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Roles of Historical Photography in Waste Site Characterization, Closure, and Remediation

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by

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ABSTRACT

Over 40,000 frames of historical vertical photography from 1938 to 1996 and over 10,000 frames of oblique photography from 1981 to 1991 of the 777-sq km Savannah River Site (SRS) in South Carolina are being reviewed, catalogued, and referenced utilizing ARCView and associated ARC/INFO software. This indexing allows environmental reviews of over 450 potential waste sites on SRS to support work plans, characterization, ecological risk assessments, and closure of waste sites in a more cost-effective manner. A case history of potential waste site mapping within a former cooling-water lake is presented to demonstrate the utility of these historical photographic records of SRS.

INTRODUCTION

The 777-ha SRS, formerly known as the Savannah River Plant, is located in south central South Carolina along the Savannah River on the upper Atlantic Coastal Plain of the United States. The SRS was established in the early 1950's for the production of special nuclear materials, primarily to support the nuclear weapons program of the United States. SRS has a rich history of remote sensing data and activities. From the initial phases of SRS, vertical aerial photography was used by the US Forest Service to manage timber resources on SRS. Therefore, photography is available every few years from this program from the 1950's until 1996. Document of SRS facilities and operations is included in this photography. Numerous other flights were conducted, as with the National High Altitude Program or by the Department of Energy (DOE) through the Remote Sensing Laboratory (RSL), Las Vegas, Nevada. Other documentation of past operations are in the form of low altitude, oblique photography and video acquisitions primarily by RSL. Low altitude, aerial gamma over flights, repeated every 5 to 10 years after 1974, provide valuable information on areas of low-level contamination of man-made radioactive on SRS and represent a reasonable alternative for surveying large areas effectively and efficiently. More recently, specialized airborne remote sensing scanners (Multispectral Scanners (MSS)) provide coverage of areas of interest, such as SRS wetlands. Satellite data (SPOT and Thematic Mapper) provide synoptic views of SRS, for landuse/land cover mapping, not easily obtained with ground based surveys. As data have accumulated and technologies advanced, the remote sensing data are becoming available in digital format in Geographic Information Systems (GIS), instead of hard copy format. As SRS moves to remediation activities, these historical data become a portion of the baseline for waste site characterization and evaluation to permit faster and more efficient closure to occur in the future.

AERIAL OBLIQUE PHOTOGRAPHY

Oblique coverage of SRS was acquired during January, 1971; June, 1974; December 1975; June, 1979; March, September, and October, 1981; August and September, 1982; March and August, 1983; March, May, and November, 1984; February, June, and August, 1985; March, April, June, and August, 1986; February, March, and June, 1987; March, 1988; April, 1990; May and June 1991; and April, 1994. The 1982, 1983, and 1984 flights are summarized in Meibaum (1984a, 1985a). The oblique photography provide SRS with a catalogue of major operating areas and construction activities, as well as areas of interest such as waste sites, cooling lakes, and forestry test plots. In the 1980's and early 1990's, numerous waste sites were photographic several times from several angles. The original negatives are stored at RSL and can be retrieved by proof book and frame number.

VERTICAL AERIAL PHOTOGRAPHY

An expansive vertical aerial photographic collection exists for SRS (Figure 1). Most of the photography prior to 1974 is black and white, while that after 1974 is color, either as normal color (NC) or false color infrared (FCIR). The most common altitude is 10,000 feet above ground level (AGL) and the most common scale is 1:15840. SRS was flown at 4 to 5-year intervals by the US Forest Service to assist with timber management (1955, 1956, 1966, 1973, 1974, 1979, 1982, 1986, 1989, 1992, and 1996). SRS was flown three times under the National High Altitude Photographic program (1981, 1989, and 1994). Since 1981, SRS has been flown, either in part or with almost complete coverage at a variety of altitudes and with differing film types by RSL (EG&G, 1981, 1983; Meibaum, 1984b, 1985b). Nearly site-wide coverage is available for almost every year since 1973; therefore, a photographic history of any location on SRS can be recreated.

