U.S. Geological Survey
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Prepared in cooperation with the
PUERTO RICO ELECTRIC POWER AUTHORITY

Sedimentation Survey of Lago Loco, Puerto Rico, March 2000

Water-Resources Investigations
Report 01-4187

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U.S. Department of the Interior
U.S. Geological Survey

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By Luis R. Soler-López

Water-Resources Investigations Report 01-4187

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Multiply	By	To obtain
	Length	
centimeter	0.03281	foot
millimeter	0.03937	inch
meter	3.281	foot
kilometer	0.6214	mile
	Area	
square meter	10.76	square foot
square kilometer	0.3861	square mile
square kilometer	247.1	acre
	Volume	
cubic meter	35.31	cubic foot
cubic meter	0.0008107	acre-foot
million cubic meters	810.7	acre-foot
	Volume per unit time (includes flow)	
cubic meter per second	35.31	cubic feet per second
cubic meter per second	15,850	gallon per minute
cubic meter per second	22.83	million gallons per day
	Mass per area (includes sediment yield)	
megagram per square kilometer	2.855	ton per square mile

Datums

Horizontal Datum - Puerto Rico Datum, 1940 Adjustment

Sea level: In this report, "sea level" refers to the National Geodetic Vertical Datum of 1929 (NGVD of 1929)- a geodetic datum derived from a general adjustment of the first-order level nets of the United States and Canada, formerly called "Seal Level Datum of 1929".

Acronyms used in this report

BLASS Bathymetric/Land Survey System
DGPS Differential Global Positioning System
GIS Geographic Information System
GPS Global Positioning System
PREPA Puerto Rico Electric Power Authority
TIN Triangulated Irregular Network
USGS U.S. Geological Survey

Translations

Lago Lake (in Puerto Rico, also reservoir)
Río River

Sedimentation Survey of Lago Loco, Puerto Rico, March 2000

***By* Luis R. Soler-López**

Abstract

Lago Loco, a small reservoir property of the Puerto Rico Electric Power Authority and part of the Southwestern Puerto Rico Project, has lost 64 percent of its original storage capacity. In 1951, the original storage capacity was about 2.40 million cubic meters, decreasing to 1.43 million cubic meters in 1986 and to 0.87 million cubic meters in March 2000. The storage loss or long-term sedimentation rate increased from 27,714 cubic meters per year from the period of 1951 to 1986 to 31,224 cubic meters per year for the period of 1951 to 2000. This represents a capacity loss of about 1.1 percent per year for the period of 1951 to 1986 and 1.3 percent per year for 1951 to 2000. The trapping efficiency of the reservoir was about 92 percent in 1951, decreasing to about 87 percent in 1986, and to about 80 percent in March 2000. The sediment yield of the net sediment-contributing drainage area increased from 1,504 megagrams per square kilometer per year between 1951 and 1986 to 1,774 megagrams per square kilometer per year between 1951 and 2000, or about 18 percent. At the current sedimentation rate of the reservoir, the life expectancy of Lago Loco is about 28 more years or until the year 2028.

Sumario

Lago Loco, un pequeño embalse de la Autoridad de Energía Eléctrica de Puerto Rico y del Proyecto del Suroeste de Puerto Rico, ha perdido 64 por ciento de su capacidad original de almacenamiento. En 1951, la capacidad original de almacenamiento era de unos 2.40 millones de metros cúbicos, que fue disminuyendo a 1.43 millones de metros cúbicos en 1986, y a 0.87 millón de metros cúbicos en marzo de 2000. La tasa de pérdida de almacenamiento o sedimentación a largo plazo aumentó de 27,714 metros cúbicos anuales en el período de 1951 a 1986 a 31,224 metros cúbicos anuales en el período de 1986 a 2000. Esto representa una pérdida de capacidad de un 1.1 por ciento anual para el período de 1951 a 1986, y un 1.3 por ciento anual para el período de 1951 a 2000. La eficiencia de este lago para atrapar sedimento era de un 92 por ciento en 1951, que fue disminuyendo a un 87 por ciento en 1986 y a un 80 por ciento en marzo de 2000. El rendimiento de sedimento del área neta de aportación de sedimento aumentó de 1,504 megagramos por kilómetro cuadrado anuales entre 1951 y 1986 a 1,774 megagramos por kilómetro cuadrado anuales entre 1986 y 2000, o un 18 por ciento. De mantenerse la tasa actual de sedimentación del embalse, la expectativa de vida de Lago Loco es de unos 28 años más o hasta el año 2028.

INTRODUCTION

The Puerto Rico Electric Power Authority (PREPA) operates the Southwestern Puerto Rico Project, which consists of a series of reservoirs connected by underground tunnels; the reservoir are used for hydroelectric power generation and irrigation of croplands. Among these reservoirs is Lago Loco, which originally provided about 2.40 million cubic meters of water storage capacity. Since construction in 1951, the reservoir has been losing storage capacity because of sediment accumulation, reducing water resources available for irrigation.

During March 2000, the U.S. Geological Survey (USGS) in cooperation with PREPA conducted a bathymetric survey of Lago Loco to determine the existing storage capacity of the reservoir, to assess the amount and location of sediment accumulation, and to estimate the sediment trapping efficiency of the reservoir and the sediment yield of the Lago Loco drainage area. The purpose of this report is to provide PREPA officials with the necessary information to manage effectively the water resources available in the reservoir and to develop strategies to mitigate the storage-capacity loss of Lago Loco.

DAM, RESERVOIR, AND BASIN CHARACTERISTICS

The construction of Lago Loco dam was completed in 1951. The dam is located on Río Loco in southwestern Puerto Rico, about 10 kilometers west of the town of Guayanilla, 4 kilometers west of the town of Yauco, and about 8 kilometers southeast of the town of Sabana Grande (fig. 1). The reservoir is the downstream unit of the Southwestern Puerto Rico Project and originally held about 2.40 million cubic meters of water. The power generation associated with the Southwestern Puerto Rico Project takes place at two power plants upstream of Lago Loco, and water stored in Lago Loco is used only for irrigation of croplands in the Lajas Valley farmlands (fig. 1).

The dam is a concrete gravity structure with a total length of 182.90 meters, a height of 21.94 meters and a base width of about 18.0 meters (table 1). The valley occupied by the dam is characterized by a comparatively long, shallow left abutment, a river channel about 46 meters wide and a steep right abutment. The left abutment section has an elevation of 73.76 meters above mean sea level and the right section has an elevation of 74.98 meters above mean sea level. The dam has two non-overflow sections, the left one is 118.70 meters long and the right one is 18.29 meters long.

Table 1. Principal characteristics of Lago Loco and Loco dam, Puerto Rico (modified from Sheda and Legas, 1968)

Total length of dam, in meters	182.90
Maximum height of dam, in meters	21.94
Maximum base width of dam, in meters	18.0
Length of left non-overflow section, in meters	118.70
Length of right non-overflow section, in meters	18.29
Length of spillway section, in meters	45.72
Elevation of spillway crest, in meters above mean sea level	70.10
Crown elevation of irrigation intake structure, in meters above mean sea level	62.03
Crown elevation of sluiceway structure, in meters above mean sea level	55.78
Drainage area at damsite, in square kilometers	21.76
Reservoir surface area in March 2000, in square kilometers	0 .29
Maximum depth during the March 2000 bathymetric survey, in meters	9.0

