1.0 SITE AND ENVIRONMENT

1.1 SUMMARY OF CONCLUSIONS

This volume of the PSAR sets forth the site and environmental data which together form a basis for the criteria for designing the facility and for evaluating the routine and accidental release of radioactive liquids and gases to the environment. These data support the conclusion that there will be no undue risk to public health and safety with the plant designed as planned and the environmental characteristics described in this volume. The strength of this conclusion rests not only upon the data themselves but upon the favorable opinions (also included in this volume) of several independent consultants to the Applicant, each speaking within his particular area of expertness, -- health physics, demography, geology, seismology, hydrology or meteorology, as the case may be.

The task of evaluating the environmental characteristics of the area has been facilitated by the significant fact that for ten years studies and measurements of these characteristics have been made, whereas for over four years measurements have been made of the effects on environment of releases from an operating nuclear power facility, the facility the subject of AEC License No. DPR-5.

Careful projections have been made of the probable growth of population in the area and these projections have been taken into account in plant design both as to control of accidents and as to assumptions about operation.

Only forty-six people reside within 1/2 mile of Unit No. 3 and only 1080 live within one mile. Approximately 53,000 people now reside within a 5-mile radius of the proposed facility. The largest concentration of population is in the City of Peekskill (Population 19,000; estimated 1980 population, 30,000) the center of which is about 2-1/2 miles northeast of the site. The most densely populated 15 degree sector, within 5 miles, is toward Peekskill to the northeast and contains 12,120 people.

The 1960 population within a 15-mile radius of the site was 326,930 whereas the 1980 estimated population is 670,210. The projections do not indicate, and there is no reason otherwise to conclude, that the land usage within this radius will shift appreciably during the intervening period. (The land is now zoned principally for residential and state park usage although there is some industrial activity and a little agricultural and grazing activity.)

The outer boundary of the low population zone (inhabited by about 66 people) has been set at 1,100 meters from Unit No. 3.

Geologically, the site consists of a hard limestone in a jointed condition which will provide a solid bed for the plant foundation. The bedrock is sufficiently sound to support any loads which could be anticipated up to 50 tons per square foot, which is far in excess of any load which may be imposed by the plant. Although it is hard, the jointed limestone formation is permeable to water. Thus, if water from the plant should enter the ground (an improbable event since the plant is designed to preclude any leakage into the ground) it would percolate to the river rather than enter any ground water supply. Additional studies by Consolidated Edison's geology consultant, Thomas W. Fluhr, and examination of recent soil borings confirms the above conclusions.

In the Hudson River, about 80,000,000 gallons of water flow past the plant each minute during the peak tidal flow. This flow will provide additional mixing and dilution for liquid discharges from the facility. In fact, however, this aspect is superfluous since the assumption in the plant design is to treat the river water as if it were used for drinking (which it is not) and thus to reduce radioactive discharges, by dilution with ordinary plant effluent, to concentrations that would be tolerable for drinking water. There is no danger of flooding at the site.

Seismic activity in the Indian Point area is rare and no damage has resulted therefrom. As stated by Applicant's consultant on seismology, the site is "practically non-seismic" and is "as safe as any area at present known." Notwithstanding such assurance, the plant is designed to withstand an earthquake of the highest intensity ever recorded in this area.

Meteorological conditions in the area of the site were determined during a two-year test program. These data have been used in evaluating the effects of gaseous discharges from the plant during normal operations and during the postulated loss-of-coolant accident. In addition, data supplied by the U.S. Weather Bureau at the Bear Mountain Station, regarding the meteorological conditions during periods of precipitation, have been used to evaluate the rainout of fission gases into surface water reservoirs following the postulated loss-of-coolant accident. The evaluations indicate that the site meteorology provides adequate diffusion and dilution of any released gases.

Environmental radioactivity has been measured at the site and surrounding area for the past nine years in association with the operation of Indian Point Unit No. 1, and the construction of the Indian Point Unit No. 2. These measurements will be continued and reported. The radiation measurements of fallout, water samples, vegetation, marine life, etc. have shown no perceptible post-operative increase in activity. Noticeable increases in fallout have coincided with weapons testing programs and appear to be related almost entirely to those programs. The New York State Department of Health recently concluded an independent two-year post-operative study(1) and found that environmental radioactivity in the vicinity of the site is no higher than anywhere else in the State of New York.

Consultants participating in the preparation of the various reports, measurements and conclusions appearing in this volume include Dr. Merril Eisenbud, Director of Environmental Radiation Laboratory, Institute of Industrial Medicine, New York University; Dr. Benjamin Davidson, Meteorologist and Director, Geophysical Science Laboratory, New York University College of Engineering; Dr. Edgar M. Hoover, Regional Economic Development Institute, Inc.: Metcalf & Eddy Engineers, hydrology specialists; Rev. J. J. Lynch, S. J., Director of the Seismic Observatory, Fordham University; Mr. Sidney Paige, Consulting Geologist; Quirk, Lawler and Matusky Engineers, Environmental Science and Engineering Consultants; Mr. Karl R. Kennison, Consulting Civil and Hydraulic Engineer; and Mr. Thomas W. Fluhr, P. E., Consulting Engineering Geologist.

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(1) Consolidated Edison Indian Point Reactor Post Operational Survey - August, 1965, Division of Environmental Health Services, New York State Department of Health, Hollis S. Ingraham, M.D., Commissioner.

Consolidated Edison Indian Point Reactor Environmental and Post Operation Survey - July, 1966, Division of Environmental Health Services, New York State Department of Health, Hollis S. Ingraham, M.D., Commissioner.

1.2 LOCATION

1.2.1 GENERAL

Indian Point Unit No. 3 will be built adjacent to and south of Unit No. 1 on a site of approximately 250 acres of land on the east bank of the Hudson River at Indian Point, Village of Buchanan in upper Westchester County, New York. Indian Point Unit No. 2 is being constructed adjacent to and north of Unit No. 1. The site is about 24 miles north of the New York City boundary line. The nearest city is Peekskill, 2.5 miles northeast of Indian Point, with a population of about 19,000. An aerial photograph, Figure 1.2-1, shows the site and about 58 square miles of the surrounding area.

1.2.2 ACCESS

The site is accessible by several roads in the Village of Buchanan. A paved road links the eastern boundary of the site to the existing plant. The existing wharf will be used to receive heavy equipment during the construction period. The site is not served by rail.

1.2.3 SITE OWNERSHIP AND CONTROL

The Consolidated Edison Company is the sole owner of the entire property. The Algonquin Gas Transmission Co. has a right-of-way running east to west through the property, 3500 feet long and 65 feet wide. The proposed reactor is 700 feet north of the Algonquin 26-inch gas main. A permanent easement for the Village of Buchanan sewer crosses the eastern corner of the property. It is 20 feet wide, 900 feet long and 2900 feet east of Unit No. 3. Units No. 1, No. 2 and No. 3 will be fenced by an eight-foot chain link type fence surmounted by three-strand barbed wire. The gates to this restricted area will be either secured or attended by plant personnel. In addition, a fence of the same type will separate the conventional and nuclear parts of the units, isolating the control area. The site is fenced in part with agricultural type fencing and the access road is continuously controlled by Company guards. A scale plot plan of the site is shown on Figure 1.2-2.

1.2.4 ACTIVITIES ON THE SITE

The principal activities on the site will be the generation, transmission and distribution of steam and electrical energy; associated service activities; activities relating to the controlled conversion of the atomic energy of fuel to heat energy by the process of nuclear fission; and the storage, utilization and production of special nuclear, source and by-product materials. Possible future activities include the addition of other nuclear and conventional electrical generating units.

An observation building is located about 800 feet southeast of Unit No. 3, and is open to the public during the day and attended by Company personnel. Limited public recreational grounds under Company control will also be provided on the site in the future.

FIGURE 1.2-1
AERIAL PHOTOGRAPH OF INDIAN POINT
SITE AND SURROUNDING AREA

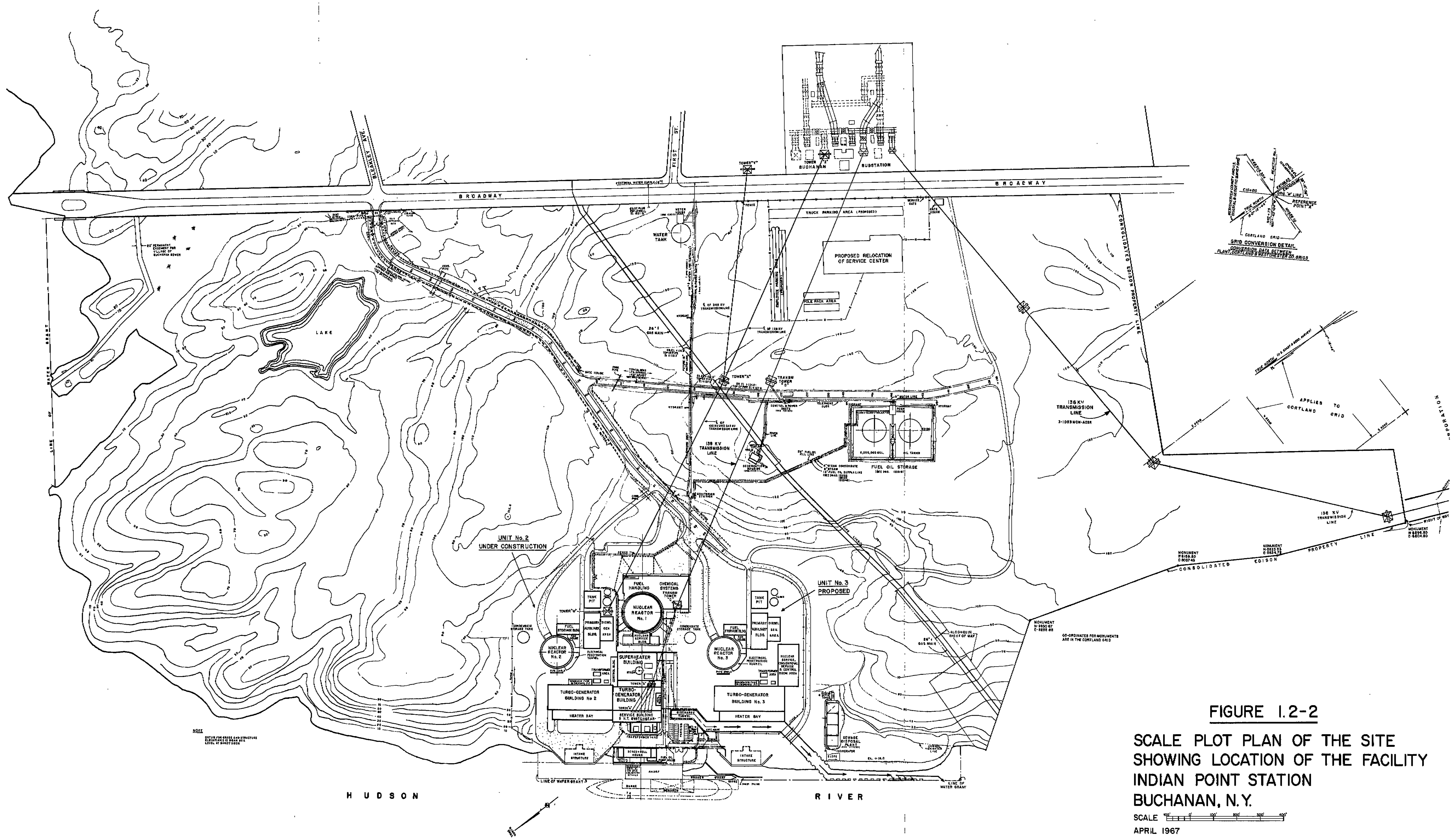


FIGURE 1.2-2

SCALE PLOT PLAN OF THE SITE
SHOWING LOCATION OF THE FACILITY
INDIAN POINT STATION
BUCHANAN, N.Y.

SCALE

APRIL 1967

1.3 TOPOGRAPHY

The Indian Point Generating Station, site of Unit No. 3, is located some two miles southwest of the town of Peekskill which is the most densely populated area in the immediate vicinity of the site. It is surrounded on almost all sides by high ground ranging from 600 to 1000 feet above sea level. The generating station is on the east bank of the Hudson River which runs northeast to southwest at this point but turns sharply northwest approximately two miles northeast of the plant. The west bank of the Hudson is flanked by the steep, heavily wooded slopes of the Dunderberg and West Mountains to the northwest (elevations 1086 feet and 1257 feet respectively) and Buckberg Mountain to the west-southwest (elevation 793 feet). These peaks extend to the west by other names and gradually rise to slightly higher peaks.

The general orientation of this mass of high ground is northeast to southwest. One mile northwest of the site, Dunderberg bulges to the east, and north of Dunderberg and the site, high ground reaching 800 feet forms the east bank of the Hudson as the river makes a sharp turn to the northwest. To the east of the site, peaks are generally lower than those to the north and west. Spitzenberg and Blue Mountains average about 600 feet in height and there is a weak, poorly defined series of ridges which again seem to run in a north-northeast direction. The river south of the site makes another sharp bend to the southeast and then widens as it flows past Croton and Haverstraw.

An aerial photograph showing these topographic features of the site and surrounding area is shown in Figure 1.2-1.

1.4 POPULATION AND LAND USAGE

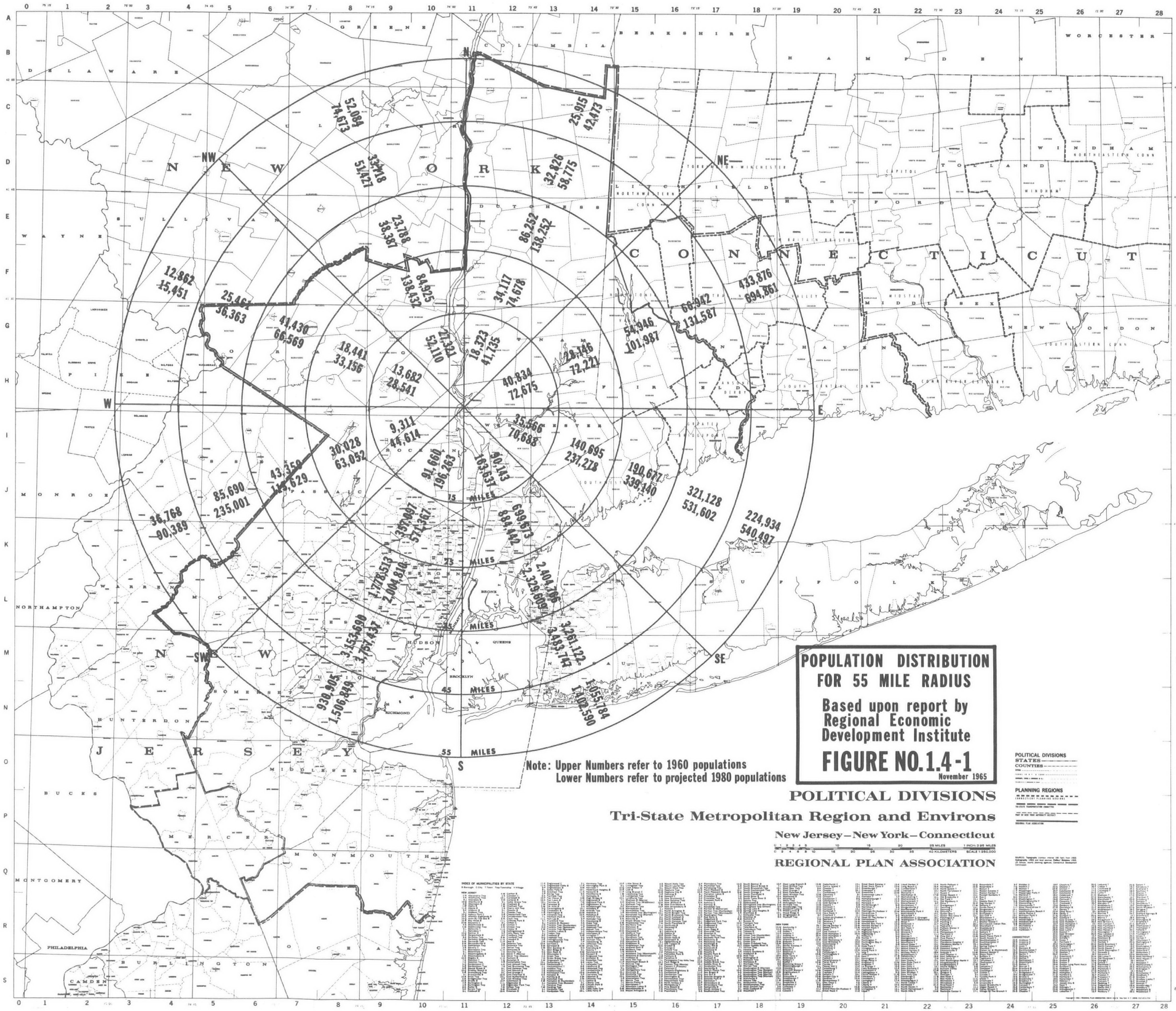
The population and land usage within a 55-mile radius of the Indian Point site has been compiled by the Regional Economic Development Institute, Incorporated, under the direction of Dr. Edgar M. Hoover. The population and land usage has been projected to 1980 by the Institute based on estimates produced by the Regional Plan Association of New York. The report prepared by the Institute is included herein.