Two sets of site-wide, vertical photography from 1938 and 1943 exist prior to establishment of SRS. These two sets provide a record of landuse on SRS prior to construction of the site (Christel, 1994) and both are available through the National Archives. Photography were taken in 1951 at 2,000 and 10,000 foot altitude, during early construction of SRS, thus details of the land cover were documented and the photography is available as a digital file (Lloyd, *et al.*, 1996). The 1955 and 1956, black and white photography is of fair quality and only prints have been located. Much of the photography in the 1950's and 1960's have portions of the frames near the operating areas of SRS removed from the prints and/or negatives, as part of the security practices at that time; thus, their utility for review of history of selected locations on SRS has been reduced. The construction activities of Par Pond are covered in a low and high altitude set of photography during 1958 and are especially useful for that project. The 1961 black and white coverage was flown at a higher altitude and has less utility. The 1973 and 1974, black and white coverages are of good quality. In 1971 and 1977, high altitude black and white coverage was flown by the US Airforce. Fall 1978, FCIR photography flown by the Savannah River Ecology Laboratory (SREL), University of Georgia, SRS, provides one of the best sets of early "color" photography. Another set of site-wide black and white coverage was flow in 1981 for the Soil Conservation Service for soil mapping of SRS. Photographic coverage by the US Forest Service occurred in 1979 (NC), 1982 (NC and FCIR), 1986 (NC and FCIR), 1989 (NC and FCIR), 1992 (FCIR), 1996 (NC) are valuable resources and are available from USDA-ASCS, Aerial Photography Field Office, Salt Lake City, Utah.

The coverages flown by EG&G (currently Bechtel Nevada) started in 1974 and are extensive, especially after 1981. These flights supported a variety of projects, mostly related to reactor operations, the National Environmental Policy Act (NEPA), and thermal and wetlands evaluation. Frequently the photography was collected in support of airborne MSS flights. For example, historical photography were used to evaluate the condition of the streams and the SRS Savannah River swamp, which received once-through, secondary cooling water from the reactors on SRS (Sharitz, *et al.*, 1974a; Tinney, *et al.*, 1986; Jensen, *et al.*, 1993a,b). Likewise, the history of aquatic vegetation development around the shoreline of the Par Pond was documented with aerial photography (Ezra and Tinney, 1985b; Jensen and Mackey, 1991a,b; Jensen, *et al.*, 1991c; Rea, *et al.*, 1996). Mackey (1993) outlined the usefulness of aerial photography for the study of Carolina Bay wetlands on SRS.

Aerial photography has been used to develop site-wide GIS coverages for SRS. A historical wetlands map, based on pre-SRS (1943 and 1951) photography (Christel, 1994), a site-wide landuse/land cover map (Ezra and Tinney, 1985a; Ezra, 1985; Ezra, *et al.* 1986; Christel and Guber, 1994), and site-wide soils GIS coverage (Rogers, 1990) were developed with the aid of site-wide aerial photography. In addition, representative historical photography of SRS was incorporated into a series of image browse files to allow for quick viewing of any location on SRS over time (Bresnahan, *et al.*, 1994; Cowen, *et al.*, 1995; Jensen, *et al.*, 1995, 1996). These resources will prove to be valuable in development of the history of waste sites at SRS for site characterization, evaluation, risk assessment, closure plans, and future monitoring (Airola and Kosson, 1989; Christel, 1996; Mackey, 1994; Stohr, *et al.*, 1987; Stohr and Lunetta, 1994).

CASE HISTORY
MAPPING OF POTENTIAL WASTE SITES IN L LAKE

To demonstrate the utility of historical photography of SRS in evaluation of waste sites, an evaluation of the types and locations of potential waste sites within a former, cooling-water lake (L Lake) is summarized below. In addition to the use to vertical photography primarily from 1984-1985, low altitude oblique photography and video was also available and was useful in verification of activities or classification of the various types of waste sites in the lake bed of L Lake, but these materials are not summarized here.