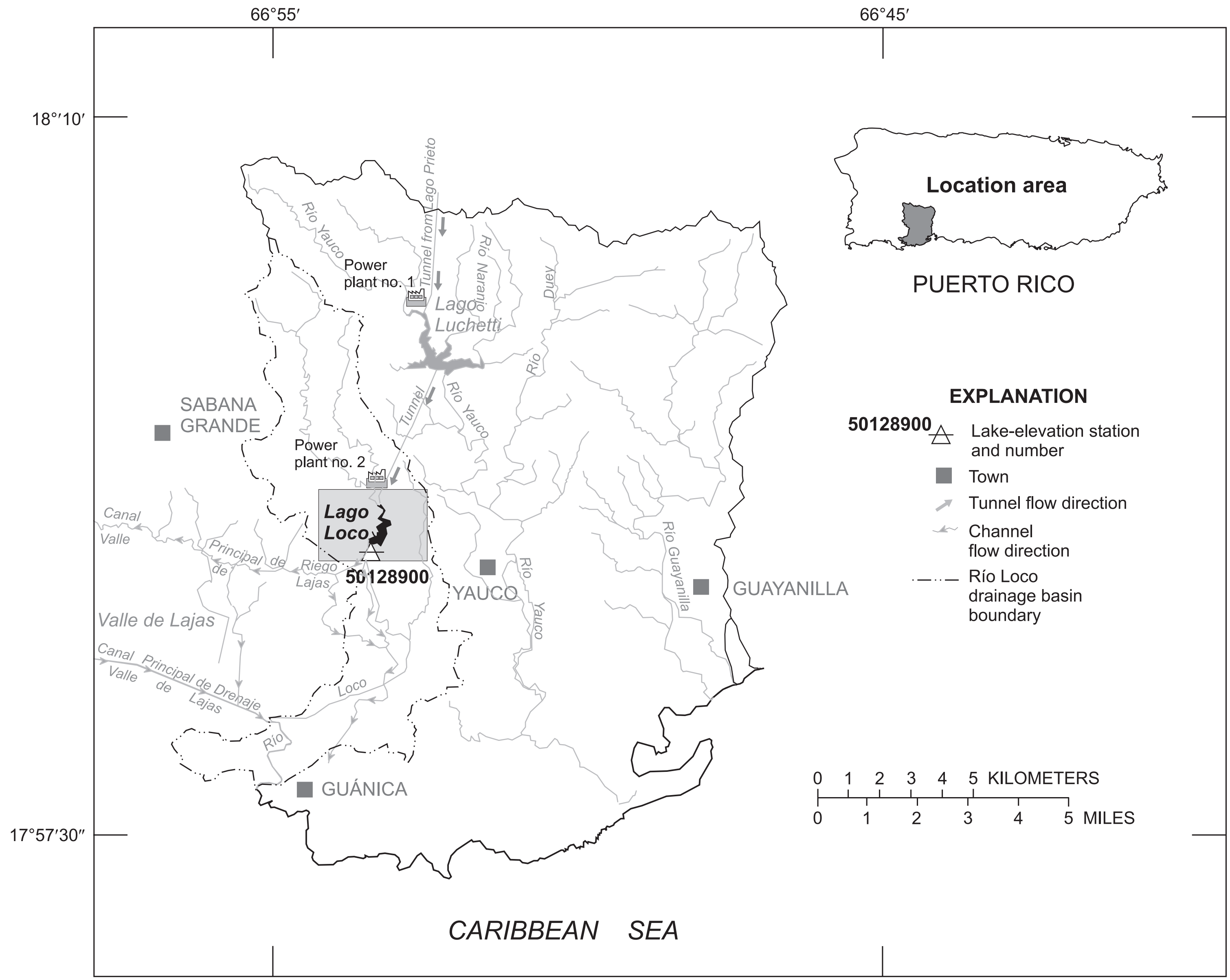

Figure 1. Location of Lago Loco in the Río Guayanilla to Río Loco basins, Puerto Rico.

An ungated overflow spillway section, 45.72 meters long is located near the right abutment and has an elevation of 70.10 meters above mean sea level. The spillway was designed to pass a maximum flow of 694 cubic meters per second between the non-overflow sections. The intake structure for irrigation releases is located at the right abutment non-overflow section at a crown elevation of 62.03 meters above mean sea level (table 1). The sluiceway structure is located at the spillway section at a crown elevation of 55.78 meters above mean sea level (Sheda and Legas, 1968).

The Lago Loco drainage area is located in the Caguabo-Mucara soil association (Gierbolini, 1975). The Caguabo soil series consists of shallow, well-drained soils that are slightly acid and moderately permeable. These soils formed in very gravelly residuum weathered from basic volcanic rocks. The slopes are high, ranging from 20 to 60 percent. The Mucara soil series consists of moderately deep, well-drained soils that are moderately permeable. These soils formed in residual material weathered from volcanic rock. The slopes are moderate to high, ranging from 5 to 60 percent and are covered mostly with brushy pasture and minor subsistence crops.

METHOD OF SURVEY

The bathymetric survey of Lago Loco involved planning, data collection, data processing, and data analyses. Arc/Info Geographic Information System (GIS) was used to plan the survey and to analyze the collected data. An electronic file depicting the reservoir shore line was loaded into a portable personal computer from the GIS, and served as the borderline for bathymetric data collection. Using the GIS cross sections were planned at a spacing of 50 meters, starting at the dam and continuing upstream along the Río Loco branch of Lago Loco (fig. 2). Bathymetric data were collected during March 2000 using a depth sounder coupled to a Differential Global Positioning System (DGPS) to control the horizontal position of the survey boat. The reservoir-pool elevation was monitored continuously at the Lago Loco lake-level station at damsite, near Yauco (USGS station 50128900, fig. 1). During the survey, the pool elevation of Lago Loco was below spillway elevation, so the collected depth data were adjusted to represent depths at spillway elevation by applying a time-elevation correction factor.

The bottom-depth profile data were down loaded onto a GIS and contour lines of equal depth were drawn at 1-meter intervals. An additional 0.5-meter contour was added to represent the shallowest part of the reservoir. These contour lines were then converted into a triangulated irregular network (TIN) to generate a reservoir-bottom surface model. From this model, the storage capacity and the amount and location of sediment accumulation was calculated using the GIS. In addition, a 1986 bathymetric map of Lago Loco (F. Quiñones, USGS 1986, unpublished report) was scanned, geo-referenced and loaded into the GIS where a TIN reservoir bottom surface model was generated and the storage capacity of Lago Loco for 1986 was determined. By comparing the two bathymetric data layers, the amount and location of sediment accumulation and the sedimentation rate from 1986 to 2000 were determined.

Lake-elevation storage-capacity curves for both surveys were generated using the TIN reservoir surface models by calculating the reservoir volumes at 1-meter lake-elevation intervals. Selected cross sections representing the reservoir bottom from shore to shore, as well as longitudinal profiles of the reservoir bottom along the thalweg of the different branches of the reservoir were constructed from the August 1986 and March 2000 TIN bottom surface models.