Dr. Hoover served on the staff of the Harvard University New York Metropolitan Region Study from 1957 to 1959. He is the author of "Location of Economic Activity", and co-author of "Anatomy of a Metropolis" and has served in several federal government agencies including the President's Council of Economic Advisers.

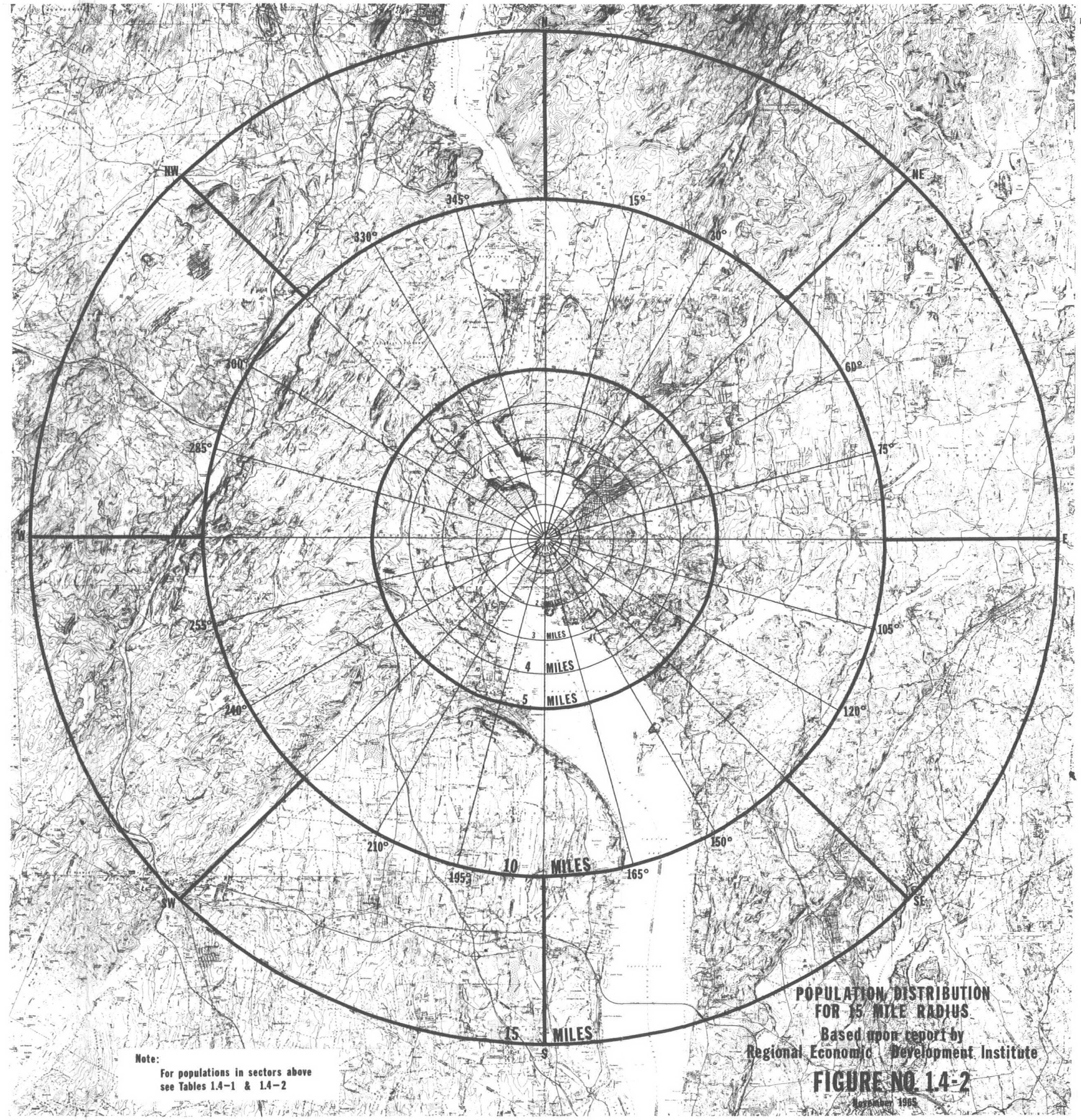
The area surrounding the Indian Point site is generally residential with some large parks and military reservations. The majority of the area to the east of the river within 15 miles of the site is zoned for residential usage as shown on the map in Figure 1.4-3. West of the river within a fifteen-mile radius the Palisades Interstate Park and residential areas are a dominant land usage. The only agricultural areas within fifteen miles are south or northwest of the plant on the west side of the river.

About sixty-six people reside within a 1100-meter radius of Unit No. 3, all of them to the east southeast. This distance has been used as the outer boundary of the low population zone in the analysis of a postulated fission product release. The outer boundary of the more densely populated area of Peekskill has been used as the population center distance which exceeds one and one-third times the distance from the reactor to the outer boundary of the low population zone as defined in 10 CFR100.11.

Several maps are included to illustrate the population distribution and land usage. Figures 1.4-1 and 1.4-2 show the population distribution radially by sectors out to 55 miles and 15 miles, respectively, which are based upon the report herein. Figures 1.4-3, 1.4-4, and 1.4-5 show respectively, the land usage based upon official zoning maps, areas served by public utilities, and areas served by sewage systems.



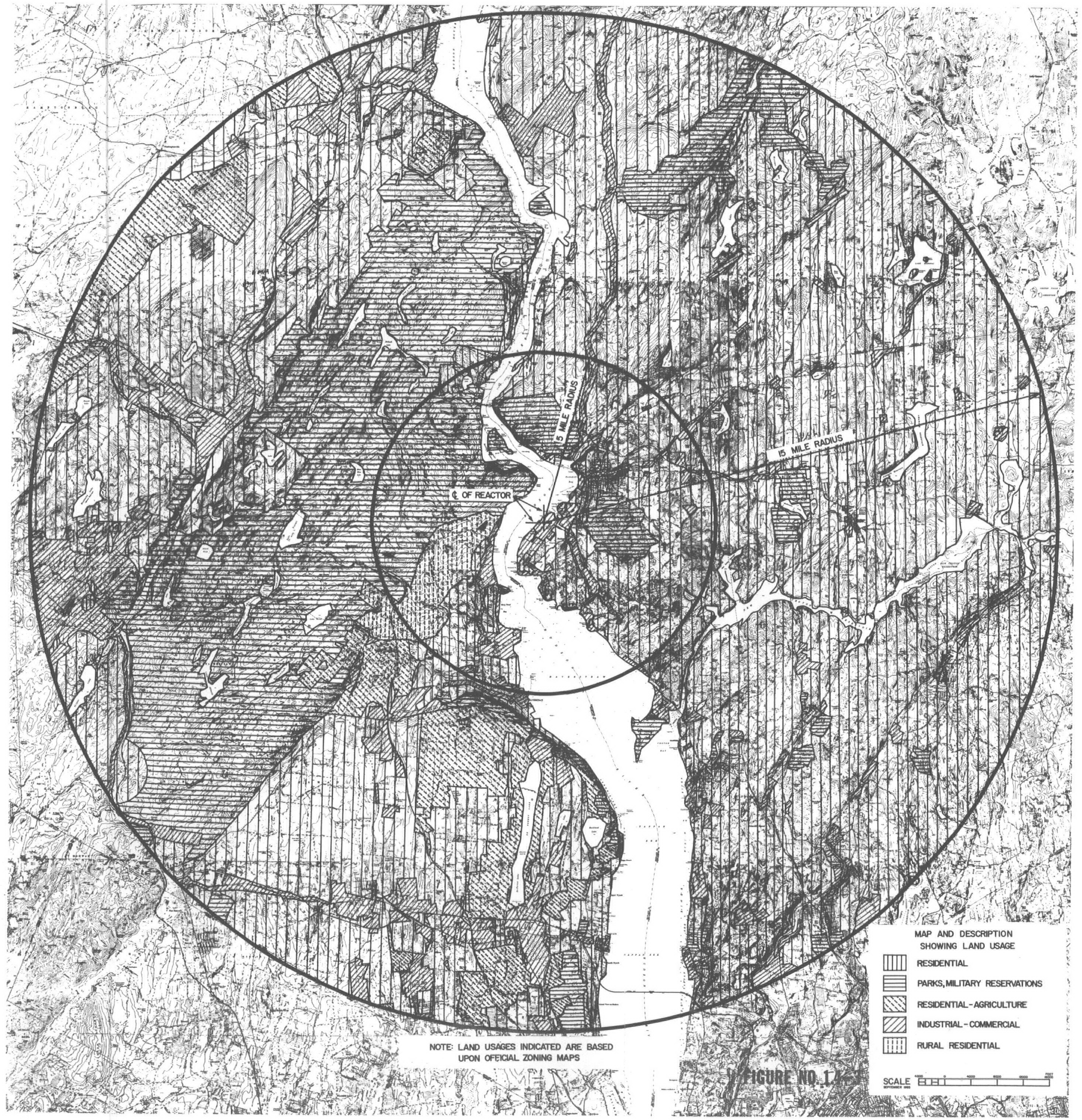
POPULATION DISTRIBUTION FOR 55 MILE RADIUS
Based upon report by Regional Economic Development Institute
FIGURE NO.1.4-1
November 1965
Note: Upper Numbers refer to 1960 populations
Lower Numbers refer to projected 1980 populations
POLITICAL DIVISIONS
Tri-State Metropolitan Region and Environs
New Jersey – New York – Connecticut
REGIONAL PLAN ASSOCIATION
N E W Y O R K
C O N N E C T I C U T
N E W J E R S E Y
15 MILES
25 MILES
35 MILES
45 MILES
55 MILES
NW
NE
W
E
SW
SE
S



POPULATION DISTRIBUTION
FOR 15 MILE RADIUS
Based upon report by
Regional Economic Development Institute

FIGURE NO. 1.4-2

November 1965



15 MILE RADIUS
5 MILE RADIUS
℄ OF REACTOR
NOTE: LAND USAGES INDICATED ARE BASED
UPON OFFICIAL ZONING MAPS
MAP AND DESCRIPTION
SHOWING LAND USAGE
RESIDENTIAL
PARKS, MILITARY RESERVATIONS
RESIDENTIAL - AGRICULTURE
INDUSTRIAL - COMMERCIAL
RURAL RESIDENTIAL
SCALE
4000 0 4000 8000 12000 FEET 16000
FIGURE NO. 1.4