Background

L Lake was developed as a cooling-water reservoir for L Reactor on SRS. The construction of the lake along Steel Creek began in the fall of 1984 and was completed one year later in September 1985. When completed, the lake had a capacity of 31 million cubic meters and a normal pool elevation of 58 meters above mean sea level. L Reactor operated from 1985 until 1988. However, in spite of L Reactor shutdown in 1985, the lake level was maintained at normal pool level. In 1996-1997 evaluations, which could lead to the eventual draining of L Lake, were initiated as part of potential cooling water system shutdown at SRS. Since the Steel Creek flood plain was an area of low level gamma contamination (Briese *et al.*, 1975; Brisbin *et al.*, 1974; Gladden *et al.*, 1985; Jobst, 1987, 1988; Sharitz *et al.*, 1974b) and contaminated soil and vegetation materials had been relocated during the L Lake construction activities, historical photography from 1984 through 1985 until just prior to filling of the lake were evaluated. Maps of disturbed areas such as borrow pits, upland vegetation ash pile burial sites, flood plain contaminated vegetation sites, flood plain dam soil removal and construction burial sites were produced for over 63 hectares of disturbed areas within the 400 hectares of the lake bed. In addition, a digital elevation model (DEM) was created using soft copy photogrammetry techniques, so that various L Lake draw-down scenarios at different lake levels could be evaluated with respect to waste site exposure and remediation (Christel, 1996).

Steel Creek is one of five major streams on SRS. This stream rises on SRS and flows approximately 18 km south to the Savannah River flood plain and Savannah River on the southern portion of SRS. Operations of P and L Reactors began in 1954 and once-through cooling-water was discharged initially from these two reactors to Steel Creek. Stream flows in Steel Creek increased from its natural flow of about 1 cubic meter per second to a maximum of 24 cubic meters per second with the secondary cooling-water effluent pumped from the Savannah River. The secondary cooling-water was released at temperatures as high as 70 degrees centigrade; thus, theses two reactors greatly influenced the hydrologic and thermal regimes of Steel Creek. The results of the increased flow in Steel Creek included inundation of the creek flood plain, erosion, and loss of the original wetland plant communities. In addition, from 1955 to 1973, approximately 284 curies of cesium-137 were released into Steel Creek. Because of a strong affinity for sediments, a majority of the released material was absorbed and/or deposited in the sediments of Steel Creek and the adjacent SRS Savannah River flood plain (Briese, *et al.*, 1975; Brisbin, *et al.* 1974; Feimster, 1992; Gladden, *et al.*, 1985; Jobst, 1987, 1988; Shartiz, *et al.*, 1974). Cooling-water effluent from P Reactor was diverted to Par Pond on SRS in 1963, and L Reactor was placed on standby in 1968; thus, returning Steel Creek to a more near normal flow regime. Refurbishment of L Reactor began in the early 1980's with plans to restart the reactor in 1985. To provide thermal mitigation of cooling-water from the restart of L Reactor, L Lake was constructed by damming the middle reach of Steel Creek. With the cessation of thermal releases to Steel Creek in 1968, scrub-shrub and persistent and non-persistent emergent plant communities had colonized the Steel Creek flood plain and were in place when L Lake construction began in 1984 (Tinney *et al.*, 1986; Wein and McCort, 1988). The upland areas of L Lake had been managed primarily as pine stands. L Reactor was restarted in the late fall of 1985 and continued operating until it was again placed on standby in 1988.

L Lake Construction

Construction of L Lake began in the fall of 1984. L Lake was formed by damming the middle reach of Steel Creek between SRS Road B and Highway 125. The resulting 400-hectare, L Lake has a capacity of 31 million cubic meters and is 7000 meters long and 1200 meters wide at it widest point (average 600 meters). The dam, located at the south end of the lake, is 1200 meters long. The normal pool of the lake is 58 meters above mean sea level (MSL) and the top of the main embankment of the L Lake dam is 61 meters above MSL. Clear cuts made during construction of the lake totaled 418 hectares including 144 hectares of bottom land hardwood and shrub wetlands, 146 hectares of upland hardwood and pine forest, and 50 hectares of other areas within the lake basin (Ezra and Tinney, 1985; Tinney *et al.*, 1986; Wein and McCort, 1988; Wein and Pierce, 1995). Timber growing above the Steel Creek flood plain was cut for commercial sale. Outside the lake basin additional areas were clear-cut for power line right-of-ways and other construction related activities (McCort *et al.*, 1988).

During the construction of L Lake dam, dredged spoil from the flood plain of Steel Creek at the dam site was placed in a special waste disposal area, allowed to dry, leveled, and then covered with 1.5 meters of soil (Ziegler *et al.*, 1985) (Figure 2). Although only the upper 1.2 meters of flood plain material was considered to be radioactively contaminated, the stream bed was excavated to a depth of about 3 meters (Gladden *et al.*, 1989). This spoil material was estimated to contain 0.2 curies of cesium-137 and 0.02 curies of colbalt-60 (Zeigler *et al.*, 1985). Approximately 46,400 cubic meters of spoil material were removed from the dam site. The area of this waste disposal site for the L Lake dam construction site was estimated to be about 5 hectares based on interpretation of digitized aerial photography from September 1985. This buried spoil site was flooded over when the lake was filled.