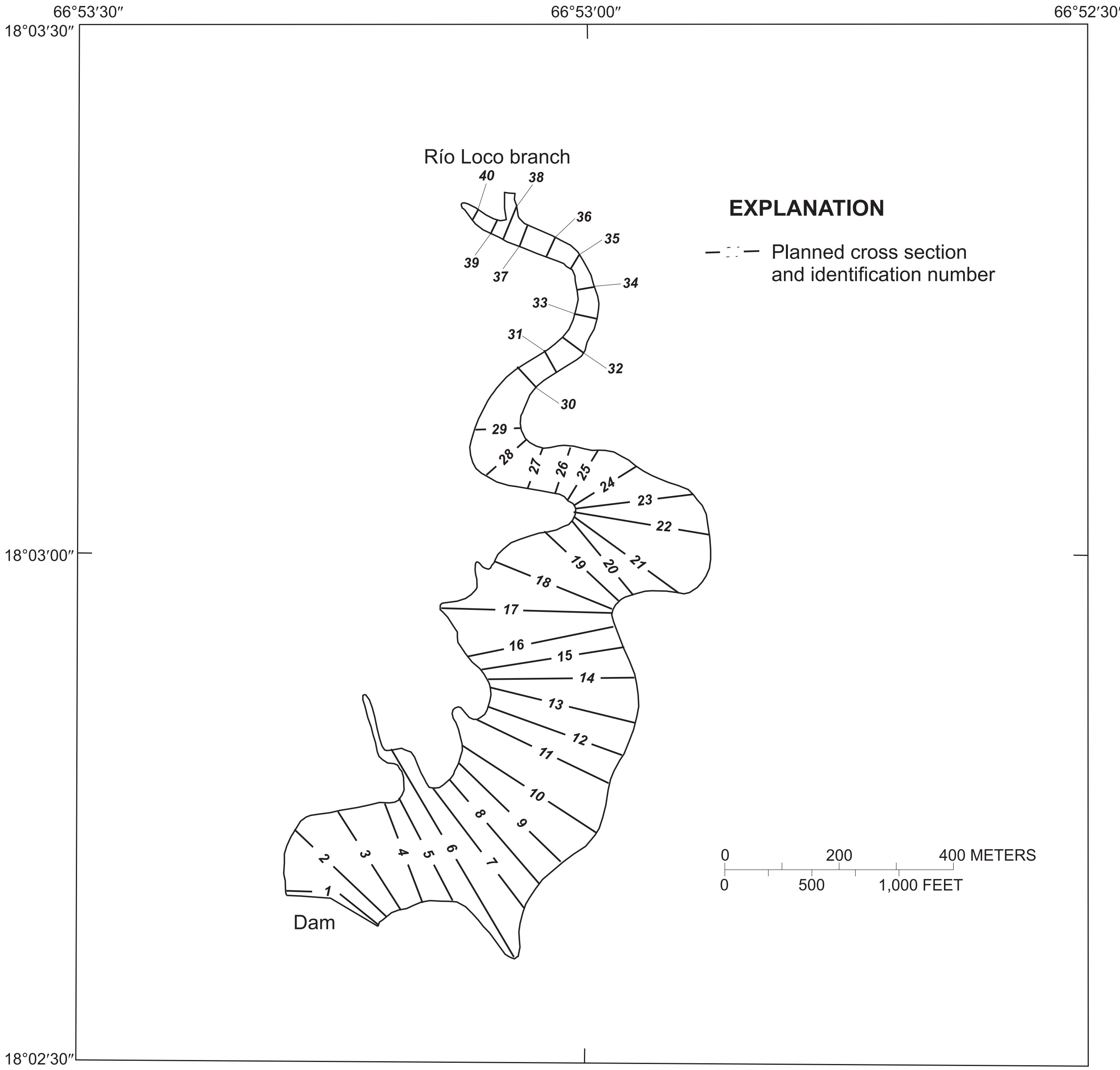

Figure 2. Planned cross-section locations for the March 2000 bathymetric survey of Lago Loco, Puerto Rico.

Field Techniques

The bathymetric survey of Lago Loco took place on March 10, 2000. Data were collected using the Bathymetric/Land Survey System (BLASS) developed by Specialty Devices, Inc. The system consists of two Novatel global positioning system (GPS) receivers coupled to a depth sounder (model SDI-IDS Intelligent Depth Sounder). The GPS receivers determine and help control the horizontal position of the survey boat, whereas the sounder collects water-depth data. The GPS units were first used in static mode to establish benchmarks at two sites overlooking the reservoir. Satellite information was recorded simultaneously at the Centro de Recaudación de Ingresos Municipales benchmark “Lajas 2” (lat. 18°04’26.3034”N., long. 66°57’34.4487”W.) and at two sites overlooking the reservoir, “Loco 1” (lat. 18°02’39.225”N., long. 66°53’18.099”W.) and “Loco 2” (lat. 18°02’39.114”N., long. 66°53’12.797”W.). Their geographic locations were calculated using the post-processing software CENTIPOINT. These new benchmarks indicated a horizontal error of less than 10 centimeters.

Once established, the benchmark with the best view of the survey area was occupied as the reference station. One GPS unit was installed at the reference station, while the other GPS unit was installed in the survey boat to be used as the mobile station. The GPS on board the survey boat independently calculates a position every second while receiving a set of correction signals from the reference station, converting the system into a DGPS. The DGPS information was used to maintain the survey boat within 2 meters of the true geographic location. The bathymetric-survey software HYPACK was used to navigate and to collect data. The software integrates the depth and position data, storing the x, y, (geographic location) and z (depth) coordinates in a portable personal computer. A total of 40 lines were planned using the GIS (fig. 2), however, low reservoir pool elevation and sediment accumulation in the upper, riverine portions of the reservoir limited the data collection to 21 lines (fig. 3).

Data Processing

Initial editing of the depth and positional data was performed within the HYPACK program. Erroneous positions were corrected by eliminating anomalous spikes or “positional jumps” that occur when the correction signal from the stationary DGPS station is lost for a period of time. The correction signal can be lost because of physical obstructions such as topographic features or because of electromagnetic interference. When this occurred, the erroneous positions were interpolated between the correct anterior and posterior positions. Depth data were also corrected to eliminate erroneous depth readings collected by the fathometer. Floating debris and/or bubbles can interfere with the fathometer’s transducer causing erroneous depth readings. Incorrect depth readings were interpolated between the correct anterior and posterior depth values. If the amount of incorrect positional and depth data was substantial, the cross section was re-measured.

Once corrected, the edited data were then transferred into the GIS database, where the final data processing took place. The Arc/Info software was customized to color code the depth-data points according to different depth values. Data points with the same color were connected to generate a bathymetric-contour map of the reservoir bottom (plate 1). The 1986 contour map (plate 2) was previously delineated and the only adjustment performed was to assign real-world coordinates to the map.

The contour maps (plates 1 and 2) were used to create the TIN reservoir-bottom surface models for August 1986 and March 2000, respectively. Distances from the dam upstream along the Río Loco branch of the reservoir were calculated using the GIS (fig. 4). The selected cross-section locations are shown in figure 5.

Sampling the TINs every 5 meters along the selected cross sections generated a graph representing the reservoir bottom from shore to shore for August 1986 and March 2000. The same procedure was employed to generate the longitudinal profile along the thalweg of the Río Loco branch of Lago Loco for August 1986 and March 2000. The selected cross sections (fig. 6) were located following a pattern that included all flooded areas of reservoir, whereas the longitudinal profile (fig. 7) was located at the deepest part of the reservoir thalweg.

