Appendix VI-3-A

Thermal Modeling of Ebb and Flood Tide Thermal Plumes

TABLE OF CONTENTS

	Page No.
LIST OF FIGURES	i
LIST OF TABLES	v
1 INTRODUCTION	1-1
2 DESCRIPTION OF THE FFTM AND CORMIX	2-1
2.1 Far-Field Temperature Model (FFTM)	2-1
2.2 Near-Field Temperature Model (CORMIX)	2-2
3 MODEL INPUT DATA	3-1
3.1 River Geometry 3-1	
3.2 Hydraulic Boundary Conditions	3-2
3.2.1 Upstream and Downstream Boundaries	3-2
3.2.2 Tributary Flows	3-3
3.3 Thermal Boundary Conditions	3-5
3.3.1 Upstream and Downstream Boundaries	3-5
3.3.2 Downstream Salinity Boundary Condition	3-6
3.3.3 Tributary Temperatures	3-6
3.4 Meteorological Data	3-9
3.5 Anthropogenic Heat Loads	3-10
4 FFTM MODEL CALIBRATION AND VALIDATION	4-1
4.1 Hydraulic Calibration	4-1
4.1.1 Salinity Calibration	4-2
4.2 Model Validation for Temperature Prediction	4-3
5 FFTM TEMPERATURE FORECASTS	5-1

TABLE OF CONTENTS
(*Continued*)

	Page No.
6 NEAR-FIELD TEMPERATURE MODELING	6-1
6.1 CORMIX Model Input and Model Limitations	6-1
6.1.1 Receiving Water Data	6-2
6.1.2 Discharge Structure and Effluent Data	6-2
6.2 CORMIX Simulations and the Heat Balance Model	6-3
6.2.1 Temperature Balance Model	6-3
6.2.2 Discussion of CORMIX Modeling and the Heat Balance Model	6-5
REFERENCES	

LIST OF TABLES

Table No.	Title
Following Chapter 3	
1	FFTM Input and Data Sources
2	Geometric Parameters, Hudson River Thermal Mode
3	June 1981 Tributary Flows
4	July 1981 Tributary Flows
5	August 1981 Tributary Flows
6	September 1981 Tributary Flows
7	June 1981 Tributary Temperatures
8	July 1981 Tributary Temperatures
9	August 1981 Tributary Temperatures
10	September 1981 Tributary Temperatures
11	June 1981 Hudson River Meteorological Data: Reach #10 (RM 114.8-153.7)
12	July 1981 Hudson River Meteorological Data: Reach #20 (RM 38.9-114.8)
13	August 1981 Hudson River Meteorological Data: Reach #30 (RM 0.0-38.9)
14	July 1981 Meteorological Data: Reach #10 (RM 114.8-153.7)
15	July 1981 Meteorological Data: Reach #20 (RM 38.9-114.8)
16	July 1981 Hudson river meteorological Data: Reach #30 (RM 0.0-38.9)
17	August 1981 Hudson river Meteorological Data: Reach #10 (RM 114.8-153.7)

LIST OF TABLES
(*Continued*)

Table No.	Title
Following Chapter 3 (Cont.)	
18	August 1981 Hudson River Meteorological Data: Reach #20 (RM 38.9-114.8).
19	August 1981 Hudson River Meteorological Data: Reach #30 (RM 0.0-38.9)
20	September 1981 Hudson River Meteorological Data: Reach #10 (RM 114.8-153.7)
21	September 1981 Hudson River Meteorological Data: Reach #20 (RM 38.9-114.8)
22	September 1981 Hudson River Meteorological Data: Reach #30 (RM 0.0-38.9)
23	Capacity Heat Loads
Following Chapter 4	
24	Hydraulic Calibration Summary
25	FFTM Dispersion Parameters
Following Chapter 5	
26	Far-Field Temperature Forecast Scenarios
26a	Ambient River water Temperatures and River flows Means, Standard ` Deviations and Correlation Coefficients
26b	Ambient River Water Temperatures and River Flows Multi-Variate t-Test Statistics
27	Sample FFTM Statistical Analysis

LIST OF TABLES
(Continued)

Table No.	Title
Following Chapter 6	
28	CORMIX Input Data
29	Characteristics of Discharge Structures
30	Cooling Water Discharge Data
30a	Survey Conditions for CORMIX Verifications
31	All Plants at Capacity Referenced to Ambient
32	All Plants at Capacity Referenced to Background
33	All Plants at Capacity Minus Roseton Referenced to Background
34	All Plants at Capacity Minus One Unit at Indian Point Referenced to Background
35	All Plants at Capacity Minus One Unit at Indian Point Referenced to Background
36	All Plants at Capacity Minus Bowline Referenced to Background
37	Ambient Plus Roseton at Capacity
38	Ambient Plus Indian Point at Capacity
39	Ambient Plus Bowline at Capacity
39a	Model Predictions for Monthly Average Summer Temperature Behavior at Roseton
39b	Model Predictions for Monthly Average Summer Temperature Behavior at Bowline
39c	Model Predictions for Monthly Average Summer Temperature Behavior at Indian Point
39d	Model Predictions for Monthly Average Summer Temperature Behavior at Indian Point Under Various Outage Scenarios

LIST OF FIGURES

Figure No.	Title
1	FFTM Cross-Section Schematization
2	Upstream Hydraulic Boundary Condition - Measured Flow Rate at Green Island USGS Gaging Station, June 1981
3	Upstream Hydraulic Boundary Condition - Measured Flow Rate at Green Island USGS Gaging Station, July 1981
4	Upstream Hydraulic Boundary Condition - Measured Flow Rate at Green Island USGS Gaging Station, August 1981
5	Upstream Hydraulic Boundary Condition - Measured Flow Rate at Green Island USGS Gaging Station, September 1981
6	Downstream Hydraulic Boundary Condition - Measured Water Surface Elevation at Battery NOAA Gaging Station, June 1981
7	Downstream Hydraulic Boundary Condition - Measured Water Surface Elevation at Battery NOAA Gaging Station, July 1981
8	Downstream Hydraulic Boundary Condition - Measured Water Surface Elevation at Battery NOAA Gaging Station, August 1981
9	Downstream Hydraulic Boundary Condition - Measured Water Surface Elevation at Battery NOAA Gaging Station, September 1981
10	Tributaries Included in the Far-Field Thermal Model
11	Upstream Temperature Boundary Condition - Measured Temperature at Green Island USGS Gaging Station (at 8:00), June 1981
12	Upstream Temperature Boundary Condition - Measured Temperature at Green Island USGS Gaging Station (at 8:00), July 1981
13	Upstream Temperature Boundary Condition - Measured Temperature at Green Island USGS Gaging Station (at 8:00), August 1981
14	Upstream Temperature Boundary Condition - Measured Temperature at Green Island USGS Gaging Station (at 8:00), September 1981

LIST OF FIGURES
(*Continued*)

Figure No.	Title
	Following Chapter 3 (Cont.)
15	Downstream Temperature Boundary Condition
16	Clear Sky Solar Radiation
17	Segmentation of Meteorological Conditions in the Far-Field Model
18	Power Plant Heat Loads, June 1981
19	Background Heat Loads, June 1981
20	Power Plant Heat Loads, July 1981
21	Background Heat Loads, July 1981
22	Power Plant Heat Loads, August 1981
23	Background Heat Loads, August 1981
24	Power Plant Heat Loads, September 1981
25	Power Plant Heat Loads, September 1981
	Following Chapter 4
26	Far-Field Model Salinity Calibration, 2 June 1981
27	Far-Field Model Salinity Calibration, 10 June 1981
28	Far-Field Model Salinity Calibration, 25 June 1981
29	Far-Field Model Salinity Calibration, 8 July 1981
30	Far-Field Model Salinity Calibration, 13 July 1981
31	Far-Field Model Salinity Calibration, 29 July 1981
32	Far-Field Model Salinity Calibration, 11 August 1981

LIST OF FIGURES
(*Continued*)

Figure No.	Title
	Following Chapter 4 (Cont)
33	Far-Field Model Salinity Calibration, 24 August 1981
34	Far-Field Model Salinity Calibration, 28 August 1981
35	Far-Field Model Salinity Calibration, 11 September 1981
36	Far-Field Model Salinity Calibration, 21 September 1981
37	Far-Field Model Salinity Calibration, 24 September 1981
38	Far-Field Model Temperature Calibration, 2 June 1981
39	Far-Field Model Temperature Calibration, 10 June 1981
40	Far-Field Model Temperature Calibration, 25 June 1981
41	Far-Field Model Temperature Calibration, 8 July 1981
42	Far-Field Model Temperature Calibration, 13 July 1981
43	Far-Field Model Temperature Calibration, 29 July 1981
44	Far-Field Model Temperature Calibration, 11 August 1981
45	Far-Field Model Temperature Calibration, 24 August 1981
46	Far-Field Model Temperature Calibration, 28 August 1981
47	Far-Field Model Temperature Calibration, 11 September 1981
48	Far-Field Model Temperature Calibration, 21 September 1981
49	Far-Field Model Temperature Calibration, 24 September 1981

LIST OF FIGURES
(*Continued*)

Figure No.	Title
	Following Chapter 5
49a	Hudson River Flow and Temperature Joint Probability Distributions-June
49b	Hudson River Flow and Temperature Joint Probability Distribution-July
49c	Hudson River Flow and Temperature Joint Probability Distribution-August
49d	Hudson River Flow and Temperature Joint Probability Distribution-September
50	Far-Field Model Temperature Forecasts - Roseton, Bowline, Indian Point, and Background Capacity Heat Loads, 30 June 1981 (at 12:00)
51	Far-Field Model Temperature Forecasts - Roseton, Bowline, Indian Point, and Background Capacity Heat Loads, 31 July 1981 (at 12:00)
52	Far-Field Model Temperature Forecasts - Roseton, Bowline, Indian Point, and Background Capacity Heat Loads, 31 August 1981 (at 12:00)
53	Far-Field Model Temperature Forecasts - Roseton, Bowline, Indian Point, and Background Capacity Heat Loads, 30 September 1981 (at 12:00)
54	Far-Field Model Temperature Forecasts - Indian Point 90 Days at One-Unit Full Capacity, 30 June 1981 (at 12:00)
55	Far-Field Model Temperature Forecasts - Indian Point 90 Days at One-Unit Full Capacity, 31 July 1981 (at 12:00)
56	Far-Field Model Temperature Forecasts - Indian Point 90 Days at One-Unit Full Capacity, 31 August 1981 (at 12:00)
57	Far-Field Model Temperature Forecasts - Ambient Conditions Plus Roseton, Indian Point, and Bowline at Capacity, 30 June 1981 (at 12:00)

LIST OF FIGURES
(Continued)

Figure No.	Title
	Following Chapter 5 (Cont.)
58	Far-Field Model Temperature Forecasts - Ambient Conditions Plus Roseton, Indian Point, and Bowline at Capacity, 31 July 1981 (at 12:00)
59	Far-Field Model Temperature Forecasts - Ambient Conditions Plus Roseton, Indian Point, and Bowline at Capacity, 31 August 1981 (at 12:00)
60	Far-Field Model Temperature Forecasts - Ambient Conditions Plus Roseton, Indian Point, and Bowline at Capacity, 30 September 1981 (at 12:00)
60a	CORMIX Verification, Roseton Generating Station, 4 August 1976, Maximum Flood
60b	CORMIX Verification, Roseton Generating Station, 4 August 1976, Maximum Ebb
60c	CORMIX Verification, Roseton Generating Station, 4 August 1976, Maximum Flood
60d	CORMIX Verification, Roseton Generating Station, 4 August 1976, Maximum Ebb
	Following Chapter 6
61	Generalized Cross-section in the Temperature Balance Model

CHAPTER 1

INTRODUCTION

The impact that thermal discharges from the Roseton, Indian Point, and Bowline Point power plants have on temperature distributions in the Hudson River was evaluated using two different computer models. The region in the immediate vicinity of each discharge, where the cooling water occupies a clearly distinguishable, three-dimensional temperature regime in the river (the near field), was modeled using the Cornell University Mixing Zone Model (CORMIX) Version 2.0. The region farther from the discharges, where the cooling water plumes are no longer distinguishable from the river but where the thermal influence of the discharge is still present (the far field), was modeled using the Massachusetts Institute of Technology (MIT) dynamic network model (hereafter referred to as the FFTM). The river-wide temperature distributions predicted by the FFTM were combined with the CORMIX results in a set of spreadsheet models. This document describes the capabilities of each model, the sources of model inputs used for these efforts, the engineering judgment applied to initialize the models, model calibration, thermal conditions forecast for the operating scenarios subject to this study, and model limitations.

CHAPTER 2

DESCRIPTION OF THE FFTM AND CORMIX

For purposes of forecasting temperature distributions in the Hudson River under various power plant operations, two broadly defined riverine regions are considered:

- The near field (or plume): the region in the immediate vicinity of each discharge where cooling water occupies a clearly distinguishable, three- dimensional temperature regime in the river and has not yet fully mixed with the river

- The far field: the region farther from the discharges where the plumes are no longer distinguishable from the river, but the thermal influence of the discharge is still present

Because different thermal and hydrodynamic processes dominate the transfer and dissipation of heat in each of these regions, two different computer models were used to represent the two regions.

2.1 FAR-FIELD TEMPERATURE MODEL (FFTM)

The computer model selected to forecast far-field conditions in the Hudson River was the Massachusetts Institute of Technology (MIT) dynamic network model. The FFTM is an outgrowth of a model developed in the early 1970s by a group of researchers at MIT led by Dr. Donald Harleman and including Dr. M. Llewellyn Thatcher. Reports by Harleman et al. (1972), Thatcher and Harleman (1972), and Harleman et al. (1973) describe the origins of the model. This model was selected because of its established credibility, prior application to the Hudson River, and ability to simulate hydraulic and thermal processes at an appropriate level of spatial and temporal detail. The FFTM is:

- Intratidally time variable: capable of forecasting conditions in the river at discrete intervals within a tidal period

- One dimensional, sectionally averaged: capable of representing the longitudinal variation of conditions in the river with lateral and vertical variations averaged over each cross section of the river

- Hydrodynamic: capable of explicitly representing the processes that govern the one-dimensional, time-variable distribution and movement of water mass (as represented by temperature, salinity, stage height, and velocity) in the river

2.2 NEAR-FIELD TEMPERATURE MODEL (CORMIX)

The computer model selected to estimate near-field conditions in the Hudson River is the Cornell University Mixing Zone Model (CORMIX) Version 2.0, which emphasizes the geometry and dilution characteristics of the plume in the near field. It provides information on the three-dimensional configuration of the plume, assuming steady-state flow conditions for both the discharge and the ambient environment. CORMIX has been developed under the overall guidance of Dr. Gerhard Jirka at DeFrees Hydraulics Laboratory, Cornell University, with funding from a variety of sources, including the U.S. Environmental Protection Agency (EPA). More detailed descriptions of the CORMIX model development may be found in List and Imberger (1973), Jirka et al. (1975), Doneker and Jirka (1990), and Akar and Jirka (1990). CORMIX was selected because it represents the state of the art in computer modeling of aqueous discharge plumes and is the most widely accepted tool for evaluating these plumes; it is supported by EPA's Center for Exposure Assessment Modeling (CEAM)

CORMIX Version 2.0, which is directly available to qualified users from Dr. Jirka, includes a number of revisions that correct deficiencies in the earlier, single-purpose versions available from CEAM. CORMIX Version 2.0 incorporates these revised single-purpose versions as submodels:

- CORMIX1 (Version 2.10): predicts the dilution and trajectory of a submerged, single-port discharge of arbitrary density (positive, neutral, or negative) into an ambient that is either stratified or of uniform density, with or without cross flow.

- CORMIX2 (Version 2.10): predicts the dilution and trajectory of a submerged multiport discharge of arbitrary density into a flowing receiving water. It includes the effects of ambient stratification, dynamic attachment of the plume to the bottom, and the limiting case of stagnant receiving waters.

- CORMIX3 (Version 1.3): predicts the dilution and trajectory of a buoyant, nearshore surface discharge into an ambient that is either stratified or uniform density, with or without cross flow.

Because the Roseton, Indian Point, and Bowline Point outlets are all multiport, submerged discharges, all the near-field results presented in this document are derived from the CORMIX2 submodel.

One of the distinguishing characteristics of CORMIX is its use of an expert system to help the user develop the discharge/ambient description, check the data for consistency, and tailor the solution technique to the specific combination of ambient and discharge conditions. The specific mathematical model formulations embedded in CORMIX are derived from previously developed and tested stand-alone models. This combination of proven mathematical formulations with expert system supervisory control provides a high level of confidence that the model has been properly used and the results may be relied upon.

CHAPTER 3

FFTM MODEL INPUT DATA

The FFTM model requires input data for river geometry, meteorological conditions, upstream and downstream hydraulic and thermal boundary conditions, and anthropogenic heat loads to the system. Some of this information, such as the upstream flow data and downstream water surface elevation data, could be applied directly in the model. Other model input, such as the solar radiation conditions, had to be computed from related meteorological parameters. Most of the input data necessary for modeling Hudson River water temperatures for June, July, August, and September 1981 were obtained from federal and state agencies, and the utilities. This section describes what raw data were obtained and how this information was adapted as input for the FFTM. A summary of the input data and data sources is provided in Table 1. (All tables and figures follow chapter text.)

3.1 RIVER GEOMETRY

The river geometry data used in the model were collected by an MIT research team in the early '70s and subsequently passed on to Lawler, Matusky & Skelly Engineers (LMS) by Dr. Llewellyn Thatcher, a member of the original MIT research team. The data set includes geometric parameters for 76 river transects, spaced approximately 2 miles apart between the Battery, New York City, and the Troy lock and dam near Albany, New York. The total model length was 153.7 river miles. Each of the 76 records contains depth and width data for the storage and conveyance portions of each transect. Additionally, estimates of Manning's n values resulting from previous Hudson River modeling studies were included. The storage and conveyance portions of a transect were defined by the MIT research team that collected the data, based on a qualitative hydraulic evaluation of each transect. By definition, the conveyance portion of a transect is the amount of cross-sectional area that allows flow to pass through the transect. This portion includes the deeper, main channel and, in some cases, a fraction of the shallower, shoreward regions. In general, shoreward regions are designated as storage areas and contribute to the total volume of water between sections, but do not make up part of the transect available to convey flow. The geometric characterization of each model transect is based on the type section shown in Figure 1. The method applied by the MIT research team to arrive at values for the depth and width values for the schematization shown in Figure 1 involved several steps, summarized below.

1. Determine the total cross-sectional area of the transect from a plot of bathymetric survey data.

2. Define the conveyance and storage portions of the cross-sectional area.

3. Determine the conveyance area and determine the storage area by subtracting the conveyance area from the total area.

4. Evaluate the average conveyance depth by dividing the conveyance area by the conveyance top width.

5. Evaluate the average storage depth by dividing the total storage area by the total storage top width.

Storage and conveyance depth and width data as well as additional geometric parameters computed from these data are contained in Table 2.

3.2 HYDRAULIC BOUNDARY CONDITIONS

3.2.1 Upstream and Downstream Boundaries

The hydraulic boundary conditions assigned in the model were upstream flow rate and downstream water surface elevation. U.S. Geological Survey (USGS) average daily flow rate data recorded at the Green Island gaging station were obtained from published documents for June, July, August, and September 1981. Hourly water surface elevation data and daily high/low tide data recorded at the National Oceanic and Atmospheric Admministration (NOAA) Battery gaging station were obtained for the same time period. In addition, tributary flows were computed from empirical relationships for freshwater flow along the Hudson and from the distribution of tributary drainage area.

Application of the upstream flow and downstream water surface elevation data as model boundary conditions was governed by the model boundary formulation options and by sensitivity analyses. Model runs were performed to evaluate whether assigning hourly water surface elevation values produced hydraulic results that differed significantly from those obtained by fitting the high/low tide data to a sinusoidal time function of constant period, an option available in the FFTM model. This analysis showed no significant difference between the two approaches and, for purposes of expediting data entry, the latter approach was chosen. No hourly flow rate data were available for the Green Island gage.

Consequently, average daily values were used in the model. A constant-value flow rate was assigned for each tidal cycle. Because the duration of the tidal cycle in the Hudson River is approximately 12.4 hrs, two tidal cycles last slightly longer than a day. In these cases the flow rate assigned over the tidal cycle was derived by proportioning average daily flows according to the number of hours of the tidal cycle falling on the two days over which the cycle extended. The upstream flow rate data assigned as the hydraulic boundary condition for the June through September 1981 simulations are summarized in Figures 2 through 5. The high/low tide data used in the sinusoidal water surface elevation formulation applied to the downstream hydraulic boundary condition are contained in Figures 6 through 9.

3.2.2 **Tributary Flows**

Tributary flows between the Green Island gage and the NOAA station at the Battery represent a third set of hydraulic boundaries. Twenty tributaries, including all major tributaries, were modeled (Figure 10). Tributary flow rates were calculated from empirical estimates of the Hudson River freshwater flow rate at Poughkeepsie and the Battery as a function of the freshwater flow rate at Green Island. The total drainage-area increases between Green Island and Poughkeepsie and Poughkeepsie and the Battery were combined with tributary drainage area data for these computations. The computational procedure for determining tributary flow rates is summarized in Equations 1 through 7.

$$\Delta Q = Q_{\text{Poughkeepsie}} - Q_{\text{Green Island}} \qquad 2$$

$$Q_{\text{tributary}} = \Delta Q \frac{DA_{\text{tributary}}}{\Delta DA} \qquad 1^{3}$$

$$\Delta DA = DA_{\text{Poughkeepsie}} - DA_{\text{Green Island}}$$

for tributaries between Green Island and Poughkeepsie;

$$\Delta Q = Q_{\text{Battery}} - Q_{\text{Poughkeepsie}} \qquad 54$$

$$\Delta DA = DA_{\text{Battery}} - DA_{\text{Poughkeepsie}}$$

for tributaries between Poughkeepsie and the Battery,

where

$Q_{tributary}$ = tributary flow rate

$DA_{tributary}$ = tributary drainage area

$Q_{Poughkeepsie}$ = freshwater flow rate at Poughkeepsie

$Q_{Green\ Island}$ = freshwater flow rate at Green Island
$Q_{Battery}$ = freshwater flow rate at the Battery
$DA_{Poughkeepsie}$ = drainage area above Poughkeepsie
$DA_{Green\ Island}$ = drainage area above Green Island
$DA_{Battery}$ = drainage area above the Battery

The freshwater flow rates at Poughkeepsie and the Battery were computed from empirical equations shown below and in the following table (Abood et al. 1992).

$$Q_{Poughkeepsie} = a + b\,Q_{Green\ Island} \qquad 6$$

$$Q_{Battery} = c + d\,Q_{Green\ Island} \qquad 7$$

MONTH	POUGHKEEPSIE a	POUGHKEEPSIE b	BATTERY c	BATTERY b
June	711	1.231	1228	1.310
July	-12	1.228	52	1.317
August	-951	1.358	-1062	1.452
September	-192	1.237	-319	1.336

Because tributary drainage area data were not available for the reach between Poughkeepsie and the Battery, a linear function relating drainage area and river mile was used to estimate tributary drainage area in that section of the model. Data for the total Hudson River drainage area above Poughkeepsie and at the Battery were used for this formulation. The tributary flows for June through September 1981, computed using the technique summarized in Equations 1 through 7, are contained in Tables 3 through 6.

3.3 THERMAL BOUNDARY CONDITIONS

3.3.1 Upstream and Downstream Boundaries

The upstream thermal boundary condition used in the FFTM was water temperature recorded at the Green Island gaging station. These data represent grab samples collected once daily at 8:00 a.m. from approximately 2 m below the water surface. Figures 11 through 14 show the upstream temperature values used for the June through September 1981 model runs. The same interpolation procedure used for the upstream flow rate data assigned in the model was applied for the upstream temperature data.

The downstream thermal boundary condition used in the model was estimated using water temperature data recorded at the Battery NOAA gaging station. These data represent grab samples collected from 1 m below the water surface near the shoreline. Collection time varied from 10:00 a.m. to 2:00 p.m. Application of the NOAA temperature data was governed by the FFTM formulation of the downstream boundary condition and by the model validation process. The FFTM option selected for the downstream boundary condition simulates a fixed ocean temperature and requires that a temperature be assigned for the floodtide stage. Theoretically, this value changes over the course of a given month in response to changing meteorological conditions. Because the temperature database for each month consisted of 20 to 25 values, it was not possible to determine with certainty what flood temperatures should be assigned in the model. As a result, two methods were tested: one using the average of the temperature values for a given month that were recorded during flood tide, the other using the daily values recorded by NOAA and, where necessary, interpolated estimates. During the validation process the method that produced model temperatures that better matched temperatures measured in the lower reaches of the river was selected for the subsequent forecast simulations. The average flood stage value was used for all July and August runs; interpolated daily values were used for June and September runs. These data are summarized in Figure 15.

3.3.2 **Downstream Salinity Boundary Condition**

The downstream salinity boundary condition is handled in a fashion analogous to the temperature boundary condition. Previous studies of salinity intrusion in the Hudson estuary showed that a flood flow salinity of 25,600 ppm is a reasonable value for the downstream salinity boundary condition. Salinity data recorded at the NOAA Battery gaging station during the June through September 1981 period are consistent with this value with one exception: lower salinities were observed in August 1981. Further review of New York Harbor survey data resulted in the selection of a flood flow salinity of 24,000 ppm for the August simulations.

3.3.3 **Tributary Temperatures**

No tributary temperature data were available for the June-September 1981 time period. Values were computed based on the assumption that tributary flows were equilibrated with meteorological conditions at all times. The formulation of equilibrium temperatures required several computational steps and assumptions, summarized below.

1. Equilibrium temperature conditions prevail night and day, with no residual heating or cooling effects transferred from either period to the other.

2. Daytime equilibrium temperature can be approximated by Edinger's equation (Edinger et al. 1974)

$$T_{eq} = T_d + \frac{H_s}{K} \qquad \textbf{8}$$

where

T_{eq} = daytime equilibrium temperature
T_d = dew point temperature (C)
H_s = gross solar input (W/m^2)
K = heat exchange coefficient (W/m^2/ C)

3. Nighttime equilibrium temperature can be approximated as the dew point temperature.

4. The average daily equilibrium temperature can be approximated by the average of the day- and nighttime values.

Gross solar input (shortwave radiation) and dew point temperature were estimated from related meteorological parameters (Equations 9 [Anderson 1954; Ryan and Harleman 1973] and 10 [(J.F. Bosen[1])].

$$H_{sn} = H_s - H_{sr} = 0.94\, H_{sc}\,(1 - 0.65\,C^2) \qquad \textbf{9}$$

$$T_d = T - [(14.55 + 0.114T)X + [(2.5 + 0.007T)X]^3 + (15.9 + 0.117T)X^{14}] \qquad \textbf{10}$$

[1]This equation was never published by Bosen, but was obtained from Bosen by McGraw-Hill and published in *Hydrology for Engineers* (Linsley, Kohler, Paulhus 1982).

where

H_{sn} = net solar input (kcal/m^2/hr)
H_s = gross solar input (kcal/m^2/hr)
H_{sr} = reflected solar input (kcal/m^2/hr)
H_{sc} = clear sky solar radiation (kcal/m^2/hr)
C = fraction of sky covered by clouds
T = air temperature (C)
T_d = dew point temperature (C)
X = 1.00 - f/100; f = relative humidity as percent

Clear sky solar radiation was obtained from Figure 16 (Hamon, Weiss and Wilson 1954). The gross solar input was derived from the net solar radiation value obtained from Equation 9 by assuming that 3% of the incoming solar radiation is reflected off the water surface (Lombardo 1972). Net solar values were thus divided by 0.97 to obtain gross solar input values. The meteorological data used for these computations were obtained from the same sources as those assigned in the model.