Trees outside of the Steel Creek flood plain were sold through commercial timber harvests. The remaining debris from the upland tree harvest and sale was pushed into piles, burned, and covered with local soil materials prior to filling of the lake. Five hundred eighty-four (584) of these ash piles were identified and mapped in aerial photography of L Lake during the construction activities (Figure 2). Trees and shrubs within the flood plain itself were potentially contaminated from the radioisotopes in the flood plain soils. Vegetation growing in the flood plain area of Steel Creek covered by the lake was estimated to contain about 12 milli-curies of cesium -137 (Zeigler *et al.*, 1985). The woody vegetation in the Steel Creek flood plain was removed from the upper two-thirds of L Lake, but was left standing in the lower one-third of the flood plain immediately upstream of the coffer dam used during the construction of the L Lake dam. The vegetation removed from the flood plain was buried in an estimated one hundred fifty-four (154) sites adjacent to the Steel Creek flood plain and covered with 1 to 2 meters of local soil material prior to the filling of the lake (Figure 2).

Before L Lake was filled, 35 artificial reefs including 3 log reefs, 7 brush reefs, 12 tire reefs, 12 concrete block reefs, and 1 floating tire breakwater were constructed. The reefs were constructed to provide habitat diversity and structure in the lake before an aquatic plant community was established (Gladden *et al.*, 1989; Wein and Pierce, 1995). These artificial structures are evident in the aerial photography used to map L Lake prior to filling. The filling of L Lake began on September 15, 1985, and the lake reached its normal operating level of 58 meters above MSL on November 4, 1985 (Gladden *et al.*, 1989). During the summer of 1986, a rip rap diversion dike and canal were constructed in the northern end of L Lake just south of SRS Road B to more effectively use the cooling capacity of the lake. Changes in L Lake caused by the construction of this dike and canal are not included here.

Historical Photography of L Lake Construction Activities

A review of historical photography available from RSL indicated that several aerial acquisitions of Steel Creek had occurred during 1984-1985. Pre-construction flights show the presence of test drillings near the future L Lake dam site and an existing borrow pit in the upper portion of the future (March 31, April 1, June 18, and September 19, 1984). Archeological survey pits are also visible in this 1984 photography. Construction began in the fall of 1984. Aerial photography of the L Lake construction activities was acquired on the following dates: April 17, April 25, May 14, May 18-19, June 21, and

September 6, 1985 (Table1). Based on the information in the photography, material appears to have been removed from within the Steel Creek flood plain at the L Lake dam construction site and deposited in a large pit north of the dam site and east of the Steel Creek flood plain (Figure 2). Aerial gamma surveys conducted in August 13-23, 1985, of the Steel Creek flood plain show no cesium-137 activity in close proximity to the dam construction site, nor in the area of the disposal site (Jobst, 1988). Commercial timber harvesting was wide spread throughout the upland areas (non-flood plain areas of the future lakebed). Following the timber harvest, the remaining debris was placed in piles and burned. Debris and ash piles are visible in the aerial photography. The ash piles, which are characteristically oval-shaped, were covered with local soil materials and numbered to several hundred (Table 3 and Figure 2).

The time sequence of photography shows that after the upland areas were harvested, the flood plain was cleared of timber and a series of disturbances or pits occurred lateral to or within the flood plain. This activity began in the northern portion of the lakebed and continued southward. These features or pits appear at irregular intervals and are likely the locations of contaminated materials removed from the flood plain. They are less well-defined in shape and appear to "cast a shadow," which indicates that they are 'mound-like." It is estimated that there are more than 150 of these "mounds" or pit burials. Some of these pits may not have been used, especially in the lower one-third of the lake where much of the flood plain vegetation was still standing as observed in the last vertical aerial photography which was taken on September 6, 1985. The filling of L Lake began on September 15, 1985. Aerial photography acquired after September 1985 shows the lake at full pool.