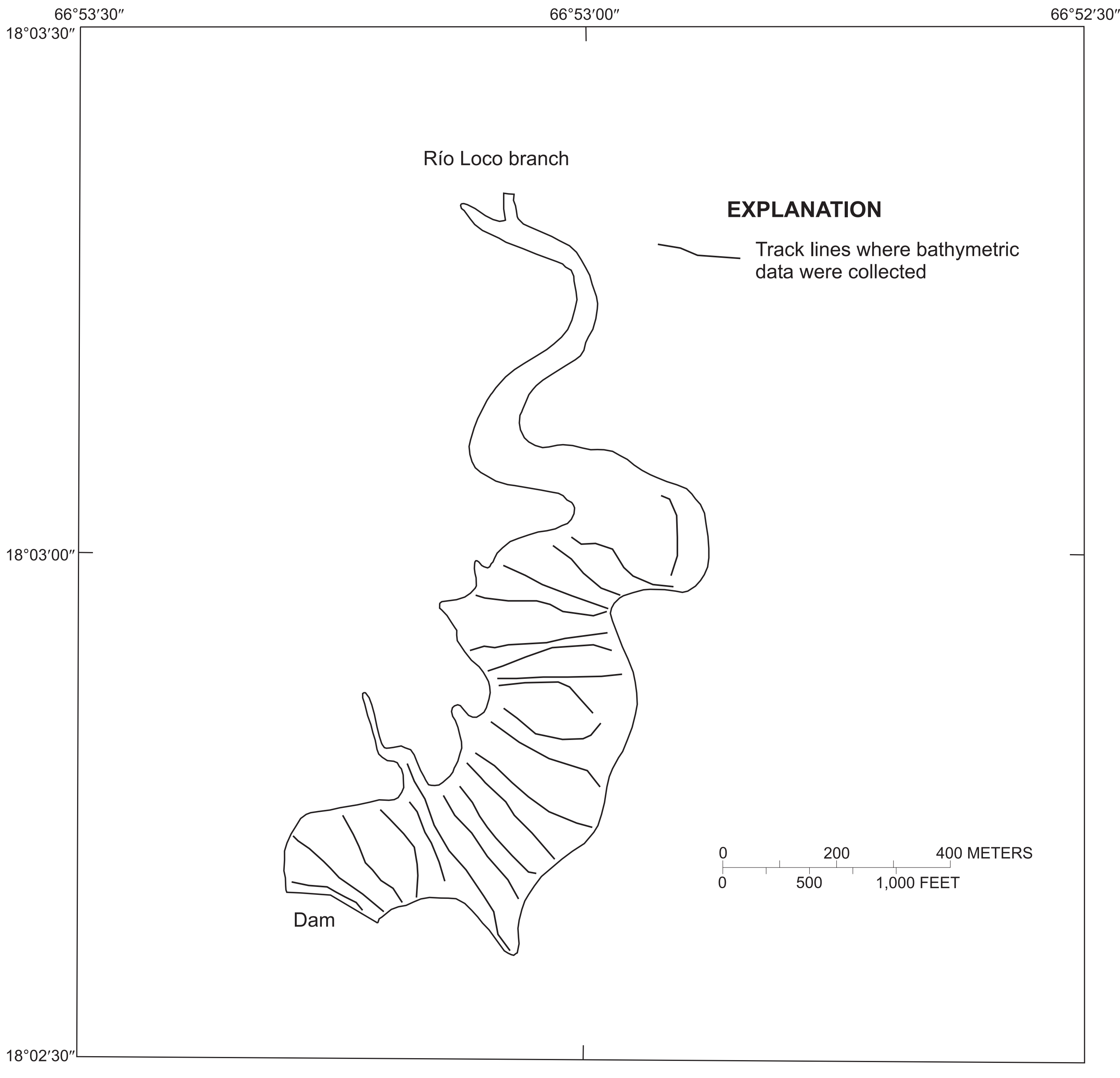

Figure 3. Actual track lines of the March 2000 bathymetric survey of Lago Loco, Puerto Rico.

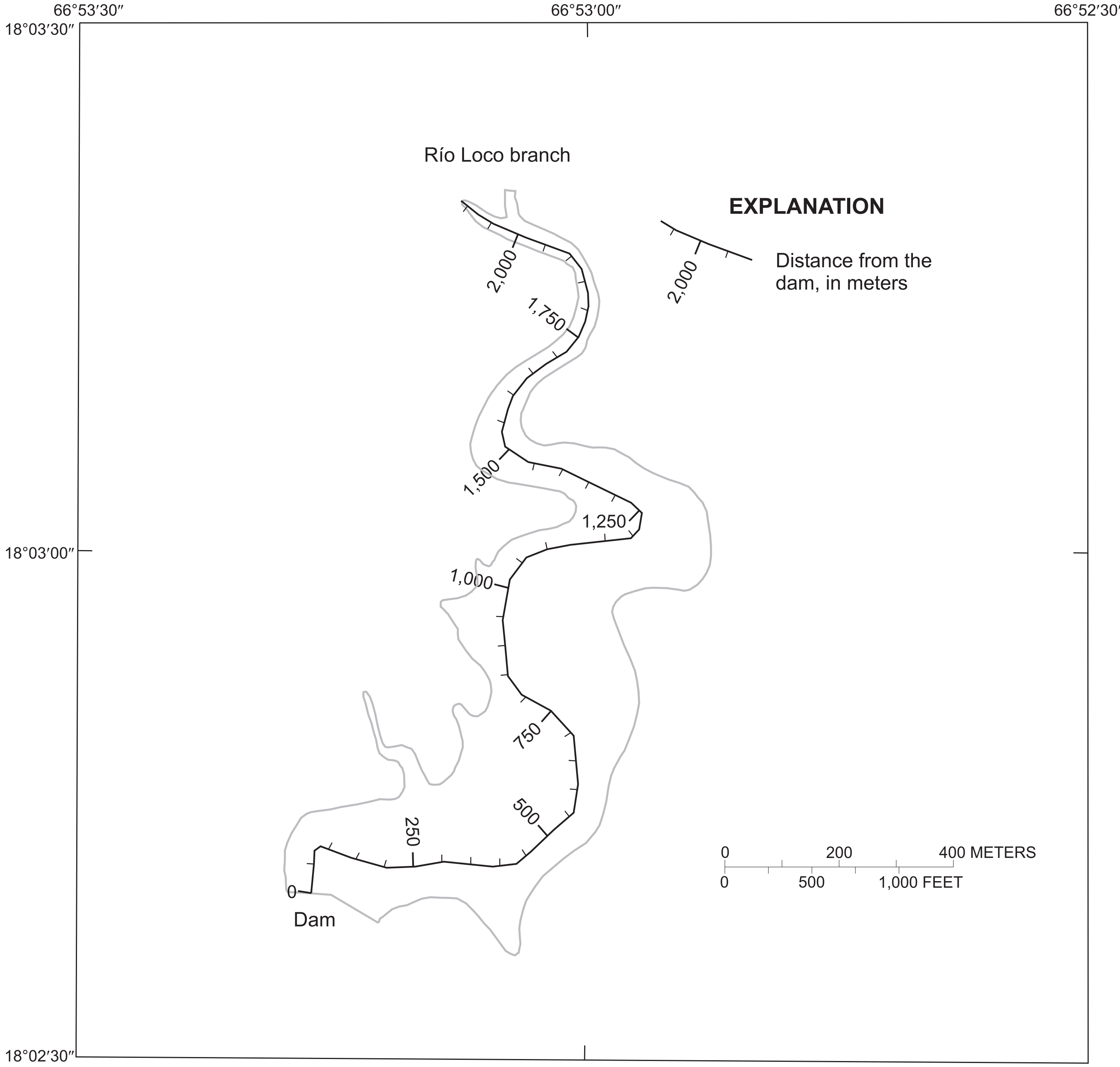

Figure 4. Distance from dam along the thalweg of Lago Loco, Puerto Rico.

Figure 5. Selected cross-section locations for the March 2000 bathymetric survey of Lago Loco, Puerto Rico.