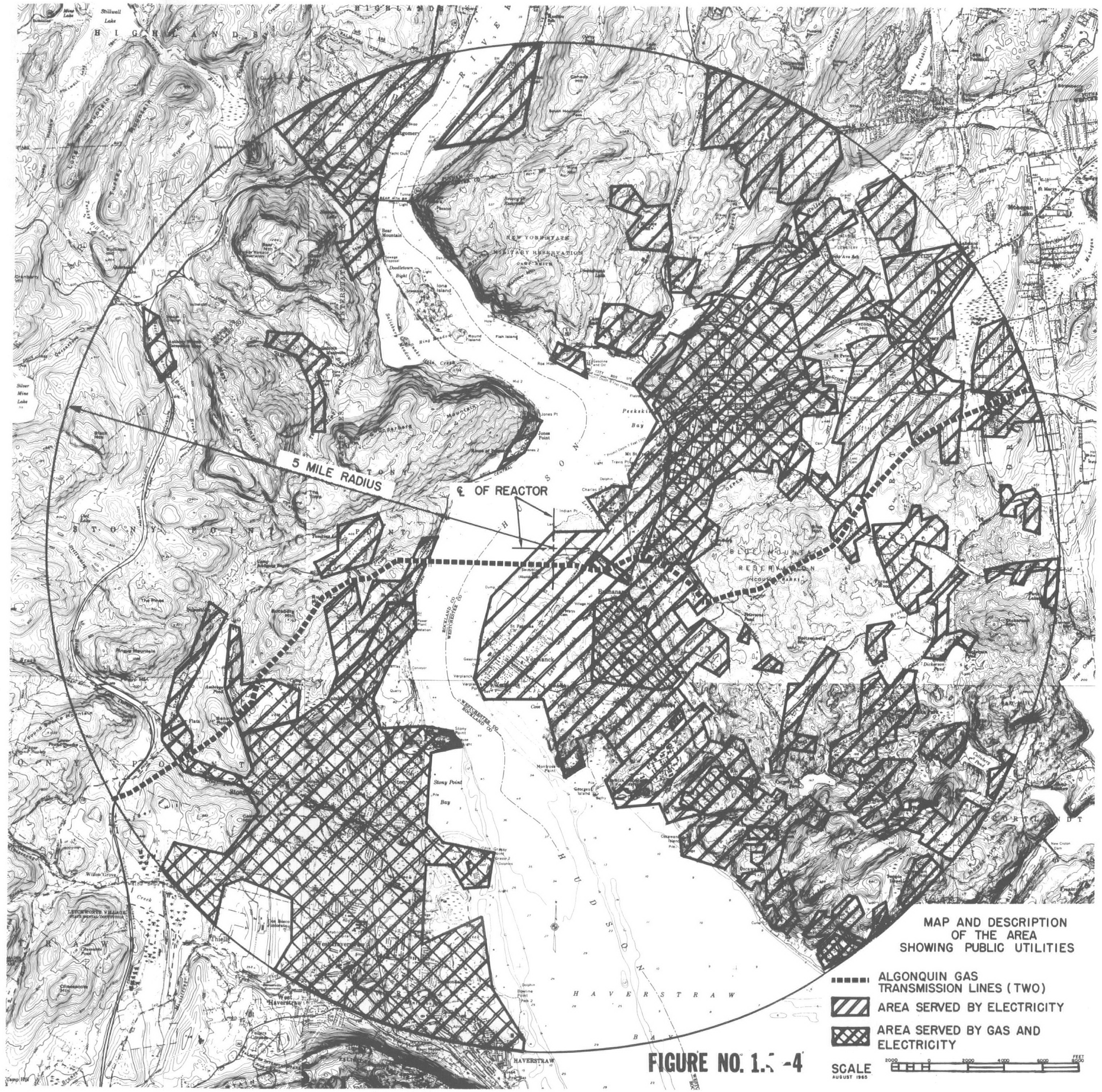


FIGURE NO. 1.5-4

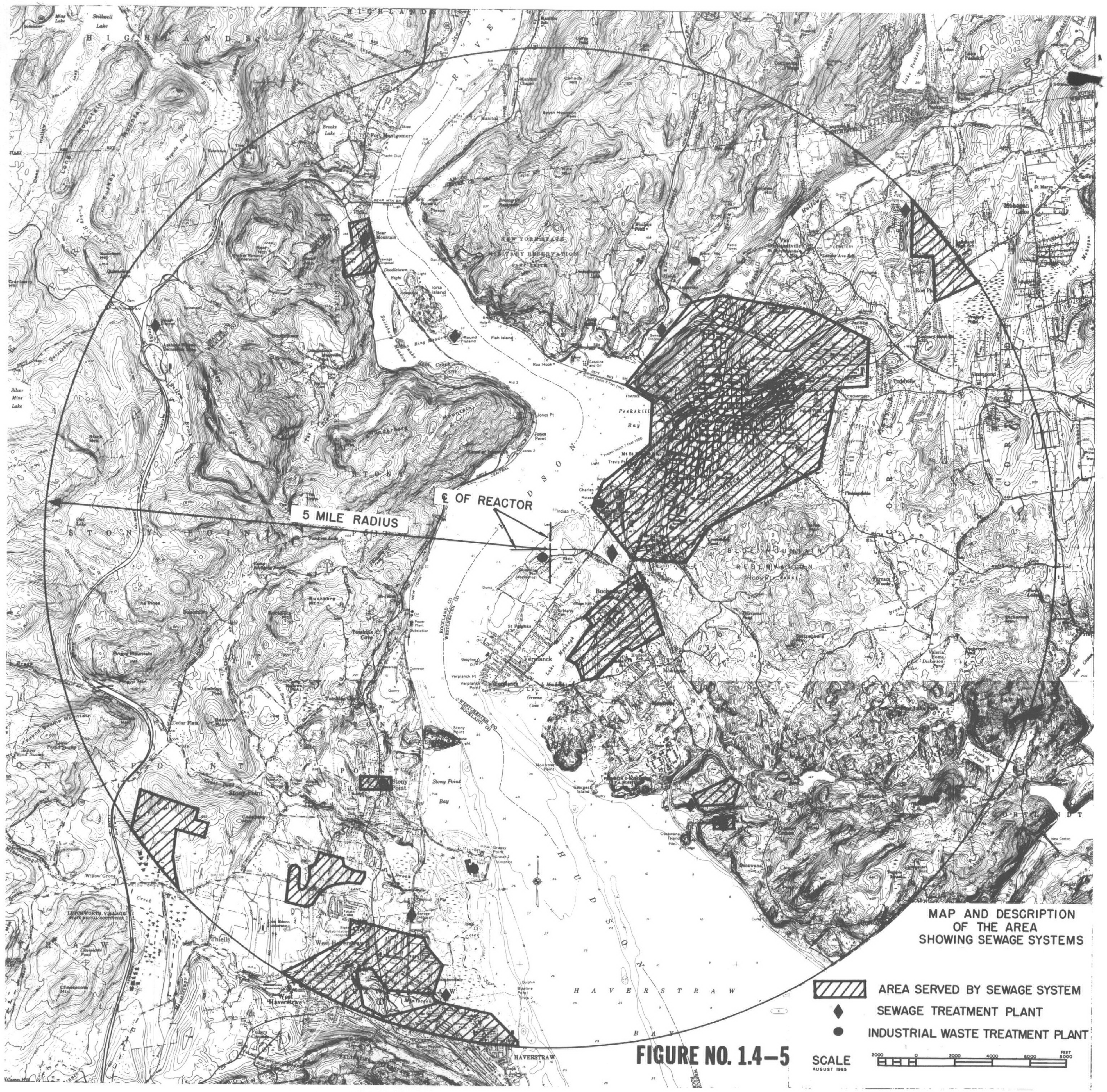


FIGURE NO. 1.4–5

REGIONAL ECONOMIC DEVELOPMENT INSTITUTE, INCORPORATED

1980 PROJECTIONS

OF

POPULATION AND LAND USE

FOR AN

AREA CIRCUMSCRIBED BY A 55-MILE RADIUS

FROM

BUCHANAN, NEW YORK

PREPARED FOR

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.

NOVEMBER 3, 1965

REGIONAL ECONOMIC DEVELOPMENT INSTITUTE, INCORPORATED

PART I

INTRODUCTION

The following two parts of this report present the results and methodology of projecting 1980 population and land use for an area circumscribed by a 55-mile radius from Buchanan, New York.

Due to the short time available to produce the projections, complete reliance was placed on the aggregate population and land use estimates produced by the Regional Plan Association of New York. These were obtained as the result of an intensive four days' perusal of their frequently revised projections, and by making extensive use of their counsel and advice.

RPA estimates for 1980 population by county were used as the limits to population growth by municipalities for the period 1960 to 1980. The 55-mile radius from Buchanan, New York, circumscribed an area which was segregated into rings-and-sectors as the following "Key to Numbering of Zones" indicates. The projections of population by municipalities constrained by RPA county estimates were then fitted to the area and totals by zones and rings-and-sectors were produced. These results appear in the following section and the methodology in the third section.

Estimates for land use in 1960 as well as projections for land use in 1980 were not available at all in county or municipal detail. Consequently, detailed land use for 1960 and projected land use in 1980 could only be controlled by average figures for land use derived from RPA estimates for some fifty

KEY TO NUMBERING OF ZONES

	Miles from Buchanan, New York				
Direction	0 - 15	15 - 25	25 - 35	35 - 45	45 - 55
N to NE	1	9	17	25	33
NE to E	2	10	18	26	34
E to SE	3	11	19	27	35
SE to S	4	12	20	28	36
S to SW	5	13	21	29	37
SW to W	6	14	22	30	38
W to NW	7	15	23	31	39
NW to N	8	16	24	32	40

municipalities, all or part of only five counties and New York City.[1]

The land use values by counties are of necessity then likely to contain error. It is believed, however, that the possible error is small and that all the values are of the correct magnitude. The results of the detailed land use estimates for 1960 and the projections for 1980 appear in the following section and the methodology appears in the third section.

Basic work sheets and data processing "print-outs" and cards, including the itemization and splitting of municipalities and subsidiary projections of municipality population, have been retained by Regional Economic Development Institute, Incorporated, and are available.

This report was directed by Professor Edgar M. Hoover and produced by the research staff of the Regional Economic Development Institute, Incorporated.

PART II

RESULTS

The following tables contain 1980 projections of population for forty zones and ring-and-sector totals as well as 1980 projections of land use by county.

REGIONAL ECONOMIC DEVELOPMENT INSTITUTE, INCORPORATED

1980 POPULATION PROJECTIONS

Zone	Population 1960	"Extrapolative" Projection 1980	"Density" Projection 1980	"Compromise" Projection 1980	Area Square Miles
1	18,323	39,898	43,809	41,735	88.0
2	40,834	73,427	72,607	72,675	73.7
3	35,566	71,378	70,322	70,688	74.8
4	90,143	161,448	165,633	163,637	65.4
5	91,660	200,223	190,255	196,263	83.0
6	9,311	41,361	50,645	44,614	94.4
7	13,682	29,164	28,159	28,541	92.2
8	27,321	53,115	50,587	52,110	77.1
9	34,117	80,065	68,931	74,678	164.8
10	28,146	70,500	74,326	72,221	145.4
11	140,695	233,058	240,843	237,278	162.8
12	699,673	986,875	980,462	984,442	211.0
13	357,097	599,794	543,170	571,367	148.1
14	30,028	58,733	67,709	63,052	150.5
15	18,441	32,471	33,116	33,156	151.6
16	84,925	141,310	135,638	138,432	130.6
17	86,252	139,785	136,592	138,252	237.4
18	54,946	99,186	104,718	101,987	186.6
19	190,677	348,846	328,943	339,140	183.9
20	2,404,766	2,311,656	2,352,125	2,329,609	120.3
21	1,778,513	2,002,018	2,007,352	2,004,810	244.5
22	43,359	110,373	116,864	113,629	243.6
23	41,430	62,763	69,242	66,569	259.1
24	23,788	37,677	38,858	38,387	246.7
25	32,826	56,608	61,401	58,775	331.7
26	66,942	129,540	133,990	131,587	312.0
27	321,128	527,513	536,210	531,602	133.2
28	3,261,122	3,485,870	3,478,298	3,483,747	333.5
29	3,153,690	3,240,678	3,273,470	3,257,437	294.2
30	89,690	237,359	232,037	235,001	316.6
31	25,461	34,124	38,459	36,363	305.3
32	33,718	50,132	52,668	51,427	321.7
33	25,915	38,780	46,254	42,473	364.5
34	433,876	672,402	716,147	694,861	380.9
35	224,934	546,199	534,771	540,497	202.9
36	1,055,784	1,439,316	1,365,059	1,402,590	181.9
37	930,905	1,517,627	1,496,222	1,506,849	304.9
38	36,768	83,814	97,434	90,389	353.8
39	12,862	15,407	15,502	15,451	335.4
40	52,084	75,837	73,789	74,673	380.3

REGIONAL ECONOMIC DEVELOPMENT INSTITUTE, INCORPORATED

1980 "COMPROMISE" PROJECTION OF POPULATION

by Ring-and-Sector Zones

	N to NE	NE to E	E to SE	SE to S	S to SW	SW to W	W to NW	NW to N	Ring Totals
0 to 15	41,735	72,675	70,688	163,637	196,263	44,614	28,541	52,110	670,263
15 to 25	74,678	72,221	237,278	984,442	571,367	63,052	33,156	138,432	2,174,626
25 to 35	138,252	101,987	339,140	2,329,609	2,004,810	113,629	66,569	38,387	5,132,383
35 to 45	58,775	131,587	531,602	3,483,747	3,257,437	235,001	36,363	51,427	7,785,939
45 to 55	42,473	694,861	540,497	1,402,590	1,506,849	90,389	15,451	74,673	4,367,783
Sector Totals	355,913	1,073,331	1,719,205	8,364,025	7,536,726	546,685	180,080	355,029	20,130,994

REGIONAL ECONOMIC DEVELOPMENT INSTITUTE, INCORPORATED

1960 POPULATION

by Ring-and-Sector Zones

	N to NE	NE to E	E to SE	SE to S	S to SW	SW to W	W to NW	NW to N	Ring Totals
0 to 15	18,323	40,834	35,566	90,143	91,660	9,311	13,682	27,321	326,840
15 to 25	34,117	28,146	140,695	699,673	357,097	30,028	18,441	84,925	1,393,122
25 to 35	86,252	54,946	190,677	2,404,766	1,778,513	43,359	41,430	23,788	4,623,731
35 to 45	32,826	66,942	321,128	3,261,122	3,153,690	85,690	25,461	33,718	6,980,577
45 to 55	25,915	433,876	224,934	1,055,784	930,905	36,768	12,862	52,084	2,773,128
Sector Totals	197,433	624,744	913,000	7,511,488	6,311,865	205,156	111,876	221,836	16,097,398

REGIONAL ECONOMIC DEVELOPMENT INSTITUTE, INCORPORATED

TABLE 1

Counties in Con Ed Study Area				1	2	3	4	5	6	7	8	9
State	In RPA Region	Outside RPA Region	Percent In Con Ed Area	Equation 1 I 1960 Projection Sq. Miles	Averaging From I 1960 RPA Total Estimate	Best Estimate I 1960	D 1980 From RPA Population Estimate	Equation 1 I 1980 Projection Sq. Miles	Equation 2 I 1980 Projection Sq. Miles	Best Estimate I 1980 From Equations 1 & 2	Adjusted to Best Estimate I 1980 RPA Total	Square Miles Total Area
Conn.	Fairfield		100	109	131	96	1666	141	126	141	216	633
		Litchfield	52			[29]	[201]	[36]			[36]	938 (49)
		New Haven	71			[77]	[1997]	[107]			[107]	610 (433)
N. J.	Bergen		100	75	68	75	4635	90	92	92	140	233
	Essex		100	62	48	73	7812	65	59	65	99	128
	Hudson		100	31	15	31	12222-	29	18	31*	31*	45
	Middlesex		46	63	59	59	3067	97	83	97	148 (68)	313 (150)
	Morris		100	58	73	53	1538	100	87	100	153	468
	Passaic		100	49	43	49	2861	58	41	58	89	194
	Somerset		33	35	44	35	1091	55	44	55	84 (28)	307 (101)
		Sussex	100			[26]	[216]	[42]			[42]	528
	Union		100	41	41	50	5825	45	49	49	75	103
		Warren	13			[3]	[287]	[4]			[4]	361 (47)
N. Y.	Dutchess		100	61	37	55	368	82	57	82	125	816
	Nassau		100	110	113	133	5119	119	177	177	271	293
	Orange		100	63	69	63	374	85	45	85	130	829
	Putnam		100	14	24	18	471	27	28	28	43	234
	Rockland		100	27	46	34	1899	43	26	43	65	179
	Suffolk		71	133	146	133	1830	216	161	216	329 (234)	921 (654)
		Sullivan	56			[18]	[62]	[22]			[22]	986 (552)
		Ulster	88			[51]	[161]	[65]			[65]	1143 (1006)
	Westchester		100	101	99	101	2690	126	104	126	193	435
	Bronx		100	38	20	29	32143-	29*	29*	29*	29*	42
	Kings		100	68	33	49	35870-	49*	49*	49*	49*	69
	New York		100	20	11	16	68182-	16*	16*	16*	16*	22

TABLE 1 continued...

Counties in Con Ed Study Area				1	2	3	4	5	6	7	8	9
State	In RPA Region	Outside RPA Region	Percent In Con Ed Area	Equation 1 I 1960 Projection Sq. Miles	Averaging From I 1960 RPA Total Estimate	Best Estimate I 1960	D 1980 From RPA Population Estimate	Equation 1 I 1980 Projection Sq. Miles	Equation 2 I 1980 Projection Sq. Miles	Best Estimate I 1980 From Equations 1 & 2	Adjusted to Best Estimate I 1980 RPA Total	Square Miles Total Area
N. Y.	Queens		100	80	52	76	17661	93	102	76*	76*	109
	Richmond		100	20	20	20	7759	30	30	30	46	58
Pa.		Pike	65			[7]	[22]	[8]			[8]	545 (354)
	TOTAL RPA REGION			1258	1192	1248		1595	1423	1645	2408	
	CONTROL TOTALS			1248	1248	1248		2408	2408	2408	2408	
	TOTAL INTENSIVE LAND USE IN CONSOLIDATED EDISON AREA					1459					2461	

NOTES: Figures in [ ] are for counties outside RPA's Region and are only added in Column 8.

Figures with * are for counties whose population density declined or projection produced over 100 percent of land used intensively. In such cases, 1960 estimates of land use intensity were used for 1980.

Figures in ( ) in Column 8 are square miles of intensively used land in the Consolidated Edison Area for those counties which are not 100 percent within that area. Those in ( ) in Column 9 are the total square miles of the county in the Consolidated Edison Area.