The heat exchange coefficient, K, is typically solved iteratively through use of published nomographs, known meteorological data, and known water temperature data. Because no tributary temperature data were available, it was not possible to apply such a technique in this study. The literature was reviewed to obtain a reasonable estimate for a summer month heat exchange coefficient. A value of 35 W/m^2/ C was selected. The tributary temperature values derived from Equations 8 through 10 are summarized in Tables 7 through 10.

It should be noted that three sets of equilibrium temperatures were computed for each day of the month. These correspond to the three sets of data applied in the model to simulate meteorological conditions between Albany and Manhattan. The assignment of meteorological data to different model reaches is discussed in the following section.

A review of the computed tributary temperatures indicates that in some cases the foregoing methodology yielded what appear to be artificially low temperatures and substantial day-to-day temperature fluctuations. For example, the June daily tributary temperature values for reach 20 fluctuate from 79.6° to 44.3°F and back up to 77.6°F between the fourth and sixth of the month. The temperature values, as computed with Equations 8 through 10, are inversely proportional to cloud cover. Consequently, excessively low values can result

from a high daily average cloud cover value. The substantial day-to-day fluctuation is explained by the fact that no residual cooling or heating effects are included in the calculations; these cases are the exception rather than the rule, however. The average monthly values, as well as the goodness of fit demonstrated during the model calibration process, indicate that the methodology is sufficient for purposes of this modeling study.

3.4 METEOROLOGICAL DATA

The FFTM requires six meteorological data values: air temperature, wind speed, relative humidity, atmospheric pressure, net atmospheric flux (long wave radiation), and net solar flux (shortwave radiation). These values are used in the model's heat balance computations, which determine water temperature. All parameters except for the two flux terms were modeled using average daily values. The two flux parameters were computed from related meteorological conditions and were input as hourly values to account for (1) solar flux only during the daytime hours and (2) differing intensities of day- and nighttime atmospheric fluxes. The gross solar flux values computed from Equation 9 and the Lombardo assumption were distributed over 12 hrs, from 6:00 a.m. to 6:00 p.m., with a peak value at noon. The atmospheric flux was computed from Equation 11 (Swinback 1963).

$$H_{an} = H_a - H_{ar} = 1.16 \times 10^{-13} (1 + 0.17 C^2)(T + 460)^6 \qquad 11$$

where

H_a = gross atmospheric long wave radiation input (Btu/ft^2/day)
H_{ar} = reflected long wave radiation (Btu/ft^2/day)
C = fraction of sky cover with clouds
T = air temperature (F)

Three sets of meteorological data were used to model conditions along the Hudson River between Albany and Manhattan. The three model reaches over which these data were applied are summarized below and appear in Figure 17.

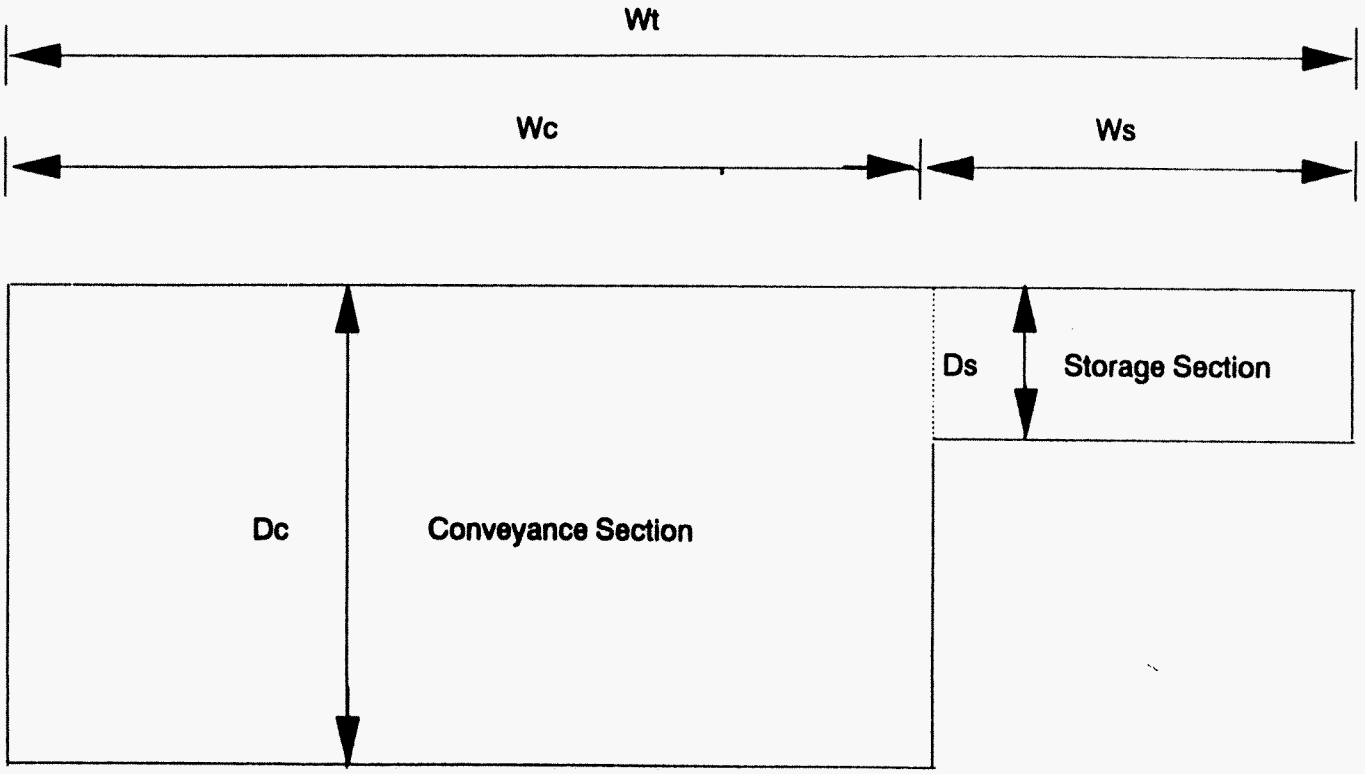
REACH	RIVER MILES	DATA SOURCE
10	153.7 - 114.8	Albany Airport
20	114.8 - 38.9	Dutchess County Airport
30	38.9 - 0.0	Average of LaGuardia and Dutchess County

The average of LaGuardia and Dutchess County data was used to represent meteorological conditions adjacent to New York City and the surrounding area as well as the less developed regions north of the city. Initial simulations utilized LaGuardia data for reach 30 and consistently produced model temperatures greater than those measured in the lower portion of the reach. The averaging method yielded a better match of model and river data. The meteorological data used in the FFTM to simulate conditions in June, July, August, and September 1981 are provided in Tables 11 through 22.

3.5 ANTHROPOGENIC HEAT LOADS

Water temperatures in the Hudson River are produced by the combined influence of natural and anthropogenic heat loads on the estuarine flow system. Modeling river temperatures requires sound estimates of both. The natural component, i.e., meteorological conditions, has been presented above. With a few exceptions, the FFTM included all heated discharges to the river that have associated volumetric discharges greater than 50 mgd. Two types of heat load data were needed for the modeling study: the actual heat loads to the river during the June through September 1981 time period for model calibration, and the capacity heat loads (where applicable) for the forecast simulations. For purposes of this study all anthropogenic heat sources other than Roseton, Indian Point, and Bowline Point are designated as "background" heat sources. The three facilities that are the main subject of study here are designated as "power plant" heat sources. The data were obtained from the utilities, other thermal dischargers, and from DEC. All heat load data were processed as average daily values for purposes of both the calibration and the forecast simulations. Figures 18 through 25 show the background and power plant heat loads for the June through September 1981 period. Table 23 summarizes the sources of anthropogenic heat loads to the river that were modeled, the capacity heat values, the data source(s), and relevant comments regarding the heat load data.

Figure 1
FFTM Cross-Section Schematization



Dc: Conveyance depth
Ds: Storage depth
Wc: Conveyance width
Ws: Storage width
Wt: Total width

Figure 2

Upstream Hydraulic Boundary Condition
Measured Flow Rate At Green Island USGS Gaging Station

June 1981

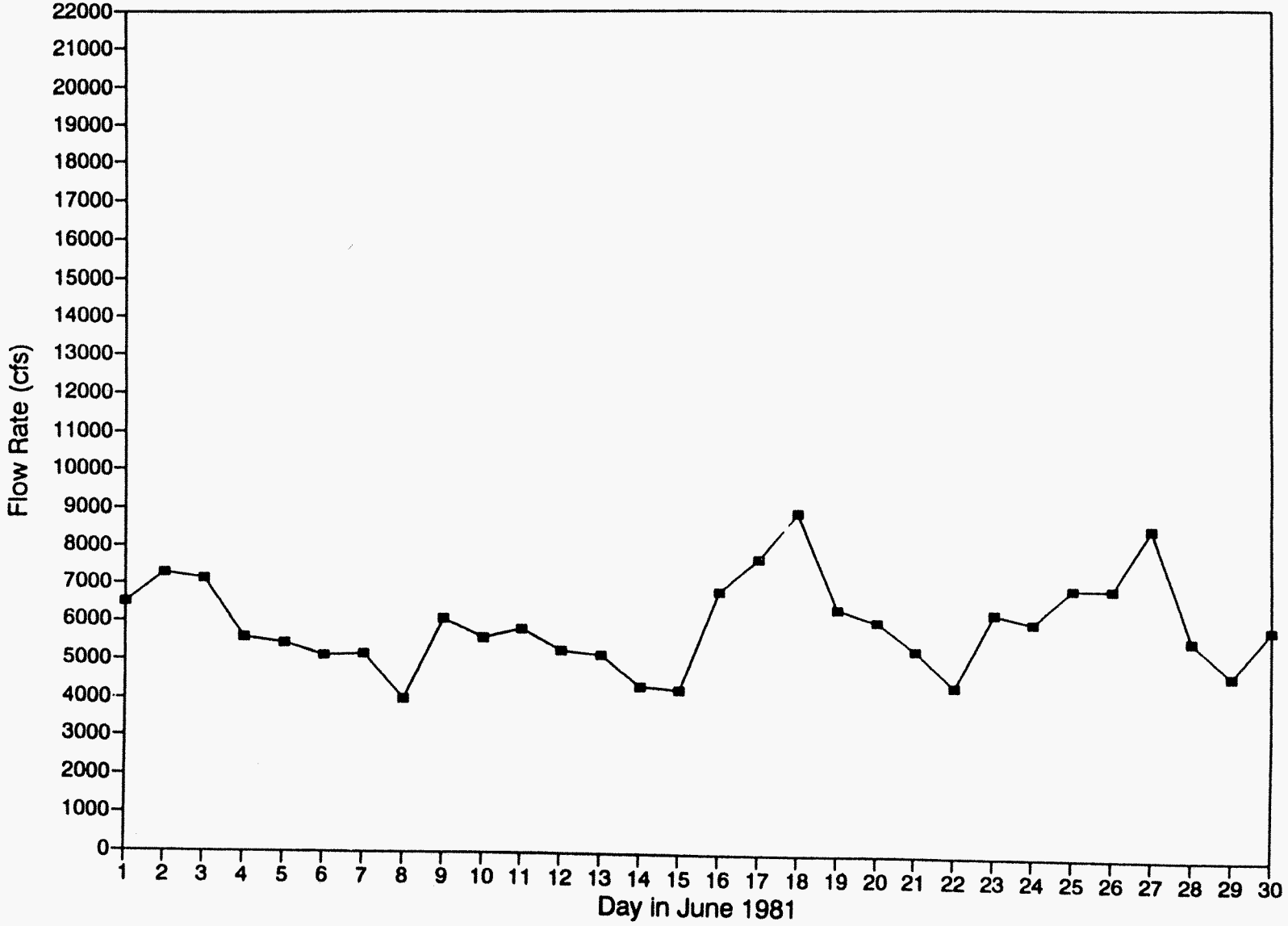


Figure 3

Upstream Hydraulic Boundary Condition
Measured Flow Rate At Green Island USGS Gaging Station

July 1981

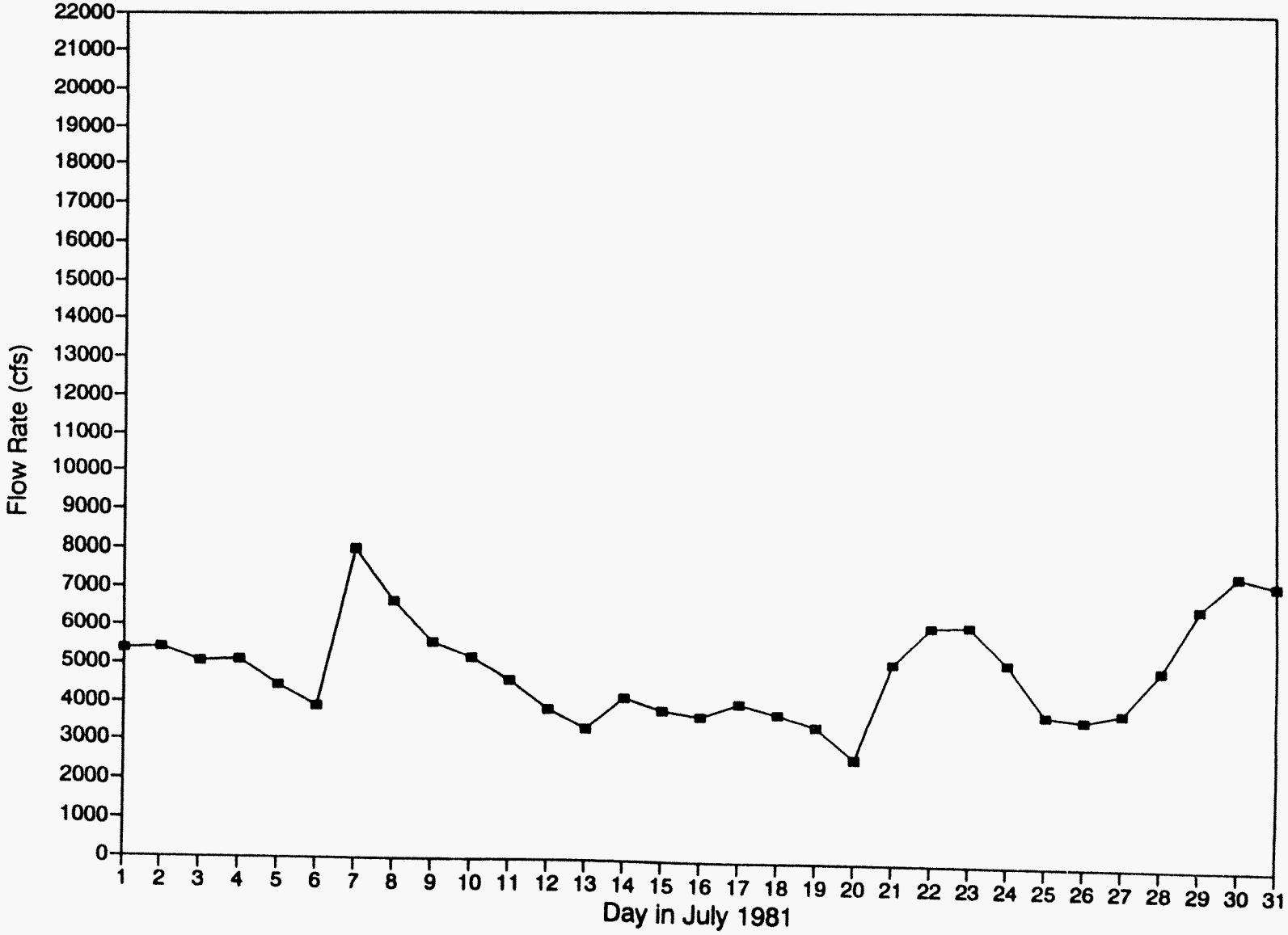


Figure 4

Upstream Hydraulic Boundary Condition
Measured Flow Rate At Green Island USGS Gaging Station

August 1981

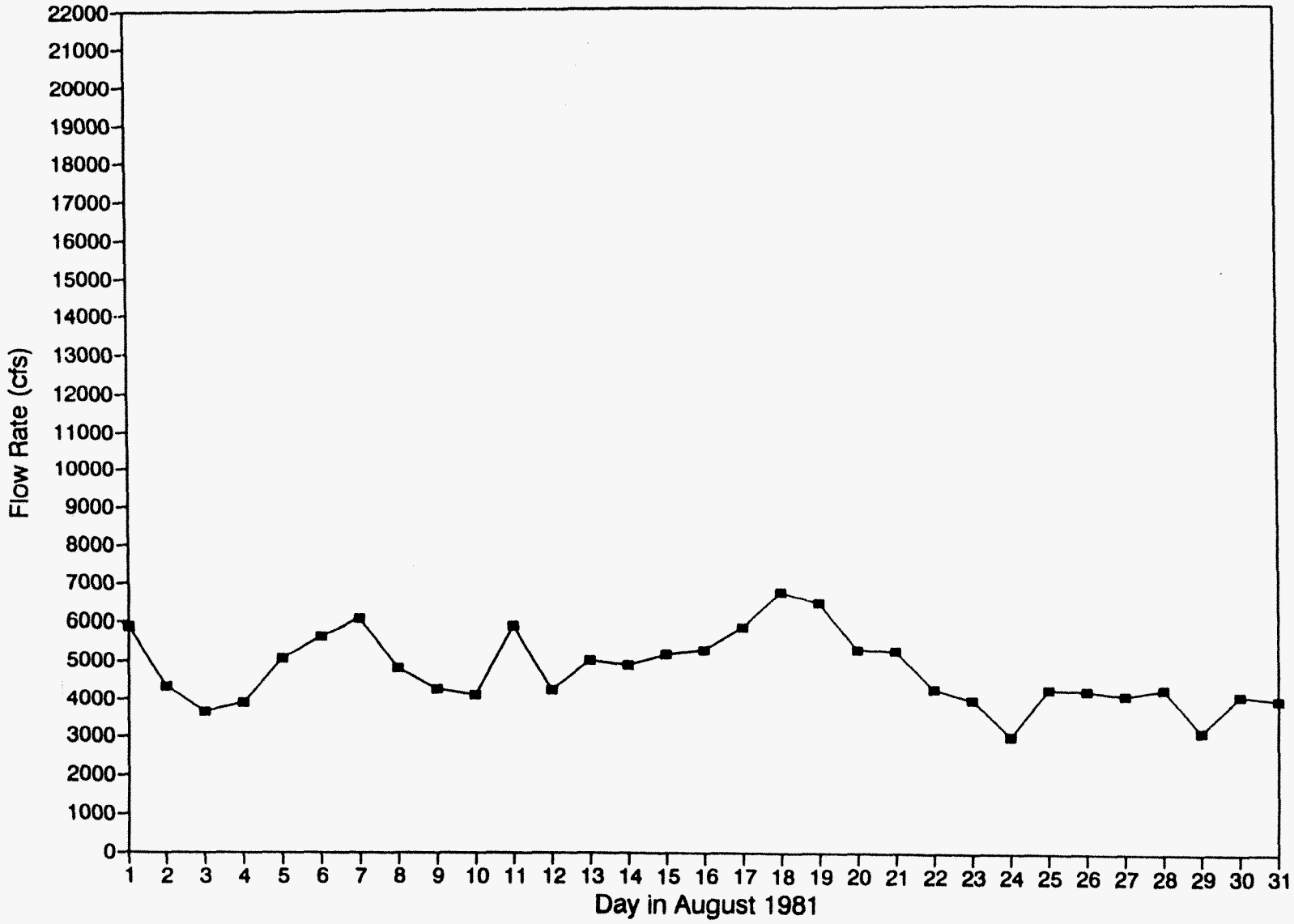


Figure 5

Upstream Hydraulic Boundary Condition
Measured Flow Rate At Green Island USGS Gaging Station

September 1981

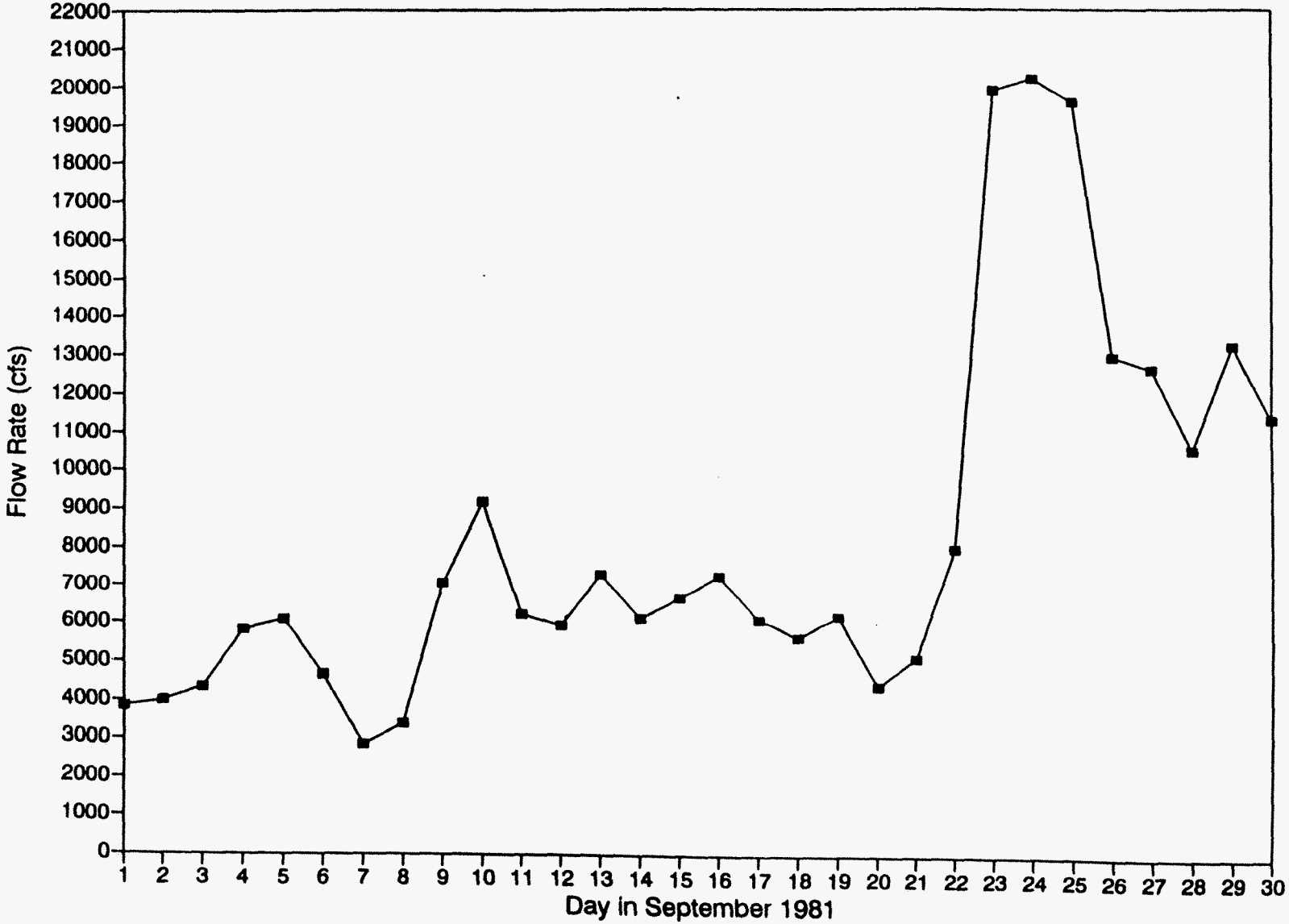
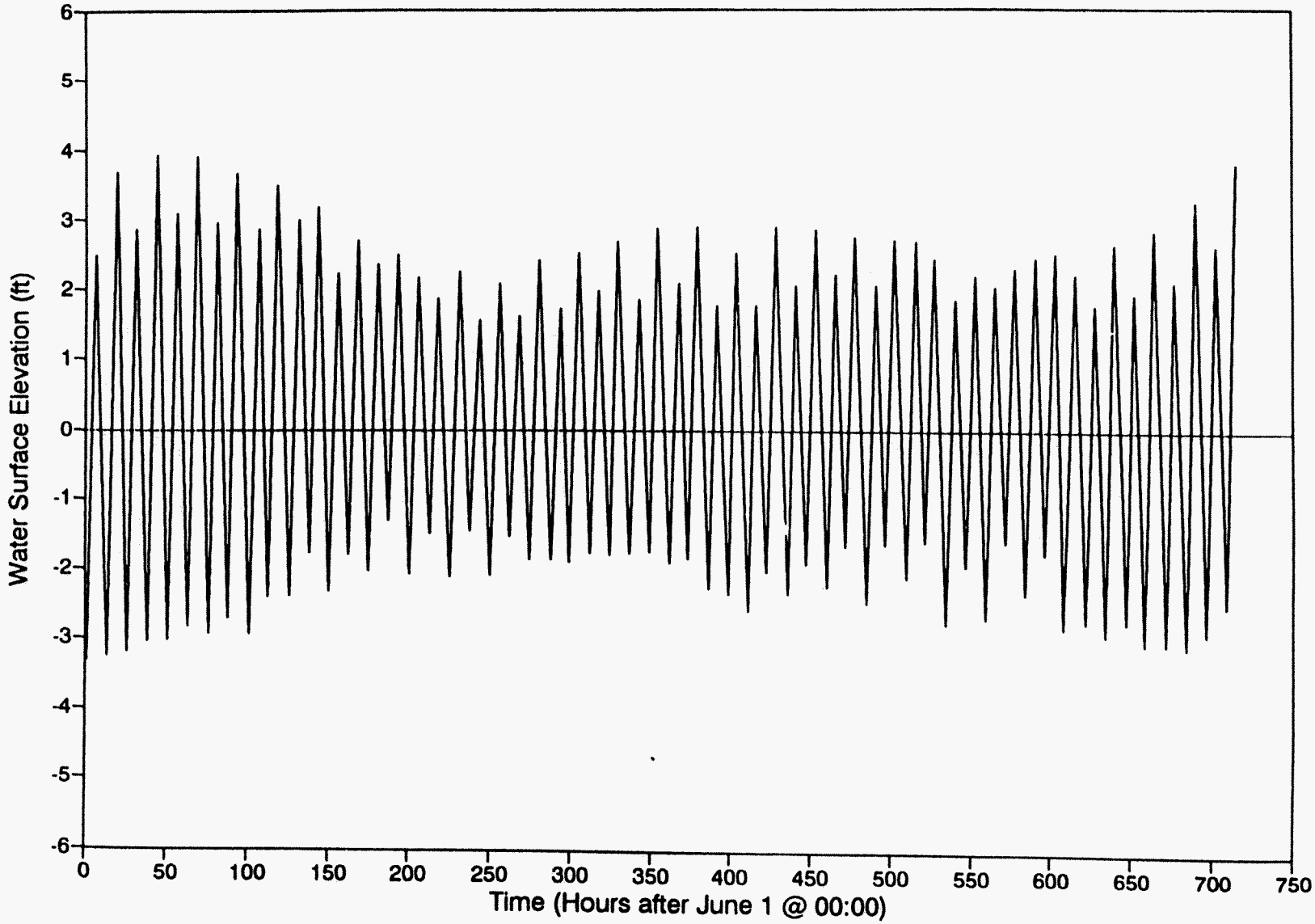


Figure 6

Downstream Hydraulic Boundary Condition
Measured Water Surface Elevation at Battery NOAA Gaging Station