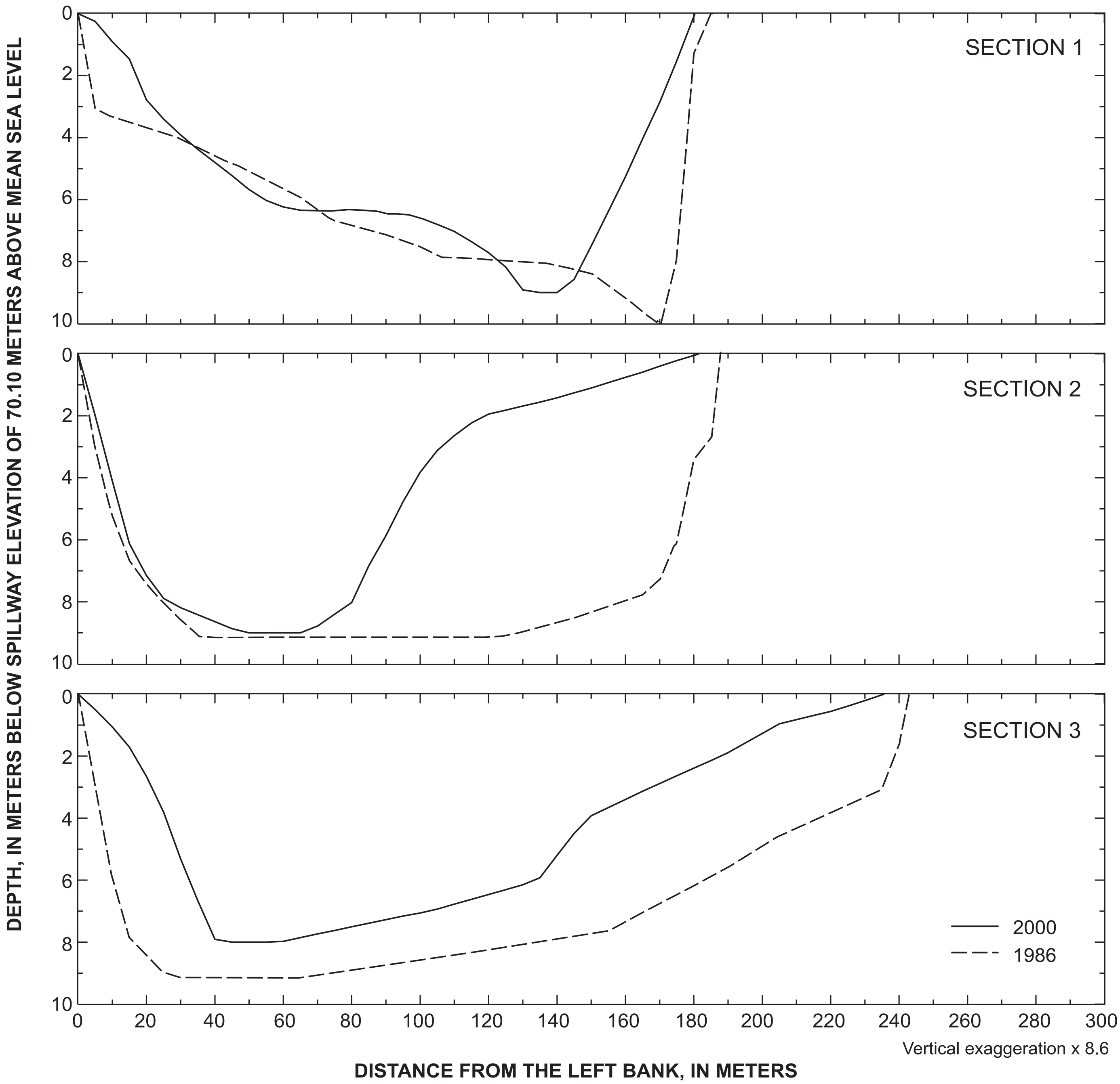

Figure 6. Selected cross sections generated from the TIN surface model of Lago Loco, Puerto Rico, for August 1986 and March 2000 bathymetric surveys. Refer to figure 5 for cross-section locations. Cross sections are oriented with the observer looking in the downstream direction.

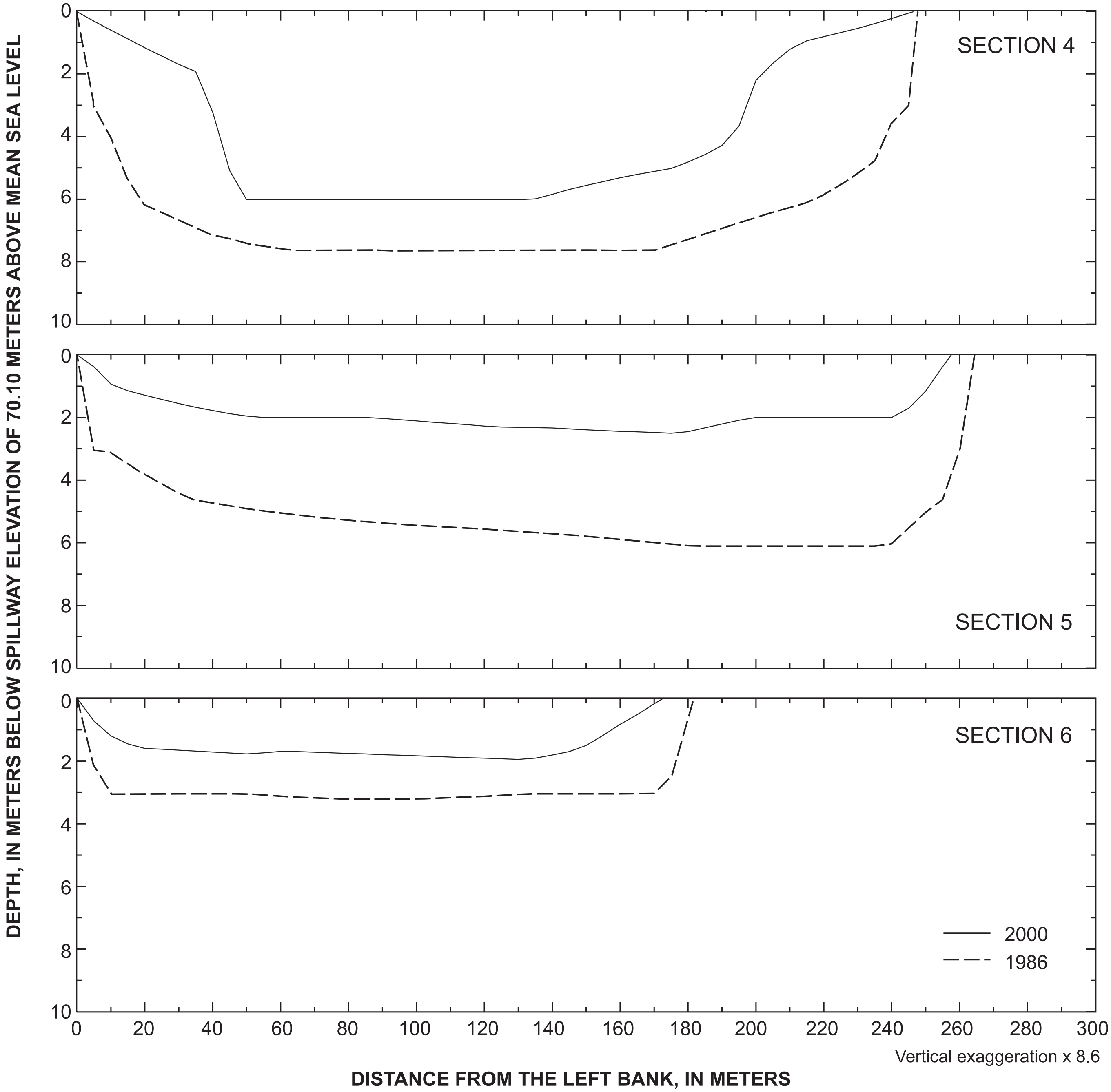

Figure 6. Selected cross sections generated from the TIN surface model of Lago Loco, Puerto Rico, for August 1986 and March 2000 bathymetric surveys. Refer to figure 5 for cross-section locations. Cross sections are oriented with the observer looking in the downstream direction—Continued.