TABLE 2

ESTIMATED LAND USE 1960 AND PROJECTED LAND USE 1980[1]

	INTENSIVE 1960 & 1980			NON-INTENSIVE 1960			NON-INTENSIVE 1980					
	1	2	3	4	5	6	7	8	9	10	11	12
	Residential	Industrial/ Commercial	Total	Institutional and Park	Public Rights of Way	Total	Community Facilities & Institutions	Parks & Recreation	Public Rights of Way	Total	Open	Grand Totals
1960												
Square Miles	1032	216	1248	696	418	1114					4062	6424
Percentage of Total Developed Land	43	9	52	29	19	48						
High	58	12		45	22							
Low	32	2		15	13							
1980												
Square Miles	2040	368	2408				876	784	682	2342	1674	6424
Percentage of Total Developed Land	43	8	51				19	16	14	49		
1960 - 1980												
Square Miles of Land to be Developed	1400	220	1620							1228		
Percentage of Total Land to be Developed			58							42		

1. The averages were derived from the data in "Table 3. The Use of Developed Land in Selected Areas of the Region." RPA Bulletin Number 100, Page 21, September, 1962. The data for square miles excludes Monmouth County from the original RPA totals.

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TABLE 3

LAND USE BY COUNTY 1954 AND 1960 IN SQUARE MILES

Counties in Con Ed Study Area			1954			1960				
						INTENSIVE		LOW INTENSIVE		
State	In RPA Region	Outside RPA Region	Intensive	Low Intensive	Open Land	Residential	Industrial/ Commercial	Institutional and Park	Public Rights of Way	Open
Conn.	Fairfield		90	13	530	80	16	64	43	430
		Litchfield				[24]	[5]	[2]	[3]	[15]
		New Haven				[64]	[13]	[43]	[28]	[285]
N. J.	Bergen		70	18	145	62	13	19	13	126
	Essex		57	19	57	61	12	7	4	44
	Hudson		21	6	18	26	5	2	1	11
	Middlesex		49	16	248	49	10	31	20	203
	Morris		46	23	399	44	9	50	33	332
	Passaic		33	43	118	41	8	17	12	116
	Somerset		23	7	277	29	6	33	22	217
		Sussex				[22]	[4]	[60]	[40]	[402]
	Union		43	15	45	43	7	6	4	43
		Warren				[2]	[1]	[5]	[3]	[34]
N. Y.	Dutchess		39	5	772	46	9	92	61	608
	Nassau		136	38	119	114	19	78	13	69
	Orange		23	66	740	52	11	92	61	613
	Putnam		14	1	219	15	3	26	17	173
	Rockland		14	51	114	28	6	30	12	103
	Suffolk		119	79	723	110	23	95	63	630
		Sullivan				[15]	[3]	[64]	[43]	[427]
		Ulster				[42]	[9]	[115]	[76]	[764]
	Westchester		79	79	277	83	18	40	27	267

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TABLE 3 continued...

LAND USE BY COUNTY 1954 AND 1960 IN SQUARE MILES

Counties in Con Ed Study Area			1954			1960				
						INTENSIVE		LOW INTENSIVE		
State	In RPA Region	Outside RPA Region	Intensive	Low Intensive	Open Land	Residential	Industrial/ Commercial	Institutional and Park	Public Rights of Way	Open
N. Y.	Bronx		31*	7	4	25	4	2	1	10
	Kings		34	4	31	42	7	2	2	16
	New York		20*	2	0	14	2	2	3	1
	Queens		98*	10	1	65	11	4	3	26
	Richmond		29*	8	21	17	3	5	3	30
Pa.		Pike				[6]	[1]	[42]	[28]	[277]
	TOTAL RPA REGION					1046	202	697	418	4068
	CONTROL TOTALS					1032	216	696	418	4062
	TOTAL CONSOLIDATED EDISON AREA					1221	238	1028	639	6272

NOTES: Figures with * are for 1954 land use in New York City. They were not used for 1960 and 1980 because the data for 1960 was assumed to be more discrete.

Figures in [ ] are for those counties outside RPA's Region. They are added in to the total for Con Ed's area.

REGIONAL ECONOMIC DEVELOPMENT INSTITUTE, INCORPORATED

TABLE 3, PART TWO

LAND USE PROJECTION BY COUNTY FOR 1980 IN SQUARE MILES

Counties in Con Ed Study Area			INTENSIVE		LOW INTENSIVE			
State	In RPA Region	Outside RPA Region	Residential	Industrial/ Commercial	Community Facilities & Institutions	Parks & Recreation	Public Rights of Way	Open
Conn.	Fairfield		183	33	92	83	71	171
		Litchfield	[30]	[6]	[3]	[3]	[2]	[5]
		New Haven	[88]	[19]	[72]	[65]	[55]	[134]
N. J.	Bergen		118	22	20	19	16	38
	Essex		83	16	6	6	5	12
	Hudson		26	5	3	3	2	6
	Middlesex		126 (58)	22 (10)	18	16	14	34
	Morris		130	23	69	63	54	129
	Passaic		75	14	23	21	18	43
	Somerset		71 (24)	13 (4)	16	15	12	30
		Sussex	[34]	[8]	[107]	[97]	[83]	[199]
	Union		63	12	6	6	5	11
		Warren	[3]	[1]	[9]	[9]	[7]	[18]
N. Y.	Dutchess		106	19	152	138	117	283
	Nassau		230	41	5	4	4	9
	Orange		110	20	154	140	119	286
	Putnam		37	6	42	38	32	79
	Rockland		56	10	25	23	19	46
	Suffolk		279 (199)	50 (35)	92	84	72	172
		Sullivan	[18]	[4]	[117]	[106]	[90]	[217]
		Ulster	[53]	[12]	[207]	[188]	[160]	[386]
	Westchester		162	31	53	48	42	99
	Bronx		25	4	3	3	2	5

TABLE 3, PART TWO continued...

LAND USE PROJECTION BY COUNTY FOR 1980 IN SQUARE MILES

Counties in Con Ed Study Area			INTENSIVE		LOW INTENSIVE			
State	In RPA Region	Outside RPA Region	Residential	Industrial/ Commercial	Community Facilities & Institutions	Parks & Recreation	Public Rights of Way	Open
N. Y.	Kings		42	7	4	4	4	8
	New York		14	2	1	1	1	3
	Queens		65	11	7	7	6	13
	Richmond		39	7	3	2	2	5
Pa.		Pike	[7]	[1]	[76]	[69]	[59]	[142]
	TOTAL RPA REGION		2040	368	794#	724#	617#	1482#
	CONTROL TOTALS		2040	368	876	784	682	1674
	TOTAL CONSOLIDATED EDISON AREA		2078	383	1385	1261	1073	2583

NOTES: Total RPA Region figures followed by # indicate that only the portion of the counties in Con Ed's area are included. This explains why these figures are further from the control total figures than in previous cases.

Figures in [ ] are for those counties outside RPA's Region. They are added in to the total for Con Ed's area.

PART III A

PROJECTIONS OF POPULATION, AND DISTRIBUTION BY ZONES

Our summary tables show the distribution by 40 zones (eight sectors in each of five concentric rings) of the 1960 population and of the 1980 population projected according to three different techniques. In this section we explain (1) how the projections were made, and (2) how both the 1960 and the projected 1980 populations were allocated among the 40 prescribed zones.

1. The Projections

We started from projected totals for each of the twenty-nine counties that lie wholly or partially within the 55-mile circle. All three of our projections agree in the total for each county. This starting-point was adopted because of the availability of a rather recent set of county population projections for 1980, prepared by the Regional Plan Association of New York and representing the outcome of extended and intensive study of the New York metropolitan region and its growth patterns. The RPA projections represent a careful revision and improvement of earlier projections made by Harvard University's New York Metropolitan Region Study in 1958-1959; the revisions take into account the findings of the 1960 Census and other subsequent materials. They are also tied in closely with the RPA's analysis of present and prospective land use in the area.

Consequently, we adopted the Regional Plan Association's county total for 1980, for each of the counties in which such an RPA figure is available. Our projections for individual municipalities were controlled so as to add up to the RPA total in each county.

The 55-mile circle includes some territory beyond RPA's sphere of analysis: Warren and Sussex Counties in New Jersey, and fractions of a half-dozen other counties in Connecticut, New York State, and Pennsylvania. For these additional counties and part-counties, we prepared our own projections--based on relative growth rates in 1950-1960 and 1960-1965, the projected 1960-1980 growth rates available from RPA for adjoining and roughly similar counties, and RPA's broad indications of the directions of most rapid outward spread of metropolitan growth in the next decade or two. These projections are of course crude compared with RPA's; but even fairly substantial errors in them will not be likely to distort the final results very greatly, since the population involved is only about five percent of the total within the 55-mile circle.

The next step was to disaggregate the twenty-nine counties into their 500-odd component municipalities. As simple rules for deciding how fast individual municipalities would grow relative to their counties, we used two different principles in separate projections, and then combined them in a third projection.

A. Extrapolative Projection. Our first set of projections is based on the assumption that places which grew faster than their counties in the 1950's will continue to do so, and that those which lagged behind their counties' growth in the 1950's will continue to lag in the 1960's and 1970's. Specifically, each municipality's population was first projected linearly to 1980, simply extending the 1950-1960 growth rate for another twenty years. This extrapolation was done both on a geometric basis (using the 1950-1960 percentage increase per annum) and an arithmetic basis (using the 1950-1960 increase rate in persons per annum). The latter was adopted after inspection of the results, since it produced fewer cases that were obviously absurd[1] and also because the projected growth for the area as a whole involves a somewhat smaller percentage rate per annum between 1960 and 1980 than was registered in the 1950's.

The extrapolated figures for all the municipalities in each county were then totaled, and adjusted up or down pro rata to make the total conform to the RPA or other total already established for the county.

B. Density-based Projection. One quite obvious shortcoming of the extrapolative technique just described is that it takes no account of restraints upon growth arising from the filling-up of developable space. We sought, therefore, to develop an alternative set of projections which would incorporate the hypothesis that percentage rates of growth of individual communities slacken off with higher population densities per square mile.

Some preliminary investigations into data for selected counties were made to see if the posited inverse relation of growth rate to density is actually present to a sufficiently significant degree to make it a useful projection guide. These investigations disclosed a marked relationship of the expected sort in the 1950-1960 growth and density rate for municipalities. It appeared also that a straight-line regression relation between the logarithms of (1) the growth ratio and (2)

1. For example, take the not unrealistic case of a small, suburban community that grew from 100 in 1950 to 2,000 in 1960. Extending that rate of percentage increase would give a projected 1980 population of 800,000! The less-exuberant arithmetic extrapolation, in the same instance, would give only 5,800 for 1980.

the density of population at the beginning of the time interval provided a more appropriate formulation than a simple linear relation.

Accordingly, the data on 1950 and 1960 population and land area for all municipalities were processed so as to yield a statistically-fitted regression formula for municipalities in each county, relating rate of population growth to density of population. In fitting the equation, the data for individual municipalities were weighted according to population, giving larger places a proportionately greater influence on the formula.

These regression formulas were, in all but a few counties, associated with a high enough degree of correlation to leave no doubt about the usefulness of this approach as a guide to relative rates of expected population growth. With one unimportant exception (Sullivan County), the relationships were consistently inverse in direction as would be expected (i. e., higher density was associated with lower growth rates in any given county). In the Sullivan County case, the correlation was too small to make its size or direction significant.

The projections produced by this method for individual municipalities were then totaled for each county and adjusted to make the county totals conform to the RPA or other total already established for that county, just as was done with the first or extrapolative set of projections.

C. Compromise Projection. The two alternative sets of projections just described rest on entirely different principles, each of which (the continuity of growth differentials, and the inverse relation of growth rate to density) has demonstrable validity but falls short of complete adequacy. Consequently, it seemed appropriate to combine the two types of projection into a third, incorporating both the continuity and the density effects.

To get this third set, labeled "compromise" projections, we took for each municipality the geometric mean between the adjusted extrapolative and the adjusted density-based projection. Then the "compromise" projections for the municipalities of each county were added up and adjusted to make the county total conform, as in the two previous cases, to the RPA or other total already established for the county.

The averaging procedure allows each of the two effects (growth-continuity and density) to exert an effect on the compromise projections. Where the extrapolative and the density-based projections were in close agreement, they reinforce each other in projecting differentiation of growth rates in different parts of a county; where the extrapolative and density-based projections give sharply differing answers, they tend to cancel one another out in terms of such differentiation, leading to compromise projections which show relatively little dissimilarity in growth rates among the parts of a county. This seems appropriate--where the two approaches we have tried give very different results, we are well advised to take both of them less seriously and have less occasion for diverging very far from the simple assumption that all parts of any given county will grow at equal rates.

The geometric mean was chosen in preference to the arithmetic as a way of still further toning-down the most extreme variations of growth rates.

It seems to us that the compromise projections are the "best" of the three so far as anyone can judge in advance. However, all three sets of projections are presented in equal detail so that users of these reported results may make their own evaluations and decisions.

2. ALLOCATION TO RING AND SECTOR ZONES

Each of the three sets of projections by municipalities (and also the actual 1960 populations of municipalities then had to be translated into population totals for the 40 ring-and-sector zones stipulated.

A little more than half of the municipalities were found to lie wholly within one of the 40 zones. Each of the rest had to be split, with portions allocated to anywhere from two to six different zones. In view of the large number of cases involved (more than 250 municipalities,) to be split into more than 600 fractional parts, the splitting was done by inspection of a map showing the municipalities and zone boundaries, the proportional division of the municipality's area among continguous zones ~~were~~ was estimated visually, and in most cases it was assumed that the same proportionate split would also apply to that municipality's population. Whenever feasible, however, and particularly where places of significant size were concerned, account was taken of the location of major concentrations of population within the municipality boundaries.

It was assumed that the same split-up of a municipality would apply in the case of each of the three projections, and also for the 1960 population.

The derivation of 1960 and projected population totals for each of the 40 zones was carried on in an electronic computer, which also provided totals in each case for each ring and each sector of the grid.