June 1981

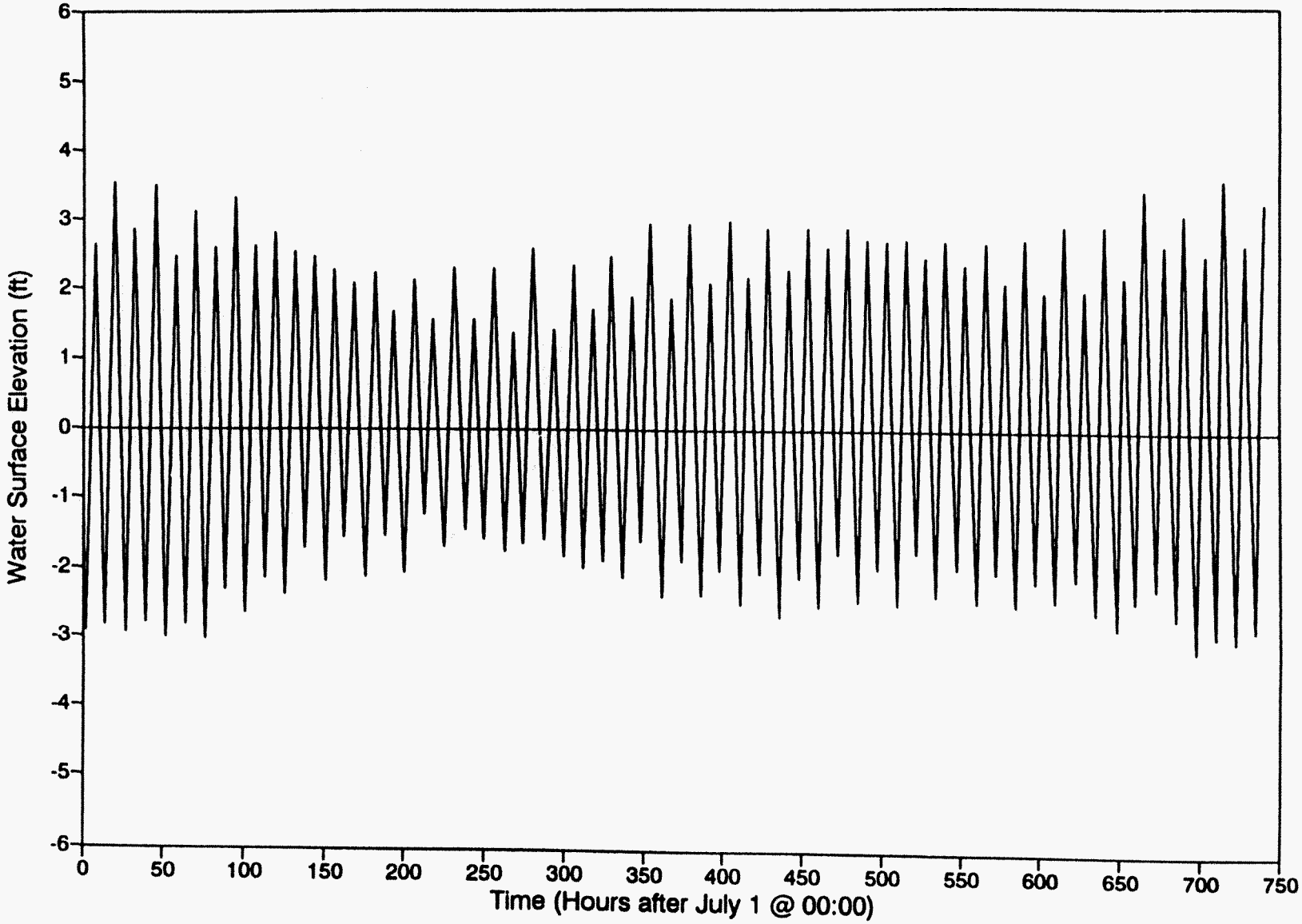


Datum: Mean Water at the Battery

Figure 7

Downstream Hydraulic Boundary Condition
Measured Water Surface Elevation at Battery NOAA Gaging Station

July 1981

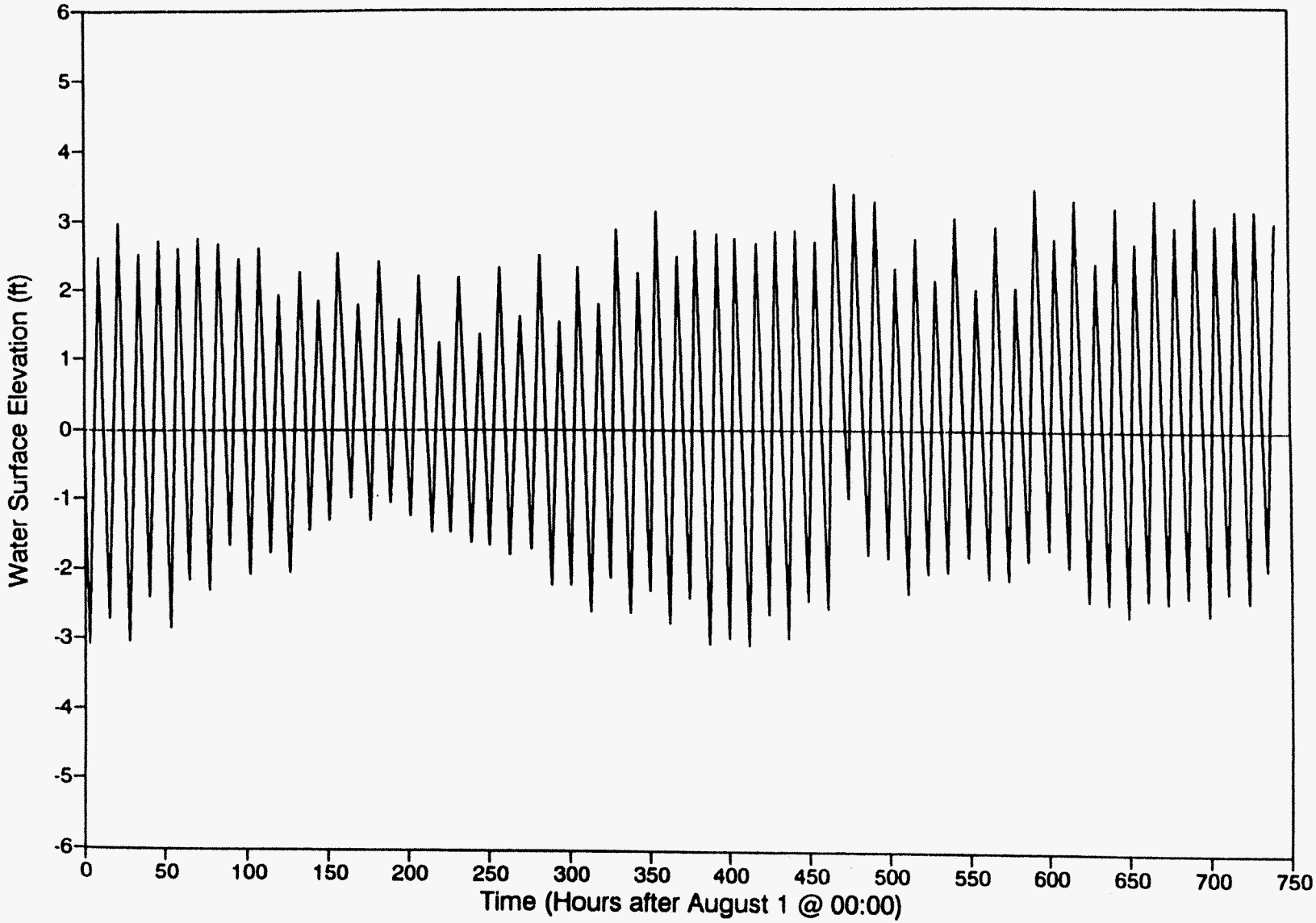


Datum: Mean Water at the Battery

Figure 8

Downstream Hydraulic Boundary Condition
Measured Water Surface Elevation at Battery NOAA Gaging Station

August 1981

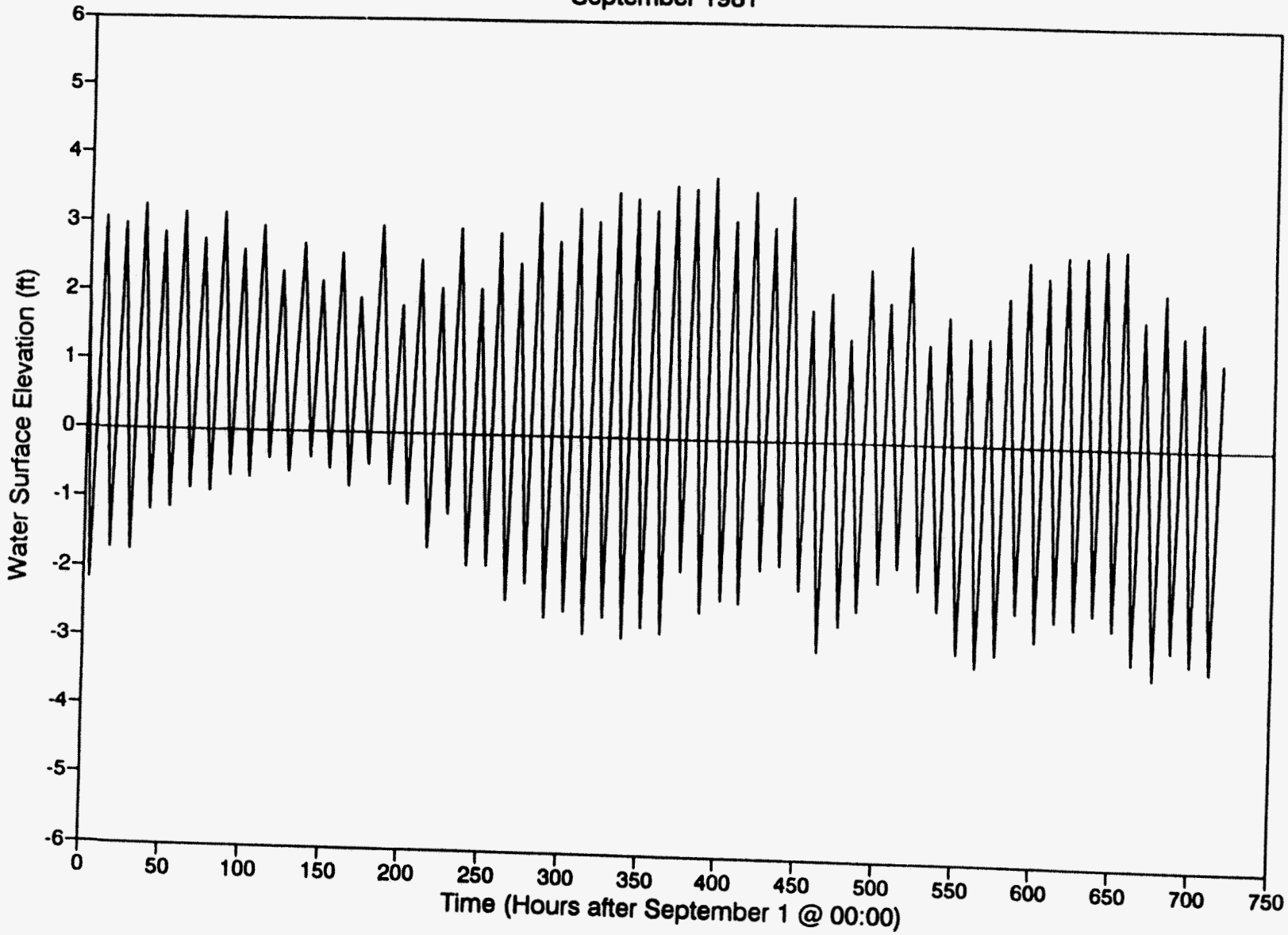


Datum: Mean Water at the Battery

Figure 9

Downstream Hydraulic Boundary Condition
Measured Water Surface Elevation at Battery NOAA Gaging Station

September 1981



Datum: Mean water at the Battery

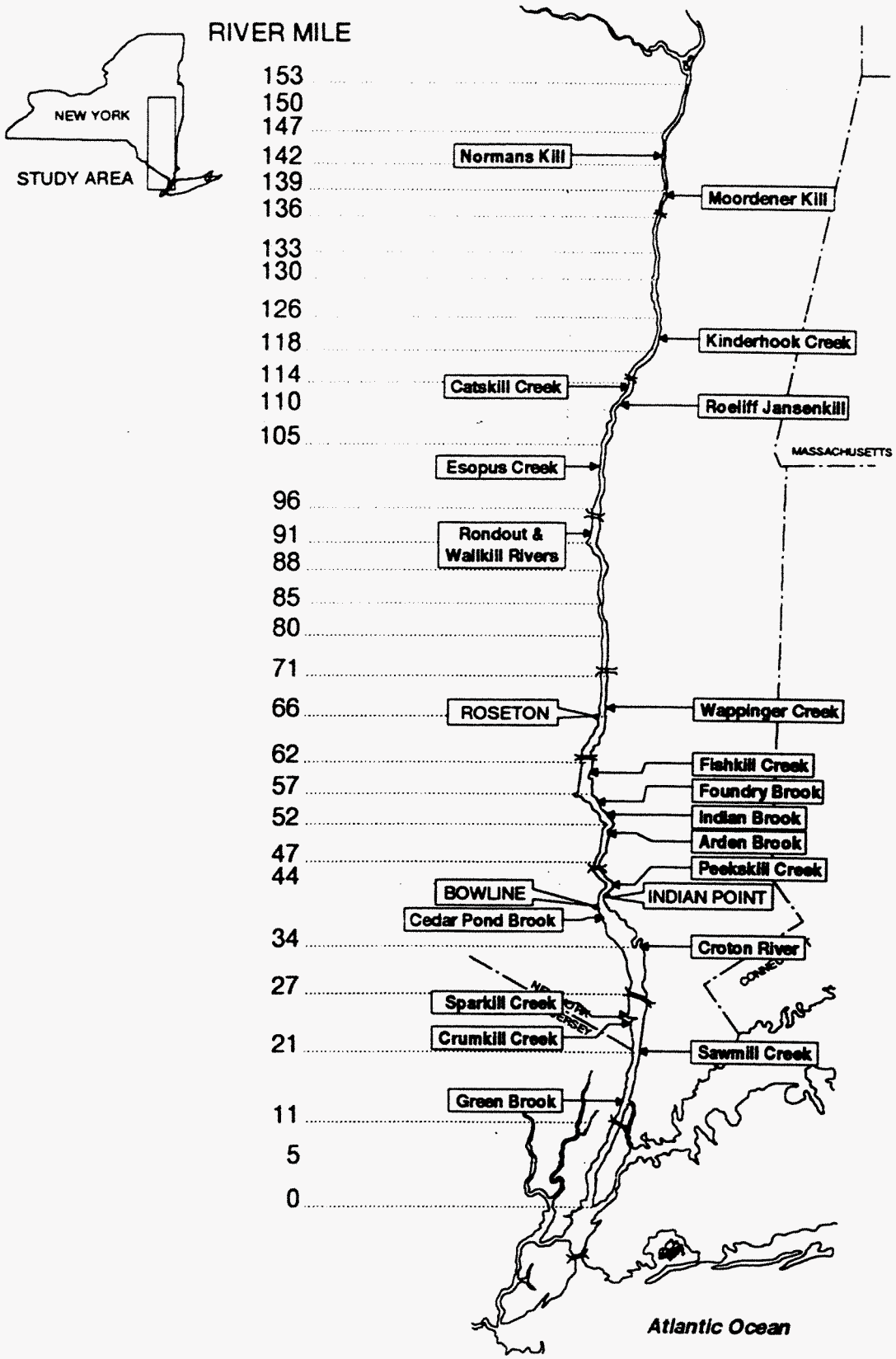


Figure 10. Tributaries Included in the Far-Field Thermal Model.

Figure 11

Upstream Temperature Boundary Condition
Measured Temperature at Green Island USGS Gaging Station (@ 08:00)

June 1981

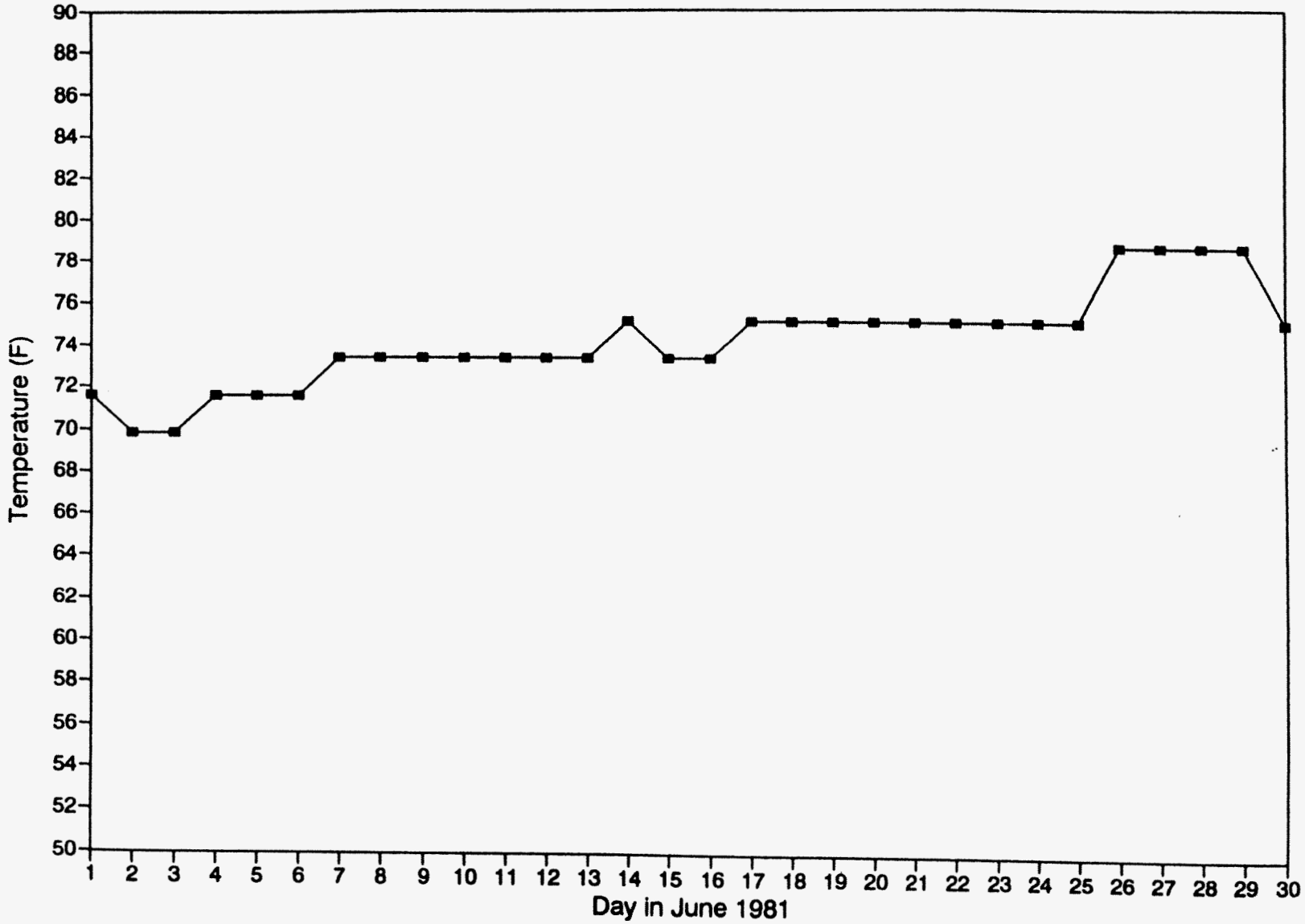


Figure 12

Upstream Temperature Boundary Condition
Measured Temperature at Green Island USGS Gaging Station (@ 08:00)

July 1981

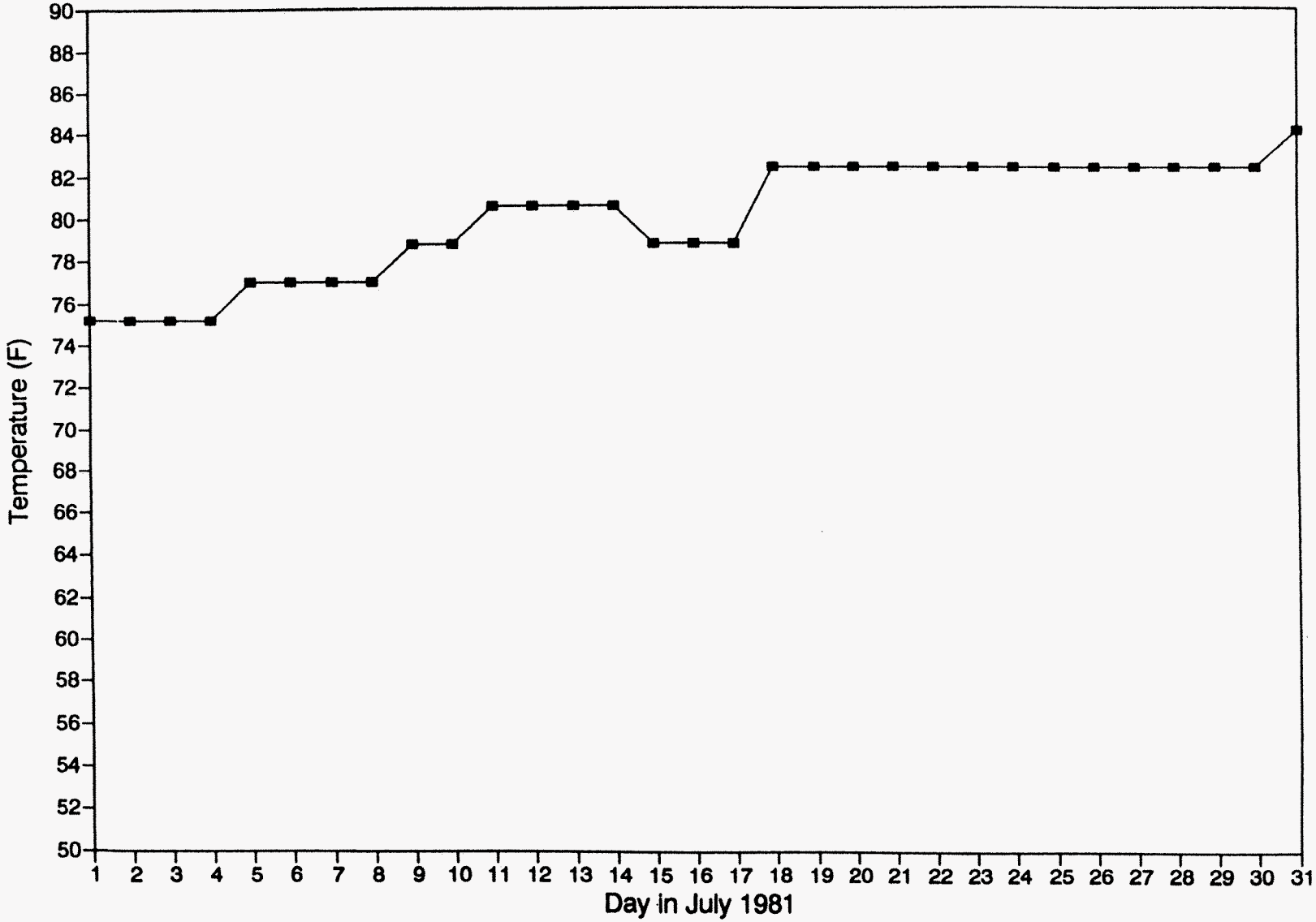


Figure 13

Upstream Temperature Boundary Condition
Measured Temperature at Green Island USGS Gaging Station (@ 08:00)

August 1981

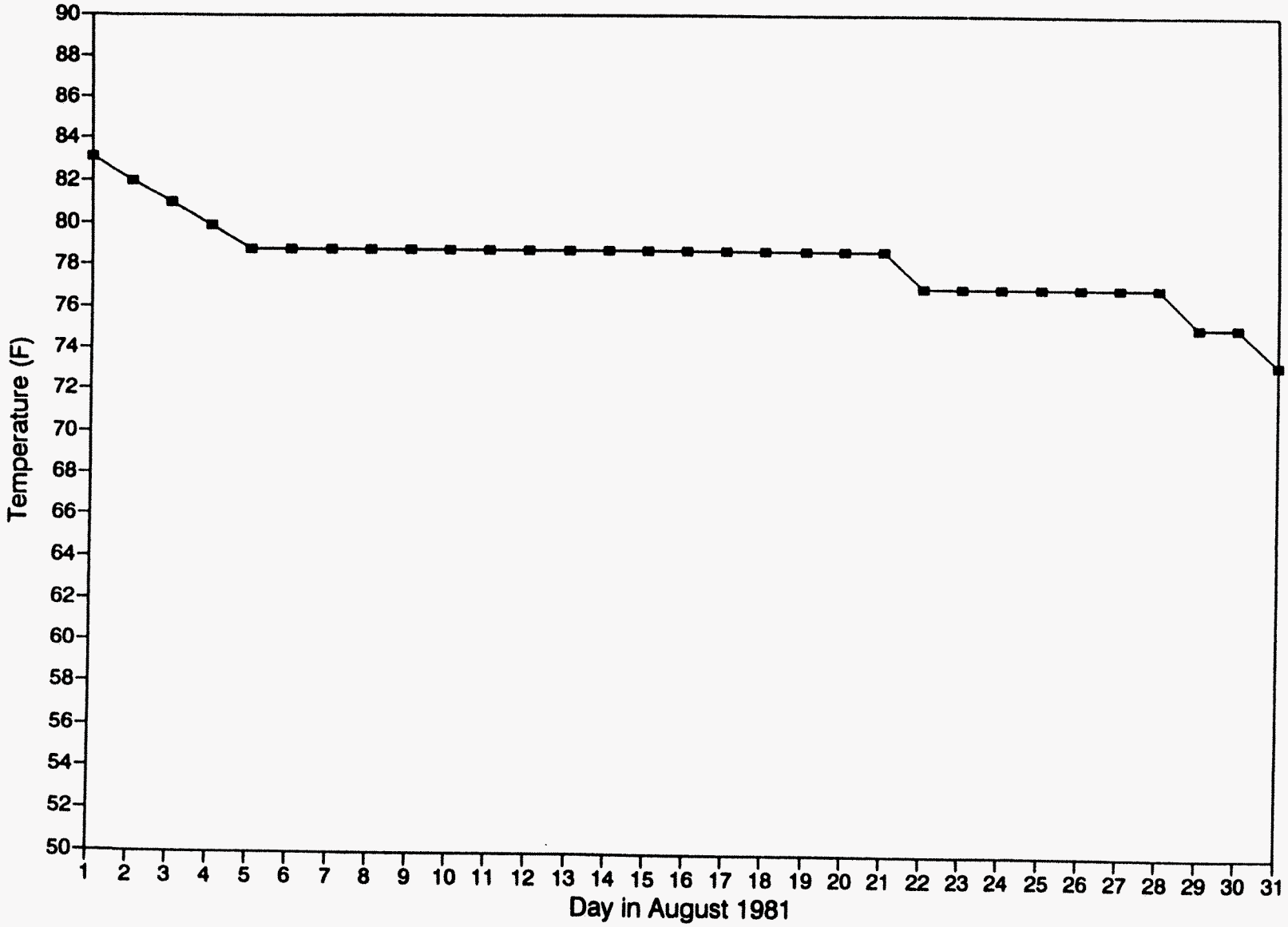


Figure 14

Upstream Temperature Boundary Condition
Measured Temperature at Green Island USGS Gaging Station (@ 08:00)

