts Bar Reservoir	0.03	3365
Kingston Fossil Plant	Roane	TH	Watts Bar Reservoir	727.41	3311
Kingston Stp	Roane	WW	Watts Bar Reservoir	0.75	3320
Oliver Springs Stp	Roane	WW	Poplar Creek	0.55	3371
Rarity Ridge Wwtp	Roane	WW	Watts Bar Reservoir	0.08	9447
Roane County Stp	Roane	WW	Watts Bar Reservoir	0.34	3049
Rockwood Stp	Roane	WW	Black Creek	1.35	3376
USDOE-ORNL	Roane	IN	Whiteoak Creek	0.29	9348
USDOE-ORNL	Roane	IN	Whiteoak Creek	0.01	9349
USDOE-ORNL	Roane	IN	Whiteoak Creek	0.65	9350

IN - Industrial, WW - Public Supply Waste Water, TH - Thermoelectric



5. END NOTES

[1] Tennessee Valley Authority, "Reservoir Operations Study - Final Programmatic Environmental Impact Statement," Knoxville, Tennessee, February 2004.

[2] Tennessee Valley Authority, "Supporting Technical Information: Norris Project," Tennessee Valley Authority, Chattanooga, Tennessee, February 2012.

[3] Tennessee Valley Authority, "Supporting Technical Information: Melton Hill Project," Tennessee Valley Authority, Chattanooga, Tennessee, May 2013.

[4] Paul E. Booth and Charles B. Dodd, "Supporting Technical Information: Watts Bar Dam," ARCADIS, Chattanooga, Tennessee, September 2013.

[5] Project Management Corporation and Tennessee Valley Authority, "Clinch River Breeder Reactor Plant," Draft Environmental Statement, Docket No. 50-537, U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, Washington, D.C., February 1976, pgs. 2-9, <http://pbadupws.nrc.gov/docs/ML0826/ML082610502.pdf>, accessed February 2014.

[6] Charles E. Bohac and Amanda K. Bowen, "Water Use in the Tennessee Valley for 2010 and Projected Use in 2035," River Operation, Tennessee Valley Authority, Chattanooga, Tennessee, July 2012, Table 3-1, pgs. 66-67.

[7] Bohac and Bowen, Chapter 4, pgs. 72-75.

[8] Tennessee Department of Environment and Conservation, Division of Water Supply, "Tennessee Source Water Assessment Report, August, 2003, http://tn.gov/environment/water/docs/water-supply/source_water_assessment_epa_report_aug_2003.pdf, accessed February 2014.

[9] Personal communication between Ernie Henley (City of Oak Ridge) and Charles Bohac (Tennessee Valley Authority), February 3, 2014.

[10] Bohac and Bowen, Table 4-3, pg. 75.