PART III B

PROJECTIONS OF LAND USE BY COUNTY, 1980

The basic theory of the projection technique used to disaggregate RPA gross estimates of land use is that in each county the "intensive use ratio" (I) defined as the percentage of total land area used for residential, commercial, and industrial purposes,[1] is a function of the population density (D) for that county. This relationship is demonstrated in the following Graph which plots the logarithms of I_{1954} (percentage of land in intensive use in 1954) against the logarithms of D, where D is the average of 1950 and 1960 population densities for each of twenty-one counties in the RPA Region.[2]

A statistical test of the relationship between I and D was then produced by fitting a regression equation of the form $\log Y = a + b \log X$ to the scatter of points in the Graph. The fitted equation,[3] $\log I\ 1954 = -.361 + .531 \log D$ (Equation 1) has an R^2, or coefficient of determination, equal to .931. This means that 93.1 percent of the variation in the percentage of land used intensively is explained by population density. Equation 1 is the basis for disaggregating by

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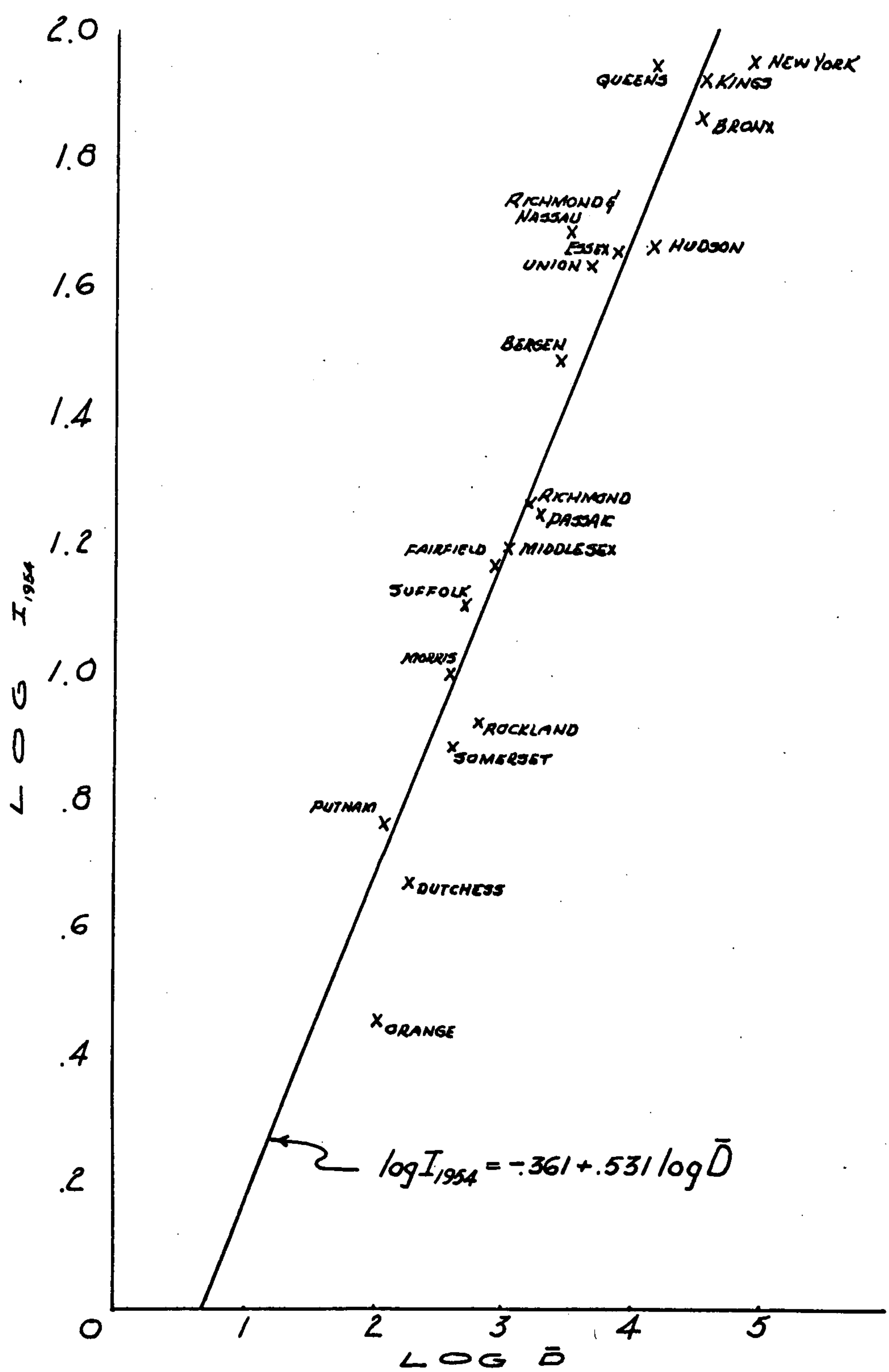
1. This definition of intensive land development is the one used by the Regional Plan Association to describe "Table 20. Land Development by County in 1954, RPA Bulletin Number 87, page 31, June, 1957.
2. Sources of Data: "Table 20. Land Development by County 1964," RPA Bulletin Number 87, page 31, June, 1957, and "Table 4. The Region's Population, 1860 to 1960, by County, RPA Bulletin Number 100, page 36 (Appendix), September, 1962.
3. An explanation of the regression technique used may be found in most general statistical research text books, such as Ferber and Verdoorn, "Research Methods in Economics and Business," New York, 1962.

GRAPH


2.0
1.8
1.6
1.4
1.2
1.0
.8
.6
.4
.2
0
1
2
3
4
5
LOG I_{1954}
LOG $\bar{D}$
NEW YORK
QUEENS
KINGS
BRONX
RICHMOND & NASSAU
ESSEX
HUDSON
UNION
BERGEN
RICHMOND
PASSAIC
FAIRFIELD
MIDDLESEX
SUFFOLK
MORRIS
ROCKLAND
SOMERSET
PUTNAM
DUTCHESS
ORANGE
$\log I_{1954} = -.361 + .531 \log \bar{D}$

counties RPA's gross land use estimates for its region. Land use values for counties not in RPA's Region were also obtained from Equation 1, but no control or scale factor was available.

Application of this relationship yielded the estimates of square miles of intensively used land by county in 1960, in Column 1 of Table 1. A second estimate of intensive land use by county in 1960 was obtained by applying an average value of 52 percent for intensive land use to RPA estimates of 1960 "committed" land.[4] This second set of estimates (Column 2 in Table 1) permits the projection estimates from Equation 1 to be judged against a control total derived from the RPA estimates for committed land. Of the total 2,400 square miles of committed land in RPA estimates for 1960, 1,248 square miles were developed intensively. The 1,258 square miles of intensively used land projected by Equation 1 is within one percent of this control total. Column 3 represents the results of an adjustment in intensively used land for those counties in Column 2 which suffered most from averaging. The adjustment was made by applying the high (low) intensity percentage for counties closer to (farther from) the core of RPA's Region.[5] This correction brought the total for the second estimate to that of the control total. The best estimates of square miles of intensively used land by counties in Column 3, Table 1. were then

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4. The average value of 52 percent was derived from 1960 RPA estimates of committed land used intensively in selected areas of the region. See Table 2, Column 3.
5. See Table 2 for high and low values of intensive land use ratio. Also "The Region's Rings of Development," <u>RPA Bulletin Number 100</u>, page 6, September, 1962.

disaggregated into residential and commercial/industrial uses by applying average figures of 83 and 17 percent, respectively, which were derived from RPA aggregate estimates. The results appear in Table 3.

With this foundation, the next step was the projection of land-use intensity in 1980 by means of Equation 1. The population density for 1980 used in the projection came from RPA estimates of 1980 population by county for those counties in RPA's region.[6] (Population density for 1980 for counties not covered by RPA were obtained by extrapolating population for 1980 from that in 1950 and 1960.)[7] The results in square miles of this projection appear in Column 5 of Table 1.

Projecting by Equation 1 requires that points in the Graph far from the regression line will be on the regression line twenty years hence. Thus, an alternative form of this projecting technique embodying the same relationship was also used. These alternative-form projections, which appear in Column 6 of Table 1 were produced by

$$\log I_{1980} = \log I_{1954} + .531 (\log D_{1980} - \log D \quad \text{(Equation 2)}$$

which uses the difference in population density between 1980 and the average of 1950-1960 to project the difference in the intensive land use ratio between 1980 and 1954. While it is felt that neither set of the projected intensive land use

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6. "Table 5. The Region's Projected Population, 1965 to 1985, by County," RPA Bulletin Number 100, page 36 (Appendix), September, 1962.
7. County and Data Book, 1962, United States Department of Commerce, Bureau of the Census, Washington, 1962.

figures are any better than could possibly be obtained from the existing data, they can be viewed with some assurance that they are of the correct magnitude.

The Regional Plan Association estimated that 2,500 more square miles of land will be developed between 1960 and 1985.[8] Assuming that this is done at an even rate over the 25-year period, about 2,000 square miles will be developed between 1960 and 1980. RPA estimates that 58 percent of this land will be developed in intensive uses.[9] Thus, 1,160 square miles of intensively developed land could be added by 1980 according to the estimate derived from RPA data. Total land used intensively in the region could reach 2,408 square miles as shown in Table 2.

With this new control total for total intensively used land in 1980, the "best" disaggregated projection from Equations 1 and 2 was adjusted by a factor of 1.529 to coincide with RPA estimates. The "best" disaggregated projected value for intensively used land in each county is given in Column 7 of Table 1. Selection of the value for this column from the values produced by Equations 1 and 2 in Columns 5 and 6, respectively, was made by taking the larger value in all cases except Hudson County and New York City. In the cases of Hudson County and New York City, Equations 1 and 2 gave smaller projected values because population is expected to decline; but, even with slight population decline, it is reasonable to assume that the percentage of land used intensively should remain

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8. "Chart 14. Extent of Land Development in the Region, 1960 and 1985." RPA Bulletin Number 100, page 20. An adjustment has been made for excluding Monmouth County in our projections.
9. Ibid.

at least as high as in 1960, so the 1960 figure is retained for 1980.

The further disaggregation of intensive land use in 1980 by county was produced by applying to the difference in land use intensity between 1960 and 1980 average values of 83 percent for residential and 17 percent for commercial/industrial uses, which were derived from RPA estimated values for the region as a whole. The resultant increment in residential and commercial/industrial usage was added to the values obtained in similar fashion for 1960; and the totals for 1980 are given in Table 3, Part Two.

TABLE 1.4-1

1960 POPULATION
BY RING AND SECTOR ZONES
FOR 15 MILE RADIUS

	0 to 1/2	1/2 to 1	1 to 2	2 to 3	3 to 4	4 to 5	5 to 10	10 to 15
N to 15°	0	0	0	60	60	0	1210	
15° to 30°	0	0	50	130	120	710	610	
30° to NE	0	0	280	5650	1000	890	4070	
N to NE								3490
NE to 60°	0	0	2930	7460	630	1100	2770	
60° to 75°	0	10	2050	1610	1470	1460	3690	
75° to E	0	10	270	180	140	250	5080	
NE to E								9720
E to 105°	0	300	130	50	330	90	2170	
105° to 120°	46	54	270	70	540	540	1720	
120° to SE	0	80	330	50	270	320	2270	
E to SE								25940
SE to 150°	0	320	630	310	410	300	23740	
150° to 165°	0	50	760	1900	20	0	1810	
165° to S	0	30	350	50	0	0	8300	
SE to S								51160
S to 195°	0	160	250	0	50	300	19200	
195° to 210°	0	0	1000	20	300	3800	6300	
210° to SW	0	0	50	530	3200	1000	8500	
S to SW								47000
SW to 240°	0	0	20	350	160	50	1000	
240° to 255°	0	0	150	120	40	100	0	
255° to W	0	0	20	150	120	0	0	
SW to W								7030
W to 285°	0	0	20	30	0	0	90	
285° to 300°	0	0	40	0	0	0	1030	
300° to NW	0	0	60	50	120	0	150	
W to NW								12090
NW to 330°	0	0	20	0	40	260	100	
330° to 345°	0	20	0	50	80	3100	780	
345° to N	0	0	50	0	0	40	7880	
NW to N								14990

NOTE: The populations above refer to Fig. No. 1.4-2

TABLE 1.4-2

1980 "COMPROMISE" PROJECTION OF POPULATION
BY RING AND SECTOR ZONES
FOR 15 MILE RADIUS

	0 to 1/2	1/2 to 1	1 to 2	2 to 3	3 to 4	4 to 5	5 to 10	10 to 15
N to 15°	0	0	0	140	140	0	2750	
15° to 30°	0	0	110	300	270	1620	1390	
30° to NE	0	0	640	12860	2280	2030	9270	
N to NE								7940
NE to 60°	0	0	5210	13280	1120	1960	4930	
60° to 75°	0	20	3650	2860	2620	2600	6570	
75° to E	0	20	480	320	250	440	9040	
NE to E								17300
E to 105°	0	600	260	100	650	180	4310	
105° to 120°	100	100	540	140	1070	1070	3420	
120° to SE	0	160	650	100	540	640	4510	
E to SE								51500
SE to 150°	0	580	1140	560	740	540	43100	
150° to 165°	0	90	1380	3450	40	0	3290	
165° to S	0	60	640	90	0	0	15070	
SE to S								92870
S to 195°	0	340	540	0	110	640	41110	
195° to 210°	0	0	2140	40	640	8140	13490	
210° to SW	0	0	110	1130	6850	2140	18200	
S to SW								100640
SW to 240°	0	0	100	1680	770	240	4790	
240° to 255°	0	0	720	570	190	480	0	
255° to W	0	0	100	720	570	0	0	
SW to W								33680
W to 285°	0	0	40	60	0	0	190	
285° to 300°	0	0	80	0	0	0	2140	
300° to NW	0	0	130	110	260	0	310	
W to NW								25220
NW to 330°	0	0	40	0	80	490	190	
330° to 345°	0	40	0	100	150	5910	1480	
345° to N	0	0	100	0	0	80	15030	
NW to N								28420

NOTE: The populations above refer to Fig. No. 1.4-2

1.5 HYDROLOGY

The hydrological features of the Indian Point site are relevant to the analysis of radioactive liquid and gaseous discharges from the plant. During normal plant operation liquid wastes are discharged to the Hudson River through the circulating water discharge tunnel. The sources of ground water will not be susceptible to contamination from accidental ground seepage or leakage from the plant because of the permeability of the bedrock and the higher elevation of the plant relative to the river. Gaseous releases from the plant following a hypothetical accident have been studied for possible deposition of contaminants into surrounding surface water reservoirs. Therefore, the hydrological features are categorized by the Hudson River, ground water and wells, and surface water reservoirs.

Two consultants have studied the hydrology of the Indian Point site. In 1955, prior to construction of Unit No. 1, Mr. Karl R. Kennison reported the flow characteristics of the river at the site. In 1965, the firm of Metcalf & Eddy reviewed Mr. Kennison's report and further reported the ground water hydrology and surface water reservoirs. The report by Metcalf & Eddy is included in this section, appended by the Kennison report.

Flow in the Hudson River is controlled more by the tides than by the runoff from the tributary watershed. Opposite the plant the width is 4500 to 5000 feet with a depth of 55 to 75 feet less than 1000 feet offshore. Total flow past the plant during the peak tidal flow is about 80,000,000 gallons per minute about 80% of the time, and it has been estimated that about 500 feet of the shore line flow is at least 9,000,000 gallons per minute in a section 500-600 feet wide. This large flow assures adequate dilution and complete mixing of the discharges from the plant. The plant is designed and will be operated such that discharges into the river would not prevent using the river water for drinking water. The net mean downstream flow due to runoff is as follows:

11,700,000 gpm may be expected to be exceeded 20% of the time;
4,710,000 gpm may be expected to be exceeded 60% of the time;
1,800,000 gpm may be expected to be exceeded 98% of the time.

The table of river flow for a 17-year period presented in both the Kennison and Metcalf & Eddy reports is for the net river runoff flow.

Flooding at the site is nonexistent. Flood stages are primarily the effect of tidal influence and the highest recorded water elevation in the vicinity of the site was 7.4 feet above mean sea level. This is well below the basement elevation of Unit No. 3.

Within a five-mile radius of the plant only one municipal water supply utilizes ground water. Other wells are for industrial and commercial usage. The rock formations in the area and elevations of wells relative to the plant are such that accidental ground leakage or seepage percolating into the ground at Indian Point will not reach these sources of ground water but will flow to the river. This subject is discussed further in the section on Geology.

Only two reservoirs within a five-mile radius are used for municipal water supplies. The Camp Field Reservoir is the raw-water receiving basin for the City of Peekskill with the Catskill Aqueduct and Montrose Water District as alternate supplies. The impounding reservoir for the Stony Point water system serves the towns of Stony Point and Haverstraw, and the villages of Haverstraw and West Haverstraw. The Stony Point system is connected to the Spring Valley Water Company to provide an alternate source of supply. A third reservoir within five miles of the plant, Queensboro Lake, supplies water to a state park area only. The location of these reservoirs and those within a fifteen-mile radius are shown on Figure 1.5-1.

The City of New York's Chelsea Pumping Station is located about one mile north of Chelsea, New York, on the east bank of the Hudson River. Water will be pumped from intakes in the river at the rate of 100 million gallons per day into the city reservoir system as required to supplement the primary supply from watersheds. The pumping station is 22 miles upriver from Indian Point measured along the centerline of the river as shown on Figure 1.5-2.

Discharge of any contaminant to a tidal estuary will result in its distribution throughout the estuary. Factors affecting this distribution include tidal amplitude and current, river geometry, salinity distribution, and fresh water discharge. Quirk, Lawler and Matusky Engineers, Environmental Science and Engineering Consultants, of New York City, have made extensive studies of the influence of these factors and have assisted Con Edison in the study of contaminant transport in the river. A report of this study is included in this section.