In addition to the vertical photography, ground photography of the construction activities were reviewed from SRS achieves and records taken primarily by the COE during the construction of L Lake. Low altitude video tapes (March and October 1984) and oblique photography (March and September, 1984, and March and August, 1985) taken from helicopter over flights of the lake during the construction activities was also reviewed. These additional sources of information were especially valuable in determining the sequence of changes associated with the construction of L Lake and in interpretation of the changes which occurred in the lakebed.

Soft Copy Photogrammetry of L Lake
Ortho-Photographic Processing

To map the L Lake basin, vertical aerial photography acquired on September 9, 1985, nine days before filling of the lake began, was selected as the base imagery (Christel, 1996). Most of the construction and clearing activities were either completed or nearly complete at this time, except for the final construction of the L Lake dam itself. The timeliness and scale (1:13900) (Table 1) provided the most comprehensive visual record available for the lake and; therefore, was used for the digital mapping effort described below.

The series of photographs used to support the digital ortho-photographic mapping of L Lake waste sites included frames 92 through 99 of EG&G file or proof book roll number 5108. The photography was acquired between 9:45 and 9:49 am on September 9, 1985, with a north heading and an altitude above ground level of 7,000 feet. The photographic system was a Wild Heerburg RC-10, large format, aerial camera equipped with a 153-millimeter lens and Aerocolor 2445 film. The imagery was cloud free, and contains well-defined shadows due to the low sun angle from the early morning flight. The original spool film was scanned at 50 microns on a Howtek flatbed scanner to yield a resolution of one-meter for the mapping. The binary digital photographs were converted to .img files, rotated, and reviewed using ERDAS Imagine, Version 8.2, image processing software (ERDAS, 1995). The images were rotated so that north (the direction of the flight line) was to the right. This rotation gave the best parallax for the correction function employed during the ortho-rectification process. Based predominantly on overlap and scan quality, frames 92, 94, 96, 97, 98, and 99 were selected and imported into SoftPlotter ™ Version 1.6, Vision International's soft copy ortho-photogrammetric package (Vision International, Inc., 1996). For best results from SoftPlotter, camera calibration information is required. This information was obtained from Leica NA, Inc. The camera calibration certificate lists import lens information including the calibration focal length, the principal point of symmetry, and the radial distortion away from the principal point of symmetry. The manufacturer's fiducial mark locations with respect to the focal center of the camera frame are also given. All of these values are used by the SoftPlotter Interior Orientation routine to calculate the mathematical relationships between the camera lens and the lens and the ground.

Table 1. Vertical Aerial Photography Used for Mapping Construction Activities and Producing the Digital Elevation Model of L Lake

Proof Book Number*	Frame Number	Date (M/D/YR)	Altitude (Feet above ground level)	Scale	Film Type
4644	006	03/31/84	17000	1:34000	Color Infrared
4655	006	03/31/84	17000	1:34000	Color
4655	161-164	04/01/84	8000	1:15700	Color
4755	174, 194	06/18/84	10000	1:19900	Color
4840	16-22	09/19/84	20000	1:39200	Color
4840	63-86	09/19/84	8000	1:7960	Color
4966	62-63	04/17/85	20000	1:41400	Color
4966	73	04/17/85	6000	1:11900	Color
4973	105-112	04/25/85	4000	1:7960	Color
4991	10-19	05/14/85	6000	1:11900	Color
4992	10-19	05/14/85	6000	1:11900	Color Infrared
4993	84-104	05/18/85	10000	1:19900	Color
4994	84-104	05/18/85	10000	1:19900	Color Infrared
4997	66-73	05/19/85	7000	1:13900	Color
4998	66-73	05/19/85	7000	1:13900	Color Infrared
5033	75-81	06/21/85	6000	1:11900	Color
5033	82	06/21/85	17000	1:33800	Color
5108	88	09/06/85	20000	1:39200	Color
5108	92-100	09/06/85	7000	1:13900	Color

* Source of photographic Proof Books is the RSL Achieves, Las Vegas, Nevada.

In SoftPlotter, the "L Lake Project" was defined, the camera type and values were entered, and the six images were imported. Interior orientation was performed and a maximum acceptable root mean square error (RMSE) was set to the equivalent of one meter or 1.4 pixels in the image data. Once information pertaining to the camera-lens relationship was determined, ground control points (GCP) were defined in order to calculate the photographic/ground relationship. GCPs came from a variety of sources (Table 2) for the triangulation portion of the mapping effort. Results of the triangulation process are dependent on several user-defined constraints. These parameters are selected based on knowledge of the factors affecting the photographic acquisition and film quality. Rigid constraints can be employed when optimum conditions, such as the following are met: known flying height, good film quality, minor distortions in the photography due to flight parameters, gentle topography, and adequate ground control. Optimum conditions were met with the L Lake project, so rigid constraints were used. Based upon image RMSE residual for x, y, and z values, the triangulation process yielded acceptable results.