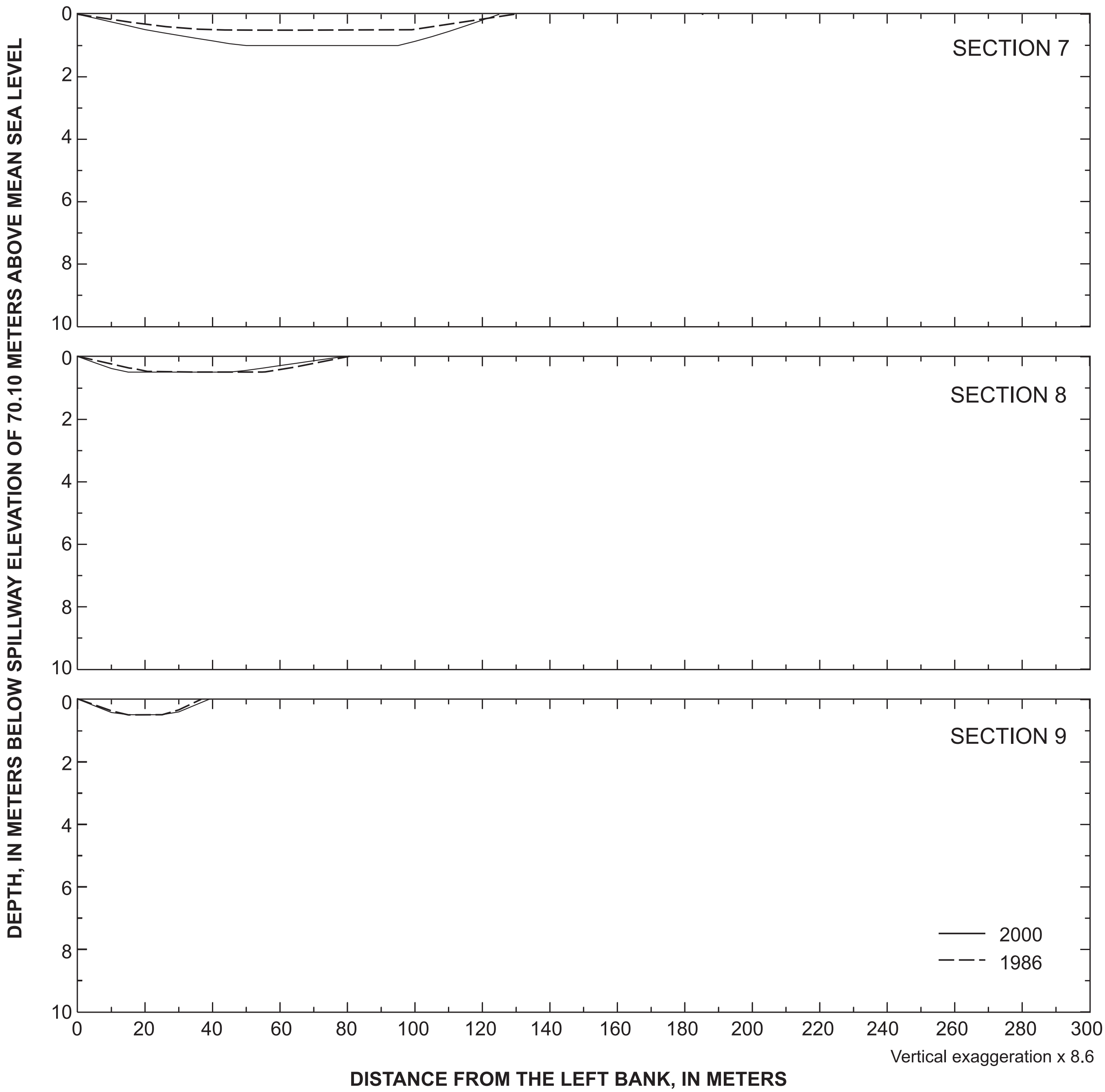

Figure 6. Selected cross sections generated from the TIN surface model of Lago Loco, Puerto Rico, for August 1986 and March 2000 bathymetric surveys. Refer to figure 5 for cross-section locations. Cross sections are oriented with the observer looking in the downstream direction—Continued.

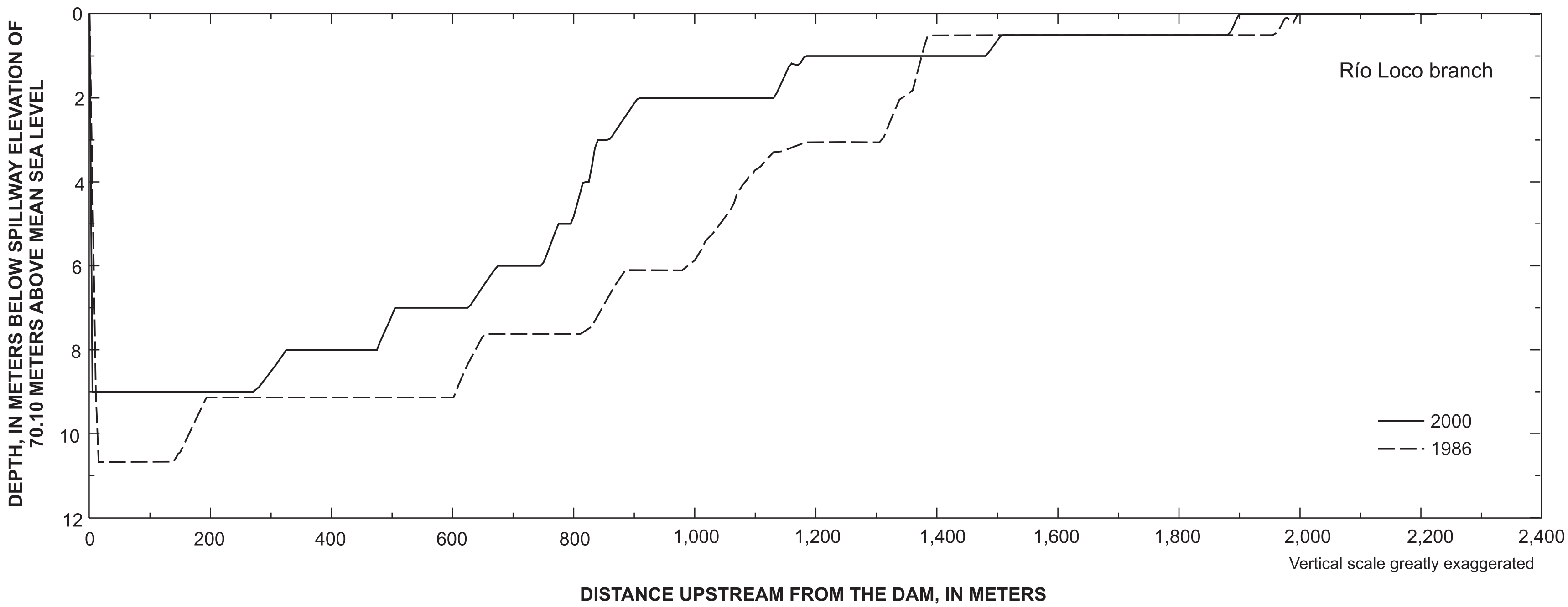

Figure 7. Longitudinal profiles along the thalweg of the Río Loco branch of Lago Loco, Puerto Rico, based on August 1986 and March 2000 bathymetric surveys.

ACTUAL CAPACITY AND SEDIMENT ACCUMULATION

The storage capacity of Lago Loco decreased from 2.40 million cubic meters in 1951 to 1.43 million cubic meters in August 1986, and to 0.87 million cubic meters in March 2000. This represents a storage loss of 0.97 million cubic meters by August 1986 and 1.53 million cubic meters by March 2000, or a storage loss of 40 and 64 percent, respectively. The long-term annual capacity loss or sedimentation rate of Lago Loco was 27,714 cubic meters in August 1986, increasing to 31,224 cubic meters in March 2000, or an average annual storage capacity loss of 1.1 and 1.3 percent, respectively. Table 2 summarizes the results of the 1951, August 1986, and March 2000 sedimentation surveys of Lago Loco.

The available storage capacity of Lago Loco is listed in table 3 at 1-meter elevation intervals and the graphical relation between pool elevation and storage capacity is shown in figure 8.

Table 3. Available storage capacity, as a function of pool elevation, for Lago Loco, Puerto Rico, March 2000

[All elevations, in meters above mean sea level; all capacities, in million cubic meters]

Pool elevation	Storage capacity
70.10	871,458
69.10	626,068
68.10	460,198
67.10	347,430
66.10	252,700
65.10	168,850
64.10	97,245
63.10	44,527
62.10	12,275
61.10	441
60.10	0

Table 2. Comparison of the 1951, August 1986, and March 2000 sedimentation surveys of Lago Loco, Puerto Rico

[---, undetermined]

Year of survey	1951	1986	2000
Total capacity, in million cubic meters	2.40	1.43	0.87
Sediment accumulated, in million cubic meters	0	0.97	1.53
Years since construction	0	35	49
Storage loss, in percent	0	40	64
Annual capacity loss, in percent	0	1.1	1.3
Long-term sedimentation rate, in cubic meters per year	0	27,714	31,224
Trapping efficiency, in percent[1]	92	87	80
Sediment yield, in megagrams per square kilometer per year	---	1,504	1,774
Year that the reservoir could be filled with sediment	---	2051[2]	2028[3]

[1] Using the capacity-inflow ratio of Brune (1953).