September 1981

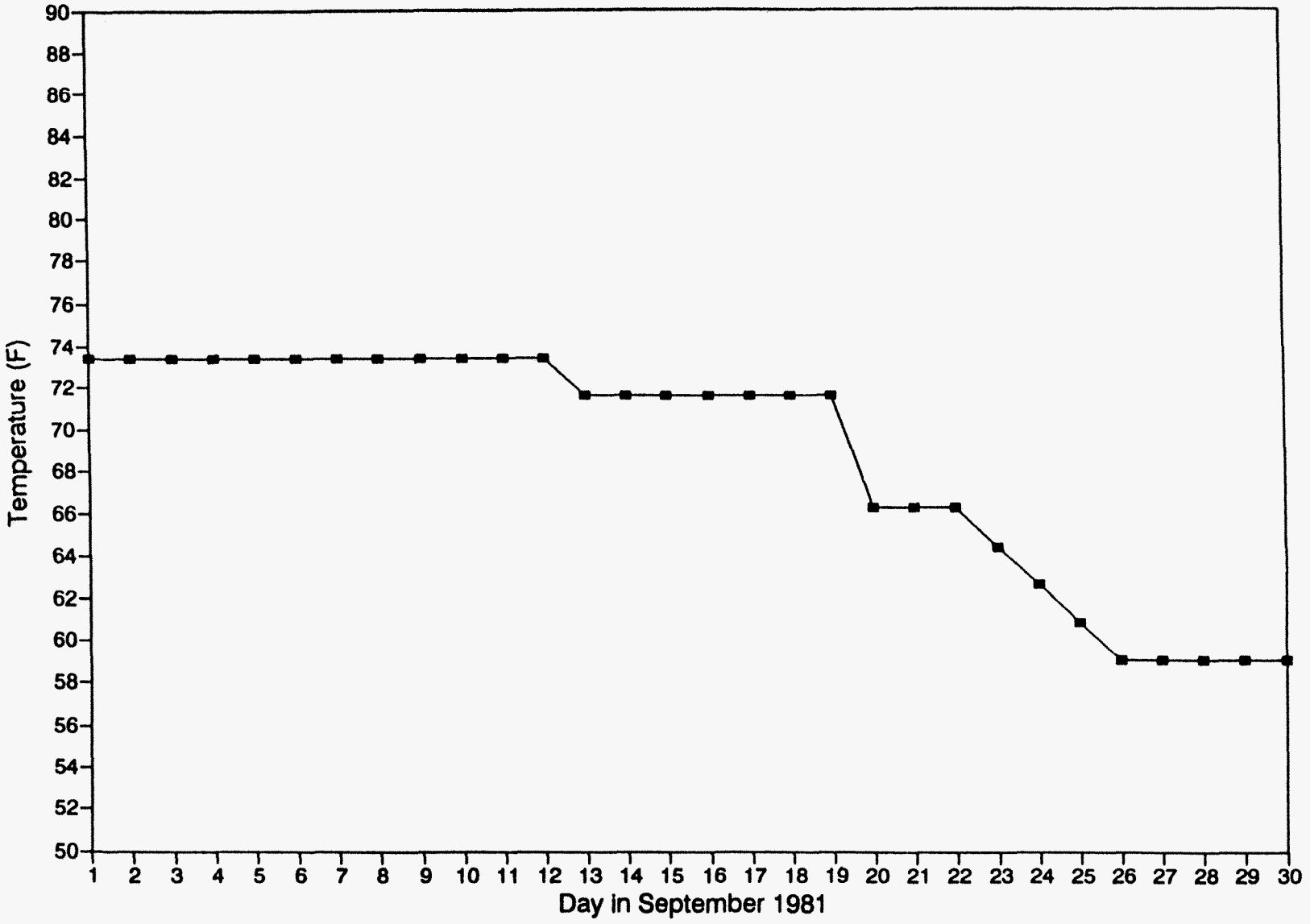
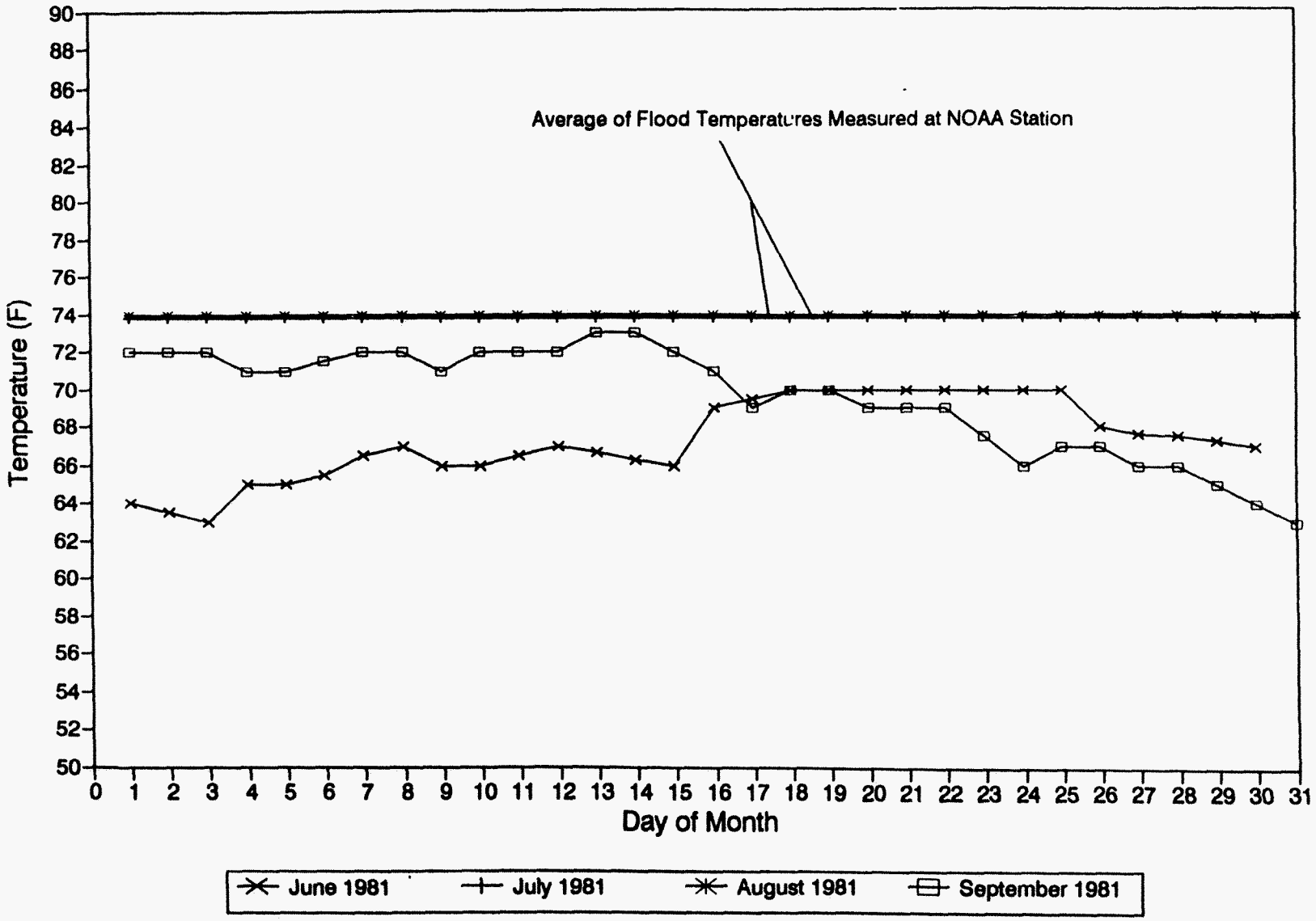


Figure 15

Downstream Temperature Boundary Condition
Temperature at NOAA Battery Gaging Station



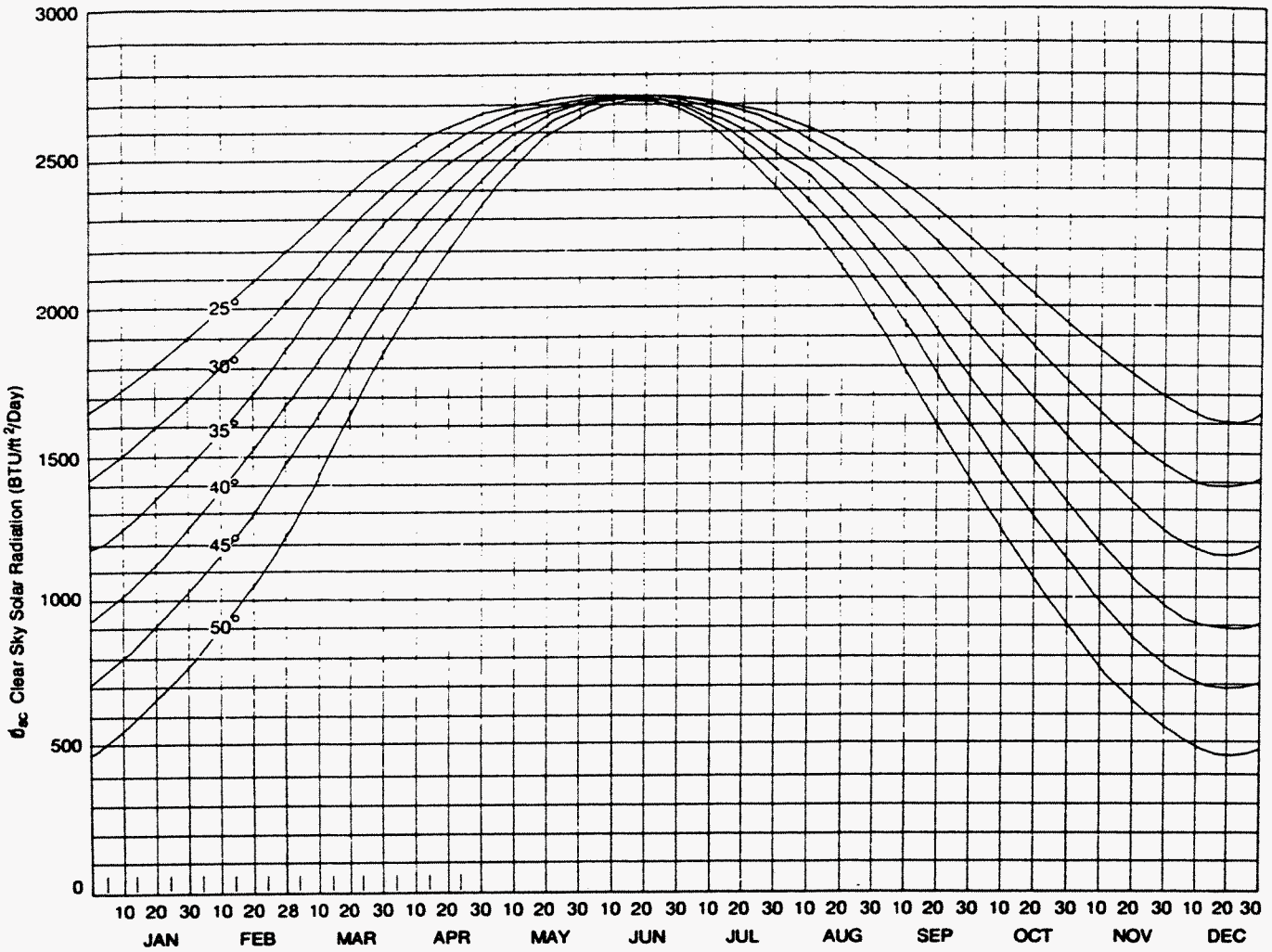


Figure 16. Clear Sky Solar Radiation.

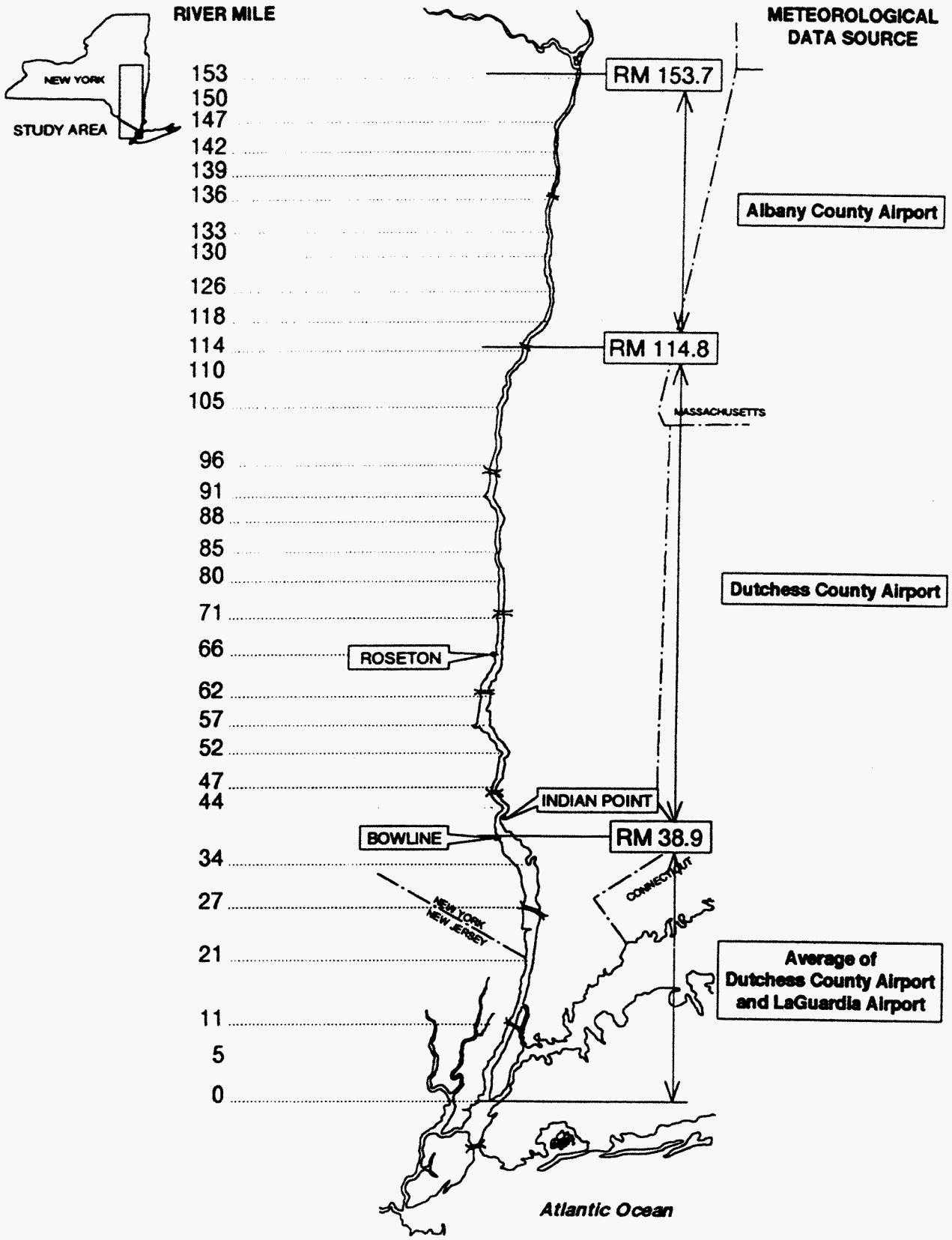


Figure 17. Segmentation of meteorological conditions in the far-field thermal model.

Figure 18

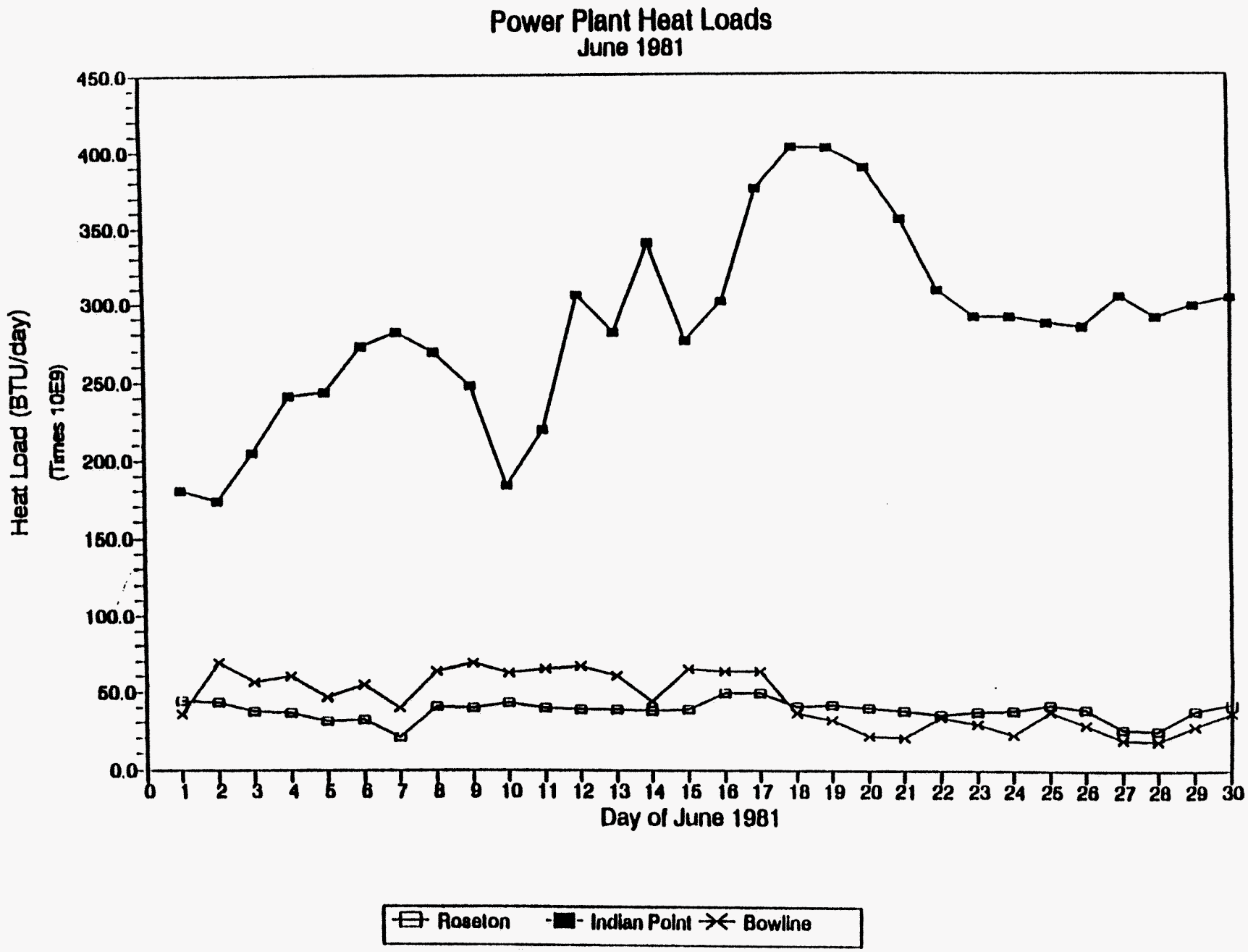

Power Plant Heat Loads
June 1981
Heat Load (BTU/day)
(Times 10E9)
450.0
400.0
350.0
300.0
250.0
200.0
150.0
100.0
50.0
0.0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
Day of June 1981
Roseton
Indian Point
Bowline