During normal operation, discharge will not result in river concentrations that exceed MPC at the Indian Point discharge canal. This study has enabled us to determine the effect of radioactive discharges on overall river contamination, and specifically conditions at Chelsea pumping station as shown in detail in Chapter 12.

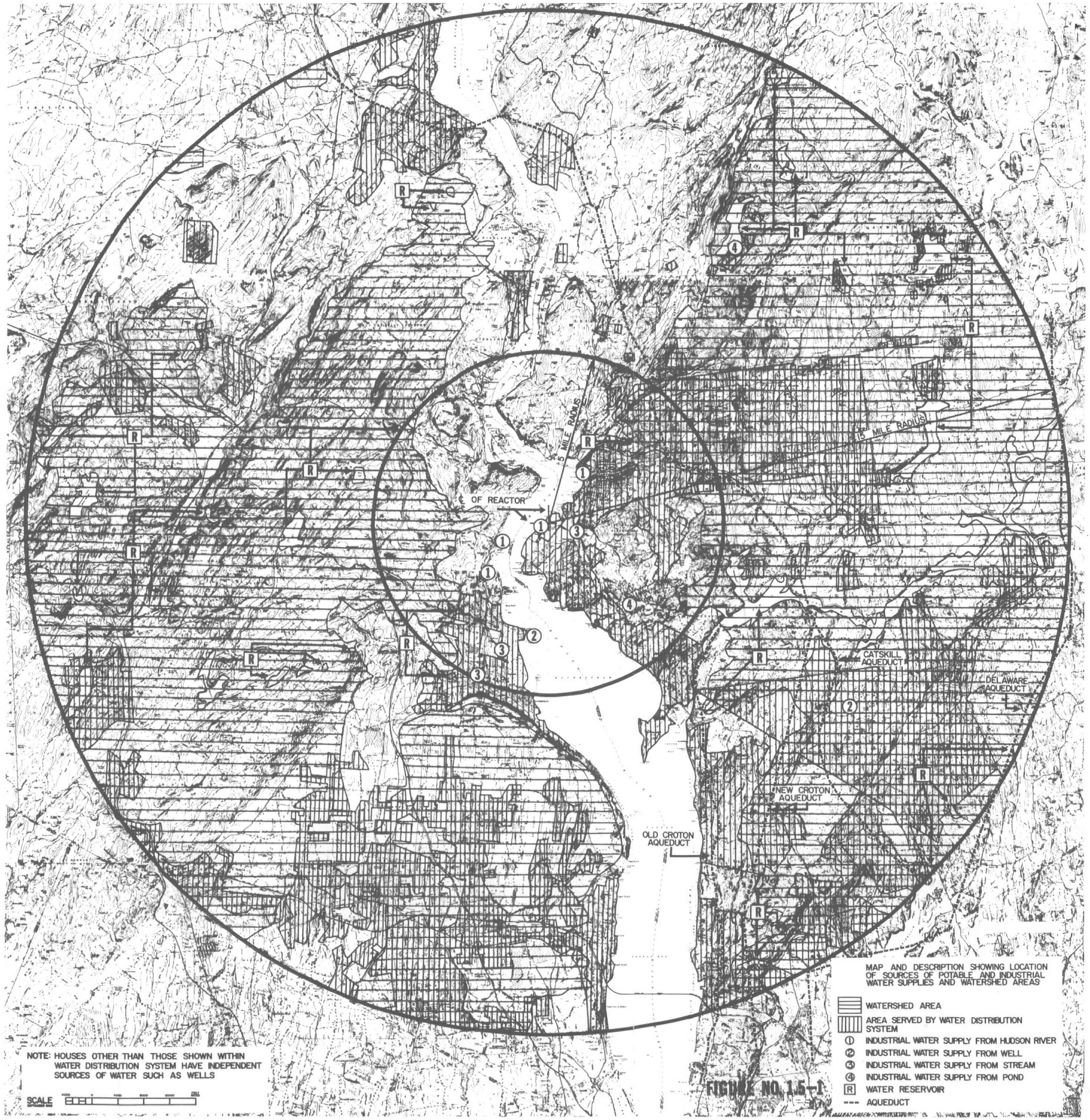
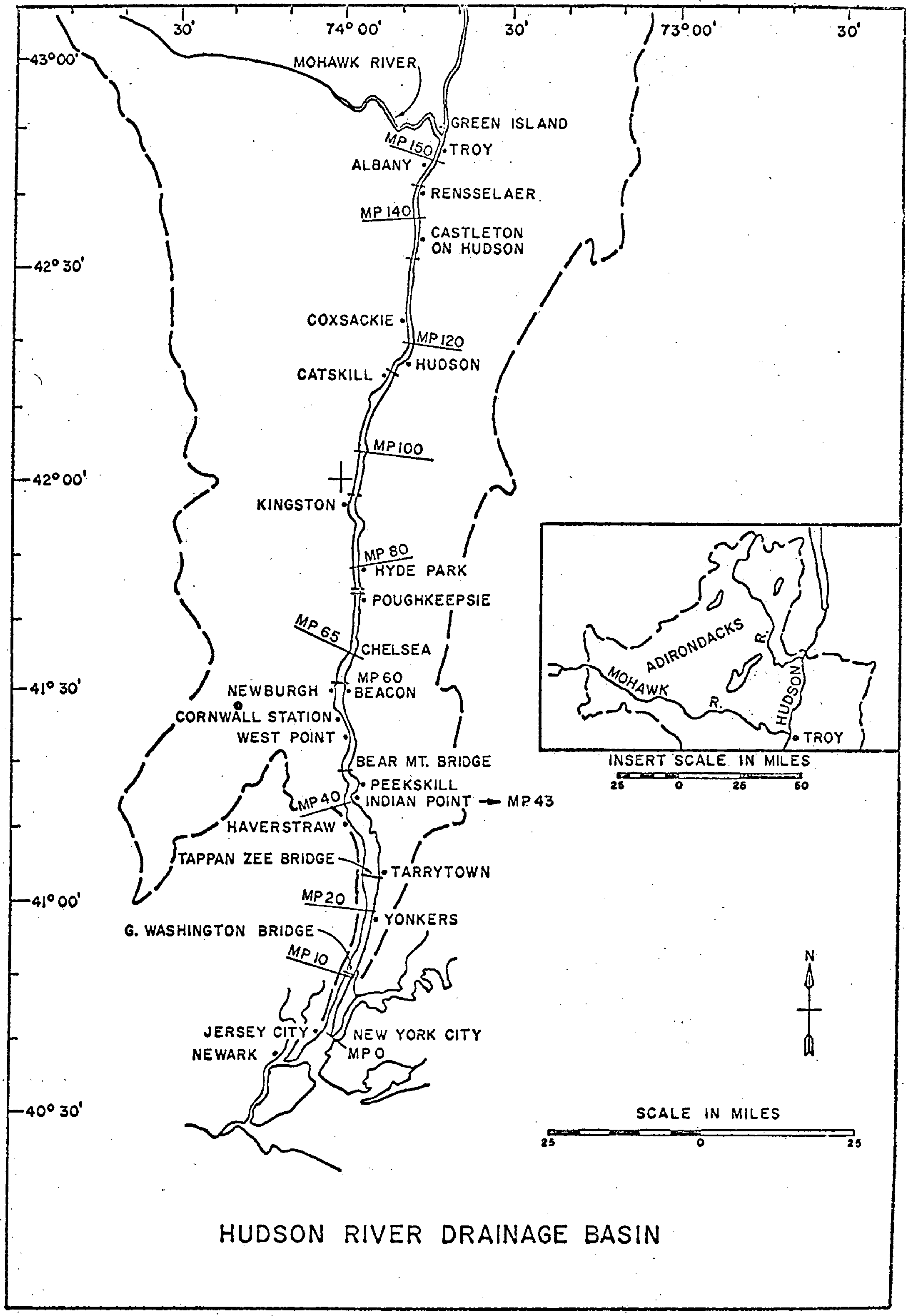


FIGURE NO. 1.5-1



HUDSON RIVER DRAINAGE BASIN

FIGURE 1.5-2

HYDROLOGY OF INDIAN POINT SITE
AND SURROUNDING AREA

METCALF & EDDY ENGINEERS

OCTOBER, 1965

REPORT PREPARED BY GEORGE P. FULTON
UNDER DIRECTION OF HARRY L. KINSEL, P. E.

ACKNOWLEDGEMENTS

We acknowledge with thanks the assistance of many public officials, including the following, in furnishing data for this report:

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County Health Department

Mr. George Natt, Director,
Westchester County Water Agency

Mr. Michael Frimpter, U. S.
Geological Survey, Middletown, New York

INTRODUCTION

The hydrological features of the Indian Point site have been studied in three categories; the Hudson River, ground water and surface water reservoirs. Flow data and the flood history of the Hudson River in the vicinity of the Indian Point plant are discussed. Ground water sources within the area are generally used for industrial or commercial purposes with some limited residential usage on the west side of the river. The surface water reservoirs in the surrounding area that are used for water supplies and sources of alternate water supplies are also described.

HUDSON RIVER

General

The Consolidated Edison Indian Point plant is situated on the east bank of the Hudson River below Peekskill, just above Verplancks Point. In the general area of the plant, water from the Hudson River is used only for industrial cooling purposes. The nearest community utilizing the Hudson River for a public water supply at the present time is Poughkeepsie, some 30 miles upstream from the plant site.

Flow

Flow data for the Hudson River were abstracted from a previous report of Mr. K. Kennison, submitted to Consolidated Edison on November 18, 1958 (included as an appendix to the section on hydrology). Flood data were obtained from the Survey Division of the Corps of Engineers in New York City.

In the vicinity of Indian Point, the width of the Hudson River ranges from 4,500 to 5,000 feet with maximum depths of from 55 to 75 feet. Cross sectional areas of the river from a point three quarters of a mile upstream from the plant site to a mile downstream are in the order of from 165,000 to 170,000 square feet.

Flow duration records of the Hudson River for a 17-year period preceding 1930 show the following:

Rate of Flow c.f.s.	Percent of Time Exceeded
26,000	20%
15,250	40%
10,500	60%
7,000	80%
4,000	98%

It is evident that even the highest rates of flow expected will influence depth of flow in the river to only a small degree in the vicinity of the plant. This is due to the relatively high available flow section and the width of the river. River depth is affected more by the tidal influence than it can be by any anticipated flood flows.

The Hudson River is tidal as far upstream as Troy, some 100 miles from Indian Point. The elevation of the water surface in the vicinity of the plant is so responsive to the tidal cycle that average rate of flow has little effect on depth of flow or velocity of flow.

Flood History

Tide elevations vary both daily and seasonally and, in addition, can be affected by atmospheric conditions such as can exist during extreme storms or hurricanes. The atmospheric conditions can cause a surge which, added to the normal tide, establishes water elevation.

The highest water elevation at the U.S.G.S. station at Verplancks Point, one-half mile below Indian Point, was 7.4 feet above MSL (mean sea level) recorded in the year 1950. A higher surge occurred in 1960, but the normal tide stage was such that actual water elevation was somewhat less than the 1950 record. In an earlier period, before 1935, the highest recorded elevation was 4.75 ft. above MSL at Verplancks Point on August 24, 1933.

Mean water elevations at Verplancks Point are just below 1.0 (MSL). The mean range of water depth stages is about 3.0 ft.. With high runoff in the Hudson River Basin, the mean range at times averages a half a foot higher during the spring period.

The highest river elevation, recorded in 1950, was about 6.5 feet higher than average river levels, or some 5.0 feet higher than average high river stages. Considering past flood history and the fact that flood stages are primarily the effect of tidal influence, flooding of the Indian Point plant site appears to be a highly unlikely possibility.

Contamination Potential

The hazards of contamination of water supplies by discharge of water borne wastes from the Consolidated Edison Indian Point plant are almost minimal. In the reach of the Hudson River that could be affected, river water is used only for industrial cooling.

It should be mentioned that the City of New York is now in the process of constructing a river water pumping station at Chelsea in Putnam County below Poughkeepsie. The intent is to pump Hudson River water into the City system.

WELLS AND GROUND WATER

General

Within a five-mile radius of the plant the only public water supply using ground water is the Stony Point system of Utilities and Industries located in Rockland County across the river from Indian Point. Reports on ground water resources within this five-mile radius indicate the existence of numerous other wells. These wells are for industrial and commercial usage and for individual water supplies for private residences. Residential usage, however, is almost entirely confined to the area on the west side of the Hudson River.

Ground Water Geology

Water bearing strata in the area within a five-mile radius of Indian Point can be divided into unconsolidated surface deposits and consolidated bedrock. Unconsolidated deposits cover most of the bedrock in this area and range in thickness from a few feet in the hills to several hundred feet in the larger valleys. Unconsolidated deposits range from clays, which produce only meager quantities of water, to coarse sand and gravel capable of yielding several hundred gallons per minute to a well.

The bedrock underlies the unconsolidated deposits and, where these are absent, crops out at the surface. Ground water in bedrock occurs principally in fractures and solution channels.

Thus, the water bearing characteristics are generally similar, although the rocks differ widely in mineral composition and water yield.

Bedrock in Westchester County is, for the most part, metamorphic in character and includes schist and gneiss, with smaller amounts of limestone, quartzite and slate. Small injections of granite can also be found. Only minimal yields of ground water can be obtained from bedrock formations in Westchester County.

Consolidated rocks are the chief source of water in Rockland County. Principal rock units include the following:

a) Newark Group - sandstone, shale and conglomerate.

b) Palisade Diabase - diabase with some basalt.

c) Cambrian and Ordovician Rocks - quartzite, limestone and dolomite.

d) Precambrian Rocks - granite, gneiss, with some schist and diorite.

The Newark group provides the greatest source of ground water supply in Rockland County. The other units of bedrock yield only minimal quantities, as in Westchester County.

A small area of Orange County lies within the 5-mile radius being considered. Wells in this area have been drilled in bedrock formations similar to those in Westchester County where the water yield is small.

Well Supplies

As mentioned before, the only public water supply served by wells in the 5-mile radius of Indian Point is the Stony Point System. This system serves the Villages of Haverstraw and West Haverstraw as well as portions of the Towns of Haverstraw and Stony Point. The Stony Point supply wells are located in stratified drift, an unconsolidated formation. These wells are relatively shallow, the greatest depth about 35 ft. Total yield of the wells to the system averages about 550 gpm.

Other wells in Rockland County, in the area being considered, include some wells for commercial and industrial use and many private wells serving individual residences. These wells are located in bedrock for the most part and range from 100 to 300 ft. in depth. Consumption of water from wells serving private homes will vary from 100 to 1,000 gpd (gallons per day), depending on the number of persons using the supply and the facilities using water.

There are only a few wells still in use in Westchester County within the 5-mile radius. Almost all the wells within 2 to 3 miles of Indian Point have been abandoned and connections have been made to public water systems for supply. At the fringes of the area a few private wells are used for individual residences. These wells are mostly in unconsolidated deposits with depths less than 50 ft. Some wells exist in bedrock with depths varying up to several hundred feet.

A small portion of the community of Fort Montgomery in Orange County lies within 5 miles of the plant. Homes in this community are served entirely by individual private wells in bedrock. Depth of the wells vary up to several hundreds of feet.

Contamination Potential

The bedrock formation is such that it is highly unlikely that wastes percolating into the ground from the Indian Point site will reach the water bearing formations used for water supply on the west side of the river in Rockland and Orange Counties. Most of the wells in Westchester County are shallow, in unconsolidated formations with ground surface elevations considerably higher than at the plant site. This situation would preclude the possibility of contamination of the supply through ground water flow. Bedrock wells in Westchester County are similarly at higher elevations and, for the most part, are drilled in different rock formations than exists at the plant site.