[2] Assuming that the reservoir will continue to fill at the sedimentation rate of 27,714 cubic meters per year.

[3] Assuming that the reservoir will continue to fill at the sedimentation rate of 31,224 cubic meters per year.

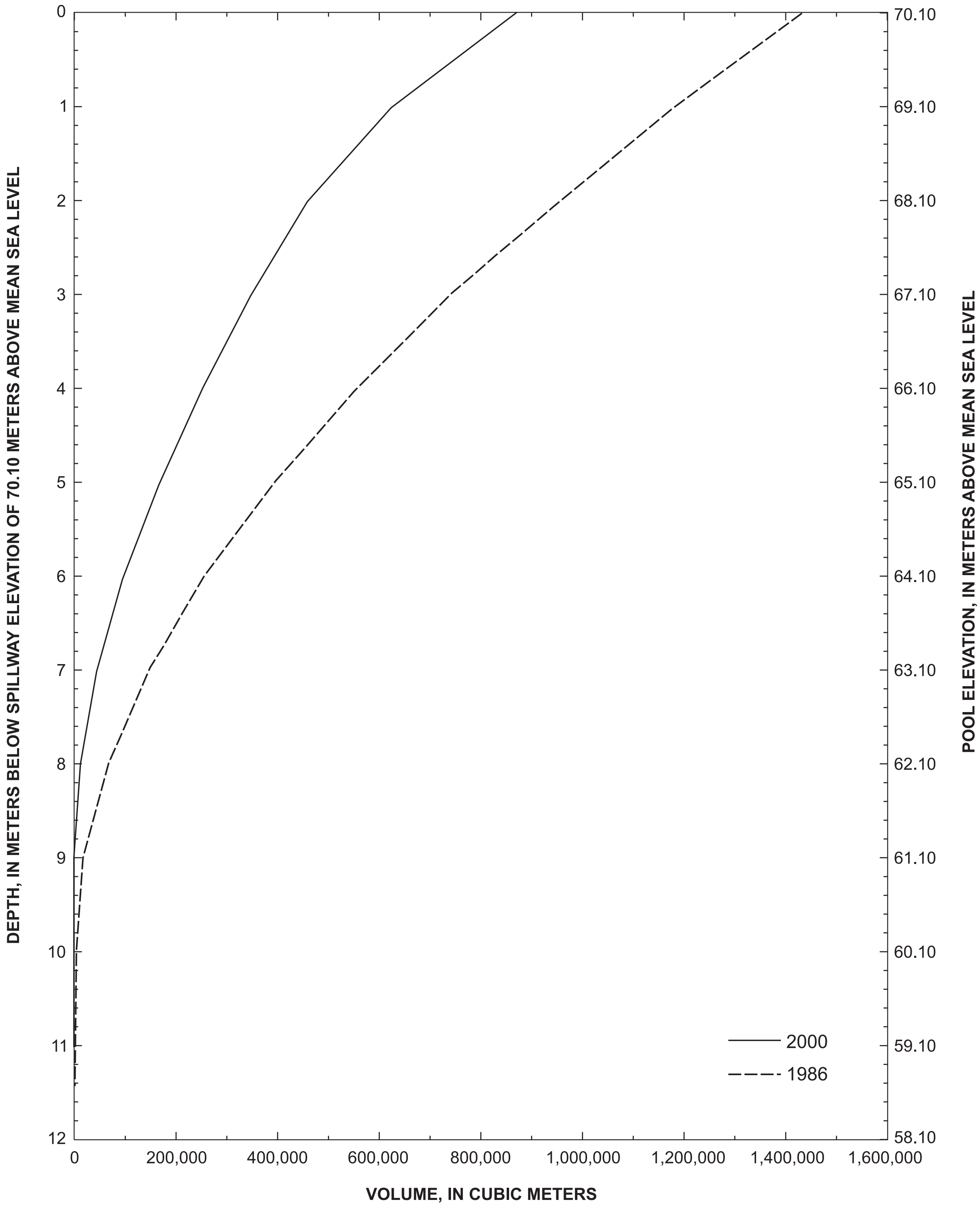

Figure 8. Lake-elevation storage-capacity curves for Lago Loco, Puerto Rico, derived from August 1986 and March 2000 bathymetric surveys.

The selected cross sections presented in figure 6 reveal substantial sediment accumulation in most areas of the reservoir, indicating sediment accumulation on the bottom as well as along the reservoir shore. These depositional patterns could result from large floods. Lago Loco is a small, shallow reservoir and hydraulic and geomorphic processes during major flood events, such as those generated by hurricanes or other tropical disturbances, cause the reservoir to behave like a natural river channel. Reservoir areas having high water velocities are sites of erosion along the outside of meanders, and areas having low water velocities are sites of deposition along the inside of meanders. Sediment deposited in Lago Loco since 1986 could have scoured in high velocity areas and accumulated in the low velocity areas, re-arranging the morphology of the reservoir bottom.

Sediment accumulation in the vicinity of the sluiceway structure at the dam has reached an elevation of about 61.10 meters above mean sea level according to the March 2000 data. The crown elevation of the sluiceway structure is 55.78 meters above mean sea level; as a result, the sluiceway structure is buried under a layer of about 5 meters of sediments. The irrigation intake structure, at an elevation of 62.03 meters above mean sea level, is in danger of being disabled because the reservoir bottom is less than a meter (0.93 meter) below the upper part of the intake. The intake soon will become useless and if not operated on a regular basis, and even with regular operation, the intake is at risk of being overwhelmed with sediment.

Dead storage is the volume below the crown elevation of an intake structure; the intake is some distance above the bottom of the reservoir used to accommodate infilling sediments without disabling the structure. The dead storage capacity of Lago Loco has been substantially reduced from 62,091 cubic meters in August 1986 to 11,065 cubic meters in March 2000. This represents a reduction of about 82 percent in dead storage between August 1986 and March 2000.

TRAPPING EFFICIENCY

Heinemann (1981) suggested that the single most informative descriptor of a reservoir is its trapping efficiency. This value is the proportion of the incoming sediment that is deposited or trapped in a pond, reservoir, or lake. Trapping efficiency is dependent on several factors, including particle size distribution and water residence time (for example, the average time that the incoming runoff remains in the reservoir). The trapping efficiency is controlled by the characteristics of the inflow hydrograph, particularly with regard to high- and base-flow volumes and frequency characteristics. The reservoir shape and outlet structures also influence the water retention time, water current velocities in the reservoir, and hence the trapping efficiency (Verstraeten and Poesen, 2000).

There have been many empirical studies of the relation between reservoir storage capacity, water inflow, and trapping efficiency of which Brune's (1953) is the most widely used and accepted. Brune (1953) developed a curve (fig. 9) that basically estimates the trapping efficiency of a reservoir based on the relation of storage capacity to annual inflow. The trapping efficiency of Lago Loco was estimated using this relation.