Epipolar re-sampling of the triangulated overlapping imagery was performed using the proprietary algorithms provided in the Stereo Tool module in SoftPlotter. This process resulted in five stereo-pairs of images that were oriented such that y-parallax was removed and x-parallax was interpreted as differences in elevation. The stereo-pairs were displayed to quality check the apparent success of the re-sampling before the digital elevation model (DEM) was generated.

Table 2. Control Point Information

Type	Number	Source
Horizontal	13	Differential GPS*
Vertical	7	USGS Quadrangles**
Tie Points	6	Frame Feature

*Global Position System provided by Westinghouse Savannah River Company Personnel, R. S. Riley
**Girard NW and Girard NE 7.5minute series (USGS, 1964)

DEM Generation

The five stereo-pairs were used as the sources for the DEM. Collection parameters were defined with a ground spacing of one meter, and a DEM was produced for each stereo-pair. This was an iterative process and the most time intensive, because the software provides ample methods for improving posting results through the use of break-lines and other site-specific point and surface adjustments. For L Lake, the forest edge was the biggest consideration during the editing process. Special attention was given to those areas directly affecting the shoreline elevations. When the DEMs for each stereo-pair were completed, a mosaic image was produced (ERDAS, 1995). Based on known and map-measured check points, elevation errors of the DEM ranged from 0.037 to 1.70 meters. Horizontal accuracy was less than 10 meters.

Digital Ortho-Photography Generation

Ortho-photographs were derived from the five images and the DEM using a defined ground spacing of one meter in the Ortho Tool module in SoftPlotter (Vision International, Inc., 1996). As with the DEMs, the ortho-photography were merged using the mosaic routine in Imagine 8.2 (ERDAS, 1995). This image and the DEM were subsequently used to generate raster products and ARC/INFO coverages (ESRI, 1996) to determine the location, extent, and type of disturbances that were visible in the lakebed on September 6, 1985, just prior to the initial fill date of the lake nine days later.

Digital Ortho-Photographic Interpretation Results

The features (feature cover types) within the lakebed were grouped into seven categories based on the preliminary review of the source photography (Table 3). The temporal sequence of the aerial (Table 1) and ground photography indicate that these feature types were the primary areas used for the removal, transport, dumping, disposal, covering, and subsequent containment of the majority of material relocated during the construction of L Lake. Thus, two areas, totaling 5.87 hectares, were identified as potentially receiving contaminated soil materials removed from the flood plain of Steel Creek during the construction of the L Lake dam (Figure 2). Borrow pits and similar areas of disturbance consisted of fifteen areas totaling 29.04 hectares. One hundred fifty-four areas, totaling 6.42 hectares, were identified as potential vegetation waste piles were materials were removed from the contaminated Steel Creek flood plain. These vegetation waste piles are typically adjacent to the flood plain or are within the Steel Creek flood plain. Five hundred eighty-four ash piles account for 21.41 hectares in the lakebed. As stated earlier, these ash piles resulted from burning of piles of debris remaining from the commercial sales of upland vegetation and the subsequent covering of the ash piles with local materials using bulldozers. Table 3 also lists other types of features and structures constructed in L Lake, i.e., fish habitat structures.

Table 3. Summary of Disturbances in L Lake Prior to Filling in September, 1985

Disturbance Type	Number of Occurrences	Mean Size (hectares)	Total Area (hectares)
Dam Soil Burial Sites	2	2.94	5.87
Vegetation Burial Piles	154	0.04	6.42
Upland Ash Piles	584	0.04	21.41
Borrow Pits and Similar Area	15	1.94	29.04
Debris Piles	13	0.04	0.46
Fish or Habitat Structures	27	0.01	0.21
		Total	63.41

SUMMARY

Historical aerial photography provided a powerful resource to assist in the reconstruction of the location of disturbances within a former cooling-water lake on a DOE site. The types, numbers, size, and locations, both as to coordinates and elevations could be reconstructed using ortho-photogrammertic and other digital imagery and Geographic Information System (GIS) technologies. By using the digital maps in conjunction with the DEM for L Lake, information can be provided to support future sampling and characterization evaluations that may be required, if the lake were to be drained and remediation and/or landscape restoration were required. Without the reconstruction of the lakebed configuration as it existed just prior to filling in September, 1985, characterization and remediation evaluations would be more difficult.