Figure 19

Background Heat Loads
June 1981

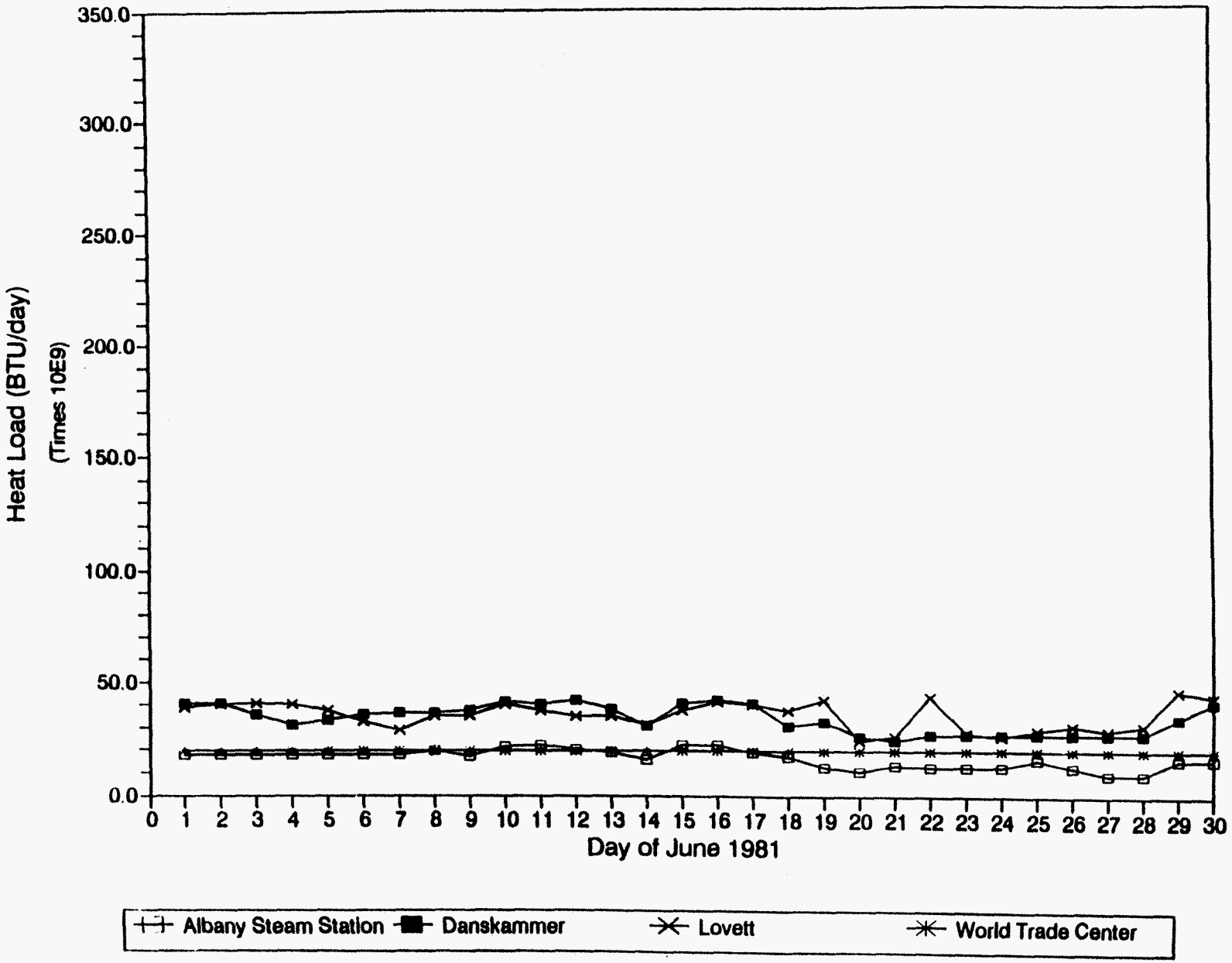


Figure 20

Power Plant Heat Loads
July 1981

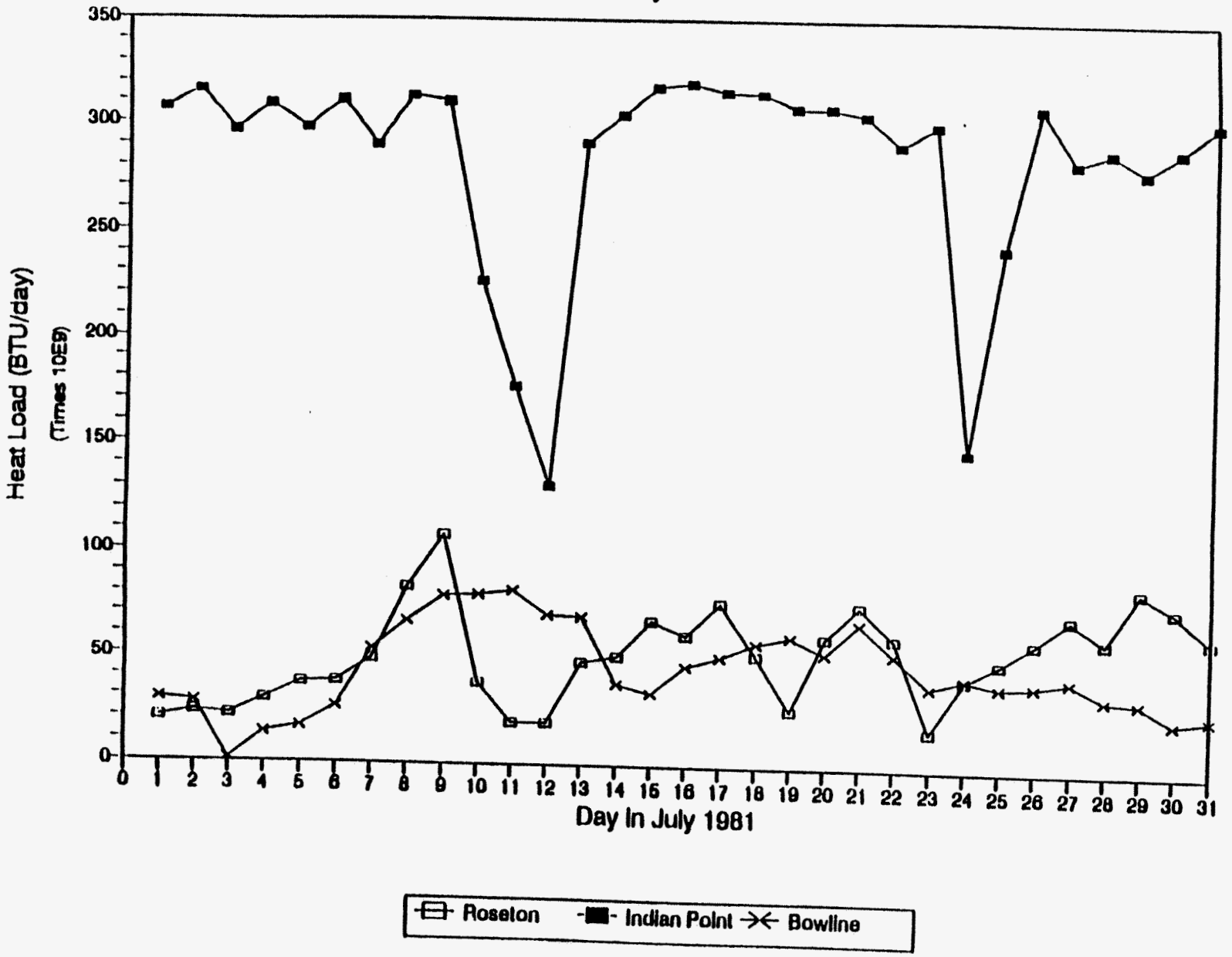


Figure 21

Background Heat Loads
July 1981

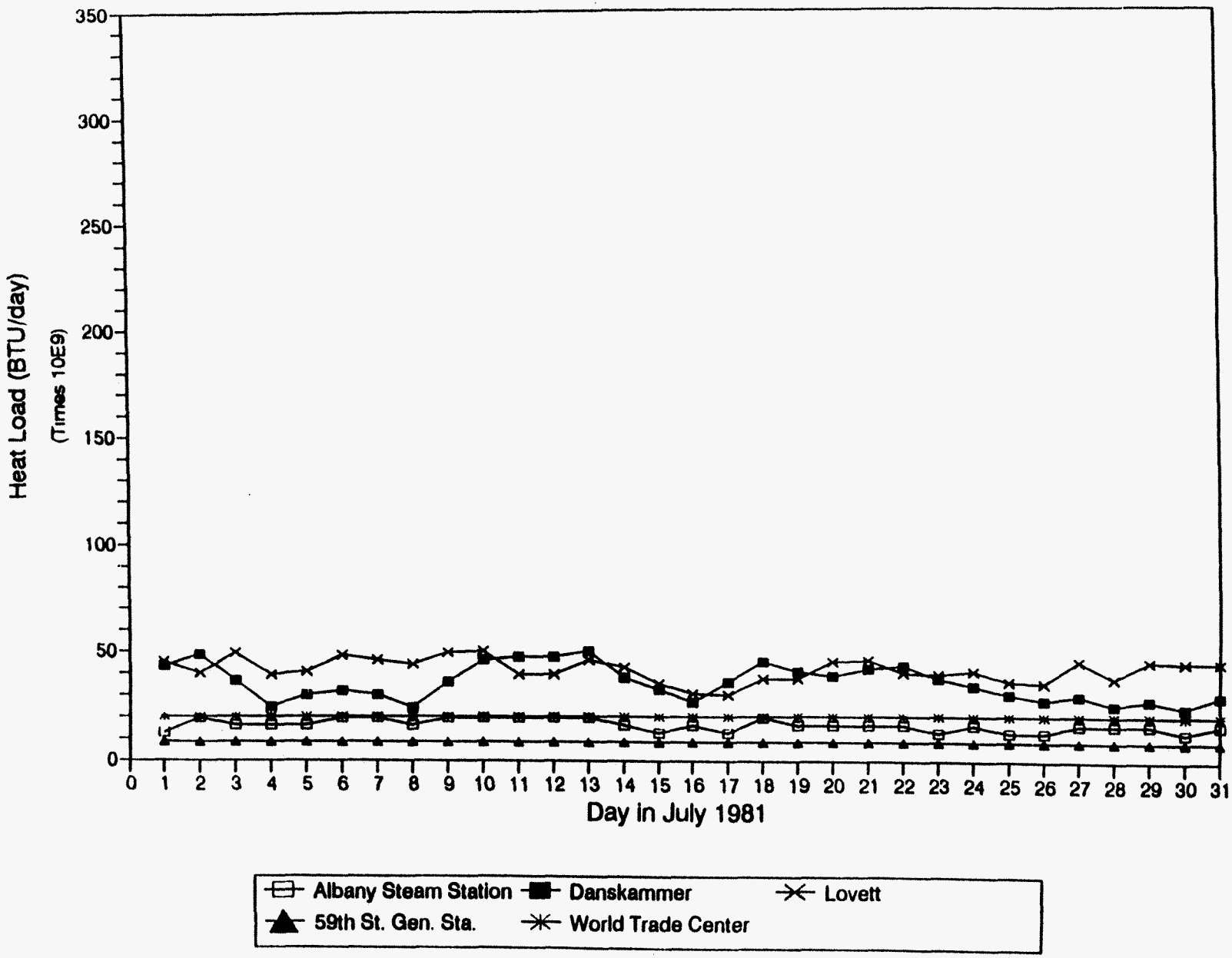


Figure 22

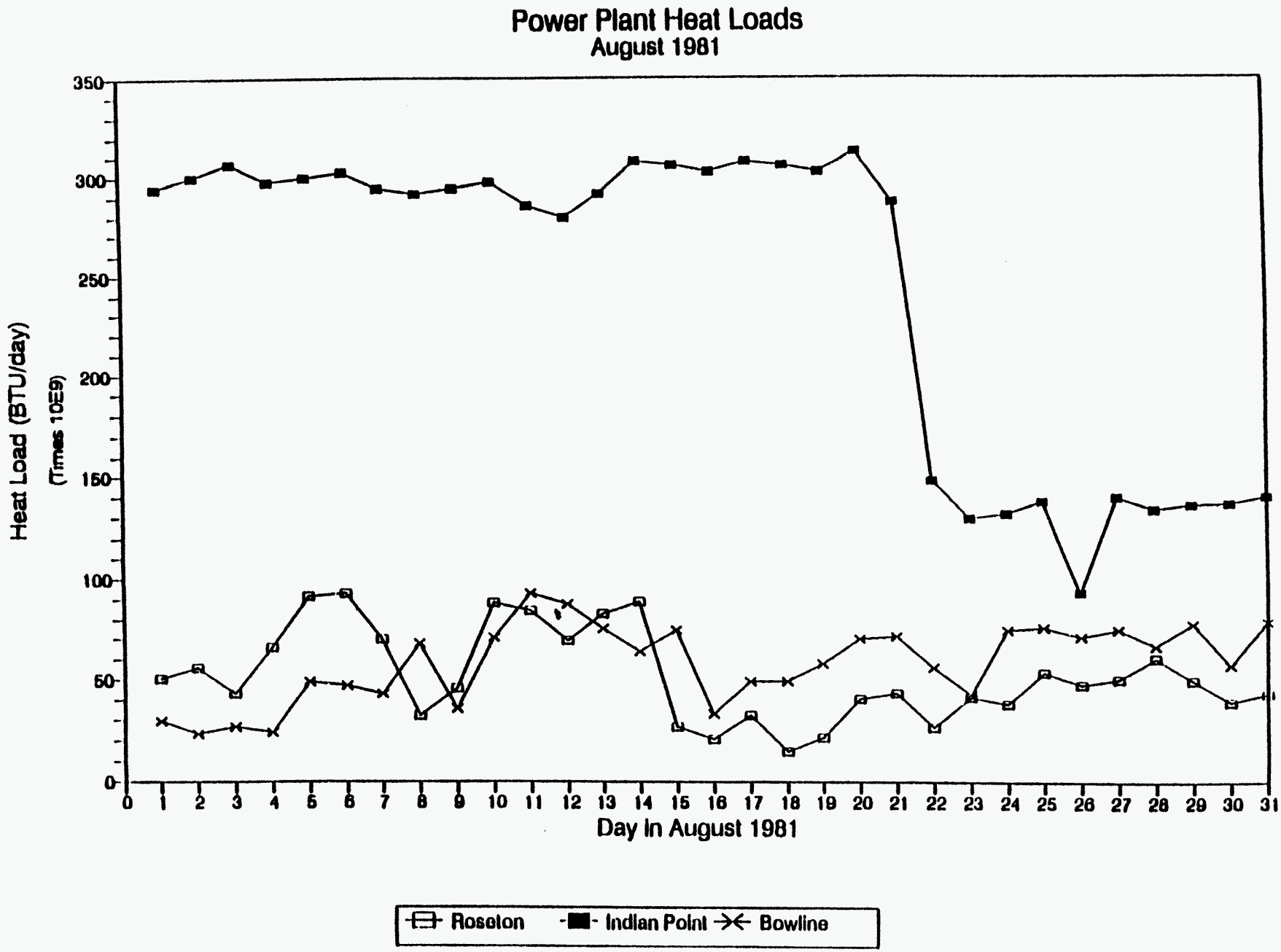

Power Plant Heat Loads
August 1981
Heat Load (BTU/day)
(Times 10E9)
350
300
250
200
150
100
50
0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Day In August 1981
Roseton
Indian Point
Bowline

Figure 23

Background Heat Loads
August 1981

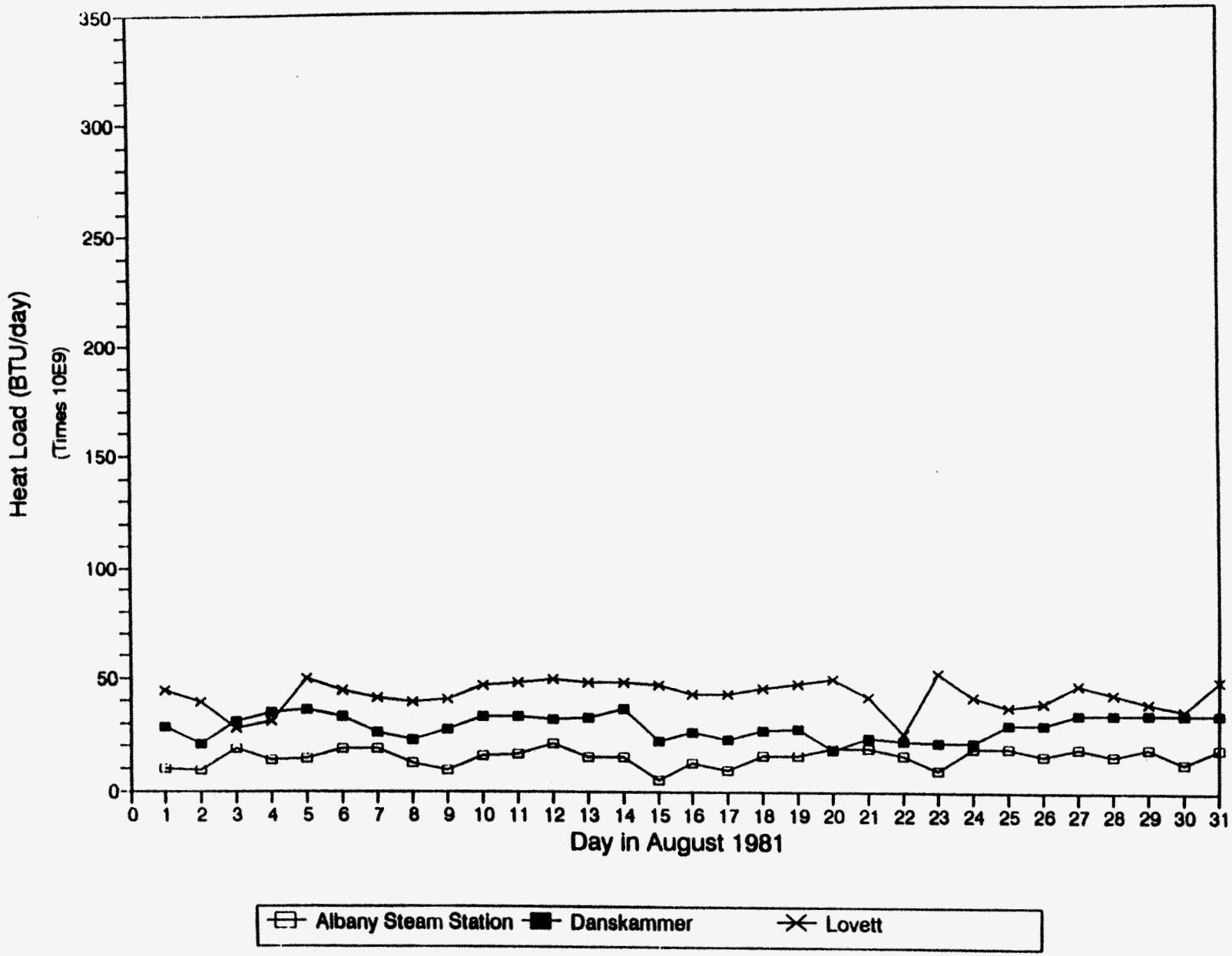


Figure 24

Power Plant Heat Loads

September 1981

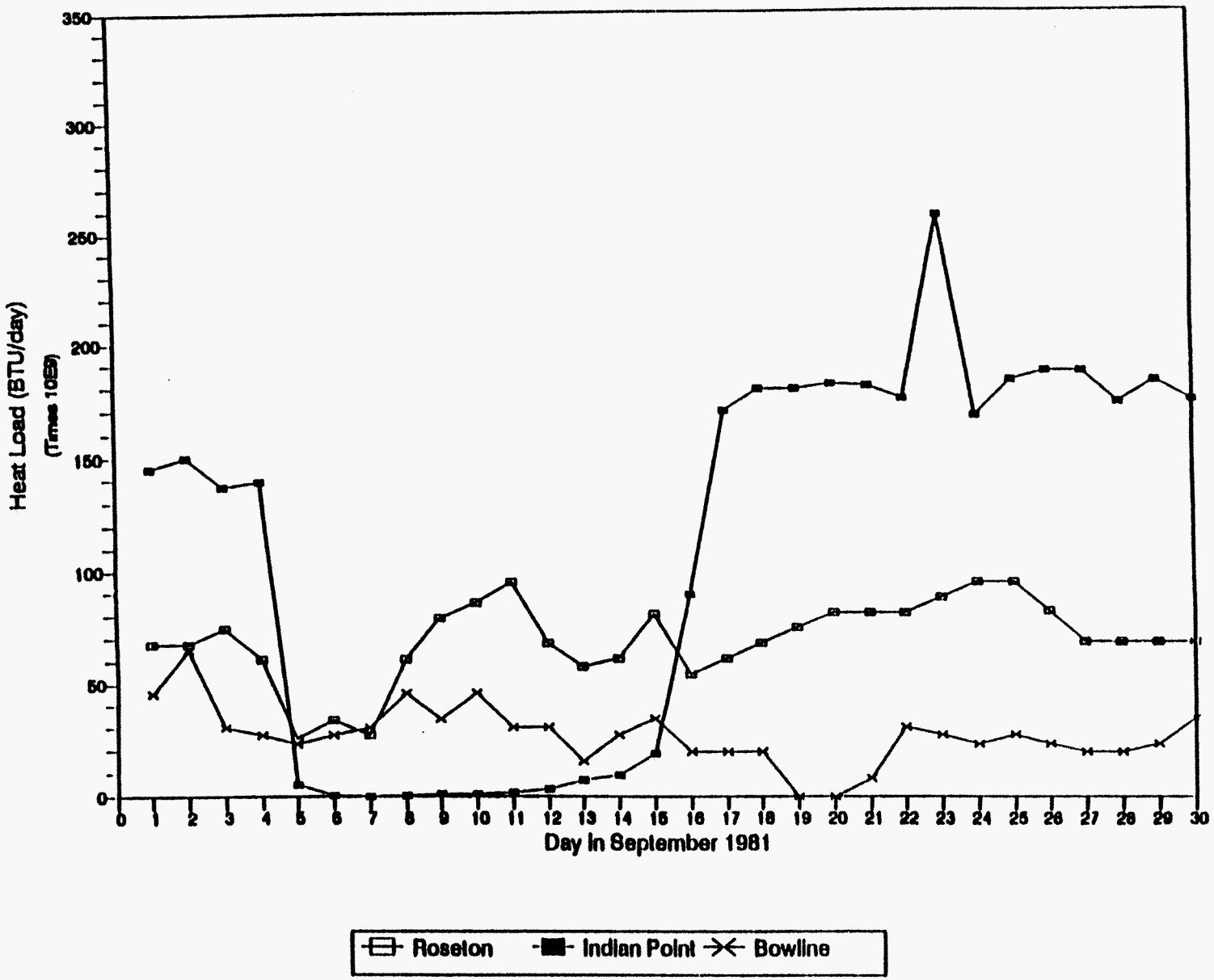


Figure 25

Background Heat Loads
September 1981

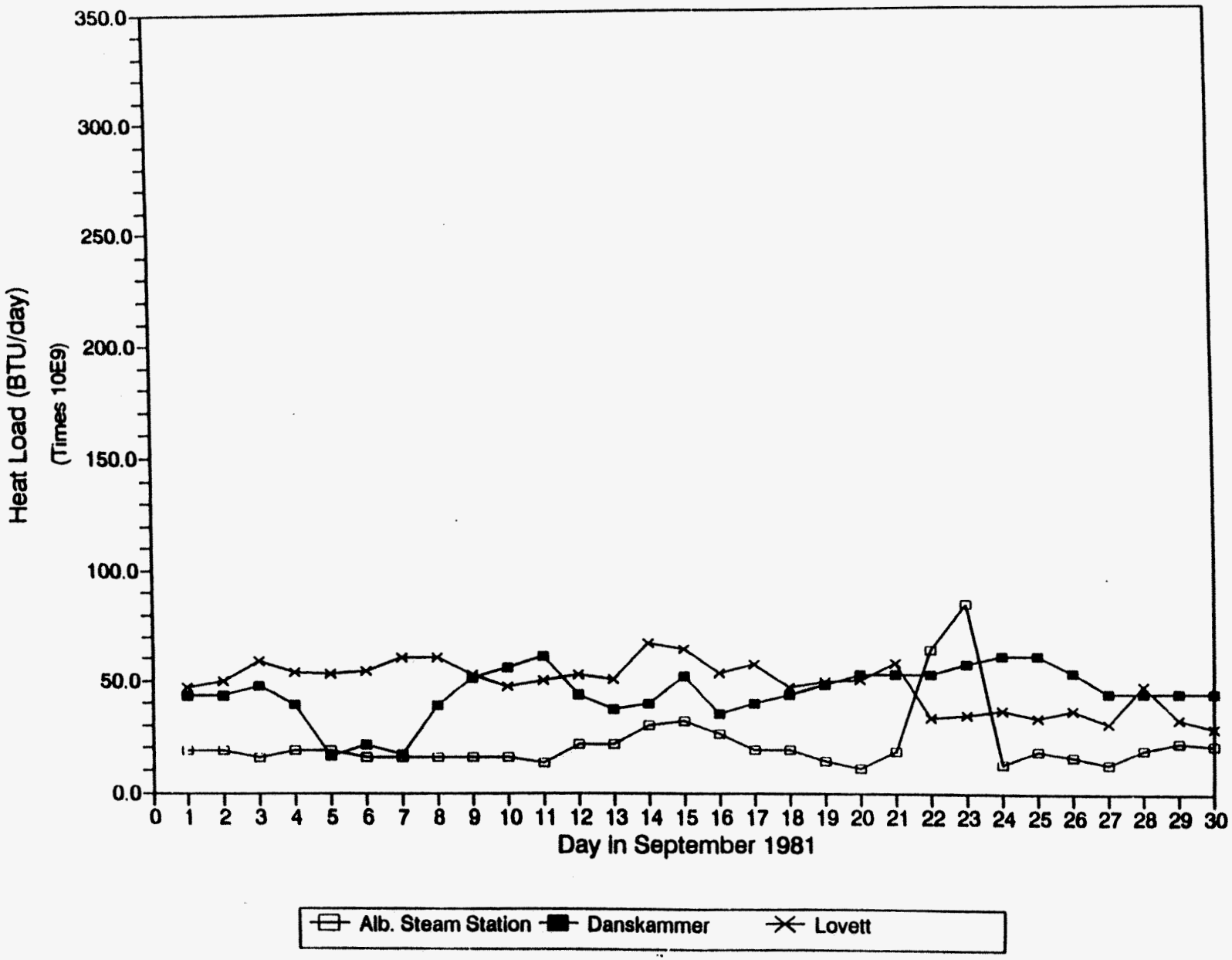


TABLE 1

FFTM INPUT AND DATA SOURCES

INPUT DATA	DATA SOURCE
Upstream Boundary Conditions	
Hydraulic: Flow rate	United States Geological Survey (USGS)
Water Quality: Temperature	USGS
Downstream Boundary Conditions	
Hydraulic: Water surface elevation	National Oceanic and Atmospheric Agency (NOAA)
Water Quality: Temperature, salinity	NOAA
Tributaries	
Hydraulic: Flow rate	LMS, USGS
Water Quality: Temperature	LMS
Meteorological conditions	National Climate Data Center
Anthropogenic heat loads	Utilities, NYSDEC

Table 2 (Page 1 of 3)

GEOMETRIC PARAMETERS

Hudson River Thermal Model

NOTE: W = Width, D = Depth, A = Area, V = Volume, EL = Elevation (relative to Mean Water @ the Battery)
c = conveyance, s = storage, t = total, RM = River Mile, surf = surface

										X-Sectional Area				End-Area Volumes	
Section	RM	EL(ft)	Wt(ft)	Wc(ft)	Ws(ft)	Dc(ft)	Ds(ft)	Ac(ft2)	As(ft2)	At(ft)	del L (ft)	Asurf(ft2)	Vc(ft3)	Vs(ft3)	Vt(ft3)
1	0.0	-41.3	4820.0	3875.0	945.0	41.3	12.2	1.60E+05	1.15E+04	1.72E+05	10818.7	4.83E+07	1.57E+09	1.45E+08	1.71E+09
2	2.0	-45.3	4116.0	2863.0	1253.0	45.4	12.2	1.30E+05	1.53E+04	1.45E+05	10824.0	4.49E+07	1.32E+09	1.83E+08	1.51E+09
3	4.1	-43.3	4175.0	2650.0	1525.0	43.4	12.1	1.15E+05	1.85E+04	1.33E+05	10818.7	4.45E+07	1.23E+09	1.50E+08	1.38E+09
4	6.1	-36.3	4060.0	3088.0	972.0	36.3	9.5	1.12E+05	9.23E+03	1.21E+05	10818.7	4.38E+07	1.37E+09	8.35E+07	1.46E+09
5	8.2	-40.6	4039.0	3488.0	551.0	40.6	11.3	1.42E+05	6.20E+03	1.48E+05	10824.0	4.71E+07	1.46E+09	4.06E+07	1.50E+09
6	10.2	-29.0	4665.0	4413.0	252.0	29.1	5.2	1.28E+05	1.30E+03	1.30E+05	10818.7	4.98E+07	1.34E+09	7.05E+06	1.35E+09
7	12.3	-26.3	4550.0	4550.0	0.0	26.4	0.0	1.20E+05	0.00E+00	1.20E+05	10818.7	5.26E+07	1.36E+09	0.00E+00	1.36E+09
8	14.3	-25.5	5175.0	5175.0	0.0	25.5	0.0	1.32E+05	0.00E+00	1.32E+05	10824.0	5.38E+07	1.49E+09	0.00E+00	1.49E+09
9	16.4	-29.8	4775.0	4775.0	0.0	29.9	0.0	1.43E+05	0.00E+00	1.43E+05	10818.7	5.08E+07	1.51E+09	0.00E+00	1.51E+09
10	18.4	-29.2	4613.0	4613.0	0.0	29.4	0.0	1.36E+05	0.00E+00	1.36E+05	10818.7	5.29E+07	1.50E+09	1.65E+06	1.50E+09
11	20.5	-27.8	5163.0	5050.0	113.0	28.0	2.7	1.41E+05	3.05E+02	1.42E+05	10824.0	6.10E+07	1.53E+09	1.05E+07	1.54E+09
12	22.5	-25.3	6100.0	5550.0	550.0	25.4	3.0	1.41E+05	1.63E+03	1.43E+05	10818.7	8.91E+07	1.60E+09	7.85E+07	1.68E+09
13	24.6	-20.3	10376.0	7625.0	2751.0	20.4	4.7	1.55E+05	1.29E+04	1.68E+05	10818.7	1.27E+08	1.84E+09	1.19E+08	1.95E+09
14	26.6	-15.9	13125.0	11475.0	1650.0	16.0	5.5	1.84E+05	9.14E+03	1.93E+05	10824.0	1.37E+08	2.07E+09	5.36E+07	2.12E+09
15	28.7	-16.6	12281.0	12150.0	131.0	16.3	5.9	1.98E+05	7.72E+02	1.99E+05	10818.7	1.27E+08	2.13E+09	6.14E+06	2.14E+09
16	30.7	-18.0	11181.0	11125.0	56.0	17.6	6.5	1.96E+05	3.64E+02	1.96E+05	10818.7	1.35E+08	2.08E+09	1.66E+08	2.24E+09
17	32.8	-20.5	13759.0	9175.0	4584.0	20.5	6.6	1.88E+05	3.03E+04	2.19E+05	10824.0	1.34E+08	2.00E+09	2.45E+08	2.24E+09
18	34.8	-19.2	11040.0	9450.0	1590.0	19.2	9.3	1.81E+05	1.49E+04	1.96E+05	10818.7	1.46E+08	2.14E+09	1.74E+08	2.31E+09
19	36.9	-15.4	15887.0	13963.0	1924.0	15.4	9.0	2.15E+05	1.72E+04	2.32E+05	10818.7	1.41E+08	2.15E+09	1.50E+08	2.30E+09
20	38.9	-22.8	10096.0	8013.0	2083.0	22.8	5.1	1.83E+05	1.06E+04	1.93E+05	10824.0	7.69E+07	1.84E+09	7.48E+07	1.91E+09
21	41.0	-43.9	4111.0	3550.0	561.0	44.0	5.8	1.56E+05	3.25E+03	1.60E+05	10818.7	5.08E+07	1.75E+09	6.22E+07	1.81E+09
22	43.0	-43.1	5281.0	3850.0	1431.0	43.3	5.8	1.67E+05	8.24E+03	1.75E+05	10818.7	4.52E+07	1.74E+09	5.70E+07	1.80E+09
23	45.1	-68.0	3080.0	2275.0	805.0	68.3	2.8	1.55E+05	2.29E+03	1.58E+05	10824.0	2.84E+07	1.60E+09	1.84E+07	1.62E+09
24	47.1	-79.1	2174.0	1763.0	411.0	79.4	2.7	1.40E+05	1.11E+03	1.41E+05	10818.7	2.23E+07	1.53E+09	6.97E+06	1.53E+09
25	49.2	-75.7	1944.0	1875.0	69.0	75.9	2.6	1.42E+05	1.79E+02	1.42E+05	10818.7	2.20E+07	1.57E+09	1.81E+06	1.57E+09
26	51.2	-71.4	2116.0	2056.0	60.0	71.6	2.6	1.47E+05	1.56E+02	1.47E+05	10824.0	2.83E+07	1.50E+09	4.03E+07	1.54E+09
27	53.3	-68.2	3122.0	1894.0	1228.0	68.4	5.9	1.30E+05	7.28E+03	1.37E+05	10818.7	3.42E+07	1.45E+09	4.69E+07	1.50E+09

Table 2 (Page 2 of 3)

GEOMETRIC PARAMETERS

Hudson River Thermal Model

NOTE: W = Width, D = Depth, A = Area, V = Volume, EL = Elevation (relative to Mean Water @ the Battery)
c = conveyance, s = storage, t = total, RM = River Mile, surf = surface