SURFACE WATER RESERVOIRS

General

The major sources of water supply in the Indian Point area are lakes and surface water reservoirs. The reservoirs within a 15-mile radius of the plant site are tabulated in Tables 1-7 along with the users, capacities and distances from Indian Point. A detailed analysis of the reservoirs within 5 miles of the plant describes alternate sources of supply to those communities served by the reservoirs.

City of Peekskill-Camp Field Reservoir

The 54-million gallon Camp Field Reservoir of the City of Peekskill system, located 2.9 miles from Indian Point, is a raw-water receiving basin for the water treatment plant. Water is pumped into this basin from Peekskill Hollow Brook. For the most part, the water supply is the continuous flow of this brook. At times of low flow the supply can be supplemented by releasing water into the stream from holding reservoirs in Wicopee (Putnam County) some 11.7 miles from Indian Point or from the Catskill Aqueduct of the City of New York, located a short distance upstream from the pump intake.

The City of Peekskill system is divided into two service pressure areas. Water for the low-pressure area flows by gravity from Camp Field Reservoir through a bank of slow-sand filters into the system. No additional storage is provided for this section of the system. Water for the high-service area flows from the reservoir through two diatomaceous earth filters by gravity and then is pumped to a pair of elevated storage tanks with a total capacity of 800,000 gallons. The high-service system serves approximately 25 percent of the Peekskill area. The remaining area, including Standard Brands and most of the other industrial consumers, is served by the low-pressure system.

Total water consumption in Peekskill averages about 5 mgd. The largest single user is Standard Brands, at an average rate of 1.5 mgd. All water is supplied from Peekskill Hollow Brook. Two connections to other systems are available for emergency conditions. One is the above-mentioned Catskill Aqueduct connection which discharges into Peekskill Hollow Brook. This flow must be processed through the two treatment facilities for use. The other emergency connection is to the Montrose Water District system which can supply between 1.0 and 1.25 mgd from the Catskill Aqueduct to the low-service section of the Peekskill system.

Since no piping is installed to bypass Camp Field Reservoir, contamination of this basin would deprive Peekskill of its normal source of supply. Installation of a bypass would involve some 800 lin. ft. of 24-in. pipe between the inlet force mains and the outlet lines to the two filter facilities. With such a bypass, it would be possible to take water directly to the filters from Peekskill Hollow Brook after the passage of contaminated water in the event of prolonged contamination of Camp Field Reservoir. It might be necessary to accelerate flushing out of the brook and the impoundment at the pumping station in such a situation by releasing water from either the Catskill Aqueduct or the Wicopee reservoirs.

Peekskill most likely could not depend on the Montrose connection alone. This can supply less than one-half the normal demands of the low-service system even with the assumption that Standard Brands would not operate during the emergency. The high-service system has only 800,000-gallon storage, which would last less than 24 hours after shutting down the Peekskill Hollow Brook supply.

As presently arranged, the City of Peekskill would be practically deprived of a water supply with elimination of Peekskill Hollow Brook as a source. A study will soon be made under the auspices of the Westchester County Water Agency and the State of New York to determine the feasibility of connecting the Peekskill system to a proposed transmission main crossing northern Westchester County from the Delaware Aqueduct of the City of New York. This proposal could furnish an independent source of water in sufficient supply to serve all the needs of the City of Peekskill in the event of an emergency.

Palisades Interstate Park Commission - Queensboro Lake

Queensboro Lake, some 5 miles from Indian Point, serves as the year-round water supply for Bear Mountain Inn. The inn facilities include the offices of the Palisades Interstate Park Commission as well as a hotel and restaurant. Three other lakes feed into Queensboro Lake through stream flow or by pipe connection. Only Queensboro Lake is connected directly to the water system and no bypass is available to route water around the lake from a more distant location.

In case of contamination of Queensboro Lake, Bear Mountain Inn would be deprived of its water supply. A neighboring community, Fort Montgomery, is served entirely by individual private wells. This would seem to indicate that installation of an emergency well supply for Bear Mountain Inn would be feasible.

Stony Point Water System - Utilities and Industries

The Stony Point supply of Utilities and Industries, an investor-owned water company, serves the towns of Stony Point and Haverstraw as well as the villages of Haverstraw and West Haverstraw. Total average consumption is about 1.8 mgd with 1.0 mgd from a surface supply and 0.8 mgd from wells.

The impounding reservoir of the surface supply of 4.5 million gallon capacity is located some 3.5 miles from Indian Point. With contamination of this supply, the system would be left with only the wells which furnish about 45 percent of total consumption.

Negotiations are now under way for purchase of the Stony Point supply by the Spring Valley Water Company, an investor-owned utility serving most of the remaining areas of Rockland County. This company derives water from a well system of 13 to 15 mgd capacity and up to 7 mgd from De Forest Lake outflow some 10.8 miles from Indian Point. Plans have been completed for construction this fall of a connection between the Spring Valley Water Company system and the Stony Point system. This connection will furnish well water from the Spring Valley supply to the Stony Point network.

As far as can be ascertained from public records, the above three systems comprise the only surface water usage within a 5-mile radius of the Indian Point power plant except for industrial cooling water usage of the Hudson River. All other supplies are reported as originating in wells or from surface storage outside the 5-mile limit.

WATER STORAGE RESERVOIRS

TABLE 1

WITHIN 15 MILE RADIUS OF INDIAN POINT

WESTCHESTER COUNTY

Code	Reservoir	User	Capacity Million Gallons	Distance Miles	Surface Acres
W-8	Indian Brook	Ossining WB.	101	6.5	17
W-18	Pocantico Lake	New Rochelle Wat. Co.	200	11.9	63
W-14	Fergusons Lake	Pocantico Hills Est.	40 *	13.5	28
W-13	Tarrytown Res.	Tarrytown	313	14.0	85
W-13	Open Res. - 2	Tarrytown	1.75 & 1.10	14.0	1
W-1	Croton Res.	New York City (See List)	65,300 (Inside 15 mi.)		4059
W-10	Whippoorwill La.	New Castle Wat. Co.	25 *	13.3	8
W-11	Byram Lake	Mt. Kisco	950	15.0	133
W-11	Open Res.	Mt. Kisco	10 *	14.0	2
W-5	Lake Shenorock	Amawalk-Shenorock WD.	90 *	11.1	16
W-6	Open Res.	Lincoln Hall School	25 *	11.9	6
W-1A	Amawalk	NYC (See List)	10,000 (Included in W-1)	11.6	588
W-4	Camp Field Res.	Peekskill	54	2.9	11

* Estimated

WATER STORAGE RESERVOIRS

TABLE 2

WITHIN 15 MILE RADIUS OF INDIAN POINT

PUTNAM COUNTY

Code	Reservoir	User	Capacity Million Gallons	Distance Miles	Surface Acres
P-20	Lake Mahopac	See List	5,000 *	12.7	577
P-10	Oscawanna Lake	See List	3,500 *	9.5	362
P-21	Pelton Pond	N.Y.S. Fahnestock Park	125 *	14.0	11
P-6	Cold Spring	Cold Spring	150 *	13.0	25
B-3	Cargill Res.	Beacon	160	15.0	22
B-2	Mt. Beacon Res.	Beacon	180	14.5	17
B-1	Melzingah Res.	Beacon	60	13.3	8
W-4	Wicopee	Peekskill	1,200	11.7	166
P-5	Lake Secor	Carmel WD #5	350 *	10.8	50

* Estimated

WATER STORAGE RESERVOIRS

TABLE 3

WITHIN 15 MILE RADIUS OF INDIAN POINT

ORANGE COUNTY

Code	Reservoir	User	Capacity Million Gallons	Distance Miles	Surface Acres
0-11	Lusk Res.	U.S. M.A.	50 *	7.5	16
0-4	Intake Res.	Highland Falls	2.5	6.5	
	Bog Meadow	" "	80	8.3	43
	Little Bog	" "	4.5	7.5	2
	Jims Pond	" "	40	8.4	16
0-12	Turkey Hill La.	Palisades Int. Park	150	5.9	58
	Nawahunta La.	" " "	22	6.7	16
0-20	Silvermine La.	Palisades Int. Park	465	6.0	84
	Queensboro La.	" " "	56	5.0	37
0-16	Lake Stahahe	Palisades Int. Park	230	11.1	90
0-16	Summit Lake	Palisades Int. Park	110	8.3	34
	Barnes La.	Pal.Int.Pk. & U.S.M.A.	24	8.0	18
	Te'ata La.	Pal. Int. Pk.	77	7.7	32
	Upper Twin La.	" " "	105	7.7	24
	Lower Twin La.	" " "	88	7.6	26
	Massawiepa La.	" " "	104	7.7	29
0-17	Lake Tiorati	Pal.Int. Pk., Tiorati & Cohasset	1,500	6.7	296
0-10	Cromwell Lake	Woodbury	80	11.2	55
0-2	Walton Lake	Chester	300	14.6	129
0-5	Lake Mombasha	Monroe	1,750	13.0	324
0-1	Echo Lake	Arden Farms	40 *	9.5	30
0-7	Or[illegible] Res.	Sterling Forest	60 *	13.7	42

Code	Reservoir	User	Capacity Million Gallons	Distance Miles	Surface Acres
0-8&9	Tuxedo Lake	Tuxedo & Tuxedo Pk.	2,500	14.5	294
0-3	Aleck Meadow	Cornwall	23	9.2	9
	Arthur's Pond	Cornwall	115	9.2	20

* Estimated

WATER STORAGE RESERVOIRS

TABLE 4

WITHIN 15 MILE RADIUS OF INDIAN POINT

ROCKLAND COUNTY

Code	Reservoir	User	Capacity Million Gallons	Distance Miles	Surface Acres
R-14	Lake Sebago	Sebago Lake, Pal. Int. Pk.	1,100	10.8	300
R-18	Lake Welch	Welch Lake	1,000	7.2	209
R-13	Breakneck Pond	Breakneck Lake, Pal. Int. Pk.	100	9.2	63
R-3	Sec. & Third Res.	Letchworth Vill.	100	8.5	40
R-1	Open Res.	Utilities & Ind.	4.5	.3.5	5
R-7	Hillburn Res.	Hillburn	1.0	14.7	4
R-6	DeForest Lake	Hackensack Wat. Co. Spring Val. Wat. Co.	5,500	10.8	960

TABLE 5

MULTIPLE USERS OF WATER SUPPLY SYSTEMS
WITHIN 15 MILE RADIUS OF INDIAN POINT
WESTCHESTER COUNTY

<u>New Croton Aqueduct</u> (New York City)

- Ossining Water Board
- Sing Sing Prison
- Village of North Tarrytown
- New Rochelle Water Company
  - Village of Bronxville
  - Town of Eastchester
  - Village of North Pelham
  - Village of Pelham
  - Village of Pelham Manor
  - Village of Tuckahoe
- Village of Irvington
- Village of Briarcliff Manor
- New Castle Water District #1
- Village of Tarrytown

<u>Old Croton Aqueduct</u> (New York City)

- Ossining Water Board
  - Village of Ossining
  - Town of Ossining
  - Sing Sing Prison

TABLE 5 (CONT'D.)

Kensico Reservoir (New York City)

- City of White Plains
- North Castle District #1
- Westchester Joint Water Works No. 1
    - Village of Mamaroneck
    - Town of Harrison
    - Town of Mamaroneck
    - City of Rye
    - City of New Rochelle
    - Village of Larchmont
    - Village of Scarsdale
    - Village of Pelham Manor
- Harrison District #1

Catskill Aqueduct (New York City)

- Grasslands (Westchester Co.)
- Hawthorne Improvement District
    - Hawthorne
    - Town of Mt. Pleasant
- Valhalla W D
    - Valhalla
    - Town of Mt. Pleasant
- City of Yonkers
- Village of Scarsdale
- New Rochelle Wat. Co. (same as Pocantico Lake)

TABLE 5 (CONT'D.)

Amawalk Reservoir (New York City)

Yorktown W S D D

Amawalk Heights W D

Town of Somers

Town of Yorktown (13 Water Districts)

Peekskill System (City of Peekskill)

City of Peekskill

Village of Buchanan

Town of Cortlandt

Indian Brook Reservoir (Ossining Water Board)

Village of Ossining

Town of Ossining

Sing Sing Prison

Whippoorwill Lake (New Castle Water Co.)

Town of New Castle (Part)

Town of North Castle (Part)

Pocantico Lake (New Rochelle Water Co.)

Village of Ardsley

Village of Dobbs Ferry

Town of Greenburgh

Village of Hastings

Village of Scarsdale

Village of Eastchester

TABLE 5 (CONT'D.)

Tarrytown Reservoir

Village of Tarrytown

Glenville W D

Town of Greenburgh

Eastview

Town of Mount Pleasant

Village of North Tarrytown

TABLE 6

MULTIPLE USERS OF WATER SUPPLY SYSTEMS

WITHIN 15 MILE RADIUS OF INDIAN POINT

PUTNAM COUNTY

Lake Oscawanna

- Hiawatha Improvement Co.
- Hilltop W D
- Wildwood Knolls W D
- Oscawanna Lake (Private Homes)

Lake Mahopac

- Lake Gardens
- Lake Mahopac Woods
- Mahopac Hills
- Mahopac Old Village
- Lake Mahopac (Private Homes)
- Lake Mahopac Ridge
- Lake View Park
- Mahopac School

TABLE 7

MULTIPLE USERS OF WATER SUPPLY SYSTEMS
WITHIN 15 MILE RADIUS OF INDIAN POINT
ROCKLAND COUNTY

De Forest Lake

- Hackensack Water Co.
- Spring Valley Water Co.
  - Town of Clarkstown (Part)
  - Town of Ramapo
  - Town of Orangetown
- Nyack
  - Village of Nyack
  - Village of South Nyack
  - Upper Nyack
  - Town of Clarkstown (Part)

Stony Point Supply (Utilities and Industries)

- Town of Stony Point
- Town of Haverstraw
- Village of Haverstraw
- Village of West Haverstraw

KARL R. KENNISON
CIVIL AND HYDRAULIC ENGINEER
361 CLINTON AVE., BROOKLYN, N. Y.

Nov. 18, 1955

Mr. G. R. Milne
Mechanical Engineer
Cons. Edison Co. of N. Y.
4 Irving Place
New York 3, N. Y.

Dear Sir :

You have described to me the general features of the atomic-energy power plant which you are planning to construct on the east bank of the Hudson River below Peekskill. I understand that you wish me to report on such hydrologic features of the site as may affect your plans.

From the information that you have made available to me I conclude that the most useful information I can give you is that which relates to the amount and character of the flow in the river. At the proposed site the river has a width of about 4500 to 5000 feet, a maximum depth of 55 to 75 feet at less than 1000 feet off shore, and a cross-sectional area of about 165,000 to 170,000 square feet. Sheet 1 shows a number of cross sections of the river, plotted from the U.S.C.&G.S. charts, at intervals of 1500 feet, from 3750 feet upstream to 5250 feet downstream from the proposed plant.

At this site the effect of the tides is all important and so far outweighs any other consideration that, at least for present purposes, the information already available on the day-by-day variation of the runoff from the tributary watershed is adequate.

On Sheet 2 I have plotted an approximate flow-duration curve from data I had already calculated covering a period of

17 years.

An	average	rate	of	about	26000	cfs	may	be expected to be exceeded	20 %	of	the	time
"	"	"	"	"	15250	"	"	"	40 %	"	"	"
"	"	"	"	"	10500	"	"	"	60 %	"	"	"
"	"	"	"	"	7000	"	"	"	80 %	"	"	"

For say 2 % of the time the rate may be as low as 4000 cfs

However as above indicated the ebb and flow of the tide is the all important consideration. The river is tidal to as far upstream as Troy. Its hourly behavior in the tidal range varies throughout its length. The U. S. Coast & Geodetic Survey has tabulated a great deal of information from which a general picture of conditions off the shore at the proposed site can be obtained.