In a manner similar to that used with historical photography of L Lake, the history of many of the waste sites on SRS can be reconstructed. This reconstruction would yield information on the location, time period of use, and environmental conditions at or near the waste site; therefore, improving future closure activities associated with these waste sites.

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SRS Aerial Photographic Centers

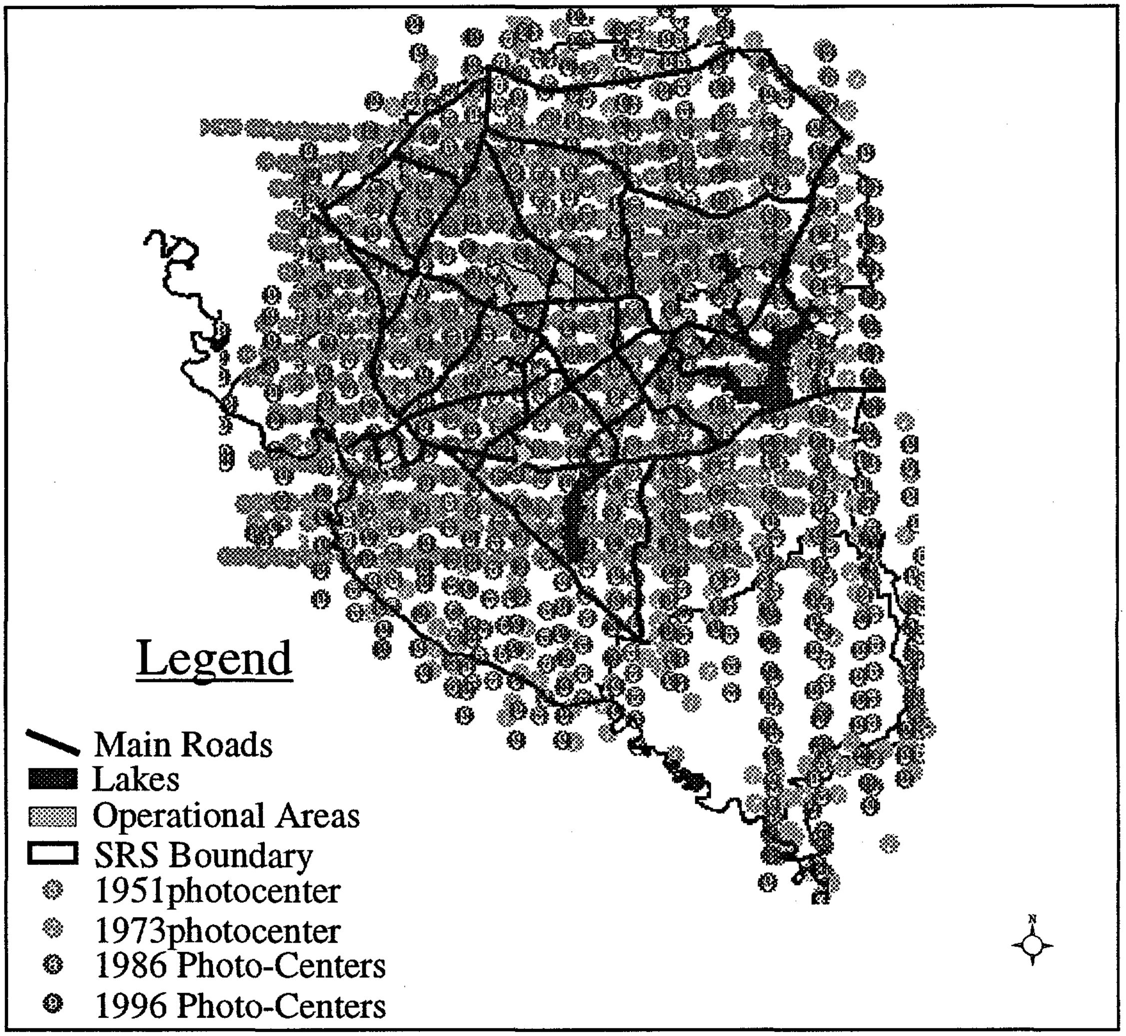

Figure 1. Examples of Vertical Aerial Photographic Coverage of the Savannah River Site for Four Representative Years