										X-Sectional Area				End-Area Volumes	
Section	RM	EL(ft)	Wt(ft)	Wc(ft)	Ws(ft)	Dc(ft)	Ds(ft)	Ac(ft2)	As(ft2)	At(ft)	del L (ft)	Asurf(ft2)	Vc(ft3)	Vs(ft3)	Vt(ft3)
28	55.3	-48.3	3203.0	2850.0	353.0	48.5	4.0	1.38E+05	1.39E+03	1.40E+05	10818.7	5.26E+07	1.61E+09	2.34E+07	1.63E+09
29	57.4	-27.5	6517.0	5738.0	779.0	27.7	3.8	1.59E+05	2.93E+03	1.62E+05	10824.0	7.48E+07	1.73E+09	3.52E+07	1.77E+09
30	59.4	-24.6	7296.0	6519.0	777.0	24.8	4.6	1.61E+05	3.58E+03	1.65E+05	10818.7	7.06E+07	1.70E+09	3.71E+07	1.74E+09
31	61.5	-30.4	5758.0	5031.0	727.0	30.6	4.5	1.54E+05	3.27E+03	1.57E+05	10818.7	6.01E+07	1.66E+09	2.40E+07	1.68E+09
32	63.5	-30.5	5359.0	4981.0	378.0	30.7	3.1	1.53E+05	1.16E+03	1.54E+05	10824.0	5.10E+07	1.61E+09	8.61E+06	1.62E+09
33	65.6	-36.8	4072.0	3919.0	153.0	36.9	2.8	1.44E+05	4.30E+02	1.45E+05	10818.7	4.21E+07	1.45E+09	2.65E+07	1.47E+09
34	67.6	-39.8	3705.0	3081.0	624.0	39.9	7.2	1.23E+05	4.47E+03	1.27E+05	10818.7	3.85E+07	1.38E+09	2.61E+07	1.41E+09
35	69.7	-39.7	3419.0	3319.0	100.0	39.8	3.5	1.32E+05	3.50E+02	1.32E+05	10824.0	3.24E+07	1.33E+09	3.82E+06	1.34E+09
36	71.7	-46.2	2562.0	2463.0	99.0	46.4	3.6	1.14E+05	3.56E+02	1.15E+05	10818.7	2.77E+07	1.26E+09	3.12E+06	1.26E+09
37	73.8	-47.6	2550.0	2475.0	75.0	47.8	2.9	1.18E+05	2.20E+02	1.19E+05	10818.7	2.73E+07	1.25E+09	1.19E+06	1.25E+09
38	75.8	-44.8	2488.0	2488.0	0.0	45.0	0.0	1.12E+05	0.00E+00	1.12E+05	10824.0	2.77E+07	1.23E+09	0.00E+00	1.23E+09
39	77.9	-43.6	2625.0	2625.0	0.0	43.8	0.0	1.15E+05	0.00E+00	1.15E+05	10818.7	2.52E+07	1.37E+09	1.27E+06	1.37E+09
40	79.9	-70.6	2028.0	1963.0	65.0	70.8	3.6	1.39E+05	2.34E+02	1.39E+05	10818.7	2.52E+07	1.39E+09	1.27E+06	1.39E+09
41	82.0	-44.8	2625.0	2625.0	0.0	45.0	0.0	1.18E+05	0.00E+00	1.18E+05	10824.0	3.19E+07	1.20E+09	4.11E+06	1.20E+09
42	84.0	-34.2	3262.0	3013.0	249.0	34.4	3.1	1.04E+05	7.59E+02	1.04E+05	10818.7	3.52E+07	1.17E+09	1.02E+07	1.18E+09
43	86.1	-36.0	3253.0	3075.0	178.0	36.3	6.3	1.12E+05	1.12E+03	1.13E+05	10818.7	4.71E+07	1.23E+09	3.82E+07	1.27E+09
44	88.1	-27.6	5452.0	4138.0	1314.0	27.9	4.5	1.15E+05	5.95E+03	1.21E+05	10824.0	5.17E+07	1.25E+09	4.80E+07	1.29E+09
45	90.2	-31.3	4102.0	3638.0	464.0	31.6	6.3	1.15E+05	2.92E+03	1.18E+05	10818.7	5.46E+07	1.19E+09	1.77E+08	1.36E+09
46	92.2	-25.5	5999.0	4038.0	1961.0	25.8	15.2	1.04E+05	2.98E+04	1.34E+05	10818.7	5.75E+07	1.11E+09	1.64E+08	1.27E+09
47	94.3	-22.1	4622.0	4475.0	147.0	22.4	4.0	1.00E+05	5.91E+02	1.01E+05	10824.0	4.69E+07	1.01E+09	9.33E+06	1.02E+09
48	96.3	-22.9	4044.0	3738.0	306.0	23.2	3.7	8.66E+04	1.13E+03	8.77E+04	10818.7	4.49E+07	9.15E+08	2.67E+07	9.42E+08
49	98.4	-25.3	4254.0	3225.0	1029.0	25.6	3.7	8.26E+04	3.81E+03	8.64E+04	10818.7	4.37E+07	8.12E+08	2.80E+07	8.40E+08
50	100.4	-19.6	3831.0	3388.0	443.0	19.9	3.1	6.75E+04	1.36E+03	6.88E+04	10824.0	4.17E+07	7.11E+08	5.00E+07	7.61E+08
51	102.5	-24.5	3867.0	2575.0	1292.0	24.8	6.1	6.40E+04	7.67E+03	7.18E+04	10818.7	4.24E+07	6.78E+08	5.39E+07	7.32E+08
52	104.5	-18.9	3969.0	3194.0	775.0	19.2	2.7	6.15E+04	2.09E+03	6.35E+04	10818.7	4.05E+07	5.96E+08	2.11E+07	6.17E+08
53	106.6	-16.8	3522.0	2844.0	678.0	17.1	2.7	4.87E+04	1.81E+03	5.05E+04	10824.0	4.58E+07	5.36E+08	4.09E+07	5.77E+08
54	108.6	-19.7	4945.0	2513.0	2432.0	20.0	2.4	5.03E+04	5.74E+03	5.60E+04	10818.7	5.04E+07	5.23E+08	5.79E+07	5.81E+08

Table 2 (Page 3 of 3)

GEOMETRIC PARAMETERS

Hudson River Thermal Model

NOTE: W = Width, D = Depth, A = Area, V = Volume, EL = Elevation (relative to Mean Water @ the Battery)
c = conveyance, s = storage, t = total, RM = River Mile, surf = surface

										X-Sectional Area				End-Area Volumes	
Section	RM	EL(ft)	Wt(ft)	Wc(ft)	Ws(ft)	Dc(ft)	Ds(ft)	Ac(ft2)	As(ft2)	At(ft)	del L (ft)	Asurf(ft2)	Vc(ft3)	Vs(ft3)	Vt(ft3)
55	110.7	-16.3	4364.0	2800.0	1564.0	16.6	3.2	4.64E+04	4.96E+03	5.14E+04	10818.7	3.83E+07	4.35E+08	5.77E+07	4.93E+08
56	112.7	-17.2	2715.0	1944.0	771.0	17.5	7.4	3.40E+04	5.71E+03	3.97E+04	10824.0	2.97E+07	3.76E+08	4.28E+07	4.18E+08
57	114.8	-15.5	2768.0	2244.0	524.0	15.8	4.2	3.54E+04	2.21E+03	3.76E+04	10818.7	3.26E+07	3.87E+08	2.18E+07	4.09E+08
58	116.8	-13.5	3250.0	2606.0	644.0	13.9	2.8	3.62E+04	1.81E+03	3.80E+04	10818.7	3.67E+07	4.29E+08	2.99E+07	4.59E+08
59	118.9	-15.7	3543.0	2656.0	887.0	16.2	4.2	4.31E+04	3.72E+03	4.68E+04	10824.0	3.95E+07	4.31E+08	4.46E+07	4.76E+08
60	120.9	-15.8	3760.0	2238.0	1522.0	16.3	3.0	3.65E+04	4.52E+03	4.10E+04	10818.7	3.81E+07	3.16E+08	1.21E+08	4.37E+08
61	123.0	-16.6	3287.0	1269.0	2018.0	17.2	8.9	2.18E+04	1.79E+04	3.97E+04	10818.7	2.86E+07	2.78E+08	1.03E+08	3.81E+08
62	125.0	-17.7	1996.0	1606.0	390.0	18.4	3.2	2.95E+04	1.25E+03	3.08E+04	10824.0	2.28E+07	3.01E+08	2.03E+07	3.22E+08
63	127.1	-17.3	2218.0	1450.0	768.0	18.1	3.3	2.62E+04	2.50E+03	2.87E+04	10818.7	2.22E+07	3.14E+08	1.77E+07	3.32E+08
64	129.1	-18.3	1887.0	1663.0	224.0	19.2	3.5	3.19E+04	7.73E+02	3.27E+04	10818.7	2.97E+07	3.12E+08	1.60E+08	4.72E+08
65	131.2	-19.6	3611.0	1256.0	2355.0	20.6	12.2	2.59E+04	2.88E+04	5.47E+04	10824.0	2.67E+07	2.76E+08	1.58E+08	4.34E+08
66	133.2	-19.7	1328.0	1206.0	122.0	20.8	3.5	2.51E+04	4.26E+02	2.56E+04	10818.7	1.50E+07	2.65E+08	1.29E+07	2.78E+08
67	135.3	-18.0	1450.0	1250.0	200.0	19.1	9.8	2.39E+04	1.97E+03	2.59E+04	10818.7	1.42E+07	2.59E+08	1.30E+07	2.72E+08
68	137.3	-20.9	1175.0	1094.0	81.0	22.0	5.4	2.41E+04	4.33E+02	2.45E+04	10824.0	1.51E+07	2.68E+08	2.16E+07	2.90E+08
69	139.4	-21.7	1624.0	1119.0	505.0	22.8	7.1	2.55E+04	3.56E+03	2.90E+04	10818.7	1.48E+07	2.58E+08	2.31E+07	2.82E+08
70	141.4	-21.7	1119.0	975.0	144.0	22.9	5.0	2.23E+04	7.19E+02	2.30E+04	10818.7	1.16E+07	2.34E+08	1.58E+07	2.50E+08
71	143.5	-23.7	1034.0	838.0	196.0	25.0	11.2	2.09E+04	2.20E+03	2.31E+04	10824.0	1.11E+07	2.11E+08	2.10E+07	2.32E+08
72	145.5	-17.9	1009.0	938.0	71.0	19.3	23.6	1.81E+04	1.68E+03	1.97E+04	10818.7	9.59E+06	1.48E+08	9.08E+06	1.58E+08
73	147.6	-11.0	763.0	763.0	0.0	12.3	0.0	9.38E+03	0.00E+00	9.38E+03	10818.7	8.61E+06	1.06E+08	2.60E+06	1.08E+08
74	149.6	-12.1	828.0	763.0	65.0	13.3	7.4	1.02E+04	4.81E+02	1.07E+04	10824.0	8.13E+06	1.00E+08	2.60E+06	1.03E+08
75	151.7	-11.2	675.0	675.0	0.0	12.4	0.0	8.38E+03	0.00E+00	8.38E+03	10818.7	9.85E+06	8.11E+07	1.25E+07	9.36E+07
76	153.7	-8.3	1146.0	700.0	446.0	9.5	5.2	6.61E+03	2.31E+03	8.93E+03					

Table 3

June 1981 Tributary Flows

Name	Normans Kill	Moordener Kill	Kinderhook Creek	Catskill Creek	Roeliff Jansen Kill	Esopus Creek	Rondout Ck & Wallkill River	Wappinger Creek	Fishkill Creek	Moodna Creek	Foundry Brook	Indian Brook	Arden Brook	Peekskill Creek	Cedar Pond Brook	Croton River	Sparkill Creek	Crumkill Creek	Saw Mill Creek	Green Brook
iver Mile	144.0	138.5	122.0	113.0	111.1	103.0	92.0	67.0	60.0	58.0	55.0	53.0	51.0	44.0	39.0	34.0	24.5	24.0	21.5	16.0
A (sq mi)	168	33	520	417	208	425	1684	208	190	82	106	82	82	202	154	154	261	47	94	166
	Flow Rate (cfs)																			
Day																				
1	101	20	314	252	126	257	1017	126	121	52	68	52	52	128	98	98	166	30	60	105
2	110	22	340	272	136	278	1100	136	128	56	72	56	56	136	104	104	176	31	64	112
3	108	21	335	268	134	273	1083	134	127	55	71	55	55	134	103	103	174	31	63	111
4	92	18	284	228	114	232	919	114	112	49	63	49	49	119	91	91	154	28	56	98
5	90	18	279	224	112	228	904	112	111	48	62	48	48	118	90	90	153	27	55	97
6	87	17	269	216	108	220	871	108	108	47	60	47	47	115	88	88	149	27	54	94
7	87	17	270	216	108	220	873	108	108	47	61	47	47	115	88	88	149	27	54	95
8	75	15	231	185	92	189	748	92	97	42	54	42	42	103	79	79	134	24	48	85
9	97	19	300	240	120	245	971	120	117	51	65	51	51	124	95	95	161	29	58	102
10	92	18	284	228	114	232	920	114	112	49	63	49	49	119	91	91	155	28	56	98
11	94	19	292	234	117	239	945	117	115	50	64	50	50	122	93	93	158	28	57	100
12	88	17	274	219	109	224	886	109	109	47	61	47	47	116	89	89	150	27	54	96
13	87	17	270	217	108	221	874	108	108	47	61	47	47	115	88	88	149	27	54	95
14	78	15	243	195	97	198	786	97	101	44	56	44	44	107	82	82	138	25	50	88
15	78	15	240	193	96	196	778	96	100	43	56	43	43	106	81	81	137	25	50	87
16	105	21	325	261	130	266	1053	130	124	54	69	54	54	132	100	100	170	30	62	108
17	114	22	352	282	141	288	1140	141	132	57	74	57	57	140	107	107	181	32	65	115
18	127	25	393	315	157	321	1271	157	143	62	80	62	62	152	116	116	197	35	71	125
19	100	20	309	248	124	253	1002	124	119	52	67	52	52	127	97	97	164	29	59	104
20	97	19	299	240	120	245	970	120	117	51	65	51	51	124	95	95	160	29	58	102
21	89	17	275	220	110	224	889	110	110	48	61	48	48	116	89	89	151	27	54	96
22	79	16	245	196	98	200	793	98	101	44	57	44	44	107	82	82	139	25	50	88
23	99	19	306	246	123	250	992	123	119	51	66	51	51	126	96	96	163	29	59	104
24	96	19	299	239	119	244	967	119	116	50	65	50	50	124	94	94	160	29	58	102
25	106	21	329	264	131	269	1064	131	125	54	70	54	54	133	101	101	172	31	62	109
26	106	21	329	264	131	269	1064	131	125	54	70	54	54	133	101	101	172	31	62	109
27	123	24	380	305	152	311	1231	152	139	60	78	60	60	148	113	113	192	34	69	122
28	92	18	285	229	114	233	923	114	113	49	63	49	49	120	91	91	155	28	56	98
29	82	16	255	205	102	209	827	102	104	45	58	45	45	111	84	84	143	26	52	91
30	95	19	296	237	118	242	957	118	116	50	65	50	50	123	94	94	159	28	57	101
Monthly Average	96	19	297	238	119	243	961	119	116	50	65	50	50	123	94	94	159	29	58	101

Table 4

July 1981 Tributary Flows

Name	Normans Kill	Moordener Kill	Kinderhook Creek	Catskill Creek	Roeliff Jansen Kill	Esopus Creek	Rondout Ck & Wallkill River	Wappinger Creek	Fishkill Creek	Moodna Creek	Foundry Brook	Indian Brook	Arden Brook	Peekskill Creek	Cedar Pond Brook	Croton River	Sparkill Creek	Crumkill Creek	Saw Mill Creek	Green Brook
River Mile	144.0	138.5	122.0	113.0	111.1	103.0	92.0	67.0	60.0	58.0	55.0	53.0	51.0	44.0	39.0	34.0	24.5	24.0	21.5	16.0
DA (sq mi)	168	33	520	417	208	425	1684	208	190	82	106	82	82	202	154	154	261	47	94	166
	Flow Rate (cfs)																			
Day																				
1	56	11	172	138	69	141	557	69	64	28	36	28	28	67	51	51	87	16	32	55
2	56	11	174	139	70	142	563	70	64	28	36	28	28	68	52	52	88	16	32	56
3	53	10	163	130	65	133	527	65	60	26	34	26	26	64	49	49	83	15	30	53
4	53	10	164	131	66	134	531	66	61	26	34	26	26	65	49	49	84	15	30	53
5	46	9	143	114	57	117	462	57	54	23	30	23	23	57	44	44	74	13	27	47
6	40	8	125	100	50	102	405	50	48	21	27	21	21	51	39	39	67	12	24	42
7	83	16	256	205	102	209	829	102	91	39	51	39	39	96	73	73	125	22	45	79
8	69	14	214	171	85	175	692	85	77	33	43	33	33	82	62	62	106	19	38	67
9	58	11	178	143	71	146	578	71	66	28	37	28	28	70	53	53	90	16	33	57
10	53	11	166	133	66	135	536	66	61	27	34	27	27	65	50	50	84	15	30	54
11	48	9	147	118	59	120	477	59	56	24	31	24	24	59	45	45	76	14	28	49
12	40	8	124	99	50	101	401	50	48	21	27	21	21	51	39	39	66	12	24	42
13	35	7	107	86	43	87	346	43	43	18	24	18	18	45	34	34	59	10	21	37
14	43	8	133	107	53	109	430	53	51	22	28	22	22	54	41	41	70	12	25	44
15	40	8	124	99	50	101	401	50	48	21	27	21	21	51	39	39	66	12	24	42
16	38	8	119	95	48	97	385	48	46	20	26	20	20	49	38	38	64	11	23	41
17	42	8	130	104	52	106	421	52	50	22	28	22	22	53	40	40	69	12	25	44
18	39	8	121	97	48	99	393	48	47	20	26	20	20	50	38	38	65	12	23	41
19	36	7	111	89	44	91	360	44	44	19	25	19	19	47	36	36	60	11	22	38
20	27	5	84	68	34	69	273	34	35	15	20	15	15	37	29	29	48	9	17	31
21	53	10	165	132	66	135	533	66	61	27	34	27	27	65	50	50	84	15	30	53
22	63	12	196	157	78	160	635	78	71	31	40	31	31	76	58	58	98	17	35	62
23	64	13	198	159	79	162	642	79	72	31	40	31	31	76	58	58	99	18	36	63
24	53	11	166	133	66	135	536	66	61	27	34	27	27	65	50	50	84	15	30	54
25	40	8	123	99	49	100	398	49	48	21	27	21	21	51	39	39	66	12	24	42
26	39	8	120	96	48	98	389	48	47	20	26	20	20	50	38	38	64	11	23	41
27	41	8	126	101	50	103	408	50	49	21	27	21	21	52	39	39	67	12	24	43
28	53	10	163	131	65	133	528	65	61	26	34	26	26	64	49	49	83	15	30	53
29	70	14	215	173	86	176	697	86	77	34	43	34	34	82	63	63	107	19	38	68
30	78	15	243	194	97	198	785	97	86	37	48	37	37	92	70	70	119	21	43	75
31	76	15	235	189	94	192	761	94	84	36	47	36	36	89	68	68	115	21	42	73
Monthly Average	51	10	158	127	63	129	512	63	59	26	33	26	26	63	48	48	81	15	29	52

Table 5

August 1981 Tributary Flows

Name	Normans Kill	Moordener Kill	Kinderhook Creek	Catskill Creek	Roeliff Jansen Kill	Esopus Creek	Rondout Ck & Wallkill River	Wappinger Creek	Fishkill Creek	Moodna Creek	Foundry Brook	Indian Brook	Arden Brook	Peekskill Creek	Cedar Pond Brook	Croton River	Sparkill Creek	Crumkill Creek	Saw Mill Creek	Green Brook
ver Mile	144.0	138.5	122.0	113.0	111.1	103.0	92.0	67.0	60.0	58.0	55.0	53.0	51.0	44.0	39.0	34.0	24.5	24.0	21.5	16.0
(sq mi)	168	33	520	417	208	425	1684	208	190	82	106	82	82	202	154	154	261	47	94	166

Flow Rate (cfs)

Day																				
1	53	10	165	132	66	135	534	66	52	23	29	23	23	55	42	42	72	13	26	45
2	27	5	85	68	34	69	275	34	35	15	19	15	15	37	28	28	48	9	17	30
3	17	3	52	42	21	42	168	21	28	12	15	12	12	29	22	22	38	7	14	24
4	20	4	63	51	25	52	205	25	30	13	17	13	13	32	24	24	41	7	15	26
5	40	8	124	99	49	101	400	49	43	19	24	19	19	46	35	35	59	11	21	38
6	48	9	150	120	60	122	484	60	49	21	27	21	21	52	39	39	67	12	24	43
7	56	11	173	139	69	142	562	69	54	23	30	23	23	57	44	44	74	13	27	47
8	35	7	109	87	44	89	353	44	40	17	22	17	17	42	32	32	55	10	20	35
9	26	5	81	65	33	67	264	33	34	15	19	15	15	36	27	27	47	8	17	30
10	24	5	73	58	29	60	236	29	32	14	18	14	14	34	26	26	44	8	16	28
11	53	10	163	131	65	133	529	65	52	22	29	22	22	55	42	42	71	13	26	45
12	25	5	78	63	31	64	254	31	33	14	19	14	14	35	27	27	46	8	17	29
13	38	7	118	95	47	96	382	47	42	18	23	18	18	44	34	34	58	10	21	37
14	36	7	112	90	45	91	362	45	41	18	23	18	18	43	33	33	56	10	20	35
15	41	8	127	102	51	104	410	51	44	19	24	19	19	46	35	35	60	11	22	38
16	43	8	133	106	53	109	430	53	45	20	25	20	20	48	37	37	62	11	22	39
17	52	10	162	130	65	133	525	65	51	22	29	22	22	55	42	42	71	13	26	45
18	67	13	207	166	83	169	670	83	61	27	34	27	27	65	50	50	84	15	30	53
19	63	12	194	155	77	158	627	77	58	25	33	25	25	62	47	47	80	14	29	51
20	43	8	133	106	53	109	430	53	45	20	25	20	20	48	37	37	62	11	22	39
21	42	8	130	104	52	106	422	52	45	19	25	19	19	47	36	36	61	11	22	39
22	25	5	79	63	32	64	256	32	33	14	19	14	14	35	27	27	46	8	17	29
23	21	4	65	52	26	53	211	26	30	13	17	13	13	32	25	25	42	7	15	27
24	6	1	18	15	7	15	60	7	20	9	11	9	9	22	16	16	28	5	10	18
25	25	5	78	63	31	64	254	31	33	14	19	14	14	35	27	27	46	8	17	29
26	25	5	77	62	31	63	251	31	33	14	18	14	14	35	27	27	45	8	16	29
27	23	5	72	58	29	59	233	29	32	14	18	14	14	34	26	26	44	8	16	28
28	25	5	79	63	32	64	256	32	33	14	19	14	14	35	27	27	46	8	17	29
29	8	1	24	19	9	19	76	9	21	9	12	9	9	23	17	17	29	5	11	19
30	23	4	71	57	28	58	229	28	32	14	18	14	14	34	26	26	43	8	16	28
31	16	3	49	40	20	40	160	20	27	12	15	12	12	29	22	22	37	7	13	24
lonthly verage	34	6	105	84	42	85	339	42	39	17	22	17	17	41	32	32	54	10	19	34

Table 6

September 1981 Tributary Flows

Name	Normans Kill	Moordener Kill	Kinderhook Creek	Catskill Creek	Roeliff Jansen Kill	Esopus Creek	Rondout Ck & Wallkill River	Wappinger Creek	Fishkill Creek	Moodna Creek	Foundry Brook	Indian Brook	Arden Brook	Peekskill Creek	Cedar Pond Brook	Croton River	Sparkill Creek	Crumkill Creek	Saw Mill Creek	Green Brook
iver Mile	144.0	138.5	122.0	113.0	111.1	103.0	92.0	67.0	60.0	58.0	55.0	53.0	51.0	44.0	39.0	34.0	24.5	24.0	21.5	16.0
ı (sq mi)	168	33	520	417	208	425	1684	208	190	82	106	82	82	202	154	154	261	47	94	166

Flow Rate (cfs)

Day																				
1	33	6	101	81	40	83	328	40	30	13	17	13	13	32	25	25	42	7	15	26
2	34	7	106	85	42	87	343	42	32	14	18	14	14	34	26	26	44	8	16	28
3	38	7	117	94	47	96	380	47	36	16	20	16	16	38	29	29	49	9	18	31
4	54	11	167	134	67	137	541	67	53	23	30	23	23	56	43	43	73	13	26	46
5	57	11	177	142	71	145	573	71	56	24	32	24	24	60	46	46	78	14	28	49
6	41	8	128	103	51	105	415	51	40	17	22	17	17	42	32	32	54	10	20	35
7	22	4	68	55	27	56	221	27	19	8	11	8	8	20	15	15	26	5	9	16
8	28	6	87	70	35	71	281	35	25	11	14	11	11	27	20	20	35	6	13	22
9	68	13	210	168	84	171	679	84	68	29	38	29	29	72	55	55	93	17	34	59
10	90	18	280	225	112	229	907	112	92	40	51	40	40	98	75	75	127	23	46	80
11	59	12	182	146	73	149	589	73	58	25	32	25	25	62	47	47	80	14	29	51
12	55	11	171	137	68	140	553	68	54	24	30	24	24	58	44	44	75	13	27	47
13	70	14	217	174	87	177	702	87	70	30	39	30	30	74	57	57	97	17	35	61
14	58	11	178	143	71	146	577	71	57	25	32	25	25	60	46	46	78	14	28	50
15	63	12	196	157	78	160	635	78	63	27	35	27	27	67	51	51	87	15	31	55
16	70	14	216	173	86	177	700	86	70	30	39	30	30	74	57	57	96	17	35	61
17	57	11	177	142	71	145	573	71	56	24	32	24	24	60	46	46	78	14	28	49
18	52	10	161	129	64	132	521	64	51	22	28	22	22	54	41	41	70	12	25	44
19	58	11	180	144	72	147	582	72	57	25	32	25	25	61	47	47	79	14	29	50
20	38	8	119	95	48	97	385	48	36	16	20	16	16	39	30	30	50	9	18	32
21	47	9	145	116	58	118	468	58	45	20	25	20	20	48	37	37	62	11	22	39
22	78	15	241	193	96	197	780	96	78	34	44	34	34	83	64	64	108	19	39	68
23	207	41	641	514	256	524	2077	256	217	94	121	94	94	230	176	176	298	53	108	189
24	210	41	651	522	261	532	2109	261	220	95	123	95	95	234	178	178	303	54	109	192
25	204	40	631	506	252	516	2044	252	213	92	119	92	92	226	173	173	293	52	106	186
26	132	26	409	328	164	334	1325	164	137	59	76	59	59	145	111	111	188	34	68	119
27	129	25	399	320	160	326	1292	160	133	58	74	58	58	141	108	108	183	33	66	116
28	106	21	328	263	131	268	1064	131	109	47	61	47	47	115	88	88	149	27	54	95
29	135	27	419	336	168	343	1358	168	140	61	78	61	61	149	113	113	193	34	70	122
30	115	23	355	285	142	290	1151	142	118	51	66	51	51	125	96	96	162	29	59	103
31	30	6	94	75	38	77	305	38	28	12	16	12	12	30	23	23	38	7	14	24
lonthly verage	79	15	244	195	97	199	789	97	79	34	44	34	34	84	64	64	109	19	40	69

Table 7

June 1981 Tributary Temperatures

Name	Normans Kill	Moordener Kill	Kinderhook Creek	Catskill Creek	Roeliff Jansen Kill	Esopus Creek	Rondout Ck & Wallkill River	Wappinger Creek	Fishkill Creek	Moodna Creek	Foundry Brook	Indian Brook	Arden Brook	Peekskill Creek	Cedar Pond Brook	Croton River	Sparkill Creek	Crumkill Creek	Saw Mill Creek	Green Brook
ver Mile	144.0	138.5	122.0	113.0	111.1	103.0	92.0	67.0	60.0	58.0	55.0	53.0	51.0	44.0	39.0	34.0	24.5	24.0	21.5	16.0
(sq mi)	168	33	520	417	208	425	1684	208	190	82	106	82	82	202	154	154	261	47	94	166

Temperature (F)