The Lago Loco drainage area was increased artificially when four other reservoirs (Lago Guayo, Lago Prieto, Lago Toro, and Lago Yahuecas) were connected by underground tunnels to Lago Lucchetti, a reservoir that supplies water to Lago Loco. These reservoirs are part of the Southwestern Puerto Rico Project and divert flow from the mountainous portions of the project area into Lago Lucchetti, providing additional water for hydroelectric power generation at power plant no. 1. Water inflow from these reservoirs into Lago Lucchetti is subsequently released via the power outlet, into power plant no. 2 for power generation, and subsequently into Lago Loco. Regardless of water diversion into Lago Loco, the amount of water released yearly from Lago Loco into the irrigation canal is greater than the yearly water influx from Lago Lucchetti. Rarely does water flow over the spillway of Lago Loco and the reservoir-pool elevation remains low as a result of the outflow to accommodate irrigation demands and for flood control. Thus, inflow from Lago Lucchetti is considered to be relatively unimportant in estimating water and sediment inflow to Lago Loco, and estimates here are restricted to runoff from the natural drainage basin.

Lago Loco has no stream gaging station to measure the inflow entering from the Río Loco. Thus, the neighboring basin of Río Guayanilla was used to estimate the average annual runoff of the Lago Loco drainage area. The hydrologic characteristics of these two basins are somewhat similar in topography and land use, and so the runoff per unit area resulting from rainfall is considered to be similar per unit surface area.

The runoff/rainfall ratio of the Río Guayanilla is 0.38 (Giusti and López, 1967). The Lago Loco drainage area has an average annual rainfall of 1,651 millimeters (Calvesbert, 1970). Multiplying the average annual rainfall by the runoff/rainfall ratio of 0.38 gives the estimated runoff of 0.63 meters per year for the Lago Loco basin. Multiplying this value by the Lago Loco drainage area gives an estimated annual inflow value of 13.71 million cubic meters. Using the median curve of Brune (fig. 9) the estimated trapping efficiency of Lago Loco is about 92, 87, and 80 percent for 1951, 1986, and 2000, respectively. This gives an average long-term trapping efficiency of 90 percent for August 1986, and 86 percent for March 2000.

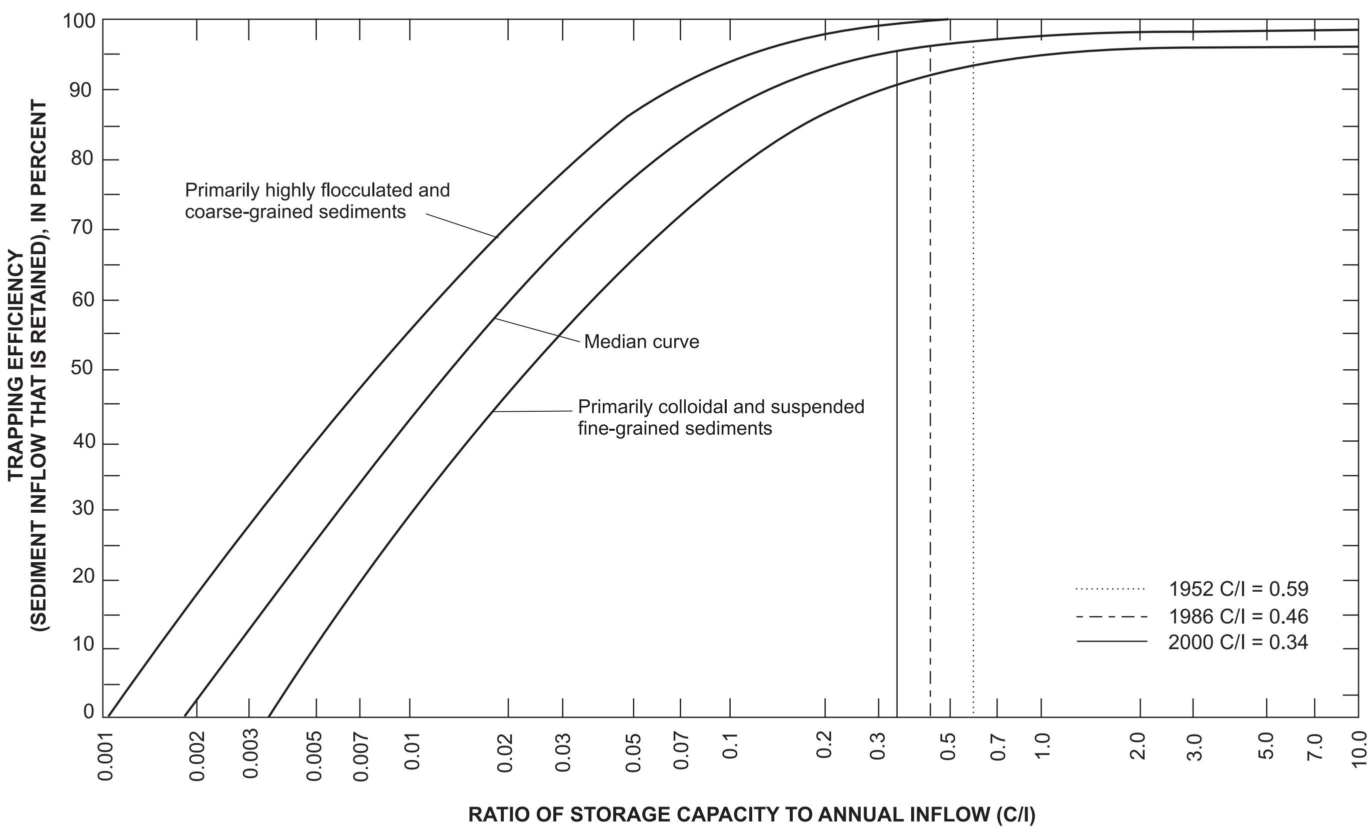

Figure 9. Reservoir storage capacity to inflow relation established by Brune (1953).

SEDIMENT YIELD

Sediment yield has been defined by the American Society of Civil Engineers as the total sediment outflow from a catchment or drainage basin, measurable at a point of reference and a specified period of time per unit of surface area (McManus and Duck, 1993). For Lago Loco, the total amount of sediment that has entered the reservoir (1.53 million cubic meters) was divided by the average long-term trapping efficiency (0.86), giving a reservoir sediment-accumulation volume of 1.78 million cubic meters. To determine the rate of sediment influx, 1.78 million cubic meters was divided by the age of the reservoir (49 years), yielding 36,326 cubic meters of sediment per year that enters the reservoir. The sediment yield of the Lago Loco drainage basin can be calculated by dividing 36,326 cubic meters of sediment per year by the net sediment-contributing area of 20.47 square kilometers (the total drainage area minus the reservoir surface area), which gives 1,774 cubic meters per square kilometer per year. Assuming a sediment dry-bulk density of one gram per cubic centimeter, the estimated sediment yield of the Lago Loco drainage area is about 1,774 megagrams per square kilometer per year for March 2000. Using the same calculations, the sediment yield of Lago Loco (using the average long-term trapping efficiency of 90 percent for August 1986) was 1,504 megagrams per square kilometer per year, which represents an increase of about 18 percent.

The increase in sediment yield between 1986 and 2000 was likely caused by land-use practices within the basin, and further accelerated sediment erosion and influx to the reservoir caused by Hurricanes Hortense (1996) and Georges (1998), which have been shown to have caused greatly accelerated sediment influx to other reservoirs in Puerto Rico (Soler-López, 2000 and 2001).

Floods associated with these hurricanes not only transported eroded material deposited in past flood events, but also temporarily stored sediment in the river channel. Eventual transport of the temporarily stored material will reduce the storage capacity of the reservoir further.

The August 1986 and March 2000 surveys show that the life expectancy of Lago Loco is a critical concern (table 2). Storage capacity is being reduced by extreme flood events. The March 2000 survey indicates that large storm events such as Hurricanes Hortense and Georges can substantially reduce the life expectancy of the reservoir. These storm events induce erosion and transport large volumes of material that is naturally weathered or made available by human activities such as farming and construction.

Although these flood events do not regularly occur, such events will likely effect Puerto Rico in the future. If the sedimentation rate recorded in March 2000 continues, Lago Loco has a useful life of about 28 more years. However, the actual life expectancy of Lago Loco probably ranges between the August 1986 (51 years) and the March 2000 (28 years) estimates, depending on the frequency of intense rainfall events.

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