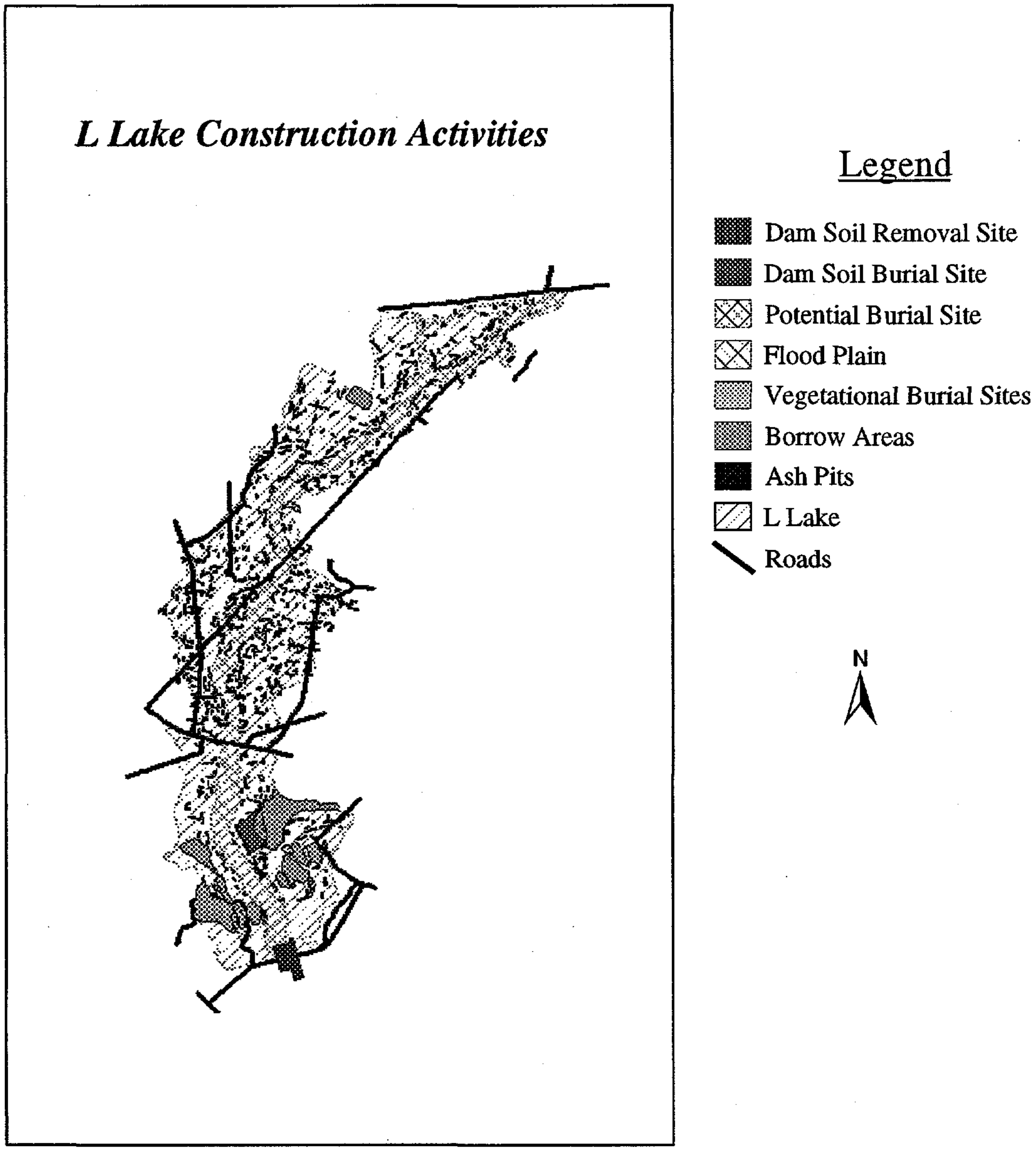

Figure 2. Construction Activities at L Lake in 1984-1985, Indicating Major Changes and Locations of Potential Waste Site Areas