Day																				
1	54.4	54.4	54.4	65.7	65.7	65.7	65.7	65.7	65.7	65.7	65.7	65.7	65.7	65.7	65.7	64.8	64.8	64.8	64.8	64.8
2	61.9	61.9	61.9	70.3	70.3	70.3	70.3	70.3	70.3	70.3	70.3	70.3	70.3	70.3	70.3	61.1	61.1	61.1	61.1	61.1
3	60.4	60.4	60.4	72.8	72.8	72.8	72.8	72.8	72.8	72.8	72.8	72.8	72.8	72.8	72.8	64.8	64.8	64.8	64.8	64.8
4	71.3	71.3	71.3	79.6	79.6	79.6	79.6	79.6	79.6	79.6	79.6	79.6	79.6	79.6	79.6	72.8	72.8	72.8	72.8	72.8
5	72.5	72.5	72.5	44.3	44.3	44.3	44.3	44.3	44.3	44.3	44.3	44.3	44.3	44.3	44.3	75.6	75.6	75.6	75.6	75.6
6	68.0	68.0	68.0	77.6	77.6	77.6	77.6	77.6	77.6	77.6	77.6	77.6	77.6	77.6	77.6	72.0	72.0	72.0	72.0	72.0
7	58.6	58.6	58.6	60.7	60.7	60.7	60.7	60.7	60.7	60.7	60.7	60.7	60.7	60.7	60.7	72.7	72.7	72.7	72.7	72.7
8	55.4	55.4	55.4	60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5	67.3	67.3	67.3	67.3	67.3
9	67.6	67.6	67.6	76.0	76.0	76.0	76.0	76.0	76.0	76.0	76.0	76.0	76.0	76.0	76.0	77.1	77.1	77.1	77.1	77.1
10	60.8	60.8	60.8	68.5	68.5	68.5	68.5	68.5	68.5	68.5	68.5	68.5	68.5	68.5	68.5	67.7	67.7	67.7	67.7	67.7
11	63.4	63.4	63.4	61.3	61.3	61.3	61.3	61.3	61.3	61.3	61.3	61.3	61.3	61.3	61.3	73.0	73.0	73.0	73.0	73.0
12	60.2	60.2	60.2	64.5	64.5	64.5	64.5	64.5	64.5	64.5	64.5	64.5	64.5	64.5	64.5	71.6	71.6	71.6	71.6	71.6
13	62.6	62.6	62.6	69.5	69.5	69.5	69.5	69.5	69.5	69.5	69.5	69.5	69.5	69.5	69.5	71.4	71.4	71.4	71.4	71.4
14	61.0	61.0	61.0	70.3	70.3	70.3	70.3	70.3	70.3	70.3	70.3	70.3	70.3	70.3	70.3	64.2	64.2	64.2	64.2	64.2
15	73.0	73.0	73.0	76.9	76.9	76.9	76.9	76.9	76.9	76.9	76.9	76.9	76.9	76.9	76.9	75.3	75.3	75.3	75.3	75.3
16	81.6	81.6	81.6	83.1	83.1	83.1	83.1	83.1	83.1	83.1	83.1	83.1	83.1	83.1	83.1	83.0	83.0	83.0	83.0	83.0
17	62.6	62.6	62.6	72.6	72.6	72.6	72.6	72.6	72.6	72.6	72.6	72.6	72.6	72.6	72.6	77.3	77.3	77.3	77.3	77.3
18	64.5	64.5	64.5	63.4	63.4	63.4	63.4	63.4	63.4	63.4	63.4	63.4	63.4	63.4	63.4	74.7	74.7	74.7	74.7	74.7
19	69.1	69.1	69.1	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	75.6	75.6	75.6	75.6	75.6
20	62.0	62.0	62.0	76.0	76.0	76.0	76.0	76.0	76.0	76.0	76.0	76.0	76.0	76.0	76.0	72.7	72.7	72.7	72.7	72.7
21	67.2	67.2	67.2	76.8	76.8	76.8	76.8	76.8	76.8	76.8	76.8	76.8	76.8	76.8	76.8	80.2	80.2	80.2	80.2	80.2
22	69.6	69.6	69.6	80.1	80.1	80.1	80.1	80.1	80.1	80.1	80.1	80.1	80.1	80.1	80.1	80.2	80.2	80.2	80.2	80.2
23	61.0	61.0	61.0	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	73.1	73.1	73.1	73.1	73.1
24	56.6	56.6	56.6	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	71.9	71.9	71.9	71.9	71.9
25	68.9	68.9	68.9	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	77.0	77.0	77.0	77.0	77.0
26	50.3	50.3	50.3	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	67.7	67.7	67.7	67.7	67.7
27	60.7	60.7	60.7	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	68.9	68.9	68.9	68.9	68.9
28	61.8	61.8	61.8	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	76.3	76.3	76.3	76.3	76.3
29	63.2	63.2	63.2	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	80.1	80.1	80.1	80.1	80.1
30	67.3	67.3	67.3	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	74.2	74.2	74.2	74.2	74.2
Monthly Average	63.9	63.9	63.9	72.4	72.4	72.4	72.4	72.4	72.4	72.4	72.4	72.4	72.4	72.4	72.4	72.8	72.8	72.8	72.8	72.8

Table 8

July 1981 Tributary Temperatures

Name	Hermans Kill	Moordener Kill	Kinderhook Creek	Catskill Creek	Roeliff Jansen Kill	Esopus Creek	Rondout Ck & Wallkill River	Wappinger Creek	Fishkill Creek	Moodna Creek	Foundry Brook	Indian Brook	Arden Brook	Peekskill Creek	Cedar Pond Brook	Croton River	Sparkill Creek	Crumkill Creek	Saw Mill Creek	Green Brook
River Mile	144.0	138.5	122.0	113.0	111.1	103.0	92.0	67.0	60.0	58.0	55.0	53.0	51.0	44.0	39.0	34.0	24.5	24.0	21.5	16.0
DA (sq mi)	168	33	520	417	208	425	1684	208	190	82	106	82	82	202	154	154	261	47	94	166
	Temperature (F)																			
Day																				
1	56.7	56.7	56.7	73.4	73.4	73.4	73.4	73.4	73.4	73.4	73.4	73.4	73.4	73.4	73.4	72.6	72.6	72.6	72.6	72.6
2	56.1	56.1	56.1	73.4	73.4	73.4	73.4	73.4	73.4	73.4	73.4	73.4	73.4	73.4	73.4	74.0	74.0	74.0	74.0	74.0
3	54.0	54.0	54.0	74.1	74.1	74.1	74.1	74.1	74.1	74.1	74.1	74.1	74.1	74.1	74.1	74.7	74.7	74.7	74.7	74.7
4	53.2	53.2	53.2	71.0	71.0	71.0	71.0	71.0	71.0	71.0	71.0	71.0	71.0	71.0	71.0	71.8	71.8	71.8	71.8	71.8
5	53.2	53.2	53.2	71.1	71.1	71.1	71.1	71.1	71.1	71.1	71.1	71.1	71.1	71.1	71.1	73.4	73.4	73.4	73.4	73.4
6	59.8	59.8	59.8	75.8	75.8	75.8	75.8	75.8	75.8	75.8	75.8	75.8	75.8	75.8	75.8	79.6	79.6	79.6	79.6	79.6
7	58.2	58.2	58.2	78.1	78.1	78.1	78.1	78.1	78.1	78.1	78.1	78.1	78.1	78.1	78.1	80.9	80.9	80.9	80.9	80.9
8	60.5	60.5	60.5	80.5	80.5	80.5	80.5	80.5	80.5	80.5	80.5	80.5	80.5	80.5	80.5	83.6	83.6	83.6	83.6	83.6
9	58.6	58.6	58.6	83.9	83.9	83.9	83.9	83.9	83.9	83.9	83.9	83.9	83.9	83.9	83.9	86.8	86.8	86.8	86.8	86.8
10	60.3	60.3	60.3	79.5	79.5	79.5	79.5	79.5	79.5	79.5	79.5	79.5	79.5	79.5	79.5	81.9	81.9	81.9	81.9	81.9
11	59.7	59.7	59.7	74.7	74.7	74.7	74.7	74.7	74.7	74.7	74.7	74.7	74.7	74.7	74.7	79.2	79.2	79.2	79.2	79.2
12	54.6	54.6	54.6	74.4	74.4	74.4	74.4	74.4	74.4	74.4	74.4	74.4	74.4	74.4	74.4	78.0	78.0	78.0	78.0	78.0
13	55.3	55.3	55.3	78.7	78.7	78.7	78.7	78.7	78.7	78.7	78.7	78.7	78.7	78.7	78.7	80.5	80.5	80.5	80.5	80.5
14	56.5	56.5	56.5	73.5	73.5	73.5	73.5	73.5	73.5	73.5	73.5	73.5	73.5	73.5	73.5	74.0	74.0	74.0	74.0	74.0
15	59.9	59.9	59.9	71.4	71.4	71.4	71.4	71.4	71.4	71.4	71.4	71.4	71.4	71.4	71.4	73.3	73.3	73.3	73.3	73.3
16	60.5	60.5	60.5	69.3	69.3	69.3	69.3	69.3	69.3	69.3	69.3	69.3	69.3	69.3	69.3	74.6	74.6	74.6	74.6	74.6
17	60.3	60.3	60.3	72.1	72.1	72.1	72.1	72.1	72.1	72.1	72.1	72.1	72.1	72.1	72.1	76.1	76.1	76.1	76.1	76.1
18	57.5	57.5	57.5	74.0	74.0	74.0	74.0	74.0	74.0	74.0	74.0	74.0	74.0	74.0	74.0	78.1	78.1	78.1	78.1	78.1
19	55.8	55.8	55.8	76.5	76.5	76.5	76.5	76.5	76.5	76.5	76.5	76.5	76.5	76.5	76.5	79.1	79.1	79.1	79.1	79.1
20	53.0	53.0	53.0	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	73.5	73.5	73.5	73.5	73.5
21	53.8	53.8	53.8	77.8	77.8	77.8	77.8	77.8	77.8	77.8	77.8	77.8	77.8	77.8	77.8	80.3	80.3	80.3	80.3	80.3
22	56.9	56.9	56.9	71.1	71.1	71.1	71.1	71.1	71.1	71.1	71.1	71.1	71.1	71.1	71.1	74.5	74.5	74.5	74.5	74.5
23	60.5	60.5	60.5	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	69.6	69.6	69.6	69.6	69.6
24	55.1	55.1	55.1	66.2	66.2	66.2	66.2	66.2	66.2	66.2	66.2	66.2	66.2	66.2	66.2	68.8	68.8	68.8	68.8	68.8
25	56.3	56.3	56.3	65.8	65.8	65.8	65.8	65.8	65.8	65.8	65.8	65.8	65.8	65.8	65.8	69.1	69.1	69.1	69.1	69.1
26	53.0	53.0	53.0	71.7	71.7	71.7	71.7	71.7	71.7	71.7	71.7	71.7	71.7	71.7	71.7	73.1	73.1	73.1	73.1	73.1
27	57.8	57.8	57.8	73.9	73.9	73.9	73.9	73.9	73.9	73.9	73.9	73.9	73.9	73.9	73.9	77.6	77.6	77.6	77.6	77.6
28	54.4	54.4	54.4	64.8	64.8	64.8	64.8	64.8	64.8	64.8	64.8	64.8	64.8	64.8	64.8	68.2	68.2	68.2	68.2	68.2
29	54.4	54.4	54.4	71.7	71.7	71.7	71.7	71.7	71.7	71.7	71.7	71.7	71.7	71.7	71.7	73.7	73.7	73.7	73.7	73.7
30	60.1	60.1	60.1	66.7	66.7	66.7	66.7	66.7	66.7	66.7	66.7	66.7	66.7	66.7	66.7	70.2	70.2	70.2	70.2	70.2
31	60.3	60.3	60.3	70.2	70.2	70.2	70.2	70.2	70.2	70.2	70.2	70.2	70.2	70.2	70.2	73.3	73.3	73.3	73.3	73.3
Monthly Average	57.0	57.0	57.0	73.0	73.0	73.0	73.0	73.0	73.0	73.0	73.0	73.0	73.0	73.0	73.0	75.6	75.6	75.6	75.6	75.6

Table 9

August 1981 Tributary Temperatures

Name	Normans Kill	Moordener Kill	Kinderhook Creek	Catskill Creek	Roeliff Jansen Kill	Esopus Creek	Rondout Ck & Wallkill River	Wappinger Creek	Fishkill Creek	Moodna Creek	Foundry Brook	Indian Brook	Arden Brook	Peekskill Creek	Cedar Pond Brook	Croton River	Sparkill Creek	Crumkill Creek	Saw Mill Creek	Green Brook
River Mile	144.0	138.5	122.0	113.0	111.1	103.0	92.0	67.0	60.0	58.0	55.0	53.0	51.0	44.0	39.0	34.0	24.5	24.0	21.5	16.0
DA (sq mi)	168	33	520	417	208	425	1684	208	190	82	106	82	82	202	154	154	261	47	94	166

Temperature (F)

Day																				
1	67.4	67.4	67.4	72.9	72.9	72.9	72.9	72.9	72.9	72.9	72.9	72.9	72.9	72.9	72.9	68.6	68.6	68.6	68.6	68.6
2	70.7	70.7	70.7	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.3	72.3	72.3	72.3	72.3
3	74.0	74.0	74.0	73.8	73.8	73.8	73.8	73.8	73.8	73.8	73.8	73.8	73.8	73.8	73.8	73.9	73.9	73.9	73.9	73.9
4	77.3	77.3	77.3	70.9	70.9	70.9	70.9	70.9	70.9	70.9	70.9	70.9	70.9	70.9	70.9	78.3	78.3	78.3	78.3	78.3
5	75.3	75.3	75.3	70.7	70.7	70.7	70.7	70.7	70.7	70.7	70.7	70.7	70.7	70.7	70.7	76.2	76.2	76.2	76.2	76.2
6	70.2	70.2	70.2	74.3	74.3	74.3	74.3	74.3	74.3	74.3	74.3	74.3	74.3	74.3	74.3	68.6	68.6	68.6	68.6	68.6
7	67.8	67.8	67.8	74.2	74.2	74.2	74.2	74.2	74.2	74.2	74.2	74.2	74.2	74.2	74.2	69.7	69.7	69.7	69.7	69.7
8	68.3	68.3	68.3	75.9	75.9	75.9	75.9	75.9	75.9	75.9	75.9	75.9	75.9	75.9	75.9	72.6	72.6	72.6	72.6	72.6
9	75.7	75.7	75.7	80.6	80.6	80.6	80.6	80.6	80.6	80.6	80.6	80.6	80.6	80.6	80.6	78.6	78.6	78.6	78.6	78.6
10	76.0	76.0	76.0	75.6	75.6	75.6	75.6	75.6	75.6	75.6	75.6	75.6	75.6	75.6	75.6	76.4	76.4	76.4	76.4	76.4
11	75.9	75.9	75.9	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	76.1	76.1	76.1	76.1	76.1
12	65.7	65.7	65.7	68.5	68.5	68.5	68.5	68.5	68.5	68.5	68.5	68.5	68.5	68.5	68.5	71.5	71.5	71.5	71.5	71.5
13	68.8	68.8	68.8	76.1	76.1	76.1	76.1	76.1	76.1	76.1	76.1	76.1	76.1	76.1	76.1	72.3	72.3	72.3	72.3	72.3
14	65.8	65.8	65.8	69.6	69.6	69.6	69.6	69.6	69.6	69.6	69.6	69.6	69.6	69.6	69.6	74.8	74.8	74.8	74.8	74.8
15	69.6	69.6	69.6	66.5	66.5	66.5	66.5	66.5	66.5	66.5	66.5	66.5	66.5	66.5	66.5	77.0	77.0	77.0	77.0	77.0
16	65.2	65.2	65.2	59.8	59.8	59.8	59.8	59.8	59.8	59.8	59.8	59.8	59.8	59.8	59.8	71.4	71.4	71.4	71.4	71.4
17	54.5	54.5	54.5	67.2	67.2	67.2	67.2	67.2	67.2	67.2	67.2	67.2	67.2	67.2	67.2	58.1	58.1	58.1	58.1	58.1
18	60.1	60.1	60.1	72.2	72.2	72.2	72.2	72.2	72.2	72.2	72.2	72.2	72.2	72.2	72.2	56.7	56.7	56.7	56.7	56.7
19	62.8	62.8	62.8	75.6	75.6	75.6	75.6	75.6	75.6	75.6	75.6	75.6	75.6	75.6	75.6	63.6	63.6	63.6	63.6	63.6
20	64.8	64.8	64.8	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	64.7	64.7	64.7	64.7	64.7
21	67.5	67.5	67.5	77.3	77.3	77.3	77.3	77.3	77.3	77.3	77.3	77.3	77.3	77.3	77.3	61.1	61.1	61.1	61.1	61.1
22	61.9	61.9	61.9	69.2	69.2	69.2	69.2	69.2	69.2	69.2	69.2	69.2	69.2	69.2	69.2	61.8	61.8	61.8	61.8	61.8
23	65.0	65.0	65.0	61.2	61.2	61.2	61.2	61.2	61.2	61.2	61.2	61.2	61.2	61.2	61.2	63.9	63.9	63.9	63.9	63.9
24	64.6	64.6	64.6	63.5	63.5	63.5	63.5	63.5	63.5	63.5	63.5	63.5	63.5	63.5	63.5	65.6	65.6	65.6	65.6	65.6
25	61.6	61.6	61.6	62.9	62.9	62.9	62.9	62.9	62.9	62.9	62.9	62.9	62.9	62.9	62.9	66.8	66.8	66.8	66.8	66.8
26	61.7	61.7	61.7	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	66.3	66.3	66.3	66.3	66.3
27	61.7	61.7	61.7	71.0	71.0	71.0	71.0	71.0	71.0	71.0	71.0	71.0	71.0	71.0	71.0	70.4	70.4	70.4	70.4	70.4
28	63.5	63.5	63.5	62.0	62.0	62.0	62.0	62.0	62.0	62.0	62.0	62.0	62.0	62.0	62.0	69.5	69.5	69.5	69.5	69.5
29	58.9	58.9	58.9	70.3	70.3	70.3	70.3	70.3	70.3	70.3	70.3	70.3	70.3	70.3	70.3	69.3	69.3	69.3	69.3	69.3
30	67.9	67.9	67.9	62.8	62.8	62.8	62.8	62.8	62.8	62.8	62.8	62.8	62.8	62.8	62.8	71.7	71.7	71.7	71.7	71.7
31	63.7	63.7	63.7	66.1	66.1	66.1	66.1	66.1	66.1	66.1	66.1	66.1	66.1	66.1	66.1	72.5	72.5	72.5	72.5	72.5
Monthly Average	66.9	66.9	66.9	70.1	70.1	70.1	70.1	70.1	70.1	70.1	70.1	70.1	70.1	70.1	70.1	69.7	69.7	69.7	69.7	69.7

Table 10

September 1981 Tributary Temperatures

Name	Normans Kill	Moordener Kill	Kinderhook Creek	Catskill Creek	Roeliff Jansen Kill	Esopus Creek	Rondout Ck & Wallkill River	Wappinger Creek	Fishkill Creek	Moodna Creek	Foundry Brook	Indian Brook	Arden Brook	Peekskill Creek	Cedar Pond Brook	Croton River	Sparkill Creek	Crumkill Creek	Saw Mill Creek	Green Brook
iver Mile	144.0	138.5	122.0	113.0	111.1	103.0	92.0	67.0	60.0	58.0	55.0	53.0	51.0	44.0	39.0	34.0	24.5	24.0	21.5	16.0
i (sq. mi	168	33	520	417	208	425	1684	208	190	82	106	82	82	202	154	154	261	47	94	166
	Temperature (F)																			
Day																				
1	66.6	66.6	66.6	62.7	62.7	62.7	62.7	62.7	62.7	62.7	62.7	62.7	62.7	62.7	62.7	69.2	69.2	69.2	69.2	69.2
2	66.6	66.6	66.6	62.4	62.4	62.4	62.4	62.4	62.4	62.4	62.4	62.4	62.4	62.4	62.4	68.3	68.3	68.3	68.3	68.3
3	60.4	60.4	60.4	59.5	59.5	59.5	59.5	59.5	59.5	59.5	59.5	59.5	59.5	59.5	59.5	63.8	63.8	63.8	63.8	63.8
4	63.7	63.7	63.7	58.1	58.1	58.1	58.1	58.1	58.1	58.1	58.1	58.1	58.1	58.1	58.1	62.5	62.5	62.5	62.5	62.5
5	59.9	59.9	59.9	56.0	56.0	56.0	56.0	56.0	56.0	56.0	56.0	56.0	56.0	56.0	56.0	61.5	61.5	61.5	61.5	61.5
6	69.5	69.5	69.5	55.9	55.9	55.9	55.9	55.9	55.9	55.9	55.9	55.9	55.9	55.9	55.9	60.7	60.7	60.7	60.7	60.7
7	64.8	64.8	64.8	61.2	61.2	61.2	61.2	61.2	61.2	61.2	61.2	61.2	61.2	61.2	61.2	65.1	65.1	65.1	65.1	65.1
8	66.4	66.4	66.4	66.6	66.6	66.6	66.6	66.6	66.6	66.6	66.6	66.6	66.6	66.6	66.6	67.1	67.1	67.1	67.1	67.1
9	50.7	50.7	50.7	52.4	52.4	52.4	52.4	52.4	52.4	52.4	52.4	52.4	52.4	52.4	52.4	56.5	56.5	56.5	56.5	56.5
10	49.5	49.5	49.5	50.4	50.4	50.4	50.4	50.4	50.4	50.4	50.4	50.4	50.4	50.4	50.4	55.6	55.6	55.6	55.6	55.6
11	62.0	62.0	62.0	59.4	59.4	59.4	59.4	59.4	59.4	59.4	59.4	59.4	59.4	59.4	59.4	66.3	66.3	66.3	66.3	66.3
12	65.8	65.8	65.8	64.4	64.4	64.4	64.4	64.4	64.4	64.4	64.4	64.4	64.4	64.4	64.4	70.4	70.4	70.4	70.4	70.4
13	65.7	65.7	65.7	58.5	58.5	58.5	58.5	58.5	58.5	58.5	58.5	58.5	58.5	58.5	58.5	63.5	63.5	63.5	63.5	63.5
14	66.6	66.6	66.6	64.2	64.2	64.2	64.2	64.2	64.2	64.2	64.2	64.2	64.2	64.2	64.2	68.4	68.4	68.4	68.4	68.4
15	60.2	60.2	60.2	59.1	59.1	59.1	59.1	59.1	59.1	59.1	59.1	59.1	59.1	59.1	59.1	60.4	60.4	60.4	60.4	60.4
16	53.9	53.9	53.9	60.4	60.4	60.4	60.4	60.4	60.4	60.4	60.4	60.4	60.4	60.4	60.4	58.8	58.8	58.8	58.8	58.8
17	52.4	52.4	52.4	62.0	62.0	62.0	62.0	62.0	62.0	62.0	62.0	62.0	62.0	62.0	62.0	58.4	58.4	58.4	58.4	58.4
18	56.7	56.7	56.7	56.5	56.5	56.5	56.5	56.5	56.5	56.5	56.5	56.5	56.5	56.5	56.5	50.3	50.3	50.3	50.3	50.3
19	52.6	52.6	52.6	57.4	57.4	57.4	57.4	57.4	57.4	57.4	57.4	57.4	57.4	57.4	57.4	54.1	54.1	54.1	54.1	54.1
20	49.7	49.7	49.7	55.3	55.3	55.3	55.3	55.3	55.3	55.3	55.3	55.3	55.3	55.3	55.3	53.9	53.9	53.9	53.9	53.9
21	46.0	46.0	46.0	50.2	50.2	50.2	50.2	50.2	50.2	50.2	50.2	50.2	50.2	50.2	50.2	52.9	52.9	52.9	52.9	52.9
22	52.4	52.4	52.4	62.7	62.7	62.7	62.7	62.7	62.7	62.7	62.7	62.7	62.7	62.7	62.7	61.8	61.8	61.8	61.8	61.8
23	44.6	44.6	44.6	48.6	48.6	48.6	48.6	48.6	48.6	48.6	48.6	48.6	48.6	48.6	48.6	49.3	49.3	49.3	49.3	49.3
24	43.7	43.7	43.7	46.9	46.9	46.9	46.9	46.9	46.9	46.9	46.9	46.9	46.9	46.9	46.9	47.4	47.4	47.4	47.4	47.4
25	49.7	49.7	49.7	47.7	47.7	47.7	47.7	47.7	47.7	47.7	47.7	47.7	47.7	47.7	47.7	53.4	53.4	53.4	53.4	53.4
26	47.9	47.9	47.9	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	54.3	54.3	54.3	54.3	54.3
27	55.8	55.8	55.8	61.4	61.4	61.4	61.4	61.4	61.4	61.4	61.4	61.4	61.4	61.4	61.4	63.8	63.8	63.8	63.8	63.8
28	43.1	43.1	43.1	48.3	48.3	48.3	48.3	48.3	48.3	48.3	48.3	48.3	48.3	48.3	48.3	49.1	49.1	49.1	49.1	49.1
29	37.2	37.2	37.2	35.9	35.9	35.9	35.9	35.9	35.9	35.9	35.9	35.9	35.9	35.9	35.9	40.1	40.1	40.1	40.1	40.1
30	35.1	35.1	35.1	32.1	32.1	32.1	32.1	32.1	32.1	32.1	32.1	32.1	32.1	32.1	32.1	38.9	38.9	38.9	38.9	38.9
Monthly Average	55.3	55.3	55.3	55.5	55.5	55.5	55.5	55.5	55.5	55.5	55.5	55.5	55.5	55.5	55.5	58.2	58.2	58.2	58.2	58.2

Table 11

June 1981 Hudson River Meteorological Data: Reach #10 (RM 114.8 - 153.7)

Year	Month	Day	Air Temperature (F)	Average Relative Humidity (%)	ATM Pressure (inches of Hg)	Wind Speed (mph)	Net Solar Flux (BTU/ft^2/day)	Net Atmospheric Flux (BTU/ft^2/day)
1981	6	1	59.0	56.6	29.82	5.2	1930	2406
1981	6	2	66.0	71.5	29.82	10.8	1337	2759
1981	6	3	62.0	84.5	29.65	13.2	882	2746
1981	6	4	72.0	76.9	29.46	11.9	1719	2849
1981	6	5	72.0	72.8	29.52	8.2	2261	2701
1981	6	6	72.0	70.8	29.24	11.2	1474	2916
1981	6	7	63.0	44.1	29.35	17.4	2422	2399
1981	6	8	61.0	52.3	29.43	9.2	1935	2462
1981	6	9	71.0	64.9	29.07	18.1	1935	2759
1981	6	10	67.0	64.5	29.27	9.9	1341	2790
1981	6	11	66.0	60.6	29.53	14.2	2266	2524
1981	6	12	66.0	63.1	29.70	7.9	1477	2724
1981	6	13	66.0	73.4	29.76	3.0	1342	2759
1981	6	14	65.0	78.0	29.73	13.4	886	2842
1981	6	15	73 0	83.9	29.66	9.8	1343	2986
1981	6	16	82.0	77.4	29.54	9.6	1838	3152
1981	6	17	67.0	60.0	29.63	15.0	1941	2637
1981	6	18	66.0	59.8	29.79	6.6	2535	2457
1981	6	19	72.0	62.3	29.68	12.7	2202	2720
1981	6	20	65.0	81.0	29.60	6.5	888	2842
1981	6	21	66.0	88.3	29.53	5.3	1201	2795
1981	6	22	72.0	77.1	29.30	12.4	1345	2953
1981	6	23	64.0	54.4	29.59	17.1	2432	2427
1981	6	24	63.0	60.0	29.81	7.2	1480	2632
1981	6	25	71.0	79.8	29.53	10.8	1200	2958
1981	6	26	58.0	61.6	29.57	13.5	1047	2585
1981	6	27	62.0	61.8	29.84	6.8	2429	2372
1981	6	28	63.0	60.8	29.97	3.9	2514	2378
1981	6	29	65.0	63.5	29.93	4.2	2266	2495
1981	6	30	70.0	56.3	29.86	9.4	2512	2575
Monthly Average			66.9	67.4	29.61	10.1	1746	2687

Table 12

June 1981 Hudson River Meteorological Data: Reach #20 (RM 38.9 - 114.8)