On Sheet 3 I have plotted the data, as they are applicable to this particular site. This indicates that the elevation of the water surface is so responsive to the tidal cycle that the average rate of flow, or runoff from the tributary watershed, has relatively little effect on the velocity past the site. I conclude that it is this velocity and the resulting volume of flow available for mixing and dilution in which you are primarily interested. In the limited time at my disposal I can only draw general conclusions. These may be adequate for present purposes. You could obtain better information by running a series of tests on surface and sub-surface floats, at varying distances off shore, throughout the tidal cycle.

The velocity recorded by the U.S.C.&G.S. is that in midstream at or near the surface. In order to be on the safe side in drawing conclusions, I have assumed that 80 % of this velocity represents the average vertically from surface to bottom, and that 80 % also represents the average horizontally from side to side, hence that roughly 64 % represents the average over the entire cross section. I have also assumed that 15 % of the total cross section, or a stretch about five or six hundred feet wide off shore, is all that should be used in considering the initial mixing or diluting effect. In making this assumption I am governed to some extent by Hazen's studies relative to the off-shore distance of Poughkeepsie's water intake to avoid direct contamination by its sewage. I have further assumed that the velocity in this off-shore stretch is only 60% of the midstream velocity, hence that roughly 48% represents the average over the cross section of this off-shore stretch.

On Sheet 4 I have shown the result of these assumptions, which, as above stated, are believed to be on the safe side in considering the direct effect of mixing or dilution of your wastes. This emphasizes the all-important effect of the tides, the quantity available for dilution varying in about three hours from a maximum of eight or ten million gallons per minute to nothing.

Although you will have to put up with this variation as far as your continuous cooling water circulation is concerned, it does point to the desirability of incorporating in your design a method of controlling the time for the discharge into the cooling water outlet of any and all waste that is to any extent radioactive. I would say that this should be done in any event for the drainage from your routine and emergency demineralizers, and it might well be done also for drainage from all areas liable to accidental contamination.

From your estimate of the extent of dilution already accomplished in the demineralizer waste overflow, I trust you can get an approximate figure for the dilution that may result in the river off shore, and can compare this with what you may find necessary or desirable for adequate protection of fish life or of the fish eating public.

As far as the effect on public water supplies is concerned, the use of the Hudson River for water supply, other than condenser cooling, is very limited. The nearest municipality involved is Poughkeepsie, 30 miles or more upstream, and even at that distance threatened at times with the problem of salinity. There is no likelihood that in the future any nearer municipality will take its domestic water supply from the Hudson. In fact the tendency is the other way, and the more remote municipalities of Catskill and Hudson have abandoned earlier supplies taken from the river.

As far as the effect on ground water is concerned, you have acquired an ample area of surrounding land. I can see no possibility of any deleterious effect.

I trust that this information which I have assembled in the limited time available will be helpful to you. If from these approximate figures there appears to be any question as to the adequacy of the safety factor in dilution, you may, as above stated, require additional information from float tests.

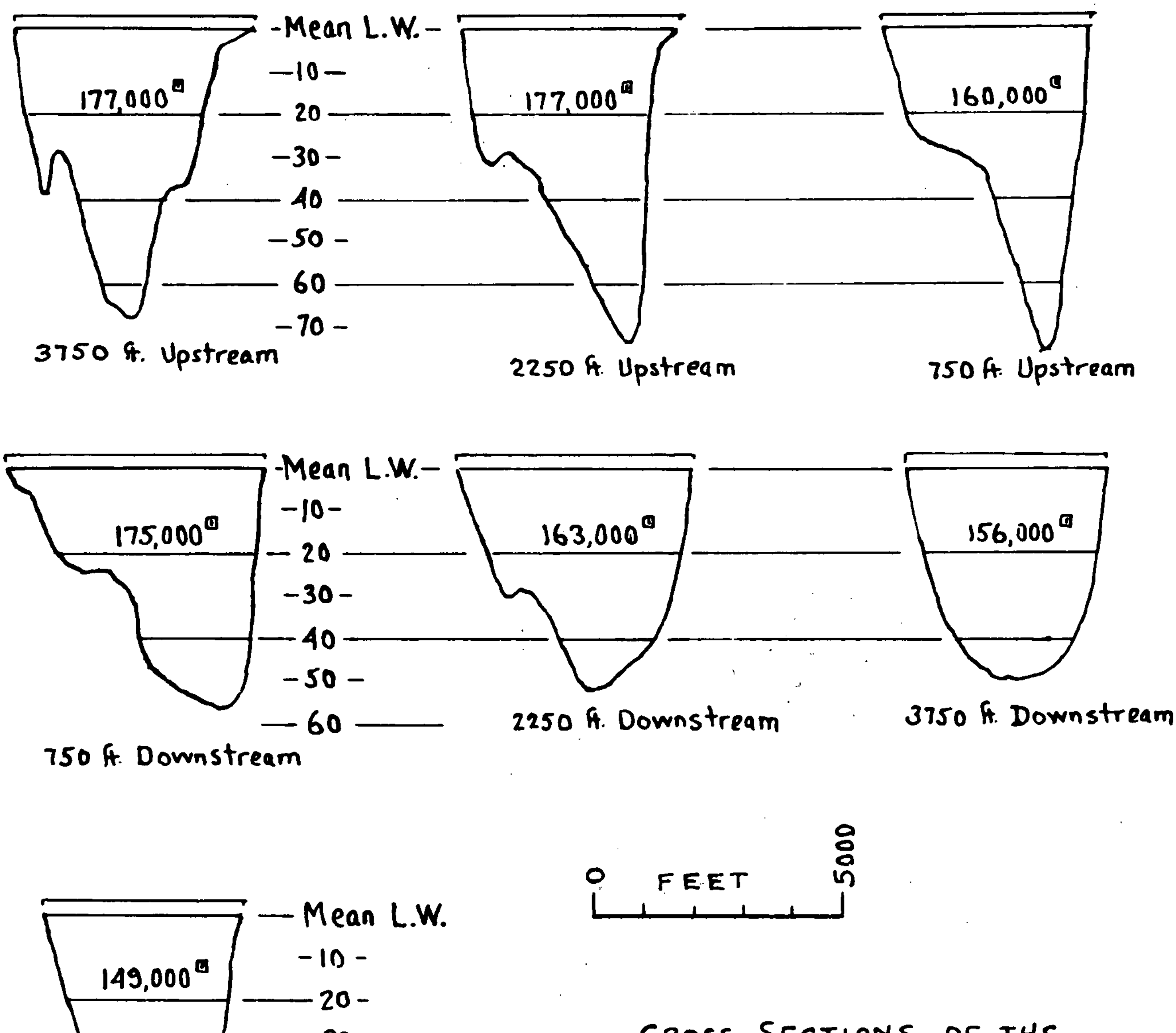
From what you have told me about your proposed designs and methods of operation, I suspect that there is no real question of safety but only one of public relations - the avoidance of even the appearance of danger.

Very truly yours,

Karl R. Kennison
Consulting Engineer

Sheet 1
9-13-'55

KARL R. KENNISON
CIVIL AND HYDRAULIC ENGINEER
361 CLINTON AVE., BROOKLYN, N. Y.



CROSS SECTIONS OF THE
HUDSON RIVER
(Looking Upstream)
Spaced 1500 ft. apart past the
PROPOSED CONS. EDISON PLANT
BELOW PEEKSKILL

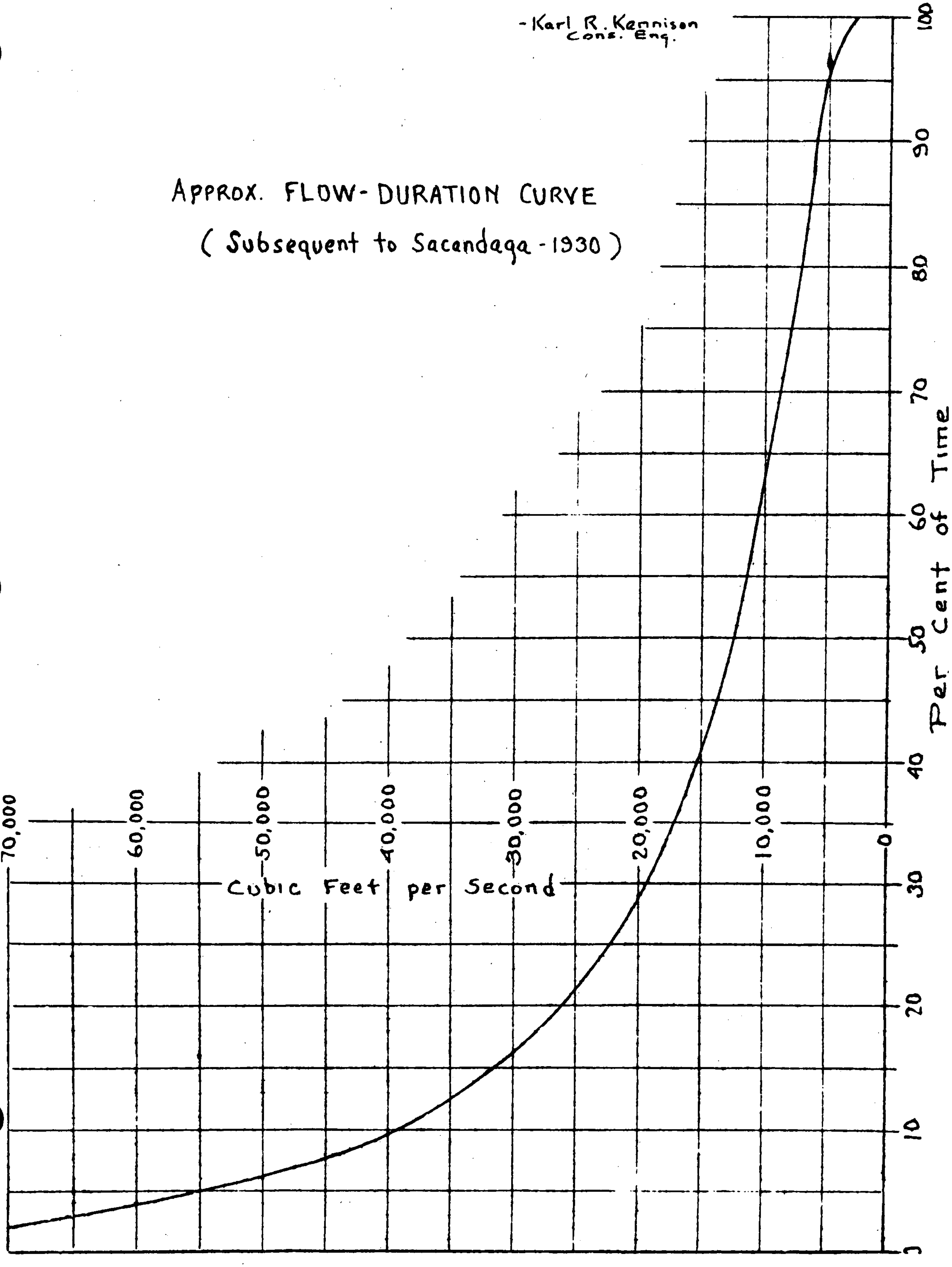
K.R.K.

Hudson River at Location of Proposed
Cons. Edison Plant below Peekskill

11-8-51

-Karl R. Kennison
Cons. Eng.

APPROX. FLOW-DURATION CURVE
(Subsequent to Sacandaga - 1930)



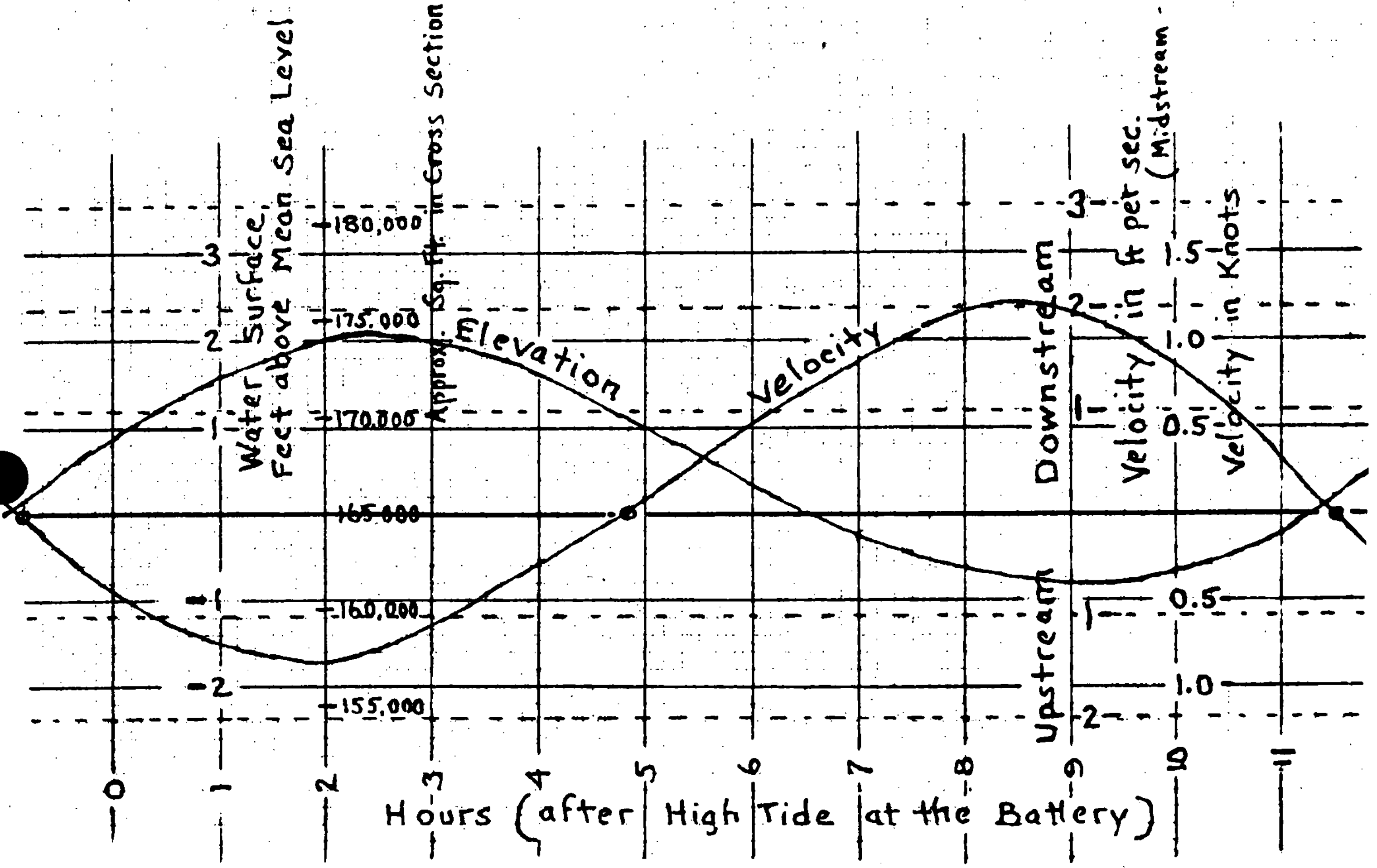
K.R.K.

Hudson River at Location of Proposed Cons. Edison Plant below Peekskill

9-13 55

- Karl R. Kennison
Cons. Eng.

Data from Coast & Geodetic Survey
"Average conditions in the axis of the main channel during the summer months"



K.R.K.

Hudson River at Location of Proposed Cons. Edison Plant below Peekskill

11-8 55

- Karl R. Kennison
Cons. Eng.