Year	Month	Day	Air Temperature (F)	Average Relative Humidity (%)	ATM Pressure (inches of Hg)	Wind Speed (mph)	Net Solar Flux (BTU/ft^2/day)	Net Atmospheric Flux (BTU/ft^2/day)
1981	6	1	62.4	51.4	29.92	3.9	2142	2450
1981	6	2	61.5	76.8	29.97	4.2	915	2722
1981	6	3	62.9	86.3	29.81	5.8	882	2774
1981	6	4	72.2	74.4	29.60	5.5	1525	2908
1981	6	5	73.1	64.8	29.65	2.7	2286	2728
1981	6	6	71.9	65.6	29.38	5.6	1474	2913
1981	6	7	65.2	43.1	29.50	9.5	2459	2451
1981	6	8	64.6	50.7	29.57	6.4	2222	2494
1981	6	9	67.8	60.9	29.23	8.5	1833	2688
1981	6	10	68.5	60.7	29.41	8.0	1876	2698
1981	6	11	64.3	52.7	29.67	4.3	2339	2457
1981	6	12	67.2	54.4	29.84	5.0	1835	2670
1981	6	13	67.7	68.6	29.89	2.8	1370	2805
1981	6	14	63.0	78.4	29.91	4.4	886	2778
1981	6	15	72.2	83.2	29.81	6.2	1655	2875
1981	6	16	82.7	74.3	29.68	6.4	2122	3090
1981	6	17	72.3	57.2	29.76	6.2	2089	2760
1981	6	18	67.5	59.1	29.94	3.8	2476	2514
1981	6	19	71.2	62.9	29.85	5.8	2019	2745
1981	6	20	68.2	81.2	29.72	2.5	954	2930
1981	6	21	68.9	81.2	29.67	3.5	1346	2851
1981	6	22	73.6	72.1	29.47	8.3	1400	2991
1981	6	23	67.5	52.1	29.77	8.5	2201	2585
1981	6	24	67.4	60.6	29.96	4.6	1921	2654
1981	6	25	73.6	80.2	29.69	7.1	984	3106
1981	6	26	62.4	60.1	29.73	8.3	1109	2704
1981	6	27	63.7	54.8	29.98	7.8	2341	2440
1981	6	28	65.6	48.8	30.11	5.2	2530	2446
1981	6	29	63.8	50.2	30.07	1.6	2427	2421
1981	6	30	71.5	63.7	30.44	7.7	2067	2740
Monthly Average			58.1	64.3	29.77	5.7	1790	2713

Table 13

June 1981 Hudson River Meteorological Data: Reach #30 (RM 0.0 - 38.9)

Year	Month	Day	Air Temperature (F)	Average Relative Humidity (%)	ATM Pressure (inches of Hg)	Wind Speed (mph)	Net Solar Flux (BTU/ft^2/day)	Net Atmospheric Flux (BTU/ft^2/day)
1981	6	1	64.7	48.7	30.02	7.6	1985	2557
1981	6	2	61.8	79.4	30.05	6.9	899	2734
1981	6	3	63.5	87.2	29.90	7.7	882	2792
1981	6	4	73.6	73.1	29.68	8.8	1360	3002
1981	6	5	74.1	60.8	29.73	7.0	2304	2752
1981	6	6	75.0	63.0	29.47	9.8	1179	3102
1981	6	7	68.6	42.5	29.56	14.1	2459	2549
1981	6	8	65.8	49.9	29.67	9.3	2273	2515
1981	6	9	73.4	58.9	29.31	15.3	1833	2868
1981	6	10	69.8	58.8	29.49	10.0	1676	2791
1981	6	11	68.7	48.8	29.75	9.3	2333	2586
1981	6	12	70.6	50.0	29.90	9.8	1835	2776
1981	6	13	69.9	66.2	29.96	6.1	1603	2812
1981	6	14	64.5	78.6	29.98	7.4	886	2826
1981	6	15	71.6	82.9	29.90	7.1	1797	2817
1981	6	16	81.4	72.7	29.78	9.5	2227	3013
1981	6	17	75.2	55.7	29.82	10.8	2106	2846
1981	6	18	70.3	58.7	30.01	7.3	2487	2592
1981	6	19	73.1	63.1	29.94	9.7	2072	2790
1981	6	20	71.1	81.2	29.80	6.0	921	3039
1981	6	21	73.0	77.6	29.75	6.7	1775	2864
1981	6	22	77.3	69.5	29.56	13.0	1564	3071
1981	6	23	70.3	51.0	29.84	13.0	2267	2650
1981	6	24	70.2	60.8	30.04	7.8	1880	2752
1981	6	25	75.3	80.4	29.78	9.1	1092	3135
1981	6	26	65.2	59.4	29.80	11.5	1572	2673
1981	6	27	65.9	51.3	30.05	10.2	2403	2485
1981	6	28	70.3	42.8	30.17	7.7	2530	2583
1981	6	29	71.4	43.5	30.15	6.0	2470	2635
1981	6	30	71.8	67.3	30.30	11.1	2092	2741
Monthly Average			70.6	62.8	29.84	9.2	1825	2778

Table 14

July 1981 Hudson River Meteorological Data: Reach #10 (RM 114.8 - 153.7)

Year	Month	Day	Air Temperature (F)	Relative Humidity (%)	ATM Pressure (inches of Hg)	Wind Speed (mph)	Net Solar Flux (BTU/ft^2/day)	Net Atmospheric Flux (BTU/ft^2/day)
1981	7	1	69	70.0	30.02	4.6	1601	2785
1981	7	2	73	72.8	30.08	7.6	1471	2949
1981	7	3	70	83.9	29.97	7.8	1039	2966
1981	7	4	69	84.6	29.75	8.5	878	2974
1981	7	5	69	89.1	29.52	9.2	876	2974
1981	7	6	73	77.6	29.55	9.8	2237	2732
1981	7	7	74	69.8	29.63	8.2	1908	2854
1981	7	8	76	65.0	29.64	11.2	2385	2780
1981	7	9	82	69.9	29.50	11.9	1993	3092
1981	7	10	76	60.5	29.58	11.5	2331	2793
1981	7	11	73	52.5	29.67	10.9	2213	2732
1981	7	12	73	65.6	29.70	5.8	1167	3026
1981	7	13	74	77.0	29.45	8.8	1305	3020
1981	7	14	65	67.4	29.39	13.8	1557	2661
1981	7	15	66	64.3	29.52	10.1	2254	2508
1981	7	16	67	54.8	29.56	9.1	2380	2502
1981	7	17	67	64.1	29.63	5.8	2339	2511
1981	7	18	68	78.1	29.69	4.6	1765	2694
1981	7	19	70	81.8	29.69	5.5	1418	2851
1981	7	20	66	97.6	29.51	10.4	848	2874
1981	7	21	73	88.5	29.30	12.2	999	3068
1981	7	22	65	73.0	29.58	12.4	1644	2631
1981	7	23	60	62.8	29.83	8.3	2391	2297
1981	7	24	62	69.0	29.94	6.2	1274	2635
1981	7	25	70	65.4	29.92	10.9	1520	2817
1981	7	26	71	77.6	29.78	12.5	837	3042
1981	7	27	67	65.3	29.74	13.5	1827	2637
1981	7	28	66	67.3	29.77	9.2	1127	2795
1981	7	29	65	77.1	29.53	13.5	1124	2763
1981	7	30	66	65.8	29.80	6.8	2308	2474
1981	7	31	71	66.4	30.00	2.5	2349	2605
Monthly Average			69.5	71.8	29.69	9.1	1657	2776

Table 15

July 1981 Hudson River Meteorological Data: Reach #20 (RM 38.9 - 114.8)

Year	Month	Day	Air Temperature (F)	Relative Humidity (%)	ATM Pressure (inches of Hg)	Wind Speed (mph)	Net Solar Flux (BTU/ft^2/day)	Net Atmospheric Flux (BTU/ft^2/day)
1981	7	1	71.0	79.8	30.15	6.6	1720	2817
1981	7	2	73.5	76.4	30.20	8.1	1390	2988
1981	7	3	73.8	83.8	30.11	4.7	1070	3087
1981	7	4	70.0	88.0	29.88	3.8	942	2991
1981	7	5	71.1	82.0	29.64	4.1	1095	2986
1981	7	6	73.3	71.6	29.69	1.8	2168	2760
1981	7	7	76.9	61.6	29.77	2.7	2315	2830
1981	7	8	79.2	59.5	29.78	6.0	2422	2870
1981	7	9	83.2	64.0	29.64	6.1	2183	3074
1981	7	10	78.3	61.7	29.71	3.8	2321	2868
1981	7	11	74.5	47.8	29.83	2.5	2378	2731
1981	7	12	76.2	56.1	29.84	2.5	1849	2937
1981	7	13	78.9	66.4	29.59	6.7	1865	3021
1981	7	14	72.6	61.2	29.53	10.1	2248	2706
1981	7	15	70.1	58.1	29.67	4.2	2397	2588
1981	7	16	69.8	47.9	29.71	2.3	2190	2635
1981	7	17	71.3	58.2	29.77	2.0	2296	2649
1981	7	18	73.6	70.1	29.83	3.5	1805	2858
1981	7	19	74.1	76.4	29.83	1.9	1897	2847
1981	7	20	71.1	91.1	29.65	4.5	848	3046
1981	7	21	77.3	81.3	29.46	7.3	1255	3142
1981	7	22	69.8	69.0	29.72	5.4	2020	2674
1981	7	23	64.5	58.2	29.97	3.3	2391	2419
1981	7	24	67.6	65.3	30.09	2.9	1592	2722
1981	7	25	68.4	64.6	30.09	4.0	1374	2806
1981	7	26	73.7	79.6	29.95	7.1	837	3136
1981	7	27	74.2	65.0	29.89	6.5	1882	2845
1981	7	28	65.7	65.1	29.92	5.1	1686	2635
1981	7	29	72.0	72.5	29.67	9.3	1529	2875
1981	7	30	65.0	61.0	29.96	3.2	2351	2434
1981	7	31	68.6	60.7	30.15	1.5	2361	2531
Monthly Average			72.6	67.8	29.83	4.6	1828	2823

Table 16

July 1981 Hudson River Meteorological Data: Reach #30 (RM 0.0 - 38.9)

Year	Month	Day	Air Temperature (F)	Relative Humidity (%)	ATM Pressure (inches of Hg)	Wind Speed (mph)	Net Solar Flux (BTU/ft^2/day)	Net Atmospheric Flux (BTU/ft^2/day)
1981	7	1	70.5	84.6	30.21	11.8	1381	2891
1981	7	2	73.8	78.1	30.27	12.2	1363	3004
1981	7	3	74.9	83.7	30.19	8.6	974	3153
1981	7	4	70.5	89.7	29.96	8.0	910	3017
1981	7	5	73.6	78.5	29.72	9.3	1278	3018
1981	7	6	77.7	68.5	29.76	5.7	2203	2891
1981	7	7	80.5	57.4	29.84	6.3	2304	2950
1981	7	8	83.1	56.8	29.86	9.2	2355	3021
1981	7	9	86.1	61.1	29.73	10.3	2300	3136
1981	7	10	81.2	62.3	29.78	8.5	2235	2989
1981	7	11	79.3	45.4	29.89	7.7	2374	2885
1981	7	12	80.1	51.3	29.91	7.6	1915	3049
1981	7	13	82.0	61.1	29.68	12.4	1824	3140
1981	7	14	73.3	58.1	29.60	14.6	2301	2712
1981	7	15	72.6	54.9	29.73	9.5	2373	2669
1981	7	16	75.4	44.5	29.78	6.7	2190	2811
1981	7	17	76.2	55.3	29.84	6.5	2240	2818
1981	7	18	77.3	66.0	29.89	7.6	2070	2899
1981	7	19	77.6	73.7	29.90	5.5	1878	2967
1981	7	20	73.1	87.9	29.74	9.5	848	3114
1981	7	21	79.7	77.7	29.54	10.1	1504	3147
1981	7	22	73.9	66.9	29.76	9.1	1979	2816
1981	7	23	68.8	55.8	30.03	8.2	2350	2554
1981	7	24	70.8	63.5	30.16	7.8	1558	2835
1981	7	25	71.2	64.2	30.16	8.1	1503	2860
1981	7	26	74.9	80.6	30.04	11.8	837	3177
1981	7	27	77.1	64.8	29.94	10.9	2064	2882
1981	7	28	69.4	64.0	30.00	8.8	1706	2743
1981	7	29	73.5	70.1	29.73	12.7	1759	2855
1981	7	30	69.0	58.5	30.02	6.4	2352	2549
1981	7	31	72.3	57.8	30.22	4.9	2355	2643
Monthly Average			75.4	65.9	29.90	8.9	1848	2909

Table 17

August 1981 Hudson River Meteorological Data: Reach #10 (RM 114.8 - 153.7)

Year	Month	Day	Air Temperature (F)	Relative Humidity (%)	ATM Pressure (inches of Hg)	Wind Speed (mph)	Net Solar Flux (BTU/ft^2/day)	Net Atmospheric Flux (BTU/ft^2/day)
1981	8	1	72	57.4	29.96	2.7	2293	2648
1981	8	2	75	64.5	29.76	4.0	1701	2915
1981	8	3	77	76.8	29.64	6.8	965	3208
1981	8	4	76	78.9	29.65	3.6	1687	2948
1981	8	5	74	81.9	29.54	10.9	1469	2947
1981	8	6	73	67	29.55	10.8	1767	2822
1981	8	7	69	74.5	29.52	4.6	1457	2785
1981	8	8	71	77.4	29.54	10.1	946	2999
1981	8	9	75	80.4	29.62	5.8	1445	2980
1981	8	10	75	72.1	29.79	3.2	2136	2762
1981	8	11	77	72.1	29.70	8.5	1730	2952
1981	8	12	71	67.4	29.67	5.9	1193	2920
1981	8	13	70	73.8	29.70	6.2	1527	2785
1981	8	14	69	64.5	29.78	6.0	1868	2650
1981	8	15	71	83.5	29.55	10.1	777	3042
1981	8	16	67	70.8	29.41	13.8	1604	2663
1981	8	17	61	55.8	29.58	14.1	1912	2400
1981	8	18	59	70.1	29.79	4.8	2192	2267
1981	8	19	63	68.5	29.87	3.2	2094	2399
1981	8	20	65	68	29.85	4.3	2141	2438
1981	8	21	67	70.9	29.89	3.7	2076	2511
1981	8	22	65	78.6	29.92	1.7	754	2842
1981	8	23	67	64.4	29.70	5.2	2113	2494
1981	8	24	66	78.3	29.62	5.8	1132	2759
1981	8	25	61	74.4	29.82	8.1	1780	2419
1981	8	26	61	74.1	29.82	2.5	1837	2400
1981	8	27	63	75.3	29.75	3.9	1336	2601
1981	8	28	66	73.8	29.92	3.7	1224	2724
1981	8	29	66	68.1	29.94	6.6	730	2874
1981	8	30	72	76.5	29.83	10.4	727	3077
1981	8	31	66	81.5	29.81	6.2	724	2874
Monthly Average			68.7	72.3	29.73	6.4	1527	2745

Table 18

August 1981 Hudson River Meteorological Data: Reach #20 (RM 38.9 - 114.8)

Year	Month	Day	Air Temperature (F)	ATM Pressure (inches of Hg)	Relative Humidity (%)	Wind Speed (mph)	Net Solar Flux (BTU/ft^2/day)	Net Atmospheric Flux (BTU/ft^2/day)
1981	8	1	72.1	30.11	54.8	2.6	2299	2649
1981	8	2	72.8	29.91	61.5	3.3	2125	2719
1981	8	3	74.2	29.80	69.0	4.5	1548	2933
1981	8	4	75.2	29.79	71.2	2.0	1992	2829
1981	8	5	75.2	29.65	71.0	6.7	1620	2940
1981	8	6	74.4	29.67	59.3	4.5	1886	2831
1981	8	7	72.0	29.65	64.8	3.6	1846	2765
1981	8	8	69.8	29.68	79.3	4.3	801	3001
1981	8	9	75.3	29.78	77.0	4.3	1354	3019
1981	8	10	77.2	29.94	65.1	4.0	2197	2811
1981	8	11	74.3	29.87	69.6	4.3	1498	2937
1981	8	12	73.0	29.93	69.7	1.6	816	3103
1981	8	13	74.1	29.86	66.2	4.6	1354	2971
1981	8	14	75.0	29.92	65.3	4.4	1868	2836
1981	8	15	75.4	29.72	77.7	5.5	1077	3100
1981	8	16	73.3	29.57	65.6	8.0	1792	2801
1981	8	17	64.0	29.74	52.1	7.3	2160	2413
1981	8	18	63.2	29.93	53.5	4.3	2192	2379
1981	8	19	64.9	30.01	61.0	2.6	2046	2466
1981	8	20	66.0	29.99	61.9	5.9	2173	2457
1981	8	21	67.3	30.05	57.4	3.1	1991	2545
1981	8	22	66.4	30.07	64.9	1.8	1094	2786
1981	8	23	67.5	29.85	57.4	2.1	2099	2513
1981	8	24	64.8	29.78	65.7	4.0	1715	2548
1981	8	25	66.4	29.96	68.7	4.7	1577	2635
1981	8	26	69.3	29.98	68.0	5.8	1729	2673
1981	8	27	70.8	29.89	71.1	5.1	1397	2823
1981	8	28	72.1	30.06	72.0	3.6	1699	2763
1981	8	29	70.1	30.11	71.1	4.5	837	2977
1981	8	30	70.9	30.00	74.5	6.2	754	3030
1981	8	31	71.0	29.96	79.6	4.4	829	3008
Monthly Average			70.9	29.88	66.6	4.3	1625	2783

Table 19

August 1981 Hudson River Meteorological Data: Reach #30 (RM 0.0 - 38.9)

Year	Month	Day	Air Temperature (F)	Relative Humidity (%)	ATM Pressure (inches of Hg)	Wind Speed (mph)	Net Solar Flux (BTU/ft^2/day)	Net Atmospheric Flux (BTU/ft^2/day)
1981	8	1	75.1	53.4	30.20	6.1	2325	2732
1981	8	2	75.9	60.0	29.99	6.6	2166	2803
1981	8	3	77.1	65.0	29.88	7.9	1515	3042
1981	8	4	78.6	67.3	29.86	6.0	2142	2890
1981	8	5	78.1	65.5	29.75	11.4	1780	2986
1981	8	6	76.2	55.4	29.74	9.0	1729	2939
1981	8	7	74.5	60.0	29.71	7.4	1803	2858
1981	8	8	71.4	80.2	29.75	7.2	801	3057
1981	8	9	77.2	75.2	29.86	6.7	1550	3019
1981	8	10	79.6	61.6	30.00	7.3	2216	2881
1981	8	11	77.7	68.3	29.94	8.7	1568	3027
1981	8	12	74.0	70.9	29.95	5.0	802	3143
1981	8	13	76.6	62.3	29.93	7.5	1489	3010
1981	8	14	77.0	65.7	29.98	7.5	1868	2900
1981	8	15	77.2	74.7	29.80	9.1	1128	3147
1981	8	16	74.7	62.9	29.63	12.4	1856	2823
1981	8	17	66.5	50.2	29.80	12.8	2179	2478
1981	8	18	68.1	45.2	29.99	7.4	2192	2520
1981	8	19	69.5	57.3	30.07	6.6	1937	2635
1981	8	20	69.0	58.9	30.04	12.2	2157	2548
1981	8	21	70.2	50.6	30.11	6.8	1991	2630
1981	8	22	69.7	58.0	30.15	5.6	992	2927
1981	8	23	71.3	53.8	29.92	6.2	2059	2637
1981	8	24	70.4	59.4	29.84	7.7	1814	2687
1981	8	25	68.7	65.8	30.02	9.6	1741	2653
1981	8	26	69.2	64.9	30.06	8.9	1715	2673
1981	8	27	72.4	68.9	29.96	8.6	1416	2868
1981	8	28	72.1	71.0	30.13	7.9	1283	2898
1981	8	29	71.6	72.5	30.18	8.2	784	3045
1981	8	30	73.5	73.4	30.07	9.9	806	3101
1981	8	31	72.0	78.6	30.02	9.1	904	3017
Monthly Average			73.4	63.8	29.95	8.1	1636	2857

Table 20

September 1981 Hudson River Meteorological Data: Reach #10 (RM 114.8 - 153.7)

Year	Month	Day	Air Temperature (F)	Relative Humidity (%)	ATM Pressure (inches of Hg)	Wind Speed (mph)	Net Solar Flux (BTU/ft^2/day)	Net Atmospheric Flux (BTU/ft^2/day)
1981	9	1	68.0	80.6	29.75	8.8	970	2859
1981	9	2	70.0	73.6	29.78	6.8	1077	2887
1981	9	3	62.0	83.4	29.85	3.3	704	2746
1981	9	4	66.0	79.8	29.83	3.5	824	2834
1981	9	5	63.0	79.1	29.81	1.2	691	2777
1981	9	6	70.0	79.5	29.8	2.7	1240	2817
1981	9	7	68.0	79.4	29.73	7.9	678	2941
1981	9	8	69.0	81.3	29.48	12.7	671	2974
1981	9	9	54.0	63.9	29.48	12.9	1748	2184
1981	9	10	55.0	60.8	29.58	10.4	1575	2256
1981	9	11	62.0	72.6	29.62	6.9	1813	2363
1981	9	12	65.0	78.8	29.59	7.1	1543	2532
1981	9	13	65.0	74.5	29.6	3.9	1821	2430
1981	9	14	69.0	79.4	29.48	5.9	855	2892
1981	9	15	63.0	81.0	29.57	5.5	625	2777
1981	9	16	61.0	67.6	29.67	10.1	731	2676
1981	9	17	56.0	78.5	29.8	5.6	612	2562
1981	9	18	61.0	73.8	29.77	5.3	819	2639
1981	9	19	57.0	76.3	29.42	5.0	599	2592
1981	9	20	55.0	66.3	29.44	6.9	1153	2344
1981	9	21	50.0	67.4	29.74	5.3	1282	2166
1981	9	22	54.0	85.1	29.65	5.9	579	2503
1981	9	23	48.0	78.9	29.61	11.9	572	2333
1981	9	24	49.0	73.4	29.68	10.9	566	2360
1981	9	25	56.0	62.3	29.88	8.5	1284	2302
1981	9	26	53.0	74.4	29.89	1.4	553	2474
1981	9	27	62.0	67.8	29.61	12.5	911	2602
1981	9	28	50.0	63.9	29.6	11.7	978	2236
1981	9	29	46.0	53.8	29.76	11.9	1434	1977
1981	9	30	44.0	55.1	29.78	12.1	1260	1982
Monthly Average			59.0	73.1	29.7	7.5	1005	2534

Table 21

September 1981 Hudson River Meteorological Data: Reach #20 (RM 38.9 - 114.8)

Year	Month	Day	Air Temperature (F)	Relative Humidity (%)	ATM Pressure (inches of Hg)	Wind Speed (mph)	Net Solar Flux (BTU/ft^2/day)	Net Atmospheric Flux (BTU/ft^2/day)
1981	9	1	68.4	82.0	29.90	4.2	922	2888
1981	9	2	70.5	75.3	29.94	4.2	1186	2867
1981	9	3	66.8	77.0	29.99	5.9	704	2901
1981	9	4	66.1	75.0	29.98	2.3	697	2878
1981	9	5	65.9	70.0	29.95	1.7	1003	2770
1981	9	6	66.4	68.5	29.96	1.4	1015	2778
1981	9	7	68.8	76.3	29.91	6.2	703	2959
1981	9	8	68.3	79.9	29.65	7.2	721	2934
1981	9	9	61.7	57.5	29.64	6.4	1828	2362
1981	9	10	61.8	57.9	29.77	6.2	1675	2408
1981	9	11	68.8	63.4	29.77	4.9	1849	2541
1981	9	12	69.3	70.7	29.74	5.5	1611	2635
1981	9	13	66.7	62.3	29.76	5.0	1824	2476
1981	9	14	71.0	69.7	29.65	4.2	1197	2829
1981	9	15	64.5	72.4	29.70	2.6	694	2801
1981	9	16	59.4	74.8	29.80	5.2	774	2612
1981	9	17	60.7	77.8	29.95	2.6	828	2630
1981	9	18	59.3	64.6	29.92	1.8	799	2595
1981	9	19	56.6	77.1	29.57	5.1	665	2558
1981	9	20	59.1	62.5	29.63	7.7	1213	2438
1981	9	21	56.5	63.5	29.90	5.1	1379	2304
1981	9	22	64.5	83.1	29.78	6.1	622	2809
1981	9	23	52.1	76.0	29.77	7.0	716	2400
1981	9	24	52.8	68.6	29.84	7.6	803	2387
1981	9	25	57.2	60.6	30.03	2.7	1471	2267
1981	9	26	56.9	68.5	30.06	3.0	971	2436
1981	9	27	66.7	66.9	29.80	6.6	1297	2586
1981	9	28	56.1	58.0	29.79	7.6	1051	2375
1981	9	29	50.9	50.0	29.93	8.5	1475	2080
1981	9	30	45.7	51.1	29.94	5.1	1340	1996
Monthly Average			62.0	68.7	29.8	5.0	1101	2583

Table 22

September 1981 Hudson River Meteorological Data: Reach #30 (RM 0.0 - 38.9)

Year	Month	Day	Air Temperature (F)	Relative Humidity (%)	ATM Pressure (inches of Hg)	Wind Speed (mph)	Net Solar Flux (BTU/ft^2/day)	Net Atmospheric Flux (BTU/ft^2/day)
1981	9	1	70.2	82.7	29.95	8.5	884	2961
1981	9	2	70.3	76.1	30.00	8.8	1237	2842
1981	9	3	68.9	73.8	30.05	10.0	704	2972
1981	9	4	68.1	72.6	30.04	7.8	697	2943
1981	9	5	68.5	65.4	30.02	6.3	1257	2765
1981	9	6	68.7	63.0	30.03	5.5	1128	2814
1981	9	7	69.9	74.7	29.98	10.0	752	2979
1981	9	8	70.2	79.2	29.72	11.7	869	2943
1981	9	9	64.4	54.3	29.71	11.1	1808	2442
1981	9	10	62.9	56.4	29.85	10.0	1739	2418
1981	9	11	72.4	58.8	29.84	8.6	1831	2655
1981	9	12	74.2	66.6	29.81	9.4	1653	2769
1981	9	13	70.9	56.2	29.83	9.1	1824	2598
1981	9	14	75.0	64.8	29.72	9.5	1407	2876
1981	9	15	67.8	68.1	29.76	6.2	659	2922
1981	9	16	61.7	78.4	29.85	10.6	752	2691
1981	9	17	61.4	77.5	30.01	7.0	828	2650
1981	9	18	60.2	60.0	29.98	7.8	809	2617
1981	9	19	57.8	77.5	29.65	10.0	832	2536
1981	9	20	61.6	60.6	29.70	12.2	1286	2481
1981	9	21	59.3	61.5	29.96	7.2	1439	2357
1981	9	22	64.3	82.1	29.85	10.2	794	2736
1981	9	23	53.6	74.6	29.83	14.3	915	2372
1981	9	24	54.4	66.2	29.90	13.5	914	2393
1981	9	25	60.1	59.8	30.10	6.4	1488	2338
1981	9	26	61.0	65.6	30.12	6.1	946	2564
1981	9	27	68.9	66.5	29.89	10.4	1326	2638
1981	9	28	60.1	55.0	29.85	13.1	1216	2421
1981	9	29	52.0	48.1	30.01	12.8	1479	2104
1981	9	30	50.9	49.1	30.01	10.5	1246	2160
Monthly Average			64.3	66.5	29.9	9.5	1157	2632

TABLE 23

CAPACITY HEAT LOADS

FACILITY	CAPACITY HEAT LOAD (BBTU/day)
Albany Steam Station	67.7
Danskammer Point	34.3
Roseton	136.0
Peekskill WHR	11.5
Indian Point	328.0
Lovett	71.0
Bowline Point	120.0
World Trade Center	19.9